Chapter 13
Synchronous Modeling

After completing this chapter, you will be able to:
- ***Modify Faces***
- ***Modify Blends and Chamfers***
- ***Reuse Faces***
- ***Relate Faces***
- ***Apply dimensions between faces***
- ***Shell faces***
- ***Group Faces***
- ***Edit the cross-section of a model***

INTRODUCTION

Synchronous Modeling is a state-of-the-art technology used to modify the parts even if the modeling history is not available. As a result, the time required for rebuilding the sketches and converting them into the solid geometry will be saved. The parts to be modified can be made in NX or any other CAD packages. Synchronous Modeling tools are used to modify and improve the already created design in the shortest period of time, regardless of its origin, associativity, or feature history. NX with Synchronous Modeling gets an edge over other modeling packages.

SYNCHRONOUS MODELING TOOLS

The Synchronous Modeling tools are available in the **Synchronous Modeling** group of the **Home** tab of the **Ribbon**. The tools in the **Synchronous Modeling** group are discussed next.

Move Face

Ribbon: Home > Synchronous Modeling > Move Face
Menu: Insert > Synchronous Modeling > Move Face

You can move a set of selected faces of a model in thelinear direction or orient them in the angular direction using the **Move Face** tool. On doing so, the adjacent chamfers or fillets will also get adjusted automatically. To move the face of a model, choose the **Move Face** tool from the **Synchronous Modeling** group; the **Move Face** dialog box will be displayed, refer to Figure 13-1. The options in this dialog box are discussed next.

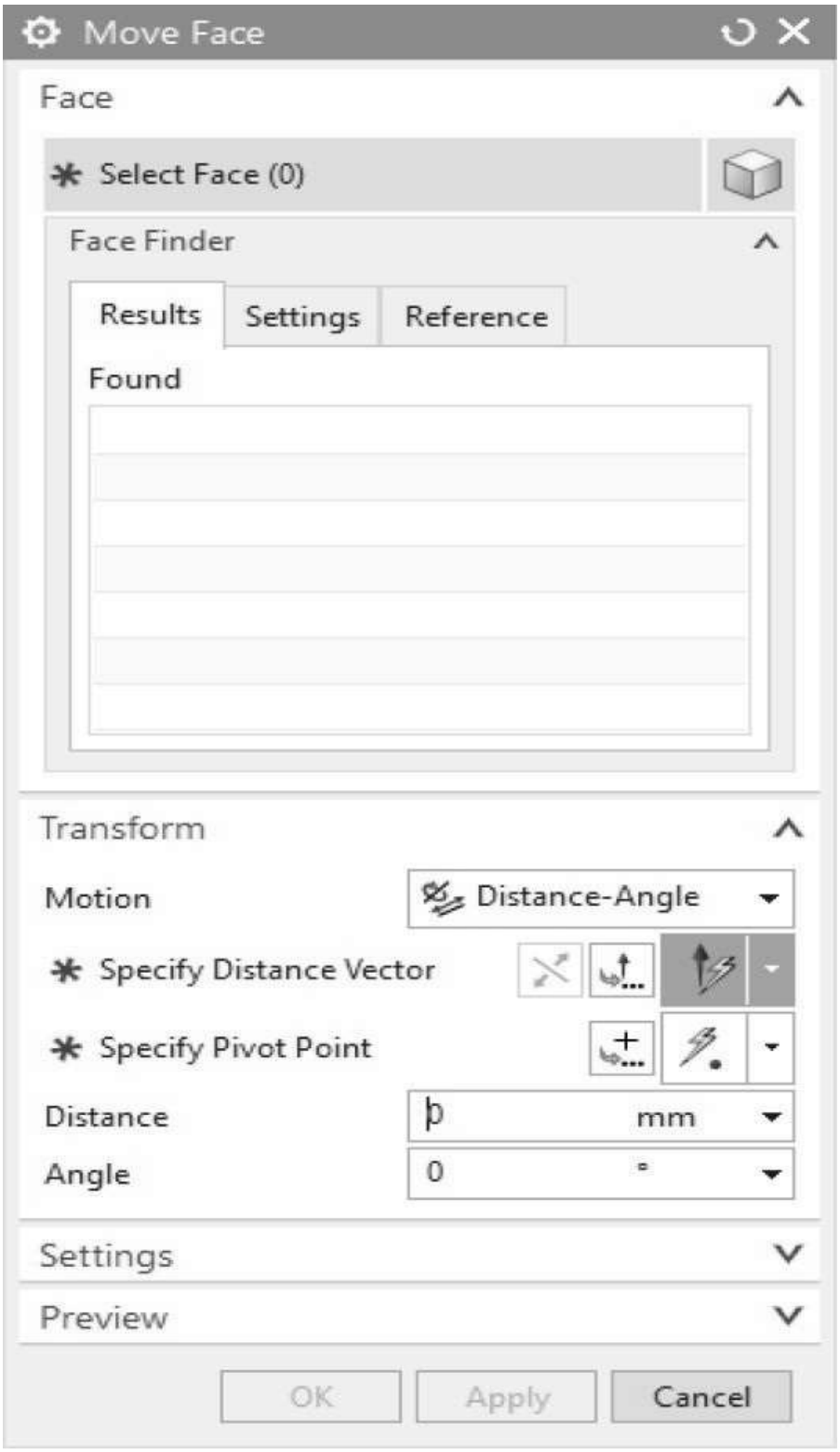

Figure 13-1 *The* ***Move Face*** *dialog box*

Face Rollout

In this rollout, the **Face** button is chosen by default. As a result, you will be prompted to select the faces to be moved. Select the faces that you want to move; a dimension handle, and a dynamic edit box will be displayed, refer to Figure 13-2. Components of the handle are shown in Figure 13-2. Click on the point located at the center of the handle, the OrientXpress tool will be displayed, as shown in Figure 13-3. Using this tool, you can choose the direction for moving the selected faces. Using the distance axis, you can drag the selected faces along the specified direction on the vector triad. Note that the component will be modified according to the movement of the cursor. Using the angle axis, you can change the angular direction of the selected face. You can also use the dynamic edit box for modifying the component. Figure 13-3 shows the selected faces, the OrientXpress tool, and the dynamic edit box and Figure 13-4 shows the preview of the dynamically updated model. Figure 13-5 shows the faces selected to rotate by using the angular axis and Figure 13-6 shows the preview of the dynamically updated model.

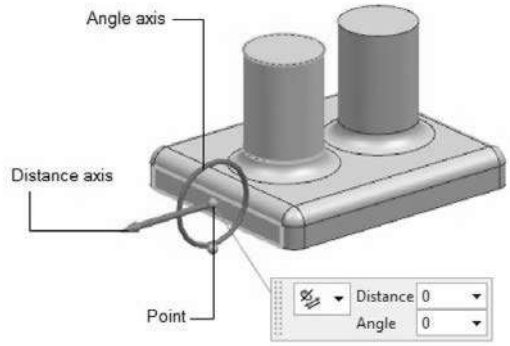

Figure 13-2 *The Dimension handle and its components*

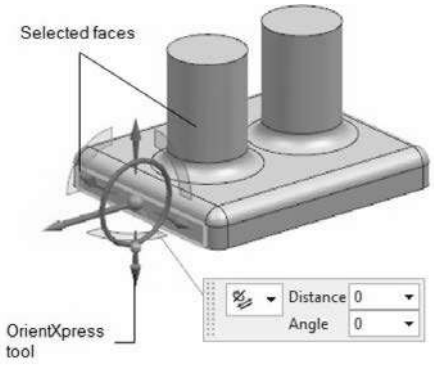

Figure 13-3 *Faces selected to move in the linear direction*

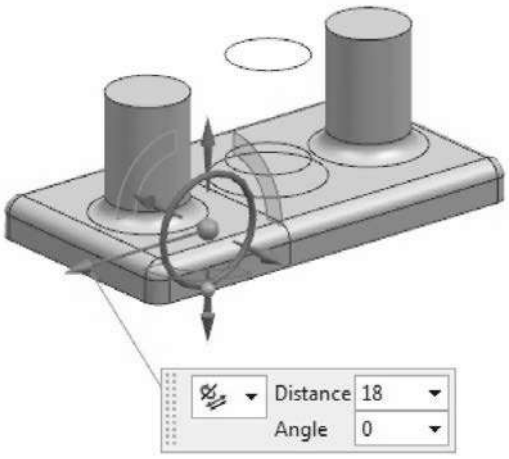

Figure 13-4 Dynamically updated model

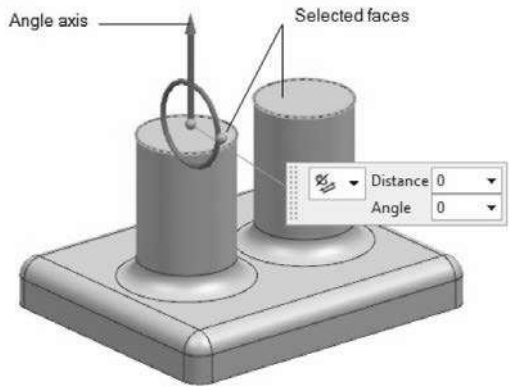

Figure 13-5 Faces selected to rotate

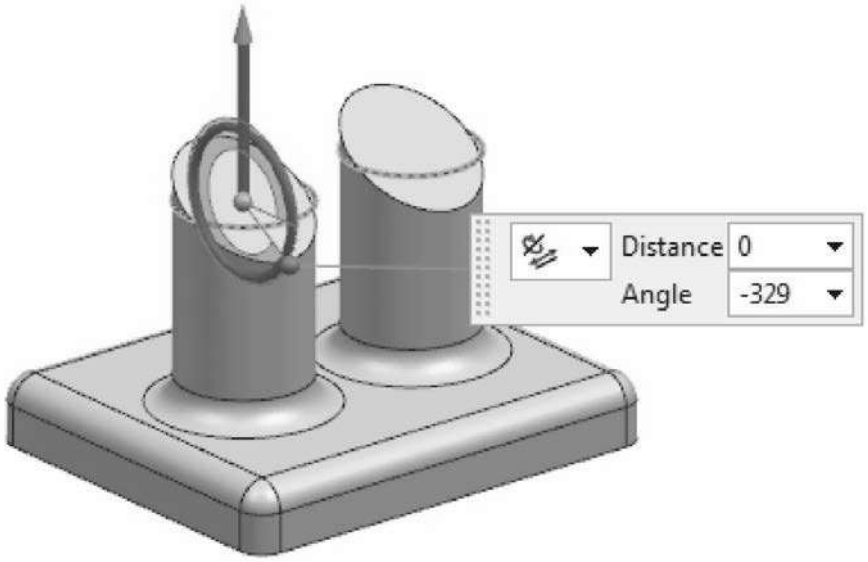

Figure 13-6 Dynamically updated model

If you select a face, a list of all possible geometrical conditions that can be applied to the selected face with respect to the unselected faces will be displayed in the **Results** tab of the **Face Finder** sub-rollout. If you move the cursor over a geometrical condition, all the faces related to it will be highlighted in the drawing window. To select the unselected faces, select the check box of the corresponding geometrical condition. In the **Settings** tab of the **Face Finder** sub-rollout, you can select the required check boxes of the geometrical conditions in such a way that if you select a single face, multiple faces are selected automatically according to the settings in the **Settings** tab. You can select the required coordinate system from the **Reference** drop-down list in the **Reference** tab, so that the faces move with reference to the

selected coordinate system.

Transform Rollout

Instead of dragging the dimension handle or using the dynamic edit boxes to move the faces, you can use the **Transform** rollout to specify the values. The options in this rollout are similar to the options in the **Move Component** dialog box discussed in Chapter 8.

Settings Rollout

The **Move Behavior** drop-down list in the **Settings** rollout is used to specify the behavior of the faces while moving them.

The **Overflow Behavior** drop-down list is used to control the output, when an offset value is specified in the **Distance** edit box in the **Transform** rollout. Figures 13-7, 13-8, and 13-9 show the output of the model when the **Extend Change Face**, **Extend Incident Face**, and **Extend Cap Face** options are respectively selected.

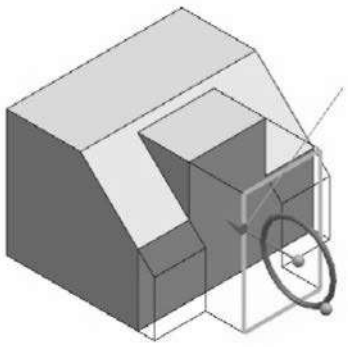

Figure 13-7 *The model output with the* ***Extend Change Face*** *option selected*

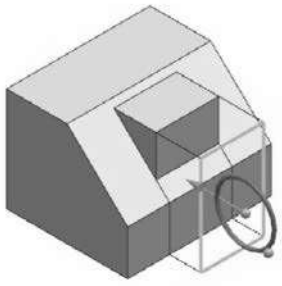

Figure 13-8 *The model output with the* ***Extend Incident Face*** *option selected*

The **Step Face** drop-down list is used to extend the neighboring faces while moving the selected face.

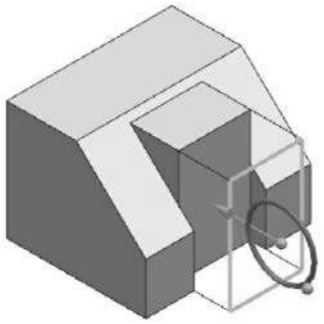

Figure 13-9 *The model output with the* ***Extend Cap Face*** *option selected*

Move Edge

Ribbon: Home > Synchronous Modeling > More Gallery > Edge > Move Edge *(Customize to Add)*
Menu: Insert > Synchronous Modeling > Edge > Move Edge

This tool is used to move the selected edges of a model. You can directly edit the shape of a model by moving the edges. To move an edge of a model, invoke the **More** Gallery of the **Synchronous Modeling** group and choose the **Move Edge** tool from the **Edge** Gallery; the **Move Edge** dialog box will be displayed, refer to Figure 13-10. The options in this dialog box are discussed next.

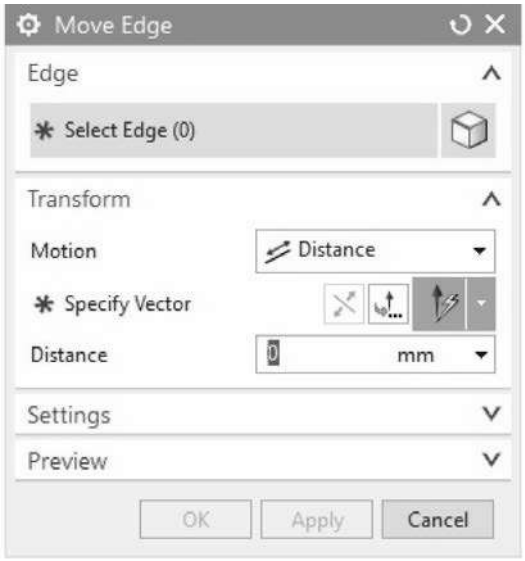

Figure 13-10 *The* ***Move Edge*** *dialog box*

Edge Rollout

In this rollout, the **Edge** button is chosen by default. As a result, you will be

prompted to select the edges to be moved. Select the edges that you want to move; a direction handle, a distance axis, and a dynamic edit box will be displayed on the selected edges, refer to Figure 13-11. Using this handle, you can choose the direction for moving the selected edges. Using the distance axis, you can drag the selected edges along the specified direction. Note that the model will be modified according to the movement of the cursor. You can also use the dynamic edit box for modifying the model. Figure 13-12 shows the preview of the dynamically updated model.

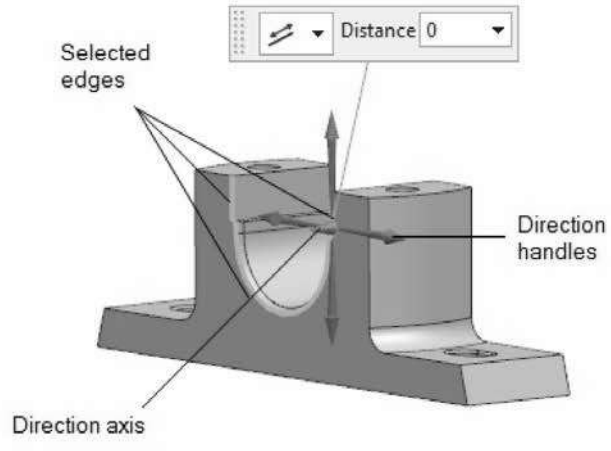

Figure 13-11 *Model with selected edges*

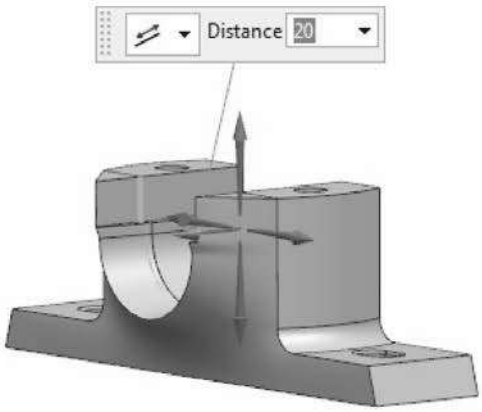

Figure 13-12 *Dynamically updated model*

Transform Rollout

Instead of dragging the dimension handle, or using the dynamic edit boxes to move the faces, you can move the faces by using the **Transform** rollout to specify the values. The options in this rollout are similar to the options of the **Move Component** dialog box discussed in Chapter 8.

Settings Rollout

The **End Face Behavior** drop-down list in the **Settings** rollout is used to specify the behavior of the adjacent faces or edges while moving the selected edges. If you choose the **Extend** option from the drop-down list, the shape of adjacent faces will remain unchanged, refer to Figure 13-13. If you choose the **Morph** option from the drop-down list, the shape of the adjacent faces will change according to the moved faces, refer to Figure 13-14.

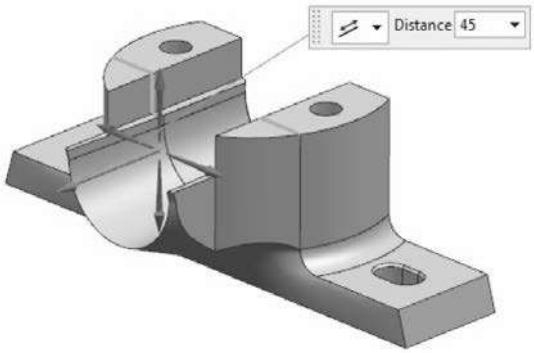

Figure 13-13 *The Model output with the* ***Extend*** *option selected*

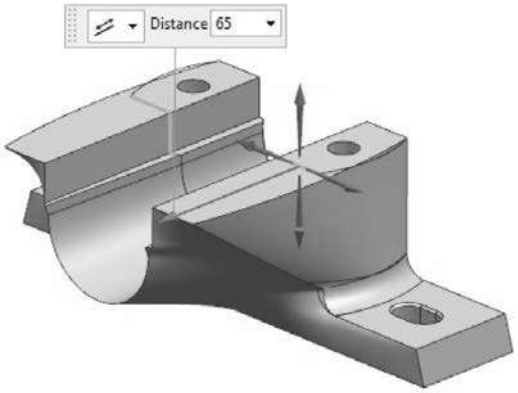

Figure 13-14 *The Model output with the* ***Morph*** *option selected*

Note

The edges selected to be moved must form a connected chain.

Pull Face

Ribbon: Home > Synchronous Modeling > More Gallery > Move > Pull Face
Menu: Insert > Synchronous Modeling > Pull Face

You can pull a set of selected faces of a model in the linear direction using the **Pull Face** tool, but you cannot orient them in the angular direction. While pulling the faces, the adjacent chamfers or fillets will be automatically adjusted. To invoke this tool, choose **Menu > Insert > Synchronous Modeling > Pull Face** from the **Top Border bar**; the **Pull Face** dialog box will be displayed, as shown in Figure 13-15. Also, you will be prompted to select the faces to pull. Select the faces; a handle, a dynamic edit box, and a vector triad will be displayed on one of the selected faces, as shown in Figure 13-16. Note that you may need to specify the direction vector after selecting the faces. Drag the handle; the model will be dynamically updated, as shown in Figure 13-17.

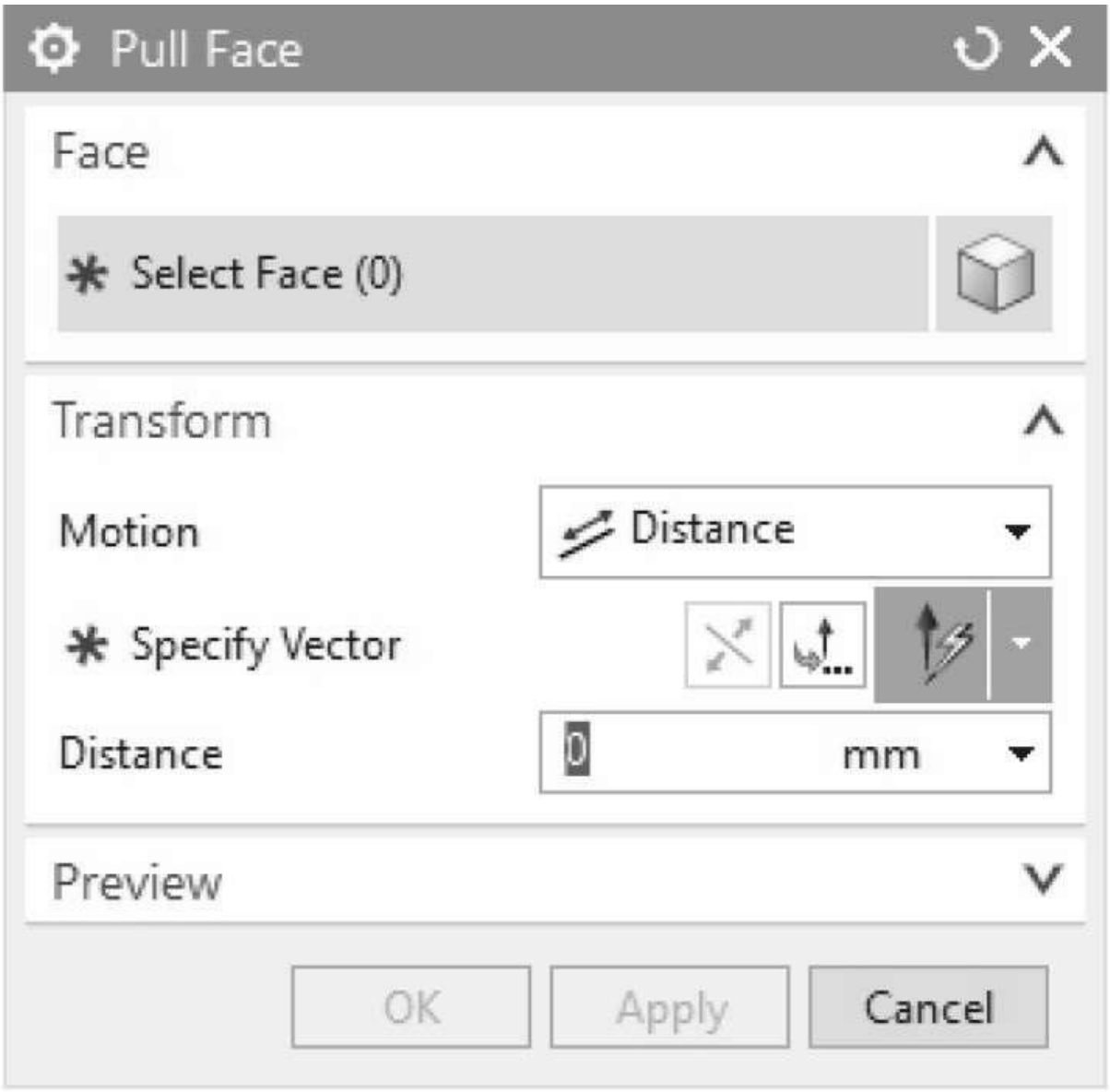

Figure 13-15 *The* ***Pull Face*** *dialog box*

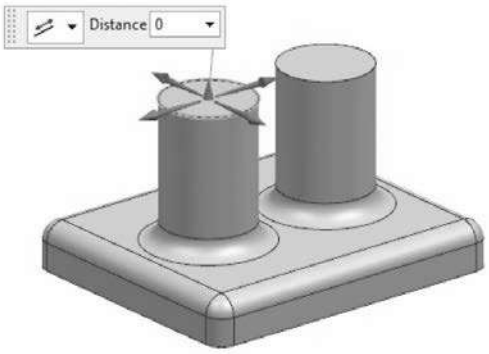

Figure 13-16 Face selected to be pulled

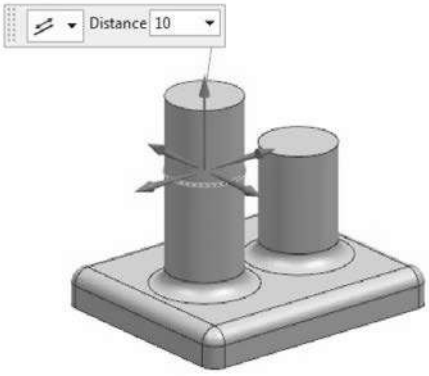

Figure 13-17 Dynamically updated model

The options in the **Pull Face** dialog box are the same as those in the **Move Face** dialog box with the only difference that the **Move Face** tool is used to move the selected faces with respect to the adjacent geometry, whereas the **Pull Face** tool is used to pull the selected faces regardless of the adjacent geometry. For example, Figure 13-18 shows the face moved using the **Move Face** tool and Figure 13-19 shows the face moved using the **Pull Face** tool.

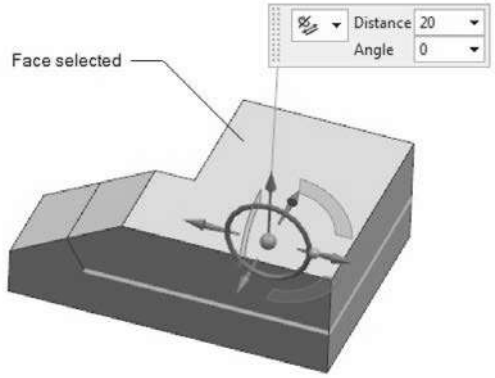

Figure 13-18 Selected face moved using the ***Move Face*** *tool*

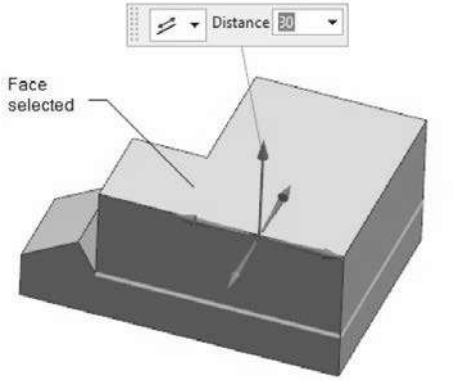

Figure 13-19 Selected face moved using the ***Pull Face*** *tool*

You can also select a sketch region to pull. Figure 13-20 shows a sketch region selected and Figure 13-21 shows the model after pulling the sketch region.

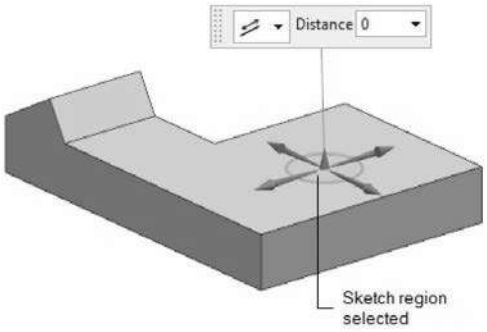

Figure 13-20 *Sketch region selected*

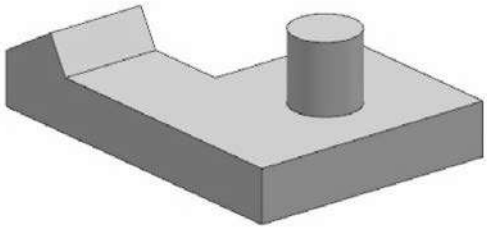

Figure 13-21 *Model after pulling the sketch region*

Offset Region

Ribbon: Home > Synchronous Modeling > Offset Region
Menu: Insert > Synchronous Modeling > Offset Region

The **Offset Region** tool is used to offset a set of selected faces of a model along the normal of the selected faces. To do so, choose the **Offset Region** tool from the **Synchronous Modeling** group; the **Offset Region** dialog box will be displayed, refer to Figure 13-22 and you will be prompted to select the faces to offset. Select the faces; a handle and a dynamic edit box will be displayed on the first selected face, refer to Figure 13-23. Drag the handle; the model will be updated, refer to Figure 13-24. The options of the **Offset Region** dialog box are the same as those in the **Move Face** dialog box.

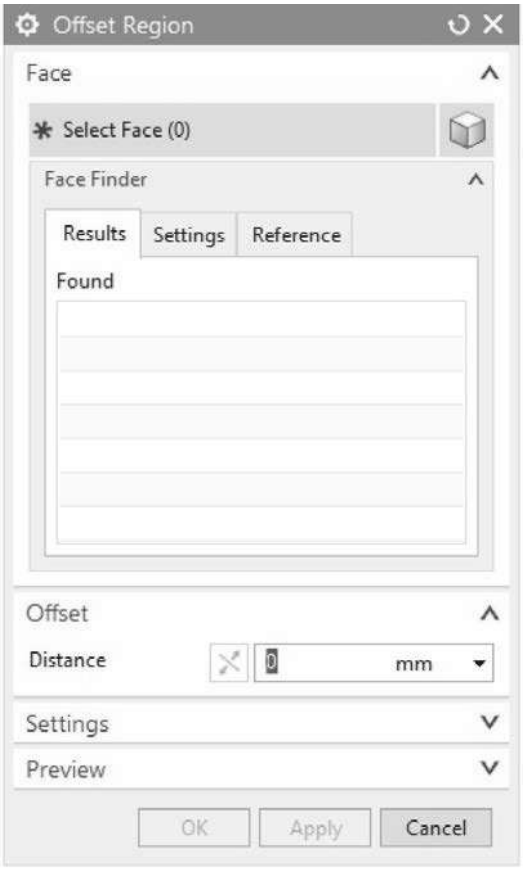

Figure 13-22 *The* ***Offset Region*** *dialog box*

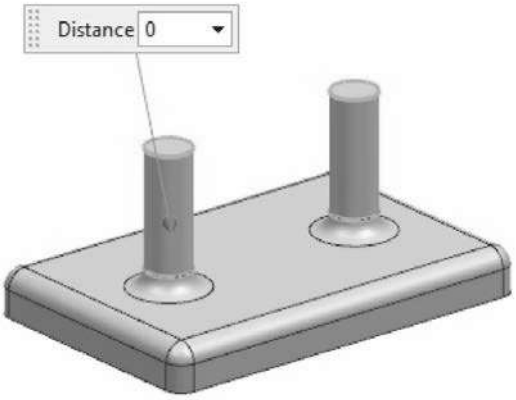

Figure 13-23 *Faces selected to offset*

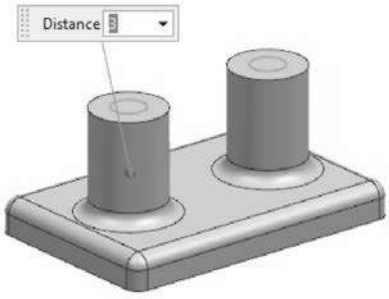

Figure 13-24 *Dynamically updated model*

Offset Edge

Ribbon: Home > Synchronous Modeling > More Gallery > Edge > Offset Edge

Menu: Insert > Synchronous Modeling > Edge > Offset Edge

The **Offset Edge** tool is used to offset the selected edge or a set of connected

edges of a model along the plane or face of the selected edges. To do so, choose the **Offset Edge** tool from **Menu > Insert > Synchronous Modeling > Edge** in the **Top Border Bar**; the **Offset Edge** dialog box will be displayed, refer to Figure 13-25 and you will be prompted to select the edges to offset. Select the set of connected edges; a handle and a dynamic edit box will be displayed on the selected edges, refer to Figure 13-26. Drag the handle; the model will be updated, refer to Figure 13-27. The other options of the **Offset Edge** dialog box are discussed next.

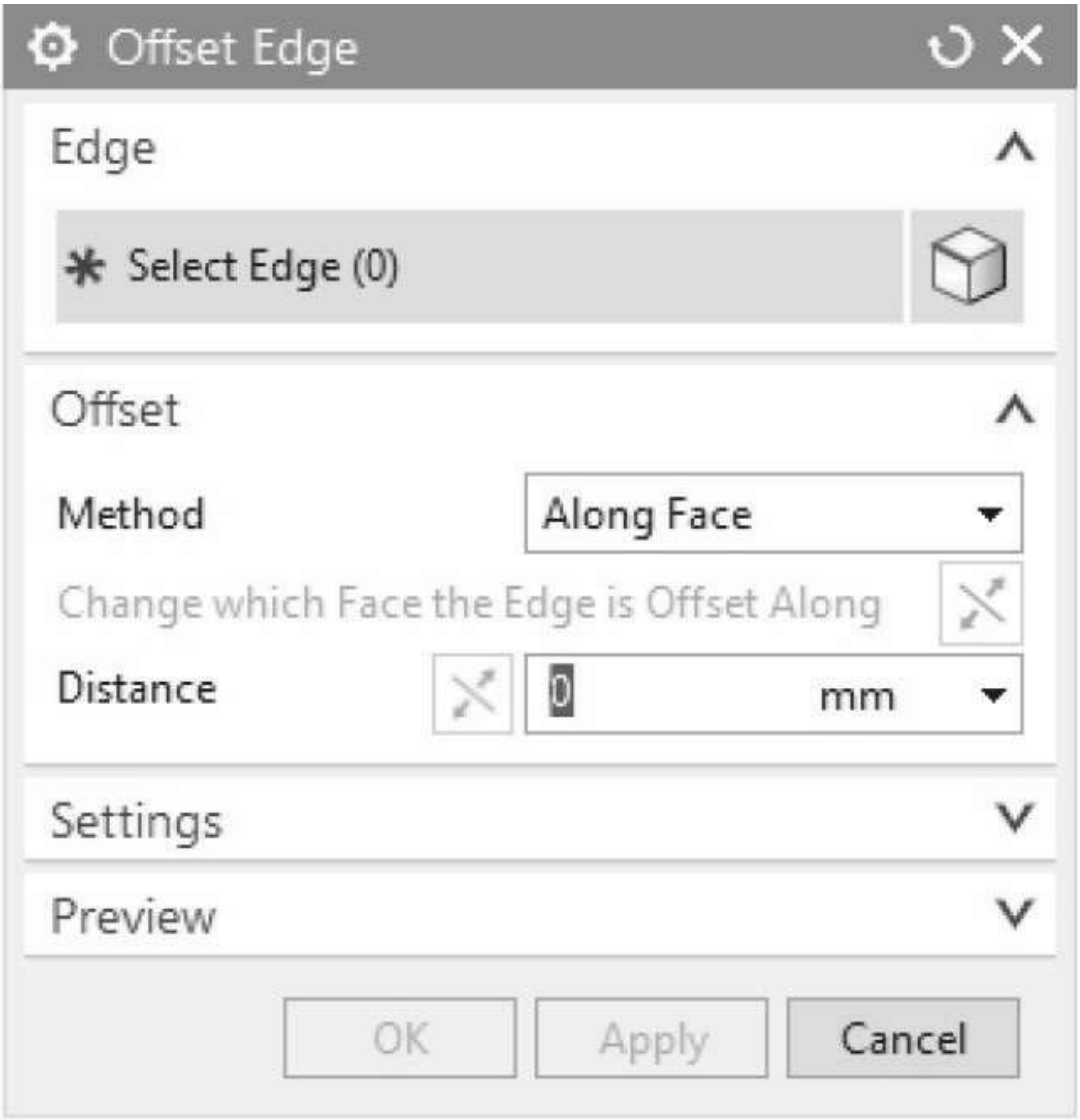

***Figure 13-25** The **Offset Edge** dialog box*

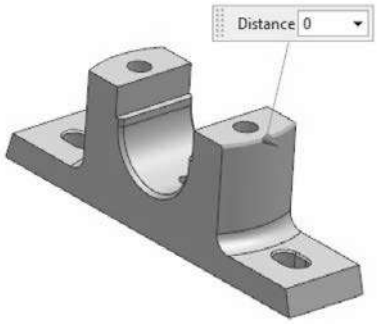

Figure 13-26 Edge selected to offset

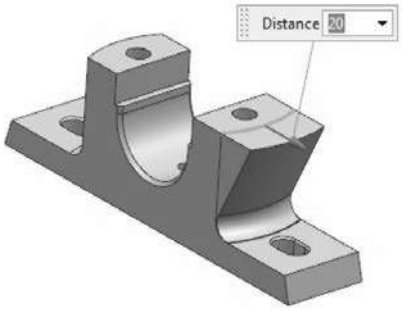

Figure 13-27 Dynamically updated model

Offset Rollout

In this rollout, the **Method** drop-down list is used to specify the side of the edge to offset. If you select the **Along Face** option from the drop-down list, the edge will offset along the adjacent face of the selected edge. When you select the **Along Face** option, the **Change which Face the Edge is Offset Along** button will be available. You can use this to switch between the two possible faces along which the edge can be offset, refer to Figures 13-28 and 13-29. If you select the **Along Plane of Edge** option from the drop-down list then the planar edge will offset along the plane of the selected edges. The **Reverse Offset Direction** button is used to reverse the direction of the offset either inside the boundary of the selected edges and face or outside the boundary.

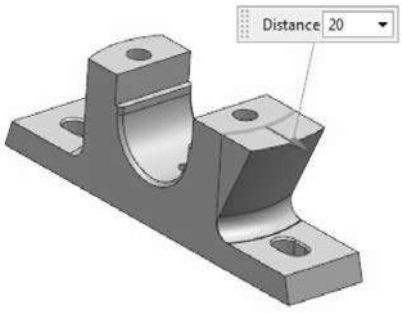

***Figure 13-28** The edge offset without using the **Change which Face the Edge is Offset Along** button*

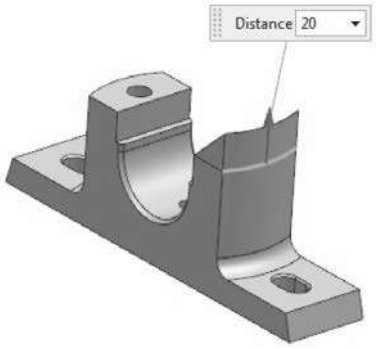

***Figure 13-29** The edge offset using the **Change which Face the Edge is Offset Along** button*

Replace Face

Ribbon: Home > Synchronous Modeling > Replace Face

Menu: Insert > Synchronous Modeling > Replace Face

The **Replace Face** tool is used to replace a selected face of a model with another face. Choose the **Replace Face** tool from the **Synchronous Modeling** group; the **Replace Face** dialog box will be displayed, as shown in Figure 13-30 and you will be prompted to select the faces to replace. Select the faces that you want to replace. Next, choose the **Face** button from the **Replacement Face** rollout; you will be prompted to select the replacement face. Select the replacement face; the face to be replaced will become coplanar with the replacement face. Also, a handle and a vector will be displayed on the replacement face. Next, click in the **Distance** edit box of the **Offset** sub-rollout of the **Replacement Face** rollout. Figure 13-31 shows the faces selected and Figure 13-32 shows the preview of the resultant model along with the dynamic edit box, the handle, and the vector. You can further modify the selected face with respect to the replacement face by dragging the handle or by modifying the offset distance in the **Distance** edit box in the **Offset** sub-rollout. To change the direction of vector, choose the **Reverse Direction** button from the **Replacement Face** rollout and to change the direction of the handle, use the **Reverse Direction** button from the **Offset** sub-rollout. To apply the changes and close the **Replace Face** dialog box, choose the **OK** button.

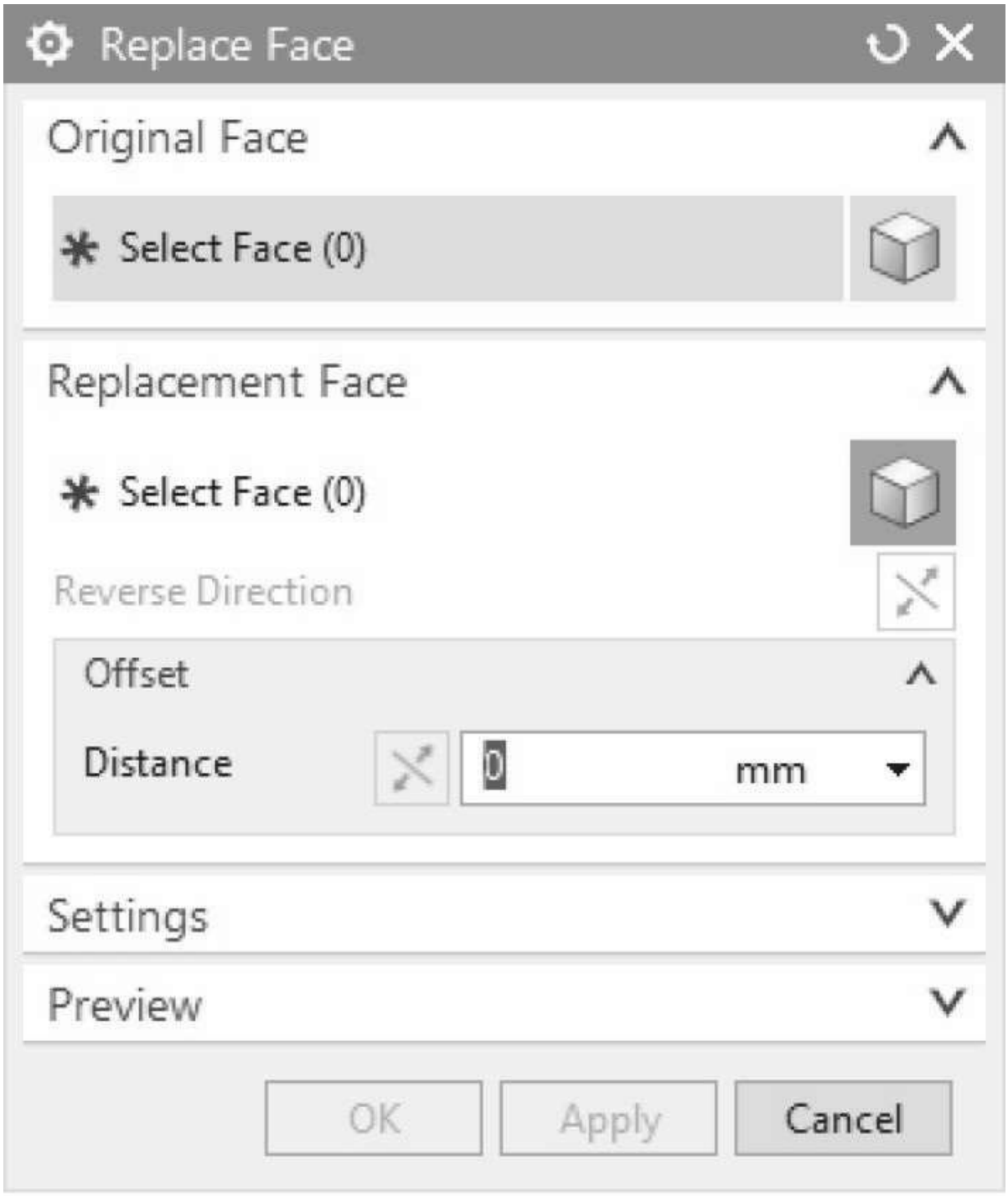

Figure 13-30 *The* ***Replace Face*** *dialog box*

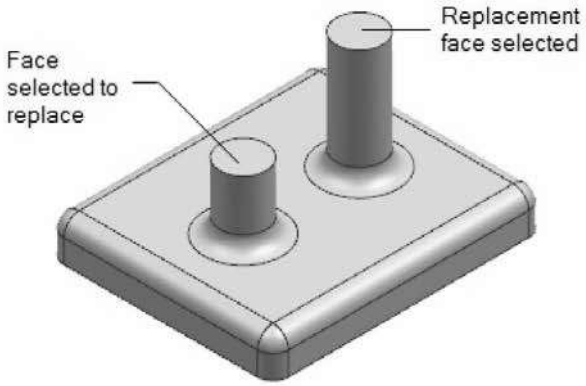

Figure 13-31 Faces to be selected

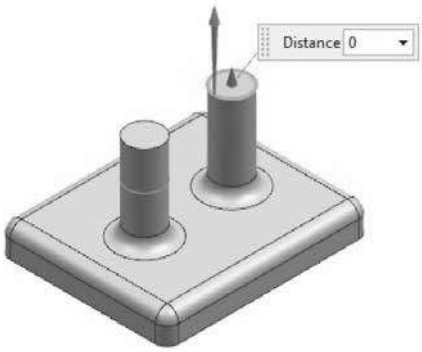

Figure 13-32 Dynamically updated model after selecting the faces

Resize Blend

Ribbon: Home > Synchronous Modeling > More Gallery > Detail Feature > Resize Blend

Menu: Insert > Synchronous Modeling > Detail Feature > Resize Blend

You can change the radius of a blend in a model using the **Resize Blend** tool. To do so, invoke the **More** Gallery of the **Synchronous Modeling** group and then choose the **Resize Blend** tool from the **Detail Feature** Gallery, refer to Figure 13-33; the **Resize Blend** dialog box will be displayed, as shown in Figure 13-34, and you will be prompted to select the blend to resize. Select a blend; the radius of the blend will be displayed in the **Radius** edit box of the **Radius** rollout. Also, a dynamic edit box with the radius of blend, and a handle will be displayed in the graphics window, refer to Figure 13-35. You can use these edit boxes to change the radius of the blend. Alternatively, you can change the radius of the blend dynamically by dragging the handle, refer to Figure 13-36.

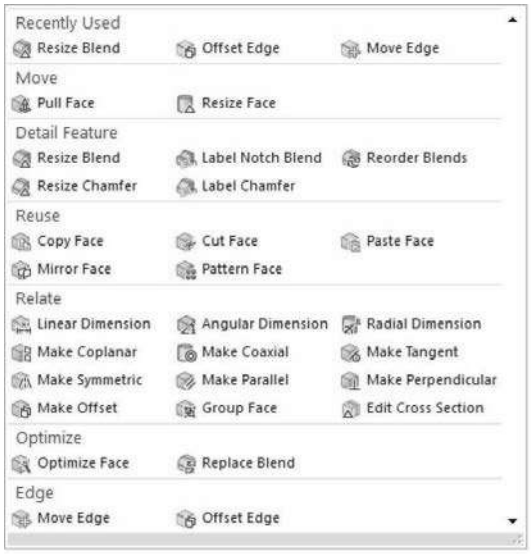

Figure 13-33 *The* ***More*** *gallery*

Figure 13-34 *The* ***Resize Blend*** *dialog box*

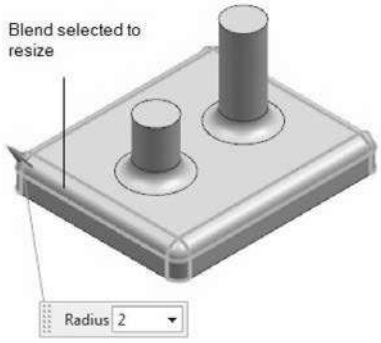

Figure 13-35 *Blend selected to resize*

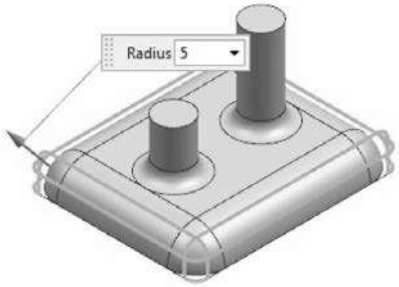

Figure 13-36 *Dynamically updated model*

Reorder Blends

Ribbon: Home > Synchronous Modeling > More Gallery > Detail Feature > Reorder Blends

Menu: Insert > Synchronous Modeling > Detail Feature > Reorder Blends

You can use the **Reorder Blends** tool to modify the shapes of the blends that are formed at the intersection of three blends. Note that the corner blend can be modified only if it is created by the combination of concave and convex shaped blends. To change the shape of a corner blend, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Reorder Blends** tool from the **Detail Feature** gallery; the **Reorder Blends** dialog box will be displayed, and you will be prompted to select the corner blend to be modified. Select the corner blend, refer to Figure 13-37; the blend will be modified, as shown in Figure 13-38.

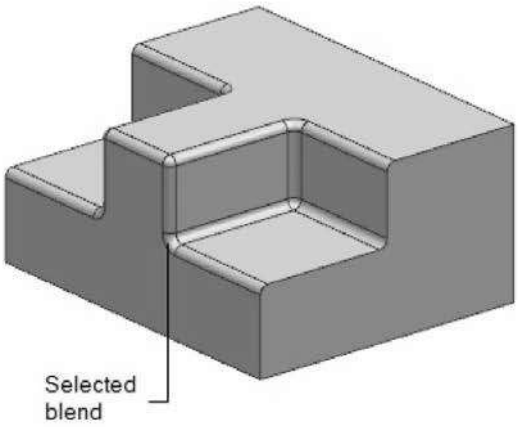

Figure 13-37 *Intersecting blend to be selected*

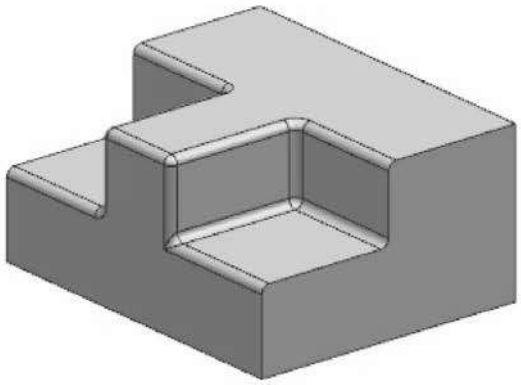

Figure 13-38 *Model after reordering the blend*

Resize Chamfer

Ribbon: Home > Synchronous Modeling > More Gallery > Detail Feature > Resize Chamfer

Menu: Insert > Synchronous Modeling > Detail Feature > Resize Chamfer

You can change the size of a chamfer in a model, regardless of its adjacent geometry, by using the **Resize Chamfer** tool. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Resize Chamfer** tool from the **Detail Feature** gallery; the **Resize Chamfer** dialog box will be displayed and you will be prompted to select the chamfer to resize. Select the chamfer; the chamfer values will be displayed in their respective edit boxes in the **Offsets** rollout. Also, a dynamic edit box, a handle, and an angular handle will be displayed in the graphics window, refer to Figure 13-39. You can change the size of the chamfer using the edit boxes available in the **Offsets** rollout or by using the dynamic edit box. Alternatively, you can change the size of the chamfer using the handles, refer to Figure 13-40. Next, choose the **OK** button to exit the dialog box.

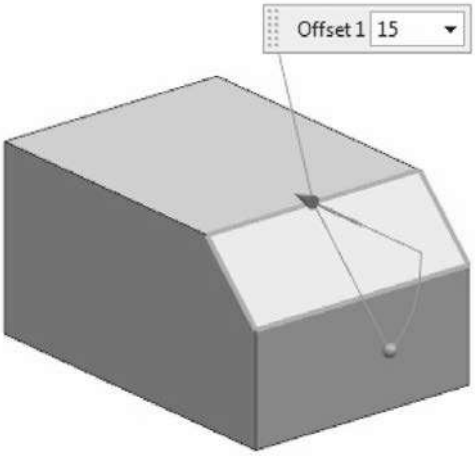

Figure 13-39 *Model with a dynamic edit box, a handle, and an angular handle*

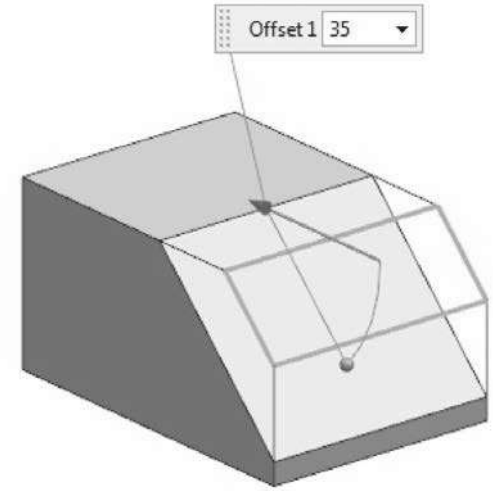

Figure 13-40 *Preview of the resultant model*

Label Chamfer

Ribbon: Home > Synchronous Modeling > More Gallery > Detail Feature > Label Chamfer
Menu: Insert > Synchronous Modeling > Detail Feature > Label Chamfer

You can label an angular face which is not created by using the **Chamfer** tool, as a chamfer by using the **Label Chamfer** tool. To do so, invoke the **Label Chamfer** tool and then select the angular face; the selected angular face will be labeled as a chamfer. After labeling the angular face as a chamfer, you can use the **Resize Chamfer** tool to resize it as a chamfer. Also, if you move its adjacent faces, it will move as a chamfer and its size will not change. However, if you move the faces adjacent to the angular face without labeling the angular face as a chamfer, the size of the angular face will change as you move the face using the **Move Face** tool.

Label Notch Blend

Ribbon: Home > Synchronous Modeling > More Gallery > Detail Feature > Label Notch Blend (Customoze to Add)
Menu: Insert > Synchronous Modeling > Detail Feature > Label Notch Blend

You can label a curved face as a blend by using the **Label Notch Blend** tool. To do so, invoke the **Label Notch Blend** tool and then select the curved face; the selected curved face will be labeled as a blend. After doing so, you can

use the **Resize Blend** tool to resize the curved face as a blend. Also, if you move its adjacent faces, it will move as a blend and its size will not change. However, if you move the faces adjacent to the curved face without labeling the curved face as a blend, the size of the curved face will change as you move the face using the **Move Face** tool. Figure 13-41 shows the labeled and unlabeled curved faces in a model and Figure 13-42 shows the preview of the resultant model after moving the adjacent faces of the labeled and unlabeled covered faces.

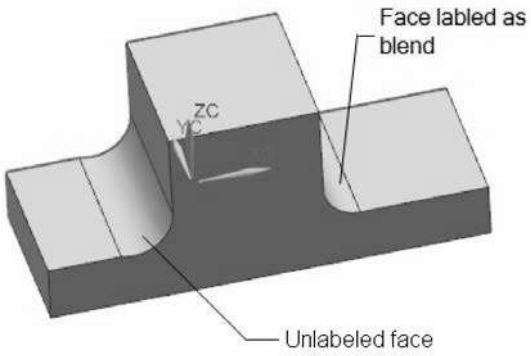

Figure 13-41 *Unlabeled and labeled faces*

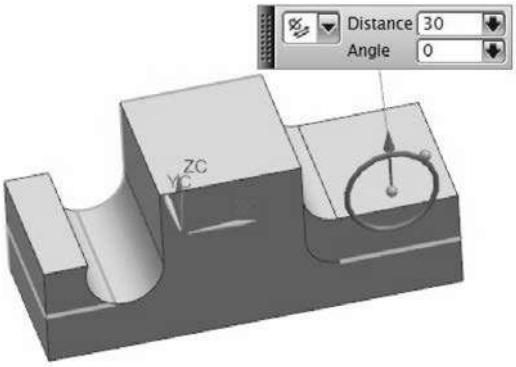

Figure 13-42 *Resulting model after moving the faces*

Resize Face

Ribbon: Home > Synchronous Modeling > More Gallery > Move > Resize Face

Menu: Insert > Synchronous Modeling > Resize Face

You can resize the selected cylindrical faces of a model using the **Resize Face** tool. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Resize Face** tool from it; the **Resize Face** dialog box will be displayed and you will be prompted to select the faces to resize. Select the cylindrical face; the diameter of the selected cylindrical face will be displayed in the **Diameter** edit box of the **Size** rollout. Now, you can use this edit box to change the diameter of the selected cylindrical face. Figure 13-43 shows the face selected to resize and Figure 13-44 shows the model after resizing the selected face. The other options in this dialog box are the same as those discussed in the **Move Face** dialog box.

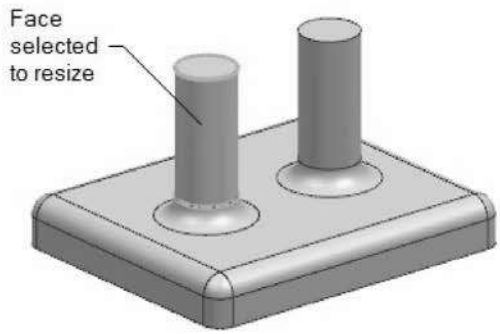

Figure 13-43 Face selected to resize

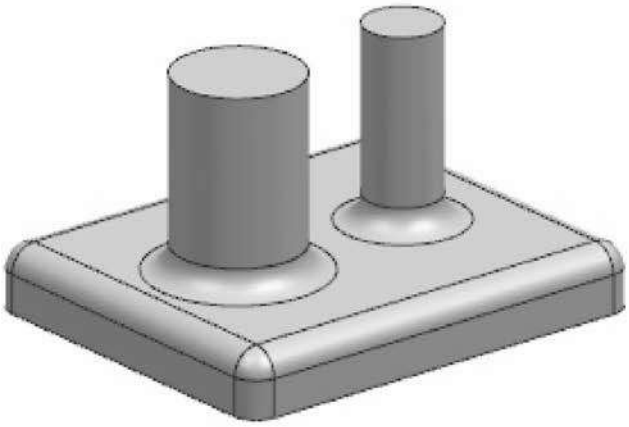

Figure 13-44 Dynamically updated model

Delete Face

Ribbon: Home > Synchronous Modeling > Delete Face
Menu: Insert > Synchronous Modeling > Delete Face

The **Delete Face** tool is used for deleting the unwanted faces of a model by projecting its adjacent faces. To do so, choose the **Delete Face** tool from the **Synchronous Modeling** group; the **Delete Face** dialog box will be displayed, as shown in Figure 13-45. In this dialog box, the **Face** option is selected by default in the drop-down list of the **Type** rollout. As a result, you will be prompted to select the faces to delete. Select the unwanted face, refer to Figure 13-46. Next, choose the **OK** button; the selected face will be deleted. In the **Settings** rollout, the **Heal** check box is selected by default. As a result, the neighbouring faces get extended and heal the opening created after deleting the face, as shown in Figure 13-47. If you clear this check box, the solid body is converted into a sheet body with open edges, as shown in Figure 13-48.

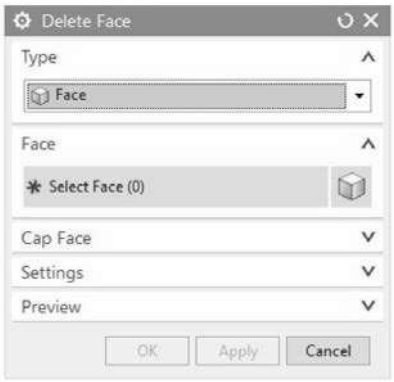

Figure 13-45 *The* ***Delete Face*** *dialog box*

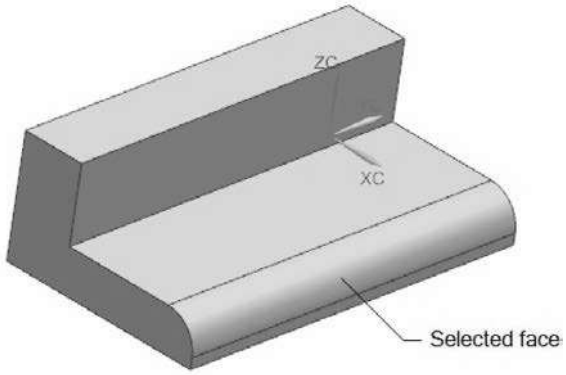

Figure 13-46 *Face selected for deleting*

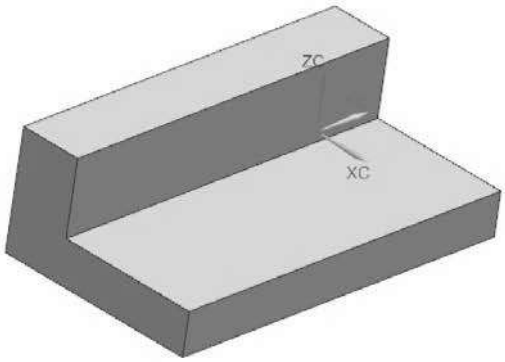

Figure 13-47 *Resultant model with the* ***Heal*** *check box selected*

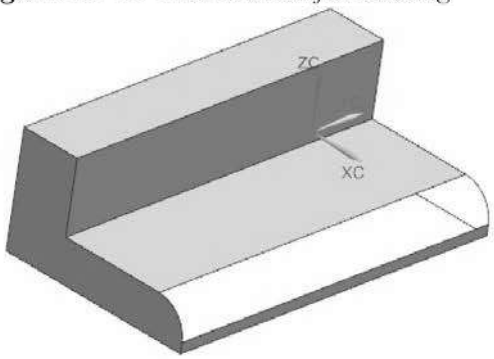

Figure 13-48 *Resultant model with the* ***Heal*** *check box cleared*

In NX, you can delete a face using a cutting plane. To do so, select the face to be deleted, refer to Figure 13-49. Next, select the **Face or Plane** option from the **Cap Option** drop-down list of the **Cap Face** rollout. Choose the **Face** button from the **Cap Face** rollout and then select a plane or face, refer to Figure 13-49. Make sure that the **Heal** check box is selected in the **Settings** rollout. Figure 13-50 shows the model after deleting the face.

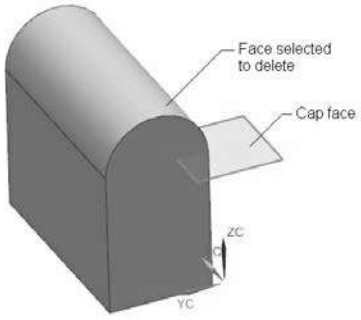

Figure 13-49 *Face to be deleted and the cap face*

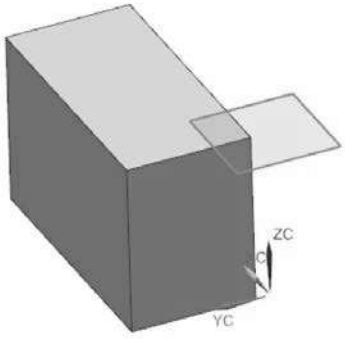

Figure 13-50 *Resultant model*

You can also delete a blend which is adjacent to another blend, refer to

Figure 13-51. The **Delete Partial Blend** check box in the **Settings** rollout can be used for deleting a blend which is adjacent to another blend. If you select this check box, the **Setback** drop-down list is enabled. Next, select the **Selected Blend** or **Neighbor Blend** option from this drop-down list. Figures 13-52 and 13-53 show the blend deleted using the **Selected Blend** and **Neighbor Blend** options, respectively. Figure 13-54 shows a blend deleted with the **Delete Partial Blend** check box cleared.

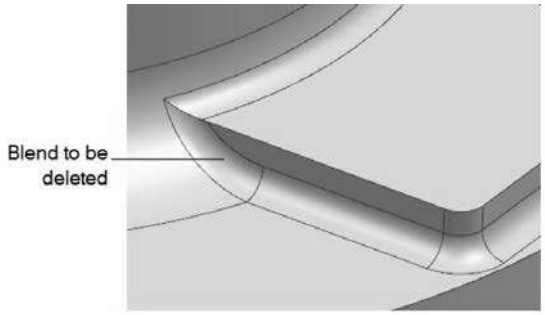

Figure 13-51 *Example of blend adjacent to another blend*

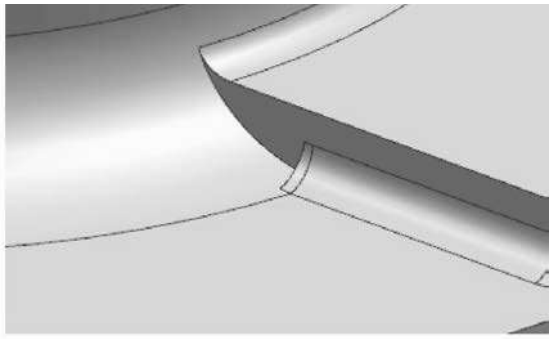

Figure 13-52 *Blend deleted with the* ***Selected Blend*** *option selected*

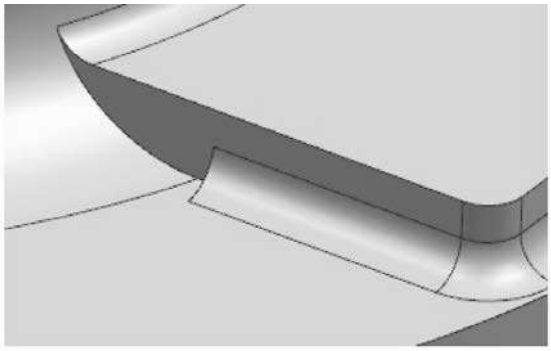

Figure 13-53 *Blend deleted with the* ***Neighbor Blend*** *option selected*

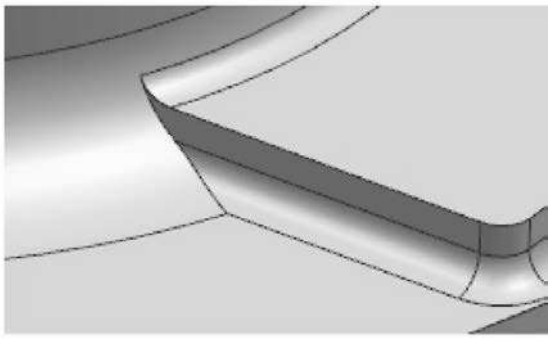

Figure 13-54 *Blend deleted with the* ***Delete Partial blend*** *check box cleared*

If you select the **Hole** option from the drop-down list in the **Type** rollout, you will be prompted to select the faces of the holes to be deleted. Select the holes to be deleted and then choose the **OK** button; the selected holes will be deleted. The **Select Holes by Size** check box available in the **Hole to Delete** rollout is used to select the holes of the specified hole diameter. You can specify the required diameter of the hole in the **Hole Size** edit box available below the **Select Holes by Size** check box. For example, if you enter **6** in the **Hole Size** edit box, then you can only select the holes whose diameter is equal to or less than 6 mm. However, if you clear this check box, you can

select holes of any diameter.

Copy Face

Ribbon: Home > Synchronous Modeling > More Gallery > Reuse > Copy Face
Menu: Insert > Synchronous Modeling > Reuse > Copy Face

The **Copy Face** tool is used to copy and place the selected faces of a solid or surface body. You can place the selected faces as a surface or as a solid body. To place them as a solid body, the selected faces must be in the form of a closed entity. To copy a face, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Copy Face** tool from the **Reuse** gallery, refer to Figure 13-55; the **Copy Face** dialog box will be displayed, as shown in Figure 13-56 and you will be prompted to select the faces to copy. Select the faces; a handle, and an edit box will be displayed, refer to Figure 13-57. You can use the handle for moving the copied object, refer to Figure 13-58. Select the **Paste Copied Faces** check box from the **Paste** rollout and choose the **OK** button to generate a solid body. If you clear the **Paste Copied Faces** check box, the resulting surface generated will be a surface body. The remaining options in this dialog box are similar to those in the **Move Face** dialog box.

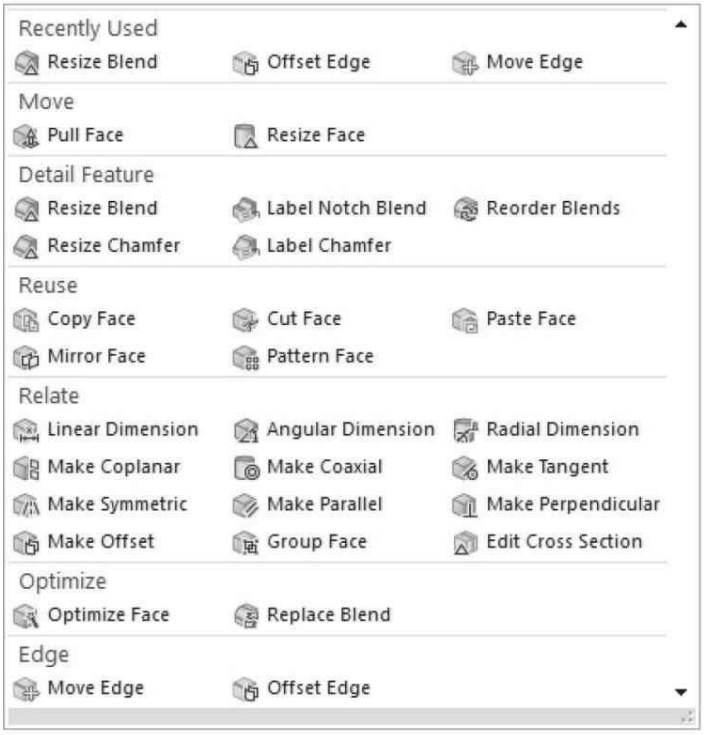

Figure 13-55 *The customized view of* ***More*** *gallery*

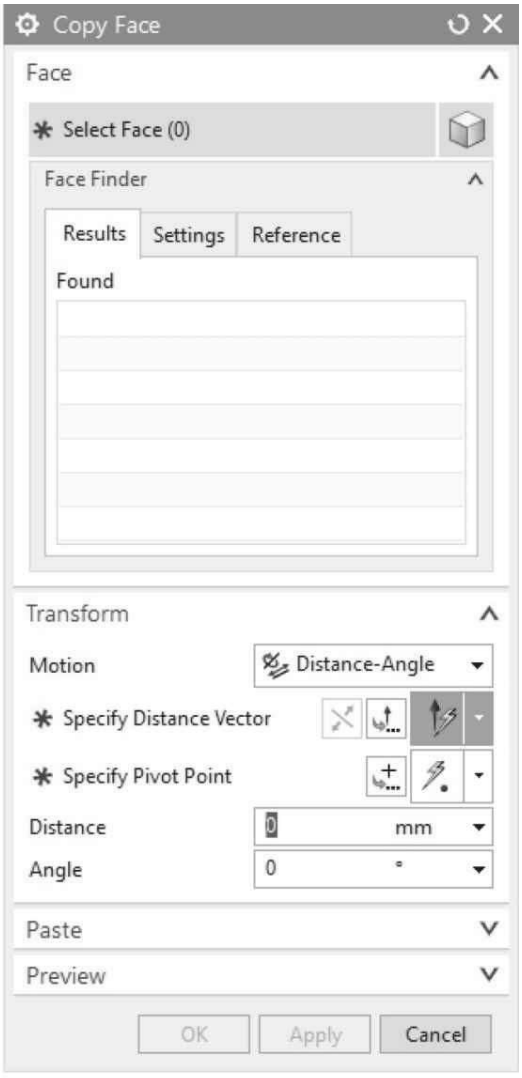

Figure 13-56 *The* ***Copy Face*** *dialog box*

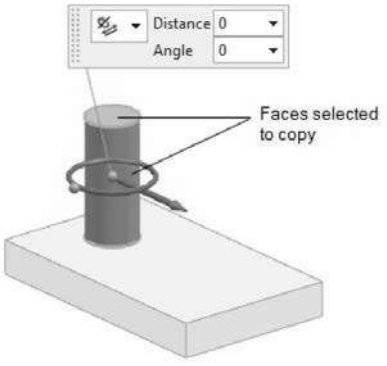

Figure 13-57 *Faces selected for copying*

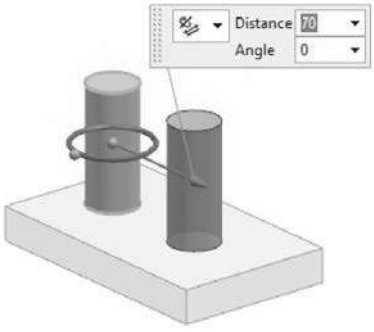

Figure 13-58 *Preview of the resultant model*

Cut Face

Ribbon: Home > Synchronous Modeling > More Gallery > Reuse > Cut Face
Menu: Insert > Synchronous Modeling > Reuse > Cut Face

The **Cut Face** tool is used to cut and place the selected faces of a solid or surface model. This tool works similar to the **Copy Face** tool with the only difference that in this case, the selected faces are moved to a new location.

Paste Face

Ribbon: Home > Synchronous Modeling > More Gallery > Reuse > Paste Face
Menu: Insert > Synchronous Modeling > Reuse > Paste Face

Once you create a surface by performing the **Copy Face** or **Cut Face** operation, you can use the **Paste Face** tool to add or subtract it from the attached body. For example, a copy face operation performed on a model, refer to Figure 13-59. In this figure, the circular surface of the hole is copied using the **Copy Face** tool. To paste a face, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Paste Face** tool from the **Reuse** gallery; the **Paste Face** dialog box will be displayed, as shown in Figure 13-60, and you will be prompted to select the target body to paste the surface. Select the target body, refer to Figure 13-61; you will be prompted to select the surface body to be pasted. Select the surface created, refer to Figure 13-61. Next, select the **Subtract** option from the **Paste Option** drop-down list in the **Tool** rollout to subtract the material from the selected target body. If the original feature is created by adding material, then you need to select the **Add** option from the **Paste Option** drop-down list so that the resulting surface is also created by adding material. After specifying the required options, choose the **OK** button; the resultant model will be displayed, as shown in Figure 13-62.

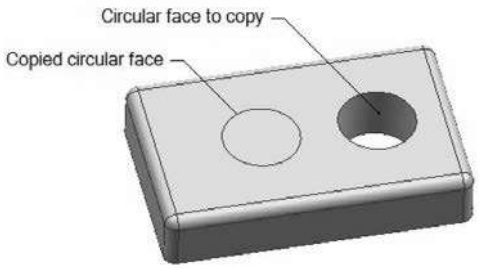

Figure 13-59 *Circular face to copy and resultant copied face after performing the* ***Copy Face*** *operation*

Figure 13-60 *The* ***Paste Face*** *dialog box*

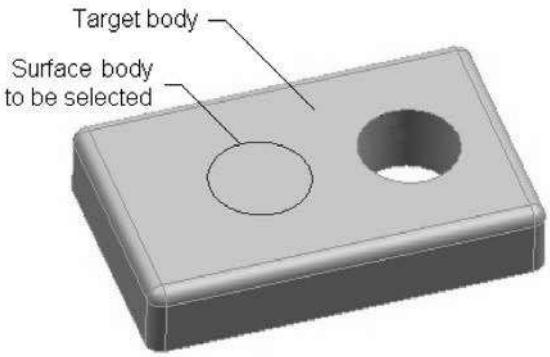

Figure 13-61 *Surface and target bodies to be selected*

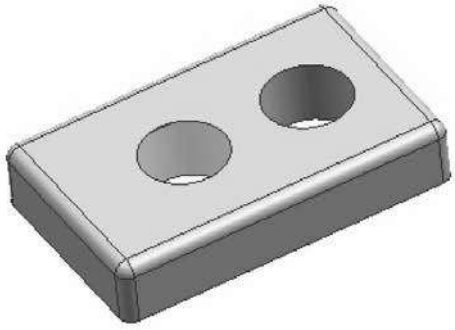

Figure 13-62 *Resultant model*

Mirror Face

Ribbon: Home > Synchronous Modeling > More Gallery > Reuse > Mirror Face *(Customize to add)*
Menu: Insert > Synchronous Modeling > Reuse > Mirror Face

The **Mirror Face** tool is used to mirror a set of faces in the same body about a selected plane. Invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Mirror Face** tool from the **Reuse** gallery; the **Mirror Face** dialog box will be displayed, as shown in Figure 13-63 and you will be prompted to select the faces to mirror. Select the faces, refer to Figure 13-64. Next, choose the **Plane** button from the **Mirror Plane** rollout; you will be prompted to select a planar face or a datum plane to mirror about. Select the required plane, as shown in Figure 13-64; a preview of the

resultant model will be displayed, as shown in Figure 13-65. Choose the **OK** button; the selected set of faces will be mirrored about the selected plane.

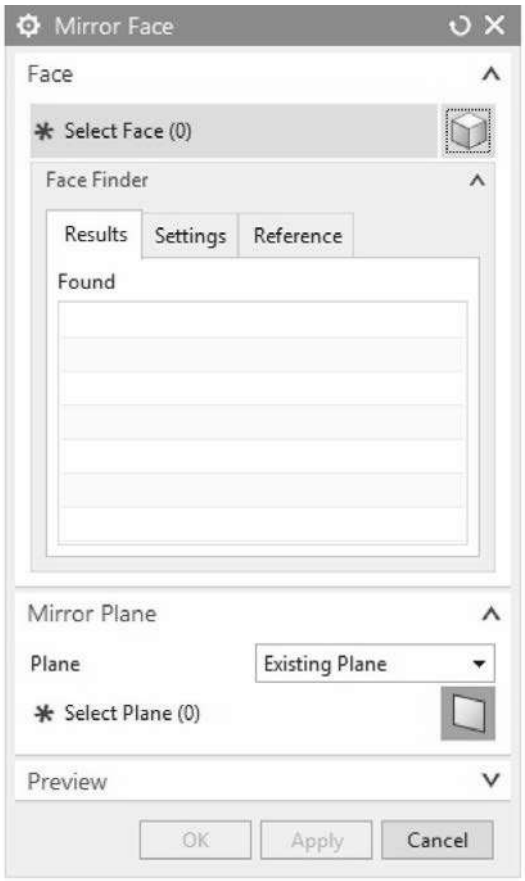

Figure 13-63 *The* ***Mirror Face*** *dialog box*

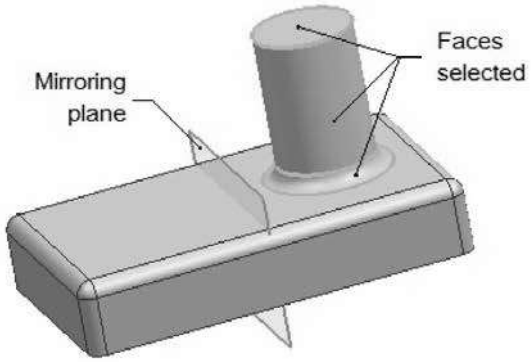

Figure 13-64 *Faces and mirroring plane selected*

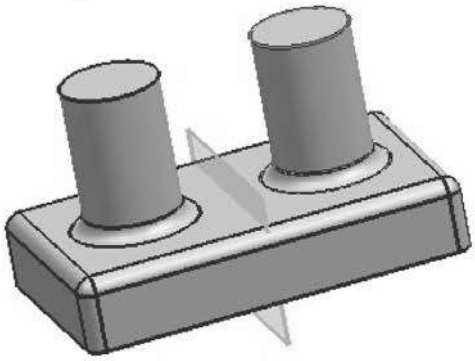

Figure 13-65 *Preview of the resultant model*

Pattern Face

Ribbon: Home > Synchronous Modeling > More Gallery > Reuse > Pattern Face *(Customize to add)*
Menu: Insert > Synchronous Modeling > Reuse > Pattern Face

You can pattern the selected faces of a component using the **Pattern Face** tool. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Pattern Face** tool from the **Reuse** gallery; the **Pattern Face** dialog box will be displayed. The options in the **Pattern Face** dialog box are similar to the options in the **Pattern Feature** tool discussed in Chapter 7.

Make Coplanar

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Make Coplanar *(Customize to add)*
Menu: Insert > Synchronous Modeling > Relate > Make Coplanar

You can make two different faces of a component coplanar to each other using the **Make Coplanar** tool. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Make Coplanar** tool from the **Relate** gallery, as shown in Figure 13-66; the **Make Coplanar** dialog box will be displayed, as shown in Figure 13-67, and you will be prompted to select a planar face to make it coplanar. Select the faces that you want to make coplanar; you will be prompted to select a planar face or datum plane to remain stationary. Select the required plane or planar face so that the previously selected face becomes coplanar with it. Figure 13-68 shows the planar faces selected to make them coplanar to each other and Figure 13-69 shows preview of the resultant component. The other options of the **Make Coplanar** dialog box are similar to those in the **Move Face** dialog box.

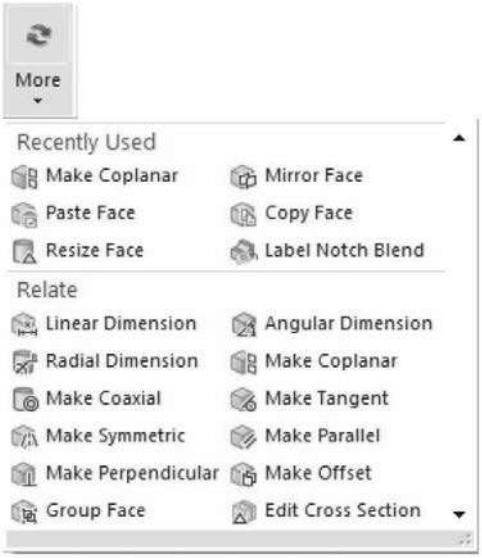

Figure 13-66 *The customized view of the* ***More*** *gallery showing the* ***Relate*** *gallery*

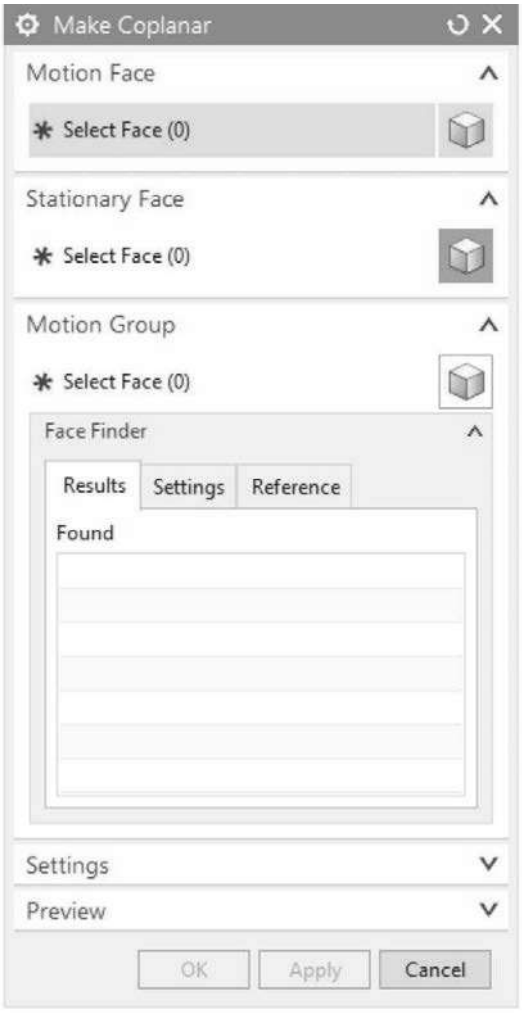

Figure 13-67 *The* ***Make Coplanar*** *dialog box*

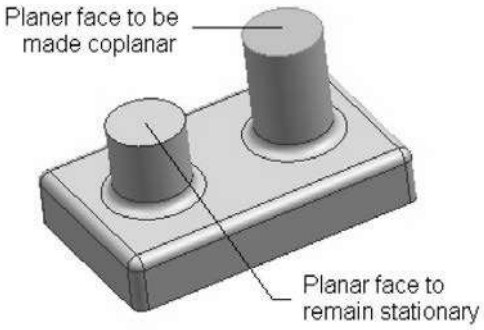

Figure 13-68 *Faces selected to be made coplanar*

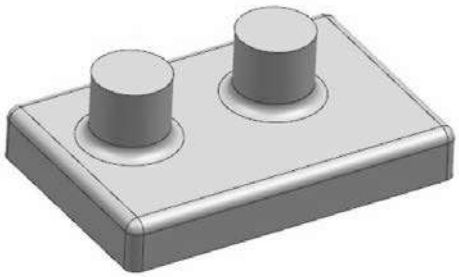

Figure 13-69 *Preview of the resultant model*

Make Coaxial

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Make

Coaxial *(Customize to add)*

Menu: Insert > Synchronous Modeling > Relate > Make Coaxial

You can make two different cylindrical faces of a component coaxial using the **Make Coaxial** tool. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Make Coaxial** tool from the **Relate** gallery; the **Make Coaxial** dialog box will be displayed, as shown in Figure 13-70, and you will be prompted to select a cylinder, cone, or torus to be made coaxial. Select the required cylinder, cone, or torus; the **Face** button in the **Stationary Face** rollout will be chosen automatically and you will be prompted to select another cylinder, cone, or torus that has to be made coaxial with the previously selected entity. Select the required cylinder, cone, or torus so that the entity selected earlier becomes coaxial to the entity selected later, refer to Figure 13-71, a preview of the resultant component will be displayed, as shown in Figure 13-72. The other options of the **Make Coplanar** dialog box are similar to those discussed in the **Move Face** dialog box.

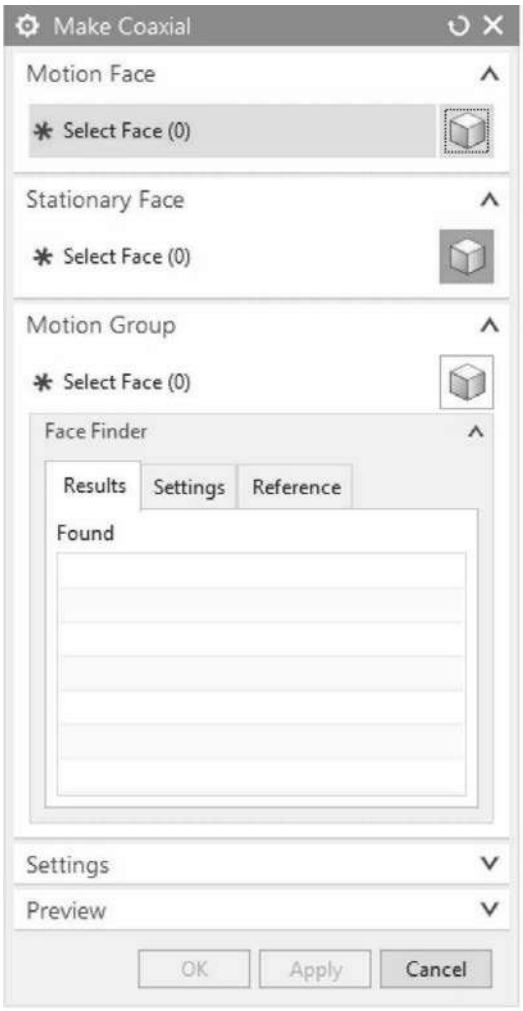

Figure 13-70 *The* ***Make Coaxial*** *dialog box*

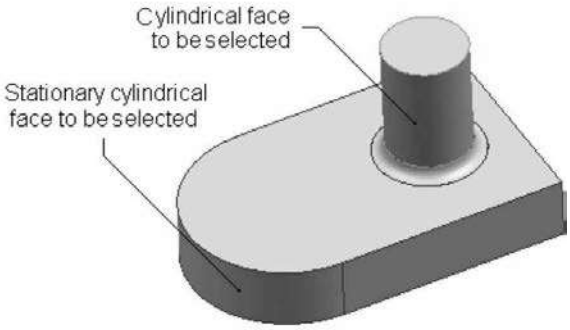

Figure 13-71 *Faces selected to be made coaxial*

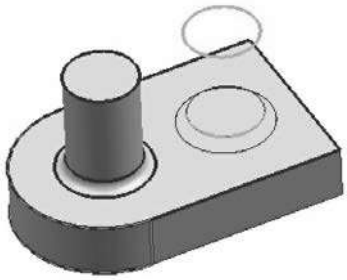

Figure 13-72 *Preview of the resultant model*

Make Tangent

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Make Tangent *(Customize to add)*
Menu: Insert > Synchronous Modeling > Relate > Make Tangent

You can make one face of component tangent to another face using the **Make**

Tangent tool.

To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Make Tangent** tool from the **Relate** gallery; the **Make Tangent** dialog box will be displayed, as shown in Figure 13-73 and you will be prompted to select the face to be made tangent.

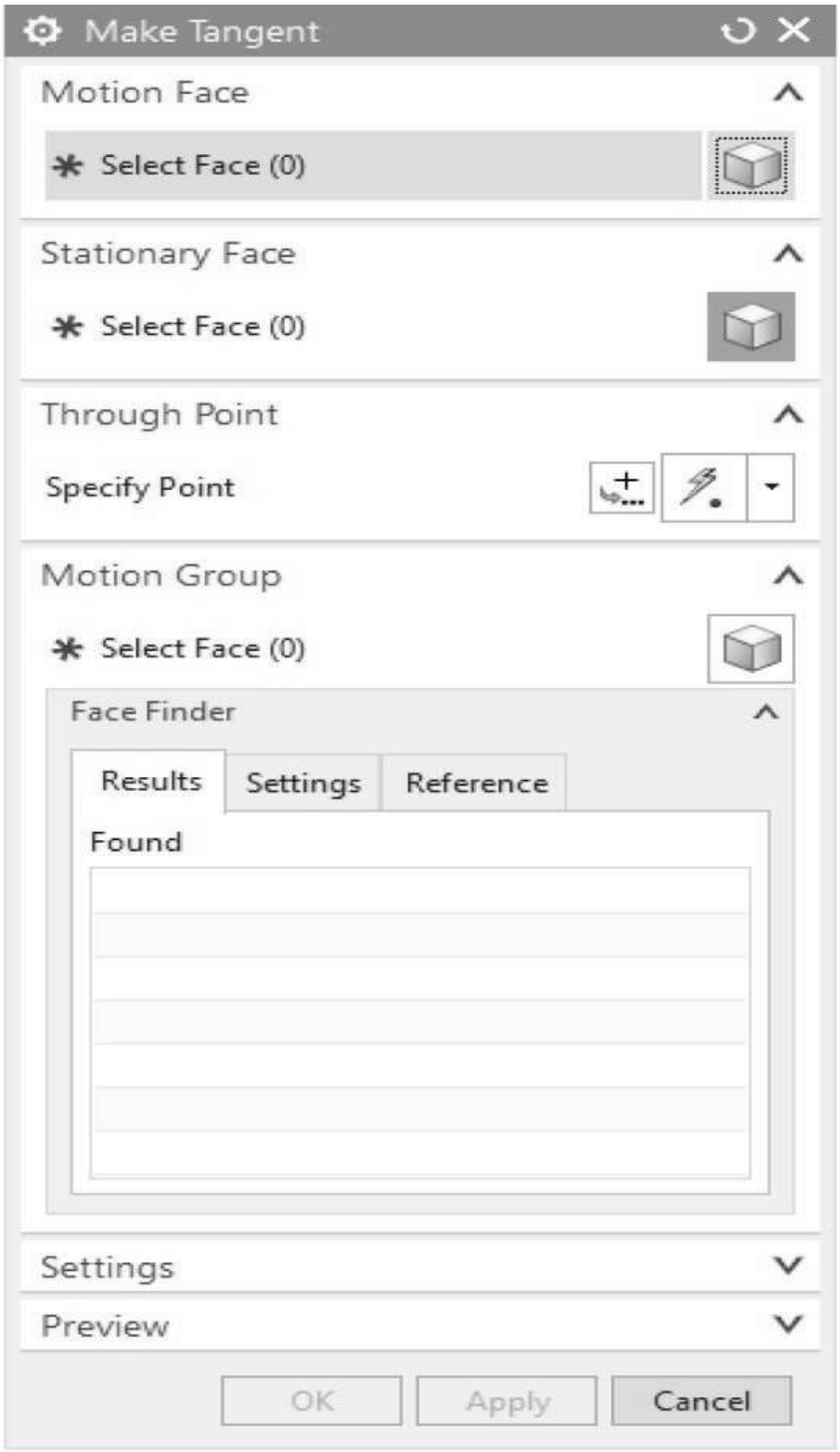

Figure 13-73 *The* ***Make Tangent*** *dialog box*

Select the face; the **Face** button in the **Stationary Face** rollout will be activated and you will be prompted to select a face or a datum plane that has to remain stationary. Select the required face or plane.

Next, choose the **Inferred Point** button from the **Through Point** rollout; you will be prompted to select a point. Select the required point through which the resultant face should pass, as shown in Figure 13-74.

After selecting the point and faces, a preview of the model will be displayed, as shown in Figure 13-75.

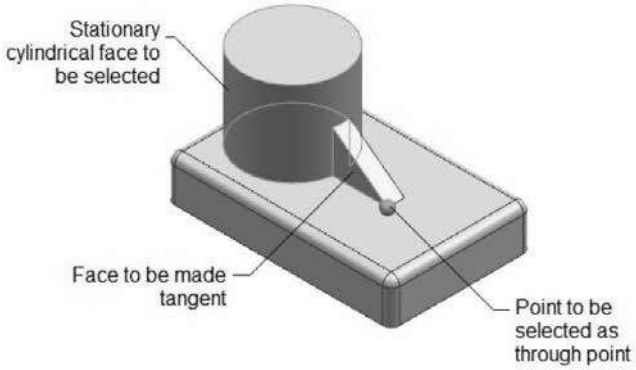

Figure 13-74 *Face selected to be made tangent*

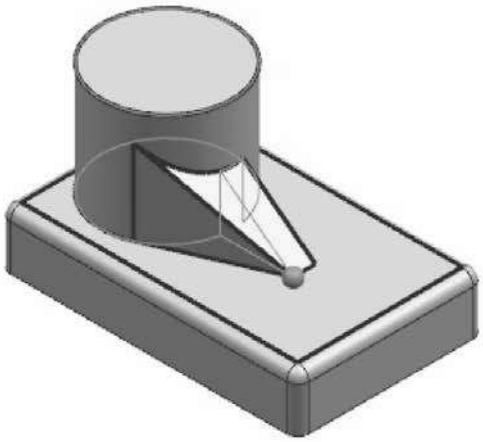

Figure 13-75 *Preview of the resultant model*

The other options in the **Make Tangent** dialog box are similar to those discussed in the **Move Face** dialog box.

Make Symmetric

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Make Symmetric *(Customize to add)*

Menu: Insert > Synchronous Modeling > Relate > Make Symmetric

You can make one face of a component symmetric to another face about any specified plane using the **Make Symmetric** tool. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Make Symmetric** tool from the **Relate** gallery; the **Make Symmetric** dialog box will be displayed, as shown in Figure 13-76, and you will be prompted to select the face to be made symmetric. Select the face; the **Plane** button in the

Symmetry Plane rollout will be highlighted and you will be prompted to select a planar face or a datum plane to make the face symmetric about. Select the required planar face or plane; you will be prompted to select the face that has to remain stationary. Select the face to be kept stationary, refer to Figure 13-77, a preview of the resultant component will be displayed, as shown in Figure 13-78. Also, the **Face** button in the **Motion Group** rollout will be activated automatically. As a result, you can select multiple faces as per your requirement for modifying. The other options in the **Make Symmetric** dialog box are similar to options in the **Move Face** dialog box.

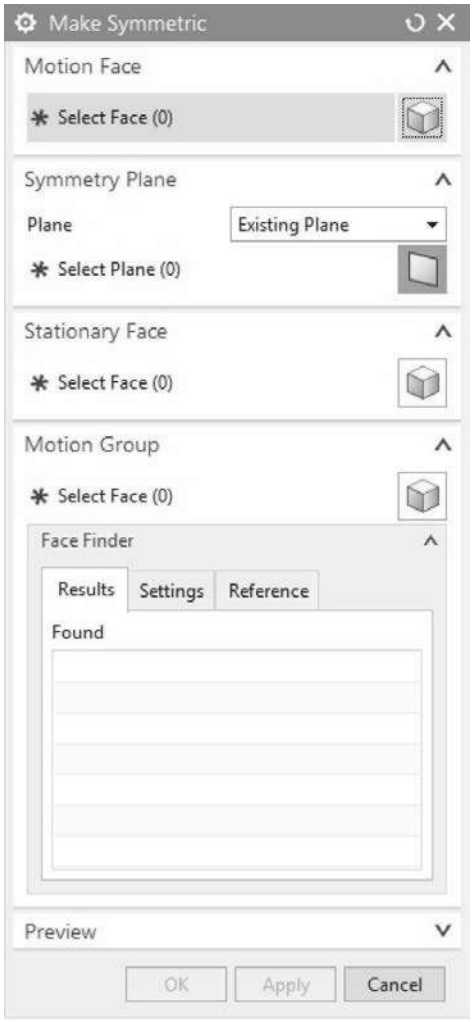

Figure 13-76 *The* ***Make Symmetric*** *dialog box*

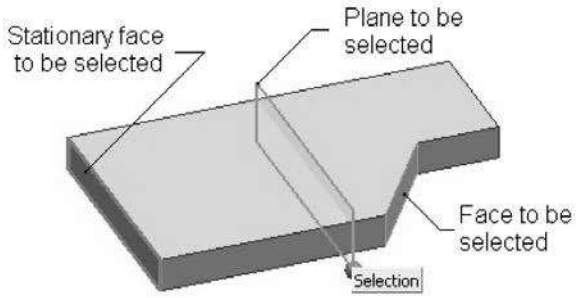

Figure 13-77 *Faces and datum plane selected to be made symmetric*

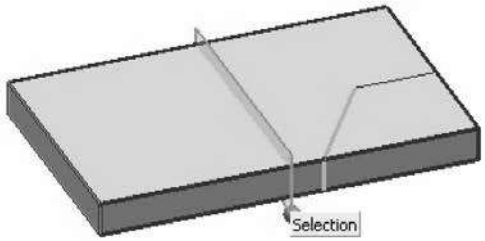

Figure 13-78 *Preview of the resultant model*

Make Parallel

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Make Parallel *(Customize to add)*
Menu: Insert > Synchronous Modeling > Relate > Make Parallel

You can make one planar face of a component parallel to another planar face using the **Make Parallel** tool. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Make Parallel** tool from the **Relate** gallery; the **Make Parallel** dialog box will be displayed, as shown in Figure 13-79, and you will be prompted to select the planar faces to be made parallel. Select the planar face that you want to modify; the **Face** button from the **Stationary Face** rollout will be chosen automatically and you will be prompted to select the planar face or datum plane that has to remain stationary. Select the required planar face or plane. Next, choose the **Inferred Point** button from the **Through Point** rollout; you will be prompted to select a point. Select the point through which the face should pass, refer to Figure 13-80. On selecting the required point and faces, a preview of the resultant model will be displayed, as shown in Figure 13-81. The other options in the **Make Parallel** dialog box are similar to those discussed in the **Move Face** dialog box.

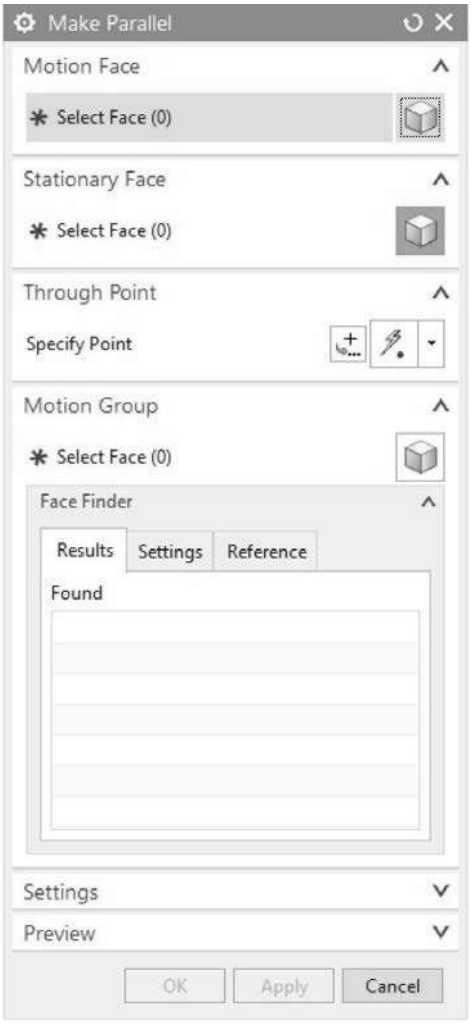

Figure 13-79 *The* ***Make Parallel*** *dialog box*

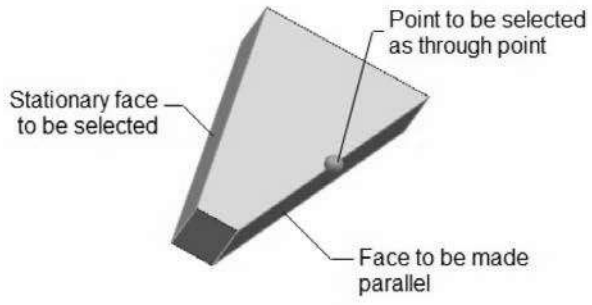

Figure 13-80 *Faces selected to be made parallel*

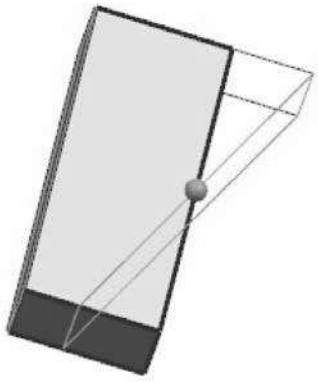

Figure 13-81 *Preview of the resultant model*

Make Perpendicular

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Make

Perpendicular *(Customize to add)*

Menu: Insert > Synchronous Modeling > Relate > Make Perpendicular

You can make one planar face of a component perpendicular to another planar face using the **Make Perpendicular** tool. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Make Perpendicular** tool from the **Relate** gallery; the **Make Perpendicular** dialog box will be displayed, as shown in Figure 13-82, and you will be prompted to select the planar faces to be made perpendicular. Select the required planar face to modify; the **Face** button from the **Stationary Face** rollout will be chosen automatically and you will be prompted to select the planar face or datum plane that has to be kept stationary. Select the required planar face or plane. Next, choose the **Inferred Point** button from the **Through Point** rollout; you will be prompted to select a point. Select the point through which the resultant face should pass, as shown in Figure 13-83. On selecting the required point and faces, a preview of the resultant model will be displayed, as shown in Figure 13-84. The other options in the **Make Perpendicular** dialog box are similar to those discussed in the **Move Face** dialog box.

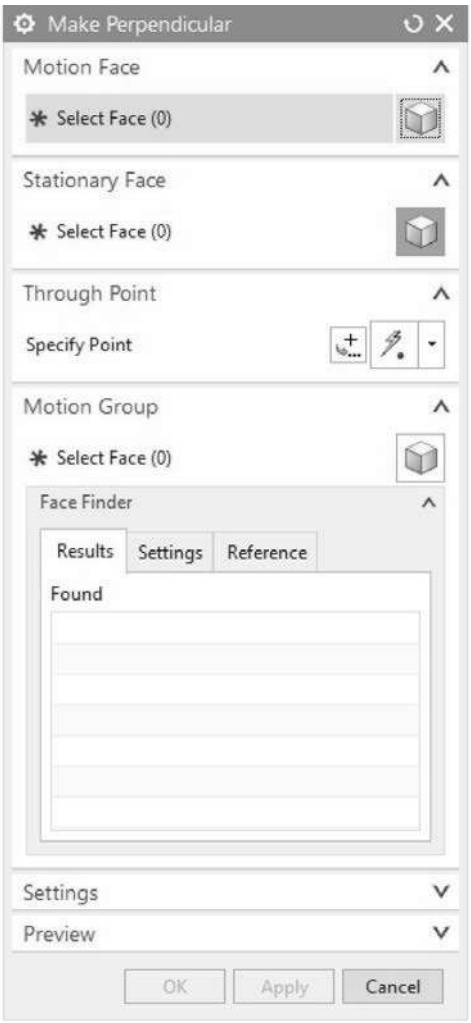

Figure 13-82 *The* ***Make Perpendicular*** *dialog box*

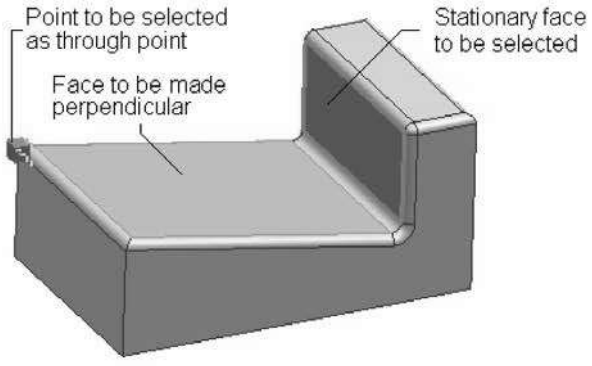

Figure 13-83 *Faces selected to apply the* ***Make Perpendicular*** *tool*

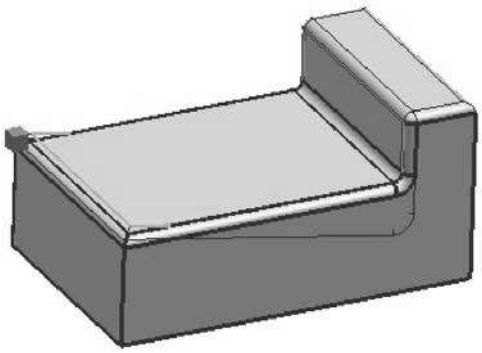

Figure 13-84 *Preview of the resultant model*

Make Offset

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Make

Offset *(Customize to add)*

Menu: Insert > Synchronous Modeling > Relate > Make Offset

You can use the **Make Offset** tool to make a face offset to another face. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Make Offset** tool from the **Relate** gallery; the **Make Offset** dialog box will be displayed, as shown in Figure 13-85, and you will be prompted to select the face to make offset. Select the face, refer to Figure 13-86; the **Face** button in the **Stationary Face** rollout will be chosen and you will be prompted to select the face that has to remain stationary. Select the face to be kept stationary, refer to Figure 13-86, and then enter the required offset distance value in the **Distance** edit box available in the **Offset** rollout; the preview of the resultant component will be displayed, as shown in Figure 13-87. You can also specify the offset distance by dragging the handle displayed on the model.

Figure 13-85 *The* ***Make Offset*** *dialog box*

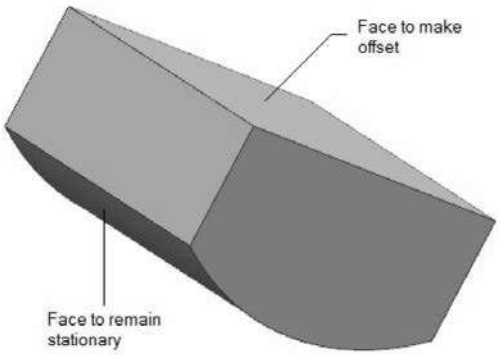

Figure 13-86 *Faces selected to be made offset*

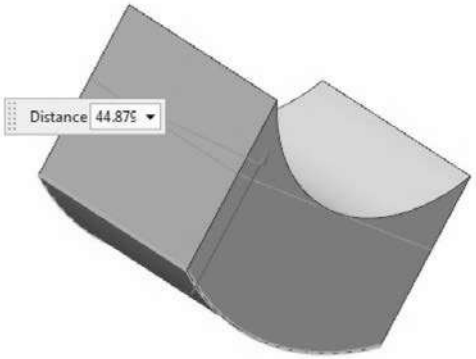

Figure 13-87 *Preview of the resultant model*

Linear Dimension

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Linear Dimension *(Customize to add)*
Menu: Insert > Synchronous Modeling > Dimension > Linear Dimension

The **Linear Dimension** tool is used to modify a model by modifying the linear dimension between two edges, axes, and faces. To modify a model, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Linear Dimension** tool from the **Relate** gallery, refer to Figure 13-88; the **Linear Dimension** dialog box will be displayed, as shown in Figure 13-89, and you will be prompted to select the origin point or datum plane for dimensioning. Select an edge, datum plane, or axis as the stationary object so that further modifications can be made in the model with respect to it. Select the required edge; the distance between the origin and the selected edge will be displayed in the drawing window. Also, the OrientXpress tool is displayed. Choose the **Specify Location** button from the **Location** rollout, if it is not chosen automatically. Now, you can locate the dimension by clicking in the drawing window. On doing so, the face corresponding to the selected measurement object is selected and a dynamic edit box will be displayed, refer to Figure 13-90. You can move the selected faces by using the dynamic edit box or by specifying the required distance in the **Distance** rollout. On doing so, the preview of the resultant model will be displayed, as shown in Figure 13-91.

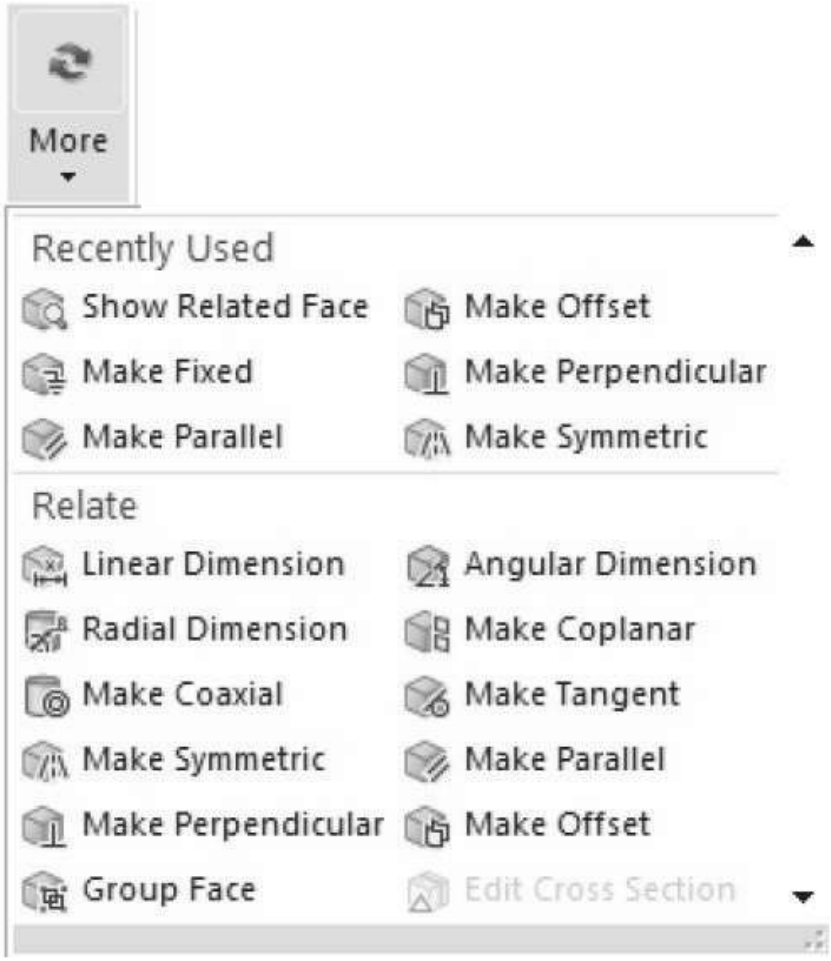

Figure 13-88 *The* ***Linear Dimension*** *tool of the* ***Relate*** *gallery*

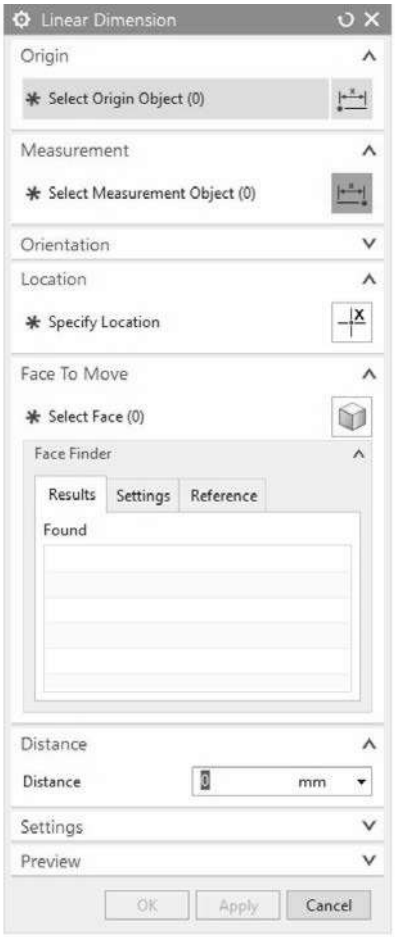

***Figure 13-89** The **Linear Dimension** dialog box*

In the **Orientation** rollout of the **Linear Dimension** dialog box, you can either specify the axis or plane, or both for dimensioning, so that the modification can be made in the model with respect to them. By default, the **OrientXpress** option is selected in the **Direction** drop-down list, so that you can specify the required axis, plane, and coordinate system using the **Direction**, **Plane** and **Reference** drop-down lists in the **OrientXpress** sub-rollout, respectively. If you select the **Vector** option in the **Direction** drop-down list, the **Orientation** rollout will be modified and you will be prompted to select the object infer vector. Specify the required vector; the linear dimension will be displayed along the specified vector and the plane to modify.

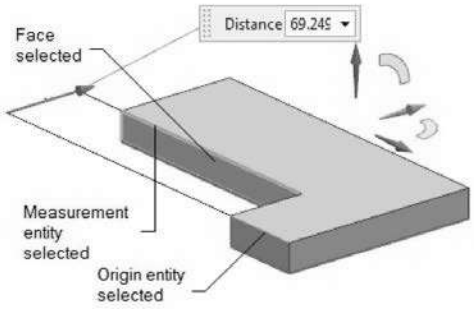

Figure 13-90 *Edges selected for linear dimensioning*

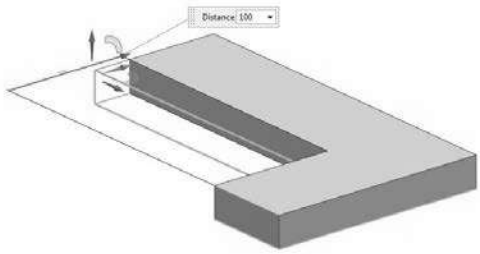

Figure 13-91 *Preview of the resultant model*

Angular Dimension

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Angular Dimension *(Customize to add)*
Menu: Insert > Synchronous Modeling > Dimension > Angular Dimension

The **Angular Dimension** tool is used to move aface angularly by modifying the angle between the two faces. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Angular Dimension** tool from the **Relate** gallery; the **Angular Dimension** dialog box will be displayed, refer to Figure 13-92 and you will be prompted to select the origin object for dimensioning. Select a face as the origin object, refer to Figure 13-93. Now, further modifications can be made with respect to this face. Also, the **Measurement Object** button from the **Measurement** rollout will be chosen automatically and you will be prompted to select the measurement object for dimensioning. Select the required face; the angle between two objects will be displayed in the graphics window, attached with the cursor and the **Specify Location** button will be chosen automatically in the **Location** rollout. As a result, you can locate the dimension by clicking in the graphics window. Specify the location of the dimension. On doing so, the **Face** button from the **Face To Move** rollout will be chosen automatically and you will be prompted to select the faces to move. Select the faces that you want to move; an angular handle and a dynamic edit box will be displayed, refer to Figure 13-93. You can move the selected faces using the angular handle or the dynamic edit box. Alternatively, you can specify the required angle in the **Angle** edit box of the **Angle** rollout. The preview of the resultant model will be displayed, as shown in Figure 13-94. Note that in the **Angle**

rollout, the **Alternate Angle** check box is clear. If you select this check box, the value of alternate angle will be displayed in the drawing window.

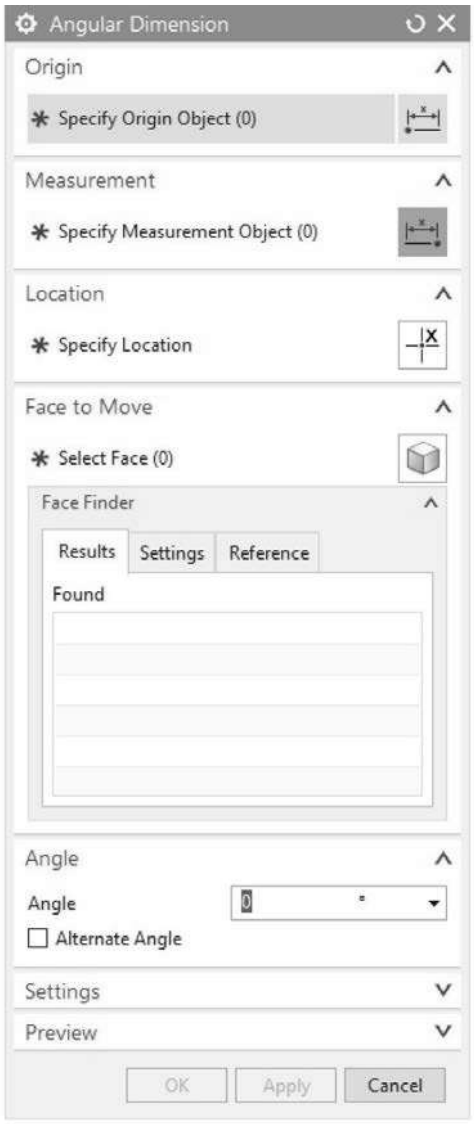

Figure 13-92 *The* ***Angular Dimension*** *dialog box*

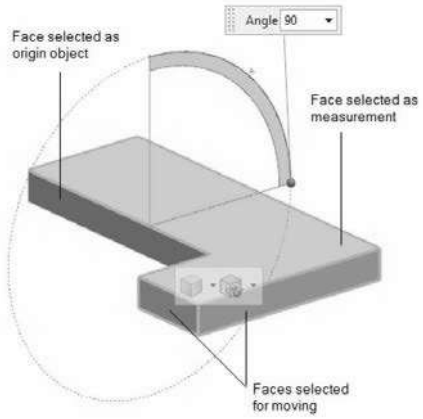

Figure 13-93 *Faces selected for angular dimensioning*

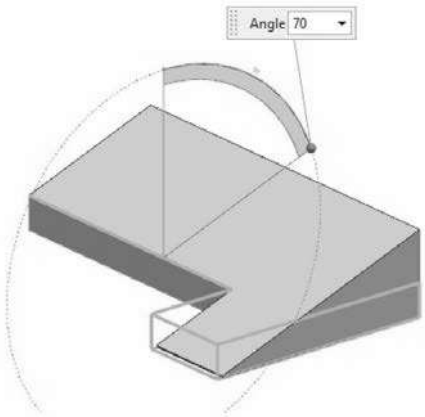

Figure 13-94 *Preview of the resultant model*

Radial Dimension

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Radial Dimension *(Customize to add)*
Menu: Insert > Synchronous Modeling > Dimension > Radial Dimension

You can use the **Radial Dimension** tool to change the dimension of a cylindrical or spherical face of the model. To do so, invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Radial Dimension** tool from the **Relate** gallery; the **Radial Dimension** dialog box will be displayed, as shown in Figure 13-95, and you will be prompted to select a face to dimension. You can select a cylindrical or spherical face. Select the face, a dynamic handle and a dynamic edit box will be displayed in the graphics window, refer to Figure 13-96. By default, the **Radius** radio button is selected in the **Size** rollout. As a result, the radius of the selected face is displayed in the dynamic edit box as well as in the **Radius** edit box of the dialog box. If you select the **Diameter** radio button in the **Size** rollout, the diameter of the selected face will be displayed in the dynamic edit box as well as in the **Diameter** edit box. After selecting the required radio button from the **Size** rollout, drag the handle to change the radial dimension of the selected face. Alternatively, you can enter the radius or the diameter values in their respective edit boxes. The preview of the resultant model will be displayed, as shown in Figure 13-97.

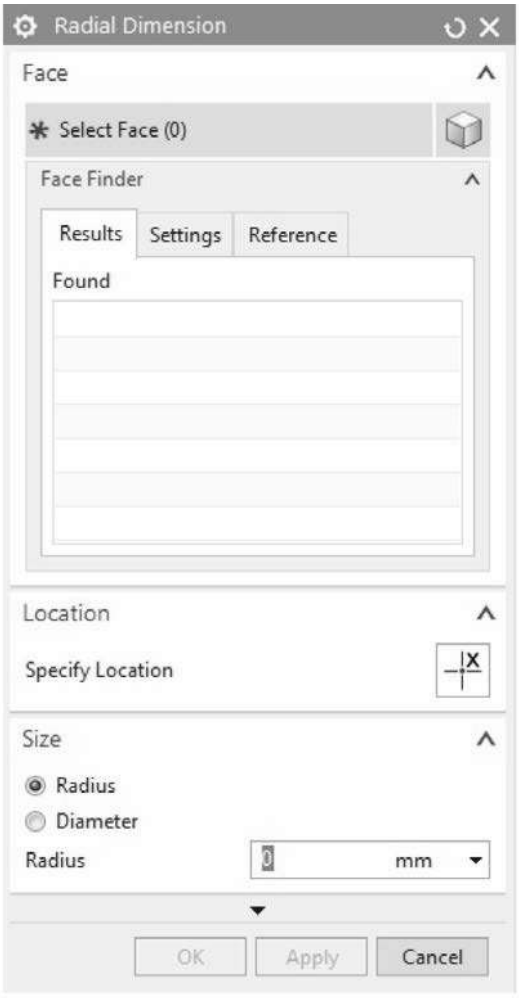

Figure 13-95 *The* ***Radial Dimension*** *dialog box*

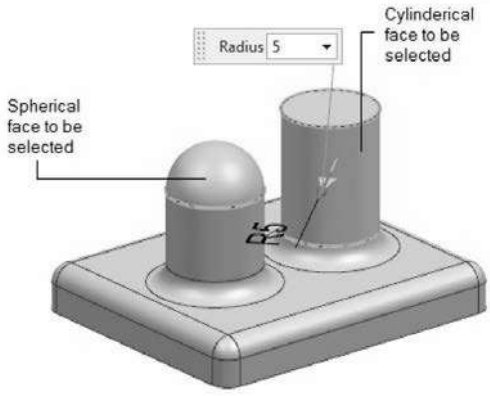

Figure 13-96 *Faces selected for applying the radial dimension*

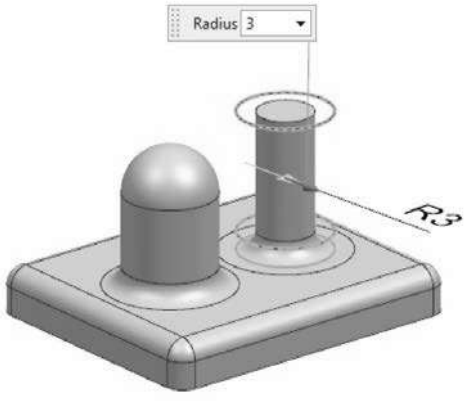

Figure 13-97 *Preview of the resultant model*

Group Face

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Group Face *(Customize to add)*
Menu: Insert > Synchronous Modeling > Group Face

The **Group Face** tool is used to create a group of selected faces of a model in such a way that if you select a single face, the remaining faces in the group are selected automatically. Invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Group Face** tool from the **Relate** gallery; the **Group Face** dialog box will be displayed, refer to Figure 13-98, and you will be prompted to select the faces to add to the group. Select the required faces to create a group. Next, choose the **OK** button; a group of selected faces will be created.

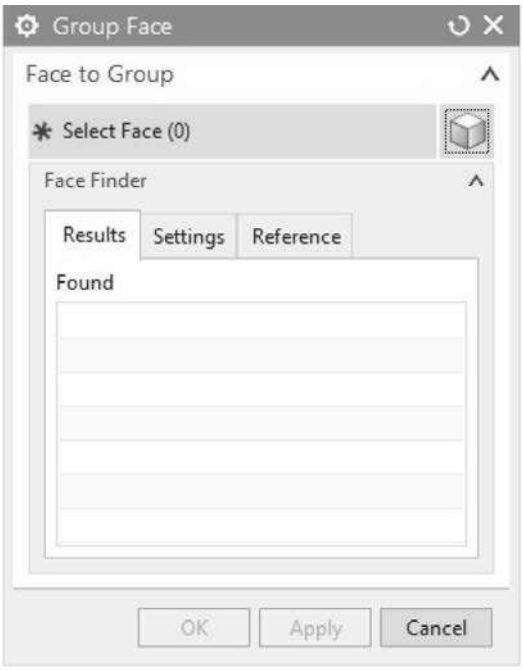

***Figure 13-98** The **Group Face** dialog box*

Edit Cross Section

Ribbon: Home > Synchronous Modeling > More Gallery > Relate > Edit Cross Section *(Customize to add)*
Menu: Insert > Synchronous Modeling > Edit Cross Section

The **Edit Cross Section** tool is used to modify the cross-section of a model in the sketching environment. Invoke the **More** gallery of the **Synchronous Modeling** group and then choose the **Edit Cross Section** tool from the **Relate**

gallery; the **Edit Cross Section** dialog box will be displayed, refer to Figure 13-99, and you will be prompted to select faces to intersect. Hold the left mouse button and drag the cursor around the model to define a box and select all its faces. Next, choose the **Plane** button from the **Plane** rollout of the dialog box. Select a planar face or a datum plane; a cross-section is created on the selected plane. Choose the **Section** button from the **Section Curve** rollout; the Sketch in Task environment will be invoked. Now, change the cross-section of the model by dragging the entities or by dimensioning it. The way you change the cross-section, the model will be updated accordingly. After updating the sketch, exit the Sketch in Task environment. Choose the **OK** button from the **Edit Cross Section** dialog box; the cross-section will be saved in the **Part Navigator**.

***Figure 13-99** The **Edit Cross Section** dialog box*

TUTORIALS

Tutorial 1

In this tutorial, you will modify the model created in Tutorial 3 of Chapter 5 using the Synchronous Modeling tools. Figure 13-100 shows the original model and Figure 13-101 shows the model after modification. **(Expected time: 30 min)**