CENTER FOR EDUCATION AND RESEARCH IN CONSTRUCTION
Department of Construction Management, College of Built Environment
CERC

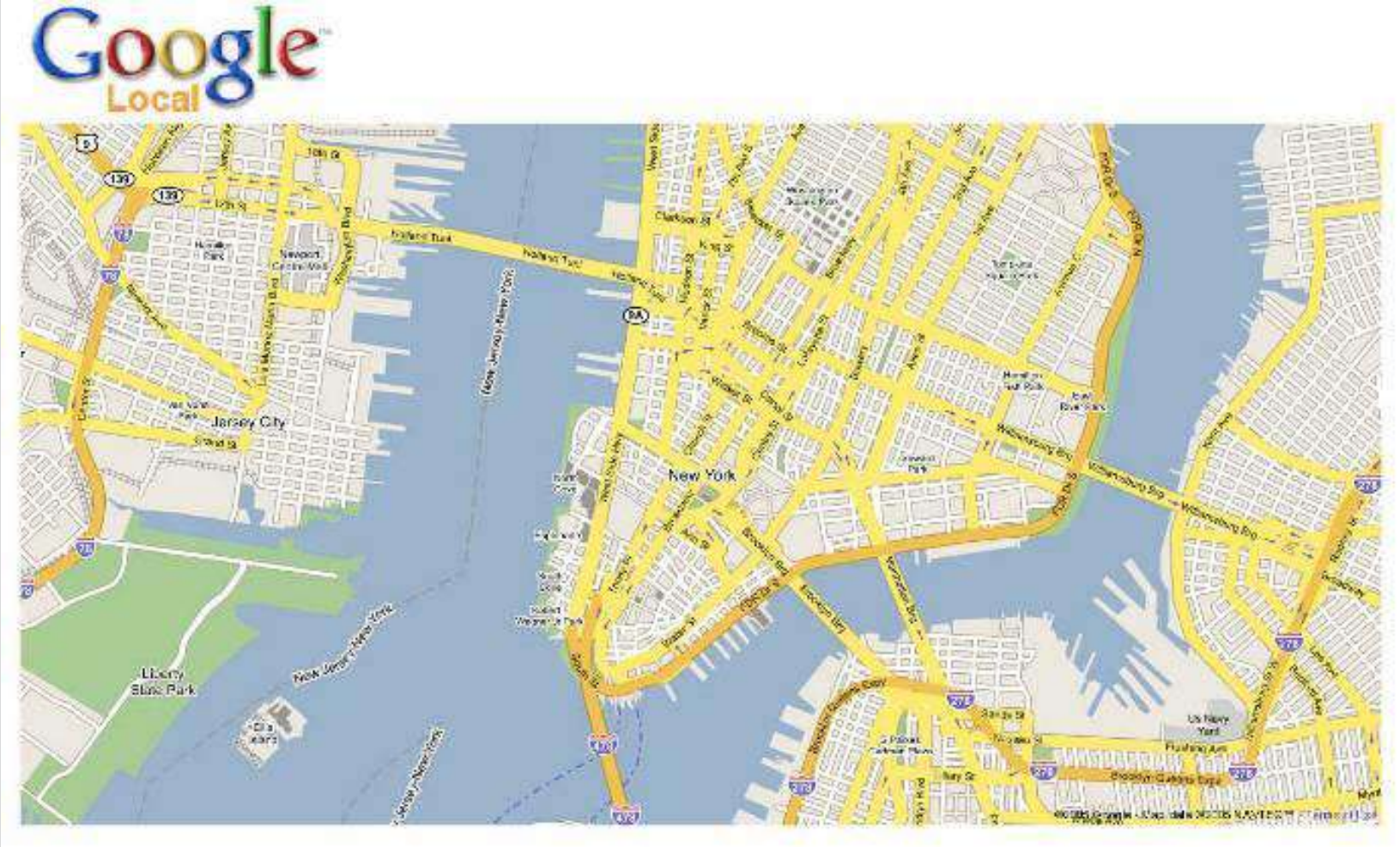
What is BIM and why should construction lawyers care about it?

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



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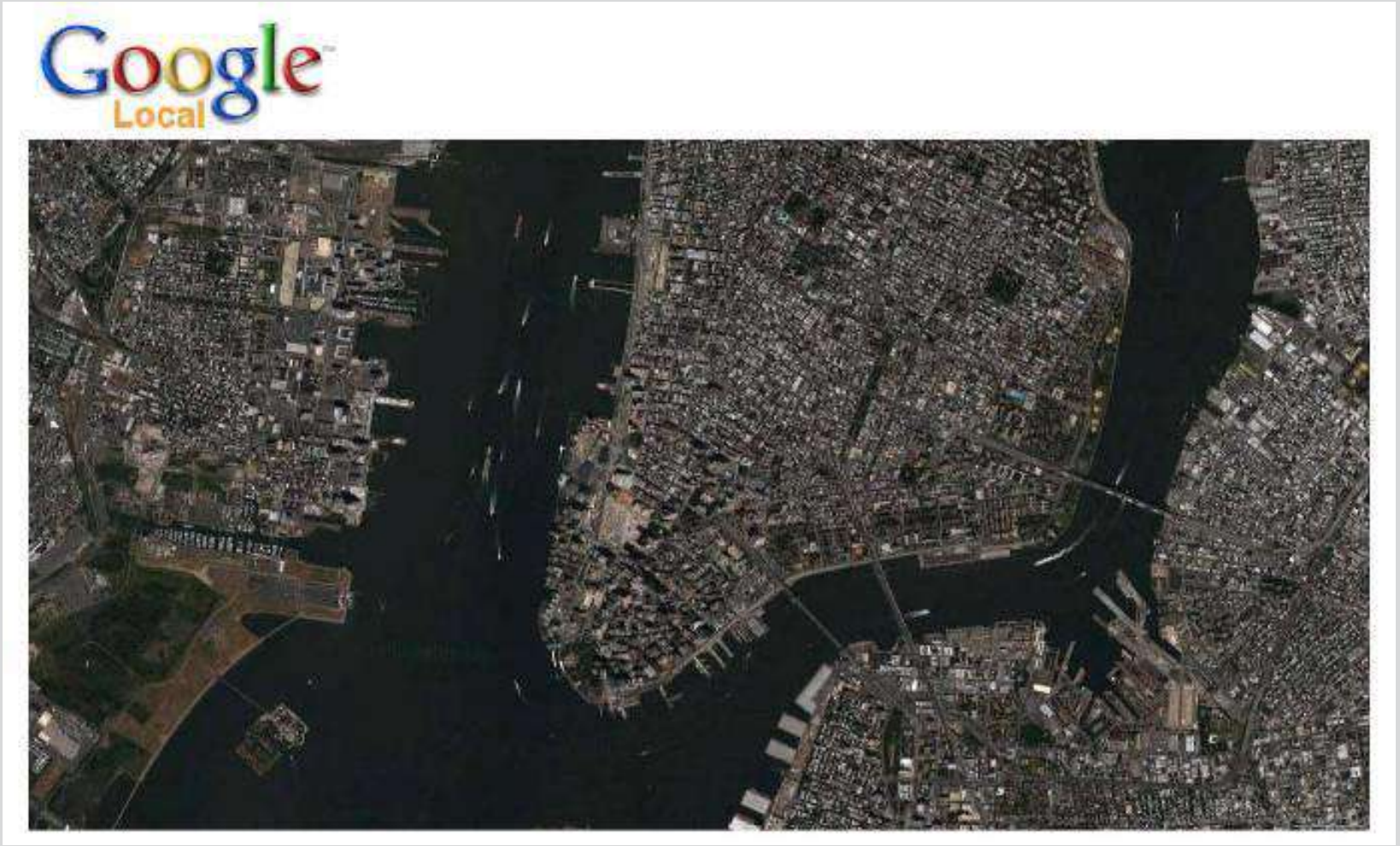
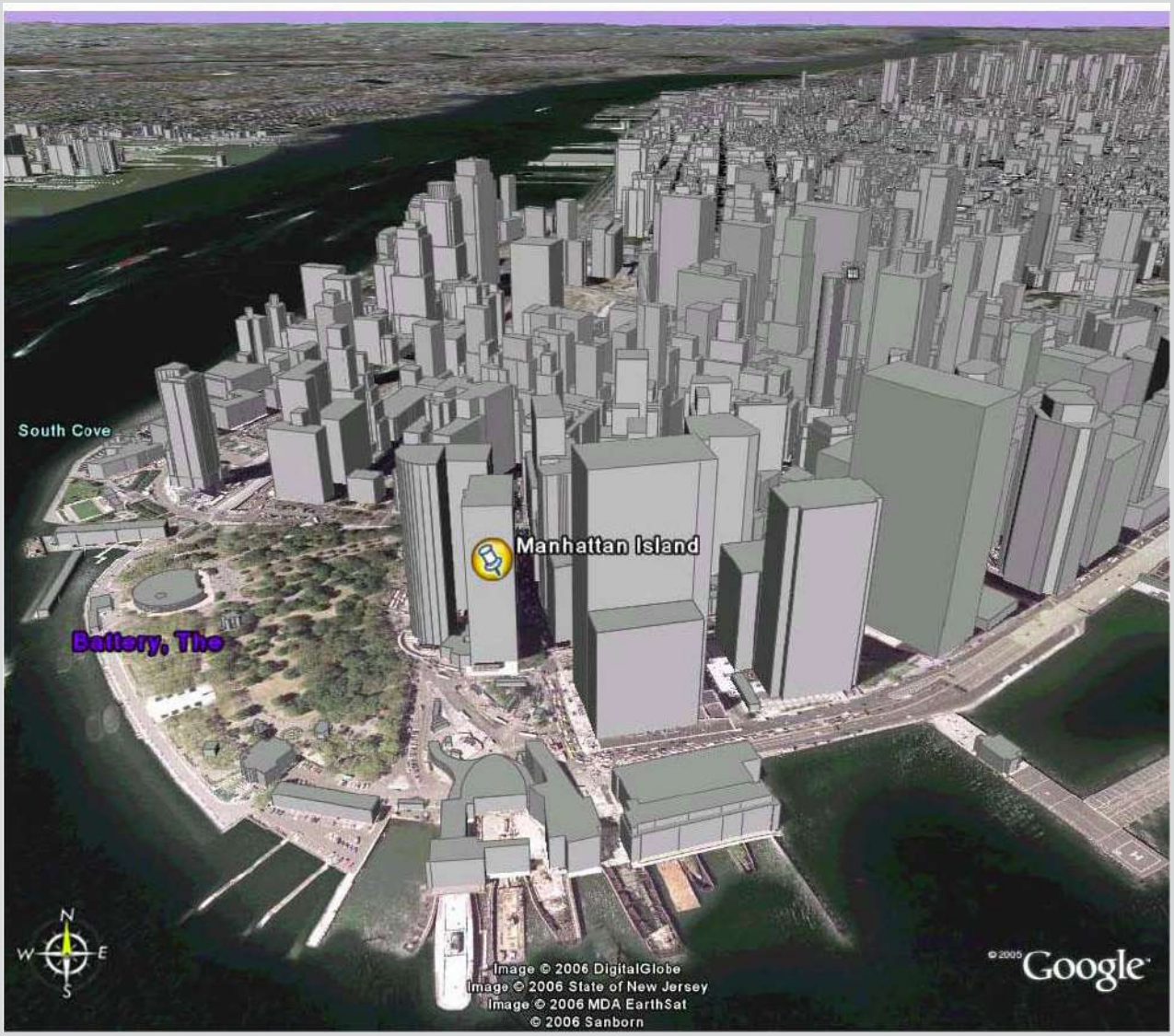
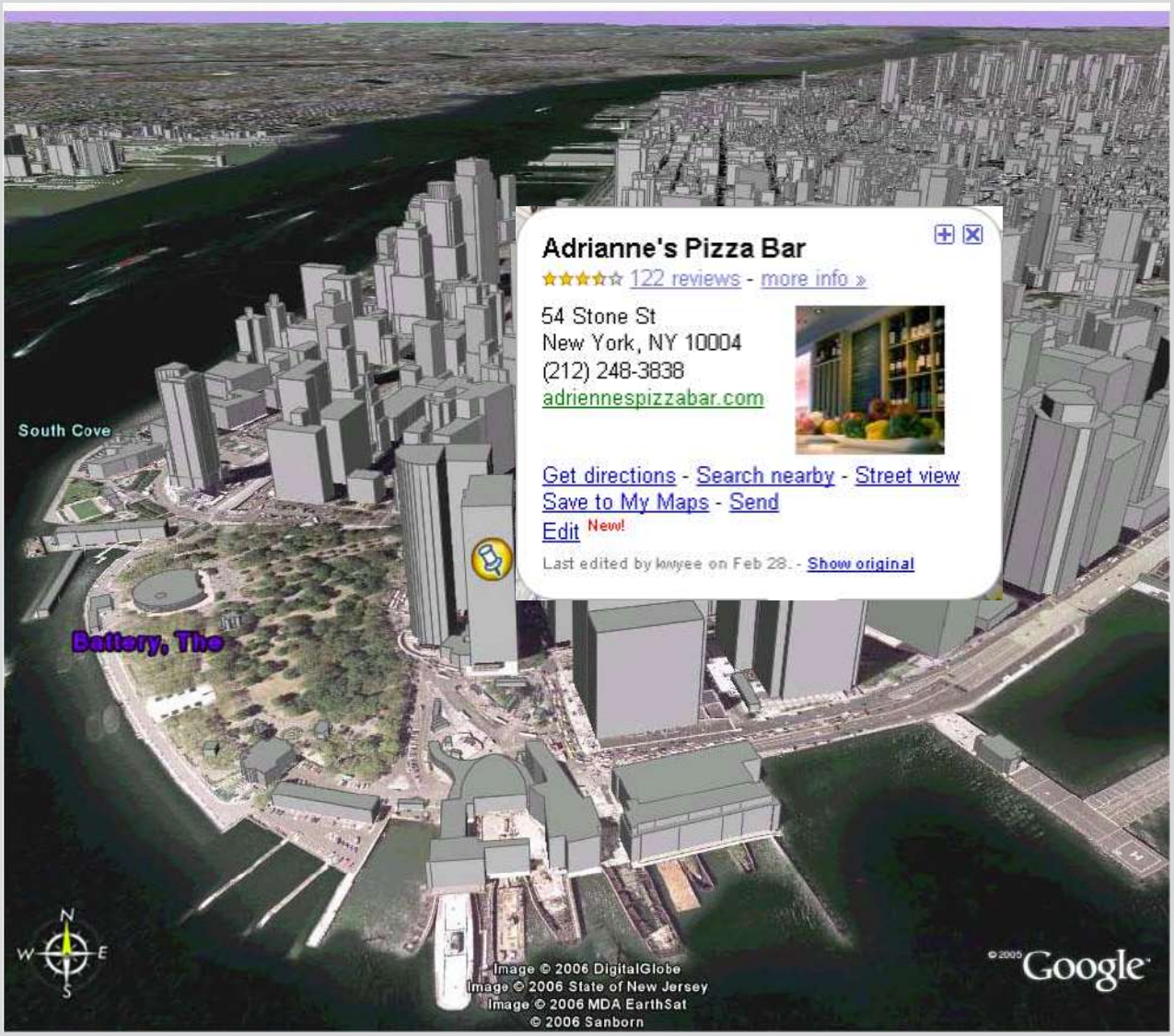


Three-dimensional Representations



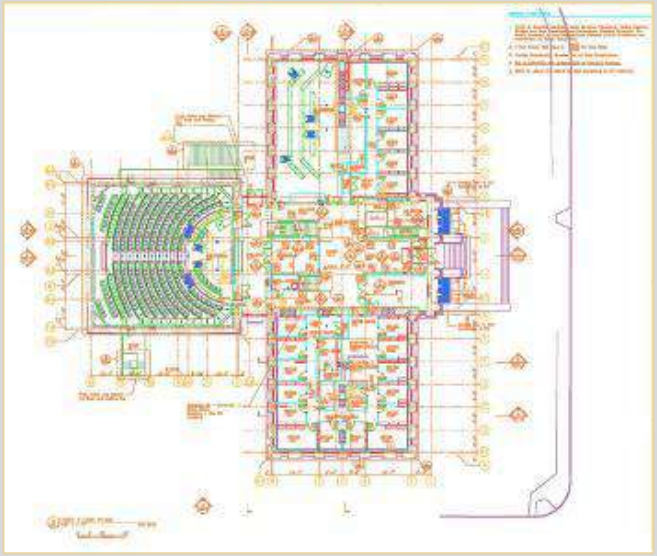
BIM Mindset -> Data

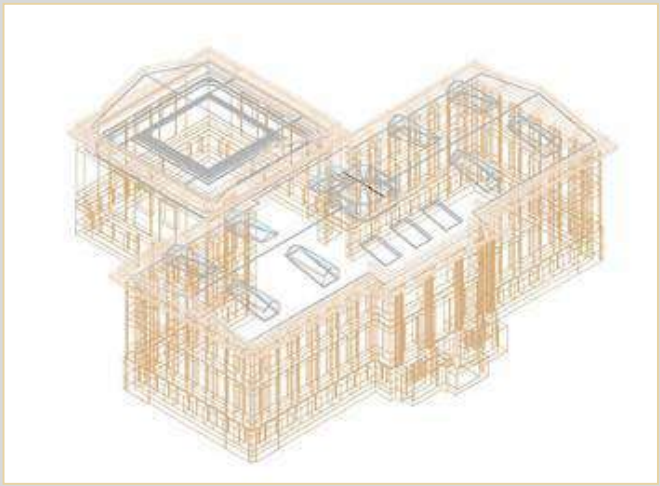


What Features does BIM have?

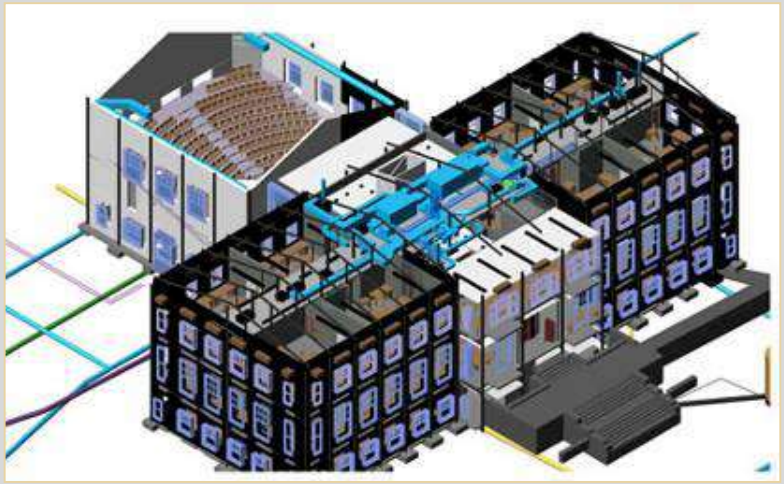
- 3D geometry
  - Ability to automate quantity take-offs
  - Ability to export points in space
- Associated data
  - Cost data
  - Schedule data
  - Make, Model, Serial number
  - Supply chain – supplier, phone number

CAD Mindset = Graphic Representation

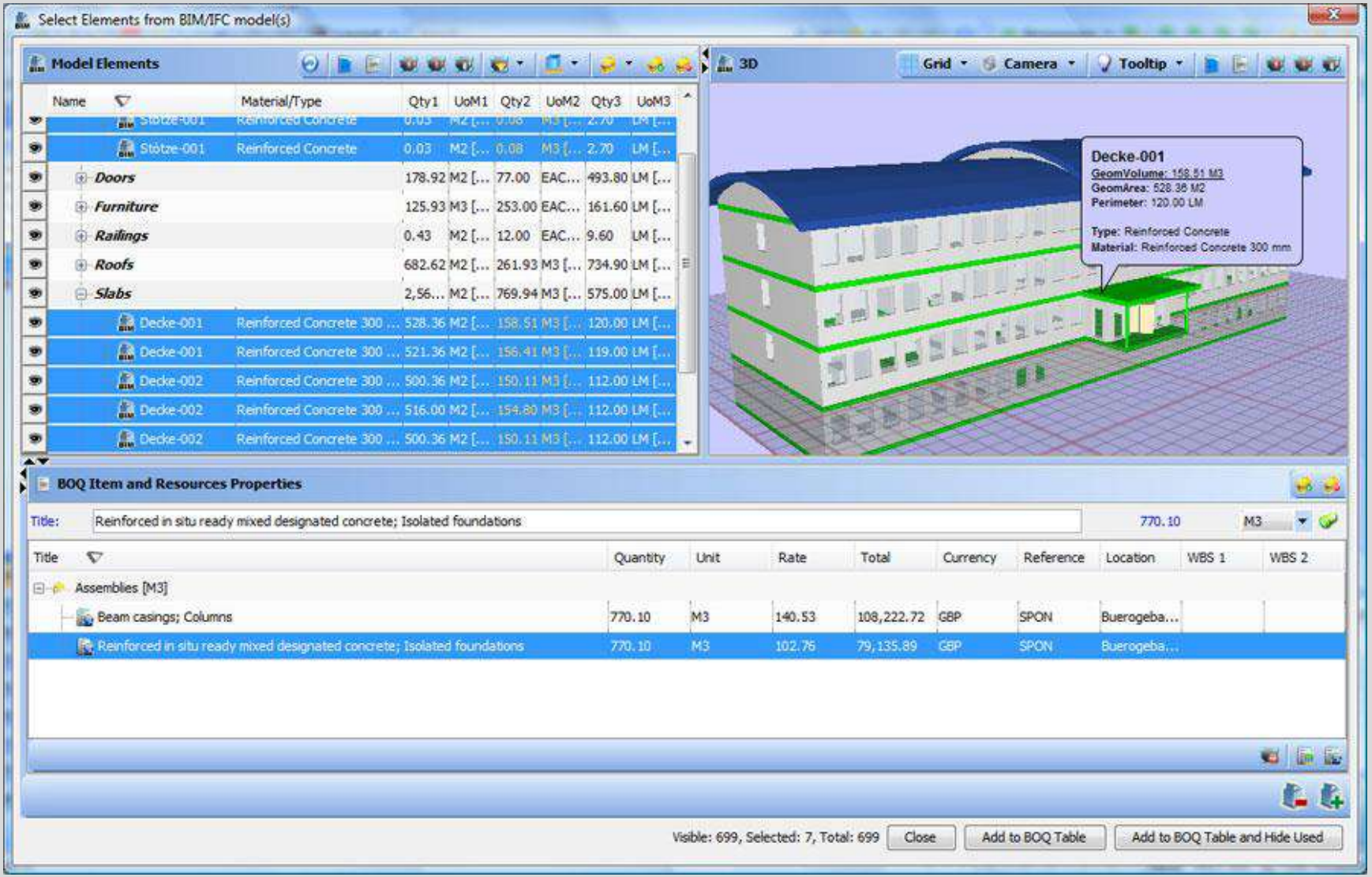




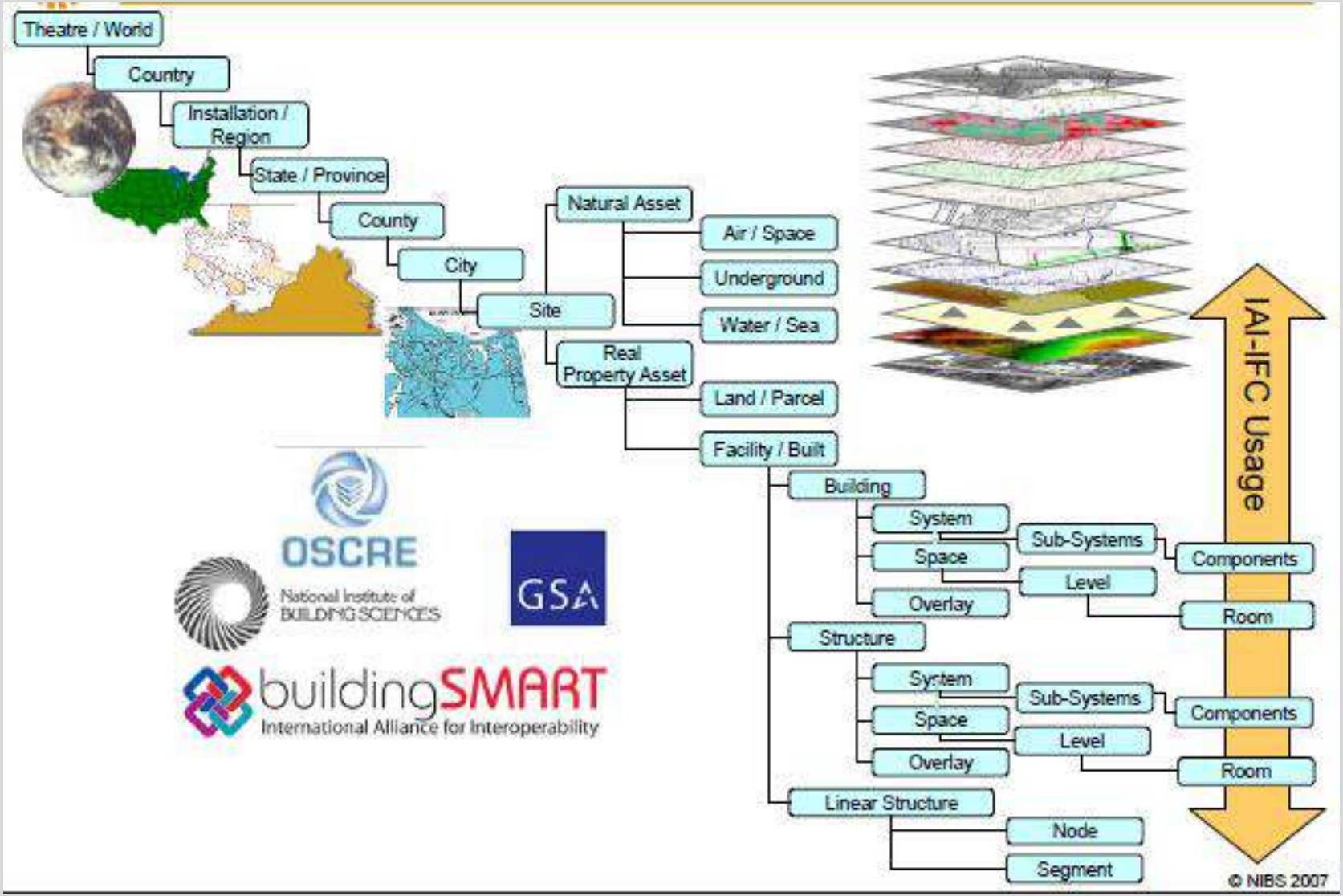
BIM Mindset = Data

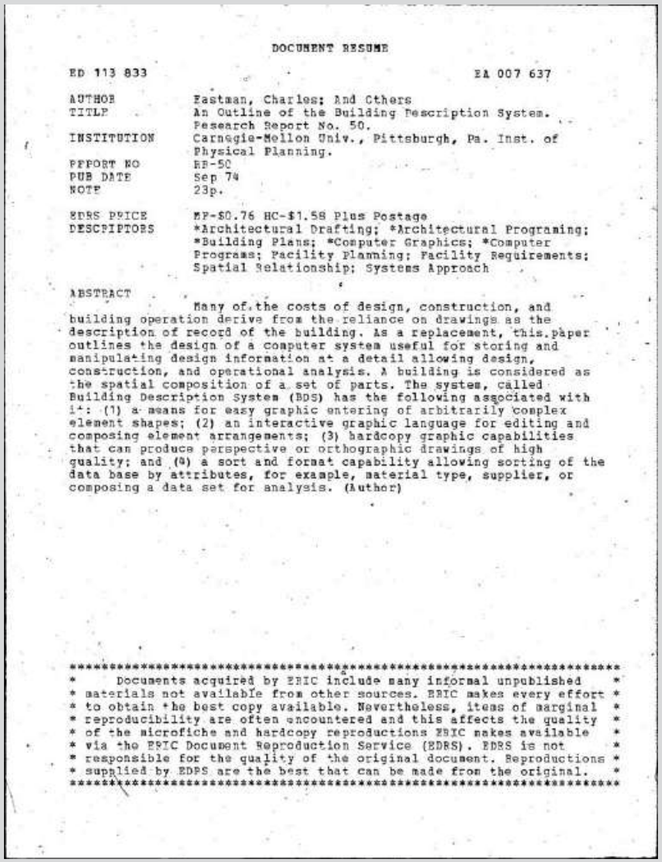


Documents as Data



Data that defines the Built Environment





DOCUMENT RESUME

ED 113 833 EA 007 637

AUTHOR	Eastman, Charles; And Others
TITLE	An Outline of the Building Description System. Research Report No. 50.
INSTITUTION	Carnegie-Mellon Univ., Pittsburgh, Pa. Inst. of Physical Planning.
REPORT NO	RR-50
PUB DATE	Sep 74
NOTE	23p.
EDRS PRICE	MF-$0.76 HC-$1.58 Plus Postage
DESCRIPTORS	*Architectural Drafting; *Architectural Programing; *Building Plans; *Computer Graphics; *Computer Programs; Facility Planning; Facility Requirements; Spatial Relationship; Systems Approach

ABSTRACT

Many of the costs of design, construction, and building operation derive from the reliance on drawings as the description of record of the building. As a replacement, this paper outlines the design of a computer system useful for storing and manipulating design information at a detail allowing design, construction, and operational analysis. A building is considered as the spatial composition of a set of parts. The system, called Building Description System (BDS) has the following associated with it: (1) a means for easy graphic entering of arbitrarily complex element shapes; (2) an interactive graphic language for editing and composing element arrangements; (3) hardcopy graphic capabilities that can produce perspective or orthographic drawings of high quality; and (4) a sort and format capability allowing sorting of the data base by attributes, for example, material type, supplier, or composing a data set for analysis. (Author)

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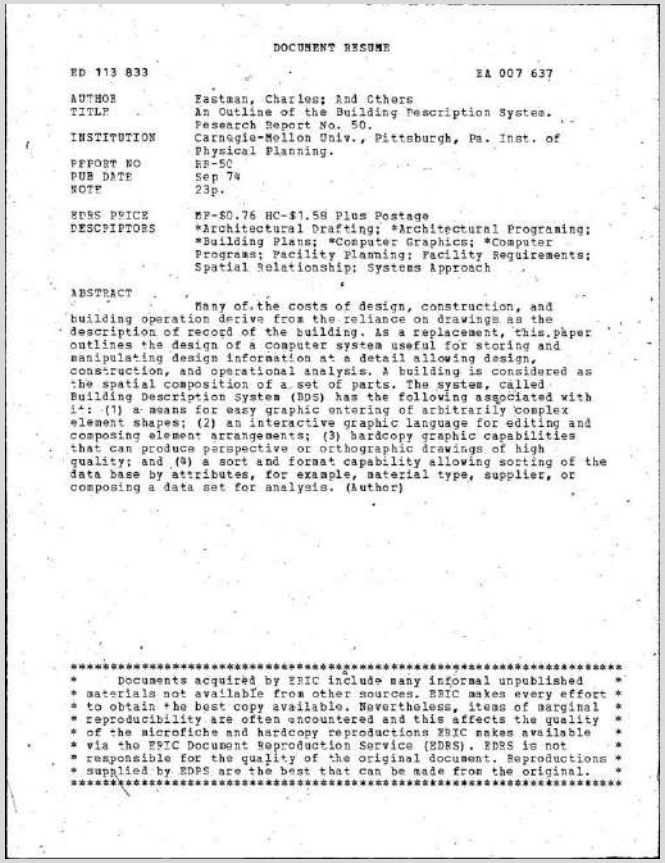
BIM

A Brief History

Chuck Eastman's 1974 Report

Building Description System



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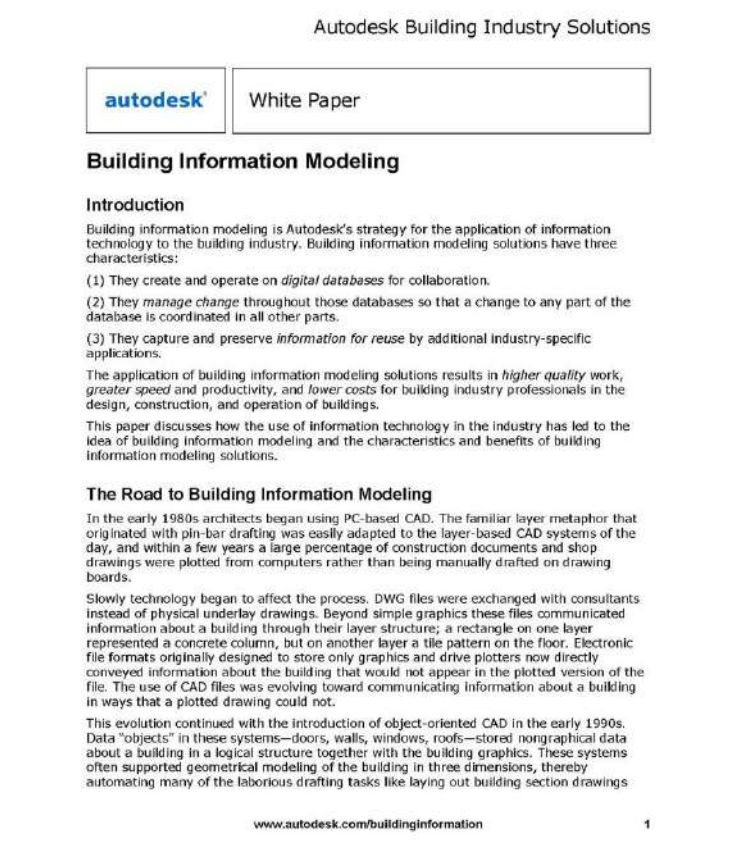
"a computer database could be developed that would allow the geometric, spatial, and property description of a very large number of physical elements, arranged in space and 'connected' as in an actual building."

Autodesk 2002 White Paper

Building Information Modeling



Autodesk Building Industry Solutions

autodesk | White Paper

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 change* 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 1980s architects began using PC-based CAD. The familiar layer metaphor that originated with pin-bar 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 underlay 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 drive plotters 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—stored nongraphical 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 laborious drafting tasks like laying out building section drawings

www.autodesk.com/buildinginformation 1

- Digital Database for collaboration
- Manage Change
- Reuse of information

Bentley Response 2002 White Paper

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).

National Building Information Model Standard

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.

National Building Information Model Standard

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…

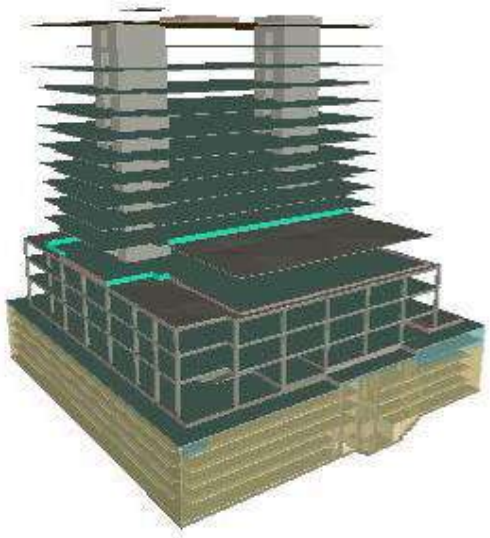
BIM

Common Uses

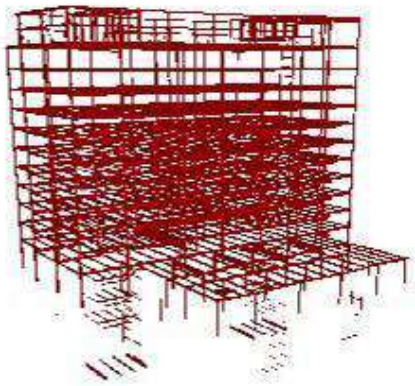
The right tool for the project…

No single tool does everything well

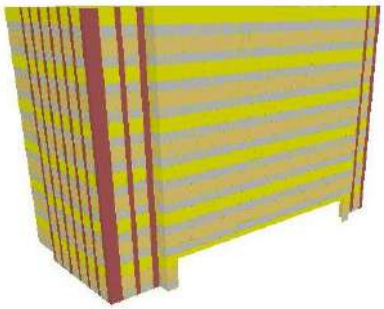
Design Authoring: Its Not One Model



Constructor

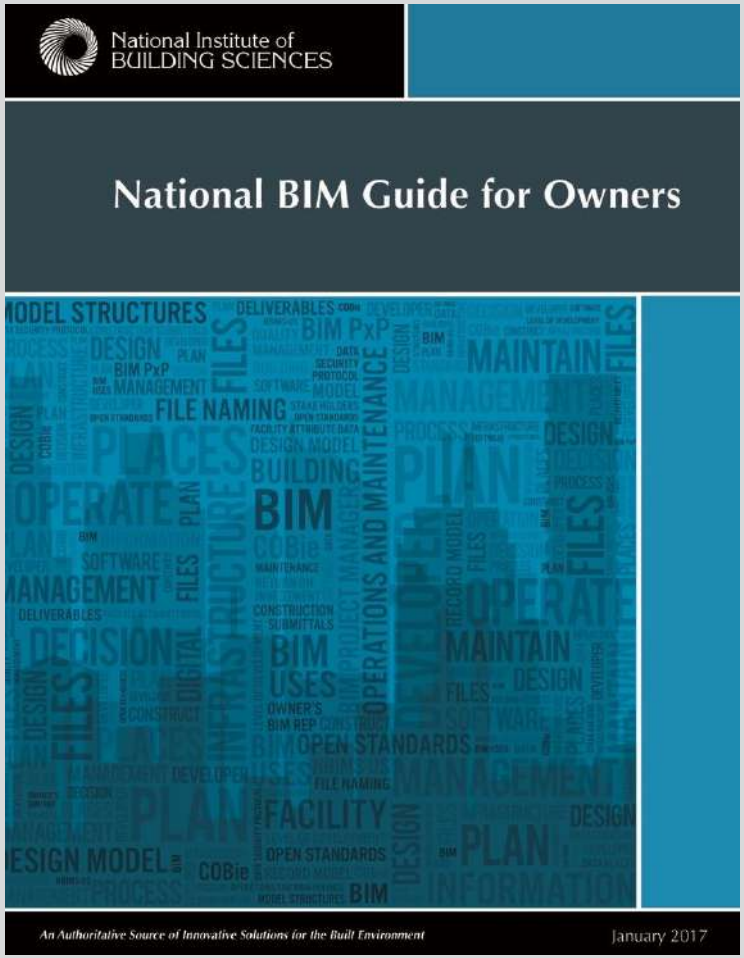


Tekla



Revit

Five Essential BIM Uses

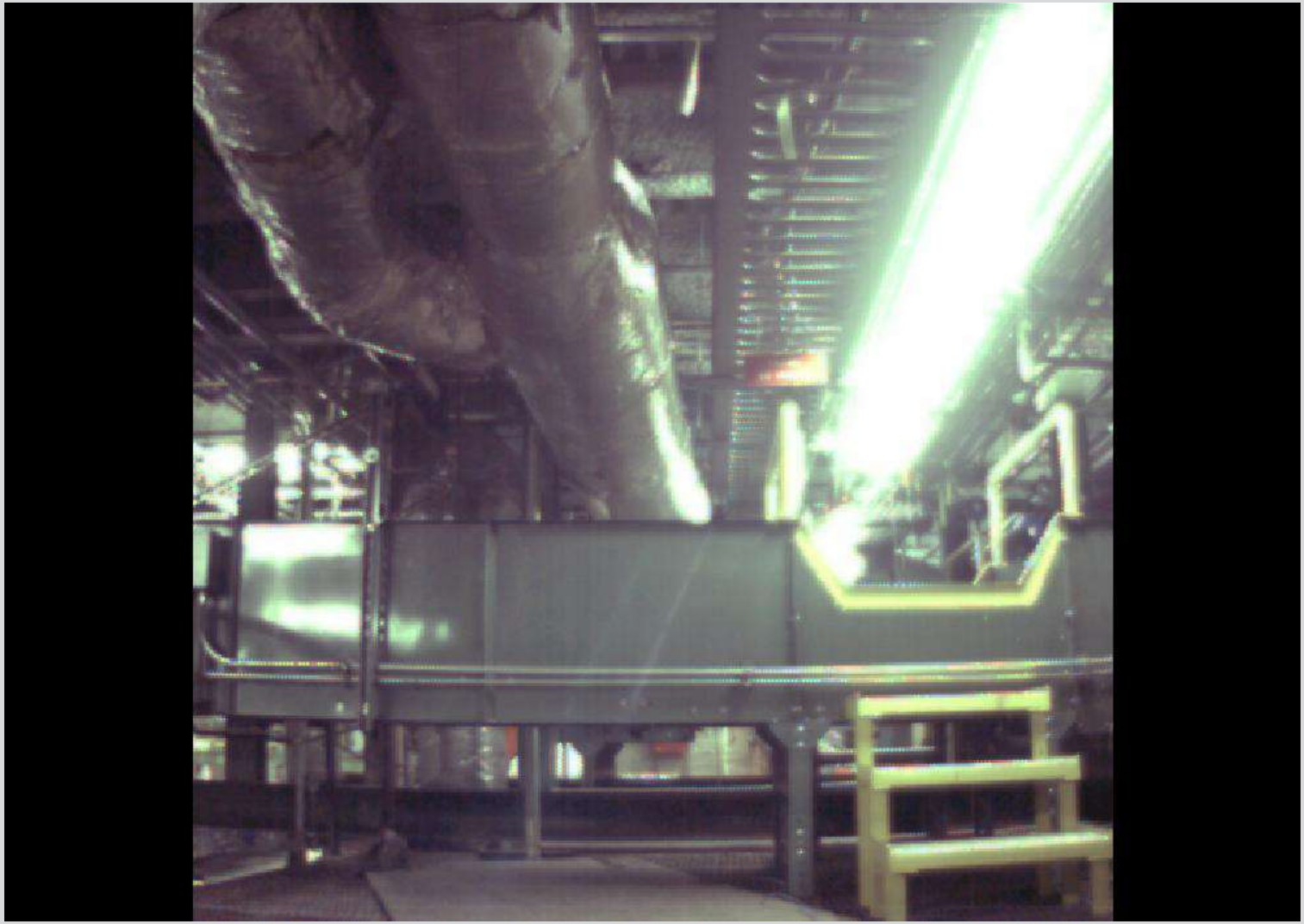


- Existing Conditions
- Design Authoring
- Design Review
- 3D Coordination
- Record Modeling

Existing Conditions

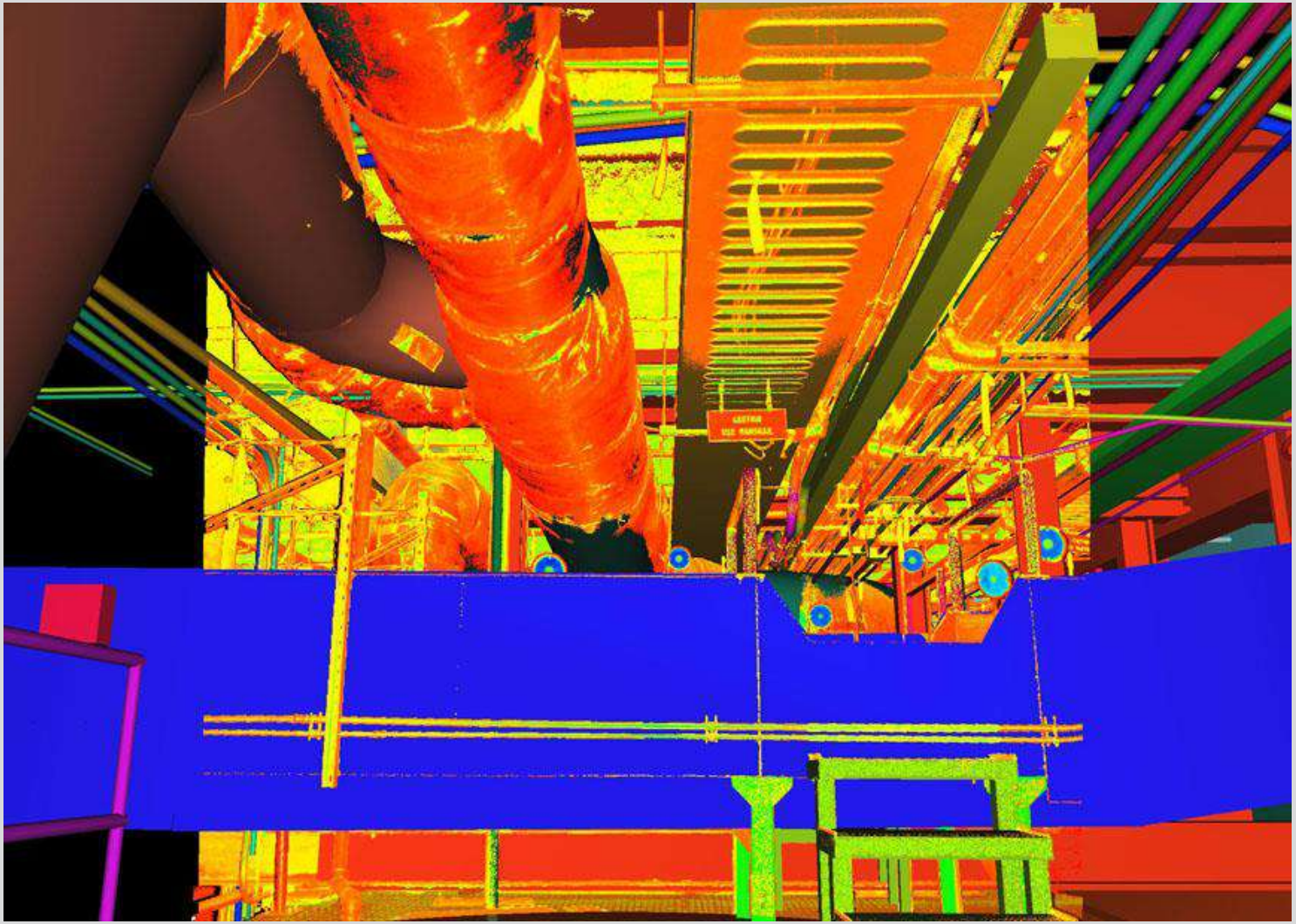
Surveying Tools…
Points, Scans & 3D Picture Tools

Laser Scanning – Seatac Airport

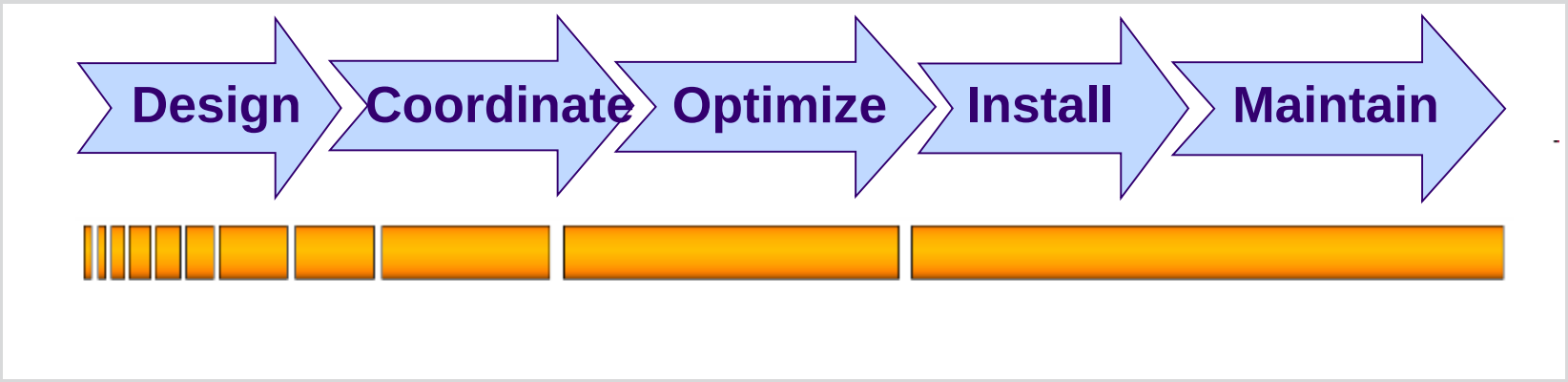


Laser Scan “Point Cloud”

Laser Scan + Model

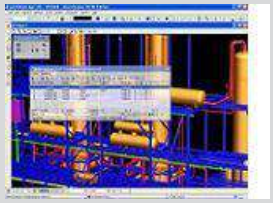


Design Authoring: Many Models, Many Iterations



SketchUp

Revit

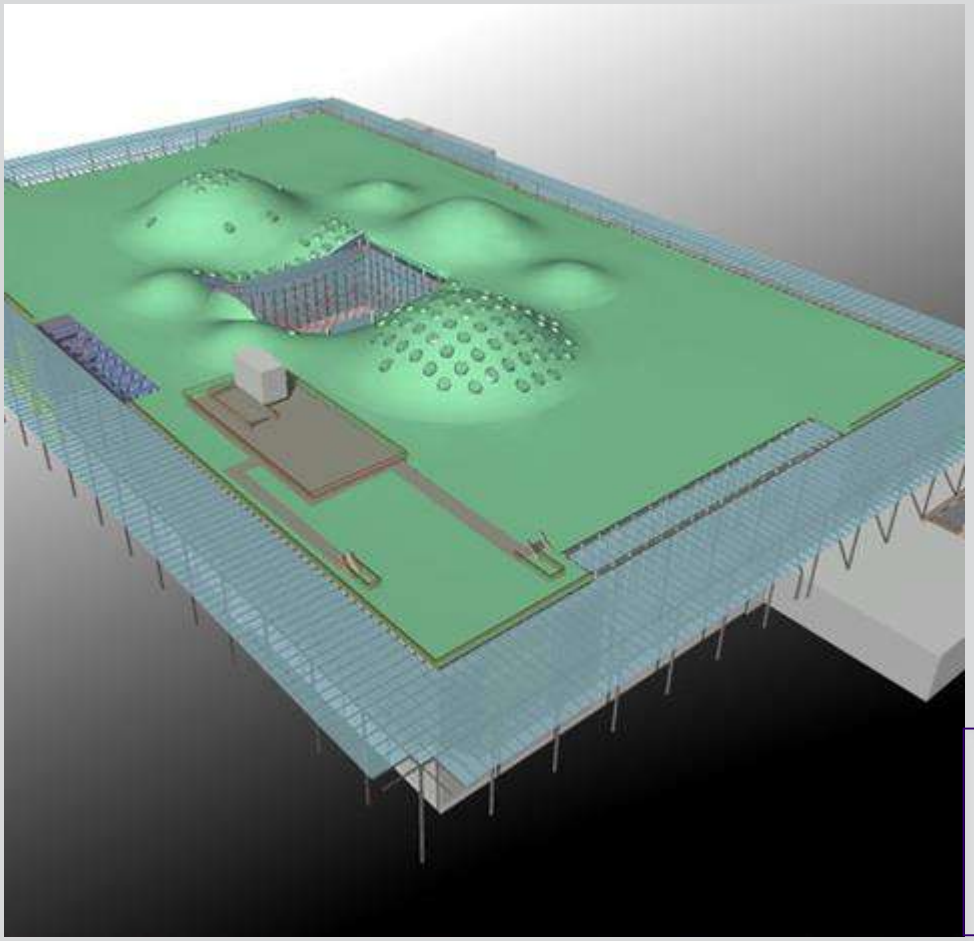


Navisworks

eDocs

Design Review - Constructability

"Built it in Virtual reality first"



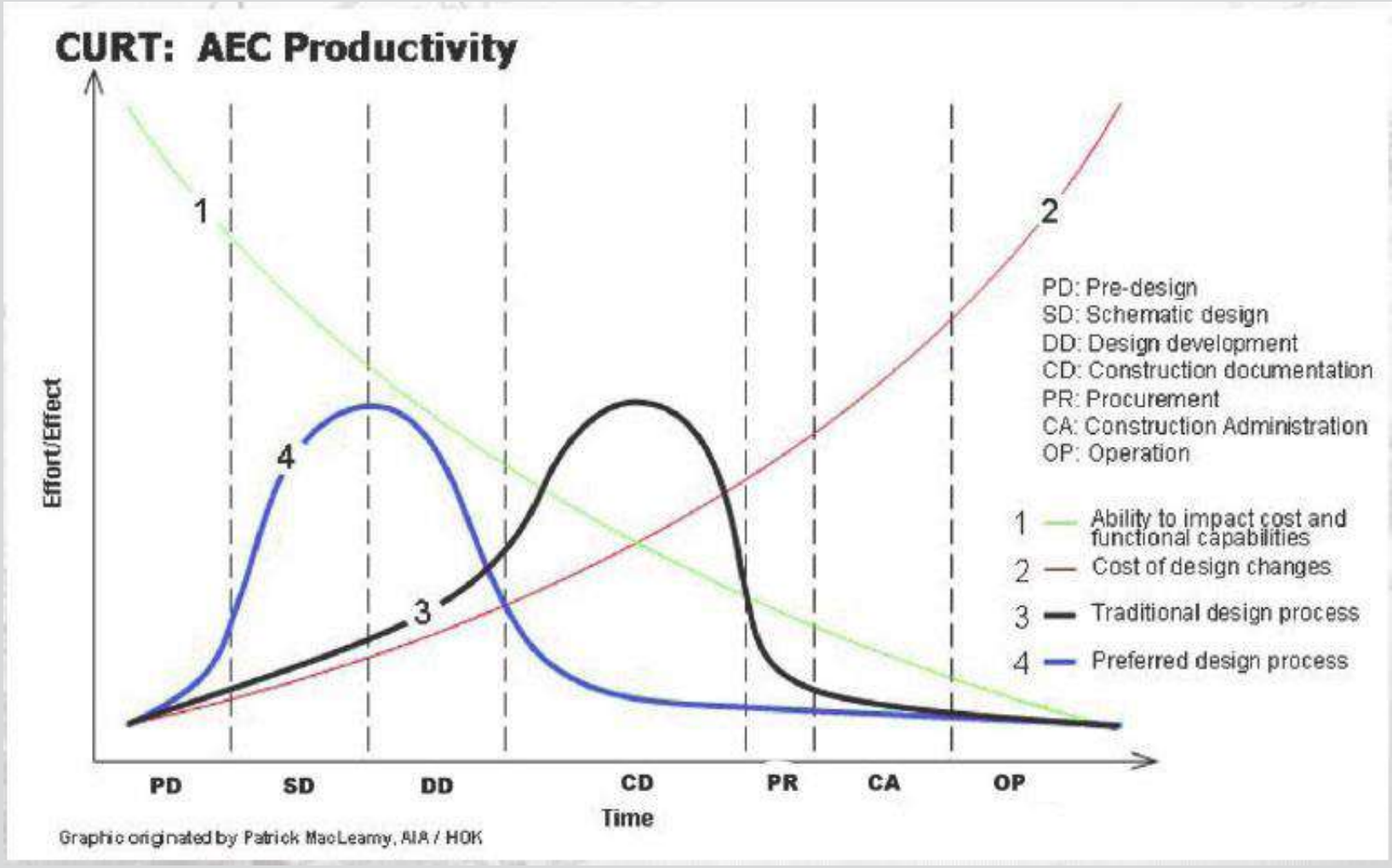
"The earlier we can spot a potential problem in production, the easier it is to avoid"

Jim Bedrick, AIA

California Academy of Science

(Golden Gate Park: SF, CA)

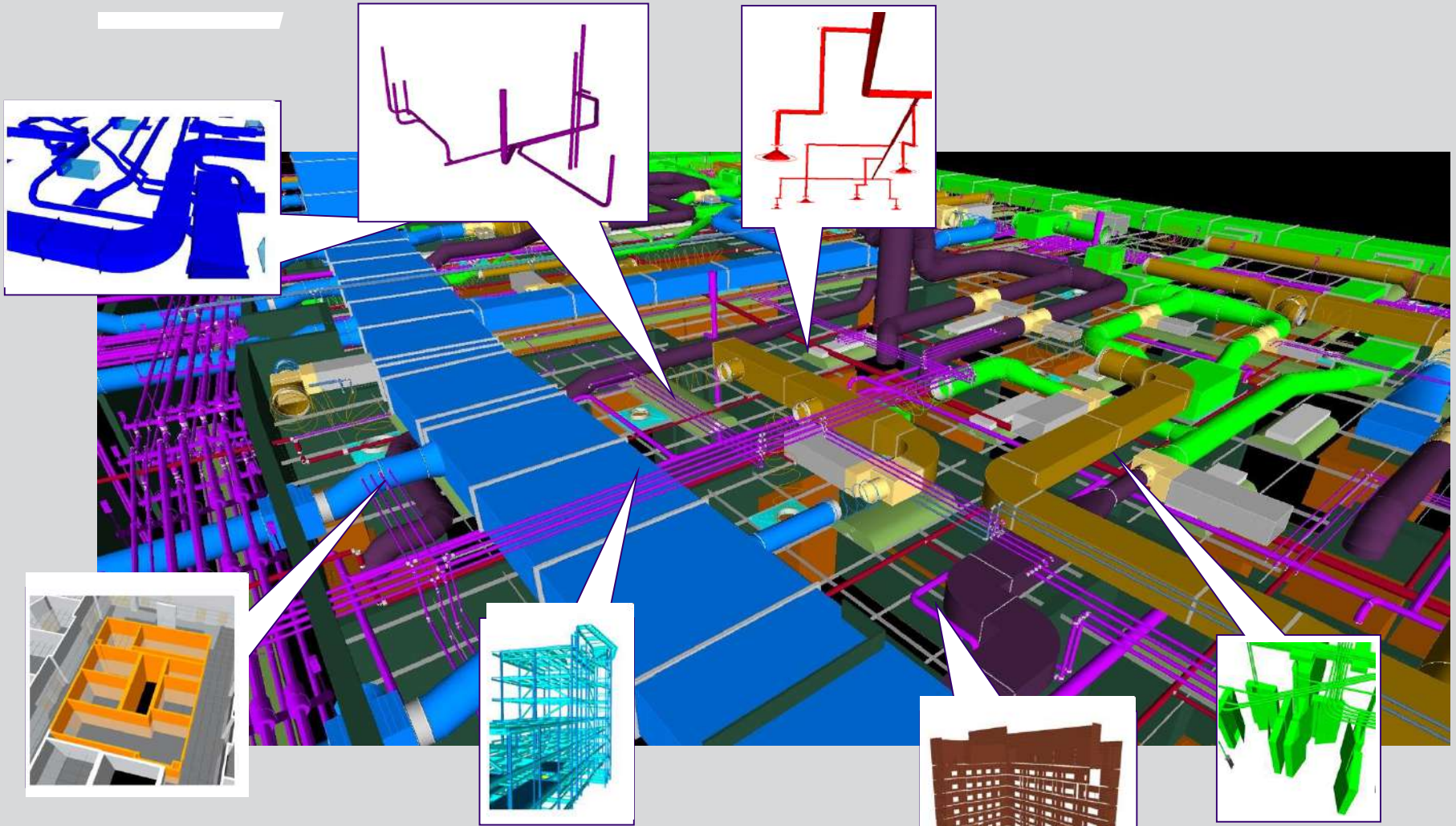
MacLeamy Curve – Integrated Design



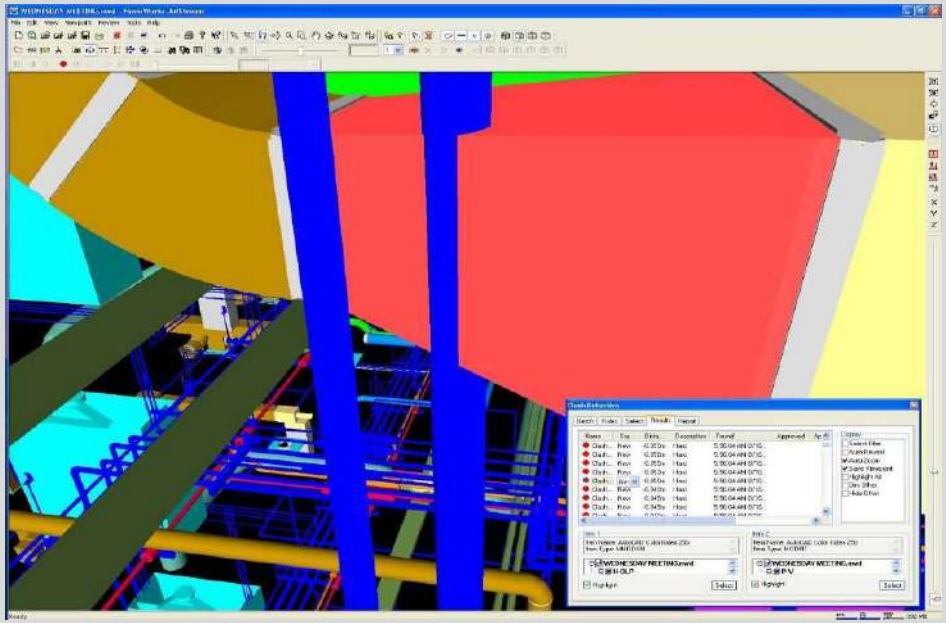
(Construction Users Roundtable, 2004)

3D Coordination
Composite Trade Coordination

3D Coordination with Consolidated (or Federated) BIM

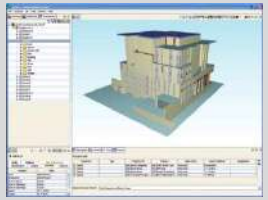


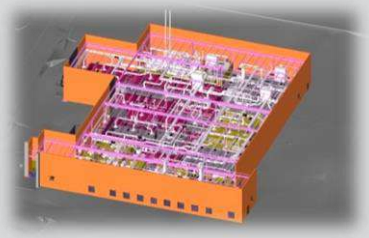
3D Coordination Meetings

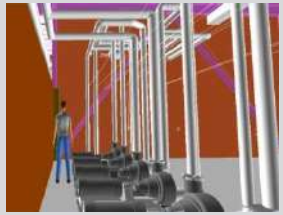


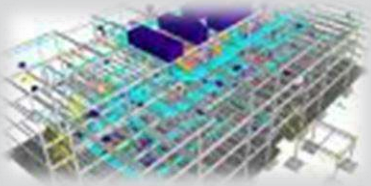
Record Modeling

Building Information Model (Design & Construction)









Building and Campus Information Management (Operations & Maintenance)

GIS

Space Planning

CMMS

Repair Orders

Reports

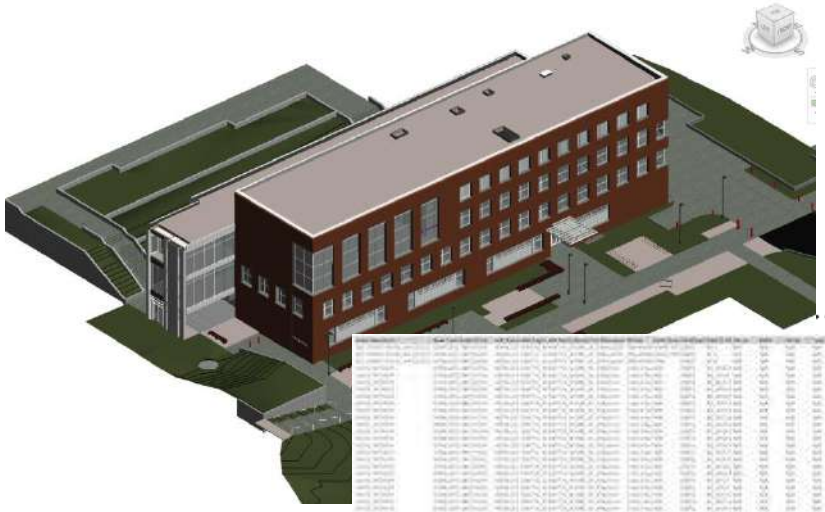
Records

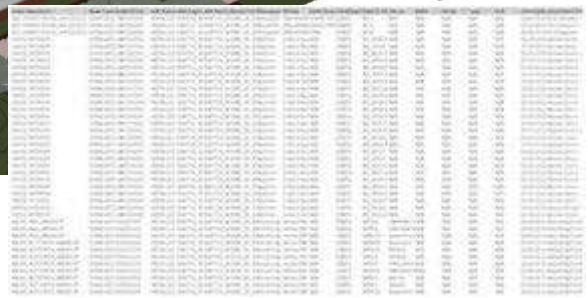
Backflow Prevention Testing

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





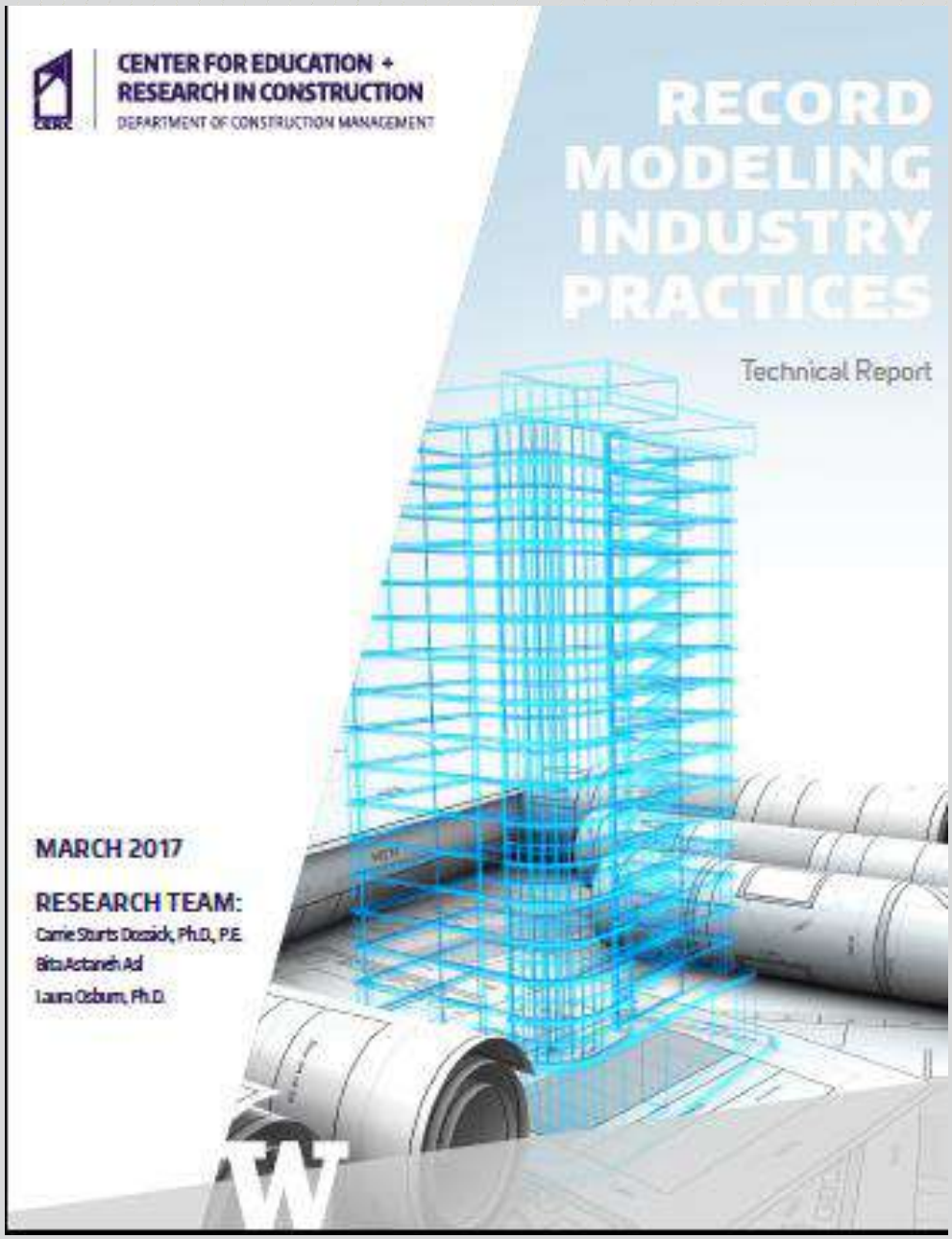
Records

BIM/CAD/GIS

CMMS

COBie/BIM (Building Information Model)

Asset Data = Make, Model, Serial Number

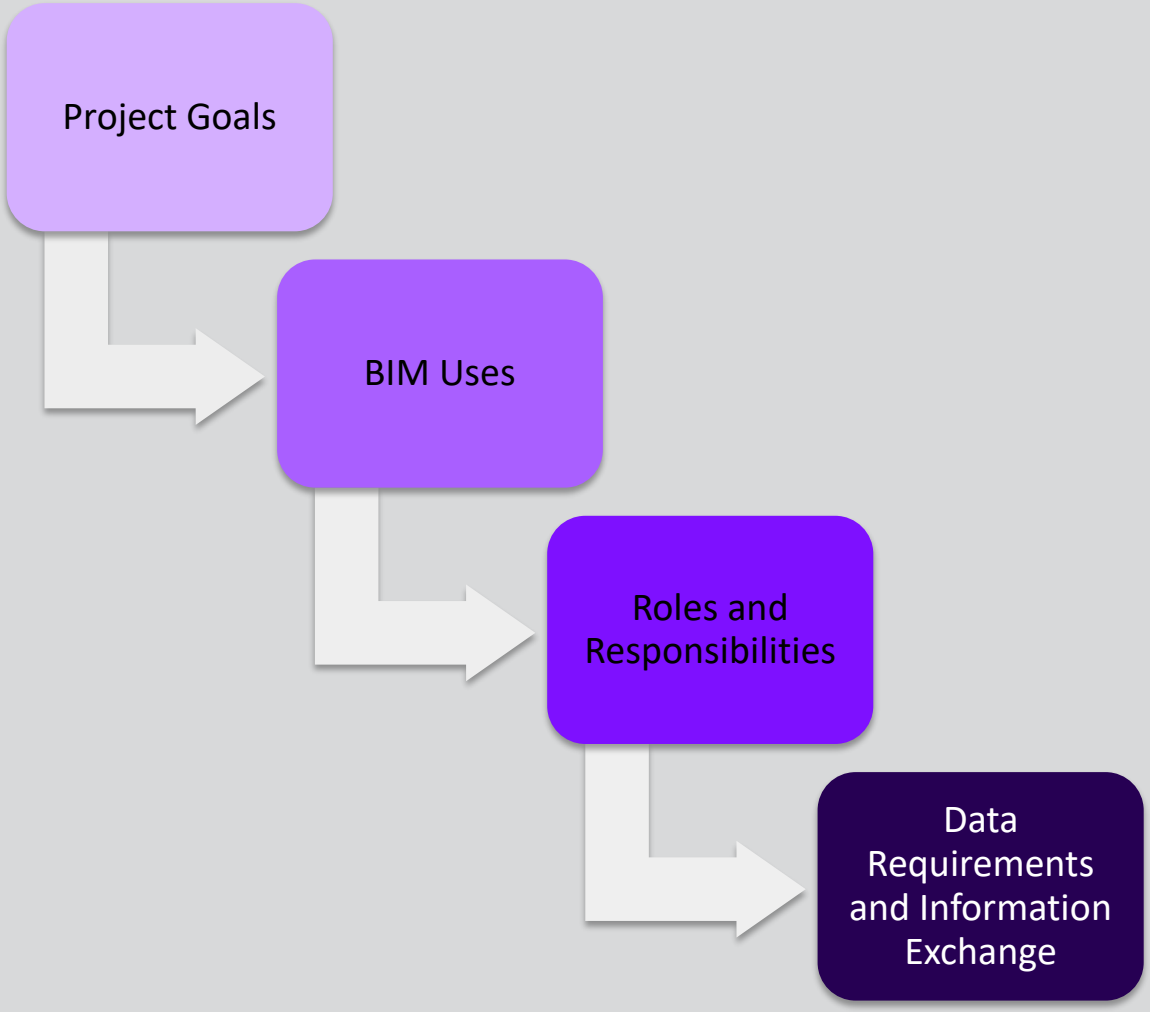


http://cm.be.uw.edu/cerc

BIM

Execution Planning

BIM Execution Planning Process



Model Element Data Requirements

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

Minimum Modeling Matrix (M3)

US Army Corps of Engineers.

Version: 1.3 (SEPT-19-2014)

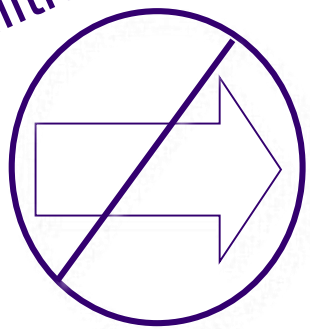
			DESIGN MODEL (CONSTRUCTION DOCUMENTS)	RECORD MODEL (AS-BUILTS)	FOR AGENCY OR CON NOT A CONTRAC
Level	Element ID	LOD	GRADE (CD)	GRADE (AB)	Primary Discipline (This will allow the team to identify discipline-specific areas of content)
Level 3	Detection and Alarm	•	•	•	Electrical
Level 4	Fire Detection and Alarm	300	A	A+	Electrical
Level 4	Radiation Detection and Alarm	300	A	A+	Electrical
Level 4	Fuel-Gas Detection and Alarm	300	A	A+	Electrical
Level 4	Fuel-Oil Detection and Alarm	300	A	A+	Electrical
Level 4	Refrigeration Detection and Alarm	300	A	A+	Electrical
Level 4	Water Intrusion Detection and Alarm	300	A	A+	Electrical
Level 3	Electronic Monitoring and Control	•	•	•	Electrical
Level 4	Electronic Detection Monitoring and Control	300	A	A+	Electrical
Level 3	Electronic Safety and Security Supplementary Components	•	•	•	Electrical
Level 4	Supplementary Components	100	-	-	Electrical

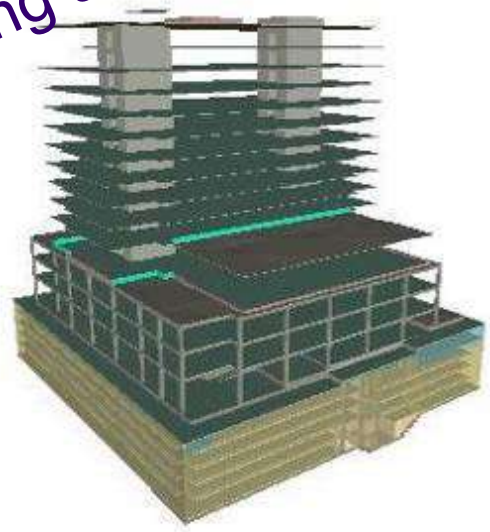
Page 7

Reluctance to exchange models

How will the contractor use the model?

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



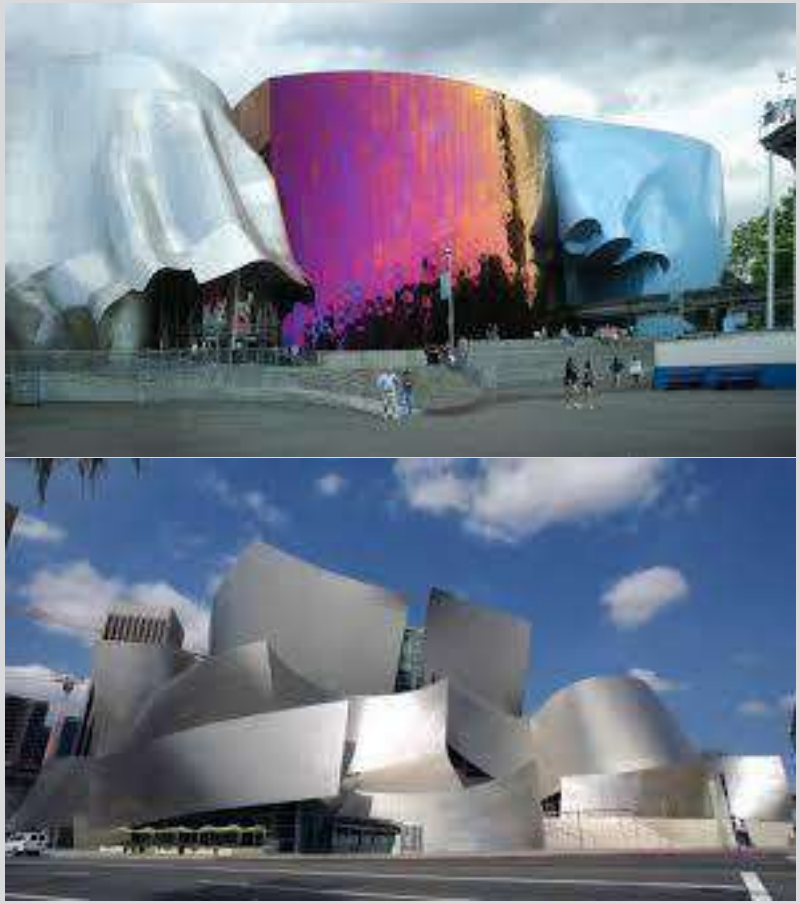


Engineer

Contractor

Who guarantees accuracy of the models, e.g., quantities?

Why not share?



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.

Guide, Instructions and Commentary to the 2013 AIA Digital Practice Documents

AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit
AIA Document G201™–2013, Project Digital Data Protocol Form
AIA Document G202™–2013, Project Building Information Modeling Protocol Form

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 1 General Provisions
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 1 General Provisions
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

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AIA E203 – 2013
Building Information Modeling and Digital Data Exhibit

- 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.

AIA A201 – 2017
General Conditions

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.

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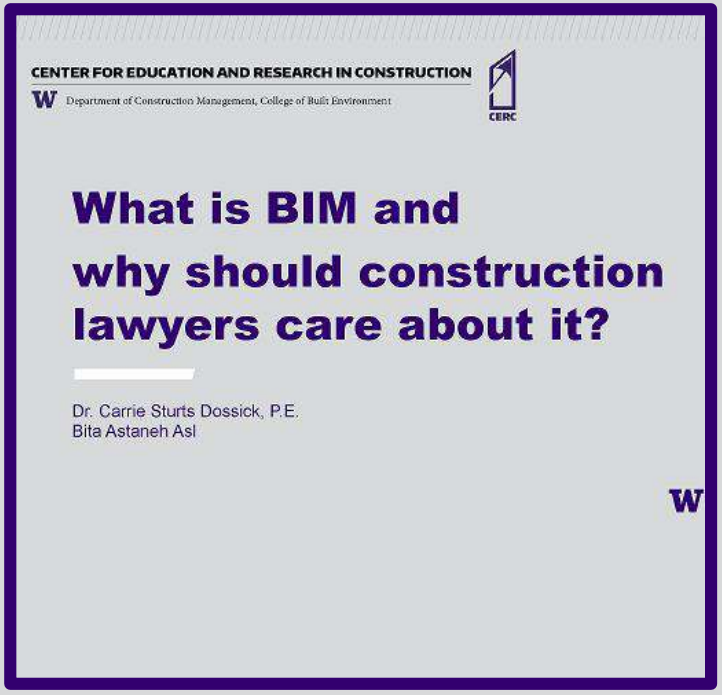

Hands On Demonstration

Bita Astaneh Asl