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APPENDIX C
LEVELS OF DEVELOPMENT DEFINITIONS

THE NEW ZEALAND BIM HANDBOOK
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Level of development

1. LOD overview

Level of Development (LOD) is a scale used to show the reliability of content that is expected to be included for specific model elements at different times during model development. The main purpose of LOD, when incorporated in Model Element Authoring (MEA) schedules and BIM execution plans, is to clarify what each member of a design/construction team is required to author in their models, at each stage, and to what extent others can rely on them.

Critically, as the LOD progresses, other information associated to those elements can also progress, not just the geometry.

LOD is a means of defining the extent to which a model element has been developed, from conception in the mind of the designer, through to its construction and operation. It represents the extent to which information about an element can be relied on for decision-making purposes, at a particular point in time.

LOD applies to elements within a model – not the overall model.

Project models at any stage of delivery will invariably contain elements at various levels of development.

This updated version of the handbook includes the distinction of LOD 500 from the BIMForum LOD Specification, their words:

LOD 500 – The model element is a field-verified representation of size, shape, location, quantity, and orientation. Non-graphic information may also attach to the model elements.

Since LOD 500 relates to field verification, and doesn't indicate a progression to a higher level of model element geometry or non-graphic information, this [LOD] specification does not define or illustrate it.

Because LOD 500 relates to As-Built and operational purposes, the information contained within these building elements becomes increasingly important. The relevance of information fields differs from project to project. Take a pragmatic approach when choosing which fields of information must be supplied and how they tie back to the building elements.

To achieve field verification, LOD progression can jump immediately from LOD 300 to LOD 500, if there isn't a project requirement to achieve LOD 350 or LOD 400 from the project team.

Not all building elements need field verification. But when they do employ, quality, visual or measured verifications. An in-depth discussion with the client and their asset management and operational teams is critical to ascertain which geometrical elements, information fields, and verification process are required for the project. Ideally, this is captured in the Asset Information Requirements (AIR) at the outset of the project. A retrofit approach late in the project may trigger rework, additional cost, and delay the handover deliverable.

2. Level of development (LOD) versus level of detail

LOD is sometimes misinterpreted as level of detail rather than level of development. However, there are important differences. Level of detail is essentially how much detail is included in the model element. Level of development is the degree to which the element's geometry and attached information has been thought through – the degree to which project team members can rely on the information when using the model. In essence, level of detail can be considered as an input to the element, while level of development is reliable output.

3. LOD notations

LOD notations generally comprise numbers at intervals to give users of the system the flexibility to define intermediate LODs. LOD 350 is identified as a higher level of detailed coordination between disciplines – higher than LOD 300, but not as high as LOD 400. Defining additional LODs can be crucial in some circumstances, particularly for contractual reasons – e.g. the handover of models from the design team to the construction team.

4. Aspects of LOD

Level of development as a concept is the sum of different aspects that define the information and geometry of each element, including:

- **Graphical model.** 3D geometry is only one type of information. Geometrical shape and composition may inform project stakeholders how building elements occupy a space. As the project develops, its shape accuracy, location, and extent in 3D space becomes more important, especially for spatial coordination. But as mentioned throughout this handbook, BIM is not just the model. These graphical models contain different types of information to explain geometrical elements individually, as a system, and as a project as a whole. How far a model should be developed will depend on the project objectives and should be defined in an MEA schedule.

- **Documentation.** This set of information can illustrate how graphical models are composed, set out, constructed, perform, and how they should to be used. Although most model authoring software includes 2D documentation capabilities, separate documentation, such as asset information, specifications, calculations, and warranties are compulsory documentation. How these separate documents tie back to the graphical model and LOD requirement can be resolved in different ways.

- **Non-graphical information.** Asset information such as hyper-links, formulas, and alphanumeric text can be embedded within geometrical elements. This information can follow the model as it is transferred between project stakeholders. Precisely defined object-based data structure and classification ensures information gets populated, transferred, and delivered in a smooth manner.

5. LOD definitions

This version of the handbook distinguishes LOD 500 from LOD specification. When specifying LODs you should reference the latest BIM Forum LOD specification. The main body of the BIMForum specification provides more detail for each LOD on an element-by-element basis. However this document has amended the LOD 300 definition for New Zealand practices as below:

LOD OVERVIEW AND POSSIBLE USAGE

LOD represents the extent to which information about an element can be relied on for decision-making purposes at a particular point in time.

LOD 100	LOD 200	LOD 300	LOD 350	LOD 400	LOD 500
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 metre, tonnage of HVAC, etc.) can be derived from other Model Elements.	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.	The Model Element is graphically represented within the Model as a **design specified system,** object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.	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.	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.	The Model Element **is a field-verified representation** in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Element.

6. Discontinuous progression

As each project requirement is unique, LOD progression for each element can also be unique. Not all elements need to start at LOD 100 (massing) and progress to a higher LOD. Some elements can start at LOD 200, increase to LOD 300, and jump to LOD 500. While some elements can jump immediately to LOD 500, such as a site boundary verified by a registered surveyor. A refurbish project with existing slab levels would also jump to LOD 500, once verified.

While LOD cannot regress, it doesn't have to be continuous, which is why a full model cannot be assigned an LOD number.

Using the example of suspended ceilings, during preliminary design, the design team may be aware that a suspended ceiling is required, without further detail on the make-up, material, and performance it has to achieve. Therefore, during this phase, an LOD 200 would suffice (LOD 200 – generic assemblies indicative of overall scope and approximate thickness/system depth of suspended ceiling), skipping

LOD 100. Even at LOD 200, services engineers would be informed on whether or not there is a ceiling and its height.

As the design progresses to developed design, further information can be assigned to suspended ceilings. Spatial expressions and requirements, such as fire and acoustic performances, would start to inform the selection of those suspended ceilings.

An LOD 300 (overall assembly modeled to design specified system thickness, including framing) would be the goal to capture model development, for geometrical and non-graphical information. During this design phase, geometry should be updated to capture a more realistic extent and build up of each ceiling selection – and systems to achieve design requirements.

Non-graphical information, such as name/system identification and performance requirements, will also be associated to those elements. Meaningful 3D coordination sessions can start when model development of the suspended ceiling is matched with services runs. At this point the design team is better informed on the void space, makeup, and material from the suspended ceilings, along with services runs to create a safe and healthy building.

Design resolutions, such as creating bulkheads and developing reflected ceiling plans documentation, can start with these sets of information. Engineering analysis can also start, thanks to better information in this phase, such as energy analysis, lighting analysis, and air flow. Export the whole model or part of the model to simulation software. A healthy iterative process between project team members results in a refined design, ready for progress to detail design.

Depending on project requirements, detailed design model progression can remain at LOD 300, or progress to LOD 350. If left at LOD 300, the design team can complete ceiling details and documentation in 2D. If project requirements demands LOD 350, structure interfaces above and adjacent to walls should also be modelled. Include relevant information to connection elements.

Connection elements may include structural backing members, including bracing lateral framing kickers. Expansion joints or control joints are modelled to indicate specific width. The higher demand for modelling and information data can be used for 3D coordination in tight ceiling spaces and complex junctions. Produce a schedule of these elements.

In the construction phase, the main contractor may need to appoint a suspended ceiling subcontractor to fabricate these items from their model to achieve LOD 400. Include all assembly components, such as tees, hangers, support structure, braces, and tiles. Comparing design and construction suspended ceiling models will show modifications from the design to suit the actual construction, if any. Pushing for LOD 400 could streamline shop drawing review.

Please note that just because one building element goes to a higher LOD, that doesn’t mean other elements should achieve the same LOD. LOD should be nominated based on milestone, or project goals. LOD covers geometrical and non-geometrical information. Assigning a LOD doesn't stop the team from progressing to higher level, if that information is confirmed.

Refer to the BIM Forum LOD Specification for examples of graphical representation of the different LODs.

The New Zealand BIM handbook

This document is one of a suite of documents forming the New Zealand BIM handbook.
You can download or view the remaining documents here:

http://www.biminnz.co.nz/nz-bim-handbook