ASCENT
CENTER FOR TECHNICAL KNOWLEDGE

Autodesk® Revit® 2021
Site Planning and Design

Learning Guide

Metric Units - 1st Edition

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ASCENT - Center for Technical Knowledge®
Autodesk® Revit® 2021
Site Planning and Design

Metric Units - 1st Edition

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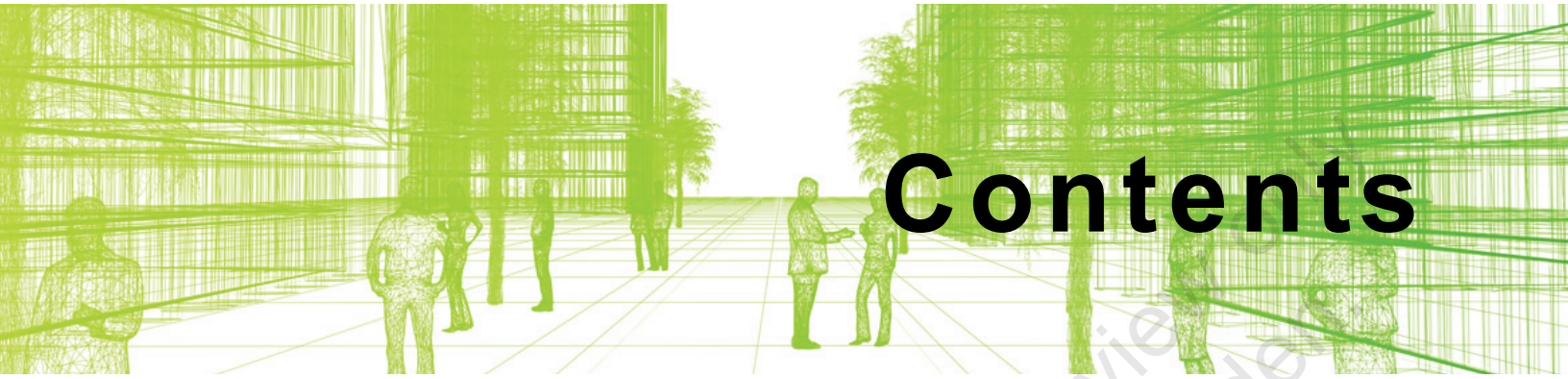

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Preface

The objective of the *Autodesk® Revit® 2021: Site Planning and Design* guide is to enable users who have worked with the Autodesk Revit software to understand concepts and tools related to site planning and design. This guide covers the Revit coordinate system, which is used to coordinate multiple files in a single project, as well as the elements and tools that are used to create topographic surfaces for site work and add structural elements.

Topics Covered

- Site Planning
  - Understanding the Revit coordinate system, positioning, true north, and project north.
  - Linking files.
  - Relocating the project elevation.
  - Working with shared coordinates by acquiring and publishing coordinates.
  - Exporting Revit models to .DWG.
- Site Design
  - Creating topographic surfaces.
  - Adding property lines and building pads.
  - Modifying toposurfaces with subregions, splitting surfaces, and grading the regions.
  - Annotating site plans and adding site components.

Prerequisites

- Access to the 2021.0 version of the software, to ensure compatibility with this guide. Future software updates that are released by Autodesk may include changes that are not reflected in this guide. The practices and files included with this guide might not be compatible with prior versions (e.g., 2020).
- Knowledge of the basic techniques of the fundamentals of the Autodesk Revit software covered in the *Autodesk® Revit® 2021: Fundamentals for Architecture* guide.

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Note on Software Setup

This guide assumes a standard installation of the software using the default preferences during installation. Lectures and practices use the standard software templates and default options for the Content Libraries.

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Lead Contributor: Cherisse Biddulph

Cherisse is an Autodesk Certified Professional for Revit as well as an Autodesk Certified Instructor. She brings over 15 years of industry, teaching, and technical support experience to her role as a Learning Content Developer with ASCENT. With a passion for design and architecture, she has worked in the industry assisting firms with their CAD Management and software implementation needs as they modernize to a Building Information Modeling (BIM) design environment. Although her main passion is the Revit design product, she is also proficient in AutoCAD, Autodesk BIM 360, and Autodesk Navisworks. Today, Cherisse continues to expand her knowledge in the ever-evolving AEC industry and the software used to support it.

Cherisse Biddulph has been the Lead Contributor for *Autodesk Revit: Site Planning and Design* since 2020.

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In This Guide

The following highlights the key features of this guide.

Feature	Description
Practice Files	The Practice Files page includes a link to the practice files and instructions on how to download and install them. The practice files are required to complete the practices in this guide.
Chapters	A chapter consists of the following - Learning Objectives, Instructional Content, Practices, Chapter Review Questions, and Command Summary. • **Learning Objectives** define the skills you can acquire by learning the content provided in the chapter. • **Instructional Content**, which begins right after Learning Objectives, refers to the descriptive and procedural information related to various topics. Each main topic introduces a product feature, discusses various aspects of that feature, and provides step-by-step procedures on how to use that feature. Where relevant, examples, figures, helpful hints, and notes are provided. • **Practice** for a topic follows the instructional content. Practices enable you to use the software to perform a hands-on review of a topic. It is required that you download the practice files (using the link found on the Practice Files page) prior to starting the first practice. • **Chapter Review Questions**, located close to the end of a chapter, enable you to test your knowledge of the key concepts discussed in the chapter. • **Command Summary** concludes a chapter. It contains a list of the software commands that are used throughout the chapter and provides information on where the command can be found in the software.
Appendices	Appendices provide additional information to the main course content. It could be in the form of instructional content, practices, tables, projects, or skills assessment.

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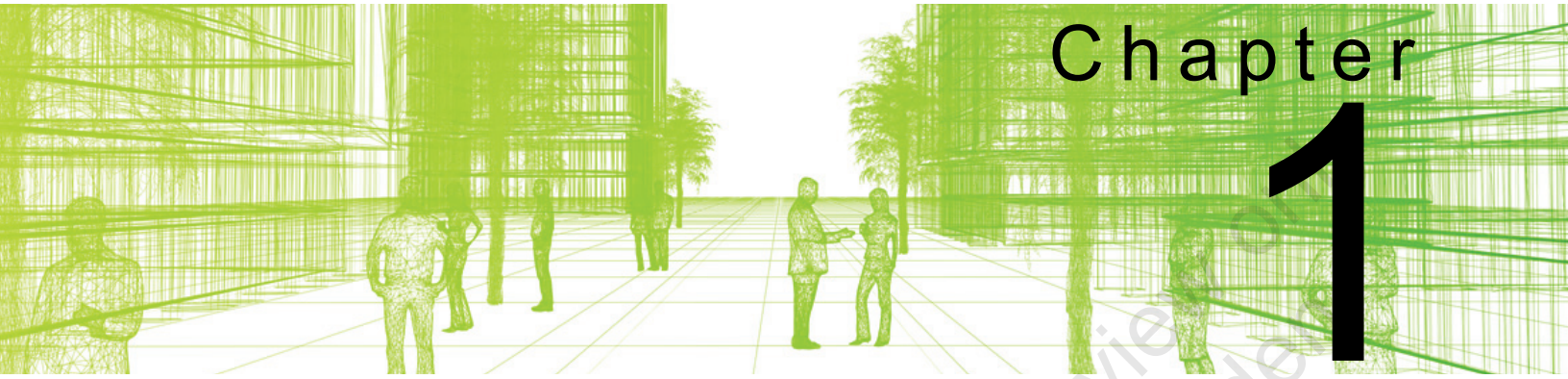

Chapter 1

Site Planning

Site planning and design collaboration is an involved and thoughtful process. A good graphical representation of the site's topography in the correct coordinate location greatly helps in the designing and placement of a building on a site. Autodesk® Revit® has a coordinate system with the capabilities of establishing a mutual location for linked files within the host model called shared coordinates. This is achieved by acquiring coordinates from a linked toposurface or .DWG file from a civil engineer or a surveyor. This shared coordinate location can then be published from the host model to the linked files. Autodesk Revit shared coordinates work to align multiple projects from different disciplines and software applications into one project location and maintain the relationship between them all.

Learning Objectives in This Chapter

- Learn about internal origin, project base point, and survey point.
- Understand coordinates, positioning, true north, and project north.
- Share, publish, and acquire coordinates.
- Relocate the project's elevation.

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1.1 Preparing a Project for Site Design

This workflow may vary depending on your company standards.

A typical project workflow will be established by your company's BIM/project manager, but may include the following:

- Model coordination (e.g., internal origin to internal origin, project base point, or shared coordinates) is typically determined at the kick-off meeting using a BIM execution plan.
- Establish the project base point and drawing units in your Revit model. Acquire coordinates from a linked file containing survey information and publish coordinates if collaborating using shared coordinates.
- Understand Revit import/linking options and positioning to facilitate creating the project site. Link necessary files into the Revit model using import/linking options. Acquire coordinates, create topography, and/or facilitate creating the project site.
- If needed, provide the civil engineer or surveyor with an exported .DWG file from your Revit host model of the preliminary site layout so they can prepare the site. The civil engineer may include the survey and project base points (with the architect's approval). They should also include a toposurface or CAD file to help build a site plan in Revit.
- Create a site or topography (e.g., add a building pad, parking lots, and site and parking components like trees, shrubs, and cars).

Terminology

It is important to understand the following terms before working with shared coordinates. Reference these definitions as you go through this guide to help clarify what each term is referring to.

- **Survey Coordinate System:** Displays in the Revit view as the survey point and is intended to display the location on the earth's surface.
- **Project Coordinate System:** Displays in the Revit view as the project base point and is intended to display the location of the building model.
- **Host Model:** The primary model into which other files and models are linked (i.e., the site model or composite building model).

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- **Shared Coordinates:** When you have multiple linked buildings, you can use shared coordinates to remember the respective positions of your buildings. Only the host Revit model (i.e., the site model or composite building model) should be used for obtaining shared coordinates.
  - If the required coordinates for the project are in a linked model/file, you will acquire the coordinates or pull the coordinates from the linked file.
  - If the required coordinates for the project are in the host model, you will publish coordinates or push your model's coordinates to the linked models/files.

- **Acquiring Coordinates:** Acquiring or pulling survey coordinates from a linked file will establish the shared coordinate system for the host model.

- **Publishing Coordinates:** Publishing or pushing survey coordinates from the host file to any linked files or models will establish the shared coordinate system for the linked files.

- **Positioning:** When linking in other models or files, use the positioning options in the Import or Link dialog box to specify where you would like the information placed relative to your host model.There are two types: Automatic (Auto) and Manual.
  - **Auto** is best used when you know the coordinates of the host model and the imported/linked model or file. Auto positioning uses a set of rules to place the incoming geometry in an exact location based on coordinates.
  - **Manual** is best used when you want to use a point that is defined in the linked/imported file. Using manual positioning gives you more control over the placement of incoming geometry.

- **Internal Origin:** The internal origin is the starting point for the internal coordinates system, which provides the basis for positioning all elements in the model.This is also known as the startup location and it never moves from its original location. By default, the internal origin is turned off in all views.

- **Project Base Point:** Defines the origin of the project coordinate system. The project base point will change based on the origin point of the survey point. The project base point can be used for coordination on a project by positioning it at a useful place, such as the intersection of grid lines or the corner of a building.

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- **Survey Point:** Defines the real world or global coordinate system. It is typically a specific point in the physical environment, such as the intersection of property lines or a survey marker. It is used to establish shared coordinates between multiple linked files.
- **Named Positions:** When working with multiple buildings that are either copied within the project or linked into the project, you can set up named positions to maintain their location in the project.
- **True North:** This is your project's location in regards to the real world coordinates. You can create a view to graphically display your model in true north.
- **Project North:** This is your project's location in regards to the paper or screen you are modeling on, typically at 90 degrees. You will usually draw with your view set to project north.

Hint: Revit Tooltips

To learn more about each tool's function, from the *Manage* tab> Project Location panel, hover your cursor over the tool to display a tooltip describing its use and a GIF showing that use in action, as shown in Figure 1–1.

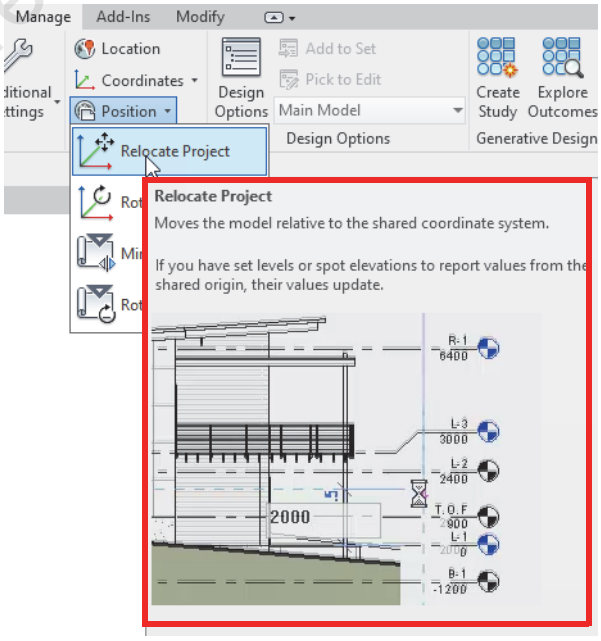

Figure 1–1

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1.2 Coordinate System in Autodesk Revit

All Autodesk Revit projects have an internal coordinate system called internal origin or startup location. All elements in the model are positioned according to the internal origin. The project and survey coordinate systems are based off of the internal origin and are specified in a view by the (Project Base Point) and (Survey Point) icons, as shown in Figure 1–2. These points, by default, are located at Revit's internal origin but can be moved according to shared coordinates and building locations.

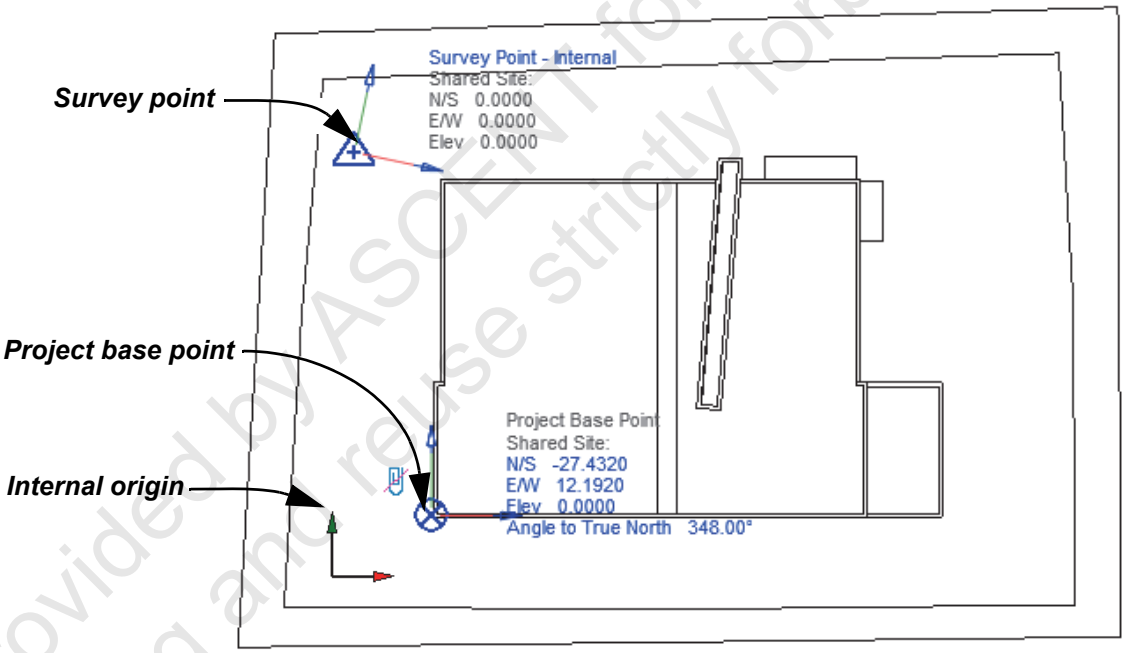

Figure 1–2

- The internal origin location will never move. Any modeled geometry needs to be within a **16km** radius from the internal origin to avoid unwelcome behavior (e.g., graphical issues or model stability).
- The project base point is for your model's internal use and shows the coordinates based on its distance from the survey point, reflecting the project coordinate system. The project base point impacts levels, label contours, and absolute elevations, as well as what is reported using the **Spot Elevation** and **Spot Coordinate** commands.

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- The survey point is usually placed relative to the site of a project and defines the project's true north Y-axis. If given the coordinates from a surveyor or engineer, you can manually specify the survey point coordinates directly in your model. If a file is provided, you can acquire coordinates from linking it into your model.

When starting from a default architectural template and opening the site view, the (Project Base Point) and (Survey Point) icons both show and by default are located at Revit's internal origin location, causing the icons to overlap (as shown in Figure 1–3). You can display the internal origin by turning it on through the Visibility/Graphic Overrides under the Site category.

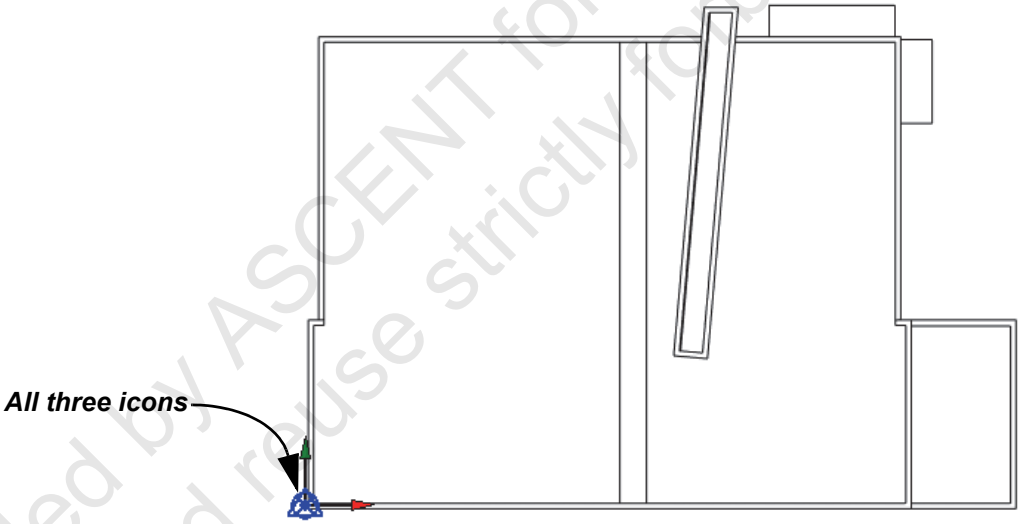

Figure 1–3

Identifying Coordinates

To help you understand where things are located within the project and its linked file(s), use the Report Shared Coordinates tool. To identify a coordinate point, in the *Manage* tab>Project Location panel, expand (Coordinates) and click (Report Shared Coordinates). displays on the cursor. Move it over a point on the project and click it. The shared coordinates display in the Options Bar, as shown in Figure 1–4.

Figure 1–4

- To move the project to new coordinates, change the project base point or click (Specify coordinates at point).

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Modify Coordinates Individually

You can specify the project base point and survey point by entering in the coordinates or manually moving them. This can be done if you have been given the site coordination from the civil engineer or surveyor, or if the project is being done internally in one office. Once moved, you can reset back to the internal origin, as well as reset the shared coordinates if coordinates need to be re-established.

- To modify the project base point, click on the icon and modify *N/S*, *E/W*, *Elev*, and *Angle to True North*, as shown in Figure 1–5. Alternatively, you can set up the values in Properties, as shown in Figure 1–6.

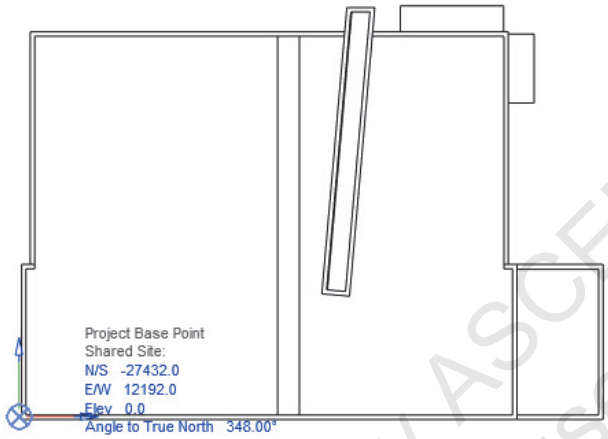

Figure 1–5

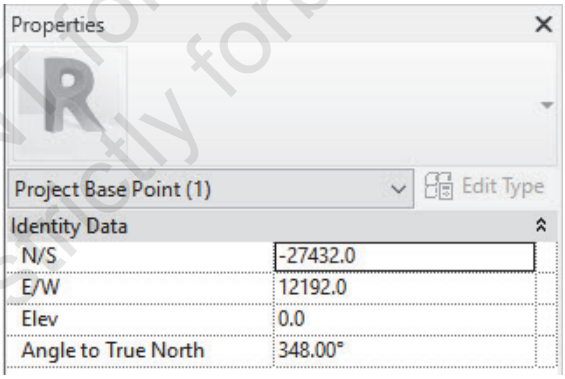

Figure 1–6

- To manually modify the survey point, you will have to unclip it and then edit the *N/S*, *E/W*, and *Elev*, as shown in Figure 1–7. Alternatively, you can modify the values in Properties, as shown in Figure 1–8.

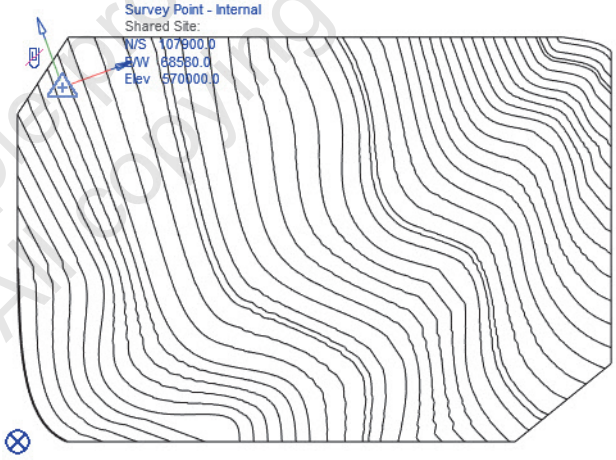

Figure 1–7

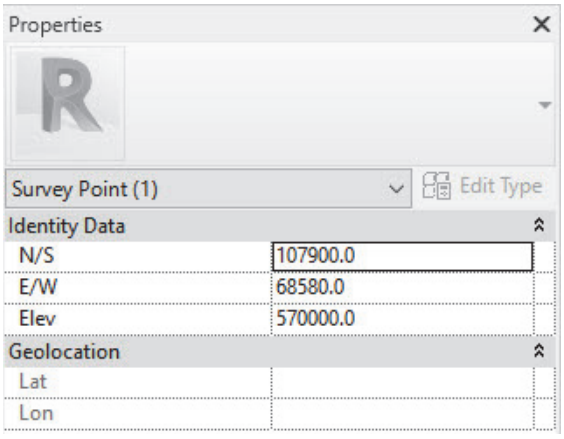

Figure 1–8

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- (Change clip state of point) displays next to the survey point and indicates whether it is clipped or unclipped. If is displayed beside the survey point, the survey point is clipped. If the survey point is moved while it is clipped, the origin of the project will change, which will affect the project base point. The internal coordinate system will always remain the same. The project base point will update according to the origin of the survey point. Should the survey point become unclipped and be moved, it will base its coordinates upon the internal origin and the project base point does not change.

- If is displayed beside the survey point, the survey point is unclipped. If the survey point is unclipped and moved, the project coordinates change but the model elements do not move.

How To: Reset the Project Base Point

If you want to reset the project base point to the internal origin, select (Project Base Point), right-click, and select **Move to Internal Origin**, as shown in Figure 1–9.

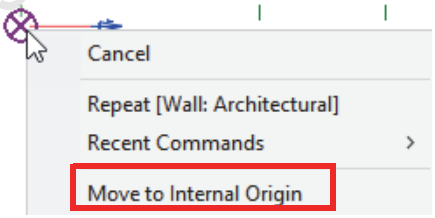

Figure 1–9

- The project base point relocates to the internal origin location.

How To: Reset the Survey Point

If you want to reset the survey point after moving it or acquiring shared coordinates, from the *Manage* tab>Project Location panel, select (Reset Shared Coordinates).

- The survey point relocates to the internal origin location.

- Resetting the survey point allows you to re-acquire coordinates from a linked file.

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1.3 Linking Files

The position of linked files needs to be established to keep the relationship between all files cohesive. In this section, you will learn about the process of linking models, what positionings are available, and how they respond to your host Revit model. When you link a Revit model, any views displaying the host's survey point and project base point will display the icons in blue, and the linked model's project base point and survey point icons will be grayed out, as shown in Figure 1–10. CAD files that have been linked into the project will not show any base points unless they have been drawn in or annotated.

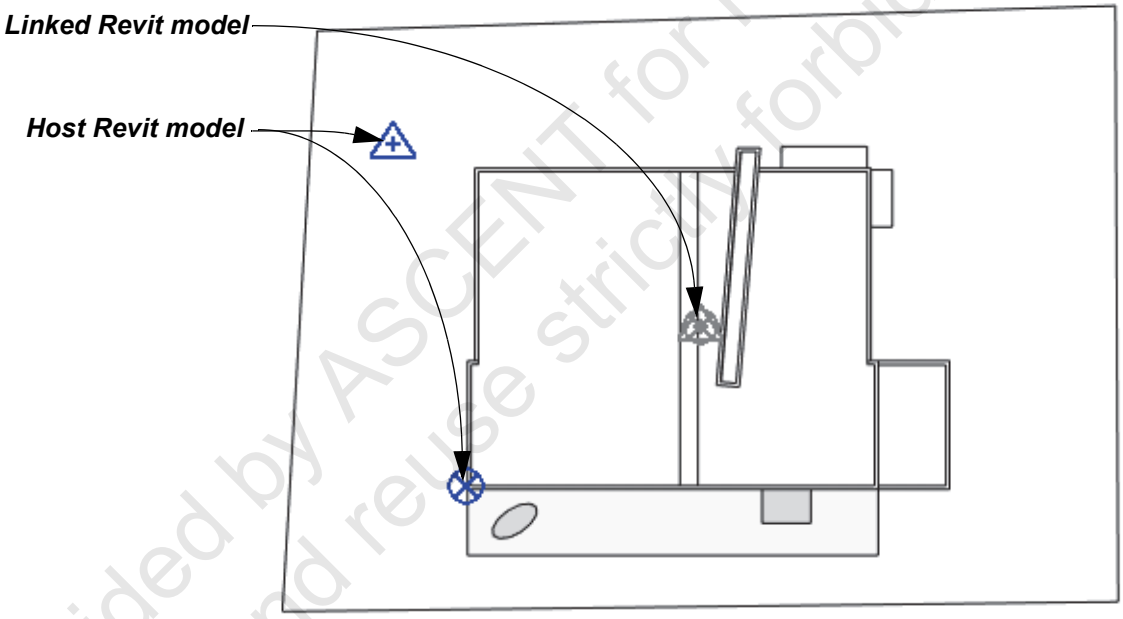

Figure 1–10

- Any linked model automatically updates if the original file is changed.
- Models created in the Autodesk Revit software need to be created from the same release cycle (i.e., created either with Revit 2021 (initial installation build) or with an update installed, such as Revit 2021.1).
- CAD file formats that can be imported or linked include AutoCAD® (DWG and DXF), MicroStation (DGN), 3D ACIS modeling kernel (SAT), Trimble SketchUp (SKP), and McNeel Rhino (3DM) (import only).

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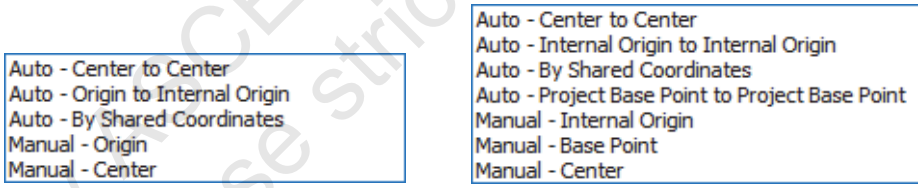
Linking vs. Importing

- **Linking:** A connection is maintained with the original file and the link updates if the original file is updated. If you plan to publish or acquire coordinates from a linked model or file, you will want to use the linking method.
- **Importing:** No connection is maintained with the original linked CAD file. It becomes a separate element in the Autodesk Revit model. You cannot publish or acquire coordinates from imported files. However, imported files are used to create toposurfaces within Revit. See *2.1 Creating Topographical Surfaces* for more on creating toposurfaces.

Link Model/File Positioning

There are several link positioning options to choose from for both CAD and Revit files, as shown in Figure 1–11. Check with your BIM manager on the method they have decide to use for linking in models and files to maintain the relationship of each model.



AutoCAD positioning options ***Revit positioning options***

Figure 1–11

Link Positioning Options

Auto - Center to Center	This option provides a way to link CAD files when the origin is miles away from Revit's internal origin.
Auto - Internal Origin to Internal Origin	Used to align models with their own internal origin. This is useful to use when aligning the architectural model with the structural model, for example.
Auto - By Shared Coordinates	This option is usually only used when shared coordinates have already been activated.
Auto - Project Base Point to Project Base Point	This option aligns two Revit models' project base points. This is the preferred approach as it allows the building models (architectural, MEP, and structural) to align even if they are in different locations from the internal origin, so long as they have their project base points set up correctly. Note that this option can get dangerous due to project base points being moved.
Manual options	All manual options are not as accurate as the auto options, so they are not used as much when working with shared coordinates.

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How To: Add a Linked Model to a Host Project

1. In the *Insert* tab>Link panel, click (Link Revit).
2. In the Import/Link RVT dialog box, select the file that you want to link. Before opening the file, set the *Positioning*, as shown in Figure 1–12.

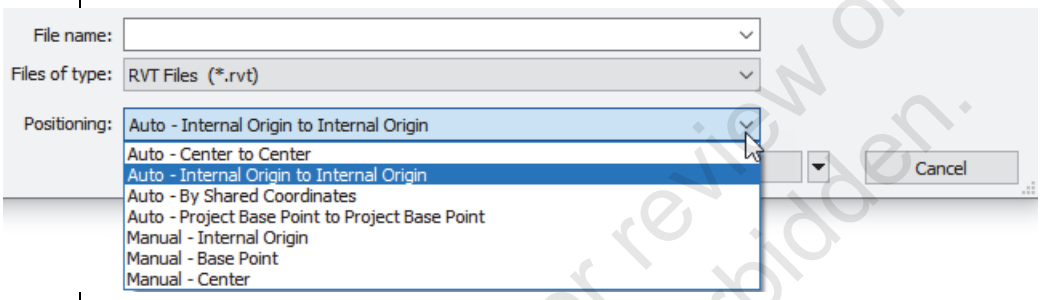

Figure 1–12

3. Click **Open**.

- Depending on how you decide to position the file, either it is automatically placed in the project or you can manually place it with the cursor.

How To: Link a CAD File

1. Open the view into which you want to link or import the file.
   - For a 2D file, this should be a 2D view. For a 3D file, open a 3D view.
2. In the *Insert* tab>Link panel, click (Link CAD), or in the *Insert* tab>Import panel, click (Import CAD).

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3. In the Link CAD Formats or Import CAD Formats dialog box (shown in Figure 1–13), select the file that you want to import.
   - Select a file format in the Files of type drop-down list to limit the files that are displayed.

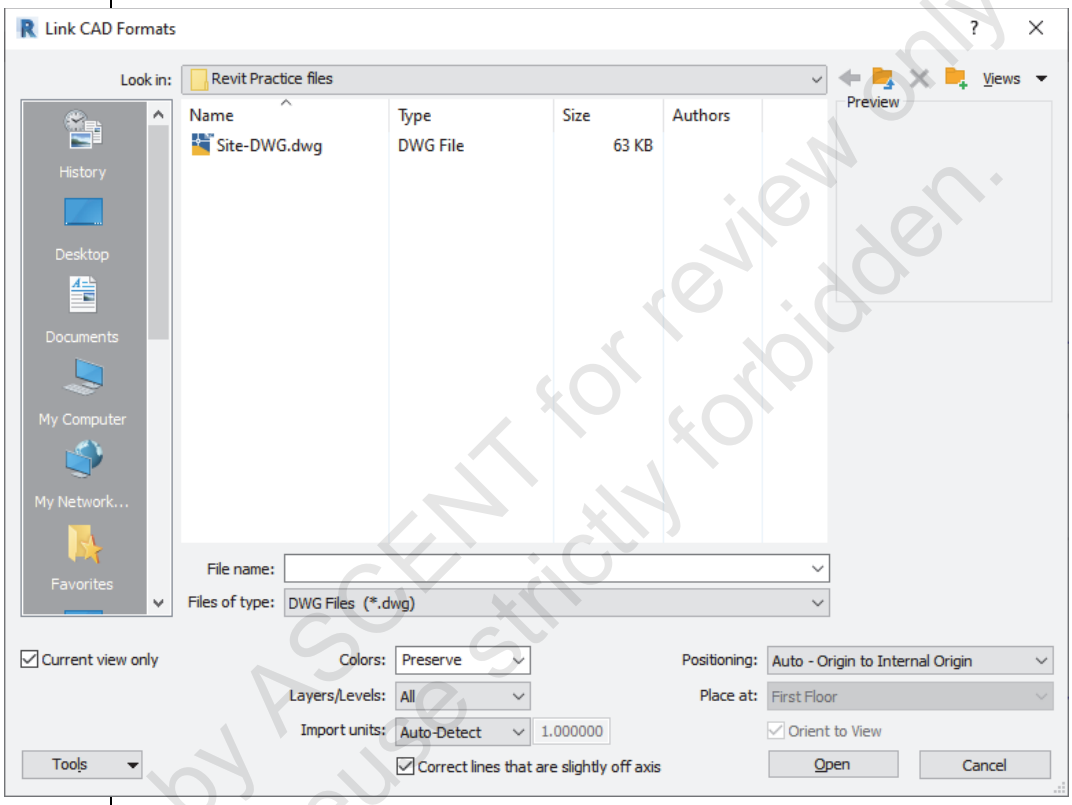

Figure 1–13

4. Set the other options and the *Positioning* (as shown in Figure 1–14) as specified by your office standards. The table below describes these settings in more detail.

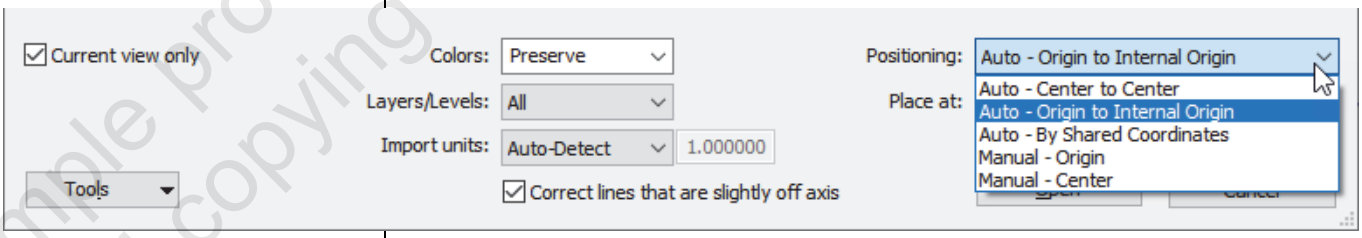

Figure 1–14

5. Click **Open**.

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CAD Linking Options

Current view only	This option determines whether the CAD file is placed in every view, or only in the current view. Turn this option off if you are linking a topography from a CAD file so you can see it in a 3D view as well.
Colors	Specify the color settings. Typically, Autodesk Revit projects are black and white; however, other software frequently uses color. You can **Invert** the original colors, **Preserve** them, or change everything to **Black and White**.
Layers/ Levels	Indicate which CAD layers are going to be brought into the model. Select how you want layers to be imported: **All**, **Visible**, or **Specify...**.
Import units	Select the units of the original file, as required. **Auto-Detect** works in most cases.
Correct lines...	If lines in a CAD file are off axis by less than 0.1 degrees, selecting this option straightens them. It is selected by default.
Positioning	Specify how you want the linked file to be positioned in the current project: **Auto - Center to Center**, **Auto - Origin to Internal Origin**, **Auto - By Shared Coordinates**, **Manual - Origin**, or **Manual - Center**. They follow the same principles as described in the Link Positioning Options table above.
Place at	Select a level in which to place the imported file. If you selected **Current view only**, this option is grayed out.
Orient to View	Used to orient the CAD file on import/link.

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Hint: Preventing a Linked Model from Being Moved

Once a linked model is in the correct location, you can lock it in place to ensure it does not get moved by mistake or to prevent the linked model from being selected.

- To pin the linked model in place, select it and in the *Modify* tab>Modify panel, click (Pin).
- To prevent pinned elements from being selected, in the Status Bar, click (Select Pinned Elements).
- To toggle off the ability to select links, in the Status Bar, click (Select Links).

If a linked model is moved, you can reposition it to the project base point or internal origin. Right-click on the model and select the appropriate option, as shown in Figure 1–15.

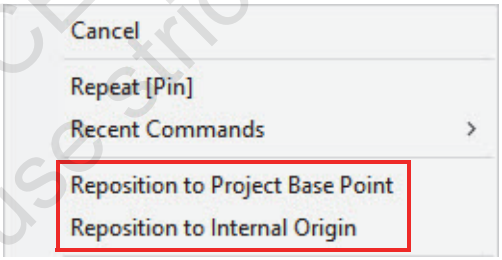

Figure 1–15

Multiple Linked Models or Copies of Linked Models

Copied instances of a linked model are typically used when creating a master project with the same building placed in multiple locations, such as a university campus with six identical student residence halls.

- Within the host model, you can display linked model coordinates by turning them on from the Visibility/Graphic Overrides dialog box, in the Site category. Linked model coordinates will be grayed out in the view, as shown in Figure 1–16.

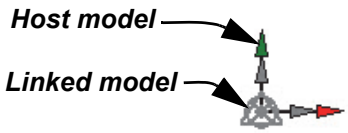

Figure 1–16

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- Linked models can be moved, copied, rotated, arrayed, and mirrored. There is only one linked model, and any copies are additional instances of the link.
- Copies are numbered automatically. You can change their names in Properties when the instance is selected.
- When you have placed a link in a project, you can drag and drop additional copies of the link into the project from the Project Browser>**Revit Links** node, as shown in Figure 1–17.

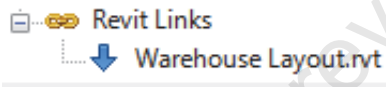

Figure 1–17

Hint: Working with Civil 3D Files

If the project is being coordinated in BIM 360, the civil engineer can publish surfaces to BIM 360 Documents. The surface can be brought into Autodesk Revit from the *Insert* tab>Link panel by clicking (Link Topography).

If the coordinates have already been acquired, the topography will place itself in the correct location based on those coordinates. Since the file is linked into the project, when the civil engineer updates the file, it will also update accordingly inside the Autodesk Revit project.

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Managing Links

The Manage Links dialog box (shown in Figure 1–18) enables you to reload, unload, add, and remove links. It also provides access to set other options. To open the Manage Links dialog box, in the *Insert* tab>Link panel, click (Manage Links). Alternatively, you can go to the *Manage* tab>Manage Projects panel and click (Manage Links).

- You can also select the link and click (Manage Links) in the *Modify* | *RVT Links* tab>Link panel.

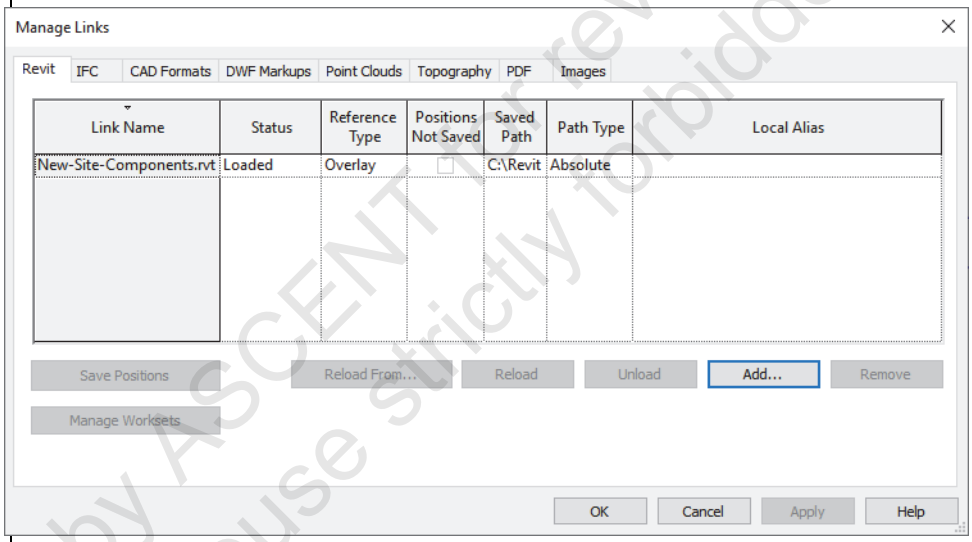

Figure 1–18

The options available include the following:

*Some of these options are also available in the Project Browser. Expand the Revit Links node, then right-click on the Revit link and select **Reload**, **Unload** or **Reload From...**.*

- **Reload From...:** Opens the Add Link dialog box, which enables you to select the file you want to reload. Use this if the linked file location or name has changed.
- **Reload:** Reloads the file without additional prompts.
- **Unload:** Unloads the file so that the link is kept, but the file is not displayed or calculated in the project. Use **Reload** to restore it.
- **Add:** Opens the Import/Link RVT dialog box, which enables you to link additional models into the host project.
- **Remove:** Deletes the link from the file.

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Links can be nested into one another. How a link responds when the host project is linked into another project depends on the option selected in the *Reference Type* column:

- **Overlay:** The nested linked model is not referenced in the new host project.
- **Attach:** The nested linked model displays in the new host project.

The option in the *Path Type* column controls how the location of the link is remembered:

- **Relative:** Searches for the link in the root folder of the current project. If the file is moved, the software still searches for it.
- **Absolute:** Searches the entire file path where the file was originally saved. If the original file is moved, the software is not able to find it.

Other options control how the linked file interfaces with worksets and shared positioning.

Reposition Linked Revit Models

Regardless of how a Revit model was linked into the host project, you have two options to reposition the linked model after insertion: **Reposition to Internal Origin** (as shown in Figure 1–19), which aligns the linked model's internal origin with the host model's origin, and **Reposition to Project Base Point**, which aligns the linked model's project base point with the host model's project base point.

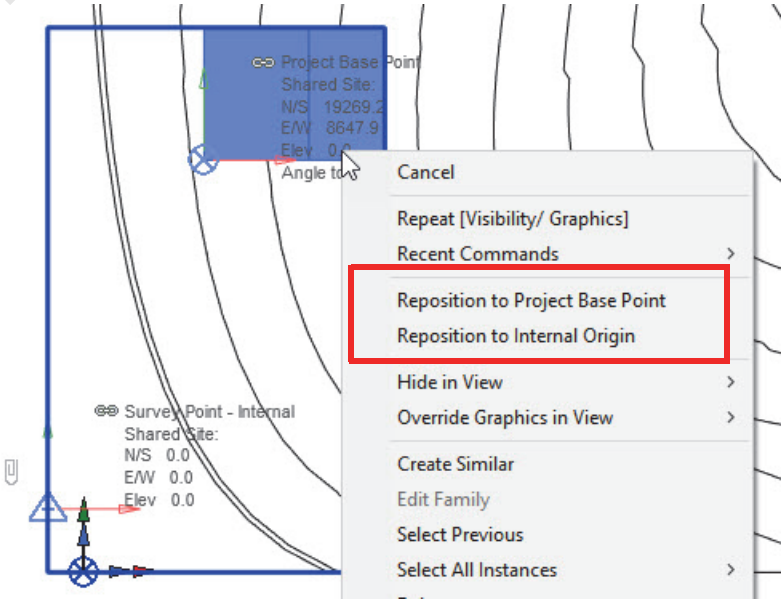

Figure 1–19

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If a linked instance has been rotated or mirrored and you select one of the reposition options, you will be asked if you want to preserve the orientation of the linked model or reset the orientation, which re-aligns it to its original position (as shown in Figure 1–20).

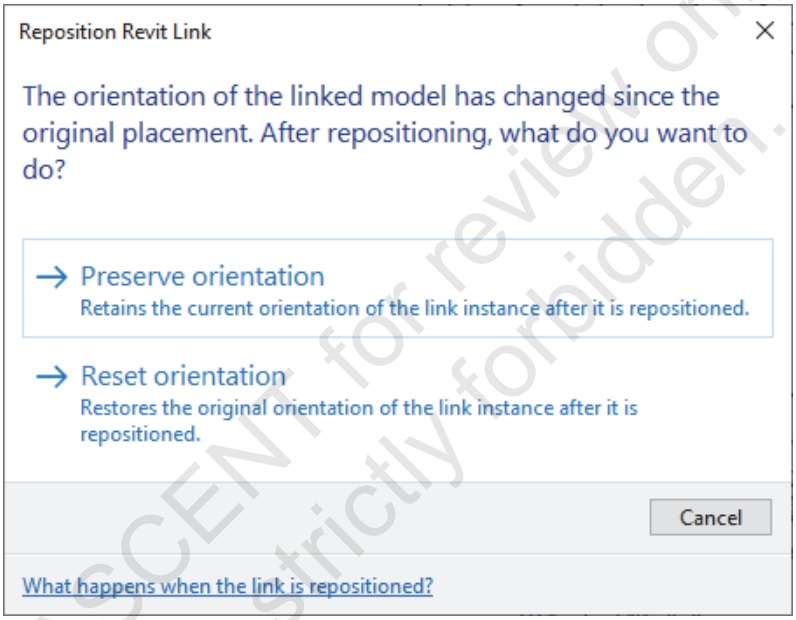

Figure 1–20

Relocate the Project

After you have linked in the site plan or linked a model into your site plan, you need to make sure you have lined up the project and site plan so that when you are working in a plan, elevation, or section view, everything is in the right location. You can use the Align and Move tools to get the link into position. There are also tools you can use to move the model elements without physically moving them. As well, you can specify whether the levels will read the project base point or survey point.

- The **Relocate Project** tool is used to relocate the project to the correct position of a linked file without physically moving the elements in a project. An example of why you would want to use the Relocate Project tool is if, in plan view, your survey point is in the correct position but your project base point is off and you need to move your building to the correct location. In elevation view, you would want to use the Relocate Project tool if your model is not at the correct elevation location and you need to move it into position.

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- **Specify Coordinates at Point** is used when you have the coordinates from a civil engineer or surveyor, or if you have a linked model in your Revit host model and you use the Report Shared Coordinates tool to determine the coordinates of the linked model. This tool allows you to enter values for *North/South*, *East/West*, *Elevation*, and *Angle from Project North to True North*, as shown in Figure 1–21.

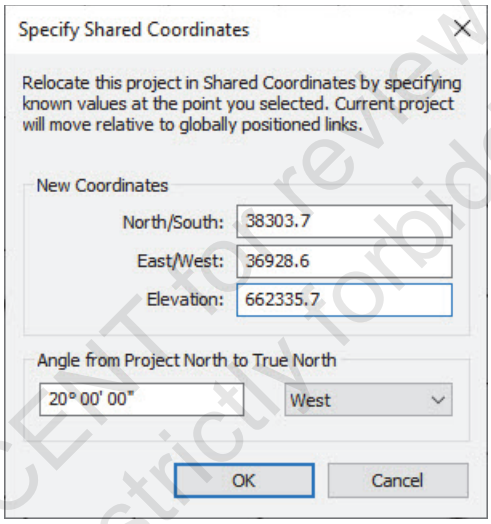

Figure 1–21

Hint: When to Relocate the Host Model

In a common workflow, repositioning the host model relative to your survey point may be required in any of the following situations:

- If you are given the survey point location from the civil engineer or surveyor and you want to align your building model and levels to the given coordinates.
- If after linking in your site plan, you need to line up your building with the site.
- After acquiring a site plan's coordinates and linking in files or models and publishing coordinates.

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How To: Relocate the Model Using Relocate Project

1. In a plan or elevation view, in the *Manage* tab>Project Location panel, expand (Position) and select (Relocate Project).
2. Select somewhere within the view as the starting base point. The second point selected is where you want to move the model to. Use the temporary dimensions to enter a precise distance.

How To: Relocate the Model by Specifying Coordinates

1. In a plan or elevation view, in the *Manage* tab>Project Location panel, expand (Coordinates) and select (Specify Coordinates at Point).
2. Select somewhere within the view as the starting base point.
3. In the Specify Shared Coordinates dialog box, enter the coordinates given to you by the surveyor or civil engineer.

Adjust the Levels' Elevation Base

In an elevation view, you can set your levels to read the project base point or survey point. Changing this allows you to measure based off of the sea level elevation (provided the correct shared coordinates are set up) without physically moving your model.

How To: Change the Levels' Elevation Base

1. In an elevation view, select a level.
2. In Properties, click **Edit Type**. In the Type Properties dialog box, in the *Constraints* section, change the *Elevation Base* to **Survey Point**, as shown in Figure 1–22. Note the difference in the levels once the *Elevation Base* has been changed.

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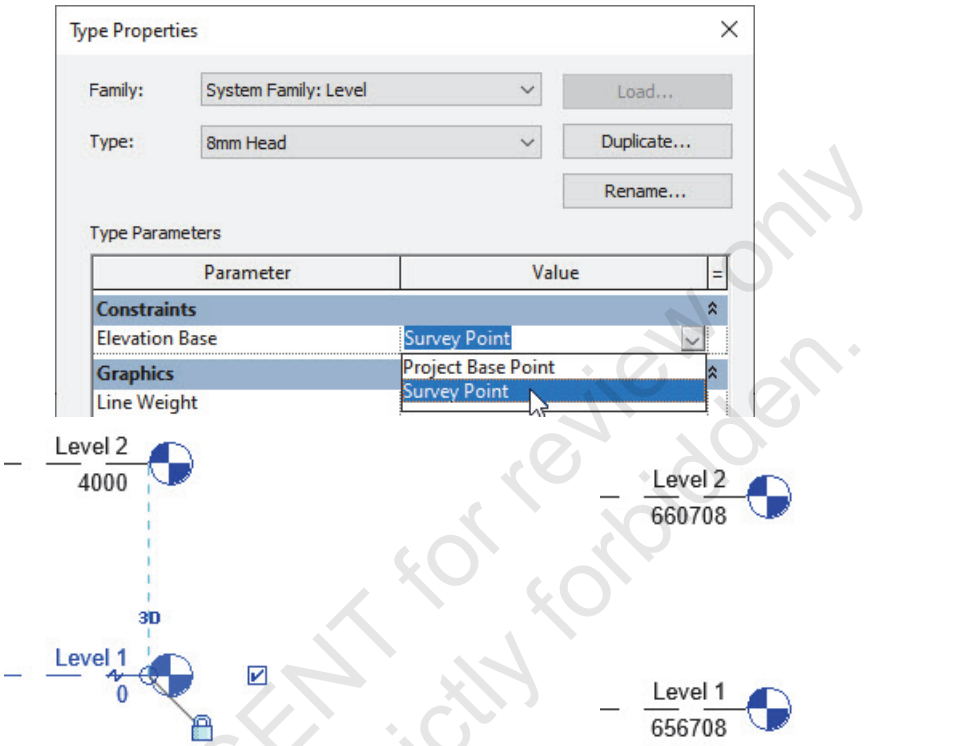

Elevation Base set to Project Base Point ***Elevation Base set to Survey Point***

Figure 1–22

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Practice 1a

Link and Modify Positioning

Practice Objectives

- Link a .DWG file into the host project.
- Link a Revit file into the host project.
- Test different locations.
- Manually set the host project's survey point.

In this practice, you will link a file to a host project using **Auto - Internal Origin to Internal Origin** and **Auto - Project Base Point to Project Base Point**, demonstrating what happens when you use the different positioning methods (shown in Figure 1–23) available in the Link dialog box. You will also learn how to reposition a model after it is linked in. Finally, you will manually set the survey point on the site plan.

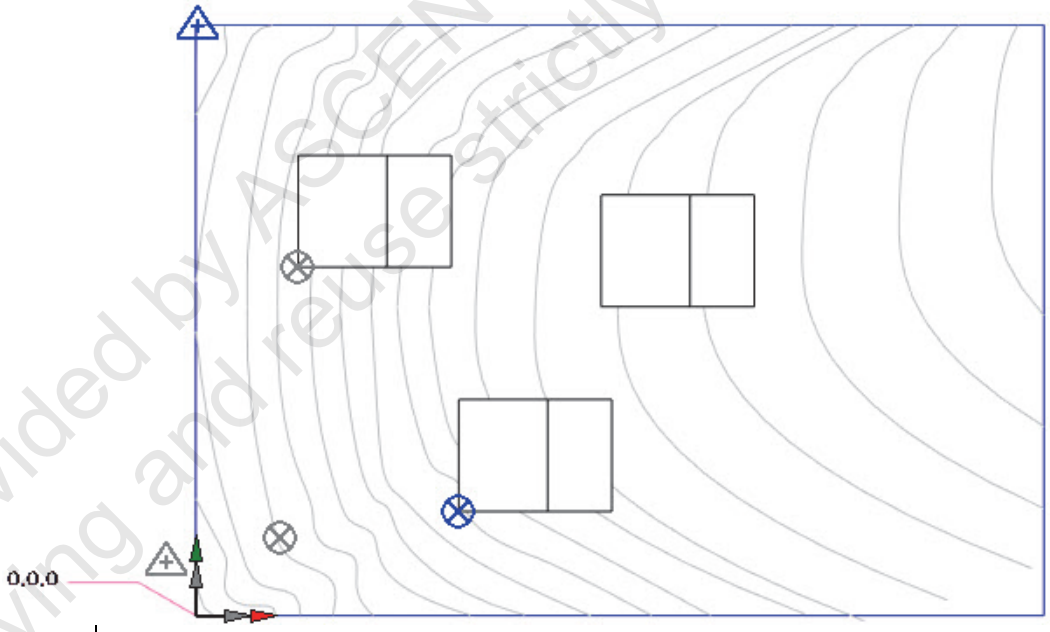

Figure 1–23

Task 1 - Link the CAD site plan.

In this task, you will link a .DWG file into your project. Its coordinates (0,0,0) are located in the bottom left of the drawing and are marked with a leader line.

1. In the practice files folder, open **Host Model-M.rvt**. You should be on the **Floor Plans: Site** view.

2. In the *Insert* tab>Link panel, click (Link CAD).

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3. In the Link CAD Formats dialog box, navigate to the practice files folder and select **BCM_Site Plan-M.dwg**. Set the *Positioning* to **Auto - Origin to Internal Origin** and leave the defaults as shown in Figure 1–24. Click **Open**.

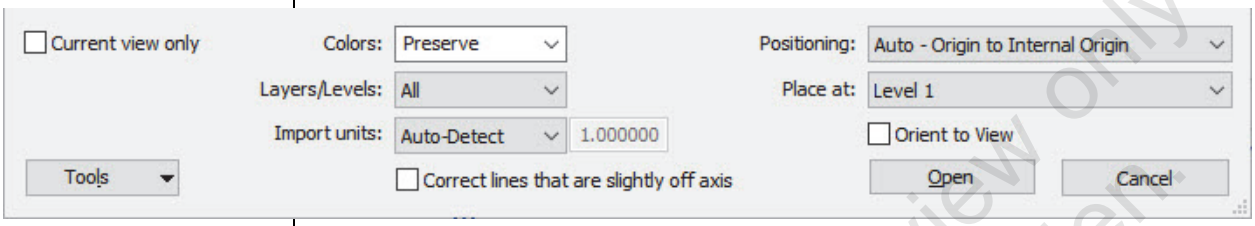

Figure 1–24

- You will note that the .DWG file's coordinates (0,0,0) line up with Revit's internal origin (0,0,0), as shown in Figure 1–25.

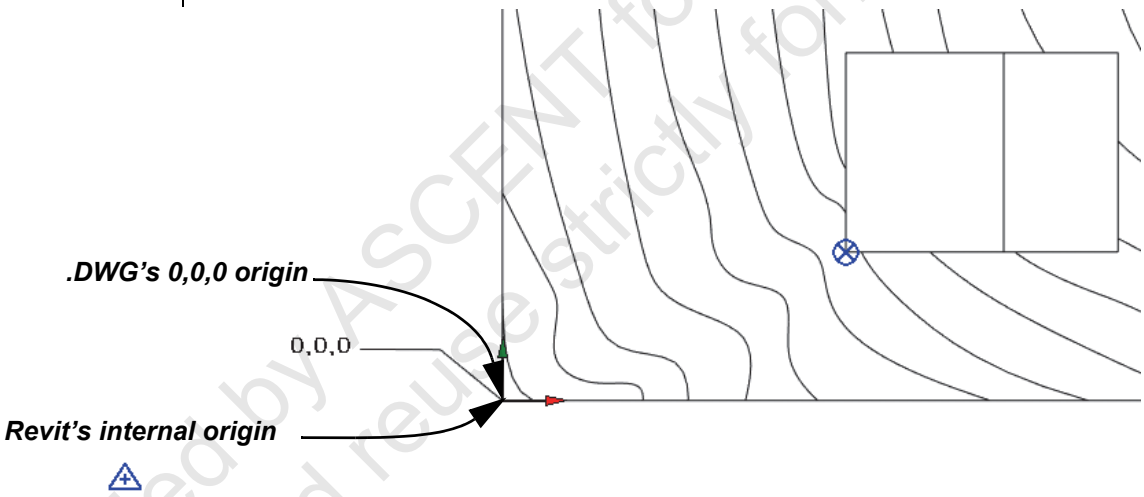

Figure 1–25

Task 2 - Link the Revit building model.

In this task, you will link in a Revit building to see how it will line up with the host model. Because the site internal origin and survey and project base point icons are turned on, you will also see the linked model's site icons but they will be grayed out.

1. In the *Insert* tab>Link panel, click (Link Revit).
2. In the Import/Link RVT dialog box, navigate to the practice files folder and select **Building-M.rvt**. Set the *Positioning* to **Auto - Internal Origin to Internal Origin** and click **Open**.

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3. You will see that the linked .RVT file's internal origin is lined up with the host model's internal origin, as shown in Figure 1–26. (The linked model's internal origin is grayed out.)

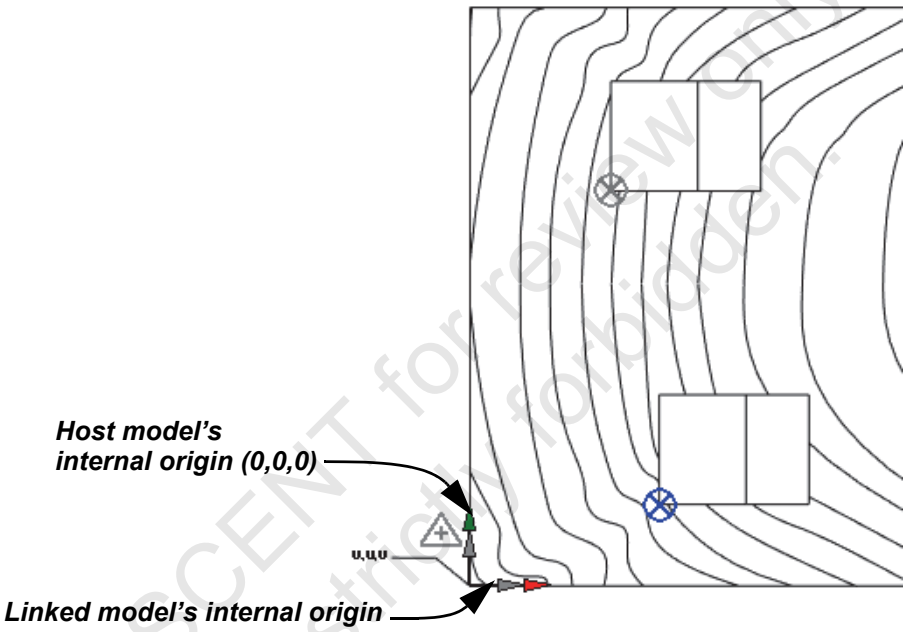

Figure 1–26

4. In the *Insert* tab>Link panel, click (Link Revit).
5. In the Import/Link RVT dialog box, navigate to the practice files folder and select **Annex-M.rvt**. Set the *Positioning* to **Auto - Project Base Point to Project Base Point** and click **Open**.

- You will note that the host model's project base point and the linked Annex-M.rvt's project base point are now lined up and on top of each other, as shown in Figure 1–27.

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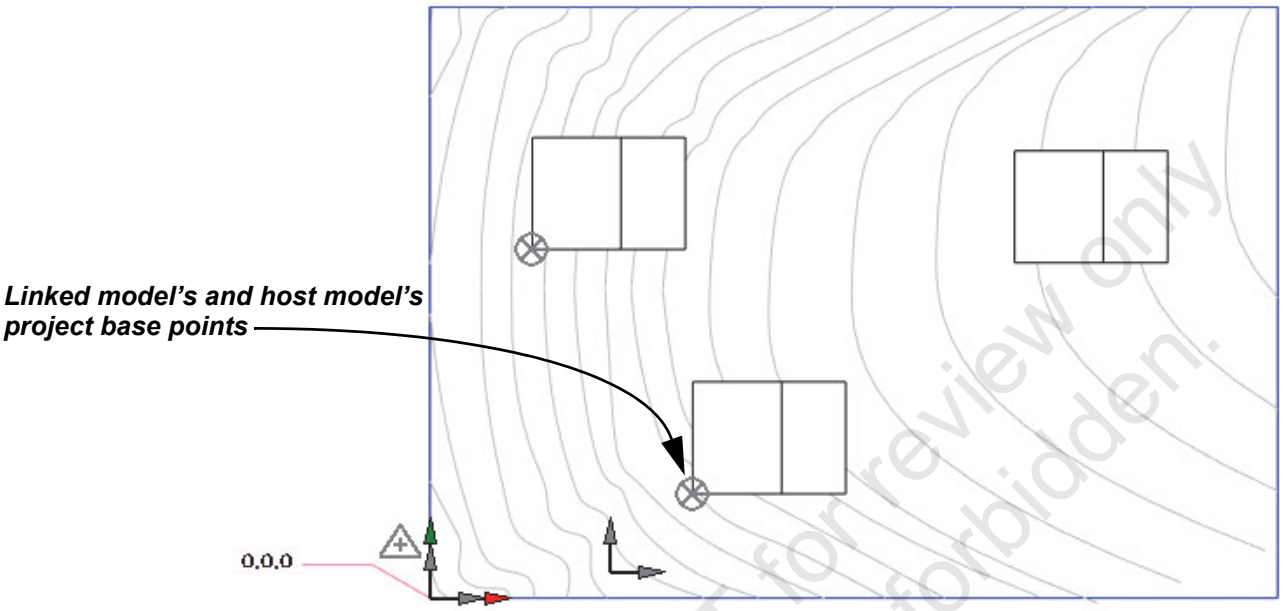

Figure 1–27

Task 3 - Move the annex to a new position.

In the view, select the linked **Annex-M.rvt** model, right-click, and select **Reposition to Internal Origin**, as shown in Figure 1–28.

- The linked annex building's internal origin now aligns with the host model's internal origin.

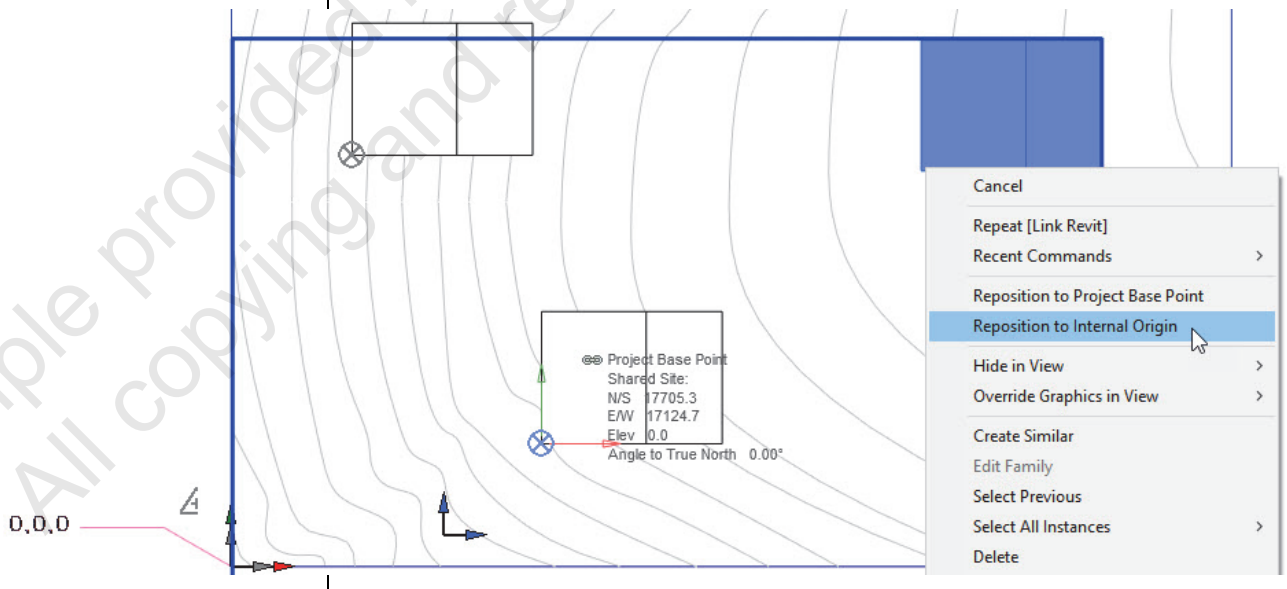

Figure 1–28

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Task 4 - Manually set the host model's survey point.

In this task, you will unclip the survey point and enter in the coordinates in Properties. Note that this is the approach you would take to set up your host model for real-world coordinates given by the surveyor.

1. In the view, select the survey point and click (Change clip state of point) to unclip it, as shown in Figure 1–29. Note that *N/S*, *E/W*, and *Elev* are now editable in Properties.

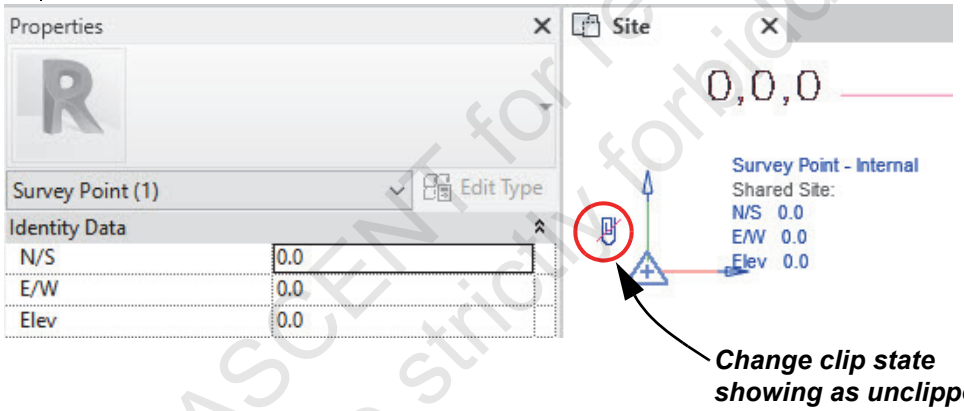

Figure 1–29

2. In Properties, enter the following:
   - *N/S*: **41468.4**
   - *E/W:* **13888.6**
   - *Elev*: **0.0**
3. The survey point is now located in the upper left corner of the site plan. Select the survey point and click (Change clip state of point) to clip it, as shown in Figure 1–30.

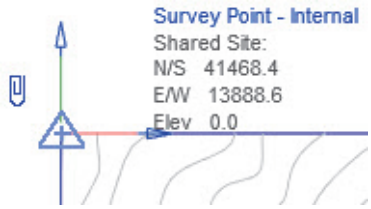

Figure 1–30

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Task 5 - Manually move the survey point in a clipped state.

1. Select the survey point and click (Change clip state of point) to unclip it. In Properties, change both *N/S* and *E/W* back to **0.0**. This places the survey point back to its original location/position.

2. Select the survey point and click (Change clip state of point) to clip it.

   - Note that a similar approach can be taken if the survey point has been moved to real-world coordinates. Changing the point's state to clipped allows the survey point to be moved from really far away (e.g., 1500 N/S and 1500 E/W) from the internal origin back closer to the origin point so that the model does not exceed the 10-mile radius limit.

3. Keeping the survey point clipped, manually move the survey point to the upper corner of the site plan. Note that the survey point still shows as **0,0,0**, as shown in Figure 1–31.

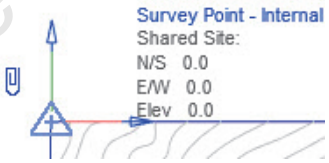

Figure 1–31

4. Save and close the project.

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1.4 Shared Coordinates

Shared coordinates are used to maintain the relationship between the host model and all linked files associated with it. **Publish Coordinates** and **Acquire Coordinates** are two ways to activate shared coordinates after files and models have been linked into your host model. You will use the method that is established by your BIM manager. Note that you cannot publish or acquire coordinates from an imported file.

The following are some examples of when you would use one of these methods.

- If you are working in a project with linked models and want to adopt the coordinates from one of the linked models, rather than from the host project, you can acquire the coordinates, as shown in Figure 1–32. For example, you might have a site plan that was created in AutoCAD that has been linked into your Revit project and you want to use the coordinates from the AutoCAD .DWG file.

Current Project Coordinates ***Coordinates Acquired from Linked Site Plan***

Figure 1–32

- If you are working in a project with linked models and want the linked models to adopt your coordinates, you would publish your coordinates to them. Publishing coordinates is also used when you are linking or copying more than one file or model. For example, you might have a project that has multiple buildings, like a campus, or multiple rooms that are the same, like an apartment complex (as shown in Figure 1–33). You can define unique positions for each of the copied linked models by specifying a named position through the link's instance properties.

  - If working with models that are within your own office on the same network, it is best practice to not have anyone working in the linked file when you publish coordinates to it.

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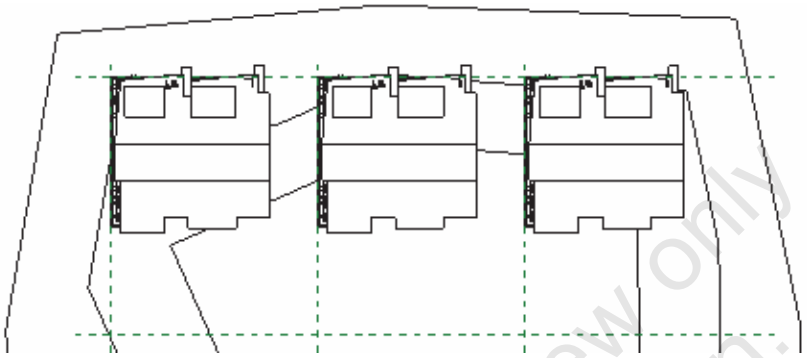

Figure 1–33

Hint: Geographic Location Information

To maintain a consistent geographic location (geolocation) between models, you can use the Geographic Information System (GIS) coordinates stored in a linked .DWG file that includes a geographic marker, as shown in the AutoCAD software in Figure 1–34. The geolocation is a specific real-world location using global coordinates.

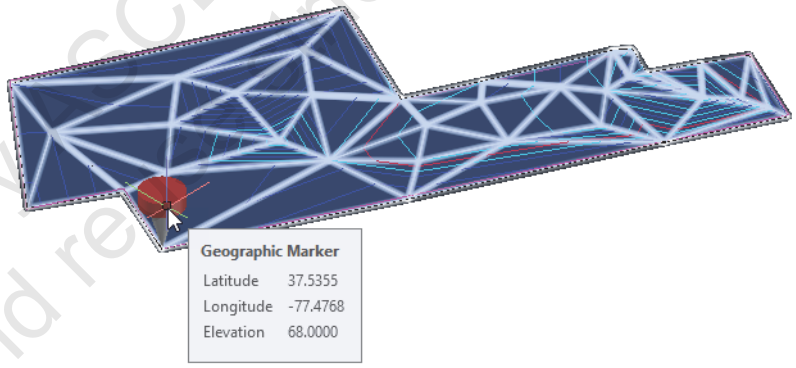

Figure 1–34

When you acquire coordinates from a geographic marker (as shown in Figure 1–35), this updates the Autodesk Revit model with the real-world position of the model, which improves energy analysis.

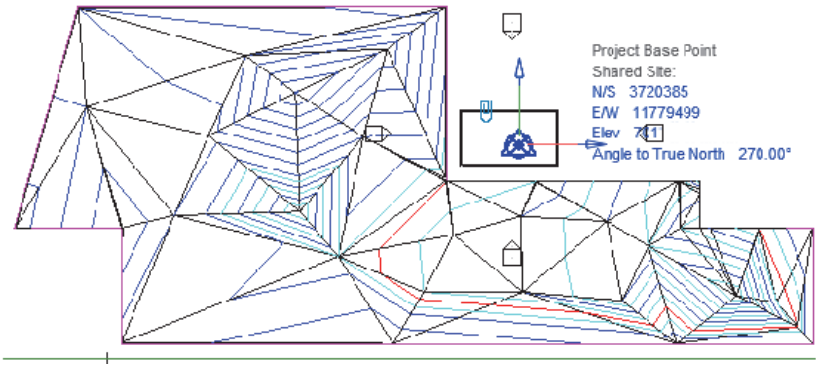

Figure 1–35

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Acquire Coordinates

Acquiring coordinates is adopting or pulling coordinates from a single linked model, typically from a site plan. This could be a CAD file or a linked Autodesk Revit model. There are two ways that you can acquire coordinates from a linked model: use the tools from the *Manage* tab>Project Location panel or use the linked file's instance properties to select the *Shared Site* parameter and bring up the Share Coordinates dialog box.

- If you are working with a linked site, before acquiring the coordinates, ensure that you move, rotate, and align your model into place.
- Linked models that share coordinates can be a combination of file types like .RVT, .DWG, and .DXF.
- You can only acquire coordinates once.

How To: Acquire Coordinates from a Linked File or Model

1. In the *Manage* tab>Project Location panel, expand (Coordinates) and click (Acquire Coordinates).
2. Select a linked model from which to acquire the shared coordinate system.
   - You will get an Acquire Coordinates Succeed dialog box specifying the name of the file you acquired from, as shown in Figure 1–36 for both a .DWG file and a .RVT file.

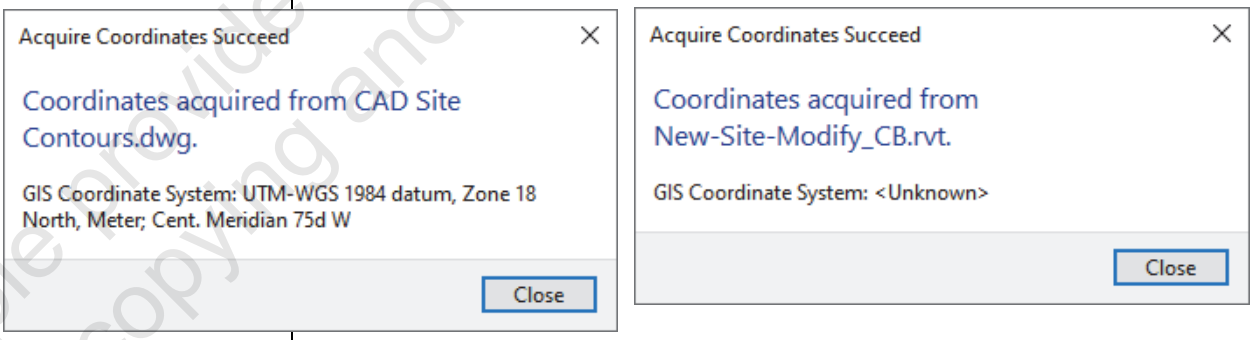

Figure 1–36

- The current project now uses the new coordinates.

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How To: Acquire Coordinates Using Instance Properties

1. In your project, select the linked file or model.
2. In Properties, in the *Other* section, beside *Shared Site,* click **<Not Shared>**, as shown in Figure 1–37.

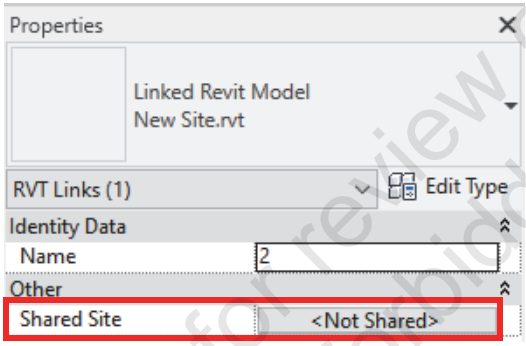

Figure 1–37

3. In the Share Coordinates dialog box, select the **Acquire** option and click **Reconcile**, as shown in Figure 1–38.
   - You will not have this option if you select an imported file.

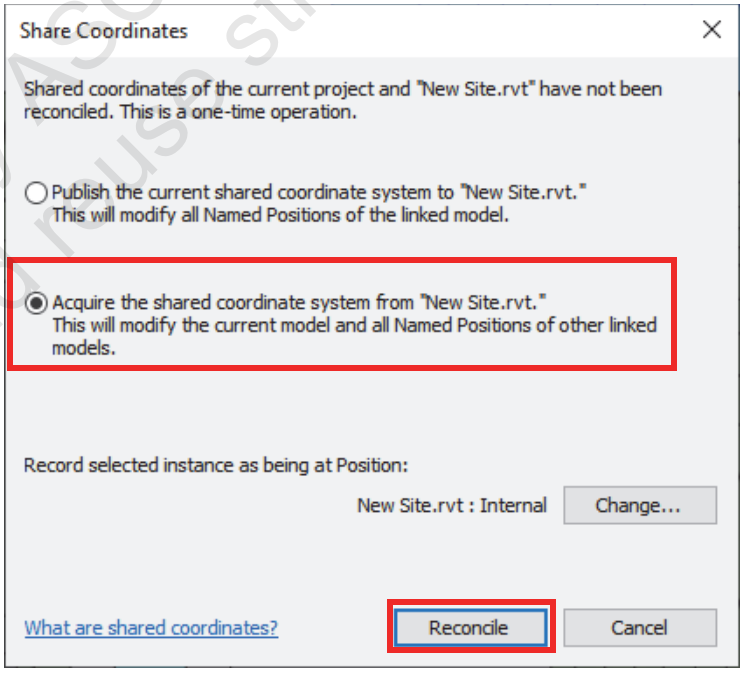

Figure 1–38

- This only occurs the first time you select a file that does not share coordinates. If you select other instances of the same link, this dialog box does not open. Instead, you will get the Choose Site dialog box.

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- If you move or rotate a linked instance after it has been shared and saved, a Warning box displays, as shown in Figure 1–39. You can click **Save Now** to save the position or click **OK** to continue working in the project. You can save the linked model later using the Manage Links dialog box.

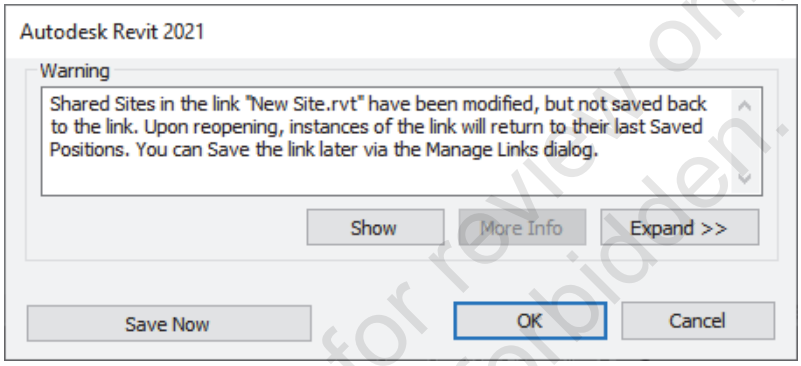
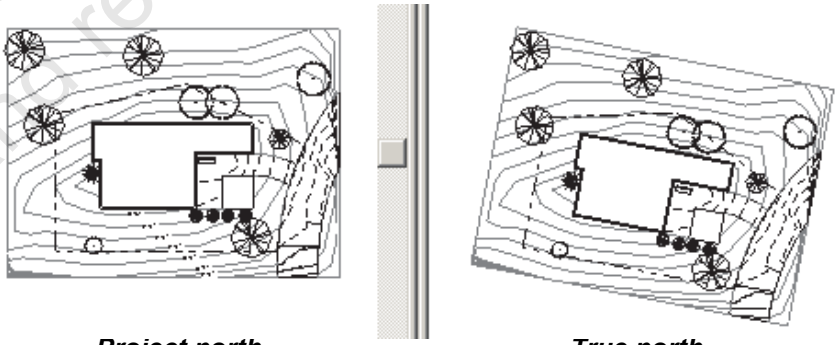


Figure 1–39

Hint: Project North and True North

When you acquire coordinates, they include the orientation of the site. When you are working on a building or site layout, it is easier to work with standard horizontal and vertical axes, as shown on the left in Figure 1–40. This is called project north. You can also display a view at true north, as shown on the right in Figure 1–40.



Project north ***True north***

Figure 1–40

- To change the orientation, activate the view where you want to change the orientation. With no elements selected, in Properties, in the *Graphics* section, set the *Orientation* to **True North**.

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Publish Coordinates

Publishing coordinates is pushing the host model's coordinates to a linked file or model. This could be a CAD file or a linked Autodesk Revit model. This is typically done when the Revit host model has already been given the survey coordinates from the civil engineer or surveyor and they have been manually entered as the host model's survey point. There are two ways that you can publish coordinates from a linked model: use the tools from the *Manage* tab>Project Location panel or use the linked file's instance properties to select the *Shared Site* parameter and bring up the Share Coordinates dialog box.

- You can publish coordinates to more than one linked file or model. This ensures that all files that are linked in are using the same coordinate system.

How To: Publish Coordinates to a Linked File or Model

1. Ensure you are in the host project that has the coordinates you want to push or publish to the linked model.
2. In the *Manage* tab>Project Location panel, expand (Coordinates) and click (Publish Coordinates).
3. Select the linked model you want to publish the coordinates to.

How To: Publish Coordinates Using Instance Properties

1. In your project, select the linked file or model.
2. In Properties, in the *Other* section, beside *Shared Site,* click **<Not Shared>**, as shown in Figure 1–41.

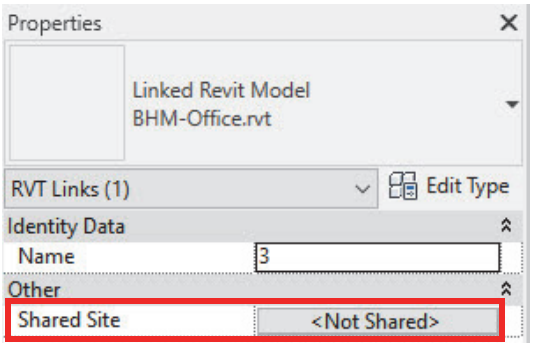

Figure 1–41

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3. In the Share Coordinates dialog box, select the **Publish** option and click **Reconcile**, as shown in Figure 1–42.
   - You will not have this option if you select an imported file.

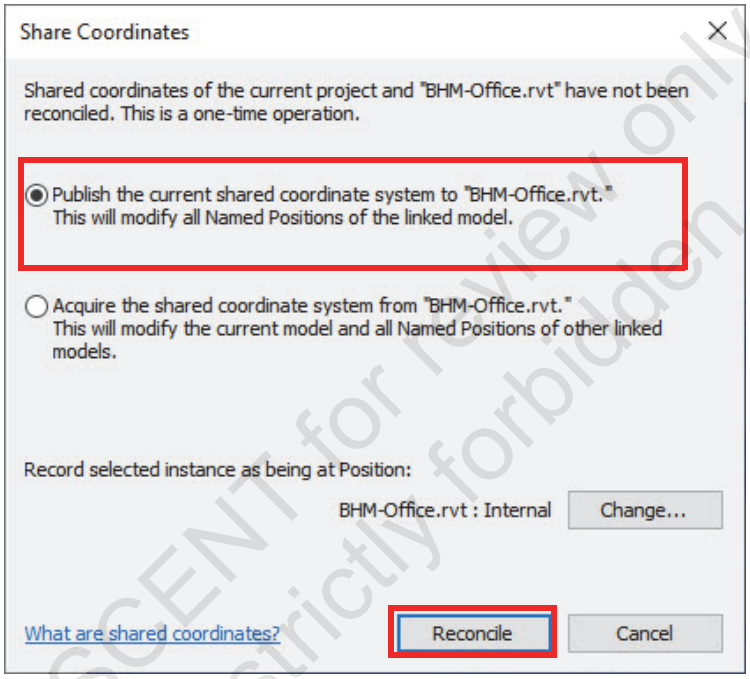

Figure 1–42

- You only need to publish coordinates to a linked model once.
- The Share Coordinates dialog box only displays the first time you select a linked model or file that does not share coordinates. If you select other instances of the same link, this dialog box does not open. Instead, you will get the Choose Site dialog box.

Define Named Positions

When you have more than one unique building or multiple copies of a building linked into the host model, you can specify their positions on a site through the linked file's instance properties. This is done by selecting the link in the view and modifying the *Shared Site* parameter, which is located in the *Other* section in Properties, as shown in Figure 1–43. Through Properties, you can move a linked instance to a new location, record the current position to a named location, or stop sharing the location of the linked instance.

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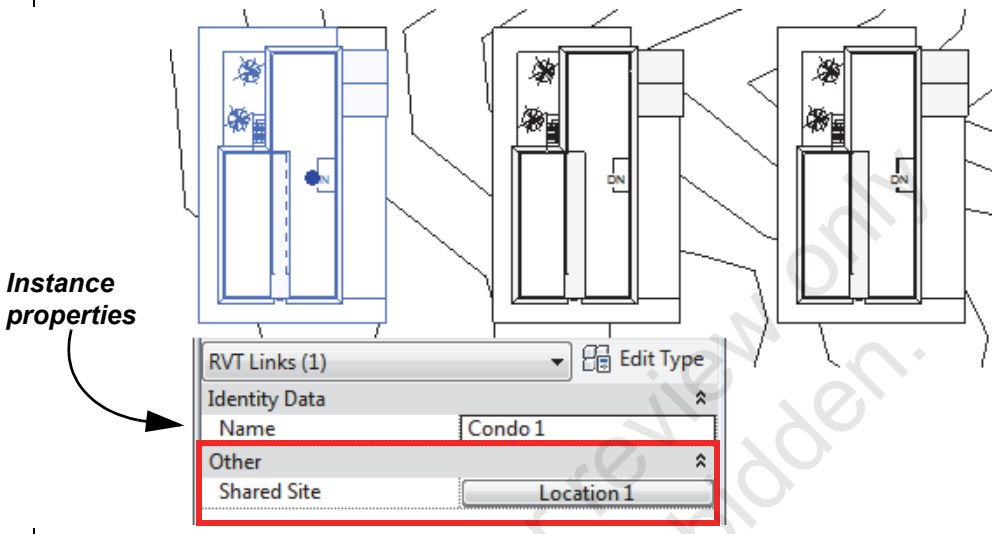

Figure 1–43

Once you click the button next to the *Shared Site* parameter, the Choose Site dialog box displays. You have the option to do one of the following:

- **Move instance to:** You can move the linked instance to a named position that is specified within the linked model.
- **Record current position as:** You can record the current position of the linked model where you have positioned it in the host model. This saves the position back to the linked model.
- **Do not share site of selected instance:** Selecting this option leaves the linked model's position in its original position from when it was first linked in. Use this option to move the linked model without modifying the linked model's position. The linked model's *Shared Site* parameter will display as **<Not Shared>**.

If you have selected the option to **Record current position as** and click the **Change...** button, the Location Weather and Site dialog box displays, where you can choose from the list of positions or duplicate and name a new position.

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- The default named position is called **Internal** and its position is set to Revit's internal origin. In the Location Weather and Site dialog box (shown in Figure 1–44), you can delete, rename, and duplicate defined positions in a project.
  - You can also rename the default **Internal (current)** position.

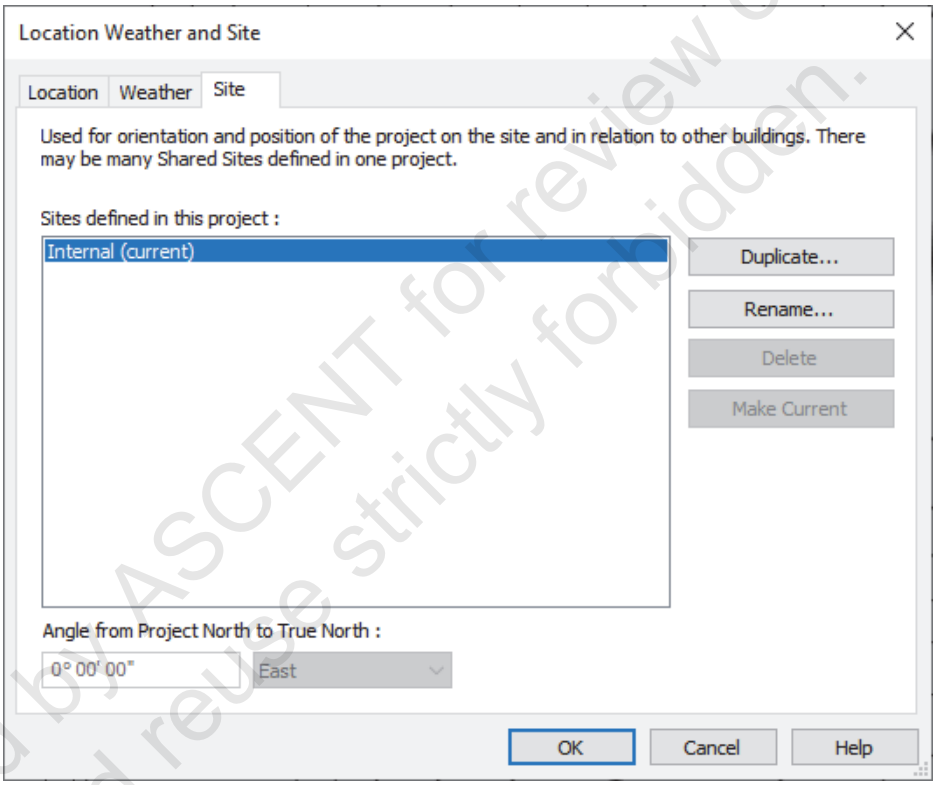

Figure 1–44

When you have specified the positioning of the linked models and you save the host model, if you have not saved the recorded positions through the Manage Links dialog box, you are prompted with the Location Position Changed dialog box, letting you know that you have changed a position of a linked model and prompting if you want to **Save**, **Do not save**, or **Disable shared positioning**, as shown in Figure 1–45.

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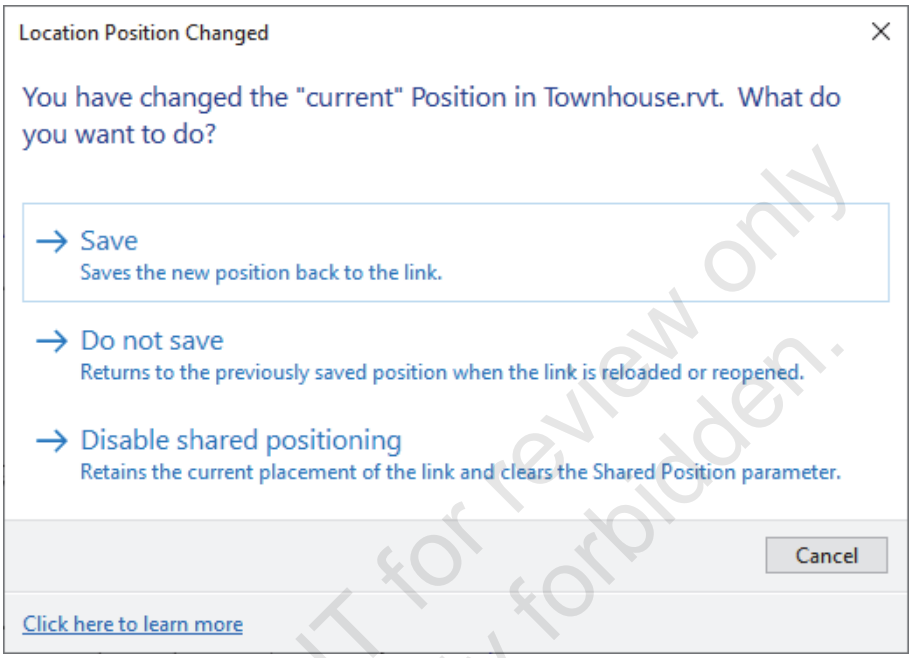

Figure 1–45

How To: Change or Record a Position Using Instance Properties

1. Select a linked file that you want to change or record the position of in the host model.
2. In Properties, in the *Other* section, click the button beside *Shared Site*.
3. The Choose Site dialog box opens. Click **Change...**, as shown in Figure 1–46.

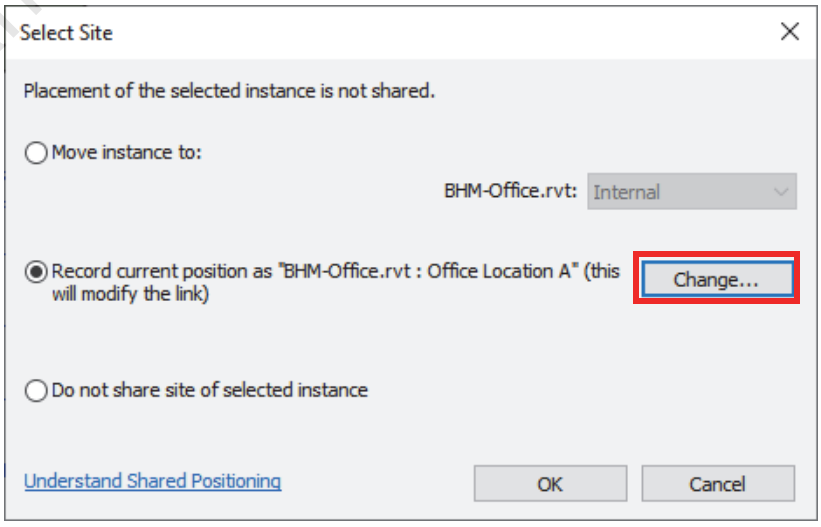

Figure 1–46

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Click (Location) in the Manage tab>Project Location panel to open the dialog box at any time.

4. In the Location Weather and Site dialog box, verify that you are on the *Site* tab, as shown in Figure 1–47.

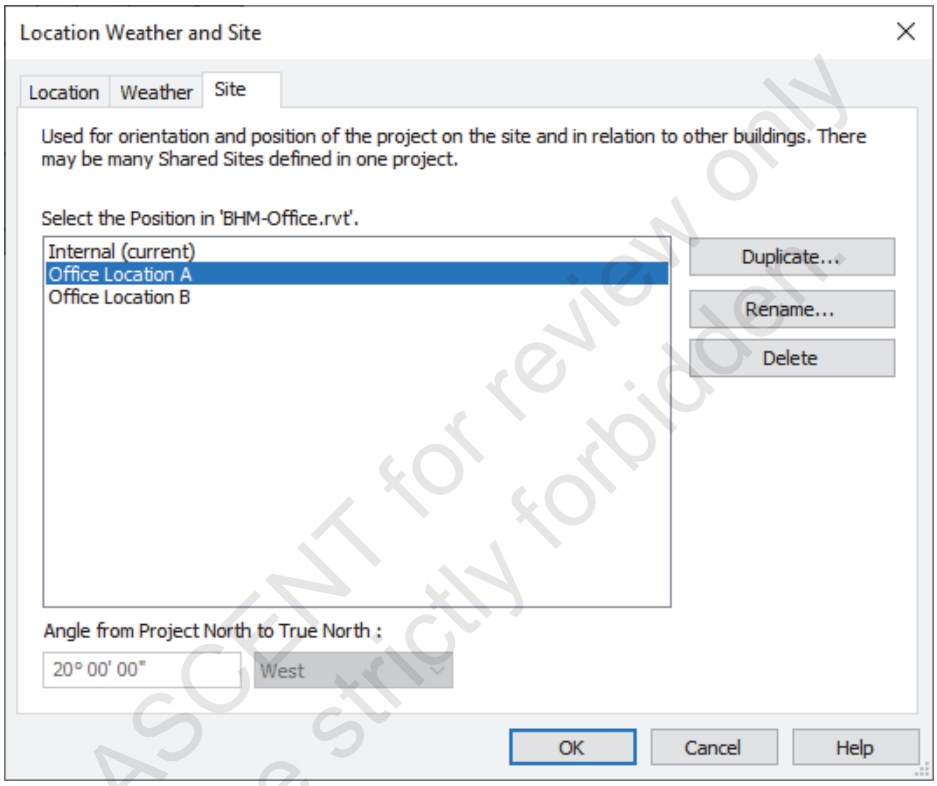

Figure 1–47

- The **Internal** named location of the linked model is the default.
  - Click **Rename...** to give the default location a different name.
  - Click **Duplicate...** to create a new name for the instance location. Each instance of the linked model should have a differently named location.

5. Select the location that you want to use and click **OK** twice.
6. The value of the *Shared Site* option is now the new location name, as shown in Figure 1–48. You can also specify a name for the linked model in the *Identity Data* section.

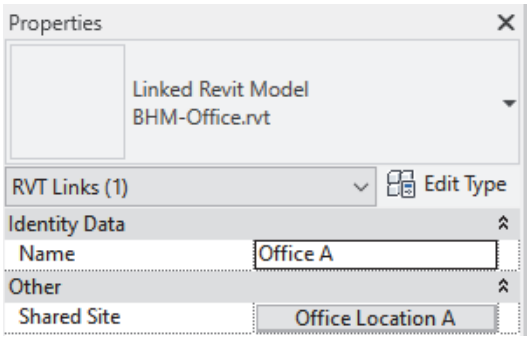

Figure 1–48

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Multiple Linked Copies

If you have copies of the same linked file or model in the host project and you select another instance of the same link, the Share Coordinates dialog box does not open. Instead, you will get the Choose Site dialog box, as shown in Figure 1–49.

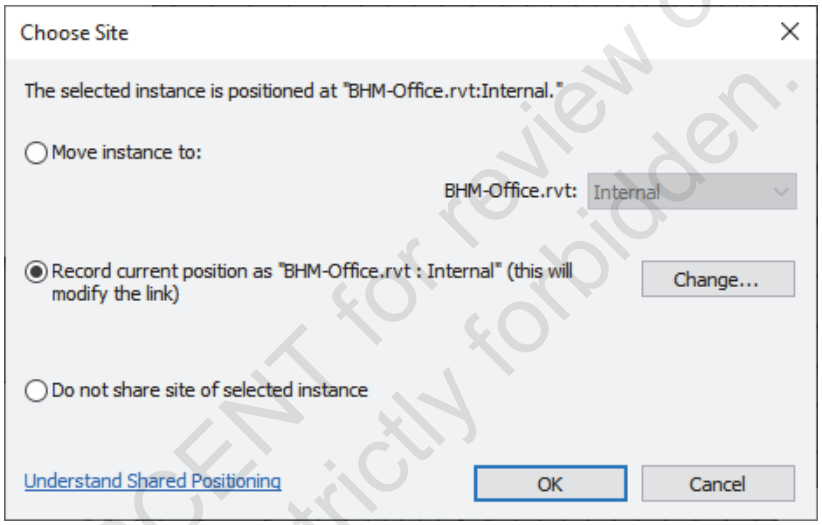

Figure 1–49

How To: Save the Recorded Locations' Positions to the Linked Model

When the coordinates from the host model have been published to linked models, they still need to be saved back to the linked file(s).

1. In the *Manage* tab>Manage Project panel, click (Manage Links).
2. In the Manage Links dialog box, select the *Revit* tab.

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3. A check mark displays in the *Positions Not Saved* column, as shown in Figure 1–50, indicating that the published coordinates have not yet been saved to the linked model.

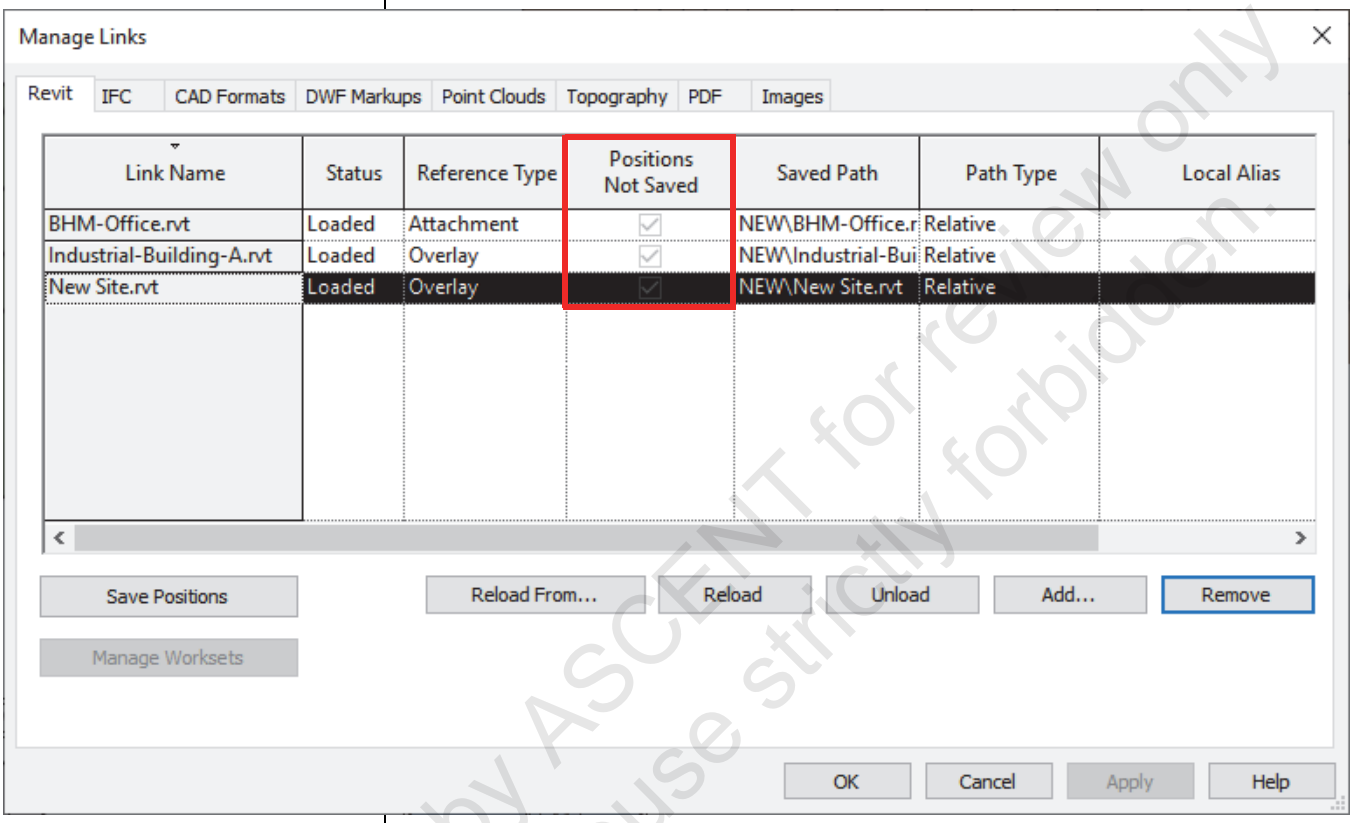

Figure 1–50

4. Select the name in the *Linked File* column and click **Save Positions**.
5. In the Location Position Changed dialog box, shown in Figure 1–51, select the method that you want to use.

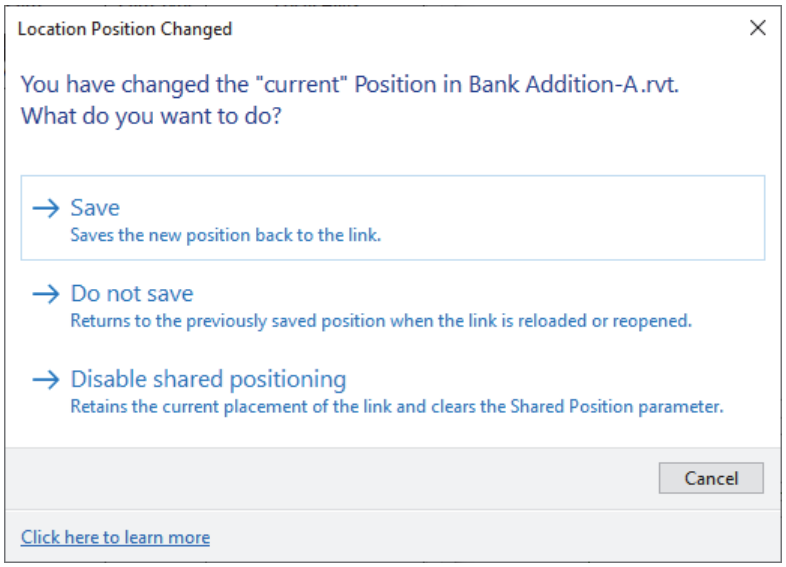

Figure 1–51

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6. If you select **Save**, the *Positions Not Saved* option is cleared in the Manage Links dialog box.
7. Click **OK** to close the dialog box.

If you make a change to the location or save the project before managing the links, you are prompted to make a selection in the same dialog box.

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Practice 1b

Working with Shared Coordinates

Practice Objectives

- Link a model to a site host project multiple times.
- Publish coordinates and share locations.
- Test different locations.

In this practice, you will link a project to a site multiple times, publish coordinates, and share locations. You will also test different locations using shared coordinates, as shown in Figure 1–52.

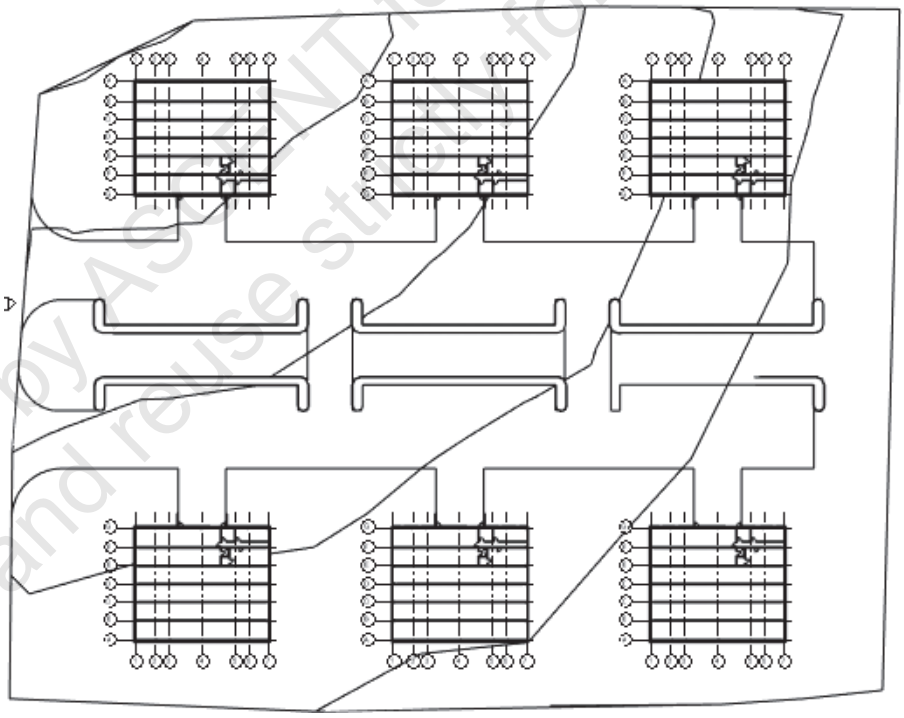

Figure 1–52

Task 1 - Link the architectural project to the site.

1. In the practice files folder, open **Industrial-Park-M.rvt**.
2. In the *Insert* tab>Link panel, click (Link Revit).
3. In the Import/Link RVT dialog box, select **Industrial-Building-A-M.rvt** and set the *Positioning* to **Auto - Internal Origin to Internal Origin**. Click **Open**.

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4. Move the link so that the upper left corner meets the intersection of the two reference planes, as shown in Figure 1–53.

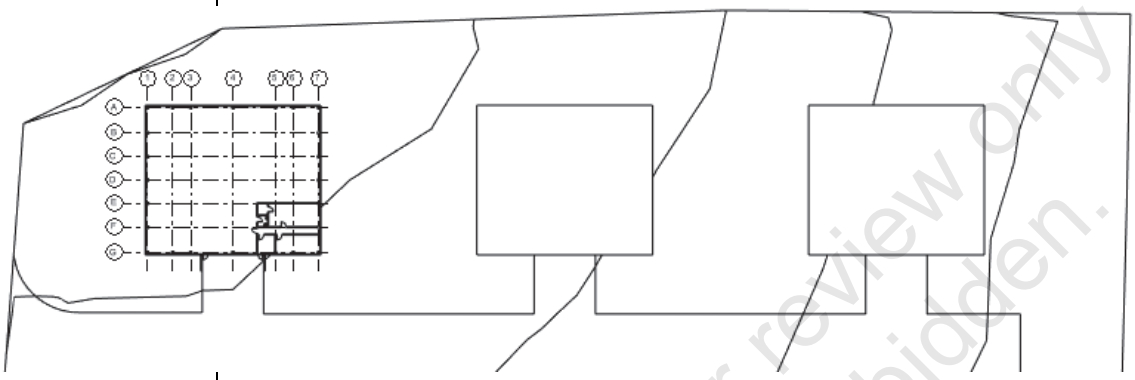

Figure 1–53

5. Select the link. In Properties, under the *Identity Data* section, type **Building A** for the *Name*, as shown in Figure 1–54. Do not modify the *Shared Site* parameter at this time.

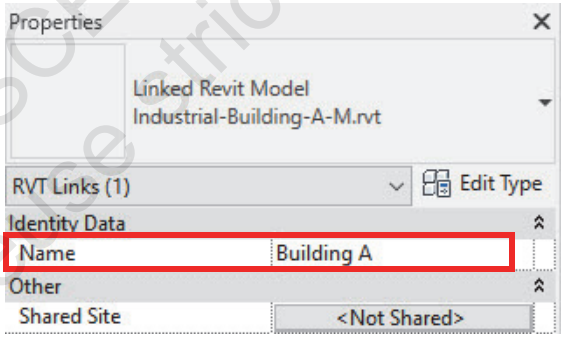

Figure 1–54

Task 2 - Publish coordinates and share locations.

1. From the *Manage* tab>Project Location panel, expand (Coordinates) and select (Publish Coordinates).
2. Select the link that you named **Building A**.

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3. In the Location Weather and Site dialog box, on the *Site* tab, click **Rename...** and rename the location to **Lot 1**, as shown in Figure 1–55. Click **OK** twice.

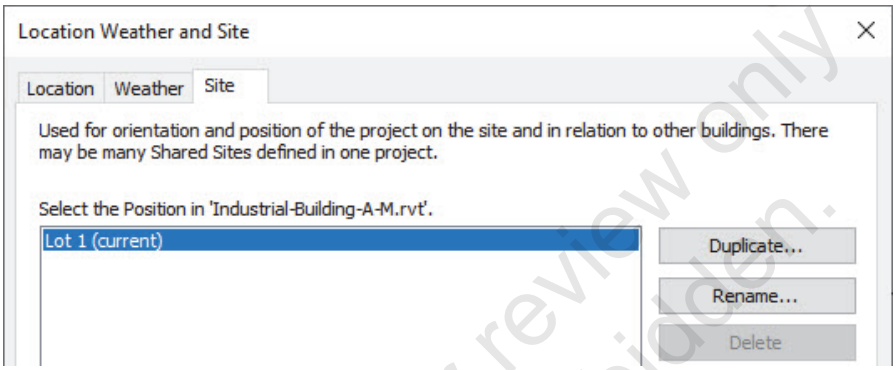

Figure 1–55

4. Save the file.

5. In the Location Position Changed dialog box, select **Save** (as shown in Figure 1–56) to save the position back to the linked architectural **Industrial-Building-A-M.rvt** file.

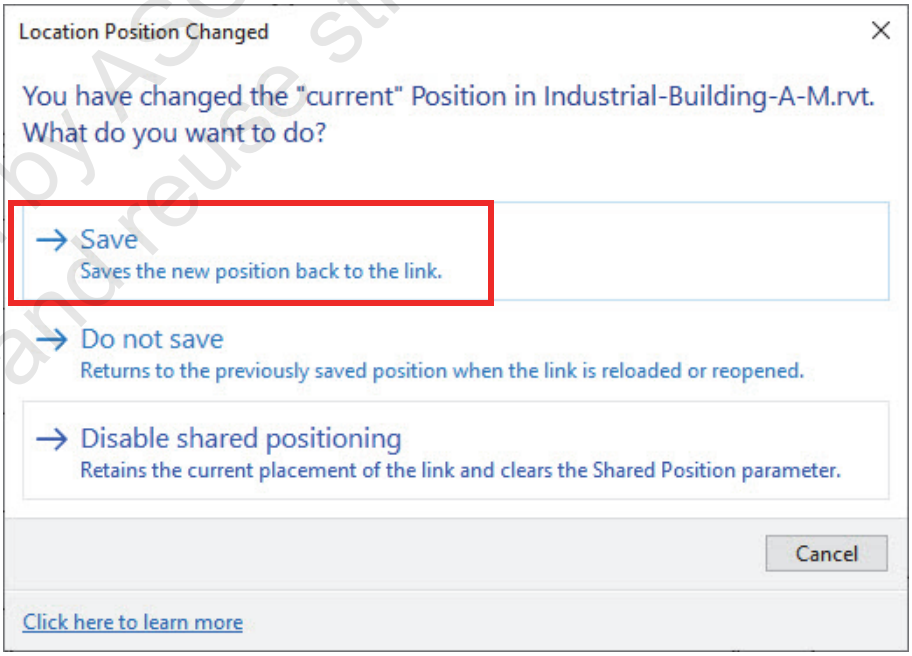

Figure 1–56

6. Close the project.

Task 3 - Acquire coordinates in the structural project from the architectural project.

1. Open **Industrial-Building-S-M.rvt** from the practice files folder.

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2. In the view, select the linked file **Industrial-Building-A-M.rvt**. Note that in Properties, the *Shared Site* is set to **<Not Shared>**, as shown in Figure 1–57.

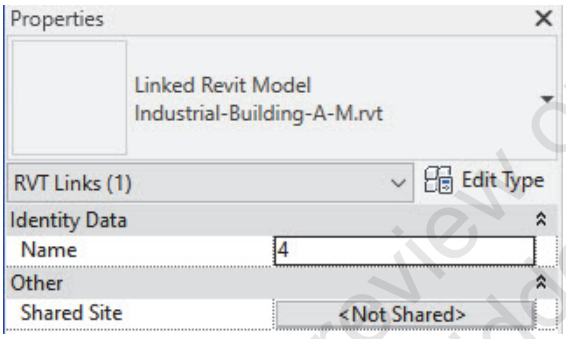

Figure 1–57

3. In the *Manage* tab>Project Location panel, expand (Coordinates) and select (Acquire Coordinates). Select the **Industrial-Building-A-M.rvt** link, as shown in Figure 1–58.

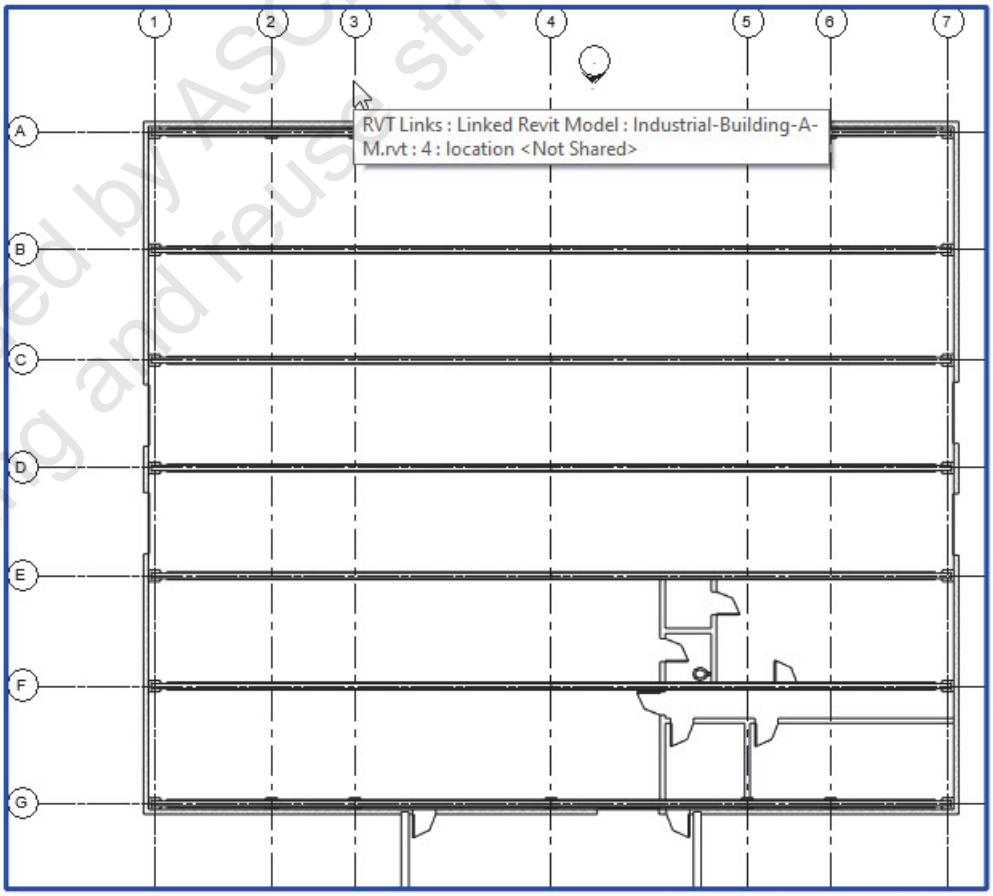

Figure 1–58

4. Click **Close** in the Acquire Coordinates Succeed dialog box.

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5. Select the linked file and note that in Properties, the *Shared Site* shows **Lot 1**, as shown in Figure 1–59.

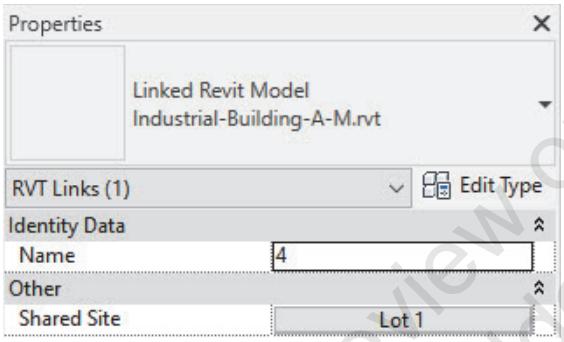

Figure 1–59

6. Save and close the project.

Task 4 - Set shared coordinates.

1. Open **Industrial-Park-M.rvt** from the practice files folder.

2. In the *Insert* tab>Link panel, click (Link Revit). In the Import/Link RVT dialog box, select **Industrial-Building-S-M.rvt** and set the *Positioning* to **Auto - By Shared Coordinates**. Click **Open**.

3. Click **Close** in the Nested Links Invisible dialog box.

4. The structural link goes on top of the **Industrial-Building-A-M.rvt** link you moved earlier in Task 1.

5. Select both linked files and copy them to the other two top lots so that they are on top of the building pads, as shown in Figure 1–60.

Use (Filter) to filter out the building pad or any other elements that might get selected.

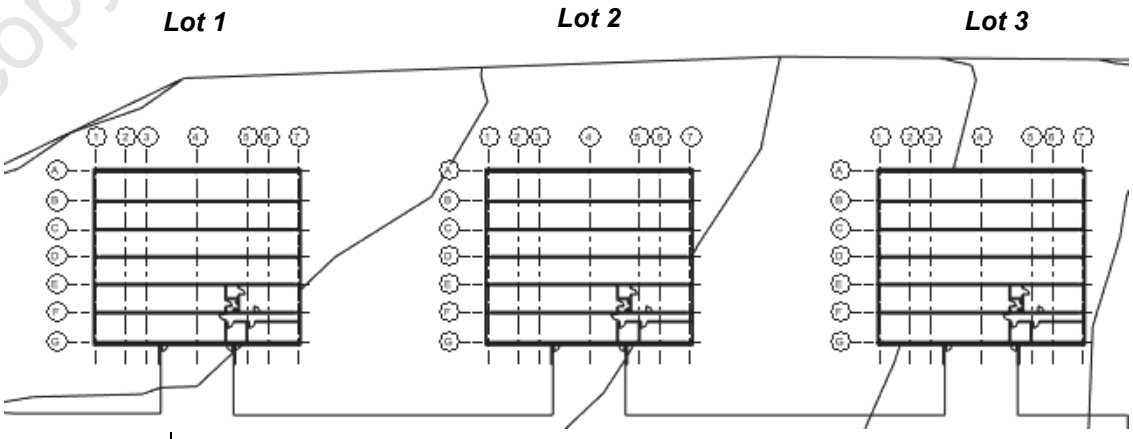

Figure 1–60

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6. Open the Visibility/Graphic Overrides dialog box.
7. From the *Revit Links* tab, uncheck **Industrial-Building-A-M.rvt**, as shown in Figure 1–61. Click **OK**.

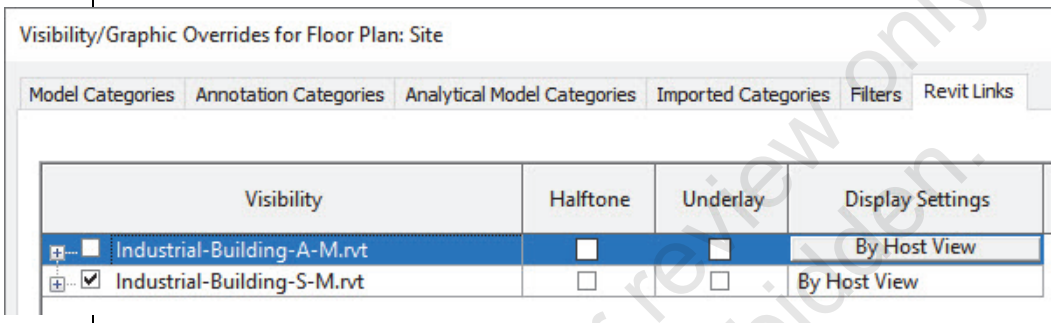

Figure 1–61

8. Select the first structural link and, in Properties, under the *Identity Data* section, type **Structure A** for the *Name* (as shown in Figure 1–62). Click in an empty area in the view to clear the selection.

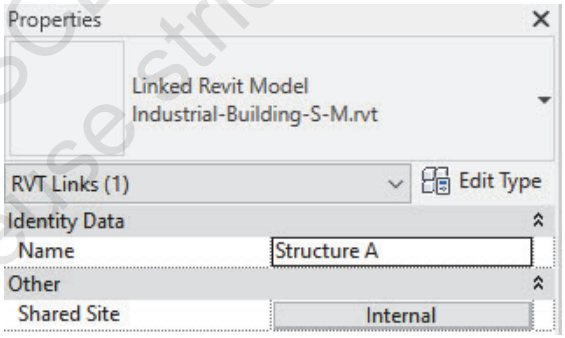

Figure 1–62

9. Repeat Step 8 for the other two links, naming them **Structure B** and **Structure C**.
10. Open the Visibility/Graphic Overrides dialog box.
11. From the *Revit Links* tab, check **Industrial-Building-A-M.rvt** and uncheck **Industrial-Building-S-M.rvt**, as shown in Figure 1–63. Click **OK**.

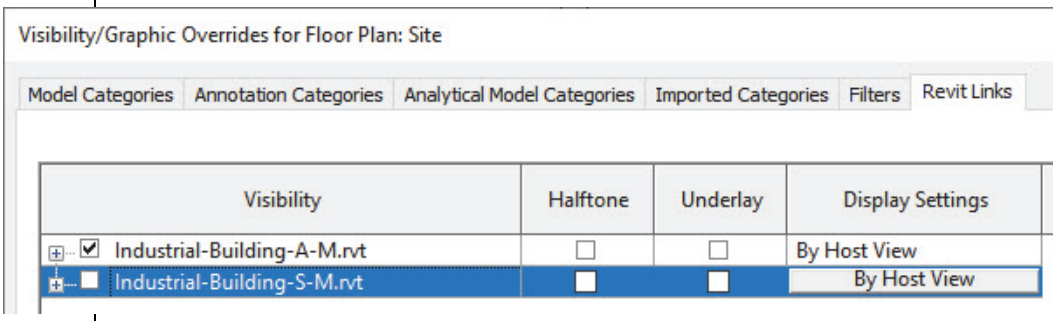

Figure 1–63

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12. Select the copied architectural link and, in Properties, under the *Identity Data* section, type **Building B** for the *Name* (as shown in Figure 1–64). Click in an empty area in the view to clear the selection, then select the next architectural link and name it **Building C**.

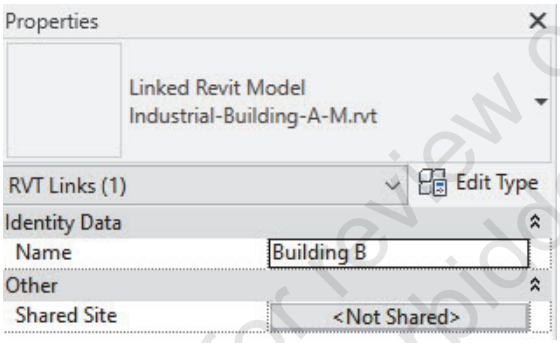

Figure 1–64

13. In the view, select the **Building B** link in the second lot, and in Properties, click **<Not Shared>** next to *Shared Site*.

14. In the Choose Site dialog box, click **Change...**, as shown in Figure 1–65.

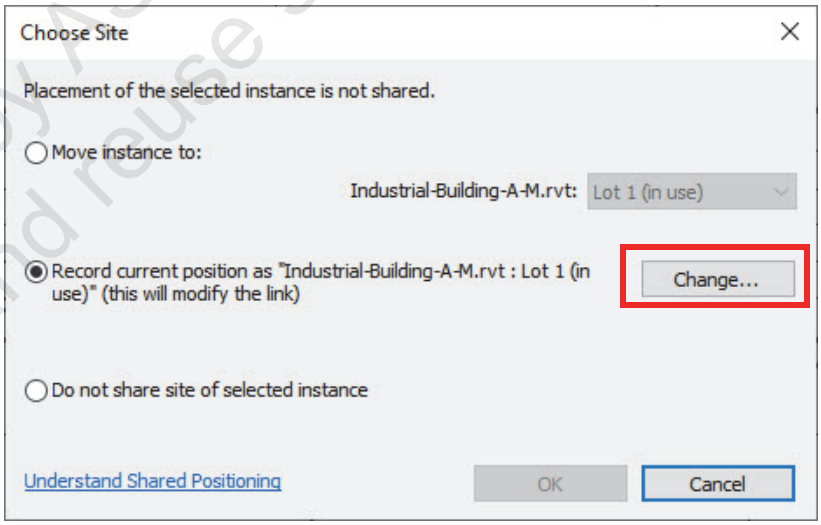

Figure 1–65

15. In the Location Weather and Site dialog box, click **Duplicate...**. In the Name dialog box, type **Lot 2** and click **OK**.

16. Click **OK** twice to return to the view.

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17. Select the **Building C** link and repeat Steps 13 to 16, naming the duplicated position **Lot 3**, as shown in Figure 1–66.

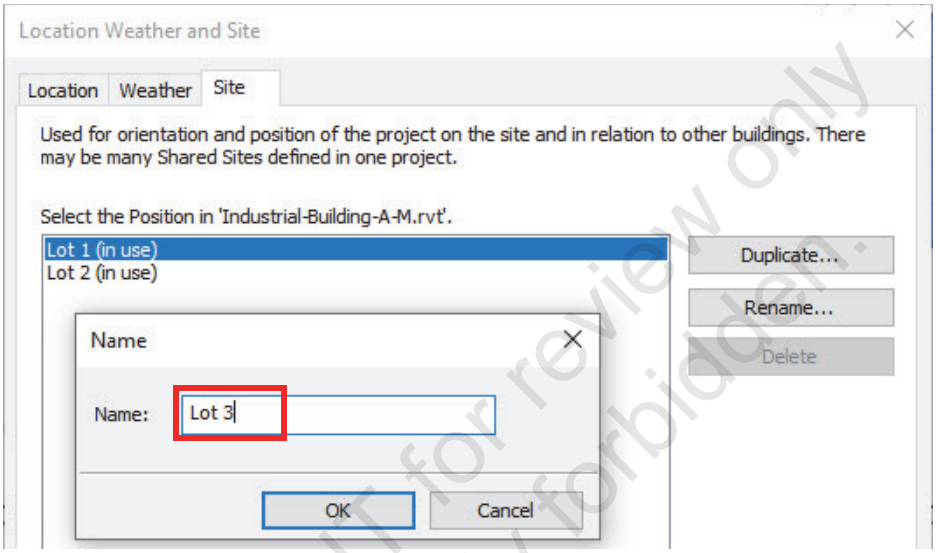

Figure 1–66

18. Open the Visibility/Graphic Overrides dialog box.

19. From the *Revit Links* tab, check **Industrial-Building-S-M.rvt** and uncheck **Industrial-Building-A-M.rvt**, as shown in Figure 1–67. Click **OK**.

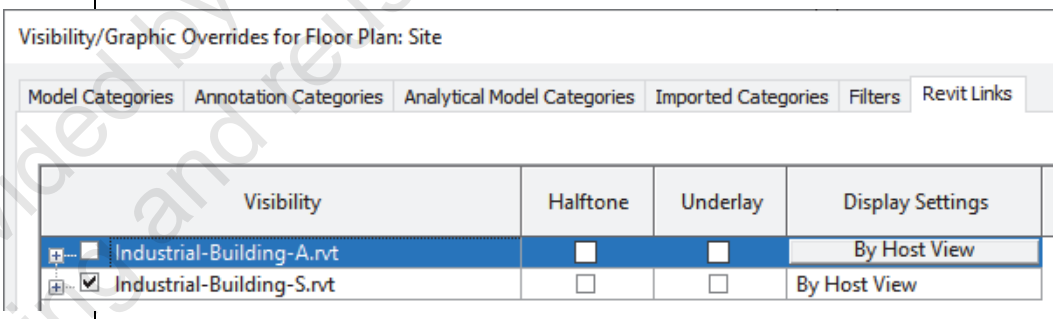

Figure 1–67

20. In the view, select the **Structure A** link, and in Properties, click on **<Internal>** next to *Shared Site*.

21. In the Choose Site dialog box, click **Change...**.

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22. In the Location Weather and Site dialog box, click **Rename...** and rename the Internal position to **Lot 1**, as shown in Figure 1–68. Click **OK** three times to return to the view.

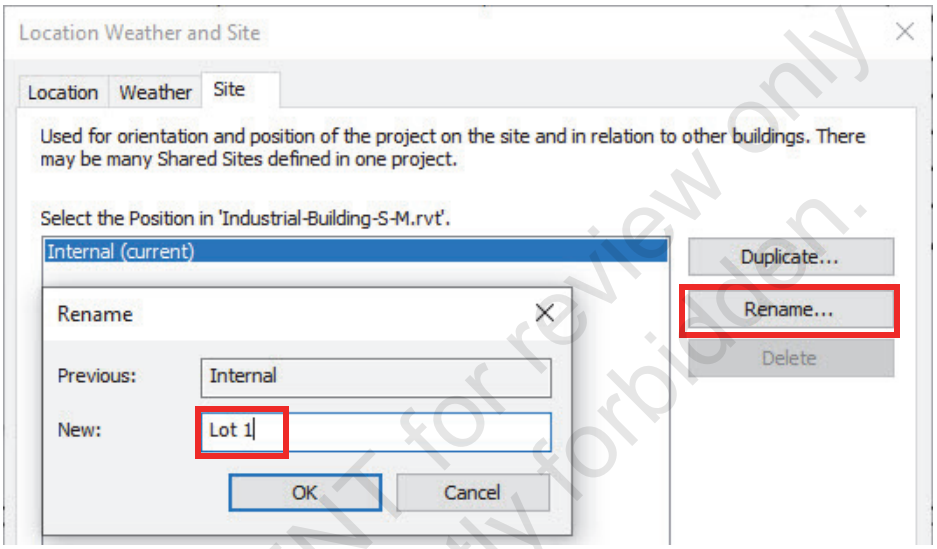

Figure 1–68

23. Select the **Structure B** link and repeat Steps 21 and 22, but this time, click **Duplicate...** and name the position **Lot 2**. Repeat the same steps for the **Structure C** link, duplicate the position, and name it **Lot 3**.

24. Open the Visibility/Graphic Overrides dialog box. From the *Revit Links* tab, check both linked files.

25. In the *Insert* tab>Link panel, select (Manage Links).

26. From the *Revit* tab, select **Industrial-Building-A-M.rvt** and click **Save Positions**, as shown in Figure 1–69.

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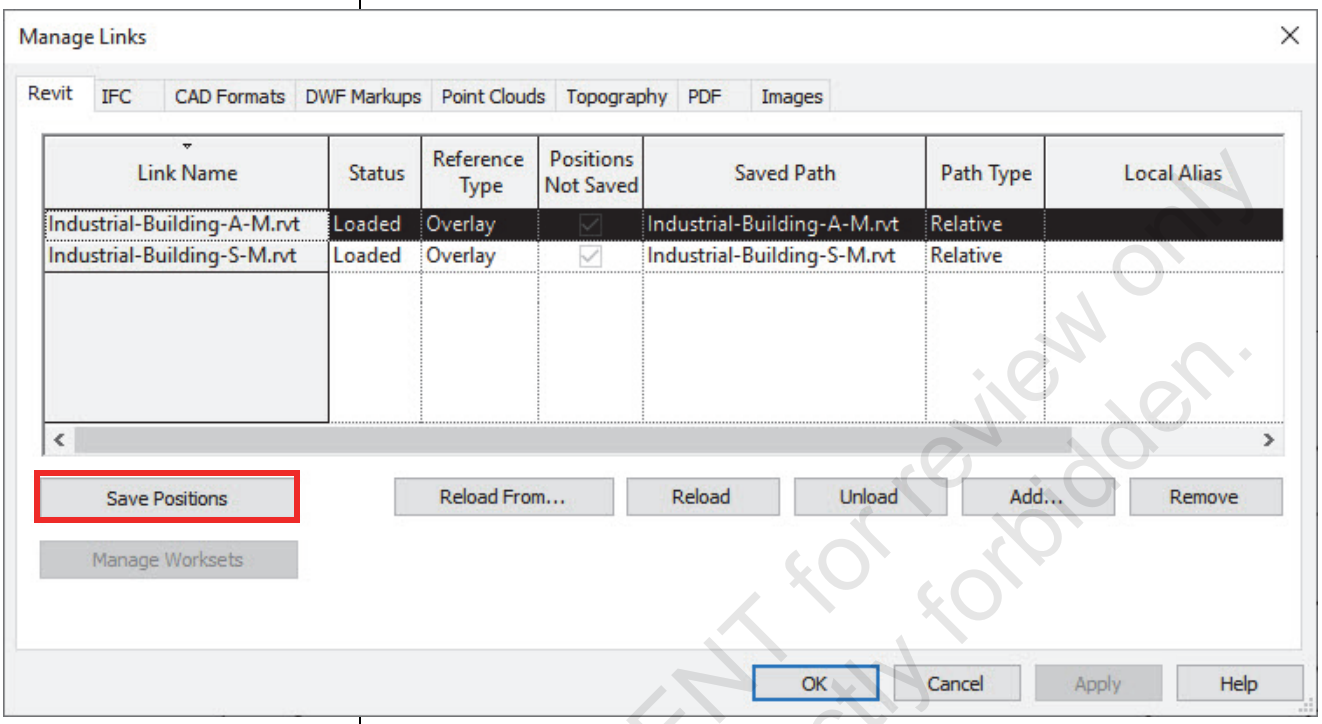

Figure 1–69

27. In the Location Position Changed dialog box, select **Save**, which saves the new position back to the linked architectural file.

28. Select **Industrial-Building-S-M.rvt** and click **Save Positions**. Select **Save** in the Location Position Changed dialog box.

29. Set the *Reference Type* to **Attachment** for both links to display any nested links, as shown in Figure 1–70. Note that the *Positions Not Saved* check boxes for both linked files are unchecked, meaning the positions have been saved.

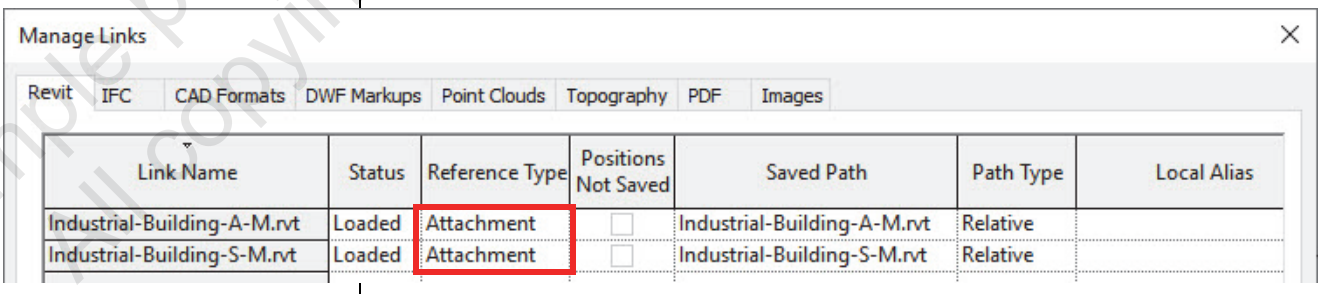

Figure 1–70

30. Save the project.

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Task 5 - Move instances to new sites.

In this task, you will see how the named positions that you created in the previous tasks will remember their locations even if the copied linked models are deleted from the project.

1. In the view, delete both links on Lot 2 and Lot 3, as shown in Figure 1–71.

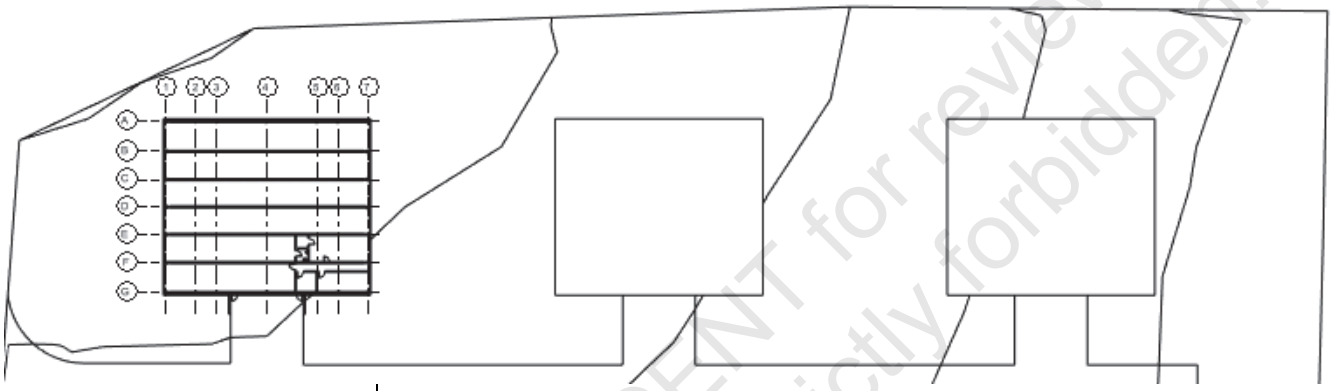

Figure 1–71

2. From Lot 1, select the **Industrial-Building-A-M.rvt** link and copy it two times over to the right side of the site. Do the same with the **Industrial-Building-S-M.rvt** link. It should look similar to what you see in Figure 1–72.

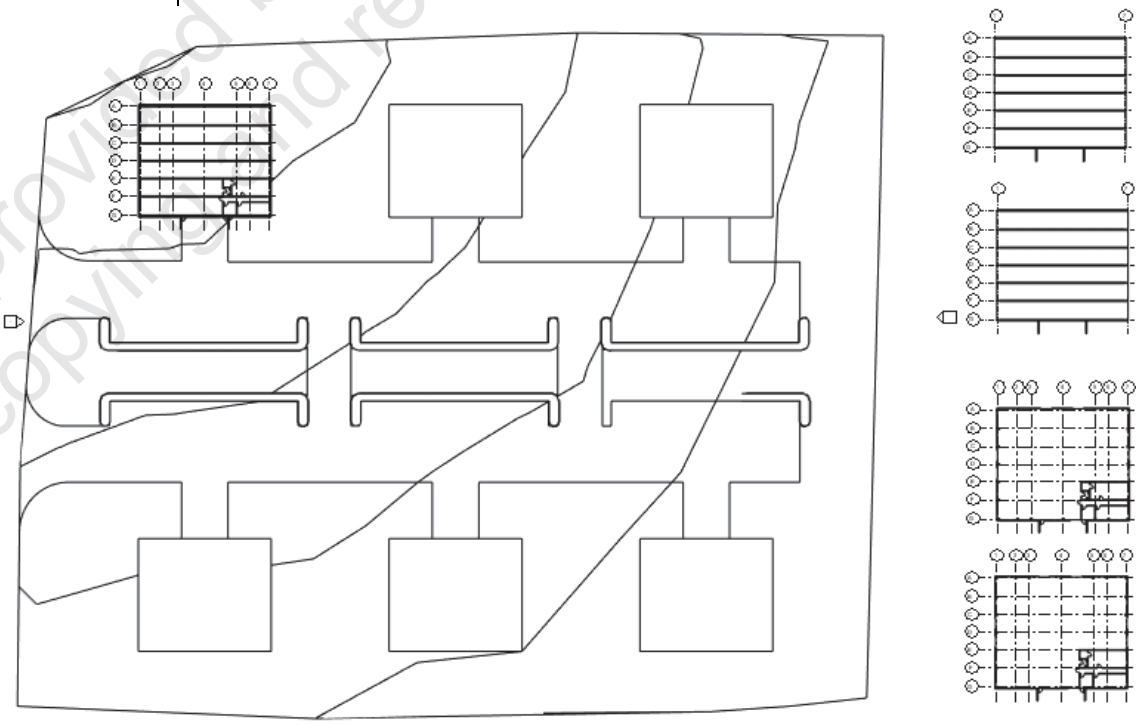

Figure 1–72

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3. Select one of the copied **Industrial-Building-A-M.rvt** links off to the right side of the site.
   - If needed, you can rename the new copied instances in Properties.
4. In Properties, click **<Not Shared>** next to *Shared Site*.
5. In the Choose Site dialog box, select **Move instance to:** and set it to **Lot 2**, as shown in Figure 1–73. Click **OK**.

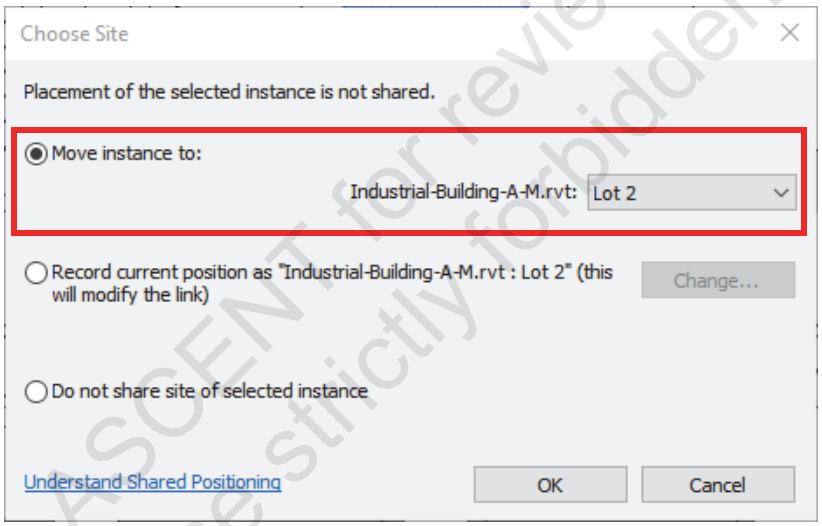

Figure 1–73

- The link will move into the Lot 2 position, as shown in Figure 1–74.

Figure 1–74

6. Repeat Steps 3 to 5 for the other links to move them into the correct positions.
7. Save and close the project.

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1.5 Exporting to CAD Format

Exporting Autodesk Revit projects to various CAD file formats is a common need in collaboration with consultants and engineers. Using this process, you can export individual views or sets of views to .DWG or .DXF, as shown in Figure 1–75, and keep the shared coordinate intact. You can also create and save sets of views to use again if needed.

Scroll down the Export list to see additional options.

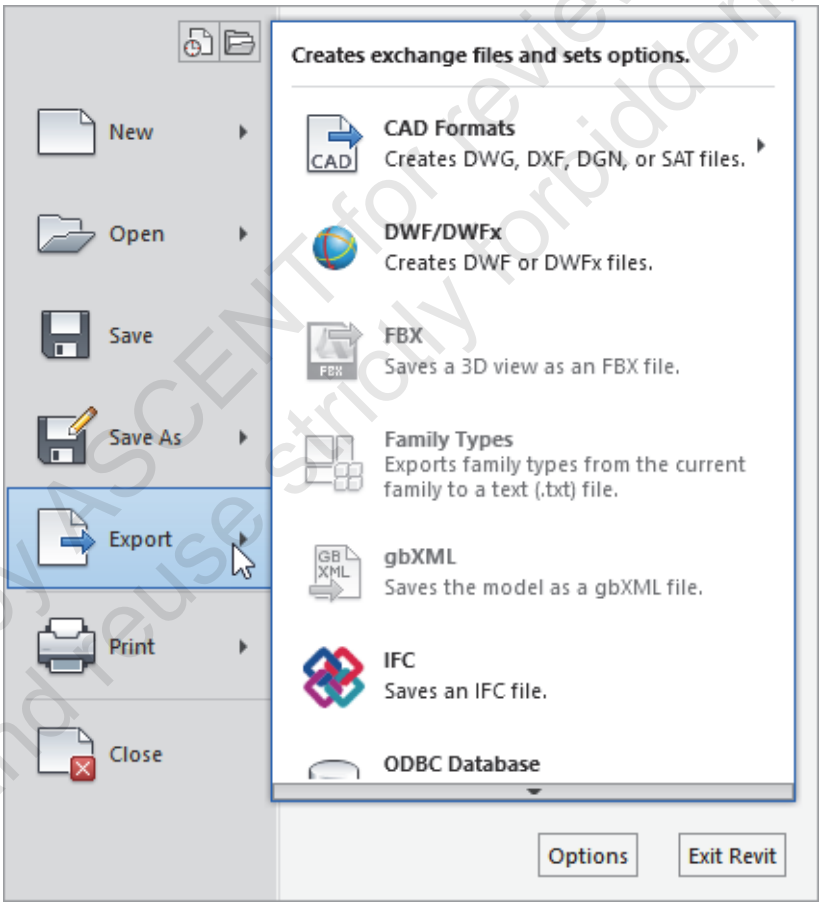

Figure 1–75

- To improve performance and file size of the exported file, you will want to use Visibility/Graphic Overrides to turn off objects that are not being seen in the view you are exporting.
- Use a section box or crop region to minimize elements outside the region.
- Reduce the amount of detail by setting the view's detail level to **Coarse** or **Medium**.
- In order for shared coordinates to work properly, only Revit views can be exported to .DWG.

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How To: Create an Export Setup

1. In the DWG or DXF Export dialog box, next to the *Select Export Setup* list, click (Modify Export Setup), or in the *File* tab, expand (Export), scroll down to (Options), expand it, and select (Export Setups DWG/DXF) or (Export Setups DGN).
2. The Modify DWG/DXF Export Setup or Modify DGN Export Setup dialog box contains all of the elements and types you can export. You can select an existing layer standard provided with the program (as shown in Figure 1–76) or create a new one.

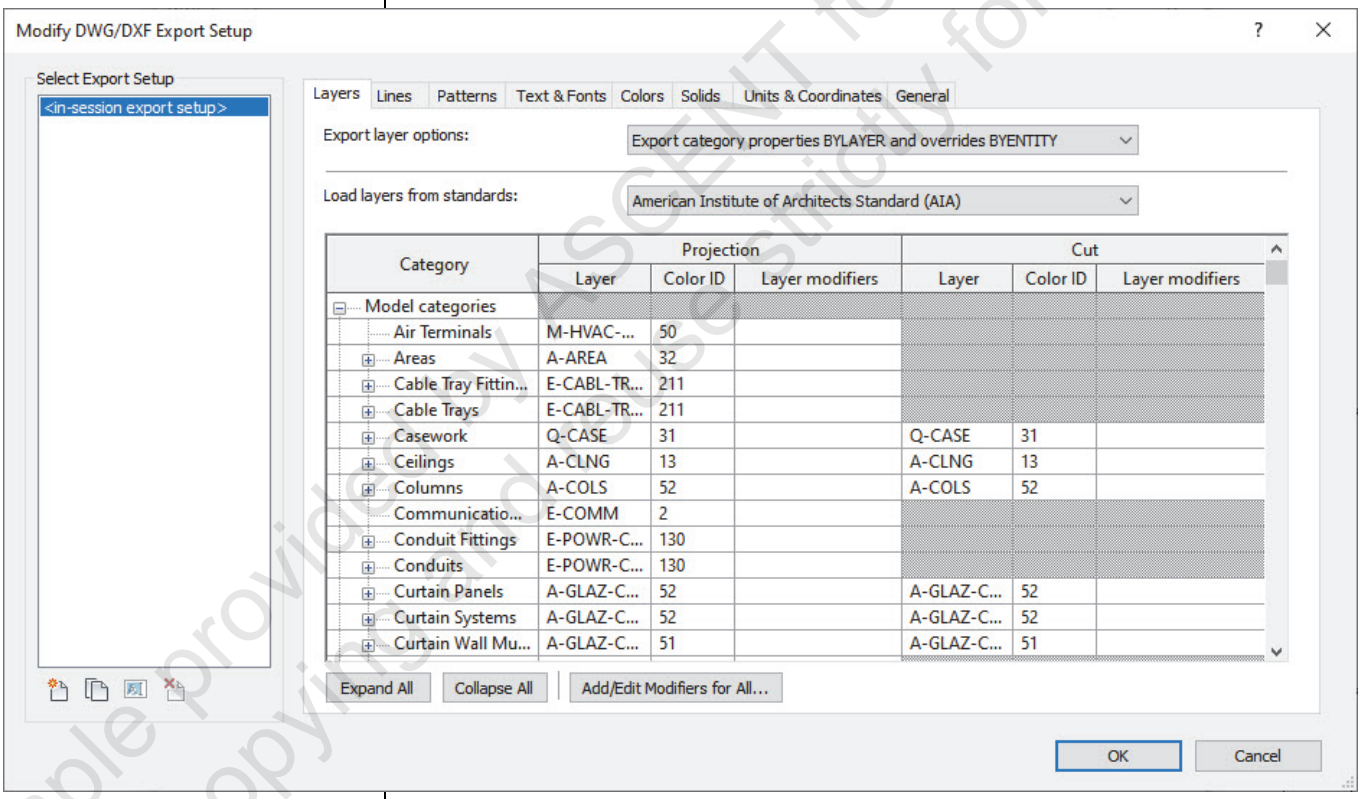

Figure 1–76

3. Select each of the tabs and apply the appropriate information.

- In the *Layers* tab, map the categories in the Autodesk Revit software to the layers (or levels).
- In the *Lines*, *Patterns*, and *Text & Fonts* tabs, map the styles required.
- In the *Colors* tab, select to export either Index colors (255 colors) or True color (RGB values).

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- In the *Solids* tab (3D views only), select to export to either Polymesh or ACIS solids.
- In the *Units & Coordinates* tab, specify what unit type one DWG unit is and the basis for the coordinate system. In order for the exported Revit file to be in the correct location when XREFed into AutoCAD, you will need to make sure the unit is correct.
  - **Shared Coordinates:** Use this method if you want to maintain the shared coordinates of the Revit host model.
  - **Internal Origin:** Use this method if you have not used shared coordinates in the Revit host model.
- In the *General* tab, you can set up how the rooms and room boundaries are exported; what to do with any non-plottable layers; how scope boxes, reference planes, coincident lines, and unreferenced view tags are handled; how views on sheets and links are treated; and which version of the DWG file format to use.
- Export setups can be created in a template file or shared between open projects using Transfer Project Standards.

How To: Export a CAD Format File

1. If you are exporting only one view, open the view you want to export. If you are exporting the model, open a 3D view.
2. In the *File* tab, expand (Export), click (CAD Formats), and select the type of format you want to export, as shown in Figure 1–77.

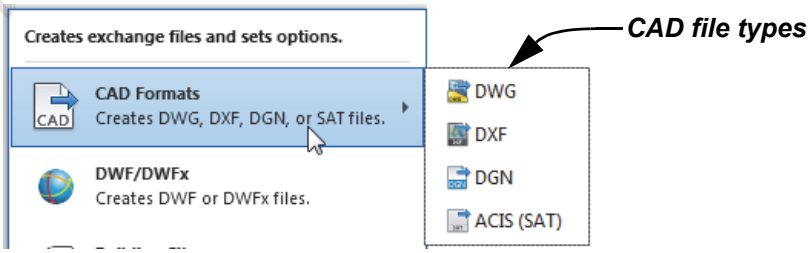

Figure 1–77

   - The examples in this section show the process for .DWG files. It is the same for other types of files.
3. The DWG Export dialog box displays, as shown in Figure 1–78.

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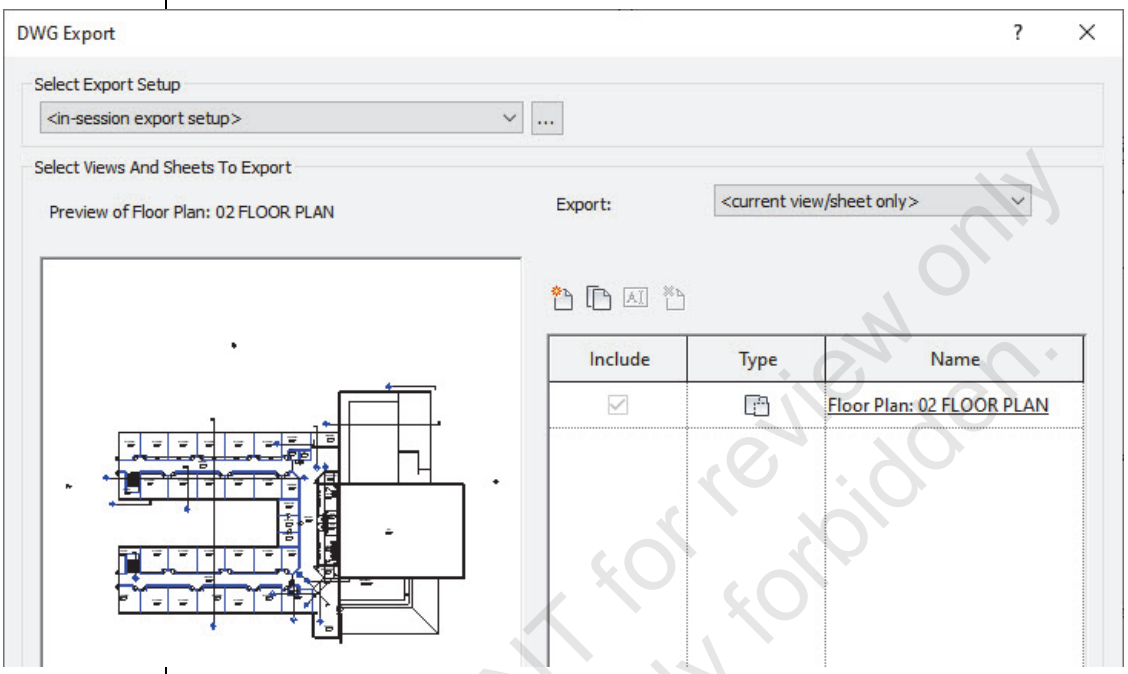

Figure 1–78

4. If you have an existing export setup, you can select it from the drop-down list (as shown in Figure 1–79) or click … (Modify Export Setup) to create a new one.

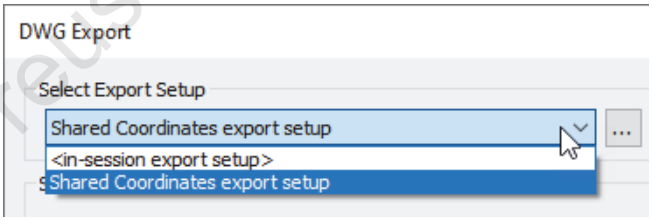

Figure 1–79

5. Select the view(s) you want to export from the Export drop-down list, as shown in Figure 1–80.

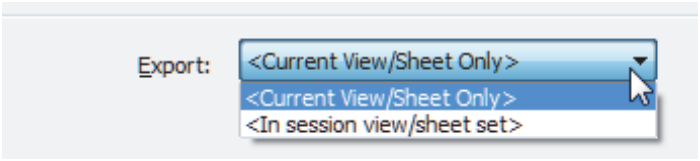

Figure 1–80

   - To export only the active view, select **<Current View/ Sheet Only>**.
   - To export any views or sheets that are open in the session of the Autodesk Revit software, select **<In session view/sheet set>**.

6. When everything is set up correctly, click **Next...**.

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7. In the Export CAD Formats - Save to Target Folder dialog box, select the folder location and name. If you are exporting to .DWG or .DXF, select the version in the Files of type drop-down list.
8. Click **OK**.

How To: Create a New Set of Views/Sheets to Export

1. Start the appropriate Export CAD Formats command.
2. In the Export CAD Formats dialog box, click (New Set).
3. In the New Set dialog box, type a name and click **OK**.
4. The tab displays with the new set active and additional information, as shown in Figure 1–81.

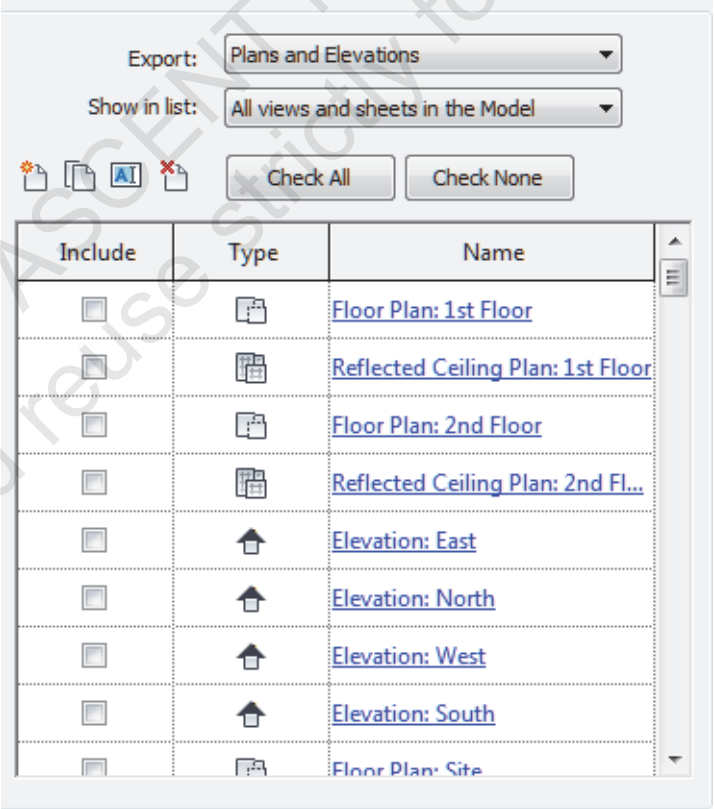

Figure 1–81

5. Use *Show in List* to limit the number of items that display in the table.
6. Select the views and/or sheets that you want to export from the project.
   - Use **Check all** or **Check none** to aid in selection.
7. When you finish with the set, continue the export process.

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Chapter Review Questions

1. The project base point defines the origin of the project coordinate system and impacts absolute elevations.
   a. True
   b. False
2. If you want a linked Revit model's internal origin to link in at your Revit model's internal origin, what link positioning method would you use?
   a. Manual - Internal Origin
   b. Auto - Project Base Point to Project Base Point
   c. Auto - By Shared Coordinates
   d. Auto - Internal Origin to Internal Origin
3. When you have a site plan linked to a host building project and want to adopt the link's shared coordinates, which of the following should you do?
   a. Relocate the project to the correct position.
   b. Acquire the coordinates from the site plan.
   c. Publish the coordinates to the site plan.
   d. Use Specify Coordinates at Point.
4. If you have acquired coordinates from a linked file, what do you need to do to share the coordinates with other linked files and models?
   a. Have the author of each file or model acquire their own coordinates.
   b. Publish the coordinates to the site plan.
   c. Publish the coordinates to the linked files and models.
5. You can publish coordinates to linked models through Instance Properties.
   a. True
   b. False

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Command Summary

Button	Command	Location
	Acquire Coordinates	• **Ribbon:** *Manage* tab>Project Location panel>Coordinates drop-down list
	Import CAD	• **Ribbon**: *Insert* tab>Import panel
	Link CAD	• **Ribbon**: *Insert* tab>Link panel
	Link Revit	• **Ribbon**: *Insert* tab>Link panel
	Link Topography	• **Ribbon**: *Insert* tab>Link panel
	Location	• **Ribbon:** *Manage* tab>Project Location panel
	Manage Links	• **Ribbon:** *Manage* tab>Manage Projects panel • **Ribbon:** *Insert* tab>Link
	Pin	• **Ribbon:** *Modify* tab>Modify panel
	Publish Coordinates	• **Ribbon:** *Manage* tab>Project Location panel>Coordinates drop-down list
	Relocate Project	• **Ribbon:** *Manage* tab>Project Location panel>Position drop-down list
	Report Shared Coordinates	• **Ribbon:** *Manage* tab>Project Location panel>Coordinates drop-down list
	Reset Coordinates	• **Ribbon:** *Manage* tab>Project Location panel>Coordinates drop-down list
	Specify Coordinates at Point	• **Ribbon:** *Manage* tab>Project Location panel>Coordinates drop-down list

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