

FAB22538 Fabrication and BIM Forum 2016 Level Of Development (LOD) Specification

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Principal

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Class summary

The presentation will provide an in-depth discussion of fabrication and Level Of Development (LOD) from the 2016 AGC BIM Forum LOD Specification from one of the specifications authors. It will address model elements at the different stages in a building life cycle: Design, Construction and Ownership. The framework of the discussion will consider the LOD Specification that defines models on a scale of 100 to 500 with a particular focus of LOD 350 which the speaker originally authored and introduced to the LOD Specification committee. The content will discuss how structural element models are used by architects, mechanical engineers, construction managers, sub-contractors and fabricators. This will demonstrate how the newly issued LOD Specification can be used to define team expectations of what should be modeled. Practical examples of model detail issues will be shown along with effective approaches to resolve the challenges using the LOD Specification as an early BIM planning tool.

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Key learning objectives

At the end of this class, you will be able to:

1. Define what is Model Element Level Of Development (LOD) for design.
2. Understand what the AGC BIM Forum LOD Specification 2016 is and how you can address LOD in projects with it.
3. Understand how the LOD Specification can be used with design and construction teams to lower risk.
4. Understand why LOD discussions are crucial early on in a project



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- **IKERD** is an internationally recognized consulting group in **buildings, civil and industrial** construction markets.
- Using our knowledge of engineering, team dynamics, communication and technology, we have built an extensive breadth of experience on a wide variety of integrated construction project types with BIM.
- Engineering and construction grade modeling.
- 3D laser scanning.





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Chair Sub-Committee on Dev., Soft. & Train.
Served since 2007

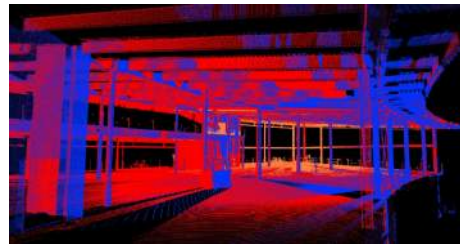
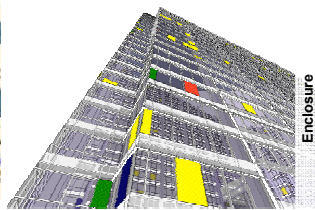
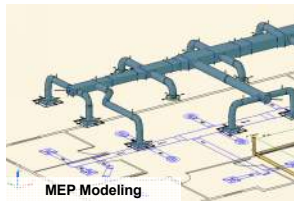
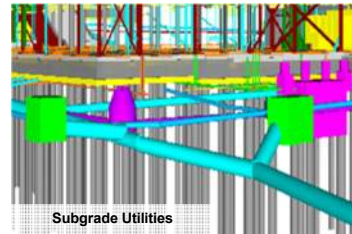
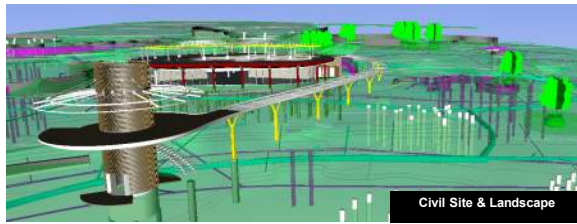


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2016 LEVEL OF DEVELOPMENT SPECIFICATION
October 19, 2016

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Level Of Development (LOD)

Milestones/Deliverables

Model Elements	100	200	300	350	400
Building Systems					
Structural					
Mechanical					
Electrical					
Plumbing					
HVAC					
Interior					
Exterior					
Landscaping					
Site					
Utilities					
Transportation					
Water					
Sewer					
Stormwater					
Other					

PARTICIPATING ORGANIZATIONS

The American Institute of Architects | AGC of America | BIM-B | USIBD | PCI Concrete Institute | U.S. Institute of Building Technology

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Level Of Development (LOD)




Major Take Away

“Everything should be made as simple as possible, but not one bit simpler.”

Albert Einstein

Why LOD?: Model Element Handoffs



*There's many a slip
between
the cup and the lip*



BIM Forum Level of Development

Milestones/Deliverables

Model Elements		SD		DD		CD	Constr. Coord.	Fabrication
Building Systems								

PARTICIPATING ORGANIZATIONS



The American
Institute
of Architects

AGC of America
THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA
Quality People. Quality Projects.



BIM-M
Building Information Modeling
for Masonry



BI

Precast/Prestressed
PCI Concrete Institute



USIBD
U.S. Institute of
BUILDING DOCUMENTATION

BIMFORUM Level of Development Specification

- Scope cannot address all of BIM
- There is NO LOD of a whole model.
- LOD does not always match design phase.
- **2008** - American Institute of Architects (AIA) First Published definition for 100, 200, 300 & 400 in 2008 E202.
- **2009-10** LOD 350 was authored and first presented at Autodesk University sessions by Ikerd.
- **2011** - BIM Forum LOD Taskforce formed
- **2013** – BIM Forum published the first LOD Spec ratifying LOD 350
- BIM forum LOD Specification is published yearly: '13, '14, '15, & '16.



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



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

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LOD 100

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LOD SPEC. 2016



The Model Element may be graphically represented in the Model with a **symbol** or other generic representation, but does not satisfy the requirements for LOD 200.

Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.

BIMFORUM
LOD SPEC. 2016

BIMForum Interpretation: LOD 100 elements are **not geometric representations**. Examples are information attached to other model elements or symbols showing the existence of a component but not its shape, size, or precise location. Any information derived from LOD 100 elements must be considered approximate.

LOD 200

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LOD SPEC. 2016



The Model Element is graphically represented within the Model as a generic system, object, or assembly with **approximate** quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

BIMFORUM
LOD SPEC. 2016

BIMForum Interpretation: At this LOD **elements are generic placeholders**. They may be recognizable as the components they represent, or they may be volumes for space reservation. Any information derived from LOD 200 elements must be considered approximate.

LOD 300

BIMFORUM
LOD SPEC. 2016



The Model Element is graphically represented within the Model as a **specific system**, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

BIMFORUM
LOD SPEC. 2016

BIMForum Interpretation: The quantity, size, shape, location, and orientation of the element as designed can be **measured directly from the model without referring to non-modeled information** such as notes or dimension call-outs.



LOD 350: Detailed Coordination

BIMFORUM
LOD SPEC. 2016

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ONLY

The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, location, orientation, **and interfaces with other building systems**. Non-graphic information may also be attached to the Model Element.

BIMFORUM
LOD SPEC. 2016

BIMForum Interpretation: **Parts necessary for coordination** of the element with nearby or attached elements are modeled. These parts will include **such items as supports and connections**. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modeled information such as notes or dimension call-outs.



LOD 400: Fabrication Assemblies

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LOD SPEC. 2016



The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation **with detailing, fabrication, assembly, and installation information**. Non-graphic information may also be attached to the Model Element.

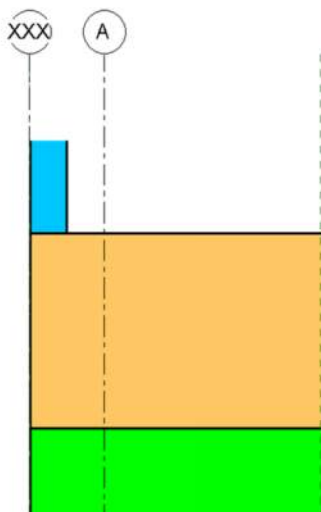
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LOD SPEC. 2016

BIMForum Interpretation: An LOD 400 element is modeled at sufficient detail and accuracy for fabrication of the represented component. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modeled information such as notes or dimension call-outs.

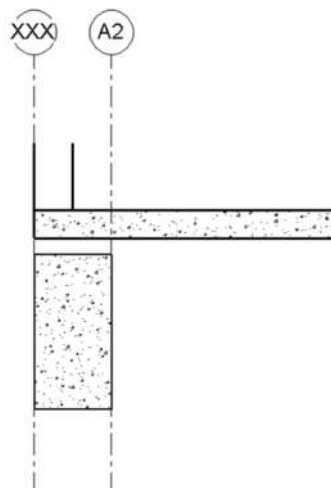
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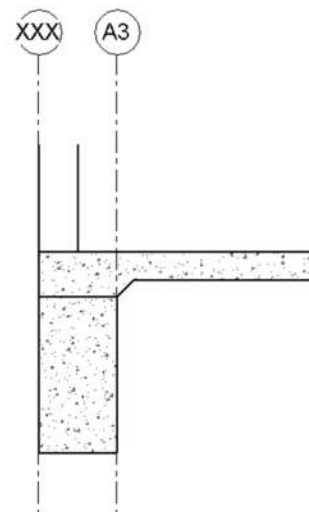
CONCRETE CAST-IN-PLACE



LOD 200



LOD 300



LOD 350

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WHY LOD 350 – CROSS TRADE COORD.

**LOD 300
PERMIT**

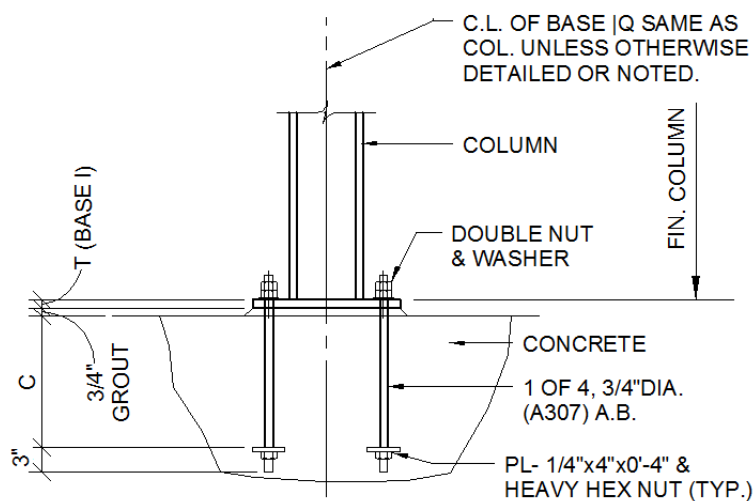


**LOD 400
FABRICATED**

~20% OF EFFORT

W/ ~80% CONSTRUCTION \$\$\$

Steel Base Plate Design Drawings








LOD Specificaion

Level of Development
Specification
Version: 2013

www.bimforum.org/lo

B1010.10 – Floor Structural Frame (Steel Framing Columns)

100	Generic column element, See B11	
200	See B11	
300	Element modeling to include: <ul style="list-style-type: none"> Specific sizes of main vertical structural members modeled per defined structural grid with correct orientation Required non-graphic information associated with model elements includes: <ul style="list-style-type: none"> Structural steel materials defined. Connection details. Penetration, i.e. overhead, gopherport, etc. 	
350	Element modeling to include: <ul style="list-style-type: none"> Actual elevations and locations of member connections. Large elements of typical connections applied to all structural steel connections such as base plates, gusset plates, anchor bolts, etc. Any reinforcement steel members with correct orientation. Any steel structure reinforcement such as web stiffeners, diaphragm stiffeners, etc. 	
400	Element modeling to include: <ul style="list-style-type: none"> Welds Coupling of members Cap plates Washers, nuts, etc. All assembly elements 	

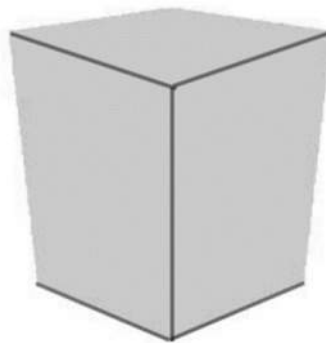
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Base Plate LOD 100



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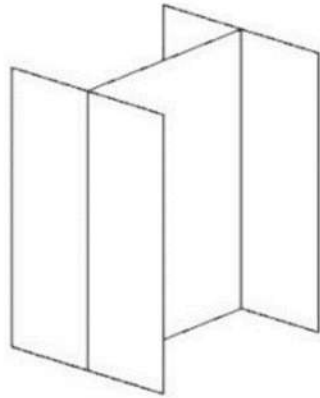
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Base Plate LOD 200

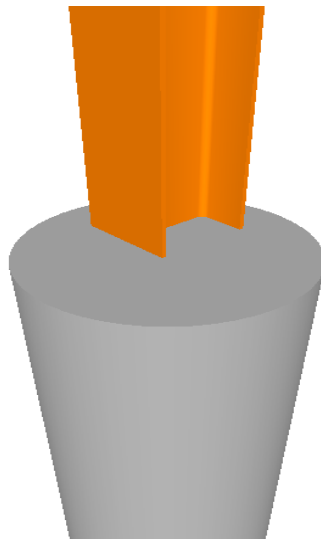


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Base Plate LOD 300

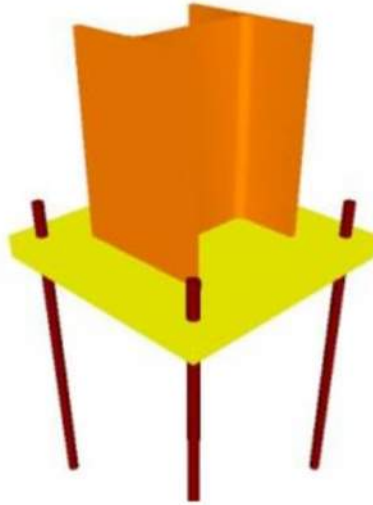


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Base Plate LOD 350

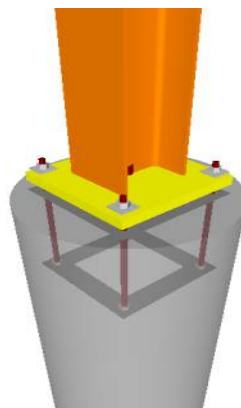


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Base Plate LOD 400

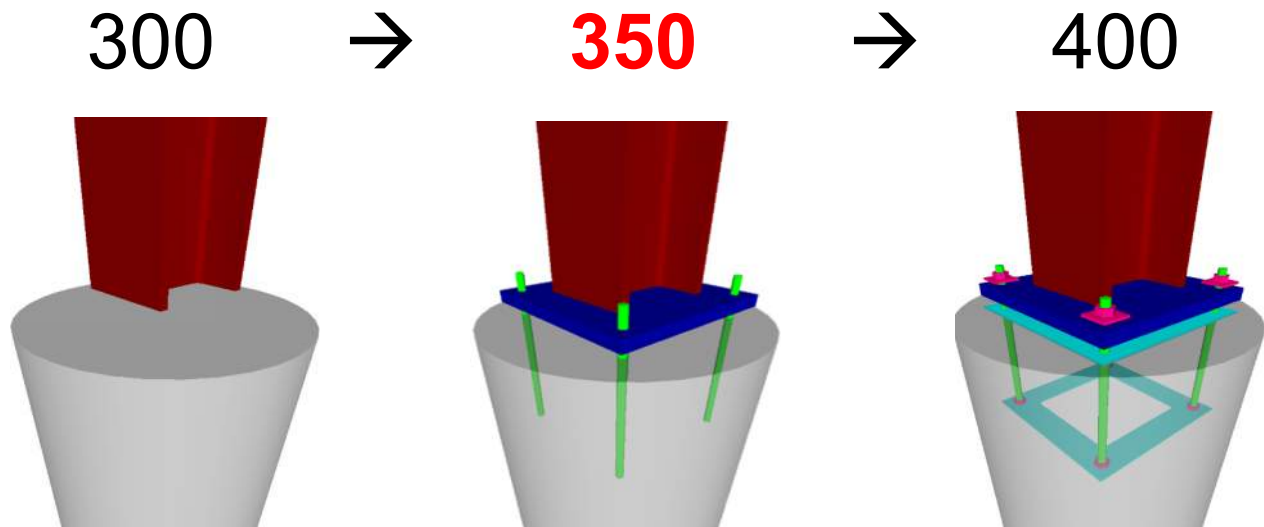


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LOD Specification Example



Images courtesy of IKERD Consulting, LLC

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Cold Formed Metal Framing (CFMF) BIM

Level of Development Specification Version: 2014 www.bimforum.org/lof

C1010 — Interior Wall (Cold-Form Metal Framing)	
100	See C1010
200	See C1010
300	See C1010

76 C1010-05-LOD-200 Interior Wall (Cold-Form Metal Framing)

77 C1010-05-LOD-300 Interior Wall (Cold-Form Metal Framing)

Level of Development Specification Version: 2014 www.bimforum.org/lof

400	<p>Cold formed metal framing is developed with sufficient elements that support the fabrication of the CFMF system.</p> <p><i>Image notes:</i></p> <ol style="list-style-type: none"> 1) Connection content is development in the wall elements. This includes but is not limited to fasteners, clips, and other related hardware. 2) Cladding and sheathing are not shown for clarity in this image.
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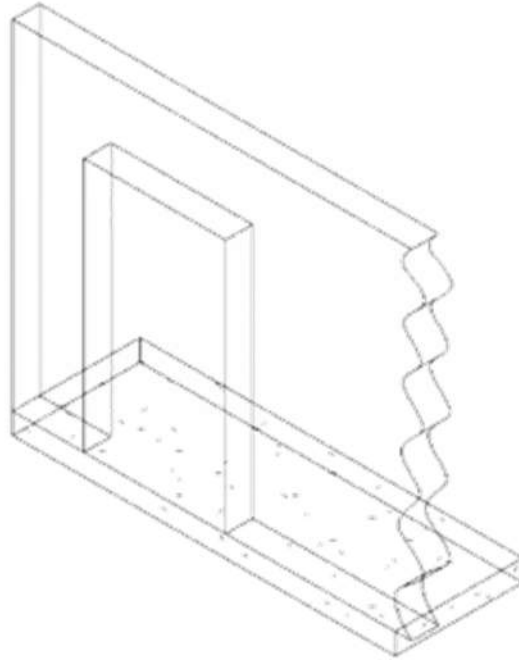
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LOD 200

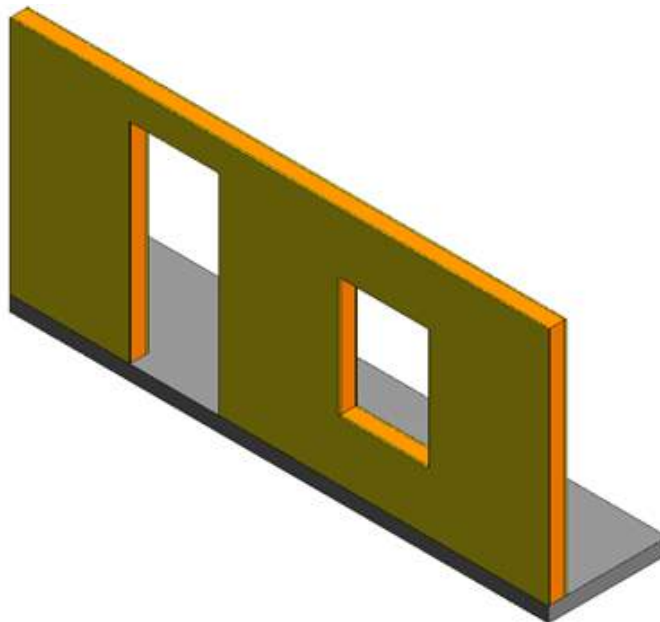


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LOD 300

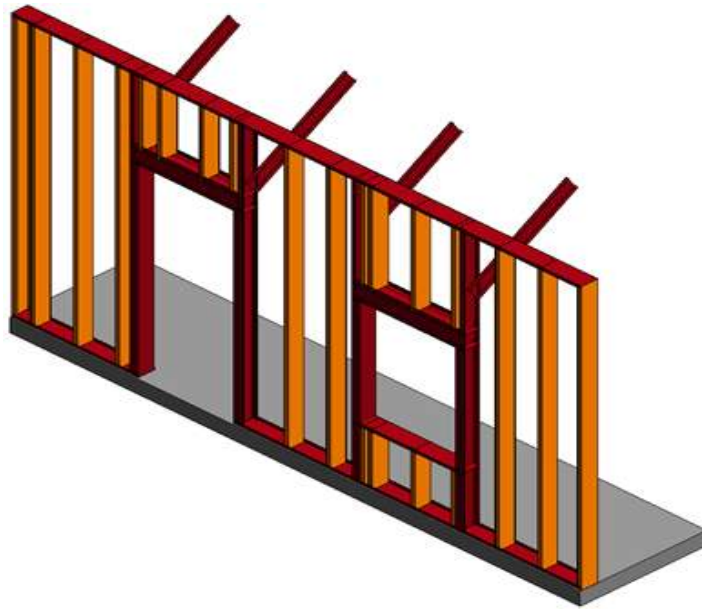


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LOD 350

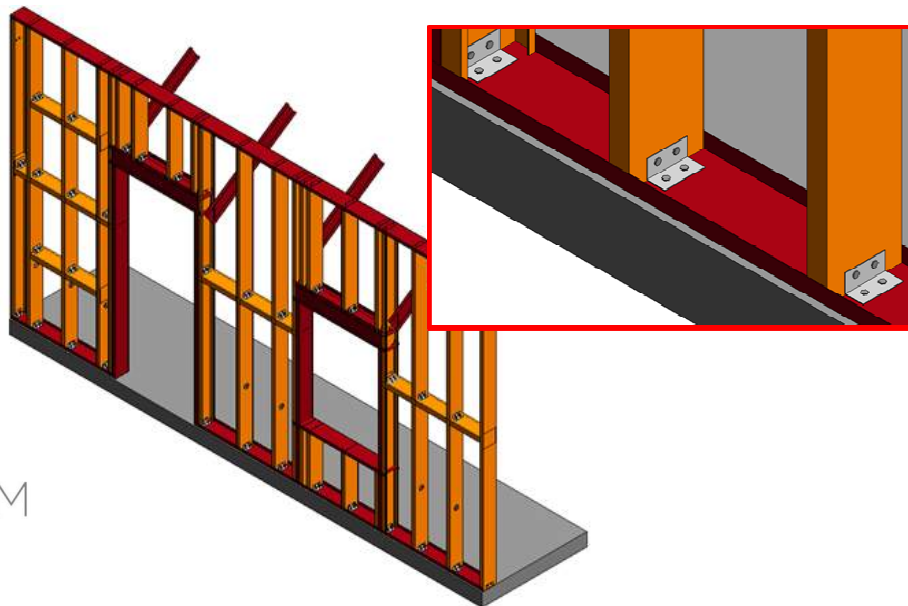


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LOD 400



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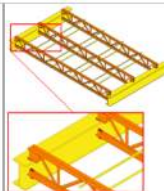
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STEEL JOIST INSTITUTE

B1010.10 – Floor Structural Frame (Steel Joists)

100	See 800	
200	Element modeling to include: <ul style="list-style-type: none"> Approximate depth 	
300	Element modeling to include: <ul style="list-style-type: none"> Joint size, depth, slope, and material Typing and end elevation Joint end depth Required nongeometric information associated with model elements includes: <ul style="list-style-type: none"> Non-standard joint seat depths and/or sloping joint seat Member designation, load capacity and deflection rating Design loads and location of concentrated loads Material requirements 	
350	Element modeling to include. Information needed for cross trade collaboration: such as: <ul style="list-style-type: none"> Actual final plate locations with accurate panel points Joint bridging and lateral bracing The connection modeling Any miscellaneous steel protruding to the joint Joint seat width Endplate details for installation Chord and web member center profiles are defined Joint layout in coordination with metal deck hardware should be coordinated Non-standard joint seat depths and/or sloping joint seat 	
400	Element modeling to include: <ul style="list-style-type: none"> Welds Connection plates Member fabrication part number Quantity Sealing Anchorage Material required for proper installation Mark identification that correlates with bill of material Type of shop paint if required 	

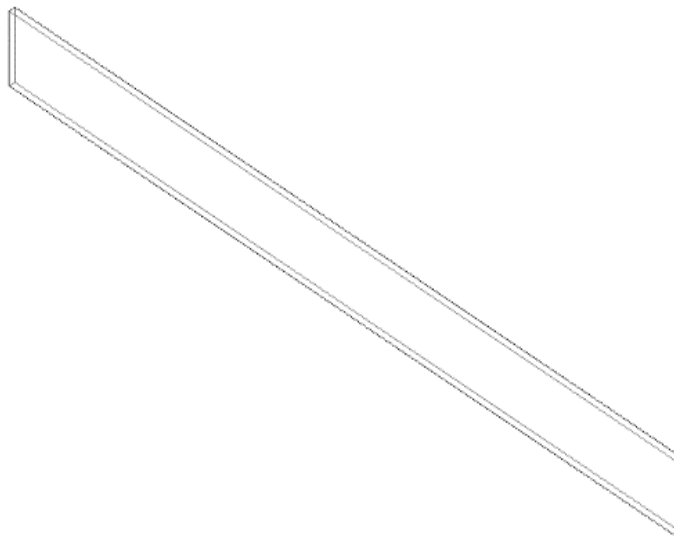


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LOD 200



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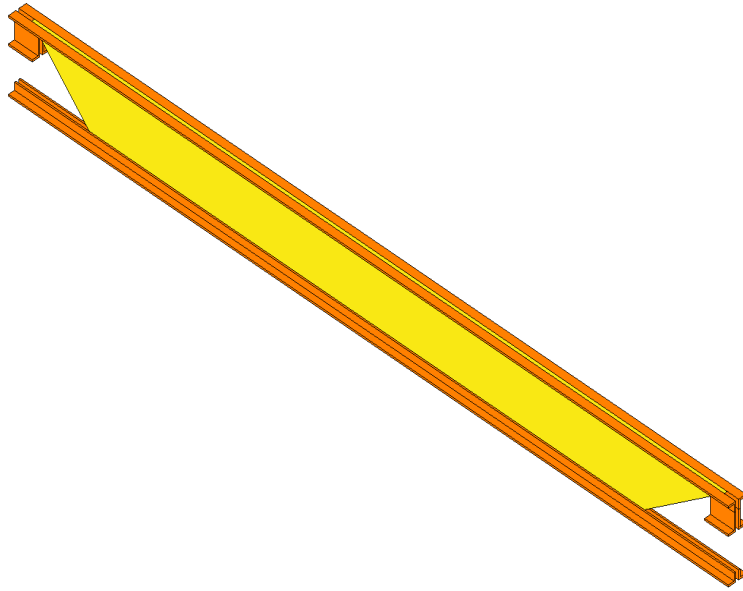
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LOD 300

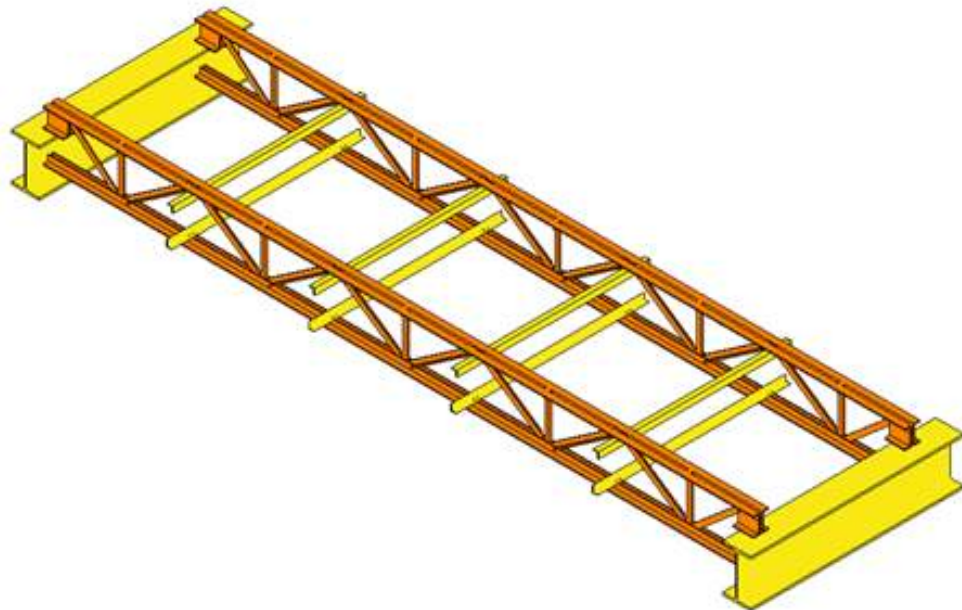


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LOD 350

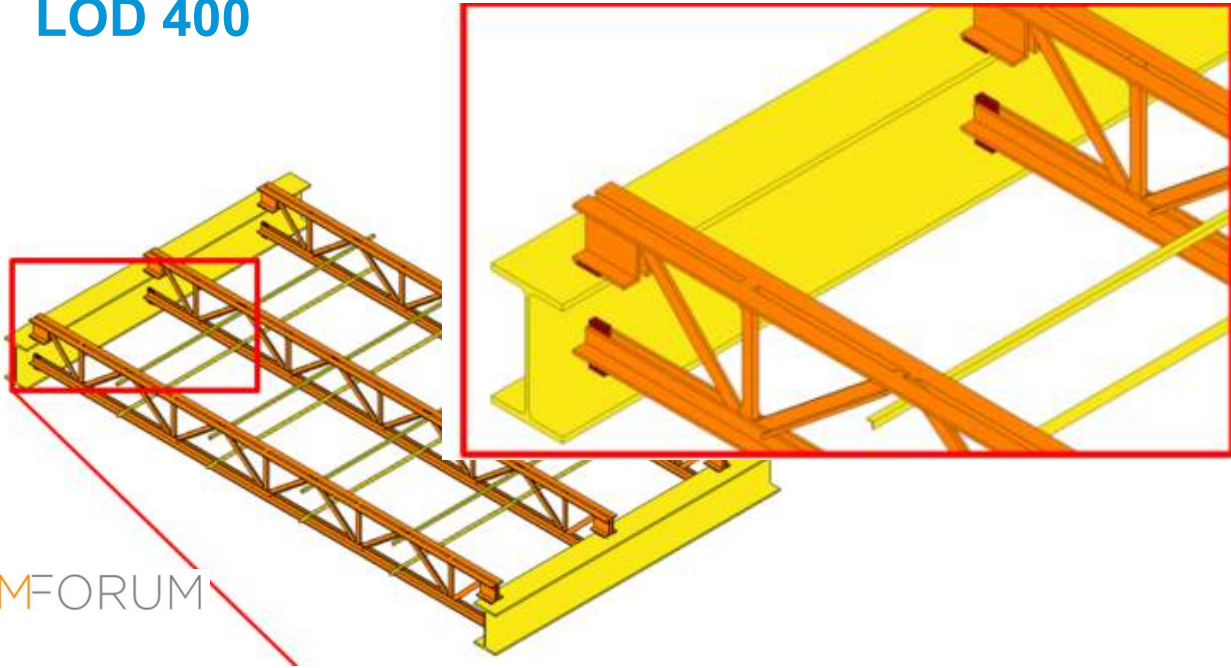


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LOD 400



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Masonry

Level of Development Specification
Version: 2016

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www.bimforum.org/lo

Uniformat	Omniclass
B2010	21-02 20 10 Exterior Walls (Masonry)

Includes: Exterior Wall Supplementary Components as appropriate. Includes Exterior Wall Opening Supplementary Components as appropriate. Includes: Solid wall construction that is composite in nature; in other words, multiple layers of materials to form an overall assembly.

Associated MasterFormat Sections: 01 43 16

100	See B2010	
200	See B2010	<p>68 B2010.04-200 Exterior Wall (Masonry)</p>
300	Element modeling to include: <ul style="list-style-type: none"> Element with design-specified locations and geometries Required non-graphic information associated with model elements includes: <ul style="list-style-type: none"> Member size, depth, and material with sloping geometry Spacing and end elevations Design loads Deflection criteria 	<p>69 B2010.04-300 Exterior Wall (Masonry)</p>

380	Element modeling to include: <ul style="list-style-type: none"> Members included at any interface with wall edges (top, bottom, sides or opening through wall) Openings modeled with support framing around openings Any regions that would impact coordination with other systems such as but not limited to: <ul style="list-style-type: none"> Roof Beams & Lintel Regions Reinforcing & Embedded Regions Joint Regions Any other grouted regions 	<p>70 B2010.04-380 Exterior Wall (Masonry)</p>
400	Element modeling to include: <ul style="list-style-type: none"> Reinforcing Connections Grouting Material Jams Steel Beams Lintels Member fabrication part number Any part required for complete installation 	<p>71 B2010.04-400 Exterior Wall (Masonry)</p>

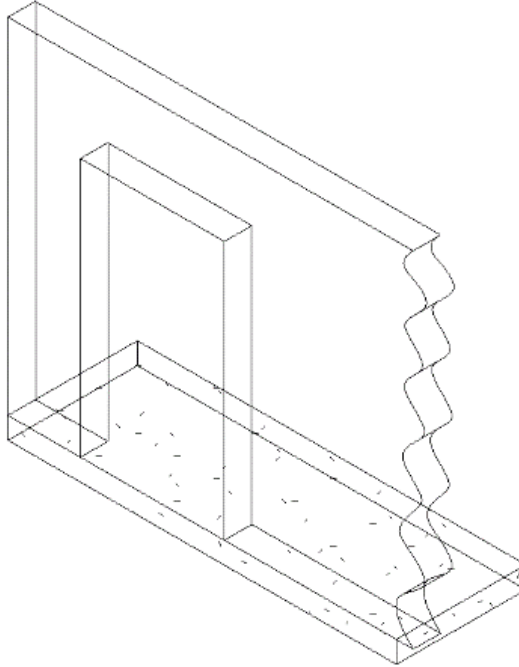
Reference Part 5 Attribute Tables for non-graphical information

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LOD 200

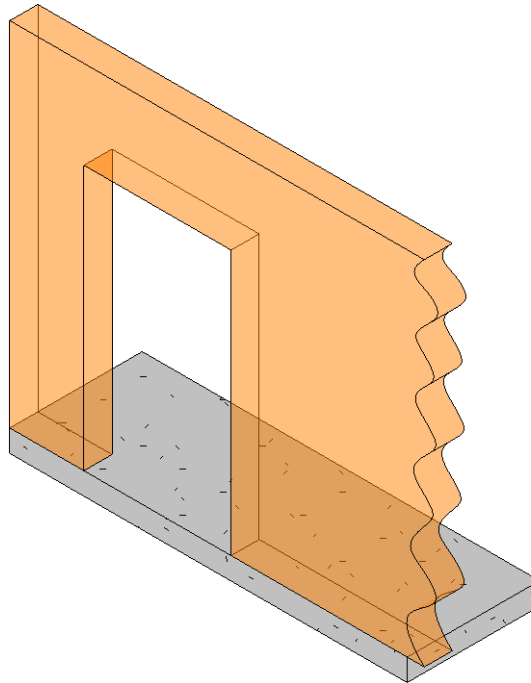


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LOD 300

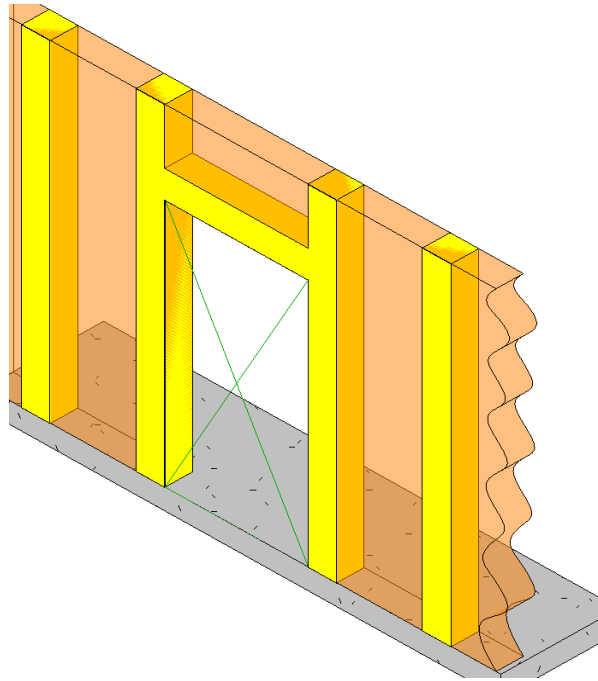


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LOD 350

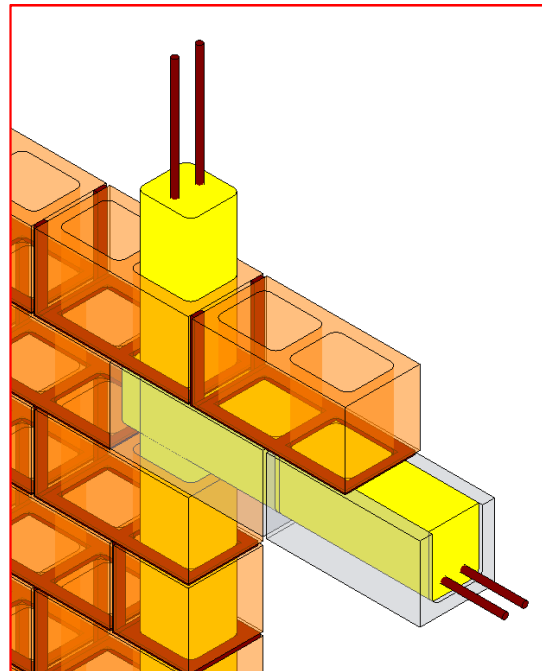
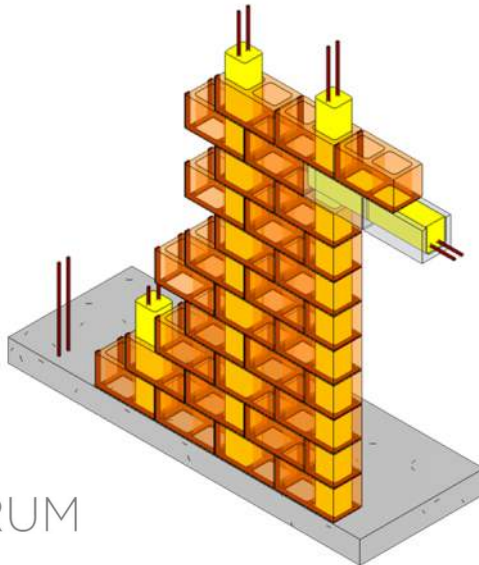


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LOD 400



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Precast Structural Double Tee

B1010.20 21-02 10 10 10 Precast Structural Double Tee (Concrete)
 Includes: Structural elements required for support of floor construction within basements and above grade. Includes columns, girders, beams, trusses, joists. Includes cast-in-place concrete, precast concrete, unit masonry, metal frames, and wood framed systems. Includes framed and sleeved openings for services. Includes Floor Construction Supplementary Components as appropriate

Associated Masterformat Sections: 03 30 00 / 03 40 00 / 04 20 00 / 05 10 00 / 05 20 00
 05 21 23 / 05 42 00 / 05 44 00 / 06 11 00 / 06 13 00 / 06 13 26 / 06 17 33 / 06 17 36
 06 17 53 / 06 18 13 / 06 18 16 / 06 90 00

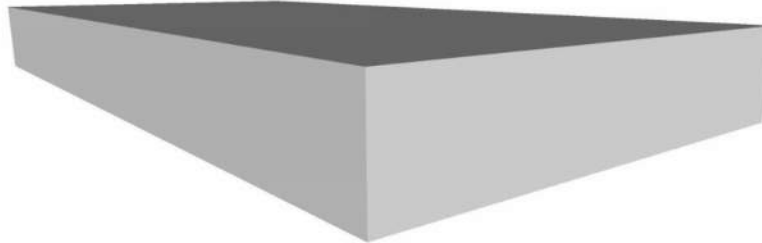
100	See B1008.10	
200	Element modeling to include: <ul style="list-style-type: none"> Type of structural concrete system Approximate geometry (e.g. depth) of structural elements 	 50 B1010.20 - LOD 200 Precast Structural Double Tee (Concrete)
300	Element modeling to include: <ul style="list-style-type: none"> Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation Concrete defined per spec (strength, air entrainment, aggregate size, etc.) All sloping surfaces included in model element with exception of elements affected by manufacturer selection 	 51 B1010.20 - LOD 300 Precast Structural Double Tee (Concrete)
350	Element modeling to include: <ul style="list-style-type: none"> Reinforcing Post-tension profiles and strand locations Reinforcement called out, modeled if required by the BIMXP, typically only in congested areas Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc. Expansion Joints Lifting devices Embeds and anchor rods Penetrations for items such as MEP Any permanent forming or shoring components 	 52 B1010.20 - LOD 350 Precast Structural Double Tee (Concrete)
400	Element modeling to include: <ul style="list-style-type: none"> All reinforcement including post tension elements detailed and modeled Finishes, camber, chamfer, etc. 	 53 B1010.20 - LOD 400 Precast Structural Double Tee (Concrete)

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LOD 200



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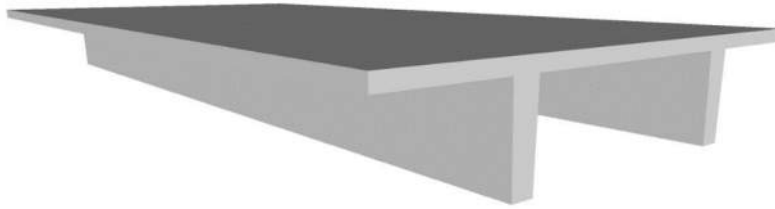
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LOD 300

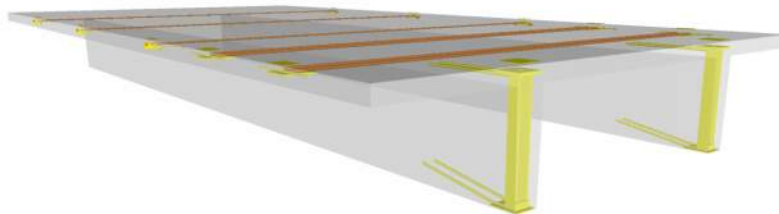


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LOD 350

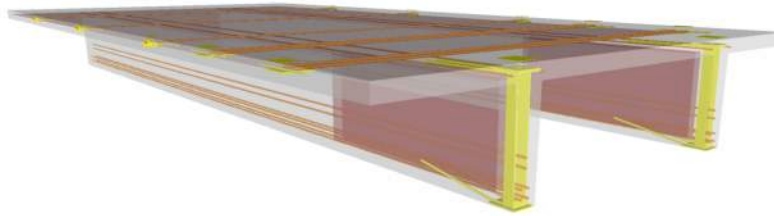


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LOD 400



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Precast Stairs

Level of Development Specification
Version: 2016

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	Uniformat	Omniclass
200	<p>Element modeling to include:</p> <ul style="list-style-type: none"> Type of structural concrete system Approximate geometry (e.g. depth) of structural elements 	<p>59 B1080 10-LOD 200 Precast Structural Slabs (Concrete)</p>
300	<p>Element modeling to include:</p> <ul style="list-style-type: none"> Specific size and locations of main concrete structural members received per defined structural grid with correct orientation Concrete defined per spec (strength, air entrainment, aggregate size, etc.) All sloping surfaces included in model element with exception of elements affected by manufacturer selection 	<p>59 B1080 10-LOD 300 Precast Structural Stairs (Concrete)</p>

Level of Development Specification
Version: 2016

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www.bimforum.org/lo

	Uniformat	Omniclass
350	<p>Element modeling to include:</p> <ul style="list-style-type: none"> Reinforcing post-tension profiles and strand locations Reinforcement called out, modeled if required by the BIMDDP, typically only in congested areas Four joints and sequences to help identify reinforcing lap splice locations, scheduling, etc. Expansion joints Lifting devices Embeds and anchor rods Post-tension profile and strands, modeled if required by the BIMDDP Penetrations for items such as MEP Any permanent forming or shoring components 	<p>60 B1080 10-LOD 350 Precast Structural Stairs (Concrete)</p>
400	<p>Element modeling to include:</p> <ul style="list-style-type: none"> All reinforcement including post-tension elements detailed and modeled Finishes, camber, chamfer, etc. 	<p>61 B1080 10-LOD 400 Precast Structural Stairs (Concrete)</p>

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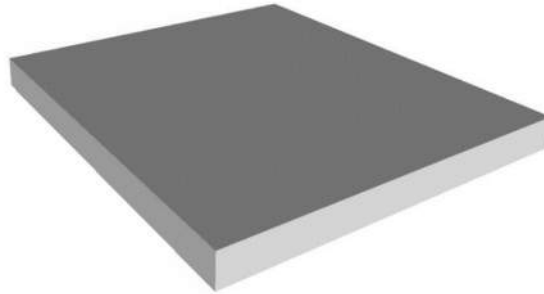
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LOD 200

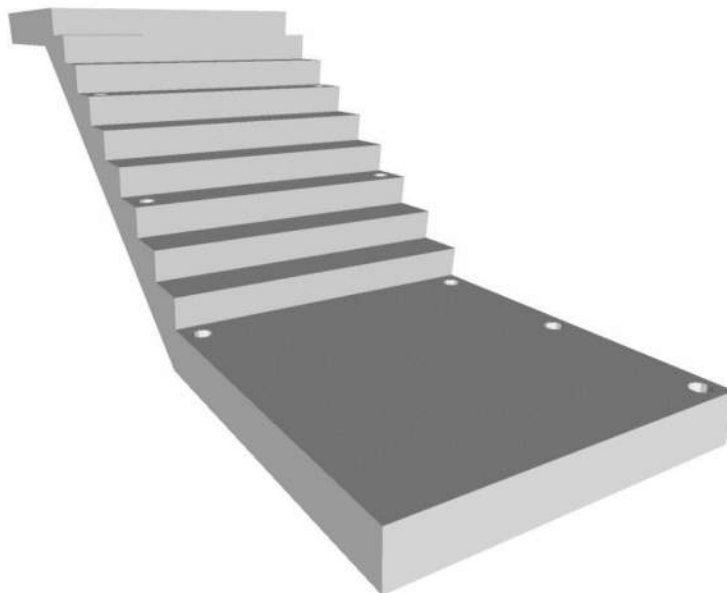


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LOD 300

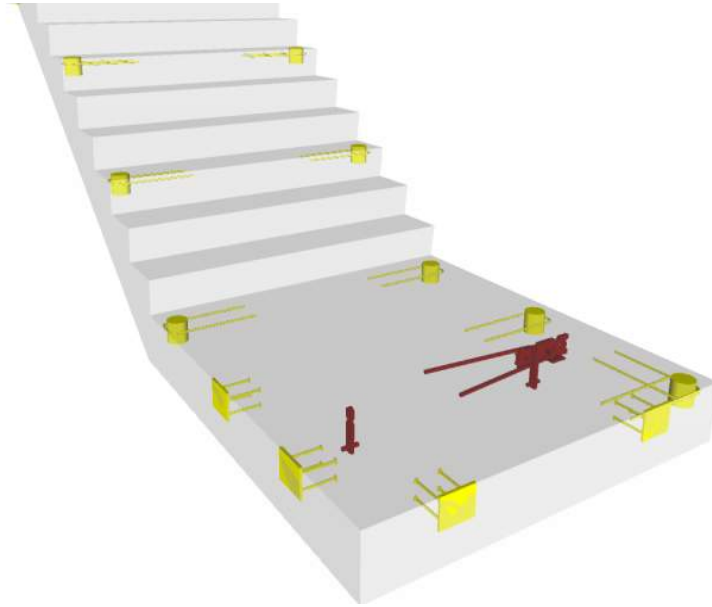


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LOD 350

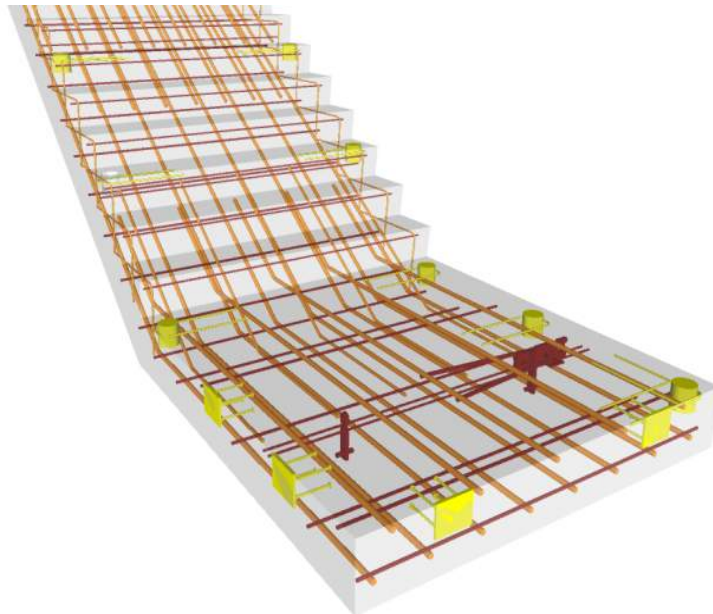


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LOD 400



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Highway Bridges: Precast Structural Girder


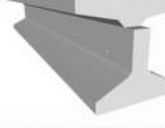
Level of Development Specification
Version: 2016

DRAFT FOR PUBLIC COMMENT

www.bimforum.org/lo

Uniformat Omniclass

Highway Bridges Precast Structural I Girder (Concrete)


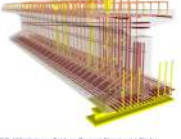
100		
200	<p>Element modeling to include:</p> <ul style="list-style-type: none"> Type of structural concrete system Approximate geometry (e.g. depth of structural elements) 	 <p>LOD 200 Highway Bridges Precast Structural I Girder (Concrete)</p>
300	<p>Element modeling to include:</p> <ul style="list-style-type: none"> Specific size and location of major concrete structural members modeled per defined structural grid with correct orientation Concrete defined per area (strength, air entrainment, aggregate size, etc.) All existing surfaces included in model element with exception of elements affected by manufacture selection 	 <p>LOD 300 Highway Bridges Precast Structural I Girder (Concrete)</p>

Level of Development Specification
Version: 2016

DRAFT FOR PUBLIC COMMENT

www.bimforum.org/lo

Uniformat Omniclass

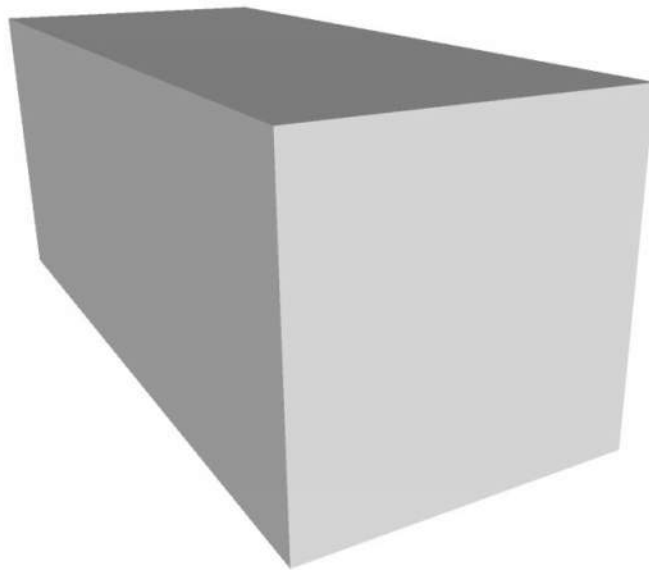
350	<p>Element modeling to include:</p> <ul style="list-style-type: none"> Reinforcing Post-tension profiles and strand locations Reinforcement called out, modeled if required by the BIMDD, typically only in congested areas Post joints and sequences to help identify reinforcing lap splice locations, scheduling, etc. Expansion joints Lifting devices Embeds and anchor rods Post-tension profile and strands modeled if required by the BIMDD Provisions for items such as MEP Any permanent formwork or shoring components 	 <p>LOD 350 Highway Bridges Precast Structural I Girder (Concrete)</p>
400	<p>Element modeling to include:</p> <ul style="list-style-type: none"> All reinforcement including post-tension elements detailed and modeled Curbs, chutes, etc. 	 <p>LOD 400 Highway Bridges Precast Structural I Girder (Concrete)</p>

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LOD 200

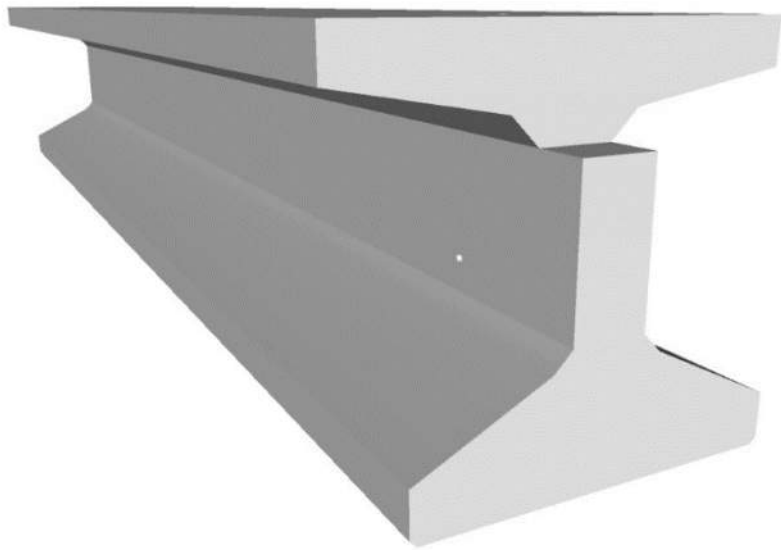


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LOD 300

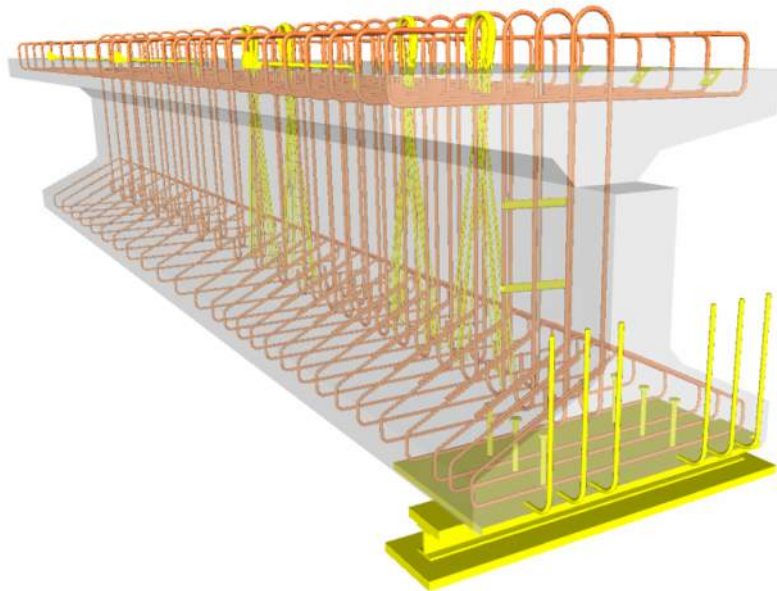


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LOD 350

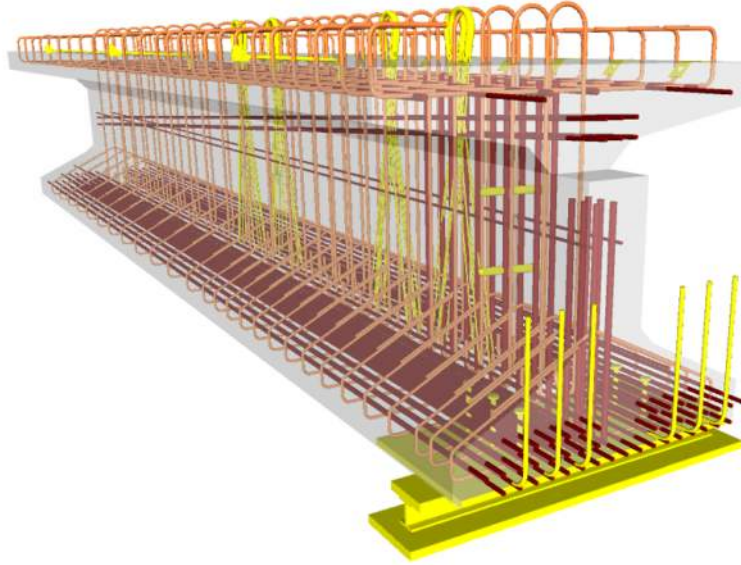


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LOD 400



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LOD Specification - Attribute Table

- Contains three categories pertaining to the options for an element
- The Baseline category contains a suggested list of attributes to be populated when no other attributes are known
- The Additional category contains a list of possible attributes to consider
- The last category contains milestones

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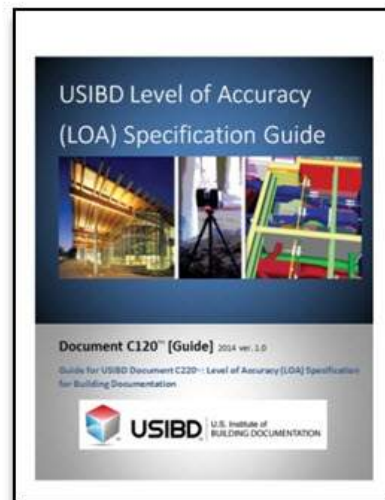
LOD Specification - Attribute Table

B – Ext. Glazed Openings		Part 1 - Attribute Description				Part 2 - LOD Profile					Part 3 - Project-Specific Milestones (Examples)			
Attribute	Data Type	Units	Option Examples	Commentary	100	200	300	350	400		Estimating	Estimating	LEED Cert.	LEED Cert
Construction	Text		options [unitized (combined glass and frame), Stick Built, Structural Glass]			x	x	x	x		Est. 1	Bid Pkg.	Check	Submittal
Material	Text		options [Aluminum Framed, Bronze Framed, Stainless Steel Framed, Channel Glass]				x	x	x					
Thermal Resistance	Number	R-Value					x	x	x					
Condensation Resistance			options [see, no, class]											
Windborne Debris Resistance		pdf												
Wind Load Capacity		pdf												
Glazing Method			options [Conventional, Two Sided, Three Sided, Four Sided, Pin Supported]											
Glass - Material			options [Glass, Plastic]											
Glass - Configuration			options [Monolithic, Insulating]											
Glass - Condition			options, multiple [Annealed, Heat Strengthened, Tempered, Laminated, Bent]											
Glass - Coatings			options, multiple [Pantonic (hard coat), Sputter (soft coat), Low E, Hardco, Ceramic/Pk, Open Coat, Digital Printed]											
Glass - Use			options, multiple [Selecting into conventional application, Glazing into structurally glazed applications, Mirror, Decorative, Fire Resistant, Hurricane Resistant, Cable Suspended, Safety/Glass, Electrochromic, Coated with heat glass, Pressure Resistant, Radiation Resistant, Security, Ballistics]											

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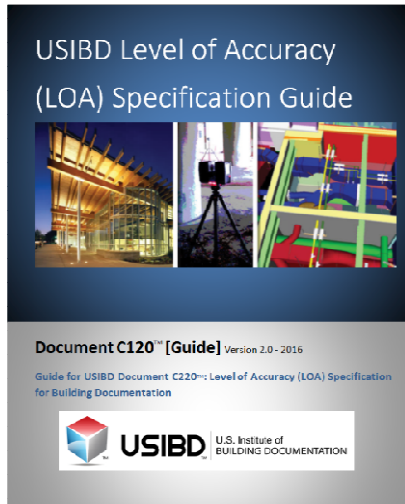
When is Close Enough, Close Enough?




Acceptable Forms of Measurement?



Level of Accuracy Specification






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BUILDING DOCUMENTATION

Document C220™ ver. 2.0 - 2016

Level of Accuracy (LOA) Specification



IMP-027007: Please read this order and exhibit this red box for the training document
of using Building C220™ Template. Please ensure level with this one used

USBD SPECIFICATION C220 2016 ver.2.0.0

This order explains the accuracy and information needed to use this form efficiently.
It is strongly suggested to read this data prior to using this specification worksheet.

Legend:

	Suggested (Must be used if level is Advanced, Proficient or Novice)
	Special (Special case - may exceed most best practices)

1 Specified (If not, it is more (if not, it is less) by at least 10% in the box.

Measured Validation

- 0 = No level used
- 1 = Check or over-reading data sets
- 2 = Based on your knowledge of the equipment or system

Recommended Validation

- 0 = No level used
- 1 = Double-check
- 2 = Inspect data

Field of application

Demolition and analysis	Construction	Operation
-------------------------	--------------	-----------

1 Measured Accuracy

0	1	2	3	4	5	6	7	8	9	10
<p>0 Measure</p> <p>0 = Measure (Show the reference to the form, then 10 is 100% accurate - otherwise, any number is not 100% accurate)</p> <p>Measure (Show the reference to the form, then 10 is 100% accurate - otherwise, any number is not 100% accurate)</p>										
<p>1 Measure (Show the reference to the form, then 10 is 100% accurate - otherwise, any number is not 100% accurate)</p>										

2 Recommended Accuracy

0	1	2	3	4	5	6	7	8	9	10
<p>0 Measure</p> <p>0 = Measure (Show the reference to the form, then 10 is 100% accurate - otherwise, any number is not 100% accurate)</p> <p>Measure (Show the reference to the form, then 10 is 100% accurate - otherwise, any number is not 100% accurate)</p>										
<p>1 Measure (Show the reference to the form, then 10 is 100% accurate - otherwise, any number is not 100% accurate)</p>										

Struggles & Issues

- **Unmet Expectations (Procurer's View)**



Image Courtesy of CyArk

Struggles & Issues

- Expectation Management (Provider's View)



Client's Expectation



Client's Budget



Struggles & Issues

- Speaking Different Languages



What LOA Does **NOT** Define

- Targeted audience
- Sensors and data acquisition methods
- Explicit LOA values (only ranges)
- QC procedures (only QA levels)
- Cost-benefit



USIBD 5 Defined Levels of Accuracy

LOA10 >>> LOA20 >>> LOA30 >>> LOA40 >>> LOA50

Low

>>>

High

Level	Upper Range	Lower Range
LOA10	User defined	5cm *
LOA20	5cm *	15mm *
LOA30	15mm *	5mm *
LOA40	5mm *	1mm *
LOA50	1mm *	0 *

**Specified at the 95 percent confidence level.*



USIBD LOA Ranges

	Level Of Accuracy				
Upper Range (Imperial)	-	2"	5/8"	1/4"	1/16"
Lower Range (Imperial)	2"	5/8"	1/4"	1/16"	0
Upper Range (Metric)	-	5cm	15mm	5mm	1mm
Lower Range (Metric)	5cm	15mm	5mm	1mm	0
	LOA10	LOA20	LOA30	LOA40	LOA50

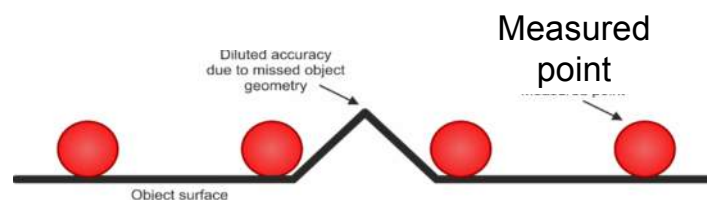
In terms of standard deviation (1 Sigma)



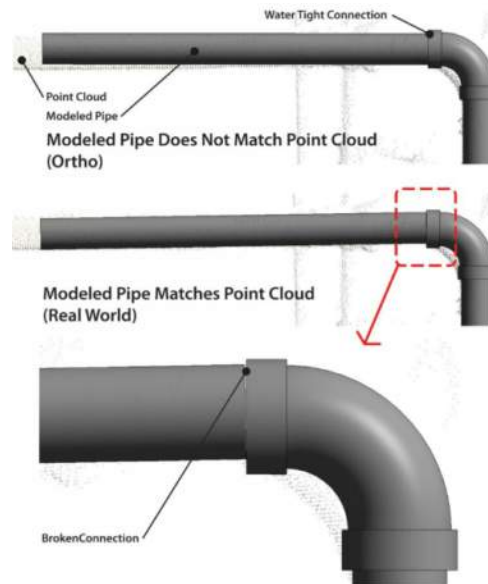
Measured vs. Represented

\$ Measured Accuracy \$\$\$\$						
X	Absolute		If Absolute - describe reference frame here			
	Relative		If Relative - describe measure of relativity here			
Level of Accuracy (2 σ std dev)						
-	2"	5/8"	1/4"	1/16"	Upper Range (Imperial)	
2"	5/8"	1/4"	1/16"	0	Lower Range(Imperial)	
LOA10	LOA20	LOA30	LOA40	LOA50		

\$ Represented Accuracy \$\$\$\$						
X	Absolute		If Absolute - describe reference frame here			
	Relative		If Relative - describe measure of relativity here			
Level of Accuracy (2 σ std dev)						
-	2"	5/8"	1/4"	1/16"	Upper Range (Imperial)	
2"	5/8"	1/4"	1/16"	0	Lower Range(Imperial)	
LOA10	LOA20	LOA30	LOA40	LOA50		



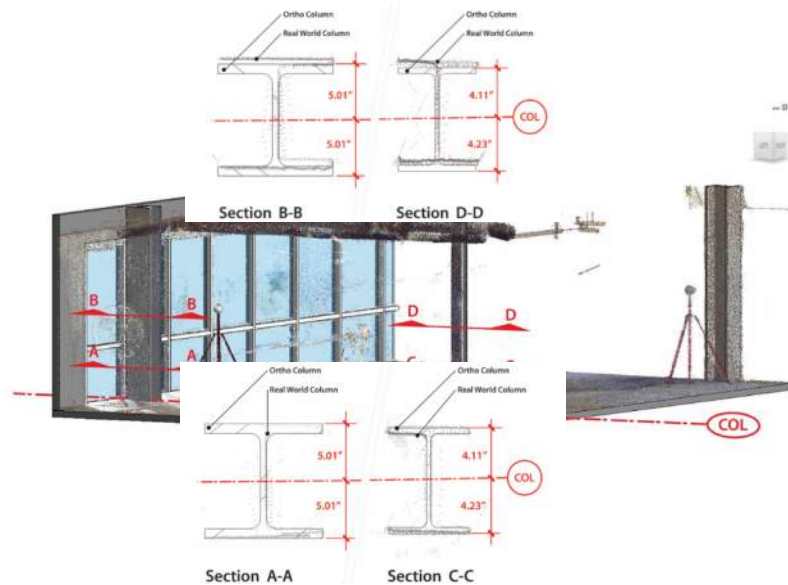
Orthogonal vs. Real World



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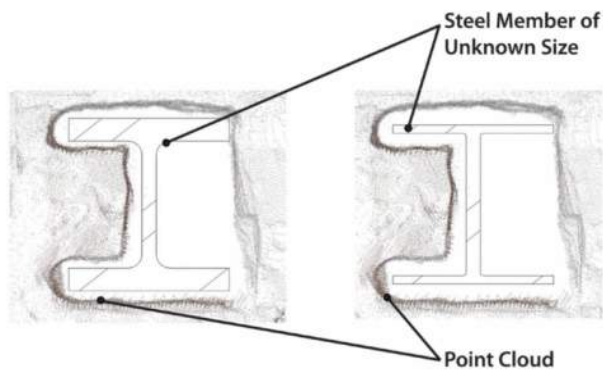
Out-of-plumb Conditions



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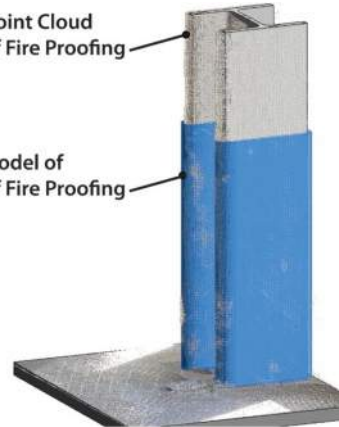
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Concealed Conditions & Best Fit



Uneven Point Cloud
Surface of Fire Proofing

Best Fit Model of
Surface of Fire Proofing



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CSI UniFormat™ 2010

level 1	level 2	level 3	CSI UniFormat™ 2010
A	SUBSTRUCTURE		
B	SHELL		
C	INTERIORS		
D	SERVICES		
F	EQUIPMENT & FURNISHINGS		
F	SPECIAL CONSTRUCTION & DEMOLITION		
G	BUILDING SITEWORK		



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CSI UniFormat™ 2010

Level 1	Level 2	Level 3	CSI UniFormat™ 2010
A	SUBSTRUCTURE		
	A10		Foundations
	A20		Subgrade Enclosures
	A40		Slabs-on-Grade
B	SHELL		
	B10		Superstructure
	B20		Exterior Vertical Enclosures
	B30		Exterior Horizontal Enclosures
C	INTERIORS		
	C10		Interior Construction
	C20		Interior Finishes
			SERVICES



CSI UniFormat™ 2010

Level 1	Level 2	Level 3	CSI UniFormat™ 2010
A	SUBSTRUCTURE		
	A10		Foundations
		A1010	Standard Foundations
		A1020	Special Foundations
	A20		Subgrade Enclosures
		A2010	Walls for Subgrade Enclosures
	A40		Slabs-on-Grade
		A4010	Standard Slabs on Grade
		A4020	Structural Slabs on Grade
B	SHELL		
	B10		Superstructure
		B1010	Floor Construction
		B1020	Roof Construction
		B1080	Stairs



LOA Specification Framework

LEGEND																			
		Suggested (Most commonly utilized)																	
		Accepted (Commonly utilized)																	
		Special (Special case - may exceed most applications)																	
	X	Specified (Specify chosen LOA by placing an X in the box)																	
Field of application		<input type="radio"/> Standard <input type="radio"/> Heritage																	
Dimensional units		<input checked="" type="radio"/> Imperial <input type="radio"/> Metric																	
Level 1	Level 2	CSI Uniformat™ 2010																	
Level 3																			
A SUBSTRUCTURE																			
A10 Foundations																			
A1010 Standard Foundations																			
A1020 Special Foundations																			
A20 Subgrade Enclosures																			
A2010 Walls for Subgrade Enclosures																			
A40 Slabs-on-Grade																			
A4010 Standard Slabs on Grade																			
A4020 Structural Slabs on Grade																			
B SHELL																			
B10 Superstructure																			
B1010 Floor Construction																			

Measured Accuracy										Represented Accuracy											
X Absolute										X Absolute											
Relative										Relative											
Level of Accuracy (2 σ std dev)										Level of Accuracy (2 σ std dev)											
- 2" 5/8" 1/4" 1/16"										- 2" 5/8" 1/4" 1/16"											
Upper Range (Imperial)										Upper Range (Imperial)											
2" 5/8" 1/4" 1/16" 0										2" 5/8" 1/4" 1/16" 0											
Lower Range (Imperial)										Lower Range (Imperial)											
LOA10	LOA20	LOA30	LOA40	LOA50	Validation	Note					LOA10	LOA20	LOA30	LOA40	LOA50	Validation	Note				
										Exposed surface									Exposed surface		
										Exposed surface									Exposed surface		
										Exposed surface									Exposed surface		
										Exposed surface									Exposed surface		
										Interior or Exposed Surface									Interior or Exposed Surface		
										Interior or Exposed Surface									Interior or Exposed Surface		
										Exposed surface									Exposed surface		
										Exposed surface									Exposed surface		
										Exposed surface									Exposed surface		

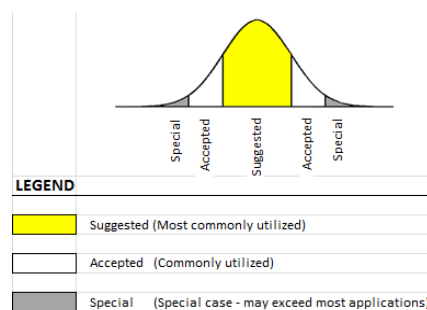


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Suggested LOA's



These 'suggested' selections are based on the most common building documentation applications. Specialized applications, such as heritage documentation, plant documentation, etc. may require LOA's other than what are suggested here.



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LOA Validation

Measurement validation

- A: No data check
- B: Check by overlapping data sets
- C: Check by independent measurements or methods

Representation validation

- A: No check
- B: Double check
- C: Triple check



Specification Schema

Measured Accuracy	Validation	Relative (rel) Absolute (abs)		Represented Accuracy	Validation	Relative (rel) Absolute (abs)
YY	A	rel	-	ZZ	A	- rel

YY	:	30	Measurement accuracy (standard deviation) of 5 to 15mm
A	:	B	Check by overlapping data sets
rel	:	rel	Relative accuracy (standard deviation) in regards to a reference system
ZZ	:	20	Representation accuracy (standard deviation) of 15 to 50mm
A	:	A	No check of the final representation
rel	:	rel	Relative accuracy (standard deviation) in regards to a reference system



Specification Schema

Measured Accuracy	Validation	Relative (rel) Absolute (abs)		Represented Accuracy	Validation	Relative (rel) Absolute (abs)
YY	A	rel	-	ZZ	A	rel

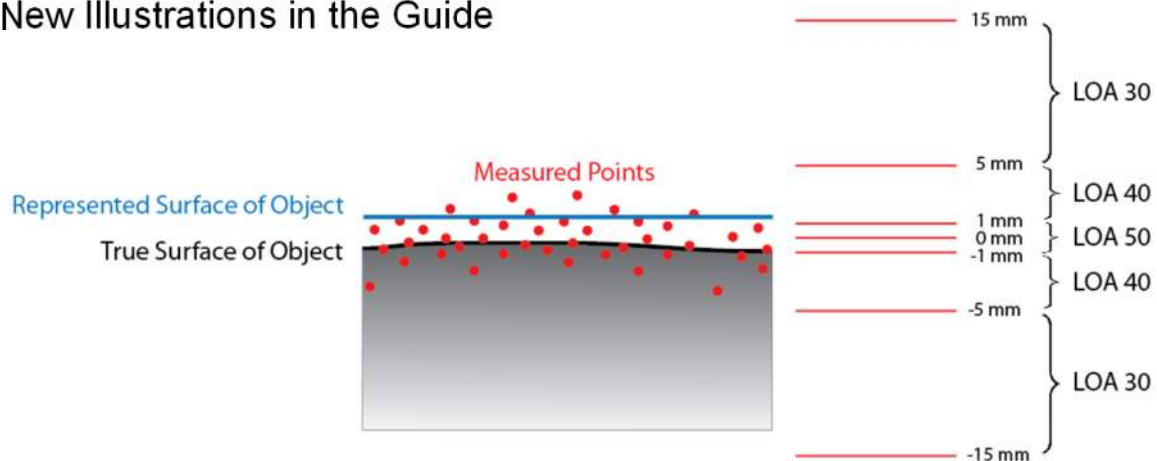
LOA 30B-rel-20A-rel

YY	:	30	Measurement accuracy (standard deviation) of 5 to 15mm
A	:	B	Check by overlapping data sets
rel	:	rel	Relative accuracy (standard deviation) in regards to a reference system
ZZ	:	20	Representation accuracy (standard deviation) of 15 to 50mm
A	:	A	No check of the final representation
rel	:	rel	Relative accuracy (standard deviation) in regards to a reference system



What's New in Version 2.0?

- New Illustrations in the Guide

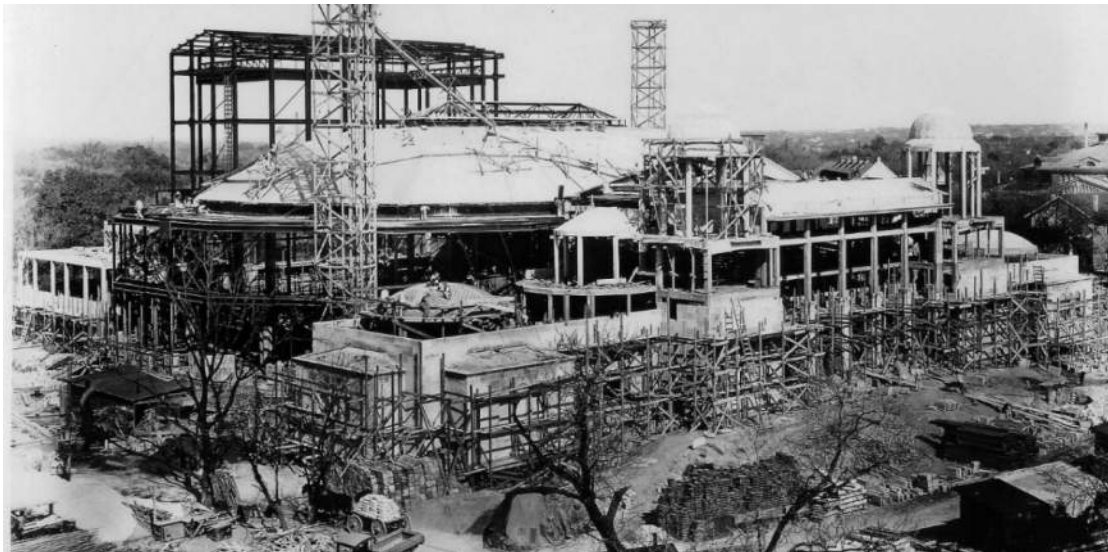


What Does The LOA Spec Provide?

- Independent standard
- Easy to use flexible template
- Suggested accuracy levels as a guideline for inexperienced users or when under time constraints
- Distinction between data acquisition and “the model”
- Extensibility for future enhancements
- Metric and imperial values



Tobin Center for the Performing Arts



IKERD Consulting, LLC Scan To Revit Example





LMN Architects

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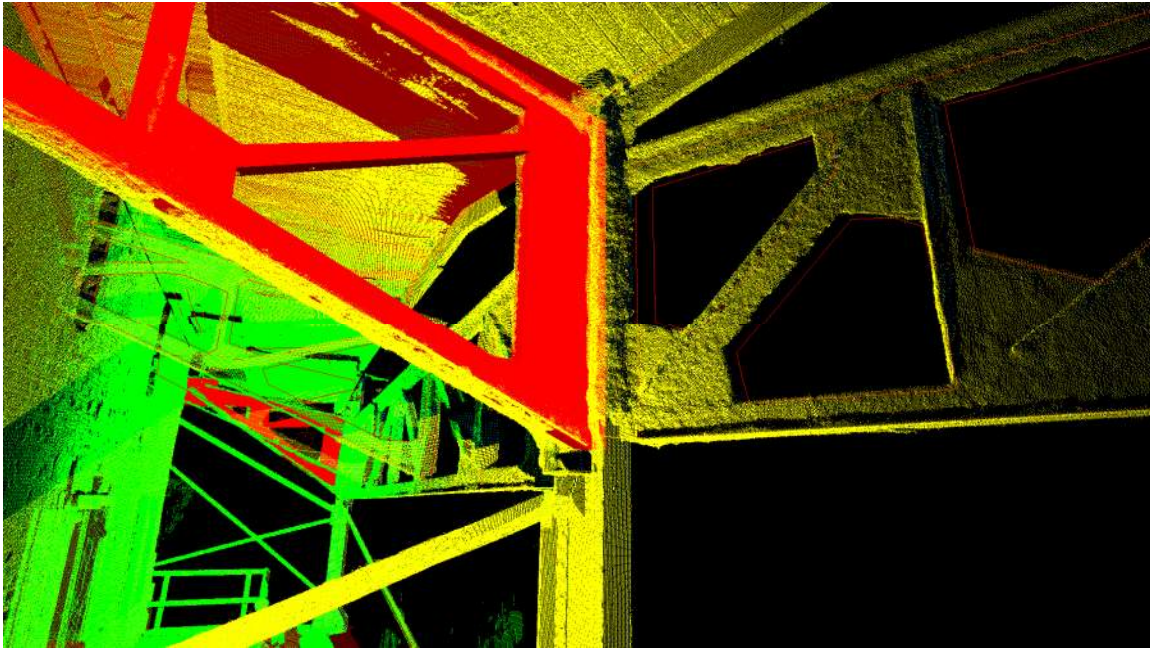
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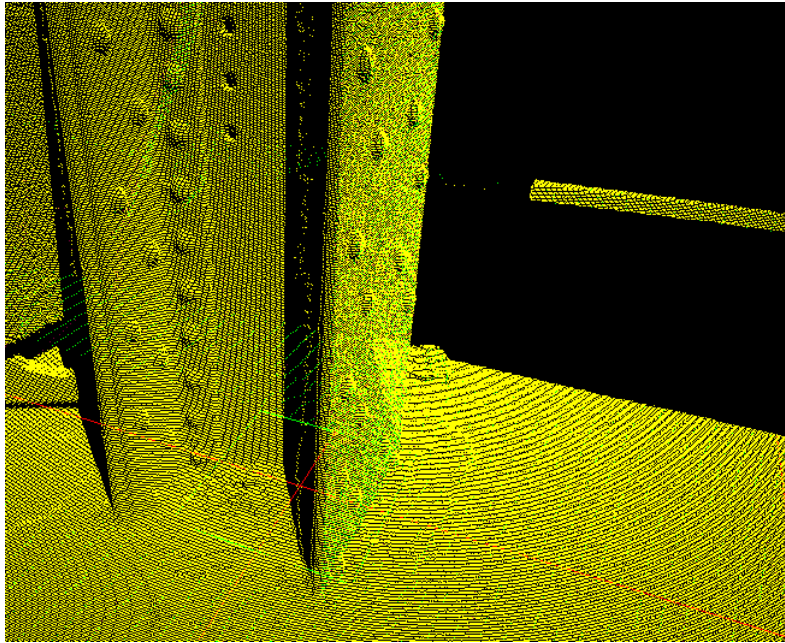
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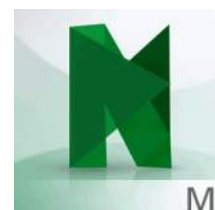
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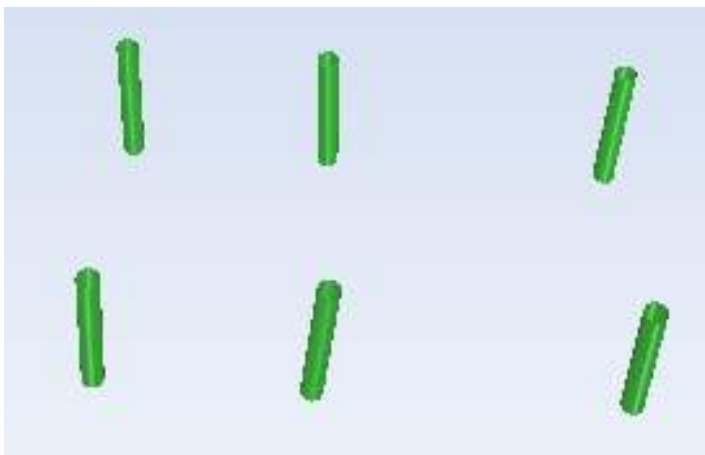
info@IKERD.com



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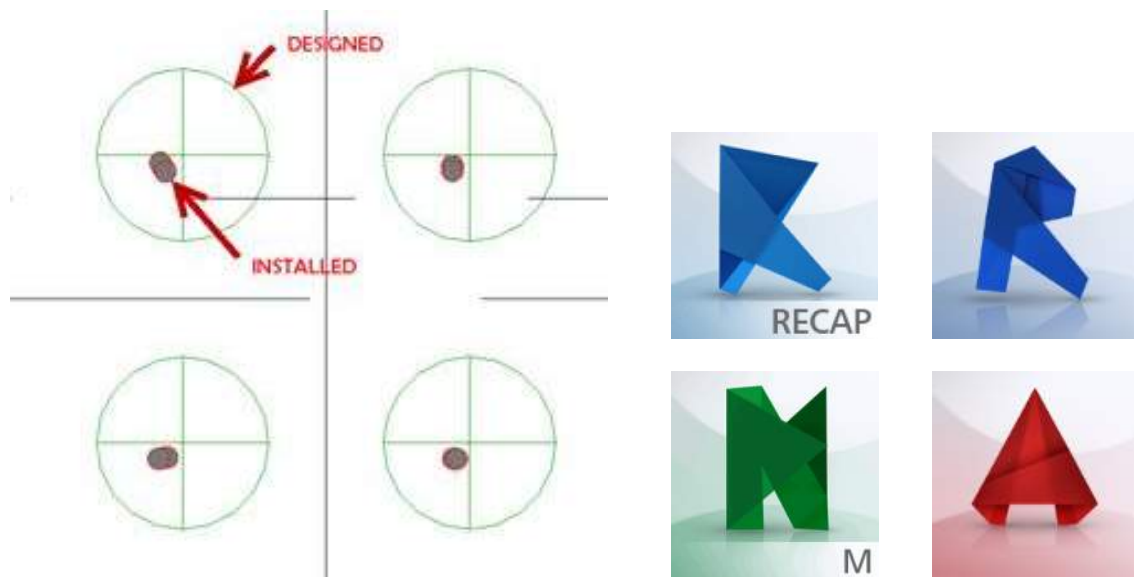


IKERD Consulting, LLC Scan To Revit Example



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IKERD Consulting, LLC Scan To Revit Example

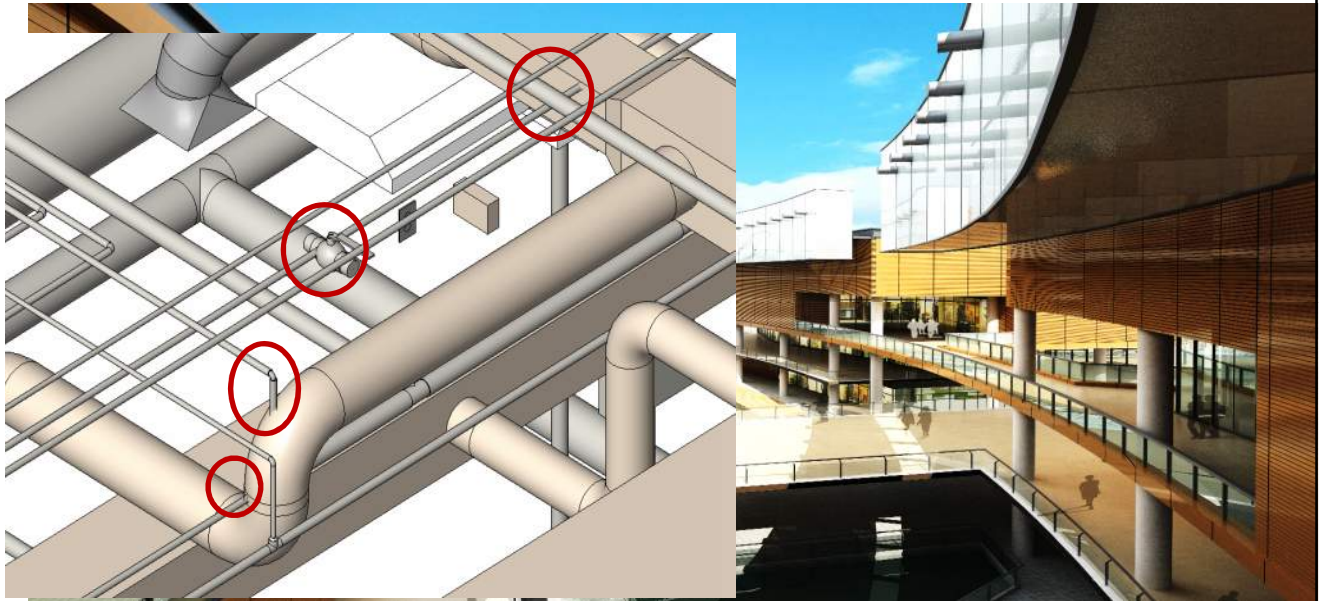
Design Teams: Examine Your Self



“The unexamined construction documents are not worth constructing.”

Ikerd's BIM Corollary for CD from BIM

ὁ ἀνεξέταστος βίος οὐ βιωτὸς ἀνθρώπῳ



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Construction Teams:



“Trust But Verify.”

Ronald Reagan

“Trust But Verify.”

*Ikerd's BIM Corollary for Contractors
Receiving Designer Models*

“Gipper BIM !!”

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info@IKERD.com

LIVE ONLINE TRAINING FOR LOD & LOA

CD-BIM.com

*Certificate of Development in
Building Information Modeling*

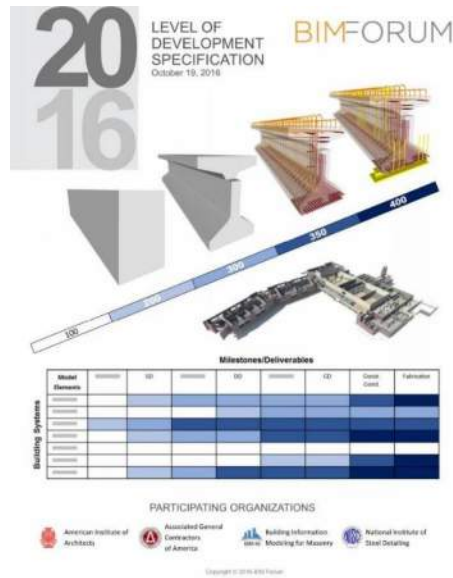


Solution: CD-BIM.com

Certificate of Development in BIM

- 1) Free Training Content
- 2) Basics of BIM for Modelers with BIM Forum LOD & USIBD LOA
- 3) Simple Online 1 hr Validation
- 4) Targeted at beginning and experienced BIM team members





LOD SPECIFICATION TASKFORCE

BIMFORUM

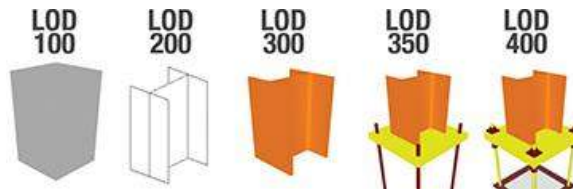


Jim Bedrick, FAIA
BIM Forum



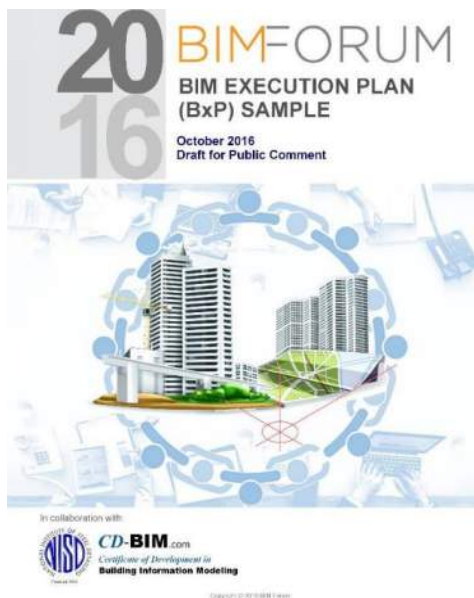
Jan Reinhardt
BIM Forum

- **BIMforum.org/LOD**
- No LOD of whole Model, only Elements
- All delivery methods
- Dictionary for BIM



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BxP SAMPLE TASKFORCE



Will Ikerd, PE
BIM Forum



Benjamin Crosby
BIM Forum



David Merrifield
NISD CD-BIM.com



John Russo
USIBD.org

1. Builds off CD-BIM sample BxP
2. 140+ projects with over 12 GCs
3. Developed by practitioners.
4. **BIMforum.org/BxP**

BIMFORUM

CD-BIM.com

*Certificate of Development in
Building Information Modeling*

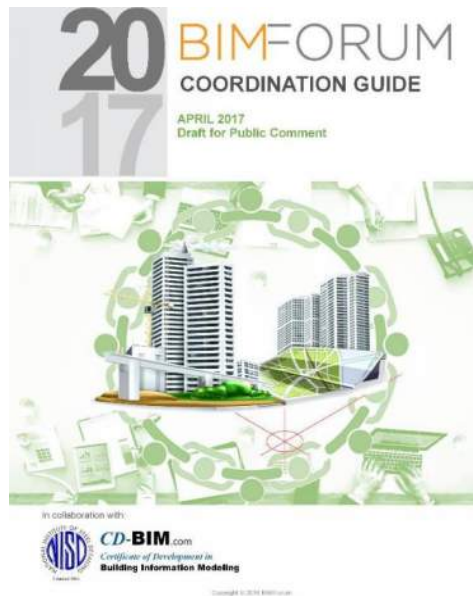
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Will Ikerd, PE, CM-BIM

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Coordination Guide Taskforce



David Epps



Mark
Mergenschroer



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*Dec. 16, 2016 has a discount
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Friday, January 20, 2017
Friday, February 17, 2017
Friday, March 17, 2017
Friday, April 21, 2017
Friday, May 19, 2017
Friday, June 16, 2017
Friday, July 21, 2017
Friday, August 11, 2017
Friday, September 15, 2017
Friday, October 20, 2017
Friday, November 17, 2017
Friday, December 15, 2017

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USIBD's Level of Accuracy

USIBD Level of Accuracy (LOA) Specification Guide

Document C125 [Guide] Version 2.0 - 2016

USIBD U.S. INSTITUTE OF BUILDING DOCUMENTATION

CD-BIM.com is providing a training course in the use of USIBD's Level of Accuracy (LOA) Specification document. This course will cover Version 2 of this document. This training will provide an overview of the document, and show how it will close the gap in your clients' expectations by increasing communication, ensuring the right use of available or chosen technology, and get the right results more easily, accurately and efficiently.

Once certified, individuals can use their expertise in the LOA documents when discussing proposals with clients and colleagues. Individuals who pass the test will be certified based upon Version 2 of the documents they test for (there is no expiration date).

The current Version 1 of the LOA is the most downloaded document currently published by USIBD. This document provides a flexible approach to specifying accuracy regardless of the size of a project, ultimately serving as a risk reduction tool for both the client and the service provider.

This training will dovetail with the publication of Version 2 of the LOA. Version 2 has been updated to include user-requested enhancements, comprehensive LOA suggestions, expanded reference frame specification, and now also includes a heritage overlay.

LOA Workshop Calendar

Date	Location	PT (Los Angeles)	MT (Denver)	CT (Chicago)	ET (New York)	GMT (UK, Ireland)	France, Poland	India	Philippines
Friday, January 27,	USIBD's LOA Workshop								

 AUTODESK UNIVERSITY 2016

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**have teamed together to provide the
LOA workshop and Exam Online.**

Visit:

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8-11am PT

Friday, January 27, 2017

Friday, February 24, 2017

Friday, March 24, 2017

Friday, April 28, 2017

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