Precast / Prestressed Concrete Trade Coordination Case Study

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Case Study Overview

• Explore BIM requirements of a prominent structure in the Colorado Market
• Review significance of the trade coordination details
• Review the construction limitations of BIM in dealing with the reality of materials
Project Definition

• Collegiate Level Athletic Facility, Division I, Mountain West Conference
• 41,000 Seats
• 220.1 Million
• Precast Stadia, CIP Stadia
• Upper Bowl - Steel Superstructure – Columns and Rakers
• Lower Bowl – CIP Walls, CIP Columns, and Precast Rakers
Contractor / Subcontractor Responsibilities

- Cast In Place
  - GC – Self Perform

- Structural Steel
  - Steel Erector
    - Steel Supplier
    - Steel Detailer

- Prestressed/Precast Concrete
  - Precast Supplier
    - Precast Detailer
    - Precast Erector

- MEP
  - MEP Designer / Detailer
  - MEP Supplier / Installer

- Handrail
  - Steel Detailer
    - Steel Supplier
    - Steel Installer
# BIM Execution Plan (BxP)

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BxP

• Deliverables from the Design Team may consist of a combination of 2D representations of the 3D model (extracted directly from the 3D model) and information that exists in 2D only, some of which may be Contract Documents and some of which may not. While every effort will be made to ensure that the 2D information and 3D information are properly coordinated, the project team understands that in the case of any discrepancies between the Contract Documents and the 3D model, the Contract Documents shall govern
BxP

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1.8 DISCREPANCIES BETWEEN THE BIM EXECUTION PLAN AND THE EXHIBIT G

1.8.1 In the event there is any conflict between the terms of this document and the Exhibit G, the terms of the Exhibit G shall control.
# Appendix C

## BIM Project Goals Worksheet

<table>
<thead>
<tr>
<th>Priority (1-3)</th>
<th>Goal Description</th>
<th>Value added objectives</th>
<th>Potential BIM Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Better communication of design intent with client, consultants and constructors</td>
<td>Design Reviews</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Higher level of building systems coordination throughout design and construction</td>
<td>Design Review, 3D Coordination</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Higher level of constructability analysis throughout design and construction</td>
<td>Design Review, 3D Coordination</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Increase effectiveness of Design. Higher level of understanding for improved aesthetics, quality of detail and building system design.</td>
<td>Design Authoring, Design Reviews, 3D Coordination, Engineering Analysis</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Reduce redundant modeling/drawing effort. Design model &gt; Fabrication &gt; Construction</td>
<td>Design Authoring</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Program confirmation</td>
<td>Programming, Design Authoring</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ADA/Code Compliance verification</td>
<td>Code Validation</td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Task Description</td>
<td>Associated Tools</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>ADA/Code Compliance verification</td>
<td>Code Validation</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Improve Construction Productivity through improved work planning and pre-fabrication</td>
<td>4D, Digital Fabrication</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Reduce project cost by reducing change orders and project rework and shortening schedule duration</td>
<td>4D, Site Utilization, 3D Coordination</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Accurate record model for post construction use. (Facilities management, future remodels.)</td>
<td>Space Management and Tracking, Asset Management, Record Modeling</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Reduce Re-Work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Reduce RFI response time latency</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Clash Detection Workflow
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Exhibit G - VDC Requirements / Highlights

• Model LOD Requirements
• Model Sharing, Coordination, Acceptance Criteria
• Acceptance of Accuracy and Synchronization between 3D and 2D Drawing Shop Drawings
• Models are possibly more accurate, contain more detail over contract documents
• Wireframe, Surface and Point Cloud models are not acceptable
Specific VDC Details on Penetrations

• “It is the intent of the project team that all penetrations through precast structures shall be coordinated prior to fabrication. Any costs associated with penetrations for this Subcontractor’s Work that are not successfully identified and coordinated prior to the fabrication and placing of the relevant Precast shall be the responsibility of this Subcontractor. Costs include, but are not limited to, refabrication, core drilling, x-raying, additional external reinforcing of the structure in question, clean-up, etc.”
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LOD Table

![LOD Table Image]
LOD Table

Construction Phase...
## LOD Table

**Structure Components / Trades / Activities**

<table>
<thead>
<tr>
<th>LOD</th>
<th>Component</th>
<th>Description</th>
<th>Requirement</th>
<th>Detailing</th>
<th>Coordination</th>
<th>Documentation</th>
<th>Construction</th>
<th>Operations</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Foundation</td>
<td>Footing</td>
<td>100%</td>
<td>90%</td>
<td>80%</td>
<td>50%</td>
<td>30%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>Frame</td>
<td>Beam</td>
<td>100%</td>
<td>90%</td>
<td>80%</td>
<td>50%</td>
<td>30%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>3</td>
<td>Cladding</td>
<td>Insulation</td>
<td>100%</td>
<td>90%</td>
<td>80%</td>
<td>50%</td>
<td>30%</td>
<td>20%</td>
<td>10%</td>
</tr>
</tbody>
</table>

*Note: LOD stands for Level of Development. LOD matrices are used to determine the level of detail required for different components of a building project.*
## LOD Table

<table>
<thead>
<tr>
<th>Specification</th>
<th>LOD Description</th>
<th>LOD 1</th>
<th>LOD 2</th>
<th>LOD 3</th>
<th>LOD 4</th>
<th>LOD 5</th>
<th>LOD 6</th>
<th>LOD 7</th>
<th>LOD 8</th>
<th>LOD 9</th>
<th>LOD 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Specified LOD

- LOD Description
- LOD 1
- LOD 2
- LOD 3
- LOD 4
- LOD 5
- LOD 6
- LOD 7
- LOD 8
- LOD 9
- LOD 10

---

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## LOD Table

Bid Phase / Bid pack

### 2D / LOD 100
# LOD Table

<table>
<thead>
<tr>
<th>Construction Document Drawing Phases</th>
<th>LOD 150</th>
<th>LOD 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>50% DD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% DD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50% SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100% SD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LOD → LOD

150 200
## LOD Table

### Issues For Construction (IFC) Drawing Phases

<table>
<thead>
<tr>
<th>LOD → LOD</th>
<th>300</th>
<th>350</th>
</tr>
</thead>
</table>

---

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## LOD Table

Bid Packet At Construction Phase

<table>
<thead>
<tr>
<th>LOD</th>
<th>Description</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Phase 5</th>
<th>Phase 6</th>
<th>Phase 7</th>
<th>Phase 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>350</td>
<td>LOD 350</td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

*Note: LOD 350 is highlighted for the Bid Packet at Construction Phase.*
## LOD Table

<table>
<thead>
<tr>
<th>TSO – Transition to Sustainable Coordination</th>
<th>LOD 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post Construction Turn Over Phase</td>
<td></td>
</tr>
</tbody>
</table>
Model Export Groups

- Steel
  - Anchor Bolts
  - Embeds
  - Stairs
  - Structural Steel

- Precast
  - Embeds
  - Walls
  - Rakers
  - Stadia

- File Naming

<table>
<thead>
<tr>
<th>Project</th>
<th>Level</th>
<th>Area</th>
<th>Discipline</th>
<th>Company</th>
<th>Filename</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSU</td>
<td>ALL</td>
<td>ALL</td>
<td>PREC</td>
<td>STC</td>
<td>CSU_ALL_ALL_PREC_STC</td>
</tr>
<tr>
<td>CSU</td>
<td>ALL</td>
<td>ALL</td>
<td>STAIR</td>
<td>LEJ</td>
<td>CSU_ALL_ALL_STAIR_LEJ</td>
</tr>
<tr>
<td>CSU</td>
<td>ALL</td>
<td>ALL</td>
<td>EMB</td>
<td>LEJ</td>
<td>CSU_ALL_ALL_EMB_LEJ</td>
</tr>
<tr>
<td>CSU</td>
<td>ALL</td>
<td>ALL</td>
<td>STL</td>
<td>LEJ</td>
<td>CSU_ALL_ALL_STL_LEJ</td>
</tr>
<tr>
<td>CSU</td>
<td>ALL</td>
<td>ALL</td>
<td>AB</td>
<td>LEJ</td>
<td>CSU_ALL_ALL_AB_LEJ</td>
</tr>
</tbody>
</table>
What content was missing

• Neither the BxP or VDC (Exhibit G) provided definition of the LOD table’s LOD Levels
  • What level of detail was required for LOD 200
  • No Referenced AIA, AGC etc document
Coordination Success

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Handrail Coordination

- Connection Details
- Elevation Details
- Panelization
Handrail Coordination - Connection Details
Handrail Coordination - Critical Elevation Details
Handrail Coordination - Panelization
Steel Coordination

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Steel Coordination
Steel Coordination
Steel Coordination

- EOR Calculates Deflection. Shows Information through RFI Process
- Deflection is not modeled at any LOD level
- Deflection is additive to the In situ Elevation to establish shim height
- This detail does not make a LOD 400 model
BIM can’t solve the silly
Conclusion

• Significant gains in the process can be achieved through BIM
• Additional understanding and modeling is still necessary for advanced topics
  • Camber
  • Deflection
  • Tolerance
• Construction means and methods can influence the outcome of any project
• Contractual language, as complex as it is, still can’t cover all the conditions that may be experienced
• Establish LOD definition at each LOD level
Thank You

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