matrix VI

software for jewelry artisans

Matrix Re-Defined!

Matrix 6 is our most extensive upgrade yet. For over two years, we have been closely examining the tools and concepts that work best for jewelry designers. With History built right into models, a library of history-enabled parts and styles, a completely updated and streamlined interface, a host of new tools that follow the hottest design trends, and new viewport controls that make subtle modifications and creative designing easier than ever before, we think you'll agree: this is the most efficient, flexible, and creative software tool for jewelry designers yet!

Matrix 6 Instruction Manual

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Technical Writer/Editor: Jill Weissbrot

Graphic Design & Direction: Danielle Schertz

Cover Layout & Design: Jennifer Hinds

Cover Ring & Render: Matt Bennett

Special Thanks to Kent West and the Matrix Development Team

Matrix 6...

What's New

Matrix History



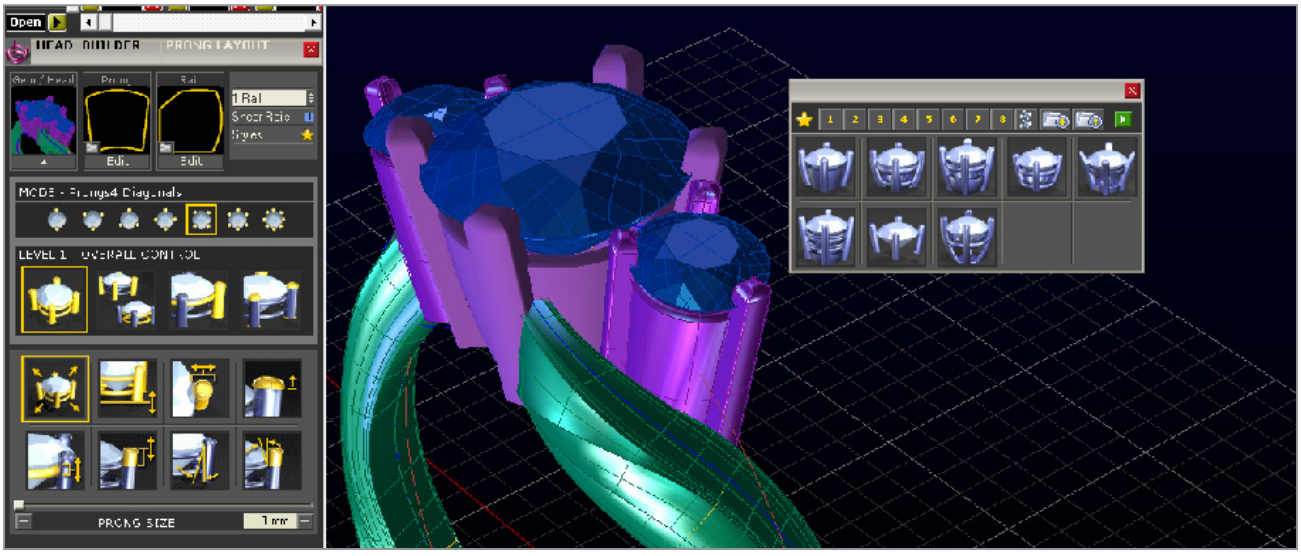




Instead of complicated history trees or a list of rules to follow, Matrix History works just the way you'd expect: intuitively, automatically, and with no surprises! Watch history update on-the-fly as you make dramatic or subtle design changes. A complex change that would have taken several steps is now quick and effortless, meaning your design work is free to become a more intuitive, creative process. And, after saving a piece made with the new tools, you can open it days, weeks, or even months later and make any required changes; or, adapt it to a new customer, size, gemstone, or style with ease.

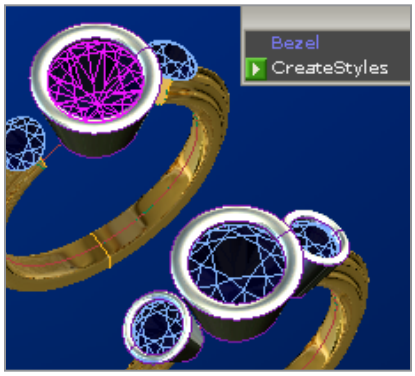
History-enabled Sweeps: Change the shape, size, or placement of Profiles and Rails to see instant results in the shape of the surface.

Style Pieces: Quickly design by making changes to a library of already-assembled parts and pieces using the principles of History.



Gems, Settings, & Cutters with History

Tools that naturally relate – such as Gems, Prongs, Heads, & Bezels – have built-in history so that changes ripple down through the design, from each related part to the next.



Match Attributes: Each gem in the program remembers the values that were used in any Setting or Cutter tools associated with it. "Match Attributes" transfers these settings to another gem in the program, while accommodating all differences in shape, size, and location. Continue editing the new object to perfect your design!

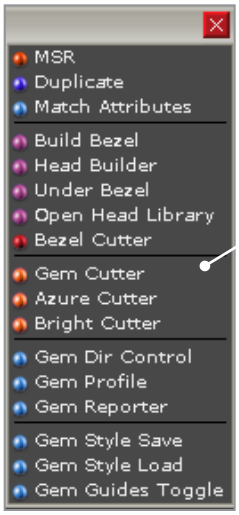
Edit Existing Objects: History-enabled Settings tools mean each object retains a "memory" of the program values used to create it. Quickly change an object by opening the builder used to create it and changing the values related to any dimension of the selected object.

Matrix 6 Interface Changes

When interacting with the product, there are now three unique yet interrelated paths a user can take. Operate Matrix completely through the familiar Rhino command line; engage the re-designed, intuitive builder interface; or directly modify pieces in the viewports using the brand-new Viewport Control Handles (VCH). Each method offers a slightly different approach to designing; yet all three work together effortlessly.

We've learned from our customers that most users get a few tools learned well and stick with them! But what about the range of other options available in the program? Inevitably, a design will arise that will require tools that are new to a user, so we've provided a shortcut to help you find the one you need each and every time! Select the item you wish to work on, from a simple ring rail to a complete gem configuration, and press the F6 key. Every option and tool available for use with that item is offered here, without any searching through menus and buttons for the one you need.

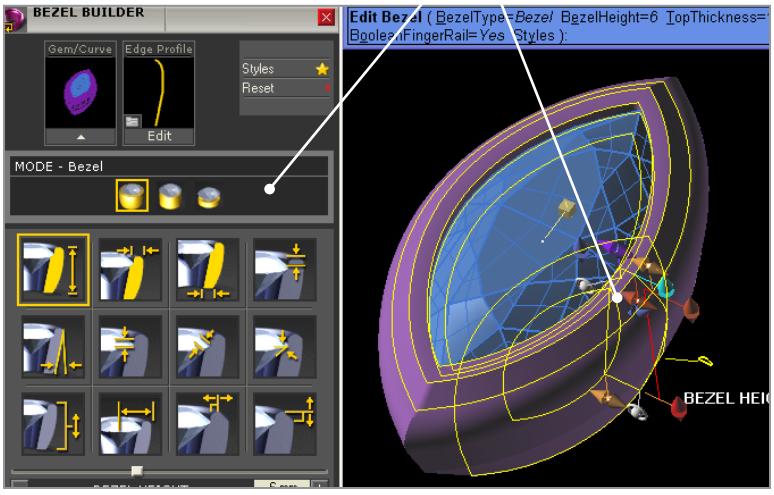
Finally, within a given function, the most commonly-applied tools are handed to you first; with more advanced or complicated options offered at higher levels to simplify your work. With these streamlined options and more ways to find the tools you need, the program is more intuitive than ever before!



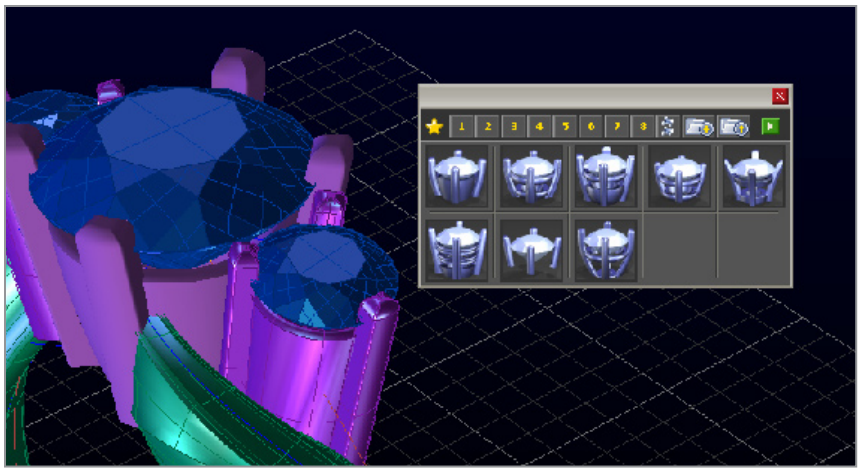
F6 Key: Select any object onscreen and press "F6" to see a menu of all possible Matrix tools that will work with that object.

Viewport Control Handles: Directly control different dimensions on a model by clicking and dragging onscreen handles related to each builder setting. See instant feedback while you work!

Redesigned Builder Interface: EVERY builder in the program has been redesigned for an updated, streamlined, and simpler look. Now, a single slider controls each setting, with many builders offering "modes" for better organization.

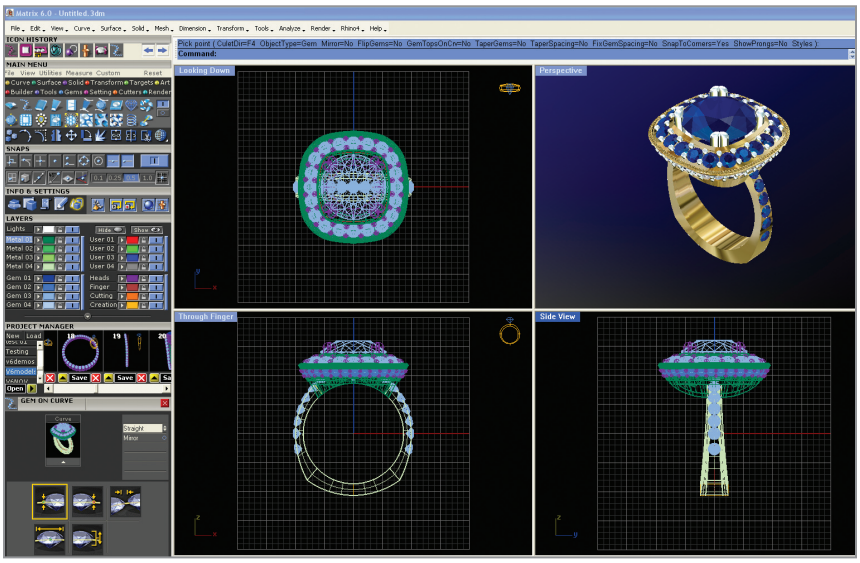


Redesigned Style Sheets: A new look for the library of styles available within each Setting and Cutter tool makes it even easier to load new default program styles, and to save your own default styles, thereby creating your own library of styles within each builder.



Interactive Booleans: Select this option, available in many new Cutting tools ("Boolean = Yes" & "Select Surface") and the preview will display the cut version of the surface – not the cutting object – while you work. The final result of the tool will also be the cut surface: not the cutters.

Rendering and shaded working modes: A whole host of new "working modes" for shading models have been created to fit the many different ways our customers use Matrix. Modes for better seeing surfaces, technical drawing modes, modes for inspecting tolerances, and design review modes displaying finished metal and gems that can be controlled in real-time are just some of the new additions. Each new offering makes it easier to see, work on, design, evaluate, and present jewelry in any of the number of ways people use the product.



Next Generation Render Engine: Cutting-edge technology available through the new VRay render engine has been combined with the speed and ease of Matrix tools to apply exclusive, Gemvision- created metal and gem materials to finished designs. Quickly configure a render through this intuitive interface, from a quick 30-second render that makes the sale to the ultra-realistic render that goes on your website or in your store window.



New Tools

Anticipate Design Trends: Jewelry is fashion, and fashion is always changing. Matrix has always been developed with an eye to the latest trends, while keeping in mind what has come before and keeping abreast of what may be on the way. Version 6.0 is no different, offering a wide variety of brand-new tools as well as newly redesigned tools that are specific to both the emerging trends and those that are yet to come!



Subtlety of design is now available with new speed and ease: Looking at great design work, it is clear that small details make a big difference. This level of subtlety has traditionally been hard to achieve in CAD; or, at the very least, time-consuming. The problem is simply that there are countless variables that can make or break great design. We examined these details very closely and developed new tools and techniques that allow designers to control small details far more quickly and easily than ever before.



Creative design workflow: Through dialoguing directly with our customer base, Gemvision has adapted the software to work the way our users work. And above all else, we've learned that everyone works on the product a little bit differently! Now, whether you take a straight line or a meandering path through the design process, Matrix 6.0 provides amazing flexibility to fit the way you work. Designing "on-the-fly" is easier than ever before, meaning you can start by laying out gems, or designing a shank, or a little bit of both!

Rhino Tools Made More Powerful: With access to the very heart of the Rhino engine, Gemvision developers were able to adapt some of the commonly-used Rhino tools to the way jewelers use them most!

Newly Redesigned Info & Settings: Quick access to a few key pieces of "Object Information" about any object onscreen is now a click away. Labels show up right beside their objects; or, try "Super-Selecting" just the ones you need. Matrix History and Rhino History can be toggled on and off easily from the new, icon-driven Information & Settings menu.

Designing and Duplicating: Two ways to use the product: When designing a new piece, you want to use tools that are more freeform and creative; but when duplicating an existing design, you need tools that are very quick and precise. Matrix provides both kinds of tools, as well as tools with the built-in flexibility to work either way.

Meets users at ANY skill-level: In a way no other version has been able to do in the past, Matrix 6.0 offers functionality that Rhino can't provide alone; making it effective for all levels of users. These tools are easy to learn for a brand-new user while being powerful enough for even the most advanced user.



Matrix 6...

New Tools List

New Cutters


Brite Cutters: Two brite cutter builders create either a complete channel of brite-cut stones or a single cutter you can rotate for a number of cool brite-cutting effects.


Micro Prongs: Create the sweet scalloped Micro Pave effect under a row of stones, even "bending" the cutter to create the neatly angled sides and fishtail-effect of the real thing!



New Gems Tools


Emerald & Baguette Builders: Control the girdle thickness, corners, and taper of emerald and baguette stones to match the exact stone you have in front of you.


Emerald Cluster & Emerald Profile: Add gems around any emerald stone, or just add an emerald-shaped setting, to create the difficult emerald cluster shape.


Advanced Cluster Builder: Create a cluster of gems around any-shaped curve, for unique and funky cluster designs.


Advanced Pave Builder: Pave has been completely overhauled, with sophisticated new mathematics that provide you with control over the exact layout of the stones, their sizes, and how they "interact" with one another and with the edge curves of their surface to create lines, hex patterns, or purely random patterns.


Gem Control: This tool points the culet of a gem to any object onscreen while using history. Move this object around and all the gems move too, for quickly designing and redesigning of pieces without the time-consuming hassle of repetitive edits.


Gems Between Two Curves: Sounds simple, but it's not: let the builder calculate the math for you, placing exactly the size of gems you'll need in the spaces between any two curves.


Baguettes Between Two Curves: Build a baguette anywhere in space by choosing two curves between which to fit it.


Gem Follow: With a complex Pave pattern or gem configuration laid out, this amazing tool orients the "North" of all the selected stones to any object you indicate. In that way, stunningly different prong arrangements can be created that offer unique effects on any surface.


Baguette Channel: Choose the size, taper, and location of a channel of baguettes, letting the builder calculate the difficult math for you to fit just the gems you need!



New Settings

Metal Piece: Instantly add a metal profile around a gem line, creating a surface from gems instead of the other way around! This amazing tool incorporates history, so that any gem you move will cause the surface to follow suit, accommodating your changes for instant style edits and spectacular surface control.

Object on a Curve: Choose a library piece or create your own to array interactively along a curve, either uniform or tapered, at the size and spacing you choose.

Millgrain Builder: Array a sphere along a curve to create interactive millgrain for which you can adjust the taper, size, and spacing.

Channel Border Curve: Quickly add a curve around a row of gems, adjusting its distance from the gems and its length on either end.



New Profile & Rail Tools

Sweep 1 History, Sweep 2 History, and Multi Rail Sweep History: Input up to four rail curves and still sweep a surface automatically. Sweep history with any number of rails and profiles accommodates any changes you make to rail and profile curves, updating the surface instantly while you work. No more slowing down for intricate design changes, Sweep History tools will save you hours on complicated surface modeling, but are easy enough for a beginner to get amazing control over how surfaces sweep along their rails!

Profile Blend: Blend Targets' new big brother, Profile Blend instantly blends a history-enabled surface between any profiles onscreen, making surface modeling a snap. Move or change the shape of surfaces to make complicated design changes in mere seconds.

Curve from 2 Views History: Just like Curve from Two Views, this tool lets you edit input curves and see the effects in the resulting curve.

Custom Rail Advanced: A true "Curve from three views", this amazing tool inputs up to 3 shape curves in 3 different views and incorporates them all into a single curve. Adjust the blend on the resulting curve, using more of one shape curve than the other, and incorporate this tool with Multi Rail Sweep History for a fully interactive model. Even the most experienced user will never model the same way again!

Profile: Create your own profile with Curve tools and instantly input it into the Profile Placer with a few simple clicks.

Profile Merge: This smart tool merges two side-by-side profiles into one, taking the "busywork" out of setting up split-shank designs that converge at the side of the ring.



Rhino Tools Made More Powerful

Polyline on Surface: Draw a polyline and instantly project it to a surface while you work.

GV Extract Isocurve: Extract an isocurve from a surface and rotate it, while it still adheres to the surface.

Extrude All: Extrude many curves at a time, with access to all Extrude tools in one.

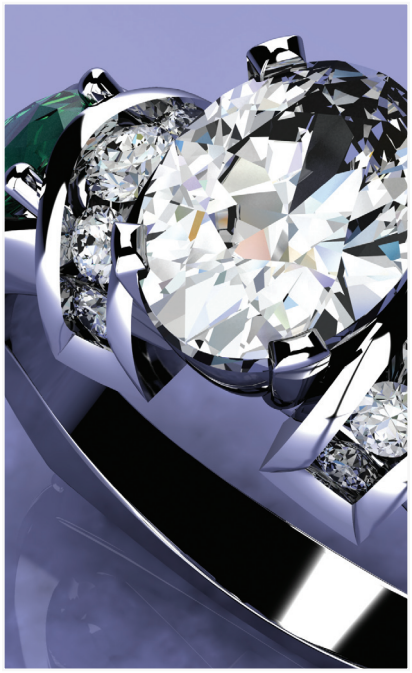
Pipe All: Pipe many curves at a time.

Make Downward Facing: Transform any object so a new side faces down.

Mirror Mode / Mirror Mode Shatter: Mirror interactively while you work, seeing changes on the other half, quadrant, or opposite quadrant of your screen.

Gem Flow Along: The Flow Along Curve and Surface commands work with gem and block objects

Gem Splop: The "Splop" command works on gems and block objects.



Newly Redesigned Info & Settings

Object Info: Labels show up right beside their objects.

Super Select: Access just the objects you need. Options are based on what you have onscreen.

Rhino & Matrix History: Quickly turn on and off Rhino History. Access Matrix History directly, to turn it on and off.

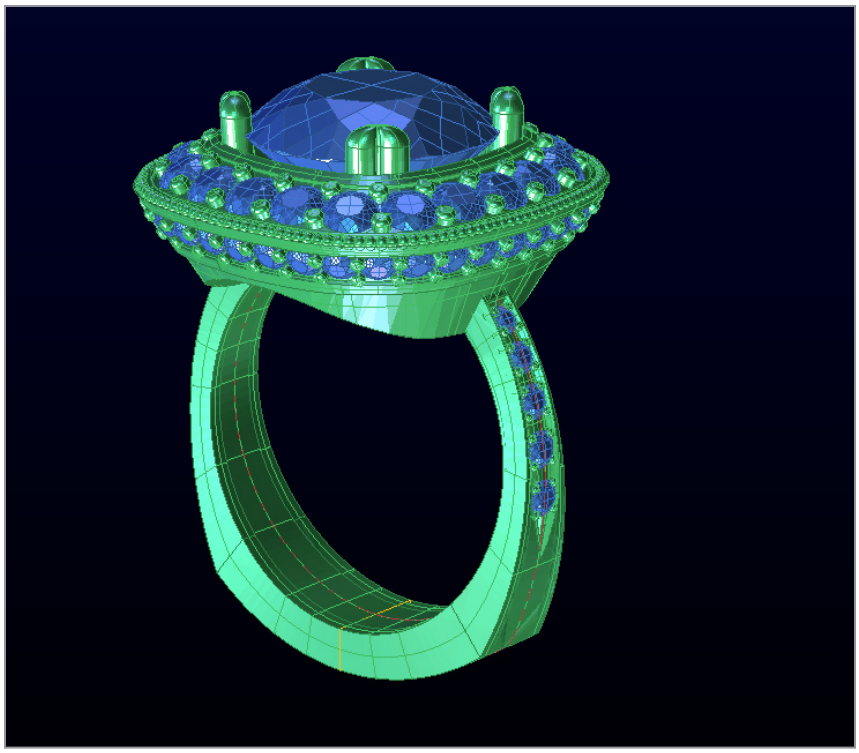


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Chapter 1 PRIMARY

An Introduction to Matrix 6

Welcome to Matrix Version 6.0! Strap in for your tour of the interface and an introduction to the fundamentals of using the software.

Welcome to Matrix!

Matrix Version 6.0 software for jewelry artisans facilitates the Computer-Aided Design of stunning jewelry models with tools unique to the industry in every sense of the word. Matrix is built on Rhinoceros CAD software by McNeel and Associates in Seattle, WA: a sophisticated tool in itself that is used in many industries - from CGI special effects in major motion pictures to boat building, and from automotive development to sneaker design!

Gemvision's development team has harnessed the Rhino software engine so that elements like gems, finger sizes, common setting types & design elements, and even whole rings - signet rings, eternity rings, raised bands - are instantly built for you by the software. Matrix Version 6.0 also has an intuitive, easy-to-use interface. When you make design decisions in the software, Matrix directs Rhino to build the design you've indicated.

Design with Viewport Control

Most Version 6.0 tools - from gems, settings tools, cutters, and even whole rings - offer Viewport Control Handles that allow you to directly control the modeling process. Move the mouse over a handle to see what dimension it controls. Then, click and drag the handle representing the dimension you wish to change to adjust that value up or down. The model will instantly change to accommodate your design decisions, making designing an immediate, interactive process.

Design with History

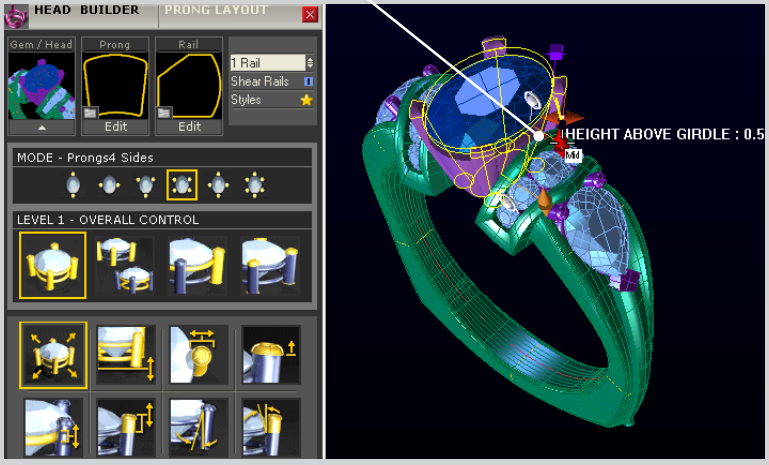
For the first time ever in Matrix, powerful History functionality is available with basic through advanced modeling applications. From instantly changing the cross-section shape of a ring, to adjusting a setting for a new gem size or shape, to seeing entire models change to accommodate a new gem layout, History is integrated into the product at many different levels and is wonderfully easy and intuitive to use.

Features Unique to Matrix 6.0

Viewport Control Handles facilitate quick design decisions by offering direct control of models with changes visible in real-time while you work.

History enables dramatic or subtle design changes - adjust gem shape or size, cross-section shape of ring, setting design, prong height and thickness, or any number of dimensions. Try out different design variations, or change up an old design for a new customer with a few simple steps.

Interface Re-design lets you choose how to use the tools. Select an item and press F6 to see a menu of tools to use with it. Choose whether to design with handles, redesigned builder controls, or Rhino Command line options.



Using This Manual

If you're excited to jump in and get started with this product, you're in the right place! This introductory chapter will detail how to use the features I've mentioned here, as well as taking you on a tour of the interface and all important stops along the way. Get a basic overview of features that you'll use every day - from beginning through advanced modeling - and learn the fundamentals necessary to get you started.

Then, proceed to Chapter 2, where you'll learn to build your first ring. This manual is divided into Primary, Intermediate, and Advanced levels and is designed to be read beginning to end to teach you everything there is to know about your new friend Matrix. However, if you need to look up a specific function, consult the Table of Contents or the Index to find what you need. Or, perform a search in the Adobe document in your software by typing the term into the Search field.

Skills & Commands in this Chapter

A Tour of the Interface: *Undo, Redo*



F6 & Matrix 6

History & Matrix 6: *Matrix History Record & Update On / Off; Rhino History On / Off*



Tour of a Builder

Modeling in the Viewports

Info & Settings Menu: *Object Info, All object Info, Command History, Project Notes, Super Select, Preview Shade On / Off, Draw all Cutters On / Off*



Layers Menu

Project Manager

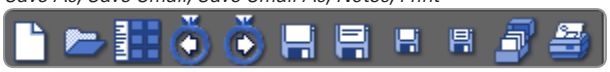
Snaps Menu: *End, Mid, Center, Quad, Near, Point, Intersection, Tangent, Perp, OnSurface, On Polysurface, Between, Ortho, Planar, Project, Grid Snaps*



Top 11 Buttons: *Shade, Copy, Edit Points On, Control Points On, Mirror, Move, Rotate, Explode, Join, Split, Trim*



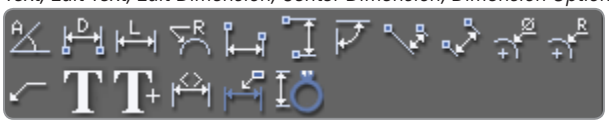
File Menu: *New, Open, Thumbnail Browser, Import, Export, Save, Save As, Save Small, Save Small As, Notes, Print*



View Menu: *Place, Discard, Hide, Show, Move, Align, Scale, and GrayScale Background Bitmap, Picture Frame, Restore Views, Synchronize Views, Zoom Dynamic, Zoom Extents, Zoom Selected, Zoom Window, Viewport to File, Crosshairs, System 6 HD 3View, Zoom 1:1 Zoom 1:1 Calibrate, Center View*



Measure Menu: *Angle, Distance, Length, Radius, Dimension Horizontal, Dimension Vertical, Dimension Angle, Dimension Rotated, Dimension Aligned, Dimension Diameter, Dimension Radius, Leader, Text, Edit Text, Edit Dimension, Center Dimension, Dimension Options*



Basic Utilities Menu Commands: *Make 2D Drawing, Bounding Box, Center Object, Group, Ungroup, Email Support*



Tips & Tricks: Changing the Matrix Menus

To change the view of your menus on the left-hand side of Matrix, try these tricks...



Changing the Menu Layout Click the gray menu bar once to "roll up" or temporarily hide the contents of any of the main menus. This saves space by getting them out of the way. Some (Snaps, Layers) keep important controls and settings on their closed title bars so you can access them with ease. Click a "rolled up" menu to see its contents again. Click and drag a gray menu title bar to reposition it. Click and drag in order above or below another menu to change the order of the menus. Click and drag it out into the viewports to "float" the menu over your model where you might be able to access it more easily. Or, click and drag it to the far right-hand side of your screen and it will "dock" there, or find itself a new home in a 300-pixel-wide menu that mirrors its counterpart on the left-hand side of the screen! Dock or float as many menus as you want this way; including builders - the menus that open up in the area beneath Project Manager. You can even drag menus off onto other monitors! If you love this menu configuration and want to keep it for the next time you open Matrix, go to the View pulldown at the very top, left-hand side of your screen, select Matrix Menus > Set as Default, and they will always open in the new configuration. Reset Menus puts them back in the default mode, while Reload Menus loads them back the way the program opens, with their factory-authorized settings - ! Use this if you drag any past the point of no return...

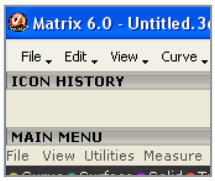
Intro to Matrix 6...

A Tour of the Interface

The Interface - starting at the left side of your screen - provides all the tools & settings you need to get acquainted with the program.

What You See Onscreen

On the left-hand side of your screen is the Matrix Interface, divided into sections by the gray title bars indicating "Icon History", "Main Menu", "Snaps", "Info & Settings", "Layers", and "Project Manager".



Matrix Interface starts on left-hand side of screen.

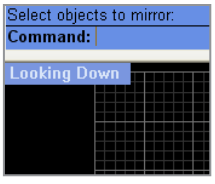
In the space below the Project Manager, the Builder interface for Matrix tools will appear, providing you menu controls to create the given model or use the tool in the viewports.

Just to the right of that menu is the bulk of your screen: four viewports that are actually the Rhino part of the program, where you will see the model appear. By working directly in the viewports with Matrix & Rhino commands, you can draw items like curves, surfaces, and solids, select items for use with builders, and complete functions you'll start up with a button in one of the Main Menus. We'll discuss the viewports in more detail in a moment.

Just above the four viewports is the Rhino Command Line. This provides the most important feedback about the tool you've selected and the model you're building, so pay close attention to this while you work. The Command line is like a miniature "Help" menu, telling you what to do next to use the tool you've selected. It also offers a series of options to change the way the selected tool works. Click on the option you want to adjust by moving your mouse over the Command Line and clicking the left mouse-button on the Option of your choice to select it.

You will also have to type values into the Command line at times, so you can use your mouse to position your cursor in the space at the end of the prompt, left-click to begin, and type. All Matrix and Rhino commands can in fact be started up in this way, by typing their name into the Command line, but that is used less frequently. Press Enter and the Command line will accept your input and deliver that information to Rhino to build your model. Just above the Command line is the Feedback line, which provides helpful feedback on a function you've just run. This manual will tell you when to keep an eye on it for vital information.

The menus at the top of the screen, starting with File, Edit, View, Curve, Surface, etc., are used less frequently in this program, and are not referred to at all in this manual. All Rhino functions can be found in these menus, including ones that aren't found in Matrix menus and aren't covered in this manual. Because Matrix is built on Rhino, you have full access to Rhino functionality and every command at their disposal. Consult the Rhino Help Manual if you wish to learn the additional commands found in this section of the program.



Command line and Feedback line, above it, are important visual cues.

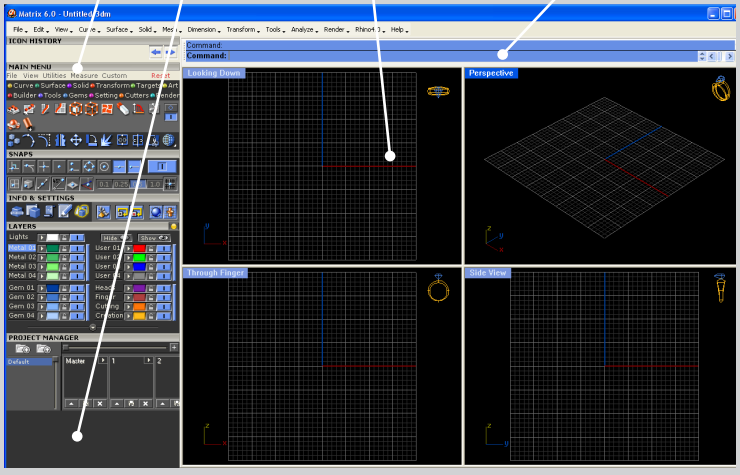
A Map of the Matrix Interface

Along the left-hand side of the software you will see the Matrix Interface divided by the gray title bars "Icon History", "Main Menu," "Snaps," "Info & Settings," "Layers," etc.

In the space below Project Manager is where the Matrix "Builders" will open - or, any Matrix commands with menu controls.

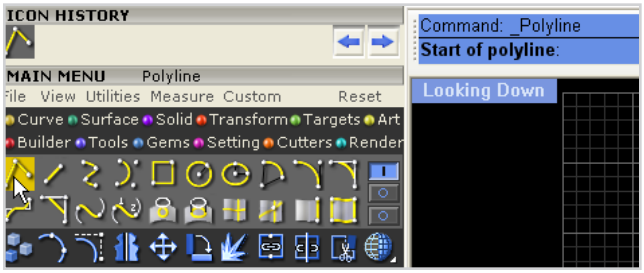
The bulk of the screen is taken up with the four Rhino viewports. This is where your model is built, and where you will work with Rhino and Matrix tools to create jewelry.

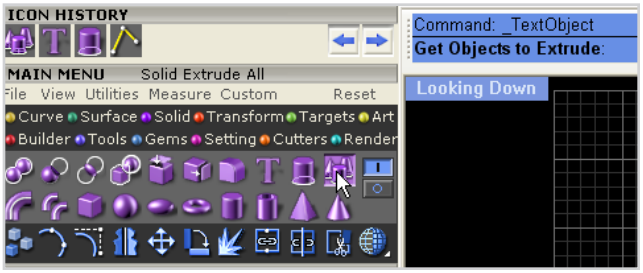
At the top of the viewports is the Command line: an important place to look often for instructions on how to use the tool you've chosen, options to change how the tool works, and feedback on your model.



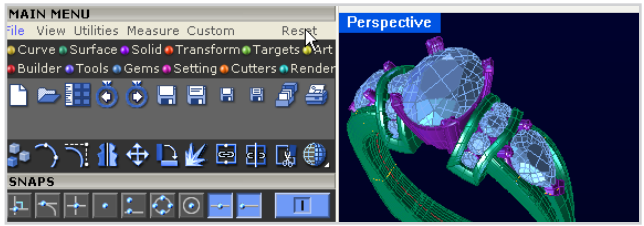
The Matrix Main Menus An Overview

Located in the upper left-hand corner, the Matrix Main Menus are where you'll find every modeling tool in the program.

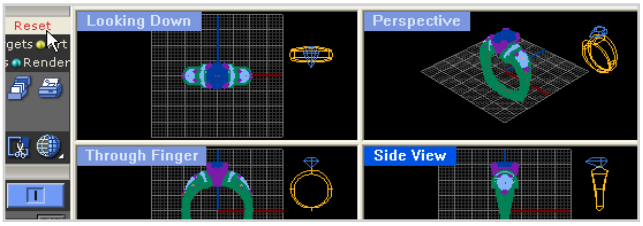




Using the Main Menus, Quick Tips, & Icon History Click on a menu title, and its contents - icons representing each command available in that menu - will open in the gray space below the menus. You can only open one menu at a time. To scroll down throughout the menu to find the command you need, use the scroll buttons on the far right-hand side of the open menu. Click the scroll button to access the next rows of menus: two at a time. Click one of the commands found in the Main Menus to start up that command. To determine which command is which, move the mouse over that command and its Quick Tip will appear in the space beside "Main Menu" on the gray title bar. If you hover the mouse over a command, its Quick Tip will appear beside the button. As you select a command, its icon will appear in the Icon History portion of your screen. Icons representing the last 8 commands you ran will appear here, so you can quickly return to them if necessary.

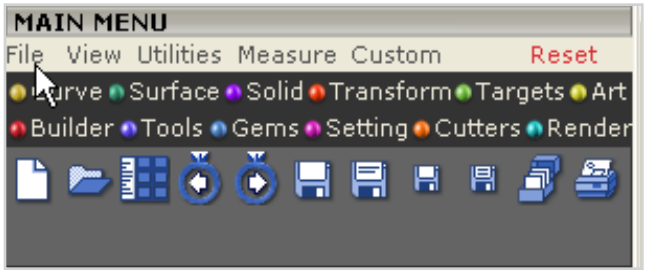


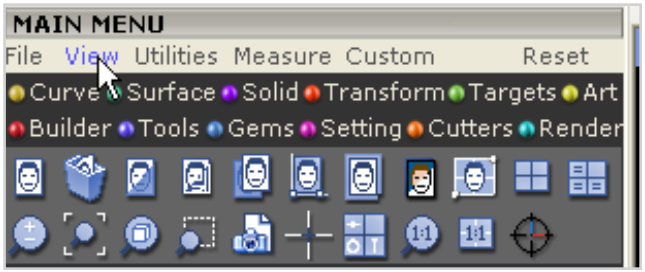
Before Reset: Viewports maximized/zoomed/panned/rotated...



After Reset: Viewports restored to all their default settings.

Undo/Redo & Reset Tools As you work, click "Undo" to undo the last command you ran. In the case of builders, which send a number of commands to Rhino automatically, it is best to use the "Undo" found in the Builder menu, where applicable. "Redo" will redo this command. As when working in Windows, "Ctrl + Z" keys on your keyboard run Undo and "Ctrl + Y" run Redo. The Reset Tools button, found after the "Custom" menu on the far right-hand side under the Main Menu gray title bar, resets the viewports to restore the default view of your work (if it is panned or zoomed), returns to Wireframe Shade, unlocks any locked items, shows hidden items, turns on any layers that are off, ends any command that is currently running, and discards any background bitmap. We used to call this the "Panic" button, because it is a good thing to click on when you're not sure what else to do. It restores program settings back to the defaults they had when the program was first started up.

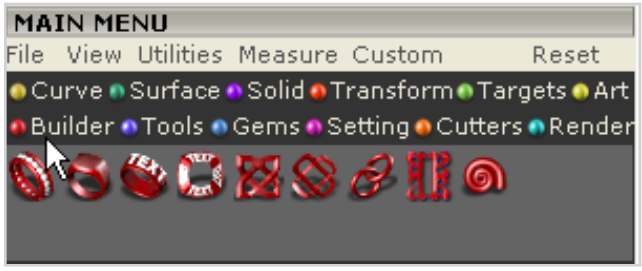




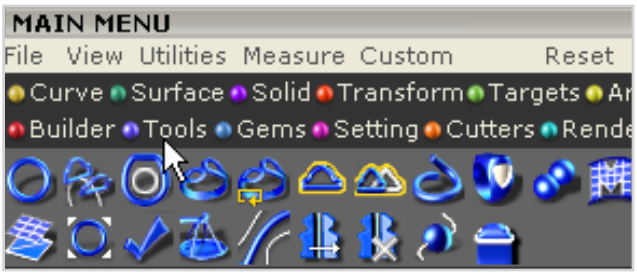
File, View, Utilities, & Measure. Each of these menus will be covered more in depth in this first chapter. Beginning with the File Menu, you will start here to perform the familiar File > New, Open, and Save features customary for Windows programs. You may also import and export models, save notes, print, and save with different options to maximize file size. The View menu is where you will import and control bitmap images you may wish to have in the viewports to assist you while you work. Change the "zoom" on the model and find other viewport view control tools here. Utilities are commands that are used once your model is made. They range from basic to advanced, so we'll cover the basic ones later in this chapter, and the advanced ones as necessary. The Measure Menu allows you to measure models onscreen, in mm, with a few easy mouse-clicks, and display measurement values right in the viewports beside your model to aid in production.

The Matrix Main Menus cont'd.

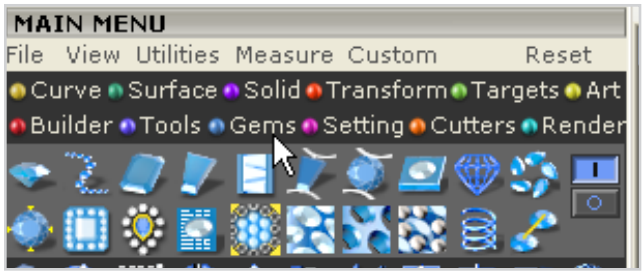
Located in the upper left-hand corner, the Matrix Main Menus are where you'll find every modeling tool in the program.



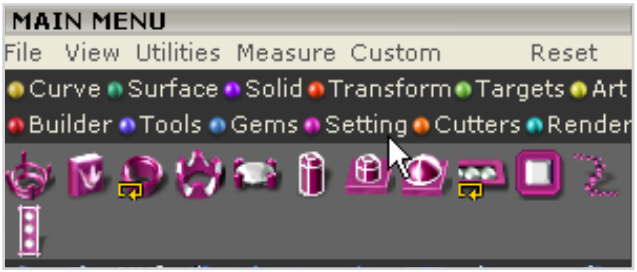
Builder Menu Matrix builders create whole rings (Signet, Eternity, & Raised Band styles) or design elements (Award Ring tops, Celtic Knots, Jump Rings, Patterns, and Nautilus curves) that you control with a Builder Menu interface. This interface opens in the lower left-hand corner of the screen, with the icon and Builder Name in the gray title bar. Close a builder by clicking the X beside its name. Builder controls will be explained in greater detail later, but notice that the Mill Version of the software also contains the Toolpath Builder for preparing models to be milled (only appears in your software if you've purchased the Revo Mill), as well as the Mill Large Fixture Area button, which places a curve in the viewports representing the size of the largest fixture on the Revo Mill. For more information on using these tools, consult your Revo manual, as this manual will not cover these topics.



Tools Menu This menu is where you will find the most basic tools you'll begin modeling with in Chapter 1 - as well as some of the most advanced tools you will learn in Chapter 8, Advanced Surface Modeling! These tools form the building blocks of your models, and include the tool to place your basic ring size (Ring Rail), apply a cross-section shape or shapes to it (Profile Placer), add control via "Rails" (Outer Rail, Curve Transform Tool, Custom Rail, Advanced Custom Rail), and control the "Profiles" or cross-section shapes you'll be building (Profile Merge, Get Profile). Other tools help you work on your models, including a tool to create an inset surface (Surface Pullback), cut out or add shapes (Boolean Builder), apply a mesh model to add a design element or texture (Mesh Mapper), Resize your ring once it's built (Ring Resizer), check your objects (Object Checker), weigh your final design (Metal Weights), mirror your design on-the-fly (Mirror Mode), place objects on a curve, and cap the end of a shape (Profile Cap).



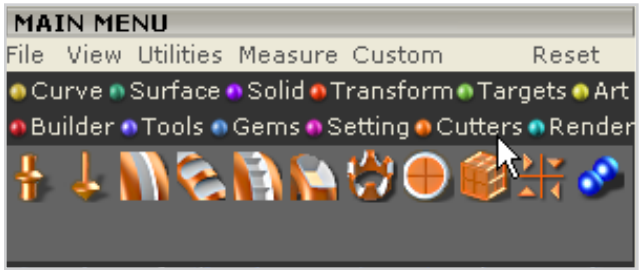
Gems Menu While building your first ring in Chapter 1, use the most basic gem tool Gem Loader to place a gem of any size, shape, and cut in the viewports. This gem can be manipulated with Gem Positioner (MSR) - also found in this menu - with the ease of Viewport Control Handles. Every dimension of Emeralds and Baguettes can be controlled with these interactive tools. Save Styles and Match Attributes are the helpful tools that make gems active with History. After learning to create curves in Chapter 3, use gem tools that incorporate curves, such as Gem on a Curve, Advanced Cluster Builder, Tapered Baguette Channel, Baguette Between Two Curves, Gems Between Two Curves, and Custom Gem - which creates a gem from any shape curve you input! Gem Guides and Gem Report report size, weight, and apply helpful cues to gems. Advanced gem tools include the six Pave' builder tools, Gem Splop (it's not a bad thing!), Gem Flow, Gem Control, and Gem Follow.



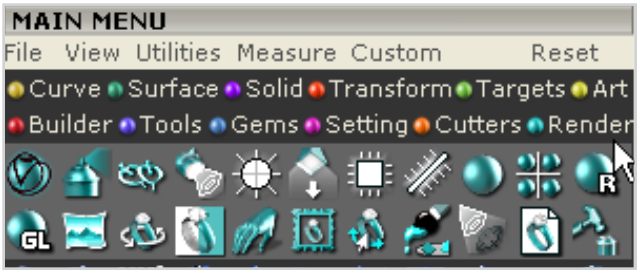
Settings Menu This is where you'll find the settings tools that build material around gems (as opposed to those that cut material away from gems, which are known to the program as "Cutters"). Those that work with single gems include Head Builder, Heads Library (a library of Stuller settings that scale and locate themselves to the gems you input), Bezel Builder (creates underbezels and gallery rails as well), Bezel Cutter to create scalloped bezels, and Emerald Profile (also found in Gems Menu), which adds metal (and gems if you wish) around a square or emerald-shaped stone with adjustable corners. For a gem line that you've laid out with the help of curves, Prong Placer, Prong Editor, Metal Piece (adds a metal border around a row of gems), Channel Border (places curves around gems for adding further details with other tools), and Millgrain Builder are all great setting tools. Bead on a Surface and Prong on a Surface supplement these tools, or may be used in conjunction with Pave' tools in the program.

The Matrix Main Menus cont'd.

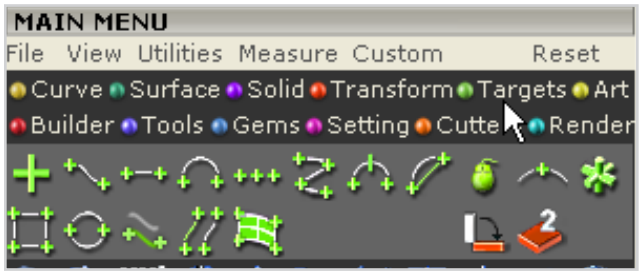
Located in the upper left-hand corner, the Matrix Main Menus are where you'll find every modeling tool in the program.



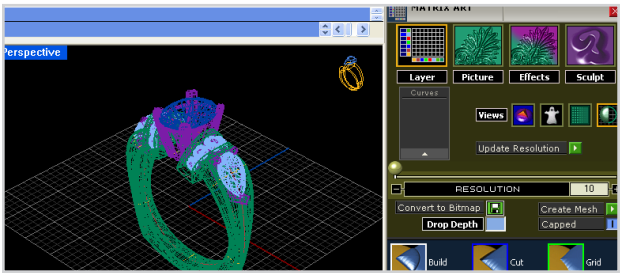
Cutters Menu Many of these tools work with gems on curves, including Azures, Gem Cutter Library (with an array of cutting tools you can scale to fit the gems), Channel, Micro Prong (scalloped settings on a row of gems), and Bright Cut Channel with its cousin Bright Cutter (for a single gem). Other tools allow you to cut away material that intrudes on the finger rail (Cut to Finger Rail), and cut a model in half or in quadrants for modeling symmetrical pieces (Plane and Cube Cutters & Quad Flip).



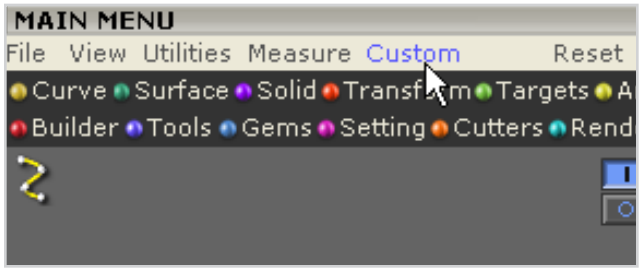
Render Menu All the tools you need for creating photo-realistic renders with a few clicks of the mouse are found in this menu. Our V-Ray render builder, together with a range of light objects and props to enhance renders, animation tools to create mini-movies or flash animations of renders, and render stylers for other rendering programs such as Flamingo (sold separately), are all found here.



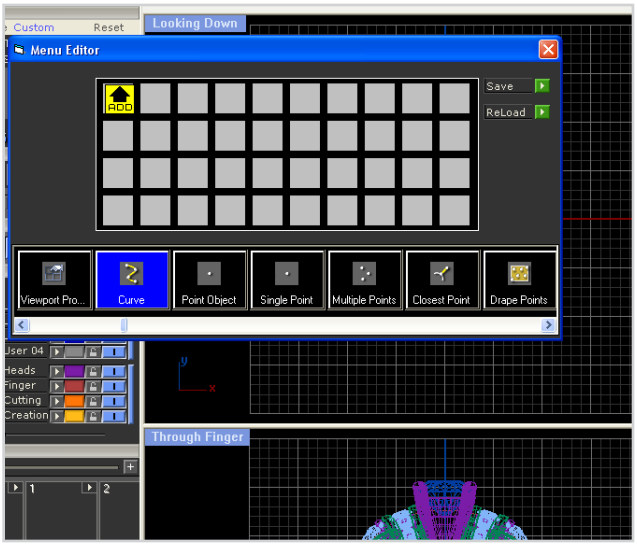
Targets Menu Advanced modeling with fully interactive shapes created with "Targets" is taught in Chapter 8. Found here are all the tools needed to create the curves and surfaces.



Matrix Art Advanced Heightfield from bitmap modeling is available in this menu. Totally different from other modeling in Matrix, you can raise up bitmap images to instantly create design elements or texture in the form of "Mesh Objects" in Matrix. Matrix Art opens in a totally different part of the program: "docked" on the far right-hand side of the screen. Advance to Chapter 10 to learn how this unique feature works.



Custom Menu Any program icon can be loaded into a Custom menu that you design. To create this menu, right-click on "Custom". The gray slots are where the icons will appear when you left-click "Custom" to open this menu. Scroll left and right through all the program icons, and "click and drag" the ones you use most often to place them in the menu. "Save" different versions of this menu to "Load" later based on the job you're doing. Or, just close the window to create your Custom menu.



The Matrix Main Menus cont'd.

Located in the upper left-hand corner, the Matrix Main Menus are where you'll find every modeling tool in the program.



The Top 11 Buttons These commands are not found in any of the Matrix Main Menus, but rather reside just above the Snaps menu and just below the area onscreen where the Main Menus open. They are in fact Rhino functions, but are so fundamental to modeling in the viewports that they are the most commonly-used tools in the program, which is why they get their own menu and are permanently "left out" for your use. These buttons are, from left to right: Duplicate, Edit Points On, Control Points On, Mirror, Move, Rotate, Explode, Join, Split, Trim, and Shade. We will describe how to use each of them in complete detail later in this chapter.



Curve, Surface, Solid, and Transform These menus contain Rhino and Matrix tools for modeling curves, surfaces, and solids - the three main types of objects used to build models - as well as tools to edit each type of object. The Transform menu commands can be used to transform any of these objects with commands like Scale, Array, Bend, Taper, etc. The same general rules apply that you're familiar with from high school geometry: a curve object is only one point object thick, and so has no dimension other than length. However, curves can be used along with tools from the Surface & Solid menus to create Surfaces and Solids. Surfaces are still only one point object thick if they have openings in them. These are known as "open surfaces", and they must be closed in almost all circumstances before a model can be produced by a mill or growing machine. Closed surfaces are called Solids, and these are produced with Solid menu tools alone or by using Solid and Surface menu tools with curves.

Using these Menus Where there are more than 1 row of buttons, as in each of these menus, you will see "scroll buttons" to the right-hand side of the icons. Click the top, middle, or lower (where present) button to advance 2 rows of buttons at a time.



Finding Each Command in this Manual Because this manual is divided into Primary, Intermediate, and Advanced levels of difficulty, it is designed for you to read cover to cover, in sequence, in order to become very well-acquainted with Matrix. However, that may make finding out about a specific button a little difficult! You will find each button listed, by its menu, in the Index of Commands by Menu found at the back of this manual. Also look to the upper right-hand corner of the page above the title of each section, and you will find the icon representing the command(s) being covered in that section. You probably figured out by now that each icon is color-coded, so it will be easy to determine which menu it is from! Also beside this icon is the Matrix History or Rhino History icon, telling you that this tool is History-enabled for Matrix or Rhino History.

Intro to Matrix 6...

The F6 Key and Matrix 6.0

F6 makes navigation quick and easy by listing all possible functions that can be run with any object onscreen in one simple menu.

Why F6?

We have discovered that, once users get really comfortable in the software, it becomes a chore to open up the builder menu, find the command you need to use, click it, input the object into the builder menu, and go about your business. Also, sometimes users forget about all the OTHER great tools in the menus, and just make a bee-line for the one they need, overlooking the other cool things the program can do.



A card of stickers came with v.6 for your F6 key!

For both reasons, we developed F6. F6 is a menu that is customized for the object you have selected onscreen. Select a curve and you'll get one set of commands; select a gem and you'll get another set. It also appears right beside your cursor, and contains commands from all of the Matrix Main Menus in one spot: you don't have to hunt through the menus to find the one you need. It eliminates the choices you don't want - because you don't have an object selected that works with them - and hands you all the possible things you can do with this object - including ones you may not have thought of before!

Using F6

It is easy to use this feature. Simply select the object you want to work on (such as a gem or a curve), and press the F6 button on your keyboard. A list of all possible Matrix builders that can be used with that object will appear.

Click on the name of the builder you wish to use, and that builder will open in the area under the Project Manager on the left-hand side of your screen. In addition, the "In Box" for that builder will be populated with the item you selected; meaning that, if the builder requires a gem, the gem you selected to run "F6" will be input automatically into the builder, and the builder will start up so that the builder-created item appears on the gem, with Viewport Control Handles and Command line options.

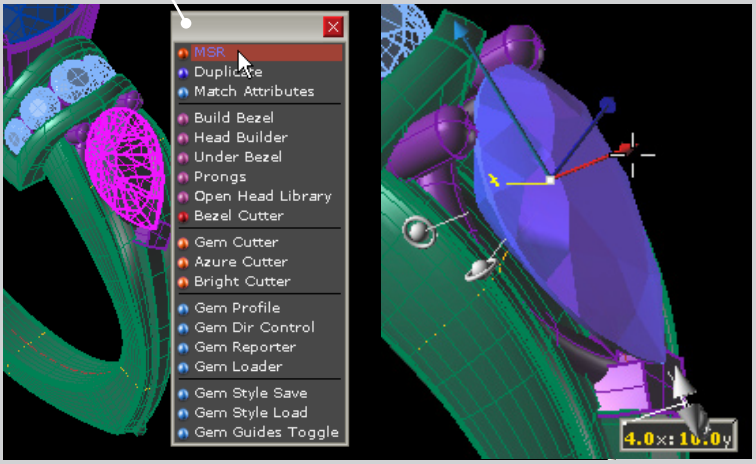


F6 menu contents differ based on object selected.

Using F6 to Access Matrix Builders

Select an object in the viewports and press F6 on the keyboard. A list of commands unique to the object you selected will appear. Make a selection from this list by left-clicking it, and the related Matrix menu will open in the Builder Menu area underneath Project Manager (if the function has a menu).

This also "runs" the function you selected on the initial object used for F6: the Builder Preview Window is populated with this object, and the Builder-created object appears in the viewports with handles and Command line options.



F6 to Edit Objects

Some objects can be edited by selecting the object, pressing F6, and selecting the "Edit (Object)" option from the menu that appears. Selecting this option starts up the builder with which the item was created AND populates the builder with the settings that were used to create it. In that way, you can start from the last settings used and continue making changes to this piece.

This functionality is also available on gems (to Move, Scale, and Rotate gems - or, open the tool known as Gem Positioner) and Profiles (the curves that create the cross-section shapes of rings), but the "Cue" available in the F6 list for these two functions is called "MSR" or, Move, Scale, and Rotate. Incidentally, selecting any curve and choosing MSR from the F6 list gives it the "Move, Scale, and Rotate" handles that are available to Profile curves, in effect turning it into a Profile curve in the program's mind. You'll learn more about how to control and make the best use of this functionality later on in this manual.

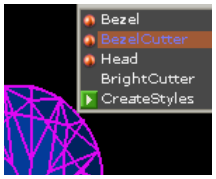
Intro to Matrix 6...

History and Matrix 6.0

Several functions brand-new to Version 6.0 make History functionality not only possible but quick, easy, and incredibly powerful.

A Gem Never Forgets

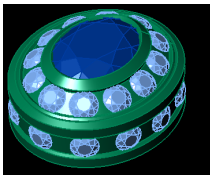
In addition to the powerful F6 > "Edit (Object)" or "MSR" selections described above in the F6 section, Matrix History is achieved above all through the gems in the program. Gems retain a memory of most of the program's Settings and Cutters Tools that were created on them (including Heads, Bezels, Bezel Cutter, Prongs, Metal Piece, Channel Border, Azure Cutter, Channel Cutter, MicroProng Cutter, Bright Cutter, Bright Cut Channel; excluding Heads Library, Prong on Surface / Bead on Surface, Emerald Profile & Cluster, Millgrain, & Gem Cutter Library).



Match Attributes: A gem remembers the settings & cutters created on it.

Using the "Match Attributes" Tool new to Matrix Version 6.0, a Setting or Cutter currently on a gem or EVER created on a gem (even if it was created and then deleted!) can be re-applied to the same gem or to another gem in the program. When that object appears, it can be edited by selecting F6 > Edit Object (where available). Alternately, without running Match Attributes, simply input the gem that already had the object on it into the same builder, and the last settings used in that builder will appear on the gem.

Another Gem tool that uses History is Gems on a Curve, which can be instructed to point to an object in the viewports. When that object is moved, the gems' culets all move as well, providing a powerful design tool that creates unique gem layouts. Similar to this command is Gem Follow and its big brother Gem Control, both of which assign the gems a "North" axis that can be told to point at another gem (Gem Follow) or any object on the screen (Gem Control). When more than one gem is manipulated in these tools, the effect can be stunning: causing all gems - for example, a Pave' layout - to flow like a school of fish toward one curve or point onscreen.



Gems on a Curve + Metal Piece: point gems to a new object and setting changes with gems!

History for Gems

Several commands & functions in the program use Gems' exceptional memory of their settings and cutters to create History functionality effortlessly and intuitively.

Match Attributes allows you to match the settings or cutters created on one gem to another gem. Or use it to re-create them on the same gem!

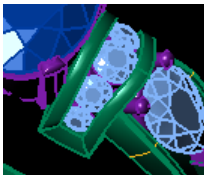
Styles may be Saved to your My Documents > Matrix 6 > Styles folders for future use. Load onto a new gem or the same gem & re-edit them for History.

Bezels, Prongs, Metal Piece, & Channel Border follow their gems faithfully when they are scaled, rotated, or moved.



Setting Tools that Follow their Gems

Thanks to Matrix History, there are a number of settings tools that follow their gems around like lovesick puppies. Move a gem with the new MSR (gem Move, Scale, and Rotate) handles (aka Gem Positioner), or just pick it up and drag it around, and bezels, prongs, metal piece (metal built around a line of gems), and channel border (a rectangle curve built around a line of gems) will follow. The powerful thing about prongs, metal piece, and Channel Border is that these tools are built around a line of gems, so the entire layout - in the case of Metal Piece, an entire surface! - can be changed as gems are scaled, rotated, and manipulated, making History a design tool in itself: when you want to adjust one of these items, simply make changes to the gems and the surfaces follow!

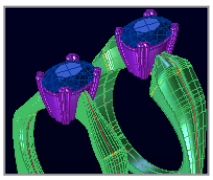


Metal Piece before scale (Above); after (below).



Other Tools with Matrix History

In this manual, you'll learn to use lots of Matrix tools that are enabled with History. Starting in the Curve Menu, the Curve from 2 Views tool creates advanced shapes that are for the first time fully interactive with History; so that you can edit them and see your changes keep up in real time.



Surfaces can be edited using Profile or Rail History.

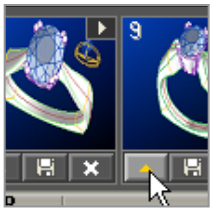
This principle also applies to the Tools menu command Advanced Custom Rail, which automatically uses ring shapes to create advanced curvature in your designs. Another Tool which employs history is "Mirror Mode", which lets you model one half of the design while the builder creates the other half for you. Again: any changes you make while in Mirror Mode are re-created by the builder in the other half of your screen, keeping up with you as you work.

In the Surface menu, Gemvision developers' tools Sweep 1 History and Sweep 2 History do what no Rhino tool can: provide real-time history for "Swept" surfaces. When you change anything about the curves with which these surfaces were created - as long as you follow the rules and don't "break" History - the surfaces keep up with your changes and "follow" their curves, updating in real-time while you watch.

Profile Sweep is a brand-new Gemvision-created tool found in the Surface menu that builds interactive surfaces between any two planar (flat) shapes. Move or edit the shapes, and the surface follows right along to keep up. And Blend Target modeling - available in the "Targets" menu - is a tool familiar to Matrix users for several versions now that creates fully interactive advanced-level models.

Application of History

By building models with these interactive surface tools, you are creating incredibly flexible models that can be changed in subtle or dramatic ways to accommodate your design changes today or days, weeks, months, or even years down the road! This means you can save items in Project Manager that you can open weeks, months, or even years later and continue changing with History. In this way, you could use one design many times for many different customers, changing it in subtle ways (new gem size or shape, new cross-section shape for shank) or dramatic ways (new setting type or an entirely new ring shape) and the builders can make the changes for you without the need to rebuild the entire model from scratch, as you would have had to do in previous versions of the program.



Job Bag different variations of models to try out on one customer or to adapt for the next customer. The possibilities are endless with History!

Turning History On and Off

History defaults to On when you open up the program. In the Info and Settings menu in the Matrix interface, you will see the History settings on the far right under this menu's title bar. Matrix History appears like a "Record" and "Play" button. These are "Matrix History Record" and "Matrix History Update", and they must both be on to see the changes History is making while you work.



Keep Matrix History on unless you are moving objects around onscreen.

If "Matrix History Update" is turned off but "Record" is on, you will not see the changes, but History will be making them "behind the scenes". When you turn on "Update" again, they will be visible. In this way, you can make changes without your computer having to "chug" away to keep up with you. But usually, you'll want them both on at the same time to see the results while you work.

If both settings are turned Off, NONE of the History functions described in this section will be available (and trust me, once you start to use them, you will LOVE them!) so it is a good idea to always leave both settings on! The only reason you would want to turn them off is to make major changes to your model: for instance, when moving a ring created with Profile Placer and Sweep History or a model created with Metal Piece clear across your screen - as when setting it up for a render, for example - you will find that all the pieces take a moment (a LONG moment, sometimes!) to "catch up", and can look quite amusing (or appalling!) while they do so.

To avoid this convoluted look - and the heavy computer power it can spend trying to achieve it! - and to avoid any crashes that may occur while the program is thinking so hard about this move, turn Off history before attempting major moves like this! But don't worry: none of the History relationships are "broken" when you turn History off on a model like this. You can turn it right back on and pick up modeling where you left off. I like to think of it as "suspending" History. If, however, you attempt to build more models once it has been turned off, History will not apply for them even after you turn it back on. It must be on at the start of working with a History-enabled tool.

Rhino History

Rhino has its own version of History that doesn't always "play well" with Matrix History. I recommend you turn it off before using the program; then, after you've read about it, if you decide it would help you out, turn it back on before running one of the tools with which it is useful. In that way, you are using it in a conscious manner. If you leave it on and forget about it, strange things can happen that you might not be prepared for! The Rhino History setting is found beside those for Matrix History. When it is dim, it is off; when it is lit up, it is on.

Rhino History works differently from Matrix History, so don't get the two confused! What it does is, when you copy or re-create an object using one of its tools, you can make changes to



Keep Rhino History OFF unless you are prepared for what it will do!

the original object (sometimes flat against the grid or easier to manipulate in some other way) and the changes will be carried through to the new object. This can be helpful in that, if you have two objects that you want to be identical and you edit one, the new object will also reflect your changes. However, it can also be a pain: what if you forgot you had it on, and you wanted the new object to be left alone - NOT exactly the same as the first! For this reason, we recommend you leave it off.

The tools that work with Rhino History, and how they work with History, are explained in their respective sections of the manual. They are: Array, Polar Array, Copy, Mirror, Rotate Commands, Divide Curve, Edge Curves, Extrude commands, Flow commands, Intersect, Loft, Curve Network, Orient commands, Project, Revolve commands, Scale commands, and Shear. In each of these commands, changes to the original object with which the new object was created affect the new object that was created from it. For instance, editing the curves you used to make a "Loft" surface or a "Revolve" Surface change the resulting surface. These are powerful tools; but again, unless you need them, we recommend you don't turn on Rhino history. When you're going to use one of these tools, turn it on to get the full effect of the tool (unless you don't want the changes, as in Mirror or another everyday command!)



We advise AGAINST using Rhino and Matrix History together: you can, just BEWARE!!!

Tips & Tricks: Using Matrix History

The following tips will help you use History correctly

Don't Break History! Of course we don't want you to break History, and there are a number of commands that do so... there are also a few ways around these, which we'll also teach you. These relate to Matrix and Rhino History, interestingly enough - ! - I guess no program can keep up with these changes that will fundamentally break the History relationship ...

1- For any History processes involving curves, don't Split, Trim, Join, or Curve Boolean curves, or the history relationship will be broken. The thought here is: these processes create a NEW curve, and History doesn't know you wanted to incorporate this new curve in your changes. If you need to edit the curves using these tools, do so before running the command; or edit them and re-run the command, and History will love you for it... !

2- For any History process that creates surfaces, don't Split or Cut away (Boolean) objects from the surface, as this also breaks History. This rule is similar to the previous one, only you're breaking it from the other end: not breaking the input objects, but breaking the output objects! Once output objects' history relationship with their curves are broken, changes to the curves won't continue to change the surfaces. However, there is a way around this limitation: if you use Matrix's Profile Placer to create the shape curves, you can always build the surface again with Matrix's Sweep History tools and re-cut it with the Gem Cutter history available on gems (Match Attributes of a gem or gem line to itself and select the cutters), and you can re-sweep and re-cut the surface.

3- Don't delete the input objects or the output objects. Obviously, if you delete the input objects used to make the surface; or the output surface you are working on, History will be broken.

Note: Although Matrix has its own set of History rules, Rhino History adds a few more: if you edit the History-created objects, History is broken. In Matrix, this is also true, but Matrix History has a bit more flexibility, explained with each tool in the manual.

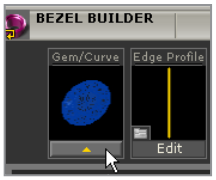
Intro to Matrix 6...

Tour of a Matrix Builder

Meet the "Builder", a typical Matrix Menu with features standard to most menus in the program, and learn what each feature can do.

Map of a Builder

Upon opening most of the Matrix Builders in the program - any of the Matrix commands that has an "interface" or menu - you will see a menu similar to the one shown at right open just below the Project Manager in the space at the bottom of the menu on the left-hand side of your screen. (You will have noticed by now that builders are not just found in the "Builders" menu, but in any of the Matrix menus - Builder, Tools, Gems, Settings, Cutters, & Render.)



To start up a builder, input gem into In Box or select builder from F6 menu.

Almost all builders have these common features, which we'll cover in detail in this section: (from the top down) Preview Windows displaying what type of object should be placed into the builder and what shape curves the builder is using to build its creation; an Options list that changes the way the builder works and offers the Styles section of the program from which you can load a library of pre-made styles specific to that builder; a Mode area, where you can change which related part the builder is making (here, bezels, gallery rails, underbezels; elsewhere, heads with different prong configurations, for example); Builder Controls, which show graphic representations of each builder dimension you can adjust, as well as a slider bar controlling the dimension you've selected from this list.

Viewport Features Common to Builders

Upon inputting the object with which the builder is going to work (some builders just require you to click "Start" in the Options list, if there's nowhere to input an item), the object being built - a bezel, here - will appear in the viewports in the preview shade mode you've selected from the Info and Settings menu. Before it is created, Viewport Control Handles appear that have counterparts to every Builder Control in the menu. Also found in and around the viewports are the Command Line options, most of which also correspond to Builder controls and Options List items in the Builder menu.

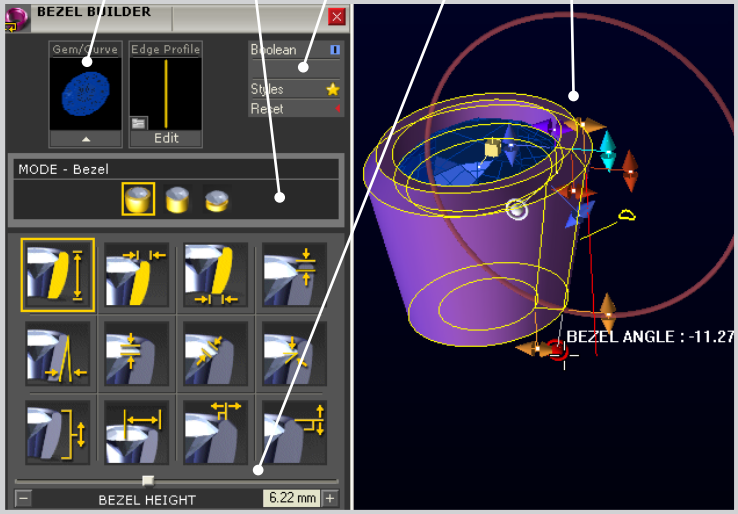
Your Guide to a Builder

At the top you will find Preview Windows. If you can input an object, you'll see the "In" arrow. The other type displays & lets you change the shape curve being used to build the object in the viewports.

The Options List appears to the right of the Preview Windows. Options such as Boolean, Styles, Reset, and others appear here.

Mode changes the object being built.

Builder Controls can change based on the Mode you have selected. Click an icon to highlight it in yellow. The slider will now control that icon. Or, choose the corresponding Viewport Control to adjust that value.



Ending a Builder

When you've used a combination of Builder Controls, Viewport Control Handles, and Command Line Options to create your masterpiece, you can end the work of the builder by pressing Enter. The handles and the preview display of the object will disappear, leaving you with a model of the object you've been building that looks exactly like the preview item you've been building; only it's now a "real" item you can select and model with in Matrix.

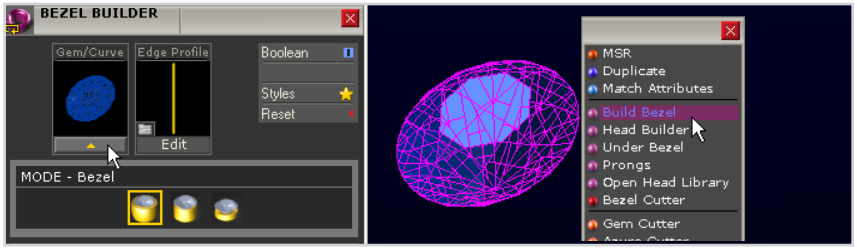
If you don't press Enter to end the work of the builder - for example, you change your mind - click Reset to end the command, or just hit Escape. Closing the builder also removes the Viewport Control Handles and ends the command.

The Features of a Builder An Overview

Learn what each Builder Feature does, and apply it to most builders in the program.

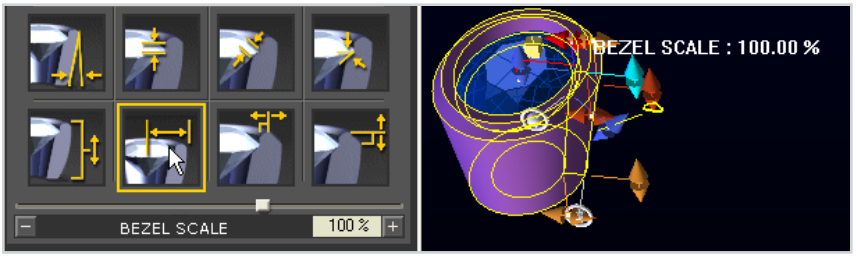
Preview Window "In" Box

Certain preview windows require you to input objects in order to start up the builder. They have an "In" arrow at the bottom. The type of object it accepts is indicate at the top of the Preview Window. Select the object in the viewports and click the "In" arrow to input that object and start up the builder. (The builder makes its creation on the input object.) If you select and try to input the wrong kind of object, the Preview window will not accept it. Inputting the object will start up the builder: placing the builder object with handles in the viewports and displaying the Command line options

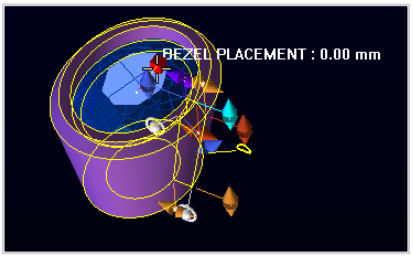


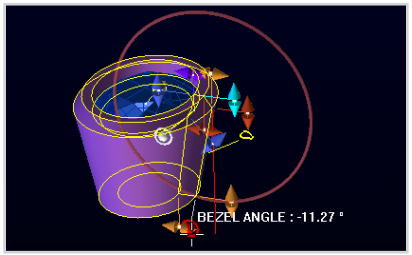
to show the command has begun. As previously discussed, another way to start up a builder is to select the object on which to build, press F6, and select the builder from the list that appears. This will open the builder, populate the Preview Window, and show the builder object with handles and Command Line options.

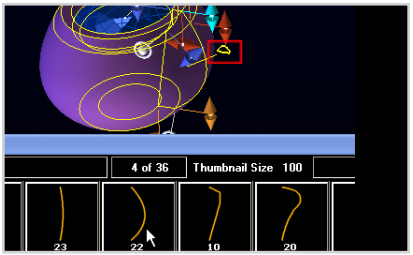
Mode. Choose the type of object to build from the icons found in the "Mode" list just above the Builder Controls. This list displays related items that can also be created by the builder - such as different types of bezels, heads with different prong configurations, etc. The selected Mode is outlined in yellow.



Builder Controls The builder can control each of the dimensions that is represented graphically in the Builder Controls. Select a dimension to change, and its name appears in the Slider Control beneath the icons. Click on the white box above the builder name and hold down the left mouse-button while you move the mouse to the right or left to raise or lower this value (click and drag the slider control). The current value is displayed in the window to the right of name of that dimension, as is the unit of measurement in which the value is represented: Percentage, here. Millimeter is another common unit you might see displayed here, as is Degree: it just depends on the dimension you are controlling at the time. Hold down Shift while you click and drag the slider control to move it in increments of 0.5. Or, click on the "+" and "-" signs on either side of the dimension name to change the value in increments of 0.10. To enter your own value into this window, left-click and drag the cursor over this value, highlighting it; then, type in a new value for this amount (a highly secretive ninja move known as the "swipe and type").



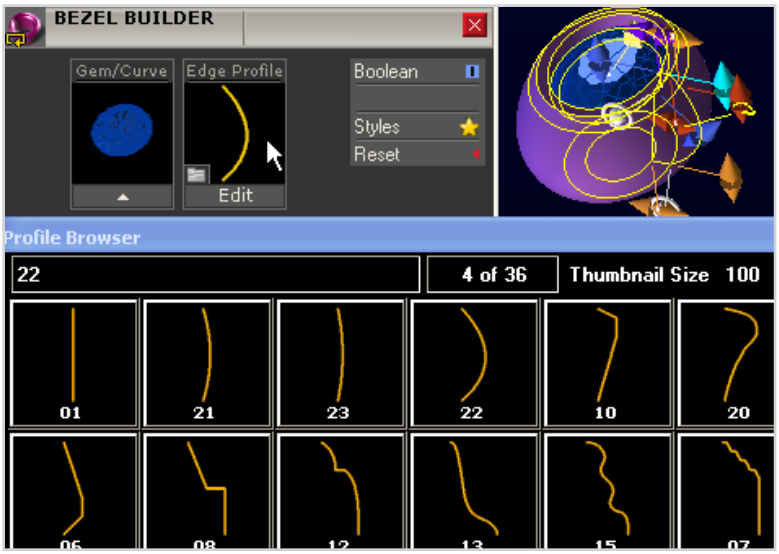




Viewport Control Handles To find out what a Viewport Control Handle does, move the mouse over it and it will be highlighted in red and display the name of the dimension it controls. If that is the one you wish to change, click on the handle and drag it to one side or the other, raising or lowering the value and visibly changing the dimension. Different handle designs indicate different dimensions. For example, the "arrows" control scale; the "cube" controls position, the "orb" controls position along curve, and the "orb + halo" controls rotation and angle. Other viewport control handles sometimes include letters (P & R stand for Prong and Rail in Head Builder; E stands for Edit control points in Profile Placer) and symbols. The symbol you'll notice most often is the Profile shape. Click here to open the Profile browser (also reached by clicking on the "Profile" preview window in the builder, explained next) and click on a new shape for the curve located beside the Profile symbol. The shape will change to the new curve.

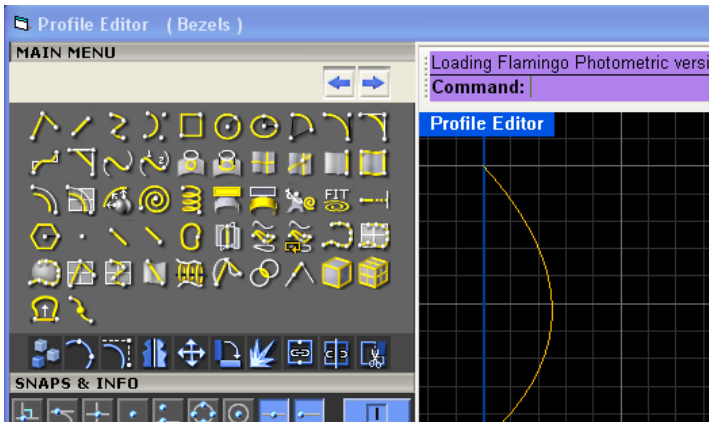
The Features of a Builder: Edit a Profile

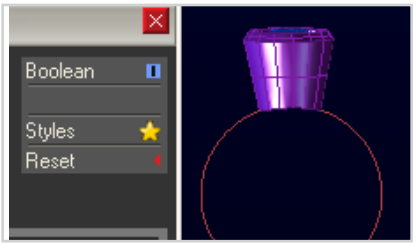
Learn what each Builder feature does, and apply it to most builders in the program.



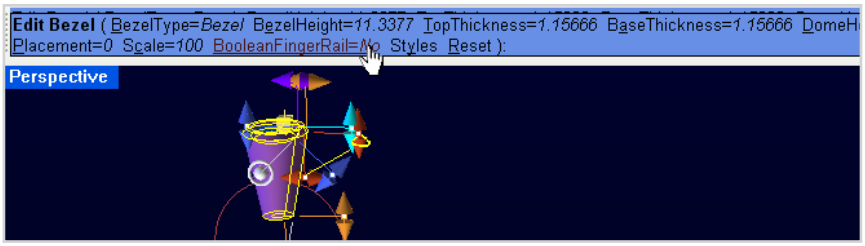
Profile Preview Window Preview the profile or "shape curve" being used to build your object in the "Profile" preview window. This window is usually named for the location on the object where the shape appears ("Edge Profile", "Top Profile", etc.). To change the profile shape, click on the shape, which will open up the profile browser - a menu of possible profile shapes for this object - at the bottom of your screen. As you move the mouse over each object in the Profile Browser, the shape in the viewports will change, previewing how that shape curve will change your design! To pick one you like, click on it with the left mouse-button and it will be applied to your design. This will close the browser and make the selected shape appear in the Profile Preview Window, as well as changing the model in the viewports to the new shape.

Edit a Profile The "Edit" option at the bottom of every Profile Preview window in the program allows you to draw a profile shape of your own to apply to that location on the object you are building ("Edge" of bezel, here: hence the name "Edge Profile" for the Preview window). Click "Edit", and a new window will open up over Matrix, complete with its own viewport that displays the currently-selected shape. It is best to first select a shape that is close to the shape you want to create; then click Edit. Using this shape as a guide or as a starting point, you can use all the Curve menu commands, OSnaps, Grid Snaps, etc. that you will learn later on in this manual to create your own profile shape.





Options List The portion of the builder menu just beside the Preview Windows contains a list of options specific to each builder. Click "Reset" to return to the builder defaults for the particular Mode you've selected. Other options are explained in the section of the manual specific to the builder in which they appear.

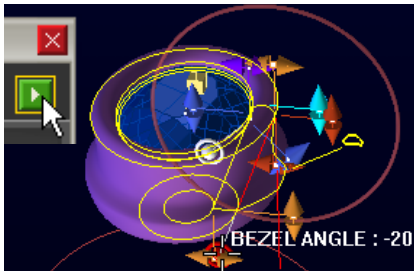


Command Line Options In many builders, these correspond to the Builder Controls and the Options List. However, there are sometimes options in the Command line that don't appear in the builder (more advanced ones!) or there are controls in the builder that don't appear in the Command line (it's not long enough!). To use a Command Line option, click on the option to access it. Some options "toggle" or change between two possible alternatives. Some options offer you further sub-options, which you can click on to select. Others prompt you for a value, which you must type into the Command line and press Enter to accept.

The Features of a Builder: Using Style Sheets

Learn what each Builder feature does, and apply it to most builders in the program.

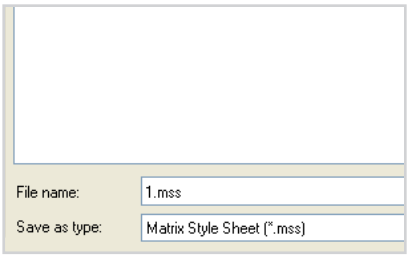




Loading "Styles" Accessible both in the Options list and in most builders' Command Line Options, "Styles", where available, comprise the Gemvision-created "library of parts" that make a great starting point from which to build any model. Click the "Styles" option in the Option list or Command line to open the Styles menu (far left, above). Styles are dependent upon Mode, so select the mode you wish to work in first or you may not see the Style choice you want. Click on a style to preview how it will appear on your model (center, above). After selecting one, click the green arrow to apply it to your model, changing the viewport model and closing the Styles interface. After applying a style, you can still adjust the model (far right, above); however, styles offer a great starting point.

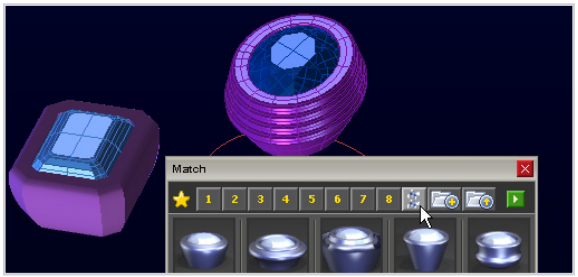
Note: Builder defaults including Styles are scaled to gem size based on a range of sizes, so you may need to adjust values if your gem size falls on one end or the other of that range.

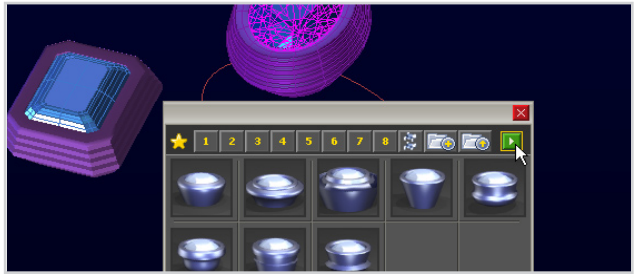






Save a Style Suppose you would like to save your OWN style to this interface, so that you can load your favorite head, bezel, prong configuration, etc. just by opening the Styles menu in that particular builder. To do so, within Styles, use the "Save Styles" option. This will take you to your My Documents > Matrix folder, which is where the program saves your styles, personal profiles, Job Bags, Animations, renders, etc. Your style will save to the folder representing that builder. If it does not, navigate here. Name the style "1" through "8" and you will be able to open it with the icons numbered "1 - 8" in the Styles menu. Or, name it anything you wish that you can remember easily, and you can access it using "Load Style" in this menu.





Match Attributes from an Existing Style One final feature of the Style menu is the Match Attributes button. Use this when you have a style onscreen to which you wish to match the new bezel. To use Match Attributes from the Style menu, select this option; select the gem onscreen with the bezel you want to match, and the Style Menu will re-appear, with that style on the new gem. Click the green button to Apply it to the new gem, closing the Style menu. Please notice that Match Attributes has its own button in the Gems Menu by which you can load any style present on a gem; using Match Attributes in the Style menu only lets you load the style relevant to the builder you're using. Match Attributes also has its own selection on the F6 menu, from which you can run this function without even jumping into the Gems menu, for you really lazy people (!). When running Match Attributes outside of a builder, you will be able to choose from a list of all the builders that were run on this gem.

Intro to Matrix 6...

Modeling in the Viewports

Learn the important features of the main workspace in the product: the Rhino Viewports. See and work on one model from 4 views at a time.

The functions left to be explained in this chapter (Snaps, Info & Settings, Layers, and Project Manager; File, View, Measure & Utilities Menus) all require knowledge of functions specific to modeling in the viewports, so let's learn a little more about those viewports and their important features before we tackle the remainder of the interface.

About the Rhino Viewports

Picture the viewports as four different views of the same thing. In this case, the model is more than likely a ring, so they are set up to present four views of the ring: "Looking Down" on the ring as though the wearer were gazing at her finger; the "Through Finger" view of the ring as though you were holding it up to look through the finger opening; the "Side View" of the ring, as though you were looking at it from one side of the wearer's finger; and finally the "Perspective" viewport, which allows the user to freely rotate the view to any angle necessary.

Each viewport contains the visible grid: a 40 X 40 mm grid or Construction Plane (shortened to "CPlane") which is centered on the ring in each of the aforementioned views (as long as the ring is not moved off center of where the Ring Rail is placed when using this tool). The center of the grid is marked with a red (horizontal) and blue (vertical) line so you can find the center visually very easily.

These grids, gridlines, and center lines represent the familiar Cartesian planes you learned in high school geometry, where X is the horizontal line, Y is the vertical line, and Z is the direction coming "toward" the user - or, up and down.

Global vs. Local X, Y, & Z

You will notice that each viewport has its own X, Y and Z (termed "Local" in Rhino), represented by the colors of the lines in the center of the grid, but this is not always the program X, Y, and Z (termed "Global" or "World") . Global X, Y, and Z are only represented in the Looking Down and Perspective viewports, and can be tracked to each of the four viewports by looking at the small Cartesian "key" in the lower left-hand corner of the viewports, which shows the global coordinates relative to each view. For example, Looking Down shows you X and Y; Through Finger shows you X and Z, and Side View shows you Y and Z.

Understanding the 4-viewport View & X, Y & Z

Looking Down shows you the view of the ring as though you were the wearer looking down at your finger (X and Y in the World Coordinates).

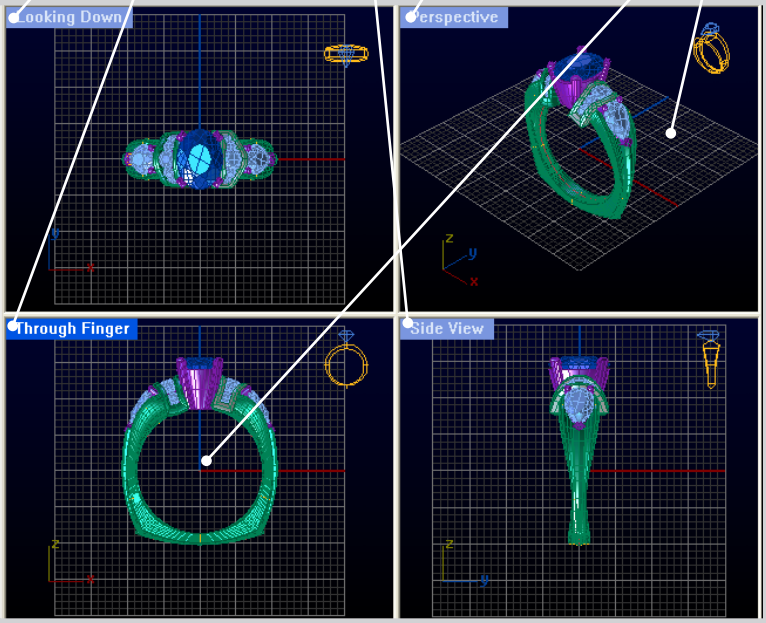
Through Finger shows you the view of your ring through the finger hole (X and Z).

Side View shows you the side of the ring as though you were looking at the side of the wearer's finger (Y and Z).

Perspective shows you all three axes at once, and you can freely rotate to see any view of ring (X, Y, & Z).

The Grid or Construction Plane ("CPlane") exists at the center of the finger hole in each of the four views, as represented by the planes below.

The center of the grid is represented by the two axes: local X (red) and Y (blue).



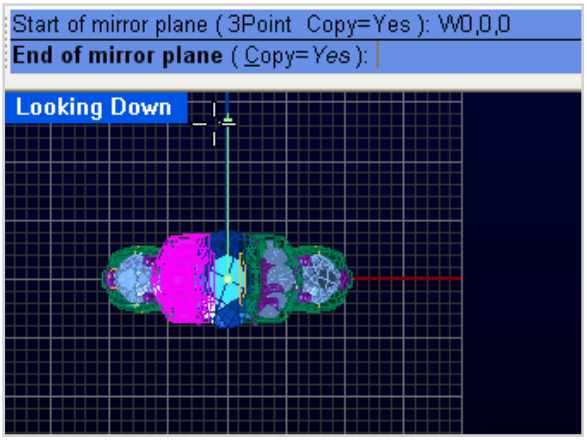
Why this is so beneficial

The program is set up this way because there are often times when it will be easier to work on one part of the ring in one viewport and one part of the ring in another viewport: the view in which you can see and access that part of the design best.

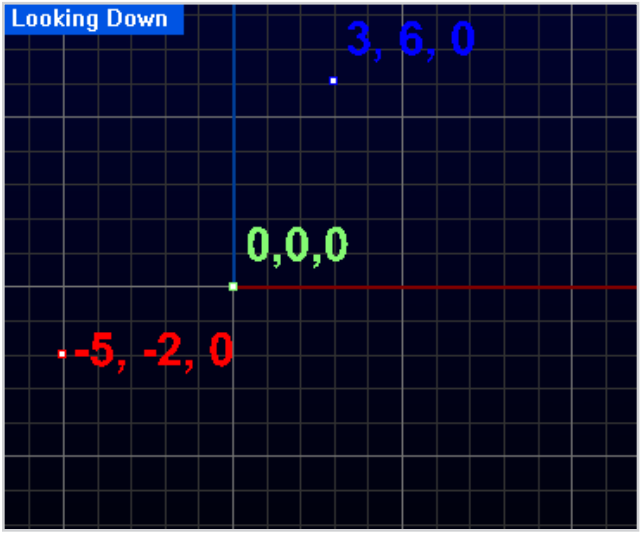
Modeling in the Viewports: An Overview

Learn the basic terms and concepts central to modeling in the viewports.

F4: The Center of the Universe From this moment on, the new center of your universe is "F4", which is the keystroke on your keyboard representing 0,0,0 in the Cartesian system in Matrix: or, the center of the grid axes. Since the finger size for the ring you will build is centered on this point (0,0,0) in space, it is very likely you will need to refer to it when performing modeling functions that - for example - make the ring symmetrical (Mirror), make a bypass shape that is the same in two corners in the Looking Down view of the ring (Rotate), or for any number of tools you will learn in the program. Whether or not you are building a ring, it is a good idea to center your model on F4, as it is very easy to Mirror designs just by pressing this key as the center of the mirror plane around which you are mirroring an item. Without it, you never know what you are centered on, and your design can easily come out lopsided and give you bigger problems down the road when you are producing it on a mill or growing machine.

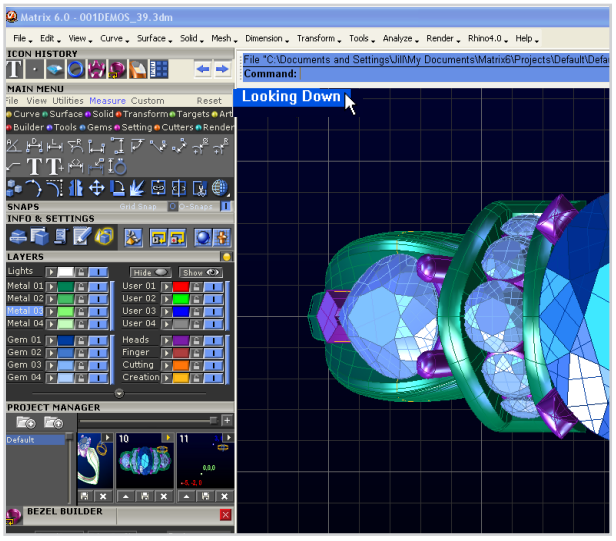


During a command such as Mirror, press F4 to indicate 0,0,0 as the "Start of Mirror Plane" and hold down Shift to mirror evenly from one side to the other.



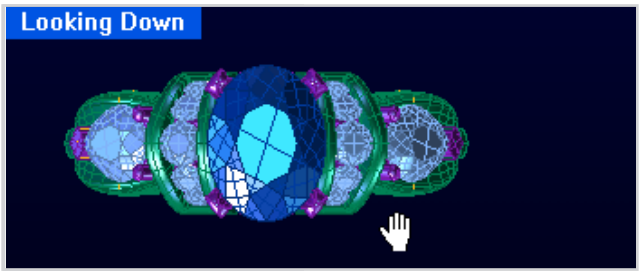
Cartesian Coordinates & MM Values Although it is possible to model this way in Matrix, I've never seen anyone do it (that doesn't mean they're not out there!), but it's worth a mention anyway just to understand a bit more about our friends the viewports. Each light gray "box" on the grid represents 1 mm. Each brighter gray box represents 5 mm square. The grid is therefore 40 X 40 mm square. But because Rhino is a sophisticated CAD modeler living in this Cartesian world, you can actually type values into the Command line to start a design at a certain Cartesian coordinate on the grid. Type in the format "1, 2, 3" to place a point at the world coordinate 1, 2, 3. Or, leave off the last number (program reads it as "0") and the point will be placed flush against the Looking Down grid. When the Command line is asking for a value, remember these are always in mm, because the grid lines each represent 1 mm square. You will learn later on in this section how to change to other values if you wish.

Activating & Maximizing Viewports For many commands, it matters what viewport you are working in. To work in any viewport, move the mouse into that viewport, left-click on the grid, and the viewport will be activated - i.e., that is the one the object will be drawn in. If you don't need to click on the grid but wish to activate the viewport, click on the viewport name, turning it from a dim blue to a brighter blue color, and it will be active. Suppose the viewport is too small to see comfortably while you are working? Double-click on the viewport name and the viewport will take up the entire four-viewport view of the product so you can really see what you are doing. Obviously, this is now the active viewport, too! To minimize the viewport again, returning to the four-viewport view, double-click the name of the viewport again and it will be reduced. Or, click the Reset button, which restores the default view of the viewports that the program originally has at startup.

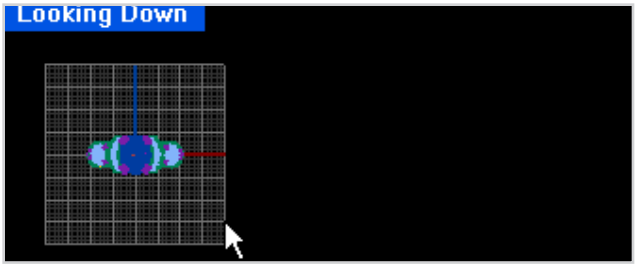


Modeling in the Viewports: cont'd.

Learn the basic terms and concepts central to modeling in the viewports.

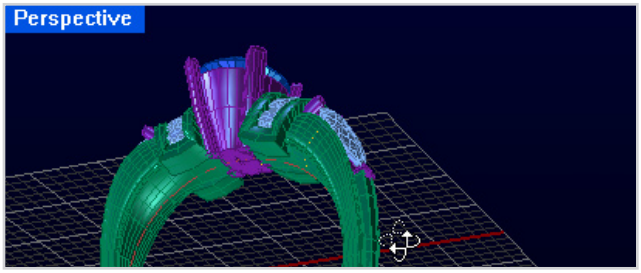


Panning the View In any of the three planar viewports, (planar means flat in Matrix-ese: you might as well get used to that one!) Looking Down, Side View, and Through Finger, position your mouse anywhere in the grid and hold down your right mouse button while moving the mouse left, right, up or down (right-click and drag). This "pans" the view - or, moves it in the direction your mouse moves - to give you a better picture of everything you can see in that viewport.

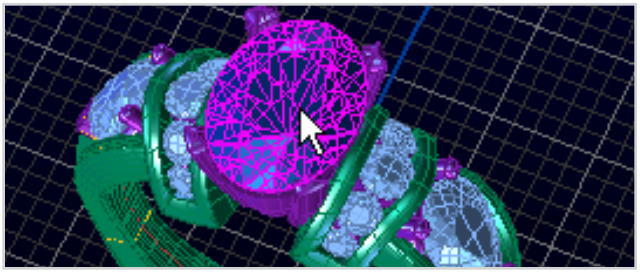


Zooming the View In any of the four viewports, move the mouse over the portion of the grid that you would like to focus in on and scroll the mouse wheel up to zoom in and down to zoom out.

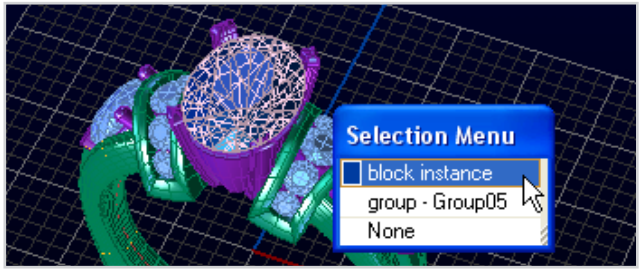
Resetting the View Again: to restore either the Pan or Zoom back to the default at program start-up, use the Reset button in the Matrix Main Menu.



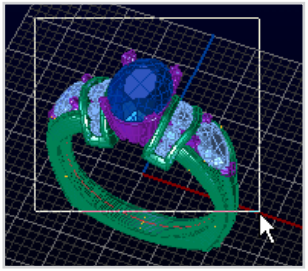
Rotating the View In the Perspective Viewport ONLY, holding down the right mouse-button while moving the mouse left, right up or down (right-click and drag) rotates the view in the direction you move the mouse. The center of this rotation might not be on your model: it is at the center of the current view of the model. So if this feels a little weird, click "Reset" and re-try. To "Pan" the Perspective viewport, hold down the Shift key while using "right-click and drag" in the direction you wish to pan.

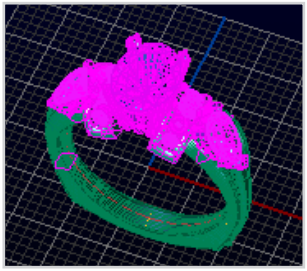


Selecting an Object There are lots of instances in the program when you'll need to select an object in the viewports. The best way is to left-click on the object, and it will turn to the pink highlighted color that indicates to you it is selected. If you need to add objects to your selection, hold down the Shift key on the keyboard and click on more objects. If you need to remove objects from your selection, hold down the Ctrl key and click on selected objects to remove from the selection.



Selection Box If the program can't figure out what you are clicking on when you are trying to select an object, it will flag you with a little Selection Box that lists all the possible objects in the general vicinity of your cursor that you could be trying to select. To help you out, it displays their layer color beside what they are (Curve, Surface, Gem, etc.) to assist you in the selection process. If you see what you want in that box, move the mouse over its name and click it. It will be selected, and the box will disappear.





Surrounding Objects to Select Another way to select multiple object at the same time (the selection box won't appear) is to region-select them. Position the mouse at the upper left-hand corner PAST the objects to select, hold down the left mouse-button, and "click and drag" a selection rectangle (solid line) down and to the right, past the other side of the objects to select and fully surrounding EVERYTHING you wish to select. Everything in that rectangle will be selected.

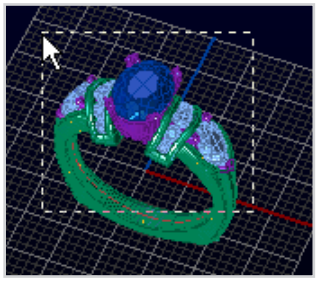
Modeling in the Viewports cont'd.

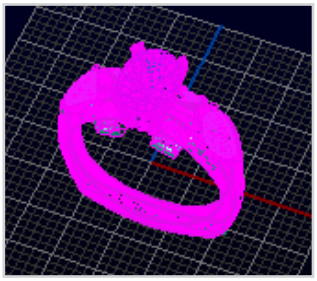
Learn the basic terms and concepts central to modeling in the viewports.

Crossing Objects to Select Another way to select multiple objects is to click to the RIGHT of all the objects to select, hold down the left mouse button, and click and drag a selection rectangle down and to the left (dotted line). In this situation, you only need to "cross" - or, touch with the selection box - everything you wish to select, and it will be selected.

Note: To deselect anything, click on another object to select; or, click on the black grid of the viewport, selecting nothing.

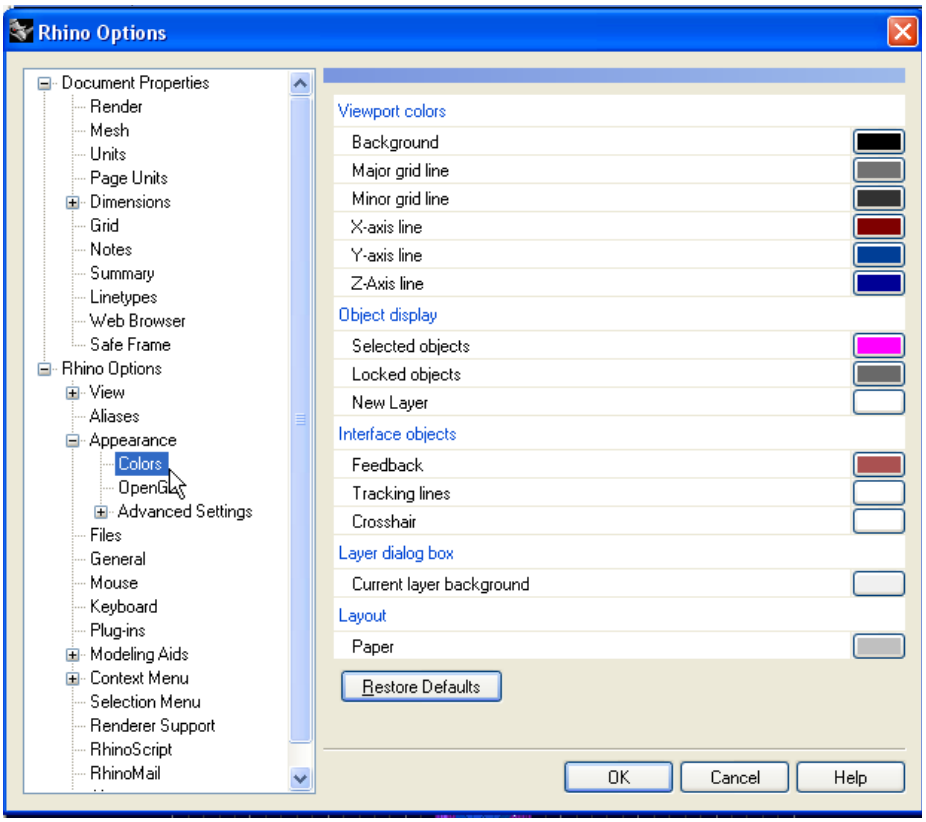
Visual Cues Obviously, the pink highlight color indicates what is selected. Other visual cues include: the cursor turns into a flat "hand" while panning; a "magnifying glass" while zooming, and a little pointer finger while selecting Command line options. A simple text cursor appears when you position the cursor to type in the Command line. While drawing, you will see cross-hairs, indicating the next point will be placed, and you may see a marker with a Tracking line in functions explained later in this chapter.





Keyboard Shortcuts for the Viewports Press F7 if you don't wish to see the grid lines, F4 to indicate 0,0,0 during a Command, and F5 to spin the viewport (NOT recommended!). "Enter" ends a command, "space bar" and "right mouse-click" start up the same command again, Ctrl+ C, V, X, Z, Y, and A are the same as they are in Windows: respectively, Copy, Paste, Cut, Undo, Redo, and Select All (objects in the viewports). Other keyboard shortcuts will be discussed with the commands they relate to.

Changing the Viewport Properties Rhino options to change viewport properties (color, dimensions, etc.) are found by typing "Options" into the Command line. Press Enter, and the Rhino Options menu will appear. It is NOT recommended that you change things in here if you are not aware of what they do, as these are the program settings and there is no easy way to put them back if you really foul them up! However, a quick exploration of the "Appearance" menu (find menu on left-hand side of this screen) will show you where to change the grid colors, while the "Grid" menu under "Document Properties" will help you change the Grid Extents (Size) and grid line properties. "Units", three menus above that, lets you switch from mm to other dimensions, such as feet (yes, more Matrix customers than you would guess have modeled their new store layout in the software!). Finally, the "Keyboard" option shows you where the keyboard shortcuts are found (and how the brave can program them!)



Intro to Matrix 6...

Using Info & Settings Menu

See basic or complex information about models, keep project notes, select certain types of objects, and control History & preview settings.

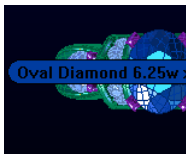
Object Information / All Object Information

The program stores information about all objects onscreen. To see this information in quick, easy-to-read format or longer, more complex format, use one of these two tools. Object Info displays a quick "pop up" label beside a selected object in the viewports. This display is the layer color of the object it is referring to. It displays the type of object and important information about it: surface or polysurface (made up of more than once surface); closed or open (can't be used in growing/milling), valid or invalid (can't be used in Boolean and further modeling operations), and point count (for curves), or surface count (for polysurfaces).



L - R: Object Info, All Object Info.

As you learn more about the program, you'll come to appreciate all this information more! To use Object Information, select the object or objects for which you wish to see information displayed, and click this tool. Their information boxes will appear. Press enter to hide them again.

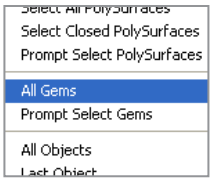


Object Info shows you just what you need to know about an object you select.

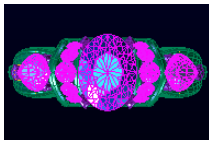
To view All Object Information, select the object(s) to view and click this button. All the same information is displayed about all objects onscreen; however, there is more stuff to wade through that we're not going to explain here. If an advanced user needs this information; it's still here. If you care to wade through this display, be my guest! I recommend you use Object Information, instead.

SuperSelect

SuperSelect is related to these two tools. It can determine what types of objects you have onscreen and display in the menu that appears only those types of objects. It's a quick way to check if you have any open curves (won't properly build solids), open surfaces (won't mill or grow correctly), invalid surfaces (won't Boolean or function properly in modeling/ growing), or duplicate objects (especially a pain: located right on top of one another and therefore indiscernible!). If you do have these problematic objects, or if you simply wish to, for instance, select all curves and hide/ job bag/ delete them, etc., you can do so here. To use this tool, simply make the selection from the list that appears and it will be highlighted in the viewports for further modeling operations. This is a powerful tool that is new to Matrix 6 and, though new users may think it banal, experienced Matrix users all over the world are bowing down & thanking the Matrix gods for it!



SuperSelect detects what objects are on-screen and offers you choices based on that. Choose one to select.



The Info & Settings Menu

(From Left to Right) Object Information displays information about just the selected object(s).

To see all information about all objects on-screen: All Object Info.

Command History displays the commands, options, and feedback displayed for the last commands you ran.

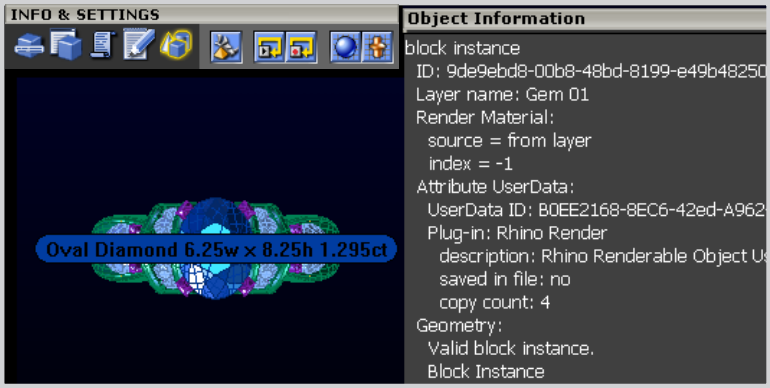
Type and save info about your model in Project Notes.

Use SuperSelect to select only the types of objects in your model you may need.

History settings are for modeling with tools that are set up for Matrix or Rhino History.

Shade settings change builder previews.

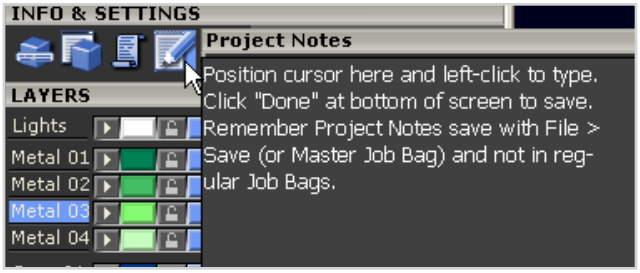
Choose to draw cutters or not during builder preview.



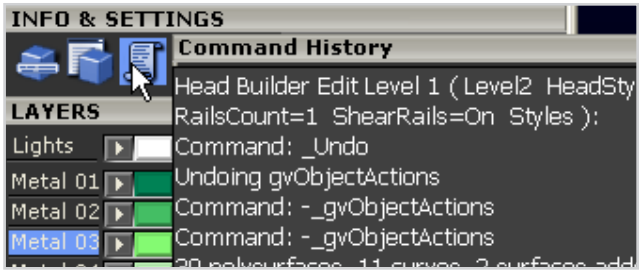
Compare Object Info on the left to All Object Info on the right.

Info & Settings: Additional Tools

These tools are also found in the Info & Settings Menu. Where indicated, they are further described elsewhere in this manual.



Project Notes Start this up and type any project notes you wish to keep in the Saved file into the window that appears. Click "Done" to keep them, and open them again in the future when you need to check them by clicking here again. Just remember to do a File > Save As, or place the file into a Master Job Bag, in order to save the notes with the file.



Command History See a list of commands you've just run (i.e. Matrix has just sent to Rhino. Also included is the feedback Rhino gave you during all those commands (displayed in the row above the Command line) in case you wondered what just happened, if there are any problems or confusion while you're modeling.



Rhino History On / Off We recommend you turn off Rhino history unless you've read this section of the manual (a few pages ago!) and really determined it's something you want on. It can also confuse Matrix History on certain commands, so we tend to leave it off. Read about History to determine your best course of action re. these settings. When this button is lit up in bright blue, it's on. Click it again to dim it out, coloring it gray and turning it off.

Matrix History Record & Update On / Off Again, you can read what these do a few pages back in the History section. Turn them off when they are not needed; otherwise, we recommend you leave them on: all History-related functionality will work as expected when they're both on.



Preview Shade On / Off While builders are doing their work, the preview model will be shaded if this is on; wireframe if it's off. This applies to all builders except for Prongs, which are not drawn shaded in preview mode because it makes them work so slowly. Turning this off makes the builders work a bit faster, but on a powerful computer, it shouldn't make much of a difference: change this setting based on the view you prefer while you work in the builder.

Draw Cutters On / Off Gem Cutter tools have a great feature where you can interactively Boolean (cut) the surface that the gems are stuck in, so you can see the results of the builder and not the cutters themselves. However, if you still wish to see the cutters (a wireframe of them, so as not to intrude on your view of the cut), turn this setting on. Again, it adds little or no speed to the way the cutting tools work; it just gives you a view of the product you might prefer to see while you work.

Intro to Matrix 6...

The Layers Menu

Organize your work and keep track of different parts of your model visually using different colors from the Layers Menu.

About the Layers Menu

The Layers menu is one of the most helpful menus when modeling with Matrix. You'll go to it every time you build something. Think of it as a giant organizer for your model. Not only does it organize things visually - i.e., when you see their colors, you can easily tell what each part of your model is - it also organizes things by turning off or Hiding those parts you don't need to see right at the moment; selecting things you need to use all at once, "locking" layers you don't wish to change with a certain operation, and even assigning different metal colors during the Presentation shade modes available in the Shade menu (described further in the section on the "Top 11 Buttons").

What is a Layer?

Well, obviously, a layer is a color: so, changing the color of items places them on different layers in the program; and in turn, changing the layer of an item turns it a different color. But I like to think of each layer color as a little "drawer" into which you can put every related type of item that makes up your model.

While you certainly don't want to build everything on one layer color, the same way you wouldn't put everything into one drawer in your desk, you also don't want to put things on so many different colors that you're using all of them! Also like when you organize your desk, you put similar things together. It's the same with the Layers menu, which is why we've helped you out by grouping colors into four: "Metals", "Gems", "User" colors, and layer colors on which the parts are typically created by Matrix builders ("Heads", "Finger" or ring size, "Cutting", and "Creation").

Does it matter what color I use?

The best part about the Layers menu is that it's a flexible system you can tailor to the way you model. We have some recommendations, though: we recommend you keep Profiles (Cross-section shape curves) on the Creation yellow layer, because that is the color our Profile Placer builder creates them on. We also like to draw Cutting objects on Cutting orange; Finger size rails and other ring shapes on the Finger layer; and Heads and Settings on the Heads layer.

To keep things organized, we teach you in class to create ("Sweep") surfaces on the Metal layers. These (conveniently!) shade in yellow gold and white gold during Presentation mode in the Shade menu. Our program gems appear on the Gem 01 - 04 layers, and we recommend you rarely or never put them on any other colors. These shade up like diamonds, sapphires, and rubies during presentation mode: also convenient!

And when you're drawing your own curves, we recommend you use the four "User" colors, because other objects in the program don't come out on these layers, so they're a good place to put your own work. But when you're drawing things yourself, you can use any of these layers - any of the 16 (32, actually, when you open the Advanced Options in this menu!) colors for anything you're working on.

The Anatomy of the Layers Menu

The arrow beside the layer name places a select object onto the layer color.

Right-click the swatch beside this arrow to select all objects on that layer color.

Click the "lock" to lock or protect all objects on that layer from being used in modeling.

Click the next button to turn a layer on or off. The long button besides each group of layers turns all layers in this group on or off.

Shift + Right-click an advanced options layer name to changes its name. Shift + Right-click its swatch to change its color.

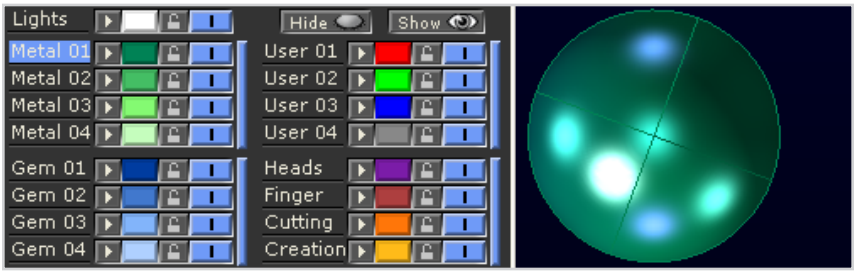


The Layers Menu is also like a anatomical drawing on transparent pages in a textbook: peel back the "skin" (surfaces) by turning off their layers to inspect the "organs" (gems); turn these off to see the "skeleton" (Curves) only to learn all about your model.

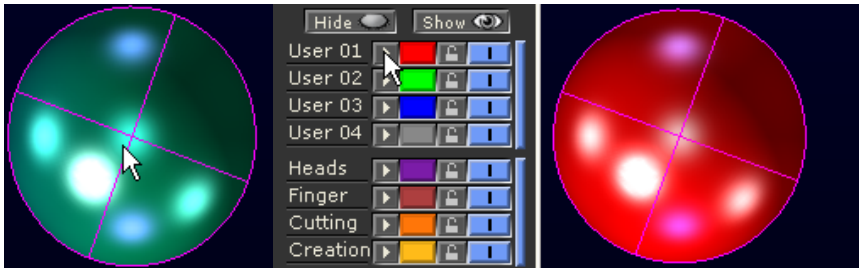
Layers Menu Functions: An Overview

Learn the basic functionality of the Layers Menu

Controlling an Object's Color You are about to learn two ways to control an object's color. The first way is to draw the object on that layer color by first making it the "Current Layer". The second way is to change the object's layer color, a process explained below.



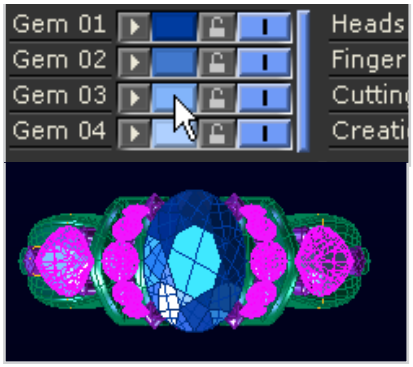
The "Current Layer" Any tool you use that does not already have an assigned layer for it in the program (Settings are purple, Cutters orange, Profiles yellow, and Rail tools maroon) will be drawn on the "Current Layer"; or, the layer that is currently selected or "active" in the Layers Menu. To make a layer color the current layer, onto which the next item you draw will be placed, simply click on its name ("Metal 01", for example, above) and that name will light up in blue, indicating it is the "Current Layer". Note that you cannot turn off the currently-selected layer.



Changing an object's layer If you wish to change the layer color of an object or objects in the viewports (even if it was created by a Matrix builder), select the object using one of the selection methods outlined in the section of this chapter, "Modeling in the Viewports". With the object selected, move your cursor over to the layers menu and click on the "In" arrow between the layer name and the swatch representing its color. I think of this as putting the object "into" the "drawer" represented by that layer color. This changes its color from its previous one to the new layer color you just selected.

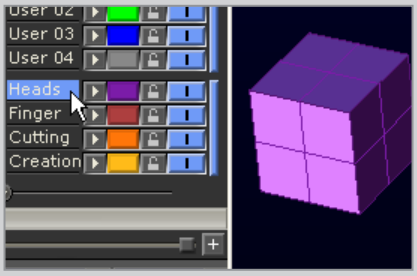
Selecting by Layer Another way to select items in the viewports is by right-clicking on the color swatch of the layer they are currently on. Right-click this swatch and all the items onscreen that are this color will be highlighted

TIP: Select like items together more easily by placing them on the same layer color.

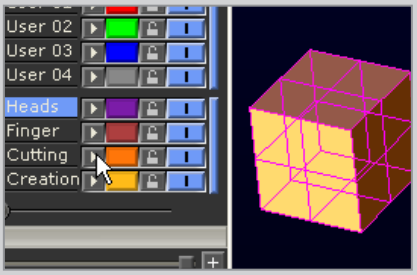


Step-by-Step

Using Layers



1 Choose Current Layer before using tool. Click the name of the color you want to draw an object on, making it the "current layer", before selecting the tool with which you are creating the object.



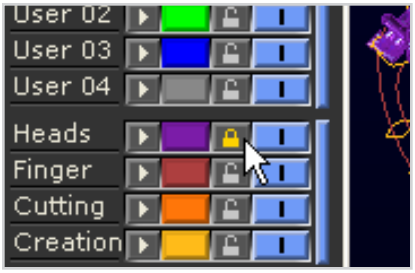
2 Or, change an object's layer. Select the object or objects onscreen and left-click on the "In" arrow between the color's name and the color swatch, placing the select object(s) onto that layer color.



3 Select the layer color of the objects. To select all objects on a certain layer (doesn't have to be the "current" layer), right-click on the color swatch representing that color and they will all be highlighted in the viewports for modeling activities in which they are all used together.

Layers Menu Functions: cont'd.

Learn the basic functionality of the Layers Menu



Locking a Layer Click the little "lock" beside the color swatch in the Layers menu to "lock" that layer; or, to prevent all the objects on that layer from being selected for use in modeling operations. You can even do a region-select and they won't be selected. You can still see objects for reference, but they are "protected" from selection. Click it again to unlock the layer.



Turning off a Layer Click on the final button in the row beside a layer's name to turn off the layer so that objects on it can't be seen while you're working on other things in your model. The final bar on a row of Layers Menu colors turns all colors in that group on and off for quicker access. Click each again to turn layer(s) back on.

An Important Note about Job Bags, Saving, & Layers Do NOT forget to Show any hidden items and turn back ON a layer you turned off before placing objects into a Job Bag if you need to save items on layers that are off. Job Bags only save what you select in the viewports, and you can't select objects on layers that are "Off" (same goes for objects that are Hidden!). However, saving a model or using the Master Job Bag will save the objects on layers that are turned OFF, as well as the current state of the layers menu (Off/ On, hidden objects, current layer, etc.)

Using Hide and Show To "turn off" or hide objects so they temporarily can't be seen using a method that doesn't depend on their layer color, select the object or objects to hide and click the "Hide" button. Similarly, click "Show" to see them again. You can run several instances of Hide, but a single instance of "Show" shows EVERYTHING that has been hidden during this instance of using Matrix (since the last File > New or Master Job Bag was opened or saved). Advanced use of Hide and Show lets you right-click on the Hide button to select the objects onscreen you DON'T want hidden; everything ELSE



will be hidden. It's like a "Reverse Hide", where you get to select what you want to see instead of what you want to hide. Right-clicking on "Show" is similarly advanced: it shows you everything that is currently hidden and allows you to select JUST those things you wish to show.



Show Materials Click on this handy button in the upper right-hand corner of the Layers menu (on the title bar) to see what materials will be displayed when using the Presentation Shade Modes. Click it again to show the conventional Layer names again. Turning this on does not change the functioning of this menu. Notice there are additional (cool!) materials for Advanced layers, which you can read about next...

Advanced Layers Menu Click the "Down" arrow beneath the layers menu to see an additional 16 layer colors. These CANNOT be used in Matrix Art ("Lights" layer can't, either) but are helpful for models with lots of different items to organize. For these colors ONLY, you can change the layer name and even the layer color of that swatch (and the items on that layer in the viewports) for any given model. To change the name of an advanced layer, hold down the Shift key on the keyboard and right-click the Advanced layer color name. Type a new name over



the old and press enter to keep it. To change the layer color, hold down shift and right-click on the layer color "swatch" This opens a palette of colors. Choose a new one by left-clicking it and click OK to make it that color.

Note: As when hiding objects or turning OFF layer colors, these settings are only saved for that particular instance of using the program. Do a File > Save As or save the model in a Master Job Bag to save these settings with the model. Upon using File > New or closing and re-opening the program, these settings will be returned to their defaults.

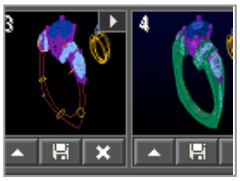
Intro to Matrix 6...

Using Project Manager

Create rows of "Job Bags" to save & organize models. Save model in stages of creation, return to earlier versions, and easily vary designs.

About Project Manager

Start using Matrix, and after a few days you'll wonder why every program doesn't have a "Project Manager"! This tool makes saving and organizing a model extremely easy and intuitive. It should become second nature for you to "Job Bag" or create a saved version of a model every time you reach a critical stage (so you have a saved version to return to); run an operation that will significantly change it (so you have a version saved before significant changes, and can try out different ones); and save objects and design elements related to that model together in one place. If you need to create a variation on the model, return to a version before you made a major change by simply retrieving it from Project Manager.



Job Bags create a step by step view of the model you've been building.

A Guide to Project Manager

Click "New" (on the left below the Project Manager Title Bar) to type the name of a new row. Do so for each new project you start.

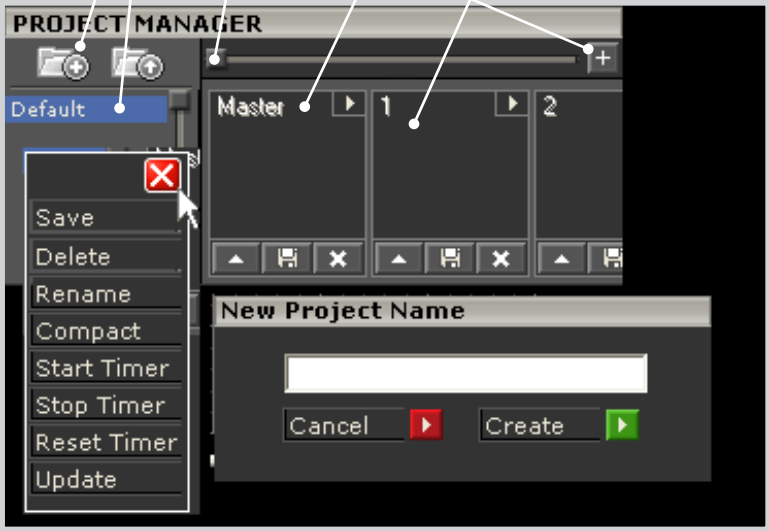
Right-click the Project Manager row name to "Save, Delete, Compact, Update", or work with the timer.

Scroll the scroll bar along the top of the individual Job Bags to see all the Job Bags you've used.

Use the "Plus" sign to see an extended view of the Project Manager row; it changes to a "Minus" sign when extended. Click this to close it.

Use the Master Job Bag like a "File > Save" and "File > New"; usually the last place you save a finished project.

Individual Job Bags run File > Export and File > Import, adding objects to current ones in viewports.



Creating a New Project Manager Row

We strongly recommend you create a new Project Manager row for each new model you work on by clicking the "Create" icon from above the list of rows. Only the "Default" row comes with the product. Make a new row by clicking this button, typing a name for your new row, and clicking "Create" (or "Cancel" to change your mind and not create the row). Do this EVERY TIME you start a new project in Matrix, for best results!

Saving & Loading Project Manager Rows

Right-click the name of a row to see the available options for managing Project Manager rows: Save a row; Delete a row; Rename a row; Compact a row (delete unused "Job Bags", or, the individual "blocks" into which you place your objects for safekeeping!), Start / Stop / Reset Timer, and Update a Job Bag row. We'll cover each of these options in detail in a moment.

Once a project row has been "Saved" into a "zipped" format called ".mpj", it can be cleared from your Project Manager to make way for new ones. When you need that row again, load it from the location where you saved it by using the "Load" icon (to the right of the "Create" icon).

How Many Job Bags?

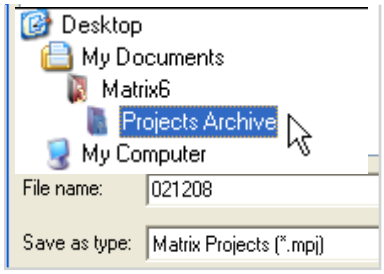
"Job Bags" are each individual "block" in a row. There are 10 in a new row; however, once you fill up the 10th, an 11th one is added, etc. We have not yet hit upon any one number that is "too many" Job Bags, but if your computer starts to choke on the memory it takes to think about all those Job Bags (upwards of 200 for most people!), consider saving them using Save / Delete / Load to give your computer a break. Same goes for Project Manager rows.

Project Manager: Functions

Options in Project Manager & individual Job Bags let you save & retrieve models.



Save a Project Manager Row
Right-click on the name of a row to access Save, Delete, Rename, Compact, Timer Options, and Update. "Save" saves the entire row as a ".mpj" file, which is a special type of zipped file that can only be opened by Project Manager using the "Load" icon above the Job Bag rows.

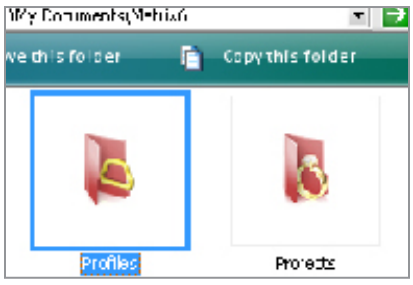


These files default to saving in your "My Documents > Matrix > Project Archives" folder, so you can find them again easily, but you can navigate anywhere in Windows and save this row wherever you want. Type a memorable file name, so you won't wonder where it is when you need it again!



Deleting & Renaming Rows Click "Delete" to ERASE Job Bag files you no longer need. (Delete it after you've Saved it off if you'll need it again!) Click "Rename" and type a new name for the row if you need to. These are displayed alphabetically, so name them with this in mind to place certain rows "on top".

Compact deletes the Job Bag blocks that are empty, in case you have any empty ones between used ones. It also changes the numbers, so if you left "2" empty, the model you placed in "3" would become "2" after clicking "Compact".

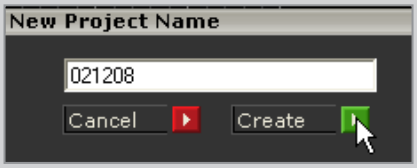


Update Working in Windows Explorer, you can "click and drag" Matrix files (.3dm is the file type) into a Project Manager row (a file folder in Windows). If you do so, and it's correctly named (explained later), click Update to see the thumbnail preview of that file appear in Project Manager so you can access it while using Matrix.

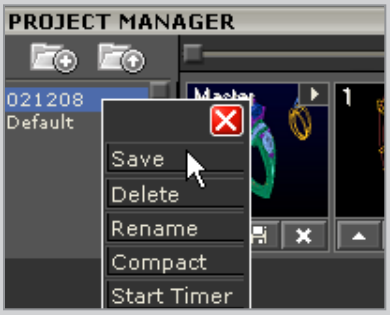


Using the Timer The final three options when right-clicking a Project Manager row Start, Stop, and Reset (to 0) a timer that displays the hours, minutes, and seconds you have had this Project Manager row open. "Stop" timer when you pause the project and "Start" it from where you left off to resume working on it. "Reset" returns the timer to 00:00:00.

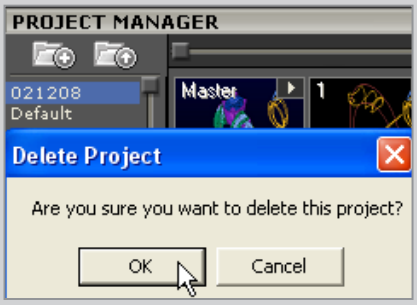
Step-by-Step
Manage a Row



1 Create a new row. Before every model you build in Matrix, create a new Project Manager row using "Create" icon just below "Project Manager" title bar. Type a name and click "Create" to see row.



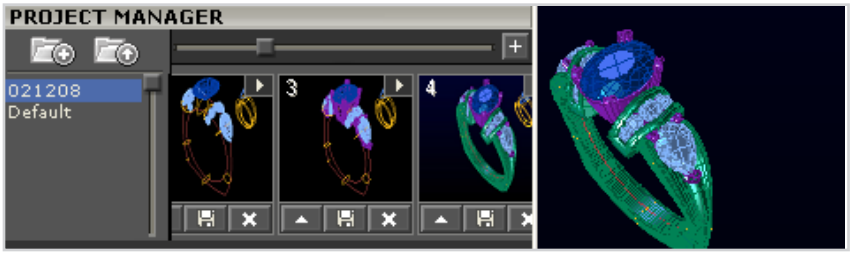
2 Save row when you are done with a project. Right-click the name of a Project row when you are done with it, and click "Save" to save it as a zipped file (.mpj) in My Documents > Matrix > Project Archives. To load again, use Load icon.



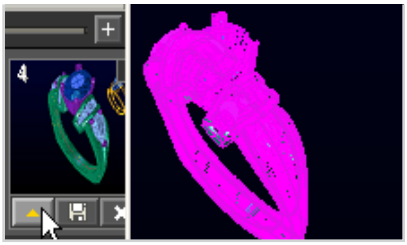
3 Delete Row to Clear Space in Project Manager. We recommend you clear old projects (though we're very bad at doing it ourselves!) by deleting project rows you've saved in Step 2. This leaves room for the Projects you're currently working on to be displayed prominently.

Job Bags: Functions

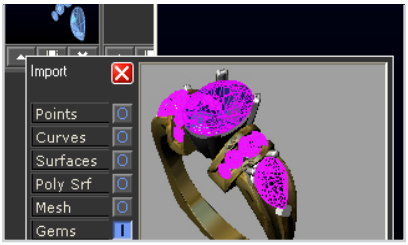
Learn to use each individual Job Bag's functions to manage projects.

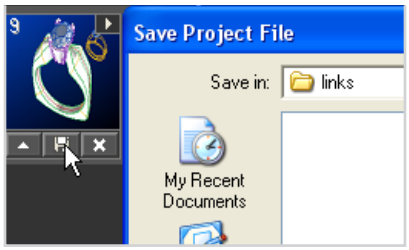


Anatomy of a Job Bag Each little "block" in a Project Manager row is known as a "Job Bag". In fact, Project Manager's first name was "Job Bag Condo", but it didn't seem to stick. The Master Job Bag in each row is its own special animal, so we'll get to that in a minute. Each Job Bag has an "In" arrow to place an object into it, a "Load" arrow to place the item from it onto the screen (or just click the thumbnail image to load it), a thumbnail image of the object as you selected it onscreen to place into the Job Bag, a number indicating which Job Bag it is in the row, a "Save" button to save it in Windows with a file name, and an "X" button to delete the contents of a bag. You will discover additional options when you right-click the Job Bag image. These allow you to place in the viewports ONLY the types of items (gems, surfaces, polysurfaces, curves, or meshes) that you want from that Job Bag. Similarly, if you right-click on the "In" arrow for a Job Bag, you can place into a Job Bag ONLY the types of items you select from this list, out of the ones you have selected in the viewports. To scroll through Job Bags, click and drag the slider above the row. (To scroll down through Project Manager rows, use the slider on the side of the rows). To open a row, extending your view of it to the right-hand side of your screen, click "+", and click "-" to return to the standard, "short" view.



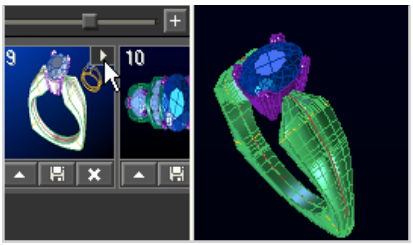
Input an Item into a Job Bag Select the object or objects in the viewports to place into a Job Bag and click the "In" arrow beneath the Job Bag, in the lower left-hand corner of the bag into which you want to place the items. To be more selective about which of the selected items you will place into the bag, right-click this arrow and select the types of items - from among those you had selected originally in the viewports - to input (such as, gems, meshes, curves, surfaces, or polysurfaces). You will know an item is placed in the bag because you can see the thumbnail preview of the view in which you selected the piece.



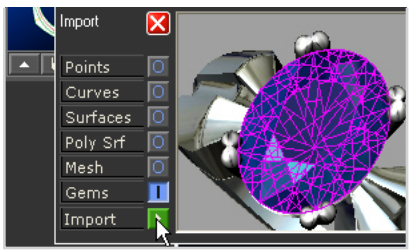


Save a File from a Job Bag The "Disk" icon beneath a Job Bag runs the Save operation on the contents of the bag. Navigate to a location where you can find it later, and save with a name you can remember.

Note: Saving is HIGHLY recommended for finished models, as Job Bags are really only for temporary saving during modeling.



Load from a Job Bag Click on the thumbnail preview of the Job Bag (or the Load arrow in the upper right-hand corner of the bag to load the item into the viewports. In all but the Master Job Bag, this does a File > Import, adding the Job Bag items to whatever you already have onscreen and not deleting or overwriting any existing work. To similarly be selective about what items you are loading into the viewports from a Job Bag, right-click the thumbnail preview or "load" arrow and select the type of object from the bag to load to the viewport. Select the object and click Load. The menu will disappear and the item will appear in the viewports.

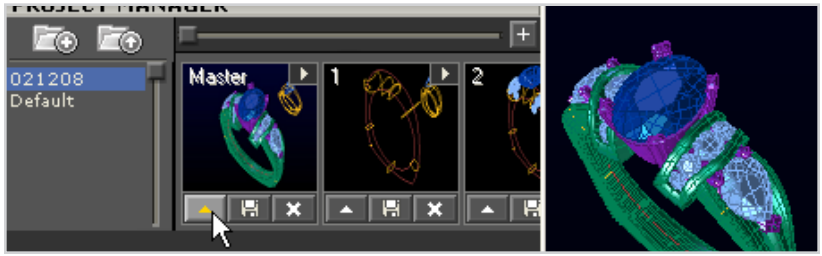




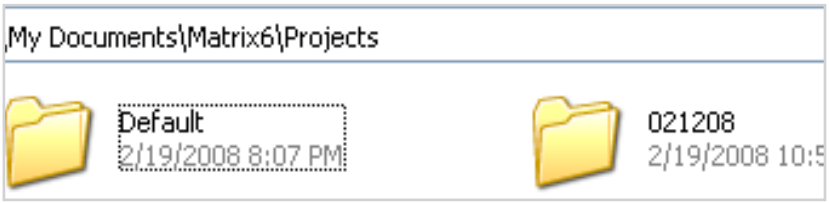
Delete a Job Bag Click on the "X" in the lower right-hand corner of a Job Bag to delete the contents of the bag. Make sure you ONLY do this if you have already saved the contents, or if you REALLY don't need them. This won't delete the Job Bag - it will just be emptied. Use "Compact" to remove empty bags.

Tips & Tricks: Project Manager

Consider these strategies when using Job Bags.



Using the Master Job Bag Although it's first in line, I like using the Master Job Bag LAST, after the model is complete. This Job Bag runs a File > Save when you input a model into it and a File > Open when you load a model from it. This is a great feature because it saves things like Layers Menu settings (current, on/off), Hidden items, V-Ray Render settings (materials, ground planes, etc), and Project Notes. However, you must be careful when loading this file, because it does NOT import the model like other Job Bags do: it actually wipes out what's onscreen at the time and opens an entirely new file consisting of just the contents of the Master Job Bag.



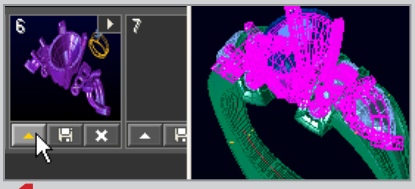
Managing Projects in Windows Explorer Your Projects folder for Matrix lives in your My Documents folder > Matrix 6.0 > Projects. Inside there, each folder is named after each row you created, and within these folders live the .3dm files for each Job Bag. They are named after the Job Bag name and Job Bag number. If you need other Matrix files to appear in a Job Bag, the "back door" way is to copy them in here and re-name them with the same naming convention. Return to Matrix, right-click the Project Manager row, and select "Update". Using this knowledge, you can back up Job Bags, copy them for use on another computer, etc. the way you would any other file folder in Windows.



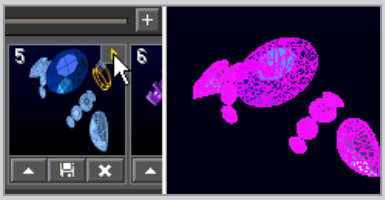
When do I use Job bags? We recommend placing an item in a Job Bag before and after placing gems on it (so you can try new gem layouts), before and after placing a setting (so you can vary the setting design and try new ones), before and after using cutters (so you can try different cutter layouts), and ESPECIALLY before using Booleans to cut away and union together objects, since there is no good way to "go back" to before a Boolean operation after a few steps, and you'll have a version that's saved prior to Booleans. Also Job Bag on a regular basis while you work, at major stages before and after you have completed important steps, to avoid losing your work.

Step-by-Step

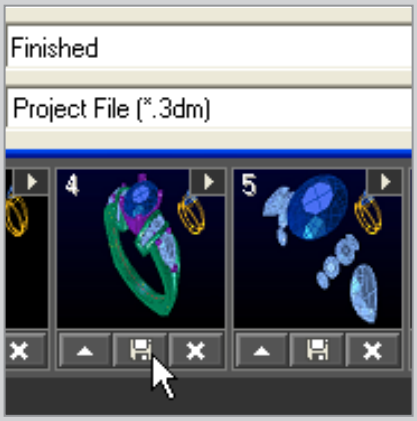
Using Job Bags



1 Select objects & input into a bag. Select objects onscreen to save to a Job Bag. Click the "In" arrow beneath an empty bag and contents (thumbnail image) corresponding to view in which object was selected will appear in bag.



2 Load Job Bag Object. Whether you're returning to an earlier version of a model to change it, make a design variation, or just start over, Load it by clicking the thumbnail preview or the "Load" arrow in the upper right-hand corner of the bag.



3 Save a Job Bag. Once you've Job Bagged a completed item, click "Save" beneath the bag and save it to a location you will remember on your computer. And/or, input your model into the Master Job Bag and "Save" this to save render settings etc.

Intro to Matrix 6...

Using the Snaps Menu

Find a location onscreen with precision using the tools in this menu. You'll use these helpers daily to ensure accurate modeling.

About the Snaps Menu

Commands found in this menu turn on viewport cues and cause tools to work in ways that make precise modeling possible. For example, using Grid Snaps, you can draw or place an item exactly to the 1.0, 0.5, 0.25, or 0.1 mm. Using O-Snaps, you can be assured that curves and other objects fit precisely together at their ends, midpoints, quadrants, and centers; perpendicular, tangent, and intersection points, etc. to ensure technically accurate modeling. And using the Project, Planar, and Ortho snaps, you can be sure you are drawing where you think you are in the viewports, so curves and other items aren't created in ways you don't expect that won't work for your particular model.

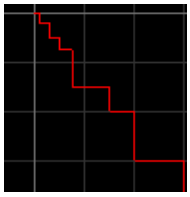


Even with menu closed, you can access important snaps.

Rather than starting up a command, each of these buttons turns on a setting that changes the way other tools in the program work. Use them before OR during a command to ensure the next point you place or the next function you run is done accurately and precisely.

Using Grid Snaps

The most simple kind of snaps, Grid Snaps, can be turned on and off by the Grid Snap icon: the rightmost button in the second row of this menu. With this setting on (lit up in blue), the current setting (0.1, 0.25, 0.5, 1.0 mm) is the Grid Snap value that tools will use while you are working in the viewports. Click on a new value to switch this depending on your needs.



Grid Snaps at 0.1, 0.25, 0.5 and 1 mm.

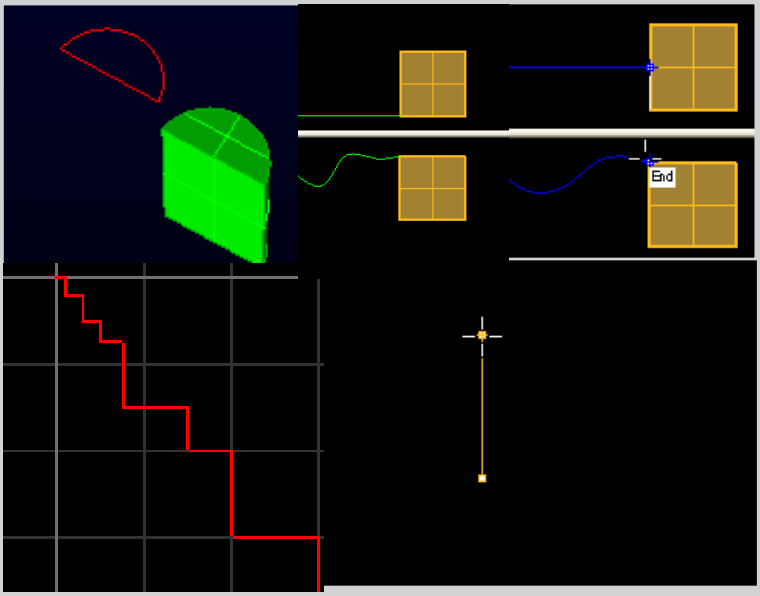
The way this works is: as you'll recall, each "square" of the grid is 1 mm. As you move the cursor around to place a point while using a tool, cursor movement will be constrained to increments of 0.1, 0.25, 0.5, or 1.0 mm on the grid. The cursor will "snap to" these increment values relative to every "square" on the grid, as shown in the illustration at left. Turn Off Grid Snaps to quit using them.

When to use Snaps, Grid Snaps, & O-Snaps

O Snaps snap drawing tools to objects, and are especially helpful when trying to draw closed curves in preparation to create closed, valid surfaces in the program.

Grid Snaps may be used to alter drawing tools so they place precise points at 1, 0.5, 0.25, or 0.1 mm increments.

Other snaps assist with drawing flat against the viewports (Project), flat against another point in space (***Planar***), or straight up and down (***Ortho***).



Other Helpful Hints while using Snaps

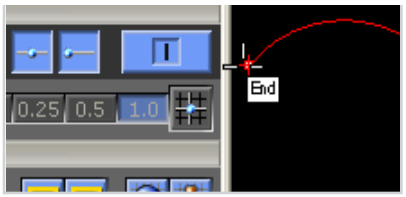
The remaining snaps in this menu will be explained next: O-Snaps or "Object Snaps" all work in similar ways, snapping to the indicated locations on objects (end, mid, center, etc). Remaining snaps assist in modeling. Please note: Snaps do NOT constrain the work of Viewport Control Handles or Builder controls. They mainly just apply to Rhino tools you will use for drawing and modeling. Also note that, if it appears the snap is on (blue) but the Snap Control (O Snap Control, Grid Snap Control) is OFF (grayed-out), the snap will not work. You must turn on the main snap control (bright blue) to turn the snap bright blue, ensuring it is on.

The Snaps Menu: An Overview

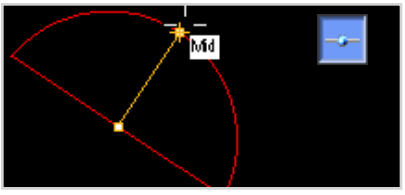
The following O(Object) Snaps and other modeling snaps will help you create technically accurate models.



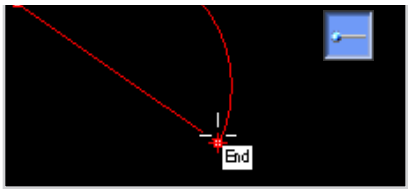
Turn O Snaps On/Off The rightmost button beside the viewport in the first row of the Snaps menu is the O-Snaps On/Off button. When it is bright blue, your selected O-Snaps are bright blue, and they will work as described here. When it is grayed-out, selected O-Snaps are dim blue and off (will not influence your modeling).



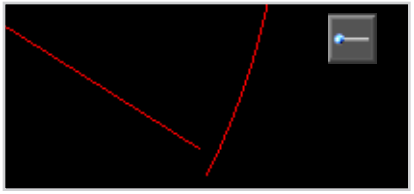
Using O-Snap Cues The way you will know an O-Snap is found is when the cue appears beside your cursor telling you that snap is found. To snap to that point, just click when you see it during the command. These are, right to left, End, Mid, Cen, Quad, Near, Point, Int, Tan, and Perp. The On Surface O-Snaps appear as "OnSrf".

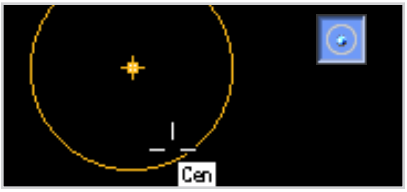


Mid To the left of End is Mid. This snaps to the midpoint of a line, curve, surface, or surface edge. It is also left on by default, since it is another common drawing tool. Again: I only turn this one off when it is distracting me from finding another O-Snap I need.

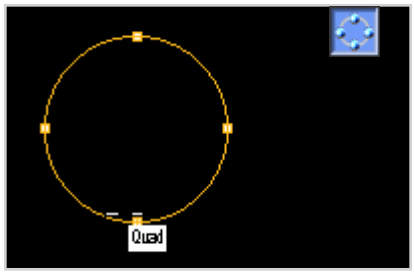


End Just to the left of the O Snaps On/Off button is the End O-Snap. Start this up when you need to draw a curve that exactly matches the endpoint of another curve. This defaults to On when the program starts up, because you almost always need it! Modeling with this turned off is ALWAYS bad news for drawing accurate curve shapes, since you can appear to be very close to another object when there is really a microscopic space that will cause your model problems down the road. Only turn it off when it is distracting you from finding another snap point you need.

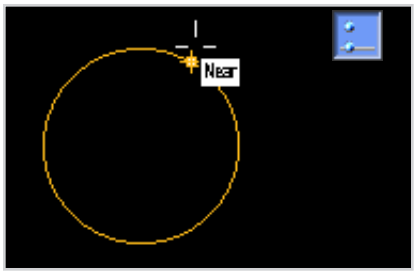




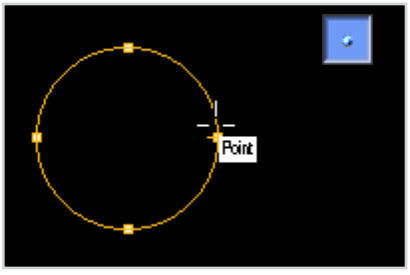
Center The Center O-Snap can find the center of a regular object, such as a circle or a rectangle. To find the center of an oddly shaped object or a 3D object, use the Center Object Utility > "Point at Center" Option. I ONLY turn this on to find the center; then turn it right off again, because it can be distracting!



Quad Just to the left of the Center OSnap is Quad. The Quad O-Snap is especially helpful when modeling with circles and circular objects (ellipses, arcs) because it snaps to the four quadrants (North, South, East and West) of a circle.



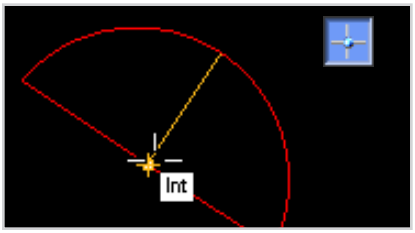
Near This O-Snap allows you to snap near to another object, but it can be deceiving: you might be near but not perfectly on the curve, surface, edge, or other object you are snapping to; and if you use Near but turn off End, and you need an Endpoint, you are definitely asking for trouble! I use it only rarely, in advanced modeling, when there is no other good way to touch one object to another.



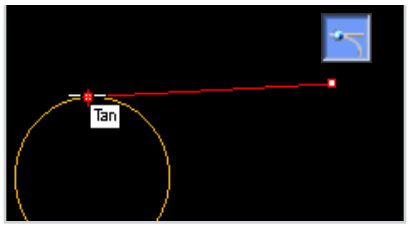
Point Turn this on to snap to any point object in the viewports. This is a helpful one when you need to snap to an already-existing point object; or when you need to snap "Near" to something but don't trust your Near O-Snap (good for you!) ... just place a point FIRST where you want to snap to, and then snap to the Point object!

The Snaps Menu: cont'd.

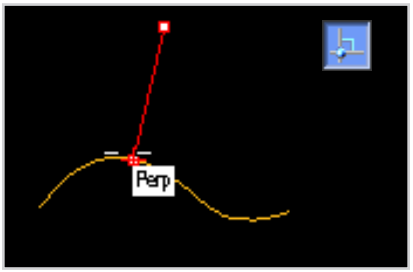
The following O(Object) Snaps and other modeling snaps will help you create technically accurate models.



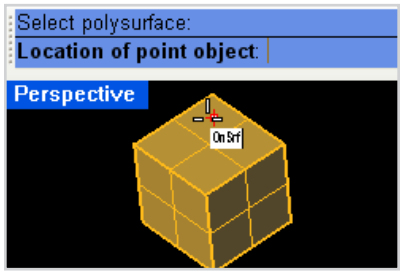
Intersection This is another O-Snap to use with care. It will appear when the object you are drawing is intersecting with another object onscreen. You can't START FROM an Intersection O-Snap: you can only draw TO it. Also, if it merely appears to intersect in the view you're in because of your perspective and it doesn't actually intersect, this snap still appears! So use with care: if you see the white "tracking line" in another viewport between the object and the cursor ("Int" O-Snap), try again. Using this with Shift (Ortho) will help you draw a straight line that you can end where it intersects with another object onscreen. End the line when you see Int. To make that line perpendicular, read on ...



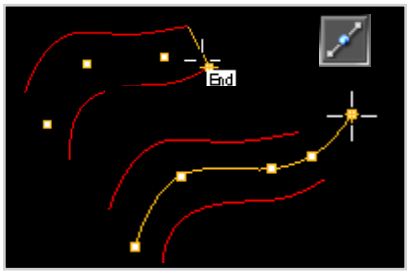
Tangent Like Intersection, you can't start a line Tangent to another object. To do so, check for this option in the Line tool. This only draws the line or curve or other object so that it approaches another curve at a tangent angle.



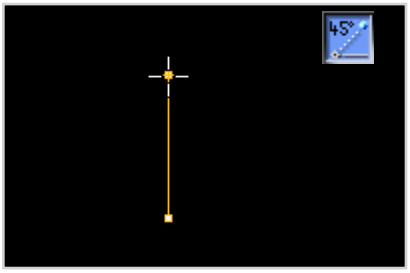
Perpendicular Once again: This cannot start a curve Perpendicular to another : look for that option in the Line command found in the Curve menu. It just tells you when the object you're drawing is perpendicular to the curve or other object you're approaching with the cursor.



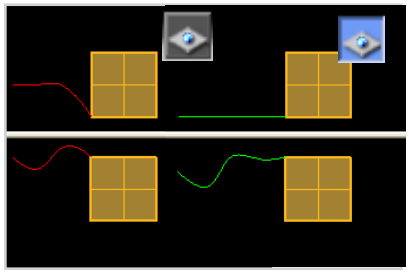
On Surface/Polysurface When placing points, turn one of these two Snaps on to snap to a surface or a polysurface. They will prompt you to select a surface or polysurface to snap to, and will then constrain the point to that object. They only work during a command.



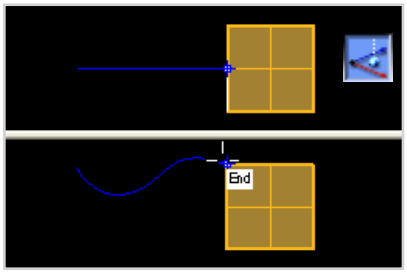
Between While running a command, select this O-Snap to place the next point during the command "Between" two other points onscreen. To locate those two points to place it between, Near and End OSnap were used in the example above. You need to select "Between" before every point you place.



Ortho Turn this on when drawing straight lines only; or, leave it Off and hold down Shift while drawing as a "shortcut" to engaging the tool. It keeps all your lines at straight 90-degree angles. Alternately, turn this on when you'll be drawing almost all straight lines and hold down Shift to temporarily defeat it.



Planar When drawing in any viewport, curves snap back flat against the grid (plane), making drawing easy. When you need to draw somewhere else in space, turning on Planar locks your drawing to an alternate flat plane in space: the one created by the first (or first and second, if you turn it on after the second) points you placed.



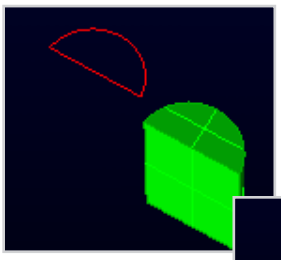
Project This makes anything you draw in a viewport snap flat to the grid no matter what. If you use O-Snaps to snap to other objects, the curve or object you are drawing may no longer be flat, which can cause problems down the road. Turn this on and Snaps will work, but objects will be drawn flat against the grid anyway. (Look in other views to see results.)

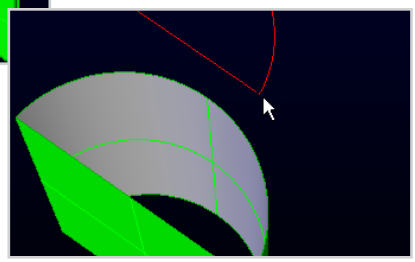
Tips & Tricks: Snaps Menu

Use these strategies when modeling with O-Snaps.

Commands you should ALWAYS run with O-Snaps

ALWAYS draw curves you will need closed (for Extrude, Matrix Art, profile shapes, etc.) with O-Snaps. NEVER skimp on this, or your modeling process will bite you - hard! - in the end. An object will not close if its creation curves do not touch perfectly, end on end. Sometimes it will look closed - sometimes it will even Join (ouch!) - and sometimes it will REGISTER closed but will be "Invalid" or unusable. For more Info, go to the end of Ch. 3.

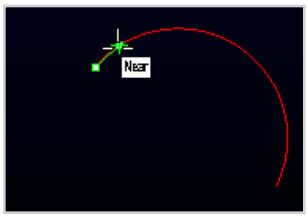


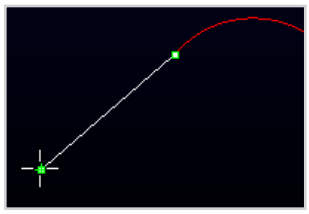


(Left) Correct: Curve and resulting surface are closed. End OSnap Used. (Below) Incorrect: curve is open - barely - because O-Snaps was not used. Resulting surface is open too, and will cause problems.

Matrix Builders & O-Snaps

You can only use O-Snaps within the Profile Placer tool to find locations along the ring rail. Other Viewport Control Handles will not find O-Snaps.

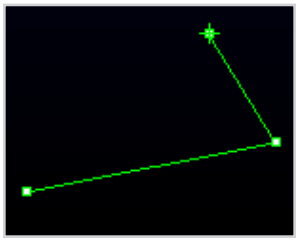


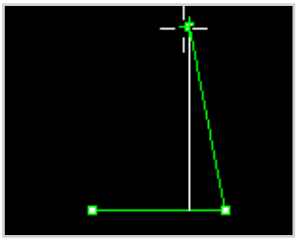


Before placing next point, hover mouse over angle to snap to (Near OSnap used above) and press Tab. Cursor now locked into that angle.

The "Hidden" O-Snap: Tab Lock

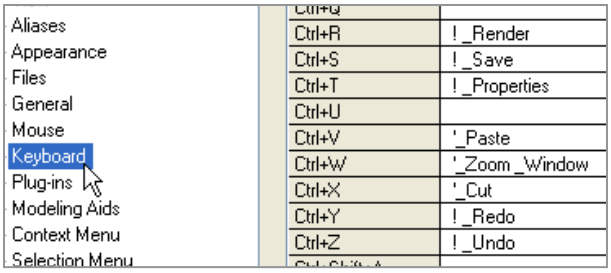
To lock a tool into a given direction, locate the mouse where you want to lock it (usually using another snap, Near above) and press Tab. The cursor is now locked into moving along that plane, so you can draw with your own "snap" without clicking any Snap button at all!





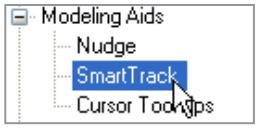
The "Hidden" O-Snap: Elevator Mode

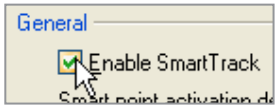
This mode is similar to the Tab Lock at left; as you are drawing, to place the next mouseclick at a location on another PLANE, use Ctrl + Click at the location and you will be locked to that location; but moving the cursor will move you up and down in the vertical plane above it. Click again to place the point.

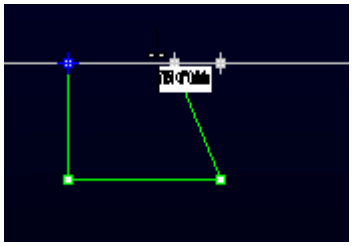


Other Keyboard Shortcuts

Like in Windows, Ctrl + A is Select all, Ctrl + Z is Undo, Ctrl + Y is Redo, Ctrl + C is Copy, Ctrl + V is paste, and Ctrl + X is cut. Shortcuts specific to Matrix can be found by typing "Options" into the Command Line and going to the "Keyboard" menu option. Scroll down to see every key with the Commands they control. If you are feeling very brave, venture onto Gemvision's online forum and read about how our users have programmed theirs.







How to turn on SmartTracking

Also found in "Options" is the "Modeling Aids" menu option (two below Keyboard). Click it and turn on SmartTracking to see drawing aids in the viewports that will inform you where O-Snaps are and "snap" to them from another point onscreen, helping you draw straight, architectural lines.

Intro to Matrix 6...

The Top 11 Buttons

These Rhino commands are used so frequently in the program they are right out "on top" for you to use whenever you need them.

About the Top 11 Buttons

These tools perform the most fundamental editing functions on curves, surfaces, and solids that it would be a crime to hide them deep in a menu somewhere! They are the tools that move and copy objects in the viewports (Copy, Move, Mirror, Rotate), edit shapes for easy design changes (Edit and Control Points On), and help you "operate" on models to cut them apart, join them to other objects, trim or split them off, and divide them into their component parts (Explode, Join, Split, and Trim).

Finally, the one tool probably clicked on the MOST in the program, Shade Mode, was put in this menu in the ideal spot - closest to the viewports and therefore your cursor! - to allow you to quickly change between different views of your model, including views that show you their contours better, black and white and other technical drawing views, a ghosted view to "see through" models, and even two "rendered" views in which you can continue manipulating the model and even keep right on working. We'll begin with this tool.

Setting the Shade Mode & Render Mesh

To view the possible shade modes, click on the teeny yellow arrow in the lower right-hand corner of the Shade button, opening the Shade mode interface. Left-click a mode to see the Active viewport (viewport name lit up) changed to that shade mode. To set that as the current mode, select it and move the mouse off the Shade menu, selecting it. Now, the following functions you run using this icon will change between this Shade Mode and the typical "wireframe" (see-through, lines-only) view of your model.

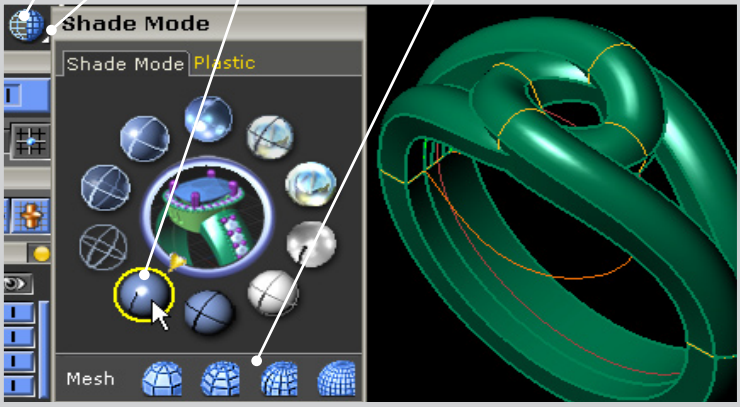
Also within this menu you can set a Render Mesh resolution that applies to the shaded model. The program creates a mesh or "skin" over the wireframe model to make it look shaded. How tightly this mesh is created is determined by one of these four Mesh settings - from left to right - Coarse, Medium, Fine, and Superfine. They raise in quality from left to right but slow down in the speed it takes to shade your model. Choose based on what is more important to you: the look of the shaded piece or the speed at which it shades. These settings will apply to the rendered piece too, so pick a high quality for best results when rendering with V-Ray.

A Guide to Shade Mode

Left-click the Shade globe to toggle the ACTIVE viewport ONLY between wireframe mode and the currently-selected Shade mode in the menu. Right-click the shade globe to toggle ALL viewports between wireframe shade and the selected shade mode.

Click on the arrow in the lower right corner of the shade globe to open the menu. Click on a new shade mode to select it (its name is displayed in the upper right above the menu.)

And/or, select a new mesh setting to raise or lower the mesh resolution (quality of the results) for shading and rendering.



Shading the Viewports

With these settings selected, left-clicking the Shade globe icon will shade the active viewport; left-clicking it again will unshade the active viewport. Right-click the Shade globe to Shade all viewports; right-click again to unshade all viewports.

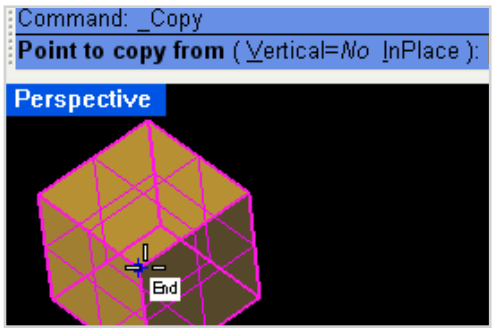
Beware of Shade Mode...

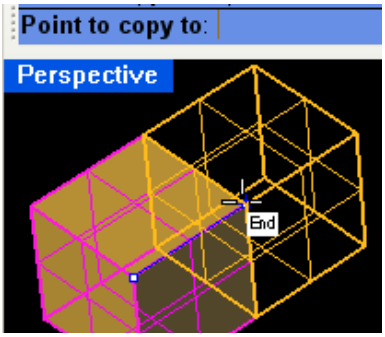
Certain shade modes will "eat" your construction curves, because they are meant for presentation only. For best results, unshade you model before selecting it for placement into a Job Bag, to make sure you have grabbed everything you expected to grab (i.e., don't feed the Shade Modes!). Also, the "Rendered" modes and the related Layers Menu settings bear NO relationship to V-Ray materials: these are all Rhino settings. (The especially brave can find and tweak these settings by typing "Options" into the Command line and going to Appearance > Advanced Settings. But don't do this unless you KNOW what you are doing, and when you foul everything up, be kind to your manual-writer and don't tell Matrix Support that I told you how to find them...!)

Top 11 Buttons: What They Do

Learn all about the Top 11 Buttons and how to use them.





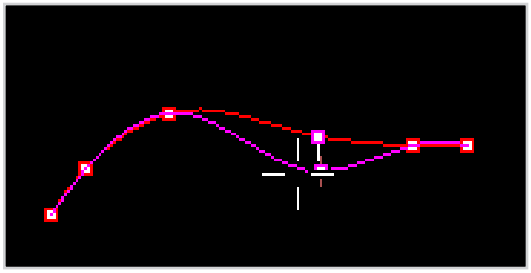


Copy This button creates a copy of an object. Start it up, and the Command line will prompt you for an object to copy. Or, select the object to copy and start up the command. It will then ask for a point to copy from and a point to copy to. Click in the viewports to indicate these two points, using O-Snaps to help you find precise locations if need be. The "Vertical" option causes the object to be moved straight "up" in the viewport you're currently in. Use "In Place" to copy an objet right on top of itself.

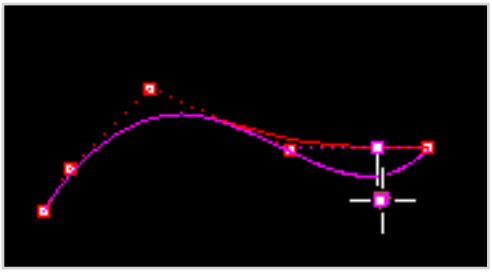
Steps for Using Duplicate: 1- Select object(s) to copy and start up tool; or, start tool and select object(s) to copy. Press enter when all objects are selected. 2- Left-click the cursor on a point to copy from. 3- Left-click the cursor on a point to copy to.

Tip: Before placing this point, enter a value into the Command line to assign a distance from the first point, in mm, to copy the object to. Now, you must still left-click to place the copy, but it is locked into this distance.





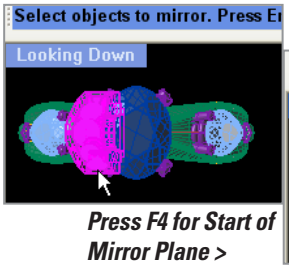


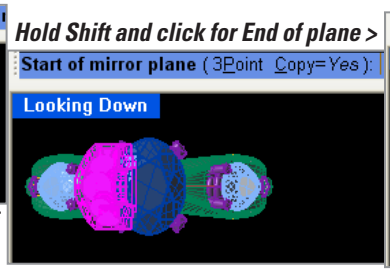


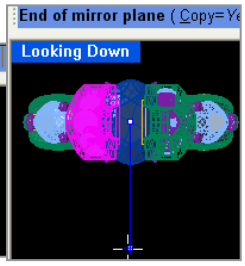
Edit Points & Control Points Best for changing the shape of curving (not straight) lines, use these tools to see and control the "Edit Points" (right on the curve) or "Control Points" (located off the curve) that make up every curve or surface. Select and Move points, or just "click and drag" them (one or more at a time) to change the curvature of a line or surface, editing it for the design you wish to create with it in Matrix.

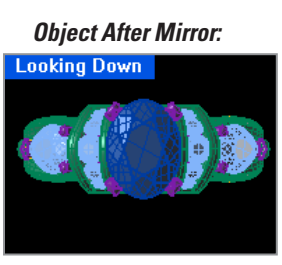
Steps for Using Edit & Control Points: 1- Select curve or surface (not Polysurface: see Cage command in Transform menu for this functionality) to edit and click one of these commands. Or, start up command and select object. 2- Click and drag or use the Move command to move edit or control points around, changing the shape of the object. 3- Press Escape twice to exit this command.











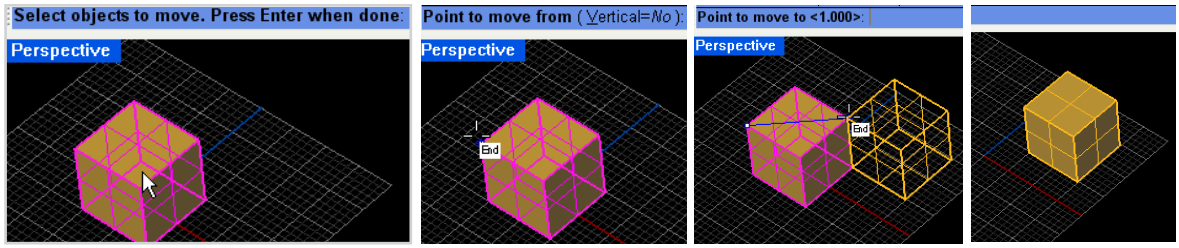
Mirror To create a mirror image of an object around any given "plane" (straight line) in the viewports - but most commonly the center (F4 or 0,0,0) of a Construction Plane (Grid), use Mirror. The available options are "Copy = Yes" (click this option to turn it off if you don't need to copy the item you are mirroring), and "3Point", which allows you to mirror outside of the viewport you are working in by placing a third point for the Mirror plane in another viewport. This is an advanced function I've never used and in fact just discovered - ! - so use only when necessary.

Steps for Using Mirror: 1- Select the object(s) to Mirror; or, start up this command, select object(s), and press Enter when done.
2- Set "Start of Mirror Plane". To Mirror to the other side of center, press F4 now. Or, for best results, find an O-Snap to help.
3- Set the "End of Mirror Plane" by left-clicking the mouse. When mirroring around F4, hold down Shift and the object will appear at the same spot on the other side of F4. Click when it's right. Without Shift (Ortho), OSnaps may help place it right.

Top 11 Buttons: What They Do cont'd.

Learn all about the Top 11 Buttons and how to use them.

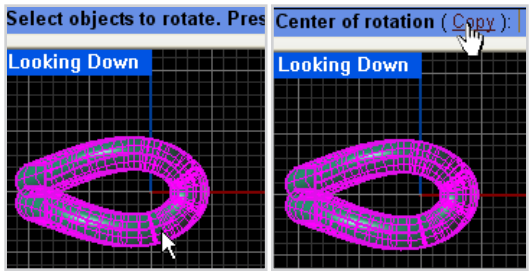


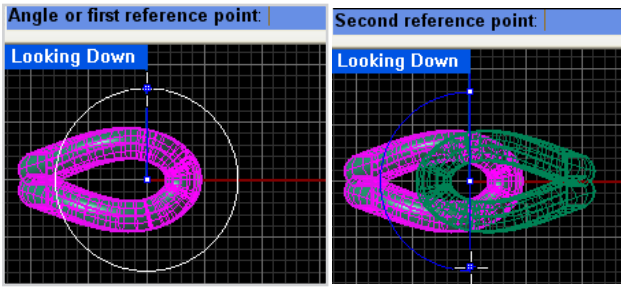


Move Start up this command and select the object(s) to move. Or, select the object(s) first and then start up the command. Select a "Point to move from" and a "Point to move to" by clicking on the grid. Or, indicate a mm value for the "Point to move to", locking it into a set distance from the original object, and left-click to place it. The other way to Move objects in the program is to simply select them; then click and drag the cursor to another location onscreen. You don't even need to start up this command to move things, which means it's easy to move things inadvertently! So take care that you don't do this, as it could really get confusing, especially if things were centered at F4 and you move them off of center by mistake.

Steps for Using Move: 1- Select object and start Move; or start Move first; press Enter. 2- Left-click on a Point to Move from (O-Snaps help Move exactly). 3- Left-click on a Point to Move to.



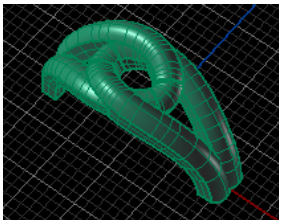




F4 is Center of Rotation, then hold Shift to place First and Second Reference Points

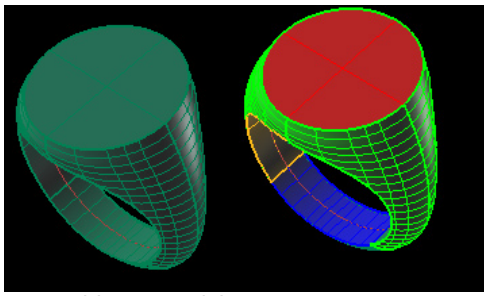
Rotate Similar to Mirror, when F4 is used, this command lets you Rotate a piece to the opposite Quadrant of the grid. It has a Copy option that usually defaults to No, but you'll want to set it to "Yes" to create a copy of the rotated piece on the other side of the grid. BEWARE that the Copy option on ANY Rhino command includes History, meaning changes made to the original object affect the new object, so if you don't want this "benefit", turn off Rhino History before employing any tool that can Copy.

Steps for Rotate: 1- Select object(s) and start up Rotate; or, start up the command, select object(s) to rotate, and press Enter. 2- The "Center of Rotation" is the point around which you want the object to rotate (usually F4). 3- The "Angle or First Reference Point" and "Second Reference Point" may be numeric values you type or a location you click - such as, the end of a line and 30 degrees' rotation from that. Hold down Shift and left-click when using F4 to place a rotated model (or copy) opposite the original.



Model After Rotate w/ Copy



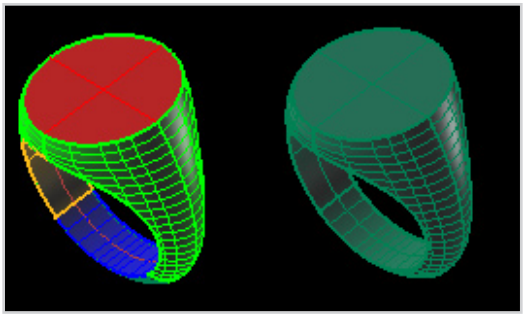


Before (L) and after (R) Explode

Explode This command separates a polysurface (an object made up of many separate surfaces, joined) or a polyline curve (made up of many curves joined together) into its component objects. There won't be any visible change in the model, but if you now select one of the component objects, it will be selected separately from the others. To re-join the objects, select them all and click "Join". ***Steps for Explode:*** 1- Select the object to explode and click the command. Or, start up the command and select the object to explode. 2- You can now select a component object - a curve or surface making up the polycurve or polysurface selected in Number 1 - separately from the rest of the model. 3- Select all component parts and click Join to re-join them.

Top 11 Buttons: What They Do cont'd.

Learn all about the Top 11 Buttons and how to use them.

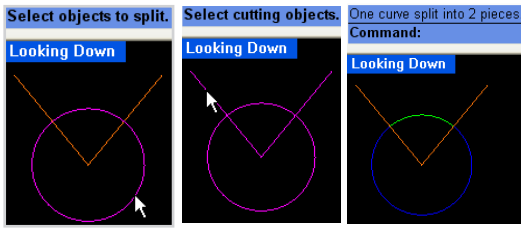


L - R: Before Join; After Join.

Join This command joins objects with "position continuity" - a big fancy way to say they're really, truly touching in the program. This means that curves' endpoints are touching and surfaces' open edges are touching. Solids cannot be joined, as they don't have any open edges. See the section of this manual about "Booleans" to learn how to Union (a fancy way to say "Join") solids.

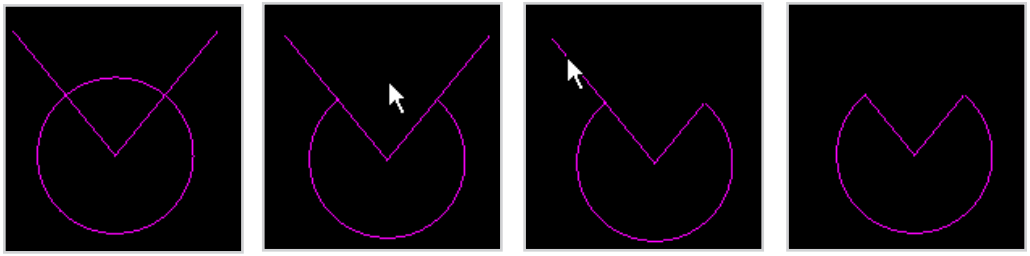
Steps for Join: 1- Select two or more objects that touch (curves end on end or surfaces with open edges that perfectly touch) and click "Join". Or, click Join, select the two or more objects to Join, and press Enter. 2- The objects will be joined. 3- To separate them again, select the new object and click Explode.

Split When an object fully intersects another (two curves cross, or two surfaces FULLY intersect, or a closed curve lays on a surface or a polysurface), you can split one object with another. Split will also work if objects APPEAR to cross in one of the viewports, so be careful to select objects that you really mean to for the Split (Hide others if necessary!) Unlike Join, you may Split solid objects with surfaces, other solids, or curves. The "Point" option in Split starts up the Point command and locks it to the curve you select. Click on the curve to indicate where to split it. Click at two or more locations in order to split closed curves. Similarly, select the Isocurve command and click on the surface anywhere to click it with a curve along it (two or more isocurves for a closed polysurface.



Steps for Split: 1- Start the command and select the object to split (cuttee); 2- Select the object to cut it with (cutter). 3- The object to be cut will be split with the cutter, if possible, at the position(s) where they intersect.

Note: Closed curves must be split in at least TWO locations, and objects splitting surfaces must fully intersect them.



Trim With curves fully intersecting one another (a closed curve must have at least two others intersecting it), start up Trim. At all locations where the curves cross one another, they will be "split" (just while the tool is running, not afterwards) with one another. Select the curves you don't want to keep in the design by clicking them, and they will be deleted. This differs from the Split command, which retains all input curves - just divides them where they cross. Trim gets rid of the ones you click, so make sure you want to delete them before you run this command.

Steps for Trim: 1- Select all the curves in the design. They must cross one another to be used, unless you use the "Use Apparent Intersections" option, for which they only need to appear to cross in the active viewport. 2- All the curves will be split with all the others. Click on the curves you don't want in the design. They will be deleted. 3- Press Enter to end the command. If the "Join" option was selected, the resulting shapes will be joined where possible.

Intro to Matrix 6...

Using the File Menu

Familiar in Windows Programs, this is where you'll find New, Open, Save, Save As, and Print; as well as functions specific to Matrix.

Open, Save, Save As:

Many of the commands in this menu will work just like their Windows counterparts, allowing you to navigate Windows to Open, Save, and Save As anything you have in the Matrix viewports.



File New and File Open: work just like Windows'.

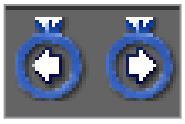
Unlike Job Bags (all except the Master Job Bag, which runs a File > Save when you put an object in it and a File > New when you load an object from it), "Save" saves turned-off or renamed Layers, Hidden objects, Render Settings, and Project Notes, all of which are associated with the "document" (or, one instance of File > New) in Matrix.

Also unlike Job Bags, you will be asked if you'd like to "Save" the current file onscreen so as not to lose your work before the program wipes out the current settings and adds those of the New file or the one it's Opening.

Upon a File > Save As, you may navigate in Windows to the location on your computer where you would like to save that file; with the subsequent File > Save(s), it will overwrite that file until you assign another file with File > Save As.

New

That being said, it naturally follows that running the "New" command in this menu will open a new "Document" or a "fresh instance" of using Matrix. This wipes out your Layer Menu settings, returning them to their defaults, deletes the current object in the viewports and anything you have on any Hidden or turned-off layers, and wipes out things like Project Notes and Render settings, creating a brand-new "Blank Page" in Matrix, as it were.



Import and Export work like Job Bags: adding to what's onscreen or saving what you select.

Thumbnail Browser

This runs a File > Open but has the added benefit that it allows you to view files as thumbnail previews of Matrix files. You will be able to see exactly the file you need. Use the menu on the left-hand side of the window browser to navigate all of the files on your computer. Whenever you click on a folder with Matrix files in it (".3dm" is the file type), the files will be displayed in thumbnail preview form in the space to the right of the menu. Click on a file to open it in Matrix.

Thumbnail Browser

Click Thumbnail browser (performs File > Open, so make sure your current work is saved or Job Bagged) and navigate the menu on the left to a folder containing Matrix Files (.3dm files)

Click the folder to see the contents on the right-hand side of the menu. Scroll down if necessary to see all the contents of this menu.

Click a thumbnail to Open it in the viewports.



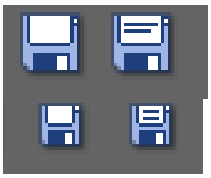
Import / Export

Importing a file merely adds it to the viewports - along with everything else out there, and is in fact the function that "Job Bags" run when you "Load" a Job Bag onto the screen.

"Export" is a good way to save only what you want from the viewports: Select it and click "Export"; or, start up Export and select only what you want to save. This is what Job Bags do when you select only what you wish to Job Bag and place it into a bag.

Export is also useful for saving an object created by Matrix in a format - such as STL or Mesh - so that it can be used in another program. You can also Import objects from other programs - if they are compatible with Matrix - into Matrix. To discover what kinds of files you can Import and Export in Matrix, pull down the "Files of Type" dropdown when in either of these commands, and check to see whether the file extension (the extension for a Matrix file is ".3dm"; for a Word file is ".doc", etc.) is present in the list. If it is, select it from the list and you'll be

able to import that file into Matrix. Upon Export, select it from the list and your file will be saved by Matrix as that file type so that it can be opened in the other program you are using.



Save, Save As; Save Small, Save Small As.

Save Small / Save Small As

These tools work just like their "Save" and "Save As" counterparts, while allowing the file size to be smaller because they don't save the "render mesh" - or, the "skin" that is placed over the wireframe model by the Shade globe to create the Shade mode look. (The same "skin" is used in rendering, which is why it's called the "Render mesh".) This reduces the amount of information that is saved with the model and therefore reduces the file size. We like you to save models this way when you send them in to Matrix Support at Gemvision, as it takes up less space in email and downloads faster.

Project Notes

An alternate place to view and create Project Notes is found here. Click this button to open the Notes section on the right-hand side of the screen (same notes as found in Utilities Menu notes; different display method). Type or read notes that accompany a file, and remember: these save with the file when you run a "File > Save" or "Save As," so they also disappear with the file when you run a "File > New" or "File > Open".



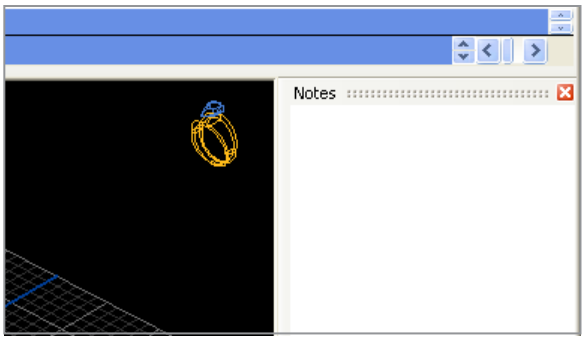
(L - R) Notes, Print

Print

To print a Matrix file, start up this interface. The print preview appears at right. Select "Print" when you are ready to print it, "Close" to close the preview, or "Cancel" to change your mind. At left, choose from the menu to change the print preview and hence what will print. The first menu allows you to assign the printer and paper size / layout, as well as the copies, output, and color or black /white.

View and Output Scale let you assign which view to print; the entire viewport or the "extents" of the part, and the scale of the item. As you make changes, they will be evident in the Print Preview at right, so you can determine from that if your print-out will be as desired.

In the remainder of the menu, assign margins, line width / size, View options (background color, any background bitmap (see View menu for details), and any features of the grid (grid, axes y/n), notes, or filename, and finally check that your printer information is correct. Please note that this does NOT print your render: it just prints a picture of the Matrix file. Your render is created by a separate program (V-Ray) that has its own set of functions for saving and printing.



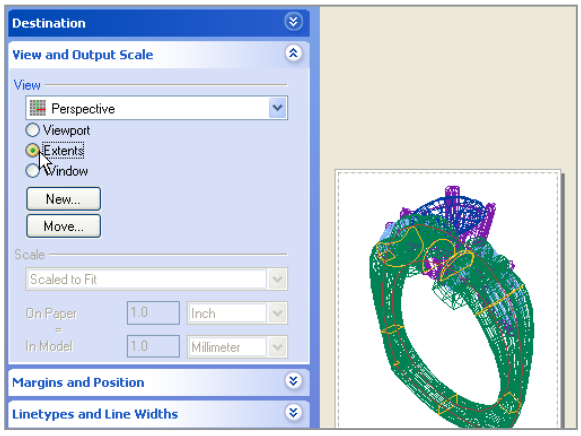
This Project Notes feature docks in the right-hand side of your screen. Contents are the same as Info/Settings > Notes.

Other Tips about File Functions in Matrix

Please note that the file type Matrix saves in is a .3dm file. This is Rhino's native file type, meaning that you should NOT double-click a Matrix file in Windows to open it. If you do so, it will open in Rhino. Opening a Matrix file in Rhino KILLS its Matrix history capabilities, since none of this information is recognized by Rhino. So please avoid opening Matrix files with Rhino.

Another facet of this: if Matrix should crash, Rhino creates a "Crash Dump" file on your desktop that is a .3dm of the last thing you were working on before the program crashed. This sounds like a really good thing, but not in every case. You see, this is a file that is saved by Rhino, so again: Matrix information is not properly recorded because it is gibberish to Rhino. So even though it appears your precious model was saved from destruction by a crash (i.e. destruction by your forgetfulness to save regularly!), if it has Matrix History on it, those features will no longer be recognized. So please don't be deceived by the Crash Dump. Nine times out of ten, it won't be useful to you.

A quick way to open files in Matrix that should curb your urge to "double click" a file sitting in Windows to open it (Matrix files open with Rhino when you do that - bad news!) is the ability in Matrix to "click and drag" a .3dm file over the open Matrix program. You will be offered the choices to Open or Import this file. When you see these, choose one and the file will either be opened in (current file wiped out) or exported into (added to file currently opened in) Matrix.



Print opens a menu with options on left and preview on right. Preview changes as you select options to show how printout will appear.

Intro to Matrix 6...

Using the View Menu

Control different aspects of the viewports: including placing images in them to guide you with modeling; zooming; and sizing views.

About the View Menu

Various features of the View menu will provide modeling helps specific to your viewport views. For example, you can place and control a "background bitmap" using eight controls specific to this functionality. Another option for placing a picture in the viewports to help you model is "Picture Frame", which is even easier to control than a background bitmap.

Nine more tools assist you with zooming in on exactly the part you need to see, or getting the right "Camera" set up to see the part of the model you want (the camera is the "window" and angle through which we are seeing the model in a viewport).

Three additional tools allow you to save the image in a viewport to a file, creating a digital picture of what you're working on onscreen; import a special file type created in one of Gemvision's other software / hardware packages: the System 6 HD Camera system, and finally assign a "cross-hair" cue to the viewports that keeps a constant track over the vertical and horizontal location of the cursor while you draw.

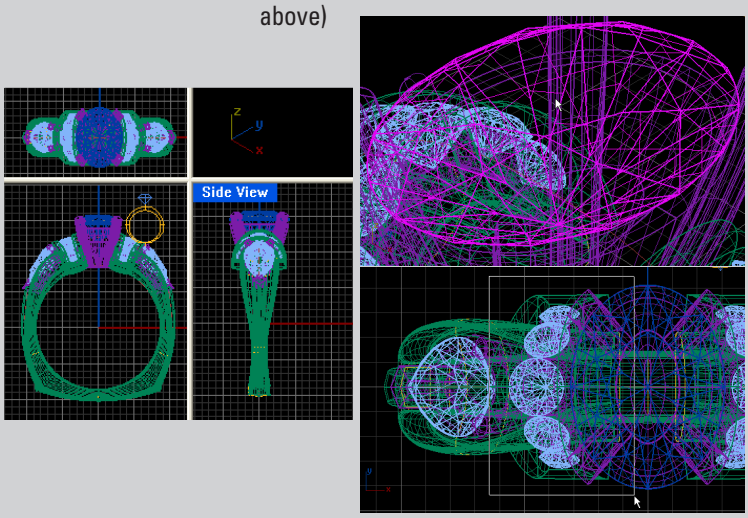
An Overview of the Zoom Tools

Restore Viewports does the work of the Reset tool without changing your shade settings. It restores the Viewports to their default Pan and Zoom positions.

Synchronize views (Left) zooms all planar views to the setting in the active viewport.

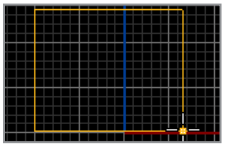
Zoom Selected fills the viewport with the extents of the object you select (Right, above)

Zoom Window fills the viewport with the extents of the window you draw (Right, below)

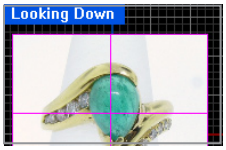


Placing an Image with Picture Frame

The most easy and intuitive way to place an image in the viewports for assistance while you model is to use the View Menu tool "Picture Frame". Start this tool up, navigate in Windows to the location of the image you wish to place, select it, and click Open. You will be returned to Matrix. Click in the viewports to place two points representing the bottom edge of the image. This will scale it evenly according to the aspect ratio of the original image. The image will appear in the viewports. You can then select and manipulate it just like any Surface object in Matrix, including scaling, moving, centering, hiding, showing, and snapping to it: functions not possible (or not as easy) with the Background Bitmap commands - older commands also found in the View menu.



Place bottom edge for Picture Frame to place a bitmap you can select and manipulate.



To see what file types work with this command, pull down the "Files of Type" menu while navigating Windows for the image. The image must be of these file types to be able to be placed using this command.

Placing an Image with Background Bitmap Commands

Use Place Background Bitmap to place an image that is cleared when you click "Reset" and is more difficult to control than Picture Frame. The benefit to this is that you can't snap to it: it merely goes in "Behind" the grid as a guideline to help you model. Follow the same steps as Picture Frame up until placing the image. Then, click to indicate two opposite corners - rather than two points on one edge - of the picture.

You can only control a background bitmap using the other Background Bitmap commands in the View menu. For example, use "Remove Background Bitmap" to



L - R: Move, Align, and Scale a Background Bitmap. Similar to Move and Scale other objects in Program, but unique to background bitmaps.

delete the background bitmap from the viewport; "Hide" to hide it, "Show" to show it again, and "Grayscale" to toggle it from grayscale to color.

The tools with which you can move, scale, and "align" a background bitmap are also found in the View menu alone. Click "Move Background Bitmap" and you will be prompted for a point to move this from and to. Click in the viewports to indicate these. "Scale Background Bitmap" is similar, asking for two reference points for the scale and a final reference point to indicate the new size. The farther away this new reference point is from the first reference points, the larger the new image (you can only 2D scale, not 1D scale or skew the image). The closer this reference point is, the smaller the image.

To "Align" the background bitmap, select a "base point" on the image and a "Reference point" on the image. Now, select a "Base point" anywhere else on the grid and a "Reference Point" anywhere else on the grid. The bitmap will be moved and scaled to the two new points; the farther apart they are, the larger it will be; the closer together they are, the smaller it will be (again, 2D or overall scale, not 1D or skewed scale).

Controlling the Viewport View

Nine commands in this menu control the viewport views. "Restore Views" resets the viewports to their defaults the way the Reset button does (also erases Background bitmap), but does not change the Layers menu settings. In this way, you can restore your viewports to their default positions without upsetting the layers you had on/off or the objects you had hidden, the way Reset does.



(L) Zoom Dynamic zooms with click and drag rather than scroll wheel; (R) Zoom extents fills viewports with extents of part.

"Synchronize Views" matches all the viewports to the zoom you have set up in the active viewport. Remember to start it up with the correct viewport active (the one with the view to which you want the rest to synchronize) or else this command will not work as expected. Only the planar viewports "synchronize": Perspective does not.

Zoom tools include "Zoom Dynamic", which lets you zoom in and out of a viewport on a specific focus (click and drag to zoom - similar to using the scroll wheel on your mouse but uses "left-click and drag", instead). "Zoom Extents", which fills the active viewport with any model you have in there, only out to the edges of the model - not to the edges of the grid, as the default zoom does. Select an object or objects and "Zoom Selected" will zoom in on that object in the active viewports, filling the viewport with the view of that object - no matter how big or small. Similarly, "Zoom Window" lets you draw a selection window around an object - however big or small you want - and fill the active viewport with the size of that selection window, so you can zoom into as small - or as large - a part of your image as you need to.

The Zoom 1: 1 and Calibrate 1:1 allow you to set a size to zoom to that makes the object the same size as it would be in real life. To use Zoom 1:1, you must first use Calibrate 1:1 to make sure your mm onscreen will zoom out to the size of a mm in real life. To do so, grab a ruler (in real life!) with mm's on it and start up this command. A window will appear prompting you to measure the bar on your screen. Although people may look at you funny, hold the ruler up to the screen and measure the bar. Type the length into the "Length of Bar" field and make sure the dimension is set to Millimeters. Click OK. Now, clicking Zoom 1:1 will zoom the active viewport to the size where your model is the same size it would be in real life, upon production.

The final viewport Zoom control, "Center Viewport", maintains the zoom level you've set and centers the viewport on the grid axes, its typical center point. This is like "Restoring" the active viewport without changing the zoom level you've set, should you need this functionality.

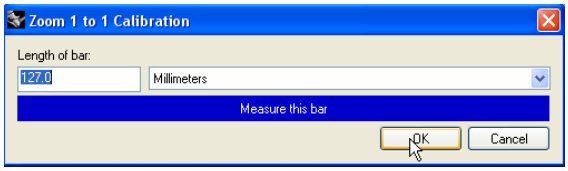
Remaining View Menu Controls

Three more View menu commands perform functions unique to the viewports. The first, Viewport to File, instantly takes a snapshot of the view currently found in the active viewport, and saves it to an image file. Before running this command, set up the active viewport the way you want the image to appear. Select this command, type in a name for this image file, and navigate to a location on your computer to which you wish to save this file.

"Set Crosshairs" turns on a set of crosshairs - or, white tracking lines that follow your cursor around onscreen as you work to help you track the vertical and horizontal location of the cursor at all times. Click this command again to toggle them off.

Finally, "System 6 HD 3View" imports an image file created by certain versions of our System 6 HD Camera & software that presents all three views (Looking Down, Through Finger, and Side View) of a ring in Background Bitmap form at the same time, to scale and centered, to use as a guide while modeling.

Measure blue bar with a ruler - yep, a ruler! - and input measurement in order to use Zoom 1:1 tool.



Intro to Matrix 6...

Using the Measure Menu

Measure objects and/or place measurements in the viewports to create presentations or assist in production.

About the Measure Menu

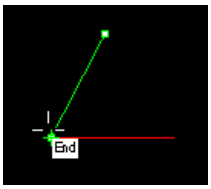
Three related parts of this menu let you measure objects onscreen (reports measurement back to you in Feedback line located just above Command line), place an alpha-numeric "cue" into the viewports alongside your model that indicates a dimension you select, and finally edit and add to these cues using several tools.



The first four tools in Measure (Angle, Distance, Length, Radius) display measurement in feedback line above Command line.

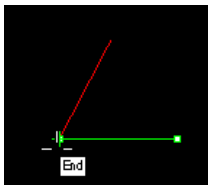
Measuring Tools

The tools Angle, Distance, Length, and Radius automatically measure the indicated value on a model based on where you click. Start up each command and follow the Command line prompts to measure each value.



Click SAME start and endpoints on two angled curves to measure angle between them.

For Angle, click the "Start and End" points of the first and second lines that are at an angle to one another, making sure the "start" and "end" points are at corresponding ends of the lines to measure the angle between them correctly. The angle will be reported in the Feedback line just above the Command line.



For Distance, click two points onscreen and the distance (in a straight line) between them will be reported in the Feedback like just above the Command line.

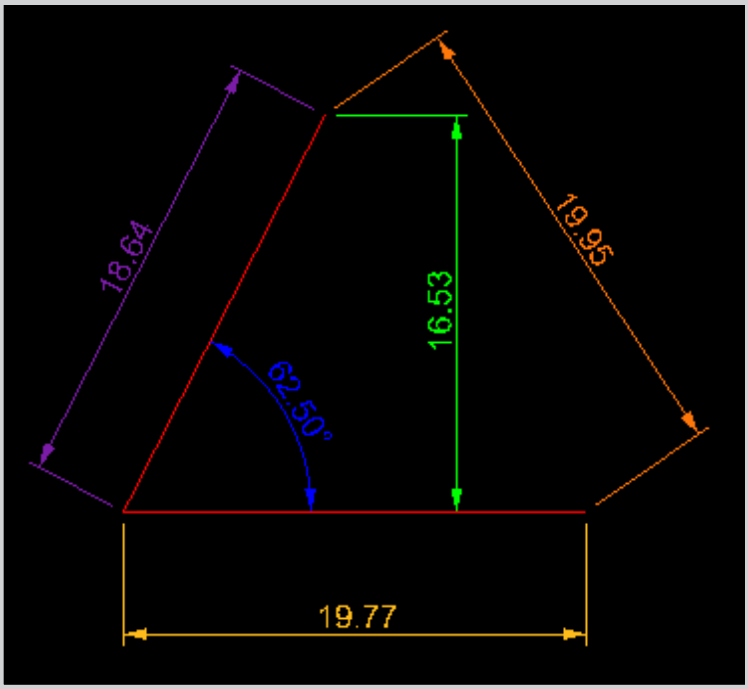
For Length, select any line and its length (need not be a straight line) will be measured. It may also be a polyline: any joined sections will be included in the measurement unless you explode the line. Feedback line reports length.

Dimension Commands

Measure between two points and use the last mouse-click to locate the onscreen "cue" displaying distance.

Yellow = Horizontal; Green = Vertical; Orange = Rotated; Blue = Angle; Purple = Aligned.

Only Dimension commands display in viewports; Measure commands display in Feedback line above Command line.

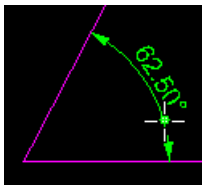


Finally, for radius, simply select a circle or an arc and its radius (for an arc, measure to the center of the imaginary circle of which it is a part) will be reported in the Feedback line.

Dimension Tools

The Dimension tools allow you to click on two points to measure the distance between, and then click a final time to locate the numeric cue plus arrows and lines that indicate the dimension that value represents.

The "Horizontal" Dimension tool only takes this measurement horizontally, and its cue is placed horizontally, too. The "Vertical" Dimension is the same, only Vertically.



In each Dimension tool, last mouseclick places Dimension "cue".

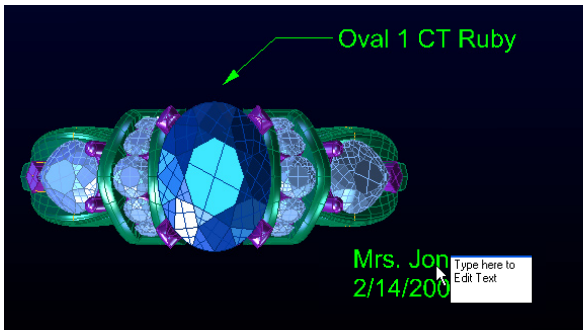
To take the measurement on an angle, select either Rotational or Aligned. For Rotational, first set the angle at which you want the cue to appear when it is placed; then select the points to measure between, along a rotated angle, and click one last time to set the cue along the initial angle you set. Aligned is similar, but places the cue on the rotation of the line created by the distance you're measuring - or "aligned" to the angle of the distance you're measuring - so there are two fewer clicks for this tool (just set the distance to measure and the location of the cue).

Finally, Diameter and Radius Dimensions ask you to select a circle or arc for the measurement, and then click once more to place the cue in the viewports.

Create & Edit your own Cues

Use the "Leader" command to draw your own arrow like those placed by these tools. Include a tip, and continue clicking to place the shape of the arrow. Finally, type text to attach to the arrow at the angle of the final arrow shape.

To place your own Text, select this command and type text, choose size (in mm) and font. Note: This text is NOT a model that you can work with or produce in Matrix: it is just a visual cue to assist you. To create text you can model with further, find the Text command in the Solid menu.

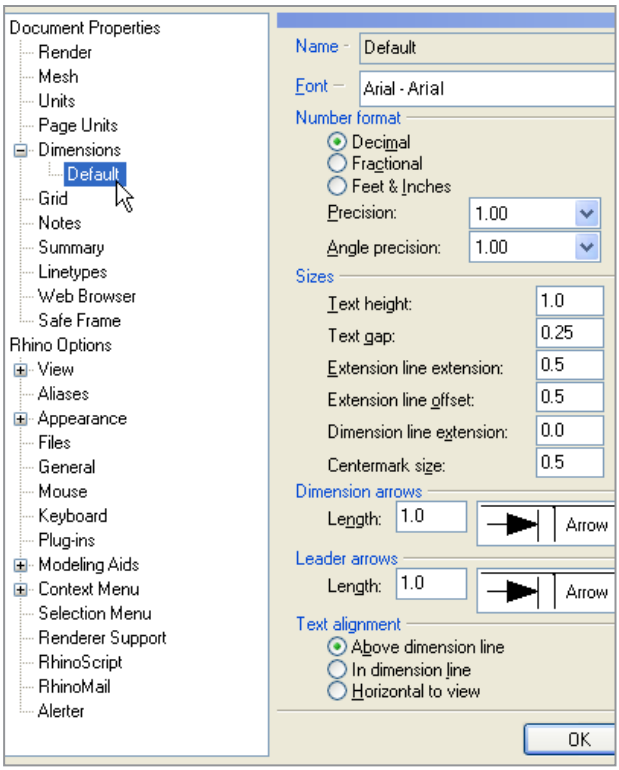


Using Leader, Leader Text, Text, & Text Edit.

Use the "Edit Text" command to edit the text placed by this tool, re-opening the Text creation menu to change aspects of the text object you selected.

Finally, three tools allow you to edit the measurements placed by the menu: including "Recentering" that measurement, "Editing" a dimension, and accessing Rhino's "Dimensions Options". Starting with this final tool will help you understand the "Edit" tool. The name of the dimension style is displayed when you click the "Options" tool. You can also start up a "New" style for which you can assign your own font and arrow styles under the next two options.

Your new style name will appear in the list. Select your new style name (or change the Default style) . Assign a font, format (decimals, fractions), precision, size and spacing for text, arrow dimensions, and text alignment. Click OK to keep your changes. Now, when you Edit a dimension, you can select the edited Default style or choose your new style name and set up all dimensions in this style.



Add a style under "Dimensions" and its name (Default, above) will be added to "outline" on left. Click it to edit its settings (right) so it can be selected during Edit Dimension Command.

Intro to Matrix 6...

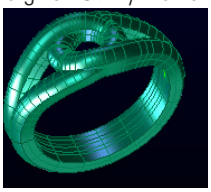
Basic Utilities Menu Tools

Most Utilities are found in the sections of this manual to which they relate. For the basic tools you will use often from this menu, read on...

About the Utilities Menu

These are all commands that work on objects after they have been created: They are not a part of modeling or creating them. Different Utilities commands work on different kinds of objects (surfaces, curves, solids, meshes, any), and also run functions that vary in complexity. The more complex utilities are explained in this manual together with their related commands from other menus. (Usually, tools used to build the object(s) a given Utility works on).

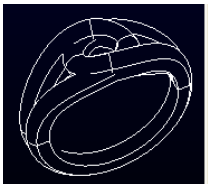
The basic Utilities menu commands that you may find yourself using on a daily basis are explained here:



Select 2D Drawing and desired options to create a curve drawing of an object.

2D Drawing

More closely related to the technical presentations possible in the View menu than the rest of the Utilities commands, this tool creates a 2D drawing of a 3D model.

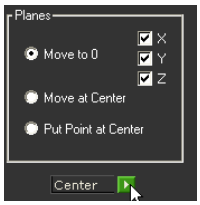


Start up this command and select the options (which view, how many views, which parts to draw, what colors, and options for visible and hidden lines, and annotations. Click OK to see 2D drawing. It will appear in the viewports as curve objects drawn on the Lights layer.

Center Object & Bounding Box

The Center Object utility is a quick way to center any object or objects in the X, Y, and/or Z planes. You can also place a point at the center of the object if you should need this; for example, you can Move or Scale an object from its center point for more precision as you model.

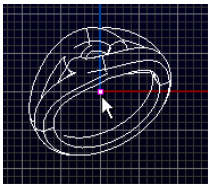
Another tool that assists with centering is the Bounding Box tool. You'll recall that the Center O-Snap can only find the center of relatively simple objects: such as a rectangle or a box. The Center Object Utility actually places an imaginary Bounding Box - or, a box as big as the largest extents of the model (H X W X L) and centers this box, moving the object with the box as it does so. You can re-create this magic with the Bounding Box tool, the Center O-Snap, the Move command, and your old friend F4. Or save yourself the clicks and use Center Object. However, you may find another reason to enclose an object in a Bounding Box. This command creates a 3D box for 3D objects (have height) and a 2D rectangle around 2D objects (are flat).



Use Center Object to move to F4 and/or place a point at center.

Group & UnGroup

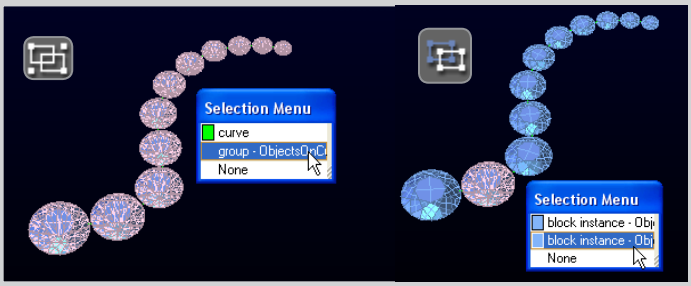
You will want to take careful note of these tools. Group causes objects to work like a single object, even though they are many. It is not Join or Boolean Union ("Join" for solid objects), as it does not change the constitution of the models. It simply changes the way they act. In this case, selecting one of them selects them all, making it easy to control large groups of objects, such as gems and prongs: to sets of objects which are commonly grouped by Matrix builders after they are created.



But there are frequently times when you'll want to select and edit one of these grouped objects by itself. The ONLY way to get it alone is to select the group and click on UnGroup. This separates the objects from one another so that you may now select and use one separately of its neighbors. In terms of History, you don't have to worry: the object still knows it's part of a Gem Line or a Prong Layout. However, it can now be adjusted separately for your modeling needs. If

Group & UnGroup Items

Many Matrix Builders create groups; or, objects that act as one for ease of selection and other modeling processes. However, sometimes you need to get one of the grouped objects by itself. To do so, select the Group and click UnGroup. Now, you may select one of the formerly-grouped objects all by itself. To group items again, select all the items to group (easy to do when they are all on one Layer color) and click Group.

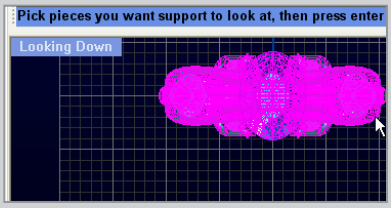


you wish to group them again, select all objects to Group and click on Group. Just remember: They're NOT a single object!

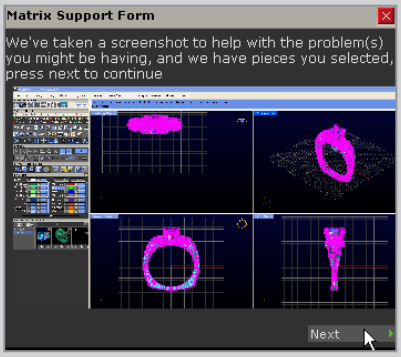
Email Support

Probably the best tool in the Utilities Menu for new users, the Email Support button allows you to instantly save a model and any necessary attachments, and either save a "Zipped" file (contains all files you elect to send) to email to support as an Attachment; or sends it directly to Support via Gemvision's FTP site (must have an internet connection to use this tool).

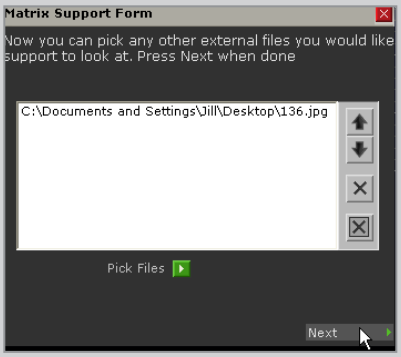
Step-by-Step Email Support



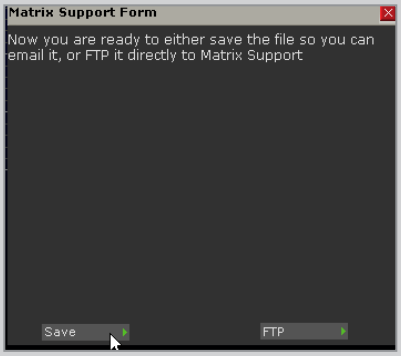
1 Start Email Support Utility. Select Object(s) to Email. Follow the directions, selecting the object(s) you wish to email to support. Press Enter to Continue.



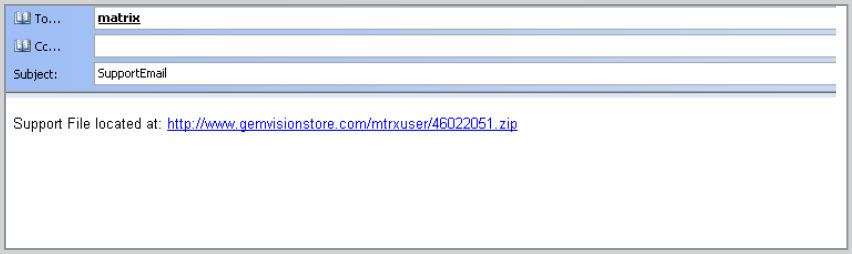
2 Confirmation Appears. Click Next to Continue. At the confirmation screen that appears, click Next to continue.



3 Choose Files to Include Click Pick Files to navigate your computer for any additional files to include, such as an image of the ring you are building, the Revo file, etc. Click Next to Proceed.



4 Choose "Save" to Save a Zip file to Email. To save this file to your Desktop (or any place you navigate to) as a .ZIP file, choose Save.



5 Or, choose "FTP" to link it to Gemvision's server. If you have an internet connection and wish to email it straightaway, select FTP and it will be uploaded to Gemvision's server. Your email client will open, with a message containing the link and our support email address. Type us a descriptive message including your name, business name, contact information (email, phone, address) and your question, and you'll receive email confirmation upon receipt. Support is very prompt and helpful, usually sending answers within the same or the next business day. If we have a question about your model, we will follow up with you via phone or email.

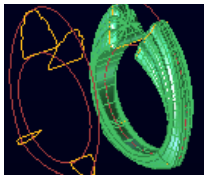
Chapter 2 PRIMARY

Building Your First Ring

With basic Matrix commands, choose a ring size, create a band or shank, and add simple gems and settings. Vary & change with History.

Basic Tools Menu Commands

The basic Tools menu commands that will be covered in this chapter help you place a Ring Rail in the standard or custom size & world region you need; Place Profiles (cross-section shapes for bands and shanks); and create your own profiles.



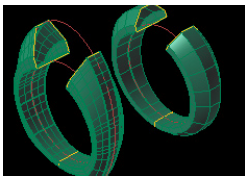
Rails & Profiles (L), swept shank (R) with History.

If placing profiles does not get the precise look you want for the ring in the Through Finger view of the ring, the Outer Rail tool will help you perfect this look. Chapter 3, **Basic Curve Tools**, will help you draw your own profile and outer rail shapes, so jump into this chapter for assistance.

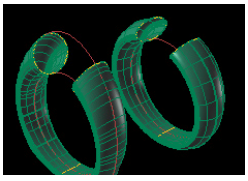
Basic Surface Menu Commands with History

Once you have 1 or 2 rails and profiles placed to create your band or shank, you are ready to "Sweep" or, apply cross-section shapes to rail curves to create surfaces.

These tools - Sweep 1 History & Sweep 2 History - do exactly what their names say, allowing you to make changes to profiles and rails and see the surfaces update immediately, reflecting your changes. Changes like these are easy to make with Profile Placer and Outside Rail tools. Use this functionality to design on-the-fly, or save variations on the same design, or both!



(Above) Sweep 2 (L) & Sweep 1 (R); (Below) Change quickly with history for design variations: profile changed to round.



Multi-Rail Sweep History, when used together with the Edit Points option in Profile Placer, lets you make subtle changes to the look of bands and shanks by assigning how the cross-section shapes interact from one shape to the next. Use this tool's history to change Profile points and sculpt new band and shank shapes quickly on-the-fly.

Sequence for Using Commands in this Chapter...

1- Ring Rail places a ring size, the basis of any ring design in the program.

2- Profile Placer adds cross-section shapes to a rail, to create a band or shank design.

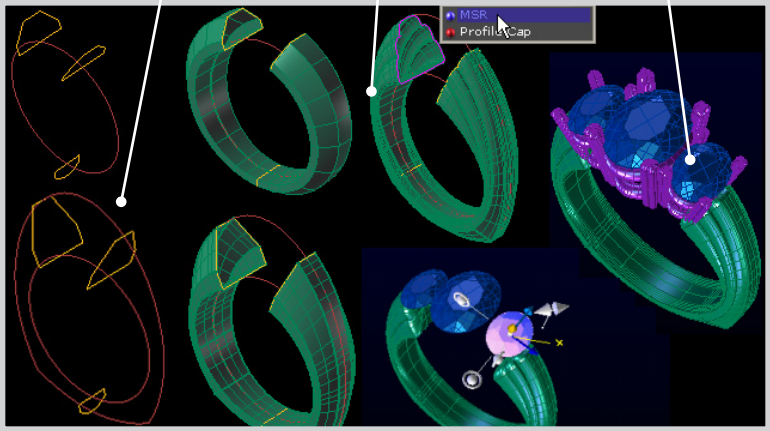
3- Optional: add a second rail to define the shape in the Through Finger view.

4- Sweep 1 History (with only one rail) or Sweep 2 (with two rails) creates the surface of the band or shank.

5- Using History, re-enter Profile Placer, Ring Rail, or Outer Rail and vary ring design.

6- Add gems with Gem Loader & place with Gem Positioner.

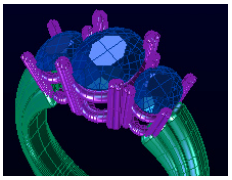
7- Add head or bezel, and Match Attributes or Save / Load Styles to create same setting on other gems.



(L - R, Top - Bottom:) Ring Rail, Profile Placer, Outer Rail, Sweep 1, Sweep 2, MSR > Change profile shape, Gem Loader, Gem Positioner, Head Builder, Match Attributes.

Basic Gems & Settings

Gem Loader places gems one at a time into the viewports, centered at F4. Position & duplicate with Gem Positioner. For Emeralds and Baguettes, use these tools to get just the right dimensions for these tricky stones.



Learn basic Tools, Gems, & settings to create a 3-stone head.

Learn to add basic settings (Bezels and Heads) to these stones, and use Match Attributes to add the same setting to another gem. Save and Load Styles lets you re-load the builder with a setting you like, so you can continue editing it for a new design.

Skills & Commands in this Chapter

Tools Menu

 Ring Rail: Place a ring size for any ring design.

 Profile Placer: Adds cross-section shapes for bands or shanks.

 Profile: Create a profile w/ curve tools learned in Ch 3.

 Outside Rail: Assigns & controls the through-finger shape of ring.

 Profile End Cap: Places a Blended end cap on any profile curve.

Surface Menu

 Sweep 1 & 2 History: Creates bands & shanks with history.

 Multi-Rail Sweep History: Enables subtle changes to cross-section shapes of band or shank.

Gems Menu

 Gem Loader & Positioner: Add and position gems.

 Emerald & Baguette Builders: Set up these shapes precisely.

 Match Attributes & Save / Load Styles: History for gems, making Settings and Cutters applicable to new gem shapes and sizes.

Settings Menu

 Bezel Builder & Heads Builder: Create bezels and heads enabled with History.

 Heads Library places a non-history-enabled head on a stone at any location onscreen, scaling head to stone.

 Emerald Cluster & Emerald Profile: This Gems and Settings menu tool sets an emerald or princess-cut stone in metal with adjustable handles, with or without gems.

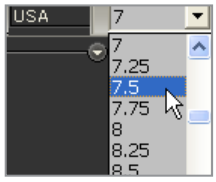
Building Shanks & Bands ...

The Ring Rail Tool

Place a ring rail in the finger size you need, using an international region or custom dimension. Learn to display and change finger sizes.

Using the Ring Rail Tool

Start up this tool by clicking the first button in the Tools menu. If you're happy with the default region that appears, click the drop-down menu beside it and click on the desired ring size (the contents of this menu change based on the region you've selected). Click the green button beside this menu to place a curve in the viewports in this ring size.



Click dropdown & choose new ring size in region.

Changing the Region

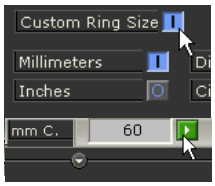
Double-click the region currently displayed beside the drop-down menu to open up a dialog box with further Region options. Select a new region by clicking in the box beside it, and click "Set Region". The region dialog will close, and the new region will appear in the Ring Rail tool beside the drop-down menu. Select a size and place the curve in the viewports as described above.



Click on current region to open region selector & choose new region.

Set a Custom Ring Size

From the region dialog, select the "Custom Ring Size" option, and additional options will appear. Select whether you want to assign the custom ring size in mm or inches. Then, select whether you want to indicate a Diameter or Circumference for the custom ring size. Click "Set Region" to select these dimensions and close the dialog. In the Ring Rail Menu, the dimensions you selected will appear (e.g., "mm D" for "Millimeters, Diameter"). Type the value you want for these dimensions into the text box beside this (formerly the drop-down menu, now a text box) and click the green button to place a Ring Rail curve of this size into the viewports.



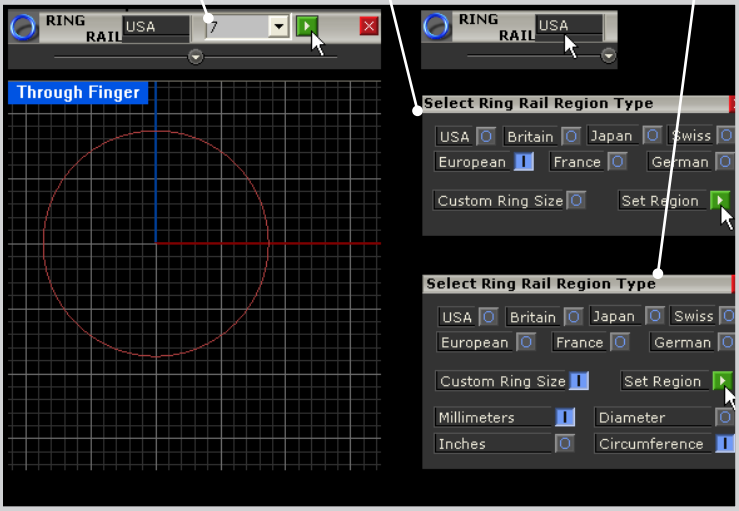
Choose dimension (diam., circumf.) & measurement (mm., in.) for custom size.

Using the Ring Rail Interface

1- If the region you need is displayed, click on the drop-down menu to see a list of available sizes in that region. Click on one, and it will appear in the list. The list will close. Click the green arrow to place the rail in the viewports.

2- If the region you need is not displayed, click on the region to open the "Select Ring Rail Region Type" interface. Select a new region and click "Set Region". Return to Step 1 to place a ring rail in that size region.

3- To place a custom rail size (mm or inches of diameter or circumference), choose "Custom Ring Size" from the window in Step 2. Choose a dimension and a unit of measurement. "Set Region" and type value in Ring Rail box. Click the green arrow to place the rail.



Replacing the Current Ring Rail

When a ring rail is already in the viewports, the builder will flag you with the message, "You already have a ring rail. Do you want to replace it?" Select "Yes" to replace the existing ring rail with one of the new size, so there is only one left in the viewports. Select "No" to place a SECOND ring rail in the viewports, in the new size. Place "Cancel" to not add another size ring rail at all.



If "Yes", new size will replace old. If "No", second ring rail is placed.

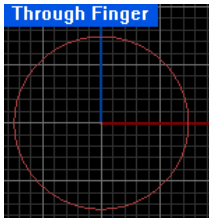


"Yes" to replace a ring rail re-sizes design.

When profiles have been added to the rail with Profile Placer, selecting the "Yes" option here with Gemvision History turned on can cause the entire ring size to change! The profiles will stay affixed to the new rail in the same positions, and the surface will follow both the new rail and the existing profiles to essentially re-size the ring overall when the new ring rail is added! This is a really powerful feature, but if it's not the result you were trying to achieve, turn OFF Matrix History before replacing an existing ring rail with Profile Placer profiles attached to it. (Or, select "No" and just add another ring rail to the viewports.) Also, be sure to Job Bag your design before placing the new ring size!

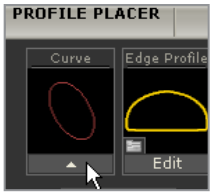
About the Ring Rail

This ring rail appears planar (or, flat) in the Through Finger viewport. This is the orientation in which you will create a ring: as though you are looking through the finger hole in this viewport perspective. You will want to be very careful with this finger rail, and not move it off of F4 (0,0,0, or, the "Center of the World" in 3D space).



For best results, don't move ring rail off of 0,0,0.

The ring rail is the item you will input into the "Profile Placer" to add cross-section shapes and create a band or ring shank. It is also the curve which the various builders will use to create signet rings, eternity bands, raised bands, and custom rail shapes.



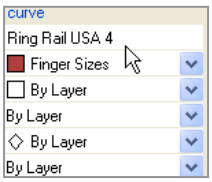
Put Ring Rail into Curve In-Box in Profile Placer.

If no ring rail exists, each of the builders offers a "Ring Rail" option which opens up the part of the Ring Rail menu containing the current region & size. Click the green arrow to place the ring rail. Double-click the region, just like before, to change it, and use the Size dropdown menu just like when accessing this tool.

To see everything you can do with a ring rail, select the rail and press the F6 key. From this menu, you can go directly to your builder or tool of choice!

Displaying Ring Size

To tell what ring size an existing ring rail is, select the ring rail curve and press "Ctrl + t" on the keyboard. This brings up the "Properties" of an object. In the "Properties" dropdown menu, "Object" should be displayed. Look beside the "Name" option in the menu and you'll see the name "Ring Rail (Region) (Size)" displayed. (You may need to click and drag the perimeter of the box to enlarge the Properties window in order to read this).

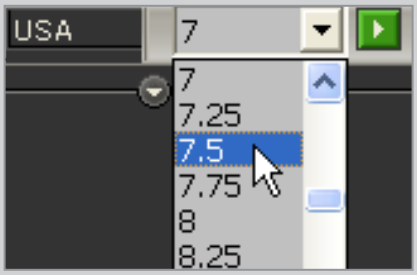


Ctrl + T (shown) & Object Info display ring size.

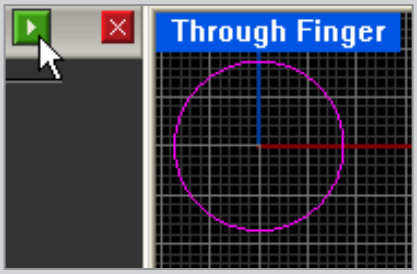
Step-by-Step
Ring Rail Tool



1 Select a region. Use the region displayed, or double-click it to open a menu of regions or Custom sizes (shown above).



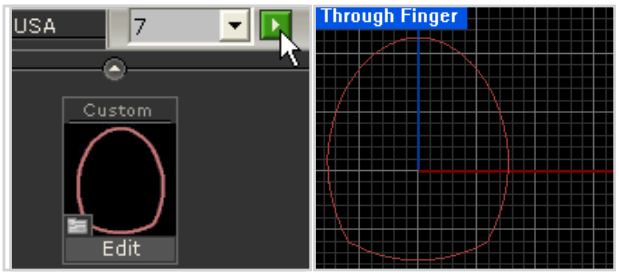
2 Select a ring size. Click on the drop-down list beside the selected region and click on a ring size to place it in the menu. When selecting "Custom Sizes", type in the Diameter or Circumference in mm or inches.



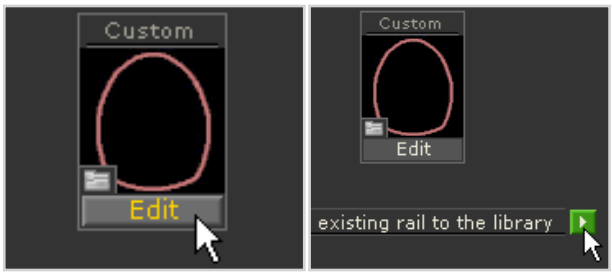
3 Click on the green arrow to place the ring rail. Clicking the green arrow will place the ring rail in the viewports. If there is already one there, even if it is "hidden" or its layer turned off, the builder will ask you if you want to Add, Replace, or Cancel. Replacing will resize the ring if profiles are already attached.

Tips & Tricks: Ring Rail

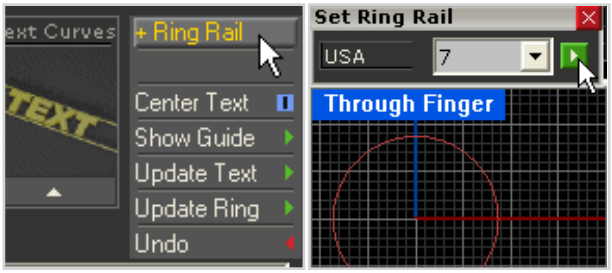
Advanced Options & Other Tips & Tricks for using the Ring Rail Tool throughout the Program.



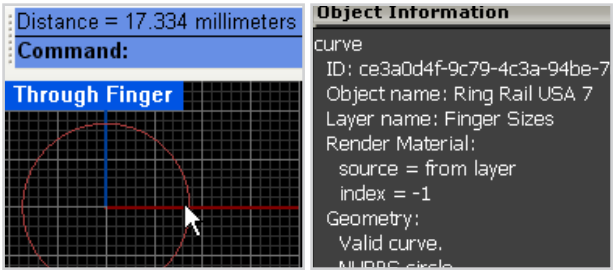
Adding a Non-Round Finger Rail. Click the "Down" arrow when this tool is open to see the Advanced Options interface for this tool. Click on the "Custom" preview window to see a library of available non-round finger rail shapes that are calculated to have the area necessary for the chosen size. Select one of these shapes from the library browser, and it will appear in the preview window. Select a size for it as usual, and click the green arrow as usual to place the rail in the viewports.



Creating your own Non-Round Finger Rail. The first way is to select a non-round rail from the library that is close to the shape you want. Click "Edit" at the bottom of the Custom preview window and open the Profile editor. Using the Curve tools taught in Chapter 3, edit this shape and save it with the steps covered in Chapter 1. Or, draw your own rail shape, centered at F4 in the Through Finger viewport, and click the "Add existing rail" option. Input the rail and add a file name to save it under.

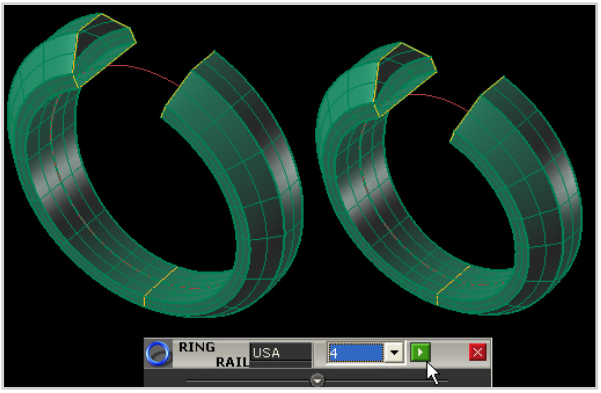


The Ring Rail Tool & Other Builders You will discover that other builders in the program, especially those in the Builder Menu (Raised Band Builder shown above) require a ring rail. Instead of returning to Ring Rail every time you use one of these builders, click the option "+ Ring Rail" to open the basic (round only) Ring Rail menu. You can also set the region in here, but you might not need to: it remembers the last region and size you set using the Ring Rail tool!



How to Check a Ring Size If you have a ring you previously built, but you've deleted the finger rail, you may Measure the Length across the finger size. If you know the diameter equivalents for ring sizes, you're set! If not, enter the Ring Rail tool and try different sizes till you find the right one. If you do have the rail but you've forgotten the size, select it and run "All Object Info". Look for "Ring Rail (region, size)". Selecting rail and pressing "Ctrl + T" (or, type "Properties") also displays it.

Using the Ring Rail Tool to Re-Size a Design If you read on about the Profile Placer and Outer Rail tools, you will learn how to place profiles (cross-section shapes) onto a ring rail, and to assign these profiles an Outer Rail curve to "adhere" to. With one or two rails, you may set up and sweep a ring design. Then, as long as History is enabled and other rules are followed (no Split, Trim, Join, or Booleans were performed on curves or surfaces), you may place a Ring Rail in a new size with this tool. The builder will ask if you wish to replace the existing ring rail. Select "Yes", and the profiles will adhere to the new ring rail; changing the surface to re-size the ring!



(L) Before: Size 7 ring; Ring rail tool used, Size 4, to Replace existing ring rail; (R) After: Size 4 ring, instantly re-sized.

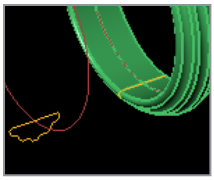
Building Shanks & Bands ...

The Profile Placer Tool

Add closed curves to a Ring Rail or another rail curve to create the cross-section shapes used in Sweep operations.

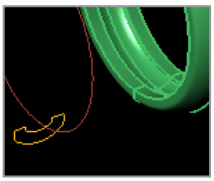
What is a Profile?

Profiles - anywhere you look in Matrix - are the cross-section shapes that are used to create a surface. In a "Sweep" operation, the cross-section shape (the profile) follows the path of the rail curve such as a ring rail (the profile is "Swept" along the rail curve) to create the surface.



Sweep a grooved profile for a grooved band.

One way to understand this is to think of the cardboard tube used for paper towel: it is a round profile (cross-section shape) applied in a straight line (rail curve) to create the tube.



Sweep a curved-in profile for a hollow band.

To create a ring, you will choose a circular rail curve in the finger size of your customer, and add profiles in the cross-section shape you want for the shank or band. The profile may be grooved on top for a ribbed ring, curved on the sides for a comfort-fit shape, or scooped on the inside for a "hollow" design.

Add two or more profiles to a rail, in different shapes or sizes, and the surface that is created with a Sweep operation will change between one profile and the next, creating a more interesting surface.

About Profile Placer

This tool facilitates the process of adding profiles to rails by handing the user interactive profiles that are easily controlled one of two ways. One way uses the Viewport Control Handles which are located on the profile that is currently active in the builder. Another way is to use the interactive slider controls in the builder menu in Matrix, which affect the profile that is currently active. Both methods affect the same dimensions.

Using Profile Placer

After starting up this tool, select the Ring Rail or another curve to which you wish to add one or more cross-section shapes, and input this into the "Curve" in-box in the builder. A profile will appear on the rail, with Viewport Control Handles. This is now the "active" profile, which means it can be controlled by adjusting either the handles or the Menu Controls.

To change the shape of this profile, click on the box next to the "Curve" in-box, where the current shape is displayed. Or, click the "Profile" Viewport Control Handle. This opens a file folder of possible profile shapes at the bottom of your screen. Select a new cross-section shape by clicking on it. The new shape will appear in the box and on the rail.



Click current shape to open Profile library & choose a new shape.

Use the remaining options - found in the Builder menu, the Viewport Control Handles, and the Command Line interface - as described in the following section of this manual to add, mirror, scale, and position profiles.

After adjusting the profile to your liking, click "Add" to place this profile on the rail and continue working on the next one. Press "Enter" and it will be added to the rail. The handles will disappear, ending the work of the builder.

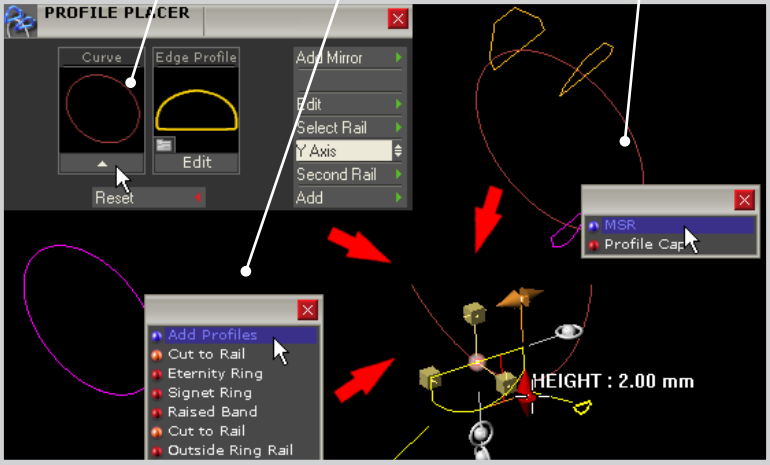
Accessing Profile Placer:

There are three ways to get profile control:

1- From the Tools menu, click on "Profile Placer". Select the rail curve and click on the "Curve" In-Box to add profiles to it.

2- Select any curve onscreen, press F6, and choose "Add Profile" from the menu. This places the curve into the "Curve" in-box, using it as the rail curve for this builder.

3- Select a profile already placed with this builder, and press F6 to edit it. This makes that profile the "active" profile in this builder, and places its rail into the "Curve" in-box.

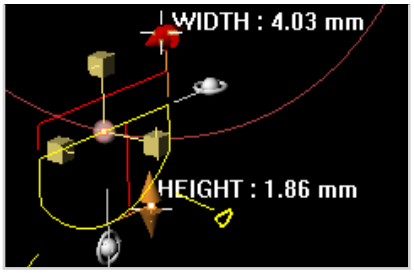


Profile Placer Builder Controls / VCH's

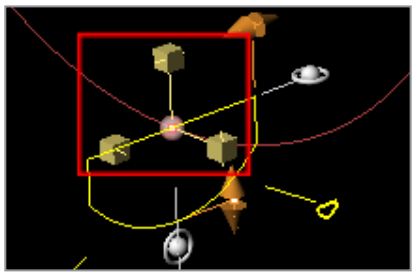
The following Builder controls and Viewport Control Handles adjust the profile.



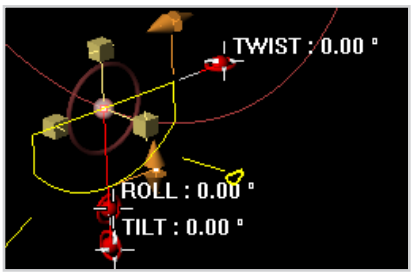
Position on Curve Select this Builder menu option and adjust the slider, or click and drag the handle in the viewports, to indicate a position on the rail for the profile. When you like the position, click "Add" to leave the profile here, and set the Position of the next profile by continuing to adjust this.



Height and Width. Select one of these Builder menu options and adjust the slider, or click and drag the related handle in the viewports, to scale the height and width of the active profile in mm. The current mm value is displayed when you mouse over a handle.



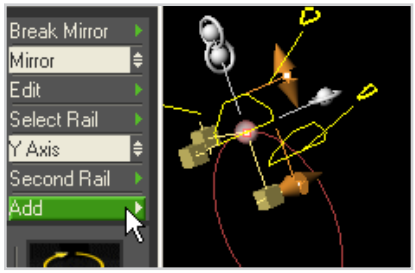
X, Y, and Z Offset. Select one of these Builder menu options and adjust the slider, or click and drag the related handle in the viewports, to move the profile off the rail in the related direction (X or Y). Z only has a handle to control it, as it is used less often.



Roll, Twist, and Tilt. Select one of these options and adjust the slider, or click and drag the related handle, to rotate the profile(s) in the indicated direction. With the "Rotate Mirror" option, the two profiles will move in opposite directions, rather than the same.

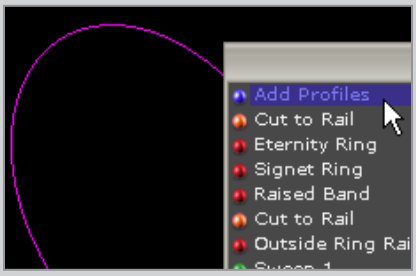


Mirror & Rotate Mirror.
Click "Add Mirror" to mirror active profile around midpoint of rail. This offers the "Mirror" & "Rotate Mirror" options. Select "Rotate Mirror" when you want the X Offset, Roll, Twist, and Tilt options to work opposite. "Break Mirror" cancels mirror relationship.



Add. Click "Add" to accept the settings you've established for the active profile and add a new profile to the rail. The new profile will become active, so that all changes made will affect it instead. If you don't need a new profile but want to keep your settings, you may click on the grid to de-activate the profile and move on.

Step-by-Step
Profile Placer



1 Start the builder. Clicking this from the Tools menu and entering your Rail curve; selecting a rail and pressing F6 > Add profile, or pressing F6 with a profile selected will all start up this tool.



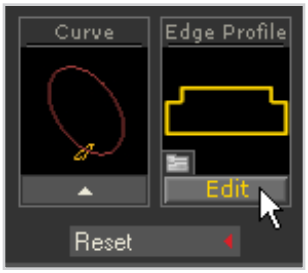
2 Adjust Builder options or Viewport Handles. Select a position, size, and shape for this profile - in any order you wish - using the Builder options and slider or Viewport Control Handles.

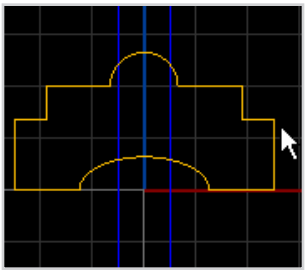


3 Click "Add" to add & modify a new profile, or press Enter to end. "Add" sets the previous profile and makes a new profile active. Set this one up as described in the previous step. Or, if you are all done, simply press Enter to deselect the profile and end this command.

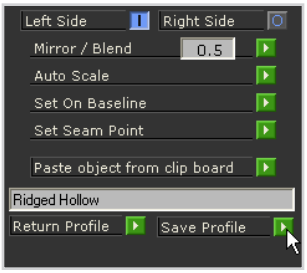
Profile Placer Advanced Options

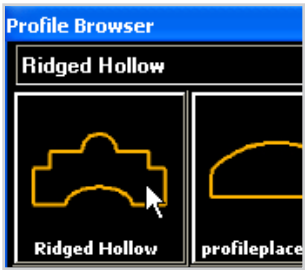
Several options within this tool allow for more advanced control of profiles.



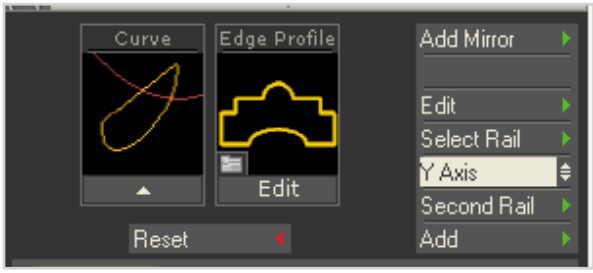


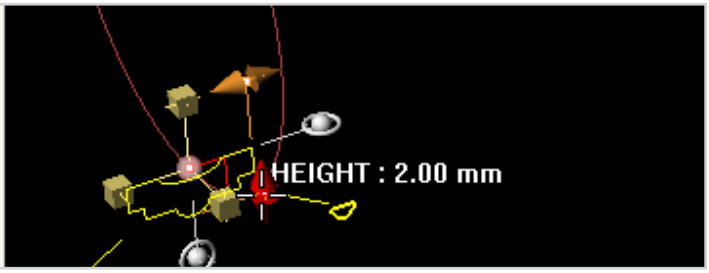
Profile In-Box "Edit" Option. This option opens the current profile up in the Profile Editor window - complete with the Curve Menu commands, Top 11 Buttons, Snaps - and allows you to draw your own profile shape. This shape MUST be closed in order to be used in this builder. For best results, FIRST set the current profile shape to one similar to the shape you want to achieve in the end, and edit it as described in the Basic Curve Tools chapter,





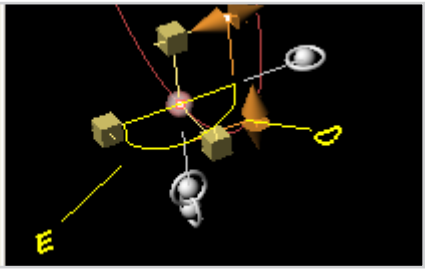
or use this profile as a guideline (size, shape and position) to help you draw one. This profile should be at the "Baseline" (along "0" on the X axis) and centered on the Y axis in this viewport. You may draw one half of the profile, select which side (Left or Right) this is on and click "Mirror". If you wish to "Blend" the middle, set a value for the size of the area to be Blended prior to Mirroring the profile (this distance is represented by the blue lines in the viewport. Finally, to prepare this profile for use back in the regular



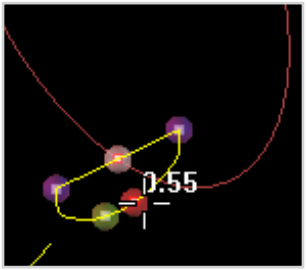


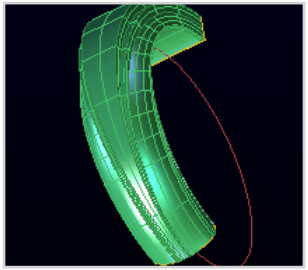
four-viewport view of the program, click "Auto-Scale", "Set on Baseline", and "Set SeamPoint". These options make the profile you drew exactly like one of our own library profiles, "Scaling" it to a 10 X 10 maximum size, setting it so it can find the "Baseline" (Rail) later on, and setting the "SeamPoint" at the bottom, center of the profile so it will scale and position properly when you adjust the interface controls. If you wish to draw this shape outside this window, do so in the "Looking Down" viewport, copy the curve by pressing "Ctrl + V", and click "Paste Object from Clip Board" upon entering this builder. You'll still need to run the other options to prepare your new profile for use with the builder. Finally, if you wish to save your new profile to the library (recommended), type a name for it and click "Save Profile". Lastly, to return to Matrix, use "Return Profile".





"Edit" Option. Via this Command Line option, the Option List in the builder, or the "E" handle in the viewport, "Edit" a Profile to adjust the Control Points used to sweep it. How this works is, when completing a sweep, Matrix must seek corresponding points on each profile to connect to one another to create the surface. Without using this option, you're letting the program pick the most natural points, from one profile to the next, between which to sweep. When you use this option, the program hands

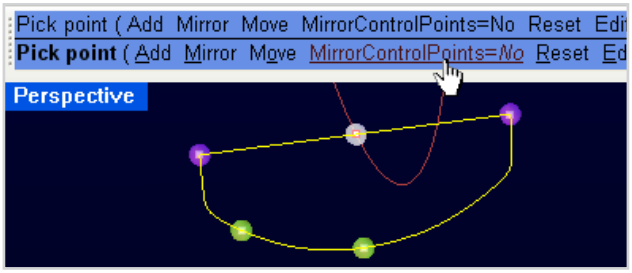




you the control over these points, so you can assign how one profile sweeps or "connects" to the next to create the surface. Imagine drawing lines from one point to the next on two profiles. If these points are at different locations on the two profiles, you'll get some pretty interesting shapes! Just be careful that your surface won't twist. Also make sure you're sweeping the rail(s) with "Multi-Rail Sweep" so the program can recognize the location of the edit points. Without this type of sweep, these

Profile Placer Advanced Options cont'd

Several options within this tool allow for more advanced control of profiles.



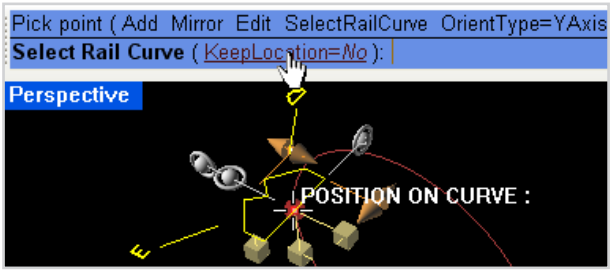
points won't be used by the program. Upon clicking "Edit", the "Pick Point" Command Line Prompt will appear. You will see four mirrored control points and a single point (seam point) at the base of the profile. Click and drag one mirrored point to position it and its counterpart. Or, set the Command line option "MirrorControlPoints" to "No", and move each one independently. (Do this with care, as it's easy to create an unwanted result with



this tool!) To change the origin point of the profile, select "Edit Origin". Click and drag this handle to change its location; click and drag its rotation control to change its "up" direction. (Again, this is NOT recommended unless you know what you're doing!) Click "Edit Sweep Points" to return to the previous step in this option; then, click "Move" (or the "M" handle) to return to the normal view of the profile handles.



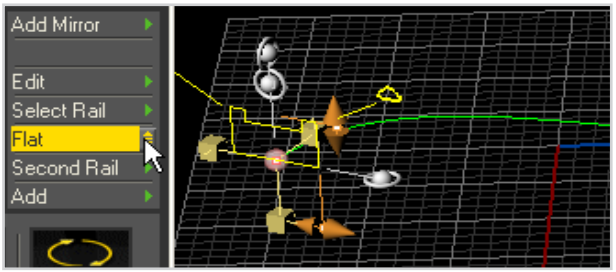
Select Rail Option. Using the "Profile" button found in the Tools menu, you can turn any curve you draw into a profile. Once the curve has become a profile, you can select it, press F6, and start up Profile Placer, complete with the handles, the builder interface: the works. However, the Profile Placer does not yet know what curve you'd like to use as a rail curve. And that's where this button comes in. Click this button in the builder menu,



or select this option from the Command line, and choose a rail curve for your new profile. The "Keep Location" option lets you indicate whether the profile is already in the right relationship to the rail ("Yes") or if you need the builder to orient it to the rail ("No"). The profile will jump up onto that curve and act just like a typical profile from the menu. Ta da!



Select Second Rail. When you wish to use an Outside Rail (explained further along in this chapter) for a 2-rail Sweep, use this option if you want the profile's height to be defined by the outside rail. The Height handle / slider control will not work, as the profile's height will "stick" to this outside rail - even when it is edited with its controls. To "break" this relationship, select this option and press enter without selecting anything.



Orient Type. Use this Command Line or Builder option to change the orientation of the profile to the rail curve. The seam point or base of the profile may be oriented toward F4 ("Origin" sub-option), the "Y" axis (default), or "Flat" - perpendicular to the rail curve. This last option is most helpful when inputting an open curve that you want the profile to follow through space - not around a finger rail - such as when creating a pendant.

Building Shanks & Bands ...

Create your own Profile

Using Curve techniques taught in the next chapter, draw a shape and use the "Profile" tool to make it compatible with Profile Placer.

About the "Profile" tool

This simple tool automatically adds Profile Placer handles to any planar curve, allowing you to turn it into a Profile curve. To begin, draw a curve in the shape you want for the cross-section of your ring or surface, using the techniques found in the "Basic Curve Tools" chapter of this manual.

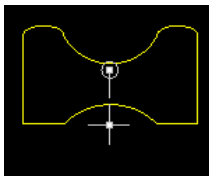


From any planar curve, create a profile & add it to a rail.

Profile Tool Workflow

Input the closed curve for the new profile into the "Curve" in-box to start up the "Profile" tool. (You may also select the curve, press F6, and choose "MSR".) Handles will appear on the profile corresponding to the Profile Placer icons (with the exception of Position on Curve). Sometimes, these handles will be right where you need them! This means your seam point (where your curve starts and ends) is located on the "base" of the profile, or, the location where you want it touching the rail. If this is the case, skip right past the next paragraph.

Usually, you'll need to tell the Profile tool where you want the handles located. To do so, click the "Edit" option (in the Command line or in the Builder interface, in the Options list). Within the "Edit" option, choose the "Edit Origin" sub-option. This will bring up a single white handle. Click and drag this handle to the location where you want the profile to touch the rail. This is usually the center, bottom of the profile. The "circle" part of this handle should be pointed straight "up" at the top of the profile. If it's not, click and drag the circle, or rotation control, part of this handle so it is pointing at the top of this profile. Once the Origin handle is properly situated, use "Move" in the Command line to get the usual handles back.



"Edit > Edit Origin" & assign middle, bottom for basepoint of profile.

The next step in using this tool is to select the rail curve on which you want to place this profile. Use the "Select Rail" option (Command Line or Builder Interface) and click on the rail curve. Does this look familiar?! You're now back in Profile Placer, using it just as you've already learned.

To save this profile so you can use it again in the Profile library, enter the "Edit Profile" window (click "Edit" beneath the Profile Preview window in the builder) and run the typical procedures (Auto Scale, Set on Baseline, and Set SeamPoint), assign a Name, and "Save" the profile. "Return to Matrix" closes the Edit Profile window.

Steps for Using the Profile Tool

1- Draw a planar curve.

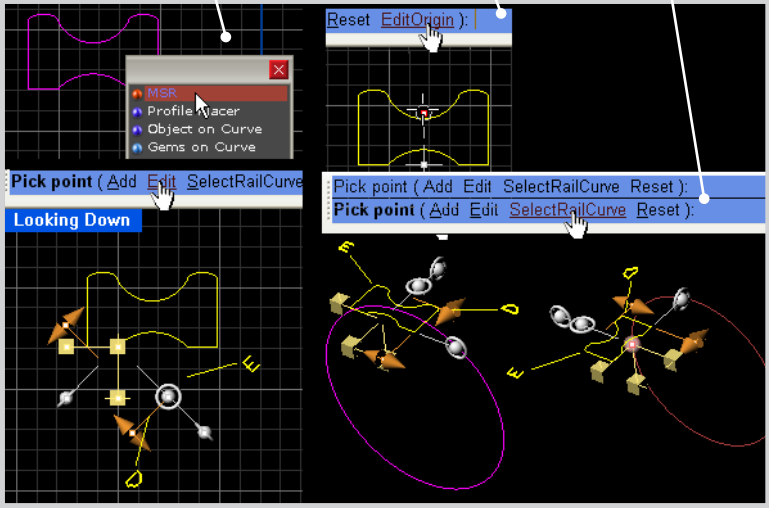
2- Start up the "Profile" tool (Tools menu or F6 > MSR)

3- Click "Edit" in the Command Line or Profile Placer interface. Then, click the "Reset Origin" option in the Command line. Orient the handle at the "Base" of your profile, where you want it to touch the rail. Rotate it so the rotation circle is pointing up at the top of the profile.

4- To exit this mode, click "Move" in the Command Line, which will return you to the usual view of the handles.

5- Click "Select Rail" to choose a rail on which to place this profile, and proceed within Profile Placer.

Note: To save this profile, enter the Edit Profile viewport (click Edit beneath the preview image of the profile) and complete the necessary steps.



Note: If your profile is an open curve or "Scooped" inward (hollowed out) at the base point, the "Reset Origin" handle will jump to the location where that profile should touch the rail - at the bottom-most extents of the profile's overall height.

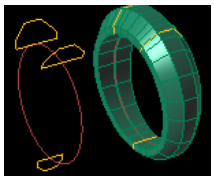
Building Shanks & Bands ...

Using Sweep 1 History

This History-enabled Surface Menu command creates a surface that updates automatically as you edit the profiles used to make it.

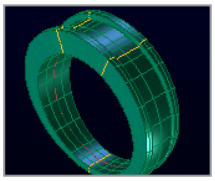
About Sweep 1 History

The easiest application of this tool is to place a ring rail in the viewports, apply a profile to it using Profile Placer, and run this command. This is the command whereby the cross-section shape (profile) is applied to the path of the rail curve to create a surface.



Start with a ring rail and profile(s); sweep a band.

When using the Matrix tool Sweep 1 History, as opposed to the Rhino Sweep 1 tool, you can edit the profile by selecting it, clicking F6, and using the handles or builder interface to change its size, location, shape, or edit points. Press Enter after making any necessary changes, and the surface made with Sweep 1 History will instantly update!



Select Profile > MSR > change profile to update band with history.

If you didn't use this tool, you'd have to Sweep the rail and profile curves again each time you want to make changes - instead of making changes, seeing the results instantly, and trying new changes much more quickly and easily, the way you can with Sweep 1 History.

Using this Tool

Sweep 1 History could not be easier! With one rail curve and at least one profile applied to it, start up this command. The Command Line will prompt you to select the rail curve. Select it; then, select the Profile curve(s), as prompted by the Command line, and press Enter. The surface will appear.

If you have more than one profile curve on the rail, you MUST select the profiles in the order you wish to sweep them, according to the direction indicated by the white arrows on the rail.

To leave an open space in the sweep, select the "Closed = No" option in the Command line. Then, start by selecting the profile on one side of the open space, proceed in the direction of the arrows, and end with the profile on the opposite side of the open space in the surface. With the "Closed" option set to "Yes", the surface will be swept all the way around the rail curve. To reverse the direction of the arrows, click the "Reverse" option in the Command line.

Steps to use Sweep 1 History & Edit the Surface

1- With a single rail curve and one or more profiles placed on it, start up Sweep 1 History.

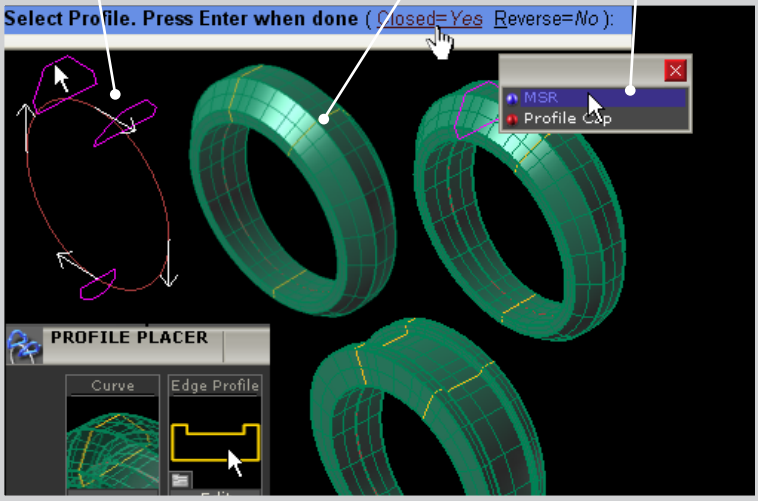
2- Select the rail. Select the profiles, in order according to the result you want for the surface and the direction of the arrows.

3- Set any options you may need ("Reverse" to switch direction of arrows or "Closed = No" to sweep an open surface).

4- Press Enter to create the surface.

5- To change a profile's shape, location, or size, select that profile, press F6, & use MSR. After editing it, press Enter to see changes in surface.

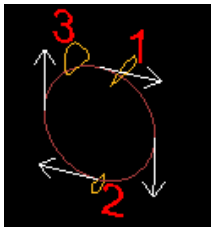
Or, change rail. Editing Control Points of rail changes surface!



Note: Proper order to select profiles for open sweep at top of rail is indicated by numbers in illustration below, right.

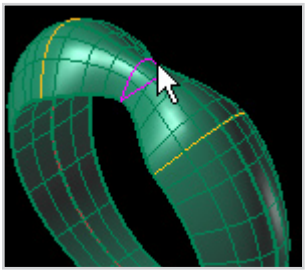


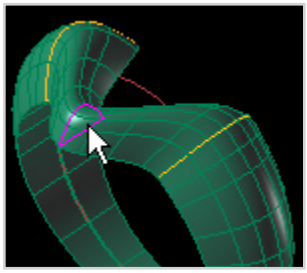
(Left) Open vs. Closed Sweep. (Right) Order in which to select profiles.



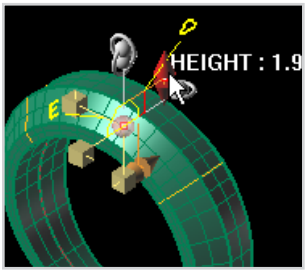
Tips & Tricks: Sweep 1 History

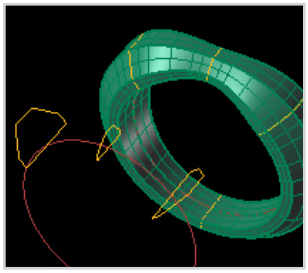
Learn some of the intricacies of editing a surface created with Sweep 1 History.



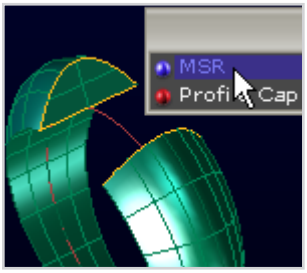


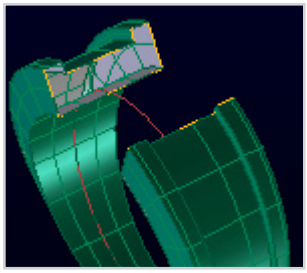
Maintaining History. In Profile Placer, with a profile active, you may edit the profile curve within the "Edit Profile" viewport and history will update. The best way to edit the profiles is with F6 and the handles. However, you can Move, Rotate, Edit Control Points, Scale, Bend, Taper, Twist, Shear, Rotate 3D - any Transform command that does not Split, Trim, Join or Boolean the profiles, rails, or surface - and history will update (click and drag profile used in above illustration.)



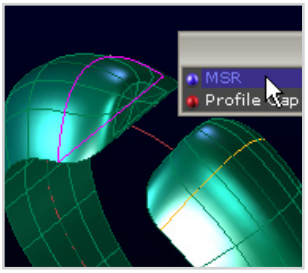


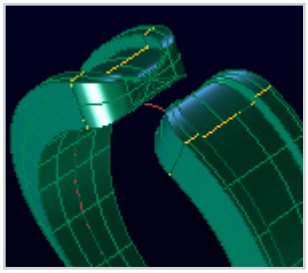
Breaking History. If you add another profile to a rail that has already been swept (above, left), you will need to re-sweep that rail (above, right). In addition, if you edit the finger rail, the profile curve, or the surface with any trim, split, join, or Boolean commands, Sweep History will be broken. Finally, deleting the profiles, rail curves, or surface breaks History. Moving the surface after the sweep and THEN updating a profile or rail will put the surface BACK where it began, following the profiles and rails.





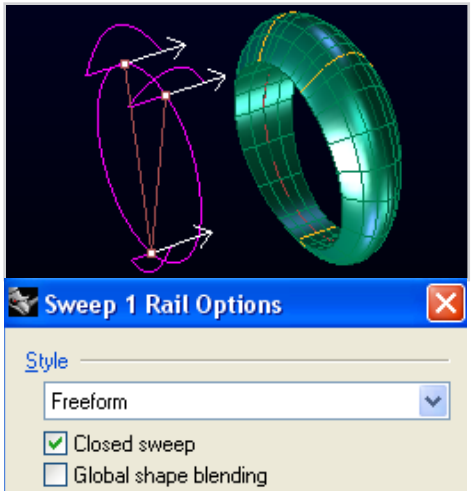
Capping an Open Surface. It's fine to Cap an open surface using Cap Planar or Profile End Cap (creates a Blend surface). When using Cap Planar, you may continue adjusting the profiles using F6 & MSR (above, left); just realize that the end caps will not be saved as part of the surface. The edited surface will need to be capped again (above, right).





Profile End Cap. This tool creates an automatic Blend shape which can be adjusted with a handle. After adding a cap this way, updating the profile shape with MSR (above, left) will change the cap shape, too (above, right). Isn't History wonderful?!

Sweep with History or Rhino Sweep? If you require additional options, or your sweep is not satisfactory, you may wish to run the Rhino Sweep command explained elsewhere in this manual. This command offers you the option to indicate the profile "Seam Point" and direction, different options for the profile orientation to the rail throughout the sweep, and different height / blending options for defining the shape of the surface throughout the sweep. Usually, these options aren't necessary for basic applications of the Sweep tool, where you would wish to apply History. However, they do introduce more advanced functionality that History just can't yet account for. So, these Rhino Sweeps - though more varied in their options - do not offer History functionality. Use them in more advanced modeling operations only, or as needed.



Rhino Sweep 1 & 2 require you to set up seam point arrows as shown at left, above. They do not work with History, but provide more shape options (below) .

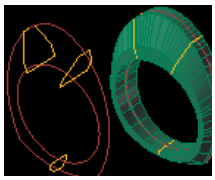
Building Shanks & Bands ...

The Outside Rail Tool

Add an "Outside Rail" shape for Sweep 2 History. Then, edit size & shape to update the surface. Or, create your own outside rail shape.

About the Outside Rail Tool

When looking at your ring in the Through Finger viewport, you might find that just adding profiles to a single rail doesn't get the shape that you want for the ring. Often, adding multiple profiles to try and achieve a certain shape in this view just ends up leaving you with a lumpy surface.



Outside Rail & Sweep 2:Curves (L) and Resulting Surface (R).

The perfect solution is an outside rail shape. This defines the height of the profiles all the way around the ring, making for smooth transitions all the way around the shape you want for the band in the Through Finger viewport.

Using the Outside Rail Tool

You should first be aware that, with this extra rail in place, you will need to run a "Sweep 2 History" (or regular Sweep 2) in order to create the surface!

To place an outside rail shape from the library, open up this tool and click on the Browser window. The library will appear at the bottom of your screen. Select a rail shape from the browser by clicking it once, and it will appear in the builder preview window, closing the library browser as it does.

To add this rail to the viewports, click on the "New Ring Rail" button in the builder. A rail with handles on it will appear. Use the handles or the corresponding builder interface controls to adjust the outside rail to your liking. Remember: this shape represents the resulting shape your ring will have in the Through Finger viewport!

The Handles and Builder Controls

Represented by a slider control and a handle, each of these values may be adjusted either of the two ways, OR by clicking the corresponding Command Line option, typing in a value, and pressing Enter.

Steps for placing and sizing an Outside Rail.

1- Start up this tool and click on the Profile preview window.

2- Select a shape for the outside rail and click on it. It will appear in the Preview window.

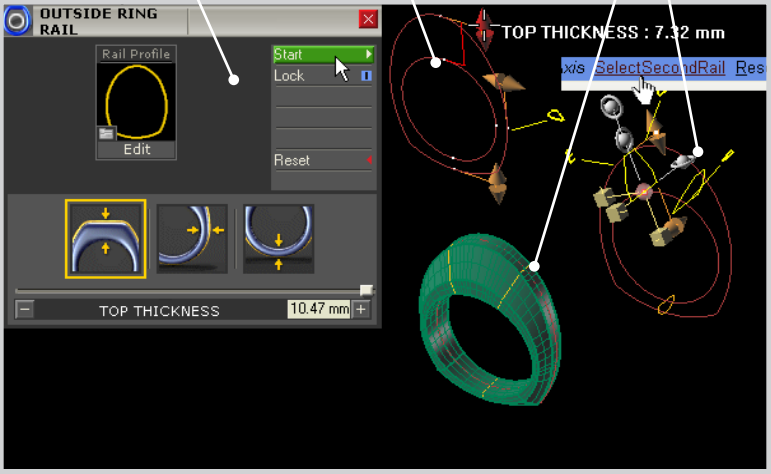
3- Click "Start" to add it to the viewports, complete with handles.

4- Adjust Interface controls, handles, or Command Line options to set dimensions for the outside rail at the Top, Sides, and Bottom. Use the "Lock" option and they won't skew the rail.

5- Press Enter to set this shape.

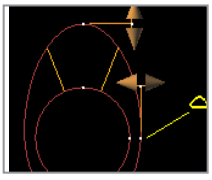
6- When setting profiles with Profile Placer, choose the "Select Second Rail" option and your profiles will adhere to the Outside Rail shape you set.

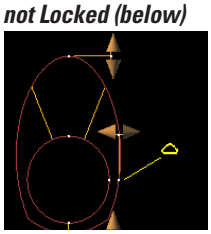
7- Run Sweep 2 History or Sweep 2 to create a surface using these shapes.



"Top Thickness" represents the distance between the finger rail and the top of the outside rail. "Side Thickness" represents the resulting thickness of the side of the ring between the finger rail and the outside rail; and, this value is mirrored to both sides of the finger. "Bottom Thickness" is the thickness at the bottom of the finger rail, between the inside and outside rails.

Turn the "Lock" option ON if you don't want each change you make to the slider controls or handles to change the shape of the outside rail (right, above). Turn it OFF if you want each value to skew the shape of the outside rail (right, below).





Adjusting Top Value - Lock (above) and not Locked (below)

Outside Rail & Profile Placer

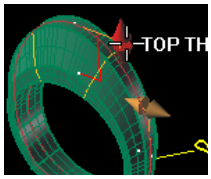
To place profiles on a two-rail ring, enter the INSIDE finger rail into the Profile Placer tool. If you want these profiles to adhere to the height of the outside rail (this will give you the most predictable results), click on the "Select Second Rail" option in Profile Placer and select the outside rail. Now, as you adjust the Position Along Rail of these profiles, they will adhere to the height of the outside rail (the Height control will have no effect, unless you use "Select Outside Rail" again, select nothing, and press Enter). Also, as you adjust the handles on the Outside Rail, the profiles will follow the rail with this option turned on, as well!



Choose "Second Rail" option in Profile Placer & select 2nd rail.

Adjusting an Outside Rail AFTER Using Sweep 2 History

With Matrix History enabled, use Sweep 2 History to sweep the design (explained in the next section of this chapter). To update the surface with History, select the outside rail and press F6 - or start up the Outside Rail Tool again and click "New Ring Rail" - to get the handles back. Adjust the handles or Outside Rail shape to your liking, and press Enter to see the results. The surface will update to reflect your changes!



Adjust 2nd rail after Sweep 2 History. Press Enter to see changes.

Creating an Outside Rail Shape

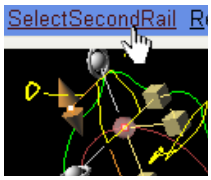
You can always draw your own Outside Rail shape, as long as it is planar (flat) against the grid in the Through Finger viewport. Use the skills taught in the next chapter, Basic Curve Tools, to draw a shape.

Now, upon entering Profile Placer, you may select this shape as your Second Rail shape, and the profiles will adhere to it in the Height direction just the way they do with a curve from Outside Rail builder.

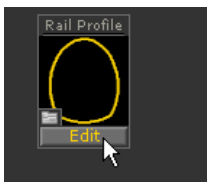
"Edit" to create an Outside Rail Shape to use with Handles

To create your own Outside Rail shape that can interact with Viewport Control Handles and the Outside Rail builder menu interface, start up the builder as usual and select the Outside Rail shape that most closely matches the shape of the one you want to place.

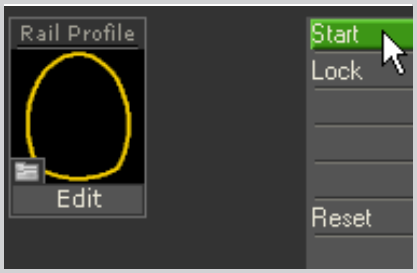
Click "Edit" beneath the Profile Preview window to open the Edit Profile viewport. In this view, draw the shape you want, using the existing shape as a guide, or edit the existing shape. The final result should be a closed curve. Run the remaining functions in this builder to prepare the curve for use back in Matrix (explained in the Profile Placer section of this chapter). Type a name for this shape and Save it to the library for future use. Lastly, Return the shape to Matrix. It will be enabled with Handles, Interface controls, and Command Line options to work just like any library profile!



(Above) Draw your own outside rail & use "Select Second Rail); (Below) Copy > Outside Rail > Edit > Paste to add to library.



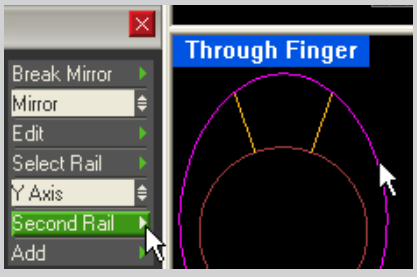
Step-by-Step
Outside Rail



1 Select a shape & click "Start". Click the Preview window in the builder to see the Library Browser. Select a shape to close the browser, and click "Start", adding it to the viewports.



2 Adjust Handles or Builder Controls. Using the Viewport Control Handles or Builder Interface controls, set a size for the shape. Click off the shape anywhere to keep this size. Select it again and click F6 to return to editing the handles.



3 In Profile Placer, use "Select Second Rail". Input the inside finger rail into Profile Placer. This tool's "Select Second Rail" option will scale the height of the profiles to this rail. Sweep with Sweep 2 History so changes you make later to the outside rail handles or the profiles will affect the surface.



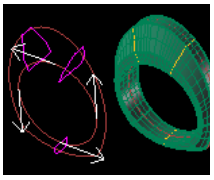
Building Shanks & Bands ...

Using Sweep 2 History

With an Outside Rail in place, Sweep 2 History creates an updatable surface using inside finger size, outside rail shape, and all profiles.

About Sweep 2 History

When you have two rails in place (inside finger rail and Outside Rail shape), together with profiles between the two, Sweep 2 History is your best bet for sweeping a surface that is edit-able with Matrix History.



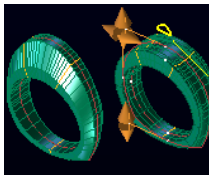
Sweep 2 History uses inside & outside rails, and any profiles you wish.

By definition, a two-rail sweep will follow both the outside rail shape and the inside rail shape to establish the path of the surface. A two-rail sweep will also adhere to the shape of the profiles. Because its job is to keep all three of these elements (two rails and all profiles) in mind, it will have the most predictable results when the profiles touch both rails.

Sweep 2 History means that, after sweeping the surface, you can change anything about these three elements - inside rail, outside rail, or profile shapes - and still have the surface update. The same rules apply as in Sweep 1 History, so refer back to that section of this chapter for more information. You cannot Split, Trim, Join, or Boolean any of the rails or profiles, or the resulting surface, or History will be broken. If you delete any of these three elements, History will also be broken.

Using Sweep 2 History

Start up this tool and select both rails used in the sweep. Next, select the profiles, in the order you want them to sweep according to the direction of the arrows that appear on one of the rails. To create an open sweep, select the profile on one side of the open area and then, working in the direction of the arrows, work your way around to the profile on the other side of the open area. Press Enter to see the results.



Update rails and/or profiles after Sweep 2 History. Press Enter & Surface will update.

Using the "Closed = No" option will leave an open area in the sweep (where this area is located depends on the order of the profiles you select). The "Closed = Yes" option will create a closed or solid surface for the sweep. Use the "Reverse" option to flip the direction of the arrows to help you select profiles. "Maintain Height" will hold the width of the profile constant between the rails. Usually, the program scales the height and width of the profile uniformly so that, where there is wider space between the two rails, the profile will be wider as well. To keep this from happening, and to maintain the profile's original width, set this option to "yes".

Steps for Sweep 2 History

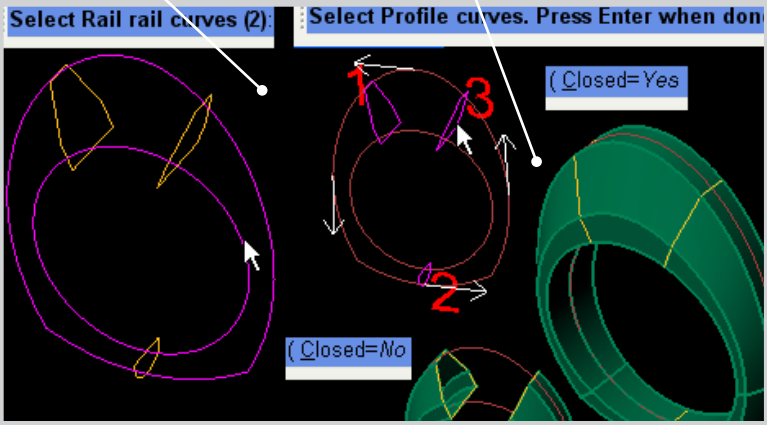
1- Select the two rails.

2- Select the profiles in order. To leave an open space, select first a profile on one side of the open space, and end with the profile on the other side of the open space, working in the direction of the arrows that appear.

Also, to leave an opening, select the "Closed = No" option. Use the "Reverse" option to change the direction of the arrows to assist you in the selection process if needed.

3- Press Enter. The surface will appear.

4- To edit the surface, select a profile or the outside rail, press F6, and select Edit tool. Adjust and press Enter. Other Move, Rotate, Edit Control Points, and Transform operations run on rails or profile curves will change the surface too, thanks to history.



Study the rules of History elaborated under Sweep 1 History earlier in this chapter. The same rules apply to Sweep 2 History.



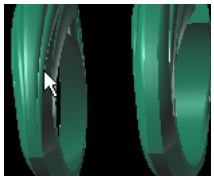
Building Shanks & Bands ...

Multi-Rail Sweep History

Use Multi-Rail Sweep instead of Sweep 1 or 2 History when you wish to control the shape of the surface using the Edit Points of the profiles.

A Basic AND Advanced Tool

This advanced tool is easy to use and extremely effective on basic designs, as well. It is also considered an "advanced" tool because it can be used with up to four separate rail curves!! (Imagine that - and you just learned how to set up a Sweep 2!) Placing four rails is a little more complicated, so we'll wait till a future time to tell you about that. But this versatile tool can also be used with all the skills you've already learned to provide amazing control over your swept surfaces.

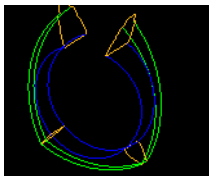


(L vs. R) Multi-Rail Sweep History makes subtle changes to surface cross-sections.

Set up with Edit Option in Profile Placer

You can run this tool with either 1 or 2 rails (or up to 4, as you'll see later on in this manual). It's designed to be used with two or more profiles of different shapes and sizes. So set up a typical model the way you just learned, using Ring Rail, Profile Placer, and (if you wish), Outside Rail.

The reason it's different than a Sweep 1 or Sweep 2, and - in fact - the reason it's called "Multi-Rail" sweep, is that the tool places additional invisible "rails" in your model to sweep in a more controlled way from one profile to the next. More precisely, it sweeps from one PART of one profile to the corresponding part of the next profile.



Multi-rail Sweep History places imaginary rails between same-color Edit Points.

The way you control which parts of one profile sweep to the which parts of the next profile is with the "Edit Points" on the profiles. Remember that you access these within the Profile Placer tool > "Edit" option (found in the Builder Menu Option list, Command Line option, or "E" handle in the viewports while Profile Placer is running).

Multi-Rail Sweep Steps

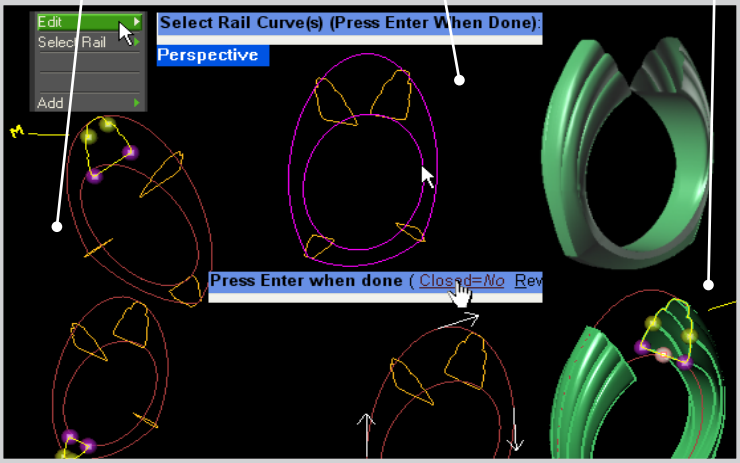
1- Set Finger Rail, Outer Rail (if desired), and profiles (at least 2, or more if the 2 are mirrored).

2- In Profile Placer, select profiles and use Edit Points to assign corresponding parts of profiles.

3- Run Multi-Rail Sweep: select rails and press Enter; select profiles and press Enter.

4- To see the "History" part of this tool really work its magic, run Profile Placer > Edit Points option again and try a new configuration for the edit points. The surface will update, creating a more interesting - or understated - twist.

Don't you just love it? And, you can still change shapes, sizes, etc. for profiles and rails, just like in any other sweep.



Run Multi-Rail Sweep History with 1, 2, 3, or 4 rail for control over profiles. Use it every time you Sweep 1 or 2 rails, replacing Sweep 1 & 2 History!

The "Edit" option places two pairs of control points along a profile. Click and drag one point and its partner will mirror its movements on the other side of the profile, unless the "Mirror" option is turned off. (Turn this off with CARE, as it is easy to "break" the surface if it has to twist too much to make the sweep. Some things just aren't possible in the CAD world or in the real one!) On a Mirrored profile, the Edit Points on the corresponding profile will move as you adjust those on its counterpart, so both halves of the ring are Mirrored.

Using Multi-Rail Sweep History

With the Edit Points set up in interesting ways, run Multi-Rail sweep. Press Enter after selecting all rails. Select all profiles, working under the rules of both Sweep 1 & 2 History (see earlier parts of this manual) if you wish to create an open surface. Set up the options (Closed and Reverse) as needed - also elaborated in Sweep 1 and Sweep 2 sections of the manual.

Building Shanks & Bands ...

Profile End Cap

Create a Blended end cap adjustable with handles on any profile. Cap updates with History when Profile is changed in Profile Placer.

About Profile End Cap

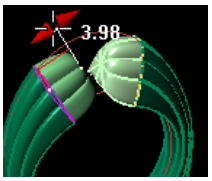


Result of Profile End Cap: Blended surface matching profile.

The Surface tool Blend is automated within the Profile End Cap tool. With capability Blend doesn't have, such as the ability to update the shape of the end cap when the profile is updated with History on, this tool works with easy and intuitive handles to define the length of the blended end.

This simple tool creates a terrific, symmetrical Blend shape every time. To get an alternate shape for the blended end, you must use the Surface Menu "Blend" tool, which is not enabled with History.

Using Profile End Cap



Profile End Cap handle: click and drag to define length of end cap.

Select a profile and start up this tool (F6 or Tools Menu > Profile End Cap). The end cap will appear, in preview mode, with a handle. Click and drag handle to define length of Blended end. Press "Enter" to keep the end cap.

Profile End Cap & History

Select the profile and enter Profile Placer (F6 > MSR or Tools Menu > Profile Placer). Edit the size, shape, or location of the profile and the Profile End cap will follow! Remember to follow the rules of history - do not Boolean, Join, Split, or Trim either the curves or the surface - for this to work!



Change profile shape, size, & position to see Profile End Cap update with History.

Profile End Cap Steps

1- Select Profile. Press F6 > select Profile End cap. Or, start up this Tools menu command.

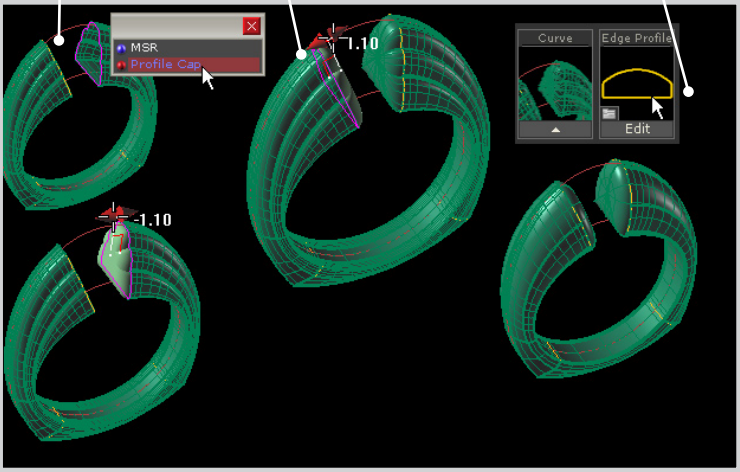
2- Profile End Cap, with handle, will appear. Click and drag handle to change length of end cap.

3- When you like the results, press Enter to keep them, ending the command.

Note: Create opposite end cap with same length (do not Mirror endcap) to ensure both ends will be updated with History.

4- To see History update with this tool, select profile and press F6 > select MSR or select Profile Placer from Tools menu to change profile.

Change size, shape, or location of profile and cap will update (if Matrix History is on).



Hold down "Shift" while moving Viewport Control Handles to adjust End Cap length in increments of 0.1 mm. To match the next cap to the first, click the "Flip" option twice, reversing the cap with the same amount of length. Do NOT Mirror Cap or History will not keep up when both profiles are adjusted. Creating a new cap (not mirroring or copying caps) ensures History will update the cap.

Adding Basic Gems ...

The Gem Loader Tool

This Gem Menu tool adds any shape, size, or cut of gem to the viewports at F4 for use in basic designs - as center or side stones.

Select a Cut Type

This tool opens up to the "Gem Shape" circular selection tool. Prior to selecting a shape, make certain the "Cut Type" reflects the design for which you'll be using this gem. The possible Cut Types are: Diamond, Simple, Gem, Cabachon, and Custom. Using a "Diamond"-cut shape will cause the stone to render like a diamond when this render material is selected. "Simple" will take up less processor speed, somewhat speeding up your program if you need to use a lot of gems onscreen at the same time and you have a rather slow computer. It is fine to use if you don't need to render your design. "Gem" is best to use when your design calls for a colored gemstone. "Cabachon" adds a cabachon-shaped gem, and "Custom" holds a list of gems you've created and saved using the "Custom Gem" tool (taught in the Intermediate chapter on gems).



"Cut Type" changes the options in "Gem Shape"

Select a Gem Shape and Size

Depending on the Cut Type you selected, the circular selection tool (referred to hereafter as the Gem Spedometer), will display different shaped gems. Select the one you wish to place by double-clicking on it. The size selection menu will appear for that shape. Based upon the Shape you selected, various sizes will be available in the "Gem Spedometer". When there is a larger number of sizes available for a gem, the sizes will be divided into ranges and offered in "tabs", so you may have two or three "Gem Speedometers" located in successive tabs which group the gems by size. (If you don't see the size you need, click another tab to get there.)

The size of each gem is listed beside it. When you hover the mouse over a gem, you'll see a full report on its size in the center of the circular display. This includes carat weight, length, and width. These values are also displayed for the current gem in a table at the bottom of the interface. Type a new value for one of these dimensions if you wish to slightly change the current gem before placing it. If you do change one of these values, add the gem to the viewports by clicking the green button in this interface.

To place one of the program gems, unaltered, simply double-click on it in the circular gem selector. It will appear at F4 in the viewports.

Replacing a Gem or Gems in Position

To replace a gem or gems anywhere in the viewports with a gem of a new size or shape, select the gem(s) and enter Gem Loader. Double-click on a new gem shape and size, and the existing gem will be replaced with the new one. To keep the same size but change the gem's shape, make sure the "Keep Original Size" option is selected in the builder.

Features of Gem Loader

Select a Cut Type: Diamond, Simple, Gem, Cabachon, and Custom (Custom gems must be created in Matrix's Custom Gem builder, explained in a future chapter.)

Select a Gem Shape: Different shapes are offered based on the cut type you select.

Select a Gem Size: Different sizes are offered based on the gem shape you select. When sizes are numerous, they are grouped in a range of sizes. Click the tab to see each range of sizes.

Enter a Custom Gem Dimension: At the bottom of the interface screen, enter a different value for Height, Width, Depth, or % Depth and click the green button to place the new gem.

Use the "On Surface" feature to open up the Gem on Surface Tool (explained later).





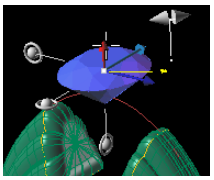
Adding Basic Gems ...

Gem Positioner & MSR

Start up Gem Positioner - or press F6 and choose "MSR" - to get position & duplication handles on a single gem or gem configuration.

About Gem Positioner

Select a gem or gems to manipulate with either movement, rotation, or duplication tools. Either press F6 and select "MSR", or click on "Gem Positioner" in the Gems menu to turn on the Gem Positioner handles. Hover (position the mouse without clicking) the mouse over each handle (it will light up in red) to see what it does. Click and drag a handle to use it to control the gem. To keep any of these values within a 0.10 mm (or degree, in the case of rotation) range, hold down Shift while you click and drag the handles.



Gem Positioner can move, scale, & rotate gems.

With a group of gems, the handles will appear on a single gem, but those handles will control all the selected gems. You can tell which ones are active, since they will be lit up in the preview color (deep blue "plastic" shading).

After using the handles to manipulate the gems as desired, simply press Enter to keep your changes and end the command. To cancel ALL of your changes, press Escape.

Position the Gem(s)

Each colored arrow moves the gem in the positive or negative direction indicated. So, to move it up or down, click and drag the mouse, and it will follow that arrow in the positive or negative direction only; same goes for left to right; same goes for positive or negative Z direction.

Rotate the Gem(s)

Hover the mouse over one of the rotation handles - the circular silver handles - to preview (ghosted red path) the direction in which this handle will rotate the gem or gem configuration. Each direction is relative to the X, Y, and Z axes of the gems, so each handle will rotate the gem on this axis. (Z rotates the gem or gem configuration around its table to culet axis; X around its left to right axis, and Y around its top to bottom axis.)

What Each Handle Does in Gem Positioner

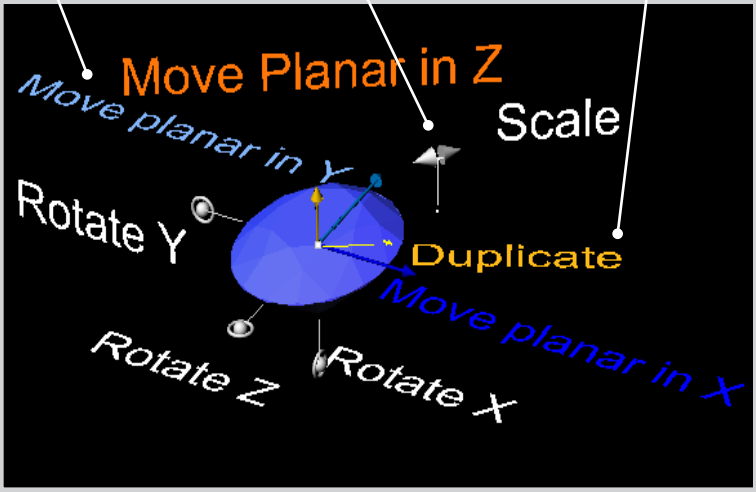
The three arrows move the gem in its relative X, Y, and Z axes. Mouse over them to see them light up in red, and click and drag them (either with or against arrow direction) to move the gem planar (flat) along each relative axis.

The silver arrows scale the gem. Click and drag to see the new gem size as you scale it.

The three silver rotation controls rotate the gem along the red axis indicated: X, Y, or Z, relative to the gem.

Use the "+" sign to duplicate the gem in place. The current gem will be placed, and the new (duplicate) gem will now be controlled by the handles.

The same goes for gem configurations & not just single gems.

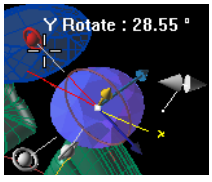


Scale the Gem(s)

Click and drag the scaling arrows to scale this gem up or down. The resulting size is displayed as you do so. Remember to hold down Shift to size this in increments of 0.10 mm if you need to.

Duplicate the Gem(s)

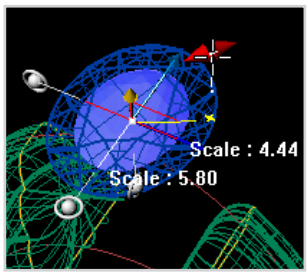
Click on the "+" plus sign to duplicate the gem or gems that are currently active in the Gem Positioner tool. The duplicated gems will appear in the same positions as the originals, so it will be hard to differentiate them until you begin to manipulate the handles - now, the handles will apply to the NEW gem (or set of gems) only.

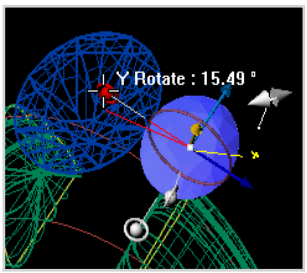


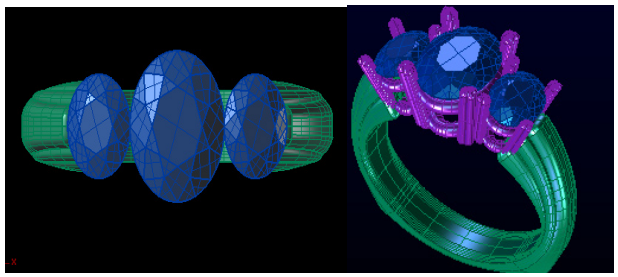
Plus sign duplicates gem, Rotational Arrow angles it.

Gem Positioner (MSR) Tips & Tricks

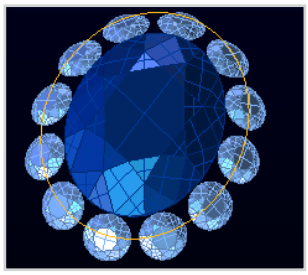
Try out some of the most common uses of this tool for creating interesting gem layouts

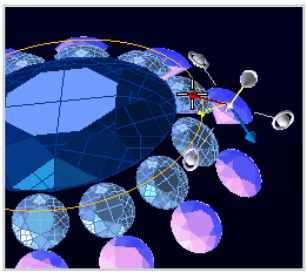


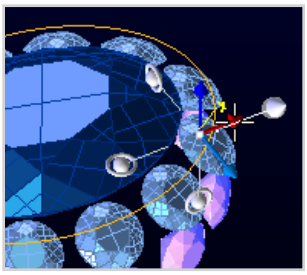


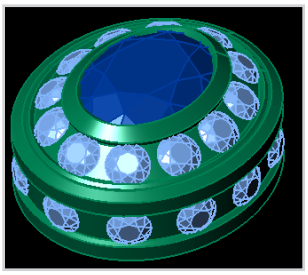


Creating a Three-Stone Head Place the first gem in Gem Loader at F4. Using the "Z" handle in MSR (Gem Positioner), drag the gem straight up above the finger rail to the desired height in the Through Finger viewport. When it is correctly positioned, click on the "+" sign to add a new gem. Scale this one down to the size of one of the side gems, using the scale handles. Then, use the "X" arrow to drag it into position beside the gem, and use the "Y Rotate" handle to angle it beside the center gem. Also use the Z placement handle to lower the gem's position in space. Continue scaling, rotating, and moving using the MSR handles until you like the results. Now, press Enter to keep the results. Mirror the new gem to the other side of the ring, holding down Shift while you do so to keep the gem in a straight line. If you wish, you may now control (or replace, using gem loader) both side stones together by selecting them and starting up MSR again.

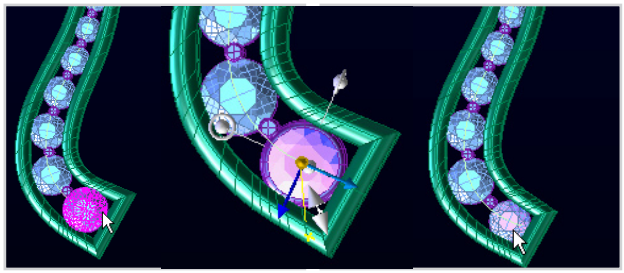


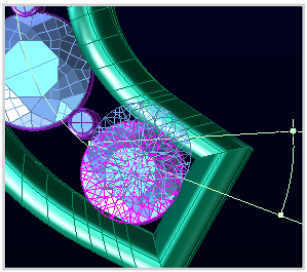


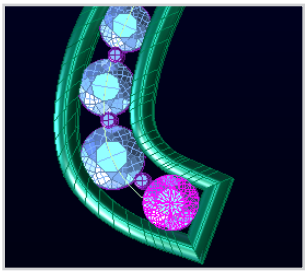




MSR with Multiple Gems Use the Gems on a Curve tools explained in the Intermediate Gem Tools chapter to arrange a multiple gem layout. Select all of the gems by right-clicking on the Layers Menu color indicating their Layer Color, press F6, and start up MSR (or, click Gem Positioner in the Gems menu). Without moving any other handles, press the "+" sign handle to duplicate the gems. Use the rotational and movement handles to rotate and move the new gems into an attractive position for the cluster head. Metal Piece (on the first set of gems) and Match Attributes (on the second set) to match the first Metal Piece and complete the design.







MSR and History After adding settings, using MSR causes the settings (bezels, prongs, underbezels, & metal piece ONLY - NOT heads) to accompany the movement of the gems, so you can easily design "on the fly", seeing the direct result your changes will have & avoiding rebuilding the design (above, gem scaled down to change design of pendant)! If you don't want changes to affect your design (e.g., metal piece will "grow" and change to accommodate design changes), turn OFF history first; then make all necessary changes with MSR.

Other ways to "MSR" You can still "click and drag" or use the "Move" command to move, use the "Rotate" command to rotate (as shown above), and the "Copy" command to duplicate, a gem or gem arrangement onscreen. History will also accommodate these changes if the gems have settings attached. MSR is simply another, more intuitive method to move gems relative to their local axes, and we think you'll find it a lot more intuitive than the old way.

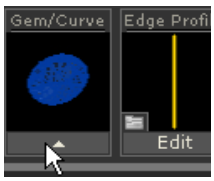
Basic Setting Tools ...

Using Bezel Builder

Adjust bezel, underbezel, or gallery rail directly with Viewport Control Handles, or with builder interface. Bezel relates to gem with History.

Starting up Bezel Builder

To add a brand-new bezel, start by selecting a gem and clicking on the Bezel Builder "Gem" input window. This will bring up the default bezel - on that gem - with handles visible. Alternately, select the gem and press F6. Select Bezel Builder from the list that appears, and the default bezel with handles will appear, together with the Bezel Builder interface in the Matrix Menu. Use the handles, Command Line options, or Builder Menu interface to adjust the bezel according to your needs - as described below. Press "Enter" when done to end the command and place the bezel.

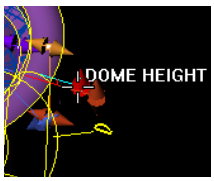


Input Gem to start; or, F6 on gem > Bezel Builder.

With a bezel already in the viewports, select it and press F6. Select "Edit Bezel" to get the handles back and edit the bezel. Or, re-input the gem OR its bezel into the Bezel Builder's "Gem" input window to get back the handles for editing the bezel. As before, press Enter when done.

Using the Bezel Builder Controls

Corresponding controls live in the Builder Interface (click the dimension of your choice to cause the Slider to control that dimension) and Command Line options (click on the dimension of your choice and type in a new value), as well as onscreen via direct Viewport Control Handles (click and drag the handle corresponding to the dimension of your choice to change it).



Hover over a handle to see what it does. Click and drag to change it.

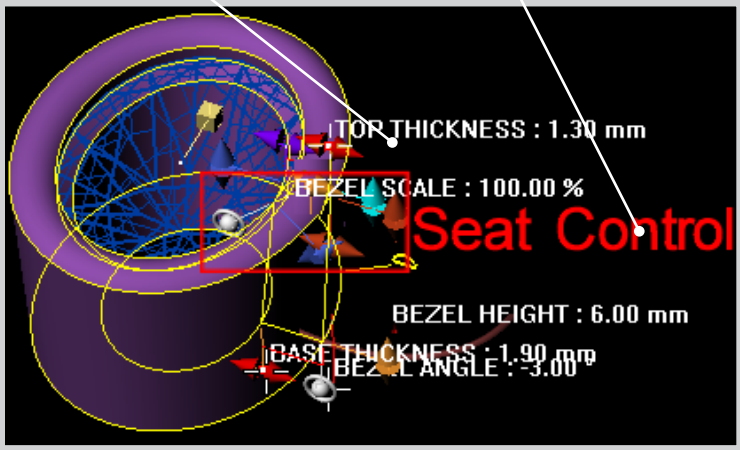
Using one of these three methods, you may adjust the Height, Top Thickness, Base Thickness, Bezel Angle, Placement, and overall Scale of the bezel. To adjust the way the gem sits in the bezel, pay close attention to the Dome Height over the gem, the Chamfer that may be added in X and Z directions to adjust the top of the bezel, and finally the Seat Depth, Length, and Angle to control the way the gem sits in the bezel.

About the Bezel Builder Handles

To adjust the overall thickness of the bezel, use the Top and Base Thickness handles. Adjust "Bezel Angle" to change the angle at the base of the bezel. Bezel Height adjusts its overall height, while Placement moves it in the Z direction in relation to the gem. Use the overall "Scale" to scale it up or down with a 3D scale feature.

To adjust the way the gem sits in the bezel, adjust the Dome Height over the table of the gem, Chamfer X and Z angle in the approach of the bezel to the table, and finally the Seat Depth, Length, and Angle to control the inside of the bezel in relation to the gem you're setting.

More limited controls are offered for Gallery Rail & Underbezel.



History & Bezel Builder: After you're done using this tool, press Enter. If you wish to continue editing the bezel, select it and press F6 > Edit Bezel. Bezel Builder controls & handles will return, and you can make further changes. If you've "broken" History by Booleaning the bezel, select the gem & re-input it into Bezel Builder. If you've deleted the Bezel altogether and want it back you may do this too. And/or, run "Match Attributes" from the gem to itself & select "Bezel". Now use F6 to edit it.

Bezel Builder Modes

Switch modes in the Builder interface or Command Line to create a gallery rail or underbezel. The default settings for either selection will appear, and fewer of the dimensions will be offered via interface, Command line, and Handle controls.



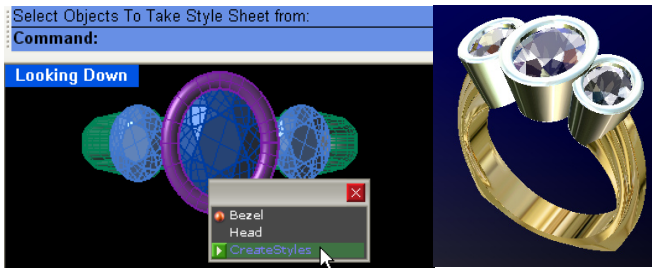
3 modes for this tool (L - R) Bezel, Gallery Rail, Under Bezel.

Tips & Tricks: Bezel Builder

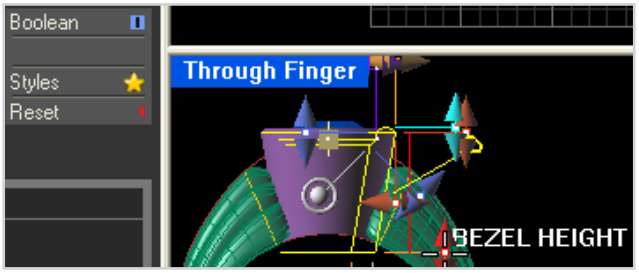
Learn to use the Options and other strategies together with this tool.



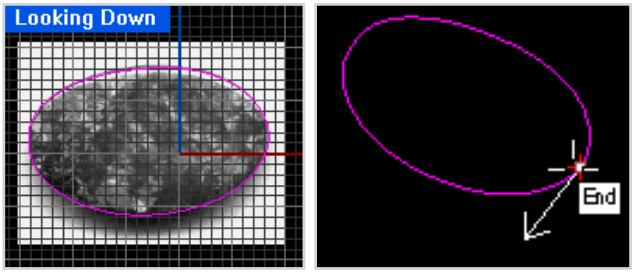
Bezel Styles Click the Styles option to open the Browser. Styles are offered for each of the three Modes of the builder, so be sure you're in the right mode. Click one of the existing styles, or one of your own that you've previously saved using 1 - 8. Load an additional style that you may have named and saved in your Styles folder in Documents > Matrix using "Style Load". Use "Style Save" to save and name a style you like for "Style Load" at a future point.



Loading the same bezel on multiple gems. Select the additional gems onscreen (without a bezel on them) and press F6. Find "Match Attributes" from the list and click it. Select the gem with the bezel on it to match them to, and select the "Bezel" option from the list that appears. The bezel will be added to the original selected gems. Use F6 on the new gem to continue editing it. Another way to do this is to Save the style and load it onto the next gem you place in the builder.

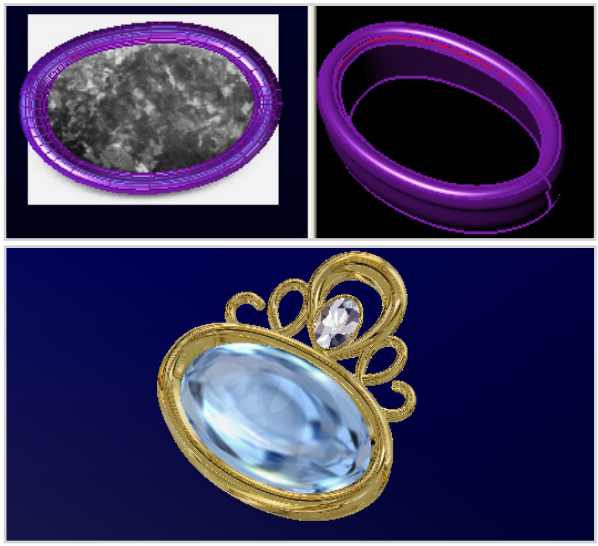


Cut to Finger Rail Use the "Boolean" option in the builder (upper left in illustration above) or the "Boolean Finger Rail = Yes" option in the Command line to cut the bezel to the finger rail "on the fly" as you adjust its height. (Notice that Bezel Height is through finger hole in illustration above). Set this to "No" to Boolean Difference the bezel from the finger rail yourself after creating it.



Bezel onto Any-Shaped Curve When loading a bezel onto any shaped curve, the curve must be closed and planar (with Seam Point on right and Directions clockwise - see Chapter 9, **Advanced Rhino Tools**. To prepare the curve for this operation, select it and click the "Profile" tool. This allows it to be recognized by Bezel Builder. NOW you may load this curve into Bezel Builder to create a bezel. You can even use this curve with an instance of Match Attributes - matching "to" or "from" the curve!!

Bezel Builder & History Moving the gems anywhere keeps the object created with Bezel Builder (Bezel, Underbezel, or Gallery Rail) with its gem, as long as Matrix History is turned on. However, replacing a gem with a new gem wipes out that history, and will not update the bezel. To update the bezel, it is recommended that you Move or Copy the first gem; load and position the new gem (or replace, if you copied the original one) in its place, and run Match Attributes between the old and new gems to load any attributes (bezels, cutters, other settings tools) from the original gem to the new. Or, if you saved the style of the original gem, simply place the new gem into the builder and load that style onto it. If you cut or alter the bezel in some way and it loses its History relationship to the gem, use "Match Attributes", selecting the attributes "from" the gem ITSELF - select the original bezel and it will be created! Or, put the gem back into bezel builder and the last settings will be used.



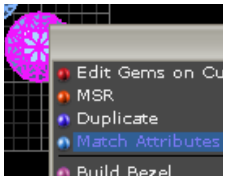
Basic Setting Tools ...

Matching Gem Attributes

Gems retain a "memory" of the settings and cutters created on them. To match these settings to a new gem or gems, run Match Attributes.

About Match Attributes

To transfer the settings or cutters from one gem or set of gems to another, use Match Attributes. This is possible because, via Matrix History, gems retain a memory of the objects created on them with builders. So, most builders for which you must input or select a gem or gems (excluding Heads Library, Emerald Profile / Emerald Cluster, and Advanced Cluster tools) will work with this tool. For a group of gems, each and every gem in that group retains the values of the objects created on it as a group (prongs, channel cutters, micro prong cutters, bright cutters, azures e.g.).



Select a gem & Match Attributes (F6 or Tools Menu)

Gems remember multiple builders, so that - if you created a bezel and a bezel cutter on a single gem; or a channel cutter, azure cutter, and prong layout on a group of gems, all of these settings or cutters tools will be offered as options. The only limitation is if you've created more than one of any single builder on a gem or gem layout - for instance, two bezels on the same gem. In that case, the gem will only retain a memory of the last settings used in that builder. (Alternately, you may save the style of both bezels using the Styles > Save Style option within Bezel Builder, and load either style onto a new gem to achieve the same outcome.) You can even create something on a gem, delete it, and them Match Attributes of a new gem to the deleted object!!



Choose style(s) from gem & click "Create Styles".

Also notice that the GEMS remember the objects created on them - the settings don't retain this "memory", so if you wish to apply a bezel cutter, select the GEM that has the cut bezel on it - not the bezel that was cut - to Match Attributes to it.

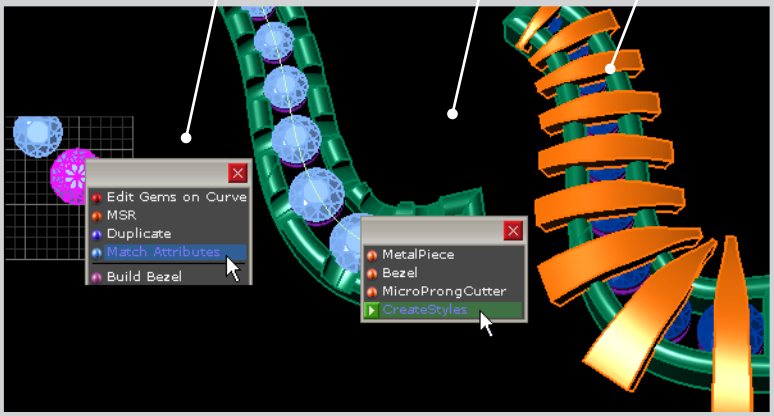
Steps for Match Attributes

1- Select the gem or gems WITHOUT the setting or cutters applied to them and start up this command using the Gems menu button or by pressing F6 and selecting Match Attributes.

2- Select the gem to take styles from. You may select as many styles as you wish that are applied to that gem by checking beside them in the list that appears.

3- Click "Create Styles", and the object(s) will appear on the new gem.

Note: Styles will appear for any Setting or Cutter builder the gem was used in, even if it's part of a group of gems. If more than one object - e.g. bezel - was applied to that gem, the LAST ONE used in the builder will be the one applied.



Note: Emerald Cluster & Emerald Cluster Profile, Channel Border, Advanced Cluster Builder, Prong or Bead on surface, and Heads Library are not offered with Match Attributes.

Using Match Attributes

This tool is very easy to use: simply select the gem or gem layout you wish to apply an existing style to and run this command via either the Tools Menu button or F6 > Match Attributes. Select the gem with the object you want on it already (or in its memory, in the case of something created on it and then deleted) and a list box containing all the possible objects will appear. (This may be any gem out of a gem layout if a style was applied to many gems.) Select the one(s) you want to apply to the new gem and select "Create Styles" from this list box. The new object will appear on the gem or gems you selected.

When to use Styles option > Match Attributes sub-option

When running a cutter tool, It is best to use "Match Attributes" by entering the Styles dialog and selecting this option. Within Styles, you will see a Match Attributes function that works like this function, but only allows you to select the style relevant to the builder you're in. If you choose to use this method, you have access to edit the style with handles after selecting it.

Adding Basic Gems ...

Emerald & Baguette Builders

If the Emeralds and Baguettes offered in the Gem Loader don't meet your needs, run Emerald and Baguette tools and assign precise dimensions.

Using these Builders

To draw a new emerald or baguette with their respective builders, start up the builder and click on the green arrow beside "New Emerald" or "New Baguette". Or, if you've already created a gem with either builder, input it into the "Gem" preview window in this builder and you can continue adjusting it with the handles, right where you left off (this only works with a gem made with its respective builder - not with one placed using the Gem Loader part of the program).

After adjusting the handles, builder controls, or Command Line options to size, position, and rotate the gem, as described below, press Enter to keep your changes and create the gem. The "Reset" option in either builder or its Command Line returns the gem to its default size and position.

About the Modes, Handles, & Sliders

Click on the "Handle Type" control - right beneath the "New Emerald / Baguette" option in each builder or in its Command Line options - to toggle among the three Handle Types for these builders: Size, Move, and Rotate. In the "Size" mode, the handles & sliders for Length, Depth, and Girdle Thickness for each gem will appear. For Emeralds, the Width and Corner Size will also appear. For Baguettes, the Bottom Width and Top Width will appear. Click and drag the Viewport Control Handle or slider control related to the dimension you wish to change (in the builder menu, select the dimension to change what the slider control affects).

Switch to the "Move" mode to get the familiar Gem Positioner Move handles - and related slider controls - to adjust the position of the gem. Finally, switch to the "Rotate" mode to get the Gem Positioner Rotate handles and related slider controls. You can return to any mode you wish by toggling through the modes in the builder menu or Command line to continue adjusting the gem to suit your design needs.

Emerald and Baguette Handles

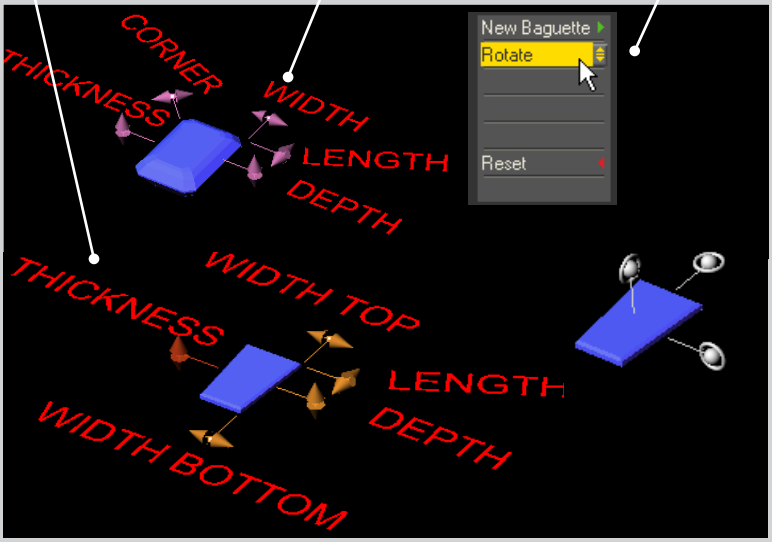
Both builders share handles controls for these dimensions - Length, Depth, and Girdle Thickness.

Baguette builder adds Top and Bottom Width controls to add taper.

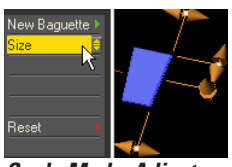
Emerald builder adds Width and Corner controls, to adjust all four corners simultaneously (there is no way to adjust corners independently of one another.)

Toggle through the "Modes" in either the Command Line or the Builder (click current mode to change it) and get the Gem Positioner Size and Rotate handles, to be used while continuing to size the gem for added convenience while you design.

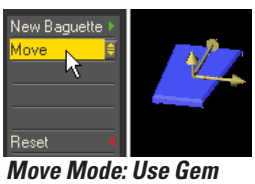
Note: You can also access these tools through Gem Loader > Emerald or Baguette > Custom option.



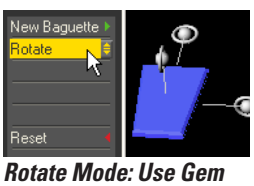
Instead of using the handles, you may opt to select the Command Line Option for the dimension you wish to adjust, type a new value for that dimension, and press Enter.



Scale Mode: Adjust length, width (top and bottom for Baguette), depth, & girdle (and Corners for Emerald).



Move Mode: Use Gem Control Handles to move in + or - X, Y, or Z directions.



Rotate Mode: Use Gem Control Handles to rotate in + or - X, Y, or Z directions. Mouse over to preview rotation direction.

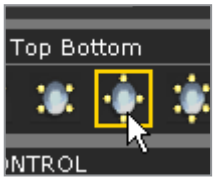
Basic Setting Tools ...

Using Head Builder

Create a history-enabled head. User defines prongs and gallery rails at varying levels of control. Prongs may be drawn as half-bezels.

Using Head Builder

Upon entering a gem into the builder, select a Mode (number of prongs, which differs for each gem shape) and the default head will appear. Now, select the "Level" of control you need, according to the definitions below. You may change levels easily, toggling between one level and another as you work depending on the control you need to create the head. Press Enter to place the head. To edit an existing head, select it and press F6. The handles will return.



Select a Mode and a Style to start from & adjust it to your needs.

Head Builder & History

Styles are also available in this tool: use them AFTER selecting a number of prongs, as they are different for each "Mode" (number of prongs) - and Modes vary with each different gem shape. Since MSR History doesn't work with heads (selecting the gem and running MSR does not update the head) because of the number of variables involved, it is a good idea to save a Style to be re-applied if necessary after MSR.

Match Attributes is another great trick to have up your sleeve when making MSR changes to a gem with a head on it: use Match Attributes and select the gem itself as the object to Match, and it will pull the head settings out of its memory and re-create it at the new location. Or, simply place the relocated gem back into Head Builder and the last style created on it will be re-created, with handles to adjust it further.

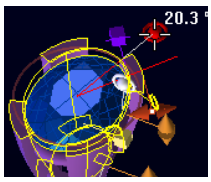
Level 1: Overall Control

Level 1, "Overall Control", brings up Slider controls and handles for Prong Size, Head Drop, Prong Nudge, Prong Dome, Rail Drop, Height Above Girdle, Head Angle, and Top Angle. The key to this level is that, as you click and drag one of these settings, the head acts as though the gallery rails and prongs are connected, scaling the rails to match the changes in the Prongs and vice versa.



In Level 1, changes affect prongs and rails together, changing head overall.

In every level, you will see a handle representing the "half-bezel". Click it to toggle from the Prong Profile shape to the half-bezel prong shape. In the first level, it affects all prongs. In Levels 2 and 3, it affects different sets of prongs, & in Level 4, it affects just 1 prong at a time. Select this handle and another handle - a Rotational Handle - appears. Click and drag it to define how far around the head the prongs reach.



Toggle between profile shape and half-bezel shape. Rotation handle defines half-bezel.

A Guide to Head Builder Levels

Level 1 - Slider controls and handles adjust Prong Size, Height, Nudge, Dome; Head Drop (height), Rail Drop (placement), Head Angle, and Top Angle (of prongs).

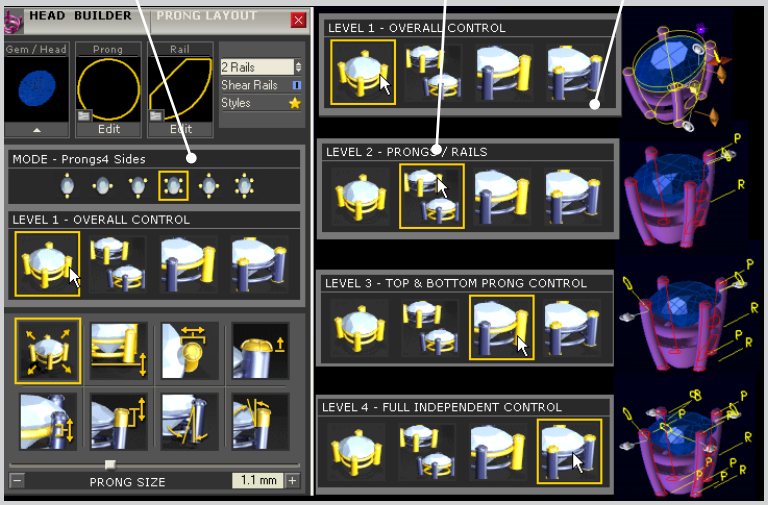
Changes made to prongs affect rails, and vice versa.

Level 2 - Click P to adjust a prong & R to adjust a rail. Related prongs change together. Toggle between half-bezels and prong profiles. Changing one rail affects all.

Changes to Prongs and rails will NOT affect one another.

Level 3 - Each prong set has a "P" control at both ends - so you can create tapered prongs. Each rail may be adjusted independently.

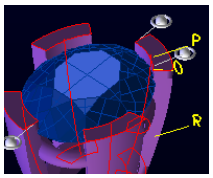
Level 4 - All prongs - both ends - and rails may be adjusted independently.



Note: History is limited for this tool: you cannot MSR the gem and have the head change to accommodate it. If you do need to re-associate the head with the gem, select the gem and run Match Attributes to itself (or re-enter in Head Builder) and head will catch up.

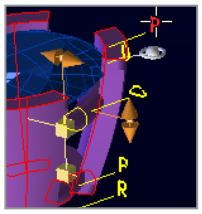
Level 2: Prongs / Rails

Level 2 provides you with separate controls for Prongs and Rails. Choose one option in the viewports ("P" for prongs and "R" for gallery rails) and the corresponding slider controls will appear in the builder with handles onscreen. "P" controls include Prong X, Y, and Nudge controls - which are NOT connected to the rails. Adjusting these controls adjusts all RELATED prongs in the head together.



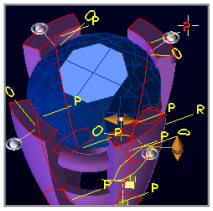
Select P or R in Levels 2 and higher to get controls for Prongs and Rails.

At this level you will notice that, with many head configurations, related sets of prongs will be controlled TOGETHER by one set of handles. So if you see several letter "P"-s, it's because these prongs will be controlled together - but will not affect the other set of prongs, which you can change separately. If you wish to control each prong independently of the others, proceed to Level 4.

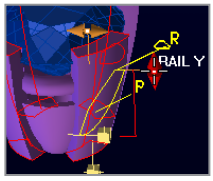


(Above) Level 3 lets you create a taper by grabbing the "P" at the top OR bottom of prongs. (Below) Also adjust each Rail independently.

Also at this level, you may click the "half bezel" handle onscreen and change the indicated prongs into half-bezels. Half-bezels include an "angle" to indicate how far around the gem they reach.



In Level 4, click on a "P" to change one end of one prong individually, or click on an "R" to change that rail, and adjust all parts of the head with full control.

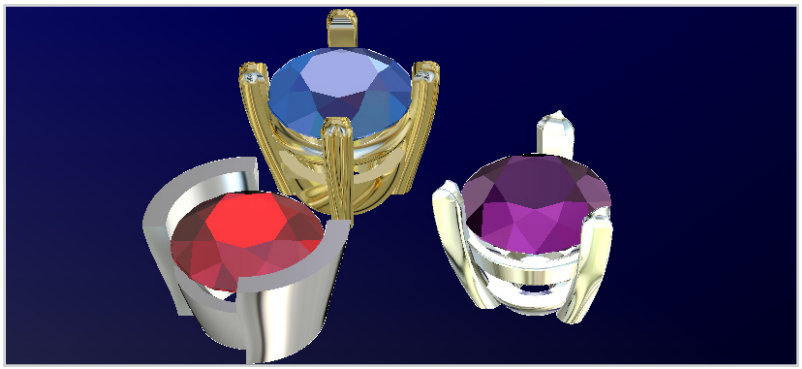


Level 3: Top & Bottom Prongs

This level provides the same controls for prongs & rails as Level 2 provides, yet it allows you to select the "P" at the top or bottom of prongs, providing handle controls for both in order to create tapered prongs. It also breaks up Rail controls so you can control each rail individually.

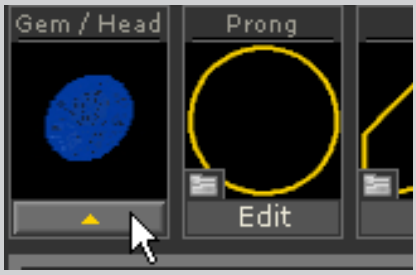
Level 4: Full Independent Control

Here is where you can go crazy: every prong and rail will let you select it (click on the P or R related to it) and adjust X and Y size (top and bottom of prongs, for taper), angle, and profile or half-bezel option. Change profiles, angles, sizes, and taper, and go nuts adjusting each one independently of its neighbors, to create some truly weird heads. Or, back up to earlier levels and control the prongs and rails together, for easier, more intuitive, and more predictable control.



Some heads you can find & adapt from Style Sheets, created with half-bezel prongs & various levels of control.

Step-by-Step
Head Builder



1 Input a Gem. Select a gem onscreen and press F6 > Head Builder. Or, enter this builder through the Settings Menu & input gem into Gem In-Box in builder. Selecting a head and pressing F6 also starts it up.



2 Select a Mode. Select a Mode (or, a number of prongs) BEFORE selecting a style, as styles vary for each mode. Different gem shapes offer different modes (prong configurations).



3 Adjust handles in correct Levels for design needs. Toggle between Levels to get the control you need, and click the "P" (prong) or "R" (rail) you'd like to adjust before sliders / handles will appear for them. Click and drag handles or slider controls to make adjustments as you'd like. Press Enter to complete head. F6 allows you to edit a completed head.

Basic Setting Tools ...

Saving & Loading Styles

Save the styles for most setting & cutter tools to a style sheet (.mss file) and load saved styles to new gems using these two tools.

About Saving and Loading Styles

Much like Match Attributes, any gem with a setting or cutter applied to it (excluding Emerald Profile / Cluster, Advanced Cluster, and Heads Library) retains a "memory" of the builder values used to create the related items. The contents of this "memory" - or, the builder values used to create the item - is known as a "Style" in the program.



Find Style Sheets in the builder menus where available or Gems menu > Save / Load Styles.

"Match Attributes" transfers these styles from one gem to another, while "Save & Load Styles" creates a file (.mss) on your computer containing this information, which you can access and apply to another gem ("Load") in the future. Note: You should ONLY use Match Attributes and Save / Load Styles to match styles to gems of the same SHAPE. Gems of a different shape may not be able to accept the styles; just the way you would never order a head style designed for a marquise for a round or square stone. Some shapes will be able to translate styles well; others will not.

Load a Style

The easiest introduction to styles is to open a builder in which they are available and select the "Styles" option in the Builder Menu or Command line. Select a style from the menu of Gemvision-created styles for that builder by clicking it. For each style you click, you will see it previewed on the gem (or curve) that you are using in the builder. Apply the style and close the style sheet by clicking the green "Go" arrow, placing the style on the gem. This also sets the Builder Menu values to those established for the selected style, but leaves you the handles and builder menu controls so you can continue editing the style.

To Load a style when you're not in a builder, go to the Style Load command in the Gems menu and navigate to the location where you saved the style. (My Documents > Matrix > Styles > Builder you created it in > Mode). Select and Load it. Remember that handles will NOT appear. If you will need to edit the style further, you should instead complete this process within the builder's Style Sheet. Open this by clicking on the "Styles" option in the builder.

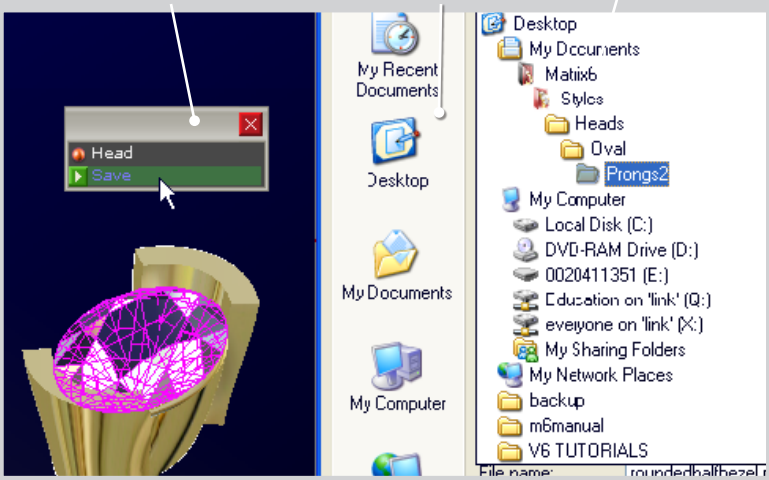
Steps for Saving and Loading Styles

1- Select a gem or gem arrangement with a History-enabled tool applied to it and click on "Save Styles" in the Gems menu or F6 > "Gem Style Save".

2- Select the desired style objects to save from the list box by clicking beside them, and click "Save Styles" in the list box.

3- In the window that appears, navigate to a location on your computer (probably My Documents > Matrix > Styles > relevant builder) in which to save this style sheet.

4- To load this or another style (.mss file), select a gem and click Load Styles (from either F6 or the Gems menu). Navigate to the location of the style file and Open it.



Note: Emerald Cluster & Emerald Cluster Profile, Channel Border, Advanced Cluster Builder, Prong/ Bead on surface, and Heads Library are not offered with Save and Load Styles.

Save a Style

Along the top of each Style sheet menu is a list of items (1 - 8) that you can assign as your top 8 favorite styles. Assign a style by selecting the "Style Save" option in the Style Sheet (or Gems menu > Save Style). Name it, for example "1", and it will appear when you click the "1" style in Style Sheets. Same goes for 2 - 8. (Note: The file extension is .mss, and this must be present with the file, so its full name is "1.mss", to work correctly.) Or you may save it with any name you choose, so you can better remember what the style is. Now, you can only access it using "Load Style" (in Builder or Gems Menu) and navigating to the location on your computer where you saved it (you can only click the number 1 - 8 if you saved it "1.mss" to "8.mss"). You can Load any named or numbered file when using Load Style in either the Builder Style sheet or in the Gems menu.

Basic Setting Tools ...

Using Heads Library

Load a head from the available Stuller Heads in this library, and it will scale to the size, position, and rotation of the selected gem.

Using Heads Library

Select a gem in the Stuller Head shapes offered in this library, and input it into the Gem input window in the builder. Or, select the gem, press F6, and select this option from the menu that appears.



The settings particular to the gem shape you input will appear in the browser unless you use "Show All".

The Heads Library Browser will open. To see all the heads in this library, and not just the ones related to this gem shape, select "Show All" in the builder menu interface.

Mouse over a head to preview it onscreen, at the size and position of the currently selected gem. Click a head to select it and close the library browser.

You will likely want the "Scale to Gem" option turned on, so the head will change in relation to the size of the gem selected. If you don't want it to scale, turn this off and the head will appear at the correct size for a 1 mm stone. If the selected gem does not have a suitable head in this library, you will see this message when you input it into the builder. To view and place the library contents anyway, select "Show All" and the library will still be available to you.



Use Scale to Gem to scale head to input gem. Otherwise, Head comes in at 1 CT size.

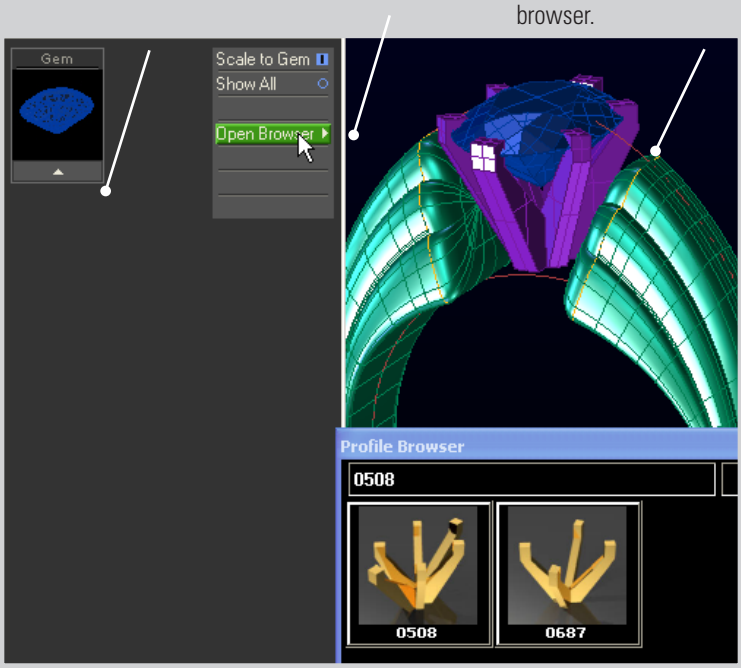
Steps for Using Heads Library

1- Select a single gem to add a head to and press F6 > Heads Library or click on Gems Menu > Heads Library.

2- Input gem into Gem preview window (if using Builder interface) and library browser will open.

3- To see other options besides just those for your selected gem shape, or if the builder tells you there are no heads available for the gem shape you've selected, click the "Show All" option.

4- To scale the head to your selected gem, choose "Scale to Gem" option in the builder. (Otherwise, it will be created in a 1 CT size.) In the browser, mouse over a head to see it on your gem. Click on a head to select it from the browser.



Note: Heads Library is not available with History, Match Attributes, or Save Styles.

Basic Setting Tools ...

Emerald Profile & Cluster Tools

Set an emerald or princess-cut stone in a metal piece, complete with a gem cluster if you need it, using one of these two tools.

Using Emerald Profile



Input a gem with square corners for use in either of these builders.

The Setting Menu tool Emerald Profile places an emerald-shaped metal piece around an emerald or princess-cut stone, with adjustable size, placement, depth, corners, and angle. To use this builder, input a stone (emerald, princess-cut, or another cut with straight sides and corners works best - no curvy stones please!). The default setting will appear. Adjust the handles to create the setting, and press Enter to end the command.

Use the handles, Command line options, and/or click the interface control of your choice to select from among the following dimensions to control: The overall Height and Width of the setting, the size of the Corners, the Profile Height, the Profile Size (measured outward from center of profile), the Vertical Offset (position) of the profile, the Global Offset of the profile (if profile is angled, global offset will move it along that angle; Vertical Offset will move it up and down only), and profile Angle.

Click the "Profile" handle or the Edit Profile window to select a new profile from the browser.

Using Emerald Cluster

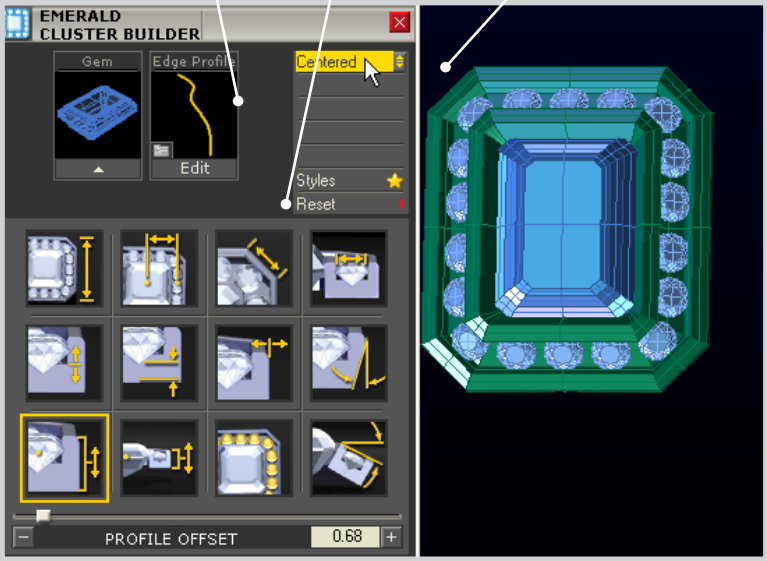
This tool adds stones in a channel layout to a similar setting as that created with the above tool, and the following handles / interface controls are added to the list above: Profile Nudge (distance profiles overlap gems), Profile Depth (below gems), Profile Offset (same as Global Offset above), Stone Size, Profile Bottom Taper, and the Builder / Command Line options "Centered" or "Split", which refer to the gem layout - it may be "Centered" at the top of the gem or "Split", with one gem on either side of the 12 o'clock position on the gem. As above, press Enter to complete this tool.

Emerald Profile & Emerald Cluster

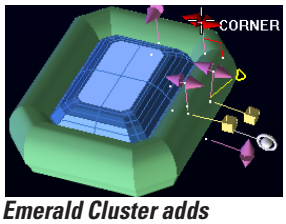
Use handles, the Builder Menu Interface, or the Command Line Options to set the Height and Width of the profile around the stone; Profile Height and Size to scale the profile that makes up the setting; Vertical and Global Offset to position the profile (Global Offset moves it along the angle if an angle is set); and Angle to angle the setting.

Additional handles offered in Emerald Cluster control the Stone Size, Nudge (overlap of profile on stones), Profile Depth (beneath gems), and Profile Bottom Taper.

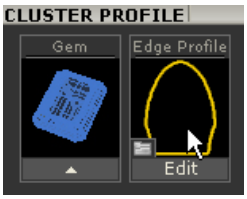
When using Emerald Cluster, choose between the options "Centered" or "Split" to assign how the cluster gems are laid out in relation to the center stone - "Centered" at the 12 o'clock position above the gem or "Split" on either side of this location.



Note: History and Match Attributes are not available with these tools. Save a Style and load that style onto a new gem if you wish to apply the setting to a new stone.



Emerald Cluster adds gems, while Emerald Profile just adds metal.



Emerald Profile allows you to place a Profile Placer profile.



Emerald Cluster offers bezel profile shapes, due to the gems.

Chapter 3

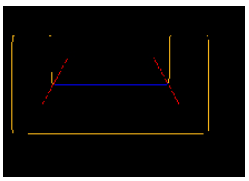
PRIMARY

Curve Tools for Basic Design

Learn to Create Closed Curves, Open Curves, and Curves on Surfaces for Basic Designs.

Why Start with Curves?

An understanding of curves is essential to 3D modeling because curves form the foundation of all surfaces and solid objects in Matrix. You'll recall from your high school geometry class that, by themselves, curves have no 3D mass: they are 1-dimensional lines that are only the thickness of a single point object. But in Matrix, when curves are used together with tools found in the Surface and Solid menus, it quickly becomes apparent that curves form the "skeleton" of almost all 3D models.



Split a closed curve with two cutting curves to change it.

Types of Curves

There are two different kinds of curves: open and closed. In most modeling you'll be doing, you will need to draw closed curves to ensure that the surfaces and solids you create from the curves are also closed, "watertight" models. You can think of a 3D model as a ship: it shouldn't have any "holes" or leaks in it where water could seep in and sink it! Closed curves will result in closed, watertight models. As for open curves... well... they can "sink" your modeling efforts pretty quickly!!

Open vs. Closed Curves

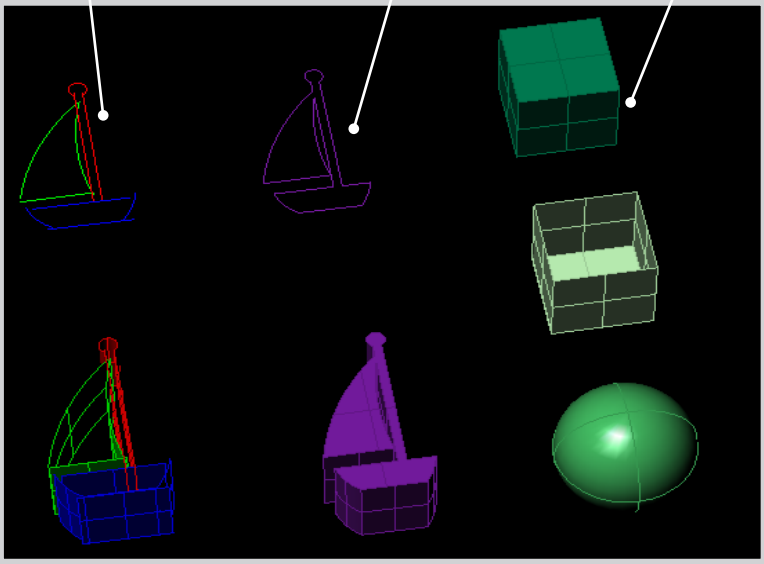
Some curve tools create closed curves (Circle, Rectangle, Ellipse, and Polygon). Other curve tools create open curves that you can "close" if you wish (Polyline, Interp Curve, Curve). Still others create only open curves (Line, Arc, Arc Direction). Usually, you'll use these shapes together to create closed and open curves. Then, with tools from the Top 11 Buttons and other basic curve tools (Fillet, Chamfer, and Offset), you'll be able to create new, closed curve shapes. The O-Snaps and Grid Snaps Menus contain tools that will help you create closed curves at the shape, location, and size you want. Later in this manual, you'll study other tools from the Curve menu that play vital roles in more advanced 3D modeling.

Relationship between Curves, Surfaces, & Solids

Why are closed curves so important? Open, unjoined curve segments create open surfaces - not watertight solids - when they are extruded. These are not successful models for growing machines and mills (curves & surfaces, below).

To create a solid object, use O-Snaps and the Top 11 Buttons to make sure the final curve is closed (top). Then, extrude the curve to see the watertight solid that results (bottom). This object is known as a solid or "closed" polysurface.

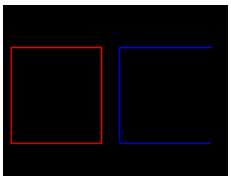
A polysurface is an object made up of two or more surfaces joined at their edges. It may either be solid and closed (top) or open (middle). A solid may also be a single surface, as in the case of a sphere (bottom).



Avoiding Problem Curves

Beware of creating curves that "loop" or intersect themselves. These will create invalid surfaces when they are used in modeling. Also, make sure you use O-Snaps to achieve closed curves. In order to be closed, each segment in a polycurve - or, the Start and End point of a Nurbs curve - must have "Position Continuity" - which means they must occupy the same point in space. The End O-Snap will help you ensure that the end of one curve snaps to the end of another curve, so they will have Position Continuity and can be joined.

Every curve has a "Start" and "End" point. On an open curve, these points are at the locations where you started the curve and ended it. On a closed curve, the start and end points exist at the same exact location (i.e., they have Position Continuity). This single location is known as the "Seam Point" of the curve.

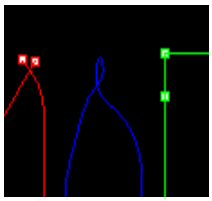


Closed (L) and Open (R) Curves

In this chapter, you'll learn how to fix problematic curves. Use Object Information to check a selected curve - it will inform you whether the curve is "Closed" or "Open". If it is open, check on it with "Mark Start Point" and "Mark End Point". There will be two points created with each of these commands: but they will be in the same place on a closed curve and in different places on an open curve. Use the Trim and Split commands in the Top 11 Buttons to fix a curve whose ends overlap in space. The Extend and Match commands found in the Curve menu can fix two ends that do not quite touch.

Further Information about Curves

Both Open and Closed curves have a "Direction". The direction of a curve points from its startpoint to its endpoint. In more advanced sections of this manual, you'll learn how to change the direction of a curve using the Utility menu function "Direction". You'll also learn how to change the location of a seam point in a closed curve using the Curve menu command "Adjust Closed Curve Seam Point". Both tools are used in more advanced modeling techniques.



Problem Curves either loop, don't close, or have start and end points that overlap.

Creating Curves on Surfaces

Finally, in this chapter, many gem designs and other tools in Matrix require curves on a surface in order to run them. We'll look at several ways to get curves on a surface, and you can use the ones that work best for you in the coming chapters! Once you've got curves on a surface, you can Offset them either right on the surface or "Normal To" the surface (which just means Perpendicular to the surface) or, above or below the existing curve.

Skills & Commands in this Chapter

Closed Curve Tools:

Circle, Ellipse, Rectangle, Polygon



Open Curve Tools:

Line, Arc, Arc Direction



Open or Closed Curve Tools:

Polyline, Interp Curve, Curve



Modifying Curves:

Offset, Offset on Surface, Offset Normal to Surface, Blend, Blend Curve Handles, Fillet, Fillet Corners, Chamfer, Curve Boolean



Fixing Problem Curves:

Rebuild, Fit, Mark Curve Start & End, Extend, Match



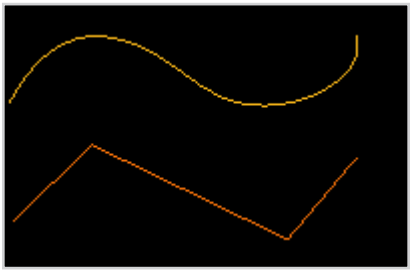
Curves on Surfaces:

Extract Isocurve, GV Extract Isocurve, Pullback, Project, Center Line Tool, Polyline & Interp Curve on Surface, Sketch, Sketch on Surface & Mesh, Curve to Lines, Helix, Spiral

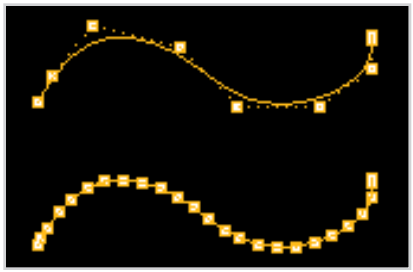


Common Command Line Options

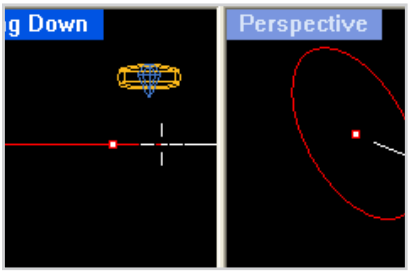
These options are common to several of the basic curve tools in this chapter.



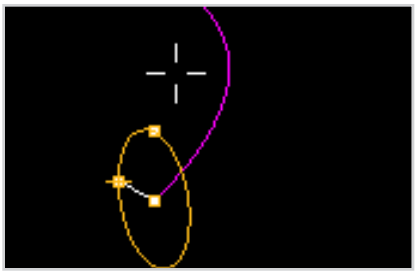
"Deformable" / "Degree" The "Deformable" option allows you to assign a "degree" (for open & closed curves) and "point count" (for closed curves only). Always keep the degree at "3" (above, in illustration), the default in Matrix, or 1 (below - for polyline curves and straight lines).



The "Point Count" Option Raise the "point count" and the curve will have more control points (below, in illustration above). Use "Control Points On" to see the points and manipulate them. Fewer points are easier to control, so use as few points as necessary to keep the shape.



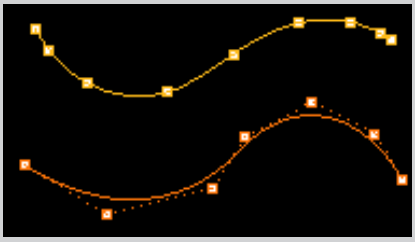
The "Vertical" Option This option, though rarely necessary, is available with several curve tools. It draws a curve that comes "toward" you (is vertical) in the active viewport. As you draw the curve, watch the other viewport(s), or switch to them to finish drawing the curve as desired.



The "AroundCurve" Option Select this option before you start to draw with one of the closed curves tools. Click on a curve around which to draw the desired shape. Indicate a point on the curve to start the shape, and the shape will be drawn perpendicular to the curve.

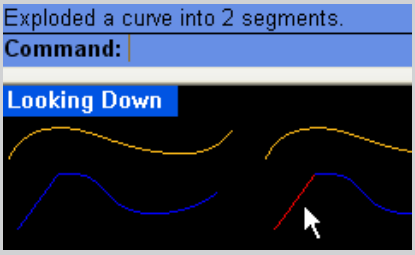
Essential Terms

All About Curves



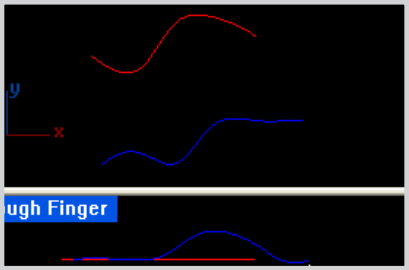
Control Points vs. Edit Points

Every curve has both kinds of points. When using Curve and Interp Curve tools, Control Points (Curve - below) and Edit Points (Interp - above) are placed with each click of the mouse. To see these points and edit them, changing the curve, select each command from the Top 11 Buttons.



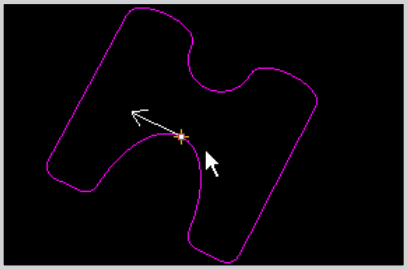
Polycurves vs. Nurbs Curves

A Nurbs curve is a single curve with no sharp edges (above). It cannot be exploded into separate curves. Polycurves can be exploded into many component curves (below). Both Polycurves and Nurbs curves may be open or closed. If a closed polycurve is exploded, it will be turned into several open curves (right).



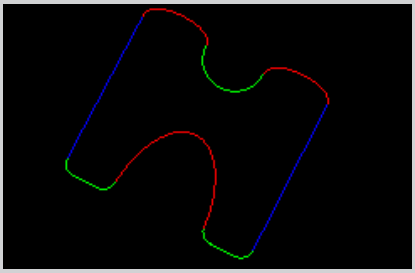
Planar / NonPlanar Curve

A "planar" curve is flat along a plane in space - or, when viewed in another viewport, it appears as a straight line (red curve, above). A "nonplanar" curve moves through different planes in space - it cannot appear as a straight line when seen in a different viewport (blue curves, above).



Seam Point & Curve Direction

Every closed curve has a "seam point" that marks where the curve was drawn from (start) and where it was drawn to (end) - whether the user drew it or the program did. The "direction" of a curve points from its start point to its end point. "Adjust Closed Curve Seam Point" adjusts this.



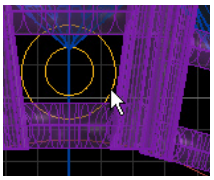
Position Continuity This term means that two curves touch in space and can be Joined to create a polycurve. Use the End O-Snap to achieve this. When a polycurve is exploded, its component curves still have position continuity, even though they are not joined. Position continuity is essential for creating closed curves.

Closed Curve Tools ...

The Circle Command

Draw a simple closed curve - the Circle - using this Curve Menu command and its related options.

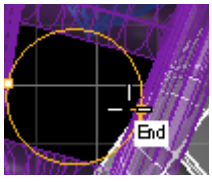
The Circle command is a simple tools used to create circle curves onscreen for use in your designs. You may start the circle at its center, or use the "2 Point" option to draw it starting from one end of its diameter, or "3 Point" to indicate three points the circle curve should pass through.



Draw two circles and Extrude together to create a design element.

Circles are closed curves, so it is easy to Extrude them all alone using the Extrude Planar Curves command to create a single cylinder. Or, you can place one circle inside another and extrude them together to create a tube. They are also useful in Split, Trim, and Join operations with other closed and open curves to create shapes that will be used in Extrude or Sweep operations for design elements.

Each type of circle shares three Command Line Options with several other basic tools in the Curve menu. These are explained in the introduction to this chapter: Deformable, Vertical, and Around Curve.



Draw a circle in relation to other design elements (Circle from 2 or 3 Points).

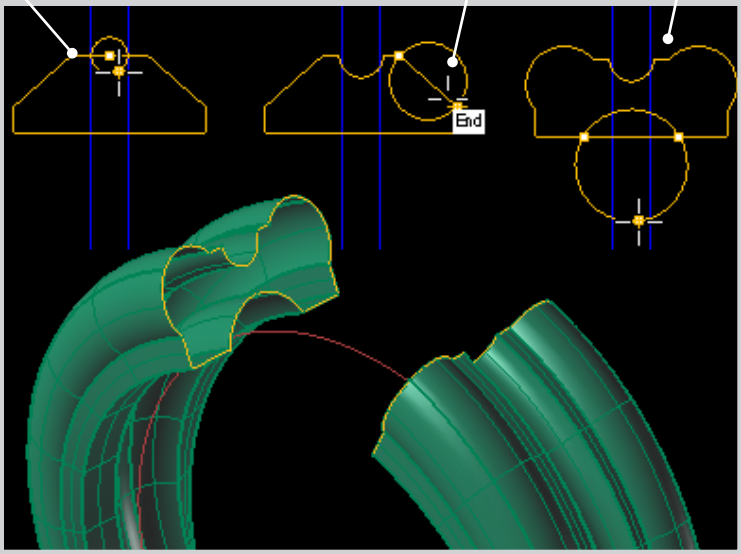
So, in this section, we'll concentrate on how to draw a circle, how to draw a circle from 2 points and 3 points (both options in the Circle command) and how to use the "Fit Points", "Tangent" and "Radius / Diameter" options when drawing circles.

When to Use Each Circle Command Option:

When you wish to start a circle from its center and work outward to where you'd like the radius of the circle to end - as when surrounding a gem or when starting the design of a shape that will incorporate a circle, select the "Circle" command.

When you would like to start a circle from one end of its diameter - and end the circle at the other end of its diameter, if, for example, the circle needs to touch two objects, use the "2 Point" option together with O-Snaps to help you.

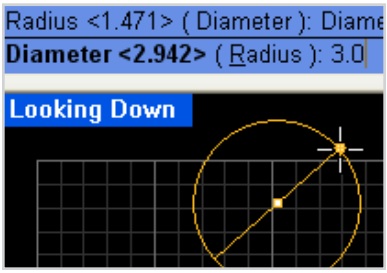
When you would like to size the circle based on three points on the circle, or, if you need the circle to touch three points in an existing model or curve arrangement, such as a triangle, use the "3 Point" option.



To create this profile, select a closed shape and select "Edit" in the Profile Placer Profile Preview Window. Use the Circle tool three times - each with a different option - and Mirror, Trim, and Join the results each time.

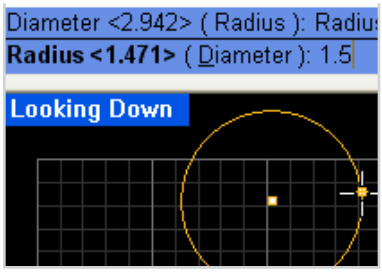
Command Line Options

"Radius", "Diameter", "Fit Points", "Tangent", "2Points" and "3Points"



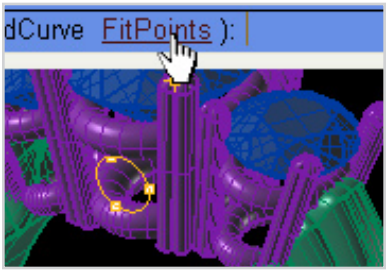
Use the "Diameter" Option

Select this option to type in a value for the diameter. Press Enter. The circle will be locked into that diameter. Note: When using either the "Diameter" or the "Radius" option, press "Enter" to accept the last value used (in parentheses).



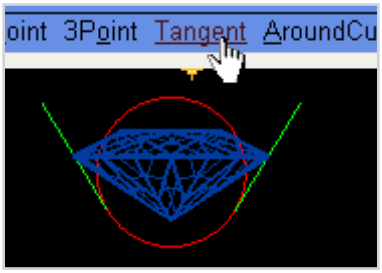
Use the "Radius" Option

This option is the default setting for the "Circle" command. Click it when "Diameter" was last used. Type a value for the radius and press Enter. The diameter of the circle will be twice the value indicated here.



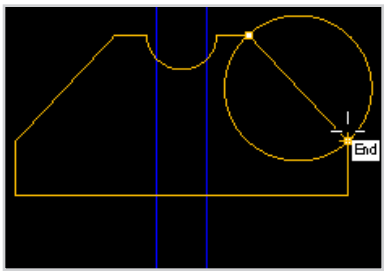
Use the "FitPoints" Option

Click this option to create a circle from three or more points onscreen. With three points, the points will touch the circle. With more than three, the program averages the distance between them to create the circle.



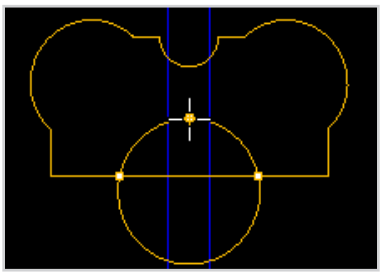
Use the "Tangent" Option

Create a circle that is tangent to one, two, or three curves. Click on a curve to start. Select a point on a new curve or the same curve. These can change until the third is placed. Or, use "From First Point" to fix that point. "Point" selects a point, not a curve.



Use the "2 Point" Option

This option lets you click once to place one end of the diameter, and click again to place the other, in order to draw the circle. Use O-Snaps to help you place each end where you need it.

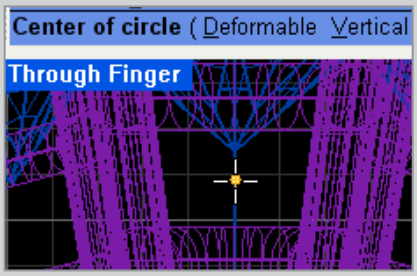


Use the "3 Point" Option

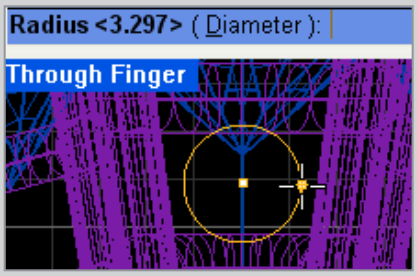
This option lets you click twice to indicate two points on the circle. Change the size of the circle by moving the mouse before placing the third point. Click to indicate the final point and end the command.

Step-by-Step

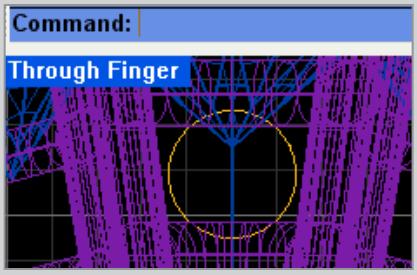
Using Circle



1 Click to place the center Click on the Circle Command. Without selecting any options, click once on the grid to place the center of the circle. Or, type in coordinates for the center of the circle. Press "F4" to start the circle at 0,0,0.



2 Indicate a radius by left-clicking mouse The circle will "grow" out from the center as you move your mouse. When it is at the desired size, left-click to indicate a size for the radius of the circle, ending the command.



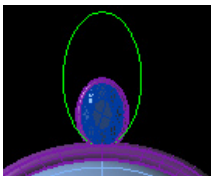
3 Or, type in a value Before ending the command, you can select the "Radius" or "Diameter" option from the command line, type in a value, and press Enter. Or, you may type coordinates at which to end the radius of the circle.

Closed Curve Tools ...

The Ellipse Command

Use the Ellipse command to easily draw this versatile shape.

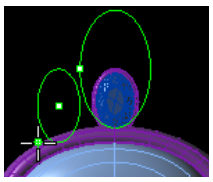
The ellipse is an elongated circle with a length and width that are different. Create it with the default options by placing its center; then, assign the distance from the center to one end (length or width) and then the other.



An ellipse is an oval - you define L and W.

The Command line options "Corner", "Diameter", and "From Foci" allow you to draw different kinds of Ellipses for use with other design elements onscreen. These will be defined in this section. The Command line options "Deformable", "Vertical", and "Around Curve" are common to several curve commands, and they are covered in the introductory section of this chapter.

The "Diameter" option allows you to draw the ellipse from the start to the end of one direction (L or W) and then "grow" it out from that dimension to create the other dimension. The "Corner" option actually starts the ellipse from a point that does not lie on the curve itself. Instead, it assigns the location of the corner Control Point of the ellipse to define its size. Finally, the "From Foci" option allows you to define a line at the center of the shape, with points on either end, as the "Foci". The Ellipse cannot get smaller than this line, and is always centered on these two points.



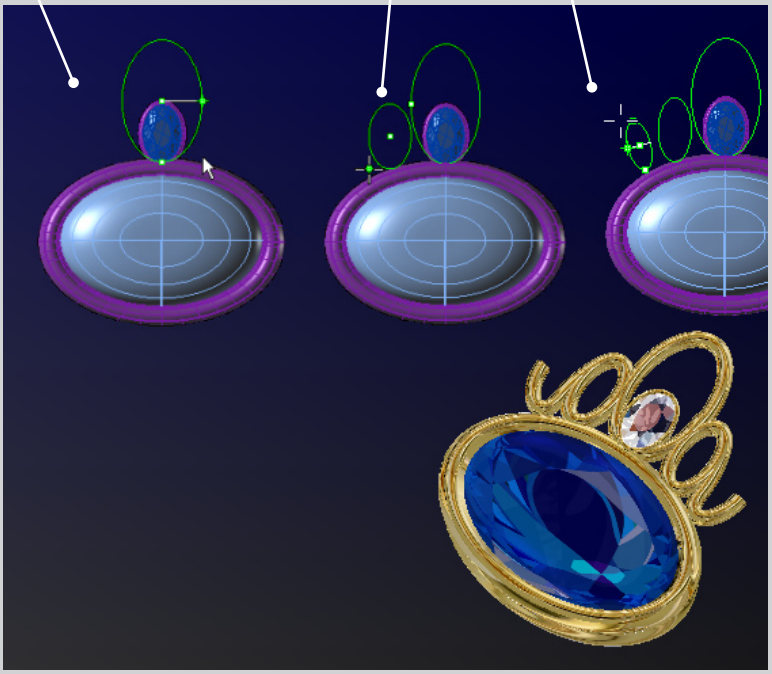
Use options to position ellipse in relation to other design elements.

The Ellipse Command Line Options

Start the default ellipse at its center and extend it out in one direction - Length or Width. Where you click the mouse is one half of this dimension. Then, assign the ellipse's size in the opposite direction in the same way.

"Corner" creates the ellipse by assigning the locations of the two opposite corner control points that define any ellipse. The "From Foci" option places two foci for the ellipse: one on either end of a line at the center of the shape.

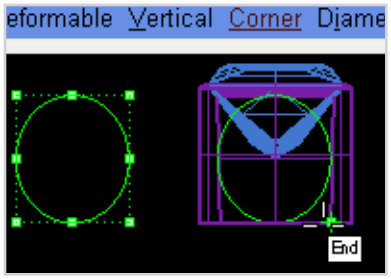
Finally, the "Diameter" option allows you to define the start and end of the diameter in one direction (L or W) and then the dimension of the ellipse in the other direction.



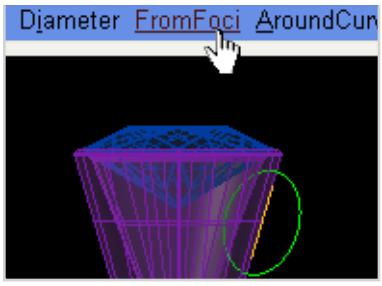
L - R = Default Ellipse; Corner Option; Diameter option. To complete the design, Split ellipses with the Point option and Blend curves between them. Pipe curves & Mirror.

Command Line Options

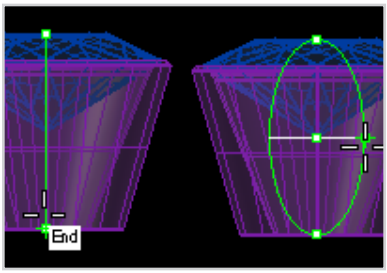
The options for use with the Ellipse command: "Corner", "From Foci", "Diameter"



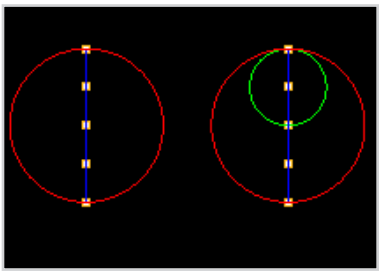
The "Corner" Option At left, you see an Ellipse with Control Points On. The Corner option allows you to place the control points in two opposite corners of the ellipse. Each mouse-click places one of the two corners. This is a good way to snap the ellipse to another shape (right).



The "From Foci" Option This option is an easy way to draw the ellipse on a slant. Start by defining an angle for the ellipse (both ends of yellow line in illustration). The final click defines the size of the ellipse, growing outward from the initial angle.

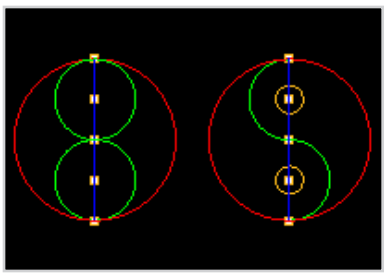


The "Diameter" Option. The Diameter option allows you to set first one end, then the other end, of the diameter - in one direction (L or W) of the ellipse. The third mouse-click defines the opposite direction to the one already set.



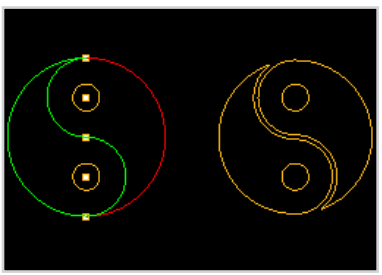
Tutorial: Fun with Circles.

Draw a circle. Then, draw a Polyline curve between the Quad O-Snaps at the top and bottom of the circle. Click Divide Curve and select "4" as the number of divisions for this curve. Create a circle around point 2, touching points 1 and 3.



Fun with Circles, cont'd...

Mirror the new circle around the middle point, holding down Shift. Now, Trim away all but the Yin/Yang shape. Select all the curves and Duplicate them with the "InPlace" option. Create the inner circles.

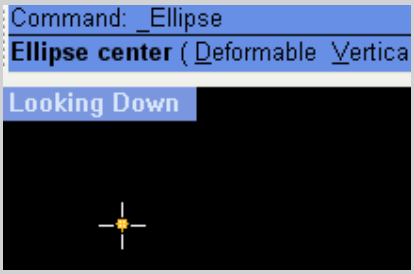


Fun with Circles, last step

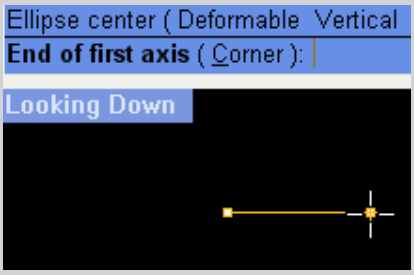
Split outer curves with the inner ones. Then, Join each half and delete what's unnecessary. To create a mill-able model, Offset both curves by the desired amount (0.25 mm to the inside used here) and extrude them.

Step-by-Step

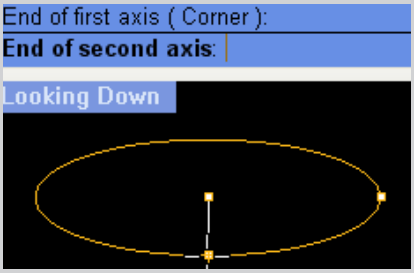
Using Ellipse



1 Click to place the center of the ellipse Without selecting any other options, the first mouse-click places the center of the ellipse. Or, you may type coordinates into the Command line to assign the location of the center.



2 Click to define half the length of one side The next click assigns the radius in one direction of the ellipse; so, whichever side you choose, the L or W, it will be double the distance from the center point to this click.



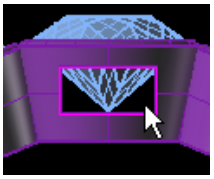
3 Click a final time to define the opposite side Move the mouse to enlarge the ellipse in the opposite direction (L or W) from the one already set. When the size is correct, click once to end the command.

Closed Curve Tools ...

The Rectangle Command

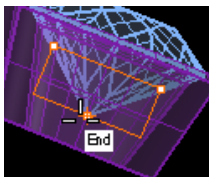
Easily draw a closed rectangle or square curve using this command.

Start up this command and place one corner (such as the upper left) and then the other corner (lower right) of a rectangular curve. The rectangle is a polyline curve, meaning it can be exploded into separate curves - four to be exact - each with position continuity, meaning they touch end to end. As when drawing a circle, the values for the dimensions of the rectangle - length and width - can be typed into the command line. Or, the user can specify coordinates at which to place each corner. To create a square, you must start by typing in the value of the width of the square, and then press enter to indicate the same value for the length.



Extrude a rectangle to use as a cutter.

Explore the command line options 3Point and Center to more easily draw rectangles in relationship to other objects onscreen. Or, use the Rounded option to change their shape. To learn about the Vertical option, consult the introduction to this chapter. As long as you do not Explode them, Rectangle curves are closed, so they can be extruded using Extrude Planar Curves to create a box. Rectangles and Squares are also useful with other curve shapes in Split, Trim, and Join operations to create design elements that will be used in Extrude or Sweep functions.



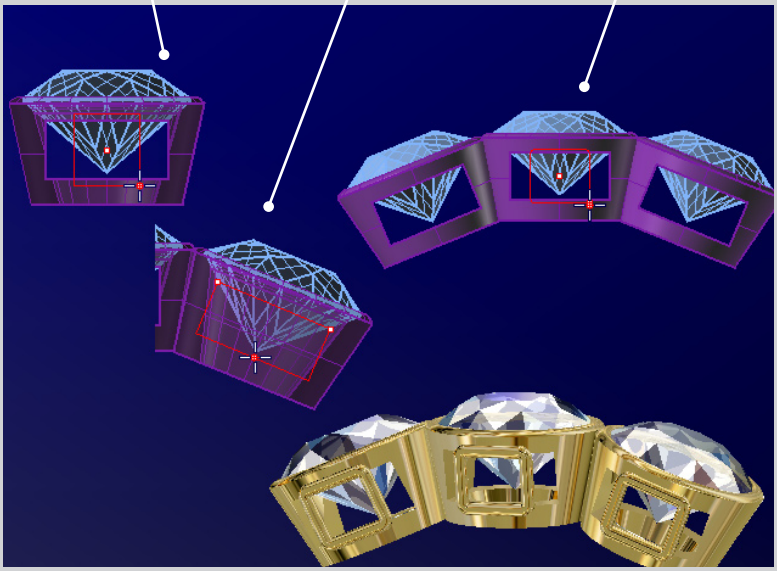
Use Rectangle Command line option 3 Point to draw rectangle in relation to other design elements.

Rectangle Tool and its Command Line Options:

Draw a rectangle starting at one corner and ending at the other: e.g. from the upper left to the lower right-hand corners of the shape. In order to draw a square, type the value for Width and press Enter to keep the same value for the length.

Use the "Center" option to start the rectangle or square at its center, making it possible to center it on another object if the "Center" O-Snap is turned on. The "3-Point" option lets you easily draw the shape on an angle.

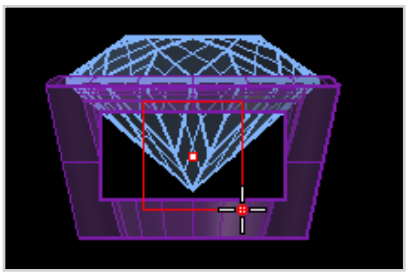
Use the "Rounded" Option together with any of the other three options to create rounded corners on the rectangle or square. The "Arc" or "Conic" options lets you choose from two different shapes for the rounded curve.



(L - R) Center option & Extrude Planar places first cut; 3Point Option places next cutter; Rounded & Center option places detail; Pipe detail and position on bezel to complete.

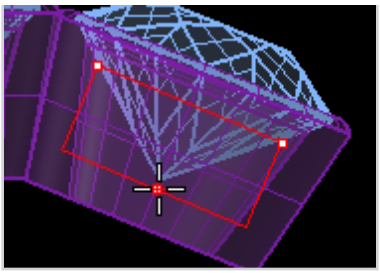
Command Line Options

The command line options are "Center", "3Point", and "Rounded"



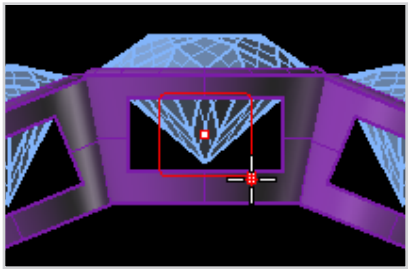
Use the "Center" Option

Click once to place the center of the rectangle. It will grow outward from this point. You may still type values to indicate the Width and the Length, and you may still create a Square by using a Length equal to the Width.



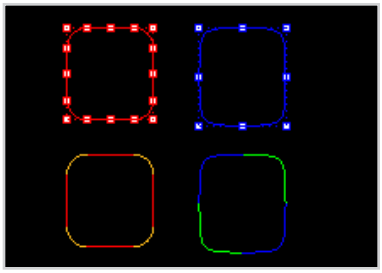
Use the "3Point" Option

This option is an easy way to draw a rectangle on a slant. Click once to place the start point of one side; the second click is the end point of the same side. From there, the rectangle is locked into this angle. The final click of the 3 assigns the length.



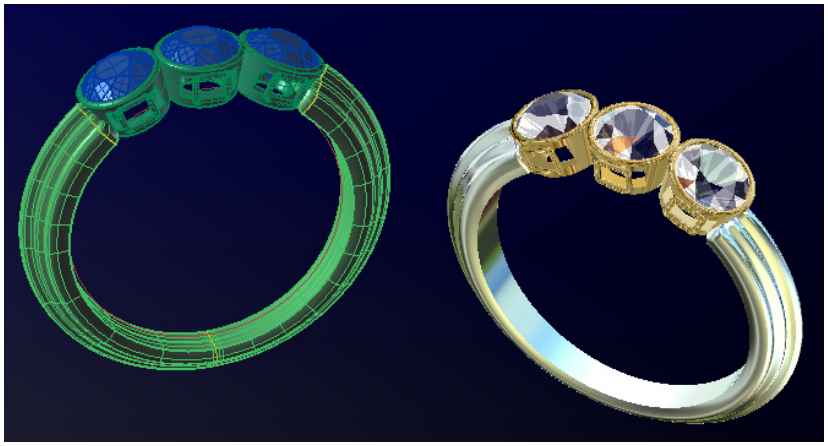
Use the "Rounded" Option

With any type of rectangle above, you may still select the "Rounded" option to round off the corners. After drawing the rectangle, move the mouse to assign a shape to the corners - more or less rounded. Then, click once to keep the shape and end the command.



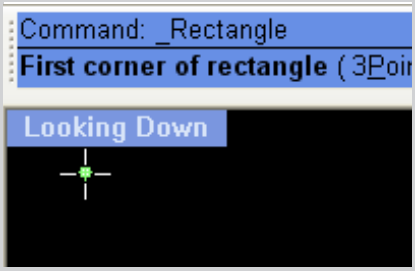
"Arc" vs. "Conic" Corners

These two suboptions within "Rounded" subtly alter the shape of the corners. Although they look different, the key difference is in how they are built: with "Arc" (left, above), the rectangle can be exploded into 8 segments. With "Conic", 4 (right). Also note the different Control Points produced.



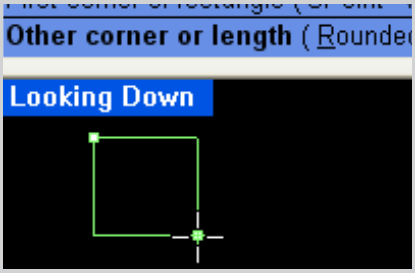
Step-by-Step

Using Rectangle



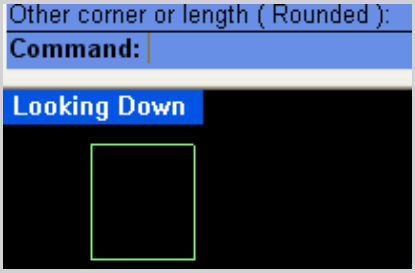
1 Click to place one corner of the rectangle

Place one corner of the rectangle first. Move the mouse to "grow" the rectangle in any direction, changing its size as needed before you place the other corner.



2 Click to place the corner or type value of width

If you choose to type a value for the width of the rectangle into the Command line, press Enter and go on to Step 3. Or, left-click to place the opposite corner of the shape.



3 Indicate a value for the length of the rectangle

Type a value for the length and press Enter. Or, to create a Square, press Enter to keep the same value as the width.

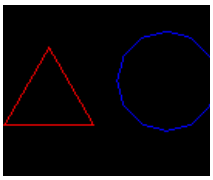


Closed Curve Tools ...

The Polygon Command

Draw a polygon or a star with any number of sides.

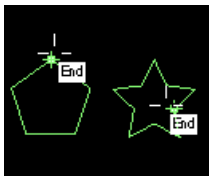
Use this command in its default mode to place the center of a polygon with the first mouse-click. Move the mouse to "grow" the polygon to the size needed, and click a final time to end the command. Like a Rectangle, a Polygon can be Exploded into its component curves, creating single, open curves which touch at each of the corners (vertices) of the shape. Use the Command line option "NumSides" to assign a number of sides to the polygon, with 3 as the minimum (a triangle).



Using Polygon tool, indicate 3 sides up to as many as you want!

In default mode, the second mouse-click controls the location of one vertice of the polygon. Alternately, you may use the "Circumscribed" option to control the midpoint of one side of the polygon. Or, instead of placing the center of the polygon first, select the "Edge" option to place one vertice. The second mouse-click places the next vertice along the same edge, making it easy to snap the polygon to another shape or draw it on an angle.

With the "Star" option selected, the value for "number of sides" equals the number of points on the star. When running Polygon in "Star" mode, a final mouse-click is added to the command. After placing the polygon, move the mouse to control the thickness of the arms of the star, which can bend inward or outward from the polygon that you placed. When you like the results, click to create the star and end the command.



Using the Star option, second click is outside of star and third click is inside of star.

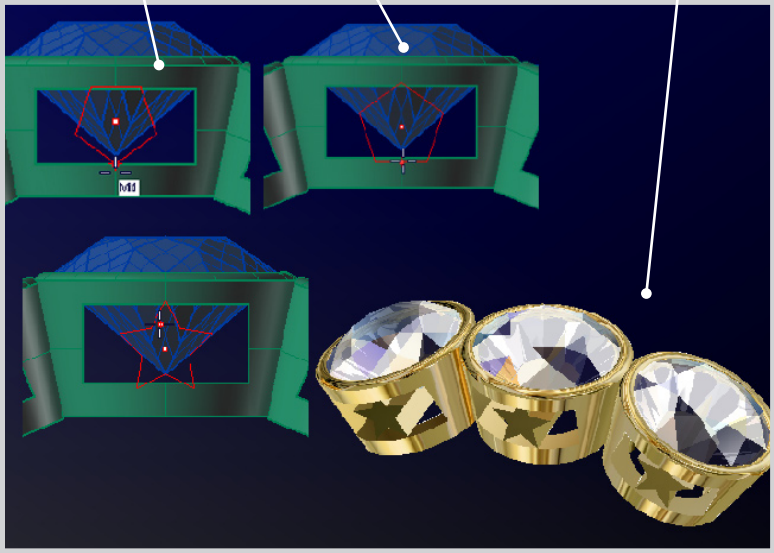
Refer to earlier in this chapter for information about the "Vertical" and "AroundCurve" options.

Polygon Tool and its Command Line Options:

Polygon, by default, places the center of the shape first, and then lets you size it. Type in a value to assign a distance, from center, of one vertice of the shape.

Use "Circumscribed" to control the mid-point of one side of the polygon rather than the vertice when sizing the shape. Or, use "Edge" to start the shape at one vertice. Size the shape by placing the next vertice on that edge.

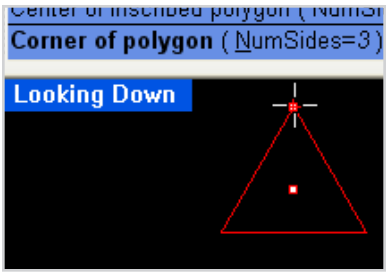
"Star" creates a star from the polygon, using the number of sides as the number of points on the star. End the polygon as usual; then move the mouse to assign a thickness to the "arms" of the star and click to end the command.



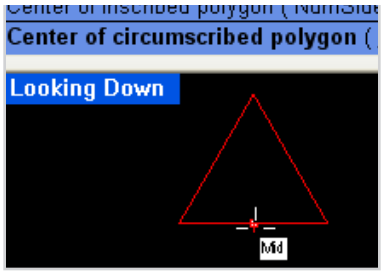
L - R = Default Polygon; "Circumscribed" and "Edge" options; "Star" option.

Command Line Options

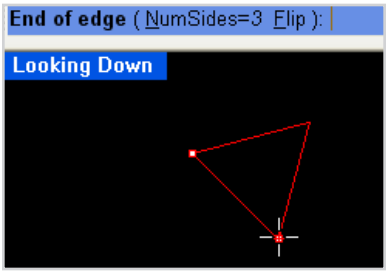
You MUST select any of these options BEFORE placing the first point.



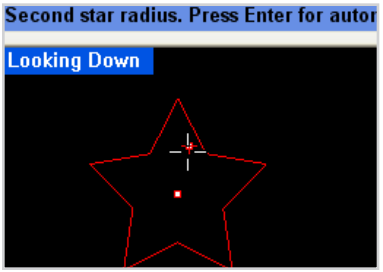
The"NumSides" Option Select this option, type in a value for the number of sides, and press Enter. Then, draw the shape as usual, placing the center and then the outer extents of the shape. Or, select one of the other options available with this tool before placing the first point.



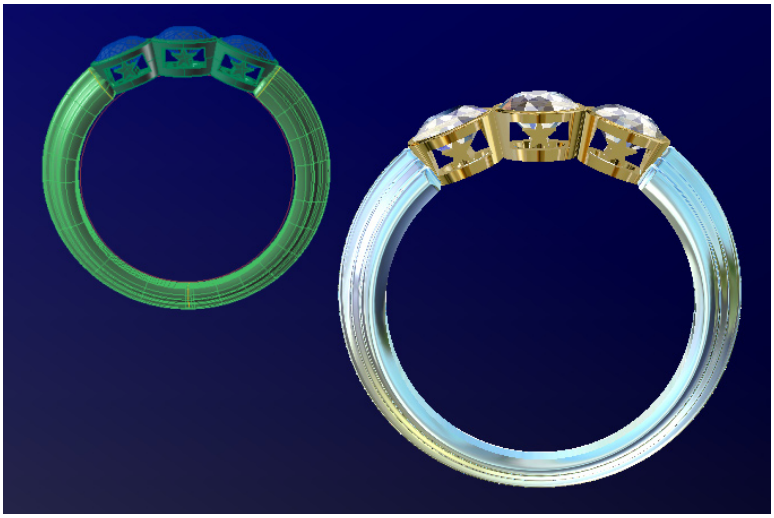
Using "Circumscribed" Select this option and, after placing the center of the polygon, you'll control the midpoint of one side of the shape instead of controlling one vertice, which is the default. This makes it easier to use O-Snaps and Ortho to achieve the angle you want.



The "Edge" Option Select this option first to change the way "Polygon" works. Now, the first mouse-click places one vertice of the polygon. Use "Flip" to change its direction. Before clicking to place the second vertice along the same edge, you can rotate and scale the shape around the first point you placed.

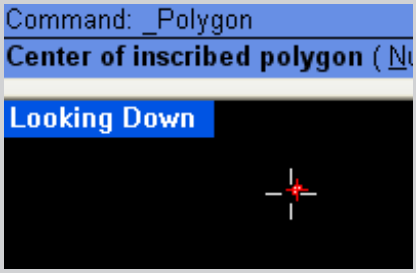


The "Star" Option With this option, "NumSides" assigns the number of "arms" of the star. Draw the polygon the same way as usual. Then, move the mouse to assign the thickness of the "arms" of the star, which "grow" in or out. Click to end the command.

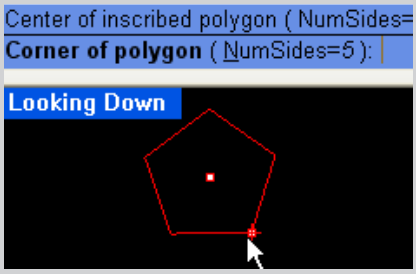


Step-by-Step

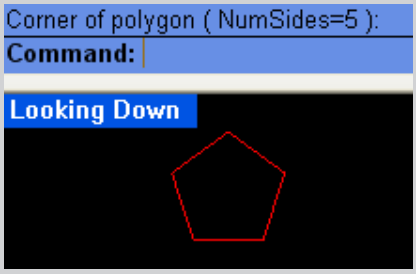
Using Polygon



1 Click to place the center of the polygon After starting up this command - and without running any of the options - the first mouse-click (or coordinate set you type) indicates the center of the polygon shape.



2 Scale the shape to the desired size Move the mouse to scale the shape to the desired size. At this step, you are controlling one of the vertices (corners) of the shape unless you use the "Edge" option explained at left.



3 Click to end the command With the polygon onscreen at the size you want it, click once to place the vertice and end the command.

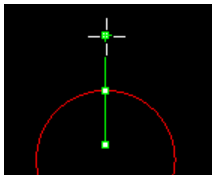


Open Curve Tools ...

The Line Command

Draw a single, open straight curve object - a line - with a start and end point.

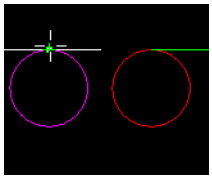
The Line command is the simplest command for creating a single, open curve. It can only draw in a straight line, and the user defines a start and end point for the line using a number of Command Line options available once the command has been started.



The BothSides option is one of the best features of the Line tool!

Of course, a single line can also be drawn with the Polyline tool explained later on in this section. Line's most useful Command Line option, perhaps, is the BothSides option, which allows you to place the center of the line first, and extend the length of the line equally to either side of the first point you placed.

Other Command Line options relate closely to other functions within the program, and you may find them more useful as you grow more advanced as a Matrix user. For instance, the concept of Surface Normals is rather advanced. For now, suffice it to say that the "Normal" option allows the Line to be drawn "Normal" to a Surface, or, perpendicular to it. Other options, such as Perpendicular and Tangent, work similar to the O-Snaps; however, unlike O-Snaps, you may start the Line perpendicular or Tangent to another curve using this command. Finally, the Extension option is just like using this tool, but with the Line option selected in the Command line. Line is also a useful command when working with angles, since it offers options to assign degrees to angle the line as well as to bisect an angle with the line.



"Tangent" and other Command line options help you draw a line in relation to other design elements.

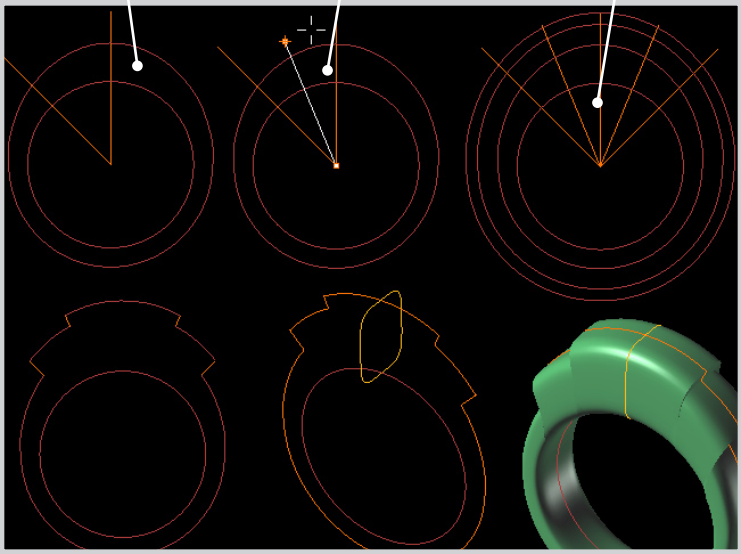
Uses for the Line Tool when Modeling in Matrix

The first (upright) Line was placed using the Line tool with no options selected.

Use the Angle option to create a line at 45 degrees to the original line. The "Base Line" during this option is the original line.

Create a bisector Line between the two lines using the Bisector option. The Starting Point of the line is F4. Click the ends of both existing lines to indicate the angle to be bisected.

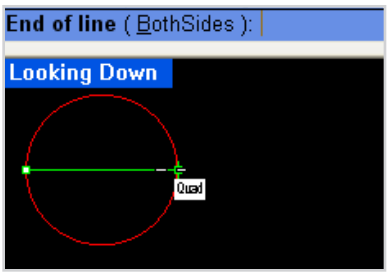
Mirror these curves and Offset the outside ring rail two times. If necessary, use the "Extension" option to extend an existing cutting line past the end of the curves. After Trim, Join, and Profile Placer, you've got a great set-up for Sweep 2 History!



After setting up lines according to instructions above, Offset curve 2 times, select all curves, and Trim till only outside and inside rail shapes remain. Add Profile(s) and Sweep 2.

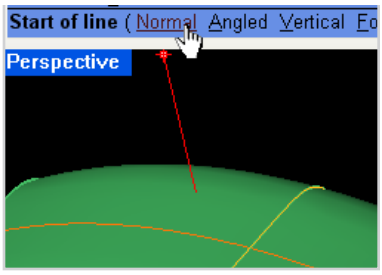
Command Line Options

Select the Command Line options available in Line to change the way the tool works.

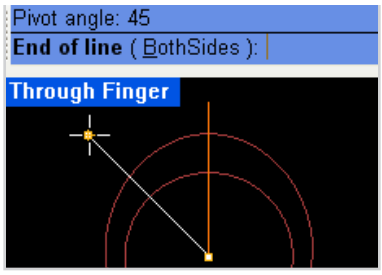


With no Options Selected Click Line. Left-click once to place the start point of the line. Left-click again to place the endpoint of the line. This will end the command.

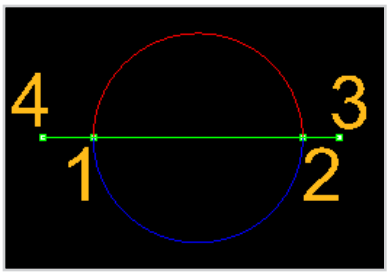
Note: The "Vertical" option is described in the Intro section to this chapter: "Basic Curve Tools".



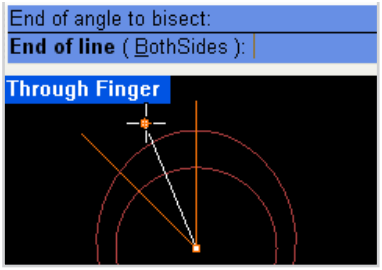
Using the "Normal" Option This option locks the angle of the line into a direction perpendicular to ("Normal to") a surface. Place the first point on any surface and the angle will be locked. With "IgnoreTrims: Yes", the curve may be drawn on an area of the surface already trimmed or Booleaned.



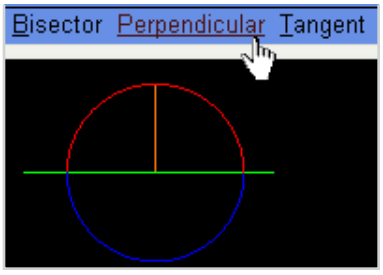
Using the "Angled" Option To draw a Line on a specific angle, select this option. You will be prompted for a "Startpoint" and "Endpoint " of a baseline for the angle. Then indicate, in degrees, at what angle you'd like to orient the line to the two points. The final mouse-click places the end of the Line.



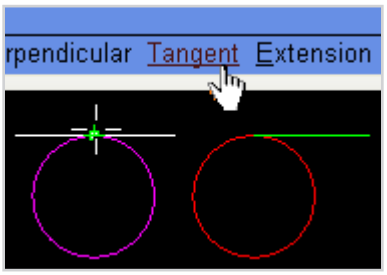
The "Four Point" Option With the first two clicks, you will assign the slant or angle of the line (1 and 2, above). You may now assign the start and endpoint of that line wherever you would like to along this angle with the final two mouse-clicks (3 and 4). In this way, the Split line can intersect the Quads of the circle, above.



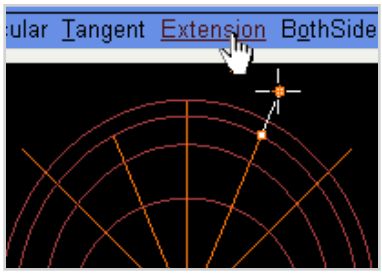
The "Bisector" Option To bisect a specified angle onscreen, place the first mouse-click at the start of the line. The next two clicks allow you to define the angle you wish to bisect. The line will be locked into an angle that bisects (is exactly half of) the original angle. Click once to end the line.



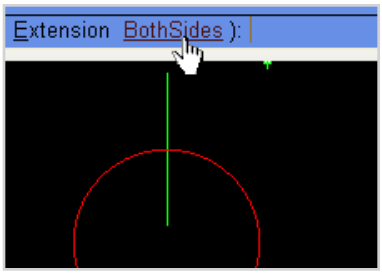
Using "Perpendicular" Use this option to draw a line perpendicular to - or from - a curve. After selecting the curve to draw a perpendicular line from, click again to select the point on the curve at which to start the line. With "2Curves", select both curves and the line will be drawn.



The "Tangent" Option Select this option to start the line so that it is tangent to - or from - another curve onscreen. After selecting the curve to draw a tangent line from, the first point of the line will snap to the possible tangent points on the curve.



The "Extension" Option This option will lock the line into the angle of an existing curve on the end you select, adding a straight line to the end of that curve (you may Join them later if you wish). The first mouse-click selects the curve to extend and the second places the end of the extended curve.



The "BothSides" Option With this option selected, the first mouse-click places the midpoint of a line. Moving the mouse extends the line straight out, evenly, to either side of this midpoint on any angle that you choose. Click once to place the end of the line.

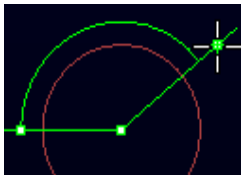


Open Curve Tools ...

Arc & Arc Direction

Draw an open curve - an arc - one of two ways using these commands.

Depending on which of these two tools you select, you will be able to draw an arc one of two different ways. A number of command line options available with either Arc command also change the way each command works.

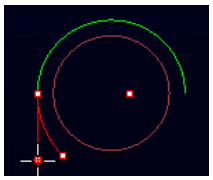


Arc places the center of the circle first & you assign an arc from it.

As you know, an arc is a segment of a circle. To assign the center of the theoretical circle first, select the "Arc" command. Click once to place this point which is, you will notice, located OFF of the arc - at its center, actually. The next two clicks will assign the shape of the arc. Their distance from the center point (the first mouse-click) and one another will determine the shape of the arc.

The other command, Arc Direction, allows you to place the first mouse-click as one end of the arc and the second mouse-click as the other end of the arc. The third mouse-click will assign the "bend" in the arc, so that you may make the arc larger or smaller depending on your need.

In the "Arc" command, you first assign the size of the circle of which the arc is a part; you then assign the length of the arc locked to that circle size. In this way, it is a good tool to use when you already know the size at which you want the arc. In "Arc Direction", you set the size of the theoretical circle last, so you have more control over the shape of the curve, but it may be more difficult to get the arc to follow the exact shape of a certain circle's circumference. Each tool is useful in different situations, so take note of which dimension you need to assign first before selecting one of these two commands.



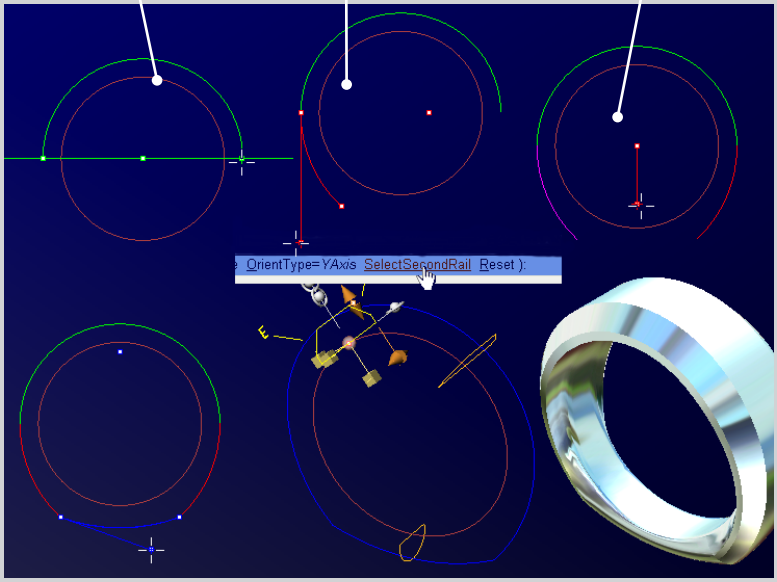
Arc Direction places two ends of arc first and you pull "bend" of arc.

Comparing Arc and Arc Direction Commands

In Arc Direction, begin by setting the center of a circle with the first mouse-click. The next two clicks assign the start and end of an arc made from that circle. Arc may only be in a semi-circular shape.

Arc Direction allows you to place two ends of the arc first; then pull the bend to however gentle or dramatic you need it. The "Circle" from which this arc comes may be of any size you assign with the final mouse-click.

Used together, they can create a stirrup-shaped outside ring rail shape that touches the outside Quad O-Snaps of the ring. Mirror the stirrup shape to create an even design, and Join them with one more Arc Direction.

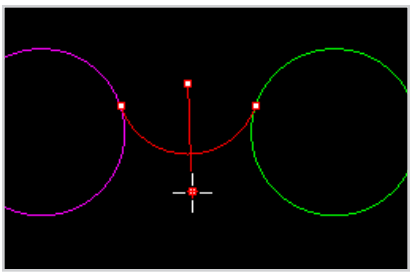


L - R: Start the Arc at F4, the center of the ring rail, and extend it from 1 Quad O-Snap to the other, roughly 2 mm away from the ring rail; Draw an Arc Direction in the shape of the Stirrup shank, and Mirror it. Join the two with one more Arc Direction. This is a great set-up for a Sweep 2: Use Select Second Rail and select the new (Joined) curve. Or, build this in the Profile Editor of the Outer Ring Rail tool to make it interactive.

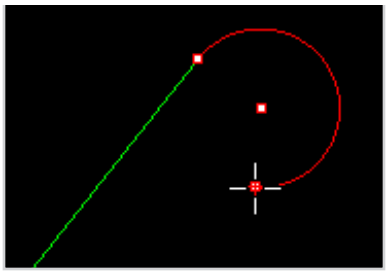
Tip: Use Arc Direction with Shift to cause the arc to extend tangent to the curve it started from. This is used in the example above to make the red "stirrup shape" curve tangent to the green half-circle.

Command Line Options

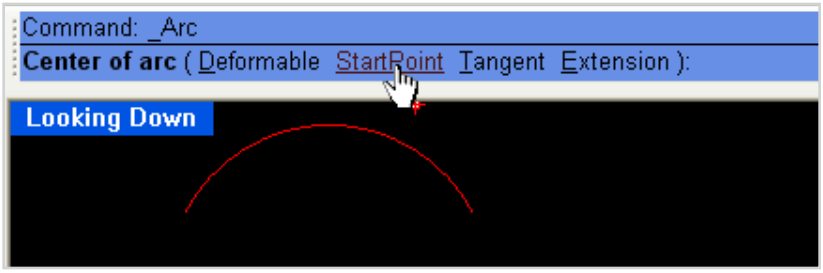
Arc options are Tangent, Extension, StartPoint, Direction, and ThroughPoint



The "Tangent" Option Draw an arc tangent to an existing curve. The circle for the arc will snap to tangent points on the curve. Use "From first point" to anchor it to the curve. Use "Point" to start the arc somewhere off an existing curve. Or use it to assign 2 to 3 points to size the circle for the arc.



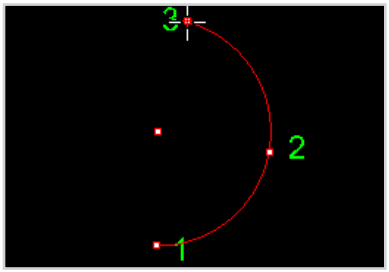
The "Extension" Option Create an arc as an extension of an existing curve. Start by selecting the curve near the end you wish to extend. Move the mouse to assign the length and curvature of the arc. You will see both the endpoint and the center of the new arc. Left-click to end the command.



The "StartPoint" Option and the "Arc Direction" Tool Select the "StartPoint" option when running the "Arc" command - or, just start up the "Arc Direction" command for the same functionality. Either selection allows you to assign points on the arc first. Click to place one end of the arc; then click to place the other end of the arc. You may then move the mouse to assign the curvature of the arc. Click a third and final time when you like the resulting shapes. Two more command line options work only with this option (Start Point) or this tool (Arc Direction).



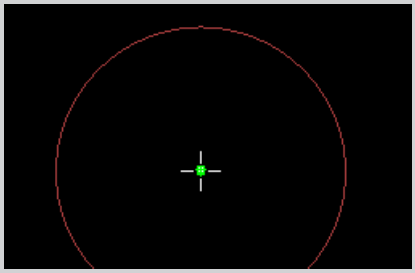
The "Direction" Option This option changes the way the "StartPoint" or "Arc Direction" tools work. The first mouse-click is still the start of the arc, but the second mouse-click assigns the control point "off" the arc, defining how it bends. The third mouse-click places the end of the arc.



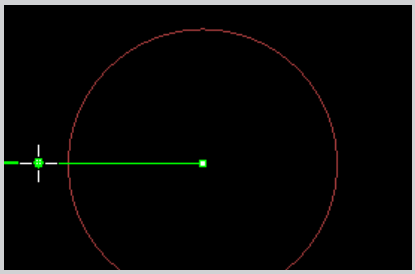
The "ThroughPoint" Option This option is similar to the "Direction" option. However, the second mouseclick is a point ON the arc, so that the arc may pass through a defined point onscreen. The third mouseclick places the endpoint of the arc as usual.

Step-by-Step

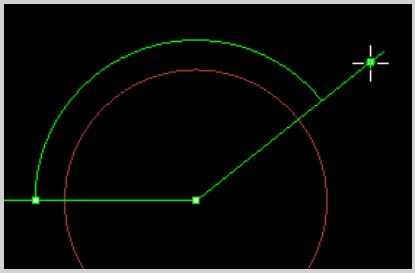
Using Arc



1 Click to place the center of the arc Without selecting any other options, the first mouse-click places the center of the arc. Or, you may type coordinates into the Command line to assign the location of the center.



2 Click to place the StartPoint of the arc The next click assigns the radius of the circle of which the arc is a part, locking the shape of the curvature of the arc into that of a circle this size.



3 Click a final time to define the EndPoint of the arc The final mouse-click assigns the endpoint of the arc. Notice that the "Deformable" option is described in the Intro section to this chapter.



Open or Closed Curve Tools ...

The Polyline Command

Draw connected curve segments - lines or arcs - to create open or closed shapes.

Upon starting up this tool, draw connected curves by left-clicking on the viewports to create a shape. Depending on the "Mode" of the tool, you may draw connected lines (Mode = Line) or connected arcs (Mode = Arc).

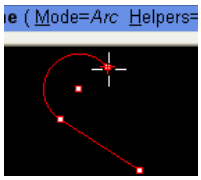


Though joined when drawn, a Polyline can be exploded into two or more curves.

The resulting curve is a polyline or polycurve ("poly" means many) with its segments joined together. It may be exploded into its component parts so that each curve segment of the exploded polycurve (each "segment" was placed with a new mouse-click when the polycurve was drawn) becomes a separate curve.

You may draw an open or a closed curve with this command. To draw a closed curve, approach the startpoint of the shape with the cursor while you are drawing, and the "Point" O-Snap will appear. Click it, and the curve will be closed. Or, as you near the endpoint, select the "Close" option and the final segment of the polyline will be drawn from the previous point placed to the startpoint of your shape.

Just check to make sure that the curve segment drawn automatically with "Close" does not cross over another section of the shape. If it does, the curve will not produce a valid surface or solid, as described in the introductory section of this chapter.



"Arc" mode creates curve segments and "Line" mode creates straight line segments.

To use the Command line options associated with the Polyline tool, read on! You will notice that the "Undo" option is also available with the Interp Curve and Curve tools described in the next section of this manual.

Drawing and Exploding Polyline Curves

Click where you want the first point of the line, and you will see Command line options appear.

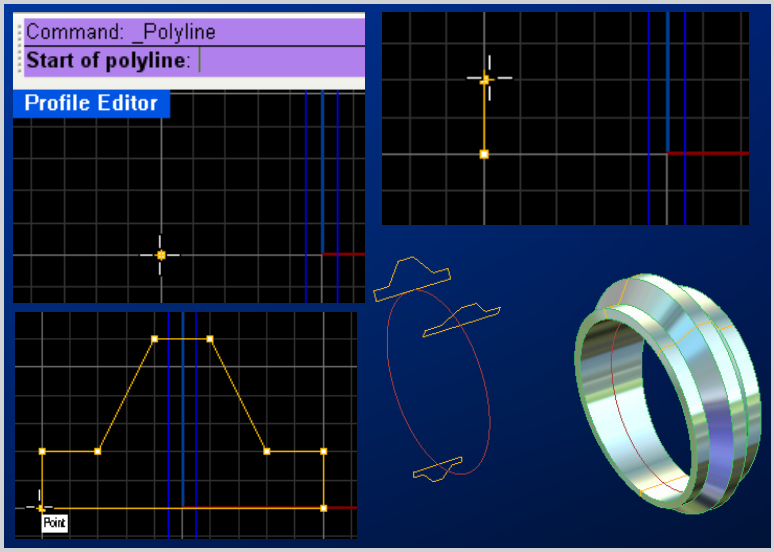
To make the first line segment into an arc, select this mode. To make it just a line, don't change the default mode.

As you move the mouse, you will create the length and direction of the line.

Left-click to place the segment and start a new one, in a new length and direction.

To close this curve, return to the first point you placed. The Point O-Snap will appear. Click it. Or, select the "Close" option.

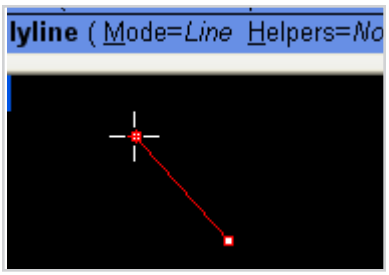
As always when drawing closed curves, Be careful that the curve does not cross through itself.

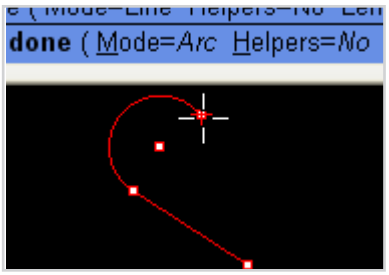


The Profile Editor is a common place to use Polyline. Use the existing profile as a guide for where to draw the new profile.

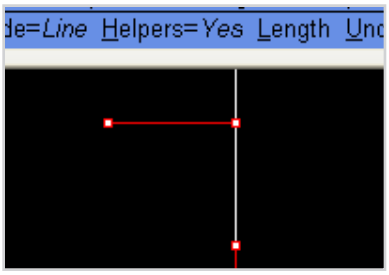
Command Line Options

Polyline options are Mode= Line/Arc, Helpers, Undo, Length, & Close

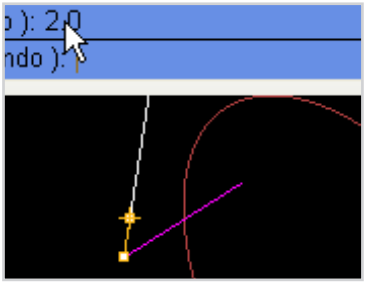




Switching Mode to "Arc" and using the Arc Sub-Options With Mode = Arc, the tool switches from drawing straight lines to drawing arcs. In this mode, move the mouse to control the length and curvature of the arc together. Or, select one of the two new suboptions. One is "Direction", which works like this option within the Arc Direction tool, allowing you to place a control point off the arc and, finally, the endpoint of the arc. The other is Center, which uses the previous point you placed as the startpoint of the arc and makes the next click the center of the arc, restricting its shape to that curvature.



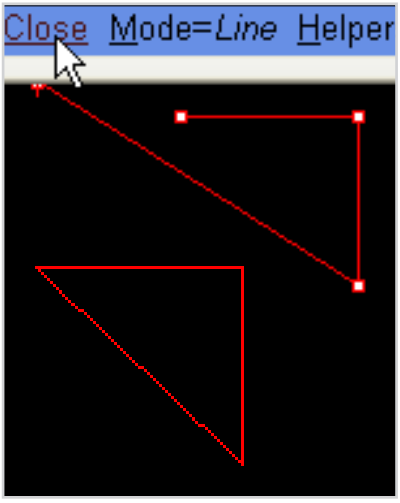
The "Helpers" Option Select this option in either Mode of the tool to turn on crosshairs that indicate where you are drawing the curve. These white lines snap to other parts of the polyline curve to provide guidelines and - well, helpers! - as you draw.



The "Length" Option Select this option and type in a value for the length of the next segment of the polyline. The curve segment will be locked into that length, but its placement will still be controlled by your cursor onscreen. Click to place the curve of that length and continue.

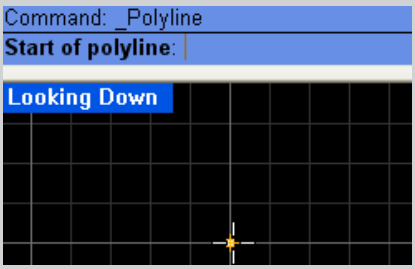
The "Undo" Option After left-clicking a second time to create the first segment of the polyline, the "Undo" option appears. Select this option to undo the last point you placed for the shape. Repeat to "Undo" as many points as necessary.

The "Close" Option This option will close the polyline curve - drawing a segment in the Mode you are currently using (Line or Arc) - to close the shape. It will make the quickest route possible from the last point you placed to the first, so beware that you do not create a loop in the shape, making it invalid.

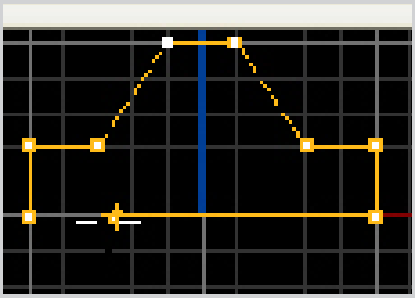


Step-by-Step

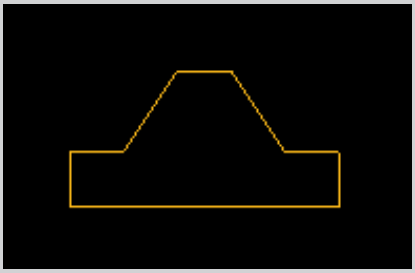
Using Polyline



1 Click to place the first point of the shape. Upon selecting the "Polyline" command, you will be prompted for the "Start of polyline". Left-click to place it anywhere in the viewports.



2 Select Command Line options such as Mode. The Command line options described at left will appear after you have placed the first point in the Polyline. Select them to change how it works. Or, continue placing points to draw (Grid Snaps on, above).



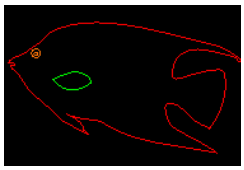
3 Click to draw. "Enter" or right-click ends command. You may change modes and other options as you draw. Each click places the next segment of the polyline. Close curve, press "Enter", or right mouse-click to end the command.

Open or Closed Curve Tools ...

Interp Curve & Curve Tools

Draw smooth, freeflowing curves to create open or closed shapes.

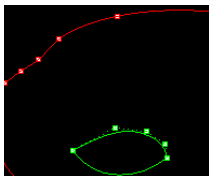
Start up one of these two tools and you will be able to place mouse-clicks to draw a smooth, freeflowing curve. Unlike Polyline curves, curves created with a single instance of either of the tools Interp Curve and Curve cannot be "Exploded" after they are created. In either one of these tools, each mouse-click helps you draw a smooth, freeflowing shape that is a single curve upon completion.



Use for freeform curves such as organic shapes.

Comparing the Interp Curve & Curve Tools

When drawing an Interp curve, each mouse-click places a point that falls on the curve. When using the Curve tool, the point you place falls off the curve you are drawing, acting like a tiny anchor that controls the shape of the curve. You can also think of it this way: the Interp Curve command places "Edit Points" on the curve - or, points that lie on the curve and affect how it is shaped. You can see the exact points you placed to draw the Interp Curve shape when you turn on the Edit Points after finishing your Interp Curve. On the other hand, the Curve command places "Control Points" - or, points that lie off the curve and affect how it is shaped. You can see the exact points that you placed when you turn on Control Points after finishing your Curve. But don't get confused: you can always use either tool (Edit Points or Control Points) to change either curve when you are through drawing them!



Control Point Curve (green) sets points off curve; Interp Curve (red) sets points on curve.

Closing a Curve

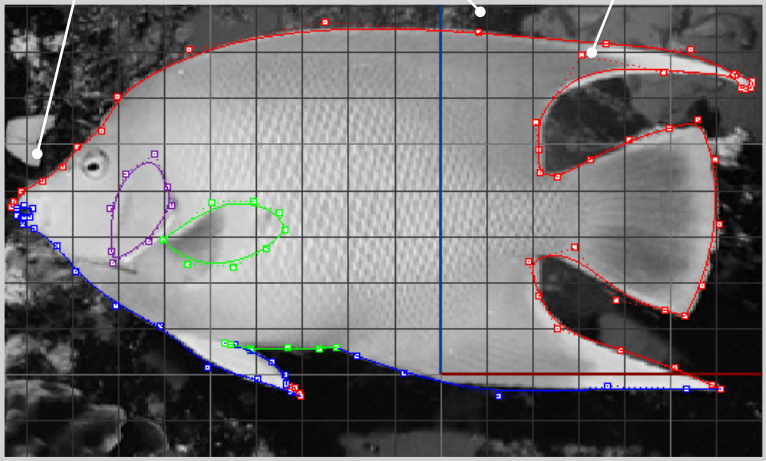
To create a closed curve with either tool, move the mouse to the startpoint until the Point O-Snap appears, and click it.

Strategies when drawing freeform curves

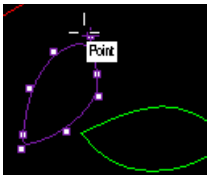
To get a sharp corner, right-click once to end the command and again to re-start it. Snap to the end of the previous curve to start the new one. Remember to Join the two curves together when you are done if you need to create a single curve.

To edit an Interp Curve shape after drawing it, select the shape and turn on "Control Points" or "Edit Points". Edit points will show the nodes on the curve that you placed while drawing it.

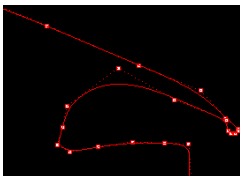
Control Points show the nodes located off the curve that control its shape. Click and drag a point object to change the shape of the curve so that it matches the shape you are after.



Hint: To create a tighter curve, place more edit points (mouse-clicks) when using Interp Curve. To create smooth, flowing lines, use fewer mouse-clicks.



To close a curve, click the "Point" O-Snap at the first point of curve. Curves from a single use of these curve tools can't be exploded.



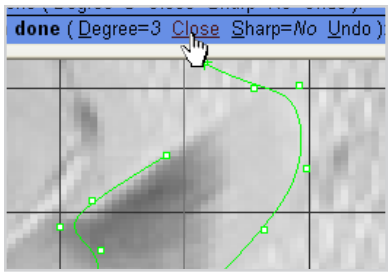
When using either tool, place more points to create tight curves and fewer points to create smooth, even curves.

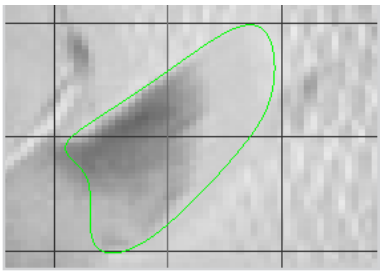


Stop and start these tools to create a sharp corner or "kink" in the design. This creates two separate curves.

Command Line Options

See information about the "Degree" option in the Intro section to this chapter.



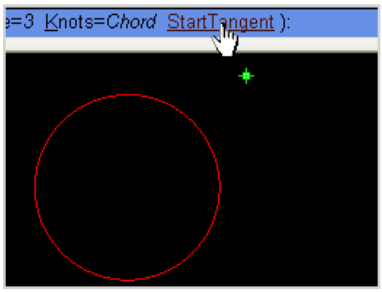


Command Line Options Common to both Curve Tools

The "Undo" command lets you undo the previous mouse-click, erasing the section of the curve you just drew and returning the line to a shorter length. To "Close" either curve the quick way, select this option. This will draw the remainder of the curve between the last point you placed and the very first point. Just be careful that this doesn't cause the curve to loop through itself! "Sharp = Y" will create a sharp corner upon closing the curve. Toggle this option to "N" to create a curved corner when closing the curve.

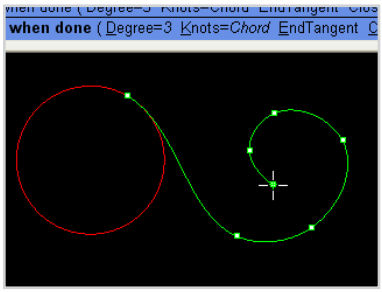
The "Knot" Option

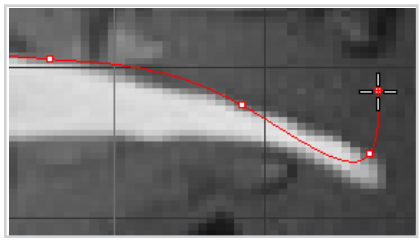
The default is "Chord", which places the Edit Points (Knots) wherever you click. Do NOT change this! "Uniform" places the knots at 1 mm intervals, while "Sqrtchord" places the knots at a location equal to the square root of the distance between your mouse-clicks.

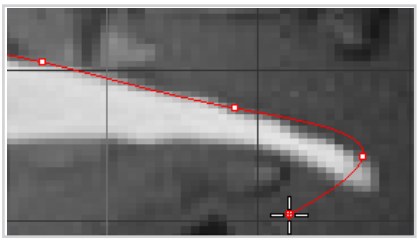


"Start/End Tangent" Options

Select either option when you are starting or ending a curve or interp curve that you want to make tangent to an existing curve. The new curve will snap to the Tangent O-Snap points on the existing curve.

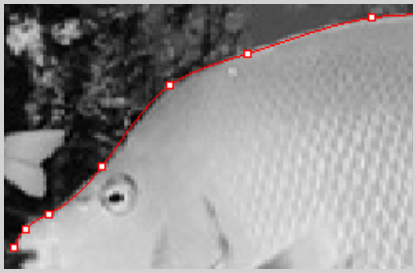




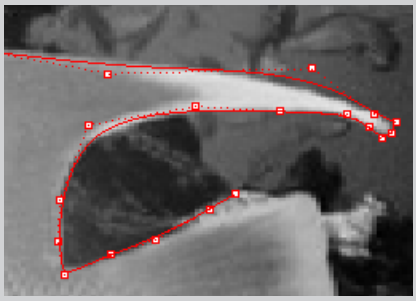


Tips on controlling the Interp Curve Tool. After placing a few points with this tool, you'll notice that the curvature of the line BEFORE the previous point will CHANGE as you place the NEXT point! To control how much - or how little - this effect is, place more points to create a tight bend in the line, easing the tension that affects the previous parts of the curve. Or, to create a more flowing, gradual curve, place fewer points and let the natural tension of the tool draw the shape for you.

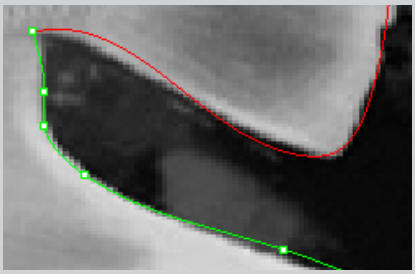
Step-by-Step
Draw a Curve



1 Click to place points in shape. The curve will flow smoothly from the first point you place. Depending on which tool you choose, the next point will be on the curve (Interp) or near - controlling or "pulling" the curve (Control Point).



2 Click more - or less - depending on shape. To create a tighter curve - using either tool - click more, making tighter corners possible. For a longer, smoother curve, click less, letting the smoothness of the curve tool do the work for you.



3 Approach first "Point" to close. Enter for open curve. For a very smooth closed curve, approach first Point O Snap. Or end with Enter. Re-start for sharp kink in curve. Join two (or more) to close shape.

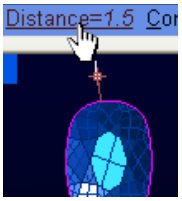


Tools to Modify Curves ...

The "Offset" Commands

Create a copy of a curve, larger or smaller than the original, at a set distance away from the original; or on / above / below a surface.

Use the ***Offset*** tool to create a copy of an existing curve that is a set distance away from the original. The new curve may be larger (Offset to the outside, or, in a positive direction) or smaller (Offset to the inside, or negative) than the original. There are several ways to assign both the offset distance and the offset direction.



Offset a certain distance for precision, or "Through Point" to match a design.

Using the Command Line with "Offset"

First, you may use the Command line to type in a distance at which to offset the original curve. This will "lock" the cursor into a set distance away from the existing curve, and you need only to click inside or outside the original curve to offset it this distance in the given direction.

Or, use the Command Line option "Through Point" to control the offset distance. With this option selected, you have two choices: (1) type in a coordinate (X, Y) through which the new curve will pass, or (2) assign a coordinate "live", on-the-fly, with the mouse, moving the cursor around onscreen to locate the offset curve. Using the ThroughPoint option, you may also "snap" the offset curve to a particular location onscreen in conjunction with the O-Snap tools.

The suboptions under the Command Line Option "Corner" allow you to define how the corners of the new curve will appear: sharp (like the corners or joints created by the Polyline tool, "Line" mode), rounded (same as the Fillet command), smooth (same as Blend) or chamfer (same as Chamfer command)

Offsetting in Relation to a Surface

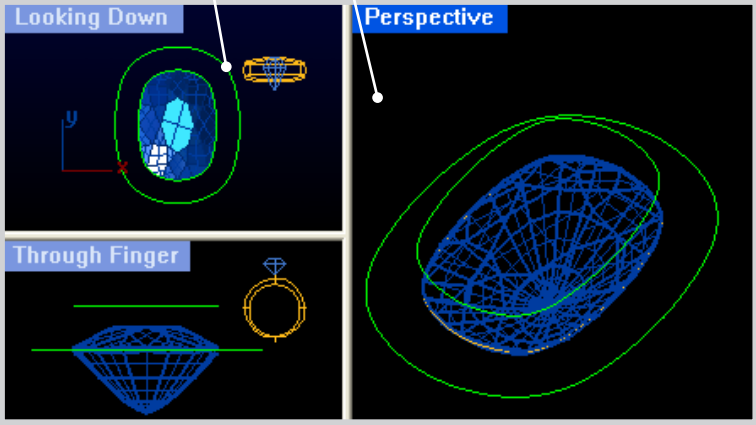
Starting with a curve on a surface (skip ahead to the "Curves on a Surface" tools to learn how), you may offset the curve either on ***(Offset Curve on Surface)*** that surface or above/below that surface ***(Offset Curve Normal to Surface).***

"Offset" in correct viewport for predictable results:

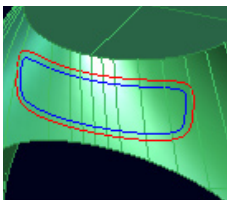
Offset a curve in different directions depending upon which viewport is active during the command. Offset this curve in the Looking Down or Through Finger viewports by selecting it in that viewport.

Or, move the cursor into the new viewport while you are running the command, to offset it in that direction. Remember: the Perspective viewport acts like the Looking Down viewport.

When Offsetting a curve on a surface, select the "base surface", the direction (inside or outside), and a distance. Or, "Offset Normal to Surface" and click where you want the new curve.



These commands offer a few more command line options: first of all, you'll be prompted to select a "base surface" - that'll be the one on which the curve you are offsetting lies. Next, type in an "Offset Distance", in mm, just like the regular Offset tool; or, choose "Through Point" to move the mouse and assign the distance interactively with the cursor. Finally, the "Flip" option will change the direction of the arrows onscreen. These arrows indicate to which side (inside or outside) of the original curve the new one will be drawn. Left-click or press Enter to place the new curve.

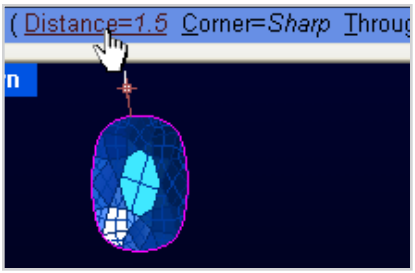


Offset a curve on a surface or normal to (perpendicular to) a surface.

In contrast, the command ***Offset Curve Normal to Surface*** does not offer any of these command line options. Simply select the curve to offset; select the "base surface" it lies on, and click either above or below the surface to indicate a "Height" to which you want to offset the curve. Press Enter to finalize the operation and place the new curve.

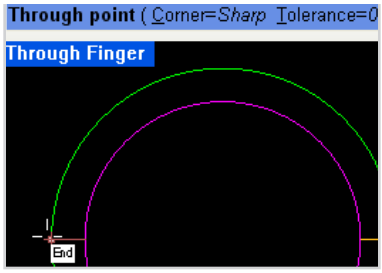
Command Line Options

"Distance", "ThroughPoint", "Corner", "BothSides", and "Tolerance".



Use the "Distance" Option

Select "Distance" and type a value to assign a distance between the original and offset curves. The new curve will be locked into this distance from the original. Click on one side of the original curve to place the offset curve.
("Distance" defaults to last value used.)

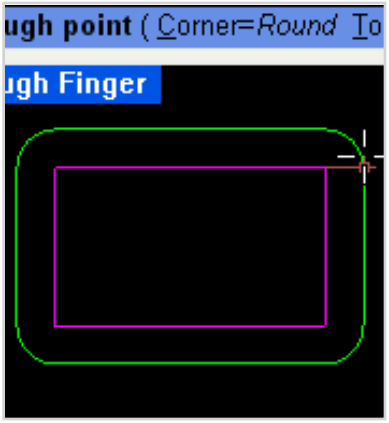


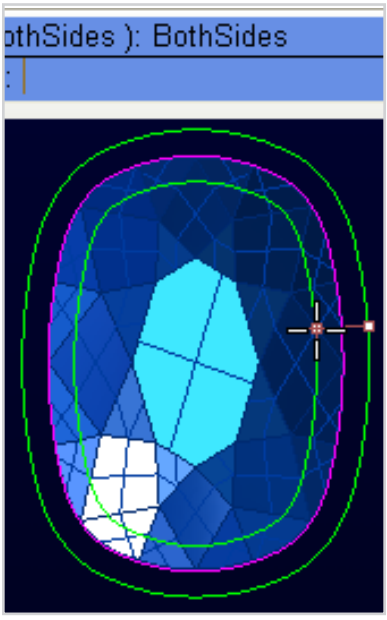
The "ThroughPoint" Option

Select this option and either (1) type in coordinates through which the new curve will pass (X, Y); or (2) move the cursor to control the offset curve live, "on the fly". Snap to an object, or just press Enter when you like the results.

The "Corner" Option

Select this option to choose the shape of the corners when offsetting a curve with corners in it. Each suboption creates a different result: "Sharp" creates a sharp corner (known as a "kink"); "Round" works like the "Fillet" command to create a rounded corner; "Smooth" rebuilds the curve after it is rounded, using fewer control points in the final shape; and "Chamfer" works like this command, creating a beveled corner rather than a sharp or rounded one.





The "BothSides" Option

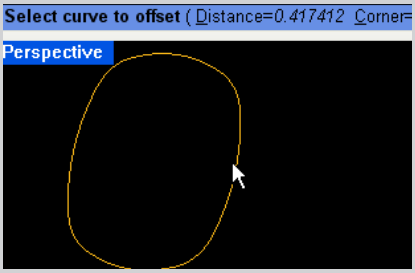
Select this option to offset the curve the assigned distance in both directions, creating two offset curves: one on either side of the original curve. The Offset will take place in the active viewport, so take care to select the curve in the correct viewport!

The "Tolerance" Option

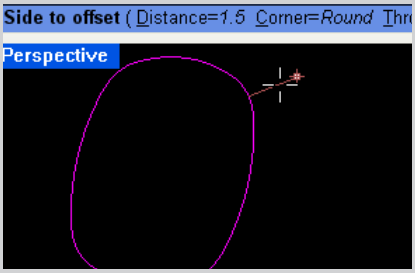
It is NOT recommended to change this value! Some commands have a given "Tolerance", or, a maximum error that will be accepted in the result. This is so small it is not visible! If you change this value, other commands that rely on it could fail or give unexpected results.

Step-by-Step

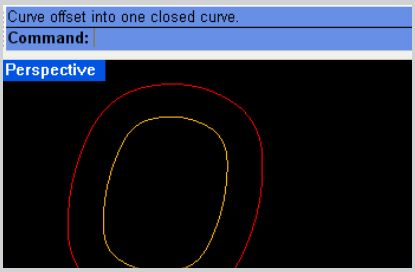
Using Offset



1 Select curve to offset. Either start up the command and select the curve as you are prompted to by the Command line; or, select the curve first and start up the command. When using the Surface command, select the surface the curve is on.



2 Type a value to indicate the offset distance. Or, select the "Through Point" option described at left to use the "Offset" command "on the fly", watching the new curve grow or shrink as you move the mouse.



3 Click onscreen to indicate the offset direction. Click once, on one side of the original curve, to assign the direction of the offset. The new curve will appear and the command will end.

Note: for best results, whenever possible offset to outside, not inside.

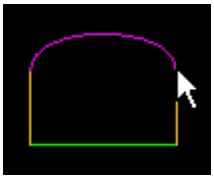
Tools to Modify Curves ...

The Two "Blend" Commands

Create a flowing "Blend"-shaped curve between two existing curves. One tool provides adjustable handles to "trim" curves.

Blend Curve

To use Blend, start up the command and select the first curve to Blend. Make sure you select the curve on the end CLOSEST TO the curve you're going to connect it to during the Blend.



Blend between two straight lines for a pretty profile shape.

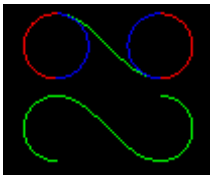
Then, select the second curve - also clicking on it on the end closest to the first curve. The Blend line will be drawn. Notice this is a separate curve which you'll need to Join to the other two curves if you wish to create a connected shape.

Blend Curve Handles

To use this tool, select the curves in the same way detailed above. Before the command ends though, the program offers you "handles", or control points, at the end of each curve, labeled "1" and "2".

Click and drag any one of the control points to change the shape of the Blend curve. You can only drag them planar or flat to the curve they're associated with. Hold down "Shift" to adjust the same control handle on the other curve, making your change to the Blend curve symmetrical.

If you click on the handle or control point representing the end of the curve, you can make the original curve shorter and the Blend curve longer, changing the shape of the original curve to better suit your needs. With the "Trim" option selected in the command line, the part of the original curve you don't need during this process will be "Trimmed" away, leaving just the new, shorter curve and the Blend curve.

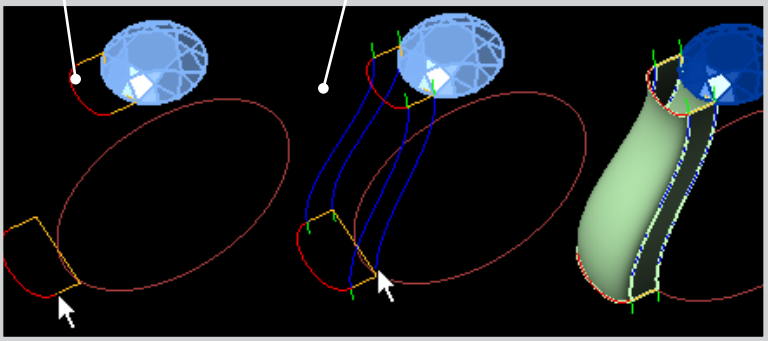


Blend between two half-circles for a pretty "S" shape for filigree.

Blend Curve

Blend Curve creates a basic Blend curve between two other curves you select. It is good for creating profile shapes (blend curves red), as below, or creating smooth shapes for rail designs (blue curves).

However, once it is drawn, it can't be changed except with Control Points or Undo!

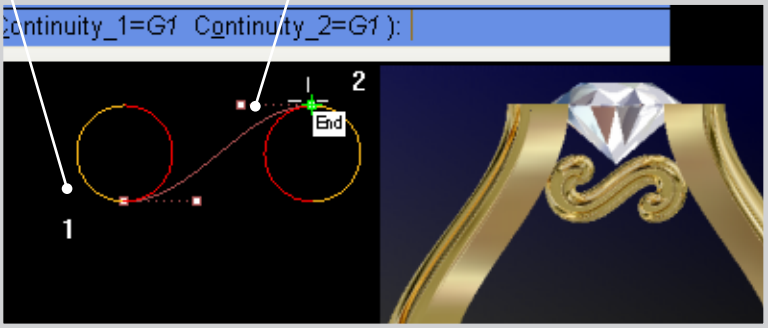


Do not Join curves; place all on same layer color (Rails Blue and profiles yellow) and use Skinner tool, explained in chapter on Targets, to sweep design.

Blend Curve Handles

Blend Curve Handles let you assign where on the curves you are blending to and from. Click and drag the numbers (1 and 2) to assign the start of the Blend curve on each original curve. Also drag the control points to fine-tune the Blend curve. Trim original curves with that option if you wish.

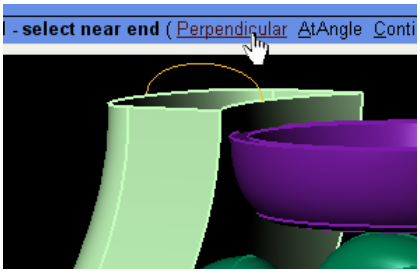
Blend Curve Handles is an easier tool for beginners (and technical writers!) to use when it's unclear exactly where to split the original curves for the best result.

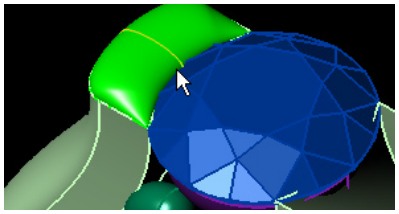


IMPORTANT: In Blend Handles tool, assign continuity "G1" to ends 1 and 2 for the tool to act predictably!

"Blend Curve" Command Line Options

Choose which Blend tool to use based on the options it offers...





Use Rhino's Sweep 2 (chain edges option) & Mirror, Join to finish pretty cap, above.

The "Perpendicular" Option with Curves and/or Surfaces

Within Blend, select the Perpendicular option before clicking either or both curves. You will be asked for a "point along curve" to start the perpendicular Blend. Click on a location, and the Blend curve will now be drawn perpendicular to the selected point(s). Also, this option allows you to blend a curve perpendicular to a surface edge. In that case, instead of selecting two curves, one or both "curves" you select will be the edge (open or closed) of a surface or polysurface.

The "At Angle" Option when Blending with Surface(s)

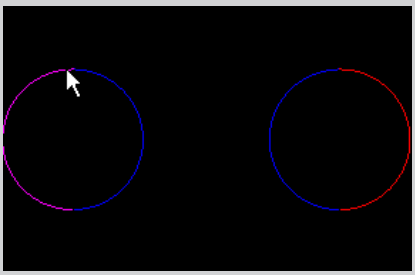
Use this option when one or both curves selected for the Blend are edges of surfaces. It allows you to place the Blend curve at an angle other than perpendicular to one or both surfaces. You'll be offered a chance to set this angle: For best results, use another object onscreen to snap to (known as reference geometry) when placing the angle.

The "Continuity" Option - Position, Curvature, & Tangency

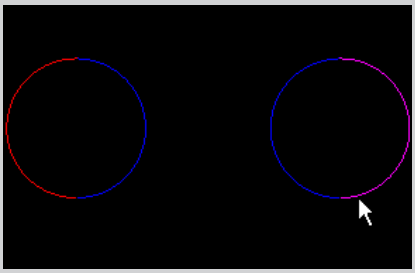
The Continuity option changes how the Blend curve looks. "Position" continuity creates a straight line. Curvature and Tangency have different shapes that are determined by their control points. "Curvature" places three control points in a row (one on the original curve and two on the new curve); Tangency places only two control points in a row (one on the original and one on the new). The default - "Curvature" - should work fine, but you may wish to experiment with both based on the results you want to achieve.



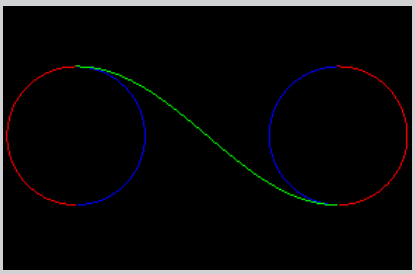
Step-by-Step
Using Blend Tools



1 Select first curve to Blend. Make sure you click on the end of the curve CLOSEST TO the other curve. To ensure you do, click near the end of the curve, or at least past the midpoint of it on that side.



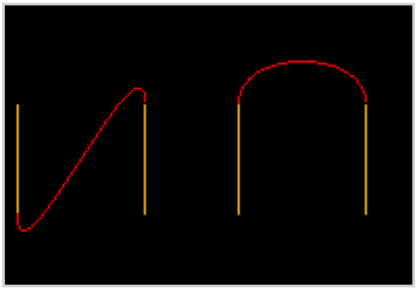
2 Select the second curve to Blend. With any Command line options you wish to use selected, click on the second curve, also selecting it near the end. If you're using Blend, the curve will be drawn. If not, proceed...



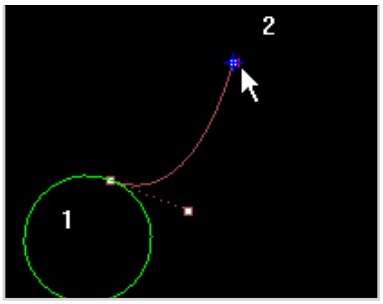
3 Adjust handles if needed & Press Enter to keep curve. Using the Command line options and handles available in "Blend Curve Handles", adjust the shape of the curve till you like the results and press Enter to end the command.

"Blend Handles" Command Line Options

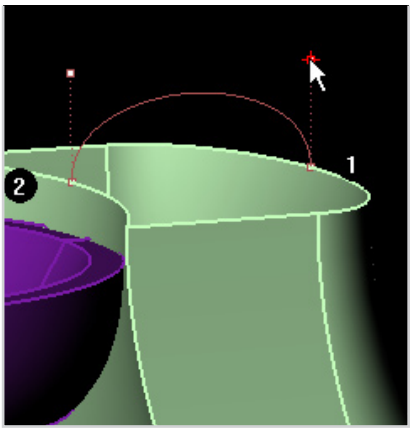
Choose which Blend tool to use based on the options it offers...



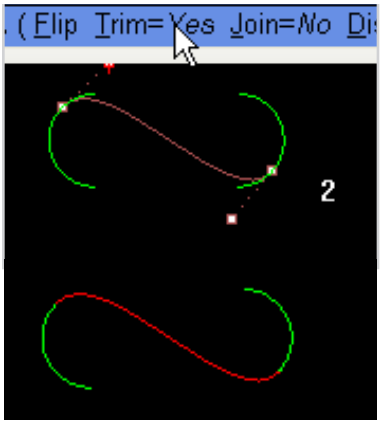
The "Flip" Option Did you notice how, when running Blend, if you select the wrong end of the curve you have to delete the results and run the command again? Well, Blend Handles lets you just grab the "Flip" option and select the end that's wrong to correct the blend curve. Nice, huh?!



The "Point" Option Select this option to choose any point onscreen as a location to blend to. This may be an existing Point object in space (use the Point OSnap to find it precisely) or any location you set with the cursor while this option is engaged.



The "Edges" Option Using the Edges option restricts the tool so you can only select a surface edge (it may be the edge of an open or closed object) as one of the Blend curves. In contrast to "Blend", where you click is the start of the new curve, and holding down the "Alt" key lets you change the angle.

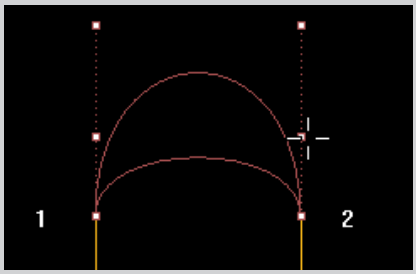


The "Trim" Option Here's the best part of the Blend Handles tool: as you click one of the endpoints of the Blend curve, it will follow the original curve, replacing it with a Blend-shaped curve. To delete the parts of the original curve you don't need, set Trim to Yes. To keep them, set Trim to No.

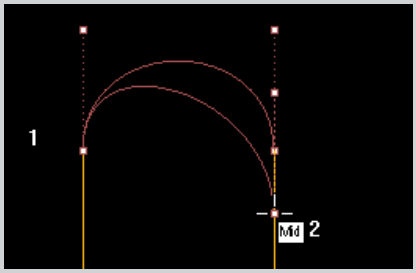
Continuity "1" & "2" - G0 through G4 To ensure this tool acts predictably, make sure Continuity for both handles is equal to "G1" (same as regular Blend Curve tool). Click this option and select "G1" to change it. Like "Continuity" in Blend, you are able to control the number of control points - which work like Handles in this command - offered on the Blend curve to control its shape. G0 is the same as Position Continuity, or a straight line. G1 acts like "Tangency", where 2 control points are aligned - one on the end of the original curve and one on the blend curve. G2 acts like Curvature, with 3 control points aligned, and so on through G4. Changing this value will change the way the end handles and control point handles behave.

Tips & Tricks

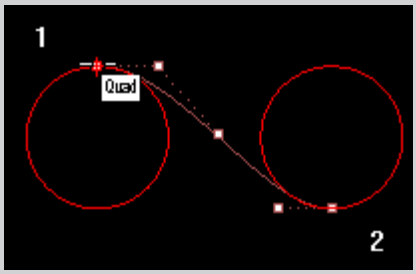
Using the Blend Handles



1 Use the Shift Key for Symmetry. If you want the Blend curve to be changed evenly on both sides, hold down "Shift" as you click and drag the handles to re-shape the curve.



2 Drag the endpoints to edit the original curves. If you're not happy with the results, click and drag one or both endpoints to edit the curves selected during the Blend command. The Blend shape will grow and the original curve will be shortened. Use the "Trim" option to delete the unused parts.



3 With closed curves, Blend starts from End Point. For both Blend tools, select a closed curve and the Blend will begin from its endpoint. Use Blend Handles for closed curves in order to change the startpoint if needed.

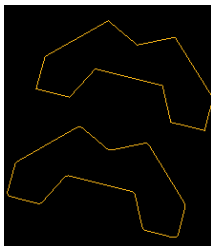


Tools to Modify Curves ...

The Fillet & Chamfer Tools

Change the shape where two curves (or two segments of one curve) meet by using "Fillet" to smooth out or "Chamfer" to bevel the angle.

"Fillet" creates a smooth arc at a sharp "joint" between two curves, while "Chamfer" creates a beveled edge between two curves that meet at a point. Otherwise, both commands work in a very similar way: select the two sides of the angle to change, assign a distance (Chamfer) or radius (Fillet) for the shape between them, and press Enter. Many of the Command line options are the same in both tools: all are explained on the next page. Make certain you select both curves close to the end at which they form the angle!

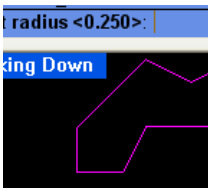


When drawing a profile, Fillet rounds corners for smooth edges after Sweep. (Bottom = After)

Either tool works with two curves that are (1) Joined, and meet at a sharp point or angle; (2) Are only touching (have position continuity) but are not joined, and meet at a sharp point; or (3) Do not touch, but would form a sharp angle if they were extended so they touch.

If Either Command Fails

If the angle you wish to Fillet or Chamfer does not meet the above criteria, you may receive an error message in the Command line, and the operation cannot be completed. Another source of error in either command is a distance that is too large in either the "Radius" (of the Fillet) or the "Distance" (of the Chamfer). So if you met the above criteria and the command still does not work, try running it again with a smaller value in the "Radius" or "Distance" option (both are fully explained next).



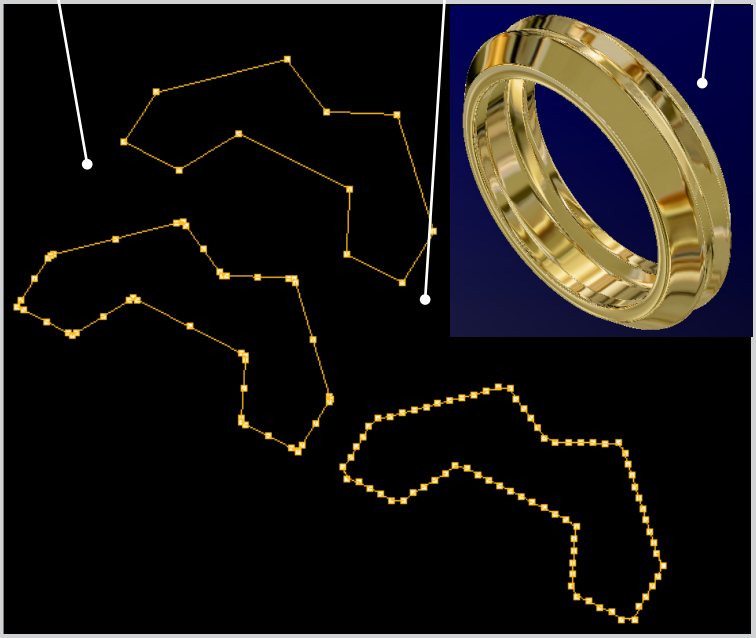
Set radius small when angle is wide, so Fillet can accommodate it.

"Fillet" and the Control Points of the new curve

If you turn on Edit Points after running Fillet, you'll notice that a number of new edit points are placed to create the arc that now connects the two curves.

With the curves Joined, you may run the Rebuild command (explained fully later on in this chapter) to re-distribute the points along the curve at regular intervals.

It is always a good idea to Fillet and Rebuild curves in this way when creating them for Profiles or even for Extruded shapes. Filleted edges look nicer in renders, and rebuilt curves make for more successful Sweeps & Booleans!



Fillet Corners

This tool works exactly like the Fillet command; however, it fillets all corners in a selected curve at the same time using a single value: saving you time, energy, and effort! It is the lazy man's Fillet curve tool. However, just be aware that, if all your corners are different sizes, the value by which you fillet them MUST be small enough to accommodate even the smallest ones; or else they just won't fillet! So, put in a small value when running this command; or, be prepared to check every angle and make sure it filleted! Time-saver? Ask the Tortoise or the Hare... !

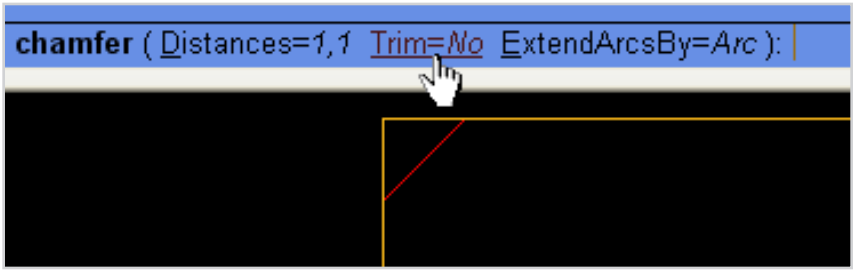
Command Line Options

The "Radius", "Distance", "Join", "Trim", & "Extend Arcs By" Options.



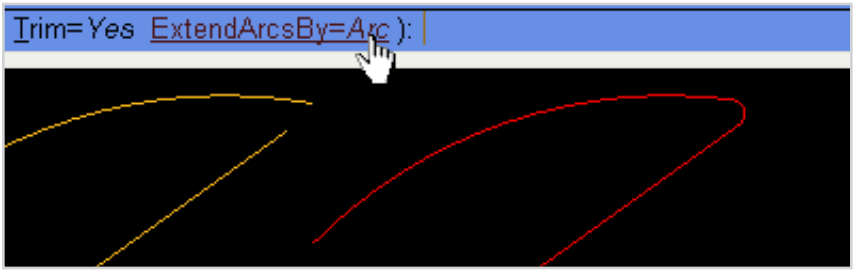
"Radius" Option in Fillet After starting up the command, select a Radius for the arc that will be drawn between the two curves. Press Enter after typing a radius. Or, simply press "Enter" to accept the default (last-used) value, in parentheses in the Command line, for the radius of the Fillet.

"Distance" Option in Chamfer Assign two distances - the first for the first curve you select and the second for the second curve. This distance assigns the number of mm from the end of each curve that the chamfer angle will be drawn. Make each value different for an uneven chamfer, or equal for an even one.



The "Join" Option Select this option to Join the three curves (original two and new curve connecting them). Otherwise, the curves will NOT be joined following each operation! Select this option, or Join them after running the command, if you need a closed curve in the end!!

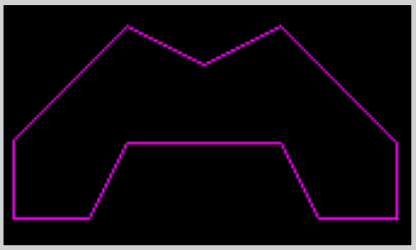
The "Trim" Option Toggle this to "No" if you wish to keep the original curves and see the new Fillet or Chamfer curve. The original curves will not be changed - the new curve (red, above) will just be drawn between them. You must use Split or Trim and Join to get the expected result after using this option.



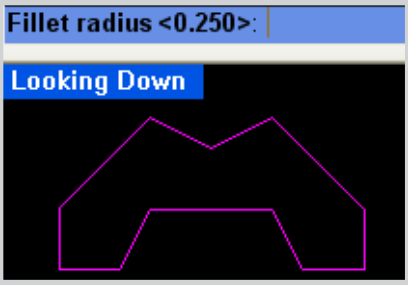
The "Extend Arcs By" Line / Arc Option in Fillet & Chamfer When using either tool - Fillet or Chamfer - to connect two curves that do not touch, and one of the curves is an arc, it will be necessary for the program to Extend the arc to meet its fillet or chamfer curve. To extend the arc as a line - i.e., to add a straight segment onto it to complete the operation - toggle this setting to "Line". To extend the curve by continuing the existing curvature of an arc, set this option to "Arc".

Step-by-Step

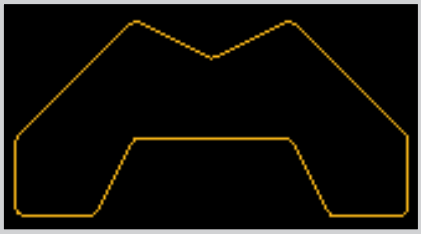
Fillet or Chamfer



1 Start up a command & select curve(s). Alternately, you may select two curves or curve segments to change and start up either command after they are already selected.



2 Type in a Distance (for Chamfer) or Radius (Fillet) Type a value to assign the shape of the curve that connects the two (described fully at left). A fillet is curved, so assign a radius, and a chamfer is straight, so assign a distance.



3 Press Enter to assign the value & end the command. Move the mouse to enlarge the ellipse in the opposite direction (L or W) from the one already set. When the size is correct, click once to end the command.

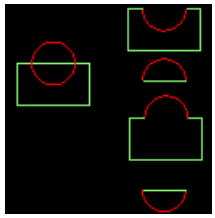
Tools to Modify Curves ...

Using Curve Boolean

Select two overlapping curves, and choose which shapes you wish to keep. This tool automatically splits, trims, and joins to create them.

Begin this tool by selecting two or more overlapping curves. The Command line will prompt you to "click inside regions to keep". Wherever the curves overlap, they can form a new, single curve: just click in each region representing a shape you want after using the command.

After you select a "region", it turns a ghosted gray color. To "Deselect" it, just click it again. Once you like the results, press Enter.

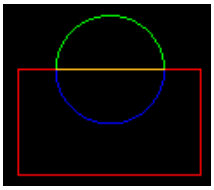


Like a shortcut to Split /Trim and Join, get any or all possible results.

The Command Line Options

"Delete Input" allows you to delete "All" the original curves you selected for the operation - leaving just the new curves; "Used" curves - or, those corresponding to the location of the new ones created; or "None" of the original curves, leaving both the original and the new curves.

The "Combine Regions" command joins the perimeter of the shapes together as well, allowing you to combine not only the overlapping pieces (creating a piece at their "intersection") but both of the curves, as long as all the regions inside the curves are selected. This is illustrated at right.



Curve Boolean long-hand: Split curves with one another and delete what isn't in your desired shape. Join.

What's Really Happening Here?

You can re-create these effects - and we always did up until this version of Rhino, when this handy little tool appeared! - using Split, Copy, and Join. Here's what it's doing. Imagine that each curve was Split at its intersection with another curve. Wherever one curve is shared with another shape, it is duplicated. Now, the curves that touch are joined up into closed curves.

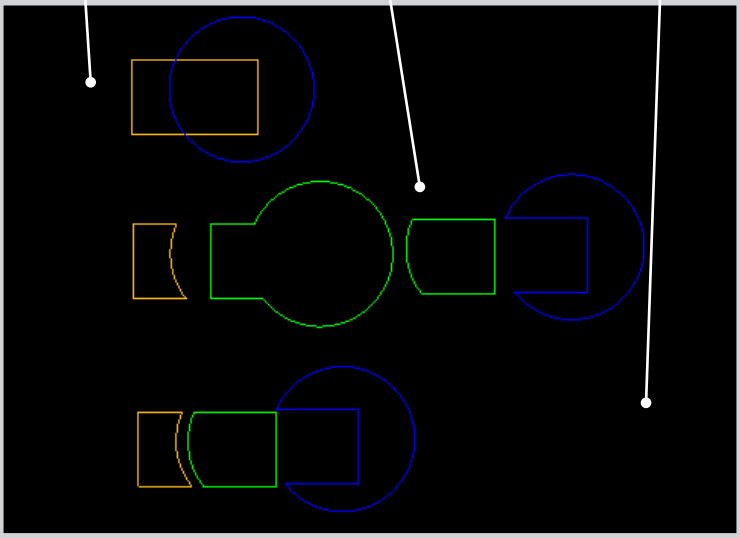
NOTE: It's important to note that this command only works on a pair of Planar curves - or, curves that are flat along the same plane in space.

"Combine Regions" Command Line Option

The Original shapes used for Curve Boolean must overlap (at least two curves). One "region" is made of the yellow curve only; one is both curves; and one with the blue curve only. For this example, all three regions were clicked in as "regions to keep".

The second illustration shows "Combine Regions = Yes". With it, you get both a "union" of the two curves, an "intersection", and both "difference" options (one curve cuts the other, and vice versa).

The final illustration shows "Combine Regions = No". It leaves out the Union.



The colors and positions shown above are only used by way of illustration: the command does not change the layer colors of the curves, and all shapes are left at their original locations. (Suddenly, I feel like playing Pac Man...)

Fixing Problem Curves...

Rebuild & Fit Commands

Redistribute Control Points on Polycurves to create a new, single curve.

Why Use these Commands?

As you know from reading about the "Polyline" tool, polylines or polycurves are single curves that can be exploded into two or more component curves. When used to create surfaces, these curves create "polysurfaces", or, surfaces that can be Exploded into two or more single surfaces. Sometimes, you don't want polysurfaces when you're modeling. To get a single surface as a result, instead of a polysurface, you will need to use a single curve to create the surface; or, a curve known as a Nurbs Curve. A Nurbs Curve cannot be exploded into more component curves; and it makes a Nurbs Surface that cannot be exploded into more component surfaces. Nurbs curves and Nurbs surfaces generally lower the possibility that your model might go bad somewhere down the line.



Same shape: (L) can be Exploded; (R) can't, after Rebuild.

About Rebuild

The Rebuild command can take a polycurve that is composed of many curve segments and redistribute its edit points evenly along the curve, creating a new, single curve segment. All of the parts of the curve you wish to rebuild must first be joined together into a polycurve (it cannot be in single curve segments), and it should not have any sharp angles or "kinks" in it.

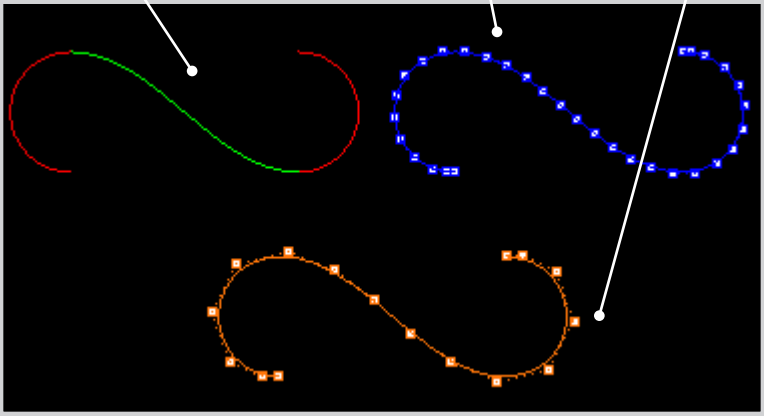
Rebuild starts up a dialog box that displays the existing number of edit points and the new number of edit points. Generally, the new number should be more than the old number so that the curve does not lose its shape. Sometimes, the new number will need to be as much as twice the value of the old number. However, for best results, you should try to make this number as low as possible without changing the existing shape. At certain times, you will make this number lower to ease some of the tension in the existing shape, creating a smoother shape, but these instances are usually rare. A good rule of thumb is this: always make this number as low as possible without changing the existing shape! You may also rebuild a single curve if you simply want a different number of edit points with which to control it when you are using the Edit Points On command.

Rebuild to convert a polycurve to a Nurbs curve

Use Rebuild after commands like Fillet, Split, Trim and Join. The curve should have no hard angles in order to best be rebuilt. You can Rebuild a single curve or a joined polycurve: the polycurve will come out as a single curve which cannot then be exploded.

Curve Before Rebuild: After running Rebuild, look at the edit points on the resulting curve. They are evenly distributed, and the curve cannot be exploded. Instead of a polycurve, it is now a Nurbs (single) curve.

Curve After Rebuild: If you use fewer edit points, the shape will be relaxed, so only do this if you want that result. However, do not use too many, either! Use as few edit points as possible while still keeping the shape of the curve.



Note: ONLY run Rebuild or "Fit" if you won't need to explode the curve or the surface you'll create from it.

About Fit

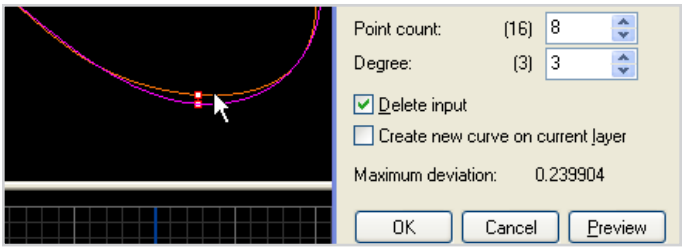
This command works very similar to Rebuild, in that it creates a single curve from a polycurve. However, "Fit" automatically uses the lowest number of control points possible. However, it will keep the original shape, so it will result in a curve with fewer control points without losing the original shape! Run this command if, during Rebuild, you have to increase the number of control points too far, creating what we call a "heavy" curve. For a "lighter" curve - a single curve with fewer control points that is easier to edit and still maintains the starting shape, "Fit" is a great alternative to "Rebuild". ONLY run this command with "Degree = 3" in the Command Line.

The "Rebuild Curve" Dialog Box

Each option in this dialog is explained in full below.

About Points & Preview The existing number of Edit Points present on the curve is displayed in parentheses beside "Point Count". To Rebuild it, type a new value into the text box beside this value. If you're not sure what results you'll get, click "Preview" to see the new curve beside the old.

About Degree Curves in Matrix use a Degree value of 3 to keep them behaving as expected. Other degree values make straight curves (Degree 1) or "curvier" curves, which will behave unpredictably when they are adjusted with Edit or Control points On. So, do NOT change this value!

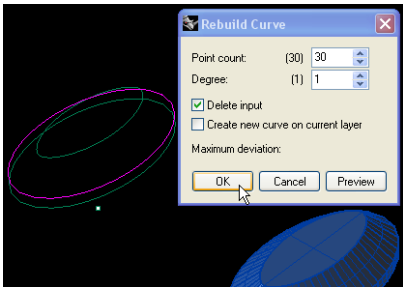


Delete Input / Layer of Curve To delete the input curve, select this, and only the new curve will remain. To place the curve on the "current layer" (the one you have selected in the layer menu), select this. Otherwise, the rebuilt curve will be placed on the layer color of the original curve.

About Maximum Deviation After clicking "Preview" to see the new curve beside the old, the "Maximum Deviation" will display. This reports the farthest distance, in mm, that the new curve is from the old. It's marked on both curves (new and old) with a point object. If it's acceptable, click "OK". Or, "Cancel" Rebuild.

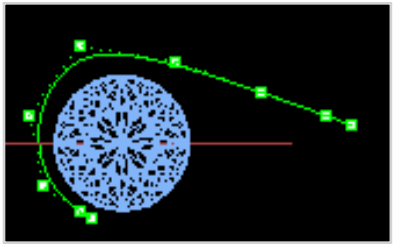
Tip: **Rebuild a curve with Degree 1 to create a custom gem.**

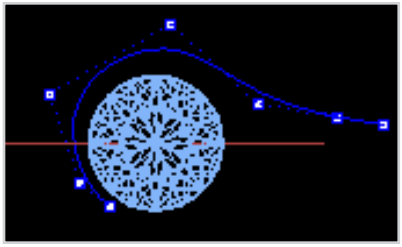
Draw a curve in the shape of a gem and Rebuild with the number of points you want as facets. Use Degree 1 to create straight lines. Duplicate curve above itself, Offset smaller and move up to Table height, place a point for Culet, and Loft between them all.



Tip: **Rebuild for better control with Edit or Control Points.**

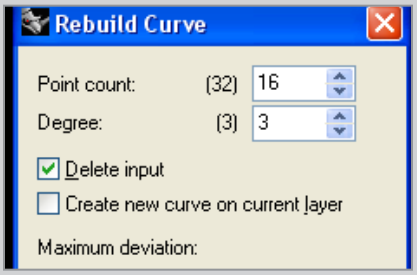
When designing a freeform shape, it's sometimes hard to get it exactly right the first time. You may of course turn on Control Points to edit it. But if the curve has too many control points, that can be even more frustrating, as moving them makes the curve look lumpy when they are too numerous. So, before cursing the Matrix gods, select the curve and run Rebuild or Fit. Use as few control points as you can without changing the curve. Now turn on Control Points, and editing will be a lot easier! (The Matrix gods will thank you later.)



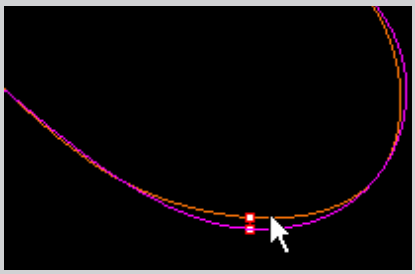


Step-by-Step

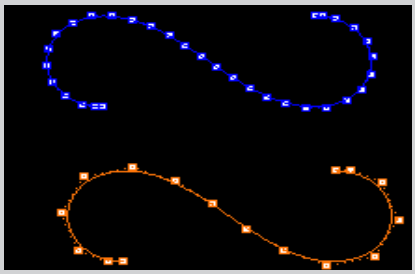
Using Rebuild



1 Start up this tool and select the curve to rebuild. Or, you may select the curve to rebuild first, and then start up the "Rebuild" command. Instead of Command line options, this tool offers a dialog box with its options, fully described at left.



2 Type a new number of "Points" into the dialog. This number will usually be more than the existing number of points (in parentheses) beside the text box. Click "Preview" to see if the shape was affected by the change.



3 Click OK when you like the results. Select any of the other options, making sure to Preview the results before you click OK, to make sure you want to change the curve. If you don't want to change it, click Cancel.



Fixing Problem Curves...
Mark Curve Start & End

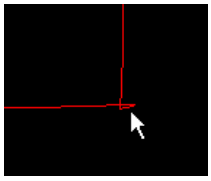
If your curve looks closed but Matrix says it's Open, use these tools as the first step towards closing it!



Cute fonts are a favorite hiding spot of bad curves!!

Closed curves are very useful in Matrix for operations such as Extrude, Loft, Sweep, etc. So, there are many instances in which you will want to have a closed curve for use with one of these tools. However, you may think you have a closed curve - i.e., it looks closed to you - but it does not act like a closed curve! At this point, you should use "Object Information" to check and see whether it is closed or not. Usually, it will not be closed!

To find where the curve went bad, select the curve and run "Mark Curve Start". Also run "Mark Curve End". The two points should be in precisely the same location onscreen. If they are not, you have an open curve, and you'll need to fix it using one of the three methods described at right. In addition, the "Match" and "Extend" commands explained next may help you close the first kind of open curve explained at right. If you do not wish to use either of these tools, or if the distance is so small that it won't be noticeable if you do so, turn on "Control Points" or "Edit Points" and select one of the endpoints of the curve (Start or End - whichever you prefer). With the Point O-Snap turned on, click and drag this point to match the other one, thereby making the Start and End point of the curve touch and closing the curve.



This is part of the "T" without my dramatizing (as above). Now, put your hand on your heart and swear to check the curves for ALL fonts - especially cute ones!

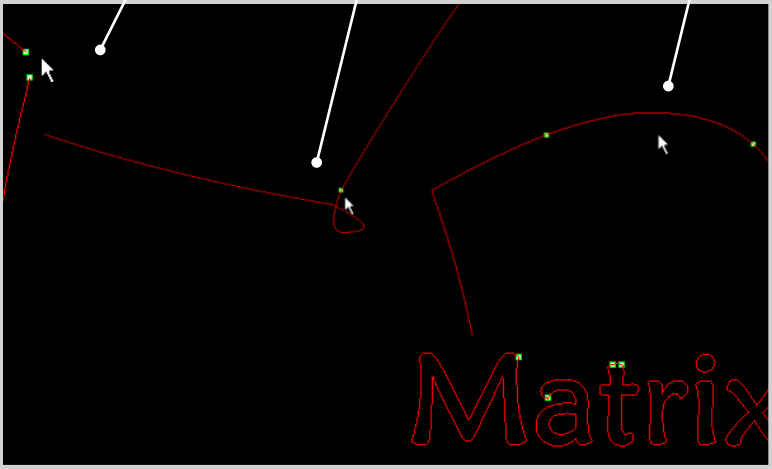
If either of the other two scenarios are your problem, you may also try this technique; or, you may need to Split or Trim the curve. Usually, the Split with a Point option (use the Intersection or Point O-Snaps to split precisely) will allow you to trim away the excess curve.

Fixing curves that went bad: the road to recovery.

Sometimes, the endpoints of the curve do not touch. Usually, this means that you did not use O-Snaps - the End O-Snap will usually prevent this from happening. Use Match, Extend, or turn Control Points ON and move start and/or end points so they touch.

The open curve may cross in space. Or, if there is a loop in the curve, it may report as "closed", but it will create invalid models! Use Split or Trim and Join to fix. The "Point" option in Split and the "Intersection" O-Snap will help.

Finally, the Start and End points may pass one another along the curve, which means that parts of the curve overlap exactly. Again, Trim or Split with the "Point" option, and Join, will fix this error.



(L - R) Zoomed-in on letters "M", "a", "t". For each open curve above, "Start" and "End" points are turned on. The font looks pretty good from far away, huh?! Tip: Fix it NOW, at the curve level, or your model will break later on down the line, and usually there won't be any way to fix it but to Undo all your hard work and fix it at the curve level anyway.

The "Point" Command

These are the first commands we've seen that place point objects in the model. However, you can just grab the "Point" command and place a point object wherever you need one. Click on "Point", and left-click on the location where you want the point. Point objects are useful in a variety of commands that have a "Point" option, such as Rhino Sweeps, They're useful in more advanced commands, as well, but are very basic and easy to use, so you might as well learn them now!

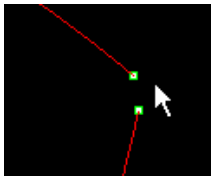


Fixing Problem Curves...

The Extend Command

"Extend" a curve to touch another curve (or other boundary object) or its own endpoint to create a closed curve; or use "Extend" as a modeling aid.

Extend is a great tool to use when there is either (1) a gap between different curves made by not using O-Snaps so they would touch; or (2) a gap in a single curve that leaves it open, as described on the previous page. This tool extends an existing curve with either a Line, Arc, or Curve segment so that it will touch another object in the viewports (called the "boundary object").



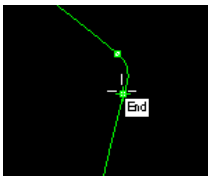
The problem Extend can solve.

Using "Extend"

To use this tool, click "Extend". At this point, you may press "Enter" for "dynamic extend", which allows you to move the mouse to control the placement of the end of the curve. Or, you may select a "boundary object" that you want the curve to touch. If you select a boundary object, the curve will automatically extend until it touches this object, at which point the command will end.

Using the Command Line Options

There are several different ways to extend the curve. The "Type" option lets you control the shape of the extension. With "Natural" selected, the curve type of the extension will be the curve type at the end of the curve you selected - Line if it ends in a line, Arc if there is an arc shape at the end of the curve you're extending, or Smooth for any other type of curve. When you select the "Natural" option or the option that matches the type of curve you're extending, the curve cannot be exploded after the Extend command! Select a Type other than the type of curve at the end of the original, and the result will be a polycurve that CAN be exploded after you run Extend. Other Command line options follow: "Line" extends the curve in a straight line that matches the angle of the existing curve.



Fixed! And you have now acquired a new appreciation for O-Snaps.

"Smooth" extends a freeform curve you can bend with the mouse; and "Arc" draws an arc matching the radius of the existing curve. Arc contains additional sub-options: "Center", which first places the center of the new arc, and "ToPoint", which creates an arc you re-size on the fly. To return to the arc that matches the existing curve, press "Enter" with the ToPoint option active. Just note: when using the Arc option, only an Extended arc that matches the radius of an existing arc will result in a single curve; otherwise, the resulting curve will be a polycurve that may be exploded.

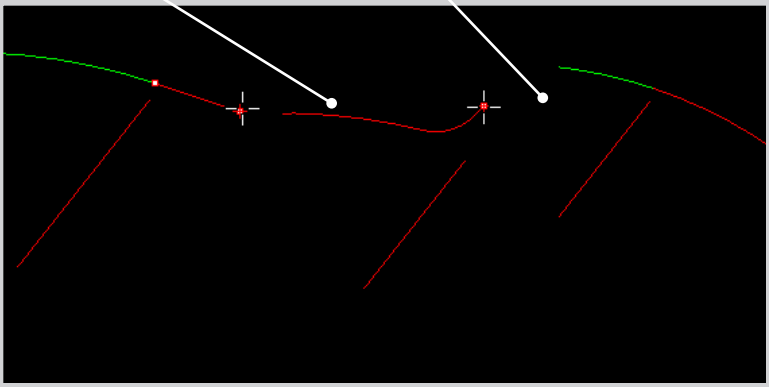
Comparing the different "Type" options in Extend

Using the Command line option "Type = Line", the curve will be extended in a straight line no matter what shape it was before.

Using the "Smooth" option, you will create a freeform curve you can bend by moving the mouse.

The "Arc" option extends the curve in the shape of an arc, with the sub-options "Center", which first places the center of the new arc, and "ToPoint", which lets you move the mouse to grow and shrink the size of the arc.

Finally, choose "Natural" to let the Extend command choose an end type for you based on the shape of the curve. The resulting curve will be a new, single curve which cannot be exploded: not a polycurve that can be exploded.



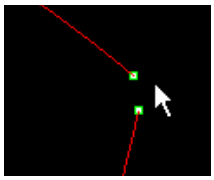
(L - R) - Line, Smooth, Arc (also Natural, since original curve was Arc). Notice here that only Smooth option will let this curve touch the other. If that is the goal, you'll need to select that option during Extend.

Fixing Problem Curves...

The Match Command

Change a curve to "match" the end of another curve when O-Snaps were not used to create a closed curve or continuous (touching) curves.

The Match command actually changes a curve, moving it to meet the endpoint of another curve. In the case of a single curve, it can change the end or ends so that the open ends touch, and the curve is closed. Since Match relies on the Edit Points to change the curves, it works best on a curve or curves that (1) almost touch or are only off by a tiny bit; and (2) have a high number of Edit Points.

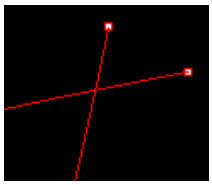


Match or Extend can solve this: Match changes the curve more, so beware.

Start up "Match", then select the two ends that need to touch. A dialog box will appear, and each selection will cause the preview of the curve to change, showing you what the result will be should you choose that option for the Match. For each option located in the top half of the dialog, the options in the bottom half of the dialog will create a different result - so, you have many combinations to choose from to get the Match you want. The important thing, though, is that the curve ends touch, and that the shape of the curve(s) is not too different from the shape you started with.

Using the "Match Curve" dialog box

The first three options, "Position", "Tangency", and "Curvature", define how the curve ends will align during the command. Click each one to see the preview image change in the viewports. "Position" merely makes them touch, leaving a "kink" or a hard edge when you are done. "Tangency" and "Curvature" create two different looks where two ends meet in a curve. The next three options offer the same three options for the other end of the curve, which can change when there are fewer than 6 control points in one or both of the curves being changed. Finally, select "Average Curve" to change both curve ends selected equally, causing them to "meet in the middle" rather than changing one (the first one you selected) to match the other. With the ends of two different curves selected, the "Join" and "Merge" options appear. With "Join" selected, the curves will be joined after the Match command is run (they can of course be exploded into their component parts). With "Merge", the curves will be joined AND rebuilt, leaving a smooth transition between the two so they cannot be exploded into the component curves that were used for "Match. Only select this option if that is the desired result after running Match.



Match can also move two ends of curves that cross each other. Be careful they don't create a loop when matched.

An Alternative to Match

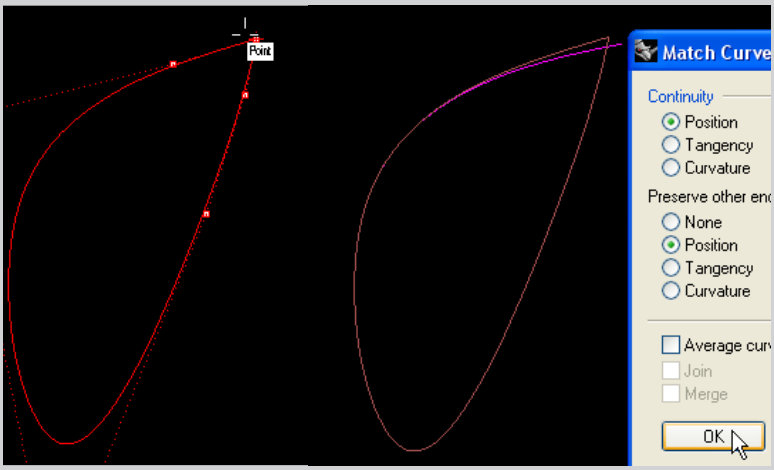
Here's what Match is doing in the "Position" option. Instead of using Match, you can do this. With all its many options, Match can sometimes change your curve dramatically! It's much better when run between two separate curves.

If you need to Match two ends of a single curve that was not properly closed with O-Snaps (shame on you!), I prefer this method:

Turn on Control points for the curve. Also turn on the Point O-Snap.

Select one of the end control points and drag it over to the other end control point. The Point O-Snap will tell you when they are touching.

(And you'll always remember your O-Snaps from now on!)



(L) "Match" by hand - moving control points to touch. (R) Match, the command, run with Position Continuity selected, and original curve. See the resemblance?

Curves on a Surface

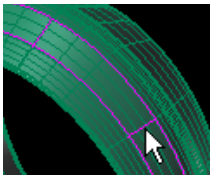


Extract Isocurve Commands

Create a curve on a surface in the "U" or "V" directions (perpendicular), both, or angled (GV Extract Isocurve) to prepare for more modeling tools.

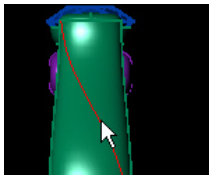
About "Extract Isocurve"

The "Extract Isocurve" command places a curve or curves on a surface. Because the curves are made "from" the surface, they are able to follow the natural shape of the surface. Isocurves are the "wires" that make up a model when it is not shaded: so, this is the shape and direction that the curves on the surface will appear when they are placed with this command.



Rhino Isocurves follow wireframe "crosshatching". "Both" option used here.

However, when you "Extract" an isocurve, you don't actually take one away: you just "copy" one. Then, you can place the curve anywhere on the surface that you want it to appear: usually, it is a good idea to snap it to a "Mid O-Snap" on the profile making up the surface, in order to place a gem line that is centered on the ring. If you don't want the gems to go all the way around the band, you can next use the "Split" command with the "Point" option selected in the Command line and split the curve at the location(s) where you want the line to start and end. (For a closed curve, remember you need to place at least two split points for this command to work.)



GV Extract Isocurve - lets you place the isocurve on an angle. You must extract the surface first.

Command Line Options

The Command Line Option "Direction = U (or V)" refers to the direction that the isocurve will go when you add it. There are two possible directions, perpendicular to one another, that the isocurve can go. One is known as "U" and one is known as "V". If your curve is going the "wrong way" on the surface, either click "Toggle" in the Command line, or click "Direction" and select the other one. Also available under the "Direction" option is the "Both" sub-option. This places two isocurves at one time - perpendicular to one another - so that now, moving your mouse around on the surface of the ring moves the intersection point where the two cross. Upon selecting the Command line option you need, Click once to place the isocurve(s).

Steps for Using Extract Isocurve

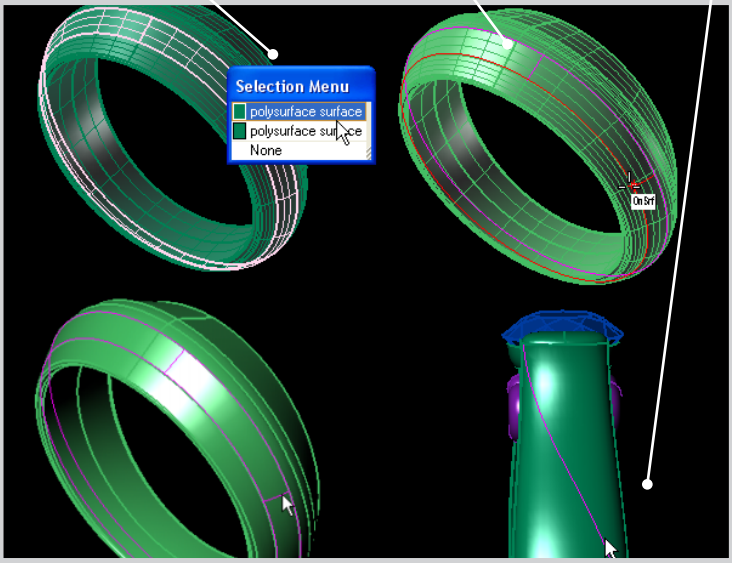
1- Select a surface from which to extract an isocurve. If this is a polysurface, you may only select one component surface, so you may need to run the command several times, snapping to the End O-Snap of the previous curve, and Join all the curves.

2- Select a Direction (U, V, or Both) in which you want the curve to be created. Or, "Toggle" to switch directions between U and V to get the one you want.

3- Move cursor along the surface until the isocurve is at the location you want.

4- Left-click to place it.

GV Extract Isocurve runs the same way (Extract Surface first, in the case of a polysurface) but doesn't offer options. However, press A and D to change the rotation of the curve.



Extract Isocurve only works on a single surface

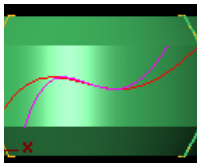
This command only works on single surfaces - not polysurfaces. This means that, if you start it up and select a polysurface, you will be offered one component surface of that polysurface to work on. It's fine to "Extract Isocurve" from many component surfaces of a single polysurface, each time snapping to the previous isocurve, if necessary for your design.



Curves on a Surface...

Pullback & Project

These two similar commands start with a curve in space and end with a curve on a surface; compare their differences and learn to use them.



Pullback shrinks curve relative to its distance away from the surface.

To place a curve of any shape onto a surface or polysurface, try one of these two commands: Pullback or Project. They both work in similar ways, beginning with a curve in space and ending with a curve on a surface. But they also have their differences, which should be noted and used to your advantage.

The "Pullback" Command

This command may be used in any viewport. For best results, the curve should be as close to the surface as possible. This is because "Pullback" literally "pulls" the curve toward a point at the center of the surface doing the pulling. In addition, this command only works with a surface, so that the curve may only be pulled back to a single surface. As a result, upon starting up this command, you will be prompted to select the curve to pullback and the surface doing the pulling. If you try to click on a polysurface, you will only be able to highlight one of its component surfaces onto which to pull back the curve. Finally, in contrast to "Project", the Pullback command will change the shape of the curve to fit that of the surface doing the pulling. "Project" will leave this shape alone.

The "Project" Command

This command will act differently depending on which viewport is active when you select the object on which to project the curve. For best results, run this command in the viewport where the curve appears "in front of" the surface; or, the viewport that already looks like the result you want to achieve. Project will work with a surface or a polysurface. When using a Polysurface, the curve may be stretched or changed as it is wrapped around the polysurface. Also in the case of a polysurface, the curve will be projected onto any part of the polysurface that lies in its "path" when projected; so, you may get extra curves you didn't want, and you may need to delete them. Note: Project (ONLY - not Pullback) works with Rhino History, so that, as you change the input curve with commands such as Scale, Edit Points, etc., the output curve on the surface will change, too.

Pullback vs. Project

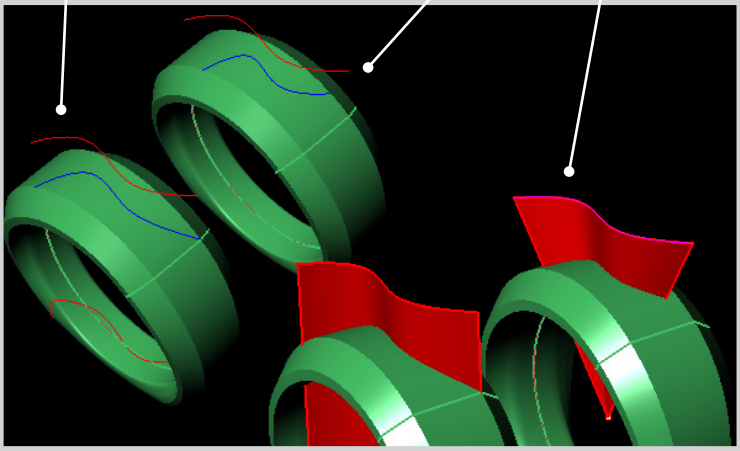
During "Project", select the surface to project onto in the viewport where the curve already appears in correct relationship to that surface.

Behind the scenes, the curve is extruded and the two surfaces are intersected. The intersection curve is produced by the command.

In "Pullback", select the curve and surface in any viewport.

Behind the scenes, the curve is extruded using the "Extrude to Point" option, with the point at the center of the object to which it's being pulled.

Hence, the curve appears to "shrink" as it is pulled back to the surface: the farther away it is, the more it shrinks. The closer it is, the less it shrinks.



Each Pair: L = Project; R = Pullback. Left illustration: result of tools; Right: "Behind the scenes"

How Each Command Works

"Project" works by creating a surface that extrudes straight out in either direction from the original curve. Wherever the curve intersects the parts of the surface or polysurface you selected during Project, the resulting curve is drawn. Pullback works with the curvature of the surface you select, so it can more easily change the shape of the curve; however, when the curve will wrap "around" a corner of a polysurface using Project, you may get better results with Pullback: so try them both!

Delete Input Y / N

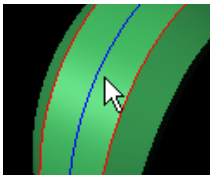
Select this command line option (Delete Input = Y) to delete the original curve. Or, turn it off to save your original creation curves (recommended).

Curves on a Surface...

The Center Line Tool

In the "Tools" menu you'll find the "Center Line" tool, which calculates the center line when handed a surface with two curves on it.

The only Tools menu command that might just belong in the Curves menu, the "Center Line" tool is a handy way to create a curve on a surface that lies perfectly between two existing curves both on the same surface.



Original curves are red; new Center Line is blue.

To use this tool, you simply need a surface with two curves on it. Select the surface, and click the In box in the Center Line Tool builder interface to place it into the builder. Repeat with both curves. Click the GO arrow to see the results.

Sometimes, to get better results on a particularly difficult curve, you may wish to reverse which In box you placed each curve into. This builder has a lot of calculating to do, and sometimes every little bit helps!

Using the Center Line Tool

It couldn't be easier: with two curves on a surface, input the surface and both curves into their respective windows in the builder, and click on "Create Line". Result is blue, below.



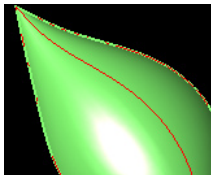


Curves on a Surface...

Other Curve Menu Tools

Polyline on Surface, Interp Curve on Surface, Sketch, Sketch on Surface, Sketch on Mesh, Section, Helix, Spiral, & Curve to Lines.

The reason these commands often don't get used is that it is much easier to edit curves flat (planar) and then project them onto a surface than to edit them once they're already on the surface. Drawing them directly onto a surface can yield unexpected results, making it hard to justify using these tools when you'll have a tough time editing their unpredictable results!



Polyline & Interp Curve on Surface are used most. They draw and project curve together.

Polyline on Surface

Probably the most useful of the lot, Polyline on Surface places straight lines along a surface (they might not look straight as you draw them - remember, they're conforming to the shape of the surface as you go!). It works as though you had drawn them first flat; then Projected them up onto the surface all in one step, as you draw. It's the most useful, because you usually know where you want straight lines to go.

To use this tool, start up the tool, select the surface to draw on, and use it just like the Polyline command, only without the command line options. Press Enter to end the command.

Interp Curve on Surface

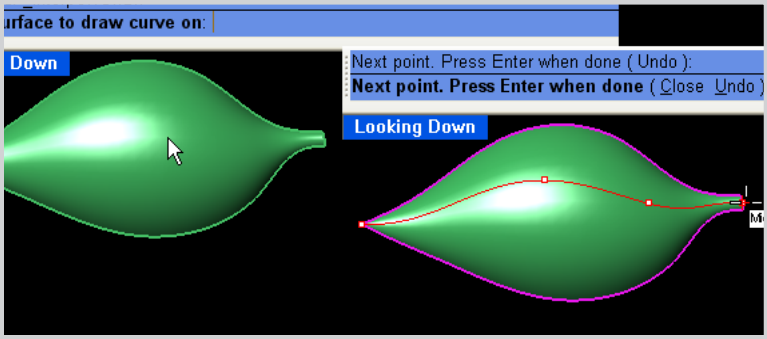
This curve works just like the Interp curve tool, only you'll first be prompted to select the surface to draw on. Although it sounds great at first, you'd better be a wiz' at the Interp Curve tool, or you'd better have a perfectly flat surface... because, when you edit control points to change the curve after you've drawn it on the surface, it's nearly impossible to keep the curve on the surface (unless it's perfectly flat). You'll need to Project the curve after editing it, so you might as well draw it flat and project it in the first place!

Draw on Surface or Draw Planar and Project?

Curves drawn planar can be more easily edited with commands like Split, Trim, Join, and Ctrl Points On. Then, Project or Pullback will get the shape onto a surface exactly where you want it.

When starting from a surface, every curve needs to be on the surface in order to use many of these Editing tools. Control Point Editing, for one, can pull points off the surface, defeating your efforts!

Your best bet for drawing on a surface is Interp or "Polyline on Surface", which can save time when you just want to draw straight lines and project them onto a surface.



Sketch, Sketch on Surface, Sketch on Mesh

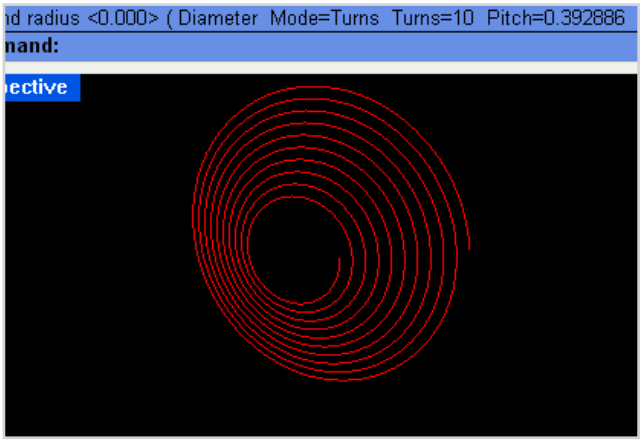
The sketch command is a bit hard to control because, unlike the other curve tools, you only click once where you want to start the Sketch curve; then, the curve is drawn wherever you move the mouse. You might want to use it to "Rough out" a design - like a pencil sketch - before making it with curves, if that's easier for you. It can be used on a surface or on a mesh, as its two neighboring commands suggest. When you start up each of these tools, select the surface or mesh, respectively, on which to sketch.

Section

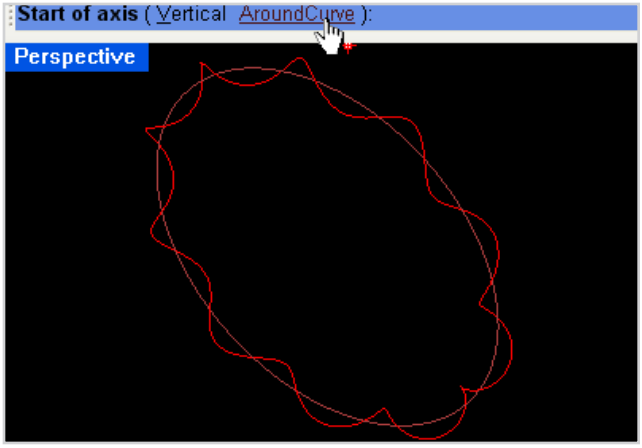
Similarly, the "Section" command places curves on an object. Select an object to add curves to. Click on either side of the object ("Start" and "End" of Section in Command line). Each mouse-click create both ends of an imaginary surface. Wherever this imaginary surface and the original object you selected intersect, a curve will be drawn on the surface. Select the "Layers" option to indicate on which layer color (Current or Input Object color) to draw the curve. Select a "Join Curve" option to select whether or not to join the curves once they are created ("None", all curves on one Polysurface; or, all curves on one "Plane" of the object); also select whether you want curves grouped upon creation; and whether the curves will be "Extended" to be created on all objects within that plane or just the object selected during the "Section" command.

Additional Commands Curve Menu

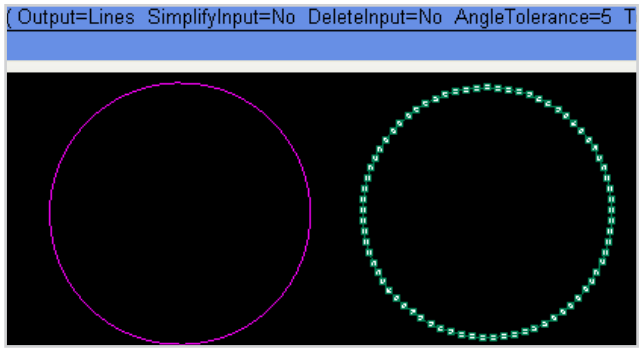
Additional Curve Menu commands used infrequently or in specific situations.



Spiral. Begin by assigning a "Start of Axis", also with the Vertical and AroundCurve options, or "Flat", to create a 1-D Spiral. Like Helix, assign a Diameter, Mode (Turns or Pitch), number of turns in the Spiral or Pitch, and indicate whether to reverse the twist or not. The final mouse-click sets the taper of the Spiral.



Helix. Select a mode: "Vertical" toward you, or "AroundCurve", around a curve you select, as above. Or, just select a startpoint for the center of the Helix. Next, move the mouse to create the helix in the viewports. Or, assign a value for one of the following dimensions by clicking one in the Command line: Diameter, Mode (Turns or Pitch), and then Turns of the helix or Pitch of the helix. To "Reverse" the way it twists, select this option. Finally, assign a number of points per turn of the helix. It is commonly used, as above, to create a twisting style ring (use several instances of the tool) along with the Surface menu command "Loft".



Curve to Lines. Though not used frequently, this tool changes a curve into a polyline (lines or arcs, you choose "Output" Command line option) that re-creates its shape. Options allow you to "Simplify Output", "Delete Input", and assign Angle and general Tolerance. Output (e.g., "Total of 73 line segments in one curve") is reported after curve is drawn. For a more predictable result, simply select the curve and "Rebuild" it with a degree of 1 and the desired number of resulting segments. All segments will be of equal length.

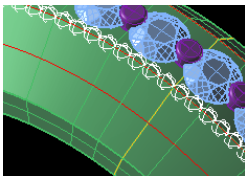
Chapter 4 INTERMEDIATE

Multiple Gems & Settings

Create designs with multiple gems, and complete with Settings & Cutters.

Before Reading this Chapter

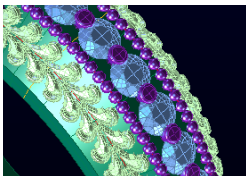
The tools in this chapter come from three menus: Gems, Settings, and Cutters. They involve creating and setting designs with single gems or lines of gems, and require a knowledge of basic Curve menu commands covered in Chapter 3 - such as getting a curve in the shape you want for the gem line onto the surface of a ring or another model you are building (e.g., Extract Isocurve, Project / Pullback Commands). Other basic knowledge covered in chapters 2 and 3, which include how to build many of the rings in this chapter to which the gems and settings will be added, as well as rules for creating good, solid models, are also essential to completing the lessons herein.



If you can place a curve onto a surface, you are ready to go!

Chapter Overview: Gems from Curve Tools

This chapter starts with an overview of the many tools in the program which create gems from curve objects. For instance, with a curve onscreen and a direction to point gems ("Down", to "F4", or to another "Object" on the screen like a curve, point, or surface), you can create a gem line along a curve, controlling start and end points, taper, spacing, sizing, and culet direction, using Gems on a Curve.



Gem, Object, and Bead on a Curve tools created this design.

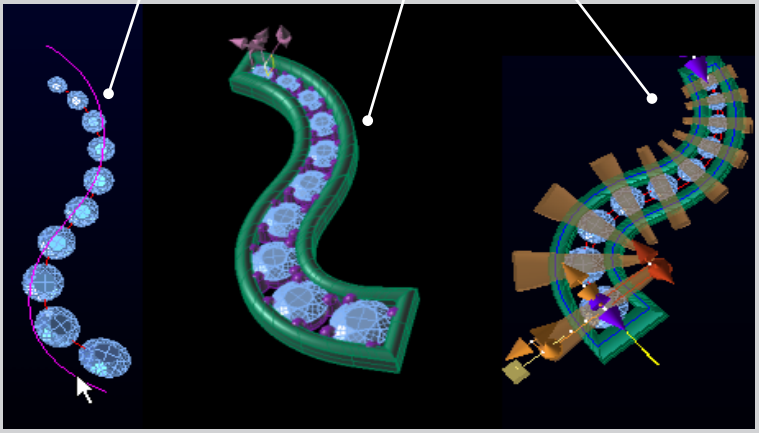
Identical controls allow you to lay out millgrain, library objects for an engraving effect, or any object you can model to create design elements or necklaces / chains with the same ease, speed, and control with which you will learn to lay out gems on a curve (Objects on a Curve tool).

Using Gems, Settings, and Cutters with History

The gem tools with history you'll learn in this chapter include Gems on a Curve and Objects on a Curve. "History" means you may assign these elements an object to point to, and - when you move that object - the gems' culets will follow it.

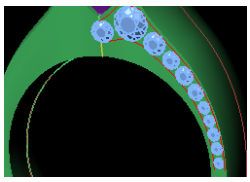
Settings - including Prongs, Metal Piece, and Channel Border learned here, as well as Bezel Builder taught in Chapter 2 - follow their gems around onscreen, keeping up with changes you make to gems using MSR or other tools.

Cutters don't follow gems as Settings do, but gems retain a history of cutters created on them, even after they are Booleaned. So, you can use Match Attributes to get a cutter back and redo the cut, for a breed of "History" with cutters.



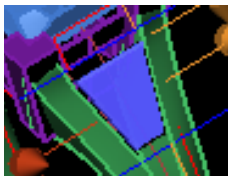
Both of these applications work with History, meaning you can change the object they're pointing to and the gems' culets (or objects' bottoms!) will rotate to continue pointing at the input "directional" object. This can make for sophisticated banking gem layouts, easy cluster-head designing, and other powerful applications.

Two similar tools lay out round gems or baguettes between two curves you create and input. This functionality is brand-new to Version 6 of Matrix, and involves really tough mathematics to create amazing - but not interactive - results. You may change settings and re-run these tools to make design changes.



Matrix can now place gems between two disparate curves.

Another tool into which you place 2 curves to create a gem is Baguette between two curves, which combines the functionality of Baguette Builder and Gem Positioner by creating the baguette right at the point in your model where you'll need it.



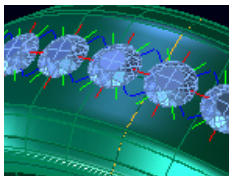
Input two curves to easily build a tapered baguette.

The Custom Gem tool also requires a closed curve in the shape of your gem with points at each corner. It creates a custom gem or diamond for which you can control every dimension to save a re-usable custom gem into the Gem Loader tool.

Chapter Overview: Managing Multiple Gems

Gem Reporter lets you know what sizes of gems you placed and where onscreen each one is, while providing you a report on Total Carat Weight (broken out by gem) which you can print and even adjust by inputting different materials (emerald, instead of diamond, e.g.) for selected gems.

Gem Guides place curves and information onscreen helpful with managing gems or modeling further designs around gems. Many of these designs involve more advanced tools, but Gem Guides can also be helpful visual cues for placing things like settings and cutters, covered in the remainder of this chapter.

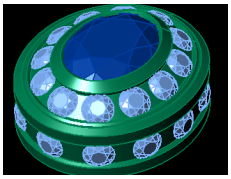


Gem guides are helpful modeling tools.

Chapter Overview: Setting Multiple Gems

To set gem lines, two helpful prong tools - Prong Adder and Prong Editor - are new in Version 6. These work with History so that, when you move gems with MSR, the prongs follow and maintain an attractive layout with other prongs in the gem line.

Metal Piece, which also works with history, builds walls with a profile top and channel floors, if desired, around a line of gems already placed onscreen. It lets you design around gems, instead of adding gems to metal the way you normally would have designed in Matrix in the past, and provides amazing new design possibilities. Since it works with History like prongs do, a metal piece follows its gems around, maintaining an attractive layout whether one or many gems is edited with Move, Scale, and Rotate.

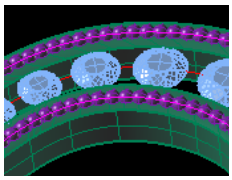


Now, base designs on gem layouts - add metal after!

Channel Border, its close cousin, places a history-enabled rectangle around gems that can also follow them when they are moved, creating path curves for millgrain or other designs along a curve, or simple rail curves for building your own "Metal Piece" with Profile Placer and Sweep 1 or 2.

Chapter Overview: Gem Cutters

To cut one or many gems, a number of new or newly-updated Gem Cutters are explained in the Gem Cutter section of this chapter: Channel Builder, Micro-Prong, Gem Cutter / Azure, Cutter Library, Bright Cutter, Bright Cut Channel, and Bezel Cutter (for scalloped bezels) are all among these tools. Most of them work with fun, intuitive "Interactive Booleans", which show the results of Booleans - not the cutter only - as you move the slider controls or handles, and produces the Booleaned result - not the cutter - as a result of running the builder.



Gem on Curve, Metal Piece, Channel Border, and Bead on Curve.

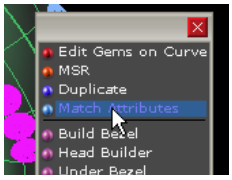
Gem Cutters don't work with "history" per se, following their gems around onscreen, but they do work with Match Attributes and Style Save / Load: meaning gems retain a "memory" of the cutters that have been applied to them. Therefore, using Save / Load Styles and/or Match Attributes, these settings can be transferred from one gem to another. A gem can also "Match Attributes" to itself, to bring back a cutter from its past and re-cut the surface if you make any changes to it (with Sweep History, for example). Together, these tools provide an intuitive History workflow that makes it easy to manage design changes - even when using Booleans!



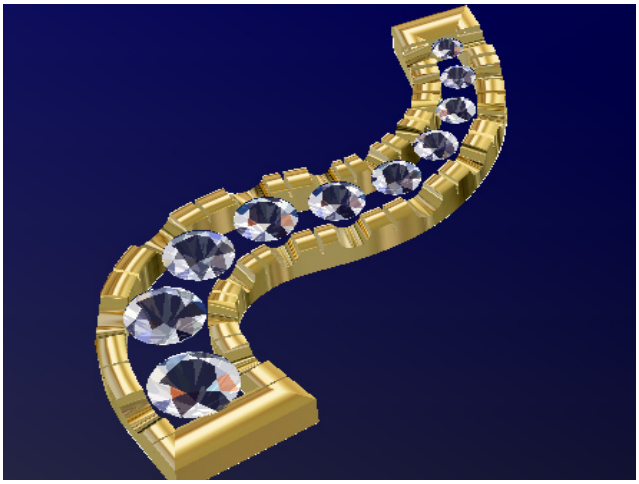
New Bright-Cutter Tool.

Chapter Overview: Boolean Tools

Finally, understanding cutters requires an understanding of our good old friends the Boolean Tools, so this chapter will end with an explanation of Boolean Builder (to union, cut, or intersect solid models), the Boolean tools in the Solids and Mesh menus, and the related tools in the Utilities menu that help you cope with misbehaving Booleans.



Match Attributes for History on Gems and Settings.



Skills & Commands in this Chapter

Gems from Curves Tools:

Gem on Curve, Object on Curve, Bead on Curve, Advanced Cluster Builder, Gems Between 2 Curves, Baguette Channel, Baguette between 2 Curves, Custom Gem Builder



Managing Multiple Gems:

Gem Reporter, Gem Guides



Setting Multiple Gems:

Prong Adder, Prong Editor, Metal Piece, Channel Border, Gem Profile



Cutters for Gems:

Channel Builder, Micro Prong Builder, Gem Cutter, Cutter Library, Bright Cutter, Bright Cut Channel, Bezel Cutter (found in Cutters & Settings menus)



Boolean-Related Commands:

Tools Menu: *Cut to Finger Rail, Boolean Builder, Object Checker, Metal Weights*



Solid Menu:

Boolean Union, Difference, Intersection, Boolean 2 Objects



Utilities Menu:

Check Object, Show Edges, Join Edges, Merge Edges, Select Bad Object, Extract Bad Surface, Directions



Info & Settings Menu:

Object Info, All Object Info, Super Select

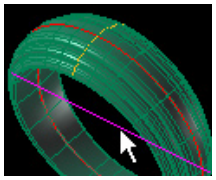


Gems from Curves ...

Gems & Objects on a Curve

Set gems along a curve, assign where they will point, and adjust size, spacing, and taper. Additional tools place millgrain & library objects.

About Gems on a Curve



Extract Isocurve or Project (above) places curve on surface.

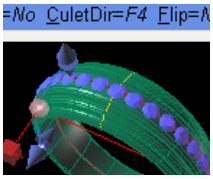
Simply create a curve along which to place gems, and start up this tool. This curve may be located anywhere in space - if you will be creating settings around the gems to design the jewelry from the gems - or it may be located on the surface of your jewelry if you created the metal first.

Using Gems on a Curve & Culet Direction

Input a curve into this builder, or select a curve and choose this builder from the F6 menu, and preview gems along the curve, with handles, will appear. The builder interface with the Command Line options will also open.

The most logical first step when using this tool is to select a "Culet Direction" by clicking this Command Line option. Choose "F4" for a perfectly round band, or "Down" when gems are on a perfectly flat curve.

For more sophisticated layouts, select the "Object" sub-option and click the curve the gems are on, or the surface if that curve is on a surface, to create the most natural layout, where the gems follow the curvature of the surface or the banking shape of a curve. Or, place a Point object in space before starting this command and select this as the object to point to, creating a uniform angle for all the gems to point to. With Matrix History turned on, the gems will keep up with this object, so that if you reposition or scale it at any point, the gems will continue pointing at it.



For Culet Direction, select "F4" or "Object" (select surface) with gems on a surface.

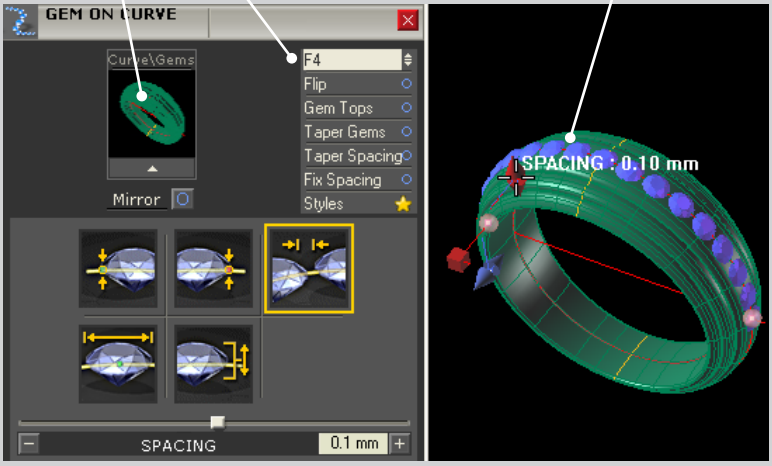
With a Culet Direction assigned, begin using a combination of the Command Line options AND the handles or builder interface controls (described below) to set up a gem layout. Press Enter to end the builder and keep these results.

Steps for Using Gems on a Curve

1- Start up this builder and input a curve into the Curve preview window. Or, select the curve, press F6, and select this builder. The preview gems (solid blue) with handles will appear.

2- Select a "Culet Direction" by choosing this option. This may be F4, "Down" (all gems pointing in a negative direction from the line), or any "Object". When choosing object, click the curve, a surface, or a point object already in space to assign a direction for the gem culets to point. "History" will cause these gems to keep pointing to this object even after it is moved or scaled.

3- Set slider controls or handles, and options, to create the layout you like. Press Enter when done.



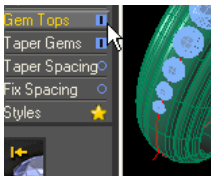
Identical controls, options, and handles appear when using Object and Bead on Curve tools.

Gems on a Curve Handles & Builder Menu

The Start and End position sliders (indicated by spherical handle controls) indicate the Start and End positions of the gem layout. The gems start and end a distance of 20% of the curve's length away from the start and end points of the curve, for ease when creating closed loops of gems.

Set the Gem Spacing slider or handle to indicate the Minimum spacing between gems. To assign a "set" (non-changing) space between gems, use the "Fix Gem Spacing" option. The builder will change the gem sizes to accommodate the spacing you want.

The "Gem Size" slider sets the exact size of the gems in the layout (unless



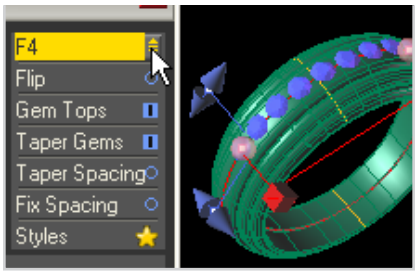
With a tapered layout, Gem Top Height ensures little gems won't be lost.

"Fix Gem Spacing" is turned on); or, in the case of a tapered layout, you will see two separate sliders and two handles - one on either end of the gem layout that assign the size of the first and last gem in the layout and allows the program to taper the gems uniformly from one end to the other between these two sizes.

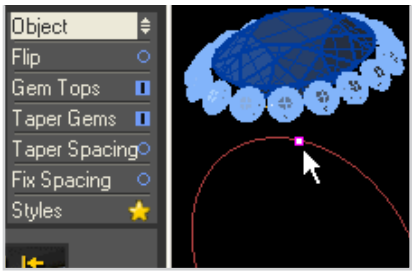
The Z offset slider / handle assigns the distance the gems' girdles will be moved above the line. In the case of a tapered gem layout or a layout that will be channel-set, you may wish to select the "Gem Tops on Curve" option, which sets every table even to the input curve and allows this slider to move the gems' tables above or below the curve.

Command Line Options Gems on a Curve

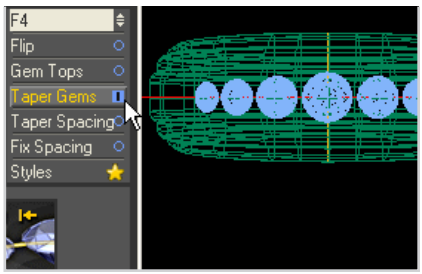
These Command Line and Builder Menu Options to change how this tool works.



Culet Direction After the preview gems appear, start with this option first. Select it and choose one of its sub-options (F4, Down, or Object) to assign where the culets will point. F4 is most commonly used when gems are on a perfectly round band, or if the center of the finger rail is a good place for a cluster to point. "Down" is most commonly used on a flat pendant. Choose "Object" and click on an object for

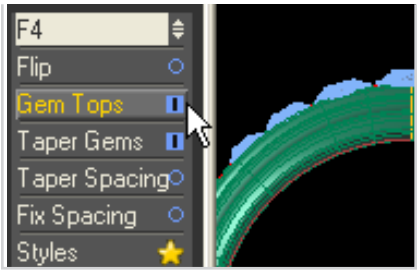


the culets to point to (select the curve on which the gems lie or surface on which curve lies) to follow the shape of a nonplanar curve most naturally. Or, select another Object in space, such as a point object you placed ahead of time, to point all culets to this - usually for a cluster head. With History enabled, moving the object will cause the gems to re-angle their culets to keep pointing to it.



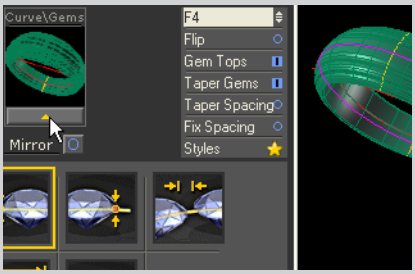
The "Taper" Option Set this to "Yes" to create a tapered layout. This adds one more handle / slider. Set largest and smallest size, and the builder will taper the gem layout uniformly between them.

The "Mirror" Option With "Taper Gems = Yes" in the Command line, this option places the extra set of handles ("End" point) in the center of the existing gem line.

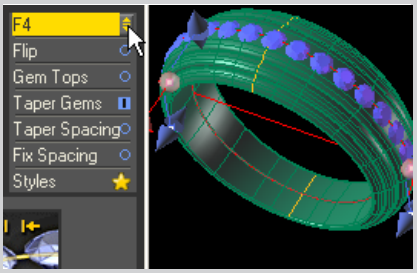


Gem Tops on Curve This is most commonly used with a tapered layout, to ensure the littlest gems do not get lost too far below the surface. It sets all the gems' top heights even with the input curve. In that way, raising or lowering them moves the tops of the gems a uniform depth in relation to the curve. Otherwise, their girdles are matched, which can leave the littlest gems too low.

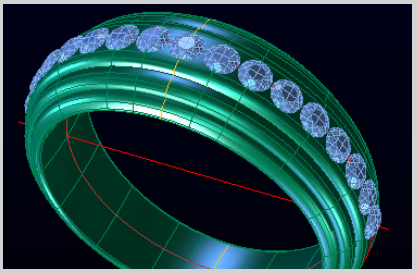
Step-by-Step
Gems on a Curve



1 Select curve. Select a curve and press F6; then, select this command to start it. Or, start up this tool and input the curve into the Curve In-Box.



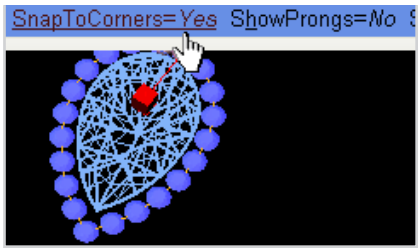
2 Select a direction to point gem culets. Select the "Culet Direction" option from the Command line and choose F4, Down, or an Object (such as the surface the gems lay on, or a Point object they should all point to).



3 Arrange sliders, handles, or options, & press Enter. Set up gems the way you want them using Command line options, handles, and/or slider controls in the builder interface. Press Enter when done.

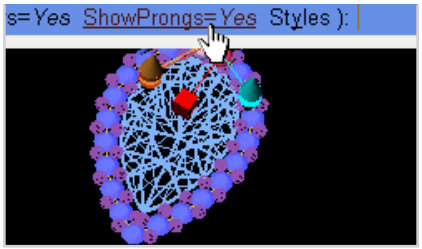
Gems on a Curve Command Line Options cont'd

These Command Line and Builder Menu Options to change how this tool works.

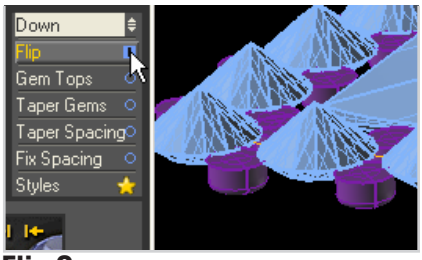


Snap to Corners When your input curve has sharp corners, select this. For best results with square and Emerald shapes, use Emerald Cluster.

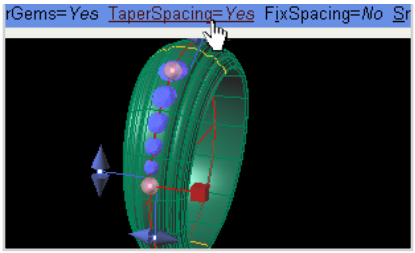
Styles Select this option and choose a Gemvision-created Style or one you've set up yourself using Style Save & Load.



Show Prongs Select this option to control prong and gem layout together. Prong Placer handles will appear. The current prong placer options will be used, so set these up ahead of time before entering Gems on a Curve to preview the look you want. Or proceed to Prong Placer using F6 on the prongs, and change them with History.



Flip Gems Click on this option when the gems accidentally come in culets-up (usually happens when surface is open and surface directions are pointing inward, not outward - which is the correct direction for a Solid object). Or, to create really cool biker jewelry, select this option to flip culets!

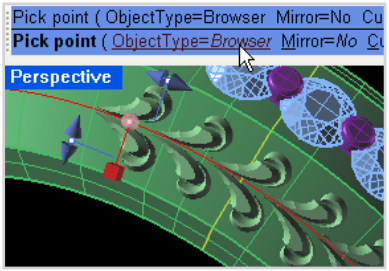


Taper Spacing With "Taper" selected, this option will taper the spacing between gems, with less space for smaller gems.

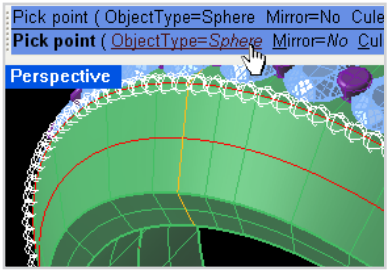
Fix Gem Spacing This fixes the spacing you choose and changes the gem to accommodate it. Usually, the builder changes the spacing in relation to the chosen gem size.

Bead / Objects on a Curve Tools & Options

Object Type option, Bead on Curve Setting, & Object on Curve Tool work the same.

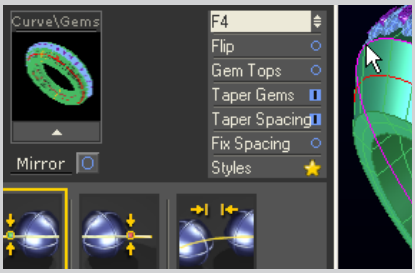


Object Type This option starts the "Object on a Curve" Tool, which begins with the "Object Type" option. Select from among the available sub-options. The tool is then identical to the Gems on a Curve tool, including all the options.

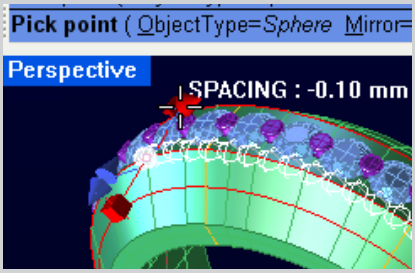


Sphere Sub-Option This option starts the "Bead on a Curve" tool, which places a bead - with all the Gem on a Curve options - along the curve. You may adjust size, spacing, taper, and all other options the way you do with gems.

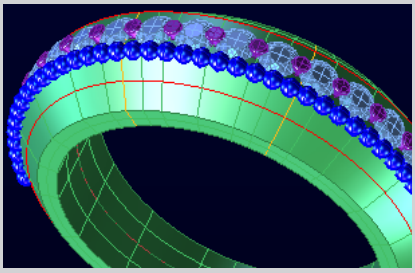
Step-by-Step
Objects on Curve



1 Select curve. Select a curve and press F6; then, select the command - Bead or Object on a Curve - to start it. Or, start up the tool of your choice and input the curve into the Curve In-Box.



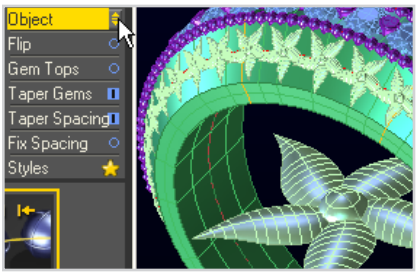
2 Select Object. Or, Beads & Handles will appear. With the Object tool, you must first select the object you have modeled to place, before handles will appear. With the Bead tool, you will immediately see beads with handles.



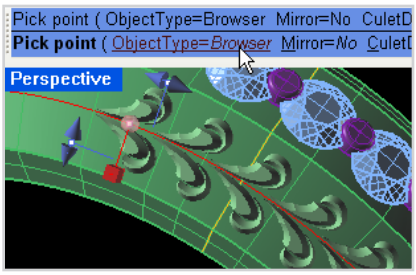
3 Use handles, builder, & options, press Enter. Set up the arrangement using the same controls, handles, and options as Gem on a surface. Choose "Browser" and select a library object to array instead of a sphere or an object you modeled. Press Enter to end the command and keep the layout.

Objects on a Curve Tools & Options

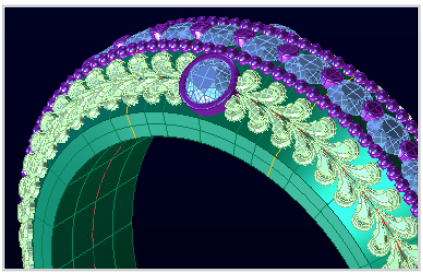
"Object Type" option, "Bead on Curve" Setting, & "Object on Curve" Tools all work the same.



Object Sub-Option Select this sub-option from "Object Type" during the Bead, Object, or Gem on a Curve tools when you've ALREADY modeled an object (centered and at the correct orientation to F4) that you wish to place onto the curve. Select the object, and it will be laid on the curve with all the available options.



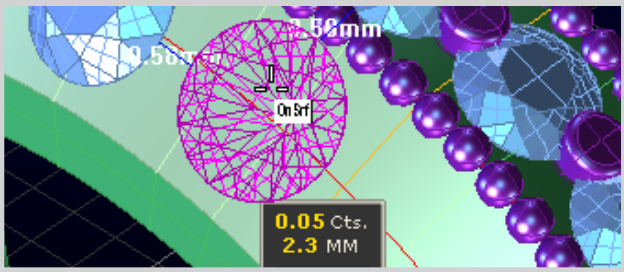
Browser Sub-Option Select this sub-option during "Object Type" to open the browser at the bottom of the screen and select a Gemvision-created object to array on the curve with all the available options in these tools.



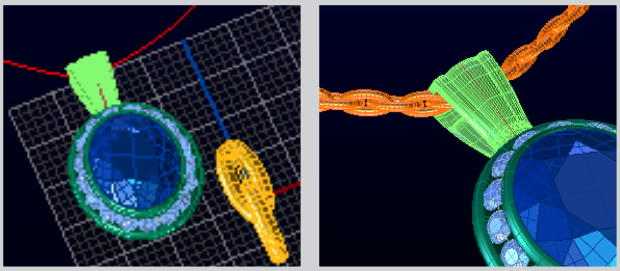
Object & Bead on Curve Tools The Object on Curve Tool & Bead on Curve Setting work just like Gems on a Curve with the relevant (Object you drew or sphere) "Object Type" sub-option selected. In other words, they start right up where each sub-option does, and are otherwise identical to the Gem on a Curve tool.

Tips & Tricks: Gems on a Curve

Check out some strategies for using this & other related builders to get exactly the design you want.

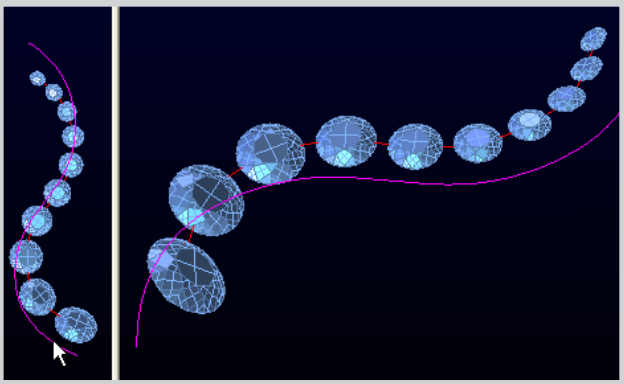


Gem on a Curve or Gem on a Surface? When you have a specific number of gems and their sizes, and you need to lay them out on a curve at a set distance apart, Gems on a Curve might NOT be your best option! Instead, jump into the Gem on a Surface tool and use the Curve option to select a curve to snap to. Within this tool, you can assign a specific gem size & spacing, and lay out gems manually (see relevant manual entry for more details.)



Create a Necklace Simply draw a "path curve" representing where the necklace will track through space, and use Jump Ring Builder or other tools to model a single instance of the repeating portion of the chain (object rotated / copied and moved). Using Object on a Curve, select the object you modeled (or choose one from the browser) and array it on the curve. Simple, huh?!

Sophisticated "Banking" Gem Designs Make the most of the History capabilities of this tool! Before adding gems to the curve, Offset the gem line a small distance below the original. Start up Gems on a Curve and use the Culet Direction > Object option to point the gems to the offset curve. After adding gems - and even history-enabled settings - select the offset curve and experiment with moving it, scaling it, and dragging its control points to create sophisticated banking and curving shapes for the gems' direction! History is a powerful design tool in and of itself, so don't miss an opportunity like this one to create never-before-imagined effects with your gem layouts!



After offsetting curve and pointing gem line at it, try transforming it with 2D scale, as above, to create banking gem designs.

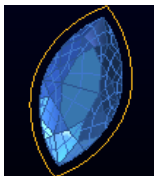
Gems from Curves ...

Advanced Cluster Builder

Place gems on a curve around center stone (except square or emerald). Control size, spacing, position, & angle. Metal Piece adds cluster setting.

Preparing to Use this Tool

Advanced Cluster Builder can place a loop of gems on any closed curve - including those with corners like Marquis shapes (although for square, rectangular, or emerald-shaped stones, use Emerald Profile or Emerald Cluster to control the corners of the layout).



Begin with a curve on which to place gems (usually around center gem).

However, it is most likely that you will set up this curve around a center stone, so proceed first to the "Gem Guides" or "Gem Profile" tool, both of which place a profile curve around a gem. The Gem Profile curve can be adjusted with Profile Placer handles to size it correctly for the cluster, while the Gem Guide curve (called "Bezel Profile" in this tool) may be offset by providing a value in the "Offset" text box in the builder. Using either method, get a curve around the stone at the size and spacing desired to start the cluster (you'll also be able to adjust its size while using the tool).

Using this Tool

Advanced Cluster Builder can place a loop of gems on any closed curve - including those with corners like Marquis shapes (though, for square, rectangular, or emerald-shaped stones, use Emerald Profile or Emerald Cluster to control the corners of the layout).

To use this tool, select the curve you placed around the center stone (above) and select this tool. Handles and Command Line Options will appear.

Using the Handles

The handles, working from left to right, clockwise, allow you to set the Length of the gem line so it can grow longer in the Y direction than in the Z direction; the Z offset above or below the curve; the Gem Size and Spacing (controlled together while using this tool), the Angle (rotational handle) of the gems, and the Curve Offset, or, how far away from the curve the gem line is placed, overall.

Adv. Cluster Builder Viewport Control Handles

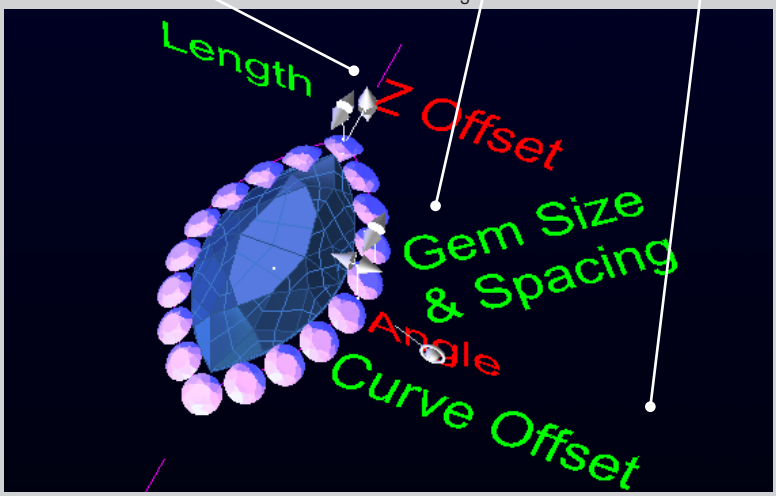
The Length handle at the top of the cluster lengthens it in the Y direction so it may be longer than it is wide.

The Z offset, also at the top of the cluster, moves the entire arrangement above or below the input curve.

Gem Size and Spacing is driven by this handle together with the Command line options that indicate how the gems will be centered in the cluster.

Angle allows you to tilt the gems in the cluster. You don't assign a "Culet Direction" when using this tool: use Gems on a Curve if you need to do this, instead.

Finally, the Curve Offset slider indicates how far away from the original curve the gem design will be placed, overall.



This tool has no interface; just select a closed curve & use handles, Command line options. The two cue lines indicate "Mirrored" or "Quad" symmetry.

Using the Command Line Options

The reason the size and spacing are controlled together during this tool is that it is automatically calculating them based on how you elect to have the gems laid out. This is determined by the settings you choose in the Command Line options. "Use Corners" will cause the gems to snap to the corners of a curve with corners. Turning this off will not allow them to snap to the corners. "Corners On / Split" determines whether the gem will be offset from (Split) or right on (On) the corners. The Top and Bottom are similar to the Corners option, allowing the gems to be centered on (On) or evenly offset on either side of (Split) the Top or Bottom of the gem layout. Finally, "Symmetry" (indicated by two cue curves that appear when handles appear) allows you to Mirror the cluster from one half to the other or in Quadrants (Quad).

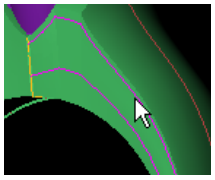
Gems from Curves ...

Gems Between 2 Curves

Assign spacing between gems and select two curves to create a gem layout that touches both curves.

About Gems Between 2 Curves

To set up this tool, start with two curves in space that roughly match in length and shape. They need not be planar, and the spacing between them may vary significantly. This tool will accommodate those differences.

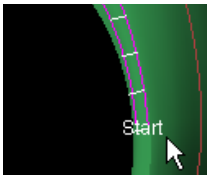


Extract Isocurve or Project to get curves on surface.

Start up this tool and select the Command Line options you want for the layout (explained below). Then, select the two curves between which you want to place the gems.

The "Start" and direction cues will appear onscreen. "Start" indicates the end at which the layout will start. Click the "ChangeStart" option to switch this to the other end. The white lines indicate the direction of the gems' tables. Click "Flip" in the Command line to reverse these, if necessary (they should be taller in the direction you want the gems' tables pointing).

With the Orientation correct, press Enter to create the layout. While this adorable tool is at work, you'll see the gems begin to appear as the "inchworm" moves along. Wait patiently for it to finish. While you do so, think up an affectionate name for this little guy! (With the AutoSpacing option on, the tool will try several times to get the spacing of the end gem right, so give it a little extra time!)



Options assign table direction & start point.

Command Line Options

BEFORE selecting the two curves, set the Command line options described here: "Spacing" sets a value for the spacing between the gems. "Mode" toggles between "Spacing" and "Shape". The builder can ONLY set the spacing you desire OR conform perfectly to the shape of the two curves - NOT both at once. So to choose which one wins - "Space" between gems or "Shape" of two curves - choose one of these two modes. "AutoSpacing" refers to the spacing of the end gem. With this turned On, the end gem will try and fall at the end of the two curves, which will affect the rest of the layout. This causes the builder to try the layout several times in a row before getting it right, so be especially patient with this option turned on. Setting this to Off lets the end gem fall in natural relation to the remaining gems in the layout, without regard to the ends of the curves. The "Gem Top" option sets the tables of the gems even with the lines. With this Off, the girdles of the gems will be even with the lines.

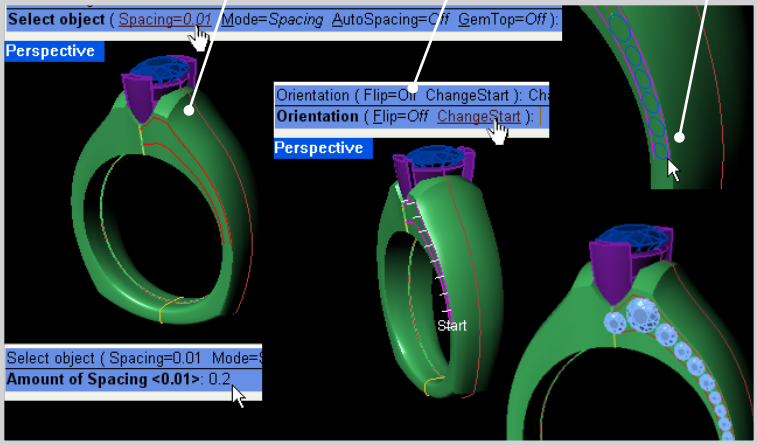
Steps for using Gems Between Two Curves

1- With NOTHING selected, start up tool and indicate spacing in the Command line.

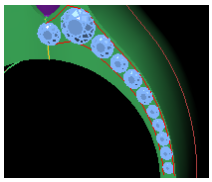
2- Select two curves to use in the builder. Gems will touch both curves, so they should be roughly the same length. The space between them may be tapered, and they need not be planar.

3- Check that the "Start" location and Table Directions (indicated by white lines) are correct. Choose "Flip" to reverse the Table Directions and "Change Start" to switch the Start and End points of the arrangement.

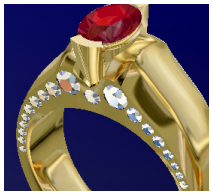
4- Press Enter to run this tool. Wait patiently while it runs, and think up a cute name for the little "inchworm" you see placing the gems.



There is no builder interface for this tool: Simply start this tool, select two curves, and set the options desired to create a gem layout between them.



1 half laid out; center gem moved; layout (except center) mirrored.



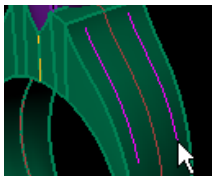
Gems from Curves ...

Building a Baguette Channel

Similar to Gems Between 2 Curves, this tool places baguettes between two curves. You assign size, taper, spacing, and banking.

Using Tapered Baguette Channel

Select two curves and input them into the "Curves" inbox in this builder. The "Start" point (which end of the lines the gem layout will begin) and gem directions - white lines indicating direction of the tables - will appear.



Extract Isocurves & Trim, or Project place curves on surface.

Use the "Flip" option to switch the directions of these white lines, if they're pointing opposite of the direction in which you want your tables. (Also try switching the order in which you select the curves to input them into the builder if this does not appear to solve your culets-up problem.)

The "Middle" option starts the first gem (at the "Start" position on the curves) so that the middle of the gem - not the edge of the gem - aligns with the ends of the curves.

Before clicking "Apply" to place the gems, check that the values in the "Size", "Aspect", and "Banking" tables in the builder match the layout you want to achieve.

Size, Aspect, Banking, & Spacing

Set the "Size" of the baguettes, in mm, the taper or "Aspect" ratio (percentage of change in size from one end of the baguette to the other) up to 100% (straight), and degrees of Banking you'll allow in a nonplanar pair of lines, to control how the gems "bank" or rotate as they move through space when they are laid out.

To add a value to one of these lists, type the value into the text box beneath the list and click on the green arrow. The value will appear in the list. To "Remove" a value from the list, select it in the list so it is highlighted, and click "Remove" at the bottom of the list.

Set the Spacing between the gems by typing a value into this field, in mm.

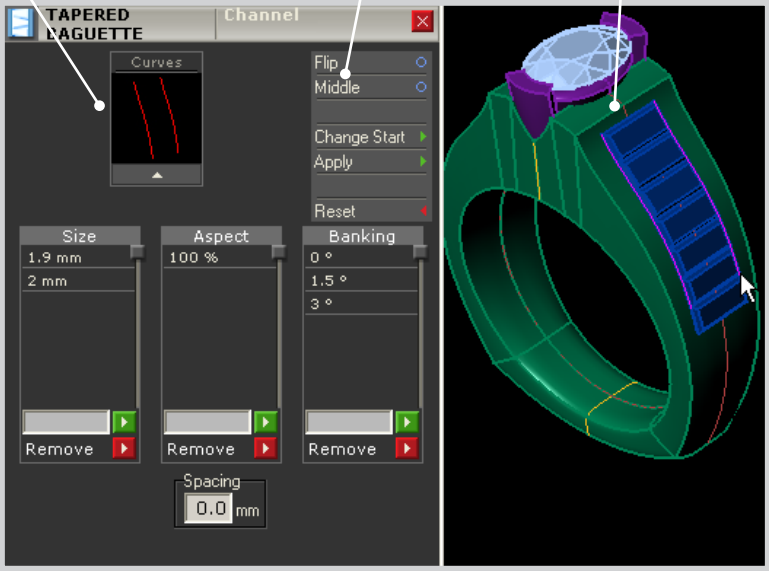
Steps for using Tapered Baguette Channel

1- Create two curves between which you want the channel. Select them both, and input them into the "Curves" In-Box in this builder.

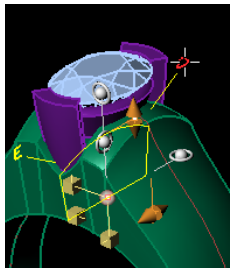
2- When the "Start" and "Direction" cues appear, determine whether you need to change the end where the arrangement starts ("Change Start" option) or "Flip" the directions of the tables (tables point same way lines do).

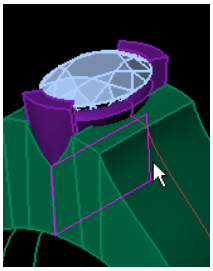
3- Set up Builder or Command line options to choose stone sizes, taper amount (Aspect ratios of either end of baguettes), and degrees stones will be allowed to bank or turn to accommodate nonplanar curves.

4- Click "Apply" to see results.



Notice: This ring and the previous ring are the same design, quickly varied using Sweep 2 History (change profile from rounded top for Gem Between 2 Curves ring and flat top for Baguette Channel ring). Easily draw curves for either gem option, and you've just quickly created two variations on one ring! You could even run this live in front of a customer, for a truly interactive custom retail experience. Quickly output it to the Revo and you'll have the customer's desired model in a few short hours, from start to finish!





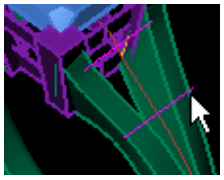
Gems from Curves ...

Baguette Between 2 Curves

Access Baguette Builder controls together with the ability to position the gem between any 2 curves. Use with MSR & Baguette Builder to perfect your design.

Using Baguettes Between 2 Curves

This builder contains all the Baguette Builder options, together with "Point A" and "Point B" handles / slider controls to position each end of the baguette along two curves you input into the builder to start it up.



Draw and Move two curves into position for baguettes.

Create these two curves where you want the gem to be located in your design.

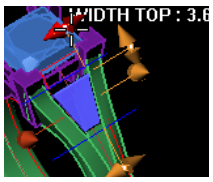
After inputting the curves, the preview gem will appear. Begin moving the handles, as explained in "Chapter 2, Building your First Ring," to create the gem. The two new handles / slider controls - "Point A" and "Point B" move the gem along each of the curves independently, to position it wherever you want in relation to your design.

The "Flip" option will reverse the table / culet of the gem.

Press "Enter" when you like the results of the builder.

Companion Tools

Tools related to this command include Baguette Builder and Gem Positioner (MSR). After creating a baguette with Baguettes Between 2 Curves, start up Baguette Builder and input the gem to continue editing it.



To edit a baguette after placing it with this tool, input it into the regular Baguette Builder.

If you need to Offset or Angle the gem in relation to the two curves, press Enter to end the command and select the gem. Press F6 and choose MSR (or use Gem Positioner in the Gems Menu). Offset or angle the gem as necessary, press Enter to end the Positioner command, and return to Baguette Builder (input the gem) to continue editing other dimensions if necessary.

Steps for using Baguettes Between 2 Curves

1- Place two curves where you need one or more baguettes.

2- Input curves into Baguette Between 2 Curves builder.

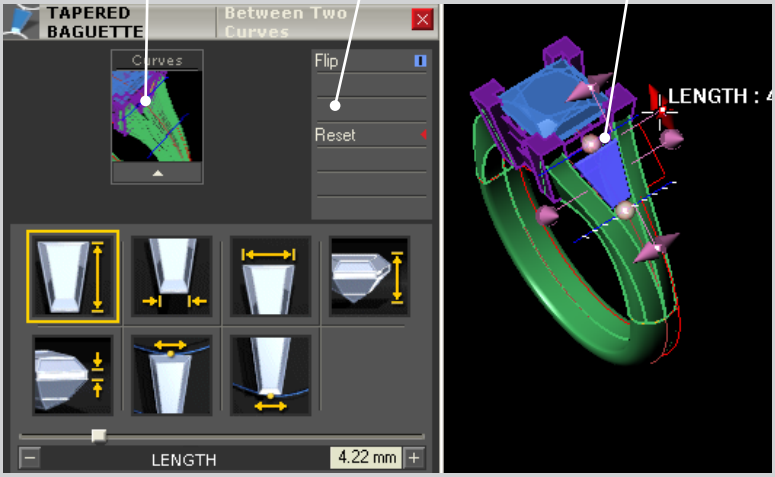
3- Gem with handles will appear. Using handles or builder controls (same as Baguette Builder), size gem. Two additional controls position top and bottom of gem along curves.

4- Press Enter to create gem.

5- Run the command again to manually create a row of baguettes.

6- To offset or angle baguette(s), run MSR (gem positioner).

7- To re-edit a gem, input it into Baguette Builder. Handles will appear at gem's current position.



Gems from Curves ...

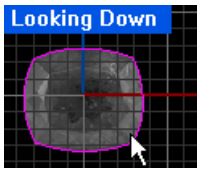
The Custom Gem Tool

To create a gem in any shape you need, draw an outline of the shape, place points at facets, and create & save gem for future use with this tool.

Preparing to Use Custom Gem

When you don't see exactly the gem shape you need in the Gem Loader, use your Curve drawing skills to create a closed, planar curve centered at F4 in the shape of the gem.

A great way to do this is to first shoot a picture of the gem, bring it into the Looking Down viewport using Place Background Bitmap, and Move / scale it so it is centered at F4 and roughly to scale (if this builder fails, your curve may be too small. Try scaling it up to a size of roughly 10 X 10 mm, and you will be able to specify the correct size upon loading the gem later on with Gem Loader).

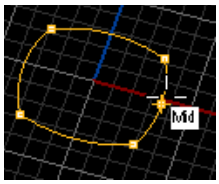


Place Background Bitmap of gem & trace with curves.

After tracing the gem, place Point objects at each of the locations on the gem where a facet will appear: usually at the corners in the shape. Also place a point object along the right-hand side of the shape, roughly in the middle of that side.

Starting Up the Custom Gem Tool

With the outline drawn - planar in Looking Down & Centered at F4 - together with its point objects indicating facets and the middle of the right-hand side of the gem, start up this builder. Input the curve into the "Curve" In Box and ALL BUT the right-hand-side point object into the "Facet" In Box. Finally, place the Right side point object into the "Right" In Box. Select whether you'd like a "Diamond Cut" or a "Gem Cut". The interface controls will change based on which cut you select.



Place points at locations of facets & middle of right-hand side.

Using the Slider Controls for this Tool

Both the Gem and Diamond Cut slider controls include selections for Facet Count, Crown Angle, Crown Height, Girdle Thickness, and Pavilion Depth.

Steps for Using the Custom Gem Tool

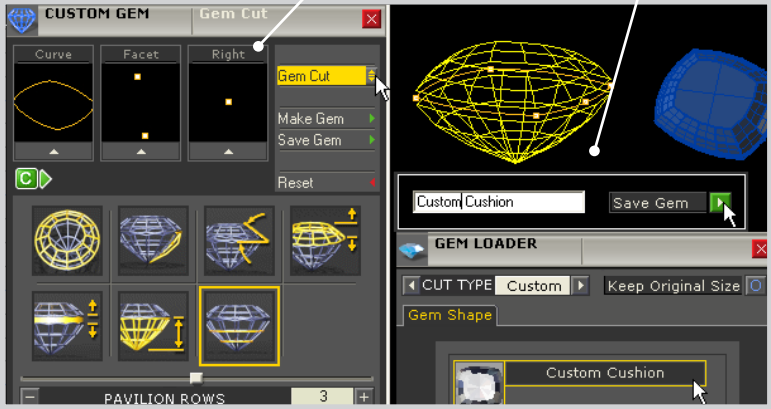
1- Use Place, Move, and Scale Background Bitmap commands to center an image of the gem at F4 (best).

2- Trace the image, or draw the gem shape, in the Looking Down Viewport. Curves must be planar, joined, closed, and centered at F4. Use Center Object Utility to help you.

3- Place Point objects at the facets (corners of shape). Place a Point object at the middle of the right-hand side of the curve.

4- Input Curve and Points into Custom Gem tool and select Diamond or Gem cut. Set up dimensions of gem and "Make Gem".

5- "Save Gem" with a name. Delete model, as gem MUST be loaded from Gem Loader before it can be used as a gem.



Remember: the object made by the builder is NOT a gem object! To create a gem object using the new gem you just added, go to Gem Loader > Cut Type "Custom". You may even change dimensions - Width, Length, Depth, and Percentage - of new gem.

With the desired dimension selected, click and drag the slider control, or type in a value and press Enter. The Gem cut adds slider controls for Bulge Factor (angle of pavilion) and Pavilion Rows, to make the colored gemstone cut look more realistic.

Creating the Gem

When the gem is set up with the dimensions you want, click "Make Gem" in the builder to keep these settings. Finally, click "Save Gem" to add this to the Gem Loader as a gem object.

Loading the New Gem for Use

Note: The gem is NOT ready to be used in your design yet!!! You MUST proceed to Gem Loader, select the "Custom" gem type, and load your gem from this list so it will work like any other gem in the program!

Managing Multiple Gems ...

Using Gem Reporter

View and save a list of gems currently in use. Report carat weights based on gem materials you assign. Select gems onscreen by size or type.

Using Gem Reporter

Start up this tool to see a report of the Total Gem Weight and Total Gem Count of the gems currently in the viewports.

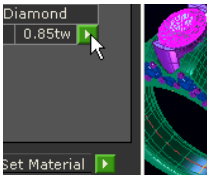


Total weight and gem count are displayed in Gem Reporter.

Click the Advanced Options arrow to open the remainder of this builder. A list box will appear, indicating (left to right, from top down): Gem Shape, Gem Type, Gem Material, Gem Size, quantity of each size, and total weight of quantity of that size.

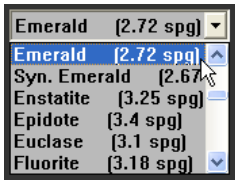
Selecting Gems, Changing Gem Material

To select all the gems of one size, click the green button beside that entry in the list. With the gems selected, you can proceed to the bottom of the menu and choose a new material from the list box. Click on "Set Material". Then, click "Update" at the top of the report. The carat weight of the gems will be calculated for the new material.



Click green button to select gem(s) listed in table.

You may also manually select any gems in the viewports, return to Gem Reporter, and set a new material for them. "Update" the list to see the changes.



Choose new gem material to calculate its carat weight.

Note: These changes do NOT affect how the ring is rendered: this part of the program is just for calculating gem weights to help you estimate cost and pricing.

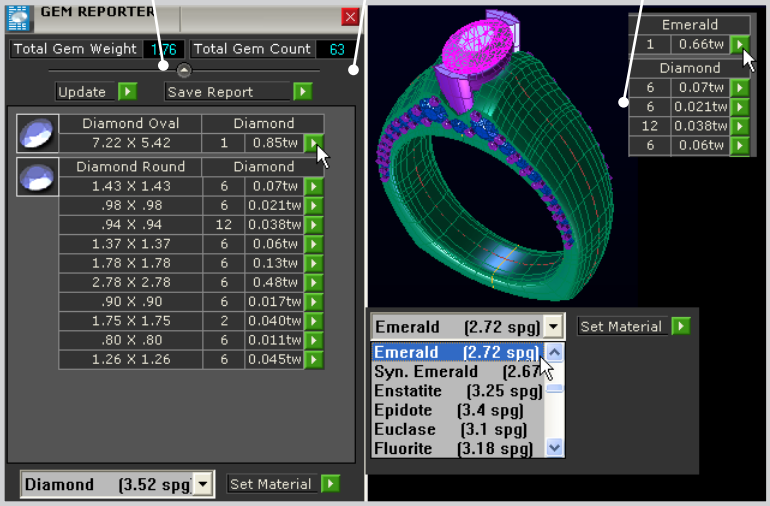
Calculating Carat Weight for Different Materials

1- Start up Gem Reporter. The current Total Weight and Gem Count will appear. Click the "Advanced Options" arrow to open the remainder of this builder.

2- Click the green arrow beside an entry representing all the gems you wish to change materials for. Or, select them manually by clicking them onscreen and holding down Shift to make multiple selections.

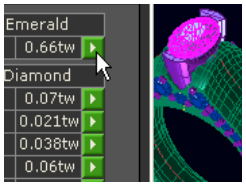
3- Select a new material from the dropdown menu at the bottom of the list. Click "Set Material" to apply the new material to the selected gems. The table (NOT the gem) will show the change.

4- Click "Update" at the top of the report when you add or delete gems.



Saving the Report

Click on "Save Report" to save a Notepad (.txt) document containing this information to any location on your computer. From here, you can open it up and print it if needed.



After setting new material, carat weight is re-calculated.

Related Tools

This tool can be helpful when used with Windows' "Print Screen", which saves a bitmap of your computer screen. Select the diamonds corresponding to a size and press "Print Screen" on your keyboard. Repeat for each size to print out images with the report, and give to your setter, making it easy to know which gems go where! Or, proceed to the explanation on Gem Guides for more sophisticated reporting and layout tools.



Managing Multiple Gems ...

Using Gem Guides

Report information on individual gems, draw helpful cues for setting and designing, and rotate viewport planar to gem for easy modeling access!

About Gem Guides

This tool is your "go to" tool for anything regarding gems! Report information on individual gems onscreen, create a curve at the girdle or helpful curve or point objects where prongs typically go on a certain gem shape, and see a report of a gem's "North" and "Culet" directions (where its axis and culet are pointed, respectively).



Prong lines are modeling aids - for spacing or for curves at prong locations.

Finally, this powerful tool can even reset your viewports so the gem is planar to the "camera" through which you're viewing it! In that way, you can model any object you wish and not worry about the angle at which you're drawing it - it will be planar to the gem, and modeling it will be just as easy as though it were planar or flat in any of the typical three viewports!

Using Gem Guides

Using this tool is easy. Simply start it up, and select which options you wish to use by selecting them from the seven icons in the menu. From left to right, these are "Gem North" (reports which way the gem is pointing - to change this, go to Gem Control or Gem Flow - both advanced gem tools explained later in this manual), "Gem Culet", Information, Bezel Profile (draws a curve at the girdle of the gem: you can assign an offset or scale size for this curve using the Mode and text box in the menu), and Prong Points, Horizontal, and Vertical Prong Lines, all of which place their specified object (point or line useful for modeling) at the location of typical prongs for most gem shapes in the program. Assign length of these curves using the text boxes in the builder interface.



Selected information displays: size &/or weight.

With the options you wish to use selected in this builder, select the gems in the viewports to apply the settings to, and click on the Apply command. Information will automatically display; Point and Curve objects will be drawn in the viewports and will act just like their counterparts do when created with the Curves menu tools.

A Guide to the Gem Guides Interface

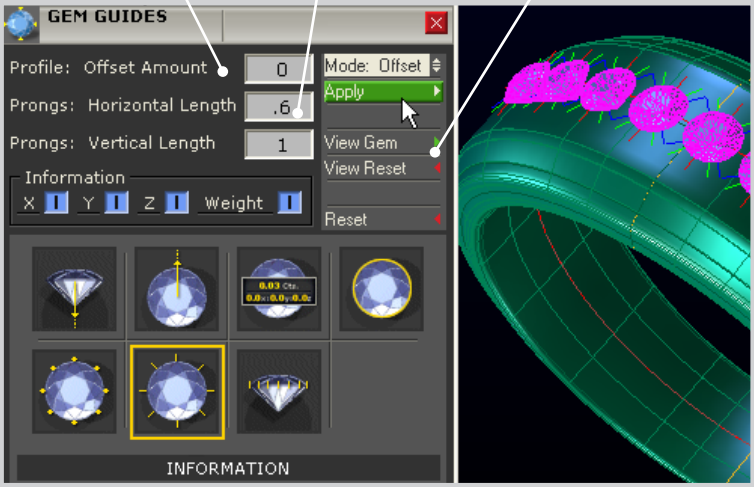
Select up to 7 options (click one to see its name appear). Click again to toggle it off. Select gems and click Apply to add changes to the viewports.

With "Profile" selected, each Mode (Offset or Scale) corresponds to the "Profile: (Offset or Scale)" amount box. Type in a value to offset or scale the profile curve.

With "Prong Lines" Horizontal or Vertical selected, indicate a length for these in the appropriate box.

With "Information" selected, report X, Y, Z and/or Weight by checking beside the box of your choice.

After using View Gem, use View Reset to restore the viewports. "Reset" restores all the builder defaults.



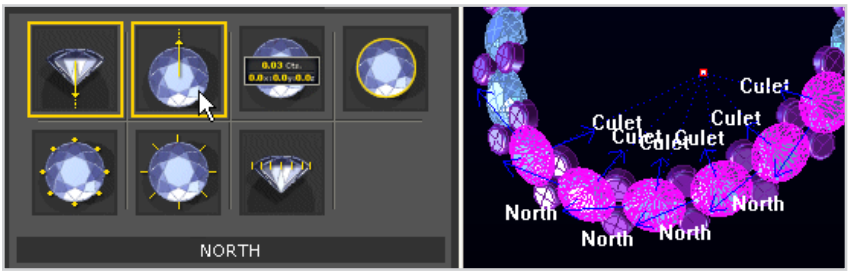
Select gems and click "Apply" to keep curves and points as usable objects for modeling.

Using View Gem / View Reset

This tool resets the three planar viewports (all except Perspective) so they are planar to the gem - meaning the gem is flat top-down in Looking Down, straight-on in Through Finger, and flat on its side in Side View. This makes it very easy to build an object on the gem, since all the viewports work the same. However, this can get very confusing when you no longer need it, so be sure to click on View Reset when you are done, to put all three views back to the way they were.

Gem Guides Options

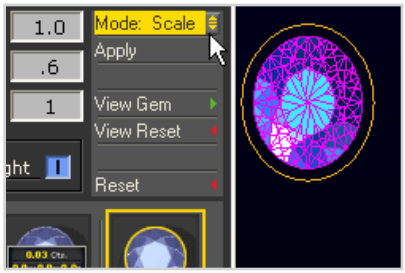
About each Gem Guide option and how to use it.



Culet & North With a gem or gems selected, choose one or both of these options to display which direction the gem's culet and "north" (axis) are pointing (in a cluster arrangement like that above, culet points toward point assigned it and North points to next gem in prong arrangement). The tools "Gem on Curve", "Gem Control", and "Gem Flow" can assign a culet direction; the latter two can assign "North". Gem Guides only REPORTS on these directions - it does nothing to change them! These distinctions are most commonly used when setting up intricate prong-work in pave or other gem & prong layouts.



Info With a gem or gems selected, choose this option to see the size and/or weight of the gem. Which "information" options you have selected influences what will display: X, Y, and Z size, as well as "Weight". Continue selecting gems (with Shift to add to selection) to see the information on additional gems.



Bezel Profile With one or more gems selected, choose "Bezel Profile" and click "Apply" to place a curve at the girdle of the gem. (This process is interactive using the "Gem Profile" tool.) To offset or scale this curve, select either "Mode" and an amount to scale or offset in the "Profile ... Amount" text box BEFORE using Apply. .

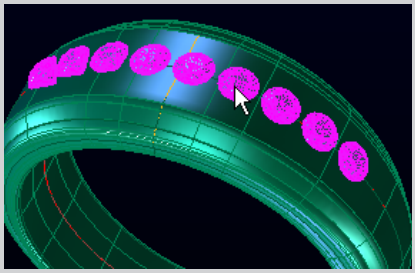


Prong Points & Lines To place cues at the common prong points on any shape of gem, select point objects, horizontal lines, and/or vertical lines. If you select one or both of the "Line" options, choose a Horizontal and/or a Vertical length in the appropriate text boxes in the builder.

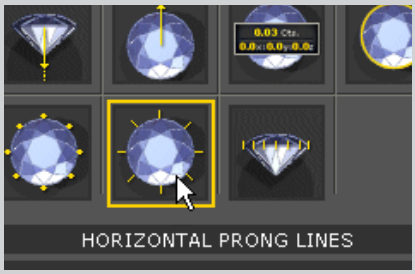
Profile Offset creates indicated distance between lines / points and gems. With a gem or gems selected, you will see the lines or point objects appear. Click "Apply" to keep them as real objects in the viewports. Now, you can use them as modeling guides or curves / points for the basis of designs.

Step-by-Step

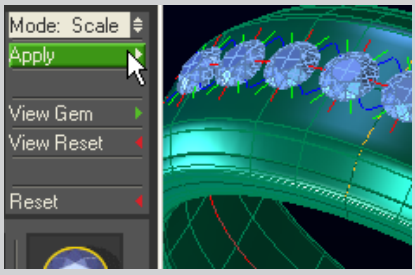
Gem Guides



1 Select a gem or gems to which to apply guides. Guides will be applied to any gems you select. With certain guides, you can continue selecting gems to see the effects. With Bezel profile, you must select gem first and "Apply".



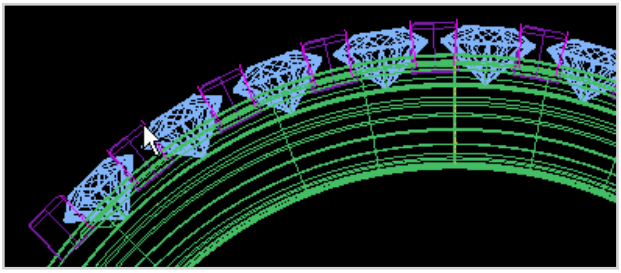
2 Select options to add to gems. In the Gem Guides interface, select which options to apply to gems. In the case of prong lines, indicate a horizontal and/or vertical length. For Profile, select a Mode and value to Offset or Scale it.

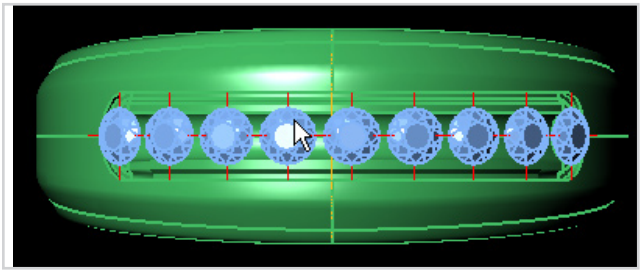


3 Click "Apply" to keep the results. "Apply" must be used to "keep" any changes you've made in the interface - i.e. if you want prong lines or a bezel profile placed as actual objects. "Info" does not need "Apply" - simply turn it off. "View Gem" only works on one gem at a time. "View Reset" ends it.

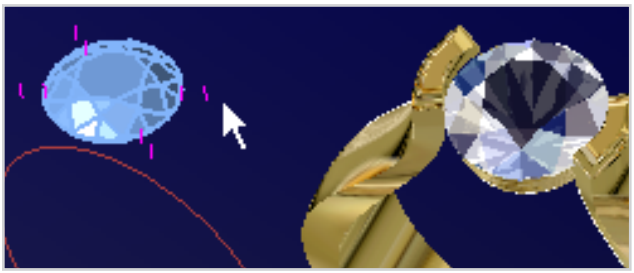
Tips & Tricks: Gem Guides

Use these strategies with Intermediate tools to assist you with designing around gems.

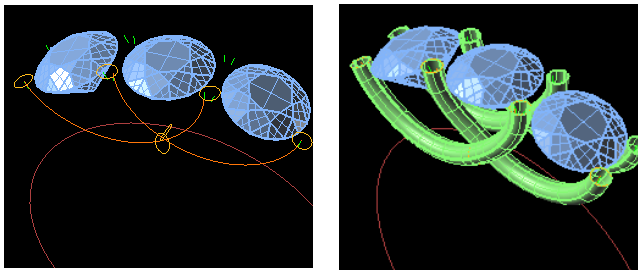




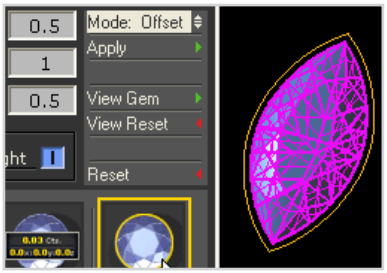
Gem Guides to Space Channels & Cutters This tool was developed with just this in mind! When you know the specifications needed by your manufacturer to space channels, millgrain edges, cutters, and other objects correctly around gems, you can use these tools as an easy way to get that spacing perfect every time! For example, set "Horizontal" gem lines and assign the distance above the gem that your setter needs for prongs, heads, or bezels. "Apply" these horizontal lines to every gem to be set this way, and use them as a guide when building the setting! Similarly, use "Vertical" lines to get either (1) the spacing between gems or (2) the spacing between gem and edge of channel or other cutters perfect. With the lines in place, enter the builder of your choice and use the guides to help you when placing the cutter.

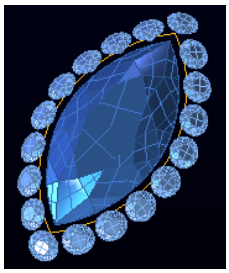


Prong Points or Lines & Intermediate Designs Set Prong Points or Prong Lines to assist you with where to draw designs for use in more advanced builders (Curve from 2 Views with History, Custom Rail, and Advanced custom Rail) when you want split prong designs or shank designs that sweep up and incorporate settings. With points objects onscreen, you'll have a spot to "snap" these curves to. With line objects, you may use these with the Blend tool to blend other curves to them, or simply incorporate them into your design.

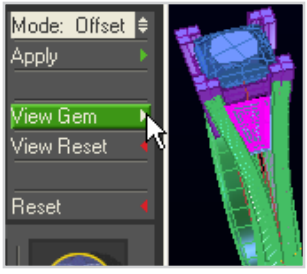


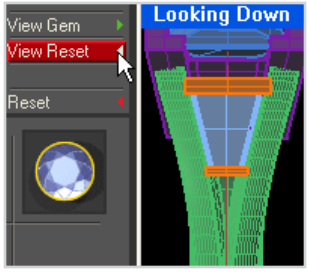
Trellis Head with Prong Lines, Arc Direction, Profile Placer, & Sweep 1 After creating a 3-stone head, set Prong Lines of a desired height above the gems, and delete all but those on the four corners of each gem. Join two corresponding points with the Arc Direction tool, and Join Curves. Place profiles and sweep with Sweep 1. Mirror all parts, and move profile back to achieve over/under effect. Rotate with "Copy" option to create other side of head.





Bezel Profile & Advanced Cluster Select a gem, indicate an Offset distance if you wish, Apply a bezel profile to it, and use this curve (at the girdle of the gem) when running the Advanced Cluster builder. The cluster will follow the shape of the gem! (The Gem Profile tool also places a curve at the girdle of a gem, and includes handles to edit it. Bezel Profile is just a static curve.)





View Gem & View Reset When a gem is on a weird angle but you'd like to place a design on it that would be MUCH easier to draw planar, select the gem (one at a time only!) and click on "View Gem". All three planar viewports (Looking Down, Through Finger, and Side View) will change to be planar to those three views of the gem. Create your object using all the modeling tools at your disposal, and click "View Reset " when you are done to put the viewports back to normal.

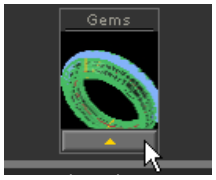
Setting Multiple Gems ...

Creating a Prong Layout

"Prong Adder" in the Settings menu adds prongs to gems. Access same handles during Gem on Curve using "Show Prongs" option.

About Prong Adder

With a line of gems already set, access the Prong Adder tool from the Settings Menu and input the gems into the "Gems" inbox. Prong previews, together with handles to control them, will appear. Use either the handles, or their corresponding Builder menu & Command Line options, to adjust the dimensions and placement of the prongs (each explained below). Press Enter to end this command and create the prongs.



Input gems & select a mode to indicate prongs' position.

Some prong layouts ("One Shared Prong", e.g.) are best set up while laying out stones. So, during the "Gem on Curve" command, select the Command line option "Show Prongs" and you will see the last-run prong layout in Prong Adder, complete with handles, appear. Use the handles just as described below to set up how these prongs will look. When using the tools in this way, the prong options will affect how the gems are laid out, and vice versa. This makes the tool extremely flexible and versatile, so you get exactly the prong/gem layout design you want!

Selecting a Mode

After inputting gems into the builder, select a "Mode" or prong configuration in which the tool will work. Notice that "Shared Prong" configurations are best to run DURING Gem on a Curve (using the "Show Prongs" option) because they are sized based on the space between the gems and the Nudge you assign. In other modes, the diameter options / handles will size the prongs.



Choose Gem Flow for a line of gems or Gem North for pave. Indicate a number of end prongs (0 - 2).

Gem Flow / North, End Prongs, & Styles

Select one of these two mutually exclusive options to assign how the prongs should follow the gems. The first, Gem Flow, is the default value, which causes each gem to align to the one beside it, in a line, for the purpose of prong layout. In the case of "Gem North", prongs will use the "North" direction of the gem, or, the way its axis points, as assigned during the Gem Control command (you MUST go into this command to change it; you cannot do so during the Prong Adder command).

Also use the Options list or Command Line options to assign a number of end prongs, between 0 and 2. (With 0 end prongs selected, run Prong Placer a second time using one of the "End Prongs" modes. Just be advised: only the last style set up in a builder is saved in the gem's "memory" to be accessed during "Match Attributes". Save both using Style Sheets if you will need them again.) "Styles" opens the Style Sheets interface.

Steps for Using Prong Adder

1- Select gems to add prongs to. Input them into the "Gems" preview window.

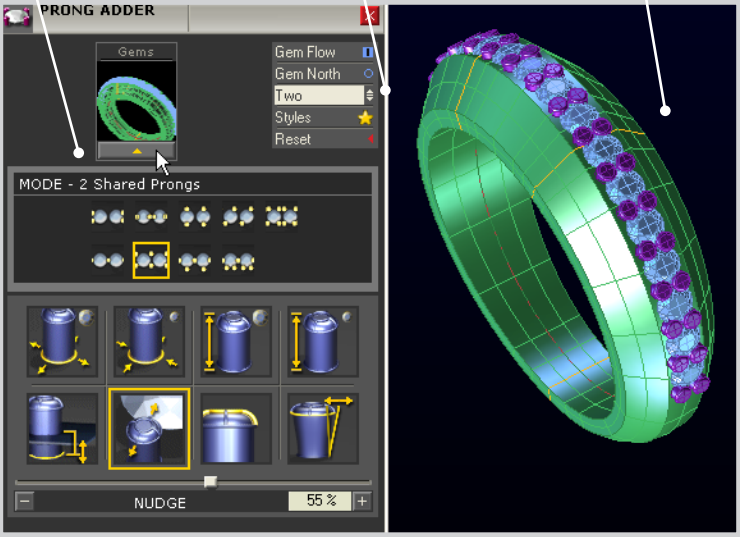
2- Select a "Mode" to assign the prong configuration from the icons below the inbox.

3- Select "Gem Flow", where prongs follow one another from one gem to the next, or "Gem North", where they point toward a gem's "North" as set in Gem Control.

4- Select 0 - 2 end prongs.

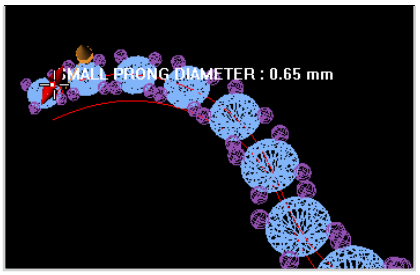
5- Choose a "Style" (optional). Or, adjust the builder controls, Command line options, and Viewport handles to set up prongs.

6- Press Enter to keep prongs and end the command.

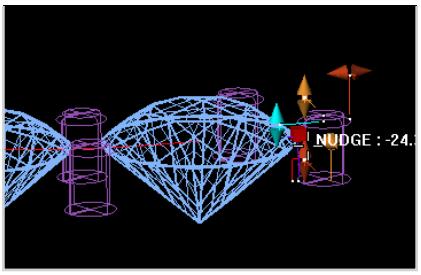


Prong Adder Builder Controls / Viewport Control Handles

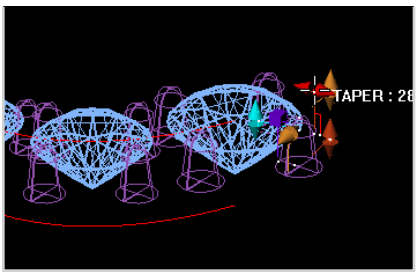
With an option selected, the slider will control that option. Or, adjust the Viewport handle or Command line option.



Large & Small Prong Sizes With tapered gems, these control the prongs (Height and Diameter) on either end of the layout, with an even taper taking place in between the two. With a uniform gem layout, only use the "Large Prong" controls. Beware during "Shared Prong" mode: prong width is based on space between gems.



Drop & Nudge Use the "Drop" setting to control the distance that the prong extends beneath the girdle of the gem in order to affix it to metal for production. Use the "Nudge" to assign what percentage of the prong overlaps the gem for setting purposes. (Usually, more Nudge is used for renders and less for production. Save each version with Job Bags or Style > Save.)

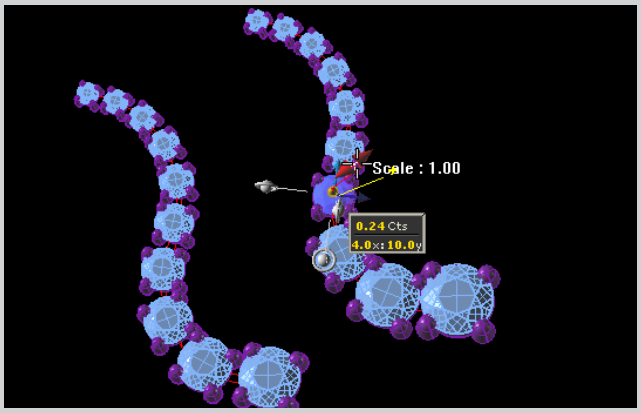


Fillet & Taper Use "Fillet" to create a domed top or bead-set / "finished" appearance to the prongs for rendering. Leave the top of the prong flat or almost-flat for production purposes. "Taper" is useful for creating wider, reflective surfaces beneath gems so prongs don't end sharply and leave shadowy areas on finished pieces.

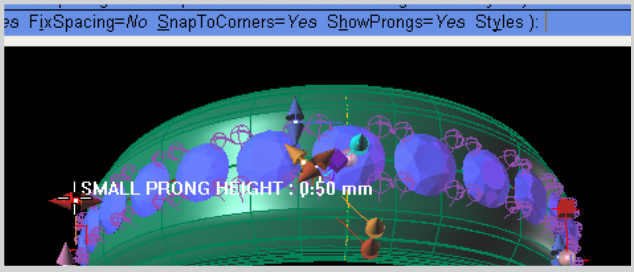
Tips & Tricks: Prong Adder

How to use the Prong Adder options during the Gems on a Curve command.

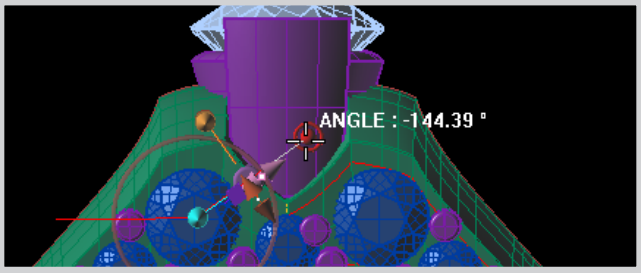
Prongs & Matrix History Upon setting prongs on a line of gems, you may move a gem or gems - with Matrix History enabled - via MSR, Move, or clicking / dragging gems, and Prongs will follow. Note that they will maintain their "flow" with nearby prongs in the arrangement, re-angling prongs in the arrangement to keep them pointed toward one another. Also note that moving gems with Springs breaks the History relationship with the prongs, so all movement with Springs should be done first; then prongs added; or, prong style should be saved, gems moved with springs, and prong style added afterward. Finally, Mirroring gems also breaks the History with their prongs. So, Save a prong style you like, Mirror gems, and apply that style to new gems. Or, Mirror gems and prongs AFTER all prong adjustments are made.



With History on, you may make changes to any gem(s) in the arrangement and prongs will follow. (L) - Before MSR; (R) - After MSR used on largest 3 gems.



"Show Prongs" during Gem on a Curve When running Gems on a Curve, the "Show Prongs" option appears in the Command line. This defaults to the last-used Prong Adder settings and places the "Prong Placer" icon into the Gem on a Curve menu. Click it to switch to Prong Placer and change options.



Prong Editor If a prong layout leaves a few prongs out of correct position but is otherwise fine, press Enter to end this use of Prong Adder and keep your changes. Now, select the prongs and click "Ungroup" in the Utilities menu. Select one of the misplaced prongs and enter it into Prong Editor. Read on for how to use this tool...

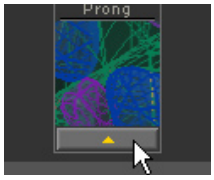


Setting Multiple Gems ...

Prong Editor

After placing prongs with Prong Adder, edit one prong at a time using Prong Editor, with all the same options as well as angle around gem.

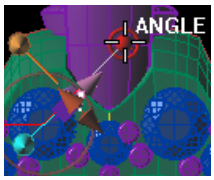
About Prong Editor



Input a prong to edit into the builder.

You'll recognize all the same Builder Sliders and Viewport Control Handles from Prong Adder, which do the same thing - only for a single gem that you input into the builder (Diameter, Height, Drop, Nudge, Fillet, & Taper). The additional (unfamiliar) options and handles are explained below:

Edit Prong

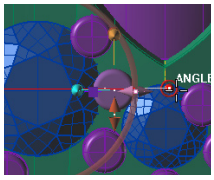


Use the "Angle" Control to rotate prong around associated gem.

To start up this tool, input a prong into the "Prong" input window and the handles will appear. Or, select "Edit Prong" and choose a new prong to edit.

Angle Control

Use the "Angle" Builder Control or Viewport Handle to indicate the angle of the prong around the gem - where the center of the gem is the center of rotation.



Use Add Prong to add a new prong in existing one's place. Handles now apply to new prong.

Add Prong

There is also the option in this builder to "add" a prong. The prong will be added to the same gem around which the current prong "orbits", and it will be added in the same position as the current prong, but the handles will affect the new prong, and the previous prong will be left in its new position.

Set Gem

If you don't want the prong you're editing to be "orbiting" around the gem it's currently associated with, select a new gem to orient it to using the "Set Gem" feature.

Keeping the Changes

Press Enter to keep your changes and end this instance of the builder.

Steps for Using Prong Editor

1- Select a prong and input it into the "Prong" In-Box in the builder.

2- Use the handles or Viewport controls as described in "Prong Adder" to change size, position, fillet, and taper of prong.

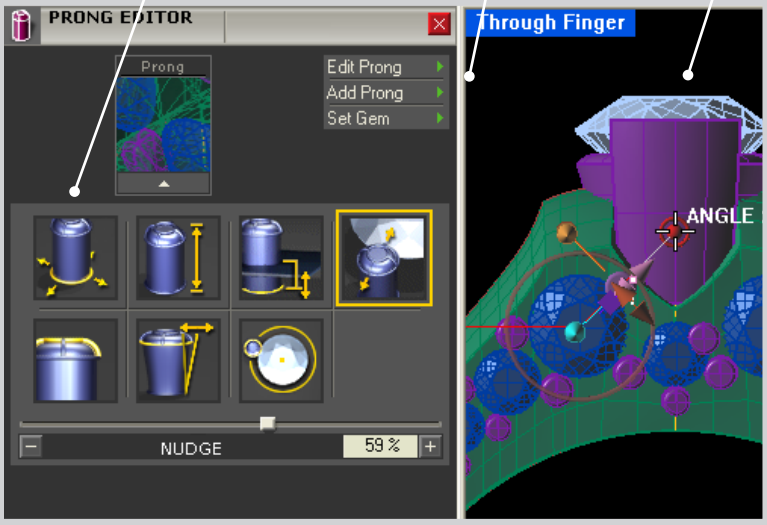
3- Use the "Angle" control to change the prong's rotation around the gem.

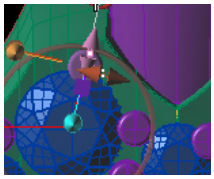
4- "Edit Prong" option selects a new prong to edit.

5- "Add Prong" option adds a new prong on top of the current prong. Handles apply to new prong.

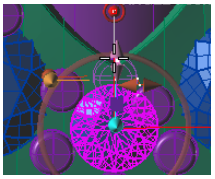
6- "Set Gem" orients current prong to a new gem. Select new gem and prong will appear on it with handles.

7- Press Enter to keep changes.

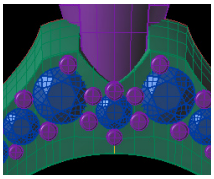




Click "Edit Prong" to select a new prong to edit.



Use "Set Gem" to orient current prong to a new gem.



In this example, Mirror prongs to duplicate changes on other side of ring.

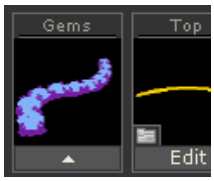
Setting Multiple Gems ...

The Metal Piece Setting

Quickly set an existing line of gems in a piece of metal which is fully interactive and history-enabled. Add this to a design, or start a design with it!

About "Metal Piece"

This powerful tool can set a gem line or a closed loop of gems into a strip of metal instantly created by the builder. The metal piece is interactive with handles and builder controls. It is also fully history-enabled, so that you can move or scale the gems after setting the metal piece, and the part will grow / move to accommodate your changes.



Input gems and the default Metal Piece will appear.

Because Metal Piece is history-enabled, you can also select a Metal Piece that was already made and press F6 to get the handles back to continue editing it.

After inputting the gems, you can select a Top profile for the shape of the metal piece above the gems. You can also Mirror the part so changes affect both ends; or, turn off this option to get separate End controls on both ends of the piece.

Selecting a Mode or Appearance

This piece creates a number of different metal pieces, so choose a Mode in which to use it to create the design you want. "Outside", "Rounded Corners", and "Pinched Ends" create a rim of metal in the shape indicated around the gems. "Outside Center" adds a "channel floor" to the "Outside" look (sharp corners only). "Inside" creates a floor for the gems, which you can size as you wish. "Top" creates a cutter which you can use similar to the channel cutter, creating a side profile beside the gems, depth beneath them, and height above to cut any metal they're currently set in.

The Outside, Inside, and Top options are also available in the "Closed" variety. Select these options ONLY when using a closed loop of gems for which you don't need or want any end adjustment (metal piece is continuous around gems).

In any mode that isn't Closed, choose the "Line, Arc, or Smooth" extension types to subtly change the ends of the metal piece, from straight, to arced, to following the natural curvature of the gems.

For a closed loop of gems and/or a gem line with corners, select the "Corners" option in the Command line, and set the value between 0 and 1 (0 = smooth corners and 1 = sharp corners). Anywhere the metal piece turns corners, the builder will try to place sharper edges as your value nears 1. Experiment with different values to get the look you want for a given design.

"Level" and Builder Controls

Because there are so many dimensions you can adjust on a metal piece, they have been divided into "Levels" with several related handles. Select a level corresponding to the dimensions of the metal piece you wish to adjust. Press "Z" to toggle forward through levels and "X" to toggle backward through them. Additional, advanced levels beyond those offered in the Builder interface are available in the Command Line or by toggling to them with Z or X (sliders are not available for these handles).

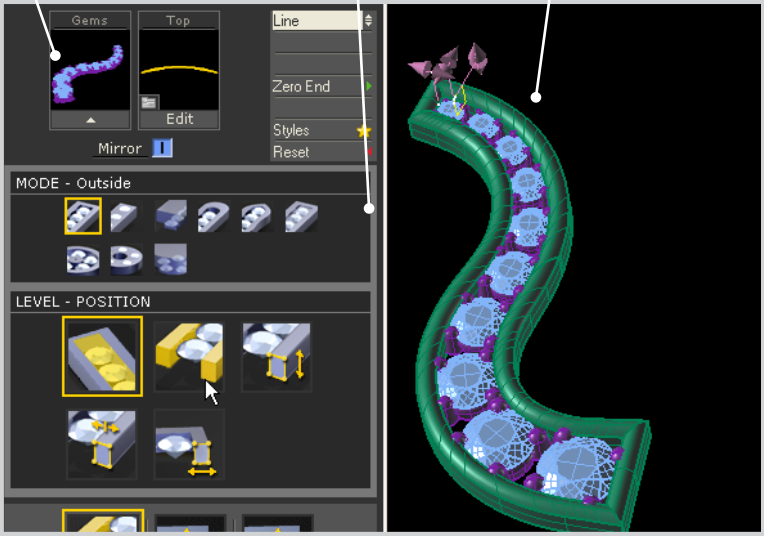
Steps for Using Metal Piece

1- Select gems (only) around which to build a metal piece, and press F6 > Metal Piece or select this tool from the Settings menu. Input gems into builder if using Setting menu tool. Select a Top profile by clicking this Builder window to open the library.

2- Choose a "Mode" or appearance for the metal piece. ONLY select "Closed" options with a closed loop of gems. Select an "End" type (line, arc, or smooth) that creates best shape.

3- Choose levels and dimensions to adjust to set up metal piece. Press Enter to keep.

4- Select metal piece and press F6 to edit.





Select closed modes only when gems form a closed loop.

Each basic level adjusts a different aspect of the profile that creates the metal piece. The advanced levels control the corners of the metal piece. The first level, Position, adjusts where the profile is in the Z plane in relation to gems (above / below them), as well as its offset from the gems all around and its offset from the gems on the end - ends have their own handles.

The second level, "Dimension", adjusts the height and width of the profile at this position, allowing you to set a "Cap" height for the top profile and a separate width for the profile at the ends of the Metal Piece.

The "Profile Corner Heights & Widths" levels provide the ability to change the overall shape of the profile by adding control points at each corner. Imagine dragging the corners of a rectangle up or down (Corner Height) to create a parallelogram or trapezoid shape, adding taper and angle to the profile! You can also drag them to the left and right (Corner Width) to complete this effect. The Corner Width option is available for the End profiles only, as well, to create a different shape for the profile on the end of the metal piece.

The final Builder Menu option, which is only available with the Outside Center mode, "Channel", lets you set the Channel floor below the gems, as well as the Channel Base or overall thickness of the channel portion of the metal piece.

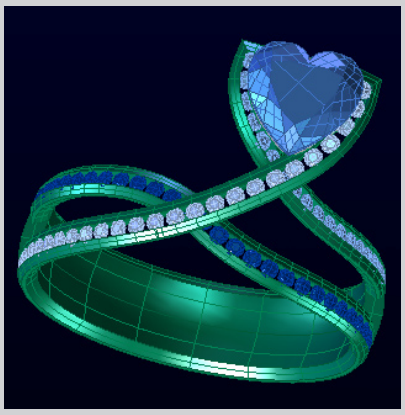
End / Corner Adjustments

Additional Command Line / Z & X toggle options are available for similar adjustments (Corner Height and Width) on each end and corner available on the metal piece. Adjust them as a whole on the lowest level (End Adjustment One), for the "Top" corners only, for the "Side" corners, and finally for "All" corners on the piece. To Mirror these effects, make sure the "Mirror" option is selected in the Builder or Command Line. To adjust them independently, turn this option off.

To "Reset" any strange results on End adjustments, click on the "Zero End" (builder or Command line) option. To reset the builder as a whole, click the Reset option, and it will return to its default values.

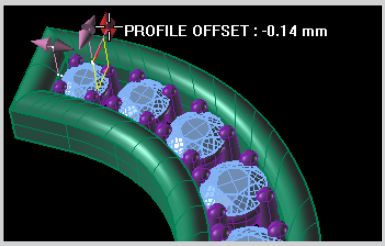
Tips & Tricks Metal Piece

Design a ring with Metal Piece This powerful tool lets you design solely using gems! Create interesting curves using more Advanced tools (Curve from 2 Views History, Custom Rail and Advanced Custom Rail tools). Place gems along these curves using the Gems on Curve tool. Then, add metal to these gems using Metal Piece, and set up options to create interesting designs. More advanced techniques, such as Extract Surface & Dup Border, can be used with Sweep tools to complete designs.

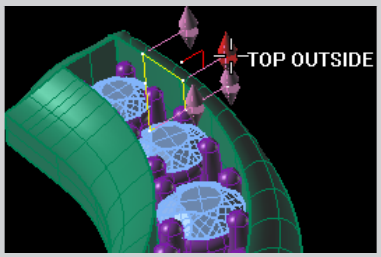


Metal Piece Levels

Each level's handles control profile shape. Mirror OFF adds controls for other end.

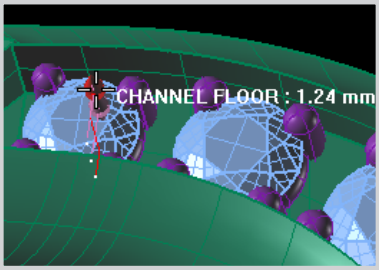


Position & Dimension Position moves the profile along the Z direction of the gems (above and below), as well as offsetting the profile on the sides and end. Dimension assigns it a height and width (separate width may be set on sides and end).



Corner Height & Width The profile acts like a rectangle with control points on each angle. Height moves each control point up and down; Width moves it side to side. Use these controls to create a tapered or trapezoidal/ parallelogram shape for the profile.

End Options Using the Command Line options (also available with Z and X toggle keys), access the same control for end profiles on all corners, with or without Mirror on.



Channel This last basic level is available with "Outside Center" mode. Use it to adjust the "Channel Floor" depth beneath the gems, as well as the "Channel Base" or overall thickness of the channel.

Setting Multiple Gems ...

The Channel Border Tool

Like Metal Piece but simpler, this tool places an offset curve around a line of gems. Use with other tools to surround gems with millgrain, metal, or other objects.

About Channel Border

With a line of gems, you can create a simple rectangular curve that follows the gems and surrounds them. Like metal piece, this curve has History enabled, so it will follow gems when they are moved and scaled.

To edit an existing channel border, select the curve and start up the Channel Border tool. The handles will re-appear so you can continue editing it.



Select just the gems and start up this tool. Use Handles and Options.

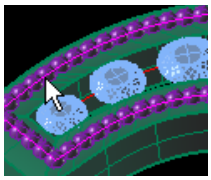
Using this Tool

Select a gem line and click on the Channel Border tool. The three handles available with Channel Border offset it from either side of the gems, the end of the layout, and in the Z direction (above or below gems).

Use the Corner options like those in Metal Piece to assign the roundness or angle of the curve as it surrounds a gem line that turns corners. (0 = smooth & 1 - sharp corners)

Tools to use with Channel Border

After placing the border, proceed to the Object on a Curve or Millgrain tools to set objects or millgrain along the gem curve, to surround the gem layout in a pleasing design.



Channel border makes a perfect path curve for Millgrain

To place two curves, select the gems (NOT the first curve) and start up the tool again. Arrange the second curve, and you can place a profile and run Sweep 2 History between the two curves, creating your own "Metal Piece"-style design.

Steps for using Channel Border

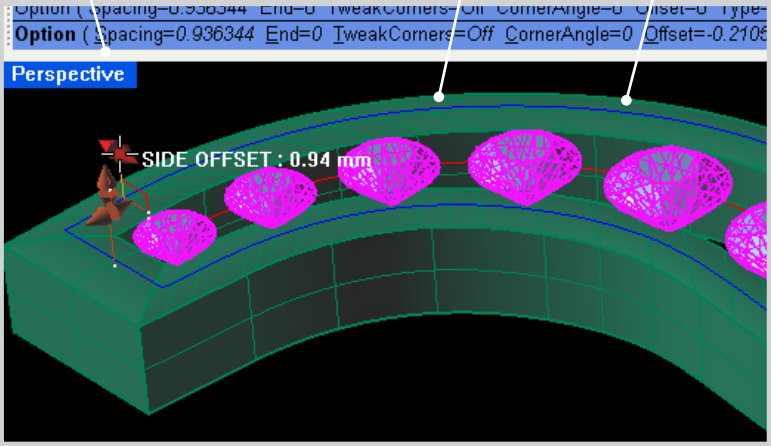
1 - Start up this tool and select the line of gems. The Channel Border, with handles, will appear.

2 - Click and drag handles to adjust Z placement, Offset on both sides of gems, and Offset on the ends of the gemline.

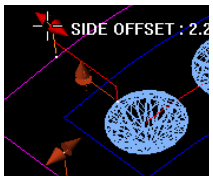
3 - Use Command line options, as no builder menu exists for this tool, to adjust other aspects of the curve (options same as those in Metal Piece).

4 - Press Enter to end this command and keep the Channel Border. Now, if you adjust gems with MSR, the Channel Border will follow.

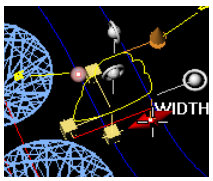
5 - To edit curve, select curve and press F6. To add another curve (as for a Sweep 2 operation), start at Step 1 and select gems again. Second curve will appear.



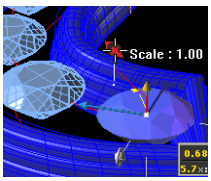
Note: Select Channel Border and re-start this tool to change curve. You will break the History if you Split, Trim, Join, or Boolean the Channel Border curve. Mirroring the curve and gems also breaks History. Place another line of gems and "Match Attributes" to the original gem line, selecting the Channel Border to add to the new gems.



Place a second Channel Border by selecting the gems ONLY and running this tool again.



Within Profile Placer, set 1 or more profiles that touch the two curves. Run Sweep 2 History.



MSR the gems to change the Channel Border curves. Sweep 2 History keeps up!

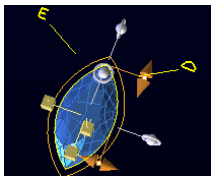
Setting Multiple Gems ...

The Gem Profile Tool

While Channel Border places a curve around a gem line, Gem Profile does the same for one gem. Adjust it with Profile Placer Handles.

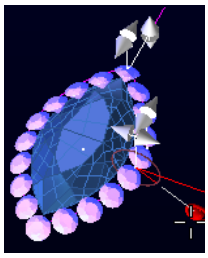
Gem Profile Tool

To help you set a gem with the Advanced Cluster tool, or to help you create an interactive curve surrounding a gem for any other modeling operation you may choose to run with it, there's the Gem Profile tool.



Gem Profile curve has Profile Placer handles.

Select a gem and click on this tool, and the tool will place a curve around the girdle of a gem. This curve has the Profile Placer handles, allowing you to re-size it, offset it, rotate it, and complete all the Profile Placer applications with it. You may add it to one or two rails with "Select Rail" and "Select Second Rail" options, set it up for use in Multi-Rail Sweep with Edit points, etc. For more details, find the Profile Placer section in Chapter 2, Building your First Ring.



Run Gem Profile on center gem & input into Advanced Cluster builder.

Gem Profile & Advanced Cluster

Create a Gem Profile around a center stone and input the Gem Profile curve into the Advanced Cluster Builder to create a cluster in the shape and size of a center stone.

Gem Profile & Profile Placer

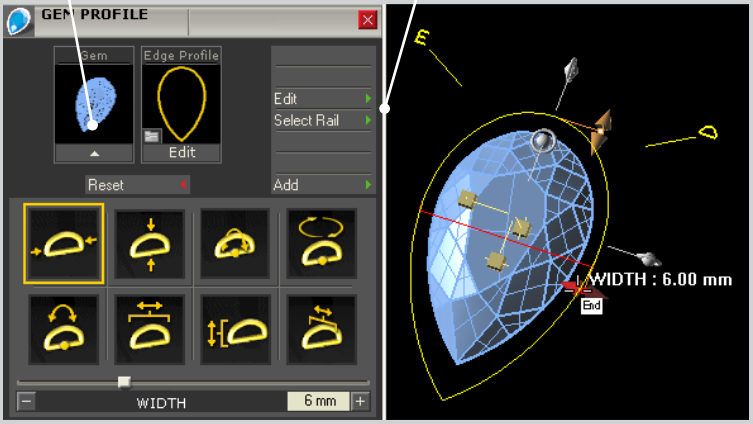
Add Gem Profile to a curve to add a gem-shaped profile to a design.

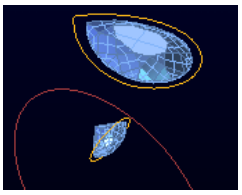
Steps for using Gem Profile Tool

1 - Input a gem and profile with handles will appear on it.

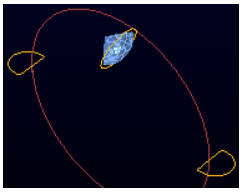
2 - Use Viewport Control Handles or Builder controls to adjust size, rotation, position, and edit points / shape (if necessary) of profile. Press Enter to end the work of the tool.

3 - The profile may now be included in a Sweep operation just like any other Profile Placer curve. Simply use the "Select Rail" option in the Command line to add it to a rail, and "Select Second Rail" in the case of a two-rail sweep. Or, input it into builders that call for a gem-shaped curve, such as Advanced Cluster Builder.

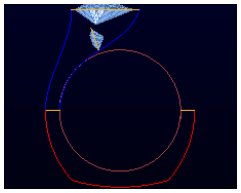




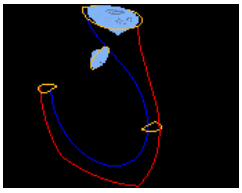
1- Place ring rail. Position gems & input into Gem Profile.



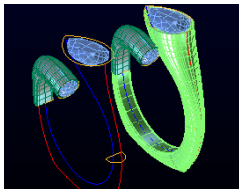
2- Add side profiles with Profile Placer.



3- Two rails created with Blend (top), Arc Direction (bottom).



4- Split & Join ring rail to inside Blend curve; Join outside rails.



5- Sweep first half with Profile Sweep. Complete with Sweep 2.



6- Join Surfaces & Cap to complete.



Gem Cutters ...

Cutters for 1 or Many Gems

Input a gem or row of gems into these cutter builders. Read about their common options, individual builder options, and Step-by-Step usage here.

About the Gem Cutter Tools

The tools that add cutters to a gem or row of gems include Gem Cutters, Gem Cutters Library, Channel Builder, MicroProng Channel, Bright Cut Channel, and Bright Cutter builder. The Scallop Bezel tool associates the cutter with the gem for the purpose of History and Match Attributes - as all gem cutters do - and cuts the bezel in which the gem is already set. This particular tool accepts a gem or bezel in its In-Box.



Cutting tools' options for Interactive Booleans.

This section will cover each tool's Command Line and Builder Menu options, as well as the steps to use the tool. Common options will be explored first - below - since they apply to every gem cutter in this list.

Common Builder / Command Line Options

Certain Builder & Command Line Options are found in many if not all of these Gem Cutter tools. Each of these will be explained here - just once - since they work the same within every cutter.

Styles: Each builder, with the exception of Gem Cutters Library, contains a "Style" option. Click this option in the Builder menu or in the Command line to open the Style sheets for this builder. Choose from an array of Gemvision-created styles, or save your own with Style Save and load one you saved using Style Load.

Reset: Click the Reset button in any of the Gem Cutter builders to set the builder controls back to their default values.

Using Interactive Booleans with Gem Cutters

Two Additional Command Line and Builder Menu options - used together - make Interactive Booleans possible when using each of these Gem Cutter tools.

Using Cutter Tools with Interactive Booleans

1- Input gems into builder. Cutter(s) with handles will appear.

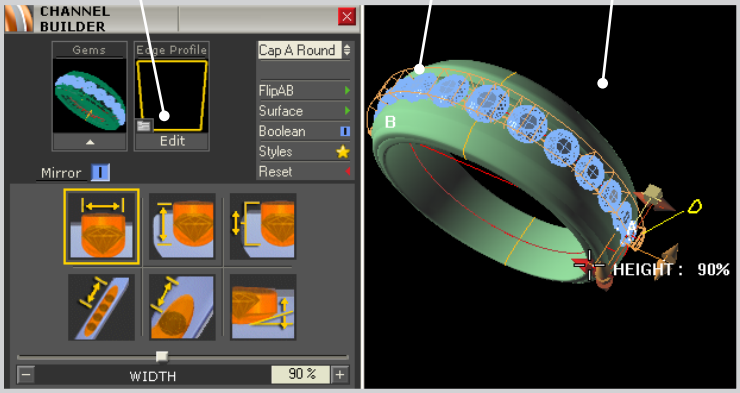
2- Select the "Boolean" option. Nothing happens, yet!

3- Select the "Surface" option to tell the Interactive Booleans what to cut.

4- The Command line will prompt you to select the surface. Click it and WAIT. Do NOT press Enter!

5- It might take a moment for the Boolean preview to appear. When it does, adjust the cutter handles and wait for the preview to change. Wait a moment each time you adjust the handles to let the Booleans catch up.

6- Press Enter to complete the Boolean and end this use of the builder. A Booleaned (cut) surface will result.

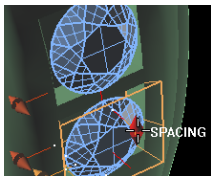


You'll notice above that Channel Builder leaves behind a wireframe preview of the cutter to assist you. Other builders might leave behind 1 of many cutters, a ghosted preview, or other cues. Even if you see the cutter, as long as you also see the Boolean, it will be Booleaned when you press Enter to complete the work of the builder!

"Interactive Booleans" simply means that, while running any of the tools with this enabled (all except Gem Cutter Library), you will see the RESULTS of the cutter - not the cutter itself. Also, upon pressing "Enter" to end the work of the builder, the Boolean will be completed: you will not need to enter Boolean Builder and Difference the cutters from the surface! (At the end of this chapter, you will learn how to do this if you wish or need to - however, I think Interactive Booleans will become your new best friends, since they make it a lot easier to preview how the cut will look when it is done, and allow you to change the results "on the fly" as you work.)

Boolean: Click this option to turn it "On". This will allow the Interactive Boolean to happen.

Surface: After turning on the Boolean option, choose this option and the Command line will prompt you to select the surface from which to Boolean



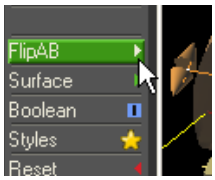
Even with Interactive Booleans, a cutter with handles is left behind.

Difference the cutters. Do NOT press Enter after selecting the surface - just wait for a moment for the tool to figure out the interactive Booleans.

Once you've chosen these two options in that order, adjusting the handles and other Builder options will reveal a preview of the EFFECTS of the cutters, not the cutters themselves. While clicking and dragging handles, you will still see cutter previews, for ease in using each builder. Once you release the mouse button, the effects of the cutters will be shown - not the cutters themselves. The surface you see while running this function is a preview surface. Press Enter to end the command and keep the changes, making this surface "real".

Mirrored / Non-Mirrored Ends & Flip AB

Mirror: When entering a line of gems into many of these tools, certain controls will only apply to the ends of the gem layout. To mirror these changes to the other end of the layout, select the Mirror option. When you don't want to mirror changes, but you want controls to change both ends independently of one another, de-select the Mirror option and additional controls / handles will be added to allow this.

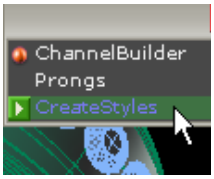


With Mirror Off, Flip AB for ease of use or for design changes.

Flip AB: When inputting a gem line, each end of the line is assigned either "A" or "B" by the builder. (In the case of mirrored ends, handles always appear on the "A" end of the gem line.) When ends are not mirrored, separate "A" and "B" handles / Builder controls for each end appear. To flip the A and B ends - either for ease of use, or for the purpose of your design, or both - select the Flip AB option.

Gem Cutters, History, & Match Attributes

Unlike Settings tools, the cuts made by Gem Cutters don't follow the gems around when they are moved. There are just too many variables at play within the program to accomplish this. (Keep your fingers crossed for a future version, though!) However, to make a certain kind of "history" possible even with cutters tools, gems retain a memory of any cutting tools that were created on them (with the exception of Gem Cutter Library). You can get these settings back using Match Attributes or Style Save & Load.



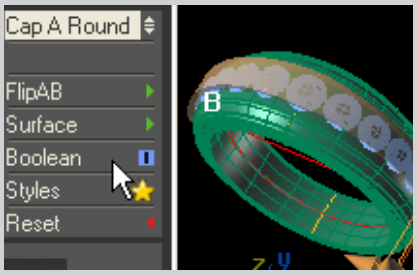
In Match Attributes, Cutters Appear, allowing for history with cutters.

How to you use Cutter "History"? Well, imagine that you wish to change the cross-section shape of a ring you've already cut. Use Profile Placer with sweep history to re-sweep the shape of the ring, and you've lost your cuts! Simply select the row of gems and start up "Match Attributes" (from F6 or from the Gems menu). One of the gems in the layout is the object to "match". Select the cutters that were saved with the gem, and click on "Create Styles". The cutters will re-appear on the gem line, and you can Boolean Difference them (explained in next section) from the new surface.

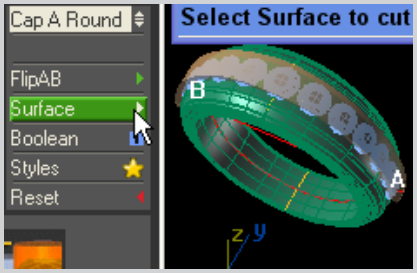
If you'll need to "tweak" the settings on these cutters to accommodate the new surface, either use "Save" and "Load" Style first, or simply run the "Match Attributes" option from within a Style Sheet. This will provide you with handles on the cutters, as well as Interactive Boolean ability, so that you may make changes before cutting the surface.

If you need to change something about the gem layout, do this BEFORE using the Match Attributes technique described above. And, be VERY certain that you save the surface BEFORE you enter its gems into a Gem Cutter builder. (With two models onscreen, you can Match Attributes from the original to the new, so saving a version of the original in Job Bags assures you'll never lose their "History", even by changing the gems.)

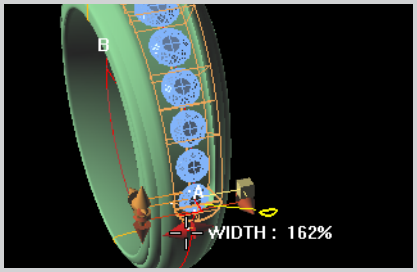
Step-by-Step
Interactive Booleans



1 Turn on "Boolean" Option. With a Gem Cutter builder running that has this option, click "Boolean" in either the Command line or Builder menu interface so it is turned "on".



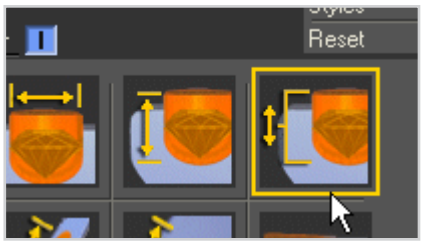
2 Select "Surface" Option, Select the "Surface" option to indicate a surface to be cut by the cutters using Interactive Booleans. This option starts up a Command line prompt to select the surface. Click it, but do NOT press Enter. Wait for Interactive Booleans to appear in preview surface.



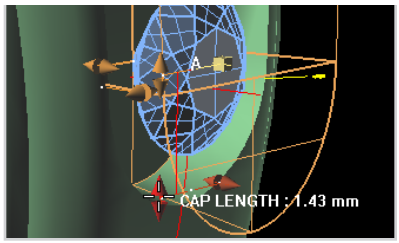
3 Use Builder. Press Enter to end. Use the builder as described in the pages below. Press Enter when you're done, and the Booleans - the result of the cutters - will be left: not the cutters themselves.

Channel Builder Options

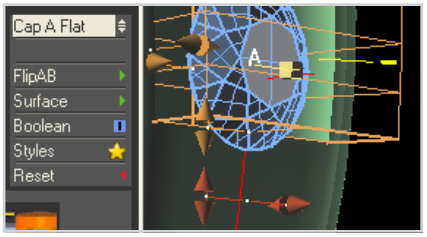
Set up the channel using these options in the Command Line, Handles, & Builder.



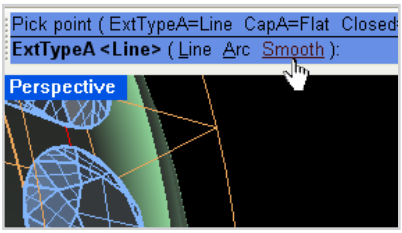
Size & Position Controls Values for Width, Height, and Offset (position above or below gems) can be set using the Builder menu (Slider controls or swipe and type), handles (click and drag handle of your choice - value is displayed), or Command line options (select option and type a value).



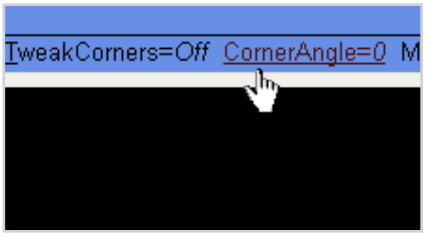
Extension, Cap Length / Scale "Extension" is the distance past the ends of the gems that the channel extends. It does NOT include the Cap Length, which sets a distance for the channel to taper into the rest of the ring. Cap Scale indicates the angle at which it slowly or quickly tapers out of the channel groove into the ring.



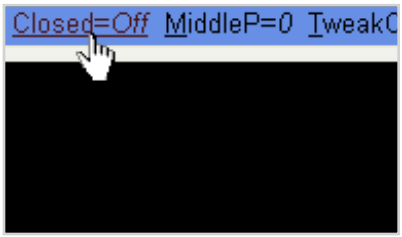
Cap A / B Shapes In the builder or Command line, toggle between "Flat, Round, Square, & Sharp" to set up the shape for the channel cap at both ends (when Mirror is on) or at either end independently (A or B controls). This defines the shape the channel takes as it is tapering into the ring at the cap.



Extension Type Only available in the Command line, Extension Type defines the shape of the channel cutter as it extends beyond the end of the gems. "Line" extends it straight; "Arc" matches an arc shape, and "Smooth" matches the natural curvature of the gem line. Experiment with these shapes for each design you make.



Corner 0 -1 & Tweak Corners Like Metal Piece, choose a value between 0 (smooth) and 1 (sharp) when your channel is wavy or turns corners. Experiment with different values to get the look you want. Experiment with "Tweak Corners" when there is a sharp turn in your design to get a different result.

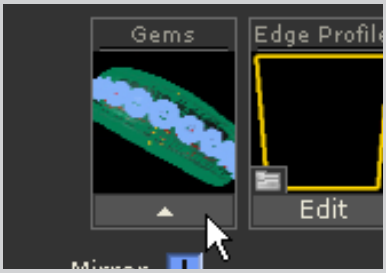


Closed Select this option in the Command Line (only) when building a channel on a closed loop of gems.

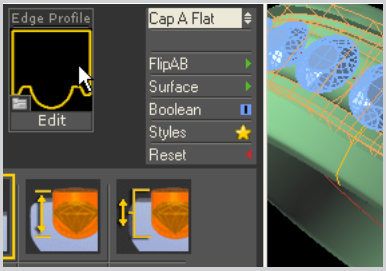
Middle Profile This command line option builds the channel cutter with more profiles (number you indicate) to improve its shape. Higher numbers = more control.

Step-by-Step

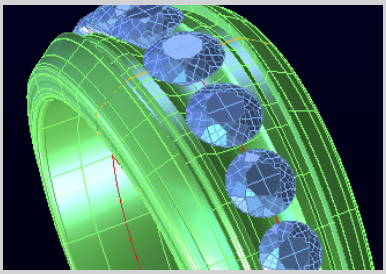
Channel Cutter



1 Select a line of gems. Start up this tool and input a line of gems into the Gems In-Box. Or, select gems, press F6, and start up this tool. A channel cutter will appear.



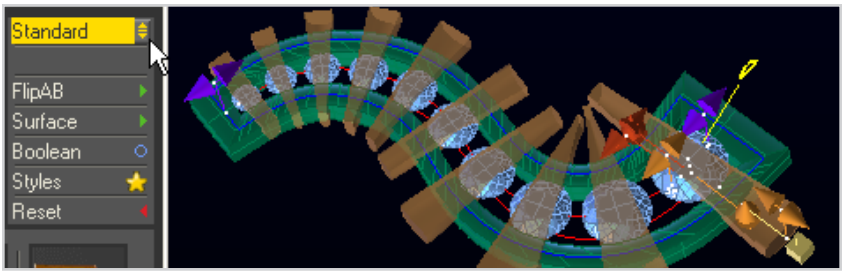
2 Select a profile. Click on the Profile preview window to select a shape for the channel floor. Or, click Edit to draw your own, using the current shape as a guide.



3 Create the Channel with Builder, Handles, +/or Command line and press Enter. To use Interactive Booleans or other Command Line options common to Gem Cutter tools, read about these above. Otherwise, use the handles, Builder controls, and Command Line options described here to create channel. Press Enter when done to end the command. If NOT using interactive Booleans, Boolean Difference cutter from surface.

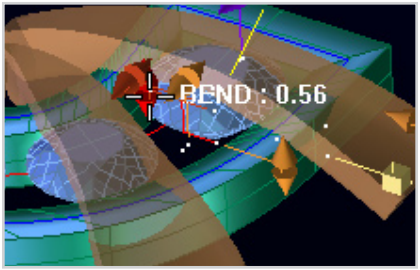
Micro-Prong Channel Options

Set up micro-prongs using options in the Command Line, Handles, & Builder.

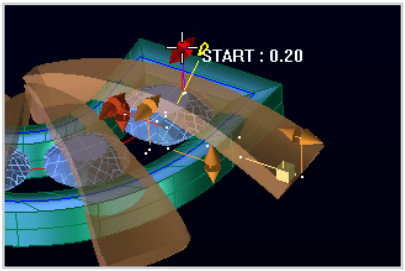


Modes In the Command line or Builder interface, select from among one of three Modes in which this tool works - Basic, Standard, or Middle. "Standard" tapers the cutters to accommodate one another when the layout turns a corner. Basic does not. Middle places cutters between - not centered on - gems.

Size & Position of Cutters Use handles and Builder to define the Height, Width, Length, and Drop (Z offset) of cutters. Adjust "Drop" down below the gems to create a gallery cut beneath each one! (Width values refer to the width of the prong left after the cut - not the width of the cutter.)



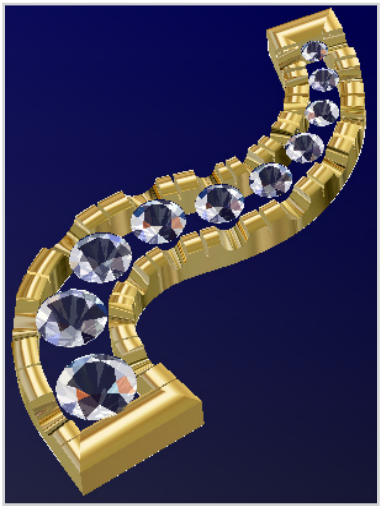
Middle Width & Bend Use these controls to control the width of the cutter at the middle and to "Bend" the cutter up or down. This creates the unique "scalloped" effect common in micro-prong work that makes for the reflective surfaces between gems that are so popular in these designs.



Start and End Width Use these Builder controls and Viewport handles to control JUST the width of either the Starting or Ending cutter. These are available regardless of whether or not Mirror is on, to provide control, if needed, at these locations in the design separate from the rest of the design.

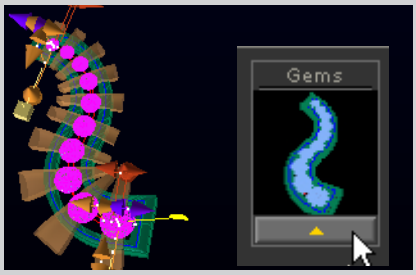
With Mirror On With Mirror on in this command, two separate sets of the above controls will be given for the A and B ends of the design. As you change each side, the same values for the cutters between one end and the other will change gradually from one end to the other TO CREATE A TAPER the two ends in the resulting design.

At Right, MicroProng was used twice - once in Standard mode and once in Middle - to produce split-prong effect. When running a builder twice, remember that gems only retain a memory of the last-used style. To save both settings for future use with History, use Style > Save / Load each time.

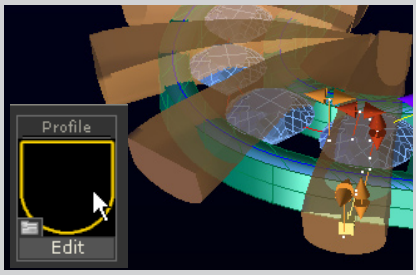


Step-by-Step

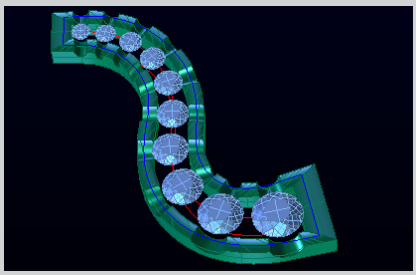
Micro Prongs



1 Select a line of gems. Start up this tool and input a line of gems into the Gems In-Box. Or, select gems, press F6, and start up this tool. Micro-Prong Cutters will appear.



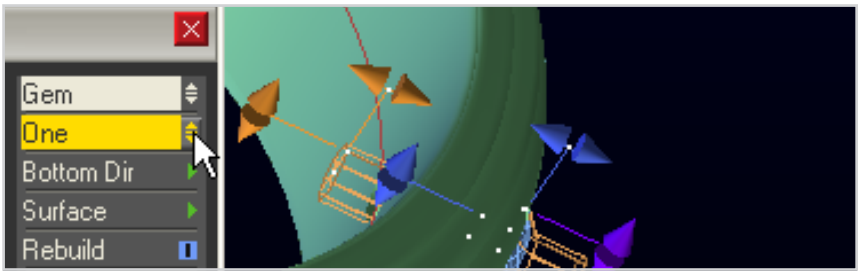
2 Select a profile. Click on the Profile preview window to select a shape for the cutter. Or, click Edit to draw your own, using the current shape as a guide.



3 Create the cutters To use Interactive Booleans or other common options, read about these above. Otherwise, use the handles, Builder controls, and Command Line options described here to create the cutters. Press Enter when done to end the command. If NOT using interactive Booleans, Boolean Difference cutters from surface.

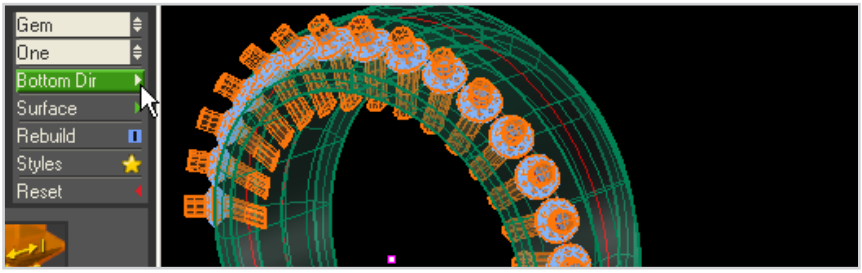
Gem Cutter Options

Set up gem cutters using these options in the Command Line, Handles, & Builder.



Interactive Boolean Options Set Interactive Booleans to "On", "Off", or "One", which will cut only one sample cutter when the "Surface" option is selected. ("On" works just like the typical Boolean option when used in other Gem Cutter tools with Interactive Boolean capability.)

Rebuild This option rebuilds the curves used to create the cutter, so that the cutter cannot be exploded into as many parts after it is created. Experiment with this setting when Booleans are unsuccessful, since rebuilt surfaces are more successful in Boolean operations.



Bottom Direction In any of the available modes, choose this option to select an object to which all the bottom lengths of the gem cutters will point. Upon starting up this option, the Command line will prompt you to select an object. Or, choose a point in space (viewport dependent).

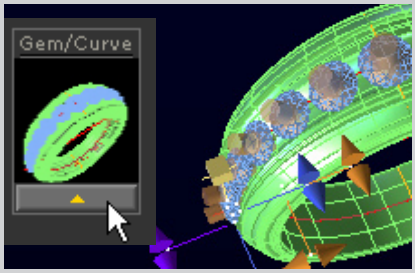
Modes Select "Gem, Azure, or Advanced" mode to add control to the cutter handles. Beginning with "Gem", each handle option is also available in the interface.

Handles in Each Mode Gem Mode provides the handles displayed in the builder menu: Upper Seat Size, Upper Height, Lower Seat Size, Lower Depth, Lower Taper, Girdle Width & Scale, and Z offset. Azure mode adds more handles: Lower Seat Depth and controls for Scale, Rotation, and Profile Shape of 2 additional profiles - one at the bottom of the seat and one at the bottom of the azure. Advanced mode adds even more handles - to change the profile shape, rotation, and scale (X and Y) at three more locations on the azure: girdle, upper seat, and top of azure. It also adds Upper Seat Height and Upper Taper.

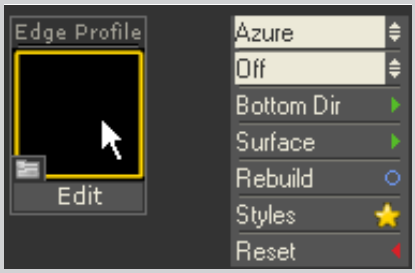


Step-by-Step

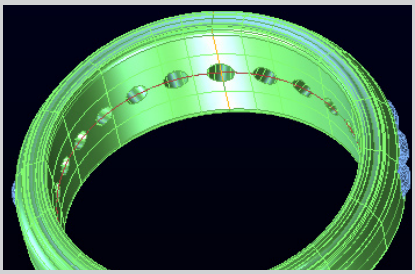
Gem Cutter



1 Select gem or gems. Start up this tool and input a gem or gems into the Gems In-Box. Or, select gem(s), press F6, and start up this tool. Preview cutters will appear.



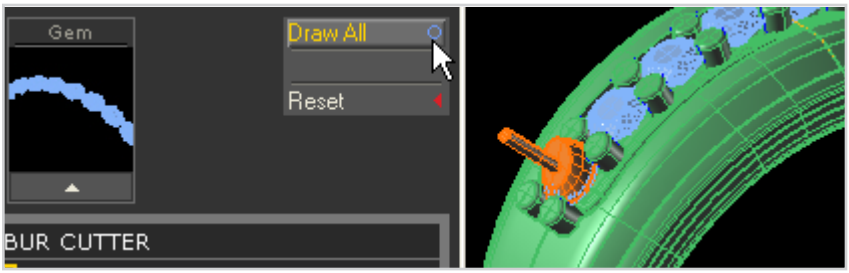
2 Select a profile. If using Azure, click on the Profile preview window(s) to select a shape . Or, click Edit to draw your own, using the current shape as a guide.



3 Create the Cutters To use Interactive Booleans or other Command line options common to Gem Cutter tools, read about these above. Otherwise, use the handles, Builder controls, and Command line options described here to draw the cutter. Press Enter when done to end the command. If not using interactive Booleans, Boolean Difference cutter(s) from surface.

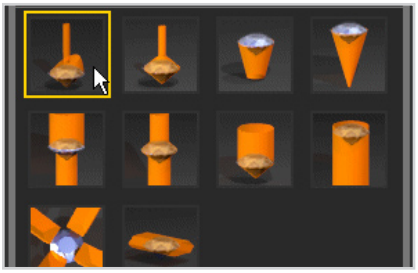
Gem Cutter Library Options

Set up a cutter from the Gem Cutter library with these options.

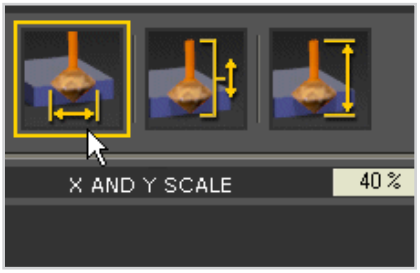


Gem Select gems to add cutters to and input them into the "Gem" inbox.

Draw All When cutters appear on gems, it takes a little while to draw them all. To keep the builder from working so hard and to speed it up, turn off "Draw All" and only one sample cutter will be drawn. Get it the way you want it, and then turn back on "Draw All" to create cutters on every gem.

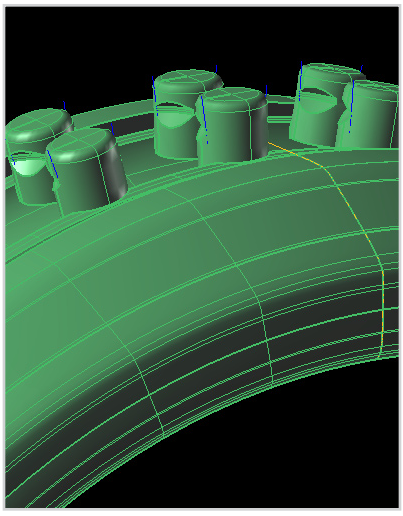


Cutter Library Icons Select a cutter from the icon library of available cutters. The selected cutter will be applied to the gem or gems, and will be controlled with (ONLY) the slider controls at the bottom of the builder menu (no handles are available with this tool).



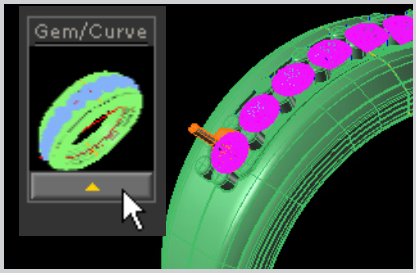
Scale and Position Select a slider control - for X and Y scale, Z offset (placement above or below gems), and Z scale. As you do so, the cutters in the viewport will be adjusted. These are already "real", so simply exit the tool to keep the changes.

History, Attributes, Styles Or rather, the lack thereof... this older tool in Matrix does not contain these new features of Version 6.0. To create the interactive versions of many of these cutters, access the Gem Cutter builder > Styles or Bezel Cutter > Styles. Alternately, just re-create them and save your own to load later with handles in "Style Save" within either of these two builders. Match Attributes and Style Save / Load are also not available with this library tool. However, for a quick way to scale these favorite old cutters to gems, and move/scale them easily, don't be afraid to use this tool ... "an oldie but a goodie!"



Step-by-Step

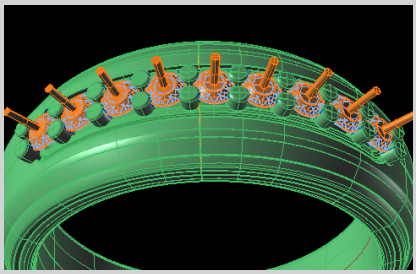
Cutter Library



1 Select gem or gems. Start up this tool and input a gem or gems into the Gems In-Box. Or, select gem(s), press F6, and start up this tool. Cutters will appear.



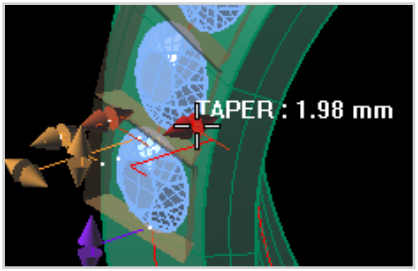
2 Select a library cutter. Turn off "Draw All" to move more quickly through library options. Turn on "Draw All" when you're done setting up a cutter.



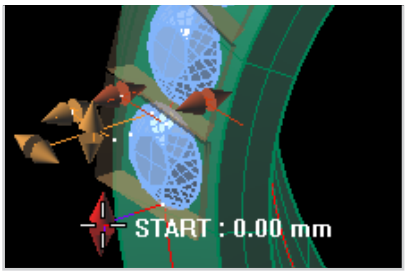
3 Adjust selected cutter with sliders. Only three Move and Position sliders are available in this tool (sliders only, not handles) - X and Y scale, Z offset, and Z scale. Click and drag slider to see cutter change in viewports. When you're done, simply exit this tool - the cutters are already "real". Boolean Difference them from surface using Boolean Builder or Solids menu Booleans. (Interactive Booleans not available.)

Bright Cut Channel & Single Cutter Options

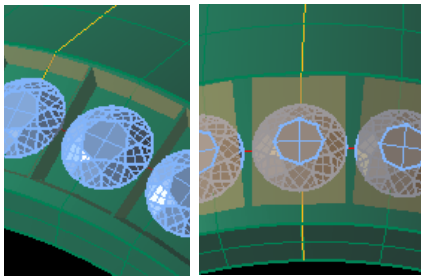
Bright Cut Channel & Single Cutter offer these handles, slider controls, & options.



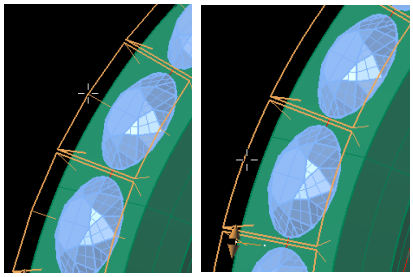
Both Height, Depth, Taper Use the sliders and accompanying viewport handles to set up the Height, Taper, and Depth of either a channel bright cutter or a single bright cutter. Height is measured above stone, Depth below stone, and taper controls the angle between the top and bottom of the cutter.



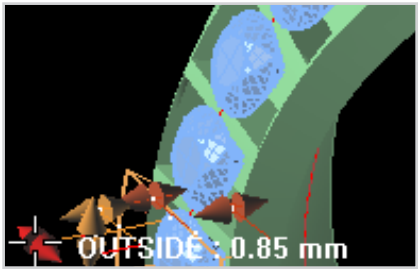
Channel Spacing, Start, End These sliders and corresponding handles control the Spacing between cutters (lower the Height if Spacing doesn't seem to grow to the size you need it); the Start and End controls allow you to change the width of the cut at the beginning and end of the gem layout.



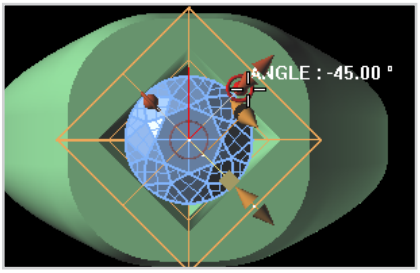
Channel Type & Curve (L - R, four illustrations above.) Select "Taper" when each cutter in the line should taper to accommodate the next. "Square" will remove this taper Use "Line" to make each individual cutter pointed or sharp, and "Arc" to make them smooth.



Channel Mirror Off With Mirror turned off, you will see duplicate controls for ends A & B. As when running MicroProng channel cutter, these controls adjust the cutters on either end, and the builder automatically applies gradual changes to the cutters between these two ends.

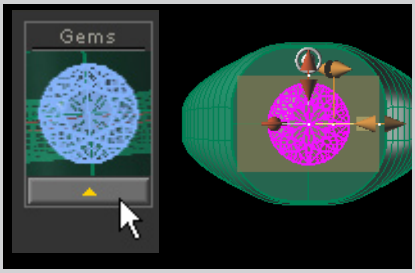


Channel Outside Width
Single Cut Length, 2D Scale
Controls on the Channel cutter (Outside Width) and Single Cutter (Length) adjust the length of the cutters above and below the gem(s). For a single cutter, scale the cutter size overall using 2D Scale.

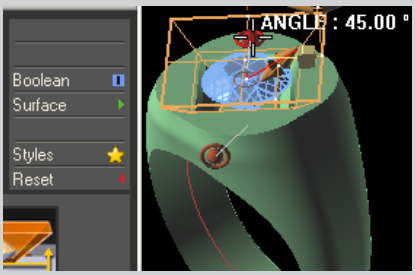


Single Cut Angle Use the "Angle" slider or viewport handle on a single cutter to rotate it around the gem, creating a "Diamond-shaped" cut instead of a typical square or rectangular cut.

Step-by-Step
Bright Cutters



1 Select gem or gems. Use Bright Cutter for one gem and Bright Cut channel for a row of gems. Input gem(s) into the In-Box. Or, select gem(s), press F6, and start up tool. Preview cutters will appear.



2 Set up Cutters. Using Viewport Control Handles and options explained at left, set up cutters. For best results, turn on Interactive Booleans to preview the effects of the cutters - not the cutters themselves.



3 Press Enter to End. Boolean Difference if necessary. "Enter" will end either command, keeping just the cuts (with Interactive Booleans on). If it wasn't turned on, use Boolean Difference to remove cutter(s) from metal.

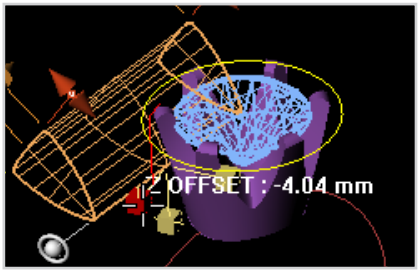
Bezel Cutter Options

"Scallop Bezel" (in Cutter and Settings menus) uses these handles & options:

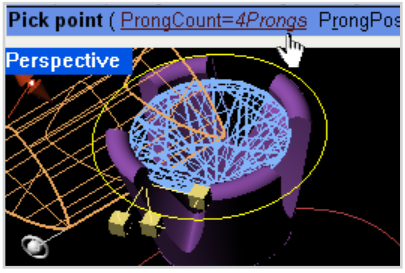


Gem / Bezel In-Box Input gem or bezel. When inputting a gem, cutter previews will be shown. Run "Boolean" and "Surface" options to turn on Interactive Booleans. When you input a bezel, the builder will automatically Boolean it. Remember that the gem always stores the cutter info on it - not the bezel - even if you input the bezel.

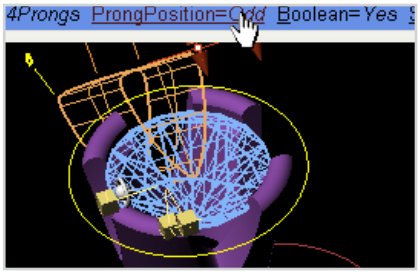
Size of Cuts To size the cut that is made, you must (naturally!) size the cutter! Four X and Y controls are given - two at each end of the cutter - so that you can create an attractive taper. Also use the Cutter Length and Angle controls to help you position and angle the cutters for an attractive cut.



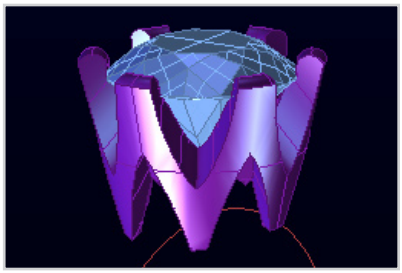
Depth of Cuts To control the depth of the cut, Z offset positions the cutter up or down in the gem's Z axis, and Y offset pulls the cutters in toward the gem or out away from the gem. Beware of X offset, which rotates the position of the cutters around the gem! In the event you do need it, it's there.



Number of Cutters Use this Builder control or Command line option to control the number of cutters in even numbers - 2, 4, 6, and 8. Click and drag the slider to the number you want, or select the Command line option and indicate a number.



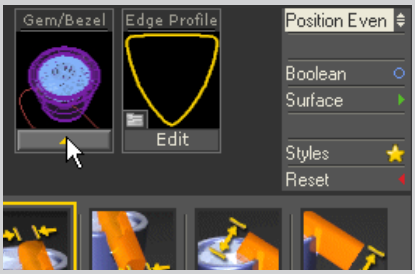
Position of Cutters The "Position" option in the builder menu and Command line let you toggle between "Even" and "Odd", which positions the cutters so the resulting metal is at the top and bottom of the gem, or offset of the top and bottom, respectively.



Angle of Cutters Like Depth, Angle affects the depth and shape of cuts. After making one cut, re-enter gem and angle cutters upside-down. Also indicate the opposite prong position (Odd if your first cuts were Even, etc) to create the popular head style shown.

Step-by-Step

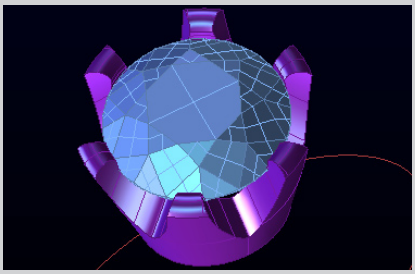
Bezel Cutter



1 Select a gem or bezel. Start up this tool and input a gem or bezel into the In-Box. Or, select the item, press F6, and start up the tool. The preview cutters (or, in the case of a bezel, preview cuts) will appear.



2 Select a profile. Click on the Profile preview window to select a shape for the profile of the cutter. Or, click Edit to draw your own, using the current shape as a guide.



3 Create the Cutters To use Interactive Booleans or other Command Line options common to Gem Cutter tools, read about these above. Otherwise, use the handles, Builder controls, and Command Line options described here to draw the cutter. Press Enter when done to end the command. If not using interactive Booleans, Boolean Difference cutter(s) from surface.



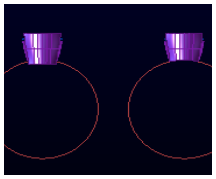
Cutting Tools ...

Cut to Finger Rail Tool

When material intersects finger rail (when placed with the Ring Rail tool), use Cut to Finger Rail to instantly cut excess away.

Using Cut to Finger Rail

When material intersects the finger rail hole, and you still have the Ring Rail curve in the model that was placed using this Tool, select the object that intersects the finger rail and start up this tool.



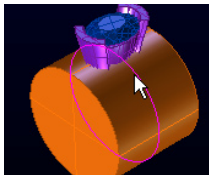
(L) Before, material from head intersected finger rail. (R) Results after Cut to Finger rail.

Where possible, this tool will instantly Boolean Difference the object you selected from the finger rail shape by using the Solid menu command "Extrude" to create a cutter in the shape of the finger hole. It then uses Boolean Difference to difference (cut) the shape of that cutter - or, the space inside the finger - away from the object that intrudes upon it.

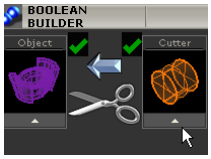
The rules for Booleans apply: meaning that if the object being cut is not solid or valid, or if it is coplanar (surfaces touch perfectly, so that their edges occupy the same points in space), it will not Boolean.

Cut to Finger Rail "Long-Hand"

To see how this works yourself, select the ring rail and use the Extrude Command in the Solid menu to extrude a solid (capped) cylinder in the size of the Finger Rail. Extend it past the shape to Boolean on "Both Sides" so as to intersect it fully. Then, proceed to Boolean Builder (explained next) and Boolean Difference the cylinder from the object that extends into the finger rail (cylinder = "Cutter", object that intersects finger rail = "Object" being cut). Perform the Boolean, and you'll begin to appreciate how many steps this handy little tool can save you!



Extrude Rail for cylinder & Boolean Difference from intersecting piece.

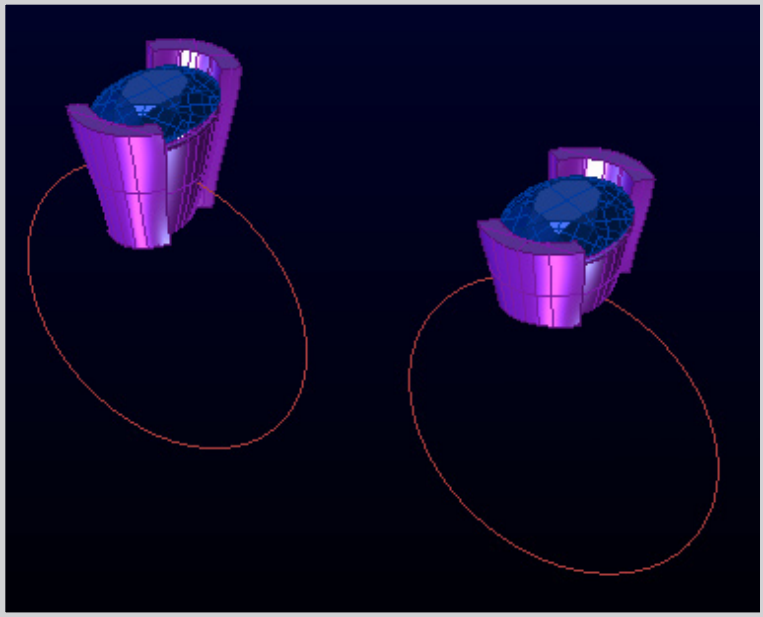


Steps for Cut to Finger Rail

1- Select the object that intersects the finger rail.

2- Start up Cut to Finger Rail. (If you do not select the object before starting up this tool, the Command line will prompt you to select it.)

3- The object will be Boolean Differenced from a cylinder - created by the builder - that represents the finger size.



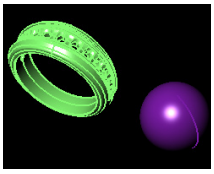


Cutting Tools ...

Boolean Builder & Booleans

Cut builder- or user-created shapes from models with Boolean Builder & Solids Menu Booleans. Booleans also Union and Intersect solids and meshes.

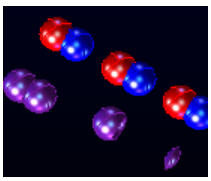
Defining "Solids" and "Booleans"



Solids may be polysurfaces (L) or surfaces (R).

You'll recall from earlier parts of this manual that a Solid is a closed surface; or, a surface with no open (unjoined) edges that completely encloses a volume. Solids may have more than one side, making them polysurfaces - like a box, pipe, cylinder, or cone. Or, a solid may be single surface with no sharp edges or corners - like a sphere or torus (all are solid menu tools you'll be learning to use later).

"Booleans" are functions that combine or cut solids. The result of a Boolean is always a solid object, if Booleans are behaving properly (more rules on the proper care and feeding of Booleans later). The input - or, the two or more objects used in a Boolean operation - may technically be surfaces or solids; but, for our purposes, they will almost ALWAYS be solids.



(L - R) Boolean Union, Difference, Intersection.

A "Boolean Union" combines two solid objects together. A "Boolean Difference" cuts one solid object out of another, leaving space in the shape of the cutter. A "Boolean Intersection" creates a solid shape only where the two objects intersect.

Understanding Boolean Builder

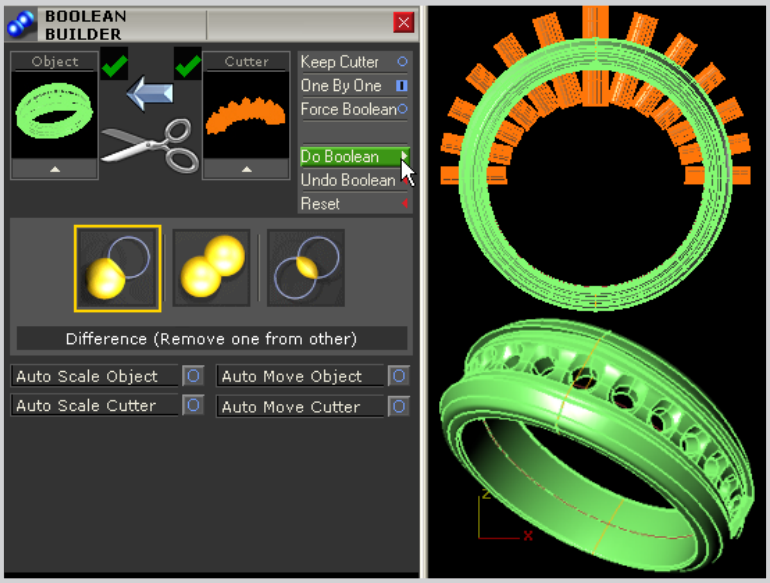
Although Boolean Tools live in Rhino's "Solids" menu, you'll find it much easier to select the Gemvision-created Boolean Builder tool from either the Cutting or Tools menu. This tool makes it easy to see which object is the "Cutter" and which is the "Object Being Cut", and makes it easy to select the Boolean you wish to do - Union, Difference, or Intersection. Also, there are a number of Command Line options within these tools, which the Boolean Builder automates and provides you in icon form.

Where to find Boolean Tools

Access the Cutting menu and Tools menu "Boolean Builder" to easily input "Object" to be cut and "Cutter"; or two objects to be Unioned or Intersected.

Once you get the hang of Booleans, try out the Solids menu tools Boolean Union, Difference, and Intersection, as well as "Boolean 2 Items", which lets you toggle through the 4 possible Boolean options for any two objects or sets of objects.

If you need to Boolean meshes, access the Mesh tools at the top of the interface and find Mesh Booleans (Union, Difference, and Intersection). Just remember: the result will be a mesh, even if a mesh and a nurbs object were used in the Boolean.

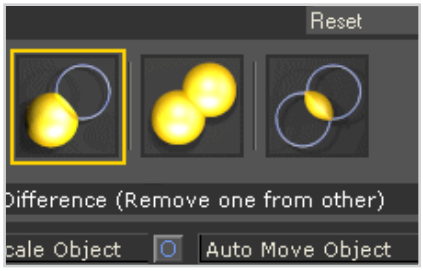


Booleans can also be a little temperamental. We'll discuss their rules in a moment. But if you find that they're not working because objects are "coplanar" (corners or edges of models both exist on the same exact plane in space), there are easy tools within Boolean Builder to move or scale one of the objects slightly, making Booleans more successful. The tool also tells you whether an object will be successful in a Boolean operation or not. That way, you don't have to guess, or check it yourself, beforehand. You'll know right away when you input it into the builder.

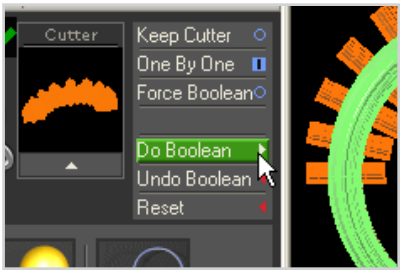
In this section, we'll look at Boolean Builder, Solids menu Boolean tools, and where to go to Boolean Mesh Objects (creation and use of these is covered in Chapter 10). Boolean "Tips and Tricks" and related tools are also discussed.

Boolean Builder Options

Understanding the following features & options will help you use Boolean Builder



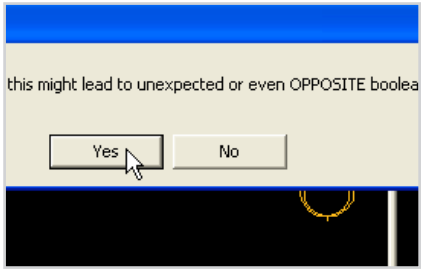
Types of Booleans Beneath the In-Boxes you'll see the three types of Booleans. "Difference" cuts the shape of one object out of another; Union joins two solids together; and "Intersection" creates a new solid at the intersection of two input solids (deleting all but the new solid).



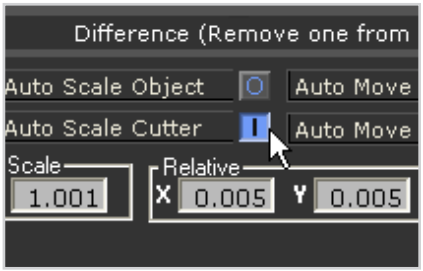
Keep Cutter/One by One Use "Keep Cutter" when you want to use the cutter again. Otherwise, the cutter will be deleted. Use "One by One" when putting many pieces into one In-Box. Booleans will try working on one object at a time, rather than all of the input objects at once, for a better chance of success.



In-Boxes Select an object onscreen and click on the In-Box in which to place it, taking care to note the difference between the "Cutter" and the "Object" being cut during a Boolean Difference. A check-mark will appear when an object can be Booleaned. If it will not work, you will receive an error message. If your object



is "Open" - or, not a solid, closed, valid object - you may get opposite results of the expected Boolean (a Union will Difference, etc.). However, it is best to go back to your model and figure out where the opening or error is. If that is the case, read the next section, "Boolean-Related Commands".



Auto Move & Auto Scale Booleans will likely fail if objects are co-planar (edges or surfaces of objects exist on the same plane in space). If this happens, choose one of the objects (usually the cutter, not the ring) to move or scale. Choose a small amount (0.01) to scale or move in 1 or more directions.



Do/Undo Boolean & Reset When all your options are set, click "Do Boolean" to see the results. "Undo Boolean" should be used instead of the program "Undo" button to undo the work of the builder. "Reset" will clear the builder In-Boxes and options.

Step-by-Step

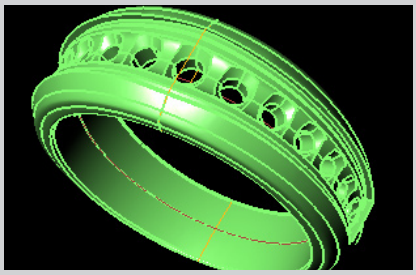
Boolean Builder



1 Select a Boolean Type. From the three icons beneath the "In-Box", select (L - R) Boolean Difference, Union, or Intersection.



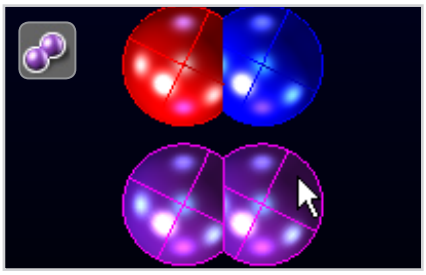
2 Input 2 Objects (Union, Intersection) or Object & Cutter (Difference). Select item and input it into the appropriate box. Take care to note which item is the "Cutter" and which is the "Object" being cut in the case of Boolean Difference. Either box will do in the case of Union & Intersection.



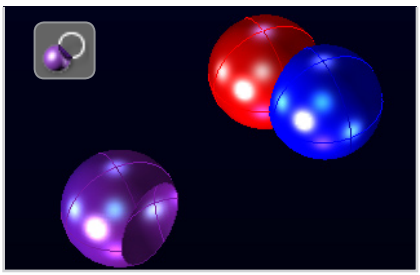
3 Select any Options Needed & Click "Do Boolean". If you'll need to use cutter(s) again, be sure to use "Keep Cutter". For multiple cutters, use "One by One". For objects that are having trouble Booleaning, use "AutoScale" and/or "AutoMove", with SMALL values indicated.

Boolean Union, Intersection, & Difference

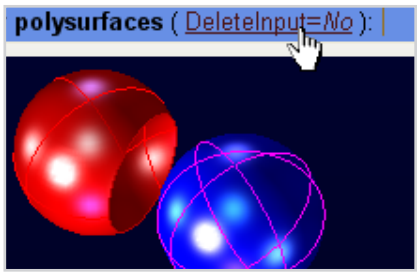
Another place to access Booleans: the Solid & Mesh Menu Boolean Tools.



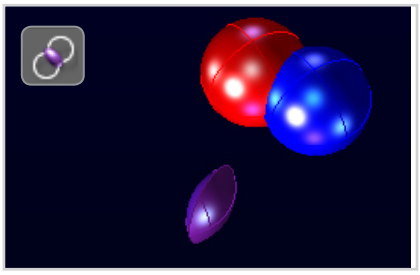
Boolean Union Start up this tool, select two or more objects to Union, and press Enter. Objects will be joined together, if possible. In the case of Mesh Booleans, select two meshes or a combination of meshes and solids; a mesh will always result.



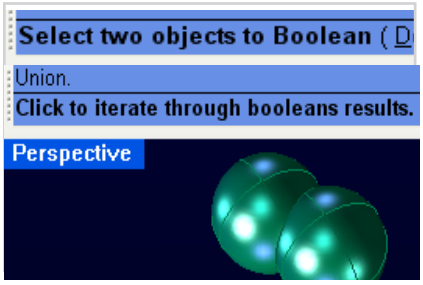
Boolean Difference Start up this tool. The first object(s) you select is the "Object being cut". Press Enter. The second object(s) you select are the "Cutter(s)". Press Enter. In the case of a Mesh Boolean, either or both input objects may be a mesh; the output will always be a mesh.



Delete Input This is just like the "Keep Cutter" option during Boolean Builder. Set this to "Delete Input = No" to keep the cutting object. "Delete Input = Yes" will delete the cutting object during a Boolean Difference.



Boolean Intersection Start up this tool and select two or more intersecting objects. Press Enter. ONLY the solid objects representing the overlapping parts of the input objects will remain. In the case of Mesh Booleans, input 2+ meshes and solids; a mesh will always result.



Boolean 2 Objects Start up this tool and select two intersecting objects to Boolean. Left-click to "iterate" or toggle through 4 different Boolean results: Union; Difference with 1 object as cutter; Difference with other object as cutter; and Intersection. Press Enter to keep the result you like.

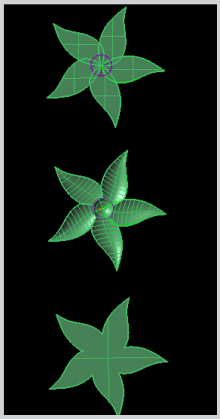


Mesh Booleans Find identical commands that work with mesh objects and mesh objects with solid objects in the Mesh menu at the top of the screen. Just remember: The output will ALWAYS be a mesh!

Tips & Tricks Boolean

These strategies, combined with the last few commands covered in this chapter, will help you make Booleans a success!

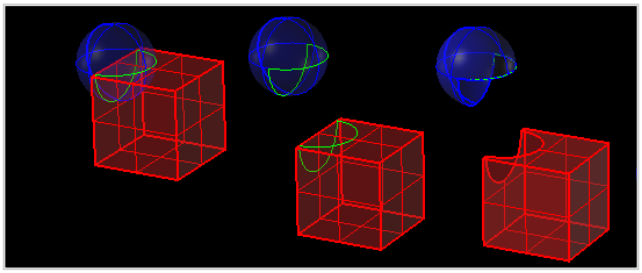
The Rules of Booleans Whether using Boolean Builder or Solid / Mesh Menu Boolean tools, the following rules apply. (1) Objects must be closed (solid) and valid polysurfaces. Boolean builder will boolean open surfaces, but the results may be opposite (Union will cause a Difference, etc). To learn how to check that an object is closed and valid, read the next section in this chapter. (2) Objects must not be "co-planar". Co-planar objects have corners or whole edges that exist on the same plane in space as the object you're Booleaning it with. To get around this, move or scale one object slightly (not the ring - the cutter, usually!), or let Boolean Builder do it for you. (3) Objects with lots of sharp corners, or objects that pass into and then out of one another one or more times can also have problems Booleaning. (4) An object that is fully inside another object cannot be Booleaned from it.

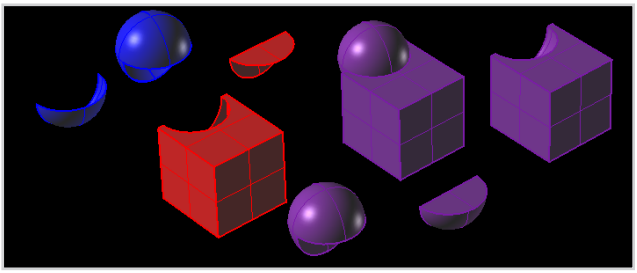


(Top - Bottom) Co-planar model won't boolean. So, Extract surface on back of model, split all surfaces with all other surfaces, delete excess, Join, and Cap: Modeling without Booleans!!

Tips & Tricks cont'd Booleans

These strategies, combined with the last few commands covered in this chapter, will help you make Booleans a success!

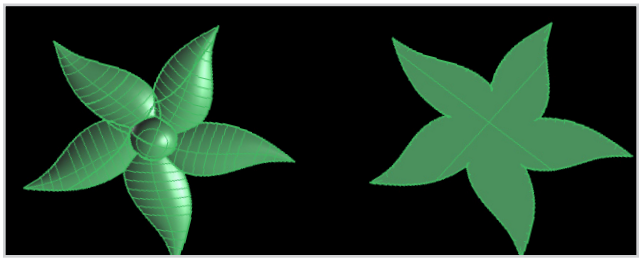




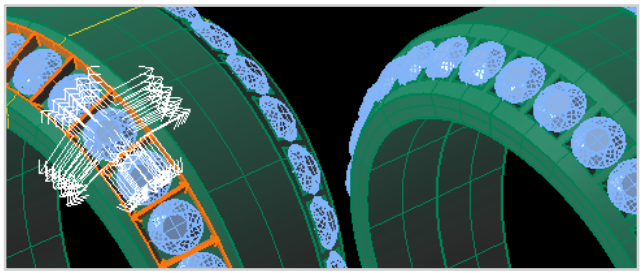
Booleans "Long Handed" ... Or, "What goes on behind the scenes"... A "Boolean" is actually an automated Split & Join operation that takes place between two solid objects. You can run one yourself, "Long-Hand", if the Boolean tools are stumped by your input objects! To do so, select the objects and run the Curve Menu command "Intersection" on them, acquiring curves on the surfaces where the two intersect. Split both objects with the new curves. Now, just delete the parts you don't need, creating the Union (delete parts between them), Intersection (delete all but overlap shape), or Difference (delete remainder of one shape or the other) that you need, and Join all remaining parts together! Congratulations... you have just completed a Boolean "long-hand".







Modeling to Minimize Booleans If you find your Booleans failing left and right, it may be time to learn some more advanced modeling techniques found in the latter parts of this manual. In the first example above, the "Loft" tool, found in the Surface menu and covered in the Advanced section of this manual, is an easy way to create surfaces between curves that act like the "skeleton" of the surface, helping you avoid having to place so many cutters in a model. It is especially important to avoid Booleans when you are trying to join together objects that need to all have the same, flat base: as in the second example above. If at all possible, begin at the curve level, using Trim to delete all curve shapes that would be in the way upon Extrude Planar Curves, so there are no co-planar objects - just one single, simple shape. Finally, use surfaces to Split one another, delete the intervening surfaces, and Join them all together. Cap the new shape, creating the flat back of the surface last of all, to avoid the coplanar condition.



(L) - Check directions of open object you're going to Boolean. All objects' directions must be outward, like a solid. (R) Boolean Difference will work!



To use "History" on cutters, re-sweep with new profile, then "Match Attributes" to the gem itself to add cutters back and re-do Boolean.

Yes Virginia, you can Boolean a Surface Although you'll receive an error message in Boolean Builder, you can use the Solids menu Booleans with 1 or more open surfaces or polysurfaces. First, read the next section to learn how to check a surface's "Directions". They must be pointing outward, the way a solid's Directions do, in order to work predictably in Booleans. If they point inward, Booleans will do the opposite.

WARNING: Booleans Break History!! Although we've told you umpteen million times, we thought it was important to say so again: Booleans break history. To get History back, re-Sweep a rail and profile, or re-apply a style to a gem using Match Attributes (select the same gem as the object to match). You may be a few steps behind in your design, but next time you'll remember to Job Bag BEFORE Booleans, won't you...?!



Tools for use with Booleans ...

Boolean-Related Commands

Tools & Utilities Menu Commands assist with checking models before & after Booleans, preparing for successful Booleans, & fixing bad Booleans.

About the Boolean-Related Commands



Check & fix a model that is rejected by Booleans.

The following tools and utilities will help you check - before and after Booleans - that your model is valid, solid, and generally happy and healthy.

Each tool is described in full - in the recommended order you'll likely need them - in this section. A quick overview of each of these tools follows:

Tools & Utilities to Check Objects

You'll notice that, when you input an object into Boolean Builder, you get a green "Check" or a red "i" (invalid) that indicates whether or not your object can be Booleaned. This is running the "Object Checker" Tool, which you can run yourself to see if an object will be successful in Booleans. This tool checks the "Shell" (validity of a model), and it checks for "Naked Edges" or open edges on a model that should be a solid object.

The "Show Edges" Utility is a way to see exactly where those naked edges are, so you can fix them with the Utilities that fix objects.

The "Check" Utility checks for validity, which can also be done in the Matrix Tools menu "Object Checker". It reports whether or not the object is valid. An invalid object has some kind of problematic surface (don't ask me how else to explain it!) that "went bad" at some point during the modeling process. If an object is invalid, fix it using the Utilities that fix objects.

Other tools that can help you find invalid and open objects include the two "Object Checker" tools (look for these words in relation to a give object), as well as "Super Select" (selects Invalid or Open objects).

Utilities to Fix Objects

Use the Join and Merge Edge tools to join open edges that should have been closed. After running these tools, check the objects again to make sure they are really closed and valid.

The "Select and Extract Bad Surface" utilities can detect (highlight) or Extract (un-join from its polysurface) surfaces that are causing the model to go invalid. After running Extract, it is best to delete the bad surface and re-build that part of the model. This may require more advanced Surface modeling tools taught in the remainder of this manual.

A Utility that Checks & Fixes Objects

Believe it or not, the one quality making your object "Invalid" might be that it's turned "inside out". Using the "Directions" Utility on a valid solid shows that the arrows are pointing outward: all is right with the world. If its arrows are pointing inward, it will show up as "invalid", which can best be translated as "Confused". Flip its directions manually, and check it again. That may have cured it...

When Booleans are Done

Once an object is a Boolean Unioned solid, it can be accurately selected for use in Metal Weights.

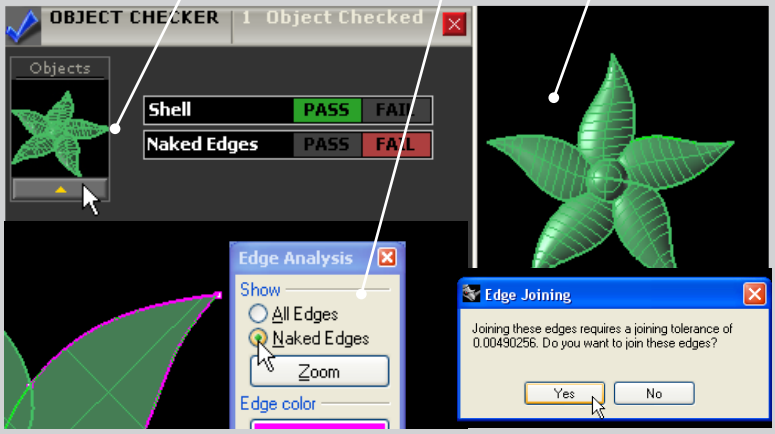
Sequence for using Boolean-Related Commands

1- Object Checker shows what is wrong with a model that does not "Pass" (receives a big red "i" in) Boolean Builder: it is either invalid (shell fails) and/or it has naked or open edges (meaning it's not a solid). The "Check" tool also tells whether it is invalid.

2- If it has naked edges, use "Show Edges" to find them and "Join 2 Naked Edges" or "Merge Edge" to fix them.

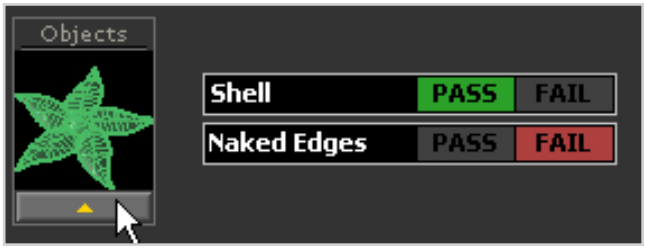
3- If a model is "invalid", check its Directions (should be pointing outward). If they're not pointing outward, "Flip" them using Command line options and check validity again.

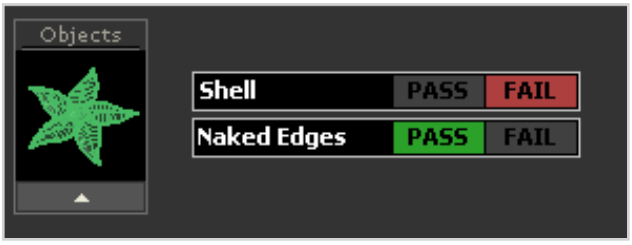
4- If Directions are correct, use "Extract Bad Surface" Utility to separate the bad surface from the model. Delete and rebuild it for a valid model.



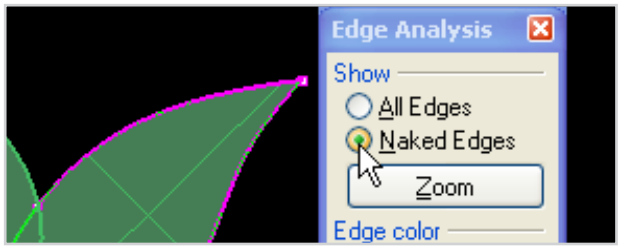
Boolean-Related Tools & Utilities

Study these commands, and use them before or after Booleans to prepare, check, and fix models for more successful Booleans.

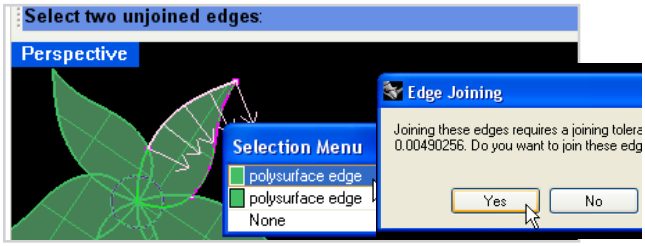




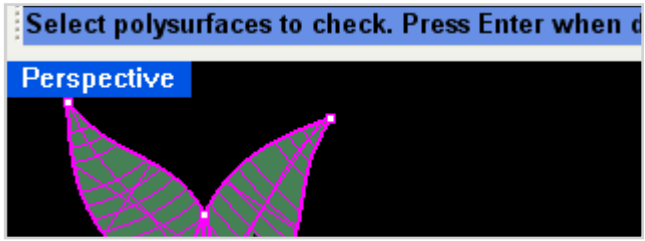
Object Checker Tool See the little check-mark (and the mean red "I") that appear when you input objects into Boolean Builder? Wonder what these are doing, and how to determine before you put an object in whether it will "Pass" or "Fail"? Well, proceed to the Object Checker Tool. Input your object, and you'll see the "checks" that are being run by Boolean builder. Does your object have any open or "Naked" edges, preventing it from being a solid object that can be used by Boolean Builder? It will tell you here. (If you "Fail" the Naked Edge test, proceed to the Show Edges Utility described below.) Is your object "valid"; that is, did it "go bad" or not at some point in the modeling process? If the "shell" is good (i.e. the object is valid), it'll pass Object Checker. If not, it will fail. (If you "Fail" the "Shell" test, proceed to Extract Bad Surface Utility described below.) See? Nothing could be easier...

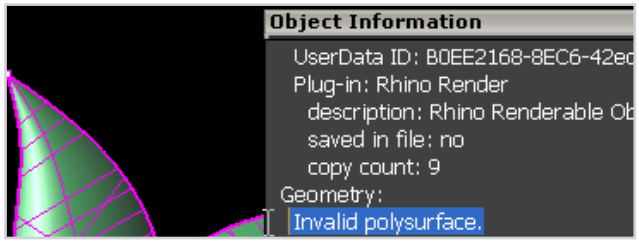


Show Edges Utility All polysurfaces have edges at the locations where two or more component surfaces join. If a polysurface is open, it also has "naked" edges where component surfaces are not joined. Think of these as "leaks" in an otherwise solid object, making it open: not solid. Sometimes, you think you have a solid object when you do not. This is where the Show Edges tool comes in. Select an object and click "Show Edges". All edges will be highlighted. Now, select the "Naked Edges" option. If you still see highlighted edges, proceed to the next command...



Join & Merge Edges Utilities Use the "Join 2 Naked Edges" or "Merge Edge" Utilities commands to help fix naked edges. If "Show Edges" reveals naked edges in a part of the model that otherwise should have joined, try "Join 2 Naked Edges" and click 2 times where you see the highlighted edges. The tool will ask you if you'd like to join the two edges. Yes, please! If this does not work, try "Merge Edges" by selecting a naked edge to join to the rest of the part. After running either of these tools, check the object again for solidness and validity with "Object Checker".

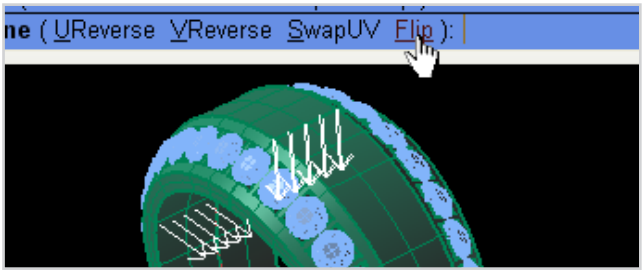


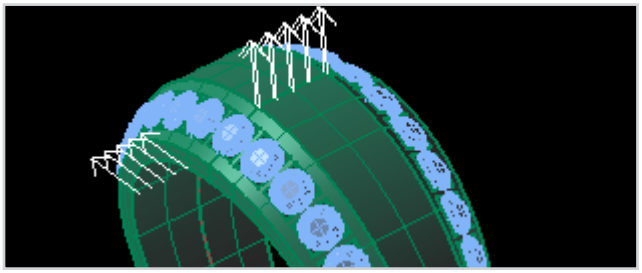


Select & Extract Bad Surface Utilities If the "Shell" fails during Object Checker, your object is not valid. This means that, during modeling, the model went bad. This can happen before or after Booleans. Sometimes, it's pretty arbitrary and mean (have you been talking about Matrix behind its back?!). Whatever the case may be, these two Utilities menu commands can find the problem surface and "Extract" or separate it from the rest of the model, giving you the chance to delete it and use other modeling skills to fill in that spot. "Select Bad Object" merely shows you the problematic object by highlighting it. That's why I like "Extract Bad Surface", which also separates or "Extracts" the problematic surface from the rest of the model. (If it still can't find your bad object, but your shell doesn't pass, try Exploding and re-joining all surfaces. It may pass after this minor fix!) Sometimes, you can Join this surface to the model again and it will Check in as valid. But most of the time, you need to rebuild that particular region of the model. To help you, read about more advanced Surface modeling tools in latter parts of this manual.

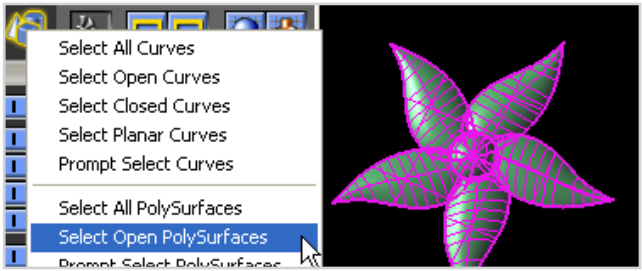
Boolean-Related Tools & Utilities

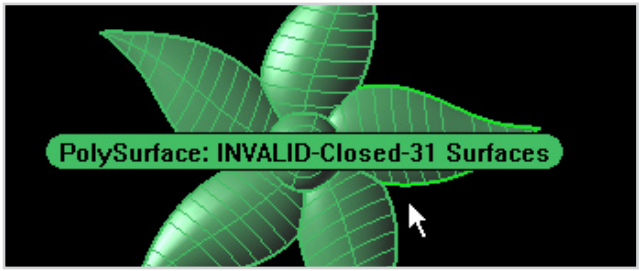
Study these commands, and use them before or after Booleans to prepare, check, and fix models for more successful Booleans.



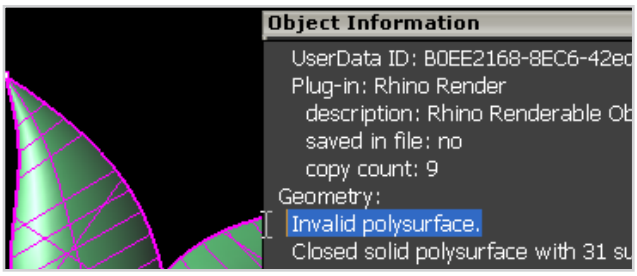


Were you given bad "Directions?" Select the "Directions" utility and click on your problematic model. In a valid solid model, the Directions should be pointing outward, away from the inside of the model. The quick explanation of this is that Nurbs modeling programs like Rhino cannot compute the volume (insides) of an object. That's why they can't recognize & Boolean an object that is fully inside another. So all objects must be pointing outward at the world (Right, above). If you check the Directions of your model and they are pointing inward, choose "Flip" from the Command line to flip them (Left, above). Now run the model through Object Checker again. This may be all the help your poor model needed to find its way back to Validity! (When Booleaning two open surfaces, their directions must both be pointing outward too, or else Booleans work opposite. So run Directions first.)

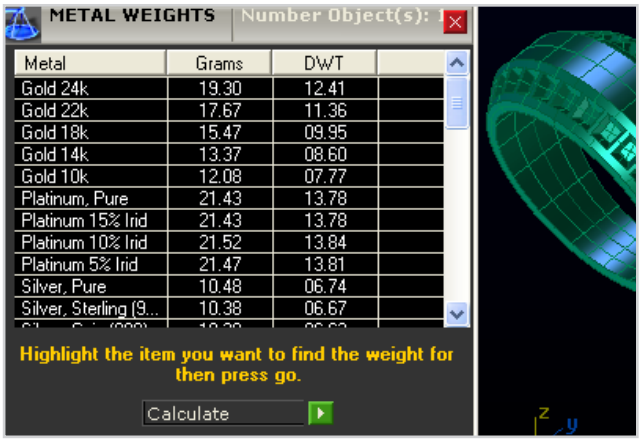




Above - Object Info displays just what you need to know about the object. Below - In "All Object Info", look for "Invalid" in the description.



Two Object Info Tools & Super-Select Another way to find bad objects or open objects quickly uses the two Object Info tools and the Super Select tool in the Info and Settings portion of the Matrix interface. When running one of the "Object Info" tools, look for the labels "Valid" or "Invalid" and "Open" or "Closed" beside the models that are giving you problems. Then you'll know which of the above fixes to try. When running "SuperSelect", you can ask the tool to select all of the "Open", "Closed", "Valid", or "Invalid" (if there are any!) models in the viewports. Now you'll know which objects need fixing!



The Metal Weights Tool Once objects are fixed and happy, and once they are fully Booleaned (i.e. no metal is intersecting any other bit of metal), the Metal Weights tool can be used to estimate how much an object will weigh in any of the available metals in the program. The reason objects must be Booleaned together is that all the metal in the piece is "weighed" by this tool, so any place that metal intersects another object, the intersecting parts will be "weighed" twice and will not display an accurate reading of the estimated weight of the finished model. Also, the objects being used in this tool must be "Solid", so you can use the above techniques to "fix" them if necessary.

Chapter 5 INTERMEDIATE

Using Matrix Builders

Learn the Builders & Tools that use Intermediate modeling concepts.

Overview of the Builder Menu

Builder menu tools employ intermediate concepts because you can easily use them with Settings tools you've already learned - for example, setting gems placed with Eternity Ring builder - or with more difficult tools explored in the Intermediate and Advanced sections of this manual - for example, how to employ the Raised Band Builder concept on other surfaces.

Other Builders create design elements that are useful together with tools you'll learn in the Intermediate and Advanced sections of this manual, including the Pattern & Jump Ring Builders, the Nautilus Builder, and the 2 Celtic Knot Builders. These elements will embellish your designs with help from design tools and concepts explored in the last two "books" or sections of this manual.

Please note: if you are a Revo customer, the Revo Builder & its large fixture border command are also found in this menu; however, we will not explore them any further here. They are fully detailed in your Revo instruction manual.

Creating a Signet Ring Design

Three commands found in the Builders and Tools menus will walk you through completion of a signet-style award ring, complete with a variety of shapes suitable for award- or fine jewelry-style signet rings available in two building modes; an Award Ring Builder which can "read" the shape and size of the top of a signet ring and provide a large number of options for creating and varying an award ring top; and finally a Surface Pullback tool suitable for creating any kind of inset surface in your jewelry, complete with a "cap" or the material "cut away" to create the inset, and perfect for completing the "side shields" of a signet ring.

Intermediate Commands in the Tools Menu

Advancing in the Tools menu, the Curve Transform tool lets you bend any curve using interactive controls to assign a "Hold" and "Bend" point; then, between these two points, you may bend, scale, blend, or straighten the shape the way you would if you were manipulating wire.

Other commands in the Tools & Cutting menus assist you with mirroring designs. Mirror Mode, which creates a copy of your design from one part of the viewports to another, "keeps up" with changes that you make to allow you to see the overall effect of your design - not just one half or one quarter of it - while you work.

Another helper in mirroring a design is the Plane and Cube Cutter tool found in the Cutters menu. This places planes or cubes in the viewports suitable for splitting or Booleaning designs to cut away all but the half or quadrant you wish to Mirror. Quad Flip builder automates this process for you, splitting away all but the quadrant of the design you choose and mirroring this twice to create a "quad flip" design.

Finally, once a design is ready for production, Ring Resizer can create a mesh copy of your model perfect for milling or growing in any number of different sizes you select, and save it to a file.

Builder & Tools Menu Intermediate Commands

Builders create a ring from start to finish. Use other Settings tools & further Intermediate and Advanced commands to complete a design.

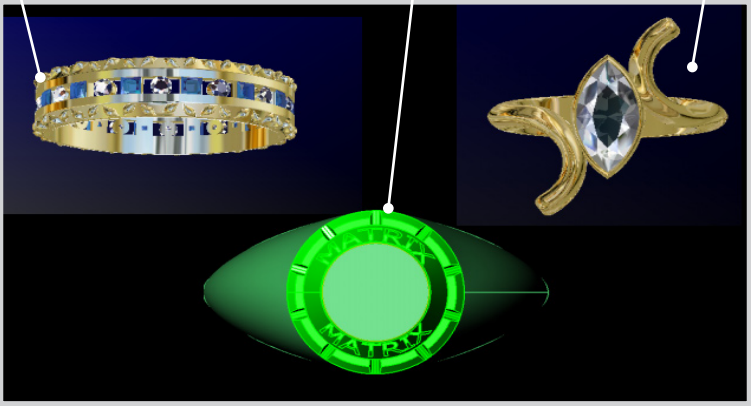
Other builders create design elements for use with more advanced tools.

A Signet Ring design uses Signet Ring and Award Ring builders together with the Surface Pullback tool to create inset side shields.

Signet and Surface Pullback tools are also suitable for fine jewelry designs.

Curve Transform Tool provides a way to control any curve with the feel of bending wire.

Remaining Tools facilitate mirroring, cutting, quad-flipping, and even resizing designs in preparation for production.



Skills & Commands in this Chapter

Rings from the Builder Menu:

Eternity Ring, Raised Band



Builder Menu Design Elements:

Pattern Builder, Celtic Knot, Freeform Knot, Jump Ring, Nautilus



Completing an Award-Style Ring:

Signet Ring Builder, Award Ring Builder, Surface Pullback Tool



Intermediate Tools:

Curve Transform Tool, Mirror Mode, Mirror Mode Shatter, Ring Resizer



Cutting Tools to Mirror Designs:

Plane & Cube Cutter, Quad Flip Builder



Rings from the Builders Menu...

Eternity Ring Builder

Create an Eternity Band design that is easy, interactive, and ready to be finished with the tools & builders you've already learned.

Using Eternity Ring Builder

You have several options for starting this builder. One is, with nothing else onscreen, you can simply open up the builder, place a Ring Rail using the "+ Ring Rail" button in the builder, (this opens the familiar Ring Rail tool), and, with a ring rail placed, click the "Start" button to create the default ring with interactive viewport handles. Or, if you already have a Ring Rail in the viewports, proceed to the Eternity Ring Builder and click the "Start" button to create the default ring. However, like other tools in Matrix, you don't need to enter the Builder menu at all: simply select the ring rail, press F6, and select "Eternity Ring" from the F6 menu. The builder will open and the default ring will appear. Finally, with the builder open and a Ring Rail in the viewports, begin clicking and dragging the slider controls to the locations you want, and the tool will find the ring rail; the eternity band will appear.



Add Ring Rail if you don't already have one.

After setting up the profile shape, gems, and ring dimensions as described below, press Enter to end the command and keep the results.

Edge Profile

To create a cross-section shape for the ring, click the Edge Profile preview window to open the Library browser, and select the profile shape of your choice. Or, click on the Edit control in this preview window to draw your own, following the current shape as a guide.



"Add Gems" to open gem interface. Select as usual.

Adding Gems

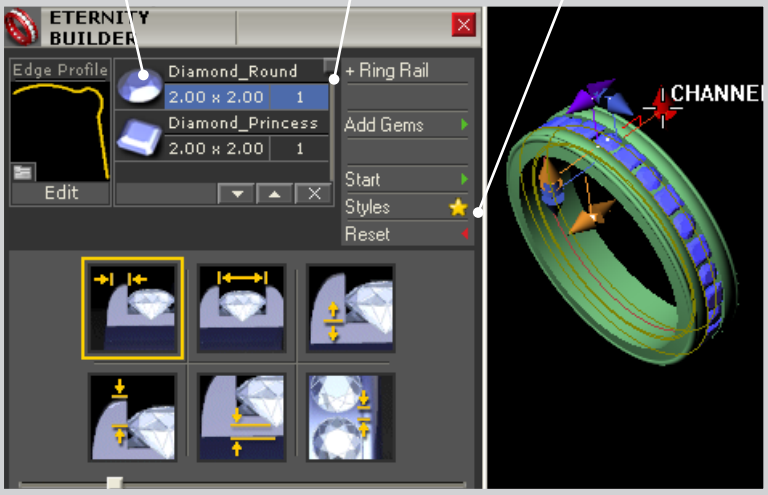
Click the "Add Gems" option in the Builder menu to open the familiar Gem Loader interface. Use this interface as always, Double-clicking a gem to add it to the ring. You can add a number of different shapes and sizes; just make sure they are realistic for your eternity ring! Click the red X in the upper right-hand corner of the Gem Loader window to close it. Now, the gem list will appear beside the Edge Profile. You can scroll up and down this list; select a gem and click the "Up" or "Down" arrow to change its order in the pattern, or click the "X" to delete it from the arrangement. The indicated gems will form a pattern in the band.

The Eternity Ring Builder Interface

Click the Edge Profile preview window to choose a new cross-section shape for the ring. Or, click "Edit" and draw your own, using the current shape as a guide.

Upon using "Add Gems" and choosing a gem or gems for the design from the Gem Loader interface, close the Gem Loader and the chosen gems will appear in the Gem List to the right of the Edge Profile window. Select one, and use the controls to move it Up or Down in the layout, or Delete it from the list. The slider controls correspond to the Viewport Control Handles and Command line options. Choose one and move the slider to adjust it; or, use the handles or options.

Reset the builder & Save / Load Styles here.



Ring Dimensions

Use the Builder's slider controls, Viewport Control Handles on the model, or Command Line options to indicate the dimensions for each part of the Eternity ring: overall "Ring Width" in mm, "Channel Width" in percentage covering gem, "Channel Depth" in mm between gem and finger rail, "Extra Height" in mm (as required for setting gems), "Culet to finger" distance in mm (pushes gems outward away from finger rail, "growing" ring in overall thickness), and "Gem Spacing".

Rings from the Builders Menu...

Raised Band Builder

Automatically place lettering - or any closed, planar curve design - onto a band in a raised or sunken pattern.

Starting Raised Band Builder

From the Builder menu, open up Raised Band Builder and place a Ring Rail using the "+ Ring Rail" builder option (opens Ring Rail tool). Or, start up this tool with a ring rail in the viewports by selecting the rail and clicking F6 > Raised Band. One final way to start this tool is to simply input an existing Ring Rail into the builder.



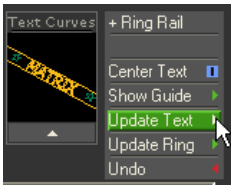
Use Update Ring to see slider changes or to add text.

Creating the Band

Select a shank profile - or, the shape on the sides and inside of the ring - by clicking the "Shank" profile preview window and selecting the shape from the Browser that appears. (You may also click Edit and draw your own, using the existing shape as a guide.) Or, click the "Text" profile - the shape at the top of the ring and the top (or inside, in the case of sunken) of the letters - and do the same.

This tool does not have Viewport Control Handles (there's just too much to calculate with the text going onto the ring!), so use the slider controls by selecting a dimension of the band to change (Width & Height of band, "Text Edge Offset" or distance between edges of ring and text, and Text Height or Depth).

At any time while using this builder, you may click "Update Ring" to preview the profile or size changes you've made. However, no text will appear on the ring until you've used "Update Text" first; then "Update Ring"



Update Text to place in viewports or if you change text. To add curves, place box & all its contents into Text In-Box.

Creating the Text

Type the text you want on the band into the Text box in the builder. Choose a font and style (Regular, Bold, Italic) from the drop-down menus beneath it. (See "Fixing Problem Curves" Section of Curves Tips & Tricks before choosing a font!) To center, choose the "Center Text" option in the Builder option list. To see guide, select this option.

Now, click on "Update Text". The text will appear in the viewports. This is the text that is going to be placed onto the ring. You may make changes to this text - including scale, move, any edits with Curve or Trim/Split/Join tools - and you may even add curves of your own to this text. However, if you do make any changes, select the final design AND the rectangular box outside it and input it into the "Text Curves" window in the builder. Now, you're ready to click on "Update Ring" to create the ring.

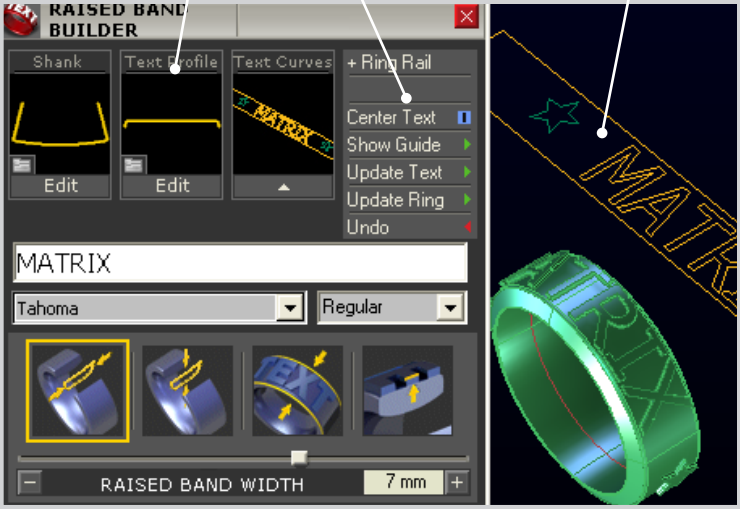
Steps for using Raised Band Builder

1- Place a Ring Rail, using either "Ring Rail" in the Tools Menu tool or "+ Ring Rail" option in the builder.

2- Select Shank and Text profiles by clicking each Profile Preview window and selecting an option for each from the library browser that appears. Or, select "Edit" and use the current shape as a guide to draw a new one.

3- Specify sizes for band and text with sliders. Choose options to "Center Text" & "Show Guide" box for text.

4- Type in the text box and select a font and style from the drop-down menus. Choose "Update Text" to add curve designs to the text. Input all curves into the "Text Curves" In-Box if text changed, and use Update Ring to create design.



Enter Raised Band Builder by selecting an existing ring rail, pressing F6, and choosing Raised Band; or, enter this tool through the Builder menu. "+ Ring Rail" adds a new rail.

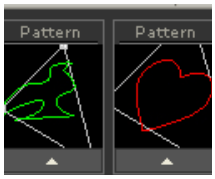
Builders Menu Design Elements ...

Pattern Builder

Input any two objects and create a variety of patterns with them in order to create a design that can be used with various other tools in the program.

About Pattern Builder

This builder accepts any two objects or sets of objects that fit in (or somewhat near!) the two triangular guides it places, and turns them into an array of different patterns. Choose a pattern, choose a number in which it repeats in the X and Y direction, and scale the pattern in both X and Y to get any size and configuration you need for your design. Various other tools in the program can use patterns created by this builder to place them up onto jewelry - such as Raised Band Builder, which can place pattern curves around a band. Flow Along Surface & Apply Mesh UVN can put (respectively) surfaces/solids/mesh combinations or meshes only up onto a surface. A few more rules apply, so consult the relevant parts of this manual for more details.



Create objects in Preview triangles.

Using Pattern Builder

Select this button in the Builder menu and click the "Preview" option. This will place two triangular guides onscreen. (Deselect the "Preview" option to turn the triangles off when you do not need them anymore!) Place or draw two objects to array into these triangles. Then, select each object and input it into the corresponding "Pattern" In-Box in the builder menu.

A preview of the pattern will appear just below the triangular Preview guides. Select a Pattern (1 - 40) from the Pattern dropdown menu.

From the slider controls along the bottom of the builder menu, choose a dimension to change: X or Y repeat (number of pattern repetitions in the X or Y direction), X or Y scale (size of pattern in X or Y direction).

Until you click "Apply", the pattern objects are not "real" - they are just previews of the pattern. To create these as "real" objects you can then proceed to model with, click the "Apply" button in the builder. "Select" and "Undo" objects to delete the old pattern and create a new one.

Steps for using Pattern Builder

1- Select "Preview" to place two triangles into the Looking Down viewport.

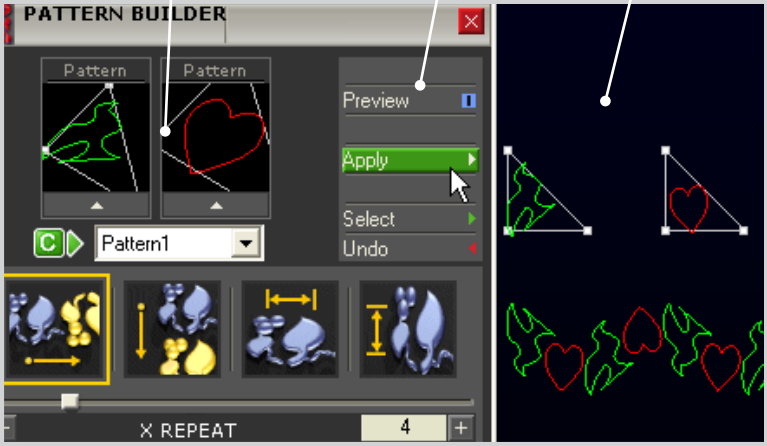
2- Draw or place one object or set of objects into each triangle. Select the contents of each triangle and input it into a builder "In-Box".

3- Choose a Pattern (1 - 40) from the dropdown menu.

4- Using the slider controls, choose a number in the X and Y directions ("X and Y Repeat"), as well as a scale for the pattern in X and Y ("X and Y Scale").

5- Click "Apply" to turn the builder preview into "real" objects ready for modeling processes.

If necessary, use "Select" and "Undo" to delete the results and create a new pattern.



Tip: When using curves, size the pattern so it fits into the box created by Raised Band builder, and apply onto a Raised or Sunken band from the builder. Or, input surfaces or meshes and apply them using the "Flow Along Surface" or "Apply Mesh UVN" tools covered later in this manual.

About the Two Preview Triangles

The degree to which the objects overlap the triangle curves indicates how much they will overlap one another. The triangles are fit together by the builder to form a square, and the configuration in which the program puts them together to create this square makes the different patterns available in this builder. Remember that you may input any type of object depending on how you'll use it in your model: curves, surfaces, solids, or meshes. Just for fun, try inputting the same object into both triangles!



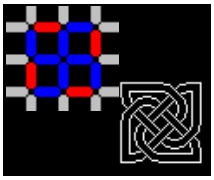
Builders Menu Design Elements ...

The Two Knot Builders

Create a classic Celtic knot shape, or design your own using the Freeform Knot Builder. Use with other tools to place into designs.

Knot Builder: Design a Celtic Knot

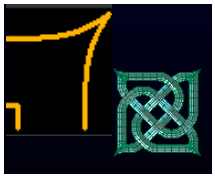
To set up a knot design, open the builder and click on the grid in the menu. A knot will appear in the preview window beneath the grid. Left-click to create blue bars in the grid indicating where the knot strands will "cross". Right-click on a white or blue bar to change it red, indicating where the knot will "loop" (not cross strands). Click a blue or red bar again (with same click type) to change it back to white. Leave white bars where you don't want parts of the knot. In this way, create the Celtic knot design you wish to use in your model. (Grid Size is determined by the X and Y variables in the "Knot Size" window. To Save and Load a knot you've created, use the "Open" and "Save" controls beside this.)



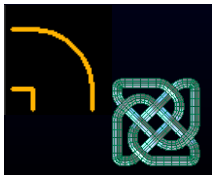
Blue bars are where knot strands cross; red is where they loop. White indicates no knots at all.

Knot Builder: Profile Shape & Size

Use the top part of the menu to indicate how your knot will be created by the builder: "Corner" displays the profile shape. The "Corner Scale" and "Corner Angle" slider controls change this shape: select a control and drag the slider to change it.



Different settings for corner shape & scale create different looks for the finished knot.



The knot will consist of a profile with this shaped-corner following a rail in the shape of the knot you indicated at the bottom of the menu. To assign the dimensions of this profile where it is tallest, use the Knot Height & Cap Height slider controls. The Knot Width slider indicates the width of the knot profile overall - regardless of how tall or short it is over the course of the knot.

Celtic Knot Builder Interface Guide

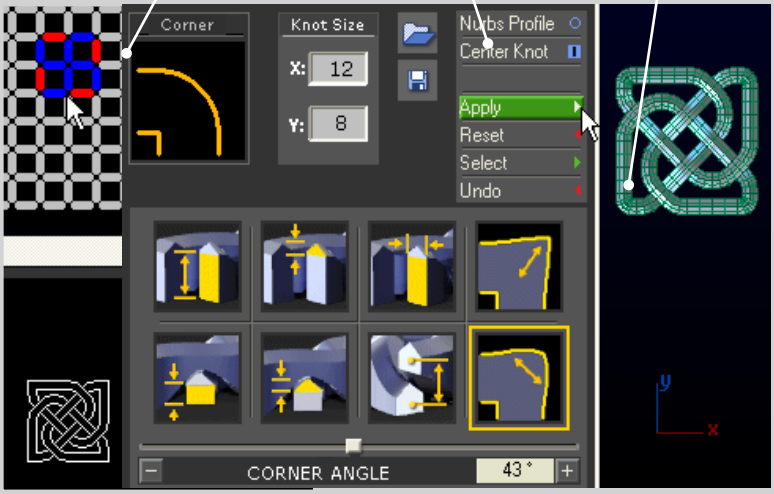
1- Start by designing the knot: Left-click to create blue gridlines and right-click to create red ones. Click again (the same way) to get white gridlines. (Blue = crossover, Red = loop, White = no knot.) The preview knot appears beneath the grid.

2- Assign dimensions for the knot using the slider controls. The two Corner controls are previewed in the left-hand corner.

3- Indicate options (Nurbs, Center) and use Apply to create the knot.

4- To save the grid settings or to change the grid, use center controls.

5- If necessary, "Reset" the grid and/or Select & Undo the knot.



The knot profile will be shrunk down by the builder to create the over/under effect of the final model. Use the Crossover Knot Height and Crossover Cap Height to indicate how small the profile should be when it shrinks down to create the over/under effect. The remainder of the knot will be scaled uniformly between these two (largest and smallest) dimensions. The distance between the two profiles when they pass over/under one another is indicated by the "Crossover Pass Height" slider control.

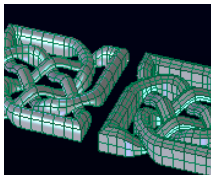
The size you will want for each of these values is determined by how you will be producing this model. If you must grow the model on a machine that cannot handle intersecting solids, you will not want the two strands to touch one another. If you are milling the model, the mill does not mind if the two intersect.

Knot Builder: Creating the Knot

Click "Apply" to create the knot. A few options in the builder will affect creation of the knot: Select the "Nurbs Profile" option to make this knot with smooth-shaped sides (a nurbs profile curve - or, a profile curve that cannot be

exploded). De-select this option to make the knot with a polyline curve, creating a polysurface from the knot. Use the "Center Knot" option to center the finished knot at F4 in the viewports.

The "Reset" option restores the builder controls to their defaults; "Select" and "Undo" deletes the knot.



Selecting Nurbs Profile (L) or Polyline Profile (R) creates different looks for the finished knot.

Freeform Knot Builder: Designing

This builder lets you draw and input your own "grid" curves to create the knot. The first "Curves" in box creates the blue (crossover) effect. The second box loops the knots in the X direction. The third box loops the knots in the Y direction.

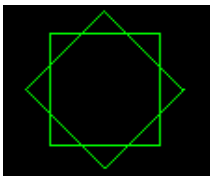
Freeform Knot: Profile Shape & Size

The knot profile is a simple rounded rectangle for this builder. Indicate knot width and height using the slider controls. Profile Spacing lets you indicate the distance from one profile to the next; smaller spacing provides more control over the shape. "Height at Knot" and "Center Height" work like the "Crossover" controls in the Celtic Knot builder, indicating (respectively) the height the knot shrinks to when it overlaps itself, and the distance between overlapping profiles.

The same rules apply when building this knot: do not let the strands intersect if you will be growing the design with a machine that cannot handle intersecting solids. They may intersect if the object is being milled.

Freeform Knot: Creating the Knot

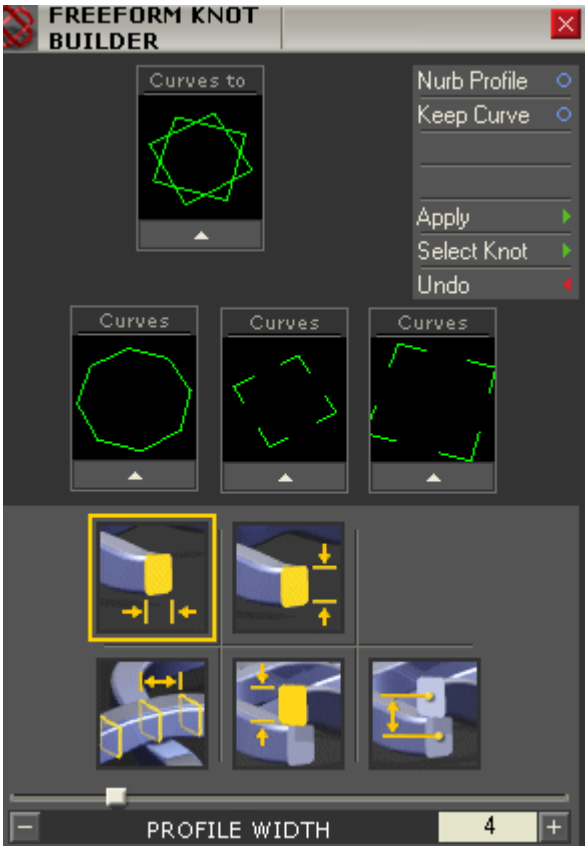
Use "Apply" to create the knot. The Nurb Profile option works the same as this option in the Celtic Knot Builder. "Keep Curve" keeps your input curves. Use "Select Knot" and "Undo" to undo the work of the builder.



Input curve design and builder set-up determines output design



Output design depends on builder settings and input curves.

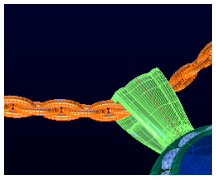


Builders Menu Design Elements ...

Jump Ring & Nautilus Builders

These two easy builders create design elements that can be used in a number of different modeling applications.

Set up a Jump Ring



Use two jump rings, rotated, with Object on Curve to create a necklace.

A jump ring is composed of a rail and a profile swept along that rail. To select a shape for the rail, click the Rail Profile preview window and click a shape from the library browser that opens. (WARNING: Only Edit the straight profiles, using the existing shape as a guide.)

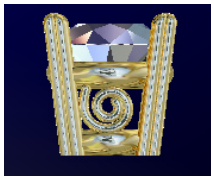
Next, select a profile shape to apply to the rail by clicking on the Shape preview window.

Use the slider controls in the builder to choose a Rail height and width as well as a Profile depth (height) and width to use for the jump ring. To assign the Rail size for the outside of the jump ring, choose the "Shape Outside" option. To set this for the inside of the jump ring, choose the "Shape Inside" option.

Click "Make Ring" when you are done to create the ring in the viewports.

Using "Nautilus"

To create a spiral you control on-the-fly with sliders, select the Nautilus builder. Input a circle into the "Curve" In-Box. Begin moving the sliders, and a preview curve will appear.



Pipe nautilus curve to create filigree.

The "Amount" slider control assigns the distance between "swirls" in the shape. "Length" assigns how many swirls in the shape, lengthening the curve as you raise this value. "Rotation" assigns the degree location on the input circle that the spiral pattern will begin, rotating the startpoint of the curve to change its look.

The "Flip" option reverses the direction of the Nautilus, while "Reset" returns you to the default settings in the builder.

Press Enter to complete the work of the builder and place the curve in the viewports.

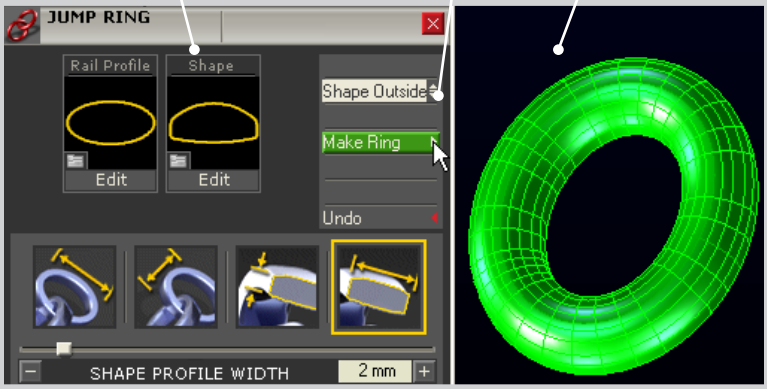
Steps for Using Jump Ring Builder

1- Assign a Rail Profile and Shape by clicking each Preview window to open the profile browser, or choosing "Edit" to create your own.

2- Choose whether the builder will create the dimensions of the Outside or Inside of the ring by toggling this Builder Option.

3- Assign dimensions using builder controls and slider; or "swipe and type" in slider window.

4- Click "Make Ring".

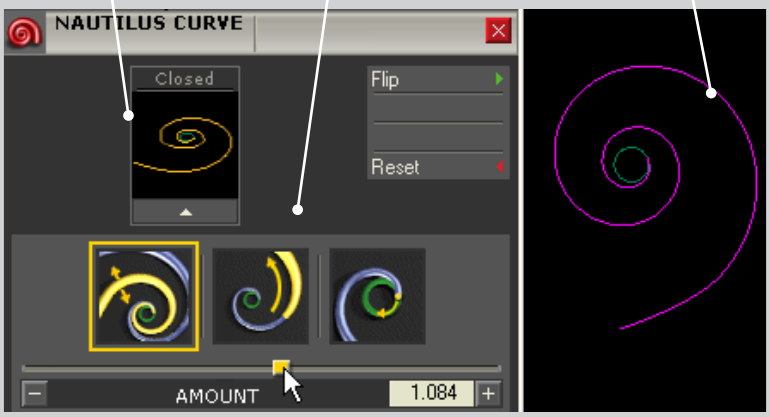


Steps for Using Nautilus Builder

1- Create a Circle curve and input it into the "Closed" Curve input window in the builder.

2- Adjust the three slider controls until you like the look of the curve.

3- Press enter to keep the curve in the viewports and end the work of the builder (until then, it's a preview curve you can't select).



Completing an Award-Style Ring

Signet Ring Builder

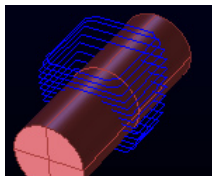
Create two types of rings suitable for award or fine jewelry styles. Choose 2 or 3 profile shapes, and adjust in real-time with handles.

Two Styles of Signet Rings

In Signet Ring Builder, you will find two styles of signet rings. Choose which one to use based on the requirements of your design. Both are built differently by the program, and so offer different options for Profile Shapes and Builder Controls / Viewport Handles.

Behind the Scenes: Cross-Section Signet

The Cross-Section signet ring is created by applying the Top profile shape in "cross-sections" - or, gradually decreasing sizes evenly distributed down along the Edge profile shape. Then, the finger hole in the size indicated is cut from it (you won't see these steps). It has a uniform look in the Side View (assigned by the "Edge" profile shape) and just one other, perpendicular profile ("Top" shape).

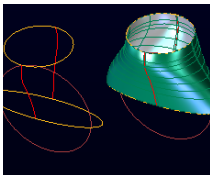


How the Cross-Section Signet Ring is Constructed.

Because of the way this ring is made, the bottom of the ring would be flat at the bottom, in the shape of the Top profile. So, this builder offers the "Cut Bottom" option, which cuts away the bottom (flat) part of the ring at the angle you indicate with the "Bottom Cut Angle" control, and a profile is placed at the bottom (6 o'clock position) of the ring. This profile's size is assigned using the Bottom Width and Length Scale in the builder.

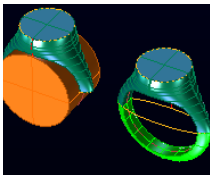
Behind the Scenes: 2 Shape Signet

Selecting this option for the builder takes away the "Bottom Cut" options and adds a "Middle" profile shape. This ring is created completely differently by the builder: A top and middle profile are placed: with the top Profile at the topmost height of the signet ring and the Middle Profile flush with the Looking Down viewport and straddling the complete distance between the 9 and 3 o'clock positions on the ring. Between these two profiles, the Edge profile shapes you assign in the Builder menu are placed. These shapes become the "Rails" of a 2-rail sweep, with the Top and Middle profiles serving as the Profiles of the sweep operation.



Construction of 2-Shape Signet Ring: Part I.

Once this shape is made, it is booleaned out by an extruded cylinder in the size of the finger rail, to fit the ring size selected. This leaves the top half of the ring. To create the bottom half, the caps are extracted on the top half, and a Sweep 1 is run along the finger rail between the shapes at the 9 and 3 o'clock positions on the ring.



Construction of 2-Shape Signet Ring: Part II.

So, if you followed all that, you could make your own signet ring: a more advanced process we'll demonstrate in a future part of this manual.

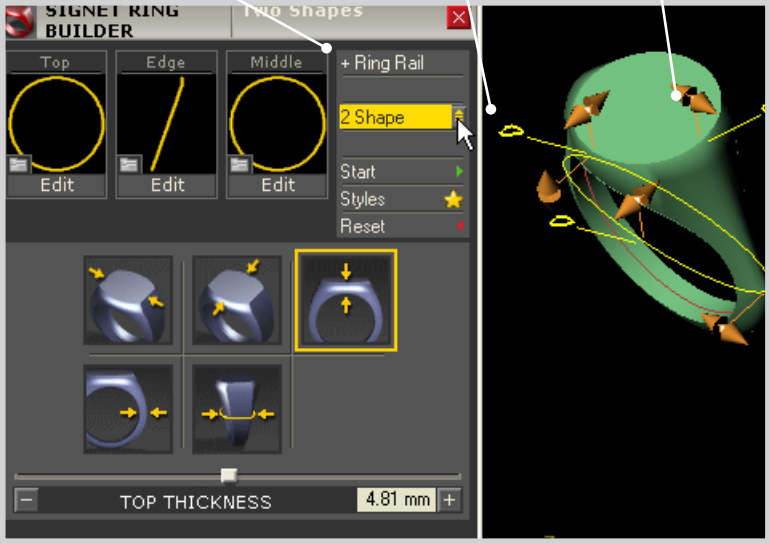
Steps for using Signet Ring Builders

1- With a ring rail in the viewports, enter this builder (F6 or Builder menu). Or, place a ring rail using the "+ Ring Rail" option in the builder. Choose a style (2-Shape or Cross-Section) at any time during the process.

2- Click "Start" to see the ring with handles, or just begin moving a slider.

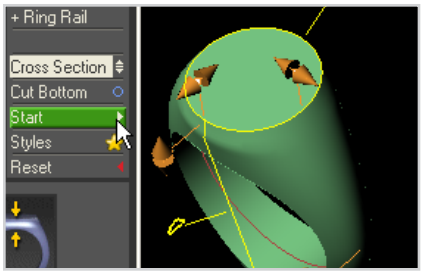
3- Choose, a Top, Edge, and Middle profile (if using 2-shape method) by clicking the Preview window of your choice,

4- Press Enter when you are done to keep the changes.



Signet Ring Options & Builder Controls

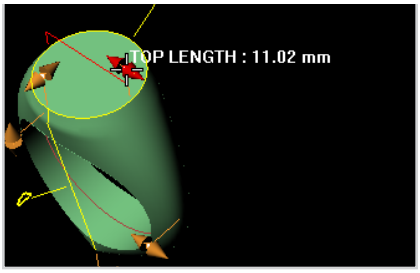
As indicated, these refer to Cross-Section, 2-Shape, or Both builder methods.



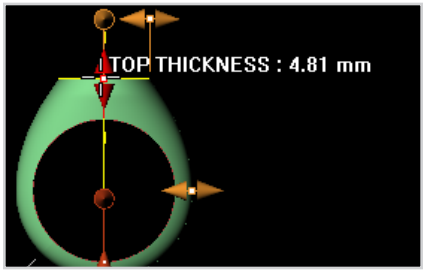
Both + Ring Rail & Start When you do not have a ring rail in the viewports, use "+ Ring Rail" to open the Ring Rail tool. Select a size and click the green arrow to place the rail. With a Rail placed, click Start for a preview ring with handles. Or, move a slider control to get the preview ring.



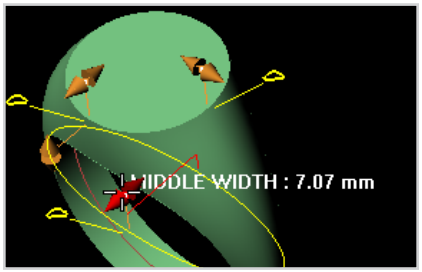
Both Top & Edge Profiles Click each Preview window to open the browser of shapes. Or, click Edit and draw a new shape using the current one as a guide. The "Edge" profile for a Cross-Section ring controls the whole length of the ring in the Side View, while in 2-Shape it only controls the Side View shape of the top of the ring.



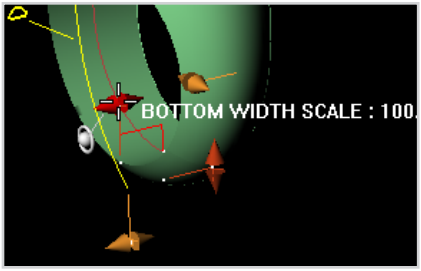
Both Top Length & Width Change these values to indicate mm distance for the Length (X in Looking Down) and Width (Y) of the Top profile of the ring.



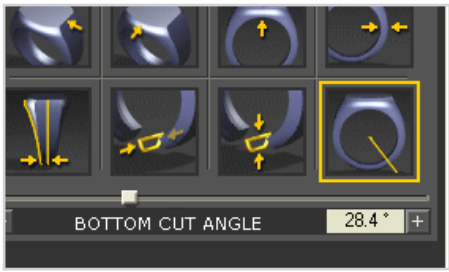
Both Top & Shank Thickness The Top Thickness indicates the distance between the finger rail and the top of the ring. Shank Thickness is the thickness of the shank between the fingers, at the 9 and 3 o'clock positions on the rail.

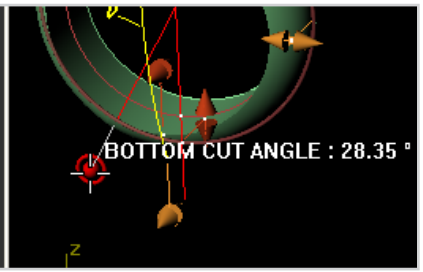


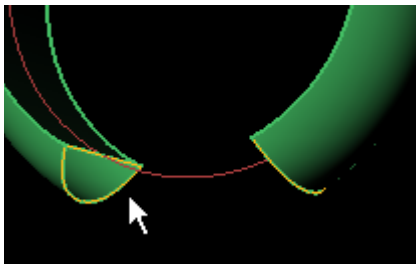
2-Shape Middle Profile & Middle Width Click the Middle profile preview window to choose a new shape for the middle of the ring. The Middle Width indicates the size of the middle profile as seen in the Side View position at the 9 and 3 o'clock positions on the rail.



Cross-Section Bottom Width This value indicates the thickness of the ring at the bottom of the Edge profile, as seen in the Side View BEFORE changes are made for the "Cut Bottom" function and its associated profile. (This value does not reference the profile used in the "Cut Bottom" option).







Cross-Section Cut Bottom; Bottom Cut Angle; Bottom Width & Bottom Length Scale Recall that the Cross-section builder offers the Cut Bottom option, which cuts away the part of the ring at the bottom of the rail that would otherwise be flat because of the cross-section method with which the ring is constructed. The builder also places a profile between the two cuts. To indicate where this cut takes place, use the Bottom Cut Angle control. The angle where the ring is cut will be mirrored to the other side of the ring. Then, use the "Bottom Width and Length Scale" to control the size of the profile that is added. If you're going to change these two values a lot (shrink or grow the base of the ring), place the Cut Angle further up the sides of the ring, giving the profiles some space to gradually taper from the sides to the bottom of the ring. Place the Cut Angle lower if you won't change the size of the bottom profile much at all.

Completing an Award-Style Ring

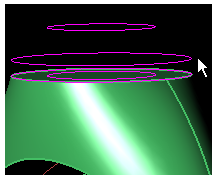
The Award Ring Builder

Create an Award Ring Top for a Signet Ring. Design every part of it: including shape, dimensions, bezel/flutes, and text / font or artwork.

Using Award Ring Builder

This detailed builder is completed in three "stages", each represented by a separate menu that is reached using the "Next" and "Back" controls in the builder.

1. Setting Size & Shape of Award Ring Top



Rails Created in Stage 1 of Builder.

You'll encounter the first menu when you open the builder. The award ring top is comprised of three main curves that will be swept with a profile to create the surface of the Award ring top. One of these curves is the base of the Award ring top; the next is directly above it and a copy of it; creating the thickness of the top. Finally, the last curve is offset to the inside and higher than the curve, creating the surface on which the lettering will lie. These are referred to as "Outer Rail" and "Inner Rail" in the first screen of the builder. (Outer rail is the same shape copied, one on top of the other.)



Select a signet ring to set X and Y sizes.

To set the size and shape of the Outer and Inner rails, you have two choices: (1) you may click the profile preview windows for each shape to open the profile browser, and select a new shape (or, as always, use "Edit" to draw a new shape); then, use the sliders to indicate sizes for each dimension.

(2) Your other option is to use the "Set Signet" option and select an existing signet ring. The builder can read the shape of the Top profile of the signet ring, and will create the Outer and Inner rail based on these. Note that the size (Outer X and Y) will also be set by this process, so do NOT adjust these slider controls if you want the Award Ring top to match the signet ring you selected. Use the remaining slider controls to indicate values for Z height (distance between two Outer rails), Z Offset (indicates where Award Ring will be drawn in the viewports: do NOT adjust this if you select the "Set Signet" option), Inner X and Y size, and Inner Z height, or the distance between the Inner and Outer rails.

When you are done setting your dimensions and shapes for the Outer and Inner rails, click "Update" to see the results. "Undo" will reverse what you've done so you can change it, and "Update" will show your changes.

Use "Update" before moving on with the "Next" button in the builder menu.

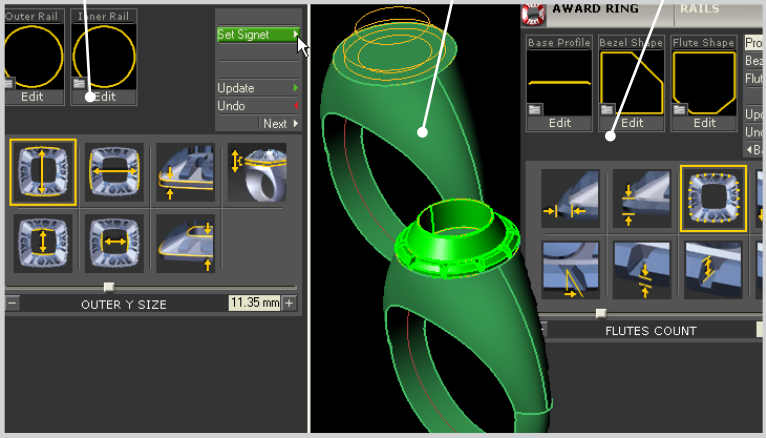
Steps for using the Award Ring Builder

1- With a Signet Ring, start up this Builder and select "Set Signet". Click the signet ring. This sets "Outer & Inner Rail" shapes, Outer X and Y size, and Z Offset. It's a good idea NOT to change these!

2- Use the remaining slider controls in the first screen (and Inner Rail shape if you wish to make it different) to set the Inner & Outer Z Height, & Inner X and Y size. Click "Update" and "Next".

3- The next screen allows you to select a Base Profile or Starburst beneath the text. If you wish to use a bezel and add flutes to it, indicate these as well. Click "Update" and "Next".

4- In the last screen, indicate size and position / orientation for text and/or artwork. Select a profile for the top of the text or artwork.

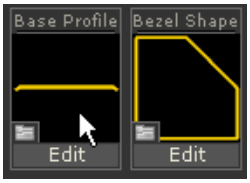


Ring created in Signet Ring Builder > 2-Shape Option. In first screen, "Set Signet" creates correctly-sized rails (Left and above). Bezel profile, Text profile, and Flutes all indicated in second screen (Right and below).

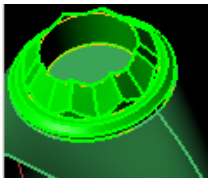
2. Details on Award Ring Top

The second screen in the builder adds details you specify to the outside of the Award Ring top. Choose the "Profiles" or "Starburst" options to indicate the surface shape of the Award Ring top.

With "Profiles" selected, click the "Base Profile" preview window and select a shape from the library browser. Or, click Edit to create your own, using the current profile shape as a guide. The profile will be placed between the Outer and Inner rails and swept with Sweep 2 to create the surface of the Award ring.



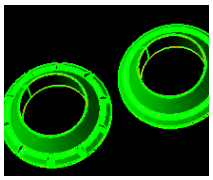
"Profile" assigns shape of the surface on which the lettering will appear.



"Starburst" makes this surface angled.

With "Starburst" selected, builder controls will be displayed that allow you to set the number of "starbursts", inner height (where they are low) and outer height (where they are high).

If you don't want a bezel around the Award Ring top, click "Update" and "Next" to proceed in the builder.



(L - R) Indicate a Bezel with or without Flutes.

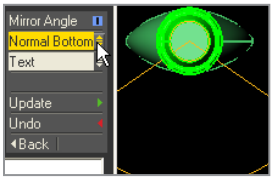
If you do want a bezel, select this option in the Builder menu and a Bezel Shape Profile Preview Window and two more sliders will appear: Bezel Width and Height. With the Bezel option turned on, you will also see the "Flute" option. Turn this option on to select a Flute Shape, and to see sliders for 6 Flute dimensions: Count, Z & X Angles, Z Offset, Height, and Width.

Make all the changes you want to the Flutes, Bezel, Starburst and/or Profile. Click "Update" and "Next" to reach the last screen in the builder.

3. Adding Lettering or Artwork

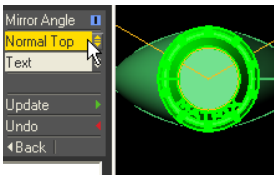
In the last builder menu, select a text profile (shape of the top surface of the lettering), Message, Font, Style (Regular, Bold, Italic), and indicate dimensions for the position and size of the lettering on the top of the signet ring.

The slider controls in this menu indicate the distance of the text from the inner and outer rails (Text Top and Bottom Offset); the distance of the text from the angles placed (angles indicate which part of ring text or artwork will go in) - Text Left and Right Offset; Height of text (set negative to create sunken text); and Text Angle. Turn off the Mirror Angle option to set the left and right angles separately (angle in degrees of a "circle" on Award Ring top between which text will be placed - set like hands of a clock).



"Normal Bottom" plus angle at bottom of bezel creates text at bottom of award ring top.

To set Artwork instead of text, click the "Text" option in the builder list, switching it to "Artwork", and input the artwork (closed, planar curves) into the "Artwork" in-box. There are four options for orienting text or artwork once you've set an angle: "Mirror Top/ Bottom" and "Normal Top / Bottom". Mirrored places mirrored text or artwork to create a "seal"-style signet ring; Top/Bottom places the artwork so it is legible (left to right) on the top or on the bottom of the Award Ring.



Repeat Text options & controls to place on top of award ring.

Once you've set up your options, click "Update", and use this builder screen all over again to create another (or an identical) message in a new location. "Update" again - as many times as you can fit into the Award Ring Top! - to add another message or artwork element.

Steps for setting Text or Artwork

1- Select a Profile for the top of the Text or Artwork.

2- For text, type message and select font and style. For artwork, select this option and input closed, planar curves (from Looking Down) into the In-Box.

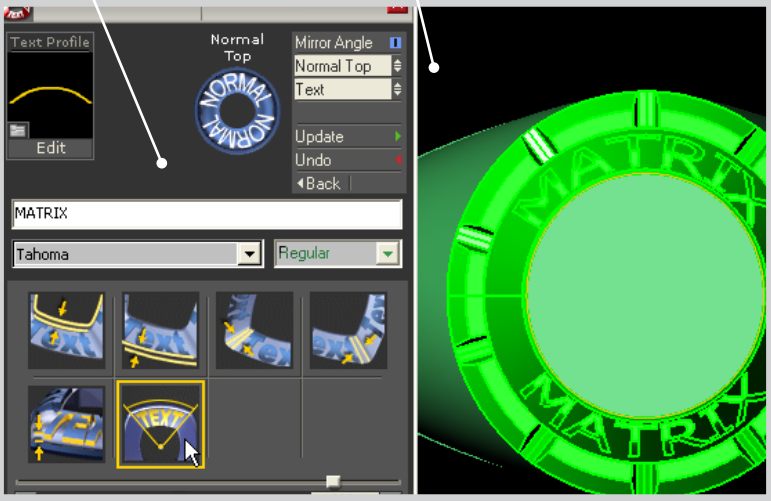
3- Use sliders to set up Distance of text from Top and Bottom of surface & Left and Right angle lines. Set height of Text or Artwork.

4- To set where text or artwork will go, use "Text Angle" (Mirrored or not - if not mirrored, set two angle lines).

5- To choose Orientation, toggle through 4 choices (preview displayed for each).

6- Click "Update".

7- Repeat steps 1 - 6 to set text or art in a different part of Award Ring top.



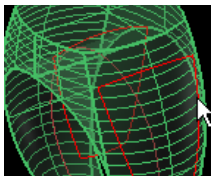
Completing an Award-Style Ring

The Surface Pullback Tool

Create inset areas in jewelry designs, such as the side shield on a signet ring, by inputting a closed curve on a surface into this tool.

Preparing to Use Surface Pullback

This easy-to-use tool starts with a closed curve on the surface of a model. Draw the curve in the shape, size, and location you need for the inset surface. Use familiar curve tools to place this curve on the surface, such as "Project". To use Project, remember that the original curve must be planar (flat), and that it must be selected, along with the surface you're projecting it to, in the viewport where the curve appears in the correct orientation to the surface. "Pullback" and several instances of "Extract Isocurve" (along with Split / Trim and Join to create a closed curve on the surface) are also good tools to use for getting a closed curve onto the surface of a ring.



This tool uses a curve on a surface. One way is to draw curve planar, then Project it onto surface.

Surface Pullback Controls & Options

Start up this tool, and input the Surface and Curve on the surface into their respective In-Boxes. Use the "Drop Depth" slider to indicate how deep you want the inset.

The "Bevel Edge" option will add a second slider control - "Extrude Distance" - which creates beveled (tapered) walls for the inset by extruding the walls to a point at the distance away you assign. Set this value lower for more sloping (tapered) walls; higher for straighter walls.

Select the "Cap" option and the builder will also create the "cap" - or, the solid piece that is "cut away" to create the inset. This is useful in many applications, as you'll see momentarily.

Creating the Inset &/or Cap

After inputting the Surface and Curve, and setting up the options & slider controls in this builder, click "Apply" to create the inset and/or cap. Use "Select" and "Undo" in the builder to reverse the process and create a new inset and/or cap.

Using Surface Pullback

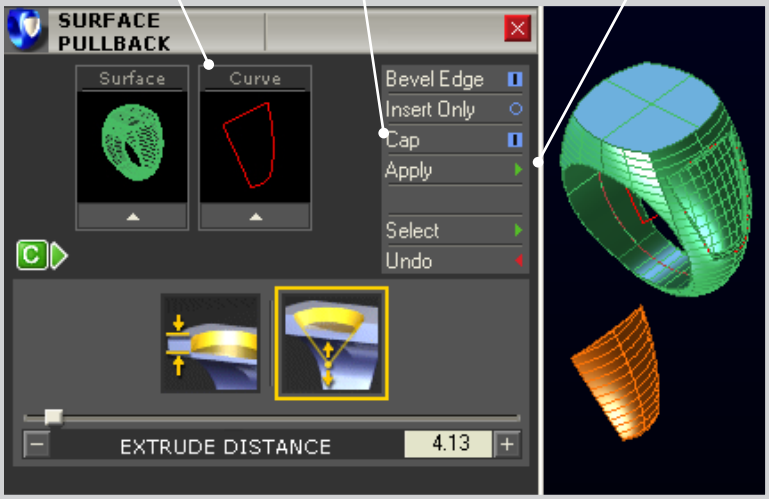
1- Create a curve on a surface in the size, shape, and location you want for the inset.

2- Input the Surface and Curve into their respective In-Boxes in this builder.

3- To taper the walls of the inset, use the Bevel Edge option. To create a "Cap" too (the solid surface that is "Cut away" during this procedure), select this option.

4- Set the slider controls to indicate Depth of inset and Extrude Distance (if beveled) of walls.

5- Click Apply to create Inset surface. "Select and Undo" to reverse changes.



Right: Surface after Pullback & Cap (orange) created with these settings.

Boolean Intersection with Cap

When creating a signet ring side shield, the cap is ideal to use with Boolean Intersection to create letters. Simply create the letters flat in the Side View, Extrude them past the Cap-shaped cutter, and Boolean Intersection the letters and the cap. That way, you have letters that match both the height and shape of the surface of the ring!

If you need to Boolean Union the letters to the ring, click and drag them slightly into the surface and complete the Union (they are coplanar with the surface of the ring before you do this).



(Above) place letters planar in Side View and extrude. (Below) Boolean Intersection with cap.



Intermediate Tools

The Curve Transform Tool

Assign a "hold" point and a "bend" point for any curve in space, and manipulate this curve. Profiles adhere to curve when modeling.

About the Curve Transform Tool

This tool allows you to bend a curve the way you can bend a piece of wire: assign a position to "hold" the curve still, and another position from which to hold the curve in order to "bend" it. If these two positions are closer, the bend in the curve will be tighter. If they are farther apart, the bend in the curve will be larger.



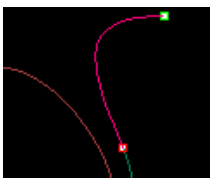
Input Curve into Curve preview window, selecting it in viewport you want to transform it.

You can also Scale (grow or shrink the curve), Straighten (undo the Bend you put in the curve), or Blend (create a Blend Curve shape) between the two points that you set. Use the Builder Menu controls for this builder, explained later, to control these settings.

Notice that this tool is Viewport Dependent, so any viewport that is active when you start up this tool is the one the curve will be affected in. You can use this to your advantage, of course, by switching viewports to make the curve bend in different ways throughout space, so it will no longer be a Planar curve.

Using the Builder Menu Controls

To use this tool, start up the builder and input any curve into the Curve preview window. Notice that the viewport which is active (viewport name is lit up in light blue) is the viewport in which the curve will move when you use the builder controls. To control the curve in another viewport, select the curve in the new viewport and re-input it into the Curve In-Box.



Curve will be transformed between Hold point (red) and Bend point (green).

To control where the curve is held still, select the Hold Point graphic to make the slider control affect this value. Click and drag the slider to position the Hold Point. Remember: the farther this is away from the Bend Point, the wider the bend will be. The closer this is to the Bend Point, the smaller the bend will be.

Place the Bend point as described above. Now, make "Bend" the active builder control and click and drag the slider to Bend the curve. Or, alternately, you may use the "Scale", "Straighten", or "Blend" controls to change the length (Scale) or curvature (Straighten or Blend) of the curve between the two points. Use the Undo button to undo the last change.

Continue moving the Hold and Bend points, and changing the shape and size controls, to affect the shape in the viewports. Change viewports to create a curve that is nonplanar and - for example - wraps around a gem or another design element.

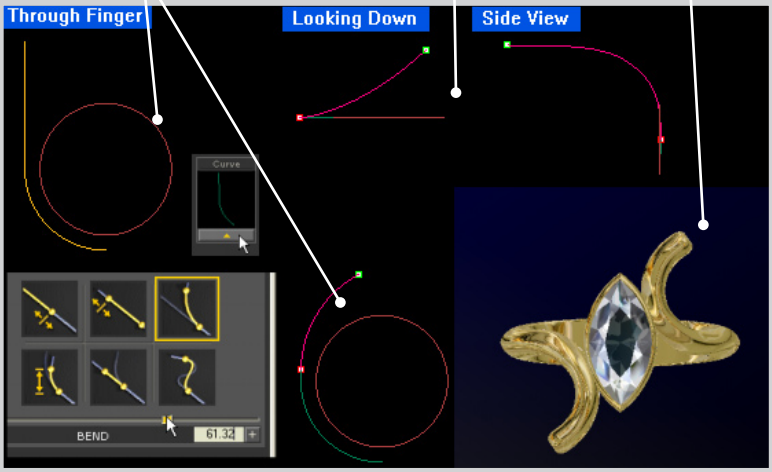
Understanding the Curve Transform Tool

Input a curve into the builder. The viewport that is active will be the viewport the curve is controlled in. Assign a Hold (red) and Bend (green) point between which to bend the curve. Use the Bend Curve slider to bend it.

To change the viewport the curve is controlled in, select it IN THAT VIEWPORT and re-insert it into the Curve preview window in the builder.

Different Builder controls - Scale, Straighten, and Blend - create different effects between the two points you set.

Place profiles on the rail and complete with the following Curve or Cutters Menu tools to sweep such freeform designs as rings, pendants, etc.



Curve Transform Tool Disclaimer:

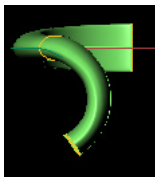
This tool does take quite a bit of experimentation to get it right. If you don't find it to be that useful right out of the gate, and you feel you are ready to take on some more advanced concepts, proceed to the Surface Modeling chapter in the Advanced section of this manual to study advanced curve-drawing techniques.

Tools to Mirror Designs

Mirror Mode & Mirror Shatter

Start up Mirror Mode and select the viewport quadrant or half to copy. While you work, Mirror keeps up (copies model). "Shatter" or "Cancel" Mirror Mode to end.

About Mirror Mode



Model Before: MUST be moved to correspond to BLUE graphic.

When you've got half a design in the viewports and you'd like to see what the other half (or quadrants) will look like while you work, turn on Mirror Mode. Select the routine you'd like Mirror Mode to complete by clicking on the corresponding graphic. It can Mirror Right to Left, Top to Bottom, Upper Right to remaining 3 quadrants, Rotate top to Bottom, Rotate Left to Right, and Complex mirror, where you set your own Mirror Plane.

Using Mirror Mode

Select the Mirror Mode corresponding to the Looking Down view of your model (blue graphic on button represents current Looking Down view of model). You will see point object(s) appear in the viewports (you may need to zoom out a little to see them). These represent the location of the ORIGINAL model that will be mirrored while you work. Once you make a change to the model (for example, MSR the profile), the model will be copied to the part(s) of the Looking Down viewport represented in the YELLOW graphic on the Mirror Mode button. As you continue working, your model will continue being updated.

To Cancel or "Shatter" Mirror Mode

When you like the results, click Cancel Mirror Mode in the builder or Mirror Mode Shatter in the Tools Menu.

"Complex" Mirror Mode

Start up this option and the "Base Point of Mirror Plane" prompt will appear in the Command line. Select a point in the Looking Down viewport from which to start your mirror plane.

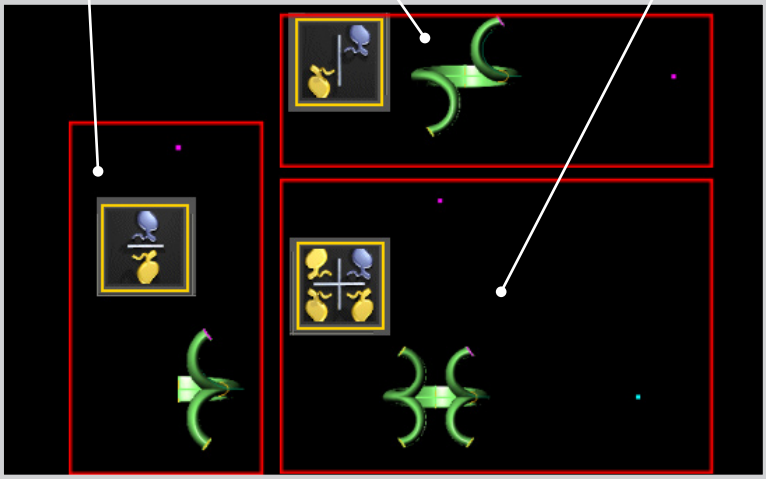
Next, during the "Select Mirror Plane" prompt, select an endpoint for your plane. Finally, during the "Side" prompt, choose the side of your plane with the ORIGINAL model located on it. As you work, the original will be mirrored around this plane, showing you the changes.

Using Mirror Mode (and yes, More Rules to Follow)

Select the button representing the part of the model you already have onscreen. (If need be, Mirror / Rotate this to the correct quadrant or half, or else the builder won't work! Blue symbol on icon represents correct quadrant/half.

Choosing different modes from the graphics on the left-hand side of the builder will produce different results. (You may need to click a different button, then the same one again, to choose the same mode twice.)

Remember to make your changes to the quadrant or half of the model (in the Looking Down viewport) that corresponds with the point objects. (Graphics ONLY represent Looking Down grid, but changes can be made anywhere.)



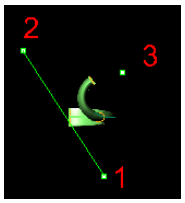
Rules of Mirror Mode

1- Mirror Mode only places a COPY of the objects: they will not have the same History as the original objects. So, after you cancel Mirror Mode, you cannot select the new profile and MSR it and see the surface update. With a few steps, though, you know how to fix that!

2- Matrix History has to be ON (Record and Update) before starting Mirror Mode. If it's off, you will see nothing. As always with Matrix History, it is NOT advisable to turn on Rhino History too. That could get ugly...

3- Since it makes COPIES of stuff, you might need to Split and Join models (read on...) before they are "done".

4- Sometimes, even supercool builders like Mirror Mode confused. If you get extra surfaces, simply delete them and carry on. No worries...



Complex Mode: place two ends of plane (clicks 1, 2 above) and side to mirror (click 3).





Cutting Tools to Mirror Design

Plane & Cube Cutters

When a design overlaps F4 and both halves should be alike, 1- select a Plane or Cube Cutter, 2- Split model (with plane) or Boolean Difference it (with cube), and 3- Mirror.

Symmetrical or Quad Flip Designs

When a design is symmetrical on two halves - or, better yet, when it is symmetrical in four quadrants - you have several options for creating it. The worst one is to build the same thing 2 or 4 times! The best idea is to build it once and mirror - or quad flip (stay tuned!) - the design.



With a plane, Split model. With a cube, Boolean Difference.

However, if that design overlaps F4 - as in the example of a Signet ring with a Side Panel - you need to Split it down the middle, Mirror both sides, and Join them together again.

A quick reminder of how to use Split vs. Boolean: with Booleans, you end up with a solid object. With Split, you end up with an open object. As long as the two openings touch perfectly, in the same shape, you're golden: the model will join. To ensure they're in the same shape and the Split is done evenly down the center of the model, it's a good idea to use this builder.



Split model is open, so Mirror and Join.

Using Plane and Cube Cutters

With the model to split all ready in the viewports, start up this builder. Planes will come out at F4, so determine how you'd like to split the model - down the middle X, down the middle Y, or down the middle Z - and select the appropriate plane.

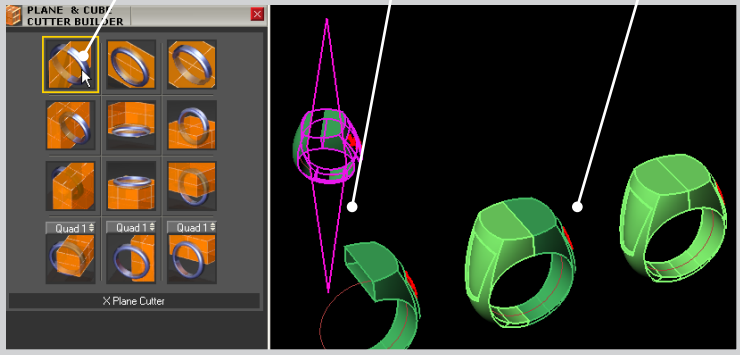
If you bring out a cube, you can Boolean Difference away half of the model, so you don't need to delete that half following the Split. However, you will need to uncap the model in order to Join it to its mirror image (if you need one solid model in the end). As with Planes, select the cube representing the quadrant of the model you wish to cut away.

Steps for Using Plane Cutters

1- Select the plane for the axis along which you want to Split model. It will appear in the viewports.

2- Split model with plane and delete plane and "bad half" of model.

3- Mirror model around F4 and Join the two open halves together to create a single, solid model.



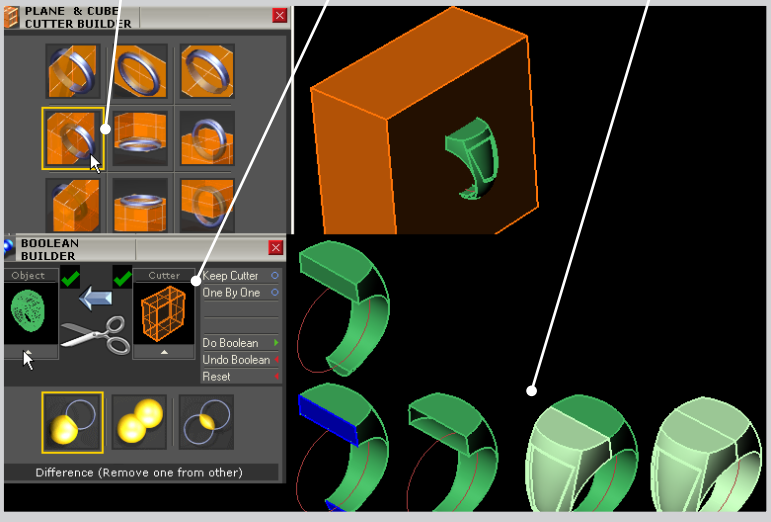
Steps for Using Cube Cutters

1- Select the cube representing the half or quadrant of the model you don't need. Click it and it will appear in the viewports.

2- Boolean Difference (yes, I guess you can use Split if you want - just follow directions above) cube from model.

3- Extract end caps (Blue) and delete.

4- Mirror open model and Join, as above, to create a closed, solid polysurface



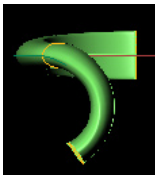
Cutting Tools to Mirror Designs

Quad Flip Builder

When a design overlaps F4 and four quadrants should be alike, this tool places the plane and does the Split for you behind the scenes: just Join and go!

Using Quad Flip Builder

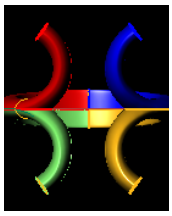
If your design is symmetrical in all four quadrants but you don't want to bother with placing the plane and splitting (child's play - puhlease!), start up this tool and select the quadrant corresponding with the correct part of the model (the part you want to copy) in the Looking Down viewport.



Before Quad Flip

Next, select the model and click Apply. The model will be automatically split by the builder and NOT re-joined, so you must select and Join the model before proceeding.

EVERYTHING in the model will be mirrored and copied to the remaining three quadrants, so if you don't want it, don't select it before hitting Apply. Gems don't do so well in this builder, so Mirror them after the fact, manually.



After Quad Flip. My pretty colors remind you your model is NOT joined. JOIN IT.

DIY Quad Flip (for all you Do-it-Yourselfer's)

If you are very astute, you will have noticed that Quad Flip builder is placing two planes - in the X and Y axes - and Splitting the model with both planes. It then deletes all but the quadrant you asked for, and Mirrors that once across the X axis, and then mirrors both of those quadrants once across the Y axis, to complete the routine.

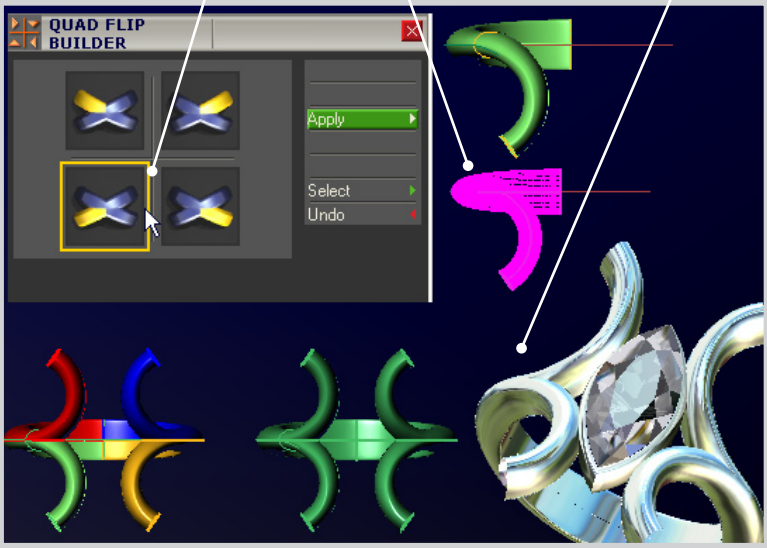
Even if you are very astute, it's possible your model may just fail in Quad Flip builder. This old goat has been around since - I don't know, Version 1 of Matrix? - so it might have some screws loose. If that appears to be the case, well, now that you've learned Plane and Cube cutters, and now that you know what Quad Flip Builder does "behind the scenes", you should know how to Quad Flip your own model without causing too much undue strain.

Steps for Using Quad Flip Builder

1- Select the quadrant that looks like the correct quadrant you have onscreen in the Looking Down view. (Lower Left, here.)

2- Select the model *in the Looking Down view* and click Apply in the builder.

3- The results are not joined (hence the pretty colors in the illustration below). Join them before completing model.

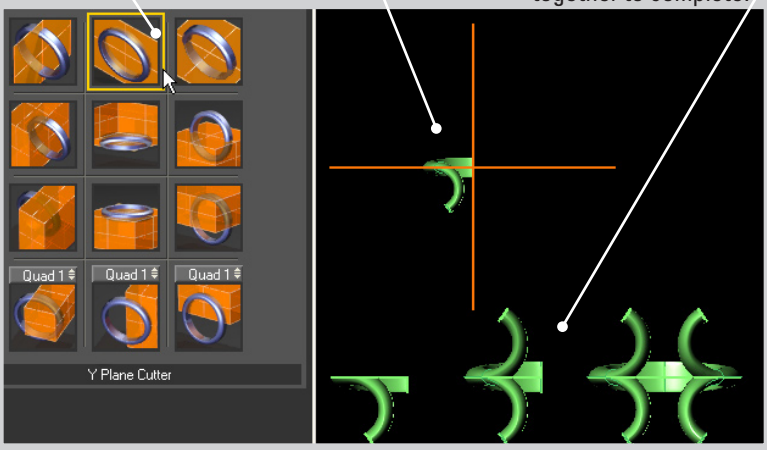


Steps for DIY Quad Flip

1- Select plane down Y or X axis and rotate / copy it.

2- Split model, using two planes as cutting objects.

3- Delete planes and bad part of model, Mirror the rest once; mirror two halves together to complete.



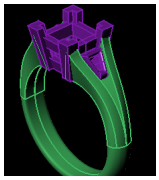
Tools Menu Builders

The Ring Resizer Tool

Once your design is complete, use the Ring Resize Tool to create various sizes of the same design. This is not history-related; it simply resizes the shank.

Preparing to Use this Tool

When you are completely finished designing your ring, and you don't need to make any more changes, you may wish to use the Ring Resizer tool to re-create the same ring in one or more different sizes.



Save model; then, turn off gems and other unnecessary items before using.

It is always a good idea to Save this ring to a Job Bag or use a File > Save function prior to running Ring Resize Builder. Because this will output as a mesh file, you will need to delete or hide your gems so they don't get changed into meshes in the process. Also turn off or hide any curves or other objects you don't want re-sized.

You should also make sure all surfaces are closed and valid so that the mesh processing will work correctly. If you will need objects Boolean Unioned together, now is your chance to do this while they are still Nurbs, before the builder turns them into Meshes and you'll need to run Mesh Booleans on them.

Using Ring Resizer

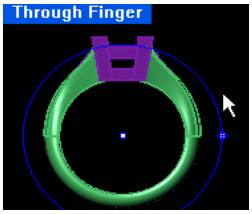
Start up the Ring Resizer and select the model to resize. Input it into the Model preview window (it need not be Boolean Unioned; it will not be unioned in the resized ring, either). If it can, the builder will read the original ring size. If it cannot, return to Ring Rail tool and find a match. Then, re-input the model into the builder. Filling in the remaining boxes in the builder assigns how the resized ring will be created. Working left to right, start up the tool above each box to assign the dimension for the Ring Resizer to look for, according to these instructions:



Input model into Model preview window in builder.

1 - Set Primary Radius

To begin, select the Circle tool and draw a circle starting at F4 in the Through Finger viewport (circle automatically starts here) that intersects the girdle of the main gem. This way, the builder knows not to skew the ring along this axis, keeping the area of the gem girdle planar (flat) with this circle. Upon completing this circle, it will automatically be input into the box, along with a measurement indicating its radius.



Start up Circle tool in builder and draw circle in Through Finger through girdle of gem.

2 - Set Left / Right Angle

Start up the Left Angle function by starting the Line tool. The line will radiate from F4. End the line in the Through Finger viewport just PAST

Steps for Using the Ring Resizer Tool

1- Turn off gems and other items (creation curves, etc.) you don't want re-sized.

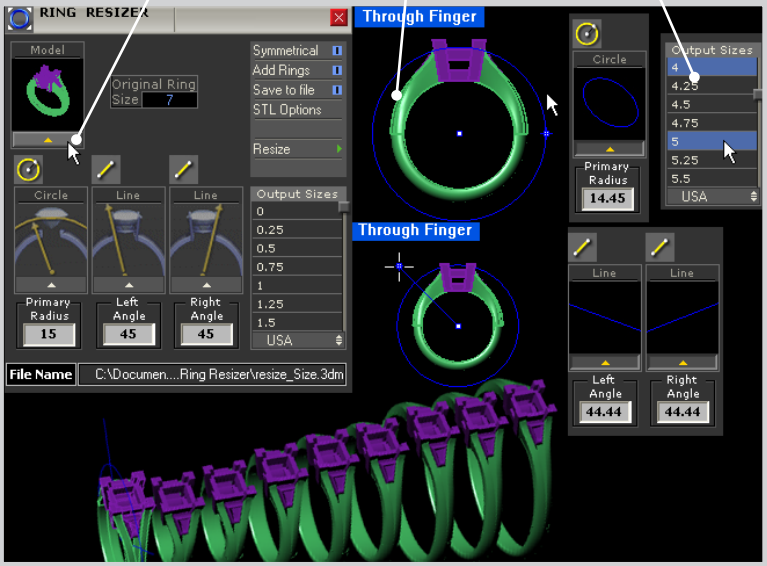
2- Select the ring and input it into the Model preview window in the builder. The ring size should be read by the tool. If it is not, place the correct Ring Rail and re-input the model.

3- If the model is not symmetrical, turn off this option FIRST. If it is, proceed.

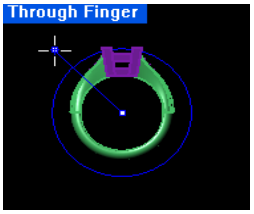
4- Start up the Circle tool and place a circle in the Through Finger viewport representing the line of the girdle of the center gem. This will protect it from bending.

5- Start up the Line tool assigning the Left Angle and place this line in the Through Finger viewport to the left of the head detail. Repeat for the Right Angle, if the ring is not symmetrical.

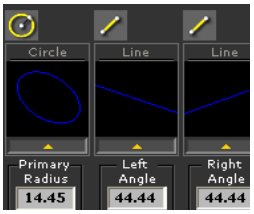
6- Choose output sizes & options and resize ring.



the head detail of the ring. If the "Symmetrical" option is turned on, this line will automatically be mirrored, and both lines input into the "Left Angle" and "Right Angle" preview windows in the builder, respectively. If the ring is not symmetrical, turn off this option FIRST; then place the Left and Right Angles separately. These angles assign the area within which the ring will not be resized, so as to protect the head details from the resize operation and ensuring that the same size gems will fit in the resized rings.

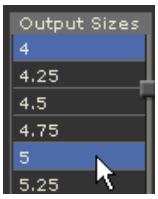


Draw line to Left of head detail; will be mirrored if Symmetrical option is on. If not, draw Right Angle line too. All objects enter preview windows upon creation.



3 - Choose Output Sizes

From the menu at the right of the preview windows, choose output size(s) by selecting them with the mouse. Hold down Ctrl to select more than one. Hold down Shift to select a range of sizes, clicking the first one first; holding down Shift, and selecting the last one to select all the sizes in between. Choose as many as you want. To switch from USA sizes to other regions, click the "Type" option just beneath this menu and select the new region.

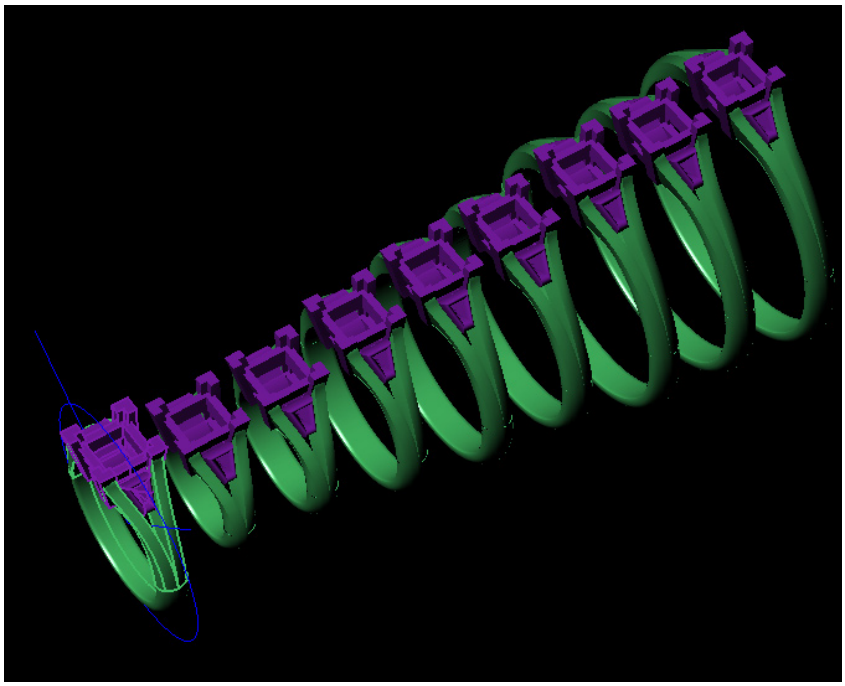


Hold down Ctrl to select more than one output size.

4 - Set Remaining Options and Resize Ring

Use the "Add Rings" option if you wish to see the rings in the viewports after they are resized. Use the "Save to File" option to save each ring to a separate .3dm file in your My Documents > Matrix 6 > Ring Resizer folder. Click the "STL Options" menu item to assign STL options to the output rings. For more details on what each of these means, see the Matrix Art & Meshes section of this manual.

Finally, click "Resize" to see the results.

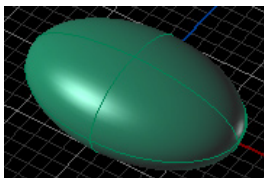


Chapter 6 INTERMEDIATE

Build, Edit Surfaces & Solids

Create surfaces & solids with Surface and Solid Menu commands; then, edit them with Transform Menu commands.

One way to model surfaces and solids uses curves as the "skeleton" of the object you are creating. As you learned when sweeping a ring with History, certain Matrix and Rhino tools require curves to indicate the "rail" And "profile" or cross-section shapes. Other Surface menu tools work in similar ways, using curves to build surfaces.

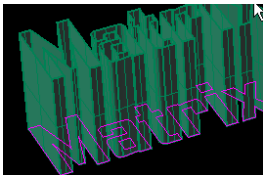


Rather than creating a "skeleton" with curves, some Solid & Surface tools create Solid objects and surfaces outright.

Easier still are the Solid menu tools that don't rely on any other items to create solids. Since these tools make it so easy to create solid objects onscreen, we'll start with these so you can get the hang of it. Then, we'll learn the basic Surface menu tools that create surfaces and solid objects by using Curves.

Essential Terms for Surfaces & Solids

A Polysurface is any object that can be exploded into two or more component surfaces. Polysurfaces can be Open or Closed. Open surfaces and polysurfaces are only one "point object" thick. In addition, they are not "watertight", meaning that, if you had to float them like a ship, they would take on water and sink! To be defined as a "Solid", an object must have no open or "naked" edges - meaning it would not take on water. A Solid may be either a polysurface (which can be exploded) or a Nurbs surface (which cannot be exploded since it is a single surface).



Other Solid & Surface tools start from curves. Be sure to check whether resulting objects are "open" (above) or "closed".

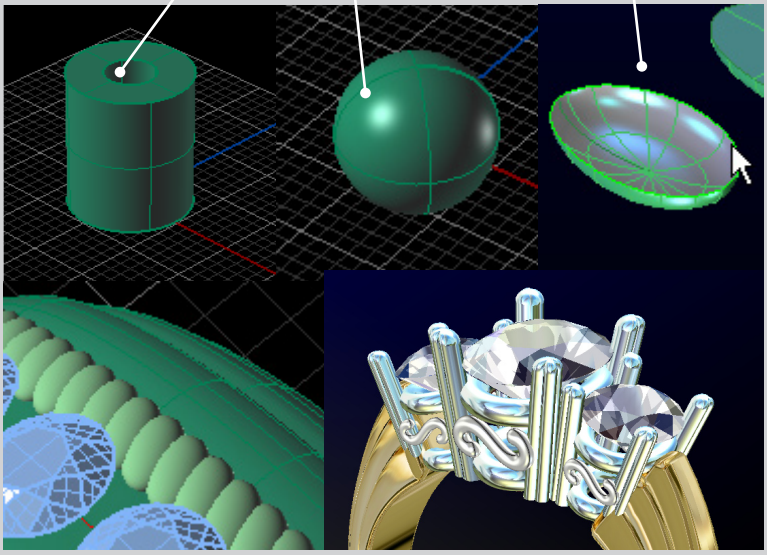
The tools in the Solids menu that can create closed Nurbs surfaces (cannot be exploded) are Sphere, Ellipsoid, and Torus. Other tools in the Solid menu create closed, Solid Polysurfaces (Box, Cylinder, Tube, Cone Tools) that can be exploded into their component surfaces.

Essential Terms for Surfaces & Solids

A ***Polysurface*** is any object that can be exploded into two or more surfaces. It may be an Open Polysurface (not watertight - has open or naked edges) or a Closed Polysurface (no naked or open edges). A closed polysurface is also known as a Solid.

A ***Nurbs Surface*** is a single surface that has no hard edges and cannot be exploded. Closed Nurbs surfaces are Solids, and they may be created with Primitive Object tools "Sphere", "Ellipsoid", and "Torus" from the Solids menu.

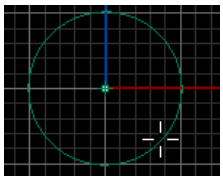
Open or closed (Solid) Nurbs surfaces may be created from Nurbs Curves (single curves that cannot be exploded into their component parts) using the Surface menu tools you'll learn in this chapter.



Above (L - R): Polysurface, Nurbs Surface, Open Surface. Below (L - R): Using basic commands in these three Rhino menus (Solid, Surface, Transform) together with Matrix tools, you'll learn how to create and edit solid objects for use as elements in your designs.

Solid Objects: Common Command Line Options

Many Primitive Objects have Command line options in common with both one another and with familiar Curve tools you learned in the previous chapter. For those objects (described in full in next section) that involve drawing a circle onscreen (Sphere, Cylinder, Tube, Cone, Truncated Cone, and Torus), the Command Line options are the same as those for a Circle, so refer to this section



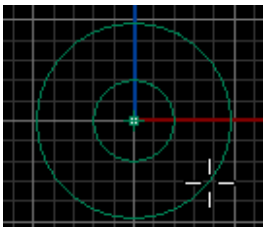
Check similar Curve commands (circle, rectangle, ellipse) to learn Command line options common to Solid tools.

of the manual for information about those command line options ("2Point", "3Point", "Tangent", "FitPoints").

Other common Command Line options are the same as those offered when drawing a similar shape in 2-D with a related command from the Curve menu. The explanations of these options are available in the Introductory section of the previous chapter about curves. These include the "Around Curve" and "Vertical" options.

The only difference here is that "Vertical" draws the solid object toward you in the active viewport, making it difficult to see its height unless you keep an eye on one of the other viewports.

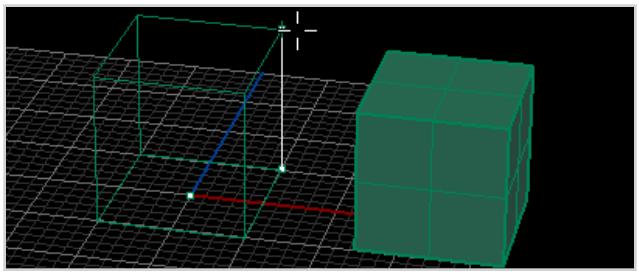
Similarly, "AroundCurve" draws the first part of the solid so that it is centered around a curve onscreen. Subsequently, the direction in which the thickness of the shape is built (i.e. the shape is "extruded") will be locked into the direction at the part of the curve that you click during the "AroundCurve" option. This is why "Around Curve" and "Vertical" are available as suboptions within the "Direction Constraint" option for tools that extrude (add thickness to) circles to create solids shape - such as Cylinder, Tube, Cone, and Truncated Cone.



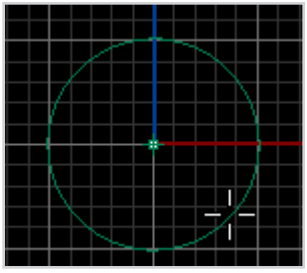
"Vertical" option draws the object toward you in the active viewport (common to several Solid object commands).

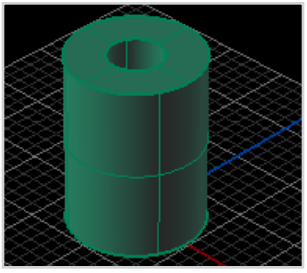
Solid Menu Creating Solid Objects



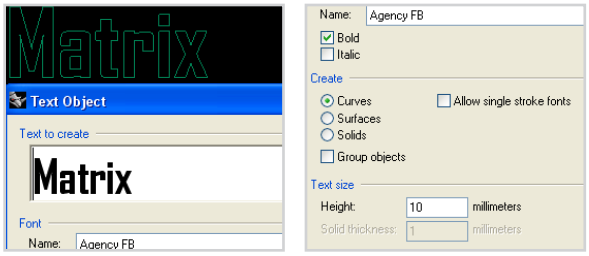


The "Box" Command Start the Box tool by drawing a "Rectangle", familiar to you from this Curve menu command. Then, move the mouse to extrude the height of the rectangle in the direction you choose, creating the box. The only Command line option unfamiliar to you - if you know the Rectangle command - is the "Diagonal" option, which allows you to first place opposite corners of the rectangle before extruding the height of the box.

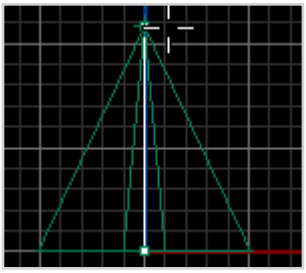


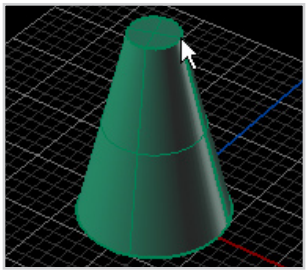


The "Cylinder" & "Tube" Commands Begin by placing a circle onscreen in the method familiar to you through your knowledge of the "Circle" command. The next mouse-click extrudes the circle straight in the direction you move the mouse. Click to end it when the length is right. The "Tube" command lets you draw a second circle to represent the inside thickness of the tube before extending the length of the object.



The "Text" Command To create text objects for use in modeling, start up this command. In the dialog box that appears, type in the text to create. Select the options to assign Font, Style, and whether your text will be created as curves, surfaces, or solids. Indicate a thickness for the solid; and, indicate a size (height) for the letters. Select whether you want them Grouped (easier to select as one) or Ungrouped (select and control each created object individually). Click OK, and select a location to place the text by clicking in the viewports.

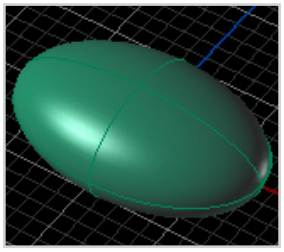


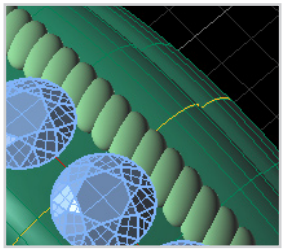


The "Cone" & "Truncated Cone" Commands

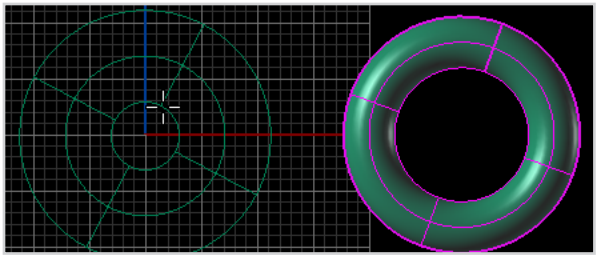
Like the "Cylinder" command, the "Cone" starts with a circle and allows you to move the cursor to add length to the shape. However, this command extrudes the shape to a point - the tip of the cone. In the "Truncated Cone" command, another mouse-click is added, allowing you to control the size of the circle at the opposite end of the cone.

Solid Menu Creating Solid Objects cont'd.

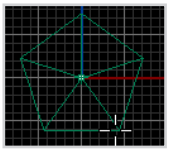


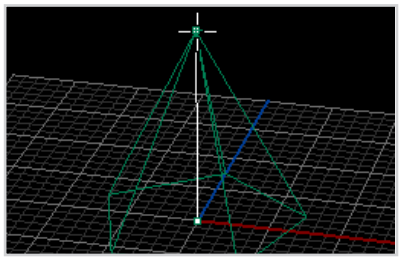


The "Ellipsoid" Command Draw the Ellipsoid the way you draw an Ellipse - familiar to you now from this Curve menu command. The Ellipsoid just adds one additional mouse-click, which assigns the thickness of the shape. Tip: (Right, above) Use this object, drawn at F4 and slightly rotated, with the "Object on a Curve" tool to create rope-like millgrain.

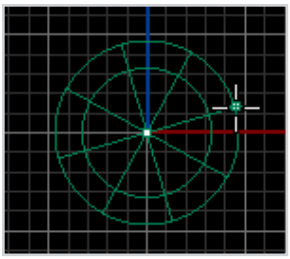


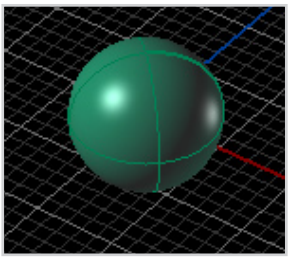
The "Torus" Command Like the "Tube" command, the first two mouse-clicks set the outside and inside thickness of the torus. Since the torus is a tube in the shape of a circle, wherein the cross-section shape of the tube is also circular, two clicks will do it! The larger the circle of the torus, the larger the thickness of the tube: and the opposite is true, as well.





The "Pyramid" Command This command starts with the same Command Line options as the Polygon command (NumSides, Circumscribed, Edge, Star). Another command line option, Direction Constraint, allows you to direct the pyramid "Vertical" to the plane you set the base, around a curve you select (AroundCrv), or anywhere you place it (None). Begin the command by setting the Center of the base of the shape (or first edge, with the "Edge" option selected); then, set the size of the base of the pyramid by setting the "Corner" of the shape (or, the opposite end of one edge). Finally, click at the height of the pyramid. With "None" selected in the Command line, this mouse-click will change the angle of the pyramid. With "Vertical" or "Around Curve" selected, the angle will be constrained to the chosen direction.

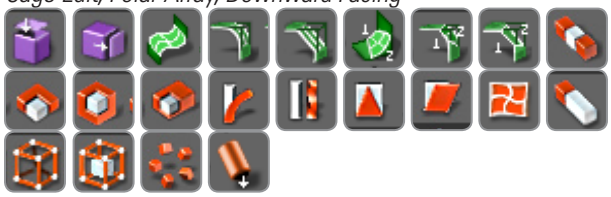




The "Sphere" Command The first mouse-click places the center of the sphere. Move the cursor onscreen to grow and shrink the size of the sphere. Or, type in a value for its radius and the sphere will be drawn, and the command ended. The only unfamiliar Command Line Option (see previous page for common Command Line Options) is "4Point", which allows you to snap the sphere to 4 locations onscreen.

Skills & Commands in this Chapter

Editing Surfaces & Solids: *Cap, Extract, Blend, Fillet, Chamfer, Variable Blend - Fillet - Chamfer, Scale 1 - 2 - 3D & Nonuniform, Bend, Twist, Taper, Shear, Maelstrom, Stretch, Cage, Cage Edit, Polar Array, Downward Facing*



Primitive Object Solid Tools: *Sphere, Cylinder, Tube, Cone, Truncated Cone, Ellipsoid, Torus, Text, Box, Pyramid*



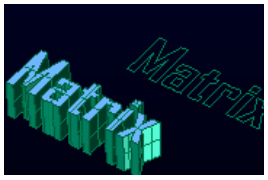
Creating Surfaces & Solids from Curves: *Extrude Planar Curves, Extrude All Solid, Extrude All Surface, Extrude Normal to Surface, Pipe, Pipe All, Revolve, Rail Revolve, From Planar Curves, Edge Curves, Plane, Cutting Plane*



Surfaces & Solids from Curves

The "Extrude" Tools

Start with curves and add thickness in the indicated direction, "extruding" curves to get surfaces or solids.



Extrude planar, closed curves to turn them into solids.

The Extrude Planar Curves command found in the Solid menu will turn a closed, planar (flat) curve (or curves) into a solid object or objects (closed, solid polysurfaces). See the "Rules" for extruding good solid shapes at right in the inset.

A number of related Extrude commands are also available. In both the Surface and Solid menus, you will find Extrude All, which is able to extrude curves or surfaces with the options explained on the next page.

Extrude All

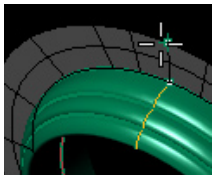
Within "Extrude All", you may select a surface to extrude into a capped or uncapped object. The surface need not even be planar (show at left). Use the Command line options explained on the next page to change the way these tools work.



Or, Extrude surfaces to add thickness, creating a solid.

Extrude Normal to Surface

To extrude a curve on a surface - according to all the options and tips found herein - find this tool in the Surface menu. Finally, if you don't know which of these tools you need, find the Extrude All tool in the Solid menu, and each of these options will be included in the Command line.



Extrude Normal (perpendicular) to surface.

Rules for Extruding Curves to create Solid Objects

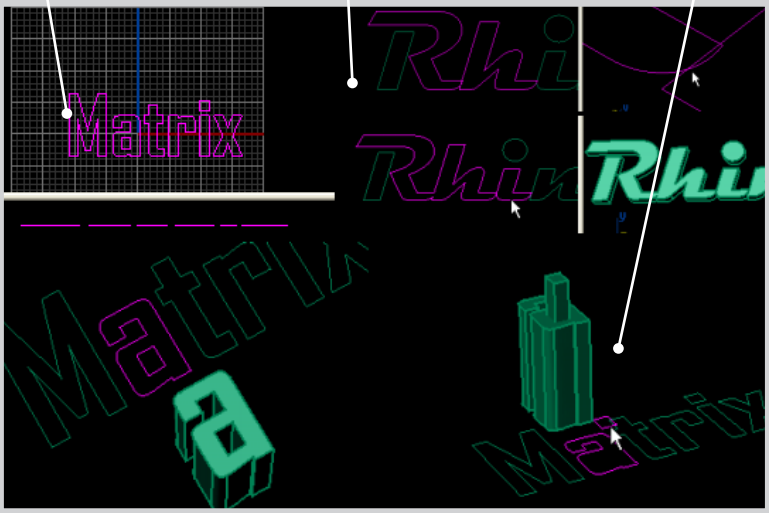
Curves must be planar, or, appear as a single line when seen in another viewport. Nonplanar curves will not extrude properly (use Extrude Normal to Surface to extrude a curve on a surface).

Curves must be closed and joined, or have position continuity (touch) to create valid, solid objects with no naked (open) edges.

When two or more curves are selected, they should not intersect. If they do, Trim them together, as shown below.

In order to make a hole through the solid object, one curve should be fully inside the other, and on the same plane in space.

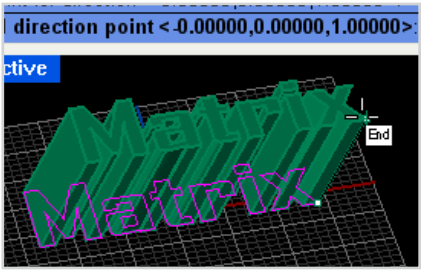
When curves on separate planes are selected together, two solid objects will result.



Tip: Before extruding lettering, check closely to ensure curves are closed and do not intersect one another (must be edited so they do not intersect; or trimmed/joined together to create a single closed curve). Also, they should not exhibit any of the errors covered in the "Fixing Problem Curves" section Chapter 3: they should not loop through themselves, have "holes" leaving them open, or have start and endpoints that "overlap" in space and therefore do not meet (leaving them open). Refer to this section of the manual to check & fix curves PRIOR TO using Extrude. This will help to ensure that your model is closed and valid upon creation.

Command Line Options

Use the following Extrude command options to change how the tool works.



Use the "Direction" Option

Click this option and the "Base Point for Direction" prompt will appear in the command line. Choose a first point for the angle of extrusion. The location of this in relation to the "Second Direction Point" will assign the angle at which the curve will be extruded.



Use the "Both Sides" Option

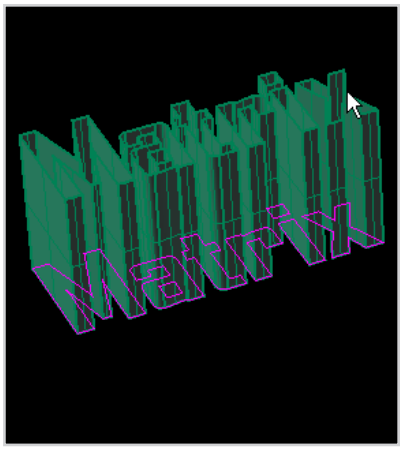
Select this option to extrude the shape to both sides of the original curve. When typing in a value, this amount will be doubled to reach the thickness of the final shape, as it will be added to both sides of the original curve. Set this to "No" to extrude in one direction only.

Using the "Cap" Option

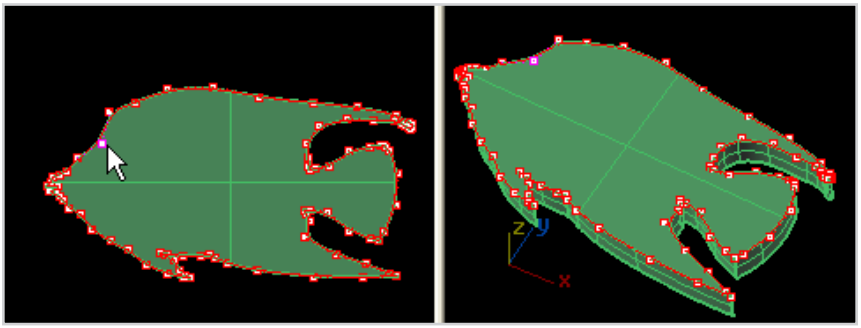
In the Solid menu, this defaults to "Yes" so that the curves can be extruded as solid objects. In the Surface menu Extrude tool, this defaults to No. Change this to remove or add a cap to a closed curve extrusion, creating a closed (Cap = Yes) or open (No) surface.

The "DeleteInput" Option

Set this to "Yes" to delete the original curve(s) selected for the Extrude command. When working in Matrix, we recommend you "save your work" as you go, so that you can retrace your steps and/or fix any mistakes, so we don't advise you use this much!



Above: "Cap = No", producing open surfaces; "Delete input = No", leaving input curves onscreen.



Extrude & History

Turn on Rhino History before running any of these Extrude commands, and you may drag Control Points, move, rotate, mirror, or perform other Transform (but not Trim!) commands on the original object to see changes in the new object.

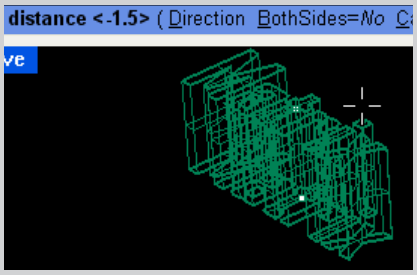
Step-by-Step

Using Extrude Planar



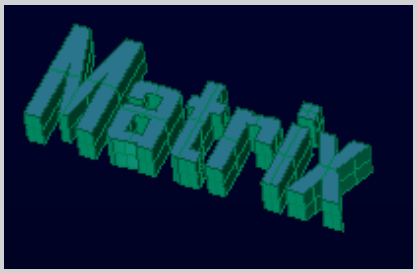
1 Select curves to Extrude

Start this command and select the curves you wish to Extrude. Press Enter. Or, to skip this step, simply select the curves and start up the command.



2 Left-click to indicate a distance for the extrusion

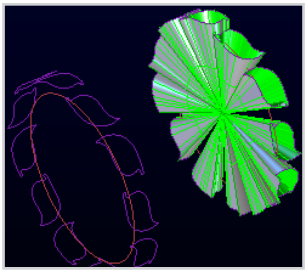
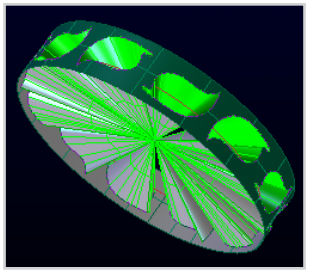
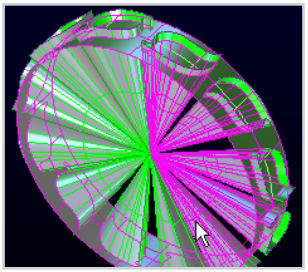
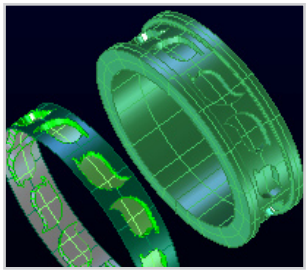
Click once in the viewports to indicate a distance for the extrusion. Solids will extrude perpendicular to direction of planar curves. Use "Direction" option if this is not desired.



3 Or, type in a value

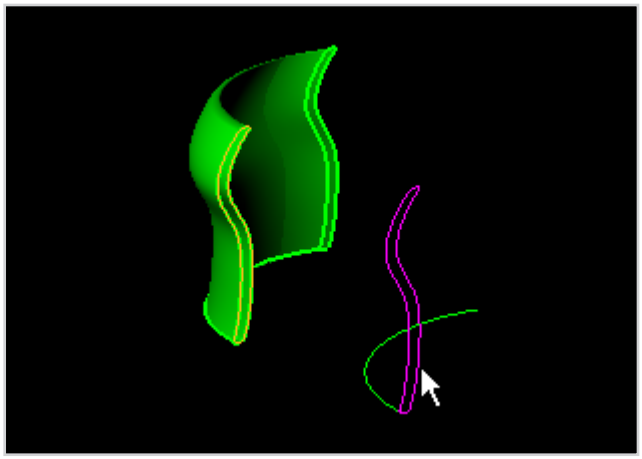
To indicate a precise distance to extrude the curves, type a value into the Command line and press Enter. To indicate a direction for the extrusion, click once in the viewports either above or below the original curves.

Tips & Tricks Additional "Extrude" Options

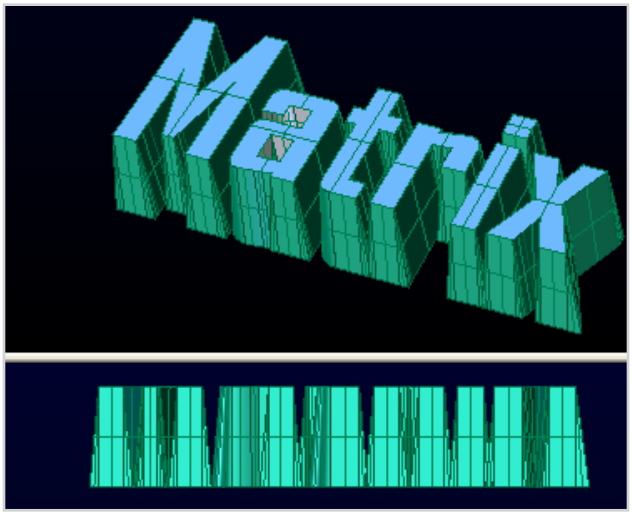





Extrude a Curve or Surface "To a Point" Use Extrude to a Point on a Curve or Surface to extrude a "cone" with a single point on one end and the shape of the object being extruded on the other. This cannot be capped unless the original object is planar. This is commonly used when placing designs around a band, and is in fact how our Raised Band Builder works: extruding letter curves to a common point (F4 when ring is centered) and splitting these "cones" with an inside surface to create the "back" side of the engraving. The extruded sides of the "cone" are the walls of the engraving. To create the top caps, since they are nonplanar, the letter curves are used to split the surface on which they lie. Delete all but the caps, and everything will join together. You will learn the Curve commands necessary to create curves on a surface in more advanced Rhino applications later on in this manual.

Extrude a Curve or Surface "Along a Curve" With a "Path Curve" - or, a curve that represents the shape along which you'd like to extrude a curve or surface - choose this Extrude command. First, select the curve or surface to extrude (selected at right). When asked to select the path curve, select this curve (green curve at right), and the original object will be extruded along it, much like the "Sweep 1" command. In addition to all the options described above, one more option available with "Path Curve" is "SubCurve", which allows you to select a start and end point along the Path Curve, extruding the shape along only that part of the path curve (or, a "SubCurve" of the Path Curve).



Extrude a Curve or Surface with a "Taper" Use the Tapered command to extrude a Curve or Surface with a taper. Several additional Command line options are available for this command. The first of these is "Draft Angle", which you select in order to type in a value for the angle of the taper. There is also a "Corners" option, which allows you to select "Sharp" or straight-edged corners, "Round" or Arc curve-shaped corners, and "Smooth" or Blend curve-shaped corners. And finally, use the Flip Angle option to reverse the Draft Angle you selected from positive to negative or vice versa.



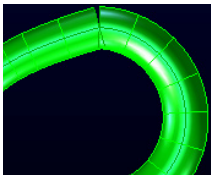


Surfaces & Solids from Curves...

The "Pipe" Commands

Apply a circle cross-section to any curve(s), creating a "pipe".

This tool is useful when a "wire" with a circular cross-section shape - of one or more widths - is needed for a model. Several options in "Pipe" create different variations on this object.

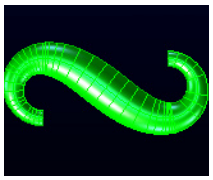


If you don't rebuild curve first, pipe can "break" upon creation.

To prepare for piping a curve, it is a good idea to Rebuild a compound curve. This will prevent the pipe from splitting or breaking in tight or "kinked" (sharp) segments of the curve. During "Rebuild", use the fewest number of control points necessary to retain the shape of the original curve.

Using Pipe

Select a curve to pipe and indicate a distance - by moving the mouse away from the original curve or typing a value into the Command line - for the thickness of the Pipe at both ends and, if desired, at additional points along the middle of the pipe (click at additional points to indicate where).



New in Rhino 4, you can assign different locations on the pipe for different thicknesses.

Press Enter to place each thickness value, until you are done (to accept the same thickness at both ends, press Enter; and to keep the pipe uniform from end to end, simply press Enter again to create it).

While you are working, select from among the options explained on the next page to change the way the Pipe is drawn.

Using Pipe All

This command works just like Pipe, but allows you to pipe more than one curve at a time!

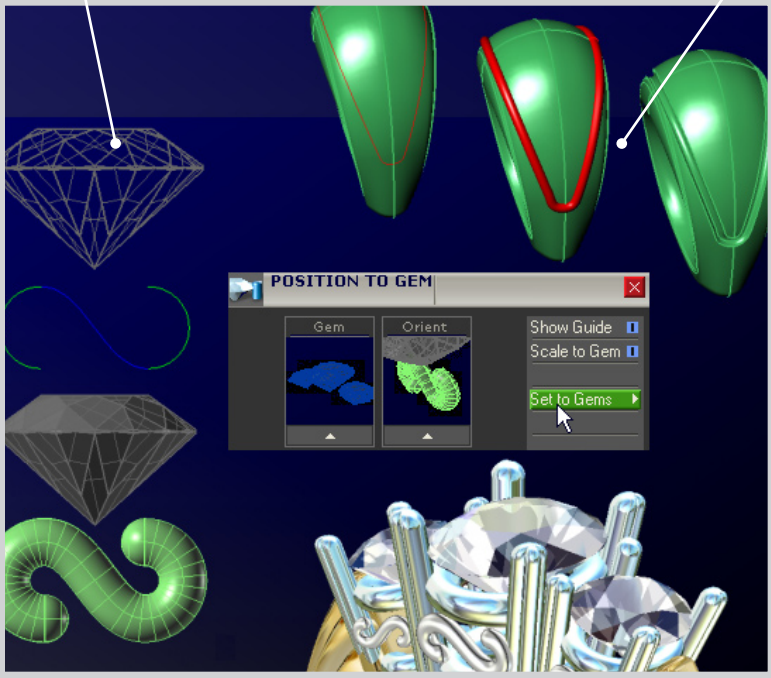
Uses for Pipe

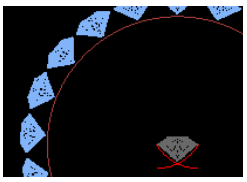
Useful for details in gallery work, underbezels (pipe a curve at seat of gem), or other design elements, Pipe is easy to use, because you just draw a curve you want in the shape of the design element.

Remember to Join and Rebuild the curve so the pipe doesn't break up upon creation.

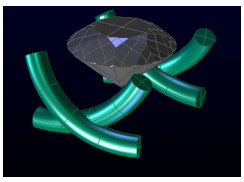
You can also use Pipe along the edge of a surface with the Chain Edges option available in the tool.

It can also be used on curves projected onto a surface. Pipe curves, then Boolean Difference pipes from surface to create a border around an area of the design. Or, leave the Pipes to define the border.

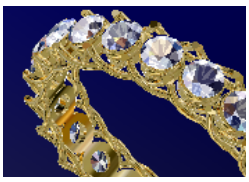




Place gems from Eternity Builder in Position to Gem tool. Curves created with Arc Direction.



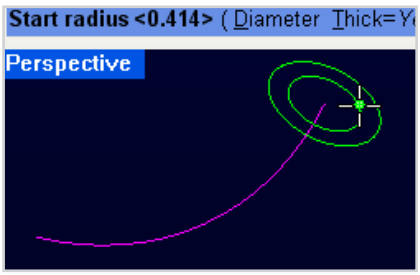
Curves Piped. Rotate one pipe for crossover effect, move next to gem, rotate/copy.



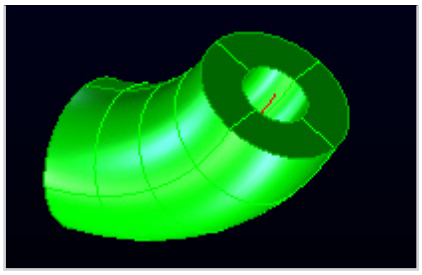
Input into Position to Gem tool and add to gems.

Command Line Options

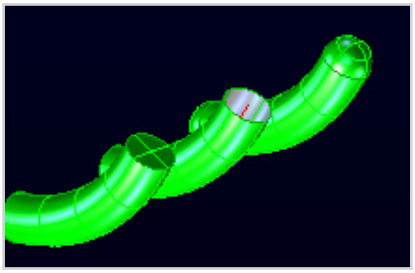
Use these Command Line options to change the way the Pipe is built.



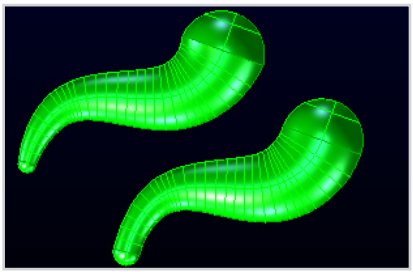
Diameter or Radius? Click "Diameter" to switch to "Radius", allowing you to define a radius for the pipe, instead, when typing a value into the Command line. The selected curve is always the center of the pipe, so the radius is the distance from the curve to the outside of the pipe.



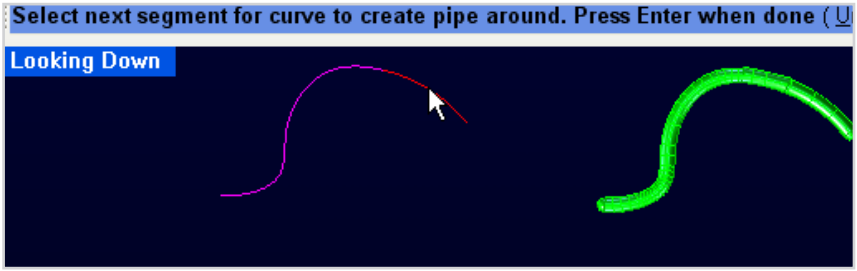
Using the "Thick" Option Switch this option to "Yes" to create a pipe that is hollowed-out inside. With this enabled, you'll need to define TWO values for the diameter or radius on each end of the pipe: one for the inside diameter and one for the outside.



Using the "Cap" Option Select "None" to create a single, open surface for the pipe (or two open surfaces in the case that "Thick=Yes"); select "Flat" for a flat cap on the end of the Pipe; or select "Round" for a rounded or domed end on the pipe.



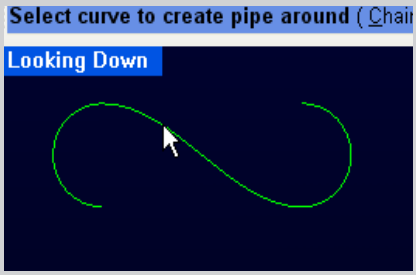
The "Shape Blending" Option With two or more sizes in the Pipe, switch this to "Global" (above) to make more even transitions between the sizes; switch it to "Local" (below) to make each new size "last longer" over the course of the shape, creating a more bumpy look for the pipe.



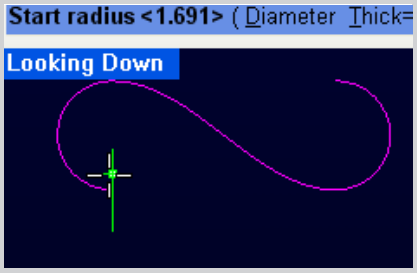
Using "ChainEdges" with Pipe and Sweep Commands Use this to pipe (or sweep - for rails only, not profiles) many un-joined curves as one. They must be touching, end to end. Choose this option and select, in order, each curve in the operation. Use "Undo" to deselect a curve you didn't mean to grab. "Next" will grab the next continuous curve, but watch out: when using surfaces, it can grab an edge you didn't want! "AutoChain" is another option to be careful with: it's easy to accidentally grab stuff you didn't want when selecting surfaces. Press "Enter" with all curves selected. Use this especially when selecting edge curves of a polysurface.

Step-by-Step

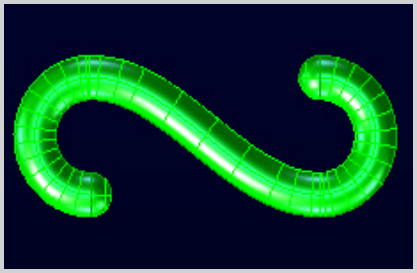
Using Pipe



1 Select the curve to Pipe Start up this command and select the curve to Pipe; or, select the curve first and click "Pipe" to skip the first Command Line prompt.



2 Type a value for diameter, or indicate with cursor. In the Command line, enter a value for the diameter of the Pipe, or click the mouse on one end at the size needed for the diameter of the pipe.



3 Press "Enter" or indicate more values for diameter To keep the pipe a uniform width, press Enter to indicate the same diameter all along the pipe, until you've ended the Command. Or, type new value(s) for each new diameter - the first at the other end of pipe; the rest anywhere along the pipe you choose to change the thickness.

Surfaces & Solids from Curves...



The Revolve Commands

"Revolve" a profile shape in part or all of a circle, or apply it to a rail shape by revolving it around a central axis.



The Revolve profile is applied in all or part of a circle.

Use "Revolve" to rotate a single curve around a central axis 360-degrees, creating what is known in the program as a "surface of revolution". The profile for a Revolve shape should only be 1/2 of the final cross-section shape that will result. If, alternately, you don't wish to revolve the surface in a perfect circle, you may elect to use the "Rail Revolve" tool, to which you can assign a shape for the "path curve" (runs perpendicular to the profile or cross-section curve) and revolve the profile around a center axis assigned for this shape, instead.

Creating the Profile to Revolve

There are several ways to create a closed surface with Revolve. First, use Grid Snaps or OSnaps to place the first and last points of an open profile, ensuring they are planar (exist on the same flat expanse of space), and use these endpoints as the central axis of the Revolve function (Revolve 360-degrees). Alternately, create a closed curve as the shape to revolve, and place the axis off it (not touching it, unless you want the surface to intersect itself!). If you leave the curve open, or if both ends of an open curve don't touch the Revolve axis, just realize you must Cap the final shape, or find another way to close it. Also, if you do not Revolve the shape a full 360-degrees, it will be left open.



Closed curve = solid, when revolved 360 dgr.

The Rail in Rail Revolve

Any curve can be useful as the rail in Rail Revolve. If the rail curve has hard edges or "kinks", a polysurface will result. The rail should touch the profile for best results. If the profile doesn't extend to the center of the rail, the surface will be left open.

About the Revolve Axis

You may revolve around any axis (straight line) that you wish. However, for most predictable results, draw this straight up and down. It is also a good idea to use "F4" to center everything, and Revolve around this. If this line is angled, the resulting surface will be angled, as well.

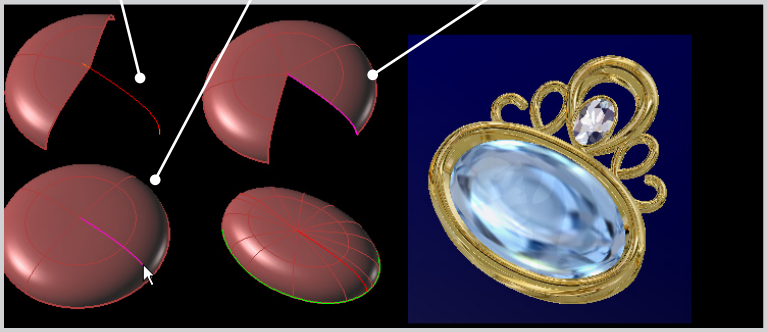
Steps & Options for "Revolve"

1- Start up this tool, and select the "Curve to Revolve".

2- For the "Start of Revolve Axis", if the curve from step 1 is centered on F4, select this. Otherwise, select a point in space where you want the new shape centered.

3- The "End of Revolve Axis" is another point on the plane around which you want the new shape centered. Hold down shift and run the axis straight up from F4 - and press Enter - to center it here. Otherwise, choose another point on a plane.

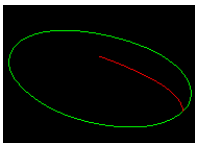
4- Click to indicate the "Start Angle" for the surface - if it will not start at the curve you selected (turn this option off it will), or simply use the Full Circle option to revolve the curve 360 degrees. If you don't choose this option, indicate an End Angle at which to end the surface of revolution.



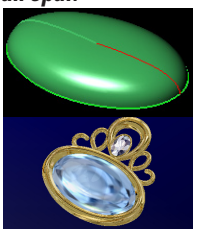
Same curve, revolved around F4. (L - R) Start and End angle; "Ask for start angle = no"; Full Circle option; Rail revolve (rail is green).

Creating a Custom Opal with Rail Revolve

A great way to render a custom-shaped opal cabachon is to model it with Rail Revolve. As shown at right, start by tracing a background bitmap of the opal. Place a point at the center of the curve and move it up to the height of the opal. Place a corresponding point on one side of the opal. From each point (working away from the curve), draw two short, straight lines: horizontal at top, vertical at bottom. Blend a curve between these two lines. Do NOT join it to the two small lines. The Blend curve (red at right) is your profile. The opal shape is your rail (green). Run Rail Revolve and cap to create the opal.



(Above) Rail & profile to rail revolve; Resulting surface (Below) - perfect for an opal!



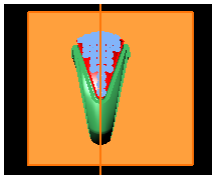


Creating Surfaces...

Creating Simple Surfaces

Plane & Cutting Plane create flat planes in space. From Planar Curves and Edge Curves create surfaces from curves: planar or nonplanar, respectively.

To simply create a flat plane for whatever purpose you may need it, use one of these three tools: Plane, Cutting Plane, and From Planar curves. To create a surface from 2 or more curves, use "Edge Curves". These need not be planar



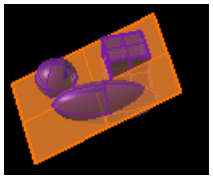
A plane is drawn flat on the grid of the viewport you draw it in unless you snap it to objects.

Drawing a Simple Plane

The "Plane" command works just like the Rectangle tool - including the same familiar Command line options, so you'll want to refer to this part of the manual to learn how to use it - except that it places a rectangular plane wherever you draw it. It's most useful when drawn flat against the CPlane (Construction Plane, or, the plane represented by the grid lines in the viewports) in a viewport when you need to Split an object centered at F4 right down its middle.

Using the Cutting Plane Tool

When you need to split one or more models NOT right down the middle, you can place a Plane as above and Rotate or Move it to get it into place. Or, you may use the Cutting Plane command. Select any objects you wish to cut. Then, in the viewport that indicates the direction in which you need them split, place two points indicating the location and angle of the cutting plane you need. The program will draw the plane so that it intersects all objects you selected for the split.



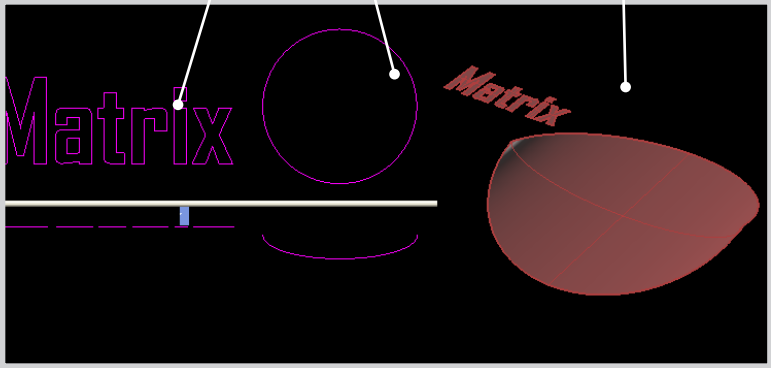
I like to cut with simple planes (above, right). But cutting planes can intersect 2 or more objects on an angle you choose.

Using From Planar Curves

Curves may be joined (polyline curves) or merely touching (have position continuity), but they must be on the same plane (flat expanse of 3D space)

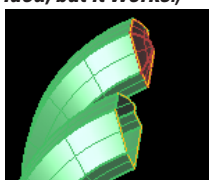
Planar vs. NonPlanar & their Importance.

Planar curves are flat along a single "plane" or straight line that extends Create a Nurbs surface by sweeping a single Nurb profile along Nurbs rail curve(s). Using the "Extrude" commands, they'll create solid blocks or single surfaces perpendicular to the original curves. NonPlanar curves don't exist on the same flat plane and, when extruded, you'll need to pick a "direction" in which to extrude them and even then, it might not work as expected. Planar curves can be made into a surface with "From Planar Curves", while nonplanar curves require the "Edge Curves" command to make them into a surface.





Above: From Planar Curves, to create planes for modeling without booleans. Below: Edge Curves from surface edges when edges aren't planar (not a great idea, but it works.)



and not have any holes between them to properly form a surface. Two or more curves that do not touch and/or are not planar will not form a surface. When a curve is fully inside another, a hole in the plane - in the shape of the inside curve(s), will appear. If two curves are intersecting, two planes will be made, which can be problematic in the long run!. Finally, if curves on two or more different planes are selected, two separate surfaces will be made. From Planar Curves may be used on edge curves, as well, and is useful for creating a planar cap to cover the open edge of a surface - as long as the opening is planar.

Using Edge Curves

This command works just like From Planar Curves, creating a surface between curves - only the curves need not be planar. Note too that this means the resulting surface will not be Planar, which is not ideal for most modeling applications!

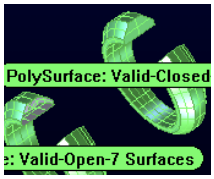
Tools to Edit Surfaces & Solids...

Cap Planar & Extract Surface

Use "Cap Planar" on an open surface or polysurface to create a solid. "Extract Surface" separates component surfaces of a polysurface.

Create a Solid with Cap Planar

"Cap Planar" creates a cap over a flat area of an open surface or polysurface. If an open surface has one or more planar openings, Cap Planar will cover each opening and automatically join the new surface to the original, creating a solid object (as long as there are no nonplanar openings). Just remember: if the original surface was a single, Nurbs surface, the result will be a polysurface, since each cap is a new component surface joined to the original object.



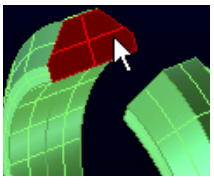
(L - R) Before & After Cap Planar

Cap Planar is often necessary for Boolean operations, so that the surface can be used predictably in a Boolean Union (joining solids together) or Boolean Intersection or Difference (cutting one solid with another) operations.

Cap Planar won't work if the opening of a surface is not planar (flat along a single plane in space). If it fails, the object will be left open and the Feedback line will read "Unable to cap that object"

Extract Surface

Use this command to separate a component surface from a polysurface, creating a single surface and an open (if it wasn't open already) polysurface. Or, use the "Copy" option to leave the original polysurface alone and just make a copy of the component surface.



Extract the surface that was capped earlier.

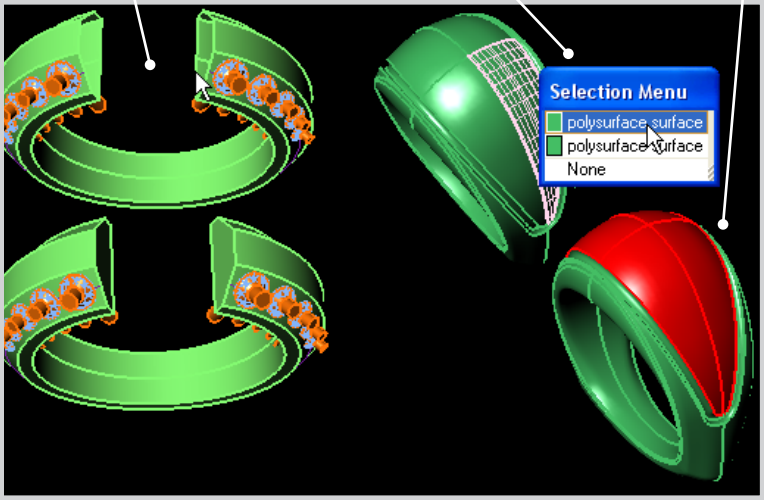
When running this command, you will be able to select as many component surfaces as you'd like to extract or copy.

Steps for Cap Planar / Extract Surface

To run Cap Planar, simply select a surface or polysurface that is open. The opening must be on a single plane (flat expanse) in space to work. It may have one or more planar openings, and it will be capped.

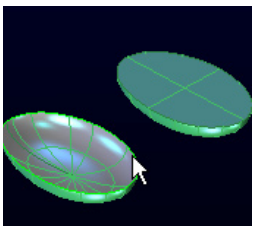
To run Extract Surface, click on the surface to extract. Select a component surface of a poly-surface. Sometimes, you will see many in the selection window. Hover the mouse over each selection and it will be highlighted.

Click the one to extract. Select surfaces till all the ones you need are extracted. If the polysurface was closed, it will no longer be. However, no visible change will result (layer color changed here for emphasis).



Above, Far right: only a single surface results from Extract surface. Join surfaces if needed.

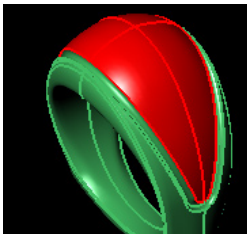
Some uses for Cap Planar & Extract Isocurve:



Cap the opal created with Rail Revolve to create a solid that can be modeled with and rendered as an opal.



Cap a polysurface so it can be used in Boolean tools as a solid object.



Extract only the surface you want to place Pave' on in preparation to run either Pave' builder in the Gems menu.

Tools to Edit Surfaces & Solids ...

The Blend Surface Command

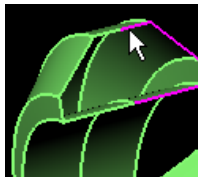
Create a pretty, interactive surface with the Blend shape between two surface edges.

This command connects or "blends" two surface edges - which may be open or closed - by creating a smooth, flowing surface between them. It may also be used to create a rounded end cap by connecting split sections of the same open surface edge. To complete this, begin with the "Split Edge" tool in the Utilities menu to split the edge at its Mid Point (a Split point already exists at the End Point of a surface). Then, Blend one half to the other.



Prepare by using Split Edge to place two midpoints on the surface edge.

Where the surface is split will determine how the Blend is created. You must also be careful to select the surface edges in sequence, and at the corresponding location on each side of the blend, lest the surface twist (the surface will twist if the two sides were selected in different locations).

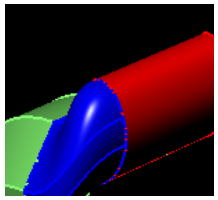


Work your way around the edge, selecting all component edges on one half, then the other.

Also beware: if the edge has multiple splits in it, or it is compound (a polysurface edge), you will need to select each separate edge, in sequence. Skipping one edge - no matter how small - will make the tool think you're starting the second part of the Blend operation

Defining the Shape of the Blend

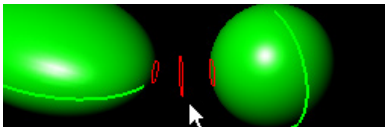
Once you've got the basics of Blend down, try defining the shape yourself by drawing a profile curve at the midpoint and perpendicular to the open edge you wish to blend (take every precaution you know - O-Snaps, Project - to make sure this is a Planar or flat curve that touches the edges of the surface!). Extrude this curve, creating a surface in one direction only. Split the original edge at the location where the new surface intersects it. Blend the original surface to the new surface you extruded. Now, Delete the extruded surface and Blend the other half of the original surface to the new Blend surface.

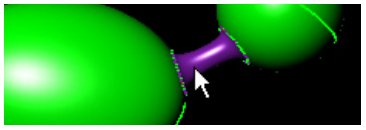


Extrude a cripple surface in a new shape (red) beside the open edge and Blend to that (blue); delete cripple surface and complete Blend.

Connecting Two Closed Shapes

You can also use Blend to connect two closed shapes by first using Pullback to get a closed curve onto both shapes (red, below). Split the surfaces with the curves. Then, Blend the open edges together, creating a smooth, flowing transition between the two shapes (purple surface, below).



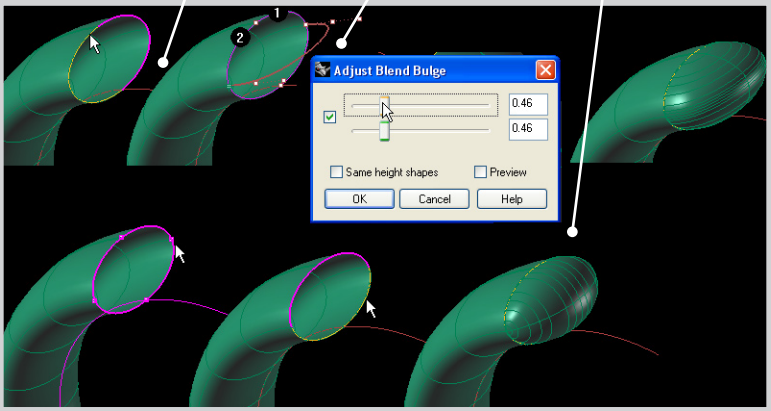


Blending an Open End: The Split Edge Command

To Blend the single edge of an open surface, as when extracting the End Cap of an open shank to create a rounded end, begin with the "Split Edge" tool in Utilities. Place the split at the Midpoint of the surface (with OSnaps on, you'll be able to find the Endpoint - put it opposite this).

Start selecting edges for the Blend on one side of one Split point (Mid or End). Select all edges up to the other point and press Enter. Select the other edge to Blend by starting on the other side of the SAME point. (After Split Edge, a surface will have 2 edges; a polysurface will have more.)

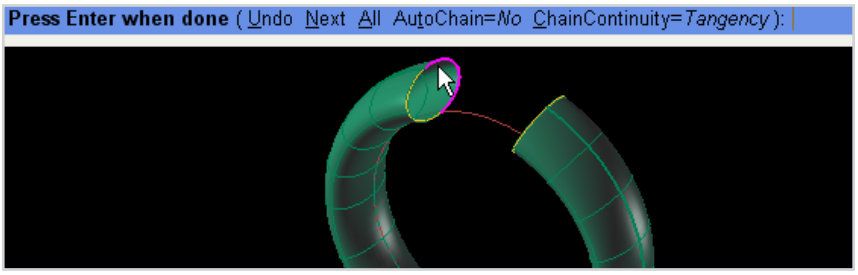
How the edges are split will affect the result of Blend. Think of it as folding a piece of paper": if you hold it on the "long ends", you get a wider fold. If you hold it on the "short ends" you get a narrow fold. Place the splits on the "short ends" of a profile so the Blend surface isn't too puffy!



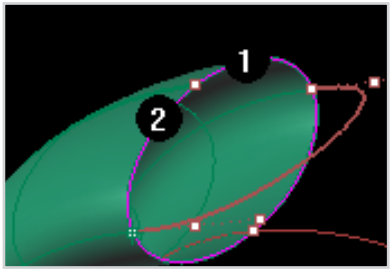
Compare the different results of Blend, above: (L - R) a single surface Split at Mid and Endpoints; the same surface Split at two opposite quads.

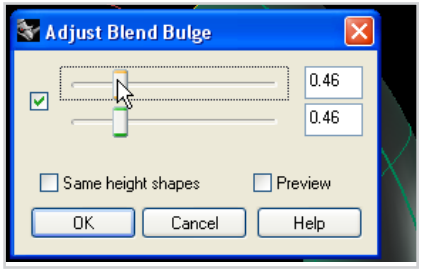
Command Line & Dialog Box Options

Using the "Blend" Command Line Options and Dialog Box Options

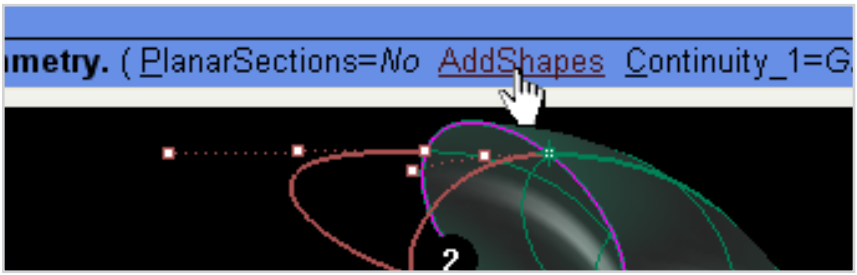


Options to Chain Blend Edges Use "AutoChain" to automatically select continuous (touching) edges in a polysurface edge (or, a single edge that consists of many component edges). Set "Chain Continuity" to "Position" to select all component edges that are touching end-to-end (selects the most edges). "Tangency" selects component edges that are tangent; "Curvature" selects those in this relationship to one another (selects fewest). "Undo" and "Next" let you control the chaining function one-by-one to ensure the correct edges in the chain are selected. Or, use "All" to select all edges in the chain.





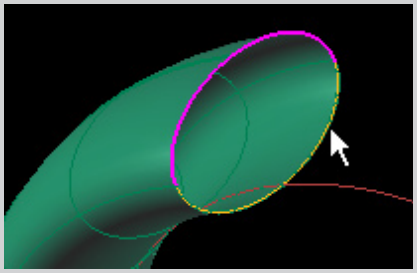
Adjusting Blend Shape There are several ways to control the shape of the resulting Blend surface. When the control-point handles appear in the viewports, click and drag one at a time (holding Alt down changes angle; holding Shift down changes both sides together). Or, enter the Adjust Blend Bulge dialog and assign a value in the slider controls. Click in the check-box between the two sliders to "lock" them, moving both simultaneously. Check-mark "Preview" to see the results live in the viewports. "Scale Height" constrains the height of the resulting surface to the width between the Blend profiles.



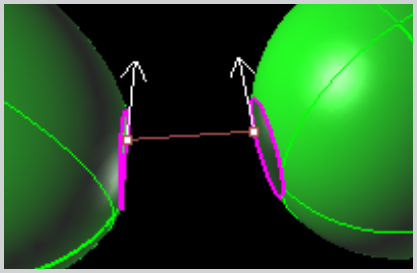
Remaining Options "Planar Sections" allows you to assign a direction (plane) with two mouse-clicks to constrain the Blend Shape curves to, in order to better define the surface shape. Use "Add Shapes" to add a control-point handle curve between the two Blend edges, allowing you to add more control to the resulting surface. Click on both edges to assign the ends of the new shape curve. Adjust it the way you do the other shape curves. The "Continuity" options, G0-G4, assign a different-shaped curvature to the resulting surface. We recommend "G1" for the most predictable results.

Step-by-Step

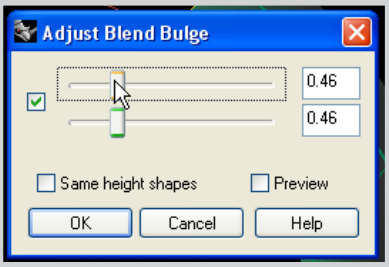
Using Blend



1 Select edges to Blend, separated by "Enter." Select an edge or edges to Blend. Press Enter to select the next edge or set of edges. Begin selecting the second edge just NEXT TO the place you started selecting on the first edge. If edges are not continuous (touching end on end), it will automatically act as the next edge without you pressing "Enter".



2 For Closed Curves ONLY, Adjust Seam Points. For ONLY closed edge curves, use the Command Line options from Sweep 2 and Loft (visit these entries in the manual to learn how) to set the seam points for the Blend.



3 Set surface shape with options and click OK. The options explained at left - the Blend Bulge Dialog, Command Line Options, and Control Point handles - will adjust the Blend shape. Click OK or press Enter to see the results.



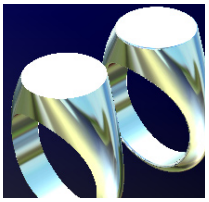
Tools to Edit Surfaces & Solids ...

Fillet & Chamfer Tools

Fillet Edges in the Solid menu or the Fillet and Chamfer tools in the Surface menu edit surfaces or polysurfaces where two edges meet.

Fillet Edges

Use this tool to fillet (add tangent curvature to) edges in a polysurface. The polysurface may be open or closed, but component surfaces must be joined. While using this tool, you may select one or more edges by clicking on them successively; or, you may region-select edges to include them in the Fillet operation. If you select the entire model, every edge will be included in the fillet.

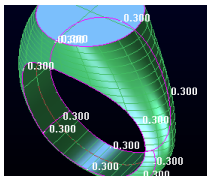


Fillet edges (right) of sharp surfaces for more realistic renders.

After selecting edge(s) to fillet, press Enter. Handles will appear on both ends of every edge selected during the command. Click and drag a handle to change its value. Click when the value you wish to use is showing. You may make both ends different. Press Enter to keep the results and add the fillets. The Command line options change how this tool will work.

Fillet Edges Command Line Options

"Current Radius" indicates what the radius of the new edge will be as a result of using the tool. "Add Handle" allows you to click somewhere along an edge to add a handle. Click to select an edge; then click to add a handle. As described above, click and drag the new handle to change the radius of the filleted edge at the new location. You can also use "Remove Handle" to delete a handle added in this way (handles at the start and end of an edge - or a single handle on a closed edge - cannot be removed with this tool, as these are required in order to run the command). "Copy Handle" will add a new handle with the radius from a selected handle. The other way to match handle values is to use the "Set All" option, changing the value of all the handles to the new radius; or the "Link Handles" option, by which editing one handle will change the value of them all.



Region-select to fillet ALL edges of a surface at one time.

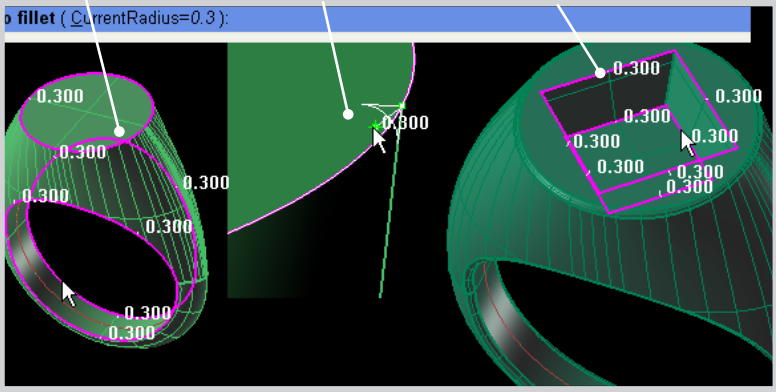
Steps to Fillet or Chamfer Edges

1- Start up the Fillet tool and select one or more edges to fillet (or chamfer - same steps; used less frequently; creates angled, not smooth, corners). If you region-select a part to fillet every edge, take care that the diameter of the fillet is small enough to work on every edge you selected, or you may get unexpected results.

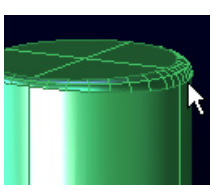
2- If you wish, click on a handle to edit it. Or, click "Add Handle" to add one; move mouse to locate it, click mouse to place it, and click it again to edit it.

3- Press Enter, and fillets will appear.

When working on an edge with one or more sharp corners, as in a square or rectangle, it is best to select all edges during one fillet. Otherwise, corners can get confused.



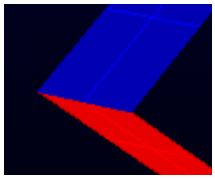
"Add Handle" creates different radii for the fillet at different locations.



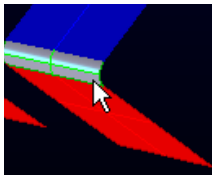
Create a smaller (L) to larger (R) fillet by adding handles.

Defining the Shape of the Fillet

Select one of the three "Rail Type" options to define the shape of the new edge. "Distance From Edge" fillets the indicated distance back from the selected edge, cutting away this much of the edge with the new corner. "Rolling Ball" indicates the radius of a "ball" you can imagine "rolling" from one end of the surface to the other, defining the shape as it goes. Finally, "Distance Between Rails" defines the distance between the start



Surface Menu tools Fillet & Chamfer unjoined surfaces.

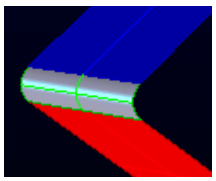


and end of the new, curved edge that will be replacing the existing shape. Each option will change the way the tool works, so you may wish to try them all to see what will work best for your surface.

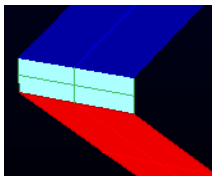
Tools to Fillet & Chamfer Surfaces

With two joined or unjoined surfaces, you may add a similar tangent, curved surface (fillet) between the two; or, you may Chamfer the two by adding a beveled edge between them, using four similar tools in the Surface menu.

First of all, the Fillet and Chamfer tools - which share common command line options - will place the selected shape between two surfaces (joined or unjoined). Select each surface (only two may be selected); then, assign the Distance (Chamfer) or Radius (Fillet) by typing a value into the Command line. The "Extend" option will extend each surface to touch - if they do not already touch - in order to complete the Fillet or the Chamfer. As a general rule, you'll want to select the "Trim" option for both of these commands. This option deletes or trims the original surface at the location where it was changed to accommodate the new shape. With this option set to "No", the original surface will be left and the new surface will also be added. This usually isn't the desired result.



Compare Fillet (above) and Chamfer (below)



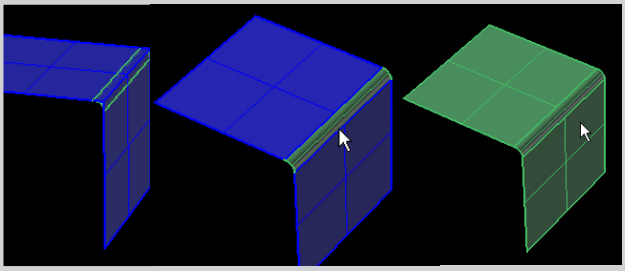
Variable Radius Surface Tools

Similar to the Fillet Corners command in the Solid menu, this tool allows you to control the Fillet or Chamfer size between two joined or unjoined surfaces. As described above in the explanation of the Fillet Corners command, use the Command Line options to change the size of handles, add handles, and change the way both tools work. Like the Fillet and Chamfer commands though, these only work with two surfaces - not many, as the Fillet Corners command from the Solid menu does.

Variable Radius Blend

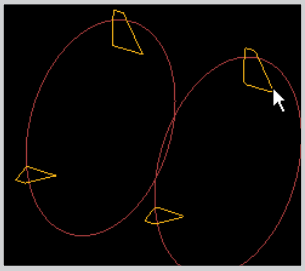
This works just like the Variable Radius Fillet or Chamfer tools; however, the resulting surface has the Blend shape to it. Use it like the Fillet and Chamfer tools, not like the other Blend tools, for best results.

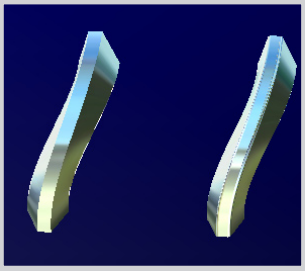
Tips & Tricks Fillet/Chamfer Command



Weird results? Try Split and Join to complete.

Sometimes, Fillet or Chamfer don't seem to complete the job. If a surface is left behind, try Splitting the original object with the new surface. Then, delete the remaining piece. Voila: the filleted shape! Join this to the rest of the piece, and you've done it! (Now why couldn't Rhino do that? Well, either way, it's good practice for you...!)





Filleting curves is more dependable and easier to control. (Filleted curves on right in each illustration; resulting surfaces shown on right.)

For best results, Fillet at the curve level first.

If fillets are just failing or are particularly difficult to do, keep in mind that it's best to start at the Curve level when filleting edges. The more work you can do filleting your original the easier it will be on your model later.



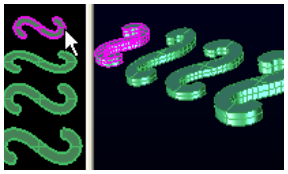
Editing Surfaces & Solids

Basic Scale Tools

1, 2, and 3D Scale any objects - curves, surfaces, solids, or meshes - using these basic Transform Menu tools.

Comparing all Three Scale Tools

The 3D Scale tool scales an object in all three directions - X, Y, and Z - so it can grow smaller or larger uniformly. 2D Scale scales an object along 2 axes: the two visible in the viewport in which you use the tool. Finally, 1D Scale scales an object along the axis you indicate when placing the "Origin Point" and "First Reference Point" during the scale operation.

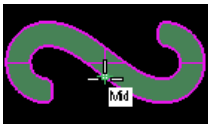


(L - R) compare the 1D, 2D, & 3D Scale Tools. Original, highlighted.

Setting the Origin Point

Use the three Scale tools to scale objects along either 1, 2, or all 3 axes. All three tools begin by asking you to select an object to scale and an origin point for the scale. The origin point is best set at the center of the piece, since the location on the piece you select as the origin for the scale will not be moved, but the piece will grow outward from or shrink toward the origin point.

Therefore, if the origin point is set off the piece somewhere, it can be unpredictable as to how the piece will change. Use the Center Object Utility with the "Point at Center" option to place a point at the center of an object.



Set origin point at center of object to keep it in its current location.

Alternately, put the Origin point at the part of the model - such as one end - where you want to hold the object still while you scale it.

First and Second Reference Points

Usually, you will want to hold down Shift while placing these points in order to scale the object uniformly. The "First Reference Point" indicates the start of the scale and the "Second Reference Point" indicates the end of the scale. After placing the first reference point to start the scale, continue moving the second reference point until the object is at the size you want. Then left-click to end the command.

Steps for Scaling Objects with 1, 2, or 3D Scale

1- Select object and select a scale tool.

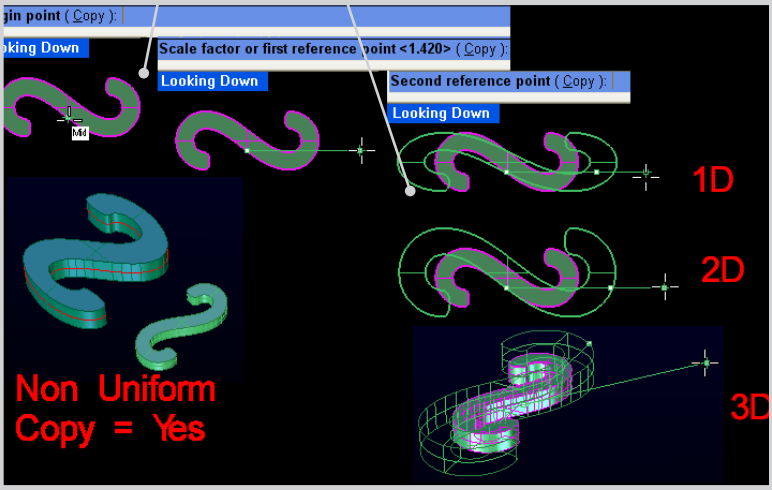
2- Select an origin point (best at center of model or touching a part of it, so piece is not relocated).

3- Set the "First Origin Point" from which to start the scale.

4- Set the "Second Origin Point" to grow or shrink the model, and click once to end the command and complete the scale.

Compare, Top to Bottom, the same object scaled with 1, 2, and 3D Scale below. See the same object scaled with Non-Uniform Scale below, left.

With Copy = Yes option selected, the original item will be left behind and a copy of the item will be scaled.



NonUniform Scale

This command runs three 1D scales - in each of the three axis directions: X, Y, and Z - all in a row, so you can scale the same item from the scale origin point in every axis to a different amount. Set the First and Second Reference points three times during the command in the direction (X, Y, and Z) indicated.

Copy Option

The only Command Line Option available during this command is Copy = Y or N. With Copy = Y set for this option, a copy of the object will be left behind in its original condition before the scale.

Editing Surfaces & Solids

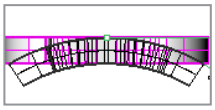


Bend, Twist, Taper, & Shear

These Transform Menu commands deform curves, surfaces, solids, and meshes with a few easy steps. They share similar options.

Bend

Begin by setting a "Spine" or location along the piece to bend it. Click to set one end of the spine first - either at the end of a piece or at the middle of it - then click to set the other end of the spine - usually, past the end of the piece (unless there are parts of the piece you do not wish to bend). Move the cursor and watch the preview as the piece follows the cursor, creating the bend. Use the Command line options - many of which are common to each of these tools - to change the way this tool works.

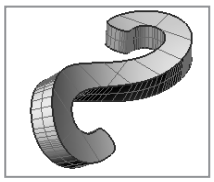


Bend: Set a Bend Spine and related options (Symmetrical used here.)

There are additional Command Line options available only with this tool. "Angle" allows you to input an angle to which to set the bend. "Symmetric" adds the same Bend to the other side of the model, mirroring the effect. "Limit to Spine = Y" does not allow the object to bend past the spine you set, so if the spine ends before the model does, part of the model will not be touched during the command. With this option set to "N", the program will treat the model as though the spine continues in a straight line all the way through it.

Twist

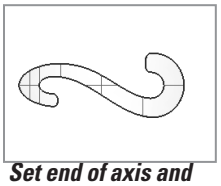
This tool also uses the first two clicks to set an "axis" along which to run the command. The third mouse-click sets a "handle" with which to perform the twist. Set this in a viewport perpendicular to the axis for predictable results. Then, move the mouse to "turn" the axis like a crank, twisting the model. When you like the results, left-click or press Enter. As above, set the Command Line options indicated next to change the way this tool works.



Grab "handle" and move mouse. to Twist.

Twist also offers the Command line option "Infinite". With this set to N, the twist will not affect a part of the model if the Twist Axis was not drawn through it. If Infinite = Y, the entire model will be twisted regardless of whether or not the twist axis was drawn through all of the model.

Taper: Set the taper axis by starting at the end of the model you DON'T want to change. Click next at the other end of the model: the end you will change. Set the third mouse-click perpendicular to the taper axis. As you move the mouse now, you'll be tapering the opposite end of the model either larger or smaller. Click one final time to keep the results.



Set end of axis and move mouse to taper.

Because this tool begins by drawing a Line, you will be offered the same options as in the Line command. Study these options in the relevant part of

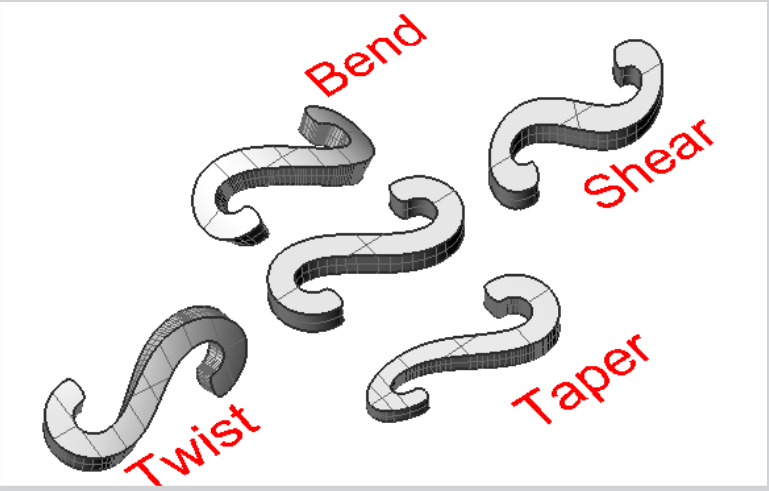
Comparing Bend, Twist, Taper, and Shear

Center, Top: Bend is useful for curving a shape so it will fit around a rounded area, such as the space between two gallery rails in a head, or a cut-out in a bezel.

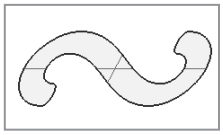
Right: When it is difficult to draw just the right shape, start with circles (original at center), Split each in half, Blend them with a curve, Offset to both sides, Join, and extrude. Now, Shear the shape to get a more interesting design.

Center, Bottom: Taper is commonly used to fit a shape down into a tapered space, such as the side shield on a signet ring. Leave one end wider and the other smaller to fit.

Left: Twist is good for unique designs, but seldom used.



this manual. The "Flat" option is the other Command Line option available only with this tool. Select this option so that Taper does not skew the object out of the flat. If you want to keep it flat, select this option. Otherwise, it is easy for this tool to cause an object to be moved out of its original flat orientation.



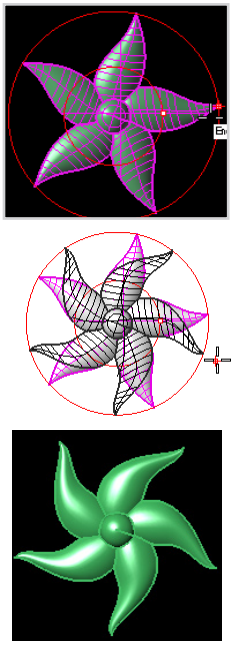
Shear angles the object on a slant.

Shear

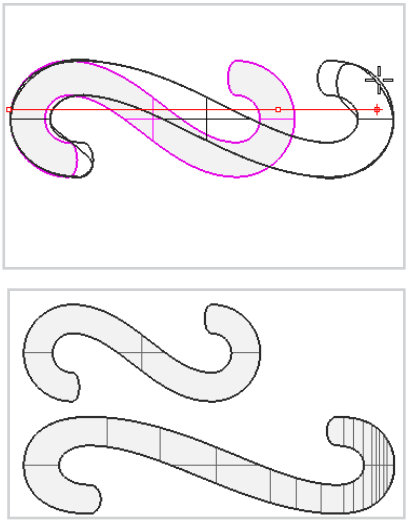
To angle an object, select the Shear tool. Select two locations on the object to indicate how much of the object to shear; then, move the mouse to angle the piece.

Maelstrom & Stretch More Tools

The Maelstrom Command A similar tool to those studied herein, Maelstrom provides another way to deform an object. Begin by setting two circles - using the command line options common to the Circle tool - the first representing the part of the object you wish to leave alone and the second representing the part of the object you wish to twist. Move the mouse to twist the piece, creating an interesting design. The Command line options for this tool are the same as those listed at right. The object will be rebuilt with more control points in order to complete the Maelstrom.

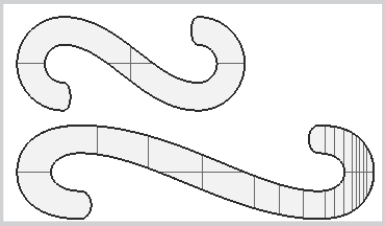


The Stretch Command More than a 1D scale tool, the Stretch tool works much like Bend, Twist, Taper or Shear; in that you are first prompted to set a "Stretch Axis". Just as with Taper, the same options as for the "Line" command appear when creating this axis, so consult that part of the manual for more information. Then, click to indicate both ends of a line representing the direction you wish to stretch the object. Before placing the third and final mouse-click, move the cursor to "stretch" the piece until you like the results. Left-click to keep the changes and end the command. The "Copy" and "Rigid" options, explained at right, are offered in the Command line.

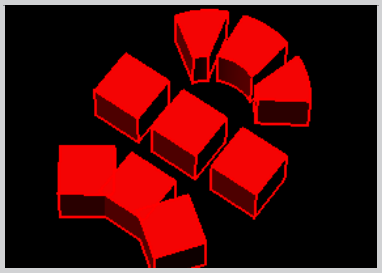


Common Command Line Options

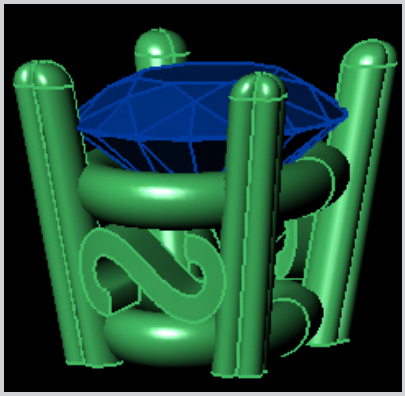
Each of these options is available with some or all of these Transform Menu tools.



The "Copy" Option Select this option with any of the four commands above to change a copy of the object and leave behind the original.



The "Rigid" Option Use this when running Bend, Twist, or Taper with multiple pieces (original, center). With Rigid = Y (left), the shape of each piece will be maintained while they are manipulated; only the configuration of the pieces will be changed. With Rigid = N (right), each piece will be transformed (bent, e.g.) to fit the new configuration.

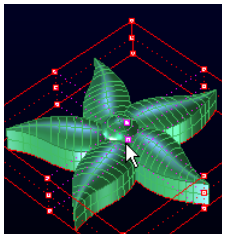


Tools to Edit Surfaces & Solids ...

The Cage & Cage Edit Tools

Place object in a cage using one of these two commands. Then "Cage Edit" to freely "warp" solid objects with Control Point Editing.

What is a Cage?



Assign control points (not too many!) to Cage to edit surface.

These two tools allow solid objects to be edited with Control Point Editing so they can be freely warped or transformed in any way the user wants. The "Cage" functionality specifically means that control point editing on one object (known as the "Cage") will cause corresponding results in another object (known as the "captive").

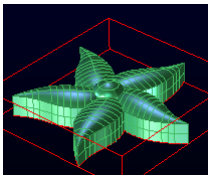
Most often, the cage you will want to use is a bounding box enclosing the object (or, a box that is as large as the largest extents of the part in each direction - in other words, the smallest box the part can fit into without poking out of the box on any side). Control points may be assigned to this box in three directions - X, Y, and Z - and are evenly distributed throughout the box. As you click and drag the points to deform the box, the results apply directly to those parts of the captive object, making it seem like you're directly deforming the object.

However, Bounding Boxes aren't the only cage objects available. While running either command, you will be offered options to create either a line or a surface with which to control the captive object. Choose one of the three (box, line, or surface) based on the nature of the transformation you'd like to make. Or, before running either command, you can create your own geometry to assign as the cage. However, to avoid unexpected results, it should be roughly the same size as the captive object. Use the Bounding Box Utility to let the program create it for you.

Comparing Cage and Cage Edit

What is the difference between these two commands? The Cage commands allows you to create a cage using the "Box" command or "Bounding Box" option. With a Cage created, turn on the Control Points of the cage to edit it. Using Cage Edit, you can select an existing cage made with the Cage command, or create a Line, Rectangle, Box, or Bounding Box to use as the cage; or select an existing object to use as the Cage. Put another way, both commands establish a "history" relationship between the "captive object" and the object you create or assign to be the cage. It is not necessary to have History turned on in Rhino, since history is built into the two Cage commands: whatever you do to the cage naturally affects the captive object, as a function of what the tool was created to do!

In contrast, the Cage Edit tool allows you to create AND edit the cage in one command. It also allows you to select an existing cage to edit. After creating the cage (or selecting an existing cage), this tool turns on the control points to allow you to begin editing right after the command is run.



Cage (above) just draws cage; Cage Edit also turns on its points.

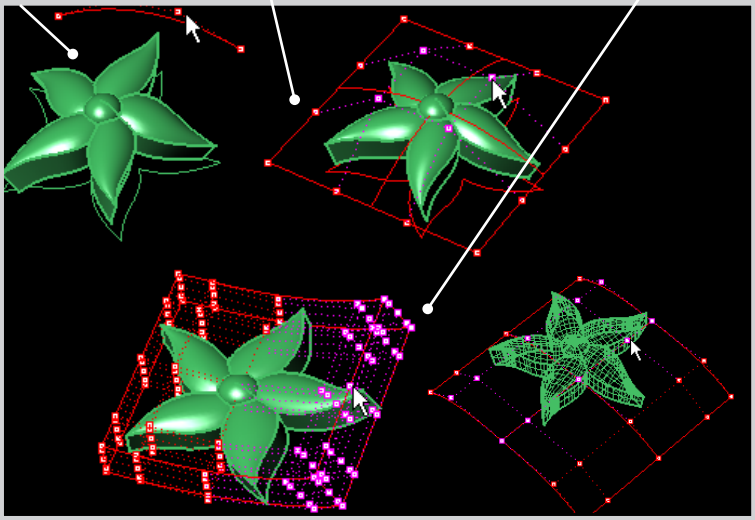
Compare Cage Objects: Line, Rectangle, & Box.

Place a line to control the object along one plane only. The same effect will happen over the entire object.

Place a rectangle to assign points all over one dimension of object. All of object will be controlled at once, but you can leave parts behind by not selecting points.

Select Box or Bounding Box to encompass object in points. Select some points, leaving behind others, to skew one part at a time.

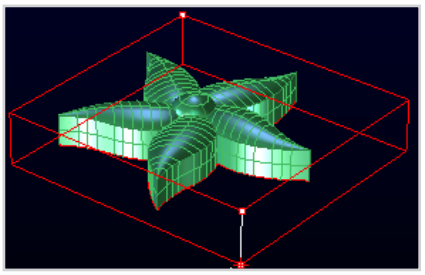
Finally, you can even select a pre-existing object (surface used here) and use its existing control point structure to adjust the Cage object.



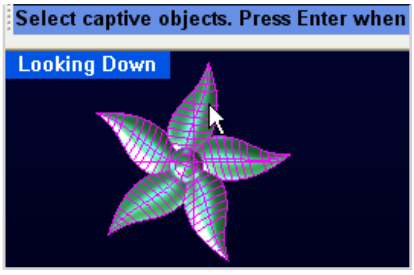
Note: Bounding Box and Box differ in that the program draws the Bounding Box for you based on the extents of the part; you draw the Box during the Cage command.

Command Line Options: Using Cage & Cage Edit

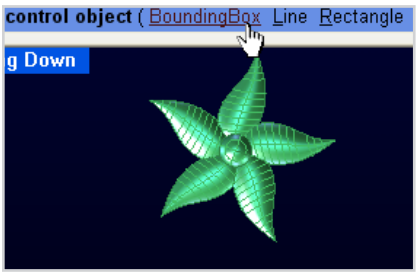
Some of these Command line options are available in both commands.



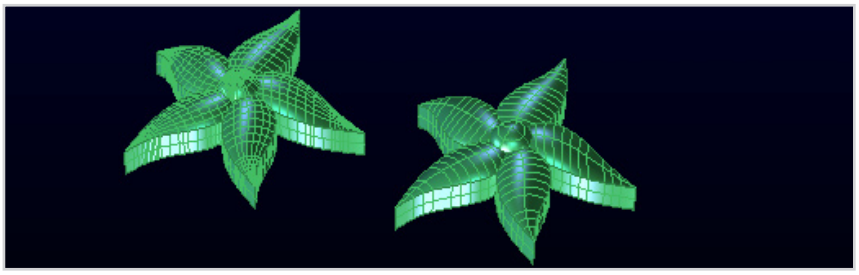
Cage Bounding Box & Other Cage draws a Box, so refer to these command line options. Or, select the "Bounding Box" option to use the object's Bounding Box as its cage. Next, you'll be prompted to select the object in the cage. Press Enter and use the other options explained here to complete the command.



Cage Edit Select Captive & Control Objects Begin by selecting the object to be controlled by the cage ("captive"). Then, select the "Control Object", or, the object that will act as the cage. Control points will be added to this object at the end of the command, and changes to it will affect the captive object.

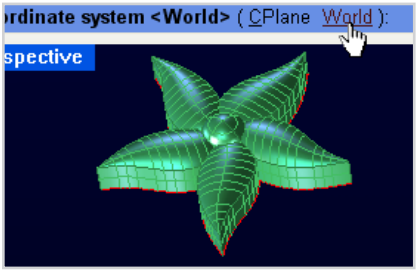


Cage Edit Control Objects Several options are offered as the "Control Object" while using Cage Edit. Select the Bounding Box of the captive object; or, create a Line, Rectangle, or Box by choosing these options within the Cage Edit command.

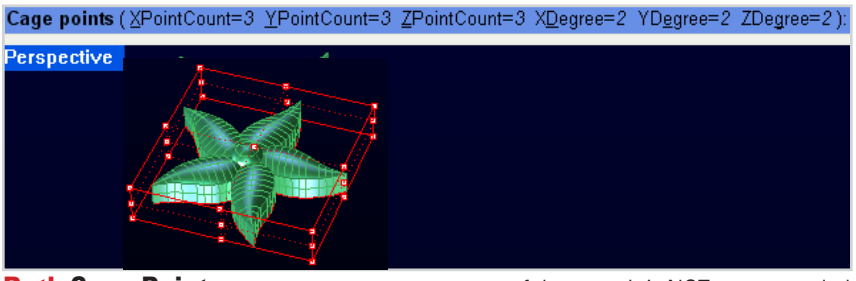


Cage Edit Deformation = Accurate Use one of the Deformation options - "Fast" or "Accurate" - to assign how the tool will work. "Accurate" (L, above) follows the changes you make more carefully, placing more isocurves (and taking up more processing power, which can make the tool run slower).

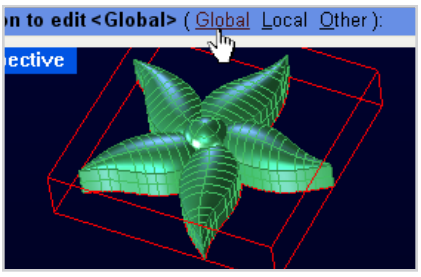
Cage Edit Deformation = Fast (R, above) This option makes your changes more quickly, but using fewer isocurves in the resulting surface. Results could be less accurate than those with the "Accurate" option; however, the tool will work more quickly. Use "Fast" if speed is more important than accuracy.



Both Coordinate System When assigning "cage points", or, the number of control points that will be used to control the cage, "X, Y" and Z" will refer to either the "Local" XYZ of the active viewport, or to the "World" XYZ of the entire workspace in Matrix - which corresponds Looking Down & Perspective.



Both Cage Points Assign the number of control points you want for control when editing in the X, Y, and Z directions. Set this rather low, as fewer points make for more gradual editing and more points can more easily make lumps. I usually use the same amount in each direction, for ease. Use an odd number if you'd like control right in the center of the cage. It is NOT recommended that you change the "Degree" from the default value of "3". This refers to the bendiness of the point editing, where 3 is comparable to the bendiness of the Interp Curve and 1 is straight, like the Polyline curve. Set this at 3 for best results.



Cage Edit Region to Edit Select "Local" to constrain editing to the active viewport. Use "Global" to apply editing to the entire workspace. Select "Other" to draw a Sphere, Cylinder, or Box around a region of the captive object to constrain the changes to. Select a "Falloff" value (0 is none) to graduate the difference between the edited and unedited regions.

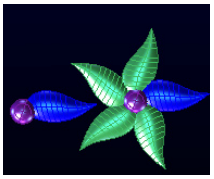
Tools to Edit Surfaces & Solids ...

The Polar Array Tool

To copy one object in a circle or arc, around a center point, to create a configuration of several identical objects, use "Polar Array".

Using Polar Array

Use this tool on curves, surfaces, or solids to copy one or more objects in a circle or arc shape. Begin by selecting the object to array. Start up the command. Or, if you didn't select the piece before starting up the command, select it and press Enter to continue.



1 petal arrayed 5 times in 360 degrees = a flower!

The "Center of Polar Array" is the point around which you want to place all the copies. It is a good idea to use F4, for its ease, if this is possible for your new configuration. Next, type in the "Number of items" you want as a final result of running the tool.

Next, select the "Angle to fill", out of 360 degrees for a full circle, to create the configuration you want for the objects. If you want to place all of the objects in a full circle, select 360 degrees. To place them in a half-circle configuration, select 180 degrees, etc. To select a configuration, type in a value and press Enter. Or, use the cursor onscreen to indicate a start and endpoint for the configuration; just keep in mind that, instead of locating them at the angle indicated, the computer will measure the value of the angle you selected and use this value for the array, starting at the present location of the object you initially selected to array. (Remember that - 180 will give you objects to the right of the original; +180 will give you objects to the left of the original - backwards from the way your high school geometry teacher taught you to measure angles.)

"Step Angle" Option

Select the Command Line option "Step Angle" if you'd prefer to indicate the distance, in degrees, between objects and not the distance (in degrees) in which to array the number of objects you've selected. This is just another way to approach the arrangement: allowing you to space the objects instead of allowing the program to space them for you given the degrees you've set. With this option selected, use the two methods discussed above to set the angle: either type in the value of the angle between the objects or click onscreen to indicate a value between the objects.

Steps for Polar Array

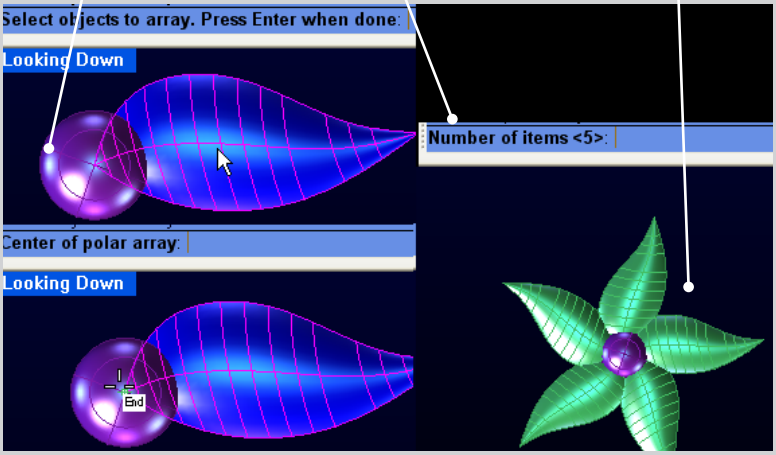
1- Follow the Command line prompt to select the object(s) you wish to array. Press Enter after selecting them all (just petal selected, below)

2- Assign a Center around which to array the items. In this case, the End of the petal (corresponding to the center of the flower) was used. It is a good idea to use F4 or another predictable reference point.

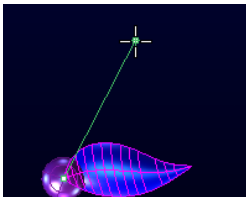
3- Assign a number of total items (including the one you selected) to end up with after the Array.

4- Press Enter to array items in 360-degrees (full circle). Or, use "Step Angle" option and click in the viewports to assign the start and end angle within which to array the items.

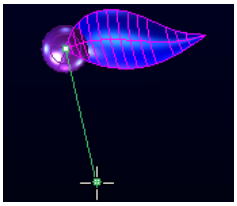
5- Press enter to see the results.



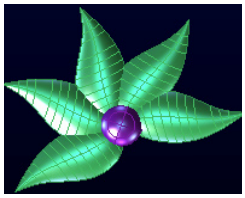
"Step Angle": Type a value or click to assign degrees for objects to array in (this step measures degrees: objects don't array into actual area you select).



"Start Point" assigns start of angle.



"End Point" assigns end of angle.



Number of items arrays in angle size (not location) indicated.



Tools to Edit Surfaces & Solids ...

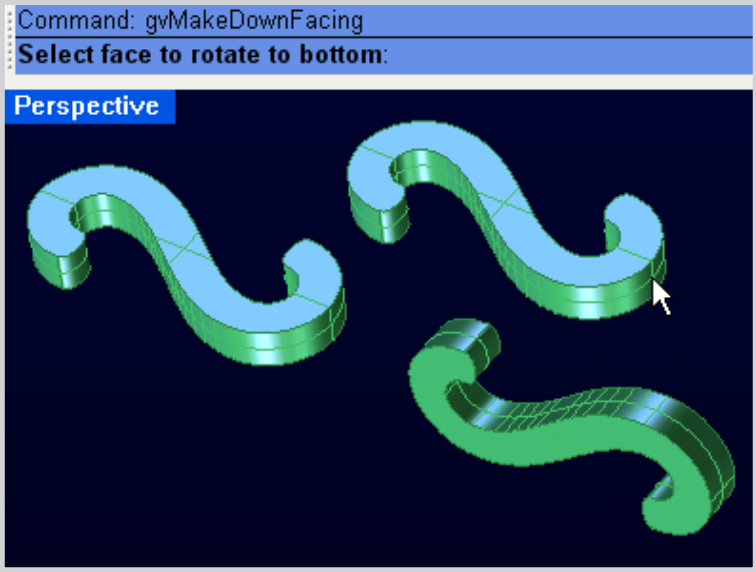
Make Downward Facing

This simple tool flips an object so that whatever side you select is made the bottom of the piece.

Using Make Downward Facing

Upon starting up this tool, the Command line will prompt you to select the object to move. It will then ask for a "face to rotate to bottom". This is the side you want to make the new base of the piece. Click this "Face" or side, and the piece will automatically be rotated to face down.

Just note: O-Snaps don't work with this tool; just click on the side of a surface you want to face down instead of the current surface.



(Left) Original object; (Center) "Face" selected to rotate to bottom; (Right) Result of using tool.

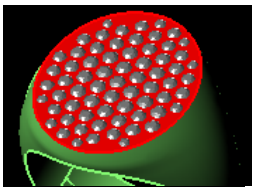
Chapter 7 INTERMEDIATE

Intermediate Gem Tools

These gem tools facilitate placing and setting Pave', gem lines with exact size and spacing, and other intermediate design applications.

Chapter Overview: Simple Pave'

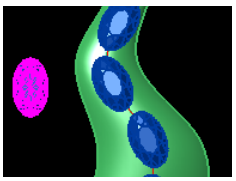
Gem tools covered in this chapter begin with Simple Pave' - a quick and useful tool for laying out pave in hex patterns with angle and spacing you can control. The reason you might choose this tool over the Automatic Pave' builder - a more advanced tool - is that you can assign precise sizes and the number of gems in each size, to make the layout according to gems you already have. It is better used on less complex surfaces, and can cover component surfaces of a polysurface.



This pave' tool is best used on simple shapes.

Chapter Overview: Gem on a Surface

The Gem on Surface tool is also useful for placing gems at the exact size and spacing required for a layout. You may lay out a pave' pattern one gem at a time; fill in a pave' pattern (if it has "holes" in it) created with either of the other two Pave' builders; or you may input a curve that the gems will adhere to, and create a "Gem on a Curve" layout with sizing AND spacing you assign (the automatic Gem on a Curve tool lets you assign either sizing OR spacing, but not both).



Gem on a Surface now lays out any shape you choose.

The key to this tool is the spacing, which ingeniously provides visual cues in the way of circles around each gem that turn red when the gems will intersect; blue to show their distance away from one another; and green when they are within tolerance of the spacing you assigned in the builder.

New to this tool is its ability to now place ANY gem on a surface that you choose. Therefore, you may access it now from the Gem Loader, choosing any gem shape and size and clicking the "On Surface" option to open this builder; or, you may use the "Gems" option in the tool to choose any gem onscreen and place it onto a surface. (When just starting up the tool, without using the "Gems" option, you can simply start placing round gems.)

Using Advanced Gem Tools Together

Begin with a pave' layout - either simple or automatic.

Gem on a Surface will place gems one by one to fill "holes" in your layout.

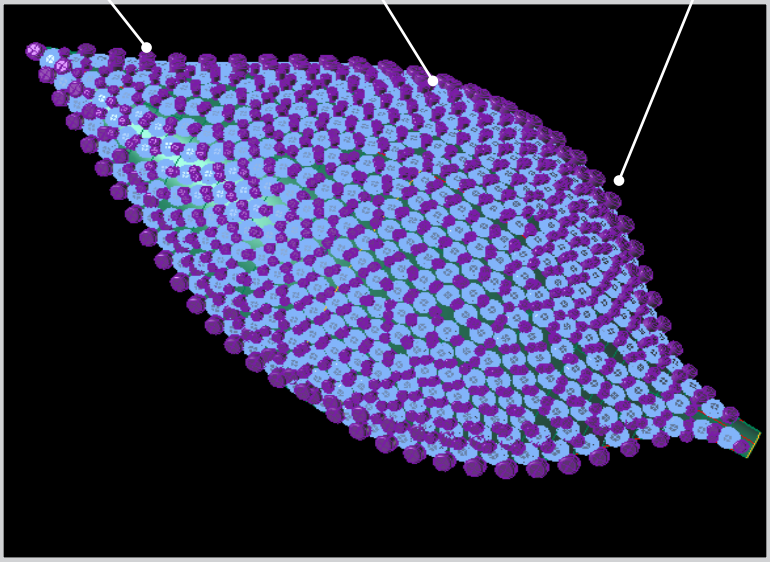
The "Springs" tool also helps fill in holes by moving gems around on the surface. Gems influence one another to keep the layout uniform.

Pave' Azures will create a honeycomb pattern for azures.

To place prongs, Pave' Prongs is your simplest choice.

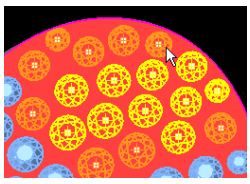
For a more complex layout, input a curve or point object into "Gem Control" as "Gem North". In Prong Placer, select "Gem North" and choose prongs.

Prong or Bead on a Surface fills in holes between prongs.



Chapter Overview: Gem Springs

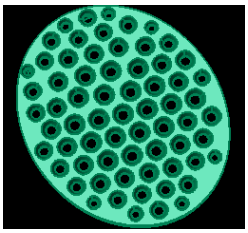
Select any set of gems on a surface and input them into Springs. This tool will allow you to edit them, moving them along the surface, while allowing the gems to interact with one another as you do so, "pulling" and "pushing" their neighbors to keep the layout uniform.



Springs (above) or Gems on a Surface fills in holes in pave'.

Chapter Overview: Pave Azures

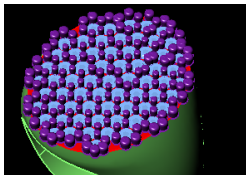
Use this tool with a pave' layout only (gems must be close together and relatively hexagonal - it won't work with a single row of gems!) to place a "honeycomb"-style pave' plate with either hexagonal or round azures.



Pave' Azures Tool lays out a hexagonal azure pattern.

Chapter Overview: Pave Prongs

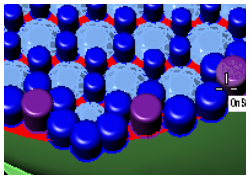
These prongs do NOT work with History or "Gem Control" (explained later), but can assign "shared prongs" among 2 or 3 neighboring gems in a pave' layout - something other prong placers in the program can't do. "Shared" prongs, "Center" prongs, and "Unshared" (edge) prongs can all be adjusted.



Pave' prongs can share prongs, but DON'T have History.

Chapter Overview: Prong, Bead, or Object on Surface

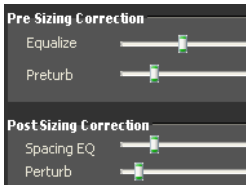
With most of the same controls as Gem on a Surface, these tools allow you to fill in holes in Pave' prong work with your own prongs or beads. Bead on a Surface allows you to snap to a curve, creating your own millgrain pattern. It also provides the "Object" option, which adds an "Object" preview window into which you place any object you'd like to array on the surface instead of a bead. You control the rotation of this object.



Prong on Surface (purple) can fill holes left by Pave Prongs.

Chapter Overview: Automatic Pave' Builder

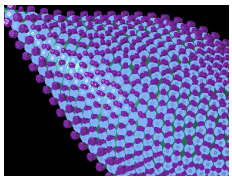
This more advanced Pave' tool is designed to allow you to try many different pave' layouts on a single surface, adjusting settings found in the builder repeatedly until you get the design you like. Pave' placed by this builder is constructed in a totally new way, using sophisticated math similar to that used to build geodesic domes (think Epcot Center)! In addition, the gems are allowed to "interact with" or "perturb" one another, and, with these settings enabled, can adjust their own position relative to their neighbors for a more pleasing layout.



"Perturb" lets gems interact while pave' is laid out, to find the best spacing possible.

Chapter Overview: Gem Control

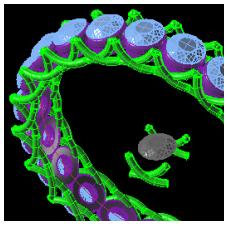
Gem Control is most frequently used with Pave' to assign a direction for gems' axes to point. After using it, assign "Gem North" in the Prong Adder builder (DOESN'T work with Pave Prongs tool), and prongs will point in the direction gems' axes point. Assigning a curve or point object in Gem Control has the best result for creating flowing, directional pave' layouts, and since gems and their prongs have History, you can toggle among different Gem Control directions and different prong arrangements until you get the results you like!



Gem Control is what makes this pave' appear to "flow" toward tip of leaf.

Chapter Overview: Object to Gem

This oldie but goodie in Matrix never ceases to amaze, providing a very simple and intuitive way to add the same design element to every gem onscreen, while scaling and orienting it to each gem's particular size and location. Simply model the item you wish to orient at F4, in proper relationship to a "Guide Gem" placed by the builder, input the item into the builder, and Orient it to each gem onscreen.



Position to gem places one object, drawn at F4, onto all gems.

Skills & Commands in this Chapter

Create & Adjust Simple Pave'

Pave' Builder, Gem on a Surface, Gem Springs



Set Pave'

Pave' Azures, Pave' Prongs, Prong & Bead on Surface



Advanced Gem Tools

Automatic Pave', Gem Control, Gem Follow, Object to Gem



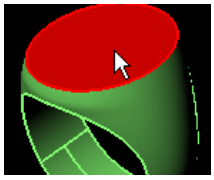
Pave Tools ...

Creating Simple Pave

This more basic of the two Pave' builders creates a hexagonal pattern only, but allows you to select exact gem number, size, & spacing.

1- Input Surface

Input a surface or polysurface to start up this tool. If you don't want the pave to extend to all parts of the polysurface, begin by using "Extract Surface" and only place that surface into the builder (red surface at right).



Extract a surface (red) if you don't want pave all over ring.

2- Select Gem Sizes

Unlike the Advanced Pave Builder, this builder lets you select an exact number and size of gems to use. To do so, click "Add Gems" and select a size from the familiar Gem Loader interface. Each time you select a size, it will be added to the Pave Builder menu. When you have selected all the sizes you wish to use, click the red "X" to close the Gem Loader window.



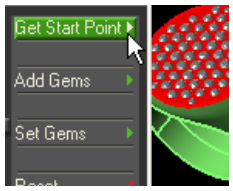
After selecting gem sizes from Gem Loader, assign quantities in Pave Builder menu.

3- Assign Gem Quantities

In the Pave Builder menu, highlight a gem size and type a quantity over where the quantity "1" is located. The builder will use all of one gem before going to the next one, so do this with care (using small numbers) if you want the builder to use EXACTLY these quantities. It's always a good idea to check Gem Reporter after using the builder to make sure it place the number and size desired.

4- Set a Start Point

Click "Get Start Point" and click a place on the surface, such as the Midpoint, from which to start the pave layout. At this point, the gray preview gems will appear. Changing the start point may change the look of your layout, so click "Get Start Point" again to change the design while you work, if you wish.



"Get Start Point" and preview gems will appear.

Steps for Using Pave Builder

1- Input a Surface into the "Surface" Preview window.

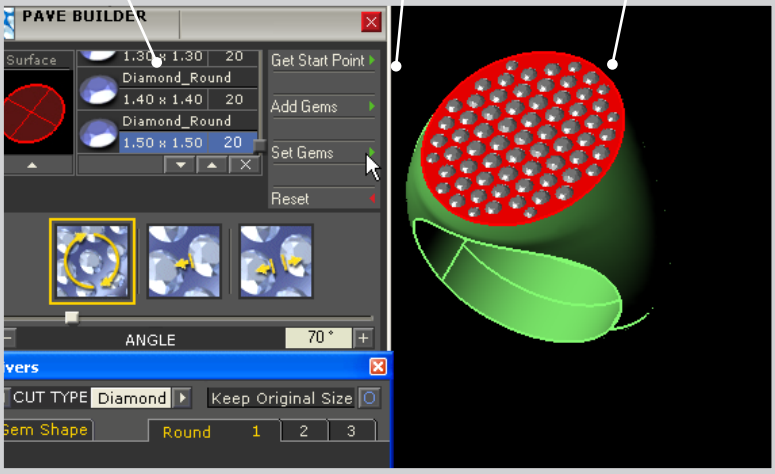
2- Click "Add Gems" to open Gem Loader. Double-click a gem to add it to Pave builder, and click the red X in the upper right-hand corner of the window to close it.

3- Where a gem is listed in Pave Builder, "swipe and type" to change the quantity from "1" to the selected number.

4- Click "Get Start Point" to see preview gems.

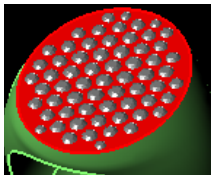
5- Change Builder menu slider controls, start point, or gem quantities to change the look of the Pave' design.

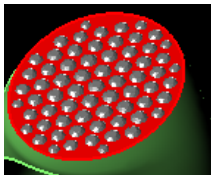
6- Click "Set Gems" to turn preview gems into real gems.



5- Adjust Sliders to Change Layout

Changing the "Angle", "Minimum Spacing" (gems will get no closer than this value), and "Spacing" (gems will get no farther apart than this value) sliders will change how the layout appears. You can also change gem quantity and location of "Start Point" to affect the look of the layout. Experiment with all settings until you like the results.





Two different layouts from two different Angle settings.

6- Set Gems

When you like the results of the builder, use "Set Gems" to turn the gray preview gems into real gems.

Pave Tools ...

Using Gem on Surface

Fill in Pave', create pave or a gem line one gem at a time - with size and spacing - or place ANY program gem on a surface with this tool.

About Gem on Surface

To improve this tool for the latest version of Matrix, we incorporated a lot of customer requests and added a number of different ways to use the tool, including the ability to use it for ANY size and shape of gem available in the program! This has made it uniquely more powerful, while not taking away any of the positive traits of previous incarnations of the tool.



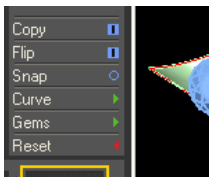
"On Surface" option in Gem Loader lets you place any gem on a surface.

As always, this tool places gems one at a time onto a surface - either to fill in some holes in a Pave design, create your own Pave design from scratch, or create a gem line along a curve with the sizes, angle, position, and spacing you indicate.

Accessing this Tool

In order to make this tool available with any size or shape of gem in the program you select (besides round!), there is a new way to start it up! Begin in the Gem Loader and select the gem size and shape of your choice.

With the gem placed in the viewports, start up the "On Surface" option to access the builder and orient THIS gem to the curve and/or surface. For instance, tapered baguettes can be placed at the exact size and taper of the baguettes in your collection!



The "Gems" option in this builder lets you match any gem onscreen to place next. Copy off moves gem; Copy on duplicates it.

Another way to start up this tool begins with the gem (any shape and size) already in the viewports. Start up the Gem on Surface tool and click the "Gems" option. Select a gem to match, and it will adhere to the surface as you move your mouse. This is a great way to fill in a pave' layout with a gem size already in the pave, letting you move that gem around or copy it, creating more (turn Copy off if you just need to move it - Copy On if you would like to duplicate it in new locations on the surface).

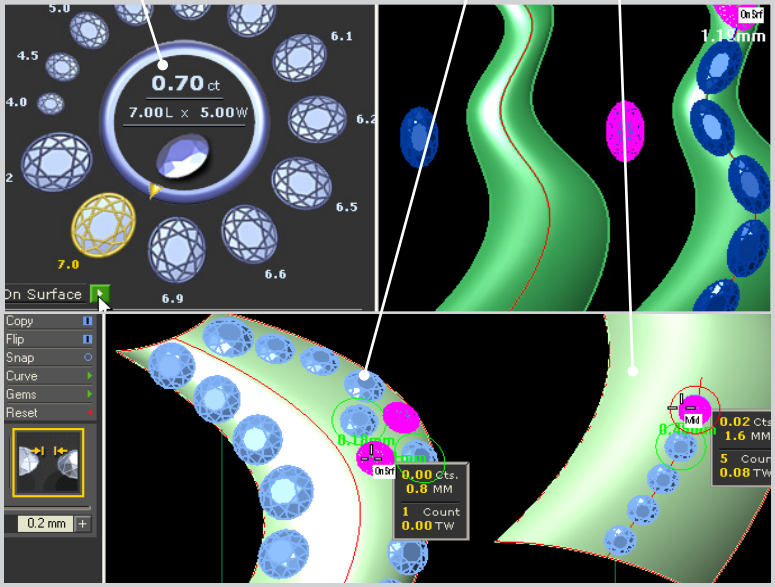
Finally, in order to set round gems, start up the builder - with the surface already in the viewports - and begin setting gems. Use the options described below to control the size and spacing of the gems. Round gems are the default for this builder, but by no means the end of what it can accomplish!

Three Ways to Access Gem on Surface

1- Go to Gem Loader, select the Cut Type, Gem Shape, and Gem Size you wish to place. Instead of double-clicking to add it to the viewports, select the gem and click "On Surface". This will start up Gem on Surface with this gem as the default to place.

2) With gems to place already on screen - such as those in a pave' layout - start up Gem on Surface and use the "Gems" option to select the gem to duplicate or move on the surface (Copy OFF moves only, Copy ON duplicates it.)

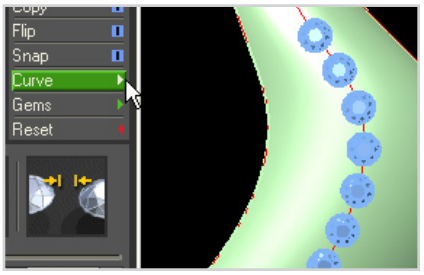
3- With no gems onscreen - just a surface and/or a curve lonely for some gems, start up this tool. The default it sets is round gems, so click away to add gems in accordance with the options explained on the next page.



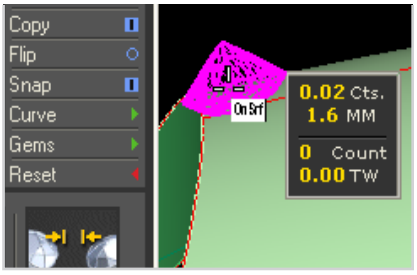
Note: You can also use a combination of these three methods!

Gem on Surface Builder Controls & Options

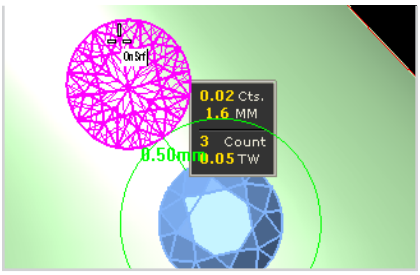
The following Builder controls and Builder / Command Line options change how this tool works.



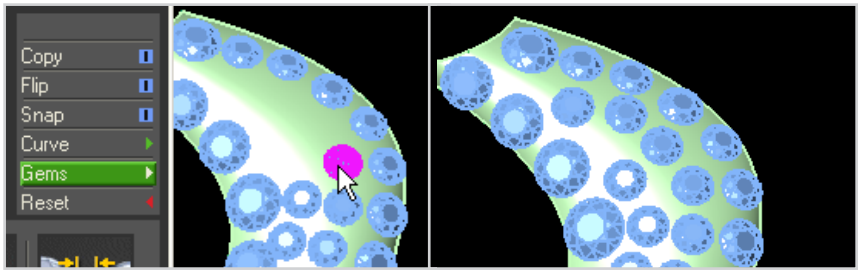
"Curve" Option Select the "Curve" option and click on a curve on the surface to which you want to snap the gems. They will ONLY be able to be placed on this curve; not anywhere else on the surface! To turn this option off, start it up again and press Enter without selecting any curve.



"Flip" Option If gems come onto the surface upside-down, click the "Flip" option to reverse the surface's directions. Do this BEFORE placing any gems, as it won't affect gems you previously placed.

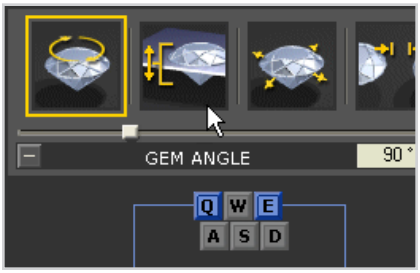


"Snap" Option. Use this to snap the gems to the "Spacing" indicated. Without this on, you will be able to see the visual cues that indicate when spacing is within tolerance; but the gems won't physically snap to the right spacing. With this on, they will.

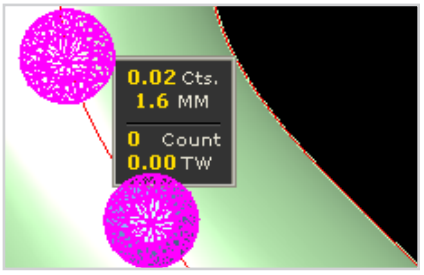


"Gems" Option This allows you to select a gem in the viewports to use as the "Gem on Surface". This gem will be "100%" on the gem size scale, and, unless Copy is turned on, this gem will be physically moved to be placed into the new position on the surface. So if you wish to duplicate it only, not move it, turn on "Copy".

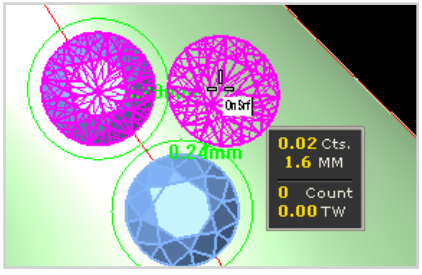
"Copy" Option This option allows you to place gem after gem on the surface, so you'll usually default to leaving it On. If you need to select a gem using the "Gems" option, and MOVE, rather than COPY it, turn Copy OFF, and the original gem will be moved rather than duplicated. (Gems option with Copy used to fill in Pave layout above.)



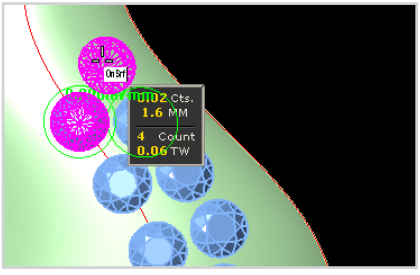
"Gem Angle" & Vertical Offset These sliders control the angle of the gem and its Z offset (0 = girdle on surface) in relation to the surface. "A" and "D" rotate the gem on the fly while you place it, and "W" and "S" change the vertical offset while you work.



"Scale" Slider This controls the size of the gem, where the gem selected for placement is 100% (when a gem is selected via the Gem Loader menu > On Surface option or the "Gems" option in the builder menu). If no gem is selected and rounds are placed, the first gem is 1 mm at 100% (displayed in size window when gems are placed). The shortcut keys for this option are Q and E.



"Spacing" This option places a circular "cue" around the gem, which turns red when the gem will be placed on top of another; turns blue when it is in relation to a nearby gem, and shows a value to demonstrate how close it is to that neighbor; and turns green when the gem is within tolerance (0.1 mm) of the spacing you selected in the Spacing slider. That way, you know exactly where to click to put down this gem so it's in the correct relationship to one or more gems. If you set this spacing and place gems where 2 or more green curves intersect, and continue placing gems all over the whole surface this way, you will have manually created a hexagonal pave' layout, one gem at a time!



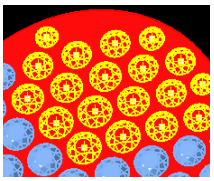
Pave Tools ...

Using Springs

To edit gems placed on a surface with ANY of the program's tools, start up Springs. Gems "pull" nearby gems to keep layout uniform.

About Springs

This tool is designed to edit gem arrangements on a surface. Usually they are placed using one of the three Pave tools (Pave, Automatic Pave, or Gem on a Surface), but they may be placed any way.

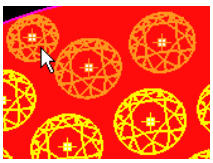


Input gems to edit and they will turn yellow.

Using Springs

Select gems to edit and input the surface on which they lie, as well as the gems themselves, into the "Surface" and "Gems" inboxes in the builder, respectively. All gems will be moved to some degree when one or more of them is edited with Springs, so input only as many gems into Springs as you wish to edit. When editing them, they will continuously be "stuck to" the surface.

After the gems are input, they turn yellow - indicating they are active within Springs. Click and drag a yellow gem, and its neighboring gems will "follow" with varying degrees of influence from the original gem - closer gems have more influence exerted over them by the gem you click and drag, while gems that are further away move less.



After editing a gem, it will turn orange and no longer be pulled by its neighbors.

The Orange Gems

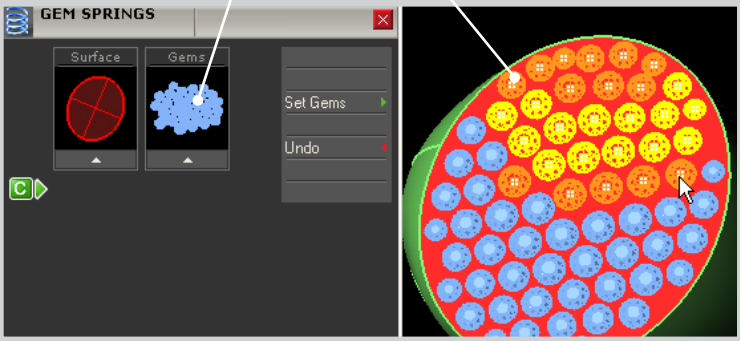
After you click and drag a yellow gem, it will turn orange. Orange gems will NOT be influenced by other gems with springs as you click and drag its neighbors. You can keep dragging them and they will affect their neighbors, but their neighbors will not affect them. The builder assumes that, once you have edited a gem with Springs, you want to keep it there! If you wish to have the other gems affect the orange gems once more, click "Set Gems"; then, select all the gems to edit and re-input them into Springs, turning them all yellow again.

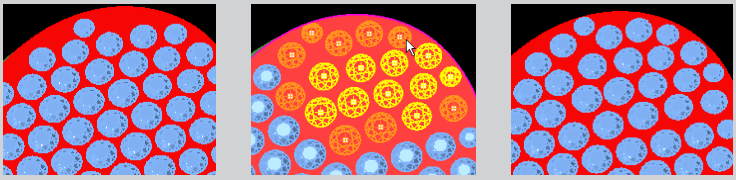
Steps for Using Springs

1- Input "Surface" and "Gems" that lie on surface. Only select and input as many gems as you want to move, since Springs will move every gem input into it at least a little!

2- Gems will turn yellow upon being input into builder. Click and drag yellow gems to edit layout. They will influence all other yellow gems as they are being dragged. After they are dragged, they will turn orange and stop being moved by yellow gems. You can continue moving orange gems, and they will influence yellow gems. But orange gems will not be moved by other gems. (To turn orange gems back to yellow, use "Set Gems" and re-input all gems to move back into the Springs builder.)

3- Click Set Gems when you are done, and Matrix gems will replace yellow and orange gems.





Use Springs to fill in a hole in your pave design. (L - R) Before, During, & After Springs.

Set Gems

When you are all through using Springs, click "Set Gems" and all gems will turn back into regular Matrix gems.

About "Undo"

Use this BEFORE "Set Gems", to undo one or more individual movements of gems (each instance of "a click and drag" will be undone, one at a time). However, please note that there is NO way to return to the layout you had before using Springs, so JOB BAG your design before entering this tool!! If you do not, and you try to use the program "Undo" to reverse the builder, Springs will eat your gems, and you will not get them back. And as always, we advise you NOT to feed the builders.

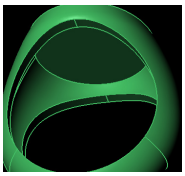
Pave Tools ...

Adding Pave Azures

After creating Pave' & using related tricks (Gem on Surface, Springs) to perfect the design, add azures. Works for hexagonal patterns only.

Using This Tool

Begin by inputting the "Top" surface on which you placed the gems during Pave builder. The "Bottom" surface is the back surface of the pave, or, where the holes will be. (In this case, the ring was Booleaned out with a scaled-down copy of itself to create a location for this surface.) Finally, input the "Gems" and the Azure previews will appear.

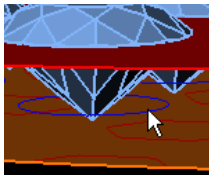


Ring hollowed out to create "Bottom" azure surface.

Builder Options

Select this "Hexagonal" option to toggle off circular azures and toggle on hexagon-shaped azures.

You will notice the azure preview is comprised of three curves. Starting from the bottom, they are: the hexagonal azure where the cut will exit the bottom surface (size controlled by "Azure Size" slider); the next one up, a circle which defines the size and angle of the azure cut ("Azure Depth" and "Through Hole" affect the location and size of this curve, respectively); and finally a curve representing the seat of the gem (size and location controlled by "Seat Angle" slider).

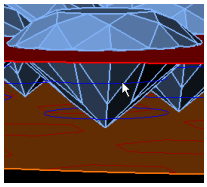


"Through Hole" depth controlled by "Azure Depth" and size controlled by "Through Hole" slider.

Click and drag these sliders to see the changes in the viewports as you set up the desired size for the pave azures.

Set Azures

When you like the results, click "Set Azures" to add the azures to the model. For best results, choose a new layer color BEFORE using "Set Azures" so you can select the results easily.



Curve representing seat - size and location controlled by "Seat Angle" Slider.

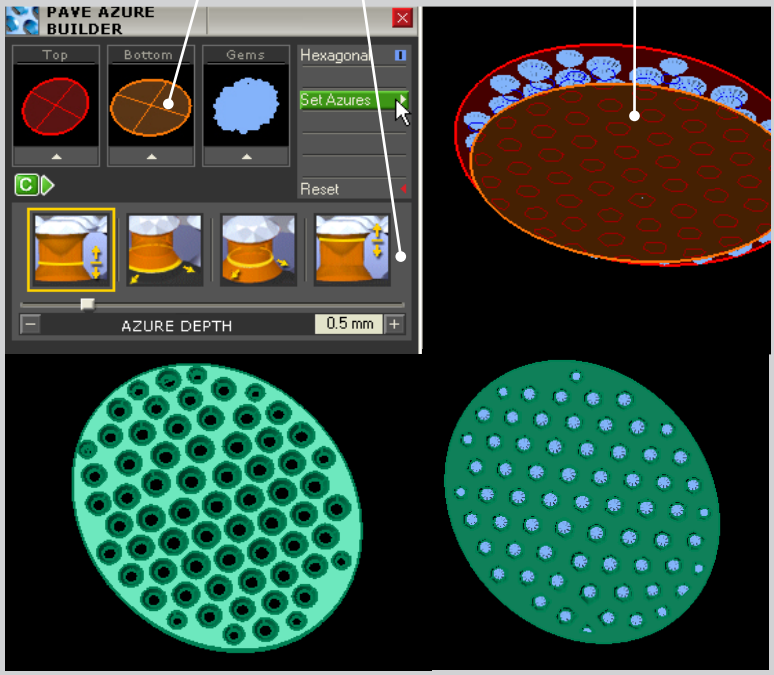
Steps for Set Azures

1- Make sure your model has a "Bottom Surface" aligned with the top one so that azures can be created.

2- Use Extract Surface to separate Top and Bottom surfaces, and input into builder, along with Gems. Azure previews will appear on model.

3- Use Builder controls to set shape ("Hexagonal On" or "Off", which produces circular azures) & size ("Azure Size" slider) of azure cut, as well as size and angle of "Through Hole" ("Through Hole" and "Azure Depth" sliders) and seat ("Seat Angle" slider).

4- With all settings correct, select a new layer color, making it active, and click "Set Azures". Wait a moment for azures to appear. Builder will re-create top and bottom surfaces - with holes in them now! - so Hide or delete your originals upon creation.



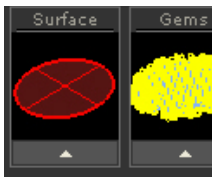
Pave Tools ...

Adding Pave Prongs

Add prongs to pave layout - touching sides of layout, 2 gems, & 3 gems at once. Also see more advanced use of Prong Placer with Pave.

Using this Tool

Input the surface on which the gems lie into this builder. For best results, if you've already used Pave Azures, use the ORIGINAL top surface for your gems, and NOT the one created by the Pave Azure builder. Also input the gems in a pave layout, and the preview prongs (yellow) will appear. Set up the sliders according to the descriptions below, and click "Set Prongs" when you like the results.



Input original surface, not Pave Azure surface, for best results.

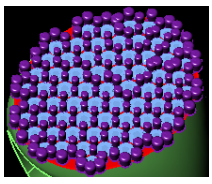
Slider Controls for 3 Kinds of Prongs

"Center Prongs" refer to prongs that touch 3 gems at once. Set the minimum and maximum size for these prongs using the first two sliders.

"Shared Prong Size" controls the prongs that touch 2 gems at once, while "UnShared Prong Size" controls the prongs that line the outside edge of the pave plate and only touch one gem.

"Scale" changes the size of all types of prongs together, uniformly scaling them starting at whatever size is currently indicated in their respective sliders and growing or shrinking them the percentage chosen in the "Scale" Control.

Prong Height, Drop, Taper, and Fillet adjust these values for ALL prongs at once, and these tools all work the same way their counterparts do in the Prong Placer tool.



Pave Prongs Done.

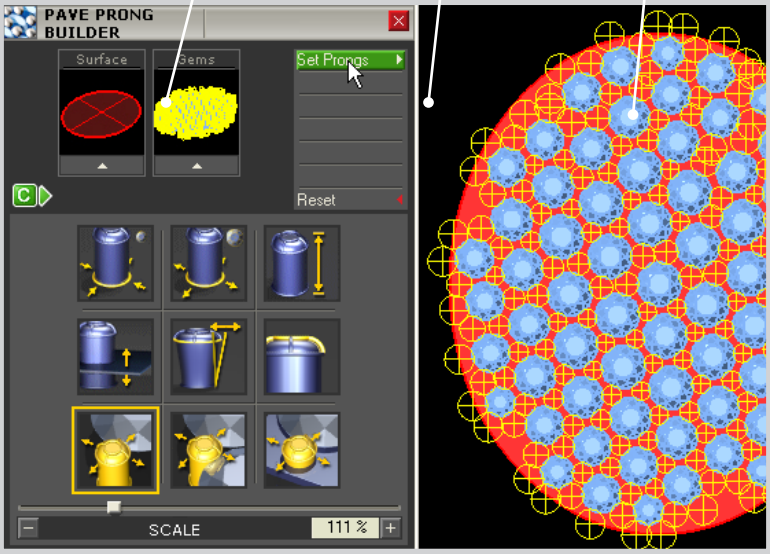
Steps for Using Pave Prongs

1- Input Surface on which gems lie and gems on the surface. If you have already placed Pave Azures, input the ORIGINAL surface, before the azures were cut, for best results.

2- Set up slider controls to indicate settings for prongs, including minimum and maximum diameter for "Center Prongs" (touch three gems), Size of Shared prongs (touch two gems), and size of unshared prongs (touch one gem), height, drop, taper, fillet, and overall scale (sizes all prongs up or down at once).

3- When you're happy with the results, click "Set Prongs" and preview prongs will be replaced with real prongs.

Note: Pave Prongs are NOT active within Match Attributes, Styles, or History. To edit them, delete originals and run builder again.



Notice in illustration at right that 3 sizes of prongs may be set: "Center Prongs" touch 3 gems; "Shared Prongs" touch 2 gems, and "Outer Prongs" touch one gem.

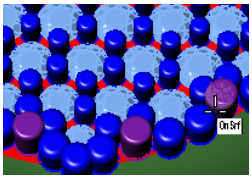
Pave Tools ...

Prong & Bead on Surface

Add prongs or beads to a surface, positioning and scaling before placement. Bead on surface can snap to a curve like Gem on Surface.

About these Tools

Like Gem on a Surface, these tools allow you to place Prongs or Beads on a surface. Move them over the surface to find the right location, and all the while they will "stick" to the surface. Bead on a surface, like Gem on a surface, can accept a curve to which it will "snap" the bead, allowing for the creation of millgrain that you lay out by hand.

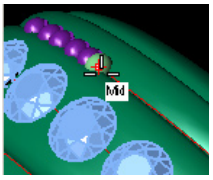


Prong on Surface (purple) fills holes in pave prongs.

Unlike Gem Diameter, no "size" slider or visual cues are offered, so you must eyeball the distance between items you are placing.

Using these Tools

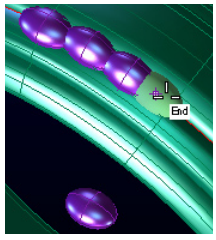
Input the surface on which to place a prong or bead. For Bead on a Curve, select the "Curve" option and input a curve if you wish to snap the beads' center to a curve only.



Bead on Surface adds beads one by one to a surface with or without curve.

Use the familiar sliders for Prongs (Diameter, Drop, Height, Fillet, and Taper) to set up the prong you wish to place. For Bead on a Surface, you are offered the Object Scale and Object Drop options. Also for this tool, you must click "Go" to start up the tool. Prong on a Surface starts up immediately.

Move the cursor over the surface to see the prong or bead appear, and left-click to place it. Another item, following your cursor around, will appear.



Object mode is like Bead on Surface - select object, curve, and rotation.

Using Prong or Bead on Surface Tools

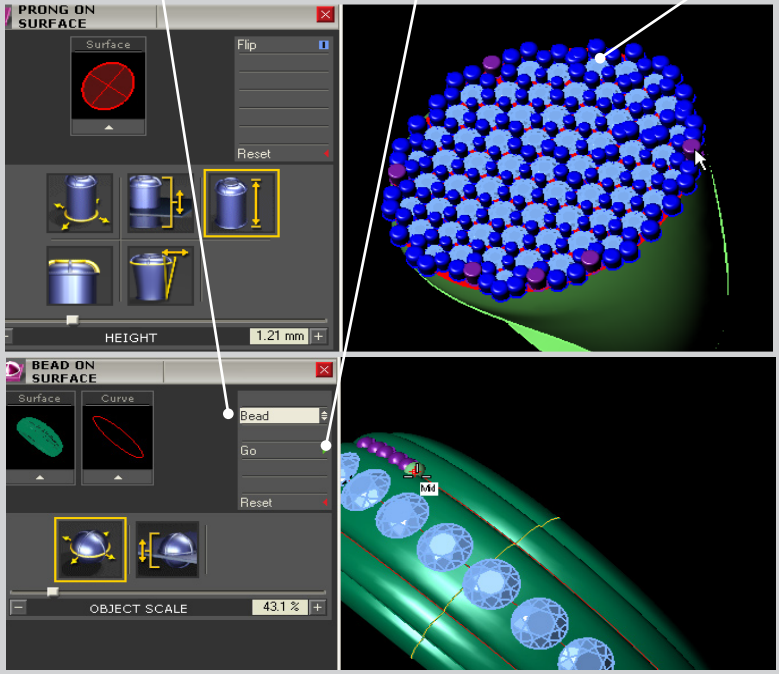
1- Input Surface on which to place item(s).

2- When using Bead on Surface with Curve option, also input a curve. All beads or objects will snap to this curve.

3- When using Objects option in Bead on Surface, input an Object into the Objects In-Box.

4- For Bead (or Object) on Surface, click "Go" at this point to start up the tool. Prong on Surface starts automatically.

5- Adjust options in builder to set up object to be placed. Move mouse over surface to position it, and left-click to place it. Identical object will appear at mouse. Repeat this step to place as many as necessary, and press Enter when done.



Top - Bottom = Prong on Surface; Bead on Surface.

Click to place it. Continue until you don't need to place any more, and press Enter to end the command.

"Objects" Option: Bead on Surface

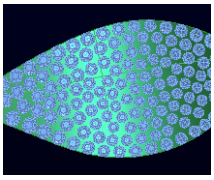
Toggle the "Mode" in Bead on Surface to "Objects" and input an object to use instead of a bead. This also adds the "Object Angle" slider, which rotates the object around its own midpoint, allowing you to set it at a new rotation as you place it onto the surface. Thanks to this powerful addition to Bead on Surface, remember that you must click "Go" to start up this tool.

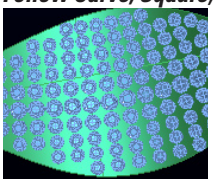
Pave Tools ...

Auto Pave': Advanced Designs

Create sophisticated pave layouts where gems interact to adjust size, spacing, direction, and randomness or uniformity of designs.

About Auto Pave Builder





One surface, different designs. (Above - Follow Edges, Hex pattern; Below - Follow Curve, Square)

Developed with math integral to advanced geodesic designs (think the Epcot Center dome), Auto Pave Builder is the more advanced of the two pave builders in the program. With a number of options and slider controls, It provides limitless ways to lay out pave' onto any surface.

It is designed to quickly offer you various combinations of settings, so you can try out a basic pave' design and continue adding options and variables until you get the outcome you desire. This means there is no "formula" for how to use this builder every time, for every surface. It is, in fact, designed to be "played with" until you get the outcome you want for the particular surface you input. This could be different every time! (But we have given you some Styles to start from!)

This section of the manual will help you "play with it" in an educated way! Once you read here about how to create a basic layout, and once you learn from the next few pages what all the buttons and knobs do, you should have a good idea of how to "play with it" effectively to get a range of different successful results on any given input surface. Depending on the shape of the surface and the design you want to achieve, one of these outcomes will be just the one you need!

Preparing to Use this Tool

Before you enter the builder, there are a few options you should learn about to prepare to use this tool. If you will use any of these three options, you must set them up BEFORE entering the Pave' tool.

Seed Gems - If you wish to use seed gems - or, gems the builder will incorporate into the final pave' design, begin with a curve on the surface you will pave, and use the Gem on Curve builder to place gems onto it BEFORE you enter Pave' Builder. Now you may use the Seed Gems option inside this builder!

Follow Curve / Attractor Curve - Another option inside this builder allows you to start the pave' on a curve (Options > Curve) or use a curve to "attract" the layout to it (pave design will more loosely follow this curve). So, use your Curve menu skills to place a curve on your surface, BEFORE entering the builder, that represents the direction of the Pave design you want.

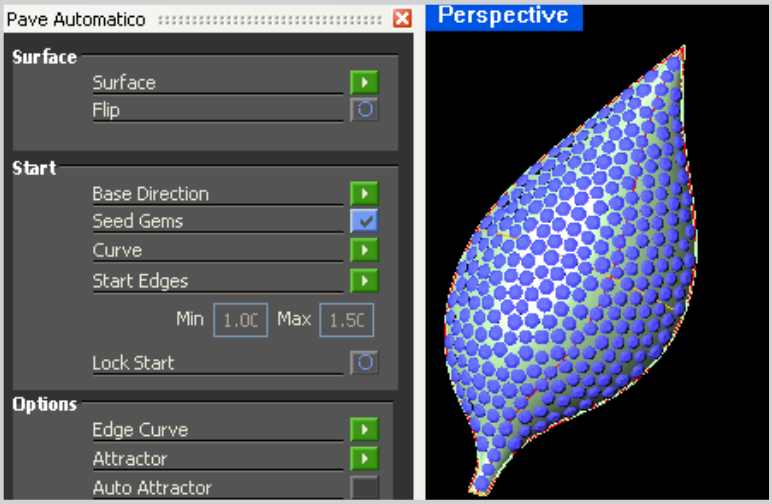
Edge Curves - If you'd rather the pave NOT reach to the edges of your surface, place Edge Curves on the surface so you can assign a place for the pave to end besides the edges of the surface.

What this Builder Does

The builder needs a "Surface" and "Start" point to begin. Click "Run" to see the first result; and/or, select options to vary the design. Try "Run" each time you change options, to preview the results. Keep "Running" options till you like the outcome.

The builder sets the gems in the size, spacing and layout you select; then runs the layout through a "Pre-Sizing" process with options you can set - the builder's first "attempt" to fill the space. "Post-Sizing" then occurs, causing each gem to interact with other related gems in the pattern, to better size and space the layout according to chosen options.

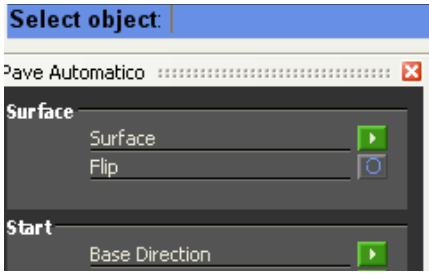
"Save" a style if you'd like to bring it back in this or a future design. Choose "Done" to create gems and exit the builder.



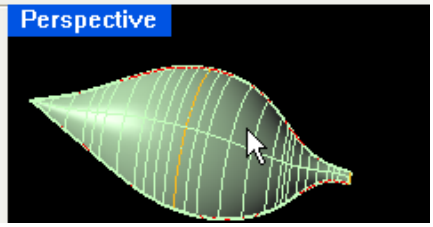
While "Running" this tool, a bright green box flashes on the outside of the Pave surface, showing that the builder is thinking. Wait patiently for this to stop before clicking again.

Auto Pave' Builder: Creating a Layout

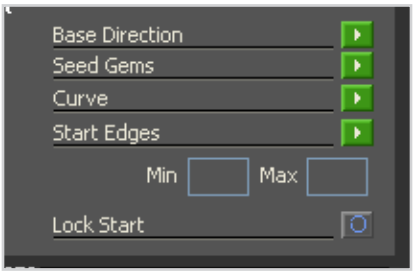
Use these options to set up your first layout each time you enter Auto Pave' Builder; the next set of options helps you vary it.



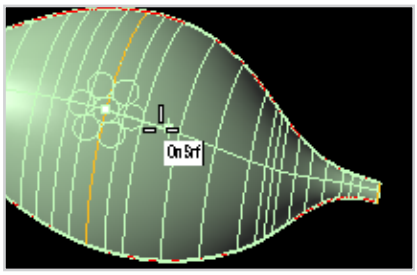
Surface The first step every time you enter the Auto Pave builder is to select the "Surface" option. You can't use any of the other options until you do so! The Command line will switch to "Select Object". Choose the surface to Pave, and wait a moment for the menu's "Go" arrows to appear.

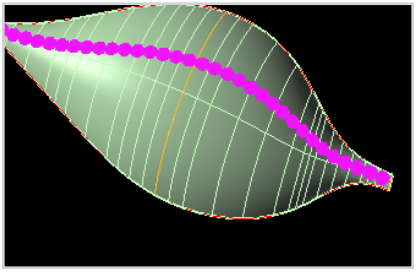


Flip After placing your first layout, (explained in a minute!), you'll know whether or not the gems are flipped (culets-up). To flip the surface directions without leaving the builder, click "Flip" and the gems will flip to tables-up. Unless you're making cool biker jewelry; in which case, use it the opposite way!

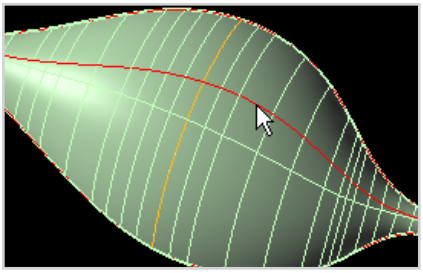


Start > Base Direction The four possible options for starting the pave' layout are "Base Direction, Seed Gems, Curve, and Start Edges". These four options are mutually exclusive. Choosing "Base Direction" places a preview circle in the viewports representing the first gem in the layout. Click anywhere on the surface to position the first gem. The next step during this command is to indicate the direction in which the pave' will be laid out around the first gem. A preview of the hexagonal layout will appear. Moving the mouse "spins" the hexagonal layout. When you like the angle, left-click to place it.

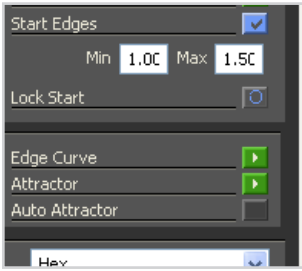




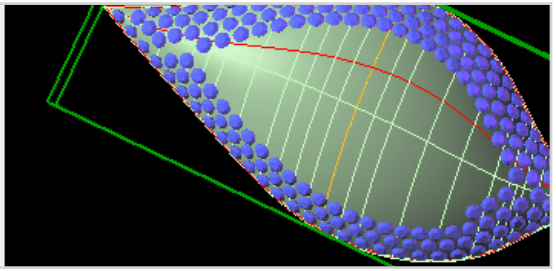
Start > Seed Gems Select this Start option if you've already prepared the surface by using Gems on a Curve to place seed gems. The Command line will switch to "Select Seed Gems". Select them all, and the builder will incorporate them into the pave' design as seed gems.



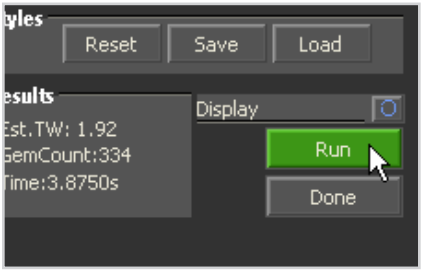
Start > Curve To start the pave' layout from an existing curve, select this option. The builder will lay seed gems for you along this curve to start the layout.



Start > Edges This is the best way to create a layout that follows the edges of the input surface. The builder will automatically use the edges of the surface unless you indicate an "Edge Curve" in the next menu down: "Options". Indicate a Minimum and Maximum size for the edge gems (must be within the overall min. and max range).



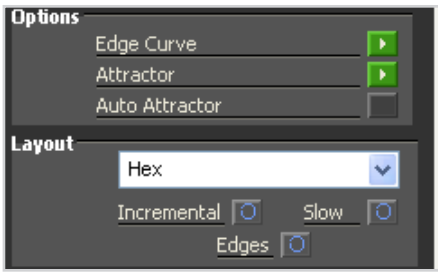
Lock Start With any of the above Start options selected, choosing "Lock Start" will protect the first gems placed by the builder from being affected by the remaining options in the menu - such as the Pre- and Post-Sizing corrections.



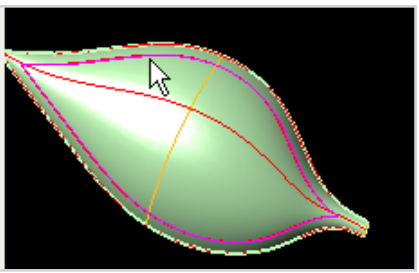
Run / Done With a Surface and a Start Point, you can create your first layout! (Sizes and layout pattern - Hex - are already chosen by default.) Click "Run" to see the results, in preview gems, and continue exploring options to vary and improve the results. "Done" makes the stones real and exits Pave' builder.

Auto Pave' Builder: Varying the Layout

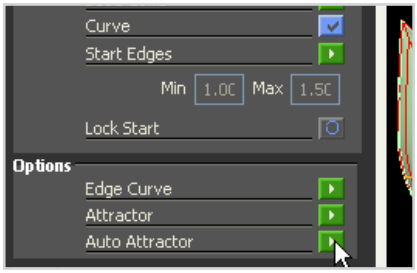
Try varying one or more of these options, and click "Run" each time to see the results.



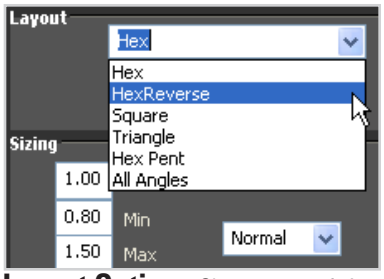
Options > Edge Curve If you don't want the pave' (any "Start" method) to stretch to the Edge of the surface you input originally, select the "Edge Curve" option and click on all the edge curves at which you want it to stop.



Options > Attractor To "attract" the direction & shape of the layout to a curve (less aggressive than the "Start > Curve" option described above), select the "Attractor" option. Choose a curve on the surface that you drew previous to entering the builder, that represents the shape and direction of the pave'.

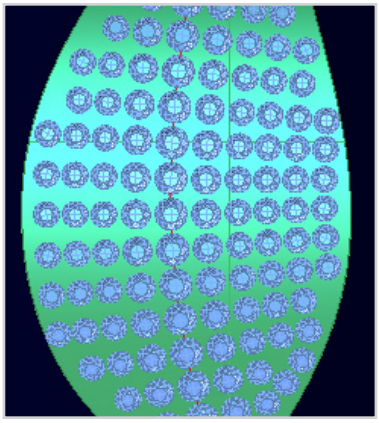


Options > Auto Attractor This option becomes available when a "Curve" is input beneath the "Start" option. Use it to "attract" the direction and layout of the remainder of the design, if you wish. Choose the "Auto-Attractor" option (just click the option to "turn it on": there is no need to re-select the curve).

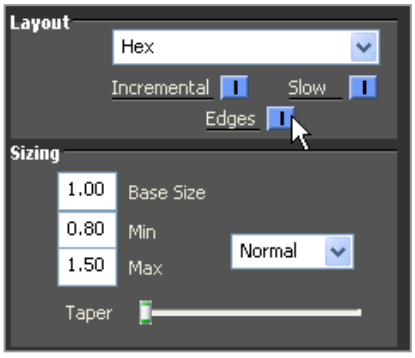


Layout Options Choose one of six pave' patterns from the Layout drop-down. "Hex" creates the traditional hex pattern. "Hex Reverse" builds this pattern in reverse - instead of working from the inside to the outside of each hexagonal configuration, the builder works from the outside-in, allowing for the possibility of smaller gems tucked into the design for a closer, tighter design. Choose this option with a combination of smaller stones and larger Taper amount if "Hex" doesn't create a tight-enough layout. The "Square" layout option creates straight rows of gems in two directions. The "Tri" pattern creates a unique triangular gem pattern. "Hex Pent" arranges sets of five hexagons, creating a more intricate hexagonal layout. "All Directions" creates a truly random layout. At some point, you may need to try all 6 options to get the right layout for a particular surface.

Try the "Square" layout to create straight lines of stones.



Layout > Incremental, Slow, Edges Once you've selected one of the six possible Layouts, choose any combination of these three options to change the way the stones are laid out in the pattern you selected. "Incremental" lays them out in all directions from the start of the design; "Slow" lets the builder think a little longer about the layout; "Edges" starts the design at the edges (not as aggressively sticking to the edges as the "Start > Edges" option does). Selecting one, two, or all three of these options creates different layouts, so try out various combinations till you like the results.

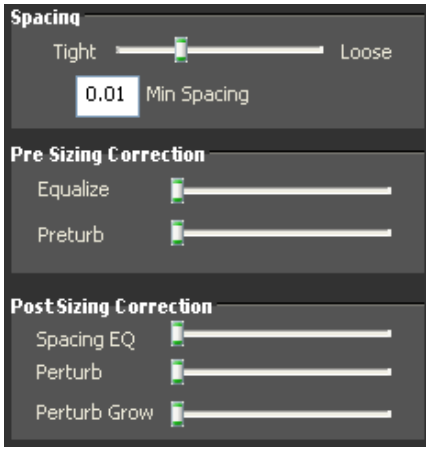


Sizing "Base Size" indicates the first gems placed. "Min" is the smallest sized gems that will be placed while filling in patterns or during Pre- and Post-Sizing Correction. "Max" is the largest the gems will grow during correction. To limit the builder to these sizes, keep Taper low. To vary between sizes, raise Taper.

Sizing > Normal, Basic, Grow, Shrink Outside Indicate how much variance you want for gem sizing by choosing "Basic" - minimal sizing change; "Normal" - gems tend to grow larger; "Grow" - gems forced to grow larger; or "Shrink Outside" - outside gems are shrunk so larger gems are inside.

Auto Pave' Builder: Varying the Layout cont'd.

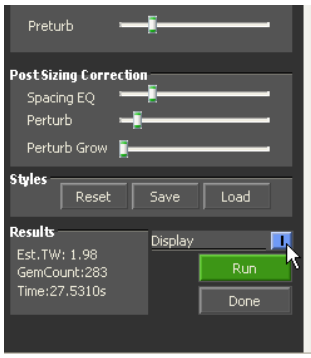
Try varying one or more of these options, and click "Run" each time to see the results.

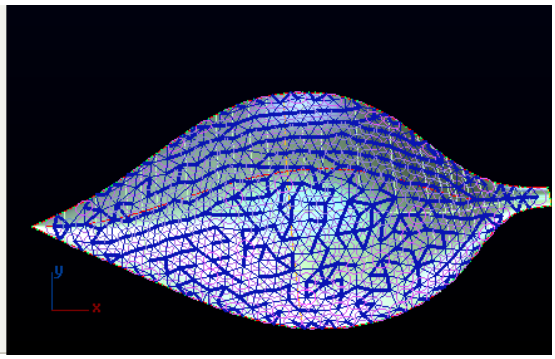


Spacing Indicate on the scale whether you want spacing Tighter or Looser for the pave layout. Then, type in a value for minimum spacing, below which the builder will not space gems.

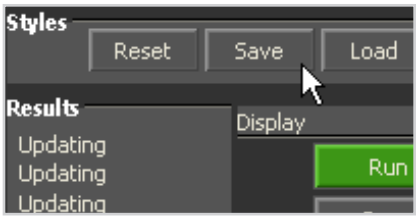
Pre-Sizing This builder makes all its calculations about where and how to place gems TWO separate times! The first time it creates the layout, it makes the changes indicated in the Pre-Sizing Correction menu. The second time, it makes the changes you indicate in the "Post Sizing Correction" menu. Crank any of these sliders JUST A LITTLE at a time, or you'll be waiting quite a while for your computer to think through some really dramatic changes! Also, I like to change one slider at a time and "Run" the changes before changing the next slider, so if I don't like the results, I know which slider to blame! During "Pre-Sizing", you can raise the value the layout will "Equalize", or, balance gem sizing. The opposite slider, "Perturb", makes the gem sizing tend towards randomness.

Post-Sizing "Post-Sizing Correction" lets you Equalize (balance) Spacing, and "Perturb" stones - or, increase the amount the stones affect one another. Put simply, the stones will "try harder" to fit together with one another. Put in a more technical way, a TON of math is going on "behind the scenes" that assigns how the stones relate together to form the pave' layout. How much math they do - how hard they try to fit in the assigned layout - can be increased by increasing these values (Equalize tends towards uniformity; Perturb tends toward randomness). "Perturb Grow" causes the stones to grow to fill spaces - not fill in with additional stones - during the Perturb function. Again, how much they grow (vs. add new stones) depends on how much you crank this value. In practice, LESS is MORE when using these sliders!! While the pave' is being created, you will see the results of these five sliders as the stones "mingle", "party", "jockey for position", or your choice of creative explanation for their movement.

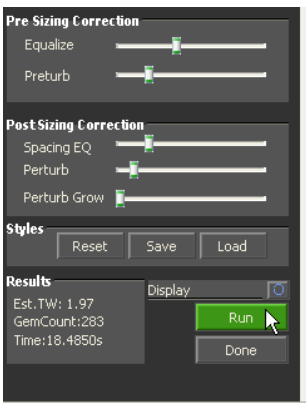


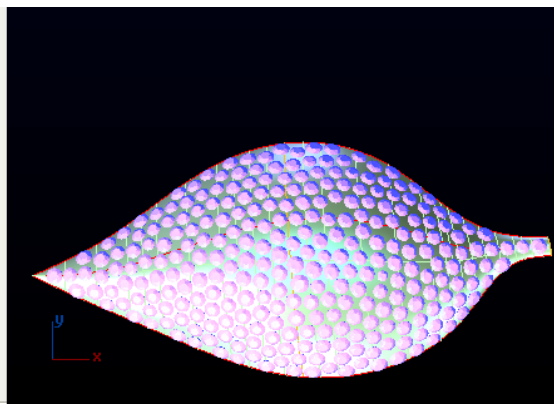


Display Choose this option before "Run" to SEE the interrelations between stones, as well as the builder's process of creating the TWO layouts and other builder options, rather than the preview stones. The blue lines display the framework (geodesic pattern - aka math) with which the stones are laid out. Thicker lines show stones that relate in the "Perturb" functionality.



Style Save/Load; Results Select Gemvision-created Styles if they fit your designs, or as a starting point for layouts; or save your own favorite styles (saves all settings in builder; you must input items for options that require it). See Results (Total Weight, Gem Count, Time to run) displayed after each instance of "Run".





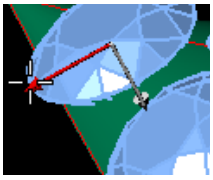


Advanced Gem Tools ...

Gem Control

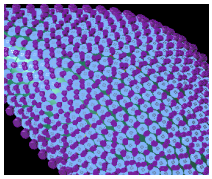
With Pave, try the Gem Control builder to "point" gems at or tangent to a line or point. Prongs will follow, creating a directional layout.

About Gem Control: "Culet" & "North"

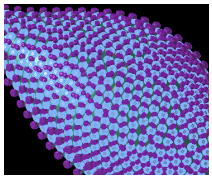


Culet (down) and North (side) arrows appear.

You may recall how, in Gem on a Curve, you can assign gems a "Culet Direction". Well, gems have one more "direction" available in Matrix: Gem North. This indicates where the axis of the gem is pointing - not easy to see in a round gem, but useful nonetheless!



Compare the effects of two different Gem Norths (curve, above and point, below) on prong arrangement & overall pave' design.



This functionality was specifically designed for use with Pave builder - to create a "directional" layout when prongs are applied to Pave (with the newer, History-enabled Prong Adder, not the Pave Prong tool). The thought process was: if you could assign gems something to "point towards", prongs would follow suit, aligning themselves to the gem based on the gem's North direction. This creates very interesting and different looks for a single pave' layout: simply assign the gems something different to point to, and/or select different prong arrangements available in Prong Adder, and you will have a range of dramatically different looks for any group of pave' gems.

Using Gem Control



In Prong Adder, select "Gem North" for Gem Control to affect prongs.

Enter this tool and input ALL of the gems in a Pave' arrangement. You will see the arrow cues appear on the Pave. The arrow following the culet indicates the Culet Direction, while the other arrow (at a 90-degree angle to the first) indicates the Gem North direction. To set either of these directions to point at a different object, you have several options: click on the arrow, click on the Builder option ("Culet" or "North" Object), or click on the Command line option indicating the direction you wish to change (North or Culet). The Command line will prompt you for the new object to point to. Select a curve, point object, surface, or other object, and the direction of ALL the gems you input into the builder will change. Arrows will show change (arrows are blue when assigned, silver when not assigned).

When setting "North", notice that the builder offers the "North Tangent" option. This means the gems may either be aligned Tangent to (ON) or pointing directly toward the North object. Press Enter to end the builder. Re-enter gems if you need to change them again.

Using the Gem Control Interface: Steps & Tips

1- Input gems to change.

2- Windows display current directions.

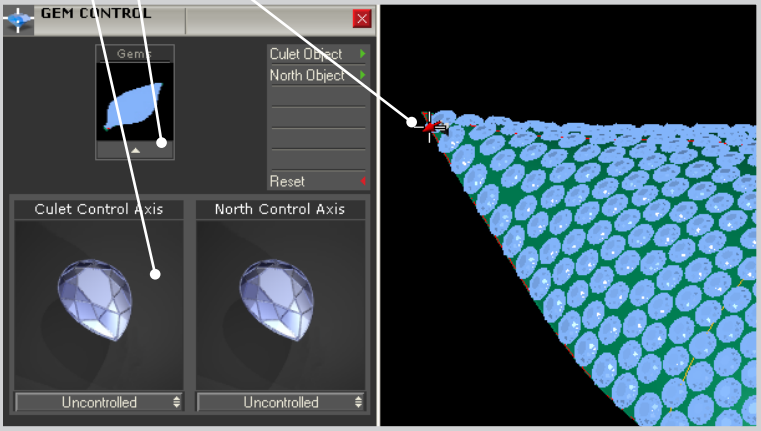
3- One gem in the layout will show two arrows - Culet (down) and North (side).

4- Click arrow or option to change, and assign a new object to point to.

5- For best results, ALSO assign Culet direction to gems' surface, as they can "tilt" with North. Press Enter to end builder.

6- Run with Prong Adder prongs to see instant results (History On).

7- Gem Guides can show (but not change) Culet & North.



Gem Control & Prong Adder

Now, jump into Prong Adder (this WON'T work with the "Pave' Prongs" tool!) and make sure you select the "Gem North" option in this tool, to follow the new North direction you just selected. Try different prong layouts, and return to Gem Control and try different directions (prongs change with History, so they will keep up when you change gems' North direction).

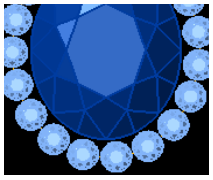
Advanced Gem Tools ...

Gem Follow

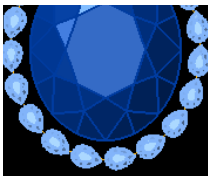
Similar to Gem Control, Gem Follow changes the condition whereby gems' "North" axes follow one another in a gem line.

About Gem Follow

The default setting for gems is to follow one another's North axis in a gem line, so that prong configuration also follows naturally from this. In the Prong Placer, the "Gem Flow" setting represents this condition, allowing you to override gems' North when necessary and follow the flow of the gem line if that best suits your design. To control this setting, enter the Gem Follow tool.



Place round gems on a curve and replace with pears (Keep Original Size in Gem Loader) to better see the results of these changes.

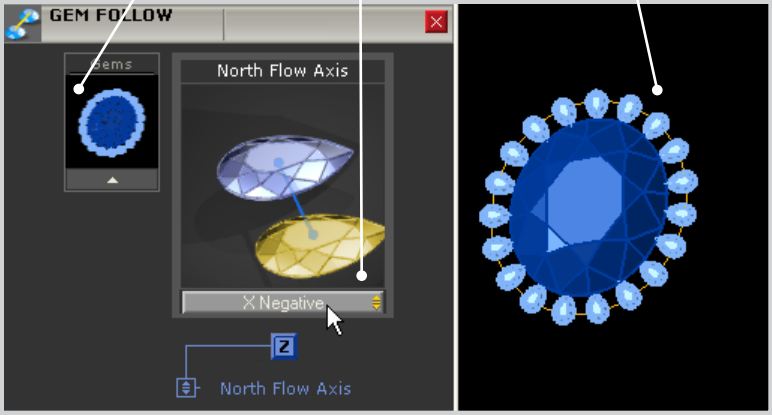


Steps for Using Gem Follow

1- Input gems to change into "Gems" preview window in builder.

2- Click on "North Flow Axis" control, press Z, or use Command Line options until you like the results.

3- Press Enter to end the command and keep the results.



Preparing to Use Gem Follow

This functionality is best seen on a line of gems which are not round, so begin by creating a line on which to place gems; then, using Gems on a Curve, place round stones along the line; and finally, replace replacing these gems with pear-shaped stones using the Gem Loader > Keep Original Size function to replace them (simply click on a pear-shaped stone and the same-size pears will replace the rounds you had in the viewports).



Input gems into "Gems" preview window in builder and click "North" button beneath graphic representation of current direction to change gems' North. 4 choices: + or - X and Y.



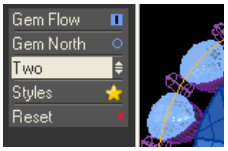
About Gem Follow

To use this tool, select the gems and enter them into the "Gems" preview window in the builder. Which "North Flow Axis" is being used will be displayed in the interface. Click the button just beneath this interface graphic to see it change. Another way to change it is to press the "Z" button on your keyboard (keyboard shortcut) or to click on the Command Line option representing the new axis.

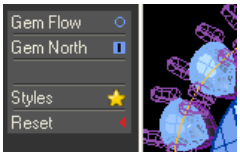
There are four different possible directions: X positive or negative and Y positive or negative, relative to the gems. This means that the gems' X or Y axes will point in a positive or negative direction with regards to each other. Toggle through the results until you get one you like; then, press Enter to end the work of the builder and move to the next tool.

Gem Follow & Prongs

Similar to Gem Control, you may use whichever Prongs setting (Gem Flow or Gem North) gets you the desired results with the configuration you have. Below, we show the differences between Gem Flow and Gem North for the configuration we just created. Choose which one to use based on the desired results. Here, Gem North causes them to share prongs, while Gem Flow causes each to have its own set of prongs, oriented to the North of the gem. Gem Follow, like Gem Control, simply offers you more choices for prong layouts.



In Prong Placer, try "Gem Flow" and "Gem North" for two different results; prongs shared (Flow) or separate (North) here.

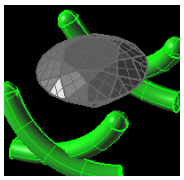


Advanced Gem Tools ...

Using "Object to Gem"

With gems at any orientation onscreen, create a design element at F4 and orient (and scale!) to all gems in your model.

About Orient to Gem



Create item(s) to orient at F4 in correct relation (size and orientation) to guide gem.

This tried and true tool has been around for several versions of Matrix, but none of the fancy new tools have been able to replace it yet!

Simply put, it can orient anything you can build to any and all gems in a model, no matter what their size or orientation, allowing you to easily create the item at F4 and let the builder do the hard work of orienting it to an awkwardly-positioned gem for you!

Using Orient to Gem: "In-Boxes"

Select the gems in the design to which you want to orient an item, and input them into the "Gem" preview window in the builder. Now, any object you draw (centered at F4) can be input into the "Orient" preview window, to be "Set to Gems" at the same orientation to the gem as it was drawn with relation to F4 (center of gem = "F4" in relation to design element being placed).

Using Orient to Gem: "Show Guide"

To assist you with drawing the design elements, click "Show Guide" to turn on this option. A gray gem will appear at F4 to help you know where to draw the design element in order to make sure the builder will create it at the expected orientation to the gems. (The gray gem is "frozen" or locked - meaning you can't select and manipulate it unless you type "Thaw" into the Command line - but trust me, you don't want to anyway! Just deselect "Show Guide" to turn it off.)

Using Orient to Gem: "Scale to Gem"



Input this item into the Orient preview window and click "Set to Gems" to see results.

If you need to scale that design element (i.e. you have input more than one size of gem into the "Gem" preview window), FIRST turn on "Scale to Gem" and THEN use "Show Guide". Draw the design in proportion to the guide gem, and input it into the "Orient" preview window. It will be scaled according to the sizes of gems you have input into the builder.

Using Orient to Gem: "Set to Gem"

With the object to orient input into the "Orient" preview window, click "Set to Gem" and the object will be oriented to all the gems. For best results, draw this object on a different layer color so that you can easily right-click to select them all and delete them if you need to run the builder again. (Undo does not work with this tool!)

Steps for using Object to Gem

1- Input ONLY gems to which you'd like objects oriented.

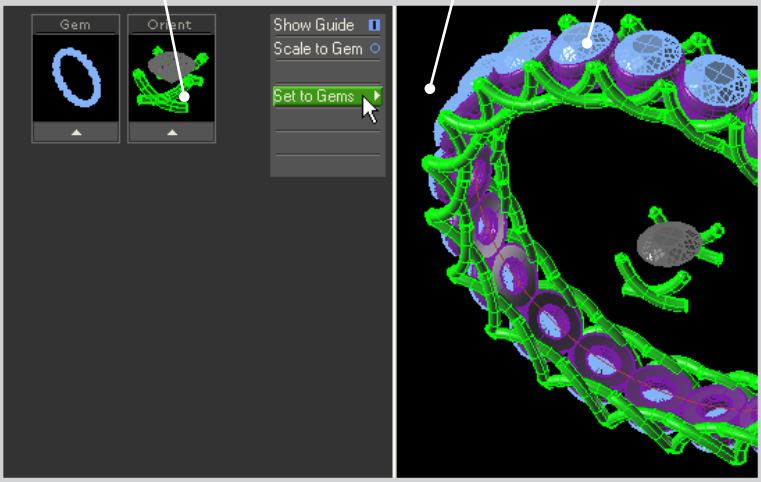
2- Click "Show Guide" for gray (locked) guide gem to appear at F4.

3- Model an object at the correct orientation, in relation to the guidestone at F4, that you wish to have it oriented to all stones.

(Option: If you input more than one size of gem, select "Scale to Gem" and create item in proportion to larger guide gem.)

4- Select the item(s) you wish to orient and input them into the "Orient" In-Box in the builder.

5- Click Set to Gems to see results. To make corrections, you will need to select and delete new items, then re-run the builder, as Undo does not work with this tool.



Tip: Place items to orient onto one, new layer color (User 2 Green above) so that you can right-click that layer to select and delete them. Undo doesn't work with this builder.

Chapter 8 ADVANCED

Advanced Modeling Concepts

Advanced tools in Matrix & Rhino provide surface-modeling control.

Advanced Modeling Strategies

Conventional rails and profiles might not get you every shape you are looking for when modeling complex or freeform designs. Additional tools in the Curve, Surface, and Transform menus will help you set up rails and profiles able to sweep more complex and freeform shapes. These techniques increase in difficulty as they increase in their ability to control the shapes of surfaces, so hang on tight for this chapter!



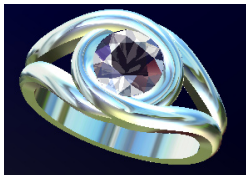
Profile Sweep uses the Blend shape to sweep planar curves with History flexibility.

Chapter Overview: Profile & Rail Tools

The Profile Sweep tool creates surfaces between two planar (flat) profile curves - open or closed. Then, as long as History was turned on when they were created, you may edit these curves using Profile Placer or conventional means (Move, Rotate, Mirror, etc.) and the surfaces will follow. This allows for designing on-the-fly, but doesn't provide the ultimate control over rail shapes, as the surfaces follow the profiles only - not any rail. Their path is determined by Rhino's Blend shape.

For additional control, the Custom Rail tools employ the "Curve from 2 Views" functionality - a Rhino tool which draws complex, nonplanar curves using the shapes of two planar curves which are perpendicular to one another.

In a more flexible application of this tool, Gemvision's new Curve from 2 Views History command allows you to edit the planar (flat) curves and see the changes in the new (nonplanar) curve they create. This provides ultimate control over this complex shape, so you get just the rail curve you want for your design.



Curve from 2 Views tools place rail curves for best control of complex or freeform shapes.

Finally, the Advanced Custom Rail tool provides the most advanced control over rail shapes, automating the Curve from 2 Views functionality with not just the inside rail curve but the outside rail curve as well, allowing you to place four rails to set up for a "Four Rail Sweep" - one of the most advanced techniques we teach to create surfaces.

To add profiles to these shapes, progressively advanced methods are also explored in this chapter. There is our old standby Profile Placer, which can add profiles to any rail or rails you place. With four rail curves, use the Edit Points option in this tool, set edit points so they are as close as possible to rails, and sweep with Multi-Rail Sweep History.

Alternately, you may draw your own profiles and place them between rails (making sure they touch) using the more advanced Curve and Transform

Comparing Tools that Create Advanced Shapes:

Profile Sweep provides the most flexibility yet the least control. Place two planar (flat) profiles and sweep a fully interactive surface between them. Move and reposition profiles to change the surface: a great foray into advanced modeling!

Curve from 2 Views is best learned in the Custom Rail Tool. Practice Curve from 2 Views with History to understand the concept and get more control; then, on to Advanced Custom Rail to set up advanced four-rail sweep shapes.

Targets provide full History control over both rails and profiles. If you don't need History, you can get even more precise with Rhino's Sweep 2. More advanced tools create increasingly more advanced surfaces, but are used less frequently.





Use Profile Placer or learn how to draw and place your own profiles to sweep complex rail curves.

menu tools explored here. Then, use conventional Rhino tools to "Sweep 2" between each set of rails and profiles, for best results. Four Sweep 2's, which give the best possible control over a four-sided surface, are also known as "Sweep 4".

Born of this "surface by surface" method, the Blend Targets menu is also explained in this chapter. Set up fully -interactive models with targets, as long as rails and profiles touch perfectly, end on end, and the Skinner tool will complete a "Sweep 4" to automatically add surfaces.

Chapter Overview: Creating & Editing Advanced Surfaces



Blend Target modeling makes designs that are fully adjustable, and sweeps them automatically.

This functionality - placing rails and profiles one by one, so they touch, and sweeping each surface with a Sweep 2 operation for best control - is known as Surface Modeling. Other Surface Menu tools common in Surface Modeling to create highly-controlled surface shapes - including Curve Network, Patch, and Loft - are also covered in this chapter.

Other advanced surface modeling tools that are used less frequently are Cross-Section Profile, Drape, and Heightfield from Bitmap. The latter two are able to produce a single Nurbs surface that matches the contours of another object (Drape), such as a mesh object, and can even match the contours of a bitmap (Heightfield from Bitmap)!

Finally, advanced tools to edit surfaces are covered. You can Offset, Extend, and Rebuild a surface just the way you can with curves; and of course, surfaces' other interesting & quirky characteristics - their ability to "Shrink" and "UnTrim" - are also explored here. These are important concepts in preparation for the next chapter, which covers the placement of objects onto surfaces with Advanced Rhino tools, so follow along closely!

Tools in the Transform, Curve, and Surface menus edit control points in "Soft" or more gradual ways than simply clicking and dragging them. We'll cover these last of all.

Skills & Commands in this Chapter

Advanced Profile & Rail Tools

Profile Sweep, Custom Rail Tool, Curve from 2 Views, Curve from 2 Views History, Intersect, Advanced Custom Rail Tool, Profile Merge, Dup Edge, Dup Border, Silhouette, Wireframe, Orient 2 Points, Orient 3 Points, Rotate 3D, Project to CPlane, Remap to CPlane, Blend Targets Menu



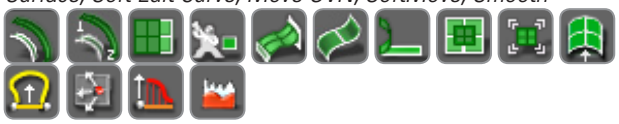
Advanced Surface Creation

Sweep 1, Sweep 2, Loft, Curve Network, Patch, Cross Section Profiles, Drape, Heightfield from Bitmap



Advanced Surface Editing

Surface Offset, Variable Surface Offset, Extend, Rebuild, Match, Merge, Unroll, Untrim Surface, Shrink Trimmed Surface, Soft Edit Surface, Soft Edit Curve, Move UVN, SoftMove, Smooth



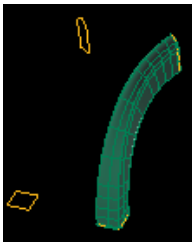
Advanced Profile & Rail Tools ...

The Profile Sweep Tool

An easy way to freeform model is to place two profiles and use Profile Sweep between them. Surface will follow as you move and edit profiles.

About Profile Sweep

This tool creates a swept surface in the Blend shape between two profiles. To continue the surface, place a third profile and run Profile Sweep between the previous and next profiles. Continue, and you'll have a surface that sweeps between all the profiles!

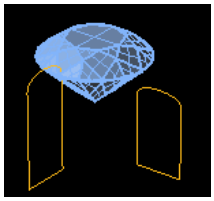


(L - R) Profile Sweep curves; resulting surfaces.

Just notice: the control you get from this tool is not as precise as the control you could get with a rail. However, for simple, freeform designs that follow "rail curves" you would have drawn with the Blend shape anyway - this is a great option.

Using Profile Sweep

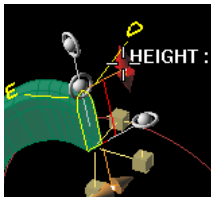
All you need to run this tool are two planar (flat) curves located anywhere in space. To run this command, start it up and select both profiles. A Blended surface will be created between them. Now, you can move, scale, rotate, etc. these curves and the surface will follow them as you do. Just don't use Trim, Boolean, Curve Boolean, Split, or Join on the curves or surface, or the history will be broken. (Also, Matrix History must be turned on for the surface to update.) Use the hints below to help you make this tool even more useful!



Draw two curves & use "Get Profile" to turn them into profiles.

Drawing Profiles for Profile Sweep

There are several ways to create profiles for use with this tool. One way is to simply draw two closed, planar curves. You can use this tool to sweep between them. Now, moving, scaling, rotating, and copying these profiles will cause the surface to follow.



Use Profile Placer to place two profiles on a rail or anywhere and MSR.

Another way is to just click the "Get Profile" option found in the "Profile" tool with nothing else selected. This will place a profile that is planar in the Looking Down viewport, centered at F4. Use the MSR handles, or other tools, to get this guy to where you want it for the sweep. Associate it with a rail if applicable, using "Select Rail" in this tool, and/or "Add" a second profile using this option.

Controlling these with MSR: "Get Profile"

Suppose you wanted to MSR and/or replace with a different shape one of your own curves the way you can with the Profile Placer tool when the profile is attached to a rail? This is no problem for Matrix! Select one of the closed curves and run the "Get Profile" tool; or just F6 > MSR.

About the Profiles for Profile Sweep

When you run Profile Sweep, you just need any two planar curves.

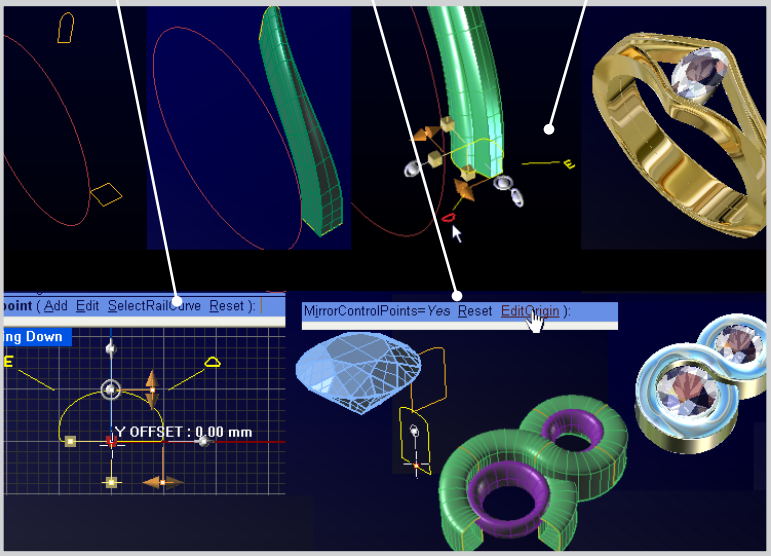
To get the most out of them, we recommend you place two profiles with Profile Placer.

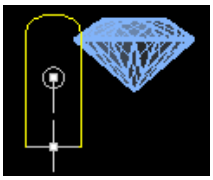
Even if you don't have a ring rail, click "Create Profile" in "Profile" Tool and a profile will appear at F4 with handles.

Or, draw your own profiles using Curve Menu tools. For best results, turn these into program profiles using the "Profile" Tool or MSR.

Then, in Profile Placer, use the "Edit" option and the "Reset Origin" sub-option to set the origin point so the handles make sense for your design.

Control the curves using MSR, and change or Edit the profile shape for the surface on the fly. Or Move, Scale, Rotate in Matrix / Rhino.



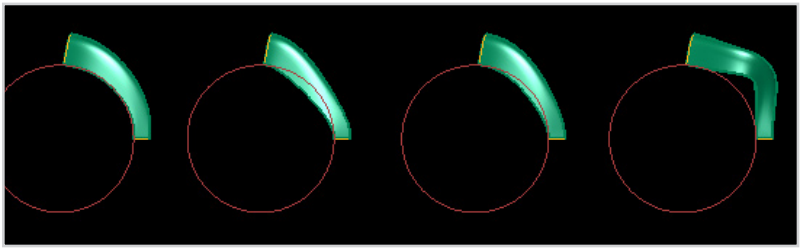


Select curve > MSR > Edit > Edit Origin > place at bottom, center of profile, pointing up (best).

The MSR handles will be attached to the curve. However, their locations may be a little funny. This is because they orient themselves to the "seam point" of the curve - or, the location where the curve starts and ends.

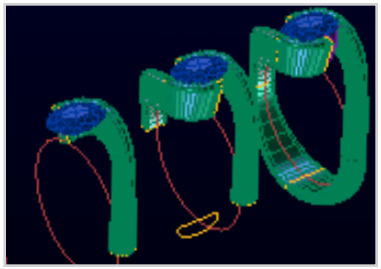
You can change the location of the seam point (and, ergo, the handles) when the MSR handles are showing. Select "Edit" from the Command line and choose the "Edit Origin" suboption. Click and drag the origin handle so it's where you want the bottom, center of the profile to be located. Note: this is the ONLY edit point (the origin) that will have ANY effect on the sweep!! Remember that moving any of the other edit points on the profile only makes a difference when running the Multi-Rail sweep - which requires 1 or more rail curves. Profile sweep uses no rail curves.

If you think you'll need a rail curve to perfect the look you're trying to achieve with Profile sweep, read on in this Advanced Tools Menu chapter.

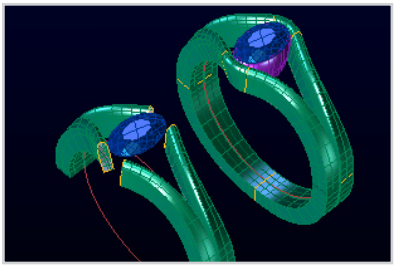


(L - R) Blend Amount = 1, default amount; Blend Amount = 0.5; Start Blend = 0.5; Blend Amount = 2.

Command Line Options Blend Amount. These can be set starting at 0.1 to change the blend amount and thereby the look of the surface overall ("Blend Amount"), or the blend amount at the Start and End of the curve. It is not recommend that you deviate much from the default value of "1", as shown above - far left. Working left to right after that, above, the amounts are "Blend Amount = 0.5", "Start Amount = 0.5", and "Blend Amount = 2.0". Again, it is up to you to experiment with different amounts to get the results you want; however, we don't recommend changing them (much or at all!) from the default value of "1".



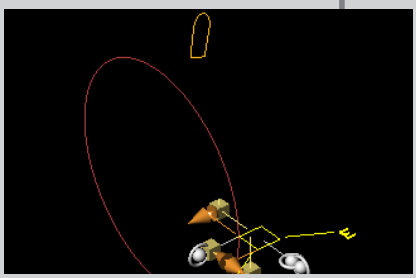
Tips & Tricks Blend Three or More Profiles. Since you can only select two profiles at a time during this tool, run it again to add a third profile to the sweep, and repeat for four, 5, etc. Placing a profile at the bottom and sides of a ring rail will create a relatively circular sweep, so you can create an entire ring that is active with History via Profile Sweep!



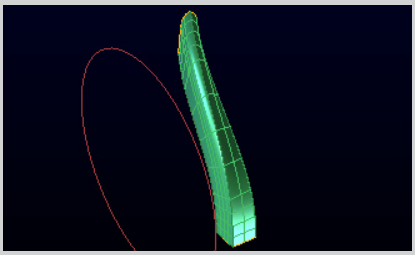
Tips & Tricks Use with Mirror Mode. This ring was created using Profile Sweep and Mirror Mode. Begin by placing two profiles in the upper right-hand quad of Looking Down and use Mirror Mode Quad. Switch to Mirror Mode Top / Bottom and Profile Sweep between two halves of ring. Cancel Mirror Mode, place another profile at bottom of shank, and Profile Sweep or Sweep to complete.

Step-by-Step

Profile Sweep

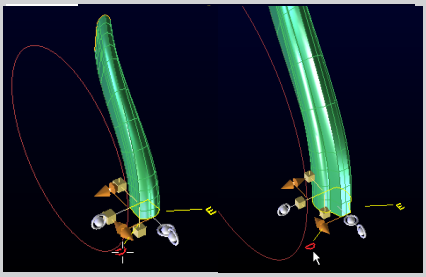


1 Draw or use Profile Placer to get two planar profiles. Place them where you want them to create your design. Since this command is profile-driven, you won't have the option of a rail. If you draw profiles, use "Get Profile" to turn them into profiles, Edit Origin Point, and you can make powerful changes in Profile Placer.



NOTE: Make sure Matrix History is turned on before you do this step!

2 Click on Profile Sweep and select both profiles. A surface in the Blend shape will be drawn between them. Use the options explained at left to get the best results.



3 Use Profile Placer, Move & Rotate to change Surface. Now, changes you make to the profiles (except for Split, Trim, Join, or Boolean, which break History) will be made in the surface as well. Profile Place curves allow you to swap out profile shapes, so make good use of this great resource!

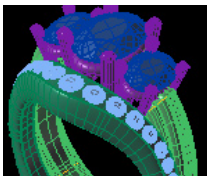
Advanced Profile & Rail Tools



Custom Rail & Related Tools

When Profile Sweep doesn't offer enough control, create rails using these Advanced Tools & Curve Commands. Then sweep with Profiles.

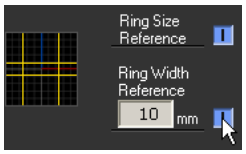
Using the Custom Rail Tool



Custom Rail shapes provide more control than Profile Sweep & other techniques.

The easiest way to understand these advanced rail concepts is to jump right in by trying the easiest tool that uses them: the Custom Rail tool. Start it up and use the Builder Menu Interface to add guidelines to the viewports, helping you know where to draw the shape for the rail.

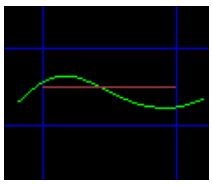
1- Place a Ring Rail. If you don't already have a ring rail in the viewports, place one using the "+ Ring Rail" Builder Menu option. Choose the size you want and click the green arrow to place it in the viewports.



After placing a Ring Rail, assign guidelines showing where to draw rail shape.

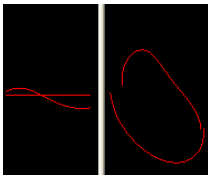
2- (Optional) Turn on Ring Size & Ring Width Guidelines. To create a new shape for the rail, begin by placing a "Ring Size Reference" by marking the checkbox in the builder for this option. This draws two vertical guidelines in the Looking Down viewport that mark the finger width as though you were looking down on the hand (at the ring size you selected above).

Next, assign a value in the Ring Width reference text box (10 mm, e.g.), and mark this checkbox to create two horizontal lines in the Looking Down viewport that mark the width of the ring when looking down on the finger.



Draw a shape planar in Looking Down. Select shape and click "Make Rail" for custom rail.

You will draw your curve between these two guidelines. It is not necessary to use them; however, if this is your first time approaching this concept, you will find them very helpful.



3- Draw a shape for the custom rail in the Looking Down Viewport. The Interp Curve and Curve tools are provided right in the Builder menu interface to assist you with this; however, you may use ANY tools in the Curve menu you've already learned to draw this.

This curve must be planar (flat) in the Looking Down viewport. If you do make a polycurve (subcurves you Join together), it is best to Rebuild them prior to making the custom rail.

4- Select the curve and click Make Rail. The tool will take your planar (flat) shape and curve it around the top of the ring rail to create a finger-shaped (and finger-sized!) rail in the shape of the custom curve you just drew.

Comparing the Custom Rail Tools

Custom Rail creates a static curve in the shape of the ring rail and the shape of a curve you draw planar (flat) in Looking Down.

This uses Rhino's Curve from 2 Views tool (top half of ring rail only) to combine the two curves.

To try this yourself, use the Matrix tool "Curve from 2 Views History", Full = False option. Using this tool, you can edit either planar curve (keeping them planar) and see the changes in the new curve with History.

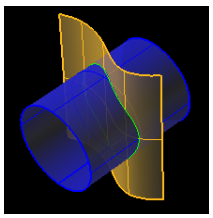
Finally, Advanced Custom Rail combines Custom Rail & Curve from 2 Views History, adding the Outside Rail option (two Curve from 2 Views operations are run - 1 with finger rail, 1 with outer rail) and the Side View option - or, Curve from "3" views. Mirror and Rotate are also found in this tool.



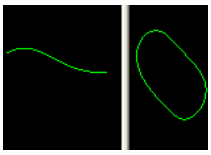
(Below) To finish up any of these designs, add Profiles using Profile Placer and Sweep techniques you've already learned. More advanced methods to finish these designs are explored in the next sections of this manual.

About the Curve from 2 Views Command

So what's happening when you run the Custom Rail tool? Well, it's simple: there is a Rhino tool in the Curves menu called "Curve from 2 Views". This command takes two planar (flat) curves that are perpendicular to one another (here, one is circular in Through Finger and the other is the shape you drew in the Looking Down viewport) and COMBINES them to make a single, new curve that follows the shape of both. You can create ALMOST the same effect as the Custom Rail tool by selecting both curves and clicking on Curve from 2 Views.



(Above) Curve from 2 Views extrudes both curves and runs Intersect between resulting surfaces. The new curve is drawn where they touch (below).



About the Intersect Command

Now you're thinking, "But wait a minute...when I do this with my two curves (ring rail and custom rail shape in Looking Down) the bottom of the finger rail follows the same shape!" That's right... how very observant of you. (You'll have to Split or Trim away what you don't need, if you happen to be using this tool.)

Here's what is REALLY happening when you run Curve from 2 Views: the program uses "Extrude" on both curves. Next, the Curve menu command "Intersect" is run between the two resulting surfaces. This tool simply places a curve where two surfaces intersect.

"Why would you do that when there's Curve from 2 Views with History? That sounds cooler. Is it?"

Excellent question!!! If you look at Curve from 2 Views' next-door neighbor in the Curves menu, you'll find the Gemvision Development team's very own creation, "Curve from 2 Views with History".

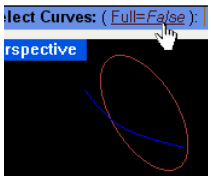
"Why?" So glad you asked. Well, if you simply use Curve from 2 Views, you'll notice there is no good way to edit the resulting curve. Despite how useful it is once you get it right, it's a pretty nasty curve until you do: it's nonplanar, so if you turn on its Edit points or Control points, they are nearly impossible to adjust.

Up until Version 6 of Matrix, all we could do to edit this curve was to run Curve from 2 Views, realize, "Oh wait, that's wrong", click Undo, and edit either one of the FLAT curves, run Curve from 2 Views again, and repeat until we got it right. Yes, this was both time-consuming and frustrating; especially if you are unobservant (like me) and don't realize your curve is wrong until you are halfway done with the ring: profiles, gems, settings, the whole shebang. And now you have to Undo all THAT. Ouch. Therefore, Curve from 2 Views with History was developed.

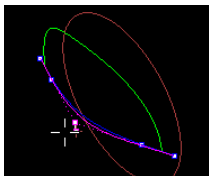
Using Curve from 2 Views w/ History

This tool works exactly like Curve from 2 Views; however, you can ask it (nicely!) to NOT create the bottom of your finger rail. (Aaaah, thanks Matrix gods!) To do so, start up this tool and make sure the Command Line option "Full" (as in, full circle) is set to "False". Then, it will only create the top half of your finger rail, and leave the other half alone for you to sweep the bottom of the shank.

Now here's the "with History" part... after creating the curve with Matrix History turned on, you may select one of the original (planar) curves that you had selected when running the tool and edit THAT curve using Control / Edit Points on, Mirror, Rotate, Move, Scale, etc (not Split, Trim, or Join because, as you know, those break History). Your changes will be made in the new curve, as well - following any of your changes to the original curve(s).



In Curve from 2 Views with History, use "Full = False" to place only top of ring. Edit Planar curves (don't Split, Trim, Join!) to see changes in new curve. (Green, below).



Rules for Curve from 2 Views Tools

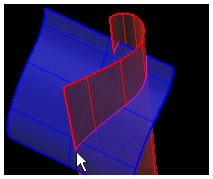
The rules for using BOTH Curve from 2 Views Tools are...

1- Both curves must be planar (flat on any plane in space). If they are not, both tools will fail. Use the Transform Menu tool "Project to CPlane" (explained in this chapter) to fix this.

2- These work best if the two flat (planar) curves are perpendicular to one another. Use curves that are flat on the C-Planes of two different viewports for best results.



Extrude both curves and run Intersect to find out what's wrong. In this case, Extend the red curve so they'll cross in space. (Edit with Control Points On in Curve from 2 Views History to fix.)



3- If the two curves are Extruded as planes, the planes must COMPLETELY cross in space to draw the curve you expect. If they don't, they'll only draw part of - or even (gasp!) NONE of - the expected curve. In fact, if Curve from 2 Views (with or without History) doesn't work as expected, select two curves, Extrude them both, and run Intersect between the new surfaces. Either you'll create the curve you were going for, or you'll find out it's not possible and discover how to fix it!

4- Use Curve from 2 Views History! Why mess around with a tool that has no History? When using Curve from 2 Views with History, if a curve is only partially created, you can edit the flat curves until you get the results you were looking for. Also, make sure curves don't go "nonplanar" while editing control points, as this breaks Curve from 2 Views with History.

5- Don't break History when editing curves! When using Curve from 2 Views with History, do NOT Split, Trim, Join, Boolean, or (obviously!) Delete your friends the planar curves, or else History will be broken between them and the new curve.

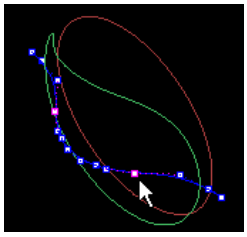
About Advanced Custom Rail

(Did all that make sense to you about Custom Rail & the Curve from 2 Views tools? If not, go read it again and try it out in the program - repeatedly! - until it does, because we're about to take these concepts a WHOLE lot further...)

The Advanced Custom Rail tool acts like a combination of the two tools you just read about, together with four POWERFUL options that make it all the more fun and useful for controlling rail curve shapes. And remember: the more precisely we can place rails and profiles, the more precisely we can control the shape of the surface, which is what surface modeling is all about. These options provide four more ways to place EXACTLY the rail curves you want in preparation for a sweep.

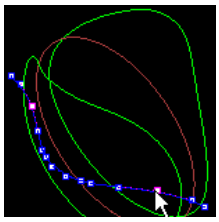
Using Advanced Custom Rail

Prepare to use this tool the same way you prepared for Curve from 2 Views or Custom Rail: draw a planar (flat) curve in the Looking Down viewport representing the shape of the ring you want in the final model.

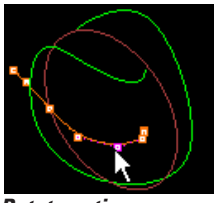


Advanced Custom Rail w/no options = Custom Rail + Curve from 2 Views History. Blue curve = "Shape Curve". Press Enter to end, and edit Shape curve to see changes.

Start up Advanced Custom Rail, and select this curve as the "Shape Curve". The curve will appear in the shape of the ring rail (round) and the Looking Down shape. A description of the four available options follow; but, to use NONE of these options, simply press Enter to accept this rail. You can now turn on Control Points for the Looking Down view (or Through Finger view) curve and edit it by following all the familiar rules from the tools we've just discussed.



"Mirror" option draws same rail on mirrored in Y axis. Both rails keep up as original curve is edited.



Rotate option continues rail on OPPOSITE side from original, rotated around F4. Yep! Edit original curve with History & BOTH sides update!

The Mirror and Rotate Options

These two options are mutually exclusive. If you draw only one half of the custom rail, select the "Mirror" option to mirror it (in the Y) around to the other side of the rail curve. Press Enter, edit the original curve, and the new curve (including its mirrored counterpart) will KEEP UP. COOL!!!

The "Rotate" option does the same; but instead of mirroring the curve about the Y axis, it Rotates it about F4, placing a copy as though you had rotated/copied the rail around F4. Same goes here: press Enter to end Advanced Custom Rail, edit the original (planar) Shape Curve, and, as long as History was turned on when you started up this command, BOTH new shapes will move to keep up with your changes. And cause you're gonna ask once you learn what the OTHER to options in this command do ("Outside" and "Side Profile") ... yes, amazing as it is, Mirror and Rotate work with them both, too.

A Little Background on this Tool

Besides Mirror and Rotate, stunning in themselves, the Advanced Custom Rail tool introduces two NEW options into the Curve from 2 Views / Custom Rail technique that make it an AMAZINGLY powerful for modeling advanced custom rail shapes.

They are so special because, up until Version 6 of Matrix, we'd have to create these effects by hand using the Curve from 2 Views tool (without History, remember!) on both an inside (finger rail) shape AND an outside rail curve to get ultimate control over the surface we were going to sweep. You could do this up to four times (or more!) and use several methods explained next (Profile Placer + Multi-rail Sweep or other profile-placing tricks with Sweep 2 between EVERY set of rails) in order to complete a ring. Setting the rails in place was a LOT of work, especially when you needed to go back and edit them. Most of this work has been automated in Version 6 using the Advanced Custom Rail tool.

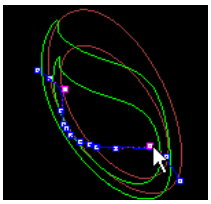
The two options introduced in this tool that make it so powerful are the "Outside Rail" and "Side Profile" options.

The "Outside Rail" Option

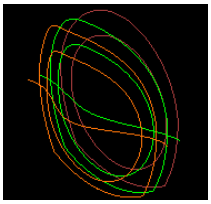
Quite simply put, if you run this tool alone without EITHER option, you will get the top half of the custom rail, as in the "Custom Rail" tool. Press Enter to end the command. Now you can edit the flat curve from which your new shape came, and Matrix History will update the new curve.

However, add the Outside Rail option and the tool will allow you to click on a SECOND rail curve (placed with the interactive Outside Rail tool as here, or any means you choose) and it will run ANOTHER instance of Curve from 2 Views History with that outside rail (top only). You've now got TWO rail curves - inside finger rail and outside rail shape - and, as we have said before, more rails mean more control over your model. And of course, you can edit these rails by editing either the Shape Curve (planar in Looking Down) OR by editing the inside or outside rail (with Outside Rail Tool handles, for example).

For the ultimate control with this option, run this command TWICE with two different planar shapes (draw a new curve or offset original curve), for a total of four rail curves in the final outcome.



"Outside Rail" Option Runs Curve from 2 Views History with inside and outside rails.

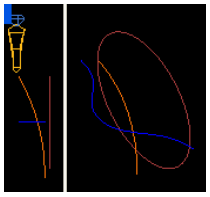


Run Advanced Custom Rail with "Outside Rail" option twice (1 Shape Curve green, 1 orange above) to prepare for a "4 Rail Sweep" (4 Sweep 2 operations).

The "Side Profile" Option

This one is a mind-bender. OK: you know how you can run Curve from 2 Views in TWO of the viewports: (Looking Down +

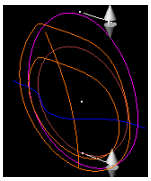
Side View, Looking Down + Through Finger, or Side View + Through Finger)? These choices mean that EITHER the Side View OR the Looking Down shapes (not both!) are driving the shape that is getting thrown around the finger rail (and/or outer rail) curve found in Through Finger.



Shape Curve blue - draw in Looking Down. "Side Profile" orange - draw in Side View.

The Side Profile option in this tool blows that limitation AWAY. Now follow me closely: in the past, we used to have to run Curve from 2 Views with Looking Down + Through Finger; THEN run it AGAIN with Side View + Through Finger; THEN, we would take a look at both curves and figure out which part of each curve we wanted to keep. We'd Split away what we didn't need, and place a Blend curve between them, trying to make a smooth transition between both shapes we needed, and usually encountering a LOT of trial and error editing the Looking Down and Side View shapes, repeating Curve from 2 Views and using trial-and-error to determine where to split the curves to get the Blend just right. We used to call this concept "Curve from 3 Views", and only teach it in the highest-level Advanced classes. Well, we've taken care of all that extra work (& difficulty!) with the "Side View" option.

Simply put, prior to entering the Advanced Custom Rail tool, draw a planar shape representing the ring in the Looking Down viewport. ALSO draw a planar shape representing the ring in the Side View viewport. Start up the tool and select the "Shape Curve" (Looking Down shape). Select the "Side Profile" option and click on the shape you drew planar in the Side View viewport.



Side Profile option gives handles that control where Looking Down and Side View shapes Blend together.

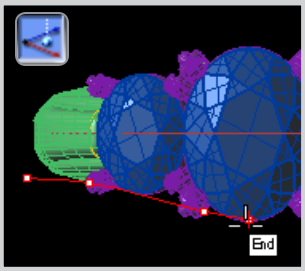
Wait just a moment, and handles will appear on the new curve. These handles represent the region between the two curves which is usually created using the Blend tool in our long-hand version of "Curve from 3 Views". Just click and drag these handles up to use more of the Side view shape, or down to use more of the Looking Down shape. Push them together to create a smaller "Blend" area or apart to create a longer, smoother transition between the two shapes. The curves are trimmed and Blended together automatically using these handles.

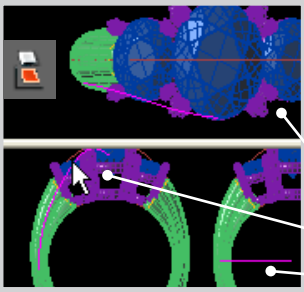
F6 > Edit Custom Rail

To get back Side View handles after ending the tool, select the new rail and press F6. Choose Edit Custom and handles will reappear. Or, with no Side View selected, use F6 > Edit Custom to add one to the shape.

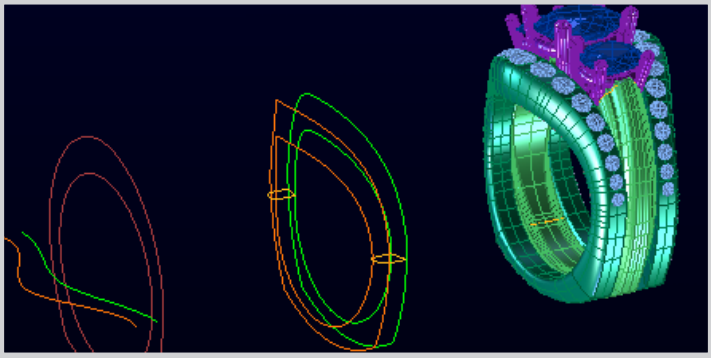
Tips & Tricks Custom Rail Tools

The Project Snap For best results, draw the original curves for ANY of these tools with the Project Snap turned on. That way, even if you do snap to something, your curve will still be drawn planar (flat). Otherwise, snapping to things in the viewports will likely create nonplanar curves.

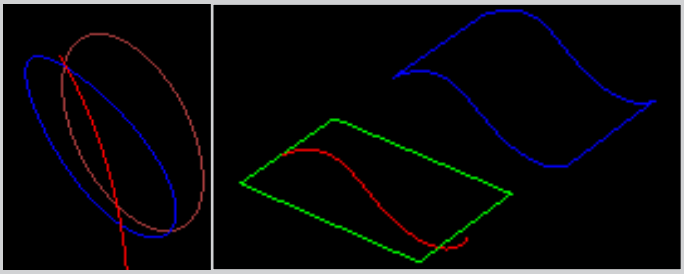




Project to CPlane Curve from 2 Views' best buddy in the Transform menu (and yours now!), this command projects an errant (i.e. nonplanar) curve FLAT in the viewport that is active (Top). If you think it's flat but it's not (Left, below), running this will fix it every time (Right, below).



Create a Shadow Band (or 2!) Use the tool from among this unique toolbox that presents you with the most control based on the shadowband you need to place. From one or two rails (Curve from 2 Views History) to all four (Advanced Custom Rail, shown above) these tools can place rail curves precisely where you need them to sweep a wedding band that's perfectly nestled up beside its matching engagement ring. See Multirail Sweep with History (next) to learn how to sweep these rails.



Don't just use Looking Down... or Rings We've been building rings, but you can create any curve imaginable with these tools. Place a Side View shape and run Curve from 2 Views History using this & the ring rail (L) . Or, don't sweep a ring... use Curve from 2 Views Shapes (R) together with other tools in the program to create pendants, earrings, shapes for design elements - anything you can dream up!



Advanced Profile & Rail Tools

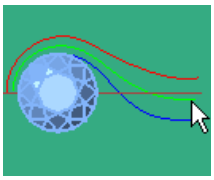
Sweeping Custom Rail Rings

Placing profiles, editing control points, and using Multi-rail sweep creates the surface of a Custom Rail Ring with History interactivity.

Preparing to use Multi-Rail Sweep

Remember your old friend Multi-Rail sweep? This is where this tool is really going to come in handy. Of course, when sweeping 1 or 2 custom rails, Sweep 1 or 2 History will work just the way they will when sweeping straight rails.

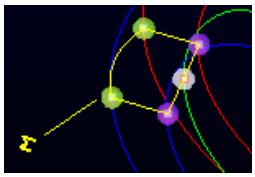
But when you've used Advanced Custom Rail to place as many as four rails, how will you sweep them? Before resorting to the tricks found in the remainder of the chapter to place more advanced profiles, try creating a central rail to load into Profile Placer. Place this central rail one of many ways - for instance, place a Plane flat on the grid (planar with the creation curves) and use the Center Line tool to create a line between them. Or, Offset one or both of the shape curves. Or, approximate this curve. Use Advanced Custom Rail one more time to place this curve between the other two.



Place a central rail curve on which to place profiles.

Position Profiles & their Edit Points

When placing a profile on an open rail, you will find that, the closer the profile gets to the ends of the rail, the more likely it is to "jump over" to the other side of the ring! Keeping clear of this point in Profile Placer, place profiles where you'd like them for the new surface. Then, use the Edit Points option for each profile ("E" handle on each profile or "Edit" option in Command line or Builder Options list) to place Edit Points as close to rails as possible - it's best if they're touching!



Align ALL Profiles' Edit Points with each of 4 rails.

Run Multi-Rail Sweep

You're now ready to use Multi-Rail Sweep. Select all the rail curves (NOT the center rail on which you placed profiles) - selecting them in sequence, inside rails then outside, or vice versa, is preferred by this tool - up to 4. Press Enter after selecting all rails if less than 4 are selected. Select profiles next, in order based on how they must be swept. The surface will be swept.

Now, you can use History as usual, editing profiles and rails to your hearts' content. Select a profile and change its shape, size, or location; or, select one of the creation curves you used in Advanced Custom Rail and edit its control points. Don't break History OR push the rails and profiles TOO far apart (surface may "break" if you do) and the surface will keep up with your changes.

What if it Fails?

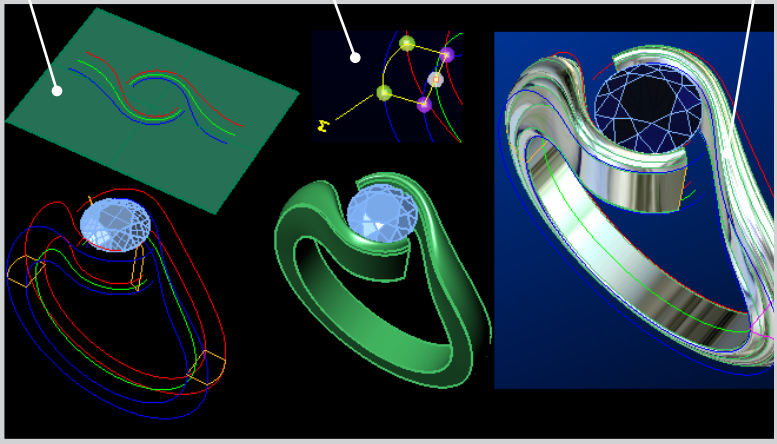
If it doesn't sweep, or if the surface "breaks" apart because rails and profiles were pushed too far apart from one another, you have a few options. You can draw your own profiles that DEFINITELY touch the rail curves; turn them into profiles using F6 > MSR or the "Profile" tool; align the "Origin" of the profile (Reset Origin suboption found in Edit Points option) with middle, bottom of profile; and use Multi-rail sweep. If this doesn't work, there are some tricks in the next few pages that will help you place OPEN curves one by one to use as profiles between each rail, and complete the ring with four Sweep 2's (known as a "Four-Rail Sweep").

Sweeping Custom Rail Rings

1- Set up for placing profiles by adding a center rail to the Advanced Custom Rail tool on which to locate profiles. (Center Line tool used here.)

2- Place Profiles as close to shapes of four rails as possible. Locate Profiles' Edit Points as close to four rails as possible for all profiles.

3- Run Multi-Rail Sweep, selecting inside pair, then outside pair, in sequence. Also select profiles in sequence. Edit Profiles or rails being careful not to separate the two too far.

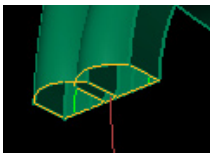


Advanced Profile & Rail Tools ...

Using Profile Merge

Combine two profiles around their edges. Or, "Dup Border" or "Dup Edge" to sweep bottom half of ring. Related Curve tools also covered.

About Profile Merge



From two intersecting profiles, make one profile that surrounds them both.

This tool makes quick work of creating a Split Shank design when two profiles (one for each side of the ring) overlap where the ring comes to a "V" - which used to entail a lot of busywork with plain old Split, Trim and Join, or with our friends Dup Edge and Dup Border, explained next.



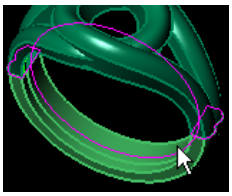
Profile Merge shape on Left. Original on Right.

Profile Merge uses the Curve Boolean tool to quickly take two overlapping profile curves and make a third curve that follows the outside shape of them both. Essentially, it is using "Curve Boolean" to "Union" the two curves, but without all the options and clicking and bothersome mouse movements. It is the perfect tool for the lazy modeler.

Using Profile Merge

To use this tool, simply start it up and select two overlapping profiles. Your Profile Merge curve will be created (original curves will be left behind): easy as that!

There are some simple rules to follow: The two curves must be planar (flat) on the same plane in space, or else the tool will just sit and look at you. If they are perfectly touching - i.e. not truly "overlapping" but with two curve edges that have position continuity (occupy exactly the same points in space), the tool may have a little trouble as well, the way co-planar objects have trouble in Booleans.



To complete Split Shank Design, use new Profile Merge curves to Sweep bottom of ring.

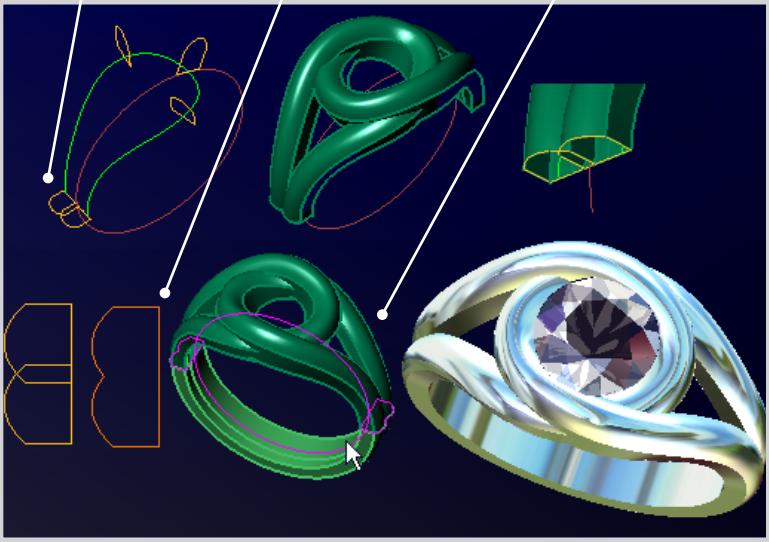
Steps for Using Profile Merge

1- With two overlapping profiles - such as these below, that make up two halves of a split-shank design - start up Profile Merge.

2- Select both profiles.

3- The Profile Merge curve will be created (orange, below).

4- To complete your ring if it is symmetrical, Mirror or Rotate/Copy profile to the other side of the ring. Sweep 1 or 2 bottom of ring.



(First row) This common "horseshoe" design was made using Curve from 2 Views and Profile Placer to complete one half with over/under design. Rotate/Copy one side. (Second Row) Merge Profiles on one side and Rotate/Copy. Sweep 1 Rhino (to align curve seam points) to complete.

Advanced Profile & Rail Tools ...

Dup Edge & Dup Border

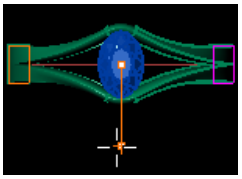
To get curves from a surface, use Dup Edge (on closed or open surfaces) or Dup Border (on open surfaces only).

About these Tools

Use the Dup Edge tool to place a curve along the edge of any surface - open or closed. To use this tool, start it up and click on the edge to add a curve to. To select multiple edges, continue selecting them. Press Enter when all edge(s) are selected, and curves on the currently-active layer will be placed along the selected edge(s).



Upon completing top half of ring, Dup Edge (one edge at a time - used here) or Border (all open edges) to create profile.

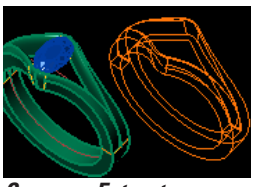


Join curves and Mirror or Rotate/Copy new profile if symmetrical & Sweep bottom as shown at left.

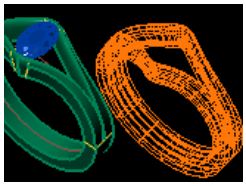
Use Dup Border on an open surface to place curves on every open edge in one shot. Just start up the tool and select an open surface or polysurface. Curves will be placed on the current layer color along every open edge. Notice that Dup Edge can duplicate any edge - open or closed - to turn it into a curve. Dup Border can only create curves on open edges.

Other Tools to Add Curves to Surfaces

The Silhouette and Extract Wireframe tools add curves to a surface in similar ways. Silhouette locates a curve at the juncture of each component polysurface, much the way Dup Edge does, but with no need to successively select each edge.



Compare Extract Silhouette (above) to Wireframe (below).



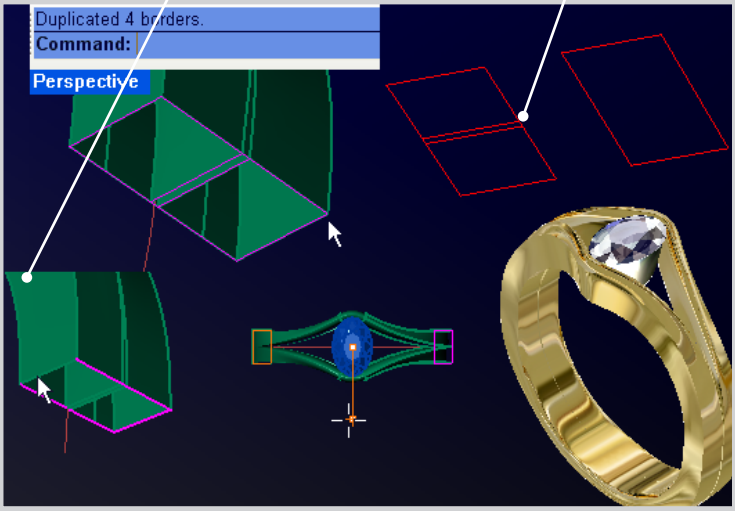
The Extract Wireframe tool also adds curves at the site of all of the isocurves visible in the wireframe of the model .

Use Dup Edge or Dup Border?

Dup Border only duplicates open edges. So, if you need to duplicate a closed edge, use Dup Edge. In this example, I like Dup Edge because you place the curves you want. Dup Border duplicates all open edges and can give you extra, unexpected curves elsewhere.

In most situations though, you can use either one. For example, the ring below misbehaves in Profile Merge, probably because the curves have position continuity (exist along the same points in space), so the builder can't sort them out.

With Dup Edge, select edges by clicking the mouse along ONLY the outside edges of the two surfaces. With Dup Border, select both halves of split shank, creating the two curves, and Split / Trim / Join them together to create the shape Profile Merge would have.



(L- R, clockwise) Dup Edge lets you choose edge curves one by one; check Feedback Line after Dup Border to check that expected number of borders were duplicated; after Dup Border, you must Split / Trim / Join to make profile. Finished ring is made by mirroring or Rotating/ Copying profile and Sweep 1.

Note: this is the way we did it before there was Profile Merge. If you have misplaced your profiles, you MUST use one of these two methods!

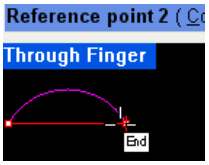
Advanced Profile & Rail Tools ...

Orient 2 & 3 Points

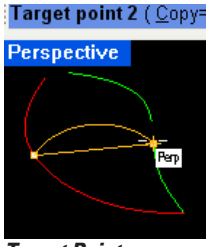
Got a complicated place to stick a profile? Use these tools to get it situated just right.

Orient 2 Points to create Profiles

Of course, Profile Placer is a great way to orient any profile curve perpendicular to a rail curve, and it has tons of flexibility with regards to rotation, offset, etc, which makes it extremely versatile for any profile you wish to place. But for a little background on how this used to be done - and still can be done - in situations calling for more advanced profile placement, Orient 2 and 3 points are the tools you're looking for ...



Draw Profile Planar in Through Finger. Reference Points at End O-Snaps.

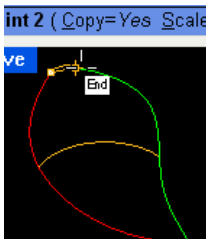


Target Points on curves to orient profile to. Use Near and Perp O-Snaps for best results.

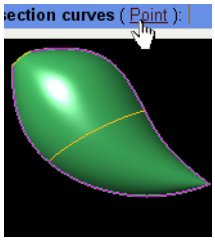
When rails are complicated - such as complex nonplanar curves, freeform shapes, or overlapping rails that create an over/under design - you may find it hard to draw a profile on them with conventional tools.

Instead, draw the profile planar in the Through Finger viewport, at approximately the right height and width. Then, start up "Orient 2 Points".

To use this tool, select two "Reference Points" on the profile or other object you are orienting. Next, select two "Target Points" on the rail (or object you are orienting it to). The profile will be oriented to the two rails, and scaled accordingly to fit between them.



Use Copy = Yes to place more than one.



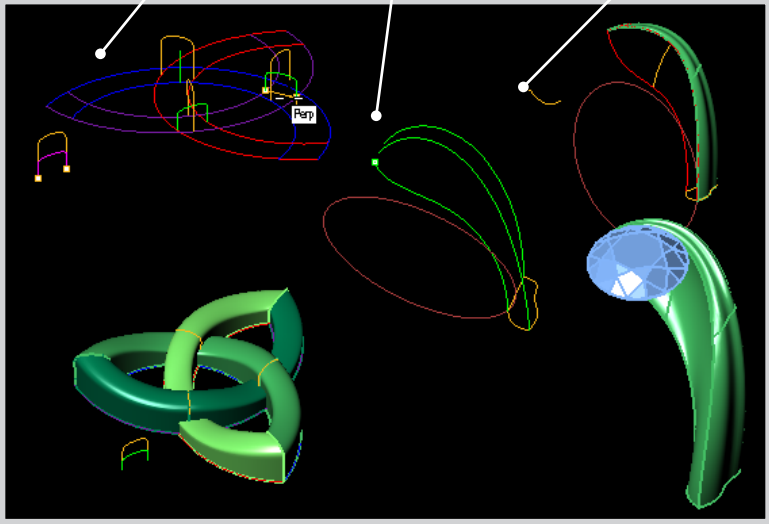
Sweep 2 (Point option as final "profile") creates shape.

Ways to use Orient 2 & 3 Points

For an over/under design along two rails, draw a taller and a shorter profile in Through Finger. Orient 2 points to place profiles at locations where design overlaps. Sweep 2, Split, and Cap to create.

Using Orient 2, coax rails to touch a common point (important for surface modeling!). Reference Points are ends of curve; Target points are correct end and point to touch.

Add profile to rails by drawing it in Through Finger at orientation (cupping gem) you want it to have on the rail. Place with Orient 2, endpoints as Reference points and Near/Perp O-Snaps as Targets.



The options available with this tool include Copy = Y/N, which, when set to Yes, keeps the original curve (always good) and allows you to repeatedly orient the curve to two new target points until you have as many as you need. "Scale" can be set to 1D, 3D, or None. To NOT scale the object (note that it may NOT reach target points if you select this option!), select "None". To scale it only in one direction - the direction it is being "Stretched" in to touch the rails, select "1D". For best results (i.e. height will be scaled to width), select 3D (used in all examples here).

Orient 3 Points

This command works the same as Orient 2 Points, but locks the scale of the object, while allowing you to select three points to orient the object to. In that way, you can assign two ends and a "Z" height - or, which way the object should "Point". This tool is less versatile than Orient 2 Points, because the object cannot be scaled. Scaling is automatically determined by the location of the three Target points relative to the three Reference points.



Advanced Profile & Rail Tools ...

Using Rotate 3D

Assign an axis to Rotate along and a "handle" with which to control object being rotated. Move mouse to rotate object around axis.

An Advanced Tool

But I TOTALLY understand "Rotate"... and now you're telling me something called "Rotate 3D" is an advanced tool?!

Don't worry: It's not really that hard to use; it just seems to only be needed in advanced applications that require you to place profiles on complicated rails. It is usually used right after Orient 2 Points, when you discover that your profile isn't in quite the right orientation for the surface you need to sweep. (We'll show you how to fix that in just a second.)

But, of course, it's easy to use this tool in other applications when you might want to rotate something - anything! - using a plane that is NOT related to any of the viewport planes onscreen, but is instead oriented somewhere along the model itself. I'll show you what I mean...

Using Rotate 3D: an Axis and a "Handle"

To use this tool, begin by clicking to set the "start" and "end" of the axis around which to rotate the object. In the case of a profile, these are usually its End O-Snaps. The axis acts as a "hinge", on which the object will "swing" like a door, so choose these two points carefully! The third mouse-click sets the "Angle or First Reference Point", just like in "Rotate". Think of this as a "handle" that you will then use to hold onto the object while you swing it around the axis. I like to place this near the object I'm rotating, using the Near O-Snap, so it's clear where I need to move the mouse - I just put it where I want the object to go!

Applications for this Tool

Here's the only application in which I've used this tool: when I'm creating a really hard model with surface modeling, and I know exactly where I want to put the profile but it just won't go there. Orient 2 Points usually gets me most of the way there. But somehow, the profile doesn't want to be perpendicular to its two rails. So I grab that guy with Rotate 3D, assign the two endpoints as the axis, set a handle Near (on) the profile, and swing it around till its perpendicular to its rails. That'll show it!!

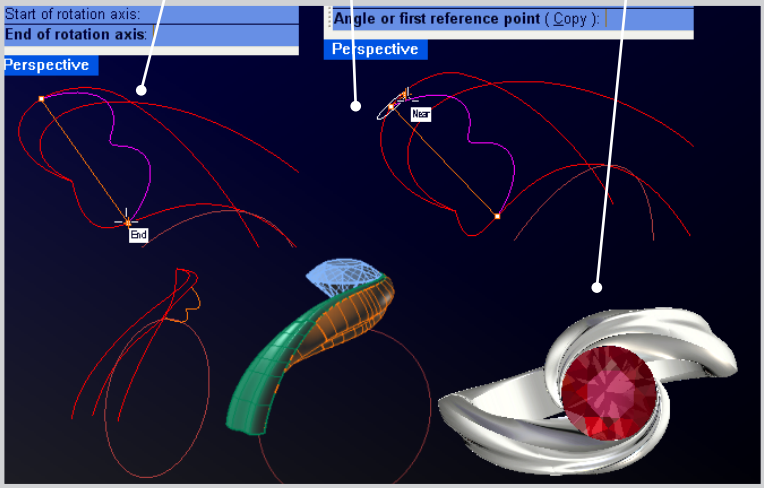
Steps for Rotate 3D

1- Start up this tool and select the object to rotate (Profile placed with Orient 2 Points, here).

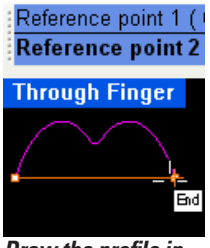
2- Click twice to assign the Start and Endpoints of a rotation axis. This acts as the "hinge" on which the object will swing like a "door".

3- The third mouse-click sets the "Angle or First Reference Point". Think of this as the "handle" with which you're holding the profile while you swing it around the axis. I use the Near O-Snap to set it near the profile, so it's clear where I should move the mouse to re-orient it: right where I want it!

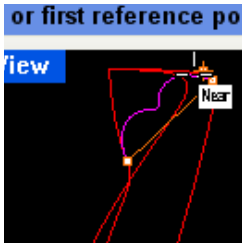
4- Move the mouse and the profile will rotate. Use all viewports to make sure the angle is correct (usually, perpendicular to your two rails). Left-click when it's correct to end the command. (Sweep 2, 3 times, using the Point Option in the Sweep Command as the final "profile" beside the gem, finished this ring.)



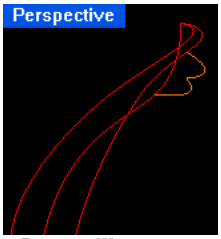
(Above) How to Rotate 3D a profile that was placed with Orient 2 Points. (Below) How to place this profile with Orient 2 Points, then fix it with Rotate 3D...



Draw the profile in Through Finger & Orient 2.



Its Axis is its end-points and its handle is a "Near" O snap.



Rotate till Perpendicular to rails & Sweep 2.

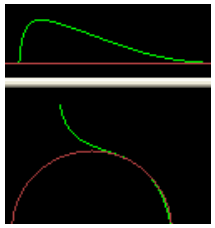


Advanced Profile & Rail Tools

Curves and CPlanes

Two Transform menu tools help you understand when a curve is planar or not; they can also make it planar in the same or a new viewport.

Why Project to CPlane

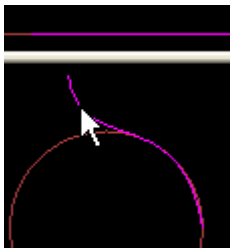


Check all viewports: a curve can look planar when it isn't! (Looking Down above; Through Finger below.)

When using tools like Curve from 2 Views and Extrude, planar curves are required. Sometimes, a curve looks planar when it really isn't; or, you think you've drawn it planar when really you haven't. Maybe it snapped to something unintentionally in the viewports while you were drawing it. Even if you eyeball it and it looks planar, it still may not be, in the most minute way! Whatever the case, you need a planar curve where you have a nonplanar one. This is where Project to CPlane comes in.

This tool will take any object in space (including surfaces, solids, and meshes, but curves are its most common application within Matrix!) and project it so it is flat against the Construction Plane (or, "CPlane") of the active viewport (commonly known as "the grid"). But beware: this command is viewport-dependent; meaning whatever viewport you select the curve in while you run this command is the viewport in which the curve will end up flat against the grid.

Using Project to CPlane



Project to CPlane with viewport active where you want it planar. Now check again: It's planar!

Start up this command and select the object to project in the viewport where you want it to be flat against the grid. If you select it in another viewport, you'll get unexpected results - i.e., the curve will project to that construction plane instead of the one you wanted it to project to. The only Command Line option available in this command is "Delete Input Yes / No".

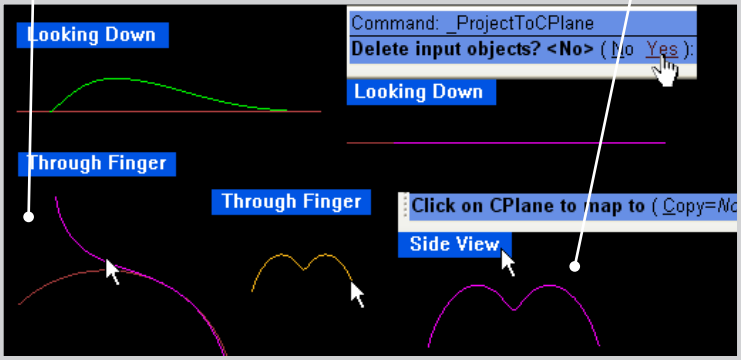
The CPlane Tools

Project to CPlane:
This tool is used to fix a curve that is not planar but should be - as when using Extrude or Curve from 2 Views, both of which require planar curves.

Select the curve in the viewport where you want it to be planar, and run this tool. If the correct viewport is not active, you will get unexpected results with this tool!

Remap to CPlane:
This tool is used to relocate a curve or another object to a new viewport. It will have the same orientation to the new viewport as it did to the old.

To use, select the object to Remap. Now, click the new viewport to map it to. If you started the command in the wrong viewport, you will get unexpected results. The object will have the same position & orientation in the new viewport as it did in the first one.

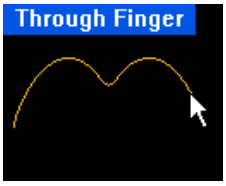


Note: These tools are most commonly used with curves, but you can Project (squash to the grid!) or ReMap (re-orient to new CPlane) any object using one of these tools.

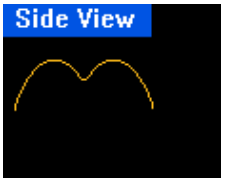
Select "Yes" if you don't need the original curve; select "No" if you do need the original curve.

Remap to CPlane

This command takes an object that is oriented to one view and places it at the same orientation in another view. It is also viewport-dependent, so start up this command by selecting the object in the viewport where it is in the correct orientation (the orientation you want it to be at in the new viewport). Then, the Command Line will read "Click on CPlane to Map to". Click anywhere in the NEW construction plane that you want the curve to appear in. It will be "Remapped". If you want to keep the original, select the Command Line option "Delete Input = No". To delete the original, select "Yes" for this option.



Select a curve in one viewport & click a new viewport to which to map it. You're ready to rock!!



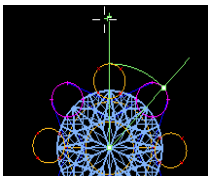
Targets

Advanced Profile & Rail Tools

The Blend Targets Menu

Fully interactive advanced modeling - for rails, profiles, and surfaces - is possible with the tools found in this menu.

About Blend Targets



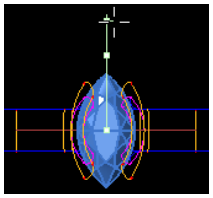
With Targets, you can rotate profiles and rails will follow, to twist head.

Before Curve from 2 Views History and Advanced Custom Rail came onto the scene in Matrix Version 6, there were Blend Targets. Developed as a means to create rails and profiles that are interactive, they are still unique among the newest tools in the program because of their ability to allow profiles to adhere to rail curves as either of them are edited, making them invaluable to advanced surface modeling, or what we affectionately call "Four-Rail Sweeps".

With Blend Targets, setting up the four-rail sweep condition does not include static curves you can't control - as it used to, before Curve from 2 Views History and Advanced Custom rail. And it doesn't even involve setting up static profiles you can't control - which is almost always necessary when creating the most complex models even with these advanced tools.

Instead, with Blend Targets, rails and profiles are both interactive and "stick" to one another when changes are made, so that the important "four-sided condition", wherein all rails and profiles touch one another for the best conditions for surface modeling, is never broken.

The Blend Targets Menu also contains the Skinner command which, if you follow the rules of this modeling strategy, applies surfaces to rail and profile curves automatically to quickly four-rail sweep an entire model. A four-rail sweep is really just four 2-rail sweeps, which means this tool saves you at least 3 steps. But it really means more, because a Blend Target model might end up consisting of numerous situations where a four-rail sweep must be run: and Skinner can do them all in one step, applying a "skin" to your model - that is, as long as you've set up your "curve skeleton" just right!



Place a new gem and resize profiles to change design.

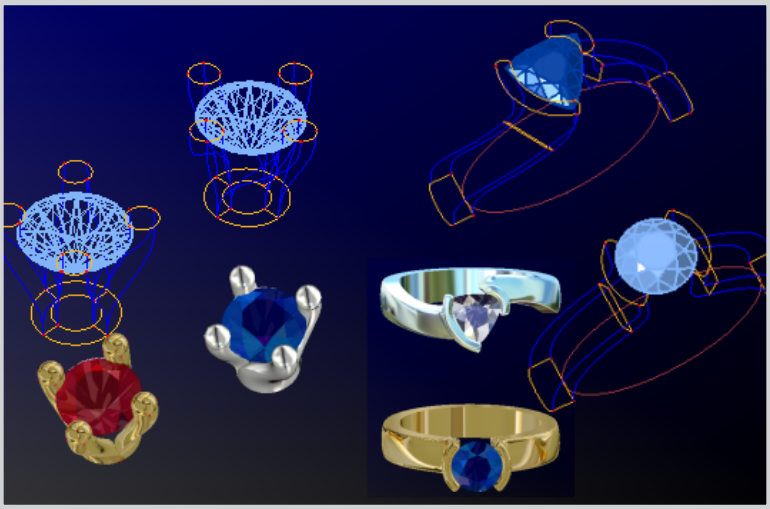
For Skinner to work, profile curves must be one color (and only one!) and Rail curves must be another. None of the curves can be joined, and all must end in a Target. And wherever a rail curve ends, a profile curve must be present (and vice versa) so that, if you're doing all Target modeling, a target exists at each "joint" between a rail and a profile. However, in some conditions it is fine - and in the most advanced Target models, can be necessary - to sweep them with a combination of Skinner and other Sweep tools.

Skinner has a secret we'll show you later: as long as all these conditions are true, you need not have modeled the piece with Targets, and it'll still "skin".

Compare Other Advanced Tools to Blend Targets.

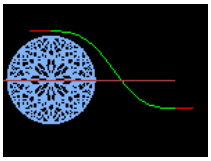
Curve from 2 Views History and Advanced Custom Rail give you the opportunity to create rail curves that are interactive with History. And when you apply profiles to these rails with Profile Placer, you can achieve profile History.

However, the best way to control the shape of a surface is with the "Sweep 4" or "four sided" condition, wherein each surface is composed of two rails and two profiles touching them. Traditional Curve tools can accomplish this when used with Advanced Custom Rail, but the profiles aren't History-enabled. With Blend Targets, the four-sided condition becomes interactive with History. Adjust rail curves, and profiles keep up. Adjust profiles, and rails keep up. Targets' tool Skinner sweeps them all at once.



L - R: Target models & their curves. It is easy to vary each model by adjusting the rails and/or profile curves. This instantly varies the model. "Skin" each version to apply surfaces instantly and see your changes. No other advanced modeling tools have this capability!

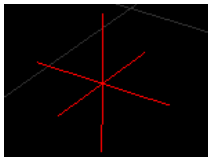
Some Blend Target History



The curve tool Blend creates a curve (green, above) between two others (red).

Blend Target modeling was created out of the Gemvision team's consistent use of the Curve tool Blend to create rail shapes for advanced models. Following Blend, as you now know, it is common to use the Curve from 2 Views command to place the Blend curve up beside the gem, above the finger rail, or basically wherever you need it to begin to build your model. And, once it was there, it was stuck there. If it was the wrong shape, you had to go all the way back to square one - create a new shape with Blend, run Curve from 2 Views again, and see if that was right or not. This was time-consuming to say the least.

Then, once you've modeled an amazing creation using this "long-hand" method, suppose your customer came back and wanted it changed a bit - or a new customer handed you a different-shaped stone and said "exactly like that ring - only different!" Well, once more, you're back to square one, building that ring from scratch all over again. So to facilitate that cumbersome process, Gemvision developers created Blend Targets.



Close-up of a Blend Target shows 6 possible directions for approach of curve.

What is a Target?

To see how Blend Target modeling works, start by using the first command, Target, to place a Blend Target anywhere on the grid. A target is simply a tiny Point object with six axes representing all six degrees of freedom: positive and negative X, Y, and Z. It is related to modeling with Blend because the rotation of the curves you are Blending from or to affects the shape of the Blend curve. With Blend Target modeling, you can choose one of these six directions to Blend your curve to, changing its shape.

But let's not get ahead of ourselves: one target all by itself will not do anything for you... they are social creatures, and only work with at least one neighbor!

The Target & Curve Commands

To place a target, start up this command and click anywhere on the screen. The target will appear where you click. To create a curve, you must place two targets, so repeat this command and place a second one (by the way, you can Copy targets too!).

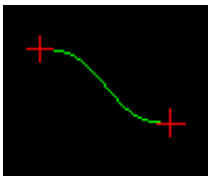
Now start up the Curve command found in the Target menu. The Command line will prompt you to "Select first blend target". It doesn't matter which target is first, so select one of the two targets. Select the second one upon being prompted to do so, and the Curve will be created.

The magic of Blend Targets - which is not available with the Blend tool alone - is that you can now select and move either or both targets and the curve will follow. You can even move them so the curve is nonplanar, and the curve will still keep up.

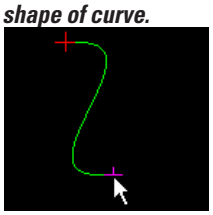
Line, Rectangle, Arc, & Circle

When modeling with targets, you'll usually want all the curves in the model to be created in the Target menu so that the model stays interactive - or, all curves keep up with the targets as you move them.

So we've provided some tools to create the "non Blend" shapes (they actually create Blend shapes we've tweaked to appear like other shapes - it's a math thing!) so you can use these in modeling without resorting to "non-Blend Target" tools.

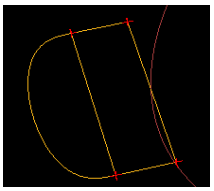


Place two Targets and create a curve between then. Moving either target changes shape of curve.

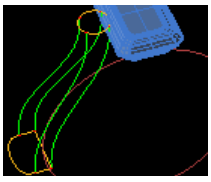


Line: To create a straight line between two targets, use the Line command and select both targets.

Rectangle: To create a rectangle, you will draw it from corner to corner just like when using the Rectangle command in the Curve menu. (None of the Curve tool options exist, so turn on Grid Snaps or use other means to get it placed just right.) Targets will be placed at each of the four corners.



A Rectangle makes a nice profile. Use Arc to make one end arced instead of straight, and delete straight end. Circle makes another Profile. Connect targets with four Curves as rails.



Arc: To create the Blend Arc, use the Arc command. Select two targets between which to draw the arc. The final mouseclick lets you orient the arc to the targets, so move the mouse to "swing it around" the two targets - which act like a hinge - until you like the placement. Then left-click to end the command. If it's not exactly the arc you wanted, skip down and read about Adjust Tension - the best tool for editing this simple shape.

Circle: To use a Circle in modeling, or to use the more traditional arc shape - the one that actually looks like it came from a circle, as opposed to the Blend Arc shape - use the Circle command. Anytime I need a half circle, a quarter circle, or maybe less (skip to the Blend Target Command "Split" - NOT the traditional Split command - to learn how to do this), I use this Circle tool and just delete what I don't need - remembering to leave a Target on either end of the curve so it will still be useful in Blend Target modeling.

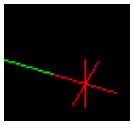
Note: While drawing a Circle, hold down Shift for Ortho to cause targets to appear at the four quads of the circle. Then, you can snap to the Midpoints of each target curve and Rotate the circle (select Targets and Curves together) to get targets angled correctly.

Six Tools to Edit Target Curves

It's more likely than not that a model you're trying to build with targets will NOT use all of the above shapes right out of the box. So you will likely need to edit these shapes using one of the six Target



Toggle changes approach of curve. Select curve and target on end to change. Click Toggle for 6 results.

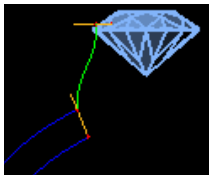


menu tools that do so.

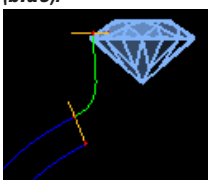
Toggle: This tool to edit target curves is the one I use the most. After you've drawn a target curve and you realize that it doesn't come in at the right angle to the Blend Target, select the curve and the target on the end where the curve is incorrect, and click Toggle. You can click toggle five times for five additional shape choices until you get back to the one you started from. If you know why this is, you get a gold star! ... Figure it out yet? It's because there are 6 degrees of freedom on each Blend Target - or, 6 axes from which the curve can approach the target, each of them on each of the 6 degrees of freedom (positive and negative X, Y, and Z).

With the curve and the target on the end you wish to change selected, continue clicking Toggle to toggle through each of the options for one end of one curve and the related Blend Target on that end until you like the results.

Set Tangency: This tool is especially useful if you are incorporating a ring rail or another round shape into your design; however, it applies to other Blend Target curve shapes as well. It matches the tangency of one curve to the tangency of the next curve so there will be no "kinks" or odd curvature in the design.



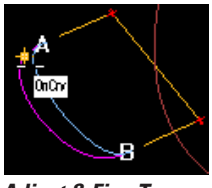
Set Tangency matches second curve (green) to tangency of first (blue).



To use this tool, start it up with NOTHING selected in the viewports. The "First Curve" is the curve to match - or, the pretty curve. The "Second Curve" is the curve you wish to change - or, the ugly curve. The ugly curve will be changed to match the tangency of the pretty curve, and all will be right with the world again.

Adjust Tension: This tool changes the curvature of a target curve by adding or taking away tension from the shape.

When you start up this tool, it will ask for the curve to edit. Select this curve, and you will be prompted for "A" and "B" - or, for which end or ends of the curve you wish to adjust the tension. You can choose one end to edit or both - sometimes, you need to experiment with different settings to get the result you want.

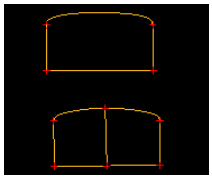


Adjust & Fine Tune: choose A and/or B end & move mouse to change curve shape.

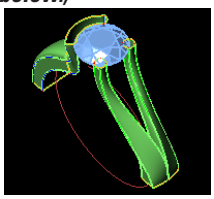
Upon choosing which end(s) to edit, mouse movement will be constrained to the curve - which will grow more tense as you move the mouse toward one end of the curve and less tense as you move it to the other end of the curve.

Fine Tune with Mouse: This command is like Control Point Editing for Target curves. If you turn on Control Points for target curves, you'll break their "targety-ness" and they won't behave as expected with other Target menu objects. Of course, if this is the result you want, that's fine with me: I can't stop you! But to keep them targety and happy, turn on Fine Tune with Mouse, choose one end or both to edit, and move the mouse to edit them.

Split: The traditional Split command breaks the Target nature of the curves as well. Instead, use the Split Command found in the Target menu. Select the curve to split, and select a point along that curve at which to split it. The curve will be divided with a Blend Target, so that both halves maintain their ability to continue interacting with the rest of the Target objects in the model.



When splitting a curve, remember that a profile and a rail must touch at each target for model to skin. Split corresponding curve also and add Line between. (Result below.)

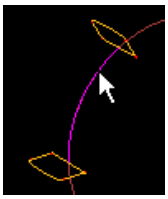


Make Planar: This command helps you keep targets planar so your model doesn't go nonplanar. If it does go nonplanar, select a minimum of three targets (including the bad one) and the nonplanar one will be brought back onto the plane of the correct ones. Sometimes, you need to select three or more "Correct" targets (on the right plane) to make this work.

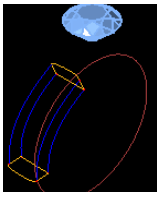
Mimic and Convert to Create Target Curves

And if none of those tricks work to get just the right curve you need for your model, there's always hope! Create a curve using one of the traditional Curve menu commands and run either the Convert or the Mimic tool found in the Target menu.

Convert Curve: Convert Curve places as many targets as are necessary to create a Target curve out of a regular curve. This is usually NOT the tool you want, since - unless the curve is very simple - you will end up with more targets than you can use! If you'll recall, a profile has to be placed wherever a rail is broken up by a target - which could mean a lot of work for you!



Draw arc and Mimic. 2D Scale + Copy to offset for thickness of ring & Move / Copy / Mirror to touch 4 profile targets.



Mimic Curve: Mimic is usually the tool you will use if you are drawing a curve using Rhino tools and wish to use it in a Target menu command. This command places a target on either end of the new curve - and none in between - so keep this in mind: usually, it must be a simple shape in order to work with Mimic. If it takes two or more complex turns, I personally would Split the original curve, then mimic two or more curves, and remember to position profiles at each of their "joints" or targets. For either tool, select the "Delete Input Yes / No" option in the Command line if you wish to keep or delete the input curve.

Using the Skinner Tool to Create Surfaces

And now the good stuff: if you were a diligent target modeler and you placed profiles at each of the "joints" of your target curves, kept profiles on one color and rails on another, and didn't' run any of the forbidden commands on any of your target curves (Split, Trim, Join, Control Point Editing) or otherwise foul them up (deleting targets, moving curves without selecting targets, etc.), you can use Skinner to create the surfaces of your model in one fell swoop.

Start up the Skinner tool and select one profile curve to indicate to the tool which layer color represents profiles. The tool will run as many 2-rail sweeps as it takes to connect all the rail curves with all their profile curves. Just note: Skinner does NOT keep up with changes to profiles and rails the way Sweep History tools do, so delete (or undo, hide, etc.) surfaces, make changes, and run Skinner again if you need to change the surface.

And remember: if you wish to use Skinner with curves NOT created by the Target menu, you need only make sure that your profiles are on one layer color - with rails on another - and that your rails and profiles are all perfectly touching, end on end (with no joined curves - the end of a rail curve must match the end of a profile) and Skinner will skin that model for you, as well! Be sure to say "Thank you" when it's done.

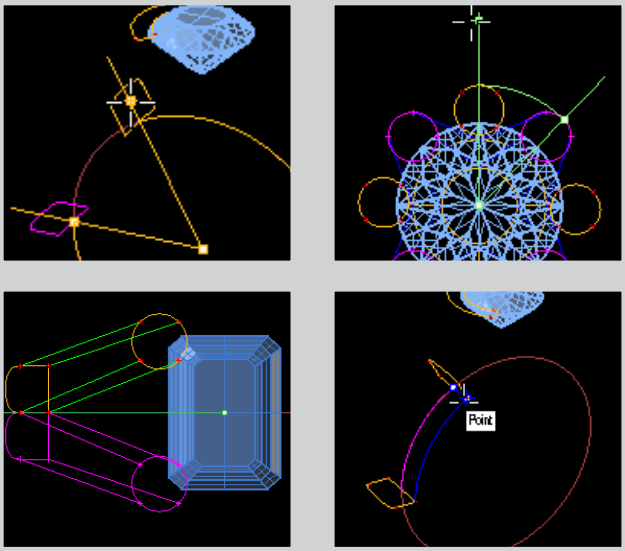
Layer Colors & Skinning Models

Do NOT forget to place profiles on one layer and rails on another. Truth be told, rails can be on several different layers, as long as profiles are on one unique layer color that is not used elsewhere in the design. If this rule is broken, Skinner will not work, and you'll have to go back through your model looking for profiles and placing them on the correct layer color. Also, if you select the wrong layer color during the Skinner command, you will get one weird-looking model!

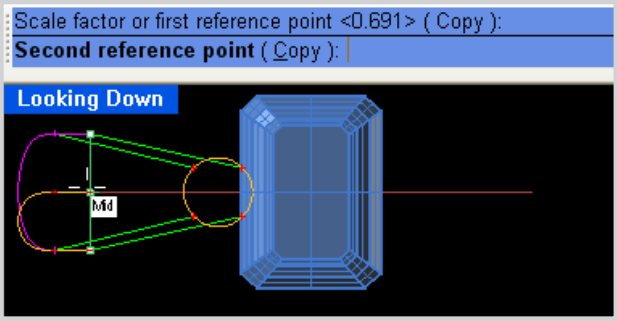
Finally, I like to select a NEW layer color that I HAVEN'T used before and make it active right before I run the Skinner command. That way, the new surfaces are all on one unique layer, and when I need to select them all for - say, Delete or Join - I won't inadvertently select any of my Target curves, for whom either Delete or Join would both end their careers as Target curves!

Blend Targets Rules for Modeling

Commands that "Break" Targets The following commands will cause curves to lose their ability to relate to their targets and "keep up" as you change them with Target commands: Split, Trim, Join, Curve Boolean, Control Points/ Edit Points On, Offset, Fillet/Chamfer, Pullback/Project, Rebuild/Fit, Curve from 2 Views, Match, Extend, and Divide Curve. ANY TIME you are using one of the methods cited below to manipulate target curves, it is IMPERATIVE that you select the curve AND one or both of its targets. Moving the curves around on their own BREAKS the target nature of the curve. Note: I would turn off Rhino History when using Targets, just to be safe!

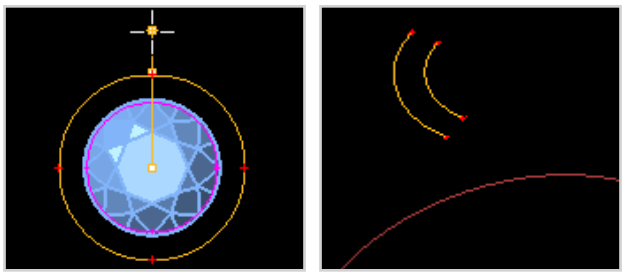


How to Mirror/Rotate/Copy/Move Target Curves As long as the curve and its target are selected, you can run the Mirror / Copy / Rotate / Move commands with no problems. If the command is going to place a target RIGHT ON TOP OF another target, the two will become a single target that connects all adjoining curves. This is fine, normal, and in fact fundamental to Target modeling, as you'll recall! Note: Targets are recognized by the program as Point O-Snaps, so use this to help you "find then" onscreen when placing them precisely.

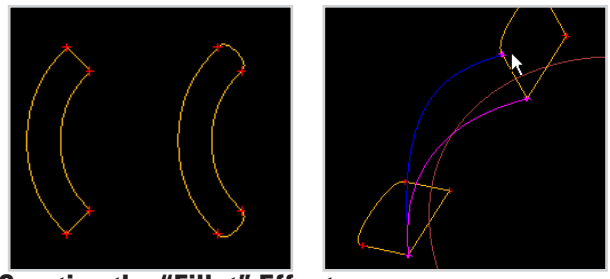


Transform Menu Commands Many of the Transform menu commands work great for manipulating target curves. As long as you select the curve and one (to stretch it) or both (to relocate it) of its targets, then Scale 1, 2, 3, Orient 2 & 3, and Rotate 3D will all be kind to targets.

Tips & Tricks Blend Targets

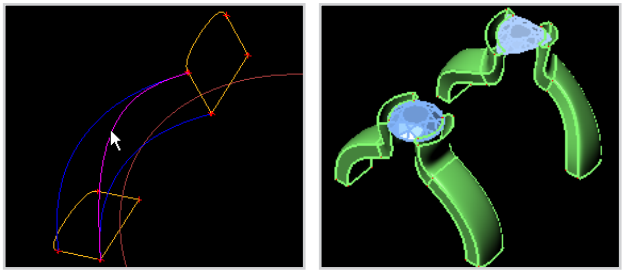


Creating the "Offset" Effect Since you just read that Target curves don't maintain their relationship to their targets when using the Offset command, what do you do if you need to offset a target curve? I like to select the curve and BOTH of its targets and use 2D Scale with the Copy option turned on to duplicate it. To create the half-bezel effect above, use the Target Circle command and 2D Scale with Copy on to "Offset" it (left). Rotate both curves from the MidPoint of one Blend Target curve, so targets are at 45 degree angles to quads of circle, and Delete all but two curves for the half-bezel (right).

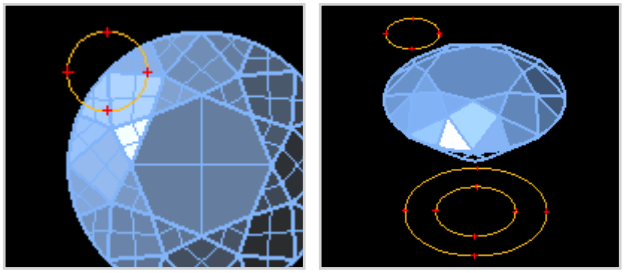


Creating the "Fillet" Effect Fillet is another helpful curve command that would break target curves. Instead, use "Set Tangency", selecting the round curve (the curve to keep) first and the straight curve (the curve to change) second.

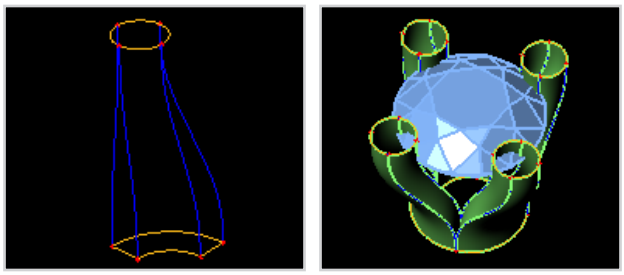
Copying Target Curves Used in more advanced models, this technique allows you to copy target curves to match the edges of profiles, like an Orient 2 Points with targets alone. Begin by selecting the curve and a target on ONE end only. Then, Copy these to a new point, leaving two target curves that end in a single target. Select the new curve and the target on the opposite end, and run "Copy" again. Copy this to the new location. Then,



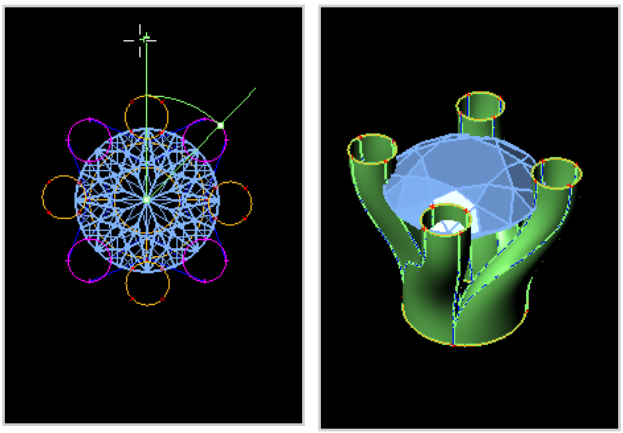
Delete the unnecessary curve. The model above was completed with the techniques discussed earlier, including Set Tangency to match the green curves to the blue, and finally Skinner to create the surfaces. Delete the surface, and you can easily place a new size or shape of stone and scale the half bezel to fit it. Experiment further: for example, rotate the half bezel so the design is asymmetrical. The possibilities with Blend Targets are endless!



Blend Target Head To practice using targets, set a small Target Circle beside a stone where you'd want the top of a prong to be positioned. Set a large Target Circle to represent the base of the head. Use the above method to "Offset" the base of the head with 2D Scale & Copy, creating its thickness. Delete all but two quadrants of the head's base. Using the Target Line command, connect the ends to create a profile. DON'T join them. Using the Target Curve command, connect the four sets of targets in the top and bottom prong profiles. Now, Mirror the prong (curves AND



targets)- and Mirror the pair again - to create four prongs. Skin the model to see the results. Now, delete the surfaces and Rotate one set of profiles 45 degrees, creating a new look for the head. The rail curves will follow their profiles, creating a twisted head design. Re-Skin to complete.



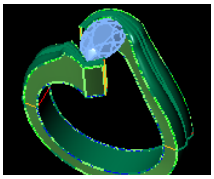
Advanced Surface Creation ...

Sweep 1, 2, & Surface Modeling

Similar to the two Sweep History tools available in Matrix, Rhino Sweep tools offer additional options for creating surfaces.

What's the Difference?

Rhino Sweep tools work along the same principles as Matrix Sweeps, applying one or more profile shapes along one or two rail curves that run roughly perpendicular to the profile or cross-section shapes being applied. But the two Rhino Sweep tools don't offer the powerful History functionality of the Matrix Sweep tools, so you'll find that you'll probably use them less in everyday designing.



Surface Modeling uses precise profiles and rails for maximum control.

One good reason to use them is when sweeping rails created with the more advanced custom rail tools, such as Advanced Custom Rail and Curve from 2 Views. They are also commonly used in Surface Modeling, which works by applying open profiles attached to two rail curves at a time to get precisely the shape of surface that you want.

In most basic applications, Matrix sweeps (Sweep 1 History, Sweep 2 History, and Multi-Rail Sweep History) will work just fine. However, in instances when you will need more control - as when surface modeling - and the History functionality is not as important as getting just the right shape for your model, you will find these Rhino sweeps more helpful.



In Surface Modeling, place unjoined profiles touching rails and run several Sweep 2's.

Creating Profiles for Advanced Sweeps

To sweep shapes such as the most advanced ones we learned earlier in this chapter, it is best to connect rails with unjoined profile shapes that start and end at corresponding points on each of the four rails (start and endpoints of profiles touch both one another and endpoints of rails; also, profiles are planar with one another for best results). Remember: do NOT join the profile shapes. Now, run Rhino's Sweep 2 between two rails and the profiles that touch them. (You can try Sweep 2 History, but the "History" part is difficult to use to the best of its ability, because if you move rails or profiles, they "pull away from" one another, and the surface can "break" because it is no longer true to either one. Rails and profiles must be touching so as not to get broken models or untrue surfaces when using this technique.)

Continue sweeping rails and profiles until all four "sides" of the surface are complete. Now, you should be able to Join all surfaces and Cap or otherwise close up the model.

Creating Rails for Advanced Sweeps

Of course, we'd love for you to use all the Matrix tools as your disposal to create these. We also advise this - above all, because they have History

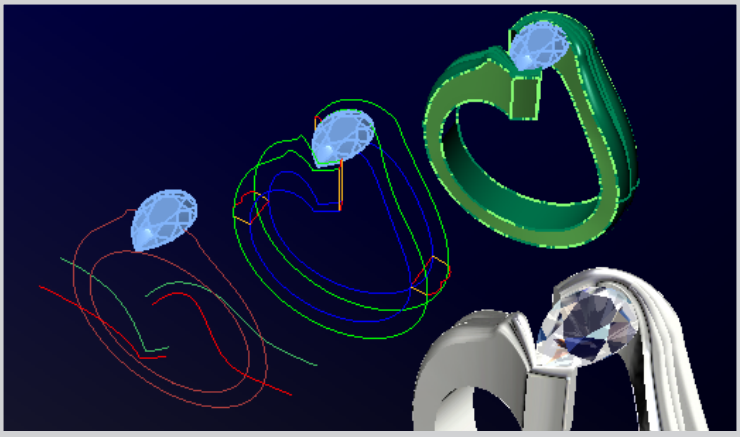
When to use each Sweep

Use Matrix Sweep 1 History to sweep one or more cross-section shapes along a single rail curve.

Use Matrix Sweep 2 History to sweep one or more cross-section shapes along two rails.

With Matrix's Sweep History, You can easily switch out profile shapes and change aspects of the profile or rails, and the surface will quickly change in real-time as you make your edits.

Use Rhino Sweeps when you need to sweep to a point, or to sweep more than one curve in a row and have it serve as a single rail. Also use when you need to adjust the seam points (surface twists on Sweep History commands).



In the sequence above, rails were placed with Advanced Custom Rail, Profiles drawn with Curve Tools and O-Snaps to touch rails, and rails were swept with 4 instances of Sweep 2 (Profiles unjoined) for a "Four-Rail" Sweep.

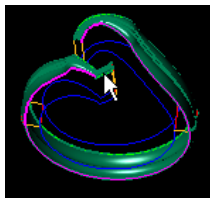
capability. However, there are other ways to draw rails for advanced Sweep operations, using all of the Curve tools at your disposal. Blend, Curve from 2 Views' History, and Rebuild are all commonly used in modeling advanced rail shapes, so as to create the smoothest shapes possible (Blend), ensure they fit around a finger rail and/or outer rail (Curve from 2 Views' History), and won't "break" when swept (Rebuild). More Advanced Transform, Curve, and Surface Menu tools taught later in this manual will also assist you with drawing these curves.

Additional Options in Rhino Sweep tools.

Rhino's Sweep 1 and Sweep 2 do offer some additional options in both the Command Line and in the Sweep Options Dialog that the Matrix Sweep History tools don't offer (since they're working so hard on keeping all that History in mind!).

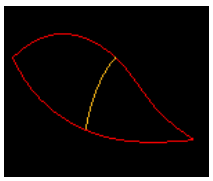
The Chain Edges Option - The first difference you'll notice when running one of these Sweep tools is that the Command line offers you several additional options. Select "Chain Edges" in either command in order to pick more than one touching - but not joined - curve to act as the rail. When this option is selected, the tool will ask you to select every curve (or touching polysurface edge curve) in a row that will make up one rail; then press Enter. For Sweep 2, you may choose this option for one or both rails.

The Point Option - Select the "Point" option when choosing profiles for the sweep, and the surface will be able to sweep to a point using one of the two Rhino Sweep tools. The Point option can be used before, between, or after selecting other profile shapes. You may use the Point O-Snap to snap to an existing Point Object you've placed in the viewports; or you may place a point anywhere in space to sweep to (use OSnaps to help you snap to other geometry when placing this point).

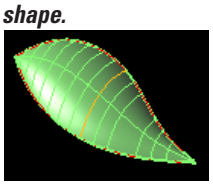


Select Chain Edges when using 2 or more curves or surface edges that touch as a single rail curve.

There are a few rules for using this option: during Sweep 1, the Point will be constrained to somewhere along the rail curve. During Sweep 2, the Point option cannot be used when closed rail curves are selected.



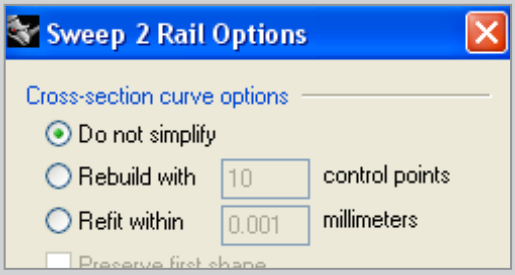
Sweep to a point (twice, here) to create a pointed shape.



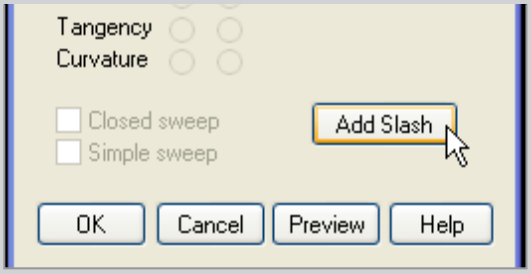
Another important rule of Sweep tools is that only 2 or more like (closed or open) rail curves or profiles may be selected. You cannot select one of each (open and closed) when selecting rails or profiles. Of course, open rail curves may be swept with closed profiles and vice versa. The stipulation is that any two rails selected in the same operation must both be either open or closed; and the same rule applies when selecting two or more profiles together in the same Sweep operation.

Sweep Options Dialog

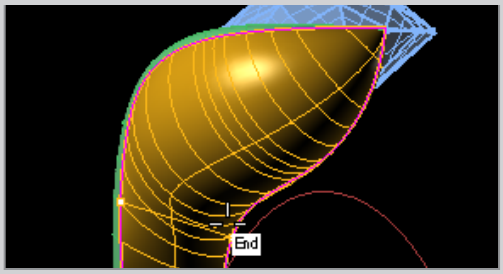
The Rhino Sweep Tools also offer additional Dialog Box options. The type of sweep associated with its option is noted below.



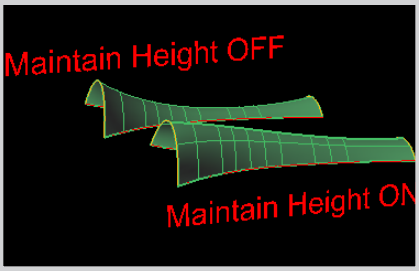
Both Closed; Do Not Simplify; Rebuild & Refit With two or more profile curves swept along closed rail curves, the surface can be continued past the first profile to touch the last, using "Closed Sweep". "Rebuild" and "Refit" allow you to set control points or a tolerance to which the tool will first rebuild or refit the curves. "Do not Simplify" will do nothing to the curves.



Sweep 2 Add Slash One of the most powerful options available in Rhino Sweeps, Add Slash can be used when the surface seems to "twist" or not align itself properly in a certain area of the sweep. Usually, this means you need a profile in this location. However, instead of having to go to the trouble of figuring out the correct size, shape, and location for this profile to correctly control the sweep, placing it, and re-running the Sweep command, just click "Add Slash". Click on two points that are roughly parallel on the two rails (or use the Perpendicular O Snap to assist), and the new curve or "slash" will re-align the surface at this location. Add as many slashes in this way as you need to heal the surface.



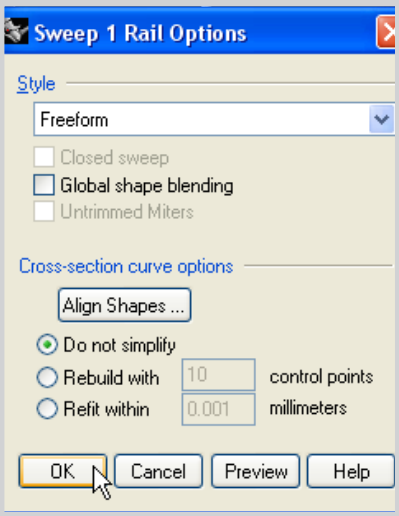
Sweep Options Dialog cont'd. Sweep Dialog Box Options Continued.



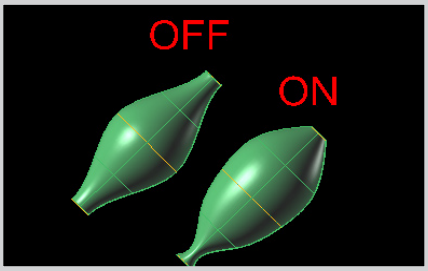
Sweep 2 Maintain Height When creating a surface, Sweep 2 usually maintains a relationship between the height and the width: where the rails are wider apart, the surface is taller; where they are closer together, the surface is shorter. To keep the height consistent regardless of width, turn ON Maintain Height.

Sweep 2 Preserve First / Last Shape; Position, Curvature, & Tangency When edge curves are used as rails, this can cause the surface to pull away from the selected profiles. "Preserve First / Last Shape" forces the surface shape to match either the first or the last profile curve selected. Also when using edge curves as rails, three continuity options are available to assign either "Position" (touching), "Tangency" or "Curvature" (two different shapes of curvature) relationships between the new surface and either A or B, which refer to the two rails you selected.

Sweep 2 Simple Sweep Use this option to create surfaces using exact input. It will generate simpler surfaces, so that the resulting surface inherits the structure (control points) of the input curves.



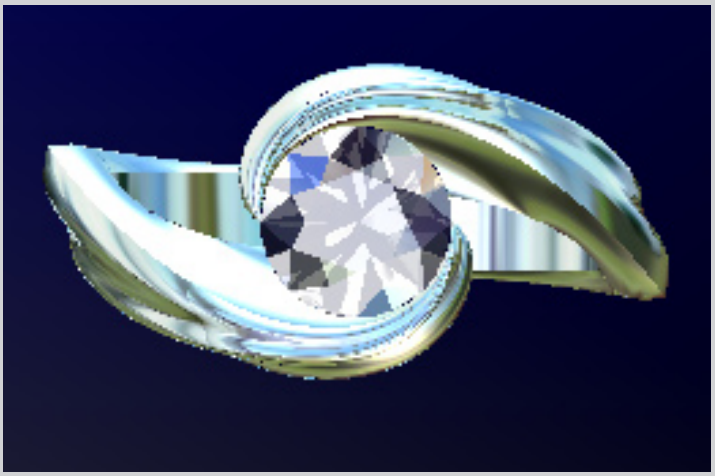
Sweep 1 Style The default "Freeform" style rotates the profile curve to maintain its original angle to the rail throughout the sweep. The remaining options (Roadlike Through Finger, Side View, and Looking Down) maintain the angle the profile had to the rail in the indicated viewport throughout the sweep.



Sweep 1 Global Shape Blending When sweeping between two or more profiles, turning ON this option will sweep a linear surface that tapers evenly from one profile to the next. With this OFF, the sweep will hold one shape much longer, and taper more rapidly to fit the next shape.

Sweep 1 Align with Surface When using Sweep 1 with a surface edge as the rail, turning this option ON will cause the new surface to be tangent to the existing surface. Turning this OFF will make no tangent relationship between the two surfaces.

Sweep 1 Untrimmed Miters If the sweep creates a polysurface with kinks (hard corners), turning this ON will ensure that the resulting surfaces are Untrimmed. If it is OFF, they will be Trimmed surfaces (with additional control points located off the surface, meaning they are more difficult to use in UV Curves commands).





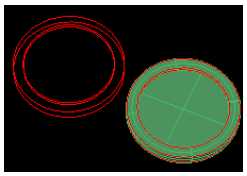
Advanced Surface Creation ...

Using the "Loft" Tool

The most basic surface modeling tool, Loft creates a surface that fits through one or more curves in a single direction.

Preparing to Use Loft

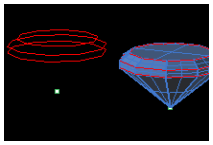
The curves you will Loft must be either all open curves or all closed curves. For best results, they should all be in the same direction (roughly parallel to one another), instead of located at perpendicular angles, located at odd angles, or located on a single plane in space.



Loft is an easy way to model a coin.

First, Select Curves and/or a Point to Loft

Select the curves to loft in the order that you want the surface to pass through them. It is also important that you click on each curve at the same location on the curve (on the same side of their midpoints) when selecting them, or else the Loft surface can twist (there is a Loft Dialog Option available to remedy this).



Use Point option to Loft to a Point object. Rebuild curves first, degree 1, to create gem.

While selecting curves, you will see the Command Line option "Point". Click this to bring the lofted surface to a point as part of the loft. It will allow you to set a point in the viewports to include in the Loft operation. The Point object must be at one end of the Loft (not somewhere in the middle).

Command Line Options for Closed Curves

When selecting open curves, the Loft Dialog will immediately appear so you can complete the command. When selecting closed curves, you will first be asked to adjust the seam points on the curve. All seam points should be roughly in the same location on the curves, and pointing in the same direction.

To change a seam point's location, click and drag the base of the arrow representing the seam point, and left-click again to place it when it's located in the desired spot on the curve. To change a seam point's direction, approach the arrow with the cursor, and an arrow pointing in the opposite direction will appear. Left-click when you see this arrow, and move the mouse away from the seam point. The new arrow will remain.

Another way to change the seam points uses the Command Line options "Flip", "Auto", and "Norm". Flip reverses the direction of the seam point, while Auto and Norm allow the program to figure out where the Seam Points should go naturally (sometimes it does a good job at this; sometimes it does not, and you'll need to arrange them by hand, as explained above).

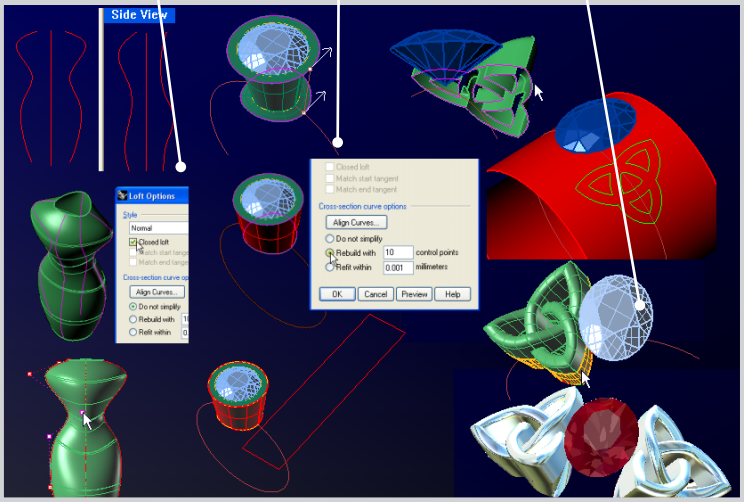
Change the seam points for any and all closed curves in the Loft so that they all match (same direction and same location on the curve) before pressing Enter to access the Loft Options Dialog box and complete the command.

Uses of Loft

Turn on Rhino History before running the Loft command. Use Loft; then, you may edit the curves and the Loft surface will follow. "Normal" Loft used here: Straight loft doesn't give you these organic shapes.

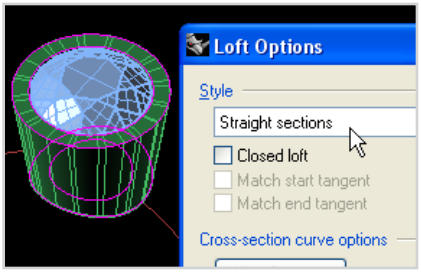
To create a surface you can use with UV Curves, set seam point to unobtrusive spot on curves. Use Curve from 2 Views on bezel curve & ring rail. Loft with this curve, creating inside of bezel in one Loft and outside in another. Use Rebuild option to rebuild outside of bezel into 1 surface.

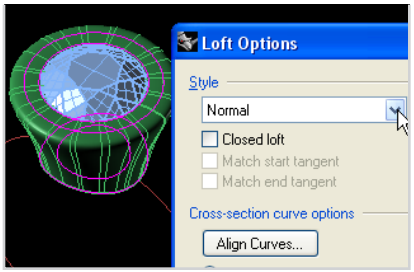
Extract Surface to uncap a solid and Dup Border to get curves from edges. Then, Extrude finger rail and Pullback edge curves to get curves that match finger rail. Split extruded rail with edge curves, delete remainder of surface, and Loft between two shapes. First shape now touches rail shape.



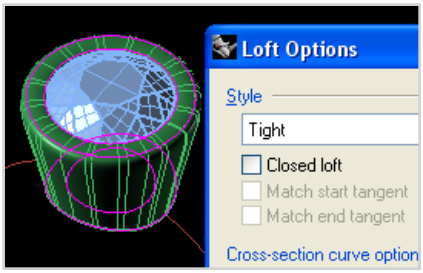
Loft Options Dialog

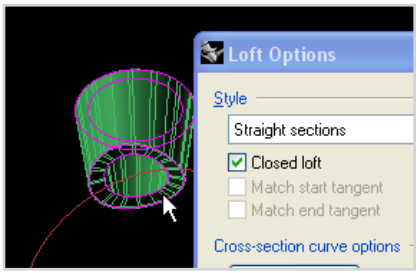
Select the options outlined below and click OK to complete this command





"Style" Option Change the shape of the Loft using these options. "Straight Sections" creates straight surfaces between curves. Since it's also the most predictable outcome, it's the most common use of Loft that we recommend. The remaining options are more freeform, with different degrees of variance from their input curves: "Normal" places "normal" stretching throughout the surface. "Loose" places surface control points where input curves' control points were located. "Tight" surfaces closely follow the original curves. Use this when curves go "around a corner". "Developable" creates a surface you can easily use in the "Unroll Srf" command, which is only used when you want to cut the surface out flat so you can work it by hand into the shape of the surface upon production. "Uniform" guarantees that every control point will affect the surface the same way upon creation.

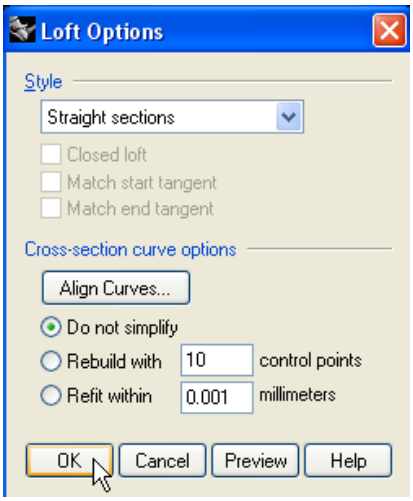




Closed; Match Start & End Tangent With three or more curves selected, you'll get these options. "Closed" continues the surface past the last curve and around to the first. Match Start & End Tangent appear when the start and/or end curve is a surface edge, so the tangency of the new surface will match the old.

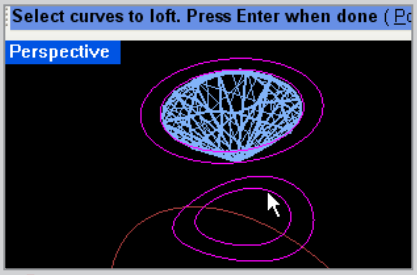
"Align Curves" Click this if you accidentally selected one of the curves on a different side of its midpoint, causing a twist in the loft. The Command Line will prompt you for the curve or curves to flip. Select them, then press Enter to return to the dialog box.

Rebuild & Refit Options Select these options to rebuild (with the number of control points you select) or refit (to the tolerance you indicate) the curves making up the loft. This can make for a smoother, more even surface that can be more successfully used in future operations.

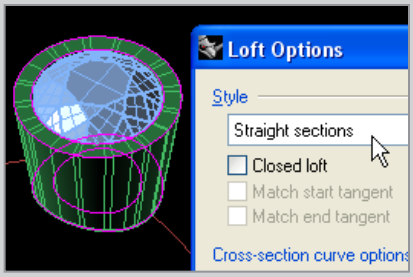


Step-by-Step

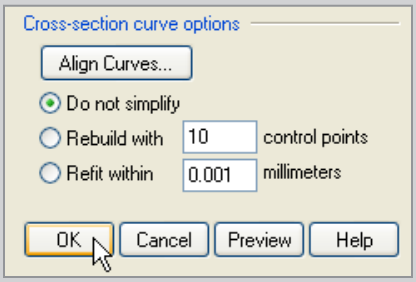
Using Loft



1 Select curves to Loft Select curves in the sequence that the surface will be created through them. Click them in the same location during selection. Assign a Point last, if it will be used. In the case of Closed curve, set Seam Points to same location and direction on curves.



2 Set the Loft Options desired According to descriptions at left, set Loft Options to determine the shape of the Loft. Click Preview to sneak a peak at the outcome, and change any further options you wish to change.



3 Click OK If Rhino History was on before using Loft, you can now move, control-point edit, or rotate original curves and the edits will change the shape of the Loft surface.

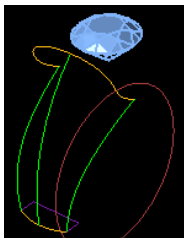


Advanced Surface Creation ...

Using Curve Network

This History-Enabled Rhino Command creates a surface from a "network" of curves in perpendicular directions.

Preparing to Use Curve Network

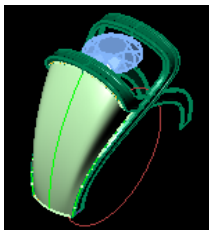


3 "rail curves" (green) & 2 "profiles" (yellow) perpendicular to them make up the "network".

When you have more than one "rail" curve, and two "Sweep 2" operations leave a strange kink in your surface (the unofficial term for that is a "butt"), try using Curve Network. To use this tool, all curves in one direction must be crossing over curves in another (usually perpendicular) direction, and curves in either given direction should not cross each other. For best results, perpendicular curves should be touching one another, but they don't need to be: it'll just give you a more predictable outcome.

Running Curve Network

To run this command, simply select all curves in the network. Sometimes, the command will prompt you to select curves in one direction and press Enter; then select curves in the other, perpendicular direction. Therefore, you may wish to start by selecting curves in one direction first; then selecting curves in the other direction, to give the program a head start on sorting out which is which. Set the Dialog Box options for this command to complete it.



Curve Network creates light green surface to fit perfectly with darker green one.

Curve Network Options

The one Command Line option, "No Auto Sort", lets you assign curves in the two directions yourself, so the tool does not attempt to autosort them for you. Use this if the results of the autosort were incorrect; or if the tool has trouble auto-sorting your curves.

The Dialog Box options begin with "Tolerances". You'll notice that this tool, in contrast with Sweeps and Lofts, often causes the surface to pull away from the curves! That's why it's a tricky command to use. Setting Tolerances for how close the surface is to Edge Curves (in one direction) and Interior Curves (in the other direction) will help, but often not perfectly solve, this phenomenon, based on the curves you input.

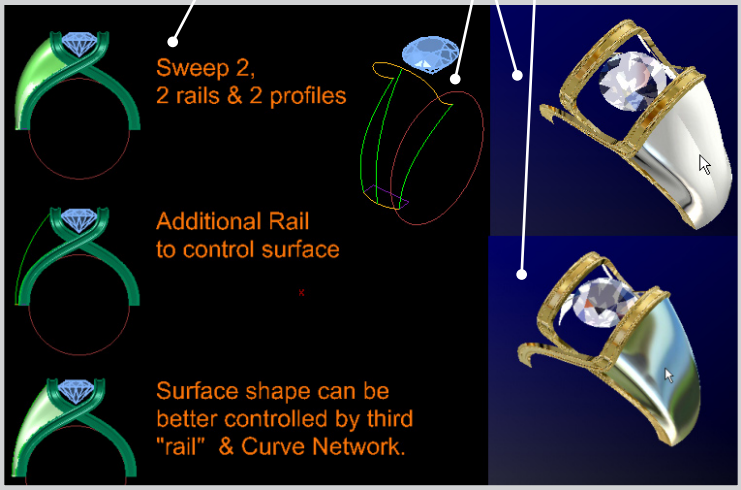
The Edge Curves default is the System Tolerance (0.01 in Matrix). The Interior Curves' default is set to the system tolerance X 10 (0.1, therefore). If the curves are a greater distance apart from one another (i.e. they don't touch) than this value, the program will make an educated guess as to the best location of the surface.

When to Use Curve Network

You likely won't come upon it frequently, but when you have a model that needs to be controlled by three or more "rail" curves with "profiles" running perpendicular to them (and touching them for best results!), you will find no better way to create the surface than with Curve Network. In this model, compare the results of Sweep 2 WITHOUT the additional "rail" - the surface can be better controlled with the third "rail" curve.

But, when you go to sweep it now, you get the... well, "butt" shape in your surface - it seems like a mystery the moment it happens, but trust me, it'll happen...

To get rid of that result, select all the curves (profiles must be Joined to one another but not to rails) and run Curve Network. The smooth result is shown below.



L - R: Two yellow profiles swept with just TWO green rails doesn't provide as good surface control as adding a third rail curve; Perspective view of rails (green) and profiles (Yellow: important to Join profiles). Above, Right - if you sweep this shape with 2 Sweep 2's: see the "butt"? Below, Right - With Curve Network, you get a smooth surface.

The Angle option accommodates edge curves that are surface edges. The Angle option is the accuracy with which the new surface will match the tangency of the existing surface (whose edges are used in the Curve Network). To match the edges of the surface to the input curves, select the "Edge Matching" options for any of the four options offered. Each option will change the shape of the surface slightly or dramatically, based on the shape of the input curves. "Loose" will match the surface to the input edge curves with less accuracy. "Position" will give them surface position continuity with the edge curves (cause it to touch only). Tangency and Curvature will give the new surface two different levels of curvature as they interact with the input curves.

Curve Network with History, and Other Pros and Cons of Curve Network.

Although the surface can pull away from its curves because it's a different kind of construction than a sweep, there are some Pros to using this tool. One is, obviously, that it creates surfaces that no sweep could do!

Another is that it works with History. Before running Curve Network, turn Rhino History on. Now, after running Curve Network, you can begin to adjust input curves, and the surface will keep up with your changes! For best results, turn on Control Point editing for BOTH curves. That way, if you move any endpoints, you can grab other curves' endpoints that the surface is also relying on and the surface will keep up as expected. Leaving behind certain curves or Edit / Control Points may prevent the surface from acting as expected with History.

One "con" to using Curve Network is that you can't then use UV Curves on the surface: if you notice the cross-hatching on a Curve Network surface, you'll notice that it doesn't retain the "U" and "V" perpendicular wireframe look of the swept surface. Keep this in mind.

Finally, try using Curve Network, Sweep, and Patch on the same set of curves to compare how the surfaces created by each of the three tools differ. Curve Network usually makes a more puffy, smooth surface: just beware that it can pull away from the edges. Patch is often more flat and contoured, while Sweeps stay more faithful to their input curves than the other two commands.

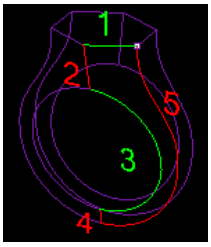
Advanced Surface Creation ...

Using the Patch Command

This sophisticated surface modeling tool fits a surface through curves and point objects. Use where Sweeps or Curve Network just won't cut it!

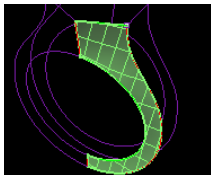
Why Patch?

When From Planar curves fail because curves are not planar; and Edge Curves creates an undesirable (too-flat) result, there is always Patch. Although it is similar to both of these tools and can usually be used successfully in their stead, it is a lot more powerful, too.



The "5-sided condition" stumps Sweep 2 & Curve Network . . .

Like Sweeps or Curve Network, Patch can handle curves in opposing or perpendicular directions; however, for best results, these should all be edge curves. Patch can also accommodate point objects, though the applications for this in Matrix are slim to none. (I've never personally come across one!)



. . . but it's perfectly matched to Patch!

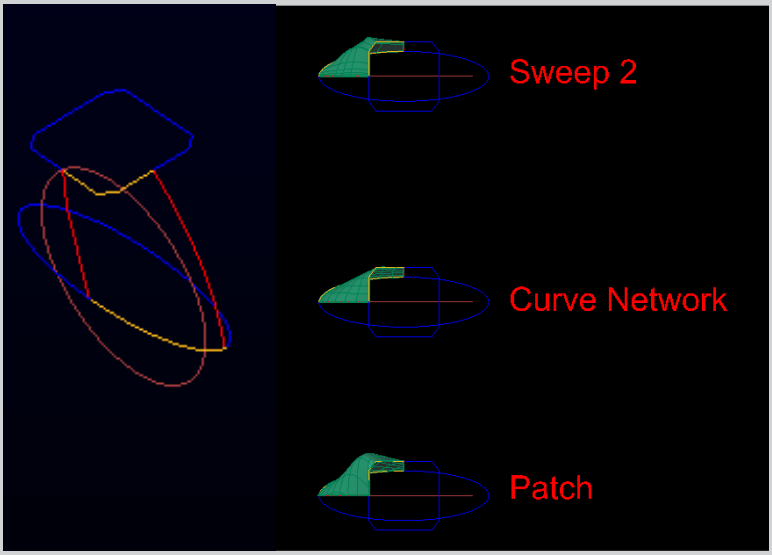
One interesting bit of trivia, though, is that the

Compare Patch, Curve Network, & Sweep 2

The familiar signet ring is a great way to compare these three tools. On the left you have the curves that were swept (red rails, yellow profiles).

Sweep 2 adheres to the rails & follows the profile shape.

Curve Network is much more relaxed, while Patch is looser overall in interpreting the profile shapes:



Surface Pullback command actually offsets a number of point objects back in space from the shape of the original surface, along with a copy of the curve you input. Using these points and the curve, the program actually runs the Patch command to create the surface that results from using this tool! Hence the cross-hatching in that surface that is so tell-tale of using the Patch command.

However, also keep in mind: like Curve Network, a Patch surface has no clear "U" and "V" directions, and therefore cannot be used in a UV Curves command. So use it with care, and note that it is not recommended (or necessary!) for daily use in Matrix. However, it certainly has its applications, in models that no Sweep could correctly handle!!

Using Patch

Simply select all the point objects, curves, and surface edges you wish to use to create the Patch. For most predictable results, curves should touch, end on end (have Position Continuity). Next, select from among the following Dialog Box options, and click OK to create the Patch Surface.

To build the surface, Rhino finds the best fit plane through selected and sampled points on the curves. The Patch Options dialog assigns how it will do this. (P.S. - I almost NEVER touch these options, but here are their explanations anyhow...)

"Sample point spacing" helps Patch make the surface by sampling points from input curves, at a minimum of 8 points per curve. "Surface U and V spans" assign the resulting control points in each direction on the surface; or, the cross-hatching pattern you see in the wireframe.

"Stiffness" lets you assign how much the best-fit plane that Rhino has come up with will be deformed by information from the input curves. The reason you use Patch is that, usually, the input curves are not planar or flat; but the tool is trying to figure out a plane, and then deform it. A larger Stiffness setting makes the resulting surface stiffer and more planar. Use the "Preview" option to check the result of changing this - and other - dialog box option.

Select the "Adjust Tangency" option when input curves are surface edges in order to match the resulting surface to the tangency of the existing surface.

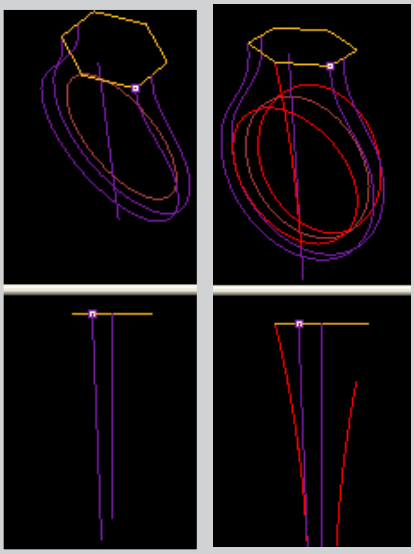
The "Automatic Trim" option finds the outside curve and trims the surface to it. Believe it or not, Patch can create a surface that pays no regard to the boundaries set by the curves you input - it merely uses their shape! When you want it to use these curves as a boundary - or at least attempt to, since this option is not always successful given the complexity of the shapes you input - select the Automatic Trim option. Otherwise, a rectangular plane that merely passes through your input curves will be created!

With a "Starting Surface", or, a surface with the patch curves located over it, the tool can trim and change the shape of the starting surface automatically in a single step. Click this option to select the starting surface. It is best if the Starting Surface is similar in shape to the surface you are trying to create. "Starting Surface Pull" is similar to stiffness. The bigger this value, the more influence the starting surface you select has on the shape of the new patch surface, making the shape of the Patch increasingly closer to that of the starting surface the larger your numbers are.

"Preserve Edges" is also used with Starting Surface. It holds the edges of the starting surface in place when you don't want the original surface to move, though you do want the Patch curves to influence its shape.

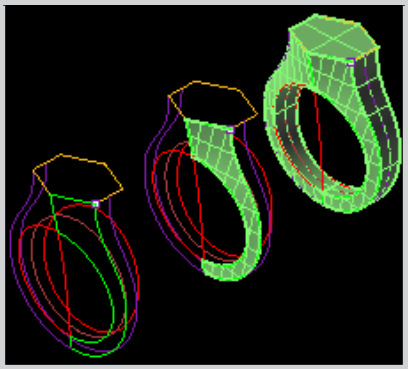
Tips & Tricks Patch

This ring is representative of the type of situation in which you'd need Patch.



"Signet Ring" Profile Set up the top profile the way you learned to build a Signet Ring from scratch earlier in this manual. Because the top profile is hexagonal, an extra angle is added (two angles red and purple, at left), creating a 5-sided condition that makes this surface impossible to create with Sweep 2 or Curve Network. Draw a bottom profile in the 6 o'clock position.

Curve from 2 Views Rails Place planar curves in two viewports and use Curve from 2 Views to orient them to the profiles. Make certain they touch the profiles. If necessary, "cheat" by using Orient 2 Points to get them to "stick to" the profiles.



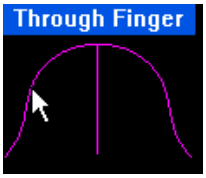
Patch Surface Select all five curves that make up the surface (you may need to Split or Explode them so each one ends where the next one begins). Remember to make certain they touch, and run Patch. Mirror this, and Loft or Sweep 2 to complete the ring.

Advanced Surface Creation ...

Cross Section Profiles

Create Cross-Section Curves through several different (parallel) curves known as "Profiles" in this command.

Using This Command

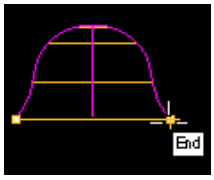


First, select the "Profiles", or curves across which to place cross-sections one by one, in sequence.

This command creates cross-section curves that touch several different and (more or less) parallel curves known to the command as "Profiles". Though you may think of the resulting curves or cross-section curves as profiles after completing this command, it is the original, existing curves which are referred to as "Profiles" when running the command.

To begin this command, start by selecting the "Profile" curves, which usually run roughly parallel to one another. Select them in the order you want the curves drawn, since they'll go from one profile to the next, in sequence.

Next, select both ends of the "Cross-section" plane. If you can imagine creating a plane that intersects all of these curves, and then running an intersection between the planes and the curves, you can imagine how this tool works.



Next, draw planar lines across profiles to create cross-section curves.

In the Command Line options, select whether or not you want these Cross-Section curves closed.

After running this command, the tool that will use all the curves (original profiles and new "Cross Sections") very successfully to create a surface is Curve Network.

Steps for Using C-Sec Profiles

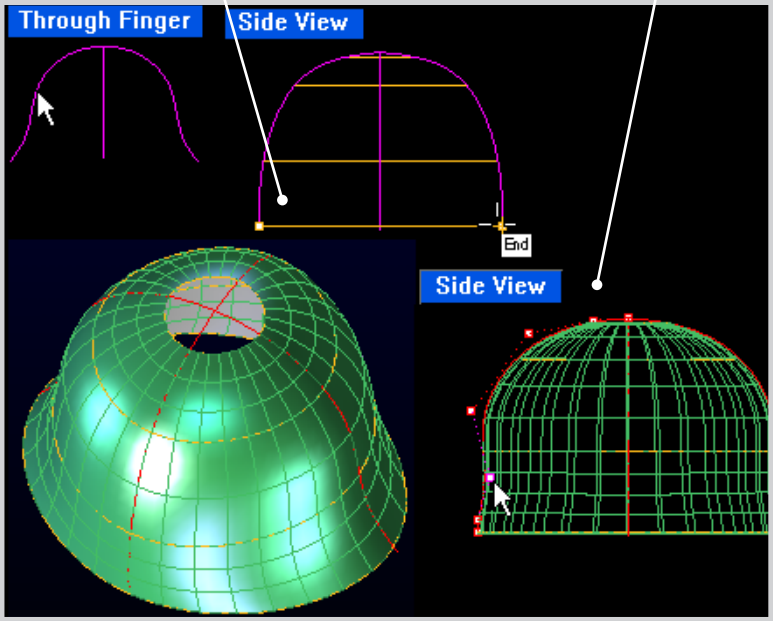
1- Select "Profiles", or, multiple nonplanar curves through which you want to draw cross-section shapes that touch them all. Select them one by one, in sequence.

2- To locate profiles, place two ends of a line in the viewport where you can see the "profiles" best, and angle the lines at the angle you want the cross-section curves (usually perpendicular to "profiles).

3- Continue placing profiles till you're done.

4 - Now, you can use surface modeling tools to complete your design.

Completing this design with a tool like Curve Network allows you to use History to edit it (edit curves with Edit Points on or Control Points on to change surface).



Note: What Matrix Manual would be complete without a helmet model?



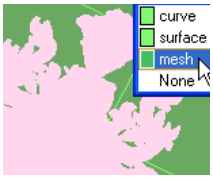
Advanced Surface Creation ...

Using the Drape Tool

When you wish to use Matrix tools with meshes, Drape can be used to place a surface over any object(s): meshes, surfaces and solids.

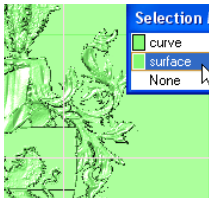
About Drape

With mesh, surfaces, or solid objects in the viewports, Drape will create a Nurbs surface that literally "drapes" over these objects, keeping their shape from the top-down, but accommodating no "undercutting".



Before Drape: you have a mesh but need a Nurbs representation of it.

It's most commonly used in Matrix when a Nurbs surface is needed where a Mesh object existed. Usually, this is no longer an issue, because Mesh Booleans are possible. However, some Matrix tools can only accept Nurbs input, not mesh input - such as Pave builder, Gem on Surface, etc - and, if these tools are needed on a mesh surface, you'll need to first create a Nurbs surface that follows the contours of that mesh. Drape is your only option for this!

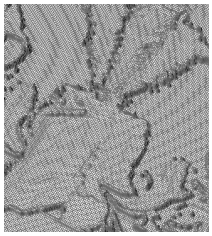


After Drape: A surface is created that follows contours of mesh.

Just beware that there are limitations to Drape: it is not a UV Surface, so it can't be used with Create and Apply UV Curves. Also, it is sometimes squirrely, in that - when you try to Split it with a curve - it can have unexpected, "raggedy"-edged results. But when you wish to apply Matrix tools to meshes, Drape is your best bet!

Using Drape

When starting Drape, you'll be prompted to click and drag a rectangle, corner to corner, over the extents of the objects you want included in the Drape surface. A surface will be created that looks as though a tea towel was dropped daintily over the objects, covering them so the new surface follows their top-down contours (no undercutting included).



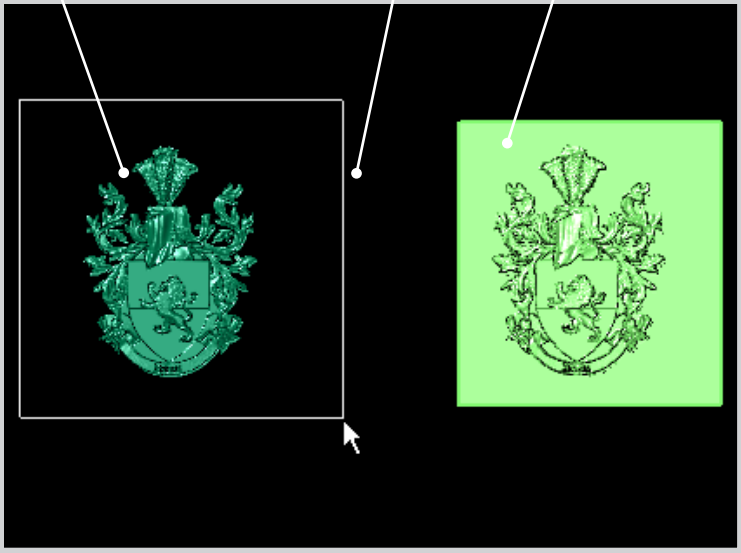
Smallest (most dense) Point Count yields best detail but takes longest.

Steps for Using Drape

1- With an object or objects, such as a mesh, to cover with a Nurbs surface present in the viewports, select Drape.

2- In the Looking Down viewport, click and drag a rectangle, corner to corner, over the objects in the size you want for the Drape surface.

3- Set the Command Line options to assign the density of control points in the new surface, as well as the depth to which the Drape surface sinks.



Drape Command Line Options

Drape works by dropping point objects at selected distances over the objects in the viewports. With the "Auto-Spacing" option set to "Yes", the points will be evenly spaced at the distance set by the "Spacing" option. Set the "Spacing" option smaller to create a more dense Drape surface, which more carefully follows the contours of a very detailed model.

With AutoSpacing set to "No", you can set custom spacing for the points in the U and V directions.

The "Auto Detect Maximum Depth" option, when set to Yes, stops the Drape surface at the farthest visible point within the rectangle. Setting this to "No" lets you control the depth setting with the "Max Depth" option. Set this to 1 to make it farther away from the camera (you look through the "camera" at what's in a viewport, in case you were wondering!); set it to 0 to make it closer to the camera, providing complete or partial coverage of an object.

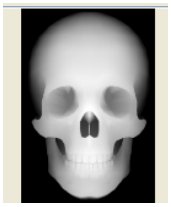
Advanced Surface Creation ...

Using Heightfield from Bitmap

Similar to both Matrix Art and Drape, this tool creates a Nurbs surface based on a bitmap image using Heightfield from Bitmap Modeling.

An Alternative to the Heightfield from Bitmap Tool?

An alternative to this tool is just to use Matrix Art and Drape. Matrix Art can better control the contours of the surface that result from the image, since it gives you direct control over aspects of the image like contrast, brightness, texture height, and blur, as well as providing direct Sculpting tools.



Use best possible image for this, as there is no control like when using Matrix Art. .

Following Matrix Art, simply run the Drape command over the result, and you'll get a Nurbs surface that matches the contours of the bitmap: which is exactly the result you'll get from the Heightfield from Bitmap command, only without the control Matrix Art can give.

Using Heightfield from Bitmap

However, if you wish to use the tool anyway, perhaps as a quick preview to Matrix Art, or when you have a really good bitmap and wish to do two steps in one, start up this tool. You'll first be prompted to select a bitmap file. Place two opposite corners to indicate where the resulting surface will be placed.

Indicate the options for this command: "Number of Sample Points" indicates the density of the surface in the U and V directions. More points gives you more detail as the resulting surface tries to re-create the bitmap you input. "Height" sets the height of the surface in the Z direction (relative to the X and Y you placed when first starting up this tool). "Control Points at Sample Locations" creates a surface control point wherever the image is sampled by the tool. "Interpolate Surface Through Samples" constrains the surface to pass through each sample location's height. Try adjusting these various options to change the outcome of the tool.

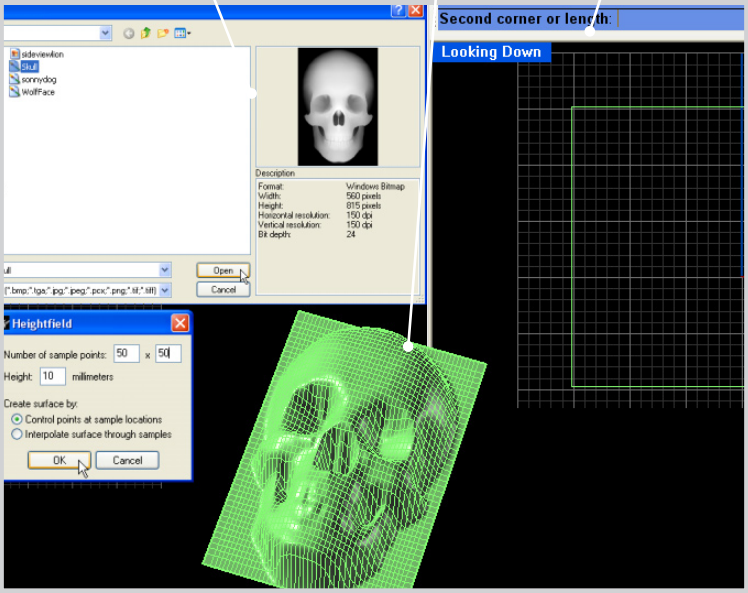
Steps for using Heightfield from Bitmap

1- This command starts right up by prompting you to browse for an image. You can therefore start it with nothing else in the viewports, if need be.

2- Browse to an image and Open it. It should be a high-quality bitmap that will work well with this tool, as there are no adjustments for its quality the way there are in Matrix Art.

3- Indicate a higher point count for more detail, lower for less detail, and click OK to place the surface.

4- Place two corners to indicate where the surface will be created by the tool. The surface's size will be locked to aspect ratio of bitmap. A surface matching the contours of bitmap (where dark colors are low, light colors are high) will appear.





Advanced Surface Creation ...

Offsetting Surfaces

With Offset Surface, create a copy a specified distance away from the original. Deform while offsetting with Variable Offset Surface.

About Offset Surface

Like Offsetting a curve, this command creates a copy of the surface or polysurface at a specified distance away from the original, so that each location on the new surface is a set distance (Offset Distance) away from each corresponding location on the original surface. Take note that, if a polysurface is offset, the resulting surfaces may no longer be joined. This is because each surface in a polysurface is offset separately.

Is there an Alternative to Offset Surface?

If you get unpredictable results with this tool, or if you are offsetting a polysurface and it is no longer joined upon offsetting, run 2D or 3D Scale with Copy on the item, instead. This will create a copy, and you can control - visually, with the cursor - the distance away that it will be placed. Sometimes, this is a better alternative to Offset Surface. Sometimes, though, Offset Surface is the way to go!

Using Offset Surface

Select the surface or polysurface to offset. Type in a value, in mm, to indicate an Offset Distance. If this value is positive, the surface will be offset in the direction of the white arrows onscreen. If this value is negative, the surface will be offset in a direction opposite to that of the arrows. Press Enter to see the results.

Offset Surface Command Line Options

"Flip All" reverses the directions of the arrows on the surface, which indicate the direction of the offset. To offset the surface to both sides at the same time, select the "Both Sides" option.

The "Solid" option makes a solid from the new and original surfaces by Lofting surfaces between them, at their edges.

The "Loose" option causes the resulting surface to have a point structure identical to that of the original surface.

Offset works with the program's Tolerance to assign an accuracy to the resulting surface. To change this value, indicate a new "Tolerance" value here (NOT recommended).

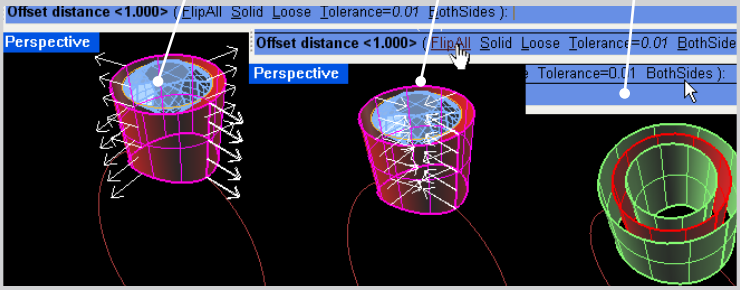
Steps for Offset Surface

1- Select the surface to Offset.

2- Check that the directions are pointing in the correct direction for the Offset. If they are not, click the FlipAll option to reverse the Surface Normals (Direction of the Offset).

3- Type a value into the Command Line and select any necessary options, such as "Both Sides" (used below).

4- Press Enter to see the results.



Using Variable Offset Surface

Use this tool to deform the surface while you offset it. It can also offset different parts of a surface to different specified distances away from the original surface.

To begin, select a surface to offset. (The "Tolerance" Command Line option will appear. We recommend leaving this at the program's tolerance, 0.1 mm.) Handles will appear at the corners of the surface, and a preview of the offset surface will appear. Click and drag the handles to define the new shape of the offset surface. Use the Command Line options to assist you.

Command Line Options

Click the "Flip" option to offset the new surface to the other side of the original surface.

Use the "Set All" option to type in an offset distance for all the handles at the same time (you can only type in a value during this option, not click and drag handles to indicate a value).

To cause all handles to move at the same time, select the "Link Handles" option, and click and drag one handle. Now, all handles will accompany the handle you drag.

Use "Add Handle" to add a handle anywhere along the surface. Offsetting this handle separately will deform the offset shape at that location, changing the shape of the surface so it no longer matches the original.

The "Side Tangency" option lets you select a side (click on the original surface to choose it) to keep in a tangent relationship to the original surface, thereby making a more curvy surface.

Advanced Surface Editing ...

Extend Surface

As with Extending a Curve, you can extend a surface. Choose different shapes for the extended section to match the remaining surface.

About Extend Surface

Similar to using the Extend Curve tool on a curve, you may extend a surface at any open edge with the Extend Surface tool. The new part of the surface will not be able to be exploded from the original part before the Extension took place: the resulting surface will be a single surface. This only works for a single surface (or single component surface of a polysurface), not a complete polysurface, and the surface to extend must be open.

Using Extend Surface

Start up this command and select the open edge of a surface to Extend. For the "Extension Factor", indicate a value in mm to extend the surface. Press Enter and the surface will be extended to the distance indicated.

Command Line Options

Choose from the Command Line options "Type = Smooth" or "Line". With the Smooth option, the natural shape of the surface will be continued in the extension. If it was curved, it will continue on the same curvature. With the Line option, the surface will be extended in a straight line.

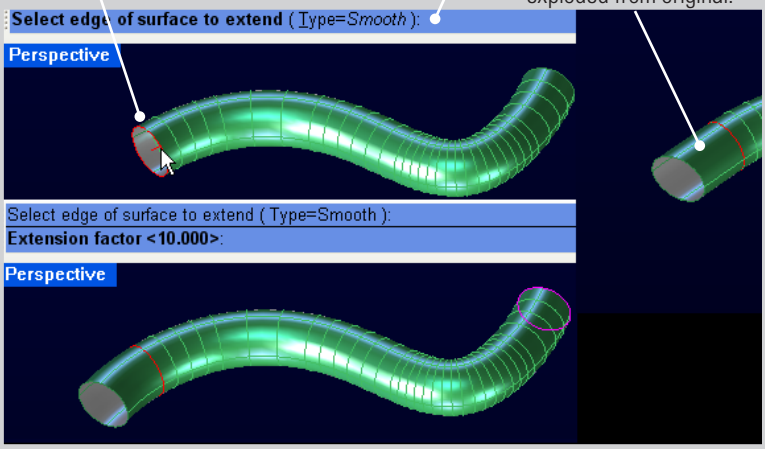
Using Extend Surface; Line & Smooth Options

1- Select an edge of an open surface (single surface - program will prompt you for a component surface if a polysurface is selected.

2- Select a Type using Command Line Option: Smooth (below) or Line (left).

3- Indicate a value for Extension Factor (in mm for distance of extended section of surface).

New surface cannot be exploded from original.





Advanced Surface Creation ...

Rebuild Surface

As when Rebuilding Curves, assign more Control Points to a surface in order to better control its shape with Control Point Editing.

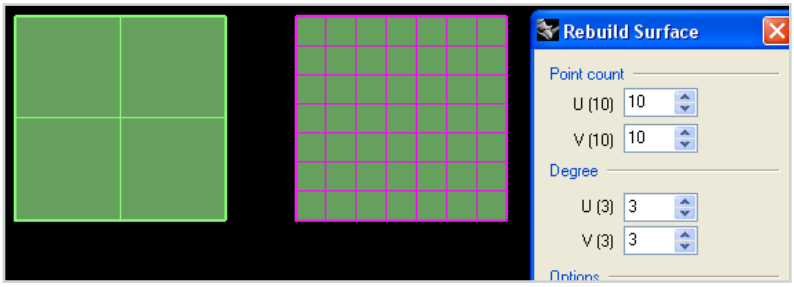
About Rebuild Surface

Just like the Rebuild command in the Curve Menu, use Rebuild on a surface when you wish to assign a new number of control points to it. Usually, the reason is just the opposite of the reason for rebuilding a curve: you want more control points in order to better control the surface.

I like to use this when rendering a ring on fabric: place a Plane, Rebuild it with more control points, turn on Control Point editing, and click and drag points to create the effect of attractively rumpled cloth.

Using Rebuild Surface

Start up this command and select the surface - such as the plane on the right, below - to rebuild. Because a surface has a U and V direction (perpendicular directions), you will need to assign a number of points in each of these directions. Other Rebuild Dialog Box Options include Delete Input, Preview, Retrim (if rebuilding a trimmed surface - or, just leave this alone to untrim it - read on for details!) and Current Layer for new surface. You may Preview the results. Always keep Degree at 3.





Advanced Surface Editing ...

Using Match & Merge

Merge will create one surface from two untrimmed surfaces with matching edges. Match will change one surface to match another.

About Merge

This tool combines 2 untrimmed surfaces (never used in a Boolean, Trim, or Split operation) together into a single, new surface - NOT a polysurface. It is a useful tool, since it can smooth out seams to eliminate kinks (sharp corners). Also, the resulting surface is NOT a polysurface, also making it useful for situations in which a single surface is imperative.

However, it has a few rules. To use this tool, the two surfaces must share an edge, and those edges must share endpoints. The shared edge must run along the U and V directions of the surfaces, meaning it doesn't cut across either of them diagonally. In other words, for best results, both surfaces have should have been created with sweeps, which have predictable outcomes for their U and V directions: one end (rails) assign one direction, and the other end (profiles) assign the other direction.

Use Merge instead of the familiar Join tool if your surfaces match these criteria and if you want the result to be a single surface and not a polysurface. Just beware: unlike Join, this tool can drastically change the shape of the two input surfaces. Also, a surface cannot be merged to itself, so there's no way to create a closed loop of Merged surfaces.

Using Merge & Command Line Options

To run this command, simply select the two surfaces to Merge. Use the Command Line options to indicate the properties of the Merge: "Smooth" will smooth out the surface following the merge, making for better control point editing. Beware that this option may more drastically alter the shape of both surfaces! "Tolerance" sets the distance from one another within which the surface edges must be for two surfaces to Merge. This is the default tolerance in Rhino, and we do NOT recommend you change it. "Roundness" is a value between 0 (sharp) and 1 (rounded) that you set to indicate how smooth or rounded the shape of the resulting surface will be. The default is 1, but you can set this all the way down to 0 to change the resulting shape.

How to use Match & Merge Together

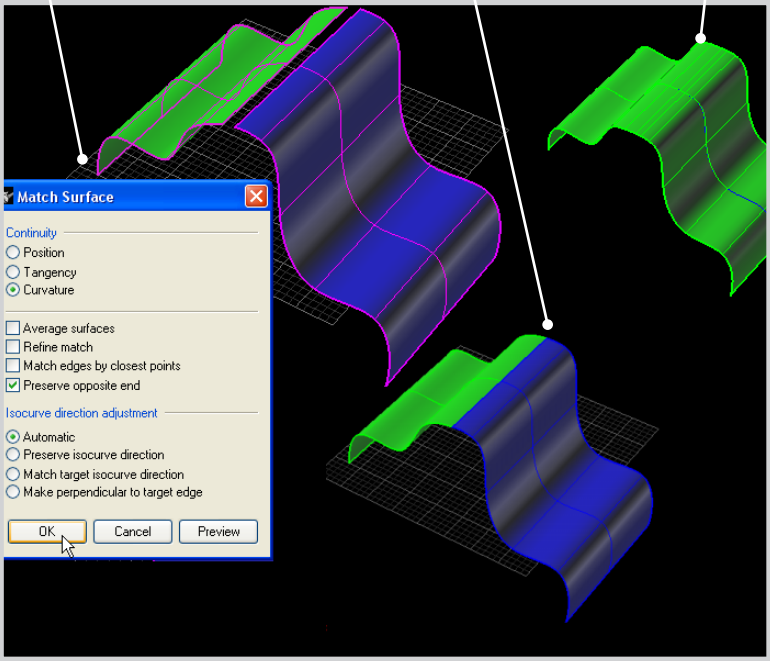
Begin by Matching surfaces. Select one edge to change to match the other (Green surface edge chosen here).

Apply dialog box options and click OK.

Green surface will be changed to match Blue surface.

Now, their edges may be Matched. Notice that, when the Blue curve was extruded, the End O-Snap was used to match the length of the surface edge to that of the Green surface. Otherwise, the two surfaces will not Merge.

There are relatively few instances when you will need to use one of these two tools.



About Match

This command also changes the shape of a surface, and should be used with care. It changes the edge of a surface to have position (touching only), tangency, or curvature (two different shapes of curviness) continuity with another surface.

The surface being changed to Match with another (the first surface you select) MUST be an untrimmed surface (never used in a Boolean, Trim, or Split operation). The surface you are matching it to may be trimmed or untrimmed. Since this command will change one or both of the edges of the surfaces, they should be close to one another for the most predictable results.

Using Match

To run this command, select the surface edge to match (this surface must be untrimmed). Then, select the edge to which you will match it (this surface may be trimmed or untrimmed). Select options to change the way the tool works:

"Multiple Matches" lets you select more than one end to match. "Chain Edges" works similar to this option in the rhino Sweeps commands, allowing you to select multiple edge curves that touch.

Select the "Continuity" you want for the Match. This changes the shape of the surface, so select the shape you like best. G0 or "Position" continuity merely makes them touch; G1 or "Tangency" aligns the second control points in each surface, creating one shape of curve; and G2 or "Curvature" aligns the second and third control points in each surface, creating a different shape for the curvature.

"Average Surfaces" may be used when the surface being matched to is also untrimmed. It will average both surfaces. The "Refine Match" option will test the match for accuracy and refine the surfaces within tolerance. If they do not perfectly touch, this will rebuild the Match surface so that it will touch and be created more accurately.

"Match Edges by Closest Points" changes the result of the Match. With this option OFF, the surface being matched will be aligned to the new surface by stretching or compressing the surface being matched to match the entire edge, end to end, of the new surface. With this option ON, the Match will pull each point object on one edge to the closest point object on the other edge, maintaining the shape of the surface.

The "Preserve Opposite End" option keeps the opposite end of the surface from changing during the Match. Use "Preview" to see the results before you accept them.

"Isocurve Direction Adjustment" also helps determine how the surface will be made. Use "Automatic" to let the program select an appropriate Isocurve configuration for the selected surfaces. "Preserve Isocurve Direction" does not change the existing U and V directions. "Match target isocurve direction" matches the isocurves on the surface to be matched to the ones on the edge of the target surface. "Make perpendicular to target edges" changes the isocurves to be perpendicular to the edge of the target surface.

Using Unroll Surface



Use this command only when you will be producing a model flat, as a pattern, to fashion into a curved surface after production.

Using Unroll Surface

This tool "unrolls" a surface so you can produce it flat, and then fashion it into a curved surface upon production. This is the only use we recommend for it: to create a pattern for the final surface. Just note that surfaces which curve in two directions, such as spheres, cannot be unrolled.

To run this command, select the surface or polysurface to Unroll. Select any curves on the surface that you want to appear on the flat surface.

The "Explode" option causes the resulting surfaces (if unrolling a polysurface) to be un-joined. Setting Explode to "No" leaves the resulting surfaces joined, just the way they were in the original polysurface.

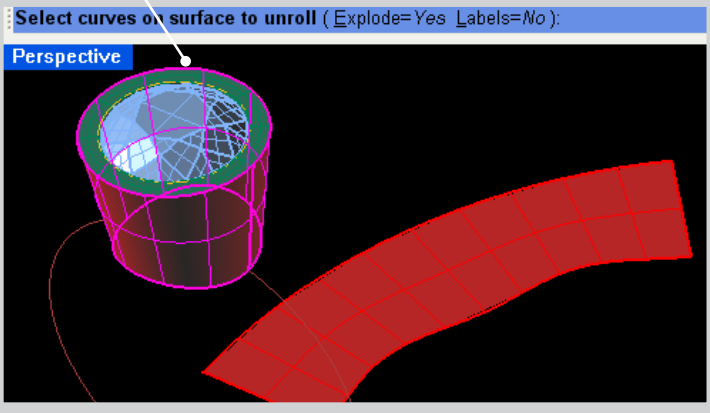
Select the "Labels" option to place matching numbered dots on the original surface and the new surface, to assist you in fashioning the pattern back into the curved surface upon production.

Steps for Unroll Surface

To use this tool, simply select the surface to Unroll and a curve representing its shape will be created.

Do NOT use this tool for further designing: the UV Curve commands are designed for that purpose.

Only use this tool when you will be using the resulting surface as a pattern you will then use to fashion the surface flat in metal, and curve it later.



Advanced Surface Editing ...

Untrim / Shrink Trimmed Surface

Boolean, Trim, and Split create surfaces that nevertheless remember their original structure. You can "Undo" a Trim or erase this memory.

What is a Trimmed Surface?

A trimmed surface has been used in a Boolean, Trim, or Split operation. It retains a memory of the surface it was when it was created, before it was trimmed. This can be seen when turning on Control Points to edit it (you will see additional points "off" the surface, representing the original surface) and when using Create UV Curves (you will see the shapes of the trimmed-away parts return in the form of curves).

Shrink Trimmed Surface

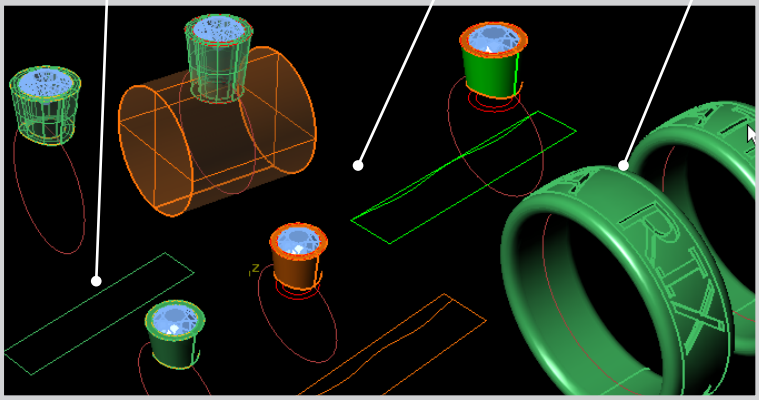
This command allows you to make a trimmed surface forget it ever was trimmed, becoming an "original" surface - as if it was created this way from the start. In that way, Control Point editing or Create UV Curves will work as expected.

Untrim Surface

This command is a way to "undo" a trim operation, causing the surface to return to its original state before that particular area was trimmed away.

Compare Shrink Trim, Untrim, & Original Surface:

An Untrimmed surface, created originally with Curve from 2 Views & Sweep 2, unrolls with UV Curves into a single rectangle. A Trimmed surface, Booleaned from the extruded Finger Rail, creates extra UV Curves. Even after Shrink Trimmed Surface, it's not perfect, so create with Curve from 2 Views for best results. Untrim Surface lets you select a surface edge that has been Split, Trimmed, or Booleaned, (R) and put it back to the way it was prior to the Trim operation (L).



Using Move UVN

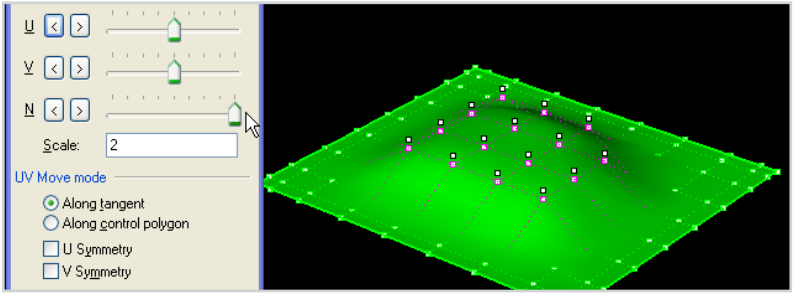
When moving Control Points for a Surface, Move UVN provides precise U/V (perpendicular) and N (normal - up and down) movement.

Using Move UVN

Turn on Control Point editing for a surface, curve, or Cage; and start up this tool. Select one or more control points. In the Dialog Box that appears, click and drag the U, V, or N sliders. U and V represent the perpendicular directions of the surface (X or Y relative to the surface - test them to see which is which on any given surface), while N slides the selected control point up or down (relative to the surface).

Dialog Box Options

In the options that appear in the dialog box, select "Tangent" to move the control point tangent to the surface in any of the given directions. "Along Control Polygons" constrains control point movement to those little dotted lines you see between each control point (those are known as Control Point Polygons, apparently!). U and V Symmetry allow symmetrical changes when control points on BOTH sides of a symmetrical surface are selected. Using the Smoothing option while running this command will smooth out results after control points are moved.





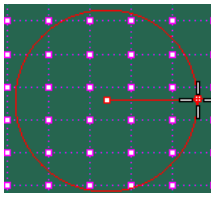
Advanced Surface Editing ...

Using the Soft Move Tools

Use Soft Move and Smooth in the Transform Menu, and the Soft Edit Surface & Curve tools for a slightly different way to edit objects.

About Soft Move

This tool is especially effective for moving control points around for an object (surface or cage) in which they are very dense (for curves or surfaces where this is not effective, read on to learn about Soft Edit Curve and Soft Edit Surface). However, it works on any group of objects.



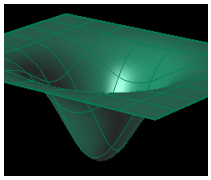
Create a radius of influence surrounding objects to move.

The tool allows you to set a radius of influence, which is a circle at the center of which objects or points will move the most and outside of which they will not be moved. Between the objects that are moved and those that are not, a "Falloff" area is set, wherein objects are moved less and less as they reach the outside of the radius of influence.

In this way, an object with very dense control points can be edited in a very natural way, without creating lots of unattractive lumps the way Control Point Editing usually does.

Using Soft Move

Select the objects or control points to move. Begin by choosing a "Point to Move from": left-click at that point in the viewports. Next, select a "Radius Point", or a size for the area of influence, which is represented in the viewports by a circle that you can grow and shrink with the mouse. Left-click to place it.



Moving control points on a dense surface in an evenly graduated fashion is difficult without this tool.

Three Command Line options available with "Radius Point" allow you to set any object as the area of influence - not just a circle. Select the "Points" option to select points already in the viewports to be used as the areas of influence. You can set a radius around each of the points, making a few, smaller areas of influence within which points will be moved.

Or, select "Curves" to indicate a curve as the area of influence. The falloff will be applied in a radius around the curve, creating a tube-shaped area of influence in the shape of the curve. Finally, select "Surfaces" and indicate a surface - in any shape - for the area of influence.

After setting a "Radius" (using any of the above options), the next Command line prompt asks for the "Offset Point", which is simply the distance to move the objects from the "Point to Move from" that you set originally. It may help you to move the cursor in other Viewports to set this. Press Enter to accept the results; or, edit the additional options before pressing Enter to change the results of the tool.

Steps for Using Soft Move Tools

1- Select objects to move, such as control points, below.

2- Select a "Point to Move from" by clicking it with the mouse.

3- Move the mouse to scale the "Radius Point" indicating the area of influence.

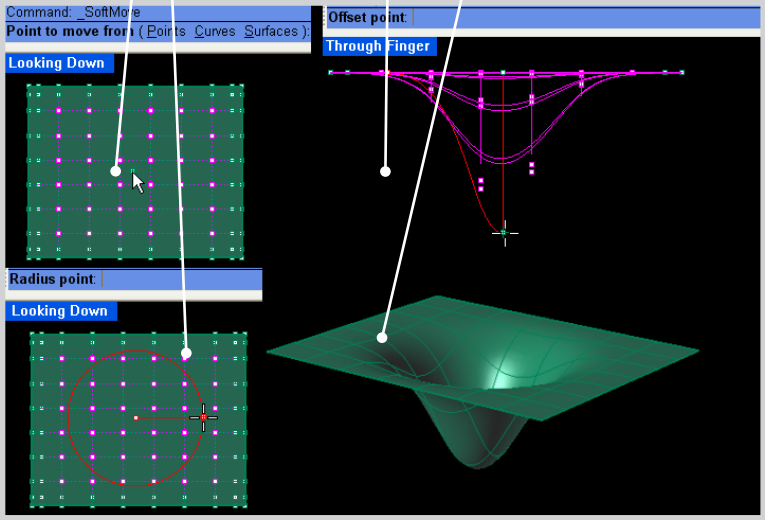
4- Set an Offset Point: the point to which you will move the objects.

5- Press Enter to accept the results.

At the center of the area of influence, where you initially clicked as the "Point to Move From", the most movement will take place.

Gradually working its way outward from that point, less and less movement will take place till you reach the "Radius Point" you set.

In this way, all objects are moved in a graduated fashion, which is time-consuming to achieve with the Move command alone.

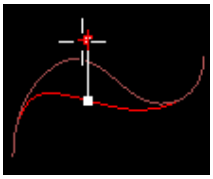


Soft Move Command Line Options to Edit the Results of Using this Tool.

The options Falloff, Radius, Offset, Anchor, and Copy Y/N can change the way the tool has affected the surface before you accept the results: "Falloff" changes the shape of the falloff curve, making the influence over the neighboring control points greater - for more of a "bulge" at the moved area - or less - for more of a point at the moved area. "Radius" lets you shrink or grow the area of influence, changing it from the setting it originally was to make a wider or more narrow area within which the objects are moved. "Offset" lets you re-set the "Point to move to", in effect changing the original distance of the move. "Anchor" lets you re-select where the "Point to Move From" was originally placed. Finally, "Copy = Y" allows you keep the original object in addition to placing the new objects onscreen at the conclusion of the command. Press Enter to accept any changes you have made and end the command.

Soft Edit Curve

Use this Curve Menu command to edit a curve with very dense control points more evenly and smoothly than may be possible with Control Point Editing alone. Start up the command and select a point on the curve central to the location you want to change. Move this point, and the control point editing of the surrounding points will be controlled by the tool, editing the curve smoothly and evenly. With a "Point to Move From" and "Point to Move To" selected, elect any Command Line options outlined below and press Enter; or just press Enter to end the command.



Choose a section of curve to gradually edit.

Soft Edit Curve Command Line Options

Use the "Distance" option to indicate a value, in mm, along the curve (from the start point) along which the falloff will occur. Use the "FixEnds = Yes" option so that, if the Distance selected is larger than the length of the curve, the ends of the curve will stay in place during the move. (Just note: if this is not turned on and the Distance is larger than the length of the curve, the ends will be moved; if the Distance is shorter than the length of the curve and this option is set to No, the ends will not be moved.) Finally, use the "Copy" option to keep a copy of the original curve in addition to the newly-edited curve.

Soft Edit Surface Command Line Options

Use this Surface Menu command to edit a surface in a similar way as the Soft Edit Curve command edits a curve. Before selecting a "Point to Move from" and a "Point to Move to", it is a good idea to set up the Command Line options for the move: "U Distance" and "V Distance" refer to the distance in each direction that the move will influence the surface. (U and V are perpendicular directions on a surface, and which is which will vary from surface to surface. Find out which is which using trial and error, or go to the "Directions" command, which indicates which is which via a cue on the surface.) Like in Soft Edit Curve, "Fix Ends" should be set to "Yes" when you don't want the corners of the surface to move but the distance you set is greater than the size of the surface in either given direction. With this set to "No", the surface will move if the Distance is greater than the size of the surface. If the Distance is smaller, the edges will not move regardless of its setting.

Using Soft Move Edit Surface

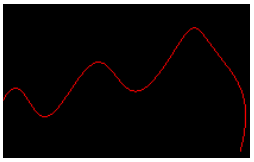
With your options set up as described above, select a point to move from and a point to move to. The indicated distance on the surface will come along for the ride! Before pressing "Enter" to accept the results, you can change any of the above options to alter the results.

Using Smooth

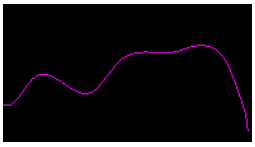
This command averages the positions of curve and surface control points, and mesh vertices, in a specified region. It evens out the spacing of these control points in small increments. It is useful for removing unwanted detail, and for removing loops in curves and surfaces. It can be a little unpredictable to use, as it is all automated (you don't control it), and the points don't move any specified distance.

To use this tool, just select the curve, surface, or mesh to smooth, and press Enter. The selected object will appear to "melt", losing its detail as the position of the control points are averaged by the tool.

To run Smooth on only a part of a curve or a surface, first turn on Control Point Editing. Then, select only those control points you wish to edit and click on the Smooth command. Select the coordinate directions and "Smooth Factor" you want. Then, the selected points will move, smoothing the curve or surface.



Above: Before Smooth; Below: After Smooth; Smooth Factor 0.9.



Smooth Options

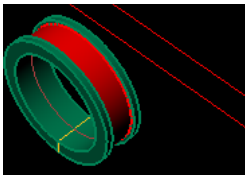
"Smooth X, Y, and Z" only smooths in the specified directions. The tool can use "World" or "CPlane" coordinates to determine the above smooth direction. A "Smooth Factor" between 0 and 1 moves the control points toward the average; a value greater than 1 moves the control points past the average; and a negative value moves them away from the average (making the object rougher).

Chapter 9 ADVANCED

Advanced Rhino Design Tools

Advanced Rhino Tools from the Curve, Transform, and Solid menus place and manipulate objects on surfaces, solids, and curves.

Advanced tools in Rhino help you model by placing objects onto surfaces. These may be surfaces that are already part of your design; or they may be "cripple" surfaces you create just to assist you in placing objects where you want them in your design. Delete these after object is placed.

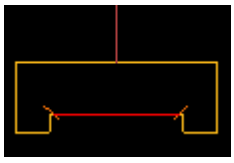


Place objects onto a surface that is part of your design (above) or onto a cripple surface you will delete once object is positioned (below).

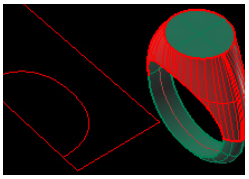


An Overview of UV Curves Concepts

To use any of these tools, you must first understand the concept of UV Curves, which are created flat against the viewport grid from any trimmed or untrimmed surface as a representation of that surface "unrolled" flat. Untrimmed surfaces work best, but sometimes we can't get around using Trimmed surfaces, so we will visit both alternatives in this chapter.



Use untrimmed surfaces (above) for UV Curves, or use trimmed surfaces and model accordingly - not using split away sections (below).



You will recall from the previous chapter that an "untrimmed" surface is original - as it was created from curves - and not used in any Split, Trim, Join, or Boolean operation. So, you may need to employ more advanced methods to create these surfaces from scratch at the curve level, rather than splitting them away from other parts of the design, to achieve the best results. If you must use Split, Trim, or Boolean, Shrink Trimmed Surface is your best bet for achieving an untrimmed surface in preparation for UV Curves; or, simply remember that the UV Curves will look different on a trimmed surface, and model accordingly.

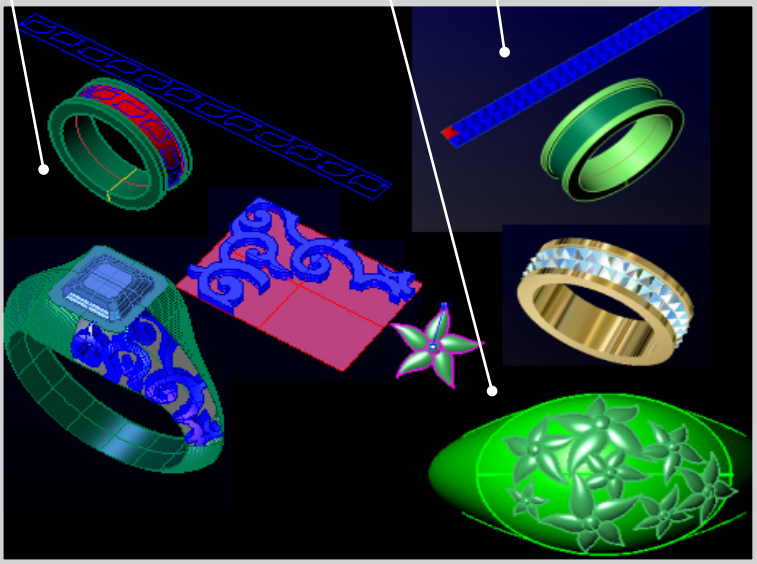
Comparing tools that place objects onto a surface:

Create UV Curves "unrolls" a surface onto which you can place curve objects (put back onto surface with Apply UV Curves) or surfaces/solids, which you can apply back onto the surface with the Transform command "Flow Along Surface".

"Array" tools in Transform and additional advanced commands in the Curves menu will help you set up a design for UV Curves.

The Orient tools will place objects onto a surface where you control scale, rotation, and size. They will also match the contour of the surface if you wish. Splop and GemSplop are similar, but work best for 3D objects and gems, respectively.

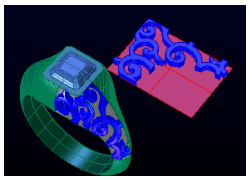
Boss, Rib, Slab and Holes make cuts or raised designs from planar curves and surfaces or solids.



Placing Curves & Other Objects onto Surfaces

After Create UV Curves, you may use Apply UV curves to place curves you drew flat in the UV Curves box back up onto the surface you used to create the box. Other Curve menu commands we will study that assist you in getting UV Curves designs right are Adjust Closed Curve Seam Point and Divide Curve.

Or, just use the UV Curves box as a guideline for creating a design with surfaces or solids that you can apply up onto the original surface using the Flow Along Surface command. Also requiring some fancy sweeping, this command



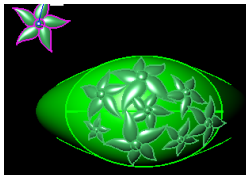
Sweep UV Curves to create a "Base" surface. "Target" surface is original. Flow is History-enabled, so change original to see results.

will require a "base surface" created from the UV Curves box - by exploding it and sweeping a flat surface using Sweep 2 - as well as a "target surface" that is the original surface from which the UV Curves box was made. Flow along Curve, its close cousin, runs roughly the same command with "Base" and "Target" curves, rather than surfaces.

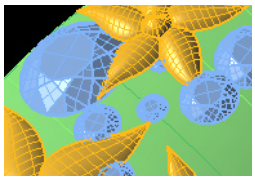
Array and Orient Objects on a Surface

Predecessors to the Matrix tool Object on a Curve, these tools array (copy) and/or orient (copy, scale, and rotate) objects to place them in space or along curves and/or surfaces. The Array tools also assist with setting up designs for use with UV Curves.

Orient tools and their close cousin "Splop" array objects at a new size and location on a surface together with an option for them to match the contour of the new surface, providing for some interesting and exciting design options. Use Splop or Gem Splop when orienting 3D objects or gems as opposed to 2D or mostly flat objects ("2 1/2 D").



Use Orient on Surface (Above) for 2 or 2 1/2 D (nearly flat) objects; Splop or Gem Splop for gems (below) or 3D objects.



Other Tools for Raised or Sunken Designs

Finally, tools that create and edit raised or sunken designs on a surface using just curves and a surface can be found in the Solids menu in Matrix: Boss, Rib, Slab, and Make Holes. You can even move around, copy, array, and edit holes (cuts) in a surface using the Holes tools Array Holes, Polar Array Holes, Move Holes, and finally Move and Rotate Face to edit one side or "Face" of a solid object.

Skills & Commands in this Chapter

Curve Menu: Objects on a Surface

Create UV Curves, Apply UV Curves, Adjust Closed Curve Seam Point, Divide Curve



Transform Menu: Objects on a Surface

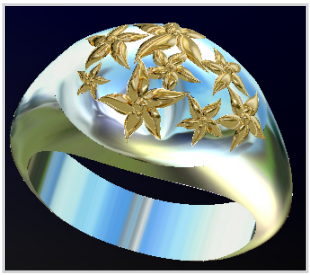
Flow Along Curve, Flow Along Surface, Gem Flow (Gems Menu), Array on Curve, Array, Array on Surface, Array on a Curve on a Surface, Orient on Surface, Orient on Curve, Orient Perpendicular to Curve, Splop, Gem Splop (Gems menu)

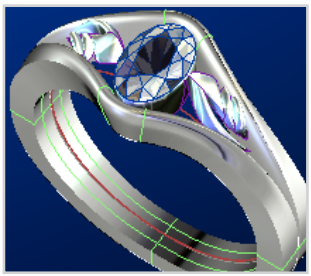


Solid Menu: Objects on a Surface

Boss, Rib, Slab, Make Holes, Array Holes, Polar Array Holes, Move Holes, Move Face, Rotate Face









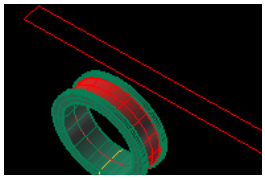


Curve Tools: Objects on a Surface

Understanding UV Curves

Create a rectangle in the shape and size of a surface with "Create" UV Curves, and then "Apply" curves back up onto the surface.

Why Use UV Curves?

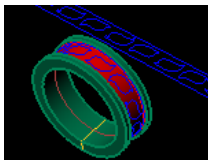


Create UV Curves draws a rectangle representing the surface.

To add curves all the way around a surface for design functions, you'll notice that "Pullback" and "Project" can make it difficult to predict the results. To complete this function more accurately, the Create UV Curves command allows you to "unroll" a swept surface into a flat representation of itself: a rectangle flat on the Looking Down viewport grid. Create a design in this rectangle, following a few simple rules, and use "Apply UV Curves" to place the curves up onto the surface. Or, use related commands - explored in this chapter - with a UV Curves box to place items other than curves up onto the surface.

This command works most predictably with a surface made from Sweep 2. That way, it is easy to recognize what the rectangle represents: the two long sides of the rectangle are the "rails" of the sweep operation and the two short sides are the profiles.

Draw any design curves that you want to place on the surface flat against the Looking Down grid in this rectangle, select the whole design - rectangle plus curves - and use Apply UV Curves to place them back up onto the surface. Now, you can use them in more advanced design applications described elsewhere in this manual.



Draw curves in rectangle to Apply back up onto surface. Or use other tools for solids, meshes.

Create UV Curves and Flow Along Surface

To prepare for using the Flow Along Surface command, select the surface onto which you'd like to place objects, and run the "Create UV Curves" command. Explode the rectangle, creating four separate curves. Run Sweep 2 on the exploded rectangle's curves, using the two long sides of the rectangle (corresponding to the rails used to create the original surface) as the rails of the new sweep and the two short sides (representing the profile of the original surface) as the profiles of the new surface. Now, you've created a surface that closely corresponds to the original surface. Place the objects to Flow on the new surface, and flow them up onto the original surface by selecting the flat surface as the Base surface and the original surface as the Target surface.

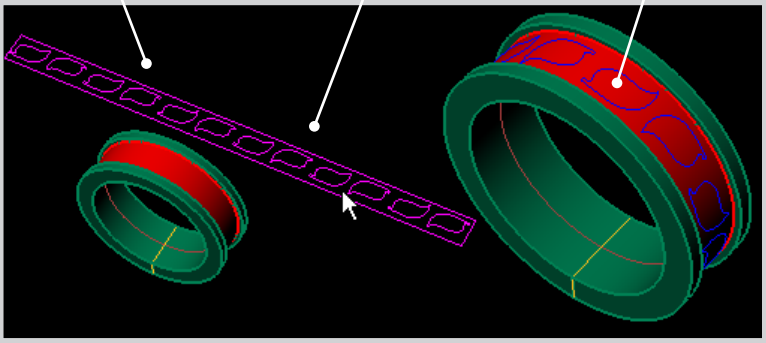
Steps for Using Create & Apply UV Curves

1 - Click "Create UV Curves" and select a single surface to "unroll flat". If there are any curves already located on this surface, select them and press Enter (or, just press Enter to continue). The rectangle representing the surface will be drawn planar (flat) against the Looking Down viewport grid.

2 - Draw any planar curves in this area that you want to apply up onto the surface.

3 - Select the curves you've drawn AND the UV Curves box (extents of selected curves will be oriented to extents of surface, so rectangle should be included for predictable results) and click "Apply UV Curves".

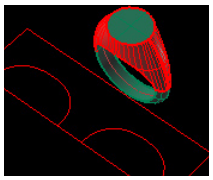
4 - Click the original surface and the curves will appear up on the surface you selected.



Note: If the resulting rectangle is rotated to a new angle to better create a design pattern, you MUST rotate it back to the original angle before using Apply UV Curves.

Rules for Create & Apply UV Curves

Create and Apply UV Curves only work with single surfaces. When selecting a polysurface, you'll only be able to click on one component surface of the polysurface. In addition, the surface you select for this command must be an "untrimmed" surface, which means it was never used in a Split, Trim, or Boolean operation. The reason for this is that a trimmed (Split or Booleaned) surface has a memory of the original surface it was before any trimming operations were run. Using Create UV Curves will result in a curve representing the ORIGINAL surface - not the smaller, trimmed surface expected. You'll know when this

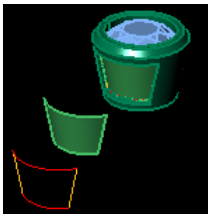


Trimmed surfaces show up as extra curves within UV Curves that represent the trimmed-away areas.

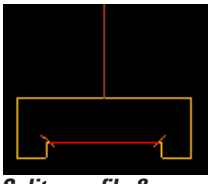
has happened, because more than one curve will appear with the rectangle representing the surface when Create UV Curves is run (one curve represents the "untrimmed" or original surface - one represents the "trimmed" or existing surface).

If you're careful, you can use this to your advantage (see Tips and Tricks at right).

However, in most cases you'll find it easier to think ahead during modeling, to create the surface you'll be using in this operation using a Sweep operation, and no Split, Trim, or Boolean operations. If you can't get around it though, you may wish to re-build a trimmed surface so it has no "memory" of the original. One way to do this is to completely delete the split-away surface and use the edge curves where it used to be as rails and profiles in a sweep operation that creates a new, untrimmed surface for use with Create and Apply UV Curves.



Use "Shrink Trimmed Surface" or re-create (above) a trimmed surface for UV Curves.

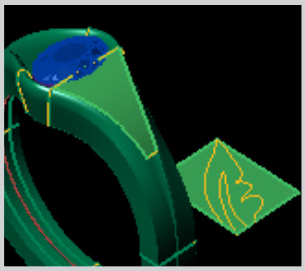


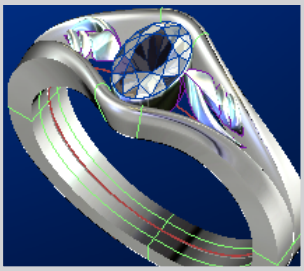
Split a profile & sweep two separate surfaces to create an Untrimmed surface for UV curves.

Another way to rebuild a trimmed surface so it can be used with these commands is to select the surface and click the "Shrink Trimmed Surface" command found in the Surface menu. This wipes the trimmed surface's memory clean, so it thinks it was created this way, and will retain no memory of the original Surface when it is "unrolled" with Create UV Curves.

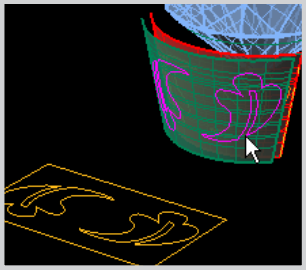


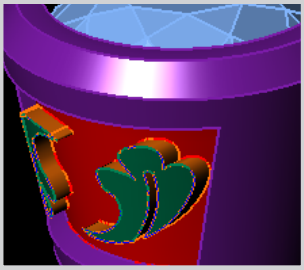
Tips & Tricks Modeling with UV Curves



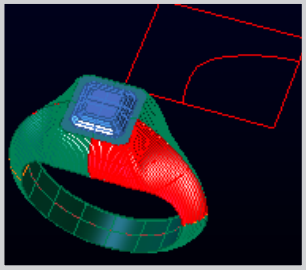


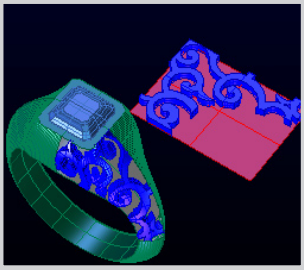
Using a Cripple Surface Whether using open curves or one of the applications below with closed curves, you may wish to create a cripple surface by sweeping rail(s) and profile(s). Use this surface in Create and Apply UV Curves (and as the target surface in a Flow command), and delete it when you're done!





Use with Loft After applying closed curves onto a surface, delete the outer rectangle curve (it cannot be used to Split the surface) and create a second surface just to the inside or outside of the original, depending on whether you want a sunken (inside) or raised (outside) design. (Create this by using 2D Scale with Copy on the original surface for best results!) Use Apply UV Curves (with the same curves) on the SECOND surface, taking care to use four different layer colors for each of the four items - two surfaces and two sets of curves. Split each surface with the curves on it and delete the excess surfaces. Loft between the two sets of curves (orange surfaces above, right), and Join everything to complete.





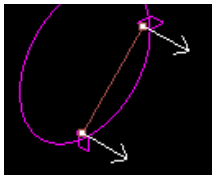
Create UV Curves with a Trimmed Surface When "unrolling" one surface of a signet ring or any other trimmed surface, place the design ONLY within the curves representing the trimmed surface. Apply ALL curves back onto the surface as usual. If creating a "base surface" for use with a "Flow Along" command, be sure to use the curves representing the untrimmed surface to make the base surface, as this is the one used during the "Apply UV Curves" command.

Curve Tools: Objects on a Surface

Adjust Closed Curve Seam Pt.

Use this command to change the location of the start and end point of a closed curve for better results in commands like UV Curves.

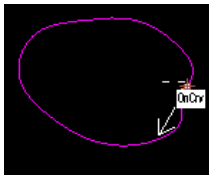
When to use Adjust Closed Curve Seam Point



Seam points appear when Lofting, Sweeping, or Blending Closed profiles.

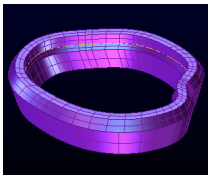
Select "Adjust Closed Curve Seam Point" before Sweeping or Lofting a closed rail curve when you'll use the resulting surface with the UV Curves commands.

How does this work? Well, you know the rectangle that is created when using "Create UV Curves"? Where that rectangle starts and ends represents the start and endpoint of the surface. When that surface is created from an open curve, it is obvious where the start and endpoint is.



Seam point of a closed curve should be on the right and clockwise. Run Get Profile & Bezel builder.

But when the surface creates a closed loop (i.e. is created from a closed rail curve), it's difficult to tell where the start and endpoint of the surface is. In the case of a closed surface or curve, the point where the start and end points are located is known as the "seam point". To change the seam point on a closed curve so that the surface it creates (during Sweep or Loft) will act predictably, run Adjust Closed Curve Seam Point. Locate the seam point (for all curves, if more than one closed curve will be used to make the surface) where you'll need the surface to start and end for the modeling operation you'll be running. Then create the surface.



For example, to create your own bezel with the Loft command, start by locating the seam point on the curves creating the shape of the bezel on one side of the bezel, where the shank of the ring will be, so you know where to draw the design so it's not interrupted somewhere in the middle by the seam point.

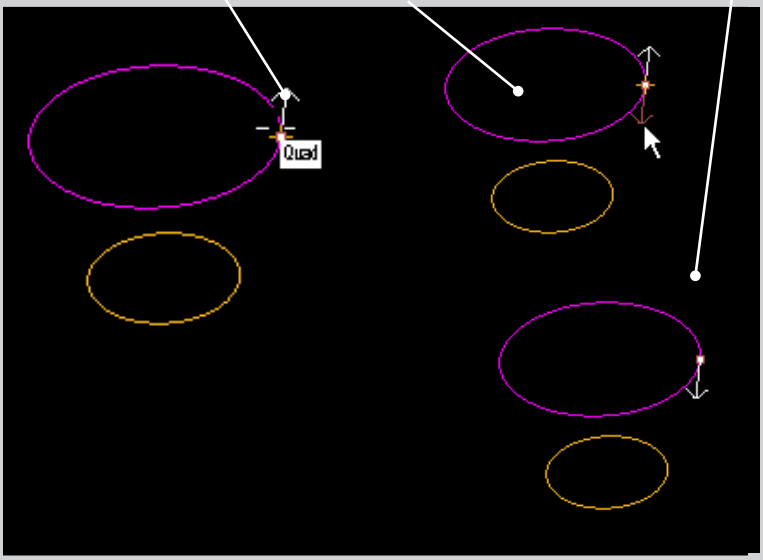
Steps for Using Adjust Closed Curve Seam Point

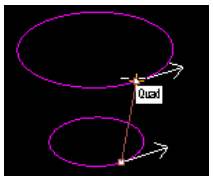
1 - Select the curve to adjust, and click this command.

2 - To adjust the location of the seam point, click the base of the arrow and drag it to the new location. Left-click again to keep this location.

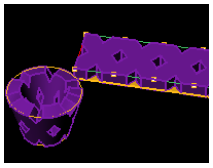
3 - To adjust the direction of the arrow, approach the arrow with the cursor until an arrow in the opposite direction appears. Left-click to keep the new arrow.

4 - Press Enter to end the command.





Place seam point so as not to interrupt UVCurves design. Create UV Curves, Flow Along Surf.



How to Use this Command

Start up this command and select a closed curve. The seam point appears, represented by a point object and an arrow. The arrow represents the direction of the curve. The direction must be the same for all curves being used to create the surface. To adjust the direction, approach the arrow with the cursor until an arrow in the opposite direction appears. Left-click the mouse, and only the new arrow will remain.

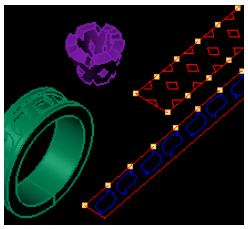
To adjust the location of the arrow so it's in a more useful location for modeling, click the point object and drag it to the new location. Click again at the new location, and the point will remain here. Press Enter to end the command.

Curve Tools: Objects on a Surface

The Divide Curve Command

Use the Divide Curve command to place point objects along a curve, visually dividing it into the number of segments assigned.

When do I use Divide Curve?

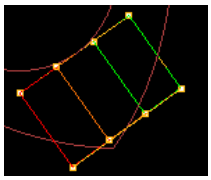


Divide UV Curves for help with arraying and/or drawing patterns.

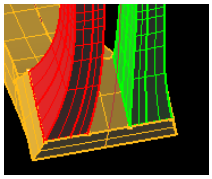
When creating a pattern for use with Apply UV Curves, it might help you to visually divide the rectangle created by Create UV Curves so you can determine the exact size and location of a repeating pattern. In this case, you should Explode the rectangle curve first, and just use Divide Curve along one edge of the rectangle. Or, if you wish to divide one side of a profile curve into equal sections to create a split shank design, Divide Curve is a quick way to get the right number of sections all of equal length.

Using Divide Curve

Select the curve to divide (remember to first use Split or Trim to separate it away from any other parts of the curve you don't want to include in the calculation) and click this command. Select the number of equal segments you wish to divide the curve into and type it into the Command line. Press Enter, and point objects will be placed, from the startpoint to the endpoint of the curve, so that the curve is visually divided into the number of segments you selected. This command does NOT split the curve for you: it merely places point objects to visually divide the curve.



Divide a profile & draw lines to create 2-3 separate profiles for a split shank design.



Now What?!

Well, if you are using this tool to lay out a pattern of curves to use with Apply UV Curves or a pattern of solids to apply with one of the Flow commands, create one of the elements of your pattern within the space between two point objects (if the number you have now doesn't leave you the right amount of space, delete the points and use Divide Curve again to place more or fewer points). With one instance of the repeating pattern drawn in the space between two point objects, select the Array tool from the Transform menu. For the number of objects in the X or Y direction (or, whichever direction the UV Curves are laid out), assign the SAME number as you used during the "Divide Curve" command. Then, when asked for two reference points representing the space around the object to array, turn on the Point O-Snap and click on both points on either side of the design. The number of designs you need will appear in the UV Curves box at the correct spacing for your pattern!

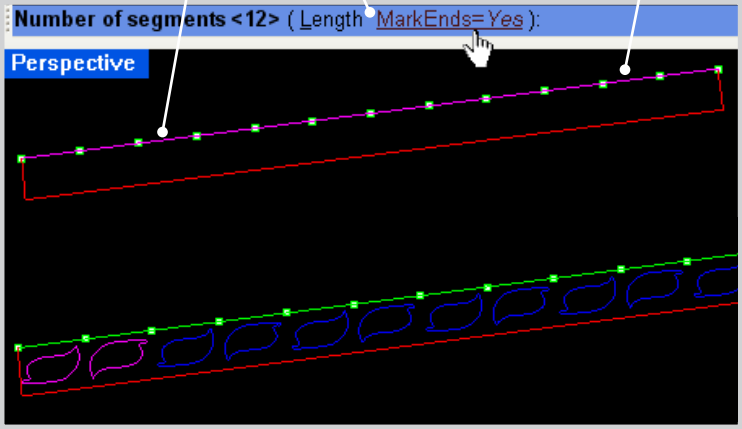
In the other example at left, in which the Profile was exploded and each end divided into 3 parts, draw Lines - with the Point O-Snap on - from each point object straight across to the other. To split the profile into 3 separate profiles that comprise the original, begin by Duplicating the original profile (with the "In Place" option in this tool). Then, Split one copy of it with the two new curves. Also Duplicate the lines ("In Place"). Join the corresponding sections to create two new profiles. Sweep the top of the ring with the two outer profiles and the bottom with the original profile. Join and Cap to complete the ring. This method works with a "V" (Split profile at midpoint) or a "U" (Split profile with two curves) split shank shape.

Steps for Using the Divide Curve Command

1 - If necessary (as here), Explode, Split, or Trim a shape so that the curve you wish to visually divide with point objects is a separate curve.

2 - Select the curve and click Divide Curve. Options allow you to divide by length of segments - not number - and choose to mark ends or not.

3 - In the Command line, type the number of curve segments you wish to divide the curve into visually, with points, and press Enter. The points will appear.



Transform: Objects on a Surface

Using the "Flow" Commands

Learn the similarities and differences between Flow Along Curve, Flow Along Surface, and Flow Along Surface for Blocks (gems).

About Each Tool



Flow Along Curve places objects from a line (below) onto a curve (above).

The Flow Along Curve command orients objects along a curve. Objects usually begin in a straight line, since this is an easy configuration to create. To place objects around a curve can prove to be more difficult, so this tool facilitates that process!

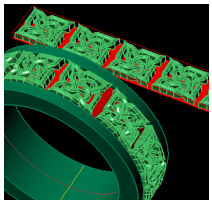
Flow Along Surface similarly allows you to copy and orient objects up onto a surface when, previously, they were all located along the same flat plane in space.

Rhino History with these two Commands

With Rhino History enabled prior to running either of these 2 commands (Record = Yes and Update = Yes), it is possible for you to run either command with Copy turned on and then, subsequently, edit the original object(s) to see the changes carry through to the new objects arranged on the surface or curve. In this way, very powerful editing can take place: position objects on a difficult surface; then edit them there by editing the original objects (Move, Scale, Rotate, and other Transform tools may be used to edit the original objects- but not Trim functions such as Booleans, Split, or Join).

Preparing to use Flow: Base & Target Objects

When using one of these commands, a "Target" Surface or Curve (the surface or curve onto which you wish to orient the objects) must be present. A "Base" curve or surface may also be drawn: either before or during one of these commands ("Line" option in Flow Along Curve; "Plane" option in Flow Along Surface).



Flow along Surface to place objects from a planar surface onto a curved surface.

For best results, though, here's how we recommend you create the Base Curve for Flow Along Curve: (1) Measure the curve you're flowing to (target curve) using the Measure Menu command "Length". (2) Start up the Line command and type this value into the Command line. (3) Hold down Shift to draw a straight line, this length, underneath the objects you want to flow.

Similarly, to create a base surface, we recommend you select the Target Surface and run "Create UV Curves". (See the relevant sections of this manual to learn the stipulations for this surface.) Explode the UV Curves box, and run the Sweep 2 command, using the two long edges as rails and the two short edges as profiles. Use this surface as the Base Surface in order to ensure that your objects will not skew too badly when they are flowed up onto the target surface (because the base surface was created directly from the target surface).

To Flow Gems

If you wish to include gems in the objects to be flowed, use the command GemFlow from the Gems menu and follow the same directions.

Steps for Flow Along Curve, Flow Along Surface

1- Create the surface or curve for the "target".

2- Create the "base". For a curve, measure its length and make a straight line of identical length. For a surface, Create UV, Explode rectangle, and Sweep 2.

3- Create the objects to flow on the curve or surface you created in step 2.

4- Turn on Rhino History so you can "tweak" the results after the objects are placed.

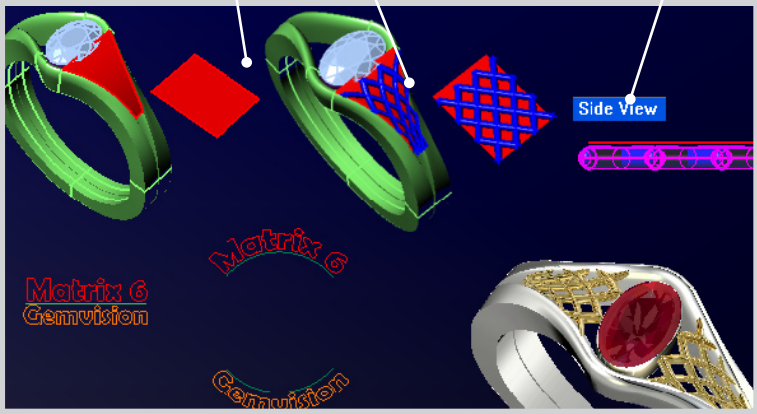
5- Run the "Flow" command that applies.

6- Select the objects to flow.

7- Select the "Base", near one end or corner.

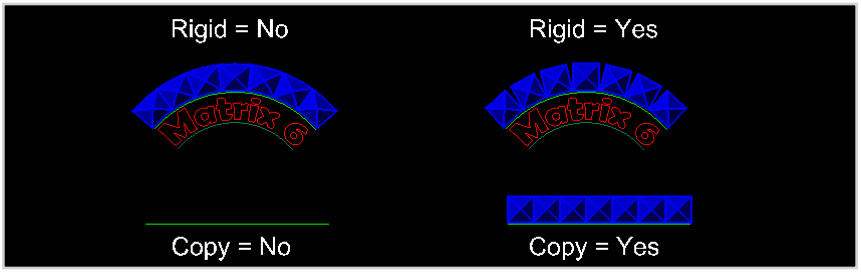
8- Select "Target", near same end or corner.

9- If History was turned on in Step 4, Transformations made to objects on Base (Scale, Rotate, Taper, Move, etc.) will appear in objects on Target.



Command Line Options for Flow Commands

Each command is noted beside its relevant option(s).



Both Copy = Y/N Keep "Copy" turned on in order to add copies of the objects you are flowing, and not delete the originals. This is a good idea when you plan to use History, since you can then edit the original items (but don't Trim or Join them) and see the same changes in the flowed items.

Both Rigid = Y / N This option keeps the command from deforming the item(s) in order to fit it to the target object. With "Rigid = Y", only the configuration of the objects being flowed will be conformed to the curvature of the target object. With "Rigid = N", the objects being flowed will be curved to fit the target object.

Along Curve "Line" Option

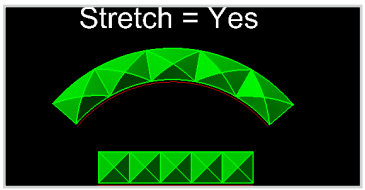
Select this option during Flow Along Curve and the Line command will be started. This allows you to draw your base line (instead of selecting it). Instead, we recommend measuring the target curve with the "Length" command and creating a base line ahead of time.

Along Surface "Plane" Option

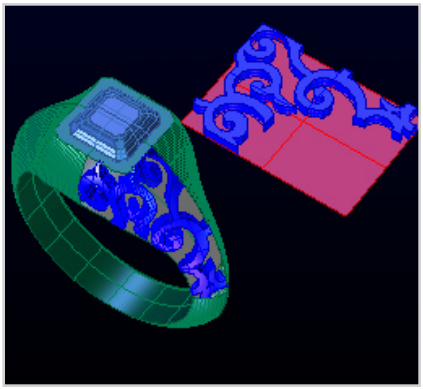
Like the "Line" option, "Plane" starts up the "Plane" command during the Flow Along Surface command, so you can draw the base surface instead of selecting one. Instead, we recommend you follow the instructions we have set forth earlier in this chapter to create your own base surface.

Along Curve "Local" Option

During Flow Along Curve, select this command to draw two circles defining a "tube" within which the objects are deformed and OUTSIDE of which they will NOT be deformed! This means part of an object may be stretched to touch the curve and part can be left alone.



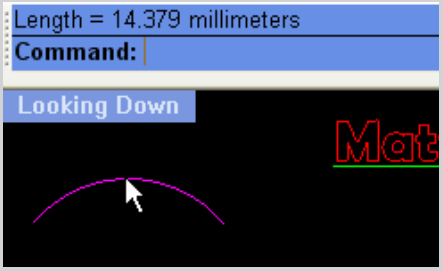
Along Curve Stretch With "Stretch" set to Yes, the objects will be stretched to accommodate the length of the curve when the Base line is shorter than the Target curve.



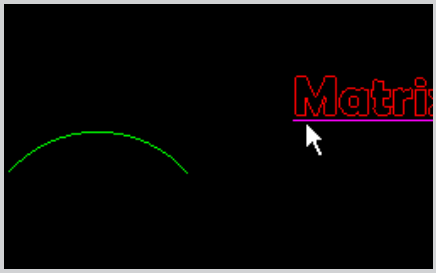
Tips & Tricks Modeling with Flow Along Surface To create a pierced-through design, first create a cripple surface using techniques you've already learned (Signet Ring Builder used here). Create UV Curves from the model, Explode, and Sweep outer (rectangular) curves to create a surface. Draw and extrude pierced-through design in UV Curves rectangle. Flow Along Surface and Mirror to complete.

Step-by-Step

Using Flow



1 Create Base Object When flowing objects along a curve, measure curve length and create a straight line of equal length on which to place objects. For Flow Along Surface, create a planar surface for objects by sweeping UV Curves.



2 Select a Base Object Select a "Base Curve" in Flow Along Curve; Select a "Base Surface" in Flow Along Surface. Or, using the "Line" option (Curve) or "Plane" option (Surface), create the base object with the relationship you want the flowed objects to have to the target curve or surface.



3 Select the Target Object Select the target curve or surface to flow the objects onto. If History was enabled before you started the command, you can now edit (but not Trim) original objects and the results will appear in the flowed objects.

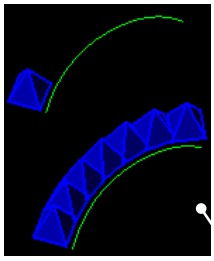
Transform: Objects on a Surface



Using The Array Tools

Use Array, Array on Curve, Array on Surface, and Array on Curve on Surface to place repeating items that follow a curve or surface.

Using Array Along Curve



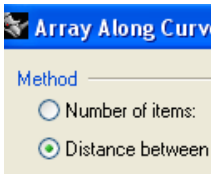
Start with object to array and path curve.

Begin with an item or items positioned near a curve in the same relationship to the curve that you'll want for all the resulting items. If the item is not located on the curve, select the "Basepoint" option offered in the Command line during this command. Click a point on the object: this will be the location where the object touches the path curve.

Whether or not you need the Base Point option, select the path curve next. In the Dialog box that appears, type in a number of items to array, or a distance between items. When given a number, the tool will array them all an even distance away from one another. When given a distance, the tool will set as many items as it can along the curve with the given distance between them.

Array Along Curve Tips & Tricks

For a closed curve, if the items don't array evenly using the distance you selected, try this: run the tool once with the distance you want. Click Undo and run the tool again. This time, look at the dialog box: the "Number of Items" is the last number used, so choose this option and DON'T change the value in the box. That way, the number of items that fit almost perfectly with the distance selected will be evenly arrayed along the closed curve using a distance that is only slightly different from the last distance you used.



In dialog box, select number of objects to array or distance between objects.

Preparing to use Array

This tool will allow you to place a number of copies of a single item in the X, Y, and/or Z directions with space between them that you indicate with two mouse-clicks.

The most common use of this tool is to array a repeating curve design or a number of objects along a UV Curve rectangle for application onto a surface with Apply UV Curves or Flow Along Surface. To determine how many items you'll need, Explode the rectangle and run Divide Curve on the top edge of the rectangle. Your design should fit between one set of point objects, with the space between the points being the same spacing you'll want between all the items you'll be arraying.

How to Use Array

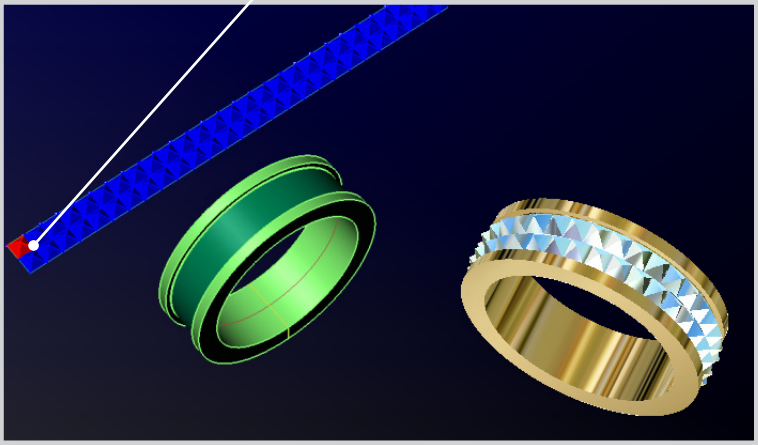
To use Array, select the item to array and type in the number of items you want in the X direction (the existing item will be the leftmost item). Also indicate values for the Y and Z directions. If you don't want any additional items in these

Comparing the Four Array Tools

Array Along a Curve by starting with the object in relationship to the curve; or, select a "base point" (using this Command Line option in the tool) on the object where it will touch the curve. Select a number of items or a distance between them.

Array places a number of items (red item, here) in the X (35-, Y (2-, and Z (1- directions. Indicate distance with mouse (snapped to edges of red model here). Or, use Divide Curve to place points representing space between.

Array on Surface lets you choose a number in the U and V directions on a surface; while Array on Curve on Surface constrains objects to a surface curve or lets you assign a number of objects or a distance between them.

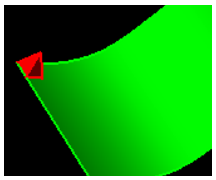


Flow Along Surface used to complete design, above right. Obviously, the interactive Matrix command "Objects on a Curve" is better to use in place of the three Array on a Curve / Surface commands wherever possible.

directions, indicate a value of "1". To indicate a distance between items to array, the tool will let you either (1) input a value in mm, or (2) snap to two points. Either option available in ANY of the directions (X, Y, or Z) in which you chose more than 1 item. (This is why it's a good idea to set point objects representing the space you want on either side of the arrayed objects with Divide Curve BEFORE running this tool, and turn on the Point O-Snap to snap to them during this step.) Before completing the command, the Command Line will read "Press Enter to Accept". Command line options indicating your selections will also appear (e.g., "X number and X spacing"). To change one of these selections, choose that command line option and re-input the value. Press Enter to finalize the results.

Using Array On Surface

Begin with an object to array on a surface, in the correct relationship to the surface on which you will array them. Start up the tool, and assign a "Base Point" on the object; or, the part of the object you want to touch the surface. Next, assign a "Reference Normal", or, the direction that will be "up" in relation to the base point. Usually, this is a point on the object straight up from the Base Point, but you can just press Enter to use the "CPlane Z Axis", or, the Z direction of the construction plane that was active when you started up the command.

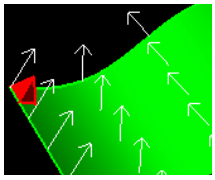


Start with object to array in correct relation to surface on which to array it.

Choose a target surface and assign a number of objects in the "U" and "V" directions on the surface. Press Enter to keep your results.

Tips & Tricks for Array on Surface

To change aspects of the surface in order to control the way this tool will work, jump into the Directions command. This will allow you to see (and switch) the U and V directions on the surface - assigning which way is which. The other helpful part of the Directions command is that you can see which way the Surface Normals Point (or, which way the surface thinks is "up"). This is the same way the object's Reference Normal (which you set two paragraphs ago!) will point, so if the objects come in upside-down, you must flip the Directions of the surface normals before running this command so that the object's normals and the surface's normals point the same way!



Surface normals point perpendicular to surface.

Using Array On Curve on Surface

Begin with an object to arrange multiple times along a curve that lies on a surface. This tool will also ask for a "Base Point"; or, the spot on the object that you want to touch the surface. Next, select the curve that lies on the surface and, finally, select the surface.

"Position Objects or Distance from Last" will appear in the Command line. This cue invites you to place the objects with the cursor and set them with a left-click (they will be constrained to the curve that lies on the surface); or, type in a value between the last one placed and the next one placed.

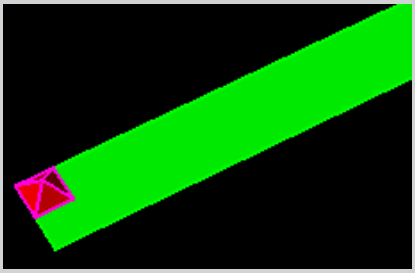
The two options available during this sequence are "Multiple", which allows you to select a distance between objects (and the number possible with this distance will be set along the curve) or "Divide", which allows you to select a number to place along the curve and the program will establish the distance apart that they can be set. Press Enter to end this command.

An Alternative to these Tools?

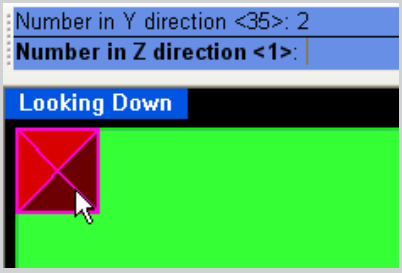
Try the Tool menu's Object on a Curve tool, with either a Library Browser object or with an object you've created at F4 in the correct orientation to the curve on which you will array the objects. Also try the Setting menu tool Bead on a Surface with the "Object" option turned on. Use with or without a Curve to snap the objects to.

Step-by-Step

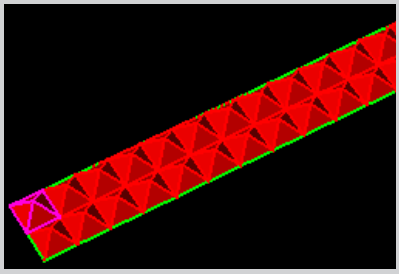
Using Array



1 Select object to Array This should be in correct relation to the surface and/or curve on which you are arraying it, when using one of these commands. Also select the object(s) you are arraying it on, when using one of these commands.

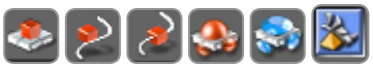


2 Indicate Number and /or Distance Between. Array on a Curve will let you choose a number or distance between objects. Other commands will require a number and distance in X, Y, and Z. (Use "1" if you don't need objects in one direction.) To assign the distance between, click the mouse. It is a good idea to place reference points first, if space will be required between each object.



3 Press Enter to keep results. Finally, check the results of the command and press Enter to keep them. Or select an option to change it.

Transform: Objects on a Surface

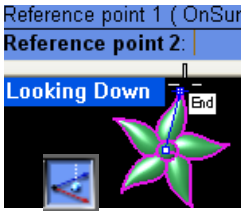


The Orient Tools & "Splop"

These tools orient objects on Surfaces or Curves (Perpendicular to Curve or Curve on Surface). "Splop" and "Gem Splop" are similar tools.

Orient on Surface

Start up this command when you'd like to place one or more objects on a surface. To begin, assign "Reference Points 1 and 2" by clicking on two points on the object that represent the center and "X" direction of the object. For best results, the object should be relatively flat and Project or Planar should be turned on while choosing these points.



Select 2 Reference Points (with Project or Planar turned on) on Object to Orient.

These two points assist during scaling and orientation, since the "Z" relative to this X position will be the "up" direction for the piece relative to the surface.

Next, select a surface on which to orient the object. A polysurface cannot be selected during this command: if you approach a polysurface to select it, component surfaces of a polysurface will be offered as options, instead. To orient to more than one component surface of a polysurface, as shown here, run Orient on Surface more than once. Also, the component surfaces must be Swept: Revolved surfaces do not work (oriented object follows "swirl" shape of revolved surface at its seampoint!)

Now, the Orient on Surface dialog will appear. To scale uniformly, type in a value for the X direction of the scale (piece will be scaled overall). To rotate the piece uniformly when it is oriented on the surface, type in an Angle.

Selecting a Size and Angle "On the Fly"

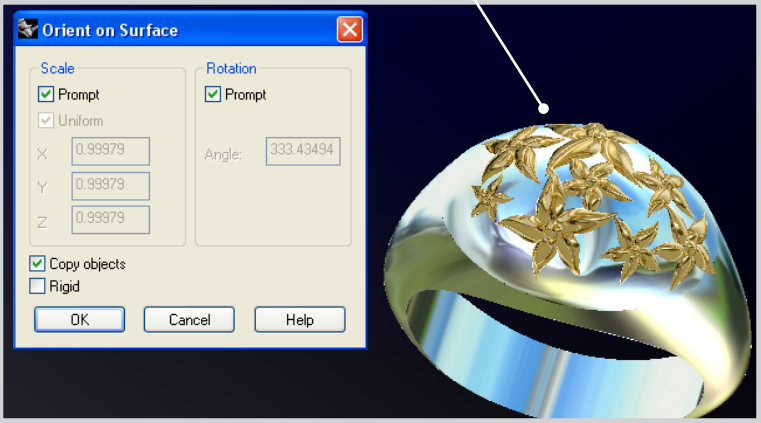
The other options for Scale and Angle in the Orient on Surface Dialog Box are labeled "Prompt". Select one or both of these options and the tool will prompt you for a scale and angle "on the fly" as you orient the object. The "Copy" option allows you to orient more than one object as you use the tool and will leave the original in its place, while the "Rigid" option will NOT deform the piece when it is selected.

Which Command do I Use When?

Array + Flow Along Srf: The most sophisticated of the tools that lets you orient objects on a surface is Flow Along Surface, which lets you lay the objects out flat first (the Array command will help you establish a repeating pattern).

Orient on Surface: For a more random pattern that you can design "on the fly", Orient on Surface with the "Prompt" option for size, angle, or both makes for a fun and useful tool. Many sizes can be placed for a fun, creative layout.

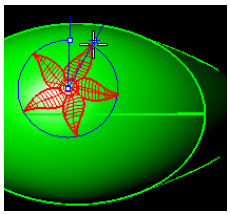
Orient Perp to Curve & Array Along Curve: Orient Perp to Curve is one of the tools our own Profile Placer employs! And you'll recognize a more interactive form of Array Along Curve in our Gem on Curve & Necklace Builders!



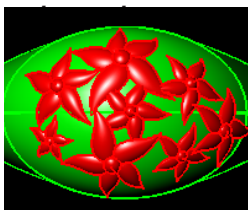
With it deselected, the piece will be deformed as it is oriented in order to match its shape to the contour of the surface.

Click OK upon selecting options, and you will be prompted to click on the surface to orient the piece. Your first mouse-click will set the piece. If you selected "Prompt" for "Scale", you can now move the mouse to adjust the size of the item to orient. Left-click when you like the size. If you selected "Prompt" for "Angle", move the mouse to assign an angle for your item. Left-click a final time to place the item. If you selected the "Copy" option, a new piece will appear beside your cursor; repeat the steps to position, scale, and/or angle the piece (or, press Enter to end the command). If you did not select Copy, the command will end.

The Flip option allows you to flip the object if it is oriented incorrectly in relation to the surface (i.e. the "up" direction is down instead of up!)

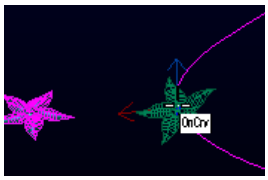


With "Prompt" for both Scale and Angle, and "Rigid = No", you can orient objects "haphazardly", clicking mouse to locate, scale,



Orient on Curve & Orient Perpendicular to Curve

The Orient on Curve command offers the Perpendicular option, which runs the same command as "Orient Perpendicular to Curve". For both commands, start by selecting an object and assigning a "Base Point" - or, the part of the object that will touch the curve. When using the "Perpendicular" option (and the Orient Perp to Curve command), the object will be oriented perpendicular to the curve relative to this basepoint. For the simple Orient on Curve command, the object will just be placed on its base point along the curve. Select a "New Base Point" along the curve to set the object on the curve. Select any of the below options that you'd like to use, and left-click to place the object and end the command.



Create an object and orient it (perpendicular if you wish) to a curve 1 or many times (Copy = Yes).

Options for Orient on Curve & Orient Perp to Curve

"Copy" allows you to place more than one object along the curve. Move the mouse along the curve to position the object and Left-click to place each one. Press Enter to end the command and stop placing objects.

"X" and "Y Flip" allow you to flip the object in these directions to re-orient it in relation to the curve.

"Rotate" places an extra step at the end of these commands. A rotation control will appear, allowing you to rotate the object, with its base point as the center of rotation, around the curve after placing it.

Splop vs. Orient on Surface

Much like Orient on Surface, the "Splop" tools allow you to place any object freely onto a surface. However, instead of choosing two planar points, as in orient on surface, it allows you to draw a "Reference Sphere" around the object being - er, for lack of a better term - "Splopped".

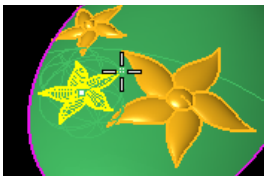


Select object to Splop and create a reference sphere using familiar Sphere options.

You will draw the same sphere at the location on the surface onto which you want to "Splop" the object. The relative size and rotation of the new sphere and the new shape will coincide with that of the originals, re-orienting (and re-sizing) the new object in corresponding ways. (Smaller sphere = smaller object; rotated sphere = rotated object, etc.)

"Splop" options are different in that the Splop command starts by asking you to select the object to Splop. It then starts up the "Sphere" command, with all the options common to that command (see Basic Surfaces & Solids chapter). After you create the sphere, similar options to "Orient on Surface" are offered: "Copy" (so you can keep placing objects one after another, and so your original doesn't disappear), "Rigid" (so your object doesn't morph out of shape to match the contour of the surface - unless you want it to, in which case set "Rigid" to "No") and "Flip" (so that, if your object comes out on the Splop surface upside-down, you can reverse it).

After selecting any options you want, pick a "Splop Drop Point" anywhere on a single surface (or component surface of a polysurface) by clicking that location with the mouse. The sphere will re-appear, allowing you to move the mouse to assign the shape and rotation of the object. Click once you like the results, and, if Copy is on, you can continue Splopping objects in this way (no, that's not a bad thing!) until you are done with your design. Press Enter to end the command.



Select a "Splop Drop Point" and move mouse to size and rotate object. "Copy" places many; "Rigid= N" warps them to surface shape.

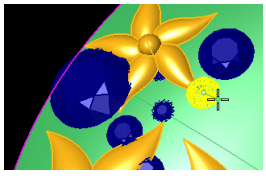
Gems Menu Tool "Gem Splop"

Splop is better used for 3D objects than flat or "2 1/2 D" ones, which is why Gemvision developed "Gem Splop", which you can find in the Gems menu. Just as the Flow tools required special accommodations for block objects (our gems), so does Gem Splop. So to orient gems on a surface, use this tool, and make sure the Rigid option is set to "Yes". (You don't want mushy gems!)

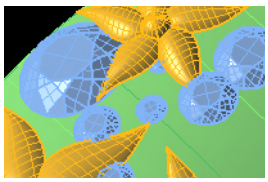
One note about this tool: it's really better suited as a freeform design tool. Gems will NOT come out at any predictable size - you size the on the fly while moving the mouse - and there is no gem report associated with it till after you place all the gems. You should use Gem on a Surface to get this perfect. However, there is no other way to "Splop" a gem so, if you're really dying to do it, this is your only shot!



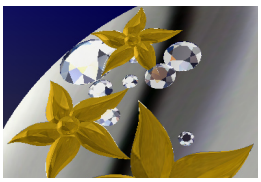
1- Select the gem to Splop and create the reference sphere. Notice it turns the gem dark blue. It's no longer a "gem", so if you cancel the command at this point, DELETE it.



2- (Rigid = Yes, Copy = Yes.)Select the "Splop drop point" just as before. Please note that you CAN'T control Z height of gem except by centering the reference sphere differently.



3- After running this tool, the Splopped gems are replaced with our regular Gem Blocks, as is the original gem you selected in Step 1, above.



4- And now they can be rendered (with VRay or Shade mode "Presentation" - above) and used as gems just like before.

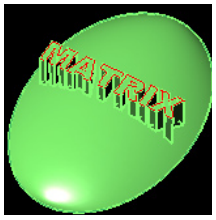


Solid: Objects on a Surface

Boss, Rib, Slab, & Holes

These similar tools automate Offset, Extrude and Split/Join or Boolean processes for you, using curves alone to edit or create solids.

Using Boss

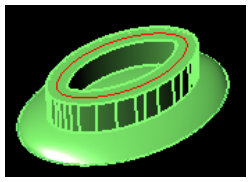


Curves are planar at height of tops of letters. Boundary should be solid (NO holes in it beneath surface to be bossed) for best results.

Start up this command with a closed, planar curve located above a solid or a surface at the distance you want for the height of the new shape. As directed by the Command line, select the "planar, closed curve to boss". Select any Command line options, described below, that you may wish to use. Press Enter (you may select more than one curve at a time). Select a "Boundary", or, the surface or solid to which you want the new surfaces to reach. The curve will automatically be extruded to the Boundary object using any Command Line options you selected, and the two objects will be joined together. If the original object was a solid, the new object will be a solid; if the original object was open, the new object will also be left open.

Using Rib

This command first offsets the curve to "Both Sides"; then runs the Boss command with the results. Start up the command and select ANY planar curve above an object (curve and object may be open or closed) to "Rib". Indicate an offset direction (in curve plane or normal to curve plane) and a distance (in mm) for the TOTAL offset (the curve will be offset half this distance to either side of original curve; so, selecting "2" will offset the curve 1 mm on both sides). Select a Boundary surface or solid. The same rules as Boss apply (selecting an open object will result in an open object; selecting closed will result in closed.



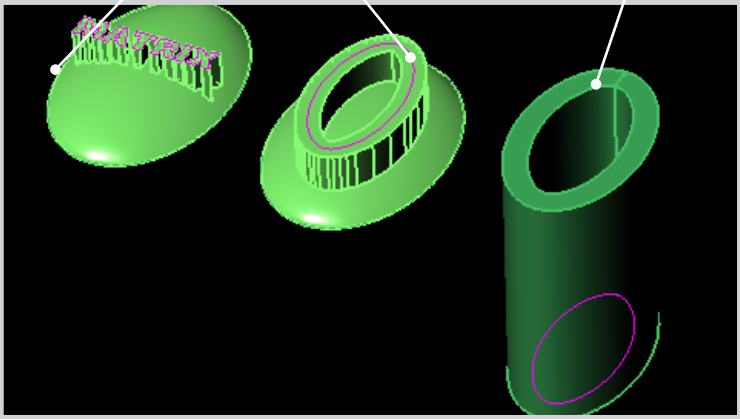
Height of Rib (or boss) equals height above boundary of curve used to create rib. Rib offsets to each side of curve the total distance indicated.

Comparing Boss, Rib, & Slab

Use "Boss" with a Closed, Planar Curve ONLY to extrude a shape (with or without taper) toward an existing solid and automatically Boolean Union it to the solid object. (If a Surface is used for Boss or Rib, the resulting object will be left open.)

"Rib" is similar to Boss, but is able to use an Open OR Closed Planar Curve. It begins by offsetting the curve a distance selected by the user; then, it extrudes it toward an existing solid (with or without a taper) and Boolean Unions the two.

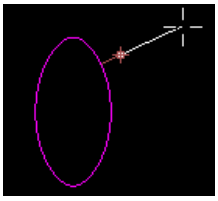
"Slab" runs the Rib command without the need for an existing solid to Union the object to. Simply offset a planar curve (open or closed) and Extrude it to either side all in one step to create a solid object. (Original curves pink in each example.)



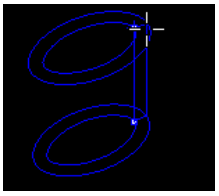
Using Slab

Without a Boundary object, you can still offset and extrude a single curve in one step using "Slab". Select the planar curve (open or closed) and select a Distance or Through Point for the Offset (the Both Sides option for Offset is not available with this command). Next, select a Height to which to extrude the shape (BothSides is not available with this extrusion, either). The new shape will appear.

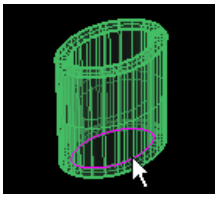
Using Slab:



1- Select curve (no boundary used) and offset distance.

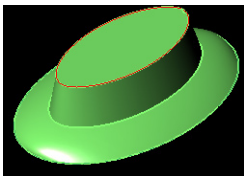


2- Assign Height of extrusion.



3- Slab only offsets to one side. (Original curve highlighted.)

Boss & Rib Command Line Options



Tapered Mode with Draft Angle 15.

Select a mode - Straight or Tapered - to extrude the curve in either of these two commands. If the "Tapered" mode is selected, the Draft Angle option will be added. Type in a Draft Angle and press Enter. WARNING: If the Draft Angle is too large for the size of the selected "Boundary" object, the surface will not be made.

Rib Command Line Options

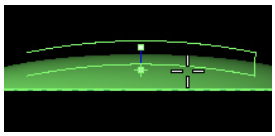
You may offset the curve for the Rib command either (1) in Curve Plane (offset to both sides of the curve along its plane in space), or (2) Normal to the Curve Plane (above and below curve). Also assign a "Distance", in mm, to offset the curve. This will be the total offset, to both sides of the curve, so that half this distance will be the offset distance on one side of the curve to Rib. In other words, if you input 2 mm as a distance, the curve will be offset 1 mm on either side of the original to create the Rib.

Slab Command Line Options

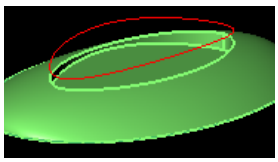
In contrast to Rib, Slab only adds thickness (offsets the curve) to one side of the curve. So, select a distance for only one side of the offset. Or, select the Through Point option to move the mouse in order to assign the thickness, just like the Through Point option in the Offset tool.

Using Make Holes

This command uses a closed curve and a solid object to create a "hole" or cut in the object in the shape of the closed curve. The curve need not be planar: if it isn't, the hole in the object (if it's cut to a certain depth and not punched straight through) will be curved in the shape of the nonplanar curve - making this a very powerful tool!



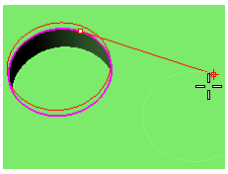
Select closed curve & border, and move mouse to "extrude" distance for hole. If penetrating surface, it will boolean through. If not, contour of cut will match that of curve.



To use this tool, select the cutting curve. Then, select the solid object to cut. Indicate a cutting depth by dragging the cursor and left-clicking (use one of the Command Line options outlined below if the direction is not accurate); or, just press Enter to pierce the object all the way through.

Make Holes' "Direction" Option

This command is automatically extruding the curve to use as a cutter. If the hole is not planar with the surface, use the "Direction" options to help you extrude the hole to the angle at which you want the cut. X, Y, and Z will extrude the cutter along their respective world axes. "Normal to Curve" is the default value for this option. It sets the direction normal (perpendicular) to the plane of the curve. "CPlane Normal" sets the direction perpendicular to the Construction Plane (CPlane, or, the active viewport) in which the curve was selected. Finally, use the "Pick Along" option with an existing curve to run the "Extrude Along Curve" command. Click on a point along an existing curve to which to extrude the cutter, and the cut will follow the shape of the existing curve.



Select hole in PLANAR surface. Assign number & distance in A and B directions with mouse.

Using Array Holes

Note: This command only works with holes in PLANAR surfaces! To lay out an arrangement of identical holes or cuts - similar to the Array command for objects - start up this tool, with any cut or hole in a solid object (need not have been made by the Make Holes command!). First, select the edge of the hole to array. Then, assign a number of holes in the "A" and "B" directions. (You'll be assigning spacing in both directions, as well as a direction for A and B in a minute.) Next, click on the "Base Point" for the array (usually right beside your hole) and click in a direction to indicate "A" and a direction to indicate "B". The options you selected, along with a preview of your results, will appear. Before pressing "Enter" to accept, change any of the Command line options you want.



Holes will array uniformly at distance and number you set.

The spacing you set will be displayed: click it and change the values to change the spacing between holes (value indicates distance, in mm, from center to center). The "Rectangular" option will keep A and B perpendicular to one another. With this de-selected, the angle you set when you click will be the angle for each direction - A and B - so they can be set on an angle other than 90 degrees if you want them to be.

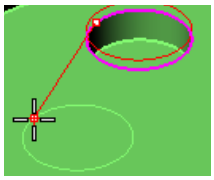
Using Polar Array Holes



Runs Polar Array command with holes - original indicated with cursor.

Use this command just like the Polar Array command, only with a hole in a solid object. Select the edge of the hole, and select a center for the array. Select the number of objects in the array, and select a number of degrees, up to 360, in which to array the holes. Press Enter to accept the results, or change the previous options using the Command Line.

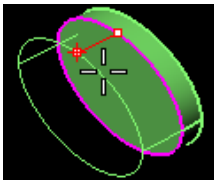
Move or Copy Holes



Select hole, Point to move from, and Point to move to. You will see a light preview outline of re-located hole.

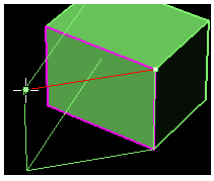
Use Move Holes to either move or copy holes in a surface. Select the hole, and click a "Point to Move From". With the Copy option set to "Yes", a copy of the hole will be placed. With it set to "No", the hole will only be moved. Select a "Point to Move To" by clicking somewhere else on the surface. Interestingly enough, clicking somewhere off the surface will create an open little tube and completely remove the hole from the surface (if Copy is set to No).

Using Move Face



"Move Face" is like "Extend" for a polysurface.

This tool essentially lets you "Extend" a polysurface. Select a component surface to move, and the other component surfaces of the polysurface will extend to touch it. It must be moved in a planar direction with the other component surfaces, or else the entire polysurface will be moved to accommodate the change. The "Direction Constraint" option sets the movement so it is "Normal" (perpendicular) to the surface selected, or "None", which leaves it up to you to move the face in a planar fashion.



Pick a start and end point of rotation (red, above), and move mouse to rotate.



Using Rotate Face

Select a component surface of a polysurface and use "Rotate Face" to rotate that surface and change the shape of the polysurface. Assign a "center of rotation" to rotate the surface in the viewport selected; or, select the 3D Axis option and set both ends of an axis of rotation and then a start / end point for rotation, just like the "Rotate 3D" command found in the Transform menu. When the face of the polysurface is rotated, the remaining surfaces will change to touch and accommodate the rotation, creating a completely new polysurface shape!

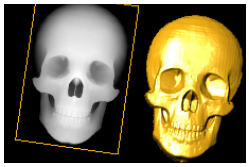
Chapter 10 ADVANCED

Matrix Art & Mesh Tools

Matrix Art creates "2 1/2 D" mesh artwork. Use Mesh Tools to model with meshes created in Matrix Art or imported from other programs.

What is Heightfield from Bitmap Modeling?

Matrix Art is a Heightfield from Bitmap modeler exclusive to Matrix. Matrix Art's Heightfield from Bitmap Modeling produces a mesh, which gets its height by referring to a table of color values, where the dark colors represent the low parts of the resulting mesh surface and the light colors represent the high parts of the resulting mesh surface.



Light parts of image become higher parts of surface and dark parts becomes low.

This is why it is possible to add a picture to a shape that has been input into Matrix Art, and have the program output a mesh that is textured to resemble the picture, where the light parts of the picture are the high parts of the mesh and the dark parts of the picture are the low parts of the mesh.

However, the program also works quickly and easily with closed curves alone to create smooth, chiseled, or otherwise contoured surfaces from profiles you can select, edit, or create from scratch. Because the same heightfield from bitmap modeling technology creates the mesh when only curves are used, you can imagine that the program "sees" your selected profile as lighter in color at the high parts of the curve and darker at the lower parts of the curve.

When using an image within Matrix Art, it is possible to edit the image that you've input with some easy-to-use yet powerful photo-editing tools: you can adjust the blur, contrast, brightness, and even reverse the lows and highs of selected parts of the image. You can also place the image wherever you'd like it in relation to the shapes you input.

Finally, using either method, you can "sculpt" the resulting surface with sculpting tools like Deposit, Carve, Smooth, Smudge, and Fade, which work with the mouse directly on the preview mesh to interactively sculpt it in real time.

The Four Parts of the Matrix Art Menu

Use the Layers Menu every time you open Art to input the curves that will be used to create the mesh. Apply profile shapes and heights to the curves. Where the curves trace the basic shape you want, this is enough. If you need to apply an image, proceed.

The Picture Menu is where you import a bitmap to add texture to your mesh. Controls to scale, position, rotate, tile, and invert your image are available here.

The Effects Menu is where you can edit the picture you imported in the Picture menu. Change brightness, blur, and contrast to improve the look of the mesh.

Sculpt can be used with or without a picture. It lets you "Deposit" or "Carve" mesh to sculpt the surface of the mesh.



How do I Use a Mesh in my Model?

Once you've got a mesh, you may apply it to a surface using Mesh Mapper or Apply Mesh UVN. Other tools help you create and use meshes from Matrix or other programs. To run familiar commands with meshes, use the Mesh menu at the top of Matrix to find Mesh Booleans, Split, etc.

Skills & Commands in this Chapter

Tools Menu : *Mesh Mapper, Mesh Reducer*



Utilities Menu: *Create Z Buffer, Apply Mesh UVN, Reduce Mesh, Nurbs to Mesh, Extract Render Mesh, Fill Hole, Fill Holes, Align Mesh Vertices*



Common Matrix Art Tools

Each Matrix Art menu shares these tools. Use them as needed while you work.



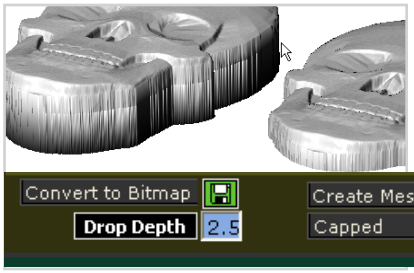


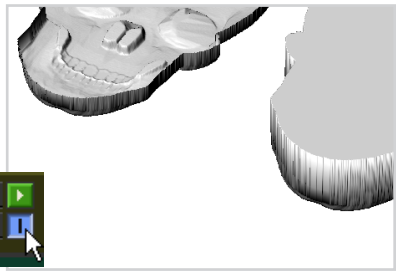
Changing Views The view options change the look of the preview image while you work. (L- R) "Colors" creates a color-coded representation of the heightfield - where orange is the highest part and purple is the lowest - so you can more easily see changes like Height and Sculpting. With this off, each part of the preview model is the color of its curve. "Ghosted" makes the current view see-through to better view the curves or bitmap beneath. "Preview" keeps the preview mesh at a lower resolution to ease the load on your processor while you work; yet the output mesh will still be at the resolution you set. Finally, toggle the preview On and Off with the Shade globe.



Note: Upon creating the mesh, the preview is simply toggled OFF. So, to edit your current settings and try the mesh again, turn it back on WITHOUT closing Matrix Art! (Closing the builder clears your settings.)

Adjusting Resolution To get a sharper look to the resulting mesh for items like chiseled profiles, click and drag this slider to raise it and click "Update Resolution". Lower the resolution for items like people, animals, or organic textures. Experiment with resolution settings to get the best look for each design you work on.

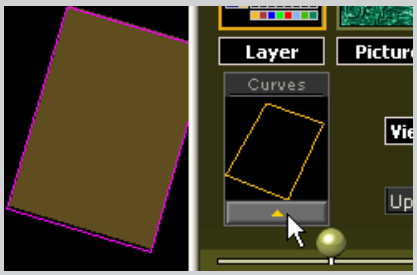




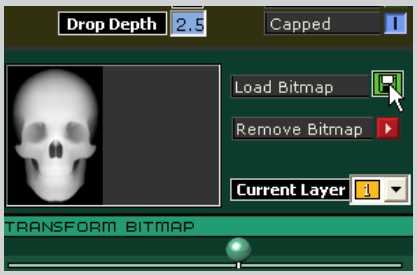
Creating the Mesh When you like the results, click "Create Mesh". Before doing so, select one or both of these two options: "Capped" caps the back of the mesh to create a closed mesh. "Drop Depth" adds the value you type into the box, in mm, beneath the Looking Down grid to add height to the resulting mesh. (L - R above: Drop Depth, No Drop Depth, Not Capped, Capped.) The final option, "Convert to Bitmap", saves the Looking Down image of the heightfield you've been creating, or, the dark to light contour map of your current design, so you can re-apply it in a more advanced use of Matrix Art described later in this chapter.

Understanding Workflow

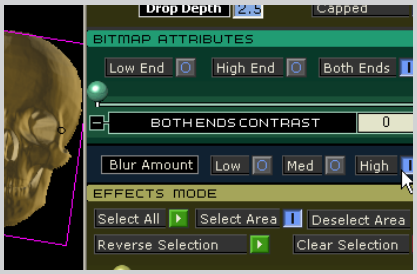
Using Matrix Art



1 Input Curves into "Layers" Menu. Use the "Layers" menu to adjust the profile shape and height of profiles, as well as the relationship between parts of the mesh. (Return to this or any part of Matrix Art as needed to change a related aspect of the design.)



2 Proceed to the Picture Menu to add texture. If you wish to add an image, choose an active layer and proceed to the Picture Menu. Here, you can add or remove a bitmap and adjust placement, size, rotation, and height.

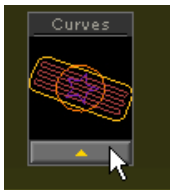


3 Use Effects or Sculpt to fine-tune a design. "Effects" only works when a bitmap has been used in the Picture menu. "Sculpt" works on any design. Use Effects to change aspects of the image. Use Sculpt to directly affect the shape of the mesh that will result.

Using Matrix Art...

Using the Layer Menu

Start here every time! Input Curves, assign a profile shape and height to each curve, and control the relationship between parts of mesh.



To create a Matrix Art model, input curves first.

Inputting Curves into Matrix Art

This is where you will start every time you use Matrix Art. Begin by selecting all of the curves you wish to use to create a shape. Click the "In" arrow beneath the "Curves" inbox to input them into the tool, and you're ready to use Matrix Art! All curves for use in Matrix Art MUST be closed and drawn flat against the grid in the Looking Down viewport. Each curve will make up a shape in the resulting model.

Importance of this Menu

Even though the final model is a single mesh, you can control each part of that mesh separately while you are working in Matrix Art based on the layer colors of the curves you input. You will be able to control each curve separately, and control their relationship to one another, in the Matrix Art Layer Menu. These are important steps whether or not you are applying an image to create texture on the mesh, so start here every time you enter the program!

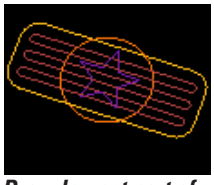


Layer colors of input curves (right) assign parts of resulting mesh (above).

The Layer Color of Curves

Matrix Art references the order of the familiar Layers menu in Matrix to establish the relationship between the curves that are input into Matrix Art. For best results, draw curves on the same layer color if they will have the same profile shape and height in the final shape. (To change a curve's layer color after inputting them, change the color the usual way in the viewports and then re-input ALL curves back into Matrix Art to make the changes.)

Also be sure to notice the ORDER of the layer colors which you place the curves. The curve representing the bottom-most surface in your design should be the lowest layer color in your design (Creation Yellow is the lowest). Work your way up through the Layers menu to the highest part of your design (Metal 01 is the highest), taking care that parts of the mesh which should be "over" other parts are on higher layer colors. (Once you get a little more practiced in Matrix Art, you'll learn how and when to "break" this rule in order to get the desired result in your design: if you're curious now, see the Tips and Tricks section below!) Just remember: in order to change the layer color of a curve in Matrix Art, change it in the viewports as usual, and then re-input ALL of the curves into Matrix Art to see the results.



Draw lowest part of design on creation yellow; highest on Metal 01.

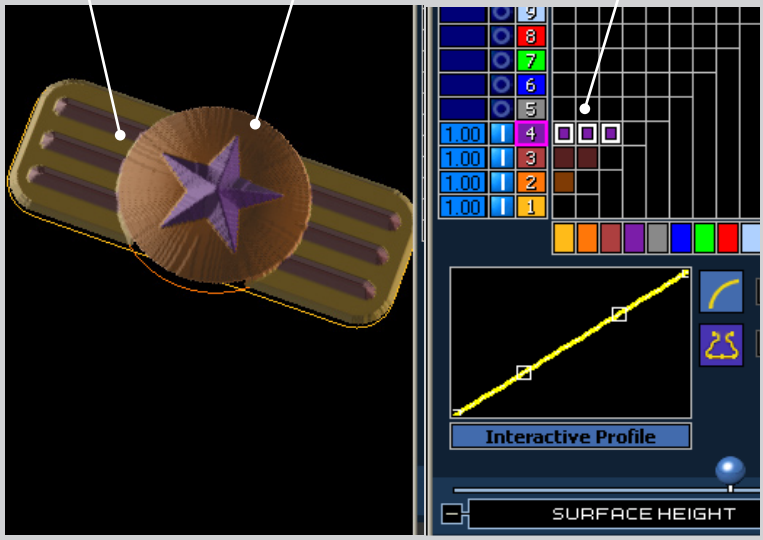
Rules for Curves & Layer Colors in Matrix Art:

All curves used in Matrix Art must be planar, closed, and drawn in the Looking Down viewport.

For best results, draw the curves that will need to be controlled together on the same layer color - in other words, those with the same profile shape and height.

If a curve is INSIDE another curve of the same color, a hole will result. If this is not the desired effect, place one curve on a different layer color before inputting them into Matrix Art.

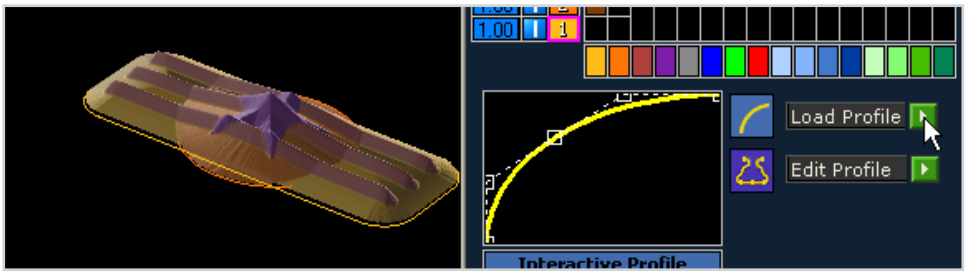
When creating a model, place the curves that represent the lowest surfaces of the model on the lowest layer colors (Creation is lowest) and those of the highest parts of the model on the higher layer colors (Metal 01 is highest).



Understanding Workflow The Layer Menu

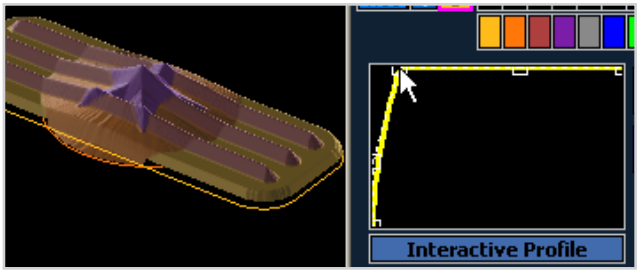
Here is the recommended "workflow" for using the Layer Menu grid each time you enter Matrix Art.





1- Activate a Layer in the Grid The grid or "matrix" in the Layer Menu is where you want to start each time you enter Matrix Art. You'll need to make a layer color "active" to change the profile shape and height, or to control the relationship between two layer colors (higher layer must be active to do this). To make a layer active, click its number on the left-hand side of the grid. The number will become highlighted with a pink outline around it so you'll know it's active.

2- Change Profile Shape of Active Layer To change the profile shape of the active layer, click "Load Profile". Mouse over options in the library to see the profile shape change. Click a profile from the library to select it, and the library will close. The selected shape will appear in the "Interactive Profile" window. This only represents one half of the profile shape: every profile is automatically Mirrored. You have two options to edit this profile shape: (1) Click and drag the profile's control points in the



interactive profile window. You'll see the changes in real-time in the viewports as you change the shape. (2) The other way to edit this shape is to click the "Edit Profile" button just beneath "Load Profile". In the Edit Profile window that appears, use the Curve tools to draw a new profile shape or edit the existing shape. If you wish, use the controls in the window to Save it to the Matrix Art profile library so you can use it again.

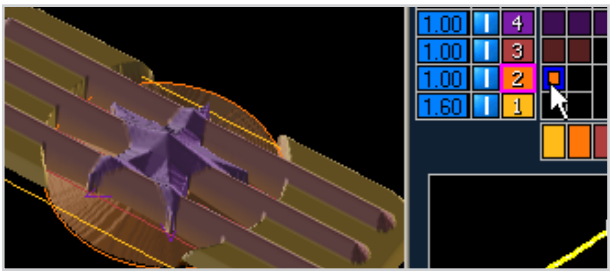


3- Change Profile Height of Active Layer Click and drag the "Surface Height" slider control, or type a new value into the text box, to change the height, in mm, of the active layer. Remember that if the layer relationship (explained next) includes the "Build" relationship, the height of the profile will "Build up on" the height of the layer colors beneath it, so add this in when adjusting the profile shapes for layers "on top of" other layers.

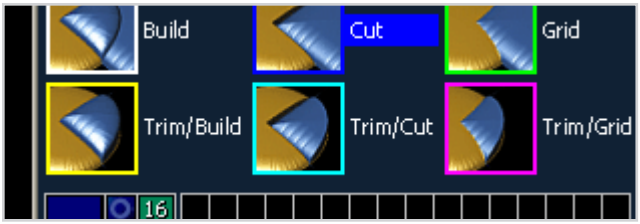
Understanding Workflow Adjusting Relationships between Layers

When two surfaces overlap in Matrix Art, select the "dominant" color to make it active & use the grid interface to control them.

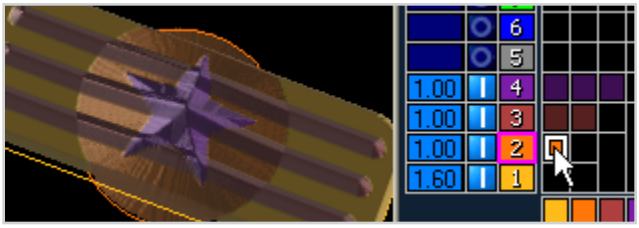
4- Activate the Dominant Layer Color When (at least) two surfaces on different layer colors overlap in Matrix Art, and the result is undesirable, control the relationship between the two using the grid interface. To begin, activate the dominant (higher) layer color on the grid so it's outlined in pink. Now, find the color of the lower surface that is interacting with it from among the swatches of color at the bottom of the grid. The location on the grid where the lower color (in the bottom row of the grid) and the active color (in the left column of the grid) line up is where to click in order to control their interaction. Picture it like the "times table" you studied when you were a kid: Where 3 on the left and 5 on the bottom lined up, you saw the number 15 - their product. The same goes for Matrix Art: the "Swatch" on the grid that controls



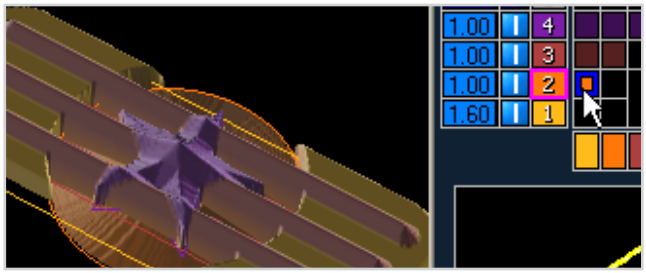
the relationship is the location where the dominant (higher) color on the left and the subordinate (lower) color on the bottom line up. This is where you will click to control the interaction between the two. Left-click to move forward through the 6 options; right-click to move backward through them.



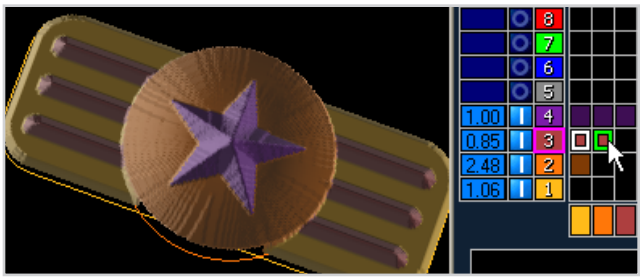
5- Click the swatch where the two colors interact to toggle through six relationships.
Each of the relationships between these two colors is displayed in a "key" above the grid. These are Build, Cut, Grid, Trim/Build, Trim/Cut, Trim/Grid. The color of these controls (white, blue, green, yellow, aqua, pink) will be the color of the outline of the swatch as you click it, and will light up in the key, revealing which relationship is being displayed in the viewports.



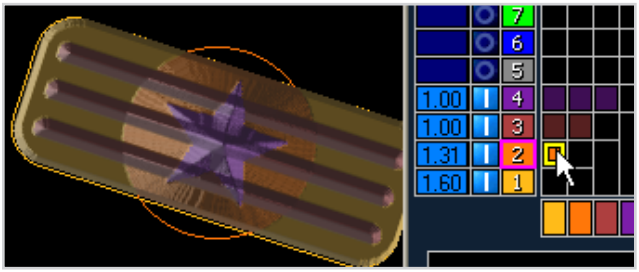
Build and Trim/ Build Note: Each option refers to the HIGHER layer color and its relationship to the lower layer color. "Build" causes the higher layer's surface to build up on (or add to) the profile shape and height of the lower layer color. It is the default setting for overlapping surfaces in Matrix Art. Trim / Build provides the Build relationship while Trimming the higher layer color so that it only appears where the lower layer color appears (see Layer Colors & the Trim Option, below).



Cut and Trim / Cut The "Cut" setting allows the higher layer color to cut through the lower one, ignoring the height and profile shape of the lower layer color as if it were not even there. Trim / Cut provides the Cut relationship between the two layer colors while Trimming the higher layer color so that it only appears where the lower layer color appears (see Layer Colors & the Trim Option, below).



Grid and Trim / Grid The Grid setting causes both layer colors to build up from the grid (or from any layers either might already Build up from), so that the taller layer appears on top. If the profile of either surface tapers at all, this makes a more natural overlap between the two; however, you may want to adjust the "Surface Height" control for one or both of the layer colors to make sure the result is to your liking. Trim / Grid provides the Grid relationship while Trimming the higher layer color so it only appears where the lower color appears.



Layer Colors and the Trim Option. "Trim" with any of the above options "trims" the surface of the higher layer color so that it ONLY appears where it overlaps the surface of the lower color. This means you can trim the background away from an image if you draw a curve that outlines the WHOLE bitmap on the higher layer color; then, trace JUST what you want in the picture on a LOWER layer color. Trim the higher layer to the lower one, and you've just trimmed out the parts of the image you don't want! Just note that this is a "reversal" of the normal strategy (explained later on in this section).



6- With all the Layers Menu Settings & Options correct, click "Create Mesh". Remember: even though the mesh looks like many parts while adjusting the mesh preview, it is created as a single mesh after using "Create Mesh". To create more than one mesh, use the tool several times.

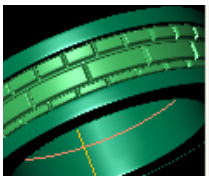
Using Matrix Art...

Using the Picture Menu

This menu adds a bitmap - such as a tileable texture or an image you wish to make into a "2 1/2 D" model - to a curve in Matrix Art.

Preparing to Add a Texture

One of the easiest ways to use Matrix Art is to add a "tile-able" (repeatable) bitmap to a curve (UV Curves and "Apply Mesh UVN" used in example at right). Several of these are available at C:/Program Files / Matrix / Matrix Materials / Bump Maps. Or, you can search the internet for a free or low-cost tile-able or repeatable bitmap in the pattern you desire.

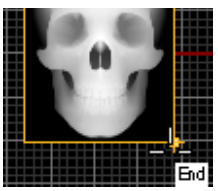


Add a tileable bitmap for texture on a design.

To prepare to add a texture, simply input the curve(s) as usual and follow the steps below. You can add a texture to any one of these curves; if, however, it has a "Build" relationship with a layer color above it, be advised that the texture will ALSO appear on the higher layer color's surface as well. To avoid this, change the relationship between the two to "Cut" or "Grid", as described previously.

Preparing to Create a 2 1/2-D Mesh Model

It is possible to add any bitmap to any curve using this menu - such as an image you wish to "raise up" into a mesh surface, also known as a "2 1/2 D model" of the object(s) in the image. However, for best results if the image is not a simple, tile-able texture, I like to begin by placing the bitmap in the Looking Down viewport using a command such as "Picture Frame" or "Place Background Bitmap". With Picture Frame, you can easily re-size the picture using familiar methods until it's the desired size for the final model. (With Place Background Bitmap, you can only use the tools in the View menu to move / align the bitmap, but you can also see the background grid "through" the bitmap, which can be an advantage over the Picture Frame tool.)



Place with Picture Frame & Trace.

Adding a Picture (tileable or not) to a curve:

1- Create a curve in Matrix to add the picture to. If this will NOT be a tileable or repeating texture, for best results use Picture Frame and trace the rectangular image.

2- Input curve(s). Select a profile shape & Surface height in the Layers menu.

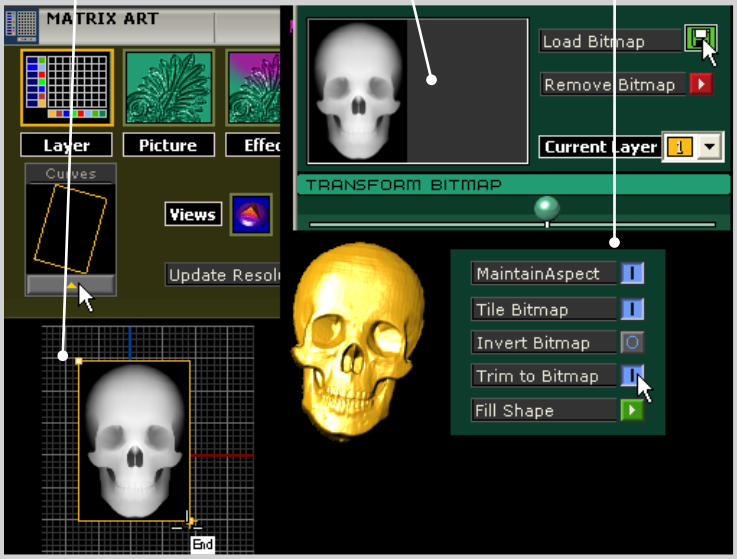
3- With the curve to add the image to active (selected in "Current Layer" in Picture Menu), click Load Bitmap.

4- "Fill Shape" will match the image to the size of its curve.

5- Size and position image using Height / Width, Rotation, X, Y offset.

6- "Trim Bitmap" will trim away black parts.

7- Proceed to Effects, Sculpt if necessary.



The next step is to trace around the edges of the bitmap using the Rectangle tool. Picture Frame also makes this easy, since it works with O-Snaps. *VERY IMPORTANT:* THIS is the curve you will apply the bitmap to!! No matter what else you input into Matrix Art, be very certain that THIS CURVE is on its own separate layer color - usually the lowest color, but read on for more tips on this - and also make sure that THIS is the layer color that is active ("Current Layer") when you load the bitmap in the Picture menu. (Incidentally, when you do run "Load Bitmap", you should load the VERY SAME BITMAP you placed in the viewports during "Picture Frame" or "Place Background Bitmap" - but you already figured that out, didn't you?!)



Hi-res, good contrast, large, & clear images are best for Matrix Art. (Above) ideal illustration; (below) ideal photograph.



Strategies for Good 2 1/2-D Mesh Models

The bitmap you load for a 2 1/2 D Mesh model can't be just any old digital image. For best results, this should be a high-resolution (at LEAST a larger-sized picture than the resulting model you want to make!) image with good contrast (large color differences between the lights and darks in the image), good lighting, and clear, focused objects.

Once you have experimented for a while in Matrix Art, you may wish to do some pre-processing on an image - trimming out the background, blurring images that are too "pixellated", brightening the dark parts, darkening bright parts, or even painting on lighter or darker colors to change the way the image will be raised up into a mesh by Matrix Art. Remember: the "highs and lows" of this image are what is going to create the shape of the surface of the mesh.

But you can do all this editing in Matrix Art: there really is no need for sophisticated pre-processing unless you find you like to use a program such as Digital Goldsmith or Photoshop Elements better than running these functions in Matrix Art (explained next, in the Effects menu).

Preparing to use "Trim to Bitmap"

As mentioned before, there is a "trick" in Matrix Art using the "Trim" functionality in the Layers menu: place the rectangle around the outside of the bitmap on a higher layer color and trace the image(s) you want from the bitmap on a lower layer color. Trim the higher layer color to the lower one, and ONLY the part of the bitmap you want will appear in the mesh, leaving out anything from the background of the bitmap that you don't want in your mesh model.



(Above) Before; (Below) after trim, grayscale, blur.

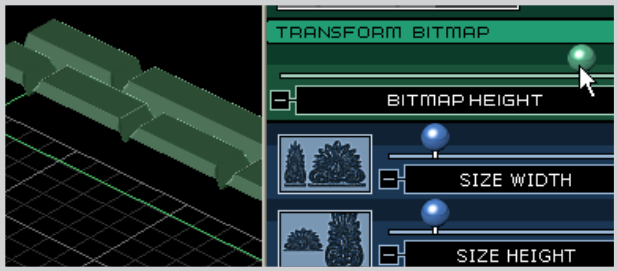


However, if you do some pre-processing to your image, there's no need to run these steps. Simply take the image into a photo-editing program such as Digital Goldsmith, Photoshop Elements, or almost any other similar program, and trace around the edges of the image from the bitmap that you want. Paste only this on a pure black (0,0,0 background, and use this newly-edited bitmap in the above procedure (Place Background Bitmap, Trace with Rectangle; import into Curves menu in Matrix Art; Load same bitmap to this curve's layer color). You can then use the "Trim to Bitmap" command to delete ALL of the pure black (0,0,0) parts of the bitmap, leaving only the object you want to raise up as the resulting mesh surface.

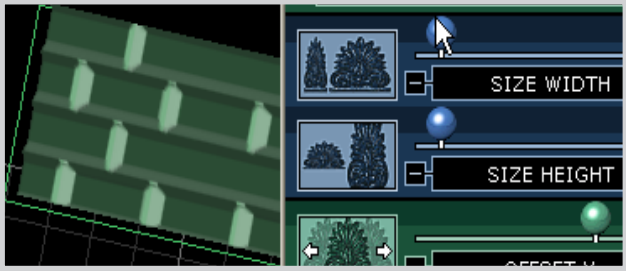
Picture Menu Interface Options



Load and Remove Bitmap Remember to first select an active layer on which to place the bitmap (use the drop-down menu beside "Current Layer" to pick the layer color on which you want the bitmap if you forgot to do this in the Layer Menu). Click "Load Bitmap" and navigate to the location on your computer where the bitmap is saved. Select it, and click "Open". A thumbnail preview of the bitmap will appear beside the Load Bitmap controls. To remove this bitmap, click "Remove Bitmap".



Bitmap & Texture Height "Bitmap Height" refers to the height of the texture of the bitmap. This is added to the height assigned to that layer in the Layer Menu in Matrix Art, so you may wish to scale one of these settings down if the bitmap causes the surface to grow too high. It refers to the highest (brightest) part of the image, so the height will go down from there based on the lower (darker) parts of the image.



Controlling the Size of the Bitmap Use the sliders under "Transform Bitmap" to control the "Width" and "Height" of the bitmap. To maintain the aspect ratio of the bitmap (so it doesn't skew while you size it), make sure the "Maintain Aspect" option is turned on. Or, to fill the curve with the selected bitmap, click the "Fill Shape" option. IMPORTANT: If the curve does not match the aspect ratio of the bitmap, the image WILL be skewed to fill the extents of the curve when using Fill Shape.

Picture Menu Interface Options cont'd

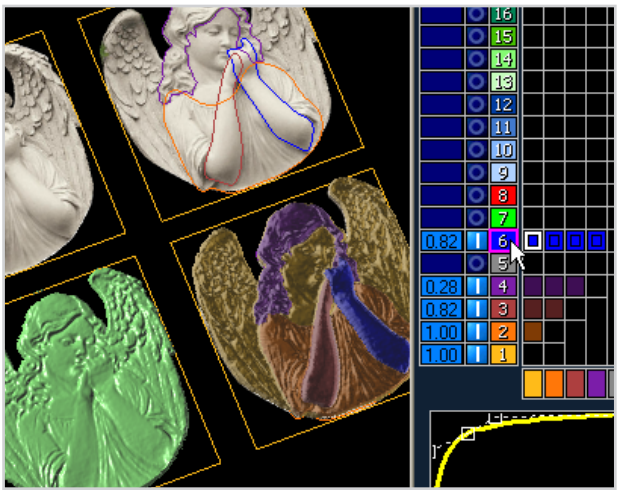


Bitmap Placement & Rotation Use "Offset X" and "Y" and the "Rotate" slider to change the placement and rotation of the bitmap on the mesh. The origin point of the bitmap is at the lower left-hand corner of the bitmap - not its center - so this is the origin around which it will rotate. Note - if you will use "Trim to Bitmap" - i.e. the image is on pure black - or if you will use the entire image, you may place the image on any shape of curve!

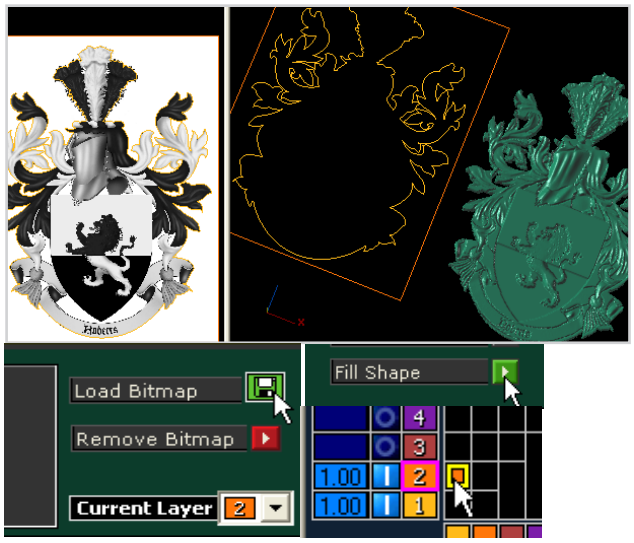
Additional Bitmap Options Use "Tile Bitmap" to repeat the bitmap image over the surface of the mesh. "Invert Bitmap" will switch the darks and the lights (lows and highs) of the image, so that the resulting mesh will instead be low where the bitmap is light and high where it is dark. Finally, "Trim to Bitmap" will cause any instance of pure black in the bitmap (0,0,0) to be trimmed away. This option is helpful if you pre-process the bitmap, trimming only the parts you want and pasting them on a pure black background.

Tips & Tricks Picture Menu

Using a Bitmap with Multiple Curves To add more shape to a bitmap if, for example, the image gets darker (the surface goes lower) where the design should go higher, or to simply add more definition to a design, as at right, you can proceed to the Effects menu to learn more about editing the lights and darks of the bitmap. OR, you can try this: in the Looking Down viewport, trace with additional closed curves those parts of the image that are too low or that need more shape and definition than the bitmap alone can give them. Place them on higher layer colors than that of the rectangle surrounding the bitmap, so they can "Build" on the layer color of the bitmap in the Layer menu - both in texture, height, and profile shape. Re-input ALL curves into the Layer Menu in Matrix Art, and place the Bitmap JUST on the layer color of the rectangle. Adjust the profile shapes and heights of the additional curves in the Layer menu (using the Build relationship with the lowermost color).



Curve only input on left - flat mesh results. Shape curves AND border curve input on right. Add height and shape to each using Layers menu using the "Build" relationship.



Using Layer Strategy to "Trim" a Bitmap As discussed earlier, there is an alternative to pre-processing the bitmap - or, placing it on a black background - for use with "Trim to Bitmap". As shown at left, place the un-edited Background Bitmap into the viewports and trace it with a rectangle curve as usual (orange rectangle at left). Then, trace around ONLY the parts you want with closed curves (yellow shape at left). IMPORTANT: The layer color of the rectangle (orange here) must be HIGHER than the layer color of the parts you want to keep (yellow here)!!! Input all curves into Matrix Art, and apply the bitmap to the RECTANGLE curve in the Picture menu (orange). IMPORTANT: Use "Fill Shape" to fill the rectangle with the picture! Then, in the Layers menu, establish the relationship between the rectangle curve (higher color) and the shape you want to keep (lower color) as Trim/Build (shown at left). Now, the image will only appear where the shape you want appears: effectively "trimming" out the background!

Using Matrix Art...

Using the Effects Menu

These powerful editing tools make changes directly to the bitmap, changing the shape of the resulting mesh to improve your design.

How the Effects Menu Works

As you now know, Matrix Art is a heightfield from bitmap modeler which, simply put, means that the dark parts of the image create the low parts of the resulting surface and the light parts of the image create the high parts of the resulting surface.



Original Image.

But what if the image you hand it doesn't make the best surface? Maybe the contrast isn't high enough to make a noticeable difference between the high and low parts; or maybe the pixels are too sharp and visible in the image and the results you want are soft and organic. Maybe, the lighting in your image makes the surface low where it should be high, or high where it should be low?! How can you fix all this without lots of trial and error in a pre-processing image editor?

The Effects menu can do all this and more. It directly accesses the bitmap you loaded into Matrix Art in the Picture menu, allowing you to adjust aspects of the image such as overall contrast and blur. It also allows you to "paint" directly onto the parts of image in the resulting mesh that you'd like to adjust for brightness, blur, or contrast and see the results in real-time onscreen as you work!



(Above) Mesh Preview BEFORE Effects menu used. (Below) AFTER Effects shown at right.



Better than the trial-and-error method necessary with pre-processing your bitmap, the Effects menu lets you see the results instantly while you work. Most pre-processors offer the same features (blur, contrast, and brightness), but it's difficult to know what effect they'll have on the resulting mesh without lots of time-consuming trial and error. The Effects menu bypasses all that, and it's easy and intuitive to use!

Steps for Using Effects Menu:

Method 1

1- "Select Area" should be activated. With nothing else in the menu selected, check that your Tool Size is correct & click and drag over the areas you wish to affect with "Brightness" or "Blur".

2- With area(s) of the mesh selected in pink, activate the "Brightness" OR "Blur" option (only one can be used at a time). When you see the desired effect, click "Apply". Repeat to add other effect.

3- "Clear Selection" and repeat steps 1 & 2 to choose another part of the mesh to affect with Brightness and/or Blur.



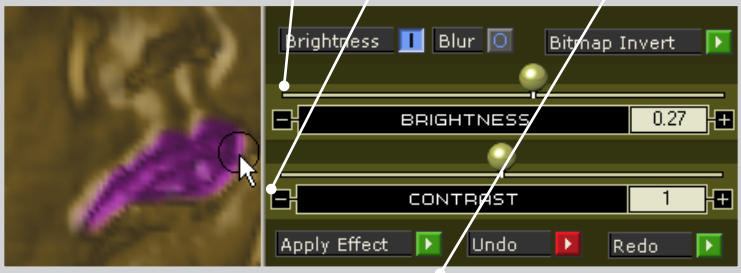
Method 2

(This second method allows you to "paint with" the desired effect. For best results, test it by using "Method 1", described above, on a small area of the design first.)

1- Set up Brightness OR Blur slider to achieve desired effect.

2- With "Select Area", click and drag over the desired parts of the mesh to change. The results will be applied as you "paint". If needed, change Brightness or Blur sliders, further adjusting ALL painted areas.

3- Click "Apply". If necessary, use other effect before clearing selection. "Clear Selection" & repeat.

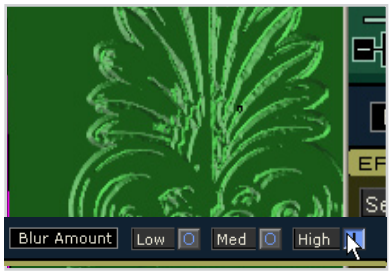


Using Effects Menu Options

These tools directly edit the Bitmap you loaded into the Picture Menu in Matrix Art.



Adjust Contrast Three settings change the way this slider works. "Low End" will allow the slider to raise the low (dark) parts of the bitmap up toward "gray" or the middle of the color spectrum, making them less deep. Use this for illustrations with extra markings in them that you don't want to see in your design (original on left, above). "High" does the opposite, bringing the light areas down toward the middle or gray (result on right, above). "Both Ends" bring the lights down and the darks up at the same time. Experiment with these settings each time you load a bitmap into the Picture menu, as every image is different.



Blur Amount Three blur settings - Low, Medium, and High - are available. Select one of the three, or none at all, to blur the entire image overall. For more specific Contrast and Blur control, read on...



Effects Mode Interface Controls

Use these tools to edit the preview with "painting" tools controlled by the mouse. Everything "painted" with this tool will be affected by the "Brightness, Blur, or Invert" tools at the bottom of the interface. To begin, select a "mode" for the painting tool. Usually, you'll want "Select Area". To "unpaint" any areas you painted in error, use "DeSelect Area". Or, to select most of the image, paint only what you DON'T want selected and click "Reverse Selection". Or, to select all of the image, click "Select All".

Diameter, Strength, & Fall-Off

As the cursor approaches the model, you'll see a circle appear. This represents the size of the "brush" which will "paint" the area to be affected by these tools. To change the size of this tool, raise or lower the "Diameter" slider in the Effects Mode menu. To change how quickly and easily or slowly and gradually the tool works, raise or lower, respectively, the "Strength" slider. "Fall Off" refers to the gradualness between the painted and un-painted areas. To blend them together more gradually, set a higher Fall Off value. To make the difference very swift and steep, set a lower Fall Off value.

Brightness, Blur, & Invert

After clicking and dragging over the area on the bitmap you wish to change, select either "Brightness" or "Blur". (The two are mutually exclusive, so you must Apply the "Brightness" effect first, for example; then set up and "Apply" the "Blur" setting separately.) When you select one, additional slider values will appear. Adjust these to set the Brightness or Blur of the selected area to your liking. Or, choose "Bitmap Invert" to reverse the high and low parts (dark and light colors) of the selected parts of the surface.

Apply, Undo, & Redo

Once you like the results, click on "Apply". (To brighten AND blur the selected area, click Apply and THEN select the next option - brightness or blur - and Apply it, as well.) If you paint more of the surface and make changes, the changes will affect everything that is selected, so it is better to use "Apply", then "Clear Selection", and then select brand-new areas to change. Undo and Redo work for each new "Apply Changes" step.

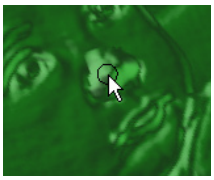
Using Matrix Art...

Using the Sculpt Menu

Sculpt the surface of the mesh preview with the Sculpt Menu controls.

Comparing the Sculpt & Effects Menus

Like the Effects menu, you will click and drag the "painting" tool connected to the cursor over the mesh preview in order to change it in the various modes offered (Deposit, Carve, Smooth, Smudge, Fade, or Erase).



Sculpting lifts up mesh AND bitmap texture.

Unlike the Effects menu, these changes do NOT affect the bitmap in any way. Here is the analogy I like to use. Have you ever seen a cat playing under a bedspread? You see the little lump where the cat is moving around, but it doesn't change the pattern on the bedspread, of course! This is how the Sculpt menu works. It does not affect the texture on the bitmap at all (the pattern on the bedspread); it merely raises it up or pushes it down (the cat playing underneath it). To continue this analogy, the Effects menu actually changes the pattern on the bedspread!

For that reason, you CAN'T use the Sculpt menu to "smooth" a lumpy texture the way you might expect you can by looking at the menu. Instead, to do this, return to the Effects menu. Yet you CAN use the Sculpt menu to adjust parts of the mesh that may be textured - raising them up or lowering them down in a way more fitting to your design - as when forming the cheeks, nose, or eye-sockets of a person; the muzzle of a dog; the surface of a leaf, etc.

Comparing changes made with Effects vs. Sculpt

The Effects Menu controls can change the texture of all or part of a bitmap, making it smoother (Blur), higher (Brightness), or less varied (Contrast).

The Sculpt menu can lift up (Deposit) or lower down (Carve) whole areas of textured or untextured mesh, creating helpful details like noses, cheeks, foreheads, eye sockets, muzzles of animals, etc.

Sculpt will work just fine on a part of the texture already edited in Effects mode; however, Effects mode cannot smooth out changes made by Sculpt. Only the "Smooth, Smudge, Fade, and Erase" controls in the Sculpt menu can do that!



To create subtle details as above, raise Falloff and Height, lower Strength, and set appropriate Diameter (smaller for nose, larger for cheeks).

Using the Sculpt Menu

Begin by selecting either "Deposit" or "Carve". Click and drag the "tool" over the mesh preview to change it. Use the Diameter, Strength, Height, and Fall Off options as described in the Effects menu section earlier in this manual to change the way the tool works as you click and drag it over the surface to sculpt.



Smooth, Smudge, Fade, & Erase AFTER using Deposit & Carve.

The key thing to remember about this menu is that the remaining tools (Smooth, Smudge, Fade, and Erase) only work AFTER you've used Deposit and Carve. These remaining four tools work to temper, outright "Erase", or otherwise edit the work you do with the other two main carving tools - Deposit and Carve. They work in increasing degrees of strength, with "Smooth" being the most subtle, "Smudge" being a bit more aggressive, and "Fade" being the most aggressive. "Erase" outright erases any sculpting you've done, leaving the "painted on" part of the surface the way it was prior to any sculpting operation. It's like a targeted "Undo" operation for this menu.

As with the Effects menu, you'll see your changes in real-time as you click and drag the mouse. But unlike "Effects", there is no "Apply Changes" function: all the changes are as you see them. You can "Undo" and "Redo" while you work, too: each instance of "clicking and dragging" the mouse can be undone and redone. Click "Reset" to undo ALL instances of sculpting on your design.

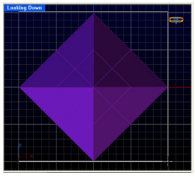
Using Matrix Art...

Convert to Bitmap

This Matrix Art Tool saves a picture of any model onscreen as a bitmap ready to be used in Matrix Art! It uses functionality shown in the next section.

About Convert to Bitmap

This tool simply takes a snapshot of the active viewport in grayscale format (how it does this is explained in the next section) so you can use it in the Matrix Art > Picture menu. It is best used when you wish to create your own texture for use in Matrix Art - for example, a pyramid pattern, "bubbles" design, or other simple shapes which you can draw with Matrix tools and capture to a bitmap to create an interesting design.



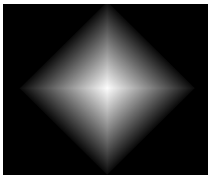
Original Design - pyramid

Preparing to Use this Tool

To use this tool, simply create the design in the viewport you wish to capture as a bitmap (usually the Looking Down viewport). When setting the viewport up to "take the picture", keep in mind that you want the biggest, highest-quality picture for Matrix Art. I like to maximize the viewport I'm going to take a picture of and zoom in almost to the extents of the part; remembering I must still have a rectangular space around the part in order to tell the tool where to "snap" the picture so as not to cut any off.

Using this Tool

With the object "posed" and ready in the viewport of your choice, start up this tool and you'll be prompted to draw a rectangle around the part to capture. After you've captured the image, you'll be prompted to save it. Save it to a location you can remember for later use in Matrix art.



Bitmap created by "Convert to Bitmap"

About this Rectangle

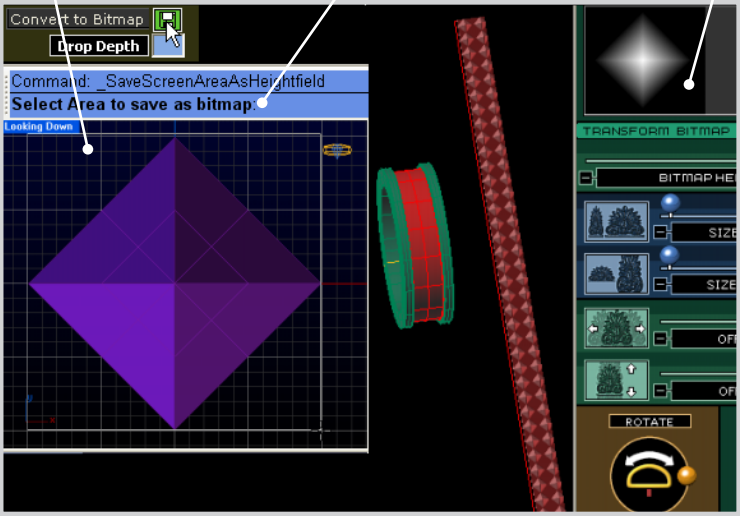
The space around the object that you enclose with a rectangle while this tool is "taking the picture" determines how much "black space" or background you'll have in your image. For instance, if this will be a repeating texture, you might want very little space around each repeating object in the case of the pyramid texture; but in the case of the bubble texture, you might want a little more to space the bubbles out interestingly over your design. Let the design determine how much of the viewport you enclose in this rectangle.

Steps for Convert to Bitmap

1- Create a design in the viewports that you wish to apply to a mesh as a repeating pattern or other texture in the Matrix Art > Picture Menu.

2- "Pose" the design in the viewports so it's large (viewport is maximized) and only has the space around it you want as "black space" between the image and, if it's repeating, its next repetition.

3- Click on "Convert to Bitmap" and place two corners of a rectangle so it surrounds your design. Navigate to a location on your computer to save your image to. To use it later on in Matrix Art, load this image in Matrix Art > Picture Menu > Load Bitmap.



Another way to use this tool

You will recall that Matrix Art has no "Save Styles" and no way to save your settings. If you find yourself in a bind, this tool can capture - as you'll recall - ANYTHING in the viewport; including a Matrix Art preview mesh! So, pose the Matrix Art preview mesh as large as you can in the Looking Down viewport and take a snapshot of it using this tool; re-apply this bitmap using the Matrix Art > Picture menu next time you run the tool, and you've got a way to save your settings and re-load them!



Utilities Menu Tools...

Show Z Buffer

This Utilities Menu command shows you the depth & contour of an object in grayscale. It's used by Matrix Art & other programs.

About Show Z Buffer

This tool shows you a grayscale image of the depth and contour of an object in the viewports. It is used by Matrix Art when taking a "snapshot" of a viewport for the Convert to Bitmap function.

For your everyday use, you probably won't click on it that often - if at all! However, to preview how a snapshot will appear when it is taken by the Convert to Bitmap tool, you may wish to use it.

Other 3D modeling programs you may use in addition to Matrix may require a Z Buffer view of your viewport; if this is the case, here is how you can create that view.

Using Show Z Buffer

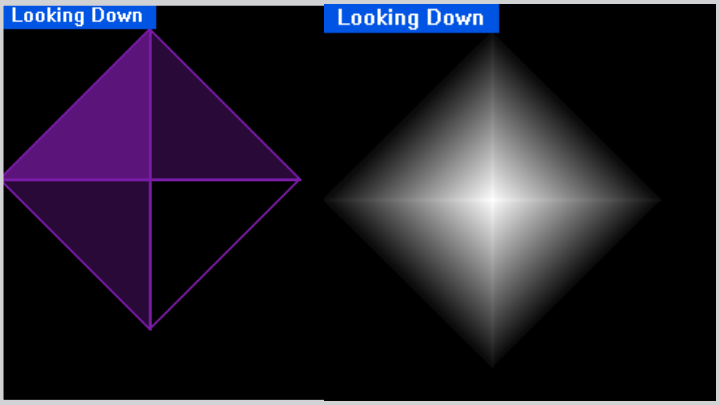
As when using Convert to Bitmap, simply create the object to see. This merely toggles the active viewport view from the Z Buffer view back to the regular view, so make the viewport active in which you wish to see the Z Buffer and click this button. Click it again to toggle back to the normal viewport view.

Using Show Z Buffer

1- Create a design in the viewports .

2- Make the viewport active in which you wish to see the Z buffer.

3- Click this button to see the Z Buffer. Click it again to toggle this view off and return to the traditional viewport view.

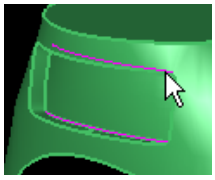


Mesh Tools...

The Mesh Mapper Tool

The most simple way to place a mesh onto a surface or just to curve it in space, Mesh Mapper is found in the Tools Menu

Mesh Mapper is a simple way to get a mesh object - either created in Matrix Art or imported from another program - onto a surface or between two curves in space.



Place two curves (Dup Edge used here) for mesh.

Preparing to Use Mesh Mapper

This tool just requires a mesh and two curves either out in space or located on the surface where you want the mesh to be placed.

The curves may either be on the Left and Right sides of where you want the mesh to go (in that case, they should be the height you want the mesh to start and end at); or on the Top and Bottom of the area where you want the mesh to go (in that case, they should be the length you want for the mesh). The mesh will be stretched and curved to touch both curves - from end to end - so keep this in mind when you draw them.

For best results, before using this tool, go to the Utilities menu and click the Directions tool. Select one curve, then the other, to make sure both of their Direction arrows are pointing Left to Right. If one or both curves are not, use the "Flip" command line option to flip their directions.

The Mesh Mapper Tool

Select "Mesh Mapper" from the Tools menu in Matrix. From the selections just below the "In" boxes, choose whether you've got "Left and Right Lines" or "Top and Bottom Lines" (click one of two illustrations to select it).



Select whether curves are Top and Bottom or Left and Right.

Now, input the Mesh and the relevant (Top and Bottom or Left and Right) curves into their In-Boxes. Click "Transform" to see the results. To select the mesh for further work, click "Select". To undo the work of the builder, click "Undo".

Steps for Using Mesh Mapper

1- Test "Directions" of Curves using this Utility: BOTH must be L - R.

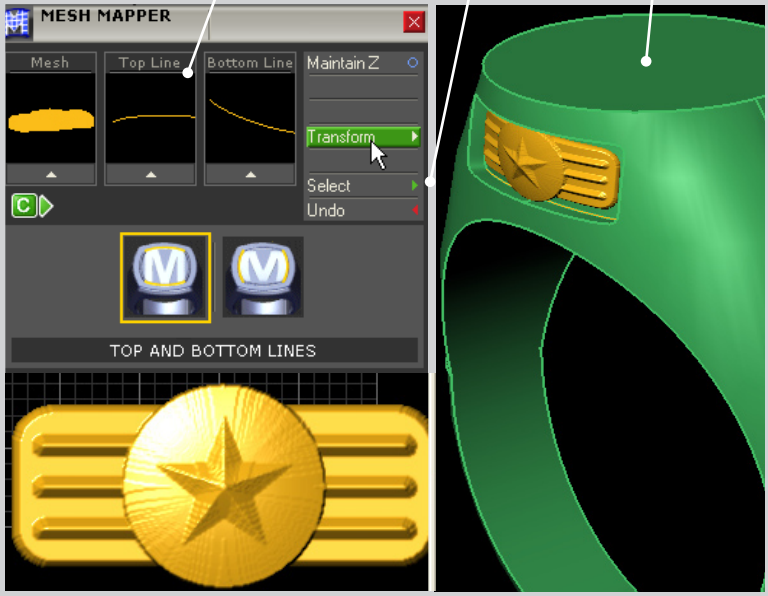
2- Select the Mesh Mapper setting corresponding to the curves you've drawn - Top and Bottom curves or Left and Right curves.

3- Place the Mesh and two curves into the three separate In Boxes provided.

4- Choose whether or not you want to keep the current Z height of the mesh (Maintain Z on or off).

5- Click Transform.

6- To continue working with the Mesh, click Select. Or, to Undo the builder, click Undo.



Maintain Z Option

Turn on the Maintain Z option when you wish to maintain the current height of the mesh in the world Z direction (the height you see in the Through Finger or Side View viewports). With this option off, the height will be scaled up or down relative to the rest of the mesh: if it is shrunk with Mesh Mapper, the height will be shrunk; if the mesh is grown with Mesh Mapper, the height will be grown. To leave the Z Height of the mesh alone during the transformation, turn this on.



Before: Original Mesh



After: Maintain Z OFF



After: Maintain Z On.

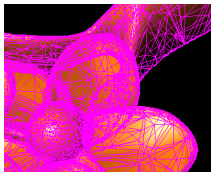
Mesh Tools...

Mesh Reducer

Also found in the Tools Menu, Mesh Reducer is an easy way to reduce the polygon count (size) of mesh objects.

How does a Mesh Work?

Here's some quick background information on how a Mesh is constructed. Tiny surfaces in the shape of polygons make up the shape of a mesh. These are usually triangles, as three sides - being the smallest number of sides for a polygon - contain the smallest amount of information for the program to keep track of.

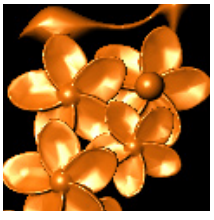


A mesh close-up: tiny surfaces comprise contour of surface.

The resolution settings in Matrix Art or another program that was used to make the mesh will determine how many triangles (or other polygons) are used to make the mesh, and how large or small they are. If the resolution is high, there will be smaller triangles used - and hence more of them - in order to try and capture the shape of that surface as accurately as possible. If the resolution is low, there will be fewer, larger triangles used, which means less information the computer has to work with and greater speed and ease while modeling - as well as less surface definition and accuracy in the resulting shape.

When do I need Mesh Reducer?

If your computer is chugging a little more slowly than usual and you have a mesh onscreen, it's possible you need Mesh Reducer. This tool reduces the number of polygons (described above) making up the surface of the mesh. It also redistributes them so that larger polygons (triangles) get a chance to make that surface instead. If they don't do as good a job as the smaller, more numerous polygons, you can always Undo the work of the tool, or try a smaller percentage when reducing the mesh.



When importing a mesh from another program, (ClayTrix, above) reduce to shrink file size.

Steps for Using Mesh Reducer

1 - Input your mesh into the Mesh In Box in the builder.

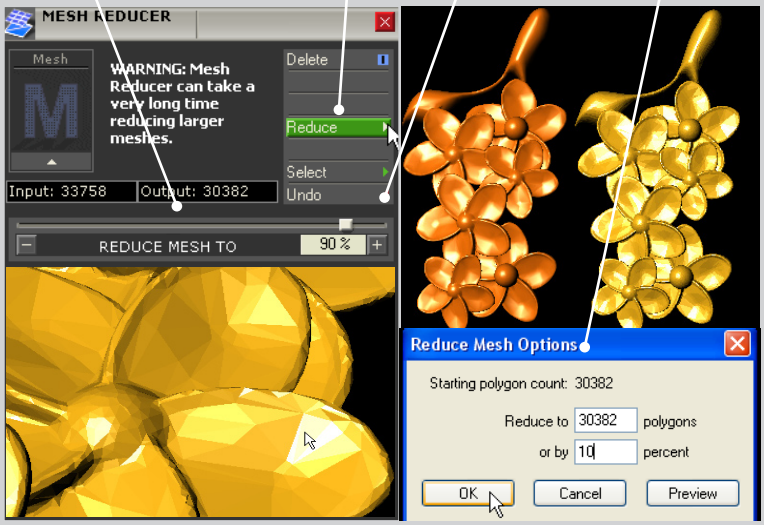
2 - Select a percentage of the original size to which to reduce the mesh using the "Reduce Mesh To" slider.

3 - If you wish to delete the input mesh, turn on the "Delete" option. To keep it, turn this off.

4 - Click Reduce.

5- To continue working with the mesh, click Select. To Undo the reduction and try again, click Undo.

(Alternately, use "Reduce Mesh" Utility)



How do I know when I've gone too far? If the surface looks choppy, "broken", or the mesh loses too much definition, you've reduced it too far (lower left corner, above) .

Using Mesh Reducer

Simply start up this tool and input your Mesh into the In Box. The current number of polygons will display in the "Input" window. Using the "Reduce Mesh To" slider, indicate a size, in percentage of the original, to which to reduce the mesh. The new number of polygons will display in the "Output" window. With "Delete" turned on, the old mesh will be deleted and the new one will remain. With this turned off, both will remain so you can compare the new to the old. Click "Reduce" when you are ready to see the results. "Select" the mesh to continue working on it, or click "Undo" to reverse the procedure.

Rhino Mesh Reduce Utility

Use this in exactly the same way, only without the fancy builder menu. Select the mesh to reduce, and indicate the percentage to reduce it to. Click OK.

Mesh Utilities...

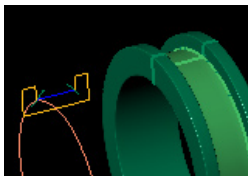
Using Apply Mesh UVN

Use this Utility Menu tool to get a mesh object up onto a surface, exactly fitting the length, width, and curvature of that surface.

About Apply Mesh UVN

When "Mesh Mapper" just doesn't seem to achieve the results you want, try using Apply Mesh UVN, which is found in the Utilities menu.

Similar to Flow Along Surface - but for mesh objects only - this tool allows you to map a mesh to a surface. For best results, this surface should be created with Sweep 2 so that it has definite "U" and "V" (perpendicular) directions.

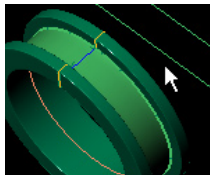


Create surface separately to start with, using Sweep 1 or 2. (DO NOT use Split or Trim!!)

Preparing to Use Apply Mesh UVN

The surface you'll be mapping the mesh to cannot be a polysurface, and it should not be a "trimmed" Surface (a surface that has been split, trimmed, or Booleaned since it was created). If you must use a "trimmed" surface, select it first and run "Shrink Trimmed Surface" from the Surface menu. Or, for better results, delete it and use the open edges where it used to be to sweep a new surface. That way, you control the U and V directions (for predictable results, rails should be the "long way" and profiles should be the "short way").

As discussed earlier in this manual, you can model your piece strategically from the start when you know you'll be using this command. For instance, sweep a separate curve to create a surface specifically for the mesh.



"Create UV Curves" and input this curve into Matrix Art. "Create Mesh".

Unroll this surface using "Create UV Curves", and input the UV Curve rectangle into Matrix Art. Now when you map the mesh up onto the surface, you'll know that it won't be skewed too far out of proportion to the original shape.

Steps for Apply Mesh UVN

1 - Create a curve with which to build the mesh, using "Create UV Curves".

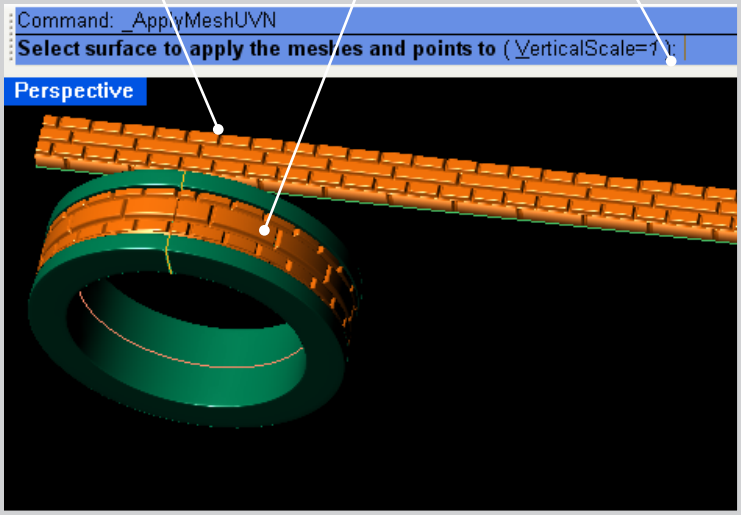
2 - Input curve or curves (if you're enhancing design with curves on additional layer colors) into Matrix Art and "Create Mesh".

3 - Select mesh and click "Apply Mesh UVN".

4 - The Command Line will prompt you for the surface to which to apply the mesh. Select the surface from Step 1, which you used in the "Create UV Curves" command.

5 - The mesh will be applied onto the surface.

(If it is backwards or upside down, click "Undo" and Rotate or Mirror without Copy the design to correct it. Then, run Apply Mesh UVN again.)



Using Apply Mesh UVN

Start up this tool. Select the mesh to apply; select the surface to apply it to. As discussed above, a polysurface cannot be selected, so trying to do so will result in the tool trying to select one of its component surfaces, instead. Select a surface and the mesh will be applied to it. (Unlike Flow Along Surface, you don't need a "base surface" underneath the mesh: just a "target" surface and a mesh. Also unlike Flow Along Surface, this tool doesn't work with History.)

Sometimes, the mesh will be applied to the inside of the surface, instead of the outside. You would think flipping the Directions of the surface would correct this but, alas, you would be wrong. If the mesh is mirrored when you apply it, click Undo and mirror the mesh onscreen. Apply the new mesh. Same goes for if it is rotated or otherwise flipped when you try and apply it. Undo the incorrect version, rotate or flip the original, and use this instead with Apply Mesh UVN.



Mesh Utilities...

Create & Fix Meshes

These Utilities Menu Commands create and "heal" any meshes imported from other programs with badly aligned polygons or holes.

"Mesh" Utility: Nurbs to Mesh

Use this command to convert Nurbs objects into Mesh objects. You may wish to do this (as described later) in order to close up a model that won't close any other way. Or, if you need the object as a mesh to export into other programs, this is the tool you need to do so.

To use this tool, first select the object to turn into a mesh. The Polygon Mesh Options dialog will appear. Move the slider towards "Fewer Polygons" in order to make a coarser mesh that will help your computer run fast. Or, slide it up toward "More Polygons" if you care more about detail than speed. Finally, use the Detailed Options dialog explained below if you wish to assign the maximum and minimum size for the polygons. However, within this dialog, the only setting we recommend you change is "Maximum Edge Length". This usually varies from 0.25 mm to 1.0 mm depending on how small (slow and fine) or large (fast and coarse) you want the polygons making up the mesh to be.

The "Extract Render Mesh" Utility

What you see when shading or rendering the object are actually meshes stored with the object and turned on when you hit Shade or Render. To get this mesh as a separate object you can model with onscreen, run the Extract Render Mesh Utility. This mesh will be created with the current Mesh settings stored in the Shade button (Fine, Superfine, Coarse, etc.), so set the desired Shade setting BEFORE you use this tool. Or, if you require different settings, just use the Mesh Utility described above.

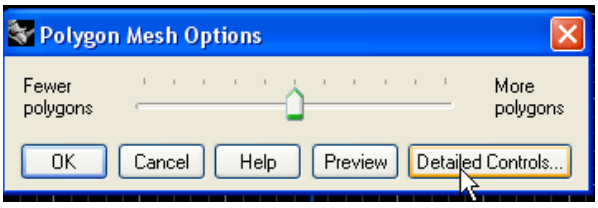
About Fill Hole / Fill Holes

Use these two commands to close up mesh object with a single hole or multiple holes. To test whether your object is open or closed, use the Object Information command found in the Snaps and Info menu. Then, to see these open edges, run "Show Edges". (Try that again after using Fill Holes to make sure it worked!) These are also useful tools when you have a polysurface that won't close no matter what you do. Simply turn it into a Mesh using the Nurbs to Mesh tool in the Utilities menu, and - if there is still a hole or holes remaining - run either Fill Hole or Fill Holes to close the object.

Using Fill Hole / Fill Holes

To use these commands, start with a mesh object that has "holes" or open edges. (Matrix Art will not produce these, but if you import mesh objects from other programs, you might get this issue.) Select the Fill Hole command. The Command Line will prompt you to "Select mesh edge on hole boundary". Click an open edge around the hole on the mesh (as described above, use Show Edges to assist). If it is possible, the hole or holes will be filled.

When using "Fill Holes", the program will attempt to fill these holes automatically for you (you won't need to select the edges).



Using Align Mesh Vertices

Sometimes, all holes will not be able to be filled using these tools. To give the program a better chance of filling the holes in a model, run the Align Mesh Vertices command first. This re-aligns the edges of the polygons used to make up the mesh, which will make it easier for the program to fill the holes of the new, curved edge that will be replacing the existing shape. Each option will change the way the tool works, so you may wish to try them all to see what will work best for your surface.

Mesh Options Dialog: "Detailed Controls"

If you wonder what these mean (so do I!) and how to use them, here you go:

How a Mesh is Made There are several steps to making a mesh. The program first estimates where the polygons (known as quads) should go; then it refines the result (splits initial "quads" into smaller objects known as "quadrangles") to get the mesh as close as possible to the target object. Some of these controls refer to the first part of that process (Maximum Aspect Ratio, Maximum Edge Length, and Minimum Initial Grid Quads); while some refer to the second part of that process (Maximum Angle, Maximum Edge Length, Minimum Edge Length, and Maximum Distance, Edge to Surface).

Density / Max Angle "Density" controls how close the edges of the mesh's polygons are to the original surface (0 - 1). Large values mean more polygons. "Maximum Angle" is the largest allowable difference between surface normal and mesh vertex. The Default value is 20 degrees; Smaller values make more accurate meshes.

Max Aspect Ratio Smaller values result in slower meshing and higher polygon count, for better detail. Setting this to "0" turns off this option, meaning "no limit". The default is "6" and the range is 1 - 100.

Min / Max Edge Length The Min Edge Length is the size of one edge of a polygon smaller than which the tool will no longer sub-divide the polygon to refine the mesh. Max Edge Length is the maximum value any polygon edge can be. Smaller values for this make tighter, more accurate meshes. Set either one to 0 to turn it off.

Max Dist, Edge to Surf This is the largest the difference can be between the midpoint of a mesh's polygon and the original Nurbs surface at any corresponding location. Smaller values result in a tighter mesh.

Refine Mesh You'll usually want to leave this value ON, as it results in more accurate meshes (it subdivides the original mesh further, making for tighter, more accurate meshes). However, if you turn it off, you'll get a faster mesh with larger polygons and less information to slow down your computer.

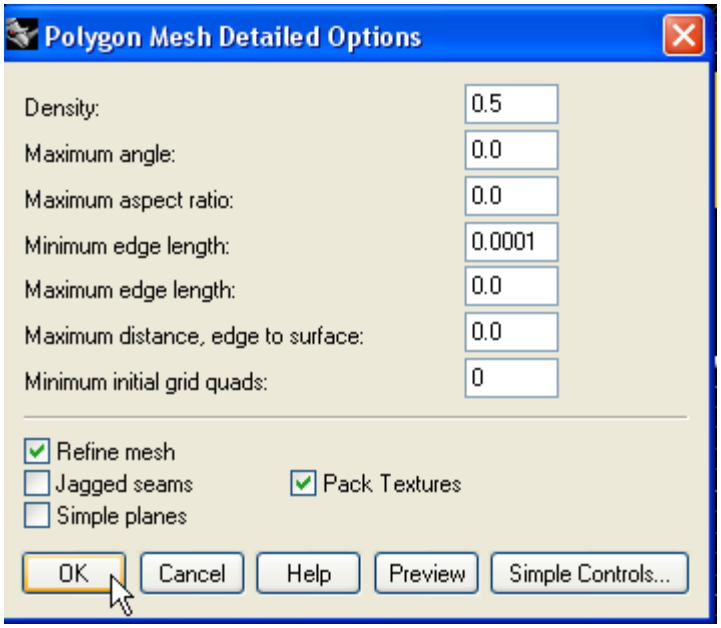
Minimum Initial Grid Quads This is the number of quadrangles created in the initial mesh grid. Rhino will use at least this many polygons to create each mesh surface. Larger values means tighter meshes. Set this to 0 to turn it off. Default = 16; range = 0 - 10,000.

Preview / Simple Controls Click "Preview" to see the results of your selected settings. Or, if all this confounds you, click Simple Controls to return to an easier way to create your mesh: more triangles or fewer triangles? Do you want fries with that? You know, questions we can all handle...

Jagged Seams After meshing a polysurface, there is no guarantee that a watertight model will be formed (the "seams" at the edges of two joined surfaces are left Jagged). To make a watertight mesh, check this box. It causes faster meshing and a lower polygon count, but can make "cracks" in a render.

Pack Textures If a mesh object is exported for use in another program, textures applied for rendering will not accompany it unless Pack Textures is left on.

Simple Planes Planar surfaces are meshed by meshing surface edges and filling in the area bounded by the edges with triangles. This option makes for slower meshing on a planar surface. With this selected, other settings are ignored and planar surfaces are meshed with as few polygons as possible.



Chapter 11 ADVANCED

Rendering With VRay

VRay, the brand-new rendering engine that accompanies Matrix Version 6.0, creates photo-realistic renders quickly and easily.

What is Rendering?

Rendering is a process that adds the look of realistic materials to Matrix models. To do so, this program assigns the properties of metal to objects you select as metal; gem materials to gem objects, etc. VRay rendering looks so realistic because the lighting in the scene is able to interact with the properties of each object the way lighting in real life interacts with all the objects we see in front of us.

The Role of Materials

To give an example of this, we'll take metal for starters: it is very reflective. So, the program assigns it a highly reflective property - several actually - to create the "layered", multidimensional reflections we see in imperfect jewelry created from soft metals rather than hard chrome or steel. Gemvision developers have taken this one step further, creating hammered, stippled, and different colored metals.

Next, let's take gems: the program knows to make them clear like "glass", so the facets in the cut of the stone onscreen create the look of faceting in your rendering the same way real-life gems do. The program can even calculate "caustics", whereby gems' faceting catches light and throws it around the scene like a prism. And finally, it can assign a "fog color" to create a colored gemstone, complete with an Index of Refraction that Gemvision developers have assigned to match their real-life gems.

By the way, if you get all the way through this chapter, you can learn to control these aspects - from the color of gemstones, to the "layers" and colors that create and change the look of metal, to the images that are reflected so realistically in the model by the "environment" you assign in the program...

The Role of Environments

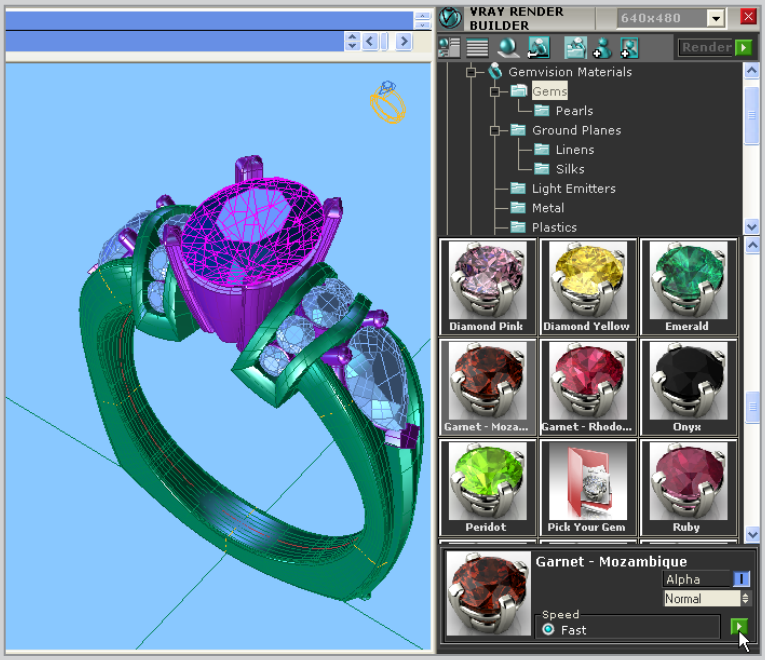
And let's talk some more about those reflections. Hold up a ring in front of you, and you'll see the reflections of the room around you - albeit tiny and warped! - but that's what makes a thing look real. VRay can create this as well, by placing your model inside an invisible "sphere" in the program. Onto the inside of this sphere it maps an environment - or, a "scene" - in your case, the room in which you are holding up your ring right now! In VRay's case, it's actually a digital image that lives in Matrix and is "mapped" onto the inside of this sphere. This is image that reflects on your ring during rendering. So in the "Kitchen" environment, for example, you can look really closely and see the inside of someone's kitchen - really! Try it sometime! - and in the "Studio" environment, we've mapped a black "room" with three light sources to simulate studio lighting.

Basic VRay

Open VRay by clicking the first button in the Render Menu. To see it better, you may wish to "dock" the menu by clicking and dragging it, from the title bar, into the upper right of your screen. Start by placing an "infinite ground plane and "posing" the view to render.

Based upon what you have onscreen, you'll want to select from two or more of the Materials - Ground Planes + Gems, Metal, and whatever else you have in your scene. Select a library, choose a material, select the object to add it to, and click the green button to apply it.

ALWAYS choose an environment in which to render your scene. Select this library and select an environment. No need to select anything onscreen - just click the green button to apply. This adds reflections & lighting. Choose a resolution from the dropdown and click "Render".



The Role of Lighting

Another aspect of the ring you're holding in front of you that makes it look so (haha - obviously!) realistic is the lighting in your room. You might have direct light from a lamp, or indirect light from the sun outside. (Even if you can't see the sun from your window, it's of course still lighting the room: this is why it's called indirect lighting.)

VRay can do something never before managed in other Matrix renderers of previous versions. It can use both of these light sources: direct lighting from any light objects you may put in the scene using the Lights objects found in the render menu; and, more importantly for the photo-realism of your renders, indirect lighting, which VRay can take from the scene in which you place the render when you select an Environment.

This means that the lights in the image of the "Studio" picture used to create the studio environment are actually being used by the program used as light sources to light your scene, making the reflections and the way the materials interact with the light exceptionally realistic! Same goes with the kitchen environment, which has far more varied - and therefore realistic - light sources: direct lighting overhead (bright kitchen lights) as well as indirect lighting from the windows in the image, which let in sunlight.

So the combination of realistic materials, which VRay can calculate just like their real-world counterparts; the environment or scene that reflects in the materials; and the lighting - also from the environment - that interacts with these materials, all work together to render your model with photorealism unparalleled before Matrix Version 6.0.

Buttons in VRay Builder

L - R, below title bar:

VRay Materials: see end of chapter, in Advanced Rendering, to use;

VRay Options: left-click to open Advanced VRay options explained later; right-click to set up basic builder options;

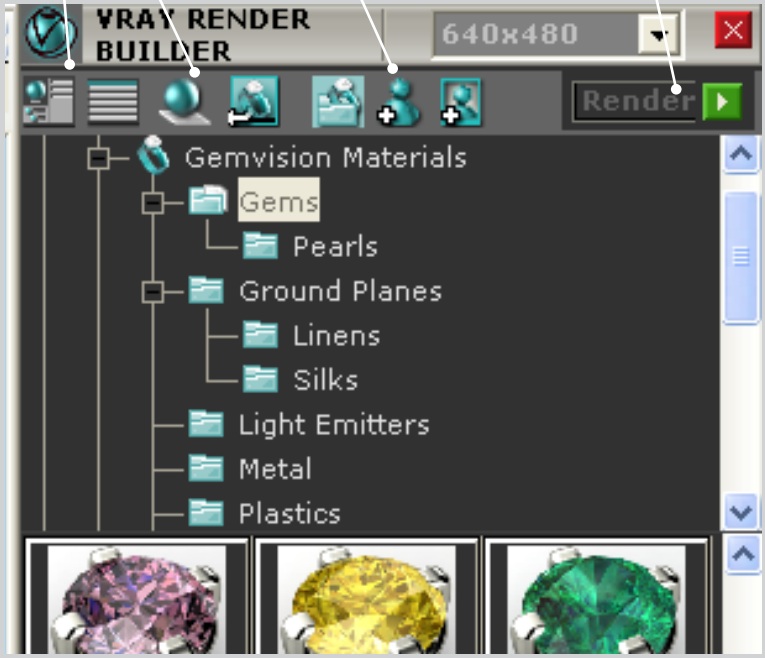
Infinite Ground Plane: Click this to set a Ground Plane into the viewports before EVERY render, unless you create your own groundplane or backdrop. You MUST assign a material to it.

Show Render Window: This opens the VRay render window if you've rendered an image.

Three Builder Views: (L - R) "Library View", selected by default & allows you to select & apply materials to objects; "Add Material" & "Add Environment", which allow you to add a material or an environment to the User section of the Library view.

Screen Resolution: Click this dropdown menu to choose a resolution, in pixels, at which to render the image.

Render: Click to render the image.



Skills & Commands in this Chapter

Render Menu: *VRay Builder, Spotlight, Point Light, Directional Light, Rectangular Light, Linear Light, Shade, Shade All, Render, Render Preview, Animation Builder, Render Compositor, Props Library, Picture Viewer, VR Maker, Set Spotlight to View, Render Print, Prong Warp*

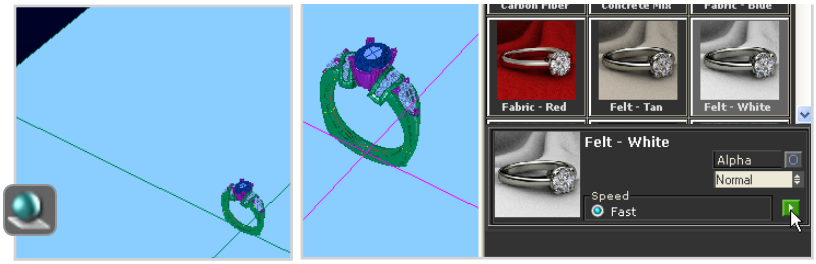


Please Note: Customers with Flamingo (renderer in earlier versions of Matrix) should refer to previous manuals.

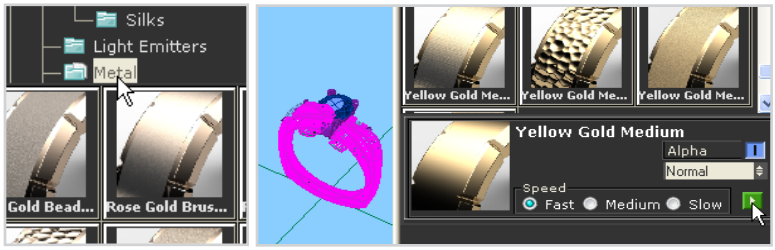


Basic Options & Settings

VRay Options and Settings for creating a basic render.



Infinite Ground Plane VRay requires a GroundPlane; or, an object on which to place the model To create the most basic version of this, click Infinite Ground Plane and it will be placed in the viewports (no, it's not infinite, so be sure and "pose" the render so you can't see the ends of it!) Assign a Ground Plane material the same way you apply any other material, selecting from the choices in the Ground Planes folders (including Linens and Silks), selecting the ground plane, and applying the material to it. You can model your own groundplane too. As long as the object is sitting on it and you can't see the end of it in your view, it will work as a ground plane!



Materials Library The default view of the VRay menu is the Materials library - the folder structure format wherein you can select Gemvision-created Gems, Ground Planes, Lights, Metal, Plastics, Glass, and Environments. To use a library, select a category, opening the menu just below the Library area.

Applying a Material Scroll down to see all the choices; then, click on a material to apply, opening it just beneath the library. To apply the material, select the object onscreen to which you want it applied, and click the green arrow in the lower right-hand corner of the menu. The object will be de-selected in the viewports, indicating that the material was applied.

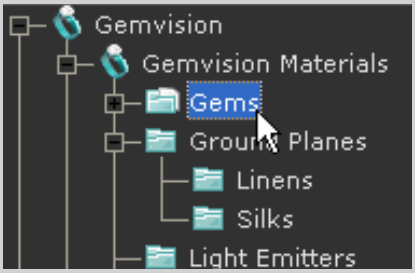
About the Material A thumbnail of the material is displayed, beside its name and the Speed at which it was designed to render (Fast = lower quality; Slow = higher quality; sometimes, only Fast is offered, meaning there is no difference). If you will use the render in processes requiring Alpha masking (explained later in this section), keep this selection at its default. Finally, when rendering gems, you will recall they act like "glass" - so, if they are intersecting metals, you will see the metal through them and the effect will not be pleasing. If you have prepared for this by cutting away the metal, choose "Normal"



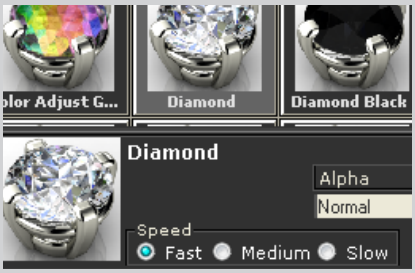
for best results. If you didn't, you can "cheat this fact by using "Forced" - or, forcing the gem to show through and not the metal. But this can create weird results in your reflections. So if it's still not looking good, choose "Complex", which corrects for these weird reflections but takes longer to render.

Step-by-Step

Set Materials

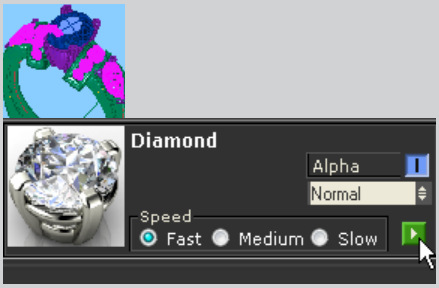


1 Choose a library category. Click a category to set - Gems, Metal, Ground Plane, Plastics, etc. - and the related library of materials will open in the area below the categories.



2 Choose a material & its settings. Click a material to select it, and it will appear in the space below the library. Set its Speed, Alpha mask settings, and Reflection settings.

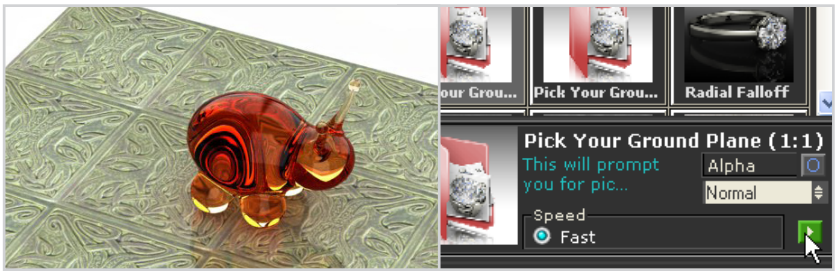
Note: Hold left mouse-button down over selected preview to see larger preview.



3 Select object to apply material to & click green arrow. Select the object in your render to which you want to apply this material and click the green arrow beside the material. The object will de-select in the viewports, indicating the material was applied. Set an Environment and Render!

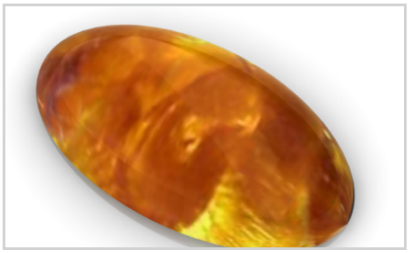
Customize Your Render

Further basic options allow you to customize your render.

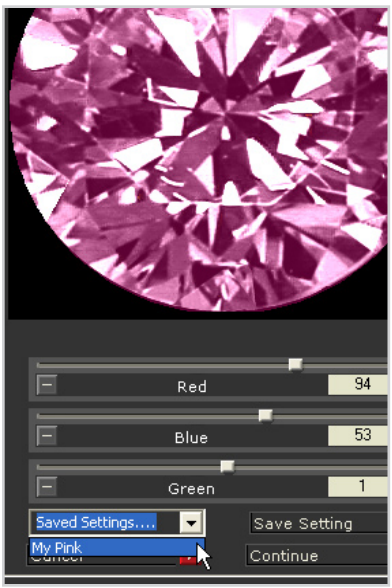


Choose your own Ground Plane: 1:1 or Tiled To add your own image as a ground-plane, scroll down to these options in the GroundPlane library (it's alphabetical!) and select either option based on whether the image is intended to be tiled (repeated) or simply placed (1:1). To use either option, select the object to apply it to (usually the groundplane) and left-click the green button as usual. The "pick picture to map" windows dialog will open. Navigate to the image and select it. Click Open, and it will be applied to the groundplane.





Choose your own Gem Use this just like the "Choose your own Ground Plane" tool above. The image should be ONLY the image of the gem - to the extents of the bitmap. If you have DG, you have a wealth of gemstone maps - amber (results above!) to star ruby - or you can Google or photograph your own. For best results, the surface of the gem that you see in the render should be a single surface that was NOT created with the Revolve or Rail Revolve tool. As above, select the object to make into a gem, click the green button, and navigate to the location of the bitmap. Select it to apply it. "Behind the scenes", VRay is making the object reflect like glass and applying your image as a "map" onto the object.

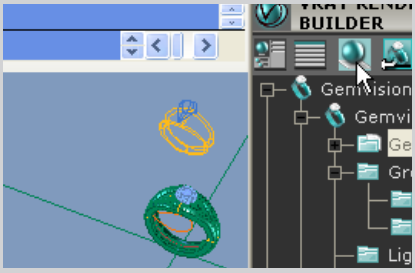


Color Adjust Gems Select this option and a gem to apply it to. Click the green button, and the Adjust Color interface will appear, previewing the stone and allowing you to click and drag the color amounts (Red, Blue, Green) to change the color of the gem. When you want to save a color, click Save Setting and choose a name for it. It will now appear in the "Saved Settings" section of the interface. Click Continue to add the color to the gemstone.



Step-by-Step

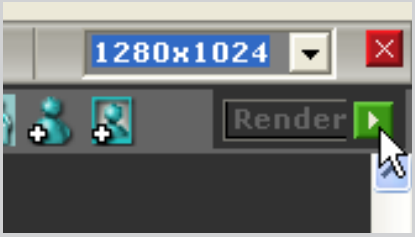
Rendering



1 Set a GroundPlane. After "posing" the view you wish to render, if you don't already have one, click the Infinite Ground Plane tool to set a groundplane in the viewports.



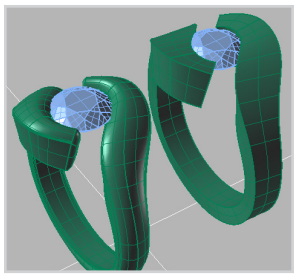
2 Assign Environment & Materials. Apply materials to everything. If an object does not have a material assigned to it, it will not look good in your render. If your scene does not have an Environment (lights and environment image to reflect), it will not look good. Do not forget either of these, or a groundplane!



3 Select a Resolution & Click Render. Use the dropdown just above the Render button to choose a resolution for your image. Click Render to render the ACTIVE viewport. If the right viewport isn't active, your render will look weird! This is almost always Perspective. To see the render window, click this button in VRay.

Tips & Tricks Using VRay Basics

For more advanced rendering options, visit the end of this chapter. For basic options & tricks, read on ...



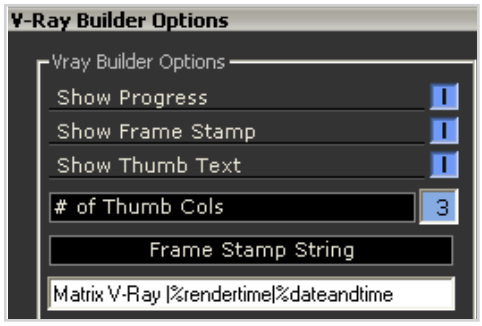


Prepare a Render Some tips to prepare for quality renders:

1- Raise the Mesh Quality in Shade. The highest possible mesh settings available in the Shade menu (found in the Top 11 Buttons, at the bottom of this menu) will help you render the best-quality objects. Lower shade settings will show up like "Facets" on models, which do not make for pretty or realistic renders!

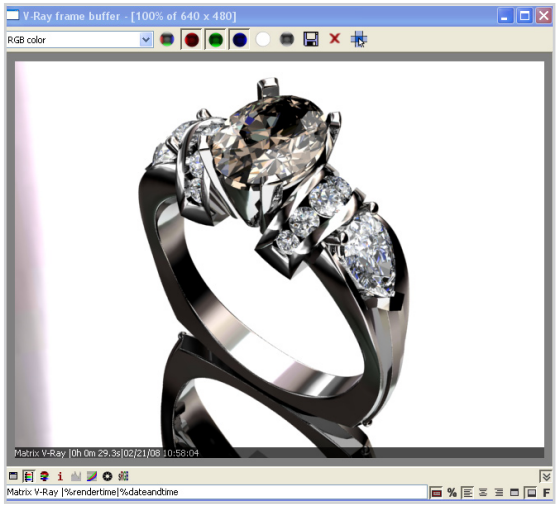
2- Fillet sharp edges. Best when done at the curve level, fillet objects that would have otherwise had sharp edges, such as profiles, for softer, more realistic-looking objects in renders. If it's not possible to do so at the curve level, use the Fillet Edges tool in the Solid menu to fillet edges. Or, use the tools in builders where available - such as Head Builder and Prong Placer - to create shorter, filleted prongs that look more realistic for rendering. Remember to Job Bag a version first for production - with longer or straight prongs - and then edit them for rendering.

3- Avoid those "What Happened Here?!" Pitfalls. Remember that VRay renders the active viewport, so be sure to double-check that the correct viewport is active. Also check that your Current Renderer button in the Render menu is set to VRay.



Options in VRay Builder Right-click the VRay Options button - second in from the left just beneath the gray title bar at the top of the builder - to set the options for the render window. Elect to see the "progress" bar as it renders; save a "Frame Stamp" with the rendered image, that includes the details in the text window (don't change these unless you're brave!) - "Matrix VRay" can be changed to your own text, for example, but to see the render time and today's date and time, leave these in or, to not see them, delete them from this text string. "Save" these settings with this render, or "Cancel" to escape this menu without making changes.

The VRay Render Window (From the upper left) Switch to Alpha and RGB views of your render, and save them separately for further applications like Render Compositor. View Red, Green, Blue, Monochrome, and Alpha channels separately. Save your render by clicking the disk; Cancel it with the red "X". To ask one part of the object to render first, click the "mouse over" button and simply hover your mouse impatiently over the area you want it to render first - yes, it works! At the bottom of the screen, you will see the Text you chose in the "VRay Builder Options" menu, along with a dropdown menu to edit that text (font, center/right or left justify, top or bottom of image) and, to the left of this, other advanced options to control your image that we won't cover here.



Saving Tips VRay settings (materials, environments, builder options, the works!) save with a Matrix file. Use this to your advantage by saving the render-ready file to a Master Job Bag, and, when you need to render it again, you can Load it from here and hit Render! Or, run File > Save as. But also remember: the environments stick around until you do a File > New... so if you load a new file to render from a Job Bag, you'll be in the same environment unless you click a new one. Use this to your advantage as well, but be careful that it doesn't come back to bite you - ! Materials only save with the objects you apply them to, so if you delete or edit an object, you must re-apply the material to a new or edited object for it to apply. (Even if you use the trick of selecting everything by a layer, you are NOT applying the material to the layer - you're applying it to the selected objects. If you bring something new out on that layer, you MUST apply it to the new object, too!) However, if you change your mind about a material, re-apply it to the same object, and it will change. Same goes for an Environment: the last one you click is the one the builder will use.



Rendering with VRay...

Using Lights

Use the six Light commands in the Render Menu. Or, model your own, place them out of the scene, and apply "Emitter" materials.

Lights or Emitters?

Light objects are Rhino objects which don't appear during a render. This makes them really beneficial to rendering, because they can be placed virtually anywhere you need something to light up your scene. They can also create dramatic effects. You'll learn how to use each of the six Lighting commands in the render menu in just a minute. First, let's talk Emitters.

Emitters can be ANY type of object, so the nice thing is, you can model and place them yourself. As an object, they ARE visible when rendered, so they need to be placed outside of the view of the "camera" - or, your view of the scene you are rendering in the active viewport. However, they can be larger than lights and easier to control.

For instance, say you need a broad area with a soft light - how do you get that with lights? I have no clue. It would take me quite an amount of fiddling around (and reading my own manual - !) to get it right. How do I get it with an Emitter? Simple. Place a large plane - maybe two, rotated like a tent - over the area I need light added to, make sure they can't be seen in my scene in the active viewport, and assign an Emitter material to them. It takes moments (see inset at right).

So are lights ever better? For a dramatic spotlight effect: yes. To make a gem really sparkle by adding a point light right beside it where the ring starts to turn away from the light and the gem would otherwise darken dramatically: yes and YES! I wouldn't fix this any other way!! Both kinds of tools work differently and serve different purposes, and both definitely have their place in VRay rendering.

Create a Spotlight

Two commands help you create and control a spotlight. The Create Spotlight button creates a cone -shaped spotlight object. The Spotlight object is projected in the direction of the open cone. Visit the Solids menu "Cone" command in the Basic Surfaces and Solids chapter for a refresher course on how to create this shape for the Spotlight.

Create and Assign an Emitter

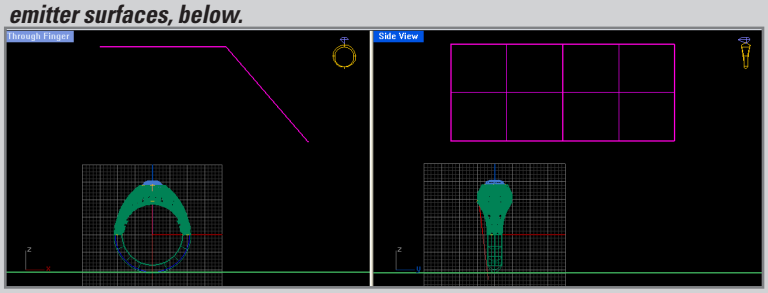
1- Create a surface or two and rotate them, as shown in the model below, so they will reflect against the model where it needs light.

(Before - left: the top and back of top of ring were lacking light. Image on right: After emitters.)

2- Select the surface(s) and apply the Emitter material to them just the way you would any other material. They get brighter as the numbers go up.



(L) Render before emitters; (R) render after emitters. Placement of emitter surfaces, below.



To use this command, start with the model to render in the viewports. Click on Create Spotlight and the Command line prompt will read "Base of cone". The "Base of Cone" is the widest part of the spotlight, or, the width that the light will be around the item being rendered. Click on a point or type grid coordinates (such as F4- on which to center the base.

The Command line will switch to "Radius". Either move the mouse until the base is the correct size or type in a distance for the radius. Please note that a very wide base tends to diffuse into the surroundings quickly, so keep the base narrow for a more direct effect; wide for a more diffuse effect.

After setting the radius for the base, the Command line will switch to "End of Cone". The closer this is to the base of the cone, the sharper the falloff or focus of the light. For diffuse light, set it farther away; for sharp light, set it closer.

This completes the spotlight. To move it around, turn on its Control Points and click and drag them to change it. When positioning this cone, keep in mind the following: the shape of the cone affects the lighting; however, the cone for the spotlight represents the direction of the light, not the range of the light. Spotlights with narrower cones produce more detail than spotlights with wider cones. In addition, the closer the smaller circle is to the large outside circle at the base of the cone, the sharper the falloff or focus of the light. Objects near the center axis line of the cone are illuminated the most brightly. That bright, full illumination continues for half of the width of the cone, and then slowly drops off to nothing at the very outside of the cone.

Set Spotlight to View

To adjust an existing spotlight or to create a new spotlight with its origin point at the camera (the angle from which you are viewing the model in the active viewport), select this command. Use the Command line option "Add" to add an additional spotlight. Or, select the spotlight to adjust. This is a good way to create a spotlight that appears to originate from behind the person looking at a render.

Or, simply use the command to place the spotlight where you want it and then rearrange the view onscreen, if the process of moving and controlling lights described in the Spotlight section, above, eludes you (it eludes me too, so don't feel bad!).

Create a Directional Light

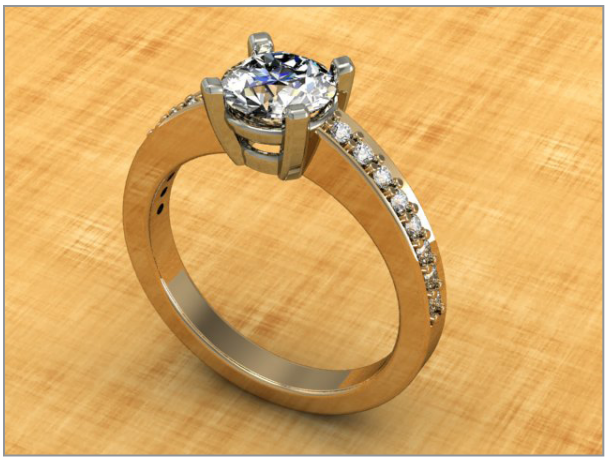
A Directional Light is similar to a Spotlight, but does not have the control of the cone. It is a parallel light beam that directs light toward the chosen target. The location of the directional light does not matter; the arrow object placed on the screen to represent the light merely indicates the direction from which this beam comes.

To use this command, start it up and the Command line will prompt you for the "End of light direction". Click a point in the viewports at which to aim the light. The Command line will change to "Start of light direction vector". Ouch. That sounds painful. All it's asking for is a location for the directional light. Left-click to place it.

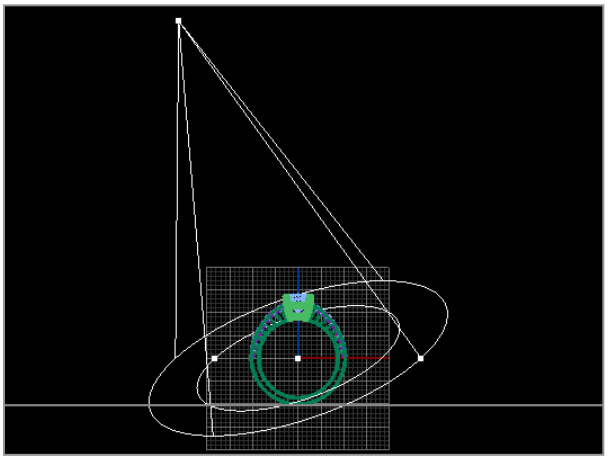
Create a Rectangular Light

Click on this command to place a rectangular light in the viewports. Experiment with using one or more rectangular lights to create the render effects desired. Place this light just like drawing with the rectangle tool, from one corner to the opposite corner. Select and scale or rotate it in all three planar viewports to set it to the angle desired. Simply place it where you need more light, angled down toward the gem. Just note: this object CAN be seen in a render, so be careful to place it where it will not be seen in the active viewport - the way you do an emitter.

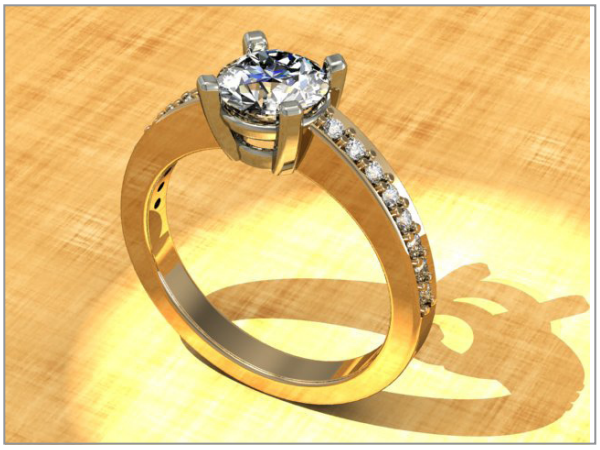
Creating a larger rectangular light makes it brighter: tone down its "Intensity" using its Properties (select it and press Ctrl + T) to counteract this effect. Try a small rectangular light just above the gem or a group of gems for a longer, differently controlled alternative to a point light. Finally, to diffuse the effect of the rectangular light, move it farther away from the ring.



Render Before Spotlight



Setup of Spotlight



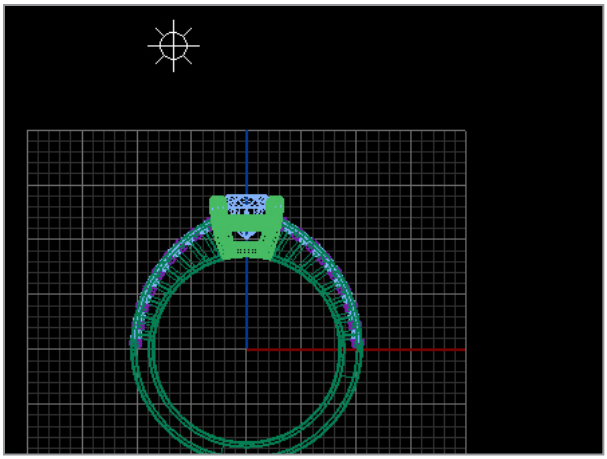
Render After Spotlight

Create a Point Light

This command places a point light in the scene to aid in rendering. A point light emits light in all directions, and can be controlled the way that the Rectangular Light was controlled: by selecting the object and accessing the Properties dialog (Ctrl + T).

Point lights are perfect for positioning right above or near a gem when it is too dark because of the angle of the ring. Remember that VRay renders exactly what it sees: if your gems are on the underside of your ring or falling away from the light, they will be dark: it's not an error! Place a point light just above their tables to really brighten them up!

To use this command, start it up and the Command line prompt "Point light location" will appear. Click once in the viewports where the point light should be placed.



Location of Point Light

Create a Linear Light

Experiment with size and placement of the linear light to create a more dramatic effect in a render. Rendering with only a linear light in the view creates dramatic shadows.

To increase the effects of a linear light, scale it larger and/or move it away from the model. Unlike the rectangular light, which diffuses at greater distances from the subject, the linear light increases in power as its moved away from the model.

Finally, to add just a subtle change, place a small linear light just above the gem. It lightens the model overall, particularly the prongs.

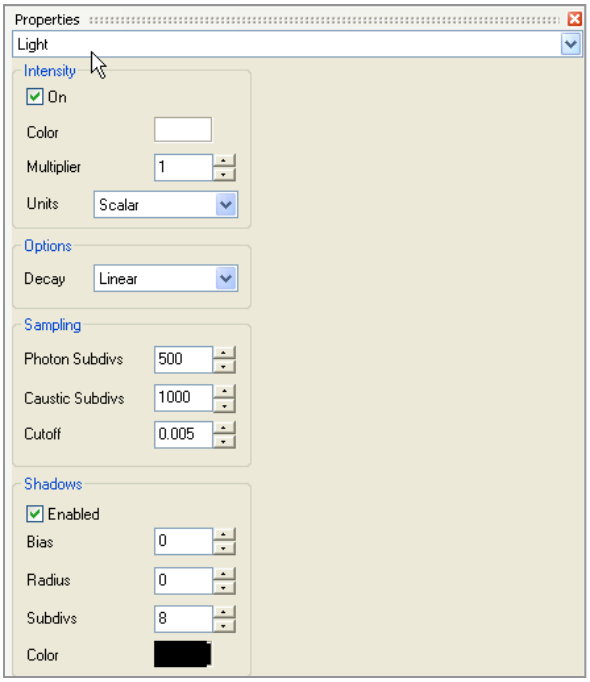


Effect of Point Light

Setting Properties of All Lights (not Emitters)

To adjust the light intensity of any Light object (not Emitters), select the light object and press Ctrl + T (or type "Properties" into the Command line and press Enter). Use the pull-down menu at the top of this dialog box to select the "Light" object and adjust its configuration for different effects.

Use "ON" to turn the light object on and off; "Color" to provide a tint to the spotlight; "Shadow Intensity" to reduce the contrast for the shadows that are cast; "Spotlight hardness" to diffuse the light in greater or lesser degrees around the spotlight; and "Light intensity" to turn up (or down) the brightness of the light.



Select Light; Ctrl + T to change properties of light.



Rendering with VRay...

Tools to Enhance Renders

Props & Prong Warp prepare your models for rendering; Render Compositor, Picture Viewer, and Printing prepare them for presentation!

Prong Warp

Prior to rendering a model, this command turns prongs into Mesh objects and "warps" them based on the "Scale" amount (1 = 100% of original size) and "Effect" amount (0.1 to 1 = least to greatest) you assign in the Command line. If your prongs are not already meshes, it will mesh them first (consult "Chapter 10, Matrix Art and Mesh Models" for how to set up mesh options) and ask questions later! After they are meshed, assign values to "warp" them. Every model is different, so experiment with these settings until you get the desired effect.

Props Library

Select this tool to open a library of available props to bring into the viewports. Select a prop and it will appear, centered at F4. Use Move, Scale, Rotate, etc to get the prop right where you want it for your render. Or, use it in further modeling applications. The possibilities are endless!

Render Compositor

This tool uses the Alpha Masking capability of VRay, which provides a means to separate your ring from the VRay background. It then lets you choose another background, such as a bitmap of your own, on which to place your ring.

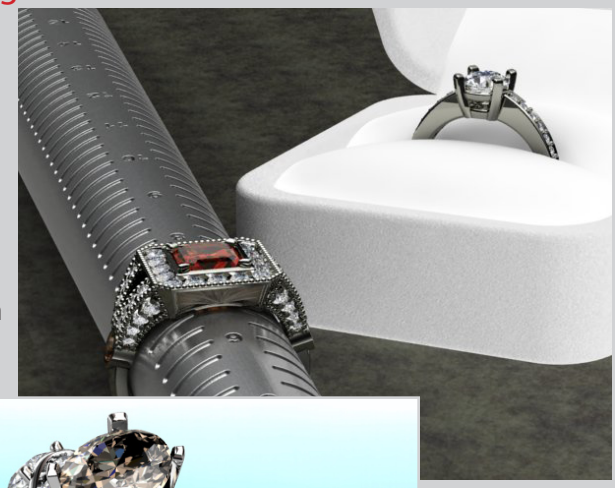
The idea here is that, if the background you really wanted is strange, would make your ring appear to be "floating", or doesn't work as a groundplane because it causes harsh, unrealistic, or just plain ugly reflections in your model, you can use this hybrid method to place it as a background anyway. Render Compositor takes your render with its nice, normal reflections out of its nice, normal environment and places it in any wacky environment you choose, leaving its nice, normal reflections behind. We can't account for your taste in backgrounds, though...

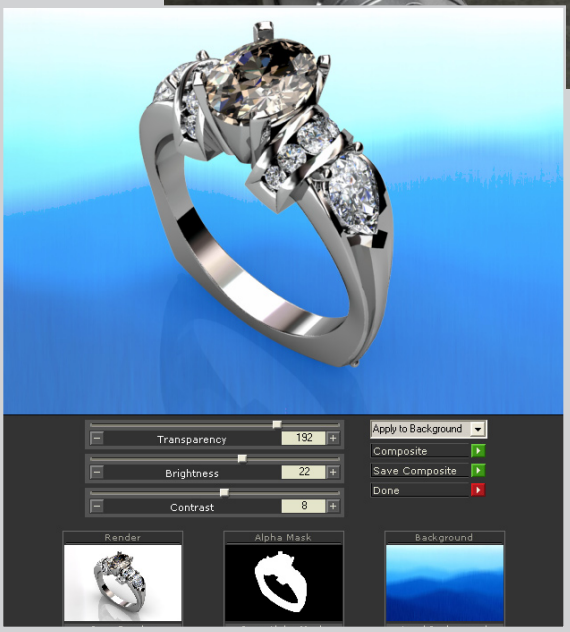
Before creating the renders necessary to use this tool, open it up and have a look at how it works. There are three boxes at the bottom of the menu labeled "Render", "Alpha Mask", and "Background". These boxes will hold the parts necessary to make a composite render. Each of the following steps will explain how to produce the files that will fill each box: the Render, the Alpha Mask (a special setting in VRay can create this correctly, display it, and allow you to save it while only rendering the image once); and the new background (try the ones found in C:> Program Files > Matrix 60 > Library > Render Backgrounds; or ones you Googled, photographed, scanned, etc. Hey - get creative, and use your clients' wedding invitation, engagement photo, anniversary party invitation - you name it!)

To create and save the render that is going to fill both the "Render" and the "Alpha" boxes, just check that your settings are correct as you assign each material: the render must be at 640X480. You should avoid using textured or

Enhancing Renders

Props Library, (L) and render compositor (below) create stunning presentations of your renders. Use Print or Picture View to share them with customers.





colorful ground planes, as they will reflect in your jewelry in a way that won't appear realistic on a new background.

Finally and most importantly, everything you WANT in your final image should be rendered with the Alpha channel turned on (this setting is found when you select and apply a material): so turn it ON for all the metal, gems, etc. that make up your model. This will protect them from being covered up by the new background image you're going to apply. But when selecting a Ground Plane material to apply, make certain the Alpha mask is turned OFF. This will make the ground plane "transparent" within Render Compositor, so that the new background can be applied in its place.

Upon rendering the image, save it as a ".TGA" file, the only file type that Render Compositor can import. This does not compress the image at all, and is able to save this Alpha Mask information. Now, switch to the "Alpha" view of the render, which shows you where the Alpha Mask was placed (it's white): right where the ring is! ALSO save this view as a ".TGA" file (save with a NEW name - it's a separate file!!). You need BOTH views of your render saved as .TGA files in order to use Render Compositor.

Now you can start up this tool. Remember the three boxes at the bottom of the menu? The two images just created (the render and the alpha mask) will be added to their corresponding boxes. Click on each gray box to open up a Windows' dialog and navigate to each file (Render and Alpha Mask, respectively). Load them into these windows. You'll see the render preview. Lastly, load the new background image in the same way. Ideally, this will be the same resolution, in pixels, as the other rendered images, but it need not be.

Click the green arrow beside "Composite" to see the results. The sliders in this menu will change the way the composite looks. Here's how: to create this image, we have the image of the ring, plus the alpha mask placed over it (mask perfectly matches ring but doesn't protect ground plane), plus the background, replacing the groundplane but not obscuring the ring thanks to the Alpha Mask. The smart Render Compositor knows you might want some things that show up in the background anyway, such as the reflection, so it provides you with settings for the Transparency, Brightness, and Contrast of the new background OR of the original render - but still the ring is protected from these settings by the Alpha Mask - in order to create an interesting effect with your render.

I find that raising the transparency on the bitmap lets the good things show through - like the reflection. The Brightness and Contrast, in my experience, just depend on what looks best with the image you have chosen and the model you are rendering. Create a pleasing effect by adjusting the Bitmap, or the render, or both. Then, use Save Composite to save this render to a file, and "Done" to exit the builder.

Picture Viewer

Once you've saved up a folder full of beautiful renders ad Render Composites, take your customer through a tour of them with one click using Picture Viewer.

Picture Viewer provides a convenient way to look at images without leaving Matrix, displaying pictures full-screen with Matrix still running underneath. When an image is displayed, the resolution in pixels is not altered to shrink or enlarge the image. Instead, a black border is placed around the image so that it does not fill the screen resolution and become blurred or skewed. Therefore, if the screen resolution is 1280 x 1024 pixels and the image being displayed is 640X480 pixels, it will not fill the screen: the image will stay at a 1:1 pixel count. Just beware: if a 1600 x 1200 image is displayed on the aforementioned screen size, a portion of the image will fall off the edge of the display area!! Picture Viewer supports the following file formats: .jpg (JPEG), .tga (Targa), .bmp (Windows Bitmap), and .tif (Tagged Image File Format).

To use it, select this tool and navigate on the left-hand side of the dialog box to the folder containing the images. Click it, and the images will appear on the right-hand side of the dialog.

To change the size of the thumbnail preview images in the picture viewer, right-click anywhere on the right-hand size of the menu where the thumbnails are displayed. There are seven different sizes of thumbnail images. After the largest size is displayed, the smallest thumbnail size appears again.

The images in the selected folder are first displayed as thumbnails in the right-hand side of the menu; then, after selecting one of the thumbnails by double-clicking it, the selected picture is blown up to full-screen size. Left-clicking the mouse advances the viewer to the next image in the file, also in full-screen size. The pictures will continue to cycle through, showing each image in the folder in succession; and, after the last image is displayed, returning back to the first image in the folder to repeat the cycle again.

To exit picture viewer, press the Escape key on the keyboard. Picture viewer cannot be minimized; close it by clicking on the X in the upper right-hand corner of the dialog box to remove it from the screen.

Render Print

With the material, lights, and groundplanes assigned to your model in Render Builder and the model arranged in ALL FOUR VIEWPORTS at the desired vantage you want for the printout, select this command. From the dialog box that appears, select a layout for the final print. Click on GO and wait for all four viewports to render. Then, a dialog box with simple 2-D editing commands will appear. Add line art, text, and rearrange images in the printout, if desired, before printing. Note: VRay will require a surface - like a groundplane - blocking the light in the Through Finger and Side View viewports for these views to come out predictably. Place another plane and assign it ground Plane material for best results.



Rendering with VRay

Other Settings in Render

Use the Render Menu Shade Tools for an alternative way to control viewport shading & rendering.

Shade / Shade All Viewports

These two commands are just like left-clicking (to toggle the shade setting for the active viewport from Shade to Wireframe) or right-clicking (same for all viewports) the Shade globe in the Top 11 Buttons. However, it lives here in the render menu, as well, for your convenience.



Shade Buttons in the Render Menu

Render / Set Current Renderer / Two Flamingo Render Builders

"Render" is another button - besides the one in VRay - that renders the active viewport. Click "Set Current Renderer" to make sure VRay is the currently-selected renderer in the program. If you have any other programs installed that can render (Flamingo, Matrix's old rendering engine; Penguin, another tool for rendering technical and other non-realistic drawings, or any of the other Rhino Plug-ins), they will appear here, and you may select them. Consult manuals for those products to use them. For longstanding customers that own Flamingo, you may consult your previous manual for questions on our PRE Render Builder and Render Stylers - both of which work with Flamingo ONLY.

The reason there is a second "Render" button is that, if you don't render in VRay, you can use this button to render in the program you have set up as an alternative.

Render Preview

This function uses Open GL Shading - not the selected renderer - to preview how the render will appear. Don't love it. In the time it takes you to preview it, you could have simply rendered how it really will look in VRay - there's your preview! However, with other rendering programs - Flamingo, for example, it will work better. We don't recommend it for use with VRay.

EMap

Here's a little secret: this is how our Presentation shade modes work - using the EMap tool! Create your own effects with this tool found in the Render menu. This feature actually wraps a bitmap (picture) around the model. It is a "Quick Render" of what the model will look like in a highly polished metal that is reflecting a scene around it. When an Environment Map is applied to an object, the object can still be rotated about in the viewports so that the user can see it from all sides. This is a good way to test out the smoothness of the surface.

To use this tool, select the objects for EMap analysis and click on the EMap tool. This will bring up the EMap Options dialog box, while applying the currently-selected bitmap to the objects in the viewport.

Click the Browse button to find Gemvision-created materials suitable for Emapping at C: Program Files > Matrix 60 > Library > Environment Maps.

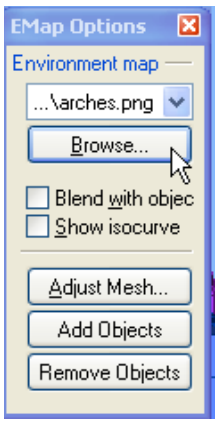
Remove Objects: To take objects out of the EMap analysis, click on this option in the dialog box and select the object to remove.

Add Objects: To add objects again, click on Add Objects and select the object to add. The select objects will be rendered again.

Show Isocurves: Select this option to see the wireframe model through the render material:

Adjust Mesh: To adjust the mesh options to fine-tune the look of this render, click on Adjust Mesh and open the Polygon Mesh Detailed Options dialog box. Adjust the settings as desired, according to the description found in Chapter 10, Matrix Art and Mesh Models.

Click on Adjust Mesh to bring up the Polygon Mesh Detailed Options dialog box and change the polygon mesh settings that make up the outer skin of the model, or, the mesh surface that is currently reflecting the new material:



Select object to apply emap to. Select options from dialog that appears. Browse to choose a new "look" for the metal.

Rendering with VRay

Creating Animations

Use Matrix & Rhino Animation tools to create large-sized, high-quality presentations or small Flash files your customer can interact with.

Animation Builder

This builder produces a brief digital movie (in .avi file format) or a series of frame-by-frame image files of a rendered model in motion on the screen. This is actually produced by assigning a path for the "camera" on-screen, not the object.

The user may define a custom path or use a pre-defined path that rotates the model 360 degrees in a span of 60 frames. This new little movie can be set to run at up to 30 frames per second, which is the same speed as a TV show, movie, or other animation that our eyes are familiar seeing. Animation Builder takes a picture for every frame, rotating the model little by little and taking a picture each time it is rotated to produce a frame.

This process takes a little while, but is well worth the wait for the effect it produces! Before creating the animation, make sure that the model in the viewports has had materials assigned to it within VRay. This is because the animation is made by taking many "pictures" of the rendered model from various angles. Keep this in mind when selecting settings: a very complex and lengthy render will also take quite some time to animate in this builder.

Within Animation Builder, select either Fixed Circle or Follow Path. The Fixed Circle option rotates the ring in a simple, 360-degree rotation at the angle specified by the user. The Follow Path option allows the user to assign a path for the camera, changing the camera as it moves through space. Also select whether you want the view to move clockwise or counterclockwise for either option.

Fixed Circle Option: Select the Fixed Circle option to rotate the ring in a simple, 360-degree rotation. Since Fixed Circle is the default setting for this builder, the "fixed circle" camera will appear in the viewport.

To rearrange this camera for a different angle during the "shoot", Find the camera by right-clicking a viewport title and selecting "Show Camera". Click and drag the control points of the camera (found at the top, bottom, and center-bottom of the camera) until the camera is properly positioned. It is a good idea to experiment with this builder to find the preferred camera orientation based upon the model and on individual taste. Do this in a Planar viewport, watching the Perspective viewport (as though you were looking through the lens) to see if your movements are having the desired effect.

As the camera is rotated, the view of the model will change in the Perspective viewport. This is also the only viewport in which the camera cannot be seen. In fact, if rearranging the camera's control points completely spooks you out, just rotate the model as usual in the Perspective viewport, achieving the desired angle for the shoot, and the camera will change with it.

With the camera adjusted perfectly and the Perspective viewport active, assign a frame count and frames per second and click Render to create the animation. Make sure you have a lot of time for this step!

Follow Path: To assign a custom path to the animation, select the Follow Path option. Two preview windows will appear in lieu of the Fixed Circle menu shown above: "Camera" and "Target".

"Target" refers to the object being "photographed": in this case the model

Understanding Render Compositor

Choose Fixed Circle or Follow Path (below, right).

In Follow Path, assign a Camera path curve and Target (focus around model) curve.

Choose other builder options and click "Render", with some time to wait!



in the viewports. Select a tool, such as the Circle tool found in the Curve fly-out menu, with which to draw a path around the object. Therefore, in this case, the camera will follow a circular path: most likely the preferred path for such an operation. Make sure that this circle is far enough away from the model, since it also assigns the distance from the camera to the target. Select the circle in the viewports so that it is highlighted and click on the "IN" arrow beside Target.

The "Camera" preview window allows the user to assign a path for the camera to follow as it rotates around the target. This is the fun part: the user can draw this path so that the camera will "zoom" in and out, focusing on different aspects of the design and providing both far-away and close-up views of the same model. Grab a tool like the Interp Curve tool for this function and, wherever this path is close to the model, the camera will zoom in: wherever it is farther away, the camera will zoom out:

In addition, the camera can be made to "swoop" up and down in space. To adjust the height of the camera in space, adjust the heights of the control points in the path that was just set.

With the Camera path and Target curve both in their respective viewports, the camera will follow the assigned path when the animation is produced: circling the model as it moves up and down through space. Check that the Perspective viewport is active; check your frames per second and frame rate, and click Render.

Frame Count: Recall that the mini movie will be recorded at 30 frames per second. Therefore, the 60-frame default value set by the builder will produce a 2 second movie. To create a longer movie, raise this value. This will cause the same path to be run in 4 seconds instead of 2 seconds. This does not cause the 2-second movie to loop: rather, the same movie runs more slowly, covering the same distance in 4 seconds that was formerly covered in 2. However, it will take additional time to create the movie, and the file size will be larger, so keep this in mind when adjusting the frame count.

File Type: Select one of the three options beneath File Type to define how the builder will create the movie. It may be produced either as (1) a digital movie file (".avi") that plays in Windows Media Player and other compatible players; (2) a series of "Frames", or, image files with one taken for each frame (60 images total), which the user may "string together" in another program to create a QuickTime file or a similar digital movie file; or (3) both ".avi" and "Frames" options, allowing the user a full range of possible ways to produce and view the new movie.

File Name: The final step before producing the animation is to click on the File Name icon to change where the animation is saved on the computer. The Windows' Save dialog will appear, allowing the user to select a file name and navigate to a location on the hard drive in which to save the file(s). Remember that multiple files will be produced (60, in fact!) when the Frames or Both option is selected under File Type, above.

Producing the Animation: To preview the animation before producing it, click on Preview instead of Render. This shows just a single frame of the animation to show the user how the model will appear. If anything about this image is incorrect, adjust the settings in Render Builder to assign new materials to the object or change other aspects of the scene. Finally, once everything is set, click on Render GO and be prepared to wait for the amount of time estimated by the builder:

Once the builder is done, navigate to the file location where it was saved during the File Name step, above, and open the file in which the .avi movie was saved. Double-click on the file to open it in a program such as Windows Media Player. Optional: say "Lights, camera, action!"

VR Maker

With material assigned to the model you are rendering, open the Virtual Reality Maker, select your model, and input it into the Render Items preview window.

Select a Render Resolution from the drop-down menu. Smaller resolutions will take less time to render and will yield smaller file sizes in the end.

Next, select a background color for your VR Render. At the moment, the only background colors are the ones available in this menu; however, stay tuned. To select a background color, click on the colored swatch beside Background Color and select a color from the palette. Click OK.

The builder allows you to define how many shots will be in the mini-animation that you are creating. The Virtual Reality Maker outputs an interactive render that the user can control by clicking and dragging the mouse much the way you do in Matrix to rotate a model. Although it feels as though you are rotating the model, you are only "scrubbing" (moving backward and forward) through a number of consecutive renders - from a number of progressively moving shots - of the ring.

In this builder screen, you will be able to define how detailed - or how scant - your virtual reality render is. A highly detailed virtual reality render will take many more shots of your ring, thereby enhancing your client's interactive experience of the ring. They will be able to see the ring from more angles, feeling as though they are rotating it more slowly and carefully than with a less detailed VR render. This is because the renderer is literally taking more pictures of the ring. The more angles from which the object is shot, the more angles from which the user can view it. Also, the larger and more unwieldy the resulting file. The render takes longer to wait for, as does the download time if it is being posted to the net or sent via email. In this case, it is your decision to make. Control the size of the render using the Interactive Controls in the second screen of the builder.

To take the pictures of the ring, Matrix sets up a virtual "camera" that travels around the ring in a 360-degree circle, stopping every so often to take a picture. It stops at the same location on every portion of the ring so that the "spinning" effect of the VR file is realistic. So, a "globe" is placed around the ring, which is visible in the viewports when this menu screen

is showing, that shows the path of the camera. The "Rows" delineate the path of the camera. It will go 360-degrees around the ring in one row, jump up to the next row, and repeat. The more rows you place - i.e. the closer together they are - the more pictures it takes and the more detailed (and larger!) your VR render is.

Similarly, the more shots per row you assign, the more pictures the camera stops to take along that row. This exponentially increases the render time, since each and every camera shot along a row is a separate render instance. This is another reason why setting a small resolution helps maintain a manageable file size!! In fact, if you could set the VR render to the resolution of a typical Matrix render, the Flash program that allows you to view the interactive animation in the end could likely not handle the rendered files!

The rows and shots per row are visible in the viewports while working in this builder as circles and points enclosing the object in a "globe". The globe size determines how big or small the ring will look in the VR window that appears when the user views the output file. As you adjust it, you will see the ring change in the preview screen in this menu. The globe will also change in the viewports. Keep an eye on the preview window in this menu, though, because you can make the globe too small, and the ring will go offscreen. If the globe is too big, the ring will appear tiny and, at an already-small resolution, you likely want to see as much of it as possible.

Once you are all done adjusting these settings, test them out by clicking and dragging the final slider control, thereby "scrubbing" - or, viewing frame-by-frame - each picture that the camera will take of your ring. The ring will move in the preview window in this screen of the builder as you do so. If you don't like what you see, re-adjust the settings above to improve the VR output.

Use "Reset" to return to the default settings in the builder.

The "Center" option centers your model in the grid, so Job Bag it first at its current location; turn OFF History, as objects with History will move with a certain funkiness that can tax your computer's power, and DON'T place a groundplane until AFTER the object is centered!

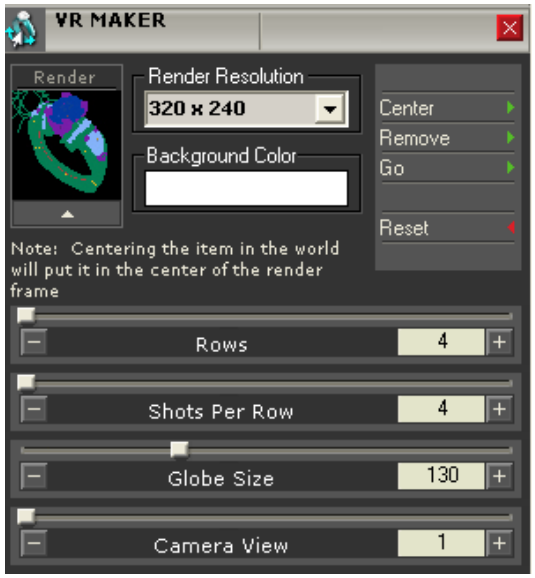
Once you are happy with the preview, click on Go. Upon doing so, select a location on your hard drive to which you will save the VR render file once it is done. Click on Save and the program will begin rendering the image at the size you specified the number of times you directed it to.

To use the Output File, left-click and drag the mouse to "spin" the ring. I know, your first impulse will be to right-click and drag to spin it the way you do in the Matrix viewports, so this will take some getting used to. At this time, you have several different options for how you may use the flash file:

1- If you have the proverbial "web guy (or girl!)", that person will know how to get an SWF file up onto your website for your customers to visit and view.

2- An SWF file can be viewed from any computer in your shop just the way you are looking at it now, as long as the computer has the Macromedia Flash Player installed (can be downloaded free off the internet if the Matrix Install is not loaded on that computer).

3- Macromedia Flash Player has a very kind application in it called "Create Projector". To access it, click on the "File" menu at the top of your tiny interactive render and click on the "Create Projector" option. This allows you to save a new file to any location you desire. The new file is an ".exe" file that can even be run by someone who does NOT have Macromedia Flash. They see exactly what you see when you view the VR render. They can even spin the ring using the left mouse-click and drag. All you need to do is send via disk or email them this .exe. Just remember: nearly every email program will not accept .exe files as attachments, so if you need to email it, you will have to ZIP it first, using WinZip (standard in any Windows OS) or WinRar (found on the Matrix Install Disk).



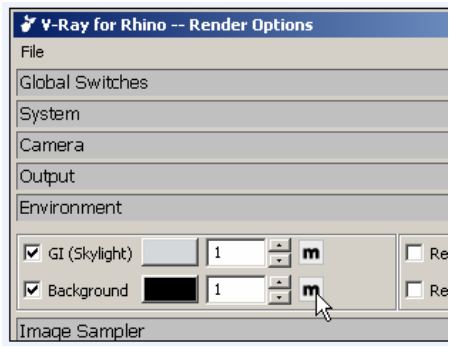
Advanced Rendering...

Creating Environments

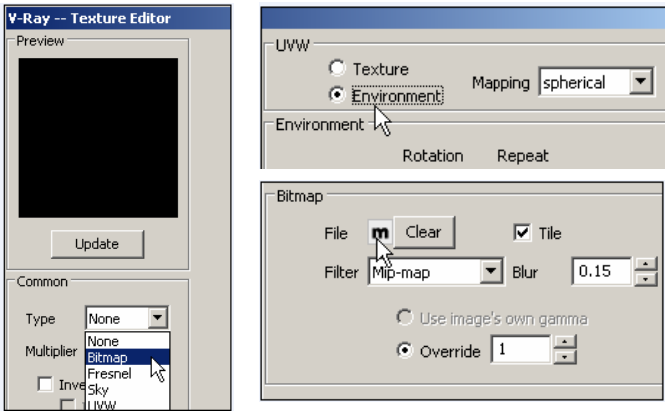
"VRay Options" takes you behind the scenes to customizable VRay settings. Learn about them, set them up, & save them for future use.

1 Adding your own Environment Image

In the Environment tab within the Render Options menu (click the word "Environment" to expand this tab and see these options), you will find the "GI" and "Background" environment options both check-marked. The first, "GI", or, "Global Illumination", is set to a default value. If you find that your scene is too dark, you may raise the GI value to 1.2, 1.5, or even as high as 2 to increase the amount of indirect lighting in your scene. "Background" is the option you'll want to change in order to place an environment in which to render your scene.



The Color, Map, & Multiplier Controls in VRay: Clicking the color swatch next to each option ("GI" and "Background", here) allows you to select a color for the option beside it, while the little letter "m" allows you to assign a map, which overrides the color selection. A Map can be any bitmap image. The number beside the color swatch assigns a multiplier (higher number = higher color saturation) to the color you selected (a map has its own multiplier, as you'll find out momentarily! This is true all throughout the VRay interface, wherever you see the color swatch, "map", and "Multiplier" tools.



2 Adding the Map

In this case, you don't want a color as your Background image: you want a map! Click on the little letter "m" in the "Background" row to assign a map that will serve as an environment for your render. This opens the Texture Editor dialog, which you'll see a lot of from now on! The first thing to do upon entering this rather empty-looking menu is to change the value in the "Common" area in the "Type" drop-down menu to "Bitmap", bringing up the menu options in the right-hand side of the menu. Ah, that's better!



(Left) sample HDRI; (Below) image rendered with this HDRI in the Environment.



Let's skip down next to see where you can load a Bitmap. Click on the small letter "m" to load a Bitmap. Select the map of your choice and click Open. What kind of map it is will determine what shape you should assign here:

How an Environment Map Works: You can imagine that your object to render is placed by VRay inside a sphere. On the inside of that sphere, the image you selected to load as a Bitmap in

this step will be mapped, so that anything in the bitmap will be reflected off your jewelry to create realistic reflections. Images that can be mapped in this way are composed using one of several methods. One way is to "unroll" a sphere. This makes a long, narrow rectangular image that is "rolled" back up by the software. Another is to "unfold" a cube. This makes a cross-shaped image that can be "folded" back up into a four-sided shape to enclose the image. Finally, artists may set a reflective ball, like a mirror ball, a Christmas ornament, or – my personal favorite – a gazing ball, down in the middle of a scene they wish to reflect and photograph it. In this way, the full 360-degree radius of the scene is captured in spherical format.

These different set-ups for creating HDRI maps are all available in the "Mapping" drop-down beside the "Texture/ Environment" switch at the top of the dialog. Select the one corresponding to the HDRI image you loaded above. For example, "Studio", found in our Gemvision menu, is a "spherical" composition. Also, make sure "Tile" is turned off (unchecked) when adding a background environment like this one to a scene.

What is an HDRI Map? An HDRI – or High Dynamic Range Image - map is a 32-bit image, meaning there is extra information about the image stored on an additional "channel" along with the image. An HDRI is a composite of multiple images, all of the identical scene shot with varying shutter speeds, in a range from very low exposure through to very high. So the exposure information that varies from scene to scene is stored on the additional channel for this image, making it easily adjustable from dark and dim to bright and blurry. And you are not just changing the blur and contrast – the actual exposure of the image is changing, allowing you to bring out various details of the bitmap.

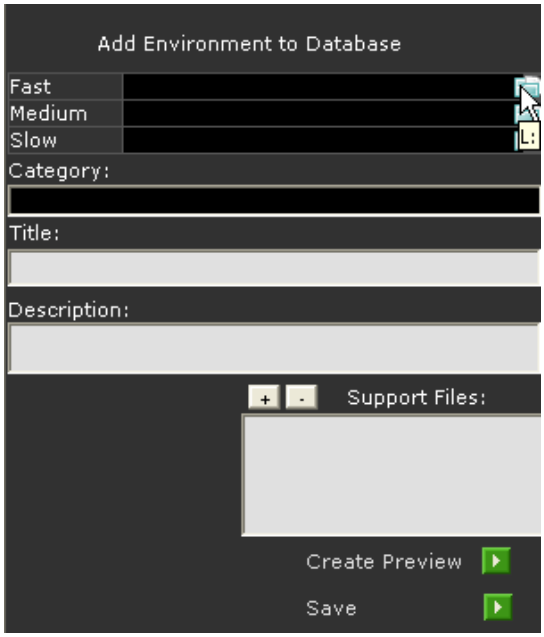
3 Controlling the Map You may now use the "Multiplier" found in the "Common" are of this dialog to crank up or down the brightness & the blur (i.e., the exposure of the overall scene – not just the contrast or color, as with other types of images) in the scene, changing the effect of the reflections that will appear in your model. Incidentally, if you do load another type of image (a traditional .tga or .jpeg image, for example), which we'll be instructing you how to do momentarily, the "Multiplier" applies to the saturation of the colors in the image – therefore changing the brightness and contrast. It is only possible to control the exposure when you have loaded an HDRI image.

Better yet, when an HDRI image is loaded in this fashion onto the GI channel (see the first paragraph of this section) within the "Environment" tab in the VRay Options dialog, the light source in the bitmap acts as the light source for your scene, making for an even more realistic render! However, this added bit of realism will increase your render time – and, of course, the defaults you loaded with any Gemvision-created Environment, places a nice sky blue GI into your scene, so try that one out before adding on the extra time.

Saving User Environments

1 Saving in Vray's "User Environments" At the top of the VRay options menu, select File > Save As. This saves your current settings as a file with the extension ".visopt". Save them anywhere you can find them again easily.

2 Go to "Add Environment" View of Vray In Matrix's VRay Builder, go to the "Add Environment" view of the menu (last button under the title bar) and browse for this "visopt" file. Choose whether to save it under Fast, Medium, or Slow, depending on how long it takes to render when using it. Assign it a name and description, and upload any files you used (HDRI or other background map) with it. This builder saves them all together, so you can also export these for your friends and neighbors to try! It will be saved in the "User Environments" section of the Library (switch back to Library View to see it).

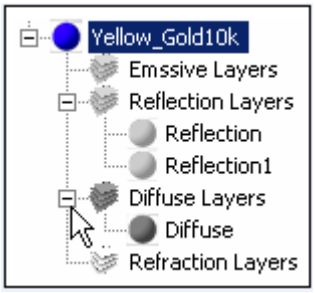


Advanced Rendering...

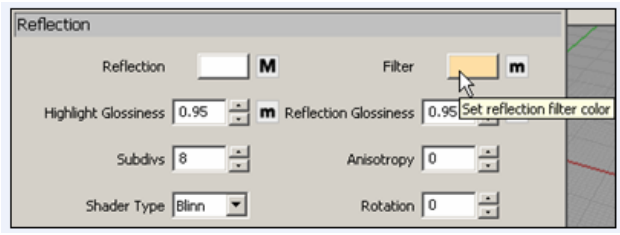
Creating Materials

Create your own Metal and Gem options (metal reflections, gem "fog colors" and Indexes of Refraction) by learning how to use the Materials Editor.

1 Open the Materials Editor Click the Material Editor option in the VRay builder to see the current materials in the scene.

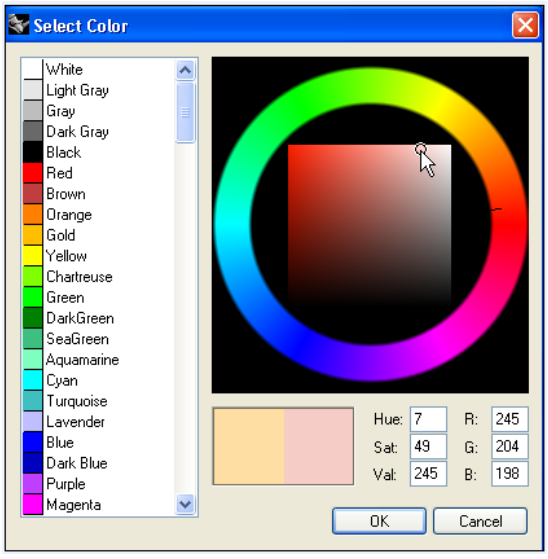


2 Changing to a different color metal Click the "+" sign to expand the metal to change; for example, "Yellow_Gold10k" menu item. With it expanded, you'll see expandable "Reflection Layers" and "Diffuse Layers" in the list. Click to expand the "Reflection Layers", and you'll see "Reflection" and "Reflection1". This means that, to make this material, two reflection layers were used.



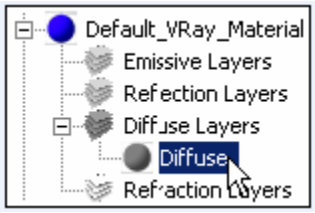
In the right-hand side of the menu, you'll see the options associated with these layers. You may either click on the "Reflection" or "Reflection1" option in the Material Workspace menu on the left-hand side of the screen, or you may click to expand either option in the right-hand side of the screen. Using either method, expand the menu to see the options for the first "Reflection" channel.

The "Filter" color is the section of these controls that makes this gold look like the color of 10k yellow gold. Click on the color swatch beside "Filter" to change the color of the gold. Try rose gold – selecting a very pale pink from the color palette – or white gold – selecting an almost-white or very pale yellow / cream – from the palette. Set the same color for both Reflection Filters (rose or white gold – or, hey, you could get creative and try green!), and re-render your scene to see the results.

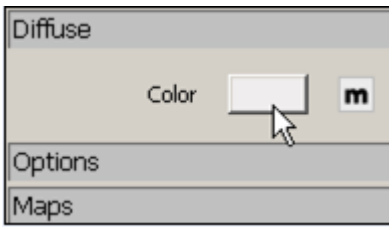


Tip: Never select pure black (0,0,0) or pure white (255, 255, 255) for a Color swatch. Why? Well, these colors don't exist in real life - so they won't produce realistic results.

3 Change the color of a VRay Material To apply your own groundplane color in the Materials Editor, click the "+" sign beside the "Default_VRay_Material" to expand it. Also expand the "Diffuse" layer by clicking the "+" sign beside it. Double-click the "Diffuse" channel to open its options in the right-hand side of your menu. Click the swatch beside "Color"



and lighten the background color to very light gray – almost white. This is the simplest, & yet most natural background plane you can set: like taking a picture of the jewelry in a light box against a white, matte background. Select the ground plane in the viewports, so that it's highlighted, and right-click on "Default_VRay_Material". Select "Apply material to object(s)" to add this material to the groundplane.



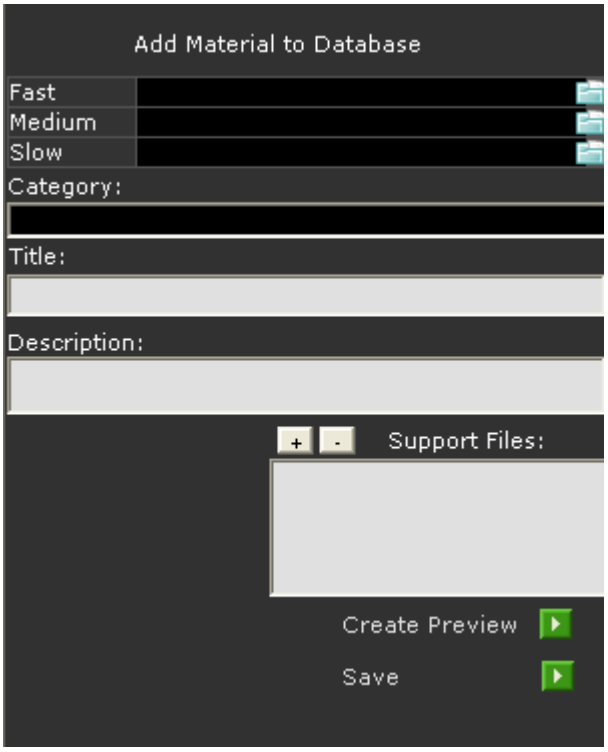
4 Change the fog color and IOR of a gem For a colored gemstone, open the "Refraction" layer and complete Step 4 to change the "Fog Color" swatch to a new fog color. Also indicate a new Index of Refraction in this layer corresponding to that of the gemstone you wish to see in your render. As above, the material has already been applied to the gem in your model; upon changing it, the changes update the material that was applied and no additional "application" is necessary.

Saving User Materials

1 Export New Material Right-click on the selection in the Material editor and be careful to rename it so as not to save over another material that may be applied in your render.

You'll also find "Export" when you right-click the new material. Save it somewhere you can remember, as a ".vismat" file, cause you'll be needing it later!

2 Go to "Add Material" View of Vray In Matrix's VRay Builder, go to the "Add Material" view of the menu (last button under the title bar) and browse for this vismat file. Choose whether to save it under Fast, Medium, or Slow, depending on how long it takes to render with it. Assign it a name and description, and upload any files you used (texture mapping and bitmapping explained later) with it. This builder saves them all together, so you can also export these for your friends and neighbors to try! It will be saved in the "User Environments" section of the Library (switch back to Library View to see it).



Advanced Rendering...

Rhino & VRay Functions

Use Rhino Tools together with VRay Settings for special render effects.

Learn how to use Rhino tools together with VRay functions to enhance renders. First, place planes in the scene that emit light, offsetting a dramatic environment lighting that can cast shadows onto metal at certain angles.

Also explore what else planes can do - use them to set up business cards, Christmas cards, or pictures together with your render for a unique effect. Other planes created flat, bent, or revolved can enhance final renders, and pretty much any geometry you can model or import into Matrix now has the potential to be a showstopping prop!

Next, learn to use Rhino camera tricks together with VRay's Depth of Field function to add realistic blur to your render. And finally, Rhino's Animation builder will string together high-quality VRay renders to create sparkling, realistic animations that will make your customers do a double-take!

Depth of Field - Aperture Values 0.1, 0.5, 1.0 (l - r)







Tutorials

1. Light Emitting Cards to Improve Renders
2. Depth of Field with Rhino Camera Controls
3. Rhino Animations of VRay Renders

Strategies

- Fun with planes & other Rhino geometry
- Other Camera Functions

Tutorial 1: Light Emitting Cards to Improve Renders

If a Gemvision-created environment causes black shadows on your render - but you have it aligned just the way you want it in the scene and you don't want to change it - place one or more Planes from the Surface menu into the scene at an angle to add light to the metal, and apply a Material to the plane with just an Emitter layer - at the intensity required to improve the render.

1 Draw and Position a Plane, using this tool from the Surface menu in Matrix. The plane or planes should be positioned so they CANNOT be seen in your render, but they should be positioned correctly to reflect off the metal. This will take a little bit of trial and error!

2 Duplicate the "Default VRay Material" (if it's already in use). If you've already assigned the Default VRay Material to something in the scene, duplicate it. If not, add it by right-clicking on "Scene Materials" and selecting "Add VRay Material". To duplicate a material, right-click on its name and select "Duplicate".

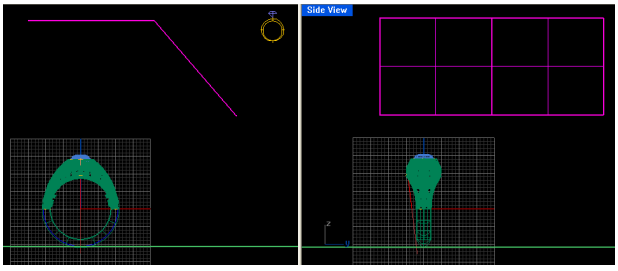
3 Add an Emitter layer to the Default VRay Material & delete the Diffuse layer. To add an emitter layer, right-click on the "Emitter" menu selection under the expanded material and select "Add new layer". Click the Emitter layer that appears and raise the "Intensifier" to a value such as 1.5, used here, that will enhance your scene. You may need to raise or lower this value based on the scene. Experiment with the placement of the surfaces, and the value of the Intensifier, to get just the effect you were trying to achieve. An Emitter card does not require a Diffuse layer, so right-click on the Diffuse layer selection under the Diffuse portion of the expanded material and choose "Remove". If you wish to experiment with the color of the light that is cast, change the color swatch on the Emitter layer itself.



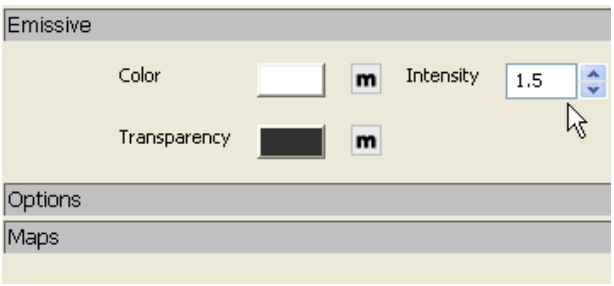
Before light cards (light emitters)



After light cards (shown below)



Placement of Light Cards

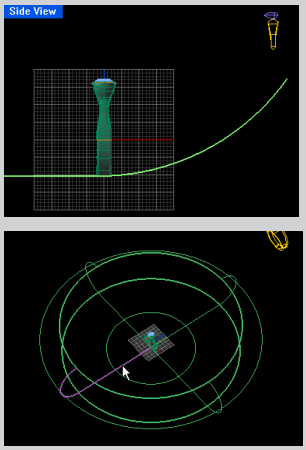


Fun with planes

Would you like to render a realistic-looking Christmas card in your scene? Or maybe you'd prefer to see your business card beside your custom jewelry line? What about your client's wedding invitation beside a set of custom wedding bands, for a spectacular gift for the bride and groom? Maybe a family photo to accompany a presentation of that special mother's ring? Or an old wedding picture for that surprise anniversary band? Well, the possibilities are endless, and you already know how to do it! In this simple example at right, a Plane was drawn with this tool from the Surface menu in Matrix, rotated, and mirrored. Using the "Select your own Groundplane" option (1:1 or tiled) in the Gemvision Materials Library, you can select ANY picture to map in this way to ANY plane or surface in the model!



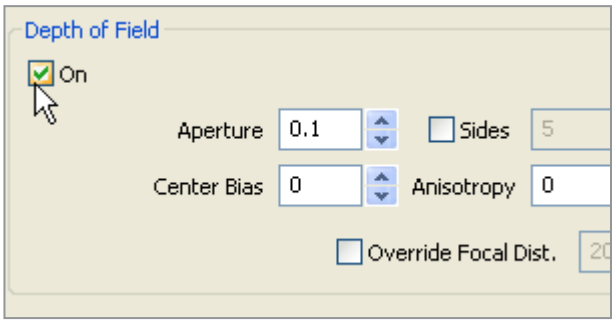
Other ways to use Rhino Geometry in VRay will help you stop the effects of the Environment Map you applied from showing up in unwanted places on your ring: select the groundplane and Bend it up behind - or in front of, or off to the side of - the ring; or, draw a profile with the Polyline and Arc tools and use Rail Revolve to create a "bowl" as your groundplane, instead of a flat Plane. Make this as tall as you need to around the ring to keep black splotches or other reflections from the environment from interfering with your beautiful design! And I'm sure you can imagine all the endless possibilities for rendering "props" in your scene - anything you can model in Matrix or find in a Rhino-compatible file format, such as an STL - can have realistic materials applied to it in just the way you learned in this manual to serve as a prop in your render.



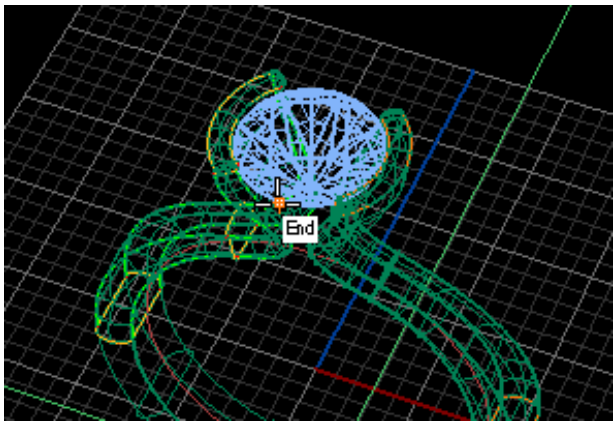
Tutorial 2: Depth of Field with Rhino Camera Controls

Within the "Camera" option in the VRay Options menu, you'll find the Depth of Field control. Set up the Camera target at the center of the render, in the most natural place for the picture to be IN focus. This is possible in a few easy steps with Rhino's camera controls. In VRay, assign a value for Depth of Field, and watch as things farther away from your target grow blurry in your render!

1 Turn on Depth of Field under Camera in VRay Options and assign an Aperture With the render all set up as described in this manual, open the VRay Options menu and click the Camera option to see the VRay camera controls. Click the check-box beside Depth of Field to turn on this option. Beside "Aperture", assign a value between 0.1 and 0.5 for a subtle blur. Raise this value as high as 1 for a dramatic blur. For a value larger than 1, you will see an unnaturally blurry scene, but this might be the effect you are trying to achieve!



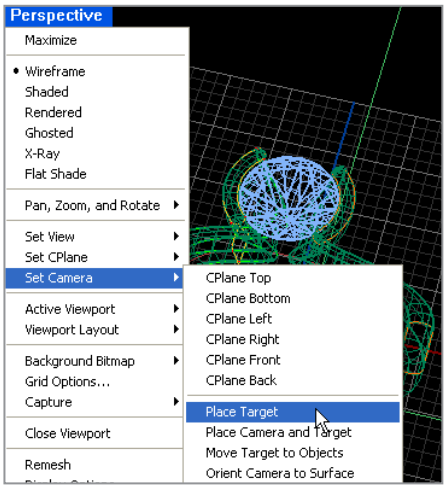
2 Type "Zoom" and assign a "Target" at the natural center of the scene. Back in Rhino, type "Zoom" into the Command line and select the "Target" option. Click once in the Perspective viewport (or whichever viewport you wish to render) at the natural center of the scene. In this case, a point on the lower quadrant of the gem was selected. The Zoom command will ask you to drag a window, with this point as its center. It doesn't matter how big this is. Drag a window and press enter or right-click the mouse. The camera will zoom in so that this window fills the viewport.



3 Zoom the mouse back, without panning, to re-align the scene. Hold down Ctrl and right-click the mouse while dragging it down to realign your scene. Do not pan, as this moves the target of the camera.

Other Camera Functions: If you do pan accidentally; or, if you wish to make certain the camera angle is correct, right-click on the viewport name and select "Set Camera > Place Target". Re-select your target from a distance to ensure it is accurate. Or, select "Show Camera" to see the current position of the camera while you zoom, ensuring it does not move side to side (pan) or lose focus.

4 Render the scene as usual. Adding Depth of Field can really slow down your render time, so sit back, relax, and put up your feet while you wait! (That's an order!!)



Tutorial 3: Rhino Animations of VRay Renders

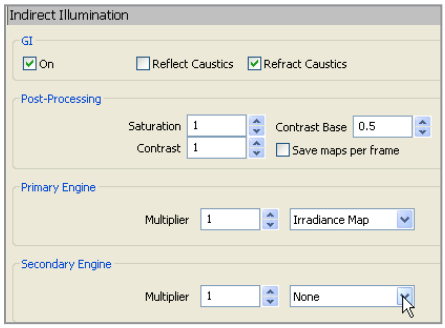
Reset the viewports and run Turntable to preview the render. Set the Turntable speed you want. In VRay, save the "Irradiance Map" for four views of the ring - one at each quadrant - being careful not to pan as you rotate the view. Run Rhino's Animation tool.

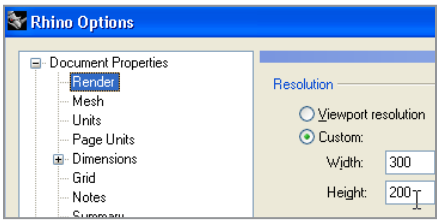
1 In Rhino Options, set "Render" to the pixel size you want for the animation Set this small to create a faster animation.

2 "Reset" the viewports and zoom ONLY, do not pan. Run "Turntable" to preview. Click Reset to center the model in the viewports. Zoom only, do NOT pan, to pose the scene you wish to render. Type "Turntable" to preview the animation. Use the turntable controls to speed up or slow down the animation effect.

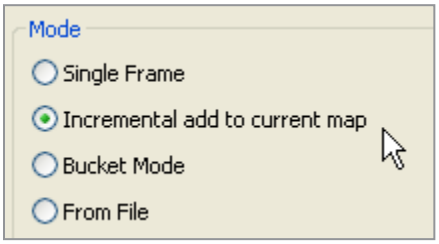
3 Set "Irradiance Map" to cumulatively save map and render 4 views of model. Back in VRay Options, go to the Irradiance Map menu and select the option "Incremental Add to Current Map". This will save the lighting settings with each render, making the animation render more quickly! Now, render four views of the ring: front on; one side, from the back, and the other side. DO NOT pan to attain each view - just rotate!

4 Save off this Irradiance Map and Load this same map for rendering animation. With the lighting information stored up, go back into the Irradiance Map option menu and "Save" this information to your hard drive. Immediately select the "From File" option and Load this same map. You are now ready to animate!!







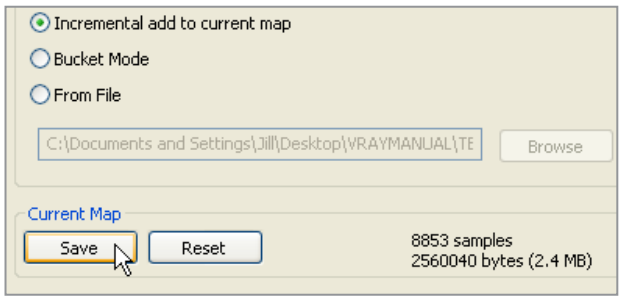


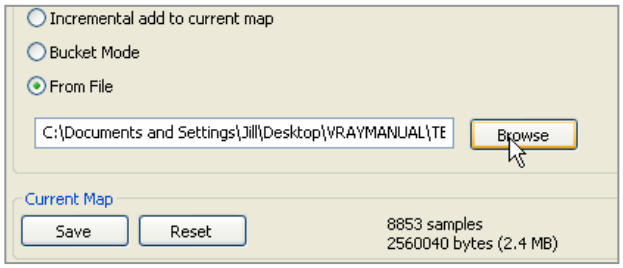
5 Type "Toolbar" and, if necessary, load "default" Rhino Toolbar. Find Animation Toolbar and assign Options. Animate! Back in Matrix, type "Toolbar" into the Command line and, if no toolbar appears, go to "File > Load" and find Rhino's "default" toolbar. From this list, select the "Animation" toolbar.

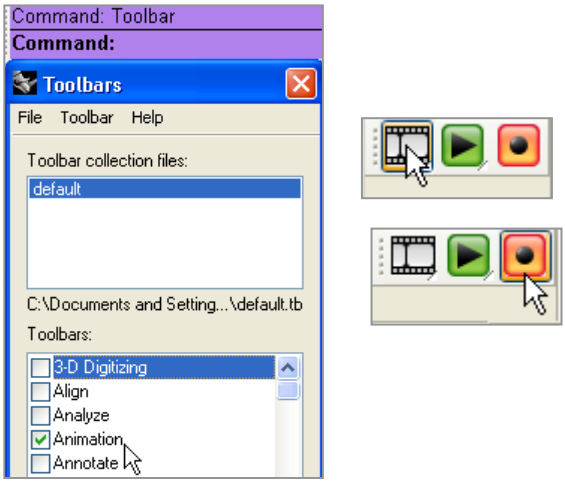
Select the first button to set up the animation, and the first button in the Set Up menu. This will walk you through a series of Command line options to assign such features as the number of frames in the animation (animations run at 30 frames per second, so 60 frames will be a 2-second animation - VRay must render each frame, which is why we sped it up and shrunk it down above! But for a very high-quality render, raise the number of frames.)

You will also assign Direction (clockwise or counter-clockwise); File type for each frame of render (jpeg, bitmap, png, etc.); type of render (choose RenderFull to get VRay to render scene for you); the Viewport to render (most likely Perspective); and a name under which to save the animation.

But you haven't animated it yet! With all the options assigned, click the "Record" animation button and assign a location on your hard drive to save all of the image files. You may also assign the file type. W ... A ... I ... T ... patiently, and, when it is done, the animation will be saved to this file!







Advanced Rendering...

Render Effects with Maps

Add Background Effects & Render special materials with Maps

You've already learned how to apply environment maps in VRay Options and images to planes via the Gemvision Materials library. In this chapter, we'll take this functionality a few steps further by exploring different types of mapping for placing renders on unique backgrounds - including bitmap images such as logos and designs, as well as textured backgrounds - or "bump maps".

While applying a Bitmap simply places a 2-dimensional picture on an object, applying "Bump" Maps actually changes the way the rendered surface interacts with the lighting in the environment, adding the appearance of realistic texture to an object. A third type of mapping, Displacement Mapping, actually changes the geometry of a surface in the render, making it truly textured - so that it can cast shadows. This mapping is useful for rendering cameos, carved stones, and textured backgrounds.

Once all this makes sense, take a foray into Rhino 4's new Multiple Channel Mapping functionality by applying different maps to different channels on the same object. In that way, you can make a logo or image appear as though it is part of an opal or another gemstone; map gems such as a star sapphire; mix gem maps together to match a unique stone you have in real-life; and many other possibilities.



Tutorials

1. Apply a Bitmap to the Groundplane
2. Apply a Bump Map to the Groundplane
3. Displacement Mapping to Create a Cameo
4. Using Multiple Mapping Channels in Rhino

Strategies

- When should I use a Bump Map vs. a Bitmap?
- Changing the geometry of the groundplane
- How an Environment Map Works
- What is the difference between Displacement Mapping and Bump Mapping?
- Why assign the same map to two channels?
- Displacement Mapping for a carved opal effect
- Trim map image, place on black background to change shape of object being mapped
- Creating a star sapphire
- Mixing a new gem material with two gem decals

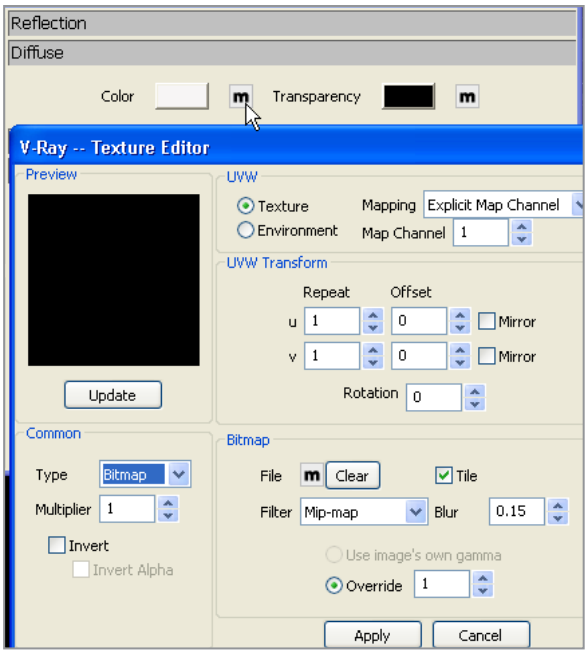


Tutorial 1: Apply a Bitmap to the Groundplane

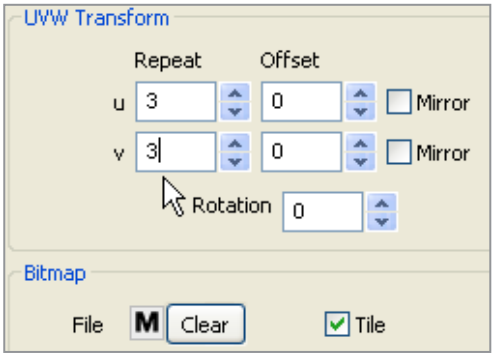
Perfect for placing a ring on your store logo or another background image, or a tileable image that doesn't quite work as a Bump map, this technique can be run with a ground plane (or any object in a scene!) to render it with a bitmap image applied.

1 Apply the Scene Material of your choice. Start with one close to the outcome you are trying to achieve - reflective or matte. Open up the Materials Editor in the VRay builder and find it in the Scene Materials list.

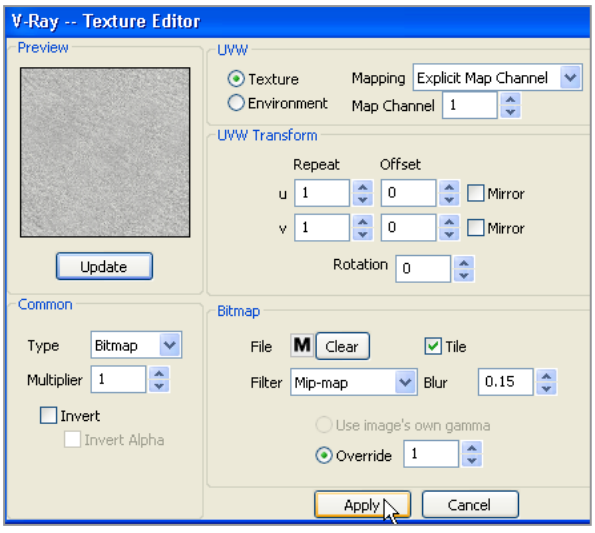
2 On its Diffuse Layer, click "m", select options for Bitmap, and Apply. Add a simple bitmap to the "Diffuse" layer of the Scene Material you wish to see the bitmap on. When adding any of these maps using the "little m" button, remember to use the "Type" dropdown in the VRay Texture Editor and select the "Bitmap" type from this menu. In the UVW section of the menu, "Texture" is the selection you want: not "Environment". The "Mapping" option should be set to the "Explicit Map Channel". Within the "Bitmap" section of the menu, click the "m" beside "File" and select a bitmap. Click "Apply" to continue (the remaining options in this menu are discussed below).



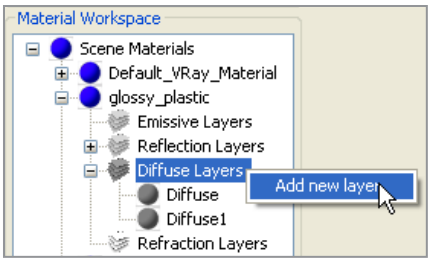
3 Tile the Bitmap if Necessary If you have a very large groundplane and you wish to see more of the bitmap in the area you have in the viewport as your scene; or, if you are applying a tileable image that has been specially prepared to "repeat" seamlessly, here is the perfect opportunity to click on the remaining controls in this menu. (We know, you were just dying to do it!) Since the bitmap will be applied to the entire groundplane surface, it will need to be repeated (i.e. "Tiled") if the surface is very large. With "Tile" enabled, you can provide a value for "Repeat" under the "UVW Transform" section of the menu. Start with a small number, such as 2 or 3, and see how that works first. A high-quality texture bitmap will be pretty large to start with, and may lose detail if it is too small when tiled.

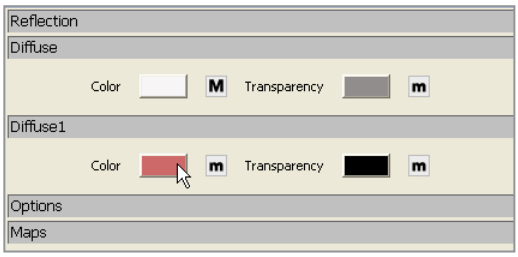


Make sure you type the same number in for the "U" and "V" directions to avoid skewing the bitmap. If this is a tile-able bitmap, you're in luck! If not, and you just want one smaller "instance" of it in your scene, you may need to use "Offset" to move the repeating pattern around so that the "seam" between the repeated patterns is not visible on the section of the groundplane that shows in the scene. This may take a little experimentation. Use the "Update" window to preview the effects. Remember to "Apply" your changes before proceeding.



4 To Change the Color of the Bitmap. You can change the color of this bitmap by making it half- transparent. To do this, find the "Transparency" option located right beside the "M" for map on the "Diffuse" layer for this material. Click the swatch, and select a medium gray color from the Transparency color palette. (When using Transparency in VRay, Black = opaque, White = completely transparent, and Gray = varying degrees of transparency. Select a medium gray color here so the bitmap will be moderately see-through.) Now, back in the Scene Materials menu, right-click on the Diffuse heading for this material and select "Add Layer". This will add a second diffuse layer to your material. Select a Color for this diffuse layer. The color of this diffuse layer will show through the partially see-through bitmap you placed above. For best results, the bitmap you placed should be black and white, so you don't have to worry about mixing colors! You can change it to a grayscale image in DG or another image-editing program.





Tutorial 2: Apply a Bump Map to the Ground Plane

This tutorial walks you through the techniques we used to create the different Ground Plane options available in the VRay builder. Follow these steps to make your own! Then, use tips found earlier on in this chapter to save them to the User Materials section of the library.

Using a Bump Map vs. a Bitmap

Another way to create an interesting groundplane is with "bump-mapping". Bump-mapping affects a surface so that, at each pixel in the image, the surface normals will be affected so that the surface no longer appears smooth. The degree to which the surface is affected is relative to a "heightfield", or, a table that assigns how high the surface will appear based on the pixel color, where lighter = higher and darker = lower. Unlike bitmaps, bumpmaps will be detected by the lighting in the scene, since they're actually changing the surface in minute ways! As opposed to simply applying the texture as a bitmap, a bump map applied to a groundplane will look more realistically shiny where the natural lighting in the scene hits it. The light is able to "glint off" the bump map, while other parts of the map can be realistically shadowy in the rendered scene. So, to review: bumpmaps placed on a groundplane interact with the lighting in the scene, while bitmaps do not. Sometimes, you will like the "bump map" effect better! Sometimes, you will like the "bitmap" effect better. It may take some trial and error depending upon the texture you are trying to achieve.

Achieving pink "Leather". With bitmap, described in Tutorial 1:

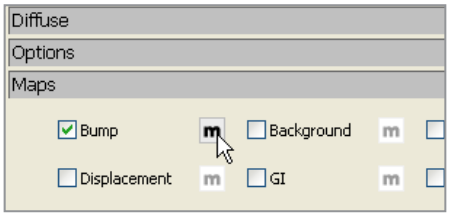


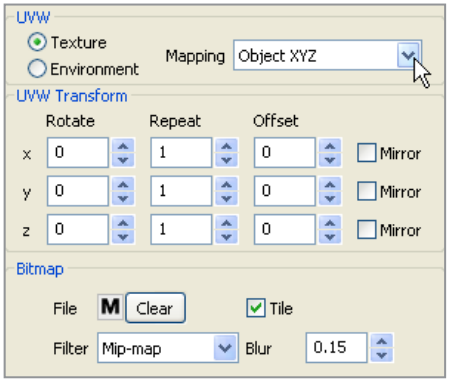
Same image applied as bump map, Tutorial 2: (Which do you prefer?)

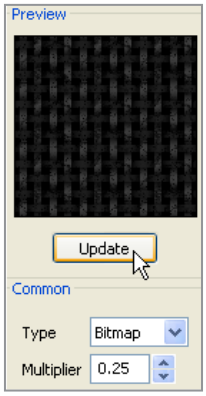


1 Apply the Scene Material of your choice. Start with one close to the outcome you are trying to achieve - reflective or matte. Open up the Materials Editor in the VRay builder and find it in the Scene Materials list.

2 On the Map Layer, select "Bump" and click "m" to apply the map. To apply a bump map, select the material to which you want to apply a bump map and click on the "Map" channel that appears on the right-hand side of the Materials Option dialog, expanding it. Here, you'll find the "bump" map option. Click in the box to check-mark it, and click the "m" to apply the map. You should recognize this menu by now! First, use the "Type" dropdown in the VRay Texture Editor and select the "Bitmap" type from this menu. In the UVW section of the menu, "Texture" is the selection you want: not "Environment". In this example, we'll use the "Object XYZ" Map Channel (but in a minute, we'll explain to you what all those map channels do, and how to use them to make some neat effects!). Within the "Bitmap" section of the menu, click the "m" beside "File" and select a bitmap. With "Tile" selected, the material will be tiled to fill the groundplane (as long as "Object XYZ" is the selected Mapping Channel! Again: more on that later). Alternately, you can select "Explicit Mapping Channel" and figure out how many repetitions you'll need in the X and Y direction, as described in the previous tutorial, but this can take a little more trial and error. With "Object XYZ" and "Tile", the program will fill the groundplane for you.

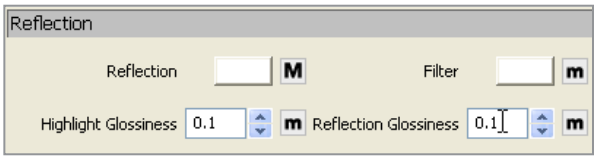


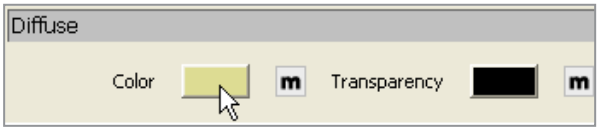




3 Lower the Multiplier within the Texture Editor dialog (try 0.25) for subtle texture. This time, beneath the "Bitmap" option in the Texture Editor dialog, lower the "Multiplier" value from "1" to "0.25" by typing this value into that text box. This will lower the effect the bump map will have on the surface, making for a more subtle texture. Click "Apply" to keep these changes and close the Texture Editor dialog.

4 In the "Reflection" channel, lower highlight & reflection glossiness. Change background color if desired. Click Apply to keep these changes. Now, over on the "Reflection" channel for this material, lower the "Highlight Glossiness" and "Reflection Glossiness" so both are equal to 0.1. This will lower the reflective quality of the glossy plastic, but still give the material a subtle sheen, the way linen has in real-life. Since a bump-map is s transformed into a grayscale image in order to be applied to the material, you may wish to add color to it! To do so, go to the Diffuse layer of this material and change the Color swatch in the same way you usually do.





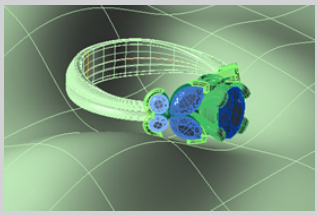
5 Apply the material and Render the scene.



Changing the Geometry of a Groundplane

This technique is useful for any groundplane you apply in VRay: Back in Matrix, select the groundplane surface and Rebuild it; then, drag Control Points around to get a neat, "Wavy" effect. Now when you apply materials and render, you'll see a wavy, interesting background for your ring!

First pair: with bump mapping; second pair: with bit-mapping.









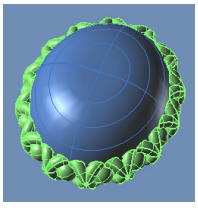
Tutorial 3: Displacement Mapping to create a Cameo

Displacement Mapping actually changes the geometry of the surface (in the render only), allowing you to create a realistically textured object that casts shadows and appears "in front of" other objects in the scene. To render a cameo, we'll be applying the map to both the Displacement channel and the Diffuse channel, to make both the image and the displacement effect clear.

Displacement Map vs. Bump Map

The third type of mapping, Displacement mapping, changes the geometry of the surface in the render, raising it up where the bitmap is lighter and lowering it down where the bitmap is darker. It's also known as "heightfield" mapping, since the colors in the pixels are compared to a range of heights that assign how much the surface will be raised or lowered at each pixel. Although Bump Mapping also uses a height field, its light and dark values (highs and lows) just affects the surface normals, changing how the surface interacts with the lighting in the scene. In contrast, Displacement Mapping actually moves points on the surface – in the render only – to the height assigned. In this way, a surface with displacement mapping will appear "bumpy" when viewed from the side, as opposed to a surface with bump-mapping only, which will appear flat when viewed from the side. Displacement Mapping works well for deeper background textures, as well as for items in the scene such as cameos or carved opals.

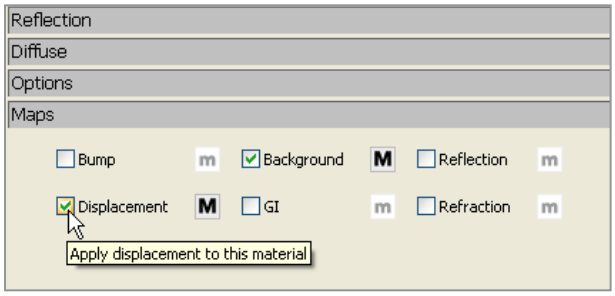
1 Set up remaining elements in scene and Explode cabachon gem. To begin with, find a nice image for your cameo and trim it so it's roughly in the shape you want (oval, e.g.) for the cameo. Then, place a cabochon gem onscreen at the size you want for the cameo. Type "Explode" to turn the block instance into a regular object in Rhino. Also, the cabochon should not be too tall, as this will warp the image of the cameo as it wraps around the gem. Boolean Difference from a Box object in the Solid menu was used to hack this one down to a reasonable size. Do any fancy footwork that you need to create a setting for the cameo: in this case, the Matrix Version 6.0 tool "Gem



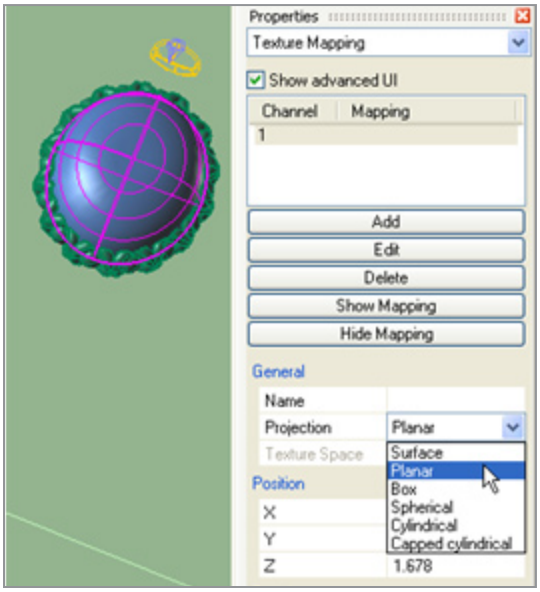


on Curve" with the "Browse" option in the Command line was used to place the "X Link" chain onto an isocurve that was extracted from the surface of the cabochon. You can add Yellow Gold to the setting and the material of your choice to the groundplane as described earlier in this chapter.

2 Apply map to Displacement channel of material. With the Default VRay Material (which has a matte look: for a glossy-look cabochon, add a Plastic to this object) applied to the gem, select the gem's material in the Material Workspace and open the "Map" channel in the right-hand side of the menu. Select "Displacement". Apply this map to the "Explicit Map Channel" and do not tile or repeat the cameo. Click the "m" beneath "Bitmap" and navigate to the cameo image that you prepared. "Apply" the cameo to continue.



3 Apply same map to Diffuse layer of material. Back on the "Diffuse" layer of the same material, follow the steps above to apply the identical cameo image to the Diffuse layer, selecting the same options in this bitmap editor. "Apply" the changes; then, apply this layer to the cabochon.



4 In Rhino Properties for the object, the Explicit Map Channel should be Planar. You have one step left! Back in Matrix, select the cabochon and type "Properties". From the Properties drop-down at the top of the menu that appears to the right of your viewports, select "Texture Mapping", and click the check-box to "Show advanced UI (User Interface)". Click "Add" one time to see the number 1 under "Channel". From the General tab beneath the buttons, make sure the "Projection" setting is at "Planar", using the drop-down menu to change it from "Surface". (The "Surface" setting would map the bitmap so it's consistent with the seam of the object – which, in a revolved surface like a cabochon, would make it appear to "swirl" around the top instead of laying it out in a "Planar" fashion!)

Assign same map to 2 Channels?

Displacement mapping can have a pretty dramatic effect, but it uses the lights and darks in an image ONLY as an assignment for creating the highs and lows of surface, which can sometimes obscure the very image you were trying to add to the surface! When the diffuse layer has the same bitmap applied to it, you are now able to see the image that is casting the shadows and creating the textures you are seeing in the render.

The Carved Opal Effect

Follow these same steps using Glossy Plastic in Step 1. Then, in Step 3, do NOT apply the same map to the Diffuse channel - instead, apply an opal map or another gem decal. For best results, the image should have a pure black (0,0,0) border in the shape of the surface to which you are mapping it - in this case, oval - because any white or colored background that extends past the image you wish to use for the displacement map will become part of the map and will have an effect on the object you're mapping it to.





Change Shape of Object (Render Only)

If, in preprocessing in an image editor program, you trim just the image you wish to map, and paste it onto a true black background (0,0,0), and then map it to an object, it will displace the object past itself (as long as "invert" is not turned on in the mapping dialog) and cause the object to take on the shape of the map. In this example, the Jade map was applied to the Diffuse Map channel and the skull bitmap was applied to the Displacement Map channel.

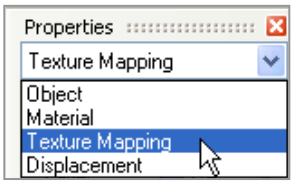


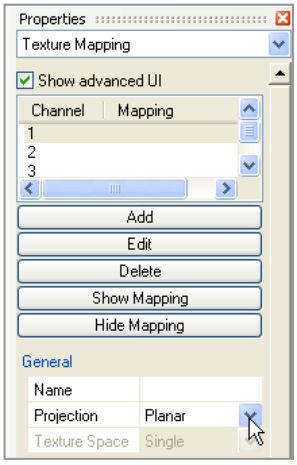


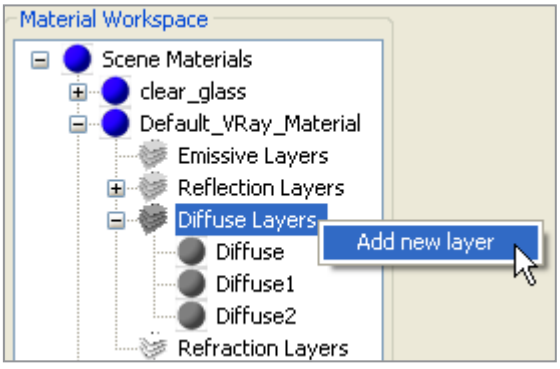
Tutorial 4: Using Multiple Mapping Channels

New Multiple Mapping channel functionality in Rhino 4 allows you to assign more than one map to a single object. This means you could map your store logo onto an opal; map a gem decal and a "star" to create a star sapphire; map two gem decals to "mix" the two materials to best match a gem in real-life, or anything else you can think of!

1 Add Map Channels in Rhino Properties for object you are mapping. To begin, let's find out where these map channels live in Rhino. Select an object to which you will apply more than one map, and type "Properties" into the Command line. This will open up the Properties window for this object on the right-hand side of the Rhino interface. From the drop-down menu at the top of the Properties window, select "Texture Mapping". Beneath this, select "Show Advanced UI" (UI stands for User Interface). This will bring up the "Channel" dialog, together with buttons beneath it for "Add, Edit, Delete" Channels, etc. Click Add for as many channels as you'll need. In this example, we'll use 3. If you are mapping an exploded cabachon gem - or any revolved surface - you must select each channel separately and, just beneath the buttons in this interface, find the "General" heading and make certain the setting next to "Projection" is set to "Planar". Do this for EACH channel to ensure that the maps you're about to apply are not following the surface seam - circular for a revolved cabachon - of the object being mapped, but, rather, are being applied in a planar or linear fashion (X, Y) to the object.

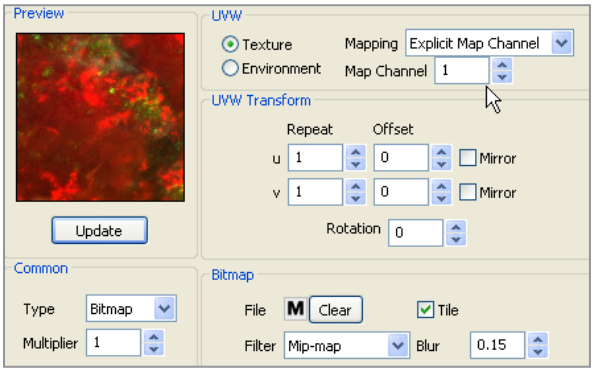




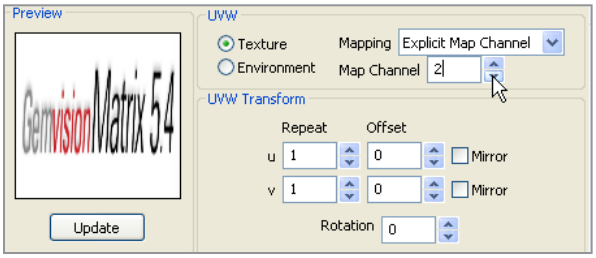


2 Set up scene Environment as usual. In Materials Editor, add Diffuse Layers. To add bitmaps to these mapping channels, add two Diffuse layers to the material you wish to map. In this case, we'll map our old standby - glossy plastic - so make sure this has been selected in the Gemvision Materials Library and applied to the object you are mapping. Select the "+" sign to expand it. Beneath that, select the "+" sign to expand the Diffuse layer. Right-click on the "Diffuse" HEADING, not the layer beneath it, and select "Add New Layer". Do this a second time, and you will have added "Diffuse1" and "Diffuse2" to the layers under "Diffuse" for this material.

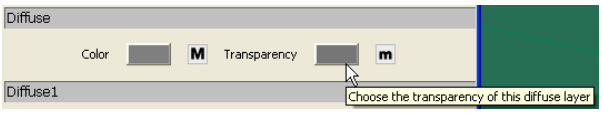
3 Apply main (stone, here) decal to first Diffuse Layer with half transparency. On the first layer (called simply, "Diffuse"), click the "m" to apply a map and apply the stone decal (Opal used here, but you may use any that you wish). While you're in the Texture Editor, make certain the "Explicit Mapping Channel" for this texture is set to "1"! Beside the map option, you'll see a color swatch for "Transparency". Set this to a medium gray, making this decal half transparent.

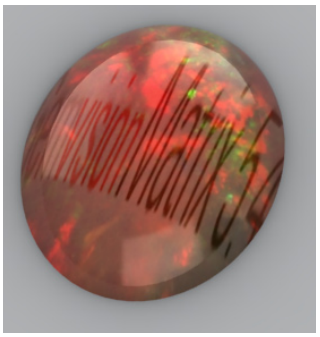


4 Apply secondary decal (logo) to second Diffuse Layer with half transparency. On the second Diffuse layer (Diffuse1), apply the logo map, selecting "Explicit Mapping Channel 2" within the Texture Editor. This bitmap should also be at half transparency.



5 Finally, apply main decal to third Diffuse Layer with no transparency The stone will look a little washed out and see-through unless you complete this step: apply the original map (from step 3) to the third Diffuse layer (Diffuse2). Within Texture Editor, "Explicit Mapping Channel 3" must be selected! Set Transparency to black: no transparency.









Creating a "Star Sapphire"

Complete the steps in this tutorial using as the main map the stone decal of your choice (DG5's Lapis Lazuli used here) and, as the secondary map, a "sparkle" from the DG5 Sparkle Brush, placed on a black (0,0,0) background, traced with the Inventory Pencil Lasso in DG, and saved as a JPEG. Depending on the logo or image you are adding as your secondary map in this tutorial, you may need to play around with both the Bitmap Multiplier (increases intensity of bitmap) and Transparency values for your first and second diffuse layers (Diffuse and Diffuse1-.

Mixing 2 Gem Decals

With only two mapping channels, you may complete the steps above and make the first decal half-transparent. The second decal should be fully opaque. In this way, the turquoise malachite was made by mixing lapis lazuli with malachite

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