Building Information Modeling (BIM) Requirements for PT Projects – Today’s Capabilities for a BIM-based Design

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What is BIM?

The ability to model project information in a computer interpretable manner that can be used to support various collaboration, simulation, and documentation processes.

Key components of BIM data include:
- Explicit typology (what is it?)
- 3D location (where is it?)
- Context specific attributes (what are its details?)
BIM to Streamline Production

2D CAD → 3D Analysis Model → Coordinated Revit Model

3D Analysis Model with Tendons → Revit Model with Tendons → Structural/Shop Drawings
BIM to Support Coordination

- Design integration
- Digital 3D clash detection
- Cloud-based collaboration

Central ‘Neutral’ Project Model

Architect
Structural Engineer
MEP
Contractor
Downstream Benefits of BIM

Submittal of electronic record of as-built-structure to support facility operation and maintenance

Design Team

Coordinated BIM Model

Digital Laser Scan of Construction Site

Integrated BIM Model Across Disciplines
Available BIM Tools

3D modeling platforms
• Revit
• Tekla
• ArchiCAD
• Microstation
• Vectorworks
• Catia

3D BIM viewers for collaboration
• Navisworks
Available BIM Tools

Database platforms
• Bentley Structural Synchronizer

Cloud-based platforms (geometry focused)
• Autodesk BIM 360 Glue

Cloud-based platforms (document and workflow)
• Newforma
Available BIM Tools

**Structural analysis software**
- Various products import/export model info from above tools
  - Geometry
  - Rebar
  - Tendons
  - Loading
  - Reactions
  - Design criteria
Main Challenge for PT Industry

None of the 3D modeling platforms support a native tendon object!

What are your options?
• Use ‘dumb’ 3D geometry objects
• Create custom families

What’s the downside?
• No commercially available integration
Case Study: 3D Clash Detection using Navisworks
MEP / PT Site Coordination
MEP / PT Site Coordination
Traditional Resolution Approach
Traditional Resolution Approach
Traditional Resolution Approach
Navisworks Model of Slab

Contractor first tried to create tendons using manual modeling process – was not cost effective and could not keep up with changes
Created 3D Tendon Models using Design Software

Used traditionally generated PT shop drawings as basis of modeling.
Created 3D Tendon Models using Design Software

Used traditionally generated PT shop drawings as basis of modeling.
Tendon Layout in Plan

Elong=11.34  #45S=6
Elong=11.34  #44S=5
Elong=11.34  #43S=5
Elong=11.34  #42S=5
3D Model of Tendons Exported from Design Software
Observations

• Recreating 3D tendon models from PT shop drawings was fast – 4 hours total
• Had to go through Revit to transfer information to Navisworks
• Contractor not willing to pay for additional modeling
Case Study: 3D Shop Drawings using Tekla
Tendons Modeled in Tekla

One of our Finnish clients models 3D tendons in Tekla using their own custom objects.
Tendons Modeled in Tekla

Tendon information is imported using their own Macro that reads ADAPT tendon database.
Automatically Generate 3D Shop Drawings from Tekla Model
Automatically Generate 3D Shop Drawings from Tekla Model
Observations

• Company needs to develop and maintain own integration software
• Tendons modeled in Tekla using “rebar” segments
• Link between design software and Tekla not dynamic
• Company added additional “placement logic” to their integration software to enable production of realistic tendon layouts
Case Study: Tendon Models in Revit using Custom Families

3D Tendons Modeled in ADAPT-Builder
Automated Tendon Modeling in Revit

Synchronized Revit model of floor system modeled in ADAPT
Tendon Data is Extracted from Design Software

Custom Revit Plugin developed in collaboration with BIM Solutions Centre

Reads directly the transfer file from Adapt
Tendon Data is Extracted from Design Software

Compile the Tendons Info in a Revit Friendly Format
Tendon Data is Extracted from Design Software

3D Tendons imported as object into Revit
Observations

- To produce usable 2D structural drawings need added representation views of tendon objects in Revit
- Imported information is usable for 3D clash detection
Case Study: Automated Generation of PT Shop Drawings

Post-tensioning shop drawing created from design software
Observations

• Used widely for bonded market where tendons are supported at specified distances
• Need additional information for US market
  • Options for different support types
  • Support accessory list
  • Support backup bars
  • Ability to specify pour boundary and adjust tendons
Concluding Remarks

BIM can take on many different forms and ultimately help your business improve quality, coordination and efficiency.

With regards to tendons, until the main BIM modeling platforms develop native tendon objects, you will have to build your own families or rely on those provided by third parties.