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AUTODESK REVIT MEP ADVANCED – PLUMBING & SANITARY (P&S)

STUDENT GUIDE
V 2014

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Welcome to Crown Systems!

Since 1996, Crown Systems has been a leading provider of fully integrated, next generation, management solutions that are widely deployed in many organisations. In 1997, we became the Regional Primavera Authorized Representative (PAR) with operations in Singapore (HQ), Brunei, Indonesia, Malaysia, Philippines and Vietnam.

Headquartered in Singapore, we have established strong international linkages with key markets through a network of overseas offices, strategic alliances and representative offices in Brunei, Indonesia, Philippines and Vietnam. Our services include project consultancy, systems integration and software training.

You can count on Crown Systems for the most reliable and comprehensive range of software that address the diverse business needs of different industries. We also ensure highly responsive and consistent service to meet clients changing needs.

Besides being an Autodesk Authorized Platinum Partner and Authorized Training Centre, Crown Systems also deals with Oracle Project & Portfolio Management, Contract & Change Management, Project Risk Management, BIM Solution and Balanced Scorecard.

In the recent year, we are working with Developers, Architects, Engineering Firms and A1 Contractors on large scale construction for BIM consulting and implementation.

We have garnered a strong portfolio of both private sector and public sector clients in the major industries. These range from engineering, construction, power, energy and process, marine and shipping, electronics manufacturing, financial, pharmaceutical to the information technology sector.

According to a recent survey, with our increasing market share in the project management field, Crown Systems is a solutions leader in these major industries and will continue to do so as more customers continue to demand for management solutions to boost their competitive edge.

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Preface

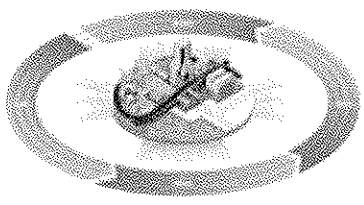
BIM:
BUILDING INFORMATION MODELLING

Building Information Modelling (BIM) is an approach to the entire building life cycle. Autodesk® Revit® Architecture, Autodesk® Revit® MEP, and Autodesk® Revit® Structure are powerful BIM programs that support the ability to coordinate, update, and share design data with team members throughout the design construction and management phases of a building's life. A key component in managing the BIM process is to establish a company foundation for different types of projects by creating standard templates and custom elements. Having this in place makes the process of any new project flow smoothly and efficiently.

The objective of this training guide is to enable students who have worked with the software to expand their knowledge in setting up office standards with templates that include annotation styles, pre-set views, sheets, and schedules, as well as creating custom element types and families.

BIM for MEP Engineers

- Visualize, simulate and analyse MEP designs before they are built, more clearly
  Communicating your design intentions and using real-world engineering information
- Analyse energy usage to support sustainable building design objectives and industry requirements.
- Reduce design conflicts with real-time clash and interference detection.



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CHAPTER 1

Creating MEP Project file

In this chapter you learn how to create MEP project using specified template, Linking Architecture / Structure Model, perform monitoring of link file and getting the project coordinates established by the architect

This chapter discuss:

- Creating a New (MEP) Project
- Linking Revit File
- Copy / Monitoring of a Link File
- Acquiring coordinates
- Creating working view
- Importing CAD

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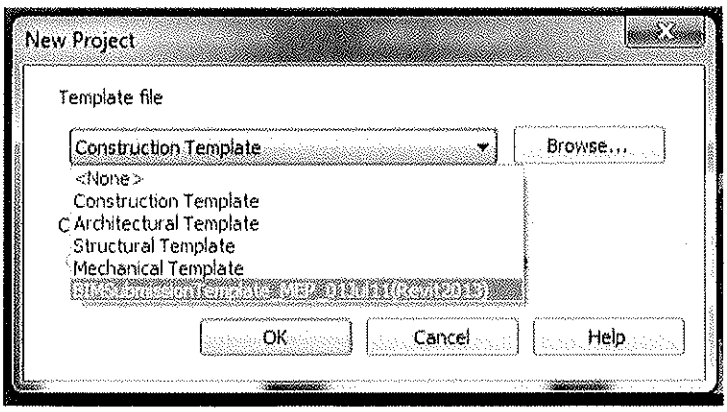
1.1 Creating New Project (MEP)

MEP projects are typically created using linked architectural models. Plenums and chases should be included when analyzing heating and cooling loads for a project. Consequently, it's often necessary to add levels to the architectural model so that you can recognize the entire volume of an MEP project.

To create a project using a template

1. Click ▸ New ▸ (Project).
2. In the New Project dialog, under Template file, do one of the following:
   - Select a template from the list.
     BIMSubmissionTemplate_MEP_01Jul11 (Revit2013)
   - Click Browse, navigate to the desired template (an RTE file), and click Open.



1.2 Linking Architectural / Structural Model

You link a project file using the Import/Link RVT dialog box. While linking, use shared coordinates, origin-to-origin, or center-to-center positioning to specify the location of the linked model in the host project.

When you link an Autodesk® Revit® Architecture or Revit Structure project file, its path is saved in the host Revit MEP project file. After linking, if the linked project file changes, you can reload it in the host project file to view the updated linked project file. If the path of the linked project file changes, you can update its path in the host project file using the Manage Links dialog box. You can access the Manage Links dialog box by selecting Manage Links on the Manage Project panel of the Manage tab or on the Link panel of the Insert tab.

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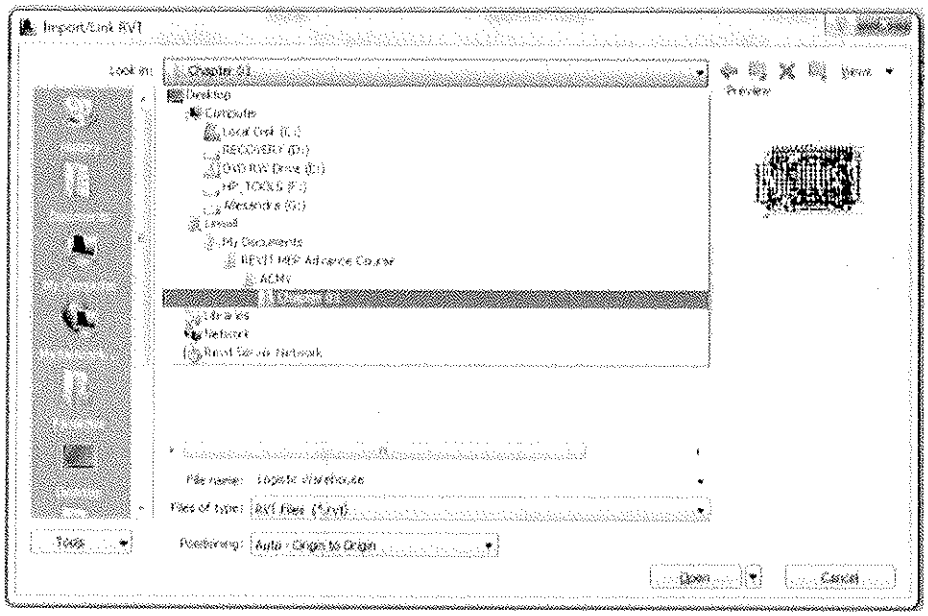
To link Architecture / Structure model

1. Continue working on the New project file and switch to floor plan view in project browser **FSSD-FP_1ST STOREY**
2. Click Insert tab ➢ Link panel ➢ (Link Revit).
3. In the Import/Link RVT dialog, navigate the select the model to link.

   Logistic Warehouse.rte



4. For Positioning select Auto - Origin to Origin
5. Click Open.
6. On the Quick Access toolbar, click (Save) to save the project
7. Continue working on the new project file and switch the view to **FSSD-_FE_SOUTH ELEVATION** in project browser, zoom in to display both the linked Revit and the datum level of the project
8. Click to select the linked Revit file and key in **PN** (PIN) to pin the model to prevent the linked file to move from the current position.
9. Click on the empty space of model view to deselect the linked model and change the View Scale to 1:200 in the properties under Graphics category or in the view control bar

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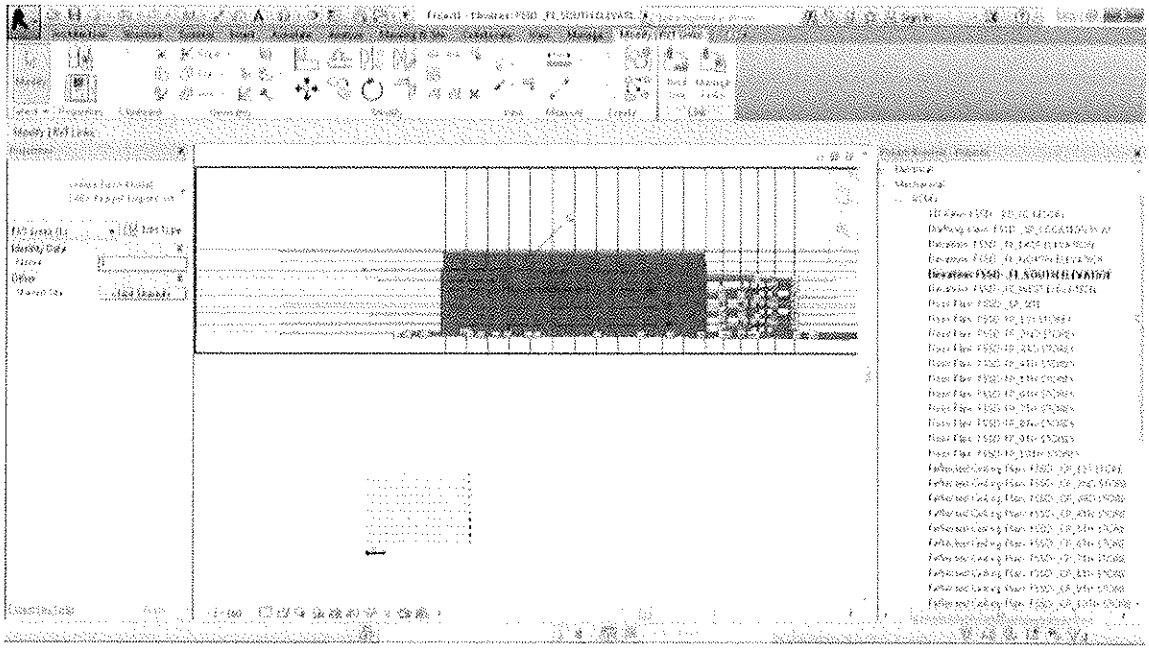
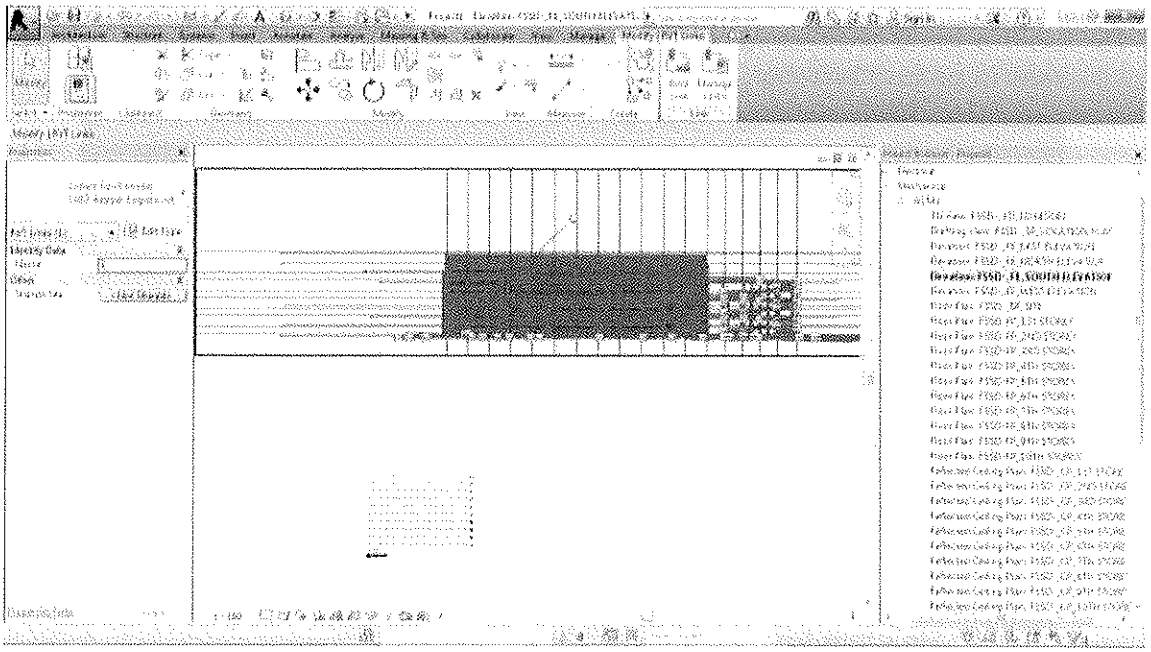


10. Click on the empty space of model view to deselect the linked model and change the View Scale to 1:200 in the properties under Graphics category or in the view control bar



11. Click on the empty space of model view to deselect the linked model and change the View Scale to 1:200 in the properties under Graphics category or in the view control bar

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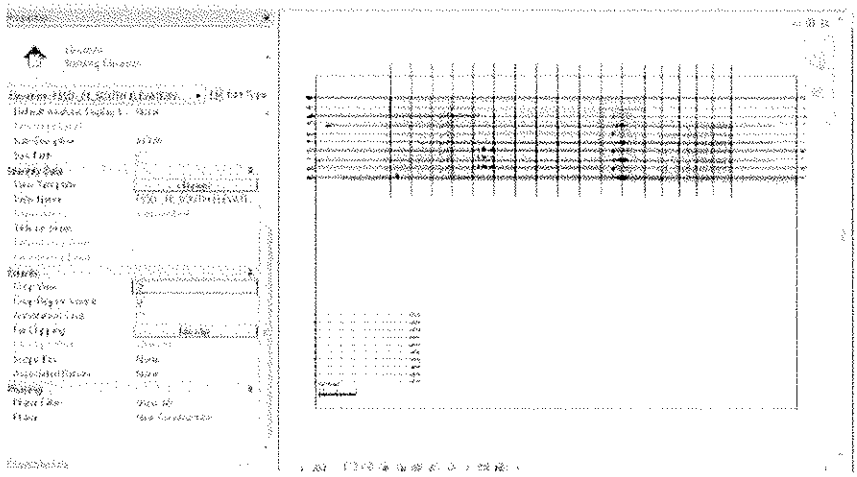
12. Enable the Crop Region Visible on the properties dialog box and adjust crop window to extents only the linked model and project datum level



13. Click Modify tab ➢ Modify panel ➢ (Align) to align Datum **Level 1** of the project to the **1st STOREY LEVEL** of the Architecture link file, rename Level 1 to 1st STOREY LEVEL and on the project browser rename the view to

14. Continue with Align tool select the **2nd STOREY LEVEL** of the Architecture link and click to select the Datum **Level 2** of the project and rename it 2nd STOREY LEVEL

15. Do the same procedure on the ff. Datum Level and consider renaming also the view in project browser. Refer on the table below.

Project Datum Level	Align to: Archi Storey Level	Level New Name	Browser View Name
Level 1	1ST STOREY LEVEL	1ST STOREY LEVEL	FSSD-FP_1ST STOREY
Level 2	2ND STOREY LEVEL	2ND STOREY LEVEL	FSSD-FP_2ND STOREY
Level 3	3RD STOREY LEVEL	3RD STOREY LEVEL	FSSD-FP_3RD STOREY
Level 4	4TH STOREY LEVEL	4TH STOREY LEVEL	FSSD-FP_4TH STOREY
Level 5	1ST DRIVEWAY LEVEL	1ST DRIVEWAY LEVEL	FSSD-FP_1ST DRIVEWAY
Level 6	1ST STOREY MEZZ.2	1ST STOREY MEZZ.2	FSSD-FP_1ST STOREY MEZZ.2
Level 7	1ST STOREY MEZZ.1	1ST STOREY MEZZ.1	FSSD-FP_STOREY MEZZ.1
Level 8	2ND DRIVEWAY LEVEL	2ND DRIVEWAY LEVEL	FSSD-FP_2ND DRIVEWAY
Level 9	2ND STOREY MEZZ.2	2ND STOREY MEZZ.2	FSSD-FP_2ND STOREY MEZZ.2
Level 10	2ND STOREY MEZZ.1	2ND STOREY MEZZ.1	FSSD-FP_2ND STOREY MEZZ.1

16. On the ribbon, click (Level). To create additional datum Level from Link Architecture Level
    - Architecture tab ➢ Datum panel ➢ (Level)
    - Structure tab ➢ Datum panel ➢ (Level)

Pick Lines is selected as Draw option, offset is equals to zero and Make Plan view is enable with the ff. Plan view type is set

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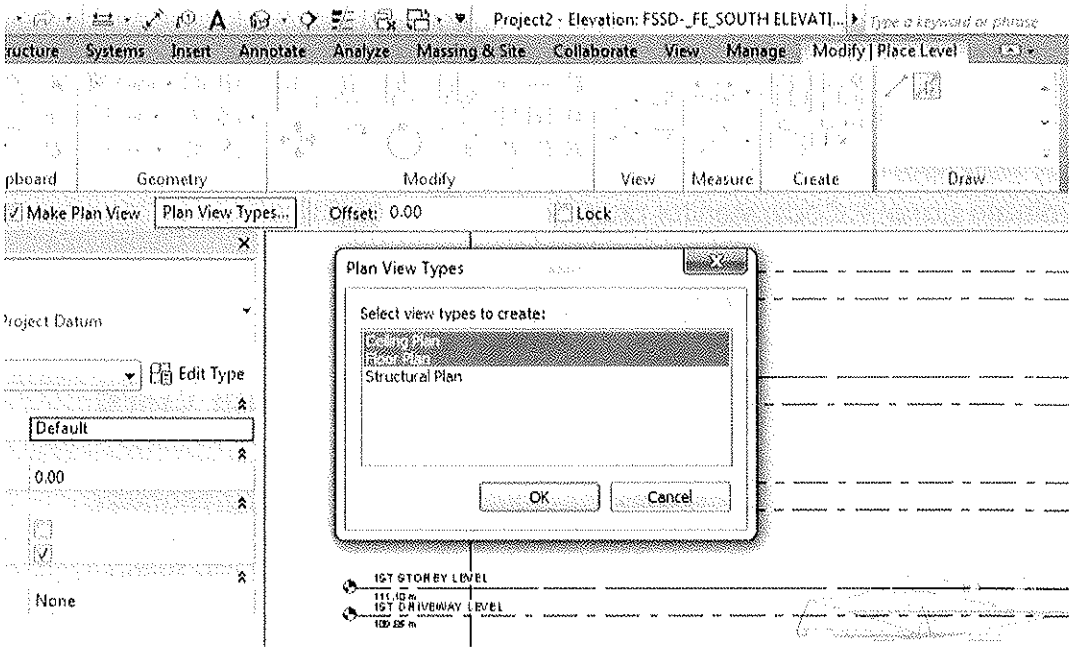

17. On the model view pick the Architectural Level to create additional Level for project and rename the new Level same on the label of link Architecture level
18. Open the new plan view on the project browser, rename the view name base on the naming convention for FSSD Floor plan and change the sub discipline to ACMV on properties dialog box
19. Repeat the process to all new floor plan view & ceiling view
20. Save the project.

1.3 Monitoring changes in Linked File

In most building projects, you need to collaborate on the building design. For example, a mechanical engineer uses an architect's preliminary building model to devise the initial mechanical design layout of the building. Therefore, proper coordination and monitoring helps ensure that the mechanical model is synchronized with the changes that the architect made to the building model. Effective change monitoring reduces errors and expensive rework during construction.

Copy and Monitor

You use the Copy and Monitor tools on the Copy/Monitor tab to coordinate and monitor the changes in the building and structural models. To access this tab, activate the Copy/Monitor mode using the Select Link option from the Copy/Monitor drop-down on the Coordinate panel of the Collaborate tab.

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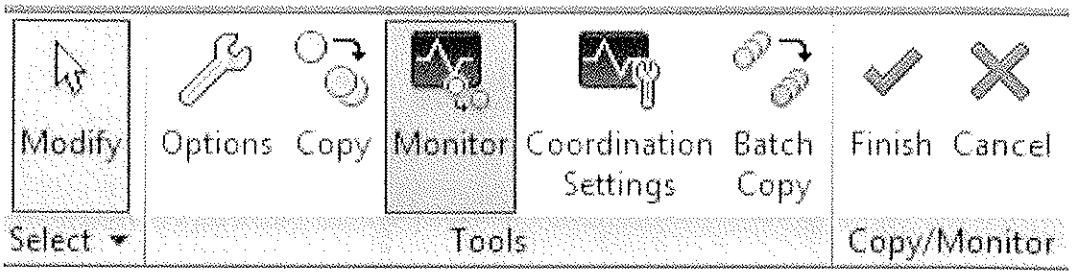
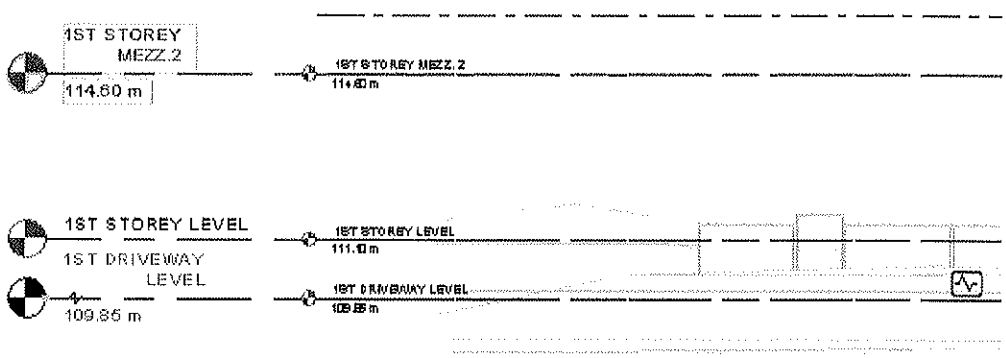
To MONITOR the Level of the Link Architecture model

Continue working on the project file or open the project file from the training folder Chapter 1> **C01-Monitor_Logistic Warehouse.rvt**

1. On the elevation view, zoom on the left side the model. Click Collaborate tab ➤ Coordinate panel ➤ Copy/Monitor drop-down ➤ (Select Link).



2. Select the Link Architecture file, on the Copy/Monitor contextual tab select Monitor option.
3. On the model view select the project datum Level 1ST STOREY DRIVEWAY and select the level 1st STOREY DRIVEWAY of the Link Architecture, the monitor icon displays next to it to indicate that it has a relationship with the original element in the linked model.



4. Select the project datum Level 1st STOREY LEVEL and select the level 1st STOREY LEVEL of the Link Architecture, the monitor icon displays next to it to indicate that it has a relationship with the original element in the linked model.

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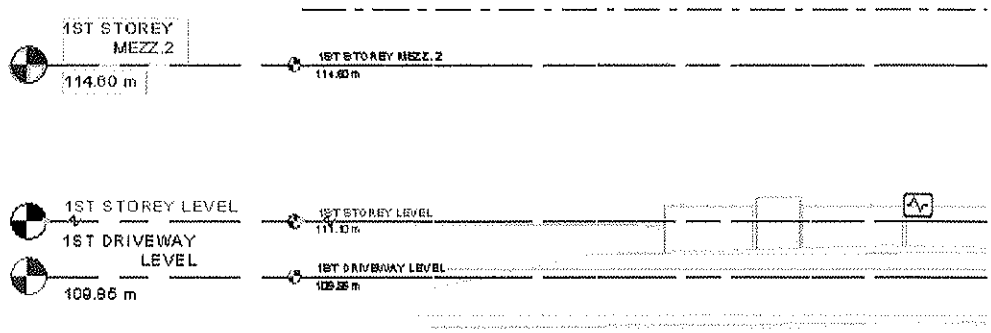


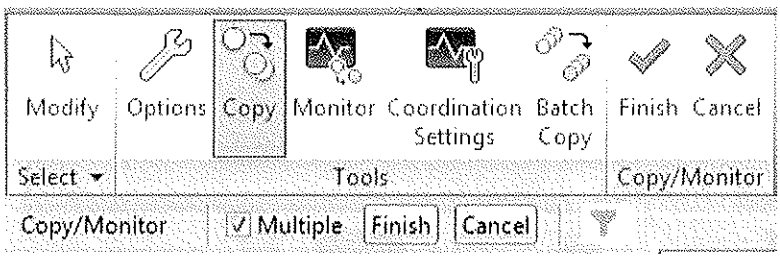
5. Repeat the process on the remaining levels
6. Click Modify to finish the monitoring tool or press ESC twice

To COPY the Grids of the Link Architecture model

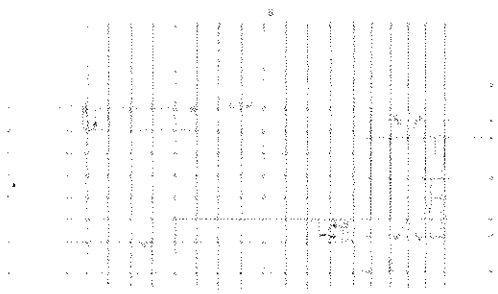
Continue working on the project file or open the project file from the training folder Chapter 1> **Copy_Monitor_Logistic Warehouse.rvt**

1. Open the FSSD-FP_1ST STOREY LEVEL on the project browser Click Collaborate tab ➢ Coordinate panel ➢ Copy/Monitor drop-down ➢ (Select Link).

2. Select the Link Architecture file, on the Copy/Monitor contextual tab select Copy option and select Multiple on the option bar



3. On the Model view select all the gridlines. Press **ctrl** on keyboard to allow multiple selection.



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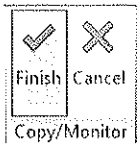
4. Click  Finish on the option bar to finish the selection.

5. Click Finish on Copy/Monitor tab to finish action. 

1.4 Monitoring changes in Linked File

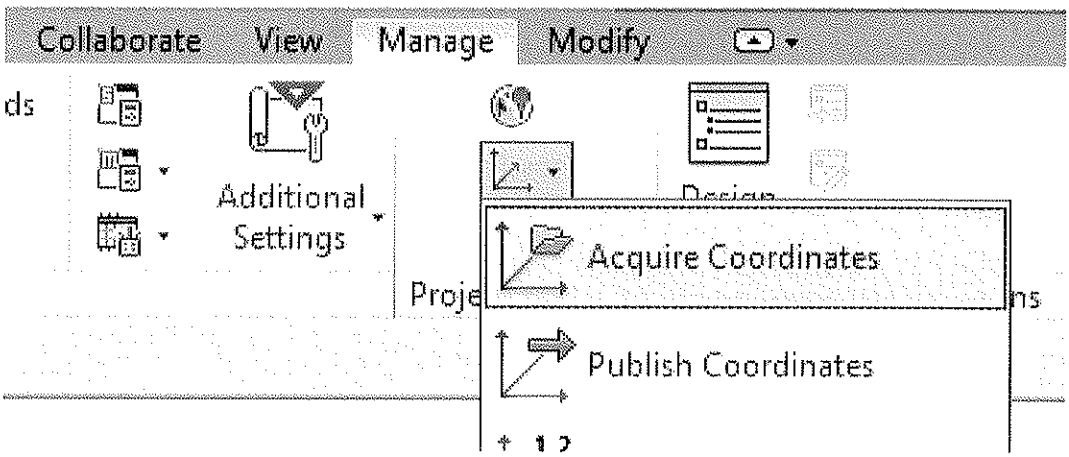
When you acquire coordinates from a linked Revit project, the shared coordinates of the linked project become the shared coordinates of the host project, based on the location of the linked project instance in the host project. There is no change to the host project's internal coordinates. The host project also acquires True North from the linked project. The origin of the linked project's shared coordinates becomes the origin of the host project's shared coordinates.

When a Revit Architecture project acquires coordinates from a linked DWG file, the World Coordinate System (WCS) of the selected linked DWG file becomes the shared coordinate system of the host Revit Architecture project, based on the location of the linked DWG instance. The Y axis of the DWG becomes True North, and the origin of the DWG becomes the origin of the shared coordinate system of the Revit Architecture project.

To acquire coordinates:

Continue working on the project file

1. Click Manage tab ➢ Project Location panel ➢ Coordinates drop-down ➢ Acquire Coordinates.



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2. Place the cursor on a linked model instance, and click.
The host model file now has the same shared coordinates as the linked model file. If other loaded linked models share coordinates with the host model, they also acquire the new coordinates.

1.5 Visibility and Graphic Overrides in Linked Models

Linked models, like other elements, can modified by hiding individual elements And categories of elements, and overriding the display settings.

When a model is linked to a host project, any changes you make in the Visibility/Graphics Overrides dialog box (VG) are also made in the linked model by default. For example if you turn off the visibility of the Grids in the host project, it turns off the visibility of Grids both in linked model and project model.

To modify display Settings in a Linked View

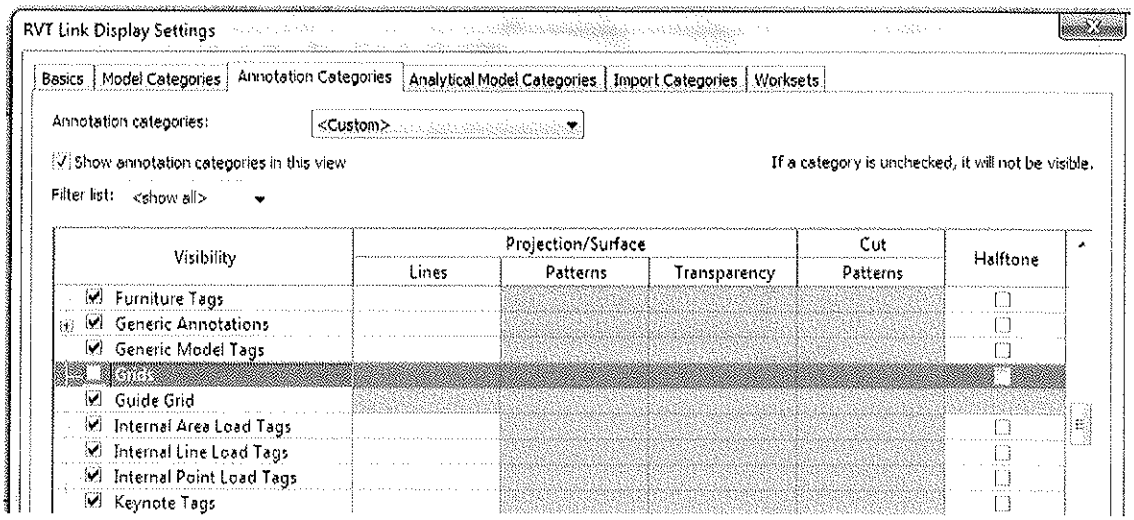
Continue working on the project file or open the project file from the training folder Chapter 1> **C01Visibility Settings_Logistic Warehouse.rvt**

1. Click View tab ➤ Graphics panel ➤ (Visibility/Graphics). Alternatively Type **VV** or **VG** to open Visibility/Graphics Overrides dialog box

2. Switch to Revit Link tab, select by **Host View** under Display Settings column

3. In RVT Link Display Settings under basic tab select **Custom** option. Click Annotation Categories and change **<By host view>** to **<Custom>**

4. Clear the visibility of Grids and click OK twice.



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1.6 Creating Working Views

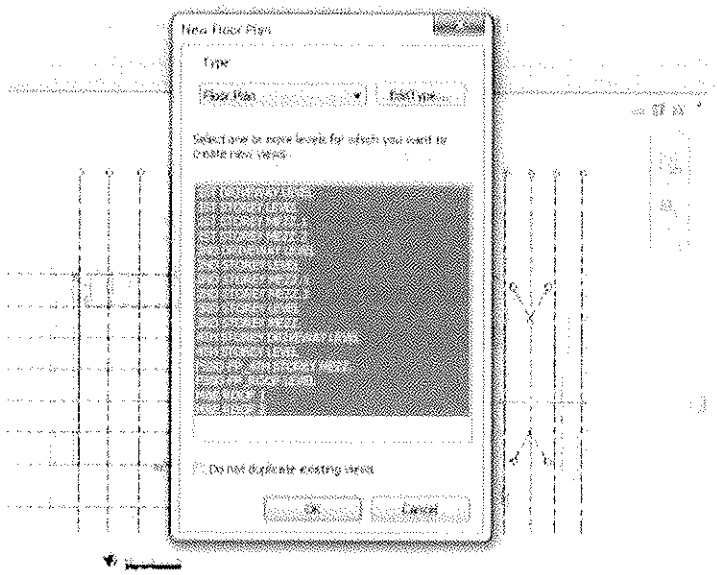
BCA template provide a set of views associated with datum level organize by approving agency. These views are refer as submission view where all the requirements stipulated by the agency should reflect on this views. However when developing the MEP service there is a lot of process and setting need to apply to the views and eventually change the arrangement of the views in browser.

Creating another Instance of floor plan views /ceiling view in developing the ACMV is not mandatory but it is recommended as good practice to ensure the neatness and organize browser of the project.

To create Floor plan/ RCP view

1. Click View tab ➤ Create panel ➤ Plan Views drop-down, and then click
   - (Floor Plan)
   - (Reflected Ceiling Plan)

2. In the New Floor Plan dialog:
   - To create a plan view for a level that has an existing plan view, clear Do not duplicate existing views.
   - Select one or more levels for which you want to create a plan view.



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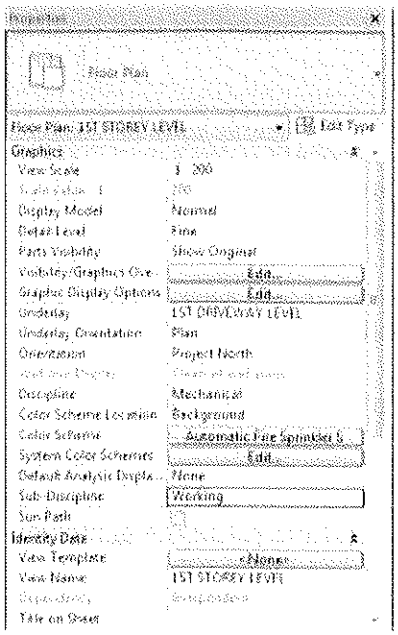
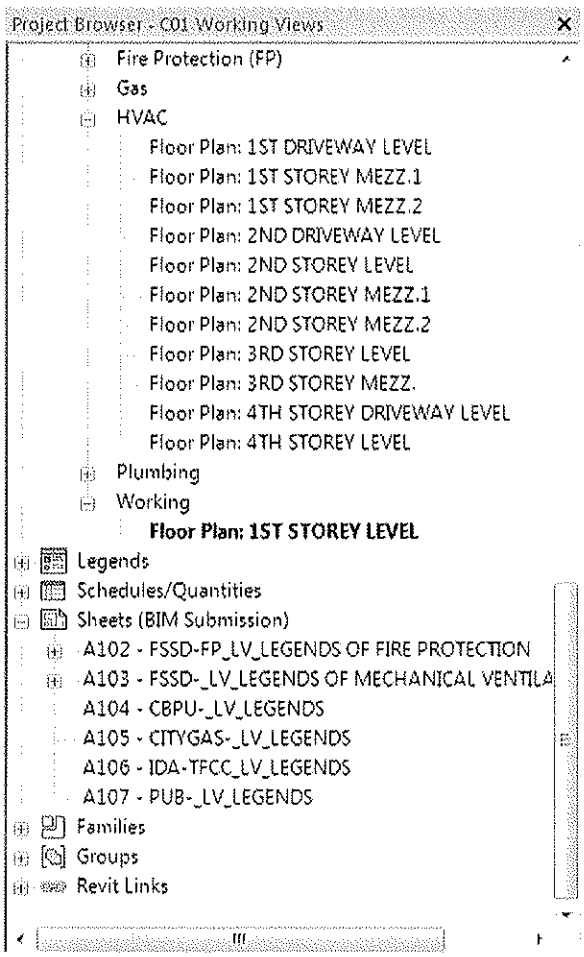
3. In the Project browser open the view **1ST STOREY LEVEL** under HVAC, this is the location of all new created Floor Plan is placed

4. In the Properties Dialog box apply a view template **Linked View FP** and click apply



- Remove the View Template applied by selecting <None> from the list.

- Change the Sub-Discipline **HVAC** to **Working** by Key-in the word Working and click apply. Notice in the project browser the view is move and create a new sub –discipline. Do the same process on the other view under HVAC.



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1.7 Importing and Linking Vector Files

Revit enables you to import or link vector data from other CAD programs, such as AutoCAD (DWG and DXF), MicroStation® (DGN), and Trimble® SketchUp® (SKP and DWG). Revit supports importing most DGN surfaces and solids with the exceptions of cones, B-Spline surfaces, and SmartSolids.

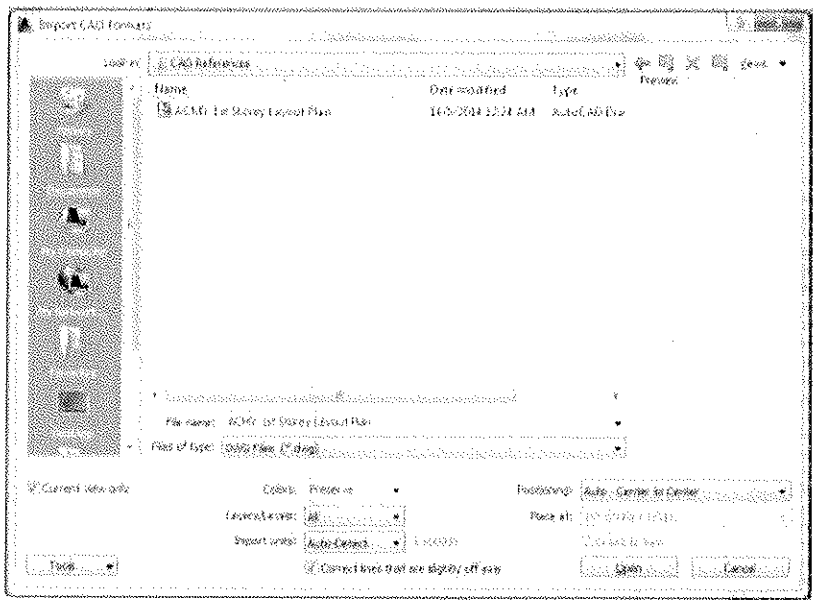
Revit does not internally use layers; however it can recognize layers and its information is retained.

To Import CAD file

Continue working on the project file or open the project file from the training folder Chapter 1> **C01 Importing CAD**

1. Click Insert tab ➤ (Import CAD), or click Insert tab ➤ Link panel ➤ (Link CAD). If you link the file instead of importing it.
2. In the Import CAD Formats or Link CAD Formats dialog, navigate to the training folder Chapter 1 > Cad references> **ACMV–1st Storey Layout Plan.dwg**
3. Set the ff. settings on Import Cad Formats dialog box

- Colors: Preserve
- Layers/Level: All
- Import units: Auto-Detect
- Positioning: Center to Center
- Place at: 1ST STOREY LEVEL
- Current view only is enable



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Process: Creating Project File

The following illustration shows the process of creating project file

STEPS	Notes & Setting
Create New Project	➢ Use BCA MEP Submission template. (rte)
Link the Architecture / Structure Model	➢ Positioning is origin to origin
Align Project Level to Link Model Level	➢ Positioning is origin to origin ➢ Pin the Link Model ➢ Use Align tool
Create Additional Level / Delete unnecessary level	➢ Select Multiple option to allow multiple selection
Perform Copy /Monitor on Levels & Grids	
Create Working View	
Import CAD (optional)	

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CHAPTER 2

Project Title block

In this chapter you learn how to edit and modify title block that will use on the project, modifying text and label, Inserting raster image and Manage project Information.

This chapter discuss:

- Editing Titleblock
- Adding Image on sheet
- Creating Text and labels

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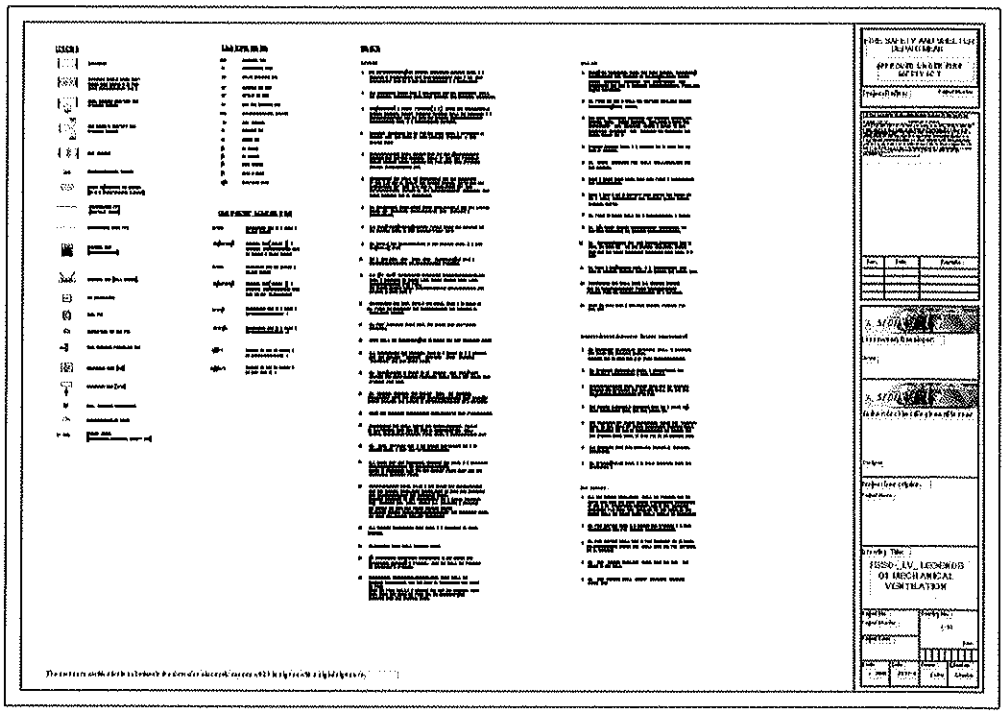
2.1 Editing Titleblock

BCA Template for Submission provide a preloaded Titleblock that you can use to generate drawing sheet of the project, you can modify or edit this title block to suite on your organization standard as well as conforming on the authorities requirements

Below graphics is the sample Titleblock loaded on BCA template for submission.



To Edit the Titleblock

Continue working on the project file or open the project file from the training folder Chapter 2> **C02 Project Title block.rvt**

1. Open a sheet view **A103 - FSSD-_LV_LEGENDS OF MECHANICAL VENTILATION** under sheet category in the project browser.
2. Select the title block from View Window and click (Edit family) from contextual tab
3. Save the family title block by clicking > (Save As) > family

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2.2 Adding Image to Sheet

You can import raster images to a project to use as background images or as visual aids needed during the creation of a model. By default, images are imported behind the model and annotation symbols; however, you can change the display order. You can import images into 2D views only.

To add image to sheet

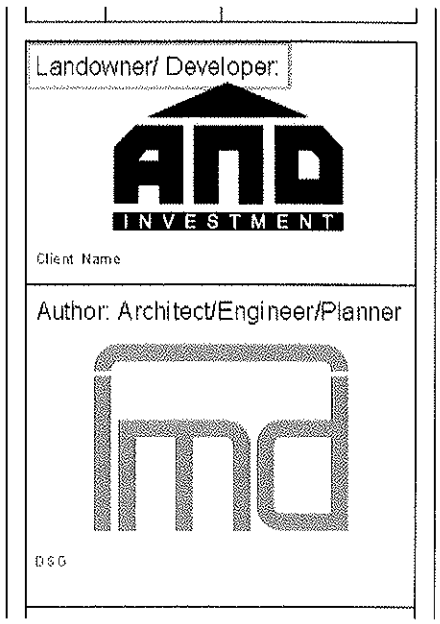
Continue working on the project file or open the project file from the training folder Chapter 2> **C02 Project Title block.rvt**

1. Zoom in to the right portion of the title block, select the two sample images and delete.
2. Click Insert tab ➤ Import panel ➤ (Image).

   Note: If the legacy details are stored using a CAD format, such as DWG, click Insert tab ➤ Import panel ➤ (Import CAD).
3. In the Import Image dialog, navigate to the location of the image file in training files Chapter 2 > **LMD logo.jpg**
4. Select the image file, and click Open.
5. Click in the drawing area to place the image on the sheet.

To reposition the image, drag it to the desired location on the sheet. To resize the image, select it and drag a blue corner dot, or enter the desired height and width on the Properties palette.

6. Import also the Image **AND logo.jpg**, if necessary adjust the location of text header to have a same result shown in graphics below



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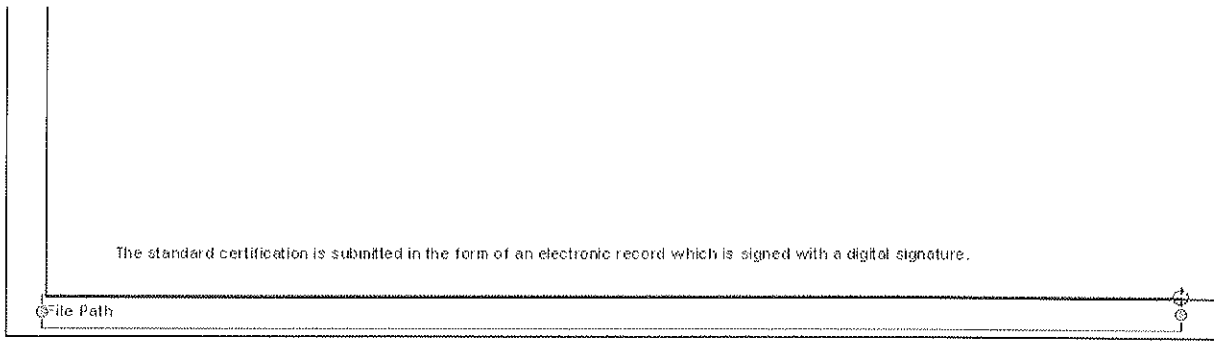
2.3 Annotation Text & Label

An annotation label is a text placeholder added to tags or title blocks. You create a label as part of a tag or title block family while in the Family Editor. When you place the tag or title block in the project, you place substitution text for the label, and the text appears as part of the family.

To place label to sheet

Continue working on the project file or open the project file and zoom in on the lower left part of the title block.

1. In the Family Editor, click Create tab ➤ Text panel ➤ (Label).
2. In the Type Selector, select the label type. **Label 4mm**
3. On the Format panel, select the vertical and horizontal justification.
4. In the drawing area, click to position the tag at lower left portion of the title block.
5. In the Edit Label dialog box select file path list of Category parameters and select add parameter(s) to label.
6. Drag the border of the label going to right.



7. Delete the text above the File path label and save the family to update.
8. Click (Load into Project) to enable to use this title block in the project.

2.4 Manage Project Information

In general, a title block contains placeholders for 2 types of information:

- **Project-specific information.** This information applies to all sheets in the project. Examples: project name, client information, project address.
- **Sheet-specific information.** This information differs for each sheet within a project. Examples: sheet name, sheet number, reviewer, sheet issue date.

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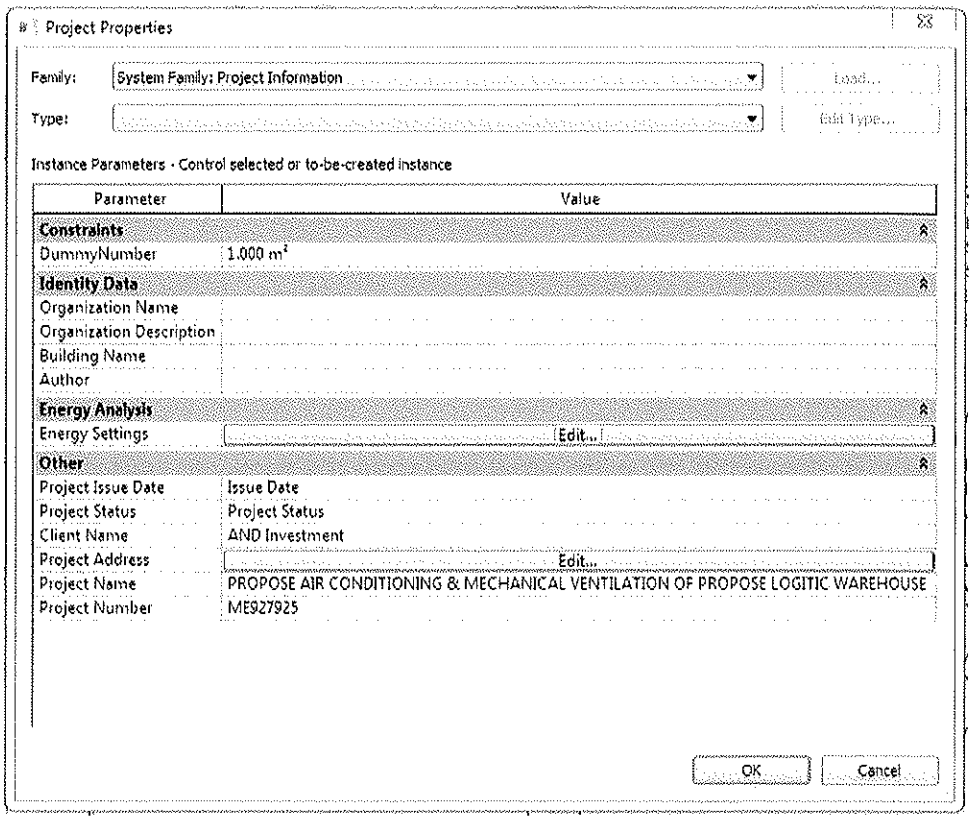
When you add a sheet to a project, the project-specific information in the title block displays the appropriate information. You can enter the sheet-specific information directly on the sheet.

Project-specific information is data that remains the same on all sheets of a project. Examples include the project issue date and status, the client name, and the project's address, name, and number.

To update the title block of a sheet with project-specific information, open the project, and use either of the following methods:

- **Enter the information directly on a sheet.** Open a sheet. Click on the placeholder text for project-specific information in the title block. Update the text as desired.
- **Change project information settings.** Click Manage tab ➤ Settings panel ➤ (Project Information). Under Other, enter values for the project information parameters. Click OK.

Under Energy Analysis click Edit, enter values for the Energy Settings parameters. Click OK.



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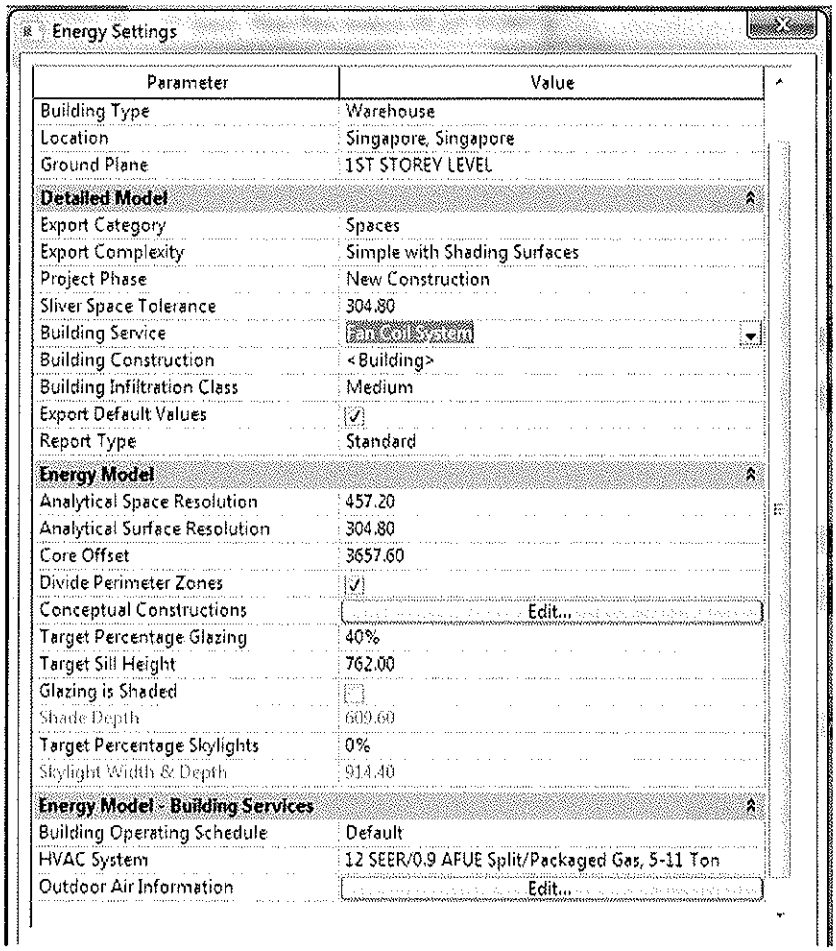
Revit updates all sheets in the project with the new information.



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CHAPTER 3

Creating Families

In this chapter you learn how to differentiate types of families the building blocks of Revit. Overview of the family editor tool, family template, Reference plane, Adding parametric controls on dimension and family connector and their properties

This chapter discuss:

- Family definition and types
- Overview of Family Editor
- Family Template
- Reference plane
- Adding Parameters
- MEP Connectors

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4.1 Family definition and types

A *family* is a group of elements with a common set of properties, called parameters, and a related graphical representation. Different elements belonging to a family may have different values for some or all of their parameters, but the set of parameters (their names and meanings) is the same. These variations within the family are called *family types* or *types*.

In Revit, there are three types of families: Loadable, System, and In-place. The following table describes these types.

FAMILY TYPE	DESCRIPTION
Loadable	These families are created in the Family Editor and can be loaded into a project file
System	These families cannot be opened in the Family Editor. However, these families have specified parameters that can be manipulated in a project. You can transfer these families between projects. Examples of System families are duct, pipe, and walls.
In-Place	These families are created in a project in the context of a custom element with unique geometry that is not intended for reuse.

4.2 Family Editor

The Family Editor is a graphical editing mode in Revit that allows you to create and modify families to include in your project. When you start creating a family, you open a template to use in the editor. The template can include multiple views, such as plans and elevations. The Family Editor has the same look and feel as the project environment in Revit, but it features different tools. The availability of tools depends on the type of family you are editing.

Opening the Family Editor

Use the Family Editor to make changes to existing families or to create new families. The method you use for opening the Family Editor depends on what you want to do.

You use the Family Editor to create and edit loadable families and in-place elements. The tabs and panels change depending on the type of family that you are editing. You do not use the Family Editor to edit system families.

To edit a family from a project

Do one of the following:

- Select an instance of the family in the drawing area, and click Modify | <Element> tab ➢ Mode panel ➢ (Edit Family).
- In the Project Browser, right-click the family and click Edit.
- Double-click an instance of the family in the drawing area.

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To edit a loadable family outside a project

1. Click ➤ Open ➤ Family.
2. Browse to the file containing the family, and click Open.

To create a loadable family from a template file

1. Click ➤ New ➤ Family.
2. Browse to the template file, and click Open.

To create an in-place element

- Systems tab ➤ Model panel ➤ Component drop-down ➤ (Model In-Place)

4.3 Family Templates

Family templates are pre-set groupings of parameters and views that aid in the creation of system specific families. After you select a template, Revit MEP starts the Family Editor and opens the commonly used views for that family creation. The template also includes common references that are required to create a family. The common references include reference planes to define the origin and sketching references, common dimensions to help capture design intent, and any solid geometry needed or commonly used to complete the family. The family template files are available in the
Imperial Templates & Metric Templates folder.

The following table describes the different types of family templates.

FAMILY TEMPLATE	DESCRIPTION
Wall-based	The wall-based template is used for components inserted into walls. Wall components can include openings so that when you place the component on a wall, it also cuts an opening in the wall.
Ceiling-based	The ceiling-based template is used for components inserted into ceilings. Ceiling components can include openings so that when you place the component on a ceiling, it also cuts an opening in the ceiling.
Floor-based	These families are created in the Family Editor and can be loaded into a project file
Roof-based	The roof-based template is used for components inserted into roofs. Roof components can include openings so that when you place the component on a roof, it also cuts an opening in the roof.
Non-hosted	The non-hosted template is used for components that are not host dependent. A non-hosted component can appear anywhere in a model and can be dimensioned to other non-hosted or host-based components.
Face-based	The face-based template is used for creating workplane-based families that can modify their hosts. Families created from the template can make complex cuts in hosts. Instances of these families can be placed on any surface, regardless of its orientation. It is recommended that all families be created using the face-based template for working in a linked environment so that when there is an architectural design change, the plumbing fixtures that are hosted to the wall move with the wall.

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4.4 Reference Plane

Reference planes are used to define relationships among the geometric components within the Family Editor. Reference planes are not displayed when a family is used in a building model, unless a defined relationship between a reference plane and geometry exists,

To create reference plane

1. On Family Editor: Create tab ➢ Datum panel ➢ (Reference Plane)
2. To draw a line:

   On the Draw panel, click (Line).

- In the drawing area, draw the reference planes by dragging the cursor.
- Click Modify to end the line.

To pick an existing line

On the Draw panel, click (Pick Lines).

1. On the Options bar, specify an offset, if desired.
2. Select the Lock option to lock the reference plane to the line.
3. Move the cursor near the line to which you want to place the reference plane and click.

4.5 Family Geometry

You can use both 2- and 3-dimensional geometry to create families. Create solid geometric shapes to represent the element that the family is intended to create. Use 2D line work to add detail to solid geometry in certain views or to create a symbolic plan representation of an element.

As you create the family geometry, you can specify the visibility, material, and an optional subcategory of the geometry. These settings determine how and when the specific geometric components of the family display.

To ensure the stability of each parametric family, build the family geometry incrementally, testing (flexing) the parametric relationships in each increment.

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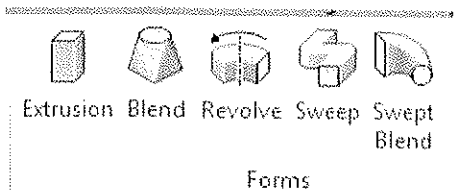
Methods of creating solid form

There are five (5) methods of creating solid form as the base of your family object, and each method uses a sketched 2D profile as the basis of the 3D shape.

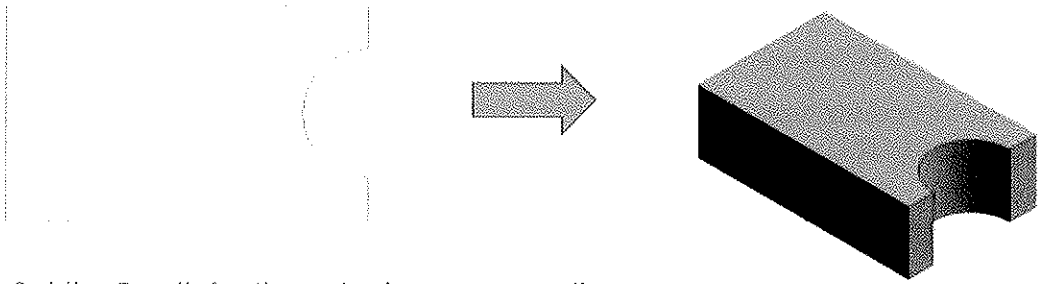
1. **Extrusion** pushes the profile out in one direction.
2. **Blend** links two profiles together.
3. **Revolve** rotates the profile around an axis.
4. **Sweep** extends a profile along a path.
5. **Swept Blend** connects two different profiles along a path.



Forms

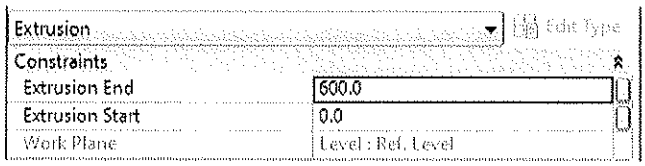
SOLID EXTRUSION

Extrude is the simplest of the four Solid Form Creation Methods. The use of this tool requires two distinct steps. *1. Sketch the profile that you wish to extrude.*



2. Set the Depth for the extrusion on properties.

Note: You can also set the absolute Start and End for the extrusion



SOLID REVOLVE

This tool is allows you to define a close profile and then revolve this 2D shape around a central axis, to form a 3D mass. Examples of when you may need any object comeson cylindrical shape or dome

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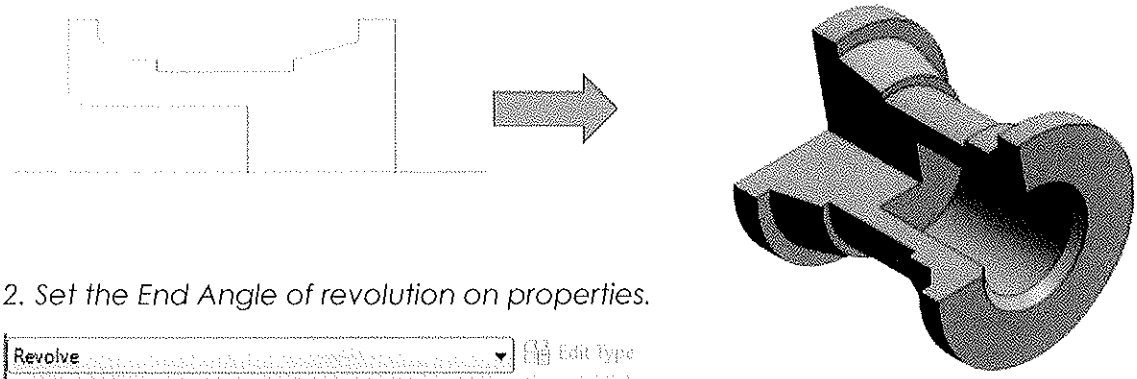
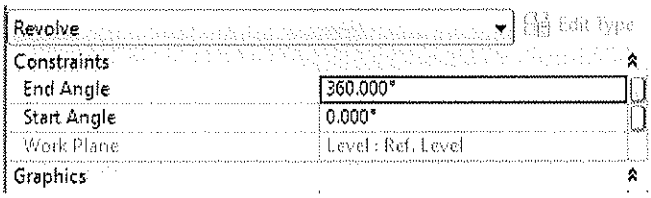
1. Sketch profile and define the axis (horizontal blue)



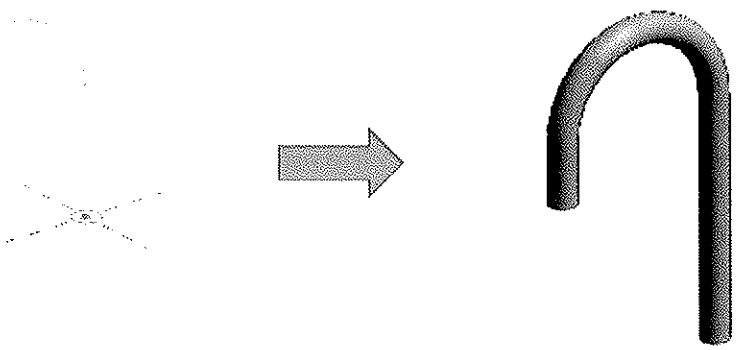
2. Set the End Angle of revolution on properties.



SOLID SWEEP

Along with Extrude, the Sweep tool will be used to create 95% of the geometry you need for your components. Using the Sweep tool is a two Step process. First of all we need to draw a 2D path along which our profile will be swept. Note: The 2D path does NOT need to be closed

Sketch path (grey) and the profile (magenta)



SOLID SWEPT BLEND

Creates a blend that sweeps along the defined path.The shape of the swept blend is determined by the starting shape, the ending shape and the 2D path that you specify.

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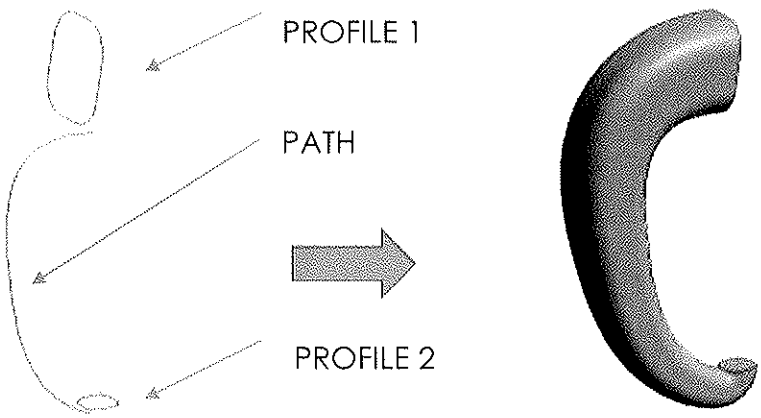


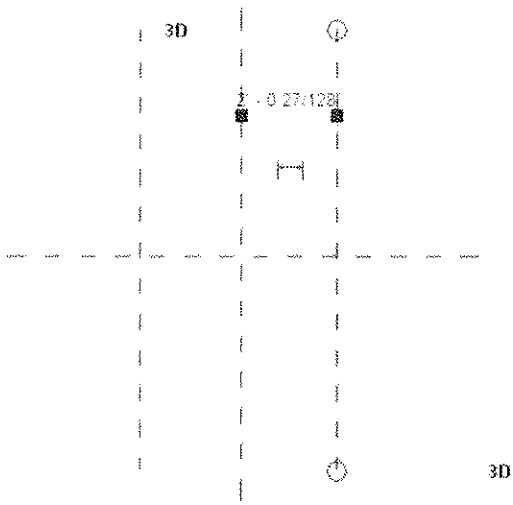
Exercise: Create an Air Terminal Family

STEPS

1. Click ➤ New ➤ Family

2. In the New Family - Select Template File dialog box:

- Navigate to the folder where you saved the exercise dataset.
- Select c_rmep_air_terminal_template.rft.
- Click Open.



3. Enter WT to tile the windows.

4. To begin drafting reference planes, maximize the Floor Plan: Ref. Level view window.

5. Zoom to fit the view.

6. Click Create tab > Datum panel

7. In the view window, on either side of the vertical centre line, draw reference planes as shown. The exact location is not critical.

8. Exit the Reference Plane tool.

9. To keep the reference planes equidistant, you need to create an equal dimension. You can then use this dimension to control the geometry. To do this, click Detail tab >Dimension panel > Aligned.

10. in the view window:

- Click the three vertical reference planes in Succession.
- Click to place the dimension string above the planes. Notice that an EQ symbol with a slash appears on Dimension string.
- Click the EQ symbol to make the planes equidistant.

11. Exit the Aligned dimension tool.

12. To add a dimension to control the two outer planes, activate the Aligned dimension tool.

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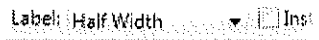
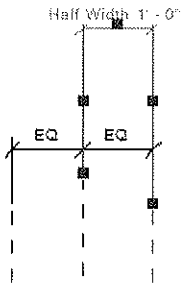
13. in the view window:

- Click to select the vertical centerline.
- Click one of the outer planes.
- Move the dimension string up and click to place it.

13. Exit the Aligned dimension tool. In the view window, select the dimension you just placed.

14. To map this dimension, on the Options Bar, select Half Width from the Label list.





15. Click anywhere in the view window to clear the selection.

16. You have set up two of the outer reference planes for the air terminal. Next, you need to create the inner reference planes for the connector segment of the air terminal. Select the right reference plane.

17. Click Modify Reference Planes tab > Modify panel > Copy.

18. Create a copy of the reference plane between the centerline and the right reference plane. The exact placement is not critical.

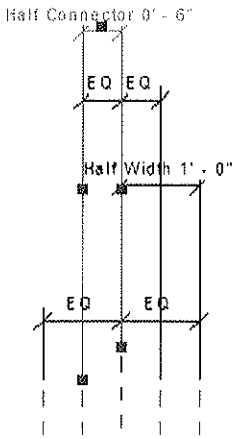
19. Create a copy of the left reference plane between the centreline and the left reference plane

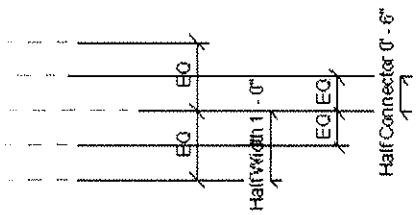
20. Add dimensions to the two inner reference planes and the centreline and make the dimensions equidistant.

21. Add dimensions to the inner reference plane on the left and the centreline and place the dimension above the other dimension strings.

22. Label the dimension that you just created Half Connector.

23. Similar to the vertical reference planes and dimensions, create horizontal reference planes and dimensions as shown.





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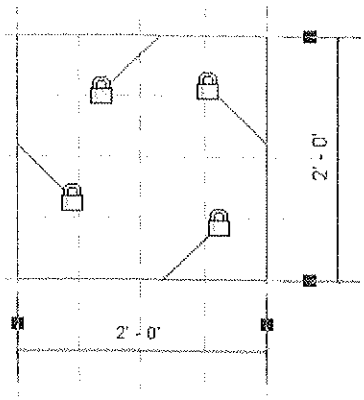
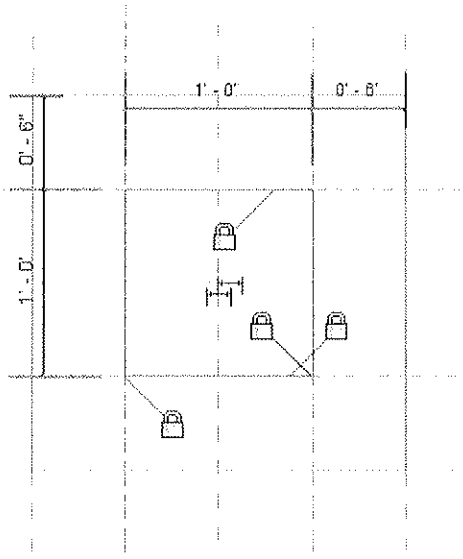
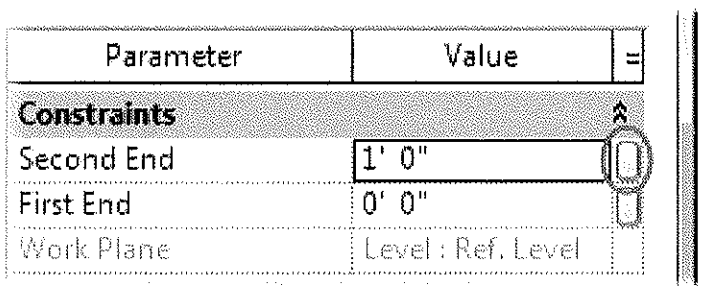
Create a Blend and Add a Connector



1. Click Create tab > Forms panel > Solid dropdown> Blend.
2. Click Create Blend Base Boundary > Draw panel> Rectangle.
3. In the view window, draw a rectangular outline from the upper-left corner to the lower Right corner created by the intersection of the reference planes.
4. To associate the lines with the reference planes, click all open padlocks.
5. On the Mode panel, click Edit Top.
6. Activate the Rectangle tool.
7. In the view window, draw a rectangle on the inner square as shown. This will be the top extrusion of the air terminal connector.
8. Lock all four padlocks to associate these lines to the reference planes.



9. On the Element panel, click Blend Properties.
10. To control the height of the air terminal, in the Instance Properties dialog box, under Constraints, for Second End, click the gray button next to 1' 0" in the Value column.



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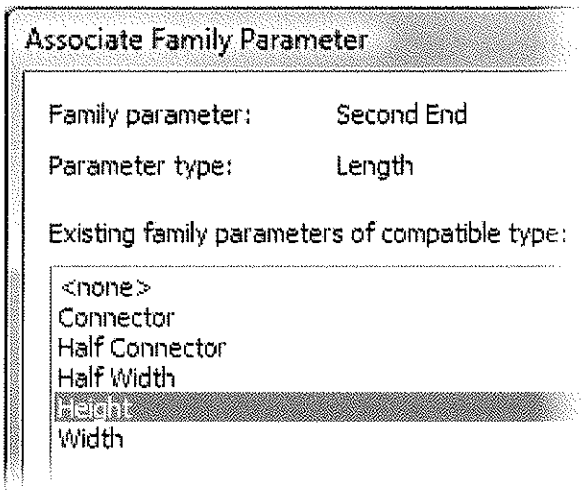
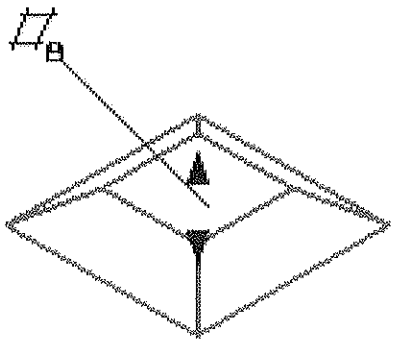
11. In the Associate Family Parameter dialog box:
    - Under Existing Family Parameters of Compatible Type, select Height.



12. Click OK to close the Instance Properties dialog box.
13. On the Blend panel, click Finish Blend.
14. Open the default 3D view.



15. Save the family

4.6 Connector

A primary difference between Revit MEP components and components for Revit Architecture or Revit Structure is the concept of connectors. All Revit MEP components require connectors to behave with intelligence. Components created without connectors cannot participate in a system topology. Connectors are primarily logical entities that allow calculating loads within a project. Revit MEP maintains information about loads associated with the spaces in a project. As devices and equipment are placed in spaces, Revit MEP keeps track of the loads based on load type: HVAC, Lighting, Power, Other. The loads associated with the spaces can be viewed in the instance properties for each space, and displayed in schedules.

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Choosing a Discipline for a Connector

The discipline assigned to a connector determines the types of systems with which it can interact and how it interacts with other system components.

When you add connectors to a family, you can specify one of the following disciplines:

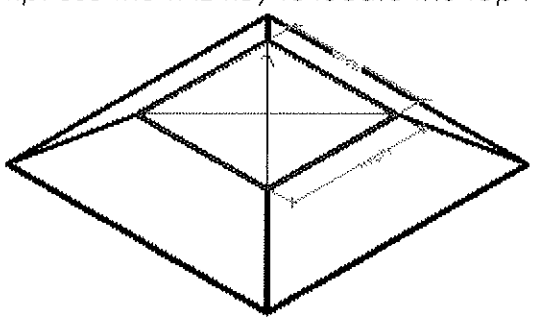
- **Duct connectors** are associated with ductwork, duct fittings, and other elements that are part of the air handling systems.
- **Electrical connectors** are used for any type of electrical connections, including power, telephone, alarm systems, and others.
- **Pipe connectors** are used for piping, pipe fittings, and other components that are meant for transmitting fluids.
- **Cable tray connectors** are used for cable tray, cable tray fittings, and other components that are meant for wiring.
- **Conduit connectors** are used for conduit, conduit fittings, and other components that are meant for wiring. A conduit connector can be an individual connector or a surface connector. The individual connector is used for connecting only one conduit. The surface connector is used for connecting more than one conduit to a surface.

To place a duct connector

Continue working on the Air terminal.rfa

1. Click Create tab > Connectors panel > Duct Connector.
2. On the Options Bar, verify that Supply Air is selected in the list.
3. In the view window, click the top face of the air terminal to place the connector on the top of the terminal.

Tip: Use the TAB key to locate the top face of the air terminal.



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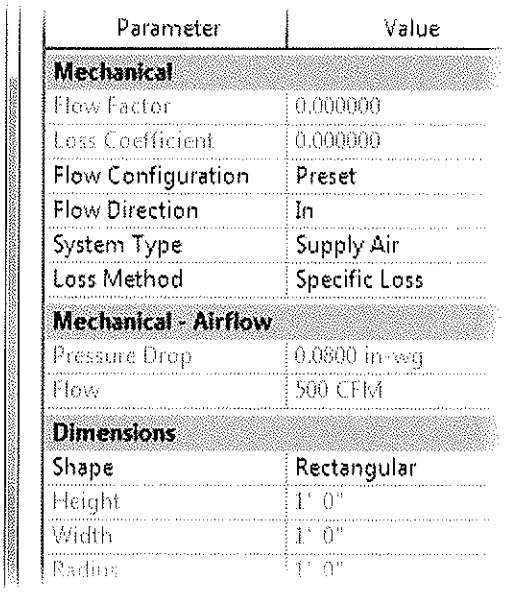
4. Exit the Duct Connector tool.
5. Select the connector you just placed.
6. Open the Instance Properties dialog box to adjust the settings in the connector so that it connects to the system properly.
7. In the Instance Properties dialog box, under Mechanical:
   - For Flow Configuration, select Preset from the Value list.
   - For Flow Direction, ensure that In is selected in the Value list.
   - For Loss Method, select Specific Loss from the Value list.

8. In the Instance Properties dialog box, under Mechanical - Airflow:
   - Map Pressure Drop to the Static Pressure parameter.
   - Map Flow to the Flow parameter.

Tip: Click the gray button next to the Value column to map the parameters.

9. In the Instance Properties dialog box, under Dimensions:
   - Map Height and Width to the Connector parameter.



Parameter	Value
Mechanical	
Flow Factor	0.000000
Loss Coefficient	0.000000
Flow Configuration	Preset
Flow Direction	In
System Type	Supply Air
Loss Method	Specific Loss
Mechanical - Airflow	
Pressure Drop	0.0600 in wg
Flow	500 CFM
Dimensions	
Shape	Rectangular
Height	1' 0"
Width	1' 0"
Radius	1' 0"

   - Click ok

10. Clear the selection. You can now load the air terminal family into a project and use it as required.

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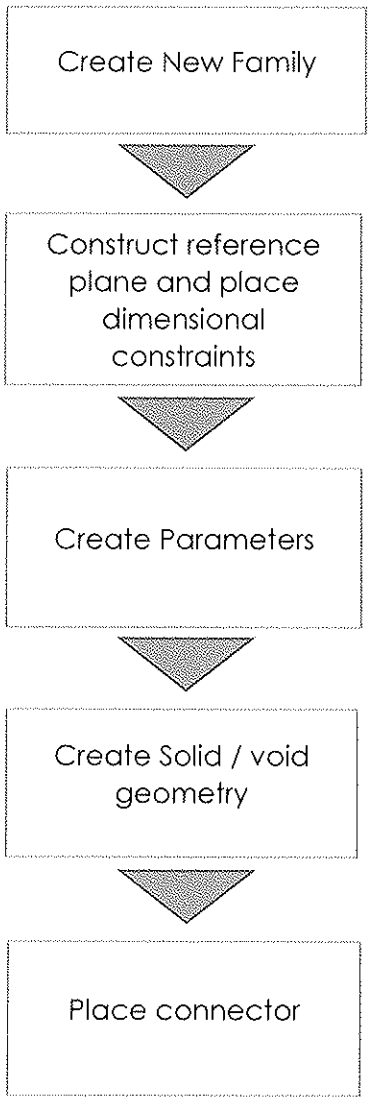
Process: Creating Families

The following illustration shows the process of creating families

STEPS Notes & Setting



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CHAPTER 4

Working on Team Project

In this chapter you learn how to open workset-related projects, work in workset-related projects, work with visibility and display options, set up worksets and use best practices for worksets.

This chapter discuss:

- Create Central File by activating work sharing and dividing the models into workset
- Allow multiple user to work on the same dataset utilizing local file
- Work with the manage workset
- Control the visibility

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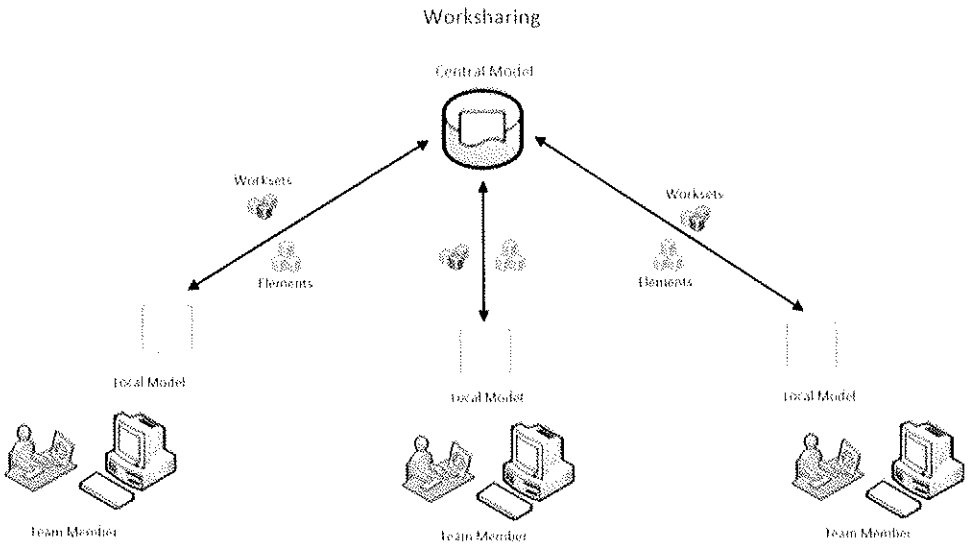
5.1 Worksharing Overview

Worksharing is a design method that allows multiple team members to work on the same project model at the same time. When worksharing is enabled, a Revit document can be subdivided into worksets, which are collections of elements in the project.



Team members share a central model

Revit projects can be subdivided into worksets to accommodate such environments. You can enable worksharing to create a central model so that team members can simultaneously make design changes to a local copy of the central model.

5.2 Worksharing Terminology

Term	Definition
central model	The master project model for a workshared project. The central model stores the current ownership information for all elements in the project, and acts as the distribution point for all changes published to the file. All users save their own local copies of the central model, work locally, and then synchronize with central so that other users can see their work.
local model	A copy of the project model that resides on the computer system of the team member who is working on the model. When worksharing is used to distribute project work among team members, each member uses a local model to work on his or her workset (functional area). Team members periodically save their changes to the central model so that others can see the changes and update their local model with the latest project information.
active workset	A collection of elements in a project.A workset is typically a discrete functional area, such as HVAC, electrical, plumbing, or piping. When you enable worksharing, you can divide a project into worksets, with different team members responsible for each workset

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con't.

Term	Definition
element borrowing	Allows you to edit an element that you do not own. If no one owns the element, permission to borrow is automatically granted. If another team member is currently editing the element, that team member is the owner, and you must place a request or wait for it to be relinquished so that you can borrow it.
workshared file	A Revit project for which worksets have been enabled.
non-workshared file	A Revit project for which worksets have not been enabled.
collaboration	Multiple team members working on the same project. These team members may be from different disciplines and working in different locations. Methods of collaboration can include worksharing and using linked models.

5.3 Enabling Worksharing

Enabling worksharing involves creating a master project model, known as a central model, from an existing model.

The central model stores the current ownership information for all worksets and elements in the project, and acts as the distribution point for all changes made to the model. All users should save their own local copy of the central model, edit locally in this workspace, and then synchronize with central to publish their changes to the central model so that other users can see their work.

To enable worksharing and create a central model

1. Open the Revit project file (RVT) on exerice file to convert as the central model.
2. Click Collaborate tab ➤ Worksets panel ➤ (Worksets).

   The Worksharing dialog displays, showing the default user-created worksets (Shared Levels and Grids, and Workset1).

3. If desired, rename the worksets.
4. In the Worksharing dialog, click OK. The Worksets dialog displays.
5. In the Worksets dialog, click OK. You do not need to create worksets at this point.
6. Click ➤ Save As ➤ (Project).
7. In the Save As dialog, specify a file name (**ACMV-Logistic Warehouse_Central Model)** and directory location for the central model.
8. In the Save As dialog, click Options.
9. In the File Save Options dialog, select Make this a Central Model after save.

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Note: If this is the first time you have saved after enabling worksharing, this option is selected by default and cannot be changed.

10. Click OK.
11. In the Save As dialog, click Save.

5.4 Creating Local copy of Central file.

When you save the central model, be sure that it is saved to a network drive to which all team members have access. If you are using server-based worksharing, Revit Server must be installed on any machine hosting a central model, and the Host role must be enabled in the RSN.ini file on that machine.

For the class set up we will configure the revit to replicate different user accessing the central file and create a local file to save in different directory or folder.

To create a local file (USER 1)

1. Close the Central model
2. Click ➢ Options.
3. Click General Tab, under Username change the username to USER1
4. Click File Location, Default path for user files, click browse and navigate or create a folder to which the local file will be save.
5. Click OK
6. Click ➢ Open and look for the location of the central file, on the open dialogue box ensure the Create New Local is selected
7. Click open, you will opening the local file created under the folder you specify on the option.

To create a local file (USER 2)

1. Run again a new Revit Application
2. Click ➢ Options.
3. Click General Tab, under Username change the username to USER2
4. Click File Location, Default path for user files, click browse and navigate or create a folder to which the local file will be save.
5. Click OK
6. Click ➢ Open and look for the location of the central file, on the open dialogue box ensure the Create New Local is selected

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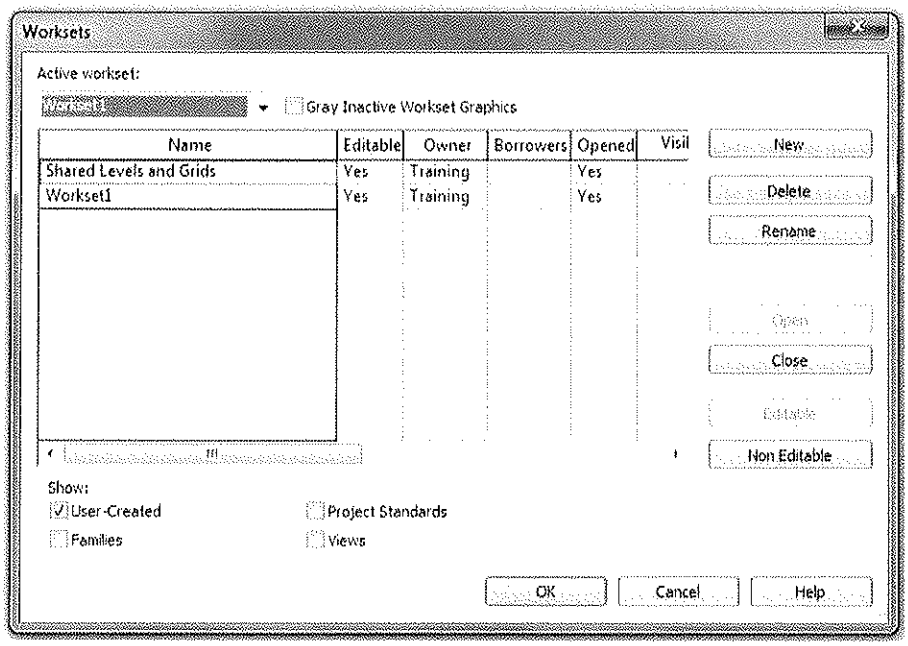
7. Click open, you will opening the local file created under the folder you specify on the option.

5.5 Setting up and Managing Workset

When you enable worksharing, several default worksets are created (two default user-created worksets, and worksets for the families that are loaded in the project, project standards, and project views)



The following image shows the Worksets dialog, with the two default user-created worksets, Shared Levels and Grids and Workset1.

To create a new workset

1. Open your local copy of the central model.
2. Click Collaborate tab ➤ Worksets panel ➤ (Worksets).
3. In the Worksets dialog, click New.
4. In the New Workset dialog, enter a name for the new workset.
5. To display the workset in all project views, select Visible in all views.
6. Clear this option if you want the workset to display only in views where you specifically turn on its visibility.
7. Click OK.
8. The new workset displays in the list of worksets; it is editable, and your user name displays for Owner.

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9. If you are setting up a workshared model for your team and want to assign owners to each workset, each team member must open a local copy of the central model, select the workset in the Worksets dialog, and then select Yes in the Editable column.

10. When you finish creating worksets, click OK to close the Worksets dialog.

11. If you have added only one new workset, Revit prompts you to make the new workset active. Click Yes or No.

5.6 Adding Element to Workset

To add element on workset

1. Select the workset from the Active Workset drop-down on the status bar or the Collaborate tab ➤ Worksets panel
2. **Note:** You can select a non-editable workset as the active workset. If you place an element in a non-editable workset, the element becomes non-editable after you synchronize with central. If you add view-specific elements, such as detail lines or dimensions, they are added to the workset of the active project view.
3. If you want all elements that were not created in the active workset to display as gray, click Collaborate tab ➤ Worksets panel ➤ (Gray Inactive Worksets).
4. Add the necessary elements to the Drawing Area.

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CHAPTER 5

Saving Workshared File

In this chapter you learn how to open synchronized your local saved files to the central file and relinquished ownership without saving local file

This chapter discuss:

- Synchronizing with central model
- Closing workshared file without saving
- Opening workshared files Independent to the central model
- Relinquishing ownership without synchronizing with central

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Saving Workshared File

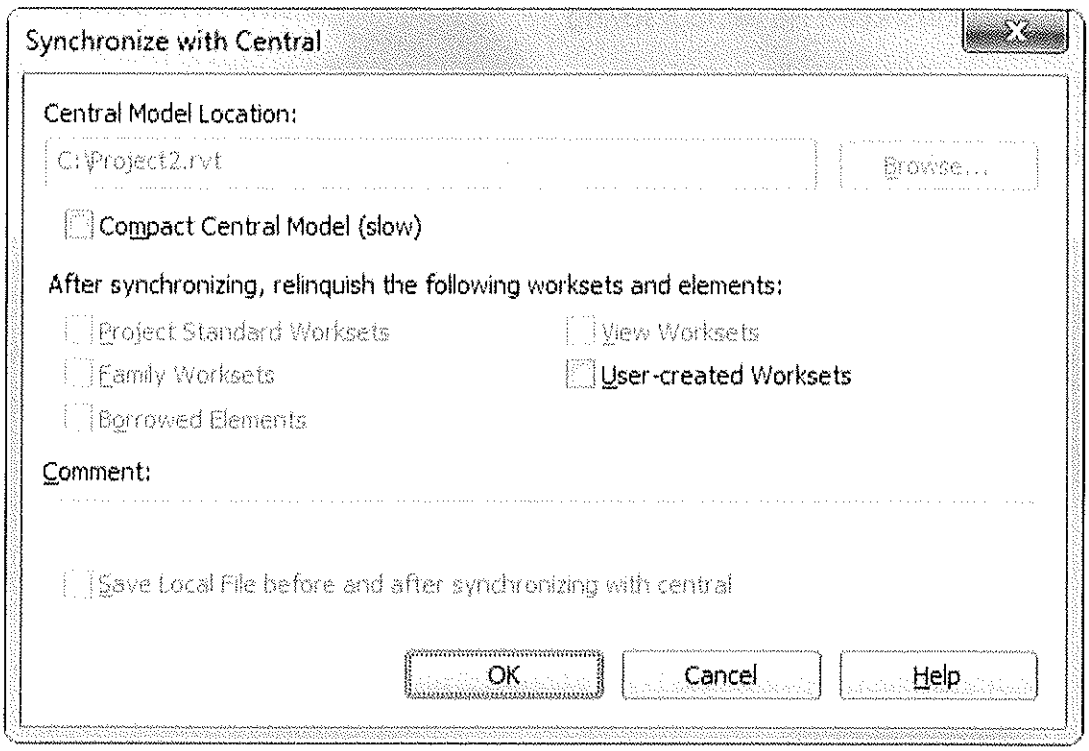
When saving the changes in your local workshared file, you can do either of the following:

- Synchronize with Central
- Save locally

6.1 Synchronizing with Central Model

To Synchronize with Central: Click Collaborate tab ➤ Synchronize panel ➤ Synchronize with Central drop-down ➤ (Synchronize Now).

If you want to modify the Synchronize with Central settings before you synchronize with central: Click Collaborate tab ➤ Synchronize panel ➤ Synchronize with Central drop-down ➤ (Synchronize and Modify Settings). The Synchronize with Central dialog displays.



1. In the Synchronize with Central dialog, verify the location of the central model.
2. If necessary, click Browse to specify a different path for the central model. Specify the new path in the Central File Location dialog, and click OK.
3. Select Compact Central Model to reduce file size when saving.
4. **Note:** Selecting this option increases the time needed to save.

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5. Under After synchronizing, relinquish the following worksets and elements, select from the following options:
    a. To make your changed worksets and elements available to other users, select the appropriate check boxes.
    b. To synchronize the changes to central but keep the worksets and elements editable, clear the appropriate check boxes.
6. If desired, enter a comment that is saved to the central model.
7. Verify that Save local file before and after synchronizing with central is selected to ensure your local file remains synchronized with central.
8. Click OK.
9. Your changes are saved to the central model and any changes from other team members are copied to your local model.

Editable Elements

If you have saved all changes to the central model, but still have editable elements when you close the local file, the Editable Elements dialog displays. If you do not want to keep ownership of the checked out worksets and borrowed elements, click Relinquish elements and worksets; otherwise, click Keep ownership of elements and worksets.

6.2 Opening Workshared Files Independent of the Central Model

Use this procedure to open a file independently for clients who want to see changes or make changes without saving them. Clients can view the file and modify it without worrying about borrowing elements or owning element worksets. This is also useful for project managers who are not working in the project file, but might want to open it for review without interrupting the team.





1. Click ➤ Open ➤ (Project).
2. In the Open dialog, navigate to the central model and select it.
3. Select Detach from Central.
4. Click Open.

If a non-workshared file is opened with Detach from Central selected, Revit ignores the option, and opens the file normally.

After you open the file, it no longer has any path or permissions information. It is in a state similar to when worksharing was first enabled; all elements in the file can be modified, but no changes can be saved back to the central model. If you save the file, it is saved as a new central model.

Note: If a longer-lasting independent copy of the central model is needed, such as when the central model is suspected to be corrupt, detach from the central model and save it as a new central model. Note that existing local files cannot synchronize

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with this new central model, and new local files created from the detached central model cannot synchronize with the old central model.

6.3 Closing Workshared File without Saving

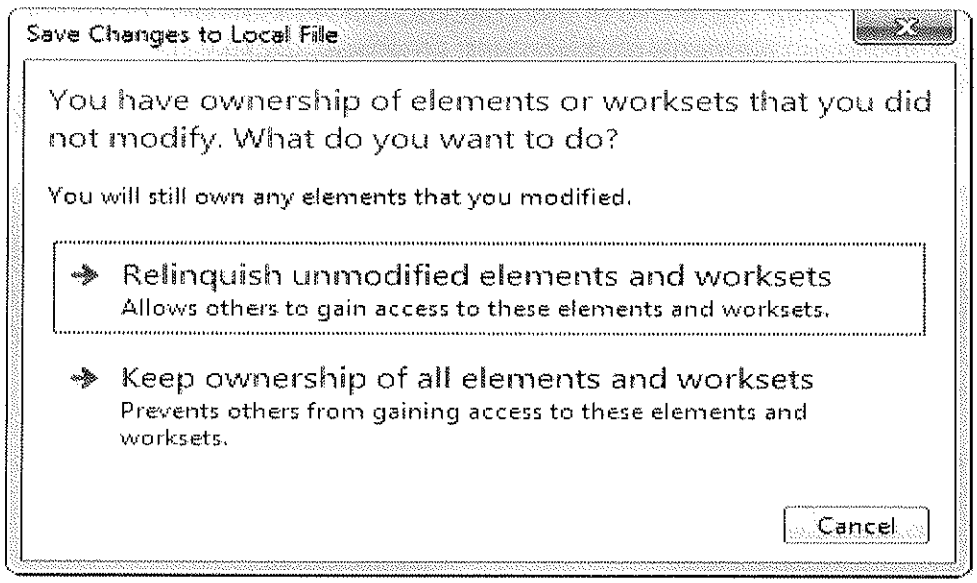
If you close your local model without saving, the Changes Not Saved dialog displays. The following sections describe the options.

Synchronize with Central

This option saves your changes to the central model. The default settings are selected, including saving your changes to the local model. Also, any changes that have been saved from other team members are copied to your local model.

Save Locally

This option saves your changes to the local model without synchronizing them with the central model and displays the Save Changes to Local File dialog. Because you did not Synchronize with Central, you still own any elements you modified.



You have the following options:

- Click Relinquish unmodified elements and worksets if you want others to have access to them. Unchanged editable elements and worksets are relinquished, and the local model is saved. You remain the borrower of any elements you changed in the editable worksets.

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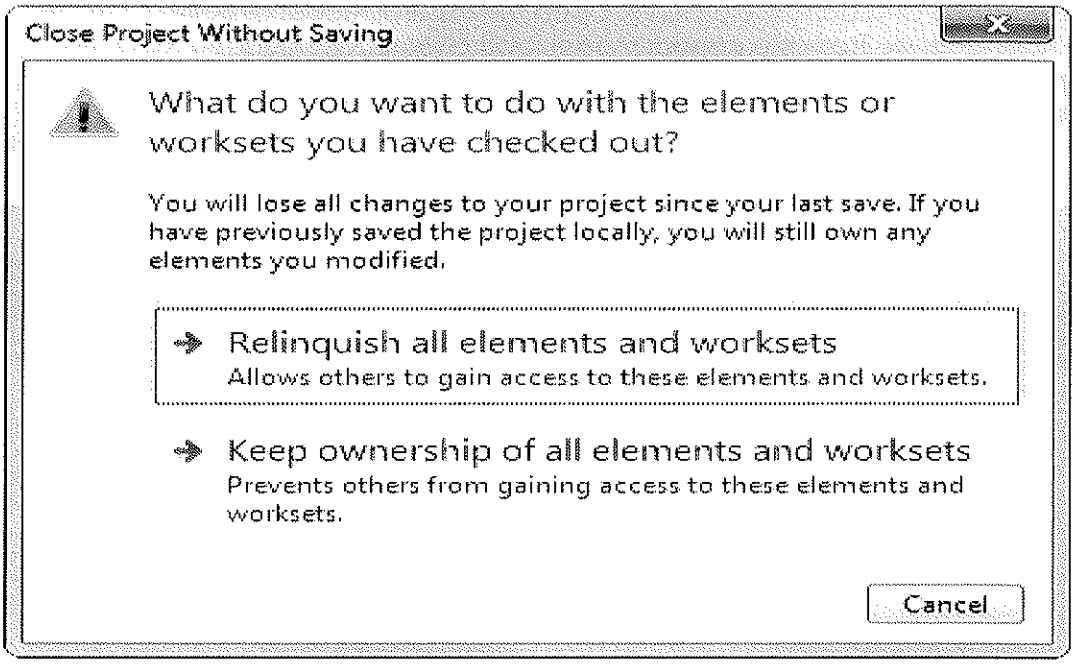
- Click Keep ownership of all elements and worksets to retain all editing permissions when the local model is saved. The local model closes without synchronizing with central or relinquishing worksets or borrowed elements.

Do Not Save the Project

This option discards any changes you made to the local model. It has no effect on your last save to the local model. This option rolls back the state of your local model to the last time you saved it and displays the Close Project **without** saving dialog.



You have the following options:

- Click Relinquish all elements and worksets to let others gain access to both modified and unmodified elements and worksets. You relinquish all changes you made to the elements you borrowed and the worksets you own.
- Click Keep ownership of all elements and worksets to retain ownership of the elements you borrowed and the worksets you own. You will lose the changes you made.

6.4 Relinquishing Ownership without Synchronizing with Central

To relinquish editable elements for which you have editing permissions without synchronizing with the central model:

1. With the local model open, click Collaborate tab ➤ Synchronize panel ➤ (Relinquish All Mine).

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2. Revit checks for any changes that require synchronizing with central:
    a. If there are no changes to the model elements, ownership of the worksets and borrowed elements is relinquished. A dialog does not display.
    b. If there are changes, ownership status does not change. You still own any model elements you modified. A dialog displays telling you that you made changes and suggests synchronizing with central.
3. Click Close to close the dialog, if one displays.
4. If you do not mind discarding your local changes, you can relinquish permissions and borrow elements. Open the central model directly or create a new local file from the central model, and choose Relinquish All Mine. Best practice is to discard your original local file so that you do not accidentally work on an outdated file or the wrong local file. If you retain your original local file, be aware that if other users have modified elements that you used to own, the original local file will be incompatible with the central model.

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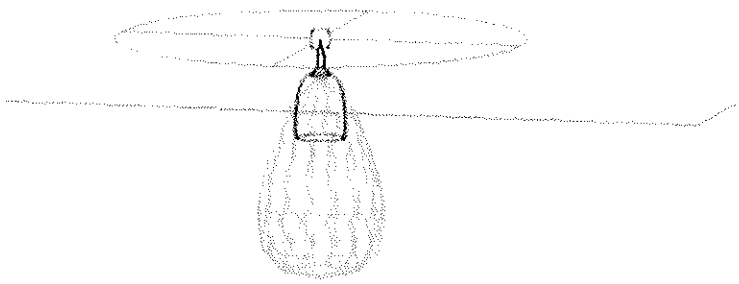
Exercise 1

Creating a Custom Lighting Fixture family

In this practice you will create a new lighting fixture family, modify the light source, create geometry for a pendant and glass shade, and apply a connector, as shown in Figure below. If you have time you can load materials and create family types using

Different materials



1. Start a new family based on the **Metric Lighting Fixture ceiling based.rft** template, found in your class folder.
2. Open the Front elevation view. It includes reference planes for the Ceiling and Light Source, a ceiling element, and the Ref. Level as shown in below.

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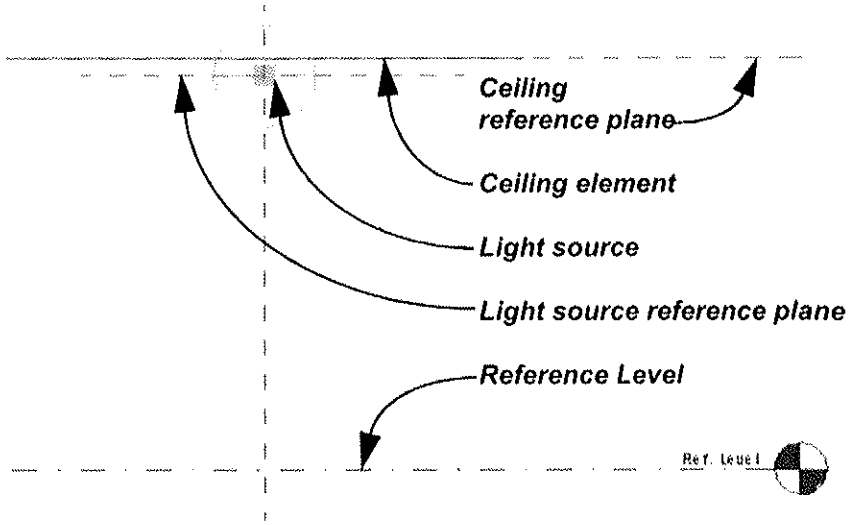
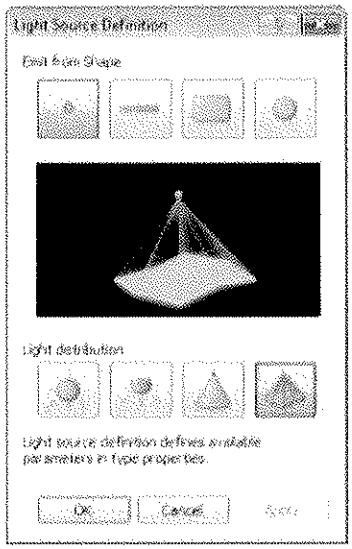


3. Select the light source. In the Modify | Light Source tab > Lighting panel, click (Light Source Definition).
4. In the Light Source Definition dialog box, change the Light distribution to (Photometric Web), as shown in picture below and click OK.



5. Open the Family Types dialog box and set the following values for the parameters:

- Lamp: CF42TRT
- Apparent Load: 44.21 VA
- Tilt Angle: 90
- Photometric Web File (click): spot_ideal.ies
- Light Loss Factor: 0.85

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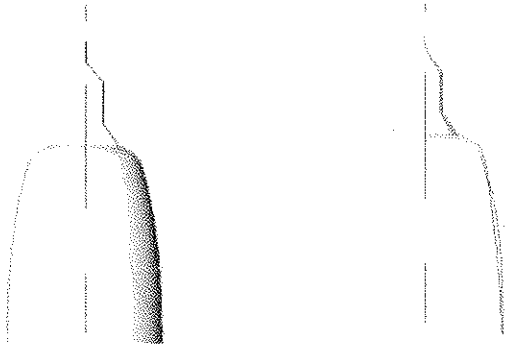
- Initial Intensity: Luminous Flux, 3200

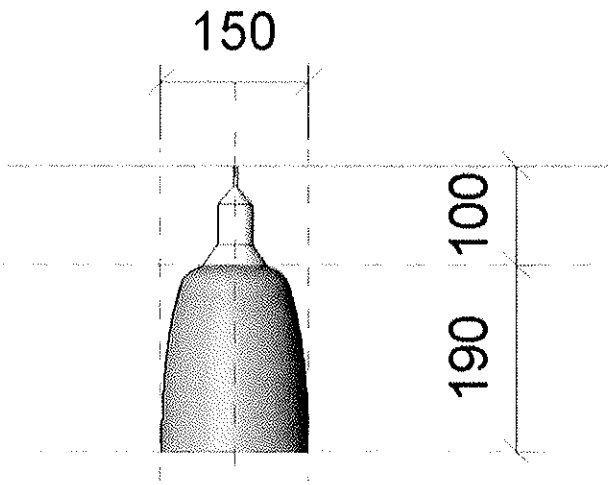
6. In the Family Types dialog box, add two Type parameters for
7. Pendant Material and Glass Material.
8. Save the family.

Creating the fixture geometry.

1. Zoom in on the area near the light source.
2. Add reference planes as needed to help you create two revolves for a pendant and glass shade, similar to that shown in pictures below.



Sketch for Pendant *Sketch for Glass*



3. Select the pendant revolve. In Properties, in the Materials and Finishes area, for Materials parameter click (Associate Family Parameter)

4. In the Associate Family Parameter dialog box, select Pendant Material and click. OK
5. Repeat this with the glass shade revolve.
6. Save the project.

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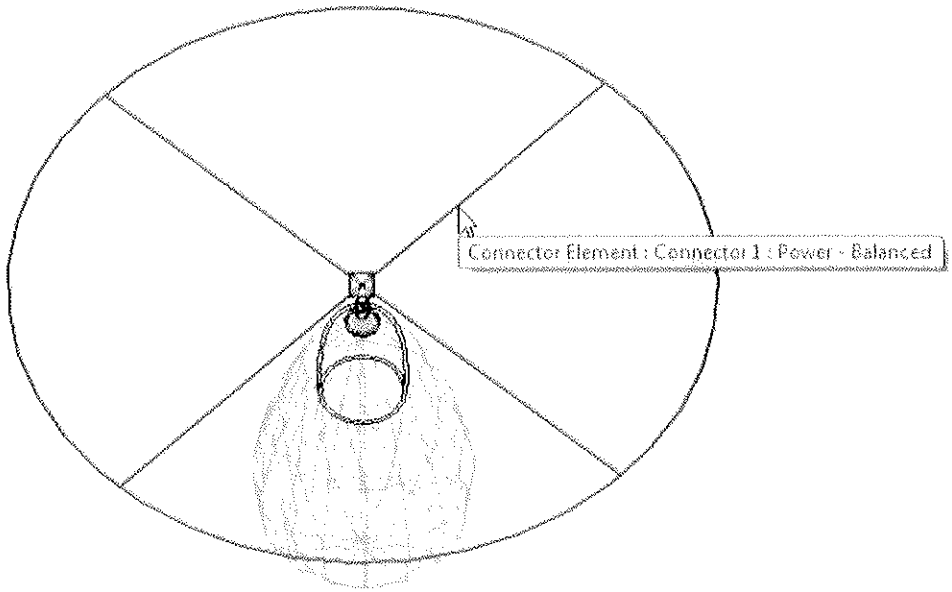
Adding Electrical Connector

1. Open a 3D view and set the Visual Style to Wireframe.
2. In the Home tab > Connectors panel, click (Electrical Connector).
3. In the Options Bar, select Power - Balanced.
4. Attach the connector to the face of the pendant at the point where the pendant touches the ceiling, as shown below.



5. Click (Modify) and select the connector.
6. In Properties specify the values for the following parameters:
    - Power Factor: 0.95
    - System Type: Power - Balanced (verify)
    - Apparent Load: Associate with the Apparent Load parameter
    - Voltage: 277
    - Load Classification: Lighting
7. Save the family.

Creating Materials

1. In the Manage tab > Settings Panel, click (Materials). In the Materials - Default dialog box, click the Materials tab. There are very few materials to choose from. Close the dialog box.
2. Open the family /MEP/Light-Fixture-Sample-Materials-M.rfa from your class folder. (This is a finished version of the light fixture with several materials added.

3. Switch back to your new light fixture family.
4. In the Manage tab > Settings panel, click (Transfer Project Standards).
5. In the Select Items to Copy dialog box, verify that Copy from
6. is set to Light-Fixture-Sample-Materials-M.rfa and clear everything but Materials

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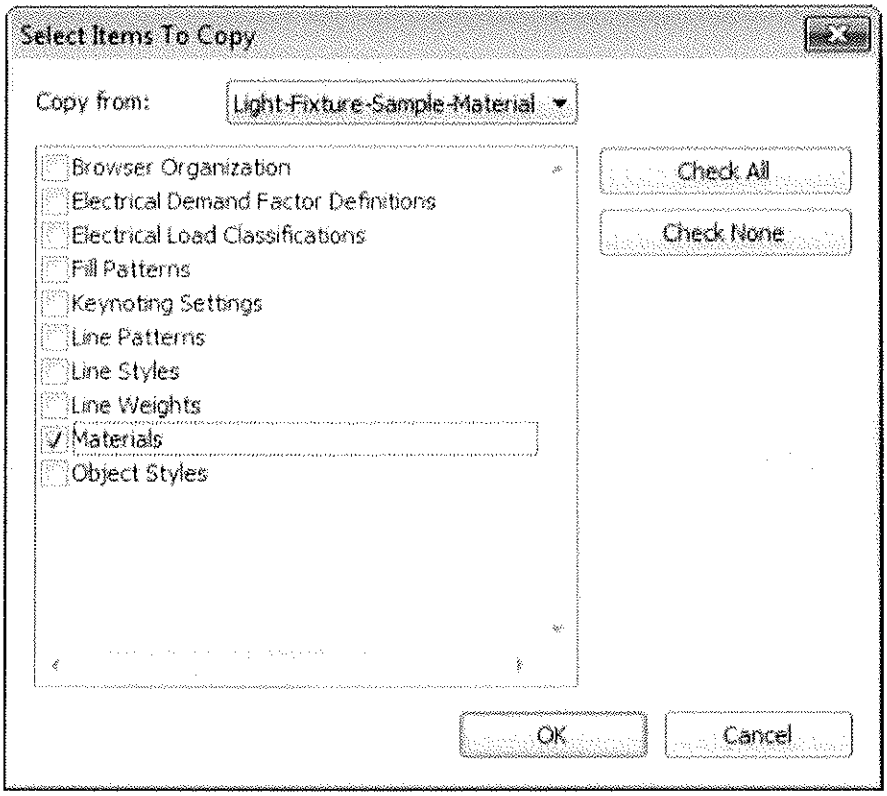

7. Click OK. The materials are copied into the current family.
8. In the Family Types dialog box assign Materials to the Glass
9. Material and Pendant Material parameters.
10. If you have time, create several Family Types that use different colours of glass and different pendant materials.
11. Save the family.

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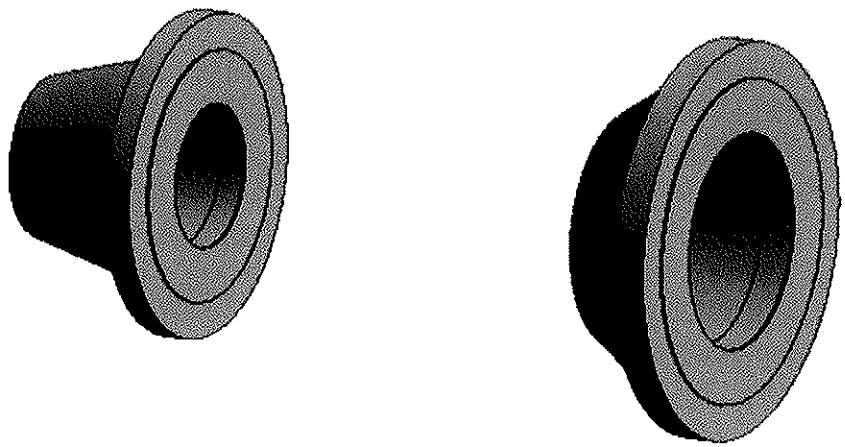
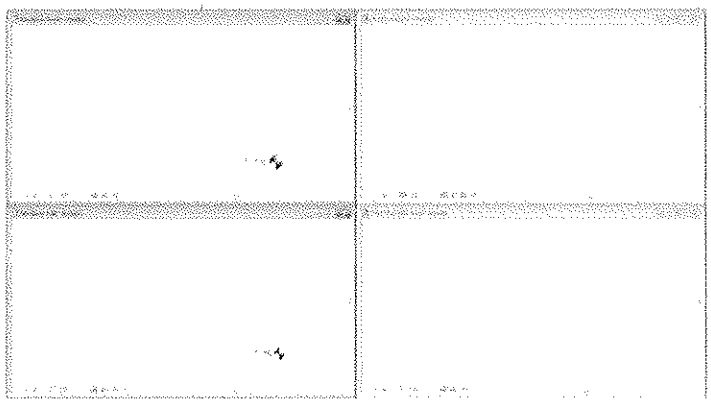
Exercise 2



TASK 1
(Create new Family)

1. Click ➢ New ➢ Family
2. In the New Family - Select Template dialog box, select the template from the Autodesk Revit Library and click open
3. Tile the four open views so you can see each of them (type WT). If needed, type ZA (the shortcut for Zoom All to Fit) to fit the view in all of the windows.



4. In the Home tab > Properties panel, click (Family Category and Parameters).
5. In the Family Category and parameters dialog box, in theFamily Category area,

   select Pipe Fittings.

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6. In the Family Parameters area, set the following options:

   - Clear the Work Plane-Based option.
   - Select Always Vertical.
   - For the Part Type select Transition.
   - Clear the Shared option
7. Click OK
8. Save the family in your class files folder as **150 WN Flange.rfa.**

TASK 2 (Parameters)

1. In the Home tab > Properties panel, click (Family Types).
2. In the Parameters area, click.
3. In the Parameter Properties dialog box, in the Parameter Type area, select Family Parameter (if it is not already selected) and specify the following:

   - *Name*: NomRad
   - *Discipline*: Piping
   - *Type of Parameter*: Pipe Size
   - *Group Parameter Under*: Dimensions
   - *Select the Type option.*
4. Click OK

5. Repeat the steps, creating parameters named **NomDia,FlgRad, FlgDia, PipeOD, PipeOR, RFD, RFR, RFT, FT, LTH, HT, and HubRad.** Define the parameters as follows:
   - *Parameter Type*: Family Parameter
   - *Discipline:* Piping
   - *Type:* Pipe Size
   - *Group Parameter Under*: Dimensions
   - Select the Instance option.

6. In the Family Types dialog box, specify the following values:
   - **RFT:** 1.5mm
   - **NomRad**: 50mm
   - **FlgDia**: 220mm
   - **PipeOD**: 115mm
   - **FT**: 20mm
   - **LTH**: 130mm

7. In the Family Types dialog box, enter the following formulae for the parameters:
   - NomDia: NomRad * 2
   - FlgRad: FlgDia / 2
   - PipeOR: PipeOD / 2
   - HubRad: PipeOR * 1.5
   - RFD: FlgDia - 50mm

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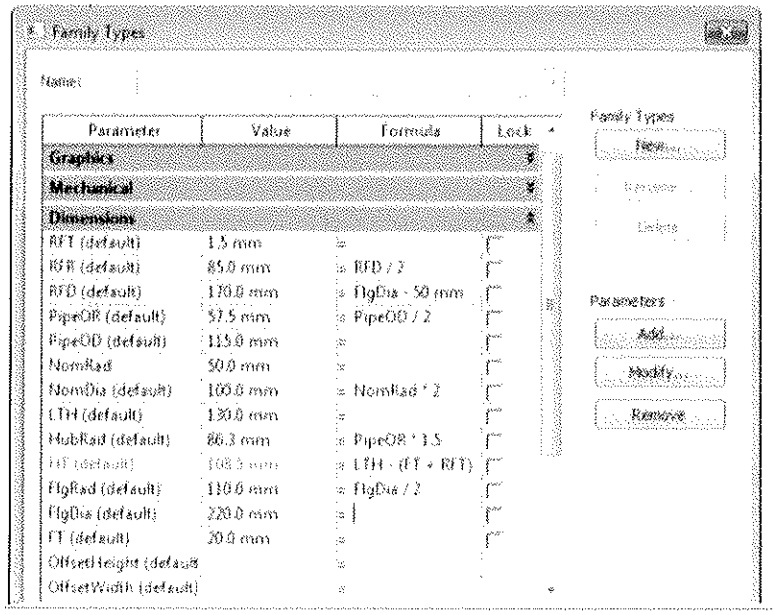
- RFR: RFD / 2
- HT: LTH - (FT + RFT)

The information will display as shown



8. Click OK
9. Click Save

TASK 3 (Create Plan View Reference Plane)

1. Continue working in the family file 150 WN Flange.rfa.
2. Maximize the Ref. Level view.
3. Click on the vertical reference plane. It is named Center Left/Right.
4. Press <Esc> to clear the plane.
5. In the Home tab > Datum panel, click (Reference Plane).
6. In the Modify | Place Reference Plane tab > Draw panel, click (Pick Lines).
7. In the Options Bar, set Offset as 50mm.
8. Hover over the vertical reference plane so that the dashed line is displayed on the left side. Click to create a new reference plane.
9. Repeat on the right of the same reference plane and again to the right of the new plane to create a total of 4 reference planes, as shown in Figure below

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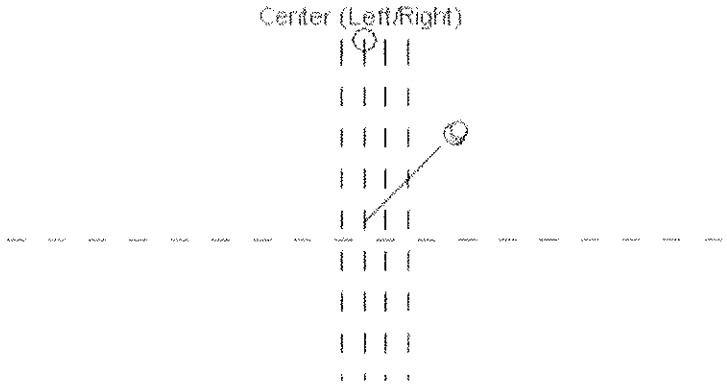
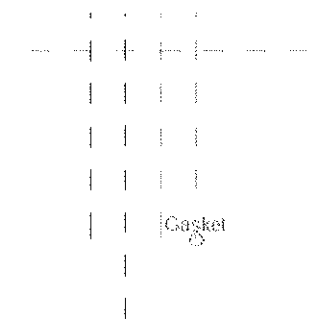


10. Click (Modify) or press <Esc> to end the command.
11. Select the extreme left vertical plane.
12. In Properties, set the Name parameter to Weld and set the Is Reference parameter value to Not a Reference.
13. Repeat the steps for the two remaining planes, setting Name to Flange Thickness (third from left) and Gasket



14. Start the (Aligned) dimension command.
15. Select the Gasket vertical reference plane and then click on the Flange Thickness reference plane to its immediate left.
16. Move the cursor up and click to place the dimension above the ends of the reference planes.
17. Click (Modify) to end the command.
18. Select the dimension. In the Options Bar, click on the arrow in the Label box and select RFT as shown in Figure below. The two planes move so they are 2mm apart

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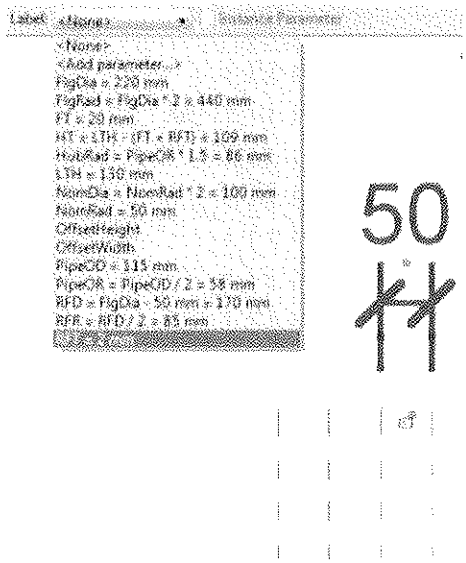
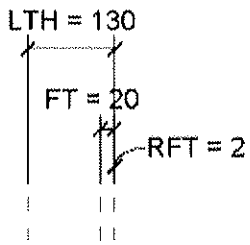


19 Repeat the steps to place a dimension between the Center (Left/Right) and Flange Thickness planes.
20. Select the dimension. In the Options Bar, click on the arrow in the Label box and select FT.
21. Repeat the steps to place a dimension between the Welds (far left) and Gasket (far right) planes.
22. Select the dimension. In the Options Bar, click on the arrow in the Label box and select LTH. The final result should be displayed as shown in Figure below.
23. Save the file



TASK 4 (Model Line)

1. Continue working in the family file 150 WN Flange.rfa.
2. Enter VG.
3. In the Visibility Graphics dialog box, in the Model tab, click Object Style
4. In the Object Styles dialog box, click select all and change the Projection Line Weight to 5 for all objects, as shown in figure below.

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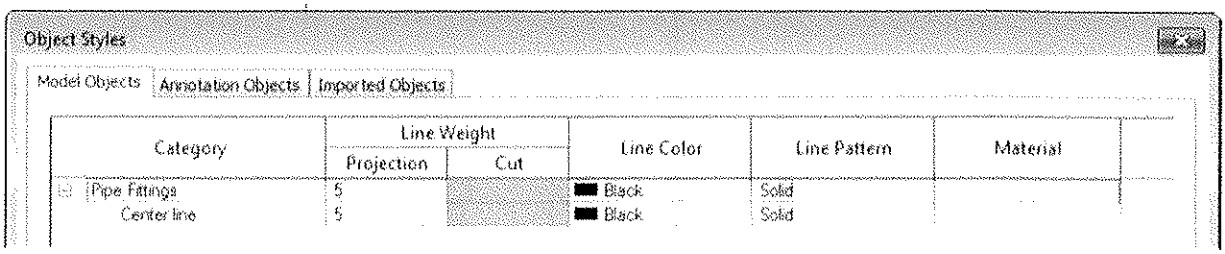
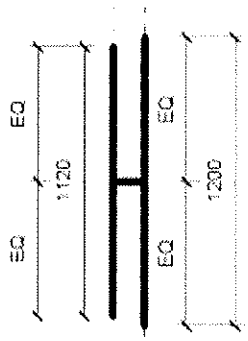


5. Click OK twice to close the dialogue boxes
6. In the Home tab > Model panel, click (Model Line).
7. In the Place Model Lines tab > Draw panel, click (Line).
8. In the Options Bar, clear Chain.
9. Draw a vertical line (no particular length) on the far left reference plane. Start the line below the horizontal reference and end above it. Draw another vertical line on the far right reference plane.
   - It is critical that the lines are directly on the reference planes. When drawing the lines, either use object snap overrides or drag the lines slightly off to the side of the planes, and use the Align tool to place them.
10. Draw a horizontal line from the intersection of the horizontal plane and far left plane to the intersection of the horizontal and far right plane.
11. Add dimensions as shown in figure below
    - To dimension from end to end of a line, hover over the end of a line and press <Tab> until you see a small circle then click to select the end.
    - The overall length of the line does not matter in this step.
    - Change the view scale as needed to see the dimensions.



12. Select the overall dimension on the far left.
13. In the Options Bar, in the Label drop-down list, select **PipeOD.**
14. Select the overall dimension on the far right.
15. In the Options Bar, in the Label drop-down list, select **FlgDia.**
    The result displays as shown in figure below.

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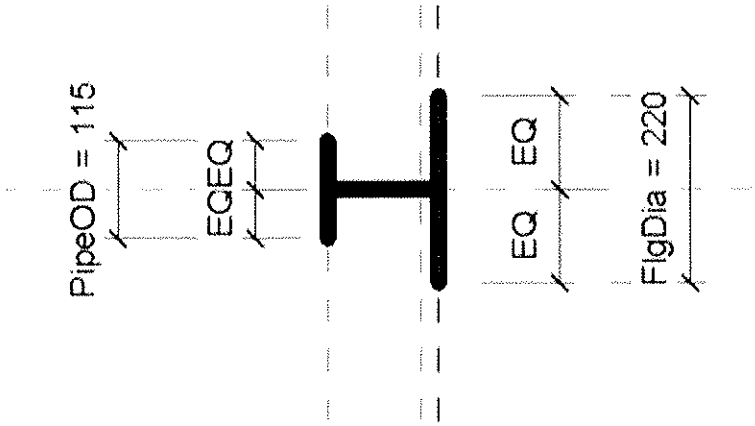
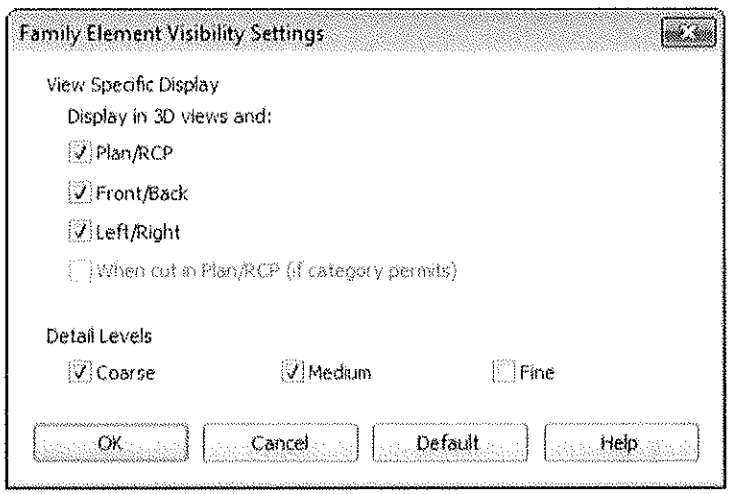


16. Deselect the dimension and select only the three lines.
17. In the Modify | Lines tab > Visibility panel, click (Visibility Settings).
18. In the Family Element Visibility Settings dialog box, in the Detail Levels area, clear the Fine option. Leave all of the others selected, as shown in figure below. This enables the selected elements to be visible only at the Coarse and Medium detail levels.



19. Click OK
20. Test the Detail Levels ending on Medium.
21. Save the family.

Task 5 - Create the Raised Face and Flange extrusions.

1. In the Project Browser, open the Left elevation view.
2. Select the model lines and temporarily hide the elements.
3. In the Home tab > Forms panel, click (Extrusion).
4. In the Modify | Create Extrusion tab > Work Plane panel, click Set
5. In the Work Plane dialog box, in the Name option drop-down list, select Reference

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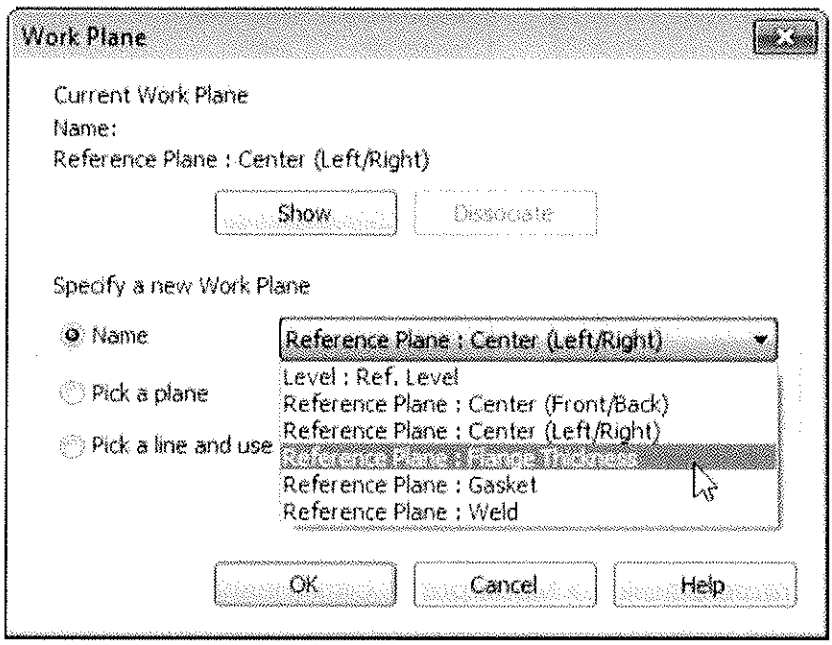
Plane: Flange Thickness, as shown figure below



6. In the Modify | Create Extrusion tab > Draw panel, click (Circle).
7. In the Options Bar, select Radius and enter 90mm.
8. Click on the intersection of the horizontal and vertical reference planes. Use the SI (intersection object snap override if required).
9. Click (Modify).
10. Select the circle and click on the icon to make the temporary Dimension permanent.
11. Click (Modify).
12. Select the dimension line. In the Options Bar, in the Label drop down list, select **RFR.**
13. Click (Modify) to release all selections.
14. In Properties, in the Extrusion End row, click the button as shown in figure below (Left)
15. In the Associate Family Parameter dialog box, select **RFT** as shown in figure below (Right) and click OK.

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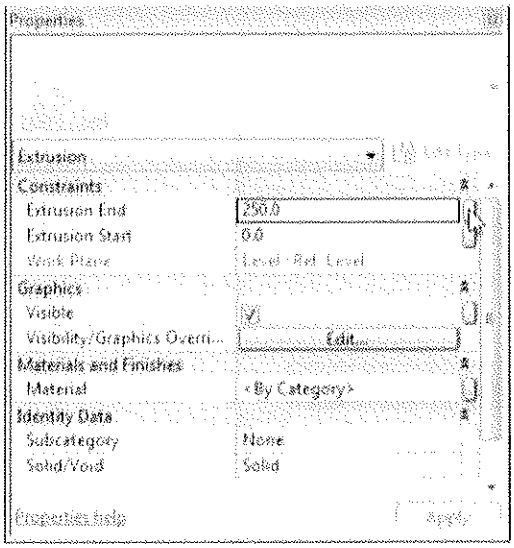

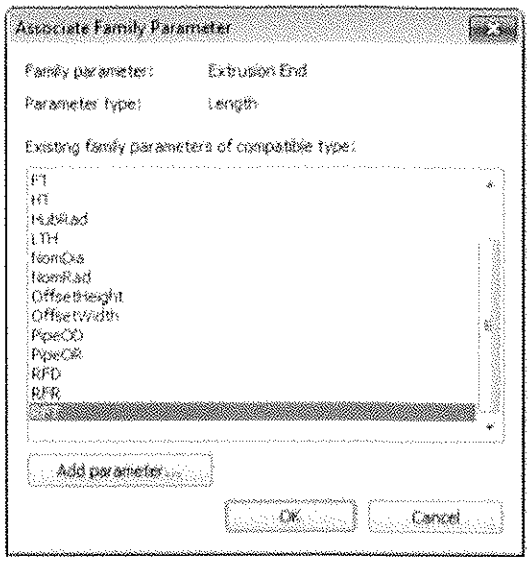

16. In the Modify | Create Extrusion > Mode panel, click (Finish Edit Mode) and click in the view to release the selection.
17. Start the (Extrusion) command again.
18. Set the Work Plane to Reference Plane: Center (Left/Right) and click OK
19. Draw a circle at the same intersection using a radius of 115mm.
20. Make the temporary dimension permanent and label it as **FlgRad.**
21. In the Extrusion End row, click on the button. In the Associate Family Parameter dialog box, select **FT** and click OK
22. Click (Finish Edit Mode) and click in the view to release the selection.
23. Save the family.

Task 6 - Create the Pipe Connection Blend.

1. In the Home tab > Forms panel, click (Blend).
2. In the Modify | Create Blend Base Boundary tab > Work Plane panel, click (Set).
3. In the Work Plane dialog box, select **Reference Plane: Weld** and click OK
4. In the Draw panel, click (Circle).
5. In the Options Bar, select Radius and enter 60mm. Place the center at the intersection of the horizontal and vertical reference planes.
6. Make the temporary dimension permanent and label it **PipeOR.**

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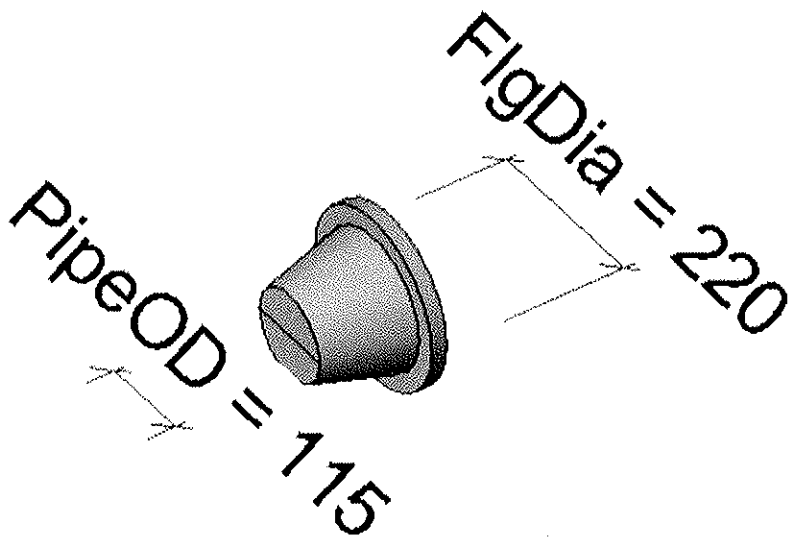
7. In the Modify | Create Blend Base Boundary tab > Mode panel, click (Edit Top).
8. Draw another circle at the intersection of the reference planes with a radius of 85mm.
9. Make the temporary dimension permanent and label it **HubRad.**
10. In Properties, for Second End, associate the parameter with **HT.**
11. Click (Finish Edit Mode).
12. Open the View 1 3D view.
13. Change the Scale to 1: 10 so you can see the elements rather than the dimension, as shown in Figure below.



14. Select the three model lines and temporarily hide them. You can also do this with the dimensions if required.
15. Save the family.

Task 7 - Create the Pipe Bore.

1. Open the Left elevation view.
2. In the Home tab > Forms panel, expand (Void Forms) and click (Void Extrusion)
3. Set the Work Plane to Reference Plane: Weld and click OK
4. Draw a circle with the Radius of 50mm at the intersection of the reference planes.

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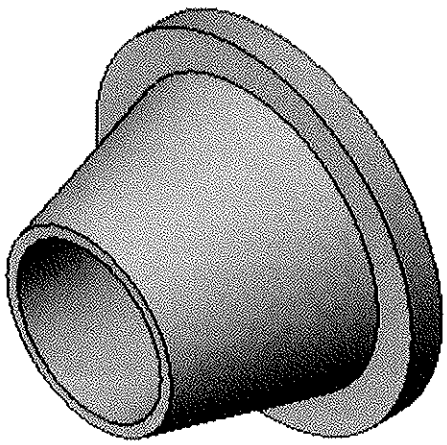
5. Make the temporary dimension permanent and Label it **NomRad.**
6. In Properties, for Extrusion End, associate it with **LTH** parameter.
7. Click (Finish Edit mode).
8. Open the View 1 3D view and shade the view. You can see the hole created by the void form, as shown in figure below.



9. Select one of the extrusion or void forms and click (Visibility Settings).

10. In the Family Element Visibility Settings dialog box, clear the Coarse and Medium options and verify that the Fine option is selected. This enables the selected elements to be visible only at the Fine detail level.
11. Click OK
12. You might need to switch to the 3D view to select the pipe bore (void form).
13. Repeat the steps for the remaining extrusion or void forms.
14. Save the family.

Choosing a Discipline for a Connector

The discipline assigned to a connector determines the types of systems with which it can interact and how it interacts with other system components.

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When you add connectors to a family, you can specify one of the following disciplines:

-  **Duct connectors** are associated with ductwork, duct fittings, and other elements that are part of the air handling systems.
-  **Electrical connectors** are used for any type of electrical connections, including power, telephone, alarm systems, and others.
-  **Pipe connectors** are used for piping, pipe fittings, and other components that are meant for transmitting fluids.
-  **Cable tray connectors** are used for cable tray, cable tray fittings, and other components that are meant for wiring.
-  **Conduit connectors** are used for conduit, conduit fittings, and other components that are meant for wiring. A conduit connector can be an individual connector or a surface connector. The individual connector is used for connecting only one conduit. The surface connector is used for connecting more than one conduit to a surface.

Task 8 - Add Connectors.

1. Continue working in the View 1 3D view.
2. In the Home tab > Connectors panel, click (Pipe Connector).
3. In the Modify | Place Pipe Connector tab > Placement panel,verify that (Face) is selected.
4. In the Options Bar, in the System type drop-down list, select Hydronic Supply.
5. Press <Tab> as required to highlight the small face of the and click to add the connector.
6. The arrow of the connector should be pointing outward from the flange object, as shown in figure below . If the arrow is pointing inward, click the Flip control.

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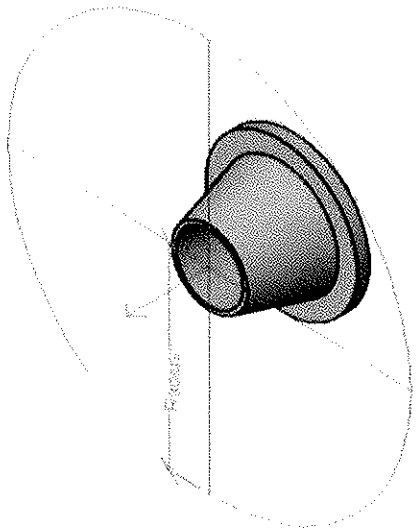
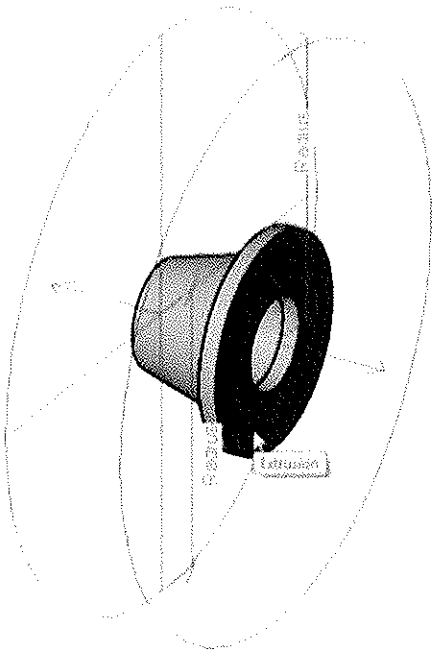


7. Spin the view so that the raised face is visible and apply another connector to that face as shown in figure below.



8. Click (Modify).
9. Select the first connector. In the Modify | Connector Element tab > Connector Links panel, click (Link Connectors).
10. Click the second connector to link it to the first.
11. Click (Modify).
12. Select both connectors

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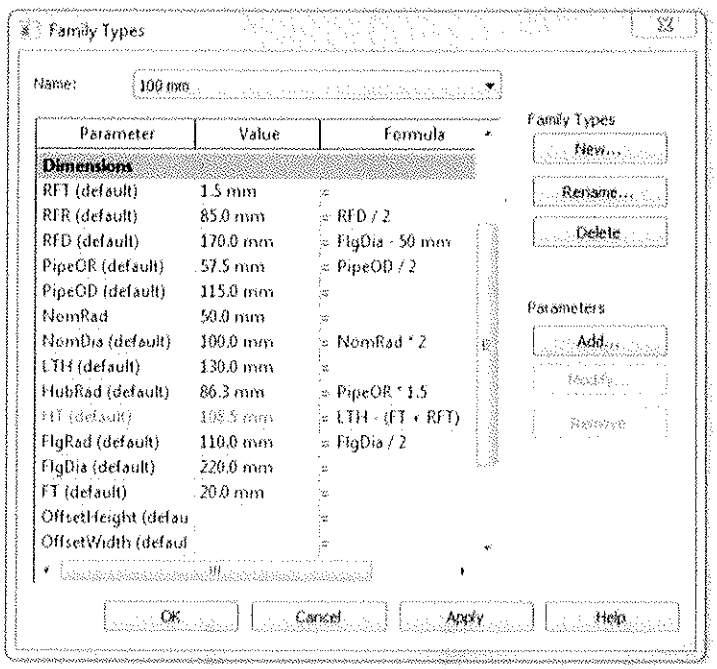
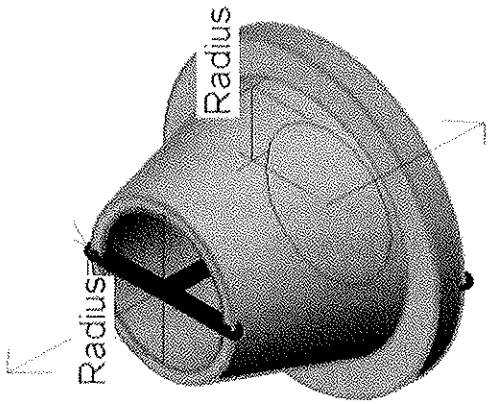
13. In Properties, for Radius, associate it with the **NomRad** parameter and click OK
14. Save the family.

Task 9 - Create family types.

1. Continue working in the family file 150 WN Flange.rfa.
2. In the Properties panel, click (Family Types).
3. In the Family Types dialog box, Family Types area, click ~~OK~~ NEW
4. In the Name dialog box, enter **100mm** and click OK
5. Click NEW again. In the Name dialog box, enter 150mm.
6. In the Dimensions area, change the parameter values according to the following
   - **PipeOD:** 170mm
   - **NomRad:** 75mm
   - **LTH:** 90mm
   - **FlgDia:** 280mm
   - **FT:** 24mm
7. Drag and move the Family Types dialog box so that the flange is visible.
8. Click Apply. The flange changes size according to the new parameter values, as shown in figure below.





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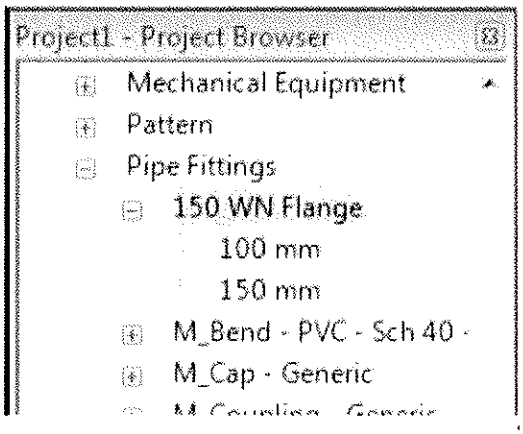
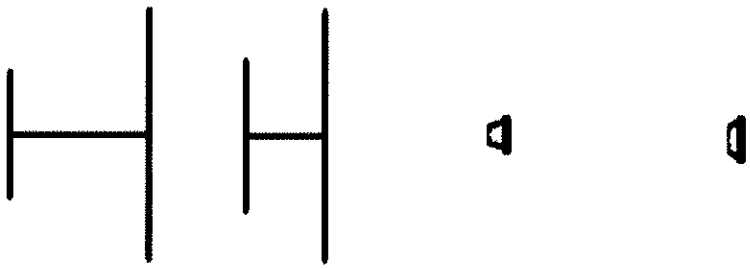
9. In the Name drop-down list, select 100mm.
10. Click again. The flange returns to its original size.
11. Click to close the dialog box.
12. Save the family.

Task 10 - Test the flange in a project.

1. Start a new project and switch back to the family.
2. In the Family Editor panel, click (Load into Project).
   * If you have one project open, the new family loads directly into it. If you have more than one project open, select the right one(s) in the dialog box.
3. You are returned to the project.
4. In the Project Browser, expand the Families area and the Pipe Fittings area. The **150 WN** Flange family is listed. Expand the 150 WN Flange family, as shown in figure below.



5. Drag an instance of each type into the drawing area of the project.
6. Zoom in to see the plan view of the flanges at a Coarse Detail level, as shown on the left in figure below
7. Change the Detail Level to Fine and the flanges display in detail at full size, as shown on the right in figure below.



8. Open a 3D view.

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9. Zoom in on the flanges and turn on (Thin Lines) as required.
10. Change Detail Level to Fine and enter SD to shade the view.
11. Spin the view to examine the flanges from all sides.
12. Save the project file.
13. Close the project and family files. Save any changes you want to keep.

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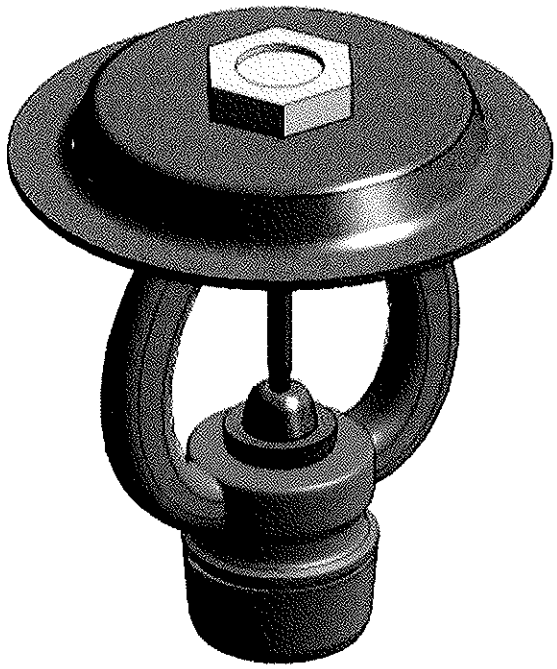
Exercise 3

Creating a Sprinkler Head

In this practice you will create a Sprinkler Head by using various method of creating geometry in Revit, place a pipe connector for wet system, create type parameter and apply materials, as shown in Figure below.



Steps

5. Start a new family, Click ▸ New ▸ Family and select **Metric Generic Model.rft** template.
6. On the new family file, Open the Front elevation view.
7. Click Insert tab ▸ Import panel ▸ (Import CAD), browse the file **K14 Sprinkler Head_Upright-View 1.dwg** found on your classfile and set the ff. settings.

- Positioning : Auto Center to Center
- Import units: millimeter
- Current view only : select

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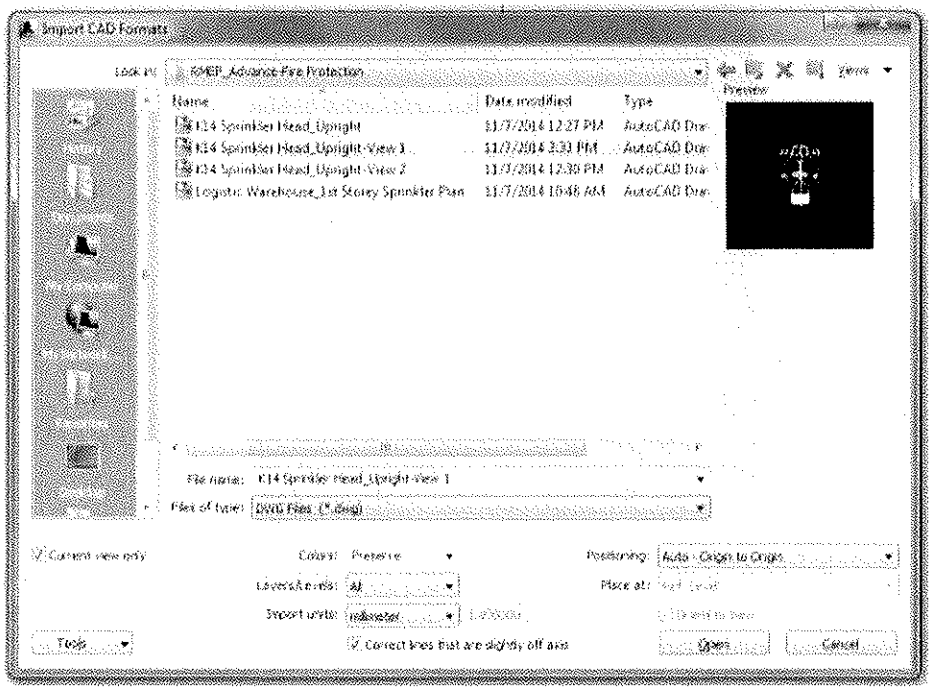
(see picture on the next page for references)

con't



8. Double click the Left Elevation view on the project browser to open
9. Click Insert tab ➤ Import panel ➤ (Import CAD), browse the file **K14 Sprinkler Head_Upright-View 2.dwg** found on your classfile and set the ff. settings.

- Positioning : Auto Center to Center
- Import units: millimeter
- Current view only : select

(Apply the same settings the same from the first imported cad file, refer to the picture above)

Creating the sprinkler body

10. In the Family Editor, on the Create tab ➤ Forms panel, Click (Revolve).
11. Using Line and pick Line Tool sketch the profile display in magenta color. Refer to the picture on next page.

    (Sketch the profile excluding the thread profile, ensure the sketch is close loop and no overlapping)

:

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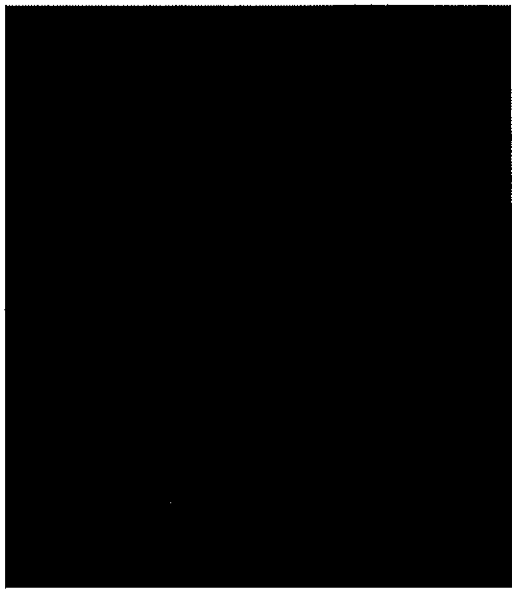
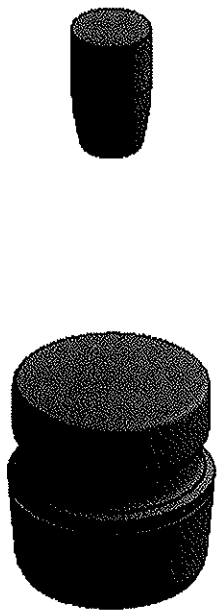


12. Place an Axis of revolution; On the Modify | Create Revolve tab ➤ Draw panel, click (Axis Line), click pick lines under draw panel and select the Reference plane: Center (Front/Back).
13. On the Mode panel, click ✓ (Finish Edit Mode)
14. To view the revolve, open a 3D view, change the visual style to shaded, you will able to produce something like the image below.
15. Save the file.



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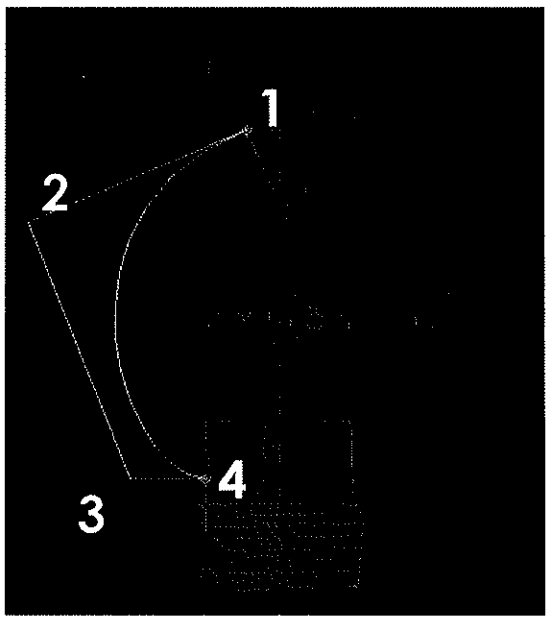
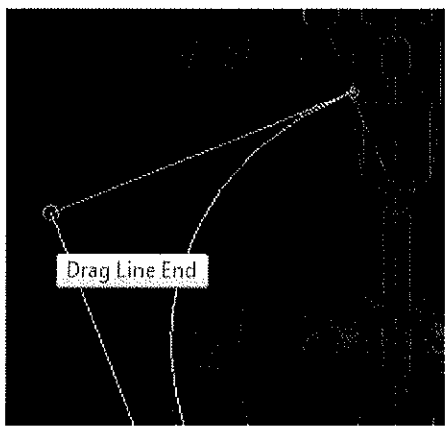
Creating the Deflector Bracket part

16. On the project browser double click **front** elevation to open the view.
17. In the Family Editor, on the Create tab ➤ Forms panel, click (Swept Blend) And on the Modify | Swept Blend tab ➤ Swept Blend panel Click (Sketch Path) to sketch a path for the swept blend.
18. On the Modify | Swept Blend tab ➤ Sketch Path ➤ Draw panel Click (Spline).
19. Start on the top portion all the way to mid part of the thread are, Click to add points (4 in total) to draw the spline (refer on the image below)



20. Adjust the shape of the spline to resemble the curve outline of the cad by click and dragging the Drag Line End.



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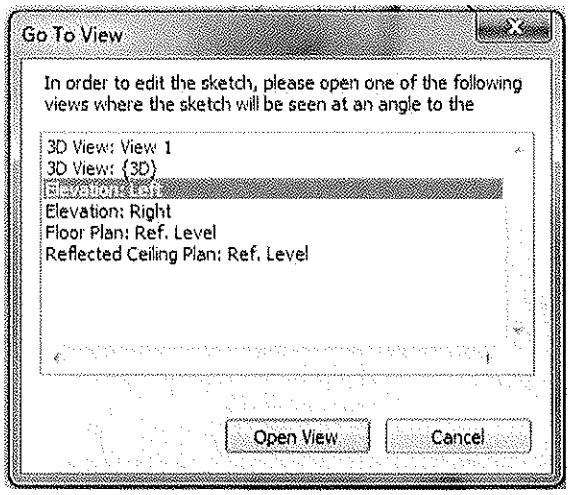
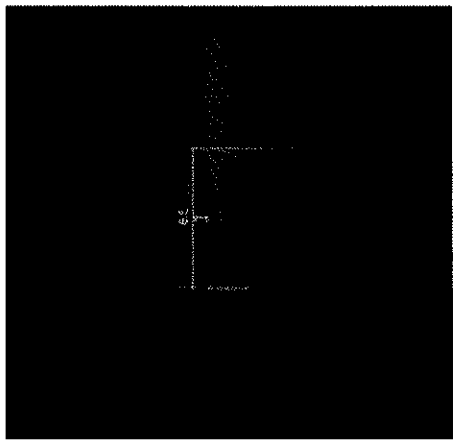
21. On the Mode panel, click ✓ (Finish Edit Mode) to finish the sketch of the path
22. On the Modify | Swept Blend tab ➤ Swept Blend Panel ➤ (Select Profile 1) ➤ (Edit Profile).
23. Select **Elevation: Left** on Go To View dialogue box and click Open View.



24. Sketch the profile 1 using the line tool and pick line tool, ensure the sketch is close loop and no over lapping of lines. refer on the picture below.



25. On the Mode panel, click ✓ (Finish Edit Mode) to finish the sketch on profile 1
26. On the Modify | Swept Blend tab ➤ Swept Blend Panel ➤ (Select Profile 2) ➤ (Edit Profile).
27. Sketch the profile 2 using the line tool and pick line tool, ensure the sketch is close loop and no over lapping of lines. refer on the picture on the next page.

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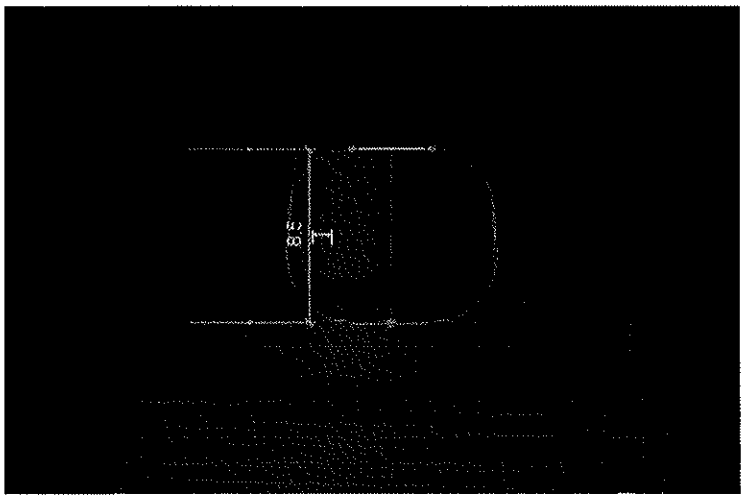
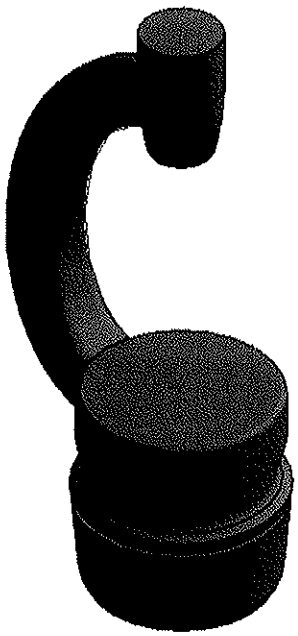


28. On the Mode panel, click ✓ (Finish Edit Mode) to finish the sketch on profile 2
29. On the Modify | Swept Blend tab click ✓ (Finish Edit Mode) to finish the Swept Blend.
30. To view the Swept Blend , open a 3D view, change the visual style to shaded, you will able to produce something like the image below.



31. To view the Swept Blend, open a 3D view, change the visual style to shaded, you will able to produce something like the image below.
32. Open the Front Elevation View and select the Swept Blend object.

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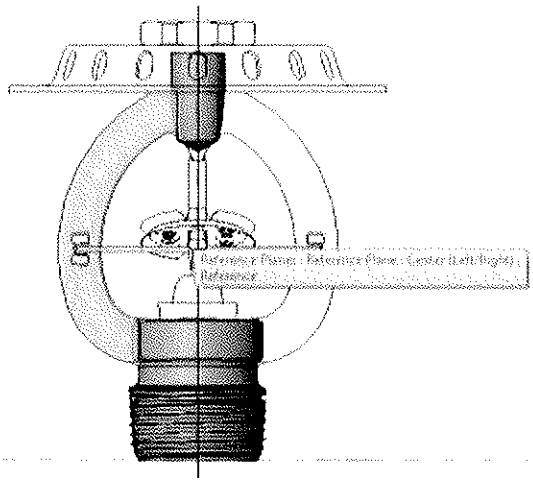
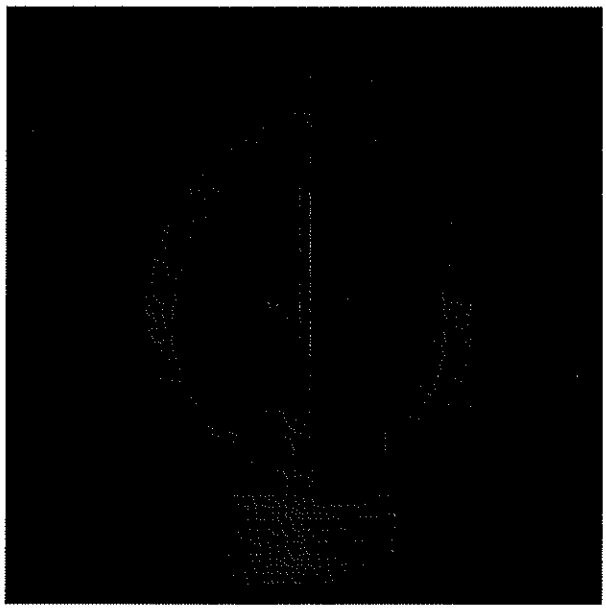
33. Open the Front Elevation View and select the Swept Blend object.
34. On the Modify | Swept Blend tab ➤ Modify panel, and click either (Mirror - Pick Axis)
35. Select the References Plane: Center Left/Right.



36. Save the file.

Creating the Trigger and Support part

37. In the Family Editor, on the Create tab ➤ Forms panel, Click (Revolve).
38. Using Line and pick Line Tool sketch the profile display in magenta color. Refer to the picture below.



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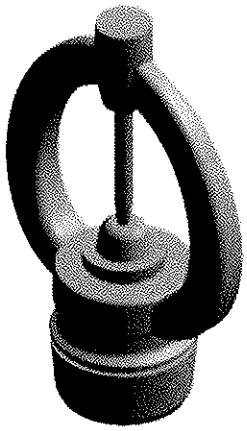
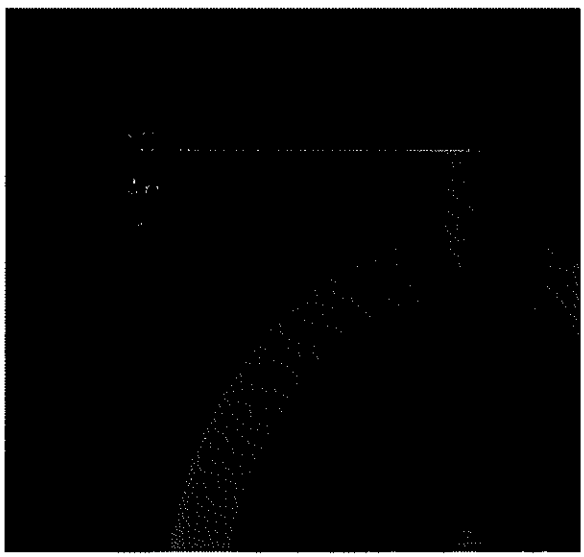
39. Place an Axis of revolution; On the Modify | Create Revolve tab ➤ Draw panel, click (Axis Line), click pick lines under draw panel and select the Reference plane: Center (Left/Right).
40. On the Mode panel, click ✓ (Finish Edit Mode)
41. Save the file.



Creating the Deflector part.

42. In the Family Editor, on the Create tab ➤ Forms panel, Click (Revolve).
43. Using Line and pick Line Tool sketch the profile display in magenta color. use the Refer to the picture below.



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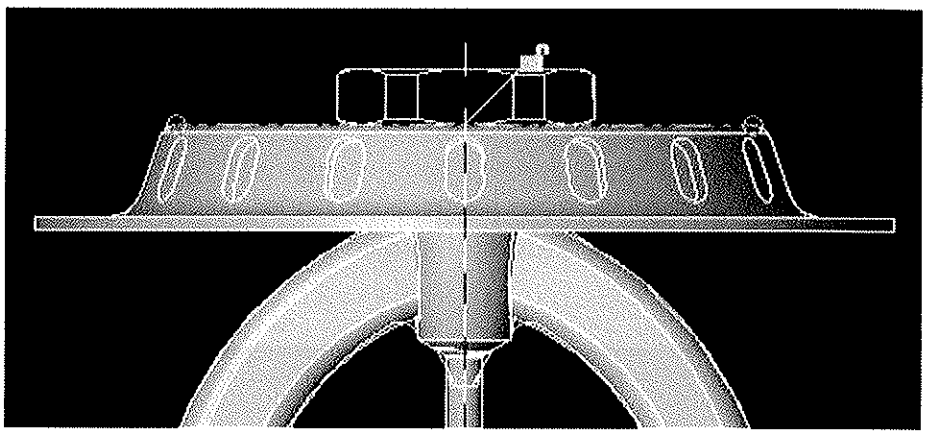
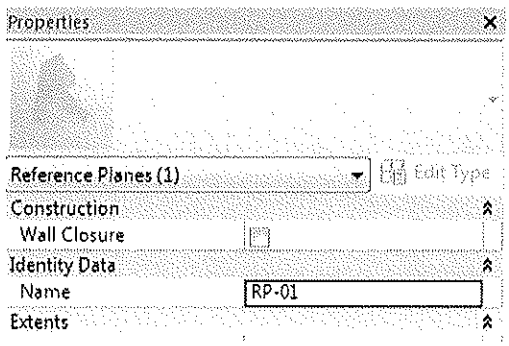
44. Place an Axis of revolution; On the Modify | Create Revolve tab ➤ Draw panel, click (Axis Line), click pick lines under draw panel and select the Reference plane: Center (Left/Right).
45. On the Mode panel, click (Finish Edit Mode)
46. Save the file.

Creating the Lock Nut.

47. Create Reference Plane; On the Create tab ➤ Datum panel ➤ click (Reference Plane).
48. On the Draw panel, click (Pick Lines).
49. Click the top portion of the deflector part to place the Reference Plane. Click modify to finish selecting.



50. Click to select the new reference plane and In the Properties palette, for Name, enter a name for **RP-01**



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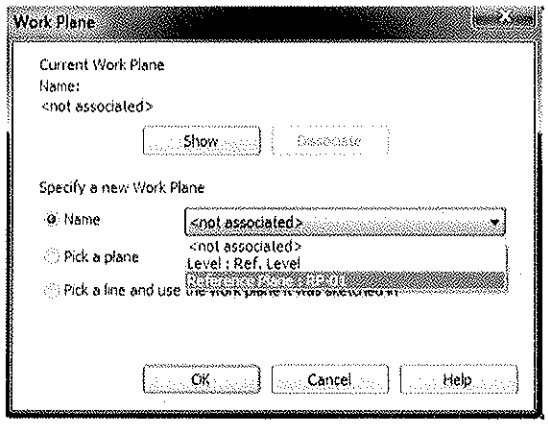
51. On the project browser open the Floor Plans; **Ref Level** view

52. Set the working plane; Click Create tab ⮞ Work Plane panel ⮞ Set.

53. Under Name of Specify a new workplane, select from list **Reference Plane : RP-01**



54. On the Create tab ⮞ Forms panel, Click (Extrusion)
55. Under Draw panel ⮞ click (Circumscribed), Number of side is set to **6** on option bar
56. Draw a radius 9.5 polygon on the center location of the deflector part and set the **Extrusion End** value to **5** in the properties palette.
57. On the Mode panel, click (Finish)
58. Save the file.

Create a void extrusion on the Lock nut.

59. Still in the **Ref. Level** view, on the Create tab ⮞ Forms panel, Click Void Forms drop-down ⮞ (Void Extrusion)
60. Under Draw panel, click (Circle) and draw a circle on the center of Lock nut with **radius** value of **5 and** set the ff. parameters value in the properties pallette.

- **Extrusion Start: 4.0**
- **Extrusion End: 6.0**

61. On the Mode panel, click (Finish)
62. Save the file.

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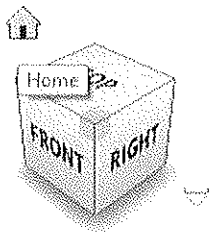
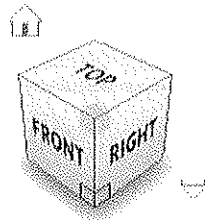
Placing a pipe connector

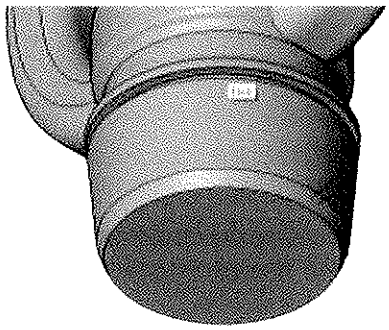
63. Open the 3D view and click the Home icon to orient the view in default isometric setting.



64. Change the visual style to shaded and on the view cube, click the lower corner between the Front & Right side to re orient the view.



65. Place a pipe connector: Create tab ➤ Connectors panel, and click a Pipe Connector on the Placement panel ensure  Place on Face is selected.
66. Zoom in closely on the thread portion and click the face of the groove to place the connector. (Refer to the image below).



67. Select the pipe connector and on the property palette set the following parameters.
    - **Diameter : 25**
    - **System Classification: Fire Protection Wet**

68. Click Modify to finish the editing.

Applying Object Material

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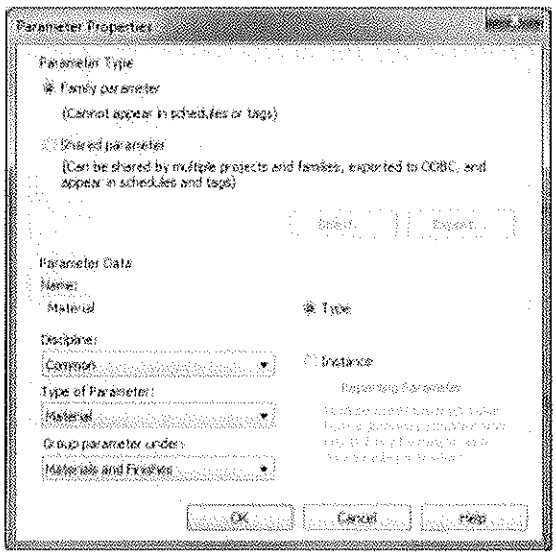
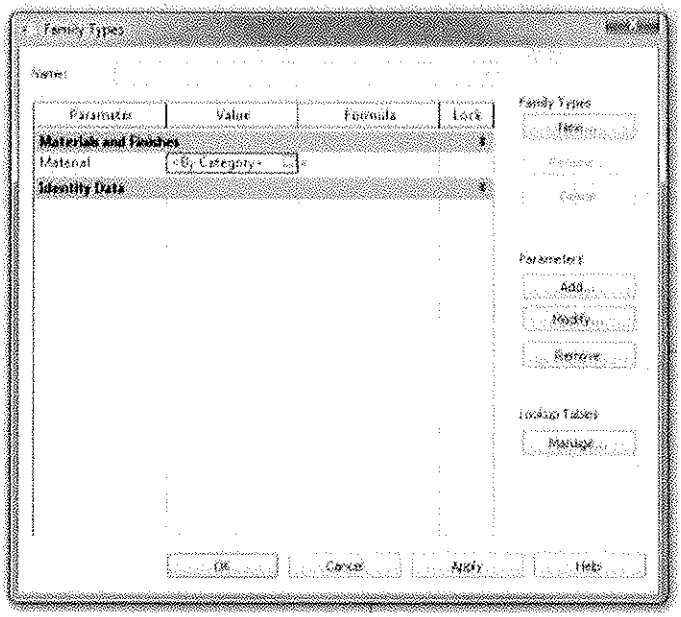
69. Create material type parameter , click Create tab ⮞ Properties panel ⮞ (Family Types)

70. Under Parameters, click Add. and set the ff. data (Refer on the image below).



71. Click OK on the Parameters Properties.

72. On the Family Type parameters click the **<By Category>** under value column, the Material Browser will be open.



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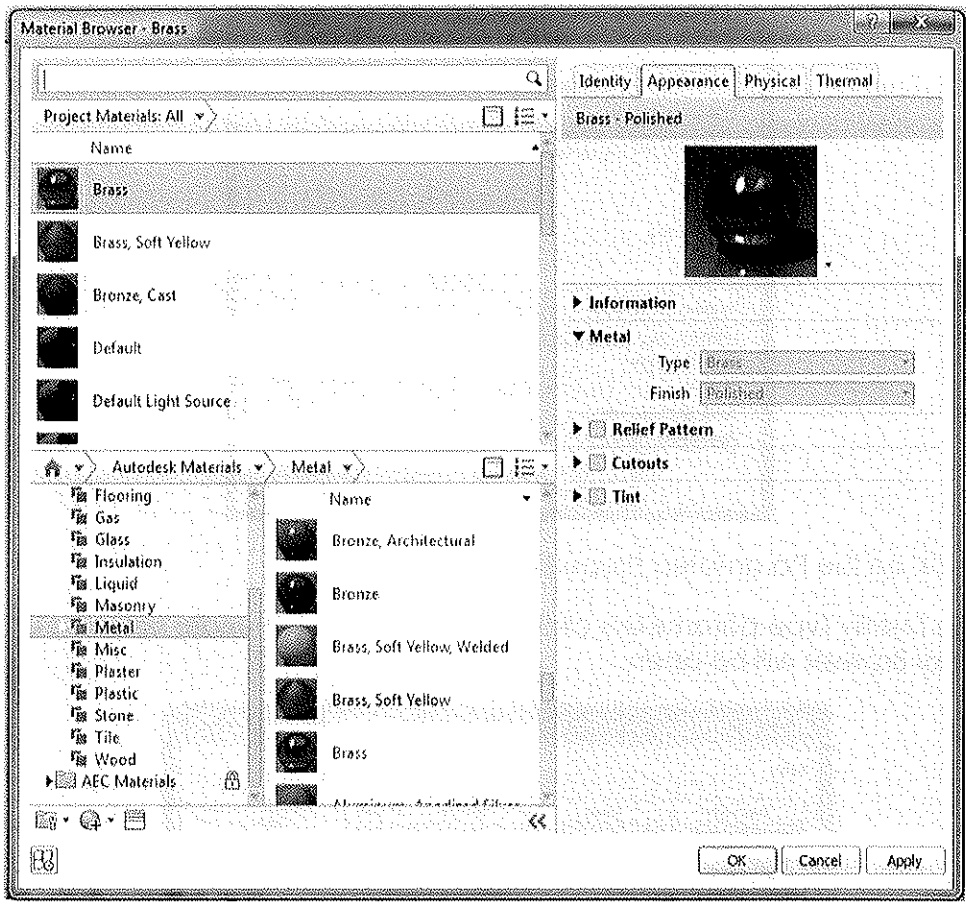
73. In the Material Browser, double click **Autodesk Material** in Material Library and click **Metal** on the subcategory on the right pane of the Library Tree you will find various materials under metal, double click the **Gold** material to load this material on project. Load the ff. materials **Steel Galvanized and Steel AISI 1050.**



74. Click OK to close the Material Browser dialogue box

75. Click OK to close the Family Type parameters dialogue box.

Applying Materials on object

76. On the 3d view select the Body (first revolve object), go to Type Properties under **Material** parameters click the value on the right column to open the Material Browser and select the material Gold to assign on the object.

77. and click OK

78. Repeat the procedure for the rest of parts on the list of assign material for every part.

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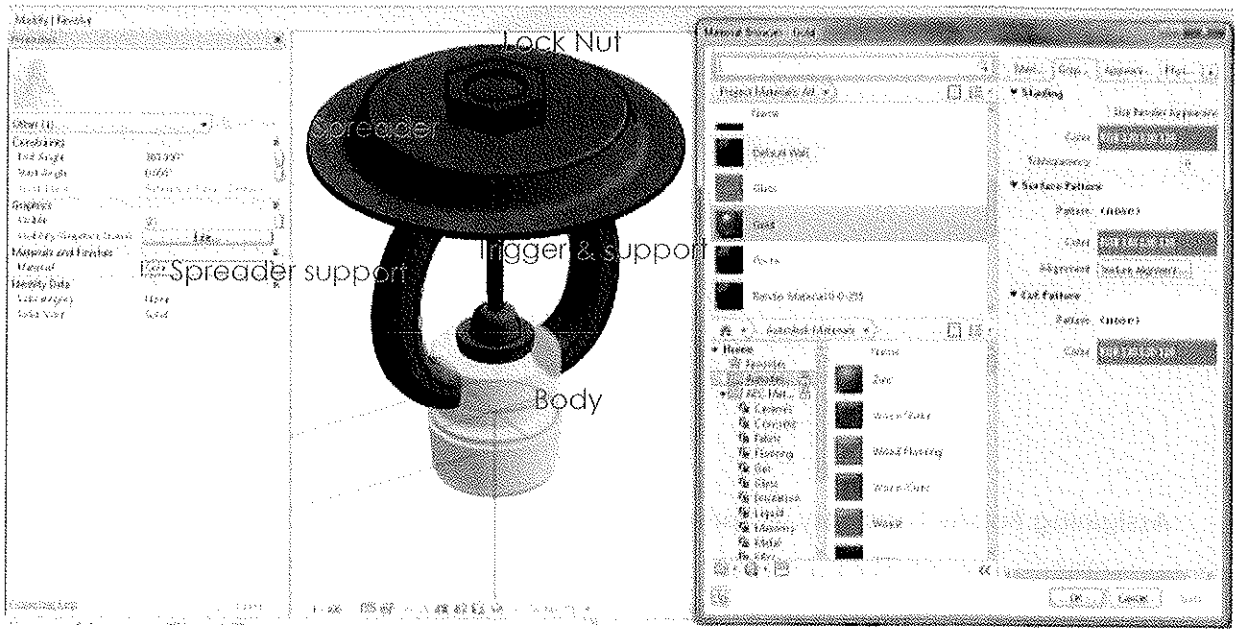

Material assignment by parts.

Spreader support: Gold

Spreader: Steel Galvanized

Trigger and Support: Steel Galvanized

Lock Nut: Steel AISI 1050

79. Save the file.

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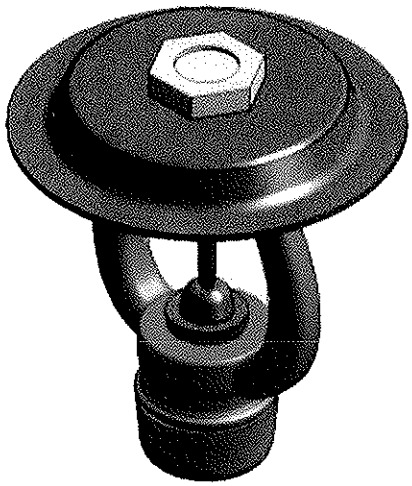

Assigining Family Category to Sprinkler

80. On the click Create tab (or Modify tab) ➤ Properties panel ➤ (Family Category and Parameters).On Family Category select **Sprinkler** from the list and on Family Parameters ensure **Always Vertical** is selected.

81. Click OK to close the dialogue box

82. Save the file.

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