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Maximizing Interoperability with Analytical Programs and Revit® Structure

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SE310-2 This class will highlight the time savings you'll experience when you create models in Revit Structure and design them with third-party analytical software. We'll focus on maximizing Revit Structure's analytical capabilities. The interoperability does not end at the engineer's desk. Sharing the BIM with the steel fabricator simplifies the construction documents and shop drawing process. Upon completion of the project, we will link the SDS/2 model for coordination. This class will also include a demonstration on how to complete construction documents (plans and sections), interference with multiple disciplines, and utilize AutoCAD for balance of the documents.

About the Speaker:

Jim is a registered structural engineer, and an associate with Harley Ellis Devereaux, a nationwide A/E firm based in Detroit, Michigan. He was part of the team that implemented Revit Structure, Revit Building, and Revit Systems in the firm. Focusing primarily on health care facilities, he also has experience with the industrial, civic, education, and automotive industries. Jim graduated from Michigan Technological University in 1995.
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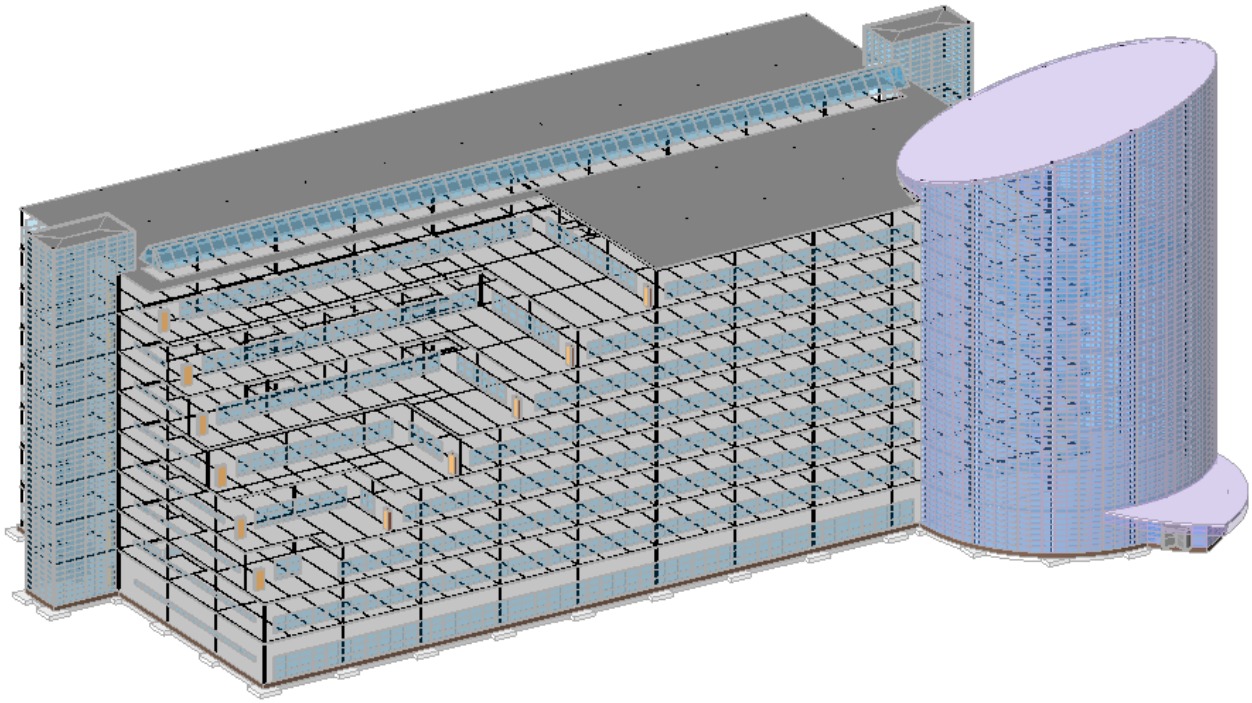

Welcome

This course was developed using our experience from working in a 500 person Architectural/Engineering company. Our projects range form 1 to 100 million dollars in construction costs. Working in a large environment; we are sensitive to working with multi-disciplines, multi-offices, and consultants. Our approach is flexible, fluid and the best fit for our firm. In Revit® Structure, as in engineering, there is more than one way to solve a problem. Harley Ellis Devereaux utilize the KISS method.

Course Objectives and Goals

- Frame work for work flow process
- Two model approach (KISS Method)
- Model structural elements in Revit® Structure
- Analytical vs. Non-analytical elements
- External analytical programs
- Create construction documents
- Embrace change

Work Flow Process

It is important to identify the work environment for each project. Every project is unique and should be treated as such.

Identifying the framework of project set up at the beginning of the project and determining the ground work of responsibility up front, allows the team to model elements only once.

Architectural Responsibilities (what the architect controls)

- Levels
- Grids
- Slab on grade
- Slab Pits and depressions
- Edge of deck (elevated floor openings, roof openings)
- Roof slope

Establish Boundaries of Structural Modeling

- Foundations
    - Grade beams
    - Spread footings/Drilled piers/Piles
    - Stepped foundations
- Super-structure
    - Gravity elements
        - Columns
        - Beams and girders
    - Lateral Elements
        - Moment frames
        - Bracing
        - Shear walls

- Lateral resistance members
- Miscellaneous steel
    - Exterior wall framing
        - Brick frames
        - Kickers (very important)
        - Punched window “goal posts” framing

AutoCAD Balance

- Typical detail sheets
- General notes

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Two Model Concept

- Invoke the KISS methodology when using the 2 model concept. The two model concept is not a replacement for work sets, but a safeguard when using third party analytical software to design your structure. One minor oversight of analytical verses non-analytical could result in a corrupt analytical model.
- We strategically break our buildings into two models. The first model contains all the analytical beams and columns. We determine the analytical elements based on our analytical software's capabilities.
- The second model contains the foundations, miscellaneous steel, and the remainder of the non-analytical structural elements.
- The main drawback to our approach is that we plot from two models. Currently there are no provisions in Revit® Structure to tag a linked file.

Typical Analytical Structural Elements

- Columns
- Beams

Typical Non-analytical Elements

- Foundations
- Miscellaneous steel
- Dog houses
- Curved beams
- Canopies
- Unique architectural features
- Brick frames/other exterior wall supports
- Anything that exceeds the analytical software capabilities

File Set-Up Process

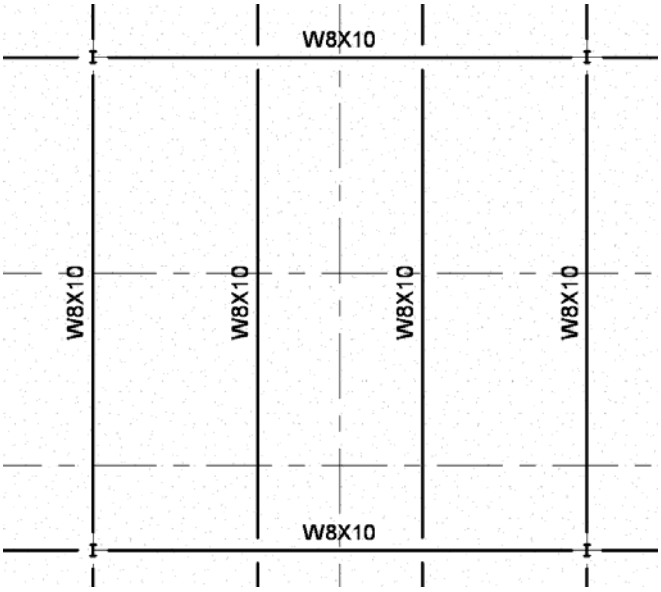
When staring a model, it is important to set up the Revit® Structure model to align with the Architectural Model. Ensuring the models are in the same location allows for other disciplines to link the Revit® Structure model without repositioning. Again, there are multiple ways to set up models, below is our best practice.

1. Go to: File/Import Link/Revit
2. Path to Architectural base file.
    a. Select Automatically place
    b. Select Center to center
3. Go to: Tools/Shared Coordinates/Acquire
4. Save the file
5. Adjust Visibility Graphics to your preference
6. Copy/Monitor
    a. Grids
    b. Levels
7. Create floor plans
    a. Select the Floor Plan tab in the View browser
    b. Select all levels that plans are desired
        i. Be sure to check the "Do not duplicate existing views"

Analytical Modeling Process

Now that the model is set up, and the analytical items to be modeled have been determined, we can get started. A trick we use when setting up our initial models is to model only W8x10 beams and columns. There are two reasons: #1 is speed of modeling, and #2 is that a W8x10 is obvious on the plans and schedules since we typical use a W10 as our minimum beam and column size for fit up considerations. A visual back check allows the engineer to verify sizes that have transferred properly from the analytical programs.

- KISS philosophy – Part 1
- Model W8X10 analytical columns
  - Model floor to floor
  - Utilize graphical offsets
- Model actual or predicted non-analytical columns
  - The modeling of non-analytical columns is required to populate the column schedule.
- Model W8X10 beams, girders and beam systems.
  - Model only analytical framing members
- Model cantilevers
- Model lateral members
- Copy floor information to adjacent floors
  - Modify framing and columns as required
  - Time saving time, adjust tags on framing plan prior to copying



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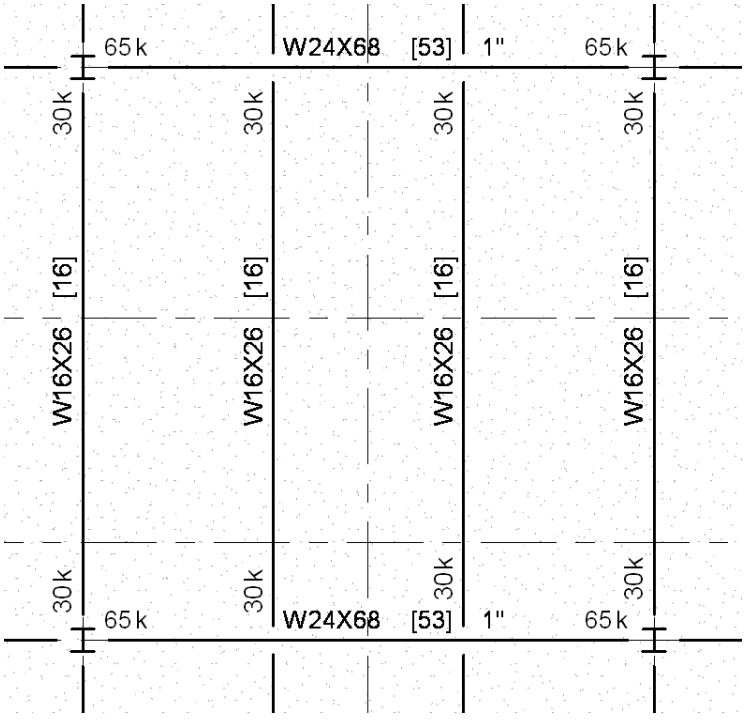
Export Analytical Model to Analytical Program

There are multiple analytical programs that are compatible with Revit® Structure, referred to as partners. Our experience is with Ram Structural Systems; however Robobat, Adapt, RISA, CSC, CSI, Oasys GSA, SofiSTik and Softek are also examples of analytical partners.

- Every analytical partner has limitations
- We manage 100% of our loads external to Revit® Structure
- Information on product compatibility is generally posted on the web
- Do not hesitate to impose your own fail safe modeling techniques (KISS)
- Do not work in the Revit® Structure Analytical model after the information has been imported from the analytical program

Verify Information Transfer (Analytical to Revit® Structure)

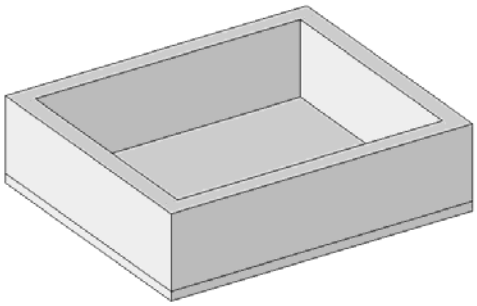
- Verify member sizes
- Verify the beam specific information (camber, studs, and reactions)
- Transfer of lateral member information has some limitations

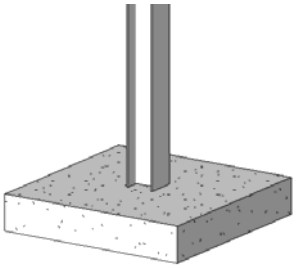


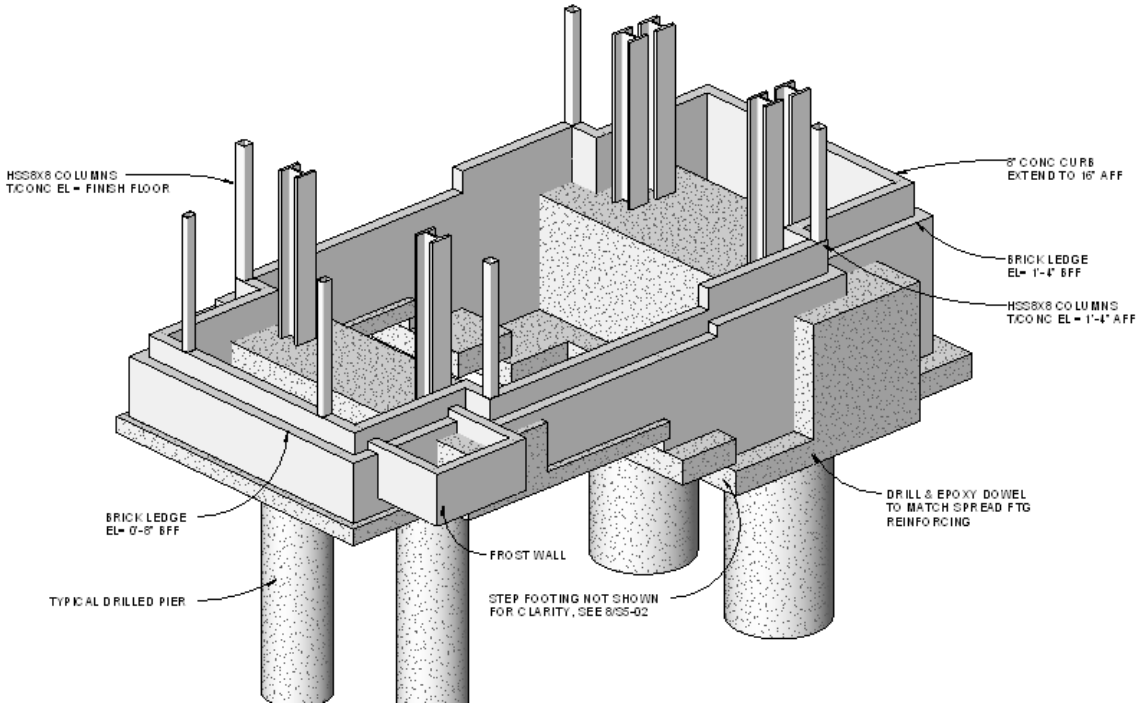
Non-Analytical Model Process

Now that the super-structure model is up and running, the next step is to model all of the non-analytical information.

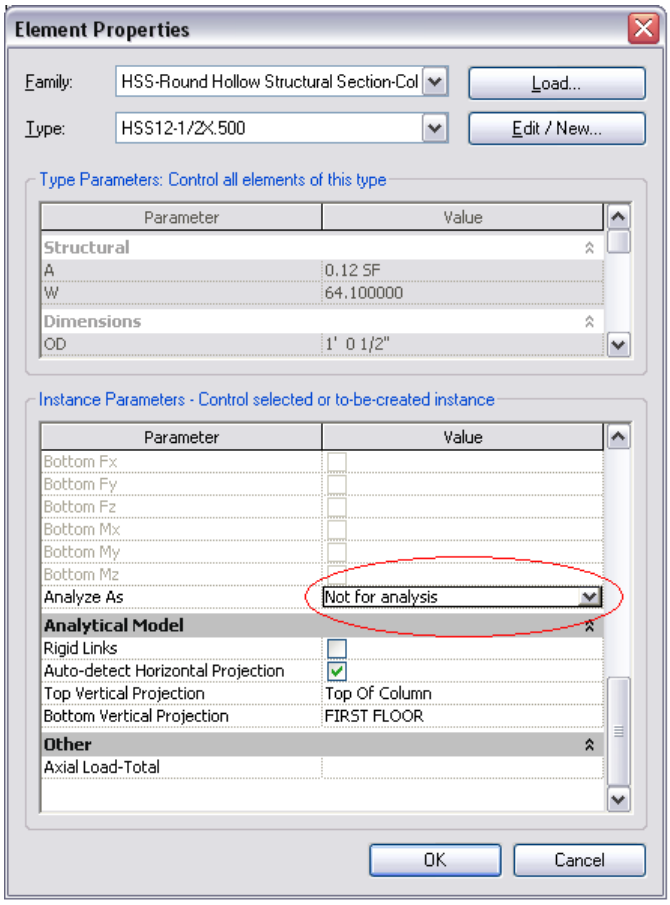
- KISS philosophy – Part 2
- Foundations
    - Spread footings
    - Column Piers
    - Pilasters
    - Elevator pits







- Above and below grade walls
- Miscellaneous steel
    - Brick frames
    - Kickers
- Elevator guide rails
- Curved beams



Link-in Other Discipline Information

- MEP Model
- AutoCAD files

Construction Documentation

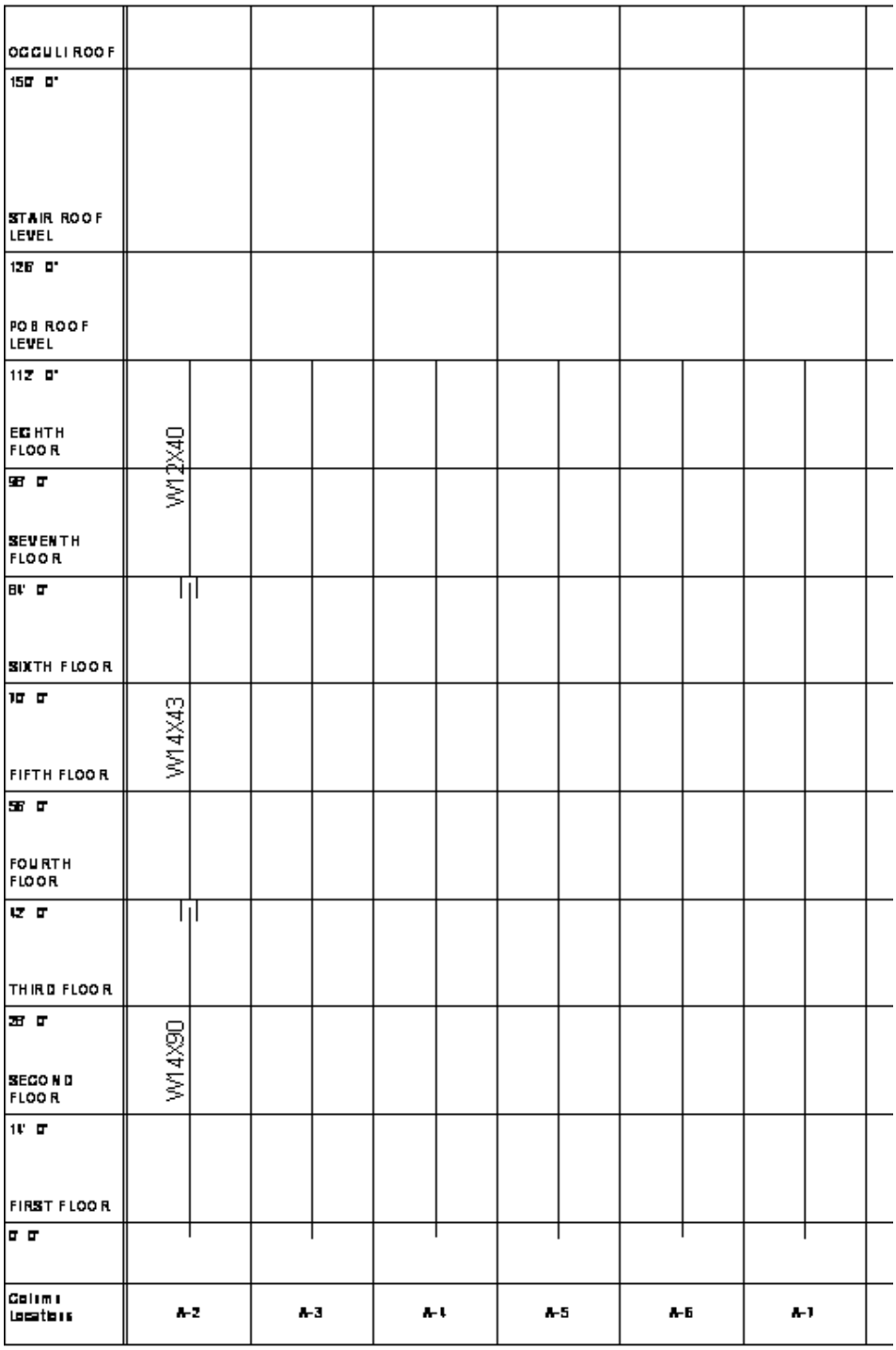
The models are now ready and engineered. The next step is to produce our construction documents.

- Foundation base plan
    - Tag desired elements
    - Create foundation schedule
    - Create sections

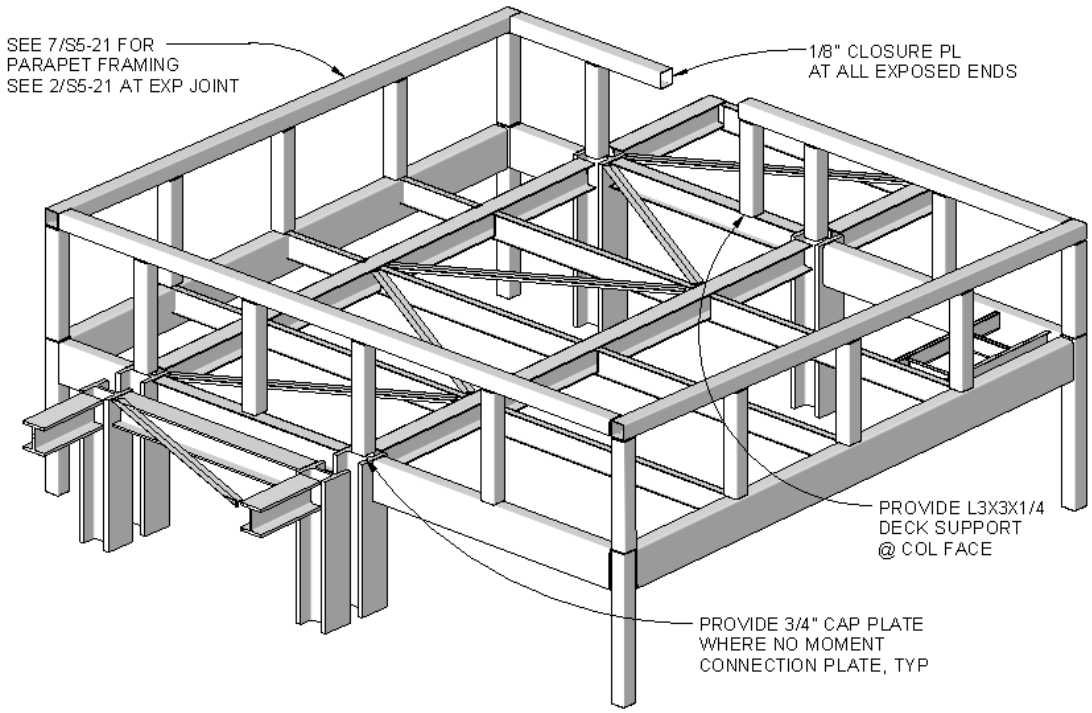
Structural Foundation Schedule		
Type	Reinforcing	Comments
8'-0" X 8'-0" X 18"	(8) - #8 EW	
8'-0" X 8'-0" X 36"	(8) - #8 EW T&B	
9'-0" X 9'-0" X 18"	(9) - #8 EW	
11'-0" X 8'-0" X 18"	#8 @ 12" OC EW	SEE PLAN FOR ORIENTATION

- Elevated floor base plans
    - Tag floor beams
    - Place additional tags for shear and moment values
    - Cut sections

- Create column schedules



- Place legends
- Create plot drawings
    - Foundation
    - Framing
- Create detail drawings



West Pier Parapet Framing

SCALE:

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Immediate Benefits of a BIM Model

- Share model with fabricators (works well with paperless shop drawing review)
- Owners use
- Archiving

Next Steps

- Constant innovation
- Embrace change
- Remain flexible and open to new ideas
- Maintain a living document of procedures, “change is good”
- House 100% of the information in the Revit® Structure model (loads, typical details, etc.)