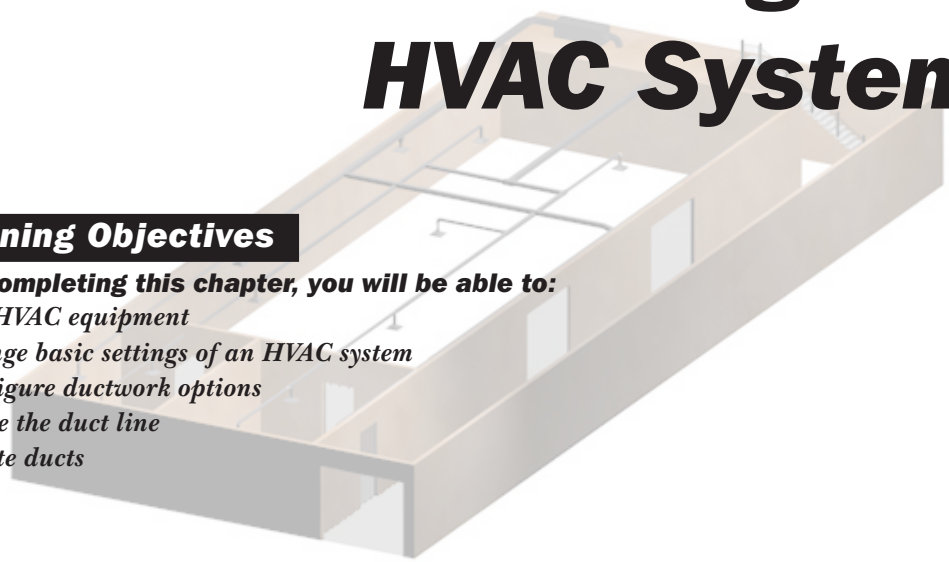
Chapter 4

Creating the HVAC System



Learning Objectives

After completing this chapter, you will be able to:

- *Use HVAC equipment*
- *Change basic settings of an HVAC system*
- *Configure ductwork options*
- *Route the duct line*
- *Create ducts*

INTRODUCTION

In this chapter, you will learn about the use of mechanical equipment that are required for creating an HVAC system. An HVAC system is used to maintain desired environmental conditions in a specific area. It consists of the heating, ventilation, and air conditioning systems. To create an HVAC system, you need to know the heating load of the desired area by using thermodynamics, fluid mechanics, and heat transfer principles. These load settings are used to determine the capacity of equipment to be added for HVAC. To start working in the **HVAC** workspace, choose the **HVAC** option from the **Workspace Switching** flyout in the **Drawing Status Bar**. The equipment available in the **HVAC** workspace of AutoCAD MEP are discussed next.

EQUIPMENT

For creating an HVAC system, you need to add equipment related to the system to the building structure. All the equipment that can be added while working in the **HVAC** workspace are available in the **Equipment** drop-down of the **Build** panel in the **Home** tab of the **Ribbon**, refer to Figure 4-1. The tools available in this drop-down are discussed next.

Air Handler



Air Handler is an equipment or a device which is used to circulate air in a specific area. The quality of air is also controlled by Air Handler. There are two types of Air Handlers available in AutoCAD MEP: Modular Air Handler and Packaged Air Handler. A Modular Air Handler consists of various components that together make an Air Handler. Some of the important components in a Modular Air Handler are AHU Coils, AHU Economizer, AHU Fans, AHU Filters, AHU Inspection Modules, and AHU Mixing Boxes. A Packaged Air Handler is a closed unit consisting of all the components available in the Modular Air Handler but in an interconnected manner. To add an Air Handler in the drawing, choose the **Air Handler** tool from the **Equipment** drop-down available in the **Build** panel of the **Home** tab in the **Ribbon**; the **Add Multi-view Parts** dialog box will be displayed, as shown in Figure 4-2. Select the AHU Large Coils component from the AHU Coils sub-category of the Modular Air Handling Unit Components category of Air Handling Units equipment. Also, the preview of the selected component is displayed in the right of the dialog box. The blue arrows in the Preview area indicate the flow of fluid through the selected component. Various components in the Modular Air Handling Unit Components category are discussed next.



Figure 4-1 *The* ***Equipment*** *drop-down*

AHU Coils

The AHU Coil is a component of Modular Air Handler which is used to cool or heat the air coming through the duct. There are four ports of AHU Coil component: Duct inlet port, Duct outlet port, Heat Exchanging fluid inlet port, and Heat Exchanging fluid outlet port. To add an AHU Coil in the drawing, click on the **+** sign adjacent to AHU Coil in the Modular Air Handling Unit Components category of Air Handling Units equipment; three types of AHU Coil will be displayed below the AHU Coil sub-category.

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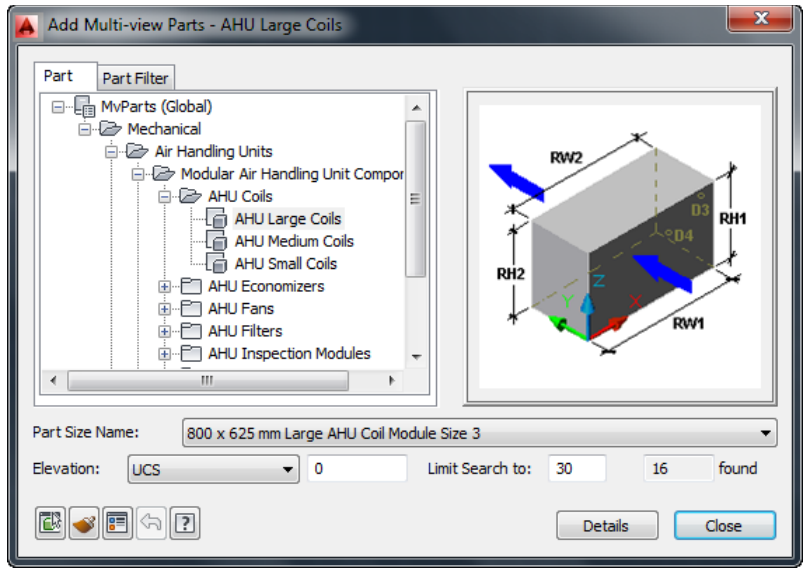

Figure 4-2 *The* ***Add Multi-view Parts*** *dialog box*

You can choose any of the three options: AHU Large Coil, AHU Medium Coil, and AHU Small Coil, as per the requirement. After choosing the desired option, select the required size from the **Part Size Name** drop-down list available below the Preview area. After selecting the respective size for AHU coil, click in the drawing area; the AHU coil will be placed at the selected position and a compass will be displayed below the AHU coil. Orient the AHU coil at the desired angle by using the compass. Figure 4-3 shows an annotated AHU Coil.

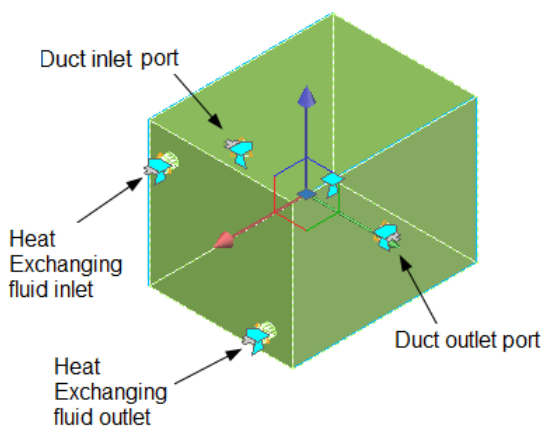

Figure 4-3 *An AHU Coil*

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AHU Economizer

The AHU Economizer is a component of the AHU system which is used to increase the efficiency of an AHU system by using natural air. In an Economizer, natural air is used to heat or cool the air in a specific area. For example, if the temperature inside a room is higher than the temperature outside, then the economizer draws air from outside and mixes with the inside air to create an ambient temperature. To add an AHU Economizer in the drawing, click on the **+** sign adjacent to AHU Economizer in the Modular Air Handling Unit Components category of Air Handling Units equipment. On doing so, the standard AHU economizer will be displayed below the AHU Economizer sub-category. After choosing the required option from the available economizers, select the required size from the **Part Size Name** drop-down list which is available below the Preview area. After selecting the size, click in the drawing area; the AHU Economizer will be placed at the selected position and a compass will be displayed below the AHU Economizer. Orient the AHU Economizer at the desired angle by using the compass. Figure 4-4 shows an annotated AHU Economizer.

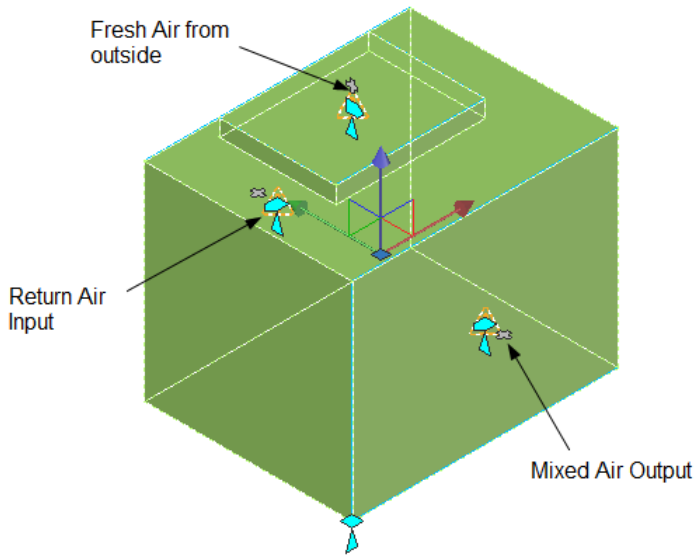

Figure 4-4 *An AHU Economizer*

AHU Fan

The AHU Fan is a component of the AHU system which forces the air to flow through the duct. To add an AHU Fan in the drawing, click on the **+** sign adjacent to AHU Fans in the Modular Air Handling Unit Components category of Air Handling Units equipment. On doing so, three types of AHU Fans will be displayed below the AHU Fans sub-category. You can choose any of the three options: AHU Fan Modules Front Discharge Up, AHU Fan Modules Rear Discharge Up, and AHU Fan Modules Side Discharge as per the requirement. After choosing the desired option, select the required size from the **Part Size Name** drop-down list available below the Preview area. After selecting the required size for AHU Fan, click in the drawing area; the AHU Fan will be placed at the selected position and a compass will be displayed below the AHU Fan. Orient the AHU Fan at the desired angle by using the compass. Figure 4-5 shows an annotated AHU Fan Modules Side Discharge.

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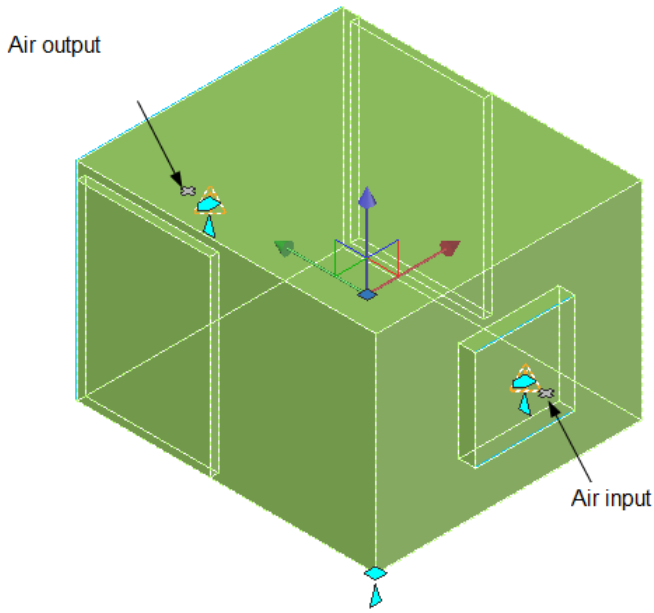

Figure 4-5 *An AHU Fan Modules Side Discharge*

AHU Filter

The AHU Filter is a component of the AHU system which filters the air coming from the input line. After filtering the air, it is passed to the AHU Inspection Module. To add an AHU Filter in the drawing, click on the **+** sign adjacent to AHU Filters in the Modular Air Handling Unit Components category of Air Handling Units equipment; various types of AHU Filters will be displayed below the AHU Filters sub-category. You can choose any of them as required. After choosing the required option, select the required size from the **Part Size Name** drop-down list available below the Preview area. After selecting the required size for the AHU Filter, click in the drawing area; the AHU Filter will be placed at the selected position and a compass will be displayed below the AHU Filter. Orient the AHU Filter at the desired angle by using the compass. Figure 4-6 shows an annotated AHU Bag Filter.

AHU Inspection Modules

The AHU Inspection Module is a component of the AHU system which is used to check the quality of air being spread in the desired area. To add an AHU Inspection Module in the drawing, click on the **+** sign adjacent to AHU Inspection Module in the Modular Air Handling Unit Components category of Air Handling Units equipment; three types of AHU Inspection Modules will be displayed below the AHU Inspection Modules sub-category. You can choose any of them as required. After choosing the required option, select the required size from the **Part Size Name** drop-down list available it. After selecting the required size, click in the drawing area; the AHU Inspection Module will be placed at the selected position and a compass will be displayed below the AHU Inspection Module. Orient the AHU Inspection Module at the desired angle by using the compass. An AHU Inspection Module has two ports, one for inlet of air and other for outlet of air.

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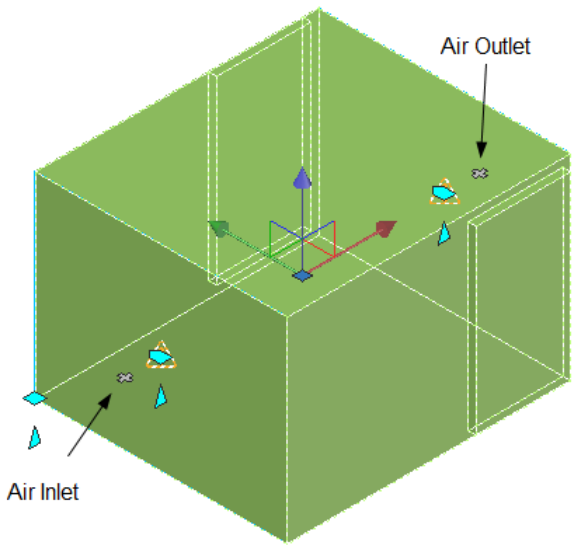

Figure 4-6 *An AHU Bag Filter*

AHU Mixing Boxes

The AHU Mixing Box is a component of the AHU system that mixes the returning air with the outside air as per the requirement. To add an AHU Mixing Box in the drawing, click on the **+** sign adjacent to AHU Mixing Box in the Modular Air Handling Unit Components category of Air Handling Units equipment. On doing so, standard available types of AHU Mixing Boxes will be displayed below the AHU Inspection Modules sub-category. You can choose any of the given types as required. After choosing the required option, select the required size from the **Part Size Name** drop-down list available below the Preview area. After selecting the required size, click in the drawing area; the AHU Mixing Box will be placed at the selected position and a compass will be displayed below the AHU Mixing Box. Orient the AHU Mixing Box at the desired angle by using the compass. An AHU Mixing Box has three ports, one for inlet of returning air, one for inlet of fresh air, and one for outlet of mixed air.

Air Terminal



Air Terminal is a vent through which the fresh air is diffused in a specific area. To add a vent in the drawing, choose the **Air Terminal** tool from the **Equipment** drop-down in the **Build** panel of the **Home** tab; the **Add Multi-view Parts** dialog box will be displayed with the options for Air Terminals, as shown in Figure 4-7. There are three categories of an Air Terminal: Diffuser, Grill, and Register. Click on the **+** sign adjacent to the desired category in the dialog box; various options related to that category will be displayed below that category. Select the required option from the displayed options; different sizes for the selected option will be displayed in the **Part Size Name** drop-down list. Select the required size from the list and then click in the drawing area to place the air terminal. On placing the air terminal, you will be prompted to specify the rotation angle by using the compass displayed below it. Specify the rotation angle either by entering the value at the command prompt or

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dynamically specify the value by clicking on the screen. On doing so, the air terminal will be placed at the desired point and angle. Close the dialog box by choosing the **Close** button after adding the required number of air terminals.

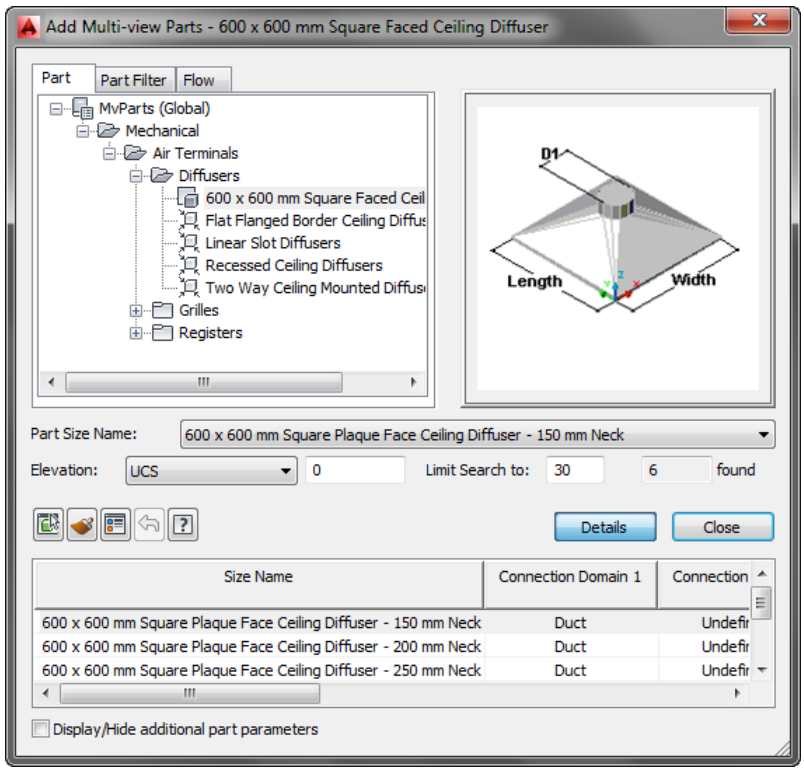

Figure 4-7 *The* ***Add Multi-view Parts*** *dialog box with options for Air Terminals*



Note

You can specify the flow rate for the selected air terminal by using the ***Flow (Each Terminal)*** *edit box available in the* ***Flow*** *tab of the* ***Add Multi-view Parts*** *dialog box. The unit for specifying the value should be liter/sec.*

Fan



Fan is an equipment that creates a current of air. To add a fan in the drawing, choose the **Fan** tool from the **Equipment** drop-down in the **Build** panel of the **Home** tab; the **Add Multi-view Parts** dialog box will be displayed with the options related to fans, as shown in Figure 4-8. Select the required fan from the list; various sizes for the selected fan will be displayed in the **Part Size Name** drop-down list available below the Preview area. Select the required size from the list and click in the drawing area; the selected fan will be placed at the specified location and a compass will be displayed below the fan in the drawing area. Using this compass, you can specify the value of rotation dynamically.

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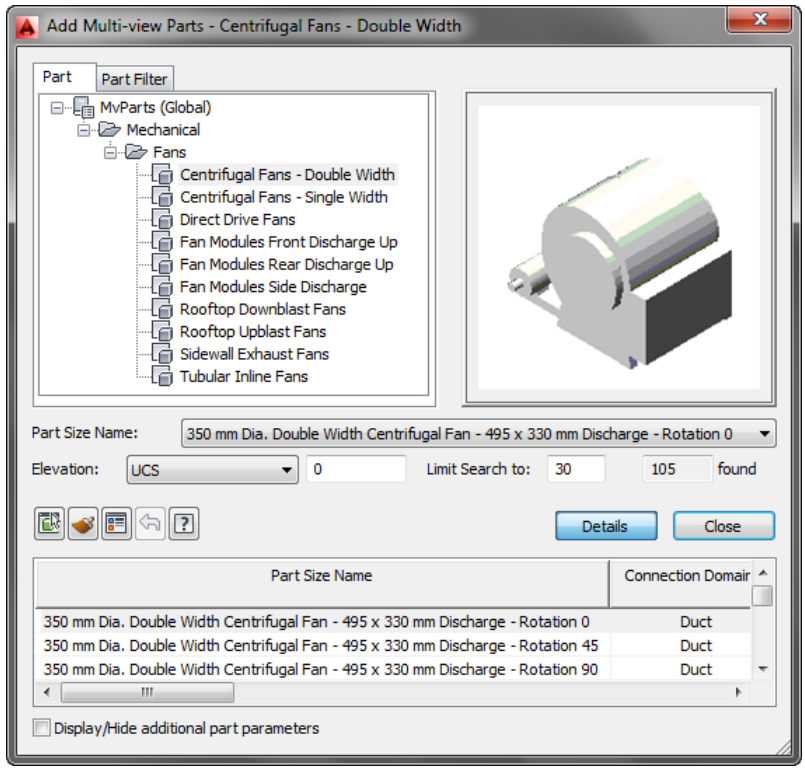

Figure 4-8 *The* ***Add Multi-view Parts*** *dialog box with options for fans*

Damper



Damper is an HVAC equipment that is used to regulate the flow of air in an HVAC system. To add a damper in the system, choose the **Damper** tool from the **Equipment** drop-down in the **Build** panel of the **Home** tab; the **Add Multi-view Parts** dialog box will be displayed with the options for dampers, as shown in Figure 4-9. There are four categories of dampers: Balancing Dampers, Fire Dampers, Rectangular Curtain Fire Shield Damper, and Rectangular Smoke Shield Damper PTC. The Balancing Damper is used to control the amount of air flowing through the duct. The Fire Damper is used to restrict the flow of fire through the duct, in case the building catches a fire. The Rectangular Curtain Fire Shield Damper is also used as a shield against fire but this type of fire dampers are in the form of curtains. The Rectangular Smoke Shield Damper PTC is used as a shield against smoke. PTC is a type of smoke shield damper which stands for Proportional Torque Control. Click on the **+** sign adjacent to the required category; a list with relative dampers will be displayed. Select the required damper from the list; various sizes for the selected damper will be displayed in the **Part Size Name** drop-down list available below the Preview area. Select the required size from the list and click in the drawing area; the selected damper will be placed at the specified location and a compass will be displayed below the damper in the drawing area. Using this compass, you can specify the value of rotation dynamically.

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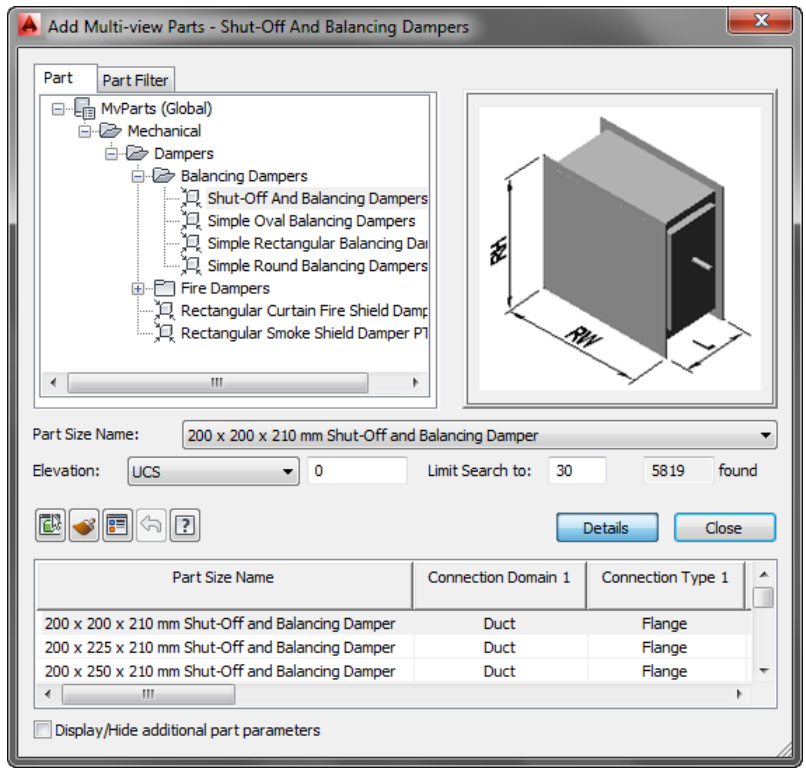


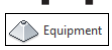
Figure 4-9 *The* ***Add Multi-view Parts*** *dialog box with options for dampers*

VAV Unit



A VAV unit is an equipment used to vary the speed of air flowing through the duct. The temperature of air to be supplied to VAV unit is constant, therefore the air flow is regulated to meet the user requirements. To add a VAV Unit in the HVAC system, choose the **VAV Unit** tool from the **Equipment** drop-down in the **Build** panel of the **Home** tab; the **Add Multi-view Parts** dialog box will be displayed with the options for VAV unit, as shown in Figure 4-10. Select the required VAV unit from the VAV Units category; the standard sizes available for the selected VAV unit will be displayed in the **Part Size Name** drop-down list. Choose the required size from the drop-down list and click in the drawing area to place the VAV unit; a compass will be displayed attached to the VAV unit for specifying the angle. Specify the rotation angle and then choose the **Close** button from the **Add Multi-view Parts** dialog box.

Equipment



Using the **Equipment** tool, you can add any equipment available in AutoCAD MEP to the structure. When you choose the **Equipment** tool from the **Equipment** drop-down of the **Build** panel of the **Home** tab, the **Add Multi-view Parts** dialog box will be displayed, as shown in Figure 4-11. Click on the **+** sign adjacent to the Mechanical category in the dialog box; the mechanical equipment available in AutoCAD MEP will be displayed in a tree structure, refer to Figure 4-12.

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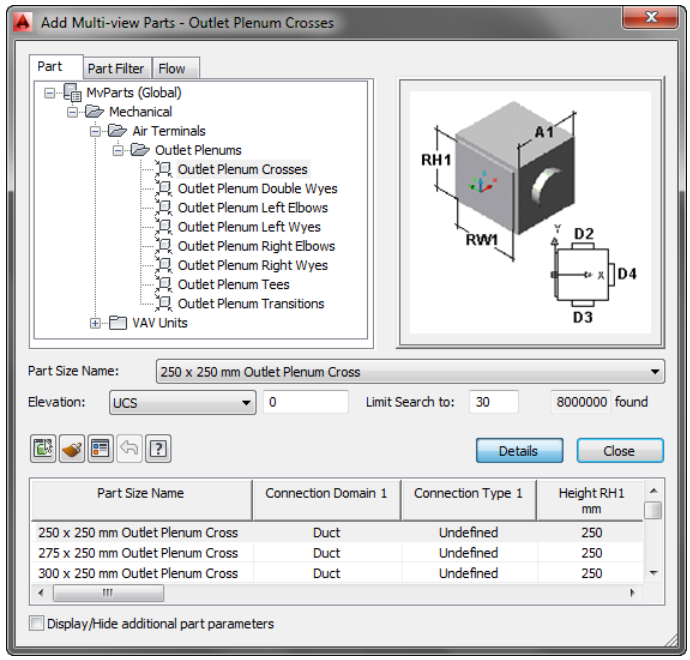

Figure 4-10 *The* ***Add Multi-view Parts*** *dialog box with options for VAV unit*

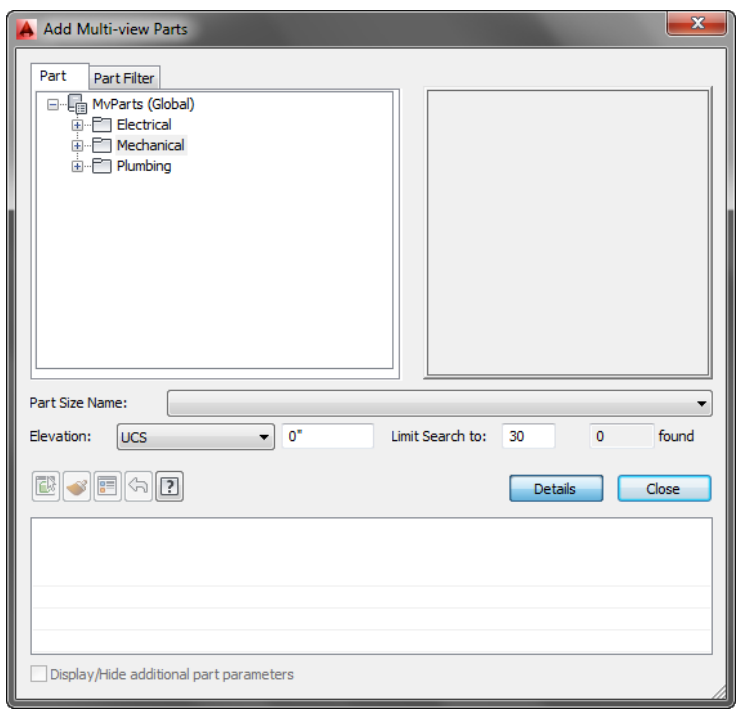

Figure 4-11 *The* ***Add Multi-view Parts*** *dialog box*

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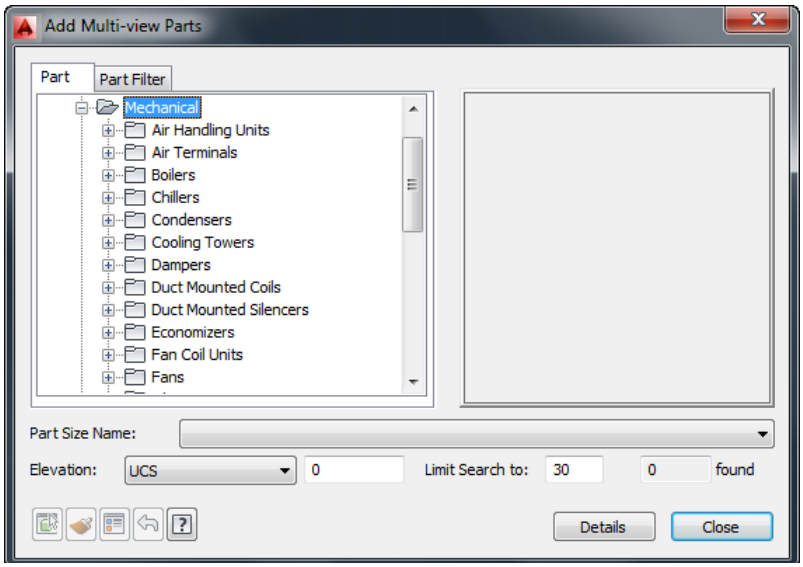

Figure 4-12 *The* ***Add Multi-view Parts*** *dialog box with mechanical equipments*

Click on the **+** sign adjacent to the required component; various options related to the selected component will be displayed in a list. Select the required option from the list and then click in the drawing area to place the component. A compass will also be displayed below the component. Using this compass, you can rotate the component at the required angle. After specifying the angle, choose the **Close** button from the **Add Multi-view Parts** dialog box to exit the dialog box.

DUCT LINE

Duct line is the circuit of ducts inserted in a particular area to create desired air and temperature conditions. Before creating a duct line, you must know about the specifications such as size of duct, air flow rate in the duct, number of branches required, and the size of duct in the branches. After entering these specifications, you will create the path of duct line. The methods of sizing the duct and creating a duct line are discussed next.

Sizing the Duct Line

In AutoCAD MEP, the duct size of main duct line is dependent on two parameters: the total amount of air to be circulated which is controlled by **Flow Rate** variable and the velocity of air in the duct which is controlled by **Velocity** variable. These two variables are discussed next.

Flow Rate

You can change the value of this variable by using the **Flow Rate** edit box available in the **Sizing** rollout of the **Properties** palette which is displayed on choosing the **Duct** tool. Flow rate is the total volume of air that is to be provided in a specific area. Enter the flow rate value in the **Flow Rate** edit box in the **Properties** palette; the value of friction and velocity will be calculated according to the rules specified in the design properties of duct type.

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Velocity

Velocity of air flowing through a duct is a dependent variable. You cannot control the value of this variable directly. This variable is dependent on the duct size. If you increase the duct size, the value of velocity will automatically decrease and also the value of friction will decrease. If you decrease the size of duct, the value of velocity and friction will increase. In other words the duct size, you can control the value of velocity. Note that the value of velocity and friction also changes according to the option selected in the **System** drop-down list in the **BASIC** rollout.

Routing the Duct Line

Routing is the process of creating a duct line in a layout. Routing of duct involves many factors such as position of handling units, position of diffusers, and layout of building. There are some major points that are to be considered while routing the duct line that are discussed next.

1. Duct line should be routed in such a way that it does not pass through an area that is having a large temperature difference from the air inside the duct.
2. Rise/Slope of duct must be determined after considering the temperature of air inside the duct.
3. Duct routes must be as straight as possible.
4. Duct must be larger at the opening point to the air filter entry and at the returning point of the unit.
5. Always try to route through either the basement or the attic so that you can support the ducts by using the duct hangers.
6. It is always good to position the air terminals and air handling unit first before routing the duct line.
7. For a vertical run, the duct must be fastened to a wall.

DUCT

Duct is an object which is used to deliver or remove air from an HVAC system. There are two types of ducts available in AutoCAD MEP: Duct and Flex Duct. Tools to create these ducts are available in the **Duct** drop-down in the **Build** panel of the **Home** tab in the **Ribbon**. These tools are discussed next.

Duct



This tool is used to create a rigid duct in the HVAC system. This duct can be rectangular, oval, round, or custom shaped. To create a rigid duct, choose the **Duct** tool from the **Duct** drop-down in the **Build** panel of the **Home** tab in the **Ribbon**; the **Properties** palette will be displayed, as shown in Figure 4-13. The options available in the **Properties** palette are discussed next.

Description

This field is available in the **General > BASIC** rollout in the **Properties** palette of the **Design** tab. When you click in this field, the **Description** dialog box will be displayed, as shown in Figure 4-14. You can enter description about the selected object in the text box available below the **Edit the description for this object** option. Choose **OK** to exit the dialog box.

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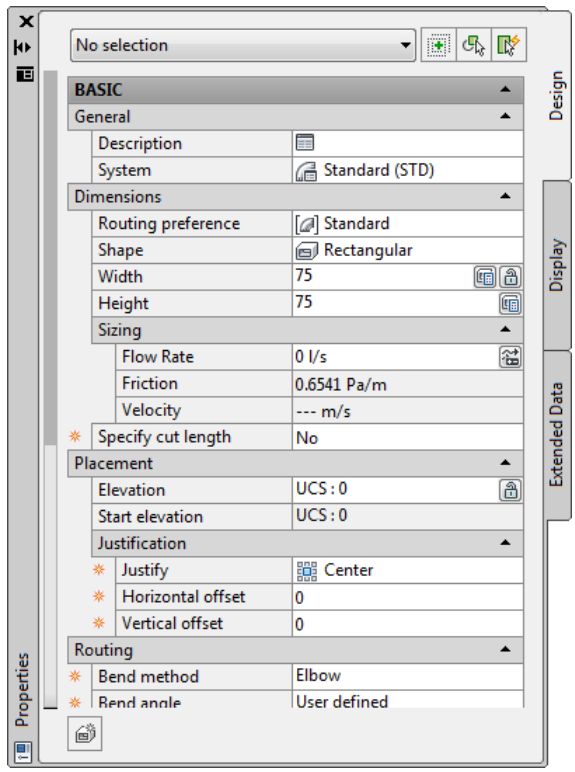

Figure 4-13 *The* ***Properties*** *palette displayed on selecting the* ***Duct*** *tool*

System

This drop-down list is available in the **General > BASIC** rollout in the **Properties** palette with the **Design** tab selected. This drop-down list contains various options for system definitions of the duct.

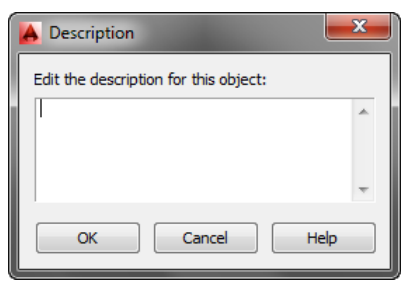

Figure 4-14 *The* ***Description*** *dialog box*

Routing Preferences

This drop-down list is available in the **BASIC > Dimensions** rollout. The options available in this drop-down list are used for specifying the routing style of duct. By default, the **Standard** option is selected in this drop-down list.

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Shape

This drop-down list is available in the **BASIC > Dimensions** rollout. This drop-down list contains options to change the shape of duct. There are four options available in this drop-down list: **Oval**, **Rectangular**, **Round**, and **Undefined**. Generally, round and rectangular ducts are used in industries.

Width

This edit box is available in the **Dimensions** rollout when the **Rectangular** or **Oval** option is selected in the **Shape** drop-down list. You can specify the value of width of the duct by using this edit box. When you click on the inverted triangle adjacent to this edit box, a drop-down list is displayed. You can select the standard sizes available for width from this edit box. The **Calculate Size** toggle button is available in the left of this edit box. When you choose this button, the width of duct is automatically calculated on the basis of flow rate, friction, velocity, and so on.

Height

This edit box is available in the **Dimensions** rollout when the **Rectangular** or **Oval** option is selected from the **Shape** drop-down list. Using this edit box, you can specify the height of duct.

Diameter

This edit box is available in the **Dimensions** rollout when the **Round** option is selected from the **Shape** drop-down list. Using this edit box, you can specify the diameter of duct. The **Calculate Size** toggle button is available in the left of this edit box. When you choose this button, the diameter of duct is automatically calculated on the basis of parameters such as flow rate, friction, and velocity.

Flow Rate

Using this edit box, you can specify the rate of flow of fluid through the duct. The flow rate is specified in liters per second.

Friction

This field is available in the **Dimensions > Sizing** rollout. This field shows the value of friction acting against the flow of fluid through the duct. The value in this field is controlled by **Duct System Definitions** section in the **Style Manager**.

Velocity

This field is available in the **Dimensions > Sizing** rollout. This field shows the value of velocity of fluid passing through the duct. The value in this field is also controlled by **Duct System Definitions** section in the **Style Manager**.

Specify Cut Length

This drop-down list is available in the **Dimensions > Sizing** rollout. There are two options available in this drop-down list: **Yes** and **No**. By default, the **No** option is selected in this drop-down list. On selecting the **Yes** option, you can specify the cut length in the respective field.

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Cut Length
This edit box is available in the **Dimensions > Sizing** rollout only when the **Yes** option is selected from the **Specify Cut Length** drop-down list. You can specify the value of cut length in this edit box. Cut length is the maximum length of a piece of duct that is available for creating duct line.

Elevation
This edit box is available in the **BASIC > Placement** rollout. Using this edit box, you can specify the value of elevation of duct from the ground.

Start Elevation
This field is available in the **BASIC > Placement** rollout. The value specified in this field is the same as the one specified in the **Elevation** edit box.

Justify
This drop-down list is available in the **Placement > Justification** rollout. Various options are available in this drop-down list to change the justification of duct.

Horizontal Offset
This edit box is available in the **Placement > Justification** rollout. Using this edit box, you can specify the horizontal distance value by which the duct is placed from the selected justification point.

Vertical Offset
This edit box is available in the **Placement > Justification** rollout. Using this edit box, you can specify the vertical distance value by which the duct is placed from the selected justification point.

Bend Method
This drop-down list is used to define the methods of bending applied on a bend in the duct system. There are three options available in this drop-down list: **Elbow**, **Offset**, and **Transition - Offset**. The **Elbow** option is selected by default.

Bend Angle
This drop-down list is used to specify the angle of bend that is to be applied on any bend while creating a duct.

Connection details
This button is available in the **ADVANCED** rollout. When you choose this button, the **Connection Details** dialog box will be displayed, as shown in Figure 4-15. There are two rollouts available in the dialog box that contain the details of both inlet and outlet connections.

Lining thickness
This edit box is available in the **ADVANCED** rollout. Using this edit box, you can specify the value of thickness of liner in the duct.

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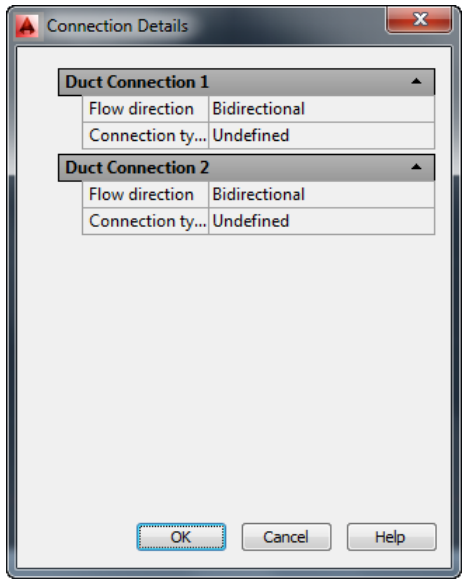

Figure 4-15 *The* ***Connection Details*** *dialog box*

Insulation thickness

This edit box is also available in the **ADVANCED** rollout and is used to specify the thickness of insulation applied on the duct.

Slope format

The options in this drop-down list are used to specify the format in which the slope value will be entered. There are four options available in this drop-down list: **Angle (Decimal Degrees)**; **Percentage, 100%=45 degree; Percentage, 100%=90 degree**; and **Rise/Run (Meters/Meters)**.

Slope

This edit box is available in the **ADVANCED > Routing Options** rollout of the **Properties** palette. You can specify the value of slope in this edit box. The format in which the value will be specified in this edit box depends on the option selected in the **Slope format** drop-down list. If you change the slope value while adding more ducts, the fitting at joints will adjust automatically to provide the changed slope.

Branch fitting

This drop-down list is available in the **ADVANCED > Routing Options** rollout of the **Properties** palette. There are two options in this drop-down list: **Tee** and **Takeoff**. When the **Tee** option is selected in the drop-down list, then the branches to be created will be joined to the main duct through a Tee fitting. When the **Takeoff** option is selected in the drop-down list, the branches will be joined to the main duct through the Takeoff fitting.

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Terminal-duct connection

This drop-down list is available in the **ADVANCED > Routing Options** rollout of the **Properties** palette. There are three options available in this drop-down list: **Flexible**, **Elbow with Rigid Duct**, and **Extended Duct**.

Fitting Settings

This option is available in the **ADVANCED > Routing Options** rollout of the **Properties** palette. When you click on this option, the **Fitting Settings** dialog box will be displayed, as shown in Figure 4-16. The options in this dialog box are used to change the type of fitting to be used while creating the branches in the duct.

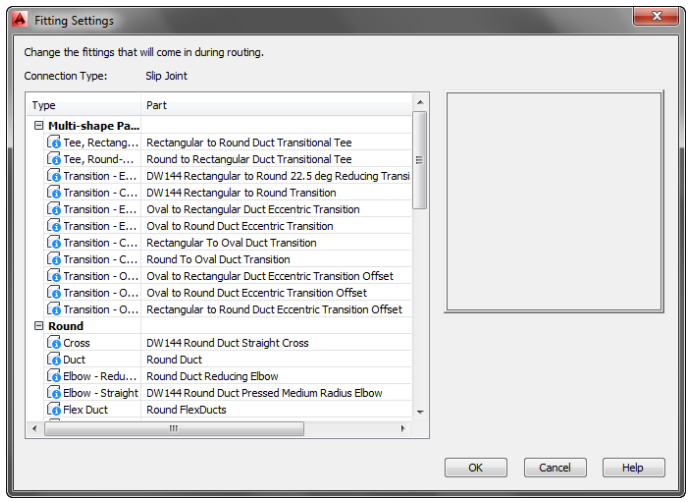

***Figure 4-16** The **Fitting Settings** dialog box*

Preferences

This option is available in the **ADVANCED > Routing Options** rollout of the **Properties** palette. When you click on this option, the **Duct Layout Preferences** dialog box will be displayed, as shown in Figure 4-17. The options in this dialog box are used to define the layout preferences for creating a duct. Using the options in this dialog box, you can set the preferences for variables such as Slope, Elevation, Label style, Flow arrow style, and Elbow layout.

Style

This drop-down list is available in the **ADVANCED > Labels and Flow Arrows > Labels** rollout of the **Properties** palette. The options in this drop-down list are used to apply the label styles to duct.

Layout method

This drop-down list is available in the **ADVANCED > Labels and Flow Arrows > Labels** rollout of the **Properties** palette only when **NONE** is not selected from the **Style** drop-down list. There are two options available in this drop-down list: **By distance** and **By quantity**. These options are used to specify the layout method of ducts.

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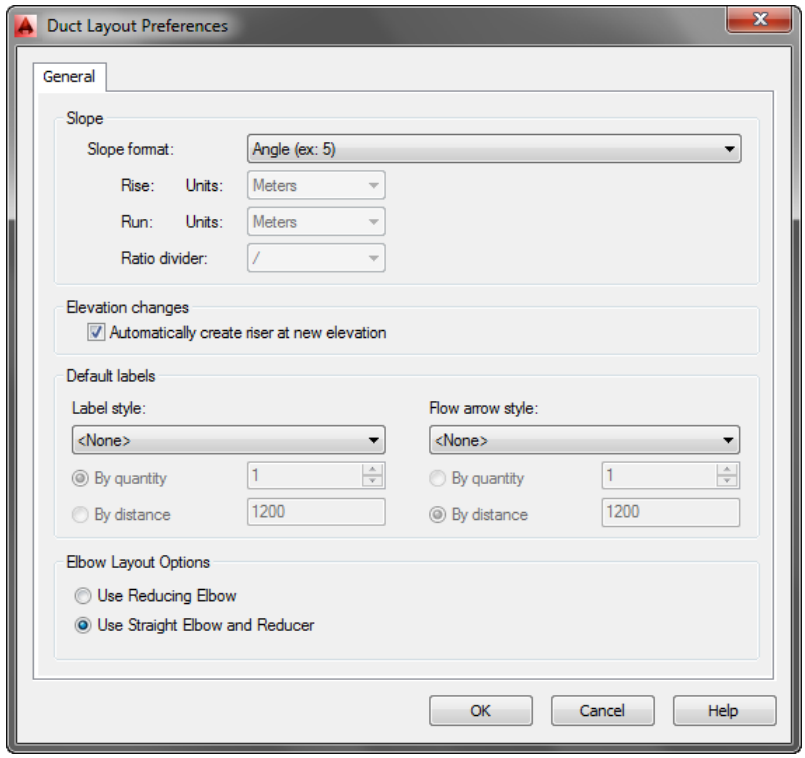

***Figure 4-17** The **Duct Layout Preferences** dialog box*

Number of Labels

This edit box is available in the **ADVANCED > Labels and Flow Arrows > Labels** rollout of the **Properties** palette only when **NONE** is not selected from the **Style** drop-down list and **By quantity** is selected from the **Layout method** drop-down list. Using this edit box, you can specify total number of labels applied on a segment duct.

Distance between

This edit box is available in the **ADVANCED > Labels and Flow Arrows > Labels** rollout of the **Properties** palette only when **NONE** is not selected from the **Style** drop-down list and **By distance** is selected from the **Layout method** drop-down list. Using this edit box, you can specify the distance between two consecutive labels applied on a duct.

The **Style**, **Layout method**, **Number of Labels**, and **Distance between** options are also available for Flow Arrows. These options work for flow arrows in the same way as for Labels.

Flex Duct



This tool is used to create flexible ducts in the HVAC system. To create a flexible duct, choose the **Flex Duct** tool from the **Duct** drop-down in the **Build** panel of the **Home** tab in the **Ribbon**; the **Properties** palette will be displayed, refer to Figure 4-13. Some of the options available in the **Properties** palette after selecting flex duct have already been discussed in the Duct section of this chapter. Rest of the options are discussed next.

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Segment
This drop-down list is available in the **BASIC > Routing** rollout in the **Properties** palette. There are three options available in this drop-down list: **Line**, **Arc**, and **Spline**. Using the **Line** option, you can create a flex duct in the form of a straight line. Using the **Arc** option, you can create a flex duct in the form of an arc. Using the **Spline** option, you can create a flex duct in the form of a spline.

Radius factor
This edit box is available in the **BASIC > Routing** rollout in the **Properties** palette. Using this edit box, you can specify the value of radius on the bend. The value entered in this edit box is multiplied by the diameter value of the flex duct gives the radius at the bend. This edit box is available only when the **Line** option is selected in the **Segment** drop-down list.

Graphics
This drop-down list is available in the **ADVANCED > Graphics** rollout in the **Properties** palette. This drop-down list is available for both 1-Line and 2-Line annotations in the respective rollouts. Using the options available in this drop-down list, you can specify the shape and pattern of the annotative representation of the duct in the 2-D drawing.

Pitch
This edit box is available in the **ADVANCED > Graphics** rollout in the **Properties** palette. This edit box is available for both 1-Line and 2-Line annotations in the respective rollouts. This edit box is used to specify the length of one piece flex duct.

Vertex
This edit box is available in the **ADVANCED > Geometry** rollout in the **Properties** palette when you select an already created flex duct. Using this edit box, you can select an available vertex of the flexible duct. You can also change the selected vertex by using the scroll buttons available in the right of the edit box. On doing so, the options relevant to the selected vertex will be displayed.

Vertex X
This edit box is available in the **ADVANCED > Geometry** rollout in the **Properties** palette. Using this edit box, you can specify X coordinate of the selected vertex.

Vertex Y
This edit box is available in the **ADVANCED > Geometry** rollout in the **Properties** palette. Using this edit box, you can specify Y coordinate of the selected vertex.

Vertex Z
This edit box is available in the **ADVANCED > Geometry** rollout in the **Properties** palette. Using this edit box, you can specify Z coordinate of the selected vertex.

DUCT FITTING
Duct fitting is used to connect multiple ducts. The tools to add duct fitting are available in the **Duct Fitting** drop-down in the **Build** panel of the **Home** tab in the **Ribbon**. There are three

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tools available in this drop-down; **Duct Fitting**, **Duct Custom Fitting**, and **Duct Transition Utility**. These tools are discussed next.

Duct Fitting



This tool is used to add a user specified fitting in the duct. On choosing this tool, the **Properties** palette is displayed, refer to Figure 4-18. Various options available in this palette are discussed next.

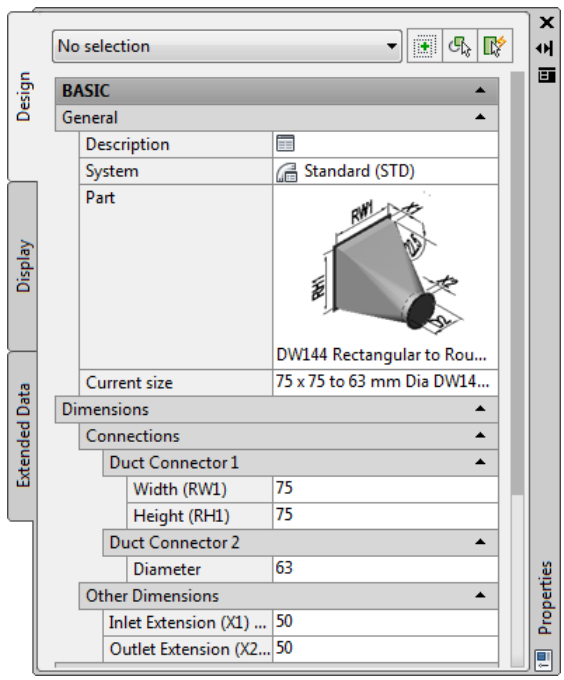

***Figure 4-18** The **Properties** palette displayed after choosing the **Duct Fitting** tool*

Description

This field is available in the **BASIC > General** rollout in the **Properties** palette. When you click in this field, the **Description** dialog box will be displayed. You can write description about the fitting in this text box.

System

This drop-down list is available in the **BASIC > General** rollout of the **Properties** palette. There are various options available in this drop-down list to change the standard of fitting to be created. By default, the **Standard (STD)** option is selected in this drop-down list.

Part

This field is available in the **BASIC > General** rollout of the **Properties** palette. When you click in this field, the **Select a part** dialog box will be displayed, refer to Figure 4-19. There are various types of fittings available for duct in this dialog box. All these fittings are displayed in the **SELECT PART FROM CATALOG** rollout. The fittings in this rollout are divided into groups

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in a tree structure. You can filter the available parts depending on your requirements by using the options in the **FILTER** rollout of this dialog box. The filtered options will be displayed in the **SELECT PART SIZE** area of this dialog box. You can also select the required fitting from the **HVAC Tool** palette. These fittings are available in the **Fitting** tab of the palette.

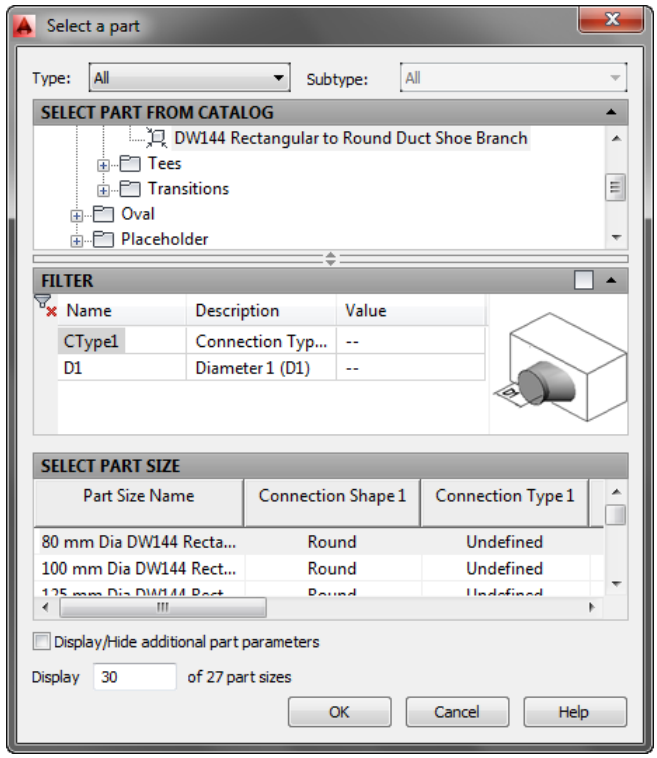

***Figure 4-19** The **Select a part** dialog box*

Current Size

This drop-down list is available in the **BASIC > General** rollout of the **Properties** palette. The options available in this drop-down list are used to change the size of the current selected fitting.

Connections Rollout

This rollout is available in the **BASIC > Dimensions** rollout in the **Properties** palette. The options in this rollout are used to change the dimensions of a selected fitting. The options in this rollout may vary depending on the selected fitting.

Elevation

This edit box is available in the **BASIC > Placement** rollout in the **Properties** palette. Using this edit box, you can specify the value of height of fitting from the ground level.

Specify rotation on screen

This drop-down list is available in the **BASIC > Placement** rollout in the **Properties** palette. There are two options available in this drop-down list; **Yes** and **No**. If you select the **Yes** option,

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you will be prompted to specify the rotation value on screen while creating the fitting. If you select the **No** option, then you need to specify the rotation value in the edit box available in the **Properties** palette.

Rotation

This edit box is available in the **BASIC > Placement** rollout in the **Properties** palette. Using this edit box, you can specify the value of rotation of the fitting before placing it in the drawing. This edit box is available only when the **No** option is selected in the **Specify rotation on screen** drop-down list.

Vanes

This drop-down list is available in the **ADVANCED > Properties** palette. There are two options available in this drop-down list: **Yes** and **No**. If you select the **Yes** option, the vanes will be added to the fitting and if you select the **No** option, the vanes will not be added to the fitting.

Duct Custom Fitting



This tool is used for creating custom fittings in the duct line. To create a custom fitting, you must have lines, arcs, or polylines created in the drawing area. Choose the **Duct Custom Fitting** tool from the **Duct Fitting** drop-down; you will be prompted to select lines, arcs, or polylines. Select lines, arcs, or polylines from the drawing area and then press ENTER; the **Create Duct Custom Fitting** dialog box will be displayed, refer to Figure 4-20.

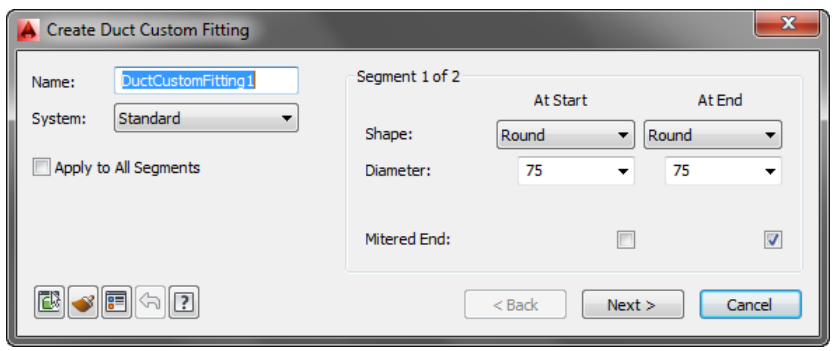

Figure 4-20 *The* ***Create Duct Custom Fitting*** *dialog box*

Depending on the entities selected, the segments will be displayed in the dialog box as Segment *n* of *m*, where *n* is the serial number of the current segment and *m* is the total number of segments in the fitting. Using the **Shape** drop-down list available in the **Segment *n* of *m*** area, you can change the shape of segments in the fitting. There are three options available in this drop-down list: **Rectangular**, **Round**, and **Oval**. After selecting the required option, you can specify the relevant parameters in the edit boxes available below this drop-down list. After specifying the parameters, You can choose the **Next >** button to change the parameters of next segment. You can also select the **Apply to All Segments** check box, if you want to keep same parameters for the other segments. After specifying parameters for all the segments,

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choose the **Finish** button; you will be prompted whether to delete the base geometry or not. Enter **Yes** or **No** at the command prompt; the custom fitting will be created.

Duct Transition Utility



This tool is used to connect two parallel ducts, duct fittings, or equipment. Various shapes that can be connected by using these tools are given next.

Round	to	Round
Round	to	Rectangular
Round	to	Oval
Rectangular	to	Rectangular
Rectangular	to	Oval
Rectangular	to	Round
Oval	to	Oval
Oval	to	Rectangular
Oval	to	Round

To create a duct transition, choose the **Duct Transition Utility** tool from the **Duct Fitting** drop-down; you will be prompted to select the first duct, duct fitting, or MvPart. Select the first entity; you will be prompted to select the second entity. Select the duct, duct fitting, or MvPart to be joined; a transition fitting will be created, joining both the entities.

TUTORIAL

Tutorial 1

In this tutorial, you will add a mechanical system (HVAC system) in the building created in Tutorial 2 of Chapter 3. You can also download the architectural file from *www.cadcim.com*. Path of the file is: *Textbooks > CAD/CAM > AutoCAD MEP > AutoCAD MEP 2014 for Designers > Tutorial*. The building after adding the mechanical system is shown in Figure 4-21. The plan for the mechanical system is given in Figure 4-22.

(Expected time: 30 min)

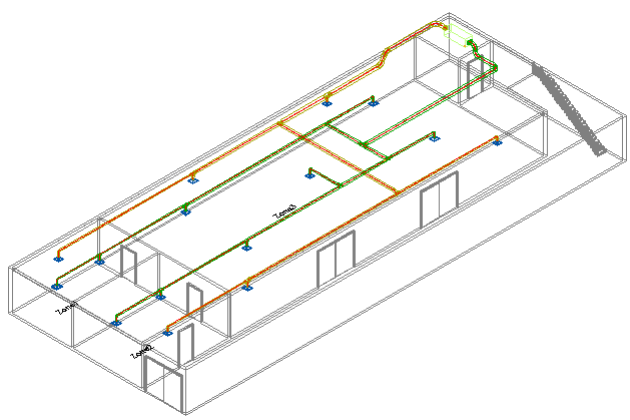

Figure 4-21 *The drawing after adding mechanical system*

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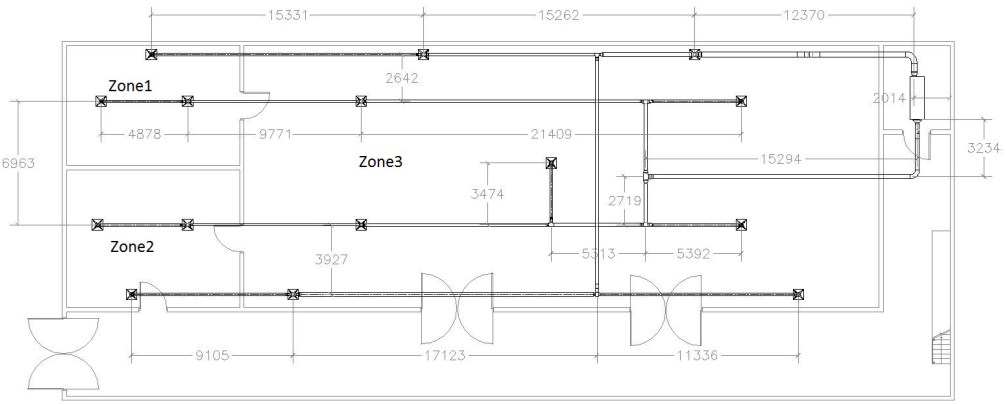

Figure 4-22 *The plan for mechanical system*

The following steps are required to complete this tutorial:

a. Calculate the zone wise airflow.
b. Install the Air Terminals on the basis of airflow required in a zone.
c. Add the duct line to the Air Terminals
d. Install the AHU on the basis of requirement.
e. Calculate the size of duct on the basis of requirements.
f. Install the duct lines and duct fittings in the system.

Now, you need to open the project file created in Tutorial 2 of Chapter 3.

Opening the Drawing File

1. Choose **Open > Drawing** from the **Application** menu; the **Select File** dialog box is displayed.

2. Select the file created in Tutorial 2 of Chapter 3 and choose the **Open** button, the file is opened.

Calculating Zone-wise Airflow

Before calculating the airflow, you need to divide the HVAC covered area into zones, refer to Figure 4-23.

1. Find out the volume of each zone on the basis of area and height of the zones.

2. On the basis of the volume of zones, the total air flow required can be given as:

Air Flow for Zone1 = 144 m3/h = 40 l/s

Air Flow for Zone2 = 180 m3/h = 50 l/s

Air Flow for Zone3 = 720 m^3/h = 200 l/s

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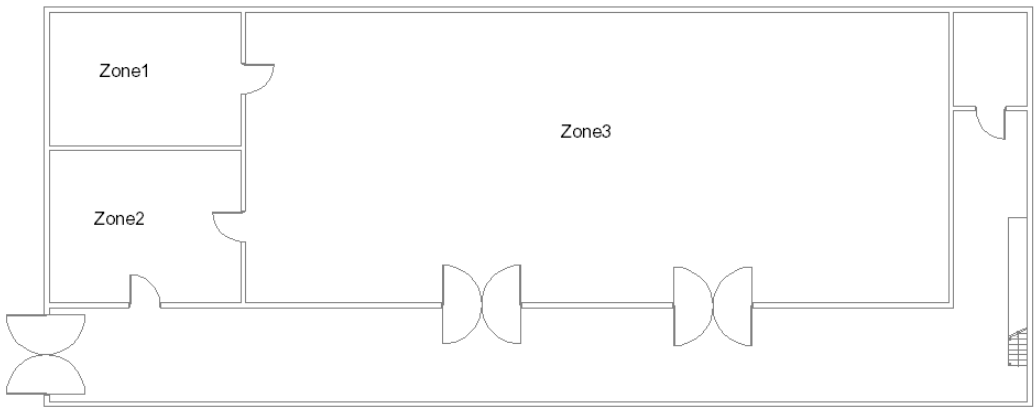

Figure 4-23 *The drawing after dividing into sections*

Installing Air Terminals

Depending on the air flow required for each zone and the area to be covered, you need to install the diffusers.

1. Choose the **Air Terminal** tool from the **Equipment** drop-down in the **Build** panel of the **Home** tab in the **Ribbon**; the **Add Multi-view Parts** dialog box is displayed with the options related to diffusers.

2. Select **600 x 600 mm Square Faced Ceiling Diffuser** from the part list displayed in the **Part** tab of the dialog box; the parts for the selected category are displayed in the **Part Size Name** drop-down list.

3. Select the part with 150mm neck from the drop-down list, set the value of elevation as **4500**, and install the diffusers according to the air flow requirements in the zones, refer to Figure 4-24.

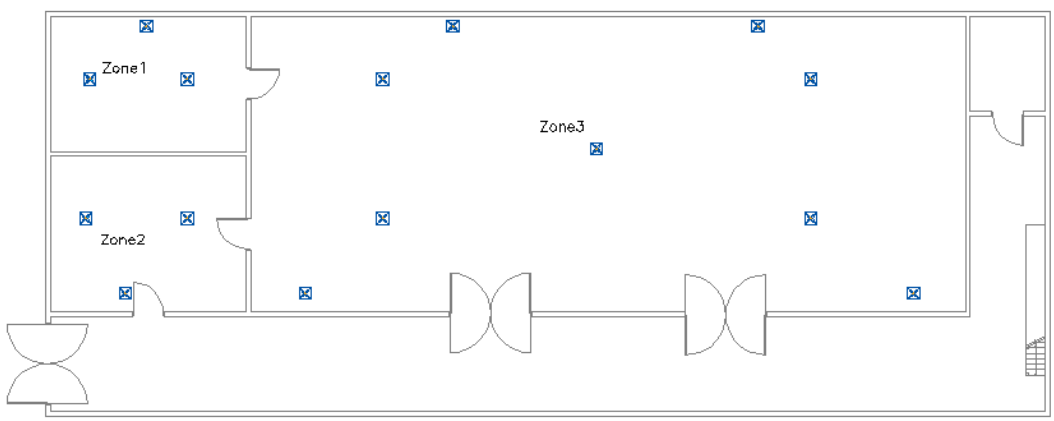

Figure 4-24 *The drawing after adding diffusers*

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4. Select the diffuser in the center of Zone1 and Zone2. Change the Flow rate as 20 l/s in the **Extended Data** tab of the **Properties** palette.

5. Select the five diffusers in the center of Zone3 and change the Flow rate as 40 l/s in the **Extended Data** tab of the **Properties** palette.

6. Select the two diffusers adjacent to the wall of Zone1 and Zone2. Change the Flow rate as 40 l/s in the **Extended Data** tab of the **Properties** palette.

7. Select the four diffusers adjacent to the wall of Zone3 and change the Flow rate as 50 l/s in the **Extended Data** tab of the **Properties** palette.

Adding the Duct Line to the Diffusers

Now, you need to route the duct line by using the **1-Line** tool.

1. To create routing of the duct line, choose the **1-Line** tool from the **By Shape** area of the **Duct** tab in the Tool Palette; you will be prompted to specify the starting point of the duct line.

2. Select the **Fresh Air - Make-up (FA MAKE-UP)** option from the **System** drop-down list in the **BASIC > General** rollout of the **Design** tab in the **Properties** palette and create the fresh air duct line, as shown in Figure 4-25.

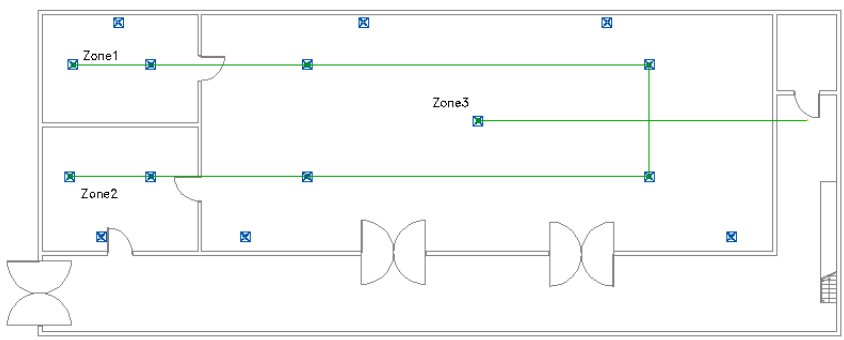

Figure 4-25 *The drawing after creating fresh air duct line*

3. Again, choose the **1-Line** tool and select the **Return (RA)** option from the **System** drop-down list in the **General** rollout of the **BASIC** rollout of the **Design** tab in the **Properties** palette.

4. Create the return duct line, as shown in Figure 4-26.

Adding an Air Handler

Now, you need to add an Air Handler in the drawing to complete the duct line.

1. Choose the **Air Handler** tool from the **Equipment** drop-down in **Build** panel of the **Home** tab in the **Ribbon**; the **Add Multi-view Parts** dialog box is displayed, as shown in Figure 4-27.

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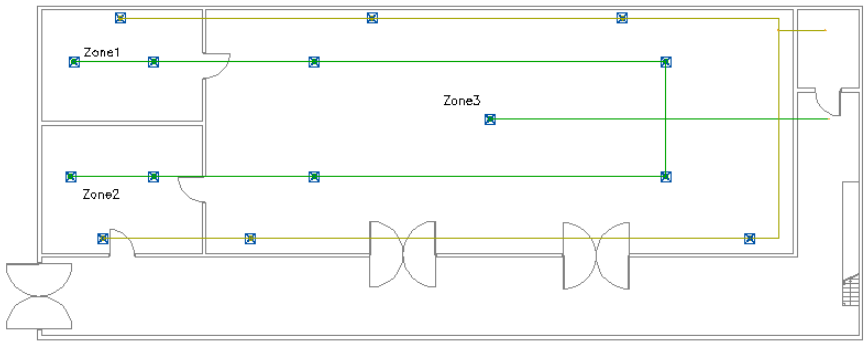

Figure 4-26 *The drawing after creating the return duct line*

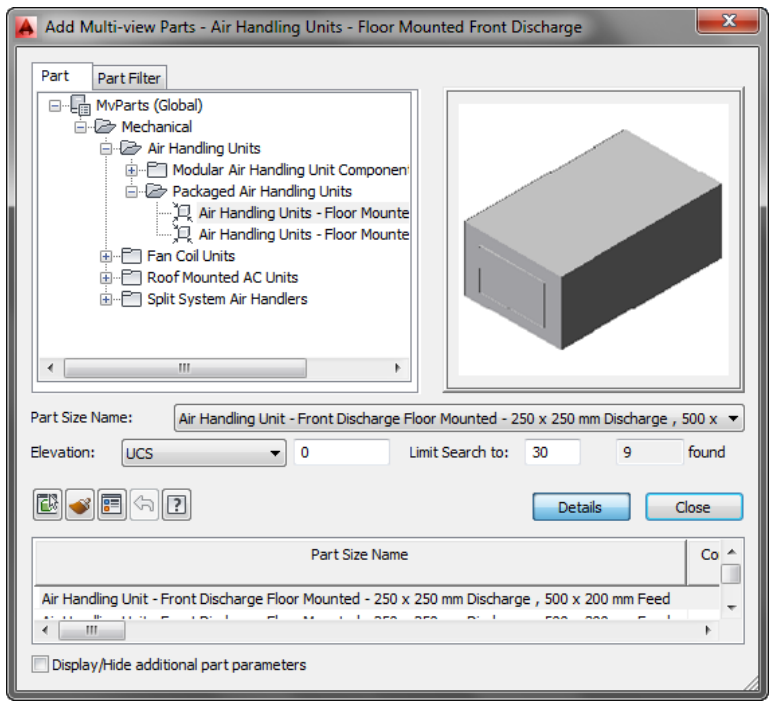

Figure 4-27 *The* ***Add Multi-view Parts*** *dialog box*

2. Select the **Air Handling Units - Floor Mounted Front Discharge** equipment from the Parts list in the **Part** tab of this dialog box. Preview of the equipment is displayed on the right of the Part list.

3. Specify the elevation value as **4500** in the **Elevation** edit box.

4. Click in the drawing area to specify the location of equipment; you are prompted to specify the rotation angle for equipment.

5. Enter the angle value as **0**; the equipment is placed at the specified location, refer to Figure 4-28.

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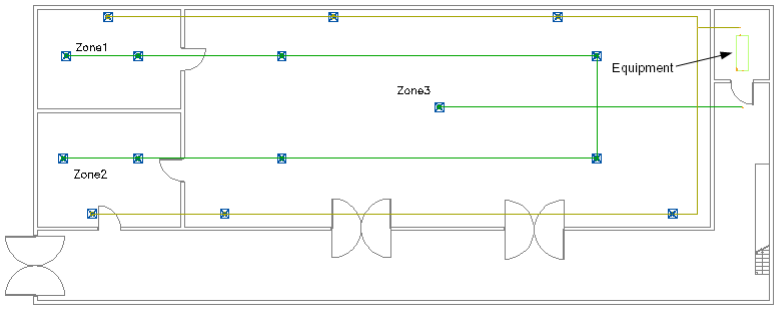

Figure 4-28 *The drawing after adding equipment*

Now, you need to add duct line to the equipment.

6. Select the equipment; the **+** sign will be displayed on various ports of the equipment.

7. Click on the **+** signs one by one and connect the equipment, as shown in Figure 4-29.

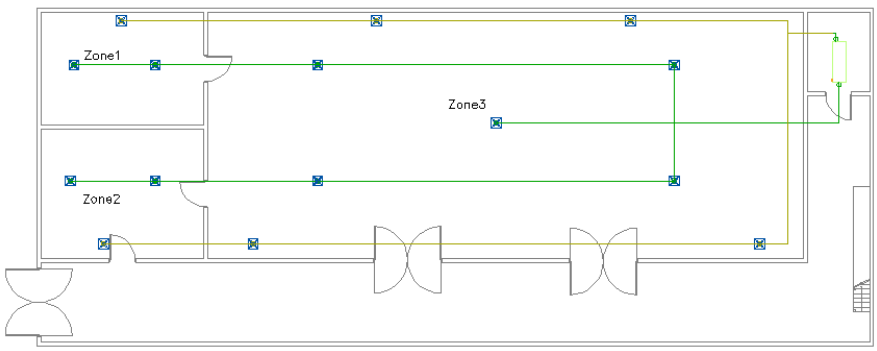

Figure 4-29 *The drawing after connecting the equipment with the duct line*

Calculating Duct Size and Installation

Now, you need to calculate the duct size of each segment.

1. Select the duct lines, as shown in Figure 4-30 and choose the **Calculate Duct Sizes** button from the **Calculations** panel of the **Duct** contextual tab in the **Ribbon**; the **Duct System Size Calculator** dialog box is displayed, refer to Figure 4-31.

2. Change all the settings in the dialog box according to Figure 4-31.

3. Choose the **Start** button from the **4** area of the dialog box; the **Multiple Parts Found** dialog box is displayed, refer to Figure 4-32.

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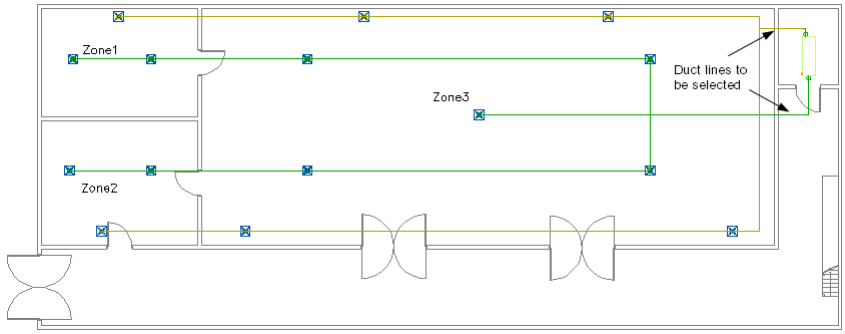

Figure 4-30 *The duct lines to be selected for calculating duct size*

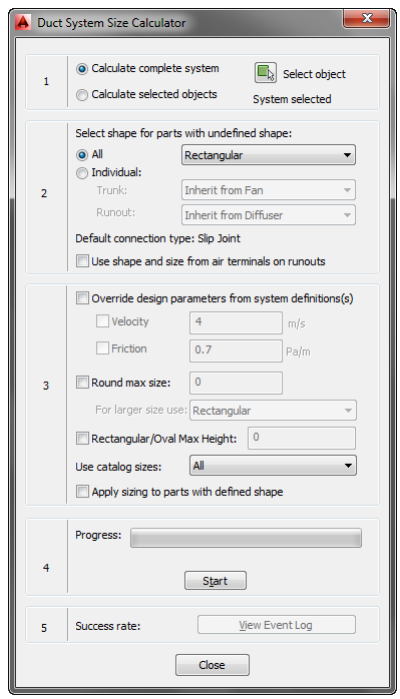

Figure 4-31 *The* ***Duct System Size Calculator*** *dialog box*

4. Select the desired part from the **Select a detailed part** area of the dialog box and choose the **OK** button; the selected part is added at the prompted position.

5. Similarly, add all the parts at the prompted locations one after the other.

6. After adding all the parts, the **Duct System Size Calculator** dialog box is displayed, as shown in Figure 4-33.

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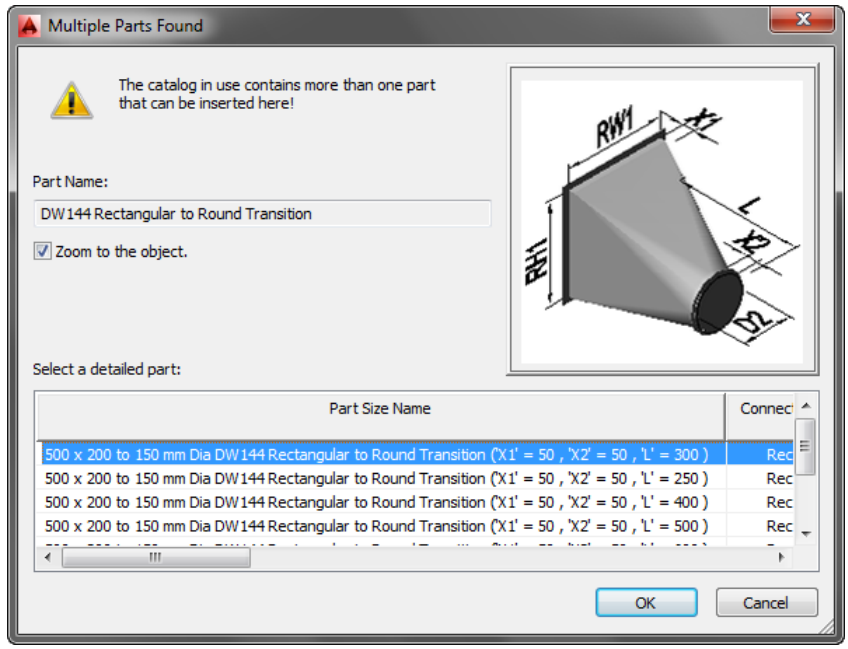

Figure 4-32 *The* ***Multiple Parts Found*** *dialog box*

7. If the success rate is displayed as 100%, choose the **Close** button and exit the dialog box.

8. If success rate is not displayed as 100%, choose the **View Event Log** button from the **5** area of the dialog box; the **Event Log** dialog box is displayed, refer to Figure 4-34.

9. Select the object in the **Object** column that shows an error in the **Error** column, refer to Figure 4-34, and then choose the **Highlight and Zoom the selected object** button  from the dialog box; the selected object is highlighted in the drawing area, refer to Figure 4-35.

10. Rectify the errors according to the description given in the **Description** column of the **Event Log** dialog box and then choose the **Start** button again after all the errors are rectified.

11. The drawing after calculating the duct size is displayed, as shown in Figure 4-36.

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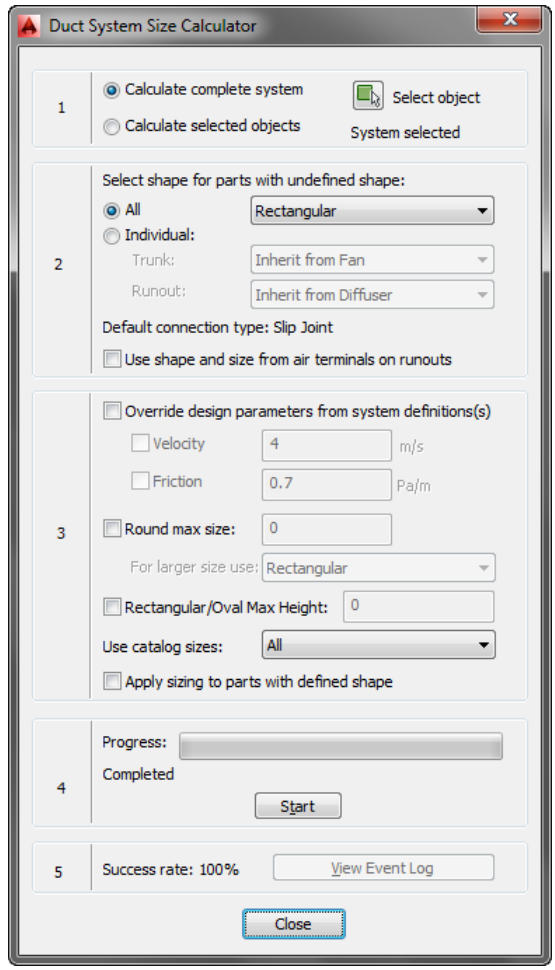

Figure 4-33 *The* ***Duct System Size Calculator*** *dialog box after completing calculations*

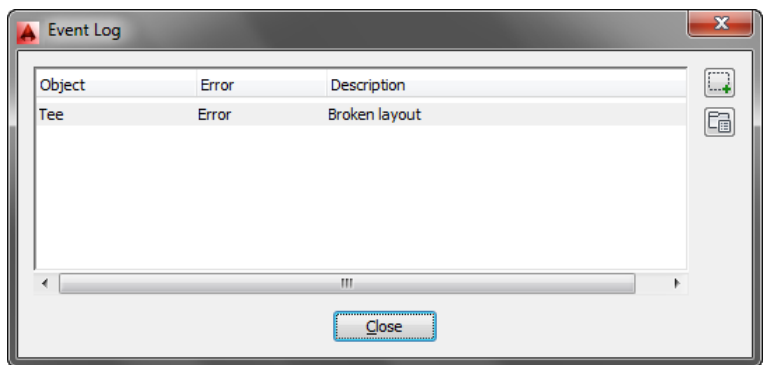

Figure 4-34 *The* ***Event Log*** *dialog box*

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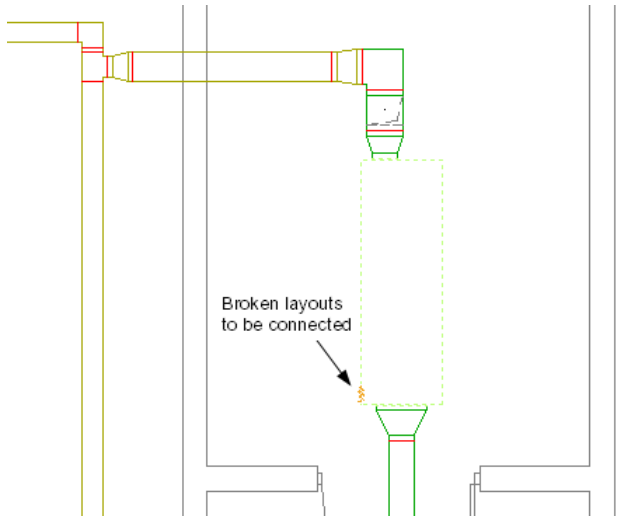

Figure 4-35 *The object causing error highlighted in the drawing area*

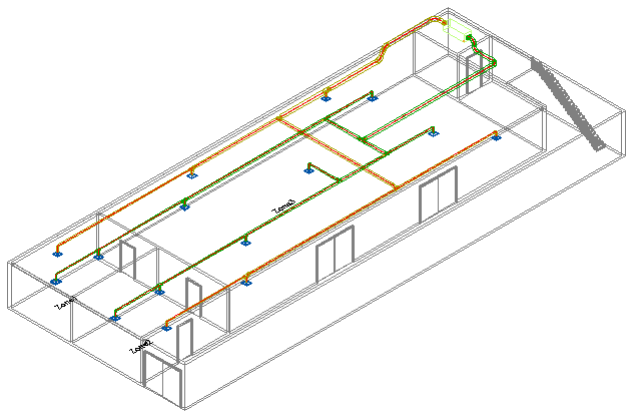

Figure 4-36 *The drawing after calculating duct size*

Saving the drawing file

1. Choose **Save** from the **Application** menu to save the drawing file.

Self-Evaluation Test

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

1. The **Air Handler** option is available in the **Equipment** drop-down of the **Build** panel. (T/F)

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2. The AHU Inspection module is used to check the quantity of air to be spread in the desired area. (T/F)

3. An AHU Mixing Box has three ports, one for inlet of _____, one for inlet of fresh air, and one for _____ of mixed air.

4. You can specify the flow rate of an air terminal by using the_____ edit box.

5. In which of the following drop-down is the **Fan** tool available?

(a) **Equipment** (b) **Duct Fitting**
(c) **Duct** (d) **Pipe**

Review Questions

Answer the following questions:

1. The AHU Mixing Box is an equipment used to vary the speed of air flowing through the duct. (T/F)

2. Using the **Elevation** edit box, you can specify the value of elevation of the object from ground. (T/F)

3. There are three options available in AutoCAD MEP for specifying bends of a duct; _____, _____, and _____.

4. For branch fitting, you can use two options, _____ and _____.

5. Which of the following buttons is used to calculate the duct size of a duct system?

(a) **Calculate Duct Sizes** (b) **Duct**
(c) **Flexible Duct** (d) **Detail Components**

EXERCISE

Exercise 1

In this exercise, you will add an HVAC system in an office. The office after adding the HVAC system is shown in Figure 4-37. The plan for the HVAC system is given in Figure 4-38. You can download the architecture model of the office from *www.cadcim.com*.

(Expected time: 30 min)

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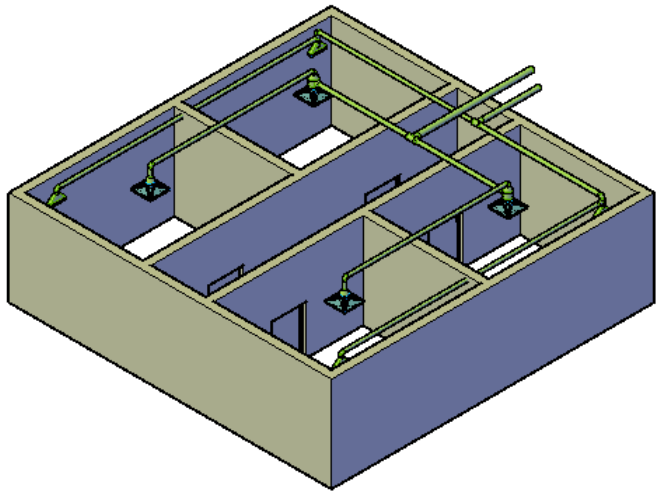

Figure 4-37 *The HVAC system in the office*

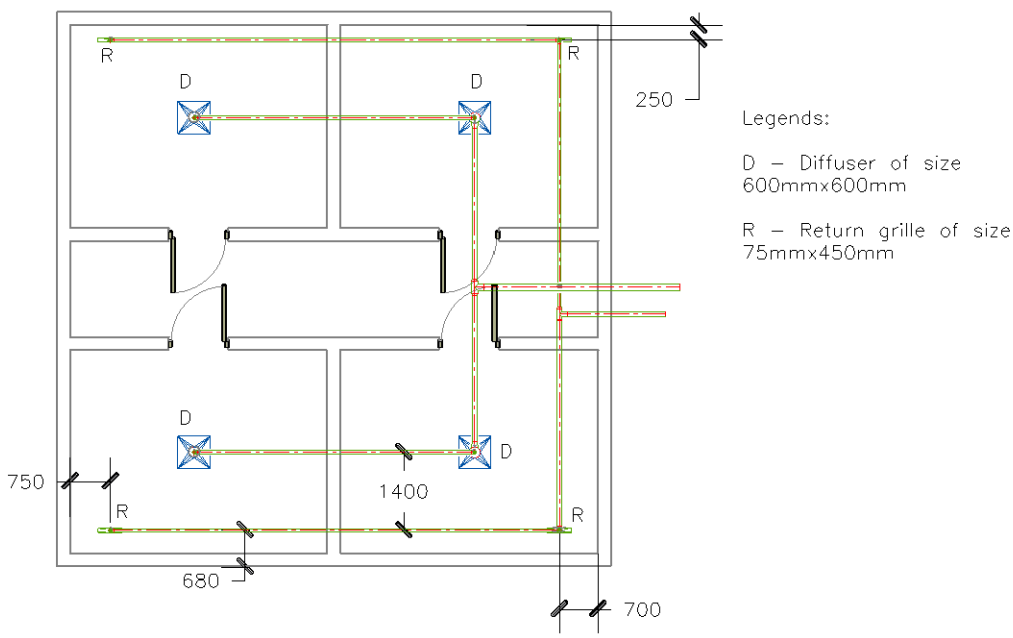

Figure 4-38 *The plan for the HVAC system*

Answers to Self-Evaluation Test

1. T, **2.** F, **3.** returning air, outlet, **4. Flow (Each Terminal)**, **5. Equipment**