



Using the Coordination Monitoring Feature in Revit® Structure to Manage Projects Across Disciplines

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SE204-1

Intended for existing Revit users, this session explores the powerful features within Coordination Monitoring for managing project changes across multiple disciplines. Understand the value of effective coordination management by reducing mistakes and time-consuming rework.

Target Audience:

Architectural and engineering professionals seeking an effective way to collaborate on the Revit platform

Key Topics:

- The underpinnings of Revit database concepts as they relate to collaboration
- The process of linking and copying work from other Revit models
- Coordination and action-item reviews
- Evaluate coordination scenarios

About the Speaker:

John joined Autodesk in 2006 as the building solutions specialist in education and supports the initiatives for strategic universities. He has more than 20 years of industry experience, where he has served as an architect, and as an applications engineer of Autodesk Building Solutions. John has trained and consulted hundreds of architects and engineers on Autodesk design software. He has a Bachelor of Science degree in Architecture. john.herridge@autodesk.com



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Introduction

Welcome to this course on multi-discipline coordination monitoring using the Revit platform. The idea was to stretch broadly across multiple disciplines to bring a common task to light and investigate how the Building Information Modeling (BIM) process and supporting application tools can better address these increasing challenges.

What comes to your mind when you hear the word “coordination”? Did you cringe at the thought? One popular way for architectural and engineering firms to “understand” the project was to perform pain-staking manual color coding of building systems of the project to visualize where potential interference conflicts may occur. Then, the process would repeat all over again when the backgrounds changed. Sound familiar?

What is the true cost benefit of coordination? Is it the net value of errors and omissions avoided or the quantity of RFI’s eliminated? Fortunately, coordination is something that we can manage and control. Preferably, we are seeking ways of optimizing this process without losing accuracy and quality. I believe we are beginning to see this optimization come to light using the coordination features integrated into Revit.

If you would like:

- To be notified of changes contemplated by another disciplinary group that may impact your work
- To have software systematically generate documentation that will facilitate face-to-face coordination meetings
- To have an enhanced potential for heading off costly, downstream rework

You have come to the right course...Let’s get started!

Multi-discipline Coordination Monitoring Concepts

As engineers and designers, we understand the value of coordination. The greatest and most effective impact designers can have on project success is in the early stages of the project, when the cost of revisions is minimal compared to the associated cost of potential rework required at later stages.

The following diagram outlines the major concepts essential for developing a coordination strategy (Figure 1).

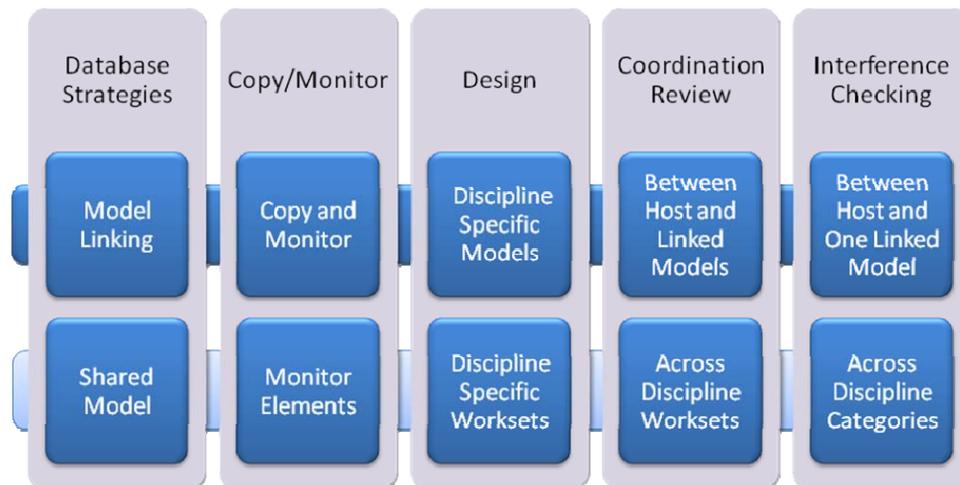


Figure 1. Multi-discipline Coordination Strategy

Database Strategies

A significant characteristic of Revit is the awareness that all information about the project is captured in one underlying database**, sometimes this is referred to as the project knowledge base. As a project progresses, so does the intellectual assets which are entered into the database. Design data is entered once into the database, yet the information can be represented in many ways depending upon how it is queried.

These elements can take on geometrical representations in 3D Isometric views, plans, sections, elevations, and other views while non-graphical data are typically displayed in tables or schedules.

Discipline Specific Database Strategy (The Preferred Strategy)

The preferred strategy is to establish a Revit database for each discipline (Figure 2) that will be participating in the project. In some respects this is similar to the approach taken with CAD based files.

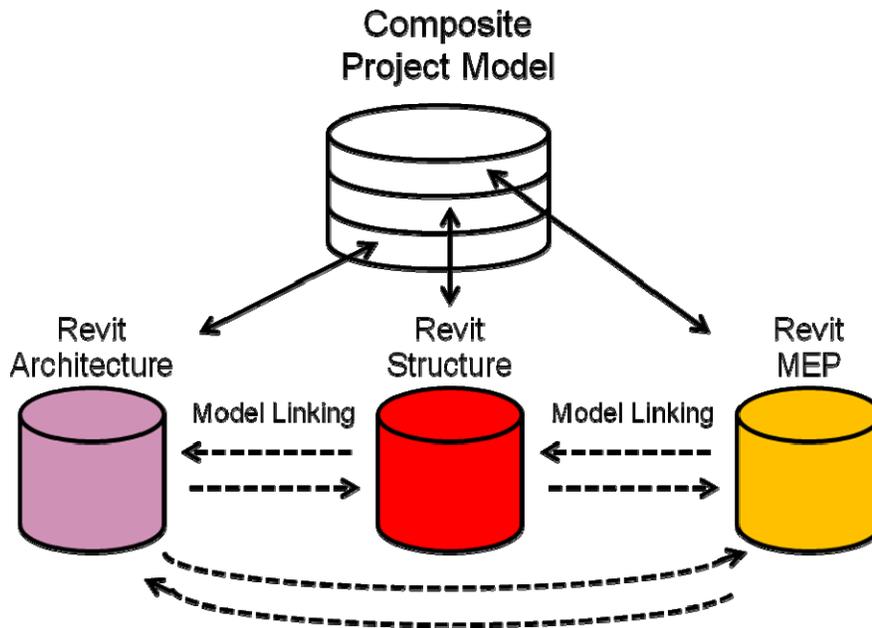


Figure 2. Linking of Separate Discipline Models

Note: The 2008 version now permits nesting of linked models. Nested linked models must manually be set visible in the host model.



Figure 3. Revit Model Linking

**Database. Per Wikipedia, “database is a collection of records stored in a computer in a systematic way, so that a computer can consult it to answer questions.”

Even though the databases for each discipline are separate, we are able to “see” each other’s database by way of linking models directly (Figure 3), indicated by the dashed arrows in Figure 2. This is similar to the notion of references with DWG files.

The linking of discipline specific models is the preferred means of sharing models between architects and engineers. However, the type of data exchanged in a Revit-based model carries far more intelligence than an equivalent DWG file. For product series compatibility, this course assumes that all parties are using the 2008 Revit platform for project implementation. If using older versions, please refer to the product matrix chart in the on-screen Revit help menu on the Linked Revit Models page. Caution should be taken prior to updating any software to ensure compatibility across the entire design team.

It is important to note that each discipline retains ownership of their own database while continuing to develop designs at their own pace while accommodating flexibility.

Shared Database Strategy

Another approach is to share a common project database for all disciplines (Figure 4). The project information is developed in a single Building Information Model by using worksets. Worksets are logically named subsets of the overall Building Information Model by which objects are assigned to them. This enables each discipline to develop their own subsets to satisfy the needs of the project, depending upon the number of team members and their roles. Each discipline uses their corresponding purpose-built Revit application for working on the Building Information Model.

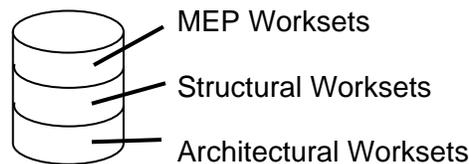


Figure 4. Shared Project Database

Each team member is able to work concurrently on a different portion of the same project. The project team is able to view each other’s worksets when necessary for contextual backgrounds or for coordination purposes.

Note: Further discussion of worksets is outside the scope of this course. Please refer to the Resources section at the end of this document for more information. In addition, any references moving forward regarding a Shared Database will appear in enclosed boxes to improve the readability of this document.

Starting A Project with Copy / Monitor



Copy / Monitor =  Copy + 

To initiate downstream discipline specific models for structure and building systems, Revit includes efficient tools for copying architectural elements from linked models and turning them into native engineering discipline elements. The following categories of objects in (Figure 5) on the following page can be copied from Autodesk® Revit® Architecture into other models.

It is important to note that each category in (Figure 5) includes Option settings (Appendix Figures A1-A5) to control how the respective information will be copied into the model. Copy / Monitor can be started from either the icon shown in the Tools toolbar or from the Tools pulldown menu (Figure 6).



Figure 5. Categories in Revit Structure

Command: Tools pulldown menu > Copy / Monitor > Select Link



Figure 6. To initiate Copy / Monitor (Tools pulldown menu)

Engineer’s Copy / Monitor Workflow Diagram

The workflow diagram below (Figure 7) starts with the onetime processes in blue from left to right; then, moves from top downwards to illustrate the repetitive processes and works in conjunction with the Design Bar (Figure 8).

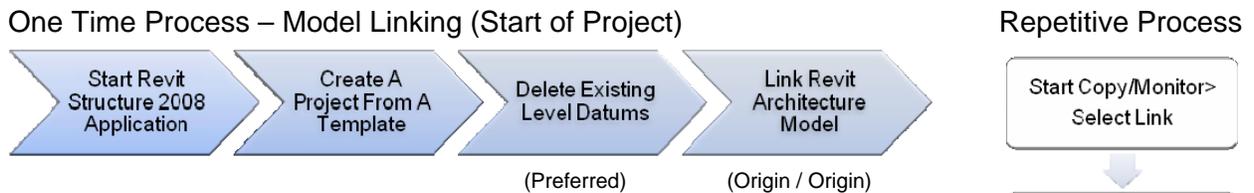


Figure 7. Copy / Monitor Workflow Diagram

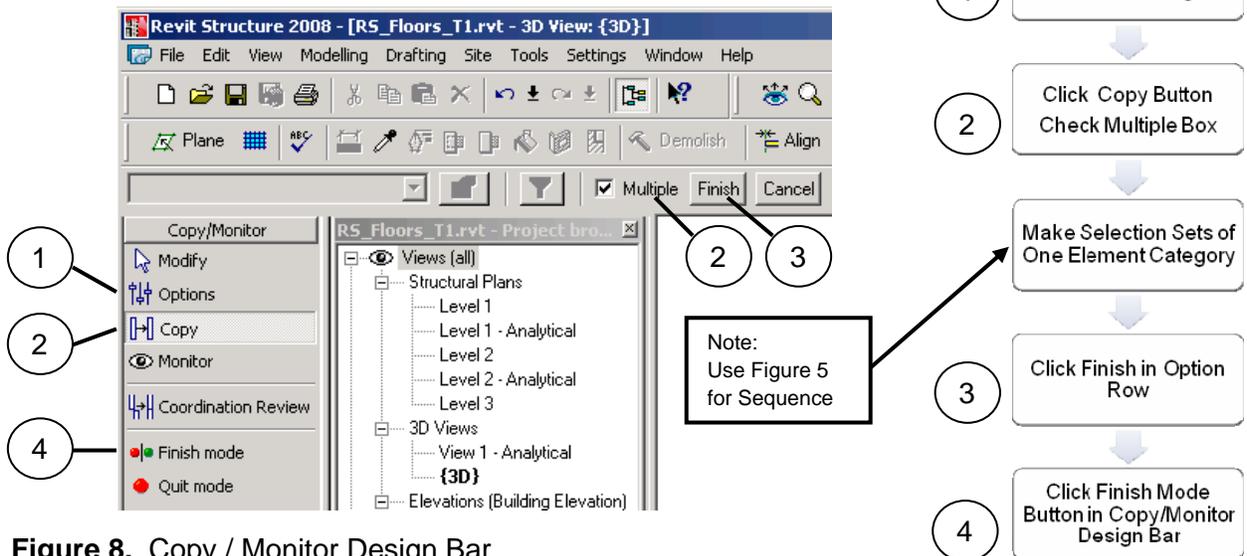


Figure 8. Copy / Monitor Design Bar



Copy / Monitor Tips

General

1. Copy one category of elements at a time (in sequence per Fig. 5), repeat as necessary for other categories
2. In-Place Model Components cannot be copied into an engineering project using Copy / Monitor

Power Tip:

Use Copy / Paste if necessary to bring In-Place elements across

Levels

1. When architectural Levels are copied, engineering plan views are not automatically created. Use the Floor Plan tool from the View design bar to generate engineering plan views.
2. Create Analytical Views for each Level
Duplicate Level > Rename Level > Apply Default View Template: Structural Analytical Stick
3. Offset Levels from Architectural if floor finishes are not to be considered, specified in Copy / Monitor Options

Power Tip:

To apply a view template to multiple views, make a selection set in Project Browser, right-click, then Apply View Template...; Select a named view template from the list

Grids

1. If Scope Boxes are present in Revit Architecture, it is recommended not to associate grid lines to them until the structural discipline has copied the grid elements. In addition, it is important to note that Scope Boxes will not be viewable in the linked model.
2. Therefore, to share region intents for Scope Boxes I would suggest creating a placeholder in the host model using a custom model line type so that engineering disciplines can trace over them.
3. Robobat Extensions (Compare Models): Alerts engineer if new grids were added to the architectural model after using Copy / Monitor in Revit. Use Copy/Monitor to bring new grids across in the structural model.

Columns

1. For schematic design, use generic column placeholders in Revit Architecture
2. The Copy / Monitor Option dialog box will list all the shapes and sizes in the architect's model. Verify that the list correlates with the families loaded in the structural project if they are to be re-used.
3. Custom Structural Column component families can be copied into a structural project



Walls

1. For schematic design, use structural walls in Revit Architecture with one of the following properties: bearing, shear, or structural combined. Wall centerline only is recognized. Non-bearing walls are excluded.
2. The Copy / Monitor Option dialog box will list all the wall types in the architect's model
3. Custom Wall Types can be copied into a structural project

Power Tip:

Copy walls from a 3D isometric view to ensure capturing all walls on the first pass

Floors

1. For schematic design, use generic floors as placeholders in Revit Architecture
2. The Copy / Monitor Option dialog box will list all the floor types in the architect's model
3. Custom Floor Types can be copied into a structural project
4. Architectural Floors require Structural property to be checked to enable analytical properties for analysis

Shared Database Model:

In instances where there is justification for duplicate elements such as walls (architectural and structural), it is acceptable for the structural designer to place native structural walls in relation to the structural core of an architectural cavity wall. In this case, a simple monitoring functionality is desired. In addition, verify room bounding property behavior of structural walls and columns.

Monitoring can be achieved by initiating Copy / Monitor mode, then selecting the Monitor tool in the design bar area and choosing the host element first then the linked architectural element. If the linked element is moved or deleted a Coordination Review of the event is generated.

Monitoring Only – Downstream Disciplines



For Structural or MEP disciplines creating their own native elements to corresponding Architectural elements and want to establish a relationship between those elements in the host project and the linked Architectural model; use the Monitor command from Copy/Monitor Design Bar (Figure 8). Alternatively, discontinuing Monitoring of elements can occur at any time by selecting the monitored element; then selecting Stop Monitoring. In addition, removing a linked model effectively stops monitoring all previous elements.

Design

After the elements have been copied, the design and documentation tasks can begin. At this point, each team starts designing in either their discipline specific model or shared model using worksets. This effort is executed in a normal fashion using the purpose-built tools within the discipline specific application programs.

In one scenario, after the architectural model elements have been copied into the respective engineering models, ownership of those elements should now be controlled by the discipline responsible for that scope of work. For example, structural columns and framing in the architectural model should be turned off or deleted and the linked structural model should govern. In addition, consideration should be given to monitoring elements from the structural model inside the architectural model; such as, Levels, Grids, Columns, and Walls.

Another scenario would encourage the structural engineering team to be involved at the inception of the project and delineate their design to coordinate with the architect's design intent without duplication of effort.

Coordination Review



This process facilitates design changes across all disciplines affected by monitored elements discussed above. Architectural modifications to Levels, Grids, Columns, Walls, and Floors are communicated to the engineer's models through the Coordination Review interface. From the Coordination Review interface, users review modifications made and determine the appropriate action to take. Coordination Review is not a substitute for verbal or written communication across the design team, however it does provide a consistent means for taking action.

Command: Tools pulldown menu > Coordination Review > Use Select Link

Once the architectural changes have been saved, the engineer would reload the architectural model to receive those changes. During the reload process, when a monitored condition changes, a Coordination Review Notification automatically occurs (Figure 9). The Coordination Review Workflow is captured in (Figure 10).

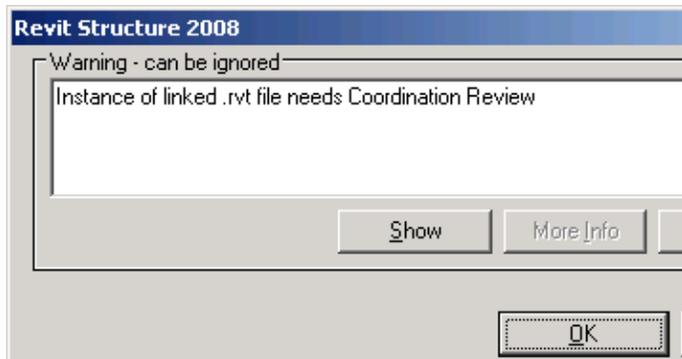


Figure 9. Coordination Review Notification

Coordination Review Workflow Diagram

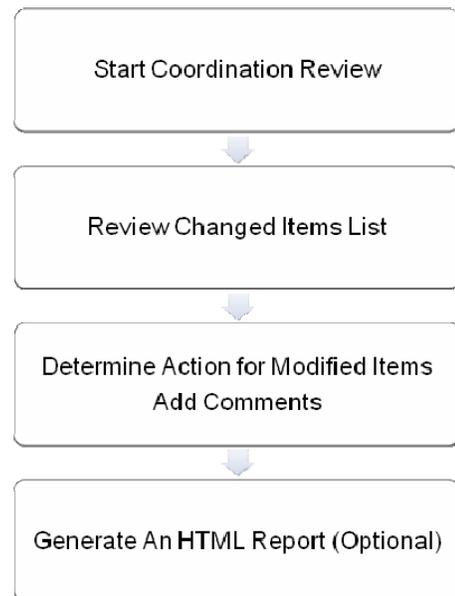


Figure 10. Coordination Review Process

Shared Database Model:

Coordination Review is available in a shared model also. The user would select Use Current Project when prompted. While this appears to be more efficient than the linked model approach, it does however require reloading the latest workset changes to ensure that you have the latest version of the project before conducting Coordination Review.

While Coordination Review is available, it is presumed that the advantages of a shared model will limit the need for duplicate elements in general and cause them to be used sparingly or not at all.

Coordination Review Interface

Once Coordination Review has been initiated, the Coordination Review dialog box (Figure 11) appears and displays the changed information from the models by group properties of the dialog box. From here you would evaluate each category and perform an action. In addition, you have an opportunity to document your comments (Figure 12) in an HTML report using the Create Report button in (Figure 11). If you are not sure where the proposed changes occurred in the project, you may use the Show button to zoom the screen to that location.

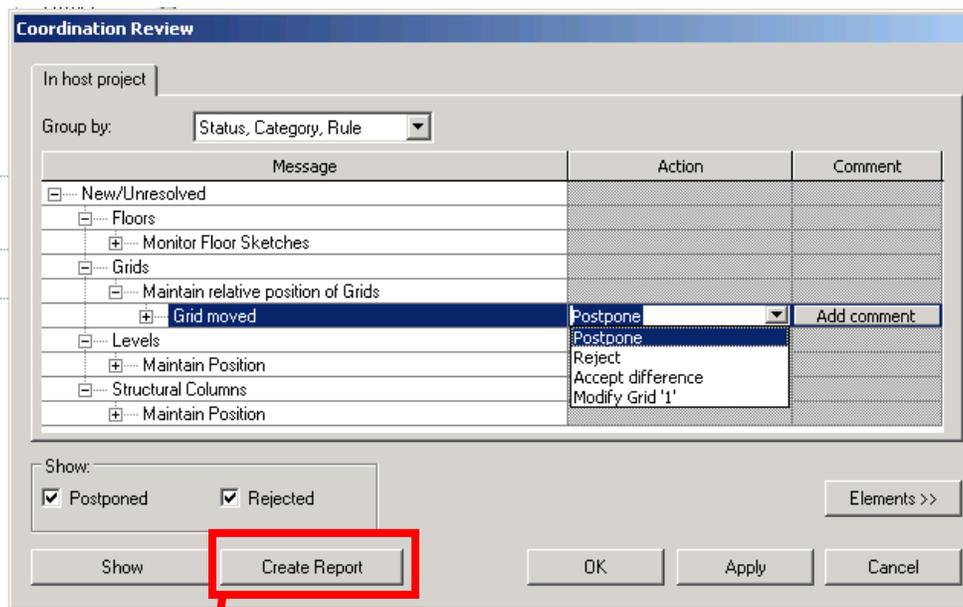


Figure 11. Coordination Review Interface

Blocking/Rejected	Floors	Monitor Floor Sketches	Sketches are different	Floors : Floor : 3" LW Concrete on 2" Metal Deck : id 157533 Small Bldg_Arch.rvt : Floors : Floor : Floor 1 : id 32059	Comment
Blocking/Rejected	Grids	Maintain relative position of Grids	Grid moved	Grids : Grid : 1 : id 155207 Small Bldg_Arch.rvt : Grids : Grid : 1 : id 43209	SEng: Span to great, not enough clearance for ductwork RFL Raise floor level? Struct, 11/3/2006 3:06:51 PM
Blocking/Rejected	Structural Columns	Maintain Position	Relative position of two Instances changed in Plane	Structural Columns : W-Wide Flange-Column : W10X49 : id 155326 Small Bldg_Arch.rvt : Structural Columns : W-Wide Flange-Column : W8X40 : id 248763	

Figure 12. Partial Coordination Report After Actions



Coordination Review Scenarios

In general, most modifications to the **monitored** elements in the project model will permit the following actions to be taken: Postpone, Reject, Accept Difference, or “Modify” the element to match monitored element. Coordination Review provides a vehicle for automating the documentation of modifications and promotes discussion with the project team; refer to (Figure 13).

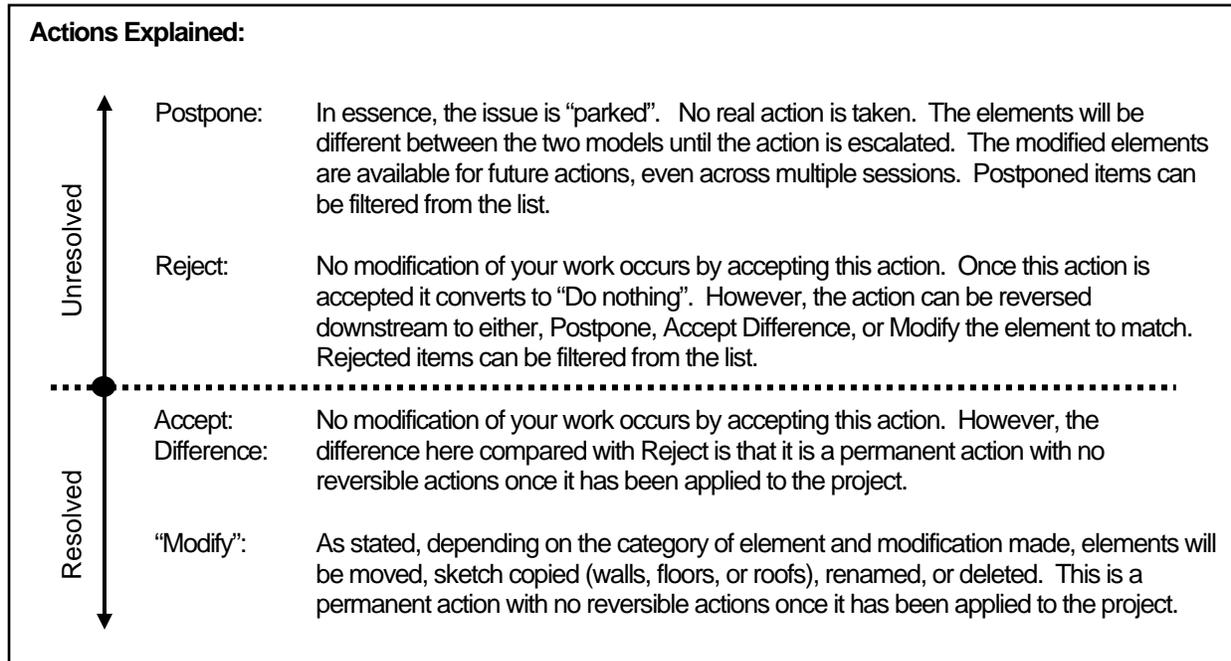


Figure 13. Coordination Review Actions Explained

As you can appreciate with large projects that require more than one author, multiple changes can occur concurrently. The Coordination Review Interface has the ability to categorize the changes for you after the linked models are refreshed or the latest worksets are reloaded. Basically, your design efforts are not hampered by any requirements related to Coordination Review. Multi-category modifications can be processed at one time.

Note: View dependent properties such as view scale, hidden in view, and other properties do not generate coordination review notifications.

Interference Checking

Engineers and Architects using the Revit platform can perform interference checks at any time during the design process by choosing which model-based Engineering and Architectural categories to check for interferences.

Interference checks can be performed on elements within the same file (shared database) or between the host model (live elements) and one other linked model (Figures 14 and 15). If there are multiple linked models, they will need to be processed as separate checks. For example, the Architectural model is the host model with Structural and MEP models linked directly to the host model, the following interference checks would have to be performed to check all discipline models: Architectural / Structural and Architectural / MEP.



Note: Interference checks cannot be performed between two linked models.

Command: Tools pulldown menu > Interference Check > Run Check

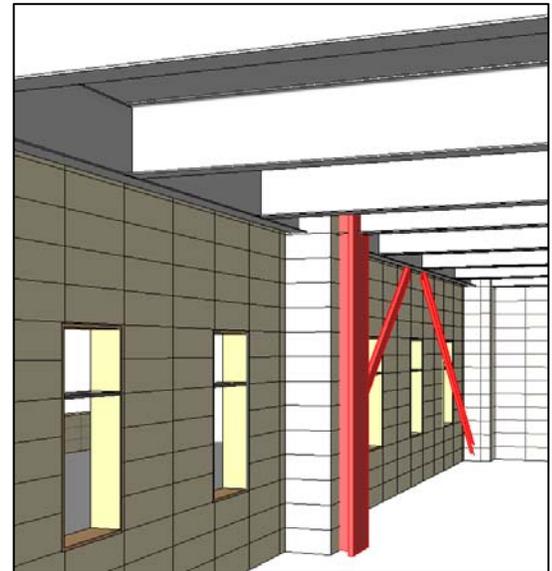
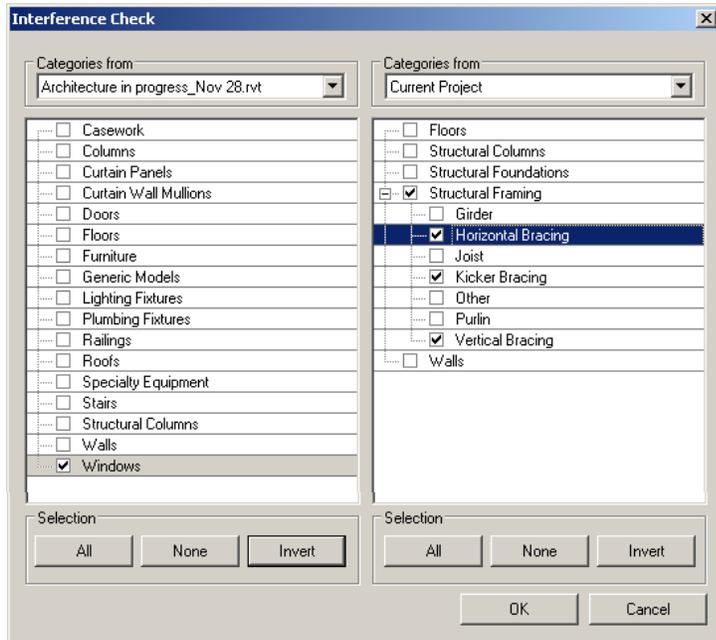


Figure 14. Linked Model / Host Model Comparison Shown

Figure 15. Interference Shown in Red

Best Practices

Communication

Adjust for Building Information Modeling process

File Names

It is recommended that file names for the project should not change after the models have been linked to maintain the Coordination / Monitoring relationship between the host and linked models

Databases

Linked Models: Use the fewest number for performance

Shared Model: Use worksets to manage element density of project
Open only those worksets that you absolutely need

Hybrid Combos: (Workset Enabled Model and Single Author Model)
Assign linked models to a dedicated workset

Copy / Monitor

To be used for downstream disciplines workflows primarily
(Either Arch to Struct, Arch to MEP)

Not to be used for upstream disciplines workflows – Refer to Monitoring
(Either Struct to Arch or MEP to Arch)

Not a substitution for Interference Checking



Monitor Only	Can be used for downstream discipline workflows as stated previously or upstream discipline workflows to become aware of proposed changes from discipline having ownership of those monitored elements (Either Struct to Arch or MEP to Arch)
Coordination Reviews	Every other day suggested, use your judgment based upon number of project changes

Summary

The benefits of coordination are invaluable. Making the coordination process timelier, more automated, and less painful – Priceless! Applying the coordination concept in a new way with 3D building components along with a systematic means for keeping the team apprised of design changes with Coordination Review presents opportunities for better quality of design earlier in the project. Remember that in either database approach, retaining ownership of your work is a strong feature. Help your firm enhance their competitiveness by implementing Revit based 3D visualization processes for coordination today!

Resources

AUGI (Autodesk Users Group International)

www.augi.com

White Papers:

“Coordination Between Revit Structure and Revit Architecture”

www.autodesk.com/structure

“Multi-User Collaboration with Autodesk Revit Structure Worksharing”

www.autodesk.com/revit

From AIA:

“BIM: Transforming a Traditional Practice Model into a Technology-Enabled Integrated Practice Model”

By H. Thomas McDuffie, AIA, RIBA

Appendix A

Option Settings

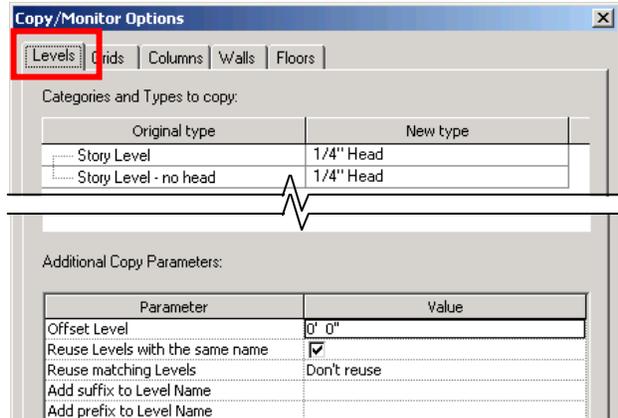


Figure A1. Levels Option Settings

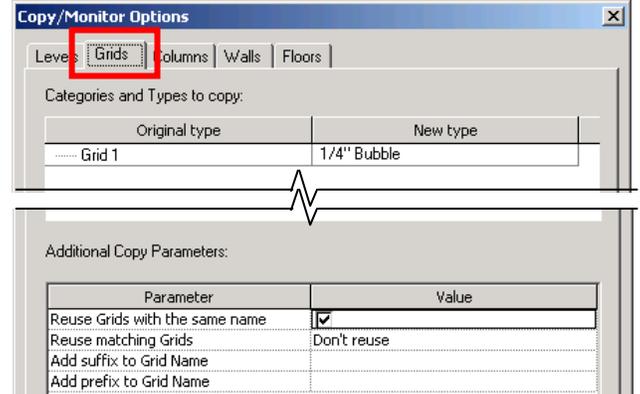


Figure A2. Grids Option Settings

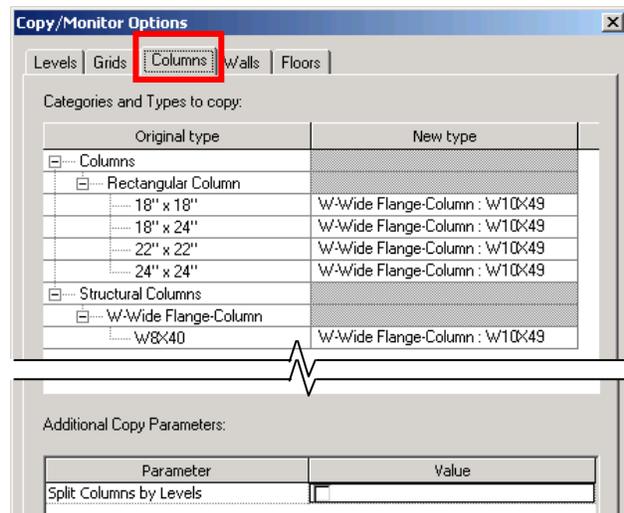


Figure A3. Columns Option Settings

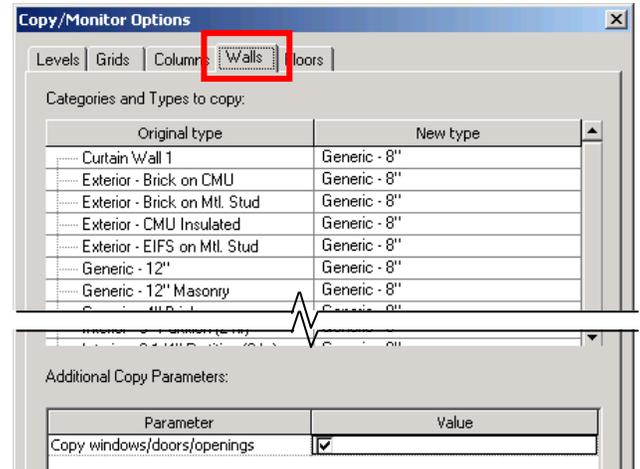


Figure A4. Walls Option Settings

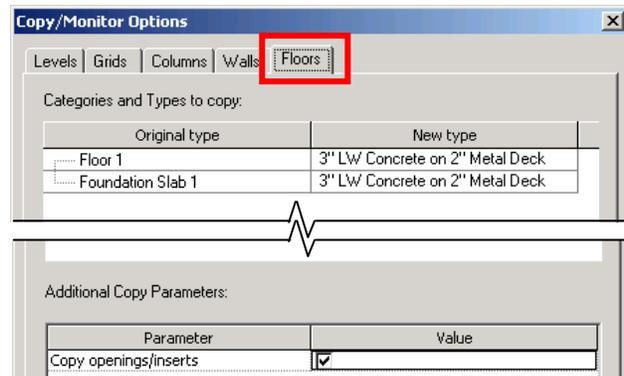


Figure A5. Floors Option Settings