What is BIM and why should construction lawyers care about it?

Dr. Carrie Sturts Dossick, P.E.
Bita Astaneh Asl
Learning Objectives – What is BIM?

- BIM definition
- BIM history
- Common current uses (3D coordination, Design Authoring, Design Review, Record Modeling)
- BIM Execution Planning
- Contracts and Data Requirement specifications
- Hands on demonstration (objects, attributes)
Escaping Flatland – Edward Tufte
Three-dimensional Representations
BIM Mindset -> Data
What Features does BIM have?

> 3D geometry
  - Ability to automate quantity take-offs
  - Ability to export points in space

> Associated data
  - Cost data
  - Schedule data
  - Make, Model, Serial number
  - Supply chain – supplier, phone number
CAD Mindset = Graphic Representation

BIM Mindset = Data
Documents as Data

Select Elements from BIM/IFC model(s)

Model Elements

- Name: Stütze-001
  - Material/Type: Reinforced Concrete
  - Qty: 0.03

- Name: Doors
  - Material/Type: Reinforced Concrete
  - Qty: 0.03

- Name: Furniture
  - Material/Type: Reinforced Concrete
  - Qty: 0.03

- Name: Railings
  - Material/Type: Reinforced Concrete
  - Qty: 0.03

- Name: Roofs
  - Material/Type: Reinforced Concrete
  - Qty: 0.03

- Name: Slabs
  - Material/Type: Reinforced Concrete 300 mm

BOQ Item and Resources Properties

- Title: Reinforced in situ ready mixed designated concrete; Isolated foundations
  - Quantity: 770.10
  - Unit: M3
  - Rate: 140.53
  - Total: 108,222.72
  - Currency: GBP
  - Reference: SPON

Visible: 699, Selected: 7, Total: 699

Add to BOQ Table
Data that defines the Built Environment
BIM
A Brief History
"a computer database could be developed that would allow the geometric, spatial, and property description of a very large number of physical elements, arranged in space and ‘connected’ as in an actual building.”
Building Information Modeling

Introduction
Building information modeling is Autodesk's strategy for the application of information technology to the building industry. Building information modeling solutions have three characteristics:

1. They create and operate on digital databases for collaboration.
2. They manage changes throughout those databases so that a change to any part of the database is coordinated in all other parts.
3. They capture and preserve information for reuse by additional industry-specific applications.

The application of building information modeling solutions results in higher quality work, greater speed and productivity, and lower costs for building industry professionals in the design, construction, and operation of buildings.

This paper discusses how the use of information technology in the industry has led to the idea of building information modeling and the characteristics and benefits of building information modeling solutions.

The Road to Building Information Modeling
In the early 1990s, architects began using PC-based CAD. The familiar layer metaphor that originated with plotter drafting was easily adapted to the layer-based CAD systems of the day, and within a few years a large percentage of construction documents and shop drawings were plotted from computers rather than being manually drafted on drawing boards.

Slowly technology began to affect the process. DWG files were exchanged with consultants instead of physical paper drawings. Beyond simple graphics these files communicated information about a building through their layer structure, a rectangle on one layer represented a concrete column, but on another layer a tile pattern on the floor. Electronic file formats originally designed to store only graphics and other pockets now directly conveyed information about the building that would not appear in the plotted version of the file. The use of CAD files was evolving toward communicating information about a building in ways that a plotted drawing could not.

This evolution continued with the introduction of object-oriented CAD in the early 1990s. Data objects in these systems—doors, walls, windows, roofs—related non-graphic data about a building in a logical structure together with the building graphics. These systems often supported geometrical modeling of the building in three dimensions, thereby automating many of the business drafting tasks like laying out building section drawings.

Digital Database for collaboration

Manage Change

Reuse of information
Building Information Modeling

We believe that "starting over" with a new, incompatible platform (as Autodesk suggests with Revit) in order to achieve these goals is dangerous, wrong and wholly unnecessary.

Centralized vs Federated Database

*Graphisoft’s Response: We’ve been doing BIM the whole time with ArchiCAD (1987).
Version 1 (2007)

A Building Information Model (BIM) is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward.

A basic premise of BIM is collaboration by different stakeholders at different phases of the life cycle of a facility to insert, extract, update or modify information in the BIM process to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability.
Version 3 (2015)

> Building Information Modeling: Is a BUSINESS PROCESS for generating and leveraging building data to design, construct and operate the building during its lifecycle....

> Building Information Model: Is the DIGITAL REPRESENTATION of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility...

> Building Information Management: Is the ORGANIZATION & CONTROL of the business process by utilizing the information in the digital prototype to effect the sharing of information over the entire lifecycle of an asset...
BIM
Common Uses
The right tool for the project...

No single tool does everything well
Design Authoring: Its Not One Model

Constructor  
Tekla  
Revit
Five Essential BIM Uses

- Existing Conditions
- Design Authoring
- Design Review
- 3D Coordination
- Record Modeling
Existing Conditions

Surveying Tools...
Points, Scans & 3D Picture Tools
Laser Scanning – Seatac Airport

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Department of Construction Management, College of Built Environment

David Evans and Associates
Laser Scan “Point Cloud”
Laser Scan + Model
Design Authoring: Many Models, Many Iterations

Design > Coordinate > Optimize > Install > Maintain

SketchUp → Revit → Navisworks → eDocs
“Built it in Virtual reality first”

“The earlier we can spot a potential problem in production, the easier it is to avoid”

Jim Bedrick, AIA

California Academy of Science (Golden Gate Park: SF, CA)
MacLeamy Curve – Integrated Design

CURT: AEC Productivity

PD: Pre-design
SD: Schematic design
DD: Design development
CD: Construction documentation
PR: Procurement
CA: Construction Administration
OP: Operation

1. Ability to impact cost and functional capabilities
2. Cost of design changes
3. Traditional design process
4. Preferred design process

Graph created by Patrick MacLeamy, AIA / HOK

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3D Coordination
Composite Trade Coordination
3D Coordination with Consolidated (or Federated) BIM
3D Coordination Meetings

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Record Modeling

Building Information Model
(Design & Construction)

Building and Campus Information Management
(Operations & Maintenance)

GIS

Space Planning

CMMS

Records

Repair Orders

Reports

Backflow Prevention Testing

Information is not neutral, often not trusted, and is connected to particular jurisdictions.
Asset data only the first step

=> owners manuals, parts lists, systems models

COBie/BIM (Building Information Model)
Asset Data = Make, Model, Serial Number
BIM

Execution Planning
BIM Execution Planning Process

1. Project Goals
2. BIM Uses
3. Roles and Responsibilities
4. Data Requirements and Information Exchange
## Model Element Data Requirements

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3D + Facility Data</td>
</tr>
<tr>
<td>B</td>
<td>2D + Facility Data</td>
</tr>
<tr>
<td>C</td>
<td>2D Only (Drafting, linework, text, and or part of an assembly)</td>
</tr>
<tr>
<td>+</td>
<td>Original Grade (A, B, or C) adjusted for contract changes and field conditions.</td>
</tr>
<tr>
<td>-</td>
<td>Not included in or tied to the model (however is still required in the deliverable)</td>
</tr>
<tr>
<td>●</td>
<td>Refer to the specific child element for appropriate Grade. (Used for categories that have multiple sub-elements for which varying Grades apply.)</td>
</tr>
</tbody>
</table>

### Minimum Modeling Matrix (M3)

**Version: 1.3 (SEPT-19-2014)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Element ID</th>
<th>LOD</th>
<th>DESIGN MODEL (CONSTRUCTION DOCUMENTS)</th>
<th>RECORD MODEL (AS-BUILTS)</th>
<th>FOR AGENCY OR CONTRACTOR NOT A CONTRACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Grade (CD)</td>
<td>Grade (AB)</td>
<td>Primary Discipline (This will allow the team to identify discipline-specific areas of content)</td>
</tr>
<tr>
<td>Level 3</td>
<td>Detection and Alarm</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 4</td>
<td>Fire Detection and Alarm</td>
<td>300</td>
<td>A</td>
<td>A+</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 4</td>
<td>Radiation Detection and Alarm</td>
<td>300</td>
<td>A</td>
<td>A+</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 4</td>
<td>Fuel-Gas Detection and Alarm</td>
<td>300</td>
<td>A</td>
<td>A+</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 4</td>
<td>Fuel-Oil Detection and Alarm</td>
<td>300</td>
<td>A</td>
<td>A+</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 4</td>
<td>Refrigeration Detection and Alarm</td>
<td>300</td>
<td>A</td>
<td>A+</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 4</td>
<td>Water Intrusion Detection and Alarm</td>
<td>300</td>
<td>A</td>
<td>A+</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 3</td>
<td>Electronic Monitoring and Control</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 4</td>
<td>Electronic Detection Monitoring and Control</td>
<td>300</td>
<td>A</td>
<td>A+</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 3</td>
<td>Electronic Safety and Security Supplementary Components</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Electrical</td>
</tr>
<tr>
<td>Level 4</td>
<td>Supplementary Components</td>
<td>100</td>
<td>A</td>
<td>A+</td>
<td>Electrical</td>
</tr>
</tbody>
</table>
Reluctance to exchange models

How will the contractor use the model?

What are the risks and liabilities with sharing and using the model?

Who guarantees accuracy of the models, e.g., quantities?
If BIM has the best information, it seems that it would be better to use models than use 2D contract documents. How can we get there?

Frank Gehry
Legal and Contract Issues

Key Question – How to facilitate the transfer, exchange and use of models (interoperability) in order to increase efficiency in design, construction and operations while at the same time reducing the liability and risks inherent in the transfer, exchange and use of project information in digital/BIM format?

One approach – New AIA Contract Documents. AIA issued new digital practice documents in 2013 and further addressed them in its 2017 contract revisions.
INTRODUCTION

Purpose of this Guide, Instructions and Commentary
Structural Revisions to AIA’s Digital Practice Documents
Revisions to this Guide
How to use this Guide

GUIDANCE

AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit
   Article 2. Transmission and Ownership of Digital Data
   Article 3. Digital Data Protocols
   Article 4. Building Information Modeling Protocols
   Article 5. Other Terms and Conditions

AIA Document G201™–2013, Project Digital Data Protocol Form
   Article 1. General Provisions Regarding Use of Digital Data
   Article 2. Digital Data Management Protocols
   Article 3. Transmission and Use of Digital Data

AIA Document G202™–2013, Project Building Information Modeling Protocol Form
   Article 2. Level of Development
   Article 3. Model Elements

RESOURCES

INTRODUCTION

Purpose of this Guide, Instructions and Commentary
As the use of building information modeling (BIM) and other types of Digital Data has continued to evolve in the design and construction industry in recent years, the industry has begun to ask practical questions regarding how these concepts and tools should be implemented. In an effort to provide guidance, the American Institute of Architects (AIA) published its first Digital Data documents, AIA Documents E201™–2007, Digital Data Protocol Exhibit, and C106™–2007, Digital Data Licensing Agreement, in October 2007. E201–2007 is an exhibit to an agreement that allows the parties to establish the procedures they agree to follow with respect to the transmission or exchange of Digital Data, including instruments of service. Unlike E201–2007, C106–2007 is not an exhibit and is instead a stand-alone agreement between...
Purpose – to initiate, at the outset of a project, a substantive discussion about the extent to which DD and BIM will be utilized and how DD and BIM can be used and relied upon.

Single version negotiated for a project and then attached as an exhibit to each contract on the project.

Thus the project participants begin the project with a common understanding of how BIM and DD will be utilized.

Requires project participants “as soon as practical” after execution of E203 to meet and decide on necessary protocols for both DD and BIM.
AIA G201-2013, Project DD Protocol Form
AIA G202-2013, Project BIM Protocol Form

> Two separate documents, one for DD and one for BIM
> Each designed to discuss and agree on protocols for use and transfer
> Expectation is that this will be done after all project participants are on-board
> Should develop a process to document the receipt of, and agreement to, each version of the protocols by each project participant.
> These documents do NOT become part of any contract.
> Thus they can be modified and adjusted as necessary without the need to separately and formally amend each party’s agreement.
1.7 Requires parties to agree on protocols for the development, use, transmission and exchange of DD and to use AIA E203 – 2013 to evidence this agreement.

1.8 Deals with the effects of non-compliance: use of or reliance on BIM without agreement to protocols and without setting forth the protocols in E203 and G202 shall be at the using party’s sole risk and without liability to any other party.
Unauthorized Use of Protocols

E203-2013

§3.4 - DD Protocols
§4.7 - BIM Protocols

Two subsections:

.1 - Prior to establishment of protocols
.2 - Following establishment of protocols

If a party uses DD or BIM inconsistent with the protocols, it does so at its sole risk.
Conclusion

Implicit Assumption of AIA approach

By agreeing to complete and follow the protocols and further agreeing about that in their contracts, the parties will be able to use, store, reproduce, exchange, distribute, integrate, and modify DD and BIM with assurances of accuracy of information and without fear of liability in that use.
Copy of Slides Available

http://cm.be.uw.edu/cerc/research-publications/

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Hands On Demonstration

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