Building Information Modeling: Understanding its Benefits and Risks

Brent Mauti, IBI Group

Andrea W.K. Lee, Glaholt LLP

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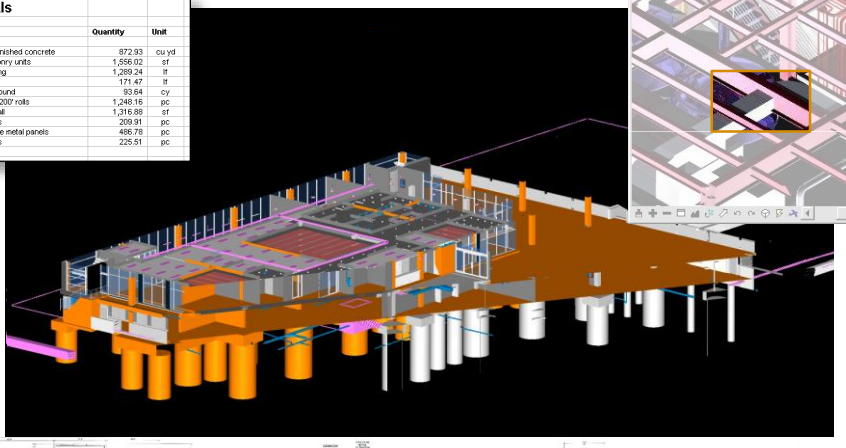
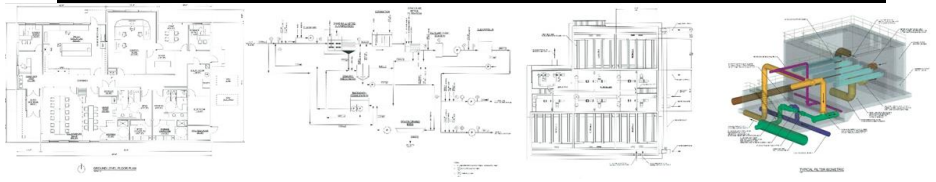
Multidiscipline Intelligent Modeling Example - BUILDING

Combined Model

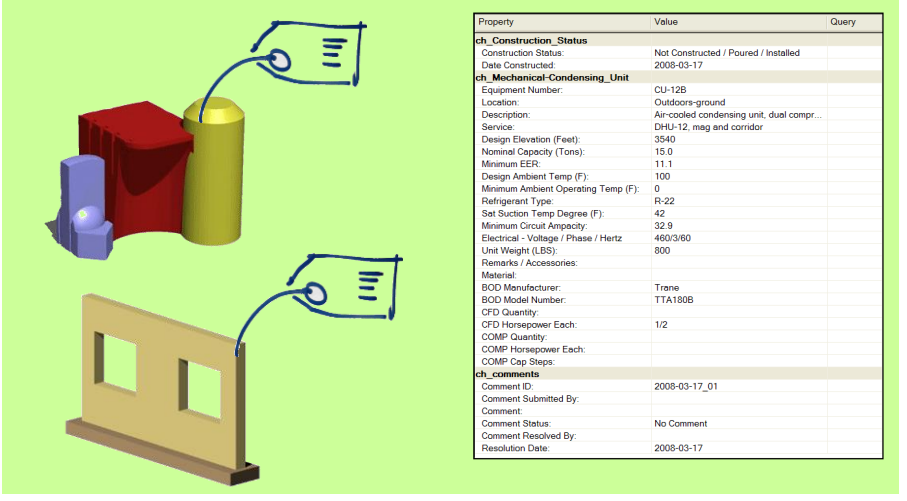
Materials

Description	Quantity	Unit
cast in place finished concrete	972.93	cu yd
concrete masonry units	1,556.02	sf
horiz reinforcing	1,289.24	lf
4" vinyl base	171.47	lf
dry wall compound	93.64	cy
dry wall tape, 200' rolls	1,248.16	pc
gypsum drywall	1,316.88	sf
16 ga mtl studs	209.91	pc
2.5' x 2.5' white metal panels	486.78	pc
16 ga mtl studs	225.51	pc



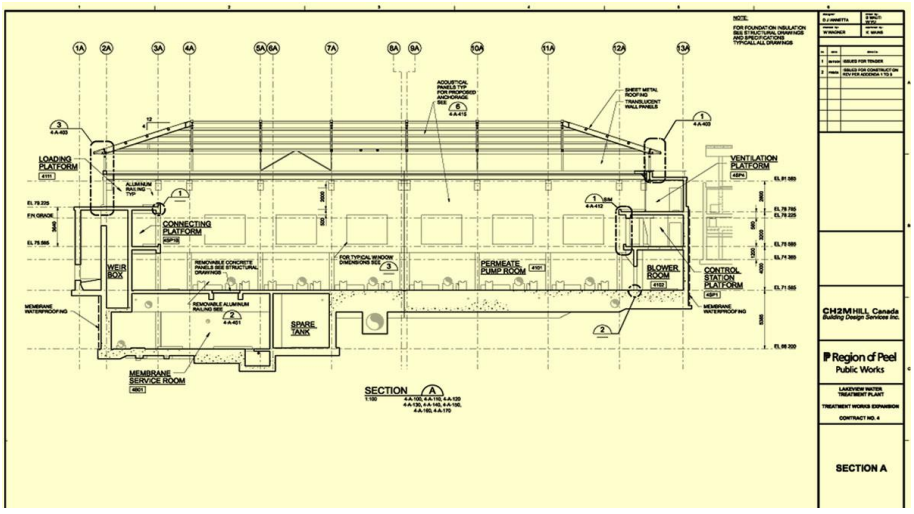


Geometry + Data = BIM



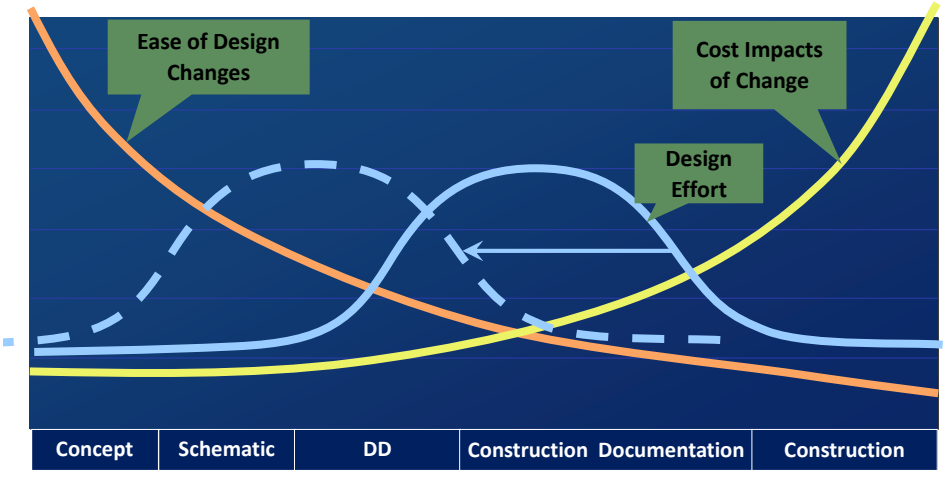
Property	Value	Query
ch_Construction_Status		
Construction Status:	Not Constructed / Poured / Installed	
Date Constructed:	2008-03-17	
ch_Mechanical-Condensing_Unit		
Equipment Number:	CU-12B	
Location:	Outdoors-ground	
Description:	Air-cooled condensing unit, dual compr...	
Service:	DHU-12, mag and corridor	
Design Elevation (Feet):	3540	
Nominal Capacity (Tons):	15.0	
Minimum EER:	11.1	
Design Ambient Temp (F):	100	
Minimum Ambient Operating Temp (F):	0	
Refrigerant Type:	R-22	
Sat Suction Temp Degree (F):	42	
Minimum Circuit Ampacity:	32.9	
Electrical - Voltage / Phase / Hertz	460/3/60	
Unit Weight (LBS):	800	
Remarks / Accessories:		
Material:		
BOD Manufacturer:	Trane	
BOD Model Number:	TTA180B	
CFD Quantity:		
CFD Horsepower Each:	1/2	
COMP Quantity:		
COMP Horsepower Each:		
COMP Cap Steps:		
ch_comments		
Comment ID:	2008-03-17_01	
Comment Submitted By:		
Comment:		
Comment Status:	No Comment	
Comment Resolved By:		
Resolution Date:	2008-03-17	

A Different Mode of Delivery



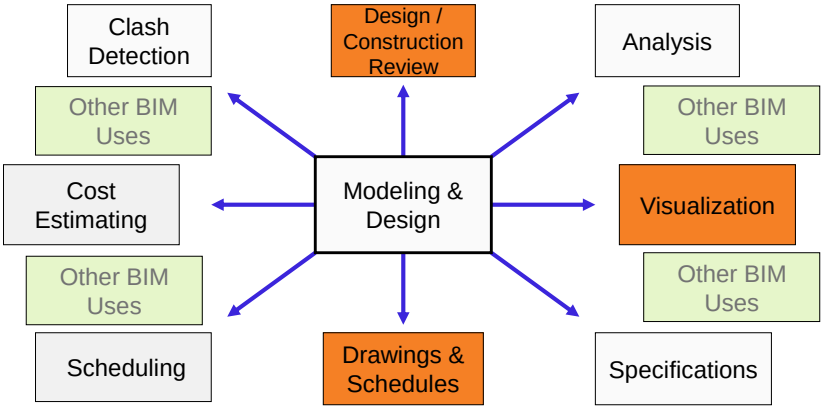
A Different Mode of Delivery

The MacLeamy Curve



BIM Uses Catered For Specific Projects…"The Wheel of BIM"

- "Base" BIM Uses
- "Typical" BIM Uses
- "Custom / Other" BIM Uses



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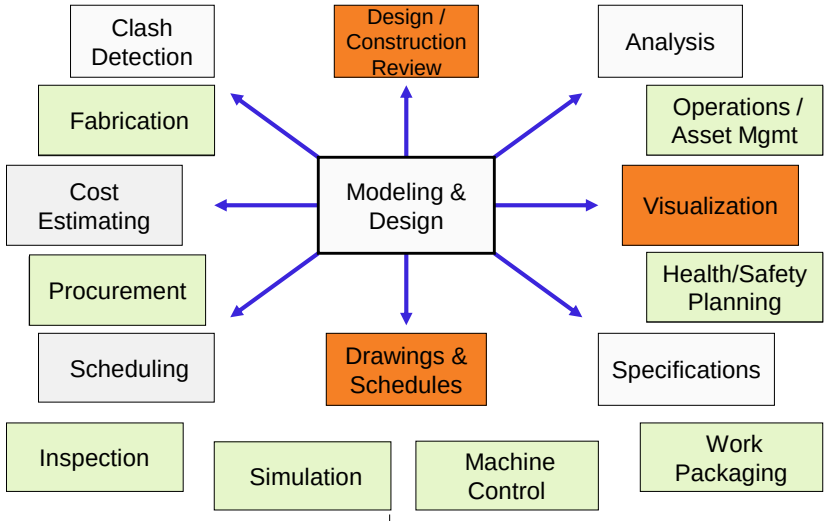
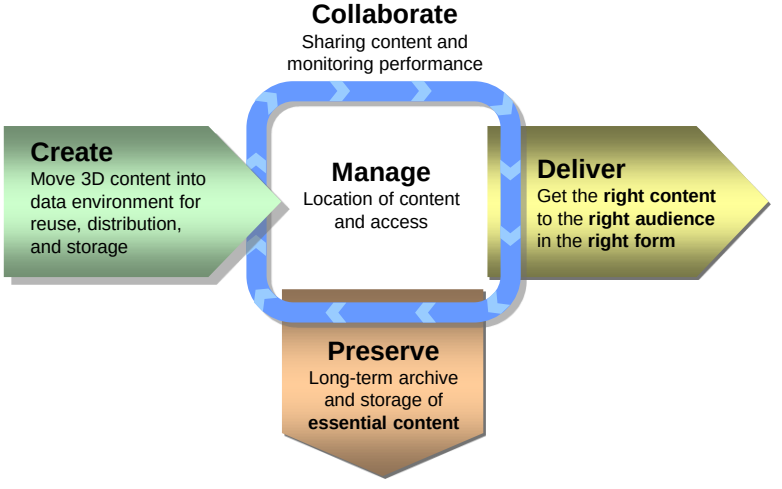
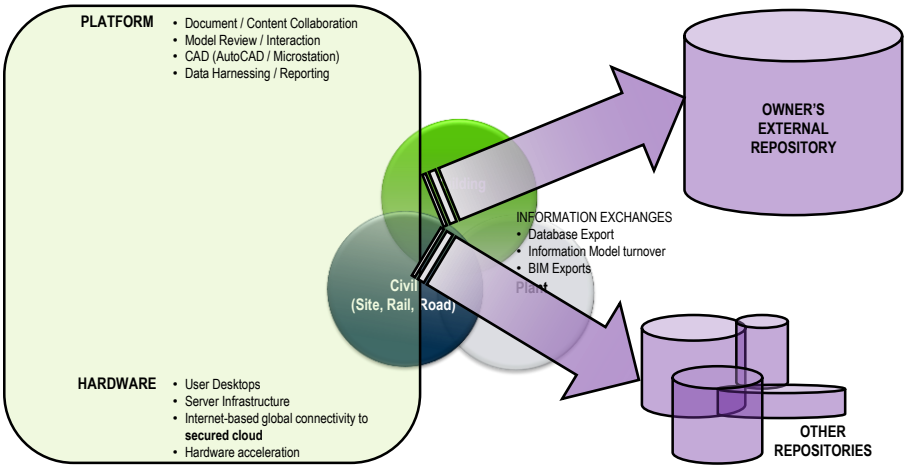


Connectivity

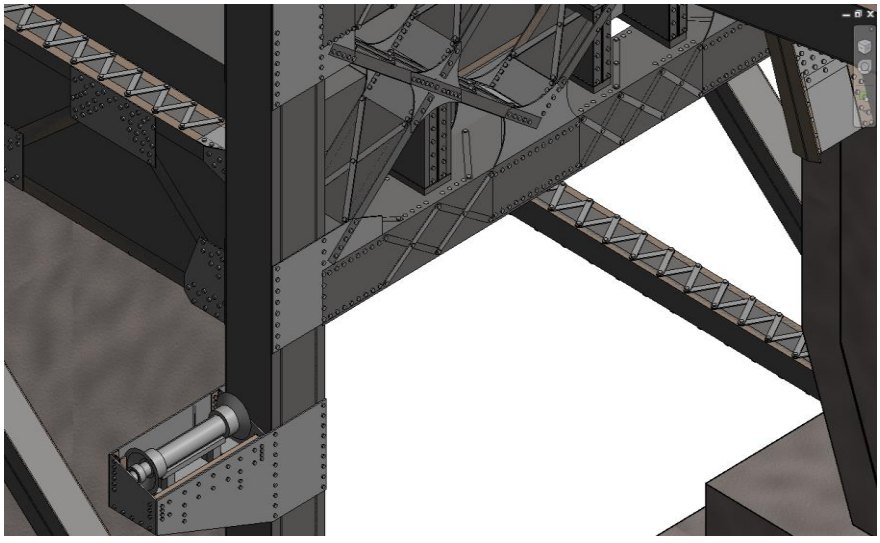


Various Tools Within The Industry

Information Modeling Synergy

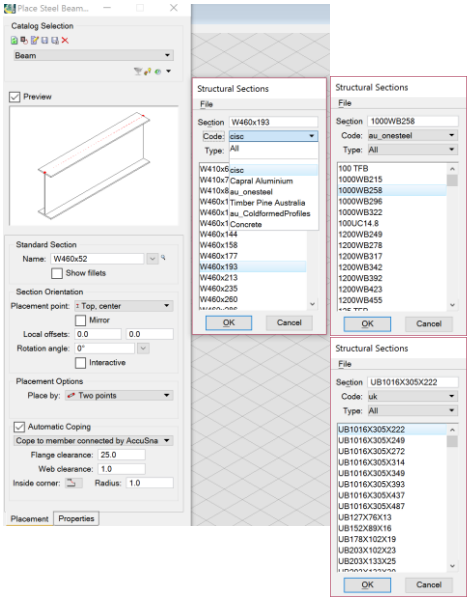


Focus on Steel Structures



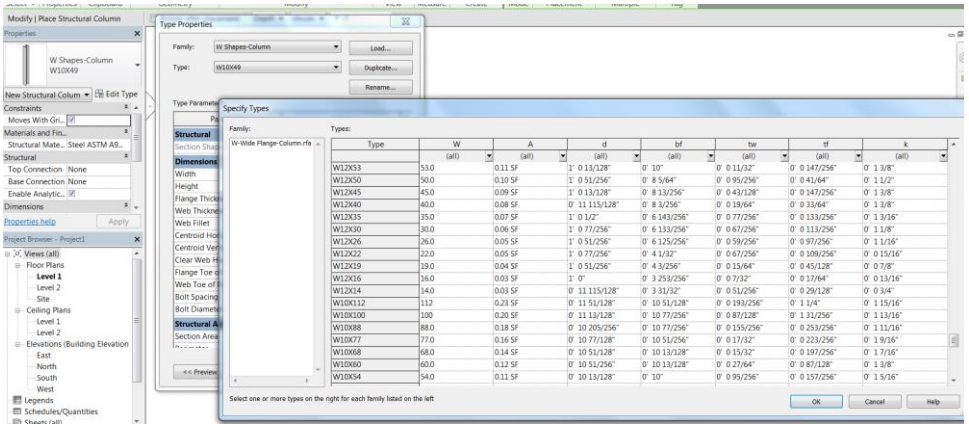
Structural Steel

- In some BIM authoring tools, industry-standard steel sections are built into the software
- User is prompted to select the standard (cisc, UK, Australia, etc.) and then select the respective member size
- This information can then be queried for quantities, schedules, analysis, and possible downstream fabrication



Structural Steel

- In Revit, steel sizes are built into a family allowing the modeler to select the correct members for use within a project

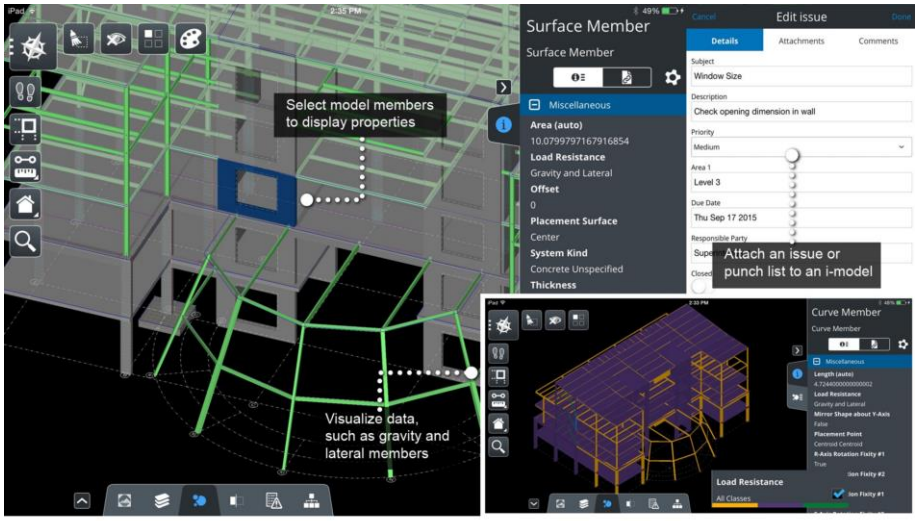


Export Intelligence

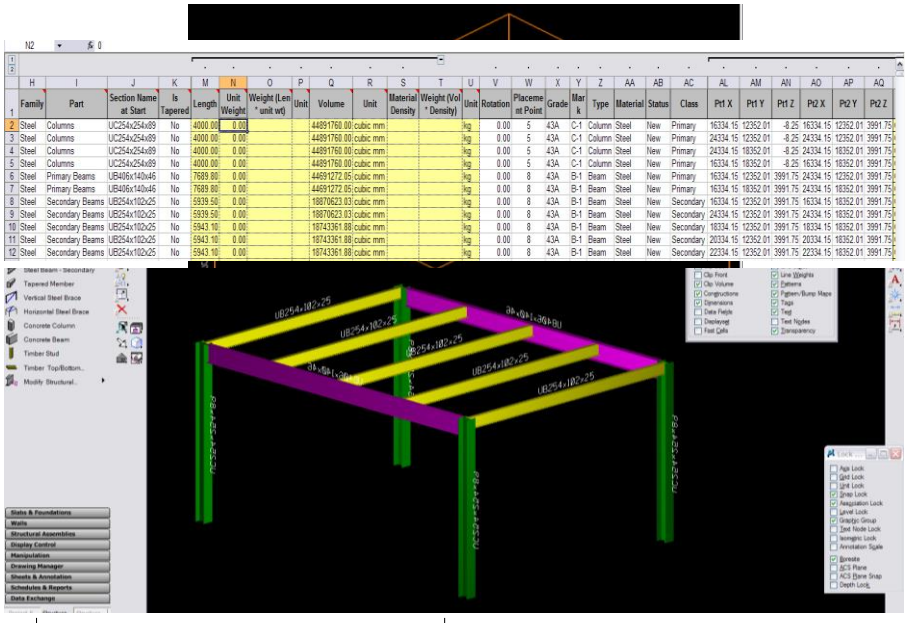
- Metadata assigned to structural components can be exported via various means to analytical programs:
  - CSI/2 (.STP file per ISO 10303-21)
  - SDNF (Steel Detail Neutral File)
  - IFC (Industry Foundation Class)
  - ISM (Integrated Structural Model)
  - Or direct to an analysis program:
    - OasysGSA, STAAD.Pro

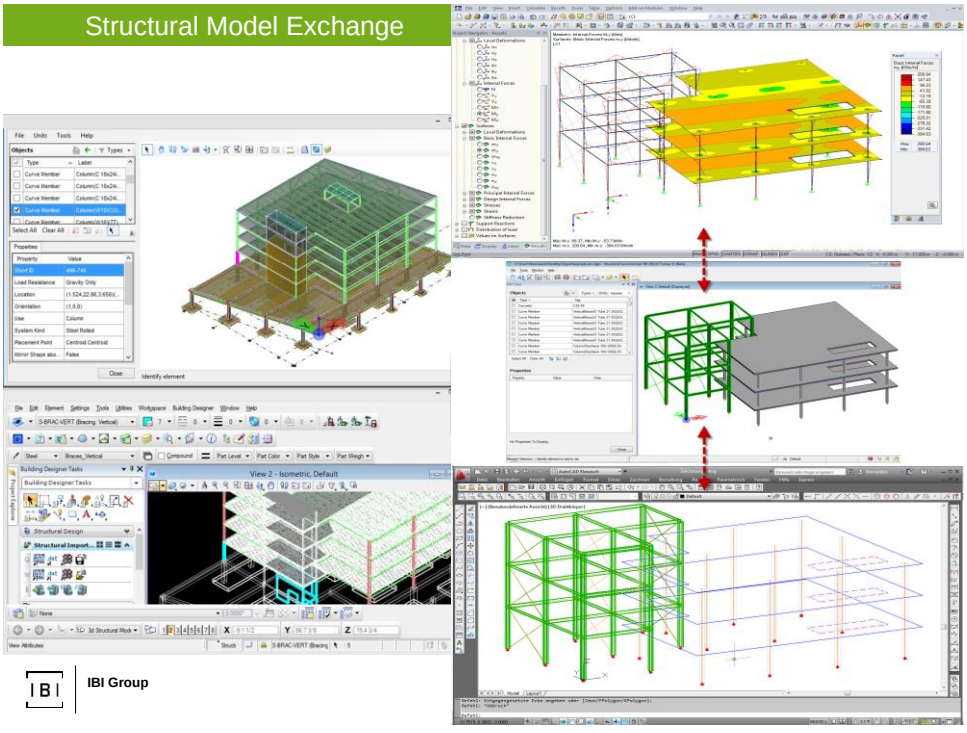
“Single-source” of Information Facilitates Access

- Mobile access to structural component information



Structural Analysis & Quantities





Legal Issues Arising from BIM

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US BIM Standard Form Contracts

- ConsensusDocs 301
- AIA E203

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ConsensusDocs 301

- Used when all essential participants are involved early in the design, procurement, and construction planning process
- Appended to the contracts between the owner and the consultant and between the owner and the contractor.
- Does not purport to replace the underlying relationships between or responsibilities of the parties.
- Does not create contractual relationship between the design professional and the contractor.
- Each party is responsible for any Contribution made by it or by any party for whom it is responsible.

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ConsensusDocs 301

- BIM Execution Plan required
  - The scope and content of each Model must be clearly identified so that Project Participants can be sure on what aspects of the Model they can rely and on what aspects of the Model they cannot rely
  - The parties agree to a set of representations that each contributor will make regarding the dimensional accuracy of their contributions
  - The Execution Plan shall identify the level of reliance that project participants may place on Contributions

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ConsensusDocs 301

- Intellectual property issues
  - Each party warrants that (1) it is the owner of all the copyrights in all of that party's Contributions or (2) it is licensed or authorized by the holder of the copyright to make Contributions
  - Each party grants a limited, nonexclusive license to reproduce/ use that party's Contributions for the purposes of the project only.
  - Owner loses its licence from a Contributor if it does not pay that Contributor.

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AIA E203 (2013)

- Companion documents:
  - AIA Document G201-2013: Project Digital Data Protocol Form
  - AIA Document G202-2013: Project Building Information Modeling Protocol Form
- Project participants must list the different types of digital data that will be used by the parties.
- Architect must manage and maintain centralized electronic document management system implemented by the parties at the project.
- If the parties agree to modify the established Protocols, a party may request an adjustment in the contract sum or contract time.

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AIA E203 (2013)

- Transmitter of digital data warrants to the receiver that the transmitter is the copyright owner of such digital data.
- Transmittal of data does not convey any ownership right in the digital data
- Receiver's use data is limited to designing, constructing, using, maintaining, altering and adding to the project.

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AIA E203 (2013)

- G202: "LOD" or Level of Development
  - LOD provisions define the specific minimum contents of the BIM at certain project milestones.
  - As BIM "graduates" to the next LOD stage, reaching an increased level of completeness, parties' reliance and utilization increases
  - G202 provides guidelines for how model can be utilized by project participants at each LOD

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Canadian BIM Standard Form Contract

- IBC 100-2014: BIM Contract Appendix

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IBC 100-2014: BIM Contract Appendix

- Appendix is a standard fillable PDF form designed to be appended to RAIC 6, ACEC 31, CCDC 2
- The parties to a project should enter into the Appendix at the time the principal agreement between the owner-architect or owner-contractor is executed.
- Recommended to be used with IBC 201-2014 , LOD, Authorized Uses and Model Element Table

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IBC 100-2014: BIM Contract Appendix

Key provisions:

- Article 1.5 allows for parties to the project to require others to prove that the Appendix has been incorporated into other contracts on the same project.

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IBC 100-2014: BIM Contract Appendix

Key provisions:

- Article 1.9 clarifies that participation of the contractor or subcontractor in the modelling does not constitute design services, unless otherwise specified.

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IBC 100-2014: BIM Contract Appendix

Key provisions:

- Article 2.5: each Model Element Author grants a non-exclusive license to other Project Participants to use model content for design and construction purposes for the project only.
- Article 2.6: Alterations are at the sole risk of the Project Participant making the alterations
- Article 2.7: Licence may be suspended or revoked in event of non-payment or breach

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IBC 100-2014: BIM Contract Appendix

Key provisions:

- Article 3.3: Following establishment of Protocol, if a party's use or reliance on the model is inconsistent with the defined authorized uses, such use or reliance is at its sole risk.
- Article 3.9 contains a clear waiver of consequential damages as a result of any modelling activities.

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IBC 100-2014: BIM Contract Appendix

Key provisions:

- Section 4 allows parties to set out extent of modelling, anticipated authorized uses, and provision of record, as-built and post-construction models. For example:

4.5 Post Construction *Models*:
The services associated with providing a *Model* for post construction use shall only be required if designated in the table below.

Post Construction *Model*	Yes / No	*Party/Project Participant* responsible for the deliverable	Location of Detailed Description of Requirements *(Section 4.6 or other location)*
Asset management			[e.g. 4.6]
Energy management			[e.g. Schedule A attached]
Space management			
Maintenance management			
Wayfinding or mapping			
Other:			

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IBC 100-2014: BIM Contract Appendix

Key provisions:

- Section 5: Protocol and Model Management
  - Minimum requirements of a Protocol:
  1. Identification of the *Model Element Authors*;
  2. Definitions of the Levels of Design ("*LODs*") and associated *Authorized Uses* for each *LOD* at each Project milestone;
  3. Identification of the Project milestones;
  4. The construction classification system to be used on the Project;
  5. A Model Element Table indicating the *LOD* to which each *Model Element* shall be developed at Project Milestones and the *Model Element Author (MEA)* at each milestone.

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IBC 201-2014: LOD, Authorized Uses and Model Element Table

- Parties have an option to use either IBC 201-2014 and the Model Element Table provided by IBC or their own detailed document for their *Protocol*.
  - For each of the five *LOD*s defined in IBC 201-2014, there are fillable sections that allow parties to add authorized uses above and beyond those otherwise delineated.

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***North American Mechanical, Inc. v. Walsh Construction Company II, LLC*, 2015 WL 5530190**

- Expansion of Mercy Walworth Hospital and Medical Center.
- General contractor Walsh created initial BIM based upon architect's two-dimensional plans, but the BIM did not include everything set forth on the plans.
- The Project called for certain of the subcontractors, including NAMI, to participate in BIM.
- NAMI quickly encountered conditions very different from those it contemplated in its bid.

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***North American Mechanical, Inc. v. Walsh Construction Company II, LLC*, 2015 WL 5530190**

- NAMI submitted four change order requests to Walsh seeking additional compensation.
- Subcontract clause 11.3: in the event of a dispute relating to or arising from any act of the owner or architect or involving the contract documents, NAMI is bound to Walsh to the same extent that Walsh is bound to Mercy
- NAMI's change order requests were rejected by Mercy.
- Walsh contended that NAMI's BIM change order requests fell within the scope of subcontract clause 11.3.

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***North American Mechanical, Inc. v. Walsh Construction Company II, LLC*, 2015 WL 5530190**

- The BIM dispute did not fall outside of the scope of clause 11.3.
- NAMI had to prove that the four BIM change order requests were really the result of a change, i.e. "an alteration to an existing contract requirement concerning work that is already required to be done."
- NAMI failed to lead specific evidence supporting such a conclusion.

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Steel Industry's Approach

- AISC Code of Standard Practice for Steel Buildings and Bridges, Appendix A
- CISC Code of Standard Practice for Structural Steel, Appendix J
  - All references to the design drawings shall instead apply to the "design model" and all references to shop and erection drawings shall instead apply to "manufacturing model".

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Steel Industry's Approach

- Both Appendices provide:

The Design Model shall:

a) Consist of Data Management Conformance Classes.
b) Contain Analysis Model data so as to include load calculations as indicated in the Contract Specifications referencing jurisdictional codes.
c) Include entities that fully define each steel element, and the extent of detailing of each element, as would be recorded on an equivalent set of structural steel design drawings (see Clause 4.1.2).
d) Include all steel elements (primary and secondary structural), as well as any other entities required for strength and stability of the completely erected structure.
e) Govern over all other forms of information, including drawings, sketches, etc.

Conclusion