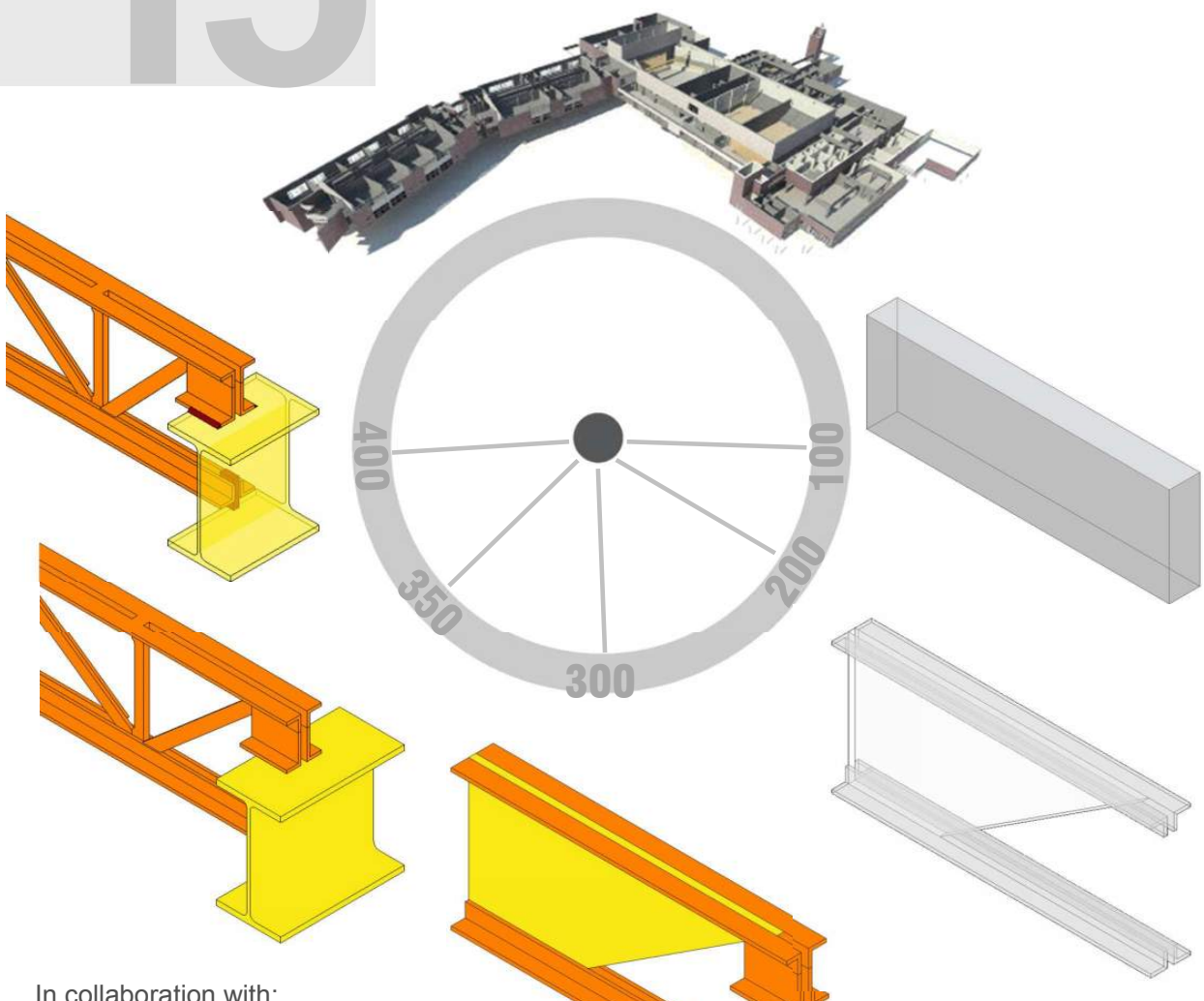
# 2015

# LEVEL OF DEVELOPMENT SPECIFICATION

BIMFORUM

October 30, 2015

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NATIONAL INSTITUTE OF STEEL DETAILING
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BIM-M
Building Information Modeling for Masonry

# Level of Development Specification

Version: 2015

October 30, 2015

## For Building Information Models

*Nothing contained in this work shall be considered to be the rendering of legal advice for specific cases, and readers are responsible for obtaining such advice from their own legal counsel. This work and any forms herein are intended solely for educational and informational purposes.*

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# INTRODUCTION

# 1 Overview

## 1.1 Description

The *Level of Development (LOD) Specification* is a reference that enables practitioners in the AEC Industry to specify and articulate with a high degree of clarity the content and reliability of Building Information Models (BIMs) at various stages in the design and construction process.

The Specification is a detailed interpretation of the LOD schema developed by the American Institute of Architects (AIA) for its *E202-2009 BIM and Digital Data Exhibit* and updated for its *G202-2013 Project BIM Protocol Form*[1], defining and illustrating[2] characteristics of model elements of different building systems at different Levels of Development, organized according to CSI Uniformat 2010[3]. Its intent is to help explain the LOD framework and standardize its use so that it becomes more useful as a communication tool.

The LOD Specification adheres to the intent of the LOD schema as developed by the AIA, and as such it is important to emphasize several points here.

### 1.1.1 LODs and Design Phase

The LODs are not defined by design phases. Rather, design phase completion, as well as any other milestone or deliverable, can be defined through the LOD language. There are several important reasons for this approach:

1) There is currently no detailed standard for the design phases. Many architects have created in-house standards, but these differ from one firm to the next, and even within a single firm the requirements are sometimes adjusted to the needs of a particular project.

2) Building systems progress from concept to precise definition at different rates, so at any given time different elements will be at different points along this progression. At completion of the Schematic Design phase, for example, the model will include many elements at LOD 200, but will also include many at LOD 100, as well as some at LOD 300, and possibly even LOD 400.

### 1.1.2 LODs and Model Definition

There is no such thing as an "LOD ### model." As previously stated, project models at any stage of delivery will invariably contain elements and assemblies at various levels of development. As an example, it is not logical to require an "LOD 200 model" at the completion of the schematic design phase. Instead, the "100% SD Model" will contain modeled elements at various levels of development.

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[1] AIA Contract Document *G202-2013, Building Information Modeling Protocol Form* is part of a series of digital practice documents the AIA published in June 2013. This series consists of *AIA E203™–2013, Building Information Modeling and Digital Data Exhibit, AIA G201™–2013, Project Digital Data Protocol Form*, and *AIA G202™–2013, Project Building Information Modeling Protocol Form*. For general information on the documents and downloadable samples see www.aia.org/digitaldocs. For executable versions of the documents see http://www.aia.org/contractdocs.

[2] All images are intended to illustrate building conditions in compliance with common building codes. However, the images do not take into account site specific conditions, regional building codes and other important information that may require a material change for specific projects. These illustrations do not make representation for fitness for a particular project nor for code or design compliance.

[3] UniFormatTM Numbers and Titles used in this publication are from UniFormat™, published by CSI and Construction Specifications Canada (CSC), and are used with permission from CSI. For a more in-depth explanation of UniFormat™ and its use in the construction industry visit http://www.csinet.org or contact CSI, 110 South Union Street, Suite 100, Alexandria, VA 22314. (800) 689-2900.

# 1.2 Intent

### 1.2.1 Not a set of Requirements

The Specification is not a set of requirements as to what is modeled when or by whom. Rather it is a language by which users can define these requirements for their own firms or projects. This clear articulation allows model authors to define what their models can be relied on for, and allows downstream users to clearly understand the usability and the limitations of models they are receiving.

To accomplish the Specification's intent, its primary objectives are:

1) To help teams, including owners, to specify BIM deliverables and to get a clear picture of what will be included in a BIM deliverable
2) To help design managers explain to their teams the information and detail that needs to be provided at various points in the design process, and to track progress of their models
3) To allow downstream users to rely on specific information in models they receive from others.
4) To provide a standard that can be referenced by contracts and BIM execution plans.

### 1.2.2 Complements a BIM Execution Plan (BIMXP)

This Specification does not replace a project BIMXP, but rather is intended to be used in conjunction with such a plan, providing a means of defining models for specific information exchanges, milestones in a design work plan, and deliverables for specific functions.

# 1.3 Background

### 1.3.1 AIA Effort

In 2008, the AIA published its first set of Level of Development definitions in AIA Document *E202™-2008 Building Information Modeling Protocol*. Due to the rapidly evolving nature of the use of BIM, the AIA evaluated the *E202–2008*, including the LOD definitions. The result is the updated and reconfigured Digital Practice documents, *AIA E203™–2013, Building Information Modeling and Digital Data Exhibit*, *AIA G201™–2013, Project Digital Data Protocol Form*, and *AIA G202™–2013, Project Building Information Modeling Protocol Form*, which are accompanied by a detailed guide document entitled *Guide and Instructions to the AIA Digital Practice Documents*. The AIA's updated Digital Practice documents include revised LOD definitions.

### 1.3.2 BIMForum Effort

In 2011 the BIMForum initiated the development of this LOD Specification and formed a working group comprising contributors from both the design and construction sides of the major disciplines. To help further the standardization and consistent use of the LOD schema, and to increase its usefulness as a foundation for collaboration, the AIA licensed the BIMForum to utilize its latest LOD definitions in this Specification. The BIMForum working group first interpreted the AIA's basic LOD definitions for each building system, and then compiled examples to illustrate the interpretations. Because BIM is being put to an ever increasing number of uses, the group decided that it was beyond the initial scope to address all of them. Instead, the definitions were developed to address model element geometry, with three of the most common uses in mind – quantity take-off, 3D coordination and 3D control and planning. The group felt that in taking this approach the interpretations would be complete enough to support other uses.

### 1.3.3 LOD Definitions

The LOD definitions that are used in this Specification are identical to those published in the AIA's updated Digital Practice Documents, with two exceptions.

1) First, the working group identified the need for an LOD that would define model elements sufficiently developed to enable detailed coordination between disciplines – e.g. clash detection/avoidance, layout, etc. The requirements for this level are higher than those for 300, but not as high as those for 400, thus it was designated LOD 350. The AIA documents do not include LOD 350, but the associated *Guide and Instructions* references it.
2) Second, while LOD 500 is included in the AIA's LOD definitions, the working group did not feel it was necessary to further define and illustrate LOD 500 in this Specification because it relates to field verification. Accordingly the expanded descriptions and graphic illustrations in this Specification are limited to LOD 100-400.

# 2 Levels of Development

## 2.1 BIM as a Communication Tool

The LOD schema addresses several issues that arise when a BIM is used as a communication or collaboration tool, i.e., when someone other than the author extracts information from it:

1) During the design process, building systems and components progress from a vague conceptual idea to a precise description. In the past there has been no simple way to designate where a model element is along this path. The author knows, but others often don't.
2) It's easy to misinterpret the precision at which an element is modeled. Hand drawings range from pen strokes on a napkin to hard lines with dimensions called out, and the precision of the drawing can be inferred from its appearance. In a model though, a generic component placed approximately can look exactly the same as a specific component located precisely, so we need something besides appearance to tell the difference.
3) It is possible to infer or extract information from a BIM that the author doesn't intend – unconfirmed dimensions can be measured with precision, assembly information often exists before it's been finalized, etc. In the past, this issue has been sidestepped with all-encompassing disclaimers that basically say, "Since some of the information in the model is unreliable, you may not rely on any of it." The LOD framework allows model authors to clearly state the reliability of given model elements, so the concept becomes "Since some of the information in the model is unreliable, you may only rely on it for what I specifically say you can."
4) In a collaborative environment, where people other than the model author are depending on information from the model in order to move their own work forward, the design work plan takes on high importance – it is necessary for the model users to know when information will be available in order to plan their work. The LOD framework facilitates this.

The LOD Framework addresses these issues by providing an industry-developed standard to describe the state of development of various systems, assemblies, and components within a BIM. This standard enables consistency in communication and execution by facilitating the detailed definition of BIM milestones and deliverables.

## 2.2 Level of Development vs. Level of Detail

LOD is sometimes interpreted as Level of *Detail* rather than Level of *Development*. This Specification uses the concept of Level of *Development*. 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 may rely on the information when using the model.

In essence, Level of Detail can be thought of as input to the element, while Level of Development is reliable output.

## 2.3 Fundamental LOD Definitions [4]

### 2.3.1 LOD 100

*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 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.

### 2.3.2 LOD 200

*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 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.

[4] The definitions for LOD 100, 200, 300, 400, and 500 included in this Specification represent the updated language that appears in the AIA's most recent BIM protocol document, *G202–2013, Building Information Modeling Protocol Form*. The LOD 100, 200, 300, 400 and 500 definitions are produced by the AIA and have been used by permission. Copyright © 2013. The American Institute of Architects. All rights reserved. LOD 350 was developed by the BIMForum working group. Copyright © 2013. The BIMForum and the American Institute of Architects. All rights reserved.

2.3.3 LOD 300

*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 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.

2.3.4 LOD 350

*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 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.

2.3.5 LOD 400

*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.*

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.

2.3.6 LOD 500

*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 Elements.*

This Specification does not address LOD 500.

## 2.4 Example – Light Fixture:

- 100 cost/sf attached to floor slabs
- 200 light fixture, generic/approximate size/shape/location
- 300 Design specified 2x4 troffer, specific size/shape/location
- 350 Actual model, Lightolier DPA2G12LS232, specific size/shape/location
- 400 As 350, plus special mounting details, as in a decorative soffit

# 3 Using the Specification

## 3.1 Glossary

The expanded definitions in this Specification use the following interpretations of these terms:

3.1.1 Specific:

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.

3.1.2 Actual:

The model element includes all the qualities of a specific element and is representative of the manufacturer's model to be installed or the construction intent of an assembly.

## 3.2 Details

3.2.1 Order of Precedence

The body of this Specification expands on the Fundamental Definitions as they apply to specific building systems and sub-systems. In the event of any conflict, more specific expansions take precedence over less specific expansions and Fundamental Definitions, e.g.

the expanded definitions for C1010 take precedence over those for C10, which in turn take precedence over the Fundamental Definitions.

### 3.2.2 LOD Definitions as Minimum Requirements

The LODs provide five snapshots of the progression of an element from conceptual to specified – there are many steps in this progression between the defined LODs. The LOD definitions, then, should be considered minimum requirements – i.e. an element has progressed to a given LOD only when all the requirements stated in the definition have been met.

### 3.2.3 LOD Definitions are Cumulative

For a given element each LOD definition includes the requirements of all previous LODs. Thus for an element to qualify for LOD 300 it must meet all the requirements for 200 and 100 as well as those stated in the LOD 300 definition.

### 3.2.4 Model Element Author

This document does not prescribe who the author of a particular component at a given LOD should be – the sequence of responsibility for modeling various systems will vary from one project to another. To accommodate this variation this document defers to the concept of Model Element Author (MEA) as defined in the *AIA E203-2013*: "The Model Element Author is the entity (or individual) responsible for managing and coordinating the development of a specific Model Element to the LOD required for an identified Project milestone, regardless of who is responsible for providing the content in the Model Element." [5]

### 3.2.5 2D Supplementary Drawings

In current practice models are often supplemented with 2D information such as detail drawings. This Specification does not address this supplementation, but rather deals only with what is actually modeled in 3D and non-graphic information associated with the modeled elements.

## 3.3 Project-Specific Information

As mentioned in the Overview above, this Specification is intended to be used in conjunction with a project BIMXP. Many information needs will vary from project to project, even for identical elements. This kind of information is therefore not included in the LOD definitions specified here, but rather is left to be addressed in individual BIMXPs. The following are some notable examples.

### 3.3.1 Size Thresholds

In most projects a determination is made to model certain elements only if they are over a specified size – e.g. conduit less than 1/2" (10 mm) diameter is not modeled. These size thresholds do not consistently correspond to certain LODs, and they vary from project to project. Thus they are not specified in the LOD definitions but rather in the project's BIMXP, for example through the "Notes" cells in the Model Element Table of the *AIA G202-2013*.

### 3.3.2 Clearances

Clearances such as door swings, maintenance access zones, and accessibility requirements can be critical design issues and in many cases are geometrically modeled to reserve the space. The implementation of this type of spatial coordination can be accomplished in various ways; therefore it is neither practical nor useful for this Specification to dictate particular requirements, for example, *all door swings to be modeled as quarter-cylinder solids*. Implementation of required clearances is to be established within individual BIMXPs.

## 3.4 Using the Specification with a BIMXP

Most BIMXPs include a section that details information exchanges – models to be produced to exchange specific information at specific points in a specific BIM use. In most cases, though, current practice is to accompany these models with the common "for reference only" disclaimer, diluting the effectiveness of the exchange. Referencing this Specification in the BIMXP and using it to concisely define the information exchange models brings many efficiencies to the process – among them:

### 3.4.1 Reliance

As noted above (see "BIM as a Communication Tool"), a major problem with allowing others to rely on a BIM is that it can contain information the author doesn't intend. By defining a model through the LOD Specification the author can limit reliance to only what he/she specifically states.

### 3.4.2 Multiple uses

Much model information is common across several information exchanges. This Specification facilitates the definition of models that will support multiple exchanges.

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[5] AIA Document *E203-2013 Building Information Modeling and Digital Data Exhibit,* Article 1.4.6. Copyright © American Institute of Architects 2013. All rights reserved. Definition quoted here by permission.

### 3.4.3 Efficient sequencing

The development of models as the design and construction process progresses follows logical sequences – much information depending on the prior development of other information. The definition of milestones, information exchanges, and other deliverables through this Specification facilitates the orderly sequencing of models to align with efficient development of information.

### 3.4.4 Avoidance of over-modeling

The LOD Specification facilitates the application of a pull-planning process to the modeling effort, limiting the development of model elements and information to that which the team identifies as useful.

Note that the definition and sequencing of models usually cannot be set in stone when the BIMXP is first developed. In most cases the modeling plan must evolve as the project progresses.

# 4 Organization of the Specification

## 4.1 Geometric and Attribute Information

To facilitate use of this Specification Attachment 1, Model Development Specification (MDS) has been provided. This attachment is a set of spreadsheets that can be used to collect and correlate LOD Information for a specific project.

A model element can contain two types of information: a) the element's geometry and b) associated numeric and/or textual attributes. To address these types of information this Specification contains two parts:

### 4.1.1 Part A: Element Geometry

Part A consists of narrative descriptions and illustrations of specific model elements at each LOD. Part A forms the bulk of this document.

### 4.1.2 Part B: Associated Attribute Information

Part B is contained in Attachment 1, a workbook that begins with the Model Element Table which mirrors the layout of the Model Element Table in the AIA *G202-2013 Building Information Modeling Protocol Form*, and can be referenced by that document. The Model Element Table references Attribute Tables that contain attribute information for various building systems.

## 4.2 Model Element Table

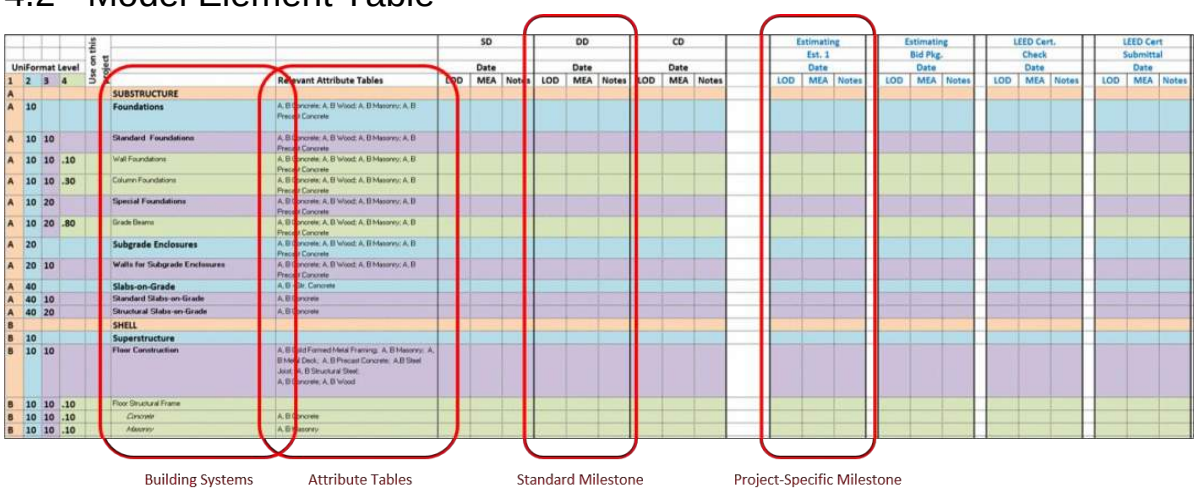



*Figure 1*

### 4.2.1 Building Systems

The rows of the Model Element Table (Figure 1) are building elements listed in accordance with CSI Uniformat 2010. The table also lists Relevant Attribute Tables for each system, referring to the tabs containing attribute information for the associated system(s). If desired users can add Attribute Tables for specific line items.

### 4.2.2 Milestones/Deliverables

The table includes columns for defining the LODs for various milestones within a project. Each milestone column has three sub-columns: Level of Development (LOD), Model Element Author (MEA), and Notes. The table in Attachment 1 shows standard milestones for the completion of the traditional design phases as well as examples of Project-Specific Milestones for interim reviews, specific deliverables, BIM-Use information exchanges, etc. Users are encouraged to modify and add to these milestones as necessary. Once the milestones for a project have been determined, they can be re-ordered into a logical sequence as in Figure 2.

| UniFormat Level | | | | Use on this project | | | SD | | | Estimating Est. 1 | | | DD | | | LEED Cert. Check | | | CD | | | Estimating Bid Pkg. | | | LEED Cert Submittal | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Date | | | Date | | | Date | | | Date | | | Date | | | Date | | | Date | | |
| 1 | 2 | 3 | 4 | | Relevant Attribute Tables | | LOD | MEA | Notes | LOD | MEA | Notes | LOD | MEA | Notes | LOD | MEA | Notes | LOD | MEA | Notes | LOD | MEA | Notes | LOD | MEA | Notes |
| A | | | | | SUBSTRUCTURE | | | | | | | | | | | | | | | | | | | | | | |
| A | 10 | | | | Foundations | A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 10 | 10 | | | Standard Foundations | A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 10 | 10 | .10 | | Wall Foundations | A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 10 | 10 | .30 | | Column Foundations | A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 10 | 20 | | | Special Foundations | A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 10 | 20 | .80 | | Grade Beams | A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 20 | | | | Subgrade Enclosures | A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 20 | 10 | | | Walls for Subgrade Enclosures | A, B Concrete; A, B Wood; A, B Masonry; A, B Precast Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 40 | | | | Slabs-on-Grade | A, B - Str. Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 40 | 10 | | | Standard Slabs-on-Grade | A, B Concrete | | | | | | | | | | | | | | | | | | | | | |
| A | 40 | 20 | | | Structural Slabs-on-Grade | A, B Concrete | | | | | | | | | | | | | | | | | | | | | |
| B | | | | | SHELL | | | | | | | | | | | | | | | | | | | | | | |
| B | 10 | | | | Superstructure | | | | | | | | | | | | | | | | | | | | | | |
| B | 10 | 10 | | | Floor Construction | A, B Cold Formed Metal Framing; A, B Masonry; A, B Metal Deck; A, B Precast Concrete; A,B Steel Joist; A, B Structural Steel; A, B Concrete; A, B Wood | | | | | | | | | | | | | | | | | | | | | |
| B | 10 | 10 | .10 | | Floor Structural Frame | | | | | | | | | | | | | | | | | | | | | | |
| B | 10 | 10 | .10 | | *Concrete* | A, B Concrete | | | | | | | | | | | | | | | | | | | | | |
| B | 10 | 10 | .10 | | *Masonry* | A, B Masonry | | | | | | | | | | | | | | | | | | | | | |

*Figure 2*

## 4.3 Attribute Tables

**B – Ext. Glazed Openings**

| | Part 1 - Attribute Description | | | | Part 2 - LOD Profile | | | | | Part 3 - Project-Specific Milestones (Examples) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Estimating | Estimating | LEED Cert. | LEED Cert |
| | Data Type | Units | Option Examples | Commentary | 100 | 200 | 300 | 350 | 400 | Est. 1 | Bid Pkg. | Check | Submittal |
| Construction | Text | | options [Unitized (combined glass and frame), Stick Built, Structural Glass] | | | x | x | x | x | | | | |
| 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 [yes, no, class] | | | | | | | | | | |
| Windbourne Debris Resistance | | psf | | | | | | | | | | | |
| Wind Load Capacity | | psf | | | | | | | | | | | |
| Glazing Method | | | options [Conventional, Two Sided, Three Sided, Four Sided, Pint Supported] | | | | | | | | | | |
| Glass - Material | | | options [Glass, Plastic] | | | | | | | | | | |
| Glass - Configuration | | | options [Monolithic, Insulating] | | | | | | | | | | |
| Glass - Condition | | | options, multiple [Annealed, Heat Strengthend, Tempered, Laminated, Bent] | | | | | | | | | | |
| Glass - Coatings | | | options, multiple [Pyrolytic (hard coat), Sputter (soft coat), Low E, Metallic, Ceramic Frit, Opaci Coat, Digital Printed] | | | | | | | | | | |

*Figure 3*

### 4.3.1 Attribute Table Anatomy

Attribute Tables consist of three parts.

1) Part 1, Attribute Description, lists Attributes relevant to the associated building system(s).
2) Part 2, LOD Profile, correlates Attribute requirements with LODs from the Model Element Table. Attributes with pre-populated LOD Profiles show a correlation between Attributes and LODs that represents current practices of proficient BIM users.
3) Part 3, Milestones, is used to mark the attributes required for specific milestones and deliverables. The tables in Attachment 1 include example milestones, but users will customize the tables by copying the milestones they created for the Model Element Table.

### 4.3.2 MEP Attribute Tables

The MEP attribute tables use a somewhat different format than other sections, since components from multiple systems might be used to make up a specific element. Case in point, an air handler is primarily a D30 HVAC element, but can include plumbing, fire protection and electrical elements as well.

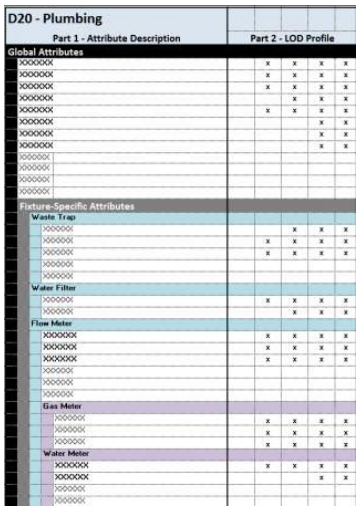



*Figure 4*

The MEP Systems tabs are grouped into two types:

1) Type 1 – source or end elements and controllers: D20 Plumbing, D30 HVAC, D40 Fire Protection and D50 Electrical.
2) Type 2 – distribution elements such as ducts, pipes, and cables: D Air Distribution, D Fluid Gas Distribution and D Electrical Distribution relate to distribution elements such as ducts, pipes, and cables.

MEP attribute tables are broken down into two main sections

3) Common Attributes: Attributes that are common to all elements within the table
4) Specific Attributes: Attributes that are specific to an individual type of element within the table. In many tables the Individual elements are organized into a hierarchy of classes and sub-classes. In these cases the attributes needed for a specific element include those listed for the element itself plus those listed in any of the classes above it in the hierarchy. E.g. as Figure 4 shows, the basic attributes for a water meter include all those shown in bold.
*Note: The Type 1 attributes use both the Common and Specific attributes section, while the Type 2 attributes use only the Specific attribute section.*

### 4.3.3 Using the Attribute Tables

There are many ways to use the Attribute Tables – three are shown here.

1) Project teams adopt the pre-populated attribute lists – using only those attributes with entries in the LOD Profile sections and leaving those entries unchanged. The pre-populated correlation between Attributes and LODs represents current practices of proficient BIM users in the AEC industry.
2) Project teams create a custom correlation between LODs and Attribute population requirements. In this case the project team would edit the LOD Profile section to reflect the specific requirements of the project.
3) Project teams create new, project specific milestones and define Attribute population requirements in the Milestones sections. This approach will give project teams the greatest flexibility for defining Attribute population requirements.

# 5 Updates of This Document

While this document is intended as a reference that can be cited in agreements such as contracts and BIM execution plans, it is recognized that the use of BIM in design and construction is evolving. To accommodate this evolution this document will be updated periodically in clearly identifiable versions. A project can adopt a specific version and then has the option to remain with that version or update if a new version is published. Initially the target update frequency is annually, but that may change in the future. In addition, interim updates may be issued if needed.

## 5.1 Revision History

| | | |
|---|---|---|
| 10/30/15 | Level of Development Specification 2015 | New changes are noted with a bold bar. Definitions have not been changed except for minor grammatical corrections and formatting. New content released as an Appendix to Part A for engineered metal building structures, precast concrete, highway bridge content and rail road bridge content. |
| 4/30/15 | Level of Development Specification 2015<br>DRAFT FOR PUBLIC COMMENT | New changes are noted with a bold bar. Definitions have not been changed except for minor grammatical corrections and formatting. Part B, Model Element Table, and Attribute Tables were added. |

| | | |
|---|---|---|
| 12/30/14 | Level of Development Specification 2014 | New changes are noted with a bold bar. Definitions have not been changed except for minor grammatical corrections and formatting. Images and image notes have been added in *blue italics font*. |
| 8/22/13 | Level of Development Specification 2013 | |
| 4/24/13 | Initial draft for public review | |

## 5.2 Revision Process

### 5.2.1 Public Comment

Each new version is first released as a draft for public comment. Feedback is evaluated and resolved prior to the publishing of the official version.

### 5.2.2 Appendix

An increasing number of professional organizations are adopting this Specification and providing additional content relating to their domains. To accommodate information that becomes available after the public-comment release but prior to the final release, content is developed in collaboration with industry organizations and leading expert practitioners, and then vetted by the LOD working group. This content is released as an Appendix to Part A and as additional identified Attribute Table tabs in Part B. The new content is then integrated into the next public comment draft.

# A: SUBSTRUCTURE

## A10 Foundations

| | | |
|---|---|---|
| 100 | Assumptions for foundations are included in other modeled elements such as an architectural floor element or volumetric mass that contains layer for assumed structural framing depth.<br><br>Or, schematic elements that are not distinguishable by type or material. Assembly depth/thickness and locations still flexible. | |
| 200 | Element modeling to include:<br>• Approximate size and shape of foundation element<br>• Structural building grids for local project coordinate system are defined in model and coordinated with global civil coordinate system (State Plane Coordinate System, etc). | |

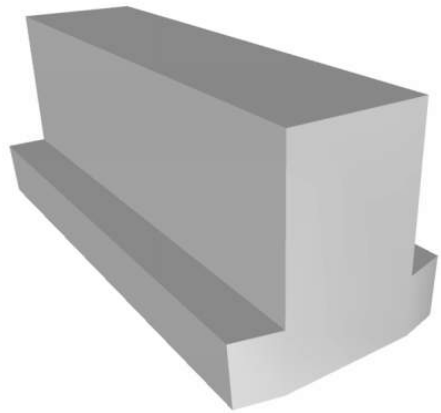
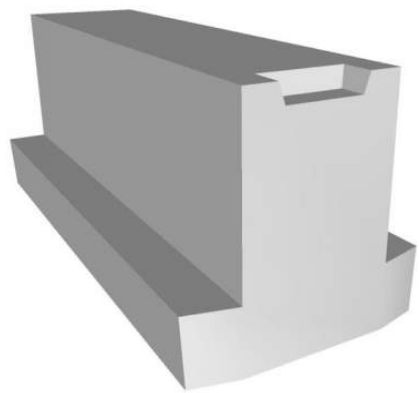
## A1010 – Standard Foundations

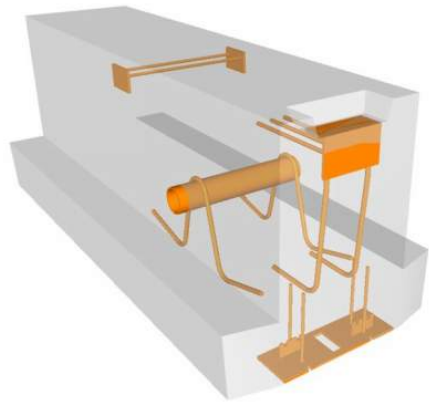
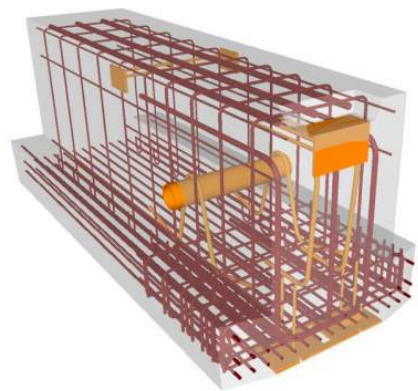
| | | |
|---|---|---|
| 100 | See A10 | |
| 200 | See A10 | |
| 300 | Elements are modeled to the design-specified size and shape of the foundation.<br><br>Element modeling to include:<br>• Overall size and geometry of the foundation element<br>• Sloping surfaces or floor depressions<br>• External dimensions of the members<br><br>Required non-graphic information associated with model elements includes:<br>• Concrete strength<br>• Reinforcing strength | |

# Appendix

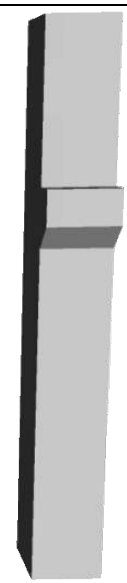
The appendix section contains content that is developed in collaboration with industry organizations, leading expert practitioners, and feedback from committees following the issue of the April 2015 Draft. They are being released in the Appendix of this edition of the LOD Specification for public comment and use. They are proposed for the main body of the next submission of the LOD Specification. The following elements shall be modeled in accordance with these additional pages when the LOD Specification is used.

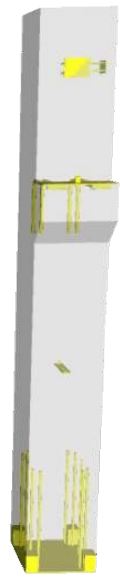
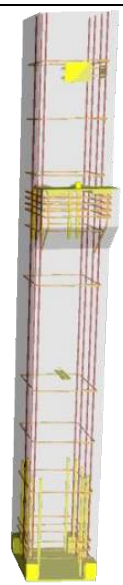
# B1010.10 – Precast Structural Inverted T Beam (Concrete)

| | | |
|---|---|---|
| 100 | See B10 | |
| 200 | Element modeling to include:<br>• Type of structural concrete system<br>• Approximate geometry (e.g. depth) of structural elements |  <br>*B1010.10-LOD 200 Precast Structural Inverted T Beam (Concrete)* |
| 300 | Element modeling to include:<br>• Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation<br>• Concrete defined per spec (strength, air entrainment, aggregate size, etc.)<br>• All sloping surfaces included in model element with exception of elements affected by manufacturer selection<br>Required non-graphic information associated with model elements includes:<br>• Penetrations for items such as MEP<br>• Finishes, camber, chamfers, etc.<br>• Typical details<br>• Embeds and anchor rods<br>• Aggregate, clear clover<br>• Reinforcing spacing<br>• Reinforcing<br>• Live loads |  <br>*B1010.10-LOD 300 Precast Structural Inverted T Beam (Concrete)* |

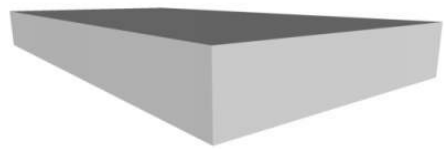
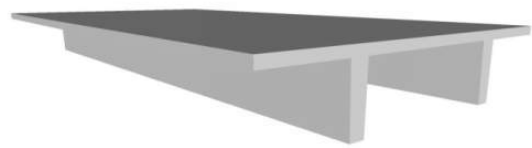
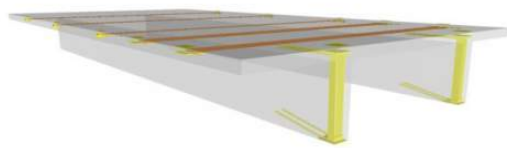
| | | |
|---|---|---|
| 350 | Element modeling to include:<br>• Reinforcing Post-tension profiles and strand locations<br>• Reinforcement called out, modeled if required by the BIMXP, typically only in congested areas<br>• Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc.<br>• Lifting devices<br>• Expansion Joints<br>• Embeds and anchor rods<br>• Post-tension profile and strands modeled if required by the BIMXP<br>• Penetrations for items such as MEP<br>• Any permanent forming or shoring components |  <br>*B1010.10-LOD 350 Precast Structural Inverted T Beam (Concrete)* |
| 400 | Element modeling to include:<br>• All reinforcement including post tension elements detailed and modeled<br>• Finishes, camber, chamfer, etc. |  <br>*B1010.10-LOD 400 Precast Structural Inverted T Beam (Concrete)* |

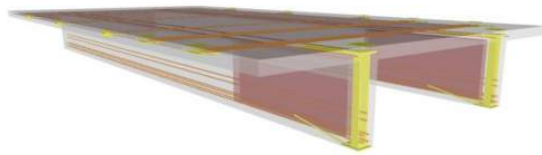
# B1010.10 – Precast Structural Column (Concrete)

| | | |
|---|---|---|
| 100 | See B10 | |
| 200 | Element modeling to include:<br>• Type of structural concrete system<br>• Approximate geometry (e.g. depth) of structural elements |  <br>*B1010.10 - LOD 200 Precast Structural Column (Concrete)* |
| 300 | Element modeling to include:<br>• Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation<br>• Concrete defined per spec (strength, air entrainment, aggregate size, etc.)<br>• All sloping surfaces included in model element with exception of elements affected by manufacturer selection<br>Required non-graphic information associated with model elements includes:<br>• Penetrations for items such as MEP<br>• Finishes, camber, chamfers, etc.<br>• Typical details<br>• Embeds and anchor rods<br>• Aggregate, clear clover<br>• Reinforcing spacing<br>• Reinforcing<br>• Live loads |  <br>*B1010.10 - LOD 300 Precast Structural Column (Concrete)* |

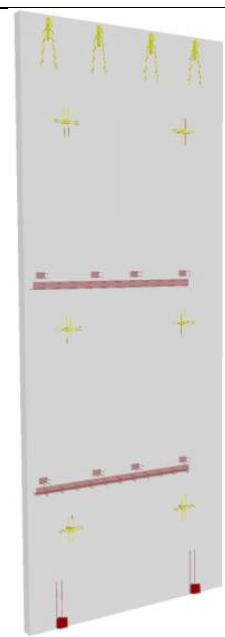
| | | |
|---|---|---|
| 350 | Element modeling to include:<br>• Reinforcing Post-tension profiles and strand locations<br>• Reinforcement called out, modeled if required by the BIMXP, typically only in congested areas<br>• Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc.<br>• Expansion Joints<br>• Lifting devices<br>• Embeds and anchor rods<br>• Post-tension profile and strands modeled if required by the BIMXP<br>• Penetrations for items such as MEP<br>• Any permanent forming or shoring components |  <br>*B1010.10 - LOD 350 Precast Structural Column (Concrete)* |
| 400 | Element modeling to include:<br>• All reinforcement including post tension elements detailed and modeled<br>• Finishes, camber, chamfer, etc. |  <br>*B1010.10 - LOD 400 Precast Structural Column (Concrete)* |

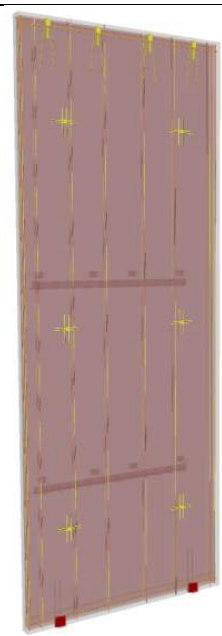
# B1010.10 – Precast Structural Double Tee (Concrete)

| | | |
|---|---|---|
| 100 | See B10 | |
| 200 | Element modeling to include:<br>• Type of structural concrete system<br>• Approximate geometry (e.g. depth) of structural elements |  <br>*B1010.1 – LOD 200 Precast Structural Double Tee (Concrete)* |
| 300 | Element modeling to include:<br>• Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation<br>• Concrete defined per spec (strength, air entrainment, aggregate size, etc.)<br>• All sloping surfaces included in model element with exception of elements affected by manufacturer selection<br>Required non-graphic information associated with model elements includes:<br>• Penetrations for items such as MEP<br>• Finishes, camber, chamfers, etc.<br>• Typical details<br>• Embeds and anchor rods<br>• Aggregate, clear clover<br>• Reinforcing spacing<br>• Reinforcing<br>• Live loads |  <br>*B1010.1 – LOD 300 Precast Structural Double Tee (Concrete)* |
| 350 | Element modeling to include:<br>• Reinforcing Post-tension profiles and strand locations<br>• Reinforcement called out, modeled if required by the BIMXP, typically only in congested areas<br>• Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc.<br>• Expansion Joints<br>• Lifting devices<br>• Embeds and anchor rods<br>• Post-tension profile and strands modeled if required by the BIMXP<br>• Penetrations for items such as MEP<br>• Any permanent forming or shoring components |  <br>*B1010.1 – LOD 350 Precast Structural Double Tee (Concrete)* |

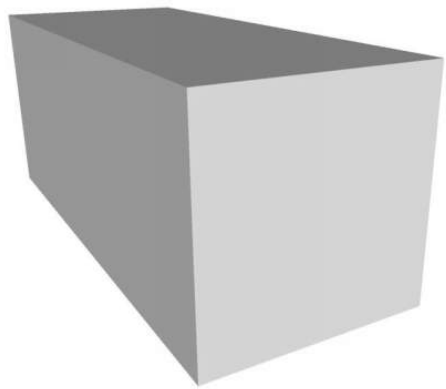
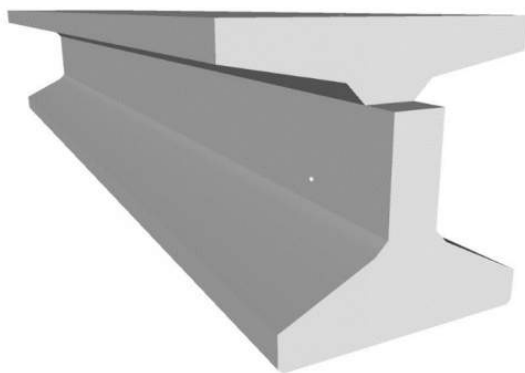
| | | |
|---|---|---|
| 400 | Element modeling to include:<br>• All reinforcement including post tension elements detailed and modeled<br>• Finishes, camber, chamfer, etc. |  <br>*B1010.1 – LOD 400 Precast Structural Double Tee (Concrete)* |

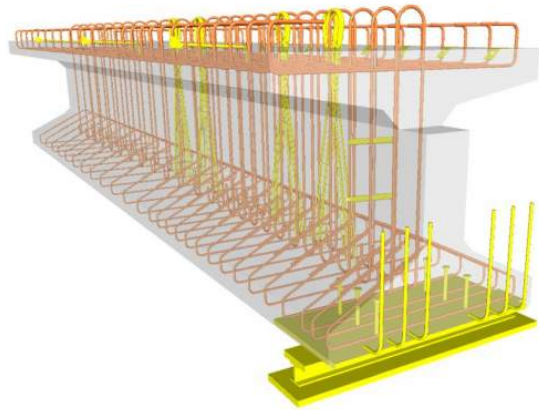
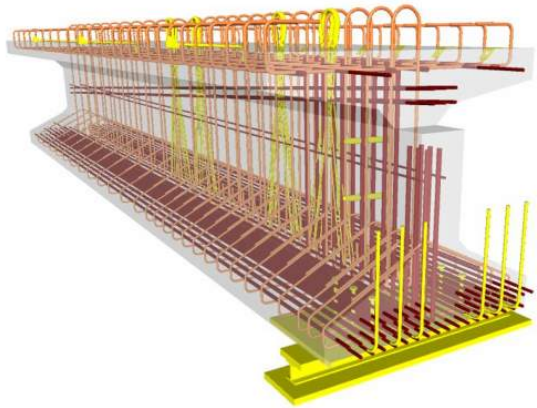
# B1010.10 – Precast Wall (Concrete)

| | | |
|---|---|---|
| 100 | See B10 | |
| 200 | Element modeling to include:<br>• Type of structural concrete system<br>• Approximate geometry (e.g. depth) of structural elements | |
| 300 | Element modeling to include:<br>• Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation<br>• Concrete defined per spec (strength, air entrainment, aggregate size, etc.)<br>• All sloping surfaces included in model element with exception of elements affected by manufacturer selection<br>Required non-graphic information associated with model elements includes:<br>• Penetrations for items such as MEP<br>• Finishes, camber, chamfers, etc.<br>• Typical details<br>• Embeds and anchor rods<br>• Aggregate, clear clover<br>• Reinforcing spacing<br>• Reinforcing<br>• Live loads | |
| 350 | Element modeling to include:<br>• Reinforcing Post-tension profiles and strand locations<br>• Reinforcement called out, modeled if required by the BIMXP, typically only in congested areas<br>• Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc.<br>• Expansion Joints<br>• Lifting devices<br>• Embeds and anchor rods<br>• Post-tension profile and strands modeled if required by the BIMXP<br>• Penetrations for items such as MEP<br>• Any permanent forming or shoring components |  <br>*B1010.10 – LOD 350 Precast Wall (Concrete)* |

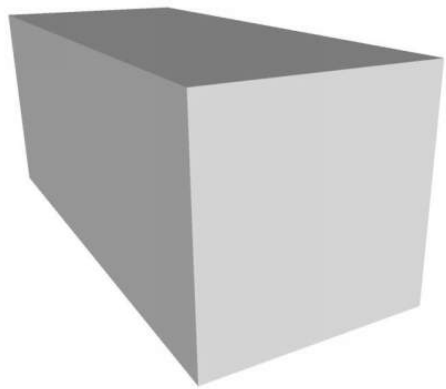
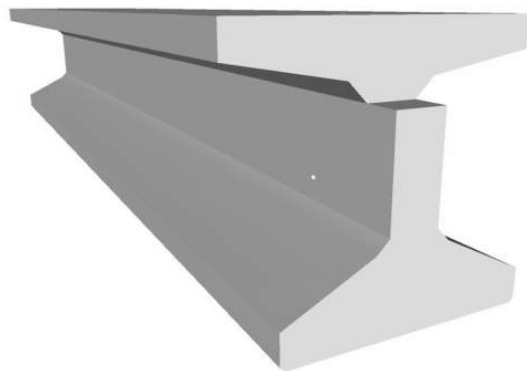
| | | |
|---|---|---|
| 400 | Element modeling to include:<br>• All reinforcement including post tension elements detailed and modeled<br>• Finishes, camber, chamfer, etc. |  <br>*B1010.10 – LOD 400 Precast Wall (Concrete)* |

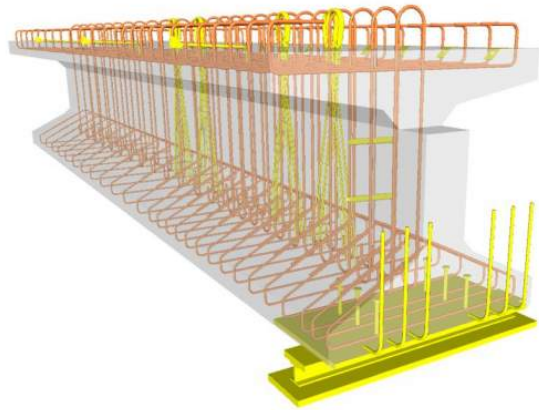
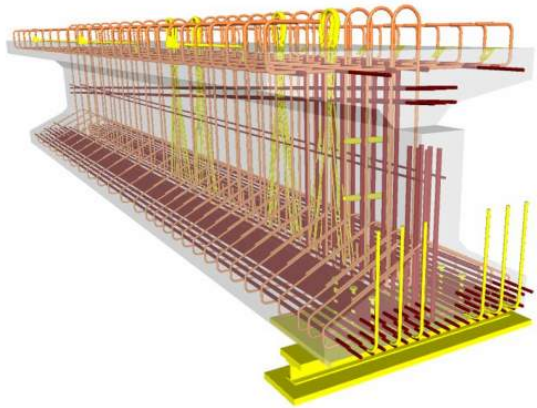
# B1010 – Highway Bridges Precast Structural I Girder (Concrete)

| | | |
|---|---|---|
| 100 | See B10 | |
| 200 | Element modeling to include:<br>• Type of structural concrete system<br>• Approximate geometry (e.g. depth) of structural elements |  <br>*B1010 – LOD 200 Highway Bridges Precast Structural I Girder (Concrete)* |
| 300 | Element modeling to include:<br>• Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation<br>• Concrete defined per spec (strength, air entrainment, aggregate size, etc.)<br>• All sloping surfaces included in model element with exception of elements affected by manufacturer selection<br>Required non-graphic information associated with model elements includes:<br>• Penetrations for items such as MEP<br>• Finishes, camber, chamfers, etc.<br>• Typical details<br>• Embeds and anchor rods<br>• Aggregate, clear clover<br>• Reinforcing spacing<br>• Reinforcing<br>• Live loads |  <br>*B1010 – LOD 300 Highway Bridges Precast Structural I Girder (Concrete)* |

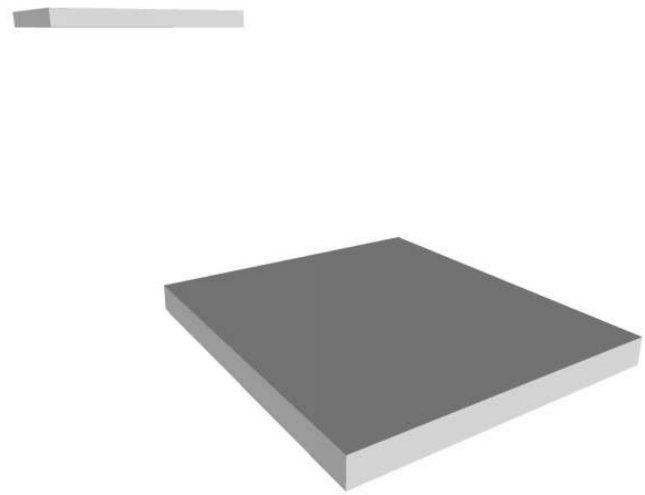
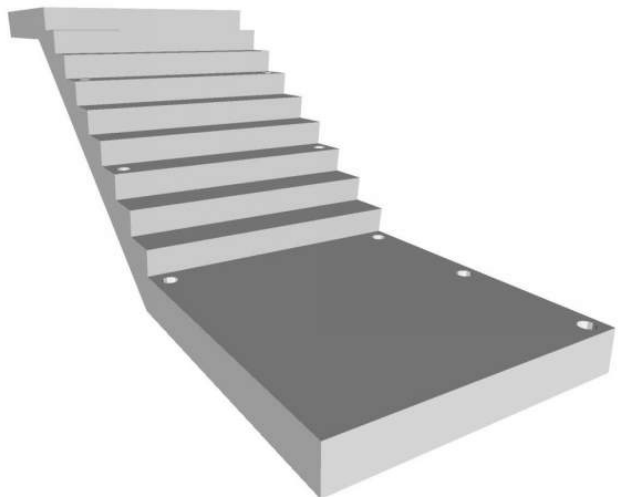
| | | |
|---|---|---|
| 350 | Element modeling to include:<br>• Reinforcing Post-tension profiles and strand locations<br>• Reinforcement called out, modeled if required by the BIMXP, typically only in congested areas<br>• Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc.<br>• Expansion Joints<br>• Lifting devices<br>• Embeds and anchor rods<br>• Post-tension profile and strands modeled if required by the BIMXP<br>• Penetrations for items such as MEP<br>• Any permanent forming or shoring components |  <br>*B1010 – LOD 350 Highway Bridges Precast Structural I Girder (Concrete)* |
| 400 | Element modeling to include:<br>• All reinforcement including post tension elements detailed and modeled<br>• Finishes, camber, chamfer, etc. |  <br>*B1010 – LOD 400 Highway Bridges Precast Structural I Girder (Concrete)* |

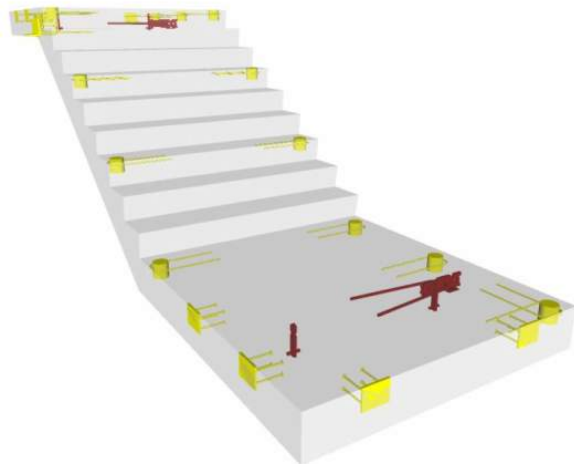
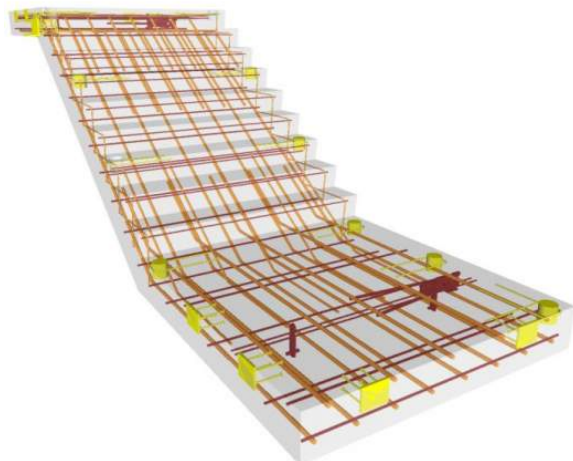
# B1010 – Railroad Bridges Precast Structural I Girder (Concrete)

| | | |
|---|---|---|
| 100 | See B10 | |
| 200 | Element modeling to include:<br>• Type of structural concrete system<br>• Approximate geometry (e.g. depth) of structural elements |  <br>*B1010 – LOD 200 Railroad Bridges Precast Structural I Girder (Concrete)* |
| 300 | Element modeling to include:<br>• Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation<br>• Concrete defined per spec (strength, air entrainment, aggregate size, etc.)<br>• All sloping surfaces included in model element with exception of elements affected by manufacturer selection<br>Required non-graphic information associated with model elements includes:<br>• Penetrations for items such as MEP<br>• Finishes, camber, chamfers, etc.<br>• Typical details<br>• Embeds and anchor rods<br>• Aggregate, clear clover<br>• Reinforcing spacing<br>• Reinforcing<br>• Live loads |  <br>*B1010 – LOD 300 Railroad Bridges Precast Structural I Girder (Concrete)* |

| | | |
|---|---|---|
| 350 | Element modeling to include:<br>• Reinforcing Post-tension profiles and strand locations<br>• Reinforcement called out, modeled if required by the BIMXP, typically only in congested areas<br>• Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc.<br>• Expansion Joints<br>• Lifting devices<br>• Embeds and anchor rods<br>• Post-tension profile and strands modeled if required by the BIMXP<br>• Penetrations for items such as MEP<br>• Any permanent forming or shoring components |  <br>*B1010 – LOD 350 Railroad Bridges Precast Structural I Girder (Concrete)* |
| 400 | Element modeling to include:<br>• All reinforcement including post tension elements detailed and modeled<br>• Finishes, camber, chamfer, etc. |  <br>*B1010 – LOD 400 Railroad Bridges Precast Structural I Girder (Concrete)* |

# C2010.20 – Precast Structural Stairs (Concrete)

| | | |
|---|---|---|
| 100 | See C10 | |
| 200 | Element modeling to include:<br>• Type of structural concrete system<br>• Approximate geometry (e.g. depth) of structural elements |  <br>*C2010.20-LOD 200 Precast Structural Stairs (Concrete)* |
| 300 | Element modeling to include:<br>• Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation<br>• Concrete defined per spec (strength, air entrainment, aggregate size, etc.)<br>• All sloping surfaces included in model element with exception of elements affected by manufacturer selection<br>Required non-graphic information associated with model elements includes:<br>• Penetrations for items such as MEP<br>• Finishes, camber, chamfers, etc.<br>• Typical details<br>• Embeds and anchor rods<br>• Aggregate, clear clover<br>• Reinforcing spacing<br>• Reinforcing<br>• Live loads |  <br>*C2010.20-LOD 300 Precast Structural Stairs (Concrete)* |

| | | |
|---|---|---|
| 350 | Element modeling to include:<br>• Reinforcing Post-tension profiles and strand locations<br>• Reinforcement called out, modeled if required by the BIMXP, typically only in congested areas<br>• Pour joints and sequences to help identify reinforcing lap splice locations, scheduling, etc.<br>• Expansion Joints<br>• Lifting devices<br>• Embeds and anchor rods<br>• Post-tension profile and strands modeled if required by the BIMXP<br>• Penetrations for items such as MEP<br>• Any permanent forming or shoring components |  <br>*C2010.20-LOD 350 Precast Structural Stairs (Concrete)* |
| 400 | Element modeling to include:<br>• All reinforcement including post tension elements detailed and modeled<br>• Finishes, camber, chamfer, etc. |  <br>*C2010.20-LOD 400 Precast Structural Stairs (Concrete)* |

## A, B - Precast Concrete

| Part 1 - Attribute Description | | | | | Part 2 - LOD Profile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Attribute | Data Type | Units | Option Examples | Commentary | 100 | 200 | 300 | 350 | 400 |
| Member Type | Integer | | (0) Foundation (1) Beam (2) Column (3) Slab (4) Wall | | | x | x | x | x |
| Concrete Compression Strength | | PSI | | Example: 3000 PSI | | | x | x | x |
| Reinforcing Steel Flexture | | PSI | | Example: 60,000 PSI | | | x | x | x |
| Reinforcing Steel Shear | | PSI | | Example: 60,000 PSI | | | x | x | x |
| Member Casting Number | | | | | | | | | |
| Exterior Exposure | Bool | True \ False | | | | | | | |
| Shop Submital Parameters | | | | | | | | | |
| Date - Issued For Construction | Date Time | | | DateIFC | | | | | |
| Date - Permited | Date Time | | | DatePermitted | | | | | |
| Date - recieved for Shop Detailing | Date Time | | | DateRecievedForShopDet | | | | | |
| Date - Detailing Submited for EOR review \ Out For Aproval (O | Date Time | | | DateOutForAproval | | | | | |
| Date - Final Erection Drawings Aproved for Fab | Date Time | | | DateFinalForFab | | | | | |
| Date - Fabrication Start | Date Time | | | DateFabStart | | | | | |
| Date - Fabrication End | Date Time | | | DateFabEnd | | | | | |
| Date - Fabrication Shipped | Date Time | | | DateFabShip | | | | | |
| Date - Fabrication Received | Date Time | | | DateFabRecieved | | | | | |
| Date - Erection | Date Time | | | DateErected | | | | | |
| Date - Inspected | Date Time | | | DateInspected | | | | | |
| | | | | | | | | | |

# Appendix- B Bridge Concrete

| Part 1 - Attribute Description | | | | | Part 2 - LOD Profile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Attribute | Data Type | Units | Option Examples | Commentary | 100 | 200 | 300 | 350 | 400 |
| Member Type | Integer | | (0) Foundation (1) Beam (2) Column (3) Slab (4) Wall | | | x | x | x | x |
| Concrete Compression Strength | | PSI | | Example: 3000 PSI | | | x | x | x |
| Reinforcing Steel Flexture | | PSI | | Example: 60,000 PSI | | | x | x | x |
| Reinforcing Steel Shear | | PSI | | Example: 60,000 PSI | | | x | x | x |
| Member Casting Number | | | | | | | | | |
| Exterior Exposure | Bool | True \ False | | | | | | | |
| Shop Submital Parameters | | | | | | | | | |
| Date - Issued For Construction | Date Time | | | DateIFC | | | | | |
| Date - Permited | Date Time | | | DatePermitted | | | | | |
| Date - recieved for Shop Detailing | Date Time | | | DateRecievedForShopDet | | | | | |
| Date - Detailing Submited for EOR review \ Out For Aproval (O | Date Time | | | DateOutForAproval | | | | | |
| Date - Final Erection Drawings Aproved for Fab | Date Time | | | DateFinalForFab | | | | | |
| Date - Fabrication Start | Date Time | | | DateFabStart | | | | | |
| Date - Fabrication End | Date Time | | | DateFabEnd | | | | | |
| Date - Fabrication Shipped | Date Time | | | DateFabShip | | | | | |
| Date - Fabrication Received | Date Time | | | DateFabRecieved | | | | | |
| Date - Erection | Date Time | | | DateErected | | | | | |
| Date - Inspected | Date Time | | | DateInspected | | | | | |
| | | | | | | | | | |

# Appendix- B Bridge Precast

| Part 1 - Attribute Description | | | | | Part 2 - LOD Profile | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Attribute | Data Type | Units | Option Examples | Commentary | 100 | 200 | 300 | 350 | 400 |
| Member Type | Integer | | (0) Foundation (1) Beam (2) Column (3) Slab (4) Wall | | | x | x | x | x |
| Concrete Compression Strength | | PSI | | Example: 3000 PSI | | | x | x | x |
| Reinforcing Steel Flexture | | PSI | | Example: 60,000 PSI | | | x | x | x |
| Reinforcing Steel Shear | | PSI | | Example: 60,000 PSI | | | x | x | x |
| Member Casting Number | | | | | | | | | |
| Exterior Exposure | Bool | True \ False | | | | | | | |
| Shop Submital Parameters | | | | | | | | | |
| Date - Issued For Construction | Date Time | | | DateIFC | | | | | |
| Date - Permited | Date Time | | | DatePermitted | | | | | |
| Date - recieved for Shop Detailing | Date Time | | | DateRecievedForShopDet | | | | | |
| Date - Detailing Submited for EOR review \ Out For Aproval (O | Date Time | | | DateOutForAproval | | | | | |
| Date - Final Erection Drawings Aproved for Fab | Date Time | | | DateFinalForFab | | | | | |
| Date - Fabrication Start | Date Time | | | DateFabStart | | | | | |
| Date - Fabrication End | Date Time | | | DateFabEnd | | | | | |
| Date - Fabrication Shipped | Date Time | | | DateFabShip | | | | | |
| Date - Fabrication Received | Date Time | | | DateFabRecieved | | | | | |
| Date - Erection | Date Time | | | DateErected | | | | | |
| Date - Inspected | Date Time | | | DateInspected | | | | | |
| | | | | | | | | | |