# 15

# NURBS Modeling

## Learning Objectives

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

- *Create NURBS curves*
- *Create NURBS surfaces*
- *Convert splines into NURBS curves*
- *Convert splines and extended splines into NURBS surfaces*
- *Convert primitives into NURBS surfaces*
- *Create NURBS models*
- *Understand NURBS sub-objects*



# INTRODUCTION

The NURBS (Non-Uniform Rational Basis Splines) curves and surfaces are used to create complex 3D models. The NURBS objects use the mathematical calculations to create accurate complex 3D objects from 2D splines. In this chapter, you will learn to create smooth editable 3D models by using the NURBS curves and surfaces.

# NURBS CURVES

The NURBS curves are similar to the splines and are used to create complex surfaces for creating 3D models. You can use the NURBS curves to create the 3D surfaces using the **Lathe** and **Extrude** modifiers. Also, you can loft the NURBS curves to create the loft objects. In 3ds Max, there are two types of NURBS curves, point curve and CV curve. These curves are discussed next.

## Point Curve

| | |
|---|---|
| **Menu bar:** | Create > NURBS > Point Curve |
| **Command Panel:** | Create > Shapes > NURBS Curves > Object Type rollout > Point Curve |

The point curves are the NURBS curves. These curves consist of points that are constrained to lie on them, refer to Figure 15-1. To create a point curve, choose **Create > Shapes** in the **Command Panel**; a drop-down list will be displayed below the **Shapes** button. Select the **NURBS Curves** option from the drop-down list; the tools to create the point curve and the CV curve will be displayed in the **Object Type** rollout, as shown in Figure 15-2. Activate the viewport in which you want to create the point curve. Now, choose the **Point Curve** tool from the **Object Type** rollout; the **Name and Color**, **Rendering**, **Keyboard Entry**, and **Create Point Curve** rollouts will be displayed. Next, click in the viewport to create the first point and then click again to create the second point; the first segment is created. Then, continue clicking in the viewport to add more points to the curve. Now, right-click to end the creation; a point curve will be created in the viewport, refer to Figure 15-1. The **Create Point Curve** rollout is discussed next.

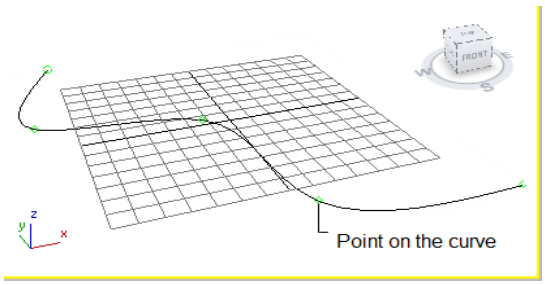



***Figure 15-1*** *A point curve*

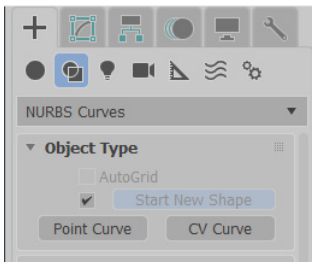



***Figure 15-2*** *The tools for creating NURBS curves*

**Tip**

*While creating a point curve, if you want to remove the last point that you have created, press the BACKSPACE key.*



**Note**

*The options in the **Rendering** and **Keyboard Entry** rollouts are the same as discussed in Chapter 5.*

### Create Point Curve Rollout

The options in the **Interpolation** area of this rollout are the same as those discussed in Chapter 5. The **Draw In All Viewports** check box is selected by default in this rollout, as shown in Figure 15-3. It is used to display a 3D curve in all the viewports simultaneously. For example, you can start by creating the first point in the Top viewport, continue creating the additional points in the Left viewport, and finish the creation of the point curve in the Front viewport.

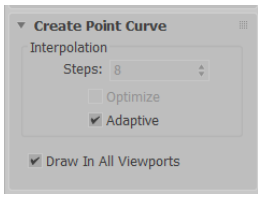



***Figure 15-3** The **Create Point Curve** rollout*

## CV Curve

| | |
|---|---|
| **Menu bar:** | Create > NURBS > CV Curve |
| **Command Panel:** | Create > Shapes > NURBS Curves > Object Type rollout > CV Curve |

The CV curves are the NURBS curves that are controlled by the control vertices (CVs). The CVs are the points that lie outside the curve and control the shape of the CV curve. The CVs of a NURBS curve are connected with a lattice known as control lattice, which encloses the curve, refer to Figure 15-4. When you move the CVs in a CV curve, the control lattice gets changed, therefore, the shape of the CV curve also gets changed.

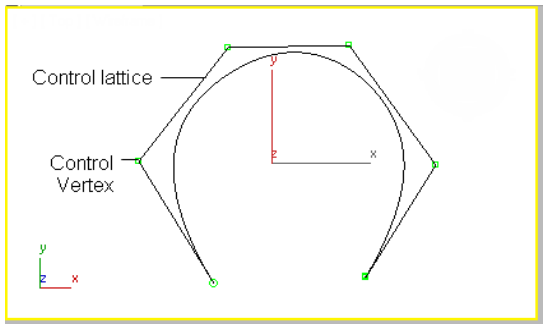



***Figure 15-4** A CV curve*

To create a CV curve, choose **Create > Shapes** in the **Command Panel**; a drop-down list will be displayed. Select the **NURBS Curves** option from this drop-down list and activate the viewport in which you want to create the CV curve. Now, choose the **CV Curve** tool from the **Object Type** rollout; the **Name and Color**, **Rendering**, **Keyboard Entry**, and **Create CV Curve** rollouts will be displayed. Next, click and drag the cursor in the viewport to create the first point and the first segment and then continue clicking in the viewport to add more points in the curve; a CV curve will be created, as shown in Figure 15-4. Next, right-click in the viewport to end the creation.



**Note**

*The rollouts that are displayed on invoking the **CV Curve** tool are the same as those discussed in the point curve.*

# NURBS SURFACES

The NURBS surfaces are the base of the NURBS model. The NURBS models can be created by modifying the NURBS surfaces at an advanced level. In 3ds Max, there are two types of NURBS surfaces, point surface and CV surface. These surfaces are discussed next.

## Point Surface

| | |
|---|---|
| **Menu bar:** | Create > NURBS > Point Surface |
| **Command Panel:** | Create > Geometry > NURBS Surfaces > Object Type rollout > Point Surf |

The point surfaces are the NURBS surfaces in which the points are constrained to lie on the surface, refer to Figure 15-5. To create a point surface, choose **Create > Geometry** in the **Command Panel**; a drop-down list will be displayed below the **Geometry** button. Select the **NURBS Surfaces** option from this drop-down list; the tools to create the NURBS surfaces will be displayed in the **Object Type** rollout, as shown in Figure 15-6. Activate the viewport in which you want to create the point surface. Now, choose the **Point Surf** tool from the **Object Type** rollout; the **Name and Color**, **Keyboard Entry**, and **Create Parameters** rollouts will be displayed. Next, press and hold the left mouse button on the upper left corner of the viewport and drag the cursor toward the lower right corner of the viewport to specify the length and width of the point surface. Release the left mouse button; a point surface will be created in the viewport, refer to Figure 15-5. The rollouts that are displayed on choosing the **Point Surf** tool are discussed next.

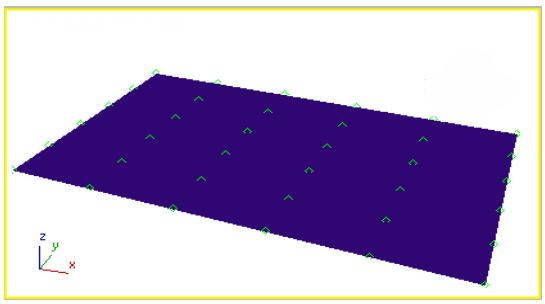


***Figure 15-5*** *A point surface*

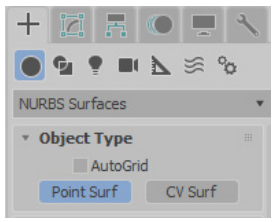



***Figure 15-6*** *The tools displayed to create NURBS surfaces*

### Keyboard Entry Rollout

This rollout is used to create the point surface by entering the parameters using the keyboard. Set the values in the **Length** and **Width** spinners to specify the length and width of the point surface. Now, set the values in the **Length Points** and **Width Points** spinners to specify the number of points along the length and width of the point surface. Next, choose the **Create** button; a point surface will be created in the viewports.

### Create Parameters Rollout

The parameters in this rollout are used to modify the dimensions of the point surface, refer to Figure 15-7. Set the values in the **Length** and **Width** spinners to specify the length and width of the point surface. Set the values in the **Length Points** and **Width Points** spinners to specify the points along the length and width of the point surface. You can modify the geometry of the point surface by moving the points on it, as shown in Figure 15-8. To do so, select the point surface in the viewport and choose the **Modify** tab in the **Command Panel**. In the modifier stack, click on the plus sign on the left side of the **NURBS Surface**; the **Surface** and **Point** sub-object levels will be displayed. Select the **Point** sub-object level and then select the points in the viewport to modify them.

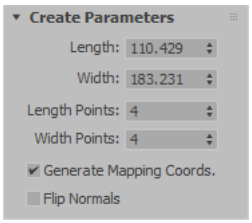



***Figure 15-7*** *The* ***Create Parameters*** *rollout*

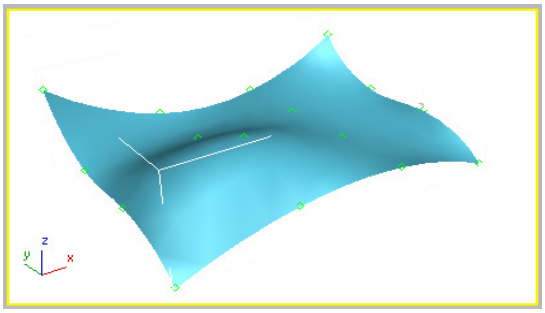


***Figure 15-8*** *The points in the point surface moved*

## CV Surface

| | |
|---|---|
| **Menu bar:** | Create > NURBS > CV Surface |
| **Command Panel:** | Create > Geometry > NURBS Surfaces > Object Type rollout > CV Surf |

The CV surfaces are the NURBS surfaces that are controlled by control vertices (CVs). The CVs are the points that lie outside the surface and control the shape of the CV surface. The CVs of a NURBS surface are connected with a lattice known as control lattice that encloses the surface, refer to Figure 15-9. To create a CV surface, choose **Create > Geometry** in the **Command Panel**; a drop-down list will be displayed. Select the **NURBS Surfaces** option from the drop-down list; the tools to create NURBS surfaces will be displayed in the **Object Type** rollout. Activate the viewport in which you want to create the CV surface. Now, choose the **CV Surf** tool from the **Object Type** rollout; the **Name and Color**, **Keyboard Entry**, and **Create Parameters** rollouts will be displayed. Next, click on the upper left corner of the viewport and move the cursor toward the lower right corner of the viewport to specify the length and width of the CV surface. Click again on the screen; a CV surface will be created in the viewport, as shown in Figure 15-9. The rollouts that are displayed on invoking the **CV Surf** tool are discussed next.

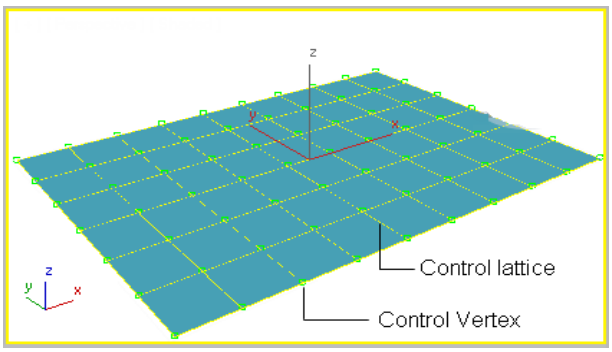



***Figure 15-9*** *A CV surface*

### Keyboard Entry Rollout

You can also create a CV surface by entering the values in the spinners in this rollout. Set the values in the **Length** and **Width** spinners to specify the length and width of the CV surface.

Now, set the values in the **Length CVs** and **Width CVs** spinners to specify the control vertices along the length and width of the CV surface. Next, choose the **Create** button; a CV surface will be created in the viewports.

### Create Parameters Rollout

The parameters in this rollout are used to modify the dimensions of the CV surface, refer to Figure 15-10. Set the values in the **Length** and **Width** spinners to specify the length and width of the CV surface. Set the values in the **Length CVs** and **Width CVs** spinners to specify the control vertices along the length and width, respectively of the CV surface. The **Automatic Reparam.** area has three radio buttons, namely **None**, **Chord length**, and **Uniform**. These radio buttons are used to edit parameters.

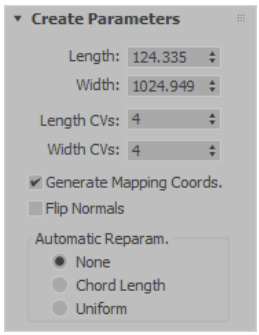



***Figure 15-10*** *The* ***Create Parameters*** *rollout*



**Note**

*If you deselect the NURBS surface objects in the viewport, then the* ***Create Parameters*** *rollout will not be displayed again. So, it is recommended to make all the changes before deselecting it.*

## CONVERTING SPLINES AND EXTENDED SPLINES INTO NURBS SURFACES

To create a NURBS model, you can also use the splines or the extended splines shapes instead of using the point curve or the CV curve. To do so, you need to convert them into NURBS surfaces.

First, choose **Create > Shapes** in the **Command Panel**; a drop-down list will be displayed with the **Splines** option selected by default. Next, choose one of the tools in the **Object Type** rollout and create a spline shape in the viewport. Now, you can convert the spline shape into NURBS surfaces using one of the following methods:

1. Select the spline shape in the viewport and right-click on it; a quad menu will be displayed. Choose the **Convert To:** option; a cascading menu will be displayed. Now, choose **Convert to NURBS**; the spline shape will be converted into NURBS surface.

2. Select the spline shape in the viewport and choose the **Modify** tab in the **Command Panel**; the modifier stack will be displayed. In the modifier stack, right-click on the name of the tool by which you have created the spline shape; a shortcut menu will be displayed. Now, choose the **NURBS** option; the spline shape will be converted into a NURBS surface.

## CONVERTING PRIMITIVES INTO NURBS SURFACES

To create a NURBS model, you can use the standard primitives. To do so, you need to convert them into NURBS surfaces. First, create an object that you want to convert into NURBS surface. Next, select it in the viewport and follow one of the methods that has been discussed for converting a spline into NURBS surfaces.

# MODIFYING NURBS OBJECTS

You can modify a NURBS object using the options available in the Modify panel. To do so, select the NURBS object in the viewport and then choose the **Modify** tab in the **Command Panel**; various rollouts will be displayed in the Modify panel. The options in these rollouts are used to modify the NURBS objects. These rollouts are discussed next.

**Note**

*1. Most of the rollouts are same for the NURBS curves and surfaces.*

*2. The options in the **Rendering** rollout are same as discussed earlier.*

## General Rollout

This rollout will be available for all NURBS objects. The buttons on the top in the **General** rollout are used to add more objects to the selected NURBS object. The **Display** area is used to define the way in which the NURBS object will be displayed in the viewports, refer to Figure 15-11.

The **Attach** button is used to add other objects to the selected NURBS object in the viewport. Once the objects in the viewport are added to the selected NURBS object, they will be converted into NURBS objects, and will become the sub-object of the NURBS object.

Also, the original parameters of the additional objects will be lost. Choose the **Attach Multiple** button to add more than one object to the selected NURBS object at the same time. The **Reorient** check box is used to orient the attached object to the NURBS object.

The **Import** and **Import Multiple** buttons are also used to perform the same function as the **Attach** and **Attach Multiple** buttons. The only difference is that while using the **Import** and **Import Multiple** buttons, the original parameters of the objects are not lost.

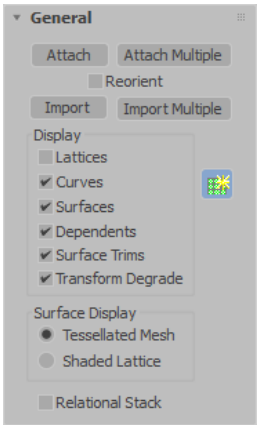



***Figure 15-11** The **General** rollout*

### Display Area

The check boxes in the **Display** area are used to define the way in which the NURBS object will be displayed in the viewports. In the NURBS curves objects, the **Lattices**, **Curves**, and **Dependents** check boxes are displayed in the **Display** area. But in the NURBS surfaces objects, three additional check boxes are displayed. These are **Surfaces**, **Surface Trims**, and **Transform Degrade**. You need to select the required check box to make the corresponding option available in the viewport.

### Surface Display Area

This area is available only for the NURBS surface objects. By default, the **Tessellated Mesh** radio button is selected in this area. As a result, the selected NURBS object will be displayed as iso lines, mesh, or as both isolines and mesh in the viewport depending on the settings made in the **Display Line Parameters** rollout, refer to Figures 15-12 and 15-13.

Select the **Shaded Lattice** radio button to display the NURBS surface object as shaded lattices in the shaded viewports, as shown in Figure 15-14.

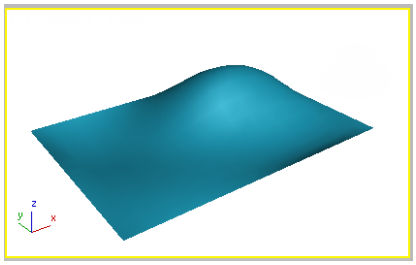


***Figure 15-12*** *The NURBS surface object displayed as a mesh object*

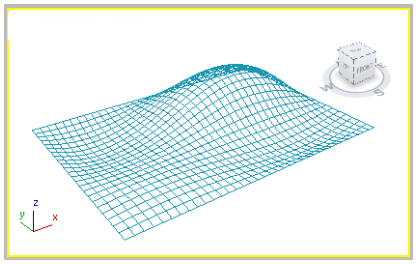


***Figure 15-13*** *The NURBS surface object displayed as iso lines*

## NURBS Creation Toolbox



This button is displayed on the right side of the **Display** area. When you choose this button, the **NURBS** toolbox will be displayed, as shown in Figure 15-15. In this toolbox, buttons available in the **Create Points**, **Create Curves**, and **Create Surfaces** rollouts are available as icons. These buttons are discussed later in this chapter.

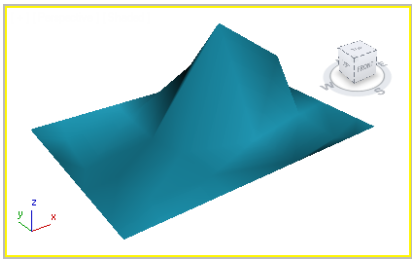


***Figure 15-14*** *The NURBS surface object displayed as shaded lattices*

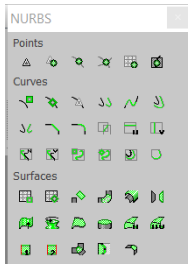



***Figure 15-15*** *The **NURBS** toolbox*

## Display Line Parameters Rollout

This rollout is available only for the NURBS surface objects, refer to Figure 15-16. The values in the **U Lines** and **V Lines** spinners define the number of iso lines that are used to create the wireframe of the NURBS surface object in the viewport. Select the **Iso Only** radio button to display only the iso lines of the NURBS surface object in all viewports. The **Iso And Mesh** radio button is selected by default. It is used to display the iso lines of the NURBS object in those viewports that are set to display the wireframes. Also, the shaded viewports display the shaded surface of the NURBS object. Select the **Mesh Only** radio button to display the NURBS object as a wire mesh in those viewports that are set to display the wireframes. Also, the shaded viewports display the shaded surface of the NURBS object.

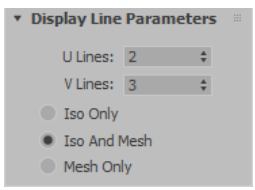



***Figure 15-16*** *The **Display Line Parameters** rollout*



**Note**

*In the NURBS modeling, an iso line, similar to a contour line is known as a line of constant parameter value.*



**Tip**

*To set the viewport to display the wireframes, click on the Shaded viewport label; a quad menu will be displayed. Now, choose the **Wireframe** option in it. Alternatively, you can press the F3 key.*

Before working with the other rollouts, you need to learn about the NURBS sub-objects. The buttons in the **Create Points**, **Create Curves**, and **Create Surfaces** rollouts are used to add the sub-objects to the NURBS curve and surface objects. These sub-objects can be dependent or independent. In other words, they can be child or parent sub-objects. For example, in the loft object shown in Figure 15-17, the surfaces are the dependent sub-objects as they are created from the curves. If you make any change in the curve, then the surface of the loft object will also be affected. But, the curves are the independent sub-objects because they are not created from any other object.

## Create Points Rollout

The buttons in this rollout are used to add the point sub-objects to a NURBS object, refer to Figure 15-18. You can add the point sub-objects on the curve or surface as well as outside the curve or surface. These additional points help you to fit the curves or to trim the curves. To create different types of points, select the NURBS object in the viewport, choose the **Modify** tab, and then choose the corresponding button from the **Create Points** rollout. Alternatively, choose the **Nurbs Creation Toolbox** button from the **General** rollout; the **NURBS** toolbox will be displayed. The buttons in the **Create Points** rollout are discussed next.

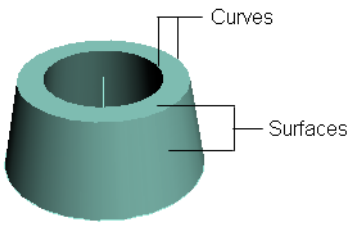



***Figure 15-17*** *The dependent and independent sub-objects in a loft object*

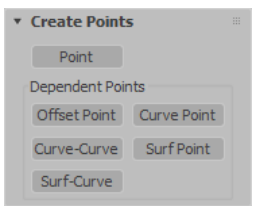



***Figure 15-18*** *The **Create Points** rollout*

### Point

If you want to add an independent point, then select the NURBS object in the viewport. Next, choose the **Point** button in the **Create Points** rollout. Now, when you move the cursor in the viewport, the shape of cursor will change, as shown in Figure 15-19. Now, click in the viewport to create a point and continue clicking to add more points. Next, right-click to exit the command. These points will be displayed as triangles in the viewport, as shown in Figure 15-20.

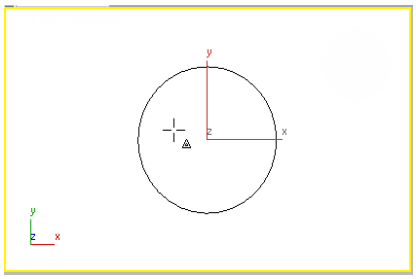


***Figure 15-19*** *The cursor displayed to create independent points*

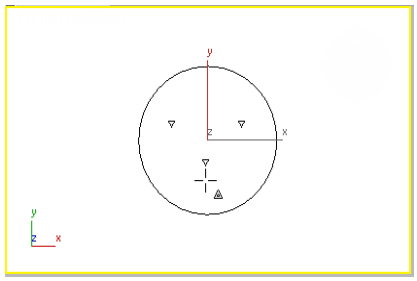


***Figure 15-20*** *The independent points created in the viewport*

## Offset Point

An offset point is a dependent sub-object and lies at a specified distance from the parent point. To create an offset point, select the NURBS object in the viewport. Next, choose the **Offset Point** button in the **Dependent Points** area of the **Create Points** rollout; the **Offset Point** rollout will be displayed at the bottom in the Modify panel, as shown in Figure 15-21. Now, move the cursor over the existing point to be used as parent point in the viewport; the shape of cursor will change. Click on the existing point; a dependent offset point will be created as green asterisk in the viewport, as shown in Figure 15-22. Next, in the Modify panel, expand the **Offset Point** rollout and set the values in the **X**, **Y**, and **Z** spinners to offset the new point from the original position. As you set the values in these spinners, the distance between the offset point and its parent will be displayed as red line, as shown in Figure 15-23. If you do not want to change the position of the offset point, then select the **At Point** radio button in the **Offset Point** rollout.

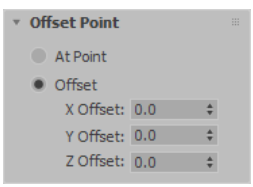



***Figure 15-21*** *The **Offset Point** rollout*

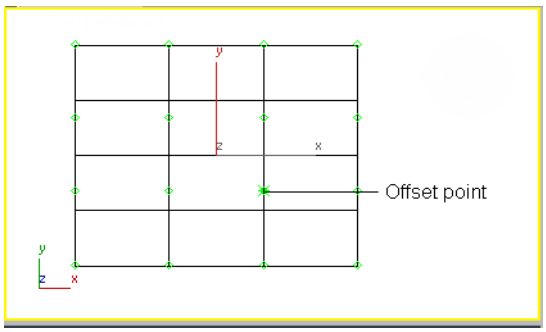



***Figure 15-22*** *The offset point displayed*

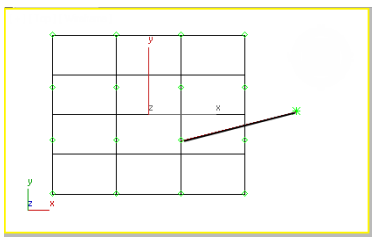


***Figure 15-23*** *The red line displayed between the parent point and the offset point*



**Note**

*The independent point sub-objects will be displayed as black triangles in the viewports. And, the dependent point sub-objects will be displayed as green asterisks in the viewports.*

## Curve Point

A curve point is also a dependent sub-object and lies on a NURBS curve. To create a curve point, select the NURBS curve object in the viewport. Next, choose the **Curve Point** button in the **Dependent Points** area of the **Create Points** rollout; the **Curve Point** rollout will be displayed in the Modify panel, as shown in Figure 15-24. Now, move the cursor over the curve; the curve will turn blue. Also, a blue box along with the cursor will be displayed on the curve, as shown in Figure 15-25. Now, position the blue box on the curve at the location where you want to add a point and then click to add it. Next, you need to modify the parameters in the **Curve Point** rollout, which is discussed next.

### Curve Point Rollout

Set the value in the **U Position** spinner to define the position of the point on the curve. The **On Curve** radio button is selected by default and is used to position the point on the curve. Select the **Offset** radio button to offset the points from the curve. Set the values in the **X**, **Y**, and **Z** spinners to define the location of the point in space.

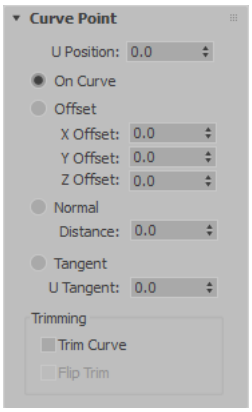



***Figure 15-24*** *The* ***Curve Point*** *rollout*

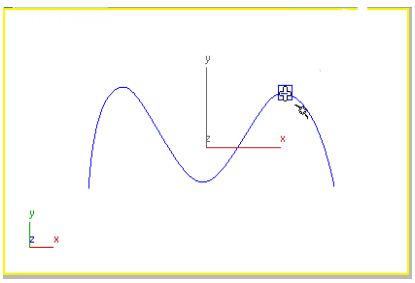


***Figure 15-25*** *A blue box displayed along with the cursor*

Select the **Normal** radio button to offset the point along the curve's normal at the U position. Set the value in the **Distance** spinner to specify the distance of the point from the curve's normal. Select the **Tangent** radio button to offset the point along the tangent at the U position. Set the value in the **U Tangent** spinner to specify the distance of the point from the curve along the tangent.

The options in the **Trimming** area are used to trim the curve. Select the **Trim Curve** check box to trim the curve according to the position of the curve point, refer to Figures 15-26 and 15-27. Select the **Flip Trim** check box to trim the curve in the opposite direction, refer to Figure 15-28.

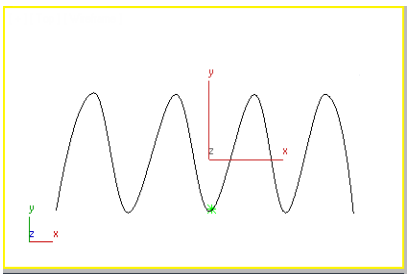


***Figure 15-26*** *A curve point placed on the curve*

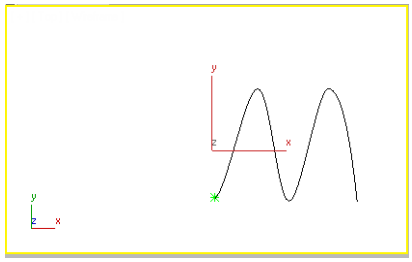


***Figure 15-27*** *The curve after selecting the* ***Trim Curve*** *check box*

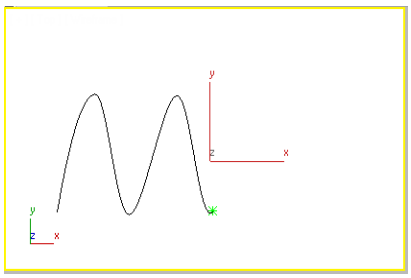


***Figure 15-28*** *The curve after selecting the* ***Flip Trim*** *check box*

## Curve-Curve Point

The curve-curve point is a dependent point sub-object created at the intersection of two NURBS curve objects, refer to Figure 15-29. Note that to create a curve-curve point, the two NURBS curves should be attached to each other and there should be an intersection between the two NURBS curves. To create this point, choose the **Curve-Curve** button in the **Dependent Points** area of the **Create Points** rollout; the **Curve-Curve Intersection** rollout will be displayed in the Modify panel.

Now, move the cursor over one of the NURBS curves; a blue box will be displayed along with the cursor and click on it. Next, drag the cursor from first curve to the second curve and click on it; an intersection point will be created at the nearest intersection between the two curves, refer to Figure 15-29. You can modify the curve-curve point by specifying the parameters in this rollout.

## Surf Point

A surface point is also a dependent sub-object and lies on a NURBS surface. To create a surface point, select the NURBS surface object in the viewport. Now, choose the **Surf Point** button in the **Dependent Points** area of the **Create Points** rollout; the **Surface Point** rollout will be displayed in the Modify panel. Now, move the cursor over the NURBS surface; a pair of intersecting blue lines will be displayed along with the cursor, as shown in Figure 15-30.

Click on the surface where you want to add a point and then modify its parameters in the **Surface Point** rollout in the Modify panel. Next, right-click to exit the command. The options in the **Surface Point** rollout are the same as those discussed earlier in the **Curve Point** rollout.

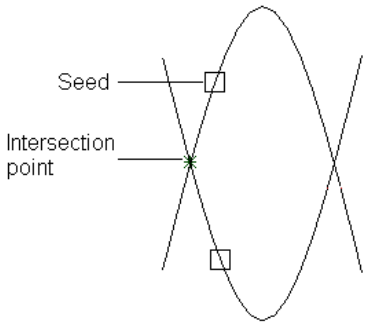



*Figure 15-29 The intersection point created*

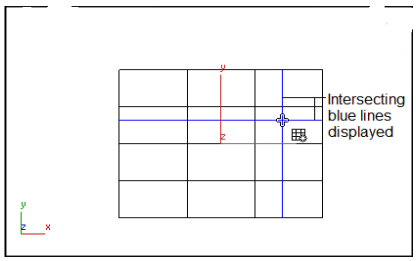



*Figure 15-30 The blue lines displayed*

## Surf-Curve Point

The surface-curve point is a dependent point sub-object created at the intersection of a NURBS curve and a NURBS surface object, refer to Figure 15-31. Note that to create a surface-curve point, the NURBS curve and the NURBS surface should be attached to each other. To create this point, select the NURBS surface and then choose the **Surf-Curve** button in the **Dependent Points** area of the **Create Points** rollout; the **Surface-Curve Intersection Point** rollout will be displayed in the Modify panel. Now, move the cursor over the NURBS curve; a blue box will be displayed along with the cursor. Click on the curve to place the first seed. Next, move the cursor over the NURBS surface object and click on it to place the second seed; an intersection point will be created at the nearest intersection between the curve and the surface that is nearest to the seed point, refer to Figures 15-31, 15-32, and 15-33. You can modify the surface-curve point by specifying the parameters in the **Surface-Curve Intersection Point** rollout.

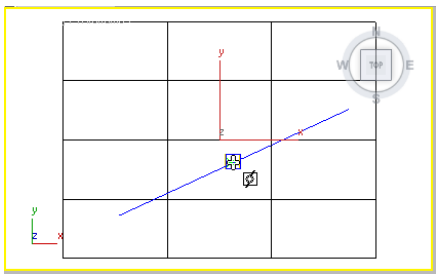


*Figure 15-31 A seed created on the NURBS curve*

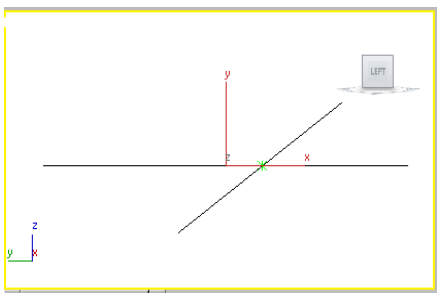


*Figure 15-32 A surface curve intersection point created in the Left viewport*

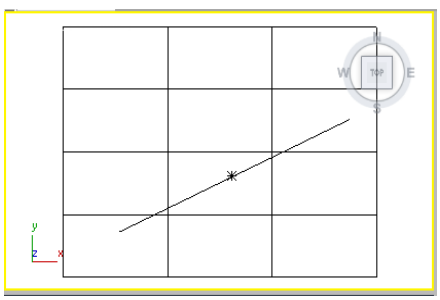


*Figure 15-33 A surface curve intersection point created in the Top viewport*



**Note**

*The buttons (tools) in the **Create Points** rollout are also available in the **NURBS** toolbox in the **General** rollout.*

## Create Curves Rollout

The buttons in this rollout are used to add the curve sub-objects to a NURBS object, refer to Figure 15-34. The curve sub-objects can be dependent or independent. The geometry of the dependent curves sub-objects depend on the curves, points, and surfaces of the NURBS object. The independent curve sub-objects can be added to an existing NURBS model. To create the curve sub-objects, select the NURBS object in the viewport, choose the **Modify** tab, and then choose the corresponding button from the **Create Curves** rollout. Some of the dependent and independent curves are discussed next.

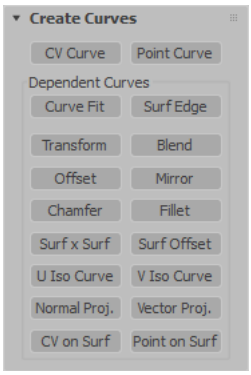



***Figure 15-34*** *The* ***Create Curves*** *rollout*

### CV Curve

The CV curve sub-object is an independent curve sub-object. It is very much similar to the CV curve object. The only difference is that the CV curve sub-object does not provide the thickness on rendering. To create a CV curve sub-object, select the NURBS object in the viewport and then choose the **Modify** tab in the **Command Panel**. Now, choose the **CV Curve** button in the **Create Curves** rollout; the **CV Curve** rollout will be displayed in the Modify panel. Also, the shape of the cursor will change, as shown in Figure 15-35. Now, create a CV curve in the viewport and then right-click to exit the command; the new CV curve will be added to the existing NURBS object, refer to Figures 15-36 and 15-37.

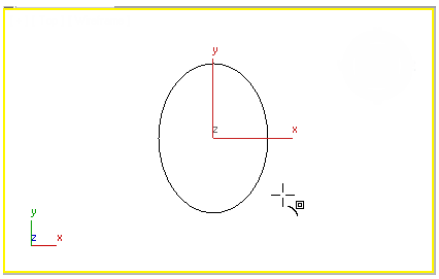


***Figure 15-35*** *The changed shape of the cursor*

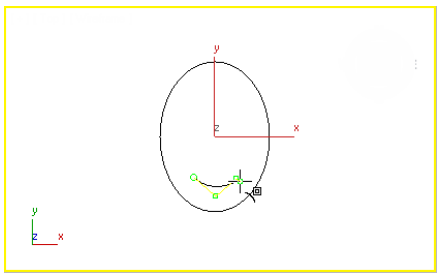


***Figure 15-36*** *The new CV curve created*

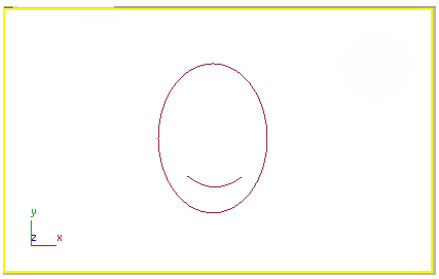


***Figure 15-37*** *The new CV curve attached to the NURBS object*

## Point Curve

The point curve sub-object is also an independent curve sub-object and is very similar to the point curve object. The only difference is that the point curve sub-object does not provide the thickness on rendering. To create a point curve sub-object, select the NURBS object in the viewport. Now, choose the **Point Curve** button from the **Create Curves** rollout; the **Point Curve** rollout will be displayed in the Modify panel. Now, create a point curve in the viewport and right-click to exit the command; the new point curve will be added to the existing NURBS object.

## Curve Fit

The fit curve is a dependent curve sub-object and is created between the existing points in a NURBS object. A fit curve can be created using any type of points such as curve points, surface points, independent points, and so on. To create a fit curve, select the NURBS object in the viewport and choose the **Modify** tab in the **Command Panel**. Next, choose the **Curve Fit** button in the **Dependent Points** area of the **Create Curves** rollout; the cursor will get changed. Also, the **Point Curve** rollout will be displayed in the Modify panel. Notice that there are no parameters in this rollout. Next, move the cursor over a point in the viewport and click to create the starting point of the curve fit. Now, drag the cursor to another point and click on it to continue the creation of the curve fit, refer to Figures 15-38 and 15-39. Next, right-click to exit the command.

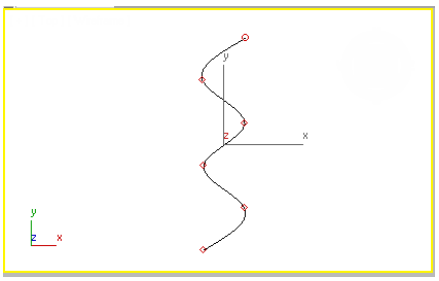


***Figure 15-38*** *A NURBS curve object*

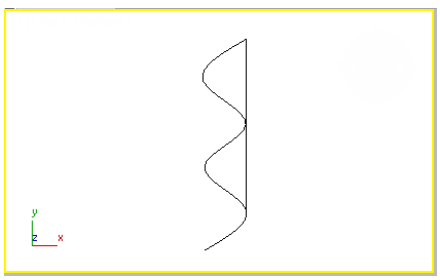


***Figure 15-39*** *A fit curve created between the points in a NURBS curve object*

## Transform

The transform curve is a dependent curve sub-object. It is a duplicate of the original curve and can be modified to a different position, rotation, or scale. To create a transform curve, select the NURBS curve in the viewport and choose the **Modify** tab in the **Command Panel**. Next, choose the **Transform** button in the **Dependent Points** area of the **Create Curves** rollout; the cursor will get changed. Then, move the cursor over the NURBS curve; it will turn blue. Now, press and hold the left mouse button on the curve, drag the cursor to create the duplicate of the selected curve, and then release the left mouse button; a transform curve will be created, refer to Figures 15-40 and 15-41.

To rotate or scale the duplicate curve, select the **Curve** sub-object level in the modifier stack, and then select the duplicate curve in the viewport. Next, rotate or scale the duplicate curve without affecting the original curve.

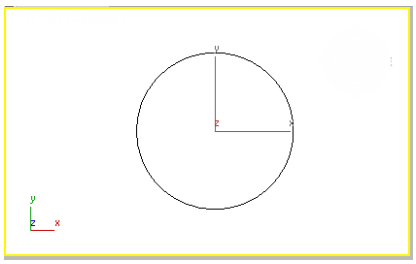


*Figure 15-40* *A NURBS curve object*

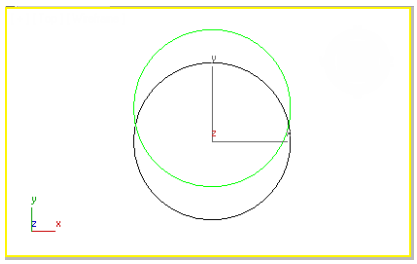


*Figure 15-41* *A transform curve created*

## Chamfer

The chamfer curve is a dependent curve sub-object. It is a straight line between two intersecting parent curve sub-objects. To create a chamfer curve, select the NURBS object that has the intersecting and attached curve sub-objects, as shown in Figure 15-42.

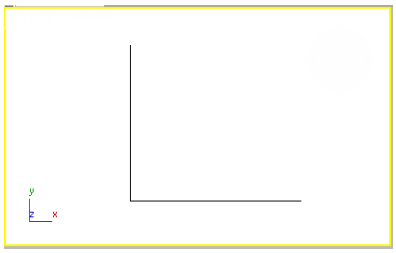


*Figure 15-42* *A NURBS curve to create a chamfer curve*

Now, choose the **Modify** tab in the **Command Panel**. Then, choose the **Chamfer** button in the **Dependent Points** area of the **Create Curves** rollout; the shape of the cursor will change. Also, the **Chamfer Curve** rollout will be displayed in the Modify panel. Move the cursor over a curve in the NURBS object; the curve will turn blue. Also, a blue box will be displayed along with the cursor. Click on the curve to place the first seed to define the intersection to be chamfered. Then, move the cursor over another curve in the NURBS object and click to place another seed; a chamfer curve will be created, refer to Figures 15-43 and 15-44. You can modify the chamfer curve using the parameters in the **Chamfer Curve** rollout in the Modify panel and then right-click to exit the command.

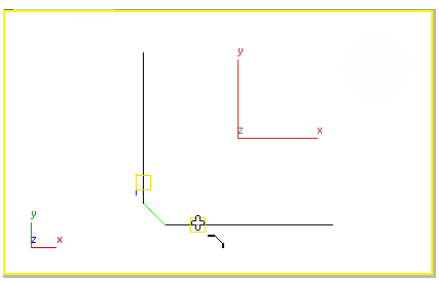


*Figure 15-43* *The seeds placed on the curves*

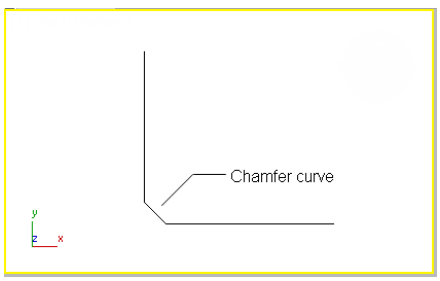



*Figure 15-44* *A chamfer curve created*

**Note**

*While creating a chamfer curve, one or both the curves of the NURBS object get trimmed. To avoid the trimming of the curves, you can modify their parameters in the* ***Chamfer Curve*** *rollout.*

### Surf Edge

The surf edge curve is also a dependent curve and it lies on the boundary of the surface. The edge can be an outside edge or a trim edge. To create a surf edge curve, select the NURBS surface. Next, choose the **Modify** tab in the **Command Panel**. Choose the **Surf Edge** button in the **Dependent Points** area of the **Create Curves** rollout; the cursor will change. Also, the **Surface Edge Curve** rollout will be displayed in the Modify panel. Move the cursor over an edge in the NURBS object; the edge will be highlighted. Now, click on the edge; the surface edge will be created. Also, a seed will be displayed on the edge, as shown in Figure 15-45.

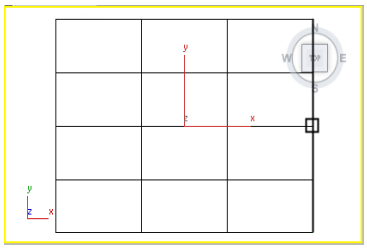


***Figure 15-45*** *A surface edge curve created*



**Note**

*The buttons (tools) in the **Create Curves** rollout are also available in the **NURBS** toolbox in the **General** rollout.*

## Create Surfaces Rollout

The buttons in the **Create Surfaces** rollout are used to add surface sub-objects to a NURBS object, as shown in Figure 15-46. The surface sub-objects can be dependent or independent. The geometry of the dependent surface sub-object depends on the curves and surfaces of another NURBS object. To create the surface sub-objects, select the NURBS object in the viewport, choose the **Modify** tab in the **Command Panel**, and then choose the corresponding button from the **Create Surfaces** rollout. Some of the dependent and independent surfaces are discussed next.




***Figure 15-46*** *The **Create Surfaces** rollout*



**Note**

*The CV surface and point surface sub-objects are independent sub-objects. They can be added to the existing NURBS object using the **CV Surf** and **Point Surf** buttons in the **Create Surfaces** rollout.*

### Blend

A blend surface is a dependent surface sub-object that is used to connect two surfaces, two curves, or a curve to a surface. To create a blend surface, select the NURBS object in the viewport that contains two or more attached curves or surface sub-objects. Next, choose the **Modify** tab in the **Command Panel** and then choose the **Blend** button in the **Dependent Points** area of the **Create Surfaces** rollout; the **Blend Surface** rollout will be displayed. Next, move the cursor over the edge that you want to connect; the edge will turn blue. Click on the edge and move the cursor over the edge of another NURBS object, as shown in Figure 15-47. Now, click on the edge of another NURBS object; a blend surface will be created between the two NURBS objects, as shown in Figure 15-48. You can modify the blend surface using the parameters in the **Blend Surface** rollout in the Modify panel. Next, right-click to exit the command.

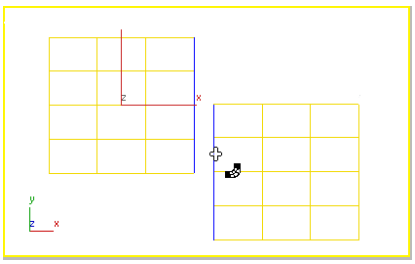


***Figure 15-47*** *The cursor placed over another edge*

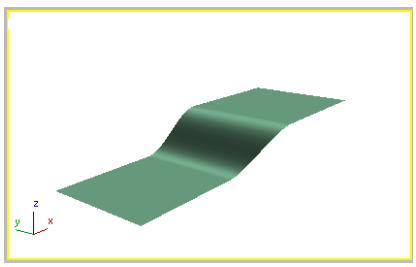


***Figure 15-48*** *A blend surface created*

## Ruled

A ruled surface is a dependent sub-object. It can be created between two curve sub-objects. To create a ruled surface, select the NURBS object in the viewport that contains two or more curves. Next, choose the **Modify** tab in the **Command Panel** and then choose the **Ruled** button in the **Dependent Points** area of the **Create Surfaces** rollout; the **Ruled Surf** rollout will be displayed. Next, move the cursor over the curve that you want to use to create the ruled surface; the curve will turn blue. Now, click on the curve and move the cursor over another curve, refer to Figure 15-49. Now, click on another curve; a ruled surface will be created between the two NURBS curves, as shown in Figure 15-50. You can modify the ruled surface using the parameters in the **Ruled Surf** rollout in the Modify panel. Then, right-click to exit the command.

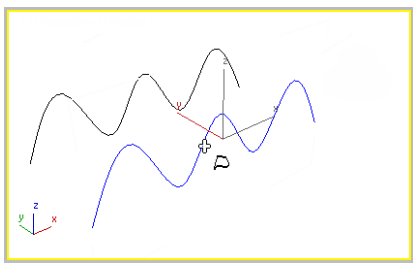


***Figure 15-49*** *The cursor displayed to create the ruled surface*

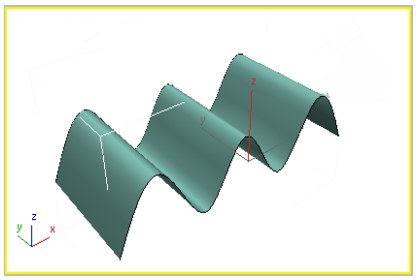


***Figure 15-50*** *A ruled surface created*

## U Loft

A U loft surface is a dependent surface sub-object and it is created across multiple curve sub-objects. To get the best effect, the curves that are to be used for U lofting should have same number of CVs. To create a U loft surface, select one of the NURBS curves in the viewport. Choose the **Modify** tab in the **Command Panel** and then choose the **U Loft** button in the **Dependent Points** area of the **Create Surfaces** rollout; the **U Loft Surface** rollout will be displayed. Next, move the cursor over the first curve that you want to use for creating the U loft surface; it will turn blue. Now, click on it and then click on all curves one-by-one to add them into the U loft surface. When you click on the curves, their names will be displayed in the **U Curves** area of the **U Loft Surface** rollout. Also, while adding the curves to the U loft surface, green colored iso lines of the U loft surface will be displayed in the viewport, as shown in Figure 15-51. Next, right-click to end the command; a U loft surface will be created, as shown in Figure 15-52. Now, you can modify the U loft surface using the parameters in the **U Loft Surface** rollout. Next, right-click to exit the U loft command.

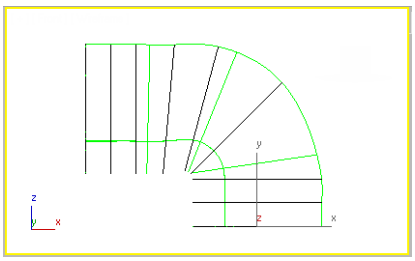


*Figure 15-51 The green iso lines of the U loft surface displayed*

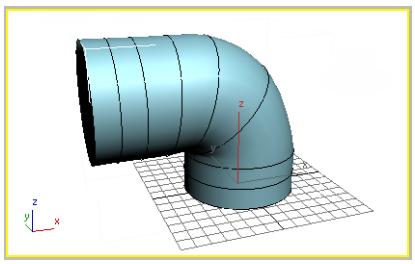


*Figure 15-52 A U loft surface created*

## 1-Rail

The 1-rail sweep surface is a dependent sub-object. To create a 1-rail sweep surface, minimum two curves are required in the viewport. One curve is used to define the cross-section of the surface and another curve is used to define the edge of the surface, which is known as rail. Before creating a sweep surface, you need to make sure that the cross-section curve is intersecting the rail curve. If two cross section curves are used, the first cross-section curve should intersect the starting point of the rail and the last cross-section curve should intersect at the end point of the rail. Also, the curves that you are using to create the cross-section of the surface should have the same direction.

Create the rail and cross-section curves, as shown in Figure 15-53. Select the rail curve and choose the **Modify** tab in the **Command Panel**.Next, choose the **1-Rail** button in the **Dependent Points** area of the **Create Surfaces** rollout; the **1-Rail Sweep Surface** rollout will be displayed. Next, move the cursor over the rail curve; the rail curve will turn blue. Click on it; the name of the rail curve will be displayed in the **Rail Curve** text box of the **1-Rail Sweep Surface** rollout. Select the cross-section curve. When you click on the cross-section curve, its name will be displayed in the **Section Curves** area of the **1-Rail Sweep Surface** rollout. Next, right-click to end the command; a 1-rail surface will be created, as shown in Figure 15-54. You can modify the 1-rail surface using the parameters in the **1-Rail Sweep Surface** rollout. Now, right-click to exit the 1-rail command.

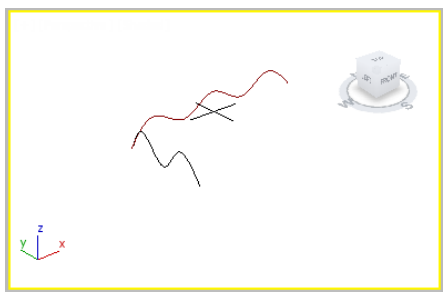


*Figure 15-53 The curves to create 1-rail surface*

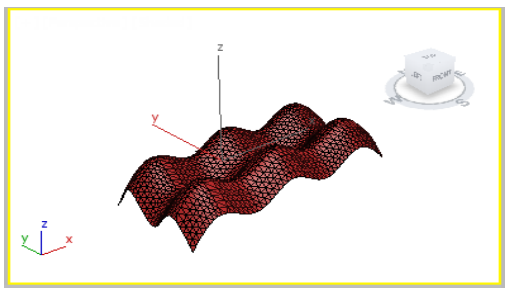


*Figure 15-54 The 1-rail surface created*

## Cap

The cap surface is a dependent sub-object and is created to cap a closed curve or an edge of a closed surface. To create a cap surface, select the NURBS object that has either a closed curve

or an open-ended closed surface, as shown in Figure 15-55. Now, choose the **Modify** tab in the **Command Panel** and then choose the **Cap** button in the **Dependent Points** area of the **Create Surfaces** rollout; the **Cap Surface** rollout will be displayed. Next, move the cursor over the closed curve or the closed surface; it will be highlighted. Now, click on it; a cap surface will be created, as shown in Figure 15-56. Right-click to exit the cap command.

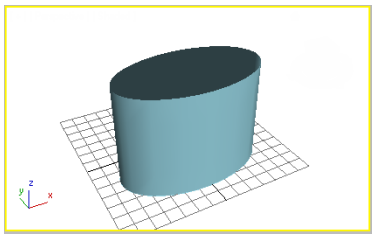


***Figure 15-55*** *An open ended closed surface*

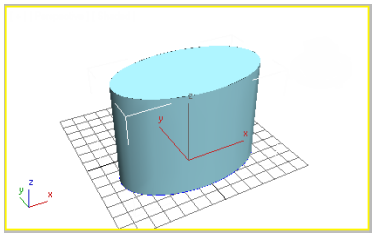


***Figure 15-56*** *A cap created to cap the open end of the closed surface*

# EDITING NURBS SUB-OBJECTS

After creating a NURBS model or an object, you can edit it at the sub-object level. To do so, select the NURBS object in the viewport and choose the **Modify** tab in the **Command Panel**; the rollouts will be displayed in the Modify panel to modify the NURBS object. You have already learned about modifying NURBS objects in the previous section. Now, to modify the NURBS object at the sub-object level, select the sub-object levels in the modifier stack. First, click on the arrow sign on the left side of **NURBS Surface** to display all the sub-object levels in the selected NURBS object, refer to Figure 15-57. Now, select a sub-object level in the modifier stack; it will turn yellow and gets activated. Also, various rollouts related to the selected sub-object level will be displayed below the modifier stack. Alternatively, right-click in the viewport; a quad menu will be displayed, as shown in Figure 15-58.

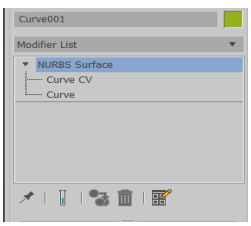



***Figure 15-57*** *The sub-object levels displayed in the modifier stack*

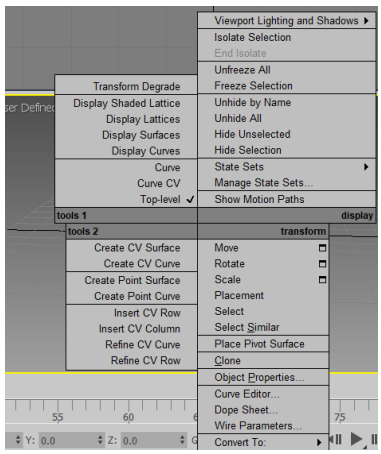



***Figure 15-58*** *The quad menu displayed*

Now, choose the sub-object level that you want to modify; it will also be activated in the modifier stack. Select the sub-object in the viewport and then modify it using the transforms or the rollouts displayed in the Modify panel.

# TUTORIALS

Before starting the tutorials, you need to download the *c15_3dsmax_2024_tut.zip* file from *www.cadcim.com*. The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2024: A Comprehensive Guide*

Extract the contents of the zipped file and save them in the *Documents* folder.

## Tutorial 1

In this tutorial, you will create a washbasin, as shown in Figure 15-59, using the NURBS tools.

**(Expected time: 60 min)**



***Figure 15-59*** *The model of a washbasin*

The following steps are required to complete this tutorial:

a. Create the project folder.
b. Create the profile curve for washbasin.
c. Create the washbasin surface.
d. Create sieve and duct.
e. Create the slab.
f. Create washbasin taps.
g. Save and render the scene.

### Creating the Project Folder

Create a new project folder with the name *c15_tut1* at *\Documents\3dsmax2024* and then save the file with the name *c15tut1*, as discussed in Tutorial 1 of Chapter 2.

## Creating the Profile Curve for Washbasin

In this section, you will create the profile curve for washbasin using the **Ellipse** tool.

1. Activate the Top viewport. Next, choose **Create > Shapes** in the **Command Panel** and then choose the **Ellipse** tool from the **Object Type** rollout.

2. Expand the **Keyboard Entry** rollout and set the parameters as follows:

   Length: **111.739** Width: **202.96**

   Choose the **Create** button; an ellipse is created with the name *Ellipse001*.

3. Choose the **Zoom Extents All** tool.

   Next, you need to convert *Ellipse001* to NURBS surface.

4. Select *Ellipse001* in any viewport and right-click on it; a quad menu is displayed. Choose the **Convert To** option in the quad menu; a cascading menu is displayed. Now, choose the **Convert to NURBS** option; *Ellipse001* is converted into NURBS surface. Next, you need to create multiple copies of *Ellipse001* to create the outer surface of the washbasin.



**Tip**

*You can also create an elliptical curve using the **CV Curve** tool from **Create > Shapes > NURBS Curves > Object Type** rollout in the **Command Panel**. In this case, you need not convert curve to NURBS curve.*

5. Choose the **Select and Move** tool. Next, select *Ellipse001* in the Front viewport and move the cursor over its Y axis. Press and hold the SHIFT key and the left mouse button and then move *Ellipse001* in the upward direction until the value of the **Y** spinner in the coordinates display becomes about 16. Now, release the left mouse button and the SHIFT key; the **Clone Options** dialog box is displayed. Set the value **3** in the **Number of Copies** spinner and choose the **OK** button; *Ellipse001*, *Ellipse002*, *Ellipse003*, and *Ellipse004* are displayed in viewports, as shown in Figure 15-60.

   Next, you need to create the ellipses for the inner surface of the washbasin.

6. Make sure *Ellipse004* (top ellipse) is selected in the Front viewport. Now, move the cursor over the vertical axis of *Ellipse004*. Press and hold the SHIFT key and the left mouse button and then move *Ellipse004* in the downward direction until the value in the **Y** spinner in the coordinates display becomes about -8. Now, release the left mouse button and the SHIFT key; the **Clone Options** dialog box is displayed. Make sure the value **1** is displayed in the **Number of Copies** spinner and choose the **OK** button; *Ellipse005* is displayed in viewports.

7. Modify the color of *Ellipse005* in such a way that you can differentiate between the curves for the inner and the outer surfaces.

8. Make sure *Ellipse005* is selected in the Front viewport and move the cursor over its vertical axis. Press and hold the SHIFT key and the left mouse button, and move *Ellipse005* in the

downward direction until the value in the **Y** spinner in the coordinates display becomes about -16. Now, release the left mouse button and the SHIFT key; the **Clone Options** dialog box is displayed. Set the value **3** in the **Number of Copies** spinner and choose the **OK** button; *Ellipse006, Ellipse007*, and *Ellipse008* are created in all viewports. Now, there are total eight NURBS curves in the viewports.

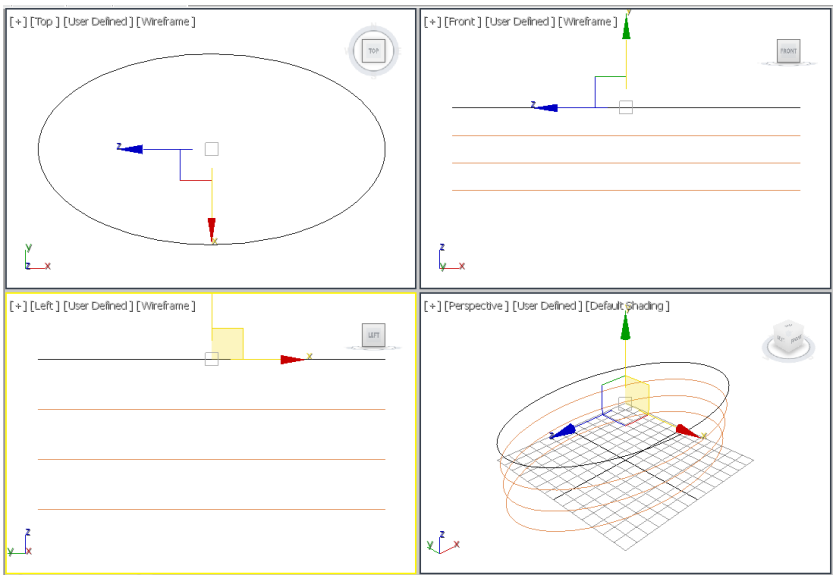



***Figure 15-60*** *All ellipses displayed in viewports*

Next, you need to scale ellipses in the Front viewport.

9. Choose the **Select and Uniform Scale** tool from the **Main Toolbar** and scale the NURBS curves uniformly in the Front viewport, as shown in Figure 15-61.

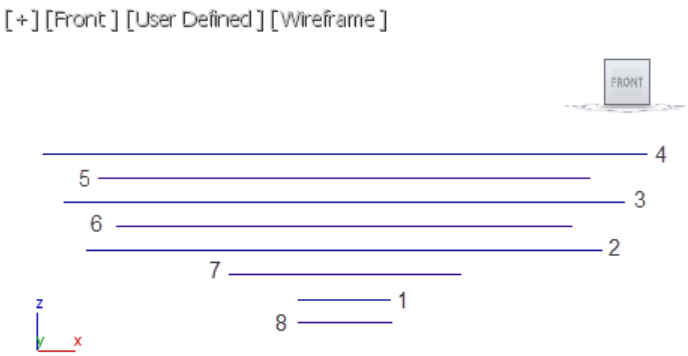



***Figure 15-61*** *All NURBS curves scaled in the Front viewport*

## Creating the Washbasin Surface

In this section, you will create a surface between the NURBS curves to give it the desired shape by using the **U Loft** button.

1. Select *Ellipse008* in the Front viewport and choose the **Modify** tab, if it is not already chosen. The **NURBS Surface** is displayed in the modifier stack and all rollouts required to modify the NURBS object are displayed below the modifier stack.

2. Expand the **Create Surfaces** rollout and choose the **U Loft** button; the **U Loft Surface** rollout is displayed in the Modify panel. Next, move the cursor over *Ellipse008*; it turns blue. Now, click on *Ellipse008* and then click one-by-one on *Ellipse007*, *006*, *005*, *004*, *003*, *002*, and *001* to add them into the U loft surface. Note that you may need to switch to different viewports to select all ellipses. Right-click to exit the command.

3. In the **U Loft Surface** rollout, select the **Flip Normals** check box. Next, right-click to exit the U loft command; a NURBS surface is created in the viewports. Choose the **Zoom Extents All** tool. Figure 15-62 shows NURBS surface in the viewports.

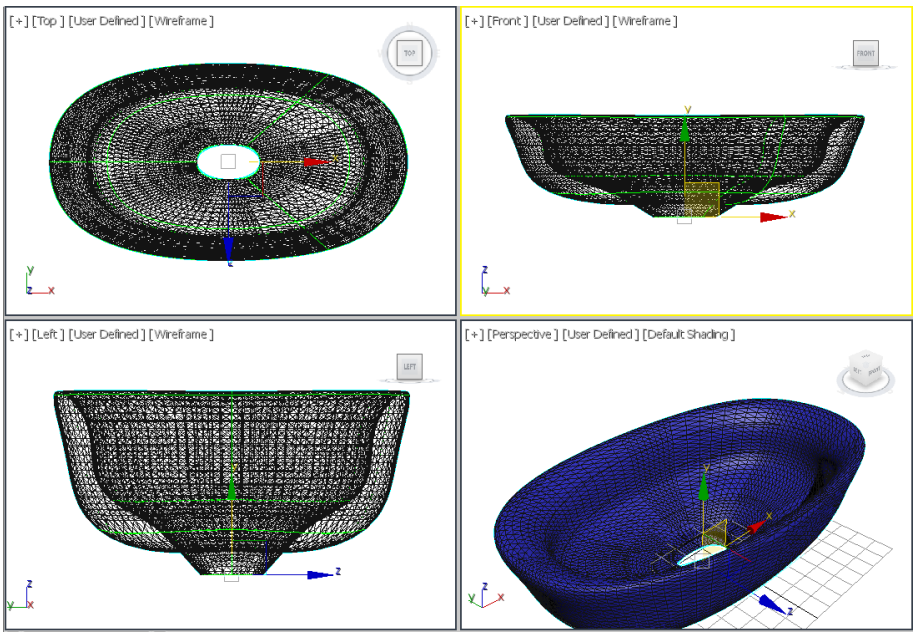



***Figure 15-62*** *A NURBS surface created in viewports*

4. Modify the name of the surface to *washbasin*.

   Next, you need to modify the shape of washbasin.

5. Select *washbasin* in Front viewport and click on the arrow sign on the left side of the **NURBS Surface** in the modifier stack; all the sub-object levels are displayed.

6. Select the **Curve** sub-object level and modify the shapes using the **Select and Move** and **Select and Uniform Scale** tools till you get a perfect shape of washbasin, refer to Figure 15-63. Note that you need to scale *Ellipse008* to a circular shape to fit the sieve in it.

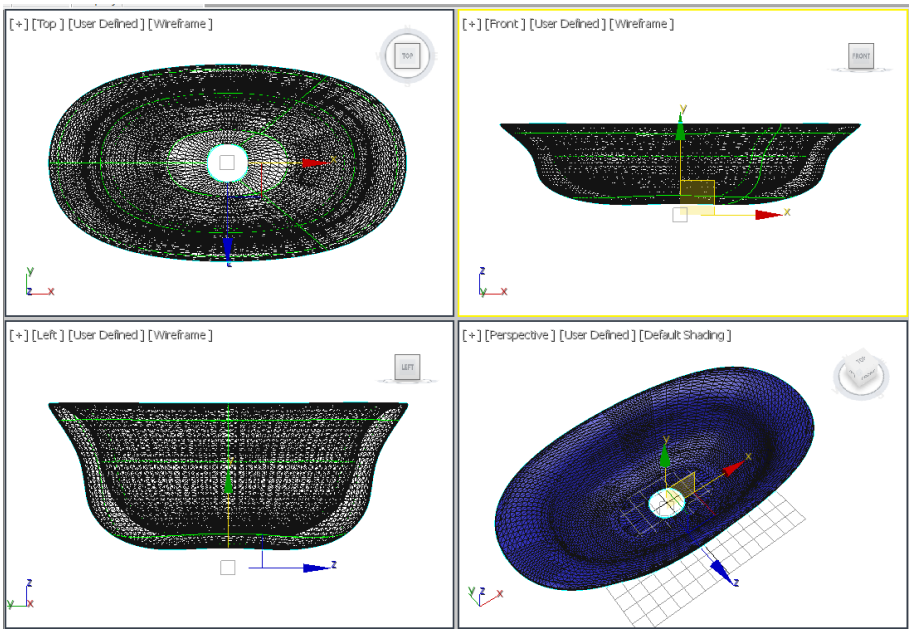



***Figure 15-63*** *The washbasin modified at the* ***Curve*** *sub-object level*

7. Again, select the **Curve** sub-object level in the modifier stack to exit the **Curve** sub-object level.

## Creating Sieve and Duct

In this section, you will create a washbasin sieve and duct by using the **Cylinder** tool.

1. Choose the **Cylinder** tool from **Create > Geometry > Standard Primitives** in the **Command Panel**. Now, create a cylinder in the Top viewport at the center of *washbasin*.

2. Change the name of the cylinder to *sieve*. Next, in the **Parameters** rollout, modify the radius of *sieve* to the same value as that of *Ellipse008* by using the **Select and Uniform Scale** tool. Also, change the values of the following parameters:

   Height: **1.0** Height Segments: **20** Sides: **30**
   Cap Segments: **4**

3. Hide *washbasin* to get more space to perform the boolean command and choose the **Zoom Extents All** tool.

4. Convert *sieve* into editable poly. Next, select the **Polygon** sub-object level and select outer polygons from all the viewports, as shown in Figure 15-64.

5. Choose the **Select and Move** tool and move the selected polygons upward and then scale them, as shown in Figure 15-65.

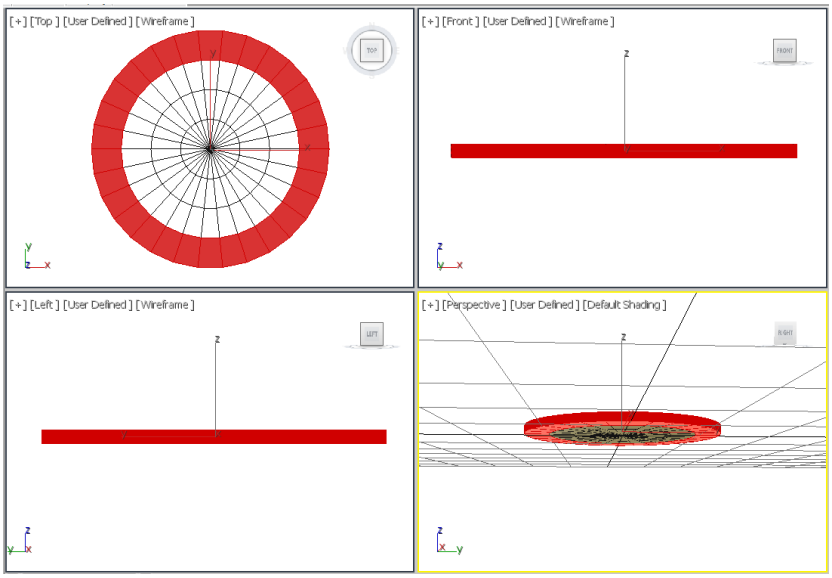



***Figure 15-64*** *Selected polygons of sieve*

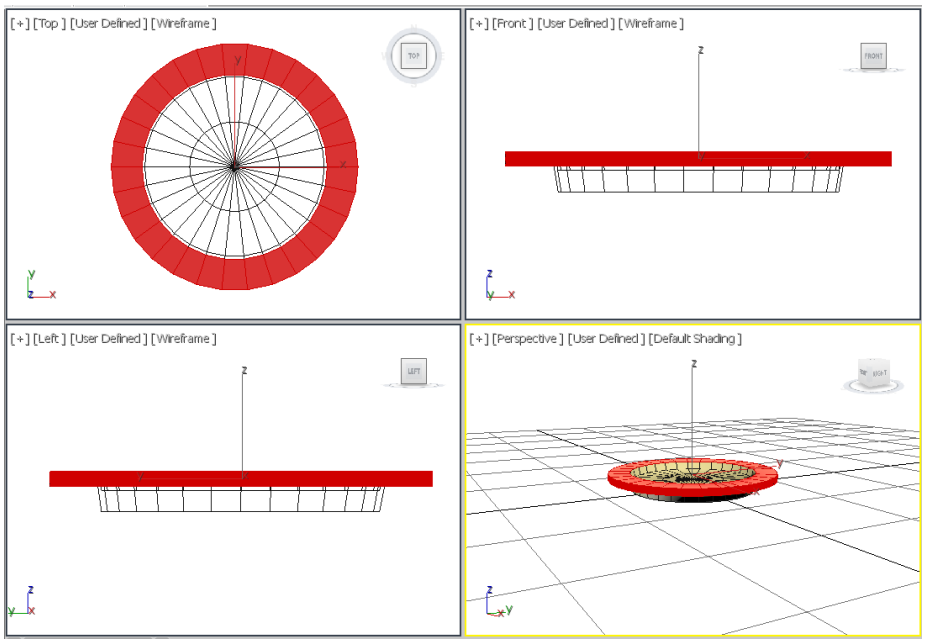



***Figure 15-65*** *The selected polygons moved and scaled*

6. Select the **Polygon** sub-object level again to deactivate it. Next, choose the **Cylinder** tool from **Create > Geometry > Standard Primitives** in the **Command Panel**.

7. Create a cylinder in the Top viewport at the center of *sieve* and set its radius to **0.8** and height to **10.0**.

8. Create copies of the cylinder according to the radius of *sieve* and arrange them, as shown in Figure 15-66.

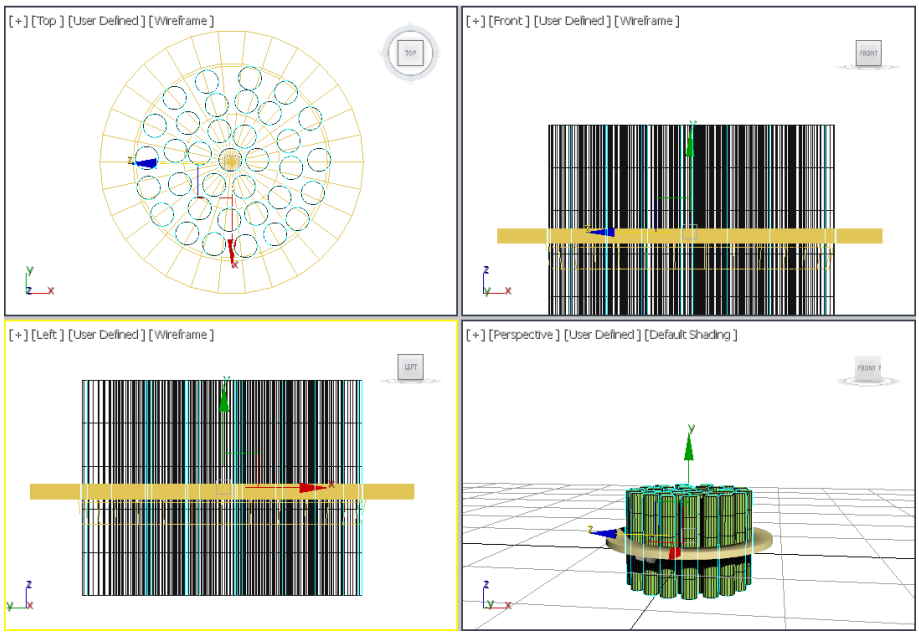



***Figure 15-66*** *Cylinders created and aligned*

9. Select *sieve* in the Top viewport and choose the **ProBoolean** tool from **Create > Geometry > Compound Objects** in the **Command Panel**. In the **Pick Boolean** rollout, choose the **Start Picking** button and click on the cylinders in any viewport one-by-one. Next, right-click to exit the command; a *sieve* is created, as shown in Figure 15-67.

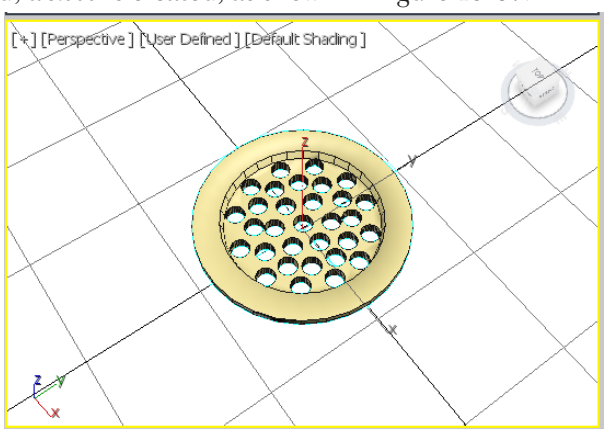



***Figure 15-67*** *A sieve created in the Perspective viewport*

10. Modify the color of sieve to light grey and then unhide *washbasin* in the viewports. Next, align *sieve* in the viewports, as shown in Figure 15-68.

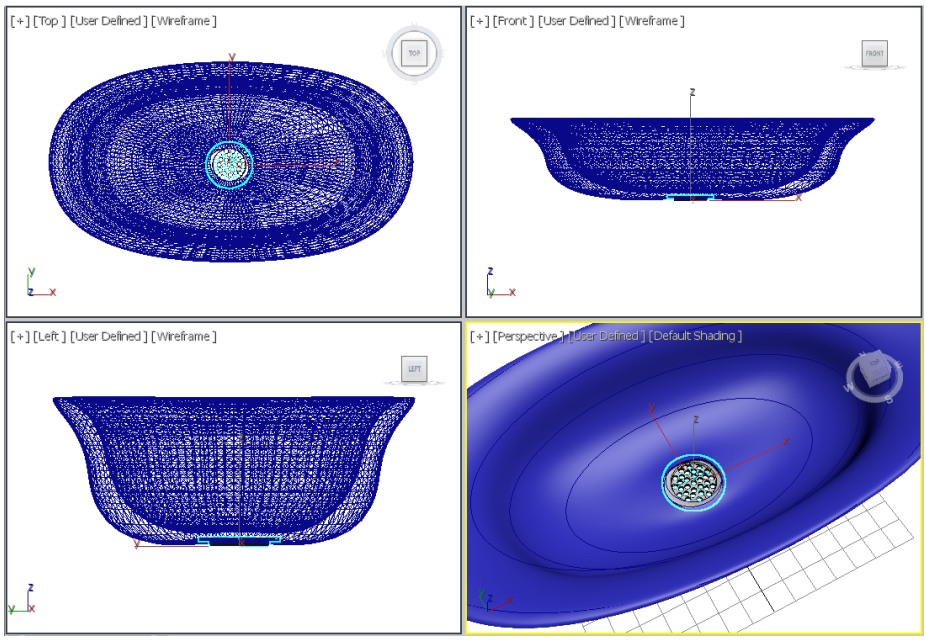



***Figure 15-68*** *A sieve created and aligned in viewports*

To create a duct, you need to choose the **Hose** tool from the **Extended Primitives**.

11. Create a hose in the Top viewport and set its height in the **Height** spinner in the **Free Hose Parameters** area according to *washbasin* size. Also, set the parameters in the **Common Hose Parameters** rollout as follows:

    Segments: **80** Cycles: **15**

    **Hose Shape** Area

    Make sure that the **Round Hose** radio button is selected. Next, set the diameter in the **Diameter** spinner and sides in the **Sides** spinner according to the radius of the sieve.

12. Modify the name of the hose to *duct* and align it in viewports, as shown in Figure 15-69.

13. Apply the **Bend** modifier to *duct* and set the values in the **Parameters** rollout as follows:

    **Bend** Area
    Angle: **40**

    **Bend Axis** Area
    Make sure that the **Z** radio button is selected.

14. Rotate *duct* in the Top viewport and align it in viewports, as shown in Figure 15-70.

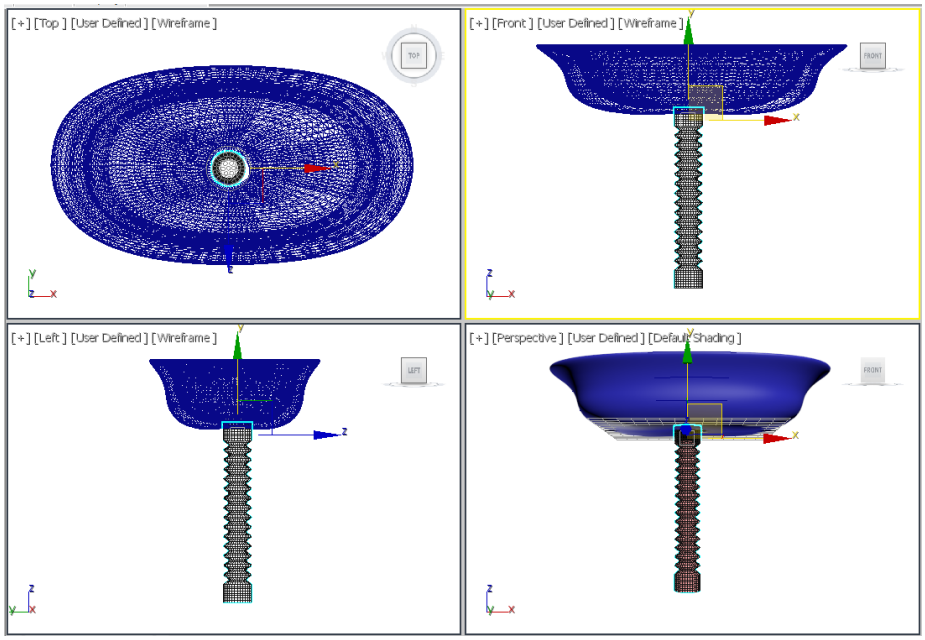



***Figure 15-69*** *A duct created and aligned in viewports*

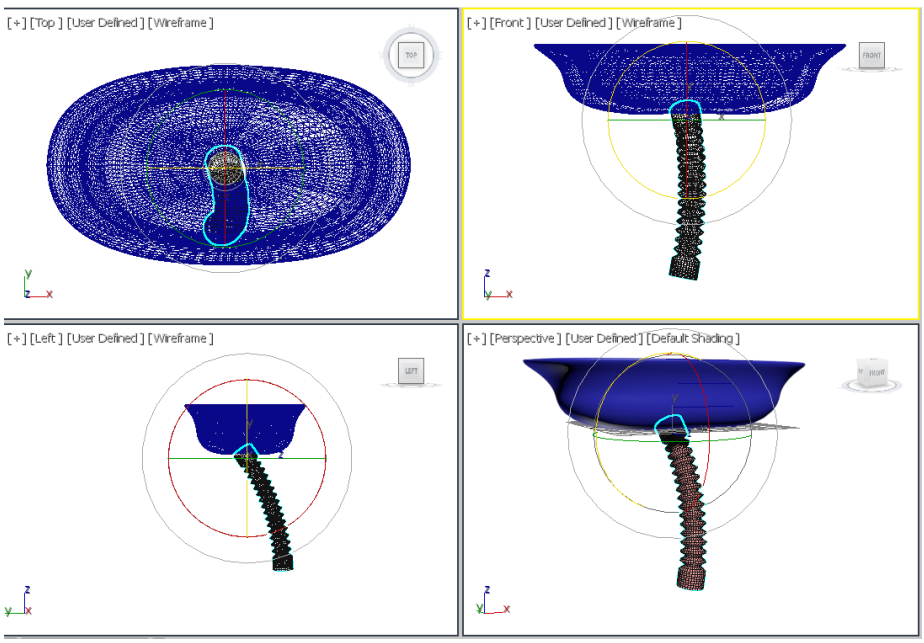



***Figure 15-70*** *The duct geometry rotated and aligned in viewports*

15. Convert *duct* into editable poly and select the **Vertex** sub-object level. Next, move and rotate its vertices to align with *washbasin* in the Left viewport, as shown in Figure 15-71.

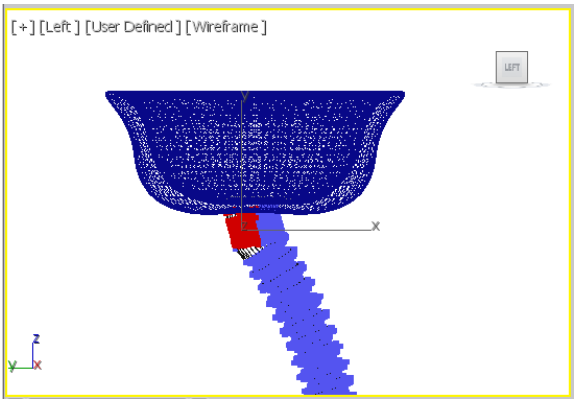



***Figure 15-71*** *The vertices of duct aligned in the Left viewport*

## Creating Slab

In this section, you will create a washbasin slab by using the **Box** tool.

1. Create a box in the Top viewport and set its parameters in the **Parameters** rollout as follows:

   Length: **190.0** Width: **300.0** Height: **46.0**
   Length Segs: **15** Width Segs: **15**

2. Modify the name of the box to *washbasin slab* and align it, as shown in Figure 15-72.

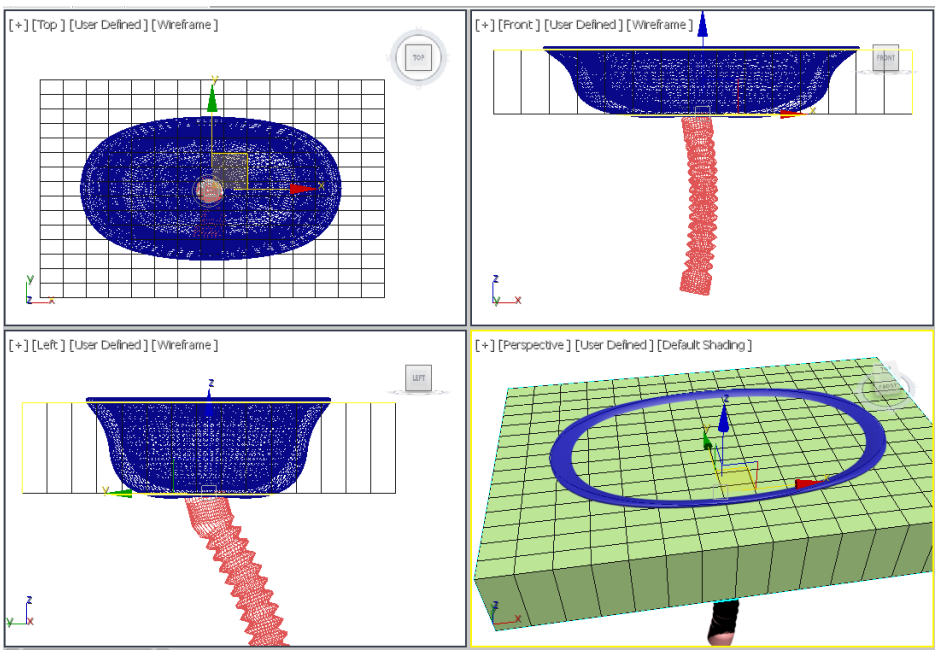



***Figure 15-72*** *The washbasin slab created and aligned in viewports*

3. Convert *washbasin slab* into editable poly and select the **Polygon** sub-object level.

4. Now, select the inner polygons of *washbasin slab,* as shown in Figure 15-73. Next, delete them, refer to Figure 15-74.

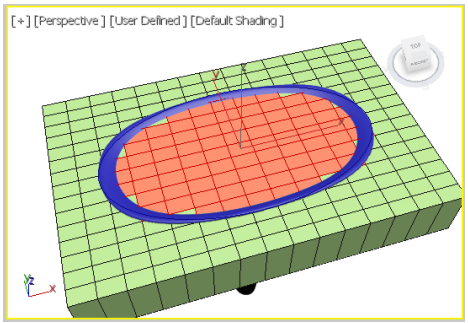



***Figure 15-73*** *The inner polygons selected to be deleted*

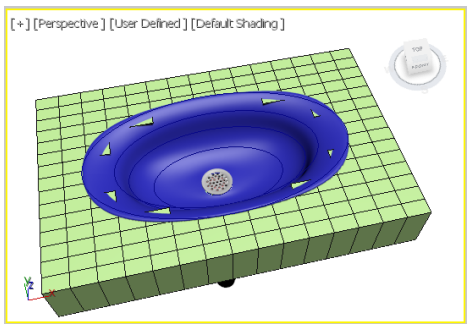



***Figure 15-74*** *The washbasin slab after deleting the polygons*

5. Select the **Vertex** sub-object level and modify the vertices of *washbasin slab* to view the inner portion of *washbasin* properly, as shown in Figure 15-75.

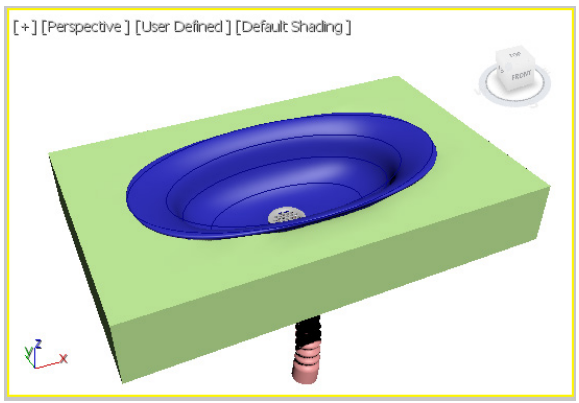



***Figure 15-75*** *The vertices moved to view the inner portion of washbasin*

## Creating Washbasin Taps

In this section, you will create washbasin taps by using the **Cylinder** tool.

1. Create a cylinder in the Top viewport and set its parameters in the **Parameters** rollout as follows:

   Radius: **12.0** Height: **3.0**

2. In the Front viewport, create four copies of the cylinder vertically in the downward direction. Now, set the radius of all four cylinders as **2.0**, **3.0**, **8.0**, and **10.0** from top to bottom. Now, select the cylinders having radius **2.0** and **3.0**, and set their height to **20.0**.

3. Align the cylinders using the **Select and Move** and **Select and Rotate** tools, as shown in Figure 15-76. Also, group all of them and name the group as *tap01*.

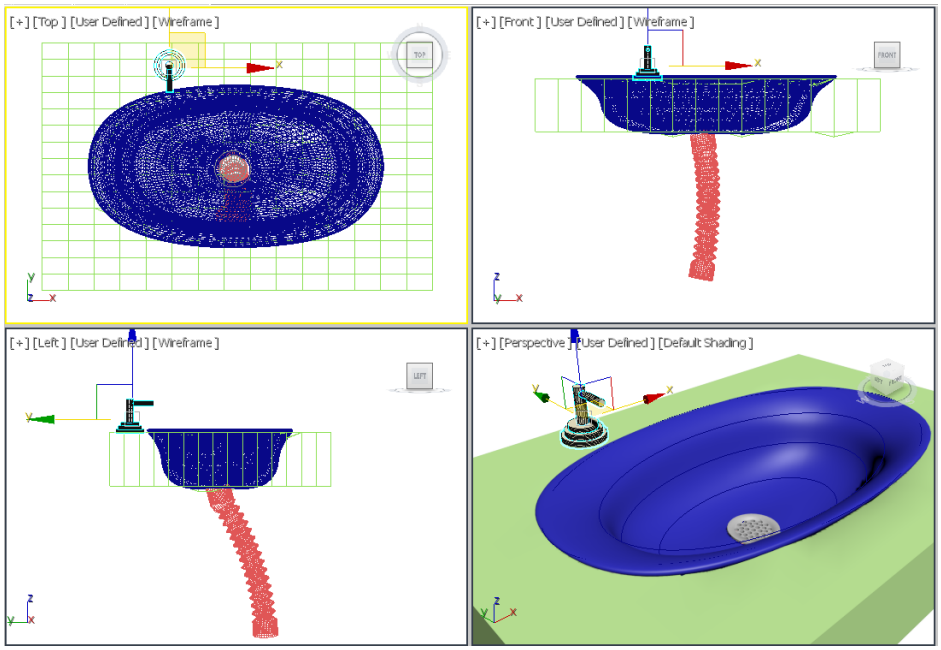



***Figure 15-76*** *The tap01 geometry created and aligned in viewports*

4. Align *tap01* on the left side of *washbasin*. Also, create a copy of *tap01*, which is automatically named as *tap002*, and align it on the right side of *washbasin*.

   Now, you need to create the main tap.

5. As discussed above, create the base of the main tap using three cylinders of radius **8.0**, **10.0**, and **12.0**, and group and name it as *base*. Now, choose the **Line** tool and create a line spline in the Left viewport, as shown in Figure 15-77.

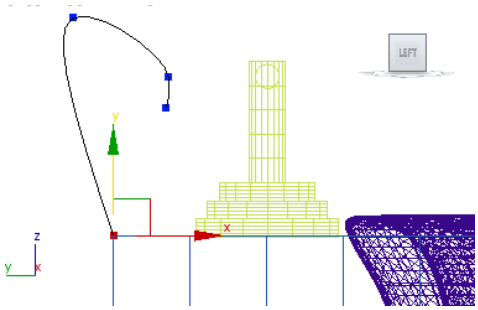



***Figure 15-77*** *The line spline created in the Left viewport*

6. Now, create a cylinder in the Top viewport and set its parameters in the **Parameters** rollout as follows:

   Radius: **3.0** Height: **20.0** Height Segments: **30**

7. Make sure that the cylinder is selected in the viewport and apply the **PathDeform** modifier to it; the **Parameters** rollout is displayed in the Modify panel.

8. In the **Parameters** rollout of the **PathDeform** modifier, choose the **Pick Path** button and then select the line spline in the viewport; a line is created at the center of the cylinder. Now, set the value in the **Stretch** spinner to get a shape similar to the tap.



**Note**

*The number of segments in the object should be high to get the smoothness on applying the* ***PathDeform*** *modifier.*

9. Group the line spline and the cylinder as *upper tap* and then align it with *base* in viewports using the **Select and Move** and **Select and Rotate** tools, as shown in Figure 15-78.

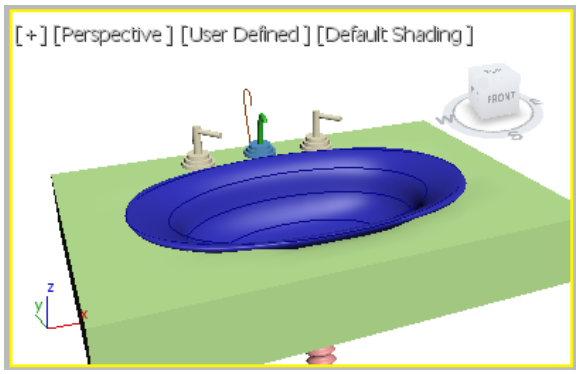



***Figure 15-78*** *Alignment of upper tap and base*

10. Group *base* and *upper tap* as *main tap* and then align it, as shown in Figure 15-79.

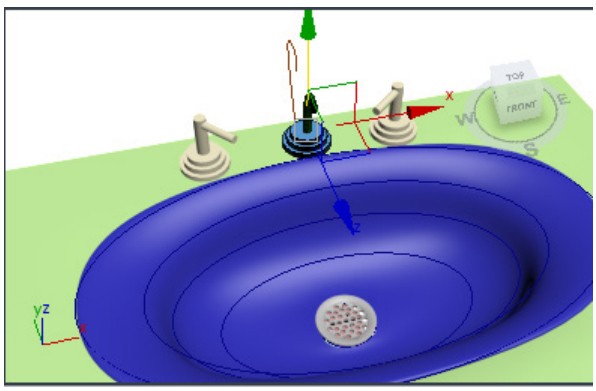



***Figure 15-79*** *Alignment of the main tap in viewports*

## Saving the Scene

In this section, you will save the scene and then render it. You can also view the final rendered image of this model by downloading the *c15_3dsmax_2024_rndr.zip* file from *www.cadcim.com*. The path of the file is as follows:*Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2024: A Comprehensive Guide*

1. Change the background color of the scene to white, as discussed in Tutorial 1 of Chapter 2.

2. Activate the Perspective viewport. Next, choose **Save** from the **File** menu.

# Tutorial 2

In this tutorial, you will create a hat, as shown in Figures 15-80 and 15-81, using the NURBS curves. **(Expected time: 30 min)**



***Figure 15-80*** *The model of hat (view 1)*



***Figure 15-81*** *The model of hat (view 2)*

The following steps are required to complete this tutorial:

a. Create the project folder.
b. Create NURBS curves using splines.
c. Create and modify the hat.
d. Assign the material.
e. Save the scene.

## Creating the Project Folder

1. Create a new project folder with the name *c15_tut2* at *\Documents\3dsmax2024* and then save the file with the name *c15tut2*, as discussed in Tutorial 1 of Chapter 2.

2. Open the Windows Explorer and then browse to the *c15_3dsmax_2024_tut* folder and copy the *cloth.jpg* file from this folder to *\Documents\3dsmax2024\c15_tut2\sceneassets\images*.

## Creating NURBS Curves Using Splines

In this section, you will create the circular NURBS curves for the hat.

1. Choose **Create > Shapes** in the **Command Panel** and then choose the **Circle** tool from the **Object Type** rollout.

2. Create a circle in the Top viewport; it is automatically named as *Circle001*. Next, set its radius to **45** in the **Radius** spinner of the **Parameters** rollout.

3. Make sure that *Circle001* is selected in the Top viewport. Right-click on the **Select and Uniform Scale** tool from the **Main Toolbar**; the **Scale Transform Type-In** dialog box is displayed, as shown in Figure 15-82. Now, in the **Absolute:Local** area, set the value **111.0** in the **X** spinner; *Circle001* is scaled along the X-axis, as shown in Figure 15-83. Now, close this dialog box.

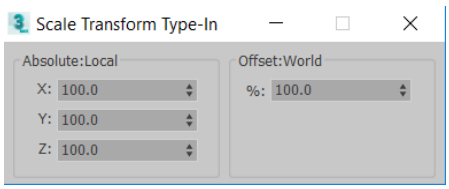



***Figure 15-82*** *The* ***Scale Transform Type-In*** *dialog box*

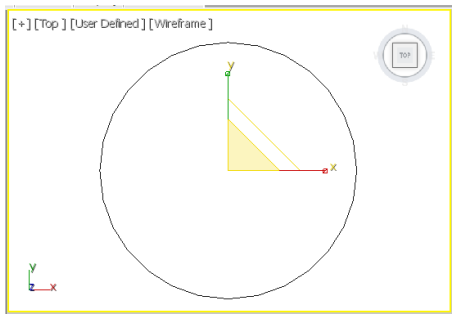



***Figure 15-83*** *The Circle001 spline scaled along the X-axis*

4. Convert *Circle001* into NURBS surface and choose the **Zoom Extents All** tool.

5. Click on the black arrow on the left of **NURBS Surface** in the modifier stack; all the sub-object levels are displayed.

6. Select the **Curve** sub-object level. Next, select the curve in the viewport. Now, choose the **Rebuild** button in the **CV Curve** rollout; the **Rebuild CV Curve** dialog box is displayed. Now, set **20** in the spinner next to the **Number** radio button, refer to Figure 15-84. Next, choose the **OK** button. Click on the **Curve** sub-object level to deactivate it.

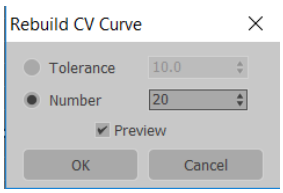



***Figure 15-84*** *The* ***Rebuild CV Curve*** *dialog box*

Next, you need to create multiple copies of *Circle001* to create the surface.

7. Choose the **Select and Move** tool and select *Circle001* in the Front viewport and move the cursor over its vertical axis. Press and hold the SHIFT key and the left mouse button, and then move *Circle001* in the upward direction until the value in the **Y** spinner in the coordinates display becomes about **17**. Now, release the left mouse button and the SHIFT key; the **Clone Options** dialog box is displayed. Set the value **4** in the **Number of Copies** spinner and choose the **OK** button; *Circle002*, *Circle003*, *Circle004*, and *Circle005* are created in viewports.

8. Choose the **Zoom Extents All** tool; the circular NURBS curves are displayed in the viewports, as shown in Figure 15-85.

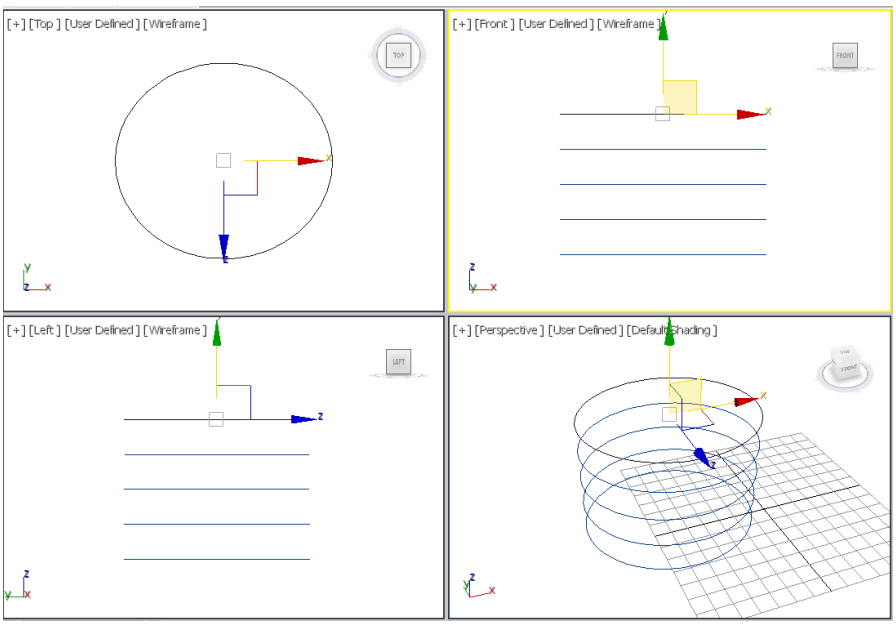



***Figure 15-85*** *The circular NURBS curves displayed in viewports*

9. Select *Circle001* that is placed at the bottom in the viewport and right-click on the **Select and Move** tool; the **Move Transform Type-In** dialog box is displayed. In the **Offset:Screen** area, set the value **13** in the **Y** spinner and press the ENTER key; *Circle001* moves in the vertical direction, as shown in Figure 15-86.

10. Close the **Move Transform Type-In** dialog box.

11. Select *Circle001* and then by pressing CTRL key, select *Circle002*. Next, right-click on the **Select and Uniform Scale** tool; the **Scale Transform Type-In** dialog box is displayed. In the **Offset:Screen** area, set the value **119** in the **%** spinner and press the ENTER key; *Circle001* and *Circle002* are scaled, as shown in Figure 15-87.




***Figure 15-86*** *The Circle001 spline moved vertically*

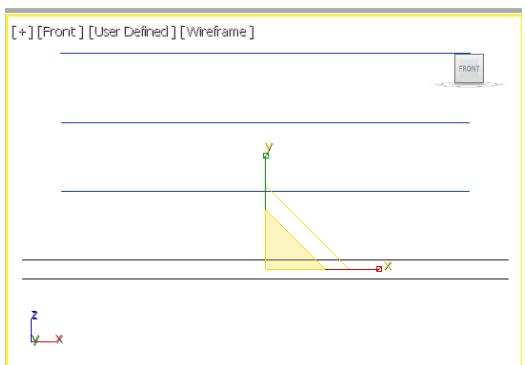



***Figure 15-87*** *The Circle001 and Circle002 splines scaled vertically*

12. Close the **Scale Transform Type-In** dialog box and choose the **Zoom Extents All** tool.

## Creating and Modifying Hat

In this section, you will create a surface between the NURBS curves in the viewport to give it a shape by using the **U Loft** button.

1. Select *Circle001* placed at the bottom in the Front viewport.

2. Choose the **Modify** tab, if it is not already chosen; the **NURBS Surface** is displayed in the modifier stack. All rollouts to modify the NURBS object are also displayed below the modifier stack.

3. Make sure the **General** rollout is expanded and choose the **NURBS Creation Toolbox** button; the **NURBS** toolbox is displayed. Now, choose the **Create U Loft Surface** button from the **Surfaces** section; the **U Loft Surface** rollout is displayed in the Modify panel. Next, move the cursor over *Circle001*; it turns blue. Now, click on it and then one-by-one click on *Circle002*, *003*, *004*, and *005* to add them into the U loft surface. Now, right-click to end the command. In the **U Loft Surface** rollout, select the **Flip Normals** check box. Next, right-click to exit the **U loft** command; a NURBS surface is created in the viewports, as shown in Figure 15-88.

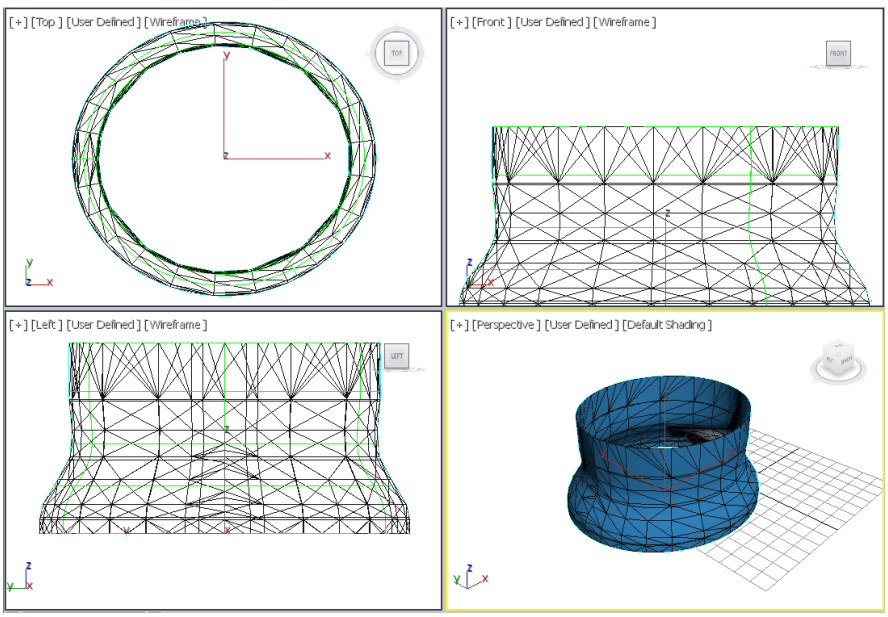



***Figure 15-88*** *A NURBS surface created*

4. Now, choose the **Create Cap Surface** button from the **Surfaces** section in the **NURBS** toolbox; the **Cap Surface** rollout is displayed in the Modify panel. Now, move the cursor over *Circle005*, which is placed at the top in the Front viewport, and then click on it. Also, in the **Cap Surface** rollout, select the **Flip Normals** check box. The open surface is now capped at one end, as shown in Figure 15-89. Next, right-click to exit the **Create Cap Surface** command.

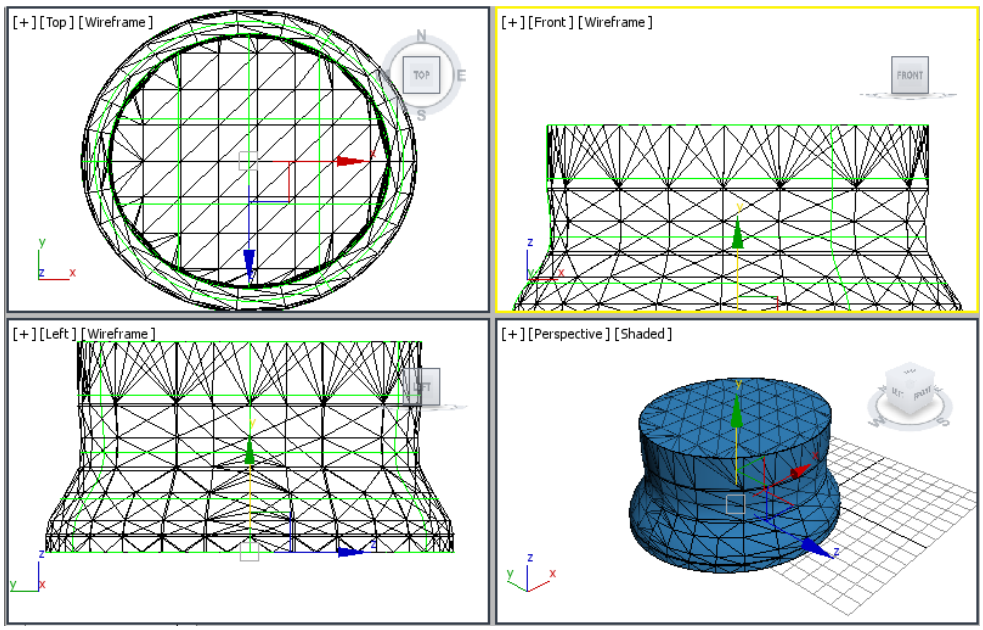



***Figure 15-89*** *The NURBS surface capped at one end*

5. Modify the name of the surface to *hat* in the **Name and Color** rollout.

   Next, you need to modify the *hat* geometry so that it resembles the shape of the hat.

6. Select *hat* in any viewport and click on the plus sign on the left side of **NURBS Surface** in the modifier stack; all the sub-object levels are displayed.

7. Select the **Curve** sub-object level. In the Front viewport, modify the NURBS curves using the **Select and Move** and **Select and Uniform Scale** tools, as shown in Figure 15-90.

8. Again, select the **Curve** sub-object level in the modifier stack to exit the command.

9. Select the **Curve CV** sub-object level; all control vertices are displayed in the viewport. Now, select the outer control vertices of the bottom curves, refer to Figure 15-91. Next, move them until the value in the **Y** spinner in the coordinate display becomes about **15**, as shown in Figure 15-91.

10. Now, modify the surface using the control vertices and curves to get the required shape, as shown in Figure 15-92.

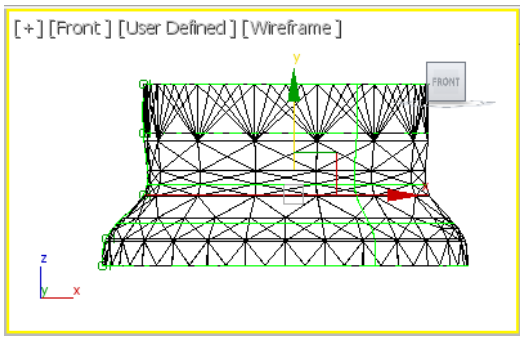



***Figure 15-90*** *The NURBS curves modified in the Front viewport*

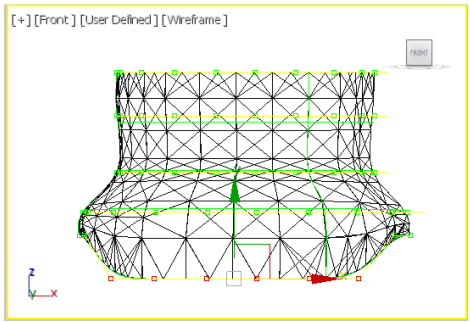



***Figure 15-91*** *The outer control vertices moved vertically*

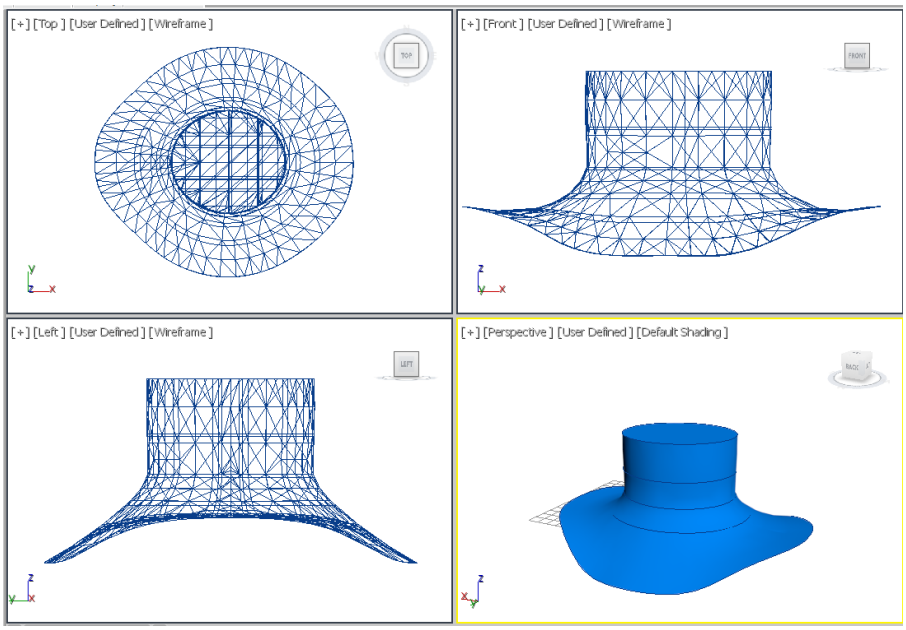



***Figure 15-92*** *The surface modified at the sub-object level*

## Assigning the Material

In this section, you will assign the material to the hat by using the **Material Editor** dialog box.

1. Select *hat* in the viewport and choose the **Material Editor** tool from the **Main Toolbar**; the **Material Editor** dialog box is displayed.

2. By default, the **Standard** material is selected in the **Material Editor** dialog box. Select the **01-Default** sample slot and modify its name to *hat* in the **Material Name** text box.

3. Choose the **Material Type** button which is labeled as **Standard** from the **Material Editor**; the **Material/Map Browser** dialog box is displayed. Select the **Double Sided** material from the

**Materials > Standard** rollouts and choose the **OK** button; the **Replace Material** dialog box is displayed. Select the **Discard old material** radio button and choose the **OK** button. Notice that the **Material Type** button is labeled as **Double Sided** now. Also, the rollouts to modify the material are displayed.

4. In the **Double Sided Basic Parameters** rollout, choose the **Facing Material** map button that is labeled as **Material#X (Standard)**; the **Standard** material is displayed that is used to specify material for the outer surface of *hat*.

5. Now, expand the **Maps** rollout, and choose the **Diffuse Color** map button that is labeled as **None**; the **Material/Map Browser** dialog box is displayed. Select the **Bitmap** map from the **Maps > General** rollout and choose the **OK** button; the **Select Bitmap Image File** dialog box is displayed. Now, select the file *cloth.jpg* and choose the **Open** button; the selected image is displayed in the sample slot. Make sure that the **Use Real-World Scale** check box is cleared in the **Coordinates** rollout.

6. Choose the **Go to Parent** tool twice to go back to the **Double Sided** material. Now, choose the **Back Material** button that is labeled as **Material#X (Standard)**; the **Standard** material is displayed that is used to specify material for the inner surface of *hat*.

7. Expand the **Maps** rollout, and choose the **Diffuse Color** map button that is labeled as **None**; the **Material/Map Browser** dialog box is displayed. Select the **Checker** map from the **Maps > General>Standard** rollout and choose the **OK** button; the rollouts to modify the **Checker** map are displayed.

8. In the **Coordinates** rollout, set the value **25** in both the **U Tiling** and **V Tiling** spinners and assign *hat* material to *hat*. Close the **Material Editor** dialog box.



**Note**

*If you want to swap the materials on the geometry, assign the **Normal** modifier.*

## Saving and Rendering the Scene

In this section, you will save the scene and then render it. You can also view the final rendered image of this model by downloading the file *c15_3dsmax_2024_rndr.zip* from *www.cadcim.com*. The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2024: A Comprehensive Guide*.

1. Change the background color of the scene to white, as discussed in Tutorial 1 of Chapter 2.

2. Choose **Save** from the **File** menu.

3. Activate the Perspective viewport and set the view using the **Orbit** tool to see the inner and outer surfaces of *hat*.

4. Ensure the renderer is set to **Scanline**. Choose the **Render Production** tool in the **Main Toolbar**; the **Rendered Frame** window is displayed with the final output of the scene, refer to Figure 15-93.

5. Close this window.



***Figure 15-93*** *The final output after rendering*

## Self-Evaluation Test

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

1. In which of the following NURBS surfaces, the points are constrained to lie on the surface?

   (a) **Point Surface** (b) **CV Curve**
   (c) **Point Curve** (d) **CV Surface**

2. Which of the following buttons in the **Create Points** rollout is used to add the independent point sub-object to a NURBS object?

   (a) **Point** (b) **Surf-Curve**
   (c) **Curve-Curve** (d) **Surf-Point**

3. Which of the following buttons in the **Create Surfaces** rollout is used to add the dependent surface sub-object to a NURBS object?

   (a) **Transform** (b) **Extrude**
   (c) **U Loft** (d) All of these

4. Which of the following buttons in the **Create Points** rollout is used to add the dependent point sub-object to a NURBS object?

   (a) **Offset Point** (b) **Curve Point**
   (c) **Curve-Curve** (d) All of these

5. The NURBS curves are the shape objects and are used to create complex surfaces to create the 3D models. (T/F)

6. The point curves are the NURBS curves in which the points lie outside the curve. (T/F)

7. In the NURBS modeling, an iso line is known as a line of constant parameter value similar to a contour line. (T/F)

8. The CV curves are the NURBS curves that are controlled by _____.

9. The CVs are the points that lie _____ the surface and control the _____ of the CV surface.

10. While creating a point curve, if you want to remove the last point that you have created, then press the _____ key.

## Review Questions

**Answer the following questions:**

1. Which of the following buttons in the **Create Curves** rollout is used to add the dependent curve sub-object to a NURBS object?

   (a) **Transform** (b) **Blend**
   (c) **Chamfer** (d) All of these

2. Which of the following buttons in the **Create Surfaces** rollout is used to add the surface sub-object to a NURBS object?

   (a) **1-Rail** (b) **2-Rail**
   (c) **Offset** (d) All of these

3. Which of the following buttons in the **Create Curves** rollout is used to add the curve sub-object to a NURBS object?

   (a) **1-Rail** (b) **U Loft**
   (c) **Cap** (d) None of these

4. You cannot convert the torus knot and prism from extended primitives into NURBS surface. (T/F)

5. To create a NURBS model, you can also use the splines or extended splines shapes instead of using the point curve or the CV curve. (T/F)

6. The buttons in the **NURBS** toolbox perform the same functions as the buttons in the **Create Points**, **Create Curves**, and **Create Surfaces** rollouts. (T/F)

7. The _____ check box is used to create a 3D curve in all viewports simultaneously.

8. In the viewports, the dependent point sub-objects will be displayed as _____ and the independent point sub-objects will be displayed as _____.

9. The _____ button in the **Create Surfaces** rollout is used to create a surface sub-object between two curve sub-objects.

# EXERCISE

The rendered output of the model used in the following exercise can be accessed by downloading the *c15_3dsmax_2024_exr.zip* file from *www.cadcim.com*. The path of the file is as follows: *Textbooks > Animation and Visual Effects > 3ds Max > Autodesk 3ds Max 2024: A Comprehensive Guide*

## Exercise 1

Start Autodesk 3ds Max 2024 and then perform the following operations:

1. Choose **Create > Shapes** in the **Command Panel**; a drop-down list will be displayed. Select the **NURBS Curves** option from the drop-down list. Now, activate the Top viewport and choose the **Point Curve** tool from the **Object Type** rollout. Next, create two or more point curves in the viewport. Finally, choose the **Modify** tab in the **Command Panel** and attach the NURBS curves in the viewport using the **Attach Multiple** tool.

2. Create a spline or a curve in the viewport from **Create > Shapes > Splines** in the **Command Panel**. Now, convert it into NURBS curve using the methods discussed in the chapter.

3. Create a NURBS object in the viewport that contains two or more curves or surface sub-objects. Choose the **Modify** tab in the **Command Panel** and then choose the **Blend** button from the **Create Surfaces** rollout. Next, move the cursor over the edge; it turns blue. Now, click on the edge and move the cursor over the edge of another NURBS object, and click on it; a blend surface will be created between the two NURBS objects. Next, modify the blend surface using the parameters in the **Blend Surface** rollout in the modify panel and right-click to exit the command.

4. Create a NURBS curve in the viewport, as shown in Figure 15-94. Next, create a NURBS model, as shown in Figure 15-95, using the **U Loft** tool. Also, apply a material to it.

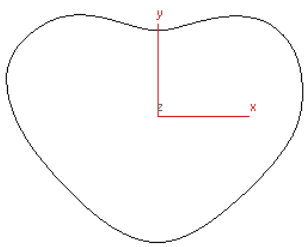



***Figure 15-94*** *The NURBS curve to create the model of heart*

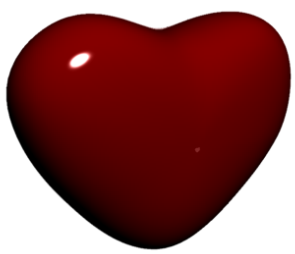


***Figure 15-95*** *The model of heart*

## Answers to Self-Evaluation Test

**1.** a, **2.** a, **3.** d, **4.** d, **5.** T, **6.** F, **7.** T, **8.** control vertices (CVs), **9.** outside; shape, **10.** BACKSPACE