Autodesk 3ds Max Design 2010
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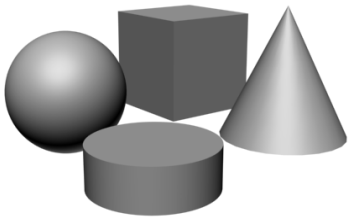
Section 3: Basic Functions

In this section you will learn how to:

- Model with 3D geometry Primitives
- Apply transforms to objects
- Make changes in Sub-object mode
- Use Poly modeling techniques
- Display statistics in the viewport
- Work with coordinate systems and transform centers
- Copy, Clone, and Group objects

Modeling with Primitives



Autodesk 3ds Max Design enables you to create and adjust 3D geometry by creating a complex model from simple 3D objects called primitives.

- Not everyone works with Autodesk 3ds Max Design as their primary modeling tool. However, even for those who do not, modeling with Autodesk 3ds Max Design primitives might still be useful for additional dressing or background objects to add to your imported scenes.
- Modeling with primitives is only one approach to creating geometry in Autodesk 3ds Max Design. Other processes, such as modeling with modifiers, creating loft compound objects or creating a 3D terrain from 2D contour objects, can also be done.

Practice - Modeling with Primitives

In this practice you will model the base for the parking lot light fixtures shown in the previous examples. You will continue this model in the following practices. Estimated time for completion: 10 minutes.

1. Open **Modeling with Primitives.max**. Start by creating the cylindrical concrete light pole base.
2. In the Command Panel select the *Create* tab. Click  (Geometry) and select **Standard Primitives** in the sub-category pull-down menu. In the Object Type rollout, click Cylinder.
3. If the Keyboard Entry rollout is collapsed, select "+" to expand it.
4. In the Keyboard Entry rollout leave the X-Y-Z coordinates at **0'0"** for each. Set the *Radius* to **0'12"** and the *Height* to **3'0"**. Click Create at the bottom of the Keyboard Entry rollout.

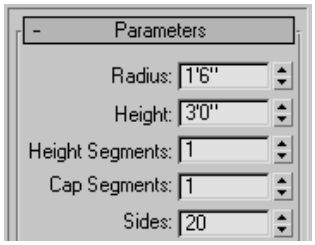
5. Click  (Zoom Extents) to get a closer look at the base.

6. Now change the *Radius* to **1'6"**. Changing the Radius in the Keyboard Entry rollout *does not* adjust the object, and clicking Create again adds a second cylinder. (If you clicked Create a second time, click  once on the Quick Access Toolbar.

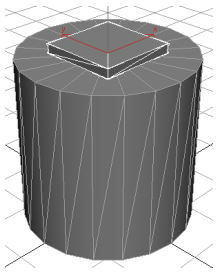
7. To alter an object's parameters after creation, it is generally best to use the *Modify* tab, not the *Create* tab. Select the object if necessary, and select the *Modify* tab.

8. In the *Modify* tab set the *Radius* to **1'6"** and rename the object from **Cylinder01** to **LP Base**.

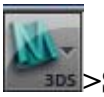
9. In the *Modify* tab you can also set the number of segments and sides for the object. Try changing these values to see what effect they have on the geometry. Finish this step by setting both *Height and Cap Segments* to **1** and the number of *Sides* to **20**, as shown below.



10. Back in the Standard Primitives sub-category in the *Create* tab, create a **Box** primitive of the anchor base plate. In the Keyboard Entry rollout enter *X-Y-Z coordinates* of **0'0", 0'0", 3'0"**. Set the *Length* and *Width* to **0'16"** and the *Height* to **0'2"**. Click Create.



11. In the *Modify* tab rename the object **LP Anchor Base**.

12. Click  **>Save As…** and save your work as **MyLight Pole.max**.

Applying Transforms

Many CAD and 3D graphic programs consider **Move**, **Rotate**, and **Scale** as modify options similar to **Stretch**, **Break**, and **Trim**. However, in Autodesk 3ds Max Design there is a significant distinction between modifiers and transforms.

- **Modifiers** add geometric and property alterations to objects. They are listed in the Modifier Stack and their parameter values are available for adjustment afterwards.
- **Transforms** are used to translate (move) and scale objects in the scene. The three Autodesk 3ds Max Design transforms are **Move**, **Rotate**, and **Scale**. Transforms are conducted by accessing a transform mode and typing new values or graphically transforming objects on the screen.
- Transforms are applied to objects after basic parameters and modifiers have been taken into account (except world-space modifiers). For example, if you scale a box primitive, the *Length* parameter shown in the Modifier Stack does not take into account the effects of the scale transform.
- An object can have any number of modifiers, but only has a single set of transform values at any time.
- Transforms and almost all object and modifier parameters can be animated in Autodesk 3ds Max Design. For example, a walkthrough animation can be created using Move Transform to move the camera or its target or both.

Transform modes are initiated through buttons in the Main toolbar or by using the right-click quad menu Transform tools:

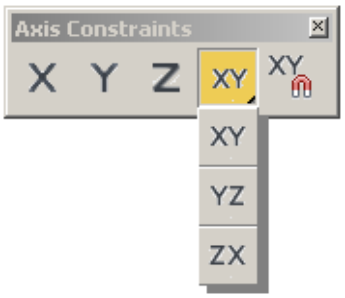
Select and Move

Select and Rotate

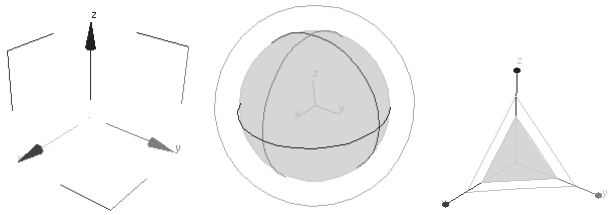
Select and Scale. Scaling has three flyout options:  (Uniform),  (Non-uniform), and  (Squash). Non-uniform enables you to scale one or two axes independently. Squash enables you to do the same, but scaling one or two axes applies a simultaneous opposite scaling to the other(s). The Scale transform gizmo also has the tools to do Non-uniform scaling.

Hint: It is best not to use the Scale transform directly on objects. Instead, apply an XForm modifier to the objects and then **Scale** the XForm gizmo. This avoids many problems in animation, because you can define when the scale is taking place at the sub-object level.

Transforms can be constrained to one or two axes by selecting one of the buttons in the Axis Constraints toolbar. However, it is more common to use the gizmos or the keyboard shortcuts to constrain the transforms. This toolbar is hidden by default, unhide it to use it.



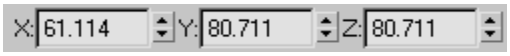
When a transform mode is active, a Transform Gizmo normally appears on the screen. If the Transform Gizmo is missing, press the <X> key to toggle it on.



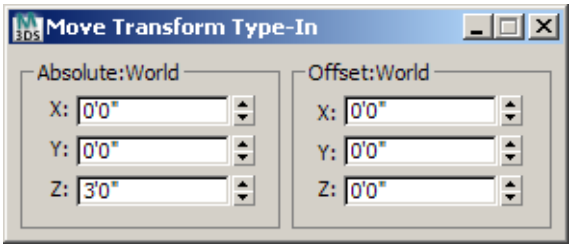
Move *Rotate* *Scale*

Clicking and dragging over the Gizmo enables you to perform the transform interactively on the screen. You can also constrain the transform by highlighting an axis handle or plane handle on the Gizmo before clicking and dragging.

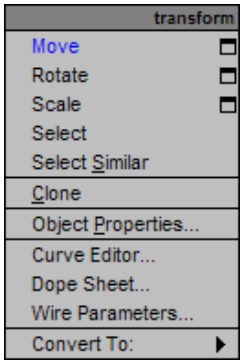
A more precise way to apply a transform (beyond clicking and dragging) is to enter desired transform values in the *Transform Type-In* area in the Status Bar, as shown below.



You can also right-click on any of the Transform buttons to open a Transform Type-In dialog box, as shown below for the Move transform.



The Transform Type-in dialog box can also be accessed by right-clicking on the object and clicking (Settings) to the right of **Move**, **Rotate**, or **Scale**, as shown below.



Transform modes remain active until they are canceled. One way to cancel a transform mode is by activating (Select) in the Main toolbar or pressing the <Q> key. You should consider selecting Select after you have finished a transform to avoid accidentally moving, rotating, or scaling objects while making selections.

Practice - Modeling with Modifiers and Transforms

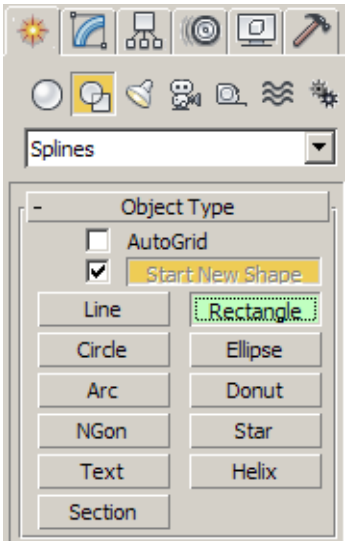
In this practice you will refine the parking lot lighting fixture with Modifiers, then use Transforms to locate objects in the correct scene positions. Estimated time for completion: 20-30 minutes.

Task 1 – Extrude and Adjust the Light Pole

To create the rectangular light pole create a 2D cross-section shape and then "extrude" it into a 3D object. This approach is one way to create 3D geometry that might otherwise not be available as a primitive. The Extrude modifier will be covered in more detail in the following section.

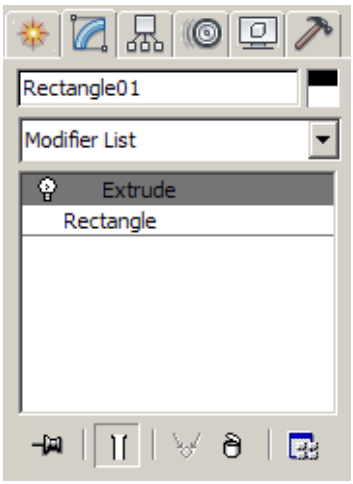
1. Continue with the file created in the previous practice (**MyLightPole.max**) or open **Modeling with Modifiers and Transforms.max**.

2. Two-dimensional objects are created from the Shapes category in the *Create* tab. Within Shapes, select the **Splines** sub-category and click Rectangle.



3. In the Keyboard Entry rollout set the *X-Y-Z coordinates* to **0'0", 0'0", 3'2"**. Set the *Length* and *Width* to **0'6"** and the *Corner Radius* to **0'1"**. Click Create.

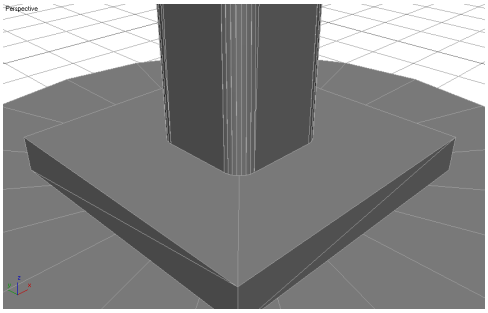
4. With the rectangle still selected, in the *Modify* tab select the Extrude modifier in the **Modifier List** pull-down menu (available in the Object-Space Modifier list).



5. Set the *Extrude* amount to **15'0"** and leave the other parameters at their default settings.

6. Still in the *Modify* tab, rename the object as **LP Pole**.

7. Use  (Zoom) to get a closer look at the light pole. Notice how much detail the light pole's fillet adds to the model.

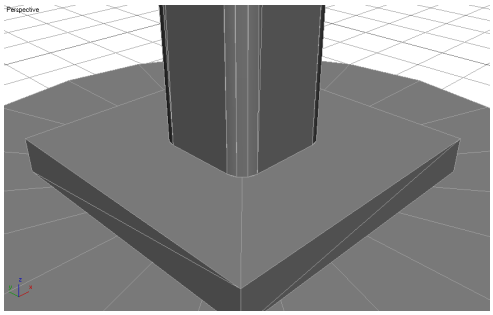


You should cut down on any unnecessary detail if the light pole is meant to be a background item and not the main focus of the visualization. Keeping models as simple as possible reduces file sizes and speeds up software performance and rendering times.

The Extrude modifier is listed directly above the Rectangle object in the Modifier Stack. The rectangle's parameters are still accessible and can be changed after the extrude is added.

8. In the *Modify* tab, select the **Rectangle** in the Modifier Stack. In the Interpolation rollout change the *Steps* to **2**. (In your own projects you might consider going as low as 0 or not using fillets at all if the object is not a focal point of the visualization.)

9. Save your work as **MyLightPole01.max**.

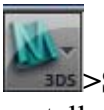


Task 2 – Taper the Light Pole

To taper the light pole width from 6" at the base to 3" at the top you will add a Taper modifier.

1. In the Modifier Stack highlight the Extrude modifier (so that the Taper is applied after the Extrude) and add the Taper modifier from the Modifier List (in Object-Space Modifiers). Although the Taper is applied to the rectangle after the Extrusion, it appears above the Extrusion in the Modifier Stack. The Modifier Stack lists modifiers in reverse historical order.

2. Set the *Taper* amount to **-0.5**, which relates to approximately a 50% size reduction over the height of the object. You can still adjust the original Rectangle and Extrude properties in the Modifier Stack.

3. Click 

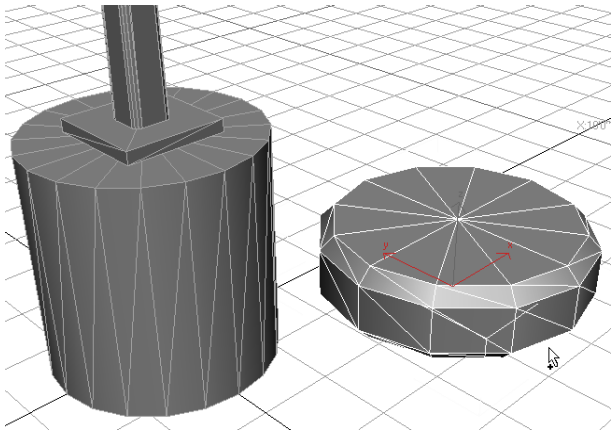
>Save As and click  to automatically save your work incrementally as **MyLightPole02.max**.

Task 3 – Create the Fixture Housing and Globe

Previously you created primitives by keying in exact values in the Keyboard Entry rollout. Now you will roughly size the primitive shapes by clicking and dragging with the mouse in the viewport.

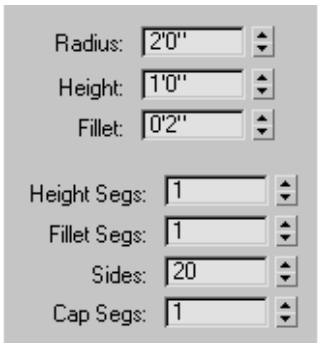
1. In the *Create* tab select the Geometry category and select Extended Primitives as a sub-category. Create a Chamfered Cylinder (**ChamferCyl**).

2. Click and drag the left mouse button to size the radius to roughly **2'0"**. After releasing the mouse button, move your cursor up the screen slightly to give the cylinder a height of approximately **1'0"**. Click a second time to set the cylinder height. Then move the cursor up and down the screen until you can roughly define a **0'2"** fillet. Complete the object creation process with a third click.



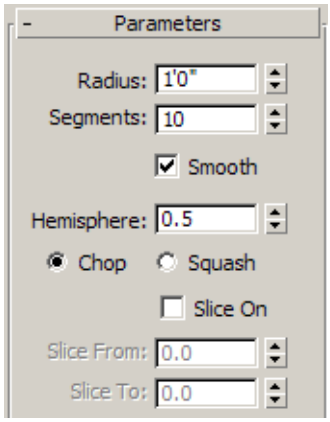
All primitives can be sized by clicks and drags as you did here. Some of you will prefer to "sketch in" an object this way and then fix its dimensions and position later rather than keying everything in up front.

3. Select the *Modify* tab in the Command Panel and use the parameters shown below for the Chamfer Cylinder.



4. Name the object **LP Fixture Housing.**

5. Create a **Sphere** from the Standard Primitives sub-category that represents the fixture's globe. Click and drag anywhere on the screen to size a sphere of approximately **1'0"** in radius. Immediately move to the *Modify* tab and assign the following parameters. Notice the effects that each of them has on the model, specifically the Hemisphere and Smooth values.



*The **Squash** option here generates more faces but creates a smoother appearance at the top of the sphere. Since the globe is often where viewer's attention will be focused when looking at the light pole, you should make it look as good as possible while keeping the polygon count low.*

6. Rename the hemisphere **LP Fixture Globe**.

7. Click 

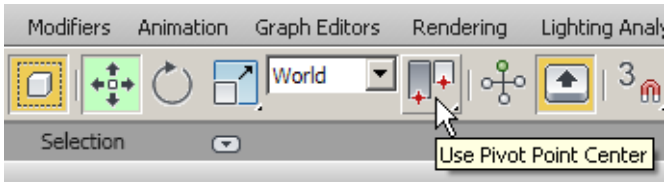
>Save As and click  to automatically save your work incrementally.

Task 4 – Use Transforms to Position Objects

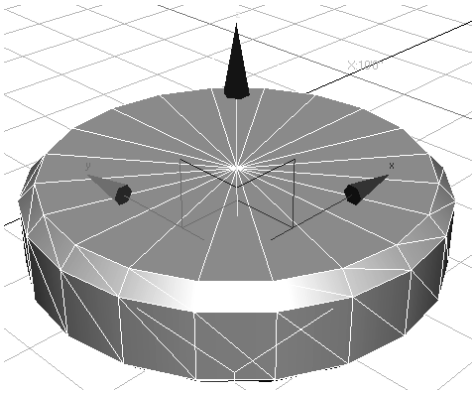
To complete this practice you will rotate and move the light pole fixture housing and globe into position.

1. Select the LP Fixture Housing (the chamfered cylinder) and click  (Select and Move) in the Main toolbar.

2. Make sure that the Reference Coordinate System is set to **World** and the Selection Center is set to  (Use Pivot Point Center).



3. The Move Transform Gizmo appears over the object. Move the fixture housing by clicking and dragging on the gizmo's axis handles and plane handles, noting how each constrains the movement to a certain axis or plane. The gizmo appears at the object's pivot point—by default the center of a primitive's base.



4. To position the object precisely use the Transform Type-In controls. Locate this area in the Status Bar at the bottom of your screen.

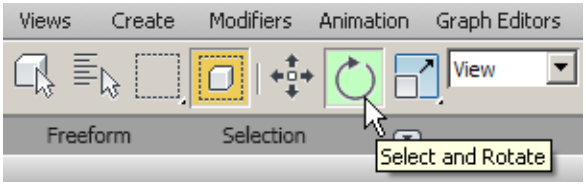
5. Make sure that your *Transform Type-In* area is in **Absolute Mode**, as denoted by the  button. The alternative is **Offset Mode** (shown as ), which is activated by clicking  a second time.

In this example the values you enter will become the new XYZ coordinates for the object. If you were in Offset Mode the values entered would instead be added to the current coordinates. (Offset Mode is useful if you want to move an object a certain distance but are not sure what the resulting coordinates will be.)

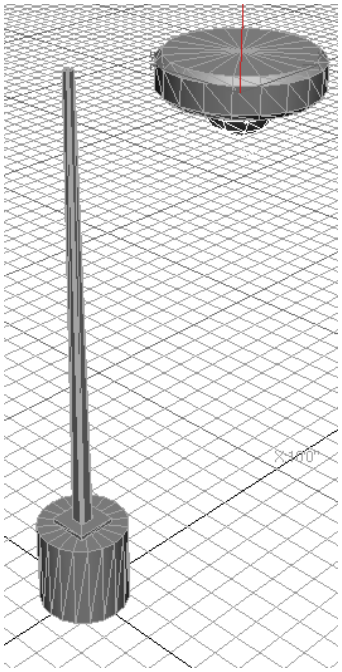
6. Change the *X-coordinate* to **0'0"**, the *Y-coordinate* to **-6'0"**, and the *Z-coordinate* to **19'0"**.

7. While still in the **Move Transform (Absolute Mode)**, select the globe object and enter the same coordinates. The globe appears inside the fixture after this move.

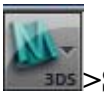
8. With the globe still highlighted switch to the **Rotate** Transform.



9. The *Transform Type-In* field now shows the current rotations about the X-, Y-, and Z-axes to be 0s. Enter a value of **180** for the *X-Rotation* and notice the position of the globe change. The object should look as shown below. (You add an arm to connect the fixture to the pole later.)



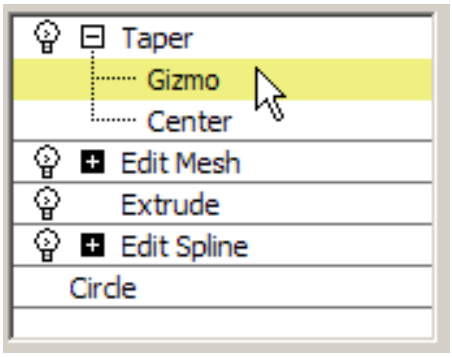
10. Click **Select Object** to end Rotate Transform mode (as a precaution to avoid rotating objects accidentally while making selections).

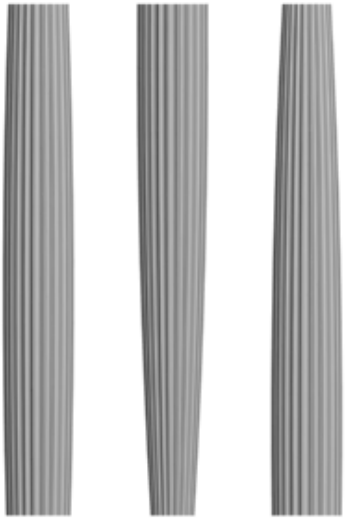
11. Click  **>Save As** and click  to automatically save your work incrementally as **MyLightPole04.max**.

Sub-Object Mode

Many of the objects and modifiers in Autodesk 3ds Max Design contain sub-objects, or sub-components that can be independently adjusted through transforms and special modifier controls.

These sub-objects are adjusted through a special Autodesk 3ds Max Design state called Sub-object Mode. For example, the Taper modifier in the column shown below has Gizmo and Center sub-objects that can be adjusted to position the Taper.





Working in Sub-Object Mode

Sub-object mode is activated through the Modifier Stack by expanding the "+" sign next to the name of an object or modifier that has sub-objects, then left-clicking at the level of the sub-object to be adjusted.

- You normally can have only a single object selected to enter sub-object mode.
- When Sub-object mode is active, the sub-object level (or the modifier name if the sub-object list has not been expanded) is highlighted in yellow (with the default user interface settings).
- Normally you are not allowed to clear the currently selected object while in Sub-object mode. Therefore, to edit another object you must first exit Sub-object mode. To do so, select the level of the Modifier Stack presently highlighted in yellow, or select the name of the modifier where you are in Sub-object mode.

- If you see your Modifier Stack highlighted in yellow accidentally, (where you did not intend to be in Sub-object mode) simply select the yellow highlighted item to exit the mode.

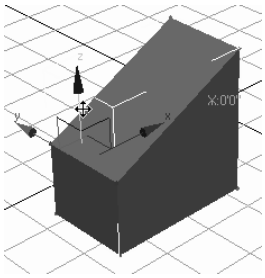
Geometric Edits through Sub-objects

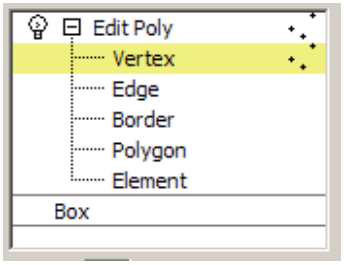
A whole range of explicit geometric changes can be made through Sub-object mode.

- Objects imported into Autodesk 3ds Max Design often take the shape of Editable Splines or Editable Meshes. These have built-in sub-object controls that can be edited directly. For example, a group of vertices in an Editable Mesh could be selected and moved, or deleted separate from the rest of the geometry.

- Many Autodesk 3ds Max Design objects can also have these controls applied to them through an Edit Spline modifier (for 2D objects) or an Edit Mesh or Edit Poly modifier (for 3D objects). This includes geometry linked to AutoCAD drawings that list only as *Linked Geometry* in the *Modify* tab.

- The illustration below shows a Box primitive that is being edited geometrically by lowering two of its vertices with the Move transform.





- The Edit Mesh modifier is best for objects based on a triangular mesh, such as triangulated terrain models. The Edit Poly modifier is best for objects with faces of more than three vertices, such as rectangular objects.

- In general it is best to adjust objects through their core parameters (such as the length, width, and height of a Box primitive) and standard modifiers whenever possible. This makes it easier to review the changes and adjust them. For cases where this is not possible, Spline, Mesh, and Poly editing can be an effective alternative.

Geometric Sub-Objects

The Editable Spline, Editable Mesh, and Editable Poly objects (as well as any other object with an Edit Spline, Edit Mesh, or Edit Poly Modifier applied to it) share a number of common Sub-object modes, summarized briefly below.

Vertex: The individual 3D points that define an object (Edit Spline, Edit Mesh, or Edit Poly).

Segment: A single line or curve segment of an Editable Spline.

Spline: A series of one or more connected Editable Spline segments. Segments are considered connected if they share a common vertex.

Edge: The linear segments connecting vertices with Edit Mesh or Edit Poly. Three edges are shown in the button.

Face: The triangular surface area defined by three edges (Edit Mesh only).

Border: A series of edges that define an opening in an Editable Poly (only).

Polygon: Enables you to work with coplanar faces (Edit Mesh) or a defined polygon (Edit Poly).

Element: Enables you to work with all the faces or polygons that form a contiguous whole (Edit Mesh or Edit Poly).

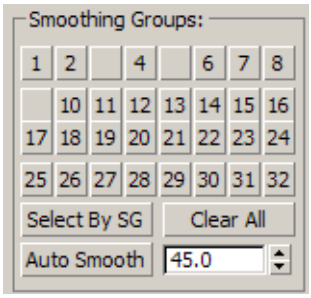
Smoothing

One of the most important properties controlled at the face or polygon sub-object level is smoothing. The graphic below shows the same geometry with and without smoothing applied.

- Autodesk 3ds Max Design can have two adjacent faces appear to be smooth or faceted. This distinction becomes very important when dealing with curved or gently undulating objects. When smoothed, faces appear smooth but Autodesk 3ds Max Design does not adjust the actual geometry.

- Smoothing is controlled by smoothing groups. Each face or polygon can be a member of up to 32 smoothing groups. If two adjacent faces share a smoothing group in common then Autodesk 3ds Max Design attempts to blend the surfaces together to disguise the edge the separates them.

- As an example of the controls for smoothing groups (in Edit Mesh and Edit Poly), the graphic below indicates that all of the selected faces fall into smoothing group 2, and some individually also fall into groups 3, 4, and 5. When some but not all selected faces fall into a particular smoothing group, that group's box is shown without a number.



As an alternative to manually assigning smoothing groups there is an Auto Smooth feature. This feature automatically places adjacent selected faces into smoothing groups if their normal vectors have an angle of separation equal to or less than the Auto Smooth angle. (Normals are formally described in the rendering material).

Note: You can also use the new Graphite Tools introduced in 2010 to perform Modeling with Edit Poly techniques. In this exercise, you will not be using the Graphite Tools so that you can learn the original methods first.

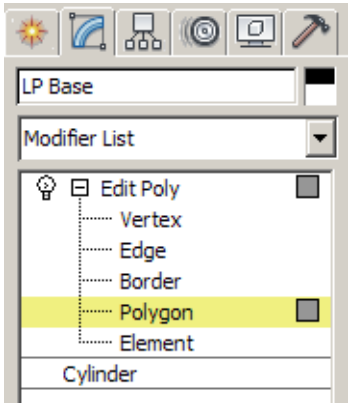
Practice - Modeling with Edit Poly in Sub-Object Mode

In this practice you will add some detail to the concrete base of the light pole by chamfering (beveling) the outside top of the cylinder. Estimated time for completion: 10 minutes.

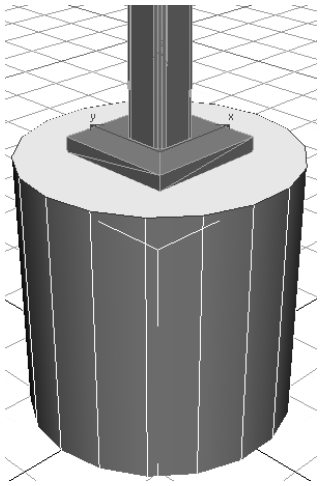
1. Continue with the file created in the previous practice (**MyLightPole04.max**) or open **Modeling with Edit Poly in Sub-Object Mode.max**.

2. Select the LP Base object and click (Zoom Extents Selected).

3. In the *Modify* tab add an **Edit Poly** modifier. Select the "+" next to **Edit Poly** and select **Polygon** to activate Sub-object mode at the Polygon level. The yellow highlighting in the Modifier Stack indicates that you are now in Sub-object mode.



4. Select the polygon at the top of the cylinder, as shown below.

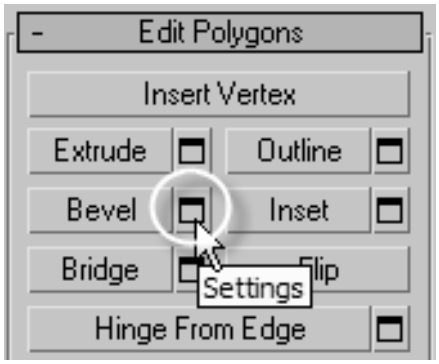


Creating a 1" bevel will raise the cylinder top by 1". In preparation you will first lower the top of the cylinder by that same 1".

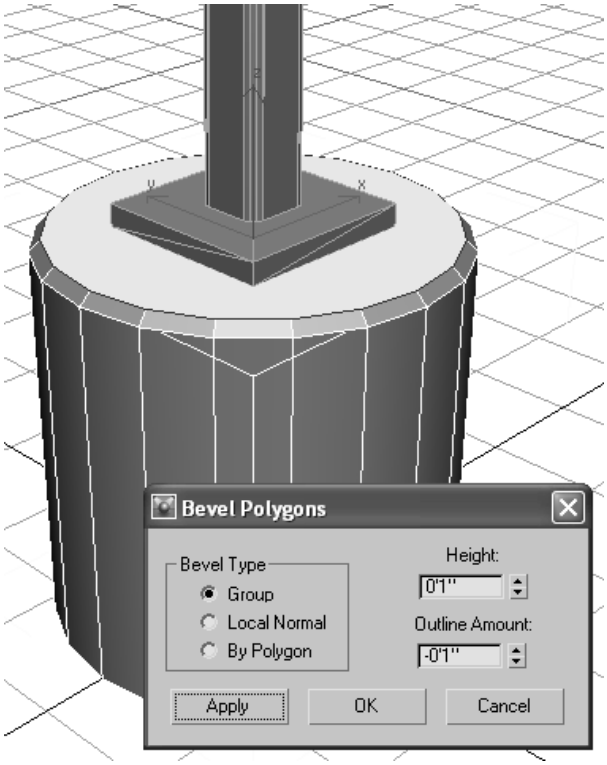
5. Activate (Move Transform) mode.

6. In the *Transform Type-In* area, if necessary click (Absolute Transform) to change into (Offset Transform) mode. Enter a *Relative transform* of **0'-1"** in the Z- field. The cylinder geometry is adjusted.

7. In the Edit Polygons rollout of the Edit Poly modifier, click (Settings) next to **Bevel**.

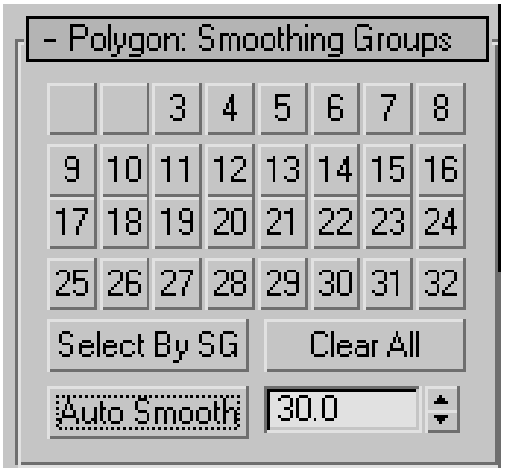


8. In the dialog box enter a *Height* of **0'1"** and an *Outline Amount* of **0'-1"**. Click OK. Do not click Apply and then OK or the bevel is applied twice.

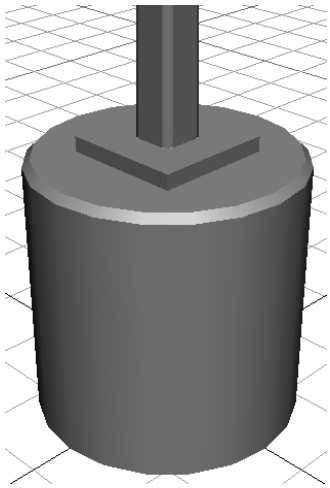


Next, to make the newly created faces appear smooth you will adjust the object's smoothing groups.

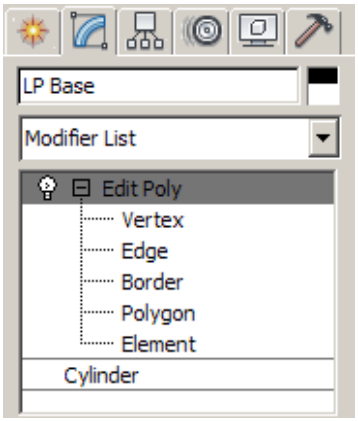
9. While still in Polygon Sub-object mode, select **Edit>Select All** in the pull-down menu. In the Polygon: Smoothing Groups rollout, click Clear All to remove the existing smoothing from the object. Set the *AutoSmooth angle* to **30** and click Auto Smooth.



10. To better see the effect of this change, turn off the **Edged Faces** in the Viewport Shading label and clearing the **Edged Faces** option. The angle of 30 degrees enabled the newly created faces to appear smooth across each other, but those faces are not smoothed with the top or sides of the cylinder. This is the *chamfered* appearance that was originally intended, but a larger smoothing angle (45 degrees) would have enabled the chamfered faces to appear smoothed out between the top and sides as well. (In practice, finding an appropriate Auto Smooth angle might take some trial and error.)



11. To end Sub-object mode, select the name of the Edit Poly modifier (i.e., the words **Edit Poly**).



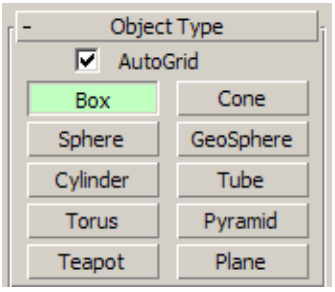
12. In the Main toolbar click  (Select Object) to end Move Transform mode (as a precaution to avoid moving objects accidentally while making selections).

13. Save your work as **MyLightPole05.max** or use  in the Save As dialog box if using the **MyLightPole04.max** file.

Reference Coordinate Systems and Transform Centers

All geometry in Autodesk 3ds Max Design is referenced to a base coordinate system called the Home Grid.

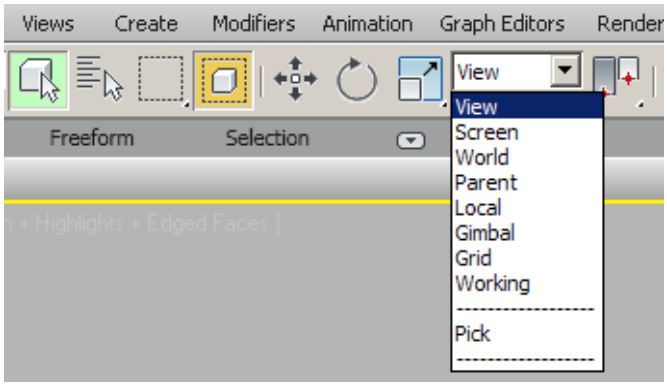
- You can create your own coordinate systems by creating and locating grid objects, available in the Helpers Category in the *Create* tab.
- User Coordinate Systems created in AutoCAD can automatically be brought into Autodesk 3ds Max Design as grid objects.
- You can also create objects in AutoGrid mode, which creates a temporary Grid aligned in 3D to the object directly under the crosshairs. The option to enable **AutoGrid** is located in the *Create* tab. (AutoGrid is similar to the Dynamic UCS feature introduced in AutoCAD 2007.) If you hold down <Alt>, the AutoGrid remains available for future use, if you use AutoGrid without any key pressed, the grid disappears after object creation.



Reference Coordinate Systems

Although a single grid is active at any one time, the current Reference Coordinate System might differ depending on which view you are in and which transform is active. It is recommended that new users stay in the **World** system as much as possible to avoid confusion from changing axis labels. The Default Reference Coordinate system is set to **View**.

- The current Reference Coordinate System, listed in the pull-down menu in the Main toolbar, controls how transform values are read.



- In the **World** coordinate system the X-, Y-, and Z-axes are interpreted based on the Home Grid, even if a user-defined grid is active. To use the coordinates of the active user-defined grid instead, select the **Grid** option in the pull-down menu.

- In the **Screen** coordinate system the X-axis is always measured along the bottom of the screen, the Y-axis is always measured along the side, and the Z-axis is measured perpendicularly out of the screen. For example, in a front view using the Screen reference system the Y-axis is measured "up" the screen. That same view in the World system would measure Z "up" the screen instead.

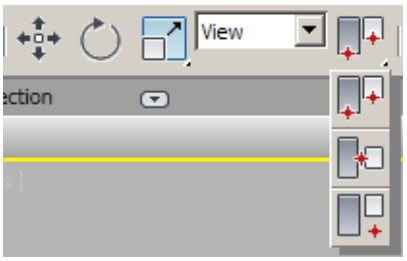
- The **View** system is a combination of World and Screen. In an orthographic view the Screen system is used, while other views use the World system.

- The **Pick** option enables you to pick any object in the viewport or from a list and use the reference coordinate system of that object as the reference for transforms. You can use XRef objects with the **Pick** option.

- The **Working** option enables you to use the Working Pivot. It is a temporary modeling pivot tool you create from the Hierarchy panel's *Pivot* tab. Generally you need to assign a hotkey to **Use Working Pivot** and **Edit Working Pivot** to make them functional tools.

Transform Centers

Transforms are applied through a Transform Center point indicated by the Transform Gizmo. There are three options available for the Transform Center. They are listed in the pull-down menu in the Main toolbar.

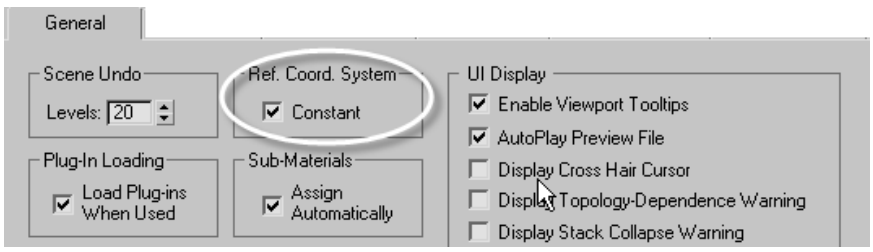


Pivot Point Center: Transforms are applied through each selected object's pivot point. Pivots often default to the bottom center or geometric center of objects. Pivot points can be adjusted through controls in the *Hierarchy* tab. Select this option if you want to rotate many objects, each around its own center.

Selection Center: Transforms are applied through the geometric center of all selected objects.

Transform Coordinate Center: Transforms are applied through the origin point of the current Reference Coordinate System. For example, if you wanted to rotate objects around their individual pivot points about the World Z-axis, you would select the World Coordinate System and Pivot Point Transform Center. Alternatively, to rotate all of the objects around the origin, you would do the same with the Transform Coordinate Center.

- The Transform Center might automatically change depending on if one or multiple objects are selected, and which transform is active.
- The Reference Coordinate System and Transform Center can be held using the **Constant** option in **Customize>Preferences**.



Practice - Modeling with Coordinate Systems

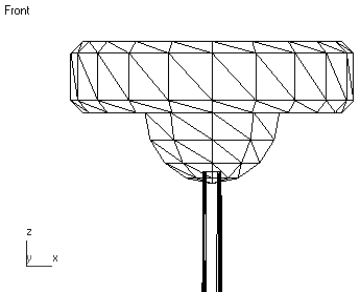
For the next step in the Light Pole model you will add the Light Pole Mounting Arm. Estimated time for completion: 10 minutes.

1. Open **Modeling with Coordinate Systems.max**.

2. Use the **Maximize Viewport** toggle  to display multiple viewports.

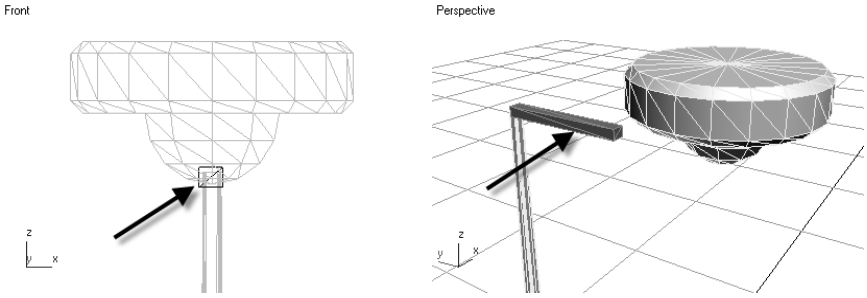
3. If the Front viewport is unavailable, right-click on the Point of View label in one of the viewports and change it into a Front view using the sub-menu.

4. **Zoom Extents** in the Front viewport, and then **Zoom** to get a closer look at the chamfer-cylinder fixture housing, as shown below in a wireframe view.

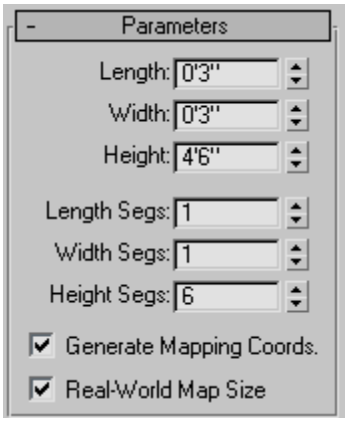


5. In the *Create* tab, create a **Box** from the **Standard Primitives** pull-down menu. Center the box on the top of the light pole. Roughly size it to **3" x 3"** with a height of **4'6"**.

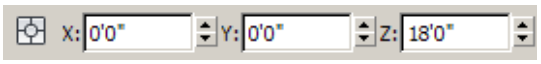
6. Since you created the box in the Front viewport (rather than the Perspective viewport) the height of the box is measured perpendicular to the view—in this case along the world Y-axis.



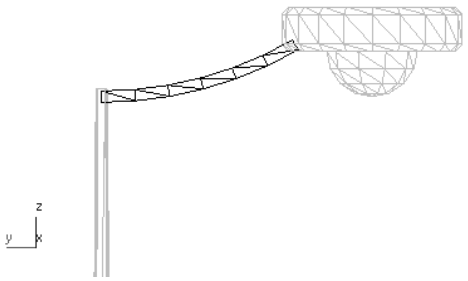
7. In the *Modify* tab set the box's name to **LP Mounting Arm**. Set the parameters as shown below.



8. In Move Transform mode, set the location of the mounting arm as shown below. In this case the transform should be set to (Absolute mode).



9. Apply a **Bend** modifier to the mounting arm to curve the arm to the housing. Use a *Bend Angle* of **30** degrees and a *Direction* of **-90** degrees, and notice the effect of each. Notice also the effect of changing the number of Height Segments of the original Box object. (The illustration below shows the results of the bend in a left viewport.)

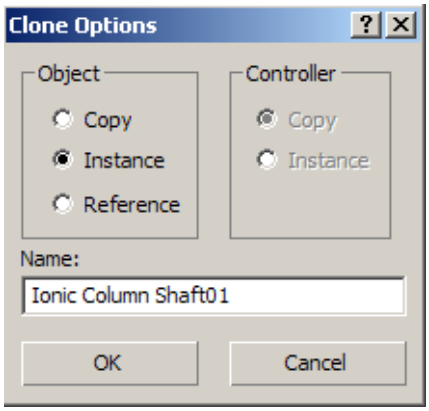


10. Save your work as **MyLightPole06.max** or use + in the Save As dialog box if using the **MyLightPole05.max** file.

Cloning and Grouping

Cloning

In Autodesk 3ds Max Design objects can be duplicated with the **Clone** option (**Edit>Clone**). When cloning you have the option of enabling the duplicate object to maintain a dynamic link to the source object.

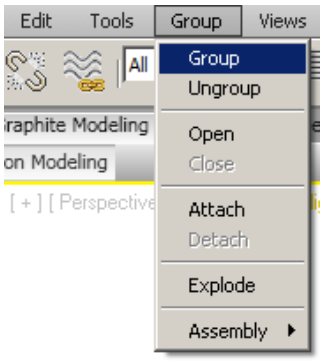


Copy	Makes an independent copy without a dynamic link to the source object.
Instance	Makes the duplicate and original Instances of each other. Changes made to any Instance automatically update all Instances, including changes to Modifiers, property changes, and material assignments (but not Transforms).
Reference	A one-directional link where changes made to the original object affect the duplicate, but you can apply Modifiers to the Reference without affecting the Source object.

- You can also clone an object by holding down <Shift> while transforming through a click and drag on the Transform Gizmo. In this procedure you also have the option of specifying the number of copies you want to make, which are arrayed at the same Transform value.
- The Controller Group in the Clone Options dialog box applies to objects in a group or hierarchy and refers to transform controllers. For now leave this choice set to **Copy**.
- Objects that are instanced or referenced appear with the Modifier Stack text **in bold type**. Instancing or referencing can be disabled by right-clicking the item in the Modifier Stack and selecting **Make Unique**.

Grouping

Grouping enables multiple objects to be treated as a single unit for selection and transforms. The Group options are available in the **Group** pull-down menu.



Group	Creates a group out of all the currently selected objects. Groups can have other groups inside them (nested groups).
Ungroup	Dissolves any selected groups back into their constituent objects. Explode dissolves the selected groups and any groups nested inside.
Open/Close	Enables you to select, modify, and transform individual group members as if they were not in a group. The group is still defined; however, it can be Closed to treat the objects as a single unit again.
Attach	Enables you to add another object to a group. First select the objects to be attached then select the **Attach** option in the **Group** menu. When prompted select a closed group to which to add the objects.
Detach	Enables you to remove selected objects from a group. You must first open the group to select the objects to be detached.
Explode	Dissolves the selected groups and any groups nested inside them.
Assembly	Special case object grouping that are intended for creation of lighting assemblies called luminaires, and for character assemblies. Assemblies have a special helper object called a “head” that helps build groups that will be animated.

- Groups appear in the *Modify* tab in the Command Panel with the group name in **bold type**, and a blank Modifier Stack. The Modifier Stack of individual group members can be accessed again if it is opened.

- Groups can be copied, instanced, and referenced. AutoCAD blocks imported into Autodesk 3ds Max Design can be brought in as instanced versions of the same group.

Hint: Avoid the use of Grouping on objects that are linked into a hierarchy and then animated.

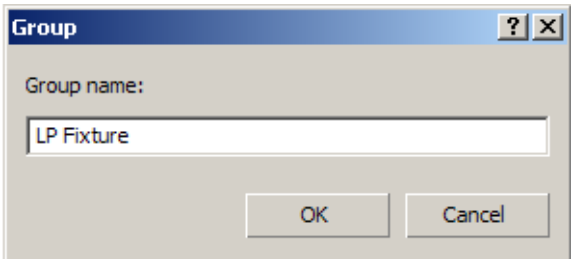
Practice - Cloning and Grouping

*In this practice you will complete the model of the light pole using **Cloning** and **Groups**. Estimated time for completion: 10 minutes.*

1. Continue with the file created in the previous practice or open **Cloning and Grouping.max**.

2. Open the Select From Scene dialog box (or use the keyboard shortcut the <H> key). Ensure that the Display Geometry display filter ( ) is selected. Select **LP Fixture Housing**, **LP Globe**, and **LP Mounting Arm** (hold down <Ctrl> to select multiple items). Click OK to close the dialog box. All three items are now selected in the scene.

3. Select **Group>Group** in the pull-down menu to combine the three objects together into a single, selectable unit. In the dialog box, name the group **LP Fixture**. Click OK.

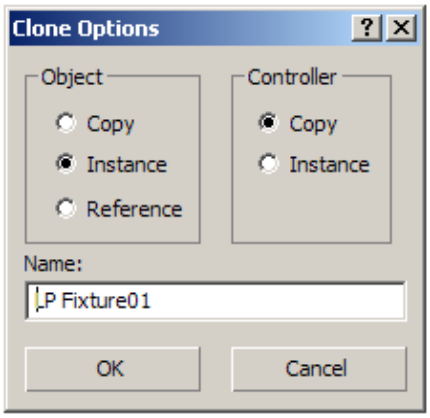


4. Open the Select From Scene dialog box again and review the new LP Fixture group. Ensure that the Display Groups display filter ( ) is selected. The group name is identified with the symbol adjacent to its name in the dialog box showing that it is a group. You can also identify that it is a group in the Type column. Ensure that the group is still selected and close the dialog box.

5. With the LP Fixture still selected, select **Group>Open** in the pull-down menu. The group still remains intact (as indicated by the pink bounding box that remains around the group's items. Once opened you can now select, manipulate, and transform the three component objects separately.

6. With one or more of the group components selected, select **Group>Close**. The pink bounding box identifying the group now displays as white.

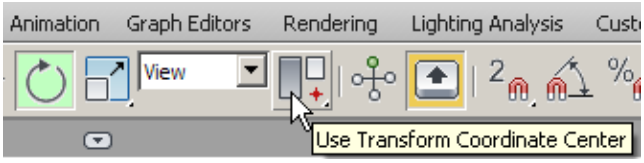
7. With the LP Fixture Group closed and selected, create a second fixture by selecting **Edit>Clone**. In the Clone Options dialog box select **Instance** for the object so that the original group and the copy share identical geometries. Leave the other options at their default values. Click OK.



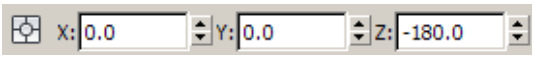
8. The original and the copy now directly overlay each other. In the Select From Scene dialog box, select **LP Fixture01**, if not selected already. You will now rotate the second light fixture to appear directly opposite to the original.

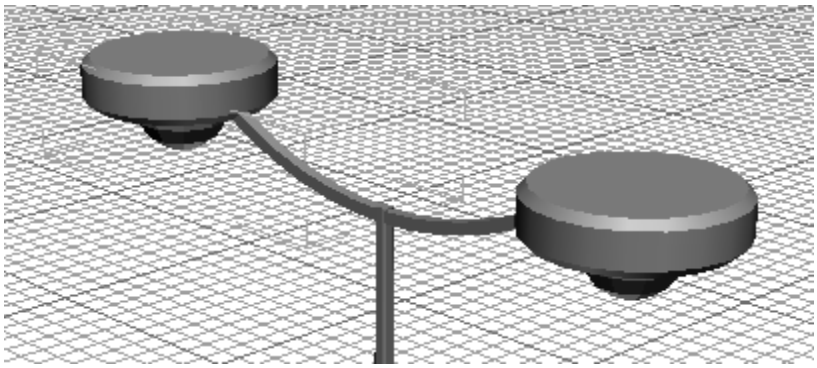
9. Activate the Rotate Transform mode. The position of the Transform Gizmo is at your current Selection Center. If you use  (Pivot Point Center) or  (Selection Center), the rotation does not place LP Fixture01 in the correct position.

10. Switch the Use Center flyout to Transform Coordinate Center mode () to use the coordinate system origin as the center of rotation.



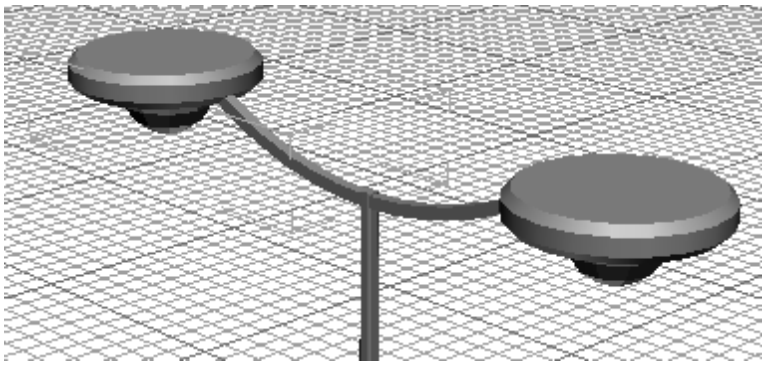
11. Rotate *LP Fixture01* **180°** about the Z-axis using the *Transform Type-In* area. The roundoff error might result in a -180° value. This is a common occurrence and is not necessarily indicative of a problem.





12. Click **Select Object** to end Rotate Transform mode (to avoid rotating objects accidentally while making selections).

13. To prove the groups are instanced, with LP Fixture01 selected, select **Group>Open**. Reduce the LP Fixture Housing01 (chamfered cylinder) from a *1'* to **8"** height. Both Fixture Housings update.



14. Select **Group>Close** to close LP Fixture01.

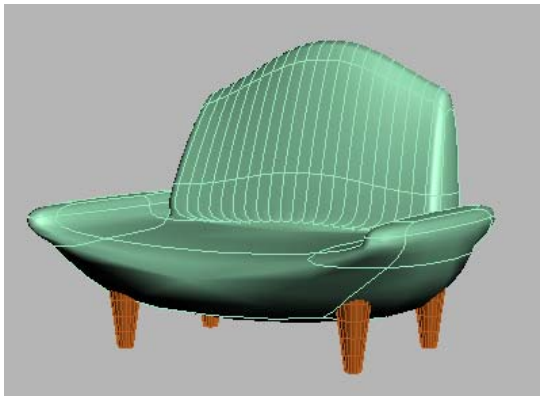
15. Save your work as **MyLightPole07.max** or use + in the Save As dialog box if using the **MyLightPole06.max** file.

Poly Modeling with Graphite Tools

Autodesk 3ds Max Design is a powerful environment for creating 3D models of virtually anything you can imagine. The “box modeling” technique is probably the most popular method of construction. It is also called polygon modeling, or mesh modeling. Essentially it is the interactive creation of vertices, edges, faces and surfaces in a free and artistic way. The term box modeling comes from the common practice of starting by building a box. The original components of the box are manipulated to create the entire model. You could as easily start with a plane, any other 3D primitive, or even begin with a 2D Shape object.

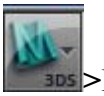
Box modeling can be performed using either the Edit Mesh or Edit Poly modifiers, or be converted to an Editable Mesh or Editable Poly object. Any of these methods give you the access to the sub-object levels needed to do this type of modeling. The Edit Poly modifier is the most recent modeling technology added to Autodesk 3ds Max Design, so it should be the preferred choice in many cases. However, if you find unexpected results using Edit Poly, you can always convert the object to an editable mesh or editable poly object and discard the modifier. You can also use the Edit Mesh modifier; it is the older technology and should be the most stable.

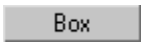
Practice - Box Modeling an Armchair



In this practice you will learn some of the tools and techniques of box modeling using the Edit Poly modifier. Estimated time for completion: 20 minutes.

Task 1 – Model the Armchair

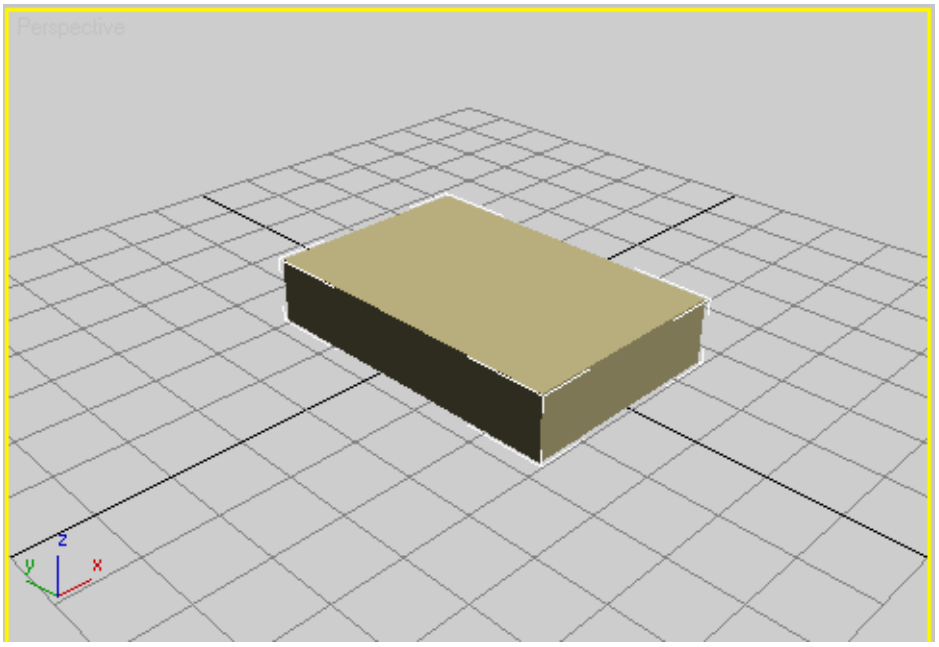
1. Click  **>Reset** to reset Autodesk 3ds Max Design.

2. In the *Create* tab, click 

in the Object Type rollout to activate the Box tool.

3. Click and drag in the Perspective viewport to define the length and width of the rectangle. Click and continue moving the mouse upwards to define the height.

4. In the Modify panel, you can edit the values. Set the *Length* = **50**, *Width* = **33** and *Height* = **10**. It is not important in this practice that you work in real-world units. You can use generic units if the fields read unadorned numbers.



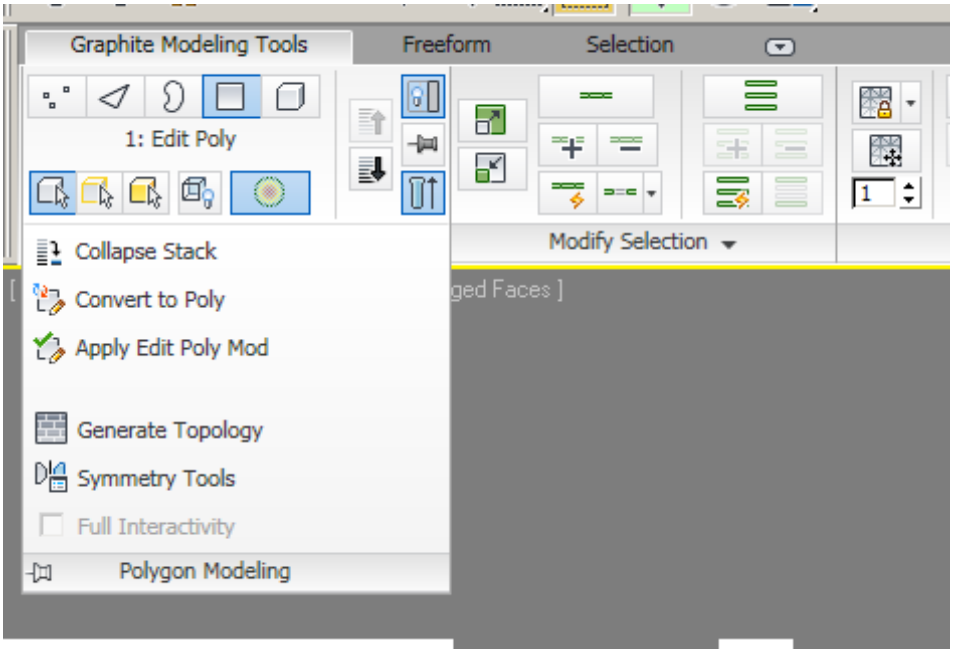
5. In the Name and Color rollout, name the object **armchair**.

6. To better see the edges, change the display mode. Click on the Viewport Shading label and select **Wireframe**.

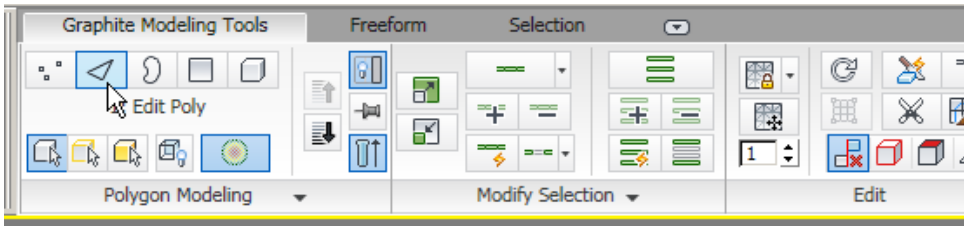
7. Press the <G> key to hide the grid.

8. If the Graphite Modeling Ribbon is only displaying tabs and panels and no commands, click ▾ until all commands are displayed in the panels.

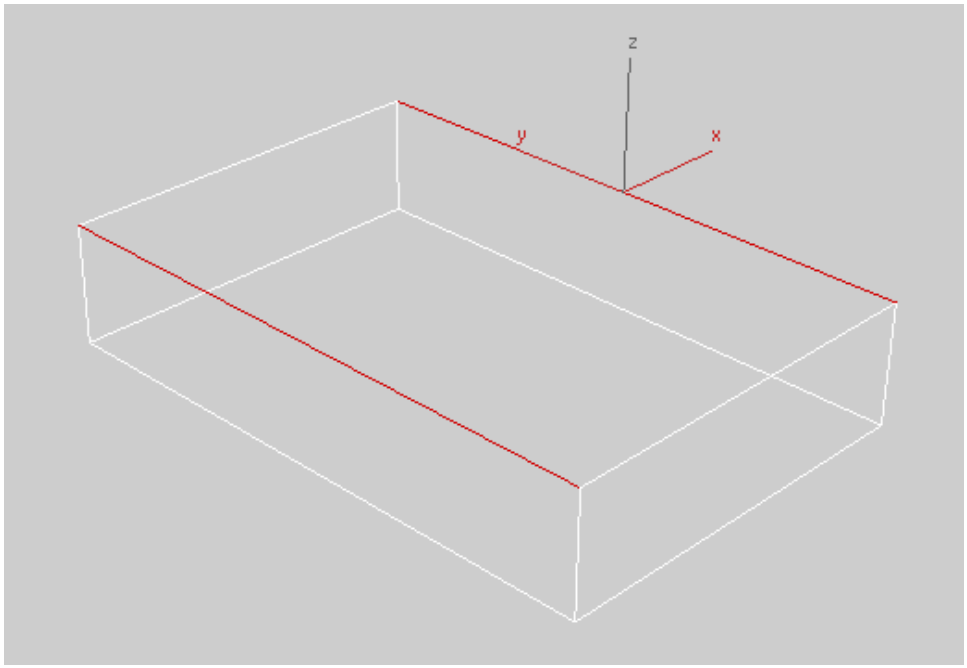
9. Select the *Graphite Modeling Tools* tab if it is not already active. On the Graphite Modeling Tools Ribbon, expand the Polygon Modeling panel and click **Apply Edit Poly Mod**. This adds an Edit Poly modifier to the object.



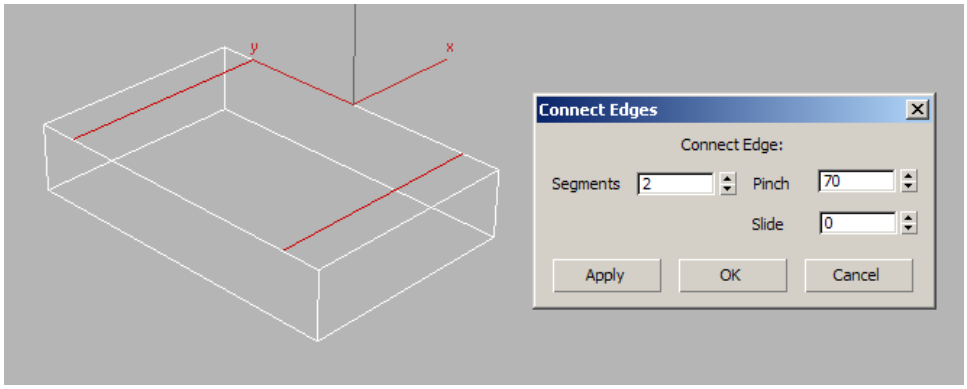
10. Click  (Edge) in the Polygon Modeling panel to activate Edge Selection. Alternatively, you can press <2> on the keyboard.

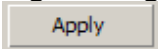


11. Hold down <Ctrl> and select the upper two long edges, as shown below.

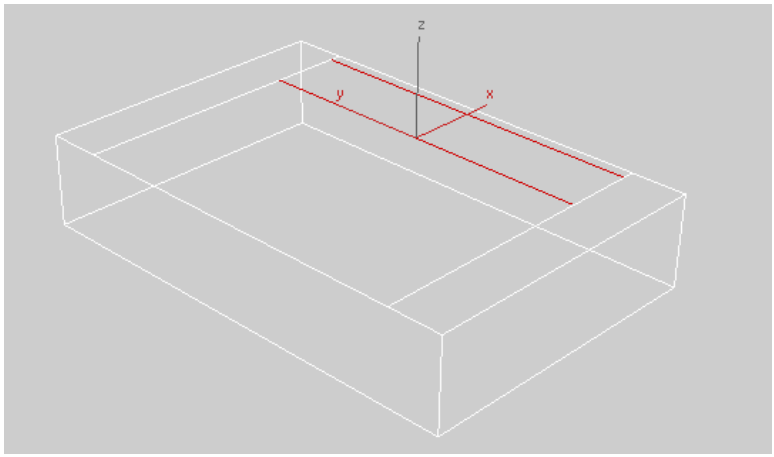


12. In the Loops panel, press and hold <Shift> and click **Connect**  to access the Connect Edges dialog box.

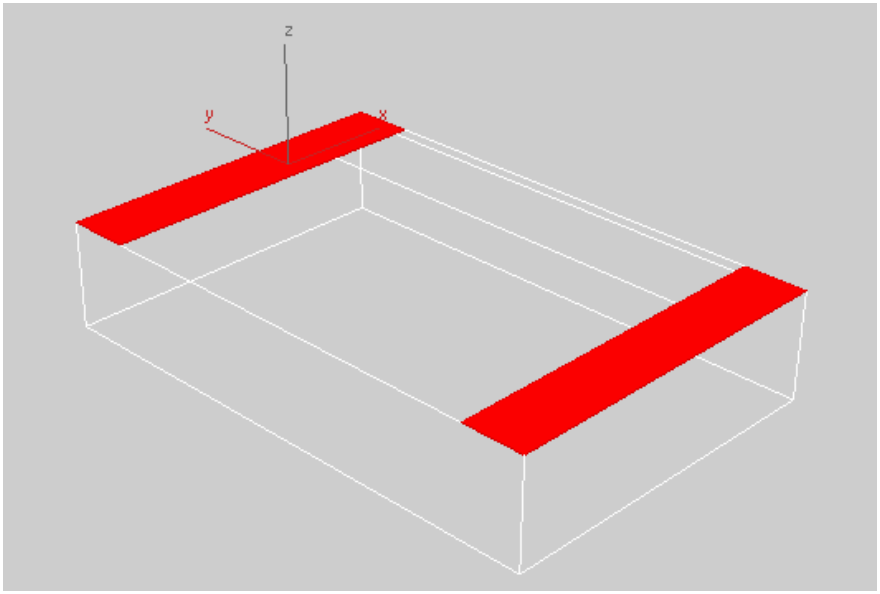


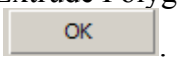
13. In the Connect Edges dialog box change the *Segments* to **2**, the *Pinch* to **70**, and click  . A new set of segments are placed, ready for pinching and sliding.

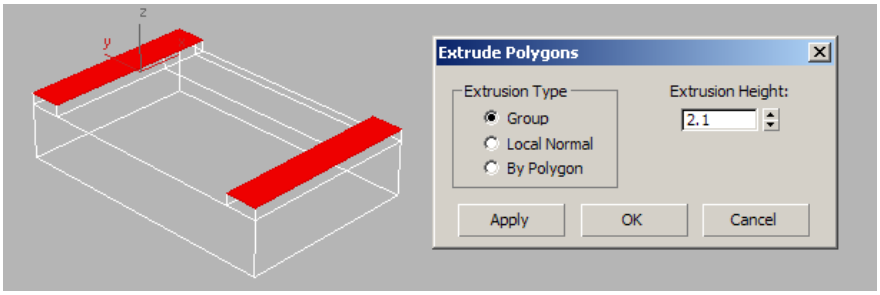
14. Change the *Pinch* and *Slide* values (*Pinch* brings the lines closer to one another and *Slide* moves them in the X-direction) to create a rectangle towards the back of the armchair. Press <Enter> each time you enter a new value to see how it affects the lines. Click OK. You might have to enter both positive and negative values.



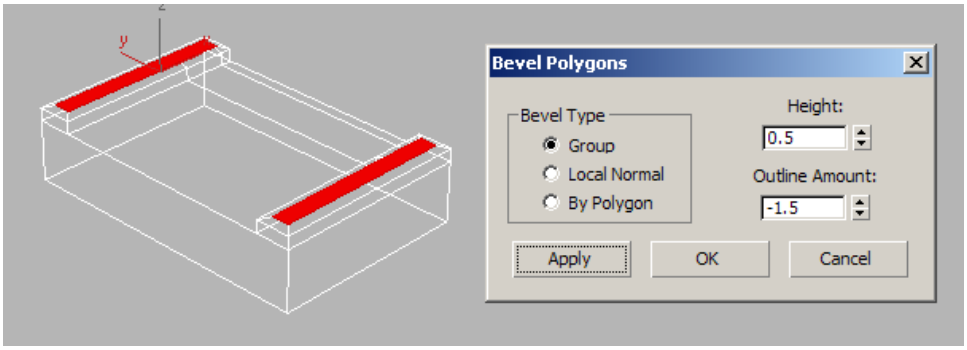
15. Click (Polygon) in the Polygon Modeling panel, or press <4> on the keyboard to change the sub-object selection level from **Edge** to **Polygon**. Right-click and choose **Select** from the quad menu. Hold down <Ctrl> and select the two polygons, as shown below.



16. In the Polygons panel, press and hold <Shift> and click **Extrude**  to access the Extrude Polygons dialog box. Set the *Extrusion Height* to **2.1**, and click  .

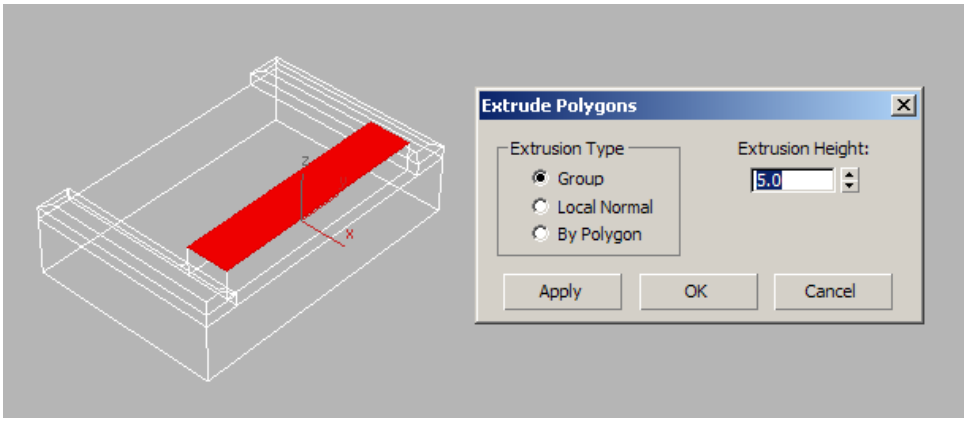


17. In the Polygons panel, press and hold <Shift> and click **Bevel**  to access the Bevel Polygons dialog box. Set the *Height* to **.5** and the *Outline Amount* to **-1.5**, then click  .

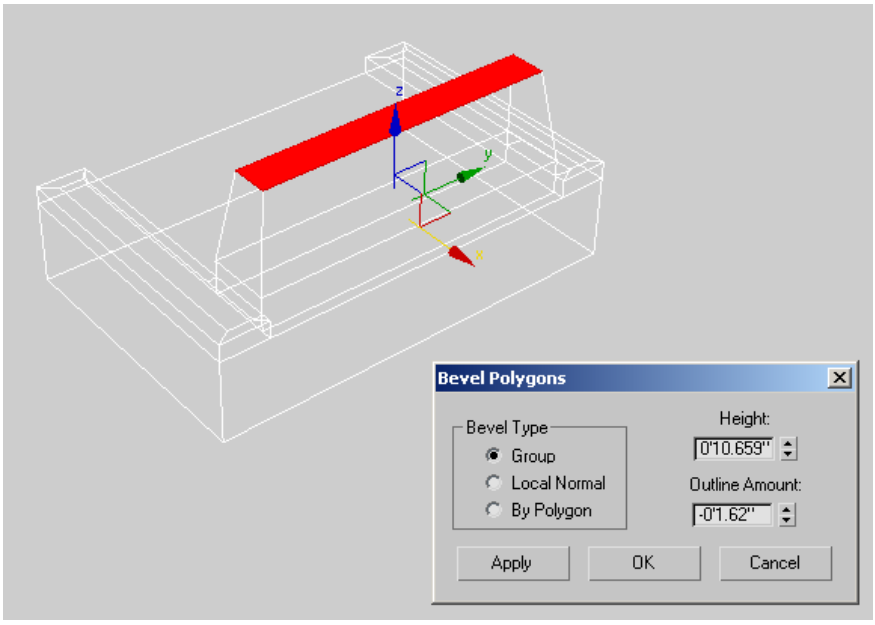


18. Orbit the viewport so that you can see the back of the armchair. The shortcut for Orbit is <Alt>+middle mouse button.

19. Select the long rectangle that will become the back of the chair. In the Polygons panel, press and hold <Shift> and click **Extrude** to access the Extrude Polygons dialog box. Extrude the back of the armchair to **5** units and click OK.



20. In the Polygons panel, press and hold <Shift> and click (Bevel) to access the Bevel Polygons dialog box. Bevel up the back of the chair. Be careful not to bevel so much that the edges overlap.

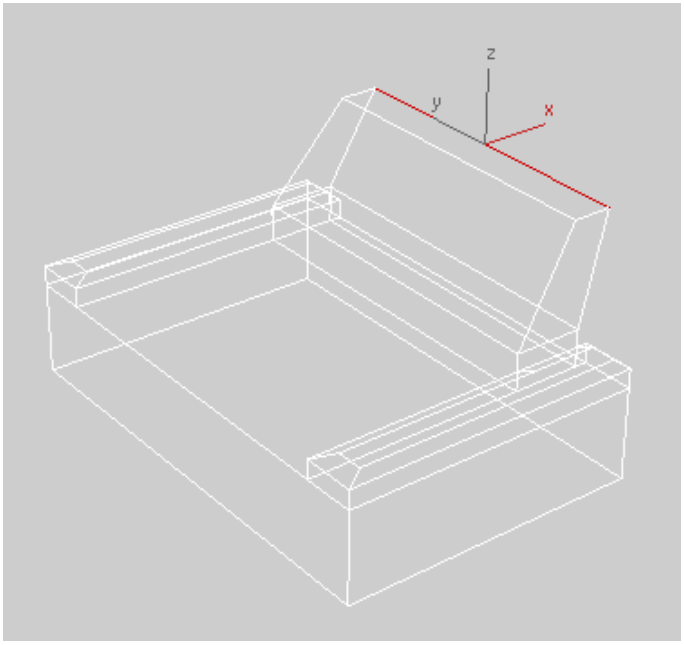


21. Move the selected polygons backwards along the X-axis. Orbit the viewport to view the design.

22. Press <2> on the keyboard to change to the **Edge Selection** level. As an alternative, click (Edge) in the Polygon Modeling panel.

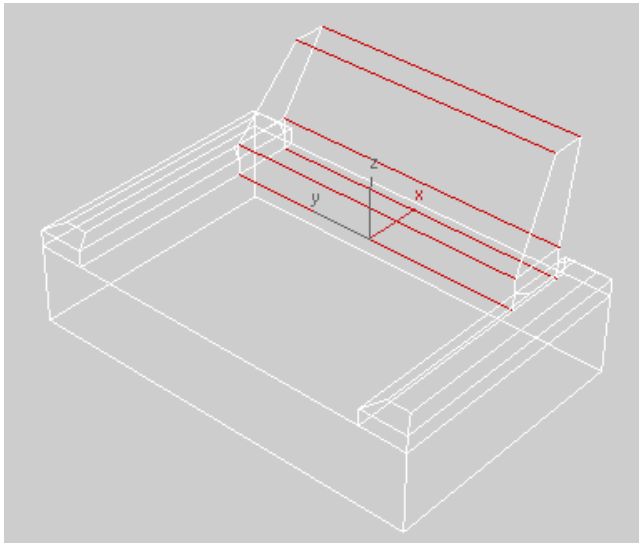
23. In the Modify Selection panel, click (Ring Mode). This enables Ring Mode to select a ring of edges when a single edge is selected.

24. Right-click and choose **Select** from the quad menu (if not already active) and select one of the long edges at the top of the chair.

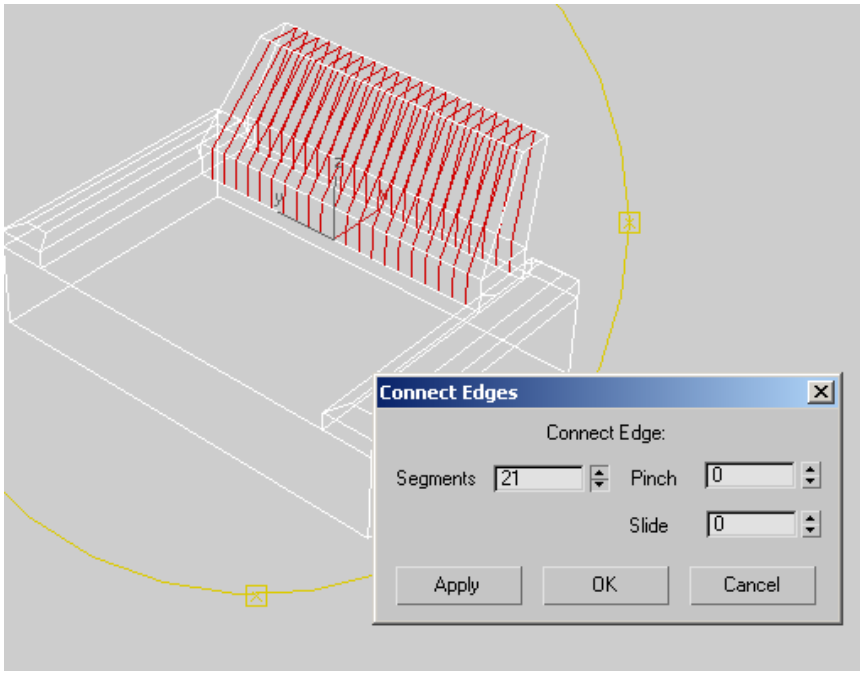


25. In the Modify Selection panel, click (Ring Mode) again to disable it.

26. Hold down the <Alt> key and clear the selection of one edge in front and one edge in the back, so that you have only six edges selected, as shown below.



27. In the Loops panel, press and hold <Shift> and click  (Connect) In the Connect Edges dialog box, reset the *Pinch* and *Slide* to **0**, and set the segments to **21**. Click Apply.

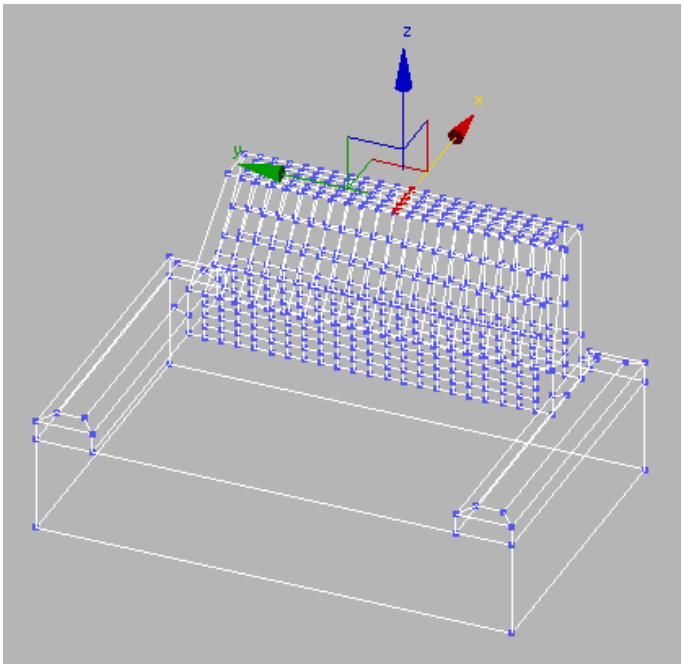


28. Change the *Segments* to **3** and click Apply again. This adds lots of segments to the armchair back. Next, you will use Soft Selection to sculpt an organic curve to the back of the chair. Note that many tools can be used in Graphite Modeling for doing this kind of modeling, but you will first learn the original method for doing Soft Selection via the Command Panel.

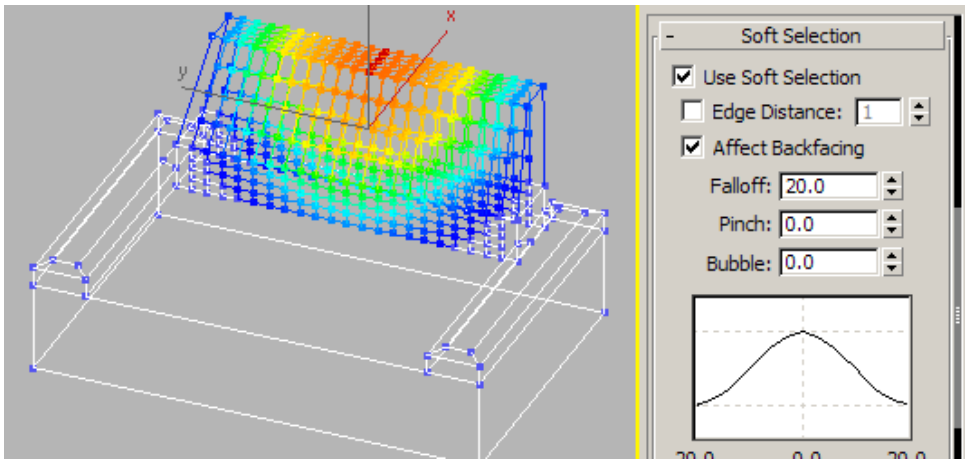
29. Change to a Left Viewport by clicking the POV Viewport label and choosing **Left**, or by pressing <L> on the keyboard.

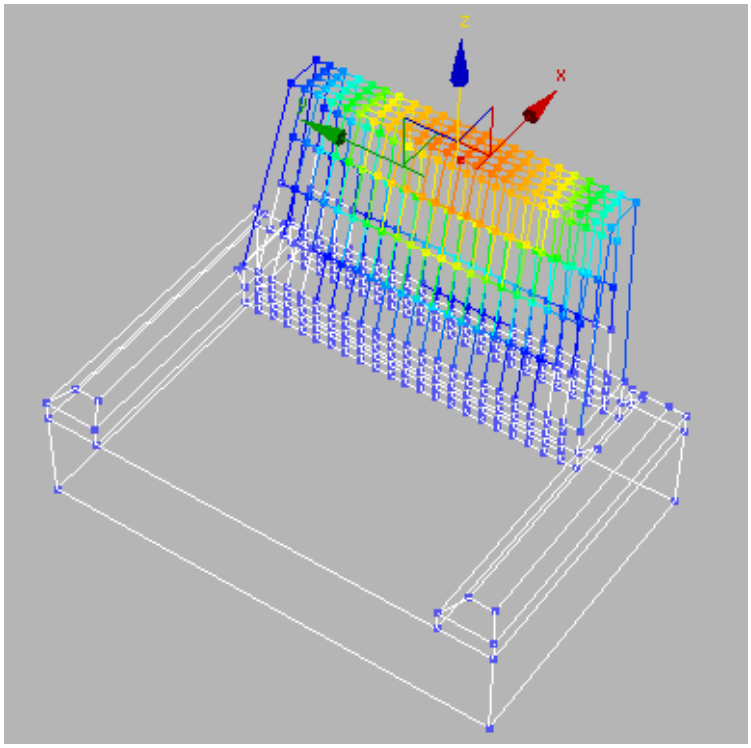
30. Click (Vertex) in the Polygon Modeling panel to switch to Vertex selection mode. Drag a selection rectangle around the row of vertices at the top middle edge of the chair. Make sure you have (Select and Move) selected on the Main toolbar, so that you can see the transform gizmo. Switch back to Perspective view to see that you have selected the correct row of vertices.

Hint: You can change the size of the transform gizmo by using the + and – keys (also – and =).

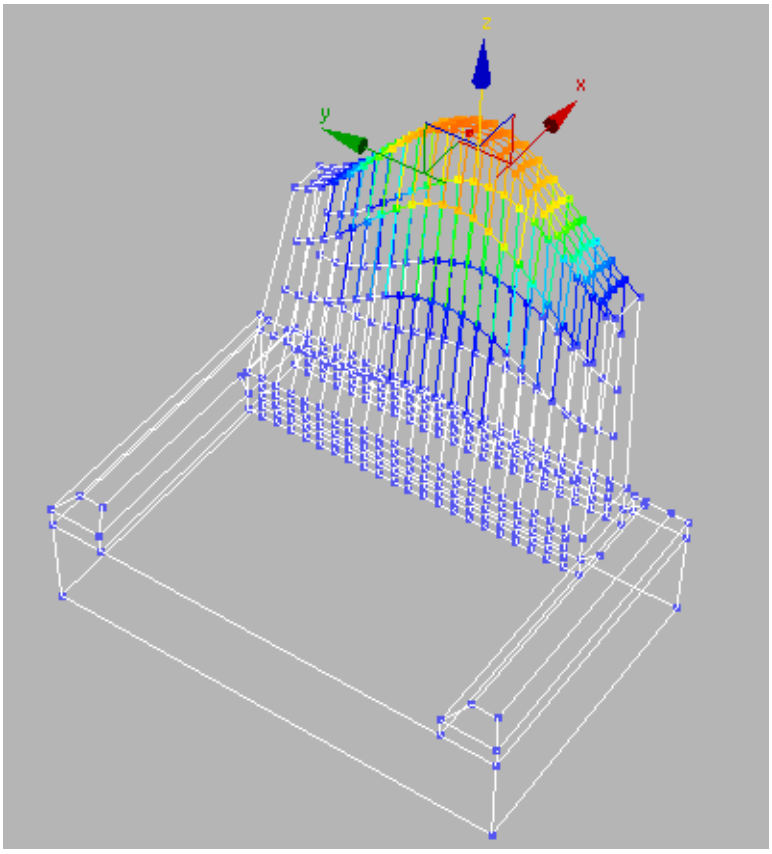


31. On the  (Modify) panel, expand the Soft Selection rollout. Enable **Use Soft Selection** and adjust the *Falloff*. A rainbow color display indicates which vertices will be moved (Red/Yellow/Orange/Green) and which are unaffected (Blue). Using soft selection, you ensure that all vertices are affected. The resulting model might differ from the screenshot shown below, based on the values and vertex you selected.





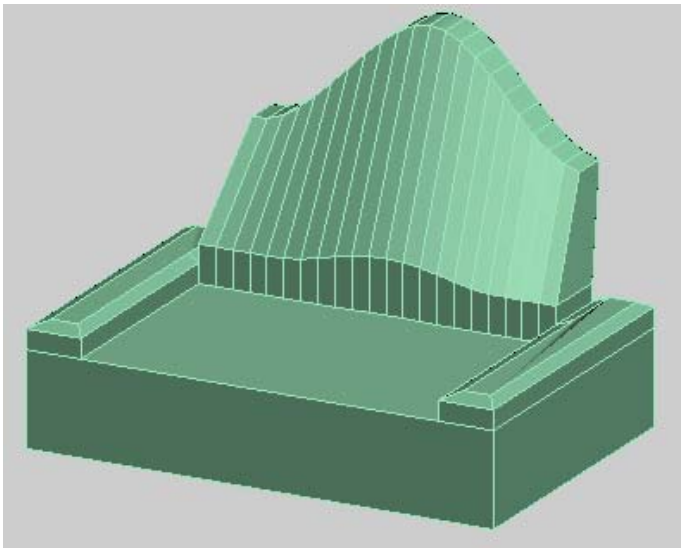
32. Move the selected vertex up in the Z-axis to create the curved chair back.



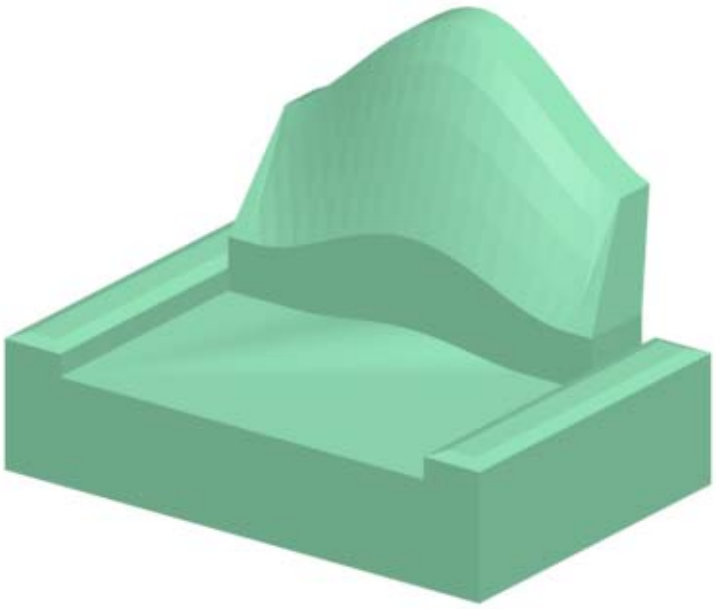
Note: New to Autodesk 3ds Max Design 2009, you can assign a hotkey to interactively adjust the Soft selection falloff and pinch in the viewport. To do this, assign a hotkey to ***Edit Soft Selection Mode****. For the exact procedure see: To edit a soft selection in the Viewport in the Autodesk 3ds Max Help).*

33. Click at the top of the Modifier Stack to turn off sub-object Selection. The Edit Poly modifier turns gray in the stack and the yellow disappears.

34. Press <F3> to toggle from Wireframe to Shaded mode and <F4> to turn on Edged Face Mode. Alternatively, you can click the Viewport Shading menu and select **Smooth and Highlight** and then **Edged Faces**. Your model appear similar to what is shown below.

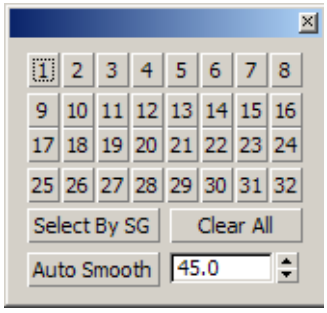


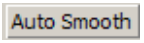
35. Select **Rendering>Environment** and change the Background color to white. Render the scene  (<F9>key). Your rendering should appear similar to what is shown below.



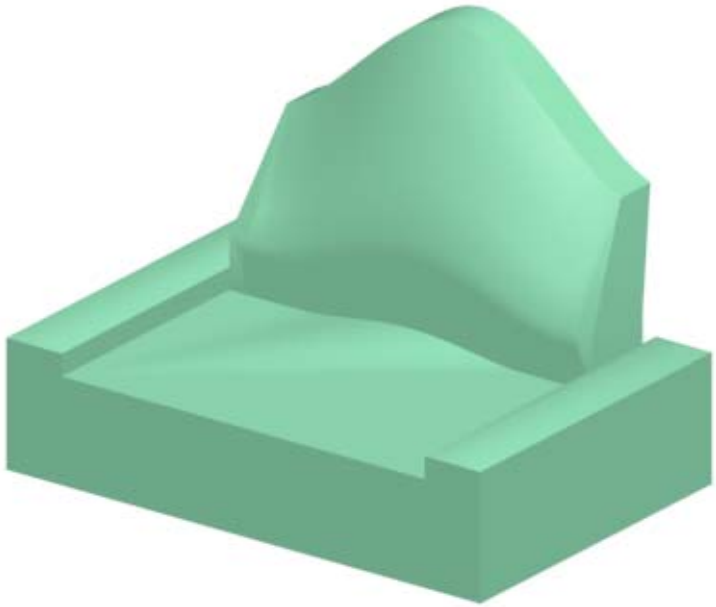
36. You will see there are some problems with smoothing. The chair looks extremely faceted. To fix this, go to the Polygon level by pressing “4” on the keyboard.

37. Expand the Properties panel and click  (SmGroups) to display a Smoothing Groups floater.



38. Press <Ctrl>+<A> to select all the polygons, then click  in the floater. Click in open space in the viewport to deselect all. You will notice a subtle change in the viewport display, the edge is softened in the upright chair back.

39. Render the scene  (<F9>key) again. The rendering shows the smoothing problem has been fixed.

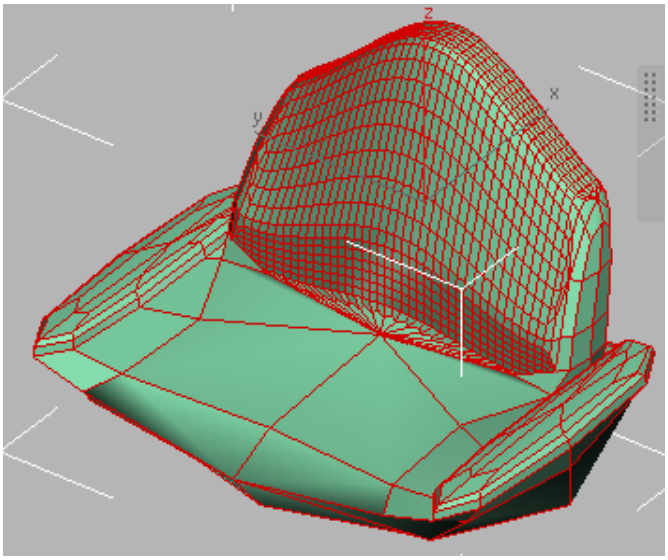


Task 2 – Apply Geometric Smoothing

You just applied a Smoothing Group to create edge smoothing in the rendering. You can also add Geometry Smoothing through an MSmooth operation.

1. Select all the polygons by pressing <Ctrl>+<A>. If they are all bright red, press <F2> to only display the selected faces in red outline.

2. In the SubDivision panel, press and hold <Shift> and click  (Mesh Smooth). Click Apply. Msmooth changes the geometry by adding density to the mesh. Notice the mesh is very dense in some parts and not dense enough in others.

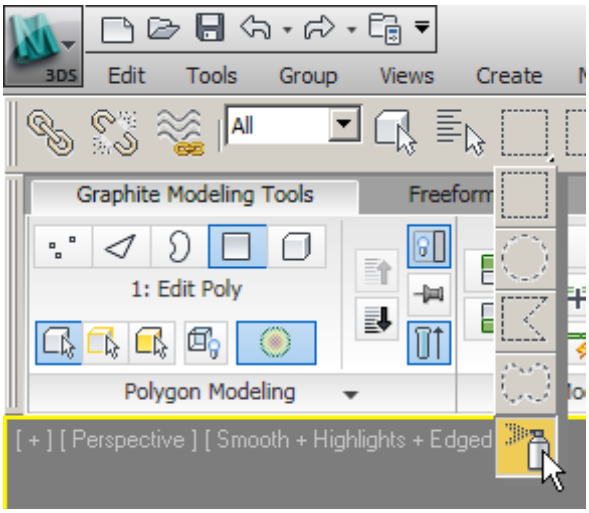


Task 3 – Subdivide the Seat

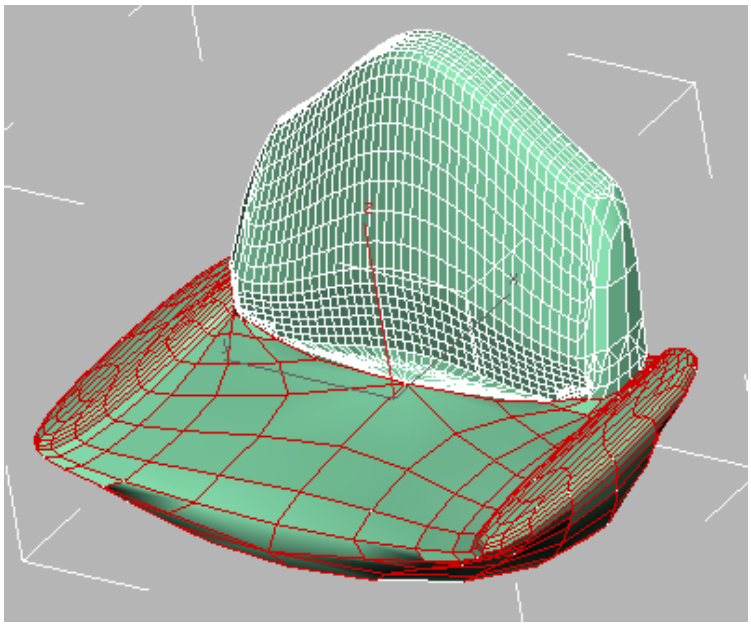
The back is dense, but the seat is not. You need to select all the polygons that need subdivision and then add a Subdivide modifier to them.

1. Ensure that the Polygon level is still active and press <Ctrl>+<A> to select all the polygons.

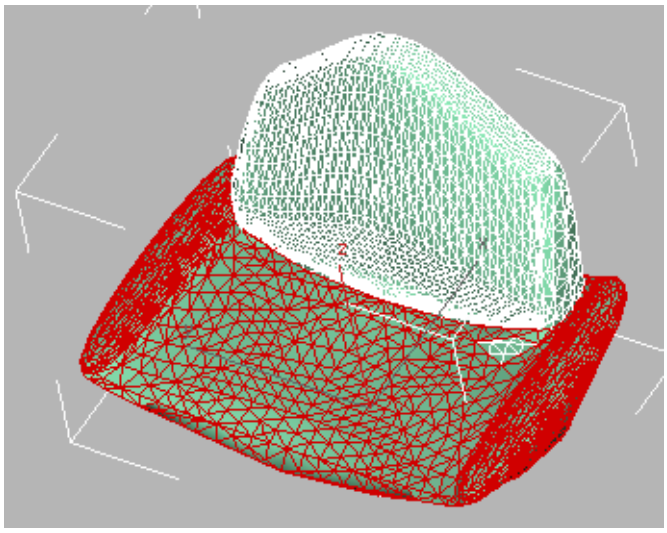
2. Expand  (Rectangular Selection Region) on the Main toolbar and click  (Paint Selection) from the Selection flyout.



3. In the Perspective Viewport, hold down the Alt key and paint to remove the dense polygons from the selection set. Leave only the polygons that need subdivision added. Take your time, orbit to a different location and continue. If necessary, press CTRL to add polygons back into the set. Give the Selection Set a name, such as **Needs Subdivision**.



4. Add a Subdivide Modifier to the selected polygons. Do not touch the Subdivide Spinner. Enter a value in the spinner. Do not go too small or you could crash your system. Try a value between 2 and 5.



5. Save your file as **My Armchair.max**.

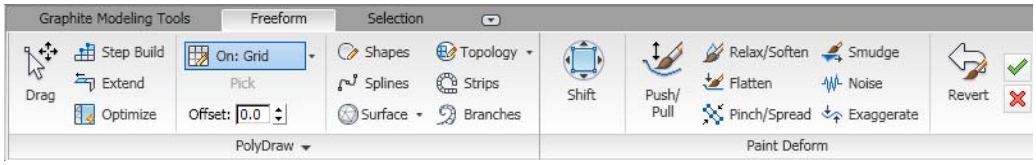
Task 4 – Continue Modeling the Armchair

You can soften up your model using the Freeform tools.

1. Continue on the armchair you were working on in the previous task.

2. Enable to the Polygon level in the Polygon Modeling panel on the *Graphite Modeling Tools* tab and press <Ctrl>+<A> to select all of the polygons.

3. Select the *Freeform* tab.



4. In the Paint Deform panel, click  (Push/Pull). Access the detailed help in the tool tip by pausing your cursor on the command.

Push/Pull

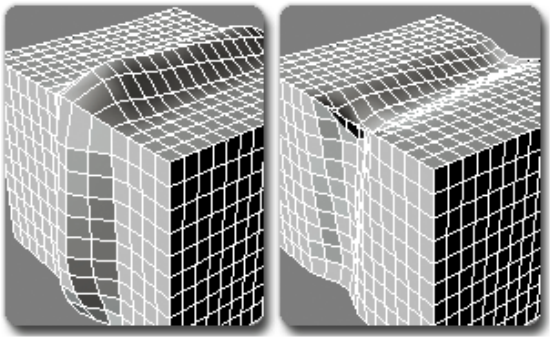
Drag the brush to pull vertices outward; **Alt**+drag to push them inward.

Change brush size, strength, and other settings on the Paint Options panel.

The following keyboard modifiers apply:

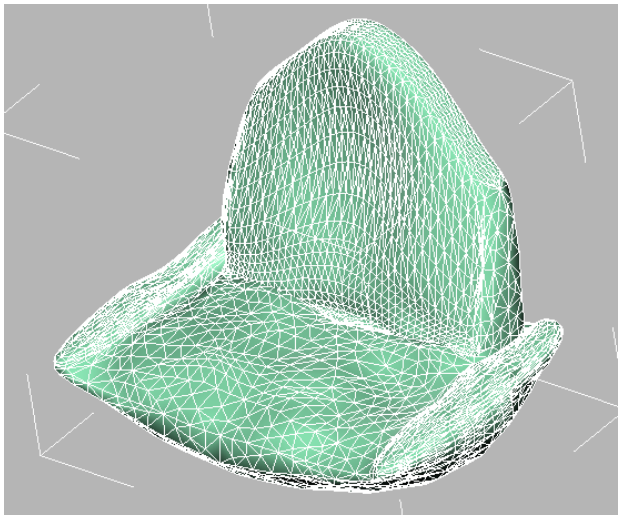
- **Shift** Relax the mesh.
- **Ctrl** Revert the mesh.
- **Ctrl+Shift** Resize the brush.
- **Shift+Alt** Change the brush strength.

Left: After using Pull; Right: After using Push (**Alt**+drag)



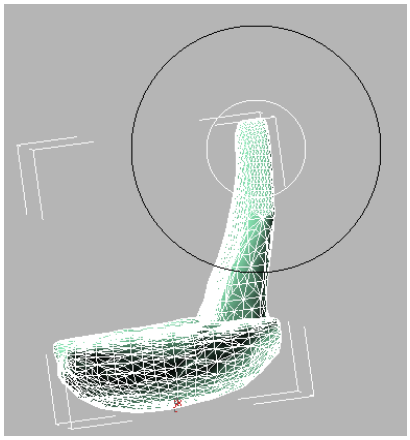
5. Use Push/Pull to create a cushion for sitting. Drag the brush to pull the vertices outward; hold down <Alt> to push them in.

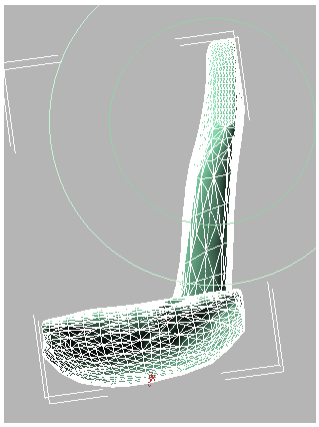
6. Change the brush size using <Ctrl>+<Shift>, and the brush strength using <Shift>+<Alt>.

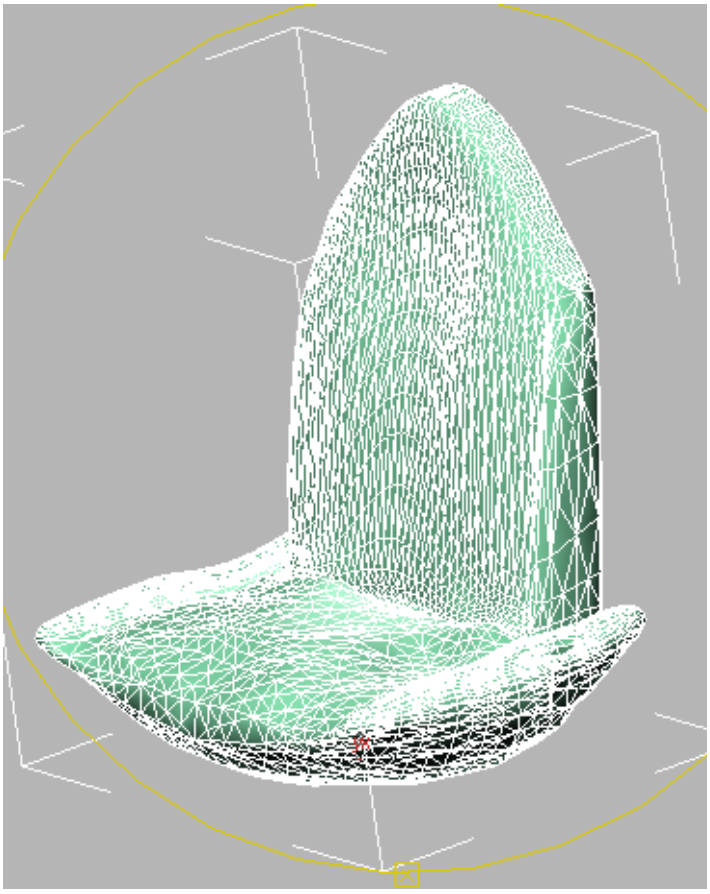


7. Finish the chair by clicking  (Shift) on the Paint Deform panel in the *Freeform* tab.

8. Orbit the viewport so you are seeing the side of the chair. Use  (Shift) to stretch and deform the chair back.



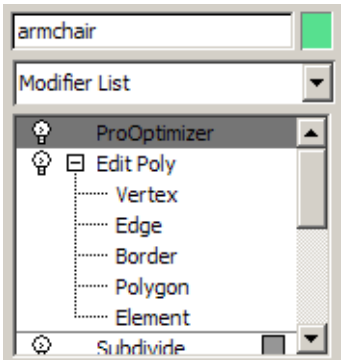




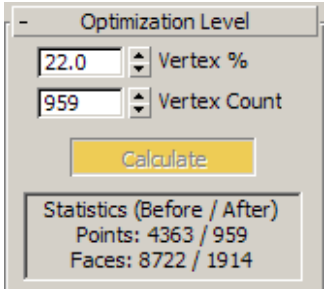
Task 2 – Optimize the Mesh

The shape of the chair has been softened; now you need to reduce the polycount so the file can be used efficiently. The ProOptimizer modifier will achieve this.

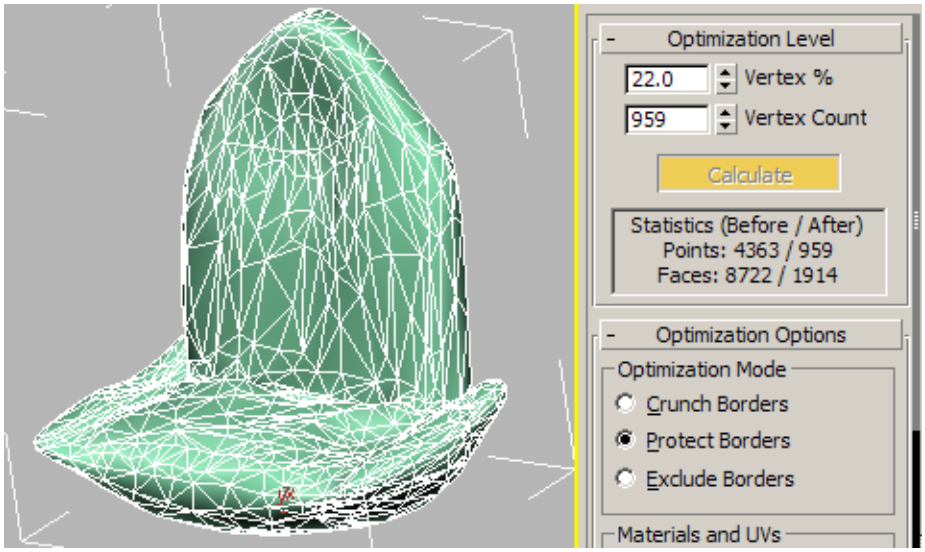
1. Add a ProOptimizer Modifier to the stack. Select the Edit Poly modifier in the stack to disable sub-object mode. Select **ProOptimizer** from the *Modifier* drop-down list.



2. In the Modify panel, on the Optimization Levels rollout, click **Calculate**.



3. Change the *Vertex %* to **22**. Dial it up or down while watching the viewport.



The Chair still needs a base. You create a base later, when you learn Lofting.

4. Save your work as **Myarmchair_softened.max**.