

# Chapter 2

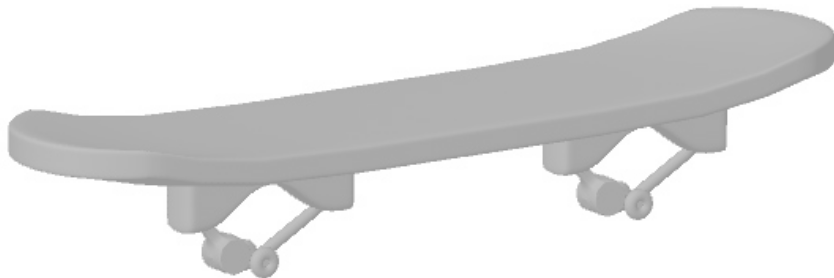
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## Polygon Modeling

### Learning Objectives

**After completing this chapter, you will be able to:**

- *Create polygon primitives*
- *Edit polygon primitives*
- *Modify the components of polygon primitives*
- *Create a complex model using polygon primitives*



## INTRODUCTION

In this chapter, you will learn to create and edit polygon shapes using polygon modeling techniques. A polygon is made up of different closed planar shapes having straight sides. The most commonly used shapes in 3D polygons are triangles and quadrilaterals. These shapes are formed by vertices, edges and faces. An edge is a straight line formed by joining two vertices. Three vertices joined to each other by three edges form a triangle and four vertices joined to each other by four edges, form a quadrilateral. By modifying faces, edges, vertices of an object, you can create a polygon model as per your requirement.

## POLYGON PRIMITIVES

In Maya, polygon primitives are classified into various objects. These objects are grouped under the **Polygon Primitives** in the menubar. The method of creating different polygon primitives is discussed next.

### Creating a Sphere

<b>Menubar:</b>	Create > Polygon Primitives > Sphere
<b>Shelf:</b>	Polygons > Polygon Sphere

A sphere is a solid object in which every point on its surface is equidistant from its centre, as shown in Figure 2-1. The sphere can be created dynamically by entering the values using the keyboard. Both the methods are discussed next.

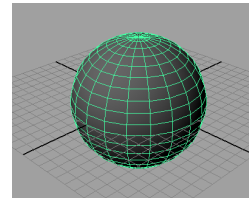


Figure 2-1 A polygon sphere

### Creating a Sphere Dynamically

To create a sphere dynamically, choose **Create > Polygon Primitives > Sphere** from the menubar; you will be prompted to drag the cursor on the grid to draw the sphere in the viewport. Press and hold the left mouse button, and drag the cursor up or down to define the radius of the sphere. Now, release the left mouse button to get the desired radius; the sphere will be created in all viewports and will be visible in the wireframe mode. Press the numeric key 5 to change the display to **Smooth Shade all**.



#### Note

By default, polygon primitives are displayed in the **Wireframe** mode. Press 5 on the keyboard to change the shading mode to **Smooth Shade all**. Alternatively, choose **Shading > Smooth Shade all** from the **Panel** menu. You can also switch back to the wireframe mode by pressing 4 on the keyboard or by choosing **Shading > Wireframe** from the **Panel** menu.

### Creating a Sphere by Using the Keyboard

To create a sphere by using the keyboard, choose **Create > Polygon Primitives > Sphere > Option Box** from the menubar; the **Tool Settings (Polygon Sphere Tool)** window will be displayed, as shown in Figure 2-2. In this window, set the properties of the sphere using the keyboard and then click in the viewport; the sphere will be created in all viewports. Choose **Reset Tool** at the top of the **Tool Settings (Polygon Sphere Tool)** window to reset the settings of the sphere.

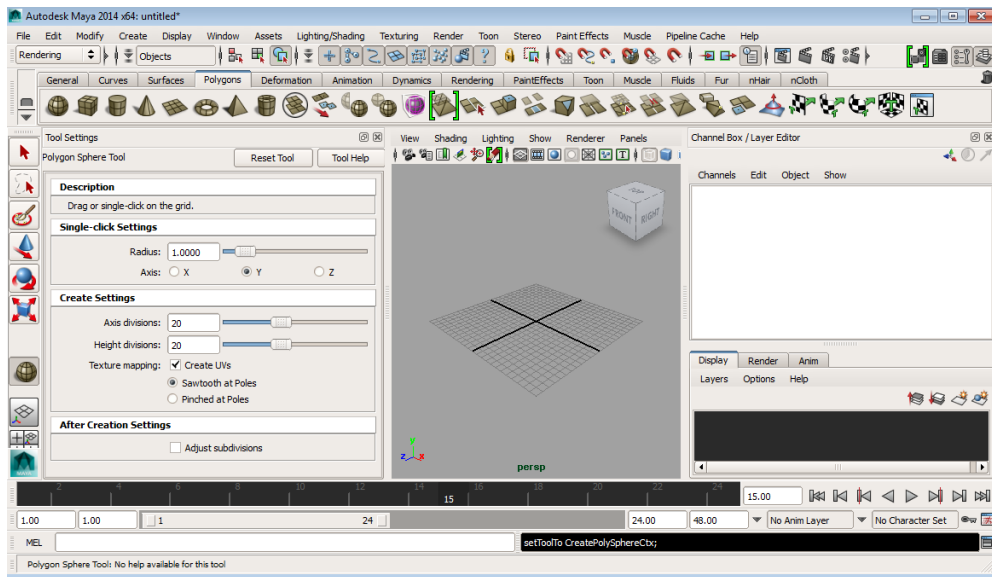


Figure 2-2 The Tool Settings (Polygon Sphere Tool) window

## Creating a Cube

**Menubar:** Create > Polygon Primitives > Cube  
**Shelf:** Polygons > Polygon Cube

A cube is a three-dimensional shape with six sides or rectangular faces, as shown in Figure 2-3. A cube can be created dynamically or by entering values using the keyboard. Both these methods are discussed next.

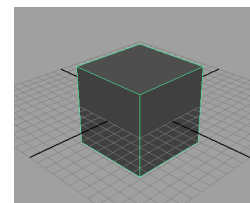


Figure 2-3 A polygon cube

## Creating a Cube Dynamically

To create a cube dynamically, choose **Create > Polygon Primitives > Cube** from the menubar; you will be prompted to draw a cube in the viewport. Press and hold the left mouse button, and drag the cursor on the grid to define the base of the cube. Now, release the left mouse button to get the desired base. Next, press and hold the left mouse button again and drag the cursor up to set the height of the cube and then release the left mouse button; the cube will be created in all the viewports.

## Creating a Cube by Using the Keyboard

To create a cube by the using the keyboard, choose **Create > Polygon Primitives > Cube > Option Box** from the menubar; the **Tool Settings (Polygon Cube Tool)** window will be displayed, as shown in Figure 2-4. In this window, set the properties of the cube by using the keyboard and then click in the viewport; the cube will be created in all viewports. Choose **Reset Tool** at the top of the **Tool Settings (Polygon Cube Tool)** window to reset the settings of the cube.

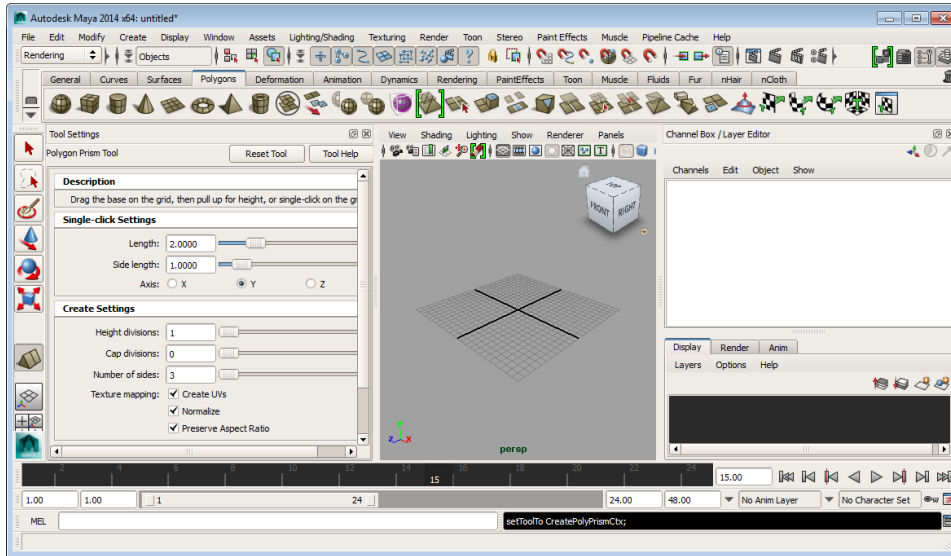


Figure 2-4 The Tool Settings (Polygon Cube Tool) window

## Creating a Prism

**Menubar:** Create > Polygon Primitives > Prism

A prism is a polyhedron that has two polygonal faces lying in parallel planes as bases and the other faces as parallelograms, as shown in Figure 2-5. You can create a prism dynamically or by using the keyboard. Both these methods are discussed next.

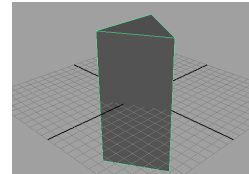


Figure 2-5 A polygon prism

## Creating a Prism Dynamically

To create a prism dynamically, choose **Create > Polygon Primitives > Prism** from the menubar; you will be prompted to draw a prism. Press and hold the left mouse button and drag the cursor; the base of the prism is created. Release the left mouse button. Again, press and hold the left mouse button and drag the cursor up to set the height of the prism, and then release the left mouse button; the polygon prism will be created in all viewports.

## Creating a Prism by Using the Keyboard

To create a prism by using the keyboard, choose **Create > Polygon Primitives > Prism > Option Box** from the menubar; the **Tool Settings (Polygon Prism Tool)** window will be displayed, as shown in Figure 2-6. In this window, set the properties of the prism by using the keyboard and then click in the viewport; the prism will be created in all viewports. Choose the **Reset Tool** button at the top of the **Tool Settings (Polygon Prism Tool)** window to reset the settings of the prism.

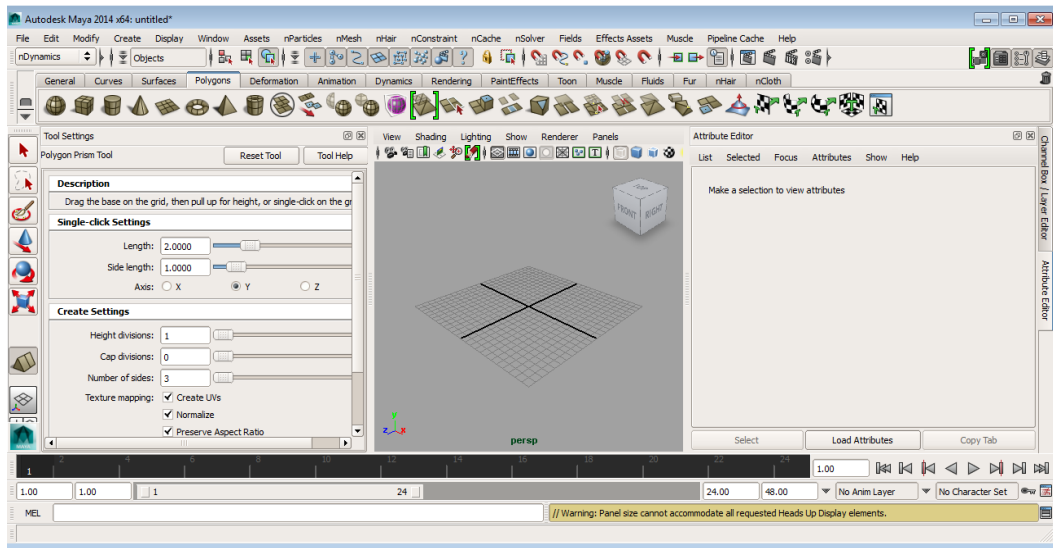


Figure 2-6 The Tool Settings (Polygon Prism Tool) window

## Modifying the Name and other Parameters of a Prism

You can modify the name and other parameters of a prism. To do so, select the prism; the **Channel Box / Layer Editor** is displayed on the right of the viewport. Click on the **pPrism1** label in the **Channel Box / Layer Editor**; an edit box will appear in its place. Next, enter the desired name in the edit box and press ENTER. To modify the properties of the prism, expand the **INPUTS** node; various options will be displayed. Enter the required values in the edit boxes; the changes will be dynamically reflected on the prism in the viewport. Alternatively, select the label of the parameter of the prism that you want to change; the corresponding label of the parameter will be highlighted in the **Channel Box**. Now, press and hold the middle mouse button and drag the cursor horizontally to change that particular value of the corresponding parameter.

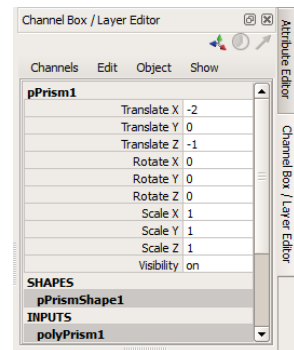


Figure 2-7 The Channel Box/Layer Editor

## Creating a Pyramid

**Menuabar:** Create > Polygon Primitives > Pyramid  
**Shelf:** Polygons > Polygon Pyramid

A pyramid is a geometric shape with a polygonal base and a point called apex. The base and the apex are connected through triangular faces, as shown in Figure 2-8. You can create a pyramid dynamically or by entering values using the keyboard. Both these methods are discussed next.

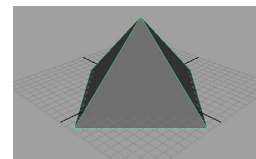


Figure 2-8 A polygon pyramid

## Creating a Pyramid Dynamically

To create a pyramid dynamically, choose **Create > Polygon Primitives > Pyramid** from the menubar; you will be prompted to drag the cursor on the grid. Press and hold the left mouse button and drag the cursor; the pyramid is created in viewports.

## Creating a Pyramid by Using the Keyboard

To create a pyramid by using the keyboard, choose **Create > Polygon Primitives > Pyramid > Option Box** from the menubar; the **Tool Settings (Polygon Pyramid Tool)** window will be displayed, as shown in Figure 2-9. In this window, set the properties of the pyramid by using the keyboard and then click in the viewport; the pyramid will be created in viewports. Choose **Reset Tool** at the top of the **Tool Settings (Polygon Pyramid Tool)** window to reset the settings of the pyramid.

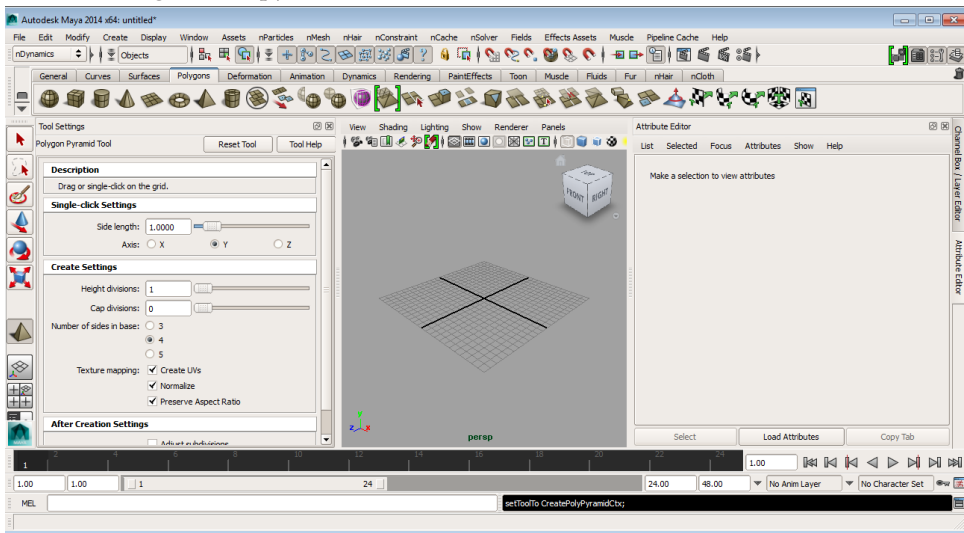


Figure 2-9 The Tool Settings (Polygon Pyramid Tool) window

## Creating a Pipe

**Menubar:** Create > Polygon Primitives > Pipe  
**Shelf:** Polygons > Polygon Pipe

A pipe is similar to a cylinder polygonal shape with thickness, as shown in Figure 2-10. You can create a pipe either dynamically or by entering values using the keyboard. Both these methods are discussed next.

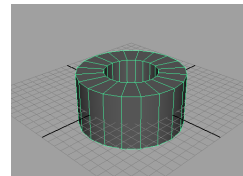


Figure 2-10 A polygon pipe

## Creating a Pipe Dynamically

To create a pipe dynamically, choose **Create > Polygon Primitives > Pipe** from the menubar; you will be prompted to draw the pipe. Press and hold the left mouse button and drag the cursor; the base of the pipe is created. Release the left mouse button. Next, press and hold the left mouse button and drag the cursor up to set the height of the pipe, and then release the left mouse button. Again, press and hold the left mouse button to set the thickness of the polygon pipe. The polygon pipe will be created in viewports.

## Creating a Pipe by Using the Keyboard

To create a pipe by using the keyboard, choose **Create > Polygon Primitives > Pipe > Option Box** from the menubar; the **Tool Settings (Polygon Pipe Tool)** window will be displayed, as shown in Figure 2-11. In this window, set the properties of the pipe by using the keyboard and then click in the viewport; the pipe will be created in viewports. Choose the **Reset Tool** button at the top of the **Tool Settings (Polygon Pipe Tool)** window to reset the settings of the pipe.

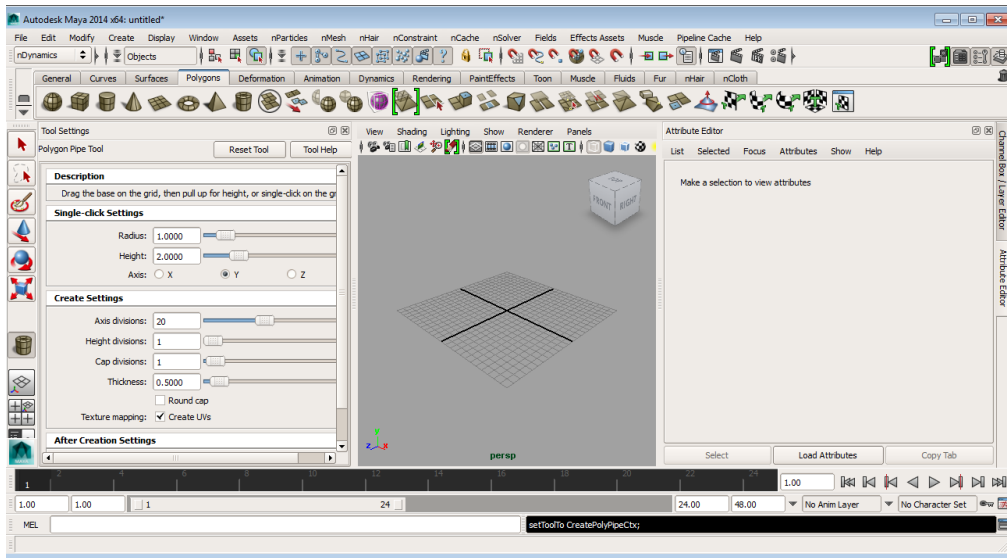


Figure 2-11 The Tool Settings (Polygon Pipe Tool) window

## Creating a Helix

**Menubar:** Create > Polygon Primitives > Helix

A helix is a geometry in three dimensional space that lies on a cylinder, so that its angle to a plane perpendicular to the axis is constant, as shown in Figure 2-12. You can create a helix dynamically or by entering values using the keyboard. Both these methods are discussed next.

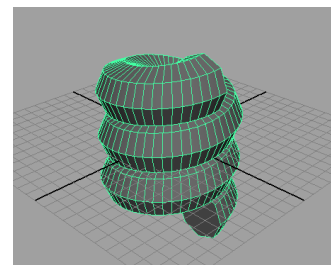


Figure 2-12 A polygon helix

## Creating a Helix Dynamically

To create a helix dynamically, choose **Create > Polygon Primitives > Helix** from the menubar; you will be prompted to draw the helix. Press and hold the left mouse button and drag the cursor on the grid to define the diameter of the helix and then release the left mouse button. Again, press and hold the left mouse button and drag the cursor up to set the height of the helix, and then release the left mouse button. Next, press and hold the left mouse button and drag the cursor to set the number of coils in the helix. Release the left mouse button after setting the number of coils. Again, press and hold the left mouse button and drag the cursor to set the section radius; the helix will be created in viewports.

## Creating a Helix by Using the Keyboard

To create a helix by using the keyboard, choose **Create > Polygon Primitives > Helix > Option Box** from the menubar; the **Tool Settings (Polygon Helix Tool)** window will be displayed, as shown in Figure 2-13. In this window, set the properties of the helix by using the keyboard and then click in the viewport; the helix will be created in all viewports. Choose **Reset Tool** at the top of the **Tool Settings (Polygon Helix Tool)** window to reset the settings of the helix.

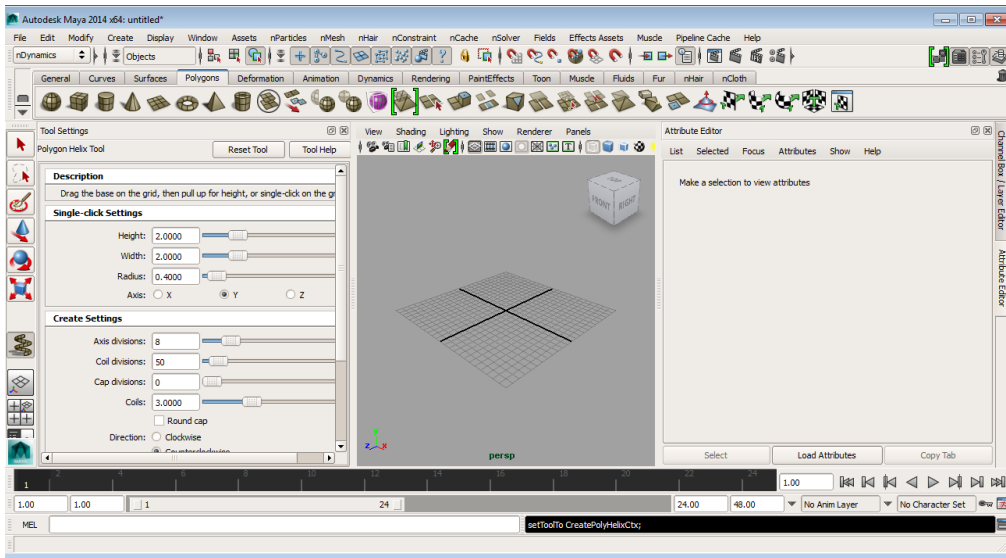


Figure 2-13 The Tool Settings (Polygon Helix Tool) window



**Tip.** By default, the **Polygon Helix Tool** is not available in the Shelf. To add it to the shelf, choose the **Custom** shelf tab from the Shelf. By default, the **Custom** shelf tab is empty. This tab can be used to add tools that are frequently used. Press and hold the **SHIFT** and **CTRL** keys and choose **Create > Polygon Primitives > Helix** from the main menubar; a helix icon is formed in the **Custom** shelf. Similarly, you can add other tools in the **Custom** shelf tab for quick access.

## Creating a Soccer Ball

**Menubar:** Create > Polygon Primitives > Soccer ball

A soccer ball polygon primitive created in Maya is very much similar to a real-world soccer ball, as shown in Figure 2-14. A soccer ball is formed by an alternate arrangement of hexagons and pentagons. It has total thirty two faces. You can create a soccer ball dynamically or by entering values using the keyboard. Both the methods are discussed next.

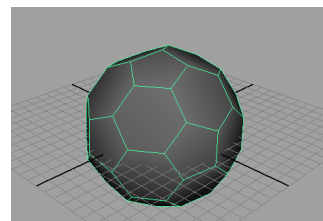


Figure 2-14 A soccer ball

## Creating a Soccer Ball Dynamically

To create a soccer ball dynamically, choose **Create > Polygon Primitives > Soccer Ball** from the menubar; you will be prompted to drag the cursor on the grid. Press and hold the left mouse button and drag the cursor on the grid; the soccer ball will be created in all viewports.

## Creating a Soccer Ball by Using the Keyboard

To create a soccer ball by using the keyboard, choose **Create > Polygon Primitives > Soccer Ball > Option Box** from the menubar; the **Tool Settings (Polygon Soccer Ball Tool)** window will be displayed, as shown in Figure 2-15. In this window, set the properties of the soccer ball by using the keyboard and then click in the viewport; the soccer ball will be created in all the viewports. Choose **Reset Tool** at the top of the **Tool Settings (Polygon Soccer Ball Tool)** window to reset the settings of the soccer ball.

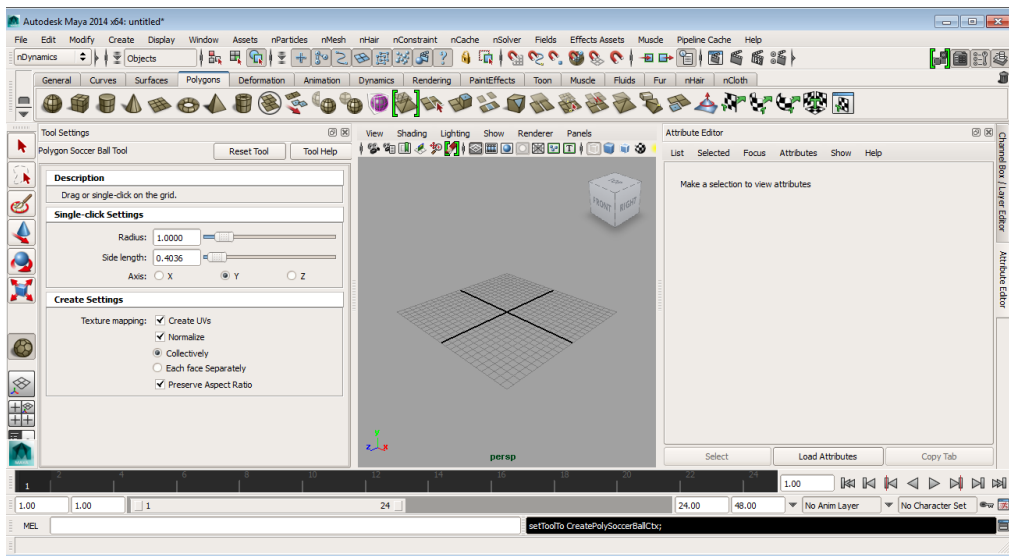


Figure 2-15 The Tool Settings (Polygon Soccer Ball Tool) window

## Creating a Platonic Solid

**Menubar:** Create > Polygon Primitives > Platonic Solids

You can create various types of platonic solids such as tetrahedron, octahedron, dodecahedron, and icosahedron. Platonic solids have identical face and its all sides are equal, refer to Figure 2-16. You can create a platonic solid dynamically or by entering values using the keyboard. Both these methods are discussed next.

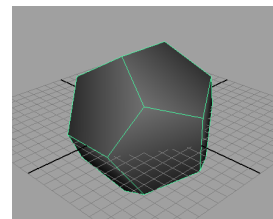


Figure 2-16 A platonic solid

## Creating a Platonic Solid Dynamically

To create a platonic solid dynamically, choose **Create > Polygon Primitives > Platonic Solids** from the menubar; you will be prompted to drag the cursor on the grid. Press and hold the left mouse button and drag the cursor on the grid; the platonic solid will be created in viewports and it will be displayed in the wireframe mode.

## Creating a Platonic Solid by Using the Keyboard

To create a platonic solid by using the keyboard, choose **Create > Polygon Primitives > Platonic Solids > Option Box** from the menubar; the **Tool Settings (Polygon Platonic Solid Tool)** window will be displayed, as shown in Figure 2-17. In this window, set the properties of the platonic solid by using the keyboard and then click in the viewport; the platonic solid will be created in viewports. Choose the **Reset Tool** button at the top of the **Tool Settings (Polygon Platonic Solid Tool)** window to reset the settings of the platonic solid.

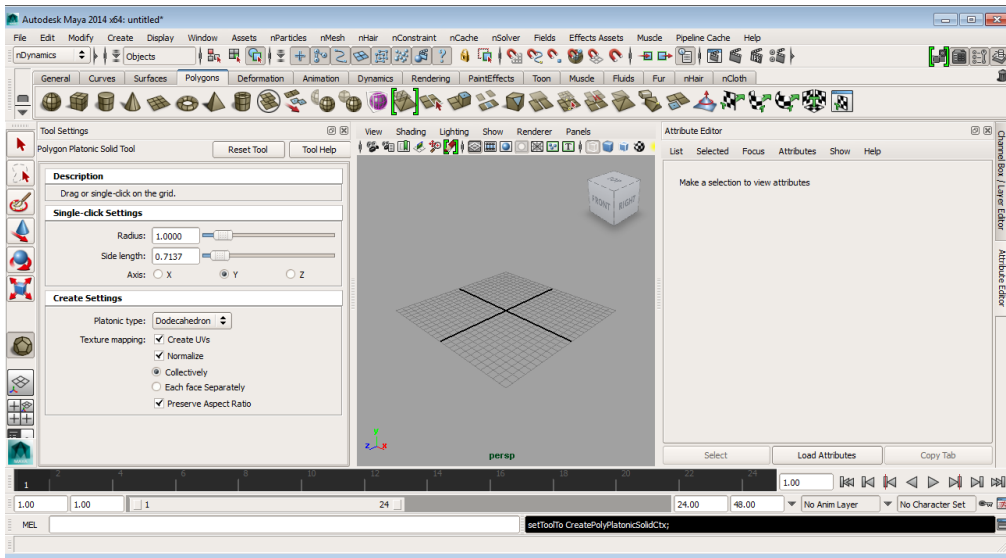


Figure 2-17 The Tool Settings (Polygon Platonic Solid Tool) window

## POLYGON EDITING TOOLS

Polygon editing tools are used to perform different operations on the polygon objects. These editing tools are available in the **Mesh** and **Edit Mesh** menus of the **Polygons** menu set. Figure 2-18 displays different tools in the **Mesh** menu. The most commonly used tools under this menu are discussed next.

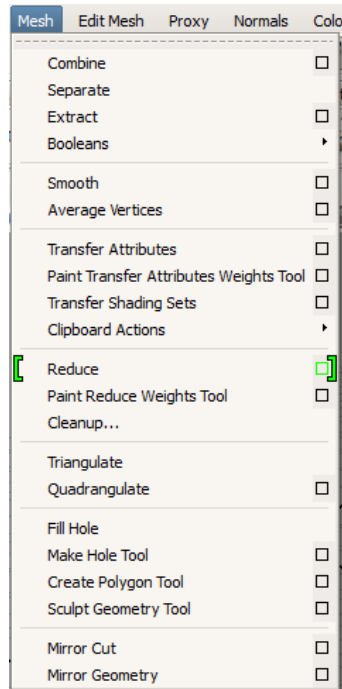


Figure 2-18 The **Mesh** menu

## Combine

**Menubar:** Mesh > Combine

The **Combine** tool is used to group two or more polygon meshes into a single polygon object. To do so, select the meshes to be combined in the viewport and then choose **Mesh > Combine** from the menubar; the selected meshes are combined into a single polygon object.

## Separate

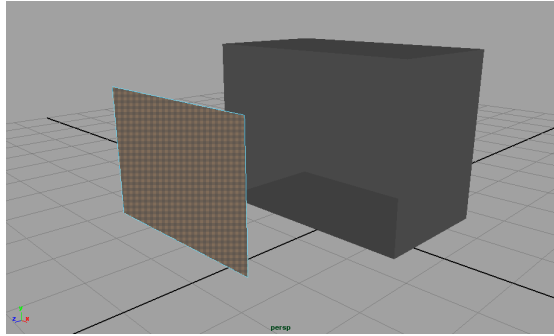
**Menubar:** Mesh > Separate

The **Separate** tool is used to ungroup the combined polygon objects into separate polygon objects. To do so, select the group in the viewport and then choose **Mesh > Separate** from the menubar; the selected group of polygon objects are separated.

## Extract

**Menubar:** Mesh > Extract

The **Extract** tool is used to separate the selected faces from a polygon object. To do so, press and hold the right mouse button over the object; a marking menu will be displayed. Next, choose **Face** from the marking menu; the **Face** selection mode will be activated. Choose **Move Tool** from the Tool Box. Next, select the face of the polygon that you want to extract and choose **Mesh > Extract** from the menubar; the selected face will be separated from the polygon object. Figure 2-19 displays the extracted face of the polygon cube extracted from it.

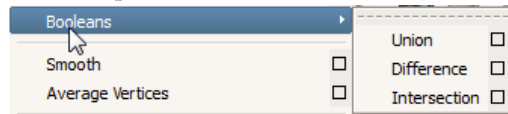


*Figure 2-19 The face extracted from the cube*

## Booleans

**Menubar:** Mesh > Booleans

The **Booleans** feature is used to combine the polygon objects to create a new shape. Using this tool, you can perform three different operations to modify the shape of the new object, refer to Figure 2-20. The three options are discussed next.



*Figure 2-20 Three options of the **Booleans** feature*

### Union

**Menubar:** Mesh > Booleans > Union

The **Union** option is used to combine the volume of two polygon meshes. To merge two objects, create a sphere and torus and place them in the viewport, as shown in Figure 2-21. Using the SHIFT key, select the torus and then the sphere. Next, choose **Mesh > Booleans > Union** from the menubar; both the objects will be merged, and the intersecting geometry between them will be deleted, refer to Figure 2-22.

### Difference

**Menubar:** Mesh > Booleans > Difference

The **Difference** option is used to subtract the last selected geometry from the geometry that was selected first. To subtract the geometry, create a sphere and a torus and place them in the viewport, refer to Figure 2-21. Using the SHIFT key, select the torus and then the sphere. Next, choose **Mesh > Booleans > Difference** from the menubar; the geometry will be deleted, as shown in Figure 2-23.

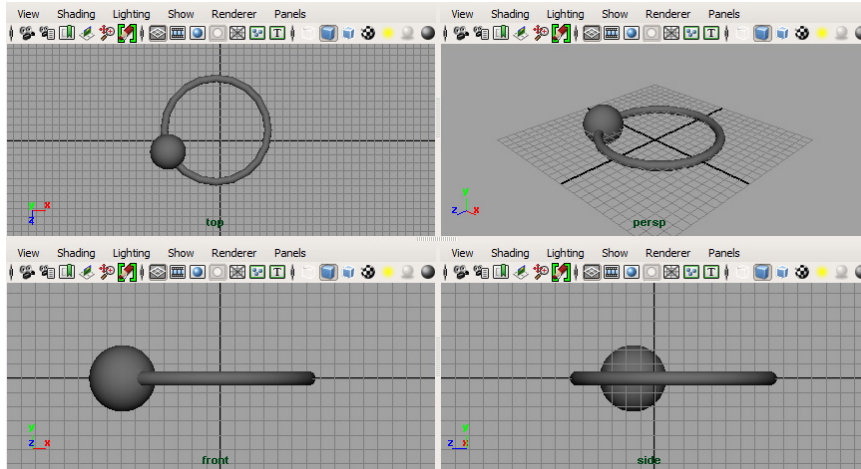


Figure 2-21 Torus and sphere placed in the viewport

## Intersection

**Menubar:** Mesh > Booleans > Intersection

The **Intersection** option is used to keep the intersecting geometry between two objects and delete the remaining geometry. To do so, create a sphere and torus and place them in the viewport, refer to Figure 2-21. Using the SHIFT key, select the torus and the sphere. Next, choose **Mesh > Booleans > Intersection** from the menubar; the intersecting geometry will be displayed and the remaining parts will be deleted, as shown in Figure 2-24.

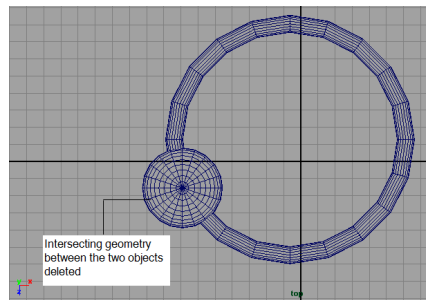


Figure 2-22 The **Union** operation carried out on the torus and the sphere

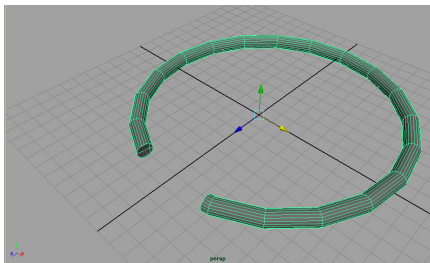


Figure 2-23 The **Difference** operation carried out on the torus and the sphere

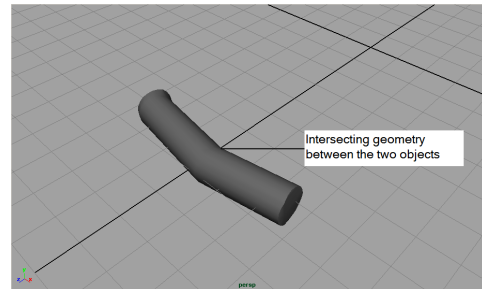


Figure 2-24 The **Intersection** operation carried out on the torus and the sphere

## Smooth

**Menubar:** Mesh > Smooth

The **Smooth** tool is used to make a polygon object smooth by adding divisions to it. To make an object smooth, create a polygonal object in the viewport and then choose **Mesh > Smooth** from the menubar; the selected polygonal object will be smoothed.

## Reduce

**Menubar:** Mesh > Reduce

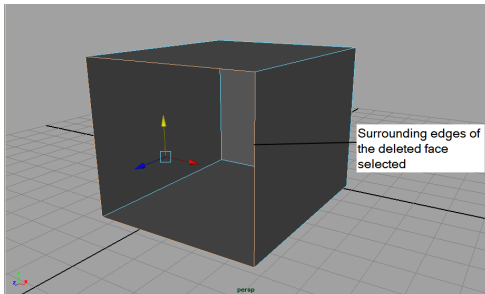
The **Reduce** option is used to reduce the number of polygons in a selected region of a polygon object. To do so, select a polygonal object in the viewport and press and hold the right mouse button over the object; a marking menu will be displayed. Next, choose **Face** from the marking menu; the face mode will be activated. Now, select a face of the object. Choose **Mesh > Reduce** from the menubar; the number of polygons in a particular face will be reduced.



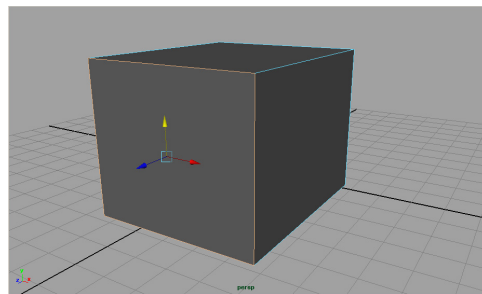
## Fill Hole

**Menubar:** Mesh > Fill Hole

The **Fill Hole** tool is used to fill a hole in an object by adding a face to it. To fill a hole, press and hold the right mouse button over an object; a marking menu will be displayed. Next, choose **Face** from the marking menu; the face selection mode will be activated. Choose the **Move Tool** from the Tool Box and then select any face on the polygon and press DELETE. Next, select the surrounding boundary edges of the deleted face by choosing **Edge** from the marking menu, refer to Figure 2-25. Next, choose **Mesh > Fill Hole** from the menubar; the empty space will be filled, as shown in Figure 2-26.



**Figure 2-25** Edges of the deleted face selected



**Figure 2-26** Filled hole of the cube



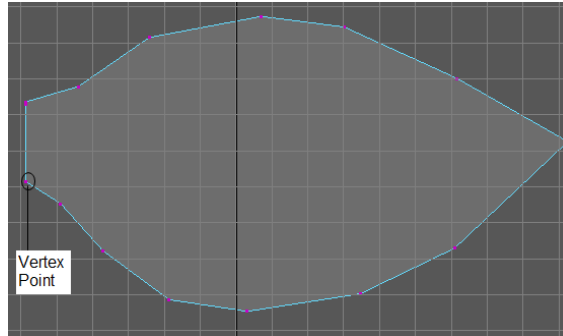
### Tip.

1. You can use the shortcut keys for displaying or activating various components of an object. For example, press F8 for object mode, F9 for vertex, F10 for edges, and F11 for faces.
2. To select the four surrounding edges of a deleted face, choose one of the edges and then press the right arrow key on your keyboard; all the four edges will be selected.

## Create Polygon Tool

**Menubar:** Mesh > Create Polygon Tool

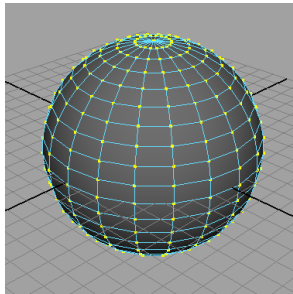
The **Create Polygon Tool** is used to create polygons by placing vertices in the viewport. To do so, choose **Mesh > Create Polygon Tool** from the menubar. Next, click in the viewport; a vertex point will be created in the viewport. Next, depending on the shape required, keep on clicking in the viewport to connect the points; a shape will be created, refer to Figure 2-27.



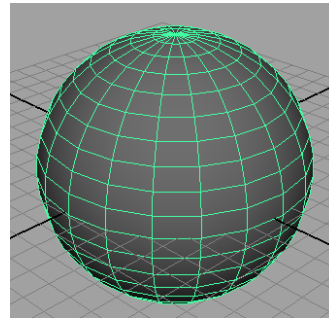
*Figure 2-27 A shape created using Create Polygon Tool*

## EDITING THE POLYGON COMPONENTS

In the previous section, you learned to modify simple polygon primitives. In this section, you will learn to edit the components of polygon primitives to create complex objects from it. To do so, select a polygon object in the viewport and then press and hold the right mouse button over it; the marking menu of the corresponding object will display various components of the object such as vertex, edge, face, and UV, refer to Figures 2-28 to 2-31. To access various tools for editing the polygon primitives, select **Polygons** from the **Menuset** drop-down list in Status Line. Next, choose the **Edit Mesh** menu from the menubar. The most commonly used component editing tools are discussed next.



*Figure 2-28 Vertices of the Sphere*



*Figure 2-29 The sphere in edge mode*

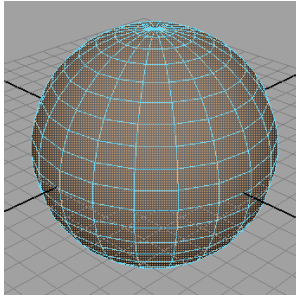


Figure 2-30 Faces of the sphere

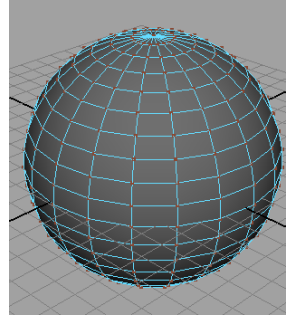


Figure 2-31 UVs of the sphere

**Note**

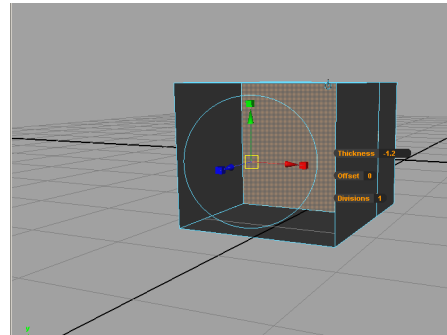
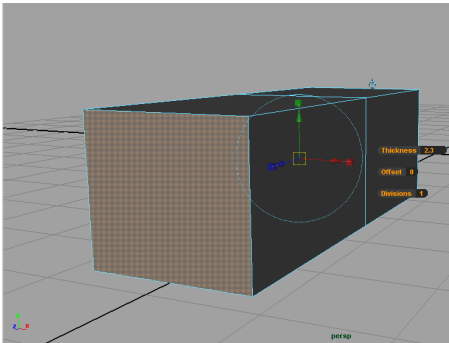
1. The **Face** option in the marking menu allows you to select the faces of the active object. When you move the cursor on a face, the face will be highlighted in red. Next, when you click on the highlighted face, its color will change to green, indicating that it is selected now. In this way, you can identify the selected and the unselected faces.

2. The **Multi** option allows you to select all components at a time without switching between components. To select all components, press and hold the right mouse button on the already selected component, and then choose the **Multi** option from the marking menu. Next, select a face on the object, press and hold the **SHIFT** key, and then select the next required component.

**Extrude**

**Menubar:** Edit Mesh > Extrude

The **Extrude** tool is used to extrude a face or an edge of a polygon object inward or outward. To extrude a face, select the face that needs to be extruded. Next, choose **Edit Mesh > Extrude** from the menubar; the **Thickness**, **Offset**, and **Divisions** sliders will be displayed in the viewport. Press and hold the left mouse button on the **Thickness** slider; the shape of the cursor will change. Next, drag the cursor in the viewport. If the value in the slider goes negative, the face will be extruded inward and for positive values, it will be extruded outward, as shown in Figure 2-32.

Figure 2-32 The **Extrude** tool used to extrude the face of a cube

## Bridge

**Menubar:** Edit Mesh > Bridge

The **Bridge** tool is used to connect two faces of a polygon object. The connection between the two faces can be straight or curved, depending on the option you choose from the **Bridge Options** dialog box. To create a bridge between two faces of an object, select the two faces and then choose **Edit Mesh > Bridge > Option Box** from the menubar; the **Bridge Options** dialog box will be displayed, as shown in Figure 2-33. In this dialog box, choose the type of bridge you want to create by selecting the corresponding radio button and then choose the **Bridge** or **Apply** button.

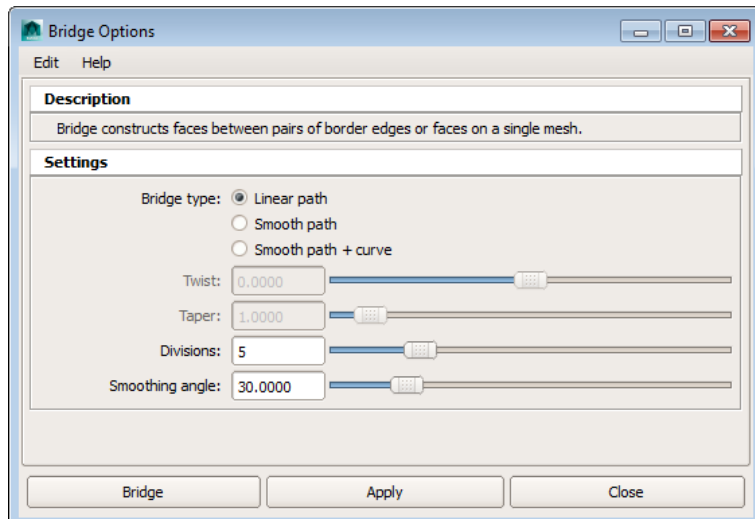


Figure 2-33 The **Bridge Options** dialog box



### Note

To create a bridge between two separate objects, you need to combine the two objects by choosing **Mesh > Combine** from the menubar.

## Cut Faces Tool

**Menubar:** Edit Mesh > Cut Faces Tool

The **Cut Faces Tool** is used to modify a selected object by splitting its faces along a cut line. To use this tool, create a polygon object in the viewport and choose **Edit Mesh > Cut Faces Tool** from the menubar and then drag the cursor on the selected object in the viewport; the faces of the object will be cut along the cut line.

## Interactive Split Tool

**Menubar:** Edit Mesh > Interactive Split Tool

The **Interactive Split Tool** is used to manually add segments between two edges of an object. To add segments between two edges, select the polygon object and then choose **Edit Mesh > Interactive Split Tool** from the menubar. Click on the edge to choose the starting

point of the segment. Next, click on the edge where you want to end the segment and press ENTER; a segment will be added between the two edges, refer to Figure 2-34.

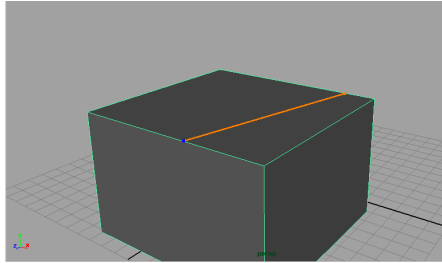


Figure 2-34 Segment added using *Interactive Split Tool*

## Insert Edge Loop Tool

**Menubar:** Edit Mesh > Insert Edge Loop Tool

The **Insert Edge Loop Tool** is used to add segments to the selected object. The segment created by using this tool, ends at the same point from where it starts, thus forming a loop. To use this tool, create a polygon object in the viewport and choose **Edit Mesh > Insert Edge Loop Tool** from the menubar; the edges of the object will turn blue. Next, click on an edge; a new segment will be created on the selected object, as shown in Figure 2-35. Note that the **Insert Edge Loop Tool** works only with the objects that have quads (quads are faces with four sides). If the sides of a face are more or less than four, then this tool will not work. To set the properties of this tool, choose **Edit Mesh > Insert Edge Loop Tool > Option Box** from the menubar; the **Tool Settings (Insert Edge Loop Tool)** window will be displayed, as shown in Figure 2-36. You can set the properties of this tool by using this window.

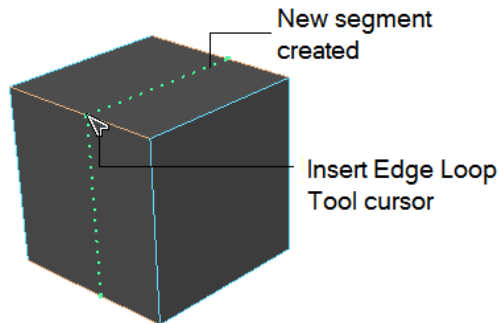
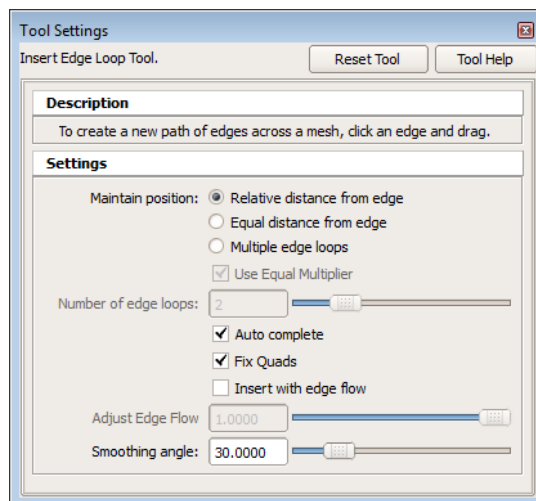


Figure 2-35 A new segment created using *Insert Edge Loop Tool*

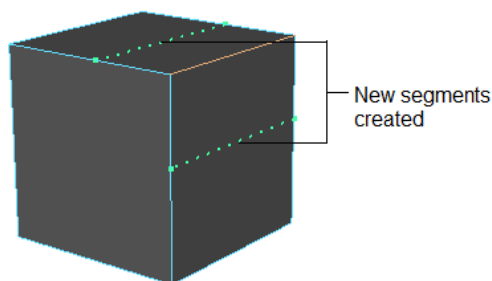


*Figure 2-36 The Tool Settings (Insert Edge Loop Tool) window*

## Offset Edge Loop Tool

**Menubar:** Edit Mesh > Offset Edge Loop Tool

The **Offset Edge Loop Tool** works similar to **Insert Edge Loop Tool** with the only difference that it creates segments on both sides of the edges selected. To use this tool, create a polygon object in the viewport and choose **Edit Mesh > Offset Edge Loop Tool** from the menubar. Next, click and drag the cursor to the already existing edges to create new segments on both sides of the selected object, as shown in Figure 2-37.



*Figure 2-37 New segments created using the Offset Edge Loop Tool*

## Edit Edge Flow

**Menubar:** Edit Mesh > Edit Edge Flow

The **Edit Edge Flow** tool is used to modify the position of edges along the curve of the surrounding mesh. To do so, select two non-adjacent edges of an object and choose **Edit Mesh > Edit Edge Flow** from the menubar; the edges move along the curvature of the object.



## Add Divisions

**Menubar:** Edit Mesh > Add Divisions

The **Add Divisions** tool is used to add segments equally on all faces of a polygon object. To add segments equally, select an object in the viewport and choose **Edit Mesh > Add Divisions** from the menubar; new segments will be created equally on all faces of the selected object.

## Duplicate Face

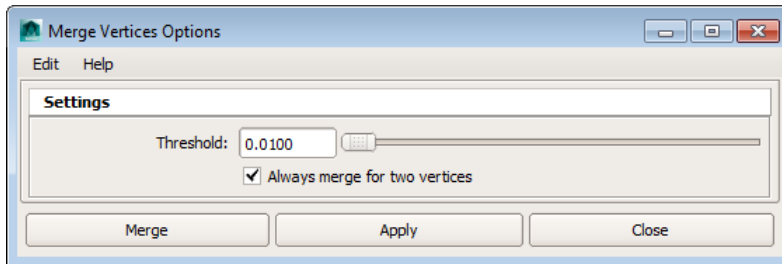
**Menubar:** Edit Mesh > Duplicate Face

The **Duplicate Face** tool is used to create the duplicate copies of the selected faces. To use this tool, create a cube in the viewport. Select the polygon cube created, press and hold the right mouse button on it; a marking menu will be displayed. Next, choose **Face** from the marking menu; the face selection mode will be activated. Choose **Move Tool** from the Tool Box. Next, select a face on the polygon cube and choose **Edit Mesh > Duplicate Face** from the menubar; a duplicate copy of the selected face will be created in the viewport.

## Merge

**Menubar:** Edit Mesh > Merge

The **Merge** tool is used to merge the selected edges or vertices that are within a numerically specified threshold distance from each other. To merge the vertices, create a polygon object in the viewport and press and hold the right mouse button over it; a marking menu will be displayed. Choose **Vertex** from the marking menu; the vertex component will be activated. Now, press and hold the SHIFT key and select the vertices that you want to merge and then choose **Edit Mesh > Merge** from the menubar; the selected vertices will merge together. You can also set the threshold value from the **Merge** tool. The threshold value is the point at which a particular effect begins to produce. To do so, choose **Edit Mesh > Merge > Option Box** from the menubar; the **Merge Vertices Options** dialog box will be displayed in the viewport, as shown in Figure 2-38. In this dialog box, set the threshold value in the **Threshold** edit box. More the threshold value, more easily the polygon components will merge together, even if they are at a longer distance.



*Figure 2-38 The Merge Vertices Options dialog box*

## Merge To Center

**Menubar:** Edit Mesh > Merge To Center

The **Merge To Center** tool is similar to the **Merge** tool. The only difference between them is that the **Merge To Center** tool is used to merge vertices to the center of the selection.

## Delete Edge/Vertex

**Menubar:** Edit Mesh > Delete Edge/Vertex

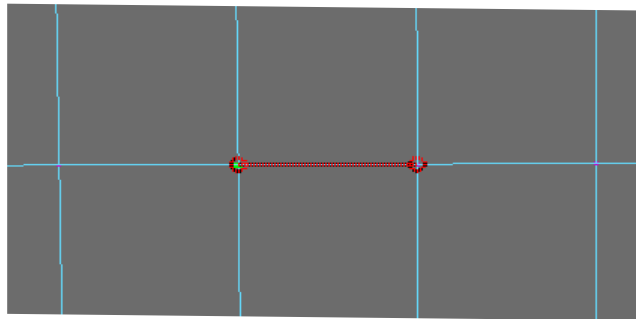
The **Delete Edge/Vertex** tool is used to delete the selected edges or vertices of a polygon object. To do so, select vertices of an object to be deleted and then choose **Edit Mesh > Delete Edge/Vertex** from the menubar; the selected vertices will be deleted. Similarly, using the **Delete Edge/Vertex** tool, you can delete the selected edges of the polygon object.



## Merge Vertex Tool

**Menubar:** Edit Mesh > Merge Vertex Tool

The **Merge Vertex Tool** is used to merge two vertices together by dragging the source vertex toward the target vertex. To merge two vertices, select an object in the viewport and press and hold the right mouse button over it; a marking menu will be displayed. Choose **Vertex** from the marking menu; the **Vertex** component will be activated. Next, choose **Edit Mesh > Merge Vertex Tool** from the menubar; the **Merge Vertex Tool** will be activated. Now, select a vertex and drag the selected vertex to the target vertex, with which you want it to merge. When you drag the cursor from one vertex to the other, a red line appears between the two vertices, indicating that these two points will merge together, as shown in Figure 2-39. You can also use the **Merge Vertex Tool** for merging the selected vertex to the target vertex or to the center of the two vertices. To do so, choose **Edit Mesh > Merge Vertex Tool > Option Box** from the menubar; the **Tool Settings (Merge Vertex Tool)** window will be displayed. Now, select the **Center** radio button from the window. Drag the cursor from one vertex to another vertex; the vertices will be merged.

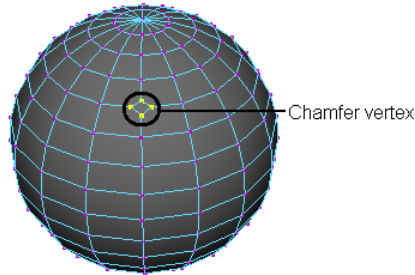


**Figure 2-39** The red line indicating the vertices to be merged

## Chamfer Vertex

**Menubar:** Edit Mesh > Chamfer Vertex

The **Chamfer Vertex** tool is used to replace a vertex and create a chamfered corner. To use this tool, create a polygon object in the viewport and press and hold the right mouse button over it; a marking menu will be displayed. Choose **Vertex** from the marking menu; the vertex component will be activated. Select a vertex of the object. Next, choose **Edit Mesh > Chamfer Vertex** from the menubar; a new polygon face will be created at the place of the selected vertex, as shown in Figure 2-40.

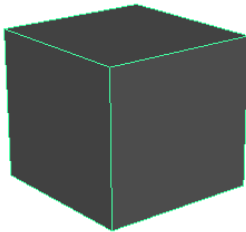


*Figure 2-40 A new face created using the Chamfer Vertex tool*

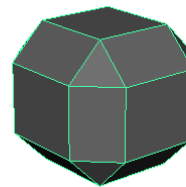
## Bevel

**Menubar:** Edit Mesh > Bevel

The **Bevel** tool is used to create beveled polygons along the currently selected edges. This adds smoothness to a sharp object by adding fillets on the edges. The bevel option adds fillet to edges by creating new faces on the selected edge. To do so, create a polygon object in the viewport. Now, select the object and right-click on it; the marking menu will be displayed. Choose **Edge** from the marking menu. Now, select any edge of the object and then choose **Edit Mesh > Bevel** from the menubar; a beveled transition surface will be created on the selected edge. Figure 2-41 shows a polygon cube before using the **Bevel** tool and Figure 2-42 shows the polygon cube after using the **Bevel** tool on all its edges.



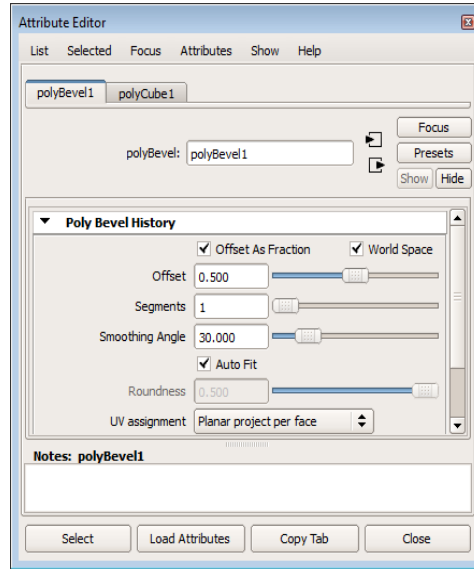
*Figure 2-41 A polygon cube before using the Bevel tool*



*Figure 2-42 The edges of the polygon cube after using the Bevel tool*

To adjust the bevel parameters, select the object in the viewport and choose the **Show/Hide Channel Box** button from the status line; the **Channel Box / Layer Editor** is displayed on the right of the viewport. Next, expand **polyBevel1** from the **INPUTS** node of the **Channel Box / Layer Editor** and then set the bevel parameters; the changes will be reflected on

the selected object in the viewport. Alternatively, select the object in the viewport. Choose **Window > Attribute Editor** from the menubar; the **Attribute Editor** will be displayed on the right side of the viewport. Next, choose the **polyBevel1** tab from the **Attribute Editor**; the bevel parameters will be displayed in the **Attribute Editor**, as shown in Figure 2-43. Set the parameters as per your requirement.



**Figure 2-43** Various bevel attributes in the *Attribute Editor*

## TUTORIALS

### Tutorial 1

In this tutorial, you will create the model of a coffee mug, as shown in Figure 2-44, using the polygon modeling techniques. **(Expected time: 20 min)**



**Figure 2-44** The model of a coffee mug

The following steps are required to complete this tutorial:

- Create a project folder.
- Create the basic shape of the mug.
- Create the handle of the mug.
- Change the background color of the scene.
- Save and render the scene.

## Creating the Project Folder

Before starting a new scene, it is recommended that you create a project folder. It helps you keep all the files of a project in an organized manner. Open Windows Explorer and browse to the *Documents* folder. In this folder, create a new folder with the name *maya2014*. The *maya2014* folder will be the main folder and it will contain all the projects folders that you will create while doing tutorials of this textbook. Now, you will create first project folder for Tutorial 1 of this chapter. To do so, you need to follow the steps given next.

1. Start Autodesk Maya 2014 by double-clicking on its icon on the desktop.
2. Choose **File > Project Window** from the menubar; the **Project Window** dialog box is displayed. Choose the **New** button; the **Current Project** and **Location** text boxes are enabled. Now, enter **c02\_tut1** in the **Current Project** text box.
3. Click on the folder icon next to the **Location** text box; the **Select Location** dialog box is displayed. In this dialog box, browse to the `\Documents\maya2014` folder and choose the **Select** button to close the dialog box. Next, choose the **Accept** button in the **Project Window** dialog box; the `\Documents\maya2014\c02_tut1` folder will become the current project folder.
4. Choose **Save Scene** from the **File** menu; the **Save File As** dialog box is displayed.



### Note

*The scenes created in Maya are saved with the .ma or .mb extension. As the project folder is already created, the path `\Documents\maya2014\c02_tut1\scenes` is displayed in the **Look in** drop-down list of the **Save File As** dialog box.*



**Tip:** After setting the project when you open or save a scene, Maya uses the scenes folder inside the project folder, by default.

5. Enter **c02tut1** in the **File name** edit box and then choose the **Save As** button to close the dialog box.



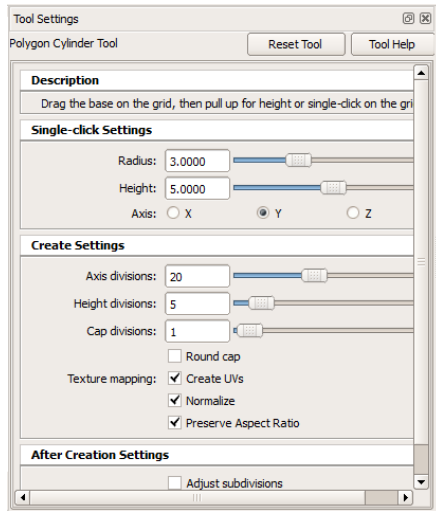
### Note

*It is recommended that you frequently save the file while you are working on it by pressing the **CTRL+S** keys.*

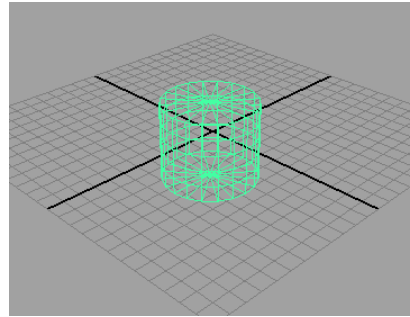
## Creating the Basic Shape of the Mug

In this section, you will use the **Cylinder** polygon primitive to create the basic shape of the mug.

1. Choose **Create > Polygon Primitives > Cylinder > Option Box** from the menubar; the **Tool Settings (Polygon Cylinder Tool)** window is displayed in the viewport. Enter the required values in the **Tool Settings (Polygon Cylinder Tool)** window, as shown in Figure 2-45.
2. Place the cursor in the persp viewport and then press the left mouse button to create a polygon cylinder, refer to Figure 2-46.

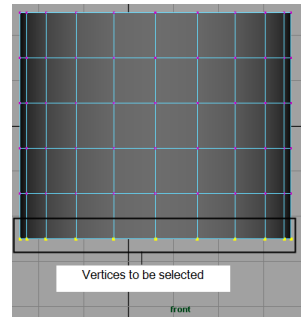


**Figure 2-45** The Tool Settings (Polygon Cylinder Tool) window

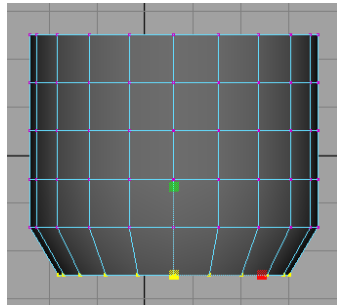


**Figure 2-46** The cylinder created in the viewport

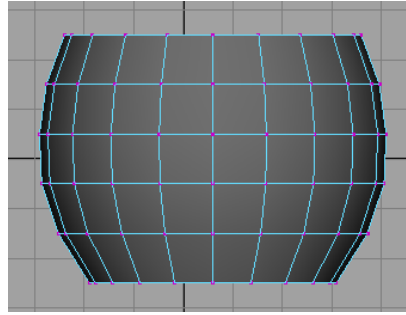
3. In the **Channel Box / Layer Editor**, double-click on **pCylinder1**; a text box is activated. Next, enter **mug** in the text box and press ENTER; **pCylinder1** is renamed as **mug**.
4. Hover the cursor in the persp viewport. Press SPACEBAR; the four viewports are displayed. Select the front viewport and press SPACEBAR; the front viewport is maximized. Select **mug** and then press and hold the right mouse button; a marking menu is displayed.
5. Choose **Vertex** from the marking menu; the vertex selection mode is activated. Press 5 to switch to the shaded mode.
6. Select the vertices at the bottom of **mug**, as shown in Figure 2-47. Next, invoke **Scale Tool** by pressing the r key.
7. Scale down the selected vertices of **mug** inward uniformly, as shown in Figure 2-48. Similarly, select the other vertices and scale the vertices to form a shape of the mug, as shown in Figure 2-49.



**Figure 2-47** Bottom vertices of the cylinder selected



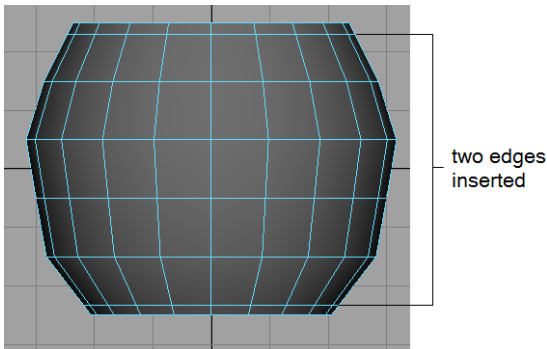
**Figure 2-48** Bottom vertices of the cylinder scaled



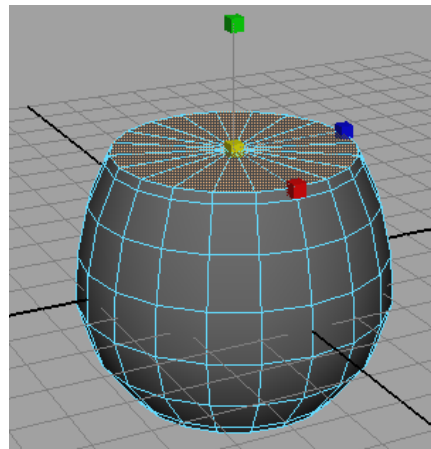
**Figure 2-49** Basic shape of the mug created

Next, you need to add segments at the top and bottom.

8. Make sure the **Polygons** menuset is selected in the **Menuset** drop-down list. Choose **Edit Mesh > Insert Edge Loop Tool** from the menubar. Next, click at the top and bottom region of *mug*; two edges are inserted, refer to Figure 2-50. Deactivate **Insert Edge Loop Tool** by pressing **w** and then press **3** to view *mug* in the smooth mode.
9. Maximize the persp viewport. Press **1** to switch back to the original mode. Make sure *mug* is selected and then press and hold the right mouse button; a marking menu is displayed. Choose **Face** from the marking menu; the face selection mode is activated. Now, select the top faces of *mug* using the **SHIFT** key, as shown in Figure 2-51. Next, choose **Edit Mesh > Extrude** from the menubar.

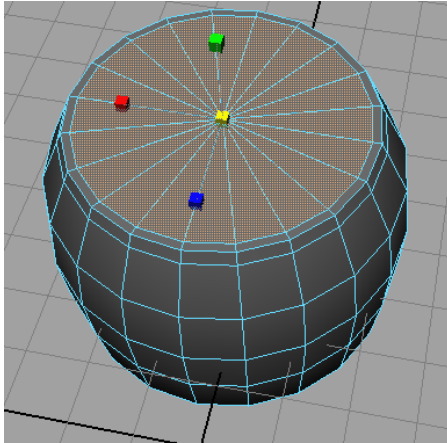


**Figure 2-50** Two edges inserted at the top and bottom of the cylinder

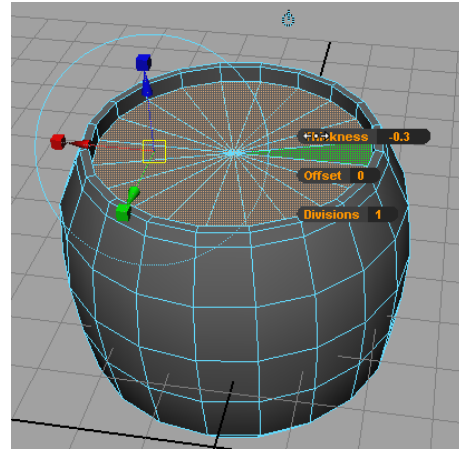


**Figure 2-51** Top faces of the cylinder selected

10. Invoke **Scale Tool** and scale down the selected faces uniformly, as shown in Figure 2-52.
11. Again, choose **Edit Mesh > Extrude** from the menubar; the **Thickness** slider is displayed; the shape of the cursor changes. Next, drag the cursor toward left in the viewport such that the value in the **Thickness** edit box becomes equal to **-0.3**, as shown in Figure 2-53.



**Figure 2-52** The top faces of the mug scaled down using **Scale Tool**



**Figure 2-53** Faces of the mug extruded downward

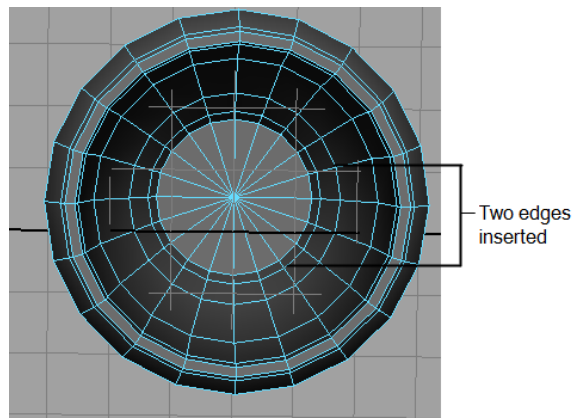
12. Press g key to invoke the **Extrude** tool again and enter the value **-1.6** in the **Thickness** edit box; the top faces of *mug* are extruded inwards.



### Note

*The g key is used to repeat the last performed action in Maya.*

13. Press g again to invoke the **Extrude** tool, and enter the value **-2** in the **Thickness** edit box. In addition to this, enter **0.8** in the **Offset** edit box; the *mug* is extruded inward.
14. Rotate the *mug* in the viewport such that you can view the inner area of *mug*. Press 3 to view the object in smooth mode. To rectify the distortion in the geometry, press 1 and then insert two edges. Choose **Edit Mesh > Insert Edge Loop Tool**, refer to Figure 2-54. Deactivate **Insert Edge Loop Tool** by pressing w.



**Figure 2-54** Two edges inserted inside the mug

## Creating the Handle of the Mug

In this section, you need to create the handle of the mug.

1. Maximize the side viewport. Press 5 to switch to the shaded mode. Select *mug* and then press and hold the right mouse button; a marking menu is displayed. Choose **Face** from the marking menu; the face selection mode is activated. Next, select a face of *mug*, as shown in Figure 2-55.
2. Choose **Edit Mesh > Extrude** from the menubar. Next, invoke **Scale Tool** by pressing the r key and scale down the selected faces of *mug*, as shown in Figure 2-56.

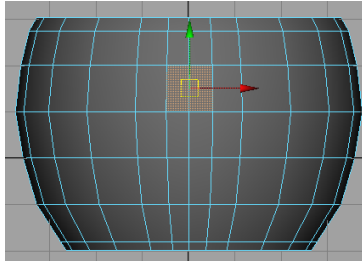


Figure 2-55 A face of mug selected

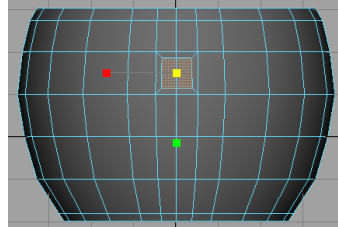


Figure 2-56 Face of the mug scaled down

3. Select the face of *mug*, as shown in Figure 2-57. Repeat the procedure as done in Step 2 to scale down the face, refer to Figure 2-58.

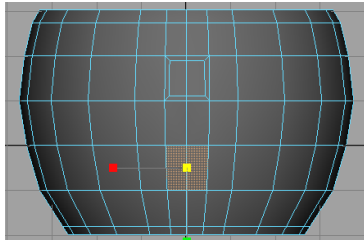


Figure 2-57 A face of the mug selected

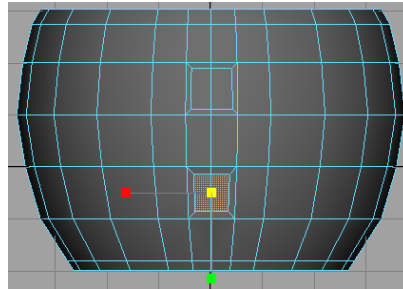


Figure 2-58 A face of the mug scaled down

4. Maximize the persp viewport. Make sure both the scaled faces are selected, and then invoke the **Extrude** tool by pressing g. Next, enter the value **0.8** in the **Thickness** edit box; the selected faces of *mug* are extruded.
5. Make sure the two extruded faces are selected. Choose **Edit Mesh > Bridge > Option Box** from the menubar; the **Bridge Options** dialog box is displayed. In this dialog box, enter the values, as shown in Figure 2-59. Next, choose the **Apply** button and close the dialog box; the extruded faces are connected to each other.

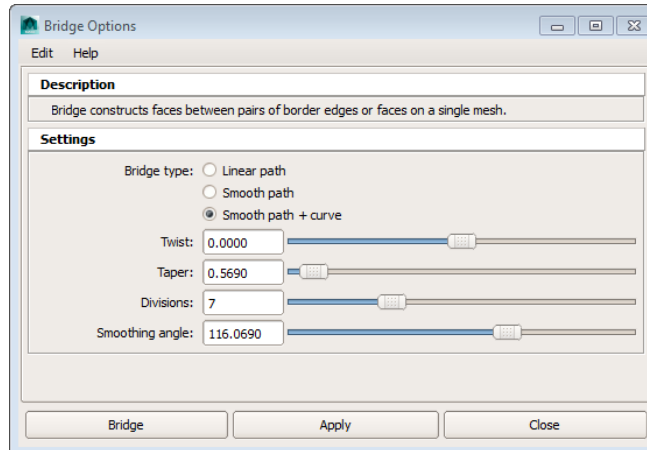


Figure 2-59 The *Bridge Options* dialog box

6. Make sure *mug* is selected and then press and hold the right mouse button on it; a marking menu is displayed. Next, choose **Object Mode** from the marking menu; the object selection mode is activated.
7. Next, choose **Mesh > Smooth** from the menubar; the mesh of *mug* is smoothed. Press SPACEBAR; the four viewports are displayed. Figure 2-60 shows the four views of *mug* after applying **Smooth Tool**.

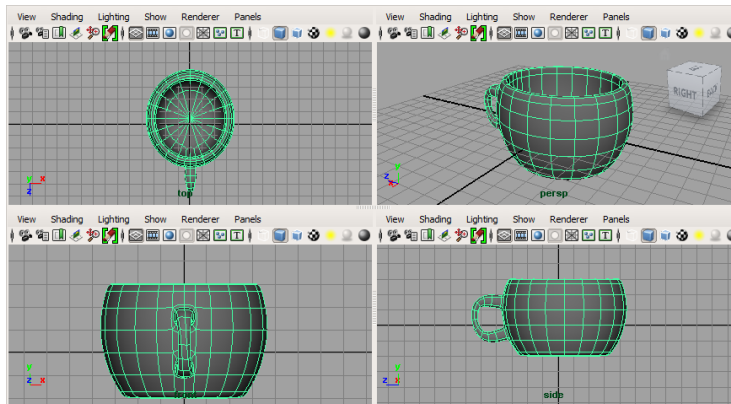


Figure 2-60 The *mug* displayed in all viewports

## Changing the Background Color of the Scene

In this section, you will change the background color of the scene.

1. Choose **Window > Outliner** from the menubar; the **Outliner** window is displayed. Select the **persp** camera in the **Outliner** window; the **perspShape** tab is displayed in the **Attribute Editor**.
2. In the **perspShape** tab, expand the **Environment** area and drag the **Background Color** slider bar towards right to change the background color to white.

## Saving and Rendering the Scene

In this section, you will save the scene that you have created and then render it. You can view the final rendered image of the scene by downloading the *c02\_maya\_2014\_rndr.zip* file from [www.cadcam.com](http://www.cadcam.com). The path of the file is as follows: *Textbooks > Animation and Visual Effects > Maya > Autodesk Maya 2014: A Comprehensive Guide*

1. Choose **File > Save Scene** from the menubar.
2. Maximize the persp viewport, if it is not already maximized. Choose the **Render the current frame** button from the Status Line; the **Render View** window is displayed. This window shows the final output of the scene, refer to Figure 2-44.

## Tutorial 2

In this tutorial, you will create the model of a skateboard, as shown in Figure 2-61, using the polygon modeling techniques. **(Expected time: 30 min)**



*Figure 2-61 The model of a skateboard*

The following steps are required to complete this tutorial:

- a. Create a project folder.
- b. Create the deck.
- c. Create the base.
- d. Create the wheels.
- e. Change the background color of the scene.
- f. Save and render the scene.

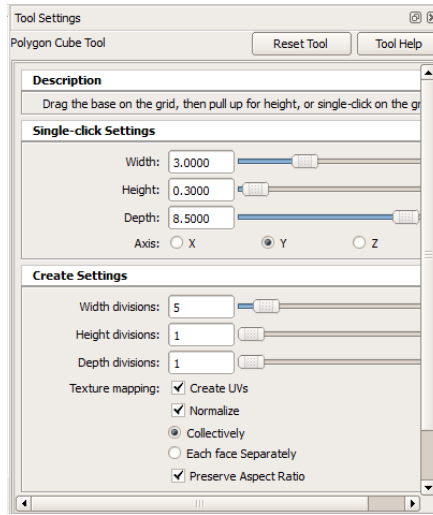
## Creating the Project Folder

Create a new project folder with the name *c02\_tut2* at *|Documents\maya2014* and then save the file with the name *c02tut2*, as discussed in Tutorial 1.

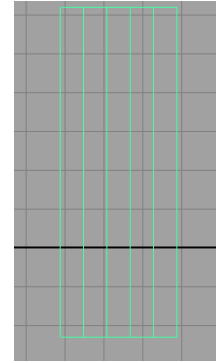
## Creating the Deck

In this section, you need to create the deck of the skateboard using the **Cube** tool.

1. Maximize the top viewport. Choose **Create > Polygon Primitives > Cube > Option Box** from the menubar; the **Tool Settings (Polygon Cube Tool)** window is displayed in the viewport. Enter the required values in the **Tool Settings (Polygon Cube Tool)** window, as shown in Figure 2-62. Next, click in the top viewport; a cube is created in the top viewport, as shown in Figure 2-63.

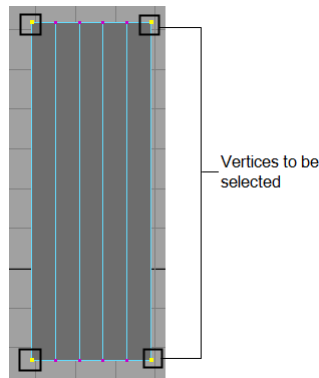


**Figure 2-62** The *Tool Settings (Polygon Cube Tool)* window

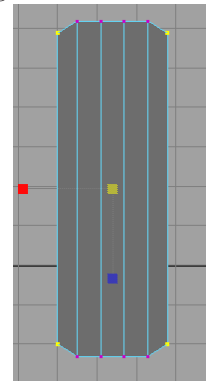


**Figure 2-63** The cube created

2. Press 5 to change the wireframe mode to **Smooth Shade All**. In the **Channel Box / Layer Editor**, click on **pCube1**; a text box is activated. Next, enter **deck** in the text box and press ENTER; **pCube1** is renamed as **deck**.
3. In the top viewport, press and hold the right mouse button on **deck**; a marking menu is displayed. Choose **Vertex** from the marking menu; the vertex selection mode is activated. Next, select the vertices, as shown in Figure 2-64. Next, choose **Scale Tool** by pressing the r key and scale the vertices uniformly, refer to Figure 2-65.



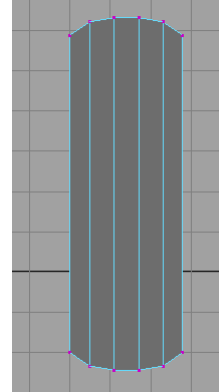
**Figure 2-64** The vertices to be scaled



**Figure 2-65** The selected vertices scaled

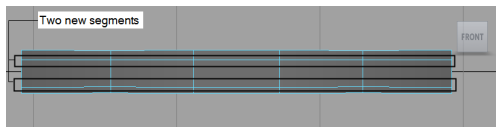
4. Similarly, scale the other vertices to create the basic shape of **deck**, as shown in Figure 2-66.
5. Press and hold the right mouse button on **deck**; a marking menu is displayed. Next, choose **Object Mode** from the marking menu; the object selection mode is activated. Select **deck** and maximize the front viewport.

- Press 5 to change the wireframe mode to **Smooth Shade All**. Make sure the **Polygons** menuset is selected from the **Menuset** drop-down list in the Status Line, if it is not already selected. Next, choose **Edit Mesh > Insert Edge Loop Tool** from the menubar; the shape of the cursor changes. Click on the top and bottom vertical edge and create two new segments on *deck*, as shown in Figure 2-67.

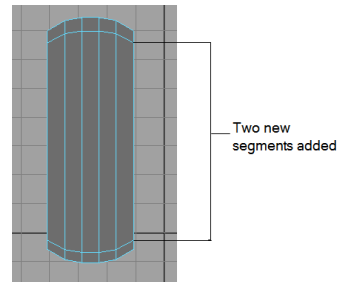


**Figure 2-66** The basic shape of the deck

- Maximize the top viewport and repeat the previous step to create two segments on *deck*, as shown in Figure 2-68. Choose **Select Tool** to deactivate **Insert Edge Loop Tool**.
- Press and hold the right mouse button on *deck*; a marking menu is displayed. Choose **Object Mode** from the marking menu; the object selection mode is activated.
- Select *deck* and choose **Mesh > Smooth > Option Box** from the menubar; the **Smooth Options** dialog box is displayed. In the **Smooth Options** dialog box, make sure the **Division levels** value is set to **1**. Now, choose the **Smooth** button; the geometry of *deck* is smoothed.



**Figure 2-67** Two new segments created in the front viewport

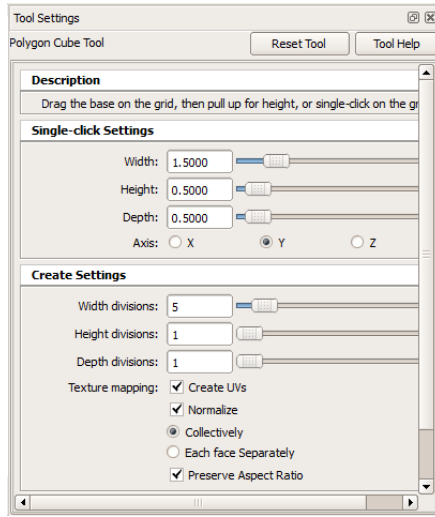


**Figure 2-68** Two segments created in the top viewport

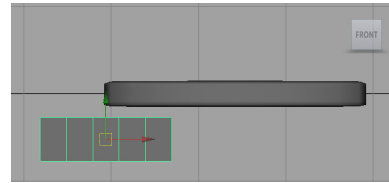
## Creating the Base

In this section, you need to create the base of the skateboard using the **Cube** polygon primitive.

- Maximize the front viewport. Choose **Create > Polygon Primitives > Cube > Option Box** from the menubar; the **Tool Settings (Polygon Cube Tool)** window is displayed in the viewport. Enter the required values in the **Tool Settings (Polygon Cube Tool)**, as shown in Figure 2-69. Next, click in the front viewport; a cube is created in the front viewport, as shown in Figure 2-70.

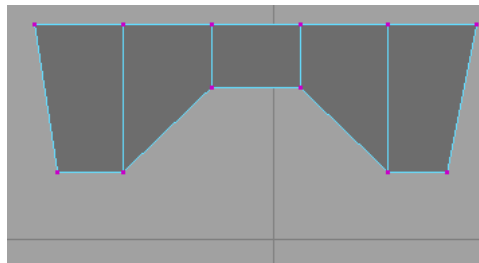


**Figure 2-69** The Tool Settings (Polygon Cube Tool) window

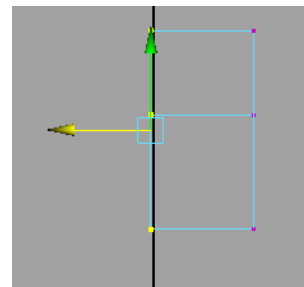


**Figure 2-70** The Cube created

2. In the **Channel Box / Layer Editor**, click on **pCube1**; a text box is activated. Next, enter **base** in the text box and press ENTER; **pCube1** is renamed as **base**.
3. In the front viewport, press and hold the right mouse button on **base**; a marking menu is displayed. Choose **Vertex** from the marking menu; the vertex selection mode is activated. Next, choose **Move Tool** from the Tool Box. Now, adjust the vertices on **base** to get the result shown in Figure 2-71.
4. Maximize the side viewport. Select the left most vertices in the side viewport and then drag them along the Z axis to reduce the size of **base**, as shown in Figure 2-72.



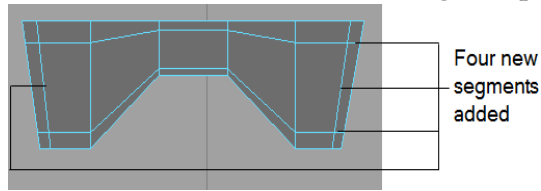
**Figure 2-71** The adjusted vertices of the base



**Figure 2-72** Dragging the selected vertices along the Z axis

5. Press and hold the right mouse button on **base**; a marking menu is displayed. Next, choose **Object Mode** from the marking menu; the object selection mode is activated.

6. Select *base* and maximize the front viewport. Next, choose **Edit Mesh > Insert Edge Loop Tool** from the menubar. Using this tool, insert four new segments, as shown in Figure 2-73. Choose **Select Tool** to deactivate **Insert Edge Loop Tool**.

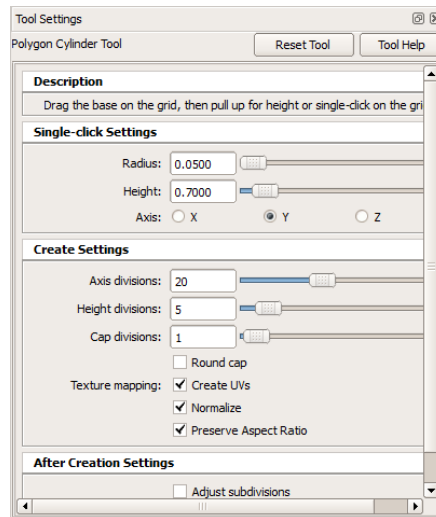


**Figure 2-73** Four new segments inserted in the front viewport

7. Press and hold the right mouse button on *base*; a marking menu is displayed. Choose **Object Mode** from the marking menu; the object selection mode is activated.
8. Select *base* and choose **Mesh > Smooth** from the menubar; the geometry of *base* is smoothened.

Next, you need to create the bolts.

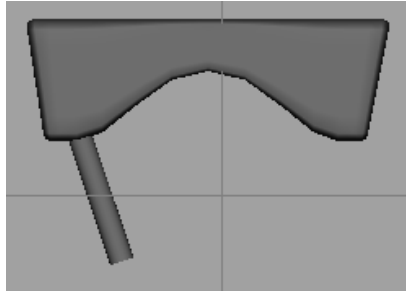
9. Choose **Create > Polygon Primitives > Cylinder > Option box** from the menubar; the **Tool Settings (Polygon Cylinder Tool)** window is displayed. Enter the required values in the **Tool Settings (Polygon Cylinder Tool)**, as shown in Figure 2-74. Click in the front viewport; a cylinder is created.



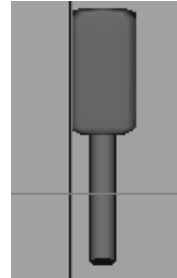
**Figure 2-74** The **Tool Settings (Polygon Cylinder Tool)** window

10. In the **Channel Box / Layer Editor**, click on **pCylinder1**; a text box is activated. Next, enter **bolt** in the text box and press ENTER; **pCylinder** is renamed as *bolt*.

11. Choose **Move Tool** from the Tool Box and align *bolt* with base in all viewports. Next, choose the **Rotate Tool** from the Tool Box to rotate and align it with both front and side viewports, as shown in Figures 2-75 and 2-76. Press 5 in the side viewport to view the object in the Shaded mode.



**Figure 2-75** The cylinder rotated and aligned in the front viewport



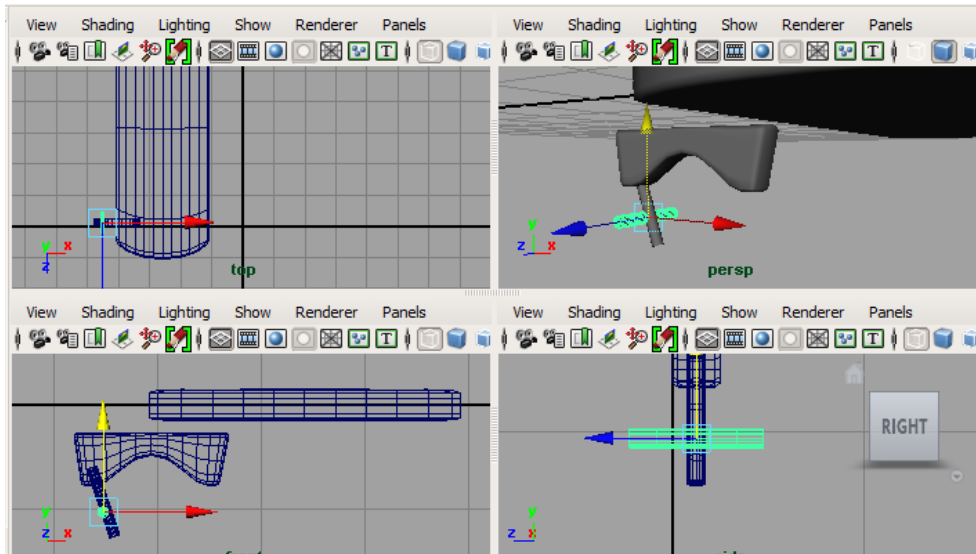
**Figure 2-76** The cylinder rotated and aligned in the side viewport

12. Activate the side viewport. Make sure *bolt* is selected and press CTRL+D; a duplicate copy of *bolt* is created with the name *bolt1*. Set the following parameters in the **Channel Box / Layer Editor** of *bolt1*:

Rotate X: **90**

Rotate Z: **0**

13. Choose **Scale Tool** from the Tool Box and scale *bolt1* uniformly. Next, choose **Move Tool** from the Tool Box and align it in all viewports, as shown in Figure 2-77.



**Figure 2-77** Aligning *bolt1* in all viewports

Next, you need to create *truck*.

14. Maximize the front viewport. Choose **Create > Polygon Primitives > Cylinder > Option box** from the menubar; the **Tool Settings (Polygon Cylinder Tool)** window is displayed

in the viewport. In the **Tool Settings (Polygon Cylinder Tool)** window, set the parameters as follows:

Axis: Z

Radius: **0.65**

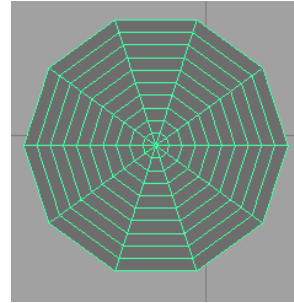
Height: **1**

Axis divisions: **10**

Height divisions: **3**

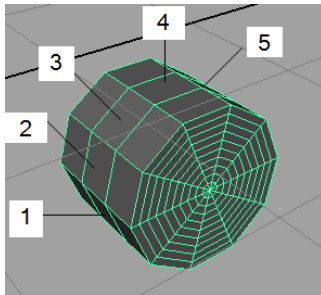
Cap Divisions: **10**

Next, click in the viewport; the cylinder is created, as shown in Figure 2-78.

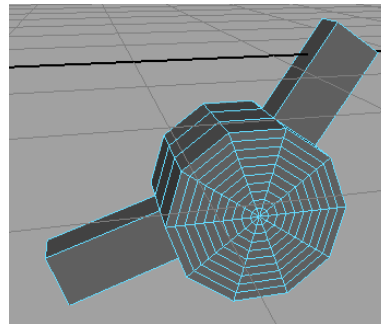


**Figure 2-78** The cylinder created in the front viewport

15. In the **Channel Box / Layer Editor**, click on **pCylinder1**; a text box is activated. Next, enter **truck** in the text box and press ENTER; the **pCylinder2** is renamed as *truck*.
16. Maximize the persp viewport. Press and hold the right mouse button over *truck* and choose **Face** from the marking menu displayed; the face selection mode is activated. Select the faces 1 and 5 of *truck*, refer to Figure 2-79. Next, choose **Edit Mesh > Extrude** from the menubar; the extrude manipulator is displayed on the screen. Drag the blue arrow to extrude the faces in the persp viewport; the faces of *truck* are extruded, as shown in Figure 2-80.

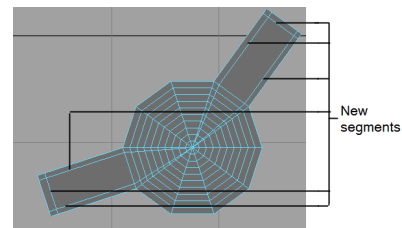


**Figure 2-79** The cylinder after extrusion in the persp viewport



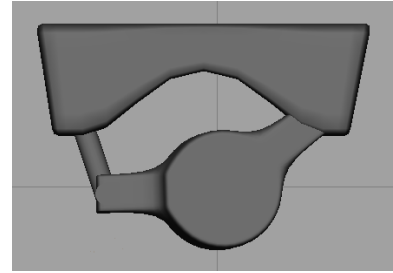
**Figure 2-80** The cylinder after extrusion in the persp viewport

17. Press and hold the right mouse button over *truck*; a marking menu is displayed. Choose **Object Mode** from the marking menu; the object selection mode is activated.
18. Maximize the front viewport and then select *truck*. Choose the **Edit Mesh > Insert Edge Loop Tool** from the menubar and add new segments to *truck*, as shown in Figure 2-81.
19. Press and hold the right mouse button on *truck*; a marking menu is displayed. Choose **Object Mode** from it; the object component of *truck* is activated. Next, choose **Mesh > Smooth > Option Box** from the menubar; the **Smooth Options** dialog box is displayed.



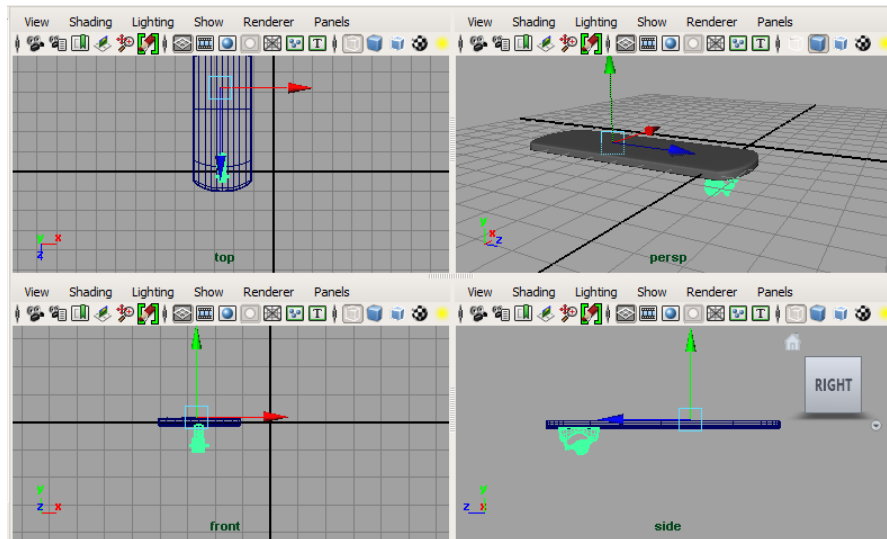
**Figure 2-81** New segments added to *truck* in the front viewport

20. In the dialog box, enter **2** in the **Division levels** edit box and then choose the **Smooth** button; the geometry of *truck* is smoothened. Choose **Move Tool** from the Tool Box and align *truck* with *base* in all viewports. Next, choose **Scale Tool** from the Tool Box and scale it uniformly. Choose **Rotate Tool** and align the parts with *base* and *bolt*, refer to Figure 2-82.



*Figure 2-82 The parts aligned with base in the front viewport*

21. Press and hold the SHIFT key and select *base*, *truck*, *bolt*, and *bolt1* in the persp viewport. Next, choose **Mesh > Combine** from the menubar; the selected parts are combined and a group with the name **polySurface1** is created.
22. In the **polySurface1** area of the **Channel Box / Layer Editor**, enter **90** in the **Rotate Y** edit box and then press the ENTER key; the .
23. Choose **Move Tool** and **Scale Tool** from the Tool Box and align **polySurface1** in all viewports to make it proportional with the deck, as shown in Figure 2-83.



*Figure 2-83 The selected parts aligned*

## Creating the Wheels

In this section, you need to create wheels for the skateboard using the **Torus** polygon primitive.

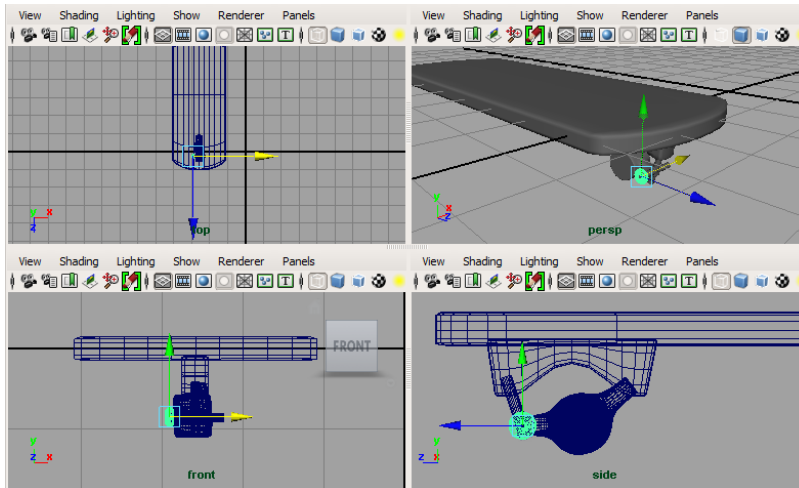
1. Choose **Create > Polygon Primitives > Torus** from the menubar. Next, click in the top viewport to create a torus.

- In the **INPUTS** node of the **Channel Box / Layer Editor**, expand **polyTorus1** and set the following parameters:

Radius: **0.07**

Section radius: **0.05**

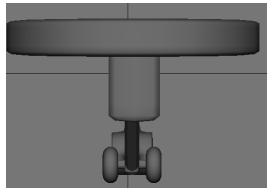
- In the **pTorus1** area of the **Channel Box/Layer Editor**, enter **90** in the **Rotate Z** edit box.
- In the **Channel Box / Layer Editor**, rename **pTorus1** as *wheel*, as done earlier.
- Choose **Move Tool** from the Tool Box to align the *wheel* with *bolt1*, as shown in Figure 2-84.



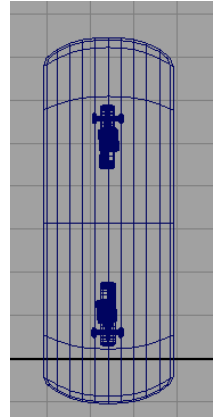
**Figure 2-84** Position of wheel in all the viewports

- Maximize the front viewport. Select *wheel* and then press CTRL+D; a duplicate copy of *wheel* is created with the name *wheel1*. Next, move *wheel1* in the opposite direction, as shown in Figure 2-85.
- Maximize the persp viewport. Select *polySurface1*, *wheel*, and *wheel1* by using the SHIFT and then choose **Mesh > Combine** from the menubar; the selected parts are combined to form a single mesh and a group with the name **polySurface2** is created.
- Choose **Modify > Center Pivot** from the menubar; the pivot point of the combined **polySurface2** is set to center. Next, press CTRL+d; a duplicate copy of the selected mesh is created in the viewport.
- Maximize the top viewport. In the top viewport, move *polySurface3* along the Z axis and rotate it. Next, align it with *deck*, as shown in Figure 2-86.
- Maximize the side viewport. Select *deck*. Press and hold the right mouse button on *deck*; a marking menu is displayed. Choose **Vertex** from the marking menu; the vertex selection mode is activated. Choose **Move Tool** from the Tool Box. Select the vertices and move up along the Y axis in the side viewport, as shown in Figure 2-87.

11. Press and hold the right mouse button on *deck*; a marking menu is displayed. Choose **Object Mode** from the marking menu; the object selection mode is activated.
12. Maximize the persp viewport and select all parts of the skateboard in the persp viewport. Next, choose **Mesh > Combine** from the menubar; the selected parts are combined.



*Figure 2-85 The wheel1 aligned to another end of the polySurface1*



*Figure 2-86 Alignment of polySurface2*



*Figure 2-87 Moving the selected vertices up along the Y axis*

## Changing the Background Color of the Scene

In this section, you will change the background color of the scene.

1. Choose **Window > Outliner** from the menubar; the **Outliner** window is displayed. Select the **persp** camera in the **Outliner** window; the **perspShape** tab is displayed in the **Attribute Editor**.
2. In the **perspShape** tab, expand the **Environment** area and drag the **Background Color** slider bar towards right to change the background color to white.

## Saving and Rendering the Scene

In this section, you will save the scene that you have created and then render it. You can view the final rendered image of the model by downloading the *c02\_maya\_2014\_rndr.zip* file from [www.cadcim.com](http://www.cadcim.com). The path of the file is as follows: *Textbooks > Animation and Visual Effects > Maya > Autodesk Maya 2014: A Comprehensive Guide*

1. Choose **File > Save Scene** from the menubar.
2. Maximize the persp viewport, if it is not already maximized. Choose the **Render the current frame** button from the Status Line; the **Render View** window is displayed. This window shows the final output of the scene, refer to Figure 2-61.

## Self-Evaluation Test

Answer the following questions and then compare them to those given at the end of this chapter:

1. Which of the following geometric shapes is formed by connecting a polygonal base and an apex?
 

(a) <b>Prism</b>	(b) <b>Pyramid</b>
(c) <b>Sphere</b>	(d) <b>Cube</b>
2. Which of the following shortcuts can be used to display an object in the object mode?
 

(a) <b>F8</b>	(b) <b>F9</b>
(c) <b>F10</b>	(d) <b>F11</b>
3. The \_\_\_\_\_ is used to merge two vertices together by dragging source vertex toward the target vertex.
4. A \_\_\_\_\_ is similar to a hollow cylinder with thickness.
5. A \_\_\_\_\_ is a curve in three dimensional space such that its angle to a plane perpendicular to the axis is constant.
6. The \_\_\_\_\_ solids are those primitives, in which all sides and angles are equal, and all faces are identical.
7. The **Insert Edge Loop Tool** is used to create beveled transition surfaces on a profile curve. (T/F)
8. The **Chamfer Vertex** tool is used to merge the selected edges and vertices that are within a numerically specified threshold distance from each other. (T/F)

9. The **Bridge** tool is used to connect two faces of a polygon object. (T/F)
10. The \_\_\_\_\_ tool is used to reduce the number of polygons in the selected region of an object.

## Review Questions

Answer the following questions:

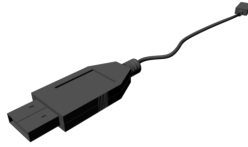
1. Which of the following tools is used to add smoothness to a sharp edge?  
(a) **Extrude** (b) **Duplicate face**  
(c) **Bevel** (d) **Merge to Center**
2. Which of the following primitives is formed by an alternate arrangement of hexagons and pentagons?  
(a) **Prism** (b) **Helix**  
(c) **Soccer ball** (d) **Sphere**
3. The \_\_\_\_\_ option is used to create a duplicate copy of a selected face.
4. The \_\_\_\_\_ tool is used to add segments on both the sides of a selected edge.
5. The function of the **Merge To Center** tool is similar to the \_\_\_\_\_ tool.
6. The \_\_\_\_\_ tool is used to replace a vertex with a flat polygon face.
7. The \_\_\_\_\_ operation is used to merge two intersecting objects by deleting the intersecting geometry between them.
8. The **Merge** tool is used to merge selected edges and vertices that are within a numerically specified threshold distance of each other. (T/F)
9. The **Cut Faces Tool** is used to modify a selected object by splitting its faces along a cut line. (T/F)
10. The **Merge Vertex Tool** is used to merge vertices together to the center of the selection. (T/F)

## EXERCISES

The rendered output of the models used in the following exercises can be accessed by downloading the file *c02\_maya\_2014\_exr.zip* from [www.cadcim.com](http://www.cadcim.com). The path of the file is as follows: *Textbooks > Animation and Visual Effects > Maya > Autodesk Maya 2014: A Comprehensive Guide*

## Exercise 1

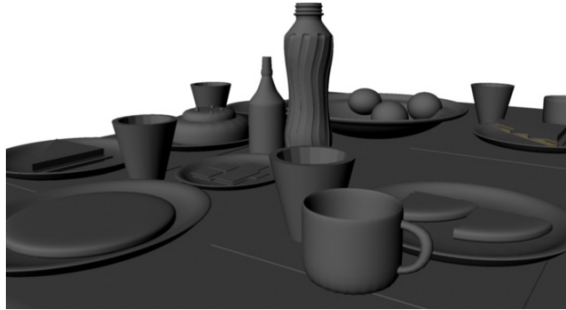
Using various polygon modeling techniques, create the model of a USB cable, as shown in Figure 2-88. **(Expected time: 30 min)**



*Figure 2-88 Model to be created in Exercise 1*

## Exercise 2

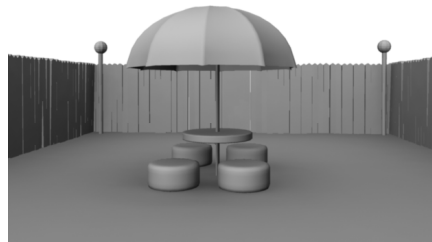
Using various polygon modeling techniques, create a scene, as shown in Figure 2-89. **(Expected time: 30 min)**



*Figure 2-89 Scene to be created in Exercise 2*

## Exercise 3

Using polygon primitive modeling techniques, create a scene, as shown in Figure 2-90. **(Expected time: 30 min)**



*Figure 2-90 Scene to be created in Exercise 3*

### Answers to Self-Evaluation Test

1. b, 2. a, 3. Merge Vertex Tool, 4. pipe, 5. helix, 6. platonic, 7. F, 8. F, 9. T, 10. Reduce