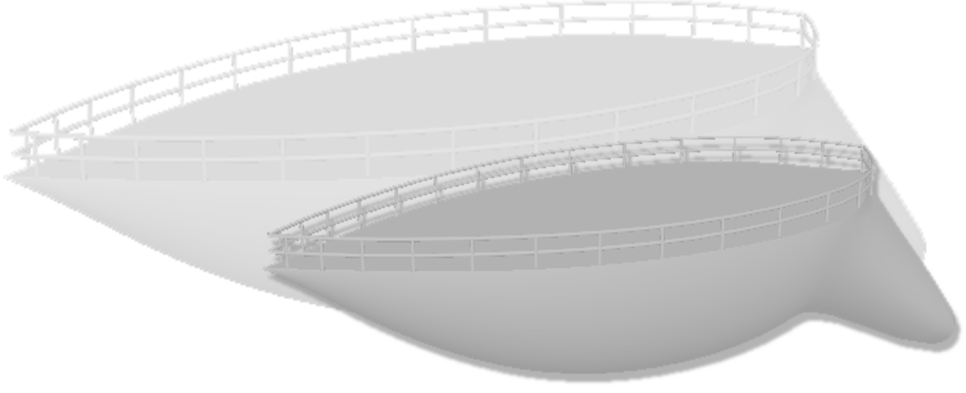
Chapter 4

NURBS Modeling

Learning Objectives

After completing this chapter, you will be able to:

- *Understand NURBS editing techniques*
- *Converting NURBS objects to polygons*



NURBS MODELING

The NURBS (Non Uniform Rational B-Spline) modeling is mainly used to do organic modeling. NURBS modeling can be used to model any simple or complex model using a 2D line, circle, arc, or curve. In the previous chapter, you have learned about different methods of creating NURBS surfaces. In this chapter, you will learn about various editing techniques used for modifying NURBS surfaces. The tools for modifying the NURBS surfaces are discussed next.

Duplicate NURBS Patches

Menubar: Edit NURBS > Duplicate NURBS Patches

The **Duplicate NURBS Patches** tool is used to make a duplicate NURBS patch from an existing one. To do so, choose **Create > NURBS Primitives > Sphere** from the menubar and create a NURBS sphere in the viewport. After creating the sphere, press 5 to switch to the shaded mode. Select the sphere, press and hold the right mouse button over the sphere and choose **Surface Patch** from the marking menu, as shown in Figure 4-1; the surface patch component will be activated on the NURBS sphere. Now, select the surface patch that you want to duplicate. Choose **Edit NURBS > Duplicate NURBS Patches** from the menubar; a duplicate surface patch will be created. Invoke the **Move Tool** from the Tool Box and move the duplicate surface patch away from the NURBS sphere. Note that the pivot point of the duplicate surface patch will remain at the same position as that of the NURBS sphere. To reset the pivot point to the center of the duplicate patch, choose **Modify > Center Pivot** from the menubar; the pivot point will be reset to its default position automatically.

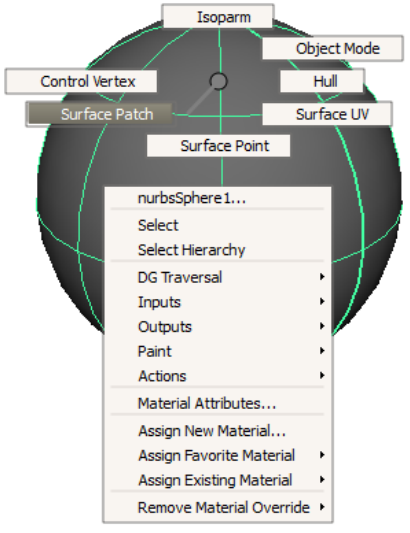


Figure 4-1 *Choosing the* ***Surface Patch*** *option from the marking menu*

Project Curve on Surface

Menubar: Edit NURBS > Project Curve on Surface

The **Project Curve on Surface** tool is used to project a NURBS curve on a NURBS surface. To do so, activate the front viewport and choose **Create > NURBS Primitives > Square** from the menubar and create a square in the front viewport. Now, choose **Surfaces > Planar** from the menubar to create a NURBS surface. After creating the NURBS surface, press 5 to switch to the shaded mode. Next, choose **Create > EP Curve Tool** from the menubar to create a curve, as shown in Figure 4-2. Next, select the NURBS curve, press and hold the SHIFT key and choose NURBS surface. Then, choose **Edit NURBS > Project Curve on Surface** from the menubar to project the curve on the surface and activate the persp viewport; the NURBS curve will be projected over the NURBS surface, as shown in Figure 4-3.

Note

The curve will be projected exactly at the same position, as visible through the camera of that particular viewport.

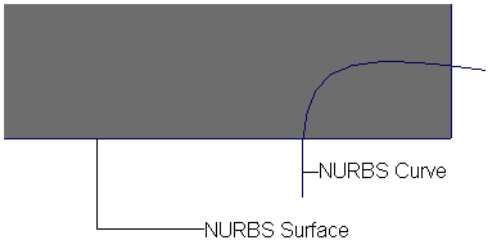


Figure 4-2 *NURBS curve created*

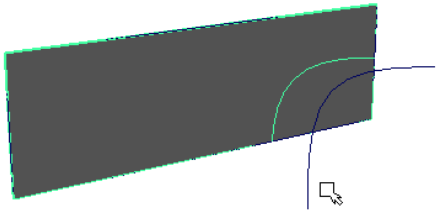


Figure 4-3 *NURBS curve projected on the NURBS surface*

Intersect Surfaces

Menubar: Edit NURBS > Intersect Surfaces

The **Intersect Surfaces** tool is used to create a new segment at the intersection of two NURBS surfaces. To do so, create two surfaces, as discussed earlier, and align them such that they intersect with each other, as shown in Figure 4-4. Select both the surfaces and choose **Edit NURBS > Intersect Surfaces** from the menubar; the selection handles will be displayed at the intersection point, refer to Figure 4-4. You can now move these handles to align the intersection point anywhere on the NURBS surface.

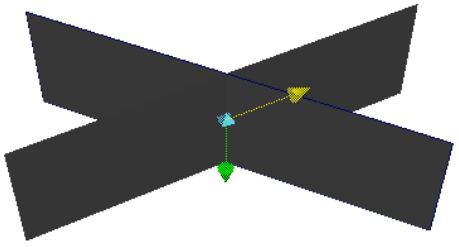


Figure 4-4 *The aligned surfaces and the selection handles*

Trim Tool

Menubar: Edit NURBS > Trim Tool

The **Trim Tool** is used to trim a particular area from the NURBS surface. To do so, project a curve on the surface as discussed in the **Project Curve on Surface** section. Next, select the NURBS surface and choose **Edit NURBS > Trim Tool** from the menubar; the NURBS surface will change to the wireframe mode with a dotted outline. Select the part that you want to trim from the surface and press ENTER; the surface will be trimmed. You can also change the settings of the **Trim Tool** as per your requirement. To do so, choose **Edit NURBS > Trim Tool > Option Box** from the menubar; the **Tool Settings** (**Trim Tool)** window will appear on

the left of the viewport, as shown in Figure 4-5. You can select the **Keep** radio button to keep the part that you selected from the NURBS surface and trim the unselected part. Similarly, you can select the **Discard** radio button to trim the selected part from the NURBS surface and keep the unselected part.

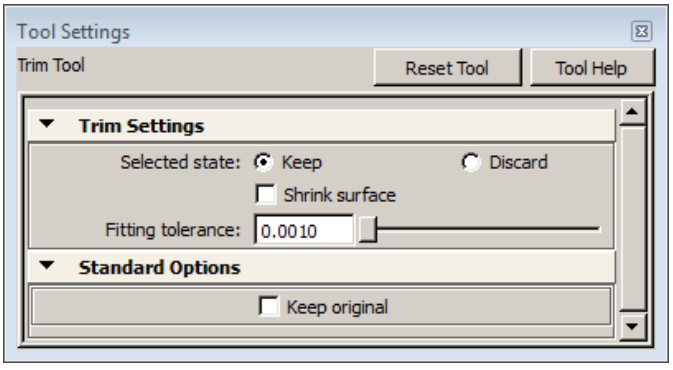


Figure 4-5 *The* ***Tool Settings (Trim Tool)*** *window*

Untrim Surfaces

Menubar: Edit NURBS > Untrim Surfaces

The **Untrim Surfaces** tool is used to untrim the trimmed surface. To do so, select the trimmed surface and choose **Edit NURBS > Untrim Surfaces** from the menubar; the surface changes back to the untrimmed surface.

Attach Surfaces

Menubar: Edit NURBS > Attach Surfaces

The **Attach Surfaces** tool is used to attach two selected NURBS surfaces. To do so, create two NURBS surfaces in the viewport, as shown in Figure 4-6. Next, select the two surfaces and choose **Edit NURBS > Attach Surfaces > Option Box** from the menubar; the **Attach Surfaces Options** dialog box will be displayed in the viewport, as shown in Figure 4-7. The **Blend** radio button is selected by default in the **Attach method** area of this dialog box. Choose the **Apply** button; the selected surfaces will be connected, as shown in Figure 4-8. You can also select the **Connect** radio button from the **Attach** method area to connect one end of the surface to another end of other surface, as shown in Figure 4-9.

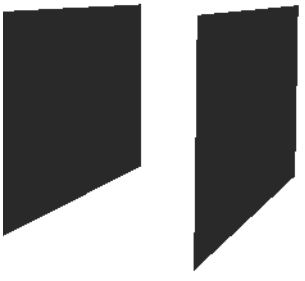


Figure 4-6 *The two NURBS surfaces*



Note

The ***Attach Surfaces*** *tool does not attach trimmed surfaces. For attaching two surfaces, they need to be untrimmed.*

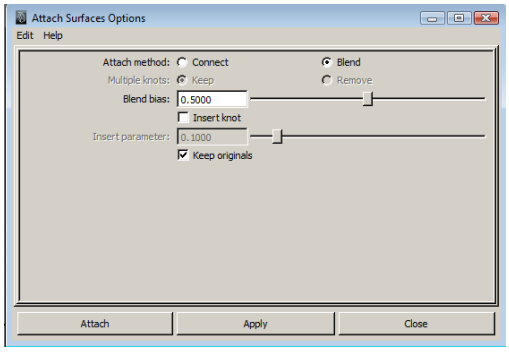


Figure 4-7 *The* ***Attach Surfaces Options*** *dialog box*



Figure 4-8 *Surfaces blend by using the* ***Blend*** *radio button*



Figure 4-9 *Connecting surfaces by using the* ***Connect*** *radio button*

Attach Without Moving

Menubar: Edit NURBS > Attach Without Moving

The **Attach Without Moving** tool is used to attach two NURBS surfaces by selecting their respective isoparms. To do so, create two NURBS surfaces and select one isoparm each from the two surfaces. Now, choose **Edit NURBS > Attach Without Moving** from the menubar; the two surfaces will be attached along the two isoparms.

Detach Surfaces

Menubar: Edit NURBS > Detach Surfaces

The **Detach Surfaces** tool is used to detach the attached NURBS surfaces. To do so, select the isoparm of a surface that is attached to another surface and then choose **Edit NURBS > Detach Surfaces** from the menubar; the surface will detach from the selected isoparm.



Tip. *You can make changes in the attached surfaces by using the* ***attachSurface1*** *tab in the* ***Attribute Editor***. *To do so, choose* ***Window > Attribute Editor*** *from the menubar; the* ***Attribute Editor*** *will be displayed. Choose the* ***attachSurface1*** *tab from the* ***Attribute Editor****; the properties of the attached surface will be displayed, as shown in Figure 4-10. You can apply different styles on the surface by using the parameters in the* ***Attribute Editor***.

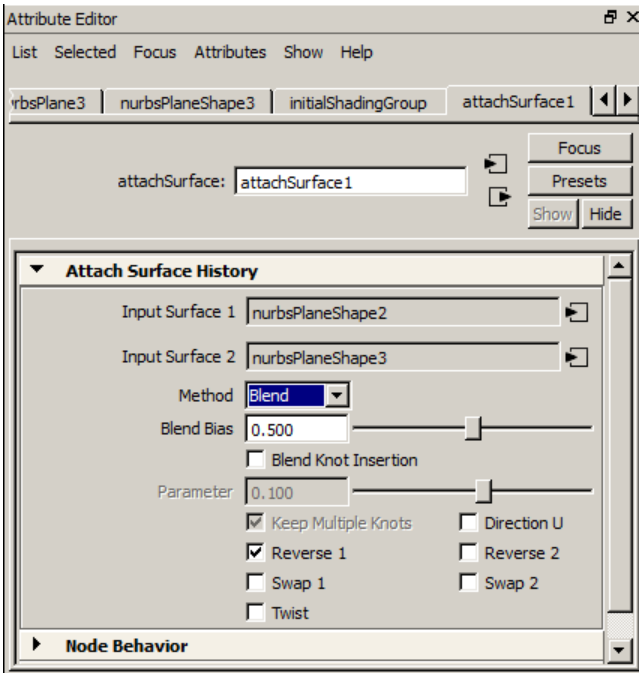


Figure 4-10 *The* ***attachSurface1*** *tab in the* ***Attribute Editor***

Align Surfaces

Menubar: Edit NURBS > Align Surfaces

The **Align Surfaces** tool is used to align the selected NURBS surfaces. To do so, select the NURBS surfaces that you want to align. Choose **Edit NURBS > Align Surfaces > Option Box** from the menubar; the **Align Surfaces Options** dialog box will be displayed, as shown in Figure 4-11. Now, you can try different options in this dialog box to align the selected NURBS surfaces as per your requirement.

Open/Close Surfaces

Menubar: Edit NURBS > Open/Close Surfaces

The **Open/Close Surfaces** tool is used to open or close the NURBS surfaces. To close an open surface, as shown in Figure 4-12, select the surface and choose **Edit NURBS > Open/Close Surfaces** from the menubar; the open surface will be closed, as shown in Figure 4-13. Similarly, select the closed surface in the viewport and choose **Edit NURBS > Open/Close Surfaces** from the menubar; the closed surface will change into an open surface.

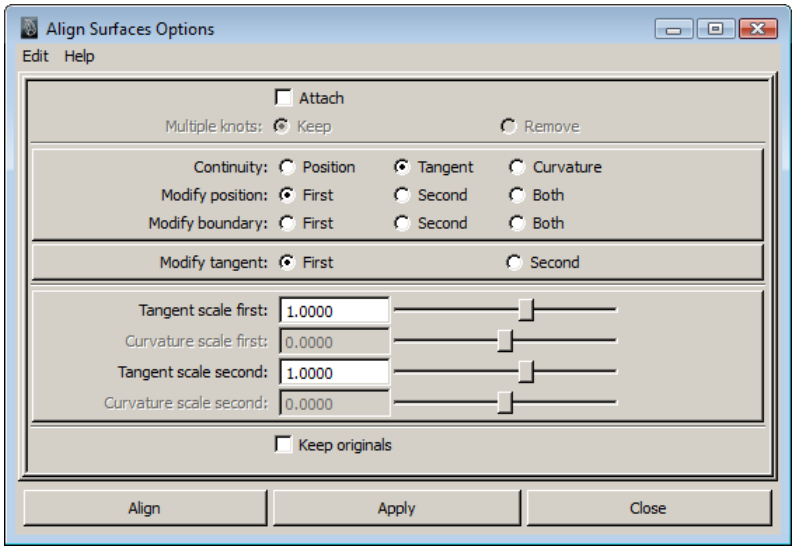


Figure 4-11 *The* ***Align Surfaces Options*** *dialog box*

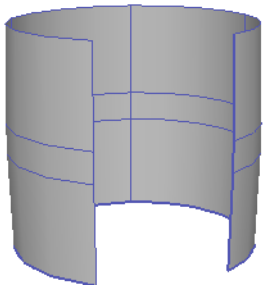


Figure 4-12 *The open NURBS surface*

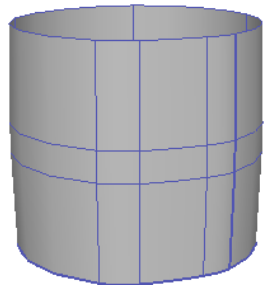


Figure 4-13 *The closed NURBS surface*

Insert Isoparms

Menubar: Edit NURBS > Insert Isoparms

The **Insert Isoparms** tool is used to insert an isoparm on a NURBS surface. To do so, create a NURBS surface and then select it. Next, press and hold the right mouse button on the NURBS surface and choose **Isoparm** from the marking menu; the isoparms will be highlighted on the selected NURBS object. Now, press and hold the left mouse button on any NURBS isoparm and drag the mouse to specify the position for the new isoparm; a yellow dotted line will appear over the NURBS surface, as shown in Figure 4-14. Next, choose **Edit NURBS > Insert Isoparms** from the menubar; a new isoparm will be inserted in place of the yellow dotted line.

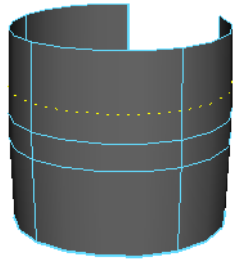


Figure 4-14 *The yellow dotted line displayed on the NURBS surface*



Tip. *To create multiple isoparms, press and hold the SHIFT key over a NURBS isoparm and then drag the mouse; multiple yellow dotted lines will appear on the NURBS surface. Now, choose* ***Edit NURBS > Insert Isoparms*** *from the menubar; multiple isoparms will be created.*

Extend Surfaces

Menubar: Edit NURBS > Extend Surfaces

The **Extend Surfaces** tool is used to extend a NURBS surface. To extend a surface, create a NURBS surface in the viewport. Then, press and hold the right mouse button on the NURBS surface and choose **Isoparm** from the marking menu. Now, select the isoparm that you want to extend from the NURBS surface and choose **Edit NURBS > Extend Surfaces** from the menubar; the selected surface will be extended. To set the properties of the extended surface, choose **Edit NURBS > Extend Surfaces > Option Box** from the menubar; the **Extend Surface Options** dialog box will be displayed, as shown in Figure 4-15. Adjust the values in the dialog box to make changes in the working of the **Extend Surfaces** tool. Figures 4-16 and 4-17 show a hut roof before and after applying the **Extend Surfaces** tool. Any change made in the original surface will also be displayed in the offset surface created.

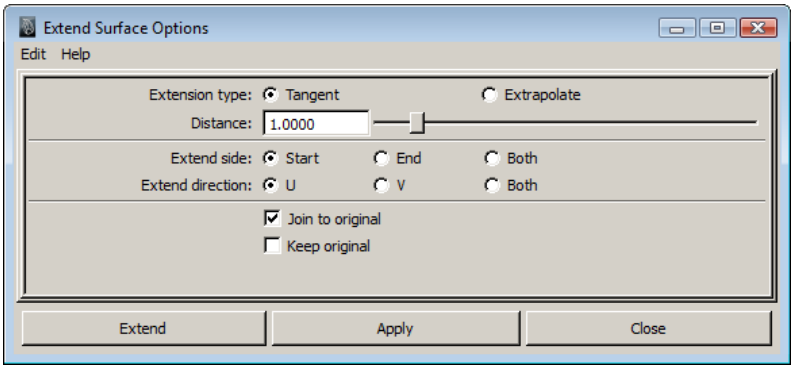


Figure 4-15 *The* ***Extend Surface Options*** *dialog box*

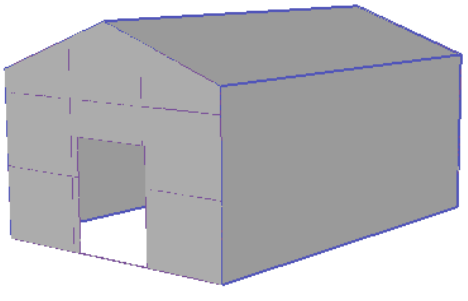


Figure 4-16 *The hut roof before applying the* ***Extend Surfaces*** *tool*

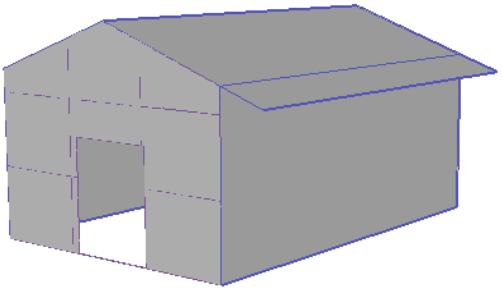


Figure 4-17 *The hut roof after applying the* ***Extend Surfaces*** *tool*

Offset Surfaces

Menubar: Edit NURBS > Offset Surfaces

The **Offset Surfaces** tool is used to create a copy of the selected surface. To do so, create a NURBS surface in the viewport, select it, and then choose **Edit NURBS > Offset Surfaces** from the menubar; a copy of the selected surface will be created. To set the properties of the **Offset Surfaces** tool, choose **Edit NURBS > Offset Surfaces > Option Box** from the menubar; the **Offset Surface Options** dialog box will be displayed, as shown in Figure 4-18. The **Offset distance** option in the dialog box is used to specify the distance of the copied surface from the original surface.

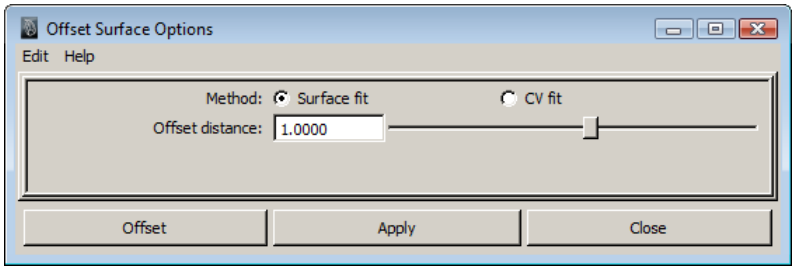


*Figure 4-18 The **Offset Surface Options** dialog box*

Reverse Surface Direction

Menubar: Edit NURBS > Reverse Surface Direction

The **Reverse Surface Direction** tool is used to reverse or swap the U and V directions of a selected surface. To do so, create a NURBS surface in the viewport, select it, and then choose **Edit NURBS > Reverse Surface Direction > Option Box** from the menubar; the **Reverse Surface Direction Options** dialog box will be displayed, as shown in Figure 4-19. Select the required radio button from the **Surface direction** area of this dialog box and then choose the **Reverse** button to reverse the surface direction.

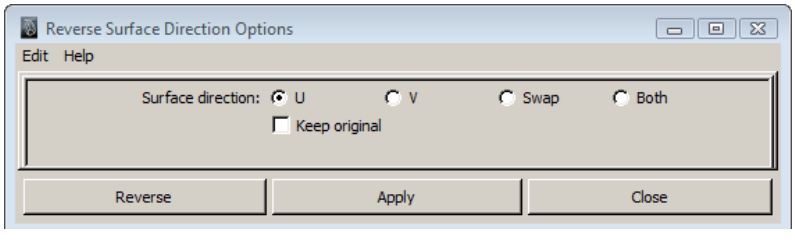


*Figure 4-19 The **Reverse Surface Direction Options** dialog box*

Rebuild Surfaces

Menubar: Edit NURBS > Rebuild Surfaces

The **Rebuild Surfaces** tool is used to rebuild the number of U and V spans on a selected NURBS surface. To do so, select the NURBS surface that you want to rebuild and choose **Edit NURBS >**

Rebuild Surfaces > Option Box from the menubar; the **Rebuild Surface Options** dialog box will be displayed, as shown in Figure 4-20. The options in this dialog box are discussed next.

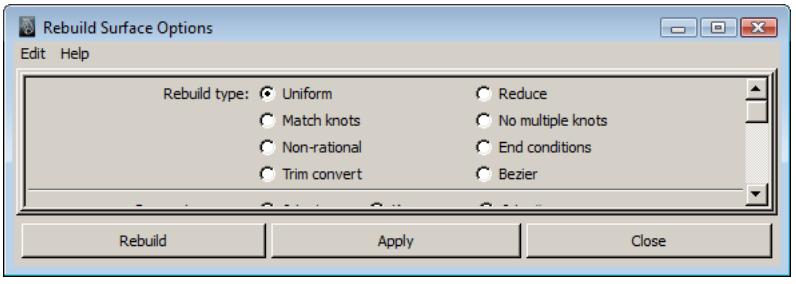


*Figure 4-20 The **Rebuild Surface Options** dialog box*

Rebuild type

You need to specify the **Rebuild type** parameter by choosing any of the following radio buttons:

Uniform

Select the **Uniform** radio button to rebuild the surface with uniform parameterization. On doing so, the number of spans will be entered uniformly on the selected surface.

Reduce

Select the **Reduce** radio button to remove the knots from the NURBS surface.

Match knots

Select the **Match knots** radio button to match the curve degree, knot values, number of spans, and sections of two surfaces.

No multiple knots

Select the **No multiple knots** radio button to remove the extra knots formed while rebuilding a surface.

Non-rational

Select the **Non-rational** radio button to convert a rational surface into a non-rational surface.

End conditions

Select the **End conditions** radio button to rebuild the positioning of the CVs and knots of the surface.

Trim convert

Select the **Trim convert** radio button to convert a trimmed surface into a non-trimmed surface.

Bezier

Select the **Bezier** radio button to rebuild a surface as a bezier surface.

Parameter range

The **Parameter range** parameter is used to specify the U and V parameters to rebuild a surface. There are three different ways to specify the U and V parameters, which are discussed next.

0 to 1

Select the **0 to 1** radio button to specify the U and V parameters from 0 to 1.

Keep

Select the **Keep** radio button to match the U and V parameters with the original surface.

0 to #spans

Select the **0 to #spans** radio button to get the rebuild surface value in integers.

Direction

The **Direction** parameter is used to determine the parametric direction of the surface in the **U**, **V**, or both **U and V** directions.

Keep

The **Keep** parameter is used to ensure that some particular characteristics of the original object or surface are retained while creating a new surface. Select the **Corners**, **CVs** or the **NumSpans** radio button to retain the corresponding characteristics.

Rebuild Method

Select the **Match Knots** radio button from the **Rebuild type** parameter to activate this radio button. The **Rebuild method** parameter is used to rebuild the surface by specifying the quality of the new surface. Select the **Classic** radio button to get the surface quality similar to that obtained with the version 5.0 or earlier versions of Maya. Select the **Match** radio button to get a better quality for surfaces having multiple knots at the end.

Number of spans U and Number of spans V

The **Number of spans U** and **Number of spans V** options are used to set the number of spans in the U and V directions of the rebuild surface respectively.

Degree U and Degree V

The **Degree U** and **Degree V** options are used to set the degree of the rebuild surface.

Keep original

The **Keep original** check box is selected to keep the original surface and rebuild a new surface.

Use tolerance

The **Use tolerance** option will be available only on selecting the **Non-Rational** or **Reduce** radio button in the **Rebuild type** area. The tolerance value is used to make the rebuild surface resemble the original surface. Smaller the tolerance value, more the rebuild surface will resemble the original surface.

Output geometry

The **Output geometry** option is used to specify the output type for the rebuild surface. Select the **NURBS**, **Polygons**, or **Subdiv** radio button to specify the output geometry.

Sculpt Geometry Tool

Menubar: Edit NURBS > Sculpt Geometry Tool

The **Sculpt Geometry Tool** is used to sculpt an object manually in the viewport. On invoking this tool, the cursor will change to a brush icon. To sculpt an object, create a NURBS surface in the viewport and choose **Edit NURBS > Sculpt Geometry Tool > Option Box** from the menubar; the **Tool Settings (Sculpt Geometry Tool)** window will be displayed on the left of the viewport, as shown in Figure 4-21.

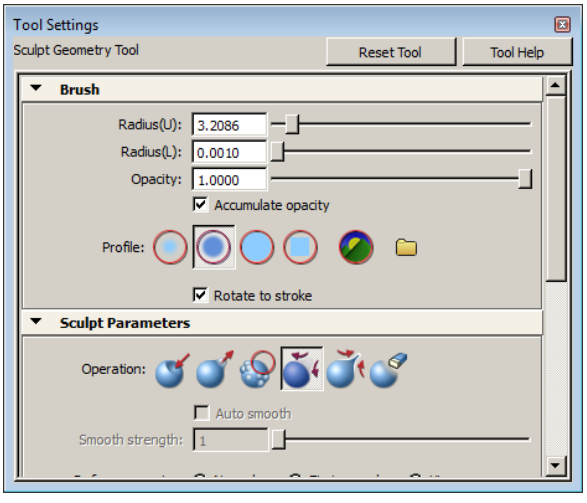


Figure 4-21 *Partial view of the* ***Tool Settings (Sculpt Geometry Tool)*** *window*



Note

The more the number of segments on an object, the better the sculpting can be done on it using the ***Sculpt Geometry Tool****. You can sculpt an object using five different options:* ***Push****,* ***Pull****,* ***Smooth****,* ***Relax****, and* ***Erase****. All these methods are discussed next.*

Push



The **Push** option is used to push down a NURBS mesh. To do so, create a NURBS plane in the viewport. Next, choose **Edit NURBS > Sculpt Geometry Tool > Option Box** from the menubar; the **Tool Settings (Sculpt Geometry Tool)** window will be displayed on the left of the viewport, refer to Figure 4-21. Choose the **Push** button in the **Sculpt Parameters** area; the cursor will be modified, as shown in Figure 4-22. Move the cursor over the NURBS plane, press and hold the left mouse button, and drag the brush over the plane. Now, move it to sculpt the mesh surface.

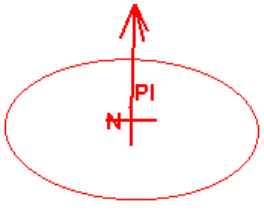


Figure 4-22 *The* ***Sculpt Geometry Tool*** *cursor*

Figure 4-23 shows a NURBS plane before sculpting and Figure 4-24 shows the NURBS plane sculpted using the **Push** tool.

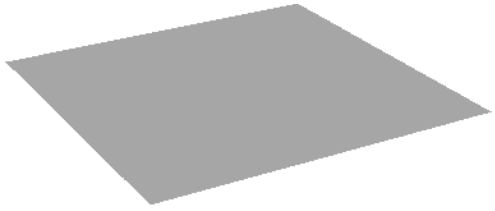


Figure 4-23 *The NURBS plane before sculpting*

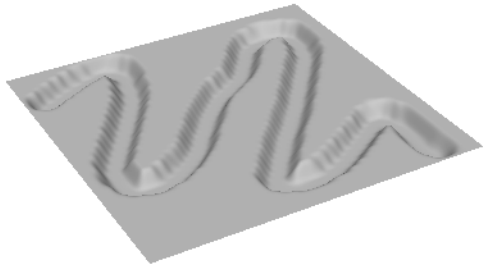


Figure 4-24 *The NURBS plane sculpted using the* ***Push*** *tool*

Pull



The **Pull** tool is used to pull the NURBS mesh from the surface. This tool works similar to the **Push** tool and the procedure to apply it on a NURBS plane is same as that of the **Push** tool. Figure 4-25 shows a NURBS plane sculpted using the **Pull** tool.

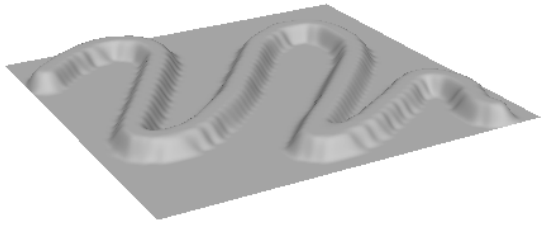


Figure 4-25 *The NURBS plane sculpted using the* ***Pull*** *tool*

Smooth



The **Smooth** tool is used to paint a mesh to give it a smoother look. To use this method, follow the procedure as discussed in the **Push** tool and choose the **Smooth** button from the **Sculpt Parameters** area of the **Tool Settings (Sculpt Geometry Tool)** window. Figure 4-26 shows a surface before smoothening and Figure 4-27 shows the surface after smoothening.

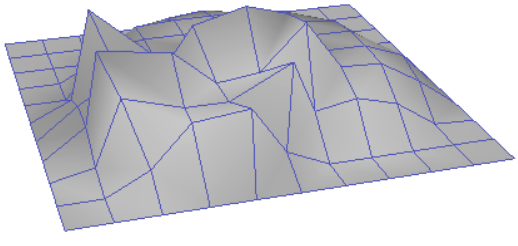


Figure 4-26 *Surface before smoothening*

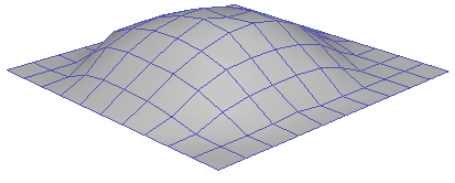


Figure 4-27 *Surface after smoothening*

Relax



The **Relax** tool works similar to the **Smooth** tool. It is used to relax the bumps over the surface, thus maintaining the overall shape of the mesh.

Pinch



The **Pinch** tool is used to pull selected vertices toward each other. It helps in bringing the vertices closer in order to make sharp or well defined creases.

Erase



The **Erase** method is used to erase the changes made by using the push or pull method on the surface. For example, create a polygonal cylinder in the viewport and paint the surface of the cylinder by choosing the **Pull** button, as shown in Figure 4-28. Next, choose the **Erase** button from the **Operation** option of the **Sculpt Parameters** area and erase the required part; you will get the output, as shown in Figure 4-29.

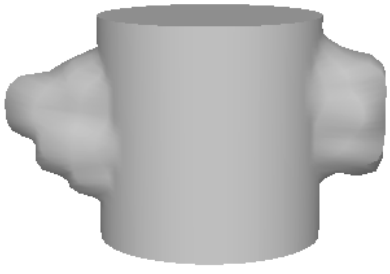


Figure 4-28 *Surface before erasing*

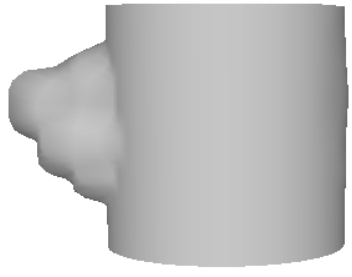


Figure 4-29 *Surface after erasing*

CONVERTING OBJECTS

In Maya, you can convert object from one form to another form. For example, using this method you can convert a NURBS object to polygonal object and vice-versa. To use this method, select an object in the viewport and choose **Modify > Convert** from the menubar; a cascading menu will be displayed. Choose the conversion type from the cascading menu to specify the output geometry for the selected object. Various options in this cascading menu are discussed next.

Converting NURBS to Polygons

Menubar: Modify > Convert > NURBS to Polygons

The **NURBS to Polygons** conversion tool is used to convert a NURBS mesh into a polygonal mesh. To do so, choose **Modify > Convert > NURBS to Polygons > Option Box** from the menubar; the **Convert NURBS to Polygons Options** dialog box will be displayed in the viewport, as shown in Figure 4-30. You can use this dialog box to set the options for the conversion of the object from NURBS to polygons. The options in the **Convert NURBS to Polygons Options** dialog box are discussed next.

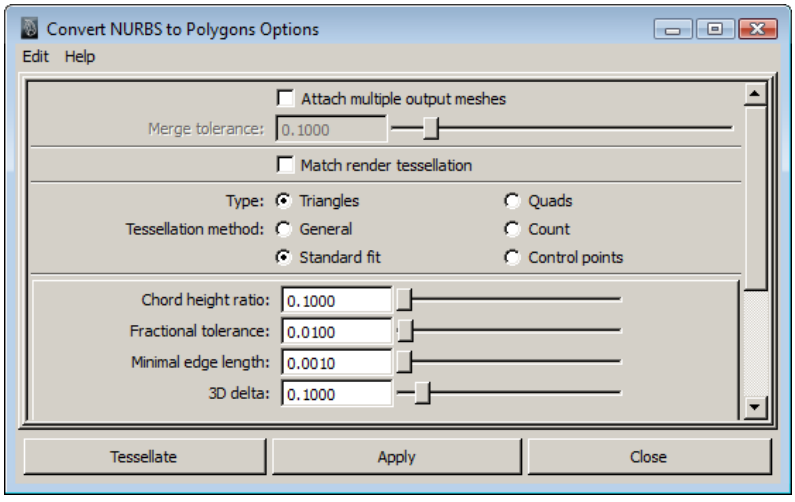


Figure 4-30 *The* ***Convert NURBS to Polygons Options*** *dialog box*

Type

The **Type** parameter is used to set the output of the conversion. If you select the **Triangles** radio button, then three-sided polygons will be created on the surface, as shown in Figure 4-31. If you select the **Quads** radio button, then four-sided polygons will be created on the surface, as shown in Figure 4-32.

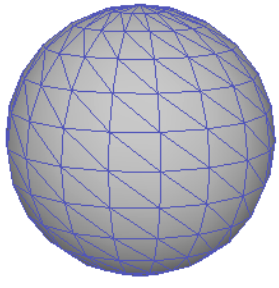


Figure 4-31 *Surface created on applying the* ***Triangles*** *polygon type*

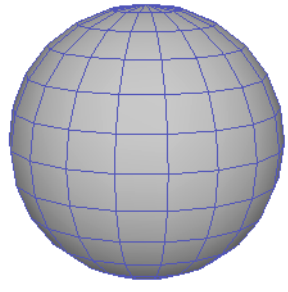


Figure 4-32 *Surface created on applying the* ***Quads*** *polygon type*

Tessellation method

The **Tessellation method** parameter is used to convert a NURBS mesh to a set of polygons. In Maya, there are four tessellation methods that are discussed next.

General

The **General** radio button is used to define the number of polygons in the U or in the V direction. On selecting this radio button, various options for setting the tessellation are displayed. Set the attributes as per your requirement.

Standard fit

The **Standard fit** tessellation method is the default tessellation method. This method is used to determine when to stop the tessellation by setting the fractional tolerance value. On selecting this radio button, the options related to it are displayed. Adjust them as per your requirement.

Count

The **Count** tessellation method is used to specify the polygon count in the mesh after the conversion. More the count value, smoother will be the object.

Control Points

The **Control Points** tessellation method is used to create a new mesh while matching its CVs to the original NURBS surface. The resulting polygons will be quads by default.

Converting NURBS to Subdiv

Menubar: Modify > Convert > NURBS to Subdiv

The **NURBS to Subdiv** conversion tool is used to convert a NURBS mesh into a subdiv mesh. To do so, select the NURBS object in the viewport and choose **Modify > Convert > NURBS to Subdiv > Option Box** from the menubar; the **Convert NURBS/Polygons to Subdiv Options** dialog box will be displayed, as shown in Figure 4-33. The options in the **Convert NURBS/Polygons to Subdiv Options** dialog box are discussed next.

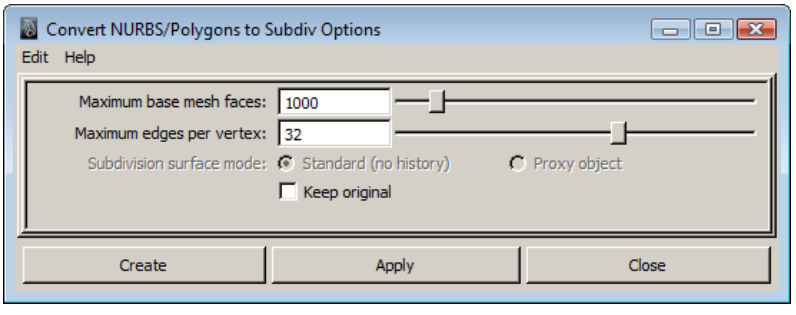


*Figure 4-33 The **Convert NURBS/Polygons to Subdiv Options** dialog box*

Maximum base mesh faces

The **Maximum base mesh faces** parameter is used to set the maximum number of faces that the original surface can have, such that it can be successfully converted into a subdivision surface.

Maximum edges per vertex

The **Maximum edges per vertex** parameter is used to set the maximum number of edges that each vertex can have in the original surface, such that it can be successfully converted into a subdivision surface.

Keep original

Select the **Keep original** check box to keep the original object while creating the new subdivision surface.



Note

The options in other tessellation methods are similar to those discussed in the previous topics.

TUTORIALS

Tutorial 1

In this tutorial, you will create the model of a cowboy hat, as shown in Figure 4-34, using the NURBS modeling technique. **(Expected time: 15 min)**

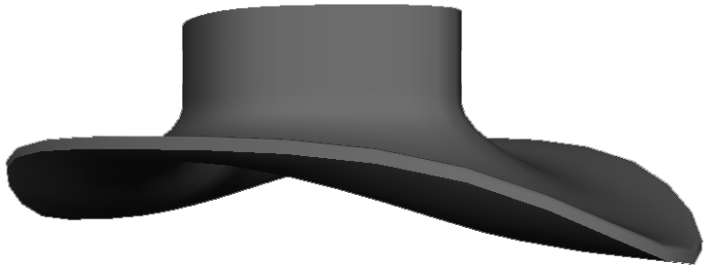


Figure 4-34 *The model of a cowboy hat*

The following steps are required to complete this tutorial:

a. Create a project folder.
b. Create a NURBS cylinder.
c. Add details to the hat.
d. Change background color of the scene.
e. Save and render the scene.

Creating the Project Folder

Create a new project folder with the name *c04_tut1* at *\Documents\Maya_Tutorials* and then save the file with the name *c04tut1*, as discussed in Tutorial 1 of Chapter 2.

Creating a NURBS Cylinder

In this section, you need to create a NURBS cylinder to form the basic structure of the cowboy hat.

1. Choose **Create > NURBS Primitives > Cylinder** from the menubar and click in the active viewport; a cylinder is created in the viewport. Next, choose **Display > UI Elements > Channel Box/Layer Editor** from the menubar; the **Channel Box/Layer Editor** is displayed on the right side of the viewport.

2. Enter the values in the **INPUTS** node of the **Channel Box/Layer Editor**, as shown in Figure 4-35.

3. Maximize the front viewport and press 5 to change it to the shaded mode. Press and hold the right mouse button on the NURBS cylinder; a marking menu is displayed. Choose **Control Vertex** from the marking menu to switch to the vertex mode. Now, select the vertices, as shown in Figure 4-36. Next, invoke the **Scale Tool** from the Tool Box and scale the vertices uniformly in the persp viewport, as shown in Figure 4-37.

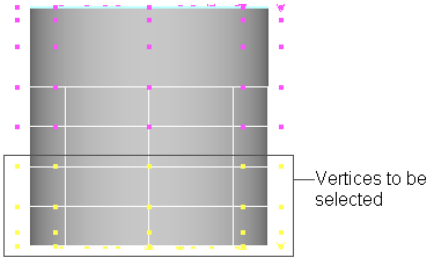


Figure 4-36 *Selecting vertices*

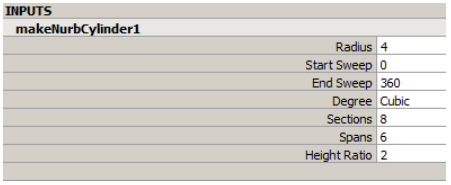


Figure 4-35 *The **INPUTS** node*

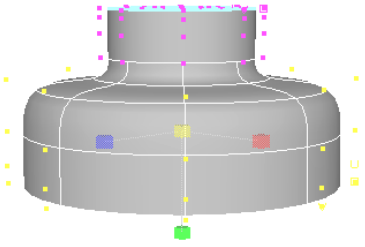


Figure 4-37 *Scaling the selected vertices uniformly*



Note

*Make sure the **Soft Selection** check box is clear in the **Tool Settings (Move Tool)** window.*

4. Select the green handle of the **Scale Tool** and scale the selected vertices upward along the Y axis; the mesh gets modified, as shown in Figure 4-38.

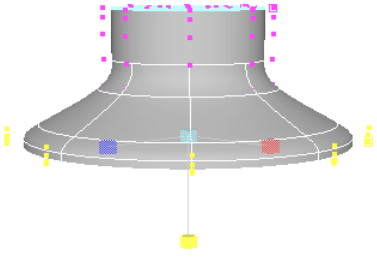


Figure 4-38 *Scaling the selected vertices along the Y axis*

Adding Details to the Hat

In this section, you need to add details to the hat to give the look of a cowboy hat.

1. Maximize the top viewport and press 5 to change it to shaded mode. Next, drag-select the vertices by using the selection window and the SHIFT key, refer to Figure 4-39 (vertices to be selected are numbered for your reference). Next, choose the **Scale Tool** from the Tool Box, and scale the selected vertices outward along the Z axis using the blue handle; the mesh gets scaled, as shown in Figure 4-40.

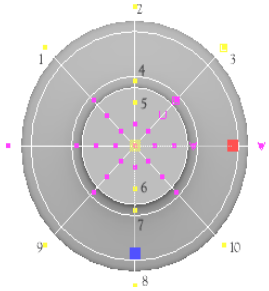


Figure 4-39 *Selecting vertices*

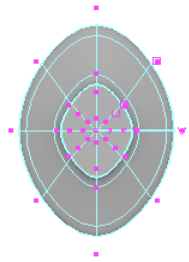


Figure 4-40 *Scaled mesh*

2. Maximize the side viewport and press 5 to change it to the shaded mode. Next, select the vertices by using a selection window and SHIFT key, as shown in Figure 4-41 (the vertices to be selected are encircled for your reference). Next, choose the **Move Tool** and move the vertices downward along the Y direction, as shown in Figure 4-42.

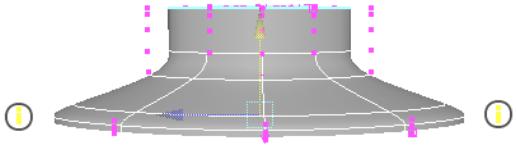


Figure 4-41 *Selecting vertices*

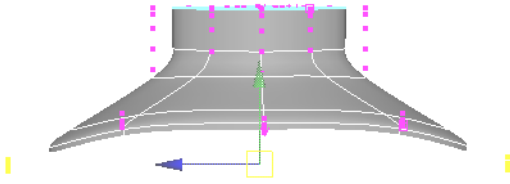


Figure 4-42 *The modified mesh after moving the vertices*

3. Press and hold the right mouse button over the cowboy hat model; a marking menu is displayed. Next, choose **Object Mode** from the marking menu.

4. Select the model in the viewport. Then, press and hold the right mouse button over the cowboy hat model and choose **Isoparm** from the marking menu.

5. Maximize the persp viewport and select an isoparm, as shown in Figure 4-43. Drag the isoparm outward; a dotted isoparm is displayed on the hat. Next, choose the **Surfaces** menuset from **Menuset** drop-down list in the Status Line and then choose **Edit NURBS > Insert Isoparms** from the menubar; a new isoparm is created, as shown in Figure 4-44.

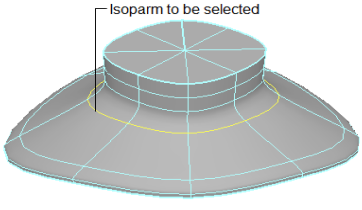


Figure 4-43 *Selecting an isoparm*

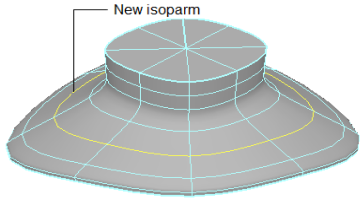


Figure 4-44 *A new isoparm created*

6. Select the model and choose **Edit > Delete All by Type > History** from the menubar; the history of all actions performed on the model is deleted.

7. Maximize the side viewport. Next, press and hold the right mouse button on the lower part of the hat and then choose **Control Vertex** from the marking menu. Next, select the vertices of the object by using a selection window and the SHIFT key in the side viewport, as shown in Figure 4-45 (the vertices to be selected are encircled for your reference). Next, using the **Move Tool**, move the vertices upward along the Y axis to change the shape of the cowboy hat, as shown in Figure 4-46.

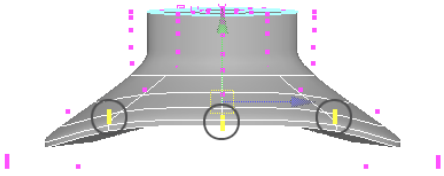


Figure 4-45 *Selecting vertices*

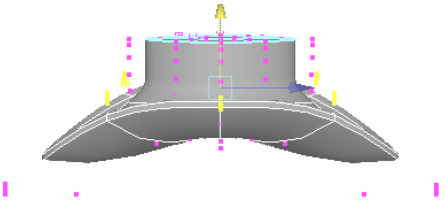


Figure 4-46 *The modified mesh*

8. Press and hold the right mouse button over the cowboy hat model and choose **Object Mode** from the marking menu. Maximize the persp viewport. Choose **View > Predefined Bookmarks > Bottom** from the **Panel** menu; the bottom viewport is activated.

9. Insert two new isoparms on the hat, as discussed in steps 4 and 5, refer to Figure 4-47.

10. Press and hold the right mouse button over the cowboy hat model and choose **Control Vertex** from the marking menu. Next, drag-select the vertices, as shown in Figure 4-48 (vertices to be selected are encircled for your reference).

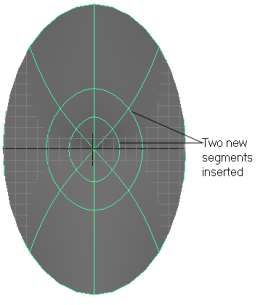


Figure 4-47 *Inserting two new isoparms*

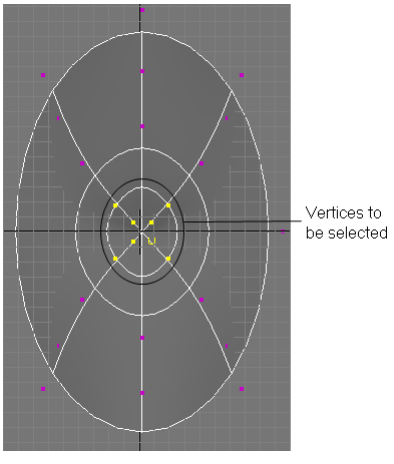


Figure 4-48 *Selecting vertices*

11. Choose **View > Predefined Bookmarks > Perspective** from the **Panel** menu; the persp viewport is activated. Make sure the **Move Tool** is chosen from the Tool Box and move the selected vertices upward along the Y axis to get the final output, as shown in Figure 4-49.

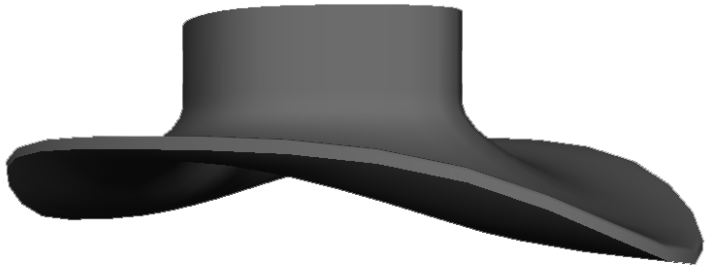


Figure 4-49 *The cowboy hat*

Changing the Background Color of the Scene

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

1. Choose **Window > Outliner** from the menubar; the **Outliner** is displayed. Double click on the **persp** camera in the **Outliner**; the attributes of the **persp** camera are displayed in the **Attribute Editor**.

2. Expand the **Environment** area in the **Attribute Editor** and set 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 this scene by downloading the *c04_maya_2013_rndr.zip* file from *http://www.cadcim.com*. The path of the file is as follows:

Textbooks > Animation and Visual Effects > Maya > Autodesk Maya 2013: 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 (Maya Software)** button from the Status Line; the **Render View** window is displayed. This window shows the final output of the scene, refer to Figure 4-34.

Tutorial 2

In this tutorial, you will create the model of a ship, as shown in Figure 4-50, using the combination of NURBS and polygonal modeling techniques. **(Expected time: 30 min)**

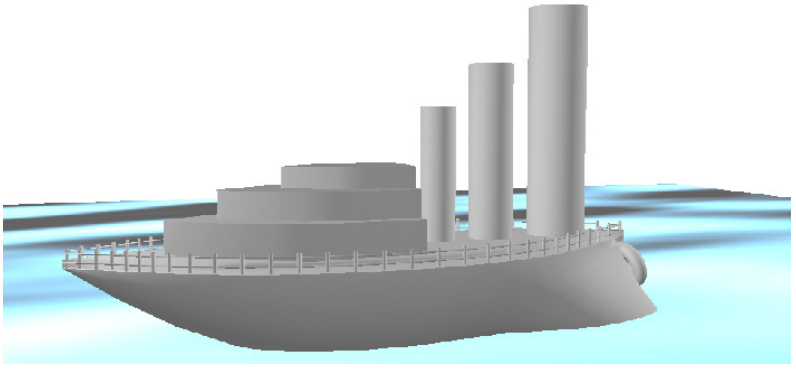


Figure 4-50 *Model of a ship*

The following steps are required to complete this tutorial:

a. Create a project folder.
b. Create the hull of the ship.
c. Create railings.
d. Create the deck.
e. Create the chimney.
f. Save and render the scene.

Creating the Project Folder

Create a new project folder with the name *c04_tut2* at *\Documents\Maya_Tutorials* and then save the file with the name *c04tut2*, as discussed in Tutorial 1 of Chapter 2.

Creating the Hull of the Ship

In this section, you need to create the hull of the ship using the NURBS curves and the loft method.

1. Maximize the side viewport and choose **Create > EP Curve Tool > Option Box** from the menubar; the **Tool Settings (EP Curve Tool)** window is displayed. Select the **5** radio button from the **Curve Degree** area of the window. Next, create a curve for the hull of the ship in the side viewport, as shown in Figure 4-51.



Figure 4-51 *Curve created for the base of the ship*

To get the exact shape, select the curve and right-click on it to display a marking menu. Next, choose **Control Vertex** from the marking menu. Now, you can select a vertex and modify the shape by using the **Move Tool**.

2. Choose the **Move Tool** from the Tool Box. Next, press and hold the d key and set the pivot point to the right end of the curve by moving the manipulators.

3. Choose **Edit > Duplicate Special > Option Box** from the menubar; the **Duplicate Special Options** dialog box is displayed. Enter the required values in the dialog box, refer to Figure 4-52, and then choose the **Duplicate Special** button; duplicate curves are created in the viewport.

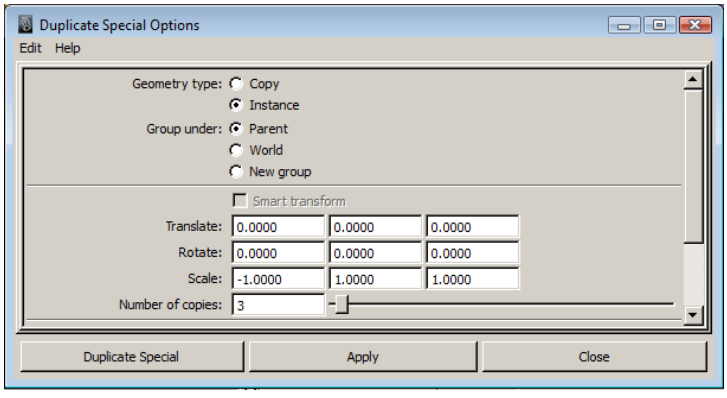


Figure 4-52 *The* ***Duplicate Special Options*** *dialog box*

4. Select the duplicate curves and rotate them. Next, align the curves in all viewports, as shown in Figure 4-53.

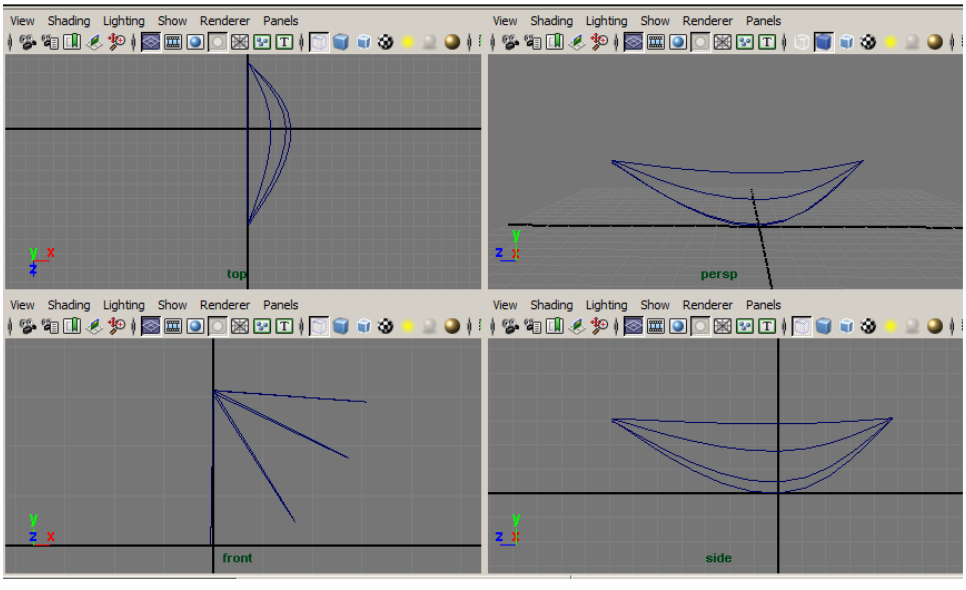


Figure 4-53 *The duplicate curve rotated*

5. Maximize the persp viewport. Press and hold the SHIFT key and then select all the curves in the viewport one-by-one.

6. Choose **Surfaces > Loft** from the menubar; a surface is created defining the half part of the ship base. Press 5 to change the view to the shaded mode. The surface is created, as shown in Figure 4-54.

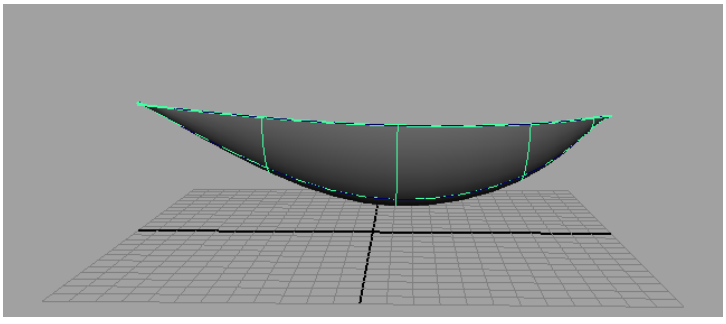


Figure 4-54 *Surface created*

7. Select the lofted surface and then set the pivot of the surface on the right end of it, refer to step 2.

8. Choose **Edit > Duplicate Special > Option Box** from the menubar; the **Duplicate Special Options** dialog box is displayed in the viewport. Specify values in the dialog box, as shown in Figure 4-55. Next, choose the **Duplicate Special** button to duplicate the surface to create a copy such that the model looks like the complete base of the ship, as shown in Figure 4-56.



Note

Press 4 for wireframe mode, 5 for shaded mode, 6 for viewing texture, and 7 to view the light effect in the viewport.

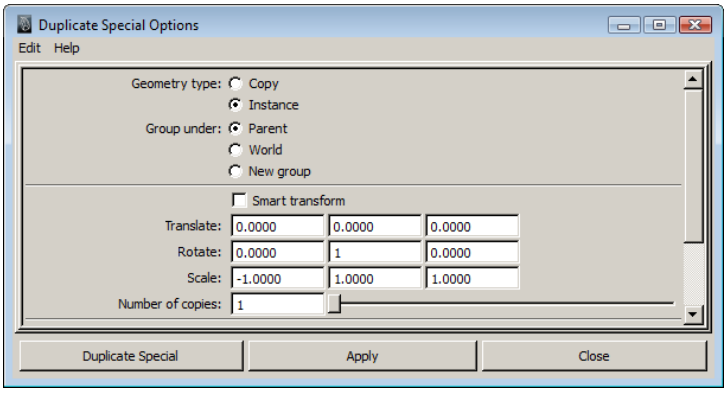


Figure 4-55 *The* ***Duplicate Special Options*** *dialog box*

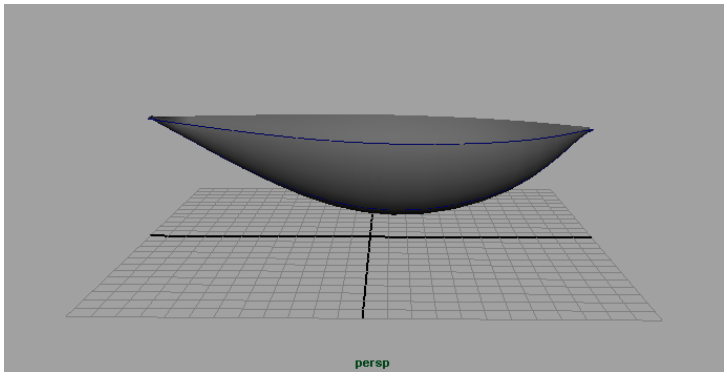


Figure 4-56 *The duplicate surfaces created*

9. Select all curves and surfaces in the viewport. Press and hold the SHIFT key and click on the surfaces so that all curves remain selected. Next, choose **Display > Hide > Hide Selection** from the menubar; the selected curves get hidden.

10. Maximize the side viewport and select the NURBS surfaces. Now, choose **Edit NURBS > Rebuild Surfaces > Option Box** from the menubar; the **Rebuild Surface Options** dialog box is displayed. Set the values in this dialog box, refer to Figure 4-57, and then choose the **Rebuild** button to rebuild the surface.

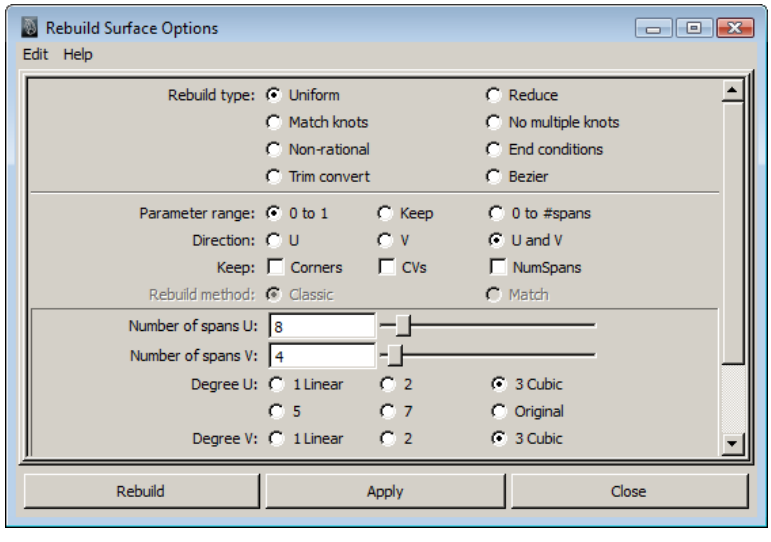


Figure 4-57 *The* ***Rebuild Surface Options*** *dialog box*

11. Select the rebuilt surface. Next, press and hold the right mouse button over the model and choose **Control Vertex** from the marking menu. Next, press and hold the SHIFT key and select the vertices, as shown in Figure 4-58. Choose the **Move Tool** from the Tool Box and move the vertices downward to create the tail of the ship, as shown in Figure 4-59.

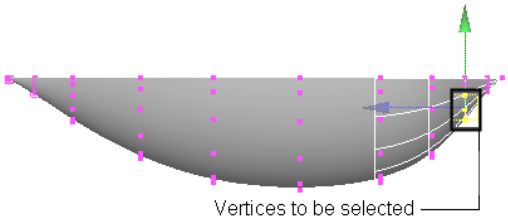


Figure 4-58 *Selecting vertices*

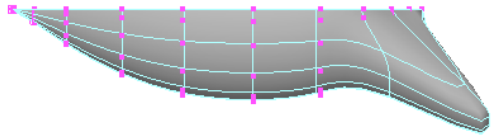


Figure 4-59 *Moving the vertices to create the tail of the ship*

12. Maximize the persp viewport. Select one half of the ship and delete it. Now, select the remaining part of the ship and choose **Edit > Duplicate Special > Option Box** from the menubar to create a copy of the half part of the ship; the **Duplicate Special Options** dialog box is displayed, as shown in Figure 4-60. Next, select the **Copy** radio button and enter **-1** in the first **Scale** edit box. Next, choose the **Duplicate Special** button from the **Duplicate Special Options** dialog box to close it.

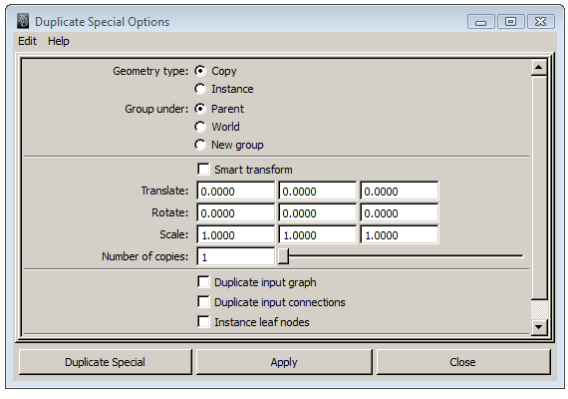


Figure 4-60 *The* ***Duplicate Special Options*** *dialog box*

13. Select half of the ship base. Press and hold the right mouse button over the ship, and choose **Isoparm** from the marking menu, and then select the topmost isoparm.

14. Press the SHIFT key and choose the remaining half of the base ship. Press and hold the right mouse button over the ship, choose **Isoparm** from the marking menu, and then select two isoparms on the ship, as shown in Figure 4-61. Next, choose **Surfaces > Loft** from the menubar to create a surface between the selected isoparms.

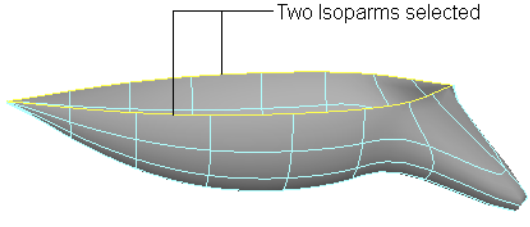


Figure 4-61 *The two selected isoparms*

15. Select the newly created surface and choose **Edit NURBS > Rebuild Surfaces > Option Box** from the menubar; the **Rebuild Surfaces Options** dialog box is displayed. Enter **8** and **4** in the **Number of spans U** and **Number of spans V** edit boxes, respectively. Next, choose the **Rebuild** button.

16. Maximize the top viewport. Select the newly created surface, press and hold the right mouse button on the selected surface, and then choose **Isoparm** from the marking menu displayed. Insert the two isoparms at the positions shown in Figure 4-62. Now, choose **Edit NURBS > Insert Isoparms** from the menubar; two new isoparms are created.

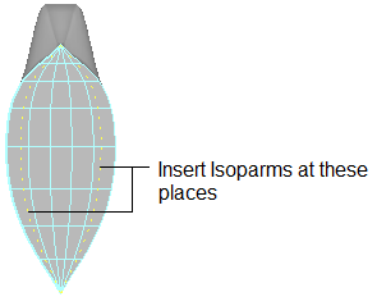


Figure 4-62 *Inserting isoparms*

17. Maximize the side viewport. Now, press and hold the right mouse button over the new surface and choose **Control Vertex** from the marking menu and select all the vertices of the new surface. Next, activate the top viewport and deselect the center vertices by pressing the SHIFT key. Now, select all the corner vertices, as shown in Figure 4-63.

18. Choose the **Move Tool** from the Tool Box and move the selected vertices downward along the Y axis, as shown in Figure 4-64.

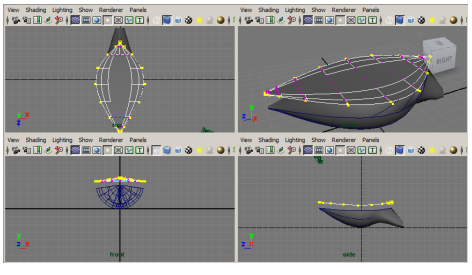


Figure 4-63 *Selecting vertices*

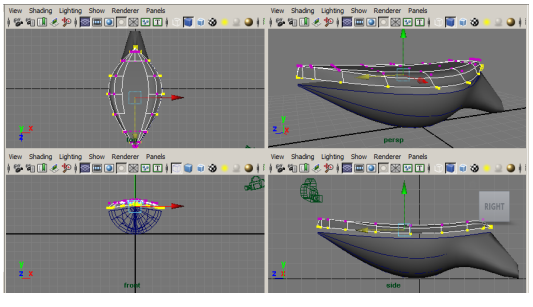


Figure 4-64 *Moving the vertices along the Y axis*

19. Press and hold the right mouse button and choose **Object Mode** from the marking menu. Choose the **Move Tool** from the Tool Box and move the new surface downward along the Y axis. The shape of the ship is shown in Figure 4-65.

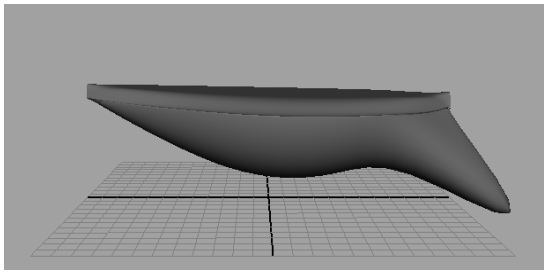


Figure 4-65 *Shape of ship*

Creating Railings

In this section, you need to create railings for the ship by using the NURBS cylinder. There are two ways to create railing: by creating cylinders and aligning them manually, or by aligning the cylinders on a curve. In this section, you need to align the cylinders on a curve.

1. Maximize the top viewport. Choose **Create > EP Curve Tool** from the menubar and create a curve, using the boundary of the ship as reference, refer to Figure 4-66. Now, move this curve using the **Move Tool**.

2. Display all viewports by choosing the **Four View** button from the Tool Box and align the curve, as shown in Figure 4-67.

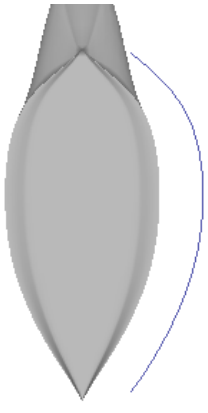


Figure 4-66 *Creating the NURBS curve*

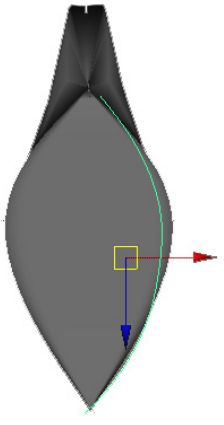


Figure 4-67 *Align the NURBS curve*

3. Maximize the persp viewport and choose **Create > NURBS Primitives > Cylinder** from the menubar. Now, create a cylinder in the viewport. Next, select the upper cap of the cylinder and delete it. Similarly, delete the lower cap of the cylinder.

4. Choose **Display > UI Elements > Channel Box/Layer Editor** from the menubar; the **Channel Box/Layer Editor** is displayed on the right of the viewport. Change the parameters of the cylinder in the **INPUTS** node of the **Channel Box/Layer Editor**, as given next.

   Radius: **0.1** Sections: **10** Height Ratio: **10**

5. Select the **Animation** menuset from the **Menuset** drop-down list in the Status Line and select the curve. Next, press and hold the SHIFT key and select the cylinder. Choose **Animate > Motion Paths > Attach to Motion Path** from the menubar; the cylinder gets attached to the curve.

6. Choose **Animate > Create Animation Snapshot > Option Box** from the menubar; the **Animation Snapshot Options** dialog box is displayed in the viewport. Enter **30** in the **End Time** edit box, **2** in the **Increment** edit box, and then choose the **Snapshot** button; the cylinders are aligned on the curved surface, as shown in Figure 4-68.

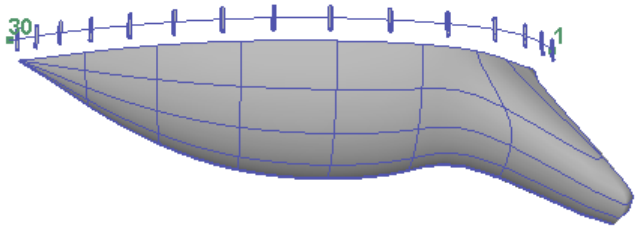


Figure 4-68 *The cylinders aligned on the curve surface*



Note

*The value in the **End Time** edit box may vary depending on the size of the NURBS surface created.*

7. Maximize the front viewport and choose **Create > NURBS Primitives > Circle** from the menubar and create a circle in the viewport. Next, choose **Display > UI Elements > Channel Box/Layer Editor** from the menubar; the **Channel Box/Layer Editor** is displayed. In the **Channel Box/Layer Editor**, adjust the radius of the circle to **0.1**.

8. Make sure the **Surfaces** menuset is selected from the **Menuset** drop-down list in the Status Line. Now, select the circle and then the curve from the viewport. Choose **Surfaces > Extrude** from the menubar; the circle is extruded and the handrail is created.

9. Press d and set the pivot on the right of the created curve and align it.

10. Select the extruded surface. Choose **Display > UI Elements > Attribute Editor** from the menubar; the **Attribute Editor** is displayed. Choose the **extrude1** tab and enter values in the **Attribute Editor**, refer to Figure 4-69. Choose the **Move Tool** from the Tool Box and align the handrail over the cylinders.

11. Maximize the persp viewport. Select the curve and choose **Display > Hide > Hide Selection** from the menubar to hide the curve. Make a duplicate copy of the railing and move it down, as shown in Figure 4-70. Next, select the complete railing and press CTRL + g to group the railing. Then, align the railings on the base of the ship.

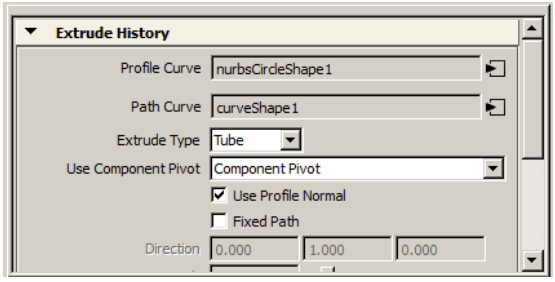


Figure 4-69 *Setting the parameters in the* ***extrude1*** *tab*

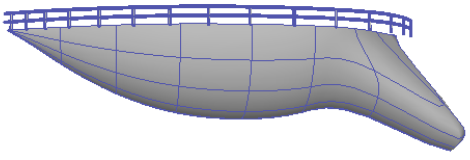


Figure 4-70 *The railings aligned on half part of the ship*

12. Choose **Edit > Delete by Type > History** from the menubar to delete the history of the surfaces created earlier. Next, choose **Modify > Freeze Transformations** from the menubar and then press d to set the pivot in the center of the ship.

13. Select the railing group and choose **Edit > Duplicate Special** from the menubar to make duplicate copies of railings to create another half part of the railing. Next, choose the **Move Tool** from the Tool Box and align the duplicate pair of the railings with the ship, as shown in Figure 4-71.

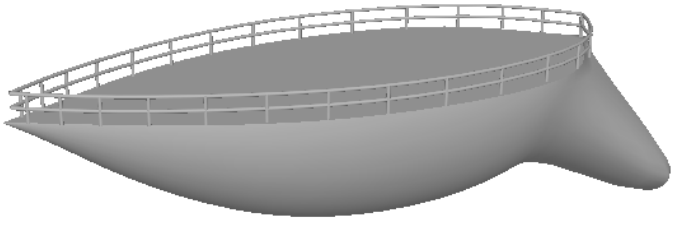


Figure 4-71 *All railings created*

Creating the Deck

In this section, you need to create the deck of the ship using the polygon modeling method.

1. Maximize the top viewport. Choose **Create > Polygon Primitives > Cube** from the menubar to create a cube in the viewport. Choose **Display > UI Elements > Channel Box/Layer Editor** from the menubar; the **Channel Box/Layer Editor** is displayed. Modify the parameters of the cube in the **Channel Box/Layer Editor**, as given next.

   Width: **5** Height: **1** Depth: **5**

   Subdivisions Width: **2** Subdivision Depth: **4**

2. Press and hold the right mouse button on the cube; a marking menu is displayed. Choose **Vertex** from the marking menu. Next, choose the **Scale Tool** from the Tool Box and adjust the vertex of the cube to form the shape, as shown in Figure 4-72.

3. Select the cube and choose **Edit > Duplicate** from the menubar to make the duplicate of the cube in the viewport. Similarly, create one more duplicate of the deck. Choose the **Move Tool** and then the **Scale Tool** to align the duplicated decks on the ship, as shown in Figure 4-73.

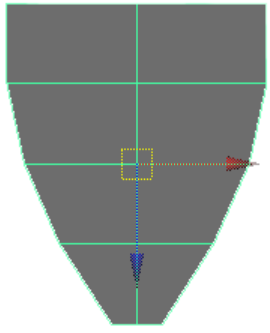


Figure 4-72 *The shape of the deck created*

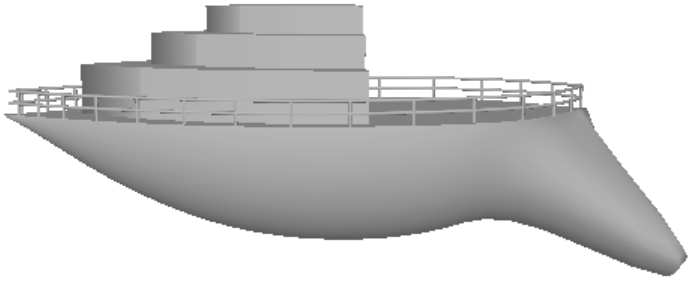


Figure 4-73 *The duplicate decks aligned together*

Creating the Chimney

In this section, you need to create the chimney for the ship using the **Polygon Cylinder** tool.

1. Maximize the top viewport. Choose **Create > Polygon Primitives > Cylinder** from the menubar to create three cylinders in the viewport. The cylinders will act as chimneys for the ship. Choose **Display > UI Elements > Channel Box/Layer Editor**; the **Channel Box/Layer Editor** is displayed. Adjust the parameters in the **Channel Box/Layer Editor** as given next:

Cylinder	Radius	Height
Cylinder1	0.8	8
Cylinder2	0.6	6
Cylinder3	0.4	4



Note

The radius and height of the cylinders may vary depending upon the size of the ship. Therefore, you need to set the respective values accordingly.

2. Maximize the persp viewport and align the cylinders to create chimneys, as shown in Figure 4-74.

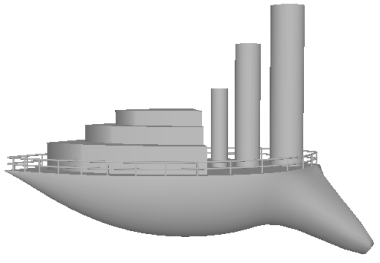


Figure 4-74 *The chimneys created*

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 this scene by downloading the *c04_maya_2013_rndr.zip* file from *http://www.cadcim.com*. The path of the file is as follows:

Textbooks > Animation and Visual Effects > Maya > Autodesk Maya 2013: 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 (Maya Software)** button from the Status Line;the **Render View** window is displayed. This window shows the final output of the scene, refer to Figure 4-74.

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 tools is used to create a new segment at the intersection of two surfaces?

(a) **Intersect Surfaces** (b) **Untrim Surfaces**
(c) **Attach Surfaces** (d) None of these

2. Which of the following tools is used to paint a mesh to give it a smoother look?

(a) **Pull** (b) **Push**
(c) **Smooth** (d) **Relax**

3. The _____ tool is used to rebuild the U and V spans.

4. The _____ tool is used to undo the last trim operation.

5. The _____ tool is used to reverse the U and V directions of a selected surface.

6. More the number of patches on an object, better is the operation using the _____ **Geometry Tool**.

7. The **NURBS to Subdiv** conversion tool is used to convert a NURBS mesh into a subdiv mesh. (T/F)

8. The process of converting an object from one mesh to another is known as mesh conversion. (T/F)

9. The **Offset Surfaces** tool is used to create a copy of a selected surface at a particular distance. (T/F)

10. The **Insert Isoparms** tool is used to insert an isoparm into an existing NURBS surface. (T/F)

Review Questions

Answer the following questions:

1. Which of the following operations is used to relax bumps over a surface?

(a) **Push** (b) **Pull**
(c) **Relax** (d) **Erase**

2. Which of the following tools is used to make the edges of surfaces tangent or curvature continuous?

(a) **Offset Surface** (b) **Attach Surface**
(c) **Align Surface** (d) None of these

3. The _____ tool is used to extend an edge of the NURBS surface.

4. The _____ **knots** radio button is used to remove the extra knots formed while rebuilding a surface.

5. The _____ tool is used to create the copy of a selected surface.

6. The **Pinch** operation is used to pull selected vertices toward each other while using the **Sculpt Geometry Tool**. (T/F)

7. The tessellation method is used to set the initial and secondary tessellation controls for an object. (T/F)

8. Tessellation is a method, which is used to convert a NURBS mesh into a set of polygons. (T/F)

9. The **Erase** operation is used to push the NURBS mesh inside a surface. (T/F)

10. The **Extend Surfaces** tool is used to rebuild a NURBS surface. (T/F)

Exercises

Exercise 1

Use various NURBS modeling techniques to create the model of a handbag, as shown in Figure 4-45. You can view the final rendered image of this model by downloading the file *c04_maya_2013_exr.zip* from http://www.cadcim.com. The path of file is as follows:

(Expected time: 45 min)

Textbooks > Animation and Visual Effects > Maya > Autodesk Maya 2013: A Comprehensive Guide



Figure 4-75 *The model of a handbag*

Exercise 2

Use various modeling techniques to create the model of a chair, as shown in Figure 4-76. You can view the final rendered image of this model by downloading the *c04_maya_2013_exr.zip* file from *http://www.cadcim.com*. The path of the file is mentioned in Exercise 1.

(Expected time: 30 min)



Figure 4-76 *The model of a chair*

Answers to Self-Evaluation Test

1. a, **2.** c, **3. Rebuild Surfaces**, **4. Untrim Surfaces**, **5. Reverse Surface Direction**, **6. Sculpt**, **7.** T, **8.** T, **9.** T, **10.** T