Beyond the Limits: Using Autodesk® Revit® and Navisworks® Manage for Design Collaboration on Large-Scale Projects

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SE4259

This class covers best practices of using Revit platform products and Navisworks Manage for design collaboration and it presents lessons learned from a design-build, fast-track, complex project with joint-venture teams spanning different geographical locations. This class will explain how BIM was implemented on one of the largest projects in the world. We will share some strategies from the pilot Revit project within available resources, and describe the workflow developed to convert different file formats between BIM applications and analysis software. We describe using Navisworks Manage for model coordination between several disciplines and how presenting animations to the client and contractor was the key to success when dealing with real-world complexity. This class will benefit AEC professionals and BIM managers, as well as any pioneers who are applying BIM on large-scale projects.

Learning Objectives
At the end of this class, you will be able to:

- Establish BIM protocol for the kick-off meeting
- Training new users during the BIM project integration process
- Developing a workflow strategy for projects with multiple models and file formats
- Classifying the color legend and purposes of Navisworks coordination models
- Use shared parameters and Revit DB Link for the life cycle database

About the Speaker
Joseph Chuen-huei Huang, PhD, AIA, NCARB - Being a design architect, researcher, and consultant with over 15 years cumulative experience in the AEC industry. He involved on a variety of project types and successfully integrated BIM into interdisciplinary design collaboration and project delivery process. Besides that, he has presented and published a several research papers on well-known international computer-aided architectural design conferences and is the author of Participatory Design for Prefab House: Using Internet and Query Approach of Customizing Prefabricated Houses. Joseph is the BIM Design Lead at MWH Global.

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Luther Lampkin is a Senior Revit MEP Designer at MWH Global providing Integrated Project Delivery expertise utilizing Autodesk software. He has over 11 years of combined knowledge of Autodesk software, 6 years of professional experience working in the AEC industry on a wide variety of international as well as local projects, i.e. federal government, hospitals, public works, wet infrastructure and skyscrapers, using BIM technology. He has also mentored, trained, developed standards & guidelines and project templates for engineering consultants, manufacturers, and architectural studios.

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Introduction

Building Information Modeling (BIM) is an integrated process built on coordinated and reliable information about a project from the design through construction and its life cycle. Similar to a database concept, BIM design tools allow for extracting different views and data from a building model for drawing production, visualization, quantity take-off schedule, analysis and other uses. Since these different views are automatically consistent and parametric updated to represent the reality, this approach eliminates many errors regarding the drawing consistency and provides a better coordination across the disciplines. In this class, we explore the lessons learned from a huge and complex project starting from BIM concept overview, protocol to a several subjects during the implementation phases.

Class Outline

- BIM Concept
- BIM Protocol
- BIM Implementation
  1. Data Collaboration
  2. Model Organization
  3. Family Creation & Special Requirements
  4. Interoperability
  5. Quantity Schedule
  6. Design Collaboration
  7. Clash Detections
  8. Documentation
  9. Revit DB Link and Access Database for Facility Management
  10. Visualization
  11. Animation

BIM Protocol

There are two fundamental concepts we learned from AIA contract document E202-2008 Building Information Modeling Protocol Exhibit:

- Level of Development (LOD) – describes the detail level of completeness to which model element is developed.
- Model Element Author (MEA) – is the party responsible for developing the content of a specific model element to the LOD required for a particular phase of the project.
Five Levels of Model Development

| LOD 100 – Similar to Conceptual Design phase with massing models that can be used to perform whole building types of analysis (volume, building orientation, cost per square foot, etc.) |
| LOD 200 – Equivalent to Schematic Design or Design Development, the model would consist of generalized systems or assemblies with approximate quantities, size, shape, location and orientation. |
| LOD 300 – Model elements are suitable for the generation of traditional Construction Documents. As such, analysis and simulation is authorized for detailed elements and systems. Most design intent models from design A/E firms meet this level. |
| LOD 400 – This level of development is considered to be suitable for fabrication, assembly, and detailing information. The MEA is most likely to be the trade contractor or fabricator as it is usually outside the scope of the architect's or engineer's services unless defined ahead. |
| LOD 500 – The final level of development represents the project as it has been constructed - the As-Built conditions. The model is suitable for owner's maintenance and operations of the facility. |

Example of Model Element table

<table>
<thead>
<tr>
<th>Model Element Utilizing CSI Uniform™</th>
<th>Preliminary Design</th>
<th>Schematic Design</th>
<th>Design Development</th>
<th>Construction Documents</th>
<th>Post Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A SUBSTRUCTURE</td>
<td>LOD</td>
<td>MEA</td>
<td>LOD</td>
<td>MEA</td>
<td>LOD</td>
</tr>
<tr>
<td>A10 Foundations</td>
<td>A1010 Standard Foundations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1070 Special Foundations</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A1030 Slab on Grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A200 Basement Construction</td>
<td>A2000 Basement Walls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B SHELL</td>
<td>B10  Superstructure</td>
<td>B1010 Floor Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B1020 Roof Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B30 Exterior Enclosure</td>
<td>B3010 Exterior Walls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B3020 Exterior Windows</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B3030 Exterior Doors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B3040 Roofing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B3050 Roof Coverings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B3060 Roof Openings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C INTERIORS</td>
<td>C10  Interior Construction</td>
<td>C1010 Partitions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C1020 Interior Doors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C1030 Finishes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C20 Stairs</td>
<td>C2010 Stair Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C2020 Stair Finishes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C30 Interior Finishes</td>
<td>C3010 Wall Finishes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C3020 Floor Finishes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C3030 Ceiling Finishes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example of BIM Collaboration Matrix

<table>
<thead>
<tr>
<th>Discipline / Model Name</th>
<th>Company</th>
<th>Office Location</th>
<th>BIM/CAD Software</th>
<th>Software Version</th>
<th>Model Coordinator</th>
<th>Last Update</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAC - MEP</td>
<td>MWH</td>
<td>Chicago</td>
<td>Revit MEP</td>
<td>2012</td>
<td>Luther Lampkin</td>
<td>11/28/2011</td>
</tr>
</tbody>
</table>

Example of Interoperability Matrix

<table>
<thead>
<tr>
<th>Project Name: XXXXX</th>
<th>Autodesk Civil 3D</th>
<th>Autodesk 3ds Max</th>
<th>Tekla Structures</th>
<th>Dassault Systèmes - SolidWorks</th>
<th>Simulia - Abaqus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autodesk Revit MEP</td>
<td>DWG</td>
<td>FBX</td>
<td>IFC</td>
<td>SAT</td>
<td>SAT</td>
</tr>
<tr>
<td>Autodesk AutoCAD</td>
<td>DWG</td>
<td>DWG</td>
<td>DWG</td>
<td>SAT</td>
<td>SAT</td>
</tr>
</tbody>
</table>

Applying Color Filter for Coordination in Revit and Navisworks

Required for any model collaboration is a precise color coded system instantly identifying specific MEP systems. Great coordination starts with establishing a color standard for all systems that is universal in the company. Once the color system has been established per system creation of work sets, project parameters, share parameters, color filters and view templates can be established inside Revit MEP Model.
Step 1: Create worksets with universal naming convention for the entire project. Limit the amount of worksets and only add as needed.

Step 2: Create custom system family names i.e. pipe types, cable trays, conduit, and electrical equipment.
Step 3: Create shared parameter for the custom families, so later the data can be extracted for filtering and scheduling purposes.

![Edit Shared Parameters](image1)

Step 4: Create project parameter for custom families you want to create custom parameters on project level. Please refer to nomenclature procedure later in the handouts for detailed step by step creation of custom parameters.

![Project Parameters](image2)
Step 5: Create a view template for coordination 3D views that can be used for collaboration and exporting to Autodesk Navisworks Manage.

**Tips: Only 3D views shall be exported to Autodesk Navisworks Manage for coordination.**

Step 6: Create MEP color filters that has been established, this creates organization and simplicity within the model between trades.

Step 7: Create custom system schedule for organization of all trades within the MEP Model.
Step 8: Create materials to assign to the system families per trade using shared parameter.

**Tips:** When exporting 3D views, you should know the view filters in Revit cannot be transferred to Autodesk Navisworks Manage, that feature is for coordination inside of Revit only.

Step 9: Click the add-in Navisworks export tab and check the settings. Make sure all settings are suitable based on the project’s standards.
Tips: make sure the units in Revit MEP match the units in Autodesk Navisworks Manage for proper scale and accuracy.

Step 10: Open the Navisworks file make sure that color scheme and data transfer from Revit MEP Model to Navisworks.

Revit DB Link and Access Database for Life Cycle Facility Management

The following document describes the procedure of using Revit DB Link (Add-Ins utility) to update information between Revit model and external database (Access) as well as project parameters, shared parameters, and tagging process.

Setting up Revit DB Link and Access database

Click Add-Ins tab>External tools drop-down>Revit DB Link:
The Link Revit Model with Database dialog displays.

![Link Revit Model with Database dialog](image)

On the Link Revit Model with Database dialog, select ODBC.

Click [Select a new connection] to create a new connection for the first time (second time can select a recently used connection showing on the 2nd row).

Once you clicked [Select a new connection] and Export button, the Select Data Source dialog displays.

Select the New button and choose Microsoft Access Driver (*.mdb, *.accdb) in Create New Data Source window.

![Create New Data Source dialog](image)

After you have selected the Access driver, select Next and then click on the Browse button and navigate to the location where you want the DSN file to reside. After naming the file select Save and then Next to create the DSN file.
The next dialogue box confirms the creation of the DSN file with its location and database definition.

Clicking on the **Finish** button will bring up the ODBC Microsoft Access Setup box where we will select **Create** to create the Access Database file and determine its location.
There are 3 steps in the ODBC Microsoft Access Setup:

Step 1: Click the Create button
Step 2: Type a new database name
Step 3: Click OK when receiving this confirm message

Click OK again in this ODBC Microsoft Access Setup dialogue box. (* sometime it won’t work due to the lack of admin permission issue).

After that, it will come back to the Select Data Source dialogue box. From here you will browse to the location of the DSN file you just created. Highlight the file and after you select OK twice the Export process begins.
Document (get a screenshot) all error messages during the process and click **Close** to continue. Those numbers under Error Rows indicate the element ID of Revit families which are not compatible with Access database. Modify your Revit families if needed.

You can now edit the data in the Access file and re-import it into your Revit model to update project parameters. Run Revit DB Link from the Add-ins pull down and select the database you just exported from the list in the dialogue box. Click on **Edit and Import** and the import process will begin.

Before the database file is imported you are given the opportunity to further edit the database file using the **Edit Data Before Import** dialogue box. If no edits are being made at this point you select OK to finish the import process. Once the import is complete DB Link generates a report highlighting the
changes made to the project parameters. The connection between Revit and Access database is bi-directional.

Shared Parameters for Revit (Family level)

First of all, we need to decide which objects/Revit families (e.g. Mechanical equipment) need to be identified. In Revit Family Types, we need to assign all required parameters from the shared parameters text file. The process is for the convenience and standardization purposes.
Shared Parameters for Revit (project level)

Once we finished adding parameters to Family Types at Revit family level, we can move to project settings.

This step is to transfer the same parameters from Shared Parameter to the specific project model, and we only need to do it once.

Click Manage tab>Project Parameters:

**Step 1:** From Project Parameters dialogue box, add the parameter properties and select Shared Parameter option.

**Step 2:** Browse the shared parameter file from the project server.

**Step 3 & 4:** Select “Identity Data” parameter group from the drop-down menu and pick those 10 required parameters from the list.

**Step 5:** Make sure the group parameter is under Identity data.

**Step 6:** Select appropriate categories (e.g. Mechanical Equipment, Electrical Equipment) to carry those information to Access database.
Below is the example of Access database showing those 10 required parameters after exporting from Revit via DB Link.

All “instance” data should be input in the project model>Properties>Identity Data (e.g. standard code, basic designation) because the same equipment may have different codes based on its location.
Shared Parameters for Revit (tag level)

Similar concept as we associated with the shared parameters at Revit family level and project level, we also need to apply it in the tag family. For example, we may use the generic tag family template from Annotation family template folder as a starter. Then create a label for the annotation symbol.

In the Edit Label dialogue box, we need to associate two parameters (Standard Code & Basic Designation) from the shared parameters.
Below is the example of nomenclature tagging with the standard code on the top line and basic designation on the bottom line:
Shared Parameters for Revit (schedule level)

The same concept we need to apply to the schedule in order to see the required parameters from the available fields. Because the nomenclature parameters (e.g. Standard Code & Basic Designation) are not Out-of-Box content from Revit, we need to associate the data that we have built in from the shared parameters in Globalscape server.

![Screenshot of Revit's Parameter Properties window]

Based on the screenshot above, the Step 3 is selecting the parameter data from the appropriate group and parameters:
Example of nomenclature schedule:

<table>
<thead>
<tr>
<th>Element ID</th>
<th>Standard Code</th>
<th>Basic Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR86-AU97</td>
<td>#A3.03040+R106.0F10CM201</td>
<td>FFT-002</td>
<td>FOAM TANK</td>
</tr>
</tbody>
</table>

**Nomenclature Data between Revit & Navisworks**

The Element ID will remain the same among Revit, Access and Navisworks. This is a new finding for life cycle facility management inside of Navisworks.
Clash Detections

There are some tips for running clash detections in Autodesk Navisworks Manage on large projects:

- Task-oriented clash review
- Break down the model by systems or building units (i.e. color-coded by trade)
- Setup rules, sets, and tolerance based on the clash reviewing purpose
- Utilize the Element ID to find in Revit
- Utilize the “SwitchBack” feature in 2012 version between Navisworks and Revit
- Setup weekly BIM coordination meetings to review those interferences
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Mechanical Pipe vs. Electrical Duct Bank