



Revit MEP Worksets and Model Management

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ME310-1 Utilizing Revit MEP requires having a Revit Architecture model into which MEP elements can be placed. Many MEP consultants work both with architects and in a separate “linked” model from the architectural model. This advanced level class explores the process for sharing models, including tips for organizing models for the extended design team. Additionally, we’ll demonstrate methods for using worksets to organize Revit models for multidiscipline collaboration. Planned organization of Revit worksets can help the extended design team control model memory requirements, as well as display model elements. Even if you’re not utilizing linked models, many concepts of this class will apply to the multidiscipline design team.

About the Speaker:

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Martin has worked closely with both the AutoCAD MEP and the Revit MEP development team to share insights gained while consulting with customers, and has developed custom solutions for customers built on AutoCAD Revit MEP Suite to streamline documentation and analysis workflows.

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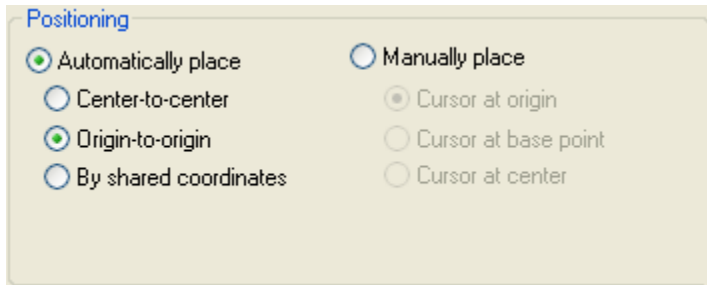
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Linking Revit Models

In general, the Origin-to-origin option provides the most predictable outcome when linking models, and for long-time CAD users, this should be no surprise. What may be of surprise is that the origin in a Revit model isn't readily apparent because the coordinate system isn't directly accessible in the Revit UI. Using the Origin-to-origin option is akin to inserting at (0,0) in traditional drafting applications.



Even though the Center-to-Center option is the default option, it isn't typically used to link entire building models (MEP, Architecture, Structure). The reason is that the center of the models change in all three coordinate axes as the model develops. For example the image on the left below shows an Architectural Model linked into an MEP model, and the MEP model contains a single duct. The image on the right shows the duct linked back into the Architectural model using the Center-to-Center option. As you can see, the duct is centered into the model, and clearly not in the location intended by the MEP design team.

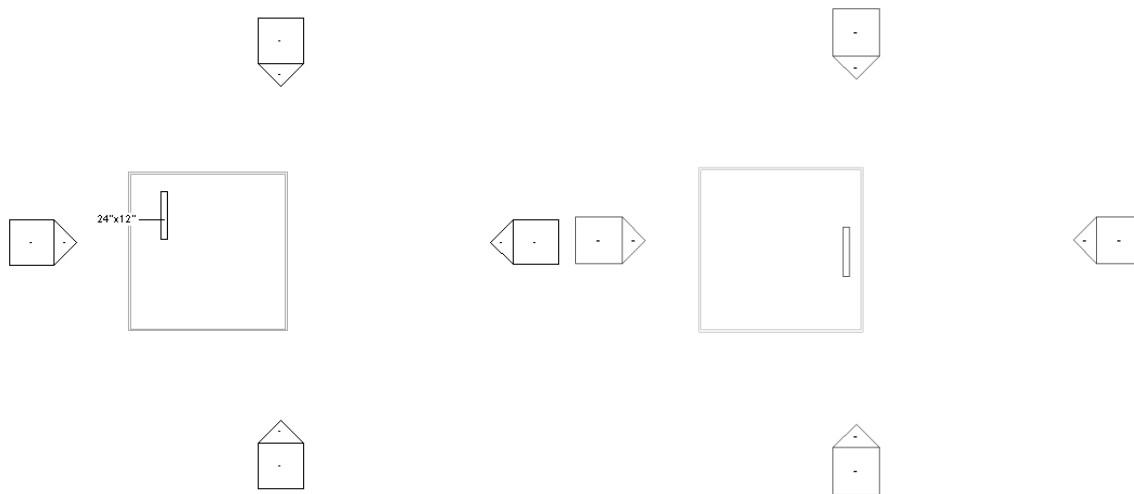


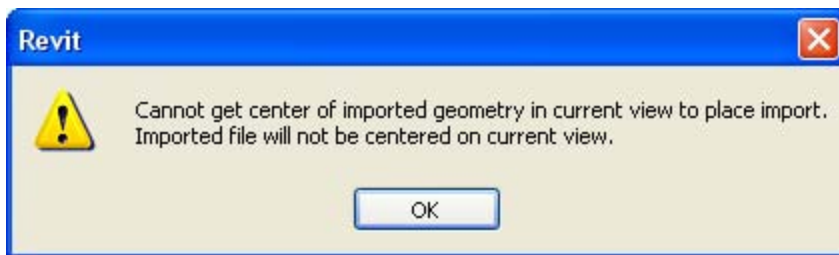
Figure 1 MEP model on the left imported into the architectural model on the right using the Center-to-Center option.




Figure 2 Model linked Center-to-center

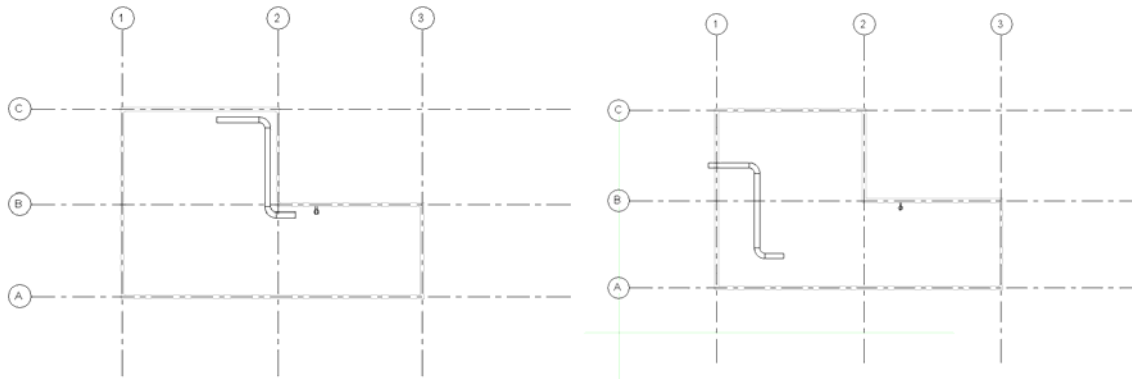
The figure above shows the same MEP model linked into the architectural model in elevation view. What you see here is that the duct is in the center of the level that the model is centered between the architectural Level 1 and Level 2, and the level lines, thus, do not align. Clearly, Center-to-center option is not what is desired.

If the Center-to-Center option is desired (in my experience, I have not come up with a use case), you may get the following message. This message indicates that your visibility or view range settings may preclude the imported geometry from showing. For the example above, by default, ducts are not visible in architectural views, so importing a MEP model may result in nothing visible in the current view. Adjusting visibility and view-range settings prior to importing may be necessary.



Tip: Once the model is linked,  pin it in place! This will prevent you for inadvertently moving it. It WON'T prevent it being deleted; however, a warning is issued when a user attempts to delete a pinned or linked element.

Consider another issue: The architect moves the whole building (they wouldn't do that, would they?!)



What we can do here is sketch in some reference lines at some original grid intersection using the Architectural model prior to the building shift (you did keep a backup, didn't you?). After doing this, you can then use **Align** to align the architectural model with the reference lines (then delete the reference lines if you wish).

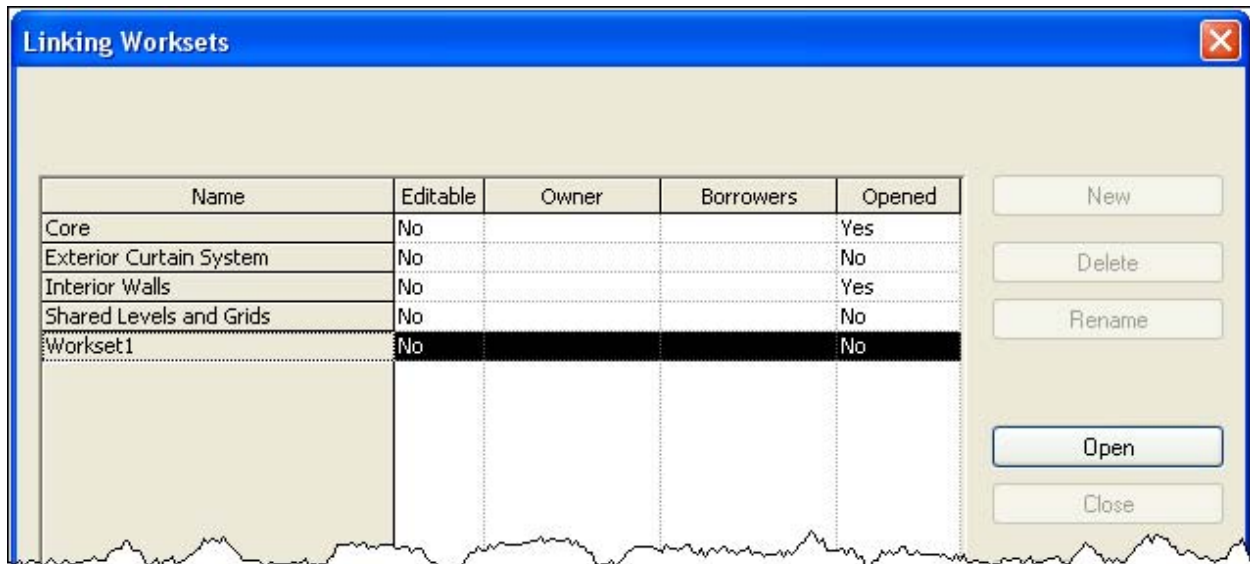
Utilizing Architectural Worksets

Worksets should help you organize your model in ways that help the extended design team utilize the model in the most efficient means possible. Utilizing the worksets from the Architectural model can be advantageous if the worksets have been created, and used, in a manner that supports effective collaboration. When linking an architectural model, it is possible to specify what worksets to load. In the Add Link window below, the Open Worksets: option is set to Specify. When linking a file using this option, the user is prompted with a list of the worksets available in the file being linked.

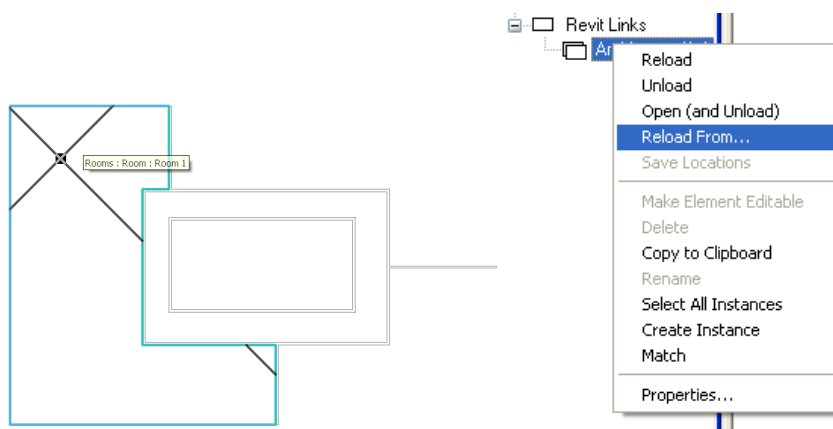


To not load particular worksets, simply select the workset name from the list, and click the Close button. When the file is linked, the memory with the associated unloaded worksets is not consumed, and can

keep a significant amount of RAM from being utilized. Additionally, since the graphics for these particular worksets don't need to be generated, you may experience better overall performance .



As you can see below, even with the Exterior Curtain System workset turned off, the room elements are still bounded by the exterior geometry. This is because the rooms are copy/monitored from the underlying architectural room, and are not bound by the geometry in the host model.

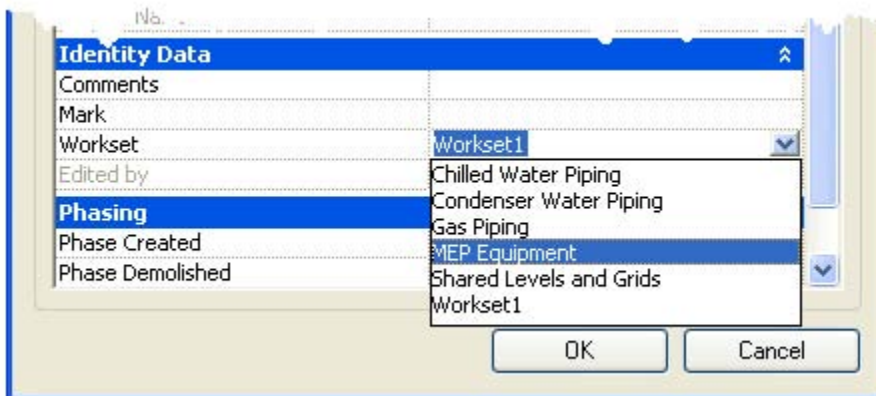



To specify a different workset configuration (i.e., unload the Interior Walls workset to work on just the Core), right click on the appropriate linked file under Revit Links in the Project Browser, and select Reload From... Leave the file name selection as is, and select Specify for Open Worksets. Click Open, and then selectively close the worksets you don't want to open as before.

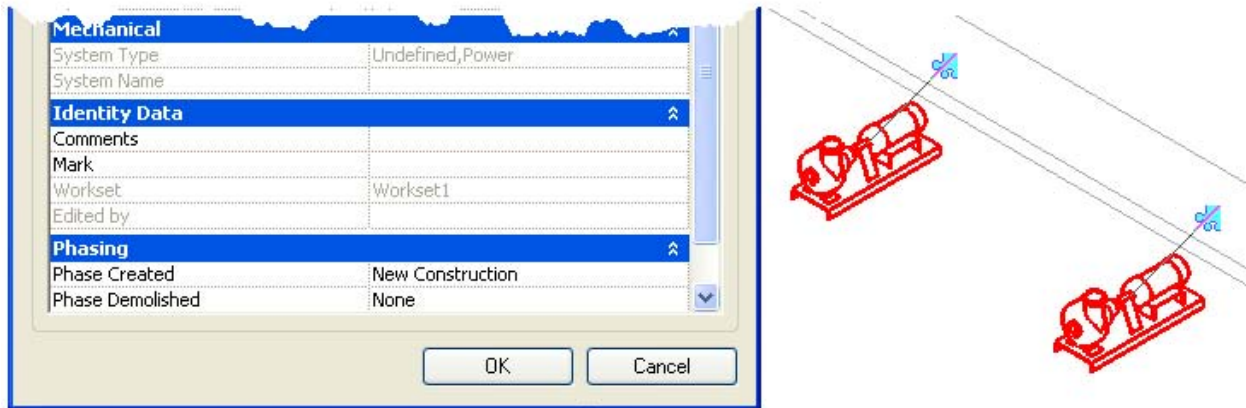
MEP users may configure worksets to help architects and structural engineers selectively load worksets. An example of this would be to utilize a separate workset for all MEP equipment. This will allow the structural engineer and architect to load only the equipment into their model for visual screening, point load and reinforcement verification, and clearance validation, without having to load all the ductwork, lighting, and other MEP appurtenances.

Creating Worksets

It is easy to go overboard with the quantity of worksets without the proper insight. Do NOT use worksets as a replacement for layer control (you should be using Visibility/Graphics Overrides and View Templates to accomplish most visibility related tasks). The more worksets you have, the less likely you are to place elements into the correct worksets, and thus, the less useful they become. If you don't know why you're creating the workset, then don't. More importantly, if other users don't know why the workset exists, confusion and misuse may ensue. There is no automated mechanism by which to ensure elements are placed in a particular workset. However, to change the workset an element belongs to, simply select the element(s), and in the Properties window, select the appropriate workset.



If the Workset property is read-only, as shown below, this indicates that the elements you have selected are non-editable. I.e., they are in a workset that you do not have ownership of. To be able to change the workset of the element, you must first make the element editable. This can be done by either making the workset editable (in otherwords, taking ownership of the entire workset), or clicking the  control to make the element editable. If you are modifying many elements, it will probably be quicker to make the workset(s) editable.

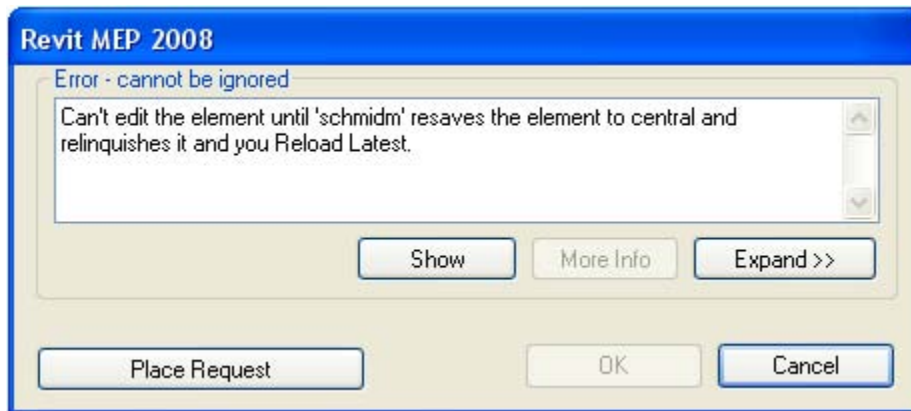


Element Borrowing vs. Workset Ownership

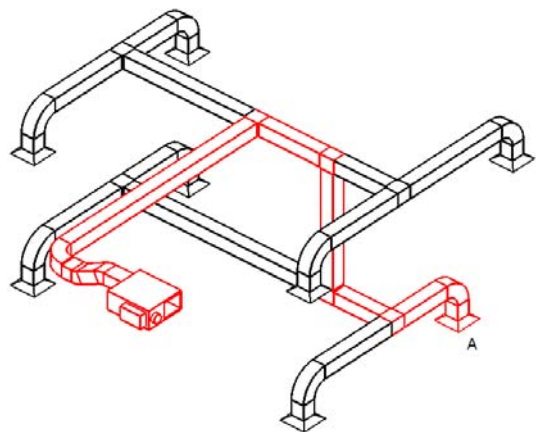
In many cases in Revit MEP, it is easier to work in what some call Element Borrowing Mode instead of using Workset Ownership. Workset Ownership creates an environment where users retain ownership of entire worksets, and permission must be granted for other users to make changes to elements. For example, if a user owns the MEP Equipment workset, and a user needs to relocate a piece of equipment, or even just change the Mark of the equipment, the user must first request permission in Revit, notify the owner that they are requesting permission, and the owner must grant permission. Using 'Element Borrowing Mode', elements are borrowed 'on the fly', and provides a much more fluid workflow. Worksets were originally implemented to allow multiple users to work together prior to the implementation of the element borrowing functionality; now that elements may be transparently borrowed when multiple users are working together, there may be limited cases where you would apply Workset ownership (i.e., perhaps to 'lock' a linked Architectural or Structural model).

There is no setting to use Element Borrowing Mode, it is just a matter ensuring that the appropriate worksets have no owner. With no owner, the elements in the workset are borrowed automatically as needed. Clicking Save to Central automatically relinquishes ownership of the borrowed element(s) so that another user may make modifications as necessary.

In Revit MEP, users should be aware that even though they are not directly modifying an element, they may end up borrowing elements unwittingly. As users work in the model, they may be inadvertently borrowing more and more elements, and precluding others from doing the same. The following message is a common occurrence in such a scenario:




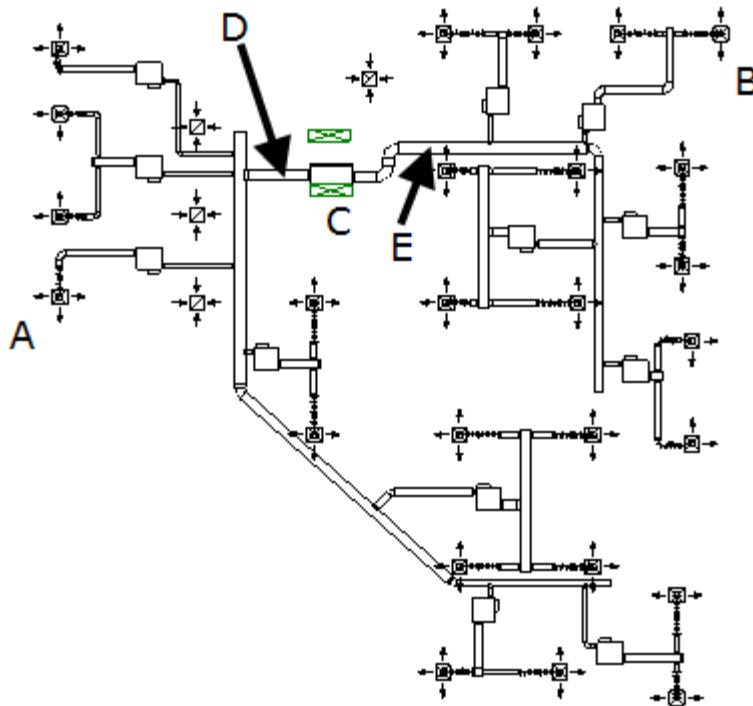
The reason for this is due to the way information is kept synchronized within Revit MEP. Whenever a change is made to an element that is 'downstream' of another element, the information must be pushed upstream to keep everything synchronized. For example if User A modifies the flow at diffuser A, the flow information is propagated through the duct system as far as it is connected. When this happens, User A not only borrows diffuser A, but also becomes borrower of all the other components upstream of that component. If User B were to attempt to modify the flow of any of the other terminals at the same time, User B would receive the above Error message, alerting that User A needs to save to central.



In most situations this is easily mitigated by strategically assigning work tasks to users. In this example, it probably isn't necessary for User A and User B to be working on the same portion of the building. What happens in a more complicated scenario? Say for example, multiple VAV boxes are connected upstream to a common air handler. The same issue would happen, only at a grander scale. If User A were to modify the flow on a diffuser in one area of the building, potentially ductwork all the way back to, and including, the AHU would be borrowed, precluding User B from making changes to any elements, even though the user may be working on a completely different portion of the building.

The easy solution is to simply 'break' the ductwork at some point to keep the flow going all the way up stream, and thereby segregating the data that users will be updating. In the example below, all the diffusers on the level are connected back to a common air handling unit on the roof (at point C). If User A modifies the diffuser at point A, all elements through to point C may be borrowed. This precludes User B from making a change to the diffuser at point B, because this would require information to be updated through to the air handler at point C as well. To allow multiple users to work together, the

 Split tool may be used to create a gap in the duct system at points D and/or E. Use the Delete Inner Segment option to create this gap to control how far information will update.



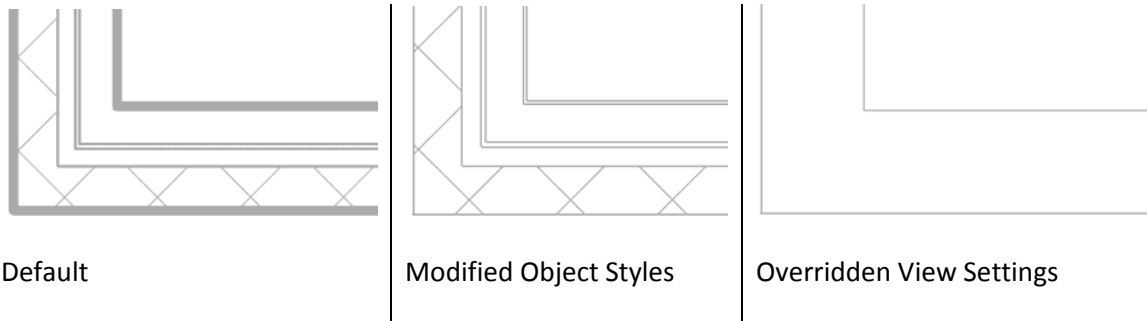
Strategically segregating the data in the model can help ensure that multiple users can work side-by-side. In the scenario above, User A can freely modify everything downstream of point D, and User B can freely modify anything downstream of point E. When all updates have been made, the ducts may be easily stretched back together to complete the system.

Controlling Visibility in Linked Files

There are two different scenarios of how you may want to control the visibility of elements in a linked model. The first is where you want to change the visibility, and it is acceptable that this change affects the visibility of the elements in the host file. The second scenario is where you want to turn off the visibility of components in the architectural model, but you want to leave the visibility of the components on in the host model.

Using Object Styles

The first scenario is handled using typical Object Styles (Settings menu) and Visibility/Graphics Overrides in View Properties. A common example of this is where you may want to modify the display of the walls in your MEP views. For example, you may want to make the linework lighter, and hide the interior wall components. The first portion is handled by modifying the Object Styles. In this example, I changed the Wall and Common Edges cut line weights, from 5 and 2 respectively, to 1.



Category	Line Weight	
	Projection	Cut
Walls	2	1
Analytical Model	5	1
Common Edges	2	1
Hidden Lines	2	2
Wall Sweeps - Cornice	1	5
Windows	2	2

Select All Select None Invert

Show categories from all disciplines

Modify the Wall's Object Styles



Override the View's Visibility/Graphics Settings

There may be other architectural object types that you want to set to Coarse, instead of using the By View setting, such as stairs, windows, and doors. You can also make the Visibility/Graphics changes to your View Templates (Settings menu). This will allow you to apply these changes to multiple views at once. This simplifies the display of the architectural background, and may result in a performance boost since there are fewer graphics to generate.

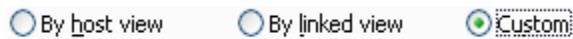
Using Linked Display Settings

The other means of controlling the visibility of linked elements is to utilize the Revit Links tab in the Visibility/Graphic Overrides window. Say, for example, an architect utilizes the Electrical Equipment category to create things like the bag conveyer system for an airport. Sure, the correct thing to do would be to set the category of the families to 'Specialty Equipment', but alas, you need to create a

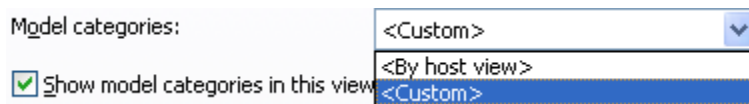
presentation drawing, and you have all these funky blobs on your electrical drawing. So, what you need to do is configure the display Electrical Equipment in the linked file to display differently than that in the host file, so the method employed above won't work.

On the Revit Links tab, click the button in the Display Settings column; by default this button is labeled 'By Host View', indicating that the linked file is displayed the same as the model it is hosted into.

Next you will see the Link Display Settings window with three main options. Instead of the default, select Custom.

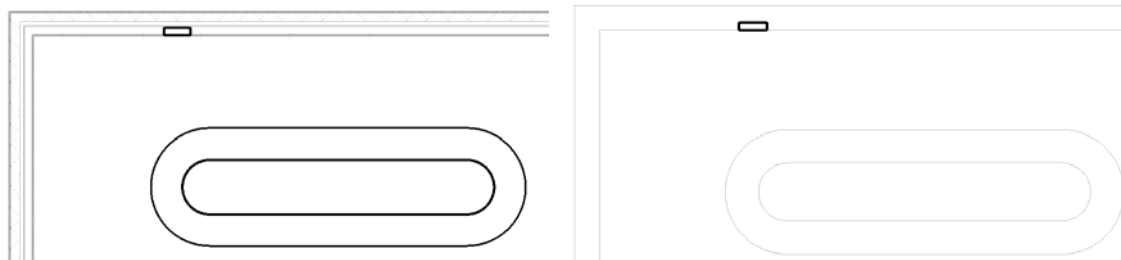


Then, on the Model Categories tab, select <Custom> from the drop down list.



You then have the ability to fine-tune the display of elements by editing the display properties. In this case, I checked the Halftone option for the Electrical Equipment, and click the Override.. button under Lines to set the line weight to 1.

Visibility	Projection/Surface		Cut		Halftone
	Lines	Patterns	Lines	Patterns	
<input checked="" type="checkbox"/> Electrical Equipment	Override...	Override...			<input checked="" type="checkbox"/>

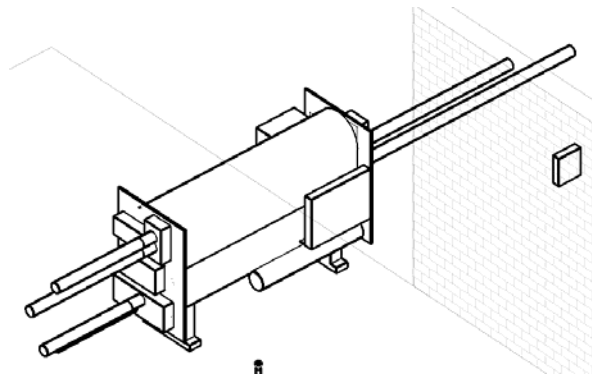


A similar approach may be utilized to control the visibility of items requiring visual coordination. Say, for example, the architect places water closets in the model. However, you find that they placed floor mounted water closets where it is desirable to utilize wall hung fixtures. You could create an inspection view that shows the locations of the architects fixtures in one color, and your fixtures in another. Then, if any changes are made, it will be easy to find where there are fixtures that don't visibly line up.



Control Visibility

In addition to the methods employed above to control visibility of objects, it is also possible to hide elements using View Filters. It is also possible to apply visibility overrides using filters to modify the color, line weight, and line type of elements.

Consider the scenario where an absorption chiller, with chilled water supply/return, condenser water supply/return, and steam supply/return is piped; however, all the piping appears the same. It is desirable to setup view filters to be able to distinguish the different piping systems. The System Browser below shows that the piping systems have already been created, and renamed as appropriate.



Systems	Size
Mechanical (0 systems)	
Piping (7 systems)	
Hydronic Supply	
Chilled Water Supply	
Condenser Supply	
Steam Supply	
Hydronic Return	
Chilled Water Return	
Condenser Return	
Steam Return	
Sanitary	
Electrical (0 systems)	
Unassigned	

Tip: To rename a system from the default 'Hydronic Supply System 1' convention, select a pipe on the system, click the Edit System button  on the Options Bar, click  System Properties on the Design Bar, then enter an appropriate system name in the Element Properties window.



Implementation of view filters is a two part process:

1. Create the View Filters
2. Apply the View Filters to view Visibility/Graphic Overrides


Creating View Filters

For the above example, we are going to use a total of six view filters to parallel the piping systems defined above.

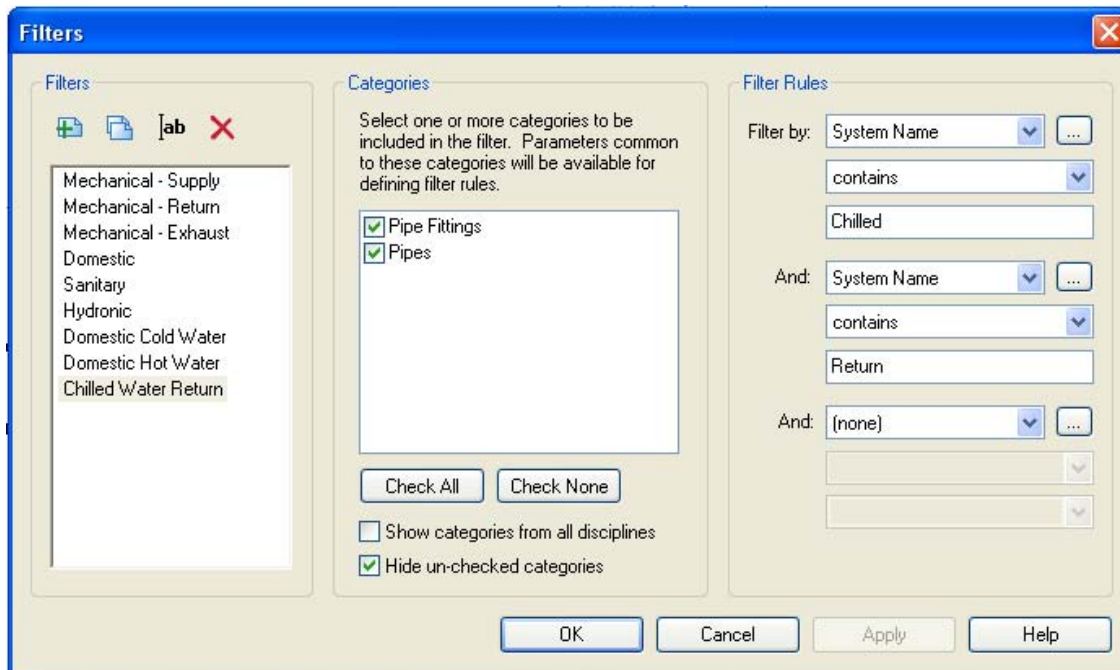
- Steam Supply
- Steam Return
- Condenser Water Supply
- Condenser Water Return
- Chilled Water Supply
- Chilled Water Return

Note: View Filters are Case Sensitive, i.e., 'Steam Supply' is different than 'steam supply'.

To create the view filters, follow these steps:

1. From the Settings Menu, select Filters...
2. Click  to add a view filter, and name it appropriately.

3. In the Categories list, select Pipe Fittings, and Pipes.
4. In the Filter Rules, create two rules. Both beginning with 'System Name', 'contains', then fill in Chilled and Return as shown below. (Using this method allows you to have multiple systems with similar names, i.e., you could have two chilled water return loops: 'Chilled Water Return A' and 'Chilled Water Return B', and the filter for modifying the visibility/graphics overrides would apply to both.)



Repeat steps 2-4 to create the 5 other Filters listed above.

Applying View Filters

Now that we have the view filters defined, we will apply them to our mechanical view template.

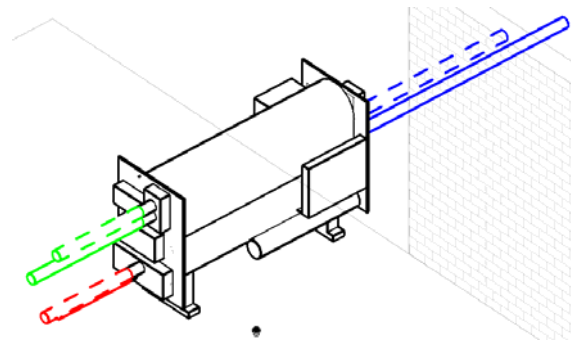
1. From the Settings menu, select View Templates...
2. From the Name list, select an appropriate view template (i.e., Mechanical Plan).
3. Click the Edit button next to Visibility/Graphics Overrides
4. Select the Filters tab.
5. Click the Add button.
6. Select the six view filters created in the previous section, and then click OK.

- For each of the view filters, click the Override button in the Project/Surface Lines column, and select a color and line type for each. Click OK when finished, and click OK to close the View Templates window.

Name	Visibility	Projection/Surface	
		Lines	Patterns
Mechanical - Supply	<input checked="" type="checkbox"/>		
Mechanical - Return	<input checked="" type="checkbox"/>		
Mechanical - Exhaust	<input checked="" type="checkbox"/>		
Domestic	<input type="checkbox"/>		
Sanitary	<input type="checkbox"/>		
Chilled Water Return	<input checked="" type="checkbox"/>		
Chilled Water Supply	<input checked="" type="checkbox"/>		
Condenser Water Return	<input checked="" type="checkbox"/>		
Condenser Water Supply	<input checked="" type="checkbox"/>		
Steam Supply	<input checked="" type="checkbox"/>		
Steam Return	<input checked="" type="checkbox"/>	Override...	Override...

Note that the Domestic and Sanitary filters in the Mechanical Plan view template have the visibility unchecked. This is what keeps domestic hot, cold, and sanitary piping from showing up on Mechanical views.

You can now apply the view template to your views as needed, and the pipes of the various systems will be represented as defined by the view filters.



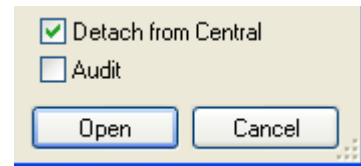


Quick Reference: Model Configuration Procedures

Setting up a linked Architectural model is relatively straight forward. After the model is linked, you'll likely want to employ Copy/Monitor to leverage levels and spaces from the architectural model. As the architect makes change to the underlying model, it may be necessary to use Coordination Review to 're-sync' the models.

Steps to Link a File

1. Open the model to be linked in, and select Detach from Central, and re-save the file, and close it. This is to ensure that the cached path stored in the file is on your network, and not referring to a drive/path on a different LAN.



Note: If you do not do this, other users linking the model may not be able to see it, and it may be unavailable when you close/reopen the MEP model due to the 'foreign' cached path.

2. Create a new model from a MEP template
3. Save the file
4. Open an elevation view
5. Delete all the levels
6. File Menu > Import/Link > Revit...
7. Select Origin-to-origin positioning
8. Select the architectural / structural model
9. Click Open
10. Select the linked in model in the drawing area
11. Click the Pin on the toolbar



Quick Reference: Steps to Copy/Monitor a Project

In general, it is only necessary to Copy/Monitor Levels and Rooms. It is not possible to Copy/Monitor other elements, such as light fixtures. And, even though you can, you really don't want to Copy/Monitor walls or architectural elements... it leads to a growing file size, with no real benefit. Although you may think to Copy/Monitor walls so you can use Wall Based families, you are better off using face based families. They are more flexible with regard to where they may be placed, and they can be hosted through a link.

1. Tools Menu > Copy/Monitor > Select Link
2. Options (Design Bar)
3. Rooms Tab
4. Click Edit next to Phases
5. Setup the phasing between the models for the rooms.
6. Click OK.
7. Copy (Design Bar)
8. Check Multiple on the Options Bar
9. Drag select all the levels in the model
10. Click Filter on the Options Bar
11. Verify that only Levels is checked
12. Click Finish on the Design Bar
13. Click Copy Rooms on the Design Bar
14. Click Finish Mode on the Design Bar

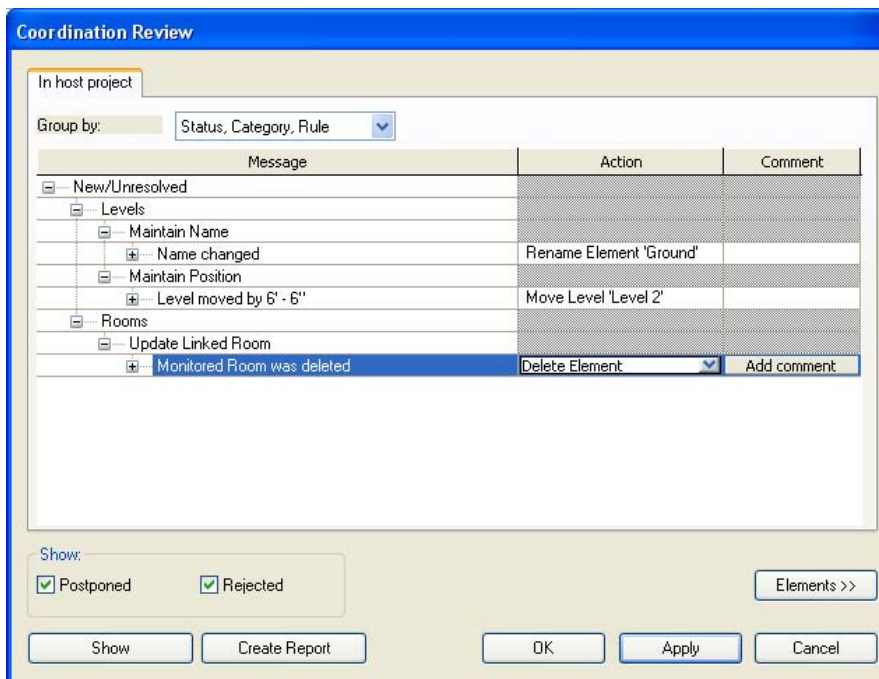
Quick Reference: Coordination Review

Coordination review is the process by which models are resynchronized if there are changes to the linked architectural model. For example, if the level to level height changes, levels are renamed, or rooms are deleted, Coordination Review is necessary to make the adjustments. When these types of significant changes are identified when a file is opened, the user is prompted, as shown here.


To address the coordination issues, select Coordination Review from the Tools menu, and select the appropriate linked file.

When the Coordination Review window opens, the issues will be listed, and you can select the appropriate action.

Assuming the architect made the changes cognitively (cough, cough), you will rename, move, and delete elements to follow suit. In the example shown here, we have selected Rename Element 'Ground' to follow the naming convention of the architect; Move Level 'Level 2', because the architect changed the floor to floor height, and we



need to follow suit; and Delete Element, because the room no longer exists.

Note: To copy newly added rooms, you must use the  Copy Rooms tool in Copy/Monitor. You are not notified when new rooms are added, so make it practice to open Copy/Monitor, and click Copy Rooms when a updated model is received.

