BIM Introduction

Building Information Management

Definitions, Applications and general information

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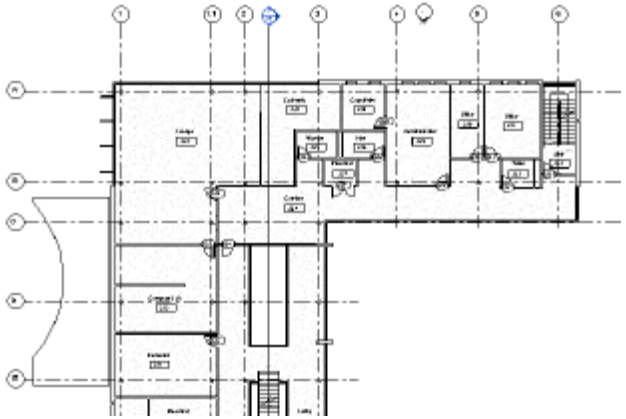


Innovations in BIM

- 3D Design: 3D visualizations allow customers to see historic preservation and site context with respect to the new project. They also allow for 3D coordination to reduce RFIs, errors and omissions10
- 4D Design (Time): Adds project phasing and construction sequencing to be added to the model

Innovations in BIM

- 4D modeling is the integration of a 3D (or BIM) model with a construction schedule in order to visualize the sequence of construction
- 4D models can be created to various levels of detail, from high-level zone analysis during the design phase, to detailed subcontractor coordination during construction
- The same model can be updated and maintained throughout the project based on the updated schedule and 3D model

Innovations in BIM

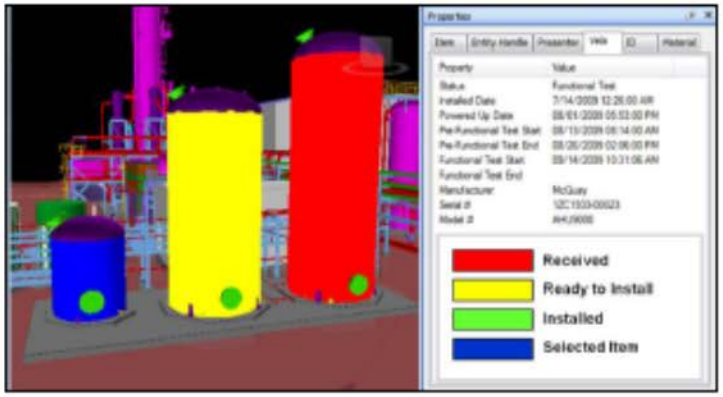
- In a 4D BIM, you would be notified that you cannot schedule installation of tie-lines until after the delayed cable trays have been installed

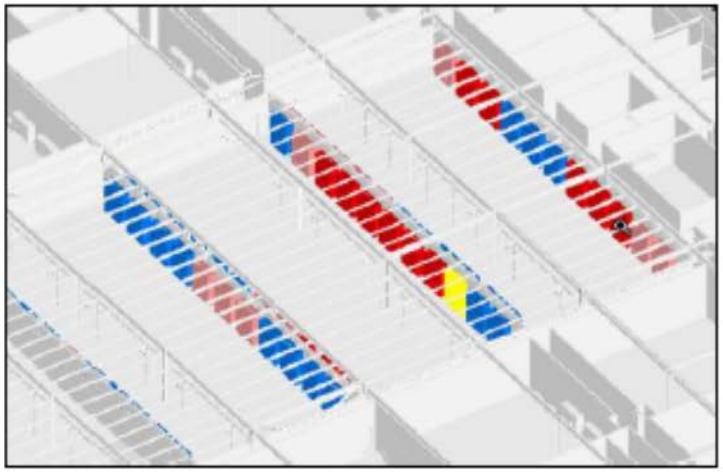
- 5D Design (Cost): Automated Quantity Take-Offs (QTO) and cost estimating, including the relationships between quantities, costs and locations

- 6D is the Maintenance

6D BIM-Enabled Facilities Maintenance

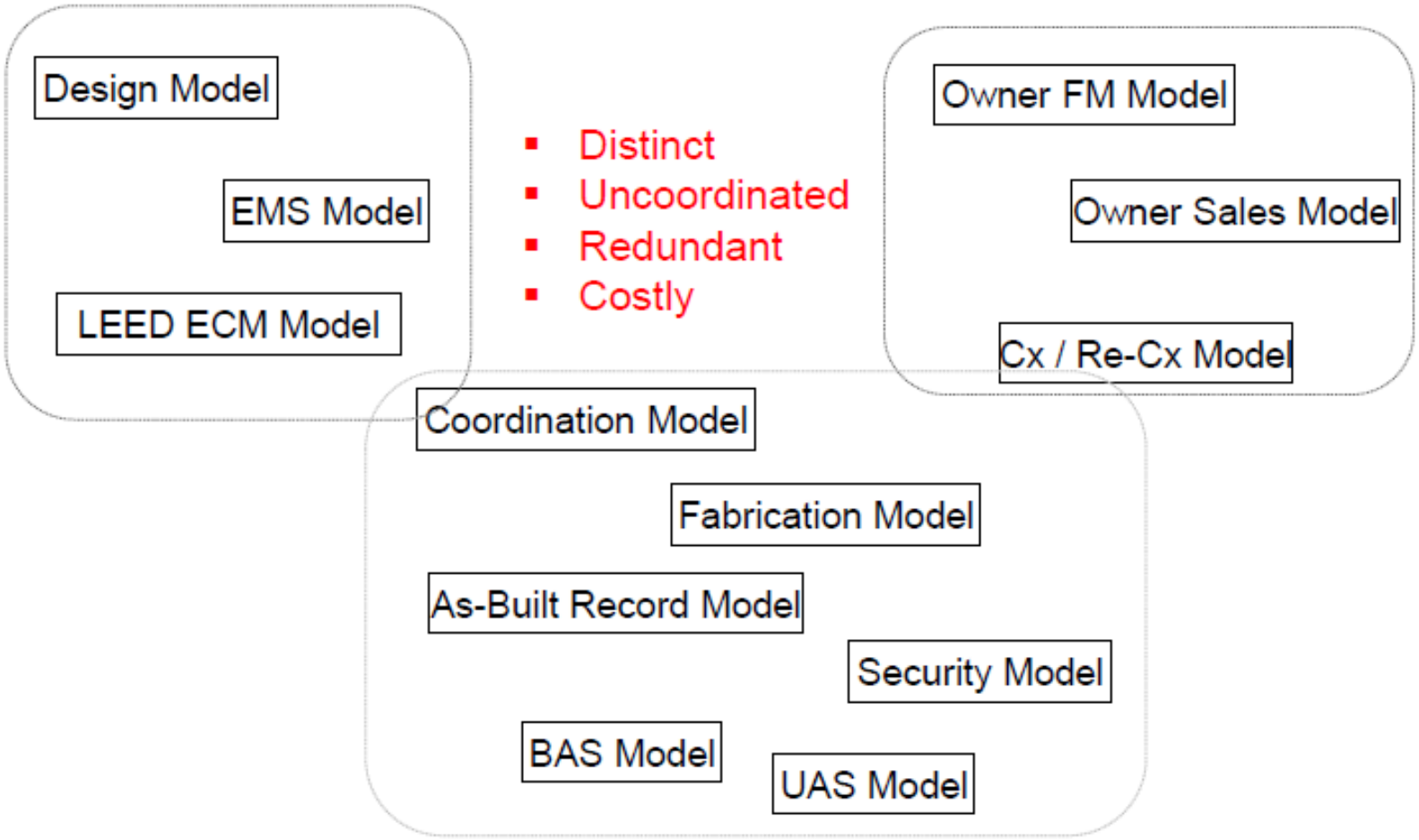
- Link BIM to FM systems as spatial/visual interface for commissioning and O&M
- Scan asset barcodes to update and track status
- "Paint" the model with alert statuses in real-time
- Process work orders *faster*
- *Reduce waste* and overhead in facilities maintenance





http://bimforum.org/wp-content/uploads/2012/10/Putting-the-BIMS-in-6D.pdf

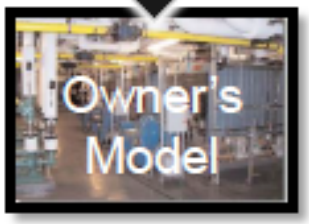
Multiple Models



Data Continuity From Design to Operations

- CAD/BIM design files
- Specifications

- CAD/BIM Superplots
- Shop Drawings
- Submittals



- CAD/BIM As-Built files
- FM Documents
- O&M information

- Old
  - Silos of information
  - Throw paper over the fence
- New
  - Electronic files in *database*
  - Layers of info added to model

Innovations in BIM

- Collision Detection: Automated ways for examining spatial and sequencing conflicts within a BIM
- For instance
  - Imagine automated notification that your cable tray now collides with the revamped air ducts
  - Thickness of existing concrete floor against the proposed level

Innovations in BIM

- Construction Operations Building Information Exchange (COBIE)
- COBIE is an information exchange format to capture the information created during design, construction and commissioning and allows this information to be passed directly to the building operator
  - The information from the model is passed directly into the owner's facility management program — without paying again for the same data.

BIM- Benefits After Close-Out

- While only a very small portion of facility life-cycle costs occur during design and construction, those are the phases where our decisions have the greatest impact
- Most of the costs associated with a facility throughout its lifecycle accrue during a facility's operations and sustainment
  - Carnegie-Mellon University research has indicated that an improvement of just 3.8% in productivity in the functions that occur in a building would totally pay for the facility's design, construction, operations and sustainment, through increased efficiency

Considerations and Limitations

BIM

Cost of Software and Hardware

- Every organization currently utilizing 2D or 3D CAD drafting software can attribute a cost element against purchasing, maintaining and upgrading software licenses to keep a competitive market advantage
- Current trends show that the cost of BIM software packages tends to be slightly more expensive than CAD software packages available on the market
- Most A/E companies can no longer request an add-on to the Fee for BIM based projects

Transition From CAD to BIM

- These tasks now require a higher-level skilled design drafter who has an understanding of the project and the materials used
- The costs associated with training and maintaining a skilled design modeler are higher than a draftsman with no knowledge of the trade
  - Companies are no longer hiring CAD Technicians, unless they demonstrate interest and basic BIM training
- AIA has projected that 80% of all designs will be modeled in BIM by 2018
  - The American Institute of Architects (AIA) has updated its Contract Documents program to integrate new language to include BIM and other digital design and communication tools

Key steps for implementation

BIM

Key Steps

- Develop a well defined BIM Execution Plan
- Analyze
  - Existing Processes
  - Technology
  - Personnel
  - Cost
  - Timeline
  - Training
  - Overall Deliverables

AS AN EXAMPLE –

BICSI BIM DRAFT DOCUMENT

ADDITIONAL INFORMATION

What is the BICSI- BIM Standard?

- The intent of this document is to expand the implementation of BIM in the telecommunications industry
  - Explain the function and different elements of BIM
  - Suggest which are most useful for telecommunications
  - And to recommend best practices for BIM's implementation and use

Scope of Standard

- Evaluate the benefits and requirements of BIM before engaging on a new project
- Better define the scope of work on a BIM project
- Have a reference point while designing for BIM
- Efficiently manage the BIM coordination

First Steps- Establish a BIM expectation plan

- AIA Document E202 BIM protocol
- Establish model sharing schedule and process
- Model coordination objectives and tolerances
- Level of development
- Progress schedule - what is to be seen in the model at what phases

First Steps- Establish a BIM expectation plan

- BIM startup matrix - what needs to be modeled for other disciplines to start
- Project origin point or common working point - to be established collaboratively near the beginning of the BIM documentation phase amongst the team members.
- Specific project areas of concern

Design Stages

- Schematic Design
- Design Development
- Bid Documents
- Construction Documents
- Close Out

Schematic Design

- Establish the horizontal equipment layouts, duct mains, large diameter conduits, cable tray, pipe mains. Establish the vertical ducts, conduits, and pipes that will be going floor to floor **(e.g.,** shafts and chases).
- The team shall review each other's plans and discuss any changes that should be made

Schematic Design

- Examples include:
  - Lights at ceiling
  - Fire protection run between lights
  - Water & gas piping 10’’ (bottom of piping) above ceiling
  - Mechanical pipe 10’’ (bottom of piping) above ceiling
  - Ductwork 18’’ (bottom of duct) above ceiling
  - Pitched piping above as tight to structure as possible

Design Development

- BIM lead shall review the model and run the clash report (Ex. Navisworks)
- Team shall discuss changes needed to clear up any clashes. If it is determined that assistance from the Architect or others is required to clear some clashes, the BIM lead will take snap shots from the model showing the conflicts. These shall be sent to the appropriate party for resolution.

Design Development

- Discuss the next steps once all clashes are resolved and the appropriate space required for the design the team has modeled has been provided

Bid Documents

- Issues with required space need to be resolved and completed by the design team
- EX.
  - Quantities and locations of telecommunications outlets shall be coordinated with the Electrical Engineer for rough-ins and ensure that there is power adjacent to the outlet.

Bid Documents

- Check for any remaining coordination issues for example, the designer may wish to verify piping for liquids or HVAC ductwork shall not be routed through telecom spaces, unless serving the room
- The ceiling space should be clear to allow the routing and installation of cable tray and cables
  - The height should be at least 2.6 m (8.5 ft.) and false ceilings shall not be installed.

Construction Documents

- A/E is expected to continuously maintain and update the model(s) with changes made during construction.

Contract Close-Out

- A/E shall update their respective models with contractor recorded changes
- Republish record documents
- Submit full model with all needed objects and reference drawings, in original authored software and in Industry Foundation Format (IFC) format (as required)

Organization of Content

- Global classification includes the following items that must be followed during the modeling output process
  - Categories
    - Subcategories
  - Families
  - Types
  - Characteristics

Categories

- BIM software usually organizes building components into categories
- The user can turn all members of a category off or on with a single checkbox or setting
  - No longer “layers”
- BIM software generally groups building components into categories based on criteria like what role the components play in a building system

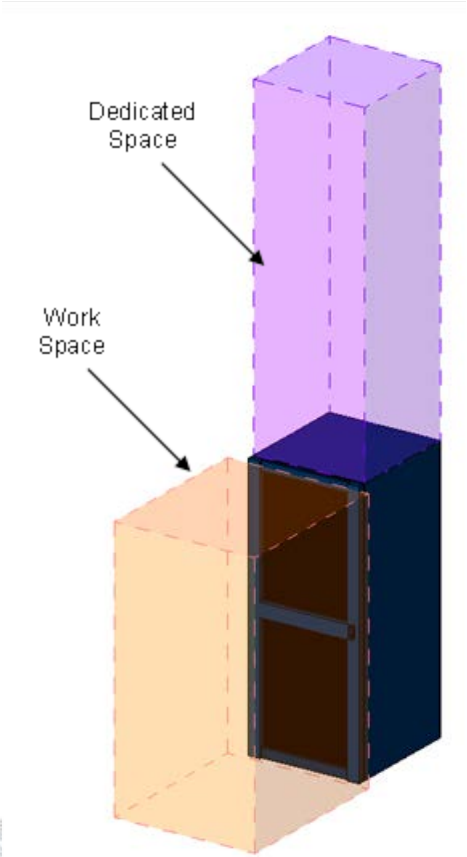
Categories

- Example categories might include
  - Walls
  - Doors
  - Nurse Call Components
  - Data Components
  - Cable Trays

Approved/ Recommended Subcategories

From BICSI Draft Document

- Work Space and Dedicated Space
- Both work spaces and dedicated spaces are best represented with 3D volumes
- These may be supplemented by 2D dashed rectangles or other representations of the zones that appear in plans
- But the 3D volumes are still needed



Levels of Detail/ Development

- In General Terms
  - LOD 100 = there is a thing
    LOD 200 = there is a thing about this size
    LOD 300 = there is a thing with these functions and options
    LOD 400 = it is this particular thing.
    LOD 500 = this particular thing provided by this person on this date

Levels of Detail/ Development

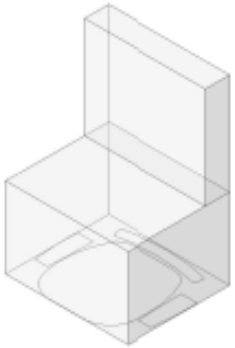
- In Specific Terms
  - LOD 100 = there is a chair
    LOD 200 = there is a chair that has nominal space requirement of 500x500
    LOD 300 = there is a chair with arm rests and wheels
    LOD 400 = manufacturer and model number.
    LOD 500 = manufacturer and model number, supplier, date purchased

Levels of Detail/ Development

- LOD is also a measure of design progress
- At LOD 100 there is obviously more work to do to reach LOD 300
  - In that sense it is like the traditional percentage complete of drawings. Assuming LOD 500 is 100%, then LOD 100 = 20%, LOD 200 = 40%, LOD 300 = 60% etc.
    Except LOD contains more information
- It tells you how decisive each element is, not just how complete its representation is on a drawing
  - It is more useful to know that on a plan the floor is 60% complete (LOD 300), the walls are 50% complete (LOD 250) and the service ducts are 40% complete (LOD 200), rather than the whole drawing is 50% complete (the average of all elements)

Levels of Detail/ Development

LEVEL of DEVELOPMENT

LOD 100	LOD 200	LOD 300	LOD 400	LOD 500
				
Concept (Presentation)	Design Development	Documentation	Construction	Facilities Management
DESCRIPTION: **Office Chair** Arms, Wheels WIDTH: DEPTH: HEIGHT: MANUFACTURER: Herman Miller, Inc. MODEL: Mirra LOD: **100**	DESCRIPTION: **Office Chair** Arms, Wheels WIDTH: **700** DEPTH: **450** HEIGHT: **1100** MANUFACTURER: Herman Miller, Inc. MODEL: Mirra LOD: **200**	DESCRIPTION: **Office Chair** **Arms, Wheels** WIDTH: **700** DEPTH: **450** HEIGHT: **1100** MANUFACTURER: Herman Miller, Inc. MODEL: Mirra LOD: **300**	DESCRIPTION: **Office Chair** **Arms, Wheels** WIDTH: **685** DEPTH: **430** HEIGHT: **1085** MANUFACTURER: **Herman Miller, Inc** MODEL: **Mirra** LOD: **400**	DESCRIPTION: **Office Chair** **Arms, Wheels** WIDTH: **685** DEPTH: **430** HEIGHT: **1085** MANUFACTURER: **Herman Miller, Inc** MODEL: **Mirra** PURCHASE DATE: **01/02/2013**

(Only data in **red** is useable)

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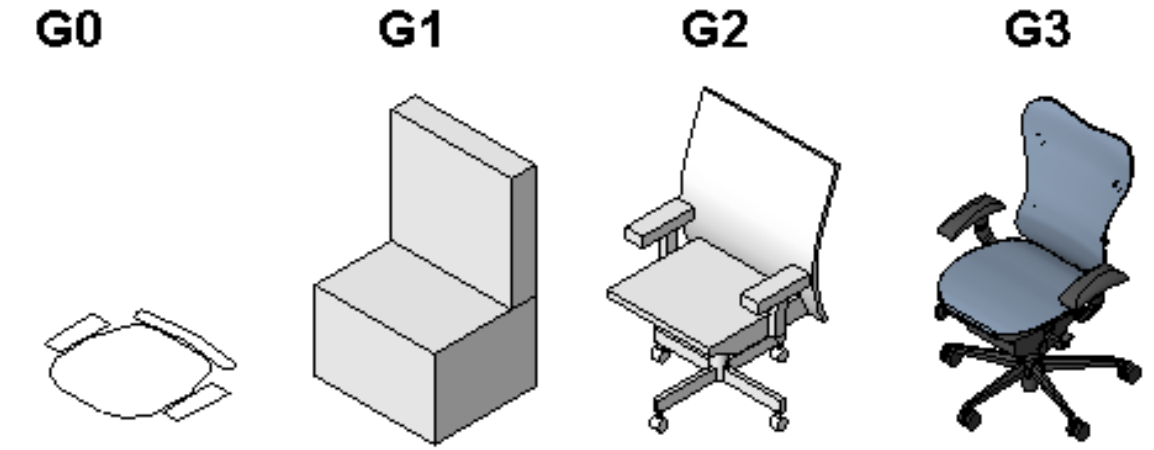
Levels of Detail/ Development

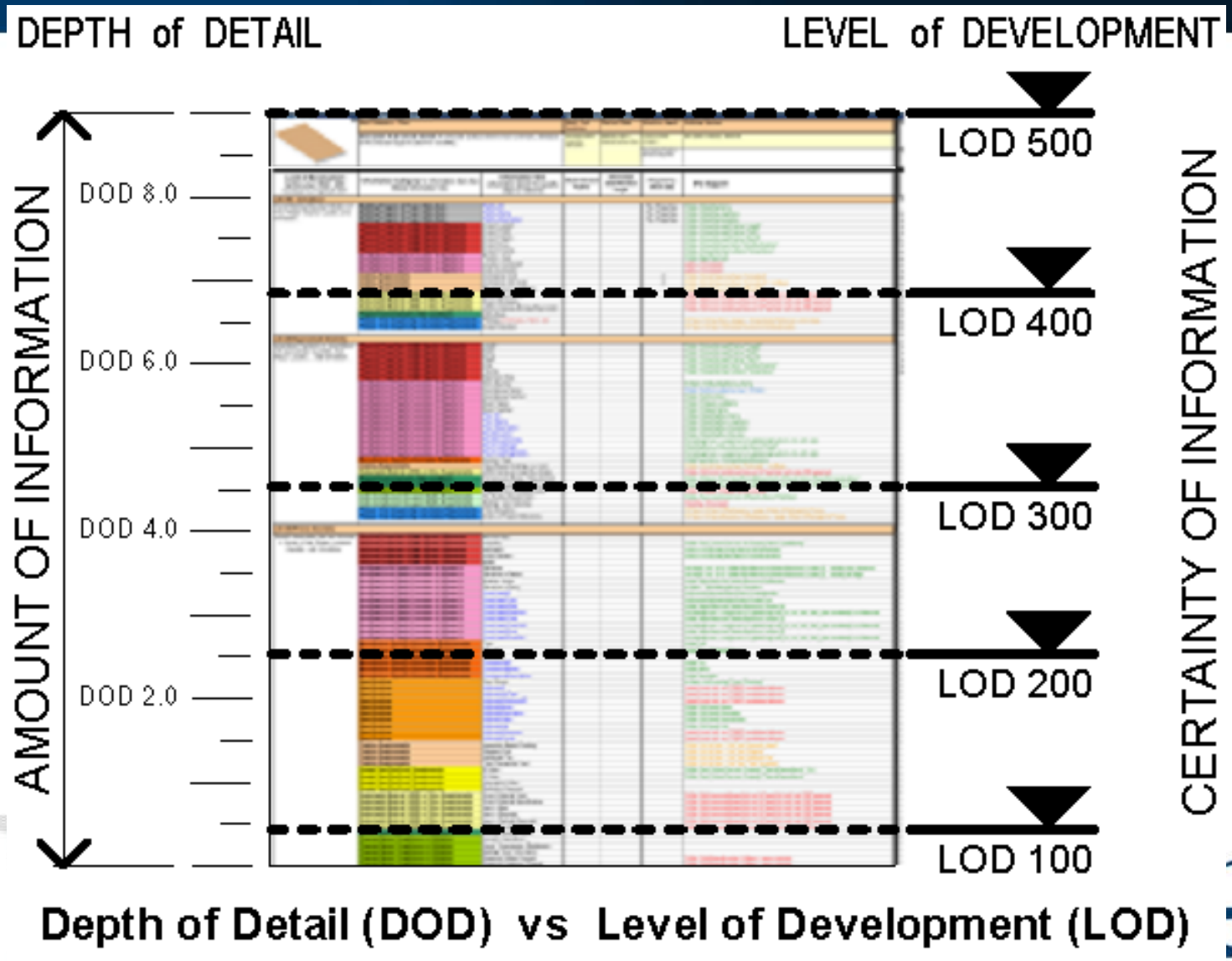
LEVEL of DETAIL



G0	G1	G2	G3
DESCRIPTION: Office Chair WIDTH: DEPTH: HEIGHT: MANUFACTURER: MODEL:	DESCRIPTION: Office Chair WIDTH: 700 DEPTH: 450 HEIGHT: 1100 MANUFACTURER: MODEL:	DESCRIPTION: Office Chair Arms, Wheels WIDTH: 700 DEPTH: 450 HEIGHT: 1100 MANUFACTURER: Herman Miller, Inc MODEL: Mirra	DESCRIPTION: Office Chair Arms, Wheels WIDTH: 700 DEPTH: 450 HEIGHT: 1100 MANUFACTURER: Herman Miller, Inc MODEL: Mirra

(based on AEC [UK] BIMprotocol v2.0 - Component Grade)

Levels of Detail/ Development

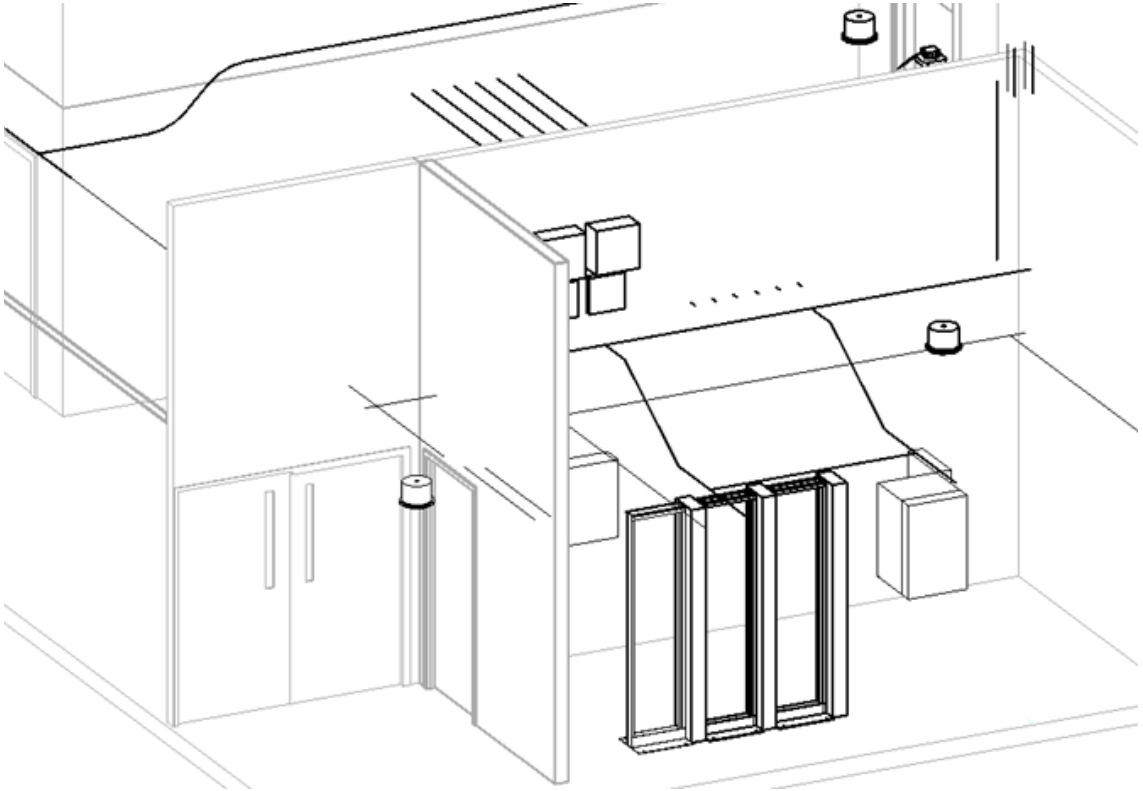


Levels of Detail/ Development

- It is a concept, not a rule
- Why not have an LOD parameter for objects in your model to track progress and work as a QA check?
- For Example

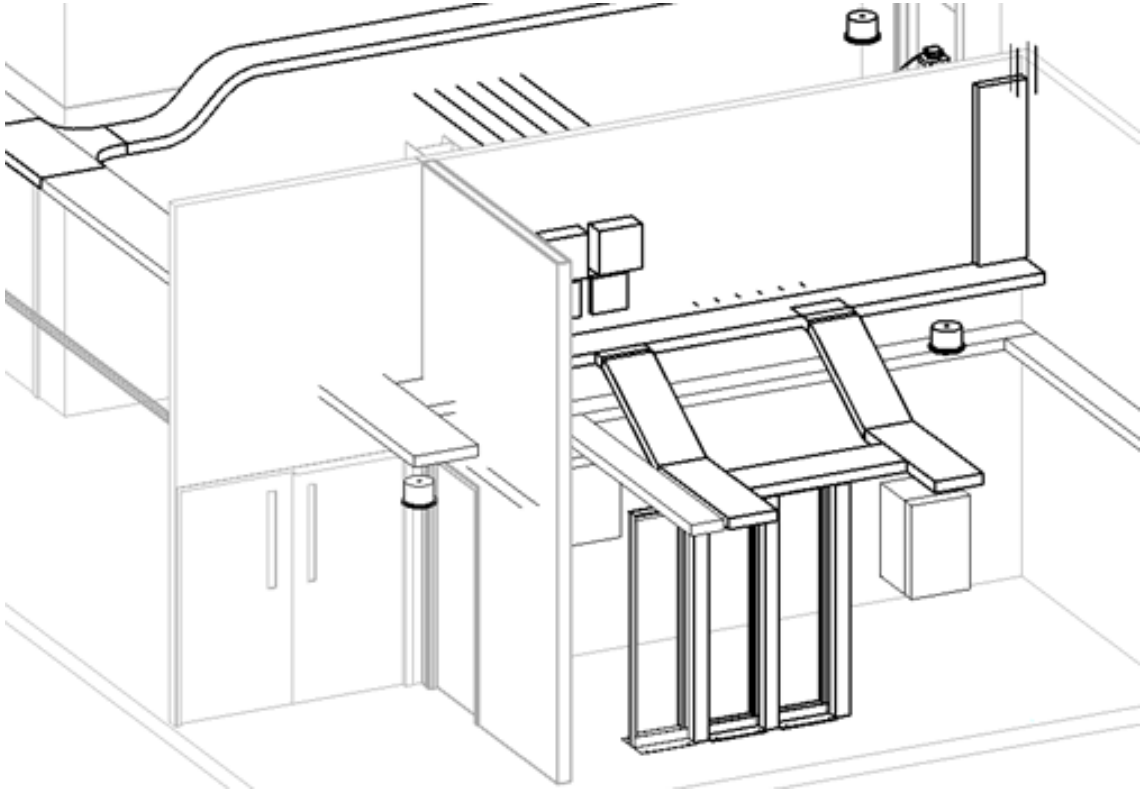
  - LOD 290 = preliminary construction defined;
  - LOD 292 = checked for functional requirements;
  - LOD 294 = checked for fire requirements;
  - LOD 296 = checked for smoke requirements;
  - LOD 298 = checked for acoustic requirements;
  - LOD 300 = final construction

Levels of Detail/ Development



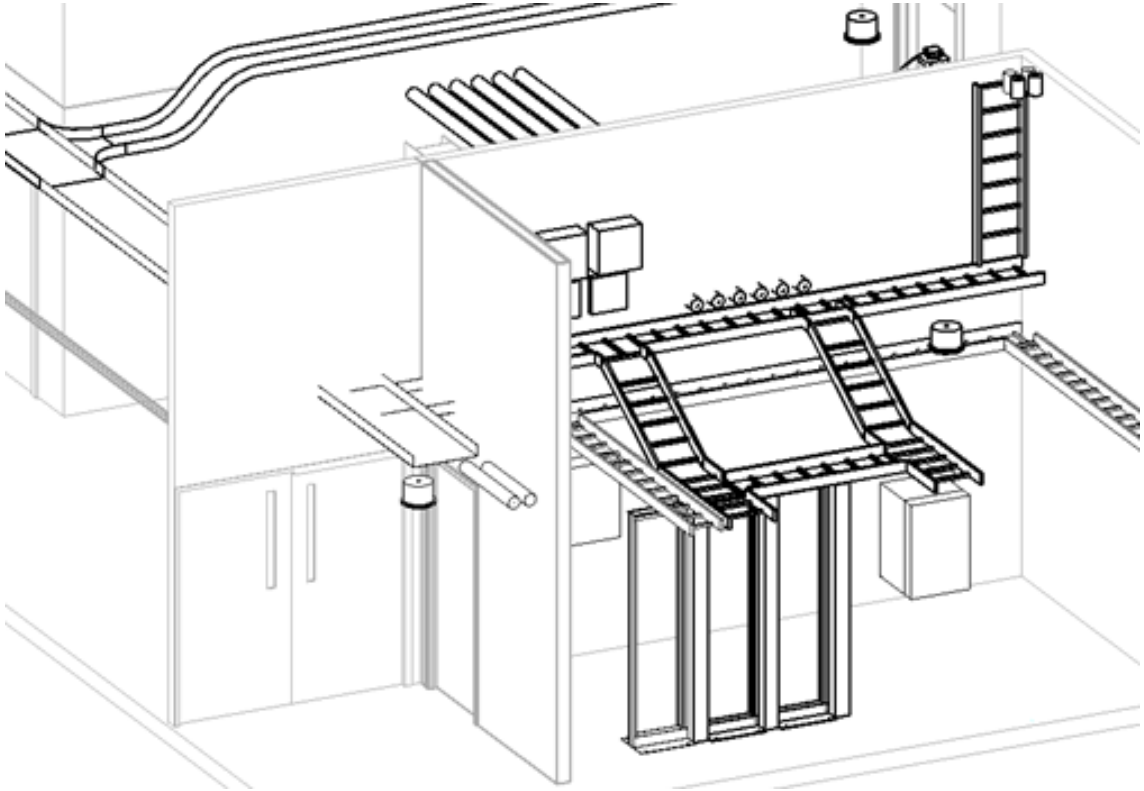
Example of a Technology Room at a Low Level of Detail

Levels of Detail/ Development



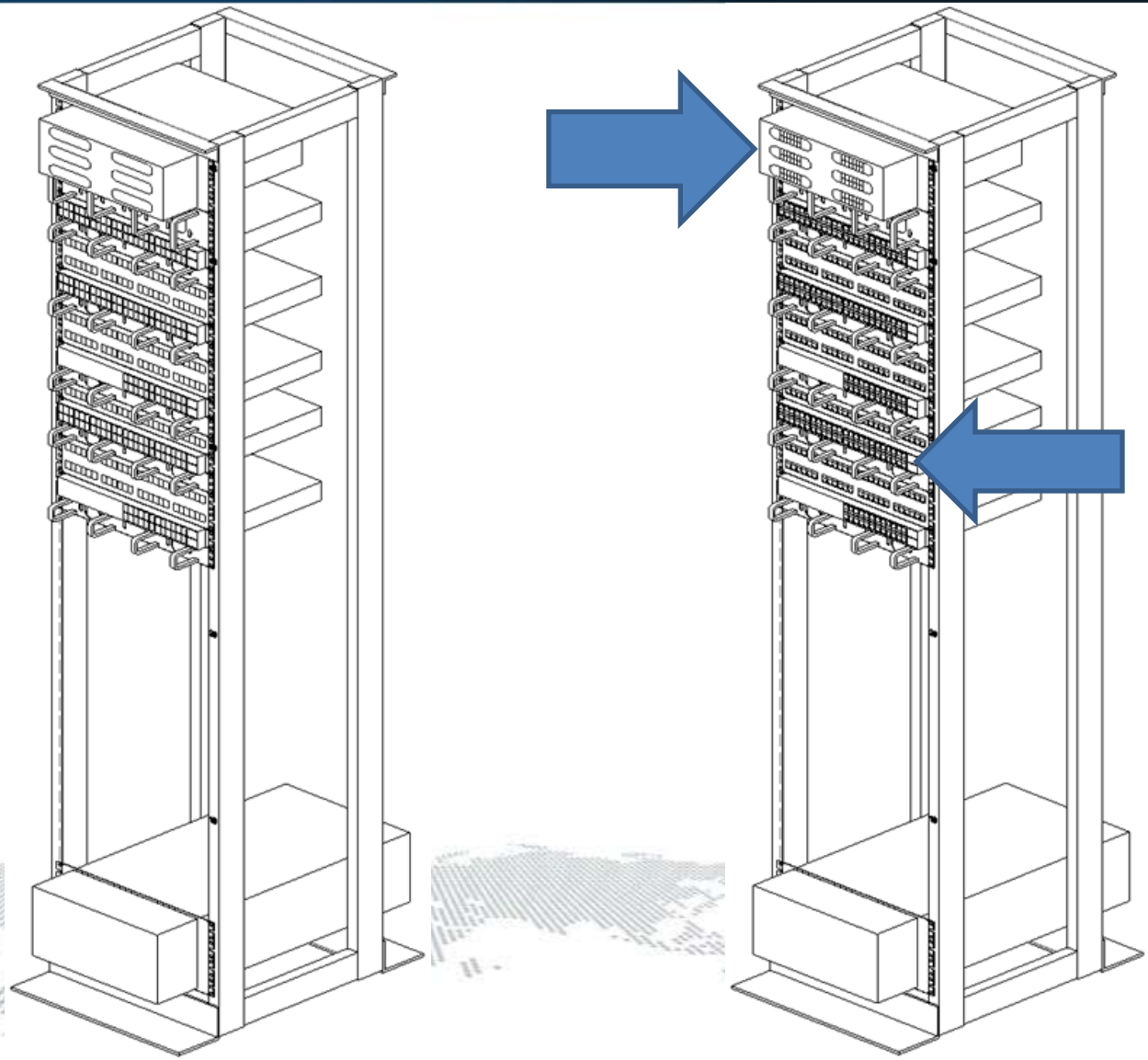
Example of a Technology Room at an Intermediate Level of Detail

Levels of Detail/ Development



Example of a Technology Room at a High Level of Detail

Levels of Detail/ Development



Object Parameters

- Parameters are a series of data containers within a BIM object
- These containers hold all the intelligence of the object
  - From the geometric constraints
  - To its performance characteristics and behaviors, and those pieces of information that can, if needed, make the exact information for each Instance be identifiable and unique

glossary

BIM

Glossary

- **2D export** Also known as a “2D take-off”. A 2-D export is a set of two-dimensional drawings derived from the design model. This is required for design team members who are still working in 2D. It is also utilized for pricing sets and final construction sets for bidding by trades.
- **4D** Leveraging BIM for project time allocation and construction sequence scheduling presentations (phasing\ sequencing)
- **5D** Leveraging BIM for cost and simulation of construction, focusing on building sequence, cost, and resources (cost estimating)
- **BIM** Building Information Modeling, was coined in early 2002 by industry analyst Jerry Laiserin to describe virtual design, construction and facilities management. BIM processes revolve around virtual models that make it possible to share information throughout the entire building industry.

Glossary

- **Clash detection** is a process of discovering the building system conflicts and issues by collaborating in 3D during the MEP model coordination process. Sometimes referred to as interference checking.
- **COBIE** Construction-Operations Building Information Exchange, is a standard way to manage information from a BIM model that is essential to support the operations, maintenance and management of the facilities by the owner and/or property manager. The COBIE approach is to enter the data as it is created during design, construction and commissioning. Designers provide floor, space and equipment layouts. Contractors provide make, model and serial numbers of installed equipment. Much of the data provided by contractors comes directly from product manufacturers who also participate in COBIE

Glossary

- **Constructability model** is a BIM model used to simulate the actual components of a building in 3D, created as the building would be built, used primarily for MEP model coordination, 4D simulations and 5D estimating or quantity take-offs (compare with design model).
- **Content:** models of devices, equipment, fittings, etc., which are suitable for use in BIM project models
- **CSI** Construction Specifications Institute

Glossary

- **Design model** is a BIM model developed by an architect from whom the automated construction documents are derived, along with automated schedules, details and client presentations (compare with constructability model).
- **Energy model** is the virtual representation of how a building will consume energy. These models are required to achieve the highest number of LEED points for energy efficiency. DOE2, eQuest, IES and Ecotect are common applications for this modeling

Glossary

- **Families** are parametric 3D building components used in Revit
- **Firm:** this refers to a consultant company, such as an MEP “firm”. This will be referenced in the context of “an RCDD’s ‘Firms’ content”
- **Generic:** “Generic Content” is referred to as non-manufacturer specific content. Generic content is what a lot of firms use early on in the building design phases because full requirements are not fully known at such an early stage

Glossary

- **IPD** Integrated Project Delivery, a new project workflow method and supporting contracts developed by the AIA, which leverages early contributions of knowledge and expertise through the utilization of new technologies, allowing all team members to better realize their highest potentials while expanding the value they provide throughout the project life cycle. IPD avoids the realization phase challenges by allowing project data to be analyzed and understood prior to construction.

Glossary

- **Level of Design (Detail) –LOD**
  - LOD 100 = there is a thing
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Glossary

- **MasterFormat** is the recognized industry standard for categorizing building products for more than 40 years. MasterFormat 2004 Edition replaces MasterFormat 1995, expanding the well-known 16 divisions to 50 divisions of construction information. www.csinet.org
- **MEP coordination** is the process undertaken during pre-construction to uncover any building system conflicts with mechanical, electrical, plumbing or fire protection systems using 3D models integrated into one master model that can facilitate interference checking or clash detection

Glossary

- **NCS** National CAD Standard, a U.S. government-sponsored standard that coordinates the efforts of the entire industry by classifying electronic building design data consistently allowing streamlined communication for the industry. (www.buildingsmartalliance.org)

Glossary

- **Objects** are parametric 3D building components used in ArchiCAD and stored in object libraries.
- **Parametric modeling** is defined by rules and constraints, which define aspects of the building and their relationships to each other. Variables control behavior in 3D geometry.
- **Point cloud survey** is a 3D laser scan of existing conditions which captures points in space (x, y, z coordinates).

Glossary

- **Reflected Ceiling Plan:** a type of scaled drawing, common in architecture but uncommon in technology engineering, in which the underside of a ceiling is drawn as if the floor of the building was a mirror and the ceiling appeared reflected in it
- **Rendering** For development of the design, presentations and client sign-off, very detailed and life-like images of the model are created

Glossary

- **Revit:** an offering of BIM software provided by Autodesk, Inc
- **Scale-Dependent:** a graphical depiction of an item, having a plotted size that is dependent on the scale of the drawing in which it appears, i.e., being drawn to scale.

Glossary

- **Scale-Independent:** a graphical depiction of an item, having a plotted size that is always the same, regardless of the scale of the drawing in which it appears. For example a triangular symbol for a faceplate, which always appears 4.8 mm (0.19 in) on a side, regardless of the scale of the drawing
- **SMARTcodes** International Code Council's effort to support automated code check of BIM models. (www.iccsafe. org)