Practice Workbook

This workbook is designed for use in Live instructor-led training and for OnDemand self study.
OnDemand videos for this course are available through *CONNECT Advisor* and on the *LEARNserver*.

Bentley® OpenBuildings™ Designer CONNECT Edition

Learning OpenBuildings Designer: Modeling and BIM Essentials

About this Practice Workbook:

- This PDF file includes bookmarks providing an overview of the document. Click on the bookmark to quickly jump to any section in the file.
- This workbook shows Imperial units—with International System (metric) units shown in blue italicized text in brackets—for example:

Height: **15:0** *[4500 mm]* where the Imperial value for the height is 15' and the SI value is 4500 mm.

- This course uses training examples delivered with the software.

Have a Question? Need Help?

If you have questions while taking this course, search in CONNECT Advisor for related courses and topics. You can also submit questions to the Building Analysis and Design Forum on Bentley Communities where peers and Bentley subject matter experts are available to help.

Bentley Institute

Revision: CE09 en.1

Course Level: Fundamental

Description and Objectives

Course Description

This course is an introduction to 3D BIM modeling with OpenBuildings Designer. This hands-on workbook contains exercises for getting started with Bentley's BIM solution, OpenBuildings Designer. The student will learn basic modeling techniques for working in a 3D environment and how to create and manage the information that is contained in the model. Each chapter will take the student step by step through the workflow of creating an intelligent model for a small transportation station.

Learning Objectives

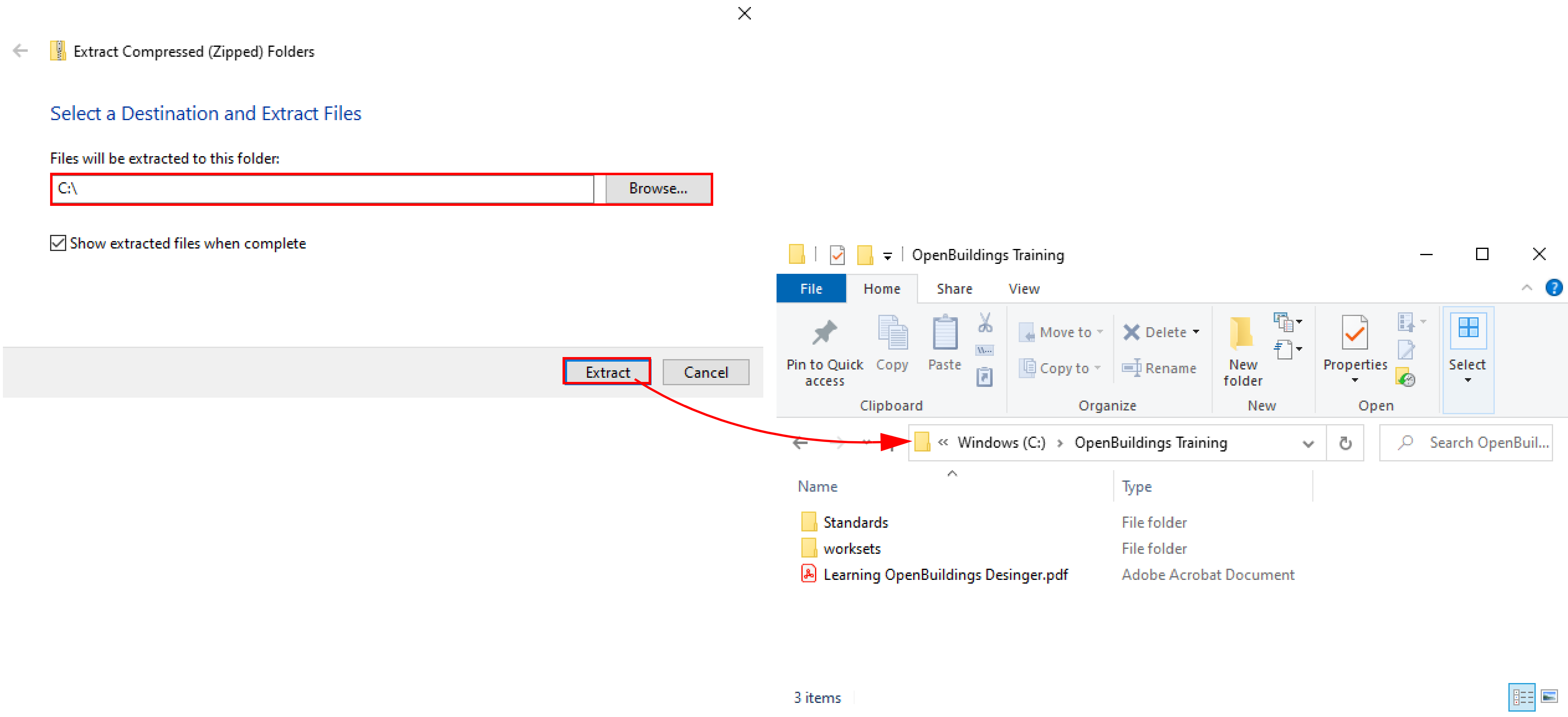
Upon successful completion of this course you will be able to work effectively in a 3D OpenBuildings Designer model. In the process you will also learn the following tasks necessary to complete an intelligent building model.

- Set up a new project WorkSet.
- Navigate the 3D model views
- Create a conceptual block model
- Model columns and beams
- Place and modify walls.
- Add doors, windows and curtain walls
- Place a sloped roof.
- Space planning
- Place assemblies
- Add furnishings and equipment
- Place Mechanical Equipment
- Route Ductork
- Create a custom profile

Installing the Training Dataset

This is a hands on course, you will need to install the course dataset in order to complete the exercises in this workbook.

1. Download the course dataset, **Learning OpenBuildings Designer.zip**, to your desktop.
2. Use **Extract All** to unzip the file to your **C:\\.** (Or another available drive.)

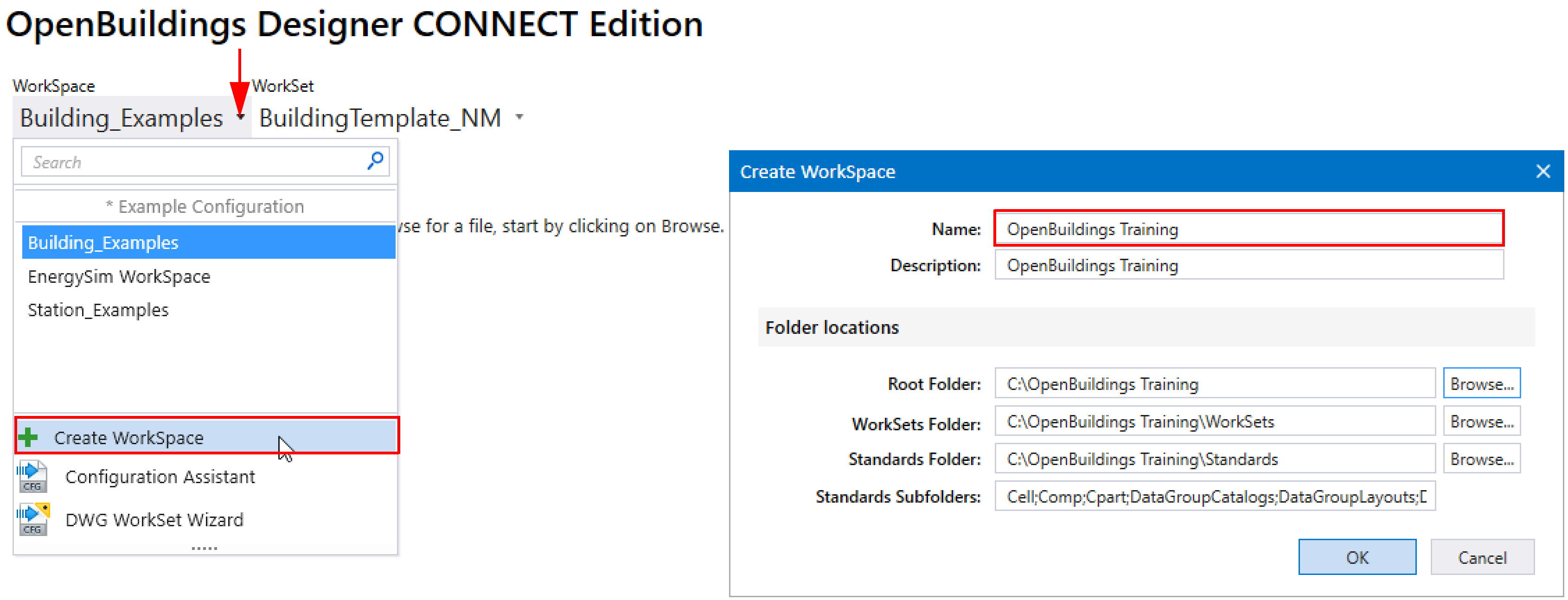


Note: The workbook for *Learning OpenBuildings Designer: Modeling and BIM Essentials* is located in the zip file.

3. **Start** *OpenBuildings Designer*.

The Workpage will open. Before creating or opening a design file you must select a WorkSpace and a WorkSet. For the training you will create a new WorkSpace that points to the course dataset that you installed in *step 2*.

4. From the WorkSpace pull-down select **Create WorkSpace.** The *Create WorkSpace* dialog will open.



Name: **OpenBuildings Training**

Note: The *Name* must be typed exactly as shown above.

Root Folder: **C:** (Or the drive where you unzipped the dataset.)

Note: Once you select the **C:** the rest of the folder path will be filled in. Do **not** select *C:\OpenBuildings Training* as the Root Folder.

5. Select **OK** and **Close** *OpenBuildings Designer.*

The WorkSpace is created, you need to close and re-open OpenBuildings Designer to see the WorkSets that were installed with the training dataset.

Welcome to OpenBuildings Designer

OpenBuildings Designer is a single, shared, multi-discipline Building Information Modeling (BIM) solution that combines architectural, structural, mechanical, and electrical design and construction documentation into a single consistent application. Delivered with this product are integrated datasets and tool sets for Architectural, Mechanical, Structural and Electrical disciplines.

OpenBuildings Designer is specifically designed for AEC engineers and other building professionals to design, analyze, and construct buildings of all types and scales. It empowers architects and engineers to design sustainable infrastructure and enables project teams to deliver well-designed and high performing buildings while taking advantage of the many benefits associated with BIM.

A unified interface presented in a ribbon format enables seamless interoperability between disciplines, and fosters collaboration throughout the project life cycle.

OpenBuildings Designer Focus

OpenBuildings Designer enables you to address essential project needs such as:

- Mass modeling and space planning that occur in the early stages of projects.
- Production of the design model including the placement of structural elements, walls, windows, doors, casework, HVAC systems and components, and electrical systems and components.
- Production of project documentation such as drawings, schedules and reports throughout the project life cycle and beyond.
- Analysis capabilities, such as structural and energy analysis, ensure the building is structurally sound, energy efficient, and meets the architectural requirements created by its designers.
- Simulation capabilities, such as clash detection for construction, review and identify coordination issues within the building model early in the design process.
- Integrated visualization with the Luxology rendering engine.

OpenBuildings Designer supports both a single model work-flow for small buildings and a federated model work-flow for larger, more complex projects. Bentley's powerful referencing capabilities are used to create a master building model made up of any number of smaller distributed models.

Chapter 1: The 3D Model

In OpenBuildings Designer, intelligent 3D models are the single source for all information and data (input and output) regardless of the discipline. So the integrated project model typically includes model data that is architectural, structural, mechanical and electrical. Data from virtually any discipline can be included in the 3D integrated project model.

When an element is placed in the model it appears as a 3D element and becomes the source for all extracted 2D information. That information can take form as plans, elevations, sections, reports, schedules, and other documentation. The entire design process, from Schematic Design to Presentation to Construction Documentation, evolves and originates from this data. All design revisions are made in the model and 2D data is automatically updated, therefore it is important to learn the skills necessary to work effectively in a 3D model. This first chapter will focus on creating the 3D model, placing simple geometry and then navigating and working in the 3D view. At this stage only a minimal amount of intelligent data is added to the model in the form of Family and Part data.

The organization of model files needs to be considered fairly early in a project. Quite often the 3D master model will be made up of several DGN master models which are necessary for the development of all the various discipline and design areas. These master models typically include a Building (architectural) model (more than one usually), a Structural model, a Site (civil) model, a Mechanical model (HVAC and plumbing), and models related to other discipline specific areas. Some key project model considerations are:

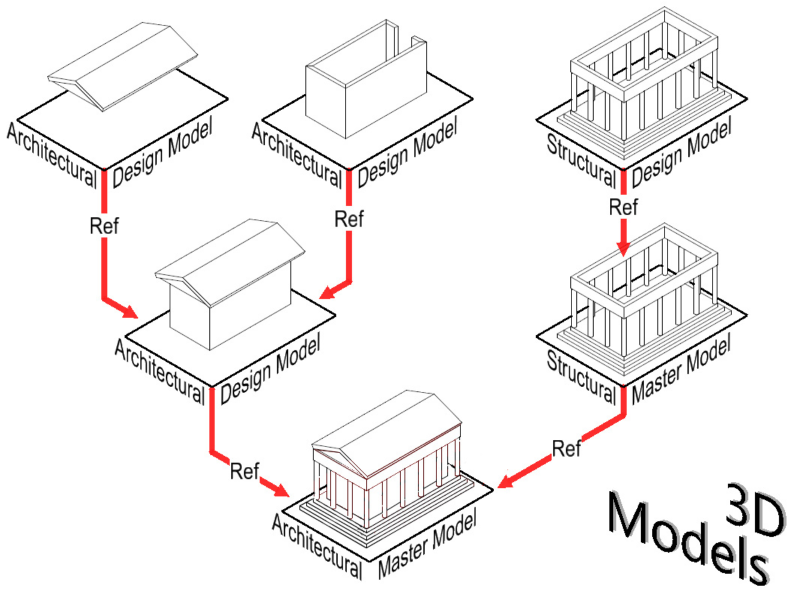
- Establishing master models for major design areas, building components, and discipline specific building applications.
- Dividing master model areas into smaller models that can be completed by other project team groups working simultaneously. The smaller models are referenced into the master model.
- Limiting models to essential data; restricting detailing to construction documentation.

In this course the focus is learning how to work in the 3D model. For simplicity, only three models are created; one for the architectural discipline, one for the structural discipline and one for the mechanical discipline. All data for each discipline is included in a single DGN file including the drawings and a single sheet. The structural model will be referenced to the architectural model so that the structural data is included in the architectural drawings. This is possible on a smaller building project or with a schematic building model. For larger, more complex building models, the model should be divided into a number of smaller models as described above and the drawings and sheets would be created as separate files from the model files.

Unified Building Dataset

OpenBuildings Designer delivers a full, multiple discipline dataset with architectural, structural, and mechanical components. It has been enhanced and streamlined for ease of use and management. This dataset supports customization which enables you to easily append the OpenBuildings Designer delivered dataset with project related data.

The Federated Model



Before starting the 3D Building Information Model, it is important to understand how **OpenBuildings Designer** uses a federated approach to assemble the building model. This means you are able to create a number of different design models and DGN files for various parts of the model. These models are considered your *working models*.

This federated approach is facilitated by the reference capability of **OpenBuildings Designer**.

These working models are organized as necessary by each discipline. Each discipline will then reference their working models together to create a *discipline master model*. These discipline master models can be referenced together creating the building master model used for coordination. This efficient method simplifies the modeling process, giving multiple team members access to the project. A project *Floor and Grid System* will be used to help keep the various model files aligned in 3D space. The discipline master models can be referenced together to create drawing composition models that are used for the creation of drawings.

Organizing the Model

The first step is to decide how to organize the working models for the project. Will it be a single model – everything modeled in a single file, or a federated model that takes advantage of powerful referencing capabilities and references numerous smaller models together to create the building model. This will be determined by the size and complexity of the project, as well as the current design phase. It is not unusual to start out with a single model in a conceptual design phase and break it apart into more models as the design effort progresses.

Also, consider the project team. Which disciplines will contribute to the model? Each of their models will need to be separate and be referenced into the overall BIM model. Also, how many team members need to work on the model. You need to break the model down into enough files that each team member has at least one file to work in.

And finally, you should think about the design itself. What is likely to change in the design? Is there a design element being studied with numerous alternates? Make that portion of the building a separate file so it can be easily switched in and out.

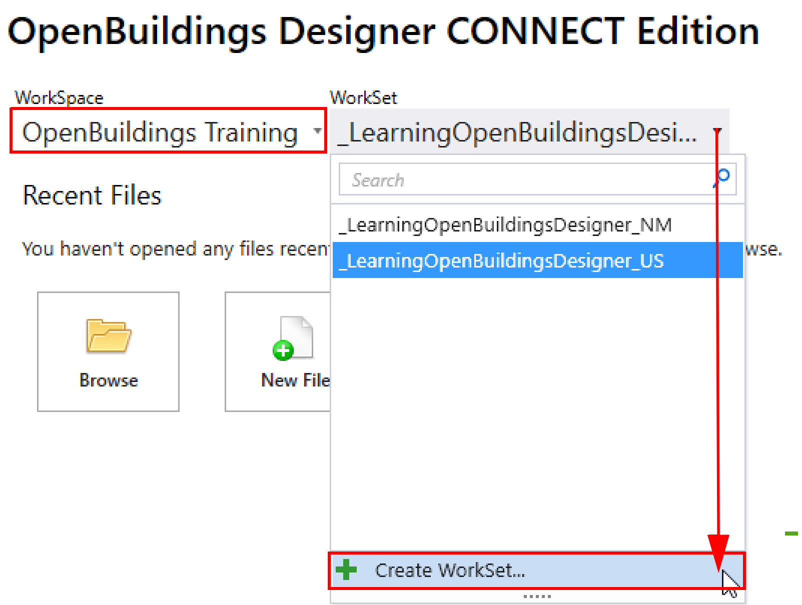
In this course you will use a single model for each discipline.

Once the model organization is determined, and keep in mind a good model organization is flexible enough to allow changes to the organization as the design progresses, the next step is to consider what is to be output from the model. Drawings? Schedules? Quantities? Clash Detection? Renderings? The output determines what you will model and how much data will be included. In the early design phases of a project the data will be minimal, the focus will be on the actual geometry, additional data will be added as the model progresses.

Exercise 1-1: Creating a New WorkSet and Model File

In order to start a building model a designer must set up their design environment by creating a new *WorkSet* and *design* file.

1. Start **OpenBuildings Designer** from the *Start* menu or desktop shortcut.



The WorkSpace and WorkSet

Upon starting up OpenBuildings Designer you will find that you need to select a *WorkSpace* and a *WorkSet*.

Every file created should belong to a *WorkSet*, basically a set of files and folders that all belong to the same project. Creating a new *WorkSet* creates a set of folders that contain and define the files and standards for that project. Every *WorkSet* will belong to a *WorkSpace* that defines common standards for all the projects in that *WorkSpace*.

For the purpose of the *Learning OpenBuildings Designer* training you will use the *WorkSpace*, **OpenBuildings Training,** and create a new *WorkSet*.

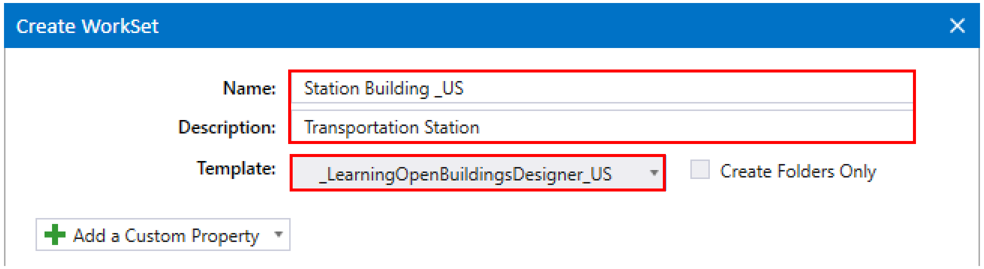
2. Set the *WorkSpace* to **OpenBuildings Training.**

3. From the *WorkSet* pull down, select **Create WorkSet...**Create a *Name, Description* and select a *Template* for the new WorkSet.

   Name: **Station Building_US** *[Station Building_NM]*.

   Description: **Transportation Station**

   Template: **LearningOpenBuildingsDesigner_US** *[LearningOpenBuildingsDesigner_NM]*.



4. Select **OK**.

The new *WorkSet*, **Station Building_US** *[Station Building_NM]* is now activated and new files will be created as part of this *WorkSet.*

5. Select **New File**.

   File name: **A_StationModel.dgn**

When you create a new DGN file, OpenBuildings Designer needs to copy one of the provided templates or seed DGN files to create the new file.

Delivered seed files include:

DesignSeed.dgn - 3D Design Model

DrawingSeed.dgn - 2D Drawing Model

SheetSeed.dgn - 2D Sheet Model

See *Design Models, Drawings and Sheets* below for more information on OpenBuildings Designer's files and models.

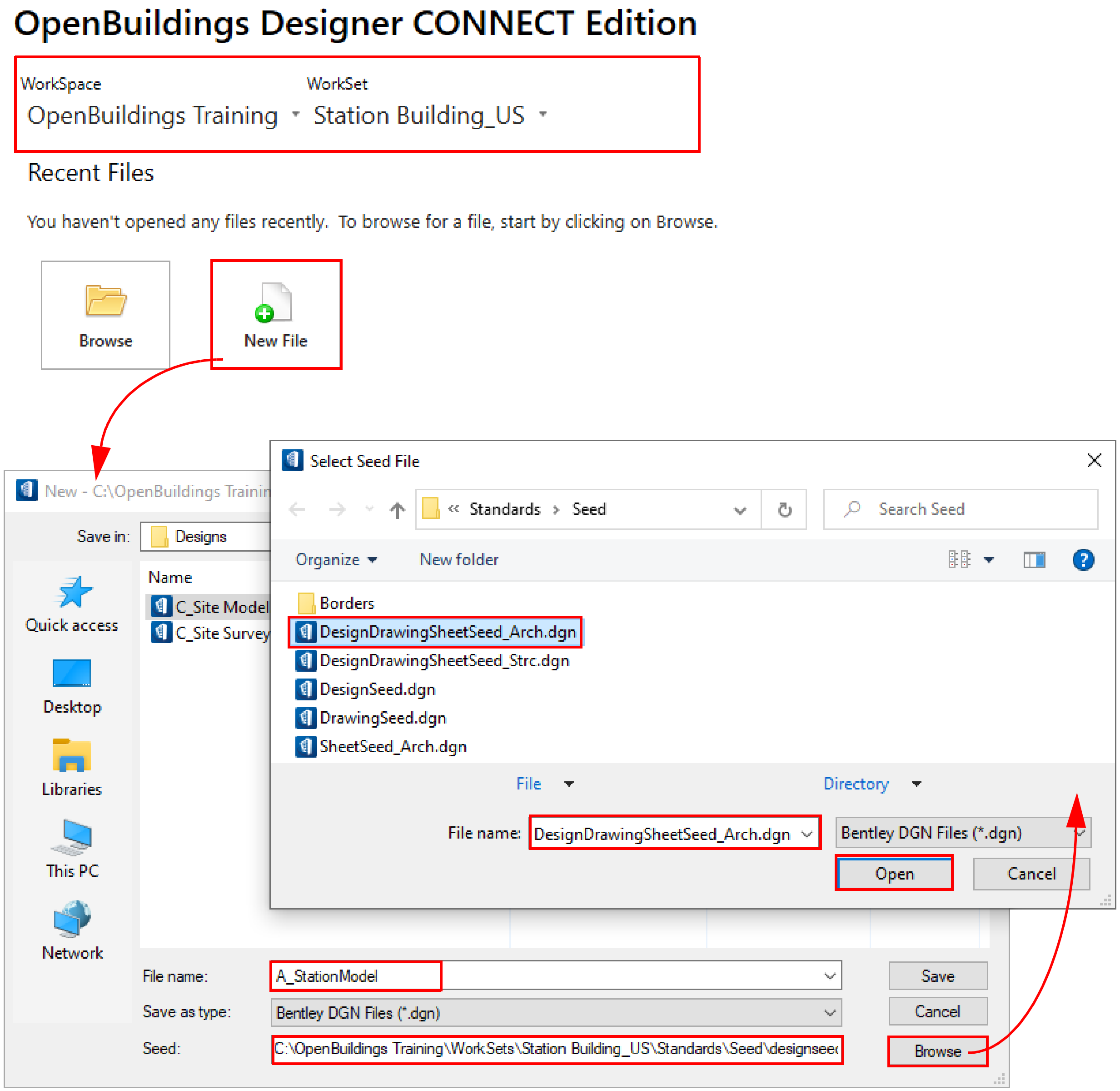
6. Select the **Browse** icon and select the seed file.

   File name: **DesignDrawingSheetSeed_Arch.dgn**

The **DesignDrawingSheetSeed_Arch** is a DGN seed file that was customized specifically for this project and has a 3D design model as well as architectural drawing models and a sheet model preset with plan, section and elevation views.

   a. Select **Open** to set the seed file.

   b. Select **Save** to open the new file, *A_StationModel.dgn*.



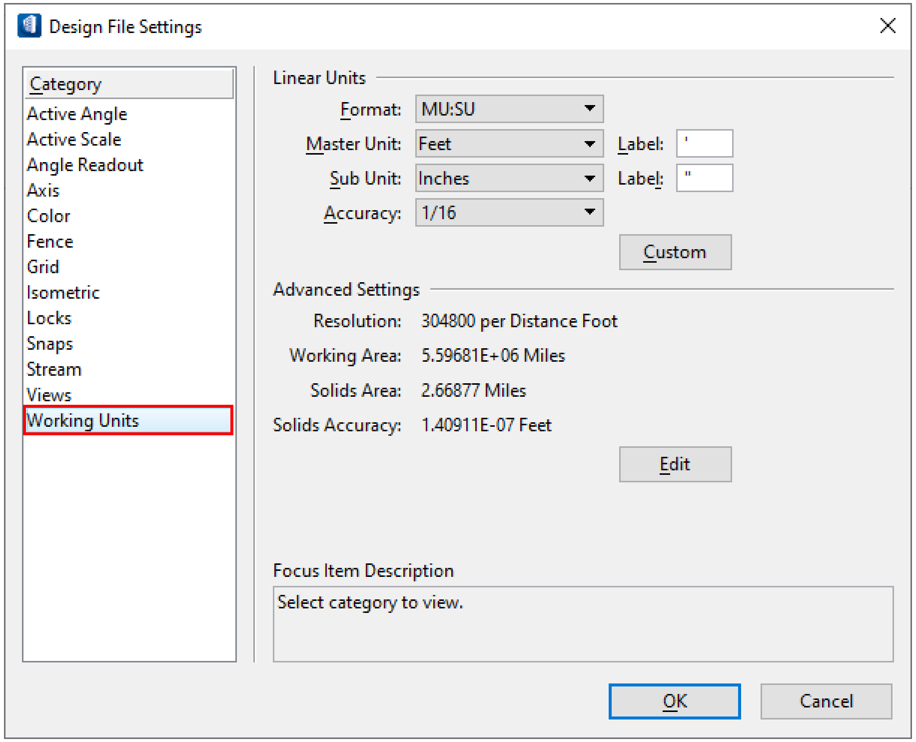
Seed Files

When you create a DGN file, you identify a seed file as a template for the DGN file. By selecting a seed file, the internal settings of the newly created DGN file automatically assume the settings of the seed file. Seed files can define many settings such as working units, dimension settings and standard drawing sheet borders.

Seed files do not (necessarily) contain elements, but, like other DGN files, they do contain at least one (default) model, settings, and view configurations. Having a seed file with customized settings frees you from having to adjust settings each time you create a new DGN file. If you wish, you can have different seed files for various types of models and drawings that you do. It is, however, best practice to create your seed file by copying one of the delivered OpenBuildings Designer seed files and then making any desired modifications.

Design File Settings

Numerous settings for the seed file, such as the Active Angle, Locks and Snaps, can be set in the *Design File Settings* dialog. It is accessed by selecting **File > Settings > File > Design File Settings**. In addition, the files working units can be set in this dialog.



The *Working Units* category is used to set "real world" units of measurement for the design model. The product recognizes Metric and English units, either of which may be selected here.

Caution: It is **not** recommended to use OpenBuildings Designer components and content within a file whose working units are defined as '*US Survey Miles/Feet/Inches*'. Files using US Survey Units and/or Geographic Coordinate System can be referenced and the unit and coordinate system transformation will be handled through the referencing system.

Changing between the units used in a model makes no difference to the size of geometry in your model. However, changing the *Resolution* setting in the *Advanced* settings does change the size of existing geometry in the model. In practice, the *Resolution* setting should never be changed from the default that is set in the OpenBuildings Designer delivered seed files.

> *US Unit Resolution: 304800 per Distance Foot*
>
> *Metric Unit Resolution: 1000 per Distance Millimeter*

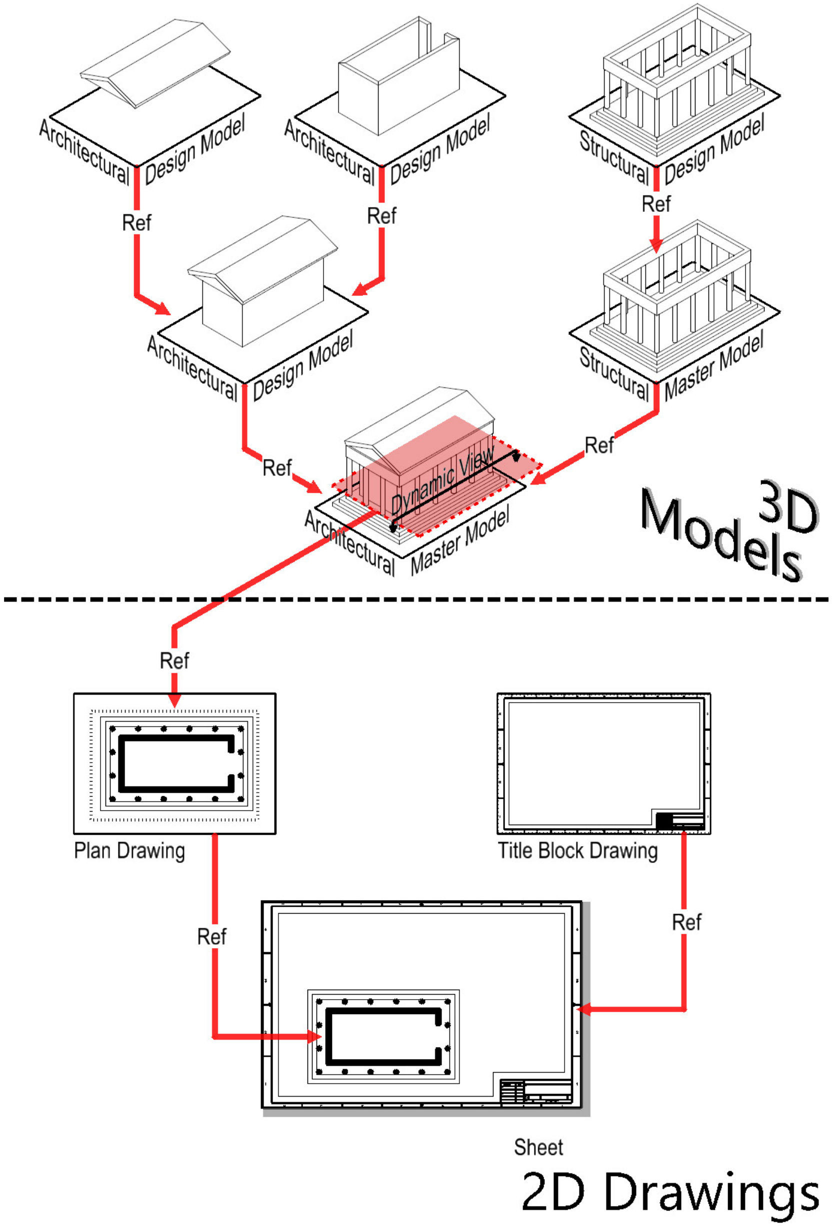
Caution: Changing the *Resolution* setting not only changes the size of existing geometry in the model, but could also impact some of OpenBuildings Designer's delivered content.

When you define new *Working Units*, you must select **File > Save Settings** from the ribbon (or the shortcut **Ctrl+F**) to save the new settings.

Design Models, Drawings and Sheets

An OpenBuildings Designer document file is called a DGN file. A DGN file is composed of one or more models. There are three types of models that can be used in your files; Design Models (2D or 3D), Drawing Models (2D only) and Sheet Models (2D only). Each has properties that make it unique and each will be used to create the files that contain the Models, Drawings and Sheets for your project.

You can have only one DGN file open at a time. You can, however, view the models contained in other DGN files by attaching them as references to the active model in the open DGN file.



Design Model Files

Purpose: Models that contain your 3D model components. The number of Design Model files in each discipline is dictated by how you want to divide the work in your model.

Master Models are container files that have design models referenced into them. Dynamic Views (such as plans, sections, elevation and details) are generated in the Master Model and saved there.

Drawing Files

Purpose: Drawing files contain your 2D drawings, either referenced Dynamic Views generated from your Design Models or 2D drawings created from scratch (CAD details).

Automatic annotation, like grid lines and rule-based annotation will be created in the drawings. This file is also the appropriate place to add additional annotation and geometry where needed.

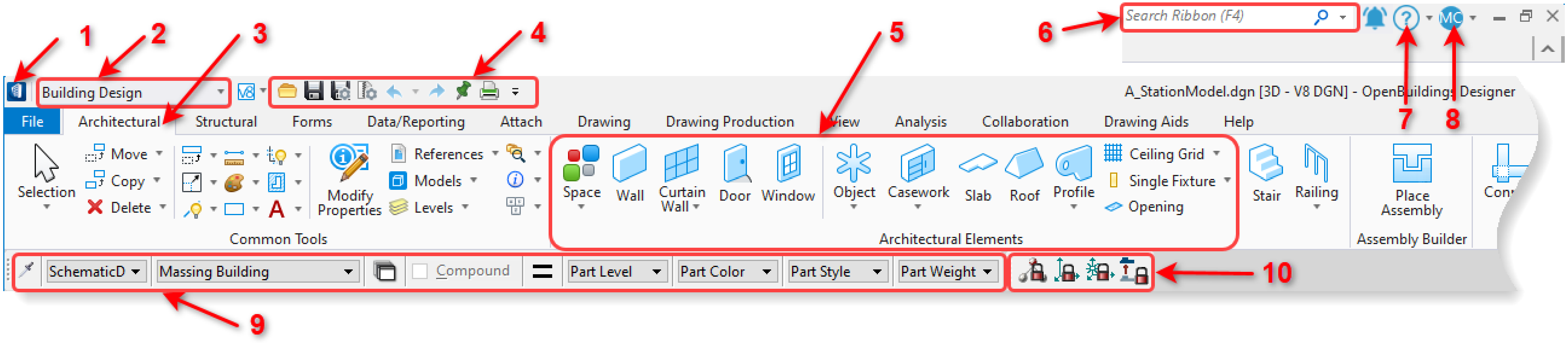
Sheet Files

Purpose: Sheet files contain sheet models that are used for printing.

A Sheet file will have a title block border and one or more drawing model files attached that are required for the information that you want to portray on that sheet. There will be some sheet annotation and depending on your project standards, may contain additional annotation and geometry.

Exercise 1-2: Navigating the Ribbon Interface

OpenBuildings Designer uses a ribbon interface. Ribbons help users easily find tools and commands with minimum number of clicks. Various ribbons are organized by workflows; *Building Design, Building Systems Design, Drawing, General, Modeling* and *Visualization*. Each workflow consists of multiple tabs, which are organized by tasks.



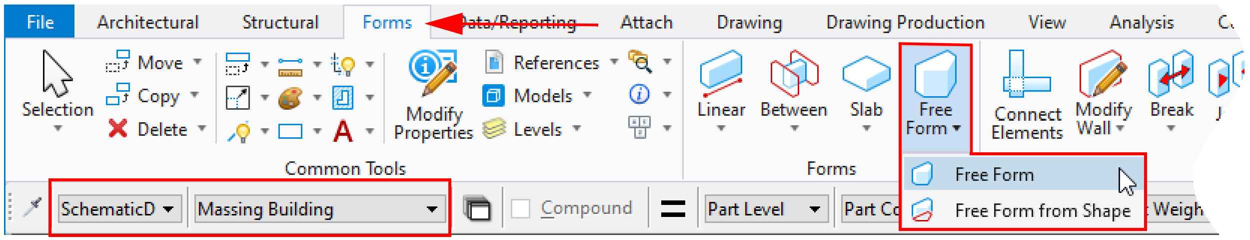
The ribbon interface is composed of the following:

1. *File Tab* - Opens the Backstage view where you can perform different operations such as managing your file and its settings, importing and exporting files, accessing help, and so on.
2. *Workflow* - Contains various workflow options; *Building Design* for architectural and structural workflows and *Building Systems Design* for mechanical and electrical workflows.
3. *Tabs* - Organized by tasks, tabs contain one or more groups of tools.
4. *Quick Access Toolbar* - Contains frequently used commands, such as Save, Save Settings, Undo and Redo.
5. *Group* - A labeled set of closely related commands or tools.
6. *Ribbon Search* - Enter words or phrases to search for in the ribbon.
7. *Help Documentation* - Access help from the ribbon by clicking this icon.
8. *Sign in glyph* - Displays when you are signed in as a CONNECTED user.
9. *Family/Part* - Used to select the active family and part for elements placed in the model
10. *Icon locks* - Frequently used locks.

Exercise 1-3: Creating a Conceptual Model

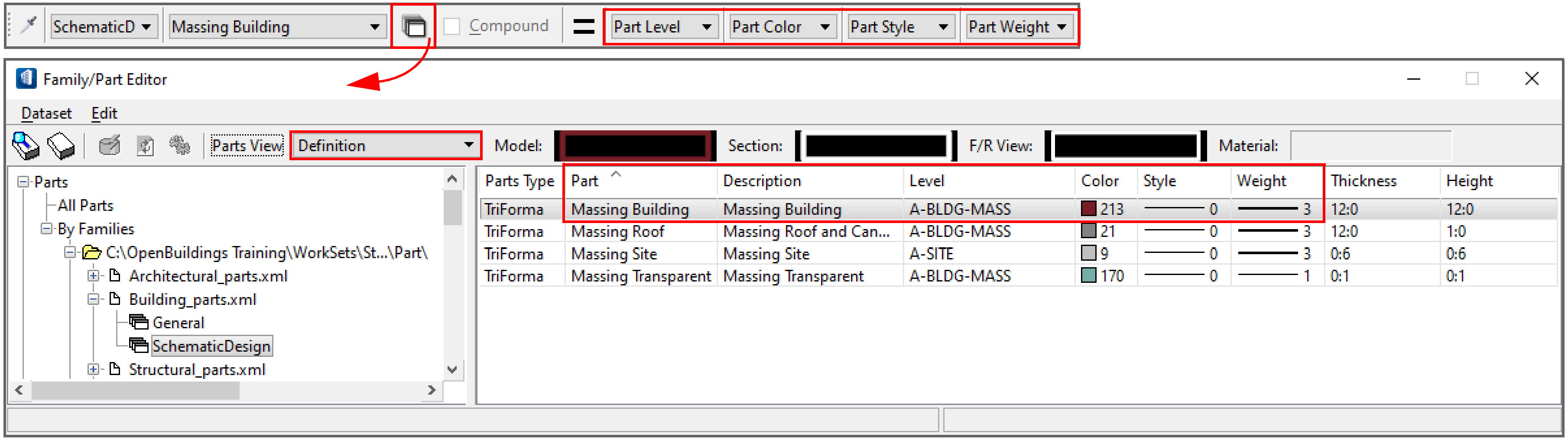
Let's get started by creating a conceptual 3D block model of the station building, then we'll step back and look at the interface and file setup.

1. Select the *Forms* tab on the ribbon.
2. Select the **Free Form** tool.
3. Set the Active *Family/Part* to **Schematic Design: Massing Building.**

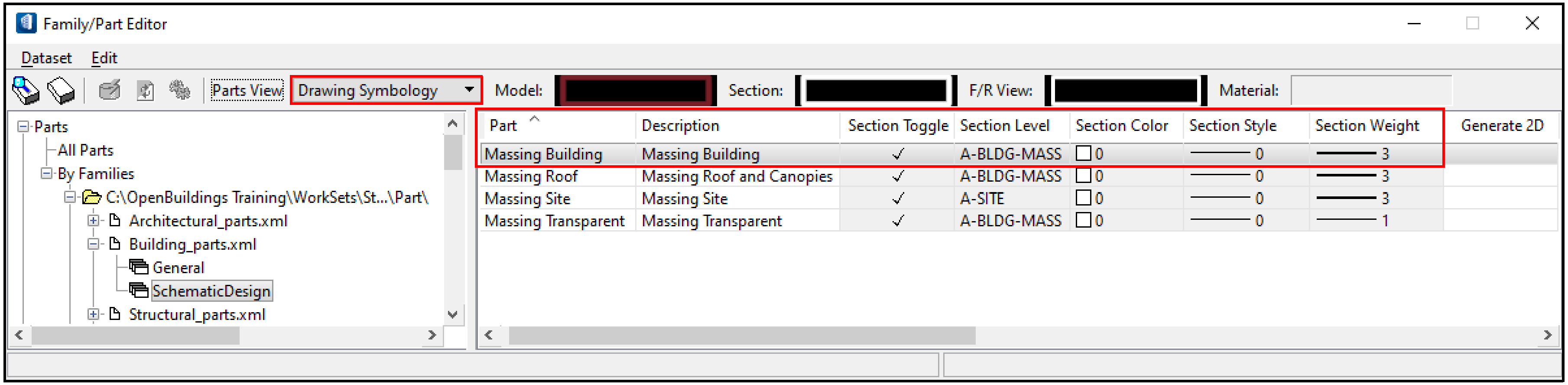


The Family/Part System

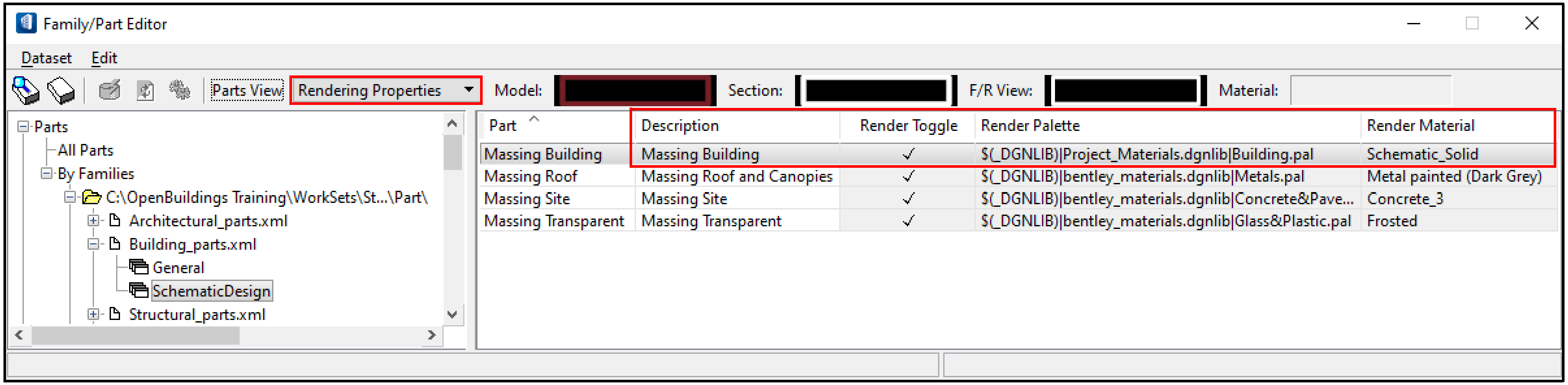
The *Family/Part* system in OpenBuildings Designer is an essential feature of the BIM environment. The active *Family* and *Part* is selected from the *Family/Part* tool bar prior to placing an object in the model. The *Part* controls the symbology of the object that you place both in the model and in the drawings generated from the model. These are organized into various *Families.* For Instance, the *SchematicDesign* family includes various parts for the building massing that display with different symbology and materials. Once a part is selected the active level and level attributes are reset based on the *Family/Part* selected. In this respect the *Family/Part* dataset is considered to control the CAD standards of the project. Different *Family/Part* datasets are available for regional datasets which are based on different CAD/BIM standards for various regions of the world. They are managed using the *Family/Part Editor.*



The Parts View set to Definition, which defines the parts attributes in the 3D model.

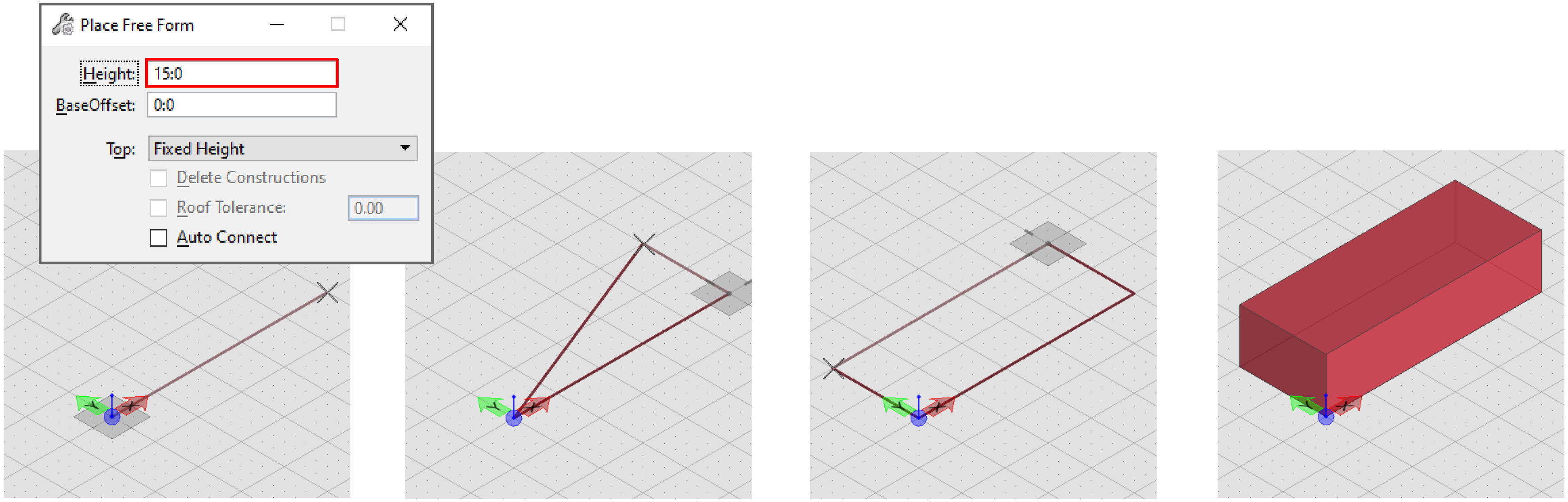


The Parts View set to Drawing Symbology, which defines the parts attributes in the 2D Drawing.



The Parts View set to Rendering Properties, which defines the material assigned to the part.

4. In the *Place Free Form* dialog set the *Height* to **15:00** *[5000 mm]*.



5. Starting at the *ACS Triad*, use the left mouse button to place **data points** *(left-click)* in the model defining the perimeter of the station footprint. The points will automatically snap to the grid points in the view. The grid is a 12’ *[4 M]* module and the station footprint should be 60’ x 24’.*[20M x 8 M]* (5 grids x 2 grids).

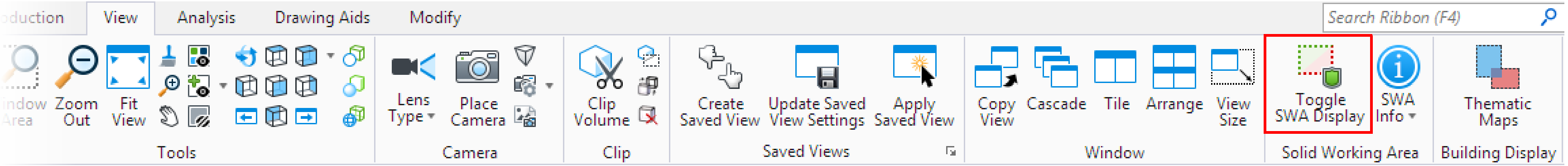
The ACS Triad and the Solids Working Area

A 3D DGN file includes a design cube in which you work. The design cube represents a 3D DGN file's total volume, in which points are defined with x, y, and z-values, or coordinates. Points can be placed anywhere within the design cube, and are not restricted to a single plane as is the case when you work in a 2D DGN file.

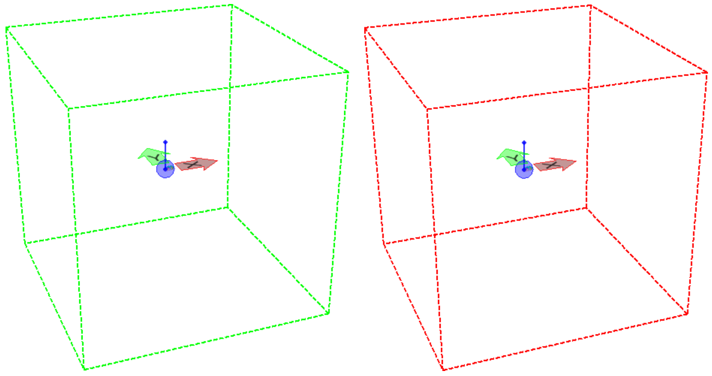
Design cube coordinates are expressed in the form (x,y,z). The global origin in the 3D seed files provided with OpenBuildings Designer is located at the exact center of the design cube and assigned the coordinates (0,0,0). Any point above the global origin has a positive z-value and any point below it has a negative z-value. Note, by default in most seed files the ACS Triad will appear positioned at the global origin of the design file (0,0,0), however, when performing view operations such as zoom in and zoom out the ACS triad will reposition itself to stay visible and present within the view boundary. The purpose of the triad is to represent the current orientation of the coordinate system indicating the positive x,y and z directions that are currently active in the file based on the current views orientation. The ACS triad, is a visual aid that can be toggled on and off as a part of a views properties.

The 0,0,0 origin of the model is also the center of the *Solids Working Area* (*SWA*). The *SWA* is a defined volume/cube related to *Solids Accuracy*, which is determined from both the *Resolution* setting and the *Solids* setting in the *Advanced Unit Settings* dialog. It is important that building models are modeled within the *SWA*, so it is good practice to locate the building geometry near the *ACS Triad*. This is why we started the block model at the ACS triad.

The *Solids Working Area* (*SWA*) can be displayed in the model by selecting the **Toggle SWA Display** icon on the *View* tab.



Fitting the view will then display the extents of the SWA. It will be displayed as a red or green box. If the box is red it indicates there are elements outside of the SWA. If the box is green it indicates there are no elements outside the SWA. The SWA should be green as your station block model was modeled inside the SWA.



the **SWA Info** tool is used to display information about elements outside the Solids Working Area. When selected, an Information box will open to show the size of the SWA and the number of elements outside of the SWA. For models having any elements outside SWA, the information dialog also displays their list with element ID, and type information. Selecting an element in the grid highlights its graphic in the view zoomed to the center of the element.

Additional tools are available to select and find the elements outside the SWA so that they can be moved or deleted.

Exercise 1-4: Views, View Display and View Controls

In OpenBuildings Designer, you have the option of having up to eight view windows open at any time. Also, you can customize the arrangement of view windows within the application window. Where multiple views are open, the view that you are working in is known as the *Active View*.Multiple view windows allow you to view, navigate and manipulate the model from multiple perspectives during the design process. In the previous exercise you used *View 1 - Isometric* to place the points and create the conceptual blocking model of the station building. You may have noted that *View 2 - Top* shows the top view and *View 3 - Front* shows the front view of the model. In this exercise, you will set up a new *view group*, a new view window and adjust various settings for the views.

View Groups

A *view group* is a set of view window layouts applicable to models within the open DGN file. View groups make it easy to access and navigate through different models. View groups let you set up your session to display your view window preferences including the number of open views, view size, and orientation. As well, a view group definition includes the attributes for each view and their level display settings.

Using view groups, you can quickly change from one configuration to another. For example, in some stages of the design process, you might prefer to arrange the screen with View 1 showing the Isometric view and covering two-thirds of the screen, while Views 2 and 3 share the remaining part of the screen equally and show the Front and Top views respectively. For other stages, you may like to have a single Isometric view, covering the whole work area.

You can also associate different models to the same view group by creating *multi-model view groups*. Multi-model view groups allow you to view more than one model or saved view from the same DGN file in separate views.

There are two methods for creating multi-model view groups. One is by applying a saved view and other is by selecting a model from the Models drop-down in the View Attributes dialog. In both methods a new view group with the name *Multi-Model Views* is created. This new view group contains the applied model or saved view in the active view. You can create a view group that displays from one to eight different models or saved views.

For more information on *Multi-Model view groups* refer to the *Help* files.

On the lower right of the interface are the *Manage View Groups* tools. You currently are using a View Group, *Building Model* that has 3 views open, set to an *Isometric* view, a *Top* view and a *Front* view. Let's create a second View Group that has a *Back Isometric* View, a *Top* view and a *Side* View.

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1. Open the **Manage View Groups** dialog from the lower right of the interface.

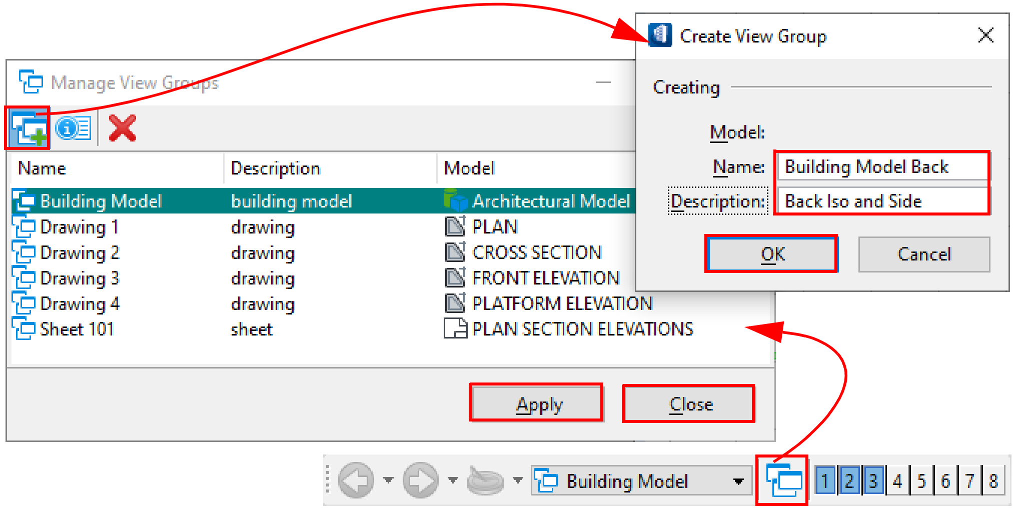
   a. Select **Create View Group**.

      Name: **Building Model Back**

      Description: **Back Iso and Side**.

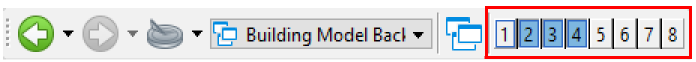
   b. Select **OK**.

   c. Select **Apply** and then **Close**.



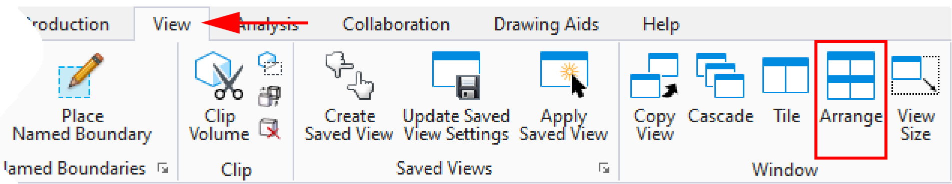
The new *View Group* is created. From the pull down you can now switch between the **Building Model** view group and the **Building Model Back** view group. Select the **Building Model Back** view group.

2. Toggle **off** *View 1* and toggle **on** *View 4.*



3. Resize *View 4* by dragging the sides and placing it roughly where *View 1* was.

4. On the *View* tab on the ribbon, select the **Arrange** option from the *Windows* group.

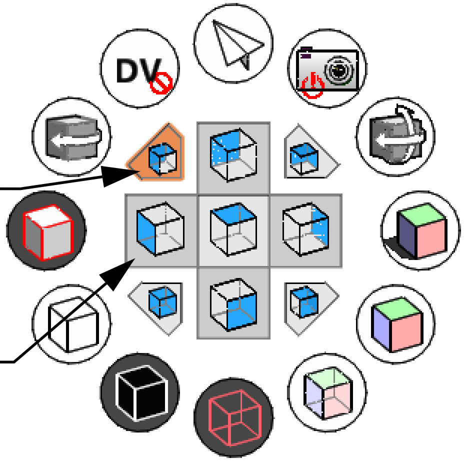


Arrange - All open view windows resize so that they fit tightly within the available space without overlapping, while preserving the view windows' relative size and position.

Cascade - Each open view window is assigned an equal amount of screen space, but only the lowest numbered view window is entirely visible. The other open view windows are stacked beneath this view window with only their title bars visible.

Tile - Each open view window is assigned an equal amount of screen space, and the view windows are arranged by number from lowest to highest starting in the application window's upper left corner and progressing from left to right. If more than three view windows are open, the view windows are arranged in an upper and lower row.

Now let's use a quick shortcut to open a screen menu of view rotations and rotate *View 4* to the *Back Isometric* view, and *View 3* to a *Side* rotation.

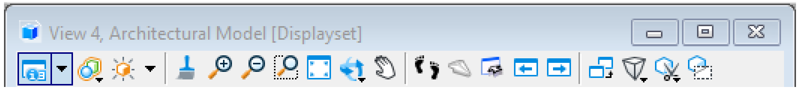


5. *Left-click* on the header of *View 4* to make sure it is the active view.
6. Then hold the **Shift** and **Ctrl** key on the keyboard and *right-click* in the view. This will display a screen menu with various view rotations displayed.
   a. Select the **Back-Left Isometric** rotation.
7. *Left-click* on the header of *View 3* to make sure it is the active view.
8. Then hold the **Shift** and **Ctrl** key on the keyboard and *right-click* in the view.
   a. Select the **Left** rotation.

Note: Changes to the views, such as the rotation, are automatically saved to the current *View Group*. View 3 will be rotated *Left* in this *View Group*, but remain a *Front* rotation in the other *View Group*.

View Controls

Various view controls are arranged in the view control bar docked by default to the top of each view window. Some of the most useful view controls include the following:



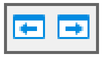
 *View Attributes* - Each view in OpenBuildings Designer has attributes that determine if certain types of elements or certain drawing aids, like the ACS Triad or design Grid, are displayed in the view. These View Attributes can be toggled on or off individually for each view.

 *Update View* - Used to redraw the display when an operation leaves a view with an incomplete display. To stop an update in progress **Reset** (*right-click*).

 *Window Area* - Used to define the boundaries of a rectangular area of the active model to be displayed within a view. The boundary can be defined from another view window.

 *Fit View* - Used to fit the entire model in a view (for the "big picture" or to get your bearings). It can be set to fit only the elements in the active file, the reference files or all elements.

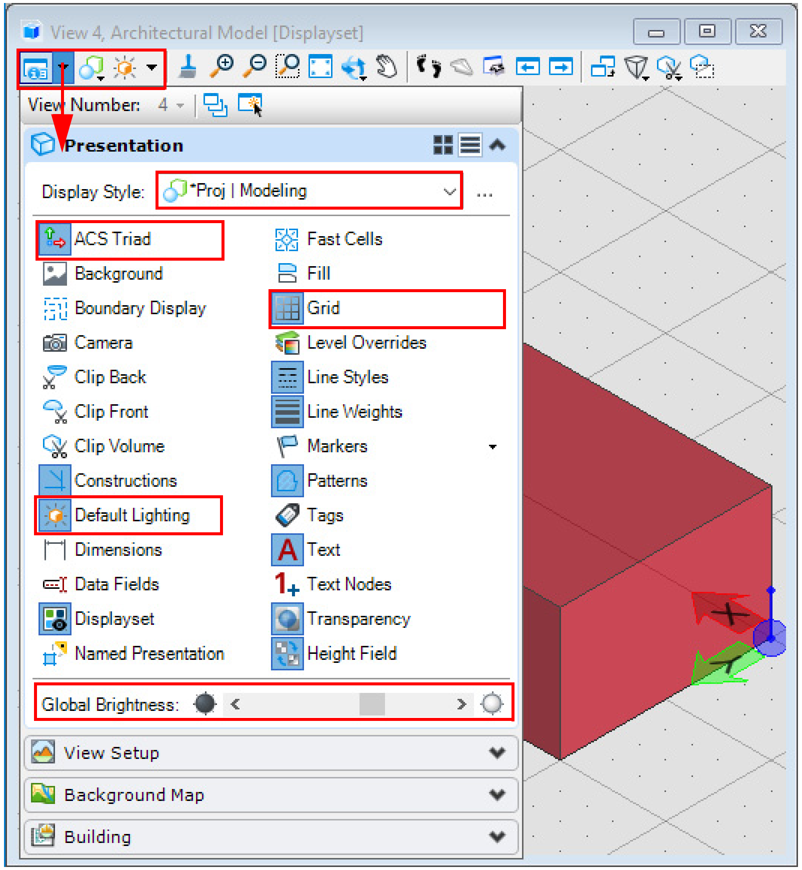
 *Rotate View* - Used to rotate a view. Views can be rotated dynamically, or using preset rotations for Top, Front, Back, Left, Right, Isometric, and Right Isometric.

 *View Previous / View Next* - The *View Previous* and *View Next* controls will step the view through any previous and next view settings, including rotation, display style changes, zooms, etc. It is used like an Undo/Redo function to negate previous viewing operations.

9. Open *View Attributes* from *View 4*.

   a. Change the *Display Style* to ***Proj | Modeling**.

      Display Styles are predefined collections of render overrides and some optional settings that can be applied to views. They can range from a simple wire-frame view of the model to an illustration view that shows materials and real world lighting. The *Display Style* chosen here is one created for the project and stored in the WorkSet DGN library.



   b. Toggle the **Grid** off and back on.

      When working in the *OpenBuildings Designer*, you have the option of turning on the *Grid* in any view. The *Grid* consists of evenly spaced points on the design plane. It is a visual measurement and alignment aid. The units, spacing and orientation can be set in the *Design File Settings* dialog. Here the grid has a **3'-0"** *[1000 mm]* spacing with reference lines drawn at every **12'-0"** *[4000 mm]*, or every 4th point. When used in conjunction with *Grid Lock*, the grid can assist in accurate "by eye" placement of elements.

   c. Toggle **ACS Triad** off and back on.

      The *ACS Triad* is a three arrow representation (in 3D) that indicates the x, y and z axis, displayed at the 0,0,0 origin of the active coordinate system. Every file has a *Base Coordinate System* based on the global origin which will be used to align models that are referenced coincidently.

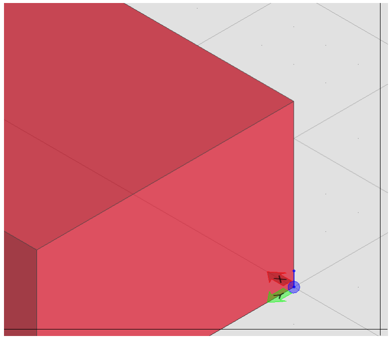
   d. Toggle **Default Lighting** off and back on.

      If *Default Lighting* is toggled on, lights that are built into the model are used. This lighting includes an over-the-shoulder camera light, flash and ambient, otherwise the solar settings and user-defined lights are used.

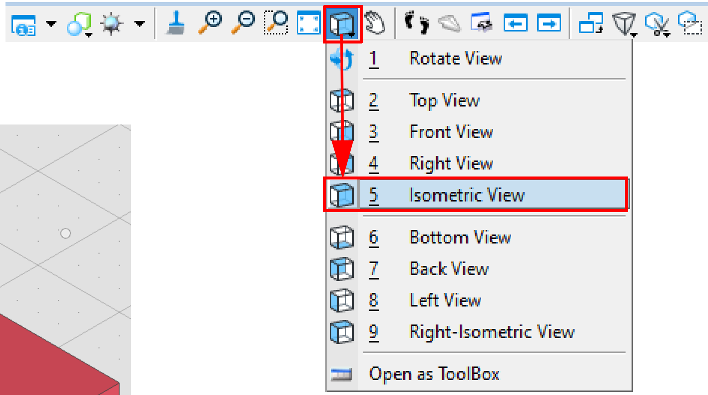
   e. Adjust the **Global Brightness** slider to adjust the brightness of the view.

Note: The *Display Style*, *Lighting* and *Global Brightness* can also be controlled from the next two pull-downs on the view window.

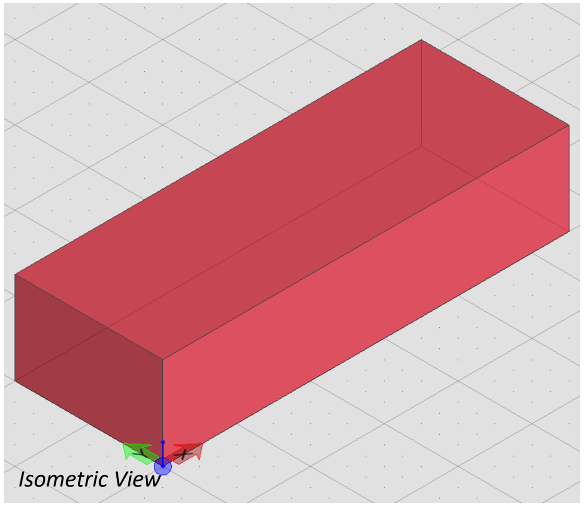
10. Select the *Window Area* tool and create a window in View 4 around one corner area of the model.
11. Select the *Fit View* tool to fit the model back into the view.

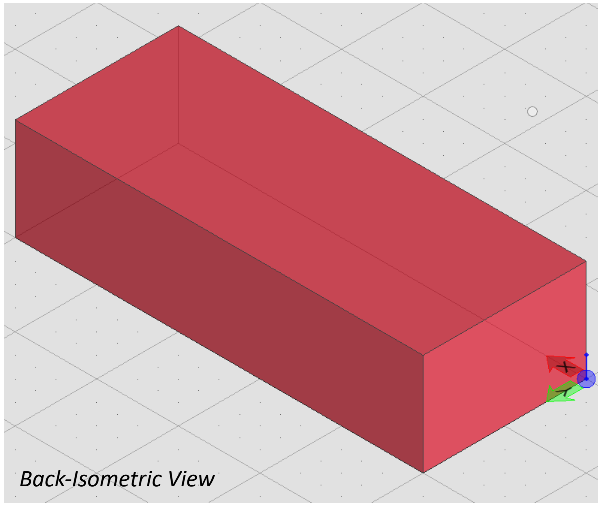


12. Select the *Rotate View* pull-down and select the *Isometric View* preset. Note the location of the ACS Triad to see that the view has rotated.



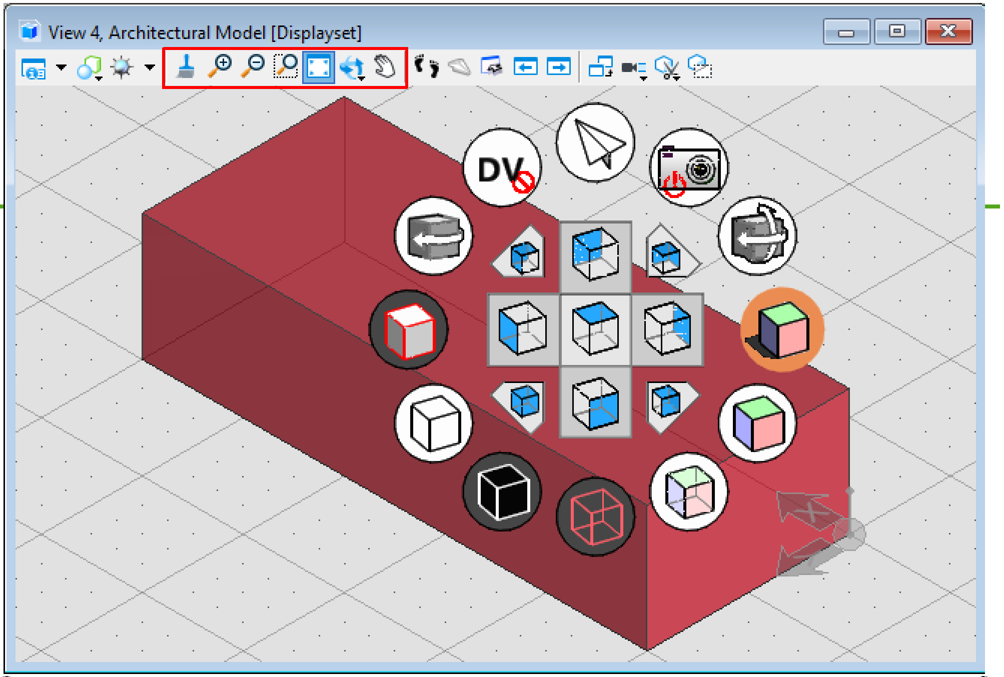
13. Use *View Previous* to return the view to the *Back Isometric* rotation.





Exercise 1-5: Zoom, Fit, Rotate and Pan the View

As seen in the previous exercise view rotation tools can be accessed from the view window or from the built-in screen menu shown earlier. However, while working in a model it is often more efficient to use mouse and keyboard shortcuts to navigate the view.



1. Practice navigating the view using the following view shortcuts

   Wheel (scroll): Zoom In/Out

   Alt + Wheel (scroll): Pan Left/Right

   Wheel (press): Pan

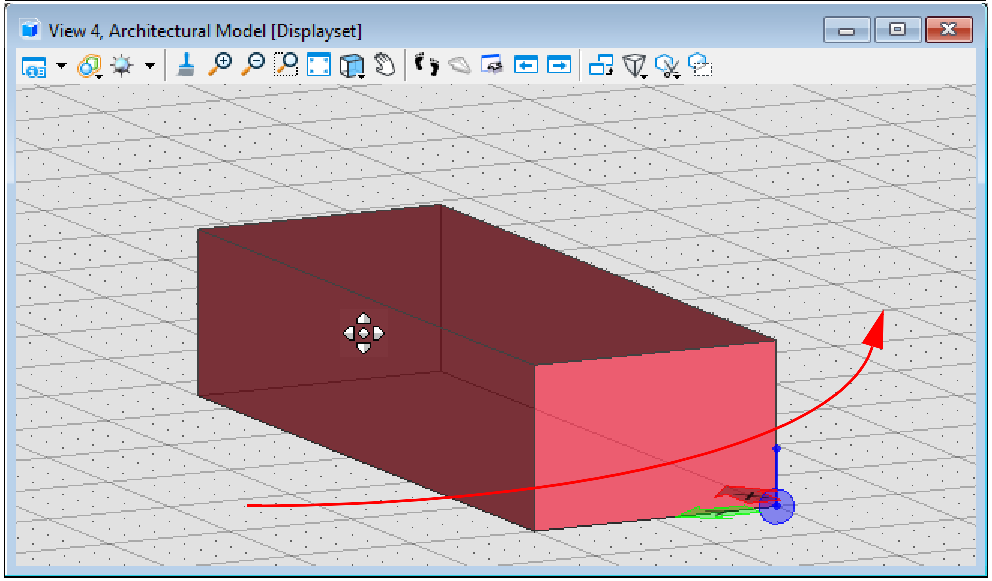
   Wheel (double-click): Fit View

   Shift + Wheel (press): Rotate the view

Note: When pressing the mouse wheel to navigate, you can use either of two methods:

Click-and-drag — click and hold the button on the mouse as you move it. Releasing the button completes the operation.

One-click operation — click in the view to commence the navigation. Move the mouse as required (without holding down the button), then click again to complete the operation.



It is also possible to turn on a camera in any view and walk through the view or model.

2. From the *View Perspective* pull-down select **Change View Perspective.**

   a. Select the view. A dot appears at the data point location.

   b. Move the pointer away from the dot to increase the perspective and accept with a data point.

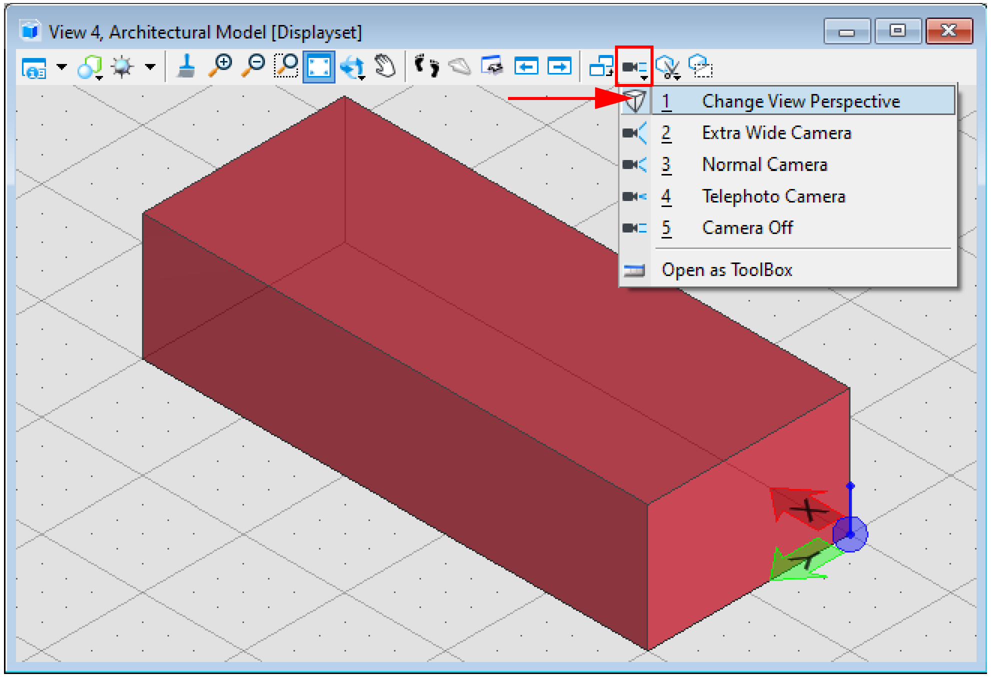
When a camera is on in a view, the *Walk*, *Fly* and *Navigate View* tools can be used to move around the model.

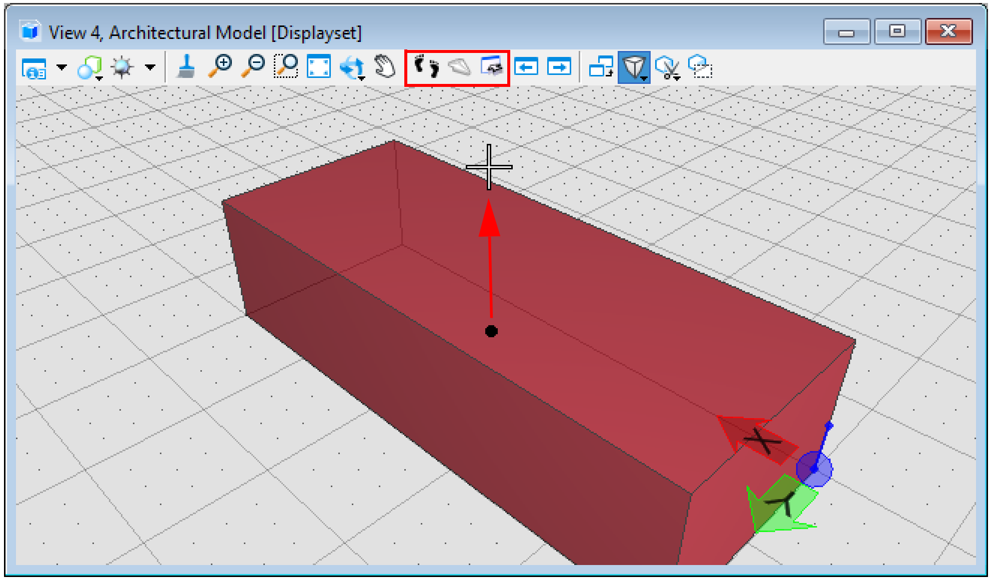
In addition, with a camera on in the view pressing the **Ctrl** key while scrolling the wheel will walk forwards and backwards in the view rather than zoom in and out.

3. Use the key-in **Ctrl + Wheel (scroll)** to walk forwards and backwards in the view.

You can now toggle between two view groups, the **Building Model**, which has a *Front Isometric*, *Top* and *Front* view and the **Building Model Back** which has a *Back Isometric*, *Top* and *Side* view.

4. Set the *View Group* back to **Building Model**.





Before ending this exercise lets save the current file settings, so that next time this file is opened, it will open to the current view group, **Building Model,** and all the changes you have made to the view display and rotation for the **Building Model Back** *View Group* will also be saved.

5. **Ctrl + F** to *Save Settings*.

Note: The file itself is saved automatically every few seconds, we do not need to worry about saving the changes to the file geometry.

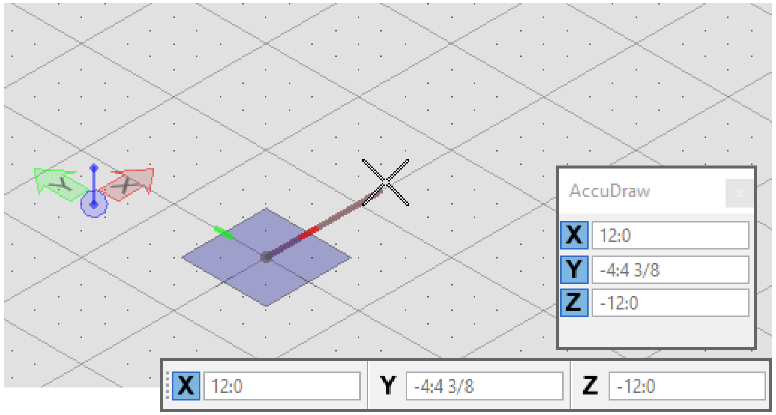
Exercise 1-6: AccuDraw Compass and Precision Input

Building models must be built precisely and *AccuDraw* and *AccuSnap* are the tools used to input precision dimensions, slopes and angles.

AccuDraw

AccuDraw is a drafting and modeling aid that evaluates such parameters as your current pointer location, the previously entered data point, the last coordinate directive, the current tool's needs, and any directive you have entered via *shortcut key-ins* or *AccuDraw options*. *AccuDraw* then generates the appropriate precision coordinates and applies them to the active tool

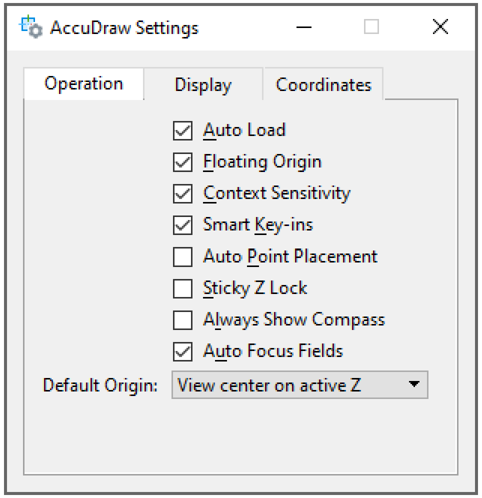
AccuDraw's most recognizable feature is its compass, visible only when *AccuDraw* is active and has control of OpenBuildings Designer's coordinate input, the compass acts as both a status indicator and a focus for your input. When *AccuDraw* has focus, its compass has a transparent blue background. When it does not have focus, the compass appears gray.



The *AccuDraw* compass in an isometric view. The *AccuDraw* window is in rectangular coordinate mode, shown floating and docked at the bottom edge of the interface.

AccuDraw has its own window which contains the data entry fields and axis lock buttons for the currently active coordinate system. *AccuDraw* has two modes *rectangular* coordinate mode (x, y and z inputs) and *polar* coordinate mode (distance and direction inputs). By default, the *AccuDraw* window is docked along the bottom edge of the application window.

AccuDraw settings are accessed from the **Backstage** view: **File > Settings > User > AccuDraw Settings**. (*Shortcut Key-in:* **G,S**)



The mechanical discipline features specific *AccuDraw* shortcuts for mechanical use.

For more information go to the Help contents: **Home > AccuSnap and Accudraw**.

AccuSnap

AccuSnap provides tentative snap functionality, which may be used stand-alone or in combination with *AccuDraw*. It provides graphical assistance — a "smart" pointer — for snapping to elements. This automates the tentative snap process, virtually eliminating the need to press the tentative snap button, thus reducing the number of "button presses" required during a design session. When in *AccuSnap* mode, you simply select a tool and move the pointer over the elements, letting *AccuSnap* find and display the nearest tentative snap point for you. When the correct snap point is displayed, you enter a *data point* to accept.

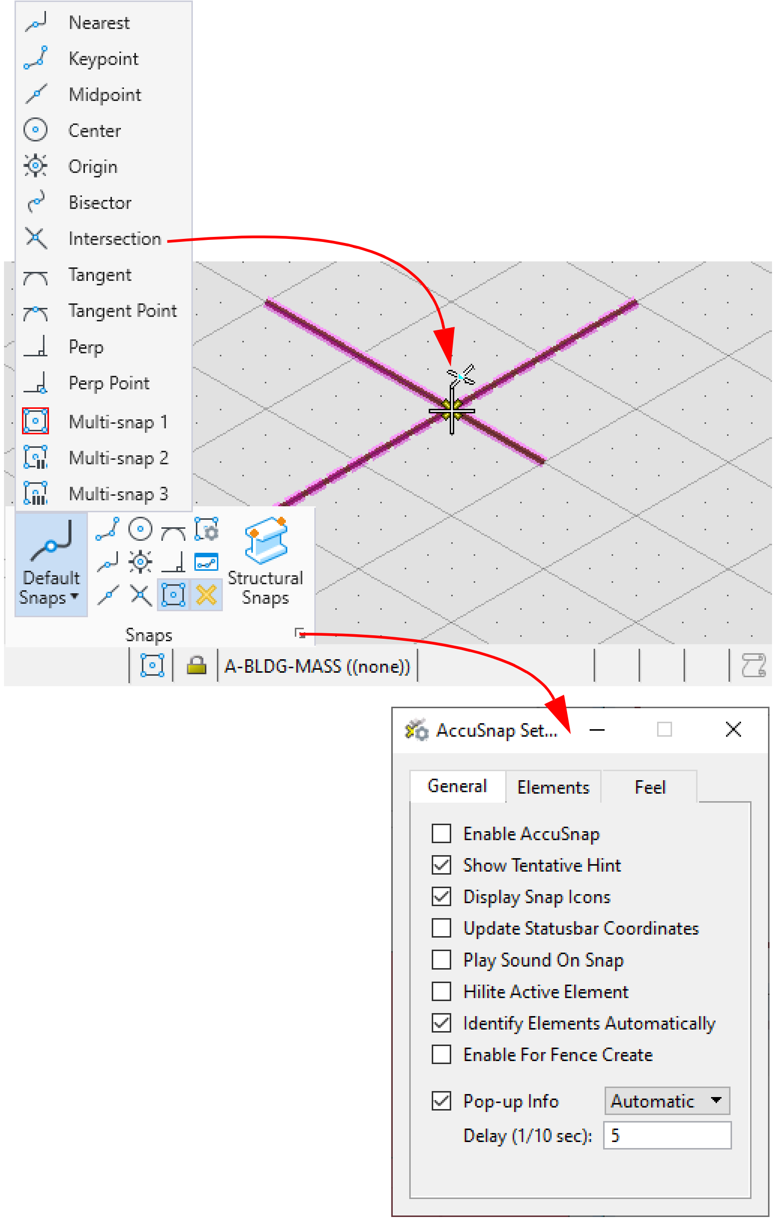
Various Snap Modes are accessed from the status bar's Snaps box. When a *multi-snap* mode is active (by default or override), *AccuSnap* processes the snaps in the order they are listed. *AccuSnap* selects the first snap mode in the list that is a candidate and on the target element. If none of the snap modes are candidates or on the target element, *AccuSnap* chooses the nearest to the cursor.

AccuSnap complements the standard, or manual, method of placing tentative points. That is, even with *AccuSnap* enabled, you can still use the standard tentative snap method (pressing the tentative button). Additionally, when you are using *AccuSnap* in conjunction with AccuDraw, you can use AccuDraw shortcuts, which include **HU** to suspend *AccuSnap* for the current tool operation, and **HS** to toggle *AccuSnap* on and off.

AccuSnap settings can be accessed by clicking the dialog launcher icon in the Snaps options.

The structural discipline features *Structural Snaps* that utilize *AccuSnap* for structural members.

For more information go to the Help contents: **Home > AccuSnap and Accudraw**.



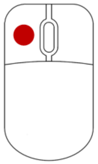
Graphical Input with a Mouse

To input graphical data you will the mouse.

> *The Data button*—used to enter data points, is mapped to the left-hand mouse button.
>
> *The Reset button*—used for resetting and for accessing the Reset pop-up menu and the view control pop-up menu, is mapped to the right-hand mouse button.
>
> *The Tentative button*—used to enter tentative snap points, is invoked by clicking the left-hand and right-hand mouse buttons at the same time. This is called a button "chord" and serves as a third button.

The mouse has several controls that utilize keyboard and mouse combinations and are included here for reference.

In this exercise you will modify the block form and place SmartLines and shapes using the *AccuDraw* compass. You will use shortcut key-ins to interactively control the compass.

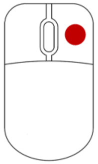


Left Button:

Click = *Data Point* – Select; Accept
Press (on tool bar) = Open additional tool choices

+ Shift = Scroll View

+ Alt = Match Selected Item Attributes



Right Button:

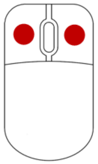
Click = *Reset* – Finish Command; Cancel Command; Reject Choice
Press = Pop-up context tool menu

+ Shift = Pop-up View Tools Menu

+ Alt = Pop-up Element Attributes

+ Ctrl = Pop-up Main Tools

+ Ctrl + Shift = Open View Control Screen Menu



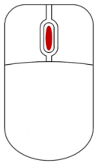
Left-Right Button Chord:

Click = *Tentative Snap*

+ Shift =Pop-up Snap Menu

+ Alt = 3D Data Point

+ Ctrl = AccuDraw Origin at Tentative Snap point



Wheel or Middle Button:

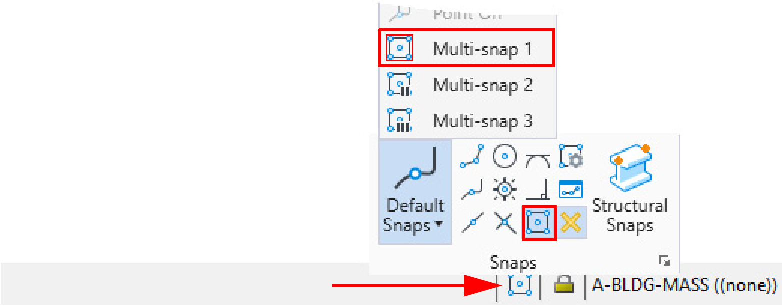
Click = *Pan Drag* (click again to cancel)
Press = *Pan Drag* (release to cancel)
Double-click = *Fit All*

+ Shift = Rotate View drag

+ Alt = Rotate View from Cursor

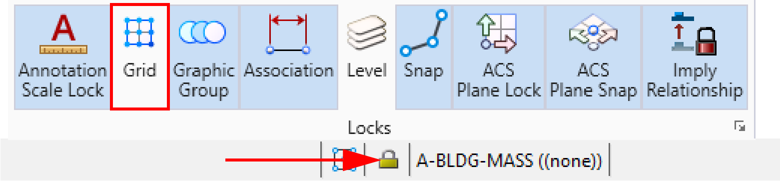
+ Ctrl = Swivel Navigate View

1. Set the *Snap mode* to **Multi-snap 1** and toggle **On** *AccuSnap.*



There are numerous snaps modes such as keypoint, center, and intersection. Unlike an ordinary snap mode, a multi-snap represents a list of snaps. When a multi-snap is active, AccuSnap and Tentative Point snap will process the list of snaps that it represents. *Multi-snap 1* represents, intersection, keypoint and nearest.

2. Toggle **Off** the *Grid* lock.

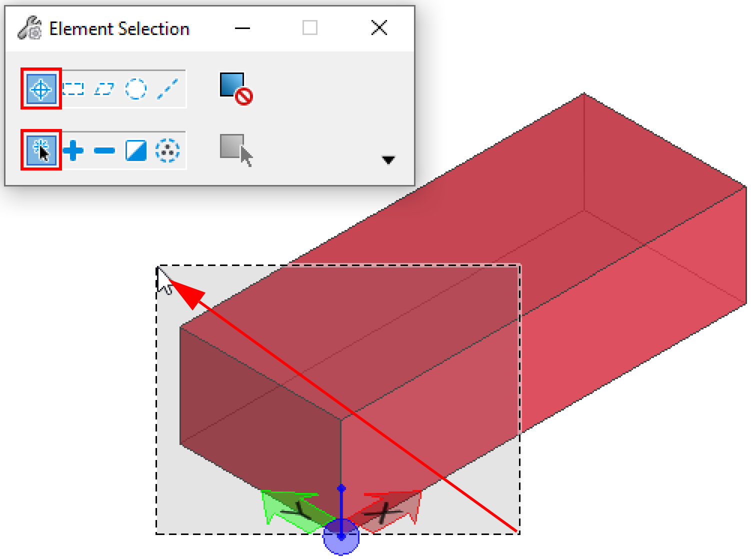


When *Grid Lock* is on, all data points and tentative points are forced to fall precisely on a point in the grid. You used this to place the initial geometry 'by eye', but now you will use *AccuDraw*, *AccuSnap* and precision input to modify the block form and to place lines and shapes for a schematic platform canopy.

You may also like to turn off the **Grid** in the *View Attributes*.

The Selection Tool

The **Selection** tool is the default tool in OpenBuildings Designer and is used to select and deselect elements for modification or manipulation. When the *Element Selection* tool is active the cursor displays as a typical mouse pointer (arrow) with a small circle at the end of the arrow, the circle is the 'locate tolerance' of the tool.



The *Element Selection* dialog box has options for the method and mode of the tool, and extended settings can be accessed via the drop arrow to select elements by MicroStation attributes like level, color, line style, etc. The default settings are **Individual** and **New**.

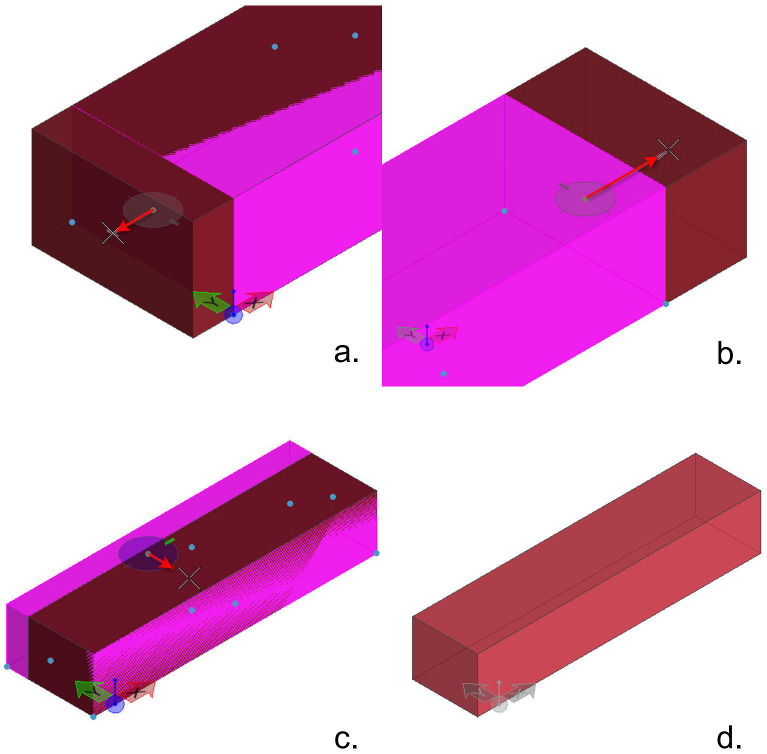
Objects can be individually selected using the left button on the mouse, a *right-click* (reset button) will cycle the selection through any element candidates that share a location within the locate tolerance circle.The **Ctrl** key allows you to add or subtract elements from the selection. You can also drag the mouse in the view to select multiple elements. Drag around the area containing the elements you want to select. As you drag, a dynamic rectangle outlines the area. Use a *left-right* direction for *inside* selection and a *right-left* direction for *overlap* selection. A set of selected elements is called a *selection set.*

A selection set can be 'released' by clicking the tool in an area where no elements are located ('in space') or by clicking the 'clear' mode in the *Tool Settings* dialog box.

3. Select the block form of the station building.

4. Select the edit handle on the left face.

Note the *AccuDraw* compass, it has been rotated and locked so that you can only drag this face perpendicular to the original face, all you need now is to indicate the direction and type in the distance.



   a. Drag this face outwards and type **6** *[2000 mm]* on the keyboard note that the face is now locked at this position. *Left-click* to accept

   b. Move the right face outward **12:0** *[3000 mm]*.

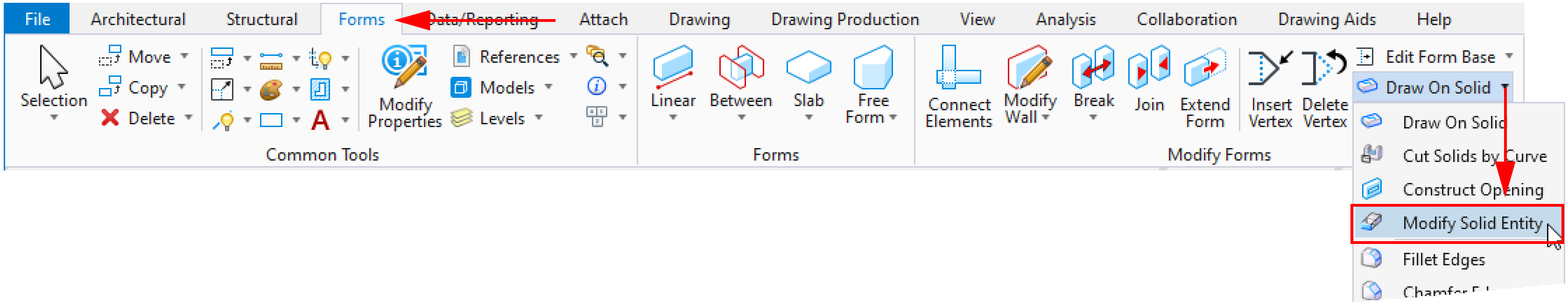
   c. Move the back face inwards by **6:0** *[2000 mm]*.

   d. *Left-click* in the view to deselect the form.

Note: When the *AccuDraw* window is open, *AccuDraw* automatically takes the focus whenever dynamic updates occur with a drawing tool selected. If, for some reason *AccuDraw* loses the focus, the function key **F11** will return the focus to AccuDraw so that dimensions can be input and shortcut key-ins can be used.

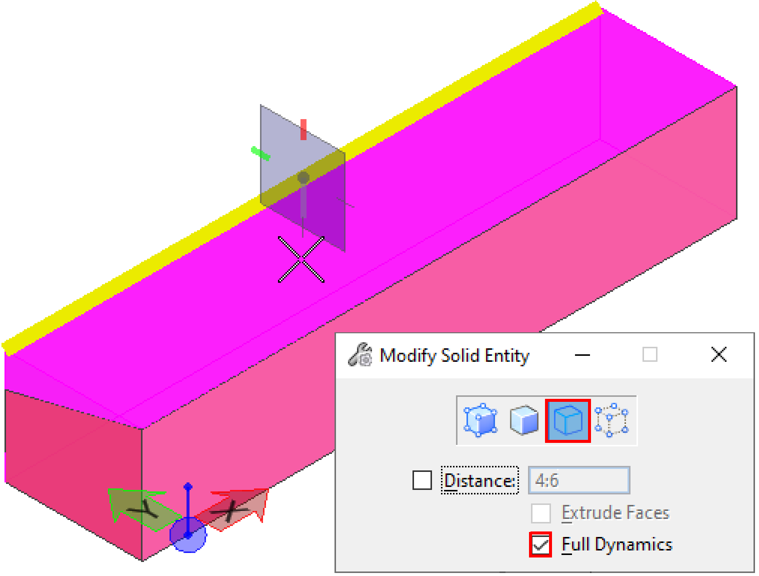
You can also modify edges of the form, for this you will use the **Modify Solid Entity** tool.

5. From the *Modify Forms* on the *Forms* tab select the **Modify Solid Entity** tool.



a. Set the method to **Edge** and toggle on **Full Dynamics**.

b. Working in *View 1 - Iso*, select the top, back edge of the form.



Note that the *AccuDraw* compass is rotated perpendicular to the edge, but this time you can move both forward and backwards and up and down. You want to drag this edge down vertically to create a sloped roof, so you will use an *AccuDraw* shortcut to lock the axis.

c. Drag the cursor vertically below the compass, use the **Enter** key on the keyboard to lock the axis.

d. Type in the distance, **4:6** *[1500 mm].*

e. **Data point** *(Left-click)* to accept.

Note: There will be an alert that this change will convert the parametric form to a Smart Solid. There are some significant differences between parametric forms and Smart Solids, but for the purposes of this block model it is not important.

f. Select **Yes** to make the changes. You now have a *3:12* slope on the roof.

You will continue to use *AccuDraw* in conjunction with the *SmartLine* tool to add some additional geometry for the platform canopy.

AccuDraw's Shortcut Key-ins

Although *AccuDraw* tries to anticipate your next move it cannot always predict your intentions. *AccuDraw* therefore includes a wide variety of single and double character command directives known as the *shortcut key-ins*. By pressing the appropriate key, you can direct *AccuDraw* to perform a specific task. In operation, *AccuDraw* is the default input focus in most cases, thus letting you just type in the shortcut without having to consider where the input focus is.

Shortcut key-ins are defined as keyboard shortcuts in the *Keyboard Shortcuts* dialog. Single letter keyboard shortcuts activate the respective command, while multi-level keyboard shortcuts display a pop-up menu when the first level of keyboard shortcut is pressed. You may then click the desired option from the pop-up menu or press the desired next level keyboard shortcut. You can create, edit, or delete the keyboards shortcuts in the *Keyboard Shortcuts* dialog.

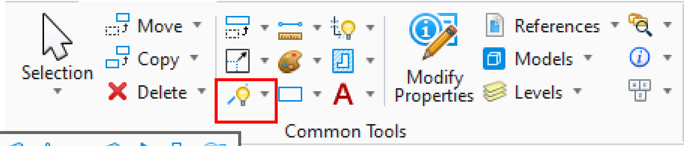
6. Set the *View Group* to **Building Model Back.**

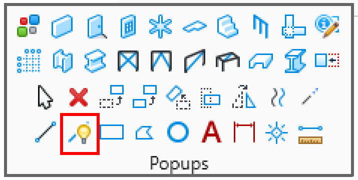
7. Set the Active *Family/Part* to **General: Constructions Dashed.**

8. From the *Common Tools* select the **SmartLine** tool.

   Hint: The **Space** key is a keyboard shortcut that will pop up a tool palette of commonly used tools.

   Therefore, the keyboard shortcut **Space + X** will quickly select the *SmartLine* tool.





Set Origin

The line you will place needs to be offset from the actual building form, so you will use some *AccuDraw* shortcuts to place it relative to the building geometry.

9. Working in *View 4,* hover your cursor near the bottom corner of the building until you see the yellow X indicating that AccuSnap has found the vertex.

   a. Do not **data point** *(left-click)* to start the SmartLine. Instead type **O** on the keyboard. This is a *shortcut key-in* that resets the origin of the *AccuDraw* compass to the current cursor location.

Now you can lock the axis and type in dimensions to move the compass again.

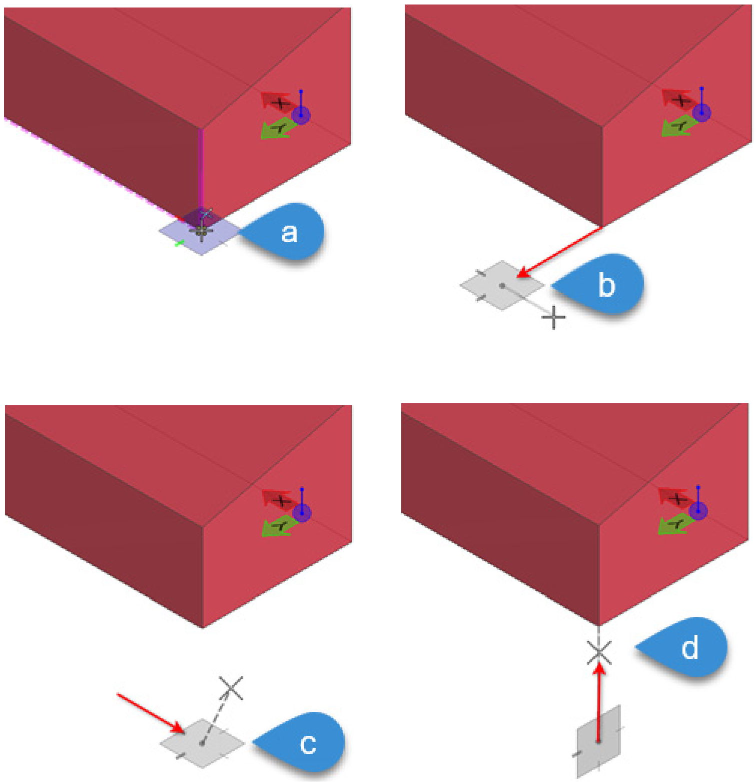
   b. Move the cursor away from the building and use **Enter** to lock the axis. Type **12:0** *[4000 mm]* to define the distance, then type **O** again to move the compass.

   c. Now move the cursor 90 degrees and use **Enter** to lock the axis, then type **12:0** *[4000 mm]* to define the distance. **Data point** *(Left-click)* to accept the point as the start point of the SmartLine.

Note that the AccuDraw compass moves and rotates with the cursor as the line is drawn, but it is currently on the *XY* or *Top* plane. The *shortcut key-ins* **T**, **F**, and **S** will rotate the compass to the *Top*, *Front* and *Side* planes.

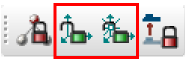
   d. Type **S** to rotate the compass to a *Side* orientation, move the cursor in the vertical direction, type **Enter** to lock the axis. Type **12:0** *[4000 mm]* to define the distance of the line, **data point** *(left-click)* to accept.

   e. *Right-click* to reset and finish the line.



Rotate to Element

Now, you will place a second line, that matches the slope of the building roof. In this case we need to rotate the *AccuDraw* compass to match the rotation of an existing element.

10. Unlock the *ACS Plane* and *ACS Plane Snap* lock. 

Note: When toggled on, these locks project a data point to the current ACS plane. When toggled off you can snap to any point in 3D space.

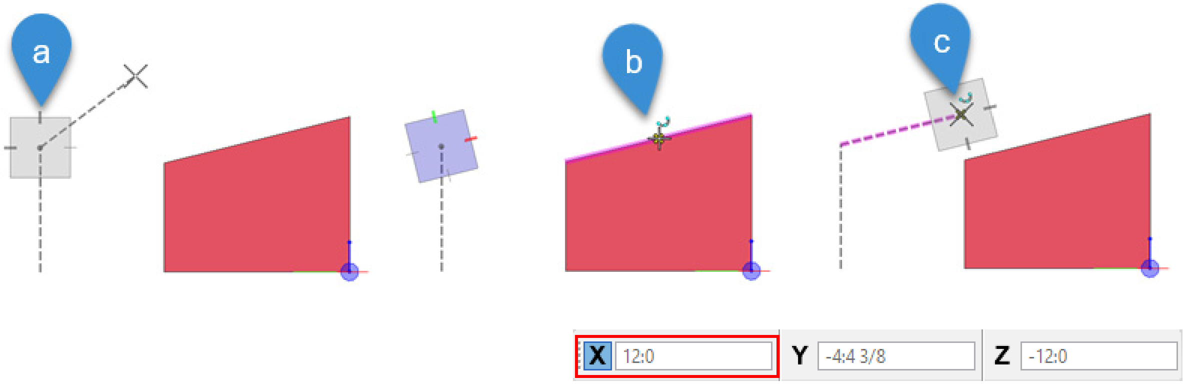
11. Start a new *SmartLine* at the top of the line just placed.

    a. Use **S** to rotate the compass to the side orientation.

    b. Type **RE** to rotate the compass to an element and select the sloped line at the edge of the roof. **Data point** *(left-click)* to accept.

    c. Type **Enter** to lock the axis and type **12:0** *[4000 mm]* to define the distance. **Data point** *(left-click)* to accept.

    d. *Right-click* to reset and finish the line.



Polar Mode

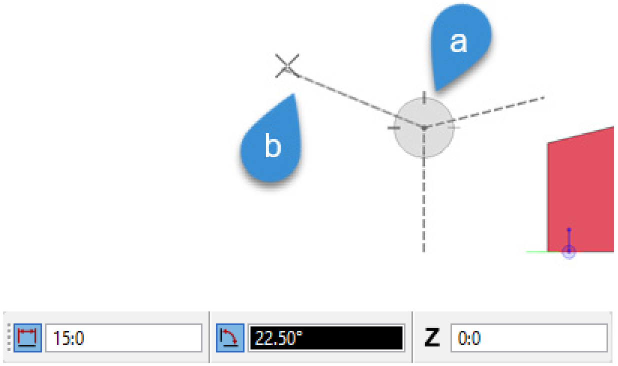
So far you have used the AccuDraw compass in the *rectangular* mode inputting X, Y, and Z coordinates. There is also a *polar* mode for inputting distance and angle.

12. **Data point** *(left-click)* to the top of the vertical line drawn for the platform canopy.

    a. Type **M** to toggle the *Mode* of the compass from *Rectangular* to *Polar.* Type **15:0** *[4500 mm]* to define the length.

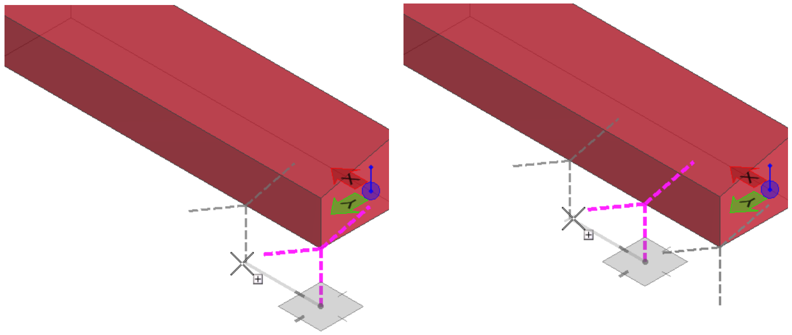
    b. Use the down arrow or the **tab** key to move the focus to the AccuDraw *Angle* field and type **22.5**. **Data point** *(left-click)* to accept.

    c. *Right-click* to reset and finish the line.

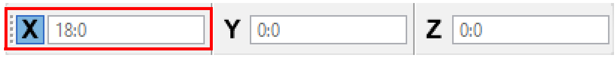


Previous Distance

Now lets use *AccuDraw* with the **Copy** tool and take advantage of an AccuDraw feature, *Previous Distance*.

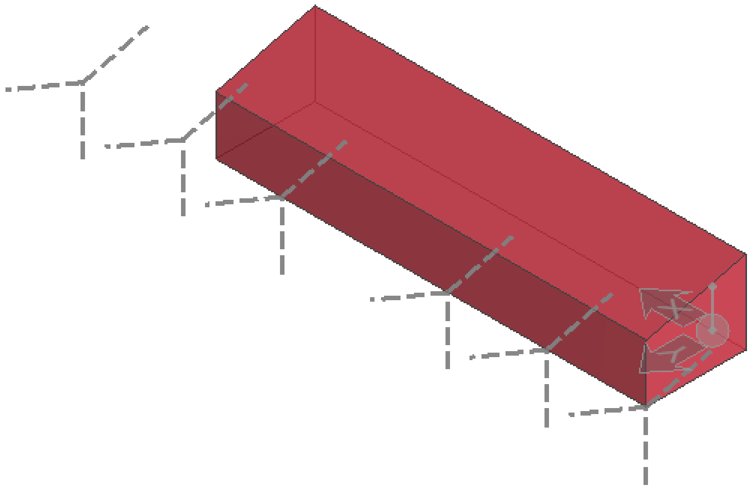


13. Select the 3 lines just placed to create a selections set.
14. From the *Common Tools* select the **Copy** tool.
    a. Select the start point at the base of the vertical line.
    b. Type **T** to rotate the AccuDraw compass to a *Top* orientation.
    c. Type **M** to change the mode back to rectangular.
    d. Drag the cursor to the left and use **Enter** to lock the axis. Type **18:0** *[6000 mm]* to define the distance. **Data point** *(left-click)* to accept.



15. The **Copy** tool is still active and you can continue to copy the selection set.
    a. Drag the cursor to the left and use **Enter** to lock the axis.

Note that the cursor temporarily locks at **18:0** *[6000 mm].* As you place elements in your model *AccuDraw* keeps track of the distance between your last two data points. Known as the *Previous Distance*. *AccuDraw* uses this distance as a hint for your next data point. As you keep the pointer within the tolerance distance of this previous distance, *AccuDraw* will keep it locked, so that you can **data point** to accept the previous distance without re-typing the distance.

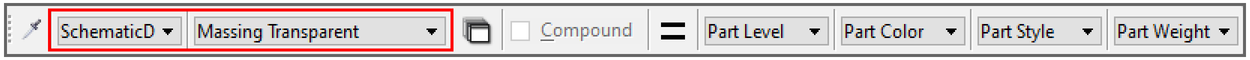


    b. With the cursor temporarily locked at the *Previous Distance,* **data point** *(left-click)* to accept.

16. **Copy** again a distance of **30:0** *[9000 mm]*.
17. **Copy** 2 more times a distance of **18:0** *[6000 mm].*
18. *Right-click* to reset and finish.

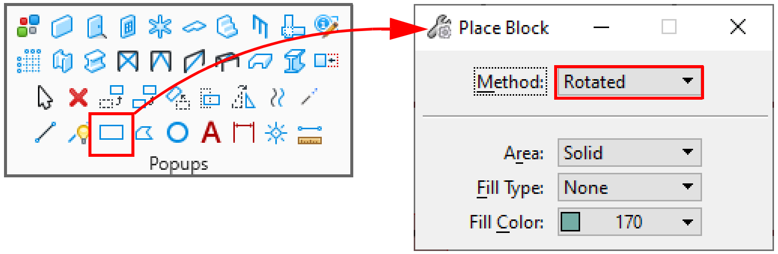
Finally, you will use the **Place Block** tool to place rectangular shapes as a place holder for a glass canopy. Later we can use those shapes to create an actual panelized roof.

19. Change the *Family* and *Part* to **SchematicDesign::Massing Transparent.**



20. Tap the *Space* bar and select the **Place Block** tool.

    Method: **Rotated**

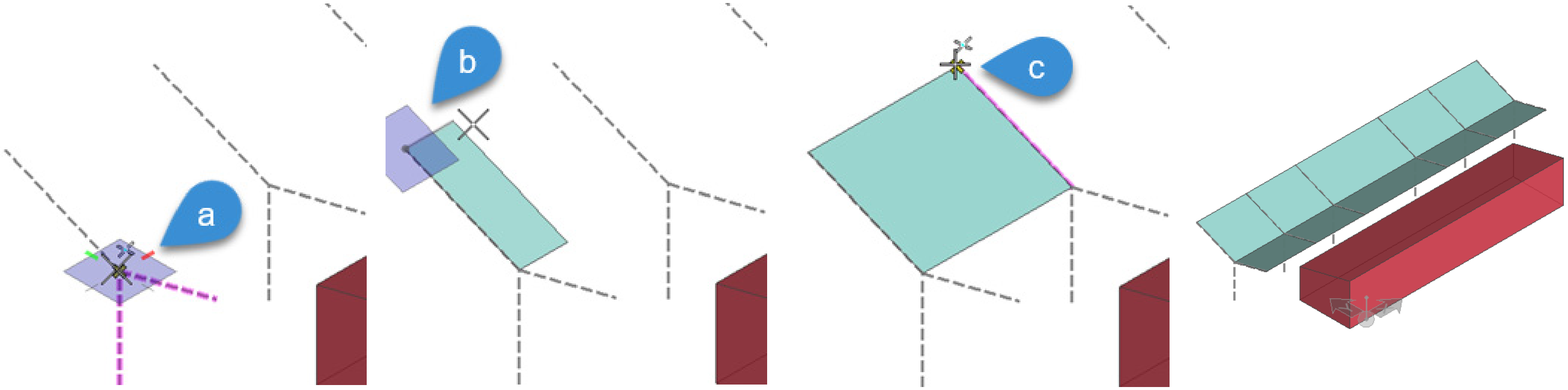


   a. Select the start point in the model, note that the *AccuDraw* compass is in the *Top* orientation, the next point will change the rotation of the compass.

   b. Select the next point at the other end of the sloped line, this moves the compass and also rotates it to the orientation defined by the two points.

   c. Select a third point to define the length of the block.

   d. Continue placing blocks to define the canopy.



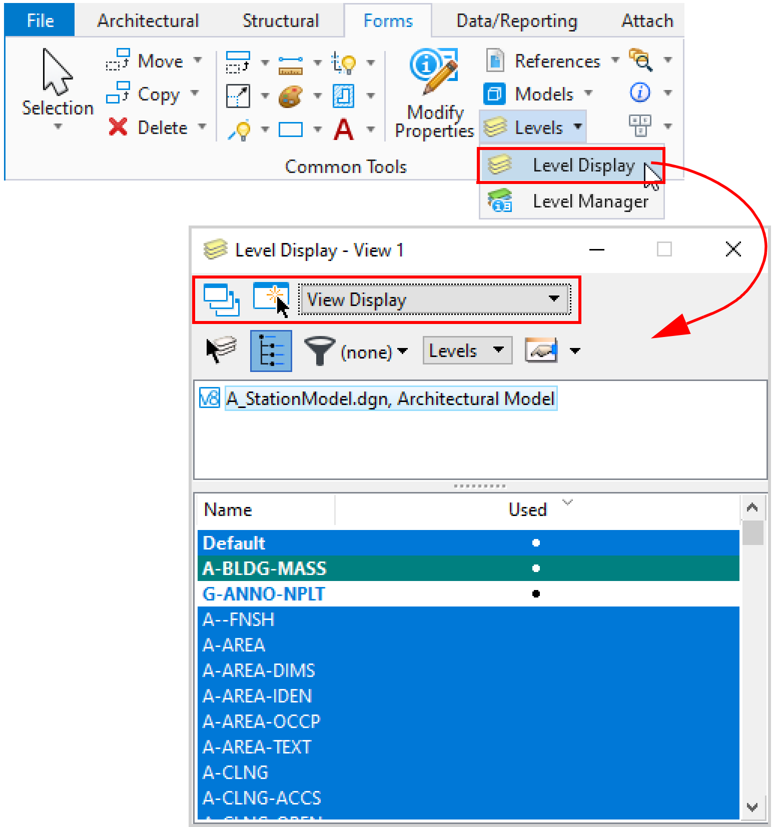
In this exercise you have learned various *AccuDraw* and *AccuSnap* techniques and shortcuts for placing geometry precisely in the model. Now that you have more geometry in the model, you may find it necessary to limit which geometry is displayed in the view. In the next exercise you will learn two techniques for controlling the display of geometry.

Exercise 1-7: Level Display and Display Sets

Now that you have more geometry in the model, you may find it necessary to limit which geometry is displayed in the view. In this exercise you will learn two techniques for controlling the display of geometry; Level Display and creating a Displayset.

Level Display

Each element in a model is on a level. The level is determined by the active part when the object is placed in the model. Levels can then be turned on and off in each view, so in different combinations they make it easier to see parts of a model. Use the *Level Display* dialog to turn levels in the active model and any referenced models on and off in the view.



1. Open the *Level Display* dialog.

   The dialog show all levels available from libraries. Levels can filtered and also sorted by the column headings.

   a. Select the **Name** column heading to sort by *Name* and then select the **Used** column heading to sort by *Used*.

   The levels are now displayed alphabetically and with all used levels shown first, followed by the unused library levels.

   b. *Double-click* on **A-BLDG-MASS** to make it the active level. The active level is highlighted in green.

   c. Select level **G-ANNO-NPLT** to toggle it off. Select it again to toggle it back on.

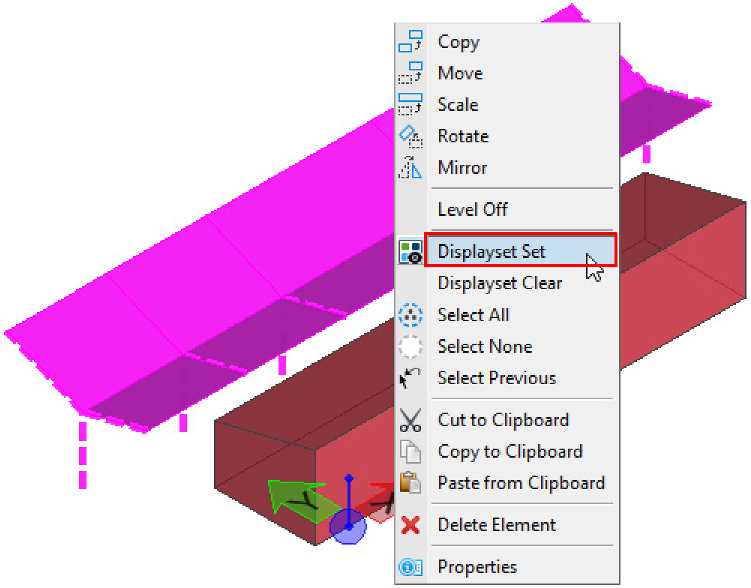
   The *Level Display* is set to *View Display*, by default, meaning changes in the level display affect the active view in the active model. Changes can be applied to a selected view or to all views if the *Apply to Selected View* or the *Apply to Open View* icon is selected.

2. Close the *Level Display* dialog.

Note: *Level Display* settings can be saved with a *Save Settings* and retained between sessions. They can also be saved as part of a *Saved View* for recall later.

Displaysets

Displaysets allow you select a group of elements to display in selected views, with all other elements hidden. This is quick way to isolate the geometry you want to work on, but it is a temporary setting and cannot be saved between session or as part of a Saved View.

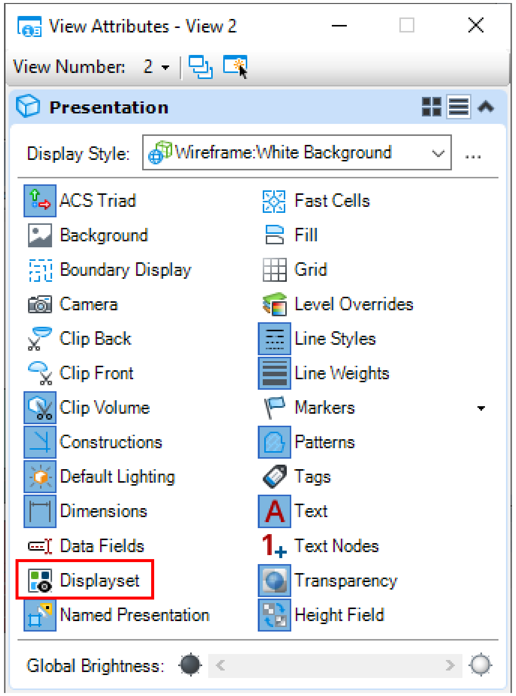


3. Create a *Selection Set* of the platform canopy geometry.

4. *Right-Press* and select **Displayset Set**. Now each view only shows the platform canopy geometry.

   a. Left-click in any view to deselect the geometry.

   The *displayset* will remain active until it is either cleared or the model is closed. However, the visibility of a *Displayset* is a *View Attribute*, so the *displayset* can be displayed in one view while all geometry is displayed in another view.



5. Open the *View Attributes* for *View 2 - Top* and toggle off **Displayset**.

   Note that now in *View 2 - Top* all geometry is shown.

6. *Right-press* in any view and select **Displayset Clear** to clear the *Displayset* and view all the geometry in all views.

Now that you have completed the first chapter you may want to close OpenBuildings Designer. Check that your views are set the way you would like them saved for the model.

7. **Ctrl+F** to *Save Settings*.

8. **File > Exit** to close *OpenBuildings Designer*.

In *Chapter 1: The 3D Model* you have learned the basics of placing geometry and controlling various views of the model in OpenBuildings Designer. You set up view windows and modified View Attributes. You used the design grid and grid locks to quickly place geometry 'by eye' on the design plane. You then used the AccuDraw compass in conjunction with AccuSnap to place lines and shapes in 3D space. And finally, you learned how to display the geometry you want to see while working on the model. In the next chapter you will begin to define the building environment by defining floor elevations, a structural grid and adding a site model for context.

Chapter 2: The 3D Building Environment

Now that you have placed the initial geometry for the station building model it is time to set up the 3D building environment for the building model. You will need floor planes and a structural grid for your building model so that geometry can be aligned between the 3D models. You will also investigate the *Explorer* dialog to see how it is used to navigate and explore all the content that makes up a 3D building model. You will use the *Explorer* dialog to add a site survey model to the building model and then align the building model with the real world using Geo-Coordinates.

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1. Start *OpenBuildings Designer* from the Start menu or desktop shortcut.

2. Set the *WorkSpace* to **OpenBuildings Training.**

3. Set the *WorkSet* to **Station Building_US** *[Station Building_NM]*

4. Select the file **A_StationModel.dgn** from the list of *Recent Files*. The file will open.

Optional - If you did not complete the exercises in Chapter 1 and would like a completed model to start the exercises in Chapter 2, there are several milestone files stored in the project WorkSet.

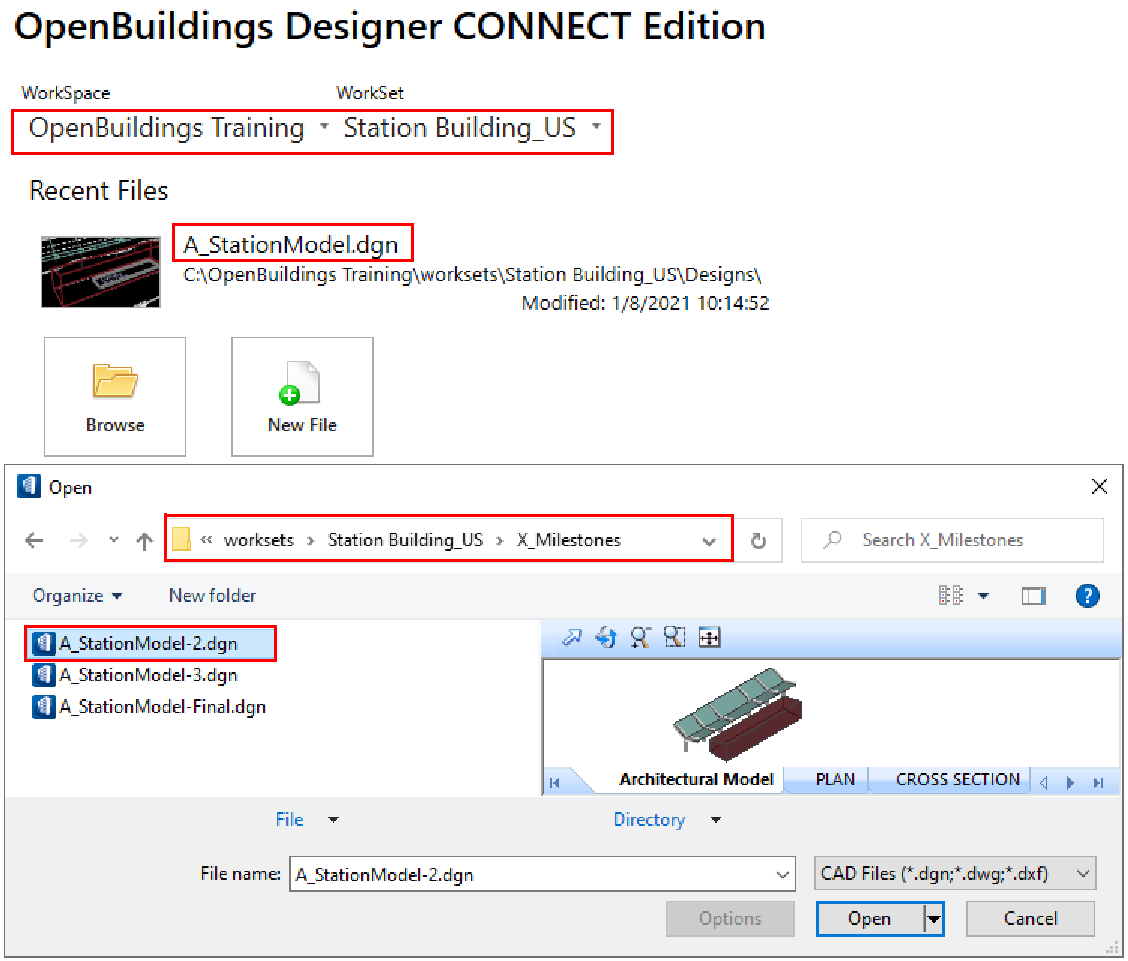
5. Select the *Browse* icon

   a. Navigate to the *X_Milestone* folder.

   b. Select the file **A_StationModel_2.dgn.**

   c. Select **Open**.

You are ready to start the exercises for *Chapter 2: The 3D Building Environment*.



Exercise 2-1: Using Floor Planes

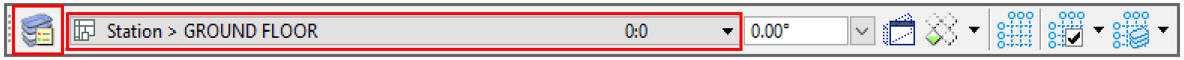
Floor Management System

OpenBuildings Designer uses Floors as a means of organizing, designing, and reporting building information. By this method, designated floors define the physical location for portions of the building relative to reference and site elevations. So the floor serves as a type of container for building elements and components in the model that include walls, doors, windows, fixtures, furnishings, equipment, structural members, mechanical components (HVAC and plumbing), and electrical equipment at a given elevation. In this capacity, floors can be used by architects, civil engineers, interior designers, landscape architects, and mechanical and structural engineers for many disciplines.

The floor definitions act as project specific *Auxiliary Coordinate Systems (ACS),* which is a utility that can be used to represent planes in a DGN file. However, the ACS is limited in what it can do to manage an extensive, multi-tiered floor and sub-floor system within a building project. While the ACS system continues to be active within the application, the building floor management utility is available for use by building design professionals who generally think in terms of floors and not auxiliary coordinate systems. Reference planes for floor elevations, and sub-floors within a floor (ceilings, raised platforms, and top of structure for example), are created with the floor management system to manage elements and components located within floor elevations.

Note: The floor management system is available across all WorkSet DGN files, meaning an ACS defined in one DGN can be shared by other DGNs.

You can define a set of floors and associated reference planes and sub-planes on a project-by-project basis using the floor management system. Sets of floor planes (and associated reference planes) can then be shared by the team for all designs created within a specific project. The floor management system provides these two tools, the *Floor Manager* and the *Floor Selector*. Both are accessible from the *Floor Selector* tool bar docked at the bottom of the interface.



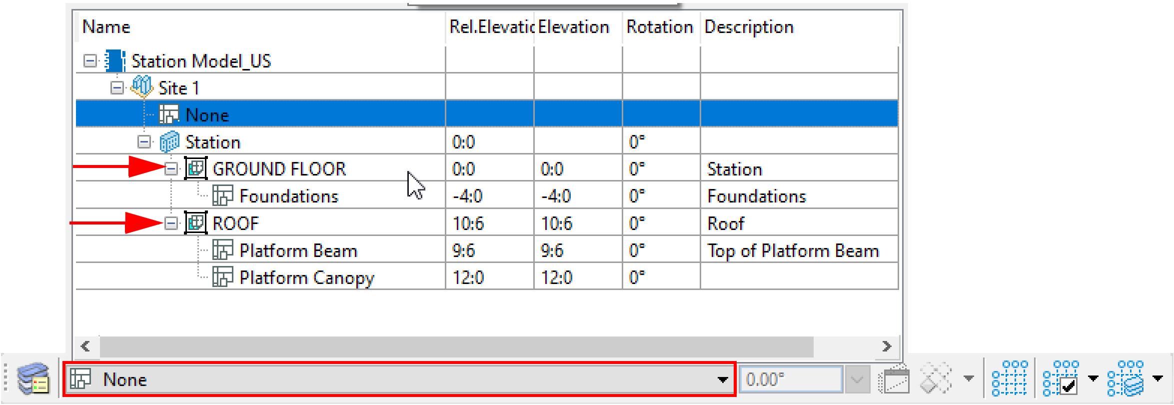
Floor Manager - The Floor Manager is used to create and manage floor definitions, floor and sub-floor reference planes and floor groups. The floor definitions information for the project is saved in a Master Floor File (BB_FloorMaster.dgnlib). The Floor Manager dialog is also used to insert floors, modify and delete floors and associated reference planes and floor groups as well as set elevation annotation.

Floor Selector - The Floor Selector is used to select floors and associated floor reference planes, and to make them active for modeling and placing graphics. The Floor Selector also sets active floors among multiple Buildings and has integrated tools interfacing with Grid Systems.

Floors and reference planes are used to help you model elements at the correct height in the 3D model. The *ACS Plane Lock* and *ACS Plane Snap Lock* are utilized in conjunction with the *Floor Selector* to insure data points are placed on the proper floor plane.

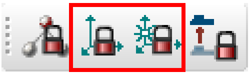
In this exercise you will select a floor plane from the *Floor Selector* to set the working plane and the appropriate snap locks.

1. From the bottom of the interface set the *Active Floor* to the **GROUND FLOOR** and then the **ROOF**.



Note that the ACS Triad changes its vertical location based on the *Floor Selector.* This indicates the ACS plane for modeling.

In addition, the *ACS Plane Lock* and *ACS Snap Plane Lock* are toggled to the locked position, this will be the default whenever a floor is selected from the *Floor Selector*.



Locking the *ACS Plane Lock* and the *ACS Snap Plane Lock* ensures that the elements you model will be placed on the active Floor.

ACS Plane Lock - If on, ACS Plane Lock sets the default view depth to be on the active ACS's xy plane rather than the view's active depth plane. As with the standard active depth, you can override this default by snapping to an existing element. When locked, the viewing operations and the AccuDraw shortcuts **T**, **F** and **S** are relative to the ACS.

ACS Snap Plane lock - If on, and AccuDraw is active, the first snap point is forced to lie on the Active ACS's xy plane (z=0). Further snap points then are controlled by AccuDraw's settings. If on, and AccuDraw is not active, all snap points are forced to lie on the Active ACS's xy plane (z=0). This lock applies only to 3D files.

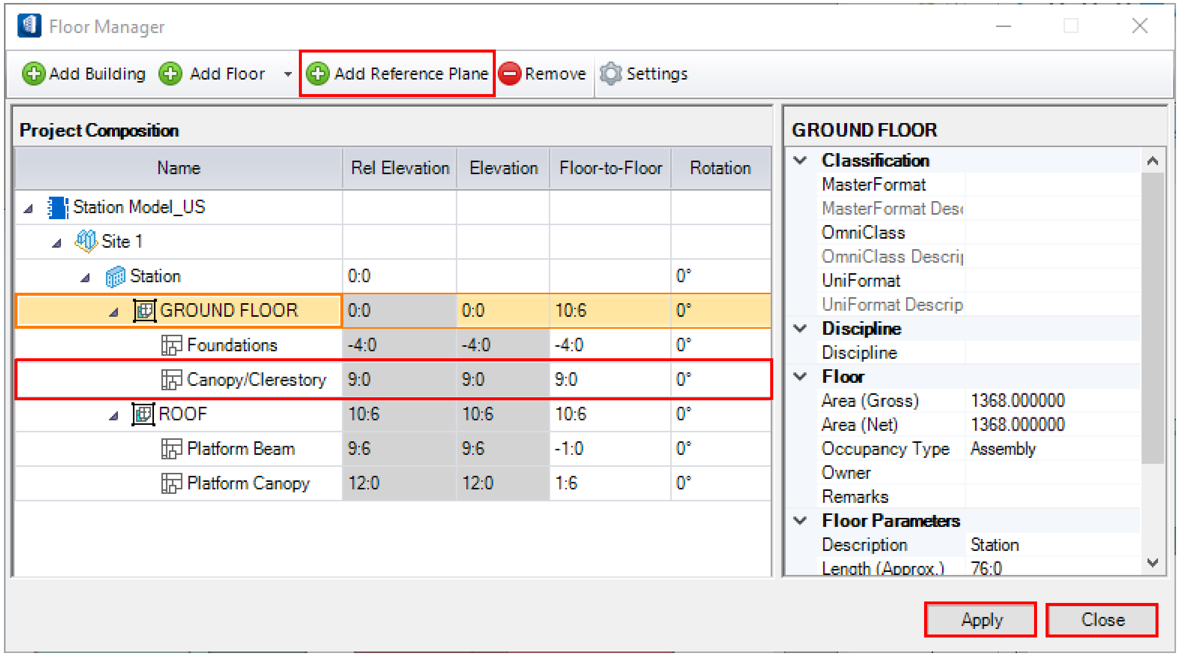
Hint: A *Save Settings* will save the floor selection, so that next time you open the file the *Floor Selector* is set to the currently selected floor.

You will now use the *Floor Manager* to add an additional reference plane for the entrance canopy and clerestory windows which will be at an elevation **9:0** [*3000 mm]* above the ground floor.

2. Open the *Floor Manager.*

The *Floor Manager* dialog opens.

Note that each floor and its associated reference planes are listed in the dialog, along with an elevation. The icons at the top of the dialog allow you to add and remove *Buildings*, *Floors* and *Reference Planes*.



3. Select the **GROUND FLOOR**.

4. Select **Add Reference Plane**. A *Reference Plane* is added to the *Ground Floor.*

5. Rename the *Reference Plane* **Canopy/ Clerestory**.

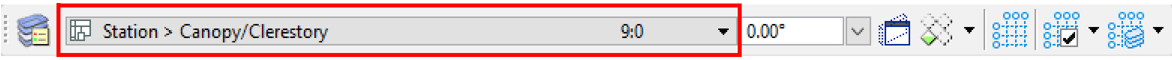
6. Set the *Floor-to-Floor* to **9:0** *[3000 mm]*.

   Note: When defining a *Reference Plane* the *Floor-to-Floor* refers to the height relative to the Floor.

7. Select **Apply**, then **Close**.

The new *Reference Plane* will now be available in the *Floor Selector.*

8. Set the *Active Floor* to **Canopy/ Clerestory.**

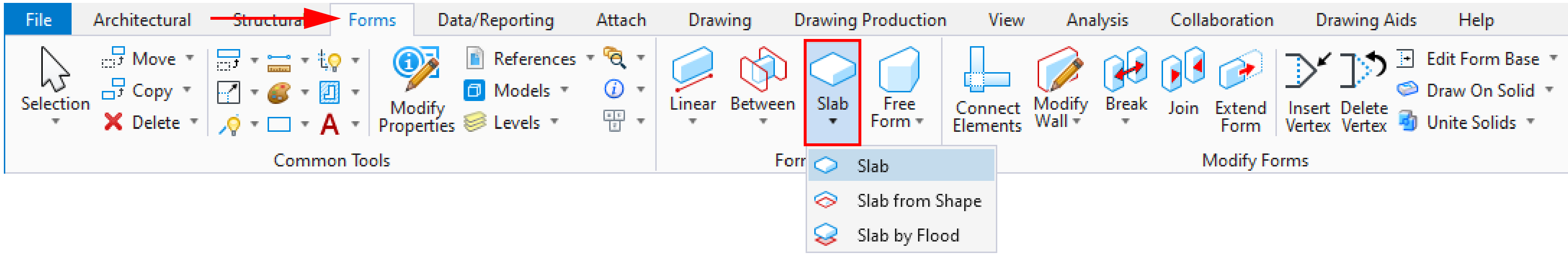


Note in *View 3 - Front* that the ACS Triad has moved up to the new elevation.

You will now place geometry in the model to understand how the *Active Floor* and the *ACS Plane* and *ACS Snap Plane* lock control the placement of geometry.

9. Set the active *Family/Part* to **Schematic Design: Massing Roof.**

10. Select the **Slab** tool from the *Forms* group on the *Forms* tab.

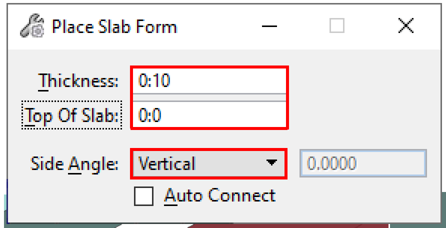


a. Set the following in the *Place Slab From* dialog:

Thickness: **0:10** *[250 mm]*.

Top of Slab: **0:0** *[0]*

Side Angle: **Vertical**.



11. Working in either the *Top* or *Iso* view, snap the cursor to the corner of the building mass near the ACS triad, but do not place a data point.

Note that even though you have snapped to the bottom corner, the AccuDraw compass has been projected to the active ACS plane.

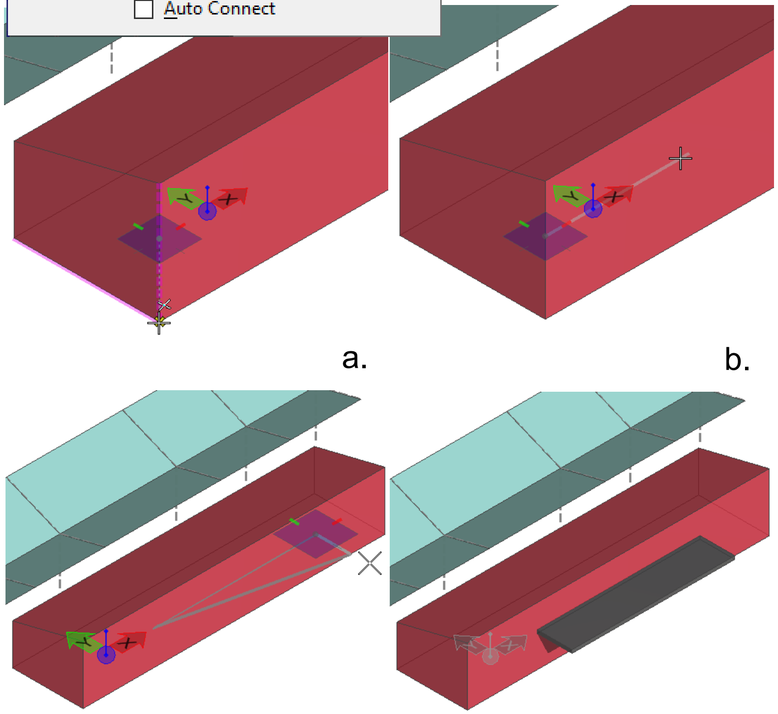
a. Use the *AccuDraw* shortcut **O** to set the origin of the compass.

b. Move the cursor **18'-0"** *[or 6000 mm]* in the *X-direction* to define the start point of the slab form. **Data point** *(left-click)* to accept.

c. Using *AccuDraw* continue to place a slab form that is **9'-0" x 42'-0"** *[2700 mm x 13000 mm]* centered on the front of the building.

d. *Right-click* to place the slab form.

Note that the top of the slab was placed at the active ACS plane.



a. b. c. d.

12. Set the *Active Floor* back to **GROUND FLOOR.**

Next you will create a basic structural grid based on the schematic massing of the building and canopy forms.

Exercise 2-2: Creating a Building Grid

Grid Systems

OpenBuildings Designer provides a comprehensive set of Grid Systems in which Buildings can have multiple grids (orthogonal, radial and sketched) applied to specific floors or ranges of floors in specific buildings. Grid Systems more effectively integrates grids into OpenBuildings Designer workflows including integration with the 3D model and the Floor Manager system. The *Grid Systems Manager* dialog contains settings for adding, copying and removing grids, inserting grid lines, manipulating grid line spacing, rotating grids, and setting grid line symbology and other preferences.

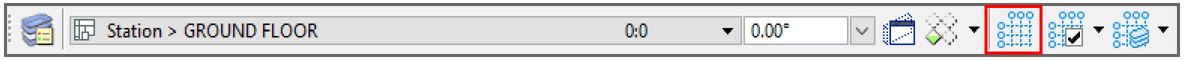
Integration with 3D model

The Grid System is dynamically integrated within the 3D model where it can respond to the current view, the active floor definition and be interactive with your design workflows.

Grids are stored as data (EC data) in the same DGNlib used by the Floor Manager. The Grid System definition and Building/Floor definition must share the same DGNlib since Grids are associated to Building/Floor definitions.

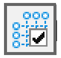
Integration with Floor Manager System

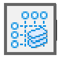
The *Floor Selector* tool bar is docked by default along the bottom edge of the application window. Selecting an active floor for the model will cause the corresponding grid to be displayed in the view. The *Grid System Manager* is opened from the icon on the *Floor Selector* tool bar.



There are additional grid display options on the *Floor Selector* tool bar which can be toggled to control the display of the grid in the model views.

*Isolate Floor* — Used to display elements on the active floor only.

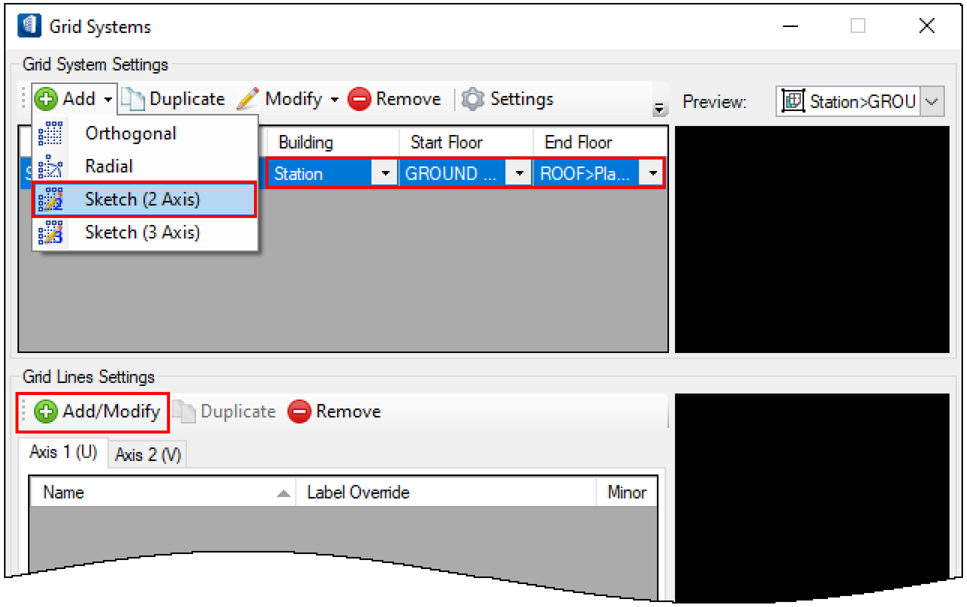
*Set Active Grid* — Used to select which grids are active and available to view and dynamically display.

*Grid Display Options* — Used to determine when and how the Dynamic Grids are presented.

A grid will serve as a datum for elements like columns beams and walls. In this exercise you will set up a simple sketch grid based on the schematic massing model.

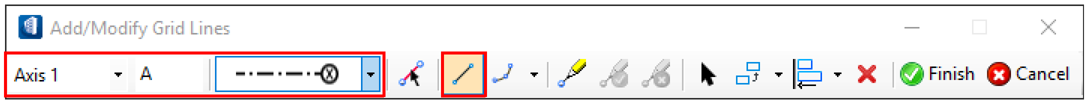
1. Open the *Grid Systems* dialog by selecting the **Grid Systems Manager** icon on the *Floor Selector*.

2. Add a new *Sketch Grid*.
   a. From the *Add* pull-down select **Sketch (2 Axis)**.
3. Rename the new *SketchGrid* to **Station Grid**.
   a. Set the *Start Floor* to **GROUND FLOOR>Foundations** and the *End Floor* to **ROOF>Platform Canopy**.
4. Under the *Grid Lines Settings* select **Add/Modify**.



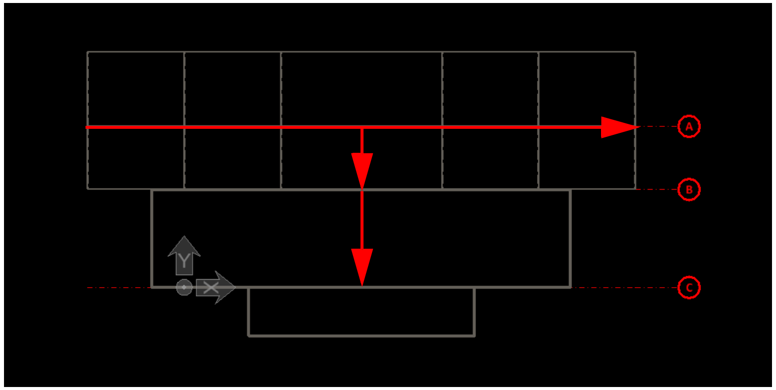
A temporary Top view will open with the current geometry grayed out. You will now draw some grid lines based on the blocking model created.

5. On the *Add/Modify Grid Lines* tool bar set the *Axis* to **Axis 1** and the *Label* to an **End Label**.
6. Select the **Place Line** tool on the *Add/Modify Grid Lines* tool bar.



a. Draw a grid line along the ridge of the platform roof canopy.

7. Select the **Copy** tool on the *Add/Modify Grid Lines* tool bar.



a. Select the grid line **A** and using *AccuDraw* copy **12:0** *[4000 mm]* to the back edge of the station building.

Hint: Since the grid line and the canopy shape overlap you may need to use **Reset** *(right-click)* on the mouse to scroll through the selected geometry until the grid line is selected.

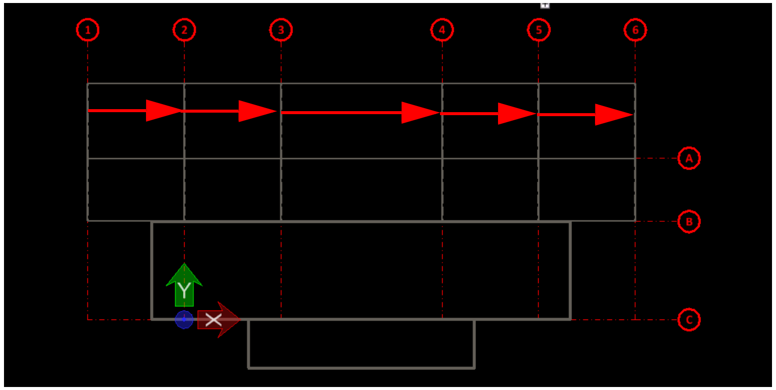
b. **Copy** the grid line again **18:0** *[6000 mm]* to the front edge of the building.

8. Set the *Axis* to **Axis 2** and the *Label* to **End Label**.

9. Select the **Place Line** tool on the *Add/Modify Grid Lines* tool bar.

a. Draw a grid line from the start point of grid line **C** to the top left corner of the platform canopy.

10. Select the **Copy** tool on the *Add/Modify Grid Lines* tool bar.

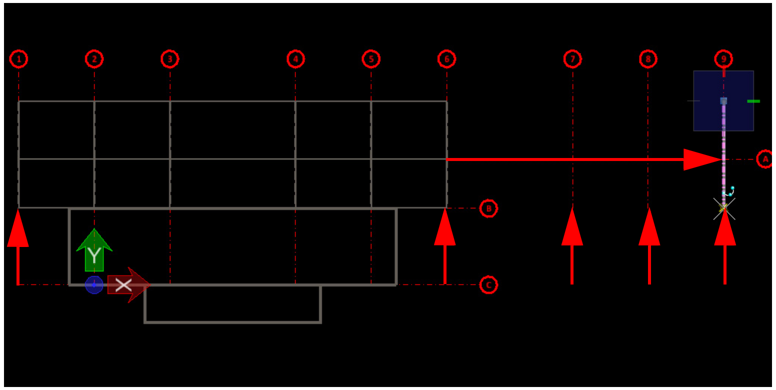


a. Select grid line **1** and copy it 5 more times at the following spacings: **18:0, 18:0**, **30:0**, **18:0**, **18:0**, *[6000, 6000, 9000,6000,6000]* creating grid lines **2**, **3**, **4**, **5** and **6**. These should align with the platform canopy panels.

Now you will create 3 additional grid lines to expand the platform canopy.

b. Select grid line **6** and copy it 3 more times at the following spacings: **30:0**, **18:0**, **18:0**, *[9000,6000,6000]* creating grid lines **7**, **8** and **9**.

Grid lines can be modified using the selection tool and handles.

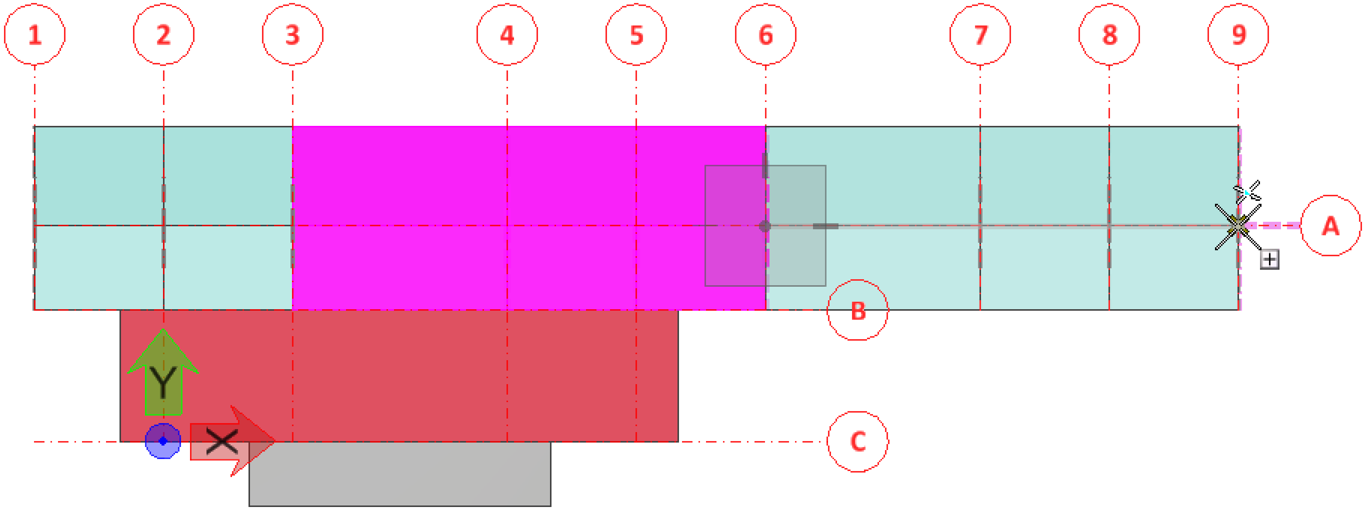


11. Select grid line **A.**
    a. Select the end handle and stretch the line to grid line 9.
    b. Repeat for grid lines **1**, **6**, **7**, **8** and **9**, trimming these grid lines back to grid line **B**.
12. Select **Finish** on the *Add/Modify Grid Lines* tool bar.
13. Select **OK** in the *Grid Systems* dialog to save the grid and close the dialog.

The grid is now displayed in each of the views. This same grid will be visible in all models created within this project WorkSet and will be used for placing and aligning geometry in the model.

Now lets use the grid intersections to copy the platform geometry and extend the geometry to the new grid lines.

14. Make a selection set of the last 3 bays of the platform canopy and then select the **Copy** tool.
    a. Snap to the intersection of grid line **A** and grid line **6** as the point to copy from.
    b. Snap to the intersection of grid line **A** and grid line **9** as the point to copy to.

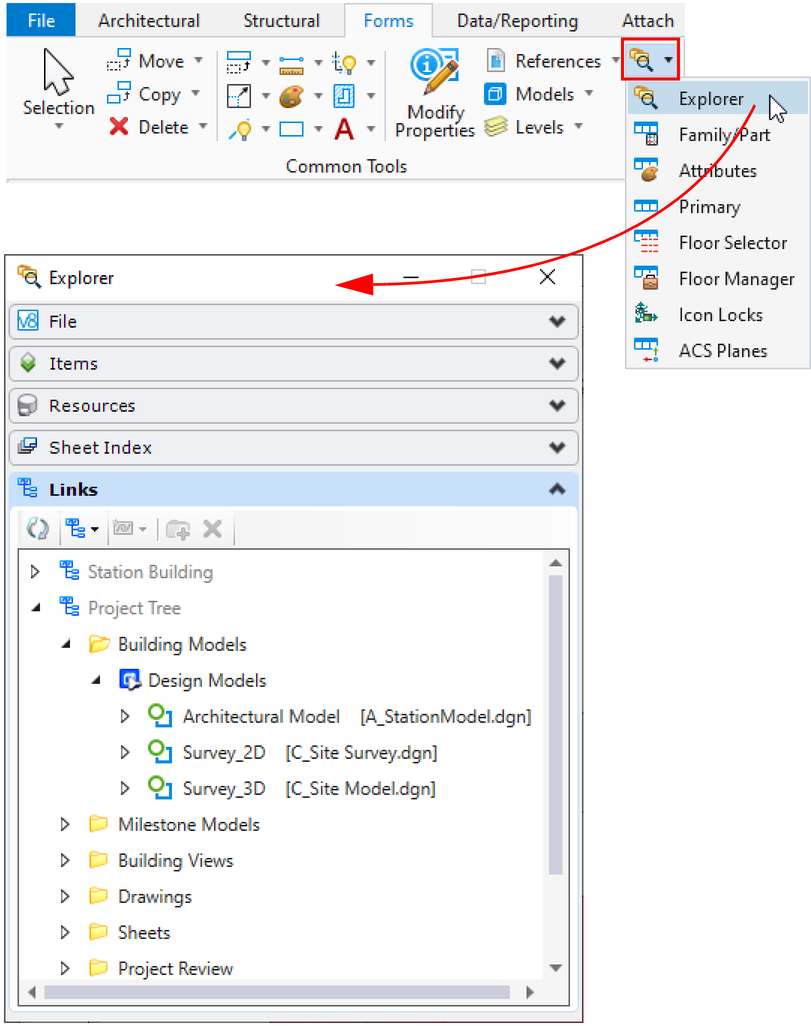


    c. *Right-click* to reset and finish.

Exercise 2-3: Working with Site Files

When modeling a building it is helpful to have a site survey or site model to help give the building context and locate it within the real world, making sure it is designed within the property and setback lines. In this exercise you will learn how to open the *Explorer* dialog, attach a reference, move and rotate the reference and then import geo-coordinates from the reference.

1. **Open** the *Explorer* dialog. It should automatically dock on the left side of the interface.



Introduction to Explorer

The *Explorer* dialog allows you to manage and control project content. It is a single interface that provides browsing function for files, links, items, resources, and sheet indexes.

The *Explorer* dialog consists of five tabs: *File* tab, *Items* tab, *Resources* tab, *Sheet Index* tab, and *Links* tab.

File tab—used to browse and manage the file content such as models, references, saved views, levels, styles, templates, and so on.

Items tab—displays non-graphical business data attached to the objects in the BIM model in hierarchical order.

Resources tab—displays resources used in a DGN file in hierarchical order.

Sheet Index tab—allows you to manage sheet indexing. A sheet index is an organized and named collection of sheet models from one or more design files.

Links tab—can be used to see the linked data, including other 2D and 3D design models, drawings and sheets within the project WorkSet.

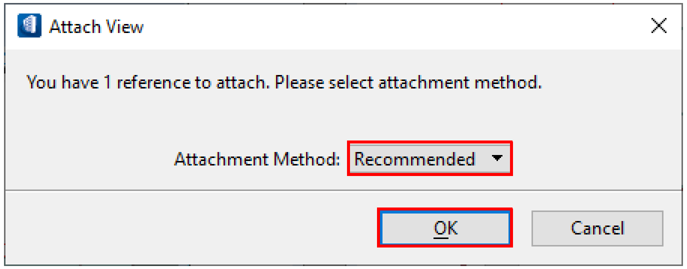
2. Select the *Links* tab.

   a. Expand the **Project Tree > Building Models > Design Models**.

   Note that there are additional design models that are part of this project or WorkSet, such as a site survey. You will now attach the *Survey_3D[C_Site Survey.dgn]* as a reference file so that the station building is modeled in the correct context.

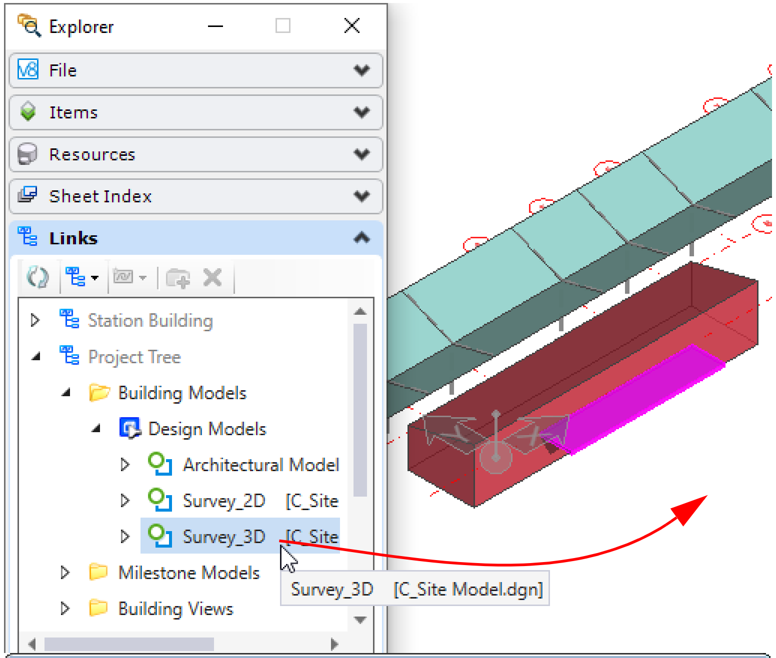
3. Select the **Survey_3D [C_Site Model.dgn]** and drag and drop it into any view.

   a. Set the *Attachment Method* to **Recommended**.



   b. Select **OK**,

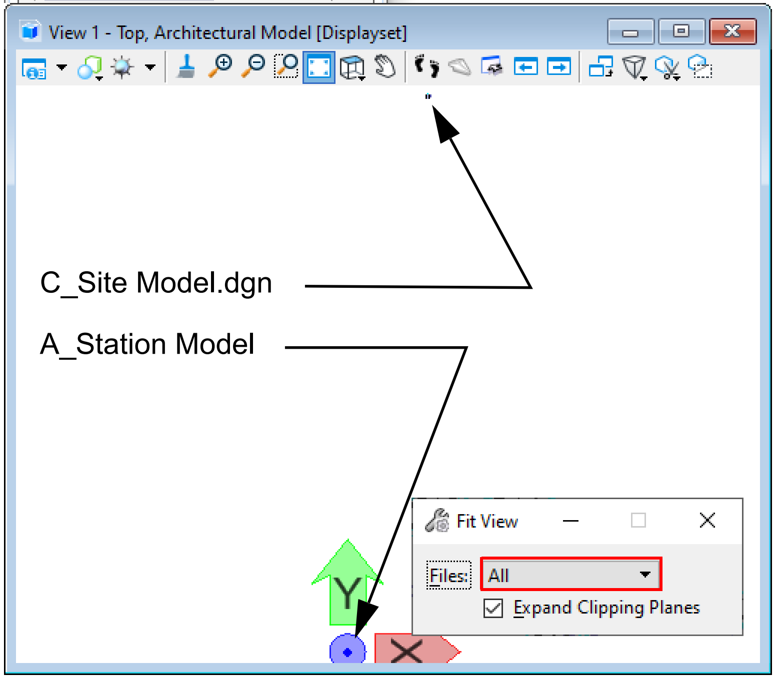
   The **Survey_3D [C_Site Model.dgn]** model is now attached as a base reference file.



Geo-Coordination

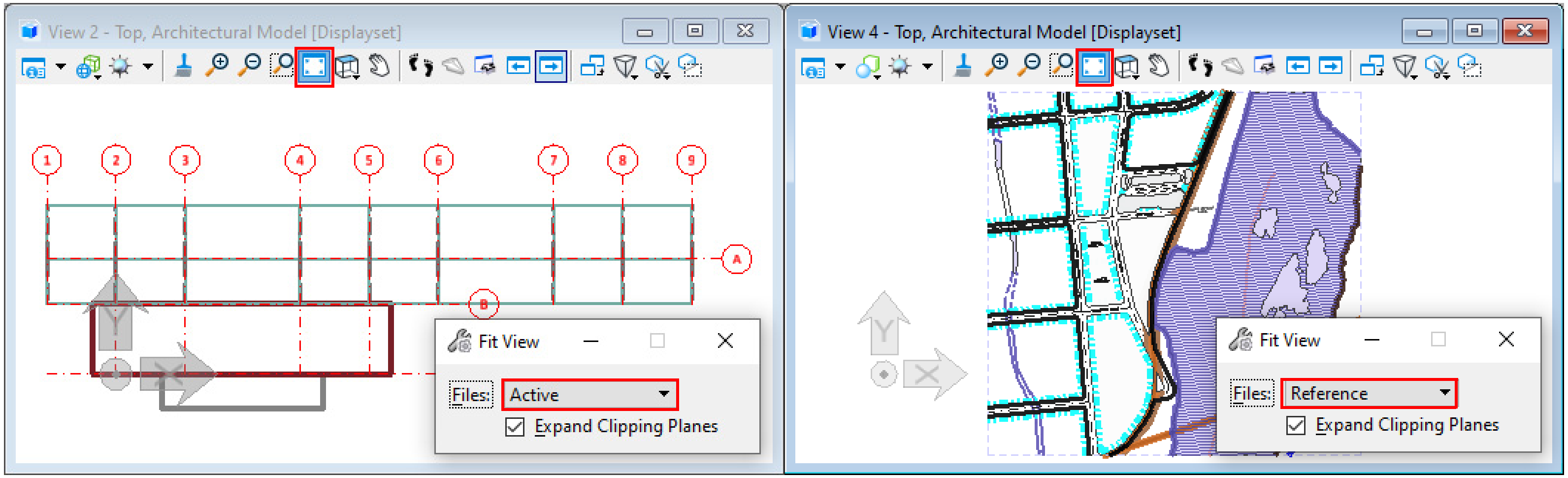
It is typical that a civil file, such as a survey or rail alignment will be modeled at real-world coordinates rather than near the 0,0,0 origin, therefore the two files do not align. It is necessary to move the site survey reference file so that the building model is within the site property. Once that is done, you can import the real world coordinates from the reference file and the building model will also be geo-located. Remember the building model must always be modeled within the *Solids Working Area* at the 0,0,0 origin.

4. Activate *View 2 - Top* and use the **Fit View** icon to fit *All* the files.



You will now move and rotate the *C_Site Model.dgn* reference so that it is aligned with the station location.

5. Activate *View 2 - Top* and use the **Fit View** icon to fit only the *Active* file.

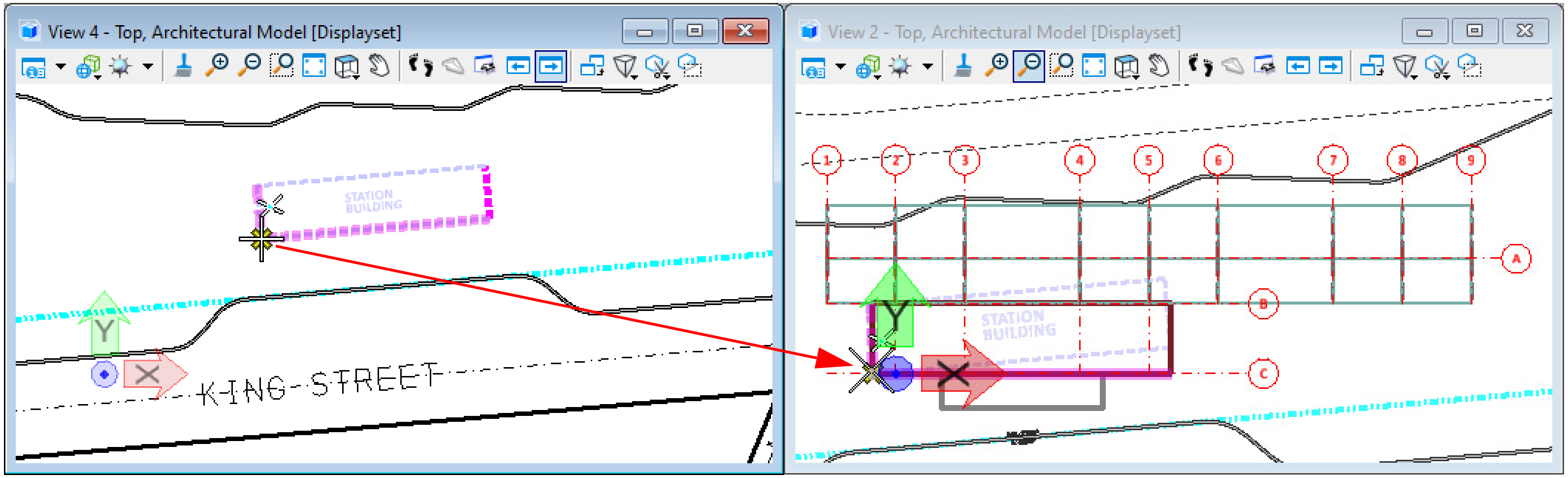


6. Open *View 4,* rotate to *Top* and use the **Fit View** icon to fit only the *Reference* file.

The station building is intended to be located along the lake front rail line on King Street. Zoom into this area.

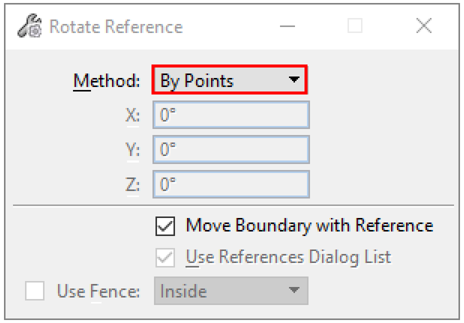
7. *Right-press* over the *C_Site Model.dgn* reference and select **Move Reference**.

   a. Select the lower left corner of the station building outline as the point to move from, move the cursor to *View 2* and select the lower left corner of the building as the point to move to.



Next you will rotate the *C_Site Model.dgn* reference so that the site is aligned with the Station Building or the X-axis.

8. *Right-press* over the *C_Site Model.dgn* reference and select **Rotate Reference**.



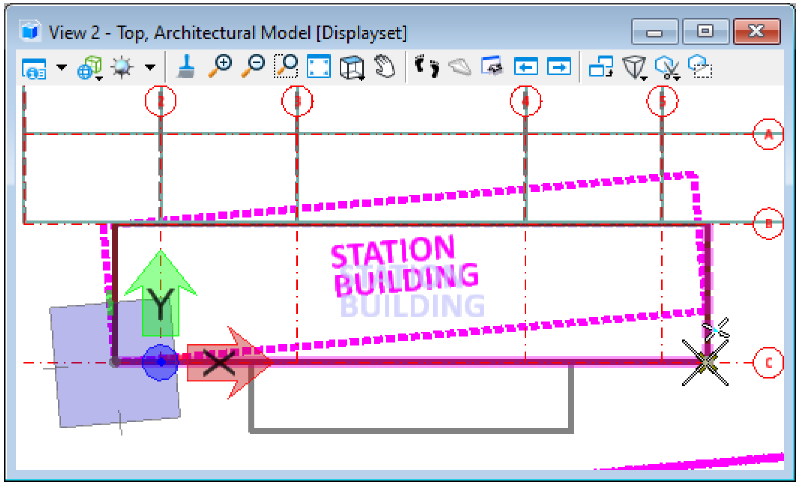
   a. Set the *Method* to **By Points**.

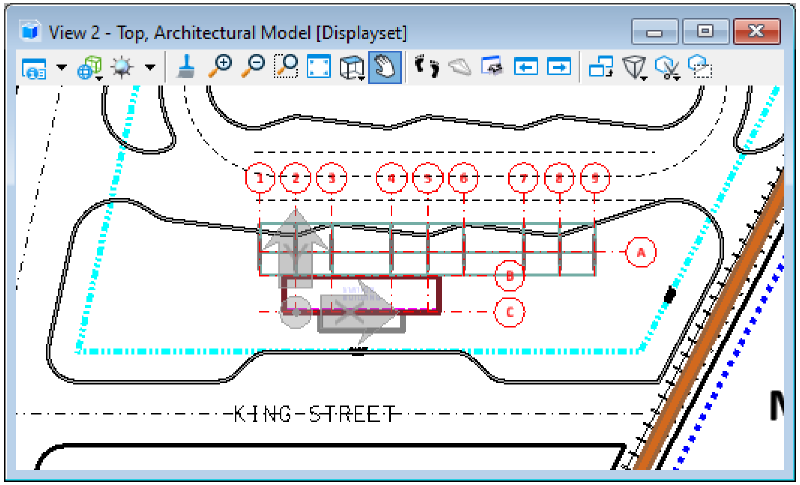
   a. Select the first point, the pivot point, as the lower left corner near the ACS Triad.

   b. Select the second point, the start of the rotation, as the lower right corner of the station building outline on the C_Site Survey.dgn.

   c. Select the third point to define the rotation, as the lower right corner of the station building model.

9. *Right-click* to reset and complete the rotation.





Now that the site is aligned with the building model you can import the *Geo-Coordinate System* from the site file so that the station building model can use this *Geo-Coordinate System* to be correctly aligned with real-world coordinates, while still being modeled within the *Solids Working Area*.

Next you will import the *Geo-Coordinate System* from the survey file.

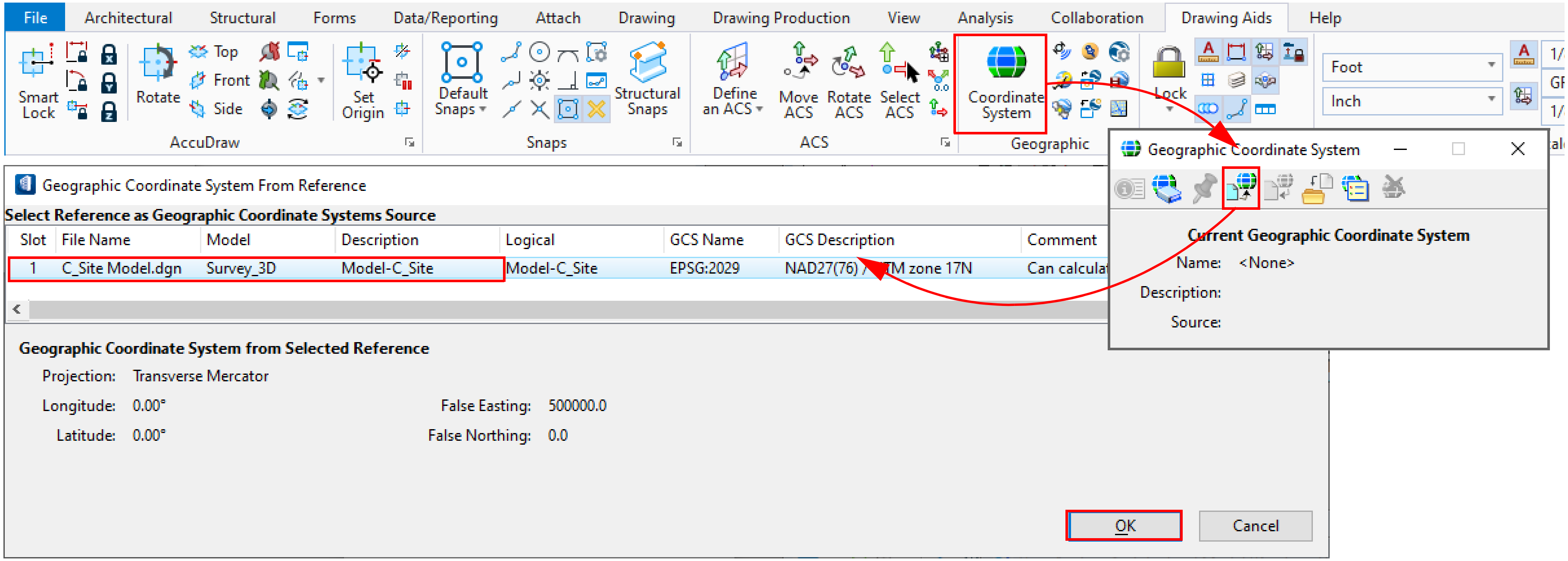
10. From the *Geographic* group on the *Drawing Aids* tab select the **Coordinate System** tool.

    The *Geographic Coordinate System* dialog will open. Note that there is currently no *GCS* in this file.

    a. Select the **From Reference** icon in the *Geographic Coordinate System* dialog.

b. The *Geographic Coordinate System from Reference* dialog will open showing the attached references.

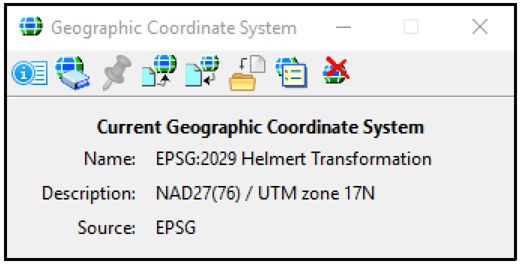
11. Select **C_Site Survey.dgn** and then select **OK**.



c. An alert will pop up about feature support in earlier versions of the software, select **OK**.

d. A second alert will pop up about the design file units, select the option *"The graphic elements are correctly drawn in feet. The storage units should not be changed."* Select **OK**.

The *Geographic Coordinate System* dialog should now show a GCS of **EPSG:2029 Helmert Transformation**.



To demonstrate the advantage of having a GCS in this file you can now re-attach the **C_Site Model.dgn** reference using *Geo-referencing* to align the two files.

12. *Right-press* over the *C_Site Model.dgn* reference and select **Detach Reference.**

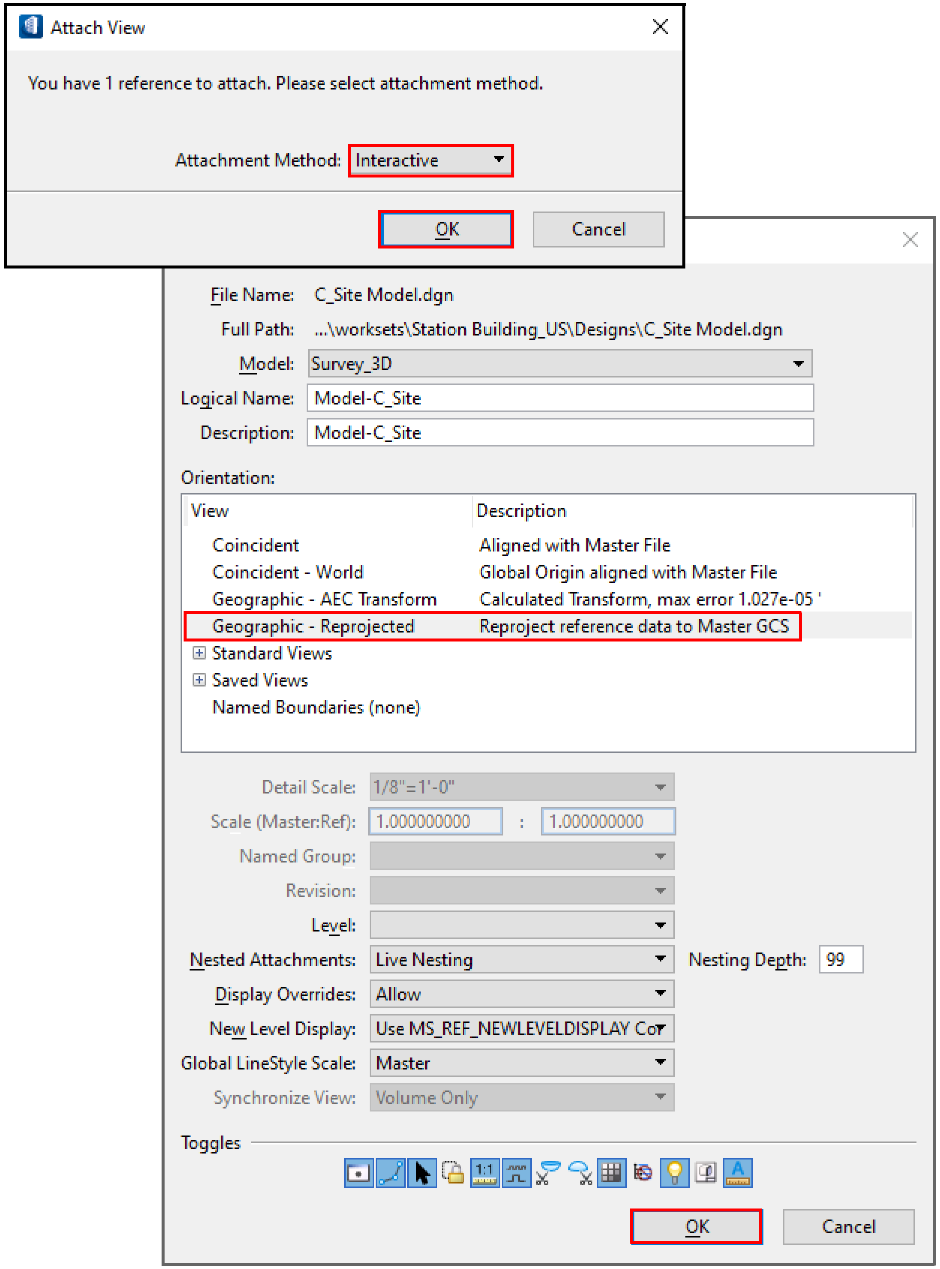
13. Select the *Links* tab in the Explorer dialog and expand the **Project Tree > Building Models > Design Models**.

    a. Select the **Survey_3D [C_Site Model.dgn]** and drag and drop it into any view.Set the *Attachment Method* to **Interactive**.

    b. Select **OK**,

14. In the *Attach Reference* dialog set the *Orientation* to **Geographic - Reprojected**

    a. Select **OK**.



The reference attaches aligned with the station building model. The **A_Station Model.dgn** file is still aligned with the Global Origin so that all the building models can be attached as coincident references, but it also has a GCS so that it can be referenced to civil site geometry with geo-referencing.

Note: When referencing a building model to a civil model using geo-referencing set the orientation to **Geographic - AEC Transform** to maintain the building geometry without any re-projection of the geometry.

Note: If the station building needs to be moved relative to the civil model at any point, you would not actually move any of the station building models, you would simply move the *C_Site Model.dgn* reference in this model and re-import the GCS.

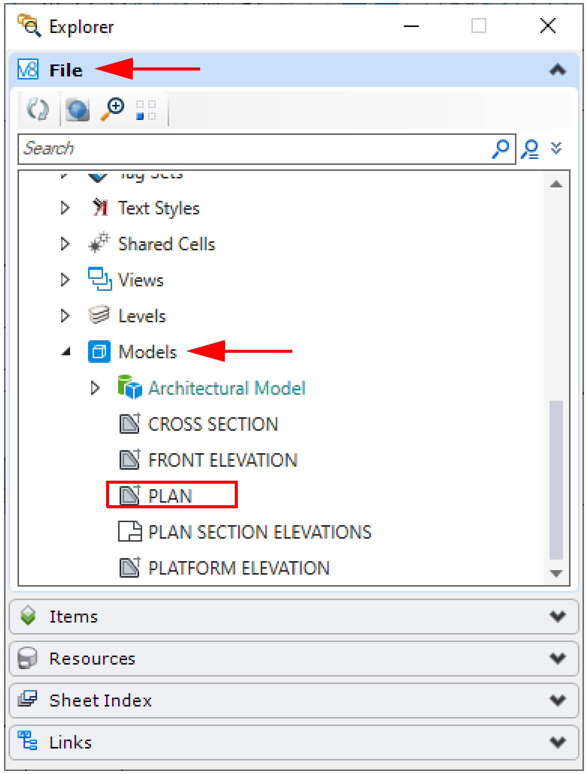
Exercise 2-4: Review the Drawing and Sheet Views

Now that you have the beginnings of a building model you can review some of the output available from the model, such as drawings. The drawings are generated from the model and should be periodically checked throughout the modeling effort. In this session you will learn how to open the drawing views for the plan section and elevation drawings. These views were already set up as part of the seed file.

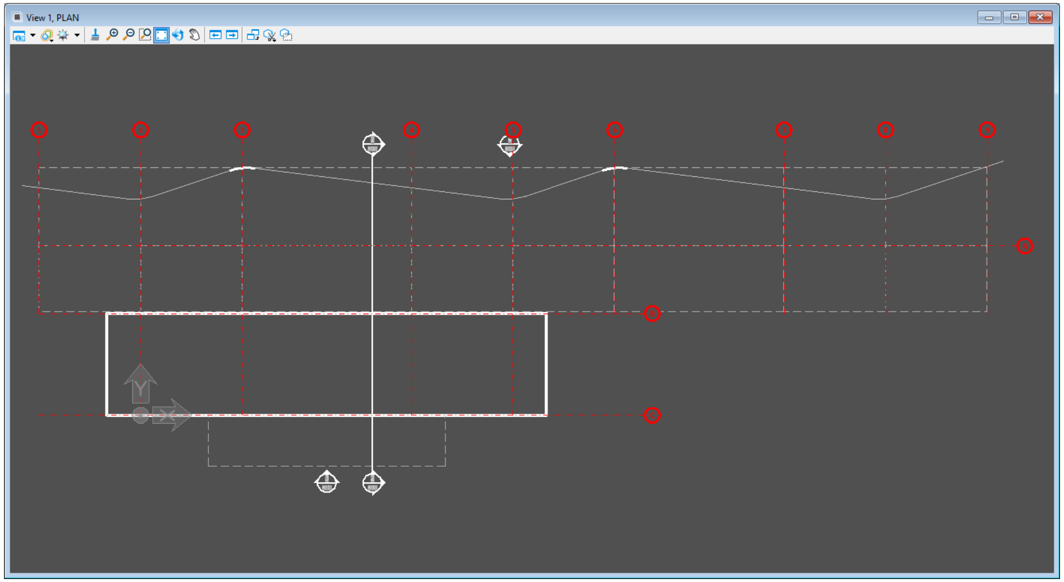
1. From the *Explorer* dialog expand the **File** tab.Expand the **Models** group.I

   Remember, in this context a model refers to a container within the DGN file and it can be a 3D model, a 2D drawing or a sheet. You can see here that within this file, in addition to the 3D model, *Architectural Model*, you have been working in, there are 4 drawing models, the grey drawing icon indicates that they are drawing models, and one sheet model, indicated by the white sheet icon.

   These drawing and sheet models were part of the DGN seed file used when this file was created.



2. *Double-click* the **PLAN** model to view the Plan Drawing. .



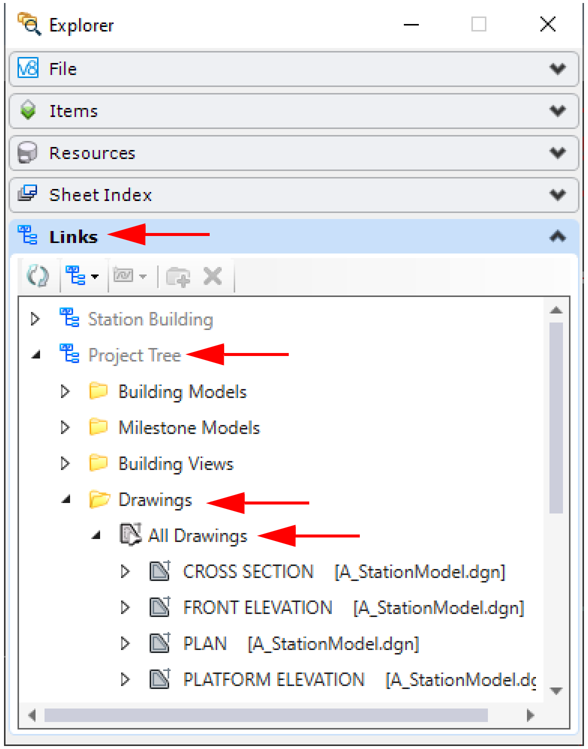
Note: The Plan Drawing is a cut view of the 3D model referenced to this drawing model, so it is updated as the model is built. Currently you have a conceptual model, so you have a conceptual drawing. Additional annotations, such as notes and dimensions would be added in this drawing model.

3. Select the **Architectural Model** to navigate back to the 3D model.
4. In the *Explorer* dialog switch to the *Links* tab.

   a. Expand **Project Tree > Drawings > All Drawings**.

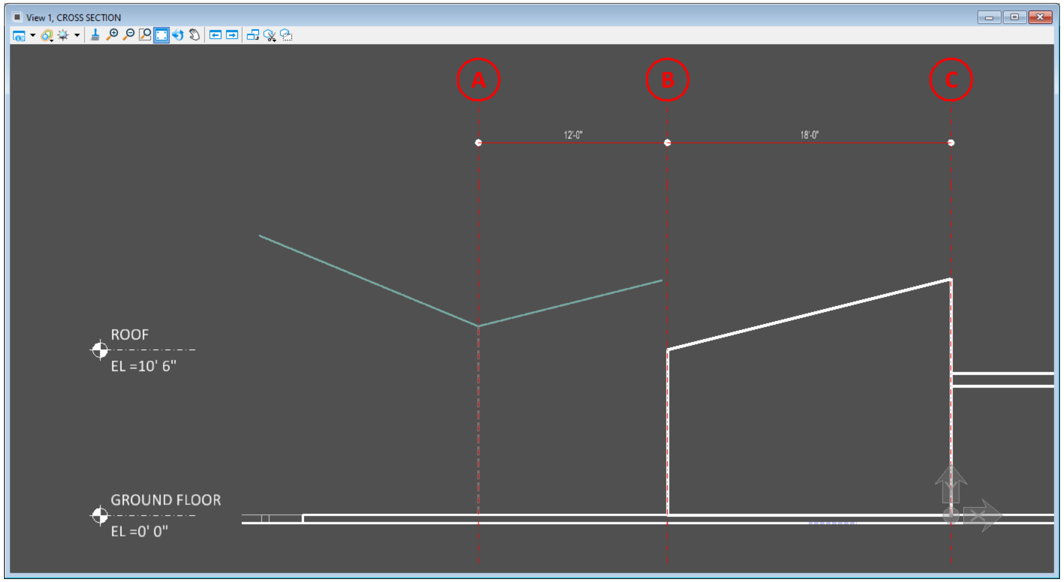
   Here you will see only drawings, but all the drawings in this WorkSet, even drawings that might be in another file. In the next chapter you will create a structural model so then you will see additional structural drawings listed here. These are links to the drawing models and *double-clicking* will open the drawing model and file.

   b. Navigate to the **Sheets** folder to see all the sheets within this WorkSet



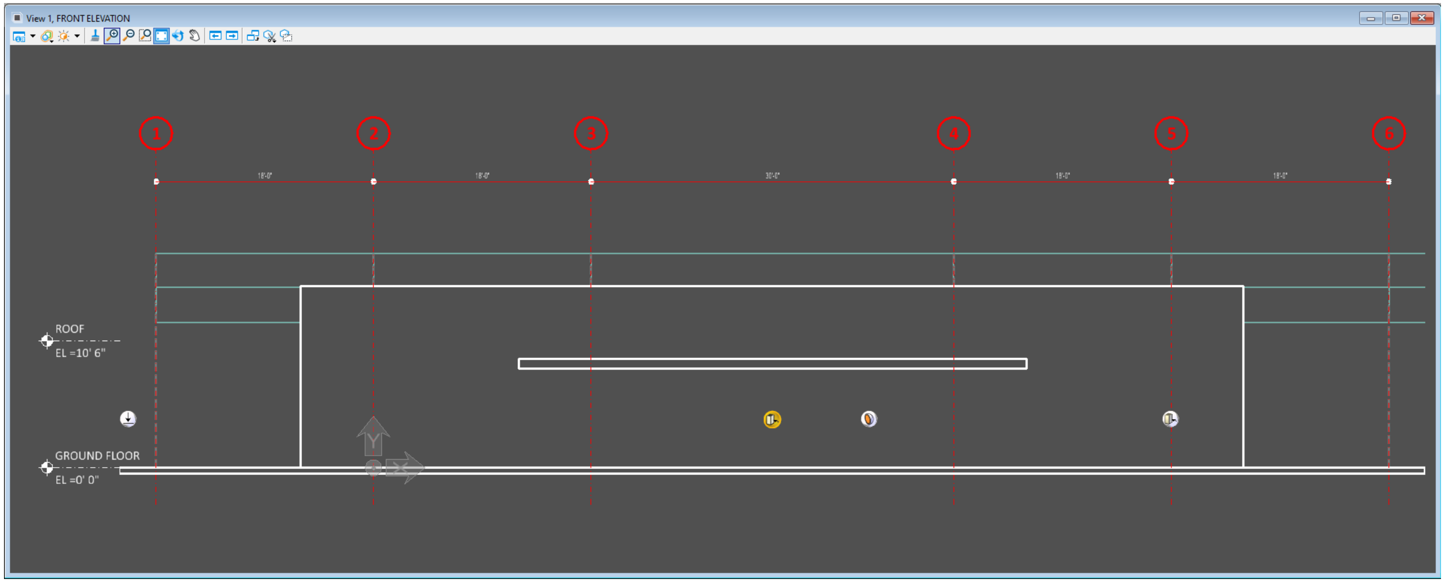
   Each drawing and sheet model within this file also has a corresponding *View Group*. We can open the model by selecting the *View Group*.

5. Select the *View Group* **Drawing 2**.This will open the model of the *CROSS SECTION* drawing.

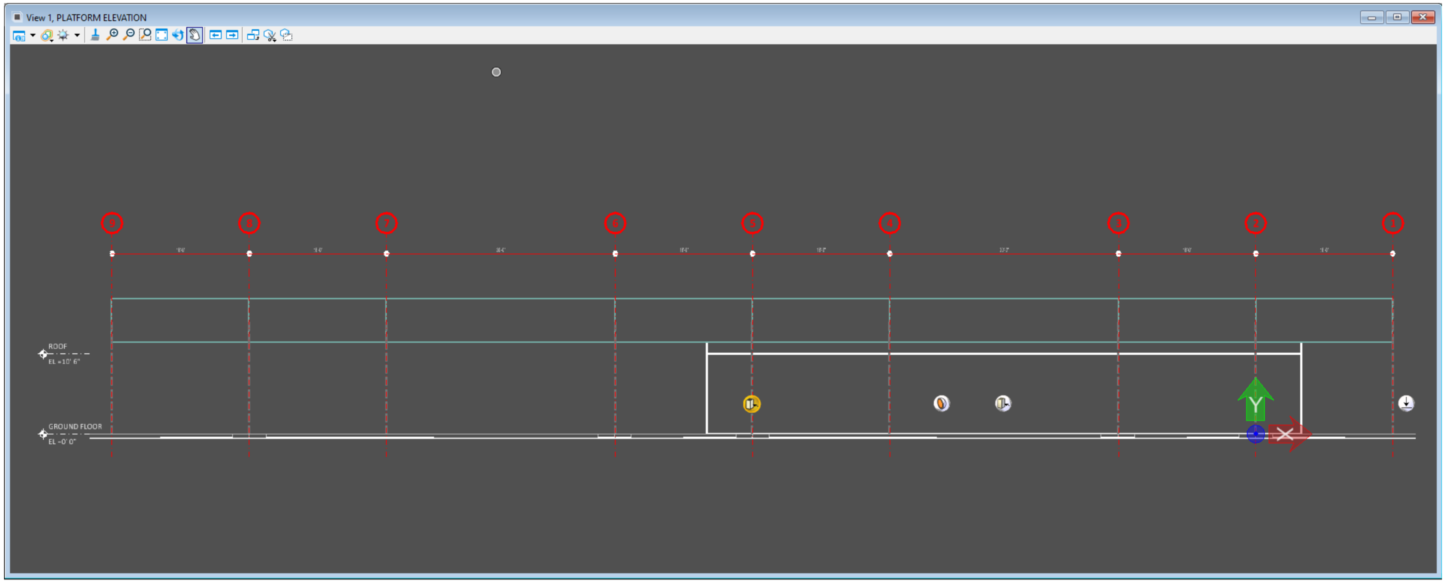


Note: The Section Drawing is also a cut view of the 3D model referenced to this drawing model, so it is updated as the model is built. Note that the floor elevations and grids are automatically generated based on the Floor Manager and Grid System Manager and displayed on the drawing.

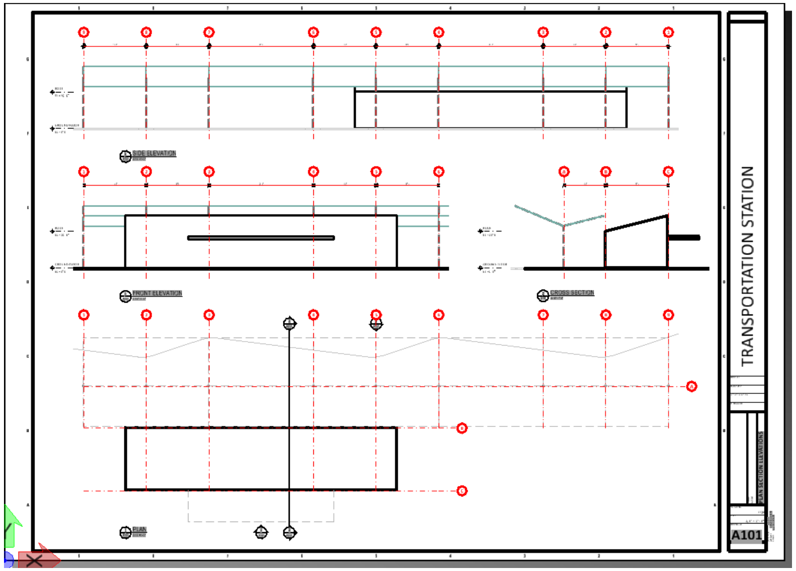
6. Select the *View Group* **Drawing 3**. This will open the model of the *ELEVATION* drawing.



7. Select the *View Group* **Drawing 4**. This will open the model of the *PLATFORM ELEVATION* drawing.



8. Select the *View Group* **Sheet 101**. This will open the model of the *SHEET.*



This is a sheet model with a border file attached and each of the drawing models referenced and arranged on the sheet ready for plotting.

This course is focused on the creation of the 3D model and does not cover the creation of drawings and sheets, but they are an important output of the 3D model and you will check the drawing progress as you build the model.

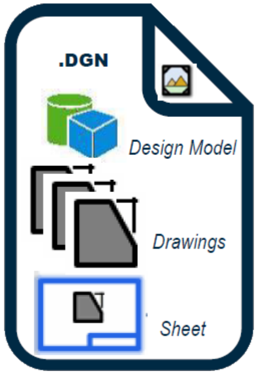
9. Navigate back to the **Building Model** *View Group*.

Now that you have completed the second chapter you may want to close *OpenBuildings Designer*. Check that your views are set the way you would like them saved for the model.

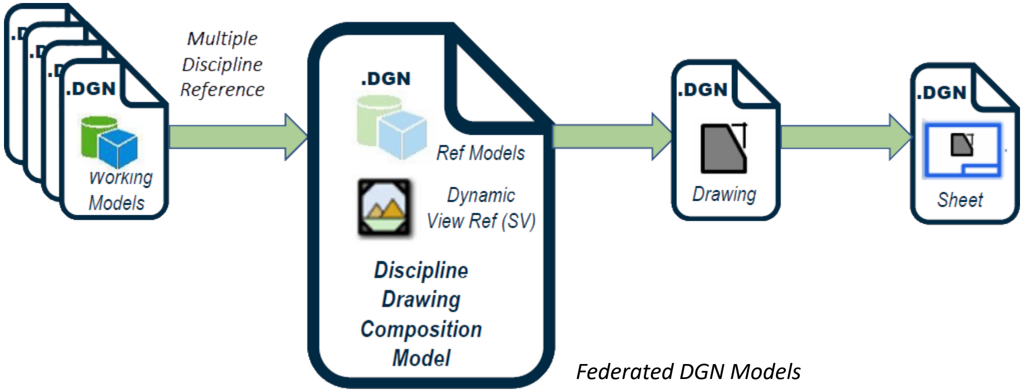
10. **Ctrl+F** to *Save Settings*.

11. **File > Exit** to close *OpenBuildings Designer*.

Note: This project is using a single DGN for the architectural model, architectural drawings and sheets. On a larger project multiple DGNs models would be referenced to a *Drawing Composition* DGN and the drawing and sheet models would be created as separate DGN files stored in the WorkSet's *Drawings* and *Sheets* folder.



Single DGN Model



Federated DGN Models

In *Chapter 2: The 3D Building Environment* you have defined the building environment. You set up floor reference planes in the Floor Manager. You then created a structural grid for the project based on the initial conceptual geometry for the building. Finally, you referenced in a site model for context and geo-located the building model using the site reference. In the next chapter you will begin to add intelligent building objects to the model, starting with some structural members.

Chapter 3. Modeling Structural Elements

So far you have created a block model using forms. While forms have family and part information that determines what they look like and geometric information, such as their base area or perimeter surface area, they are generic in nature and do not have DataGroup information, meaning they are not part of the DataGroup catalog system and cannot be scheduled and reported.

You will now add intelligent objects to the model, such as structural columns and beams. These objects are part of the DataGroup catalog system and can hold a great deal of information, not only graphical data like height, width and areas, but meta data such as their material and structural function.

The DataGroup System

Generally, design teams approach modeling work with a set of familiar placement tools to construct models and complete designs. An architectural team may use an assortment of door, window, and space planning tools, whereas a structural team may use several beam, column, and footing tools. Each of the placement needs to be able to not only place objects, but assign important information to the object being placed.

Design teams from every discipline need a system that enables them to assign important model data and properties to model objects to distinguish their specific use. For instance, whereas multiple structural columns may be placed in the model they might differ in their properties; material, section name, structural function, fire rating, etc. Assigned catalog item data must be placed with each item instance and the software must also track and manage the data for schedules and reporting. Furthermore, design teams need to be able to set catalog items and instance data for a host of placement tools so that the workflow can begin and continue without interruption.

The *DataGroup* system assigns catalog property data to modeled components. Each catalog type has specific properties that can be assigned to its catalog items. OpenBuildings Designer placement tools include the *DataGroup* properties inherent to the object being modeled: walls, doors, windows, columns, beams, ductwork, HVAC equipment, lights, receptacles, etc.

As such, the *DataGroup* system is the core of BIM *information* for OpenBuildings Designer and *DataGroup* system tools are used to track and schedule items. The *DataGroup* system is organized by catalog types, catalog items and catalog instances:

> *Catalog Type* — The catalog type refers to a group of objects that share the same property definitions, such as walls, doors, windows, columns and beams. Catalog types are defined by the application and by the user, within application and user defined definitions.
>
> *Catalog Item* — Catalog items are predefined sub-classifications of objects for each catalog type. For instance the catalog items *AL | Awning*, *AL | Casement* and *WD | DoubleHung* are all catalog items under the *Window* catalog type. Catalog items may have some of their properties pre-defined and be linked to a specific cell or parametric cell.
>
> *Catalog Instance* — Any Building object placed in a model. The objects are considered as unique instances of the catalog items. Multiple catalog instances in the same model may share the same catalog item definition, but have their properties defined differently.

DataGroup System Definitions

DataGroup System Definitions help you use and customize a system of data to facilitate the creation of standard and custom parametric object catalogs and object properties, values and attributes. The system also enables instance data to be assigned to individual objects when placement tools are used and the data is managed and tracked for many uses including reports and schedules.

Generally, a DataGroup System Definition is a catalog (a set of many data definitions) where one definition applies for each catalog type. Examples of catalog types are cabinet, door, space and window. There are usually many different catalog items for each catalog type. For example there can be several different doors for the door catalog type. Individual catalog item definitions set the name and format for each catalog item attribute. Examples of item attributes are cabinet depth, door fire rating, space volume, and window hardware. There are two types of DataGroup System definitions, Application Definitions and User-Defined Definitions.

> *Application definitions* define catalog items, properties and values that are required by an OpenBuildings Designer applications (architectural, structural, mechanical and electrical). For example, an *application definition* might define the parametric values of a component, like the width and depth of rectangular ductwork or the height and thickness of a wall assembly. The object cannot be created and placed without this information.
>
> *User-defined definitions* describe attributes that projects and users require in discipline-specific designs and models. An example of an item attribute is the fire rating of a door.

---

1. Start **OpenBuildings Designer** from the Start menu or desktop shortcut.
2. Set the *WorkSpace* to:

   OpenBuildings Training

3. Set the *WorkSet* to:

   Station Building_US *[Station Building_NM]*

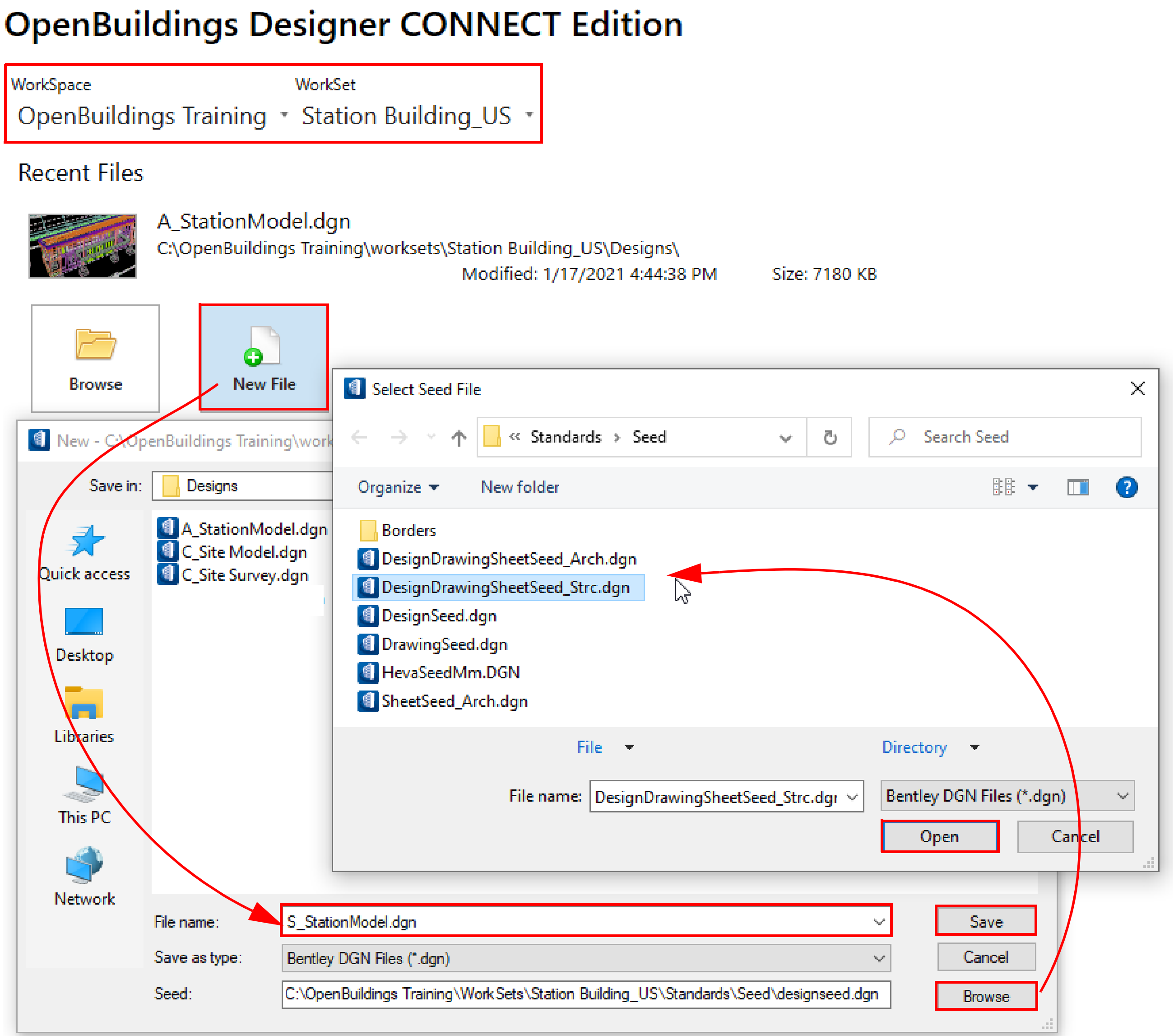
4. Select **New File**.

   File name: **S_StationModel.dgn**

5. Select the **Browse...** icon and select the seed file, **DesignDrawingSheetSeed_Strc.dgn**

   a. Select **Open** to set the seed file.

   b. Select **Save** to open the new file, *S_StationModel.dgn*.

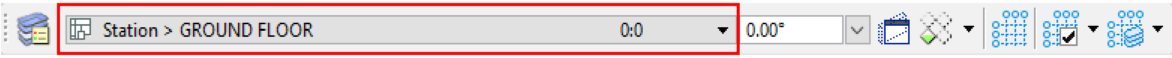


The **DesignDrawingSheetSeed_Strc** is a dgn seed file that was created specifically for this project and has a 3D design model as well as structural drawing models and a sheet model preset with foundation plan and framing plan views.

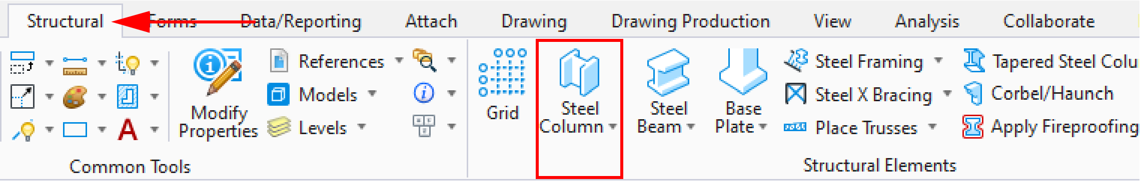
Exercise 3-1: Placing Columns

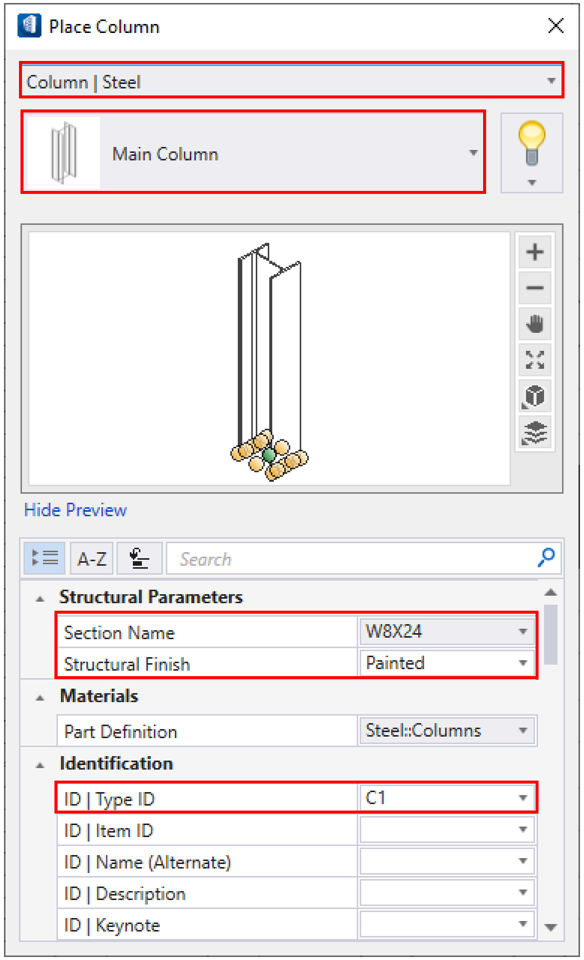
Columns are a structural element. In this exercise you will select a column from the library, modify its properties, save it as a new catalog item and place it in the model using the grid intersections.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.



2. Select the **Steel Column** tool from the *Structural Elements* group on the *Structural* tab of the ribbon.





The *Steel Column* tool is used to place structural steel columns. Columns are defined by points which include the start point and the end point or the start point and the length. All column types placed using this tool are supported by the catalog library in the *DataGroup* System. Catalog data is applied to columns at the time of placement.

3. From the *catalog type* **Column | Steel** select the *catalog item* **Main Column.**

   a. Select a steel section from the library of shapes pull-down.

   Section Name: **Standard > AISC_I_W > W8x24** *[Standard > BS UC > UC203X203X46]*

OpenBuildings Designer is delivered with a great number of different international shape series. The *Shape Catalog* dialog is used to browse and load more shape category types.

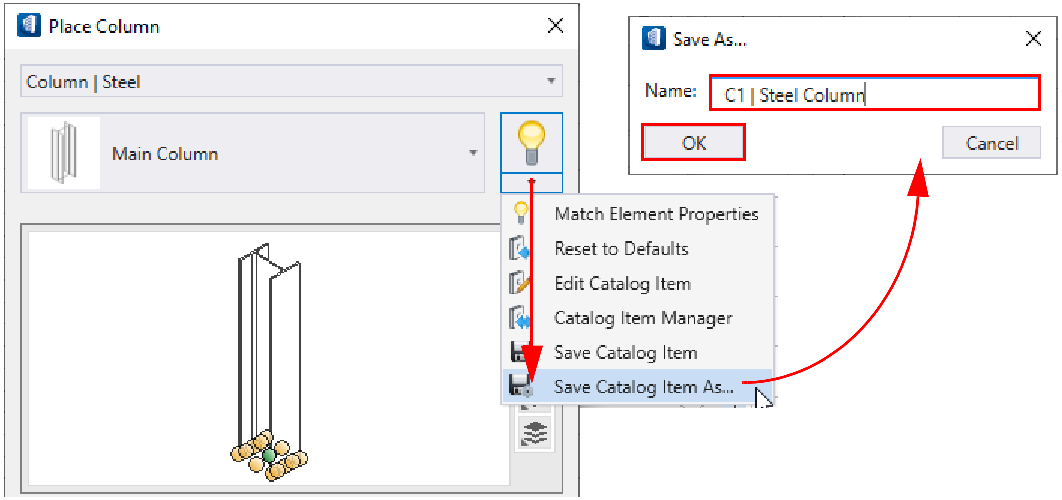
In addition to selecting the steel section, there are a number of other properties that could define the column, such as a structural finish, fire rating, construction phase and even a column type that would be used for annotation and scheduling. These are all *DataGroup* properties of the *catalog type* **Column | Steel**.

b. Set a few of the *DataGroup* properties:

Structural Finish: **Painted**

ID | Type ID: **C1**

Now that you have defined a few properties for this column, you can save it as a new *catalog item* within the project WorkSet. This will allow you to place the same column again without resetting the properties.



4. From the catalog item pull-down select **Save Catalog Item As...** and name the new catalog item **C1 | Steel Column** and select **OK**.

The new catalog item is created and now the active column ready for placement.

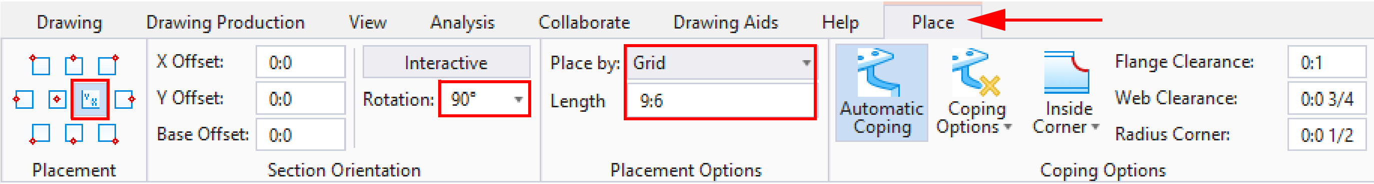
5. On the Placement ribbon set the following placement properties:

Placement: **Centroid**

Rotation: **90°**

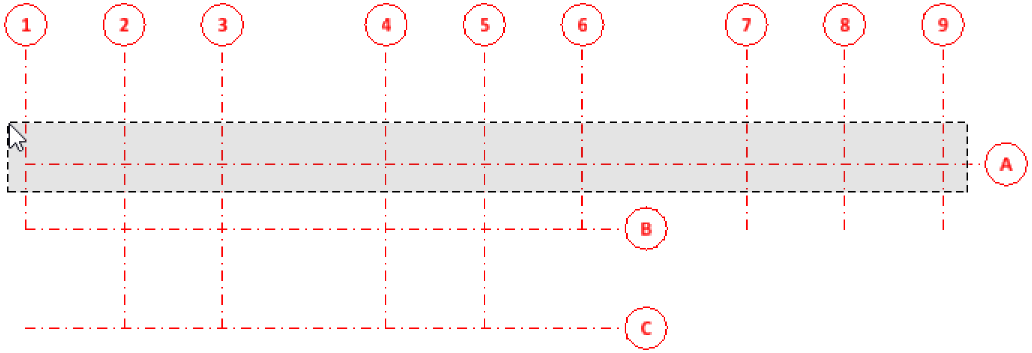
Place By: **Grid**

Length: **9:6** *[3200 mm]*



6. Select all the grid intersections along grid line A.

a. **Data point** *(left-click)* to accept.



Nine columns are placed for the support of the platform canopy.

Next, you will place a second set of columns for the building.

7. With the *Place Column* dialog still open change the following properties:

   Section Name: **W10x26** *[UB254X146X31]*

   Structural Finish: **Painted**

   ID | Type ID: **C2**

8. From the catalog item pull-down select **Save Catalog Item As...**

   a. Name the new catalog item **C2 | Steel Column** and select **OK**.

The new catalog item is created and now the active column ready for placement.

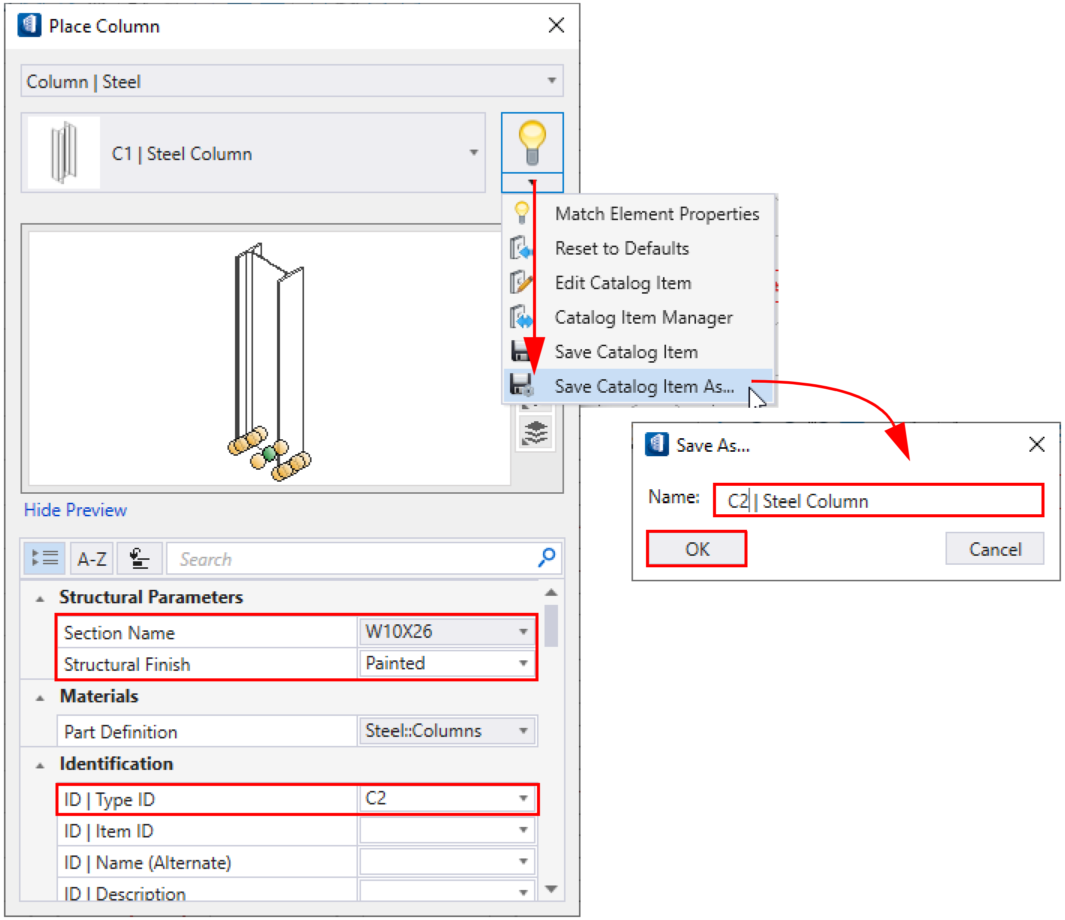
9. On the *Placement* ribbon the inputs should remain the same:

   Placement: **Centroid**

   Rotation: **90°**

   Place By: **Grid**

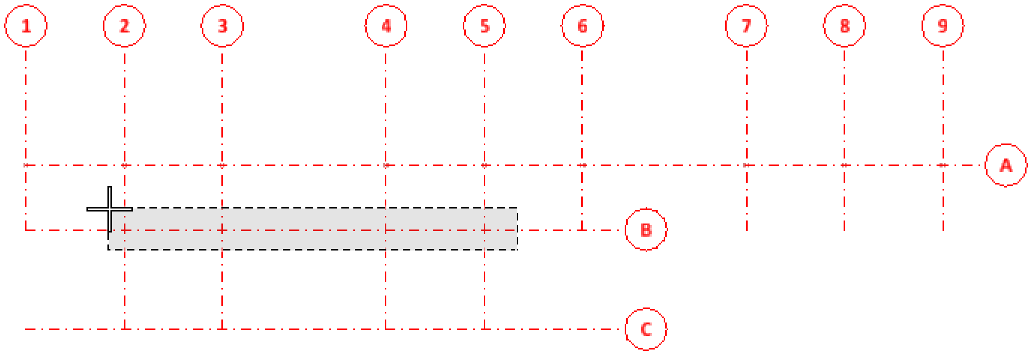
   Length: **9:6** *[3200 mm]*



10. Select all the grid intersections along column line **B2, B3, B4** and **B5** using a crossing window.

    a. **Data point** *(Left-click)* to accept.

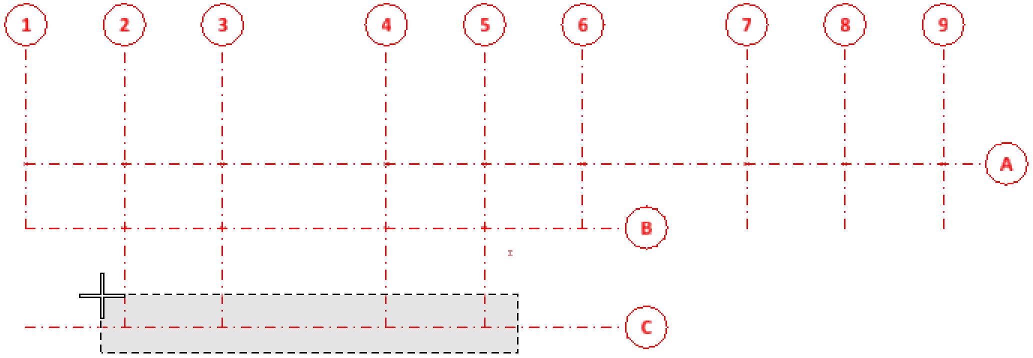
Four columns are placed in the model. These columns are on the low side of the building, but the building has a roof slope, so you will change the height for the next set of columns.



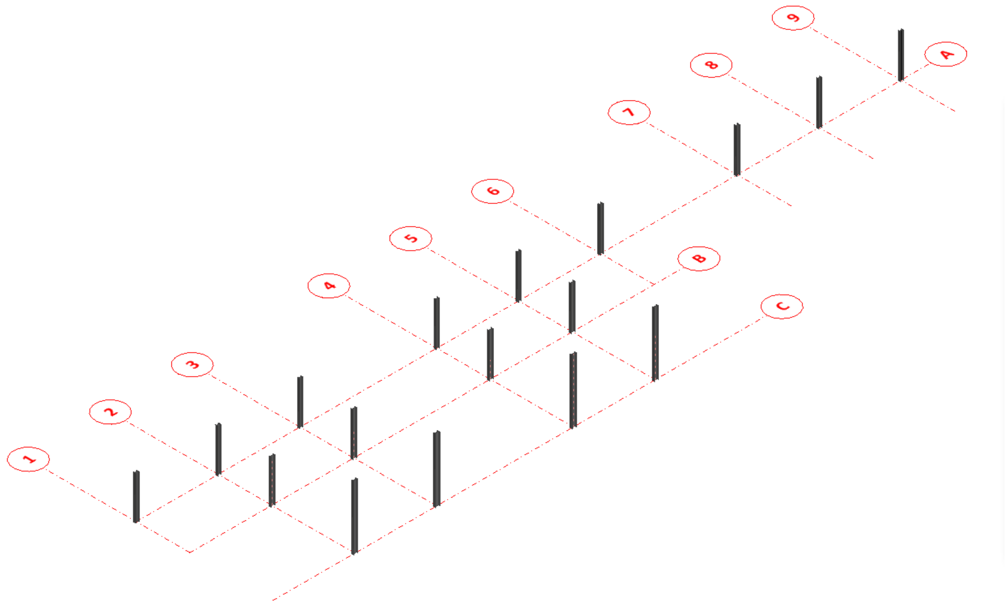
11. On the Placement ribbon change the *Length* to **14:0** *[4700 mm]*.

12. Select all the grid intersections along column line **C2, C3, C4** and **C5** using a crossing window.

    a. **Data point** *(Left-click)* to accept.



Four more columns are placed in the model.

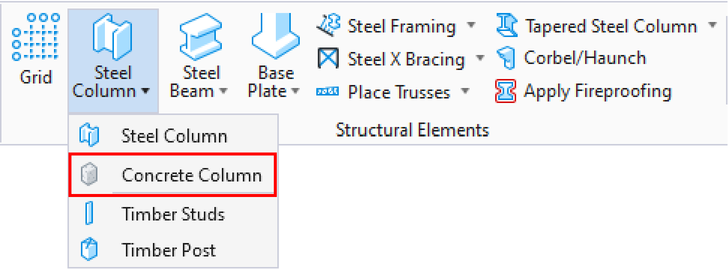


In the next exercise you will place footings under the columns.

Exercise 3-2: Placing Footings

In this exercise you will place footings under the columns placed in the previous session. You will first place a concrete pier under the column and then add a concrete spread footing.

1. Select the **Concrete Column** tool from the *Structural Elements* group on the *Structural* tab of the ribbon.



The *Concrete Column* tool is used to place rectangular and round concrete columns and piers.

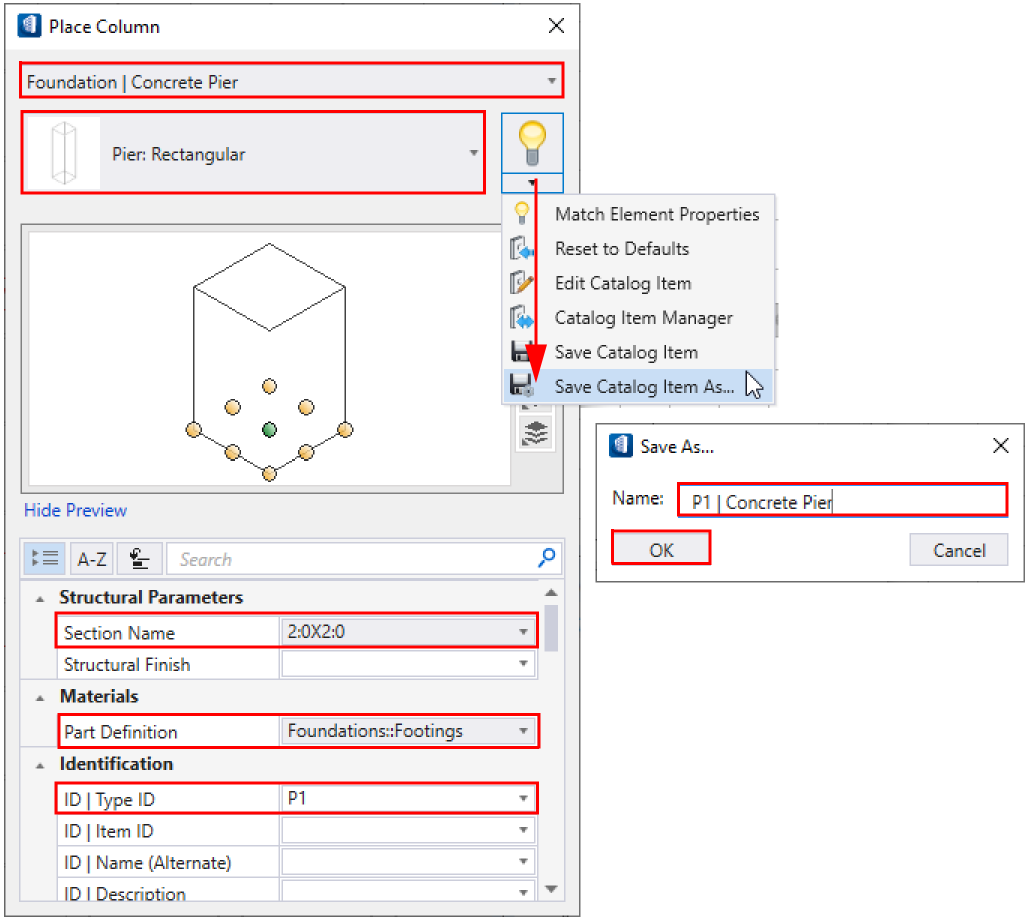
2. Change the *catalog type* to **Foundation| Concrete Pier** and select the *catalog item* **Pier: Rectangular**

   a. Create a *Section Name* by selecting the *Parametric* tab to create a custom size. Set the *Class* to **Rectangle** and create a rectangular section that is **2:0 x 2:0** *[600 mm x 600 mm]*

   b. Set a few of the DataGroup properties:

      Part Definition: **Foundations::Footings**

      ID | Type ID: **P1**



3. From the catalog item pull-down select **Save Catalog Item As...**

   a. Name the new catalog item **P1 | Concrete Pier** and select **OK**. The new catalog item is created and now the active column ready for placement.

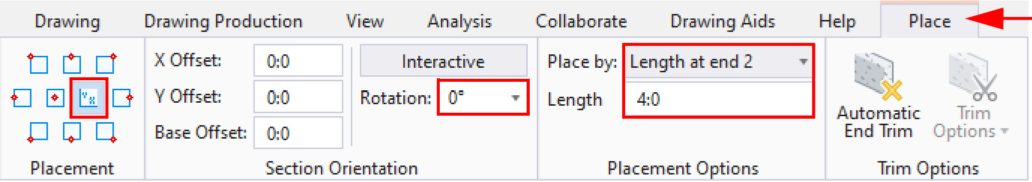
4. On the Placement ribbon set the following placement properties:

   Placement: **Centroid**

   Rotation: **0°**

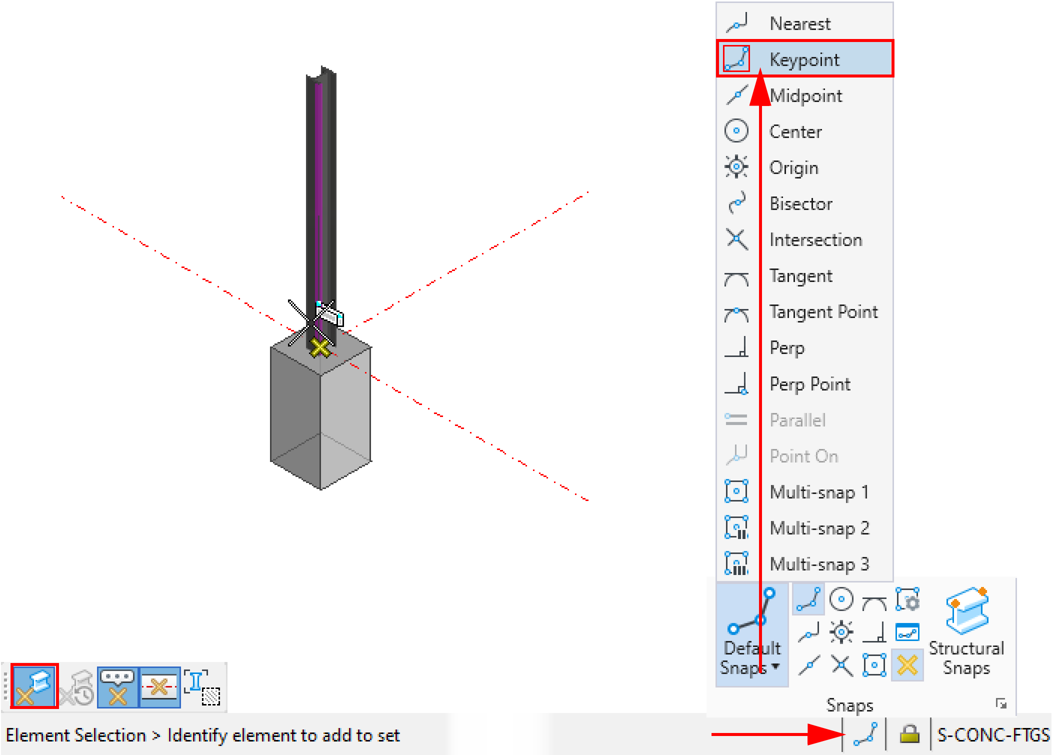
   Place By: **Length at end 2**

   Length: **4:0** *[1200 mm]*



5. Snap to the bottom of the columns. To easily snap to the ends of structural members you want to make sure the *Default Snap* is **Keypoint** and that *ProStructures snaps* are enabled. This is the snap toggle on the lower left of the interface.

Note: *ProStructures snaps* enables snapping to OpenBuildings Designer structural insertion points. These are ten cardinal points at start, middle, end of steel shapes, concrete beams, and concrete columns while honoring the default "Keypoint Snap Divisor".



6. Select the column at **A1**, snapping to the bottom of the column. The pier will be placed extending **4:0** *[1200 mm]* below the column.

With the *Place Column* dialog still open, you can now create the spread footing.

7. Change the *Section Name* by selecting the *Parametric* tab to create a custom size. Set the *Class* to **Rectangle.** Type in a *Width* of **5:0** *[1500 mm]* and a *Depth* (Length) of **6:0** *[2000 mm]*.

8. Change the following properties:

   ID | Type ID: **F1**

9. From the catalog item pull-down select **Save Catalog Item As...**

   a. Name the new catalog item **F1 | Spread Footing** and select **OK**. The new catalog item is created and now the active footing ready for placement.

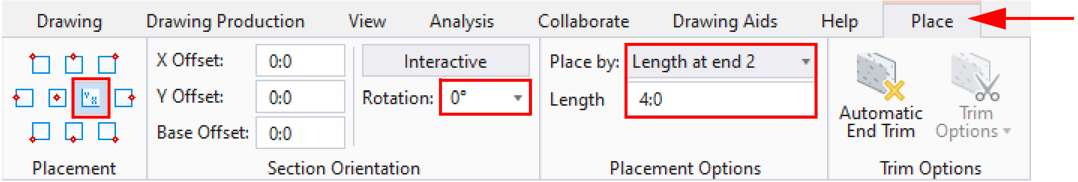
10. On the Placement ribbon set the following placement properties:

    Placement: **Centroid**

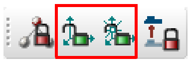
    Rotation: **Interactive**

    Place By: **Length at end 2**

    Length: **1:6** *[500 mm]*

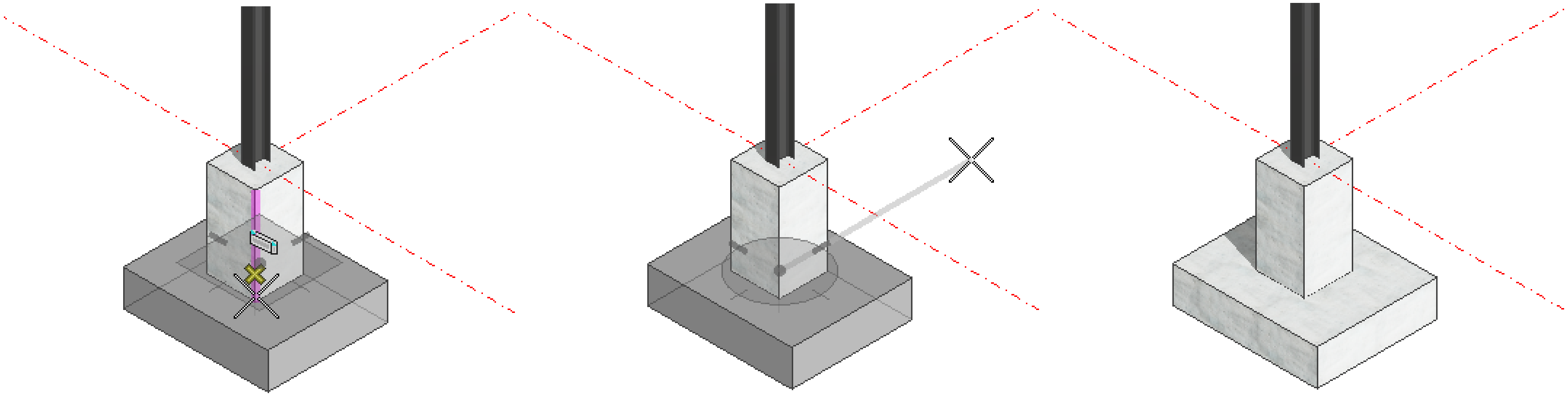


11. Toggle off the *ACS Plane* and *ACS Plane Snap* lock so that the footing is not placed on the Ground Floor ACS plane, but at the bottom of the pier.



12. Select the pier at **A1**, snapping to the bottom of the pier.

    a. Data point again to set the rotation of the spread footing..



The spread footing will be placed extending **1:6** *[500 mm]* below the pier.

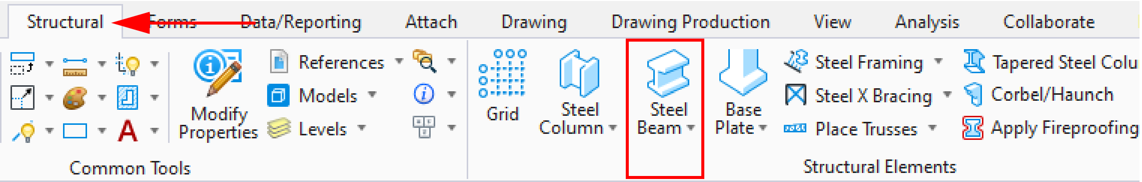
13. **Close** the *Place Column* dialog.

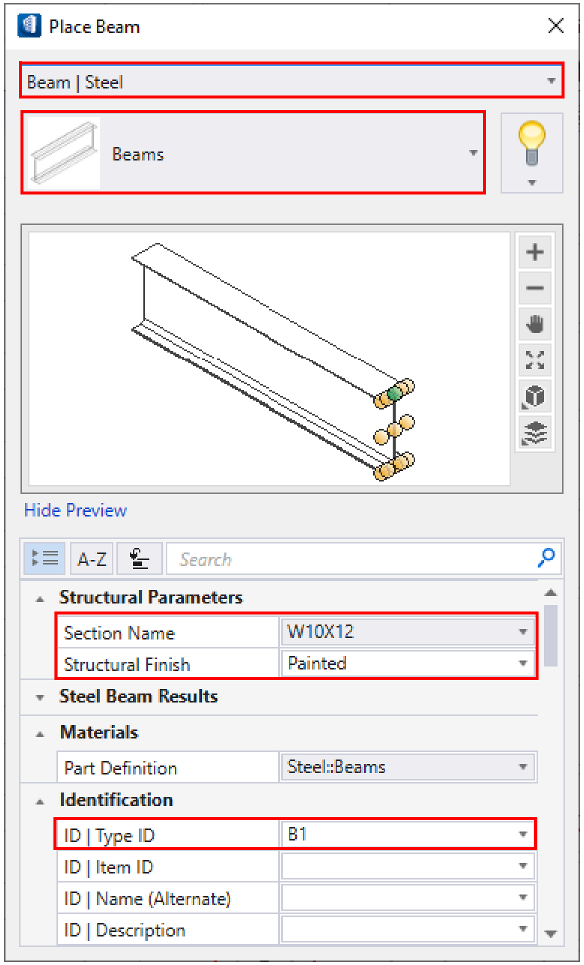
14. Select the pier and footing at **A1** and copy to each steel column location using the **Copy** tool.

Exercise 3-3: Placing Beams

In this exercise you will start by placing steel beams connecting the steel columns for the platform canopy columns and then place timber beams to support the sloped roof over the station building.

1. Select the **Steel Beam** tool from the *Structural Elements* group on the *Structural* tab of the ribbon.





The *Steel Beam* tool is used to place steel girders or other primary structural steel members.

2. From the *catalog type* **Beam | Steel** select the *catalog item* **Beams.**

   a. Select a steel section from the library of shapes pull-down.

      Section Name: **W10x12** *[Standard > BS UB > UB254X102X25]*

   b. Set a few of the DataGroup properties:

      Structural Finish: **Painted**

      ID | Type ID: **B1**

3. From the catalog item pull-down select **Save Catalog Item As...**

   a. Name the new catalog item **B1 | Steel Beam** and select **OK**. The new catalog item is created and now the active beam ready for placement.

4. Check that the structural snaps are toggled on. 

5. Set the *Floor Selector* to **Station > Platform Beam**, this will lock the *ACS Plane* and *ACS Plane Snap*. The top of the beam will be placed at this elevation..

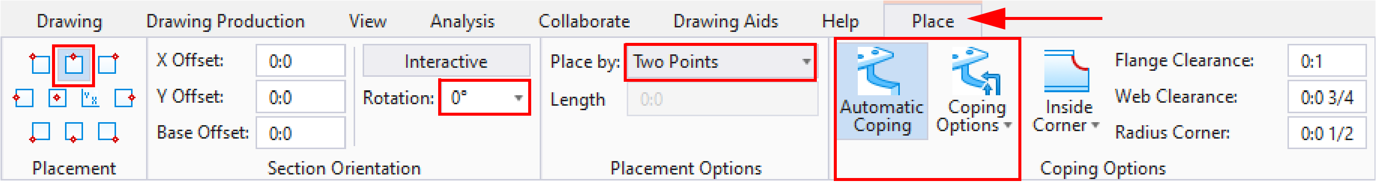
6. On the *Placement* ribbon set the following placement properties:

   Placement: **Top Center**

   X Offset: **0**

   Y Offset: **0**

   Base Offset: **0**



The *Placement* defines the location of the baseline relative to the member section.

The *X/Y Offset* moves the physical member's placement points in the X and Y axis direction relative to the section definition orientation.

The *Base Offset* is enabled when a floor is selected in the Floor Manager as a reference plane. It sets the Z axis distance between the elevation of the active floor ACS plane and the elevation of the component being placed. The value defines offsetting structural members from the active floor, thereby allowing placement at an appropriate elevation relative to the active floor. *Base Offset* can be a negative value.

   Rotation: **0°** — Sets the rotation angle of the member.

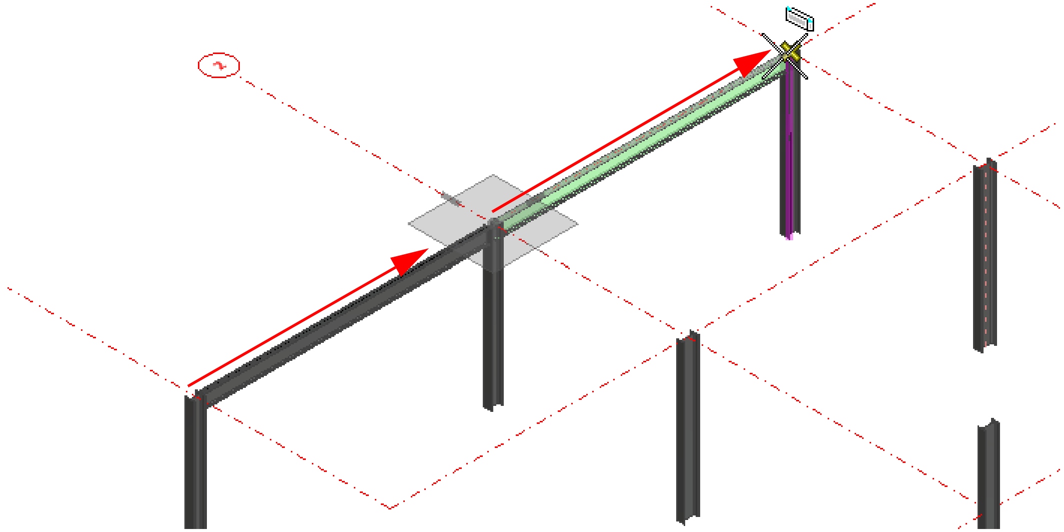
   Place By: **Two Points**

   Automatic Coping: **On** — When on, enables automatic coping as steel members are placed connected to other steel members.

   Coping Options: **Cope to any interfering member**

7. Snap to the top of the column at **A1**, **data point** *(left-click)* to accept. Snap to the top of the column at **A2**, **data point** *(left-click)* to accept.

A beam is placed between the columns and coped to the columns.



8. Continue to select each column along grid line **A** to place beams between each column.

Next you will place timber beams to support the building roof.

9. From the *Structural Elements* group select the **Timber Joist** tool.

10. From the *catalog type* **Beam | Timber Joist** select the *catalog item* **Gluelam Beam** and set the following properties.

    Section Name: **0:5 1/2X1:6** *[150 mm x 400 mm]*

    Structural Type: **Beam**

    Structural Finish: **Sealed**

    Part Definition: **Framing::Gluelam**

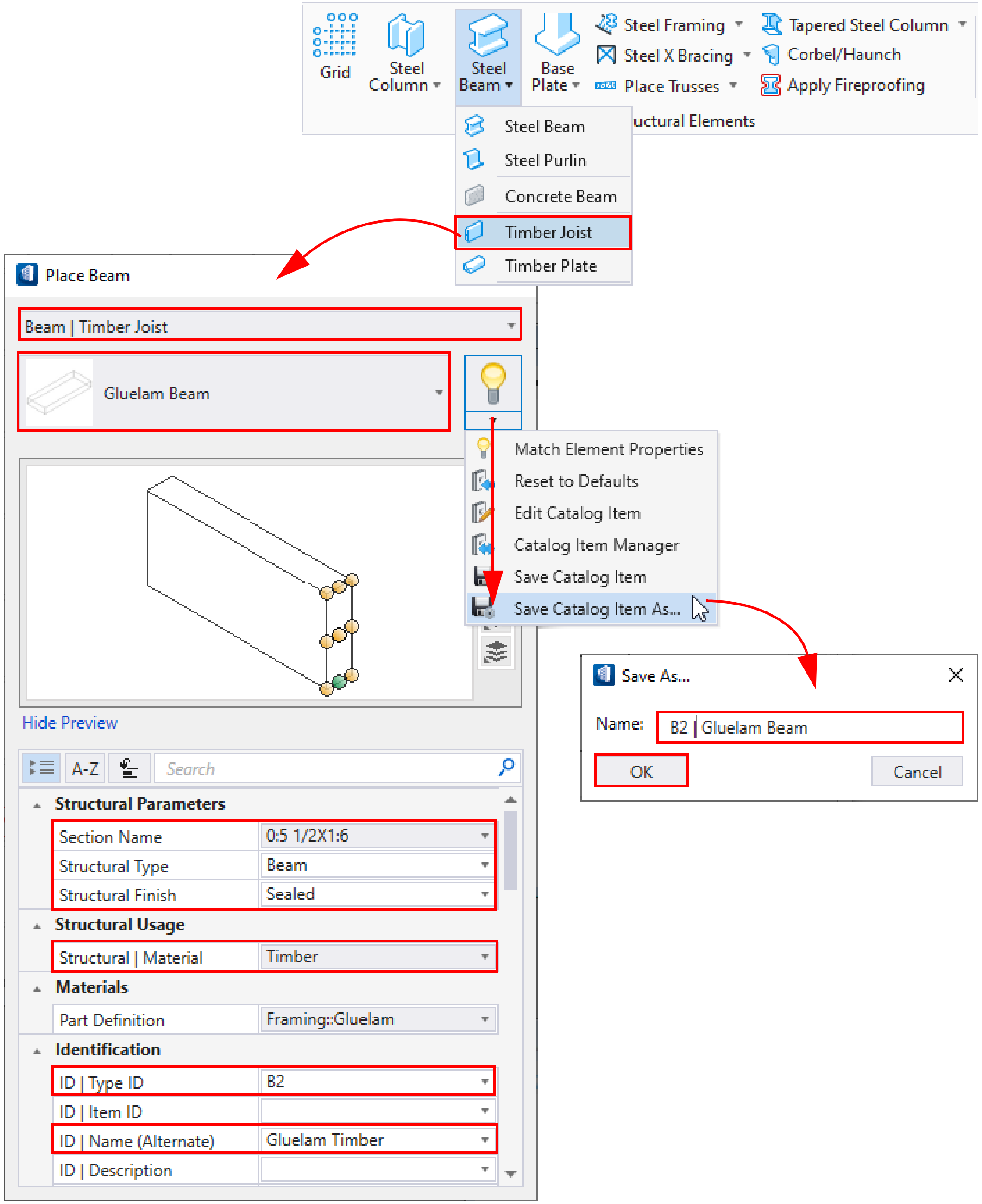
    ID | Type ID: **B2**

    ID | Name (Alternate): **Gluelam Timber**

11. From the catalog item pull-down select **Save Catalog Item As...**

    a. Name the new catalog item **B2 | Gluelam Beam** and select **OK**.

The new catalog item is created and now the active beam ready for placement.

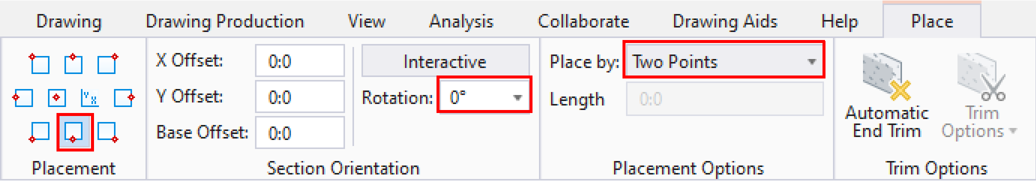


12. On the *Placement* ribbon select:

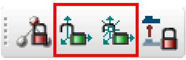
    Placement: **Bottom Center**

    Rotation: **0°**

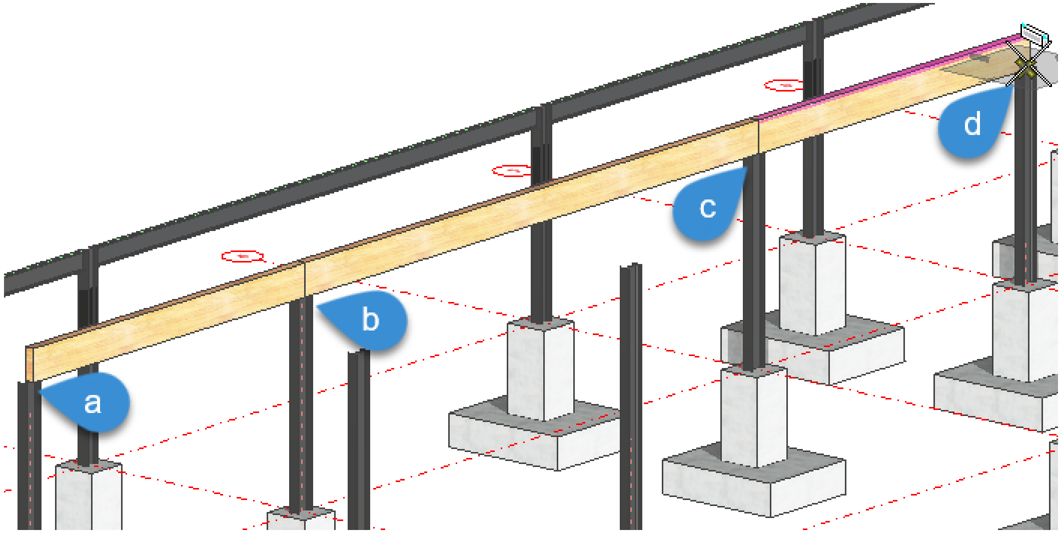
    Place By: **Two Points**



13. Unlock the *ACS Plane* and *ACS Plane Snap* lock.

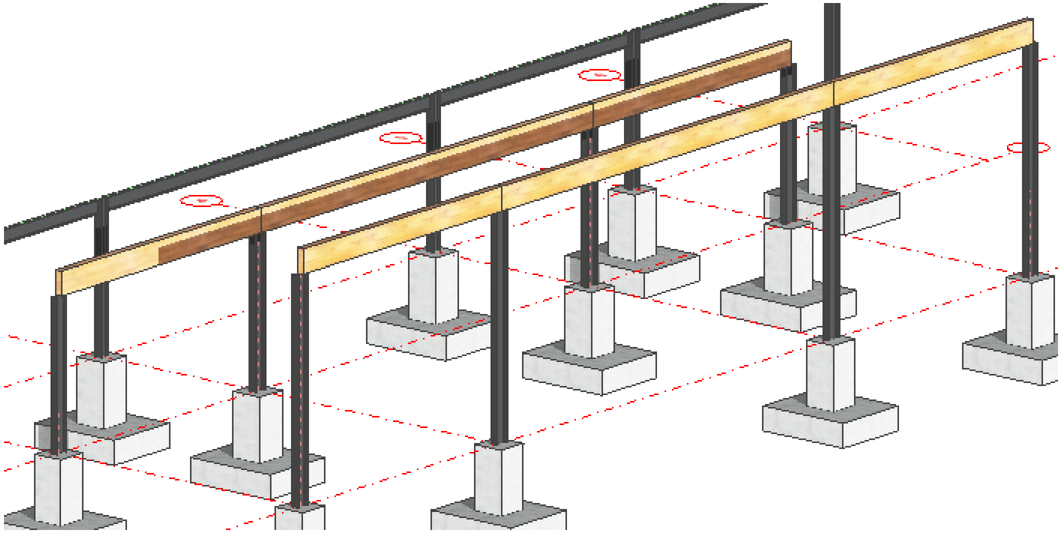


With the *ACS Plane* and *ACS Plane Snap* unlocked the bottom of the beam will be defined by the actual snapping location, which in this case, will be the top of the column.



14. Place the beam in the model.
    a. Snap to the top of the column at intersection **B2**.
    b. Snap to the top of the column at intersection **B3**.
    c. Snap to the top of the column at **B4**.
    d. Snap to the top of the column at **B5.**
    e. **Reset** *(right-click)* to complete the command.

15. Place a second series of Gluelam beams between the columns at grid intersections **C2**, **C3**, **C4** and **C5**.



In the next exercise you will add the roof joists framing between the main timber beams.

Exercise 3-4: Place Wood Joists by Framing Between

In this session we will complete the roof framing over the station building by adding the joist framing between the timber beams.

1. From the *Structural Elements* group select the **Timber Joists at Spacing** tool.The *Timber Joists at Spacing* tool is used to place timber floor and roof joists at specified intervals. All joist types placed using this tool are supported by the catalog library in the *DataGroup* System. Catalog data is applied to joists at the time of placement.

2. From the *catalog type* **Beam | Timber Joist** select the catalog item **Gluelam Beam** and set the following properties.

   Section Name: **0:3 1/2 x 0:9** *[100 mm x 250 mm]*

   Structural Type: **Beam**

   Structural Finish: **Sealed**

   Part Definition: **Framing::Gluelam**

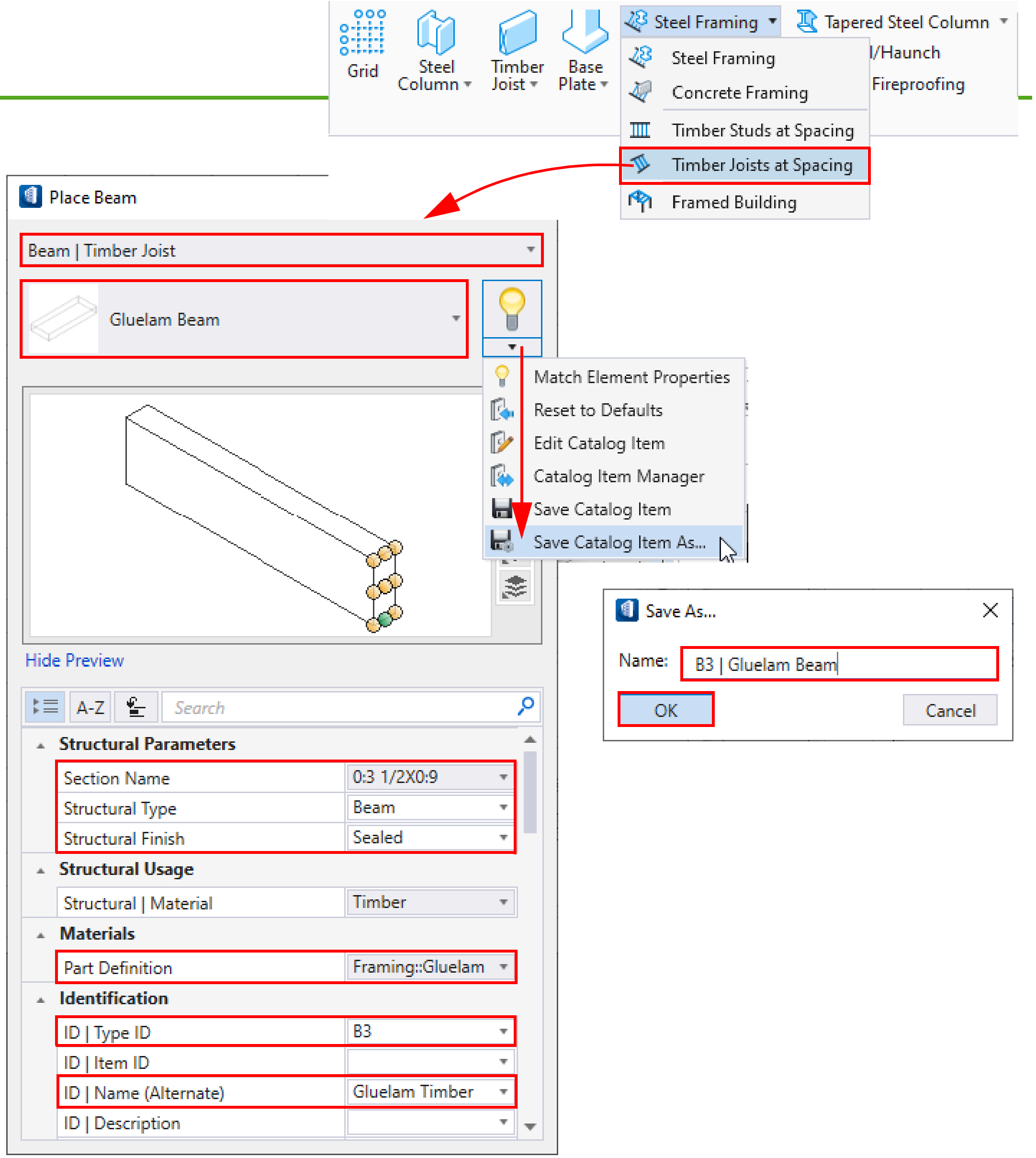
   ID | Type ID: **B3**

   ID | Name (Alternate): **Gluelam Timber**

3. From the catalog item pull-down select **Save Catalog Item As...**

   a. Name the new catalog item **B3 | Gluelam Beam** and select **OK**.

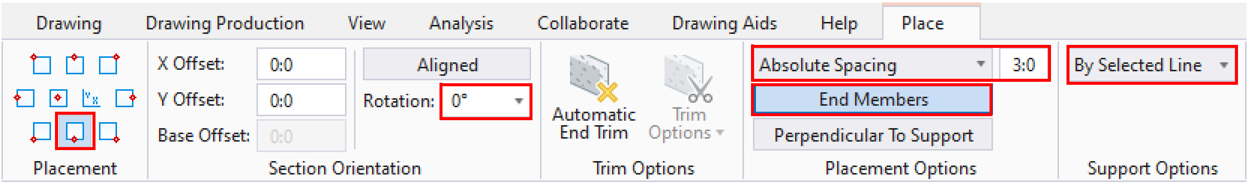
   The new catalog item is created and now the active beam ready for placement.



4. On the *Placement* ribbon select:

   Placement: **Bottom Center**

   Rotation: **0°**



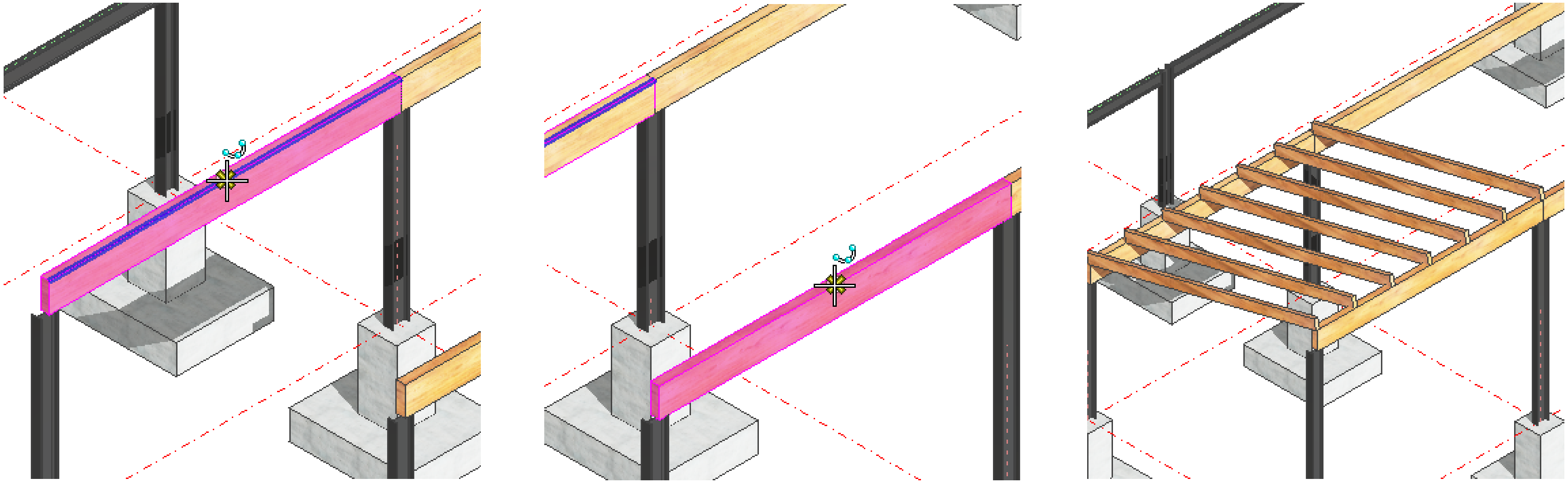
   a. Set the *Placement Options* to **Absolute Spacing** at **3:0** *[1000 mm]*.

   b. Turn on **End Members** to create members at the ends of the supports.

   c. Set the *Support Option* to **By Selected Line**, since the placement line of the support members was the bottom center you will want to select a different edge as the placement for the alignment of the joists, this selection will allow you to do that.

5. Toggle **off** the *Structural Snap*, this will allow you to select an edge of the beam rather than automatically snapping to the placement line of the support beam.

6. Select the supporting members.



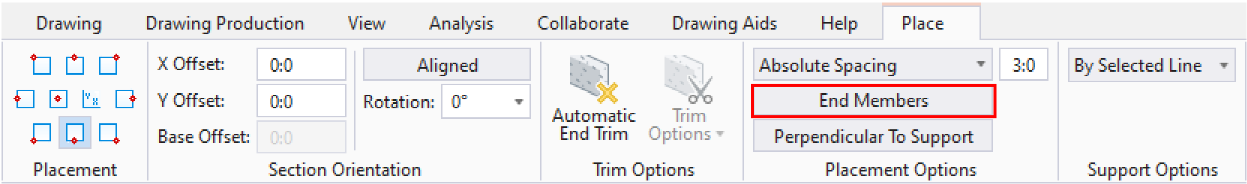
   a. Snap to the top inside edge of the first beam along grid line B. **Data point** *(left-click)* to accept.

   b. Snap to the top outside edge of the first beam along grid line C. **Data point** *(left-click)* to accept.

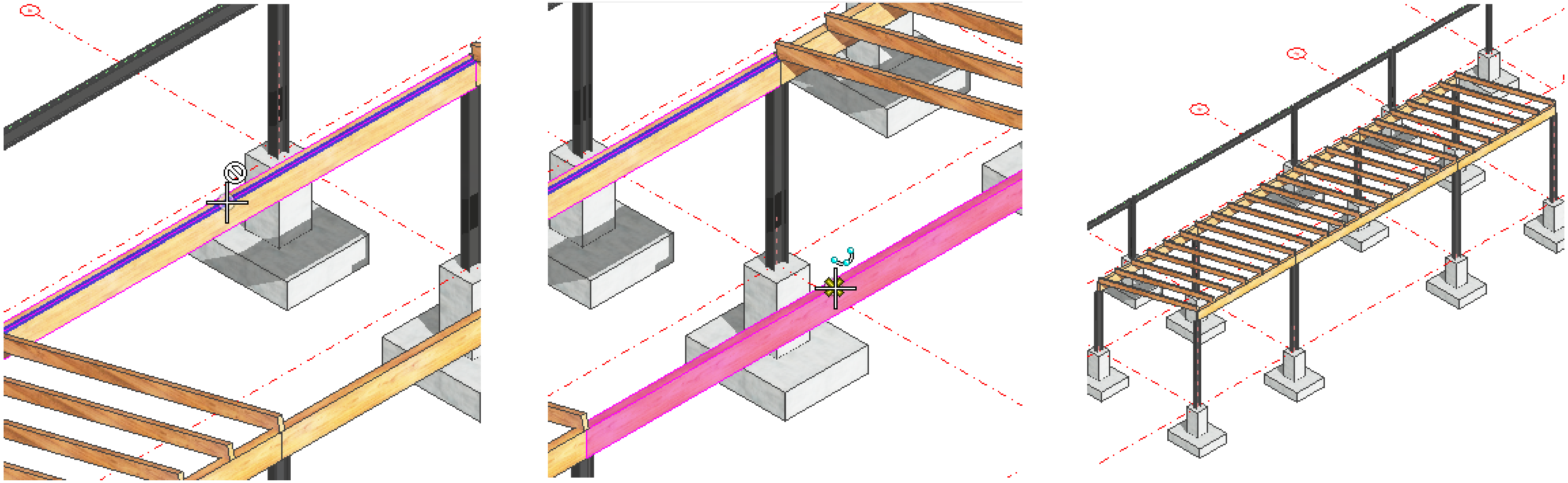
Joists are placed at the defined spacing.

7. Note that joists are placed at the ends of the support beams, since you do not want to duplicate those end joists with the next placement, skip the next bay and continue to place joists on the end bay.

8. On the *Placement* ribbon toggle **off** *End Members*.



9. Place joists on the center bay that was skipped.



a. Snap to the top inside edge of the first beam along grid line B. **Data point** *(left-click)* to accept.

b. Snap to the top outside edge of the first beam along grid line C. **Data point** *(left-click)* to accept.

Joists are placed at the defined spacing.

In the next exercise you will modify the ends of the timber beams and joists so that they cantilever beyond the column lines to support the roof overhang.

Exercise 3-5: Modifying Structural Elements

The design process is not static, the building design is often modified and enhanced as the model is built and drawings are prepared. Since elements in the model include not only their physical geometry, but also additional data and information in the form of DataGroup properties, it is usually preferable to modify an existing element rather then rebuild the element.

The geometry of structural elements can be modified by selecting the element and using the handles or using one of the modification tools, like *Modify Member End*, *Modify Curved Beam* or *Extend Form*. In addition, the data on structural elements, or any building element for that matter, can be modified using the *Modify Properties* tool.

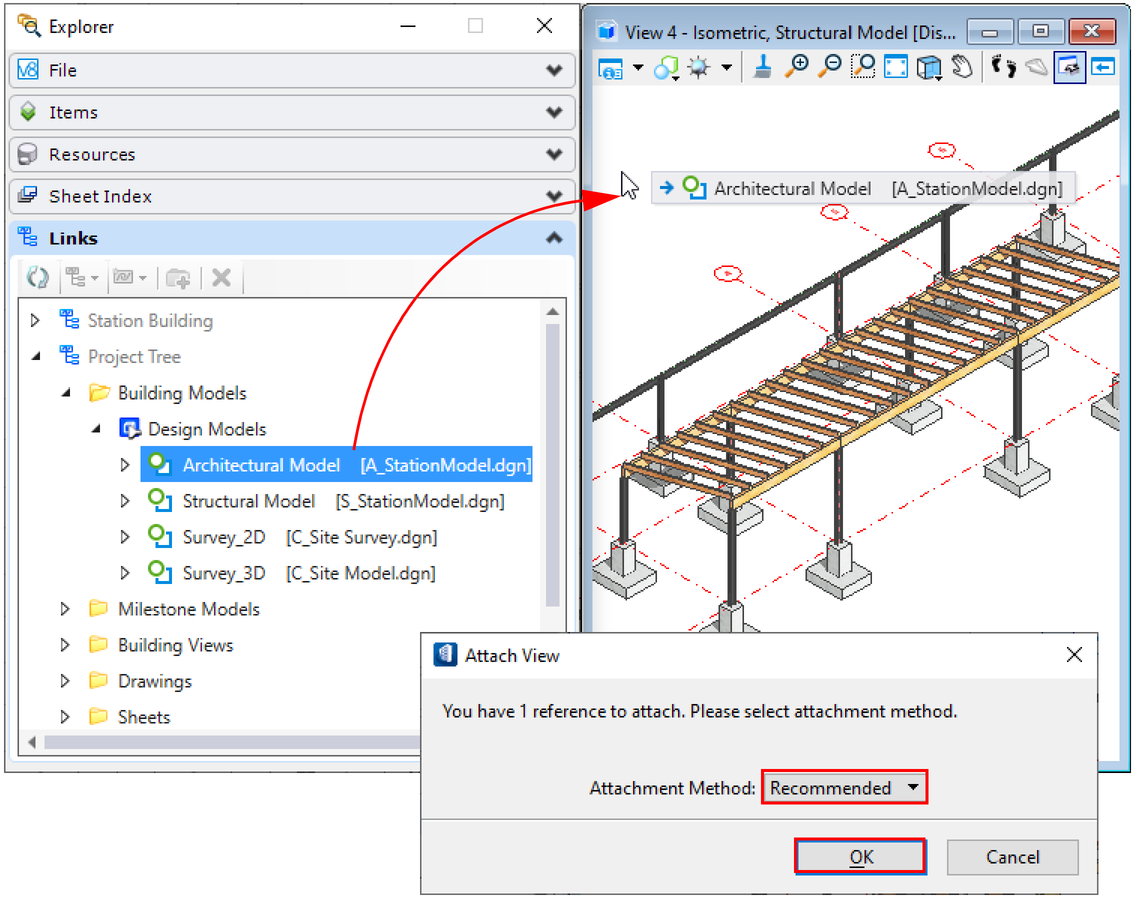
---

1. Open the **Links** tab on the *Explorer*. You will use the *Explorer* to add the architectural model as a reference so that you can coordinate the structural framing with the architectural model.

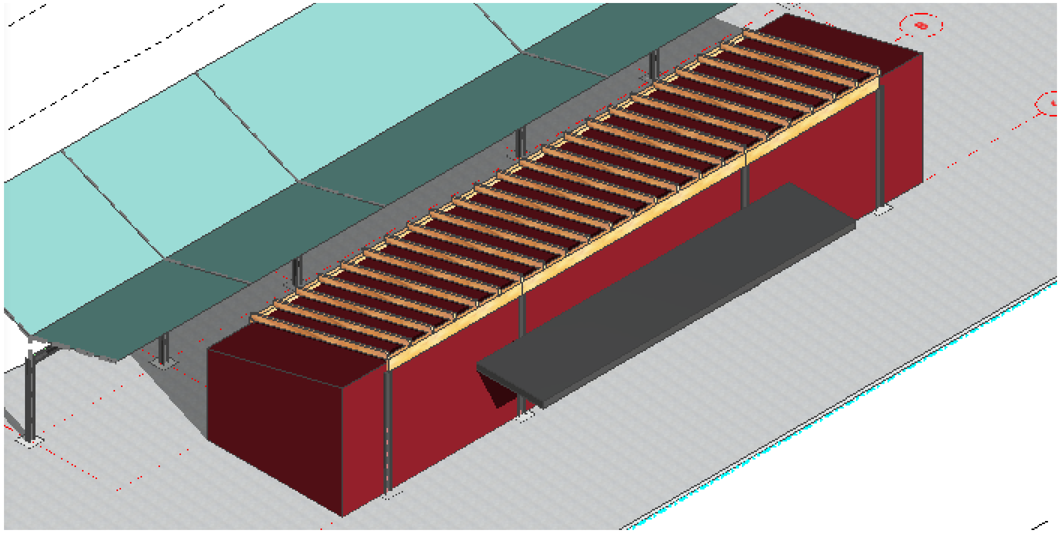
   a. Navigate to the **Project Tree > Building Models > Design Models.**

   b. Select the **Architectural Model** and drag and drop it into any view.

   c. Use the *Attachment Method* **Recommended**.

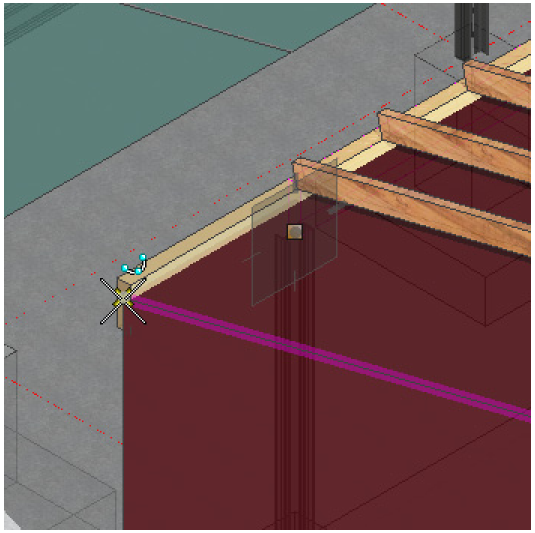


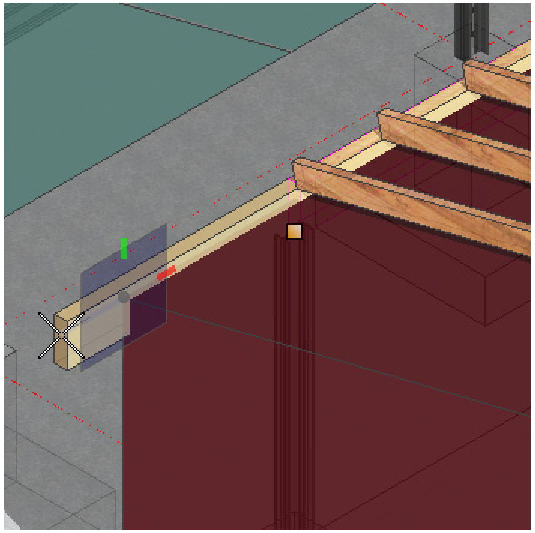
Note that the building mass was extended beyond the column line, you will need to cantilever the beams and add more framing. You can also assume the sloped roof will overhang the building mass and therefore you need to extend the framing out to support the roof overhang.

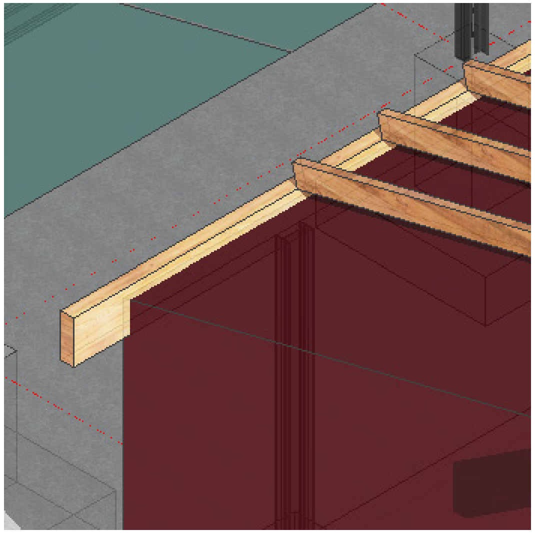


First you will modify the ends of the timber beams so that they extend beyond the columns to support the building extension and roof overhang.

2. Select the beam. The handles are visible.







a. Drag the end handle out to the edge of the building mass, use the *AccuDraw* shortcut **O** to reset the compass.

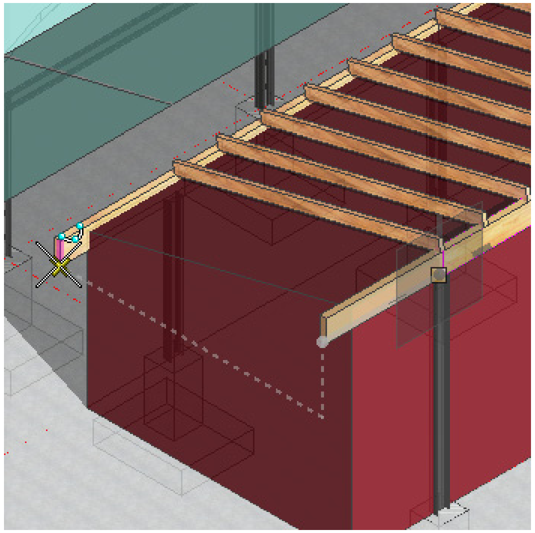
b. Extend the beam another **2:0** *[600 mm]* for the roof overhang.

c. **Data point** *(left-click)* to accept.

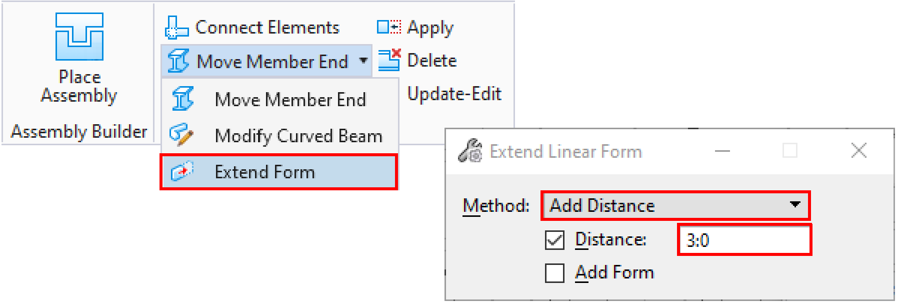
3. Select the next beam and extend by the same length, simply snapping to the endpoint of the first beam.

4. Repeat for the other end of the building.

If you have a number of elements to modify by the same distance you might prefer to use the *Modify Member End* or *Extend Form* tool.



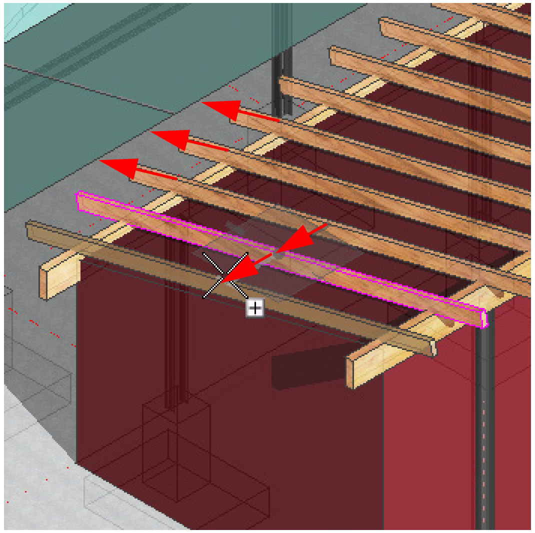
5. Select the **Extend Form** tool.



a. Set the *Method* to **Add Distance**, set the *Distance* to **3:0** *[900 mm].*

b. Data point to one end of the joist that needs to be extended.

c. Continue to modify the joists ends until all the joists have been extended on both sides of the building.



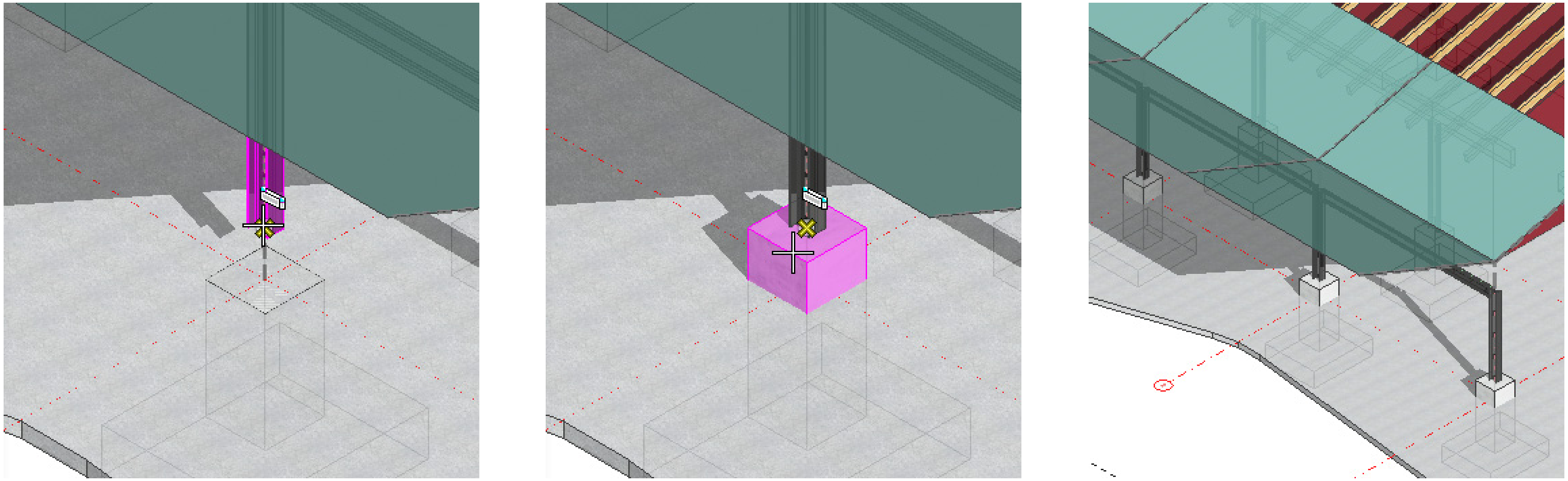
6. **Copy** the last member on each side, to extend the framing over the building extension.

These modifications can also be made to columns. You will modify the columns and piers at the platform canopy so that the pier becomes a visual base for the column.

7. Select the **Extend Form** tool.

   a. Set the *Method* to **Add Distance**, set the *Distance* to **-1:6** *[-500 mm].*

   b. Select the base of each of the **C1** steel columns at the platform canopy.



8. Change the Distance to **1:6** *[500 mm]* and extend the concrete piers up to create a visual base for the columns.

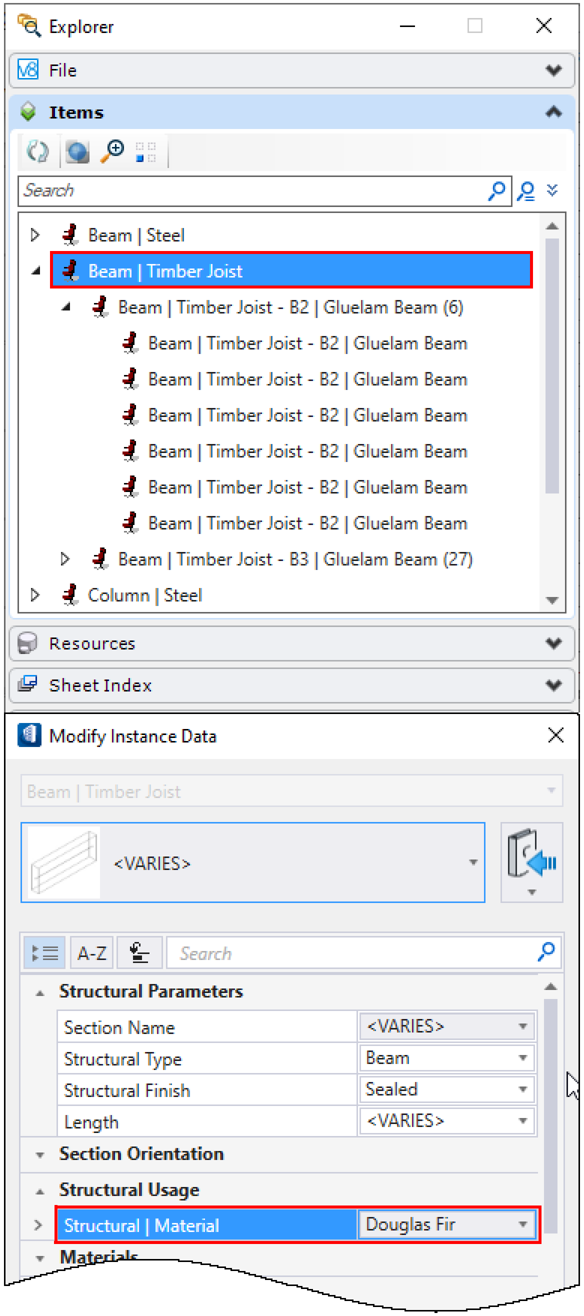
   In addition to modifying the geometry of elements, it is also necessary to modify the properties of elements. This is done with the *Modify Properties* tool.

9. In the *Explorer* dialog select the **Items** tab. Note that items are now showing grouped by their *DataGroup* properties.

    a. Expand the **Beam | Timber Joist** type.

Note: The count of each catalog item is shown in parenthesis.

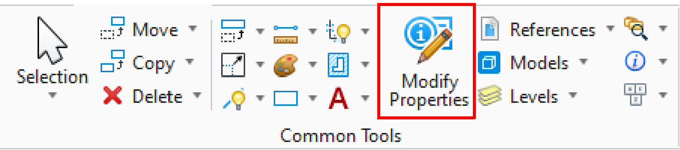
    b. Expand the **Beam | Timber Joist - B2 | Gluelam Beam** catalog item to show each individual member in the model, if you select a member in the *Explorer* dialog it will be selected and highlighted in the model.



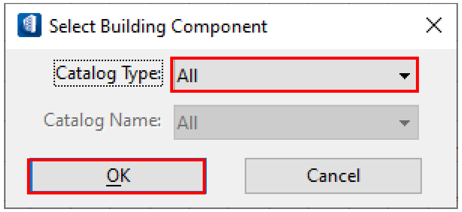
10. Collapse the list again and just select the **Beam | Timber Joist - B2 | Gluelam Beam** heading all of the beam members will be selected in the model.

11. Collapse the list further to select all the **Beam | Timber Joist** items in the model.

    a. Select the **Modify Properties** tool from the *Common Tools*.



    b. In the *Select Building Component* dialog set the *Catalog Type* filter to **All** and select **OK**.

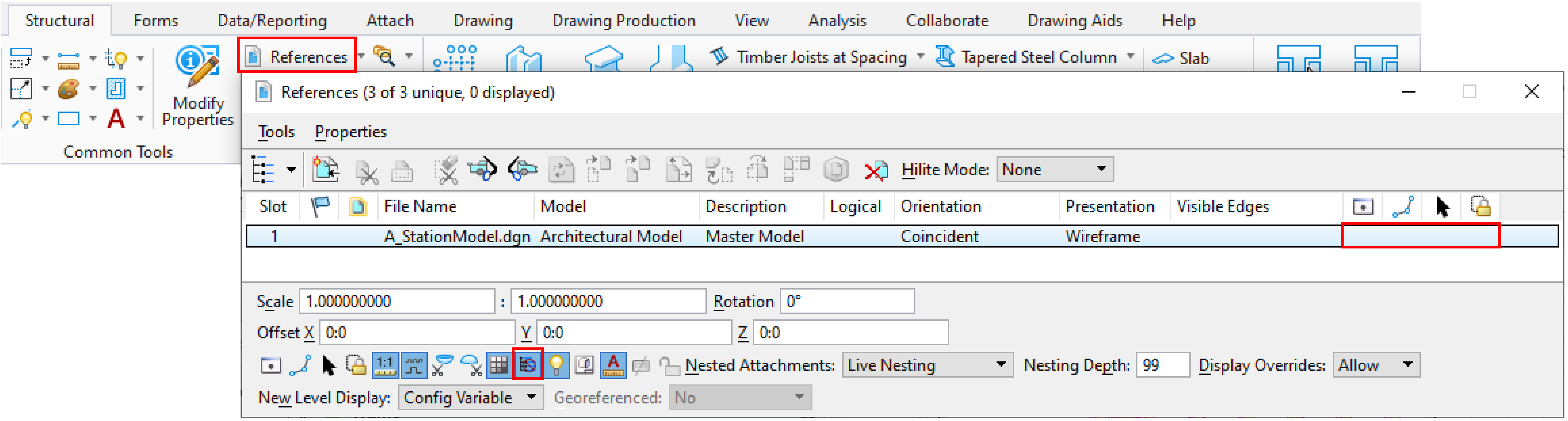


    c. In the Modify Instance Data dialog change the *Structural | Material* to **Timber > Douglas Fir.** This will modify only this property for all the items selected.

    d. **Data point** *(left-click)* in any view to accept.

12. Open the *References* dialog and **Display Off** the Architectural Model.

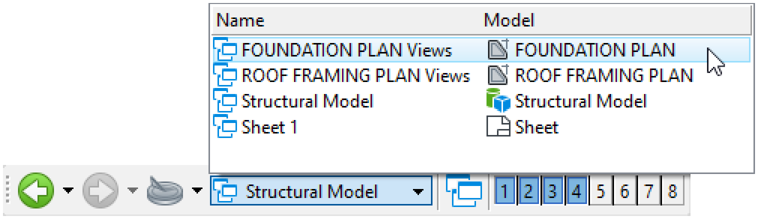
   a. Toggle **On** the setting *Ignore While Live Nesting*. This will prevent this reference attachment from nesting with the structural model when it is referenced to another model.



Exercise 3-6: Reviewing Structural Drawings

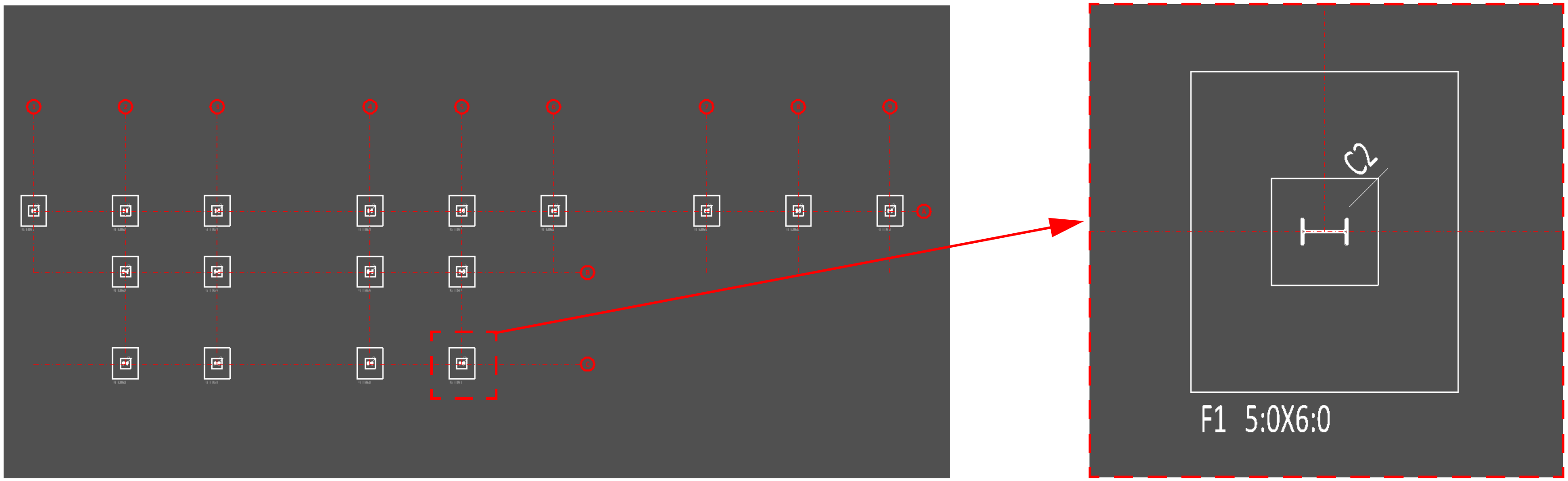
Now that you have the basic structural elements placed in the model you can review some of the output available from the model such as drawings. In this exercise you will learn how to open the drawing views to review the drawing information.

1. Select the *View Group* **FOUNDATION PLAN** from the *Manage View Groups* tools on the lower right of the interface.



The **FOUNDATION PLAN** drawing model will open. This plan is a cut view of the model referenced to this drawing.

2. Zoom into one of the footings.

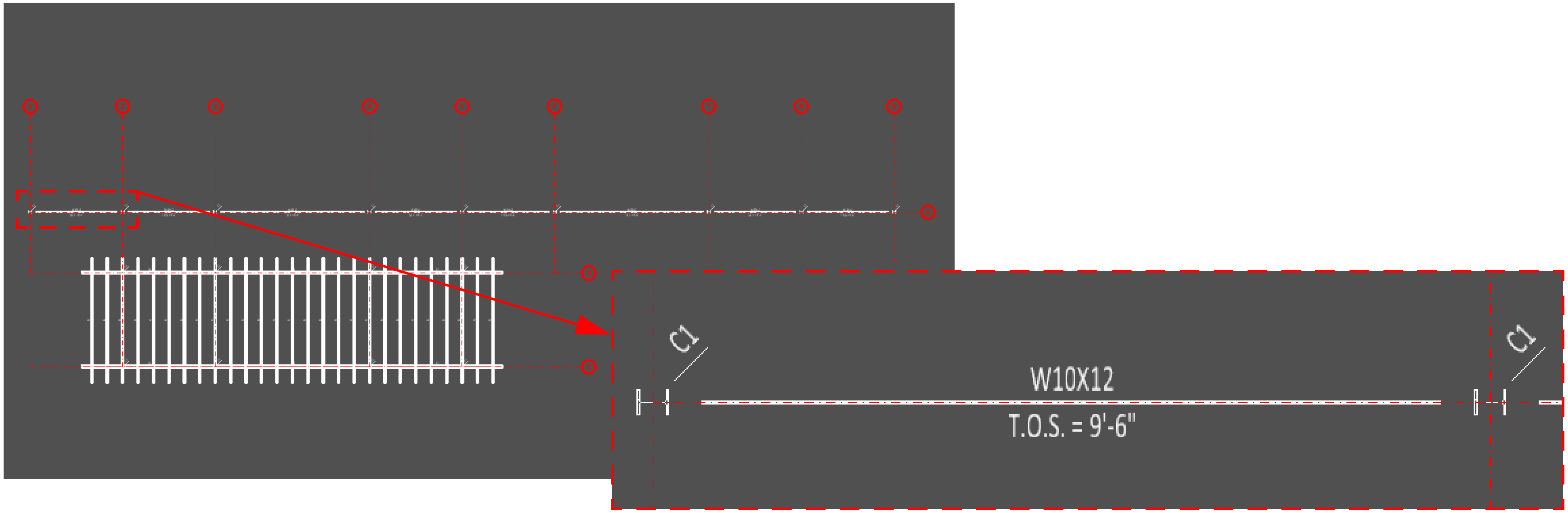


The line color, weight and symbology are all determined by the Family and Part assigned to each element.

The column, pier and footing are all labeled based on the *ID | Type ID* property and size that were assigned when placing the elements. *Structural rules* are used to extract this information from the model and use it in the drawing annotations. While structural rules can automate much of the drawing annotation additional annotations such as notes and dimensions would be added in this drawing model using standard text and dimension placement tools found on the *Drawing* tab of the ribbon.

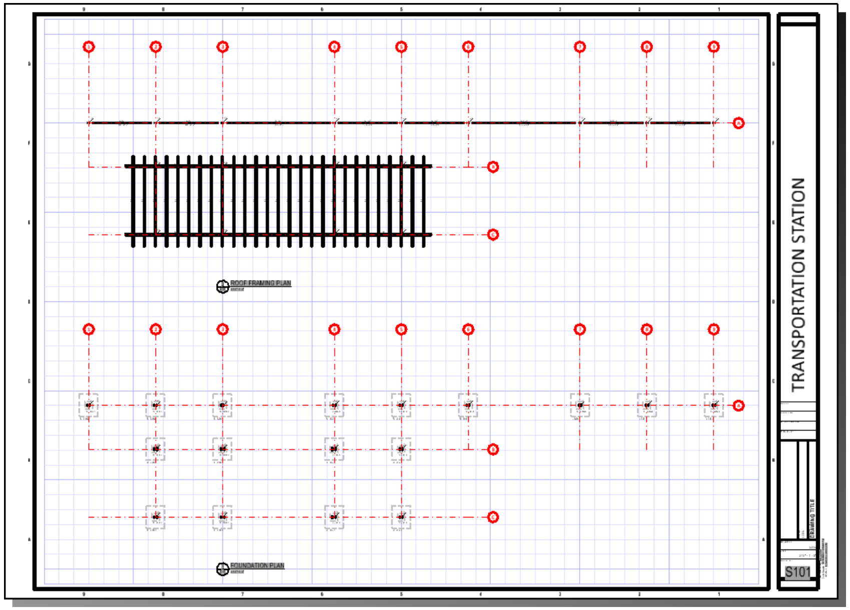
3. Select the *View Group* **ROOF FRAMING PLAN**. The **ROOF FRAMING PLAN** drawing model is opened.

4. Zoom into the columns and beams that frame the platform canopy.



Note that *structural rules* are not only used to add the annotation, but in the case of the steel beam it is re-symbolized to a single line representation. In fact, additional information is extracted from the model, the *Top of Steel (T.O.S.)* annotation is not a property you input, but simply calculated from the beams position in the model.

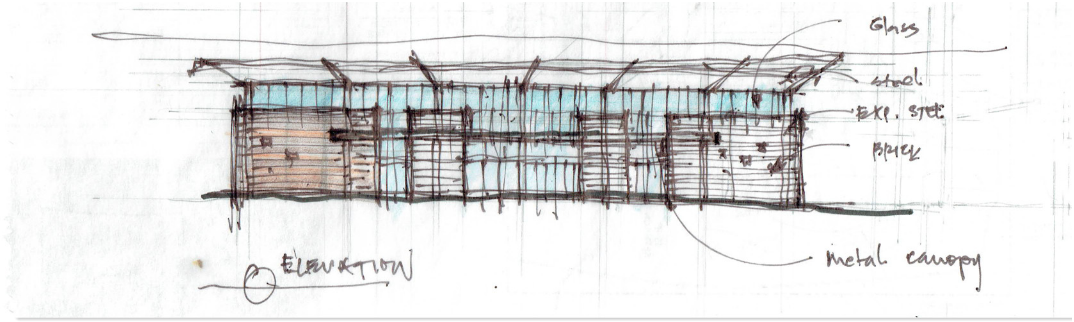
5. Select the *View Group* **Sheet 1**. This will open the model of the *Sheet*. This is a sheet model with a border file attached and each of the drawing models referenced and arranged on the sheet ready for plotting.



In this chapter, *Chapter 3: Modeling Structural Elements*, you have modeled the basic structural framing for the station building and canopy. You have modeled, columns, beams and footings and coordinated their placement with the conceptual architectural model, making the necessary modifications. The geometry and information that was modeled in the 3D model is now reflected in the 2D drawings. In the next chapter you will model the architectural elements of the station building.

Now that you have created a structural model with the basic structural framing, it is time to go back to the architectural model and place actual building elements rather than just blocking forms. You will now replace the forms placed earlier with intelligent objects like walls door and windows. These objects are also part of the *DataGroup Catalog* system and can hold a great deal of information, not only graphical data like height and width, but meta data such as type ID's or numbers, materials, fire rating, and manufacturer or model number.

Lets go back and review the design sketch. We can see that the design includes a brick exterior wall with a lot of glass, glass storefront, glass doors, and a number of clerestory windows. There are also exposed columns and beams and a sloped metal roof. As you place the walls, doors and windows in the next several exercises you will also add data or information about each object as it is placed.



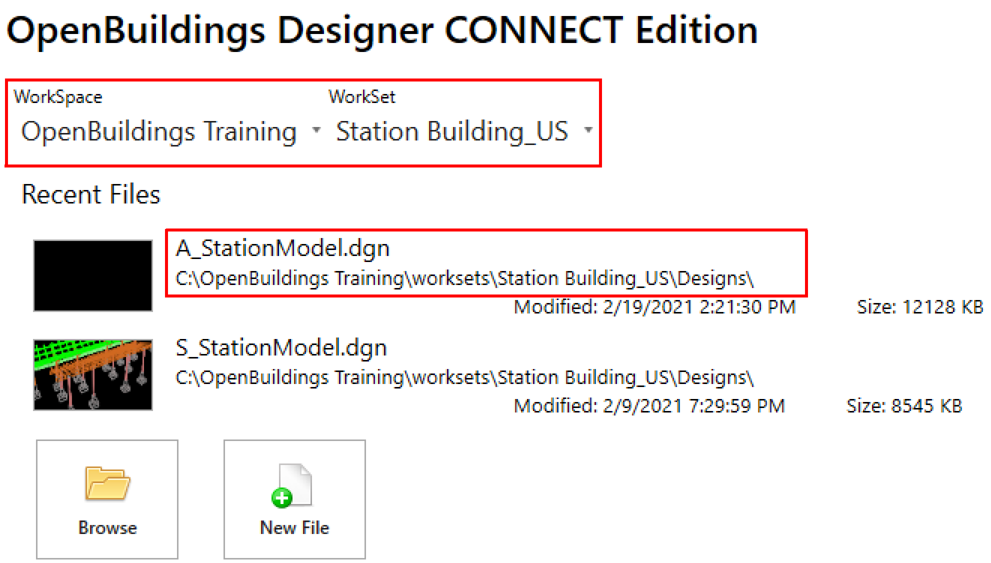
1. Start **OpenBuildings Designer** from the Start menu or desktop shortcut.

   WorkSpace: **OpenBuildings Training**

   WorkSet: **Station Building_US** *[Station Building_NM]*

2. Select the file **A_StationModel.dgn** from the list of *Recent Files*. The file will open.

Optional - If you did not complete the exercises in the previous chapters and would like a completed model to start the exercises in Chapter 4, use the **Browse** icon to browse to the *Station Building_US / X_Milestones* folder and open the file **A_StationModel_4.dgn**.



In order to begin you should reference in the structural model for coordination.

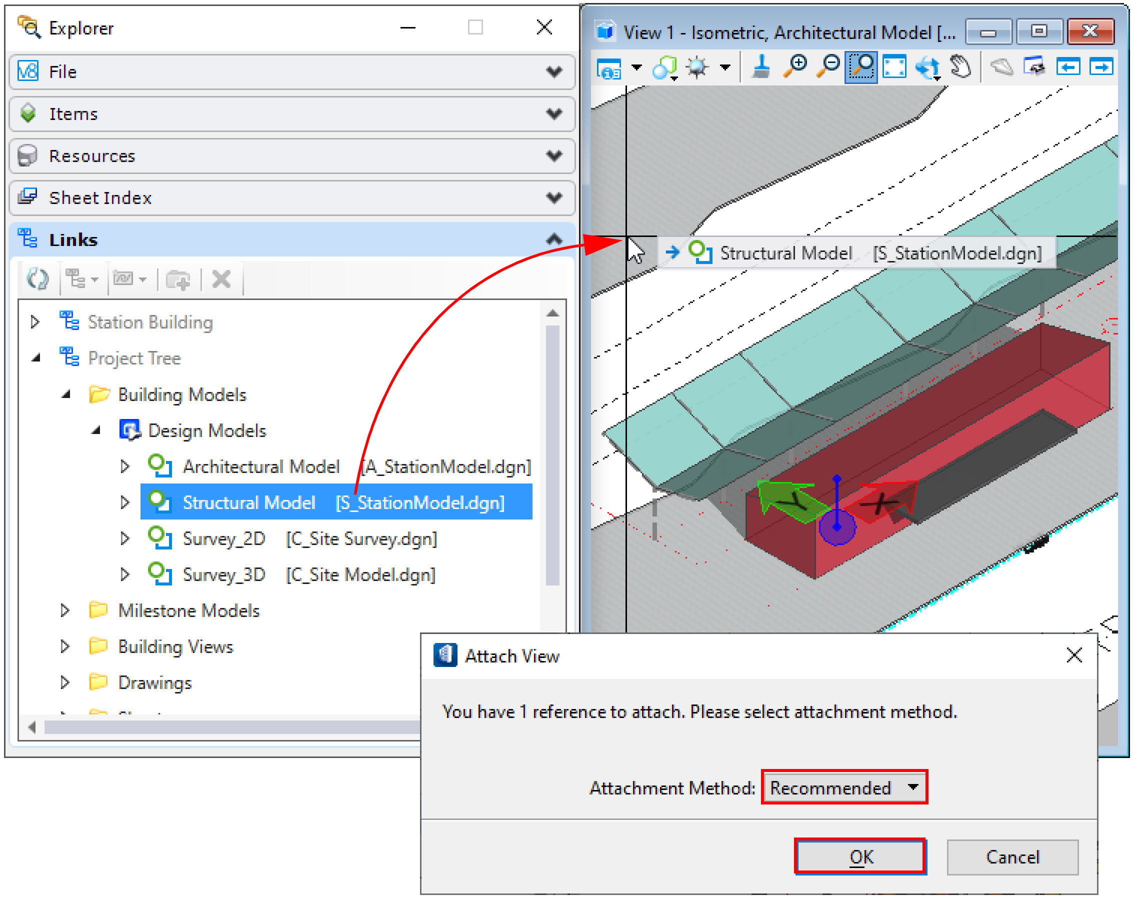
3. Open the **Links** tab on the *Explorer*. You will use the *Explorer* to add the structural model as a reference so that you can coordinate the architectural elements with the structural framing.

    a. Navigate to the **Project Tree > Building Models > Design Models.**

    b. Select the **Structural Model** and drag and drop it into any view.

    c. Use the *Attachment Method* **Recommended**.

Optional - If you did not complete the exercises in the previous chapters and would like a completed structural model to reference, navigate to the **Project Tree > Milestone Models > Milestone Models** and select the **Structural Model [S_StationModel-4.dgn]**

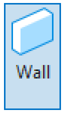


You are ready to start the exercises for *Chapter 4: Modeling Architectural Elements*.

Exercise 4-1: Placing Walls

In this exercise you will select a wall type from the library and place it in the model using the same techniques used to place lines and shapes.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

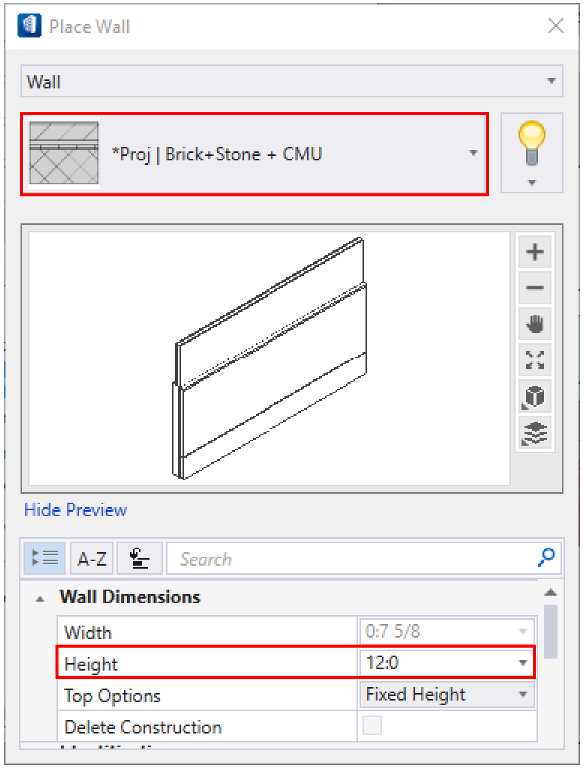


2. Select the **Wall** tool from the *Architectural Elements* group on the *Architectural* tab on the ribbon.

The *Wall* tool is used to place linear, arc, curve, and compound walls. Walls are defined by points which include the start point and the end point. All wall types placed using this tool are supported by the catalog library in the *DataGroup* System. Catalog data is applied to walls at the time of placement. The **Place by** options also allow creating walls from space elements or placing a wall along a grid line.

3. Select a wall item type, ***Proj | Brick + Stone + CMU** and set properties.

   Height: **12:0** *[4000 mm]*



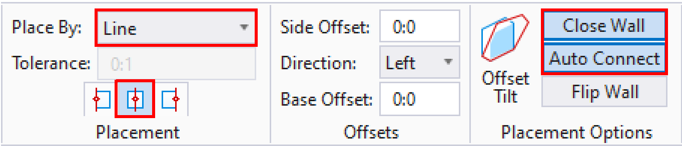
This is a *compound wall*, meaning it is made up of multiple layers of different parts. For example, the primary layer is concrete block with additional layers of brick, stone, metal and gypsum. This wall catalog item was created for the project and stored in the WorkSet.

4. On the *Placement* tab on the ribbon select:

   Place By: **Line**

   Placement: **Center Justify**

   a. Toggle **On** *Close Wall* and *Auto Connect*.



When toggled on, *Auto Connect* trims and cleans up wall intersections and wall ends during placement. The utility recognizes wall intersection conditions with other walls, and with other components and elements such as square columns and grid lines.

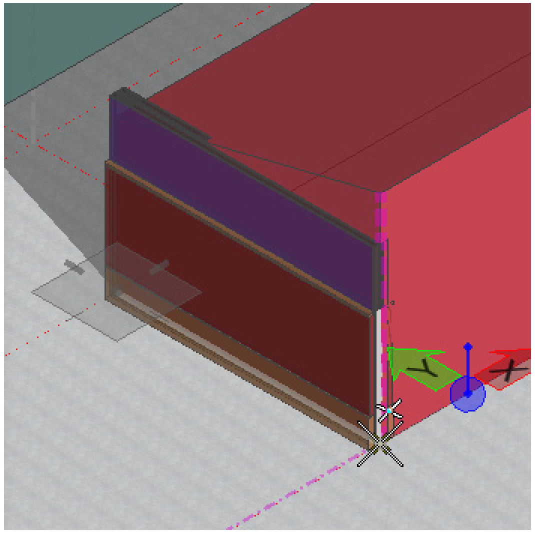
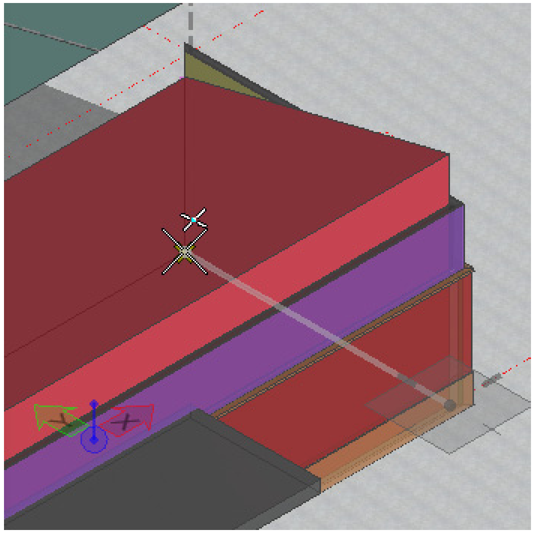
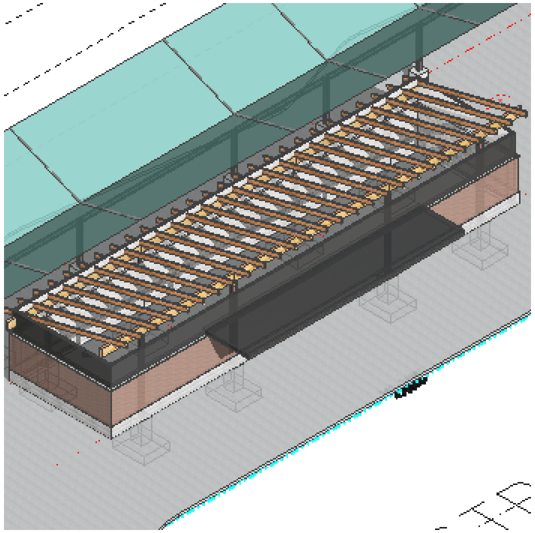
5. Place the wall in the model.

   a. Start the wall by snapping to the base of the building form at one corner. **Data point** *(Left-click)* to accept.

   b. For the next point snap to the next corner moving in a counter-clockwise manner. **Data point** *(Left-click)* to accept.

   c. For the next point snap to the next corner. **Data point** *(Left-click)* to accept.

   d. **Reset** *(right-click)* to close the shape and complete the wall.

Now that you have placed the wall, you may want to delete the building form.

6. Select the form, *right-press* to pull up a context sensitive list of modification tools and select **Delete**.

The walls placed have an *implied relationship*, so that if you move one wall the adjacent walls will be adjusted. In the next several steps you will move the front and back wall to expose the structural columns.

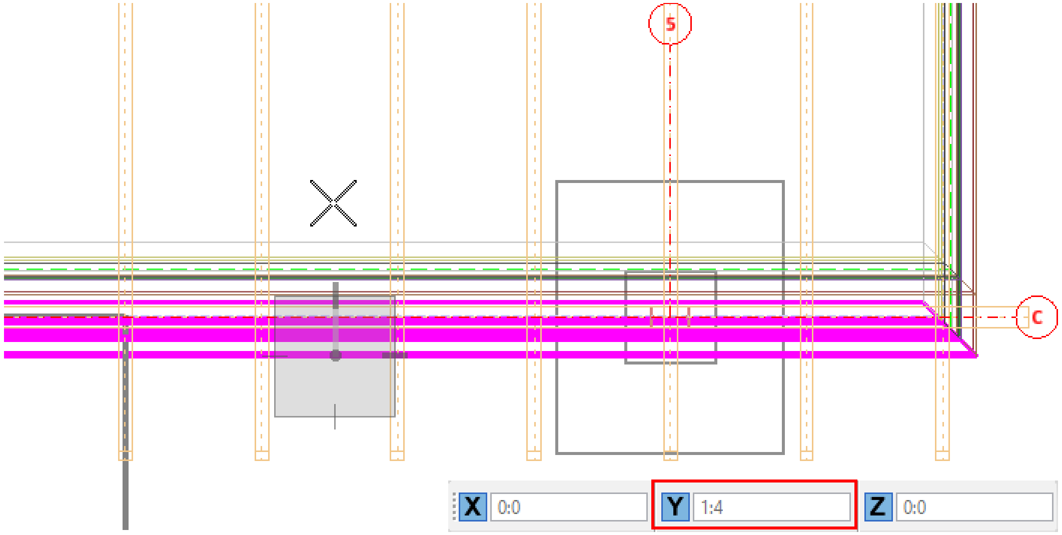
7. Tap the *space bar* to activate the ribbon popup menu. Select the **Move** tool.

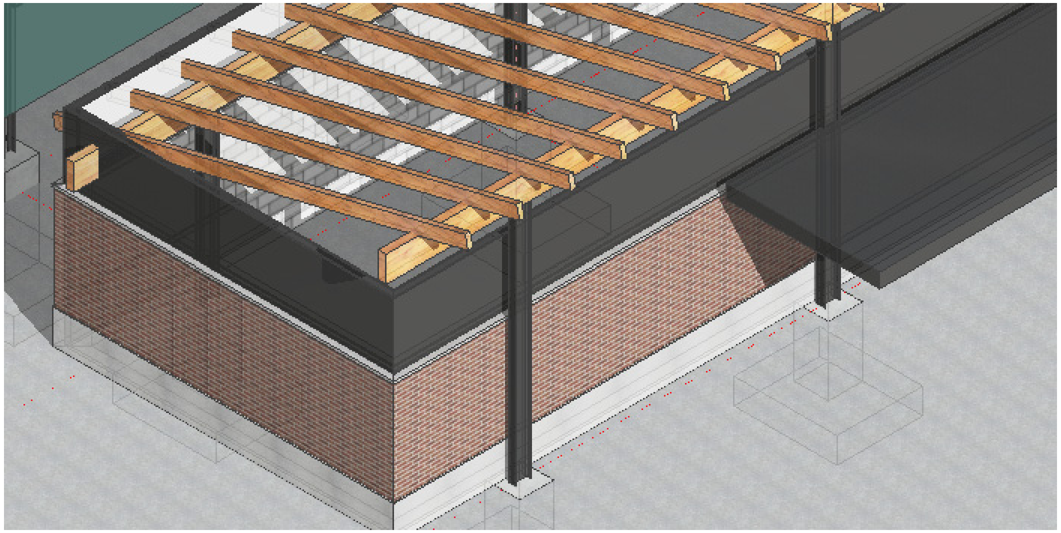
8. Select the wall along grid line **C**.

9. With the AccuDraw compass in the Top orientation move the cursor along the Y-Axis and move the selected wall **1:4** *[500 mm]* towards grid line **B**, exposing the columns along grid line **C**.

   Note that the adjacent walls have also been modified.

10. Repeat with the opposite wall moving it **1:4** *[500 mm]* in the same direction, this time exposing the columns on the interior of the station building.





In this exercise you have selected a wall type from the library and placed it in the model and then made some simple modifications to see that walls have an implied relationship to other walls and will maintain that relationship when modified.

In the next session you will add the sloped roof and then modify the height of the walls to meet the sloped roof.

Exercise 4-2: Placing Sloped Roof

In this exercise you will add the sloped roof over the station building. This requires drawing a closed shape representing the bottom edge of the roof then using the *Roof* tool to build the thickness and slope. The roof will be built in several layers to represent exposed wood decking, insulation and a flat seam metal roof.

1. Set the *Floor Selector* to the **Station > Roof**.

2. Set the *Family* and *Part* to **General::Construction**.

   Hint: You may need to toggle **Off** *Compound* to select the *Family* and *Part.*

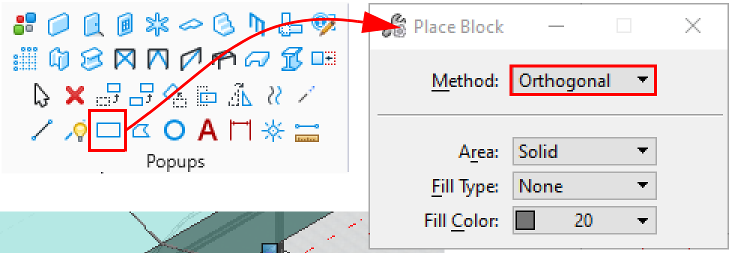
3. Tap the space bar to activate the ribbon popup menu. Select the **Place Block** tool.

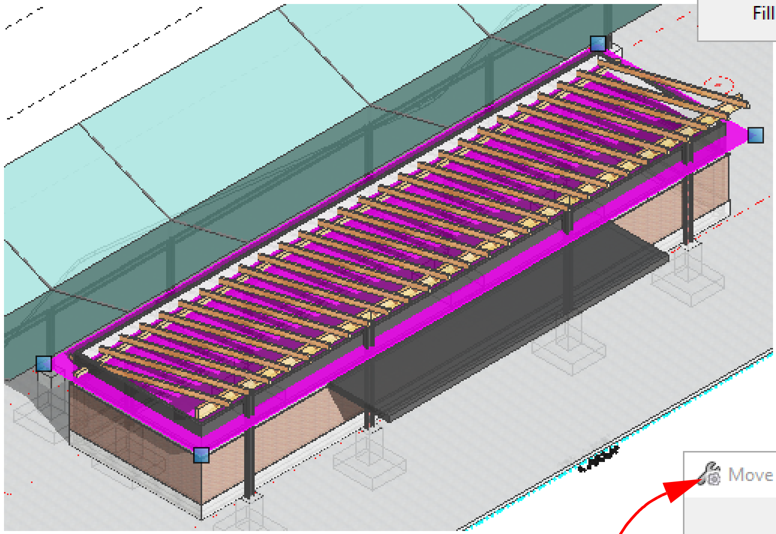
   Method: **Orthogonal**

   a. Select one corner of the brick wall as the first point for the block shape.

   b. Select the diagonal corner of the brick wall as the second point.

   Note: The shape should be created at the roof elevation.



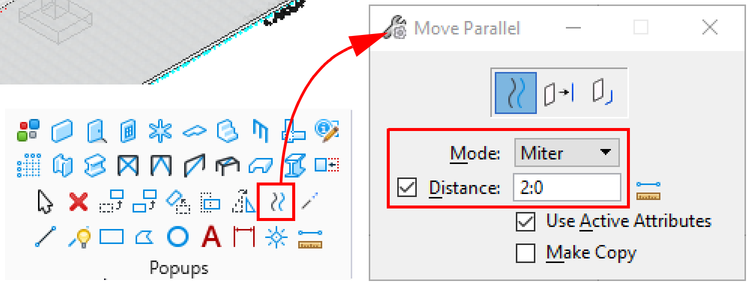


4. Tap the space bar to activate the ribbon popup menu. Select the **Move Parallel** tool.

   Mode: **Miter**

   Distance: **2:0** *[600 mm]*

   a. Select the rectangle and move parallel to represent the roof overhang.



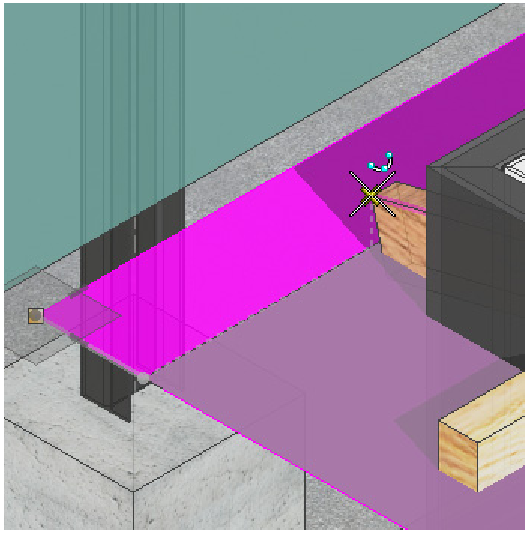
The overhang at the front and back can be modified to align with the timber joists.

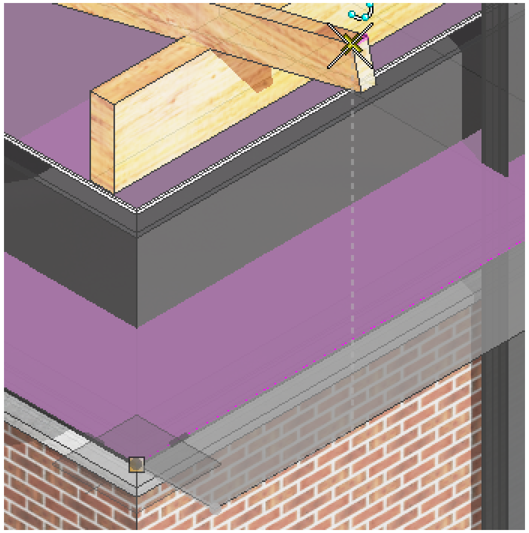
5. Select the shape and use one of the corner handles to drag the shape to the edge of the timber joists at both the front and back of the building.

Hint: Toggle **off** the *ProStructure snaps* so that you can snap to the top edge of the timber joist.

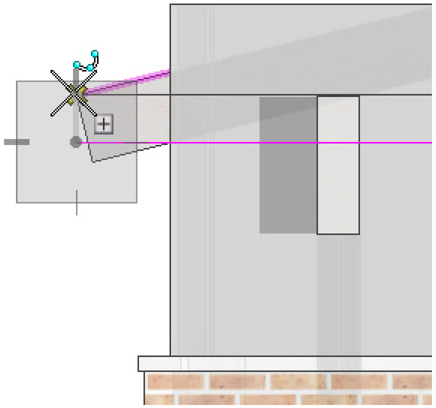
The shape represents the bottom edge of the roof. In order to make sure this shape is at the same elevation as the wood joists that support the roof you may need to move it in a *Side* view.

Hint: Unlock the *ACS Plane* and *ACS Plane Snap* lock, so that you can move the shape vertically.



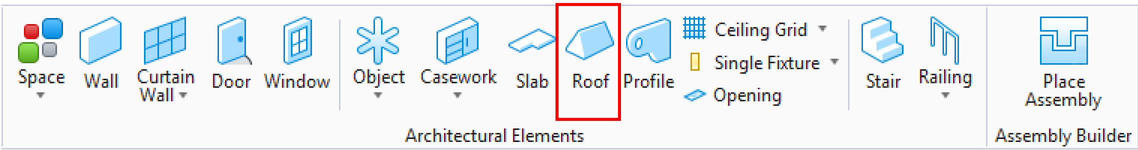


6. Rotate *view 3* to a Left Side orientation.
7. Zoom in to the end of the joist.
8. Tap the space bar to activate the ribbon popup menu. Select the **Move** tool.
   a. Select the edge of the shape as the point to move from.
   b. Use **S** to rotate the compass to a side orientation, then use the **Enter** key to lock the direction.
   c. Snap to the top end of the joist and **data point** *(Left-click)* to accept.



You will now build the roof up in layers starting with the bottom layer which is a wood decking.

9. From the *Architectural Elements* group select the **Roof** tool.



The *Roof* tool is used to create 3D solids that represent common roof shapes including sloped, mansard, gambrel, hip, and shed roofs. All roof types placed using this tool are supported by the catalog library in the *DataGroup* System. Catalog data is applied to roof layers at the time of placement.

10. Select the catalog item ***Roof | Wood Decking**

    Note: The slope can be controlled by *Rise and Run*, *Angle* or *Percentage*.

    Slope Control: **Rise : Run**

    Slope: **3:12**

    Thickness: **0:1 1/2** *[40 mm]*

    Part Definition: **Roof::Wood Decking**

11. Set the placement options on the ribbon.

    Roof Type: **Gable**

    Base Offset: **0:0**

    Place By: **Shape**

    Place From: **Bottom**

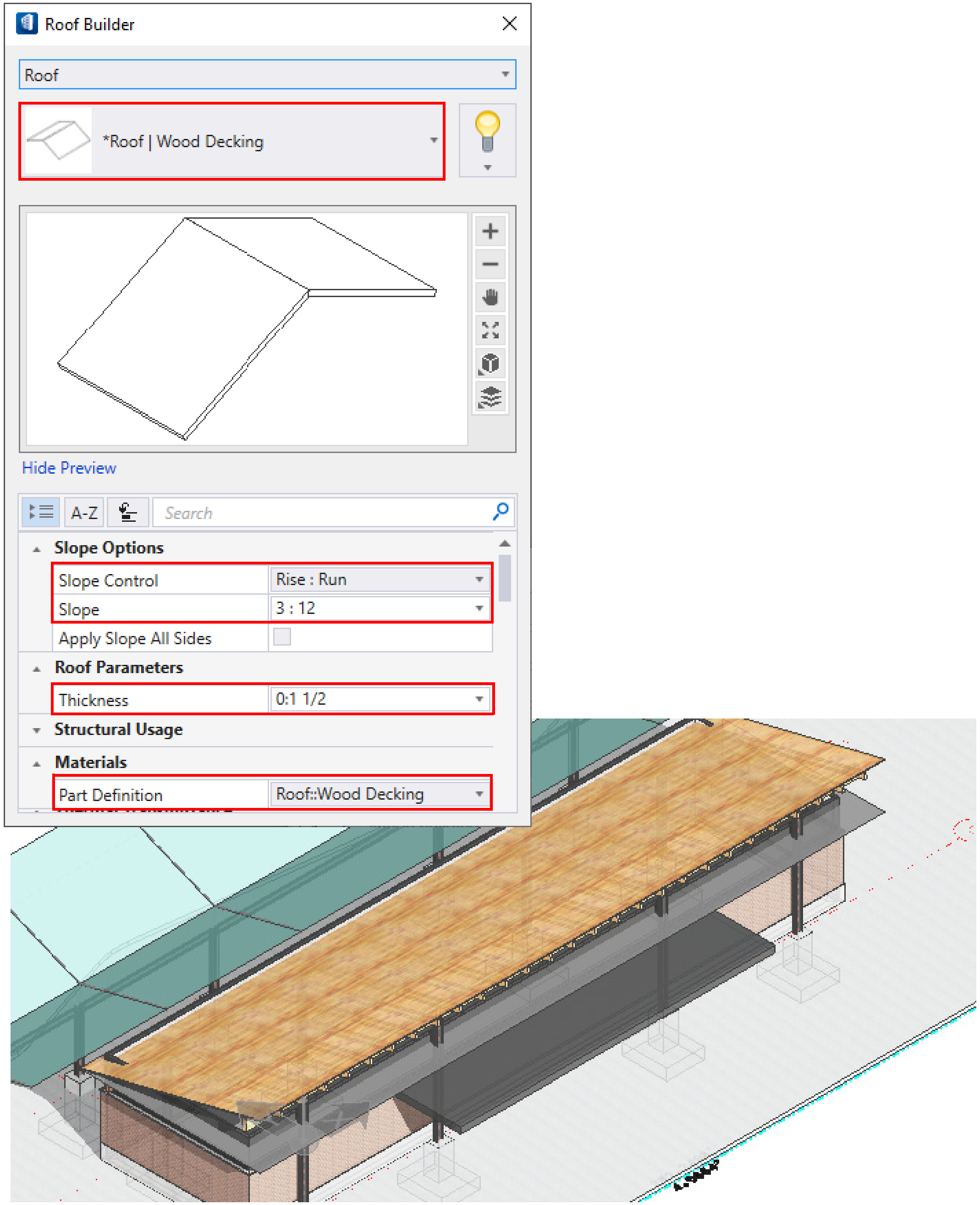
    a. *Delete Constructions* should be toggled **off**. The shape will be used again for the other layers of the roof.

12. Follow the prompts in the lower left.

    a. Select the shape for the roof.

    b. Select the side of the shape along the platform as the side to apply slope to.

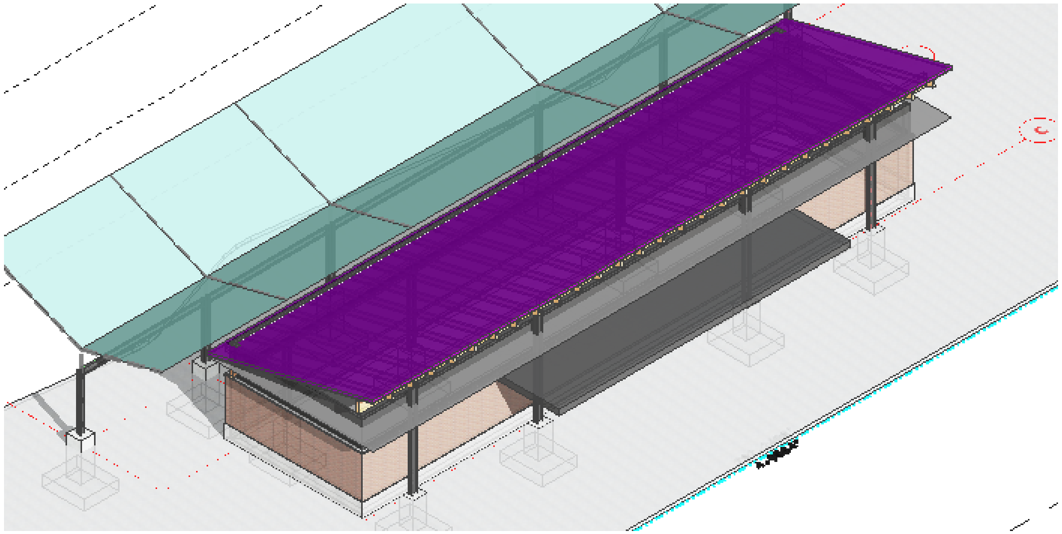
    c. **Reset** *(right-click)* to place the roof.



13. With the *Roof Builder* dialog still open change the catalog item to ***Roof | Insulation**.

Note: The *Thickness* of this layer is **0:4** *[100 mm]*.

  a. On the *Placement* ribbon change the *Base Offset* to **0:1 1/2** *[40 mm]* to offset for the thickness of the wood decking.



14. Follow the prompts in the lower left.

  a. Select the shape for the roof.

  b. Select the side of the shape along the platform as the side to apply slope to.

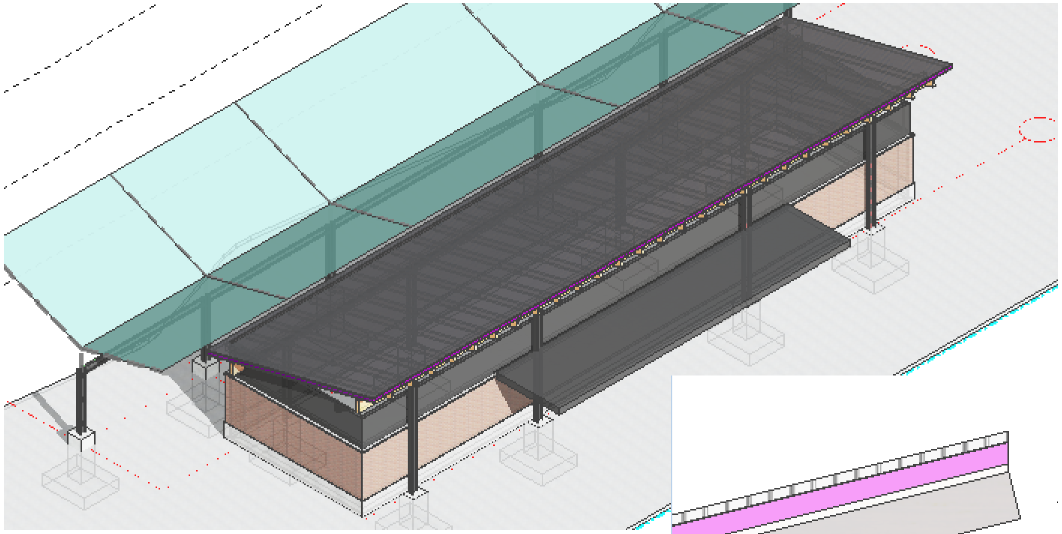
  c. **Reset** *(right-click)* to place the roof.

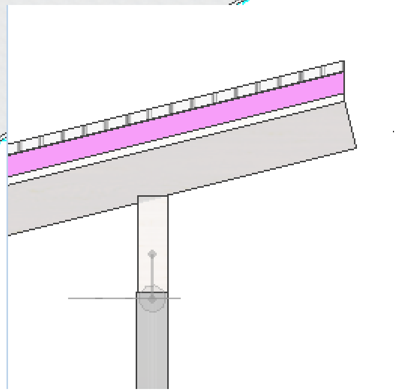
15. With the *Roof Builder* dialog still open change the catalog item to ***Roof | Flat Seam Metal**.

  Note: The *Thickness* of this layer is **0:2** *[50 mm]*.

  a. On the *Placement* ribbon change the *Base Offset* to **0:5 1/2** *[140 mm]* to offset for the thickness of the wood decking and the insulation.

  b. This is the last layer so toggle **on** the *Delete Construction* option.





16. Follow the prompts in the lower left.

  a. Select the shape for the roof.

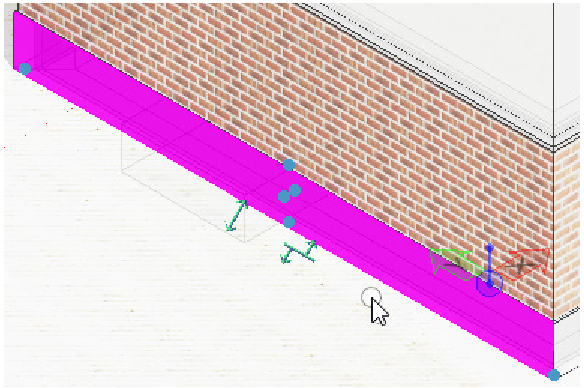
  b. Select the side of the shape along the platform as the side to apply slope to.

  c. **Reset** *(right-click)* to place the roof.

In the next exercise you will modify the height of the exterior walls to match the underside of the sloped roof.

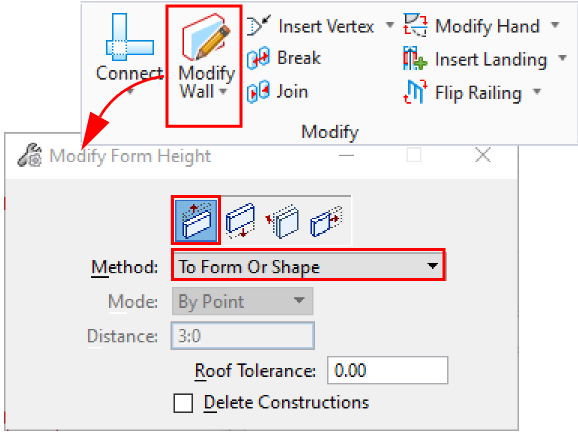
Exercise 4-3: Modify Walls

In this exercise you will modify the walls placed previously. Just as with the structural elements, the wall can be selected and several handles are available to modify the height, width, base and sides of the wall. Be aware however, that on compound walls these handles will modify each layer of the wall independently, not all layers as a group. Note that there are also handles to flip the wall, which will flip all the wall layers as a group.



There is also a *Modify Wall* tool. This tool is a combination of 4 tools; *Modify Form Height*, *Modify Form Base*, *Modify Form Width* and *Extend Linear Form*. This tool can be used to modify all the layers of a compound wall as a group or each layer independently. This is controlled using the *Graphic Group* lock. When it is locked the layers are treated as a group and when it is unlocked the layers are treated as independent elements.

1. Select the **Modify Wall** tool from the *Modify* group on the *Architectural* tab of the ribbon. I



   a. Select the first tool, **Modify Form Height.**

   b. Set the *Method* to **To Form or Shape.**

   Note: There are various *Methods* to modify the height of a wall.

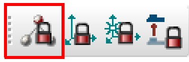
   Add Distance—extends the form by the *Height* setting when the mode is *Absolute*; extends the form by the *Distance* setting when the mode is *Relative*; extends the form by a data point when the mode is *By Point*.

   To Imaginary Line—extends the form to an imaginary plane defined by 2 data points.

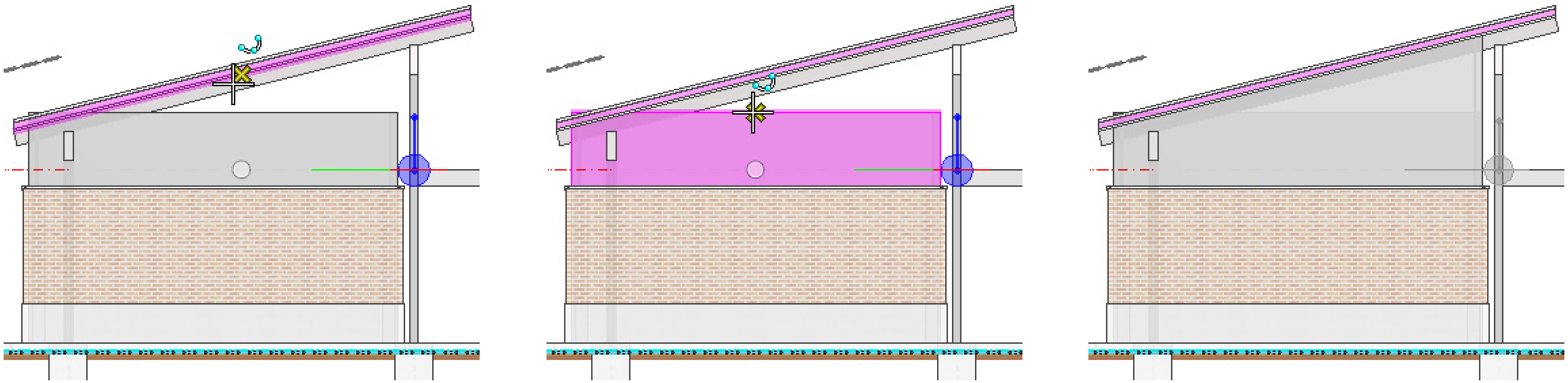
   To Form or Shape—extends a linear form to a selected shape or form.

   To Plane (3 Pts)—extends the form to a plane defined by 3 data points.

   The *Method* to **To Form or Shape** is used here so that the roof form can be used as the form to extend the wall to.

2. In order to extend all the layers of the walls to the roof, toggle on the *Graphic Group* lock. 

3. Now follow the prompts in the lower left to select the elements.

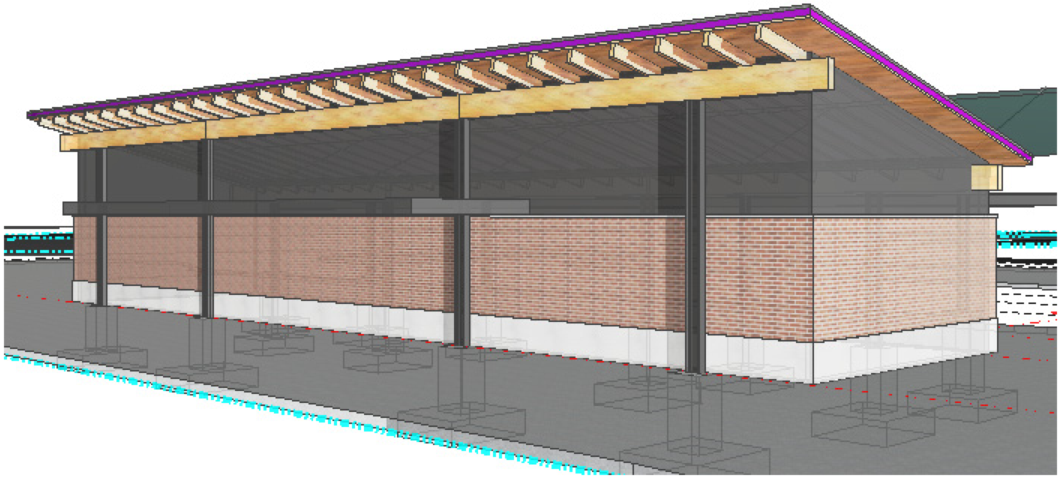


a. Select the bottom layer of the roof as the form to connect to.

b. **Data point** *(left-click)* in the view to accept.

c. **Reset** *(right-click)* to continue.

d. Select each of the 4 walls that need to be extended to the roof form.



In this exercise you have modified the heights of the station walls to meet the underside of the roof.

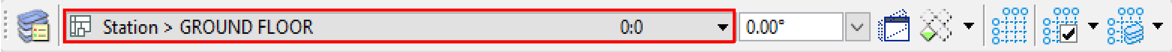
Just as with other building elements, the data on the wall can also be modified using the *Modify Properties* tool.

In the next exercise you will place a door in the wall.

Exercise 4-4: Placing Doors

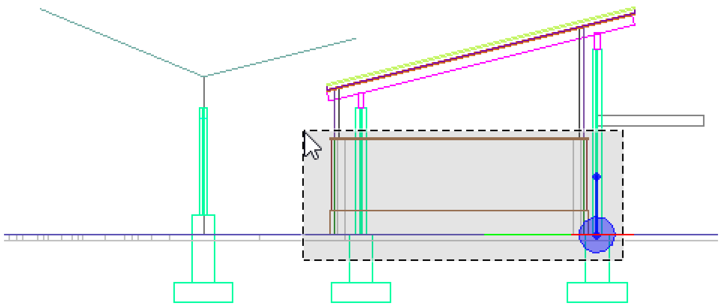
Doors are objects that can be selected from the library, modified on the fly, setting the basic size, as well as type, fire rating and other information needed in the schedule, and then easily placed in the model. In this exercise, you will learn how to load doors that are stored in a library not immediately visible in the dialog, then modify the properties and save a version in the project WorkSet.

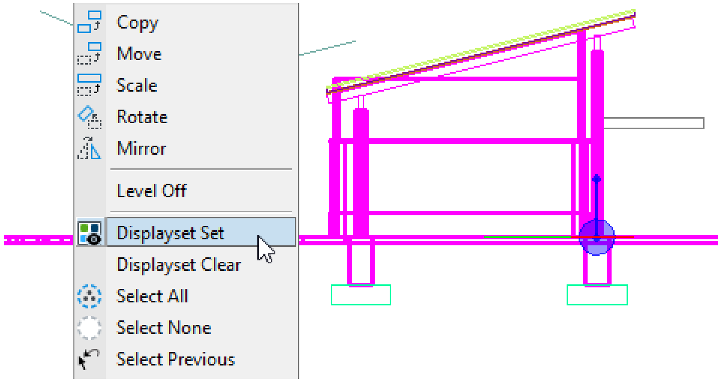
1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

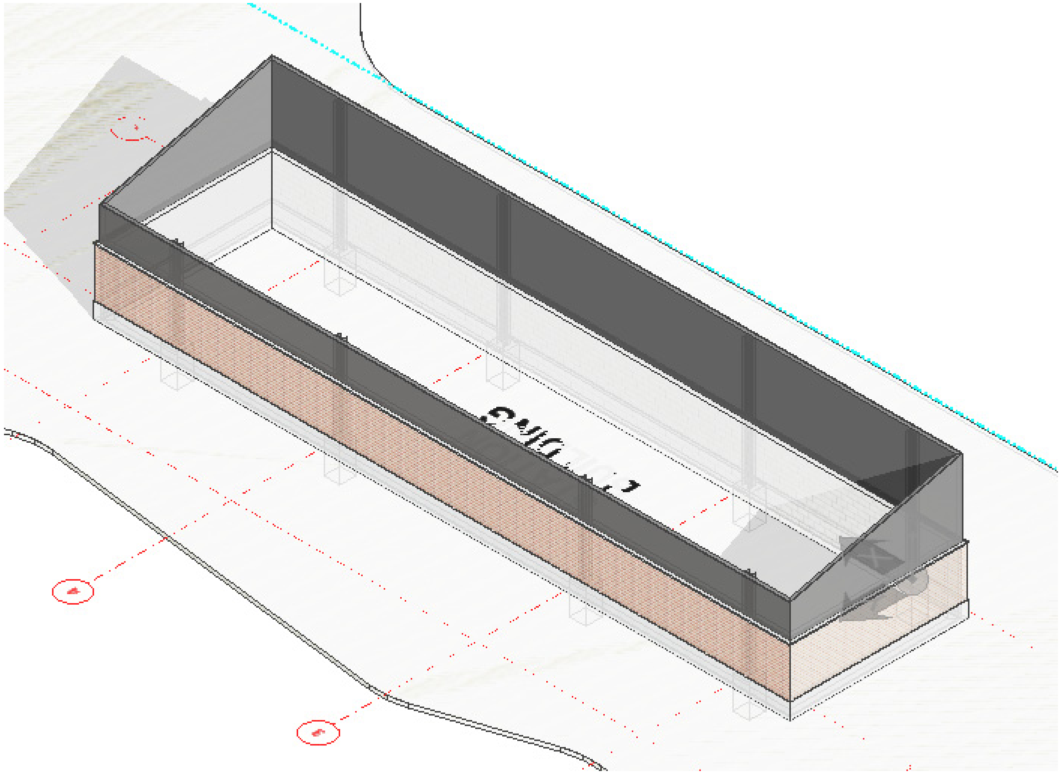


2. Create a *Display Set* of the station building without the platform canopy and roof geometry.

3. Set the *View Group* to **Building Model Back**.

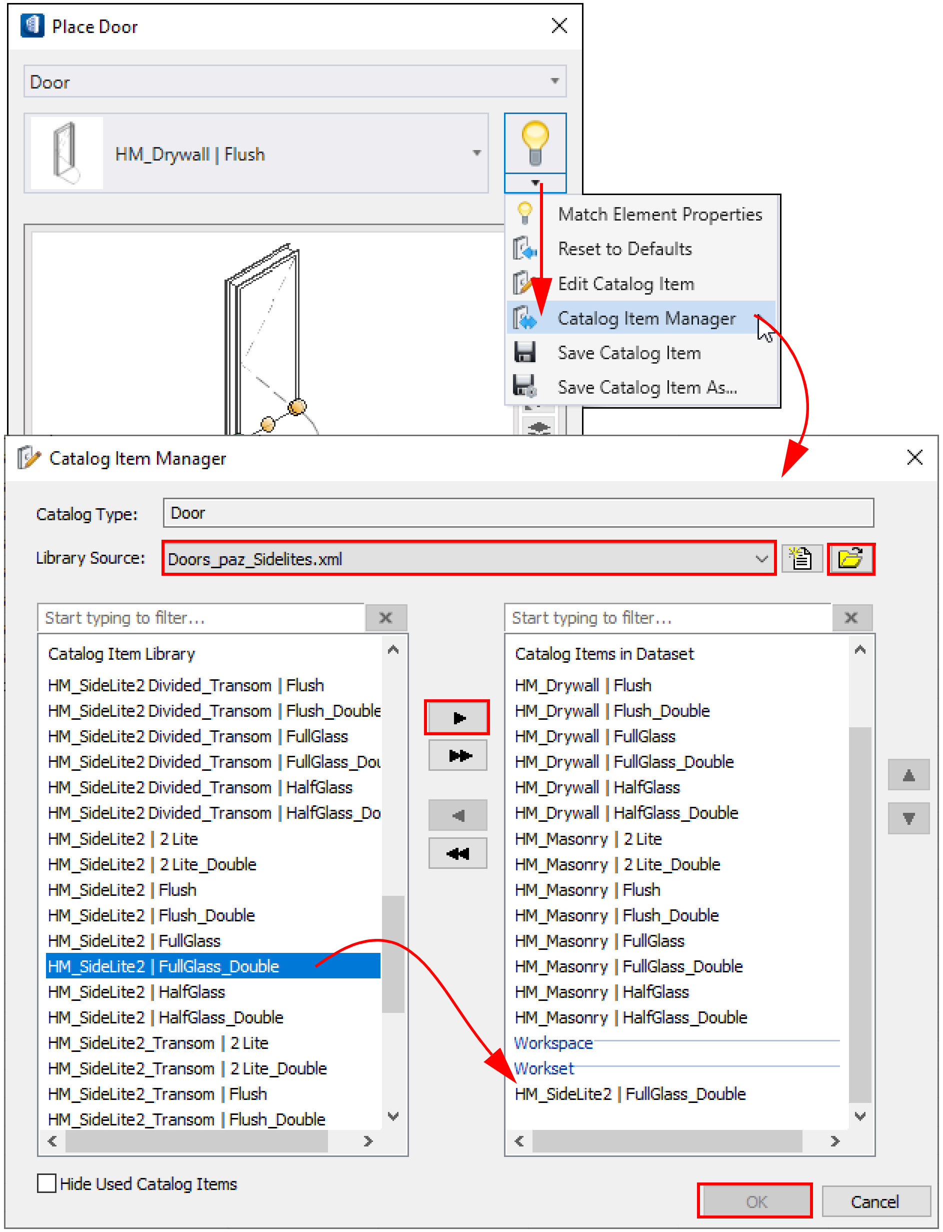






4. Select **Place Door** tool from the *Architectural* ribbon.

   Note: The current door catalog has a limited number of hollow frame metal doors available, there are more doors stored in additional libraries.



5. From the light bulb pull down select **Catalog Item Manager.**

   This will open the *Catalog Editor* and the *Catalog Item Manager*. The *Catalog Editor* is the heart of the DataGroup System and where all the various catalog types and items are defined. The *Catalog Item Manager* is used to manage which catalog items are stored in libraries and which items are available in the current WorkSet. The right hand field shows all the doors currently available.

   a. Select a *Library Source* file form the pull-down.

      Catalog Type: **Door**

      Library Source: **Doors_paz_Sidelites.xml** *[Doors.xml]*

   The left field is now populated with all the doors in that library.

   b. Scroll down and find **HM_Sidelite2 | FullGlass_Double**. This will be a full glass double door with 2 sidelites, one on each side.

   Note: This door is not in the metric *Doors.xml*, it has already been added to the *WorkSet.* You may add a different door if you wish.

   c. Select this door on the left side, then use the arrow button to move it to the right.

   By default it will be moved to the *WorkSet*. Note that you can use the up and down arrows on the right to move it to the *WorkSpace* or *Organization* level.

   d. Select **OK** and close the *Catalog Editor*.

6. In the *Place Door* dialog change the *Catalog Item* to **HM_Sidelite2 | FullGlass_Double**

   a. In the Preview window select the placement origin for the door.

   b. On the *Preferences* tab, set the *Front Offset* and the *Sense Distance*.

      Front Offset: **0:4** *[100 mm]*

      Sense Distance: **1:0** *[400 mm]*

      The *Front Offset* defines a distance that the door frame will be recessed or offset from the front face of the wall.

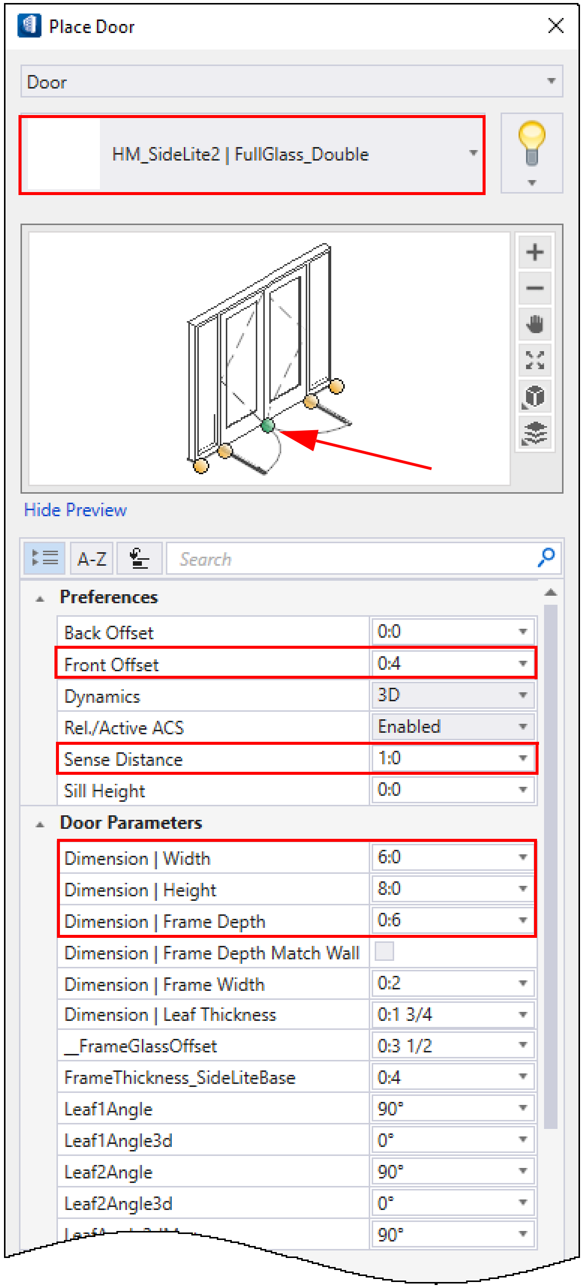
      The *Sense Distance* is the distance from the front face of the wall that wall layers will be cut by the door perforator.

   c. On the *Door Parameters* tab, set the door dimensions.

      Width: **6:0** *[1800 mm]*

      Height: **8:00** *[2400 mm]*

      Frame Depth: **0:6** *[150 mm]*



d. On the *Identification* tab, input a door number and/or door type for the door. This information can be used to automatically annotate the drawings.

ID |TypeID: **D1**

ID |ItemID: **01**

There are numerous dimensions that can be changed on the fly to change the geometry of the door. These can then be saved to the library as either a new catalog item (*Save Catolog Item As...*) or to update the current catalog item (*Save Catalog Item*).

e. Scroll down to *Door Dimensions - Extended* and change the dimensions that define the width of the sidelites.

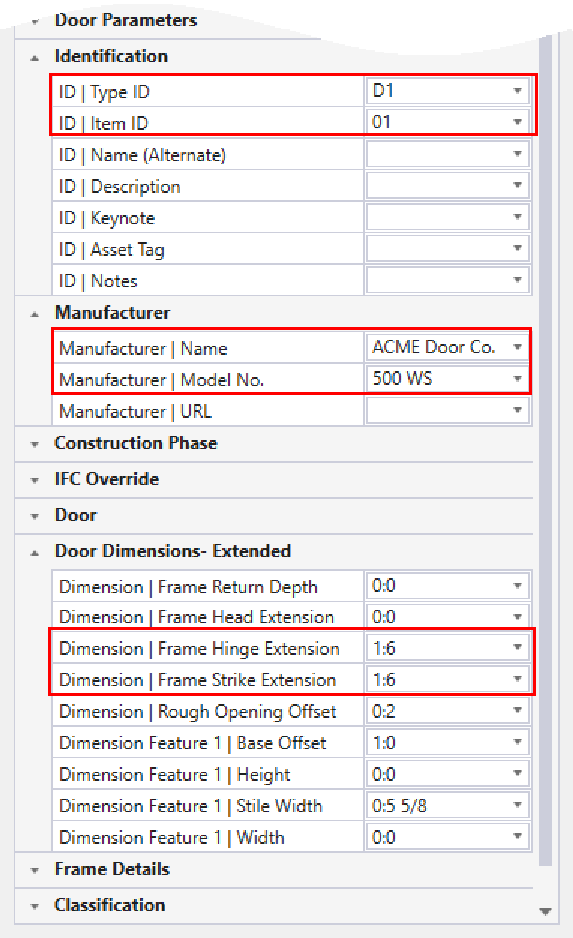
Dimension | Frame Hinge Extension: **1:6** *[400mm]*

Dimension | Frame Strike Extension: **1:6** *[400 mm]*

f. Add additional data properties such as a manufacturer and model number. This information can be harvested from the model when creating schedules.

Manufacturer |Name: **ACME Door Co.**

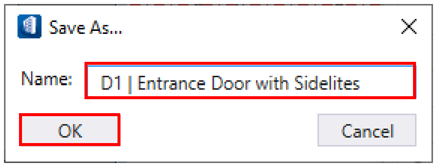
Manufacturer |Model No.: **500 WS**



You should now save these changes as a new catalog item within your dataset so that you can easily select this door again.

7. From the dialog pull-down select **Save Catalog Item As...**.

a. Name it **D1 | Entrance Door with Sidelites** and select **OK**.



This new catalog item is saved to your project WorkSet and will now be available when placing doors in this WorkSet.

You will now place the door in the model at the platform entrance of the station building. You will place two doors centered between column lines 2 and 3 and 4 and 5.

8. Working in either the Iso view or the Top view, select the exterior brick wall where the door is to be placed. An implied relationship will be created between this wall and the door.

   The next step is to select the placement point along the wall. For this you will use some of the *AccuDraw* shortcuts learned earlier.

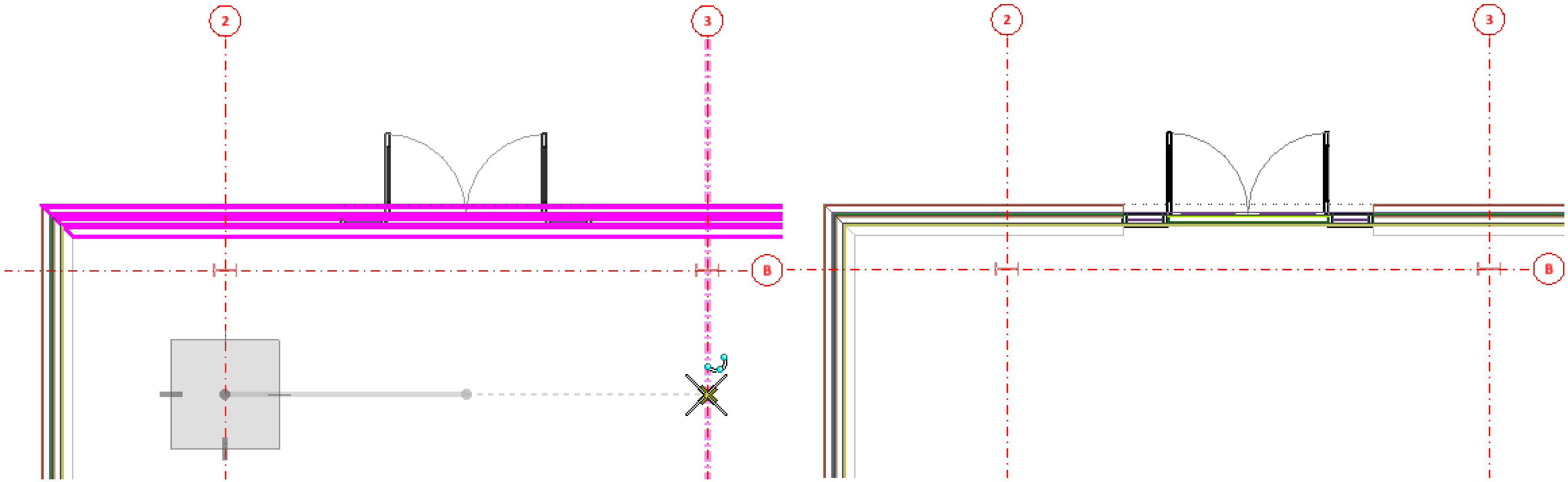
   a. Snap to grid line **2**, type **O** on the keyboard to move the *AccuDraw* compass to the current snap location.

   b. Now move the cursor towards column line 3 and use **Enter** to lock the Axis. Snap to grid line **3**.

   c. Type **/** (slash) and then **2** on the keyboard to divide this distance between the two points in half. The cursor moves to the midpoint between the two grid lines,

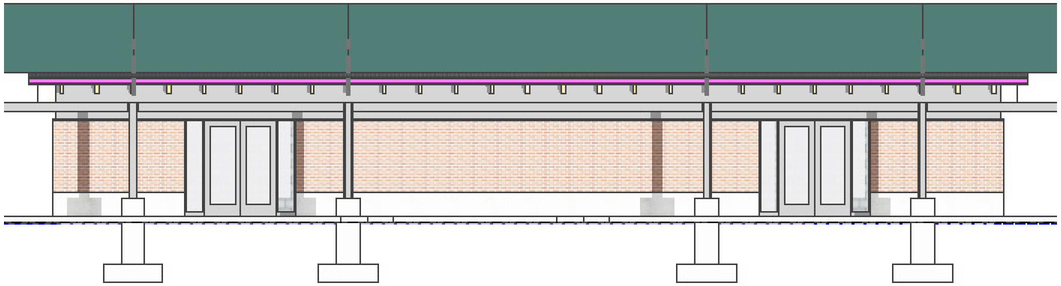
   d. **Data point** *(left-click)* to accept the placement point.

   e. Finally, you must determine which way the door swings. Select a point on the exterior of the building so that the doors swing out.



The door is placed.

9. Repeat to place a door between grid lines 4 and 5.



10. Place a third door on the front of the building centered on the front wall.

    Once placed a door can be moved and copied.

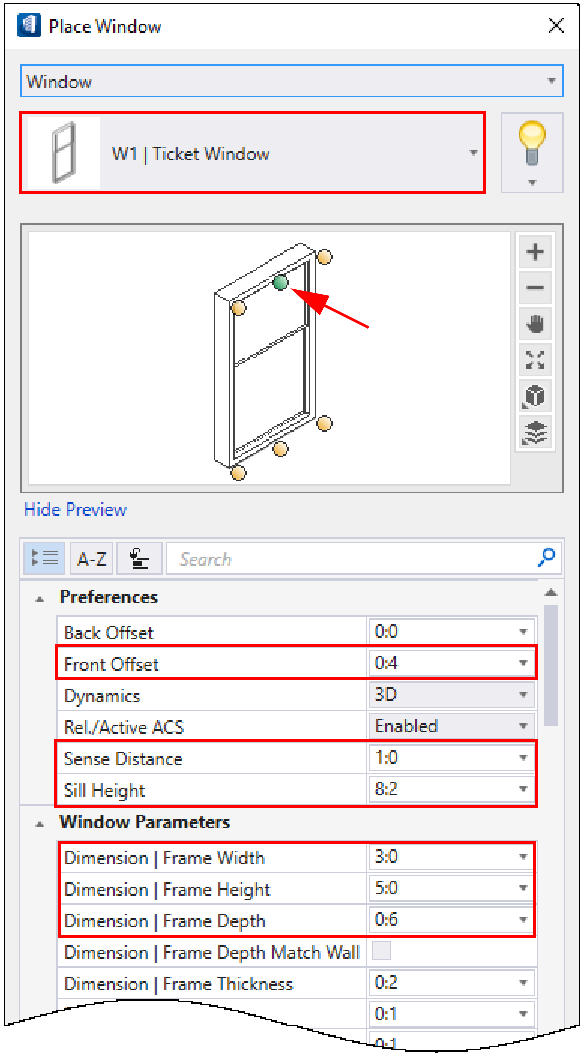
11. Select the **Copy** tool then copy the door to each side creating 3 doors at the front of the building.

In this session you have added an additional door to your dataset by loading it from a library, you have modified the dimensions and properties of this door and then saved it as a new catalog item in your WorkSet and finally placed the door in the exterior wall.

In the next exercise you will place windows.

Exercise 4-5: Placing Windows

Similar to doors, windows are objects that can be selected from the library, modified on the fly, setting the basic size, as well as type, manufacturer and other information needed in the schedule, and then save the customizations to the project WorkSet.



1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

2. Select the **Place Window** tool from the *Architectural* ribbon.

   a. Select a window catalog item from the pull-down.

      Catalog Item: **W1| Ticket Window**

   Note: This is a window catalog Item that was already created and saved to this project Workset.

   b. In the preview window select the placement origin for the window.

      Note: The window can be placed from either the head or the sill. The selection will affect the *Sill/Head Height* setting below.

   a. On the *Preferences* tab, set the *Front Offset* and the *Sense Distance*.

      Front Offset: **0:4** *[100 mm]*

      Sense Distance: **1:0** *[400 mm]*

   b. Set either the sill or head height based on the origin selected for the cell. This will be the distance above the active floor level.

      Sill/Head Height: **8:2** *[2450 mm]*

   c. On the *Window Parameters* tab, set the window dimensions.

      Dimension | Frame Width: **3:0** *[900 mm]*

      Dimension | Frame Height: **5:0** *[1500 mm]*

      Frame Depth: **0:6** *[150 mm]*

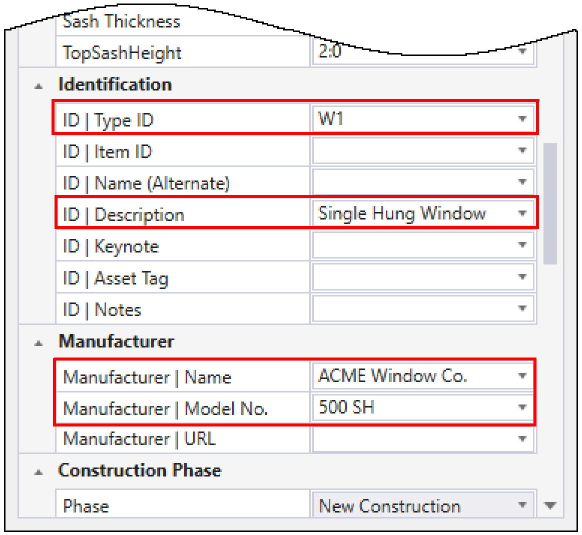
d. On the *Identification* tab, input a window type for the window.

ID |TypeID: **W1**

e. Add additional data properties such as a manufacturer and model number. This information can be harvested from the model when creating schedules.

Manufacturer |Name: **ACME Window Co.**

Manufacturer |Model No.: **500 SH**

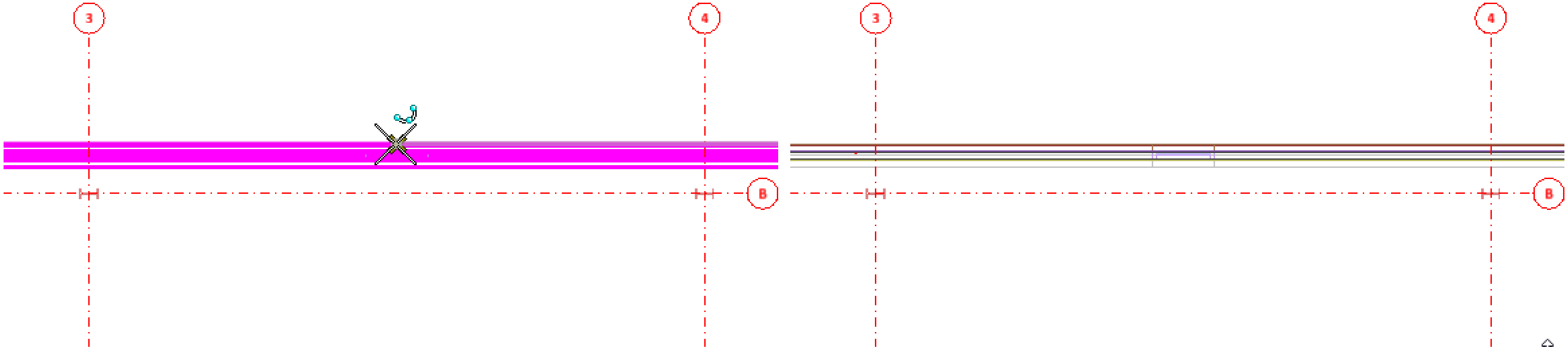


3. Place the window in the model at the platform side of the station building.

a. Select the exterior brick wall where the window is to be placed (you can work in any view).

b. Next select the placement point along the wall, *AccuSnap* to the midpoint of the wall and **data point** *(left-click)*to accept.

c. Finally, **data point** *(left-click)* again to define the exterior side of the window.



The window is placed.

4. Copy the window to create additional windows.

   a. Select the window and *right-press,* select **Copy** from the pop-up menu. Copy the window to the right a distance of **4'-6"** *[1500 mm]* two times.

   b. Select the window again and *right-press,* select **Copy** from the pop-up menu. Copy the window to the left a distance of **4'-6"** *[1500 mm]* two times.

You should now have 5 ticket windows placed in the center bay along the platform.

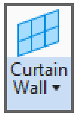
In the next you will place glass and aluminum storefront using the Curtain Wall tool.

Exercise 4-6: Placing Curtain Wall

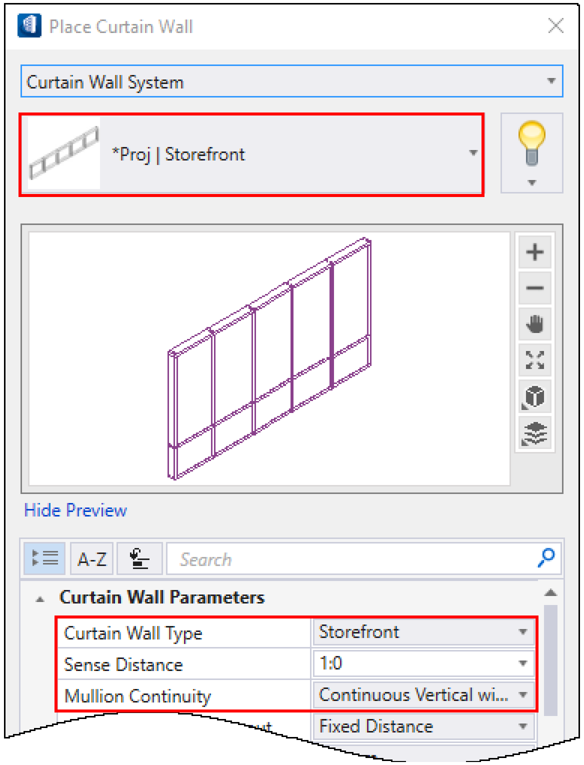
The **Curtain Wall** tool allows you to place, modify and manipulate **Place Curtain Wall** element types, that include Curtain Wall, Storefront, Ribbon Window, and Punched Opening. They can be placed as linear (by line), arcs, curved, along drawing elements, and by shape on an elevation. Once placed they can be manipulated further by moving, or copying selected mullions across panels to create a desired pattern.

Unlike doors and windows, curtain wall is a system rather than an object, it is made up of *panels* and *frames* both of which have data and can be scheduled. In this exercise you will select a storefront system and place it in the model in order to create the storefront on the front entry of the station building.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.
2. Set the *View Group* back to **Building Model** and create a *Displayset* including just the 4 exterior walls.



3. Select the **Curtain Wall** tool from the *Architectural* ribbon.
4. Select *Catalog Item* ***Proj | Storefront**. This is a pre-defined storefront system set up for the project.



Review and/or modify the curtain wall parameters listed below.

a. Select the *Curtain Wall Type* – Sets the type of the curtain wall being placed:

Curtain Wall Type: **Storefront**

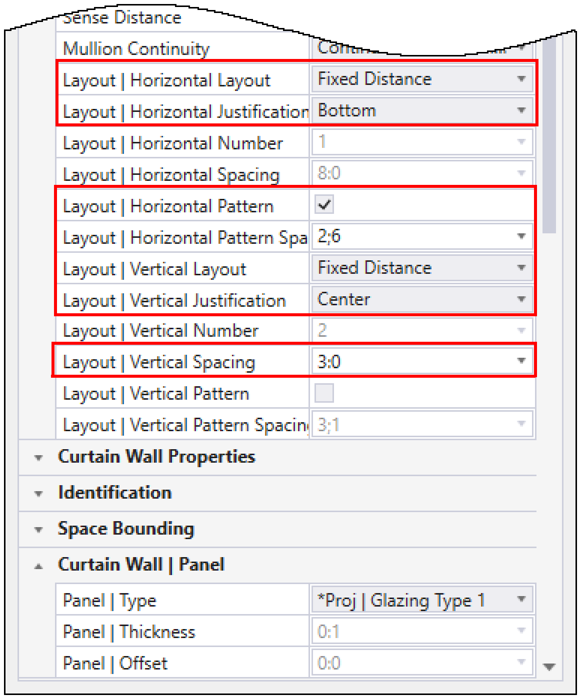
b. Set the *Sense Distance*.

Sense Distance: **1:0** *[300 mm]*

c. Set the *Mullion Continuity*. This determines how the mullions and frame are joined.

Mullion Continuity: **Continuous Vertical with Continuous Frame**

d. The *Horizontal | Vertical Layout, Justification, Number and Spacing* - are all options that determine how the mullions are spaced both in the horizontal and vertical direction. These values will determine the initial geometry of the panel.



Layout | Horizontal Layout: **Fixed Distance**

Layout | Horizontal Justification: **Bottom**

Layout | Horizontal Pattern: **Bottom**

Layout | Horizontal Pattern Spacing: **2; 6** *[600; 1800]*

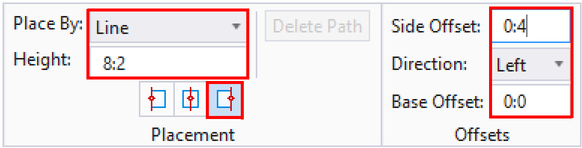
Layout | Vertical Layout: **Fixed Distance**

Layout | Vertical Justification: **Center**

Layout | Vertical Spacing: **3:0** *[900]*

These values will create a storefront window system that has horizontal mullions at a **2:0** *[600 mm]* then **6:0** *[1800 mm]* spacing and vertical mullions that are equally spaced at **3:0** *[900 mm]*.

5. On the *Placement* ribbon set the following:



Place By: **Line**

Height: **8:2** *[2450 mm]*

Placement: **Right Justify**

Side Offset: **0:4** *[100 mm]*

Direction: **Left**

The *Right Justify* placement puts the placement line for the curtain wall on the outside face of the frame, so you will draw the placement line along the face of the brick wall. The *Side Offset* of **0:4** *[or 100 mm]* will offset it from the face by **0:4** matching the door and window placement earlier.

Placing the curtain wall is similar to placing a wall. You will draw a line defining the placement line of the curtain wall, the difference is that it will behave like a window or door perforating walls that it comes into contact with.

a. Snap to the intersection of the wall and grid line **2**, type **O** on the keyboard to move the *AccuDraw* compass to the current snap location.

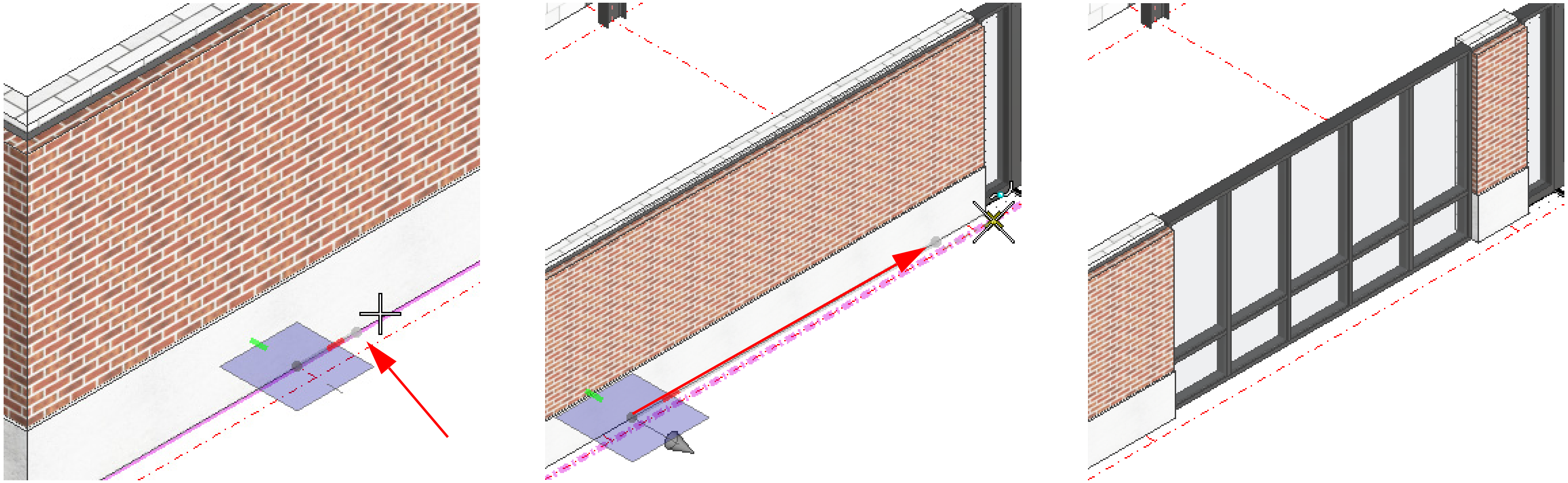
b. Move the cursor towards grid line **3** and use **Enter** to lock the Axis.

c. Type in **1:6** *[750mm]* to move the cursor from the column line and then **data point** *(left-click)* to select this as the start point.

d. Move the cursor towards grid line **3** and use **Enter** to lock the Axis.

e. Type in **15:0** *[4500 mm]* and then **data point** *(left-click)* to select this as the end point.

f. **Reset** *(right-click)* to complete the command and place the length of curtain wall.



6. Repeat to place additional sections of the storefront at the opposite bay along the front of the building.

In this session you have learned how to place curtain wall using the *By Line* method.

For an additional challenge you can place additional curtain wall above the brick on the front face of the station building as a clerestory.

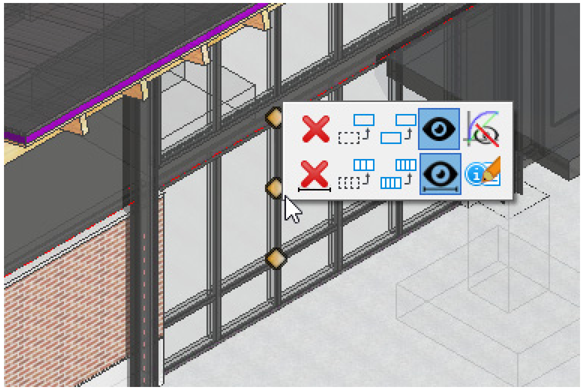
7. Use the catalog item ***Proj | Clerestory** with a *Height* of **5:0** *[1500 mm]*.

    a. Set the *Floor Selector* to the **Station > Canopy/ Clerestory** level. Then place to match the door and storefront openings below.

In the next exercise you will modify the curtain wall sections placed.

Exercise 4-7: Modifying Curtain Wall

Once placed, the curtain wall system can be easily modified. Curtain Wall mullions and panels can be selected individually. When selected the panel will display a single edit (grip) handle at the center and a mullion will display 3 edit (grip) handles, one at each end and one in the center. Each mullion is provided with a toolbar equipped with edit tools used to manipulate a curtain wall assembly. You can thus easily add or remove the entire mullion after placing, or partially omit individual, vertical or horizontal mullions.



Delete/Delete Line—removes the selected mullion/line of mullions or panel boundary, thereby merges it with the adjacent mullion panel.

Move/Move Line—moves the selected mullion/line of mullions or panel to the data point defined on other segment of curtain wall.

Copy/Copy Line—copies the selected mullion/ine of mullions or panel to the data point at destination dividing the mullion panels.

Toggle Visibility/Toggle Line Visibility—makes the current mullion/line of mullions or panel of the curtain wall invisible, effecting a clear opening.

Toggle Base Curve Visibility—makes the base line/curve/arc the curtain wall is drawn from visible, selectable to manipulate.

Tip: The visible base curve can be selected and when displaced or reoriented, the associated curtain wall assembly will follow.

---

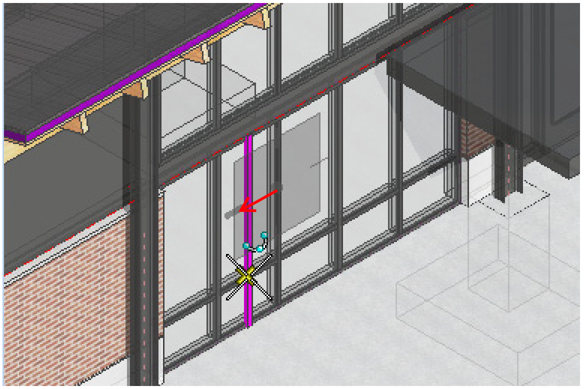
1. Select the mullion left of the center of the storefront.

   a. Move the mouse over the grip on the center of the mullion.

   b. Select the **Move Line** icon.

   c. Move the line of mullion to the center of the next bay to the left snapping to the midpoint of the horizontal mullion.

   d. **Data point** *(left-click)* to accept.



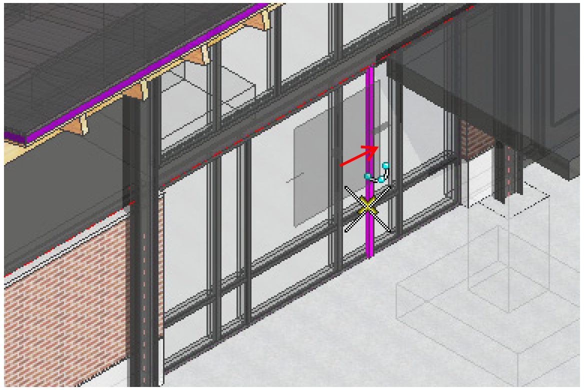
2. Select the mullion right of the center of the storefront.

   a. Move the mouse over the grip on the right vertical mullion.

   b. Select the **Move Line** icon.

   c. Move the line of mullion to the center of the next bay to the right snapping to the midpoint of the horizontal mullion.

   d. **Data point** *(left-click)* to accept.



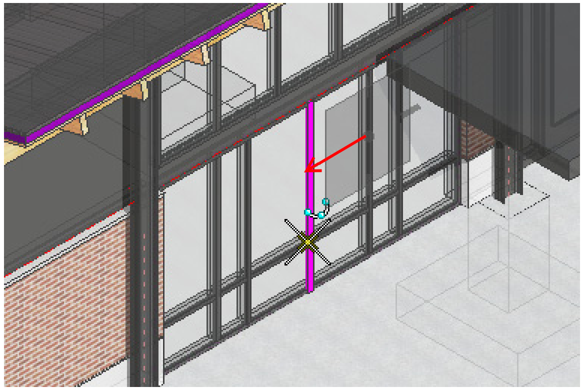
3. Select one of the mullions just moved.

   a. Move the mouse over the grip on the right vertical mullion.

   b. Select the **Copy Line** icon.

   c. Copy the line of mullion to the center of the center bay snapping to the midpoint of the horizontal mullion.

   d. **Data point** *(left-click)* to accept.



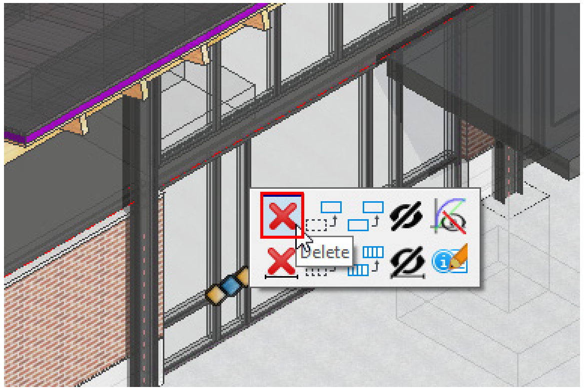
4. Select the horizontal mullion on one of the narrow panel.

   a. Move the mouse over the grip on the center of the horizontal mullion.

   b. Select the **Delete** icon.

   c. **Data point** *(left-click)* to accept.

   d. Repeat for the opposite narrow panel.



Modify Properties

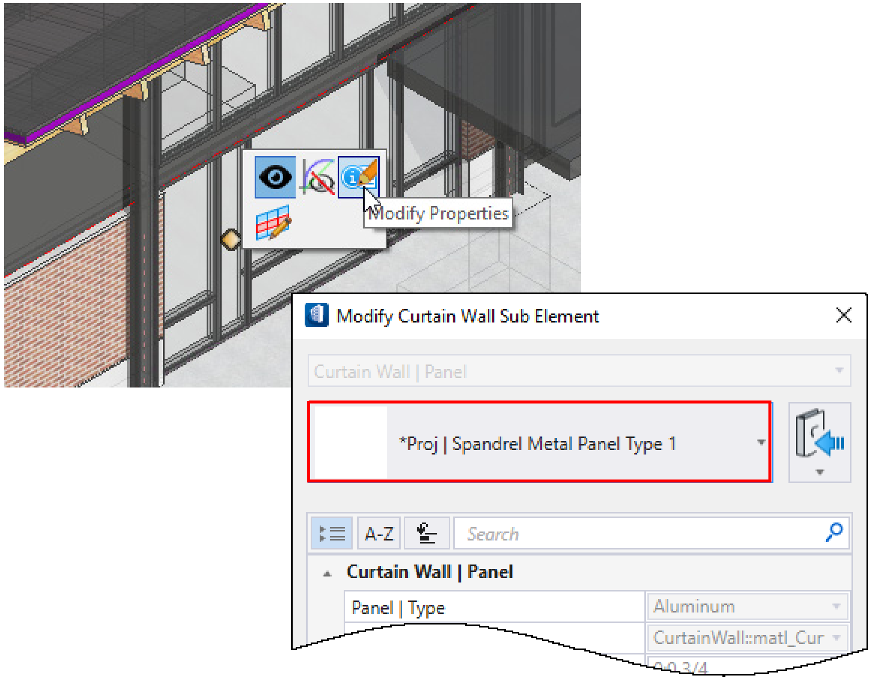
5. Select one of the narrow panels where you might like a spandrel panel.

   a. Move the mouse over the center grip on the panel.

   b. Select the **Modify Properties** icon.

   c. In the *Modify Curtain Wall Sub Element* dialog change the panel type from ***Proj | Glazing Type 1** to ***Proj | Spandrel Metal Panel Type 1**.

   d. **Data point** *(left-click)* to accept.



Continue to modify panel properties to design the desired pattern of the storefront panels.

In the next exercise you will review the architectural drawings to see how they have changed with the addition of the walls, doors, windows and curtain wall.

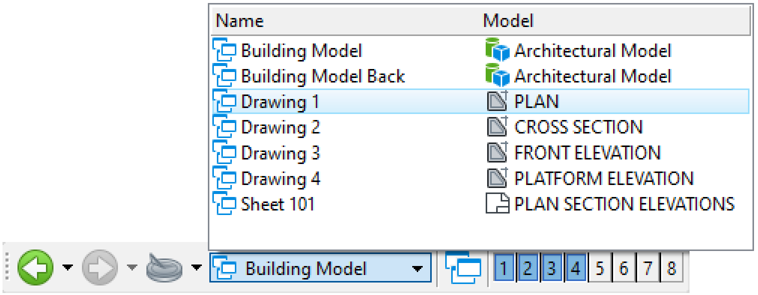
Exercise 4-8: Reviewing Architectural Drawings

It is important that you understand the difference between what is viewed in the model and what is re-symbolized in the drawing. In this exercise you will review the output from the model and note the objects like doors and windows are re-symbolized in the plan drawing.

1. From the *Manage View Groups* tools on the lower right of the interface select the *View Group* pull-down.

   a. Select the *View Group* **Drawing 1**. This will open the model of the PLAN drawing.

   Note: The architectural drawing also includes the structural elements since we have the 3D structural model referenced to the 3D architectural model, making it part of the cut view of the model that is referenced here to the drawing.



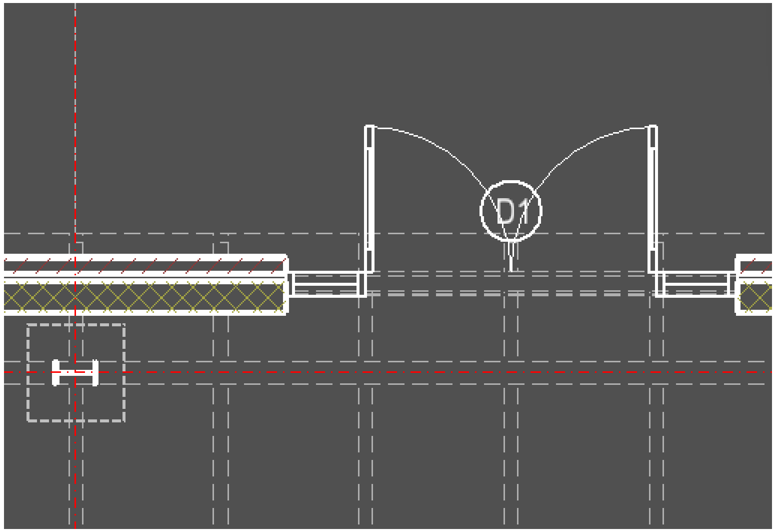
2. Zoom into the exterior wall.

   Note: The brick and block layers of the wall have been re-symbolized to show standard hatching patterns for these materials.

   Line weights have been modified to show the elements that are cut versus shown in a forward view. This resymbolization is based on the *Family and Part* assigned to these elements.

   Elements in the back view (elements above the cut plane), have been re-symbolized with a dashed line style.

   Doors are shown with a 2D graphic showing the door is open. Doors and windows have annotation showing the door type that was assigned when they were placed in the model. If that property is changed in the model it would automatically change the annotation on the drawing.



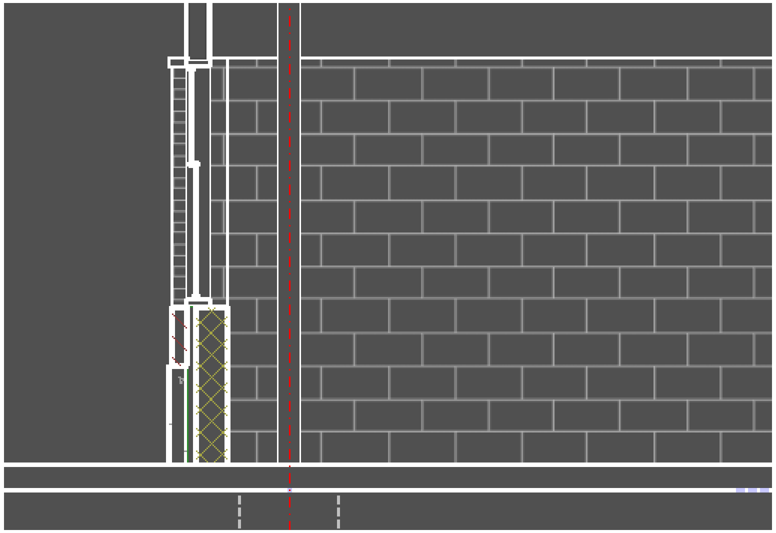
3. Select the *View Group* **Drawing 2**. This will open the model of the CROSS SECTION drawing.

   Note: The walls are re-symbolized here in the same way they were re-symbolized in the plan. In the forward view a pattern has been added to show the masonry block on the interior face of the wall. Again this is based on the render material defined by the *family and part*.

4. Select the *View Group* **Drawing 3**. This will open the model of the FRONT ELEVATION drawing.

5. Select the *View Group* **Drawing 4**. This will open the model of the PLATFORM ELEVATION drawing.

6. Select the *View Group* **Sheet 1** to view the current status of the sheet.



The drawings now reflect the current state of the 3D model, they have come a long way from the conceptual drawings viewed earlier.

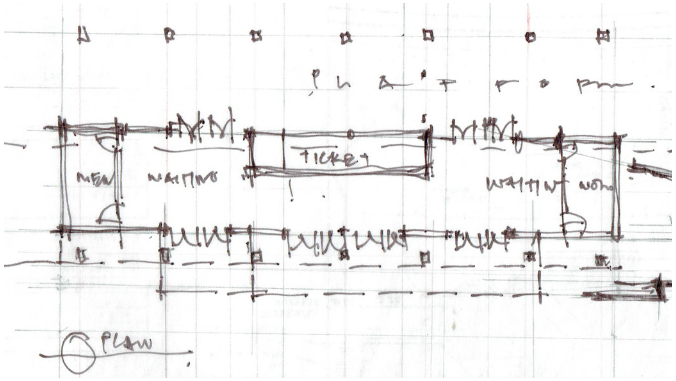
In this chapter, *Chapter 4: Modeling Architectural Elements*, you have modeled the architectural exterior of the station building. You have modeled the exterior walls and a sloped roof coordinated with the structural framing.You have then added doors, windows and curtain wall. The geometry and information that was modeled in the 3D model is now reflected in the 2D drawings.

In the next chapter you will work on the interior of the station building, starting with a space layout, adding the toilet rooms, casework for the ticketing area and furniture and equipment.

Chapter 5. Spaces, Finishes and Content

Now that you have modeled the basic architectural shell and structural framing it is time to move into the interior of the building model. One of the primary steps on the interior model will be to add spaces to the model so that data, including area and finishes, can be tracked.

The layout is fairly simple, You will need a ticketing area opposite the front entry, restrooms to either side and a lobby or waiting area in between. In the next series of exercises you will place spaces in the model, add the restrooms by placing an assembly, add casework for the ticketing area and then equipment and furnishings. Finally, you will review all the data and add a furniture and equipment schedule to the drawings.



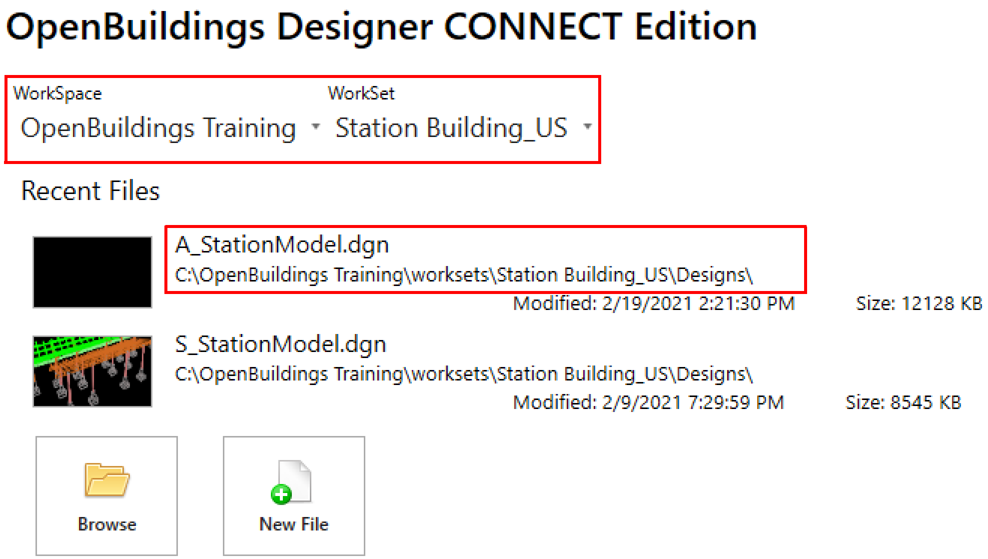
1. Start **OpenBuildings Designer** from the Start menu or desktop shortcut.

   WorkSpace: **OpenBuildings Training**

   WorkSet: **Station Building_US** *[Station Building_NM]*

2. Select the file **A_StationModel.dgn** from the list of *Recent Files*. The file will open.

Optional - If you did not complete the exercises in the previous chapters and would like a completed model to start the exercises in Chapter 5, use the Browse icon to browse to the *Station Building_US / X_Milestones* folder and open the file **A_StationModel_5.dgn**.



Exercise 5-1: Spaces

The *Space* tool in OpenBuildings Designer is used for space planning activities. The tool is used to draw, locate, identify, and label individual spaces such as rooms, or logically related spaces such as departments that are identified by a name and/or number. Spaces can be drawn or placed prior to the creation of walls for the purposes of space planning based on a space program. Walls can then be created from the space shapes.

In this exercise you will lay out the basic spaces that make up the station program. You will start by adding the ticketing area, then the restrooms and a few small storage areas. You will then use the spaces defined to create the interior walls.

---

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

2. Set the *View Group* back to **Building Model** and create a *Displayset* of the station building.

3. Select the **Space** tool from *Architectural Elements* group on the *Architectural* ribbon.

4. On the *Placement* ribbon set the *Place By* method to **Draw Rectangle**.

   When using the method **Draw Rectangle** you can set the actual area so that it matches the programmed area ensuring that the initial rectangle you place is locked to that area. Once placed it can be modified and adjusted.

   b. Set the catalog item to ***Proj | Station Area.**

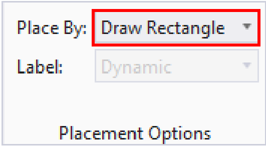
   Label: **TICKETING**

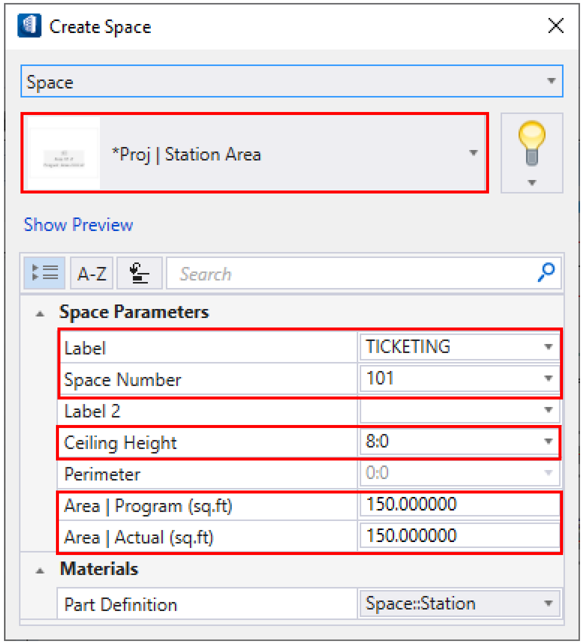
   Space Number: **101**

   Ceiling Height: **8:0** *[2400 mm]*

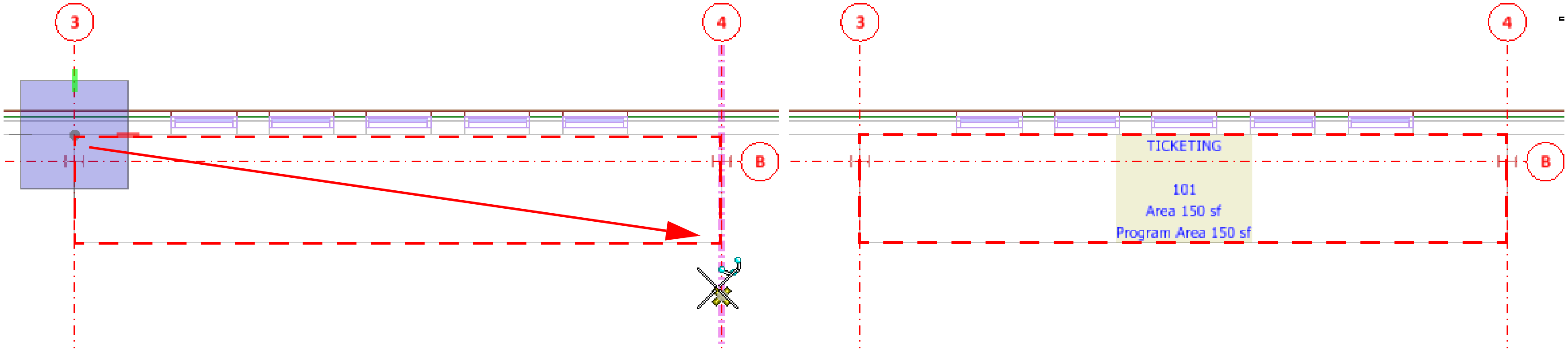
   Area | Program: **150 s.f.** *[15 m2]*

   Area | Actual: **150 s.f.** *[15 m2]*



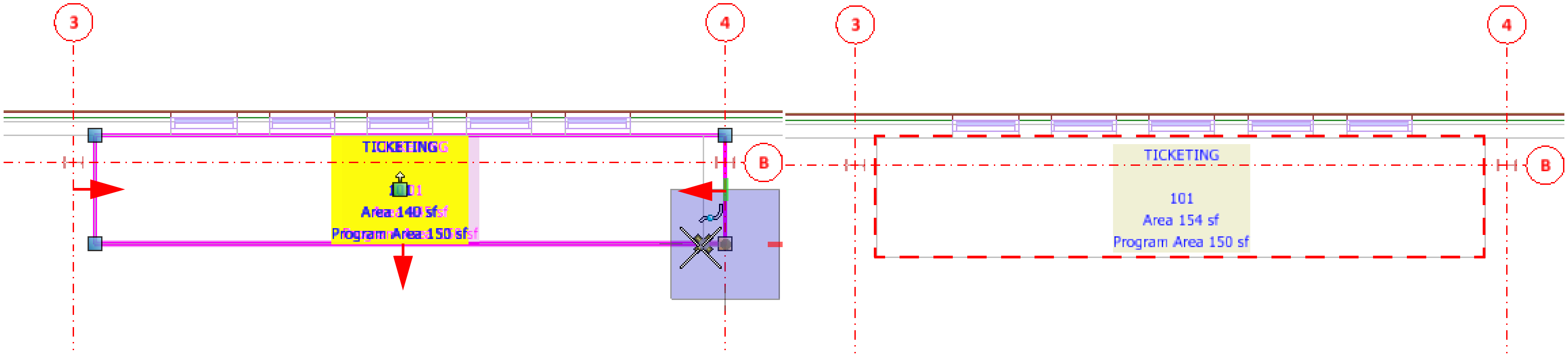


5. Place a rectangle from grid line 3 to grid line 4.



A space tag is added to the model to indicate the space name, number and area. This will be re-annotated on the drawing.

6. Select the space and use handles to adjust the width by **1:0** *[300 mm]* on each side. Then adjust the bottom downward by **0:6** *[150 mm]* to adjust the area.



Note: The *Programmed Area* in the tag remains as it was defined when placed, but the *Actual Area* updates to show the area of the revised space.

7. Place the next space using the same catalog item ***Proj | Station Area.**

   Label: **MENS TOILET**

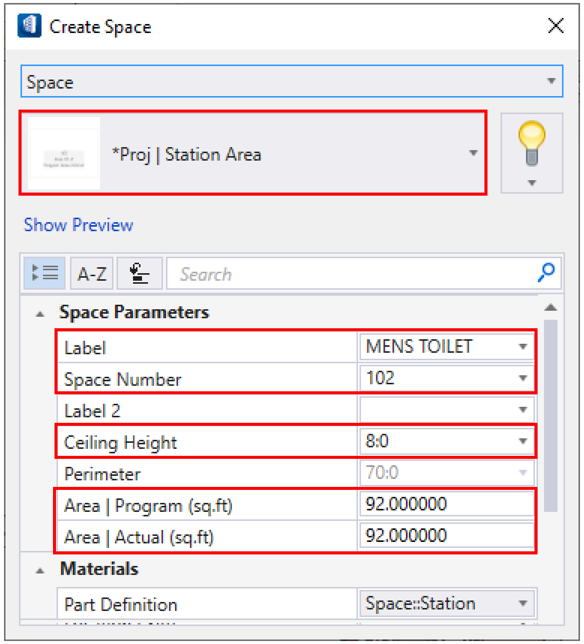
   Space Number: **102**

   Ceiling Height: **8:0** *[2400 mm]*

   Area | Program: **92 s.f.** *[9 m2]*

   Area | Actual: **92 s.f.** *[9 m2]*

   Note: The *Space Number* should have automatically incremented from **101** to **102**.

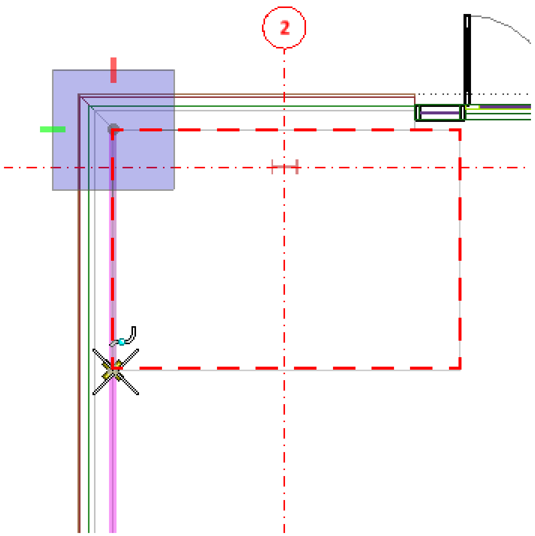


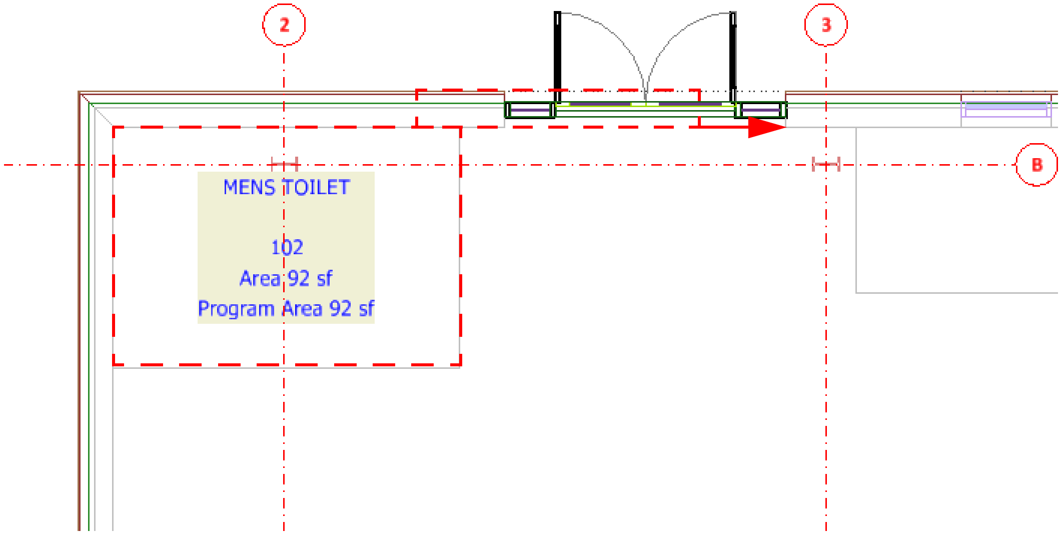
a. Snap to the left corner, use the *AccuDraw* shortcut key-in **RZ** to rotate the compass for placement so that the X-axis is vertical.

b. Use AccuDraw to define the width of the space as **8:0** *[2400 mm]* along the side of the building.

c. **Data point** *(left-click)* to accept and place the space.

d. Select the **Move** tool and move the platform door to the right **3:0** *[900 mm]* to make room for the new space.





8. Place the next space using the same catalog item ***Proj | Station Area**.

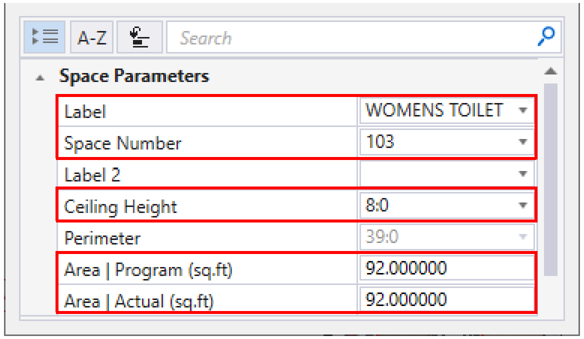
Label: **WOMENS TOILET**

Space Number: **103**

Ceiling Height: **8:0** *[2400 mm]*

Area | Program: **92 s.f.** *[8.5 m2]*

Area | Actual: **92 s.f.** *[8.5 m2]*



a. Place in right corner, use **RZ** to rotate the compass for placement.

b. Move the platform doors to the right to make room for the new space.

Now lets create some storage areas on the left and right side. This time you will set the *Actual Area* to **0**, which will allow you to place the rectangular shape at any size.

9. Place the next space using the same catalog item ***Proj | Station Area**

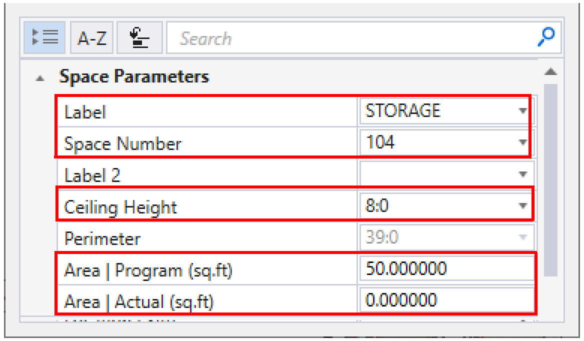
Label: **STORAGE**

Space Number: **104**

Ceiling Height: **8:0** *[2400 mm]*

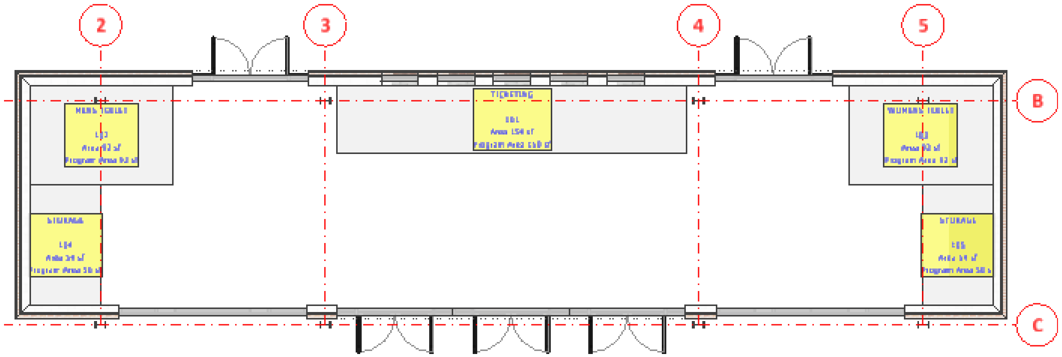
Area | Program: **50 s.f.** *[5 m2]*

Area | Actual: **0 s.f.** *[0 m2]*

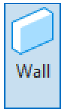


a. Place two storage spaces adjacent to each of the toilet rooms using two points.

There should now be 5 spaces.



Now that you have laid out the basic arrangement of spaces you can actually use those spaces to create the interior walls.

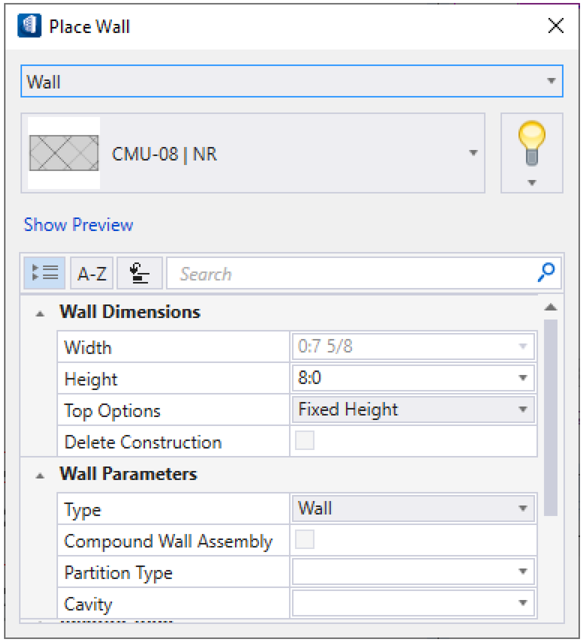


10. Select the **Wall** tool from the *Architectural Elements* group.

    a. Set the *catalog item* to **CMU-08 | NR** *[Internal Block Wall]*

    Width: **0:7 5/8** *[140 mm]*

    Height: **8:0** *[2400 mm]*

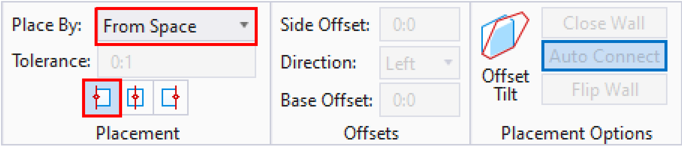


This is a *single layer* wall, meaning it is a single form that represents one or more construction materials, in this case an 8" *[140 mm]* concrete masonry unit.

11. On the *Placement* tab on the ribbon select:

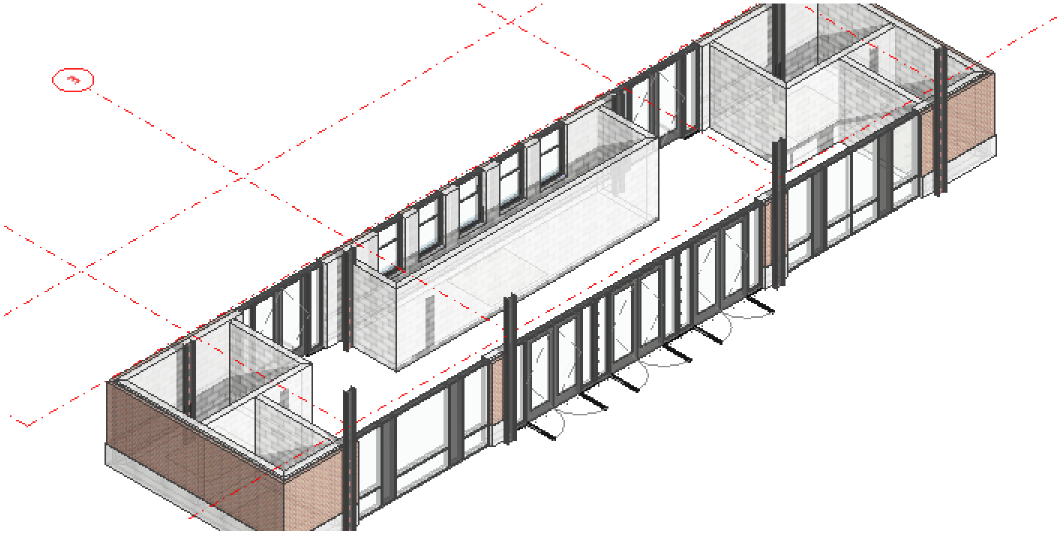
    Place By: **From Space**

    Justification: **Left Justify**



    b. Holding the **Ctrl** key, select each of the spaces.

    c. **Data point** (*left-click*) to accept.



Walls are created for each space. Walls should only be created where an adjacent wall is not found.

When the walls were created the spaces were re-flooded to allow for the walls. The spaces are now actually associated with the walls so that if the wall is moved the space will modify as well. Go back to the Ticketing space, note that the side walls are clashing with the steel columns.

12. Use the **Move** tool to move each of the side walls at the Ticketing area in by **0:4** *[100 mm]*.

    Note: The space boundary has changed and the *Actual Area* has been updated.

Now that you have the basic layout lets place the final space for the **Waiting Area**. This time you will just *Flood* the area.

13. Select the **Space** tool from *Architectural Elements* group on the *Architectural* ribbon.
    a. Set the *catalog item* to ***Proj | Station Area**

       Label: **WAITING**

       Space Number: **100**

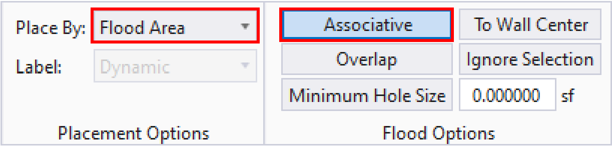
       Ceiling Height: **12:0** *[3500 mm]*

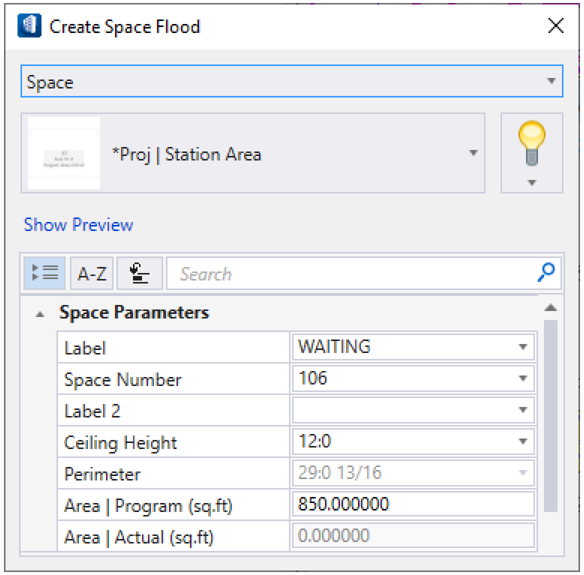
       Area | Program: **850 s.f.** *[85 m2]*

    b. On the Placement ribbon

       Place By: **Flood**

       Toggle **On** *Associative*.

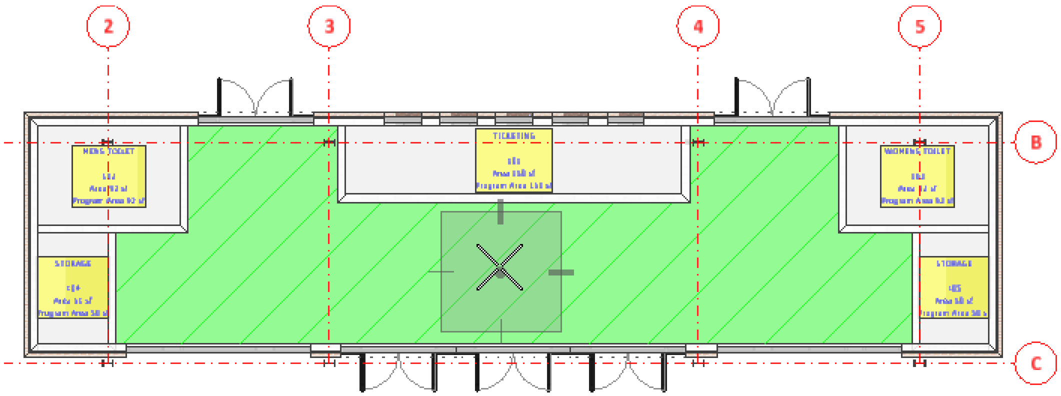




c. **Data point** *(left-click)* within the area to be flooded.

d. **Data point** *(left-click)* to accept.

e. **Reset** *(right- click)* to finish.



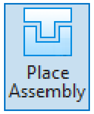
In this exercise you have placed spaces in the 3D model that are initially used to track the program and actual areas, but can also be used to track additional room data such as occupancy type and finishes. Those spaces were then used to quickly create the interior walls for the station building. In the next exercise you will add the toilet room layouts by placing an Architectural Assembly.

Exercise 5-2: Place Architectural Assembly

In this exercise you will use the Place Assembly tool to place a toilet layout from the Assembly library. An Assembly is a group of components stored in a library that can be selected and placed in the model. Once placed the components behave as if they were placed individually. These can be useful for many things, but architecturally they are particularly useful for common layouts that are used over and over again in models, such as furniture groupings, toilet room layouts or anything that includes multiple items that have a relationship such as a bank of elevators or escalators.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

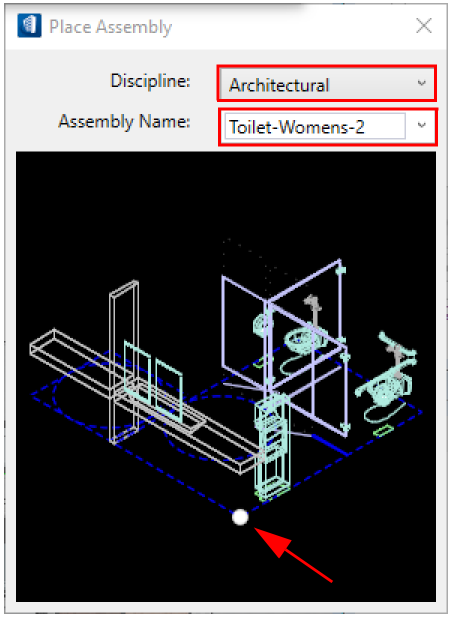
2. Set the *View Group* back to **Building Model** and create a *Displayset* of the station building.



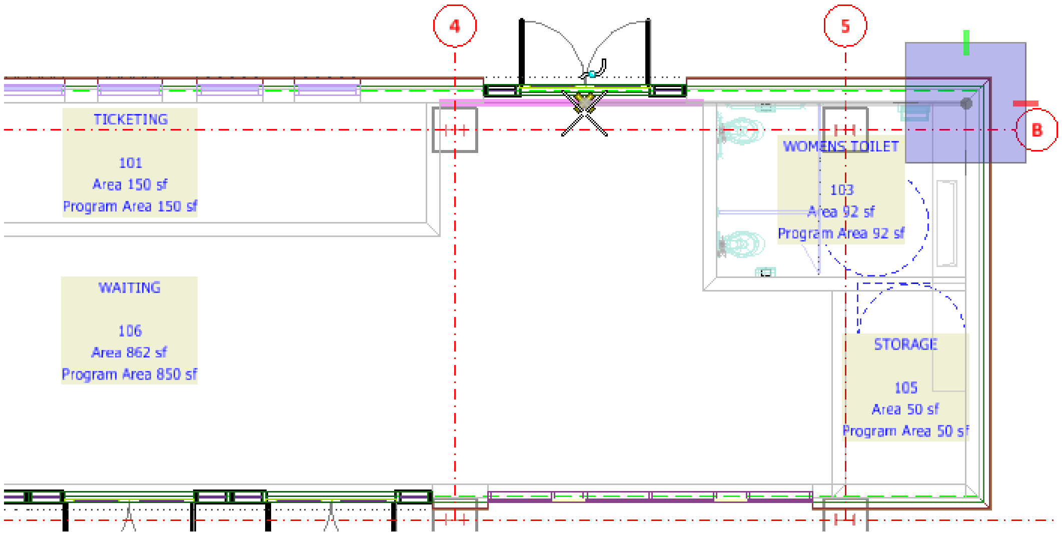
3. Select the **Place Assembly** tool from *Assembly Builder* group on the *Architectural* ribbon.

   Discipline: **Architectural**

   Assembly Name: **Toilet-Womens-2**



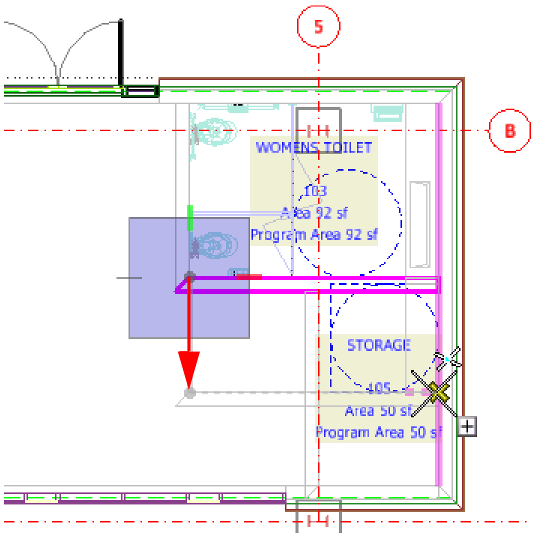
4. Place in *Womens Toilet* space by selecting the upper right corner of the space and then a second **data point** to determine the rotation.

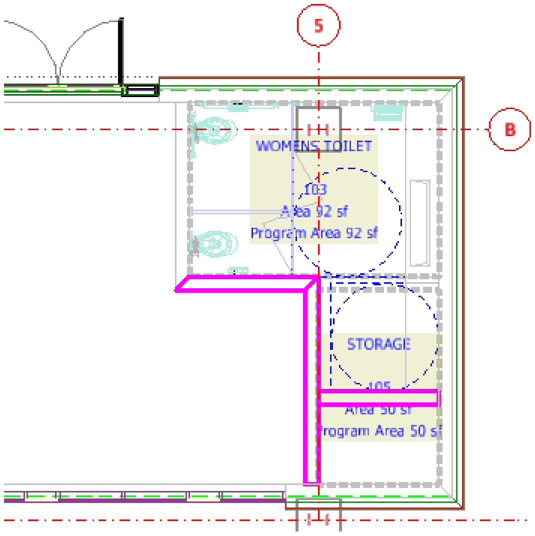


The Assembly included a vestibule area that was not accounted for in our space layout. Adjust walls around the placed assembly elements to create the vestibule for the Womens toilet and reduce the size of the Storage space.

5. Use the **Copy** tool to copy the wall between the Toilet room and the Storage room to the edge of the vestibule.

6. Use the **Connect** tool to clean up the walls.





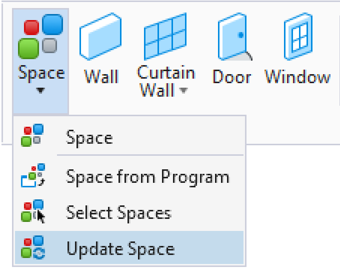
Once the walls are adjusted, The **Update Space** tool can be used to redefine the space boundary. In order to accurately update a space the tag must be within the area to be flooded.

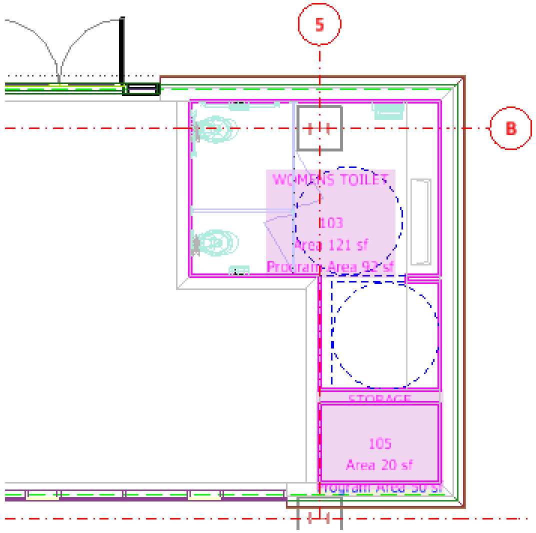
7. Use the **Move** tool to move Storage space to the center of new room.

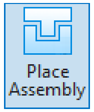
8. Select the **Update Space** tool from the *Architectural Elements* group.

   a. Select the Storage space, **data point** *(left-click)* to accept.

   b. Select the Womens Toilet space, **data point** *(left-click)* to accept.



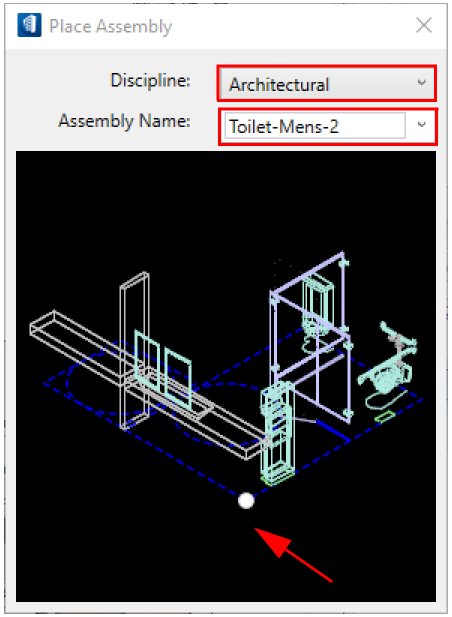




9. Select the **Place Assembly** tool from *Assembly Builder* group on the *Architectural* ribbon.

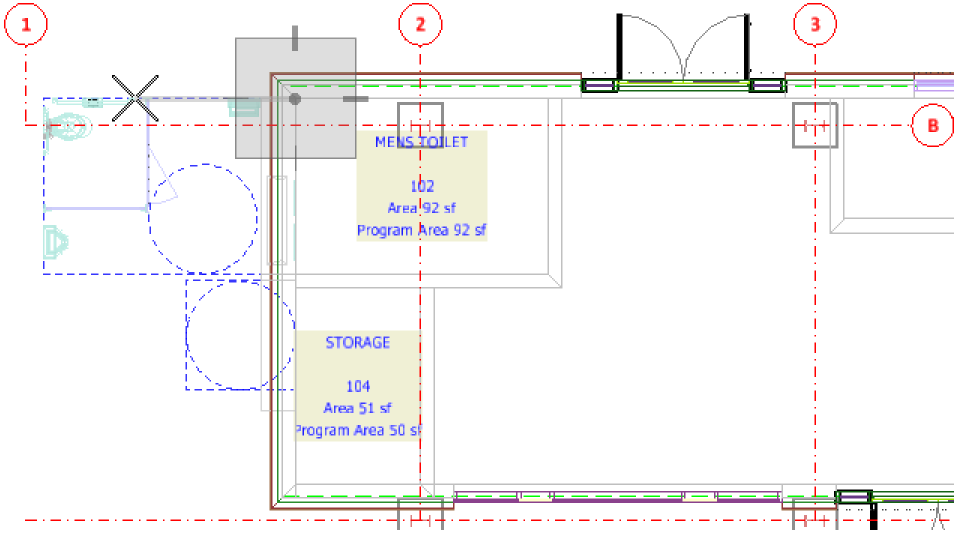
    Discipline: **Architectural**

    Assembly Name: **Toilet-Mens-2**



10. Place in *Mens Toilet* space by selecting the upper left corner of the space and then a second **data point** to determine the rotation.

    a. This Assembly will have to be placed outside the space and then use the **Mirror** tool to mirror the components into the space.



11. Adjust the walls and update the spaces.

In the next exercise you will once again use the door and window tools to add the interior doors for the restrooms, a cased opening for the ticket counter and window sills on the ticket windows.

Exercise 5-3: Interior Openings

In this session we will review placing doors and windows, this time using some of the settings that assist with the placement on interiors.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

2. Set the *View Group* back to **Building Model** and create a *Displayset* of the station building.

3. Select the **Door** tool from *Architectural Elements* group on the *Architectural* ribbon.
4. In the *Place Door* dialog change the *Catalog Item* to **HM_Masonry | Flush**
   a. Set the placement point to the hinge side of the frame.
   b. Set the following *Door Parameters*:

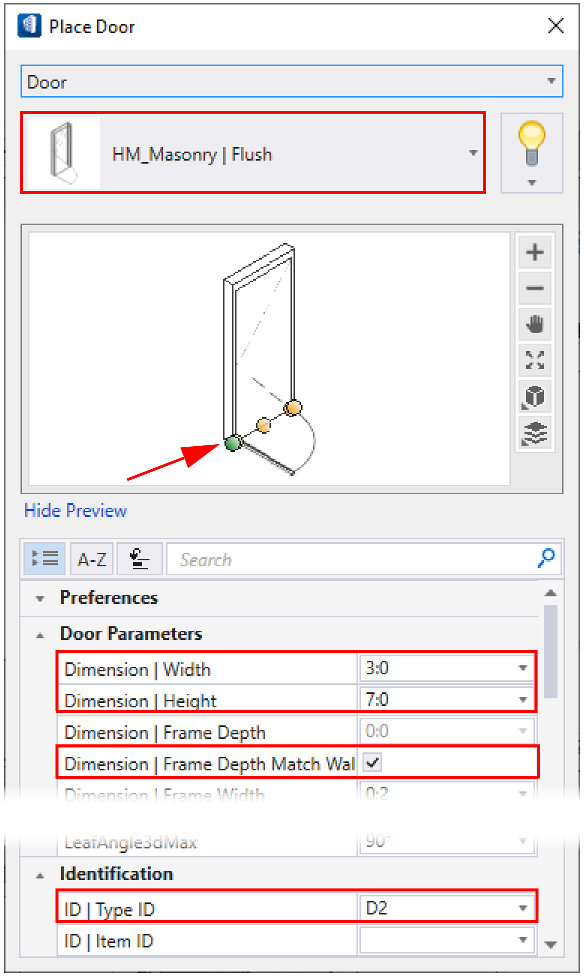
      Width: **3:0** *[900 mm]*

      Height: **7:0** *[2100]*

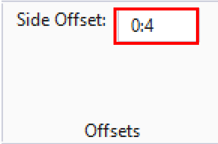
      Dimension | Frame Depth Match Wall: **On**

   c. Set the *Identification*:

      ID | Type ID: **D2**



5. From the dialog pull-down select **Save Catalog Item As....** and save the door as **D2 | Flush**
6. On the *Placement* ribbon set the *Side Offset* to **0:4** *[100 mm].*



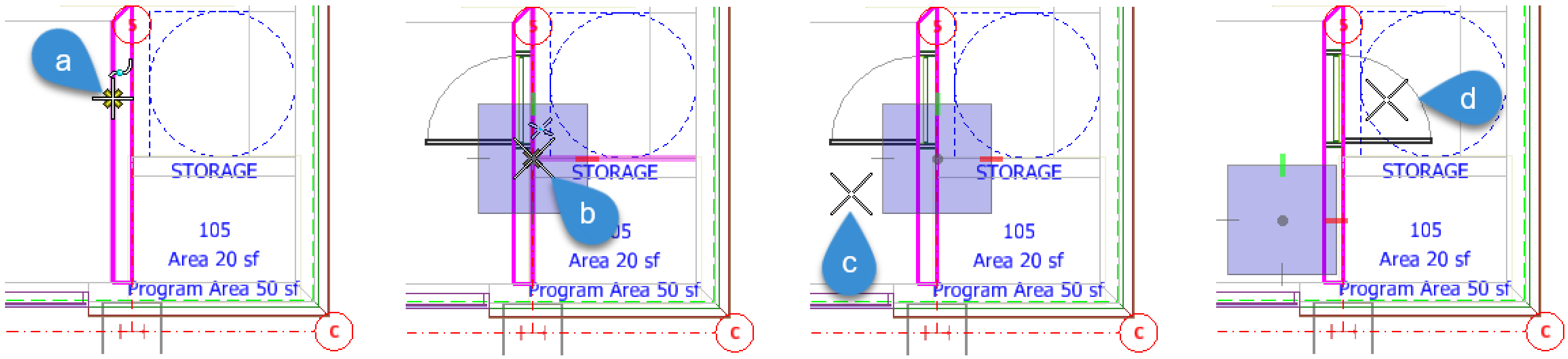
7. Place the door at the Toilet Rooms.

   a. Select the wall where the door is to be placed.

   b. **Data point** *(left-click)* at the wall intersection to define the placement point. The door will be offset **0:4** *[100 mm]* from this point.

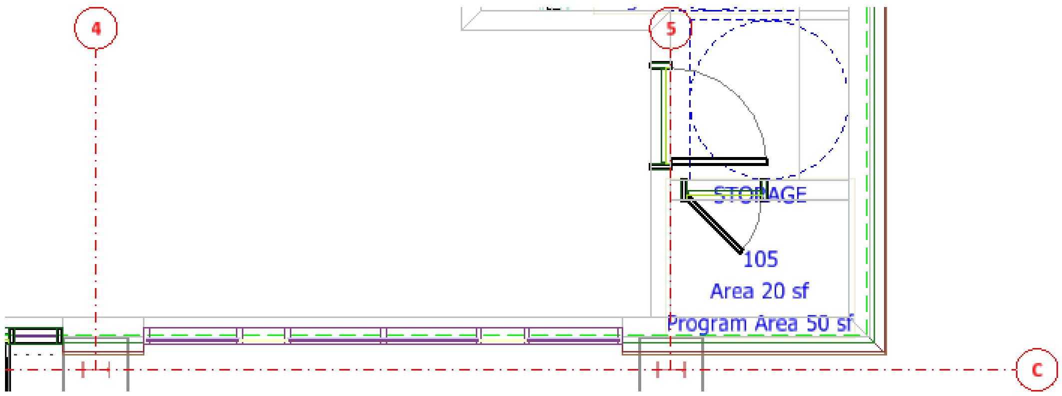
   c. **Data point** *(left-click)* again to determine which side of the placement point to offset.

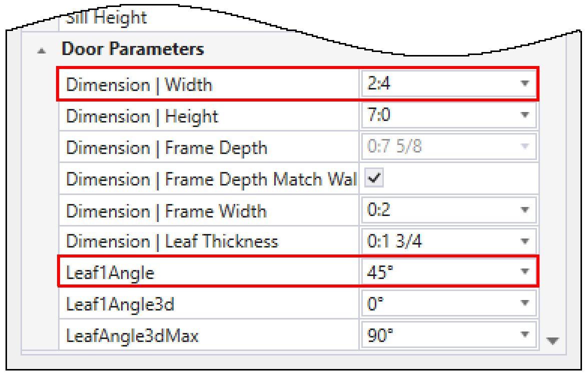
   d. **Data point** *(left-click)* a third time to define the rotation and swing direction.



8. In the *Place Door* dialog change the *Width* to **2:4** *[700 mm]* and the *Leaf1Angle* to **45°**.

   a. Place a door at each Storage area.





The *Side Offset* offsets the placement point of the door along the selected wall. Sets an offset distance and direction for the door frame which is parallel to a line defined by two placement data points. Direction can be set by setting a negative distance for Left offset and a positive distance for Right offset.

Placing a Door with a Feature

9. In the *Place Door* dialog change the *Catalog Item* to **HM_Masonry | Half Glass**

   a. Set the placement point to the hinge side of the frame.

   b. Set the following *Door Parameters*:

      Width: **3:0** *[900 mm]*

      Height: **7:0** *[2100 mm]*

      Dimension | Frame Depth Match Wall: **On**

   c. Set the *Identification*:

      ID | Type ID: **D3**

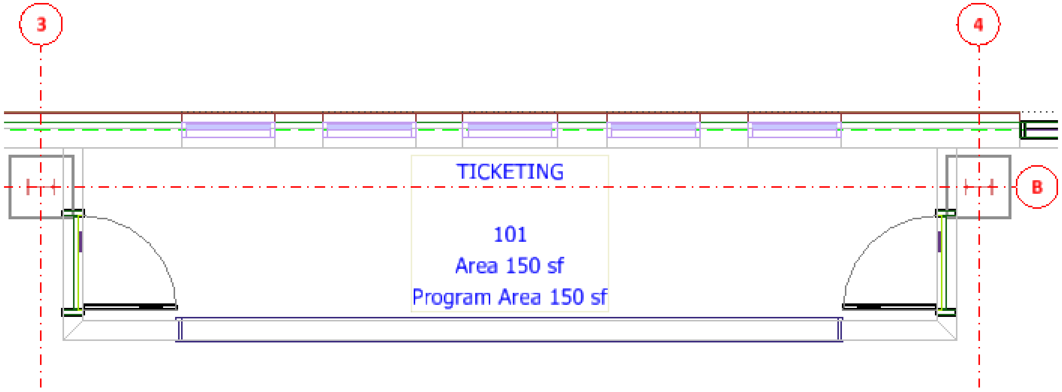
   d. Scroll down to *Door Dimesnions - Extended*. These properties control the glass feature in the door.

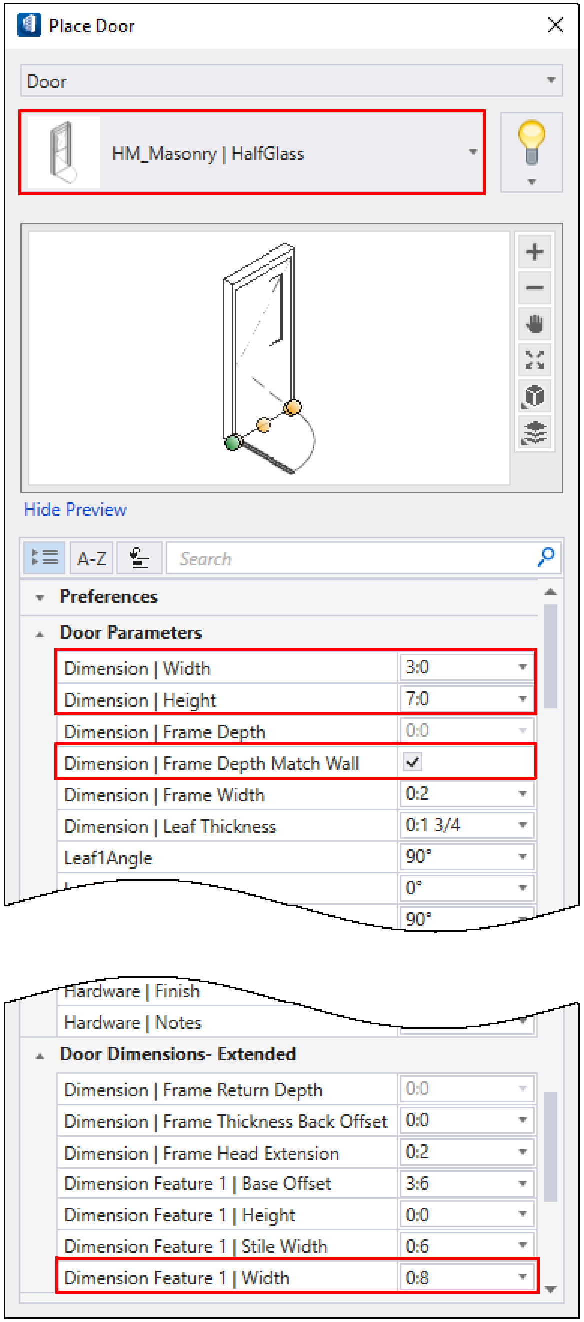
      Dimension Feature 1 | Width: **0:8** *[200 mm]*

   e. From the dialog pull-down select **Save Catalog Item As....** and save the door as **D3 | Half GLass-Narrow View**

10. On the *Placement* ribbon set the *Side Offset* to **0:4** *[100 mm].*

11. Place this door at either side of the Ticketing.





Placing a Cased Opening

12. Set the *catalog item* to **WD | Cased Opening.**

    a. Set the placement point to the center of the opening.

    b. Set the following *Door Parameters*:

    Width: **21:0** *[7000 mm]*

    Height: **7:0** *[2100 mm]*

    Dimension | Frame Depth Match Wall: **On**

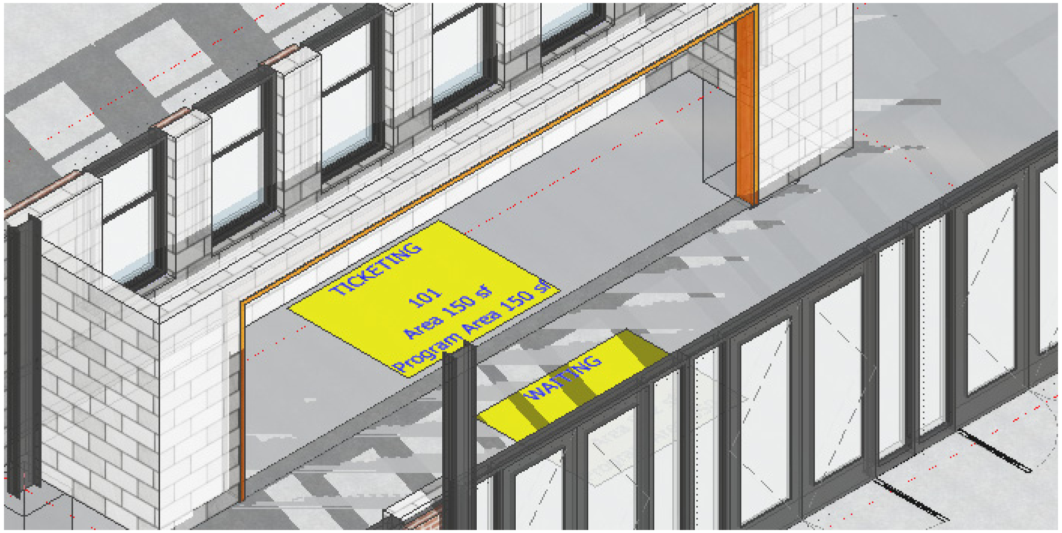
13. On the *Placement* ribbon set the *Side Offset* to **0:0.**

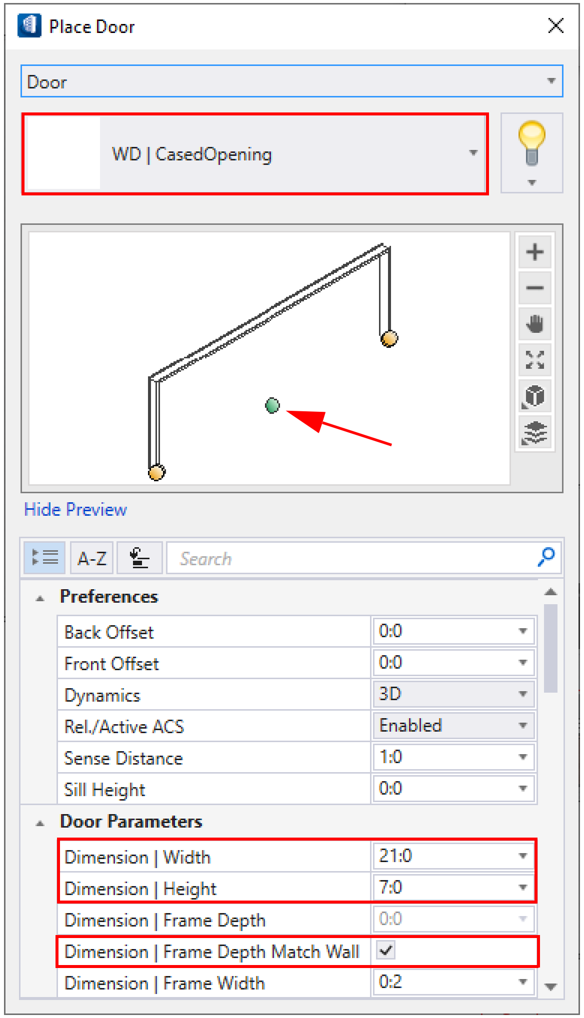
14. Place the opening in the front wall of the ticketing area.

    a. Select the front wall of the Ticketing area.

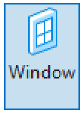
    b. **Data point** *(left-click)* at the center of the wall to define the placement point.

    c. **Data point** *(left-click)* again to place.





Placing a Window Sill



15. Select the **Window** tool from *Architectural Elements* group on the *Architectural* ribbon.
16. In the *Place Window* dialog change the *Catalog Item* to **_Sill Wood.**

    a. Set the placement point to the hinge side of the frame.

    b. Set the following *Door Parameters*:

    Front Offset: **0:0**.

    Sense Distance: **0:1** *[25 mm] -* This is to ensure that only the first layer of the wall is perforated for the sill, not all the layers, such as the exterior brick.

    Sill Height: **3:2** *[950 mm]* - This should match the bottom of the window.

    Frame Width: **3:0** *[900 mm]* - This should match the width of the window.

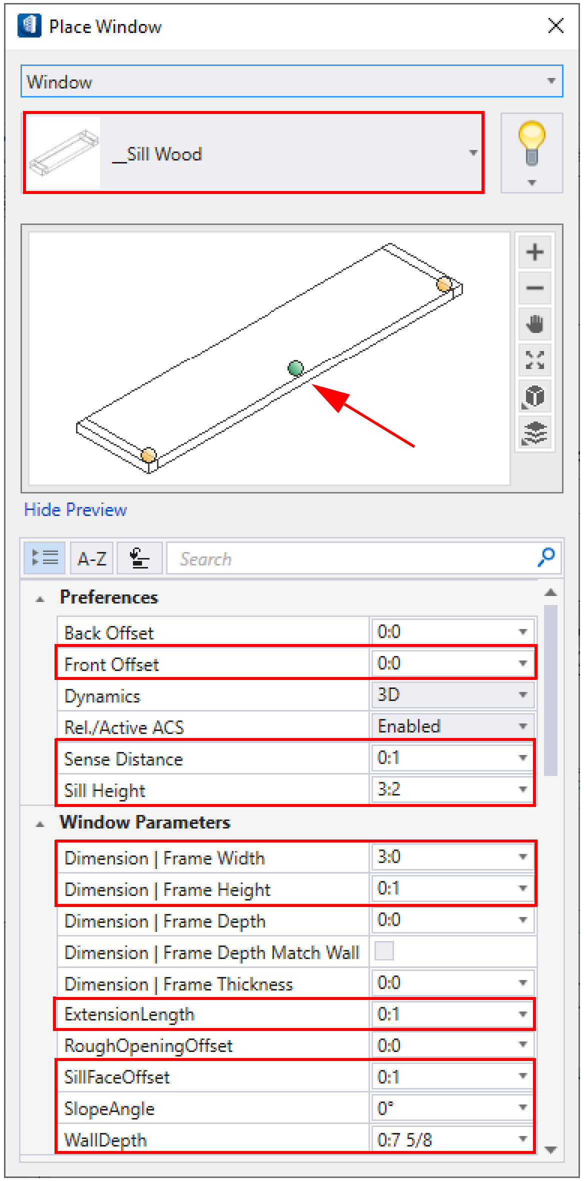
    Frame Height: **0:1** *[25 mm]* - This will be the thickness of the sill.

    Extension Length: **0:1** *[25 mm]* - This is the dimension that the sill extends beyond the width of the window.

    SillFace Offset: **0:1** *[25 mm]* - This is the amount the sill extends beyond the face of the wall.

    Slope Angle: **0°** - This would only be used if we needed the sill to slope as might be the case on an exterior sill.

    Wall Depth: **0: 7 5/8** *[200 mm]*. - This is the depth the sill will extend into the wall under the window.

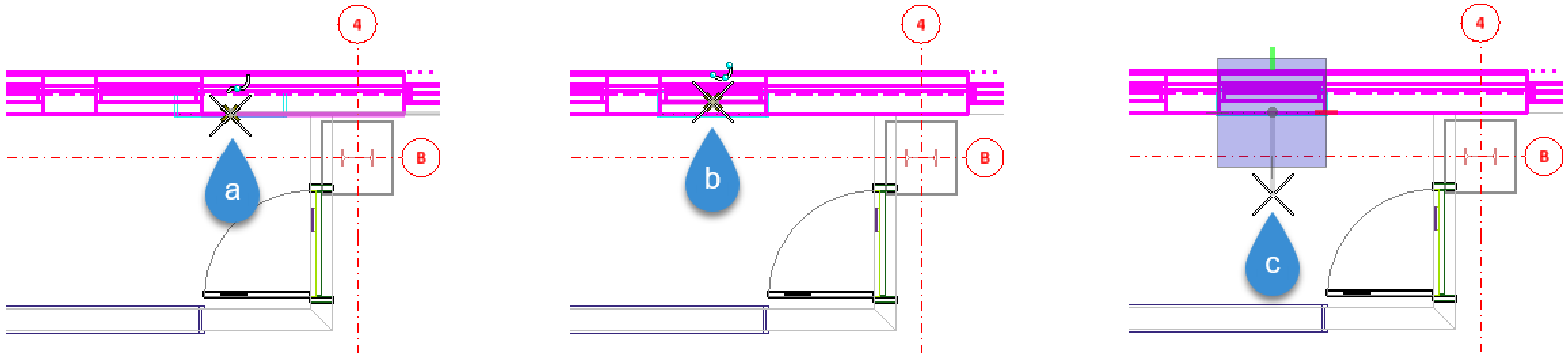


17. Place the sill.

   a. Select the wall.

   b. **Data point** *(left-click)* to select the center of the window as the placement point.

   c. **Data point** *(left-click)* again on the interior side of the wall to indicate the direction of the sill.



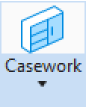
In this exercise you have added interior doors, a cased opening and window sills to the interior of the Station building.

Exercise 5-4: Casework and Trim

In this exercise you will complete the ticketing area by adding casework detail. You will add some under counter cabinets from the casework library and a wood counter and trim using the profile tool.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

2. Set the *View Group* back to **Building Model** and create a *Displayset* of the station building.



3. Select the **Casework** tool from the *Architectural Elements* group on the *Architectural* ribbon.
4. Select a base cabinet to place under a counter; **Base | Frameless 2 Drawers**.
5. Select a placement point.
6. Set the *Width, Height* and *Depth* of the cabinet.

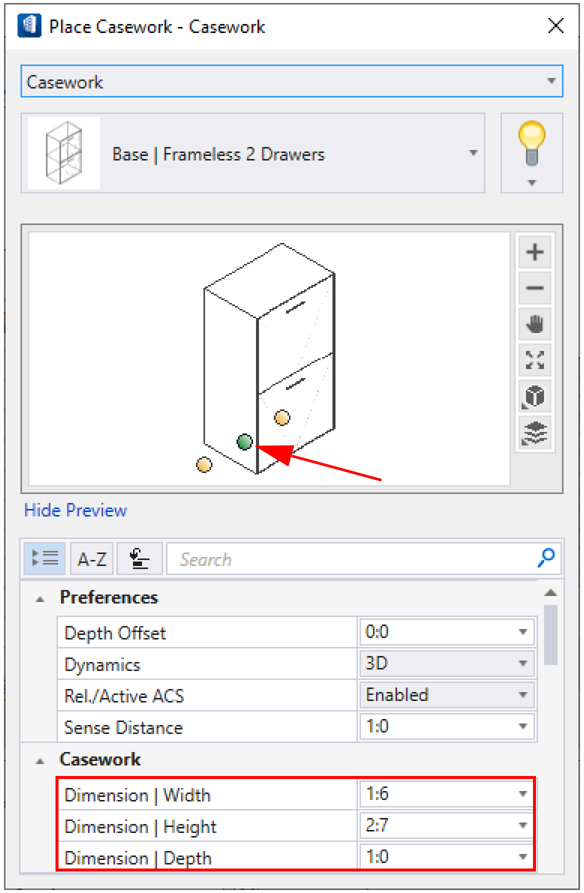
   Width: **1:6** *[600 mm]*

   Height: **2:7** *[775 mm]*

   Depth: **1:0** *[300 mm]*

   Note: The base cabinets are placed **0:4** *[100 mm]* above the floor plane to allow for a base.

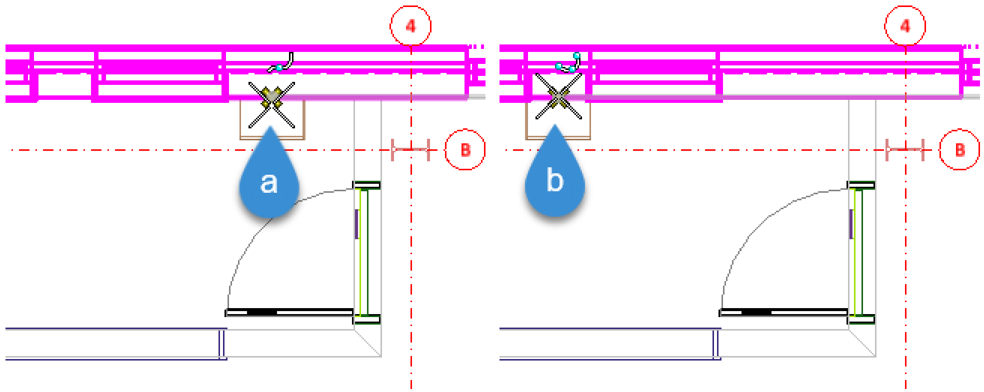
   Note: In the metric dataset the placement points are on the front edge of the cabinet so you will need to set the *Depth Offset* to match the *Depth* value.



7. Place the cabinet.

   a. Select the face of the wall.

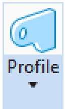
   b. **Data point** *(Left-click)* to define the position along the wall.



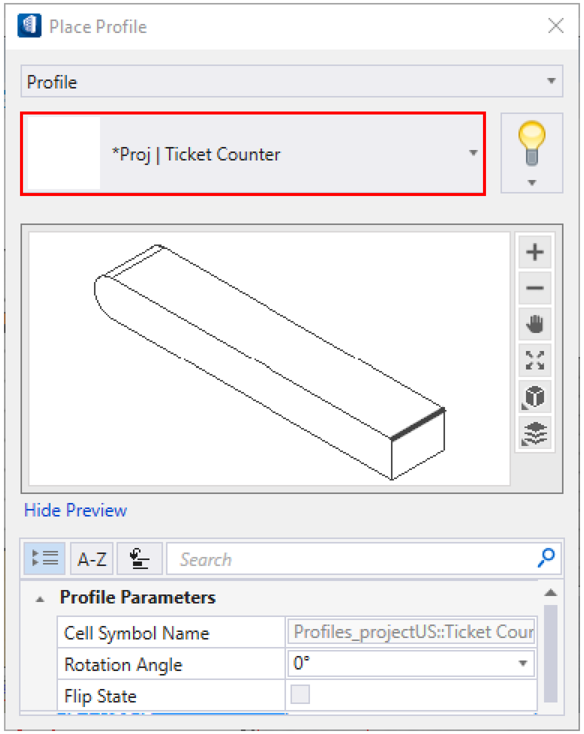
8. Continue to place cabinets or copy the one already placed.

Placing Counters using a Profile

To place the ticket counter you will use the *Profile* tool. The *Profile* tool uses a 2D shape stored in a cell library, and extrudes it along a path, similar to placing a wall. DataGroup properties are added to each profile so they have intelligent data and can be scheduled if necessary,

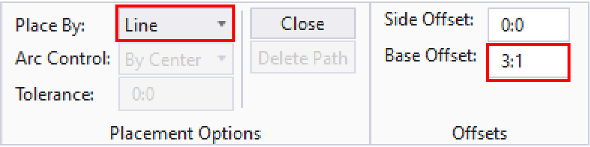


9. Select the **Profile** tool from the *Architectural Elements* group on the *Architectural* ribbon.



10. Select the catalog item **Proj | Ticket Counter.**

    a. On the *Placement* ribbon set the *Place By* method to **Line** and the *Base Offset* to **3:1** *[925 mm].* This will be the height of the counter.

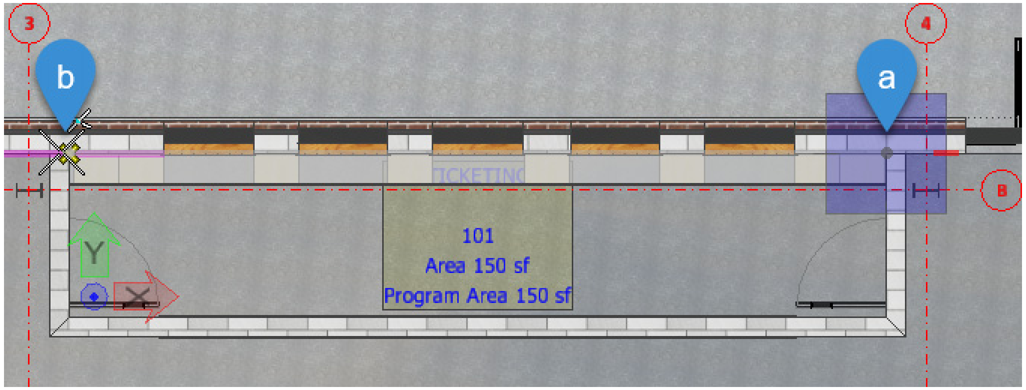


11. Place the profile.

   a. Select the start point for the counter at the intersection of the back wall and side wall. The *AccuDraw* compass should be in a Top Orientation.

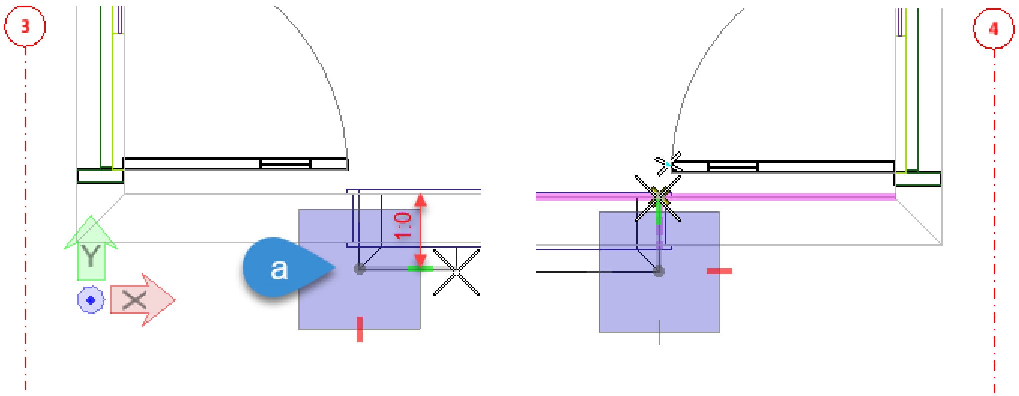
      Note: The *Flip State* in the *Properties* dialog can be toggled to change the direction of the profile.

   b. Draw the placement line along the back wall.



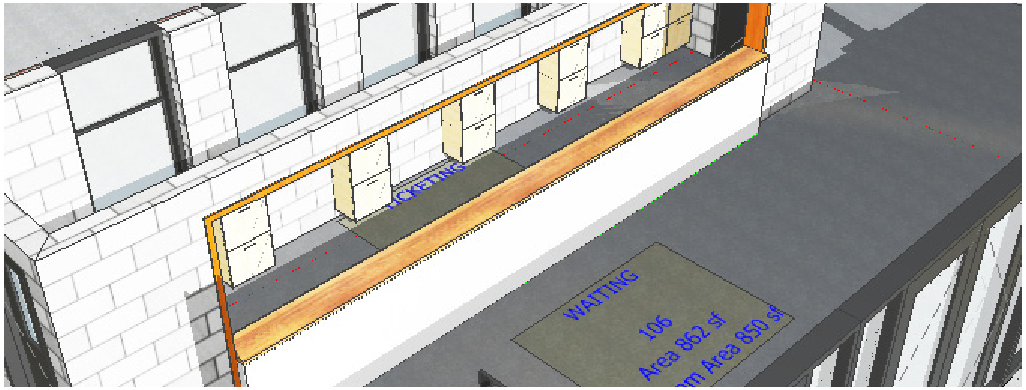
The ticket counter in the cased opening will need a knee wall to support the counter.

12. Place a ***Default Interior Wall*** with a *height* of **3:0** *[900 mm]* projecting **1:0** *[300 mm]* to support a counter in the cased opening.



Note: It may be necessary to change the *Sense Distance* on the Cased Opening to just **0:1/2** *[15 mm]* so that the perforator only cuts through the masonry wall and not the knee wall which is only projected out from the opening by a few inches.

13. Draw a second counter along the outer edge of the knee wall.



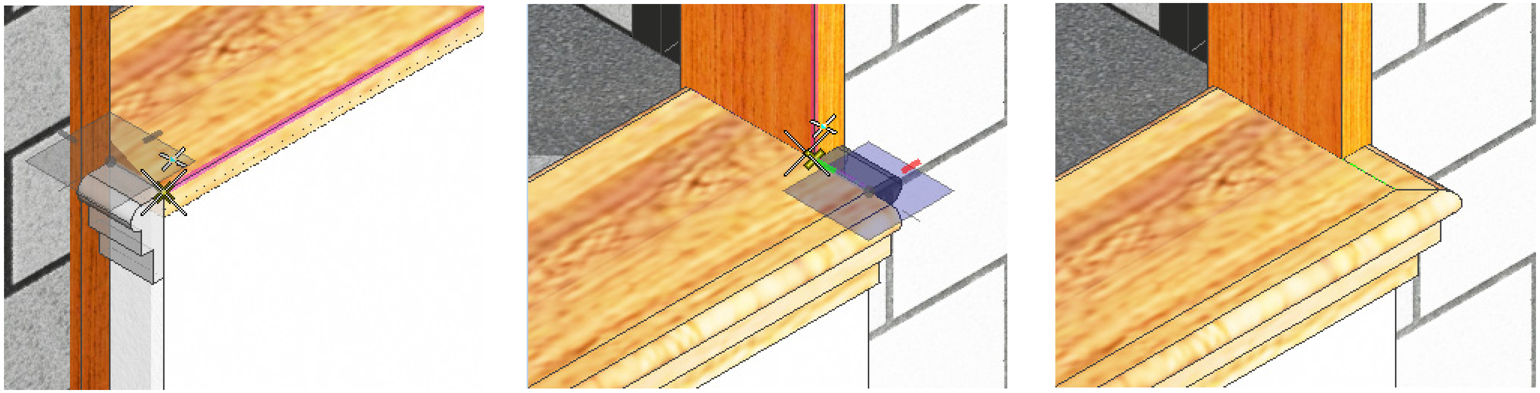
This counter needs some trim on the exposed front edge. Again we can use the profile tool for this.

14. Change the catalog item to **Proj | Ticket Counter Edge**.

    a. Change the *Base Offset* to **0:0**.

    b. Unlock the *ACS Plane* and *ACS Plane Snap* locks.

15. Place this profile by tracing the counter edge.



In this exercise you have added casework details to the architectural interior using both the CaseWork tool and the Profile tool. In the next exercise you will add additional content, such as furniture and equipment to finish out the interior.

Exercise 5-5: Furniture and Equipment

While BIM Models are a great tool for modeling the architecture of a building in order to generate plans, schedules and 3D views, they can also be a great tool for tracking furnishings and equipment.

In this exercise you will use the *Object* tool to place furniture and equipment in the architectural model.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

2. Set the *View Group* back to **Building Model** and create a *Displayset* of the station building.

3. Select the **Object** tool from the *Architectural Elements* group on the *Architectural* ribbon.

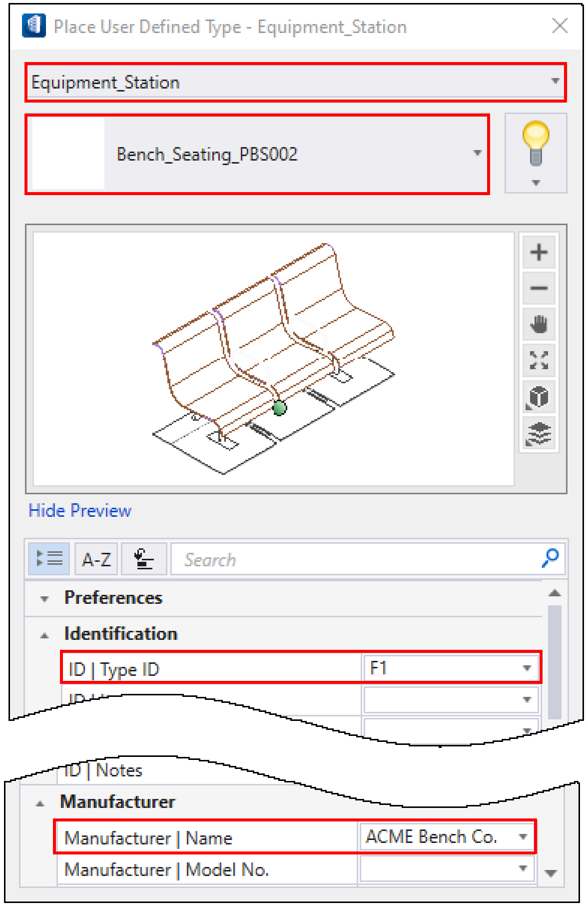
   The *Object* tool is used to place objects in the model. Each catalog item is linked to some type of cell, static or parametric, and various DataGroup definitions that create the properties that can be tracked with each item. Note the number of different catalog types that can be selected with this tool. The *catalog type* determines the properties that will be available.

   a. Set the *Catalog Type* to **Equipment Station**.

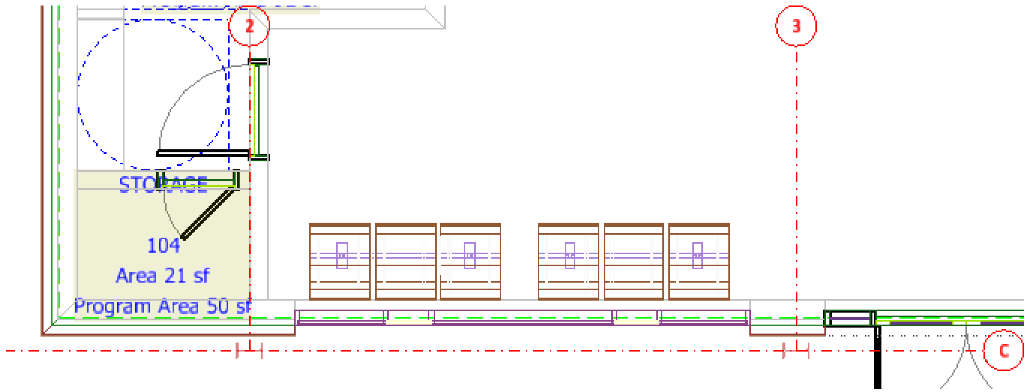
   b. Set the *Catalog Item* to **Bench_Seating_PBS002** . This is an example of a non-parametric cell, but note that is does have 2D Plan symbology that will display in the drawing plan view.

   c. Set the *ID | Type ID* to **F1**.

   d. Add additional properties, such as the *Manufacturer | Name*.



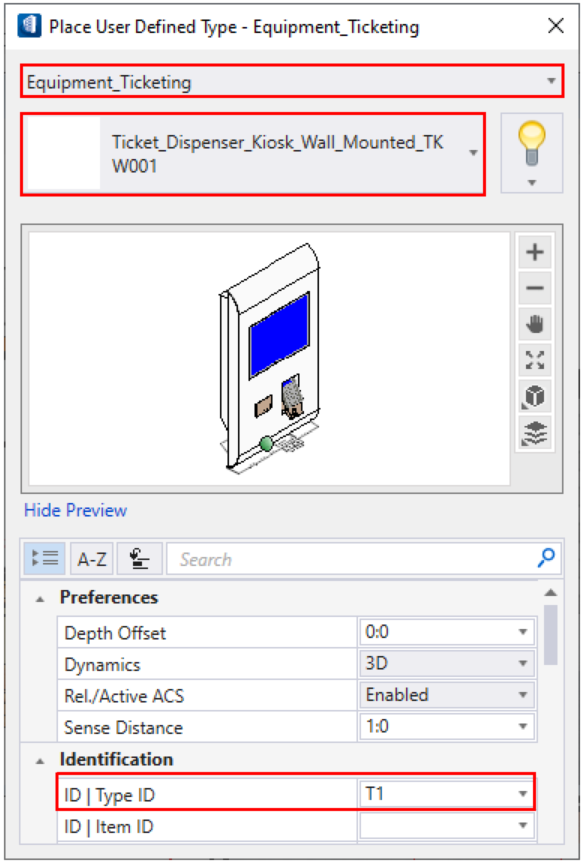
4. Place a few benches in the model within the Waiting Area.



5. In the *Place Object* dialog, change the *Catalog Type* to **Equipment_Ticketing**.

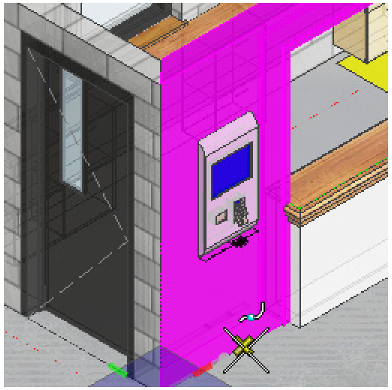
   a. Select the *Catalog Item* **Ticket Dispenser Kiosk Wall Mounted TKW001**.This is also an example of a non-parametric cell with 2D plan symbology, but it also has a perforator like a door or window, so that it can be recessed into a wall.

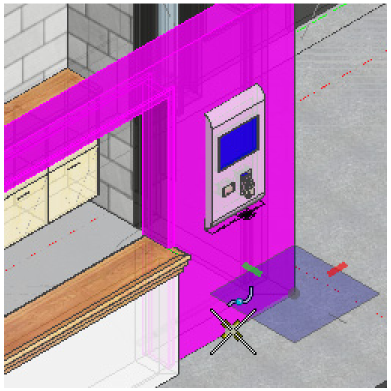
   b. Set the *ID | Type ID* to **T1**.



6. On the *Placement* ribbon set the *Base Offset* to **3:0** *[900 mm]* to determine the placement height in the wall.

7. Place one in each wall to either side of the ticket counter.





8. Continue to place furniture and equipment to finish the interior of the station.

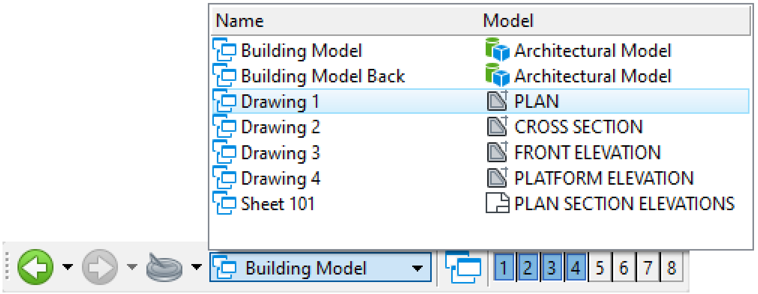
In the next exercise you will create a schedule of the equipment and furnishings and place it on the drawing.

Exercise 5-6: Annotation and Schedules

This course has been very focused on building the 3D model and adding data to that model. As a designer it is very desirable to work in the 3D environment so that you can visualize exactly what you are designing as you are working. Ultimately the information in the model shows up in the drawings and on schedules. In this exercise you will go back to the drawing plan view and study the information that can be used to annotate the drawings and schedules.

1. From the *Manage View Groups* tools on the lower right of the interface select the *View Group* pull-down.

   a. Select the *View Group* **Drawing 1**. This will open the model of the PLAN drawing.



Automatic Annotation

Note that the plan is now annotated with Room Names and Door Numbers. These are automatically generated from the DataGroup Properties on each object and rules set for the drawing. Additional annotations could be generated for other items and other properties.

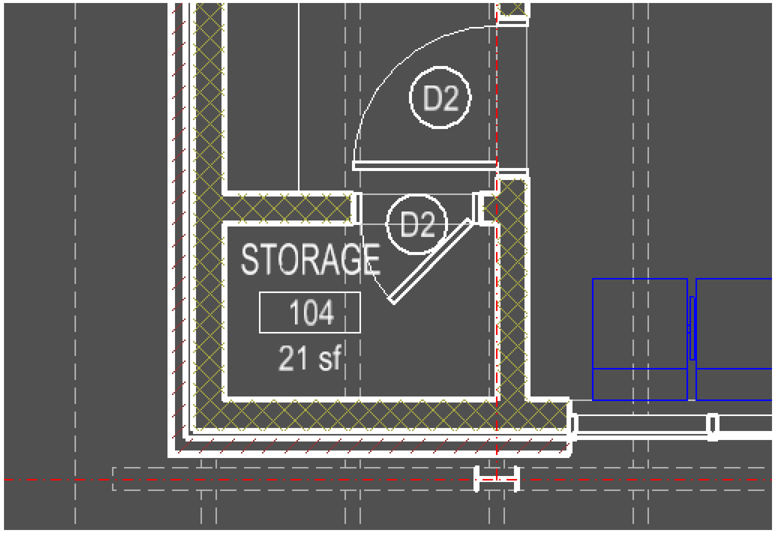
Once generated the annotations will update with changes to the model properties. Additionally they can be moved if necessary, for the readability of the drawing.

2. Select one of the STORAGE room labels and *right-press,* select **Move** from the pop-up menu.

   a. Move the label so that it does not overlap the door and door number.

   b. Move the door number so that it does not overlap the door.

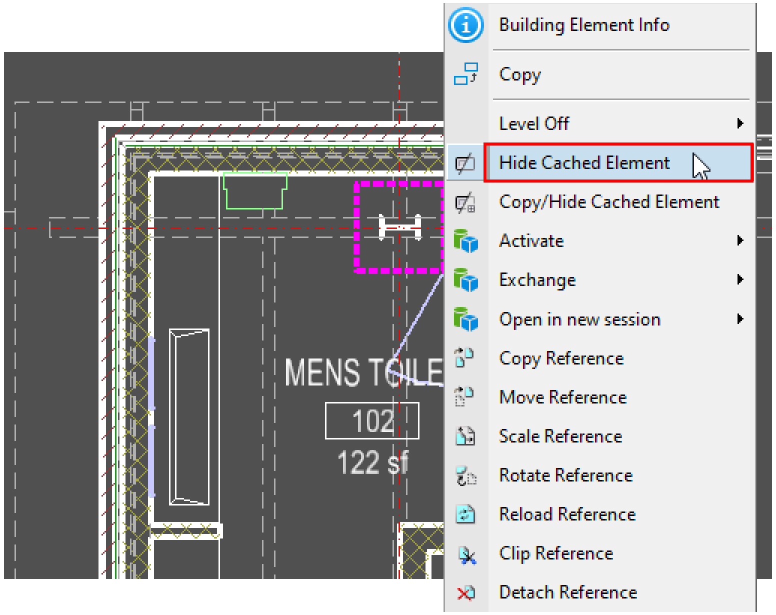
   c. Repeat for any other annotations that need to be moved.



Linework can be hidden if something is shown from the model that you would prefer was not shown on the drawing.

3. *Right-press* on a footing outline and select **Hide Cached Element**.

   Note: *Copy/Hide Cached Element* copies the element or selection set into the master file and hides the cached element or selection set. You can then manipulate the copied elements.

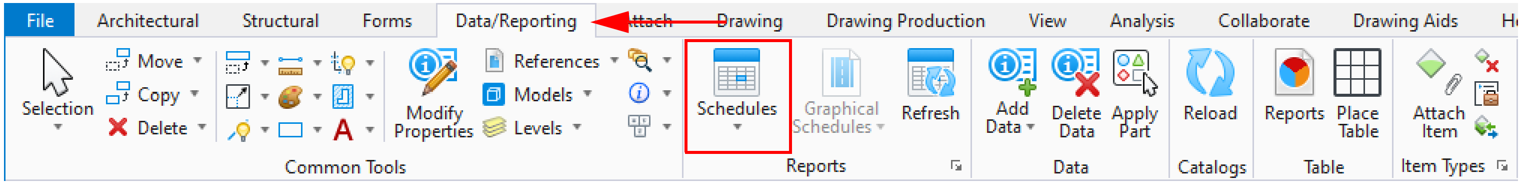


Schedules

OpenBuildings Designer has a *Schedule* tool which is used to query existing catalog item data, create new schedules (e.g. door, wall, beam, space, duct, etc) from existing catalog types, and manage reports for new catalog definitions, catalog items and catalog instances within existing reports.

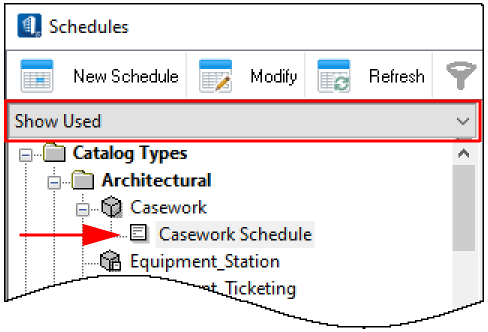
User defined catalog types and data information is also created, displayed, updated and exported from here. Schedules facilitates completion of many data management tasks including the export of data to several formats (Excel, text, CSV, XML) and the creation of selection sets for edits, manipulations, and modifications of any size.

4. Select the **Schedules** tool from the *Reports* group on the *Data/Reporting* ribbon. The *Schedule* dialog will open.

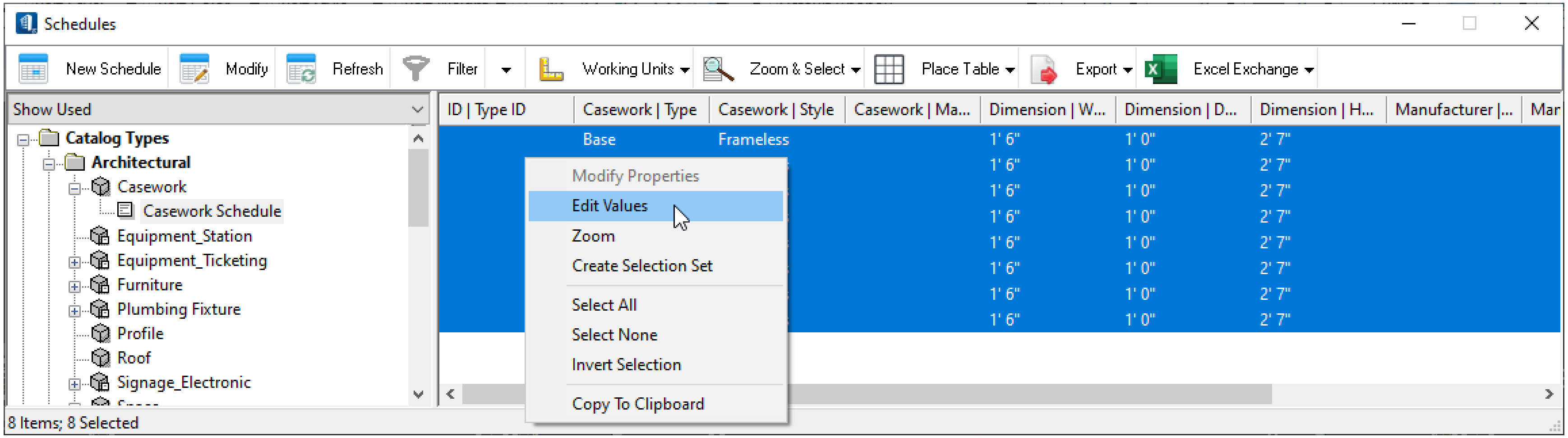


Note there is a filter that is set to **Show Used** so that we are only seeing catalog types that are used in our current model.

If you expand a *Catalog Type*, you will find one or more layouts. These are saved layouts of particular properties that you want to see in schedule. These can be customized and saved based on your standards.



5. Select the *Casework Schedule*.



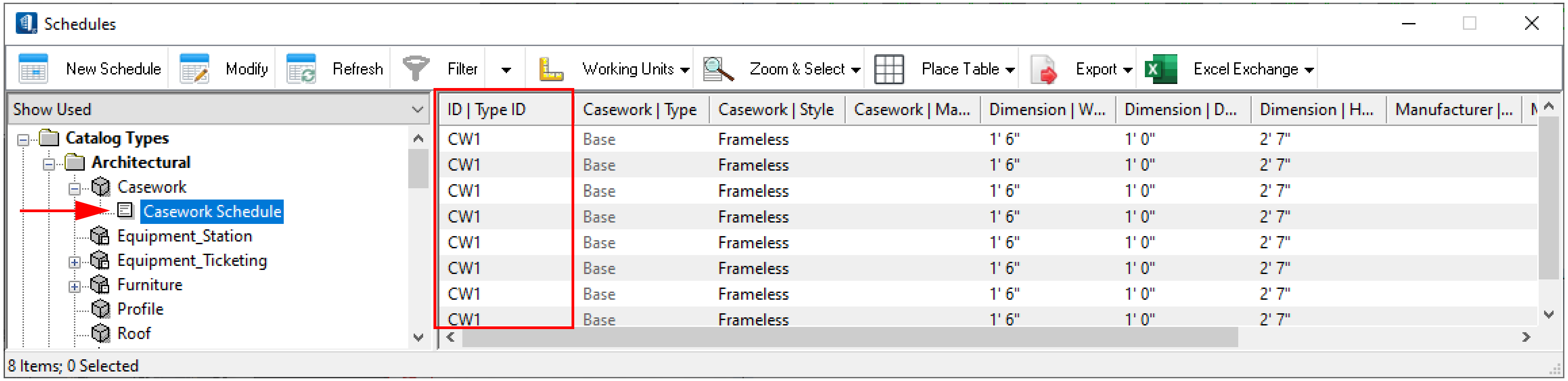
Each of the base cabinets that you placed in the model is listed here along with the properties. Note, that while you have changed properties on items in the model using the **Modify Properties** tool, you can also edit properties here in the schedule and those properties will be changed on each item in the model.

a. Select all the base cabinets listed in the right hand field.

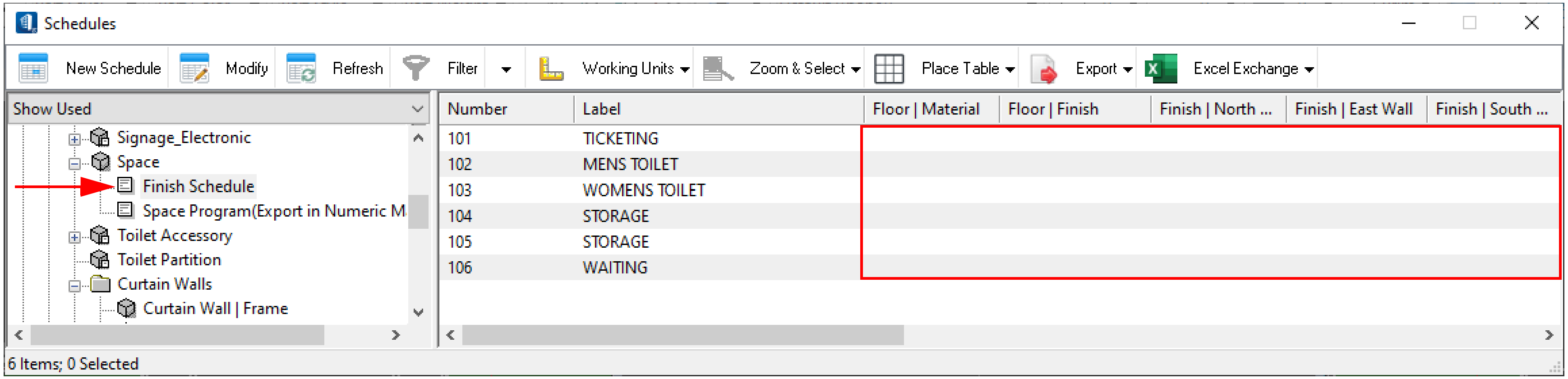
b. *Right-press* in the *ID | Type ID [ID | Asset Tag]* property and select **Edit Values**.

c. Type in **CW1** as the Type ID.That information has now been added to each cabinet in the model.

The *Casework Schedule,* now reflects the new information that was added to the model..



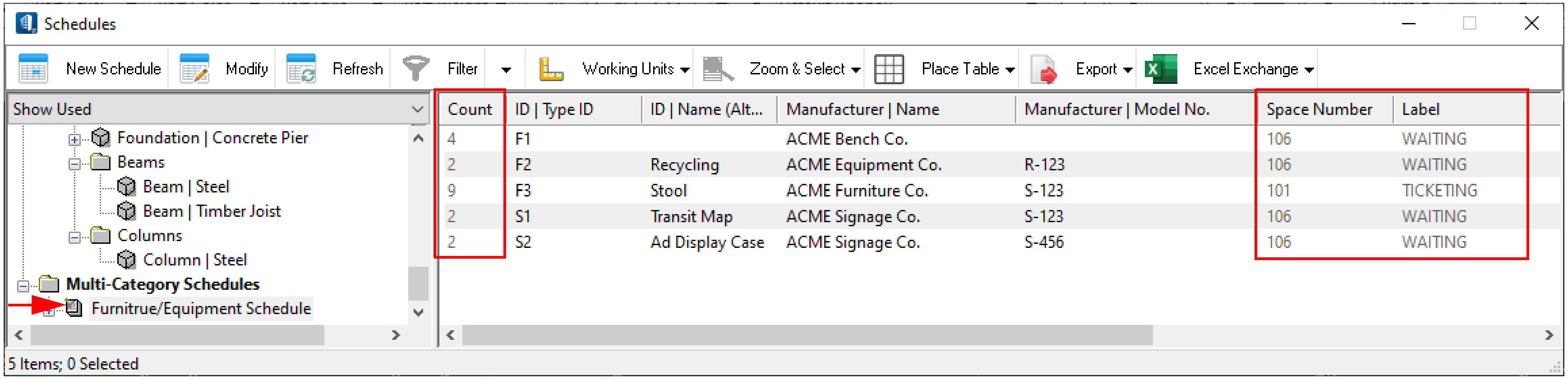
Note under Spaces there are two schedule layouts. One is just extracting program areas, the other is a finish schedule, where finishes can be added for each room or space.



Under the Transportation folder you will find the various equipment you may have added to the model.

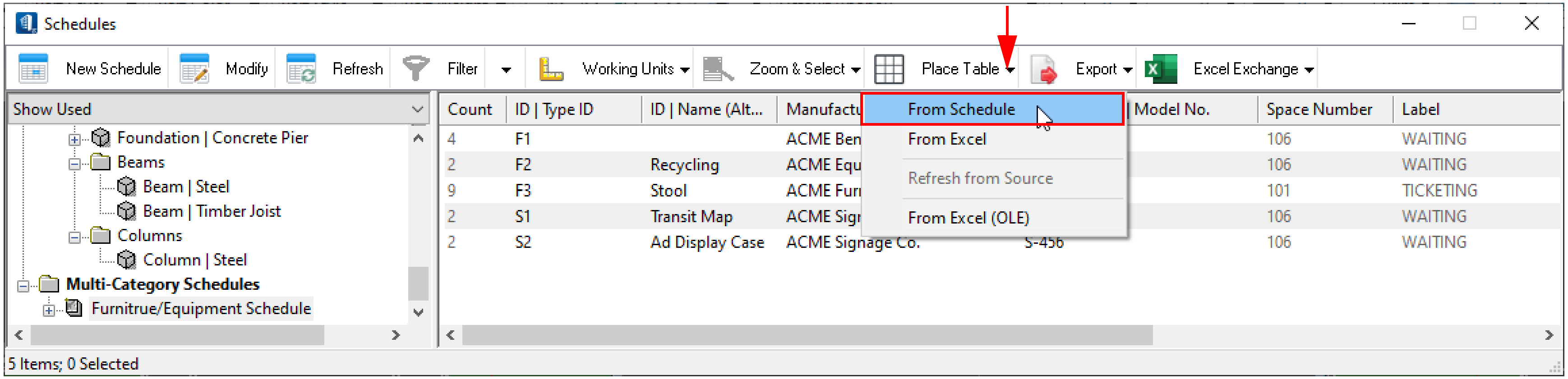
Schedules can also be created to include multiple catalog types, this works well when they share many of the same properties, such as the transportation equipment and furnishings.

6. Scroll down to *Multi-Catagory Schedules* and select the **Furniture/Equipment Schedule**.



Note that on this schedule Items are only listed once with the count given for the number of each item in the model. Also it indicates the space where the item is placed.

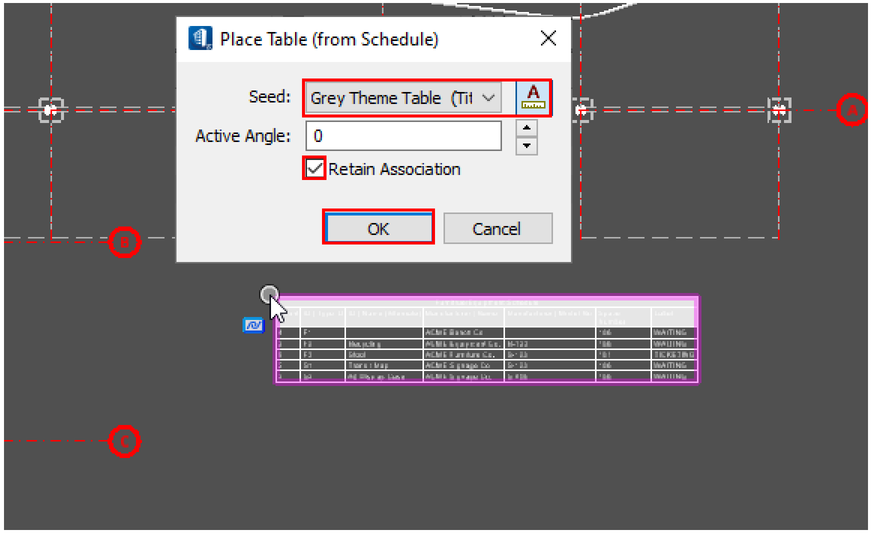
7. To place the current schedule on the drawing go to **Place Table > From Schedule**.

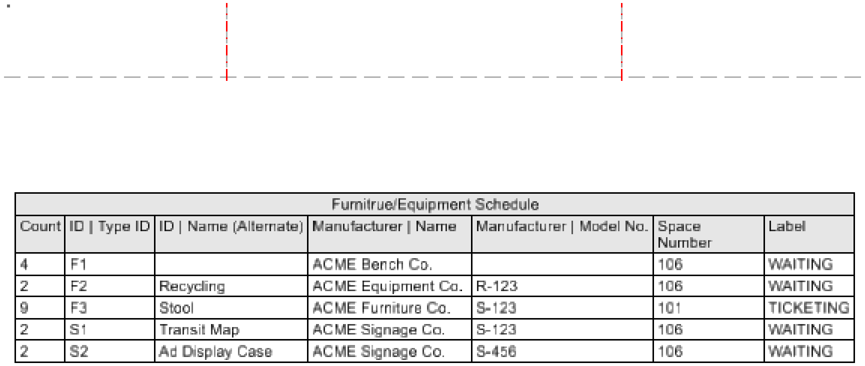


a. Select a *Seed*, such as **Grey Theme Table**.

b. Toggle **on** *Retain Association*, so that the table can be updated when changes are made to the model.

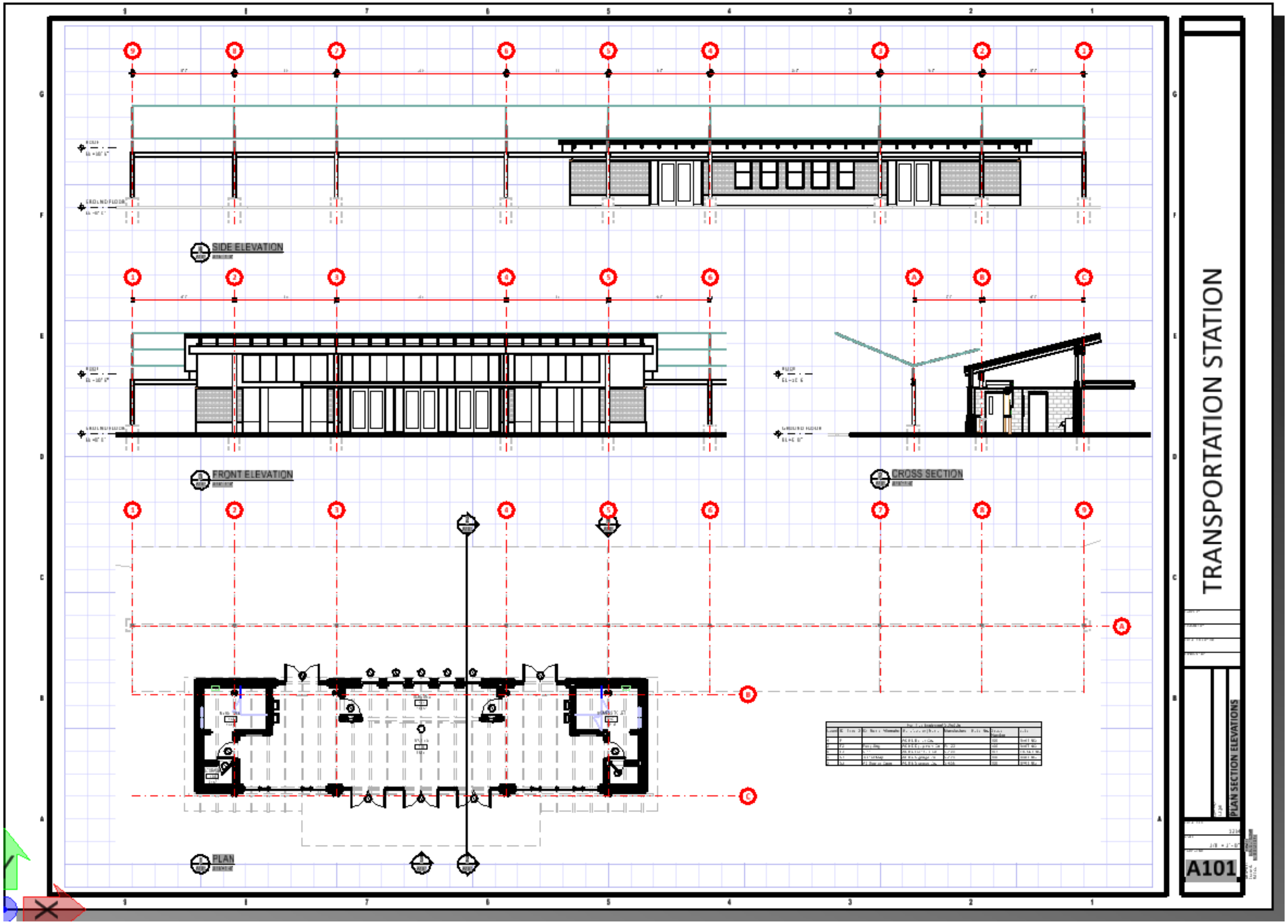
c. Place the table on the drawing.





Furnitrue/Equipment Schedule						
Count	ID | Type ID	ID | Name (Alternate)	Manufacturer | Name	Manufacturer | Model No.	Space Number	Label
4	F1		ACME Bench Co.		106	WAITING
2	F2	Recycling	ACME Equipment Co.	R-123	106	WAITING
9	F3	Stool	ACME Furniture Co.	S-123	101	TICKETING
2	S1	Transit Map	ACME Signage Co.	S-123	106	WAITING
2	S2	Ad Display Case	ACME Signage Co.	S-456	106	WAITING

8. Open the sheet model to see that the schedule is now visible on the sheet.



The model and drawings have come a long way since you started the conceptual model.

Now that you are familiar with the architectural and structural modeling tools, in the next chapter you will be introduced to the mechanical modeling tools and model the main ductwork and plumbing for the transportation station.

Chapter 6. Modeling Mechanical and Plumbing Components

Mechanical discipline is a fully integrated 2D and 3D workflow solution for building mechanical and environmental systems design and documentation. This Building application is supported by an extremely powerful modeling engine and takes full advantage of all OpenBuildings Designer technology. Mechanical discipline provides engineering design and documentation support for many international and regional industry standards. Using parametric features and static cells, standards are easily customized and expanded to meet the needs of any mechanical design requirement.

Focus

Mechanical discipline building information modeling (BIM) supports both 2D and 3D workflows. Intelligent components allow design engineers to work in either design mode at any time, while changes automatically update and synchronize between the two environments. Automatic drawing generation uses industry-standard representations of mechanical system components. Automated connections, routing and sizing tools, and system component editing, all increase efficiency and workflow. Defining of custom label variables by adding attributes such as System ID, in Mechanical drawing rules helps stacked compound annotation in drawings.

Mechanical discipline is also integrated with all Building solutions to ensure that designs and documentation are coordinated throughout the design and construction phases. Design project models provide extensive continued use during life cycle operations and future projects. Compatible OpenBuildings Designer tools such as Clash Detection, provide integrated collaboration and analysis to facilitate coordination of designs with all disciplines in the project team.

The placement of mechanical components is done via place tool interface that displays the controls on it dynamically. The standard fittings and components are supported with manufacturer catalogs. The catalog controls the component specifications supplied to the DataGroup System to use when placing a component.

The Place Mechanical Content tool is available to specifically handle mechanical RFA file content that is assimilated by the Content Interpreter utility.

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1. Start **OpenBuildings Designer** from the Start menu or desktop shortcut.
2. Set the *WorkSpace* to:

   OpenBuildings Training

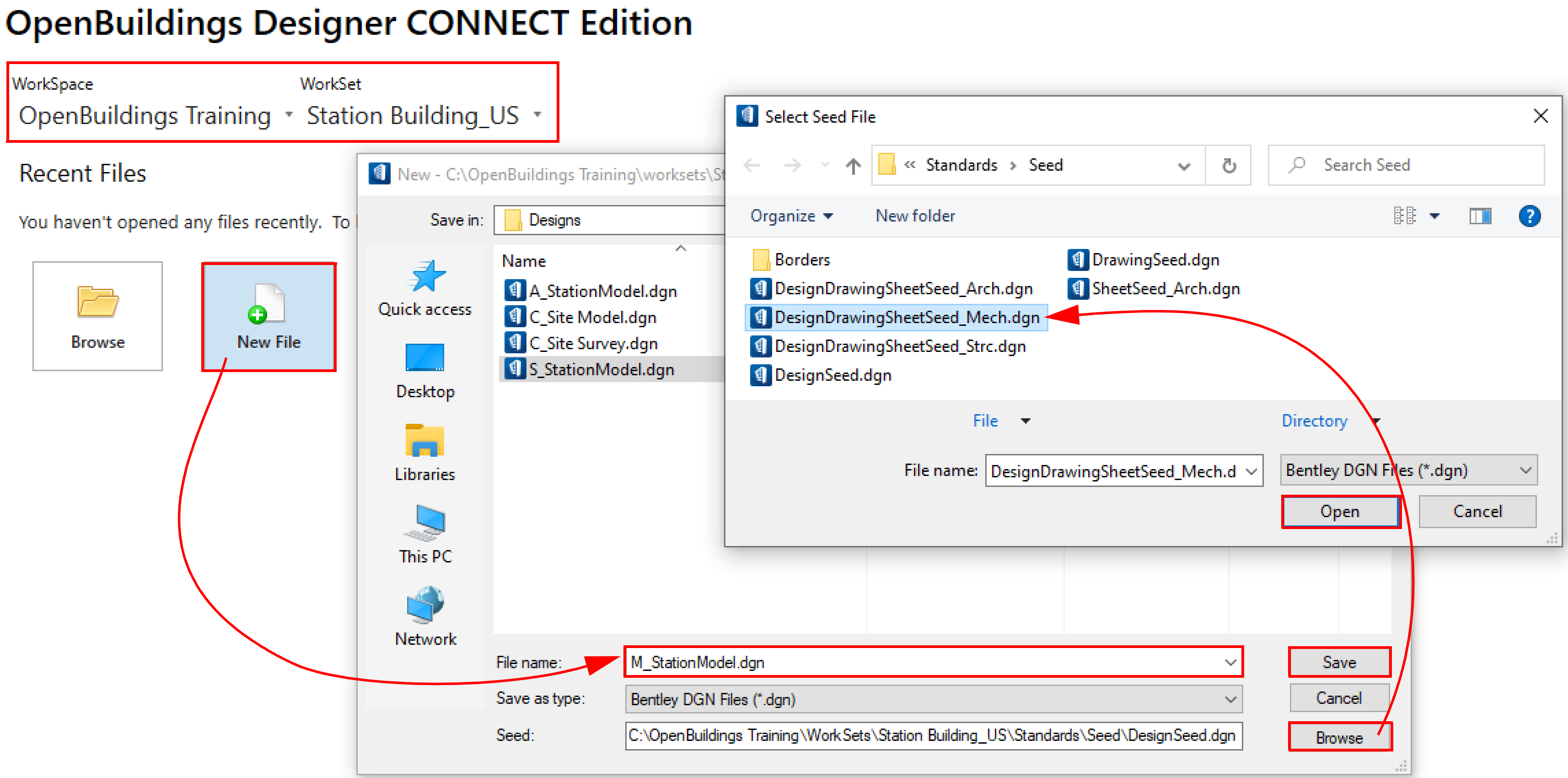
3. Set the *WorkSet* to:

   Station Building_US *[Station Building_NM]*

4. Select **New File**.

   File name: **MEP_StationModel.dgn**

5. Select the **Browse...** icon and select the seed file, **DesignDrawingSheetSeed_Mech.dgn.**



   a. Select **Open** to set the seed file.

   b. Select **Save** to open the new file, *MEP_StationModel.dgn*.

The **DesignDrawingSheetSeed_Mech** is a dgn seed file that was created specifically for this project and has a 3D design model as well as mechanical drawing models and a sheet model preset with an HVAC plan and plumbing plan views.

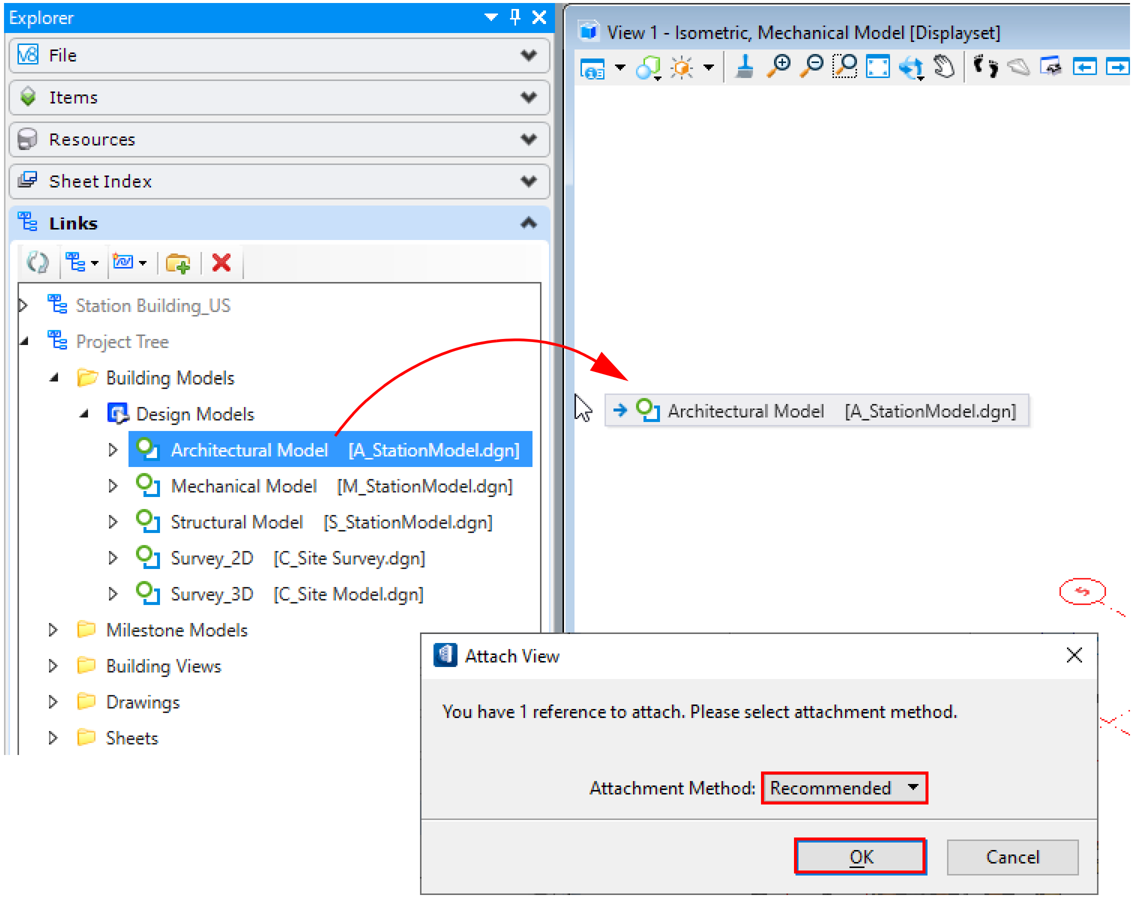
In order to begin you should reference in the architectural and structural models for coordination.

6. Open the **Links** tab on the *Explorer*. You will use the *Explorer* to add the structural model as a reference so that you can coordinate the architectural elements with the structural framing.

   a. Navigate to the **Project Tree > Building Models > Design Models.**

   b. Select the **Architectural Model** and drag and drop it into any view.

   c. Use the *Attachment Method* **Recommended**.



.The structural model should be attached as a nested reference of the architectural model.

7. Open the *References* dialog and toggle **on** the *Ignore When Live Nesting* option for the reference. These references are being used for coordination, but we do not want them to nest with the mechanical drawing views.

Optional - If you did not complete the exercises in the previous chapters and would like a completed architectural and structural model to reference, navigate to the **Project Tree > Milestone Models > Milestone Models** and select the **6_Architectural Model [A_StationModel-6.dgn]** and drag and drop it into the view.

You are ready to start the exercises for *Chapter 6: Modeling Mechanical and Plumbing Components*.

Exercise 6-1: Placing Equipment

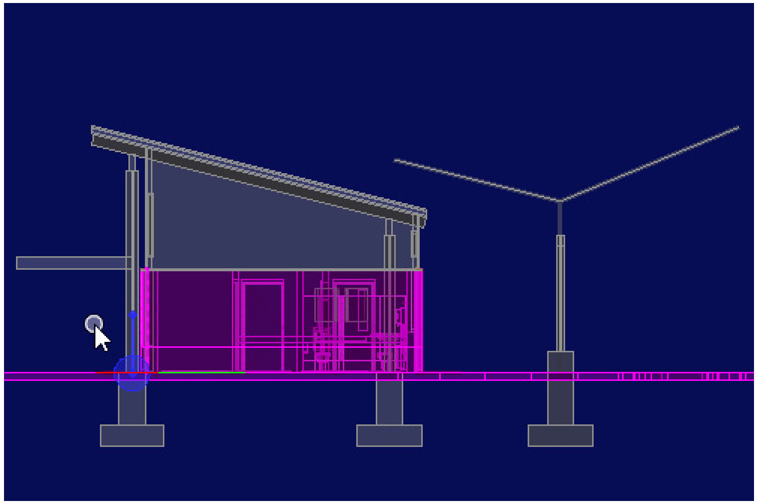
In this exercise mechanical equipment is placed in the model using a base offset.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

2. Create a *Display Set* of the station building without the platform canopy and roof geometry.

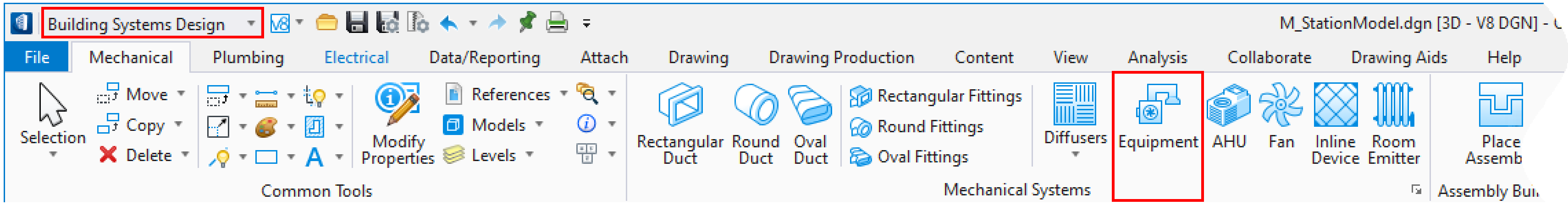
Note: Include the space shapes in the selections set, they will be used to help place the mechanical and plumbing elements.

3. Set the *Display Styles* for all views to **Modeling:Mechanical**. Zoom into the 'Storage' room on the right side of the building.



4. Change the *Workflow* to **Building Systems Design**.

   a. Select the **Equipment** tool from the *Mechanical Systems* group on the *Mechanical* tab of the ribbon.



5. In the *Place Component* dialog box select the catalog item **Equipment | CCUnit | Type 01.**

   a. Set the following *Width* and *Depth* for the *End Connections:*

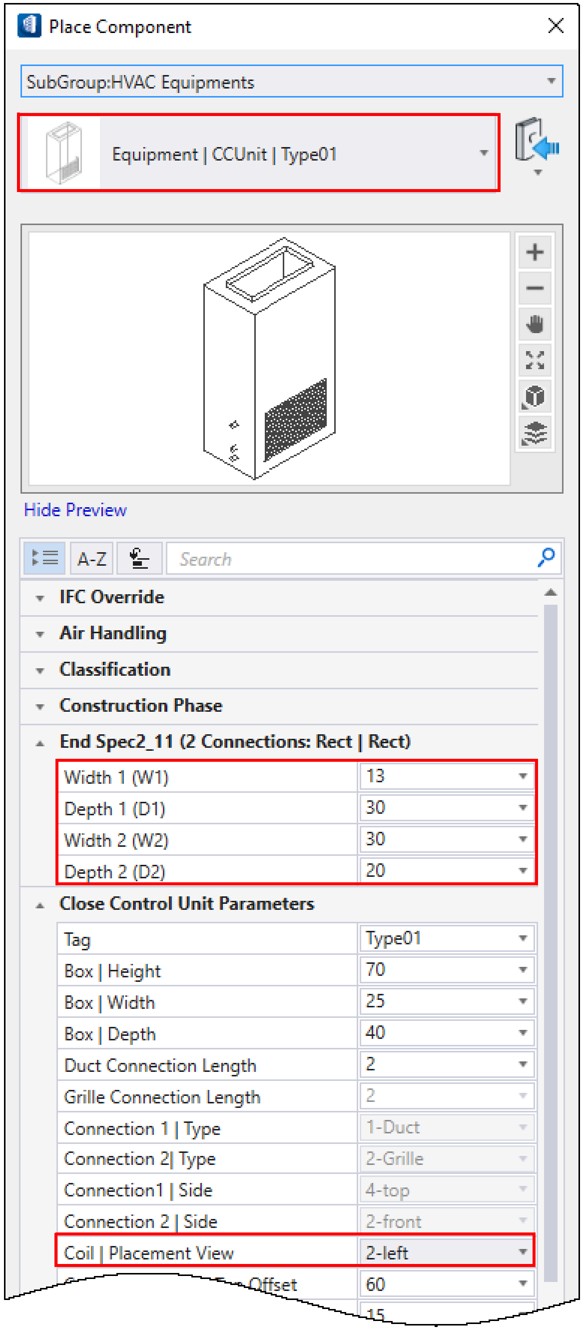
      Width 1 (W1): **13** *[325]*

      Depth 1 (D1): **30** *[750]*

      Width 2 (W2): **30** *[750]*

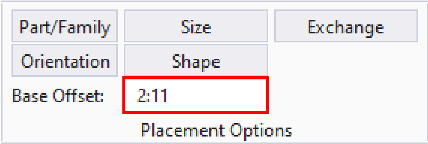
      Depth 2 (D2): **20** *[550]*

   b. The *Close Control Unit Parameters* can be left to the default values, except change the *Coil | Placement View* to **2-left**.



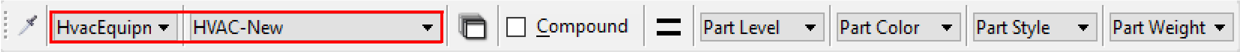
Note that the *Box | Height* is 70 inches *[1750 mm]*. The Placement point is at the midpoint of the unit so you will set a *Base Offset* that is half of this height.

6. On the *Placement* ribbon set the *Base Offset* to **2:11** *[875]*. Toggle off all other placement settings.

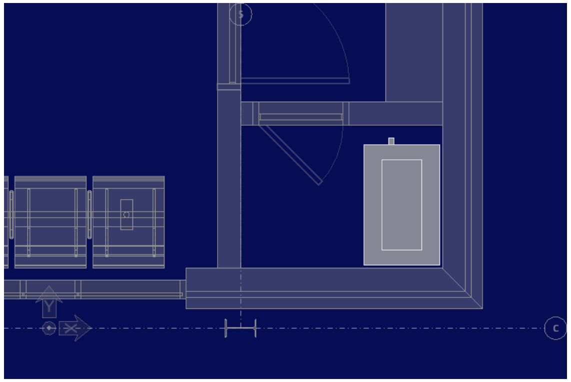


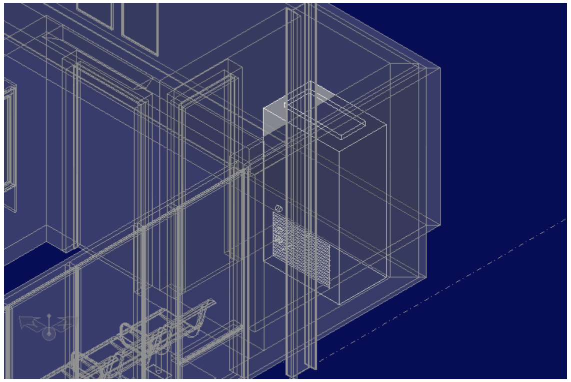
7. In the *Building Primary* tool bar insure the *Family* and *Part* are set to:

   a. *Family::Part* **HvacEquipment::HVAC-New**



8. In *View 2* select a data point (*left-click*) inside the ‘Storage’ room, select a second data point (*left-click*) to define the orientation.
    a. Reset (*right-click*) to end the placement command.
9. Select the **Move** tool and move the unit so that it sits in the corner of the room with the return air grill facing outwards.



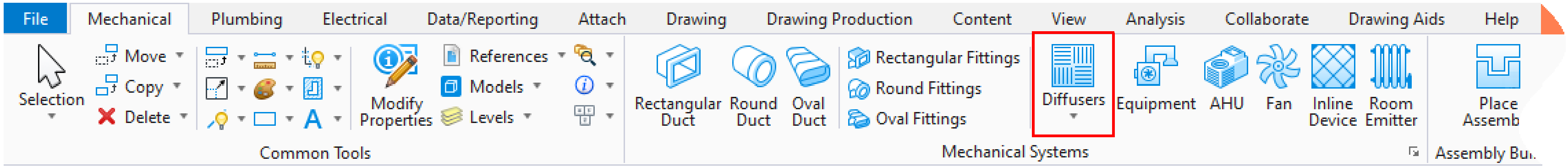


Exercise 6-2: Placing Diffusers

The building space layout often requires placing multiple equipment devices in a regular pattern, straight in lines. Devices, such as diffusers, can be placed individually or as an array. The below procedure states the steps followed when placing a device such as diffuser in the region bounded by a space in your model.

1. Set the *Floor Selector* to the **Station > GROUND FLOOR**.

2. Select the **Diffusers** tool from the *Mechanical Systems* group on the *Mechanical* tab of the ribbon.



Note: Mechanical discipline offers functionality that simplifies component placement and modification by embedding editable dimensions into component elements, thus enabling direct parametric editing of an element in a *Heads Up Display.* Modifying dimensions on the element itself provides a visual reference to what is being modified as well as simplifying navigation through long lists of component properties. There is no need, when targeting specific dimensions to modify, for a full DataGroup property panel showing all dimensional and data associated with the component. Returning to the property panel is easy by using a toggle switch that appears in every heads up display item.

Heads up display is designed to first, isolate the target component from the rest of the working model by fitting it to a predetermined view, then provide pop up dialogs when dimensions are selected. Reorienting the view to another standard viewing angle displays different dimensions. To increase efficiency, only the key dimensions that change geometry are available in the heads up display. This is especially advantageous when working with complex components containing many driven dimensional properties. That is, dimensional properties that are not directly editable, but are determined by other dimensional properties.

3. In the *Place Component* dialog box select the catalog item **Diffuser | Round-Ceiling| Round Diffuser Top.**

Tip: Type *Ceiling* in the search field to filter the catalog item list to ceiling diffusers.

4. Set the following *End Spec1_2* property:

   Diameter 1 (D1 Ø): **8** *[200]*

5. Set the following *Round Diffuser Parameters*:

   Body | Cone Height: **4** *[100]*

   Body | Cone Diameter: **16** *[400]*

   Body | Cone Top Diameter: **8** *[200]*

   Connection | Length: **2** *[50]*

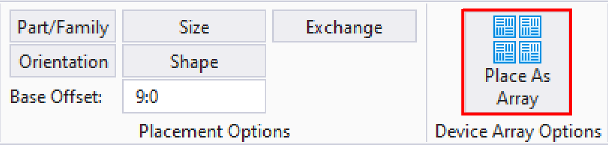
   Grille | Diameter: **16** *[400]*

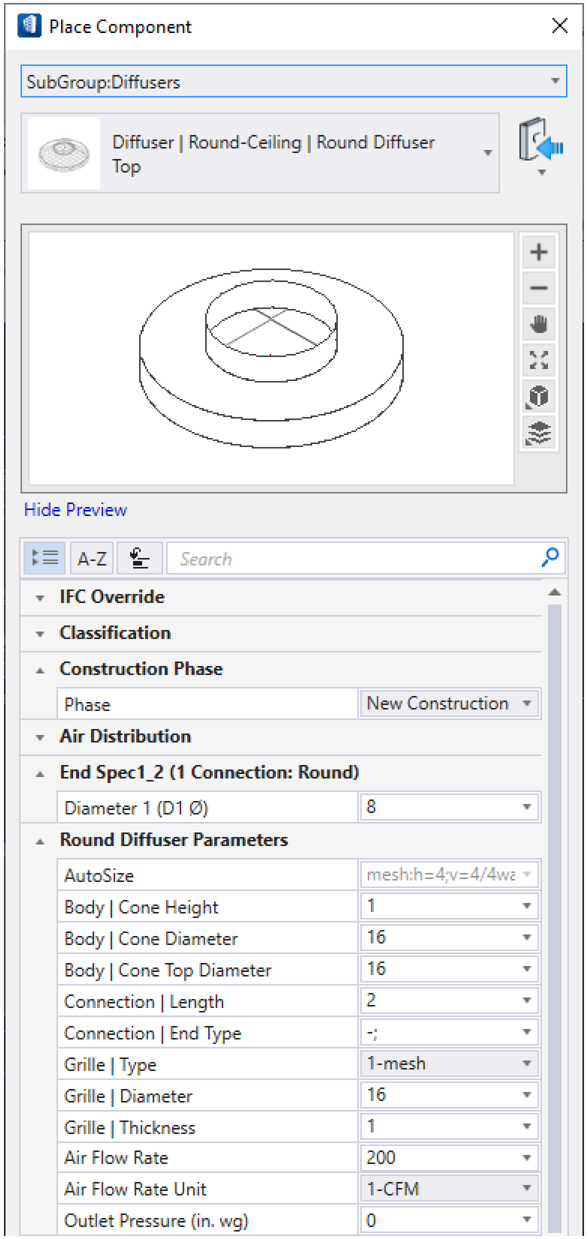
   Grille | Thickness: **1** *[25]*

   Air Flow Rate: **200** *[100]*

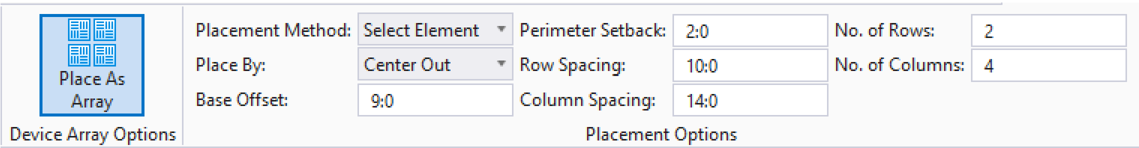
   Air Flow Unit: **1-CFM** *[1-L/s]*

6. From the *Placement* ribbon select the **Place As Array** tool.





7. On the *Place Device Array* ribbon set the following:



Placement Method: **Select Element**

Place By: **Center Out**

Base Offset: **9:0** *[2700]*

Perimeter Setback: **2:0** *[600]*

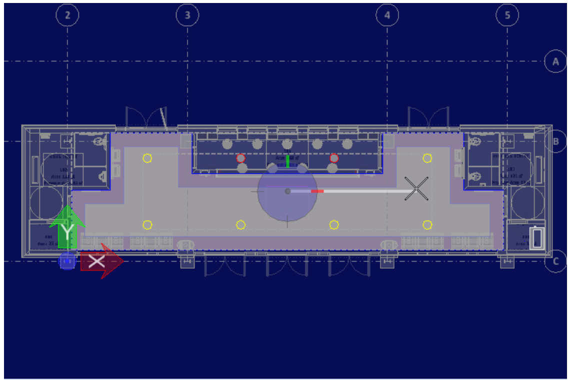
Row Spacing: **10:0** *[3000]*

Column Spacing: **14:0** *[4200]*

No. of Rows: **2**

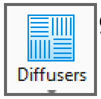
No. of Columns: **4**

8. Select the ‘Waiting’ space from the architectural reference, the array of diffusers will be located based on the center of the space..



   a. Select a second data point to define the rotation and place the diffusers.

Now you will manually place additional diffusers in the ‘Ticketing’ area and the ‘Men’s and Women’s Toilet Rooms.



9. Select the **Diffusers** tool from the *Mechanical Systems* group on the *Mechanical* tab of the ribbon..

The *Place Component* dialog should default to the previous settings.

10. On the *Placement* ribbon set the *Base Offset* to **9:0** *[2700 mm]*.

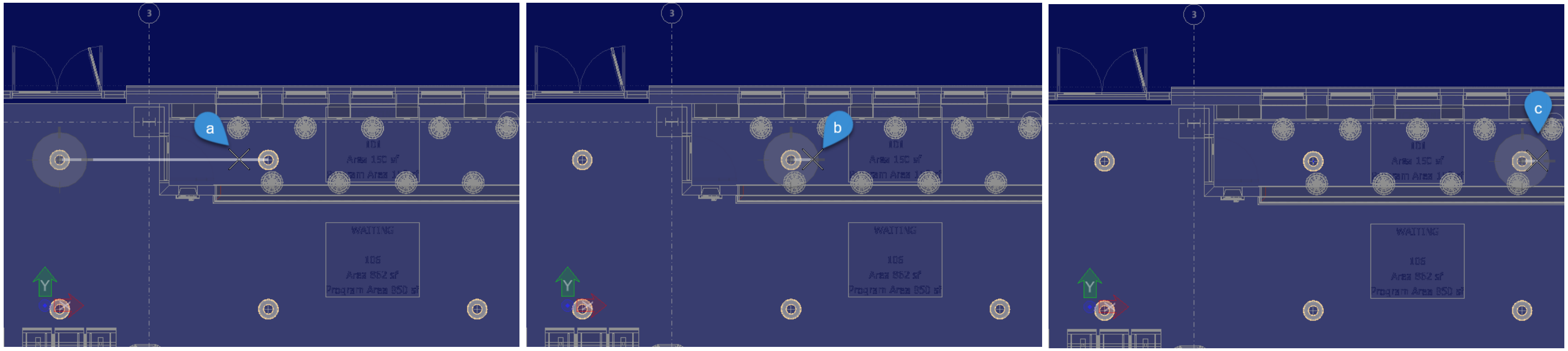
11. In the *Top* view snap to the diffuser on the upper left and type the AccuDraw shortcut **O** to reset the AccuDraw compass’s origin.

Hint: To return the *focus* to AccuDraw use the shortcut key-in **f11**.

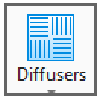
   a. Move the cursor towards the ticketing area and use **Enter** to lock the axis. Type **14:0** *[4200 mm]* to define the distance, and **Data point** *(Left-click)* to define the location for the diffuser.

   b. **Data point** *(Left-click)* again to define the rotation.

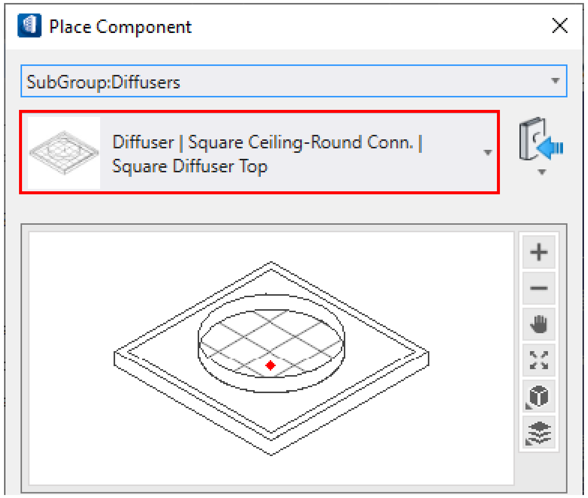
c. Place a second diffuser **14:0** *[4200 mm]* to the right of the first diffuser.



Finally you will place diffusers in the Men's and Women's rooms selecting the diffuser from a Manufacturer's catalog.



12. Select the **Diffusers** tool from the *Mechanical Systems* group on the *Mechanical* tab of the ribbon.
13. In the *Place Component* dialog box select the catalog item **Diffuser | Square Ceiling-Round Conn.| Square Diffuser Top.**



Note: The various properties for the diffuser can be added manually, or automatically added by selecting a manufacturer's catalog. When available, manufacturer catalog entries are scanned for the nearest match to user inputted data. DataGroup property values for key dimensional parameters such as diameter, radius and angle are examples of the scanned properties. Data is automatically applied from the manufacturer catalog to the DataGroup Properties (Parameters) during placement. If you attempt to enter a parameter that is not in the specific catalog the *Place Component Property Panel* will not accept the value.

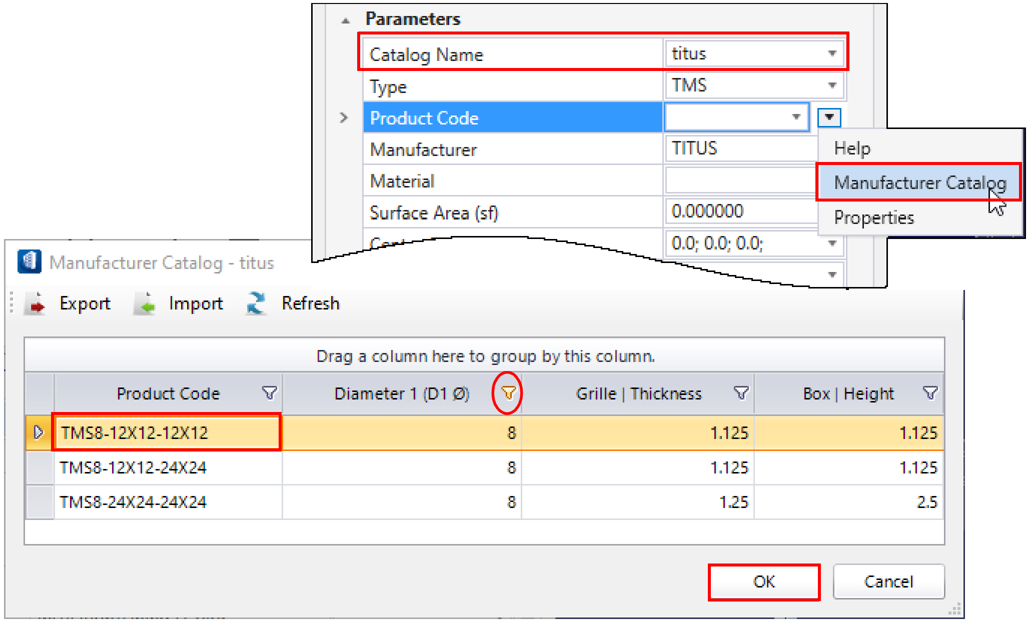
For example, in the *Trox* catalog the available diameter connections for a square ceiling-round connection air terminal are 6" *[150 mm]*, 8" *[200 mm]* and 10" *[250 mm]*. If you enter 12" *[300 mm]* value for the Diameter (D1 Ø) the property panel will not accept that value as it is not in the catalog.

a. On the *Parameters* tab select a Manufacturer's catalog.

Catalog Name: **titus** *[Trox]*

b. On the *Product Code* line select the pull-down, a drop down arrow appears to the right of the field.

c. Select **Manufacturer Catalog** from the right pull-down.



The catalog will open. The selections can be grouped by columns, filters applied, and rows can be pinned and unpinned.

d. Filter the *Diameter 1 (D1 Ø)* to **0:8** *[200]* and select a diffuser that is **12x12** *[ZH-Q--/400x198x16/0].*

e. Select **OK**.

The *Diffuser Parameters* are changed to match the catalog item. In addition the *Type*, *Product Code* and *Manufacturer* fields are filled in.

f. Set the *Air Flow Rate* to **150** *[75]*.

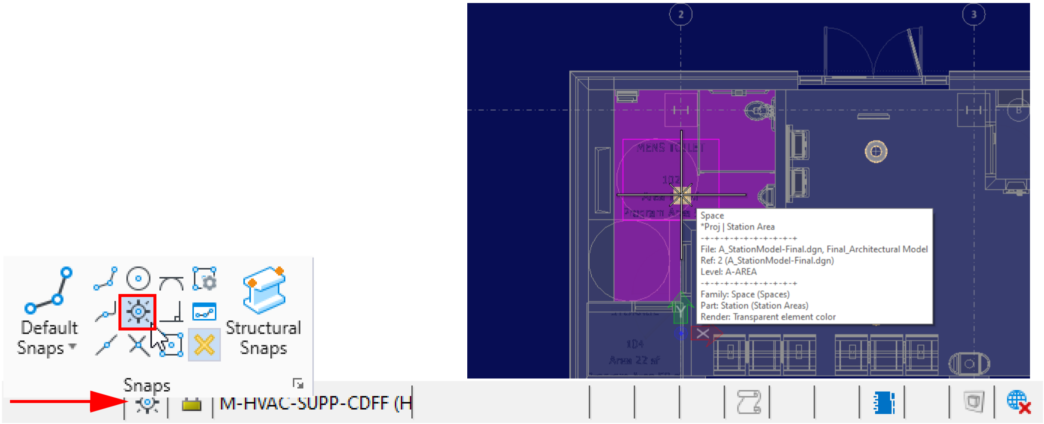
14. Place the diffuser in the Men's Toilet.

a. Set the active snap to **Center**.

Hint: Use the shortcut keyin **C** to change the snap to *Center*.

b. Tentative snap *(Left-Right Button Chord)* to the Men's Toilet space. **Data point** *(Left-click)* to accept.

c. **Data point** *(Left-click)* again to define the rotation.



15. Place a second diffuser in the Women's Toilet.

Exercise 6-3: Placing Single-Line Ductwork

Routing in Mechanical discipline is a fully dynamic process in which fittings (Transitions, Elbows and Branches) are automatically placed without exiting the place duct/pipe tools. Individual route segment manipulations via application specific AccuDraw key-ins offer an additional level of control. Combinations of fittings are logically placed between differently shaped and sized routes. The preferences for these fittings, for instance a radius elbow vs. a mitered elbow, are determined by the **Autofitting Preferences**.

HVAC Autofitting Preferences

Autofitting Preferences are used to set preferences and define common settings for fittings applied automatically while routing. These preferences are stored in an XML file, and used as you route the system. The standard placement settings and preferences set interactively through the dialog, will be applied to all fittings during routing. Changes in direction, size, or shape will automatically add the respective fitting, e.g. elbow, transition/reducer or branches such as take-offs, taps, or tees will be taken from what is set in the *Autofitting Preferences*. HVAC Autofitting Preferences are accessed from the dialog pull-down on the *Mechanical Systems* group. Plumbing Autofitting Preferences are accessed from the dialog pull-down on the *Plumbing Systems* group. The saved *Autofitting Preferences* remain valid for the current project. The default values however can be restored as required.

Single-Line Mode

The placement tool also provides an option of routing in a single line mode, that can be later promoted to 3D. A duct in a route is normally routed in a horizontal plane. Routing in different planes needs to be done carefully. The Autofitting property and AccuDraw Compass facilitate to branching the route in a perpendicular direction.

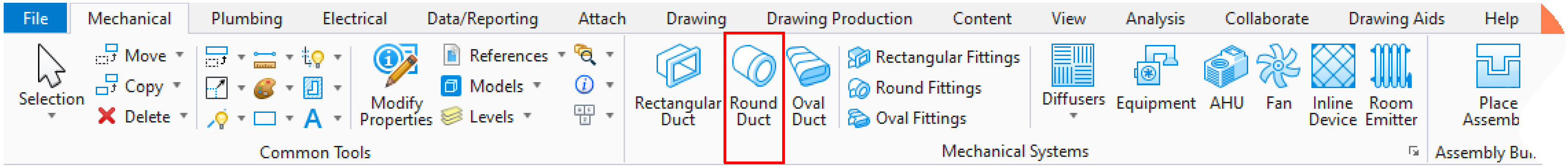
As part of the duct sizing analytics, the single line workflow is included to shorten the time spent on doing preliminary routing of the system paths by making it extremely quick to establish basic routing paths and connections so that calculations can be run and the system size requirements can be established. The process often involves laying ducts or pipes, and then connecting fittings. The entire route is drawn in a single line geometry with nodes added at turns and branches where the size and type fitting change along the route and end-caps at the terminal ends. The fittings and equipments are shown as cell symbols.

The single line feature quickens creating systems without needing to change size or shape. It utilizes single click connections to outlets and vertical changes in elevation using AccuDraw, making modeling a system easy.

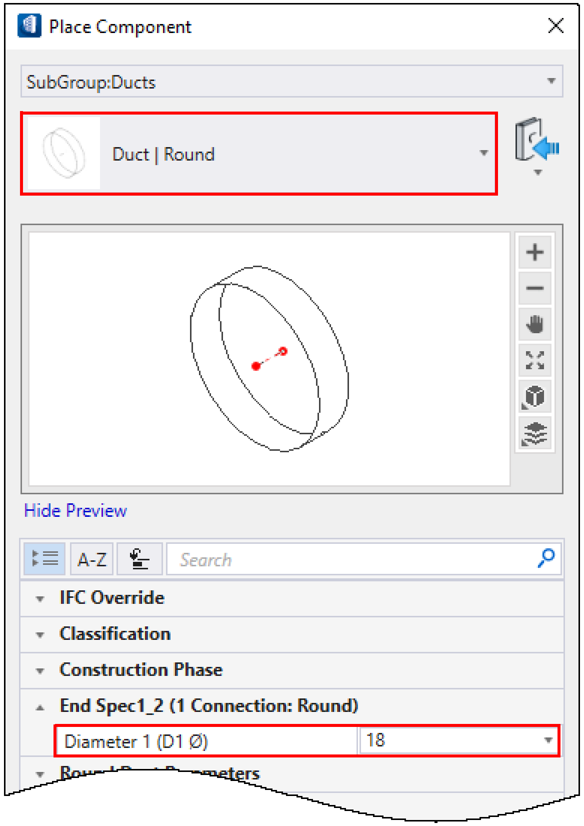
The system optimizes the route by creating a vertical drop when connecting duct or pipe to fittings in elevated plane. This mode provides an easy way of creating a riser, say by placing a diffuser at a lower level and attaching it with single line. However, placing inline devices along the single line route doesn't visually break the continuity of the duct until it is promoted to 3D. Once the route and connections have been created the single line system can be loaded in the Duct Sizing System to calculate flows, losses and size information which will be written to the system.

1. Working in the *Top* view, zoom in to the CC unit that was placed in the previous exercise.

2. Select the **Round Duct** tool from the *Place Mechanical Systems* group on the *Mechanical* Tab.



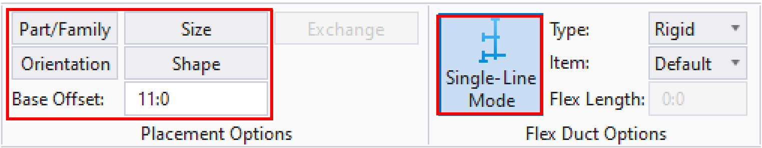
The ribbon bar shows a contextual *Placement:Place* tab. A small segment of duct (icon) appears on the pointer, and the *Place Component Property Panel* dialog opens. The catalog item will default to **Duct | Round**



3. Set the *Diameter 1 (D1 Ø)* to **18** *[450].*

4. Toggle on the **Single-Line Mode** option on the *Placement:Place > Flex Duct Options* tab to begin with route in a single line. the routing workflow draws the model in single line.

The Placement (Justification) options automatically void for single line mode.



Part/Family: **Off** — When on, the Part/Family definitions of the selected component are assigned to the new duct. When off, the active family/part is assigned to the new component.

Orientation: **Off** — When Off the shape is determined by the Place Component dialog.

Size: **Off** — When Off the size is determined by the Place Component dialog.

Shape: **Off** — When Off the shape is determined by the Place Component dialog.

Base Offset: **11:0** *[3500 mm]* — Enabled when a floor is selected in the Floor Manager as a reference plane. Sets the Z axis distance between the elevation of the active floor and the centerline elevation of the ductwork being placed, there by allowing to route the ductwork relative to the active floor.

5. Set the *Family* and *Part* for the ductwork to **Duct::Supply-New**.

   a. Set the active snap to Keypoint.

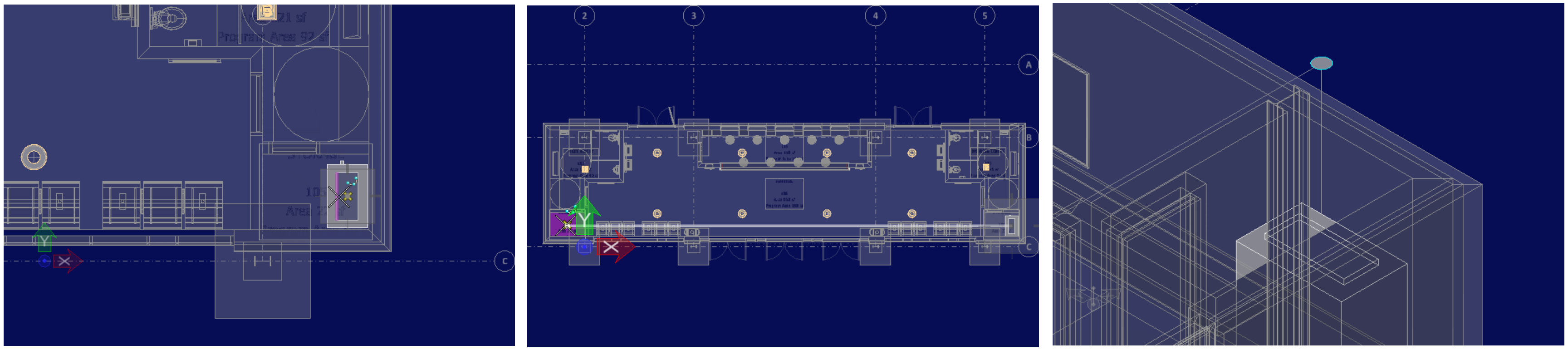
   b. In the *Top* view, AccuSnap to the supply connection on the CC unit (at the top of the unit). **Data point** (*left-click*) to accept the snap point. The free end of the new duct is dynamically attached to the pointer.

   c. Move the cursor towards the 'Waiting' area, then press **Enter** to lock the *AccuDraw* axis.

   d. Move the cursor to the 'Storage' space on the opposite side of the 'Waiting' area and **Data point** (*left-click*) to accept.

Hint: Do not snap to the 'Storage' space. If you do the duct end or cap will not get created.

   e. **Reset** (*right-click*) to complete the main duct route. The duct route appears in a single line presentation. The nodes which appear at turns and connections signify their type (viewed with mouse hover). The route will also have endcap symbols added at the open terminals..



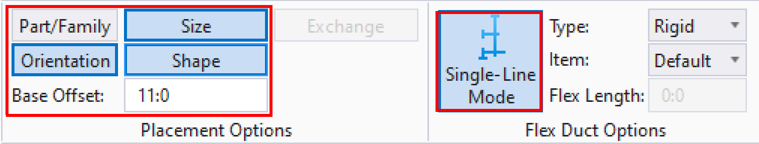
Note: The Bend typically is the default fitting, and when promoted would result as an elbow set in Auto Fitting option. You can however, override the node catalog to suit your design.

Note: If the route changes direction and size, a Branch is automatically placed to connect the changing route. If the shape is round (duct), the branch incorporates a coupling fitting at the node.

Note: While placing a different size duct segment on the fly, ensure the Size on the Placement Options tab is unchecked to accept different dimensions being set in the Place Component dialog.

Next you will connect the diffusers to the main duct route.

6. Select the **Round Duct** tool from the *Mechanical Systems* group on the *Mechanical* tab of the ribbon.
7. In the *Ribbon Interface > Placement: Place* options set:



   Part/Family: **Off**

   Orientation: **On**

   Size: **On**

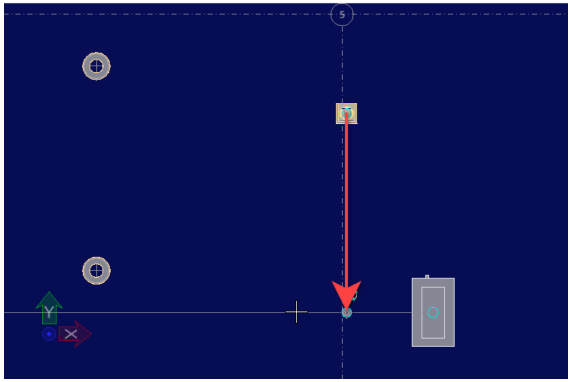
   Shape: **On**

   Base Offset: **11:0** *[3500 mm]*

   Single-Line Mode: **On**

   When *Orientation*, *Size* or *Shape* are toggled on, the new ductwork's *Orientation*, *Size* or *Shape* is automatically set to match the connection of the selected component.

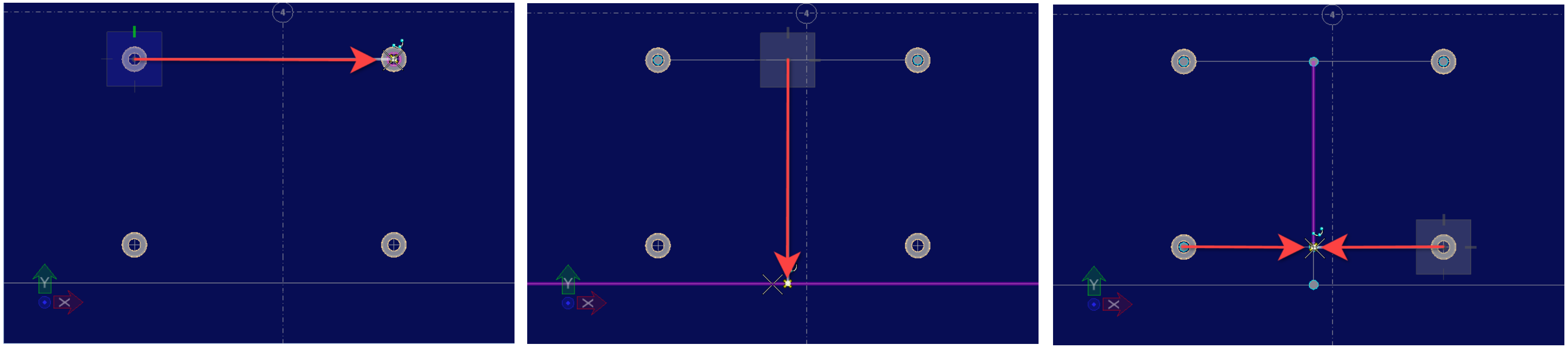
8. Snap to the diffuser in the Women's Toilet room. **Data point** (*left-click*) to accept.
9. Select the main duct route. A single-line route is drawn from the diffuser to the main duct finding the shortest path. The diffuser gets hooked up to the main route with a vertical drop to the diffuser.



Diffusers can be connected together and then routed to the main ductwork.

10. Connect two of the diffusers.
11. Connect the route between the diffusers to the main route.

12. Connect the remaining two diffusers to the branch duct.



13. Repeat for the opposite side.

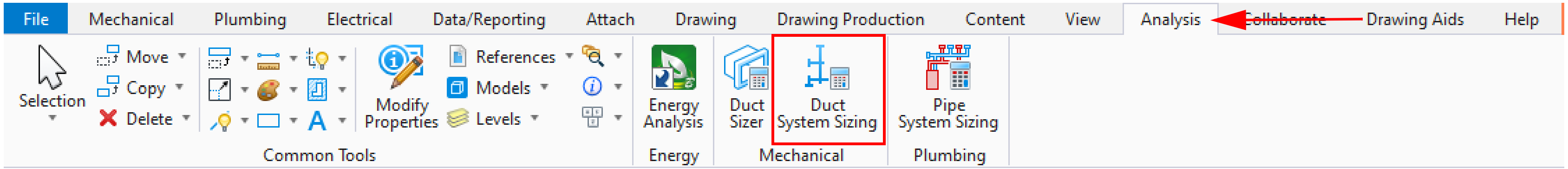
The single line route is ready for analysis or manipulating.

Note: Single line design is only a schematic representation that utilizes a nodal approach to reflect changes in *direction* (elbows), changes in *size* (reducers), *branches* (take-offs, tees) and changes in *shape* (transitions). No actual geometry or component data is attributed to these nodes until after calculations and a 'promote to 3D' is used through the Duct Sizing process, therefore IFC export should be used on the 3D model only. To achieve a single line representation in drawing output the rules available in the Dynamic View capabilities to create a single line view should be used.

Exercise 6-4: Duct System Sizing

The *Duct System Sizing* tool is used to compute and, based on velocity pressure requirements, perform sizing algorithms, and rebuild system after resizing by optimizing route path duct sections.

1. Select the **Duct System Sizing** tool from the *Mechanical* group on the *Analysis* Tab.

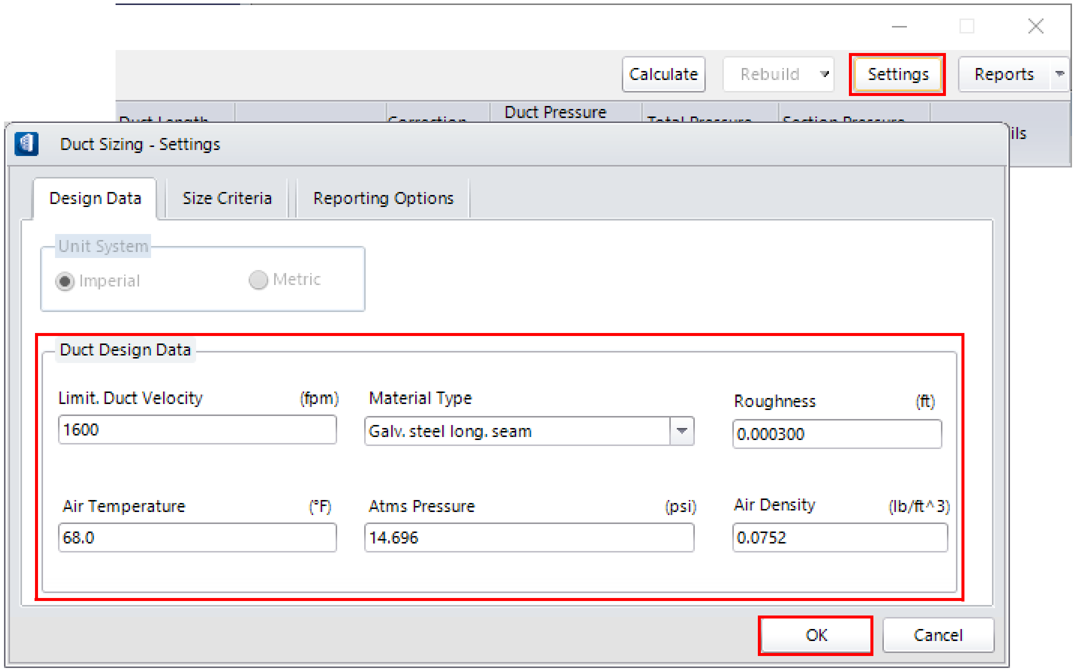


The *Duct Sizing* dialog will open. This dialog is used to load, set and compute duct sizing parameters to construct an optimized duct system by Equal Friction method. The dialog also allows you to recalculate the duct system, promote a single-line route to 3D, and generate various reports.

2. Select **Settings** from the dialog tools.

The *Duct Sizing - Settings* dialog is used to define design data and set size criteria for a duct system. In addition, reporting options for presentation and reporting are set here.

   a. Use the default settings. Select **OK**.



Select **Load System** from the dialog tools.

3. Select the CC Unit from the model. **Data point** (*Left-click*) to accept.

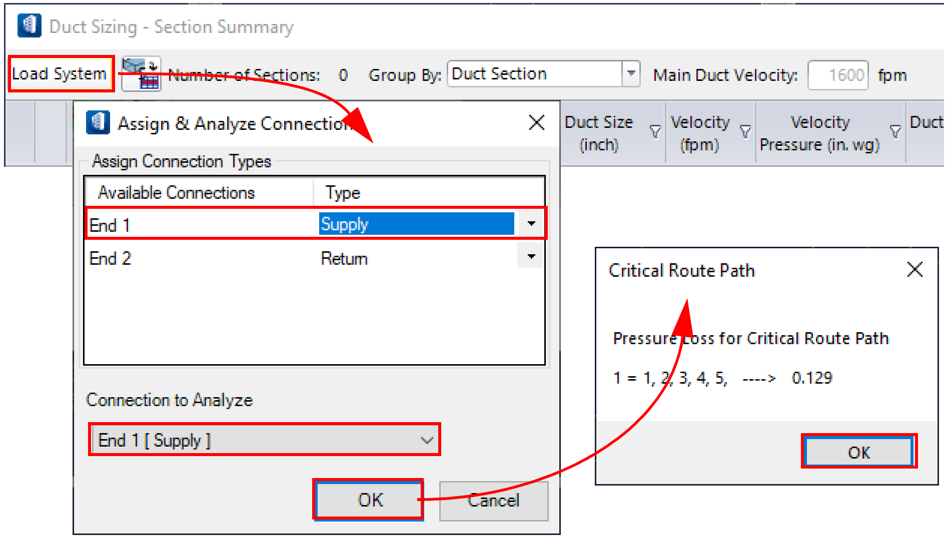
The *Assign & Analyze Connection* dialog will open.

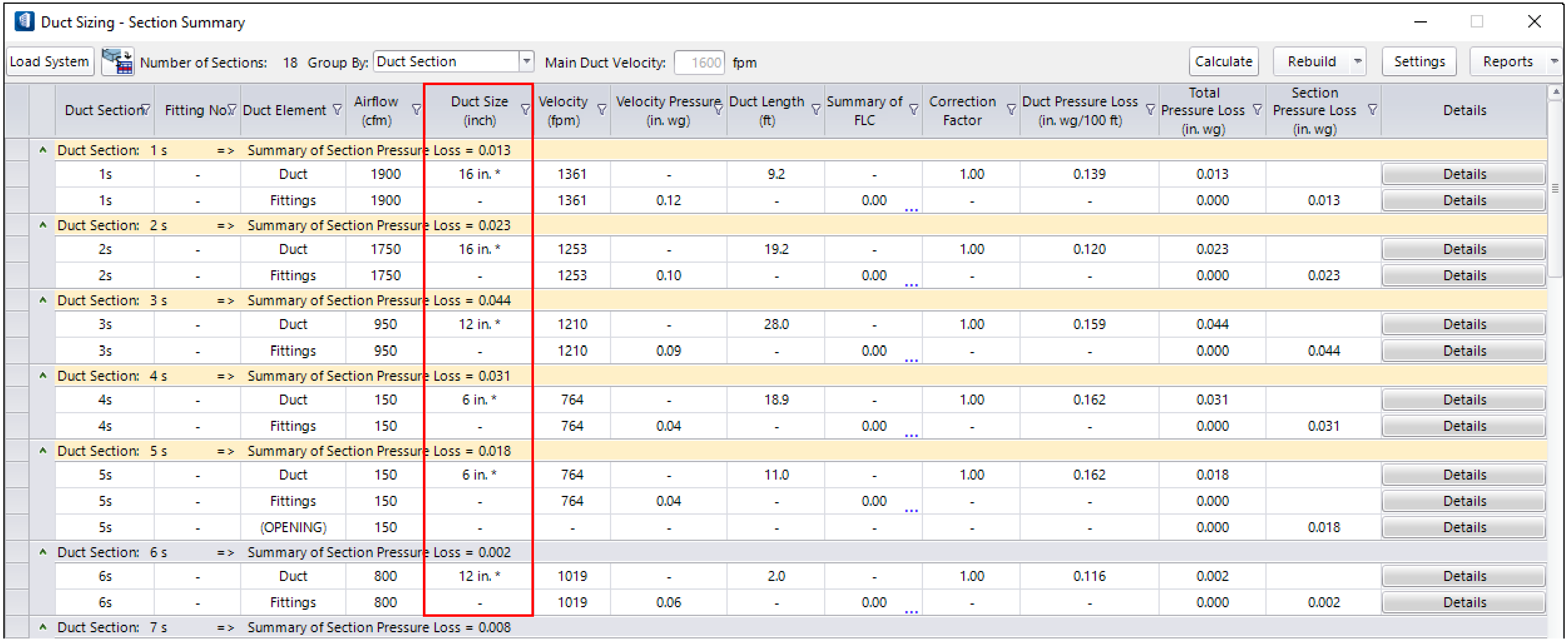
4. Select **End 1 [Supply]** as the *Connection to Analyze* and select **OK**.

The *Critical Route Path* information dialog will open.

5. Select **OK**.

The *Duct Sizing - Section Summary* dialog is populated with data from the single-line model. Duct sizes are determined for the system and the critical path is highlighted in the model as well as the table.



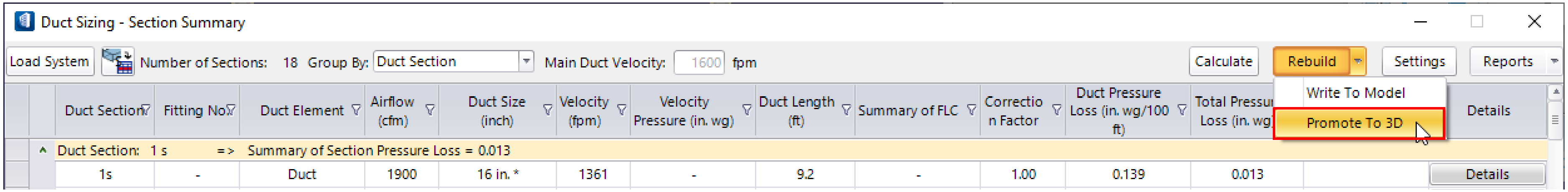


Duct Section	Fitting No	Duct Element	Airflow (cfm)	Duct Size (inch)	Velocity (fpm)	Velocity Pressure (in. wg)	Duct Length (ft)	Summary of FLC	Correction Factor	Duct Pressure Loss (in. wg/100 ft)	Total Pressure Loss (in. wg)	Section Pressure Loss (in. wg)	Details
Duct Section: 1 s => Summary of Section Pressure Loss = 0.013													
1s	-	Duct	1900	16 in. *	1361	-	9.2	-	1.00	0.139	0.013		Details
1s	-	Fittings	1900	-	1361	0.12	-	0.00 ...	-	-	0.000	0.013	Details
Duct Section: 2 s => Summary of Section Pressure Loss = 0.023													
2s	-	Duct	1750	16 in. *	1253	-	19.2	-	1.00	0.120	0.023		Details
2s	-	Fittings	1750	-	1253	0.10	-	0.00 ...	-	-	0.000	0.023	Details
Duct Section: 3 s => Summary of Section Pressure Loss = 0.044													
3s	-	Duct	950	12 in. *	1210	-	28.0	-	1.00	0.159	0.044		Details
3s	-	Fittings	950	-	1210	0.09	-	0.00 ...	-	-	0.000	0.044	Details
Duct Section: 4 s => Summary of Section Pressure Loss = 0.031													
4s	-	Duct	150	6 in. *	764	-	18.9	-	1.00	0.162	0.031		Details
4s	-	Fittings	150	-	764	0.04	-	0.00 ...	-	-	0.000	0.031	Details
Duct Section: 5 s => Summary of Section Pressure Loss = 0.018													
5s	-	Duct	150	6 in. *	764	-	11.0	-	1.00	0.162	0.018		Details
5s	-	Fittings	150	-	764	0.04	-	0.00 ...	-	-	0.000		Details
5s	-	(OPENING)	150	-	-	-	-	-	-	-	0.000	0.018	Details
Duct Section: 6 s => Summary of Section Pressure Loss = 0.002													
6s	-	Duct	800	12 in. *	1019	-	2.0	-	1.00	0.116	0.002		Details
6s	-	Fittings	800	-	1019	0.06	-	0.00 ...	-	-	0.000	0.002	Details
Duct Section: 7 s => Summary of Section Pressure Loss = 0.008													

While the HVAC system is routed and loaded into this utility, with the selection of a starting component, calculations occur, and missing data is highlighted, making it visually distinct. An interactive table populates with data complying with ASHRAE or CIBSE standards, such as the table of "Total Pressure Loss by Section". This utility allows you to use the interface to "walk-through" the duct system and link components to a mix of detailed design data (such as ASHRAE Fitting number) or estimated data (Loss Coefficient ~ 0.0) and continues the full calculations.

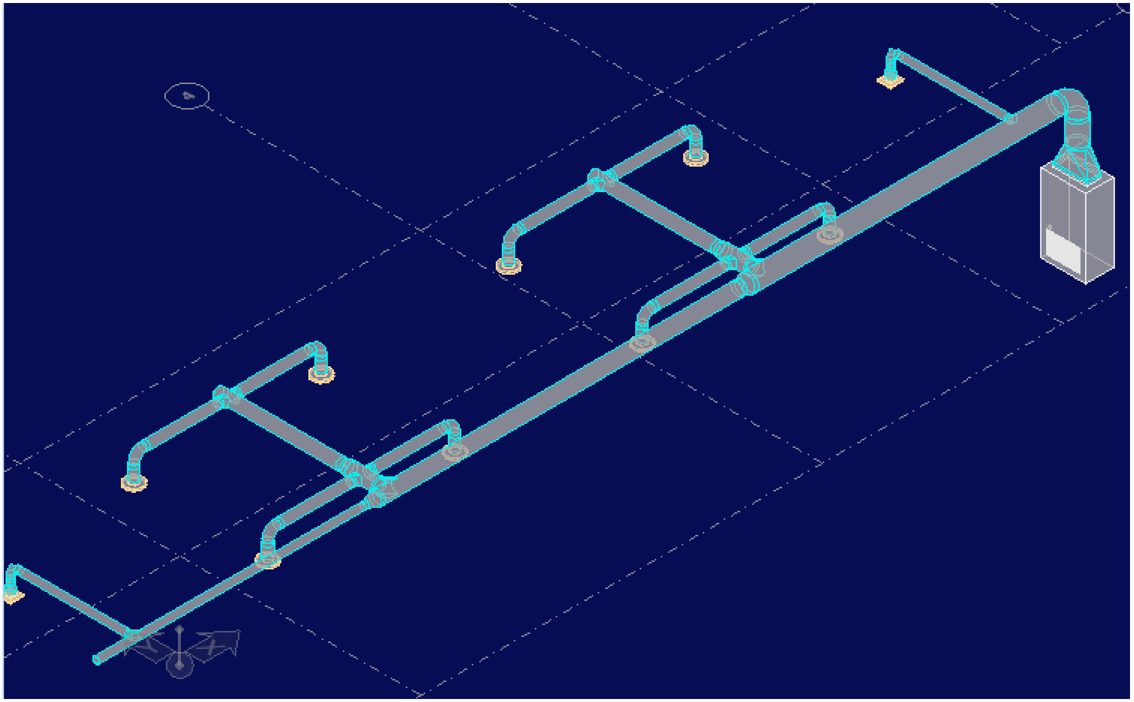
Editing in many fields is available to adjust specific data to refine the re-build process, such as locking sizes on sections and combining groups of outlets to reduce the number of transitions or adjusting loss coefficients for fittings to match conditions or standards. Once promoted the system will rebuild based on the values and restrictions defined within the system grid of the *Automated Duct Sizing* tool. After the system is balanced and pressure losses are in an acceptable range, you can write to model.

6. Select the **Promote to 3D** option from the *Rebuild* pull-down.



The single-line model has been rebuilt as a 3D model with the calculated duct sizes and the correct fittings.

7. Close the *Duct Sizing* dialog.



Exercise 6-5: Routing Piping

Both HVAC and Plumbing manipulation operations are associated with the component in your model. This includes standard modifications on duct or pipe like stretch, break, join, move, hookup, modify etc. Using the end points a drag manipulators, the ducts and pipes can further be lengthened or shortened to a required length.

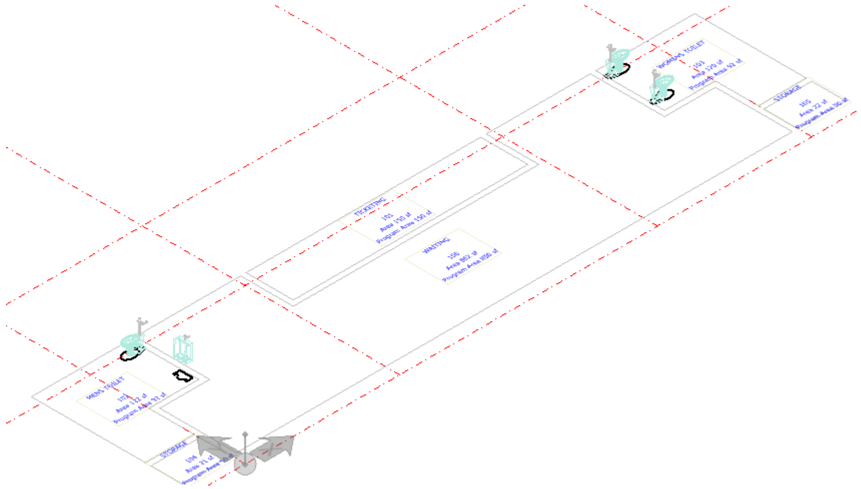
1. Open the References dialog and display on the Architectural reference.
2. Set the *Display Styles* for all views to **Wireframe:White Background**.

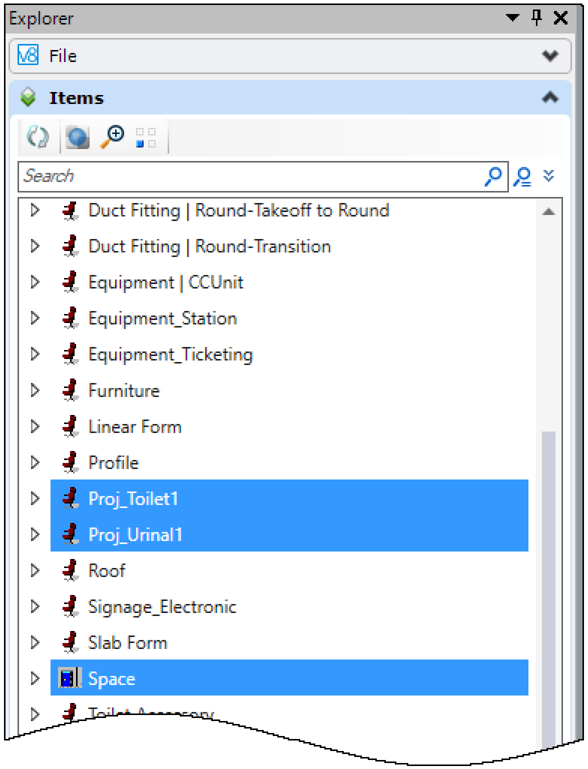
You will now create a *Display Set* of the plumbing fixtures and spaces from the architectural model. This will make it easier to layout the piping. For this you will use the *Items* tab in the *Explorer* dialog to create a selections set.

3. Expand the *Items* tab in the *Explorer* dialog.

   a. Select the **Space**, **Proj_Toilet1** and **Proj_Urinal1**. All the catalog instances form these three types will now be selected in the model.

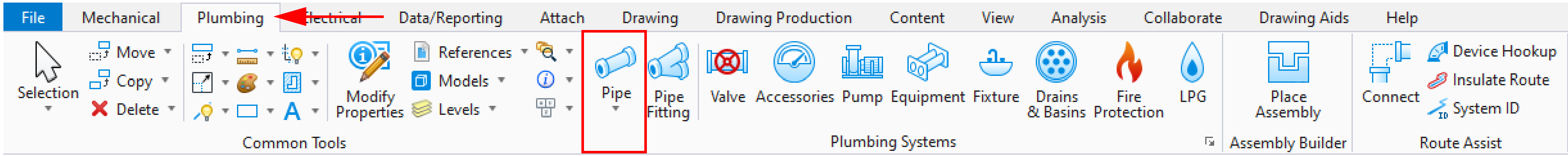
   b. *Right-press* in View 1 and select **Displayset Set**.





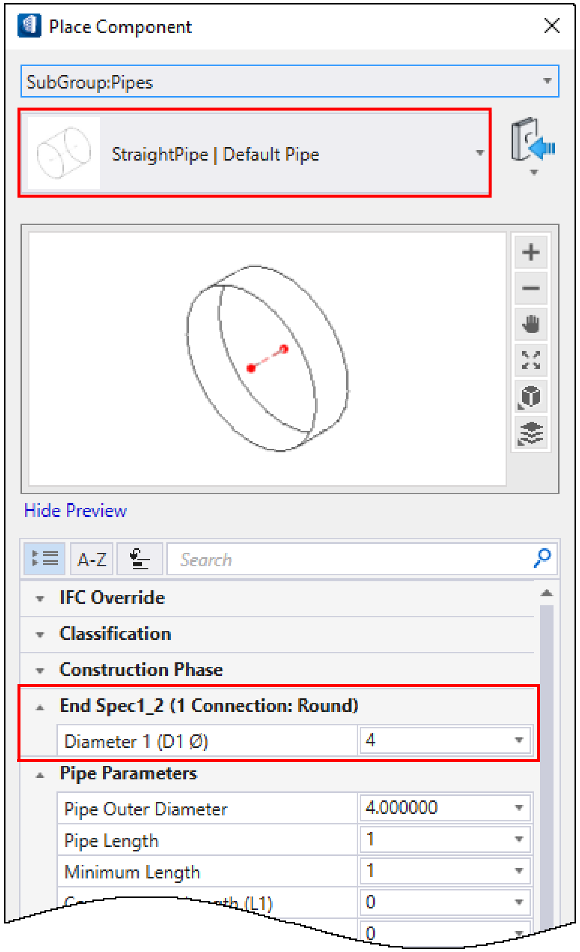
To start, you will place a main sewer pipe under the building. Then you will connect the toilets and urinal to that pipe, apply a slope to the pipes and finally adjust connections as needed.

4. Select the **Pipe** tool from the *Plumbing Systems* group on the *Plumbing* Tab.

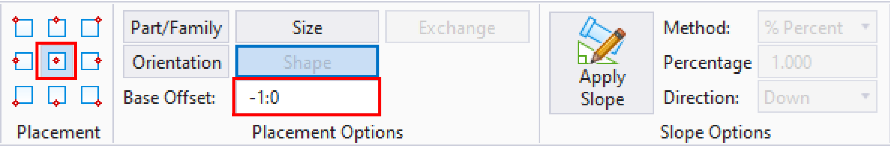


a. Set the pipe diameter on the *End Spec 1_2 (1 Connection: Round)* tab.

Diameter 1 (D1 Ø): **4** *[100]*



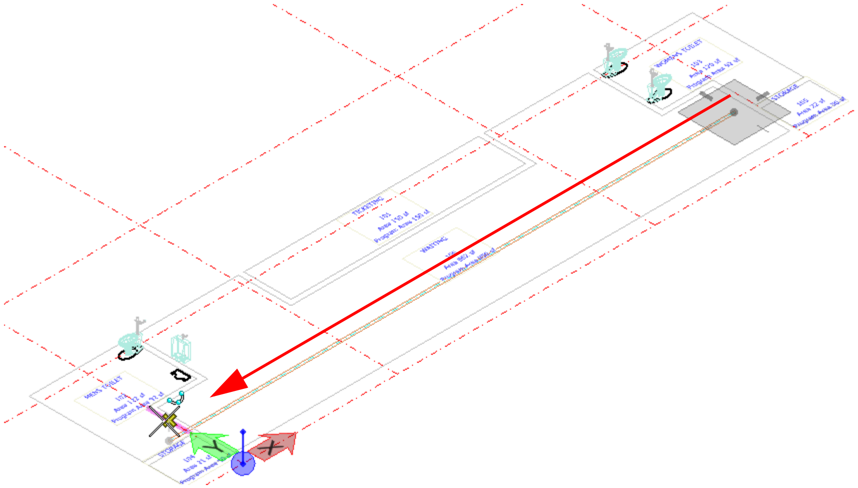
5. On the Placement ribbon set the *Base Offset* to **-2:0** *[-600 mm]*.



6. Set the *Floor Selector* to **Station> GROUND FLOOR**. The pipe will be placed **2:0** *[600 mm]* below this elevation, based on the *Base Offset*.

7. Set the *Family::Part* to **Plumbing::Sanitay Sewer-New**.

8. Place the Pipe from one end of the building to another connecting the two toilet rooms.

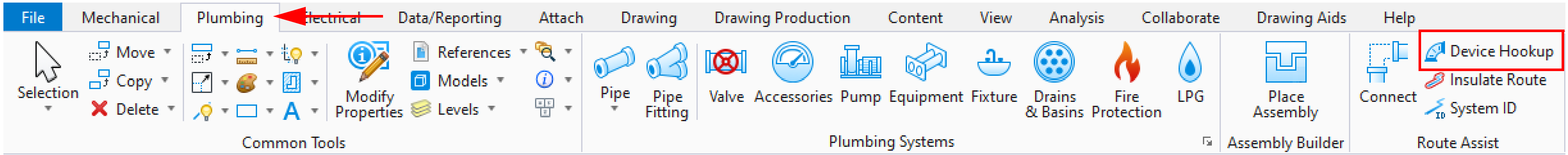


Device Hookup

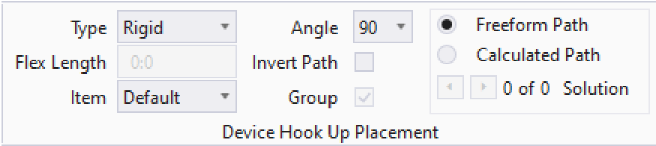
The *Device Hookup* tool is used to automatically connect disconnected components using combinations of fittings and rigid or flex components. Tool options provide additional detail for connection geometry.You will use the *Device Hookup* tool to connect the plumbing fixtures to the main pipe just placed. In order to connect components they must be in the active model, so you will copy the plumbing fixtures from the architectural model to the MEP model.

9. Select the four plumbing fixtures and use the **Copy** tool to copy them into the active model.

10. Select the **Device Hookup** tool from the *Route Assist* group on the *Plumbing* Tab.



a. On the *Placement* ribbon toggle on **Freeform Path** and set the following:



Type: **Rigid**

Item: **Default**

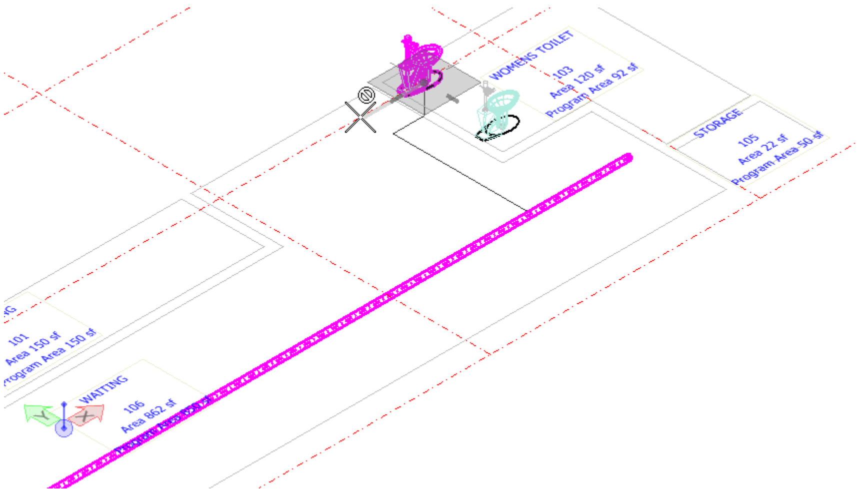
Angle: **90**

b. Toggle **off** the *ACS Plane* and *ACS Plane Snap* locks.

c. Select the first toilet near the sanitary connection.

d. Select the pipe. A free form path will appear.

Hint: Select the pipe at the midpoint of the pipe for more flexibility on the free form path.



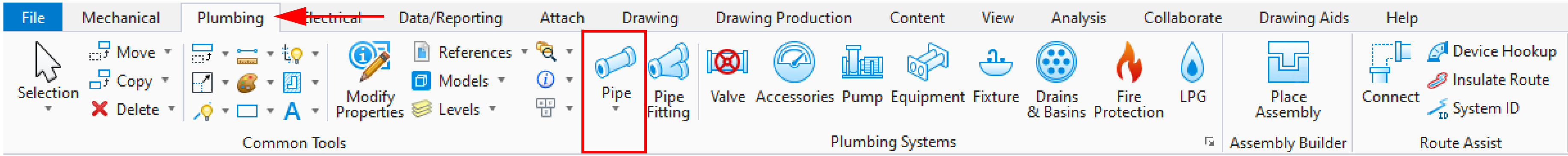
e. Move the cursor to adjust the path so that it is outside the 'Women's Toilet'. **Data point** (*left-click*) to accept.

A pipe route is placed connecting the toilet to the main sewer pipe. Elbows and fittings are added as needed.

11. Repeat the steps for the other two toilets, connecting the second toilet in the 'Women's Toilet' to the branch pipe from the first toilet.

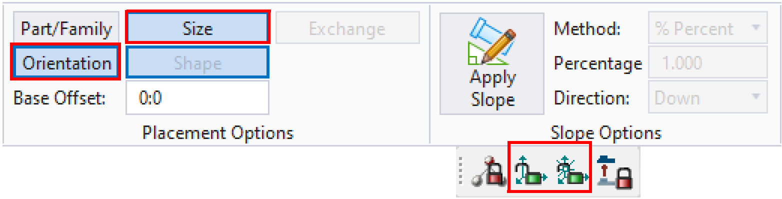
You will need to manually route the piping for the urinal as it needs to drop vertically in the wall behind the urinal.

12. Select the **Pipe** tool from the *Plumbing Systems* group on the *Plumbing* Tab.



a. On the *Placement* ribbon toggle on **Orientation** and **Size.** The size and orientation of the pipe will be determined by the connection point on the fixture.

b. Toggle **off** the *ACS Plane* and *ACS Plane Snap* locks.



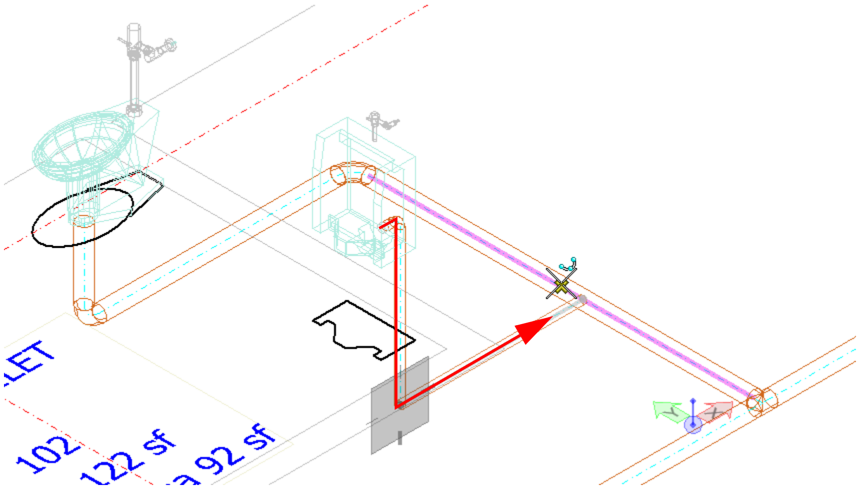
c. Snap to the sanitary connection point on the urinal and **data point** to accept. This will size the pipe and start the route.

d. Using *AccuDraw*, place the pipe horizontally **0:4** *[100 mm]* and data point to accept.

e. Type **F** to rotate the *AccuDraw* compass to a front orientation. Move the cursor down and type **Enter** to lock the *AccuDraw* axis in the vertical direction.

f. Snap to the branch pipe from the toilet to align the new pipe and **data point** (*left-click*) to accept.

g. Finally, place the pipe horizontally connecting to the branch pipe from the toilet.



13. Close the *Place Component* dialog.

Now that the plumbing route has been placed you will use the **Apply Slope** tool to properly slope the pipes.

Apply Slope

Apply Slope is a manipulation tool that is used to apply a slope to an existing route by sensing downstream connected components. Slope refers to small inclines in a route to facilitate flow or drainage from a system. The slope can be applied either up or down from a selection or start point and will continue through connections and even vertical risers if this option is selected. However, the slope will continue in the same direction so the start point must be selected carefully. For example, if you were to start the slope downward from the toilet in the 'Women's Toilet', the slope would continue down on the branches to the other connected toilets and urinal and this would be incorrect. It is better in this case, to use the outlet or lowest point of the main pipe and slope upwards from this pint.

14. Select the **Apply Pipe Slope** tool from the *Manipulate* group on the *Plumbing* Tab.

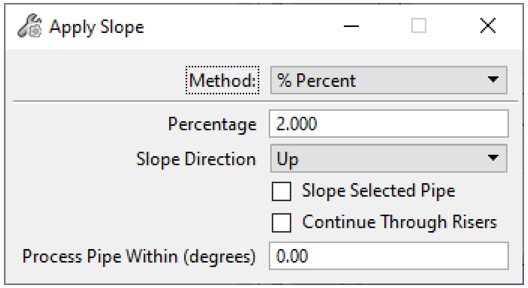
    a. Set the following settings on the *Apply Slope* dialog.

    Method: **% Percent**

    Percentage: **2.00**

    Slope Direction: **Up**

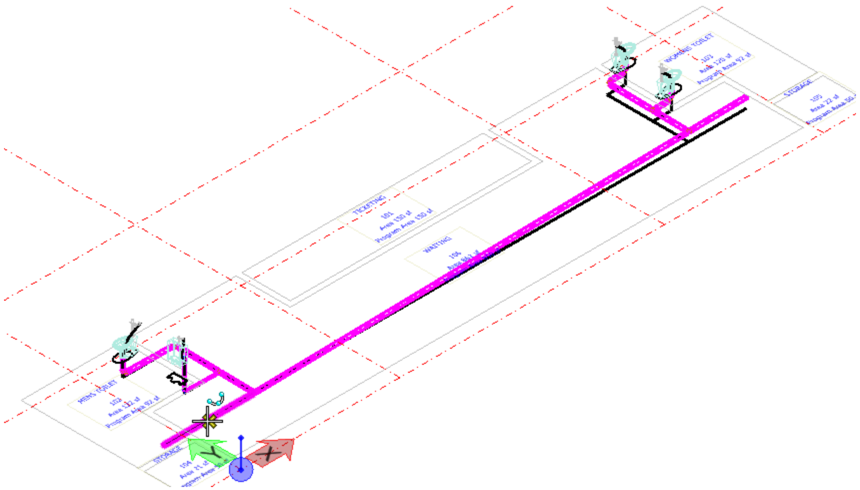
    Process Pipe Within (degrees): **0.00**



    b. Select the last piece of the main pipe. A preview will show the manipulated pipe, with a single black line indication the current location of the pipe.

    c. **Data point** (*left-click*) to accept.

The pipes and corresponding fittings are adjusted to the new slope. However, you may now want to replace some of the Tee connections with Wye fittings.



Connect Ducts/Pipes

The *Connect Ducts/Pipes* tool is used to quickly join common duct or pipe intersections; Turns, tees and cross intersections. Depending on the circumstances, individual fittings or a combination of fittings are inserted using Mechanical discipline's *auto fitting* placement functionality.

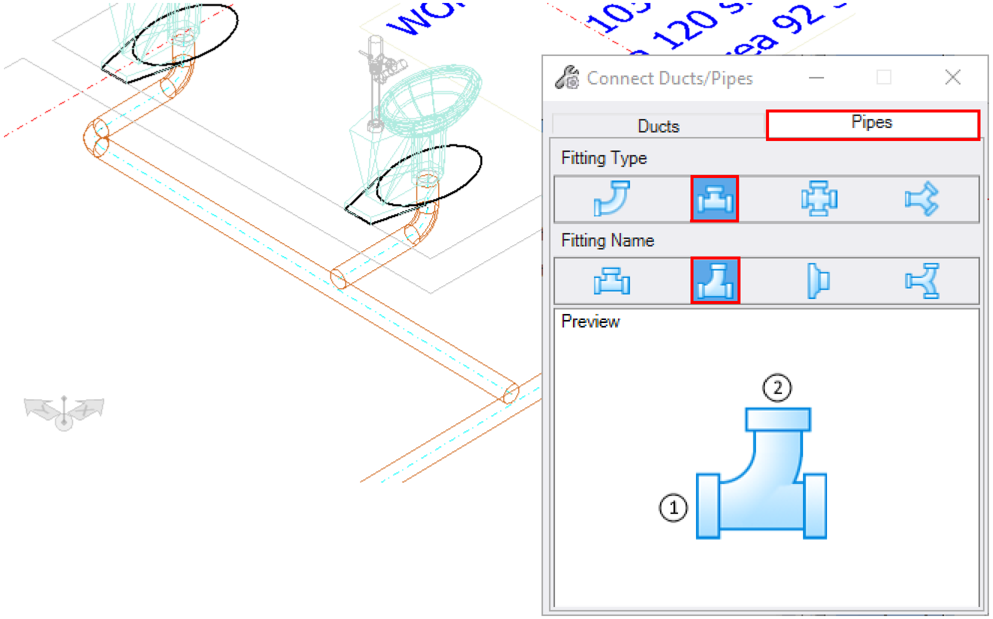
15. Delete the Tee connections from the second toilet in the ‘Women’s Toilet’ room and where this branch connects to the main sanitary line. Note that the straight pipe is joined together as one.

16. Select the **Connect** tool from the *Route Assist* group on the *Plumbing* ribbon.

    a. In the *Connect Ducts/Pipes* dialog select the **Pipes** tab.

       Fitting Type: **Join with Tee**

       Fitting Name: **Sanitary Tee**



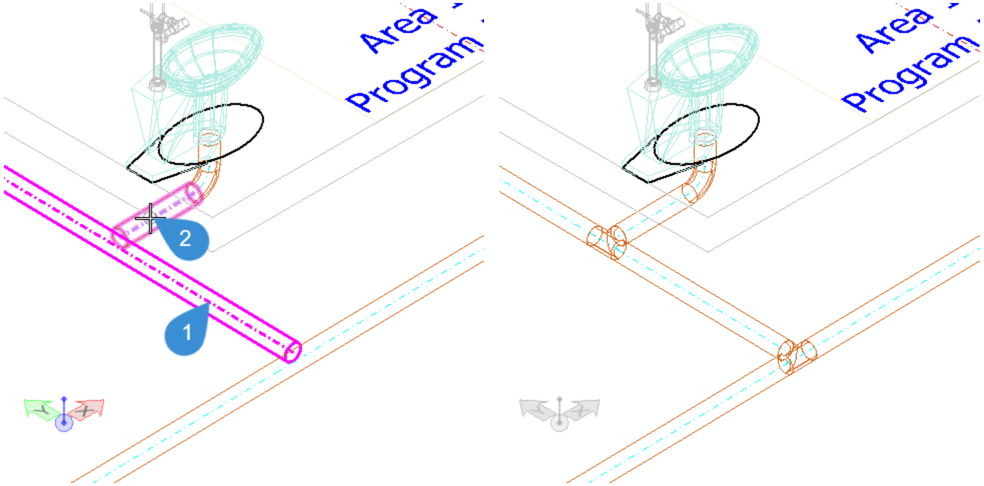
Note: The number 1 2 3 in the preview window represents the place order of each fitting, by which you can easily know how to place the fitting and tell which point need to be placed first.

    b. Select the first pipe.

    c. Select the second pipe.

A Wye connections is added correctly oriented based on the slope of the pipes.

17. Repeat for additional Wye connections.

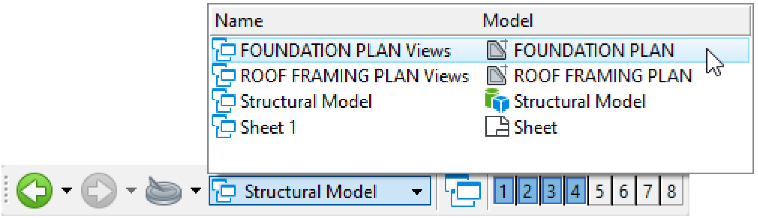


Use what you have learned to place cold and hot water supply piping for the toilet rooms. Remember to change the active *Family:Part* before placing the different types of piping. The toilets and urinal each have a supply connection. The sink does not, so you will need to size the piping and run it to the correct location at the sink.

Exercise 6-6: Reviewing Mechanical Drawings

Now that you have some basic HVAC and plumbing elements placed in the model you can review some of the output available from the model such as drawings. In this exercise you will learn how to open the drawing views to review the drawing information.

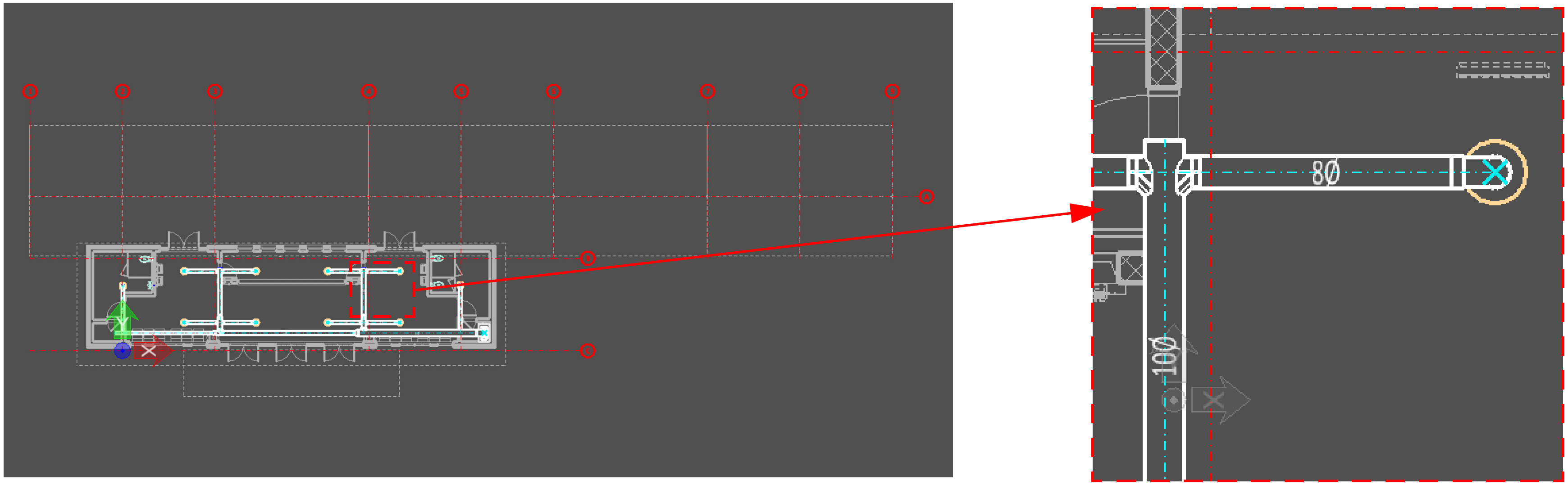
1. Select the *View Group* **HVAC PLAN** from the *Manage View Groups* tools on the lower right of the interface.



The **HVAC PLAN** drawing model will open. This plan is a cut view of the model referenced to this drawing.

This drawing actually references two dynamic views. In addition to the cut view of the HVAC model, the architectural background is a reference of the cut view in the architectural model that has had its *Reference Presentation* changed to halftone.

2. Zoom into one of the diffusers and ductwork.

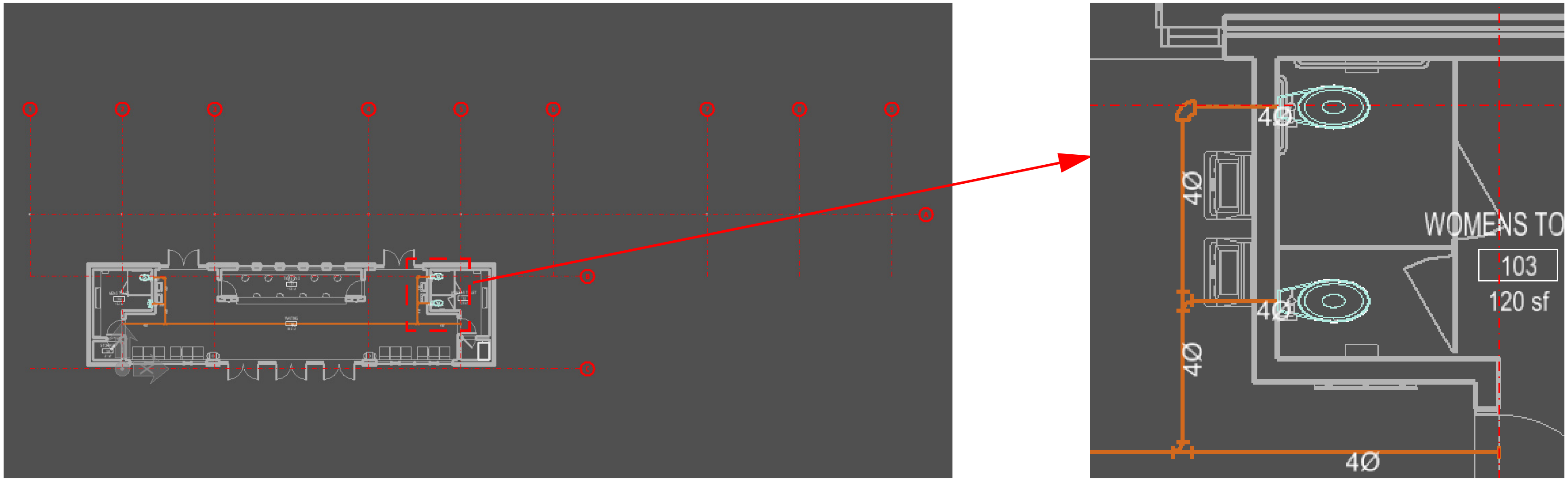


The line color, weight and symbology are all determined by the Family and Part assigned to each element.

The ductwork is labeled based on the *diameter* property that was assigned when placing the ductwork. *Mechanical rules* are used to extract this information from the model and use it in the drawing annotations. While mechanical rules can automate much of the drawing annotation additional annotations such as notes and dimensions would be added in this drawing model using standard text and dimension placement tools found on the *Drawing* tab of the ribbon.

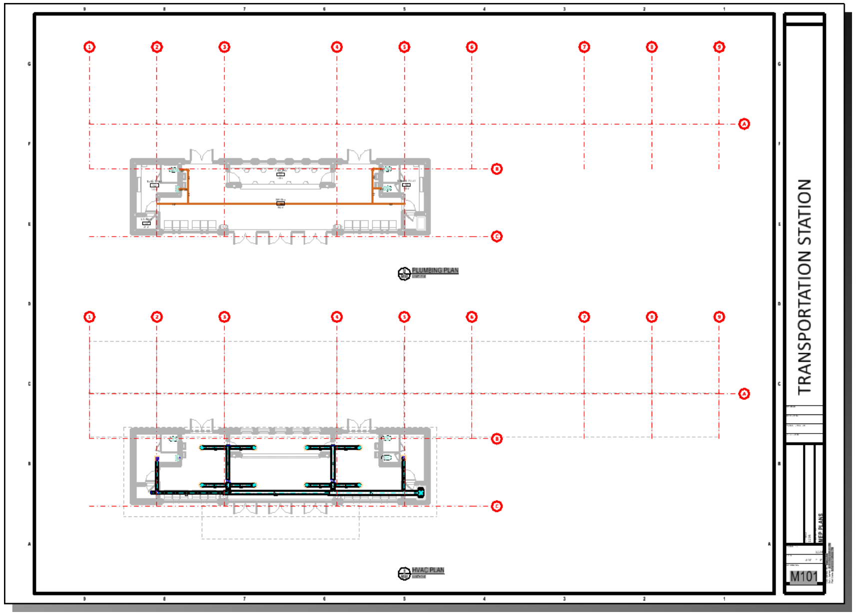
3. Select the *View Group* **PLUMBING PLAN**. The **PLUMBING PLAN** drawing model is opened.

4. Zoom into the plumbing at the 'WOMENS TOILET' room.



Note that *mechanical rules* are not only used to add the annotation, but in the case of the piping it is re-symbolized to a single line representation.

5. Select the *View Group* **Sheet 101**. This will open the model of the *Sheet*. This is a sheet model with a border file attached and each of the drawing models referenced and arranged on the sheet ready for plotting.

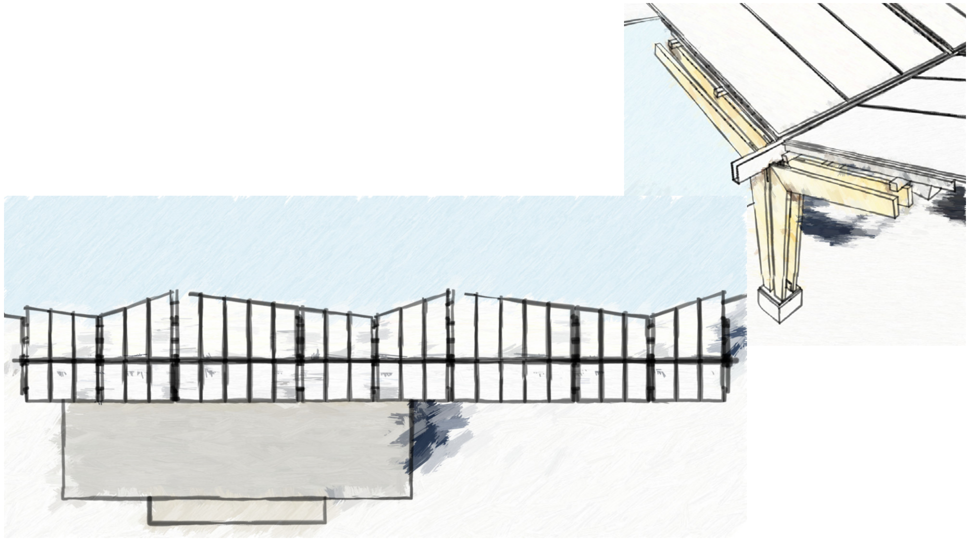


In this chapter, *Chapter 6: Modeling Mechanical and Plumbing Components*, you have modeled the basic components of the HVAC and plumbing systems for the station building. You have placed equipment and diffusers, placed single-line ductwork, sized the system and converted it to 3D ductwork. You have also routed plumbing, placing a main sanitary line, used the Device Hookup tool to connect fixtures, added slope tot he entire route and then modified connection fittings. The geometry and information that was modeled in the 3D model is now reflected in the 2D drawings.

The one item you still need to model is the platform canopy. In the next chapter you will apply some of the skills you have learned throughout this course and model a custom glass canopy with tapered wood members.

Chapter 7. Advanced Modeling - The Roof Canopy

Throughout this course you have learned a number of basic modeling tools and techniques to model standard architectural and structural elements. You have built a simple model of a simple building. Of course, designs are not always standard or simple, in fact they are often not standard at all. Lets look at some of sketches for the platform roof canopy. Note that the designer is suggesting to use tapered wood columns and beams supporting a glass panel roof.   Each side of the platform canopy slopes at different angles and in fact he wants to jog the edge of the canopy to follow the curb line where the buses disembark.



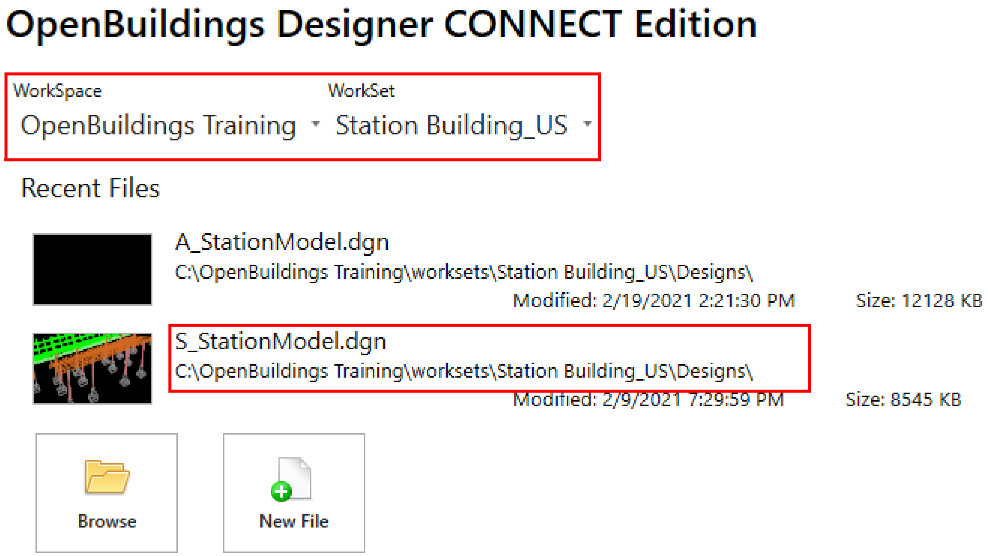
In the next series of exercises you will use tools and techniques you have learned in this course in conjunction with more advanced modeling techniques to model the custom platform roof canopy.

1. Start **OpenBuildings Designer** from the Start menu or desktop shortcut.

   WorkSpace: **OpenBuildings Training**

   WorkSet: **Station Building_US** *[Station Building_NM]*

2. Select the file **S_StationModel.dgn** from the list of *Recent Files*. The file will open.



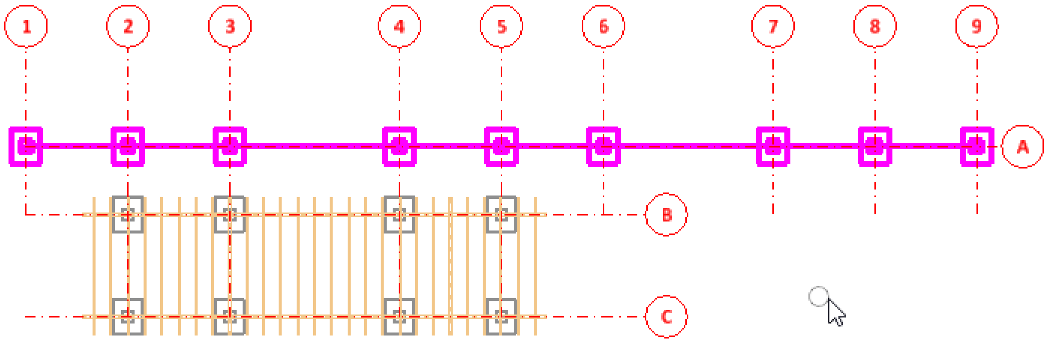
Optional - If you did not complete the exercises in the previous chapters and would like a completed model to start the exercises in Chapter 6, use the Browse icon to browse to the *Station Building_US / X_Milestones* folder and open the file **S_StationModel-6.dgn**.

You are ready to start the exercises for *Chapter 7: Advanced Modeling - The Roof Canopy*.

Exercise 7-1: Placing Plates

In this exercise you will be introduced to some more detailed modeling. In *Chapter 3: Modeling Structural Elements* you placed some standard steel columns and beams to support the platform canopy. You will use that as the base support and then add tapered wood columns and beams and attach them to the steel column. In order to make this attachment you will want some plates, so in this session you will add several different types of plates to the model.

1. Create a *DisplaySet* of the columns, beams and footings that make up the canopy support.



Base Plates

You will start with a simple detail, adding a base plate for each of the steel columns.

2. Select the **Base Plate** tool from the *Structural Elements* group on the *Structural* ribbon.

   a. Set the *Catalog Item* to **1 1/2" base plate** *[32 mm base plate]*.

   b. On the *Placement* ribbon set the following:

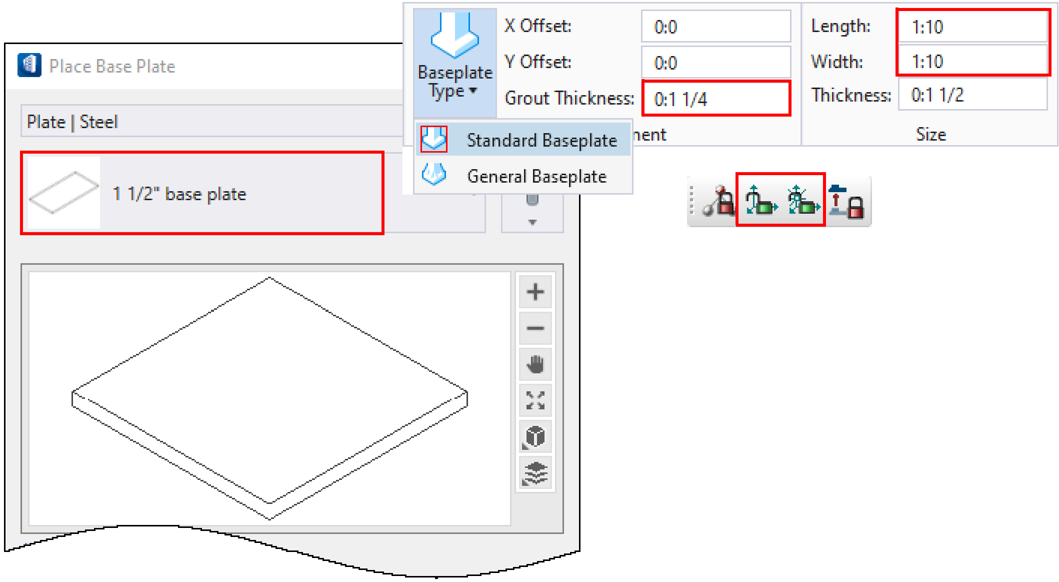
      Baseplate Type: **Standard Baseplate**

      Grout Thickness: **0:1 1/4** *[30 mm]*

      Length: **1:10** *[550 mm]*

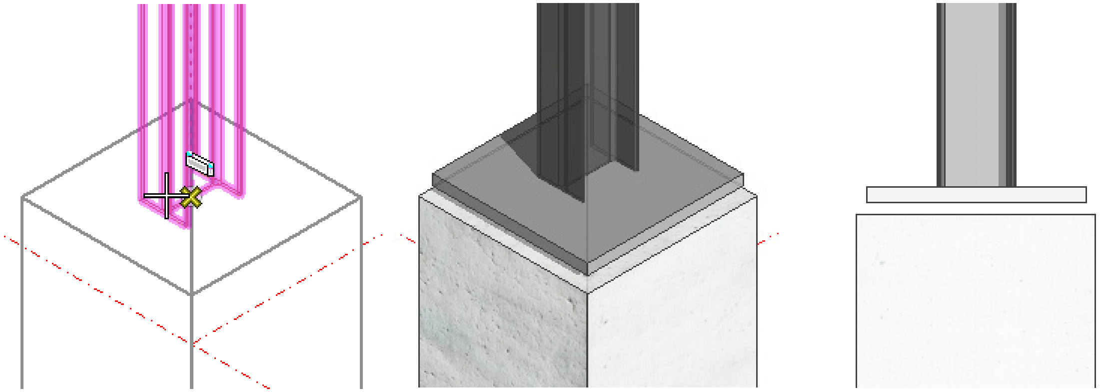
      Width: **1:10** *[550 mm]*

   c. Unlock the *ACS Plane* and *ACS Plane Snap* lock and toggle **on** the *Structural Snaps*.



d. Select the bottom of each steel column.

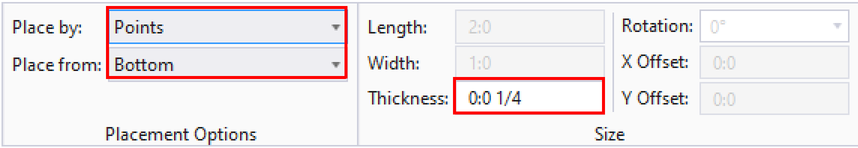
The base plate is placed, offset for the grout thickness and the column is trimmed to meet the base plate.



Plates

Now you will add additional plates on the column that will be used to support the tapered wood members. This time you will actually draw the shape of the plate using *AccuDraw*.

3. Select the **Plate** tool from the *Structural Elements* group on the *Structural* ribbon.Set the *Catalog Item* to **1/4" plate** *[6 mm plate].*

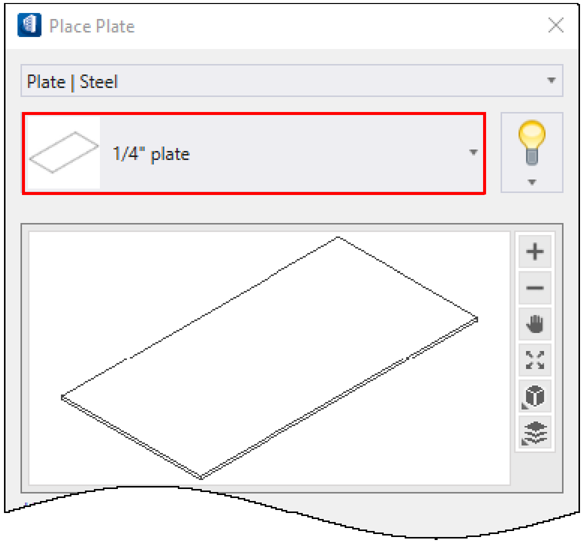


Rather than simply use the **Rectangle by Single Point** *Place By* method, you will switch it to **Points.** This will give you more control over the placement of the plate.

Place By: **Points**

Place From: **Bottom**

Thickness: **0:0 1/4** *[6 mm]*



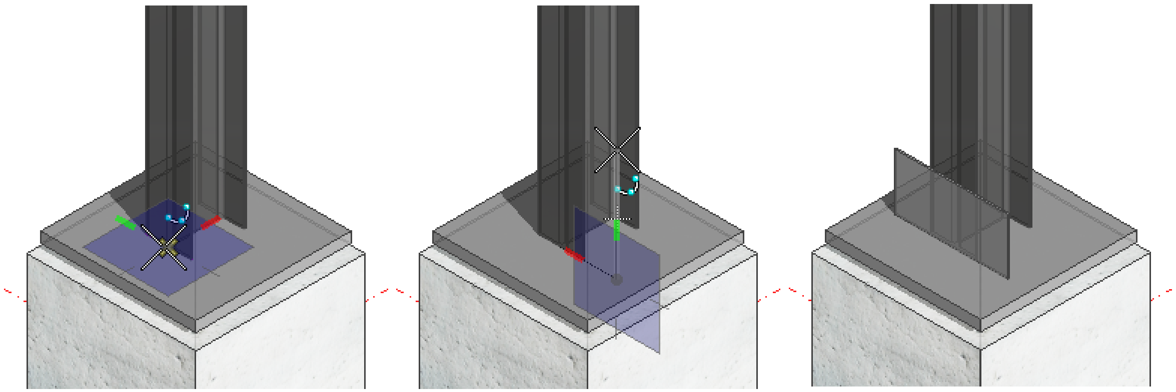
a. Turn off the structural snap so that you can snap to any keypoint on the steel member.

4. Place the plate in the model.

   a. Snap to the bottom center of the face of the column.

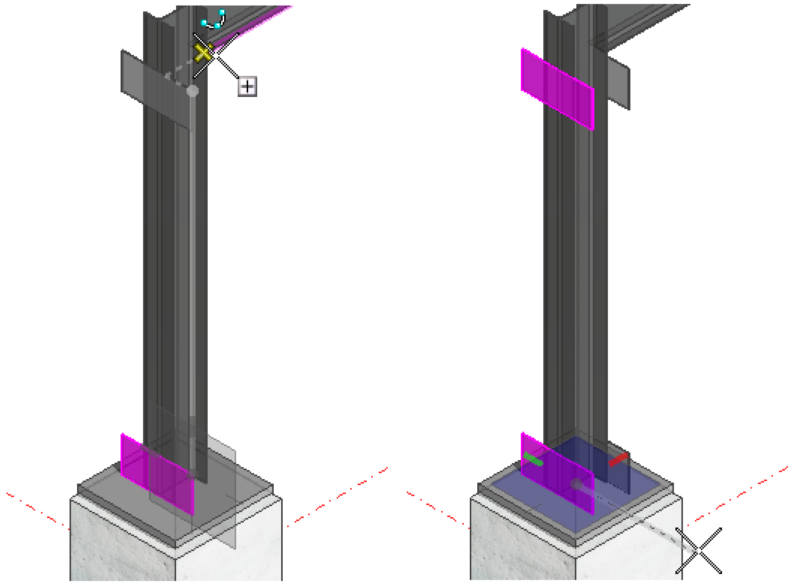
   b. Type **S** to rotate the compass to a *Side* orientation. Then using AccuDraw select the next point **0:8** *[200 mm]* in the *X* direction and **Data point** *(left-click)* to accept.

   c. Continue to define points to create a plate that is **1:4 x 0:8** *[400 mm x 200 mm]* on the front face of the column flange.



5. **Copy** the plate up the face of the column to the underside of the beam.

6. **Mirror** both plates to the opposite side of the column.



You should now have 4 plates attached to the column, these will be used to help support the tapered wood members. You will complete the entire assembly for one column and then create a structural assembly to place the same assembly of components at the other columns.

Bent Plates (Challenge)

For an additional challenge you can use the **Plate** tool to create the support between the steel column and the timber gluelam beams supporting the station roof.

7. Clear the current *DisplaySet* and create a new *DisplaySet* of one steel column and the timber gluelam beam that support the station building roof.

   a. Toggle **on** the *Structural Snaps*.

8. Select the **Plate** tool from the *Structural Elements* group on the *Structural* ribbon.

   a. Set the *Catalog Item* to **1/4" Plate** *[6 mm plate]*.

   b. Set the following:

      Place By: **Rectangle by single Point**

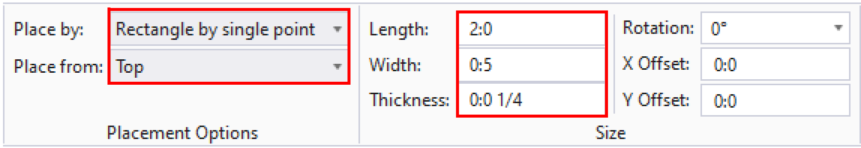
      Place From: **Top**

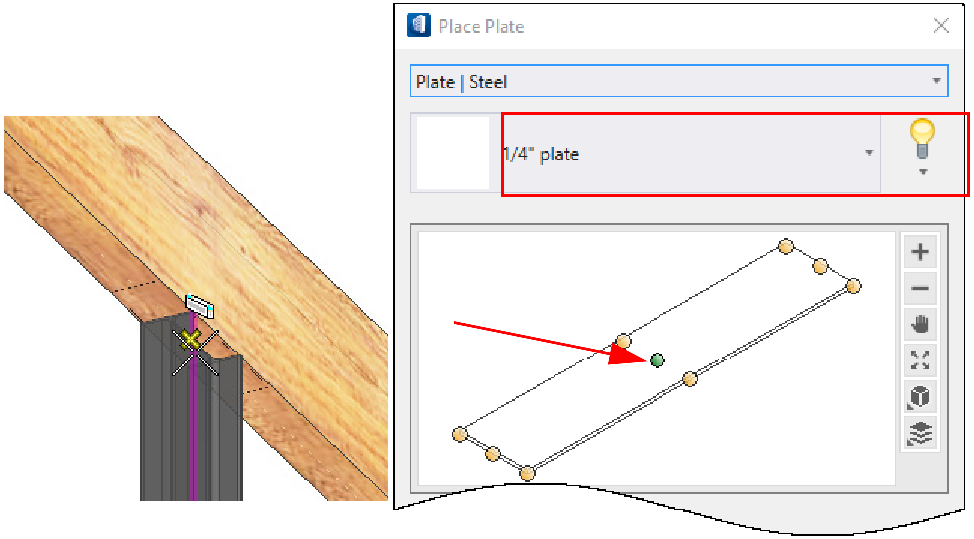
      Length: **2:0** *[600 mm]*

      Width: **0:5** *[150 mm]*

      Thickness: **0:0 1/4** *[6 mm]*

   a. Select the top of the steel column to place the plate.





A plate is created between the column and beam. Now you can add a flange to both sides of the plate to create the support.

9. Select the **Add Flanges** tool from the *Structural Elements* group on the *Structural* ribbon.

   a. Set the following:

      Tool Mode: **Add**

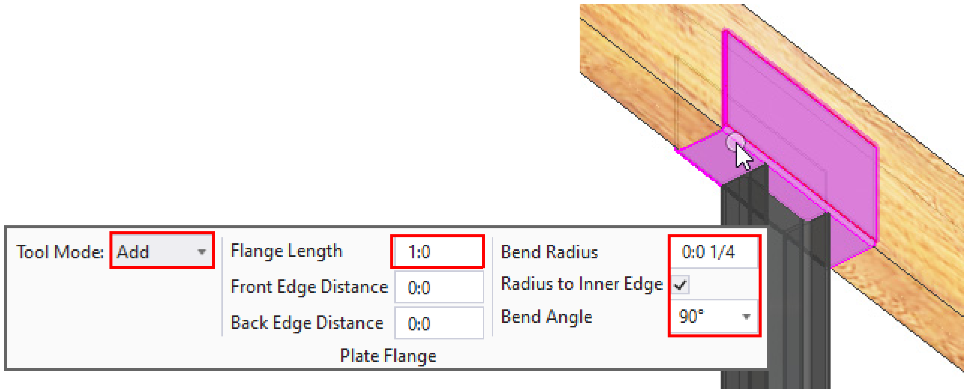
      Flange Length: **1:0** *[300 mm]*

      Bend Radius: **0:1/4** *[6 mm]*

      Radius to Inner Edge:

      Bend Angle: **90°**

   b. Select the long edge of the plate, **data point** to accept.



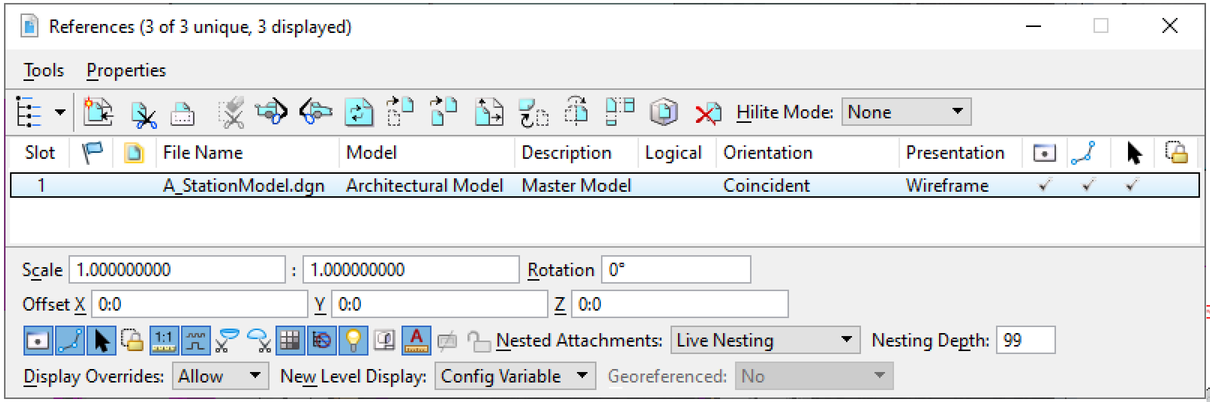
10. Repeat at each column.

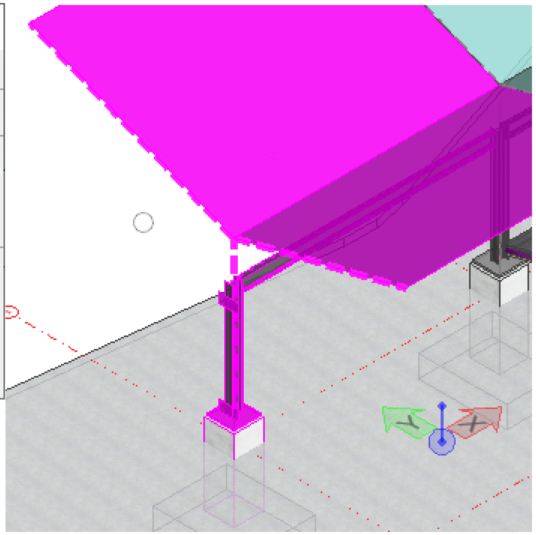
In this exercise you have placed base plates for columns, connection plates and added flanges to a plate to create a bent plate support. In the next exercise you will add the tapered timber members for the canopy support.

Exercise 7-2: Placing Tapered Columns and Beams

In this exercise you will model tapered wood columns and beams for the roof canopy supports.

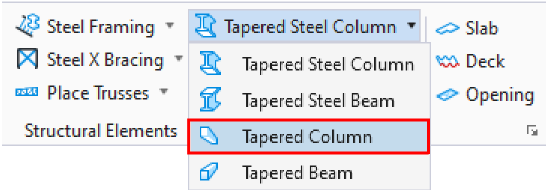
1. Open the *Reference* dialog and display on the **A_StationModel.dgn** reference file.
2. Make a *DisplaySet* of the column, beam, footing and plates at grid line **A1**.





Tapered Columns

3. Select the **Tapered Column** tool from the *Structural Elements* group on the *Structural* ribbon.

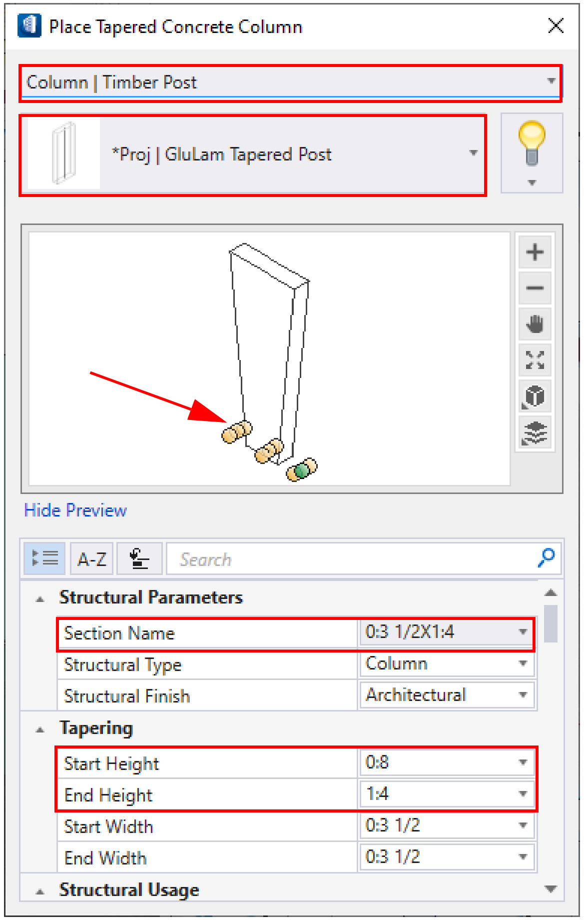


a. Set the *Catalog Type* to **Column | Timber Post** and the *Catolg Item* to ***Proj | Gluelam Tapered Post.**

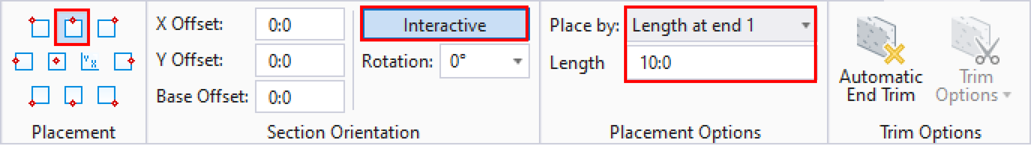
Section Name: **0:3 1/2 x 1:4** *[100 mm x 400 mm]*

Start Height: **0:8** *[200 mm]*

End Height: **1:4** *[400 mm]*



b. On the Placement ribbon set the following:



Placement: **Top Center**

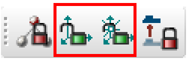
Rotation: **Interactive**

Place By: **Length at End 1**

Length: **10:0** *[3000 mm]*

You will initially place the column at the center of the steel column, then move it more precisely into position.

4. Toggle **on** the *Structural Snaps* and unlock the *ACS Plane* and *ACS Plane Snap* lock

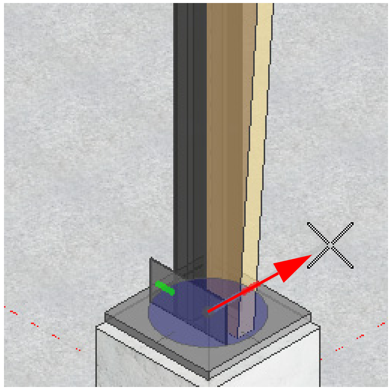


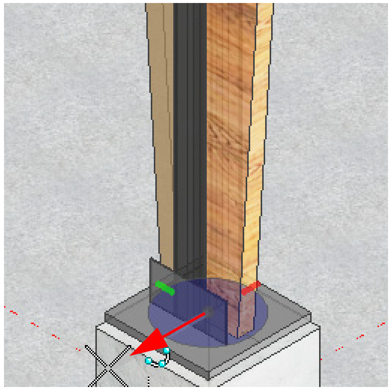
5. Snap to the base of the column and **data point** *(left-click)* to accept.

   a. **Data point** again to define the rotation. The first column is placed.

6. Set the rotation back to **Interactive** on the *Placement* ribbon, and then place a second column rotating the column in the opposite direction.

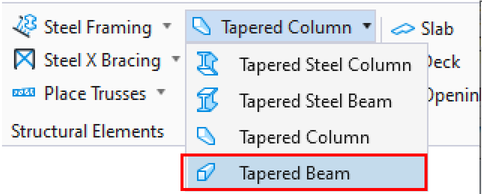
7. Use the **Move** tool to move each column **0:2 1/2** *[65 mm]* away from the center of the column, creating a **0:5** *[130 mm]* gap between the columns.

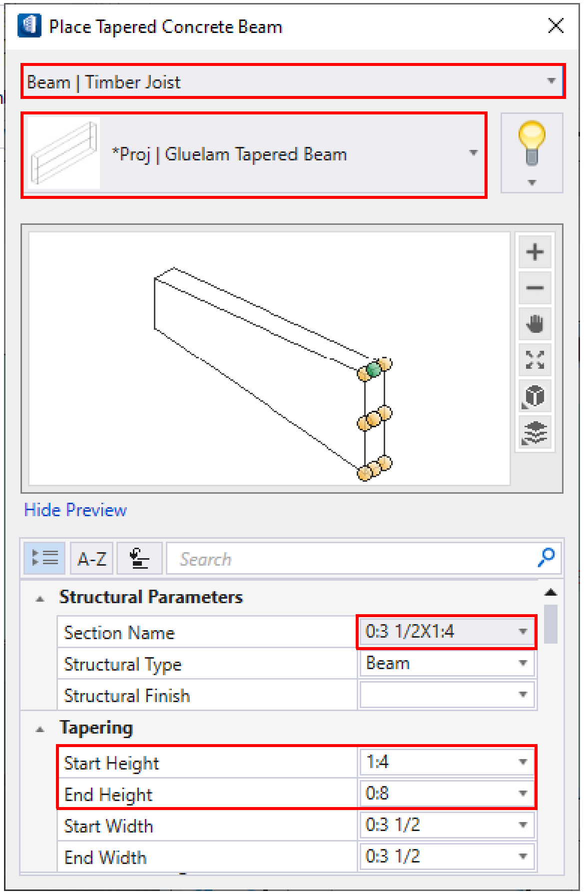




Tapered Beams

8. Select the **Tapered Beam** tool from the *Structural Elements* group on the *Structural* ribbon.





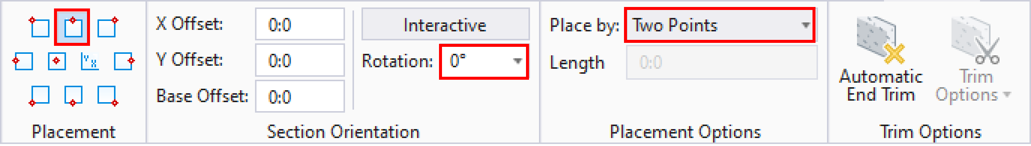
   a. Set the *Catalog Type* to **Beam | Timber Joist** and the *Catalog Item* to ***Proj | Gluelam Tapered Beam.**

      Section Name: **0:3 1/2 x 1:4** *[100 mm x 400 mm]*

      Start Height: **1:4** *[400 mm]*

      End Height: **0:8** *[200 mm]*

   b. On the Placement ribbon set the following:



      Placement: **Top Center**

      Place By: **Two Points**

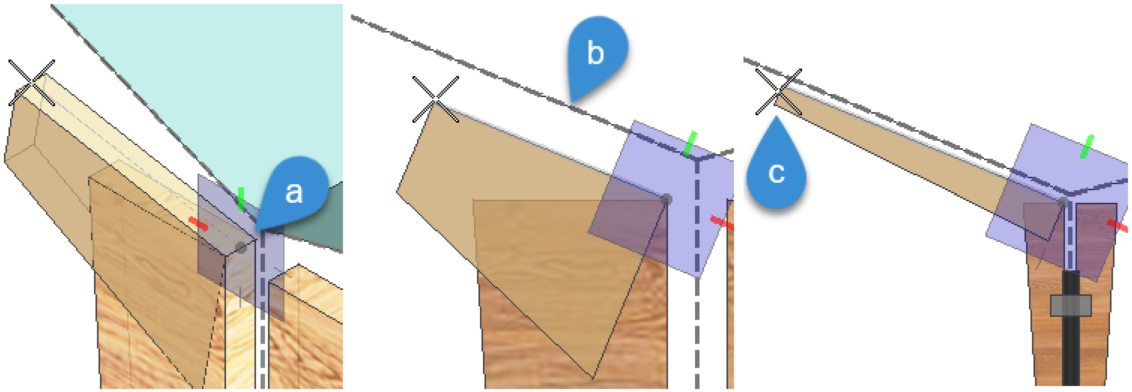
      Rotation: **0:0**

9. Place the longer beam.

   a. Using the structural snap, select a start point at the top center edge of the column.

   b. Rotate compass to side. Type **RE** to rotate to element and select the angled canopy from Architectural model.

   c. Type enter to lock axis, and input a distance of **10:0** *[3000 mm]*. **Data point** *(left-click)* to accept.



10. In the *Place Tapered Beam* dialog change the settings for the second beam. This beam is shorter, so the *End Height* is adjusted to create the same taper.

    Start Height: **1:4** *[400 mm]*

    End Height: **0:10** *[250 mm]*

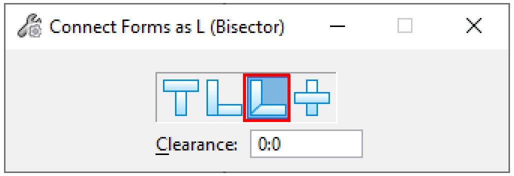
11. Place the shorter beam. select top of column.

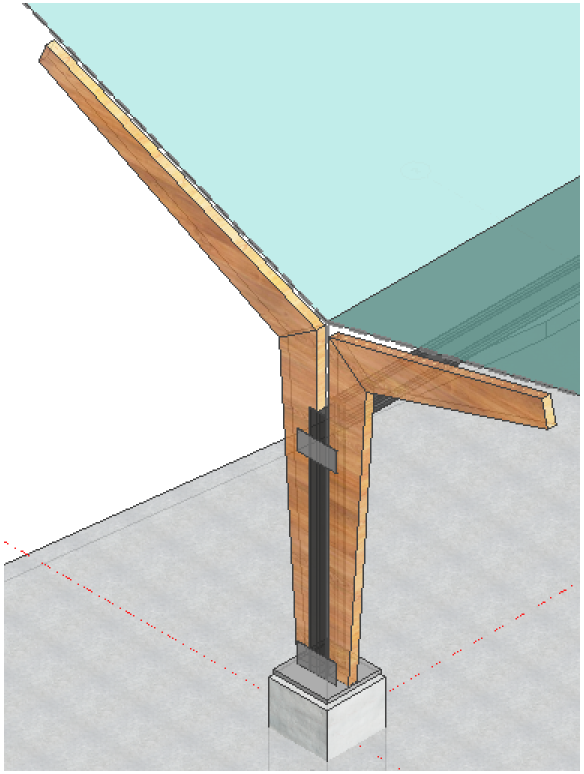
    a. Using the structural snap, select a start point at the top center edge of the column.

    b. Rotate compass to side. Type **RE** to rotate to element and select the angled canopy from Architectural model.

    a. Type enter to lock axis, and input a distance of **7:6** *[2250 mm]*. **Data point** *(left-click)* to accept.

12. Use Connect Shapes tool to miter the connection between the column and beam.





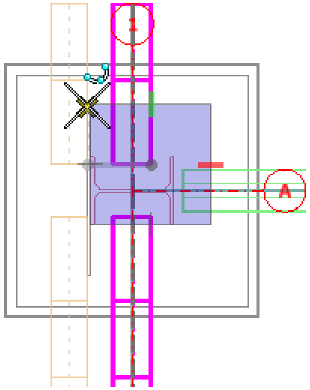
You have now modeled the tapered columns and beams, but this is still not exactly what is designed in the sketch, you need to create a double set of columns and beams.

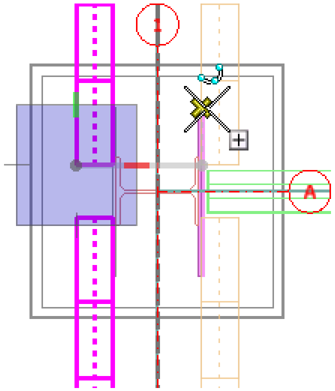
You will move the tapered columns and beams to one face of the steel column, and then copy them to the other face of the steel column.

13. Make a selection set of both columns and beams.

14. Use the **Move** tool to move everything to the face of the plate created earlier.

15. Use the **Copy** tool to copy everything to the face of the plate on the opposite side of the column.





To complete the tapered columns and beams you will embed a plate at the mitered connection.

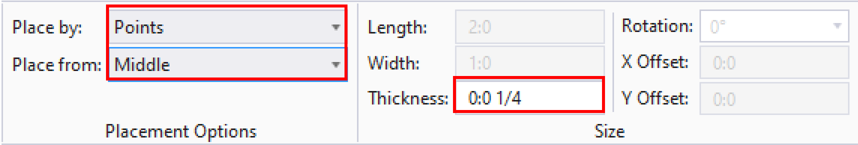
16. Select the **Plate** tool from the *Structural Elements* group on the *Structural* ribbon.

    a. Set the *Catalog Item* to **1/4" plate** *[6mm plate].*

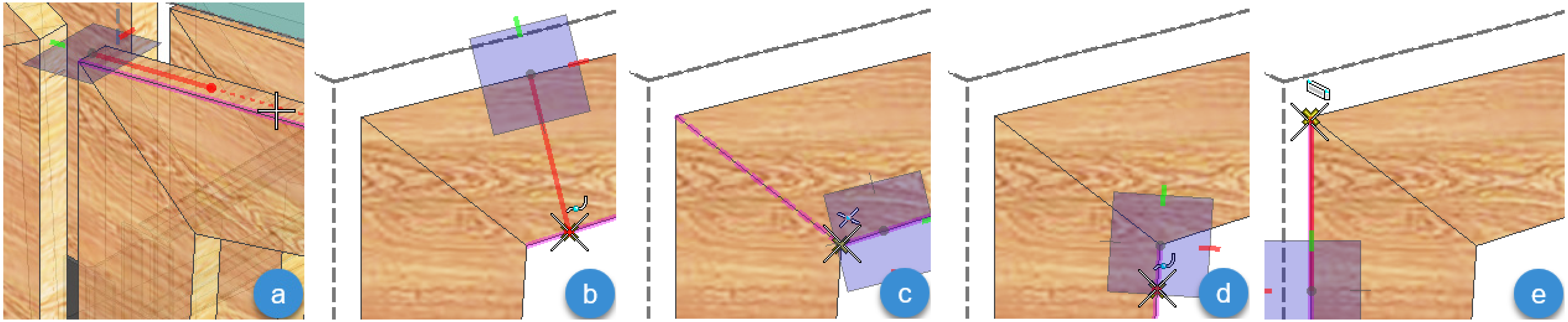
    b. On the Placement ribbon set the following:

    Place By: **Points**

    Place From: **Middle**



17. Place a shape at the center of the beam and column connection, using *AccuDraw* to get all the angles correct.



    a. Select the top center of the column for the start point.Type **RE** to rotate compass to the beam angle and define a distance of **1:4** *[400 mm]*. **Data point** *(left-click)* to accept.

    b. Move to a *Side* view. With the compass still rotated to match the beam, type **E** to rotate the compass 90° from its current plane. Move the cursor perpendicular to the top of the beam and use **Enter** to lock this angle. Type **N** to set the snap to *Nearest* and move your cursor over the bottom edge of the beam, this will be the intersection of the projected locked angle. **Data point** *(left-click)* to accept.

    c. Type **I** to set the snap to *Intersection* and snap to the intersection of the column and beam. **Data point** *(left-click)* to accept.

    d. Type **RE** to rotate compass to the tapered edge of the column and define a distance of **0:4** *[100 mm]*. **Data point** *(left-click)* to accept.

    e. Type **S** to rotate the compass back to the *Side* orientation with the *X* and *Y* axis aligned with the view, then use **Enter to** lock the axis and define the distance by snapping to the straight edge of the column.

    f. Complete the plate by snapping back to the start point.

The plate is embedded in the middle of the column and beam joint.

18. Create a second plate for the second column and beam.

19. Once both plates are created copy them to the other column and beam.

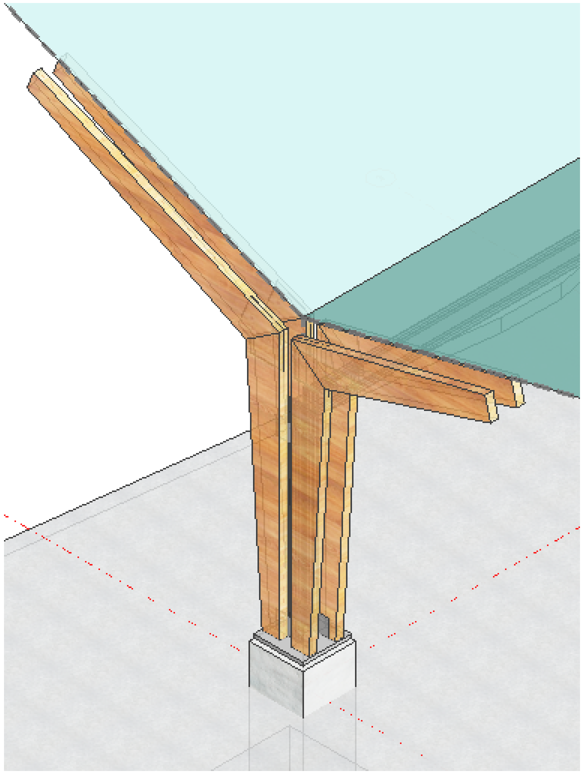
You have now completed the canopy support assembly for one column.

20. Create a *Selection Set* of the 4 tapered wood columns and the 4 tapered wood beams along with the supporting plates. Do not include the steel column.

21. **Copy** the selection set to the other canopy support columns, snapping to the steel column for placement.

In this exercise you placed tapered beams and columns precisely where you wanted them in the model. Once that was finished you grouped the components into a selection set and copied it to the other columns.

In the next exercise you will finish the structure for the roof canopy by adding purlins to support the glass panels.



Exercise 7-4: Framing Purlins

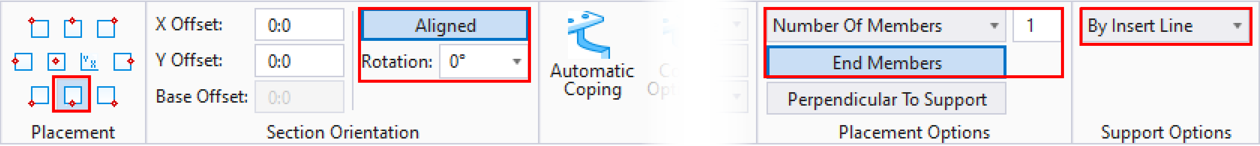
In this exercise you will add steel purlins spanning between the wood supports. You will want to pay attention the spacing of the purlins as well as their rotation so that they sit correctly on the wood supports.

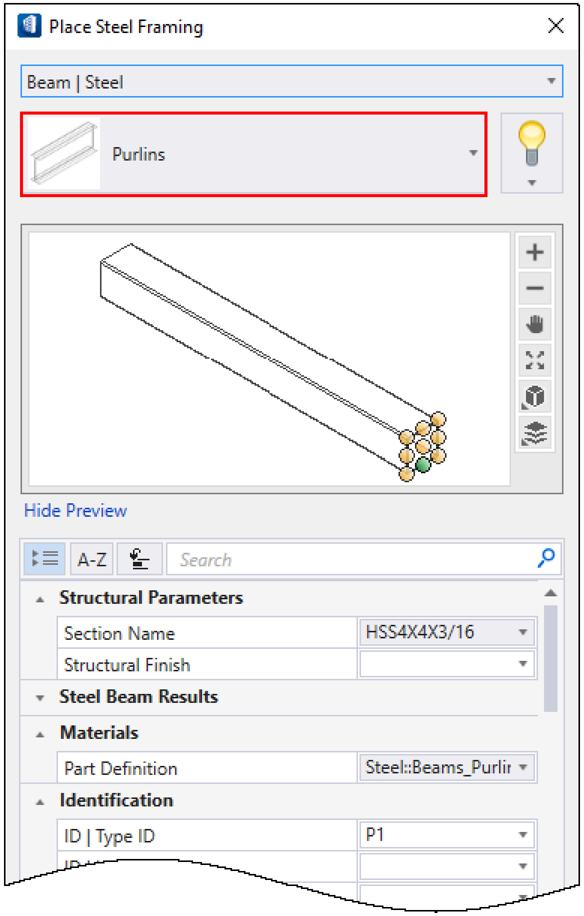
You will first create the framing on the first three bays, then you can copy it to the remaining bays since the spacing repeats.

1. Select the **Steel Framing** tool from the *Structural Elements* group on the *Structural* ribbon.

   a. Set the *Catalog Item* to **P1 | Purlins**. This is a tube purlin already created for this project and in the WorkSet library.

   b. Set the *Placement* options:





Placement: **Bottom Center**

Rotation: **0**

Aligned: **On** - This will rotate the purlin to the slope of the wood member.

Automatic Coping: **Off**

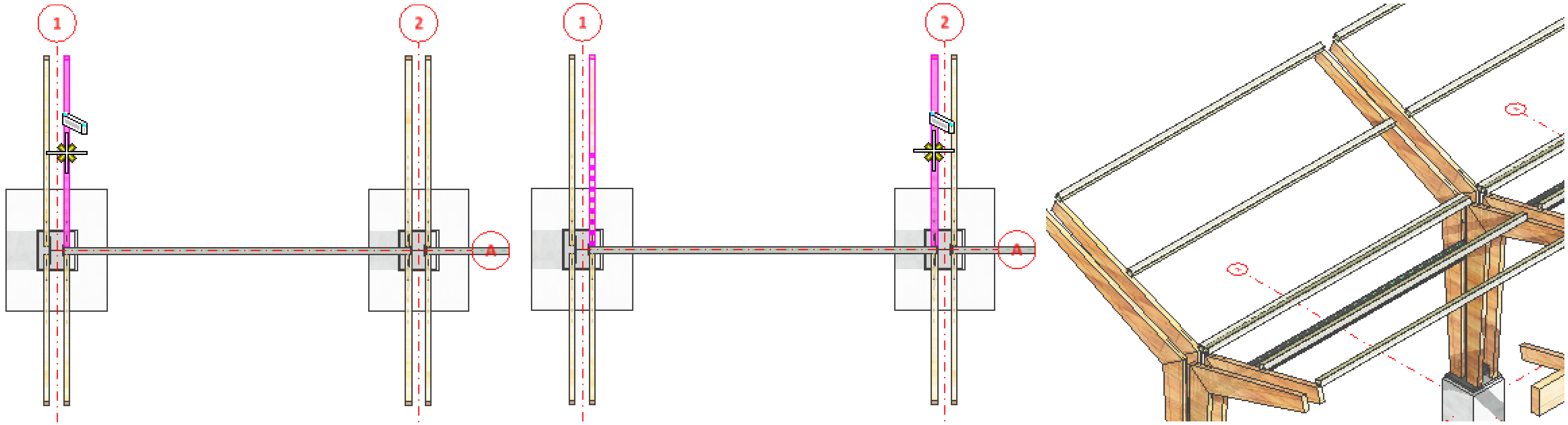
Number of Members: **1**

End Members: **On** - This will create end members at both ends of the support.

Support Options: **By Insert Line** - The placement line of the supporting member.

c. Select the first support

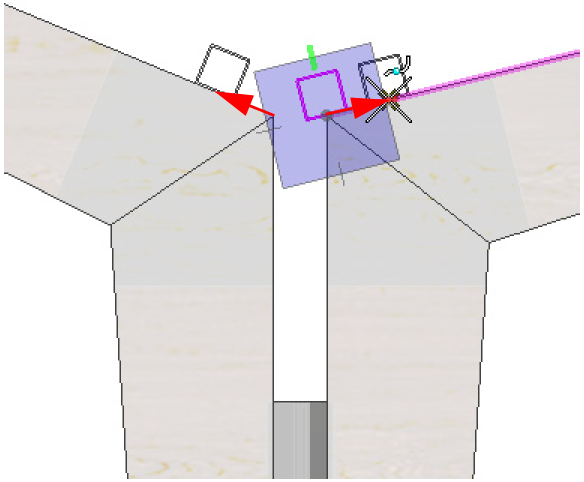
d. Select the second support..



Three framing members are placed between the two supports.

2. Repeat for the first three bays on both sides of the steel beam. After that the spacing repeats and you will be able to copy the completed framing when finished.

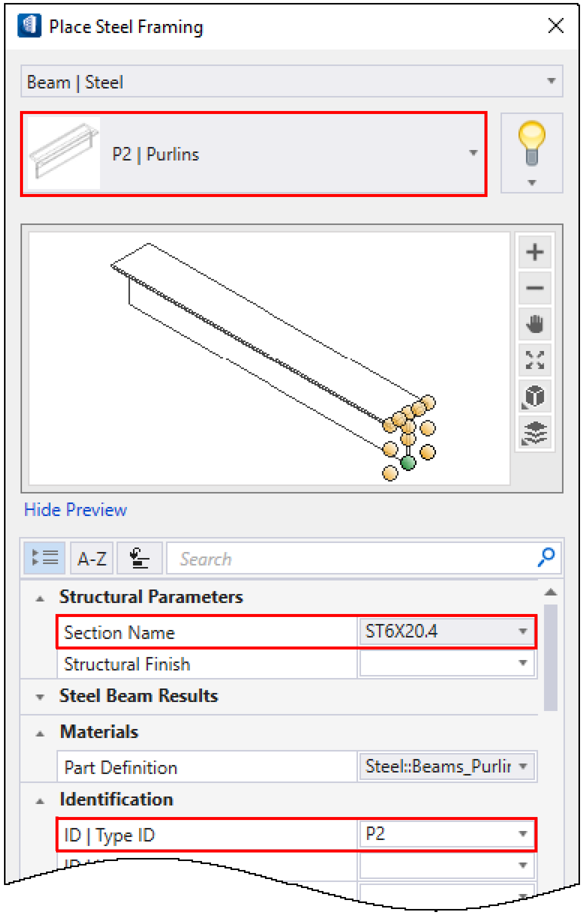
3. In the *Side* view select each set of end members and move away from the end by a distance of **0:6** *[150 mm]*. so that the members are not centered on the ends of the wood beams.



4. Repeat for each bay.

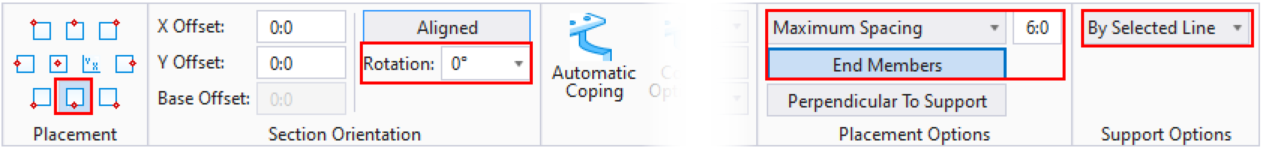
Now you will add additional framing between these purlins, these are the members that will actually support the glass panels.

5. Select the **Steel Framing** tool from the *Structural Elements* group on the *Structural* ribbon.



a. Set the *Catalog Item* to **P2 | Purlins**. This is a T Shape that will support the glass panels of the roof canopy.

b. Set the *Placement* options:



Placement: **Bottom Center**

Rotation: **0**

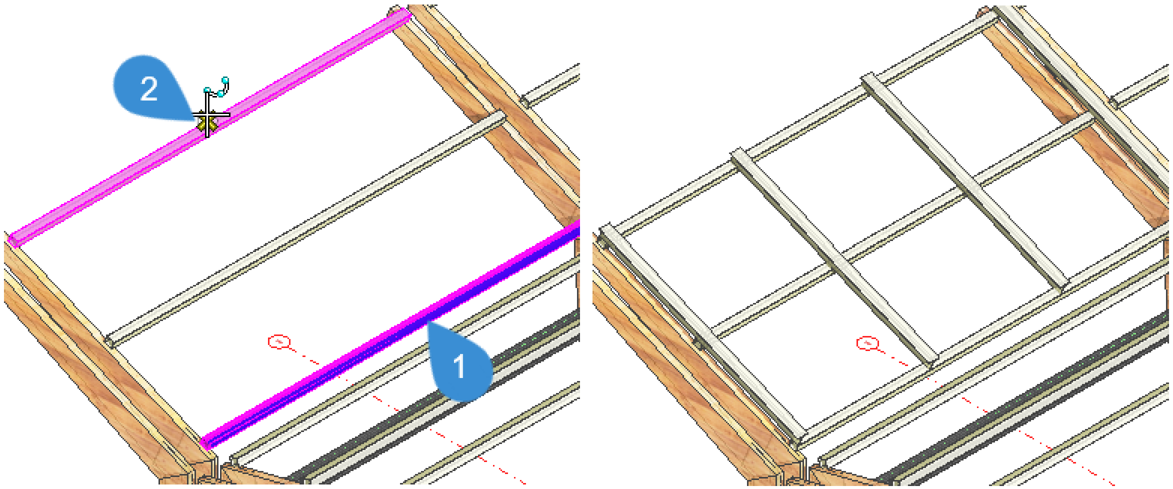
Maximum Spacing: **6:0** *[2000 mm]*

End Members: **On** - This will create end members at both ends of the support.

Support Options: **By Selected Line**

c. Select the outside edge of the first support member.

d. Select the outside edge of the second support member.



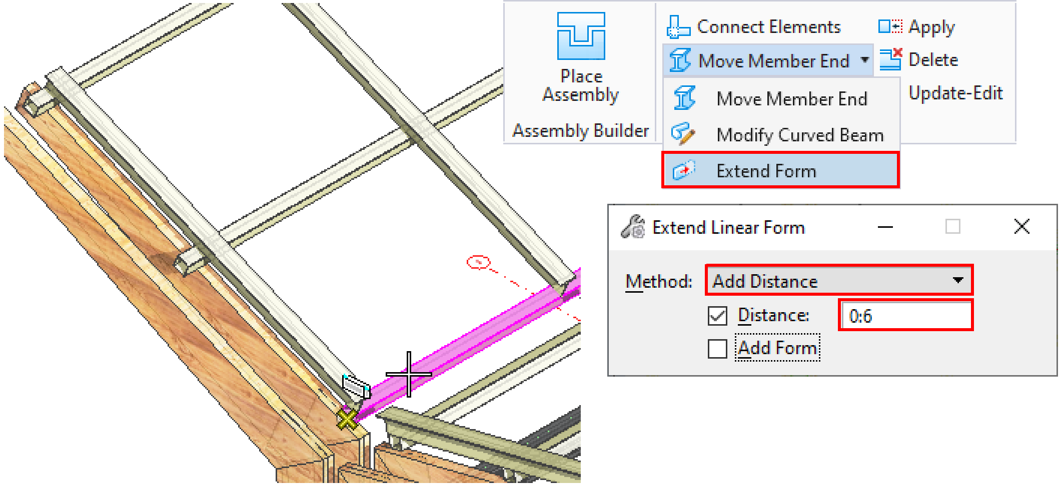
Now that the members are placed you will make some modifications to model exactly what you want the design to be.

6. Select the **Extend Form** tool.

   a. Set the *Method* to **Add Distance**.

   b. Set the *Distance* to **0:6** *[150 mm].*

   c. Select each end of the square tubes to extend them over the gap between the wood supports.



For the T purlins, you will change the length of the member so that it extends beyond the last purlin so that it supports the glass panels which are longer than the wood supports.

7. Select all the T shapes on the shorter side of the canopy.

8. Select the **Modify Properties** tool.

   a. Change the *Length* property to **9:0** *[2700 mm].*

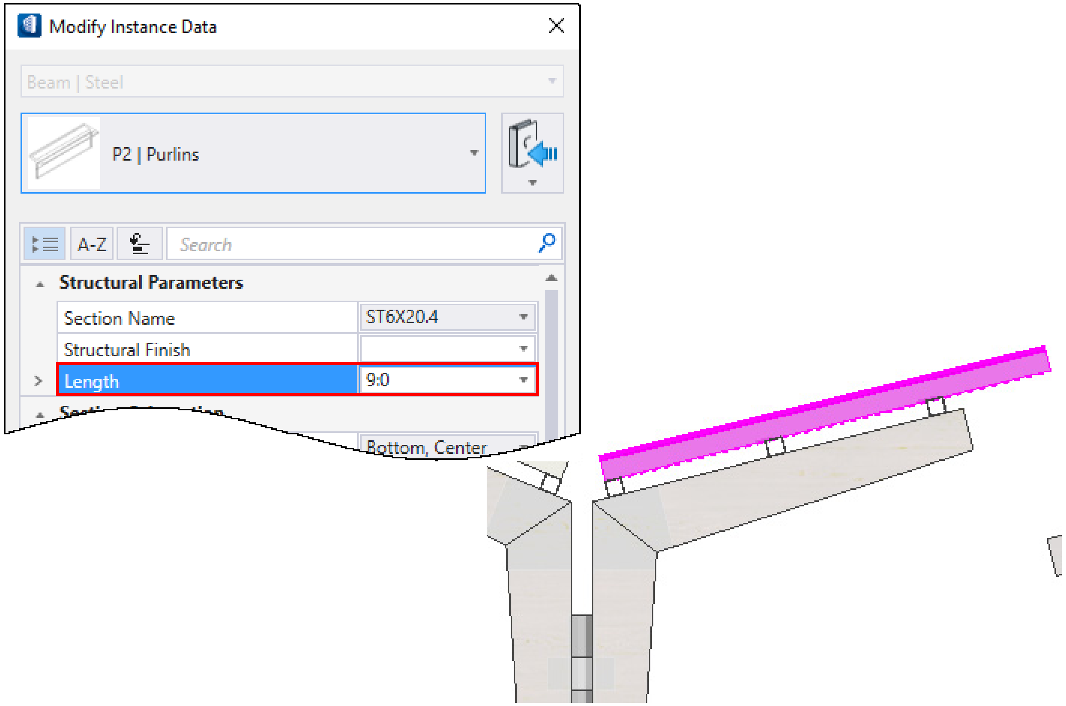
   b. **Data point** in the view to accept.

9. Select all the T shapes on the longer side of the canopy.

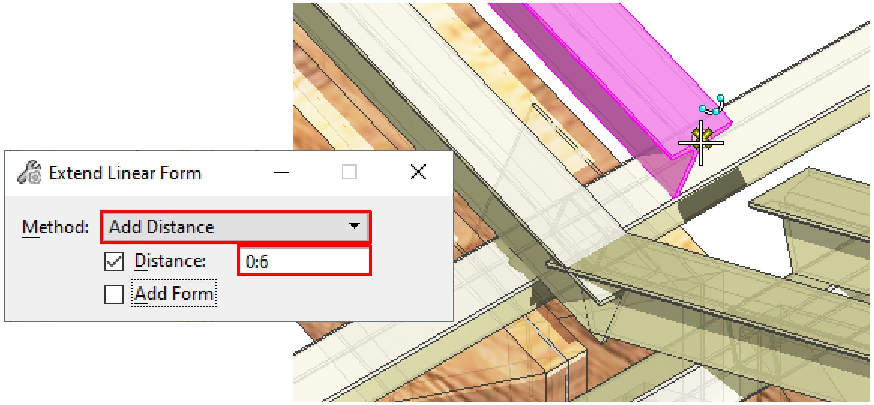
10. Select the **Modify Properties** tool.

    a. Change the *Length* property to **10:6** *[3150 mm].*

    b. **Data point** in the view to accept.



Next you will trim the T Supports where they meet at the valley between the two sides of the canopy. You want the edge of these members to align with the vertical edge of the wood column.



11. Use the **Extend Form** tool to extend each member so that it can be trimmed or cut back.

    Method: **Add Distance**

    Distance: **0:6** *[150 mm]*

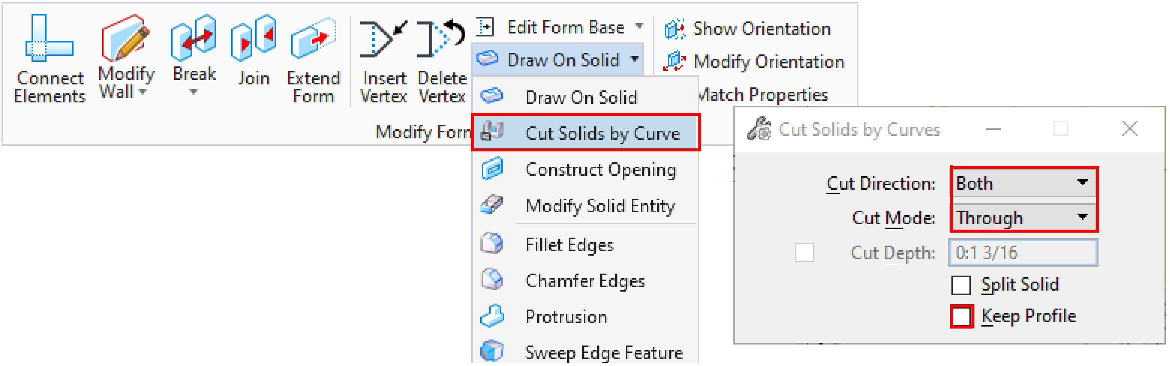
12. In the *Side* view draw construction lines from the edge of the wood member vertically upwards.

13. Select the **Cut Solids by Curve** tool from the *Modify Forms* group on the *Forms* tab.

    Cut Direction: **Both**

    Mode: **Through**

    Keep Profile: **Off**

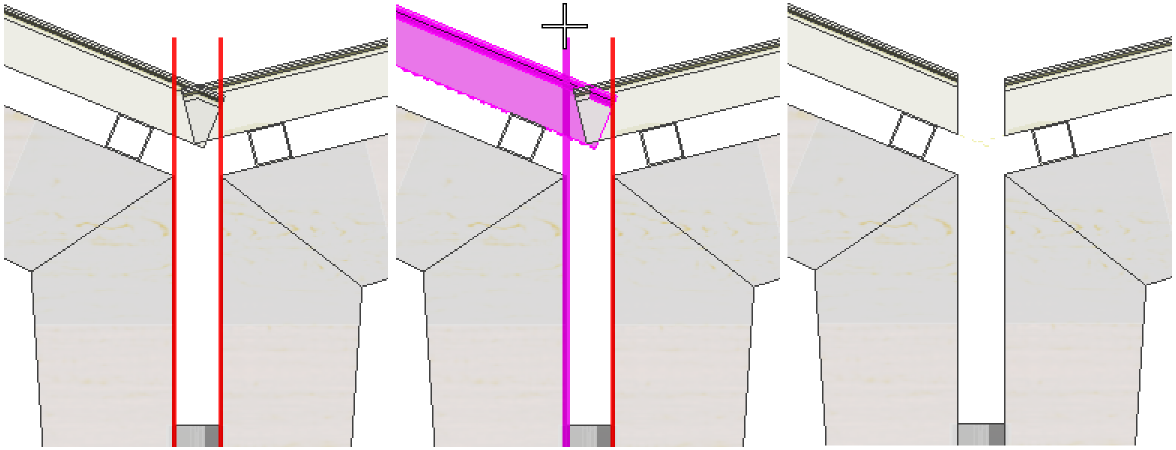


14. Working in the *Side* view select all the purlins on one side of the canopy.

    a. Select the trim line.

    b. **Data point** *(left-click)* to preview the trim, then **data point** *(left-click)* to accept. All the members are trimmed.

15. Repeat for the purlins on the other side of the canopy.



Note: The cut does not have to be a simple straight line. Any profile or closed shape can be used to trim a structural member.

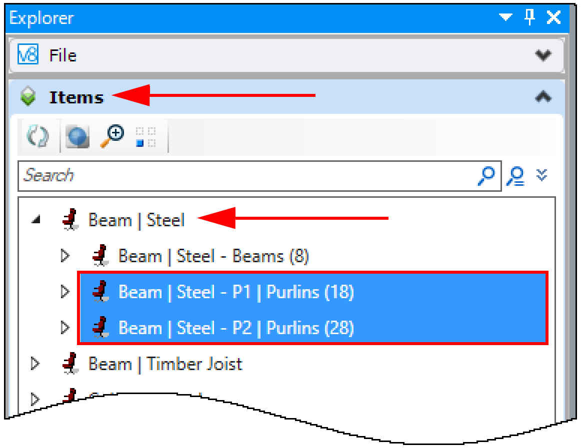
Finally, you will select all the purlins that were placed and copy them to the remaining bays.

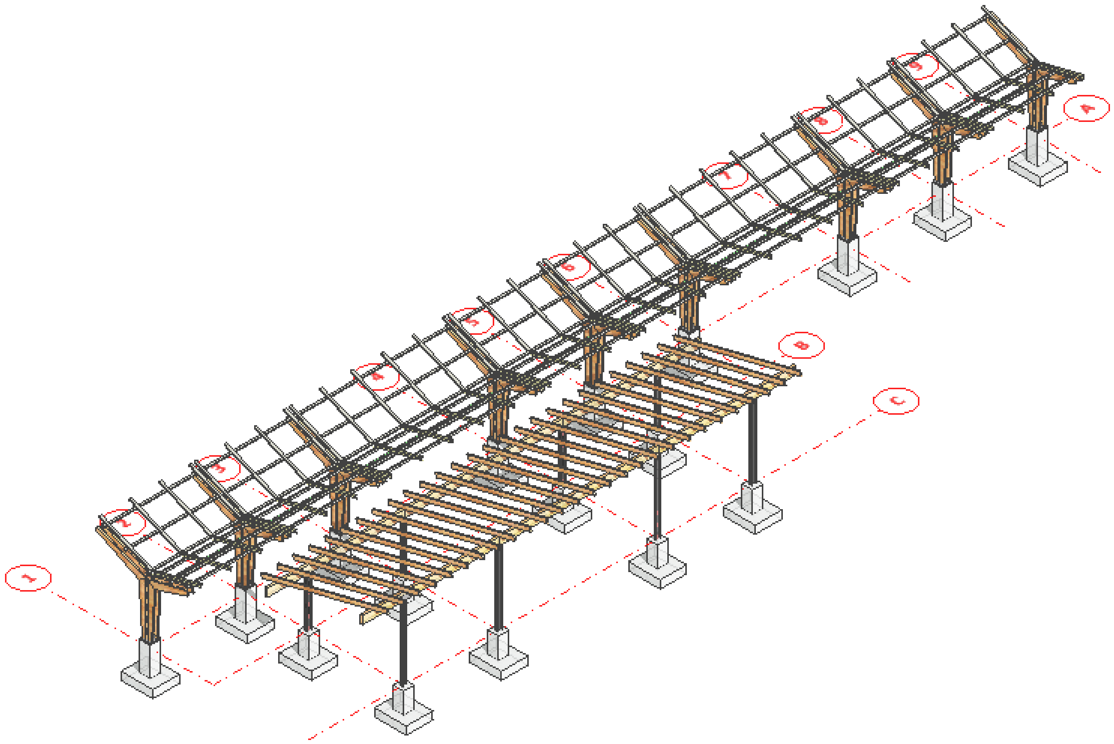
16. Select the *Items* tab on the *Explorer* dialog. Expand **Beam | Steel**.

    c. Select all the **P1 | Purlins** and **P2 | Purlins**.

17. Tap the *Space* bar and select the **Copy** tool.

    a. Copy all the selected members to the remaining bays.



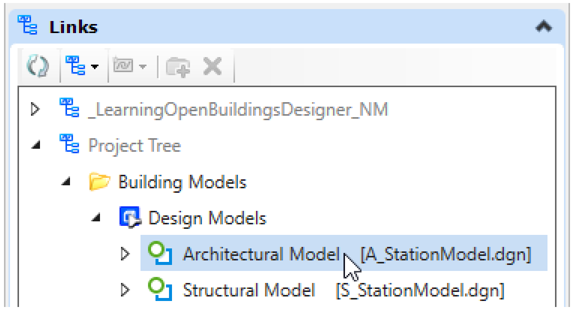


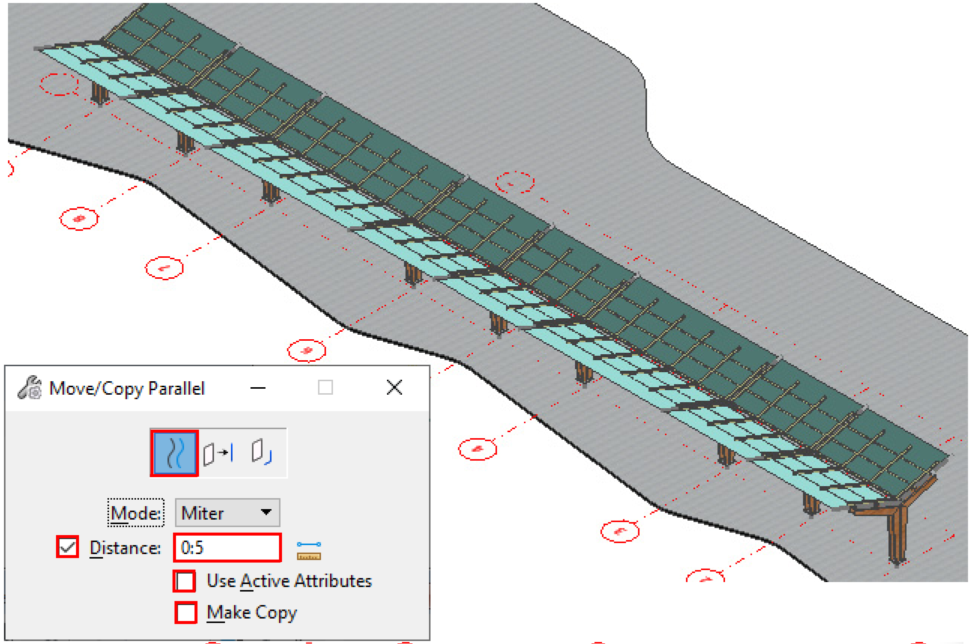
In this exercise you have placed purlins using the framing between tool. You then modified those members to achieve the design intent. In the next exercise you will re-open the architectural model and add the glass canopy.

Exercise 7-5: Modeling Glass Panels from a Shape

The conceptual roof shapes have been used as a place holder in the model. They represent the glass canopy, but are not an intelligent object that could be scheduled and quantified. In this exercise you will panelize the roof form into intelligent glass panels using the roof shapes.

1. Open the Architectural model, **A_StationModel.dgn**, from the *Links* tab on the *Explorer.*





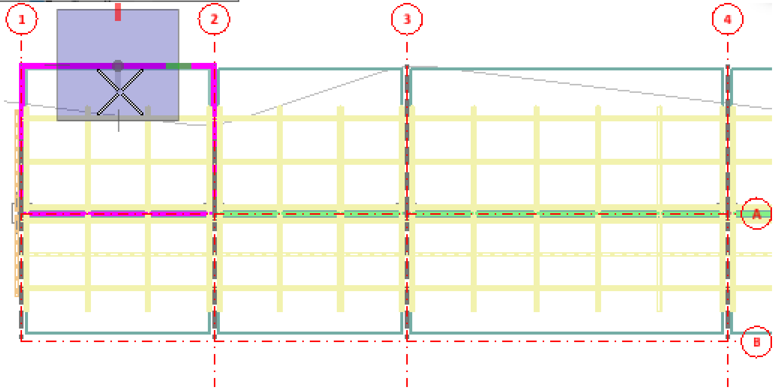
2. Create a *Displayset* of the canopy structure, glass shapes and the curb slab

You will use the place holder shapes to create intelligent glass panels. Prior to creating the panels, you will go through several steps to get the shapes correctly sized and positioned in the model. For the first step you will modify the panels so that there is a gap between each panel that aligns with the gap between the wood supports. You can easily do this by using the **Move Parallel** tool to modify each shape.

3. Tap the *Space* bar and select the **Move Parallel** tool.

   a. Set the *Distance* to **0:5** *[125 mm]*.

   b. Select each shape and move inwards the set distance.

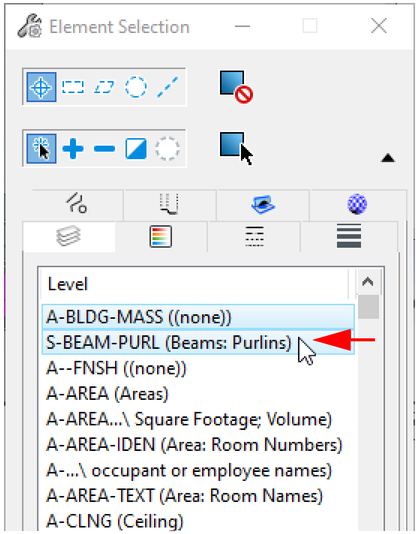


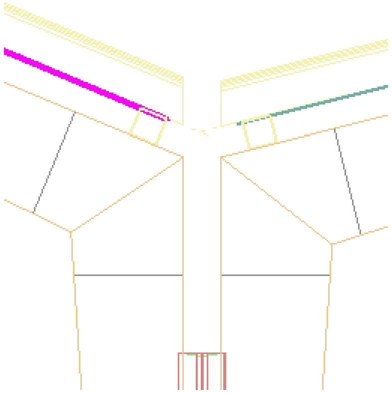
Note: You may wish to delete the construction lines drawn earlier so that you can identify the shapes in the Side View.

Next you will move the shapes so that they are the correct distance above the purlins. The shape will represent the centerline of the glass, so you will move the shape so that it is **0:3/4** *[20 mm]* above the purlins allowing for a narrow mullion and edge frame around the glass.

4. Create a *Selection Set* of all the shapes on one side of the butterfly canopy.

   Hint: If the shapes and purlins are overlapping, it might be easier to create a selection set in the *Side* view that includes both the shapes and the purlins, then expand the *Element Selection* dialog, select the *Level* tab and toggle the selection of fthe **S-BEAM-PURL** level. This will remove the purlins from the selection set.





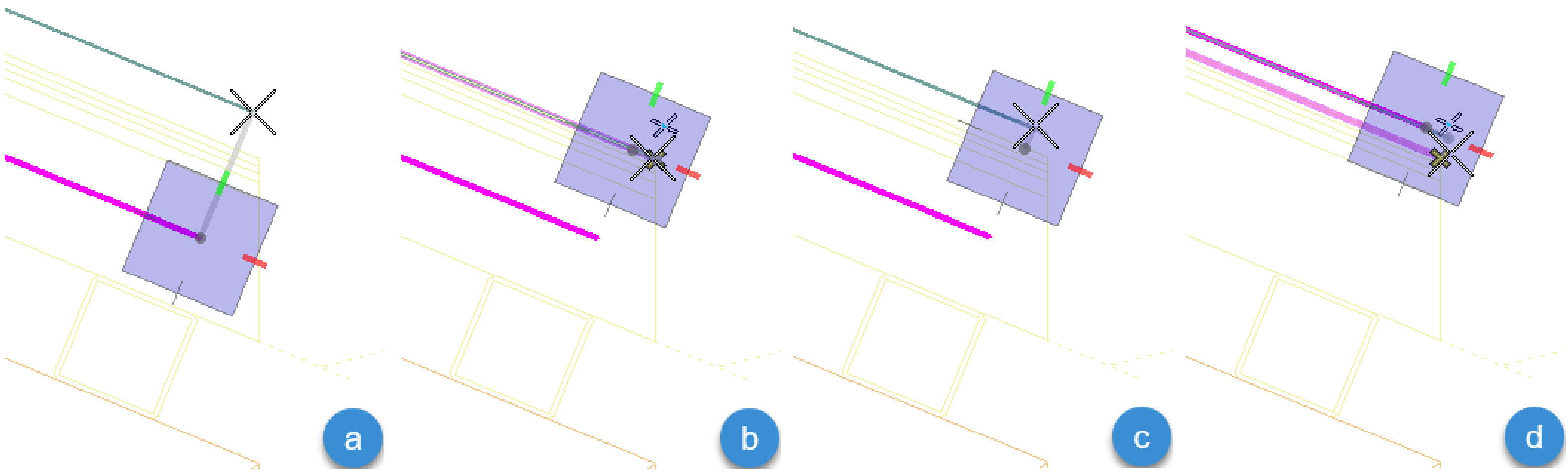
5. Tap the *Space* bar and select the **Move** tool.

   a. Select a start point at the end of the shape and use **RE** to rotate the *AccuDraw* compass to the slope of the shape.

   b. Move the cursor towards the top of the purlin, use **Enter** to lock the axis. Snap to the top of the purlin, and type **O** to reset the *AccuDraw* origin.

   c. Use **Enter** to lock the axis and move a distance of **0:3/4** *[20 mm]*. **Data point** *(left-click)* to accept.

   d. Move the selected shapes again along the slope so that the end of the shapes align with the end of the purlins.

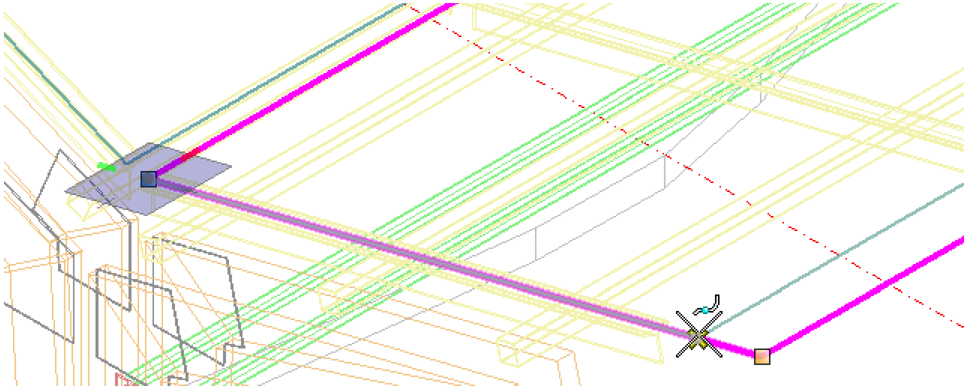


6. Repeat these steps for the other side of the canopy.

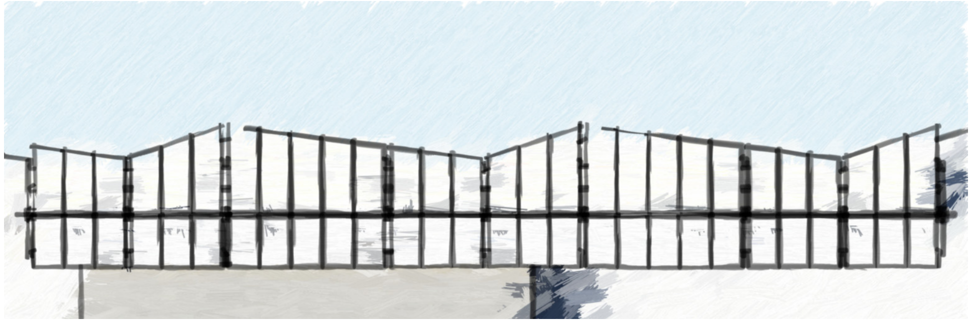
Now that the shapes are correctly positioned relative to the structural purlins you will adjust the length of the panel shapes. You will start with the straight side.

7. Select the first shape and use a corner handle to extend the shape to be **10:0** *[3000 mm]* along the beam.

   Note: Once the first shape is extended the remaining shapes can just be extended to match the adjacent shape.



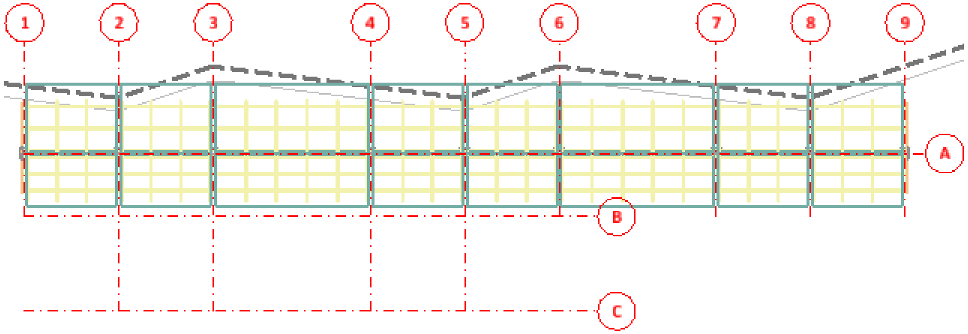
Next you will create the sawtooth edge on the front of the canopy. You will start by creating a construction line indicating the edge geometry.



8. Set the *Family* and *Part* to **General Constructions Dashed**.

9. Tap the Space bar and use the **Move Parallel** tool to copy the curb edge out by **2:6** *[1000 mm]*.

This will create a closed complex shape.



10. Select the **Drop Complex Status** tool from the *Common Tools* and select the shape to drop the shape to line segments.

11. Delete the rounded corners so that the only the line segments are left. Delete all segments that are not at the front curb edge.

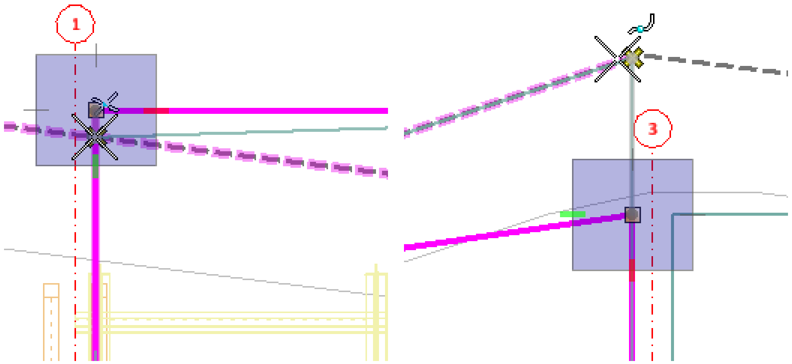
12. Select the **Trim to Intersection** tool from the *Common Tools* and connect the remaining line segments.

13. Use the **Create Complex Chain** tool to chain them back together as a single element.

    a. Set the *Method* to **Automatic**.

    b. Select the first line segment and it will automatically chain the adjacent line segments.

Now you will adjust the shapes to the new construction line.



14. Working in the *Top* view, select the first shape.

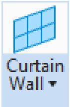
    a. Select the handle on the first vertex. Press the **Alt** key on the keyboard and move the vertex to the intersection of the construction line.

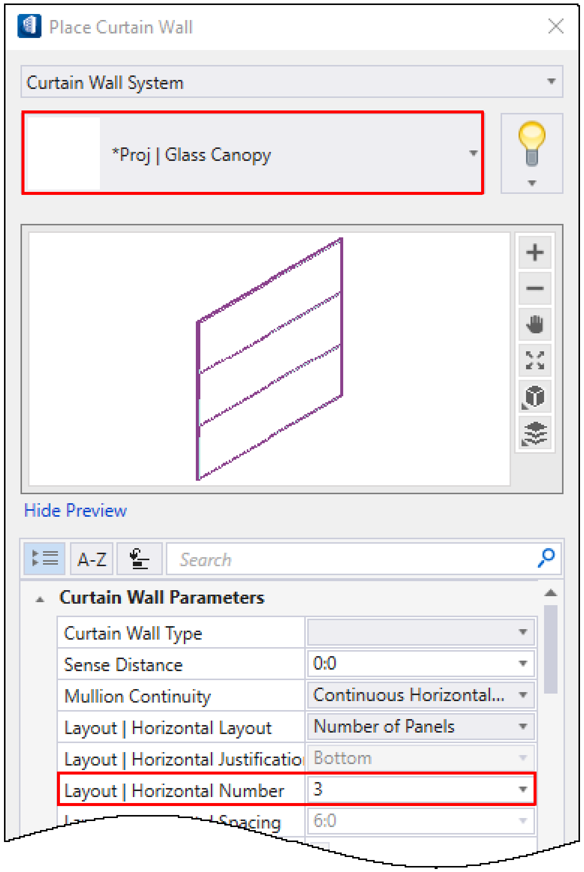
    Note: The **Alt** key toggles between moving just the vertex or the entire edge of the shape.

15. Repeat for each vertex.

    Note: In some cases there will not be an intersection to snap to, because the construction line is beyond the existing shape. In this case, use the **Enter** key to lock the Axis, then use a *Nearest* snap to the construction line to find the projected intersection. **Data point** *(left-click)* to accept.

Once all the shapes are adjusted you will be ready to use the Curtain Wall tool to create the glass panels.



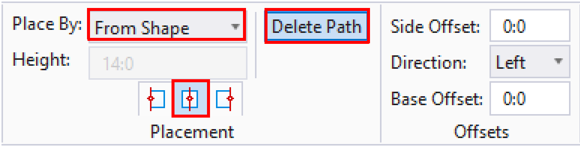


16. Select the **Curtain Wall** tool from the *Architectural Elements* group on the *Architectural* ribbon.

    a. Set the *Catalog Item* to ***Proj | Glass Canopy.**

    b. The *Layout | Horizontal Number* should be set to **3**. This should match the purlin spacing.

    c. On the *Placement* ribbon set the *Place By* method to **From Shape**.

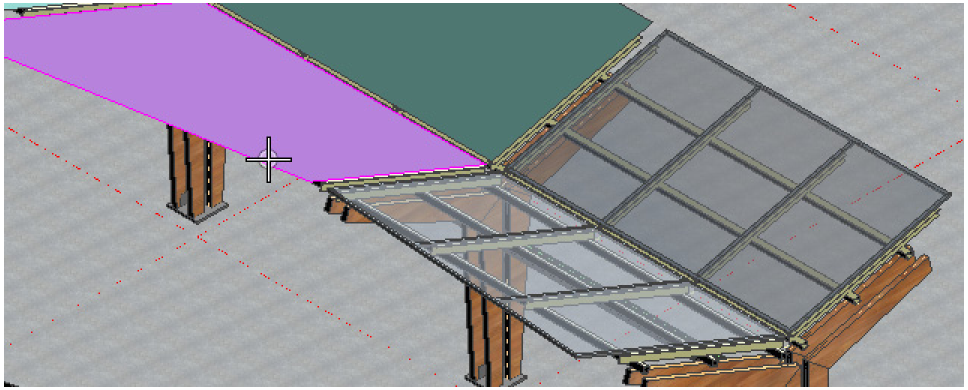


    d. Set the *Justification* to **Center**, again this means the centerline of the glass panel.

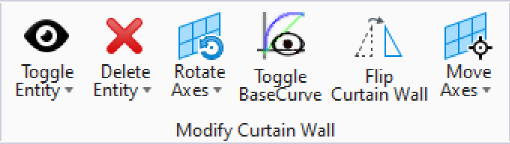
    e. Toggle **on** *Delete Path*. This will delete the place holder shapes.

17. Select each shape. **Data point** *(left-click)* to accept.

18. For the wider shapes change the *Layout | Horizontal Number* on the curtain wall dialog to **5**.

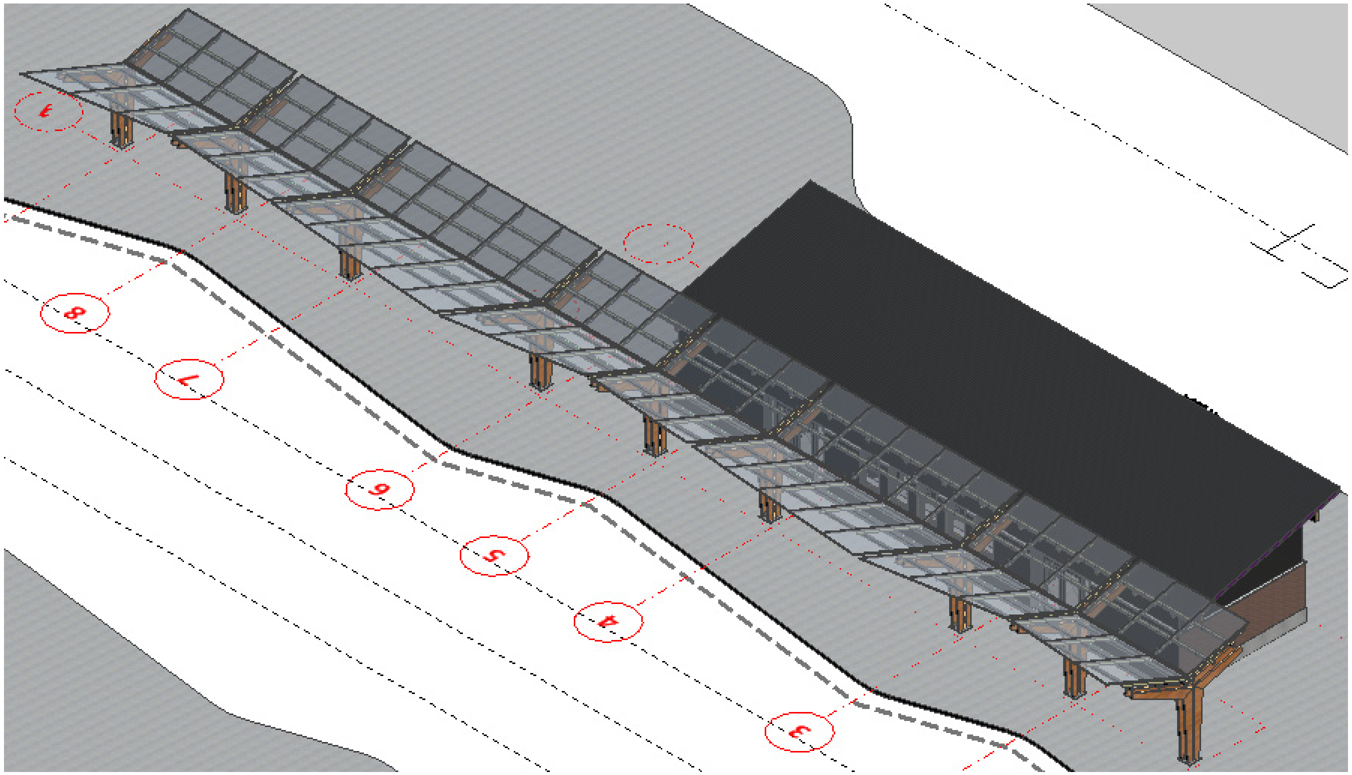


Note: If the layout of the panels need to be adjusted after creation there are modification tools on the ribbon move, rotate and flip the panel arrangement.



In this exercise you have created a glass canopy using shapes and the curtain wall tool. You carefully modified the shapes to align with the structure and the curb edge of the drop zone.

In the next exercise you will add one final detail to the roof canopy, which is the gutter that runs between the two sides. You will create a custom profile for this gutter.

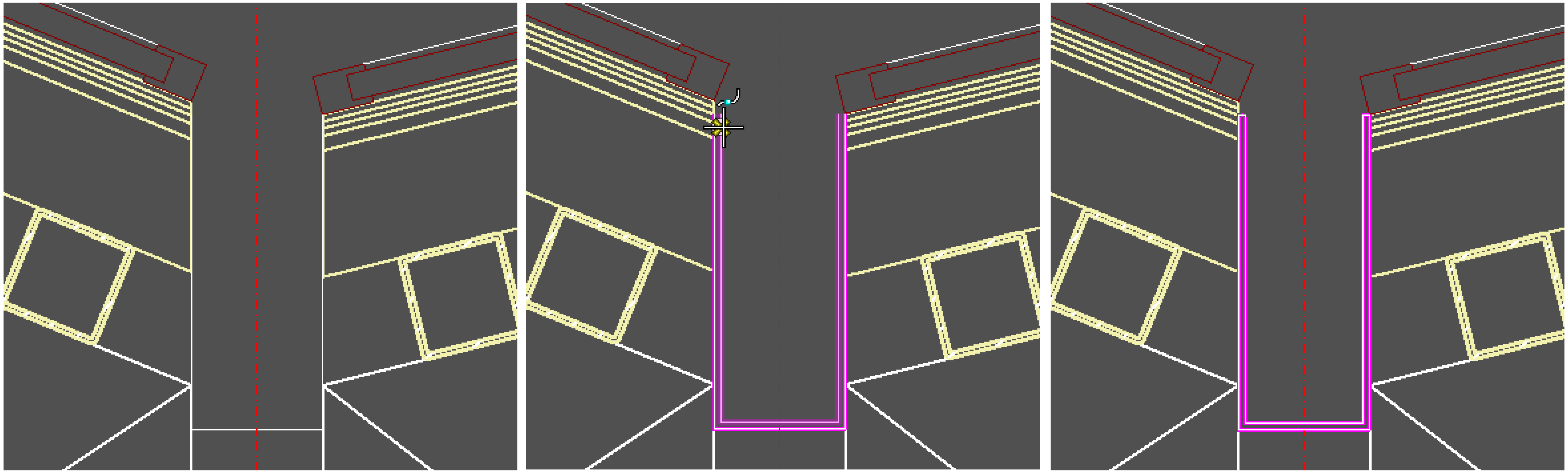


Exercise 7-6: Create a Profile

In this exercise you will create a custom profile for the gutter, link it to a DataGroup catalog Item, then place it in the model using the Profile tool. The first step will be to draw the 2D shape or profile that will be extruded to create the gutter.

For this you may wish to work in the Side view, or you can open the 2D drawing view and work there.

1. Select the *View Group* **Drawing 2**. This will open the model of the *CROSS SECTION* drawing.
2. Set the *Family* and *Part* to **General::Default.**
3. Tap the Space bar and select the **Place SmartLine** tool to place a SmartLine.
   a. From the top of a purlin, go down **1:0** *[300 mm]*, across to the other wood beam, and back up another **1:0** *[300 mm]* matching the other side.
4. Use the **Move Parallel** tool, to copy the SmartLine by **0:1/4** *[6mm]*.
5. Draw 2 small lines to connect the ends of the smart lines.



6. Use the **Create Complex Shape** tool to automatically chain the line segments together into a closed shape.

Now that you have a 2D shape you can create the profile cell. This is created the same way you would create any MicroStation or OpenBuildings cell.

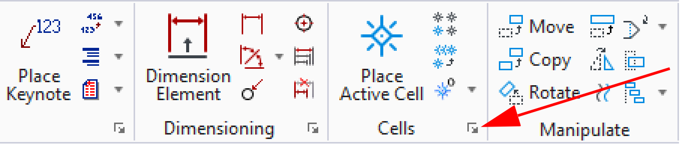
First you will need an origin, this will determine the placement line when placing the profile in the model, so you want to think about the geometry that you might want to snap to as a guide. For instance, you could use the top corner of the tapered wood members, or find the center point between them.

7. Select the **Define Cell Origin** tool from the *Cells* group on the *Drawing* tab.

   a. Select a point at the midpoint between each wood member, cross hairs will be placed in the model.

8. Select the closed shape.

9. Open the **Cell Manager** from the *Cells* group on the *Drawing* tab.



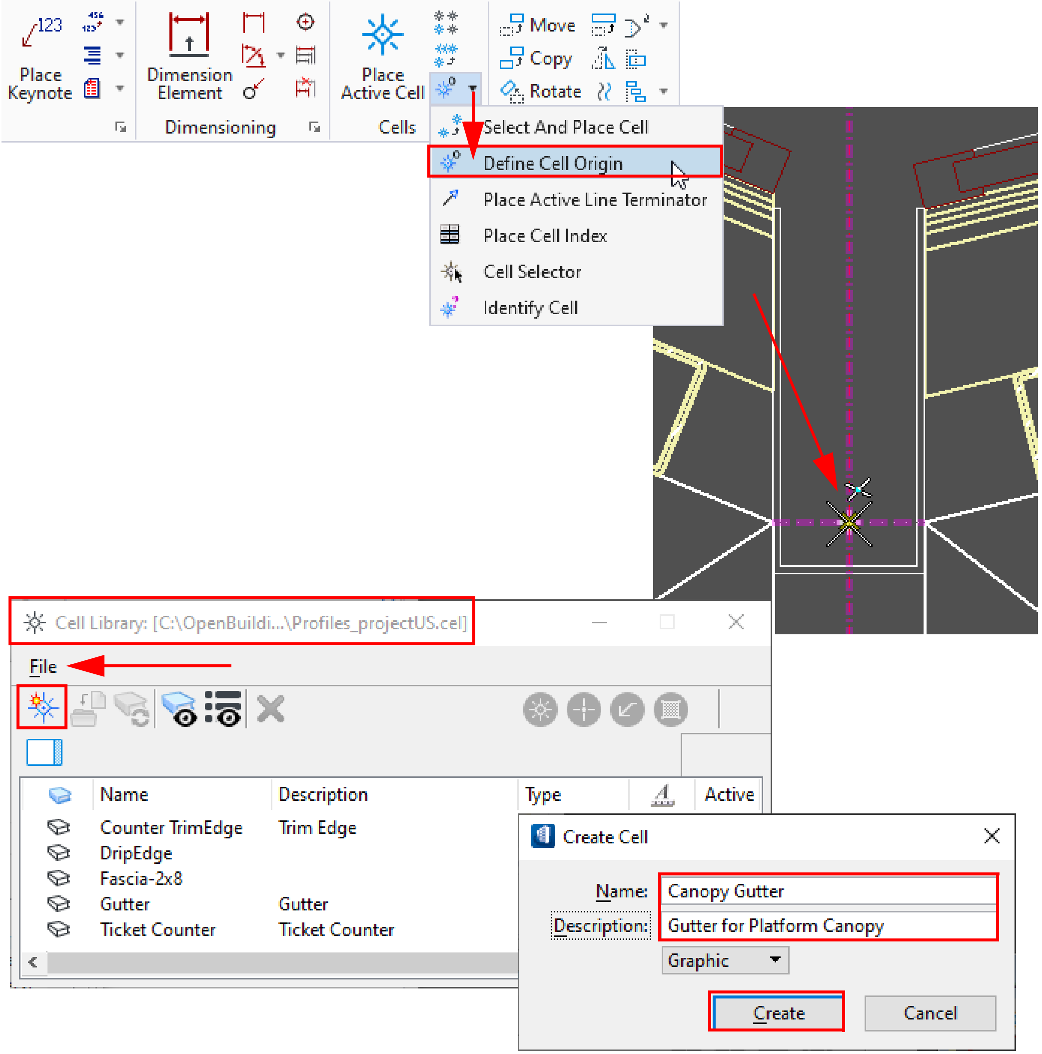
   a. From the *Files* pull-down select the **Profiles-projectUS.cel** *[Profiles-projectNM.cel]* library.

10. Select the **Create** tool.

   a. Add a *Name* and *Description* for the new profile cell and select **Create**.

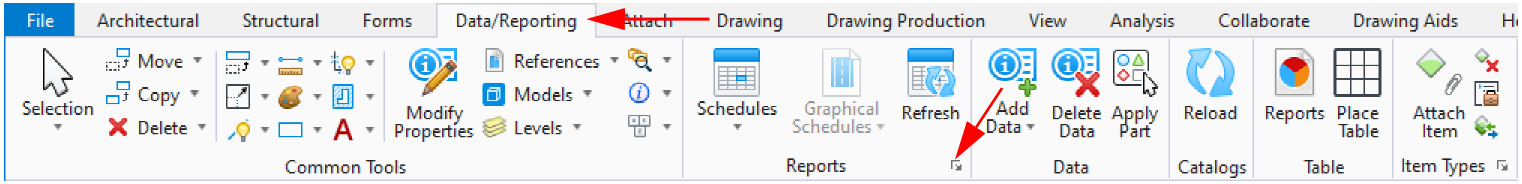
   The profile cell is now part of the WorkSet library. The next step is to create an item in the *DataGroup* system so that this profile can be placed as a linear form using the **Profile** tool and the correct data is attached to it.

11. Close the *Cell Manager* and delete the cell geometry.



Next you will link the newly created cell to the **Profile** tool and the *DataGroup System*.

12. From the *Data Reporting* tab open the *Catalog Editor*.



The *Catalog Editor* is used to manage all the various catalog types and catalog items. New catalog items can be added here in the catalog editor.

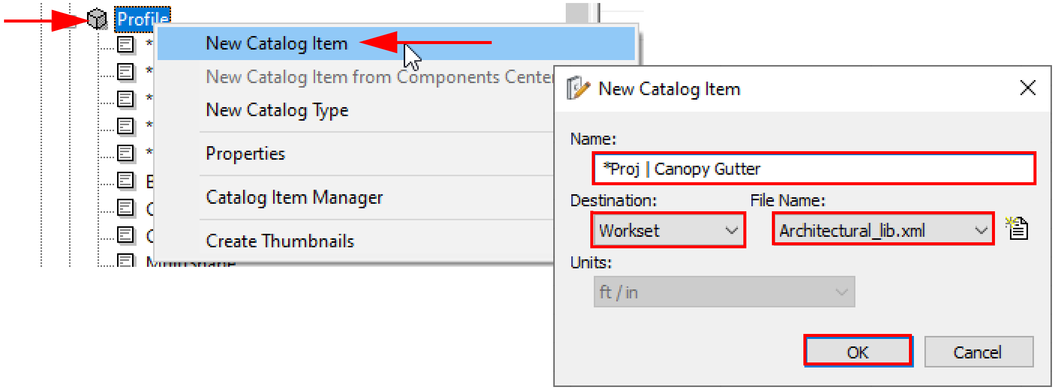
13. Expand the Architectural group and select the **Profile** *Catalog Type*.

    a. *Right press* and select **New Catalog Item**.

    b. Give it the name ***Proj | Canopy Gutter.**

    c. Set the *Destination* to the **WorkSet**.

    d. Accept the default *File Name* and select **OK**.

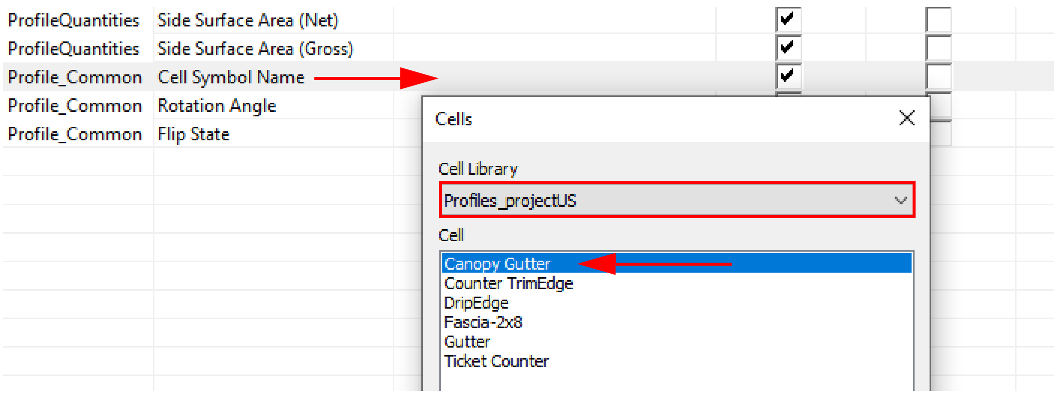


The new catalog Item is created. It includes a number of properties which can be defined here or on placement. But the one property that must be defined now is the *Cell Symbol Name*.

14. *Double-click* in the field to the right of *Cell Symbol Name*. Select the **Profiles-projectUS.cel** *[Profiles-projectNM.cel]* cell library from the *Cell Library* drop down.

    a. Then select the **Canopy Gutter** from the *Cell* list.

    b. Select **OK**.

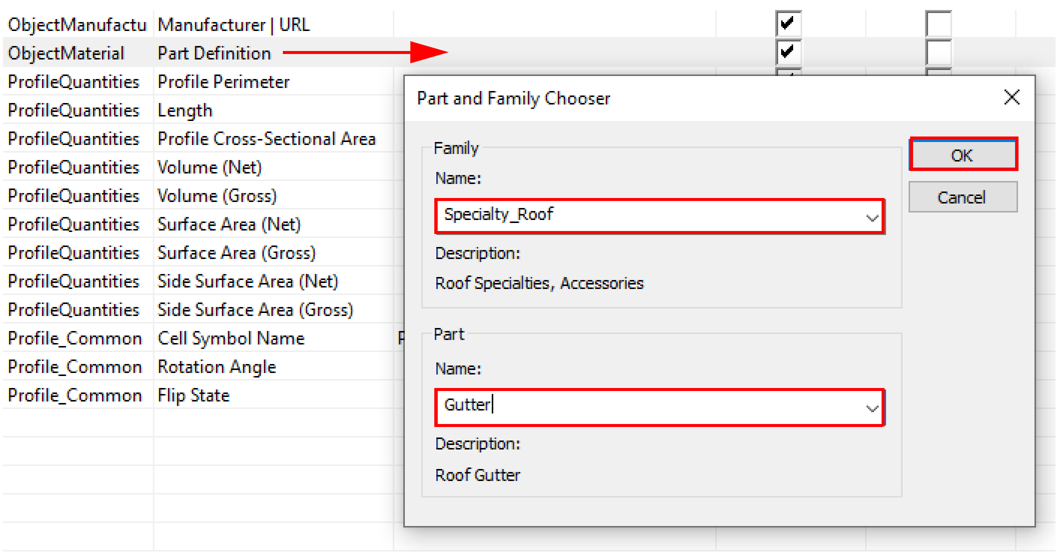


15. Define the *Part Definition*. *Double-click* in the field to the right of *Part Definition* and select the *Family:* **Specialty Roof** and the *Part:* **Gutter.**

    c. Select **OK**.

    d. Select **Save** and close the *Catalog Editor*.

16. Navigate back to the *Building Model.*

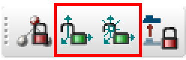


You will now place the new profile. You may wish to draw a construction line between the two wood members to help in the placement of the gutter profile.

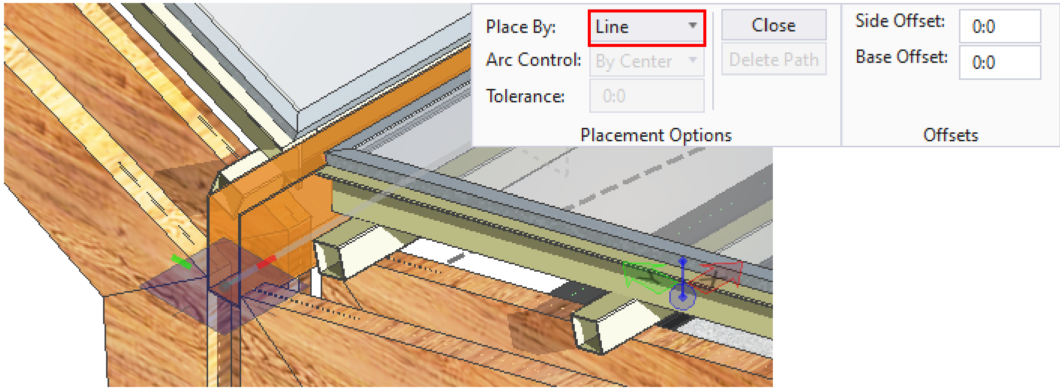
17. Select the **Profile** tool from the *Architectural Elements* group on the *Architectural* ribbon.

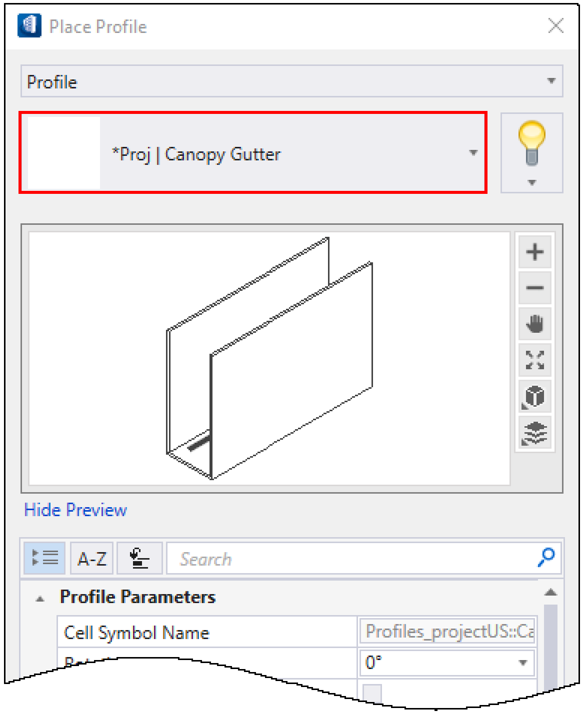
    a. Select the ***Proj | Canopy Gutter** *Catalog Item*.

    b. On the *Placement* ribbon set the *Place By* method to **Line**.

    c. Toggle off the *ACS Plane* and *ACS Plane Snap* lock. 

    d. Select a start point, then use *AccuDraw* to place the gutter down the center between the two groups of roof panels.

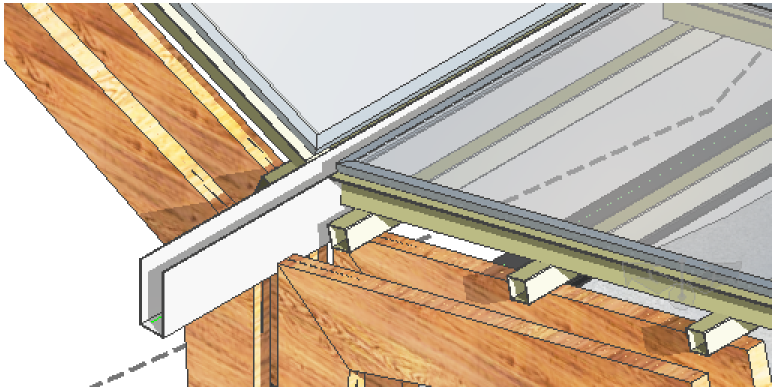




Once placed a profile can be modified using its handles.

18. Select the gutter profile.

    a. Select each end handle and extend the gutter by **2:0** *[600 mm]*.

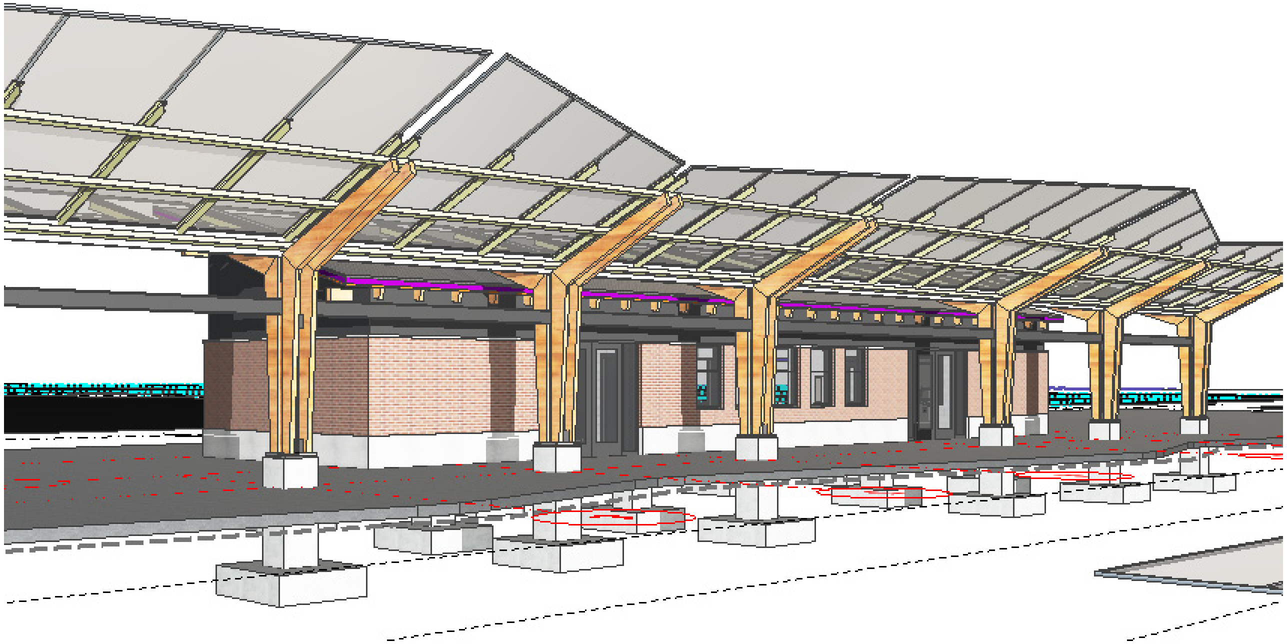


In this exercise you have created a 2D cell to define a profile, then linked it to a new *DataGroup Catalog Item* and finally, you placed the new profile in the model. You may wish to create additional profiles for the edge of the roof and the edge of the entry canopy.

Several camera views are already set up in the file.

19. From the *View* tab, select the **Apply Saved View** tool.

a. Select the *View* **'View of Platform'** then data point in View 1.



Summary

This course was an introduction to 3D BIM modeling with OpenBuildings Designer. You have created a small transportation station starting with some 3D conceptual modeling, then setting up your BIM environment with floor planes, a structural grid and a site model. You then created the structural frame for the building and canopy using intelligent columns, beams and footings. Next, you added the architectural shell, modeling the walls and roof layers over the structural framing. You completed the architectural shell by adding doors, windows and storefront to the exterior of the building. You then worked on the interior of the station building, adding spaces, interior walls, doors, casework and finally furniture and equipment. You also added some mechanical equipment, ductwork and plumbing to the model.

Finally, you tested your new skills with some advanced modeling exercises, modeling the platform canopy with tapered columns and beams, steel plates, purlins and custom glass shapes.

Throughout this course you have learned techniques to work effectively in the 3D model. When an element was placed in the model it was immediately visible in the context of the design environment, but also became the source for the extracted 2D information. That information took the form of plans, elevations, sections, and schedules. The entire design process, from Schematic Design to documentation, evolved and originated from the geometry and data in the 3D model. All design revisions were made in the model and the 2D data was automatically updated.