

LOD for Coordination - Presentation Handout

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Hi I'm AJ Bridwell with Invicara. Invicara is a software and services company operating in the United States, Ireland, the United Kingdom, Singapore, and Australia.

Quick Summary of LOD

What is LOD? LOD, or Level of Development, is a way for modelers to communicate their elements current status of maturity in a collaborative BIM project. That statement might make sense to some people but for everyone else let's role-play a scenario. Say you're a structural engineer and you need to finalize your roof steel but there are some big roof top units in the building.

You will need to know that these monster RTU's have been sized, located, and oriented properly before you can finalize your design. To make sure you can proceed, instead of stopping work and getting on a call (aka voicemail pit of hell) or sending an email that might not get a response for a day or two, you can quickly check the LOD status of those RTU's in the mechanical model you have referenced into your working BIM project.

If the RTU's indicate they are at LOD 300 or greater you know they are set for that period and you can finalize your steel sizing and design for the roof of the building. An easy click of a mouse or view of a report and you know the status!



Figure 1: Voicemail HELL!!!

For today's discussion we will be focusing on the BIMForum LOD specifications.

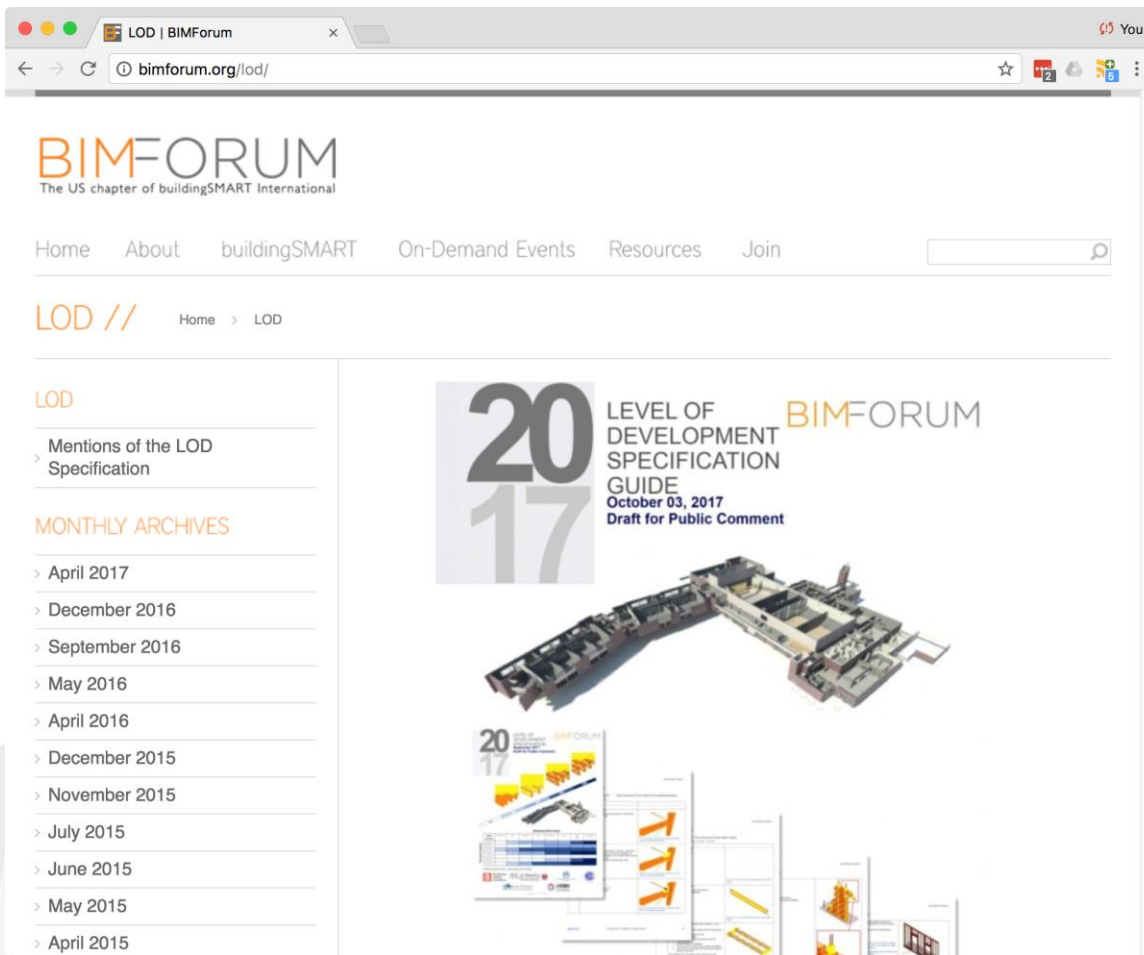
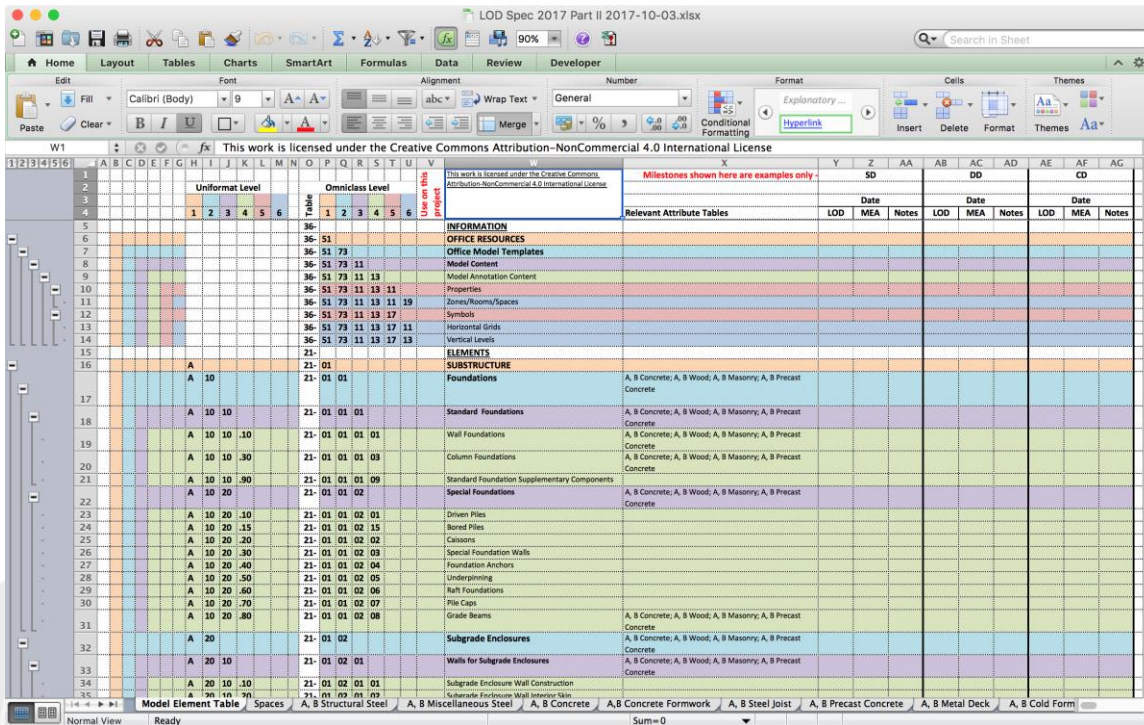


Figure 2: The BIMForum official website

You can find this on the web at <http://bimforum.org/lod/>

The BIMForum LOD Committee started work on the LOD specification in 2011, building on the work the AIA had done on the topic. The committee issued its first public LOD specification in 2013 and has released an update to the specification every year since then. They are set to release the 2017 version by the end of this year.



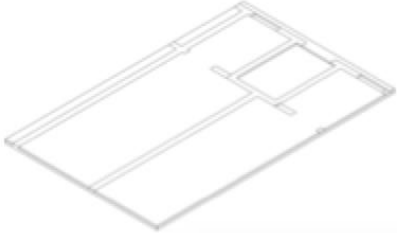
The screenshot shows a spreadsheet titled "LOD Spec 2017 Part II 2017-10-03.xlsx" with a ribbon menu including Home, Layout, Tables, Charts, SmartArt, Formulas, Data, Review, and Developer. The spreadsheet is organized into columns for Uniform Level, Omniclass Level, and various building elements. The table includes sections for INFORMATION, OFFICE RESOURCES, SUBSTRUCTURE, and ELEMENETS. The SUBSTRUCTURE section lists various foundation types and their corresponding LOD levels. The ELEMENETS section lists various building components and their corresponding LOD levels. The table is color-coded by element type and includes a 'Milestones shown here are examples only' note.

Uniform Level	Omniclass Level	Element	Material
A 10	21-01-01	Standard Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete
A 10 10	21-01-01-01	Wall Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete
A 10 10 10	21-01-01-01-01	Column Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete
A 10 10 30	21-01-01-01-03	Standard Foundation Supplementary Components	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete
A 10 10 50	21-01-01-01-09	Special Foundations	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete
A 10 20	21-01-01-02	Subgrade Enclosures	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete
A 10 20 10	21-01-02-01	Walls for Subgrade Enclosures	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete
A 10 20 15	21-01-02-01-01	Subgrade Enclosure Wall Construction	A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete

Figure 3: The BIMForum LOD specification

The updates have focused on adding clarity, refining the definitions and giving the industry useful tools to encourage the use of LOD on more projects. So LOD is not a new process for our industry.

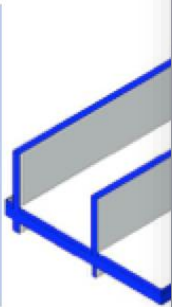
In my experience, I'm seeing LOD referenced more and more both in design and construction project execution plans and now even in owner BIM handover mandates!



At this level, the project model contains model elements with approximate quantities, size, shape, location, and orientation. Models developed to this level are best used for general coordination.

LOD 200

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

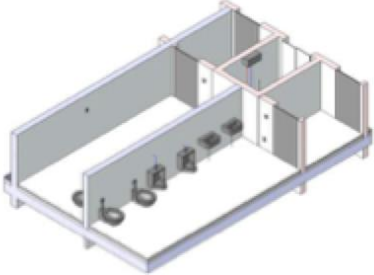


At this level, the project model contains model elements with visual graphics and data sets that are specific and accurate to the elements' shape, size, position, and orientation. Additional data sets, systems and/or assemblies may be contained in these model elements. Models developed to this level can be used for visualization, project coordination, construction logistical planning, and quantity calculations.

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LOD 300

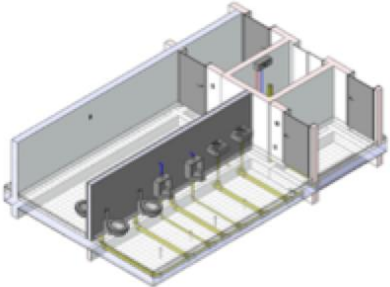
Official Definition: The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.



At this level, the project model contains model elements with visual graphics and data sets that are specific and accurate to the elements' shape, size, position, and orientation. Additional data sets, systems and/or assemblies may be contained in these model elements. Models developed to this level can be used for visualization, project coordination, construction logistical planning, and quantity calculations.

LOD 400

Official Definition: 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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Figure 4: Example of LOD in owner's handover requirements

Demystifying LOD for BIM

When talking about LOD, what you should focus on is the level of development of specific elements, not the level of an entire model. So it's not a model discussion, it's an element in the model discussion.

For example, if we look at a final owner's handover model, elements in that model will have a wide range of LOD scores. The mechanical engineer might leave things like ductwork at LOD 350 while modeling the mechanical equipment in the same system to LOD 500. This will also happen during design and construction modeling, some elements only need to be modeled to LOD 300 to give specific location, quantities, etc. while other elements will need to be modeled to LOD 400 for fabrication.

How do Architects and Engineers benefit from LOD?

Now let's look at what a workflow would look like when using LOD in a project. The objective of LOD is to watch as elements that impact your workflow mature along the LOD path. Elements or groups of elements that are still not mature enough for you rely on from other trade models will be anything that is at 100, 200 or in some cases 300 LOD score.

	Generic Graphic	Approximate Graphic, Quantities, Size, Shape, Location, Orientation	Specific Graphic, Quantities, Size, Shape, Location, Orientation	Interfaces to other systems (e.g. supports, hangers, connections)	Attached Details, Fabrication, Assembly, & Installation Info.	Field Verified
LOD 100	X					
LOD 200		X				
LOD 300			X			
LOD 350			X	X		
LOD 400			X	X	X	
LOD 500			X	X	X	X

Figure 5: LOD "none official" cheat sheet

Looking at the LOD Chart, if you are mechanical modeler you would want to wait for the steel in an area to get to at least LOD 350 before you start to set your duct runs.

At LOD 300, the structural engineer has located and sized the main steel. You probably shouldn't start your work yet. At LOD 350, the supports and braces for that area have been added to the model. Now, with that

information, you can start your work because you know that the structural engineer has locked down the steel for that area.

As the mechanical engineer starts to layout the mechanical system for that area, the piping engineer can also check the structural LOD and now can also start to check the LOD status of the mechanical model. Again, the objective is to know when any model elements that will impact your design and layout of the piping have been properly sized and positioned.

At this stage the steel model is at LOD 350, with the main steel elements and with their connectors sized and located! But at an early stage the mechanical model is only LOD 300, so you know that the system is sized and placed properly and you could start to work on your pipe runs, or you could wait for the mechanical model to include its hangers and supports.

With this new version of the models with the hangers and supports now in the mechanical model its passes the LOD 350 test and you know that you can start to finalize your pipe runs and layouts.

This process of checking model elements for their maturity continues for the other trades and for the rest of the building as more and more trade models are added and model elements score higher and higher on the LOD score table. As a general rule of thumb, when new models are updated and shared, you should recheck the model to make sure none of the elements or areas have reset to below your desired LOD score for those trades.

[Why should Architects and Engineers request LOD as part of the project execution plan?](#)

So why should you as an architect or engineer request LOD to be part of a project execution plan, and how do you benefit from the LOD process? Besides having immediate knowledge of model element maturity and know when you can start your work for that area, LOD can also help you pinpoint bottlenecks in projects. For example, you can tell when a firm might be having trouble getting their work done and that delay will in turn slow down your modeling efforts.

Think of it this way, from a modeling perspective, LOD ties our digital workflow to a more physical real world experience. i.e., In the real world, if the steel is not up and installed then no one can start to hang their elements from them. So by using LOD in the virtual world, if the steel is not sized and placed any work by other trades in that area will be based on speculation and will need to be rechecked later as the project matures. It's this dependency that helps create a more responsive workflow and can also help to prevent rework of your models.

Also with LOD goals established there is a level of accountability for each partner on the project. As each firm's models achieve the required LOD score, other trades know they can rely on them. They can trust the other firms' models and get their models to the required LOD.

How to implement and when to start testing for LOD?

So, we have covered the nuts and bolts of LOD and we have run through several workflow examples of how you can use LOD to trigger when work can begin. Now let's discuss checking for LOD in projects!

To quickly discover the LOD status of elements in models, the single property to check is called `Current_LOD`. This property should be kept up-to-date and indicates that element's LOD status.

In Revit, you can build display filters to help isolate elements based on this single property `Current_LOD` value. While this is an option, it is only effective if modelers stay on top of this value.

A more in-depth and reliable process to make sure elements have truly reached the desired LOD is to use a rules based cloud platform like BIM Assure. This allows you to easily build LOD rules for model elements once and reuse them to check data from various modeling platforms.

This approach allows you to instantly check multiple properties in the elements of interest, not rely on the single property `Current_LOD`.