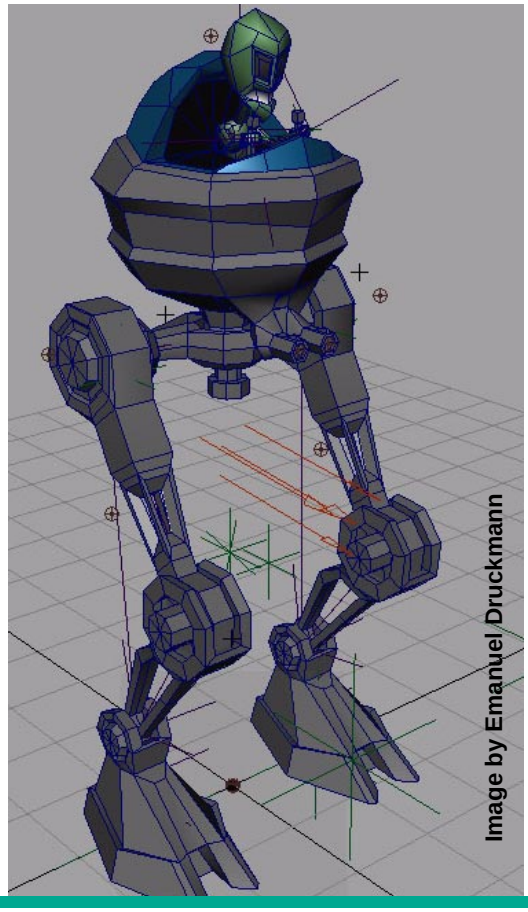

POLYGONAL MODELING

VERSION 4

POLYGONAL MODELING

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CONTENTS

POLYGONAL MODELING

1 INTRODUCTION TO POLYGONAL MODELING 11

What you have to know about polygons 11

What is a polygon? 11

What are polygon components? 11

Tools and actions 18

Planar and non-planar polygons 18

Shared and unshared edges, vertices, and UVs 19

Valid and invalid polygonal geometry 19

2 BASIC POLYGONAL MODELING 23

Creating new polygons 23

Using the Create Polygon Tool 23

Create Polygon Tool options 25

Appending to polygons 28

Using the Append to Polygon Tool 28

Append to Polygon Tool options 29

Creating polygonal strips 33

Making holes using the Create and Append Tools 34

Mirroring Polygonal Objects 35

Polygon Mirror options 35

Displaying polygon count statistics 37

Copying and pasting UVs, colors, and shaders 39

Cleaning up polygonal data 40

Cleanup Polygon options 40

Editing polygons in the Attribute Editor 42

Changing tessellation attributes 43

Changing the component display 43

Displaying the current UV set 46

Setting custom polygon display options 47

Using the Component Editor with polygons 49

3 POLYGON COMPONENTS 51

Selecting polygonal components 51

Retaining a component selection 52

Changing component colors 53
Paint-selecting components 53

Transforming polygonal components 53

Moving components using Move Component 53
Using Move Component 54
Move Component manipulator 55
Switching between local and global modes 56
Moving UVs 57
Move Component options 57

Deleting polygon components 59
Deleting vertices 59
Deleting edges 60

Transferring components 61

Flipping Triangle Edges 61

Reducing Polygon Counts 62
Polygon Reduce Options 62

4 NORMALS AND DISPLAY SETTINGS 65

Moving vertices along their normals 65

Editing polygon normals 66

Setting polygon vertex normals 66

Averaging vertex normals 68
Average Normals options 69

Splitting vertex normals 69
Set to Face options 70

Reversing polygonal normals 70

Conforming normals 72

Softening and hardening polygon edges 73
Soften/Harden Edge options 73

5 POLYGONAL PRIMITIVES 75

Basic polygonal primitive objects 75
Creating polygonal primitives 75

Setting primitive options 76
Specifying a primitive's radius 76

Specifying a primitive's subdivisions 77
Specifying a primitive's width and height 79
Changing a primitive's orientation 79
Preparing a primitive for texture mapping 80
Editing primitives in the Attribute Editor 82

Creating and editing text 82
Polygonal text settings 83

6 POLYGONAL BOOLEANS 85

Polygonal Boolean operations 85

Boolean types 86
Union Boolean operation 86
Difference Boolean operation 88
Intersection Boolean operation 89

Editing Booleans with construction history 89

Trimming using polygonal Boolean operations 92

Animating polygonal Boolean operations 93

7 SETTING GLOBAL TOOL OPTIONS 95

Keeping new faces planar 95

Keeping faces together 96

Converting the selection mode 97

Installing Smart Command Settings 97

Resetting current command settings 99

8 SELECTION OPERATIONS 101

Growing and shrinking selections 101

Selecting boundaries 101

Selecting a band of edges 102

Converting the selection to another component 103

Displaying only selected polygonal faces 103

Using selection constraints 104
Selecting constraint components 104
Polygon selection constraint options 106

9 CONVERTING NURBS TO POLYGONAL GEOMETRY 115

Converting NURBS to polygons 115

Using NURBS To Polygons options 116

Choosing a tessellation method 117

10 TRIANGULATING AND QUADRANGULATING POLYGONS 121

Triangulating polygons 121

Quadrangulating polygons 122

11 EXTRUDING, DUPLICATING, AND EXTRACTING 125

Extruding faces and edges 125

Extruding faces 125

Extruding edges 127

Duplicating faces 129

Extracting faces 129

Keeping faces together 130

Extrude, Duplicate Face, and Extract options 133

12 MAKING AND FILLING HOLES IN POLYGONS 137

Making holes in polygons 137

Setting Make Hole Tool options 140

Filling holes with faces 142

13 COMBINING, SEPARATING, AND COLLAPSING POLYGONS 143

Combining polygons 143

Separating polygons 144

Separating polygonal shells 144

Separating polygons with merged edges 145

Separating combined polygonal objects 146

Collapsing polygons 147

14 SPLITTING AND SUBDIVIDING POLYGONS 149

Splitting polygons 149

Splitting shared vertices 152

Subdividing polygons 152

15 SMOOTHING, BEVELING, AND SCULPTING POLYGONS 155

Smoothing polygons 155

Smoothing by modifying the topology 155
Smoothing by averaging vertices 158
Emulating subdivision surface workflows 158

Beveling polygons 160

Sculpting polygons 163
Sculpting overview 163
Sculpting operations 163
Setting Sculpt Polygons Tool options 167
Sculpting surfaces 170
Sculpting masked surfaces 170
Importing attribute maps 171
Flooding sculpted surfaces 171
Sculpting tips and tricks 171

16 MERGING VERTICES AND EDGES 173

Merging vertices 173

Merging edges 175
Merging edges using the Merge Edge Tool 175
Merging border edges between two polygonal objects 179
Merging multiple edges 180

17 COLORING POLYGONS 183

Applying colors and prelighting 183
Displaying color feedback for color operations 183

Applying color 184
Applying colors using generic selection methods 184
Painting vertex color 186
Copying and pasting color 188
Transferring vertex color 189

Prelighting for polygonal surfaces 189
Prelight advantages 190
Setting up a scene to Prelight 192
Prelighting a scene 192
Saving your prelighting to texture maps 195
Prelighting examples 195

Animation for vertex colors 197

18 WORKING WITH BLIND DATA 199

Defining blind data types 199
Type Editor tab options 200
Editing blind data types 201
Exporting blind data types 202
Viewing template data 202

Applying blind data 202
Apply tab options 202

Coloring or querying blind data 203
Color/Query tab options 203
Some notes on coloring and querying blind data 207

Viewing blind data values 207

19 MAPPING UVS FOR POLYGONAL SURFACES 209

About UVs and mapping 209
About UV mapping 210
Guidelines for UV arrangement 210
Previewing texture placement 211

Creating UVs based on the camera view 211

Using Best Plane Texturing 212

Planar mapping for polygonal surfaces 213
Polygon Planar Projection options 214

Cylindrical and Spherical mapping 216
Cylindrical and Spherical Projection options 216

Automatic mapping 218
Automatic Mapping options 220

20 EDITING UVS FOR POLYGONAL SURFACES 225

UV editing basics 225

Transforming UVs in the UV Texture Editor 226

Normalizing UVs 227
Normalize UVs options 227

Unitizing UVs 228

Flipping UVs 228
Flip UVs options 228

Rotating UVs 229

Laying out UVs 230
Layout UVs options 231

Relaxing UVs 232
Relax UVs options 232

Mapping the UV border 233
Map UV Border options 234

Straightening the UV Border 236

Cutting and sewing UVs 237

Moving and sewing UVs 239

Merging UVs 240

Deleting UVs 241

Creating a UV Snapshot to paint a matching texture 242

Copying and pasting UVs 243

Changing the grid 244

Displaying the texture 244
Displaying textures for the object or faces 245
Selecting an image to display 245
Setting the texture image ratio 245
Changing the image range 245
Displaying images unfiltered 246
Snapping UVs to pixels 246

Creating good UVs on complex models 246
Transferring vertices 247

Multitexturing 248
Creating and editing UV sets 248
Applying layered textures to UV sets 249
Blend modes 256

1 INTRODUCTION TO POLYGONAL MODELING

This chapter helps to define polygons and their components and basic polygonal terms. As well as the basics, it provides a list of hotkey shortcuts you can use when modeling with polygons.

To quickly learn the basics of polygonal modeling, see the Polygonal Modeling lesson in *Instant Maya*.

About the Polygonal Modeling guide

The Polygonal Modeling book provides information on modeling with polygons. It also covers related features such as coloring vertices, creating blind data for interactive games, and setting up UVs in preparation for applying a texture to the surface.

WHAT YOU HAVE TO KNOW ABOUT POLYGONS

This section discusses some of the basic rules of polygonal modeling and a few tips on how to get the results you want.

What is a polygon?

A polygon is an n-sided shape defined by a group of ordered vertices and the edges that are defined by pairs of those vertices. A polygonal object is a collection of polygons (called polygonal faces).

Polygonal objects can be either simple shapes, such as polygonal primitives, or you can use the various Maya polygonal tools and operations to build complex models. A polygonal object can be closed, open, and can consist of shells, which are disjointed pieces of geometry.

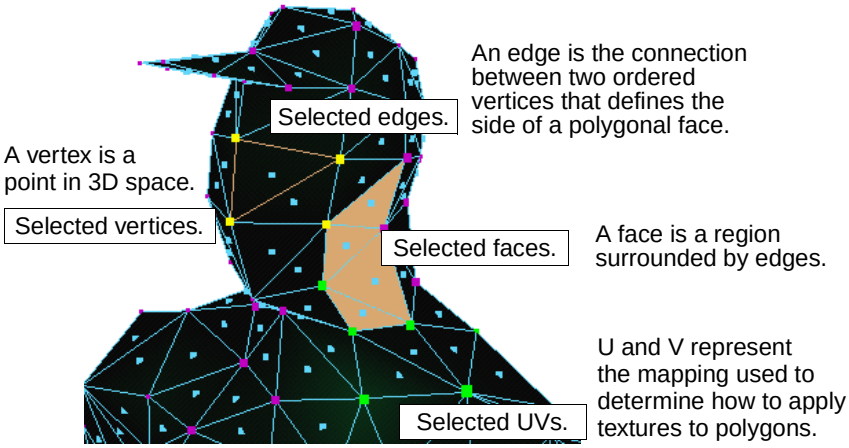
You can also build models using NURBS geometry and turn them into polygonal geometry by selecting NURBS to Polygons from the Polygons menu (see "Converting NURBS to polygons" on page 115).

What are polygon components?

Polygons are made up of several components:

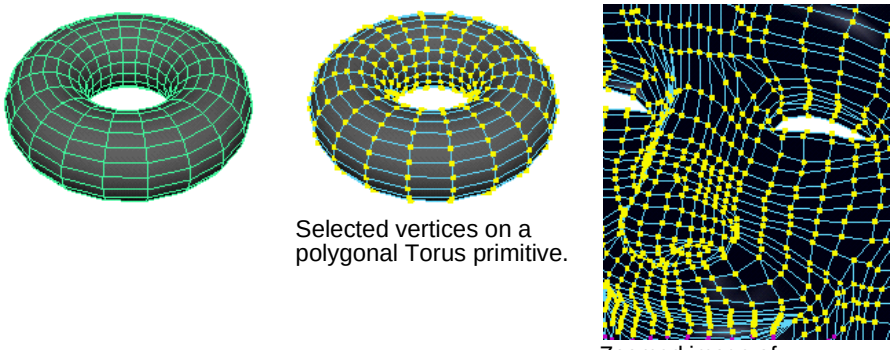
- vertices (see "Polygonal vertices" on page 12)

- edges (see "Polygonal edges" on page 15)
- faces (see "Polygonal faces" on page 12)
- UVs (see "Polygonal UVs" on page 16)



Polygonal vertices

Polygonal vertices, like a connect-the-dot picture, determine the final outcome of a polygonal model. In the following example, the vertices are selected to show you how these connect to complete the model.



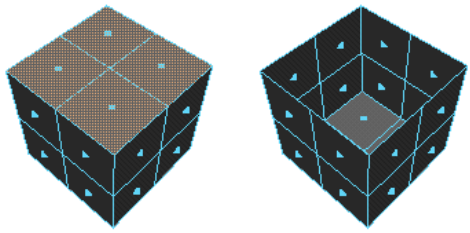
Selected vertices on a polygonal Torus primitive.

Zoomed image of selected vertices on a complex model.

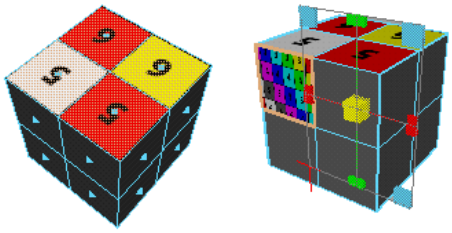
Polygonal faces

A *face* is defined as the region bound by joined edges. A polygonal object is a set of faces. When closed, it forms a solid. This gives you the flexibility to edit and texture a model on a per-face basis. A face is graphically represented as a solid unit with a dot in the center by default.

You can use faces in various ways to transform polygonal objects. For example, if you want to create a hollow polygonal cube, simply select the top faces and press the backspace key to delete them.



You can also assign textures to polygonal objects on a face-by-face basis.



To change how you select faces:

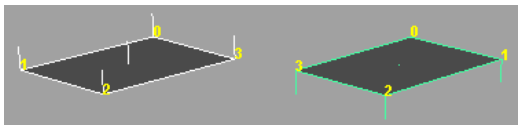
By default, you select faces by clicking the small box in the center. If you want to be able to select faces by clicking anywhere within the faces:

1. Select Window > Settings / Preferences > Preferences to open the Preferences window.
2. Under the Settings category, click Selection and in the Polygons section, select Whole Face.

For more information on customizing your UI (User Interface), see *Using Maya: Essentials*.

Polygonal face normals

The order in which vertices appear determines the direction of the face. The front of a polygon's face is graphically represented using a vector called the polygon's *normal*. A normal is a line representing the direction perpendicular to a polygonal surface, and can be shown at the center of a face, at each vertex on the face, or both.

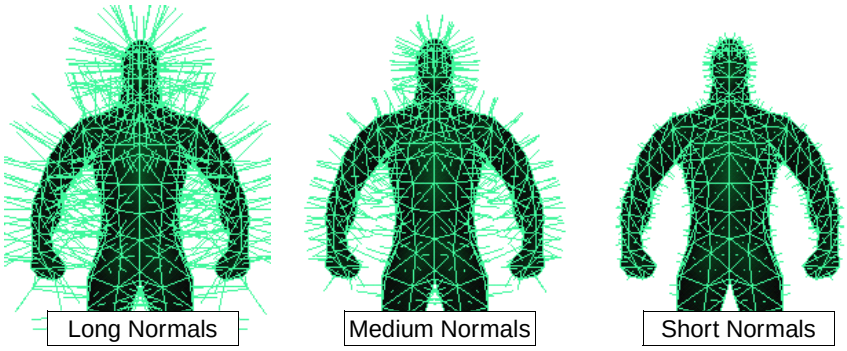


To find out more about normals, see *Chapter 4, "Normals and Display Settings"*.

Displaying normals from the Polygon Components menu

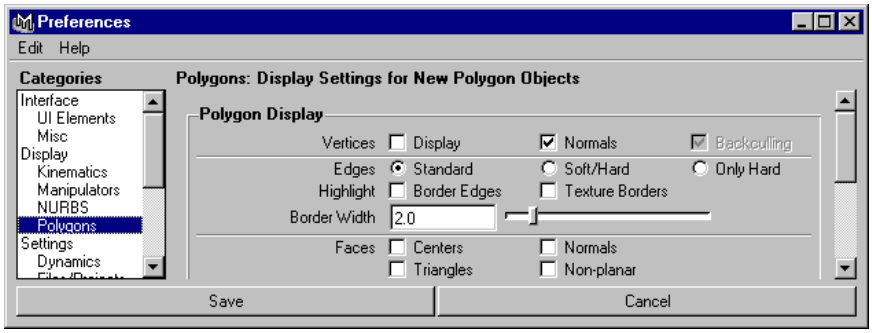
Normals display as fine lines protruding from the model. By default, face normals display. You can change the normal display settings in the Custom Polygons Display window to display both face and / or vertex normals. For details, see "Displaying normals from the Custom Polygon Display window" on page 14.

You can display or hide normals using Display > Polygon Components > Normals. The size of the normals that display when you select Normals depends on the last normal size you turned on in the Polygon Components menu (Long Normals, Medium Normals, or Short Normals).



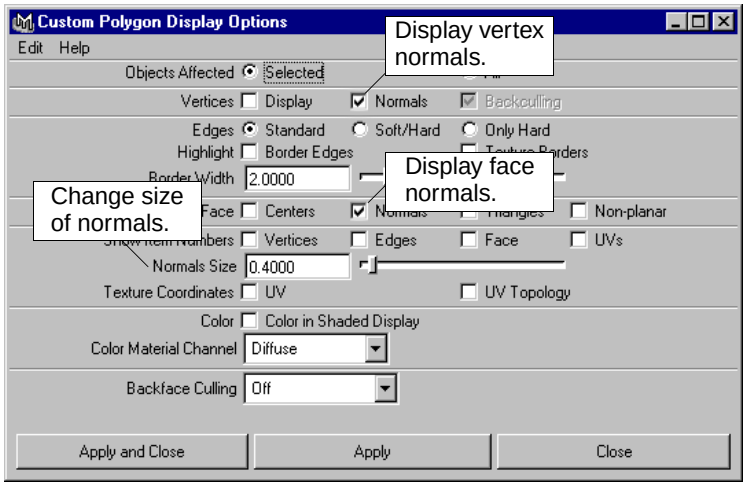
Displaying normals from the Preferences window

You can also display normals every time you create a polygonal model by turning on Normals beside Vertices in the Polygons category of the Preferences window (Window > Settings / Preferences > Preferences).



Displaying normals from the Custom Polygon Display window

Open the Custom Polygon Display options window to precisely set the size of normals and display them on faces and / or vertices as you work (Display > Custom Polygon Display ❐). Turn on Normals for Vertices and / or Faces, set the Normals Size to what you want, and click the Apply button.



Using normals when texturing and coloring polygons

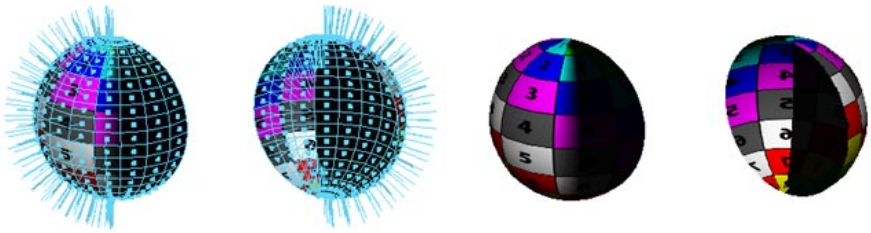
When rendering polygons (including displaying them in shaded mode in the modeling window), the normals are used to calculate the way light reflects from the surface.

For example, if you apply color or project a texture to only part of the front or outside of a polygonal object, you simply select the faces and reverse the normal direction for those faces to reverse that application to part of the back or inside of the object.

To reverse the direction of polygonal normals, select the faces, turn on the vertices normal display in the Custom Polygons Display window, and then select Edit Polygons > Normals > Reverse.

Reversing normals when projecting textures

In the following example, a texture is projected onto half of a polygonal primitive sphere. Several faces have been selected and their normals reversed. Notice how the texture projects on both sides of the object. Maya projects the texture according to the normal direction.



Normals and texture. Unobstructed view.

Tip

If connected polygons on a surface have opposing normals, the surface may not render as desired.

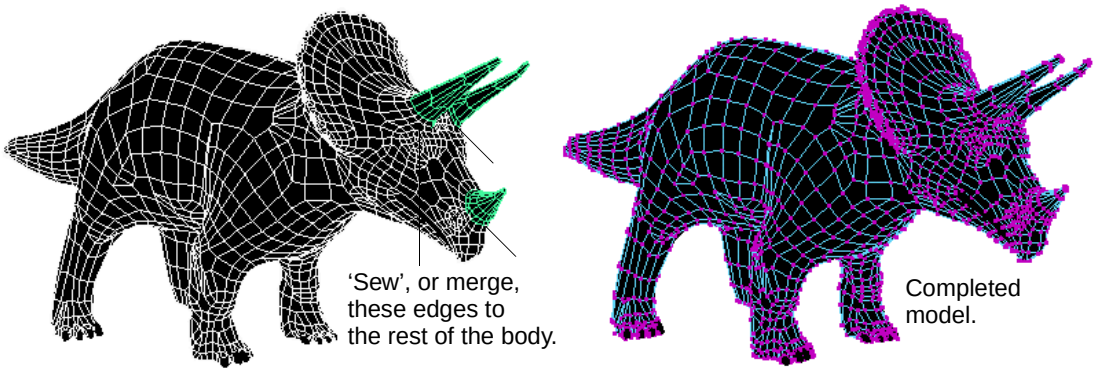
Select Edit Polygons > Normals > Reverse ❐, select Reverse and Propagate, then click Apply to adjust the normal direction. See "Reverse and Propagate" on page 72 for details.

Polygonal edges

An edge is a side of a polygonal face defined by two ordered vertices. An edge is represented by a straight line between the two vertices that define it. Edges that bound a single face only are *border edges*.

Edges can be useful when working with disconnected polygonal surfaces. You simply merge the edges together to connect the surfaces.

For example, if you create elements of a complex object separately, like the horns of the beast in the following example, you can 'sew' them to a larger object by selecting the border edges of the objects and merging them together.



You can also use the Polygons > Append to Polygon Tool, click to add to the original polygon, and then select Edit Polygon > Merge Multiple Edges. Select adjacent edges, merge them, and adjust the tolerance between them to create one solid 'welded' polygonal surface.

Polygonal UVs

Polygonal UVs are points on a polygon that are used by Maya to map a texture onto the polygon. By arranging the UVs, you can position the texture on the polygon.

In Maya, polygonal UVs are created optionally. You can create polygonal objects without UVs (for example, by turning the Texture option off or to None when you create primitives), however, UVs are required if you want to assign textures to the object or apply paint or Fur to it.

For information about UVs and textures for polygons, see Chapter 19, "Mapping UVs for polygonal surfaces."

Important note about UVs!

UVs must be present on an object or the mapped textures will not display or render. UVs will not be present if you inadvertently create an object without UVs or import a model without UVs.

To create UVs on objects, select the faces of the object and use any of the mapping tools in the Edit Polygons > Texture menu.

You can then use the UV Texture Editor to view and arrange the created UVs. Select the object and use any of the UV creation or editing Texture menu items.

Default component display

By default, components display in different colors and sizes to help you identify which picking mode you are in. The following table lists the default display for polygonal components.

Component	Inactive display (unselected)	Active display (selected)
Vertex	small purple boxes	boxes change to yellow
Edge	light blue lines	lines change to light orange

Component	Inactive display (unselected)	Active display (selected)
Face	blue dot in the center of connected edges	area changes to light orange
UV	medium size purple boxes	boxes change to bright green

To change active and inactive colors:

1. Select Window > Settings / Preferences > Colors.
2. Click the Active or Inactive tab.
3. Click the down arrow to open the Component section of the Colors window.
4. Drag the slider beside the component you want to change until you see the color you want.

For more information on customizing your UI (User Interface), see *Using Maya: Essentials*.

Polygonal solids

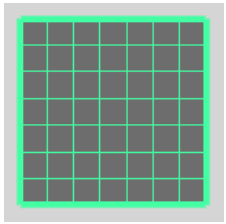
A solid consists of faces which form a closed volume. Each edge in a solid is shared by exactly two faces. A solid always has an inside and outside defined by the direction of the normals.

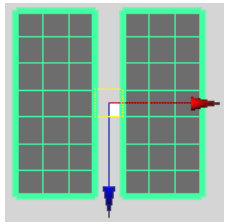
You can create solids either as primitives (spheres, cylinders, cones, cubes, or toruses), by converting open surfaces to closed surfaces, or from non-solid polygonal objects using polygonal operations, such as the Merge Edge Tool (Edit Polygons > Merge Edge Tool).

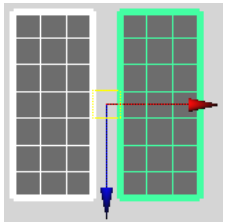
Polygonal shells

A polygonal object consists of one or more shells. An edge can only belong to a single shell.

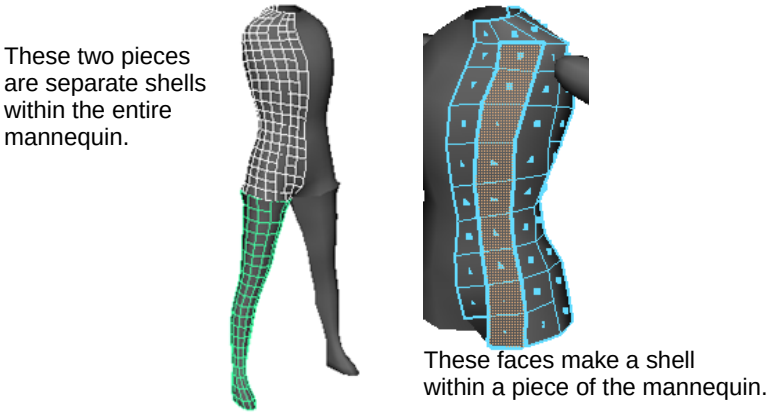
For example, a primitive plane is a polygonal shell. If you delete faces to split the plane in two, two shells are created (each with its own border edge) but the pieces remain connected. If you then separate the shells using Edit Polygons > Separate, the shells become disconnected.


Primitive plane.


Plane split into two shells.


Separated shells.

The following image shows two more examples of shells.



Certain polygon operations work on a shell-by-shell basis, such as Edit Polygons > Normals > Reverse in Reverse and Propagate mode, and Edit Polygons > Separate. See "Reverse and Propagate" on page 72 and "Separating polygonal shells" on page 144 for details.

Tools and actions

As with most of Maya's functionality, the picking order of objects and components depends on whether you are using a tool or an action.

With Maya's polygonal modeling tools, you select the tool first from the menu, then you select the object or component. To make it easier for you to differentiate, all of Maya's tools have the word *Tool* after the menu item's name (as in Polygons > Create Polygon Tool).

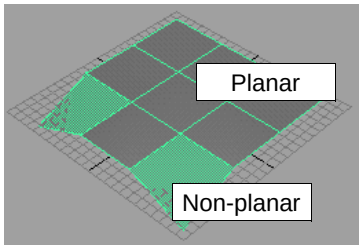
With actions (or operations), you select the object or component first, then you select the menu item (as in Edit Polygons > Extrude Face).

Planar and non-planar polygons

A *planar* polygon is a polygon whose vertices all lie along the same plane (that is, it lies flat). For example, a triangle is always planar because you cannot bend or twist a polygon with only three vertices describing it.

A polygon is *non-planar* if it has more than three vertices, and those vertices do not lie in the same plane.

For example, the following figure shows a polygon plane primitive with two faces bent into non-planar faces. They were made non-planar by moving the corner vertices.



In most cases, avoid non-planar faces, because unexpected results might occur when you deform a surface with non-planar faces. See the following Tips.

Tips

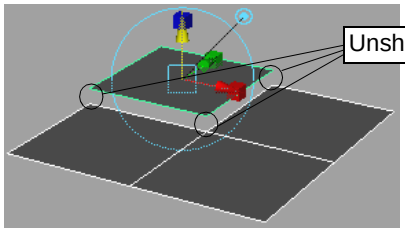
- You can ensure planarity by setting the Keep New Faces Planar option on in the Tool Options menu, or by turning Ensure Planarity on in the Tool Settings window for the Create Polygon Tool and the Append to Polygon Tool. For details, see "Creating new polygons" on page 23, "Appending to polygons" on page 28, and "Keeping new faces planar" on page 95.
- Non-planar quads can be fixed using the Split Polygon Tool (see *Chapter 14, "Splitting and Subdividing Polygons"* for details) and using Polygons > Cleanup (see "Cleaning up polygonal data" on page 40).
- You can quickly identify which faces are non-planar by turning on Non-planar in the Display > Custom Polygon Display options window.

Shared and unshared edges, vertices, and UVs

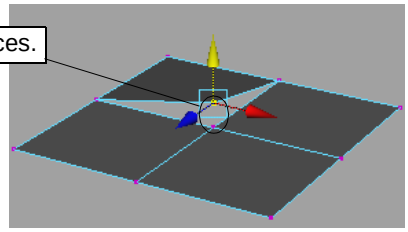
Within a polygonal object, one or more adjacent faces may share vertices where they meet. If one or more polygons share a vertex, they are connected, or shared. This connectivity information is maintained when transforming or editing polygonal data.

'Unsharing' vertices

There may be times when you have a completed a polygonal model whose vertices and edges are shared, but you need to modify only one of the faces. To do this, select the face or faces you want to modify, then select Edit Polygons > Extract to 'unshare' the vertices and edges of these faces from the rest of the model. To 'unshare' vertices selectively, select the vertex or vertices, then select Edit Polygons > Split Vertex.



Extracted face.



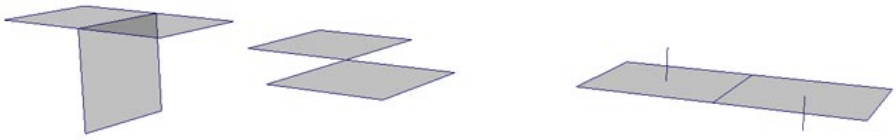
Split vertex.

Valid and invalid polygonal geometry

In Maya, valid polygonal geometry can have 2-manifold topology or it can have *nonmanifold* topology. A single edge or vertex is not valid geometry.

2-manifold topology basically means you can unfold the geometry so that it lies flat on a plane without overlapping pieces.

Nonmanifold topology is illustrated by the following three examples:



Three or more faces share an edge.

Two or more faces share a single vertex but no edge.

Adjacent faces have opposite normals.

In the first example (the “T” shape), more than two faces share an edge.

In the second example (the “bowtie” shape), two faces share a single vertex without also sharing an edge. This shape is also possible where two three-dimensional shapes share a vertex (such as two cubes meeting at a single point).

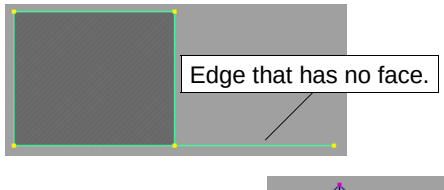
In the third example, a single shape has non-contiguous normals (without border edges). This is a less obvious example of nonmanifold geometry.

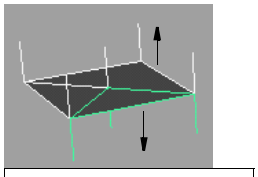
The following operations can produce nonmanifold geometry:

- Extrude Edge
- Normals > Reverse (reverse normals without extracting geometry)
- Merge Vertices
- Delete Face (select the face and press the backspace key)
- Collapse (Face or Edge)

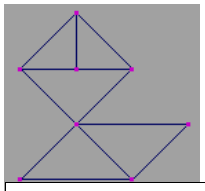
To keep the polygon count down and make tasks such as mapping textures to your objects much easier and quicker, make the pieces of polygonal geometry making up a model fit properly. Avoid creating a polygonal edge that has no face. Also, try to create your polygons so that their normals point in the same direction. Although it is technically valid for the normals to point in opposite directions, textures may not behave as expected.

You can automatically make nonmanifold geometry 2-manifold (including the less obvious case of adjacent faces with opposite normals) using Polygons > Cleanup. For more information, see "Cleaning up polygonal data" on page 40.





Normals pointing in opposite directions.



Complex polygonal object: vertices/edges do not match up.

Notes

- Boolean and Reduce operations have no effect on polygonal objects with nonmanifold geometry.
- Merge Edge operations have no effect on nonmanifold edges, although they work on 2-manifold edges that are part of nonmanifold geometry.

2 BASIC POLYGONAL MODELING

This chapter shows you how to create polygonal models from scratch using the Create Polygon Tool and provides information about appending to polygons, displaying the polygon count for your polygonal models, copying and pasting colors and shaders, and selecting and editing polygonal components using the Attribute Editor and the Component Editor.

CREATING NEW POLYGONS

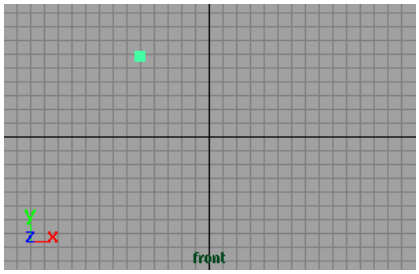
Use the Create Polygon Tool to create a polygon with only one face. You can create the polygon with holes, and you can relocate the individual points that define an object's geometry.

Using the Create Polygon Tool

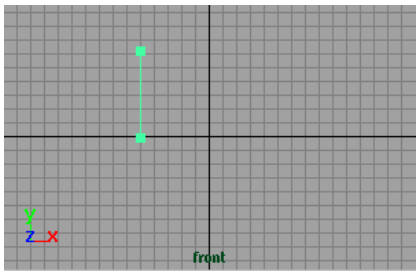
Since this is a tool, you should set the options in the options window before you create the polygon if you know what you want. If you forget or don't know what you want, you can also create a new polygon and edit the result in its Attribute Editor or the Channel Box.

To create a new polygon:

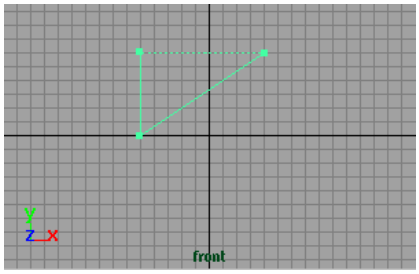
1. Select Polygons > Create Polygon Tool.
2. In any view, click the left mouse button to place the first point, or vertex.



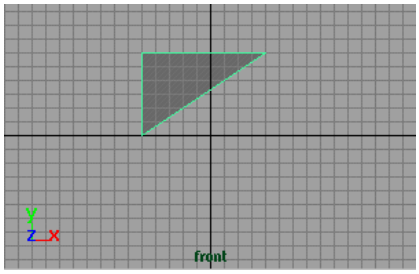
3. Click to place the next vertex. Maya creates an edge between the first point and the last point you placed.



4 To close the polygon, place another vertex. A dashed edge connects the three vertices.



5 To complete the new polygon, press Enter.

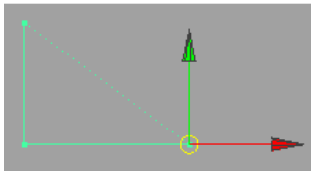


6 Keep placing vertices to create different polygonal shapes.

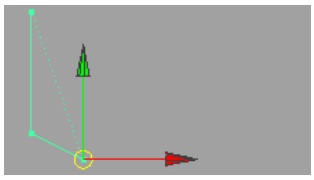
If you want to immediately create other polygons, press the Y key and continue to place points.

To reposition a point:

1 To reposition the last point you placed, press the Insert key on the keyboard. A move manipulator displays.



2 Drag to move the point.



If you are in a Maya snap mode, you can use the middle mouse button to reposition the point in increments.

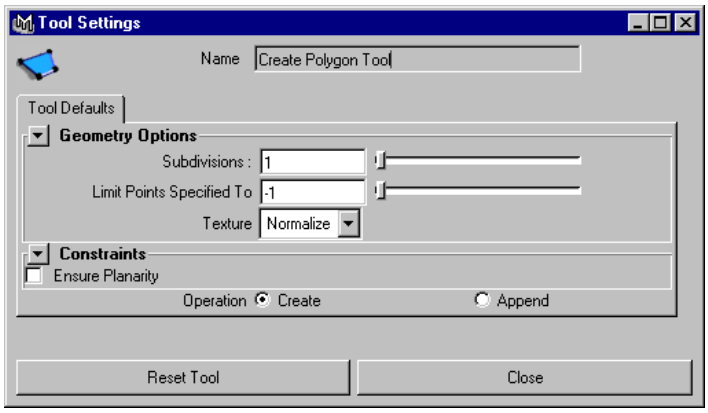
3 To complete the polygon with the point in the new position and exit insertion mode, press the Insert key again.

Note

You cannot add points that create a nonplanar polygon if the Ensure Planarity mode is selected in the option window. For details, see Create Polygon Tool options next for details.

Create Polygon Tool options

Select Polygons > Create Polygon Tool ❒ to display the Tool Settings window.



Changing Geometry Options

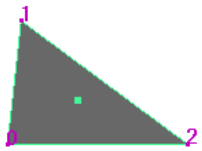
Use these sliders and select from the Texture pop-up menu to adjust the final outcome of the new polygon.

Tip

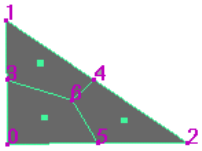
You can set these options before you create your polygon, or you can always change the options as you work.

Subdivisions Use the slider or enter a value to change the number of subdivisions that are distributed along the edges of the polygon being created. The default is 1. Extra vertices are created along the edges. You can manipulate these vertices in subsequent operations.

This is not the same as subdividing polygons using Edit Polygons > Subdivide. When using the Subdivide operation, new faces are created by default. To create new vertices, you have to subdivide the edges specifically (see "Subdividing polygons" on page 152 for details).



Newly created polygon, Subdivisions = 1.



Same polygon subdivided using Edit Polygons > Subdivide, Subdivisions = 1.

Limit Points Specified To

This value specifies how many vertices the new polygon will have. The polygon closes automatically after you place the number of points specified here and you can continue to click to create new polygons in the view without re-selecting the tool.

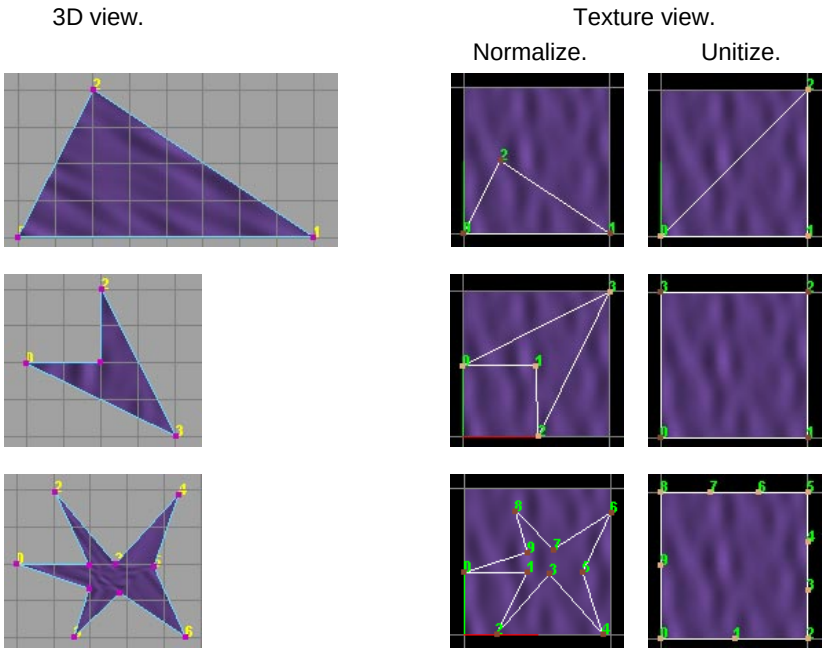
Changing Texture options

Select a how texture coordinates (UVs) are created for the new polygon.

Normalize / Unitize

If Normalize is selected, the texture coordinates are scaled to fit into the 0 to 1 texture space.

If Unitize is selected, the texture coordinates are placed on the corners and boundary of the 0 to 1 texture space. A polygon with three vertices will have a triangular UV texture map (with sides of equal length), while a polygon with more than three vertices will have a square UV texture map.



See *Chapter 20, "Editing UVs for polygonal surfaces"* for more information about UVs and textures.

Ensuring planarity when creating polygons

Ensure Planarity By default, any faces you add are in the same plane as the polygonal object you append to. Turn off Ensure Planarity if you want to add faces in another plane using Append to Polygon or if you select the Append Operation.

Important!

If you click Ensure Planarity in the Tool Settings window, Maya sets the Keep New Faces Planar option on or off in the Tool Options menu. If you click the Keep New Faces Planar option in the Tool Options menu, Maya sets the Ensure Planarity options on or off in the Tool Settings window.

Tip

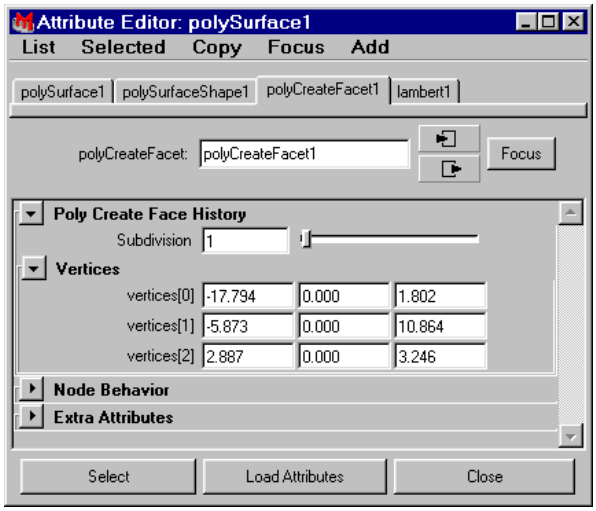
If you select Keep New Faces Planar from the Tool Options menu, the setting is saved to the preferences file when you exit Maya. It applies to all new objects until you change the setting.

Switching between operations

Create is the default Operation. Select Append if you want to add to the newly created polygon and click to place points on the border edge. Press Enter to complete the polygon.

Editing the new polygon in the Attribute Editor

To edit the attributes for newly created polygons, select the polygonal surface you want to edit and use the Attribute Editor.



Poly Create Face History

Subdivision Use the slider or enter a value to change the number of subdivisions that are distributed along the edges of the newly created polygon. The default is 1.

Vertices

These values represent the position of the vertices you placed when creating the polygon. For example, if you placed three vertices (as in the example in the Attribute Editor), only three sets of values display. Change these values and press Enter to move the vertices and change the shape of the polygon.

APPENDING TO POLYGONS

The Append to Polygon Tool lets you add a single face to any edge on the border of an open polygonal object. The appended face becomes a connected part of the polygonal object.

An appended face automatically conforms to the object's orientation, no matter how you build the appended face. That means if the original face has an outward facing normal, the new face's normal also faces outward.

Note

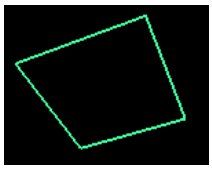
You cannot append faces to non-border edges to create nonmanifold geometry.

Using the Append to Polygon Tool

Since this is a tool, you should set the options in the options window before you append to a polygon if you know what you want. Otherwise, you can create a new appended polygon and edit the result in its Attribute Editor or the Channel Box.

To append a single face to a polygon:

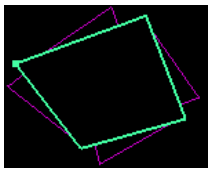
1. Select the polygon you want to append to.
2. Select Polygons > Append to Polygon Tool. The border edges highlight and appear thicker.



Tip

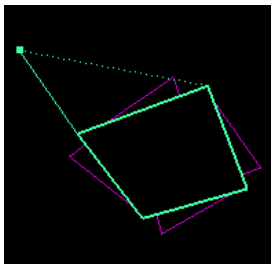
To easily see the border edges, open the Attribute Editor for the polygonal object. Click the arrow to open the Mesh Component Display section of the editor and turn on Display Borders. Increase the Border Width if necessary.

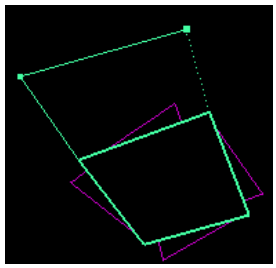
3. Click and place a point to select the border edge you want to append to. The edge you select is the first edge of the new face. Several arrows indicate the edge direction.

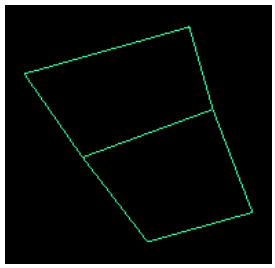


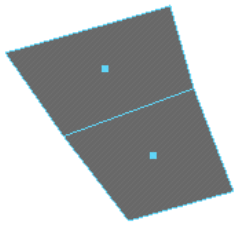
4 Click to add a point in space. A new point appears with a line connecting it to the last point of the selected face edge. Keep placing points. A dashed edge displays as you place points.

The dashed edge turns into a real edge when the new face is completed or when you press Enter. Now if you select faces you can see that the new face is connected to the original object.


Place a point in space.


Keep placing points.


Press Enter.


Select faces.

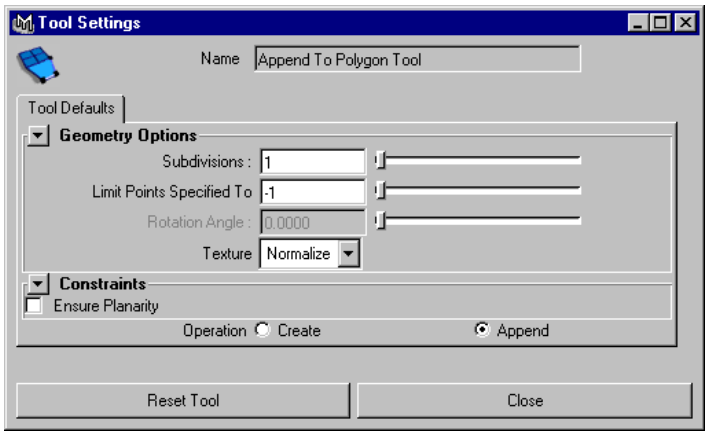
- You can also add an edge by clicking on another border edge.
- If you change your mind, press the Backspace and change the order in which you picked edges or placed your points.

Tip

As when you create a polygon using the Create Polygon Tool, to reposition the last point you placed, press the Insert key. Use the move manipulator to move the point.To exit Insert mode, press the Insert key again.

Append to Polygon Tool options

Select Polygons > Append to Polygon Tool ❒ to display the Tool Settings window.



Changing Geometry Options

Use these sliders and select from the Texture menu options to adjust the final outcome of the texture coordinates (UVs) on the new polygon.

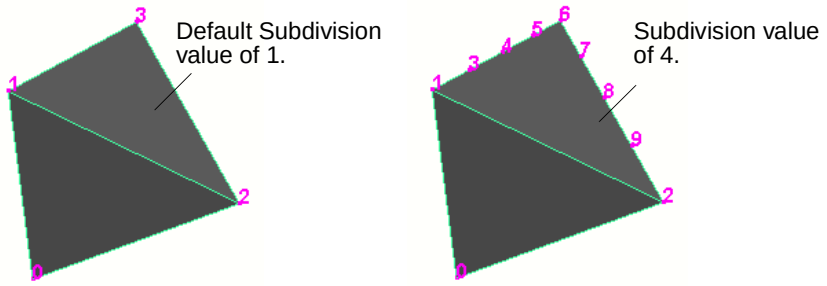
Tip

You can set these options before you create your polygon, or you can always change the options as you work.

Subdivision

Use the slider or enter a value to change the number of subdivisions that are distributed along the edges of the polygon being appended. The default is 1. Extra vertices are placed along the edges to create the subdivisions.

The following example shows the appended polygon subdivided with a setting of 4.

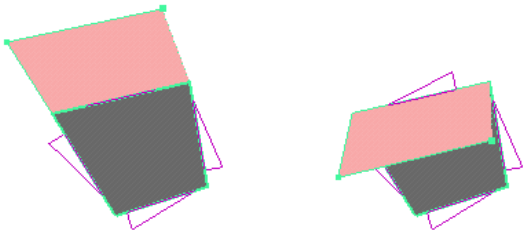


Limit Points Specified To

The value you specify here indicates how many vertices are allowed on the new polygon. If set to 3 or more, you can create polygonal strips. See "To create tri polygonal strips when appending to polygons:" on page 33 for details. Using this option, you can continue to append to polygons without re-selecting the tool.

Rotation Angle

This option becomes available while you are placing points to append to the polygon. Use the slider to rotate the new points before you complete the append operation.



The newly created face rolls around the first edge you selected. If all the edges can be set on a hinge, the face turns around the reference line. If the edges you select are not aligned, the face will not turn around this reference line.

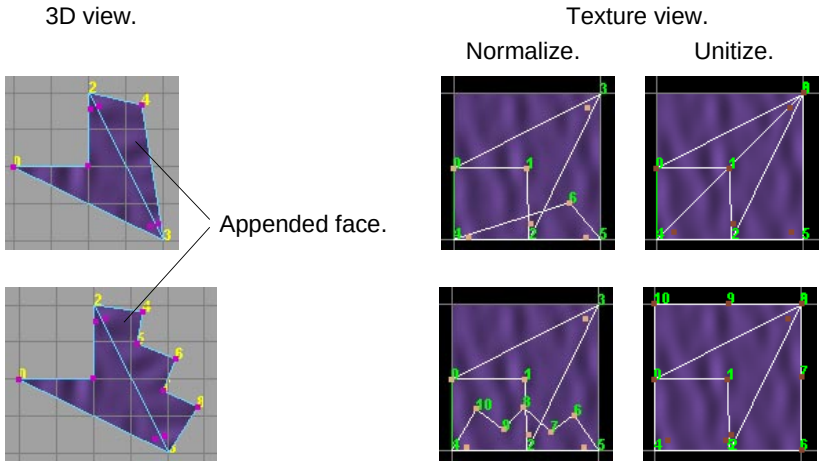
Changing Texture options

Select how texture coordinates (UVs) are created for the appended polygon.

Normalize/ Unitize

If Normalize is selected, the texture coordinates are scaled to fit into the 0 to 1 texture space, maintaining the shape of the face.

If Unitize is selected, the texture coordinates are placed on the corners and boundary of the 0 to 1 texture space. A polygon with three vertices will have a triangular UV texture map (with sides of equal length), while a polygon with more than three vertices will have a square UV texture map.

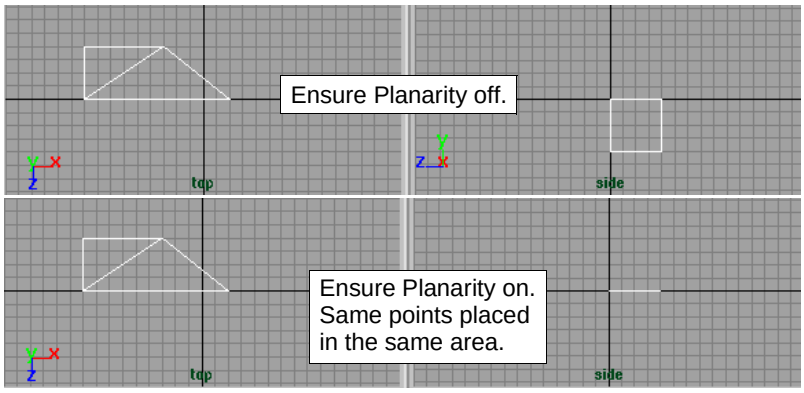


For more information on UVs and textures, see Chapter 19, “Mapping UVs for polygonal surfaces.”

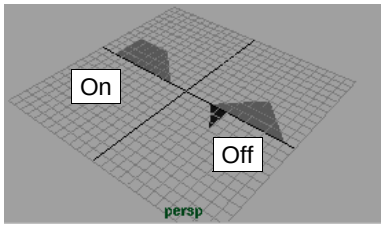
Ensuring planarity when appending to polygons

Ensure Planarity

By default, any faces you add are in the same plane as the polygonal object you append to. Turn off Ensure Planarity if you want to add faces in another plane.



Result in perspective view.



Important!

If you click Ensure Planarity in the Tool Settings window, Maya sets the Keep New Faces Planar option on or off in the Tool Options menu. If you click the Keep New Faces Planar option in the Tool Options menu, Maya sets the Ensure Planarity options on or off in the Tool Settings window.

Tips

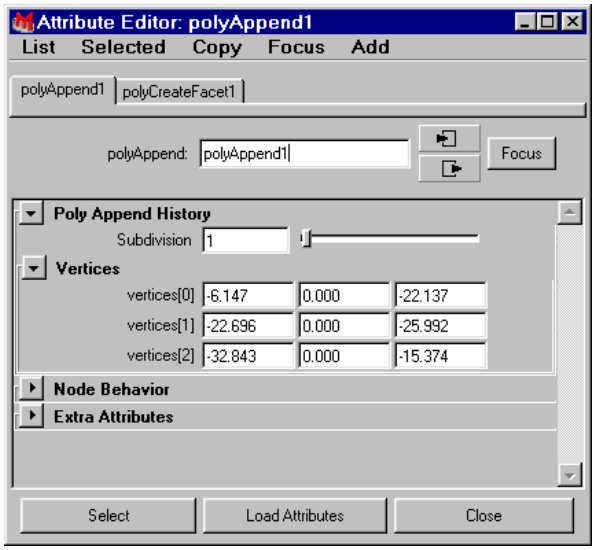
- If you select Keep New Faces Planar from the Tool Options menu, the setting is saved to the preferences file when you exit Maya. It applies to all new objects until you change the setting.
- Select the Non-planar option in the Custom Polygons Display window to verify that your new faces are planar. If they are not, the Non-planar option highlights them. See "Highlighting non-planar faces" on page 48.

Switching between operations

Append is the default Operation. Select Create if you want to create a new polygon.

Editing the appended polygon in the Attribute Editor

To edit the attributes for appended polygons, select the polygonal surface you want to edit and use the Attribute Editor.



Poly Append History

Subdivision Use the slider or enter a value to change the number of subdivisions that are distributed along the edges of the polygon being appended. The default is 1.

Vertices

These values represent the position of the vertices you placed when appending to the polygon. For example, if you placed three vertices (as in the example of the Attribute Editor), only three sets of values display. Change these values and press Enter to move the vertices and change the shape of the appended polygon.

CREATING POLYGONAL STRIPS

Use the Limit Points Specified To option for the Create Polygon Tool to start tri or quad polygon strips or the Append to Polygon Tool to create tri or quad polygonal strips.

To start tri polygonal strips when creating polygons:

1. Before you create a polygon, set the Limit Points Specified To value to 3 in the Create Polygon Tool options window and press Enter.
2. Choose the Create Polygon Tool and click to place three points.
3. The polygon strip closes and now has 3 points.
4. You can now continue to create polygons without re-selecting the tool. Simply click in the 3D view to keep adding points to create a new polygonal strip.

To create tri polygonal strips when appending to polygons:

1. Before you append to a polygon, set the Limit Points Specified To value to 3 in the Append to Polygon Tool options window and press Enter.
2. Choose the Append to Polygon Tool and select a border edge.

3 Click where you want your next point. The polygon strip is closed and now has 3 points.

4 You can continue appending to polygons without re-selecting the tool. Select a new border edge and add another point to continue the strip.

Tip

You can also create quad strips using either of these methods by increasing the value to 4 and clicking to place an extra point.

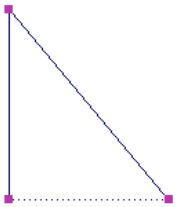
MAKING HOLES USING THE CREATE AND APPEND TOOLS

Both the Create Polygon Tool and the Append to Polygon tool can be used to create holes.

To create holes when creating a new polygon:

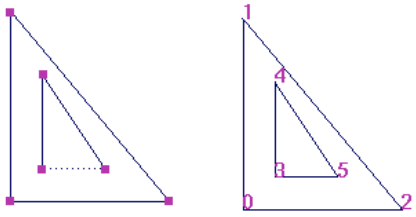
1 Place the first point, second point, and the third point.

2 Do not press Enter.



3 Press the Ctrl key and place the points inside the face to create the hole. The subsequent vertices are used to define the hole.

4 Once you have placed the points you need, press Enter to create the hole.



Tip

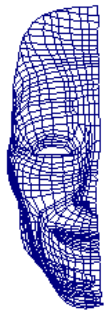
You may find it easier to select faces with holes when face selection is set to Whole Face in the Selection Settings section of the Preferences window. If the face selection is set to Center and the hole is in the center of the face, you may not easily see the center dot to select it.

MIRRORING POLYGONAL OBJECTS

Polygons > Mirror Geometry duplicates and flips geometry relative to the axis for the bounding box and, if you want, merges it with the original polygon object.

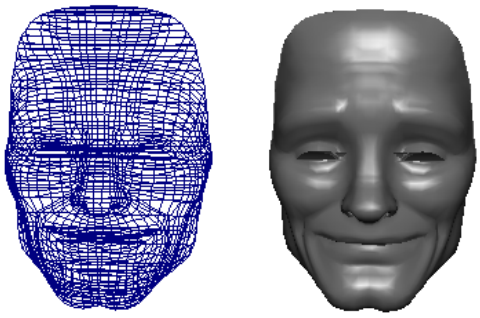
To mirror polygonal geometry:

1 Select the geometry you want to mirror.



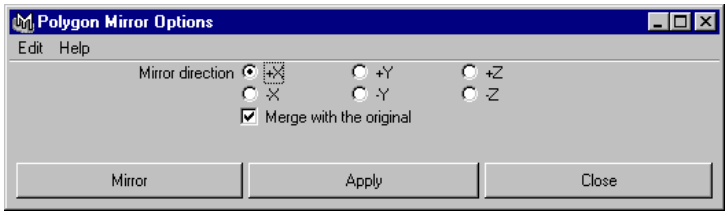
2 Select Polygons > Mirror Geometry.

By default, Maya duplicates and flips the geometry by the positive X axis and merges it with the original polygon.

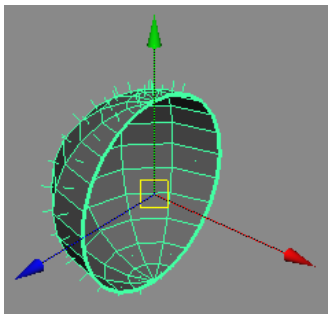


Polygon Mirror options

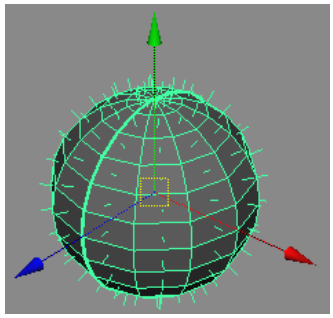
Click the ❐ next to the Mirror Geometry menu item in the Polygons menu to open the options window.



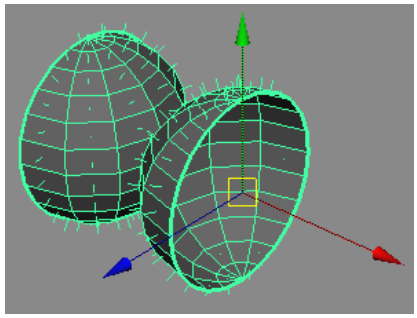
Mirror direction Select the direction in which direction you want Maya to mirror the selected polygonal object. By default, the direction is positive X.



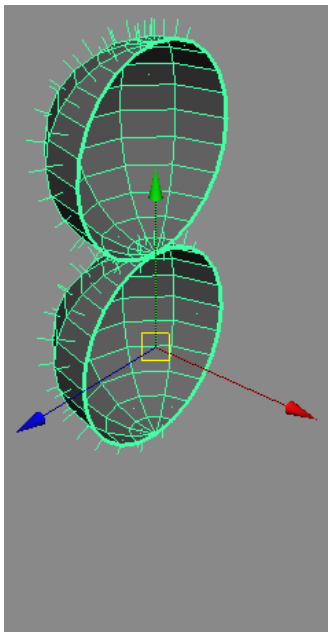
Original object.



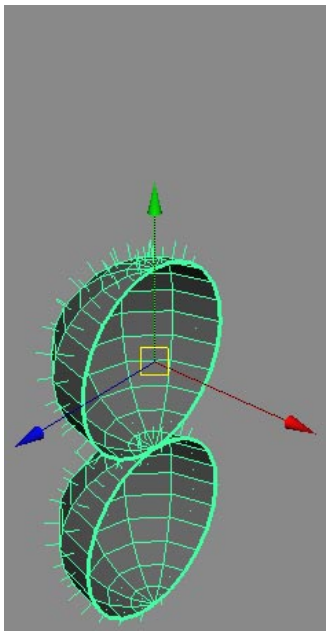
Mirror +X.



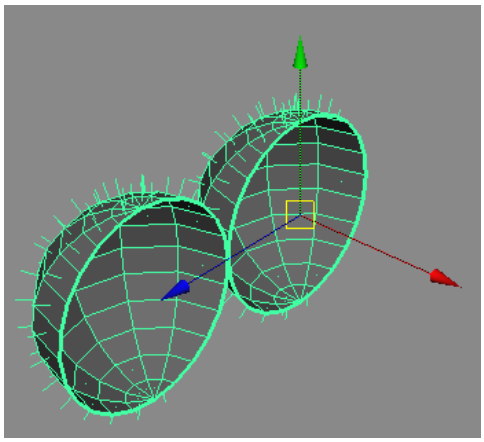
Mirror -X.

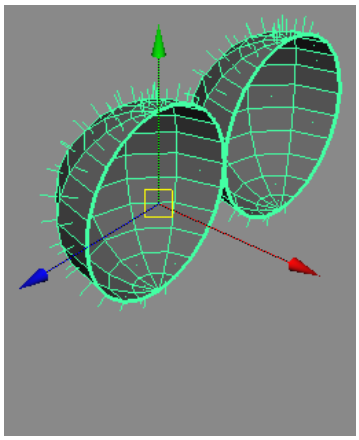


Mirror +Y.



Mirror -Y.


Mirror +Z.

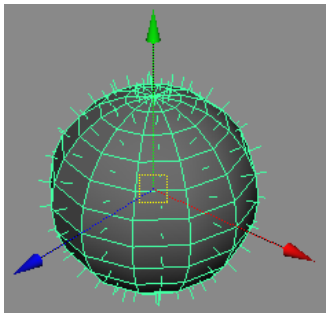

Mirror -Z.

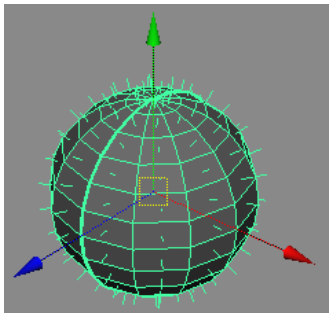
Change these options and click Mirror if you want to mirror the object in another direction.

Merge with the original

When turned on (the default setting), Maya duplicates and flips the original polygon and merges the duplicate polygon with the original polygon. This makes the new polygonal object one shell.

When turned off, Maya duplicates and flips the original polygon but does not merge the separate shells.


Mirror +X merged.

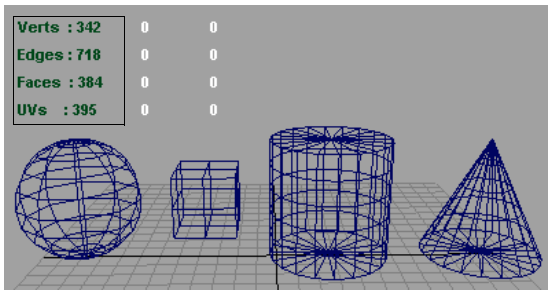

Mirror +X separate.

DISPLAYING POLYGON COUNT STATISTICS

Turn on the Display > Heads Up Display > Poly Count option to display the polygon count for vertices, edges, faces, and UVs of polygonal objects in the views.

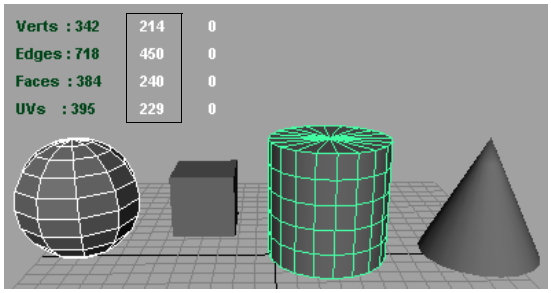
Total polygon count

The statistics on the left represent the total polygon count for all visible polygonal objects.



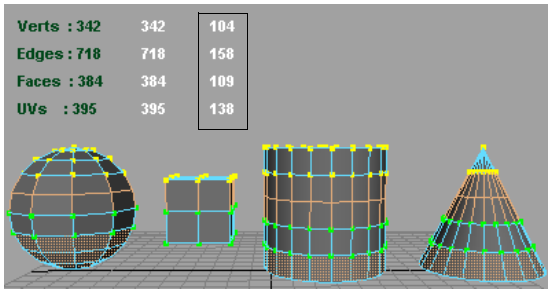
Polygonal count for selected polygons

The statistics beside the total polygon count list (displayed in white by default) represent the polygonal count for selected polygonal objects visible (or partially visible) in the view.



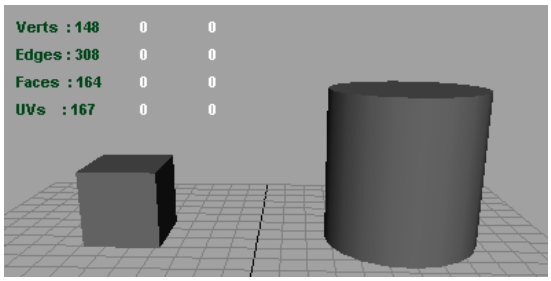
Polygonal count for selected components

The statistics listed to the far right of the polygon count list represent the count for all selected components on objects that are partly visible in the view.

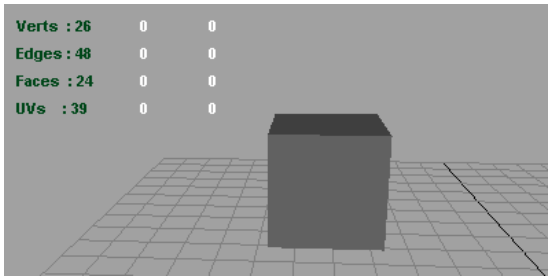


Changing the statistics by moving the view

Since statistics only display for visible objects whether they are selected or not, if you track the view and lose sight of some of those objects, you will not see their counts. This can come in handy if you only want to view one selected object's polygon count. For game developers, if your perspective camera is set up to match the game camera, you can get a feel for whether you're getting close to your game engine's drawing limits from that view.



All objects visible.



Track the view so that only one object is visible.

Notice the decrease in the total polygon count.

Changing the polygon statistics colors

You may want to display the polygonal statistics in different colors. These colors correspond to the cameras (the views) and can be changed in the Colors window.

To change the color of selected polygon count statistics:

1. Select Window > Settings / Preferences > Colors.
2. Click the Active tab then press the down arrow next to Objects and scroll down to the Cameras color box.
3. Drag the slider to change the color for the statistics for active, or selected, polygons.

To change the color of the total polygon count statistics:

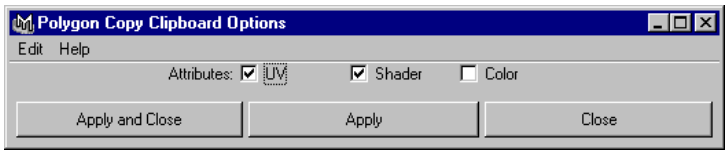
1. Select Window > Settings / Preferences > Colors.
2. Click the Inactive tab then press the down arrow next to Objects and scroll down to the Cameras color box.
3. Drag the slider to change the color for the statistics for all polygons.

COPYING AND PASTING UVS, COLORS, AND SHADERS

The Edit Polygons > Clipboard Actions menu provides you with a fast and easy way to copy and paste UVs, shaders, and colors from one object to another, or even within the same object, on a per-face basis.

Open the Copy options window by clicking the ❐ beside the option name from the Clipboard Actions menu, turn the attributes you want to copy on or off, and click the Apply button.

Whatever attributes you turn on or off in any of these options windows applies to all three operations. That means when you are ready to copy and paste, all you have to do is select the menu item.



To copy and paste:

UVs and Shaders are selected in the Clipboard Options windows by default. If you want to copy and paste these attributes, you do not have to open the options windows. Start the following procedure at step #2.

For details on copying and pasting colors, see "Copying and pasting color" on page 188.

1. Select or deselect the Attributes you want to copy from the Copy Clipboard options windows and click the Apply button. These attributes are now selected or unselected in all three windows.
2. In the view, select the face you want to copy UVs, Shaders, or Colors from.
3. Select Copy from the menu.
4. Now select the faces you want to paste the attributes to.
5. Select Paste from the menu.

To clear the clipboard:

In the Polygon Clear Clipboard Options window, select the attributes you want to clear and click the Apply button.

CLEANING UP POLYGONAL DATA

Cleanup provides you with the ability to remove unwanted geometry such as zero area faces or zero length edges. You can also tessellate faces that may be valid in Maya, but not in your game engine, such as concave faces, or faces with holes.

To clean up polygonal geometry:

1. Select the geometry.
2. Select Polygons > Cleanup.

Cleanup Polygon options

Click the ❐ next to the Cleanup menu item to open the options window. Change the options to suit your needs, then click Cleanup to perform the operation.

General Options section

Use these options to specify what parts of the polygonal geometry you want to clean up.

Operation Select one of the following options.

Select and Cleanup Use this option to repeatedly clean up the selected polygonal geometry using the same option settings. This is the default.

Select Geometry Use this option to select geometry that meets the criteria you set, but do not do the clean up.

Select all Polygonal Objects

Turn this option on to clean up all polygonal objects in the scene. The default is off.

Construction History

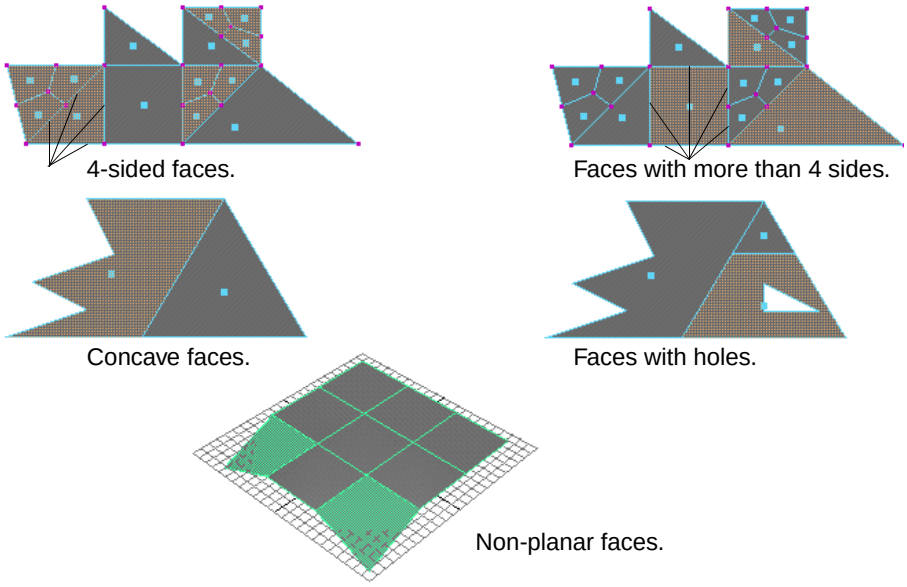
Turn this option on to keep the construction history associated with the polygonal geometry you select.

Tessellate Geometry section

Use these options to specify the types of faces you want to clean up by tessellating (triangulating).

When you create polygonal geometry and use some of the polygonal editing operations, Maya may create some faces with attributes you do not want.

The following illustrations show the kinds of problems you can encounter with polygonal faces.



Other section

Nonmanifold geometry

Turn this option on to clean up nonmanifold geometry. Select one of the following options to control what happens to the resulting normals. For information on nonmanifold geometry, see "Valid and invalid polygonal geometry" on page 19.

Normals and Geometry Turn on this option to conform normals when cleaning up nonmanifold vertices or edges.

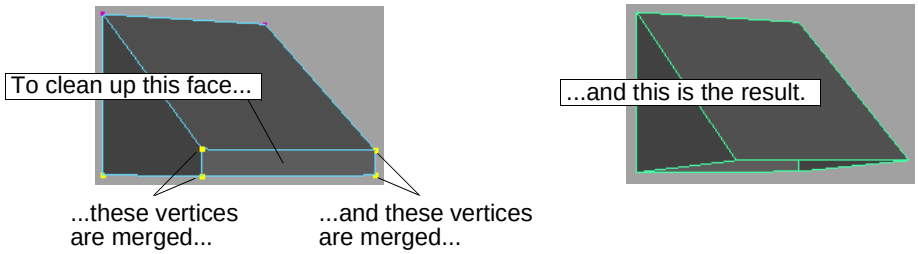
Geometry Only Cleans up nonmanifold geometry without changing the resulting normals.

Remove Geometry section

Select which geometry you want removed during cleanup and specify the tolerance within which the geometry must be to be removed. You can remove the following:

- edges within a defined length tolerance
- faces within a defined geometry area tolerance
- faces within a defined map area tolerance
- Lamina faces, which are faces that share all edges

When you select to remove faces within a set geometry area tolerance (for example, remove faces with areas between 0 and 0.0001), faces are removed by merging vertices. To ensure that this operation removes faces with areas within the defined tolerance, you must set the edge length tolerance for the edge vertices to be merged. If you do not otherwise want to remove edges within the length tolerance, you can turn off the Edges with zero length option after setting the tolerance.



When you select Lamina Faces for removal, Maya removes faces that share all edges. By removing these types of faces, you can avoid unnecessary processing time, especially when you export the model to a game engine.

You might inadvertently create faces with shared edges. For example, suppose you performed Edit Polygons > Duplicate Face with the Separate Duplicate Faces option turned off. You would have two faces on top of each other. If you later merge the vertices of the two faces, they would share the same edges. You could then remove the extra face using Cleanup with Lamina Faces turned on.

EDITING POLYGONS IN THE ATTRIBUTE EDITOR

To edit the attributes for polygonal geometry, select the polygonal surface you want to edit and use the Attribute Editor.

There are various ways to open the Attribute Editor to edit the result of a polygonal operation on a specific object. The easiest is to select the object, then in the Channel Box click the Object menu and click the ❐ next to the object's name.

For example, if you have created a polygonal primitive sphere and want to edit its attributes, select Objects > pSphere ❐ from the Channel Box.

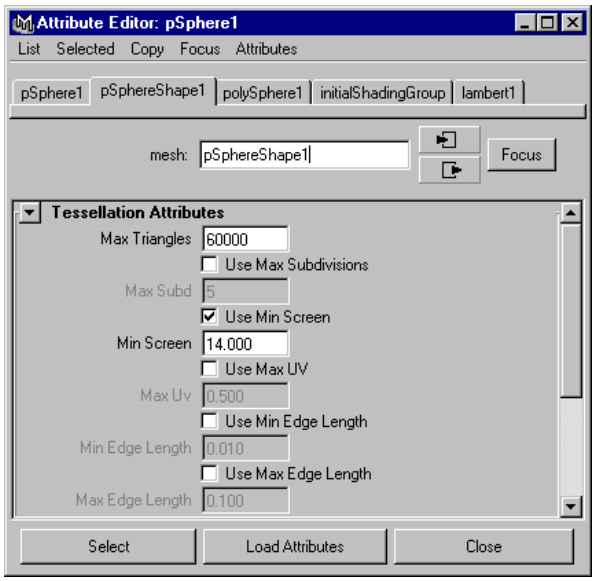
You can also open the Attribute Editor from the marking menu. While the cursor is over the active item, press the right mouse button and select the name of the object from the marking menu.

Alternately, you can select Windows > Attribute Editor, or press Ctrl a if the Channel Box is in the right-hand panel of the workspace.

Changing tessellation attributes

Tessellation attributes are used only when rendering a polygonal object with a displacement map. The attributes guide how much the displacement should force further subdivision of the object.

Click the arrow to open the Tessellation Attributes section of the Attribute window.



Max Triangles This is the maximum number of triangles used to represent a surface.

Max Subd This is the maximum number of levels of subdivisions performed.

Min Screen This is the minimum screen size of a polygon before stopping the polygon's subdivision.

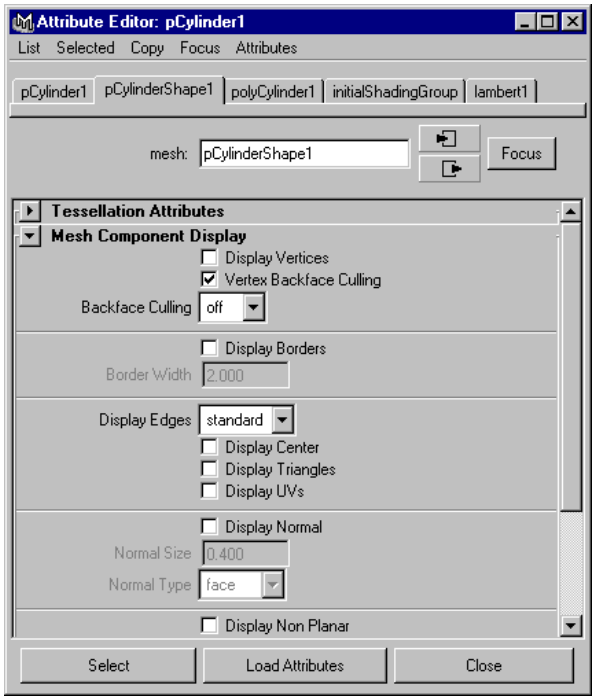
Max Uv This is the maximum U and V an edge can span before further subdivisions.

Min Edge Length This is the minimum edge length before stopping the polygon's subdivision.

Max Edge Length This is the maximum edge length allowed before a subdivision is required.

Changing the component display

Click the arrow to open the Mesh Component Display section of the Attribute Editor.



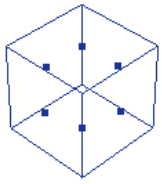
Display Vertices Click to switch the display of vertices on the polygonal model on or off.

Vertex Backface Culling

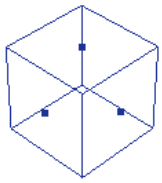
This attribute is turned on by default. If Display Vertices is turned on, you can switch the display of vertices off or on when performing a backface culling operation.

Backface Culling Backface Culling is used to select and only draw what is facing the camera in the 3D view. Select one of the following options.

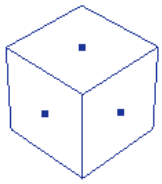
wire If you select wire, Maya culls the back faces during selection but draws the back faces in wireframe. The main difference between off (the default setting) and wire is that you can still select the back faces in off mode. In wire mode, the back faces are displayed but are unpickable.



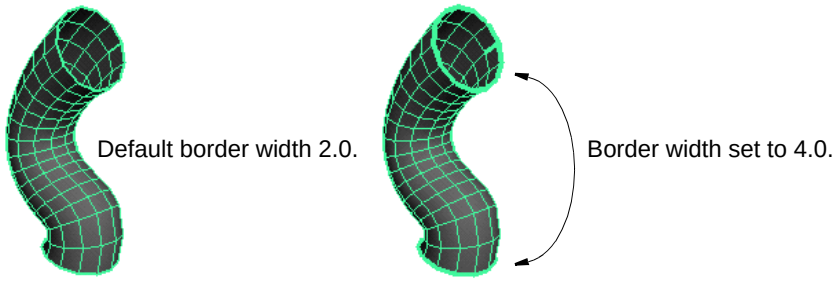
hard If you select hard, Maya culls the back faces but draws only the hard edges, and not the back faces, in wireframe.



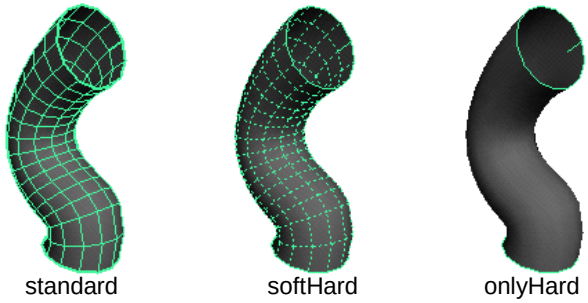
full If you select full, Maya culls back faces entirely—the back faces are not drawn and cannot be selected.



Display Borders Turn this on to highlight the polygonal borders and to change their widths.

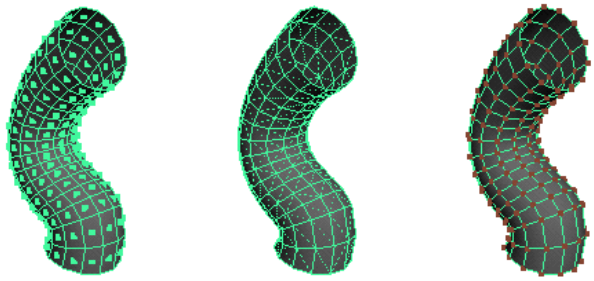


Display Edges Select how you want to display polygonal edges. Select to display all edges the same way (standard), soft edges as dotted lines and hard edges as solid lines (softHard), or show hard edges only (makes soft edges invisible).



Display Center, Display UVs, Display Triangles

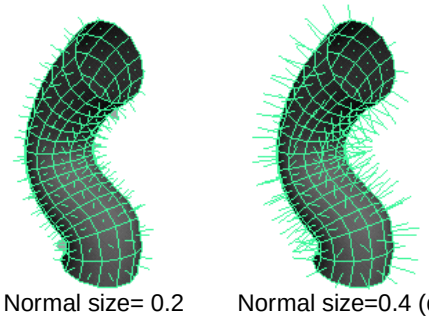
Switch Display Center, Display UVs, and Display Triangles on or off to specify which component you want displayed.



Display Center Display Triangles Display UVs

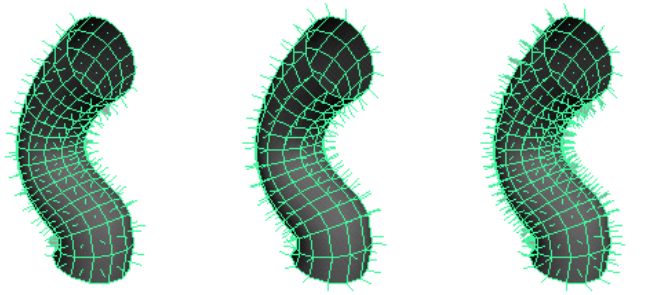
Display Normal Turn this on to display normals on the polygonal object. When turned on, you can change the size of the normals and beside Normal Type select which normal you want displayed—face normals, vertex normals, or vertex/face normals.

Normal Size Type the length of the displayed normals. The default is 0.4.



Normal size= 0.2 Normal size=0.4 (default)

Normal Type Select where you want the normals displayed: face (at the center of each face), vtx (at each vertex), and vtxface (at the center of each face and at each vertex).



face vtx (vertex) vtxface (vertex/face)

Display Non Planar Turn this option on to highlight all non-planar faces.

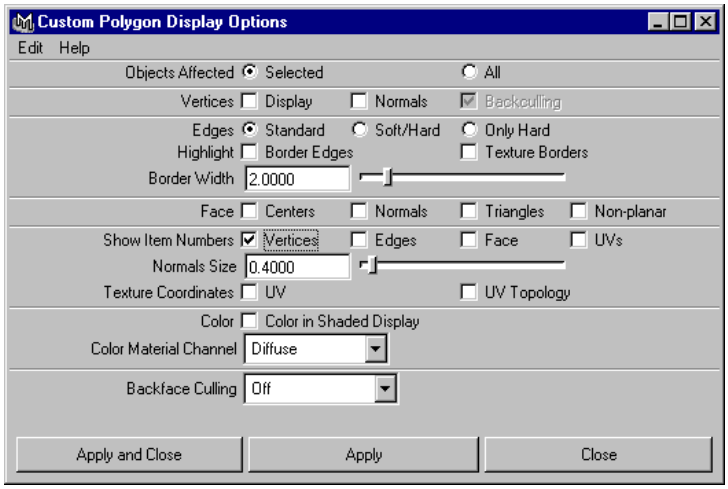
Displaying the current UV set

The Current UV Set box displays the name of the current UV set. Do not change the name in this box. Changing it does *not* change the UV set that UVs for the selection belong to.

SETTING CUSTOM POLYGON DISPLAY OPTIONS

Using the Custom Polygon Display window, you can set how specific components of your polygons display to enhance the view while you work. For example, if you want to select edges to perform a merge edge operation, select the object, click an option to highlight the border edges, increase the size of the border width, then click the Apply button to enhance the display.

Select Display > Custom Polygon Display ❒ to open the window.



Remember to click the Apply button each time you set one of the options for your active objects. If you want to return to the regular display, select Reset Settings from the windows Edit menu then press the Apply button.

Displaying vertices and normals display

Switch the display of vertices or normals on or off. You can change the size of the normals by setting the Normals Size value.

Setting the normals size

In the Normals Size box, enter a value or use the slider to specify the normals display size. The range is from 0.2 to 10.

Backculling

Backculling is used to select and only draw what is facing the camera in the 3D view. In effect, Maya displays vertices in areas where the normal is pointing away from the camera. For details, see "Backface Culling" on page 44.

Displaying edges

Select to display all edges the same way (Standard), soft edges as dotted lines and hard edges as solid lines (Soft / Hard), or show hard edges only (makes soft edges invisible).

Highlighting borders

Select to make outside edges thicker (Border Edges) or to display a thick border to highlight the area a texture affects per-polygon or per-vertex.

Changing the border width

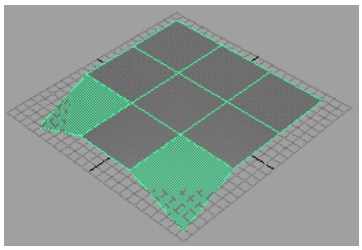
You can change the Border Width by dragging the slider or entering a value.

Setting the face display

Select to display a small square to indicate the face center (Centers), to show the normals at the center of each polygon (Normals), or select Triangles to show all polygons as triangles for display purposes.

Highlighting non-planar faces

Select Non-planar to highlight all non-planar faces.



Showing item numbers

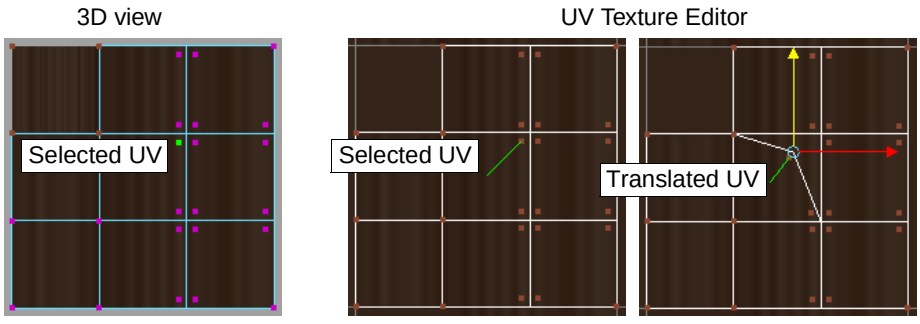
Use the Show Item Numbers options to display index numbers on an object's vertices, edges, faces, or UVs, depending on which component types you select. If you turn on UVs, the numbers appear in the UV Texture Editor only.

Displaying texture coordinates (UVs) and UV topology

Turn on the UV and UV Topology options to see the UVs on your object.

- If UVs are shared, they display as single purple dots.
- If unshared, multiple purple dots display close to the vertex to which a given UV belongs. When you select the UV in the UV Texture Editor, a line displays pointing to the face it belongs to.

Turn on the UV Topology option to display and be able to select unshared UVs.



Color operations

When Color in Shaded Display is on, you can see the effects of Apply Color, Prelighting, and the Paint Vertex Color Tool while in shaded mode. This option is turned on by default whenever you select these commands. Select a Color Material Channel to refine your application. See *Chapter 17, "Coloring Polygons"* for details about using these options and the Apply Color operation.

Backface Culling

Backface Culling is used to select and only draw what is facing the camera in the 3D view. Select one of the following options.

Off Maya turns backface culling off. This is the default.

On Maya displays backface culling, causing surfaces to appear invisible in areas where the normal points away from the camera. You can improve performance on some systems by toggling on Backface Culling.

Keep Wire Maya sets backface culling for all surfaces except wireframe outlines.

Keep Hard Edges Maya sets backface culling for soft edges only.

See "Backface Culling" on page 44 for more details.

USING THE COMPONENT EDITOR WITH POLYGONS

The Component Editor for polygons contains two tabs that display information on components for polygonal objects: Polygons and AdvPolygons. All displayed values can be edited by typing values into the entry fields.

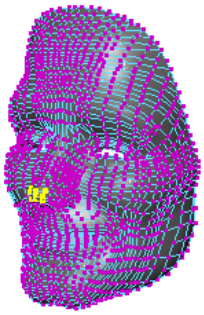
The general Polygons tab of the Component Editor has three columns displaying vertex position in world space—vertex.x, vertex.y, and vertex.z. It also has four columns displaying color information, and three columns displaying normal information (normal.x, normal.y, and normal.z) The normal values displayed are the normals at the vertex level.

If the color or normal values are not shared at the vertex level, *UnShared* appears in the column. These unshared values can be viewed and edited by clicking the AdvPolygons tab which converts the vertex components into vertex-face components and displays the normal and color values at the vertex-face level.

All displayed values can be edited by typing values into the entry fields. For more information, see *Using Maya: Essentials*

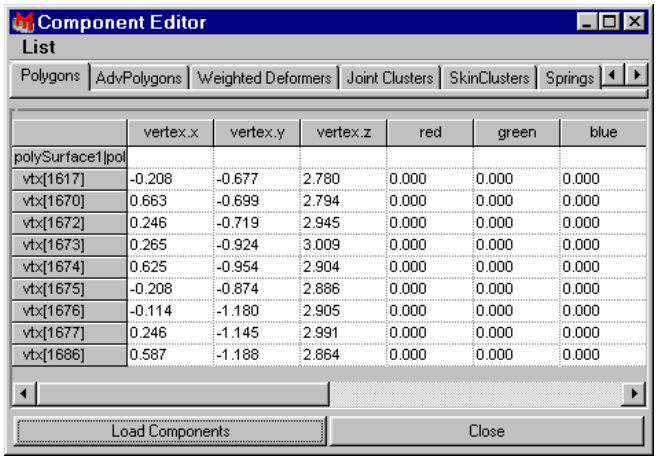
To view polygonal components in the Component Editor:

1. Select the components in the 3D view you want to list.



2 Open the Component Editor. Select Window > General Editors > Component Editor.

3 Click the Polygons tab or the AdvPolygons tab.



The first time you select components they are listed in the editor. If you want to list subsequent selections, press the Load Components button at the bottom of the editor.

3 POLYGON COMPONENTS

This chapter provides information on selecting, transforming, and deleting polygonal components.

SELECTING POLYGONAL COMPONENTS

To alter the shape of a polygon and to perform many of the polygon menu operations, you must select components. The main polygon components are: vertices, faces, edges, and UVs. Each component has its own component mode for you to select them.

Polygons also have the vertex / face component mode, which lets you select vertices corresponding to individual faces as opposed to the entire vertex.

To select components:

Switch to the component mode using any of the following methods, then click, Shift-click, or click-drag to select the components:

- Right-click on the subdivision surface and select Vertex, Edge, Face, or UV from the marking menu.

  or

- On the Status Line, click the Select by component type icon, then click one or more of the component-mode icons.

  or

- Press a component-mode hotkey: F9 (vertices), F10 (edges), F11 (faces), or F12 (UVs).

To select vertex/face components:

Using the Vertex / Face selection mode you can control object characteristics at a very fine level. You can change the characteristics of a vertex on a particular face without modifying all the faces connected to the vertex.

Note

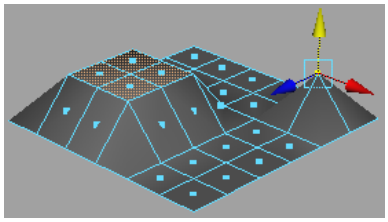
You can only enter this component mode from the marking menu or by pressing Ctrl-F9.

Other selection tools:

There are many other selection operations that let you grow, shrink, and convert your component selection. You'll find these operations on the Edit Polygons > Selection submenu. For example, to quickly select the edges around a face on the model, you can select the face and choose Edit Polygons > Selection > Convert Selection to Edges. For more information, see Chapter 8, "Selection operations."

Retaining a component selection

You can select a number of components and keep them selected when you change the selection mode. You can then Shift-select the new components so that two types of components are simultaneously selected. You could then, for example, transform two component types at the same time.

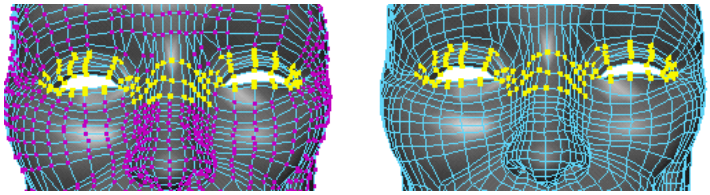


To retain a component selection, you must use the marking menu (press the right mouse button and select a component type), or select a component mode from the Status Line. This does not work with the function keys, although it is customizable using the Hotkey editor (see *Using Maya: Essentials* for details about customizing hotkeys).

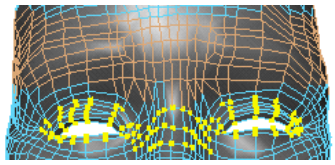
To retain a specific component selection:

1. Click or marquee-select to choose the components you want to remain selected when you switch to another component mode.
2. Enter another component mode (for instance, press the right mouse button and select Edge from the marking menu to enter the Edge component mode).

   The components you selected remain highlighted (selected) even though the component mode has changed. The following example shows vertices selected and what happens when you enter the Edge component mode.



3. Press the Shift key to select the edges and add to your selection. Notice how the vertices remain selected.



Changing component colors

You may want your components to display in colors other than the default colors. These colors can be changed in the Colors window.

To change the component color:

1. Select Window > Settings / Preferences > Colors.
2. Click the Active or Inactive tab then click the down arrow next to Components.
3. Drag the slider to change the color for active (selected) or inactive polygon components.

   See *Using Maya: Essentials* for more information about changing colors and customizing your display.

Paint-selecting components

For greater control and speed when selecting, you can use the Paint Selection Tool to select and unselect components by painting over them. When you select Edit > Paint Selection Tool, Maya switches to vertex component mode automatically. To paint-select edges and faces, you must first switch to the appropriate component mode. For more information about paint selecting components, see *Using Maya: Painting*.

Note

You cannot paint-select UVs or the Vertex / Face components.

TRANSFORMING POLYGONAL COMPONENTS

You use Maya's transformation tools, Move, Rotate, and Scale, to transform polygonal objects and components.

For example, if you want to animate the lips of a polygonal modeled face to prepare them for sound syncing, you simply select vertices, transform them, and set keyframes to animate the vertices.

See *Using Maya: Essentials* for details about generic Maya transformation tools.

MOVING COMPONENTS USING MOVE COMPONENT

Use Edit Polygons > Move Component to translate, rotate, or scale polygonal components.

Move Component creates history nodes. That means that the options you set for particular transformations on particular components are preserved. You can select the transform node for subsequent operations without having to tediously reset the transform values.

Move Component also has additional constraints that Maya's generic transformation tools do not have, such as moving perpendicular along normals.

Using Move Component

Once you are in Component selection mode, click to select the specific components you want to transform or marquee-select a number of components. After you select Move Component, you can change the settings for the selected components from the Attribute Editor or from the Channel Box, or use Maya's Move Component Manipulator handles to interactively transform vertices, faces, or edges.

You can also edit the transform values for a particular transform node after a Move Component operation from its Attribute Editor.

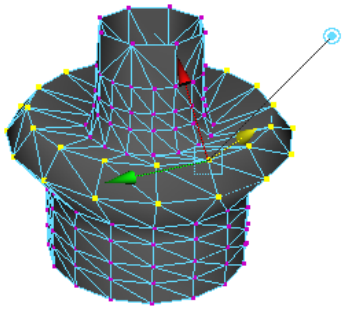
To move components:

The following is a general description on how to use Move Component. Essentially, this operation works the same for each selected component except for UVs—textures must be assigned to the object to be able to see the results. Also, the manipulator displays for selected faces, edges, and vertices. It does not display for UVs in the 3D view, but it does display in the UV Texture Editor.

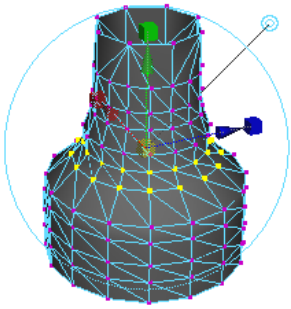
1. Select the components you want to move.
2. Select Edit Polygons > Move Component.
3. A transform manipulator displays. Drag the manipulator handles to transform the components to suit your needs or change the settings in the Attribute Editor or the Channel Box.

   The components are transformed in local mode by default. If you want to switch to global mode, click the circle at the end of the line originating from the pivot point. See "Switching between local and global modes" on page 56 for details.

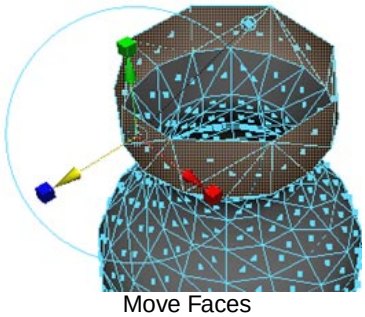
   The following examples show how components can be moved interactively using Move Component and the manipulator handles.



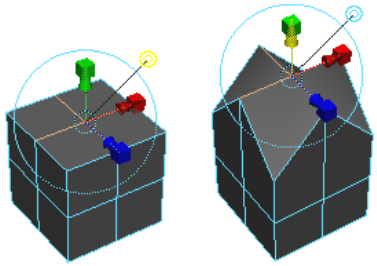
Move Vertex (local mode)



Move Vertex (global mode)



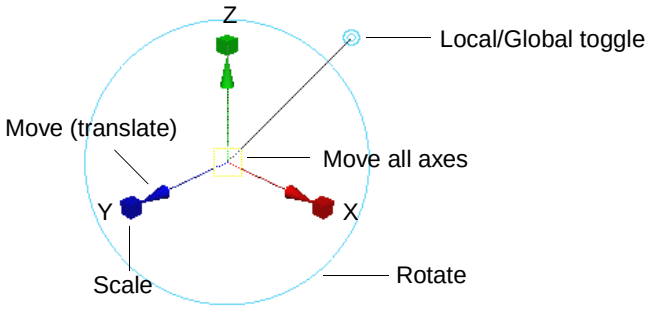
Move Faces



Move Edges

Move Component manipulator

The manipulator that appears when you use Move Component is the same manipulator that appears when you perform an Extrude, Duplicate, or Extract operation (see "Extruding, Duplicating, and Extracting" on page 125). It is much the same as the standard Maya transform manipulator. Using the manipulator handles, you can interactively transform the selected components.



When you select a translate manipulator handle (the arrows), it highlights in yellow. The same thing happens when you select a scale manipulator handle (the boxes). The square in the center of the manipulator lets you transform the components in all directions at once. If you are in a snap mode, this square becomes a circle. Like the standard Maya transform manipulator, you can also change the pivot of the Move Component manipulator. For details, see *Using Maya: Essentials*.

Moving

The translate arrows of the manipulator handles correspond to the X, Y, and Z axis directions. Click-drag one of these arrows to move the components in the desired axis direction.

Scaling

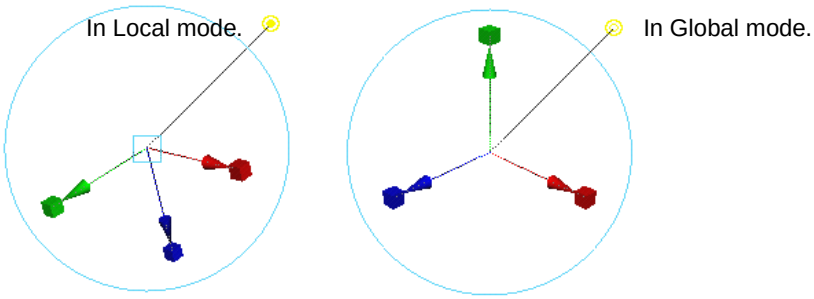
Click-drag the boxes at the ends of the manipulator handles to scale the components in the desired axis direction.

Rotating

Click to select and then drag the circle around the manipulator to rotate the selected component in the desired axis direction. The colors of the lines in the circle correspond to the X, Y, and Z-axis directions.

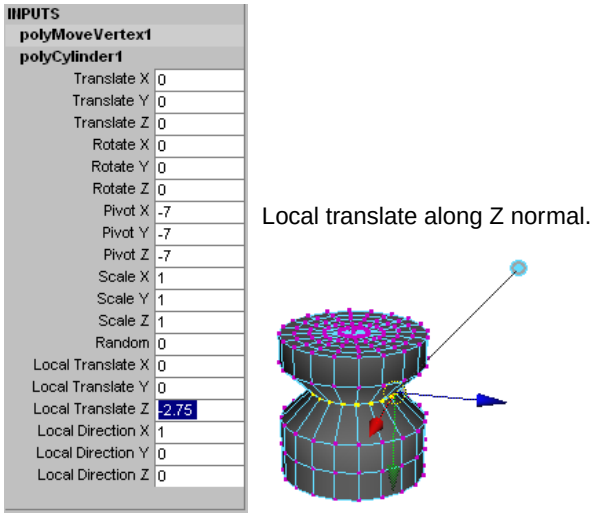
Switching between local and global modes

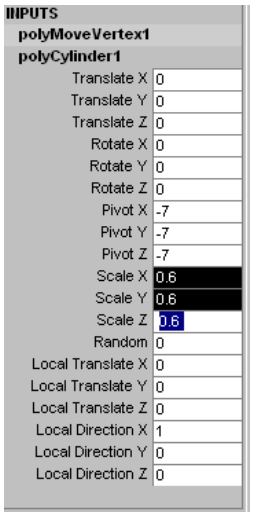
When using Move Component or after an Extrude, Duplicate or Extract operation, an additional handle displays as part of the Maya transform manipulator. It appears as a line with a circle at the end originating from the pivot point location.



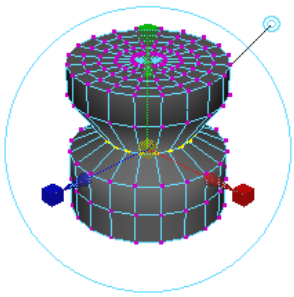
Click this circle to switch between local and global mode. If you use local coordinates (the default), the dot within the circle is solid. If you use global or world coordinates, the dot is hollow. For information on local and global coordinates, see *Using Maya: Essentials*.

You can also change local and global transform values from the Channel Box. Global transformation attributes reside at the top of the list as with default Maya transformation attributes. Local attributes reside under these attributes.





Global scale X, Y, Z.



These values correspond to the local and global values in the options window. You can enter values in the window and press the Move Vertex button (or whichever component you have selected) to perform the transformation.

Moving UVs

- The manipulator does not display if you use Move Component on UVs in the 3D view, but it does display in the UV Texture Editor.
- Local coordinate mode is not applicable for UVs.
- A texture must be assigned to the object to see the results in the 3D view.

Once you select the UVs on the object, use the options window or the Channel Box to change the settings and transform the UVs within the area you selected.

Use the UV Texture Editor window if you want more control when transforming UVs. See "Transforming UVs in the UV Texture Editor" on page 226 for details.

Move Component options

Select Edit Polygons > Move Component ❐ to display the options window for the currently selected component.

The options windows for selected components contain most of the same options. For instance, Global Values and Other Values are included in each options window for each selected component.

If an option is different for a particular component, it is described separately.

Local Values for selected faces

Offset The Offset option is only available for selected faces. Enter a value to offset the edges of transformed faces. This option can be used to produce a bevel effect. In effect, using this option uniformly scales a face.

Note

The options window for selected UVs does not contain Local Values.

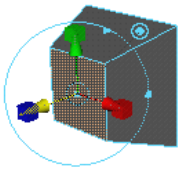
Translate This value moves the component locally along the X, Y, or Z axis. Positive or negative values indicate how far the components are moved locally.

> ***Tip: Transforming along a face normal***
>
> The path you transform along can be perpendicular, or at any other angle to the transformed face. To transform along a face normal, set the Z value for Local Values Translate to 1, and then click the Move Face button.

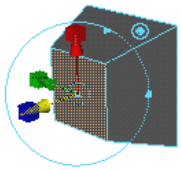
Rotate This value sets the angle at which you want to rotate the components locally around the X, Y, or Z axis.

Scale This value scales the components locally along the X, Y, or Z-axis.

Direction Enter a value to set the location of the X, Y, or Z point in the local axis. Notice how the manipulator handles change accordingly when you change the Y direction value to 4.0.



Default values.



Direction changed to 4.0 in Y.

Global Values

Translate This value moves the components along the X, Y, or Z axis.

Scale Enter a value to scale the components along the X, Y, or Z axis.

Rotate This value sets the angle by which you want to rotate the components around the X, Y, or Z axis.

Other Values

Random Enter a value to transform the components randomly varying from a value of 0 to 1.

World Space Coords

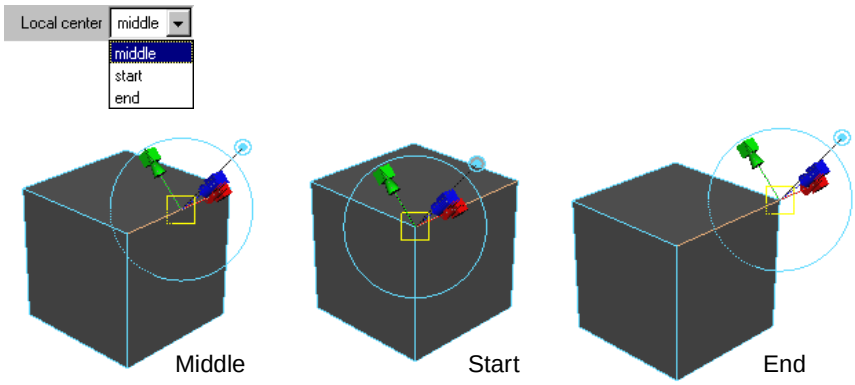
Turn on the World Space Coords to use the world coordinate system when you change values randomly. See *Using Maya: Essentials* for information about World Space Coordinates.

Move Vertex Options — Translate along normal

Instead of the generic Translate, Rotate, and Scale transformation values, vertices can be moved along the vertex normals. The value in this box indicates how far the vertices move along the Z axis (or normal).

Move Edge Options — Local center

Selecting an item from the Local center pull-down menu repositions the manipulator along the selected edge. Depending on which item you select, all subsequent transforms derive from that position. The default is middle.



DELETING POLYGON COMPONENTS

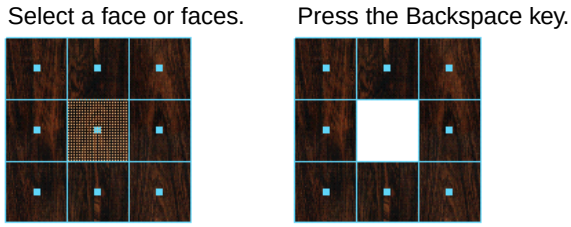
Press the Backspace key to delete selected polygonal components. For example, you can delete the selected edge between two faces and merge the original two faces. The result is a single face, but the vertices shared at the ends of the edge are not deleted.

Note

Deleting faces can make your geometry nonmanifold. To correct nonmanifold geometry, perform a cleanup. For details, see "Cleaning up polygonal data" on page 40.

To delete polygonal components:

1. Select the type of component you want to delete, for example, faces.
2. Press the Backspace key to delete the components you selected.



Deleting vertices

Delete Vertex allows you to simplify your polygonal geometry by deleting interior vertices directly.

The faces surrounding the deleted vertex are replaced by a single n-sided polygon with the vertices surrounding the deleted vertex. Quads and triangles are not created in the affected area since the intent is to reduce the geometry. This is equivalent to selecting all the edges surrounding the vertex and deleting them.

To delete vertices:

1. Select one or more vertices.
2. Select Edit Polygons > Delete Vertex.

The vertices are deleted from the polygonal geometry.

Notes

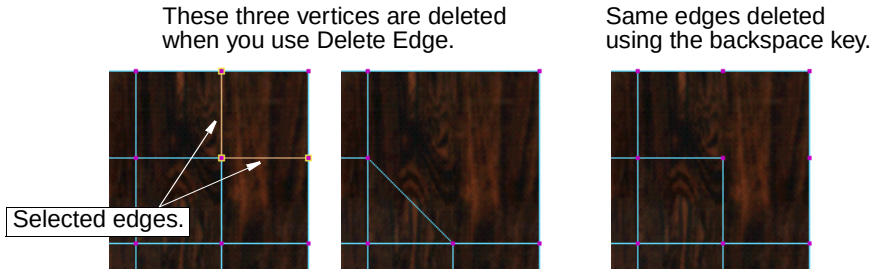
- Texture coordinates (UVs), color, and blind data will be affected by the operation. Color, shading, and textures may change in appearance.
- Shader and other set memberships based on vertices and faces are preserved.
- For polygonal instances, the geometry changes for all instances.

Deleting edges

Pressing the backspace key only deletes edges and there may be times when you want to delete the vertices shared at the ends of the edges. Use the Delete Edge operation to delete vertices that are no longer needed

To delete unwanted vertices in addition to edges:

Select the edges you want to delete, then select Edit Polygons > Delete Edge.



Delete error messages

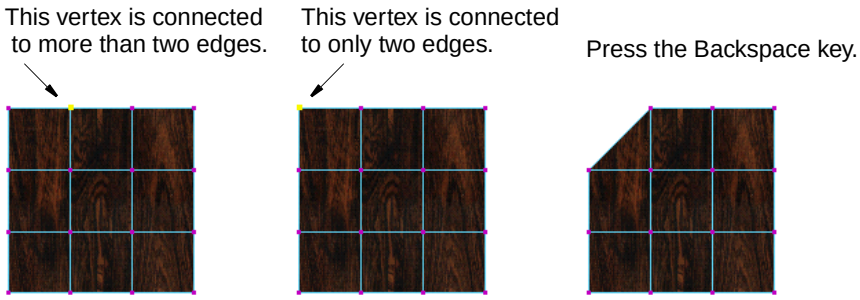
Occasionally you may encounter problems when trying to delete edges or vertices.

Deleting vertices

If you try to use the Delete or backspace keys to delete vertices that are connected to more than two edges, or *non-winged*, the following error message displays:

```
Error: Non-winged vertices cannot be deleted.
```

Use Edit Polygons > Delete Vertex on these vertices or select vertices that reside at a corner or are connected to two edges only (*winged* vertices).



Deleting edges

If you select edges that are border edges, you cannot delete them. The following error message displays:

```
Error: Border Edges cannot be deleted.
```

Select edges within the border edges to delete them.

TRANSFERRING COMPONENTS

Use Transfer to transfer vertex positions, UV sets, and/or vertex color between two models with identical topology.

To transfer components:

1. Select both the source object and the destination object, in that order.
2. Select Polygons > Transfer ❐.
3. Select the type of information you want to transfer (Vertices, UV Sets, Vertex Color), then click Transfer.

FLIPPING TRIANGLE EDGES

Edge placement is often crucial in determining the shape of a polygonal object. Use Flip Triangle Edge to control the orientation of edges of adjacent polygons. You can manually determine the general edge placement within a polygonal shape.

For example, the placement or orientation of an edge on a polygonal face could determine the placement of the bridge of a nose or the placement of the cheeks.

This option provides a fast way to do the equivalent of deleting an edge, finding the two diametrically opposing vertices and performing a split operation.

Tip

Flip Triangle Edge is also known as turn-edge, flip-edge, swap-edge, and rotate-edge.

To flip edges:

1. Select one or more edges to flip.

   The edge should be a shared edge between two triangles.
2. Select Edit Polygons > Flip Triangle Edge.

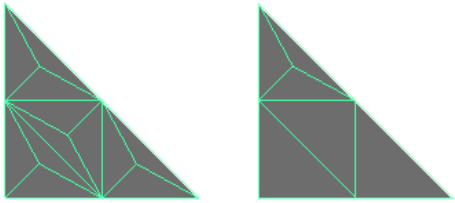
Some edges cannot be flipped

The following conditions determine when you cannot turn an edge. You cannot flip edges if:

- Edges are texture borders (in texture space)
- Edges not connected to two polygons (border edges, including hole borders)
- Edges have zero length.

REDUCING POLYGON COUNTS

You can reduce your polygon count on objects that do not need fine detail.



Before Reduce. After Reduce.

To reduce the polygon count of an object:

1. Select the objects that you want to reduce.
2. Select Polygons > Reduce ❒ and specify reduce options.
3. Click the Reduce or Apply button.

Polygon Reduce Options

Select Polygons > Reduce ❒ to display the options window for the currently selected component.

Reduce by (%)

Reduces the number of polygons by the specified amount. The default is 50 percent.

(In the Attribute Editor and Channel Box, this option is called Percentage.)

Preserve Properties

Geometry Border Edges

If a geometric edge is shared by only one polygon then it is a *geometric border edge*. A connected series of such edges is a *geometric border*. Turn this option on to preserve the border edge geometry. The default is on.

(In the Attribute Editor and Channel Box, this option is called Keep Border.)

Border Point Preservation

You must turn off Geometry Border Edges to enable Border Point Preservation.

This option specifies how much the reduction preserves or ignores existing vertices along the geometric border. A value of 1 means the reduction preserves the existing border vertices. A value of 0 means the reduction process does nothing to preserve the existing vertices.

(In the Attribute Editor and Channel Box, this option is called Border and the value displayed is 1 minus the value entered in the Polygon Reduce Options window.)

UV Border Edges

If a map (or UV space) edge is shared by only one map polygon, then it is a *map* (or UV) *border edge*. Turn this option on the preserve the UV border. A connected series of such edges is a *map* (or UV) *border*. The default is on.

(In the Attribute Editor and Channel Box, this option is called Keep Map Border.)

Tip

When you tesselate a subdivision surface, UV borders are created on all the created faces. To ensure that Reduce actually reduces, turn off UV Border Edges.

Hard Edges

Preserves hard edges. An edge has faces connected to it, and each face has its own normal. An edge is considered to be *hard* when the edge normals are interpreted as the separate face normals. A *soft* edge is one that computes the edge's normals using an averaging of face normals. The weighting for this averaging is determined by the *smoothness* angle. The default is on.

For example, two faces share an edge, and they are at a 90 degree angle to one another. One face is pointing in the X direction and the other in the Y direction. If the edge is marked as being *hard*, then it appears as a sharp crease. The edge has 2 normals, one pointing in the X direction, the other in Y. If the edge is marked as being *soft*, it appears as a smooth crease. The edge has 2 normals, and the angle between them is determined by the *smoothness* angle (which in Maya can be set by the soft / hard edge feature).

(In the Attribute Editor and Channel Box, this option is called Keep Hard Edge.)

Sharp Geometry Angles

This option specifies how much the reduction preserves or ignores existing areas with sharp angles between faces. A value of 1 means the reduction attempts to preserve areas with sharp angles. A value of 0 means the reduction process does nothing to preserve areas with sharp angles.

(In the Attribute Editor and Channel Box, this option is called Line and the value displayed is 1 minus the value entered in the Polygon Reduce Options window.)

High Curvature

This option specifies how much the reduction preserves or ignores existing areas with high curvature between edges. A value of 1 means the reduction attempts to preserve areas of high curvature; it concentrates more vertices and edges in those areas. A value of 0 means the reduction process does nothing to preserve areas of high curvature; it distributes vertices and edges evenly.

(In the Attribute Editor and Channel Box, this option is called Detail and the value displayed is 1 minus the value entered in the Polygon Reduce Options window.)

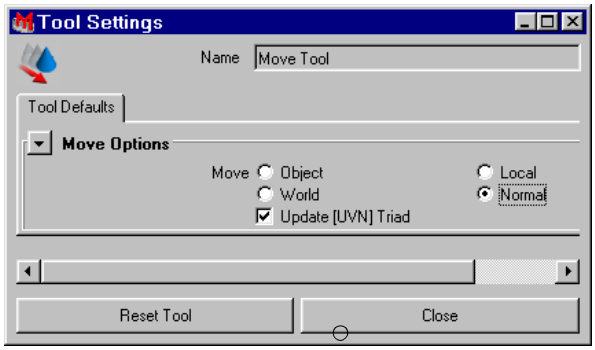
4 NORMALS AND DISPLAY SETTINGS

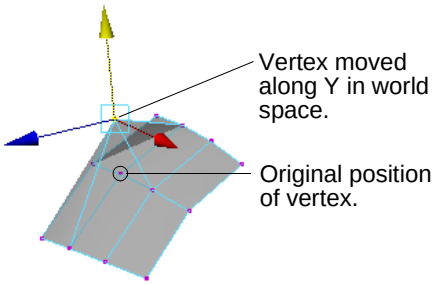
Maya provides options that you use to view and edit polygonal normals. This includes polygon and vertex level normals. This chapter describes these options and also provides information on how to use the Soften / Harden option to produce a smoothly shaded appearance when you display polygons in Smooth Shaded mode.

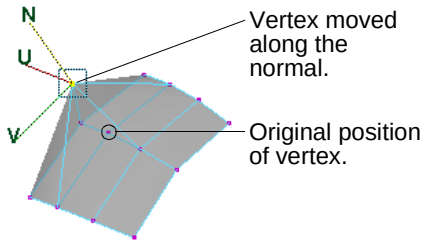
MOVING VERTICES ALONG THEIR NORMALS

You can precisely move vertices along their normals by dragging the N (normal) manipulator handle or by entering X, Y, or Z values in absolute or relative mode in the Numeric Input Field.

To do this you must change the Move Tool's Move Options to Normal and turn on the Update (UVN) Triad option. A different manipulator displays on the object indicating the U, V, and normal direction.

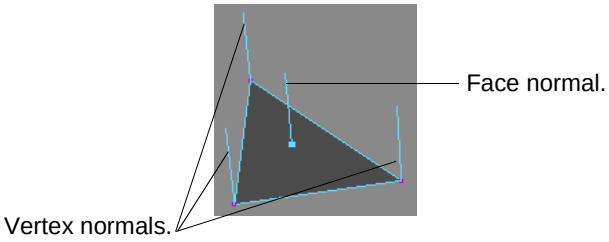






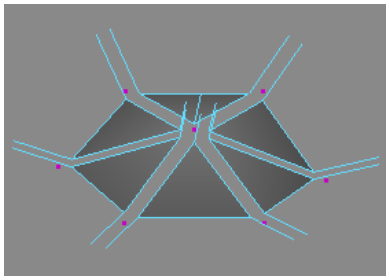
EDITING POLYGON NORMALS

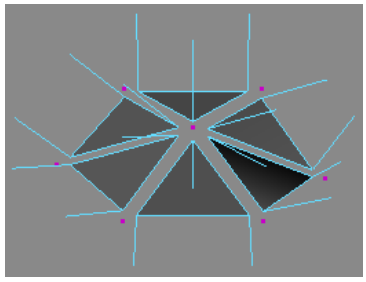
The normal shows the direction of a face. Vertex normals can either be computed from the face normals, or you can set them explicitly. There may be times when the normals may not be correct, for example, if you import a polygonal object created by another modeler.



Use the options on the Edit Polygons > Normals menu to help correct poorly oriented normals, or to lock or unlock normals to fine-tune your bump maps, or shading and rendering results.

When all the vertex-faces surrounding a vertex have the same normal, the normals are *shared*. If any face has a different normal, the normals are *unshared*.


Shared normals at vertex.


Unshared normals at vertex.

SETTING POLYGON VERTEX NORMALS

Set Vertex Normal (or Lock Normal) stores the given normal for the vertex (or vertex face). The computed value is ignored thereafter, until the normal is Unlocked. The vertex normals stay fixed in object space, even if the geometry is deformed, or the face normals are reversed.

If you use the Set Vertex Normal option, normals do not have to be re-computed every time you move a vertex. By specifying specific option settings in the options window, you can avoid the possibility of normals changing every time you change a vertex position.

To set vertex normals for a polygonal operation:

1. To display normals on the vertices, open the Custom Polygons Display window (Display > Custom Polygon Display ❒) and set apply the following:

- Beside Object Affected select All.
- Beside Vertices turn on Display and Normals.

2. Select one or more vertices or Vertex/Face components.

Tip

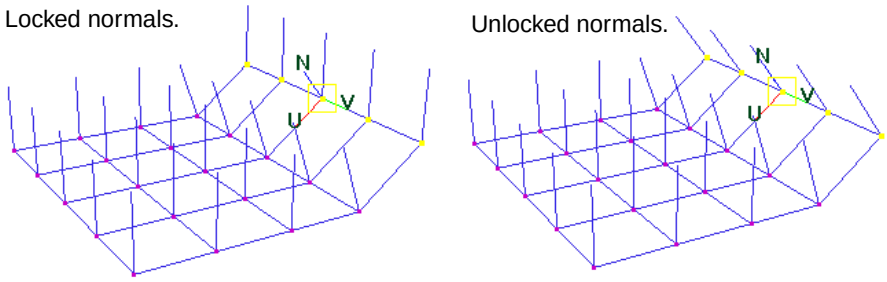
Using Vertex/Face selection you can set normals on a per-vertex per-face basis.

3 Select Edit Polygons > Normals > Set Vertex Normal ❐.

4 Use the options in the option window to set and size normals if necessary, click the Set Normal button, then continue with your transformation.

5 Transform the vertices in X, Y, or Z. If the normals are “locked” they move with the transformation. If they are “unlocked”, they move in the X, Y, or Z direction as you drag.

The following example shows what happens when you move vertices and locked and unlock normals on a polygonal plane.



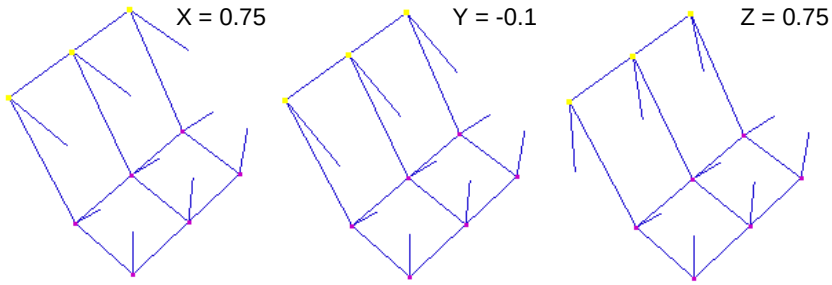
Polygon Set Vertex Normal options

By default, Maya locks normals to their existing values. To Unlock normals or to change the X, Y, or Z values, open the options window (click the ❐ next to Set Vertex Normals in the menu).

Lock Normals To change the X, Y, or Z values for normals, turn this option off. The normal values you specify (or if you use the default values) are fixed for each normal associated with the vertex or vertex/face component. This means that if you change a vertex position, normals do not change position.

Unlock Normals Use this option to unlock locked normals. You can change the X, Y, and Z values, click the Set Normals button and transform the vertices.

X, Y, and Z Values Enter a value or drag the slider to change the range of the normals associated with the vertices and faces. You can lock or unlock these values using the Lock Normals or Unlock Normals option.



Normalize Normal

Regardless of the current normal's values, clicking this button sets the normals to unit length (or normalizes them).

The unit length of a normal is calculated by the point offset from the vertex. You may inadvertently change the X, Y, Z values to ones that change this unit length to something undesirable which could un-normalize the normals (for example, changing X to 1.11).

AVERAGING VERTEX NORMALS

Using this operation, you can average vertex or vertex/face normals. You can do the following:

- You can average the vertex-face normals at a single vertex.
- You can increase the tolerance and average the normals of several vertices in the same region to give the area a flattened look.
- You can pick vertices on opposite sides of a seam and average them to smooth across the seam.
- Using a small tolerance, you can select all the vertices along a seam, and each group of close-together vertices will be averaged separately.

Depending on which normals are averaged, they may be represented as computed normals (if this can be achieved by softening the related edges), or they may need to be stored explicitly.

Average Normals usually results in explicit normals being set, except in cases where exactly the same values for the normals can be achieved by softening or hardening the edges.

Averaging normals works in object space, so if you want to average normals across two different shapes, make sure that the path for each shape has the same transforms.

To average vertex normals:

1. To display normals on the vertices, open the Custom Polygons Display window (Display > Custom Polygon Display ❐) and apply the following:

- Beside Object Affected select All.
- Beside Vertices turn on Display and Normals.

2. Select one or more vertices or Vertex/Face components.

Tip

Using Vertex/Face selection lets you set normals on a per-vertex per-face basis.

3. Select Edit Polygons > Normals > Average Normals ❐.
4. Use the options in the option window to average normals if necessary and click the Average Normals button.

Average Normals options

Select Edit Polygons > Normals > Average Normals ❐ to display the options window.

Pre-normalize Normals

Turn this option on so that all the normals in the calculation have a length of 1, and each one contributes equally to the average. This is on by default.

If this option is turned off, and if you explicitly set normals where the length is not equal to 1, then the contribution of these normals to the average is weighted by the length of the normal (the new normal will be closer in direction to the longer normals).

Distance Tolerance

The vertices within the distance you specify are considered as a group to share a normal which is the average of the normals in the group. So your selected vertices may be divided into several groups, and each group averaged separately.

Allow Zero Normals

If two normals of exactly opposite direction are averaged, the result will be a zero-length normal. While this is valid in Maya, it may not be what you want. If this option is turned off, the normals are replaced by user-specified value (see below).

Replace Zero Normals By

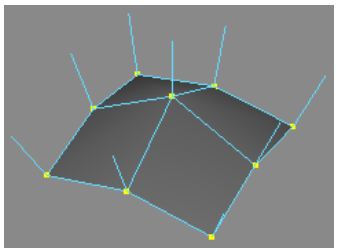
If Allow Zero Normals is on, this option is disabled. If Allow Zero Normals is off, the normals are replaced by the X, Y, and Z values you specify here.

Post-normalize Normals

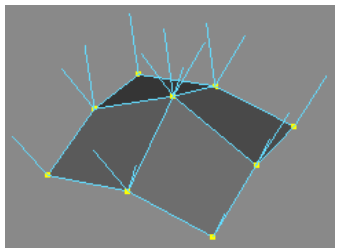
If Pre-normalize Normals is off, you can keep the length of the normal that resulted from the calculation, or set the length to 1 by turning on Post-normalize Normals. The length may be significant in future invocations of Average Normals. If Pre-normalize Normals is on, this option is disabled, since the result will be automatically normalized.

SPLITTING VERTEX NORMALS

Use Set to Face to set the vertex normals to the face normals, in effect splitting the vertex normal.



Before Set to Face.



After Set to Face.

Setting the vertex normals to the face normals creates the same effect at that vertex as hardening the adjacent edges (the vertex-face normals will be equal to the face normals). You also have the option of setting these values for the normals explicitly.

Set to Face usually results in explicit normals being set, except in cases where exactly the same values for the normals can be achieved by softening or hardening the edges.

To split vertex normals:

1 To display normals on the vertices, open the Custom Polygons Display window (Display > Custom Polygon Display ❒) and apply the following:

- Beside Object Affected select All.
- Beside Vertices turn on Display and Normals.

2 Select one or more vertices or Vertex/Face components.

Tip

Using Vertex/Face selection you can set normals on a per-vertex per-face basis.

3 Select Edit Polygons > Normals > Set to Face.

Set to Face options

Select Edit Polygons > Normals > Set to Face ❒ to display the options window with the following option.

Set User Normal If turned on (the default), the vertex/face normal value is locked to its current face normal. Otherwise, the edges surrounding the vertex face are hardened if it is possible to do so, and the normals unlocked.

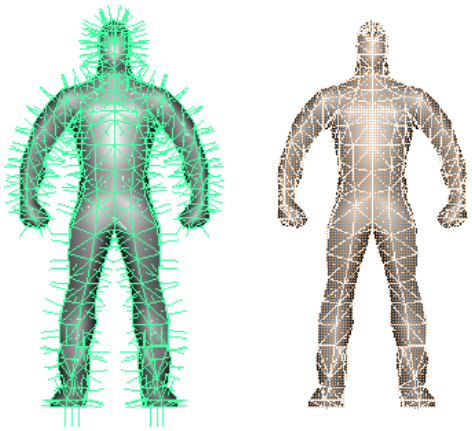
REVERSING POLYGONAL NORMALS

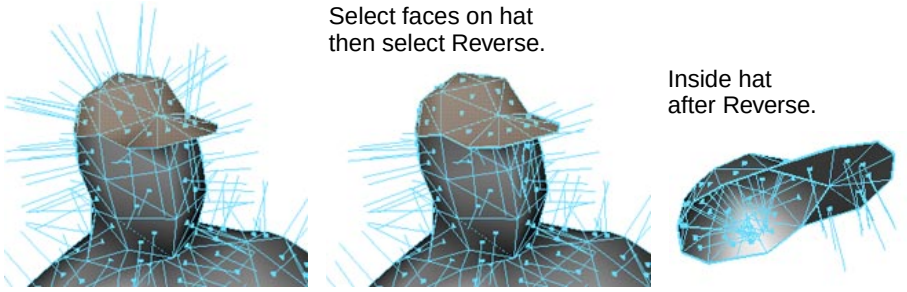
Reversing face normals affects the orientation of the face and causes the face normals to be computed in the opposite direction. Vertex normals are computed from the face normals, so they are affected as well.

There are three ways to reverse normals. You can:

- Only reverse face normals.
- Reverse face normals and vertex normals and then extract the vertices.
- Reverse face normals and propagate the change to the rest of the normals in the shell.

You can reverse face normals one at a time or reverse multiple face normals.





To reverse polygonal face normals:

1. To display normals on an active object, select Display > Polygon > Components > Normals.
2. Select the faces you want to reverse normals on:

- To reverse the normals on an entire object, marquee-select the object.
- To reverse normals on individual faces, press F11 or press the right mouse button and select Face from the marking menu, then click to select the faces whose normals you want to reverse and select Edit Polygons > Normals > Reverse.

3. Select Edit Polygons > Normals > Reverse ❐.
4. Beside Mode, select how you want to reverse normals and click Reverse Normals or Apply.

Reverse Maya reverses the normals on the selected faces.

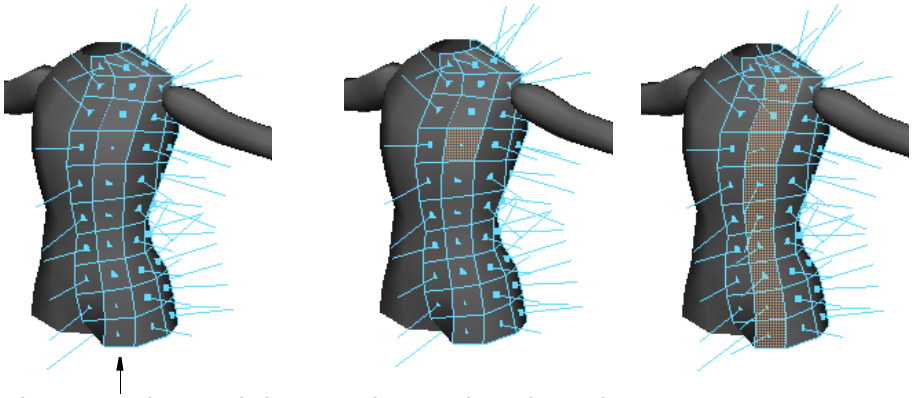
Note

Reversing normals using this option can make your geometry nonmanifold. To correct nonmanifold geometry, perform a cleanup. For details, see "Cleaning up polygonal data" on page 40.

Reverse and Extract Maya reverses the normals on the selected faces and then extracts, or splits the vertices.

Reverse and Propagate

Maya reverses the normals on the selected faces and forces all the normals in the shells to which the faces belong to go in the direction of the reversed selection. This can come in handy if you create models where some of the normals are pointing in the opposite direction of the others.

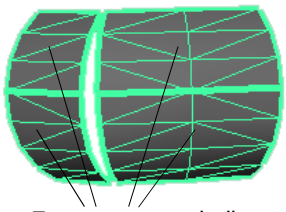


These normals are pointing in the opposite direction of the others.

Select one face, then select Reverse and Propagate.

Shells and propagating normals

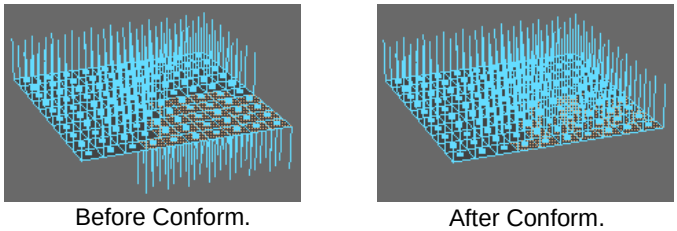
Propagation can only happen within a shell. A shell is a portion of the mesh that is not connected to the rest of the mesh by any edges, but is self-contained.



Four separate shells make up this mesh.

CONFORMING NORMALS

Using the Conform normals option you can make all the normals of selected faces point in a consistent direction (no normals point in opposite directions).



Before Conform.

After Conform.

To conform normals:

1. Select the faces whose normals you want to conform.

2 Select Edit Polygons > Normals > Conform. Normals conform to the direction shared by most of the faces.

SOFTENING AND HARDENING POLYGON EDGES

Using the Soften / Harden option, you can specify an angle at which the polygonal object is to be smoothed when displayed in Smooth Shaded mode.

If the angle between two faces is larger than the smoothing angle, the edge is hard. If the angle between two faces is smaller than the smoothing angle, the edge is soft.

If an edge is hardened, the face normals are used for the vertex-faces adjacent to that edge. If an edge is softened, the average of the face normals surrounding the vertex is used.

Note

If you import a model that was created as .obj format with vertex normals already specified, you might not be able to soften or harden the resulting edges in Maya. Try unlocking the normals by choosing Edit Polygons > Normals > Set Vertex Normal ❐, and turning on Unlock Normals in the options window. Then soften or harden the edges.

To make edges soft or hard:

1 Select an object whose edges you want to soften or harden.

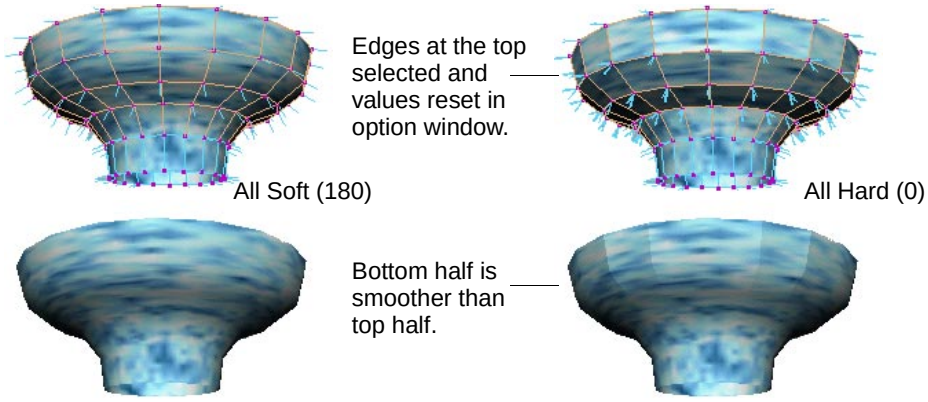
2 Press F10 or press the right mouse button and select Edge from the marking menu.

3 Marquee-select the edges you want to change, or select individual edges.

4 Select Edit Polygons > Normals Soften / Harden ❐.

5 If necessary, change the angle in the options window to soften or harden the edges you want and then click the Soft / Hard button.

For example, if you want to render edges hard, you can set the smoothing angle in the options window to 0 degrees. To render soft edges, set the angle to 180 degrees.



Soften/Harden Edge options

Select Edit Polygons > Normals > Soften / Harden ❐ to display the options window.

Angle	Use the slider or enter a value to set the angle. Angles greater than the current value render hard; angles less than the current value render soft.
All Hard	Click this button to set the angle to 0, making all selected edges render hard.
All Soft	Click this button to set the angle to 180 degrees, making all selected edges render soft.

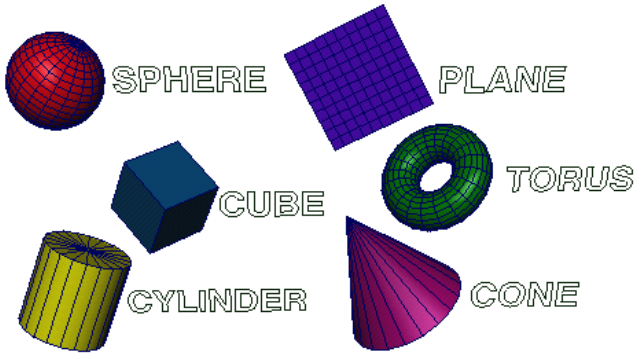
5 POLYGONAL PRIMITIVES

This chapter introduces you to polygonal primitive objects and shows you how to create polygonal text.

There are several ways to use primitives to build objects quickly and easily. Use primitives as a starting point, then use a combination of polygon creation and editing operations to complete a task. Throughout this book you'll find examples where primitives are used as the base element of a particular task in combination with many of the Maya editing and creation operations.

BASIC POLYGONAL PRIMITIVE OBJECTS

The most basic object type is the *primitive*. Primitives are pure shapes that can be used as the basis of creating more complex models. There are six polygonal primitive objects—Sphere, Cone, Cylinder, Cube, Plane, and Torus.



Creating polygonal primitives

You can instantly make simple objects like spheres, cubes, cylinders, cones, planes, and toruses. When you select the polygon primitive from the menu, it displays in all views at the origin of the grid.

To create a primitive with the default option settings, select Create > Polygon Primitives and choose the primitive you want to create from the menu. If you are not satisfied with the results, you can always edit the primitive from the Channel Box or its Attribute Editor.

SETTING PRIMITIVE OPTIONS

Most of the options for polygonal primitives are the same, therefore all options are described for all polygonal primitives in the following sections:

- "Specifying a primitive's radius" on page 76
- "Specifying a primitive's subdivisions" on page 77
- "Specifying a primitive's width and height" on page 79
- "Changing a primitive's orientation" on page 79
- "Preparing a primitive for texture mapping" on page 80

If there are special options that do not apply to every primitive, they will be discussed separately.

To set primitive options:

1. Click the box (❒) beside the type of primitive you want to create to open the options window (for example, Create > Polygon Primitives > Sphere ❒).
2. Change the option settings and click the Create button to create the primitive.

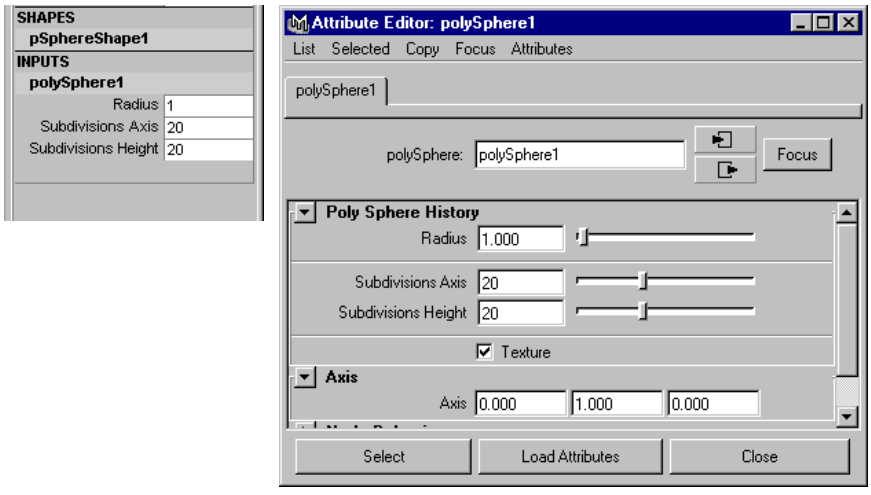
   By default, the primitive displays centered at the world coordinate system. You can move it to any location using Maya's Move tool.

Specifying a primitive's radius

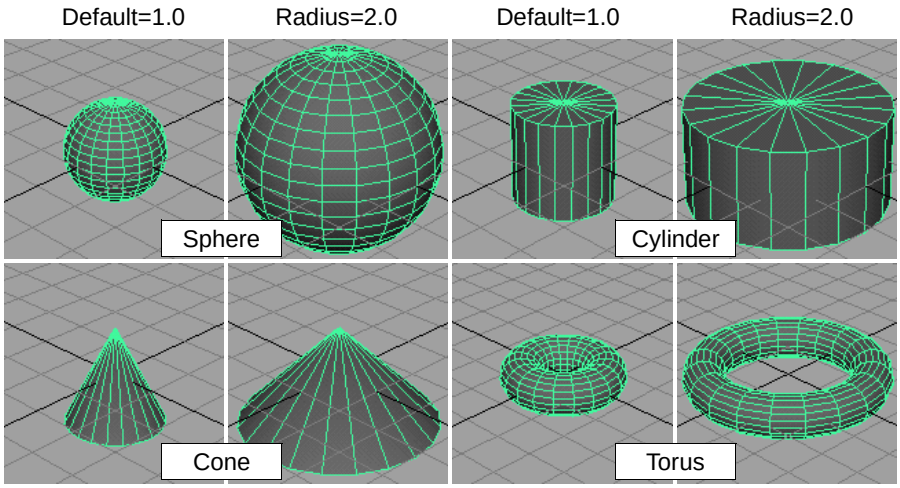
The Radius value specifies the distance from the center of the primitive in all directions. Polygonal primitives that have this option include Spheres, Cylinders, Cones, and Toruses.

Adjusting the Radius for these primitives is like changing the width for primitives that do not have circumference (like primitive planes and cubes).

Type a value or use the slider bar to specify the primitive's radius. You can also change these values in the Channel Box or Attribute Editor after you create the primitive.

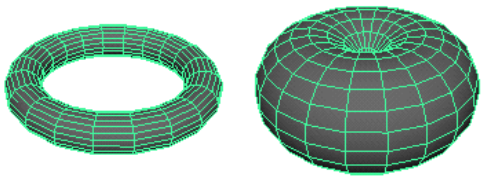


The following examples show the difference between a Radius value of 1.0 (the default) and what happens when you change this value to 2.0.



Using the Section Radius option for a primitive Torus

The Section Radius option value specifies the size of the sections that make up a Torus. Change this value to increase or decrease the radius of these sections.



Using the Twist option for a primitive Torus

The Twist option value specifies the twist angle of the torus. Change this value to adjust the distance around the Torus in all directions.

Specifying a primitive's subdivisions

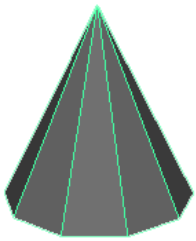
The values you enter in these boxes change the primitive by adding or taking away faces of the polygon.

For primitives without caps (or sides) you can only subdivide in the X and Y direction. These include Spheres, Planes, and Toruses.

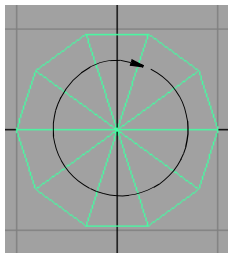
For primitives with caps, you can subdivide in all three directions, X, Y and Z. These include Cones, Cubes and Cylinders.

Using the Subdivisions around Axis (Subdivisions Axis) option

For spheres, cylinders, cones, and toruses, this option defines the number of subdivisions there are around the axis defined by the Axis option. This option is also called Subdivisions Axis in the Channel Box and the Attribute Editor.

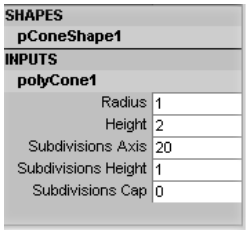


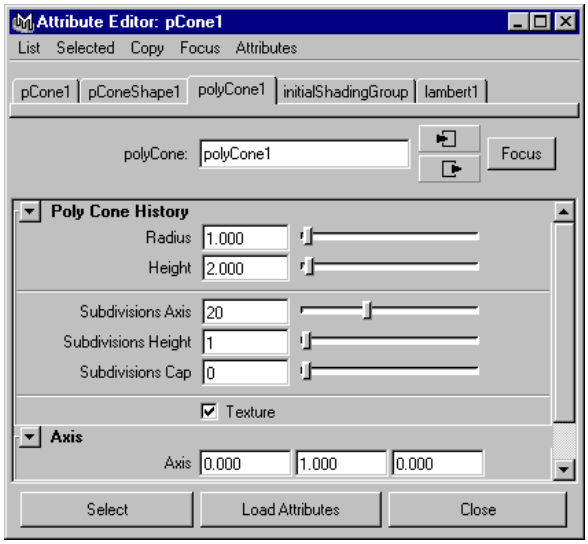
Perspective view of cone with 10 Subdivisions around Y Axis.



10 Subdivisions around the Y axis.

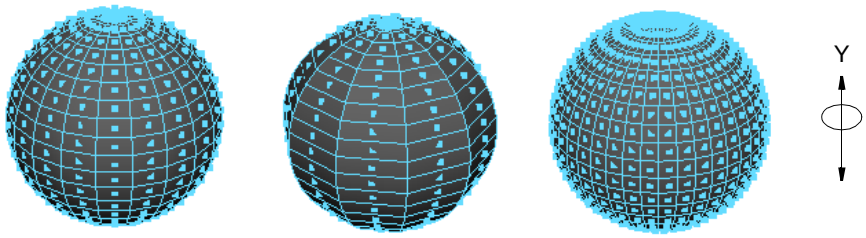
Top view of cone.





Increase or decrease this value to add or take away faces around the axis defined by the Axis option.

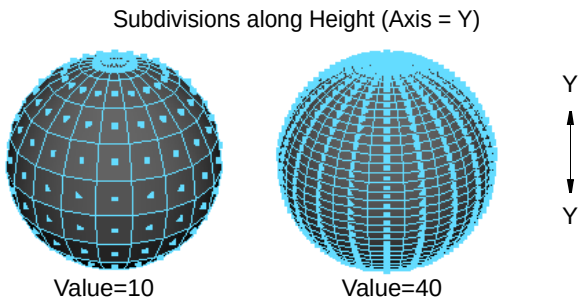
Subdivisions around Axis (Axis = Y)



Default=20 Value=10 Value=40

Using the Subdivisions along Height (Subdivisions Height) option

This option defines the number of subdivisions there are along the axis defined by the Axis option. Height is equivalent to the Y direction by default. This option is also called Subdivisions Height in the Channel Box and the Attribute Editor. Increase or decrease this value to add or take away faces in the Axis direction.

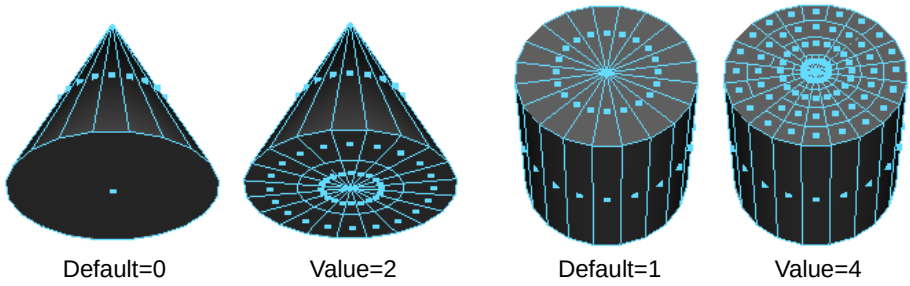


Using the Subdivisions along Depth option

When Axis is set to X or Y, depth is equivalent to the Z direction for polygonal cubes. When Axis is set to Z, depth is equivalent to the Y direction. This option is also called Subdivisions Depth in the Channel Box and the Attribute Editor. Increase or decrease this value to add or take away faces along the depth.

Using the Subdivisions on Caps option

Caps are the tops, bottoms, or sides of Cones and Cylinders. This option defines the number of subdivisions around the origin of the primitive caps. This option is also called Subdivisions Cap in the Channel Box and the Attribute Editor. Increase or decrease this value to add or take away faces around the caps.



Specifying a primitive's width and height

Enter values or use the slider to specify the height or width of a primitive. For polygonal primitive Cones and Cylinders, the Radius value is like the Width of the primitive so only the Height option applies. For primitive Planes and Cubes, both Width and Height values can be adjusted.

For a primitive plane, the Width value increases or decreases the plane along the X axis while the Height value increases or decreases the plane along the Z axis.

Changing a primitive's orientation

Be default, a primitive is created along the Y axis. You can change a primitive's default orientation before you create it by changing the Axis option.

You cannot change the orientation for a new primitive from the Channel Box, but you can enter values in the Axis boxes in the Attribute Editor.

Preparing a primitive for texture mapping

By default, UV values are assigned for texture mapping. If you do not plan to map textures on a polygonal primitive, you can turn off the Texture option in the options window. Texture is on by default.

Important note about UVs

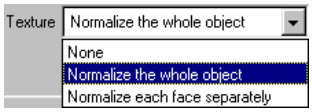
It is important to make sure UVs are present on an object or you cannot see the mapped textures in the view. This can happen if you inadvertently create a primitive object with the Texture option turned off or set to None.

To correct the problem, select the faces of the primitive and use any of the tools in the Edit Polygons > Texture menu.

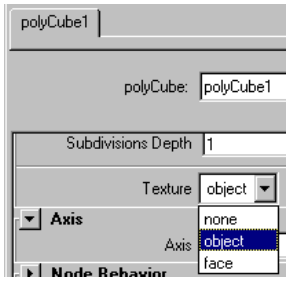
You can then use the UV Texture Editor to view the created UVs. Select the object and use any of the UV creation or editing Texture menu items.

Texture mapping options for primitive Cubes and Cylinders

The options window for a polygonal Cube and Cylinder primitive includes a Texture pop-up menu where you can select how you want the texture to cover the primitive when you assign it. This pull-down menu is also available from the Attribute Editor.



Options window.



Attribute Editor.

None Selecting None is like turning Texture off for polygonal primitive Spheres, Cones, or Toruses.

Normalize the whole object/object

The default setting maps the texture over each face of the primitive and normalizes it so that it covers the entire object.

Normalize each face separately/face

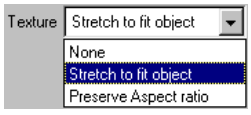
If you select this option, Maya maps the texture to each face separately.

Normalize the caps separately/face

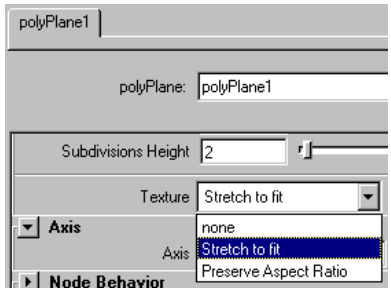
For cylinders only. If you select this option, Maya maps the texture separately to each cap of the cylinder.

Texture mapping options for primitive Planes

The options window for a polygonal Plane primitive includes a Texture pop-up menu where you can select an item to specify how you want the texture to behave when you transform the plane after it is created. This pop-up menu is also available from the Attribute Editor.



Options window.



Attribute Editor.

None Selecting None is like turning Texture off for polygonal primitive Spheres, Cones, or Toruses.

Stretch to fit object/Stretch to fit

This is the default setting. When you change the shape of the primitive plane by adjusting the options in the option window or by adjusting the Width and Height in the Channel Box, the texture stretches to fit within the plane's transformed shape.

The following example shows a rock texture mapped to a plane whose Width has been changed to 3.

Preserve Aspect ratio/Preserve Aspect Ratio

If you select this option, when you change the Width of the primitive plane, the texture fits uniformly to the new dimensions of the object.

Editing primitives in the Attribute Editor

To edit a primitive after you create it, use the Attribute Editor. The Attribute Editor for a polygonal primitive includes the same options and attributes you find in its options window and the Channel Box.

To see these attributes, click the tab with the primitive's name. For example, click the polySphere tab for a polygonal Sphere primitive.

CREATING AND EDITING TEXT

The Poly text type creates text as polygons which you can manipulate as you would any other polygonal entity. When this text type is selected, a planar trim curve is created between the curve and tessellate nodes. By default, Maya creates text as NURBS geometry.

To create polygonal text:

1. Select Create > Text ❐ to open the Text Curves options window and set the Type option to Poly.
2. Type the text you want to create in the Text box.
3. Change the default font settings if necessary.
4. Change the options settings (see "Polygonal text settings" on page 83 next for details).
5. Click the Create button to create the text.

   Two instances of the word display—a NURBS (or curve) based text string and a polygonal text string. The polygonal text string is highlighted.

   Once you move and transform your polygonal text, you can first delete the history on the new text, and then delete the NURBS text if you want to.

- To delete the history of the polygonal text, select the text and choose Edit > Delete by Type > History.
- To delete the NURBS text, select it either in the 3D view or from the Hypergraph and press the Backspace key.

To change the default font:

- If you are working on a UNIX machine, select the font that you want from the menu that appears.
- If you are working on a Windows machine, do the following steps:

1. At the end of the Font box, click the down arrow and click Select to display the Font window.
2. Select a font from the Font menu, a style from the Font style menu, and a font size from the Size menu, and adjust any other properties you want to change.
3. The type of font you select appears in the Sample box. Click OK when done to select the font and close the Font window.

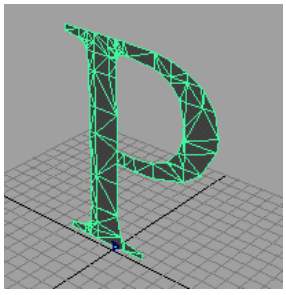
Polygonal text settings

When you create polygonal text, Maya provides options that you can set to display and create your text for subsequent polygonal-type editing.

Change any of these options before you create the text.

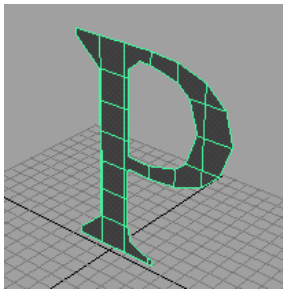
Polygon Type options

Triangles 3-sided polygons are created. This is the default.



Quads 4-sided polygons are created. The following example shows text using the default font and the following settings:

- Polygon text Type – Quads
- Tessellation Method – Count
- Count value– 50



Tessellation Methods

These options are the same ones you set when you convert NURBS geometry to polygonal geometry. See *Chapter 9, "Converting NURBS to polygons"* for details.

For specific information, see "Choosing a tessellation method" on page 117.

- "Standard fit" on page 117
- "General" on page 118
- "Count" on page 119
- "Control Points" on page 119

6 POLYGONAL BOOLEANS

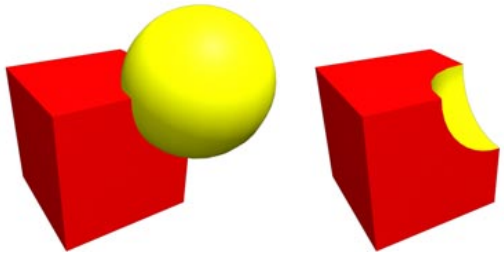
You use polygonal Boolean operations on objects whose surfaces intersect. The results of these operations produce new geometry based on the subtraction, union, or intersection of the objects.

Note

Surfaces do not necessarily have to intersect for a Boolean operation to succeed, although the results may not always be useful.

POLYGONAL BOOLEAN OPERATIONS

Boolean operations are a popular and intuitive modeling solution which involves using one shape to act upon another as a volumetric tool. This can be useful for "carving" objects.



Using a sphere to "carve" a cube using the Difference operation

The first object selected is the shape upon which the result is based, and the second selected object is the tool object which operates upon the first one. Boolean operations always generate a new shape node as a result, and if construction history is maintained, the original shapes can be selected in the Channel Box, Hypergraph, or Outliner and manipulated to edit the Boolean operation after the function is completed.

NURBS to polygon conversion and Boolean operations

Boolean operations require that the tool and original surfaces both be closed in the area where they intersect. Boolean operations are very sensitive to the quality of the surfaces intersecting. NURBS objects converted to polygons (using NURBS To Polygons) may require some editing of converted surfaces to achieve successful Boolean operations.

Failed Boolean operations

Occasionally Boolean operations may fail for topological reasons. The following error message displays:

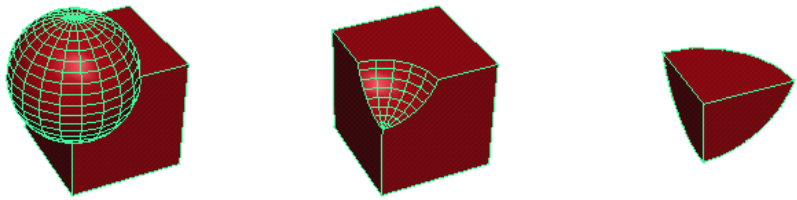
```
Cannot perform boolean operations for topological reasons.
```

If this happens, the objects that were selected before performing the (failed) operation become invisible. To return to the original state, undo the last Boolean operation.

BOOLEAN TYPES

There are three types of Boolean operations—*Union*, *Difference*, and *Intersection*. Their names describe how the tool object operates on the first selected (or original) object

You access the Boolean operations from the Polygons menu.



Note

Booleans operations do not work on objects that have zero (or very small) area faces. Before performing a boolean operation, either enlarge these faces or remove them. To select these faces:

1. Select the objects you want to perform the boolean operation on and switch to face component mode.
2. Select Edit Polygons > Selection > Selection Constraints.
3. Beside Constrain, select All Next.
4. Expand Geometry, then expand Area.
5. Turn on Activate and set Min to 0 and Max to 0.0001. The offending faces become highlighted.

You can now enlarge them or remove them.

Union Boolean operation

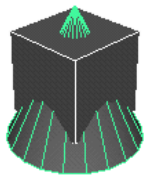
The Union operation merges the original and tool objects, removing surfaces which overlap while retaining the original surface's shadier information.

Tip

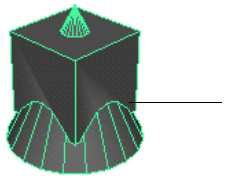
In a situation where there may be more than one object that you want to use for Boolean operations, it is possible to use the Boolean Union function to join these objects beforehand even if they do not intersect.

To perform a polygonal boolean Union operation:

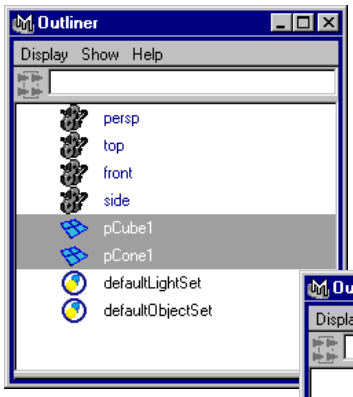
1. Create a polygonal cube. Select Create > Polygon Primitives > Cube. Scale the cube to make it larger than the default size.
2. Create a polygonal cone. Select Create > Polygon Primitives > Cone. Scale the cone to make it larger than the cube.
3. Select the cube, press the Shift key, and select the cone.



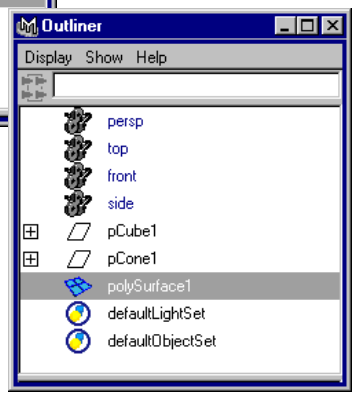
4. Select Polygons > Booleans > Union. Notice how the edges of the cube and the cone are now connected and both primitives act as one single object.



If you open the Outliner, you can see the difference before and after the operation.



Before Union operation.



After Union operation.

Difference Boolean operation

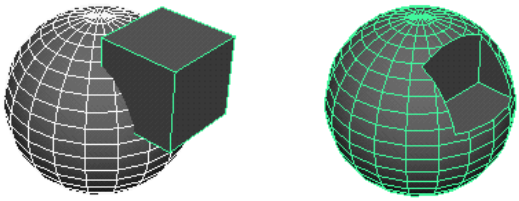
The Difference operation creates a new surface that subtracts the intersecting volume of the tool object from the original object. This operation, in effect, carves the first selected object (the original object) with the tool object.

Note

The new surface created will have the same shader characteristics at the component level as the tool object, while the original object retains its original shader information at the component level where it was not effected by the operation.

To perform a polygonal boolean Difference operation:

1. Create a polygonal cube. Select Create > Polygon Primitives > Cube.
2. Create a polygonal sphere. Select Create > Polygon Primitives > Sphere.
3. Select the sphere, press the Shift key, and select the cube.
4. Select Polygons > Booleans > Difference.

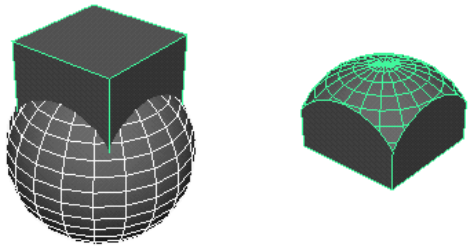


Intersection Boolean operation

The Intersection operation creates an object consisting of the volume enclosed by the original and tool objects. As with the Difference operation, the component surface shaders correspond to the shaders of the original objects.

To perform a polygonal boolean Intersection operation:

1. Create a polygonal cube. Select Create > Polygon Primitives > Cube.
2. Create a polygonal sphere. Select Create > Polygon Primitives > Sphere.
3. Select the sphere, press the Shift key, and select the cube.
4. Select Polygons > Booleans > Intersection.



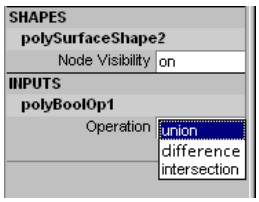
EDITING BOOLEANS WITH CONSTRUCTION HISTORY

While construction history is maintained for the created geometry, you can access the objects you used for the Boolean operation and edit them in the Channel Box, Attribute Editor, or Hypergraph as well as change the Boolean operation after it has been performed.

To switch polygonal Boolean operations from the Channel Box:

You can switch between Boolean operations from the Channel Box even after the initial operation has been performed.

1. Click the polyBoolOpt heading for the Boolean operation you want to change.
2. Click with the left mouse button or click the down-pointing arrow to access the pull-down menu.



3. Select a Boolean operation.

You can also switch the Boolean type from the Attribute Editor by selecting an operation from its pull-down menu.

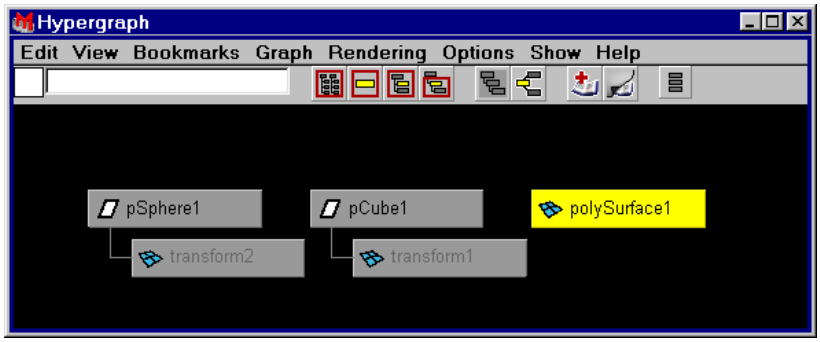
Note

It is important not to assign shaders at the component level if you want to use construction history to transform or animate the original objects of the Boolean operations. Because the components (faces) are created as the Boolean operation is recalculated with each transform, new faces revert to the default shader since the new faces are, for all intents and purposes, new.

To edit the original polygons after a Boolean operation:

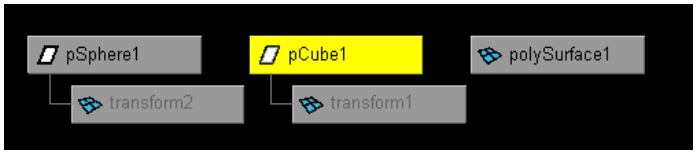
If you want to transform the objects after a Boolean operation, you have to access the history of the objects from the Hypergraph, Outliner, Channel Box, or Attribute Editor. You can then use Maya's transformation tools or enter values to transform the objects. In the following example, an Intersection operation was performed on two polygonal primitives.

1 After an Intersection Boolean operation, select Windows > Hypergraph to open the Hypergraph.

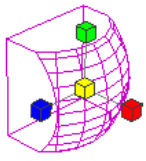


Notice that the Intersection operation displays the result as one entity.

2 Select the object you want to transform from the Hypergraph. For this example, click to select the pCube then select the Scale tool.

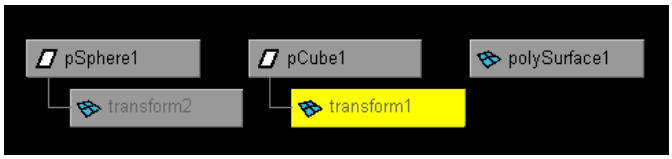


In the view, notice how the object changes color to indicate that you are now working on an object's history nodes.

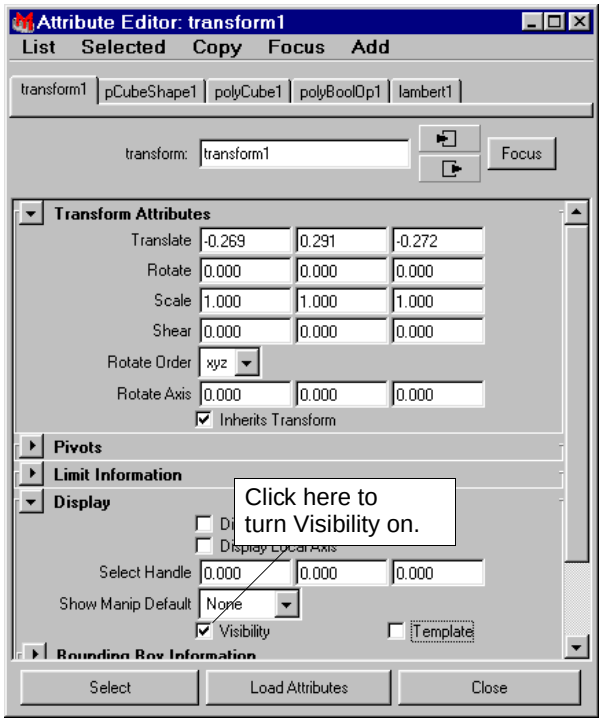


To display the tool object you used when performing the Intersection operation (the cube in this case), all you have to do is select the transform node for the tool object in the Hypergraph, turn Visibility on in the transform node's Attribute Editor, and interactively edit the objects in the view.

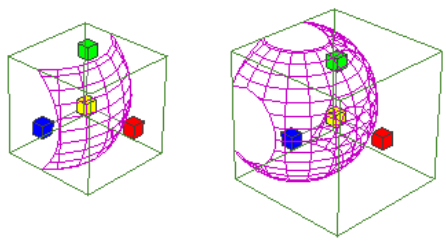
3 Open the Hypergraph and double-click the transform node for the cube. The transform node's Attribute Editor displays.



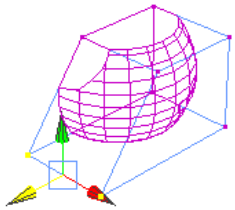
4 In the Attribute Editor, click the transform tab (in this case transform1), click the arrow to open the Display section, and turn on Visibility.



Now you can see the tool object (the cube) and scale it. The Boolean operation constantly updates the original object based on the new transformed tool object.



You can also select the vertices on the tool object and transform them to change the original object. In this example, two vertices were selected and moved. Notice how the original object changes as the vertices move.

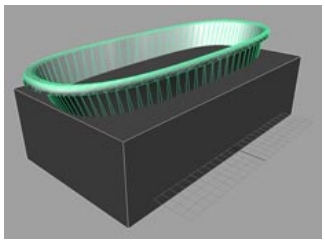


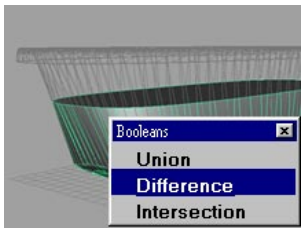
TRIMMING USING POLYGONAL BOOLEAN OPERATIONS

In situations where the model you are working on is a polygonal shape, you can use Boolean operations to perform trim functions.

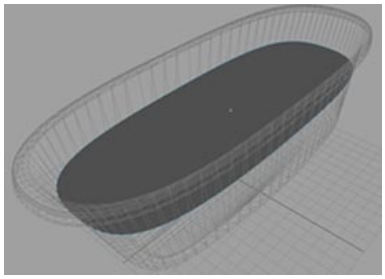
For example, the bathtub in the following example is a polygonal object, and the scene requires that it contain a water surface which is not part of the bathtub data file. To quickly create the water surface, a polygonal cube is positioned in such a way as to “fill” the bathtub object.

The bathtub is duplicated to be used as the tool object, and a Difference Boolean operation is then performed on the cube. The result is the volume of the cube within the bathtub. Notice the original bathtub shape has been templated (using Display > Object Display > Template).



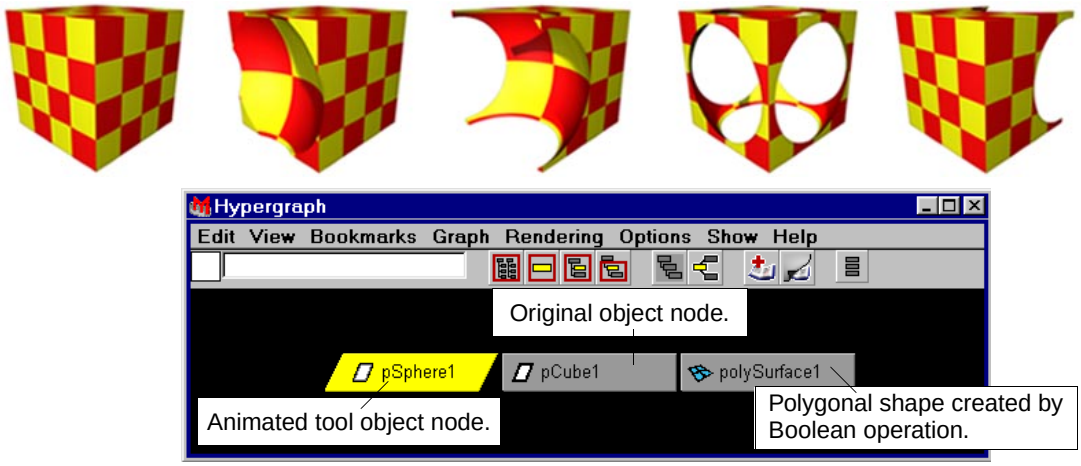


The faces which make up the bottom and sides of the result object can also be deleted, leaving a perfectly trimmed surface for use as the water surface. A displacement shader completes the water surface.



ANIMATING POLYGONAL BOOLEAN OPERATIONS

Boolean operations create new geometry when they are performed. When construction history is maintained, the tool and original object's nodes can be selected and animated, opening up new creative and problem-solving possibilities.



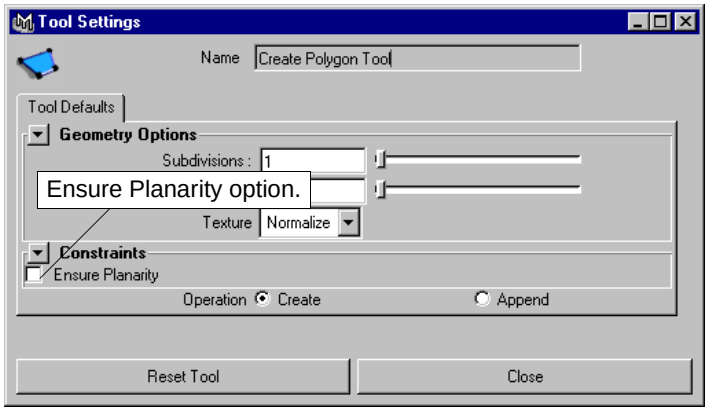
7 SETTING GLOBAL TOOL OPTIONS

The Polygons > Tool Options menu offers a variety of options that you turn on or off to globally set the results of polygonal operations.

KEEPING NEW FACES PLANAR

Turn Polygons > Tool Options > Keep New Faces Planar on if you want to create planar faces each time you create new faces using the Create Polygon Tool and the Append to Polygon Tool. Keep New Faces Planar is off by default.

The Tool Settings window for both these tools include the Constraints option, Ensure Planarity, as shown in the Tool Settings window for the Create Polygon Tool.



If you click Ensure Planarity in the Tool Settings window, Maya sets the Keep New Faces Planar option on or off in the Tool Options menu.

If you click the Keep New Faces Planar option in the Tool Options menu, Maya sets the Ensure Planarity options on or off in the Tool Settings window for both the Create Polygon Tool and Append to Polygon Tool.

See "Ensuring planarity when creating polygons" on page 27 and "Ensuring planarity when appending to polygons" on page 31 in *Chapter 2, "Basic Polygonal Modeling"* for details about the Ensure Planarity option.

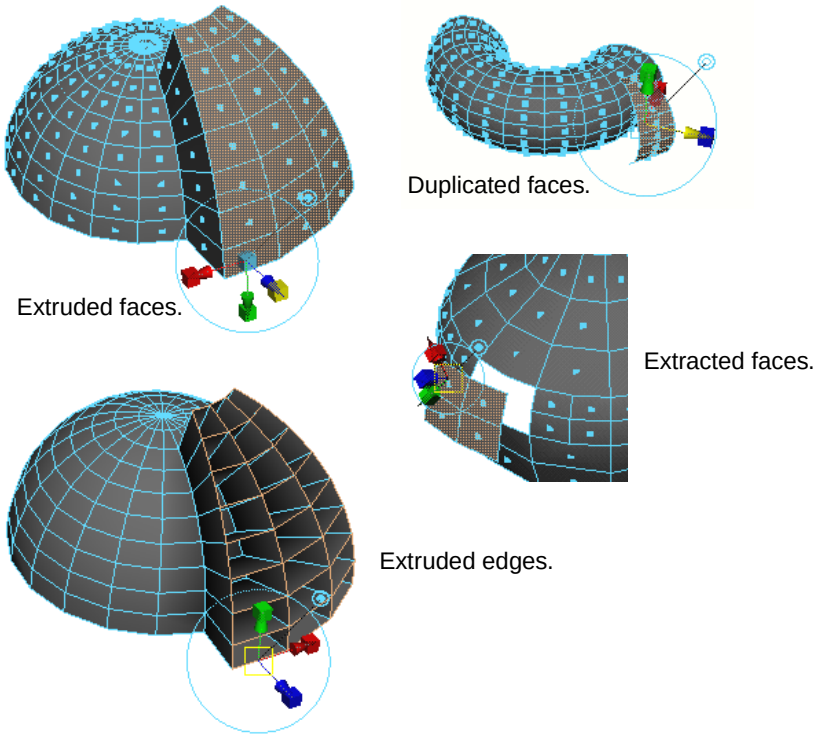
KEEPING FACES TOGETHER

Turn Polygons > Tool Options > Keep Faces Together on or off while you are extruding, extracting, or duplicating faces to specify whether you want to retain the edges of each face or the border edges. By default, this option is turned off.

If on, Maya automatically sets the option in the Attribute Editor and Channel Box for Edit Polygons > Extrude Face, Extrude Edge, and Duplicate Face, and Edit Polygons > Extract. If off, Maya does not set the option.

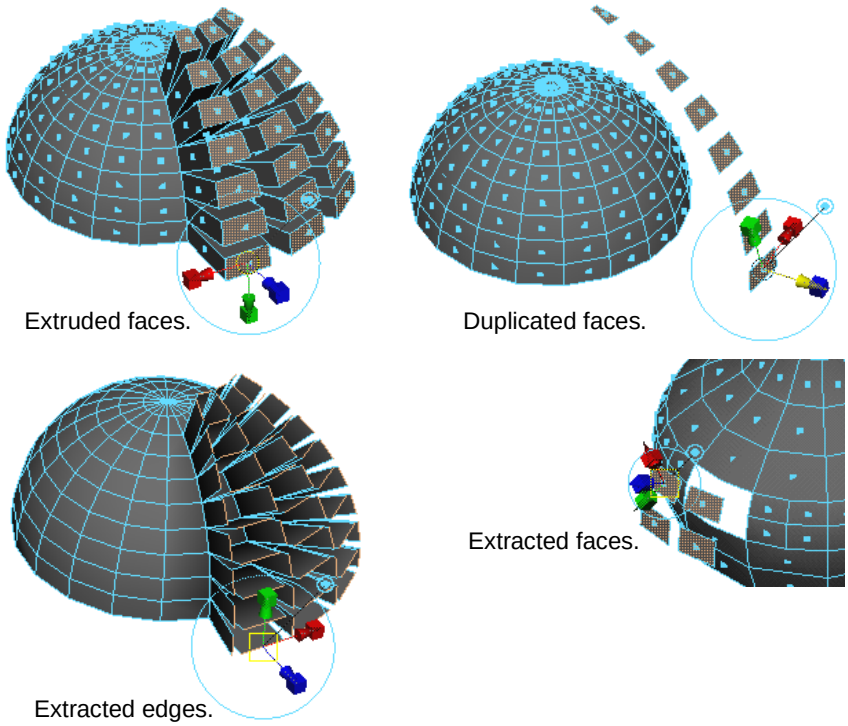
Keep Faces Together on

If you turn Keep Faces Together on, only the border edges make walls as they are extruded, extracted, or duplicated. Faces connected by their edges create a single tube, with the connected faces as a single roof.



Keep Faces Together off

If Keep Faces Together is off, each edge makes a wall as it is extruded. Duplicated faces are duplicated separately, and extracted faces are extracted separately. The faces separate from each other and scale from their own center.



See "Extruding faces and edges" on page 125, "Duplicating faces" on page 129, and in *Chapter 11, "Extruding, Duplicating, and Extracting"* for details about using these operations.

CONVERTING THE SELECTION MODE

When Polygons > Tool Options > Convert Selection is turned on (the default), and you perform an operation on an object requiring components to be selected, Maya automatically converts the object selection mode to the appropriate component selection mode, and proceeds.

For example, if you are in object selection mode and you select a polygonal Plane and try to extrude faces, Maya automatically converts the selection mode to faces, selects all the faces on the selected object, and proceeds.

When Convert Selection is turned off, operations work at the object level. If this is not appropriate for the operation, you will get the message:

```
Warning: Try turning the Polygons->ToolOptions-> ConvertSelection
ON.
```

INSTALLING SMART COMMAND SETTINGS

If you turn on Polygons > Tool Options > Smart Command Settings (it is turned off by default), when you perform polygonal operations from the Polygons or Edit Polygons menu, Maya installs certain settings based on the kind of action being performed.

Maya modifies the following settings:

- Display attributes (for instance, displaying normals or border edges)
- The pick mask (selection mask)
- Applies selection constraints that make sense for the action

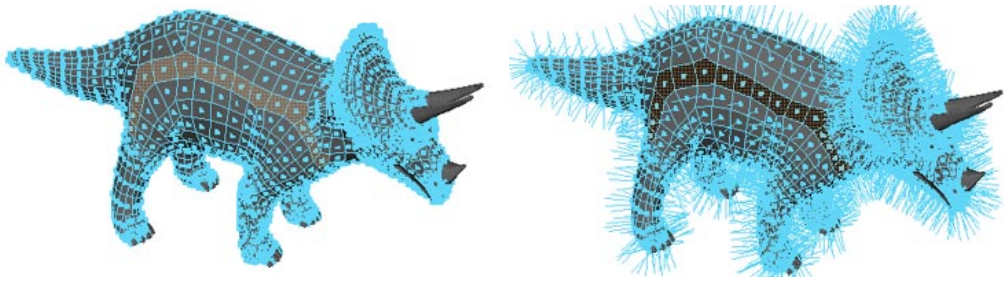
After performing an operation, you can return to the previous state either by selecting the Reset to Default Settings from the Tool Options menu item or by performing another action.

If you do not want this workflow for subsequent polygonal edits and modifications, turn off Smart Command Settings before you perform your next operation.

To display normals using Smart Command Settings:

The following example shows how normals display automatically when you turn on Smart Command Settings.

1. Turn on Smart Command Settings in the Polygons > Tool Options menu.
2. Select a few faces on a polygonal model.
3. Select Edit Polygons > Normals > Reverse. The normals automatically display.



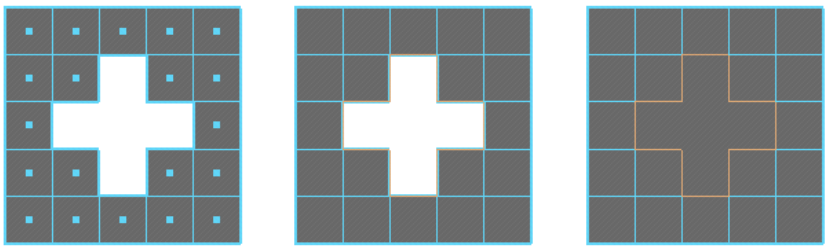
If Smart Command Settings is turned off, to see the normals you have to display them by turning on Normals from the Display > Polygonal Components menu or in the Custom Polygon Display window (Display > Custom Polygon Display ❒).

To constrain the selection using Smart Command Settings:

In this example several holes in a polygonal plane are filled using the Fill Hole operation.

1. Turn Smart Command Settings on.
2. Select Edit Polygons > Fill Hole.

   The border edges highlight around the hole, you only have to click on one edge to select them all, then select Fill Hole to fill the hole.



Border edges highlight around the hole automatically.

Click one edge to select them all.

The hole is filled.

If Smart Command Settings is off, you have to perform two extra steps:

- The border edges around the faces where the hole has been made are not highlighted. To highlight the border edges to be able to see them better, you have to select Display > Polygon Components > Border Edges.
- To fill the hole, you have to select the edges one-by-one.

RESETTING CURRENT COMMAND SETTINGS

Use Polygons > Tool Options > Reset to Default Settings to clear all changes you have made to the actions you performed when using the Smart Command Settings option.

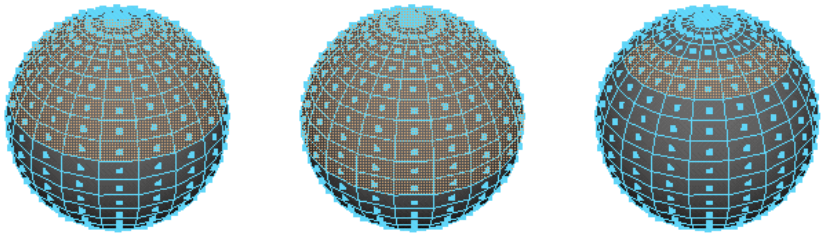
8 SELECTION OPERATIONS

Using Maya's powerful polygon selection operations in the Edit Polygons > Selection menu, you can constrain the selection of components to a specified area of a polygonal model and perform operations on those components in that specified area only without disturbing the rest of the model.

You can also constrain the selection of components to a specified area of a polygonal model so that the operations you perform in that area do not affect the rest of the model.

GROWING AND SHRINKING SELECTIONS

Select Edit Polygon > Selection > Grow Selection Region to increase the number of components you initially selected, or Shrink Selection Region to decrease the number of components you have selected. This works on any component type.

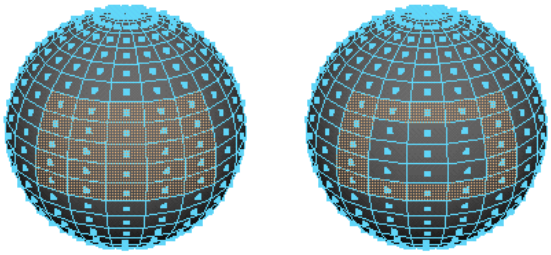


Original selection. Grow Selection Region. Shrink Selection Region.

See also Selecting boundaries next and "Converting the selection mode" on page 97 in *Chapter 7, "Setting Global Tool Options"* for details about how to switch between component selections and defining selection boundaries.

SELECTING BOUNDARIES

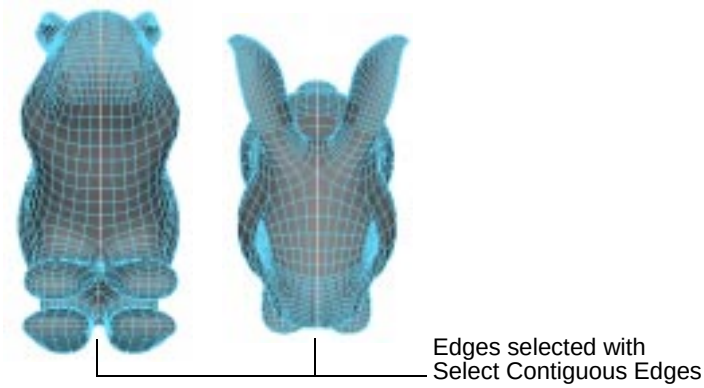
You use Edit Polygons > Selection > Select Selection Boundary to define the boundary of the current selection region. This is a quick way to select the boundaries of whatever is currently selected (faces, vertices, edges, or UVs).



Faces selected. Choose Selection Boundary.

SELECTING A BAND OF EDGES

Use Edit Polygons > Selection > Select Contiguous Edges to select a contiguous band of edges around your polygonal model. For example, to select the edges along the center of a figure, you can select one edge, choose Select Contiguous Edges, and it will select the rest of the edges in the center automatically.



Some practical uses for Select Contiguous Edges include preparation for the Extrude Edge operation and preparation for UV texturing operations that require you to select edges, such as Cut UVs.

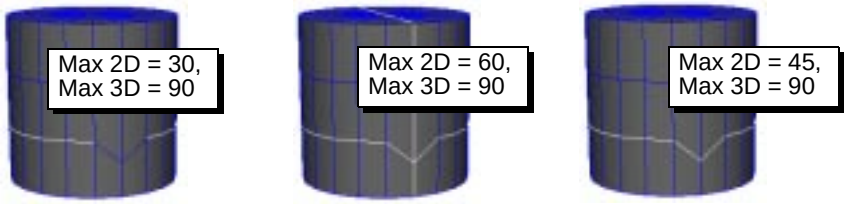
The automatic selection moves outward in either direction from the edge or edges you selected. It includes each contiguous edge if it is within the constraints of the Select Contiguous Edges options.

Select Contiguous Edges options

Max 2D Angle, Max 3D Angle

These settings determine how far the selection continues based on the angles between edges. If Maya is considering an edge for selection and it exceeds the specified angles, automatic selection stops.

The 2D angle refers to angles made by the surface topology, regardless of the surface's shape. The 3D angle refers to angles made by the surface's shape, as measured in world or local space. The following example illustrates how the combination of these settings control the selection.



The Max 2D Angle is too small for this topology and prevents full selection

The Max 2D Angle is too large and causes selection of unwanted edges

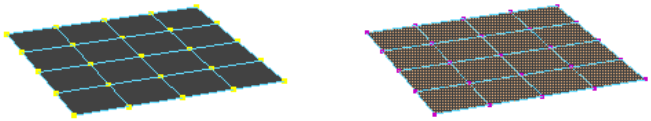
The Max 2D Angle is just right

Edge Count, Edges Either Side

Turn on Edge Count to set the Edges Either Side option. Edges Either Side is the number of edges that Maya will select on either side of your original selection. For example, you can avoid selecting too many edges by setting Edges Either Side to a low number and applying Select Contiguous Edges several times until enough edges are selected.

CONVERTING THE SELECTION TO ANOTHER COMPONENT

If you selected components (for example, vertices), but want to change the selection to another component type (for, example, faces), use the Convert Selection options on the Edit Polygons > Selection menu. You can convert your selection to faces, edges, vertices, or UVs.



Vertices selected.

Convert Selection to Faces.

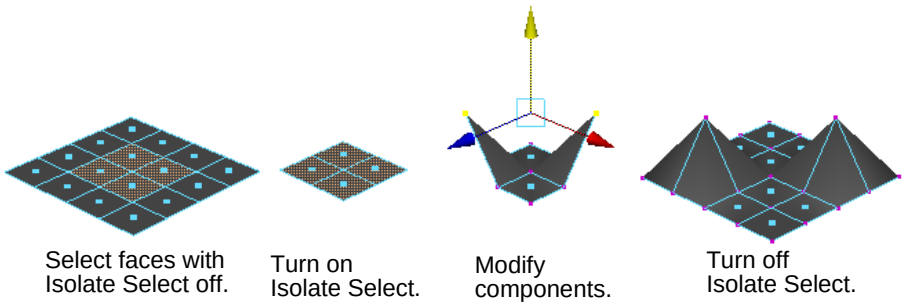
To convert a selection:

1. Select the components.
2. Select Edit Polygons > Selection and then select the appropriate Convert Selection option.

DISPLAYING ONLY SELECTED POLYGONAL FACES

Using Isolate Select you can simplify your view by displaying only those faces you select. Once you have isolated the faces, you can edit them in any other polygon component mode without viewing the rest of the scene.

For more information on Isolate Select, see *Using Maya: Essentials*.



To isolate the view to selected faces:

1. Select the faces you want to view in isolation.
2. On the view menu bar, select Show > Isolate Select > View Selected to turn it on. All other faces and components in the scene become hidden in that view.

   You can now work on these faces in isolation from the other faces and components in the scene.

To view all faces:

- On the view menu bar, select Show > Isolate Select > View Selected to turn it off. All faces and components in the scene display.

USING SELECTION CONSTRAINTS

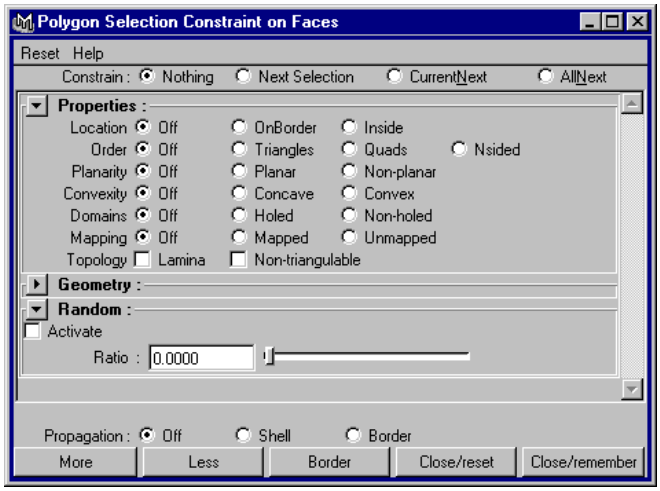
You set and choose selection constraint options from the Polygon Selection Constraint window (Edit Polygons > Selection > Selection Constraints). Depending on what component mode you are in, the window changes accordingly.

Selecting constraint components

Depending on whether you select vertices, edges, faces, or UVs, the corresponding options display in the Polygon Selection Constraint window. The following procedure shows the Polygon Selection Constraint window for selected faces.

To set selection constraints:

1. Select a polygonal object to apply constraints to.
2. Make sure you are in a component selection mode (see previous).
3. Choose Edit Polygons > Selection > Selection Constraints.
4. Click the arrows to open the sections of the window where you can specify various selection constraint areas and conditions.



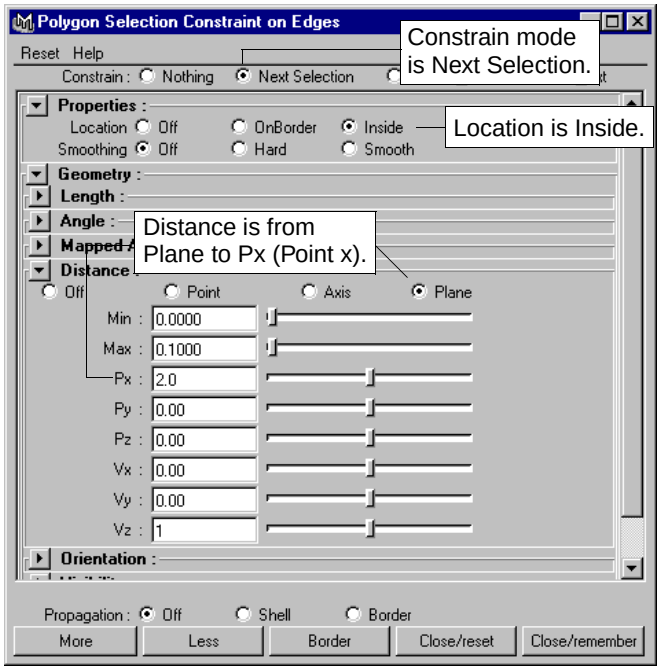
5 Apply the constraints to the chosen components, then use a tool or operation on those components. See the following example.

To constrain specific edges to delete:

1 Make sure you are in the edges component selection mode. (Select the Lines selection mask icon on the Status Line, press the right mouse button and select Poly Edges.)

2 In the Polygon Selection Constraint window, set the options to constrain a selection area.

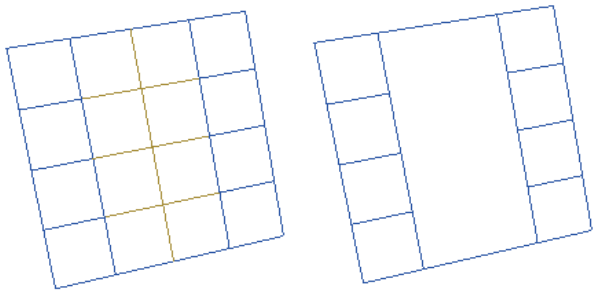
The following example shows a simple selection constraint setup for edges where most of the defaults have stayed the same with the following exceptions:



3 Once the options are set, marquee-select the plane. Notice only those areas specified in the window are selected.

4 Use Edit Polygons > Delete Edge. Maya deletes only the selected edges.

See the following example.



Resetting selection constraint options

You may set a number of selection Properties options in the Polygon Selection Constraint window and then want to change your property selection yet retain the values you set in the various sections of the window for other component types.

You can turn off all Properties constraints at once without resetting those values by selecting Reset > Disable All at the top-left of the window.

Polygon selection constraint options

The Polygon Selection Constraint window changes according to the type of component you select. The following section describes all the options applicable to all component types.

Important Tip!

To completely reset all the settings in this window, select Polygons > Tool Options > Uninstall Current Settings.

Generic selection constraint options

At the very top of the window in the Constraint list, you set up conditions to filter your selection actions in different ways. These options apply to all component modes. Click the option to make your selection. Which constraints will be applied, and to what settings, is determined by the options you set. There are four different modes:

Nothing When on, no selection constraints are used.

Next Selection When on, the constraints affect only the next selection mode with a technique such as holding the Shift key and clicking the left mouse button.

Current Next When on, Maya applies the constraint to whatever has already been selected, plus whatever selection you make next.

All Next When on, Maya applies the constraints to the entire object automatically, plus whatever group you select next.

Important!

To be sure you are applying constraints, set the Constrain mode to All Next. To avoid any side effects, make sure to turn off other constraints that may affect what you are trying to do unless you also want to apply those other constraints. When you know that you are not applying a constraint, set Constrain to Nothing, meaning the item(s) you are going to select will not be affected by constraints.

Constraint Properties options

The following section describes the options you can set for selected components in the properties section of the window.

Generic Location properties

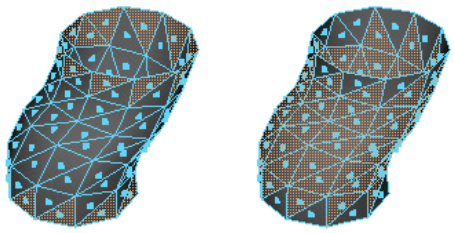
The following options are applicable to all component types.

Location

Off — If selected, this constraint is not taken into account. The Off option means the same for every option in the Properties section.

On Border — If on, the selection constrains to only the items on the perimeter of the current objects.

Inside — This is the default setting for Location properties. Maya selects only the items on the inside of the current objects. It has the reverse effect of On Border.

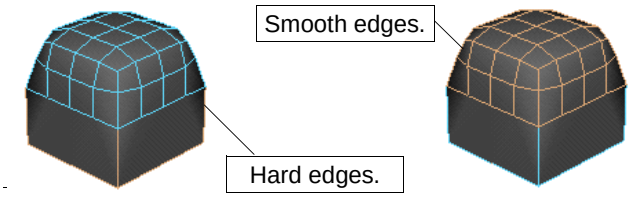


Smoothing properties (for edges only)

If you select edges, Smoothing options are made available. These Properties options do not display for any other component type.

Smoothing

Hard/Smooth — Click one of these options to constrain the selection to either hard or soft edges.



Constraint Properties for faces

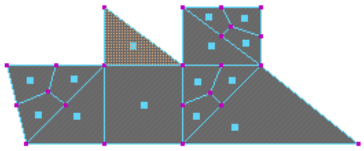
In addition to the properties that all component modes share, when you are in the face component mode, Maya provides numerous face-specific properties. For example, you can set options to select faces according to order, planarity, and shape— if a polygon is concave instead of convex—as well as mapping and topology.

These are described next.

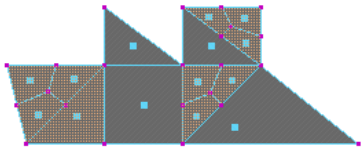
Order

Order options are used to set a valid range for the shape of the faces. If the following options are on, Maya constrains the selection to what you specify.

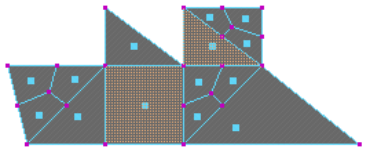
Triangles Maya only selects faces with three edges.



Quads Maya only selects faces with four edges.

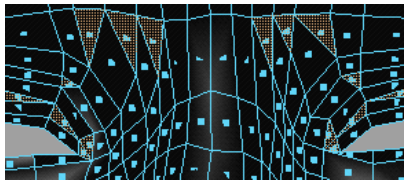


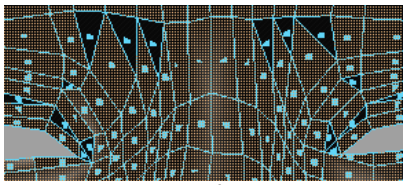
Nsided Maya only selects faces other than triangles or quads (faces that have more than four edges).



Planarity

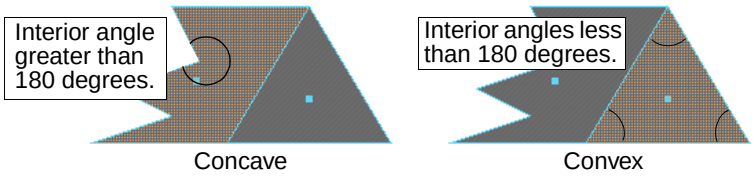
Planar/Non-planar Planar selects only planar faces. Non-planar selects only non-planar faces.


Planar


Non-planar

Convexity

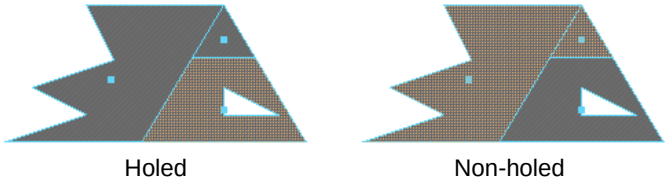
Concave/Convex Concave selects polygons that have at least one interior angle greater than 180 degrees. Convex selects polygons whose interior angles are all less than or equal to 180 degrees.



Domains

Holed/Non-holed

If you select non-holed, only faces that do not have holes are selected. If you select Holed, only faces in which holes have been created (using the Edit Polygons > Make Hole Tool) are selected.



Note

Holed faces are considered concave.

Mapping

Mapped/ Unmapped

Depending on what you choose, only mapped or unmapped faces are selected. Mapped faces are faces with texture (UV) coordinates—unmapped faces do not have texture (UV) coordinates.

Topology

Lamina

A group of faces glued on top of each other are selected. For example, two faces whose normals face each other.

Non-triangulable

Lets you select faces that cannot be triangulated. Use this constraint option to select these problem faces, then repair them using the Split Polygon Tool (Edit Polygons > Split Polygon Tool). See *Chapter 14, "Splitting and Subdividing Polygons"* for details.

Geometry options

The following table lists the various Geometry sections of the Polygon Constraint Selection window. In the window, click the arrow to display the section. The options available depend on the current component mode.

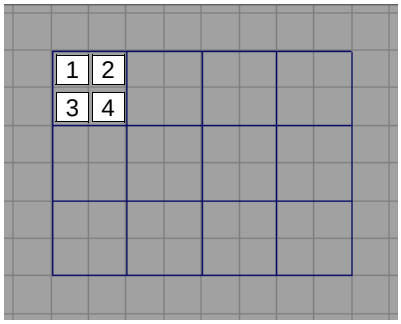
OPTIONS	SET FOR:	PAGE
Area	Faces	111
Neighbors	Vertices and UVs	112
Length	Edges	112
Angle	Edges, vertices, and UVs	112

Mapped Area	All components	113
Distance	All components	113
Orientation	Faces, edges, and vertices	113
Visibility	Faces, edges, and vertices	113
Random	All components	114

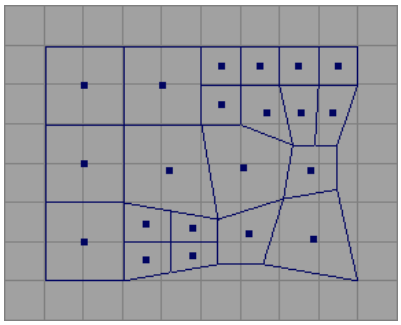
Changing Min and Max values

The Min and Max values for most of the Geometry options correspond to the units of a polygonal face. The values you set constrain the selection to the size of the face that corresponds to those units. The default unit size is in centimeters by default. You can change this in the Preferences window (Window > Settings / Preferences > Preferences, then click the Settings category).

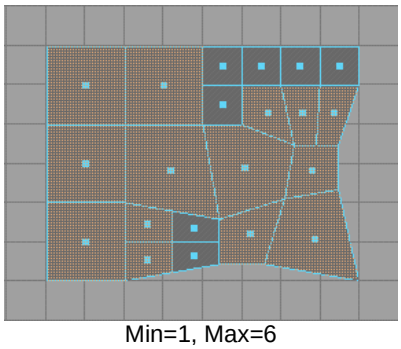
In this example, each face of a polygonal primitive plane is four units. You can determine this by looking at the squares of the grid within each face.



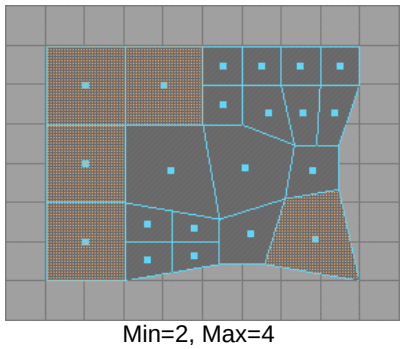
When you scale some of the faces and subdivide others, the topology changes as do the Min and Max values you can enter to constrain the selection area.



Try setting different Min and Max values for the Area option for faces, for example, to determine which faces fall within the Min / Max criteria determined by the unit size.

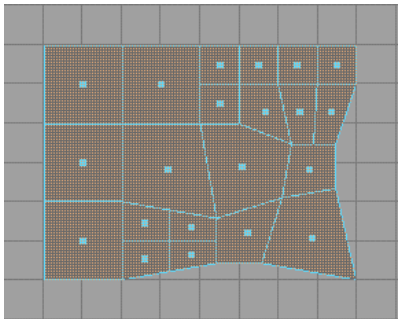


Min=1, Max=6



Min=2, Max=4

If you set the Area criteria to a Min value of 0 and a Max value of 7, all faces are selected because there are no faces with a unit area less than 0 or greater than 7.



Min=0, Max=7

Important tip!

If you want to constrain the selection for a unit area that is very small, such as the area under the eyes on a polygonal modeled face, set the Min and Max values to a small value. The opposite is true if you want to set the constraint area to the cheeks of the face where the faces cover more unit space.

Options common to all Geometry sections (Activate and Off)

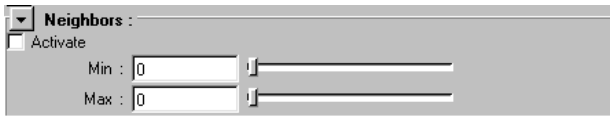
Each section contains an Activate switch or an Off option.

- Click Activate (to turn it on) to tell Maya to acknowledge these option settings when making your selections.
- Click Off (to turn it on) to tell Maya not to acknowledge these option settings when making your selections.

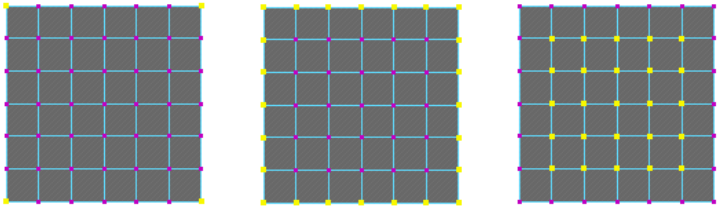
Setting Area options for faces

Maya selects the faces with an area that is within the range specified in the Min and Max boxes. See "Changing Min and Max values" on page 110 for details about using these values.

Setting Neighbors options for vertices and UVs

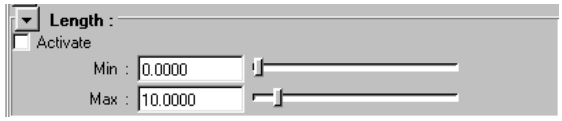


Maya selects the vertices with no fewer than the Min number of edges connected to them and no more than the Max number of edges connected to them.



Min=1, Max=0 Min=1, Max=3 Min=4, Max=7

Setting Length options for edges



Maya selects the edges whose lengths are within the range specified in the Min and Max boxes.

Tip

Use this selection constraint option after collapsing edges (Edit Polygons > Collapse) to remove the extra tiny edges sometimes produced as a result of converting a NURBS object.

Setting Angle options for edges, vertices, and UVs

In the case of edges, Maya selects them according to the Min and Max range you set for the angle between them.

In the case of vertices, Maya selects them according to the range you set for the angle between the edges joining them.

In the case of UVs, Maya selects them according to the range set for the angle between the edges joining the UVs corresponding to vertices.

Tip

This option works only for non-border edges.

Setting Mapped Area options

These options are used to control the area range of components that are flattened out in the UV Texture Editor window.

Unsigned If on, Maya selects all faces whose flattened areas (whether they are positive or negative) are within the minimum and maximum values you set. Unsigned tells Maya to ignore the direction the face normal is facing.

Signed If on, Maya selects all faces whose normals are pointing in the same direction and whose flattened areas are within the minimum and maximum values you set.

Min/Max values You can enter the minimum (Min) and maximum value (Max) for this area which lies in the UV plane. The mapped area of a flattened component can be positive or negative. It is positive if the face is seen from the front and negative if seen from the back.

Setting Distance options

These options are used to set a reference point and a valid range for the distance between the component, (such as the face center) and the point you specify.

Point The Point option determines whether Maya acknowledges the distance to the origin you specify (the P, or PointX, PointY, or PointZ values).

Axis The Axis option determines whether Maya acknowledges the distance to the line defined by its origin (P) and its axis (V).

Plane The Plane option determines whether Maya acknowledges the distance to the plane defined by its origin (P) and its normal (V).

Px, Py, Pz These values are used to define the location of the point from which you want the selection to extend.

Vx, Vy, and Vz If Axis is selected, these values define the axis along which the selection is made. If Plane is selected, these values define the normal vector along which the selection is made.

Setting Orientation options for faces, edges, and vertices

Orientation The Orientation option determines whether Maya uses the orientation of the component for the selection.

Direction The Direction option determines whether Maya uses the direction of the component or the selection. Using this option, even two faces facing opposite each other can be selected.

Vx, Vy, and Vz These values define the axis along which the selection is made.

Setting Visibility options for faces, edges, and vertices

These options are used to set a target point and a focal angle for your selections. Maya selects a component if the target point can be viewed from the center of a face with its normal as the viewing axis (the Px, Py, and Pz values) and the angle as the field of vision.

Angle This value determines a focal angle for selected components.

Px/Py/Pz The Px value determines the location of the target point in the X axis, the Py value for the Y axis, and the Pz value for the Z axis.

Setting Random options

Ratio This value determines how many components to randomly select according to the ratio value you set within the face units. For example, 0=no faces, 1=all faces, or 0.5=50% of the faces.

Propagation options

You can extend your selection using the propagation options at the bottom of the window.

Off This option is on by default. That means that no extensions are performed.

Shell Select Shell to extend the selection up to the border of the individual piece within which the selection has been made. This option is useful for objects made from a series of individual pieces such as those produced when you use Polygons > Combine.

Border Choose Border to select the border of the current selection only.

Tip

With Constrain set to All Next, select Inside as the Properties Location and Propagation Shell at the bottom of the Constraints window, then click a single face to selects all the faces that are inside your object.

More, Less, Border buttons

These buttons work the same way as the Edit Polygons > Selection menu items, Grow Selection Region, Shrink Selection Region, and Select Selection Boundary.

- Click More to increase the number of components you initially selected.
- Click Less to decrease the number of components you have selected. This button can be useful if you want to shave off one face around every face in the current selection.
- Click Border to define the boundary of the current selection region. This is a quick way to select the boundaries of whatever is currently selected (faces, vertices, edges, or UVs).

9 CONVERTING NURBS TO POLYGONAL GEOMETRY

This chapter shows you how to create polygonal models from NURBS geometry using the NURBS to Polygons operation.

CONVERTING NURBS TO POLYGONS

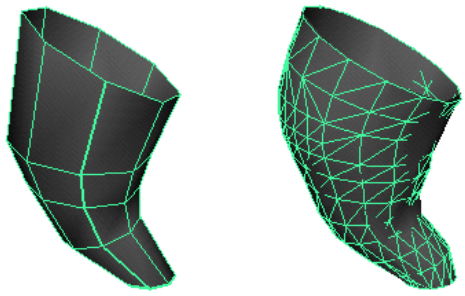
Use Modify > Convert > NURBS To Polygons to convert NURBS surfaces to polygonal geometry. You can convert any NURBS surfaces created in Maya or imported surfaces, including trimmed surfaces.

If the NURBS surface has a texture applied to it, this texture is assigned to the new polygonal object. The NURBS to Polygons action bakes the NURBS UV values onto the corresponding polygonal vertices.

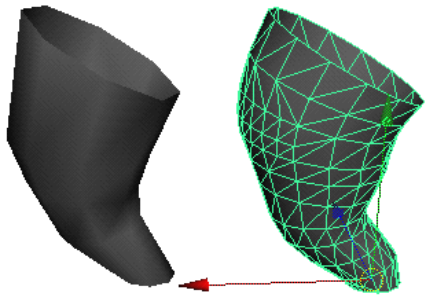
Use the options in the options window to specify the resulting polygonal output. You can also change the result in the Channel Box or Attribute Editor.

To convert NURBS geometry to polygonal geometry:

1 Select the NURBS surface then select Modify > Convert > NURBS To Polygons. A polygonal representation of the surface is created on top of the NURBS surface.



Use Maya's Move tool to move the new polygonal surface to the side if you want to re-convert the NURBS surface again using different option settings. You can then pick and choose the polygonal surface you want.



Note

If you convert the NURBS surface while construction history is on, you can edit the surface and the polygonal surface will be recreated to match the edited NURBS surface.

If you convert the NURBS surface while construction history is off, changes you make to the NURBS surface will not be reflected on the polygonal surface (in which case you may want to delete the NURBS surface after creating the polygonal one).

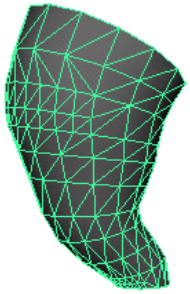
USING NURBS TO POLYGONS OPTIONS

Select Modify > Convert > NURBS to Polygons ❐ to open the options window.

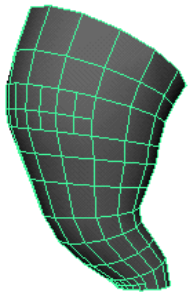
Outputting to triangles or quads

Type Select the type of polygons to use when you convert NURBS geometry to polygonal data.

If you select Triangle (the default), 3-sided polygons are created. If you select Quads, 4-sided polygons are created.



Triangle polygon type.



Quad polygon type.

Note

When you tessellate a trimmed NURBS surface, some 3-sided (triangle) polygons may be created along the trim edge even when the option is set to Quads.

Choosing a tessellation method

Tessellation means that you create a set of polygons from NURBS geometry. Each tessellation method provides you with options that let you control the resulting polygonal surface.

There are four tessellation methods: Standard fit, General, Count, and Control Points.

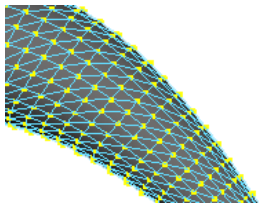
Standard fit

Standard Fit is the default tessellation method. It is "adaptive" tessellation, meaning that the following options are used to determine when to stop the tessellation.

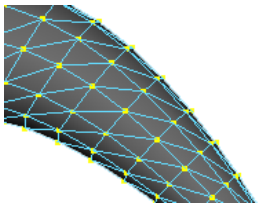
For example, the tessellation stops at the Fractional Tolerance value you set. If there is an edge shorter than the Minimal Edge Length, the tessellation stops on that edge. If the surface is flat enough within the edge (the specified chord / height ratio is small enough), the tessellation stops there.

Chord Height Ratio

The Chord Height Ratio is the ratio between the maximum distance of the curve from the polygon edge used to approximate it and the chord length. The chord length is the linear distance between two polygon vertices.



Chord Height Ratio value 0.05.



Chord height Ratio value 0.1 (default).

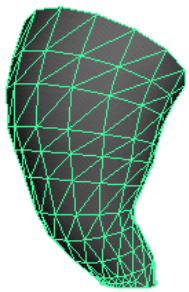
Valid values range between 0 and 1, where larger values result in fewer polygon vertices.

For example, the default value, 0.1, means that the height must be larger than 1 / 10 of the chord length before additional edit points are created.

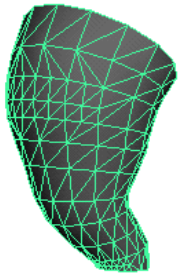
Fractional Tolerance

The Fractional Tolerance value determines the degree of accuracy maintained between the original surface and the interpolated polygonal surfaces. The default is to be accurate to within 0.01 units, where a unit refers to the current unit of linear measure (the default unit of measure is centimeters). Therefore, at no point will the polygonal surface be more than the tolerance distance away from the original NURBS surface.

In this next example, notice how you can enhance the polygonal surface's accuracy when you change the Fractional Tolerance value from 1 to 0.01.



Value set to 1.0.



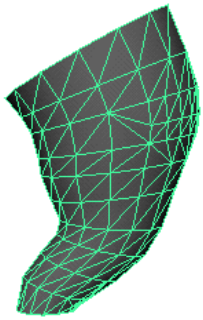
Default Fractional Tolerance value (0.01).

Minimal Edge Length

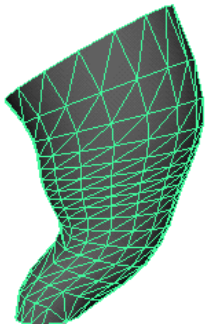
Enter a value or use the Minimal Edge Length slider to set the minimum length of the edges of the triangles or quads that are created.

3D Delta

The 3D Delta value determines the 3D spacing for U and V isoparms on a surface that makes up the initial grid for the tessellation. In the following example, the 3D Delta value is changed from the default 0.1 to 1.0.



3D Delta default value 0.1.



3D Delta value changed to 1.0

General

Set the Tessellation Method to General to display the following options.

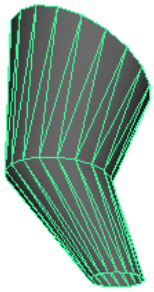
Setting the initial tessellation controls

Unless Use Chord Height or Use Chord Height Ratio is turned on, a uniform tessellation is performed. Each span / surface is split into a number of polygons depending on the Number U and V values you set.

U Type/V Type

The U Type and V Type pop-up menu items let you specify whether you want to split the surface based on where the spans are (then split each span), or based on the parameterization of the whole surface.

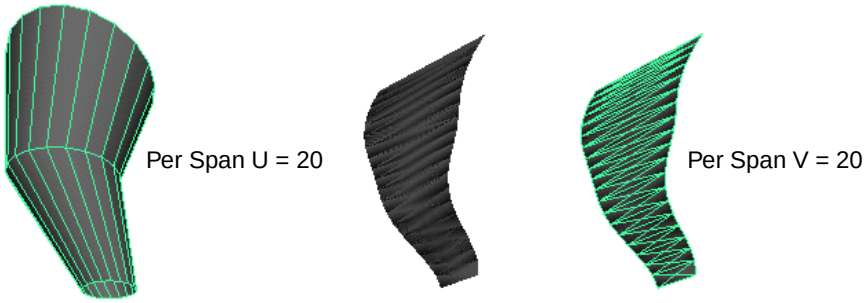
Per Surf U value = 3



Per Surf U value = 20

Number U/Number V

Each span or surface is split into the number of polygons you specify here.



Specifying the secondary tessellation controls

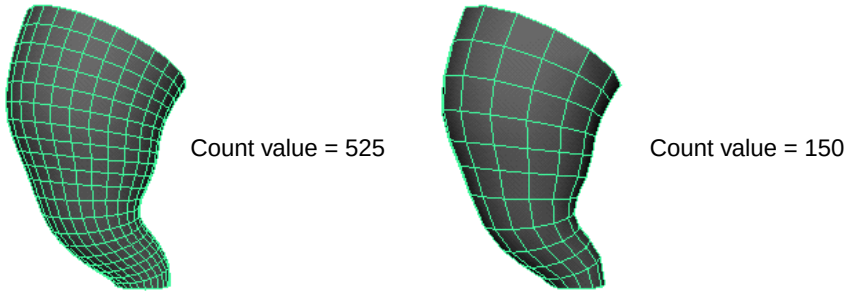
If Use Chord Height or Use Chord Height Ratio is turned on, you can set a specific value for both the Chord Height and the Chord Height Ratio. A value greater than 0 results in fewer polygon vertices if the ratio on the curve is greater than the current value. For example, the default value, 0.1, means that the height must be larger than 1/10 of the chord length before additional edit points are created.

Turn Edge Swap on to produce triangles with the opposite orientation for the final quadrilateral.

Count

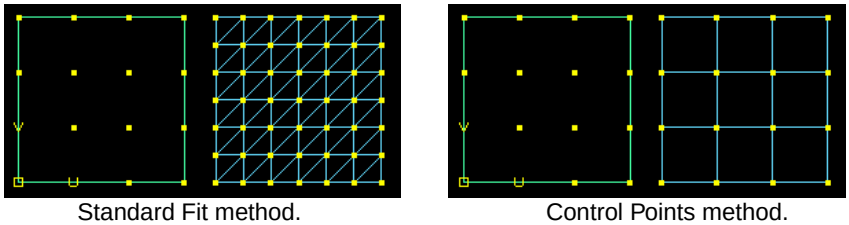
Set the Tessellation Method to Count to display the following slider.

Count slider Use the Count slider to determine how many polygons the surface can be tessellated into. See the following examples.



Control Points

This tessellation method converts the NURBS model to polygons while matching the CVs of the original NURBS surface. There are no other options for this operation.



Standard Fit method. Control Points method.

Notes

When you use the Control Points Tessellation Method:

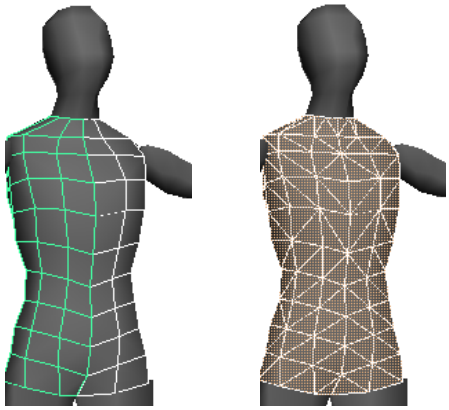
- The Type option you set is ignored and the resulting polygon is in Quads by default.
- If you convert trimmed NURBS surfaces the surfaces convert as though they were not trimmed.

10 TRIANGULATING AND QUADRANGULATING POLYGONS

This chapter provides information on how to triangulate, or break polygons down into triangles and quadrangulate, or merge triangles of a polygonal object into four-sided faces.

TRIANGULATING POLYGONS

Use Triangulate to break polygons down into triangles. This ensures that all your polygons are planar and without holes. Triangulation ensures proper rendering of non-planar faces.



Before Triangulating. After Triangulating.

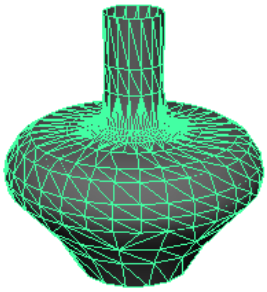
To triangulate faces:

1. Marquee-select the faces you want to triangulate, or press F11 and Shift-click to select individual faces.
2. Select Polygons > Triangulate.

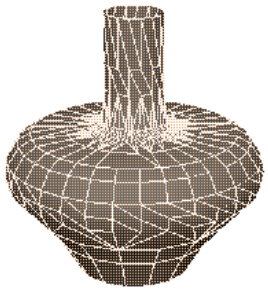
QUADRANGULATING POLYGONS

Use Quadrangulate to merge triangles of a polygonal object into four-sided faces.

By default, when you convert NURBS geometry to polygonal geometry, the tessellation type is triangles. Although you can change this in the NURBS to Polygon options window before converting, there may be times when you have either forgotten to or have specified triangles for a specific reason, like texturing. This operation lets you change the topology of your model from triangles into quadrangles.



Before Quadrangulating.



After Quadrangulating.

Quadrangulating can also be a good way to clean up polygons or reduce the number of polygonal faces.

To quadrangulate polygons:

1. Marquee-select the faces or sets of faces you want to quadrangulate, or press F11 and Shift-click to select individual faces.
2. Select Polygons > Quadrangulate.

Quadrangulate Face options

Select Polygons > Quadrangulate ❐ to display the options window.

Angle Threshold

Use the slider or type a value to set the limit beyond which two triangles are merged or not (where the limit is defined by the angle between the face normals of adjacent triangles). If Angle Threshold is 0, only co-planar triangles are merged. The maximum angle is 180 degrees. A value of 180 degrees means that all possible pairs of adjacent triangles are converted into four-sided faces.

Keep Face Group Border

Turn this option on to maintain the borders of face sets. If turned off, the borders of face sets can be modified. This option is on by default.

Keep Hard Edges

Turn this option on to maintain hard edges. If turned off, hard edges can be deleted between two triangles. This option is on by default.

Keep Texture Border

Maya maintains the borders of texture maps when this option is turned on. If off, the borders of texture maps can be modified. This option is on by default.

World Space Coords

If turned on (the default), the specified Angle Threshold value is the angle between the face normals of adjacent triangles in world space. When turned off, the Angle Threshold value is the angle between the face normals of adjacent triangles in local space.

11 EXTRUDING, DUPLICATING, AND EXTRACTING

This chapter provides information on how to extrude faces and edges, and how to duplicate, and extract faces.

EXTRUDING FACES AND EDGES

You can pull faces and edges out from polygonal objects using the Extrude Face and Extrude Edge commands. For details, see:

- "Extruding faces" on page 125
- "Extruding edges" on page 127

Extruding faces

You can extrude faces either interactively or directly through the options window. If you prefer to set the options first and then extrude the faces, select Edit Polygons > Extrude Face ❐, set whatever options you need, and click the Extrude Face button.

To extrude faces:

In the following examples, faces are extruded interactively using manipulators.

1 Select the faces of the object you want to extrude. Press the right mouse button and select Face from the marking menu or press F11.

- If you want to extrude all the faces of an object, marquee-select the whole object to highlight the faces.
- If you want to extrude certain areas of an object, Shift- or Ctrl-click to select those faces only.
- If you want to extrude, duplicate, or extract multiple faces together, turn on Polygons > Tool Options > Keep Faces Together. You can change this option in the Attribute Editor or Channel Box after performing the extrude.

Tips

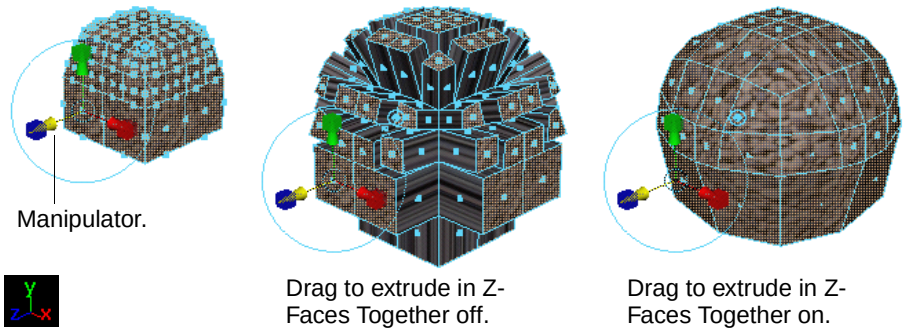
- If you set Keep Faces Together on in the Polygons > Tool Options menu, the options window automatically updates to turn this option on for Extrude, Extract, and Duplicate Face.
- You can change the way you select faces by setting Select Faces With to Center or Whole in the Selection Preferences window (Window > Settings / Preferences > Preferences, then click Selection).
- Press Ctrl-Shift to add faces to your selection, Ctrl to remove faces from a selection, and Shift to switch between selections without affecting the rest of the object.

2 Select Edit Polygons > Extrude Face. A manipulator displays, which you can use to interactively extrude the faces. The manipulator handles correspond to the X, Y, and Z directions indicated at the bottom-left of the view. Like the standard transform manipulator, you can move, scale, and rotate with it. You can also change its pivot. Unlike the standard transform manipulator, you can also switch between global and local modes. For more information, see "Switching between local and global modes" on page 56.

3 Drag a manipulator handle to transform the extrusion of the face or faces you selected.

The Faces Together option is turned off by default the first time you extrude. Turn this option on if you want to extrude all the faces together. See "Keeping faces together" on page 130 for more information.

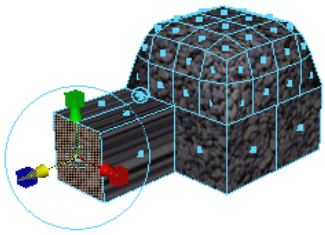
The following example shows all faces translated and extruded in the Z direction.



Tip

If you lose the manipulator display, click the Show Manipulator icon in the Tool Box. 

The following example shows only one face selected, translated, and extruded in Z.



If you are not satisfied with the results, press the z key or select Undo from the Edit menu, change the extrusion settings in the Channel Box or Attribute Editor and press Enter.

Extruding edges

You can extrude edges either interactively or directly through the options window. If you prefer to set the options first and then extrude the edges, select Edit Polygons > Extrude Face ❐, set whatever options you need, and click the Extrude Edges button.

Note

Extruding edges can make your geometry nonmanifold. For information on nonmanifold geometry, see "Valid and invalid polygonal geometry" on page 19. To correct nonmanifold geometry, perform a cleanup. For details, see "Cleaning up polygonal data" on page 40.

To extrude edges:

In the following examples, edges are extruded interactively using manipulators.

1. Select the edges of the object you want to extrude. Press the right mouse button and select Edge from the marking menu or press F10.

- If you want to extrude all the edges of an object, marquee-select the whole object to highlight the edges.
- If you want to extrude certain areas of an object, Shift- or Ctrl-click to select those edges only.
- If you want to keep together the new faces created by the extrude, turn on Polygons > Tool Options > Keep Faces Together. You can change this option in the Attribute Editor or Channel Box after performing the extrude.

Tips

- If you set Keep Faces Together on in the Tool Options menu, the options window automatically updates to turn this option on for Extrude, Extract, and Duplicate Face.
- Ctrl-click to add edges to your selection, Shift-click to switch selected or not-selected without affecting the rest of the object.

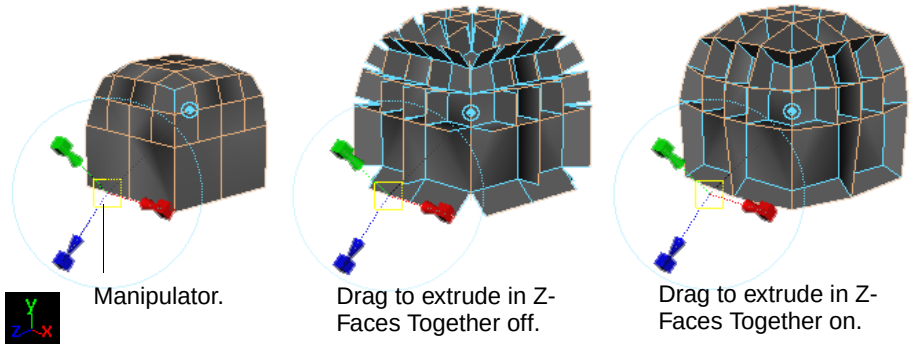
2. Select Edit Polygons > Extrude Edge. A manipulator displays, which you can use to interactively extrude the edges. The manipulator handles correspond to the X, Y, and Z directions indicated at the bottom-left of the view. Like the standard transform

manipulator, you can move, scale, and rotate with it. You can also change its pivot. Unlike the standard transform manipulator, you can also switch between global and local modes. For more information, see "Switching between local and global modes" on page 56.

3 Drag a manipulator handle to transform the extrusion of the edges you selected.

The Faces Together option is turned off by default the first time you extrude. Turn this option on if you want to extrude all the edges together. See "Keeping faces together" on page 130 for more information.

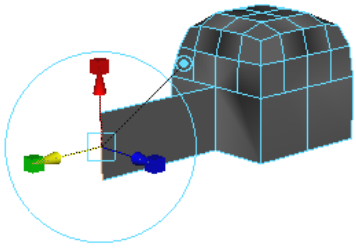
The following example shows all faces translated and extruded in the Z direction.



Tip

If you lose the manipulator display, click the Show Manipulator icon in the Tool Box. 

The following example shows only one edge selected, translated, and extruded in Z.



If you are not satisfied with the results, press the z key or select Undo from the Edit menu, change the extrusion settings in the Channel Box or Attribute Editor and press Enter.

DUPLICATING FACES

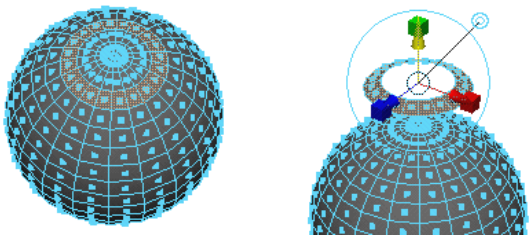
You can duplicate and transform faces either interactively or directly through the options window. In the following examples, faces are duplicated by setting the options first in the options window and clicking the Duplicate button.

To duplicate faces:

1. Select the faces of the object you want to duplicate. Press the right mouse button and select Face from the marking menu or press F11.
   - If you want to duplicate all the faces of an object, marquee-select the whole object to highlight the faces.
   - If you want to duplicate certain areas of an object, click to select those faces only.
2. Select Edit Polygons > Duplicate Face. The selected faces are duplicated and the duplicates transformed according to the options set in the options window. By default, Duplicate also separates the extracted faces. (Separate Extracted Faces is turned on in the options window.)

   You can also use the manipulator handles to interactively transform the duplicated faces. Like the standard transform manipulator, you can move, scale, and rotate with it. You can also change its pivot. Unlike the standard transform manipulator, you can also switch between global and local modes. For more information, see "Switching between local and global modes" on page 56.

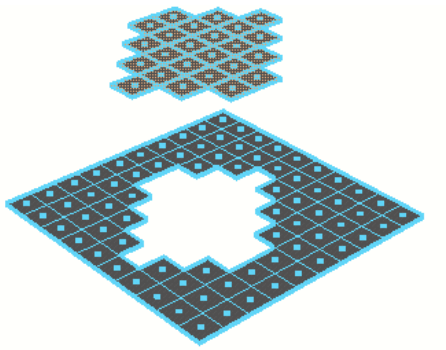
   This example shows multiple faces duplicated in global mode with faces kept together (see "Keeping faces together" on page 130 for details). The global translate Y value in the options window is set to 5.0.



EXTRACTING FACES

When you use Extract, Maya disconnects the selected faces from the original shape, by duplicating the appropriate edges and vertices. The extracted faces become their own shell within the object. This is another way to make holes in the object while retaining the original faces.

By default, Extract also separates the extracted faces. (Separate Extracted Faces is turned on in the options window.) Separating the extracted faces creates distinct polygons out of the faces and the original object.

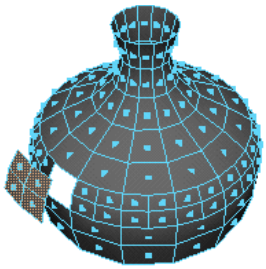


To make it easier to see the border edges, open the Custom Polygon Display Options window and beside Highlight, turn Border Edges on (Display > Custom Polygon Display ❒). Increase the Border Width too if necessary.

To extract faces:

1. Select the faces of the object you want to extract. Press the right mouse button and select Face from the marking menu or press F11, then Shift- or Ctrl-click to select the faces.
2. Select Edit Polygons > Extract. The selected faces are extracted and the extracted faces transformed according to the options set in the options window. You can also use the manipulator handles to interactively transform the extracted faces. Like the standard transform manipulator, you can move, scale, and rotate with it. You can also change its pivot. Unlike the standard transform manipulator, you can also switch between global and local modes. For more information, see "Switching between local and global modes" on page 56.

   This example shows four faces extracted in local mode with faces kept together (see "Keeping faces together" on page 130 for details). The Local Translate Z value is set to 1.0.



KEEPING FACES TOGETHER

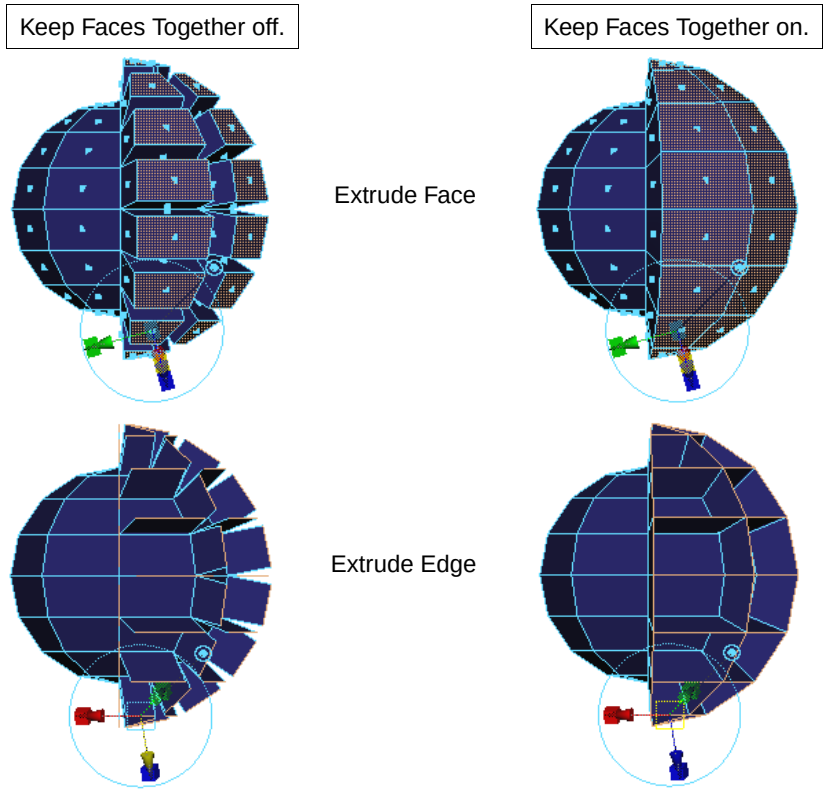
By default, faces and edges are extruded separately, and faces are duplicated and extracted separately. To keep faces or edges together before you perform these operations, turn Keep Faces Together on in the Polygons > Tool Options menu. If you do, the Keep Faces Together option is automatically turned on in the Attribute Editors and Channel Boxes for all three of these operations.

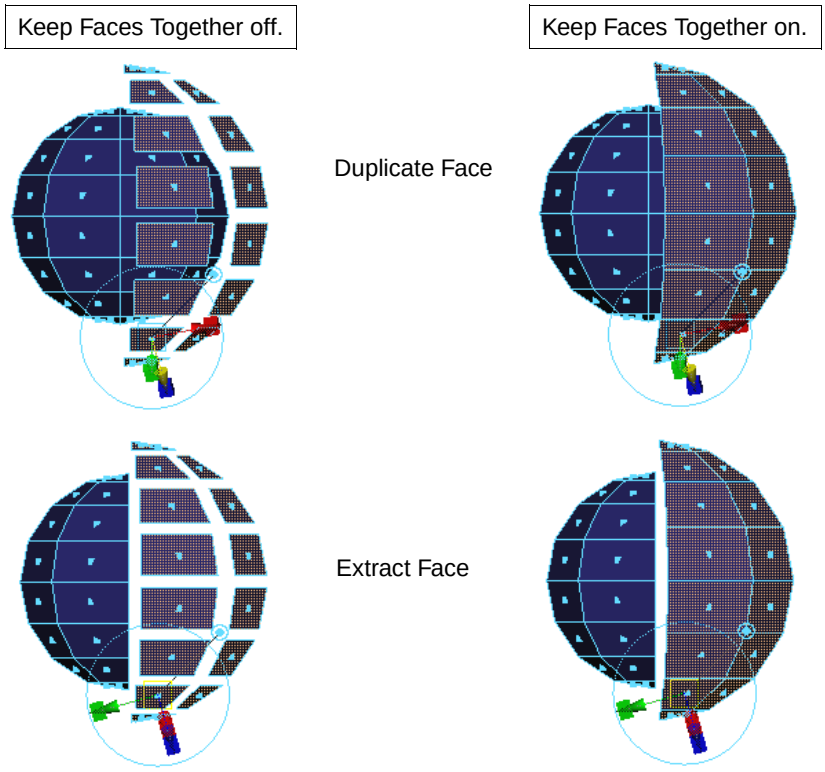
If you do not set this option on and decide you want to keep the faces together *after* you performed the operation, turn Keep Faces Together on in the Attribute Editor, or type the word “on” in the Keep Faces Together box in the Channel Box.

To extrude, duplicate, or extract multiple faces together:

1. Select all the faces you want to extrude, duplicate, or extract.
2. Turn Keep Faces Together on.
3. Drag the manipulator handles or change the values in the Channel Box to extrude, duplicate, or extract the faces.

   The following examples show the difference between extruding faces and edges, duplicating faces, and extracting faces with Keep Faces Together set to on and off.





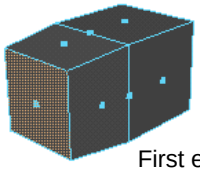
The Duplicate and Extract operations are similar. While Duplicate Face leaves selected faces unchanged and creates a copy of them, Extract breaks off the selected faces where they share vertices with the neighboring unselected faces, creating a hole in the model. If after completing an Extract, you decide you really wanted to Duplicate (you do not want a hole where the faces were extracted), type the word “on” in the Duplicate box in the Channel Box.

EXTRUDE, DUPLICATE FACE, AND EXTRACT OPTIONS

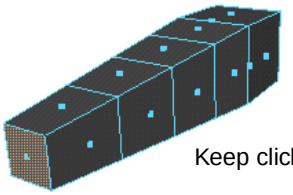
Extrude Face and Extrude Edge share the same option settings. Extract and Duplicate Face also share the same option settings. There are some slight differences, which are noted in the following descriptions.

Clicking the Extrude Faces or Extrude Edges buttons to continue extruding

Keep clicking the Extrude Faces or Extrude Edges button to continue extruding the polygon using the values you set for one extrusion. See the following Offset example.



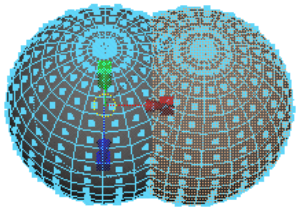
First extrusion.

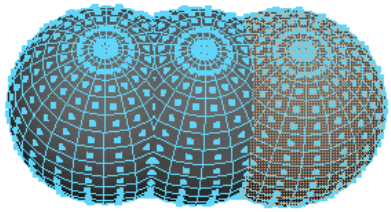


Keep clicking Extrude button.

Clicking the Duplicate button to continue duplicating faces

Keep clicking the Duplicate button to continue duplicating faces using the values you set for one duplication.





Separate Extracted Faces

This option is available only for Extract. Turn it on to separate faces automatically after they are extracted. This is the default. If this option is turned off, you're in component selection mode with all the extracted faces selected.

Separate Duplicate Faces

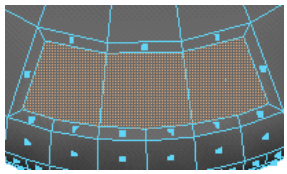
This option is available only for Duplicate Face. Turn it on to separate faces automatically after they are duplicated. This is the default. If this option is turned off, you're in component selection mode with all the duplicated faces selected.

Local Values

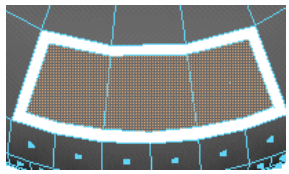
Offset

Enter a value to offset the edges of the extruded, extracted, or duplicated faces.

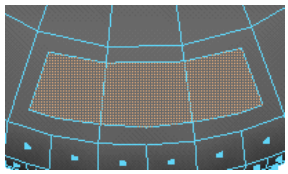
This option can be used to produce a bevel effect for extrusions, cut-outs around faces using Extract, and to uniformly scale duplicated faces.



Extrude offset of 0.2.



Extract offset of 0.2.



Duplicate offset of 0.04.

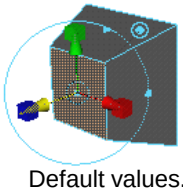
Translate This value moves the extrusion or duplicated face locally along the X, Y, or Z-axis. Positive or negative values indicate how far the extruded or duplicated faces are moved locally.

> ***Tip: Extruding or duplicating along a face normal***
>
> The path you extrude or duplicate along can be perpendicular, or at any other angle to the extruded or duplicated shape. To extrude or duplicate along a face normal, set the Z value for Local Values Translate to 1, and then click the Extrude or Duplicate button.

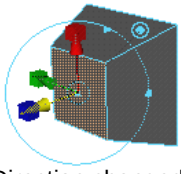
Rotate This value sets the angle at which you want to rotate the extruded or duplicated faces locally around the X, Y, or Z-axis.

Scale This value scales the extrusion or duplicated faces locally along the X, Y, or Z-axis.

Direction Enter a value to set the location of the X, Y, or Z-point in the local axis. Notice how the manipulator handles change accordingly when you change the Y direction value to 4.0.



Default values.



Direction changed to 4.0 in Y.

Global Values

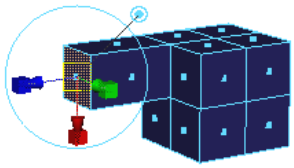
Translate This value moves the extruded or duplicated faces along the X, Y, or Z-axis.

Rotate This value sets the angle by which you want to rotate the extruded or duplicated faces around the X, Y, or Z-axis.

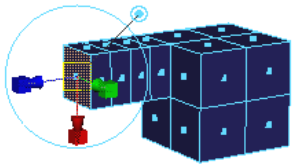
Scale Enter a value to scale the extrusion or duplicated faces along the X, Y, or Z-axis.

Other Values

Divisions For Extrude Face and Extrude Edge only. Enter how many intermediate faces are generated.

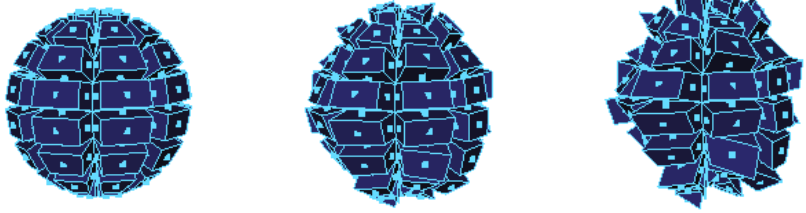


Divisions value 1



Divisions value 4

Random Enter a value to extrude faces or edges, or extract or duplicate faces randomly varying from a value of 0 to 1. In the following example, faces were extruded with random values of 0, 0.5, and 1.



Random value 0 Random value 0.5 Random value 1

World Space Coords

Turn on the World Space Coords to use the world coordinate system when you change values randomly. See *Using Maya: Essentials* for information about World Space Coordinates.

Attribute Editor for extrusions, duplications, and extractions

To edit the attributes for extruded or duplicated polygons, select the polygonal surface you want to edit and select the appropriate node in the Attribute Editor. For extruded edges and faces, the node is called polyExtrudeFace and polyExtrudeEdge, respectively. For extracted and duplicated faces, the node is called polyChipOff.

Extruded polygons and duplicated polygons share the same attributes except for two exceptions:

- An extra option, Duplicate (under the Random attribute in the editor) and at the bottom of the Channel Box for extracted or duplicated faces. See "Additional option—Duplicate" on page 135 for information.
- The Keep Faces Together option is not available from the options window. See "Additional option—Keep Faces Together" on page 136 and "Keeping faces together" on page 130 for details.

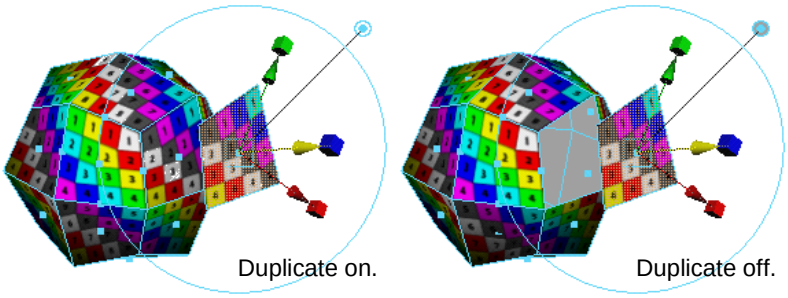
This Attribute Editor is for duplicated faces. The options in the Attribute Editor for extracted faces is identical, however the Duplicate option is not available for extracted faces.

These Attributes can also be found in the options window and the Channel Box. See the descriptions for information ("Extrude, Duplicate Face, and Extract options" on page 133).

Additional option—Duplicate

Turn Duplicate on if you want to preserve the original face. Duplicate is turned on for duplicated faces and off for extracted faces.

If Duplicate is turned off, the duplication occurs, but the original face is deleted, which is what Extract does — basically the Duplicate Face operation with Duplicate turned off works the same as Extract and vice versa.



Additional option—Keep Faces Together

Turn Keep Faces Together on to keep faces together when extruding, extracting, or duplicating faces. This attribute is also accessible from the Channel Box, or you can set this option for all these operations from the Polygons > Tool Options menu. See "Keeping faces together" on page 130 for details.

Changing the setting in the Channel Box or Attribute Editor modifies the behavior for the current operation. Changing the setting in the Tool Options menu only affects subsequent operations.

12 MAKING AND FILLING HOLES IN POLYGONS

This chapter shows you how to make and fill holes in polygonal models.

MAKING HOLES IN POLYGONS

You can use the Make Hole Tool to punch a hole in a selected face of a polygon using a second face to shape the hole. You can also create a face with a hole in it using the Create Polygon Tool or the Append Polygon Tool.

Making a hole in a face does not increase the number of faces in your polygonal model or change the component indexing for its vertices, edges, or faces. This can be especially important when applying colors-per-vertex, or when importing foreign polygonal objects.

Tip

By default, you select a face by clicking the small box in its center. There may be times when the face you want to use to cut a hole lies directly on the plane you want to cut a hole through. Trying to select both face centers might be difficult, and the Make Hole Tool does not work if you marquee-select the faces.

After creating a hole, the face center may be where the hole is, and also difficult to select.

To select faces by clicking anywhere within the faces:

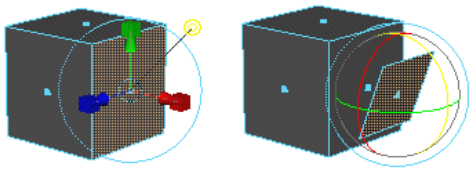
1. Select Window > Settings / Preferences > Preferences to open the Preferences window.
2. Under the Settings category, click Selection and in the Polygon Selection section select Whole Face.

For more information on customizing your UI (User Interface), see *Using Maya: Essentials.*

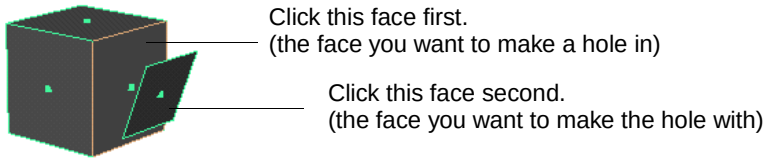
To make a hole using a second face and the Make Hole Tool:

The following example shows how to punch a hole in a selected face of a cube using a separate face created by duplicating a face of the cube. It also demonstrates how the object you make the hole in can change its shape if you move and transform the face you make the hole with. You could also simply create a hole flat on the plane.

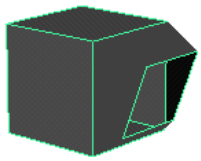
1. Select the cube, press F11 and click to select a face on the cube.
2. Select Edit Polygons > Duplicate Face ❐.
3. Turn off Separate Duplicated Faces and click Duplicate.
4. Scale and rotate the duplicated face and move it slightly off the plane. You can use the manipulator handles for the Duplicate Face tool or use the Maya scale, rotate, and move tools.



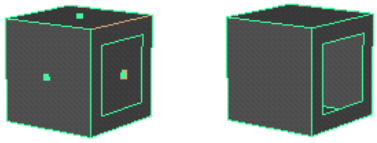
5. Select Edit Polygons > Make Hole Tool. Follow the prompts on the Command Line—first select the face you want to make a hole in, then select the face you want to make a hole with.



6. Press Enter to make the hole.



You can also simply duplicate and scale the face without rotating or translating it to make the hole flat to the plane.



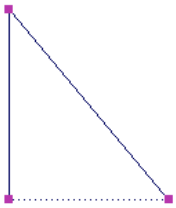
Tips

- You may find it easier to select faces with holes when face selection is set to Whole Face in the Selection Preferences section of the Preferences window. If the face selection is set to Center and the hole is in the center of the face, you may not easily see the center dot to select it.
- If you want to make a hole using a polygonal face that was not duplicated from the object you are making a hole in, you must combine the face with the object (select both objects and select Polygons > Combine) before using Make Hole.

To make a hole when creating a new polygon:

1. Select Polygons > Create Polygon Tool, or Polygons > Append to Polygon Tool.
2. Click to place the first point, second point, and the third point.

   Do not press Enter. If you do, you will complete the new polygon.

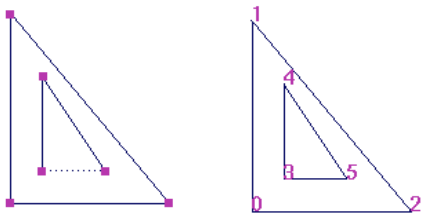


3. Press the Ctrl key and click to place the points inside the face to create the hole. The subsequent vertices are used to define the hole.

Note

You can only place three points inside the face. If you want the hole to have more than three vertices, insert them afterwards by subdividing the edges of the hole. For details, see "Subdividing polygons" on page 152.

4. Once you have placed the points you need, press Enter to create the hole.



Tip

You may find it easier to select faces with holes when face selection is set to Whole Face in the Selection Preferences section of the Preferences window. If the face selection is set to Center and the hole is in the center of the face, you may not easily see the center dot to select it.

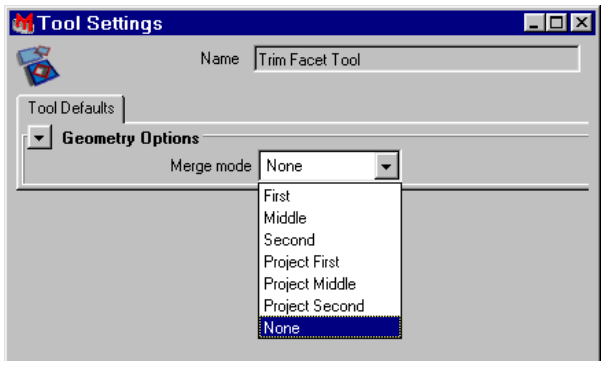
Setting Make Hole Tool options

You can control how the face stamp affects the shape of the polygonal object you are making a hole in, and how it punches the hole by selecting the Merge mode for the Make Hole Tool. The hole increases or decreases in size depending on the mode you select, but does not lose its shape.

You can either change the Merge mode in the options window before you punch holes, or you can change the Merge mode from the Channel Box or the Attribute Editor after you have punched a hole.

Setting the Merge mode before using the Make Hole Tool

To change the Merge mode before you use the tool, select Edit Polygons > Make Hole Tool ❐ to open the options window and select a Merge mode.



None The stamp face projects directly onto the face plane you select. This is the default.

First, Middle, and Last merge modes

Using the First, Middle, and Last merge modes, the center of the stamp face is made to match with the center of the face the hole is made on.

First The face selected second is transformed to make the centers match. The first selected face does not get transformed.

Middle Both the first and the second faces are transformed to make their centers match.

Second (Or last) The face selected first is transformed to make the centers match. The second selected face does not get transformed.

Project Merge modes

The Project Merge modes make the hole exactly where the stamp face resides. These modes do not center the hole but align the hole flat with the plane face. They also do not rotate the face to match the center as with the First, Middle, and Second (last) merge modes.

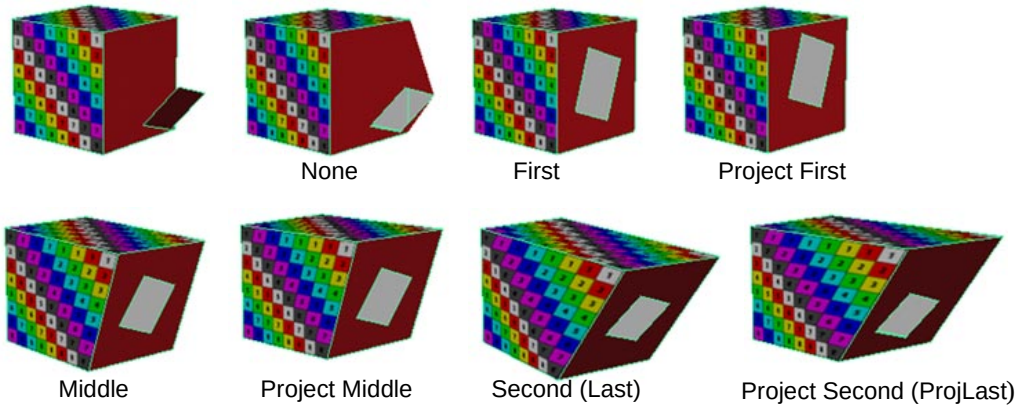
Project First The second selected face is projected onto the first and the centers do not match. The face is not rotated, unlike the First merge mode where the face is rotated to match the center.

Project Middle Both faces are projected onto a plane lying between them; their centers do not necessarily match.

Project Second (or projLast) The first selected face is projected onto the second (last) selected face and the centers do not match.

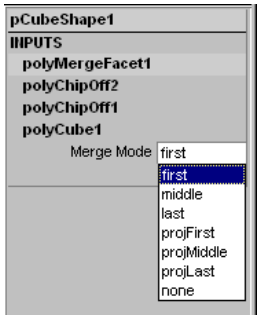
Merge mode examples

The following examples show the difference between using the merge modes.



Setting the Merge mode after using the Make Hole Tool

You can change the Merge Mode in the Channel Box or Attribute Editor after you punch the hole.

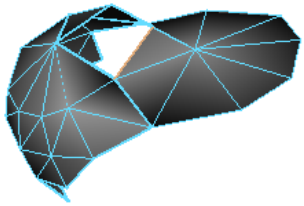


FILLING HOLES WITH FACES

Use the Fill Hole to create a face that fills the hole around a selected border edge. This tool can be especially useful when importing foreign polygonal models that may have holes, or to correct and rebuild models that have been damaged when importing.

To fill holes in polygons

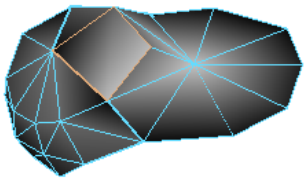
1 Press F10 and select the border edge where you want to fill the hole.

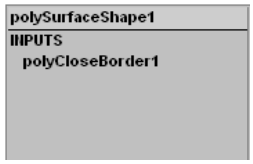


Tip

To highlight border edges, select Display > Polygon Components > Border Edges

2 Select Edit Polygons > Fill Hole. The hole is filled and the Channel Box includes a node called polyCloseBorder.



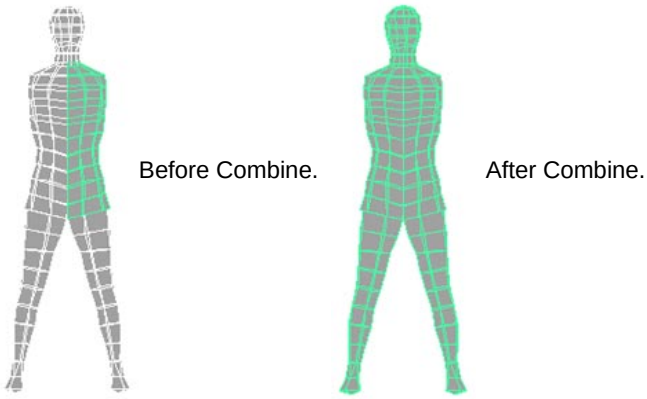


13 COMBINING, SEPARATING, AND COLLAPSING POLYGONS

This chapter provides information on how to combine several selected pieces to form a single object, separate an object into distinct objects, and by using Collapse, delete edges or faces and the unwanted vertices connected to those edges to turn an edge into a point.

COMBINING POLYGONS

Use Polygons > Combine to combine several selected objects to form a single object.



When using Combine, avoid creating invalid objects. Invalid objects are those with inconsistent normals across their different parts. Any materials previously assigned to the original objects are maintained when you use Combine.

Before combining objects with opposing normals, select the faces with the offending normals and use Edit Polygons > Normals > Reverse to reverse them so all normals are pointing the same way. If normals are not pointing the same way, you will have trouble when it comes time to map textures onto your models.

To combine polygons:

1. While in object selection mode (press F8), marquee-select the pieces you want to combine into a single object.
2. Select Polygons > Combine. All selected pieces become pieces in one new object. When you click on one of the pieces, the entire object is selected, but the pieces are still at their original coordinates.

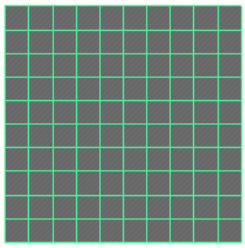
   You can also verify the combine operation in the Hypergraph or Outliner (Window > Hypergraph or Outliner).

SEPARATING POLYGONS

The Separate operation separates disjointed polygonal faces into separate objects. That means Separate only works on objects with more than one polygonal shell.

Separating polygonal shells

A polygonal shell is a collection of faces that are connected in a single piece—for example, a primitive plane is a polygonal shell.



Since the plane has no border edges within the enclosed shape, you cannot separate it. If you try, you will get the following error message:

```
Error: polySurface has only one piece. Ignored.
```

To separate a shell, extract or delete some of the faces to create separate border edges and then select Edit Polygons > Separate.

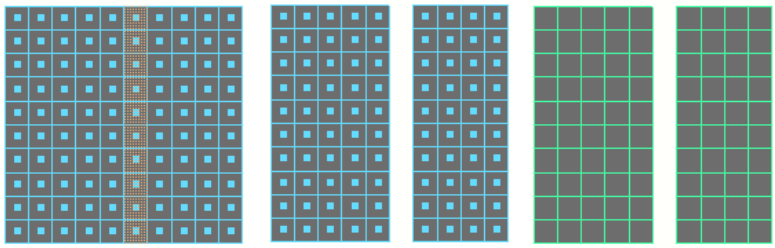
To separate a shell:

1. Select the faces within the shell where you want to separate it.
2. You can either press the Backspace key to delete the faces if you do not need them, or select Edit Polygons > Extract. By default, Extract also separates the extracted faces. (Separate Extracted Faces is turned on in the Extract Options window.) If you used Extract, you need only proceed to step #3 if this option was turned off when you performed the Extract.

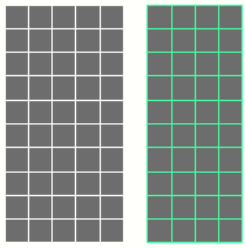
Note

When you use Extract the Move Component manipulator displays, which you can use to relocate the extracted faces. It is not necessary to use any of the manipulator handles.

When you delete the faces and then select the object, even though they are separate shells, they are still part of a single polygonal object.



3 If you want to select each piece as an object independent of the other, use Edit Polygons > Separate.



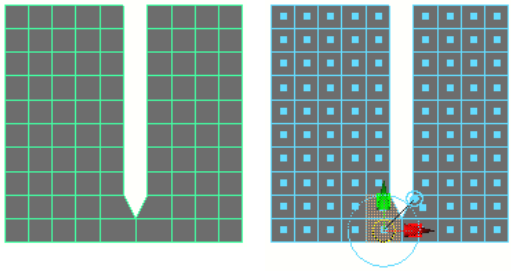
Separating polygons with merged edges

You cannot separate objects whose edges have been merged. For example, if you merge edges between two polygonal planes and try to separate them later on, you will get the error message:

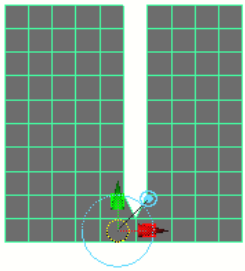
```
Error: polySurface has only one piece. Ignored.
```

To separate polygons with merged edges:

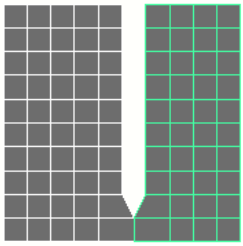
1 Select the faces where you merged the edges, and use Edit Polygons > Extract. By default, Extract also separates the extracted edges. (Separate Extracted Faces is turned on in the Extract Options window.) If you used Extract, you need only proceed to step #2 if this option was turned off when you performed the Extract.



2 Press the right mouse button while the cursor is off the object and Select All to select the entire object. Even though you extracted the faces, the object remains connected as one piece.

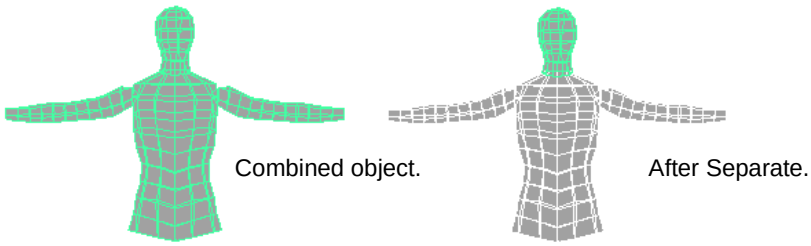


3 Select Edit Polygons > Separate to separate the object. Now when you select the entire object, notice how it separates into two pieces where you extracted the faces at the merged edges.



Separating combined polygonal objects

The following example shows how to separate a combined set of polygonal objects. You select two shells whose border edges are not connected.



To separate combined polygonal objects:

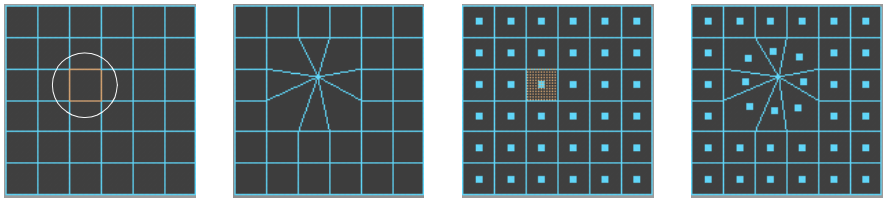
1 While in object selection mode (press F8), marquee-select the combined polygonal object you want to separate.

2 Select Edit Polygons > Separate. Maya separates the object into individual pieces. This means you can select one of those pieces and transform it or change it using polygonal modeling tools and operations without disturbing the other pieces.

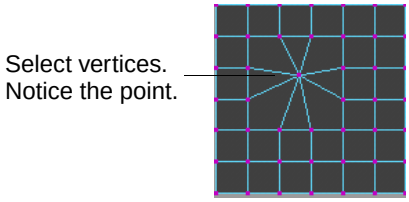
This can come in handy if you want to copy a piece of a model, such as the head in the example, and use it somewhere else. The separation is also verified in the Outliner or Hypergraph (Window > Outliner or Hypergraph).

COLLAPSING POLYGONS

Use Collapse to turn an edge or faces into a point and also to clean small edges.



Collapsing edges. Collapsing faces.



Note

Collapsing edges or faces can make your geometry nonmanifold. To correct nonmanifold geometry, perform a cleanup. For details, see "Cleaning up polygonal data" on page 40.

To collapse edges or faces:

1. Press F10 to enter component mode for edges, or F11 for faces.
2. Select the edges or faces of the polygonal object you want to collapse.
3. Select Edit Polygons > Collapse.

The following example shows how you can quickly and easily create the roof of a tower using the Collapse operation.

14 SPLITTING AND SUBDIVIDING POLYGONS

This chapter provides information on how to create new vertices and edges by splitting polygons and how to subdivide edges and faces to create sub-edges and new faces.

SPLITTING POLYGONS

Use the Split Polygon Tool to create new faces, vertices and edges. This lets you split existing faces into pieces.

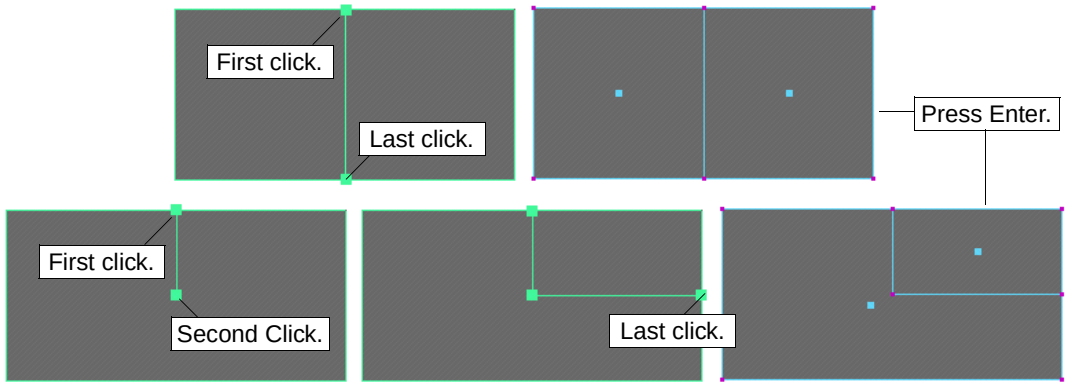
To split polygons and create new faces and vertices:

Points must be placed on at least two edges in order to complete the operation.

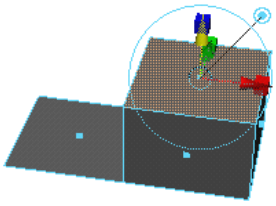
1. Select Edit Polygons > Split Polygon Tool.
2. Click on the first edge you want to split.

If you want to move the first split point before you let go of the mouse, drag along the edge.

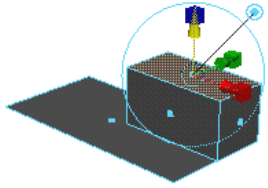
3. Click on another edge and press Enter or click to place a point inside the face, then place another point on an edge and press Enter.



4 You can use this new face with polygonal operations, such as Extrude. See the following example.



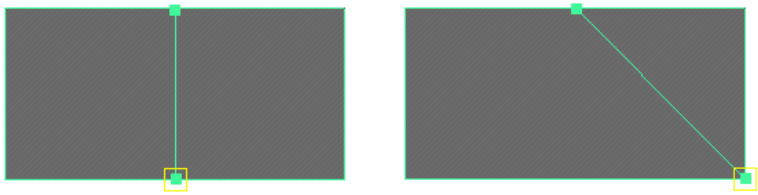
Face created by splitting original face in two pieces.



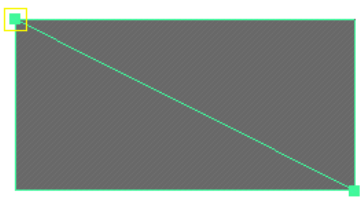
Face created by splitting inside the original face.

Repositioning points

- To reposition the last created point you placed, hold down the middle mouse button. A small box displays around the point. Drag to re-position it.



- Press the Insert key to re-position a previously created point. Drag the point to re-position it, then press the Insert key to return to the Split Polygon Tool.



Tip

To precisely place your points, you can take advantage of the Edge Snapping magnets option in the options window, or if the grid is displayed, click the Snap to Grids icon to turn grid snapping on before you place your points.

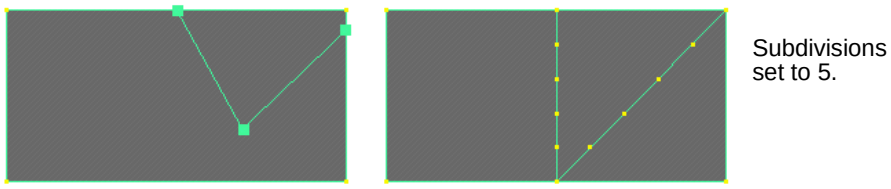
Split Tool options

Because the faces are split based on the current settings in the options window, you may need to change the tool options before you perform the operation. Select Edit Polygons > Split Polygon Tool ❐ to open the options window.

Subdivisions Drag the slider to change the number of subdivisions you want for each edge of the new face. Vertices are placed along the edge to create the subdivisions.

Important!

Subdivisions are not created if you split the polygon by placing the second point inside the original face. Your second point must be placed on another edge to create subdivisions.



Second point placed inside face. Second point placed on edge.

Edge Snapping When on, the pointer snaps to a point along the edges of the face you are splitting. In order to position the pointer freely, turn off Edge Snapping.

Snapping Magnets Specify how many snapping magnets are evenly placed along the edge. The default is one, and it is placed at the middle of the edge.

Snapping tolerance Drag the slider to change the snapping tolerance you want to use for each new edge point you are going to create. The tolerance value can range from 0 to100%. A value of 0 indicates no tolerance.

The tolerance controls how sensitive the Split Polygon Tool is to where you click. If you turn on Edge snapping, and click the edge where you want to split it, the pointer will snap to the nearest snapping magnet, endpoint, or midpoint that falls inside the tolerance range and is contiguous to the point on which you clicked.

Tips

- When you want to split an edge at a specific location, you may find it useful to turn off Edge snapping.
- When you want to split an edge midway between a pair of endpoints, set Snapping tolerance to 100 and place the first point near the middle of the edge. This splits the edge precisely in the middle of the segment with the two endpoints on each side.

SPLITTING SHARED VERTICES

You can split a shared vertex into multiple vertices—one for each polygonal face that shares it. This removes connectivity at the vertex, so you can perform independent operations on the split edges.

To split a vertex:

1 Select the vertices you want to split.

Note

Any selected vertices that are not shared are ignored.

2 Select Edit Polygons > Split Vertex.

SUBDIVIDING POLYGONS

Use Subdivide to subdivide an edge into one or more subedges. You can also subdivide a face into one or more faces, creating new faces.

Note

You cannot subdivide faces with holes. Also, you cannot subdivide concave faces unless the center point (the average of all the vertices of the face) lies within the interior of the face.

Center point
outside the interior.
Cannot subdivide.

Center point
inside the interior.
Can subdivide.

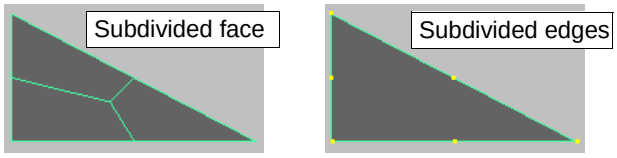
To subdivide a concave face into convex parts, use Edit Polygons > Split Polygon Tool or Polygons > Triangulate. You can also use Triangualate to remove holes.

To subdivide edges or faces:

1 Select an object whose edges or faces you want to subdivide.

2 Click to select or marquee-select the edges or faces of the polygonal object you want to subdivide. Press F10 to select edges, or press F11 to select faces.

3 Select Edit Polygons > Subdivide. Maya subdivides the edges or faces.



The current settings in the option window determine the way the edges or faces are subdivided. You can change the subdivision values and modes in the Channel Box or the Attribute Editor after you have performed the subdivision.

To subdivide faces automatically after selection:

You can use the Edit > Paint Selection Tool to select and subdivide faces right after you select them.

1 Select a polygon.

2 Select Edit > Paint Selection Tool ❒. The Tool Settings window opens.

3 On the Select tab, turn off Add to Current Selection.

4 Change the pick mask to Poly Faces.

5 Click the Misc tab.

6 In the After Stroke Cmd box, enter:

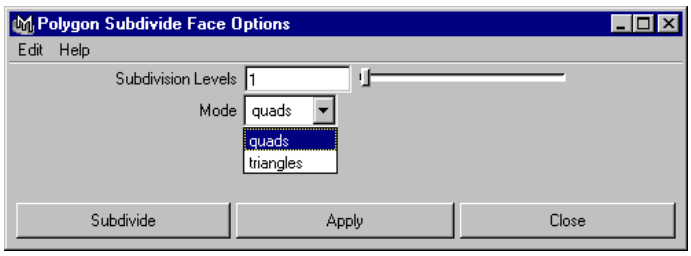
```
polySubdivideFacet -dv 1 -m 0 -ch 1
```

7 Paint the faces you want to subdivide. Each painted face subdivides automatically into four faces when you release the mouse button.

See *Using Maya: Painting* for details about the Paint Selection Tool. See also "Paint-selecting components" on page 53 in this book for information on how to select components using the Paint Selection Tool.

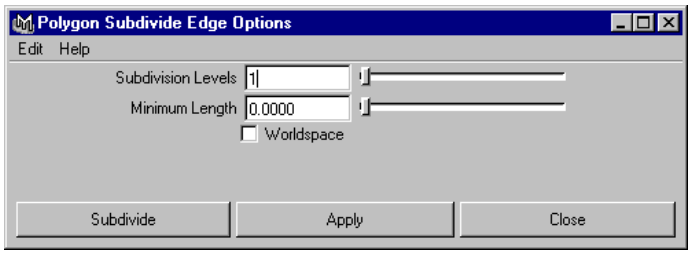
Setting Subdivision options

Select Edit Polygons > Subdivide ❒ to open the options window. The options window that displays depends on which component mode you are in—faces or edges.



Options for face subdivisions.

What you select decides what gets subdivided. If edges are selected, Maya subdivides edges. If faces are selected, Maya subdivides faces, inserting extra vertices along the edges.



Options for edge subdivisions.

Subdivision Levels

For edges, enter the maximum number of vertices to be inserted in each edge.

For faces, enter the number of times each selected face is recursively subdivided. The number of faces created is proportional to $3^{(x-1)}$ for triangles, or $4^{(x-1)}$ for quads, where x is the number of subdivision levels. The number of edges on the original face determines the proportion.

Mode (for faces)

quads/triangles

Turn quads on to subdivide faces into quads or turn triangles on to subdivide faces into triangles. These options are only available for faces.

Note

If you subdivide to triangles, any vertex normals that you set on the faces being subdivided are lost. If you subdivide to quads all normals that you set are preserved.

Minimum length

Sets the minimum length of each subedge created. This option is only available for edges.

Worldspace

This option is only available for edges. When turned on, the specified Subdivision value is the distance between vertices in world space. When turned off, the Subdivisions value is the distance between vertices in local space.

15 SMOOTHING, BEVELING, AND SCULPTING POLYGONS

This chapter provides information on how to modify the topology of polygonal objects by smoothing out vertices and their connected edges and how to expand each vertex and each edge into a new face by beveling polygons. It also provides information on how to sculpt polygonal models using the Sculpt Polygons Tool.

SMOOTHING POLYGONS

There are three methods of smoothing polygons:

- Using Polygons > Smooth. Maya modifies the topology of the polygonal object by smoothing out vertices and their connected edges. See "Smoothing by modifying the topology" on page 155.
- Using Polygons > Average Vertices. Maya averages the values of the vertices to produce a smoother surface without modifying the topology. This method of smoothing is useful for creating smooth geometry to produce good UVs. "Smoothing by averaging vertices" on page 158.
- Using the Smooth operation of the Sculpt Polygons Tool to average the values of painted vertices to produce a smoother surface. Like Average Vertices, the Sculpt Polygons Tools does not modify the topology. For more information, see "Sculpting surfaces" on page 170.

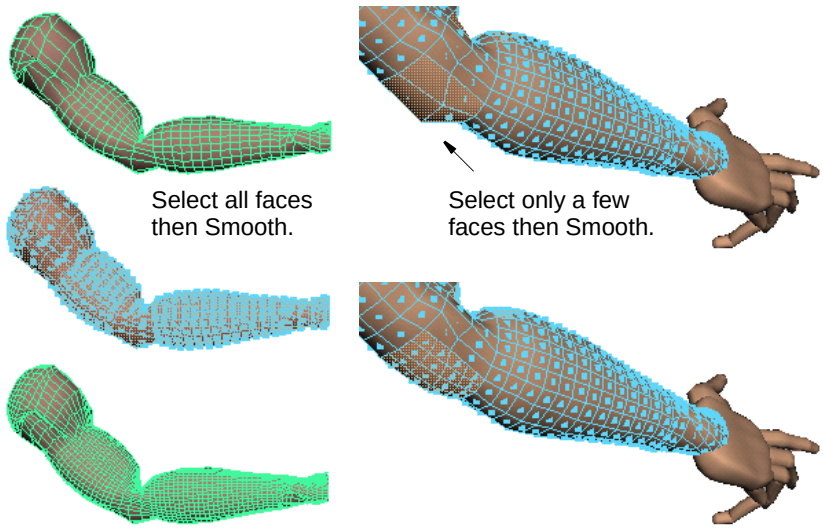
Smoothing by modifying the topology

Use Polygons > Smooth to smooth polygons by expanding each vertex and each edge into a new face. These faces are either positioned at an offset or scaled towards the original face center.

To smooth polygonal faces by modifying the topology:

1. Press F11 or press the right mouse button and select Face from the marking menu.
2. Either marquee-select the entire object, or click to select just the faces you want to smooth.
3. Select Polygons > Smooth.

If you select the entire object, the shape of the object changes depending on the Smooth options you set. If you select only some of the faces, only those faces change and the rest of the object maintains its shape.The following examples show the results based on the default option settings.



Note

Smoothing works with convex and even star-shaped concave faces. However, it can give unwanted results with concave faces when the center point (the average of all the vertices of the face) does not lie within the interior of the face.

Polygon Smooth options

Select Polygons > Smooth ❐ to open the options window.

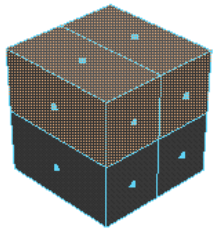
Set the options and then click the Smooth button to perform the operation. If you are not happy with the results, either press the z key to undo, or change the values in the Channel Box or Attribute Editor for the Smooth operation.

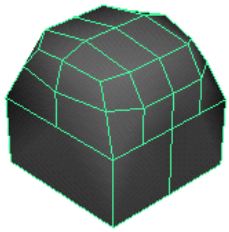
Tip

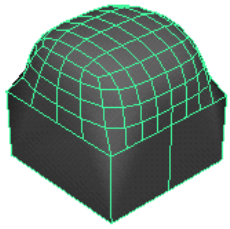
You can repeatedly smooth selected polygonal faces if you keep clicking the Smooth or Apply button in the options window.

Subdivision Levels

Use the slider or type a number in the Subdivision Levels box to increase or decrease the number of times Maya performs the smoothing operation. This also increases or decreases the object's smoothness. The Divisions range is from 1 to 4. The higher the value, the smoother the object.

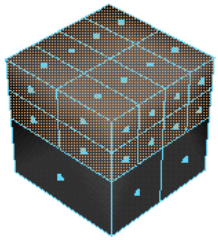

Select several faces.

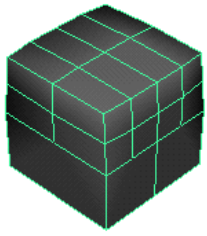

Division set to 1.

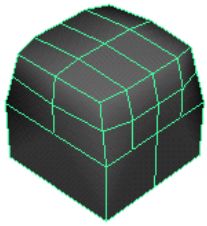

Division set to 2.

Continuity

The value you enter here determines the degree of smoothness.


Continuity set to 0.0.

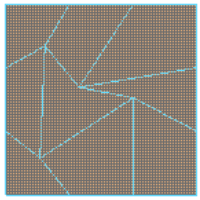

Continuity set to 0.2.

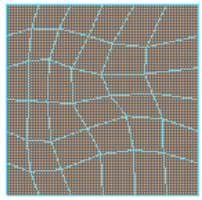

Continuity set to 0.5.

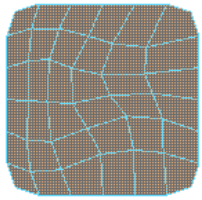
Preserve Properties

Geometry Border Edges

When turned on (the default), this option preserves the properties of the border edges of the geometry.

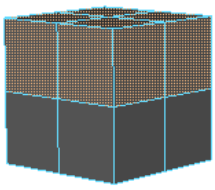

Before smooth.

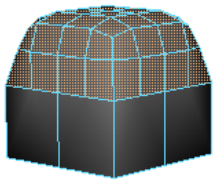

Geometry Border Edges on.

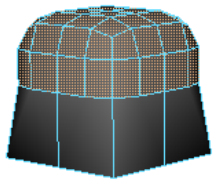

Geometry Border Edges off.

Selection Border Edges

When turned on (the default), this option preserves the properties of the edges bordering the selected and non-selected faces.


Before smooth.


Selection Border Edges on.


Selection Border Edges off.

Keep Tesselation Turn this option on so that when changes are made to the history nodes, the smooth node does not redo the tesselation, but just repositions the generated vertices.

Smoothing by averaging vertices

Use Polygons > Average Vertices to smooth geometry by averaging the values of vertices without changing the topology of the object. This method of smoothing can be used with the Transfer command to easily produce good UVs for texturing. For information on using Average Vertices and Transfer to produce good UVs, see "Creating good UVs on complex models" on page 246.

Note

Using the Smooth operation of the Sculpt Polygons tool you can paint vertices to produce the same result. For information on the Sculpt Polygons tool, see "Smoothing" on page 164.

To average vertices (smooth them) without changing the topology:

1. Select the vertices you want to smooth.
2. Select Polygons > Average Vertices ❐.
3. Enter the required number of iterations then click Average or Apply.

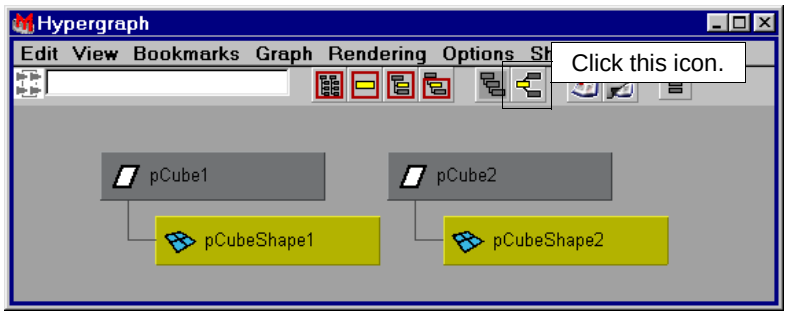
   Smaller iteration values produce more subtle results. Because iterations are accumulative, the more iterations you enter, the more smoothing will take place each time you average.
4. Click Average or Apply repeatedly until the desired smoothness is achieved.

Emulating subdivision surface workflows

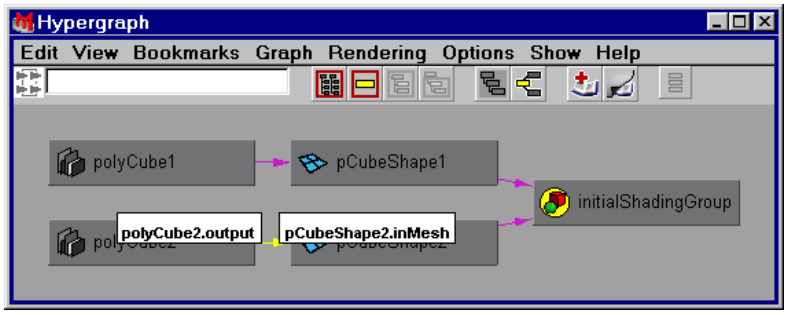
This smoothing tip lets you emulate the workflow for subdividing surfaces. While true subdivision surfaces (available in Maya Unlimited) are preferred—you can have fewer points and different levels of hierarchy—the workflow described in the following example may satisfy your needs.

To smooth and modify a polygon as a subdivided surface:

1. Create two polygonal primitive cubes on top of each other.
2. Open the Hypergraph (Window > Hypergraph) and select Options > Display > Shape Nodes to display the cubes' shape nodes.
3. Select both shape nodes, then click the Up and Downstream Connections icon.



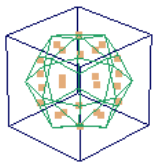
4 Select the arrow between pCubeShape2 and polyCube2 and press the Backspace key to break the connection.



5 Connect the Outmesh of pCubeShape1 to the inMesh of pCubeShape2 as follows:

- Select pCubeShape1
- In the Script Editor or on the Command Line, execute polyDuplicateAndConnect

6 In the Hypergraph, select pCubeShape3, then select Smooth from the Polygons menu. The following displays in the 3D view.

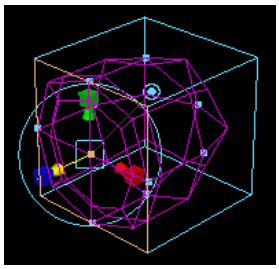


7 Because Smooth works on a per-face basis, in this case only six faces, you must modify the input components (the .inputComponents attribute of polySmoothFace1 in the following command) to include all faces that result in the topology changes while modeling. This is done by replacing the original number of faces selected for smoothing by a wild card (“f[*]”).

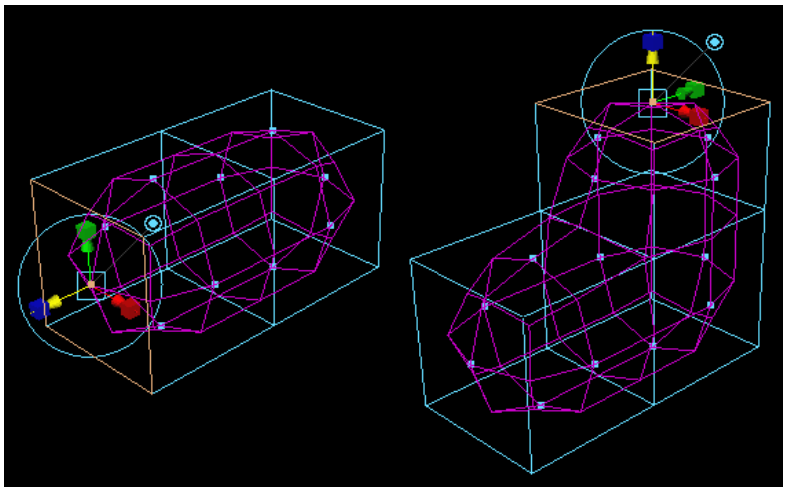
For example, type this command at the Command Line or in the Script Editor:

```
setAttr polySmoothFace1.inputComponents -type "componentList" 1 "f[*]";
```

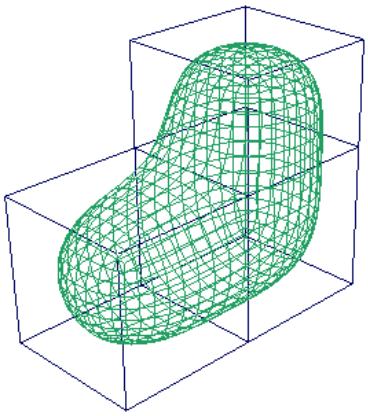
8 Select a face on pCubeShape1 (the unsmoothed cube shape) and Extrude it (Edit Polygons > Extrude Face). Notice how the inner shape is modified when you transform the face using a manipulator handle.

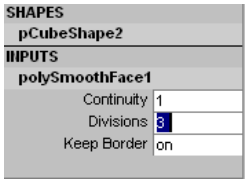


Continue to extrude, duplicate, or use any of the Polygon tools and operations to modify the shape.



You can also increase the smoothness of the shape by changing the Division value in the Channel Box or Attribute Editor for the smoothed polygon.





BEVELING POLYGONS

Use the Bevel operation to smooth out rough corners and edges.

Beveling expands each vertex and each edge into a new face. You can position these faces at an offset or scale them towards the original face center using the options in the options window.

Important note about beveling and textures

Bevel your object before you assign a texture to it. You will lose the texture coordinates and face material assignments if you bevel a textured object.

Note

Beveling works with convex and even star-shaped concave faces. However, it can give unwanted results with concave faces when the center point (the average of all the vertices of the face) does not lie within the interior of the face.

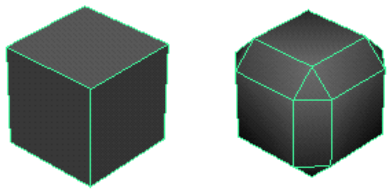
Center point outside the interior.

Center point inside the interior.

To bevel an entire polygonal object:

1. To bevel the entire polygonal object, marquee-select the object you want to bevel, then select Edit Polygons > Bevel.

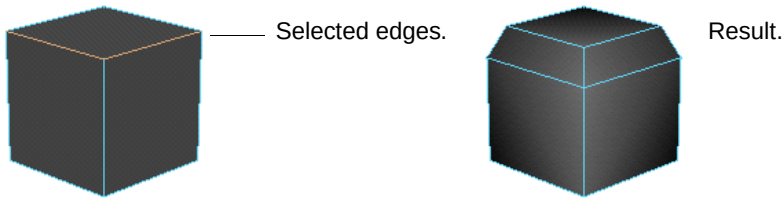
   Maya bevels all the edges of the polygonal object based on the current settings in the options window. The following example uses the default settings.



To bevel specific edges of a polygonal object:

1. Press F10 or press the right mouse button and select Edge from the marking menu.
2. Click the edges you want to bevel, then select Edit Polygons > Bevel.

   Maya bevels only the selected edges based on the current settings in the options window. The following example uses the default settings.



Selected edges.

Result.

Tip

You can change the way edges are displayed by selecting Display > Custom Polygon Display ❐. In the window, set Edges to Standard, Soft / Hard, or Only Hard.

If necessary, adjust the options in the Channel Box or the Attribute Editor after you perform the operation.

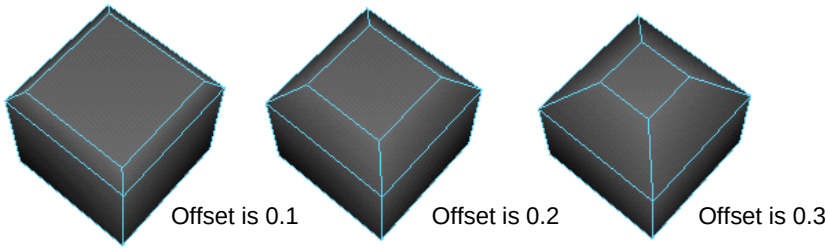
Polygon Bevel options

Choose Edit Polygons > Bevel ❐ to open the options window.

Set the options and then click the Bevel or Apply button to perform the operation. If you are not happy with the results, either press the z key to undo, or change the values in the Channel Box or Attribute Editor for the Bevel operation.

Offset

This value represents the distance between the edge and the center of the face. This is like the radius of the bevel. Use the slider or enter a value to change the offset value.



Values range from 0.2 to 10.0, although smaller values produce better results if World Space is turned off.

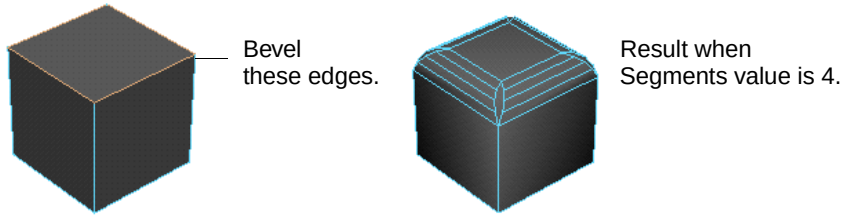
If World Space is turned on, the specified Offset value is the distance between edges in world space. When turned off, the Offset value is the distance between edges in local space.

Roundness

By default, Maya automatically adjusts the rounding to bevel an object based upon the object's geometry. If you select Auto Fit, this option is dimmed. If Auto Fit is not selected, use the slider or enter a value to round the bevel edges.

Segments

The Segments value determines the number of segments created along the edges of the beveled polygon. Use the slider or enter a value to change the number of segments. The default is 1.



Auto Fit

If you select Auto Fit, Maya automatically determines how the bevel fits the object. If selected, you cannot change the Roundness value.

World Space If turned on, the specified Offset value is the distance between edges in world space. When turned off (the default), the Offset value is the distance between edges in local space.

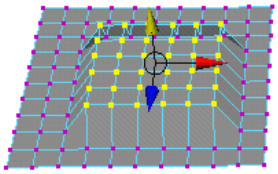
SCULPTING POLYGONS

This section describes how to use the Sculpt Polygons Tool to sculpt polygonal surfaces. It includes the following topics:

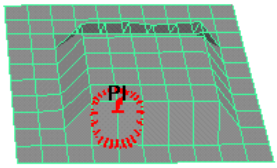
- "Sculpting overview" on page 163.
- "Sculpting operations" on page 163.
- "Setting Sculpt Polygons Tool options" on page 167.
- "Sculpting surfaces" on page 170.
- "Sculpting masked surfaces" on page 170.
- "Importing attribute maps" on page 171.
- "Flooding sculpted surfaces" on page 171.
- "Sculpting tips and tricks" on page 171.

Sculpting overview

In Maya, you can change the shape of polygonal surfaces by moving, rotating, or scaling vertices. Using the Sculpt Polygons Tool, you can produce the same results quickly with the stroke of a brush. Although you are still actually manipulating vertices, the Sculpt Polygons Tool removes that level of detail so you can work directly with the surface. You simply “paint” the surface with the Sculpt Polygons Tool.



Transforming vertices using the Move Tool in component mode.



Transforming vertices using the Sculpt Polygons Tool.

If you want to change the attributes for this tool while you work, you don’t have to leave the Tool Settings window open. Once you are in sculpting mode, you can double-click the icon in the title bar to re-open the Sculpt Polygons Tool settings window. 

Sculpting operations

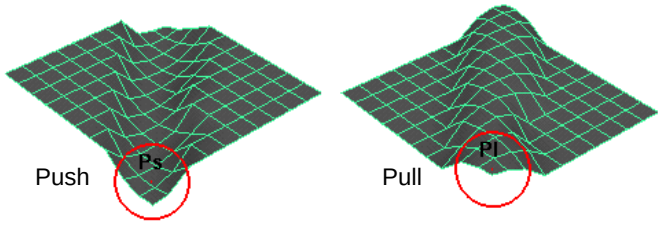
You can perform four different operations—push, pull, smooth, and erase. These operations can be selected from the Sculpt Polygons Tool Setting window (Polygons > Sculpt Polygons Tool ❐).

Pushing and pulling

Pushing a surface with the Sculpt Polygons Tool is like pushing a lump of clay with your thumb. When you push your thumb into the clay, it transforms the clay, creating an indent the shape and radius of your thumb.

Similarly, when you "push" a polygonal surface in the direction of the surface normal, the surface transforms, creating an indent the shape and radius of the tool.

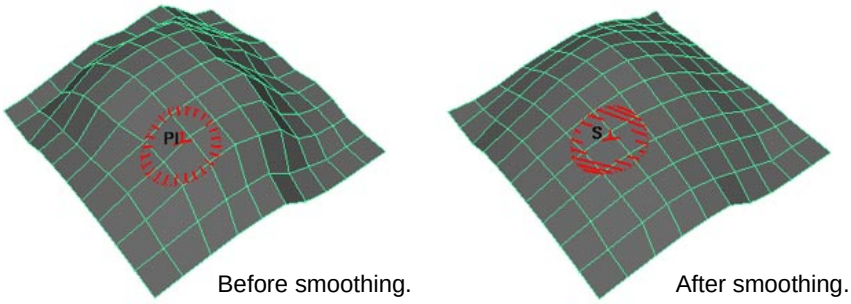
Pulling a surface is like pushing a surface, but in the opposite direction.



Just as you can push and pull clay in different directions to achieve different effects, you can push and pull surfaces in different directions. The Sculpt Polygons Tool translates vertices in the direction of the tool's reference vector.

Smoothing

You can smooth bumps in your surfaces by painting them with the Sculpt Polygons Tool.



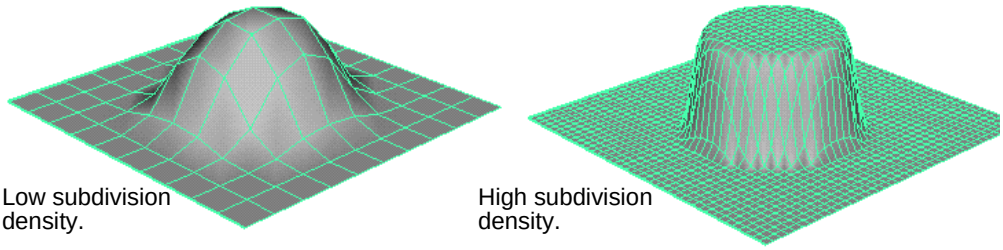
Before smoothing. After smoothing.

Erasing

The Sculpt Polygons Erase operation is like using an eraser. You paint the areas you want to erase and the vertex displacements for those areas return to the displacements in the last updated, or "baked" *erase surface*. By default, you must manually update the surface. So if you never update the erase surface, the area you erase returns to the original surface (the surface before you started sculpting or the surface when you first opened the scene), no matter how many strokes you've applied. If you set the Sculpt Polygons Tool to update automatically after each stroke, the area you erase returns to the surface defined by the last stroke. For details, see "Erase surface" on page 166.

Constructing surfaces

Although you should typically try to keep the number of subdivisions to a minimum when you model polygonal surfaces, Maya produces more detailed results the denser the subdivisions. The following two examples were produced using the same brush stroke on surfaces with different subdivision densities.



Low subdivision density.

High subdivision density.

Construction history

When you sculpt on surfaces with construction history, Maya's performance can decrease because the construction history may need to be recomputed as you sculpt. Also, you could experience unpredictable results if you later change the history in ways that affect the vertex count. If the construction history is not required, you may want to delete the history before sculpting.

The Sculpt Polygons Tool does not create construction history, even when construction history is turned on.

To delete construction history for a surface:

1. Select the surface.
2. Select Edit > Delete by Type > History.

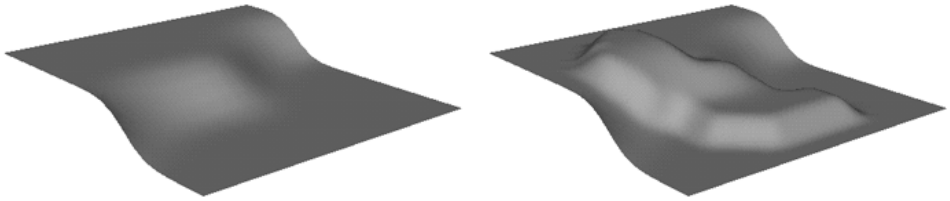
Backup surfaces

The Sculpt Polygons Tool maintains two "backup" surfaces as you sculpt:

- reference surface
- erase surface

Reference surface

Maya uses the reference surface as a basis for any sculpting you do. Initially, it is the surface you start sculpting on. It is only used when the Sculpt Polygons Tool is set to Push or Pull. You cannot displace the reference surface any further than the maximum displacement set for the Sculpt Polygons Tool.



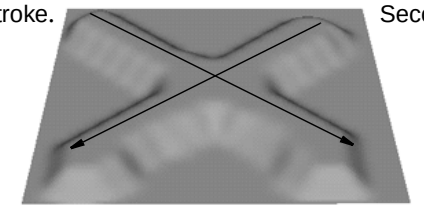
Reference surface.

Sculpted reference surface.

If you want to displace your surface more than the maximum displacement, you can update, or "bake," your surface and then sculpt on it. When you update the reference surface, the updated surface becomes the new reference surface. Maya gives you the option of updating the reference surface manually, or updating it automatically after every stroke (the default).

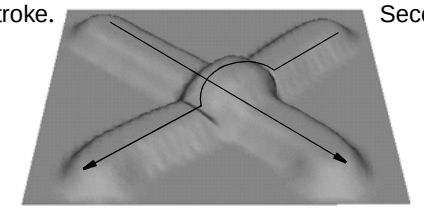
If you *do not* update your surface, no matter how many brush strokes you make, the displacement will never exceed the maximum displacement. In the following example, the displacement at the intersection point of two strokes does not exceed the maximum displacement set for the tool because the reference surface was never updated.

First stroke. Second stroke.



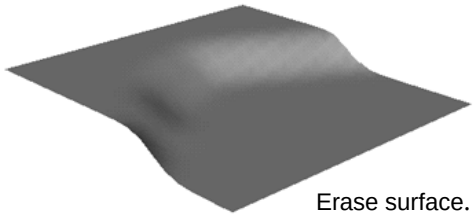
If you *do* update your surface, your stroke displacements are additive. In the following example, the reference surface was updated after the first stroke.

First stroke. Second stroke.

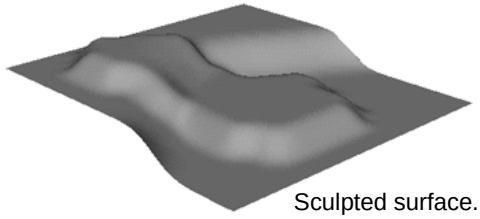


Erase surface

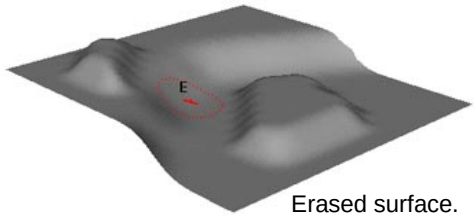
The Sculpt Polygons Tool uses the *erase surface* as the basis for selectively undoing any sculpting you do. Like the reference surface, the erase surface is initially the surface you start sculpting on. When you perform an erase operation on your sculpted surface, the erased portions are restored to the erase surface.



Erase surface.



Sculpted surface.



Erased surface.

You can change the erase surface to be the current surface by updating it. When you update the erase surface, the updated surface becomes the new erase surface. You can update the erase surface manually (the default), or update it automatically after every stroke.

When you save a scene, then open it, the erase surface is the last sculpted surface.

Setting Sculpt Polygons Tool options

Before you sculpt a surface, set the options for the Sculpt Polygons Tool. The settings determine the effect you will achieve when you sculpt with the tool. You can define the following tool settings:

- brush stamp profile
- sculpt operation
- auto smooth
- sculpt variables
- maximum displacement
- surface updates

You can save your tool settings by adding the tool to a shelf. For details, see *Using Maya: Painting*.

Using the Sculpt Polygons Tool settings window

Select the Sculpt Polygons Tool and open the Tool Settings window (Polygons > Sculpt Polygons Tool ❐).

Tip

You can define hotkey combinations to change most of the settings without opening the Tool Settings window. For details on setting hotkey combinations, see *Using Maya: Painting*.

This book explains only tool settings that apply to surface sculpting. For details on the tool settings not explained in this book, see “Brush Tool settings (original architecture)” in *Using Maya: Painting*.

Setting the brush stamp profile

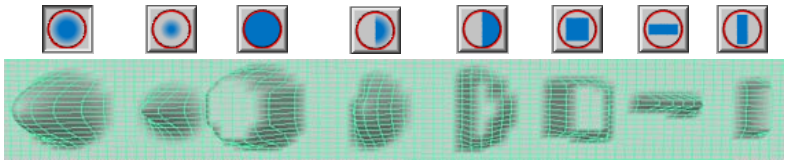
Radius (U) If you are using a stylus, set the upper or maximum possible radius for the brush. No matter how hard you press the stylus, the brush radius will not exceed this radius. If you are not using a stylus, this setting defines the radius for the brush.

If the brush stamp compensation mode is set to None, the radius is expressed as a percentage of the surface. Otherwise, the brush radius is measured in the working units set for Maya. For details on selecting the stamp compensation mode, see "Brush Tool Settings (original architecture)" in *Using Maya: Painting*. For details on setting units, see *Using Maya: Essentials*.

Radius (L) If you are using a stylus, set the lowest or smallest possible radius for the brush when pressure is applied to the stylus. If you are not using a stylus, this setting is not used.

Opacity Set the displacement of the stroke relative to the maximum possible displacement. For example, if you set the maximum displacement to 4 cm, and the opacity to 0.5, your brush stroke will have a displacement of 2 cm.

Shape Click on the shape of the brush. This determines the shape of the area affected by the brush action.



For brush shapes that are not uniformly round, you can change the profile alignment. For details, see *Using Maya: Painting*.

Selecting the brush operation

Select Push, Pull, Smooth, or Erase (see "Sculpting operations" on page 163). Notice that the brush stamp changes to reflect the operation.

Push Pull Smooth Erase

To remove the letters and gradient marking from the brush stamp, open the Sculpt Surface Tool Settings window, click the Display tab and turn Draw Brush Feedback off.

Tip

To change the brush operation from within the modeling view, press the u key on the keyboard and a menu of brush operations appears.

Setting autosmoothing

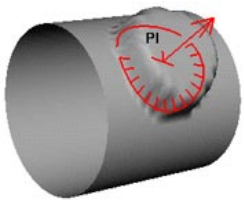
Auto Smooth If you selected Push or Pull as the brush operation, turn Auto Smooth on to smooth the surface automatically after every brush stroke.

Strength If you turned Auto Smooth on, type the smooth strength in the Strength box. This is the number of times the Sculpt Surface Tool smooths the surface for each push, pull, or smooth stroke. The higher the number, the more smoothing takes place for each brush stroke.

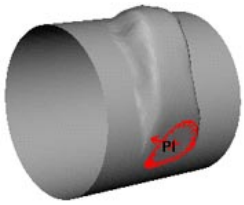
Setting sculpt variables

In the Sculpt Variables section, select the reference vector. The reference vector controls the direction the vertices move when you push or pull. The brush arrow represents the reference vector.

Normal The vertices move in the direction of the surface normal.

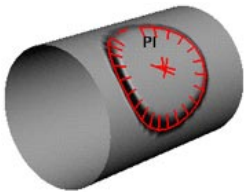


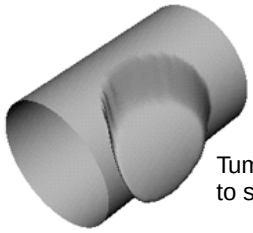
First Normal The vertices move in the direction established by the surface normal at the beginning of the stroke.



View

The vertices move parallel to the camera view direction.

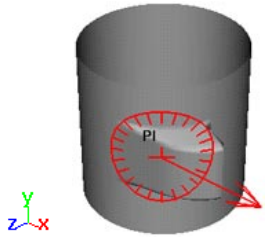




Tumble the view to see the effect.

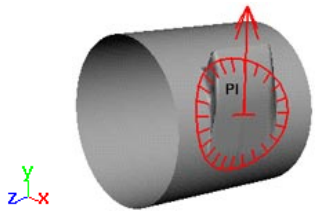
X Axis

The vertices move in the direction of the X axis only. They do not move along the Y or Z axis.



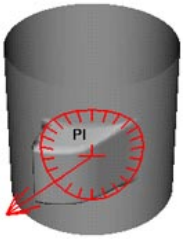
Y Axis

The vertices move in the direction of the Y axis only. They do not move along the X or Z axis.



Z Axis

The vertices move in the direction of the Z axis only. They do not move along the X or Y axis.



Setting the maximum displacement

Max Displacement Type the maximum possible depth or height of the brush stroke, or use the slider to select it.

Setting surface options

Reference Srf: update on each stroke

To “bake” or update the surface automatically on each stroke, turn Reference Srf: update on each Stroke on. For a description of reference surfaces, see "Reference surface" on page 165. To update the reference surface manually, click Update.

Erase Srf: update on each stroke

To update the erase surface automatically on each stroke, turn Erase Srf: update on each Stroke on. For a description of erase surfaces, see "Erase surface" on page 166. To update the erase surface manually, click Update.

Sculpting surfaces

Sculpting surfaces in Artisan is as easy as painting. By applying brush strokes to your surface with the Sculpt Polygons Tool, you can transform vertices to achieve a sculpted effect.

To sculpt a surface:

1. Select the polygon surface you want to sculpt.
2. Select the Sculpt Polygons Tool (Edit Polygons > Sculpt Polygons Tool) and define tool settings, if required.
3. Drag the brush across the surface.

Note

You can update or “bake” the reference surface at any time by clicking the Update button in the Surface section of the Tool Settings window. You may find this useful when you do not have Reference Srf turned on.

Similarly, you can update the erase surface. You may find this useful when you do not have Erase Srf turned on.

Tip

You can create hotkeys to update the reference surface and update the erase surface without opening the Tool Settings window. For details see *Using Maya: Painting*.

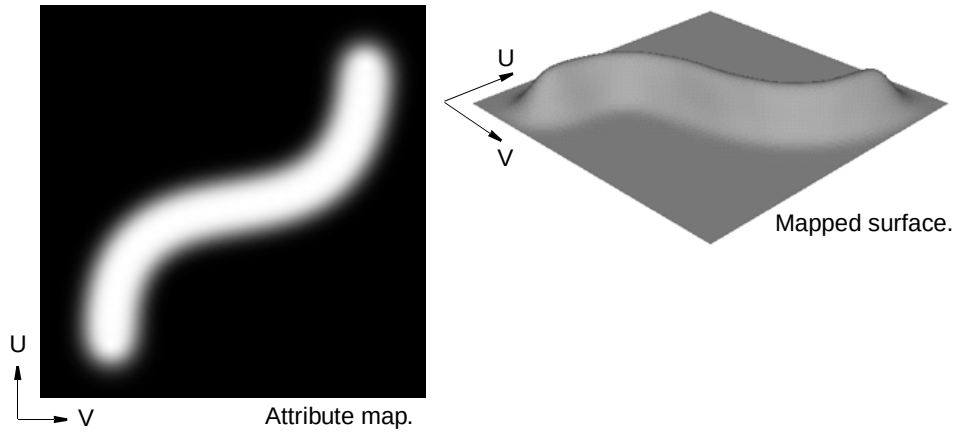
Sculpting masked surfaces

You can create a mask on your surface that is unaffected by any sculpting you do. When you apply brush strokes over the mask, the vertices on the masked area retain their position, regardless of the sculpting operation. For details, see “Restricting an area for painting” in *Using Maya: Painting*.

Importing attribute maps

When you import an attribute map to a surface using the Sculpt Polygons Tool, Maya applies the tool settings to the vertices, mapping the greyscale values to the Opacity value set for the tool.

In the following example, the Sculpt Polygons Tool is set to Pull with a stroke displacement of 2.



For details, see "Mapping attributes" in *Using Maya: Painting*.

Flooding sculpted surfaces

Flooding a surface is like taking a huge brush and applying its settings to the entire surface. The result depends entirely on the brush settings defined when you perform the flood.

When you flood a surface, Artisan displaces each vertex on the reference surface according to the operation, displacement, and reference vector set for the tool.

Flooding with the operation set to Smooth is an effective way to smooth the entire surface.

Flooding with the operation set to Erase is a quick way of erasing your sculpting and returning the surface to the reference surface.

To flood a surface:

1. Select the surface.
2. Select the Sculpt Polygons Tool and open the Tool Settings window.
3. Define the settings you want to apply to the entire surface.
4. In the Stamp Profile section, click the Flood button.

Sculpting tips and tricks

You may find the following tips and tricks useful while sculpting.

Building sculpting gradually

To retain control while sculpting, keep the Opacity and Max Displacement low and build up sculpting gradually.

Progressively smoothing a model

To progressively smooth a model, use the Flood button with Smooth as the selected operation, and set the opacity low.

Key framing changes made with the Sculpt Polygons Tool

By key framing the changes you make with the Sculpt Polygons Tool, three-dimensional morphing is easy.

1. Use the Paint Selection Tool to select the vertices that you want to keyframe and go to the first frame in the Time Slider.
2. Turn Auto Key on. Click the key icon at the bottom-right corner of the Maya main window. It displays in red when on. 
3. In the Animation menu set, select Animate > Set Key.
4. In Object mode, select the surface.
5. From the Modeling menu set, select the Sculpt Polygons Tool (Polygons > Sculpt Polygons Tool).
6. Move to the required frame and sculpt. The new positions of the vertices are automatically keyframed. Click the play button to see the animation.
7. Repeat step #6 as required.

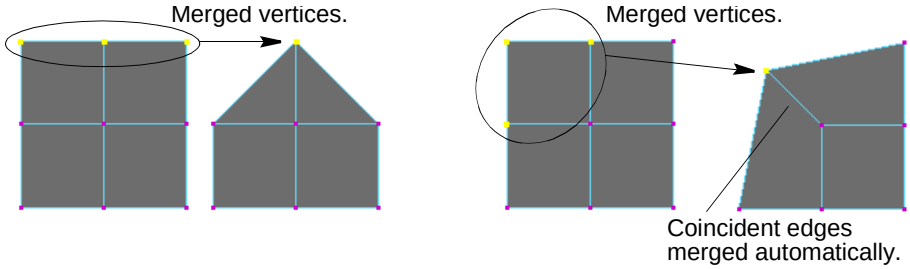
16 MERGING VERTICES AND EDGES

By merging vertices and edges, you can fill small holes in your model, join two polygon shells that line up into a single shell, and eliminate duplicate but coincident vertices in your model (thereby reducing its complexity and eliminating interior border edges).

This chapter provides information on how to merge vertices and edges on your polygonal models.

MERGING VERTICES

You can merge vertices using the Merge Vertices operation. When you merge vertices, coincident edges and their associated UVs are also merged automatically (within the specified threshold).



Before you begin, there are a few things to remember:

- You must be in component mode to select vertices.
- You must set the Distance value (the tolerance) before you perform the operation.

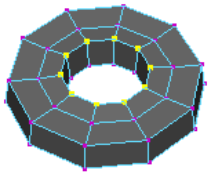
Notes

Merging vertices can make your geometry nonmanifold. It is important to be aware of the orientation of face normals and the existence of coincident edges when performing this operation, and to consider this possibility when cleaning up a model, or preparing for export. To correct nonmanifold geometry, perform a cleanup. For details, see "Cleaning up polygonal data" on page 40.

Merging vertices also merges the corresponding UVs. You may need to remap the UVs after merging vertices.

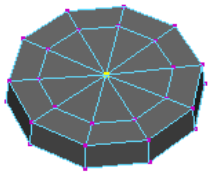
To merge vertices:

1 Press F9 and select the vertices you want to merge.

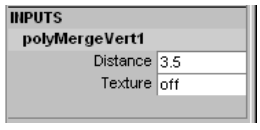


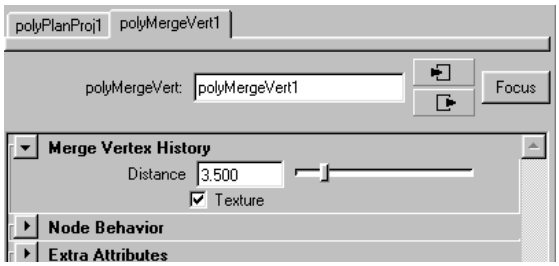
2 Open the Merge Vertices options window. Select Edit Polygons > Merge Vertices ❐.

3 Change the Distance value in the option window then click the Merge Vertex button. In this example, the Distance value was changed to 0.5, because the vertices were about that far apart.



After you merge the vertices, you can also change the Distance value in the Channel Box or the Attribute Editor.





Merge Vertices options

Click the ❐ next to Merge Vertices in the Edit Polygons menu to open the options window.

MERGING EDGES

In Maya, you can select boundary edges of a model and merge them (or sew them) to create one common edge.

Merging edges can reduce your polygon count. You merge the boundary edges of a model and then delete the interior edges which results in fewer faces.

- Edges can be merged only if they are part of the same polygon mesh.
- Only boundary edges can be merged.

There are two ways to merge edges: using the Merge Edge Tool or the Merge Multiple Edges operation.

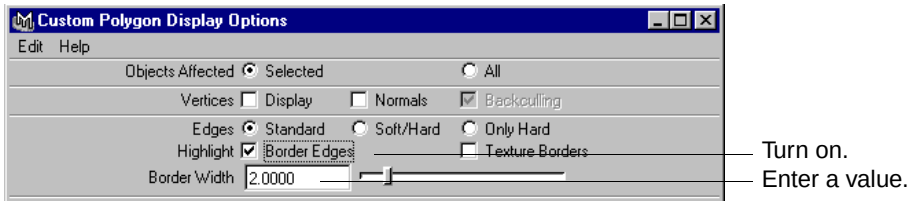
Note

Edges will not merge if the normals of adjacent faces point in opposite directions. Try either of the following before performing the merge:

- Select either of the adjacent faces and reverse the normals using the Reverse and Propagate mode. For details, see "Reversing polygonal normals" on page 70.
- Merge the vertices, which will make the object nonmanifold. Perform a Cleanup on the object to remove the nonmanifold geometry and conform the normals. For details, see "Cleaning up polygonal data" on page 40.

Preparing for a merge edge operation

To make it easier to distinguish between border edges and interior edges, open the Custom Polygon Display Options window (Display > Custom Polygon Display ❐) and beside Highlight, turn Border Edges on.



Now when you select the object, border edges display as thick lines. If you want, you can change the width of the border edge by using the slider or typing a value in the Border Width box.

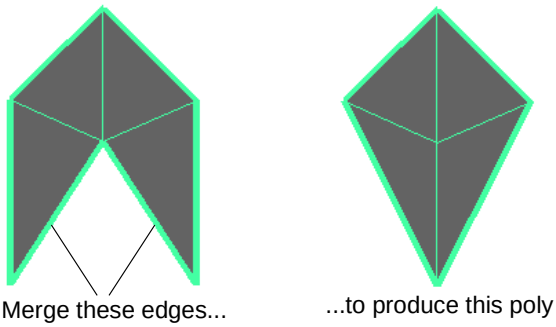
Merging edges using the Merge Edge Tool

Using the Merge Edge Tool, you select the tool, then select the border edges you want to merge. You can change the merge mode from the options window before you use the tool, or change the settings in the Attribute Editor or Channel box after you perform the operation.

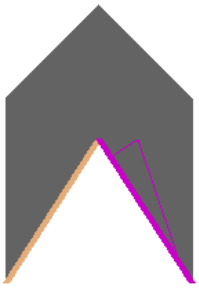
The Merge Edge Tool offers three separate merge modes—First, Middle, and Second. Middle is the default merge mode. That means the edges you select to merge are deleted and replaced with an edge that spans the area.

The following procedure shows how to merge edges using the default settings.

To merge edges using the Merge Edge Tool:

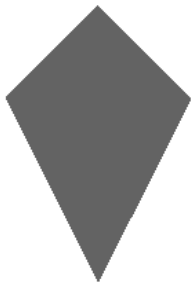


1. Select Edit Polygons > Merge Edge Tool.
2. At the prompt, click to select the first border edge you want to merge. The next pickable edge displays in purple.



3. At the next prompt, click to select the second edge you want to merge (the purple edge). Do not Shift-click and drag the mouse.

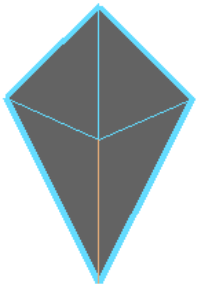
4. If your selections are correct, you can now press Enter to merge the edges, or the backspace key to select another edge.



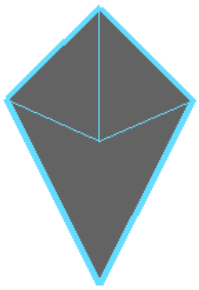
To reduce the poly count of your model:

If you are satisfied with the resulting shape of your model after you merged the edges:

1 Select the interior edges you want to delete.



2 Press the Backspace key.

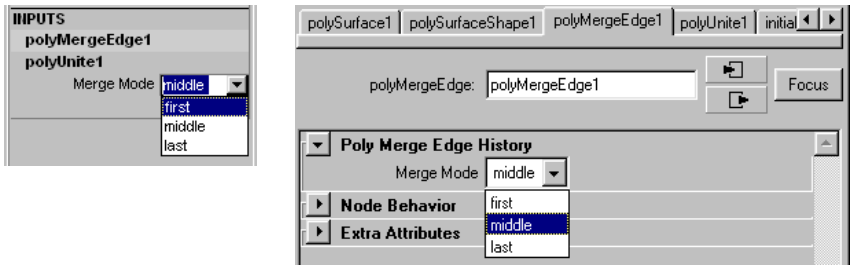


If your object is already texture-mapped and does not fit properly after you delete the edges, select all the faces of the model and use a projection tool from the Edit Polygons > Texture menu to place the texture to fit. See *Chapter 19, "Mapping UVs for polygonal surfaces"* for details.

Merge Edge Tool options

Click the ❐ next to Merge Edge Tool in the Edit Polygons menu to open the options window.

You can change these options before you use the tool if you know what you want, or you can change these options from the Channel Box or the Attribute Editor.



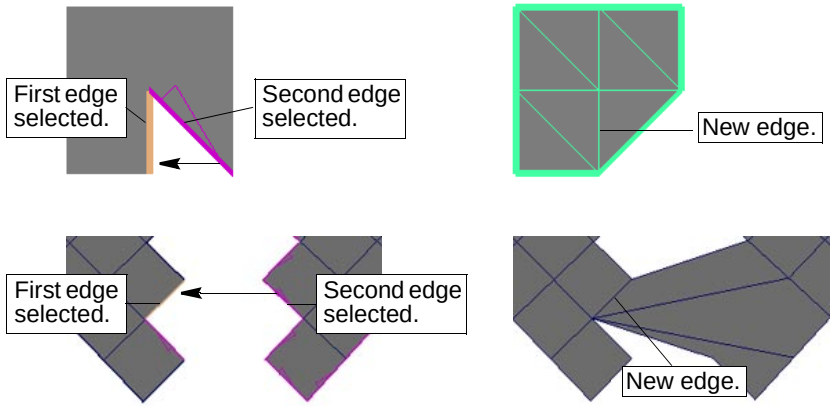
Tip

To switch between the Channel Box and the Attribute Editor, press Ctrl a.

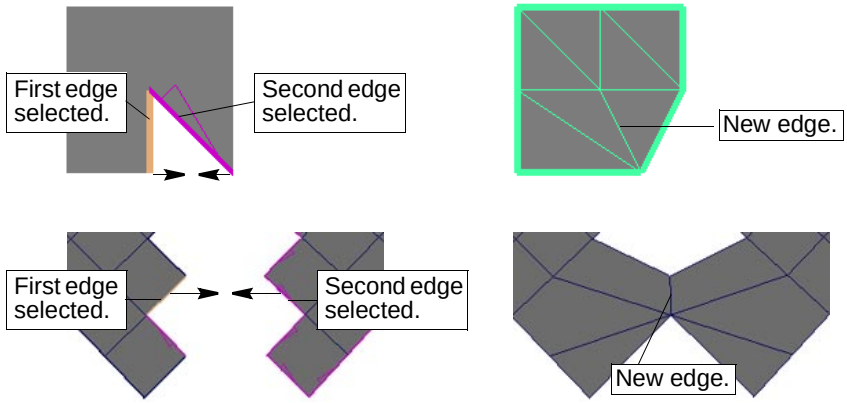
Using the Merge Modes

These modes specify where the merged edge results. If First, the merged edge results on the first selected edge, if Middle, the merged edge results in the middle of the two selected edges, and if last (or Second), on the second or last edge selected.

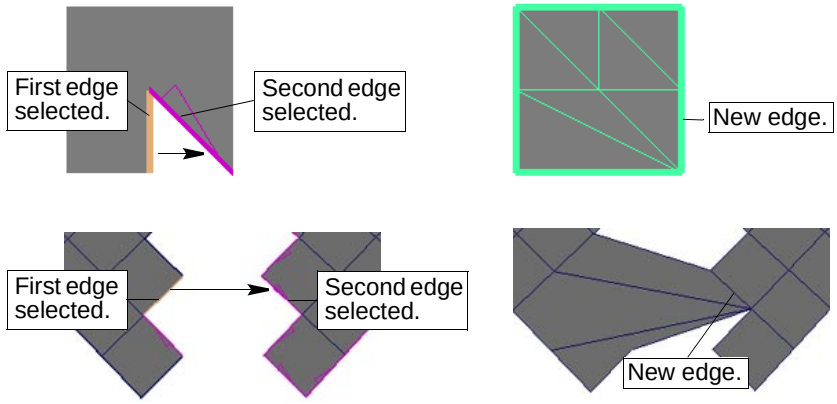
First If you select First, the first edge you click becomes the new edge and the second edge you click is removed.



Middle If you select Middle, the default, the new edge is equidistant between the first and the second edge and the first and second edges you click are removed.



Second/Last If you select Second (or Last), the second or last edge you click becomes the new edge and the first edge you click is removed.

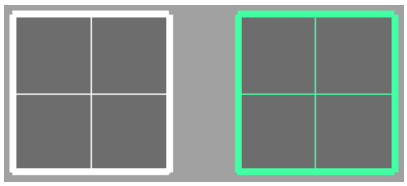


Merging border edges between two polygonal objects

If you want to merge the border edges of two separate objects or shells, you must unite, or combine, the objects before you use merge edge operations. You then pick the boundary edges when you are ready to merge them.

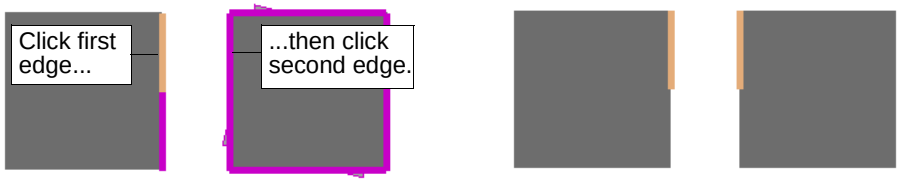
To combine polygonal objects to merge edges:

1 Marquee-select the objects whose edges you want to merge.

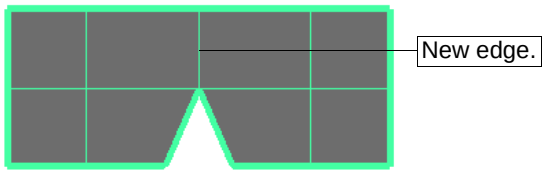


2 Select Polygons > Combine to combine both objects into a single object. (The INPUTS section of the Channel box now reads polyUnite and the Hypergraph and Outliner show the two objects as one.)

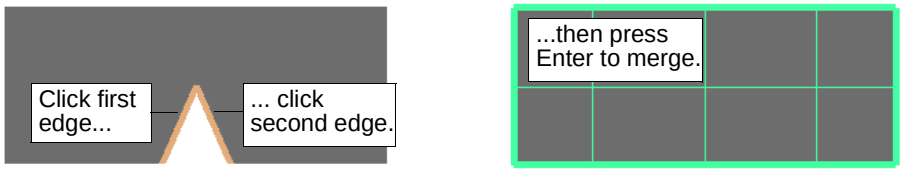
3 Select the Merge Edge Tool and click the border edges you want to merge, following the prompts. (Do not Shift-click to select the second edge.)



4 Press Enter to merge the edges.



5 Continue to select edges if you want to close the shape.



Tip

You don't have to select the tool every time you want to merge the edges. Simply click the Merge Edge Tool icon in the mini bar (the last icon at the right end of the list of icons) to re-activate the operation, or press the y key instead of Enter to remain in the tool and complete the operation.

Merging multiple edges

Merge Multiple Edges lets you select more than one edge for a combined set of polygonal meshes and merge them together. You can merge interior edges, border edges and nonmanifold border edges.

To merge multiple polygon edges:

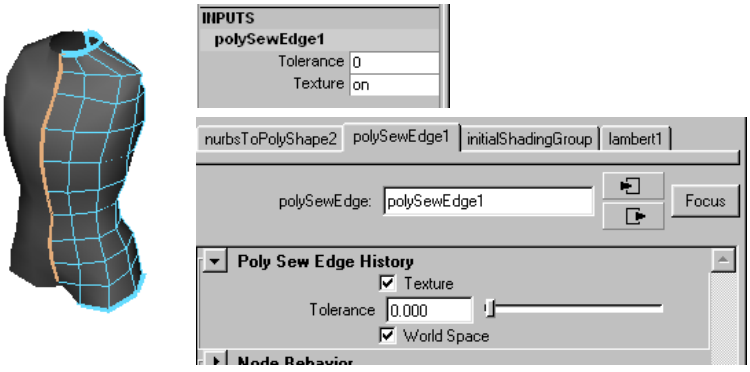
If you are merging edges between two separate objects, remember to combine the objects first (Polygons > Combine).

Because edges are components of a polygonal model, you must select the edges you want to merge while in component mode.

1 Press F10 and click to select the edges you want to merge.

2 Select Edit Polygons > Merge Multiple Edges.

Once you perform the merge operation, the edges are merged and the Channel Box and Attribute Editor update.



Merge Multiple Edges options

Click the ❐ next to Merge Multiple Edges in the Edit Polygons menu to display the options window.

Merge UVs Also Merges the UVs shared by the edges. If turned off, the UVs are not merged and can be manipulated and edited independent of each other.

Tip

If you have a model that is mapped with different textures on either side of where the edges merge, it is a good idea to turn this option off.

Threshold Any edges further apart than this distance will not be merged. Set this value carefully. If it's too small, no edges will merge. If it's too large, the operation may merge edges that you do not want attached.

World Space Coords

If turned on (the default), the specified Threshold value is the distance between edges in world space. When turned off, the Threshold value is the distance between edges in local space.

17 COLORING POLYGONS

This chapter shows you how to color polygons using various methods, and how to prelight your scene.

APPLYING COLORS AND PRELIGHTING

The Apply Color, Paint Vertex Color Tool, and Prelight features let you color your polygons on a per-vertex level, as well as prelight and shade your scenes to get them ready for production.

You use Apply Color and the Paint Vertex Color Tool to color code polygonal surfaces with non-shading related values (for example, you could color code blind data attributes). You can also use certain types of blending effects such as illumination blending, through operations such as prelighting. See "Prelighting for polygonal surfaces" on page 189 for details.

Displaying color feedback for color operations

To display color feedback for a color operation, the following conditions must be met. These conditions are met automatically when you use Apply Color, perform a Prelight operation, or start painting vertex colors. However, if you want to view color-per-vertex on a model that you edited previously, independently of these three operations, you must ensure these conditions are met.

- You must be in a shaded mode (select any of the shaded modes, such as Smooth Shade All, from the Shading menu in the perspective view panel menu).
- Color in Shaded Display must be turned on and a Color Material Channel must be selected in the Custom Polygon Display Options window. The Color Material Channel options override any existing material channels and replace them with the vertex colors you assign. For all options other than None, lighting affects the object's shading. The Color Material Channel options are:

None	None of the material properties of the shader(s) assigned to the object are used. In this case lighting is also disabled.
Ambient	The ambient material channel of the assigned shader(s) is overridden by the vertex color.
Ambient+Diffuse	The ambient and diffuse material channels of the assigned shader(s) are overridden by the vertex color.
Diffuse	The diffuse material channel of the assigned shader(s) is overridden by the vertex color. This is the default setting.

Specular	The specular material channel of the assigned shader(s) is overridden by the vertex color.
Emission	The emission material channel of the assigned shader(s) is overridden by the vertex color.

Note

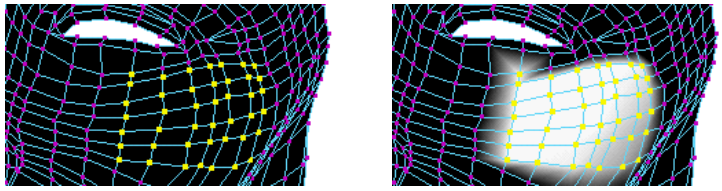
These conditions are met automatically when you apply color, perform a Prelight operation, or start painting vertex colors, as long as Edit Polygons > Color > Convert Display is turned on. (This is the default.)

APPLYING COLOR

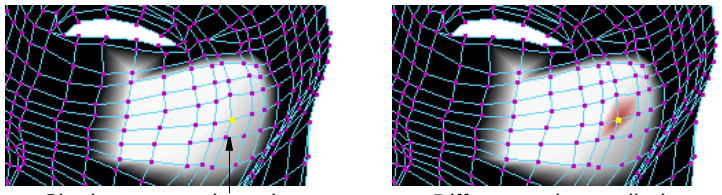
There are three methods for applying color to vertices:

- By selecting the vertices and using the Apply Color operation. For details, see "Applying colors using generic selection methods" on page 184.
- By painting color on the vertices using the Paint Vertex Color Tool. For details, see "Painting vertex color" on page 186.
- By copying and pasting color on faces. For details, see "Copying and pasting color" on page 188.

The following close-up example shows what happens when you pick multiple vertices and apply a color to them.



This next example shows what happens when you select a single vertex and apply a different color.



Single vertex selected. Different color applied.

Applying colors using generic selection methods

Follow these steps to use the Apply Color operation to apply color to polygons on a per-vertex basis using Maya's generic selection methods.

To apply color to vertices with Apply Color:

1. Select a shading mode, such as Smooth Shade All, from a panel's Shading menu, or press the number 5 key.
2. Select a vertex or vertices or select the entire object if you want to apply color.

Tip

Use the Paint Selection Tool to quickly and easily paint-select vertices. For more information, see "Paint-selecting components" on page 53.

3 Select Edit Polygons > Colors > Apply Colors ❐ to open the Polygons Apply Color Options window.

4 Select an operation to determine how color is applied to the selected vertex or vertices.

5 Change the color values as necessary by clicking the Color swatch and selecting the color from the Color Chooser, or by grabbing the color as follows.

- Click the eyedropper button beside Grab Color.

- The cursor changes to the eyedropper icon.
- Click on any color you want on your monitor.

  The color you pick is applied to the color swatch in the Polygon Apply Color Options window.

6 Click the Apply Color button

Polygon Apply Color options

Operation section

The selected option determines which operation is applied to the selected vertex or vertices.

Replace Replaces the selection's color with the color you define in the Color Value section. This is the default.

Add Adds the color you define in the Color Value section to the selection.

Subtract Subtracts the color you define in the Color Value section from the selection.

Remove Removes the color from the selection.

Color Value section

Color Click the swatch to display the Color Chooser. Use the slider to adjust the value of the swatch color.

Grab Color Click the eyedropper button to enable the eyedropper, which lets you pick any color on your monitor to define the Color.

Selected Vertex Color

Click this button to change the Color to the color of the selection.

Alpha Sets the alpha channel of the Color, which defines the object's transparency.

Resulting Color Displays the actual color that is applied to the selection, taking into account both the Color and the Alpha settings.

Color Channel Values section

Set Individual Color Channels

Turn this option on to make the Color Channel Values options available and the Color Value options unavailable.

You can set the red, green, blue, and alpha (RGBA) values individually by turning on the Set Red, Set Green, Set Blue, and Set Alpha options, respectively, and changing the corresponding values.

Painting vertex color

Use the Paint Vertex Color Tool to paint a specified color value and alpha onto polygon vertices.

The Paint Vertex Color Tool interface is common to many paint tools in Maya, known collectively as Artisan tools. For general information on the tool settings, see *Using Maya: Painting*.

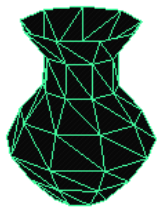
To paint vertex color on a polygon:

1. Select the surface you want to paint color on.
2. Select Edit Polygons Colors > Paint Vertex Color Tool ❐ to open the Tool Settings window and set the brush radius and shape if necessary.
3. Make sure you are in Projective Paint mode (click the Misc tab in the Tool Settings window).

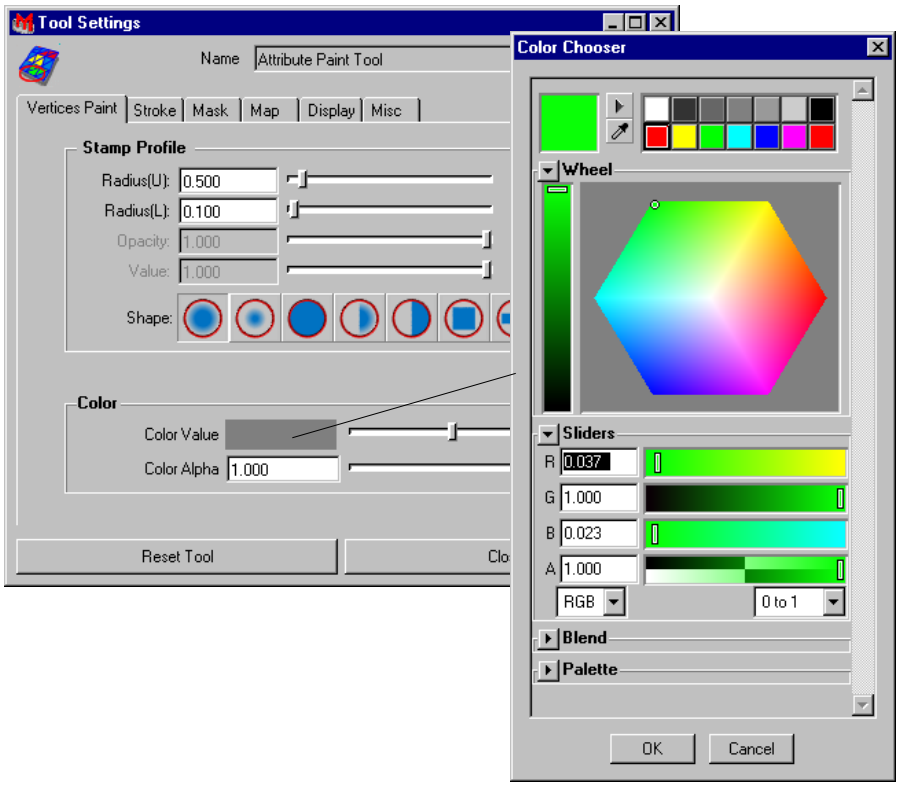
Note

If you are painting on polygonal surfaces in projective paint mode, you cannot reflect paint. To reflect paint, you must be in UV texture paint mode and the UVs on the polygon must be evenly distributed, symmetrical, and not overlapping. For information on setting the paint mode, see *Using Maya: Painting*.

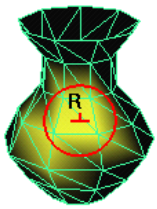
The selected polygonal surface should display in black.



4. Click the color swatch to open the color chooser and select the color you want to use.



5 Click the OK button to validate your choice, then click-drag the brush across the polygon, or to paint the entire surface, click the Flood button in the Tool Settings window.



Tip

You can change the attributes for the brush and the color in the Tool Settings window on the fly as you paint and you don't necessarily have to leave the Tool Settings window open. Once you are in color mode, simply click the icon in the title bar to re-open the Tool settings window.

Using hotkeys to pick and copy color values

You can quickly pick color values from a vertex and paint them on another using hotkeys.

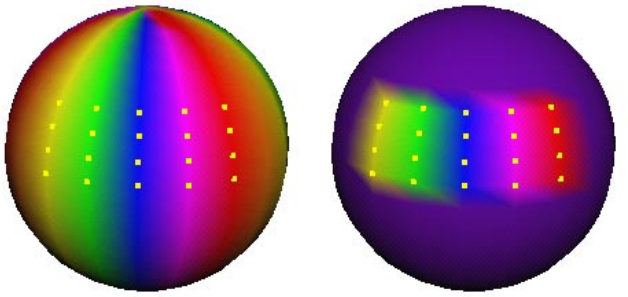
1 Select the polygonal surface with the color values you want to pick and select the Paint Vertex Color Tool.

2 Hold down the Pick Color Mode hotkey (default, /), click on the color you want to pick, then release the hotkey.

3 Click-drag the brush across the surface you want to paint with that color.

Painting vertex color on masked vertices

You can create a mask on your polygonal surface that is unaffected by any color painting you do. When you apply brush strokes over the mask, the vertices on the masked area retain their color, regardless of the color you paint them.



Masked polygon. Masked polygon after Flood.

For details on masking surfaces, see *Using Maya: Painting*.

Mapping color values to vertices

Using the Paint Vertex Color Tool you can map color values onto vertices relative to the U/V surface direction. For details on mapping, see "Mapping attributes" in *Using Maya: Painting*.

Copying and pasting color

The Edit Polygons > Clipboard Actions submenu provides you with a fast and easy way to copy and paste colors from one object to another on a per-face basis. The copied color is placed on the clipboard. When you paste, the color on the clipboard is applied to the selected faces.

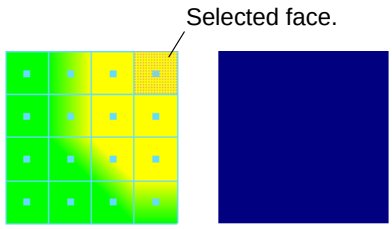
The attributes you turn on or off in the options windows for Copy, Paste, and Clear Clipboard apply to all three operations. That means when you are ready to copy and paste the color, all you have to do is select the menu item.

To copy and paste colors:

1 Make sure that both the object you are copying from and the object you are copying to are in smooth shaded mode and that you applied the Custom Polygon Display options to both objects with Color turned on and a Color Material Channel selected.

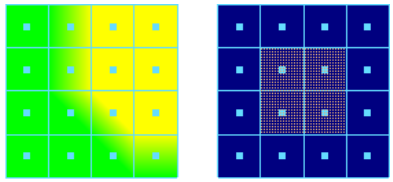
2 Select Edit Polygons > Colors > Copy ❐, select the Color attribute and click the Apply button (Color is turned off by default. You must turn this attribute on).

3 In the view, select a face that contains the color you want to copy onto another object.

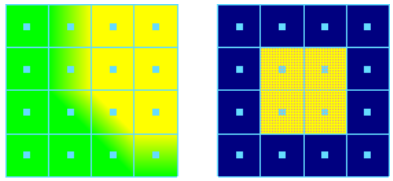


4 Select Edit Polygons > Clipboard Actions > Copy.

5 Select the faces you want to paste the attributes to.



6 Select Edit Polygons > Clipboard Actions > Paste.



Transferring vertex color

Use Transfer to transfer vertex positions, UV sets, and/or vertex color between two models with identical topology.

To transfer vertex color:

1 Select both the source object and the destination object, in that order.

2 Select Polygons > Transfer ❐.

3 Select Vertex Color then click Transfer.

PRELIGHTING FOR POLYGONAL SURFACES

When you render, Maya takes the material properties of the surface, considers the effect of each light illuminating the surface, and computes a final color for each visible point on the surface. These calculations are complex, and depending on the size of your model and the number of lights in your scene, can take a great deal of time to compute.

When you prelight an object, you perform the rendering calculation in advance and only at each vertex of your object (rather than at every visible point on the surface). Maya stores the resulting colors at each vertex, so at run-time, the color at each vertex of the object displays as though it were illuminated without doing the illumination rendering calculation.

You can use the Color in Shaded Display mode to display vertex colors and blend them across each polygon face rather than performing the normal illumination and shading calculations.

See "Applying color" on page 184 for details about how to color polygons on a per-vertex basis.

Prelight advantages

This section describes some of the advantages to prelighting your polygonal models and scenes.

Simplifying the scene

If you have a limited amount of resources such as memory storage or computational power, prelighting simplifies the scene to reduce resource limitations in a number of ways:

- Lights can be removed since the lighting and / or shading has been pre-computed and stored with the geometry.
- Complicated shading networks can be replaced with simple ones since the shading network has been pre-evaluated and the resulting color has been stored with the geometry.

Overcoming platform limitations

You may export to a platform that does not support certain shading effects. For example, some graphic APIs only support a limited number of lights, and many platforms have a limited amount of texture memory available. If these lights and textures are pre-evaluated and their effects baked onto the geometry, they can then be removed from the scene.

Exporting and view effects

It can be impractical to export the shading network used for software rendering evaluation. Some platforms may be unable to fully achieve the effects available from Maya's software rendering network. Prelighting provides you with a way to pre-evaluate shading effects. Basic examples include:

- evaluating a solid texture such as a marble texture
- evaluating a procedural texture such as a ramp texture

Although you can use Maya's Rendering convert-solid-to-texture functionality, currently special shading effects and textured geometry types cannot be evaluated, including:

- Textured lights cannot be exported or viewed in 3D views.
- Polygonal surfaces with texture coordinates that overlap within a surface cannot be shown or exported.

In Maya, the term *prelight* means the evaluation of materials and lights that have been assigned to a polygonal object at the object's vertex positions. This is the same as a software rendering evaluation when a pixel value has to be evaluated to render some part of an object. An actual software render is not performed, but the same shading network evaluation is performed.

Sample storage

A sample can either be stored as color-per-vertex-per-face, or used to displace the position of a vertex.

If stored as a color-per-vertex-per-face color, RGB color and alpha (transparency) is stored. For displacement, the X,Y,Z coordinates of the vertex position changes. Since a sample contains four channels (RGBA), the displacement uses the luminance value of the color.

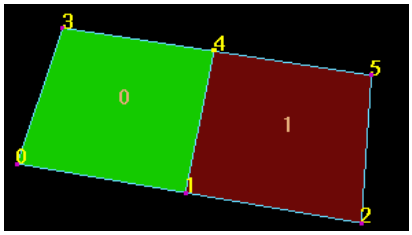
Since Maya supports color-per-vertex per-face, or un-shared colors, prelighting is computed on a per-vertex per-face basis. So for example, if a vertex is connected to N faces, then N shading evaluations are done, one for each vertex-face combination. This is important in order to be able to capture possible different sampling results due to one or more of the following.

These possible differences can be called *shading discontinuities*:

- **Different normal-per-vertex per-face**: The normal is used to compute shading, so differing normals may give different sample results.
- **Different UV-per-vertex per-face**: The texture coordinate is used to compute a texture value for shading, so differing UVs may give different sample results.
- **Hard versus soft edges**: A hard edge uses a face normal, while a soft edge uses the vertex normal average.
- **Different shader per connected face**: Different material properties on shaders give different sample results.

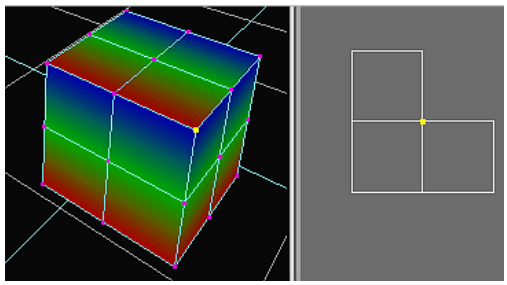
The following shows connected polygons on a single surface—each polygon was mapped with a different shader.

Vertex 1 is connected to face 0 and 1 and two samples are computed, one for each connected face, since their shaders differ. The same holds true for vertex 4. Vertex 0,2,3 and 5 are connected to one face so only 1 sample is computed for each.



For shared texture coordinates between faces, software rendering actually only samples a connection at the vertex position once for one of the faces, and then slightly offsets the sample from the initial position for each subsequent face. Since sampling is done on a per-pixel basis this is satisfactory. Per-vertex level sampling must perform a similar action to evaluate different un-shared sample values.

In the following example, the selected vertex on the cube has one texture coordinate that is shared (as shown in the texture view on the right).



For Maya to compute different colors for the three connected faces, different UV values have to be used for the top face to compute a “red” sample value. So, the UV has to be offset by the same amount as used for the software rendering to achieve the desired results. If, however, highly detailed textures are applied to a dense mesh of vertices, the computed sample may be slightly off.

Setting up a scene to Prelight

For the best interactive visual display mode that matches software rendering, select None from the Color Material Channel menu in the Custom Polygon Display Options window.

When you select None, the object only uses the computed vertex colors to shade the object in a perspective view. That is, the object will not be affected by hardware shading evaluations.

For prelighting to work, the scene must have at least one light. However, there is no maximum to the number of lights that can be evaluated.

Prelighting a scene

Prelighting can be an iterative process. You may need to repeat the following process to achieve the effect you want, tweaking the prelight options each time.

To prelight a scene:

1. Select the objects or object components that you want to prelight.
2. Select Edit Polygons > Colors > Prelight ❐. The Polygon Prelight Options window opens.
3. Set the desired prelight options and click Prelight.
4. Repeat steps #1 to #3 for the other objects in your scene that you want to prelight.

To view the scene with prelighting:

1. Hide the lights in the scene.
2. Select Display > Custom Polygon Display ❐.
3. Beside Color Material Channel, select Emission then click Apply.

Maya displays an approximation of the texture and color per vertex information. To see the actual prelighting, you must output the scene to your display engine.

Polygon Prelight options

The Prelight menu item can be found in the Edit Polygons > Colors menu. Click the ❐ to open the options window.

By default all options are turned off, and the Sample scale factor is set to 1.0.

Sample selected faces only

You can select objects and or any type of polygonal component of an object. This includes vertices, edges, faces, and UV / map component types. By default Maya examines each component type to determine which vertices have been selected and the selected vertices are then sampled.

If Sample selected faces only is turned on, Maya examines each component type to determine which complete faces have been selected. The selected faces are then sampled.

For example, if a face has four vertices, and only three of them are selected:

- if Sample selected faces only is off, three vertices are used for sampling.
- if Sample selected faces only is on, no sampling will be performed since the face is considered to be only partially selected.

Sample using face normals

This option uses the corresponding face normals for sampling regardless of whether Sample selected faces only is off, or whether the edge is hard or soft.

Compute shadow maps

Turn this on if you want shadows to be computed. A software rendering Shadow Pass occurs, which outputs a set of depth shadow maps, and then uses these maps during a sample evaluation.

It is equivalent to doing the following in Maya rendering:

- Set Shadow Pass on in Render Globals.
- Select each light and turn Compute shadow maps on.
- Select each light and turn Write maps on, then turn Reuse and Read maps off.
- Perform a software render with the current active view camera.
- Select each light and turn Write and Reuse maps off, then turn Read maps on.
- Read in the shadow maps, and use them during sampling.

Override shadow map options on lights

This option is available only if Compute shadow maps is on. If Override shadow map options on lights is turned on, shadows will be computed for each light, even if Use Depth Map Shadows is turned off for the lights.

Reuse computed shadow maps

To re-use computed shadow maps, turn Compute shadow maps on. Turn this option on to skip the Shadow Pass computation (Compute Shadow maps above). This lets you use statically created shadows, and / or computes shadows just once for future adjustments of the prelight operation or the software rendering.

Ignore mapped channels on surface shaders

Turn this option on to turn on Ignore when Rendering for each channel of the surface shader.

Sample incoming illumination only

If this option is selected, only incoming illumination lighting is computed. This option is useful if you want to use this information for your own shading computations. It is also useful if you want to sample lighting effects, such as when a light's color has been mapped (see "Combining prelighting effects" on page 197 for more details).

Note that the lights in your scene must have a Decay Rate for this option to have an effect.

Displace geometry

Using sampled shading values to displace geometry is not a prelighting effect, but is related to using sampling data to modify attributes on an object's geometry. The positions of the vertices selected to sample are displaced along their normals by the sampled data value amount. The normal used for displacement is the vertex normal used for rendering.

You can see this normal in a perspective view by turning on the Vertices Normals option in the Custom Polygon Display Options window (Display > Custom Polygon Display ❒).

Notes

- Sample using face normals is disabled when this option is turned on. That is because performing a displacement for each face of a vertex cannot be done, which would be attempted if Sample using face normals was available.
- Rendering > Lighting / Shading > Displacement to Polygon achieves much the same effect (although it can only be applied to the entire object).

Store shared values

If there are multiple vertices are selected, turn this option on to average the values at the vertices and store the average value.

Sample scale factor

The scale factor is useful if you want to brighten or darken colors before storage, or to adjust the amount of displacement to be performed.

It is possible to scale the sample before applying it to the geometry (meaning, you can store color or displace a point). For colors, a negative scale factor is ignored. For geometric displacement, the scale factor is taken into consideration regardless of whether it is positive or negative.

Note

A value between 0.0 and 1.0 is usually applied to each channel of a sample, though values greater than 1.0 can be used.

Clamp minimum RGBA value
Clamp maximum RGBA value

Turn on these options to clamp the minimum and maximum RGBA values so that the values are forced to be within the range you set.

Saving your prelighting to texture maps

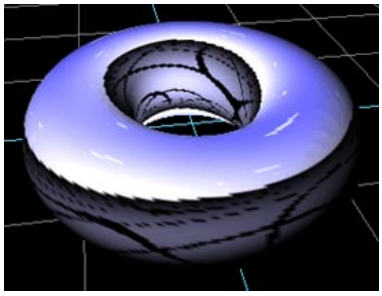
After prelighting your scene you may want to save the prelighting as texture maps and then apply the texture maps to the surface shaders.

To save prelighting to a texture map:

1. Select the object with the prelighting.
2. Select Edit Polygons > Colors > Paint Vertex Color Tool ❒. The Tool Settings window opens.
3. Click the Map tab.
4. In the Export Attribute Map section, select a location and type a name for the texture file in the Map Name box. Set the other options as appropriate. For details, see the "Using Artisan Paint Tools" chapter of *Using Maya: Essentials*.
5. Click Resave.

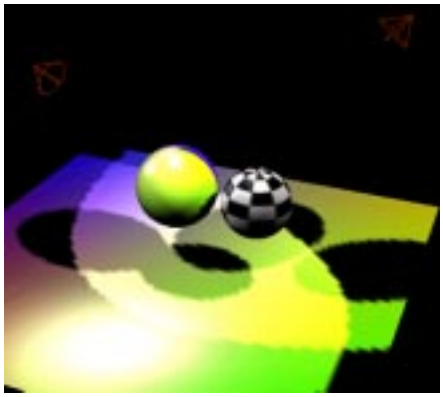
Prelighting examples

All examples shown have hardware material display disabled for the modeling view. This next example shows a torus which has been assigned to a Phong shader and mapped with a sky environment texture map.



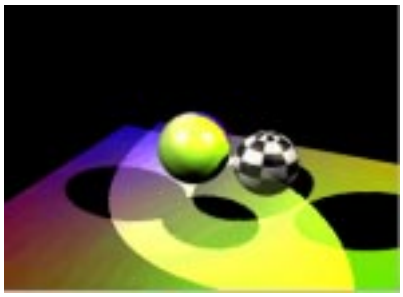
Using shadows for the sampling process

Two spotlight shadow maps were used for evaluation in this example. A ramp texture is mapped to the plane and one of the sphere's associated shaders, while the second sphere is mapped with a checker texture.



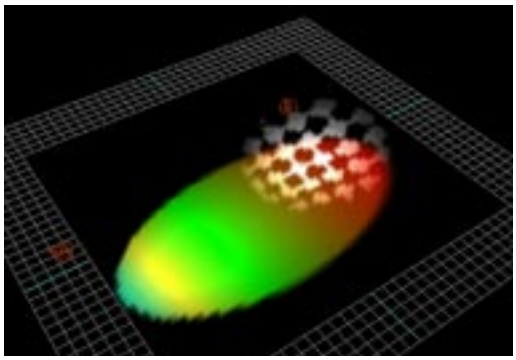
Software rendering versus prelighting

This next example shows the same scene rendered using software rendering. Since the same shading evaluation is used in Prelight, the results are similar. There are differences because Prelight is sampling at a per-vertex level while software rendering is performed at a per-pixel level, but all relevant visual cues are there for prelighting.



Prelighting lights

This example shows the result of sampling only the incoming illumination. The plane geometry has no texture applied to it at all. The texture mapping has instead been applied to the two spotlights in the scene.

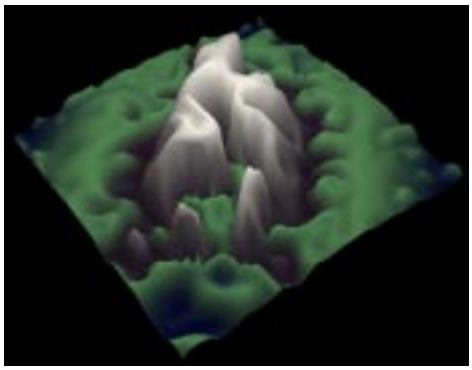


Note

This effect cannot be pre-visualized or exported in hardware or software rendering without first prelighting.

Using Displace Geometry

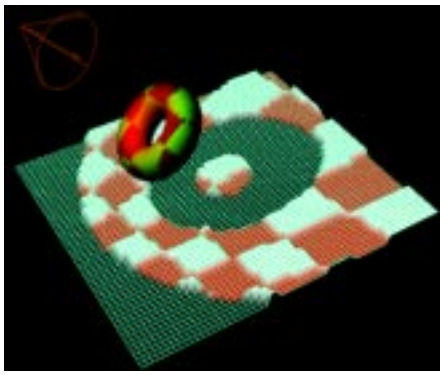
A mountain texture has been assigned to the shader associated with the plane geometry. Higher luminance values result in greater displacement of the original plane, as seen in the white sections of the resulting geometry.



Combining prelighting effects

This example shows how a number of separate prelights can be used to combine a number of effects onto a scene.

A spotlight's color channel has been mapped with a red and white checker texture. The polygonal plane has sampled twice with Sample incoming illumination turned on: once for color and once for displacement information. The torus and the plane both have a ramp texture assigned to them, but Sample incoming illumination has not been selected for the torus. Shadows were computed for the first sampling of the plane (using the Compute shadows option), and then Reuse computed shadow maps was turned on for each subsequent prelight operation.



ANIMATION FOR VERTEX COLORS

You can animate colors that are assigned per vertex. For example, you can create an animation of blood color dripping down a wall or of a crystal changing from dull to glowing green. The colors per vertex feature appears only in the scene view with Shading > Smooth Shade All on.

To animate vertex colors:

1 Before beginning, make sure the object has some construction history. If it does not have construction history, the colors per vertex feature will fail to set a key. You can quickly create history on a model by choosing Edit Polygons > Move Component, but moving nothing.

2. On a given frame, assign colors to selected vertices. The color assignment operations are under the Edit Polygons > Colors menu, such as Apply Color and the Paint Vertex Color Tool.
3. Choose Edit Polygons > Color > Set Vertex Color Key. (You cannot use any other keyframing method.)

   If you receive the warning "Active objects have no keyable attributes," you must first apply a color. You cannot set a keyframe if there is no color assigned.

   If you receive the warning "Current manipulator and active objects have no keyable attributes," you must add construction history to the object; see step 1.
4. Repeat steps 2 and 3 for additional frames.

To delete vertex color animation:

In the Channel Box or Hypergraph, select the polyColorPerVertex node and delete it.

Warning

If you choose Delete by type > History on a model with vertex color animation, Maya also deletes the color per vertex animation.

Effect on performance

When you animate vertex colors, Maya creates animation curves for each vertex per face. For this reason, playback performance slows down significantly if you animate too many vertices. Try to limit the number of vertices you animate. Another alternative is to delete the static animation curves.

18 WORKING WITH BLIND DATA

You can use Maya's Blind Data Editor to define the blind data types you need, and then apply the blind data to objects or components in your scene. The blind data editor also allows you to query your scene for blind data of a specific type or set of values and use false coloring to visualize what blind data is assigned to each objects.

Note

You can also use *blindDataType*, *polyQueryBlindData*, and *polyBlindData* MEL commands to work with blind data. For details, see the *MEL Command Reference* (online only).

DEFINING BLIND DATA TYPES

You must define blind data types (or templates) before you can apply blind data to your polygonal components (vertices, edges, and faces) or objects. (You can also apply blind data to NURBS patches using "face", but you cannot false color it.)

Types of data include:

- int
- float / double
- boolean
- string
- binary

The template needs to have a unique Type id and both long and short Attribute name for setting and retrieving the data. Multiple attributes can be defined within the same template.

You can do this in the Type Editor tab of the blind data editor.

To define new blind data types:

1. Select Window > General Editors > Blind Data Editor. The Blind Data Editor opens.
2. Click the Type Editor tab, and define the data type in the fields.
3. Click Save to create the data type and save it.

You can create new blind data type templates by choosing New in the Type Editor tab.

Type Editor tab options

Id Must be a unique integer which specifies which blind data type you're working with.

> ***Note***
>
> Subdivision surfaces (available in Maya Unlimited) use blind data to store hierarchical edit information when converting from a subdivision surface to a poly proxy object. The Id numbers between 65119000–65119999 are reserved for this purpose. Do not assign them to your blind data types.

Name A word or string (with no spaces) that will help you remember what the blind data types are. It must be unique.

Association type Describes what the blind data is attached to. Valid choices from this editor are Face, Vertex, Object, or Any. If you select Any you have to choose what you want to apply the data to when you are applying it. If you select Face, Vertex, or Object, the data is assigned only to that type of component or object (and selected objects / components are converted to this type).

If the component type you are going to be applying this data to is always going to be the same, it's a good idea to select it here so that Maya will know how to treat your selection when applying, coloring, or querying components.

Free Set Turn this option on if you want to be able to set the value manually (according to the appropriate data type). Turn it off to use only the values that have been explicitly defined as Presets (see "Presets" on page 201).

New Attr When you first enter a new type, only one attribute is presented to you. To create a blind data type that has more than one attribute (for example, two ints), click New Attr.

Long Name Type the long name for the attribute you are defining, such as "message." It can contain, but not start with, numeric characters.

> ***Note***
>
> The names *vertexBlindData*, *faceBlindData*, *edgeBlindData*, *fbd*, *vbd*, and *ebd* are reserved for the parent attribute of the corresponding types and cannot be used for attribute names for those components.

Short Name Type the short name for the attribute you're defining, such as "msg" for *message*. This name must be 3 characters or less and can contain, but not start with, numeric characters.

For object blind data, choose unique long and short names for the blind data type, making sure they are different from any attribute name on the object to which you are going to apply the blind data. For component blind data, the names must be unique within the DG node.

To see all the long names of attributes on a shape, type:

```
listAttr pPlaneShape1;
```

To see all the short names of attributes on a shape, type:

```
listAttr -sn pPlaneShape1
```

Data Type Select which type of data the attribute is. Valid choices are:

- **double** A floating point decimal number. This choice is equivalent to a float type.
- **int** An integer.
- **hex** This is a special case of integer in which hex values are used to represent the data. Using this type, you can pack a large number of binary values into one integer.
- **boolean** True or false (1 or 0) only.
- **string** An ascii string of text.
- **binary** An arbitrary stream of data, stored as text.

Ranged This option is available only if you have a numeric data type selected (double, int, or hex) and if Free Set is turned on. Turn on Ranged to restrict the data to an upper and lower range. When you turn it on, the Min and Max boxes appear for you to specify the upper and lower range.

Presets

You use Presets to set up values you can quickly select by name instead of having to know which values to use. They provide a means for enumerating integral or (in the case of the hex type) flag values, that let you quickly set frequently-used data and, if Free Set is turned off, restricting what values you can apply to data.

New Preset Click this button to create a new preset; when you do, several input boxes appear. There is one box for the Name of the preset and one box for each attribute in this blind data type. Click Delete to remove presets you do not want.

Once you have entered all of the data, click the Save button to save this blind data type to the scene so that you can apply data using it as a template.

Editing blind data types

You can edit blind data types.

To edit a blind data type:

1. Select the blind data type you want from the list of data types in the Type Editor tab.

   You can edit the Name, Association type, and Free Set values. You can also edit and add new Presets.

2. Click Save to save the changes.

Note

You can use blind data templates created outside of the Type Editor within the Blind Data Editor. If you do, however, it is a good idea to edit that type within the Type Editor (select its Id from the list of data types) so that the Apply and Color/Query sections of the Blind Data Editor know how to handle the data.

Exporting blind data types

You can export blind data types. This is useful if you are going to use the same blind data in multiple scenes.

To export blind data types:

Click Export to export all of the blind data types to a file.

Viewing template data

You can save the blind data template information in your scene to a text file and then print it for the level designer or programmer to review. Programmers can parse this text file and use it directly in the game engine if they want.

To save blind data template information:

After you create and save all your blind data templates, click Text Dump and save the file.

APPLYING BLIND DATA

After you define and edit blind data types, you can apply them to objects or polygonal components.

To apply blind data types:

1. In the Blind Data Editor, click the Apply tab.
2. Select the blind data type you want to apply from the list.
3. Select or enter the value you want to apply to the selected objects or components.

   If there are presets defined for the selected blind data type, you can select the value with the radio buttons.

Apply tab options

Assoc Type If the selected blind data type already has a particular association type assigned to it, then this option is available and the data will only be applied to that component type (or, if the type is object, to the whole object). Otherwise, if the type was Any, this option is not available and you should select the association type you want to apply your data to. The default is face.

Selected components are converted to the Assoc Type before the data is applied.

Apply Type If the data types of the selected blind data type are not all either int or double, this menu is unavailable. Possible values are Absolute, Offset, and Scale.

- **Absolute** The value is applied to the data. If selected components or objects already have blind data of this type, the values are overwritten.
- **Offset** The values are added to the data that is assigned to the selected components or objects. If no data exists on a selected component or object, no data is applied. If the attribute being affected is Ranged, the values are clamped at the minimum and maximum values.

Scale The existing data associated with the selected components or objects is multiplied by this value. If no data exists, none is applied. If the attribute is Ranged, the values will also be clamped.

Paint values Selects the Artisan Paint Selection Tool and opens the Tool Settings window. This tool only works if you have a blind data type selected and if the association type is face or vertex. The component pick mask is switched to the association type selected for this blind data type, and the data is applied on every mouse release.

Color data on apply When turned on, the selected components are false colored after the apply is done according to how you have color set up in the Query / Color tab.

COLORING OR QUERYING BLIND DATA

You can also false color or query based on a particular value or range of values.

To color or query blind data:

1. Right-click in the Tab / Id field and select the blind data.
2. Turn on the check box to the right of the Tag / Id to enable the values for the row.

   The Select value section displays below the row, providing you with several different options for the color or query action.
3. In the Value box, type values for the attribute(s) for this type.
4. In the Select value section, select which type of value you want to color or query for a particular type.

Color/Query tab options

Use this tab to false color and query polygonal objects and components based on criteria you set up. There are several levels through which you can look at the data.

The first is a high level view of what components or objects have the specified blind data assigned to them, regardless of value.

Note

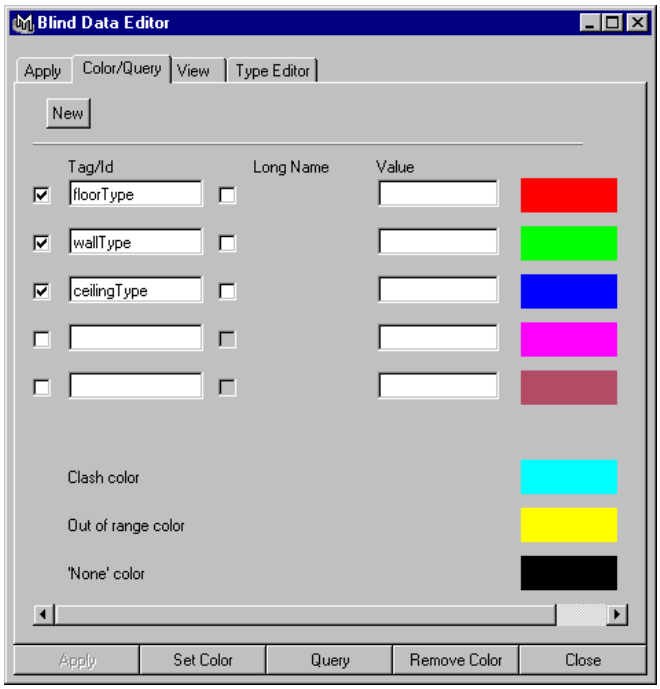
The colors show the sequence of queries that were performed, and do not get updated by subsequent changes to blind data. If the object's topology changes, colors may no longer be accurate.

Tag/Id To complete the Tag / Id fields, right-click in the field to bring up a popup of the available types, or type in the fields.

Set Color In the following illustration, Set Color goes through the selection list and colors components that have floorType blind data red, wallType blind data green, and ceilingType blind data blue. If any components have two or more of the specified types assigned, the components (or objects) are colored with the Clash Color, in this case, light blue. Components that have none of the specified types are colored with the None color, which is black in this case.

Tip

To see the colors in the illustrations in this section, view the online help.



Query Click Query to select the components (or objects) which would be colored if you had chosen Set Color. Note that if any of the row conditions are satisfied, the component or object is selected.

Note

To use a row in the Color / Query operation, turn on the check box to the left of the Tag / Id field. Disabling a row is useful if you do not want to use a particular type or value but may want it later.

Remove Color Click Remove Color to remove color from the components that have the listed blind data types.

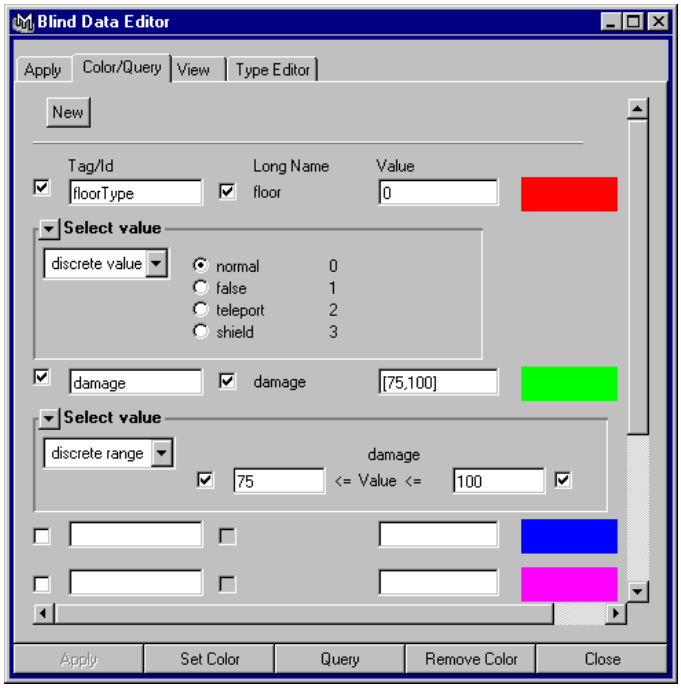
Select value options

When you enable the values for a row, this section displays below the row, providing you with the following options for the color or query action.

discrete value Select this option to color or query one value for a particular type.

discrete range Select this option to color or query a range of values for a particular type.

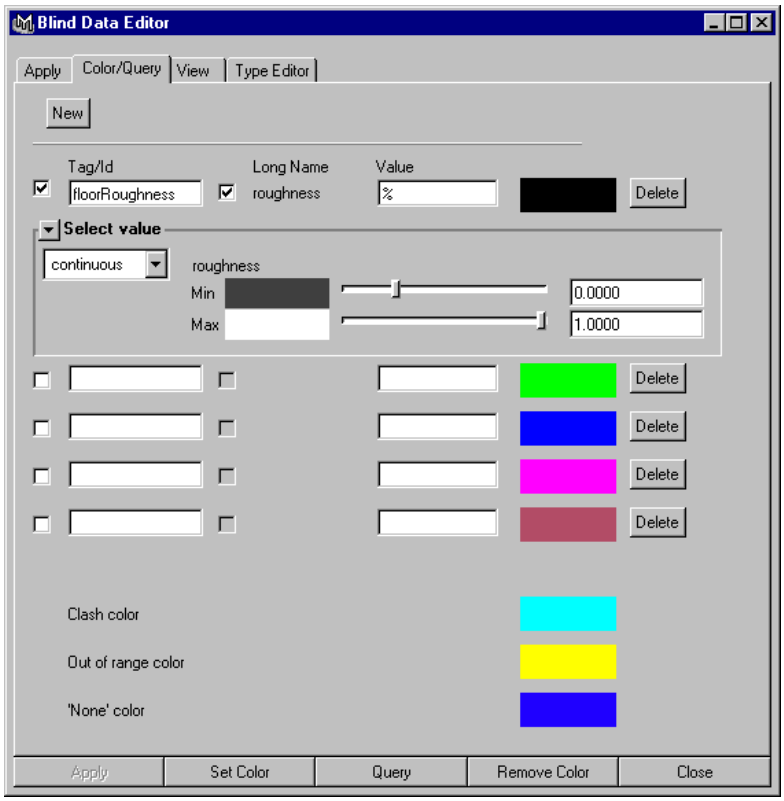
In the following illustration, components with the blind data type floorType with a value of 0 (corresponding to preset: normal) are colored red. Components with blind data type damage and values between 75 and 100 are colored green. Components with both floorType and damage blind data are colored with the Clash color.



Continuous

Integer or double data can also be colored with grayscale values. Select continuous from the drop down menu, and select min and max values and colors to use in coloring the data.

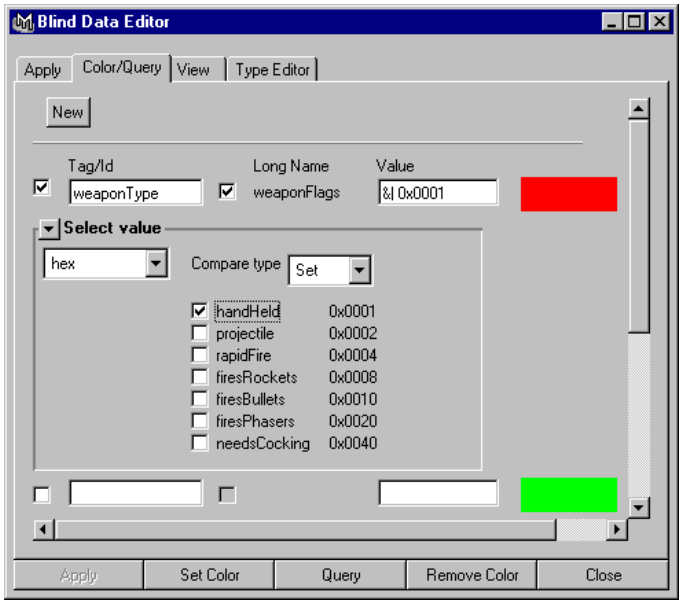
In the following illustration, the blind data type floorRoughness is displayed. Components which have a value of 0 are colored black, those with values of 1 are colored white, and those in between will have the appropriate grayscale. Values less than 0 or greater than 1 are colored yellow, the Out of Range color. The None color is blue to differentiate between components with 0 floorRoughness and components that have no floorRoughness assigned at all.



When using the continuous type, query works as if discrete range were selected; any components that have blind data with values between the min value and the max values are added to the selection list.

Hex

You can also color and query with the hex type if the blind data type selected consists of hex data.



When the selected Compare Type is Set, components with the selected value(s) set are colored or selected. If it is Not Set, only components with the value not set are colored or selected. If set to Equal, only values which equal the selected value are colored or selected.

Some notes on coloring and querying blind data

Although you can examine multiple types of blind data at one time, you are only allowed one type of Color / Query action. The possible types are:

- Binary: either the data is assigned or not
- Discrete: either a discrete value or discrete range
- Continuous: use grayscale values for coloring
- Hex: use bit operations on the values

If you have rows with different types, the operation will fail.

Association type and selection type are also important in this regard: If all the rows have blind data types that are specifically tied to a particular association, your selection is converted to this selection type. If, however, any of the rows have *Any* as the Association Type, or if the rows do not match (one row's blind data has *Face* Association Type and another's Association Type is *Vertex*), the selection will not be converted and the components and objects selected are queried or colored in their present state.

VIEWING BLIND DATA VALUES

You can look at the values of assigned blind data in the View tab of the Blind Data Editor.

The View tab shows the data assigned to the lead component or object for all blind data types defined in your scene. The Name of the lead component or object displays at the top of the tab, followed by columns indicating the blind data Id, the name of the attribute, and the value. If there is no data assigned to the component for a particular type the value column is blank for that row.

19 MAPPING UVS FOR POLYGONAL SURFACES

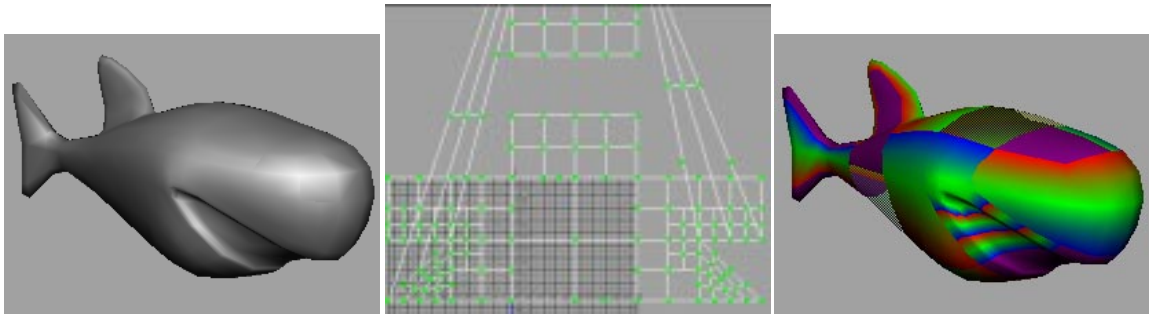
Before you create shading for your polygonal surface, you must set up UVs on your model. This chapter and the next chapter describe how to do this.

ABOUT UVS AND MAPPING

UVs are points that correspond to polygon vertices and provide the information needed to apply textures to the object. Polygons require specific arrangement of the UVs so that textures look correct when applied to the surface material.

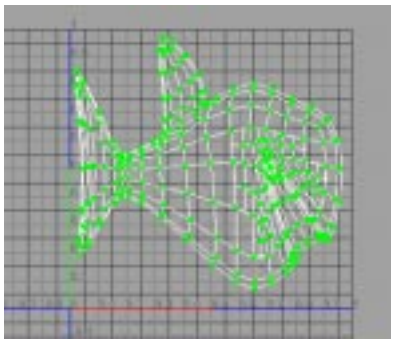
Although Maya creates UVs by default, in many cases, you'll need to rearrange UVs because the default arrangement will not match the modeling changes you make. Typically, you arrange UVs after you have completed your modeling and before you assign textures to the model.

UVs are arranged in a 2D coordinate system called texture space. You can see the texture space coordinates in Maya's UV Texture Editor (formerly called Texture View). For example, the following illustration shows the default UV arrangement for the model of a fish. When a texture is assigned using this default UV arrangement, the result is haphazard.

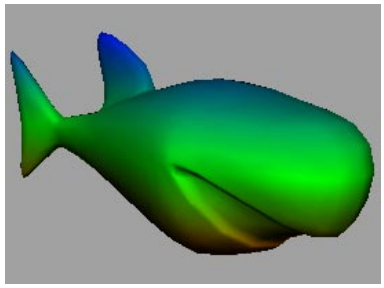


Fish model | Default UVs for fish model | Default texture appearance

In this example, you can use Maya operations to rearrange the UVs into a pattern that more closely resembles the fish model. The new arrangement applies the texture more evenly around the model. See the following illustration.



UVs rearranged for model



New texture appearance

About UV mapping

To begin rearranging UVs, you first need to assign them to the surface, known as *mapping* UVs. You'll learn how to map UVs in this chapter.

Polygonals have their own mapping and editing operations, separate from the subdivision surface operations. There are numerous mapping operations available, under the Edit Polygons > Texture menu. These operations are also available from the UV Texture Editor, under the Polygons menu.

To create a UV mapping arrangement that works best for your model, you may need to map several times, using various mapping operations, until you find a mapping arrangement that is suitable. See the following guidelines.

Guidelines for UV arrangement

Knowing how to arrange UVs is somewhat of an art form. The best arrangement depends on the types of textures you will apply and also on whether you are creating rendered images or models for interactive games. A full description of UV arrangement is out of the scope of this guide. At a minimum, though, you should consider these guidelines:

Keep UVs within the 0 to 1 texture coordinates

The UV Texture Editor displays a grid marking the coordinates for UVs. You should keep UVs within the 0 to 1 coordinates because Maya automatically fits textures into these coordinates. If UVs extend beyond the 0 to 1 range, the texture will appear to repeat around the corresponding vertices. The exception is when you want the texture to repeat on the surface, such as a brick texture along the model of a wall.

By default, the UV mapping operations automatically fit UVs within the 0 to 1 coordinates.

Avoid overlapping UV mesh pieces

As the prior illustration of the fish model shows, UV points have interconnecting lines that form a mesh. If meshes overlap in the UV Texture Editor, the texture will appear to repeat on the corresponding vertices. In general, you should avoid overlapping UVs, unless you want the the texture to repeat. For example, if you want the arms of a character to share the same texture pattern, you can place the UV mesh corresponding to one arm on top of the mesh corresponding to the other arm, using the Move tool.

The Planar Mapping operation often results in overlapping UV mesh pieces, but you can easily separate the meshes using the Layout UVs operation, as described in Chapter 20, “Editing UVs for polygonal surfaces.”

Previewing texture placement

If you want visual feedback while you modify UVs, you can assign a dummy shader before assigning the final texture. By turning on Assign Shader to Each Projection, a defaultPolygonShader with a checker texture is created in Hypershade.

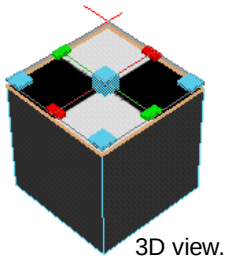
If you do not need to pre-adjust your texture maps, turn off Assign Shader to Each Projection (off by default).

You simply assign your texture to selected faces then use any of the mapping techniques to adjust it. The extra defaultPolygonShader is not created in Hypershade when this option is turned off.

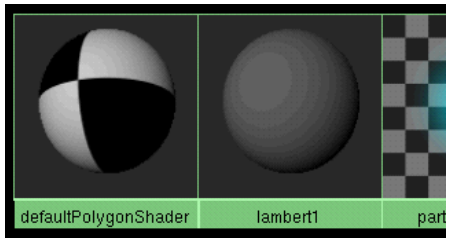
To assign shaders to each projection:

1. Turn on Assign Shader to Each Projection on in the Edit Polygons > Texture menu.
2. Select a face on the model.
3. Select a mapping technique, such as Planar Mapping.

   The mapping manipulator as well as a checker texture displays on the face. A checker shader is also created in Hypershade.



3D view.



Hypershade.

Tip

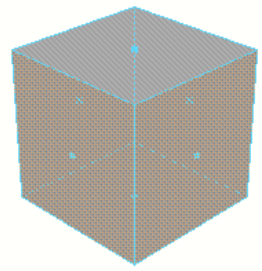
The defaultPolygonShader uses a checker texture by default. You can assign another texture to the default shader and rename it if you want to. For instance, if you know you will be mapping a stone texture to many objects, import your stone file texture to the default shader and change the defaultPolygonShader name to *stones*.

CREATING UVS BASED ON THE CAMERA VIEW

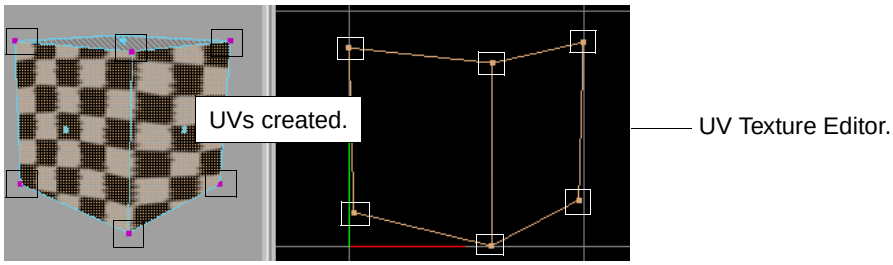
The results of the Create UVs Based on Camera operation depends on the current view of the camera. When you select the operation, UVs are computed based on the projection of the faces on the view plane. This means that the geometry you see in the perspective view window and the result you see in the UV Texture Editor window after selecting the option are identical in shape.

To create UVs based on the camera:

1 Select the faces on which you want to create UVs. Press F11 or press the right mouse button and select Face from the marking menu, then click on the faces.



2 Select Edit Polygons > Texture > Create UVs Based on Camera. Maya creates UVs and maps the texture to the faces you selected.



To create a new UV set with the UVs you create based on camera, select Edit Polygons > Texture > Create UVs Based on Camera ❒, turn on Create New UV Set and type a new set name in the UV Set Name box, then click Apply.

USING BEST PLANE TEXTURING

The Best Plane Texturing operation computes the UVs based on the plane you define, and applies the textures to the selected faces.

To create UVs using Best Plane Texturing:

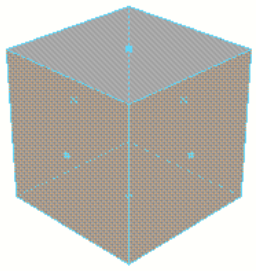
1 Select the faces for which you want to create UVs.

2 Select Edit Polygons > Texture > Best Plane Texturing Tool.

3 Make sure your cursor is in the 3D view.

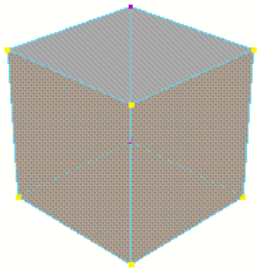
At this point, you can follow the prompts in the Help Line if the Help Line is displayed. The following steps take you through the prompts.

4 Select one or more faces on which you want to map the texture. You cannot marquee-select the faces—you must select the faces one by one, or select the faces before using the operation.

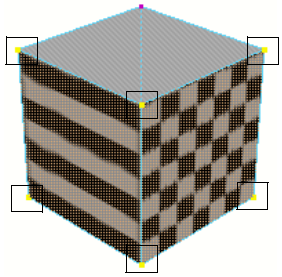


5 Press Enter once you have selected the faces you need, or select more faces if necessary then press Enter when done.

6 You are now prompted to select vertices. Use the marking menu technique. Press the right mouse button, select Vertex from the marking menu, then click to select one vertex or Shift-click to select several vertices.



7 Press Enter to create the UVs where you clicked the vertices and to map the texture.



UVs created.

PLANAR MAPPING FOR POLYGONAL SURFACES

Use Planar Mapping to create a texture map by projecting UVs at the vertices of an object onto a plane.

To project a planar texture map:

The following example shows you how to map a planar texture using Smart Fit and the Fit to Best Plane or Fit to Bounding Box options. You can also use the manipulator handles to fit the texture to your needs.

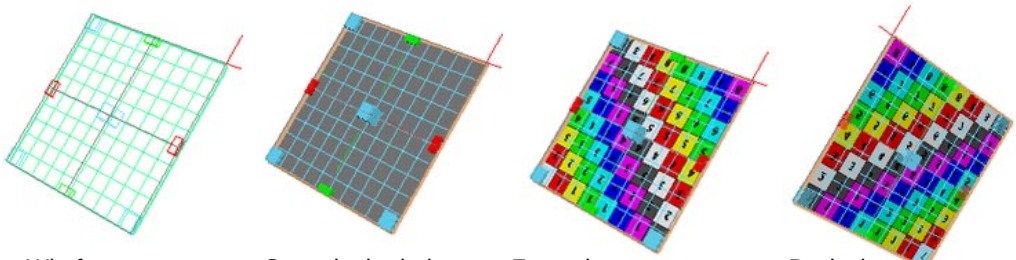
1 Press F11 or press the right mouse button and select Face from the marking menu, then marquee-select the entire object or click to select the faces you want to map.

2 Select Edit Polygons > Texture > Planar Mapping ❐ to open the Polygon Planar Projection Options window.

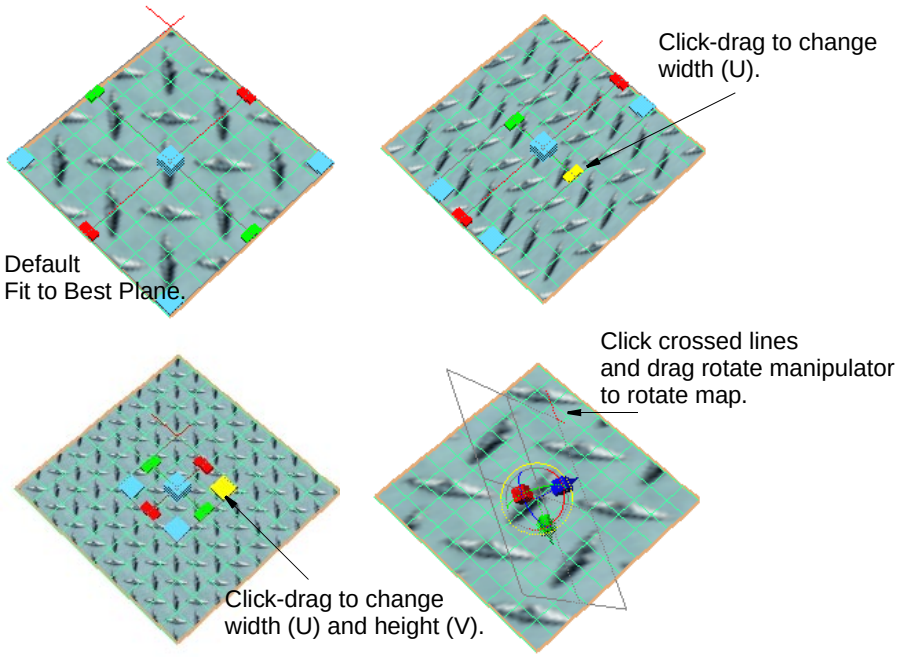
3 Make sure Smart Fit is turned on. If it is not on, the Fit to Best Plane or Fit to Bounding Box options cannot be used.

4 Click Fit to Best Plane or Fit to Bounding Box.

5 Click the Project button. A manipulator displays.



6 If you'd like to change the scale of the resulting UV mesh, resize the projection manipulator on the model by dragging one of the corners. If the manipulator doesn't appear, select subdPlanarProj in the Channel Box.



You can also rotate the manipulator by clicking the red crossed lines, which reveals the Show Manipulator tool. Click the light blue circle around the Show Manipulator handle to activate the rotate handles.

Polygon Planar Projection options

Select Edit Polygons > Texture > Planar Mapping ❐ to open the options window.

Smart Fit turned on

By default, Smart Fit is turned on, which automatically positions the projection manipulator. If you prefer to specify exact values for the projection manipulator, you can turn off Smart Fit and change the values in the Projection Center, Rotation, Width, and Height settings instead. See "Smart Fit turned off" on page 215.

Fit to Best Plane If you want to map UVs for a portion of the object's faces, you can turn on Fit to Best Plane and the projection manipulator snaps to an angle and rotation aimed directly at the selected faces.

Fit to Bounding Box This option works best when you are mapping UVs to all or most of an object's faces. It snaps the projection manipulator to fit within the object's bounding box. With this option on, you must choose one of the Mapping direction options to establish the orientation of the projection manipulator.

Mapping direction Choose an axis so that the projection manipulator is aimed at the majority of the object's faces. For example, a turtle model sitting on the grid would have most of its faces pointing toward the Y axis, while a horse model standing on the grid would have most of its faces pointing toward the X or Z axis.

If most of the model's faces point somewhere that is not directly along the X, Y, or Z axis, you can choose Camera. This option positions the projection manipulator based on the current active view.

Insert Before Deformers

The Insert Before Deformers option is relevant when the polygonal object has a deformation applied to it. If the option is turned off and the deformation is animated, the texture placement is affected by the change in vertex positions. This leads to "swimming" textures.

Turning this option on applies the texture placement to the polygonal object before the deformation is applied to it. Basically, the texture placement dependency graph node is inserted before the deformer dependency graph nodes and the texture "sticks" to the geometry even after the deformation.

Image Center This value represents the center of the projected UVs. Changing this value translates the center accordingly.

Image Rotation This value changes the angle at which UVs are rotated in the 2D window. Drag the slider or enter a value to rotate the image.

Image Scale This value represents the width (U) or the height (V) of the 2D map relative to the 2D center point.

Keep Image Ratio Turn this option on to retain the width to height ratio of the image so that the image does not distort.Turn it off so that the mapped UVs fill the 0 to 1 coordinates in the UV Texture Editor.

Create New UV Set Turn this option on to create a new UV set and place the UVs created by the projection in that set. Change the name in the UV Set Name box.

Smart Fit turned off

If Smart Fit is turned off, you can enter values to change the Projection Center, Rotation and Scale. These values correspond to the manipulator handles that display when you map your texture onto the polygon.

After you project a texture, you can change these values from the Channel Box or the Attribute Editor, or use the corresponding manipulator handles to interactively adjust the map.

Projection Center The projection center defines the point of origin in the X, Y, or Z axis from where you can project a texture map. By default, this is the center of the selected faces in the X, Y, or Z axis.

Projection Rotation Type a value to rotate the projection in the 3D view around the X, Y, or Z axis which subsequently rotates the texture.

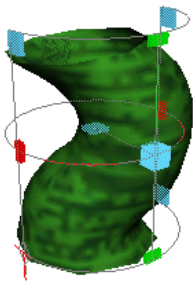
Projection Scale Scaling a projection enlarges or reduces the height (V) and width (U) of the projection relative to the 3D projection axis.

CYLINDRICAL AND SPHERICAL MAPPING

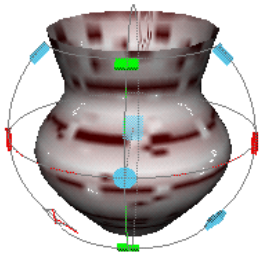
- Use Cylindrical Projection mapping to create a texture map by projecting UVs at the vertices of the object to a cylindrical shape wrapped around the object.
- Use Spherical Projection to create a texture map by projecting UVs at the vertices of the object to a spherical shape wrapped around the object.

To project a cylindrical or spherical texture map:

1. Press F11, or press the right mouse button and select Face from the marking menu, then marquee-select the entire object or click to select the faces you want to map.
2. Click the ❐ beside Edit Polygons > Texture > Cylindrical or Spherical Mapping to open the options window.
3. Adjust the settings in the options window if necessary.
4. Click the Project button. A manipulator displays on the selected faces.



Cylindrical projection manipulator.



Spherical projection manipulator.

5. To fit the texture to suit your needs, drag the manipulator handles to adjust the texture placement on the polygonal faces, or change the settings in the Channel Box or Attribute Editor.

Cylindrical and Spherical Projection options

The Cylindrical and Spherical mapping options windows share the same options.

Smart Fit on

Smart Fit is turned on by default. This automatically fits the texture and the manipulator onto the polygonal model.

Insert Before Deformers

This option is turned on by default. The Insert Before Deformers option is relevant when the polygonal object has deformation applied to it. If the option is turned off and the deformation is animated, the texture placement is affected by the change in vertex positions. This leads to “swimming” textures.

Turning this option on applies the texture placement to the polygonal object before the deformation is applied to it. Basically, the texture placement dependency graph node is inserted before the deformer dependency graph nodes and the texture “sticks” to the geometry even after the deformation.

Image Center This value represents the center of the projected UVs. Changing this value translates the center accordingly.

Image Rotation This value changes the angle at which UVs are rotated in the 2D window. Drag the slider or enter a value to rotate the image.

Image Scale This value represents the width (U) or the height (V) of the 2D map relative to the 2D center point.

Create New UV Set Turn this option on to create a new UV set and place the UVs created by the projection in that set. Change the name in the UV Set Name box.

Smart Fit off

If Smart Fit is turned off, you can enter values to change the Projection Center, Rotation, Scale, or Scale Height. These values correspond to the manipulator handles that display when you map your texture onto the polygon.

After you project a texture, you can change these values from the Channel Box or the Attribute Editor, or use the corresponding manipulator handles to interactively adjust the map.

Projection Center The projection center defines the point of origin in the X, Y, or Z axis which is the center of the application of the projection. By default, this is (0, 0, 0) if Smart Fit is not turned on.

Projection Rotation Type a value to rotate the projection in the 3D view around the X, Y, or Z axis which subsequently rotates the texture.

Projection Horizontal Sweep

Use the slider or type a value to scale the projection around the polygonal object. This value corresponds to the Projection Scale Aperture handles on the manipulator. For instance, pull the Projection Scale Aperture handles all the way around the object until they meet. This is equivalent to entering 360 in the box.

Projection Height

Scaling a projection enlarges or reduces the height (V) of a map relative to the 3D projection axis.

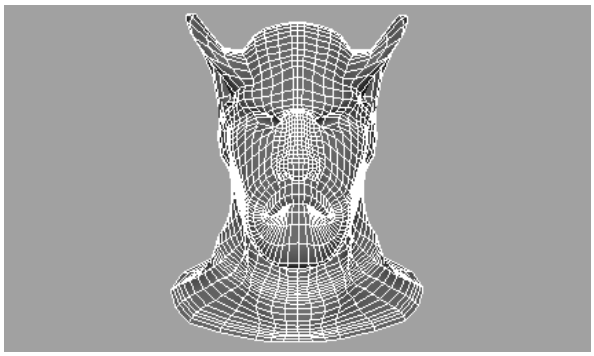
AUTOMATIC MAPPING

Use Automatic Mapping to create a texture map by simultaneously projecting UVs onto multiple planes. This technique is very useful in cases where the simple planar, cylindrical, or spherical projections would result in severe distortion of UVs in some areas (as is often the case in more complex models). Automatic Mapping maps the model to multiple disjoint pieces in texture space.

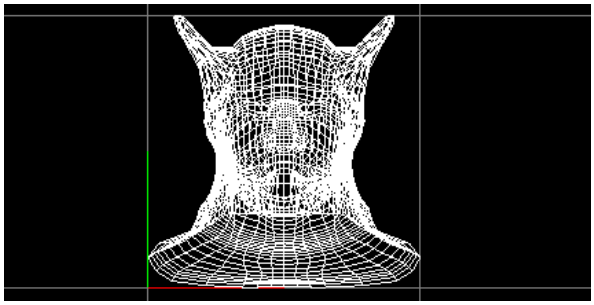
Automatic Mapping is most useful for standard (not combed) Fur and the 3D Paint Tool in projection mode. For both of these features, the small UV mesh pieces created by Automatic Mapping work fine.

In other cases, you may want to combine the small UV mesh pieces into larger pieces, for example, combining pieces that correspond to fingers together with the mesh of the palm. It's easier to create file textures for the model when the UVs of adjacent faces are combined in a logical way. To combine pieces, you use the Merge and Sew UVs operation, as described in Chapter 20, "Editing UVs for polygonal surfaces."

In the following example, the planar, cylindrical, and spherical projections all have overlapping UVs, and the cylindrical and spherical projections are distorted. The automatic mapping projection automatically cut the overlapping areas of the UV mesh and laid them out within the 0 to 1 texture space.

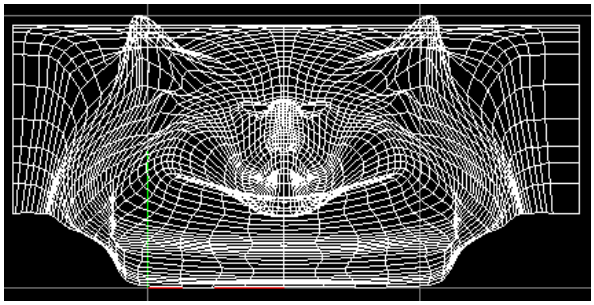


Polygonal model.



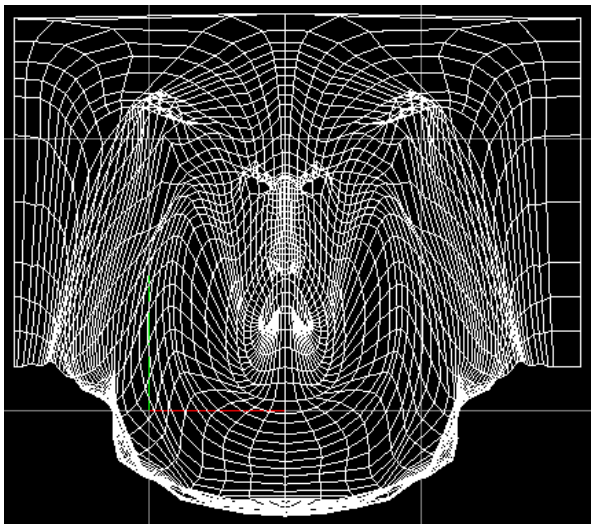
Planar Projection.

(Overlapping and distorted UVs.)



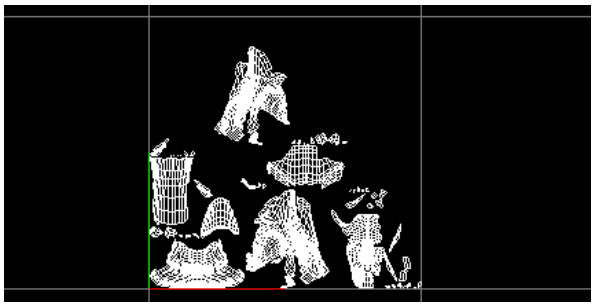
Cylindrical Projection.

(Overlapping and distorted UVs.)



Spherical Projection.

(Overlapping and distorted UVs.)



Automatic Mapping.

(UVs cut and laid out in the 0 to 1 texture space.)

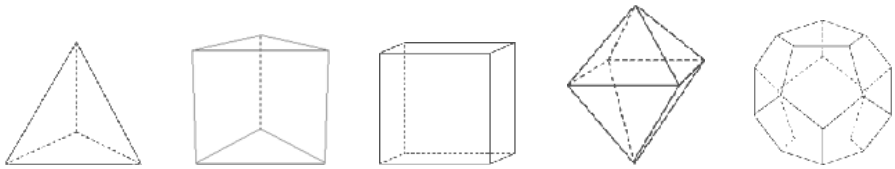
Although the mesh is typically broken into many small pieces, and some of the texture space is wasted, you can use the Move and Sew UVs command to join the pieces together (see "Moving and sewing UVs" on page 239). You can also use the transformation tools in the UV Texture Editor to make better use of the texture space.

To project UVs from multiple planes automatically:

1. Open the UV Texture Editor window (Window > UV Texture Editor) so you can view the projection.
2. To clearly see the 0 to 1 texture space, change the texture Grid to 1, if it is not already (View > Grid ❒). This is particularly important for Fur and the 3D Paint Tool, which both require the mapping to be positioned entirely within this space.
3. In the modeling view, select the faces you want to map (usually the entire model).
4. Select Edit Polygons > Texture > Automatic Mapping ❒.
5. Select the required settings, then click Project or Apply.

Automatic Mapping options

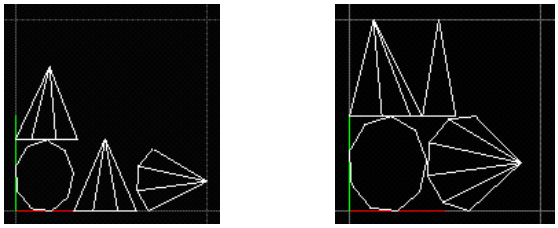
Planes Select the number of planes you are projecting from. The more planes used, the less distortion occurs and the more pieces created. You can choose a projection based on shapes with 4, 5, 6, 8 or 12 planes.



Optimize Select how you want the projection optimized.

Less Distortion Projects all planes equally. While this method provides the best projection for any face, you may end up with more pieces. It is particularly useful if you have a symmetrical model and you want the pieces of the projection to be symmetrical.

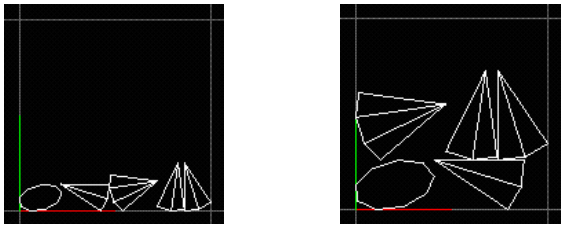
Fewer pieces Projects each plane until the projection encounters a projection angle that is not ideal. This can result in larger pieces, and fewer of them. This is the default.



Layout Select where you want the pieces of the UV mesh to lie in the texture space.

Along U Positions the pieces along the U axis.

Into Square Positions the pieces within the 0 to 1 texture space. This is the default.

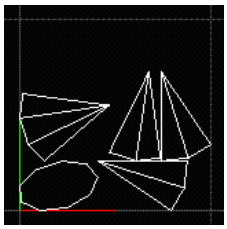


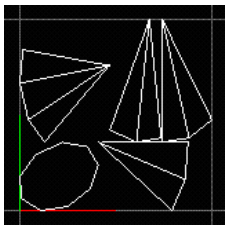
Scale Select how you want the pieces of the UV mesh scaled within the texture space.

None Performs no scaling.

Uniform Scales the pieces to fit the 0 to 1 texture space without changing the aspect ratio. This is the default.

Stretch to Square Stretches the pieces to fit the 0 to 1 texture space. The pieces may become distorted.


Uniform


Stretch to Square

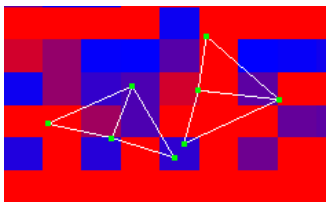
Insert Before Deformers

The Insert Before Deformers option is relevant when the polygonal object has a deformation applied to it. If the option is turned off and the deformation is animated, the texture placement is affected by the change in vertex positions. This leads to “swimming” textures.

Turning this option on applies the texture placement to the polygonal object before the deformation is applied to it. Basically, the texture placement dependency graph node is inserted before the deformer dependency graph nodes and the texture “sticks” to the geometry even after the deformation.

Spacing Presets

Maya puts a bounding box around each piece and lays out the pieces so that the bounding boxes are very close together. If the pieces end up positioned exactly next to each other, two UVs on different pieces can share the same pixel and when painting with the 3D Paint Tool, overscanning can also cause the paint to spill onto the adjacent piece.



To avoid this situation, ensure that there is at least a pixel between the bounding boxes by selecting a spacing preset from this menu. Select a preset that corresponds to your texture map size. If you don’t know the size, select a smaller map, which will result in a larger spacing between adjacent pieces in UV space. (The smaller your map in pixels, the bigger the UV spacing must be between bounding boxes.)

Select Custom to set the size of the space as a percentage of the map size (in the Percentage Space box).

Percentage Space

If you select Custom beside Spacing Presets, enter the size of the space between bounding boxes as a percentage of the map size.

Create New UV Set

Turn this option on to create a new UV set and place the newly created UVs in that set. Type the name of the set in the UV Set Name box.

Note

After performing an Automatic Mapping projection, you can modify the Planes, Optimize, Layout, and Scale settings for the projection in the Channel Box. However, do not modify these settings after painting a texture or applying Fur—the UVs may change drastically.

20 EDITING UVS FOR POLYGONAL SURFACES

After you map UVs, you are ready to edit them further. This chapter describes the UV editing operations for polygons.

For editing UVs on subdivision surfaces, see *Using Maya: Subdivision Surfaces Modeling*.

UV EDITING BASICS

The UV Texture Editor (Window > UV Texture Editor) is the main tool for editing UVs. When you edit UVs, be aware of the following basic usage:

Menus for polygonal surfaces

There are separate menus for polygons and subdivision surfaces; use the menu items under the Polygons menu, not the Subdivs menu. These items are also available in the Edit Polygons > Texture menu.

Selecting components

Editing UVs requires you to select a variety of components, including faces, edges, and UVs. The easiest method for selecting components in the UV Texture Editor is to right click in the editor and select the component type from the marking menu.

You can also convert from one selected component to another. For example, if you have faces selected, you may want to convert the selection to UVs in order to move them, because you cannot use the Move tool on faces. To convert component selection, choose from the following options on the Select menu:

- Convert Selection to Faces
- Convert Selection to Edges
- Convert Selection to Vertices
- Convert Selection to UVs

On the Select menu, you can also extend your selection using the Select Contained Faces and Select Connected Faces menu items:

- Select Contained Faces—selects all faces within a border of UVs or edges that you select.

- Select Connected Faces—selects faces that share the UVs or edges you select.

Zooming the view

You can dolly in or out and track the view using the same keyboard and mouse shortcut you would use in the scene view. For example, press the Alt key and the middle and left mouse buttons to zoom in or out.

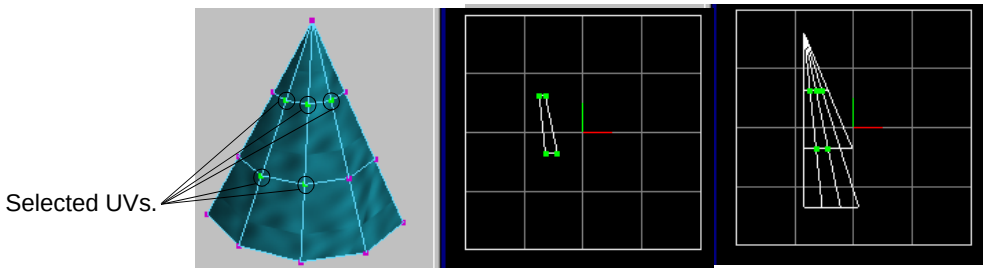
You can also quickly focus the view by selecting View > Frame All or Frame Selection.

Viewing contained or connected faces

If you want to isolate and view only certain faces, you can turn on View Contained Faces or View Connected Faces under the View menu.

- View Contained Faces—selects all faces within a border of UVs or edges that you select.
- View Connected Faces—selects faces that share the UVs or edges you select.

The following illustration shows examples for each setting.



Selecting UV mesh pieces or borders

For transforming UV mesh pieces you can easily select a piece by selecting a single component (UV, vertex, edge, or face) and choosing Select > Select Shell.

For other UV editing operations, you may need to select the border of a UV mesh piece. Select a single component (UV, vertex, edge, or face) and choose Select > Select Shell Border.

TRANSFORMING UVS IN THE UV TEXTURE EDITOR

You can reposition UVs and UV mesh pieces using the Move, Scale, and Rotate tools. For example, you can move a UV mesh piece so that it occupies another part of the texture space and, consequently, another part of the texture you assign to the model.

To transform components:

1. Select the UVs you want to move. If you want to move an entire mesh piece, select all UVs in that mesh.
2. Select the Move, Rotate, or Scale tool and transform the components.

Notes

You can move the pivot point of the Move, Rotate, and Scale tools. Press the Insert key, move the pivot, and press Insert again.

You can transform the selected UVs by entering coordinates. Use either the rel (relative) or abs (absolute) entry box on the Status Line (it doesn't matter which you choose). For example, you can scale UVs exactly 2 times by selecting the Scale tool and entering 2 in the numeric entry box.

When you apply a texture, an image of it appears by default. If you then move mesh pieces to align with the image, you can automatically snap the UVs to image pixels by turning on Image > Pixel Snap.

NORMALIZING UVS

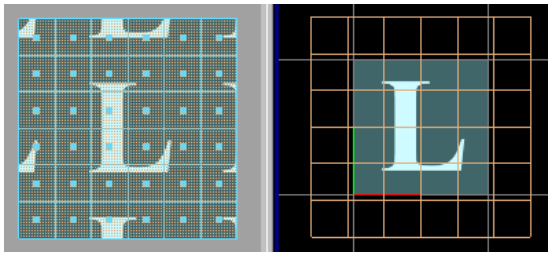
When you normalize UVs, you fit them into the 0 to 1 texture space.

To normalize UVs:

1. Select the faces for which you want to normalize the UVs.
2. Select Edit Polygons > Texture > Normalize UVs ❐, or in the UV Texture Editor, select Polygons > Normalize UVs ❐.
3. Select how you want the UVs normalized and click Apply.

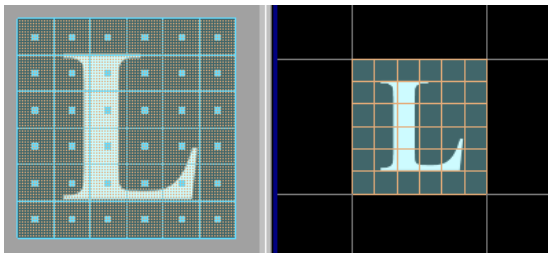
Normalize UVs options

Use the options in the option window to Normalize the texture coordinates (UVs).



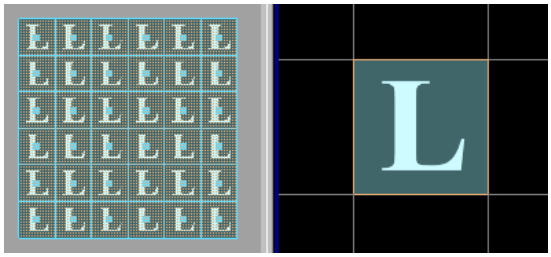
Before Normalize.

Collectively Select Collectively to normalize the UVs for all selected faces collectively. That means the texture coordinates for all selected faces are "collectively" fit to the 0 to 1 texture space. This is the default setting.



Each face separately

Select Each face separately to normalize the UVs for each selected face separately. That means the texture coordinates for each selected face are fit to a boundary of 0 to 1.



Preserve Aspect Ratio

Turn this option on to scale the UVs uniformly along U and V.

Turn this option off (the default setting) to stretch the texture to fit by scaling U and V non-uniformly.

When you normalize texture coordinates, you scale the UVs of the selected faces. If Preserve Aspect Ratio is on, the scaling is guaranteed to be uniform on both the U and V axes. If turned off, the scaling is different for the U and V axes.

UNITIZING UVS

Use the Unitize UVs option to place the UVs of the selected faces on the boundary of the 0 to 1 texture space.

Select Edit Polygons > Texture > Unitize UVs, or in the UV Texture Editor, select Polygons > Unitize UVs.

To create a new UV set with the unitized UVs, click the ❒ beside the Unitize UVs option, turn on Create New UV Set and type the name of the set in the UV Set Name box, then click Apply.

FLIPPING UVS

By flipping UVs, you can flip the texture placement on selected faces.

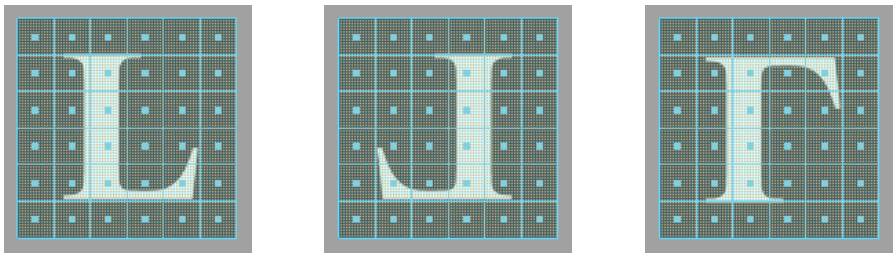
To flip UVs:

1. In the 3D view, select the faces you want to flip the texture for.
2. Select Edit Polygons > Texture > Flip UVs ❒, or in the UV Texture Editor, select Polygons > Flip UVs ❒.
3. Select the desired Flip options and click Apply.

Flip UVs options

Direction Select which direction to flip the UVs of the selected faces: horizontally or vertically. Horizontal is the default.

Coordinate Select Global to flip the UVs in global UV space in the 0 to 1 texture space axis. Select Local to flip the UVs within the bounding box of the selected faces. Local is the default.



Selected faces before flip.

UVs flipped Horizontal, Local.

UVs flipped Vertical, Local.

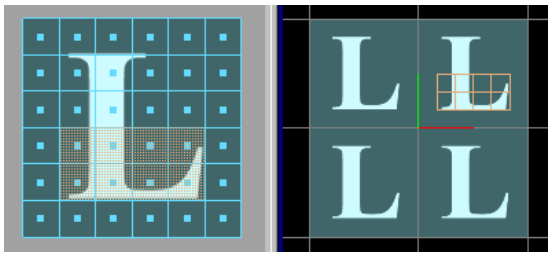
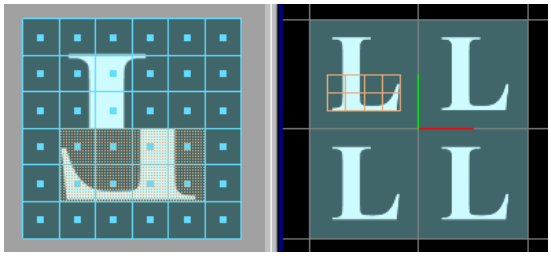
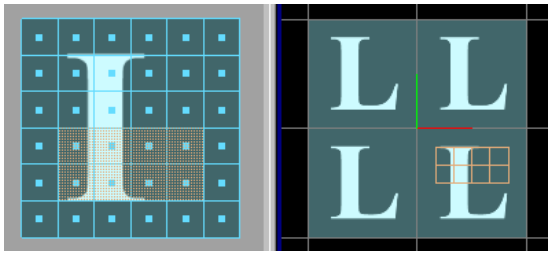


Image Range in UV Texture Editor set to -1

Selected faces before flip.



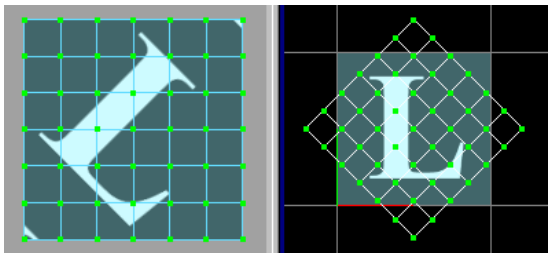
UVs flipped Horizontal, Global.



UVs flipped Vertical, Global.

ROTATING UVS

Use the Rotate UVs option to rotate the selected UVs by the angle specified in the option box. This is the same as rotating UVs interactively with a manipulator. This menu option makes it easy to save commonly-used rotations (such as +/-90 degrees) to the shelf for frequent use.



Selected UVs rotated 45 degrees.

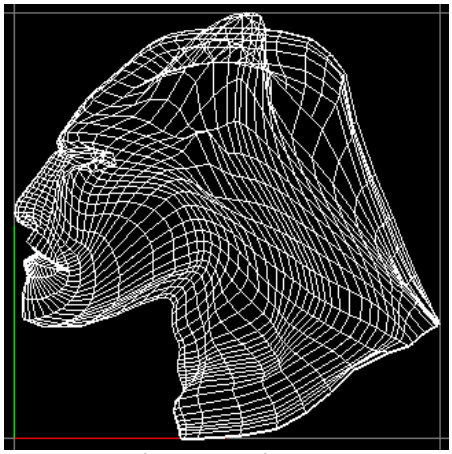
To rotate UVs:

1. Select the UVs you want to rotate.
2. Select Edit Polygons > Texture > Rotate UVs ❐, or in the UV Texture Editor, select Polygons > Rotate UVs ❐.
3. Enter the rotation angle and click Rotate or Apply.

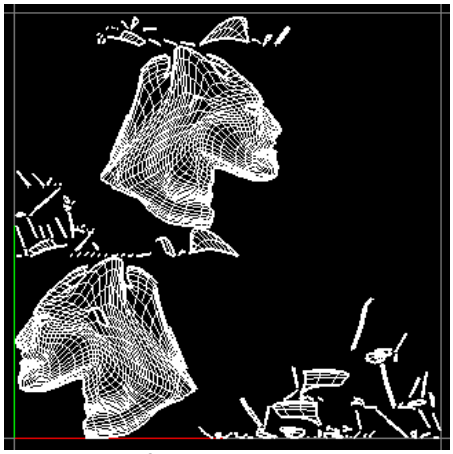
LAYING OUT UVS

Use Layout UVs to lay out overlapping pieces of an existing UV mesh (optionally, cutting them if necessary) so that they no longer overlap, either along U or into a square. (Automatic Mapping does this automatically for new mappings.)

For example, you could perform regular planar mapping on a character, and then use the Layout UVs command to separate any overlapping pieces—this typically separates the front and back pieces intact. Although in most cases, other smaller pieces will also be produced, you can sew them back together using the Move and Sew UVs command (see "Moving and sewing UVs" on page 239). You can also scale or stretch the UVs to fit within the 0 to 1 texture space, and flip and reverse pieces.



Planar mapping.



After Layout UVs.

To lay out existing UVs on an overlapping UV mesh:

1. Open the UV Texture Editor window (Window > UV Texture Editor) so you can view the projection.
2. To clearly see the 0 to 1 texture space, change the texture Grid to 1 if it is not already (View > Grid ❐). This is particularly important for Fur and 3D-paint, which both require the mapping to be positioned entirely within this space.

3 In the modeling view, select the faces with UVs you want to lay out.

4 Select Edit Polygons > Texture > Layout UVs ❐.

5 Select the required options, then click Layout UVs.

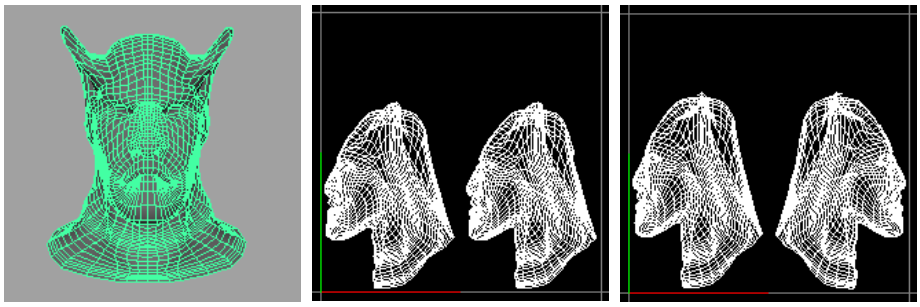
Layout UVs options

The default settings give the best results in most situations.

Separate Select how you want to cut, or separate overlapping pieces of the UV mesh.

- **Off** Does not separate overlapping pieces of the mesh. Only the Scale option has an effect.
- **Folds** Separates only pieces where the surface normals of overlapping pieces point opposite directions. This method is faster, especially for larger models, however, you may be left with overlapping UVs.
- **All Intersecting** Separates all pieces where the UVs overlap. This is the default.

Flip Reversed Turn this option on to flip pieces of the UV mesh that have normals pointing in opposite directions.



Original polygon | Flip Reversed off | Flip Reversed on

Tip

If your model is symmetrical (for example, a character's face), you can save texture space by turning this option off and superimposing the pieces of UV mesh so they occupy the same texture space.

Rotate for Best Fit When turned on, allows some UV mesh pieces to be rotated by 90 degrees to maximize the space between the 0 to 1 coordinates. If turned off, Layout UVs does not rotate UV mesh pieces.

Layout Select where you want the pieces of the UV mesh to lie in the texture space.

- **None** Does not lay out pieces after they have been cut. Some pieces may lie on top of others.
- **Along U** Positions the pieces along the U axis. This is the default.
- **Into Square** Positions the pieces within the 0 to 1 texture space.

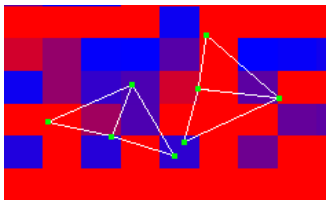
Scale Select how you want the pieces of the UV mesh scaled within the texture space.

- **None** Performs no scaling.
- **Uniform** Scales the pieces to fit the 0 to 1 texture space without changing the aspect ratio. This is the default.

Stretch to Square Stretches the pieces to fit the 0 to 1 texture space. The pieces may become distorted.

Map Size Presets

Maya puts a bounding box around each piece and lays out the pieces so that the bounding boxes are very close together. If the pieces end up positioned exactly next to each other, two UVs on different pieces can share the same pixel and when texture painting, overscanning can also cause the paint to spill onto the adjacent piece.



To avoid this situation, ensure that there is at least a pixel between the bounding boxes by selecting a spacing preset from this menu. Select a preset that corresponds to your texture map size. If you don't know the size, select a smaller map, which will result in a larger spacing between adjacent pieces in UV space. (The smaller your map in pixels, the bigger the UV spacing must be between bounding boxes.)

Select Custom to set the size of the space as a percentage of the map size (in the Percentage Space box).

Space If you select Custom beside Map Size Presets, enter the size of the space between bounding boxes as a percentage of the map size.

RELAXING UVS

Use Relax UVs to automatically untangle and even out UVs, while retaining a fixed border or fixed UVs. This is extremely useful for untangling UV meshes when used in combination with Map UV Border.

To relax UVs:

1. Select a UV within the UV mesh.
2. Select Edit Polygons > Texture > Relax UVs ❐.
3. Select the required options, then click Relax or Apply. You may need to click Relax again until you achieve the desired results.

Relax UVs options

Edge Weights Select how the UV relax affects edges.

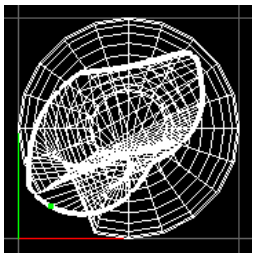
Uniform Attempts to make all of the edges the same length. This is the default.

World Space Attempts to retain the original world-space angles (subject to the restrictions of the pinned border).

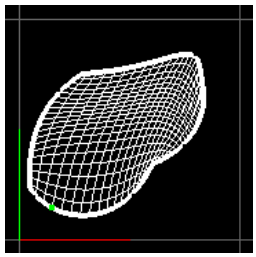
Pin UVs

Use the following options to relax only selected parts of the UV mesh.

Pin UV Border Turn this option on to maintain the position of the border UVs. This is the default.



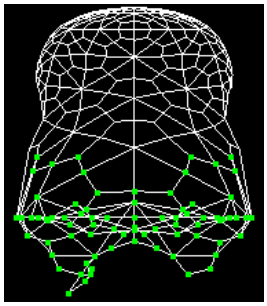
Pin UV Border, before Relax UVs.



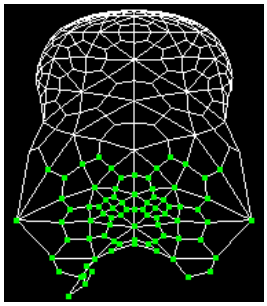
Pin UV Border, after applying Relax UVs several times.

Pin Selected UVs Turn this option on to maintain the position of selected UVs. For example, if you want more texture space for an area on a face with very dense UVs, you could select these UVs, scale them up, pin them, then relax the rest of the UVs to eliminate any overlapping you may have introduced during the scale.

Pin Unselected UVs Turn this option on to maintain the position of the unselected UVs. This option is useful for relaxing only the selected UVs.



Pin Unselected UVs, before Relax UVs.



Pin Unselected UVs, after applying Relax UVs several times.

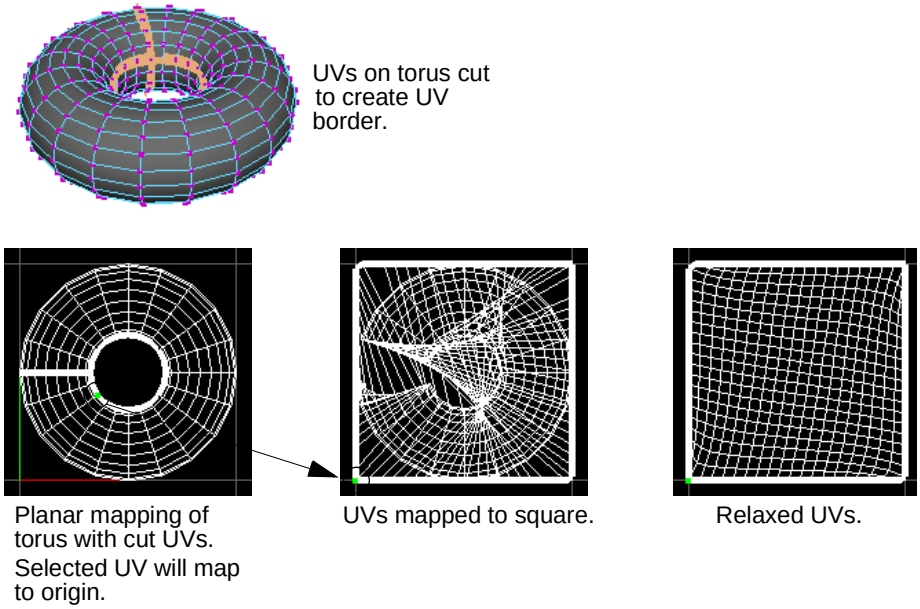
Stopping Conditions

Max Iterations Enter the number of relaxation iterations that will be performed on the UVs—ideal UV relaxation is subjective and iterative.

MAPPING THE UV BORDER

With Map UV Border, you can automatically force the border of a UV mesh to a square or circle shape fitting within the 0 to 1 texture space, optionally maintaining a proportion of the original world space relationships between the edges (Shape Detail). This is very useful for untangling borders, prior to using a tool such as Relax UVs to untangle the interior UVs.

In the following example, UVs were cut along the inside and back of a torus, creating a UV border. The UV border was mapped to a square, then relaxed to eliminate overlapping UVs.



To map a UV border:

1 Select a UV on the border.

Note

The UV you select maps to a point on the diagonal of the 0 to 1 texture space. It maps as closely as it can to the origin while containing the UV mesh in the 0 to 1 space.

2 Select Edit Polygons > Texture > Map UV Border ❐, or in the UV Texture Editor, select Polygons > Map UV Border ❐.

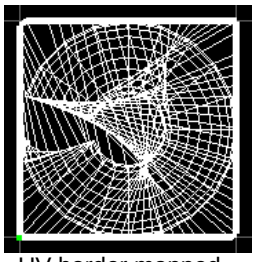
3 Select the required options, then click Map.

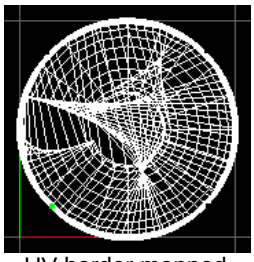
Remember that you are only dealing with the border—don't worry about how tangled the interior UVs appear. You can untangle the interior UVs using the Relax UVs tool (see "Relaxing UVs" on page 232).

Map UV Border options

Border Target Shape

Select the shape you want to map the UV border to (Circle or Square). The Square option makes best use of texture space, but can result in faces having zero or very little texture space around the edges of the mesh. The Circle option is less likely to produce this type of problem, but uses texture space less efficiently.


UV border mapped to square.


UV border mapped to circle.

These UV border mappings produce overlapping UVs, which can be fixed using the Relax UVs tool.

Preserve Shape Detail

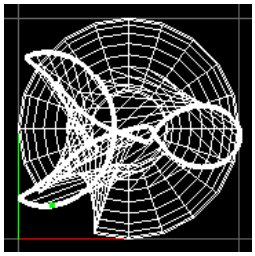
Automatic

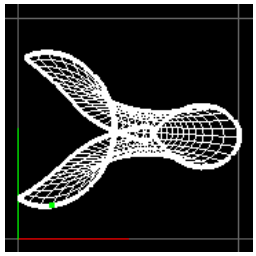
Turn on Automatic to map the UV border automatically using a Shape Detail value (see next) that approximates the best use the texture space while maintaining the world-space relationships between edges.

Shape Detail

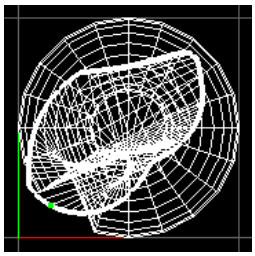
Turn off Automatic and use the slider or enter a value between 0 and 1 to control the blend of the border with the specified shape. A value of 0 produces a border closest to the specified shape. A value of 1 produces a border that closely represents the world-space relationships between edges, but can result in concave areas along the border—these will produce overlapping interior UVs once relaxed.

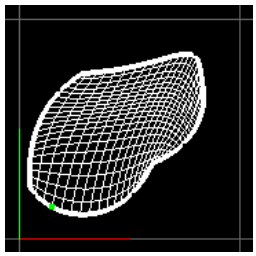
Border Target Shape = Circle.


Shape Detail 1.0.

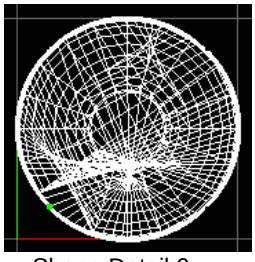

Relaxed.

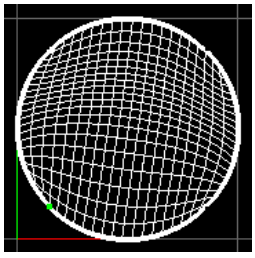
Concave areas produce overlapping borders. In this situation, reduce the Shape Detail value.


Shape Detail 0.3.


Relaxed.

Reducing the Shape Detail value eliminates the overlapping borders while attempting to minimize distortion.

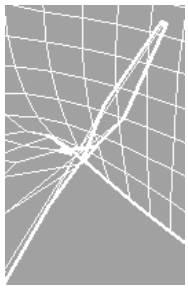

Shape Detail 0.

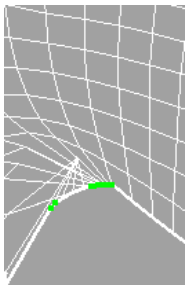

Relaxed.

A Shape Detail value of 0 eliminates the overlapping borders, forcing them into the set shape.

STRAIGHTENING THE UV BORDER

Use Straighten UV Border to untangle the border of a UV texture shell, such as an edge that loops around itself. Straighten UV Border provides more control than the Map UV Border operation. (Both of these operations are used in preparation for the Relax UVs operation, which works better if the texture border is untangled.)





Before you straighten the border:

For best results, we recommend you do the following before using Straighten UV Border.

- Turn on construction history so you can change the curvature options after the operation.
- Choose Display > Custom Polygon Display ❒, and turn on Texture Borders so you can see the texture border.

To straighten selected border UVs:

1. Right click in the UV Texture Editor and choose UV.
2. Select UVs around the tangled UV border.

   Your selection can include UVs within the shell because Straighten UV Border only affects the border UVs.

   In some cases, it is difficult to select the UVs you want to straighten without selecting other UVs you want to leave unaffected. In these cases, you can leave a gap in your selection and use the Fill Gaps in Selection option to straighten the UVs you could not select.
3. Choose Edit Polygons > Texture > Straighten UV Border.
4. In the Channel Box or Attribute Editor, open the polyStraightenUVBorder node and adjust the options as needed. By adjusting the attributes on the node, you can interactively see the results. See the following descriptions.

Straighten UV Border options

Curvature Pushes the selected border area outward or inward by the specified amount. A value of zero forces the edge to be straight. Each Curvature unit is .01 on the UV coordinate scale.

Maya curves the border outward or inward depending on whether the value is positive or negative. However, you cannot tell in advance whether to use positive or negative. With the polyStraightenUVBorder node opened in the Channel Box or Attribute Editor, try positive and negative values and check the results in the UV Texture Editor.

Preserve Length Ratio

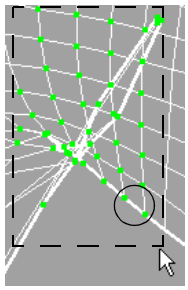
Controls the size of UV texture edges when straightened. Set to one, Maya preserves the original edge lengths. Set to zero, Maya averages the lengths. Values between zero and one change the length proportionally.

Blend Original Shape

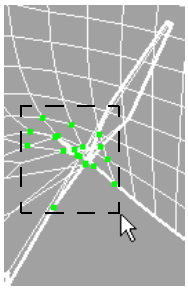
Affects the shape of the straightened border by blending it with the original border shape. You can use this setting to constrain the effect of the above two settings. Set to one, Maya keeps the original shape and overrides the other settings. Set to zero, Maya does not consider the original shape when straightening. Values between zero and one proportionally blend the original shape with the curvature created by the other settings.

Fill Gaps in Selection, UV Gap Tolerance

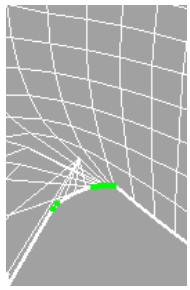
These settings help you straighten UVs that are missing from your selection because they are difficult to select. The following illustration shows an example.



Problem: selection includes extraneous UVs that you do not want to straighten (shown encircled).



Alternative: Select a smaller area of the border and...

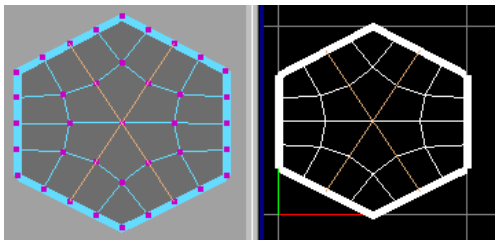


...apply Straighten UV Border with Fill Gaps in Selection turned on.

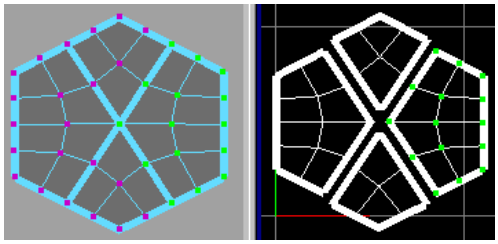
The UV Gap Tolerance setting is the threshold of when Maya selects and straightens the unselected UVs. For example, if there are three unselected UVs in the middle of two selected UVs, UV Gap Tolerance must be 3 or higher in order for Maya to select and straighten the middle UVs.

CUTTING AND SEWING UVS

You cut UVs to separate the UV map along selected edges. You can then manipulate the pieces separately.

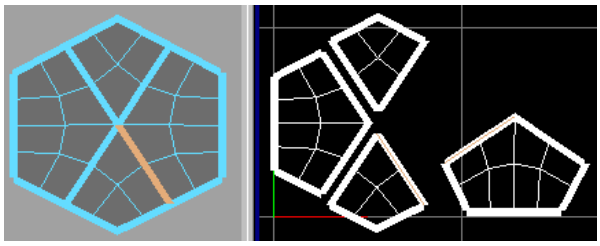


Before UVs cut at selected edges.

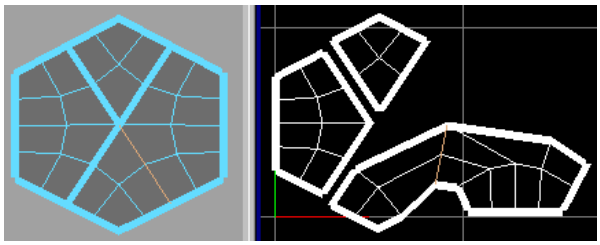


After UVs cut at selected edges. Pieces of UV mesh were moved to separate them.

You sew UVs so that all UVs along the edges are merged, creating a single UV shell.



Before UVs sewn at selected edges.



After UVs sewn at selected edges.

To cut UVs:

1. To help you differentiate between texture border edges (produced by cutting UVs) and ordinary edges, select the object, turn on the Texture Borders option in the Custom Polygons Display Options window and increase the Border Width.
2. Press F10 and either click on a single edge or Shift-select the edges you want to cut.
3. Select Edit Polygons > Texture > Cut UVs, or Polygons > Cut UVs in the UV Texture Editor. Cut edges become texture borders. You can now manipulate the texture pieces separately.

Note

A single edge cannot be cut unless it touches a border.

Tip

Use the Select > Select Shell in the UV Texture Editor to select a piece of UV mesh after cutting.

To sew UVs:

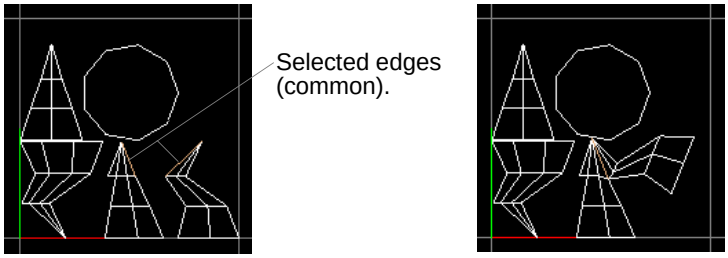
1. To help you differentiate between texture border edges (produced by cutting UVs) and ordinary edges, select the object, turn on the Texture Borders option in the Custom Polygons Display Options window and increase the Border Width.
2. Press F10 and either click on a single edge or Shift-select the edges you want to sew.
3. Select Edit Polygons > Texture > Sew UVs or Polygons > Sew UVs in the UV Texture Editor.

MOVING AND SEWING UVS

Use Move and Sew UVs to sew together separate pieces of the UV mesh by merging selected edges *and* moving one piece (the smaller one) of the mesh to the other (the larger one). You can quickly join separate pieces of the UV mesh produced by Automatic Mapping or Layout UVs back to their neighboring UVs.

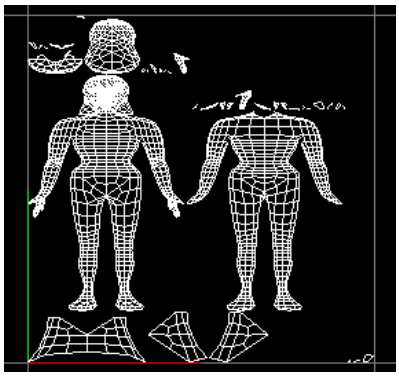
There are two methods of moving and sewing UVs: manual and automatic. With the manual method, you must select the edges you want to join. With the automatic method, smaller pieces are moved and sewn automatically. You define how small the pieces should be.

Manual Move and Sew.

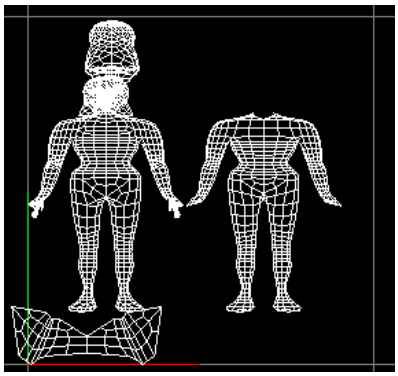


Before Move and Sew. After Move and Sew.

Automatic Move and Sew.



Before Move and Sew UVs.



After Move and Sew UVs (moved and sewed only those meshes with fewer than 50 pieces.)

To move and sew pieces of UV mesh manually:

1. Select the edges you want to join. The common edges are highlighted in the texture view and in the modeling view.
2. Select Edit Polygons > Texture > Move and Sew UVs ❐.
3. Turn off Limit Piece Size.
4. Click Apply.

To move and sew pieces of UV mesh automatically:

1. Select all the pieces.
2. Select Edit Polygons > Texture > Move and Sew UVs ❐.
3. Turn on Limit Piece Size and select the maximum number of faces a piece of the UV mesh can have to be moved and sewn.
4. Click Apply.

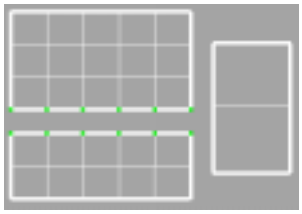
Tip

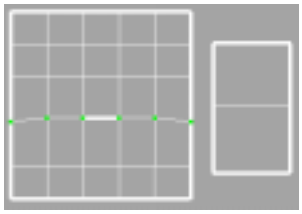
After performing a Move and Sew operation, you can select the history node (polyMapSewMove) in the Channel Box and adjust the Number of Faces until you achieve the results you want.

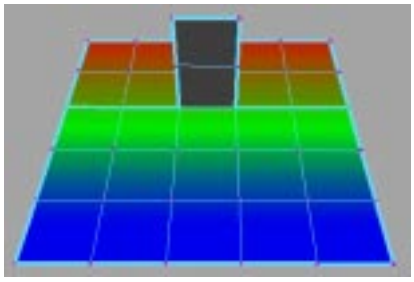
MERGING UVS

Use Merge UVs to merge together separate UV mesh pieces (shells). Merge UVs has a similar effect to Sew UVs. However, Merge UVs is better suited to merging shells when the polygon has nonmanifold geometry.

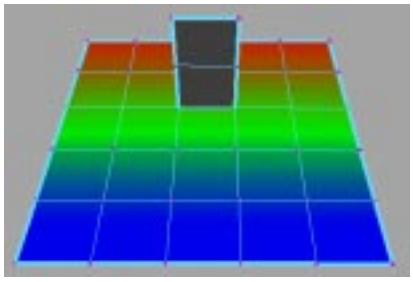
For example, suppose you have three mesh pieces that all share an edge because the geometry is nonmanifold (see the illustration below). Using Merge UVs, you can combine two of the mesh pieces without affecting the other. If you used Sew UVs in this example, all mesh pieces would be combined because they all share an edge.







UVs and surface before Merge UVs



After Merge UVs—notice the texture border on the surface is gone

To merge UVs:

1. To see the texture border, choose Display > Custom Polygon Display ❒, and turn on Texture Borders.
2. Right click in the UV Texture Editor and choose UV.
3. Select UVs from separate mesh pieces.

   Merge UVs only merges the UVs that share the same vertex. There is also a maximum distance you can set to control which UVs in your selection become merged (see the next step for details).
4. Choose Texture > Merge UVs.

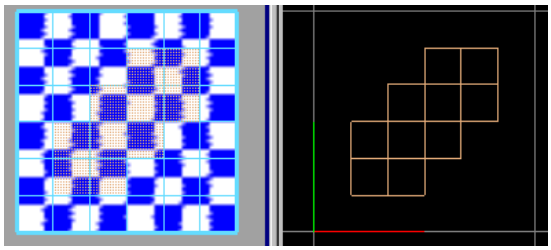
   As an option, you can set a maximum distance in the Merge UVs option box. Turn on Use Distance Threshold and set Distance to the maximum distance between UVs, measured in UV units. Any UVs in your selection that exceed this distance will not be merged.

DELETING UVS

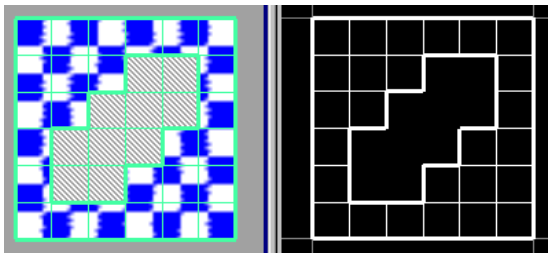
Use Delete UVs to remove UVs from an object. Deleting UVs removes them permanently until you re-create them using any of the UV creation methods.

To delete UVs:

1. Select the faces for which you want to delete the UVs.



2 Select Edit Polygons > Texture > Delete UVs, or in the UV Texture Editor, Polygons > Delete Mapping. The UVs are removed.



Because the selected faces have no UVs, textures cannot be applied to them unless UVs are re-created using any of the UV creation methods.

CREATING A UV SNAPSHOT TO PAINT A MATCHING TEXTURE

After you edit UVs in the UV Texture Editor, you can export an image of the UV mesh pieces with the UV Snapshot operation. Then you can open the UV snapshot in a Paint Effects canvas or a painting program, such as Adobe Photoshop®, and paint a texture that exactly matches the UVs.

Before you save a snapshot, have the final UV arrangement complete and fitted within the 0 to 1 coordinate range. The snapshot image is limited to this range.

To save a snapshot, select the object or a component and choose Polygons > UV Snapshot in the UV Texture Editor. In the window that opens, complete the following settings.

File Name You can save the file anywhere in or out of your project. Maya automatically assigns the file extension based on the image format you select.

Size X, Size Y Sets the dimensions of the exported image. Use the same dimensions you want for the file texture you are about to create. If you are not sure, use the default size; you can scale the exported image later in your paint program.

Keep Aspect Ratio The aspect ratio is the ratio of Size X to Size Y. With it turned on, you can change one size slider and Maya automatically adjusts the other size value to keep the same ratio. If you need to change the aspect ratio, turn off this option temporarily and adjust one of the sizes.

Color Value Sets the color of the UV patches in the exported image. The background of the snapshot is black; therefore, the Color Value should be white or another contrasting color. You can click the box to open the Color Chooser.

Anti-alias Lines Controls whether lines in the output image have anti-aliasing.

Image Format Use an image format that your paint program can read. If you require an alpha channel while painting, use TIFF or a similar format.

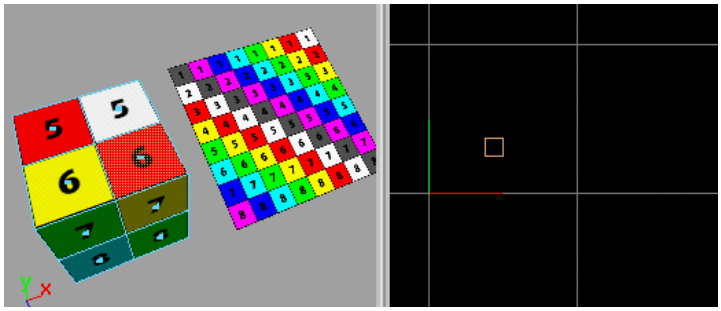
COPYING AND PASTING UVS

Use the Copy UVs and Paste UVs menu items to copy and paste UVs from one object onto another object.

To copy and paste UV texture coordinates onto faces:

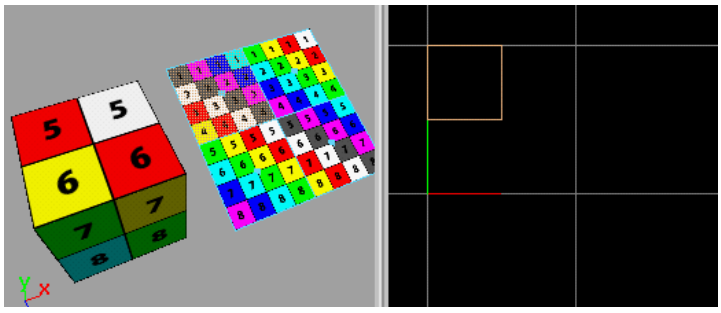
The following example shows a polygonal primitive cube and primitive plane that have been mapped with a file texture. A face from the cube is selected and copied to a face on the plane and then flipped to fit the face.

1 Select the face of the cube you want to copy to the face of the plane.

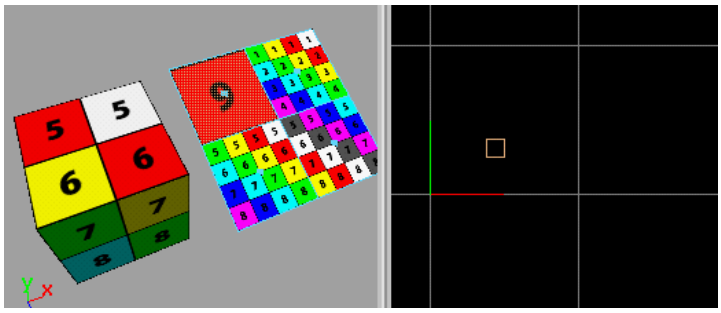


2 In the UV Texture Editor window, select Polygons > Copy UVs.

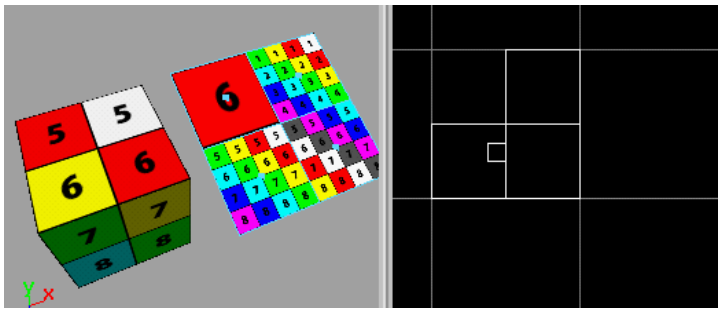
3 Select a face on the plane.



4 In the UV Texture Editor window, select Polygons > Click Paste UVs.



Use the Flip UVs options to apply the texture correctly if necessary. See "Flipping UVs" on page 228 for details.



CHANGING THE GRID

You can turn the UV Texture Editor grid on and off with the View > Grid menu item. You can also change the following grid options:

Length and Width Controls the overall size of the grid, measured in UV coordinates. The Length and Width is set to 1 (one) by default, because you typically want UVs to fit within the 0 to 1 range and this setting clearly shows the 0 to 1 range.

Grid Lines Every Sets the spacing between grid lines. Grid lines appear in increments based on the decimal value you specify. This setting affects where UVs snap if you use the Snap to Grid feature.

Subdivisions Sets the number of lines between each grid line. By default, subdivision lines do not show; you must turn on Subdivision Lines for them to appear.

Display Axes, Grid Lines, Subdivision Lines, Labels

Displays or hides items within the grid.

DISPLAYING THE TEXTURE

To see the texture in the UV Texture Editor, turn on Display Image in the Image menu. There are a number of texture display options:

Displaying textures for the object or faces

Once you have assigned a texture to your model, turn on Image > Display Image to see how the UVs align with the texture image.

Displaying on a per-object level

In the modeling view, select the object for which you want to display the texture. The texture for the selected object displays in the grid area in the UV Texture Editor.

Displaying on a per-face level

Select the face for which you want to display the texture. The texture for the selected face displays in the grid area in the UV Texture Editor.

Note

If the texture quality is poor or if parts of the texture do not display correctly, you can modify the display quality with the Hardware Texturing settings in the Attribute Editor for the material node.

If you are using a file texture, the best display mode for the Texture quality setting is Default. (The other settings, such as High, are best for procedural textures.)

Selecting an image to display

If you have multiple textures applied to object, you can choose which texture you want to display. Select Image > Selected Images and select from the list of the textures that you applied.

Setting the texture image ratio

You can display rectangular file textures images. To enable this feature, turn on Image > Use Image Ratio. For example, if you assign a 256 x 512 image of a logo onto a surface, turn on Use Image Ratio so you can see the image in it's proper ratio.

Note

The UV Texture Editor will scale images into a square display if you reposition the file texture.

Changing the image range

Use the settings in the Image Range options window to change how much of the texture displays (select Image > Image Range ❐).

Minimum U/V and Maximum U/V

You can explicitly set the size of the image by setting these options, or you can select one of the presets.

Presets Select one of the preset image ranges and click Apply.

None The texture space is defined by the Minimum and Maximum U and V values.

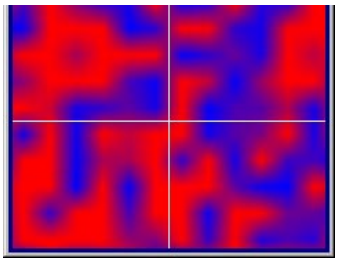
Grid Size The texture fills the extent of the grid (defined in the Grid Options window.) In the following example, the Extent value was set to 2 in the Grid Options window.

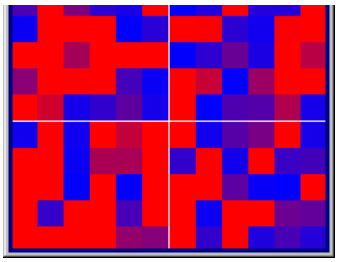
Unit Size The texture fills the 0 to 1 (or unit) texture space.

Displaying images unfiltered

By default, images display filtered so that pixels blend into each other for a smoother quality. You can display images unfiltered so that when you zoom in you can see each pixel clearly. With pixels clearly displayed, you can use the Pixel Snap option (see next) to snap UV points to precise points on the texture.

To display images unfiltered, turn on Display Unfiltered in the Image menu of the UV Texture Editor.


Filtered image display.


Unfiltered image display.

Snapping UVs to pixels

For greater control over UVs when you translate them, you can snap them to pixels (like snapping to a grid).

To snap UVs to pixels:

1. Turn on Image > Pixel Snap.
2. Zoom in on the texture so you can see the pixels.
3. Select the UV you want to snap to a specific pixel and select the transformation tool.
4. Drag the UV. It will snap to the closest pixel corner.

CREATING GOOD UVS ON COMPLEX MODELS

Use Average Vertices to smooth geometry so that good UVs are simpler to produce. (For example, the wrinkles on a model of a finger would likely result in overlapping UVs because the angle necessary for a good projection changes continuously.) You can then transfer the good UVs back to the original model using the Transfer command.

To average vertices for mapping without changing the model's topology:

1. Duplicate the original model.
2. On the duplicate model, select the vertices you want to smooth.
3. Select Polygons > Average Vertices ❐.
4. Enter the required number of iterations then click Apply.

5 Click Apply repeatedly until the desired smoothness is achieved.

6 Project the UVs onto the smoothed duplicate model using any of the projection methods under Edit Polygons > Texture.

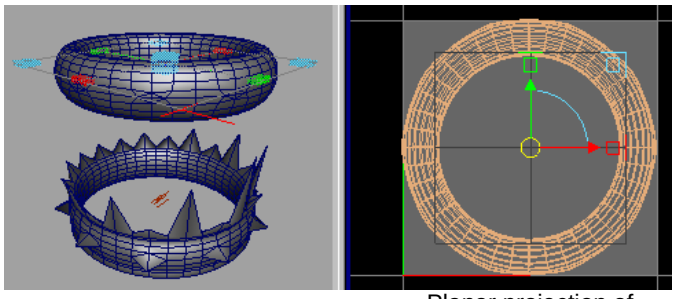
7 Use the new Transfer command (see next) to apply the UVs to the original model.

Transferring vertices

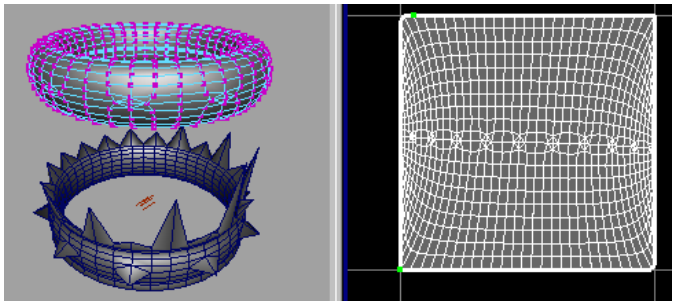
Use Transfer to transfer vertex positions, UV sets, and / or vertex color between two models with identical topology. To create good UVs, you can incorporate the Transfer tool into your workflow by first duplicating the original model, manipulating the vertices so that it is more suitable for projection using a method that does not change the topology (for example, using Average Vertices, or the Sculpt Polygons tool), projecting the UVs on the modified model, then using Transfer to copy them back to the original model.

Smoothed Duplicate of complex model.

Complex model.

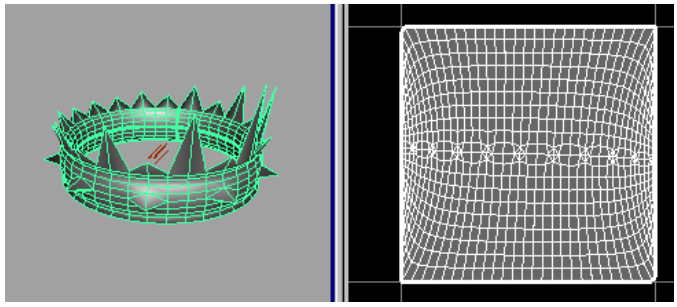


Planar projection of smoothed duplicate.



Good UVs created using Map UV Border and Relax UVs.

Good UVs transferred back to original model and smoothed duplicate deleted.



To transfer UVs:

1 Select both the source object and the destination object, in that order.

2 Select Polygons > Transfer ❐.

3 Select the type of information you want to transfer (Vertices, UV Sets, Vertex Color), then click Transfer.

MULTITEXTURING

Multitexturing is the layering and blending of multiple textures on an object, potentially using a distinct UV set for each layer. Although it is not necessary that each texture contains its own set of UVs, it is often an important part of multitexturing.

Creating and editing UV sets

You can create and edit multiple UV sets for working with multitextured objects which can be viewed in hardware shaded display mode as well as software rendered.

You can create a new UV set when you do the UV mapping or you can create an empty UV set independently of a projection.

To create a new UV set when you project a map:

In the projection option box, turn on Create New UV Set and type a name for the set in the UV Set Name box.

To create a new empty UV set:

1 Select the object, then select Edit Polygons > Texture > Create Empty UV Set ❐.

2 In the Create UV Set Name box, type the name of the empty set and click Create.

To set a UV set to be current (select the set):

- Right-click on the object and drag down and select UV Sets > *UVsetName*, where *UVsetName* is the name of the UV set you are selecting.

or

- In the UV Texture Editor, select Image > UV Sets > *UVsetName*, where *UVsetName* is the name of the UV set you are selecting.

or

- Select the object, then select Window > Relationship Editor > UV Linking > UV-Centric and click on the UV set name.

or

1 Select the object, then select Edit Polygons > Texture > Set Current UV Set ❐.

2 In the UV Set Name box, type the name of the UV set you are making current.

To rename a UV set:

1 Select the set you want to rename.

2 Select Edit Polygons > Texture > Rename Current UV Set ❐.

3 In the New UV Set Name box, type the new name for the set and click Rename Current or Apply.

To copy values from one set to another existing set:

1. Select the set you want to copy from.
2. Select Edit Polygons > Texture > Copy Current UV Set ❐.
3. In the UV Set Name to Copy to box, type the name of the UV set you want to copy the UVs of the selected set to.

To delete a UV set:

1. Select the set you want to delete.
2. Select Edit Polygons > Texture > Delete Current UV Set.

Applying layered textures to UV sets

Use the Layered Texture node to manage multiple textures. You can drag and drop file textures onto this node using the middle mouse button, and RGB and alpha connections are automatically made. You can alternatively drag textures from Hypershade into the Layered Texture's Attribute Editor.

The following workflow shows you how to create UV sets, layer textures, and how to manage the correspondence between texture layers and UV sets.

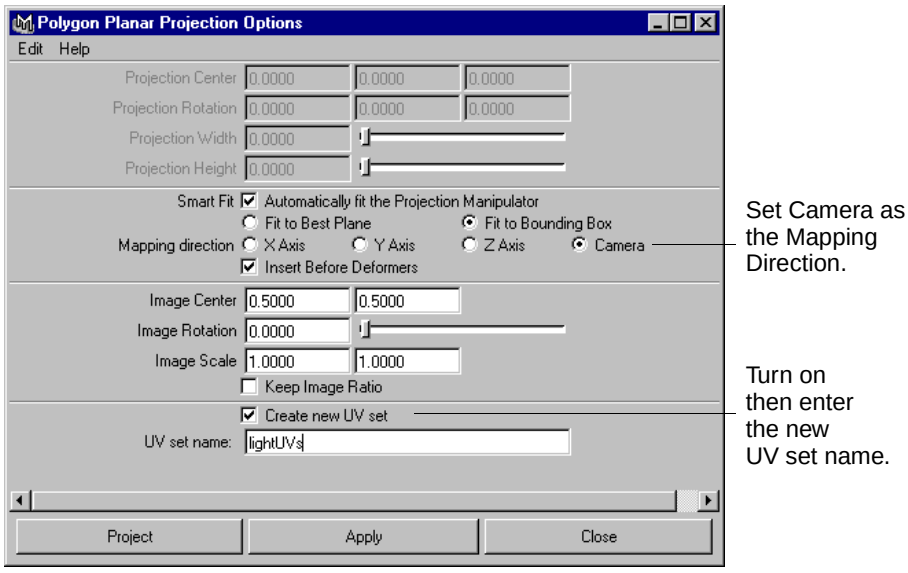
To create UV sets:.

1. In the top view, create a polygonal plane, scale it larger than the default, and select it.

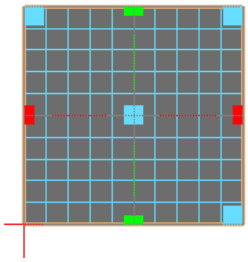
Tip

From the top view panel's menu, select Shading > Smooth Shade All and Hardware Texturing to see the results when you have completed the texture assignment.

2. Select Edit Polygons > Texture > Planar Mapping ❐ to open the Planar Projections Options window.
3. Set the Mapping Direction to Camera, turn on Create New UV Set, and enter *lightUVs* as the set name, then click the Project button.

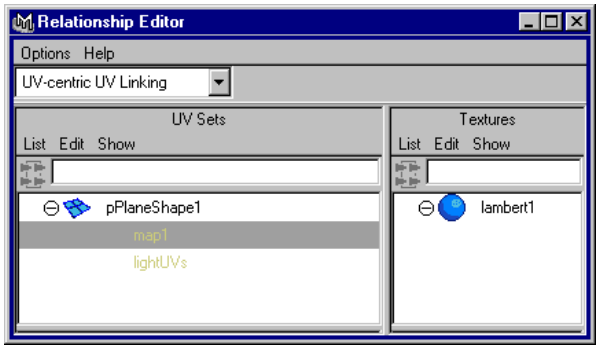


The plane should now display the projection map manipulators.

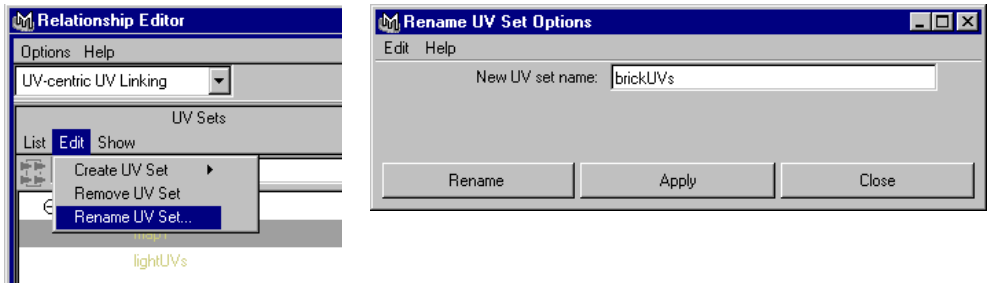


4 Select Window > Relationship Editors > UV Linking > UV-Centric.

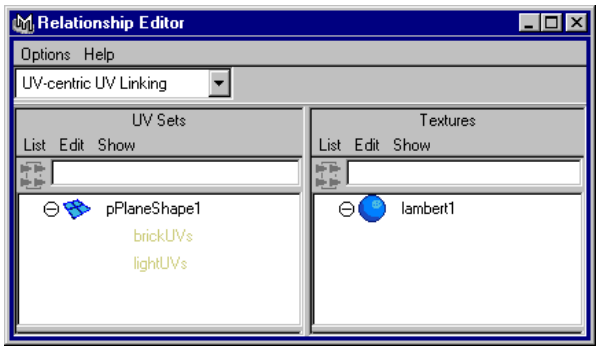
5 Click map1 to make it current.



6 Select Edit > Rename UV Set and enter *brickUVs* in the Rename UV Set options window.



The Relationship Editor displays both UV sets.

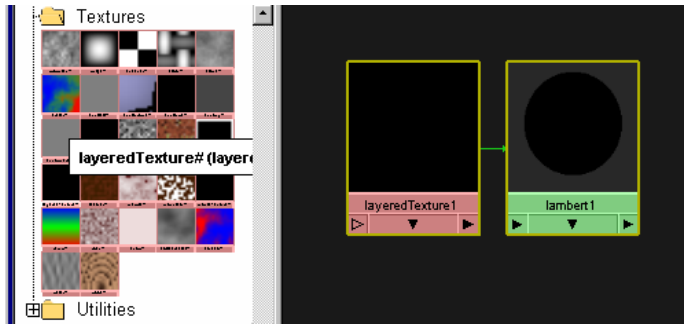


7 Make sure *brickUVs* is selected in the Relationship Editor.

8 Select half the faces on the plane and then select Edit Polygons >Texture > Unitize UVs to tile the UVs for the *brickUVs* UV set.

To create texture layers:

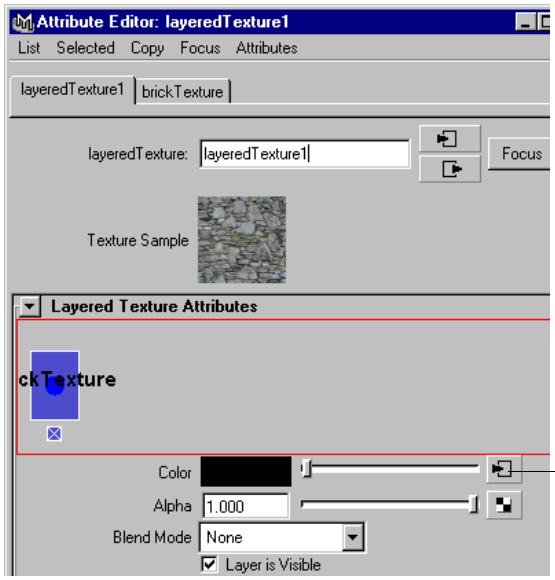
1 In Hypershade, use the middle-mouse button to click-drag the Layered Texture swatch from the Visor panel onto the material swatch in Hypershade and connect it to one of the material's attributes (such as Color. Select Color from the material swatch's pop-up menu).



or

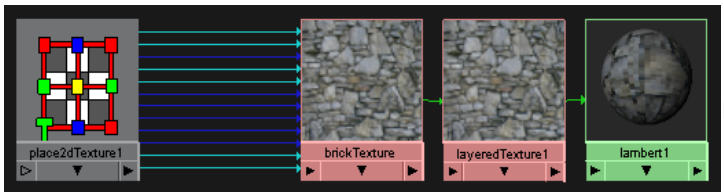
Select Create > Textures > Other > Layered Texture, click in Hypershade and middle-mouse-button drag the texture swatch over the material swatch to connect it to an attribute.

2 Double-click the Layered Texture swatch in Hypershade to open its Attribute Editor. In the Layered Texture's Attribute Editor, map the Color to a file texture (for example, some kind of brick or stone texture you may have). Rename this texture brickTexture.



Result in the view panel.

Click to map a 2D file texture to the Color attribute.

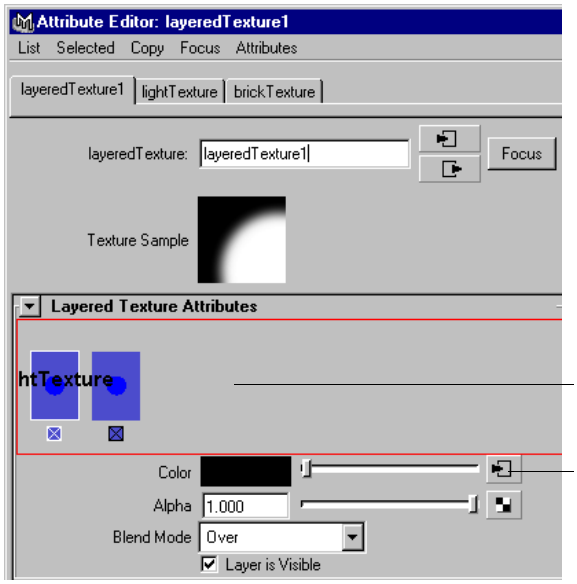


Hypershade view.

3 Click in the top-most area of the Layered Texture Attributes section of the Attribute Editor to create a second layer and click the box next to Color to map it to another file texture. Rename this texture lightTexture.

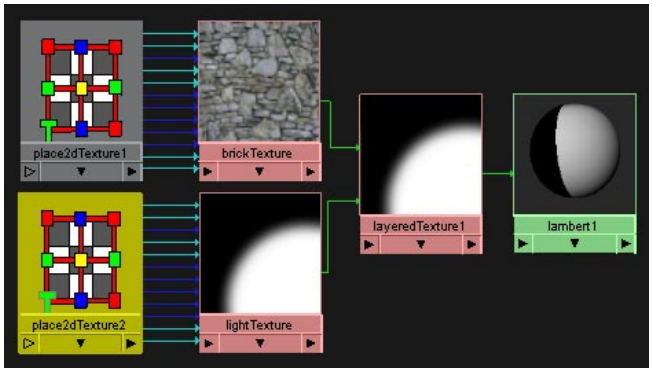
Note

You can use any file texture and not necessarily a light map. See "Example 2" on page 255.

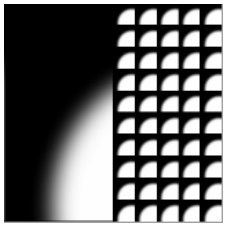


Click in this section to add another layer.

Click to map a 2D file texture to the Color attribute.

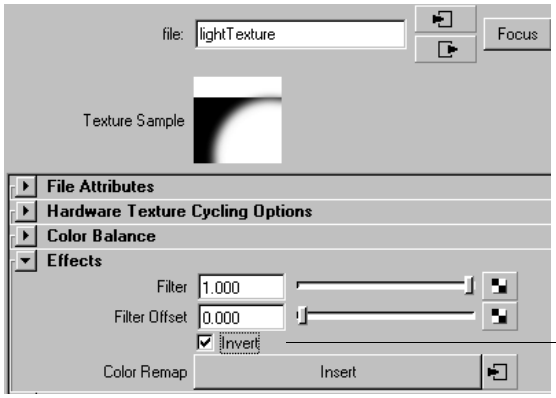


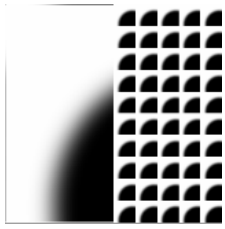
Hypershade view.



Result in the view panel.

4 In the lightTexture's Attribute Editor, open the Effects section and turn on Invert to invert the lightTexture.

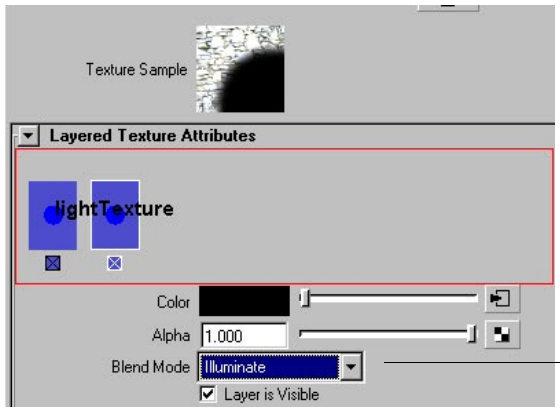




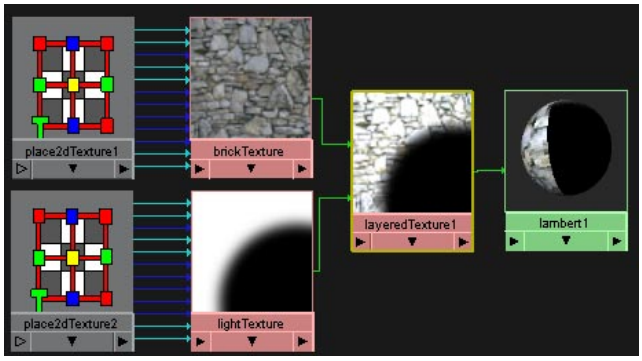
Result in the view panel.

Turn Invert on.

5 In the Layered Texture's Attribute Editor, click the lightTexture swatch and set the Blend Mode to Illuminate (or Subtract).



Select the Illuminate or Subtract Blend Mode.



Hypershade view.

6 Click the brickTexture swatch and make sure the Blend Mode is None (the default).

The order of layers within the Layered Texture Attribute Editor is important since you want the light file texture to blend on top of the brick texture. Make sure the brickTexture is first (the right-most texture).

To connect the UVs to the textures:

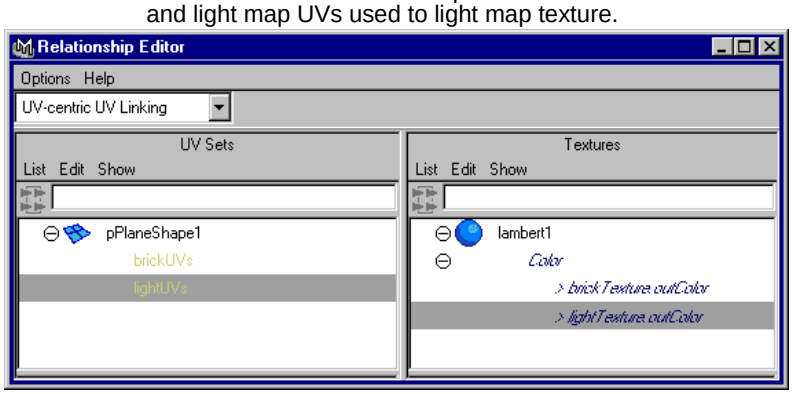
1 Open the Relationship Editor in UV-Centric mode (Window > Relationship Editors > UV Linking > UV - Centric).

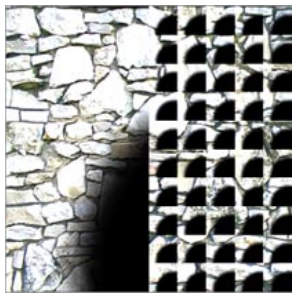
2 Select the plane to update the Relationship Editor.

3 Click the lightUVs UV Set in the left column, and click the texture items in the right column to compare results. See the following examples.

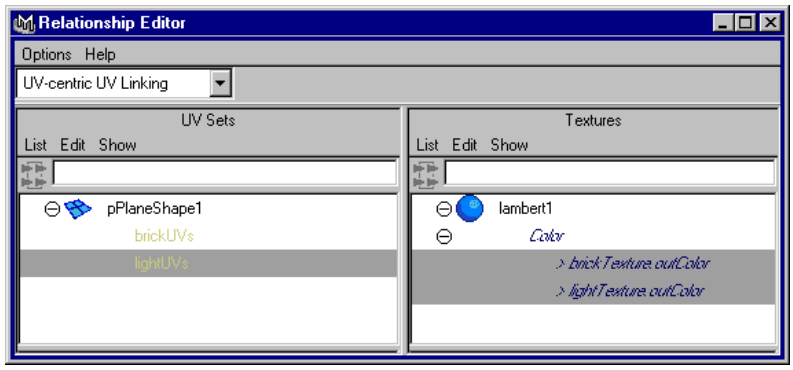
Example 1

Shows brick UVs used to map brick texture
and light map UVs used to light map texture.



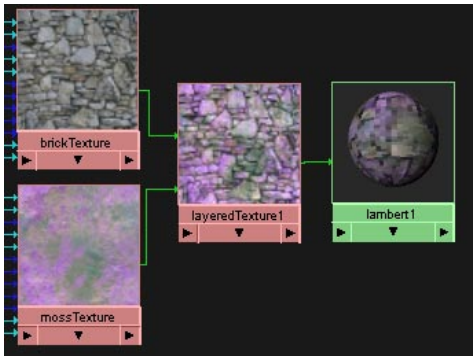


Shows light map UVs used to map both textures.



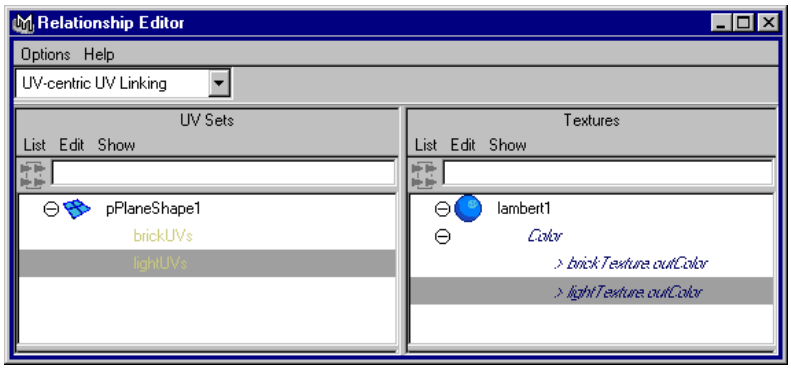
Example 2

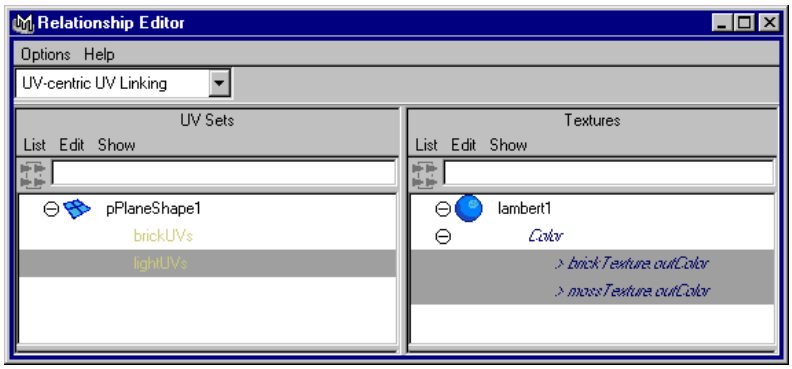
These next few images show what happens when you change the overlaying texture by mapping another file and selecting the lightUVs set in the Relationship Editor.



Double-click the texture swatch
to open its Attribute Editor and select
another file texture.

Rename the new file texture.





Blend modes

Textures can be blended with the texture below them using the Texture Blend attribute in the Layered Texture's Attribute Editor.

The Blend Mode specifies how the currently selected layer blends with the layers behind it. The following blend modes are available.

None The foreground texture covers up the background texture entirely.

Over The foreground texture is applied like a decal to the background. The blending of the decal is determined by the foreground alpha.

In The result is the background texture cut in the shape of the foreground alpha.

Out The result is the opposite of In. It is as if the shape of the foreground alpha has been cut out of the background.

Add The foreground color is added to the background color as if being projected on the background through a slide projector.

Subtract The foreground color is subtracted from the background color.

Multiply The result color is the foreground color multiplied by the background color.

Difference The result color is the difference between the foreground color and the background color.

Lighten The result color of each pixel is the background color or foreground color, whichever is lighter.

Darken The result color of each pixel is the background color or foreground color, whichever is darker.

Saturate The result color is the background color with saturation increased in proportion to the foreground alpha.

Desaturate The result color is the background color with saturation decreased in proportion to the foreground alpha.

Illuminate The result color is the background color mixed with the foreground color, brighter where the foreground color is bright and darker where the foreground color is dark. It is as if the foreground texture represents the light falling on the background.

Numerics

3D Delta
NURBS to Polygons option 118
3D morphing
Sculpt Polygons Tool 172

A

Activate
toggle in Selection Constraint window 111
Add attribute 185
All Hard edges
Soften / Harden option 74
All Soft edges
Soften / Harden edges 74
Allow Zero Normals attribute 69
Alpha attribute 185
Ambient
material channel
color per vertex 183
Ambient + Diffuse
material channel
color per vertex 183
Angle
Selection Constraint option 112, 113
Angle edges
Soften / Harden edges 74
Angle Threshold
Quadrangulate polygons option 122
Append to Polygon Tool
description 28
options 29
Apply Color operation
description 184
Apply Type attribute 202
Area
Selection Constraint option 111
Assign Shader to Each Projection 211
Assoc Type attribute 202
Association type attribute 200
attribute maps
importing, sculpting polygons 171
attributes
polygonal, editing
in Attribute Editor 42
Auto Fit
Bevel option, polygons 162
Auto Smooth
Sculpt Polygon Tool option 168
Automatic Mapping
options 220
Automatic mapping 218
Average Normals 68
Average Normals options 69
Average Vertices 158
Axis
Selection Constraint option 113
setting orientation for polygonal primitives 79

B

backculling
description 47
Backface Culling
description, polygons 44, 47, 49
full, polygons 45
hard, polygons 44, 49
modes, for polygons 44, 49
vertex display, polygons 44
wire, polygons 44, 49
backup surfaces
sculpting polygons 165
Best Plane Texturing 212
Bevel (polygons)
description 160
options 162
blind data
applying 202
editing types 201
exporting 202
presets 201
querying 203
troubleshooting 207
types 199
Blind Data Editor 199
Boolean operations (polygonal)
animating 93
description 85
Difference 88
editing, with construction history 89
Intersection 89
trimming 92
Union 86
visibility, toggle on 91
Border
Selection Constraint option 114
Border Point Preservation attribute 62
Border Target Shape map UV border option 234
borders
display with Smart Command Settings 98
display, changing 45, 47
boundaries
defining, selecting components 101
brush operations
Sculpt Polygon Tool 168

C

Chord Height Ratio
NURBS to Polygons option 117
Cleanup option 40
Cleanup Polygon options 40
Clipboard Actions
description 39, 188
Collapse (polygons)
description 147
Collapse polygons
edges or faces 147
Collectively
normalize UVs 227
Color attribute 185
Color data on apply attribute 203
color interpolation
color per vertex 183
Color Material Channel
options, Custom Polygon Display 183
color-per-vertex
introduction 183
using 184
colors
change for polygon components 53
copy and paste 188
copy and paste for polygons 39
options, in Custom Polygon Display window 183
Paint Vertex Color Tool 186
Prelight 189
using Apply Color 183
colors per vertex feature 197
Combine (polygons)
description 143

Component Editor
for polygons
description 49
components
change color of 53
changing display attributes for 43
definition 11
deleting 59
display, changing 43
display, default 16
moving, using Move Component 53
retaining selection for 52
set selection constraints for 101, 104, 113, 114
vertex / face 51
Compute shadow maps
prelight option 193
Concave
Constrain Properties option 108
Conform normals 72
Constrain Properties
Concave option 108
Convex option 108
for edges 107
for faces 108
Holed option 109
Lamina option 109
Mapped option 109
Non-holed option 109
Non-planar option 108
Non-triangulable option 109
Nsided option 108
Planar option 108
Quads option 108
Triangles option 108
Unmapped option 109
construction history 165
polygonal Booleans, editing with 89
when sculpting polygons 165
Construction History attribute 41
Continuity
Smooth option, polygons 157
Continuous attribute 205
Control Points
tessellation method 119
Convert Selection
description 97
Convex
Constrain Properties option 108
copy
UVs, colors, shaders 39
Copy options window
description 39
Copy UVs 243
Count
tessellation method 119
count (polygons)
change display colors for 39
display for selected components 38
display for selected polygons 38
display in view 38
display polygon count 37
Create New UV Set
automatic mapping option 222
cylindrical, spherical mapping option 217
Create Polygon Tool 23
description 23
options 25
Create UVs Based on Camera 211
culling
backface, polygons 44, 47, 49
Current Next
Constraint Mode option 106
Current UV Set 46
Custom Polygon Display
backculling 47
backface culling 49
borders, display 45, 47
edges, display 45, 47
faces, display 45, 47
non-planar faces, highlight 48
normals, display 47
numbers, display on components 48
texture coordinates, display 48
UVs, display 48
vertices, display 47
window 19, 47
Cut Textures
description 237
cylindrical mapping
description 216
image center, changing 215, 217
image rotation angle, change 215, 217
image scale (width, height), change 215, 217
options 216
projection options 217
Smart Fit, snapping projection 217

D

Data Type attribute 201
Delete Edge 60
description 60
Delete Mapping operation 241
Delete Vertex option 59
deleting
components 59
error messages, for components 60
texture maps 241
vertices 51
Difference
Boolean operation (polygonal) 88
Diffuse
material channel
color per vertex 183
Direction
Duplicate Face option 134
Extract option 134
Extrude option 134
Move Component option 58
Selection Constraint option 113
Discrete Range attribute 203
Discrete Value attribute 203
displace
points, when prelighting 194
Displace geometry
prelight example 196
prelight option 194
displacement
for brush stroke
Sculpt Polygon Tool 170
Display Image 245
Display Poly Count 37
Distance Tolerance attribute 69
Duplicate
Duplicate Face option 135
Extract option 135
Duplicate Face
description 129
options 133

E

Each face separately
normalize UVs 228
Edge Count 103
Edge Snapping
Split Polygon Tool option 151

Edge Swap
NURBS to Polygons option 119
Edge Weights relax UVs option 232
edges
collapse 147
constrain properties for 107
constrain selection, example 105
create new by splitting polygons 149
definition 15
display, changing 45, 47
extruding 127
flipping 61
hard 73
hard, keep when quadrangulating polygons 122
hard, selecting only 107
illegal 62
merge multiple 180
merging 175, 179
set selection constraints for 112
smooth, selecting only 107
soft 73
soft, selecting only 107
subdividing 152
Edges Either Side 103
Emission
material channel
color per vertex 184
Ensure Planarity
Append to Polygons option 31
Create Polygon Tool option 27
faces, keeping planar 95
erase
sculpting polygons 164, 166, 170
Erase Srf update option
Sculpt Polygon Tool 170
Extract (polygons)
description 129
options 133
Extrude (polygons)
options 133
Extrude Edge
description, polygons 127
Extrude Face
description, polygons 125

F

faces
collapse 147
create new by splitting polygons 149
definition 12
deleting 59
display with Smart Command Settings 98
display, changing 48
duplicating 129
extracting 129
extruding 125
face normals, definition 13
filling holes in 142
keeping together 96, 130
making holes in 137
non-planar, definition 18
planar, definition 18
planar, keeping 95
quadrangulate 122
removing if all edges shared 42
set selection constraints for 108, 109, 111, 113
single, create 23
subdividing
automatically after selection 152
triangulate 121
Fill Holel
description 142
First Normal
Sculpt Polygon Tool option 168
Fit to Best Plane
planar mapping option 215
Fit to Bounding Box
planar mapping option 215
flip
edges 61
Flip Reversed layout UVs option 231
Flip Triangle Edge option 61
Flip UVs 228
Flood
Sculpt Polygon Tool option 171
font
changing for polygonal text 83
Fractional Tolerance
NURBS to Polygons option 117
Free Set attribute 200
full
Backface Culling option 45

G

General
NURBS to Polygons option 118
tessellation 118
Geometry
Constrain Properties options 109
geometry
polygonal, displaced
during prelight 194
Geometry Border Edges 157
Geometry Border Edges attribute 62
Global Values options
for Duplicate Face 134
for Extract 134
for Extrude 134
for Move Component 58
Grab Color attribute 185
grid options for UV Texture Editor 244
Grow Selection Region
description 101
select components 101

H

hard
Backface Culling option 44
hard edges
keep when quadrangulating polygons 122
Hard Edges attribute 63
Heads Up Display 37
height
set for polygonal primitives 79
Hex attribute 206
High Curvature attribute 63
history
construction
sculpting polygons 165
with Booleans (polygonal) 89
Holed
Constrain Properties option 109
holes
filling 142
making 137
making, with Append to Polygon Tool 34, 139
making, with Create Polygon Tool 34, 139

hotkeys
for applying colors 187

I

Id attribute 200
Image Center
cylindrical, spherical mapping option 215, 217
image range
changing in UV Texture Editor 245
Image Rotation
cylindrical, spherical mapping option 215, 217
Image Scale
cylindrical, spherical mapping option 215, 217
importing attribute maps
sculpting polygons 171
Insert Before Deformers
Automatic Mapping option 222
Planar Mapping option 215
Spherical Mapping option 217
Insert key
using when subdividing polygons 150
Inside
Constrain Properties option 107
Intersection
Boolean operation (polygonal) 89
invalid polygonal geometry 19
Isolate Select 103

K

Keep Face Group Border
Quadrangulate polygon option 122
Keep Faces Together
description 96
Duplicate Face option 130, 136
Extract option 130, 136
Extrude option 130, 136
Keep Hard Edges
Backface Culling option 49
Quadrangulate polygons option 122
Keep New Faces Planar
description 95
Keep Tesselation 158
Keep Texture Border
Quadrangulate polygons option 122
Keep Wire
Backface Culling option 49

L

Lamina
Constrain Properties option 109
lamina face removal 42
Layout
automatic mapping option 221
layout UVs option 231
Layout UVs 230
Layout UVs options 231
Length
options for selection constraints 112
lighting
compute incoming prelight 194
pre-evaluate 189
prelighting 196
Limit Points Specified To
Append to Polygon option 30
Create Polygon Tool option 26
creating polygonal strips 33
local and global modes
using Move Component 56
Local Values options
for Duplicate Face 133
for Extract 133
for Extrude 133
for Move Component 57
Location
Constrain Properties options 107
Long Name attribute 200

M

Make Hole Tool
description 137
merge modes 140
manipulators
for Move Component 55
Map Size Presets
layout UVs option 232
Map UV Border 233
Mapped
Constrain Properties option 109
Mapped Area
Selection Constraint options 113
mapping
cylindrical and spherical 216
planar 214
Mapping direction
planar mapping option 215
mapping textures
cylindrical 216
planar 213
masked polygonal surfaces
sculpting 170
masked vertices
paint color on 188
material channel
Ambient
color per vertex 183
Ambient + Diffuse
color per vertex 183
Diffuse
color per vertex 183
Emission
color per vertex 184
Specular
color per vertex 184
Max 2D, 3D Angle 102
Max Iterations relax UVs option 233
merge
edges 175
edges, first 178
edges, last 178
edges, middle 178
edges, multiple 180
edges, second 178
modes for merging edges 178
modes, when making holes 140
two polygons 179
vertices 173
Merge Edge Tool
description 175
First mode 178
Middle mode 178
modes, description 177
options 177
Second (last) mode 178
Merge Multiple Edges
description 180
options 180
Worldspace option 181
Merge UVs 240
Merge UVs Also 181

Merge Vertices
description 173
options 174
UVs merged 174
Merge with the original option 37
Minimal Edge Length
NURBS to Polygons option 118
Minimum length
Subdivide (edges) option 154
MinMax values
changing, for constraint selection 110
Mirror Direction option 35
Mirror Geometry option 35
mirroring polygons 35
morphing
key framing changes, Sculpt Polygons Tool 172
Move and Sew UVs 239
Move Component 53
description 54
Global Values options 58
Local Values options 57
manipulator 55
Move Edge options, Local center 58
Move Vertex options, translate along normal 58
options, general 57
Other Values options, Random 58
Move Edge options
for Move Component 58
Move Face options
for Move Component 57
Move Tool
Triad options, when moving normals 65
Move Vertex options
for Move Component 58
Move Component, Translate along normal 58
moving a projection
cylindrical, spherical 217
planar 216

N

Name attribute 200
Neighbors
options for selection constraints 112
New Attr attribute 200
New Presets attribute 201
Next Selection
Constraint Mode option 106
Non-holed
Constrain Properties option 109
Nonmanifold geometry
cleanup option 41
nonmanifold geometry 19, 28, 127, 174
Non-planar
Constrain Properties option 108
custom polygon display option 48
highlight non-planar faces 48
non-planar faces
definition 18
highlight 48
Non-triangulable
Constrain Properties option 109
non-winged vertices
description 60
Normal
Sculpt Polygon Tool option 168
Normalize
each face separately, for polygonal primitives 80
texture option
creating new polygons 26, 31
UVs 227
whole object, for polygonal primitives 80
normals
conforming 72
definition 13
display with Smart Command Settings 98
display, changing 46, 47
display, custom 14
display, general preferences 14
face normals, definition 13
locking 67
moving, in absolute and relative modes 65
normalize 68
reversing 70
reversing and propagating 72
reversing, introduction 15
setting 67
shells, when reversing 72
size, changing 46, 47
splitting 69
texturing / coloring, introduction 15
type, changing 46
unlocking 67
vertex 66, 68
vertex, splitting 69
X, Y, Z, change range of 67
Normals menu
Reverse 70
Reverse and Propagate 72
Set Vertex Normal 66
Soften / Harden 73
Nsided
Constrain Properties option 108
Number U / Number V
NURBS to Polygons options 118
numbers
displaying on components 48
NURBS to Polygons
3D delta 118
and Booleans (polygonal) 85
change in Attribute Editor 32
Chord Height Ratio 117
Control Points tessellation 119
Count tessellation 119
description 115
Fractional Tolerance 117
General tessellation 118
Minimal Edge Length 118
options 116
Quadrangulate 116
Standard Fit tessellation 117
Triangles 116

O

Offset
  Bevel option, polygons 162
  Duplicate Face option 133
  Extract option 133
  Extrude option 133
  Move Component option 57
On Border
  Constrain Properties option 107
Opacity
  Sculpt Polygon Tool option 167
Optimize automatic mapping option 221
Orientation
  option for selection constraints 113
orientation
  setting for polygonal primitives 79
Other Values options
  for Duplicate Face 134
  for Extract 134
  for Extrude 134
  for Move Component 58

P

Paint Selection Tool
  selecting polygonal components 53
Paint values attribute 203
Paint Vertex Color Tool
  description 186
paste
  colors, for polygons 39
  shaders, for polygons 39
  UVs 39
Paste UVs 243
Percentage Space
  automatic mapping option 222
pick mask
  change with Smart Command Settings 98
Pin Selected UVs relax UVs option 233
Pin Unselected UVs relax UVs option 233
Pin UV Border relax UVs option 233
Pin UVs relax UVs options 232
pixels, snapping UVs to 246
Planar
  Constrain Properties option 108
planar faces
  definition 18
planar mapping
  description 213
  options 214
  projection options 214
  Smart Fit, snapping projection 215
  using 213
planar trim curve
  create for polygonal text 82
planarity
  ensuring 27, 31
Plane
  Selection Constraint option 113
Planes option 220
Point
  define selection location of for polygons 113
  Selection Constraint option, polygons 113
Poly Count 37
Poly text type 82
polyColorPerVertex 198
polygon count
  change display colors for 39
  display 37
  display for selected components 38
  display for selected polygons 38
  display in view 38
  display total count 37
Polygon Cylindrical Projection options
  window 216
Polygon Mirror options 35
Polygon Planar Projection options
  window 214
Polygon Prelight options
  window 192
polygon primitives
  creating 75
Polygon Reduce options 62
Polygon Selection Constraint
  window 104
Polygon Set Vertex Normal
  window 67
Polygon Spherical Projection options
  window 216
Polygon Type options
  for polygonal text 83
polygonal primitives
  options 76
  setting axis (orientation) for 79
  setting radius for 76
  setting subdivisions for 77
  setting texture mapping for 80
  setting texture mapping off 80, 81
  setting width and height for 79
polygons
  3D spacing 118
  appending to 28
  beveling 161
  border, selection constraint for 114
  components, definition 11
  convert NURBS to 115
  creating new 23
  edges, definition 15
  editing in Attribute Editor 42
  face normals, definition 13
  faces, definition of 12
  flooding, sculpting 171
  grow selection 101
  introduction to 11
  invalid and valid geometry 19
  masked, sculpting 170
  non-planar faces, definition 18
  planar faces, definition 18
  quadrangulate 122
  reducing counts 62
  sculpting 163, 170
  set polygon count, NURBS to Polygons 119
  shared, definition 19
  shells, definition 17
  shells, selection constraint for 114
  shrink selection 101
  smoothing 155
  texture coordinates, definition 16
  triangulate 121
  units, constrain selection 110
  unshared, definition 19
  UVs, definition 16
  vertices, definition 12
Post-normalize Normals attribute 69
prelighting 189
  combining effects 197
  Sample selected faces only 193
  Sample using face normals 193
Pre-normalize Normals attribute 69

Preserve Aspect Ratio
normalize UVs 228
texture mapping, polygonal primitive plane 82
Preserve Shape Detail map UV border options 235
primitives
edit polygonal in Attribute Editor 82
polygonal, creating 75
polygonal, options 76
polygonal, setting axis (orientation) for 79
polygonal, setting radius for 76
polygonal, setting subdivisions for 77
polygonal, setting texture mapping for 80
polygonal, setting texture mapping off 80, 81
polygonal, setting width and height for 79
projection
cylindrical, spherical mapping options 217
planar mapping options 214
snap to best plane 215
snap to bounding box 215
snapping to faces 215
Projection Center
cylindrical, spherical mapping option 217
planar mapping option 216
Projection Height
cylindrical mapping option 217
Projection Horizontal Sweep
cylindrical, spherical mapping option 217
Projection Rotation
cylindrical, spherical mapping option 217
planar mapping option 216
Projection Scale
planar mapping option 216
Projection Scale Height
cylindrical, spherical mapping option 217
spherical mapping option 217
propagating and reversing normals 72
pulling
sculpting polygons 164
pushing
sculpting polygons 163
Px, Py, Pz
Selection Constraint option 113

Q

Quadrangulate (polygons)
description 122
when converting from NURBS 116
Quadrangulate polygons
options 122
quads
Constrain Properties option 108
NURBS to Polygons option 116
option for subdividing faces 154

R

Radius
Sculpt Polygon Tool option 167
setting for polygonal primitive 76
Random
Duplicate Face option 134
Extract option 134
Extrude option 134
Move Component option 58
Selection Constraint option 114
Ranged attribute 201
Ratio
Selection Constraint option 114
Reduce by (%) attribute 62
reducing polygons 62
reference surface
sculpting polygons 165
reference vector
setting, sculpting polygons 168
Relax UVs options 232
relaxing UVs 232
Remove attribute 185
Remove Geometry options 42
Replace attribute 185
Replace Zero Normals By attribute 69
reposition
points, when creating polygons 24
points, when splitting polygons 150
Reset to Default Settings 99
Resulting Color attribute 185
Reuse computed shadow maps
prelight option 193
Reverse and Extract option 71
Reverse and Propogate option 72
Reverse normals
description 70
Reverse option 71
reversing and propagating normals 72
Rotate
Duplicate Face option 134
Extract option 134
Extrude option 134
Move Component option 58
Rotate UVs option 229
rotating a projection
cylindrical, spherical 217
planar 216
Rotation Angle
Append to Polygon option 30
Roundness
Bevel option, polygons 162

S

Sample incoming illumination only
prelight option 194
Sample scale factor
prelight option 194
Sample selected faces only
prelight option 193
Sample using face normals
prelight option 193
sampling
data, when prelighting 194
process, using shadows for prelighting 195
shading values prelighting 194
Scale
automatic mapping option 221
Duplicate Face option 134
Extract option 134
Extrude option 134
layout UVs option 231
Move Component option 58
scale factor
for prelighting 194
scaling a projection
around object, cylindrical, spherical 217
height 217
planar 216

Sculpt Polygon Tool 168
description 163
erase surface 170
options 167
reference surface 170
reference vectors 168
sculpt variables 168
shape option 167
sculpting polygons
building gradually 171
flooding 171
masked polygonal surfaces 170
pulling polygons 164
pushing polygons 163
tips and tricks 171
variables 168
Segments
Bevel option, polygons 162
Select all Polygonal Objects attribute 41
Select and Cleanup attribute 40
Select Connected Faces 226
Select Contained Faces 225
Select Contiguous Edges 102
Select Geometry attribute 41
Selected Vertex Color attribute 185
Selection (polygonal)
converting polygonal component selection 101
growing selection region 101
selecting selection boundary 101
shrinking selection region 101
using constraints 104
Selection Border Edges 157
Selection Boundary
description 101
Selection Constraints
Activate toggle 111
description 104
Off radio button 111
options 106
resetting 106
set MinMax values for 110
setting 104
Separate Duplicate Faces option 133
Separate Extracted Faces option 133
Separate layout UVs option 231
Separate polygons
combined 146
description 144
with merged edges 145
Set Individual Color Channels attribute 186
Set to Face 70
Set to Face options 70
Set User Normal attribute 70
Set Vertex Color Key 198
Set Vertex Normal
description 66
Sew Textures
description 237
shaders
assign placeholder shaders 211
copying, pasting for polygons 39
shadow maps
compute, for prelighting 193
re-use, for prelighting 193
Shape Detail map UV border option 235
Shape option
Sculpt Polygon Tool 167
shared
edges, vertices, UVs definition 19
Sharp Geometry Angles attribute 63
Shell
Selection Constraint option 114
shells
definition 17
separating 144
when reversing normals 72
Short Name attribute 200
Shrink Selection Region
description 101
select components 101
Signed
options for selection constraints 113
Smart Command Settings
description 97
uninstalling 99
Smart Fit
cylindrical, spherical mapping toggle 217
planar mapping toggle 215
Smooth (polygons)
and Sculpt Polygons Tool 164
decrease smoothness 157
degree of smoothness 157
description 155
increase smoothness 157
options 156
Smoothing
Constrain Properties options 107
smoothing
Artisan Sculpt Polygons Tool 164
Average Vertices 158
Snapping Magnets
Split Polygon Tool option 151
Snapping tolerance
Split Polygon Tool option 151
snapshot for UVs 242
Soften / Harden edges
All Hard edges 74
All Soft edges 74
Angle edges 74
description 73
window 73
software rendering
and prelighting 196
solids
polygonal, definition 17
Space
layout UVs option 232
Spacing Presets
automatic mapping option 222
Specular
material channel, color per vertex 184
spherical mapping
change image center 215, 217
change image rotation angle 215, 217
change image scale (width, height) 215, 217
description 216
options 216
projection options 217
Smart Fit, snapping projection 217
Split Polygon Tool
description 149
options 151
Split Vertex 152
split vertex normals 69
splitting polygons 149
stamp
profile, Sculpt Polygon Tool 167
Standard Fit
tessellation method 117
Stopping Conditions relax UVs options 233
Straighten UV Border 236

Strength
Sculpt Polygon Tool option 168
Stretch to fit
texture mapping, polygonal primitive plane 81
strips
polygonal, creating 33
Subdivide
description 152
faces, automatically after selection 152
options 153
Subdivision Levels
Smooth option, polygons 157
Subdivide polygons option 154
subdivision surfaces 158
Subdivisions
Append to Polygon Tool option 30, 33
Create Polygon Tool option 25, 27
Split Polygon Tool option 151
subdivisions
setting for polygonal primitives 77
Subtract attribute 185
surfaces
backup, sculpting polygons 165
erase, sculpting polygons 170
options for Sculpt Polygon Tool 170
swap-edge 61

T

Tag / Id attribute 203
Tessellate Geometry options 41
tessellation
Control Points method 119
Count method 119
description 117
changing attributes 43
Edge Swap toggle 119
General method 118
methods, for polygonal text 84
methods, NURBS to polygons 117
Standard Fit method 117
text
creating, polygonal 82
texture border
keep when quadrangulating polygons 122
texture Coordinates
setting for polygonal primitives 80
texture coordinates
displaying 48
setting
appending to polygons 31
creating new polygons 26
UVs, definition 16
texture mapping 209
automatic 218
cutting and sewing 237
cylindrical 216
delete maps 241
for polygonal primitive cubes and cylinders 80
for polygonal primitive planes 81
laying out UVs 230
moving and sewing UVs 239
options for polygonal primitives 80
planar 213
preserve aspect ratio for polygonal primitive plane 82
relaxing UVs 232
setting for polygonal primitives 80
setting off for polygonal primitives 80, 81
spherical 216
stretch to fit for polygonal primitive plane 81
UV border 233
texture placement
visual feedback for 211
Texture View renamed 209
textures
display in UV Texture Editor 245
Insert Before Deformer option 215
Threshold 181
Tool Options (polygonal)
Convert Selection 97
Keep Faces Together 96
Keep New Faces Planar 95
Smart Command Settings 97
Translate
Duplicate Face option 134
Extract option 134
Extrude option 134
Move Component option 58
Triangles
Constrain Properties option 108
NURBS to Polygons option 116
option for subdividing faces 154
Triangulate
when converting from NURBS 116
Triangulate (polygons)
description 121
Triangulate polygons
faces 121
turn-edge 61

U

U Type
NURBS to Polygons option 118
Union
Boolean operation (polygonal) 86
Unitize
texture option
creating new polygons 26, 31
UVs 228
units
polygonal, constrain selection 110
Unmapped
Constrain Properties option 109
unshared
edges, vertices, UVs 19
Unsigned
options for selection constraints 113
Use Chord Height Ratio
NURBS to Polygons option 118
Use Image Ratio 245
UV Border Edges attribute 63
UV Snapshot 242
UV Texture Editor usage 225

UVs
and Merge Vertices 174
and merging edges 181
automatic mapping 218
copy and paste for polygons 39
create UVs based on camera view 211
create UVs based on plane 212
creating 209
definition 16
displaying 48
flip 228
laying out 230
mapping border 233
moving
with Move Component 57
moving and sewing 239
normalize 227
normalize, collectively 227
normalize, per-face 228
normalize, preserve aspect ratio 228
on complex models 246
relaxing 232
rotating 229
set selection constraints for 112
snapping to pixels 246
unitize 228
untangling 232

V

V Type
NURBS to Polygons option 118
valid polygonal geometry 19
variables, when sculpting 168
vertex colors
Custom Polygon Display 183
vertex normals
splitting 69
vertex, averaging 68
vertex / face selection 51
vertices
append to polygon option
Attribute Editor 33
apply color to 184, 186
create new by splitting polygons 149
create polygon tool option
in Attribute Editor 28
definition 12
deleting 51, 59
display with Smart Command Settings 98
display, changing 44
map color values to 188
masked, paint color on 188
merging 173
move when sculpting 168
set selection constraints for 112
smoothing 158
splitting shared 152
View
Sculpt Polygon Tool option 169
View Connected Faces 226
View Contained Faces 226
Visibility
options for selection constraints 113
visibility
toggle on for Boolean operations (polygonal) 91
Vx, Vy, Vz
Selection Constraint option
axis 113

W

width
setting for polygonal primitives 79
winged vertices 60
wire
Backface Culling option 44
Worldspace
and merging multiple edges 181
when beveling polygons 163
when duplicating faces 135
when extracting polygons 135
when extruding polygons 135
when moving components 58
when quadrangulating polygons 123
when subdividing polygons 154

X

X Axis
Sculpt Polygon Tool option 169

Y

Y Axis
Sculpt Polygon Tool option 169

Z

Z Axis
Sculpt Polygon Tool option 169