March 2024

# BIM Implementation Manual

ILLINOIS STATE TOLL HIGHWAY AUTHORITY

Illinois Tollway

# INTRODUCTION

## BIM Implementation Manual

The Illinois Tollway's vision is to provide efficiency and technological advancements in the project delivery practices of construction projects. This document is intended to provide guidance on how to implement Building Information Modeling (BIM) in the context of roadway design, construction, and asset management to achieve the Illinois Tollway's vision. This manual is to provide a basis for project management, design, model use for construction and asset management practice for all BIM implemented projects.

The BIM Implementation Manual dated March 2024 replaces the previous version dated March 2023.

**Major Revision Highlights**

| | |
|---|---|
| **Section 2.0: Project Management** | |
| Article 2.3 | Added clarification and link to access editable Appendix B and F documents. |
| Article 2.4 | Added article to elaborate on how to finalize scope of a MALD project. |
| Article 2.5 | Added article to provide avenue for existing projects not initially scoped with MALD to transition portions of contract to MALD. |
| **Section 4.0: Design** | |
| Article 4.1.3 | Added article to explain how to approach existing ground models when setting up parameters for design models. Specifically for multi-location design contracts. |
| **Section 5.0: Design Milestone Reviews** | |
| Article 5.2.2 | Provided details on review process and more direction to user on how to navigate comments and successfully dispose review comments on iTwins. |
| **Appendices** | |
| Appendix C | IDOT/Illinois Tollway – LOD MDD Table<br>• Earthwork<br>  ○ Added asterisk for Existing Grounds with foot note below table for direction on how to handle multi-location design contracts which have separate construction contracts. |
| Appendix F | BIM Execution Plan Form (For reference) added to manual. |

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# SECTION 1.0 INTRODUCTION

## 1.1 Overview

Based on the National Building Information Modeling Standard, BIM is defined as a "continuous use of a shared comprehensive digital representation of a built asset to plan, design, construct, operate, maintain and manage that supports reliable decision-making, maximizing efficiency and reducing costs throughout the life cycle of the facility. BIM is an activity using tools, processes and technologies involving information management throughout the life cycle of the facility" (Adapted from BIM ISO 19650 BSI / National BIM Standard-US BSI / Borrmann, A et., 2018 / Sachs, R. et al., 2018).

The benefit of BIM is that the data provided in the model is easy to understand for all project stakeholders from design, construction, and asset management. Building information modeling has furthermore been expanded to define project details beyond that of the 2-Dimensional realm. This document references the advancements in BIM by integrating information into the modeled elements:

- 2-Dimension
- 3-Dimension
- 4-Dimension – overall data of the modeled elements include schedule data such as fabrication lead time and assembly duration time.
- 5-Dimension – with 4D included, overall data of the modeled elements cost data such as unit costs and applicable cost index.
- 6-Dimension – with 4D and 5D included, overall data of the modeled elements include sustainability data such as recycled content, embodied energy per unit, transportation distance, etc.
- 7-Dimension – with 4D, 5D, and 6D included, overall data of the modeled elements include maintenance data such as material durability after installation, life-cycle, impact resistance level, warranty duration, etc.

Implementation of BIM beyond 3 dimensions is achievable in the civil industry and the Tollway will continually look to these other dimensions in the future but will primarily focus initially on the first 3 dimensions. In the future, advancing BIM to further dimensions may promote a more efficient approach to construction by allowing the project to be built virtually before being built in real-life.

## 1.2 Best Practice Guidelines

The primary objective of the Illinois Tollway is to establish efficient guidelines for project delivery using model as legal document. BIM fulfills this objective by:

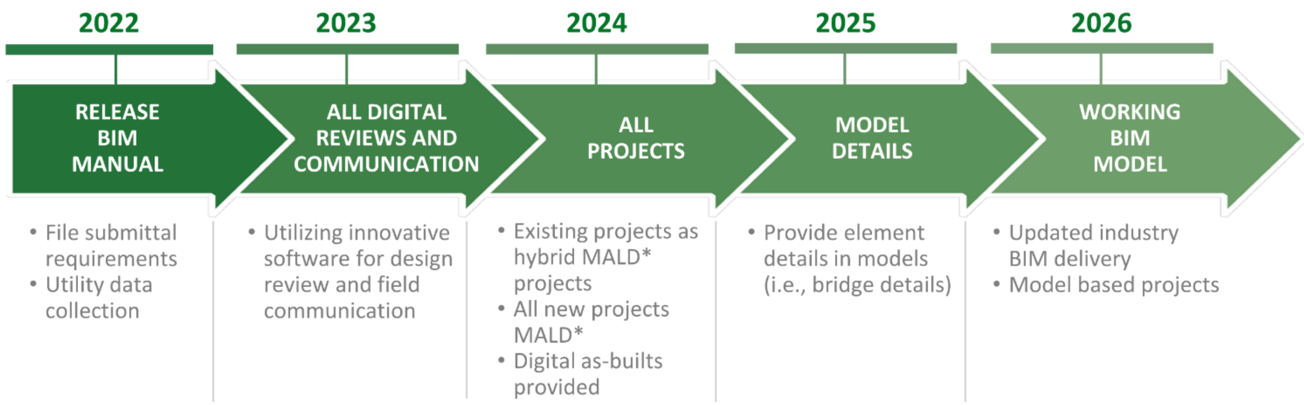
- Inclusivity of all project stakeholders in design, construction, and asset management by providing multidisciplinary coordination tools and protocol.
- Use of 2D and 3D visualization with all the element attributes and specifications identified in the modeled elements.
- Expediting the project delivery by centralizing the project model for design, construction, and facilities management teams.
- Reducing waste by using the central model as the governing entity of the contract documents in lieu of printing high volume of sheets for issuance.

- Saving time on document revisions by adjusting the model as the design is being constructed.
- Providing a higher level of precision and accuracy of the as-built project and the data associated for lifecycle assessment management.
- Creating a user-friendly database to track material supplier and maintenance records.
- Using the as-built model as a baseline for O&M to improve maintenance standards and a baseline for future projects.

Using BIM, the objective of this manual is to provide guidelines for implementation on Illinois Tollway contracts according to the CADD standards. This manual is intended to enhance the processes and associated technologies to implement BIM cohesively throughout Illinois Tollway programs.

## 1.3 Implementation Goals

The 5-year timeline for the implementation goal is as follows:




* MALD = Model As Legal Document

The goals are defined as the following:

- File submittal requirements
  - Define what items will need to be delivered as which file type (i.e., DGN, XML, DTM) for design reviews, construction, and asset management.
- Utility Data Collection
  - Standardize the documentation process for collecting utility data during construction and setting the delivery requirements for digital as-builts for utilities.
- Utilizing innovative software for design review and field communication
  - For Design – Select the appropriate platform for reviewing the electronic data files. submitted for each milestone review and the process for disposing the comments.
  - For Construction – Select the appropriate platform for documenting electronic data file revisions and for a more efficient process for answering RFIs.
- Existing projects to as hybrid Model As Legal Document (MALD) projects

    - Existing projects that are in design during this period will have portions of the scope using the electronic data files placed above the hierarchy over the PDF plan sets where appropriate.
- All new projects to be Model As Legal Document (MALD)
    - New projects to be model-centric where the electronic data files are above the PDF plan sets in the hierarchy.
- Digital as-builts provided
    - Standardizing the requirements for non-utility digital as-builts to be delivered to the Illinois Tollway asset management.
- Provide element details in models (i.e., bridge details)
    - Detail conditions to be modeled as standardized cells as future modeling software advances
- Updated industry BIM delivery
    - As software and industry processes advances, the workflow for BIM implementation will adapt accordingly
- Model-based project delivery
    - All projects to use model-base delivery as the standard practice.

## 1.4 Definitions and Acronyms

### 1.4.1 Definitions

This section contains the definitions for the following terminology applicable to the Illinois Tollway BIM Implementation Manual.

**2D:** Graphic display using only the X-Y coordinates of the Cartesian plane where the Z-coordinate, which represents the single elevation value, is typically set to zero. In a 2D-only work environment, the elevation coordinates are omitted from being reported since all values are the same.

**3D:** Graphic display using the X, Y, and Z-coordinates of the Cartesian plane where the origin (O) sets at zero for all coordinates. 3D coordinate systems are represented as a cube.

**3-D Engineered Model:** A digital representation of any three-dimensional engineered object.

**American Association of State Highway and Transportation Officials (AASHTO):** A standards-setting body for specifications, test protocols, and guidelines. Voting members are representatives of US state highway and transportation agencies.

**Automated Machine Guidance (AMG):** AMG is a broad spectrum of hardware and software technologies that enable heavy equipment and other robotic tools to operate with minimal or no human control. The design intent is represented with 3D geometry published into an instruction set that activates and manipulates the controls of the machine, such that its operation creates an output precisely matching the design in the real world. This equipment allows for safer, faster, and more precise construction and is being implemented on all manner of construction equipment.

**Bentley CONNECTED Project:** Projects configured on the Bentley CONNECT portal. This portal is a cloud-based suite of tools for integrating teams, managing deliverables, publishing content, resolving issues, collecting field data, sharing files, and driving project performance.

**BIM Model:** is a static or dynamic digital replica or virtual model linked to physical assets, processes, and systems containing reality captured or real-time data throughout the life cycle of the facility. The "BIM model" and "digital twin" are the next generation replacement of traditional "design and construction drawings", as well as the "fabrication model" that is a replacement for "shop drawings" and the "as-built model" that is a replacement for "as-built drawings." See Digital Twin. (Adapted from National BIM Standard-US BSI 2015 and Sachs, R. et al., 2018).

**Bluebeam Studio:** A third-party collaboration platform that is included with a Bluebeam Revu license. Bluebeam Studio connects team members on construction projects, giving them the ability to mark up and review documents in real-time. This is bundled with the Bluebeam PDF file authoring and view suite of tools.

**Design Section:** Any one of the numerous divisions into which design of the roadway, facilities and appurtenances of the Illinois Tollway may be divided for the purposes of design.

**Design Section Engineer (DSE):** The Engineer or firm of Engineers and their duly authorized employees, agents and representatives retained by the Illinois Tollway to prepare the Contract Plans and Special Provisions for a Design Section.

**Digital Twin (DT):** is a dynamic digital replica or virtual model continuously linked to physical assets, processes, and systems containing up-to-date real-time data throughout the lifecycle of the facility. A digital twin model as part of the facility life cycle may monitor performance with sensors, internet-of-things (IoT), artificial intelligence, machine learning and big data information management. See BIM Model.

**E-Builder:** See Web-Based Program Management (WBPM). e-Builder is the Illinois Tollway's WBPM system. Accessed at [https://app.e-builder.net](https://app.e-builder.net) with Illinois Tollway login credentials.

**Federal Highway Administration**: Agency of the United States Department of Transportation that oversees the maintenance and improvement of America's roads and highways.

**General Engineering Consultant (GEC):** The Engineer or firm of Engineers retained by the Illinois Tollway for the purpose of carrying out the duties imposed on the General Engineering Consultant pursuant to the terms and conditions of any trust indenture, and any additional requirements, entered into, by, or on behalf of the Illinois Tollway.

**Geographic Information System (GIS)**: A system to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.

**Illinois Department of Transportation (IDOT)**: "IDOT is responsible for building and maintaining the state's non-tolled highways, supporting air, rail and public transportation projects. The Department also strives to encourage multi-modal transportation safety which enables the avenues of commerce and travel remain open and accessible to all of Illinois."[1]

**Illinois Tollway:** The Illinois State Toll Highway Authority.

**Illinois Tollway Project Manager (PM):** The representative of the Illinois Tollway that the Chief Engineering Officer assigned to be the technical and administrative liaison between the Illinois Tollway and its various contractors, DSEs, program manager, consulting engineers and CMs.

[1] www.IDOT.gov

**Illinois Tollway-Specific Criteria:** A set of four Criteria written by the Illinois Tollway to supplement the Federal Highway Administration's (FHWA) INVEST v1.2 and add relevant sustainable practices from I-LAST™ Version 2.2 (v2.02) to the Illinois Tollway's INVEST Program.

**Illinois Tollway-Specific Supplements:** A set of five Supplements that amend FHWA's INVEST v1.2 and add relevant sustainable practices from I-LAST™ v2.02 to the Illinois Tollway's INVEST Program.

**Illinois Tollway Supplemental Specifications:** The Illinois Tollway Supplemental Specifications to the current Illinois Department of Transportation Standard Specifications for Road and Bridge Construction.

**i-Model:** A generic term inclusive of a range of Bentley file formats that share some common traits but are customized to specific usage cases. i-Models include the following formats:

- **.dgn** – Can be viewed in MicroStation and Navigator Desktop
- **.imodel –** SQL-Lite version of the .dgn format, used inside the Bentley mobile apps
- **.iBim** – The latest evolution of the i-model formats, this native format to the new Bentley Navigator CONNECT product replaces .icm and .imodel formats completely

**Links:** Hyperlinks that can be applied to geometry to allow a user to connect to and access a wide range of external files and formats. These links are very similar to hyperlinks in the Microsoft Office products and can be used to link to web addresses, folders, ProjectWise files and folders, PDF and image files, Microsoft Office files, model workspaces inside .dgn files, and a myriad of other locations.

**Level of Development:** a measurement of how complete the design is based on the design stage and level of information provided through specific analyses and decision making.

**Model:** A term that is used interchangeably for a CAD based software output that defines how a project will be constructed. It is important to note that preconstruction models developed for owners e.g., departments of transportation (DOT), municipalities, commercial building owners, etc. are not on the same platform as construction/contractor models. DOT models are typically produced using Autodesk or Bentley products while contractor models are typically produced using Agtek, Leica, TopCon, or Trimble Business Center. While the term Model may be used in this document, it may or may not reconcile whether it is the owner's model or the construction model.

**Model Detail Display:** This means to what extent of totality and precision the 3D geometry matches the real world or design intent. For example, modeling the outside areas or physicality of a concrete structure is a lower amount of detail displayed; a model that includes the outside structure, internal rebar, and associated accouterment would be a higher amount of detail displayed. This item coordinates directly with the LOD MDD Table.

**Model Workspace:** File-based containers, including. dgn or .dwg files (MicroStation and AutoCAD native formats, respectively), that store 2D or 3D data. MicroStation has "models" that correspond to the AutoCAD concepts of a model space versus a paper space. In this document, model space is used as a generic term for any file-based container that can store any 2D or 3D geometry.

**OpenBridge Modeler (OBM):** New software published by Bentley to allow for accurate modeling of 3D bridge structures. OpenBridge operates as a standalone program allowing use of its own workspace variables for templates and additional information. Models can be output into design programs such as LEAP to design specific elements of the structure and then brought back to OBM to be displayed correctly.

**OpenRoads Designer (ORD):** A new core civil design toolset by Bentley that is available inside the legacy Geopak, InRoads, and MX software packages. OpenRoads is an entirely new set of design tools that is slated to replace the legacy tools in a future single version, simply called OpenRoads Designer. OpenRoads Designer is a single-install application that includes the OpenRoads civil tools inside the CONNECT edition of MicroStation. OpenRoads heavily leverages the very mature InRoads technology while moving all core data out of separate files and into the MicroStation CAD platform directly.

**ProjectWise:** A Bentley server-side file management application that integrates into all Bentley applications and allows users to connect to and manage files across projects and organizations with a desktop application specific to that task, but not connected to any vertical (i.e., civil, mechanical, geotechnical, geospatial, etc.) application.

**Quality Assurance (QA):** The materials inspection, sampling, and testing programs performed by the CM and/or the Illinois Tollway to verify and validate the results of the Contractor’s Quality Control Program (CQP) to assure general conformance with the contract requirements. In the CQP-CM, QA is performed by the Consultant’s Quality Representative (QR) as an internal audit of the CM staff’s tasks.

**Quality Control (QC):** The process and activities put forth by the contractor to ensure conformance with the specification requirements. This is the responsibility of the Contractor. The CM shall refer to the Illinois Tollway Contractor’s Quality Program (CQP), the Illinois Tollway CQP Manual, and Capital Program Procedures.

### 1.4.2 Acronyms

This section contains the commonly used acronyms of the abbreviated nomenclature applicable to the Illinois Tollway BIM Implementation Manual.

| | |
|---|---|
| AMG | Automated Machine Guidance |
| BIM | Building Information Model |
| BEP | BIM Execution Plan |
| BrB | Bridge Rating |
| CM | Construction Manager |
| CIM | Civil Information Model/Management |
| CAD/CADD | Computer-Aided Design/Computer-Aided Drafting and Design |
| CQP | Quality Control Program |
| DMR | Design Milestone Review |
| DOT | Department of Transportation |
| DSE | Design Section Engineers |
| FHWA | Federal Highway Administration |
| FYI | For Your Information (referring to non-contractual electronic data files) |
| GIS | Geographic Information Systems |
| GPS | Global Positioning System |
| IDOT | Illinois Department of Transportation |
| ITS | Intelligent Transportation Systems |
| LOD | Level of Development |

| | |
|---|---|
| MALD | Model As Legal Document |
| MDD | Model Detail Display |
| MOT | Maintenance of Traffic |
| OBM | OpenBridge Modeler (Bentley) |
| ORD | OpenRoads Designer (Bentley) |
| PDF | Portable Document Format |
| QA/QC | Quality Assurance/Quality Control |
| SP | Special Provisions |

# SECTION 2.0 PROJECT MANAGEMENT

## 2.1 Project Scope Implementation

The Illinois Tollway will assist in the scoping of a project by evaluating the LOD requirements for each milestone of the modeled elements to match the correct design scope. To qualify an Illinois Tollway project to be BIM implemented, the following steps will need to be applied using the scoping document in Appendix B:

1. Identify the primary categories and project boundary where each item in the base scope inquired will be applicable to the project.
2. Identify secondary or incidental items affected within the project boundary and confirm if these items will be contractual or FYI.
3. Assign the LOD for the affected elements as deemed necessary by the respective Illinois Tollway PM from design through construction.

Once these steps are completed, the project will be BIM implemented and is ready to be contracted with the prospective DSE and CM. Refer to **Subsection 4.2.3.** for further information on the scoping document in coordination with LOD expectations.

## 2.2 Project Management Factors to Consider

The following list below shall be factored when scoping and managing a BIM implemented project:

- Determine if the project will be using Full MALD vs. Hybrid approach vs. FYI Models.
    - If a project uses Full MALD, this indicates that contractual electronic data files deliverables in the project scope will govern over PDF plan sets.
    - If a project uses the Hybrid approach, this indicates that the PDF plan governs the scope in the hierarchy. Where possible conflicts occur between MALD files and the plan set, portion of the plan set may be removed. A variation to this during transition is providing MALD files and having cross sections or other pdf plan sections provided as FYI.
    - If a project uses FYI models, these electronic data files will not be contractual but will supplement the contract.
- Items that are not contracted nor have an LOD assigned are considered “Not Applicable (N/A)” and not in the project scope.
- Evaluate the level of work required for each item in the project scope. This will impact the LOD to be assigned.
- Consider the surrounding items not in scope that will impact the design and construction of the contractual items. The critical information needed may require the provision of FYI electronic data files of non-scoped items a with higher LOD.
- Identify items that will require coordination with local or outside agencies. The provision of FYI electronic data files of items that are non-contractual but owned by outside agencies may be required if they will influence the contractual electronic data files for design and construction.

## 2.3 BIM Execution Plan

The purpose of the BIM Execution Plan (BEP) is to assist the DSE in creating an execution strategy for BIM implemented projects using MALD. The DSE shall establish the BEP by providing a document with the following information to the Illinois Tollway PM:

- Main person(s) of contact responsible for model management, coordination, and deliverables packaging.
- Firms involved with the design.
- Which firm is designing what part of the project scope.
- MALD Quality Plan.
- Timeline for progress model review and clash detection between milestones
- Project baselines and critical elevations.
- Which cross-sections or portions of the plans removed during model development
- Deliverable methods (electronic data files or PDF plots).
- Reference copy of Appendix B scoping document applicable to the contracted design project.
- Identifying non-contractual portions of the electronic data files provided.
- Element tolerances.

The BEP is to be developed once the MALD scoping process (Section 2.4) is completed. In that way, the DSE will have the copy of the Appendix B scoping document which was agreed upon with Illinois Tollway Project Manager as a basis for planning the execution of the work. Refer to Appendix F for sample BEP Form. The editable Appendix B and Appendix F documents are available in the link below.

Click Here to Download editable Appendix B and Appendix F documents

## 2.4 MALD Scoping Process

The MALD scoping process will proceed with the following steps:

- The Illinois Tollway will ensure PSB includes language for 3D requirements and determine extents of scope to use MALD.
- Pre-Scoping Meeting between The Illinois Tollway and GEC BIM Manager to go through scoping process.
- MALD Scoping Meeting Sessions between the Illinois Tollway PM and GEC BIM Manager with DSE:
    - Session 1
        - Appendix B Scoping Document Walkthrough
        - GEC to provide initial draft to DSE
        - DSE to review and confirm/provide counterresponses.
    - .Session 2
        - Finalize scoping document for Illinois Tollway board review and official execution of contract.

Although ideally MALD scoping is intended to conclude by end of Session 2, please note that other follow up meetings may occur as deemed necessary.

## 2.5 Transition from non-MALD to MALD During Design

During an existing contract which was not initially scoped to use MALD, the DSE may request to transition the entire contract or portion of the contract to become MALD at any point during design. The DSE will need to notify the Illinois Tollway Project Manager and the Illinois Tollway GEC BIM Manager of the request indicating the specific scope to use MALD. If approved by the Illinois Tollway Project Manager, the process will need to go through scoping process indicated in **Section 2.4**. The DSE will begin the process following the upcoming milestone deliverables. For example, if the DSE is looking to transition after their 60% Design Milestone Review (DMR) submittal, Appendix B will have the assigned LOD start at the 95% milestone deliverable. The BIM Execution Plan (BEP) will still need to be completed and submitted for the upcoming DMR. It is strongly advised that the DSE requests the transition with the confidence that they are able to achieve LOD assigned of the respective scope in Appendix B and to sign and seal the prospective model files for advertisement release indicated in **Section 6.2**.

# SECTION 3.0 WORKSPACE

## 3.1 Workspace Setup and Management

The person identified in the BEP as responsible for model management shall also be responsible for the setup and management of the workspace for BIM implemented projects. Refer to the current Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual for more details and specifics for the project workspace setup.

## 3.2 Workspace Customization

The Illinois Tollway workspace will contain all the standard resources (feature definitions, cells, levels, etc.) necessary for delivering a BIM-implemented project. The Bentley CONNECT managed workspace in ProjectWise allows project-specific additions. Designers working on a BIM implemented project need to create and deploy custom project CADD resources and notify Illinois Tollway GEC and IDOT when this has been done.

Custom project resource libraries can be created and stored in the project workspace folder. The DSE shall notify the Illinois Tollway GEC CADD standards managers of all project-specific custom resources so that recurrent or trending items can be identified and added to the standard workspace. It is necessary to provide metadata (notes and information) during the final submittal to assure any future users of the data are aware of the differences between the project and the standard Illinois Tollway environment. Contact the Illinois Tollway at cadd@getipass.com and IDOT CADD support at DOT.CADD.GIS.Support@illinois.gov for further information and direction on Workspace Customization.

# SECTION 4.0 DESIGN

## 4.1 Model Approaches and Definitions

### 4.1.1 Full MALD

There are two model approaches a BIM implemented project will use. The first approach to use is the Full Model As Legal Document (Full MALD). If a project uses Full MALD, this indicates that electronic data file deliverables in the project scope that are contractual will govern over PDF plan sets. A project using Full MALD may use PDF plan sets as FYI or use 2D detail sheets as supplementary files to the contractual electronic data files. Electronic data files may be modeled and provided as FYI electronic data files to enhance coordination efforts and supplement MALD files. Cross-sections will be completely removed from project scope and may be provided as FYI only.

### 4.1.2 Hybrid Approach

The second approach is the Hybrid which is defined as a set of electronic data files that are MALD to govern specific portions of the scope while the PDF plan sets govern the remaining scope of the project. If a project uses the Hybrid approach, this indicates that some items will be contractual electronic files while the remaining items will be FYI electronic data files within the base scope. Cross-sections for the Hybrid approach may be removed as necessary in coordination of the MALD files. Referring to the scoping document in Appendix B, items that are not contracted but assigned LOD higher than L100 will be considered as FYI electronic data file deliverables for projects using MALD as well as for projects using Hybrid.

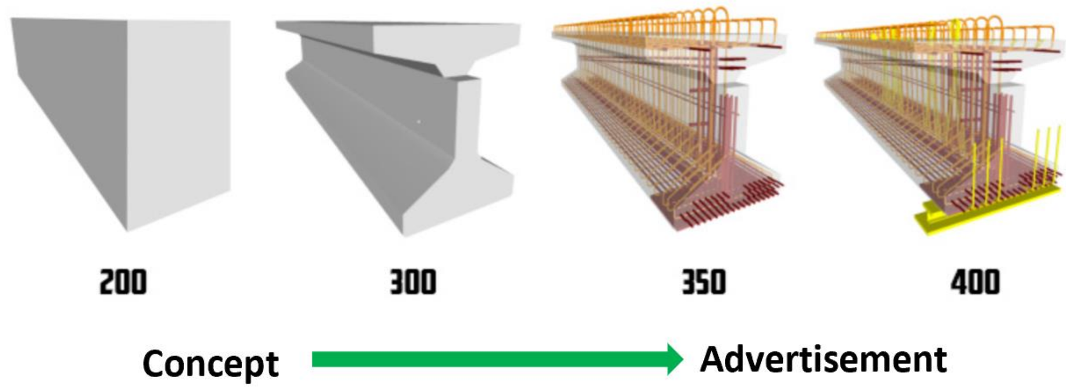
### 4.1.3 Existing Ground Model Best Practices

For a multi-location design contract where adjacent locations are part of separate construction contracts, the as-built model files of the adjacent location affecting the scope shall be used as the existing ground. If the adjacent location affecting the scope is not yet constructed, the latest advertised package of adjacent locations shall be used as existing grounds model. This best practice is also applicable to a single contract with an advanced grading or preloading contract that is followed with a final grading and pavement contract. For multi-design contracts that are adjacent to one another, close coordination with the adjacent designer must be maintained throughout the design process.

## 4.2 Model Level of Development (LOD)

### 4.2.1 LOD Overview

As defined in Section 1.4, the Level of Development (LOD) is a measurement of how complete the design is based on the design stage and level of information provided through specific analyses and decision making. LOD typically depends on the stage of the design phase. The LOD is measured on a scale of L100-L500 where L100 is the least developed while L500 is an "as-built" model. Conceptual phase will have a lower level of development, which then affects the model detail display that can be graphically displayed. The more the design is developed, the more information is provided to increase the amount of detail to be graphically displayed.




### 4.2.2 LOD Definitions

Based on the AIA definition in **Appendix A**, the LOD is defined based on the stage of the design specifically for buildings and their respective sites. This table **Appendix A** would be applicable for any of the Illinois Tollway's facilities projects. **Table 4.1** below uses the same table as the AIA definition but with minor adjustments to suit roadway and transportation design projects for the Illinois Tollway. Adjustments to these definitions may occur based on AASHTO development of similar tables.

**Table 4.1** LOD for Illinois Tollway Transportation Design and Construction Projects

| LOD | Phase | Description |
|---|---|---|
| L100 | Concept Design | A conceptual model where parameters like area, height, volume, location and orientation are defined. Alternative alignments and profiles researched in more detail. ROW general needs are defined. Pavement widths and end treatments are defined. (Typically, 2D) |
| L200 | Schematic Design | A general model where elements are modeled with approximate quantities, size, shape, location and orientation. We can also attach non- geometric information to the model elements. (2D-3D transition; quantities and sizes) |
| L300 | Detailed Design/Design Development | Accurate modeling and shop drawings where elements are defined with specific assemblies, precise quantity, size, shape, location and orientation. Here too we can attach non- geometric information to the model elements. (All 3D; specific data) |
| L350 | Higher Detail Quality | LOD 350 includes model detail and elements that represent how building elements interface with various systems and other building elements with graphics and written definitions. (Non-standard, custom or unique design or finish pattern; complex detail) |
| L400 | Fabrication & Assembly | Model elements are modeled as specific assemblies, with complete fabrication, assembly, and detailing information in addition to precise quantity, size, shape, location and orientation. Non- geometric information to the model elements can also be attached. (Shop drawings, contractor-produced plans) |
| L500 | As-Built | Elements are modeled as constructed assemblies for Maintenance and operations. In addition to actual and accurate size, shape, location, quantity, and orientation, non-geometric information is attached to modeled elements. (Asset Management) |

### 4.2.3 LOD Expectations Per Milestone

The scoping document referenced in Section 2.0 is intended to assist Illinois Tollway PM in setting measurable expectations for deliverables at each milestone to be submitted to the Illinois Tollway. The expectations are set by using the Master LOD MDD Table defining each item's LOD to coordinate with the milestones provided in the DSE Manual. **Appendix B** serves as a sample scoping document with each item assigned an LOD per milestone. These tables are intended to communicate to the DSE what LOD each element should be at by each milestone. The LOD assigned in the scoping document directs the user of this manual to review the Master LOD MDD Table in **Appendix C** as a guide for the model detail display requirements for the milestone deliverables of each element.

When an item reaches a certain LOD for a milestone, this does not alleviate the design completely from updates and revisions. This also does not negate the potential need another field verification for minor but important information of existing elements surveyed at a L300. The purpose of the LOD assigned to each milestone is to indicate that the necessary information of the designed items has reached a level of certainty where they are ready to be reviewed and properly interpreted by the Illinois Tollway. Depending on the milestone, the items may be developed enough to be scoped out for the CM to provide the best prices when bidding. Coordination efforts and some clarifications for the developed design still need to occur to further reduce conflicts in the field during construction.

## 4.3 Model Detail Display

As defined in Section 1.4, Model Detail Display (MDD) indicates the extent of totality and precision the 3D geometry matches the real world or design intent. This term was created to distinguish LOD (Level of Development) from LOD (Level of Detail) that is used industry wide. The MDD is specific to the graphic display of the element that is dependent on the assigned LOD of each milestone. Each item during the design phase may be assigned an LOD anywhere between L100-L350 with L200 often being the minimum for 3D models and L350 being the limit for detailed design. Depending on the project scope, some elements may need to reach higher LOD while others are sufficient or feasibly modeled at lower LOD. Depending on the item indicated in the LOD MDD Table, the designer is to not exceed L350.

L400 is the transition between design and construction. The CM will monitor the work to be completed in L400 and will be responsible for providing L500 deliverables to asset management. The contractor will be responsible for performing the work required for L400 and provide critical field data collection necessary to assist the CM for the L500 deliverables. When LOD reaches L400, the shop drawings are going to display a higher amount of detail to assist with constructability. More design sensitive elements will have a higher amount of detail display required to ensure the contractor places higher importance on construction quality and overall coordination level.

It is important for the DSE to determine which items require critical dimensions and determine the construction tolerance for each element based on the LOD assigned. Items where dimensions and construction tolerances are more forgiving typically do not require a high LOD. For bridge design however, dimensioning and construction tolerance is more critical since structural integrity is at stake.

## 4.4 The Master LOD MDD Table

The Master LOD MDD Table (Appendix C) is a coordinated effort between both Illinois Tollway and Illinois Department of Transportation, IDOT. The vision for Illinois Tollway and IDOT is to provide more efficient and sustainable digital project delivery practices for future construction projects. This document is for the respective reviewers to review each category's LOD MDD Table and their associated elements with the details should be shown to satisfy their respective LODs. It is not intended to be a prescriptive list of detailed instructions or means and methods mandated for all projects. It is intended to be a means for setting measurable expectations for delivering a model and developing its content. Every project is unique, therefore will have different specific requirements depending on the size and scope of work requested by an agency.

The Master LOD MDD Table is available in **Appendices C.1, C.2, C.3, C.4, C.5a, C.5b, C.6a thru 6.h.** The tables are organized based on 16 categories and then followed by elements associated with them. With each element comes the LOD spectrum from L100-L400 with each respective LOD describing the amount of detail to be displayed in the model. L000 and L500 is intentionally left out since L000 dictate what from the overall table will need to be scoped, making L100 as the starting point of the new project. L500 on the other hand is the by-product of L400 or whichever LOD the respective element concludes at in the master table.

It is important to be aware that if the entire model is at the highest level of detail down to the last nut and bolt, the file may not be able to handle this many data and cause the model to malfunction. Therefore, it is important that the DSE decides where the importance of the level of detail is shown and where it is not a concern. If it is critical for the entire model to be at the highest level of detail, the DSE may need to break up the model into separate files.

**Figures 4.1, 4.2, 4.3,** and **4.4** are extracted from the IL Route 47 over I-88 project to demonstrate how the model display would read at each LOD throughout a BIM implemented project. Refer to **Appendix D** for more examples of graphic visuals.

**Figure 4.1** L000-L100 visual

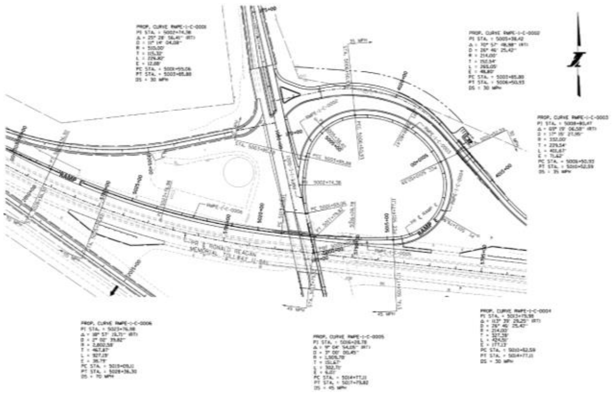


**Figure 4.2** L200 visual

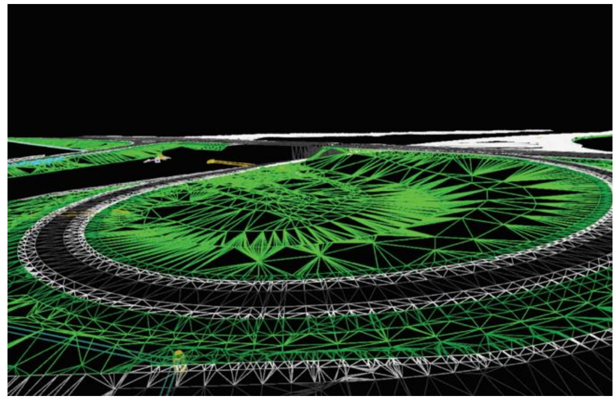


**Figure 4.3** L300-L350 visual

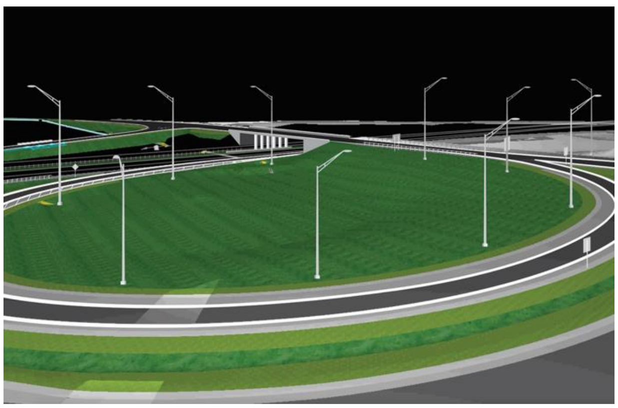


**Figure 4.4** L400-L500 visual

## 4.5 Roadway Modeling Considerations

Although modeling software has not been mandated by the Illinois Tollway, OpenRoads Designer (ORD) is the strongly recommended choice for all BIM implemented projects. Its modeling capabilities allow for parametric design for roadway corridors, geometrics, surface terrains, utilities, and sites. ORD also contains the dynamic section tool, which allows the user to pick any point that is modeled in plan and cut a section. A section view is then created showing all the elevation levels and slopes based on the location of the section cut. It is a simple yet very powerful tool for helping the designer visualize the design more effectively and very useful for overall coordination.

The Illinois Tollway ORD workspace was released for industry implementation in cross-agency coordination with IDOT. Refer to the current <u>Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual</u> for further direction and specifics on modeling requirements.

Consider the following when modeling the roadway:

- When modeling alignment profiles, it is critical for the roadway profiles to remain continuous and not segmented. Otherwise, station points will restart at each segment endpoint which will not provide a set of continuous station points from start to end of the profile.

- DO NOT MODEL ALIGNMENTS IN 3D seed file. As explained in the current Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual, alignments shall be created in 2D seed files but will automatically create the 3D model when profiles are created.
- Ramp alignment profiles must be modeled separately from the main road.
- Vertical and horizontal alignments shall have all of the curve data (Vertical: point of vertical curvature (PVC), point of vertical intersection (PVI), point of vertical tangency (PVT), tangent offsets, grade of forward/back tangents, curve lengths, etc.; Horizontal: point of curve (PC), point of intersection (PI), point of tangent (PT), superelevations, external distance, radii, tangent distance, length of curve, intersection angle, etc.) incorporated into the profile so that it can be easily identified when the model is being reviewed in ORD & iTwins and visible for the reviewer to identify.
- It is recommended pavements be modeled as one corridor. This is applied per direction of the roadway path (i.e., Interstate going EB will have shoulders and all corridors modeled as one with the appropriate slopes included for drainage while Interstate going WB will have its respective shoulders and corridors modeled as one. EB and WB elements are to be modeled separately but remain within the same file.)
- Repetitive linear method modeling using corridors to separate holistic element types such as new corridors for each lane, is not recommended since this method of modeling increases the risks for potential vertical misalignments between each corridor surface pavement.
- Where bridges are needed to be modeled, obtain the existing ground(s) model of roadway passing below.
- Make sure there is not more than one element component being modeled within the same space over multiple corridors. This can lead to erroneous component quantities and errors or confusion during construction. It is not uncommon during model milestone reviews to discover duplicate or double components in areas like medians, where display rules dictate which components or median options are to be modeled.
- Verify barriers, walls and curbs for triangulation issues jumping or skipping to adjacent points. Verify the most current workspace to utilize new civil cells that are typical.

## 4.6 Structural Modeling Considerations

It is recommended for the DSE to use OpenBridge Modeler (OBM) especially as roadway modeling is completed using OpenRoads Designer (ORD). This will allow compatibility and consistency between the roadway and bridge models since both software are Bentley products.

It is highly encouraged to use accurate templates reflecting Tollway standards and criteria when using OBM for 3D modeling. The use of templates creates intelligent objects that has capability to update itself when changes are made to the alignment or the terrain model(s). OBM has library of basic templates for barriers, decks, girders, bearings, pedestals, piers, and abutments. These templates can be further modified as required and the library can be further expanded with templates that are needed to satisfy the Illinois Tollway's bridge standards. OBM templates will be created and released in the Tollway workspace in each revision.

Consider the following when modeling structures:

- All bridge design models shall be created with an active scale of 1:1 and the measurements in the design model shall correspond to the actual measurements. Active scale can be accessed through design file settings.
- Verify that all necessary information, such as, 3D alignment, corridor model, terrain model, utilities model, has been referenced into the OBM model space before creating the 3D Bridge Model.
- A DGN alignment must be created using the same process used for roadways (refer to the Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual for details). The DGN alignment must contain a horizontal alignment information attached to a vertical profile information.
- All Bridges shall be created using "Bridge Wizard" or "Add Bridge" tool to ensure that bridge elements are smart and adjust automatically with changes to the alignment.
- Bridge support lines shall be placed at correct orientation and have applicable skew angles required by the geometric design.
- Bridge templates shall be used wherever possible for creating bridge elements such as, deck, barrier, pier, abutment etc.
- All the bridge elements shall have appropriate material definitions as defined in the Illinois Tollway Structure Design Manual.
- All designed structural framing members shall be modeled to display design data of the properties of the members. Framing shall be modeled as intelligent objects capable of providing design data of the element. Using only intelligent objects decreases risk of displaying inaccurate section or material properties, or providing insufficient design data, within the framing model.
- All designed concrete structures, foundations, and piles shall be modeled to display reinforcement data such as rebar type, number of rebar types, rebar properties, stirrup spacing, concrete mix data, pile properties, etc. Concrete structures and foundations shall be modeled as intelligent objects capable of providing design data of the element. Using only intelligent objects decreases risk of displaying inaccurate section or material properties, or providing insufficient design data, within the framing model.
- Coordinate units and tolerances of the critical elevations should be using the same units as the survey. Although means and methods are not the intention of this manual, the purpose of having this direction provided is to emphasize the aspect of coordination with design and construction.
- Connection points shall be shown clearly in the electronic data file for projects using MALD such as bearing plates, connection plates, splices, etc.
- Use modeling software which is capable of exporting as 3D .dgn files and .ifc files.

Refer to the current Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual, Illinois Tollway Design Section Engineers (DSE) Manual, and Illinois Tollway Structure Design Manual for more specific requirements related to structural design and software requirements.

## 4.7 Subsurface Modeling Considerations

Consider the following when modeling subsurface utilities:

- Start a utility model with a DGN from the 2D project file from the workspace database.

- Subsurface Utility Design and Analysis (SUDA) is a subset of the OpenRoads Designer (ORD) product and is located in the Drainage and Utilities tab. All types of utilities can be modeled with a high level of accuracy and provide design-based information. The drainage portion is based on the rational method, but there are software upgrades which provide more thorough and detailed analysis. This program will allow for users to create and manage subsurface elements in 2D while the program automatically creates a 3D model.
- The files from ORD can easily be transferred to the other DSE disciplines for coordination. Existing utilities can be included in the model by importing other file types with all their information provided, whether it is simple linework, GIS, or other 3D elements.
- Some of the 3D files that can be imported, like StormCAD and SewerCAD, provide all the data including the elevations into ORD. When the simple line work is imported only, tracing over them on ORD will result in a 3D representation of the utilities.
- When coordinating new utility design model with existing utilities, the DSE shall refer to electronic data files which have collected the existing utility data (if applicable) with high Quality Levels (QL) such as QL-A and QL-B. Refer to the current Illinois Tollway CM Utility Collection Guide for more information on utility data collection.

## 4.8 Earthwork Modeling Considerations

### 4.8.1 Surface Terrain Modeling

Existing Surface Terrain files should be trimmed within reason to the project boundary extents to reduce file sizes. The surface terrain container file accounting for environmental soil classifications will have a series of electronic data files with each soil type being its respective electronic data file within the container file. The soil type can be identified in the description portion of the file naming convention. Each soil type electronic data file shall coordinate with the volumes in the earthwork schedule of quantities by being able to display surface depths when a dynamic section is cut on the selected area.

### 4.8.2 Environmental Classifications

The environmental classifications for the affected terrain files will be documented using the Illinois Tollway's earthwork schedule of quantities base sheets as a guide. This is achieved by using the earthwork calculation methods provided in the following subsection. Electronic data files of each soil type will be distinguished based on the following options: excavated, fill soils sourced from outside the project limits (i.e., furnished excavation, furnished special, or burrowed), and disposal. Electronic data files representing soils to be disposed shall be classified with the following data: Disposal Type, Reuse options, and construction worker precaution areas.

Environmental soil classifications can be found on the environmental soil classification plans. Volumes are located in the earthwork schedule of quantities. Both can be found in sheet M-RDY-416 in the roadway base sheets.

### 4.8.3 Earthwork Calculation Methods

The methods for calculating earthwork specific to BIM implementation are as follows:

- Analyze Volume Tools
- Component Quantities
- Element Component Quantities

- Create Cut & Fill Volumes
- Cross Sectional/End Area

The Analyze Volume Tools method provides three different types of calculations:

- Terrain Model to Terrain Model
- Terrain Model to Plane
- Terrain Model to Volume

This method also includes shrink and swell factors for the soil types, a definable boundary of the work area, and the calculations of each prismoidal area created by Triangulation modeling technique. The user is also able to save the result outputs in CAD. This method is best used for stockpiles, strip mining, basin and detention pond volumes, basis and staged earthwork.

The Component Quantities method is best used for ballpark quantities for any type of component within the earthwork. This method uses the entity-attribute-value (EAV) results to calculate area for non-closed components such as seeding and topsoil while the results calculate volumes for closed components such as pavement. This is most appropriate when the earthwork design is at the LOD of L100-200, which is typically between the Conceptual and Preliminary Design milestones. It is also very effective when planning the project scope and establishing a preliminary budget. This method excludes earthwork cut and fill.

The Element Component Quantities method is similar to the Components Quantities method but provides the next level of precision. In lieu of using EAV results, the values are extracted directly from the 3D model taking into account the topography. It calculates the total area and volume based on the components selected. Although this method can be applied at any of the design stages, it is more effective to use when the LOD is at L300. Like the Components Quantities method, it excludes earthwork cut and fill.

The Create Cut and Fill Volumes method is done by modeling the 3D mesh of the existing terrain and then modeling the 3D mesh of the excavated terrain and the filled terrain in the same location modeled on the existing. Using the Elements Components Quantities method, the values of the cut and fill will be extracted directly from the model by clicking on the terrain.

Although the Cross-Sectional method, also known as the End Area Volumes method, is the traditional method of calculating earthwork, it does not mean it is disqualified from being highly effective for BIM implementation. Stations can be assigned to each point of the 3D model and a dynamic section will automatically coordinate any changes done on the 3D model automatically. However, the level of accuracy will be dependent on the cross-section frequency. The more stations placed, the more accurate the values will be. Regardless of the rising level of sophistication 3D modeling is evolving to be, cross sections will always be needed to show the most accurate level change at a specific station on the 3D model along with its exact cut and fill volume.

## 4.9 Model Coordination with Specifications and Standards

Future versions of software may have the capability to reference specifications but is currently not required at this time. The modeled items will have a parameter to reference and display the applicable specification(s) and standard(s). The purpose of including the standards, specification sections, and pay item codes is to coordinate with modeled items directly in one location using the software's respective dynamic annotation. This allows for the modeled items to reference the specification once and in the right spot in case the specifications are modified. In addition, this assists the bidder to navigate the model, click the modeled element, view specification and pay item code in the element properties, and then navigate the specifications manual to the specifications section identified in the element.

## 4.10 Deliverables

### 4.10.1 Design Reviews

File type deliverables for BIM implemented projects are listed in the current Illinois Tollway Design Section Engineers (DSE) Manual.

If not already created, when submitting a container file, create a 2D seed container file using the geocoordinate system as identified in the current Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual.

### 4.10.2 File Naming Convention

All the respective DSE disciplines involved in an Illinois Tollway project will use the same file naming convention directed by the current Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual.

### 4.10.3 Submission to GEC

All deliverables identified in **subsection 4.10.1** shall be submitted in the project directory on e-builder in the subdirectory of the applicable milestone.

# SECTION 5.0 DESIGN MILESTONE REVIEWS

## 5.1 Overall Strategy for Quality Control

The intent of this manual is to not provide a prescriptive method for how to conduct quality control for BIM implemented projects but its intended to ensure that the DSE contracted has factored in a quality control plan that best suits the firm's workflow by ensuring professional standard of care for the file deliverables to the GEC, CM, and Tollway. As indicated as part of the BIM Execution Plan, the DSE will provide a quality control plan for their internal and coordination reviews. Included with the quality control plan is the timeline for progress model review and clash detection between milestones. The scoping document will set measurable expectations per milestone that assist the DSE in evaluating their progress throughout the project schedule.

## 5.2 Design Milestone Reviews for BIM Implemented Projects

### 5.2.1 iTwins Setup for Two-Way Communication

To ensure the models do not get altered, design milestone reviews (DMR) for electronic data files will be uploaded by the GEC onto Bentley CONNECT as an iModel for iTwins, a cloud-based model review platform where the model is displayed as a reference. Once electronic data files are submitted by the DSE on e-builder, the BIM Manager of the Illinois Tollway GEC will compile the electronic data files and upload the files onto iTwins as an iModel for design review. The GEC discipline leads will then review the iModel and provide comments by creating "issues" using the forms created by the GEC BIM lead.

### 5.2.2 Review Comments Disposition

Once the review session is completed, the GEC BIM Manager will send an invitation through Bentley Connect to the respective DSE contacts listed on the BIM Execution Plan (BEP) for access to the iTwins model review. The invite will come via email from no-reply@bentley.com. The DSE will need to open the email invitation and access the project directly in the box labeled "View Project" as indicated in **Figure 5.1**. The DSE will then have access to ProjectWise 365 via Bentley Connect to the project assigned by the GEC BIM Lead and be able to review comments indicated in **Figure 5.2.** In order to locate where the comment was made on the model, there is column on the right side in **Figure 5.3** labeled as "Linked Items" which are links that will take the user directly to the location where the comment was made on the iModel. the GEC BIM lead will then inform the DSE to review the issues created by the reviewers and

The DSE will then dispose of the comments directly on the issue forms by clicking the display ID links on the left indicated in **Figure 5.3**. The user will then type into the disposition box and then select the green tab on the bottom left of the form to set the disposition status, similar to the process done for DMR via Bluebeam Studio for plan sets. Once the disposition status is set, this completes the disposition of the respective comment.

Another way to dispose the comments is go into the iModel directly in tab labeled "iModels" indicated in **Figure 5.2**. After iModel view is opened, the user will go to the flag icon tab on the top left corner of the view and select the flag icon next to the "Issues" tab as indicated in **Figure 5.4**. The user will be able to select the comment, which will automatically navigate to the location on iModel. From here, the user will be able to dispose of the comment directly on the iModel by clicking the pencil icon to the comment ID number and type directly into the disposition box and then select the green tab on the bottom left of the form to set the disposition status to complete disposition of comment as indicated in **Figure 5.5.** Once all comments are disposed, the GEC BIM lead will download the review as a .csv file, archive into the project directory, and then issue to the DSE as a receipt to indicate the completion of the design review.

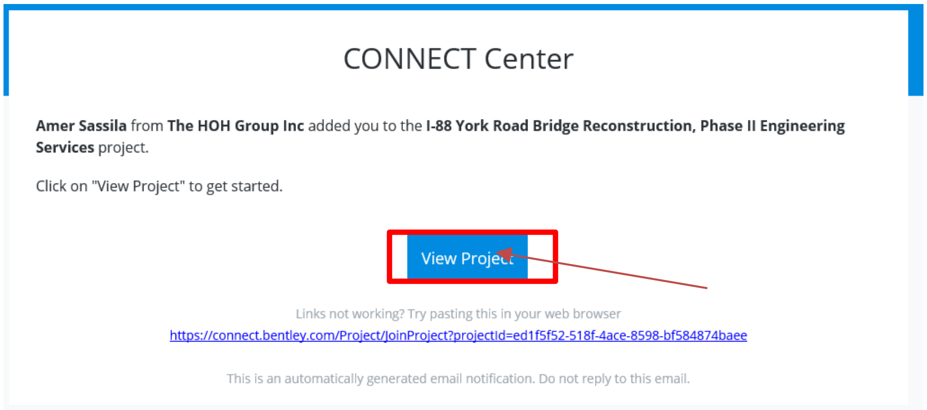



**Figure 5.1** Bentley Connect email invitation link to access project

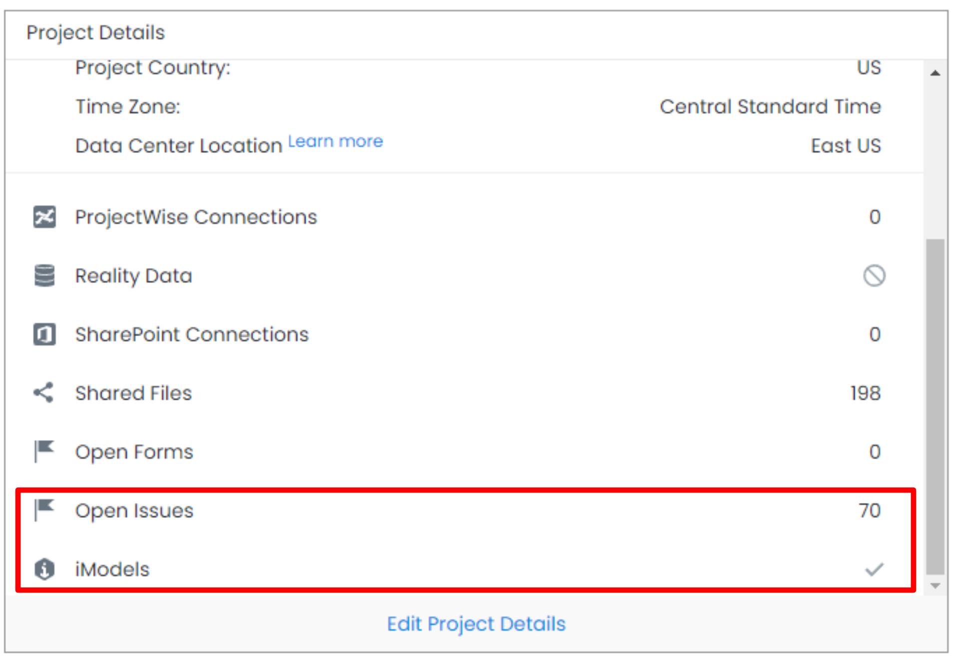



**Figure 5.2** Bentley Connect project page where to locate review comments

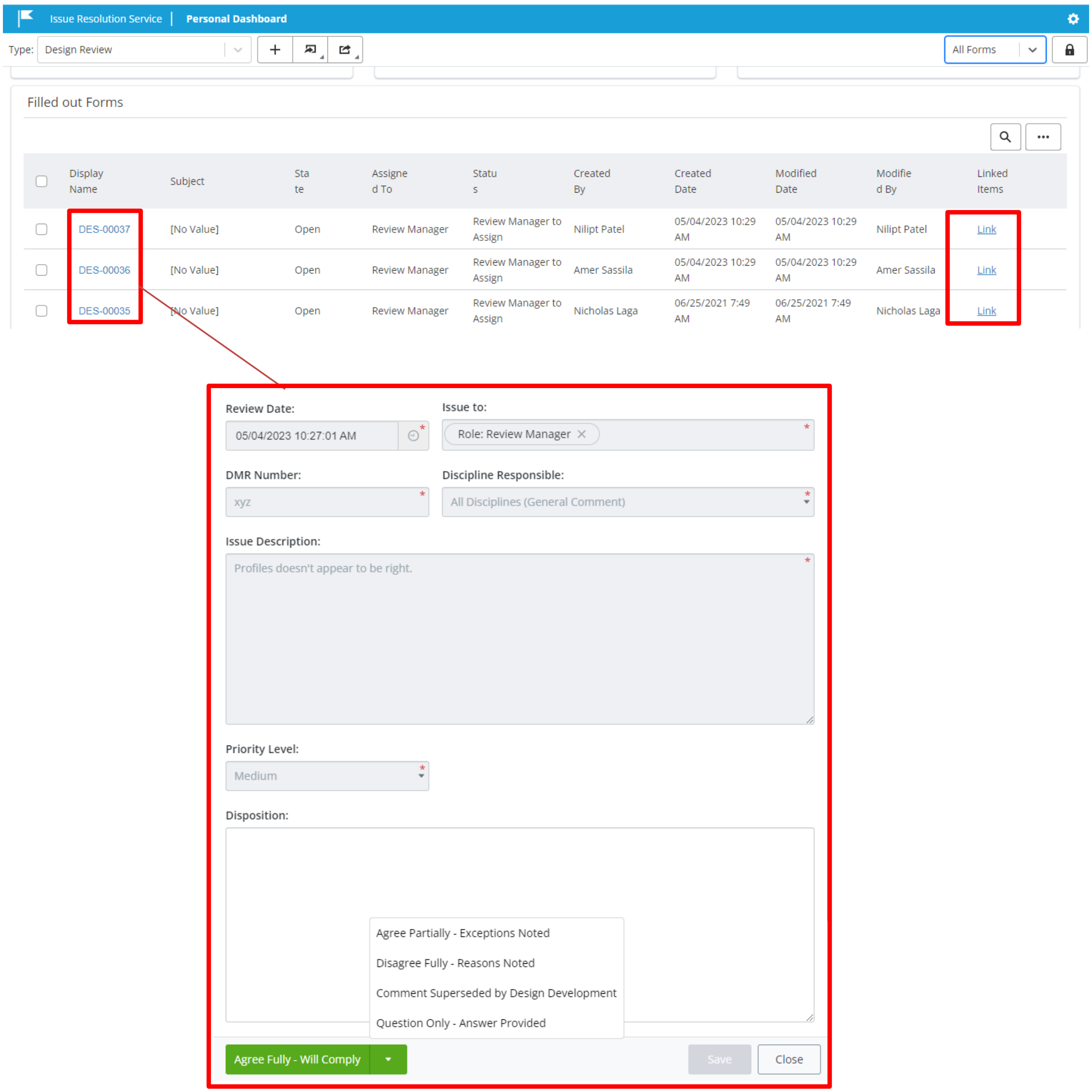



**Figure 5.3** Comment view from Open Issues Tab

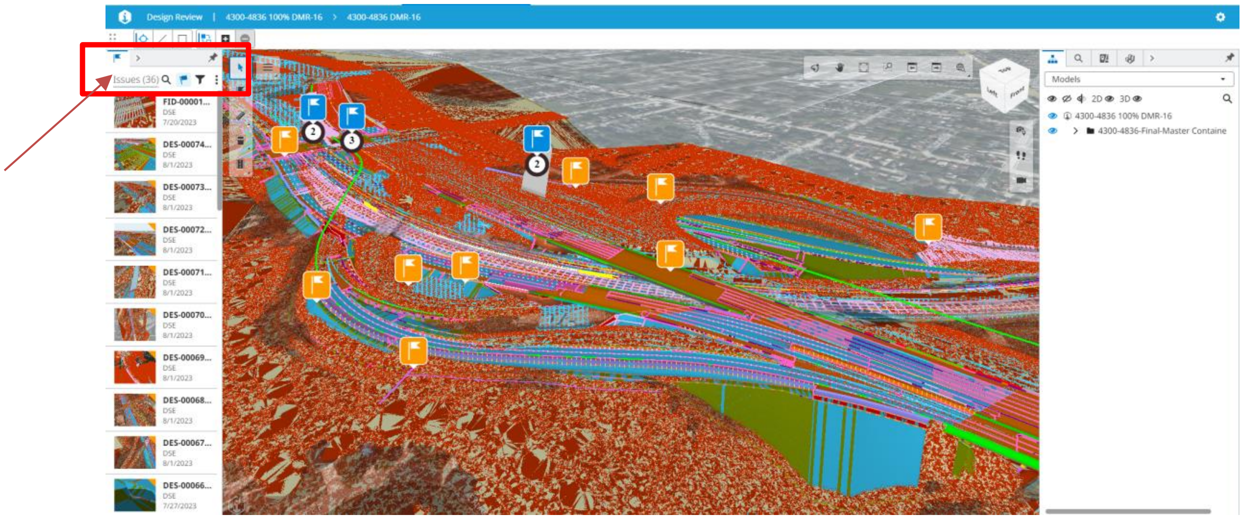


**Figure 5.4** iModel view of location of all the comments

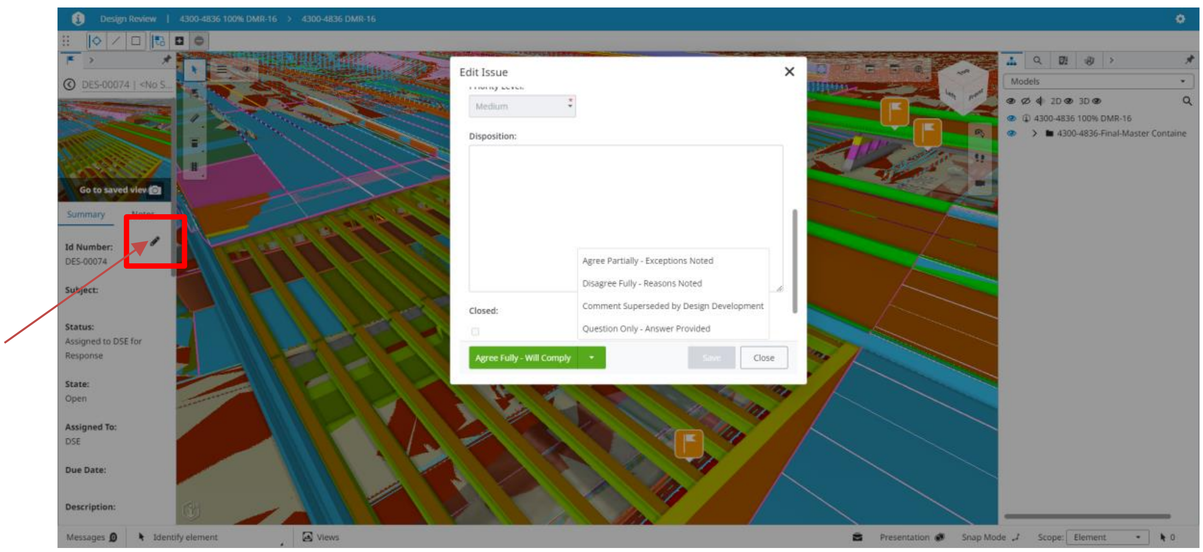


**Figure 5.5** Comment view directly on iModel

### 5.2.3 Expectation for Design Reviewers

The LOD MDD Table is provided in this manual to also serve as a guide for the design reviewer to use when checking the model elements during each milestone. For example, if the design of a retaining wall element needs to reach only L200 during 60% concept design submission, the reviewer should make note of the missing information per the Model Detail Display requirements with respect to the Milestone's assigned LOD in the scoping document. However, the reviewer should not enforce this note on the DSE to add missing information for this wall that is typically found at L350 for the later milestones. The Design Review Checklist provided in **Appendix E** will serve to evaluate the quality of the modeled elements. It is recommended for the DSE to use the checklist as a guide to assist with implementing effective quality control.

# SECTION 6.0 DELIVERABLES FOR ADVERTISEMENT/CONSTRUCTION

## 6.1 Overview

The model to be released for advertisement will include a collection of electronic data files provided by the DSE as indicated in the deliverables. The same model, with all the addenda incorporated and documented, will be used as the official MALD for construction.

### 6.1.1 File Size Limit

The electronic data file size provided for a BIM implemented project should not exceed 128 MB or as requested by the CM's contractor to accommodate their AMG equipment for grading and surface paving. Larger files exceeding 128 MB may run into issues uploading to different software.

### 6.1.2 File Types & Naming Conventions for CM's Use

The file types shall follow the same naming convention as indicated in Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual. The contractors bidding for the work will be responsible for using their respective means and methods to review the model. If at any point a bidding contractor requests a specific file type other than what was initially issued, the DSE is obligated to issue the file type as requested to enable the contractor to cover all bases for a fair bid evaluation.

## 6.2 Model as Legal Document (MALD) Files

### 6.2.1 Contract Models For Advertisement

The contract model consists of multiple models from each DSE discipline that is intended to be part of the overall project work scope. The contract model, although a collection of electronic data files, is the legal document governing the construction contract. When the model is ready to be released for advertisement, it will need to be uploaded to e-builder by the DSE and facilitated by the Illinois Tollway GEC.

As is required for design review deliverables to the GEC, the DSE will create a 2D seed container file, using the geocoordinate system as identified in the current Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual.

File type deliverables for BIM implemented projects are listed in the current Illinois Tollway Design Section Engineers (DSE) Manual. Each electronic data file shall account for interoperability with the software used by the contractors' field equipment.

### 6.2.2 Contract Changes for FULL MALD Projects

For FULL MALD projects the hierarchy for the contract documents will be changes to have contractual electronic data files above the plans. This will require changes to Vol 1 which is managed by the Tollway. Changes will also require the DSE do provide a signature page with the contractual files listed. The following special provisions will need to be modified.

SP 121: This makes the files legally binding and lists the files that are contractual and elements within them. It will also provide a list and description of the FYI files provided at advertisement.

### 6.2.3 Contract Changes for Hybrid Projects

For a hybrid approach project, the hierarchy for the contract documents adds contractual electronic data into the contract below the plans. Possible conflicts such as cross sections may be removed and provided as FYI. This will require changes to Vol 1 which is managed by the Tollway. Changes will also require the DSE do provide a signature page with the contractual files listed. The following special provision will need to be modified.

SP 121: This makes the files legally binding and lists the files that are contractual and elements within them. It will also provide a list and description of the FYI files provided at advertisement.

### 6.2.4 Addenda Documentation Procedures

Procedures during the addenda phase shall follow the guidelines indicated in the Illinois Tollway Design Section Engineers (DSE) Manual.

### 6.2.5 Signing & Sealing (Electronic Seals & Signatures)

Prior to releasing the files for advertisement, the PDF signature page depicting the names and descriptions of the electronic data files will be provided in the plans. The signature sheet is located in the new ORD Workspace. The DSE will obtain a third-party certificate verifying the DSE's identity and will seal the electronic data files listed. This is to ensure that the contractor has an unaltered bid set of files issued and will protect the model from any unauthorized updates and deviations. If for any reason the model undergoes unauthorized changes and deviations, the electronic signature of the DSE is removed from the MALD file, therefore holding the contractor liable for these deviations from the signed and sealed files.

To effectively communicate to the CM and contractors which electronic data files are signed and sealed, the list of file names indicated on SP 121 will be placed on the PDF signature sheet where the DSE will sign and seal the contractual files to be officially used as MALD as shown in **Figure 6.1**. The Tollway Project Manager will update the hierarchy in Volume I to include the electronic data files.

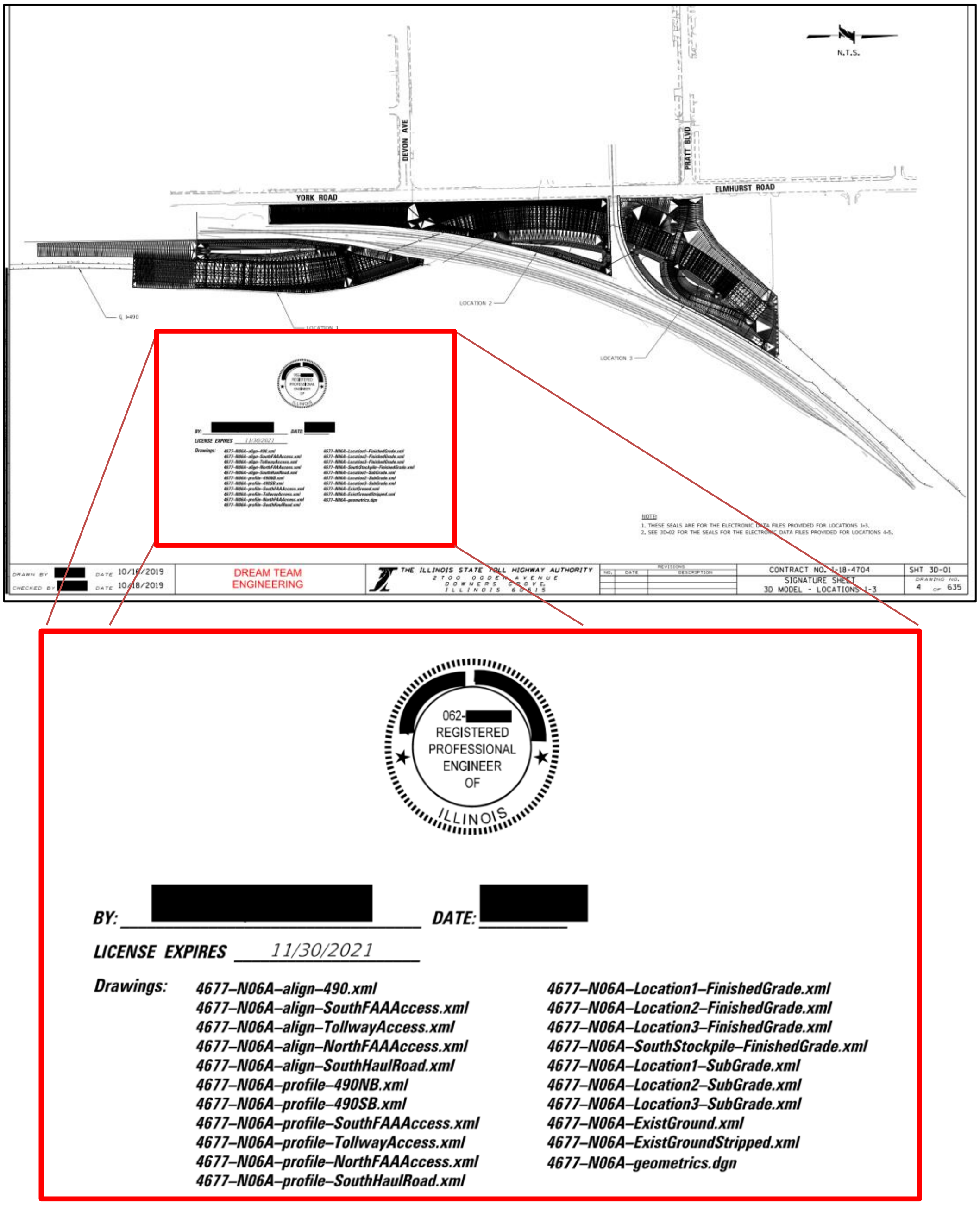



**Figure 6.1** PDF signature page of the electronic data files as legal documents.

### 6.2.6 Steps for Signing and Sealing Digital Files

**<u>To obtain third-party certificates</u>**:

<u>Step 1:</u> Select an approved digital certificate provider from the list below and acquire a certificate through their respective application process:

Identrust: https://www.identrust.com/support/downloads
Digicert: https://www.digicert.com/digicert-root-certificates.htm
Entrust: https://www.entrustdatacard.com/knowledgebase/entrust-root-certificates

Step 2: After the user installs the digital certificate, the user will export it for use on other devices and/or for safe keeping in case your installed certificate is lost. It is recommended to save the certificate in 2 locations. These could include the local computer (i.e. My Documents) and an external drive (i.e. thumb drive or hard drive). The digital certificate will come as a PFX file.

**To sign and seal XML files, please follow these steps:**

Step 3: Open the following link below to download the XML file signature application. This will utilize the same application as FDOT but will be apply for Tollway projects. When clicking the link, it will take you to the WBPM website where the XML file signature application can be download and is labeled "FDOTXMLSigning for Tollway Projects":

Click Here to Download Application

Step 4: To apply a certificate obtained from third-party certification entities listed in Step 1, select the "Sign" tab in the application followed by "Choose Certificate". Next, click the "PFX Digital Certificate File" box below and then click the "Select" box to browse your network for the saved PFX Digital Certificate File. After the PFX Digital Certificate File is selected, select the "Verify" tab and then select "Verify Signature" box. From there the user may browse for the signed and sealed XML files and select to verify signature's validity. If the files are signed and sealed and verified, the selected PFX Certificate will confirm this with green checkmarks. If the files get altered or is not signed and sealed by DSE, warnings will appear in the "Signature Information" textbox below. **Figure 6.1** below provides the visual of what appears both scenarios.

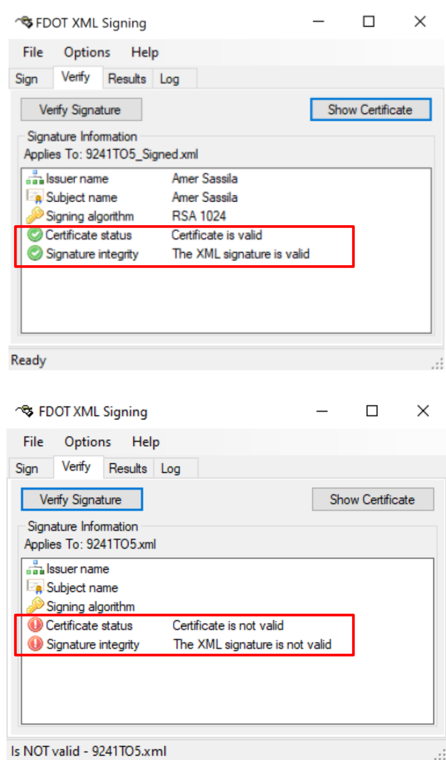



**Figure 6.2** XML signature application when signature is validated (above) and when signature is invalidated (below).

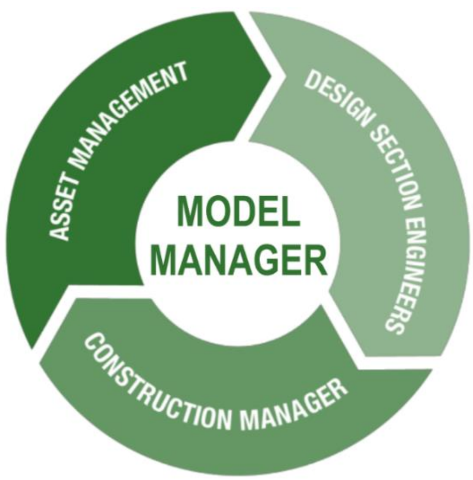
**<u>To sign and seal the DGN files, follow these steps:</u>**

Obtain the signature sheet from the new ORD workspace and verify the electronic seal model is active. Then select and delete the dotted line covering the seal. Once the seal is cleaned from dotted line, set the horizontal signature active and merge into master reference.

Protect the DGN files by opening the DGN file on Openroads Designer and select the “File” tab in top left corner and select “Tools”. After selecting “Tools” select the “Protection” tab and select “Protect” option below to create a certificate/password as a means of protection. Afterwards, select “File” tab in top left corner again and select “Tools” again and select “Protection” again and select “Application” to apply the third-party certificate obtained from Step 1.

### 6.2.7 Model Management Transition from DSE to CM

Once the contracts are awarded, the electronic data files with all the addenda or construction revisions included will transition into the as-constructed model. At this point, the changes or updates that occur in the model will potentially affect the contract work scope and price. Once a contract awarded, the CM will be responsible for updating and coordination changes with the contractor to managing the model through construction.




### 6.2.8 Use of FYI Model

An FYI model is a non-contract model that is necessary for coordination for the CM and contractor. This type of model could be a 3rd-party model within the contract models issued that are used for reference for coordinating a specific contractor’s work in the field. The contractor may wish to use these models to coordinate exact placement of the designed utilities. Therefore, the models not associated with the contractual duties of the contractor performing utilities work will become reference models in context of their work scope.

To verify which items have an FYI electronic data file associated, the contractor may refer to the scoping document which identifies an item that is not listed as contractual but has an LOD assigned above L100. If the FYI electronic data file was not issued during advertisement, the CM and/or contractor may request the DSE to provide them the FYI electronic data file.

## 6.3 Digital As-Builts

Due to field conditions that may direct changes, the electronic data files need to be updated with as-built conditions. The CM and associated contractors shall be responsible for updating the contract model if required changes occur in the field. In the event of change orders, the CM shall be responsible for obtaining the current version of the MALD or FYI electronic data files.

Digital As-Builts will be produced as Land XML files for the following:

- Existing ground surface
- Proposed surface
- Stripped surface
- Top of Clay, (otherwise known as bottom of subgrade or hold down surface)
- Alignments
- Profiles

Digital As-Builts will be produced as DGN files for the following:

- Stormwater Drainage
- Utilities/Lighting/ITS
    - In addition to the underground utilities .dgn files, the CM and associated contractors shall be responsible for collecting existing and new utility data, documenting the data, and implementing the data into a .dgn file. The documentation format and quality level (QL) of the utility data collection shall follow the requirements provided in the current Illinois Tollway CM Utility Collection Guide and the Utility Digital As-Builts Special Provisions (SP) Specification.
    - Signage
    - Pavement Design
        - Includes guardrails and concrete barriers
        - DGN file of alignments and profiles
    - Bridge Structure Categories
    - Retaining Walls
    - Noise Abatement Walls (NAW)
    - Temporary Structures
    - Culverts

# SECTION 7.0 DELIVERABLES FOR ASSET MANAGEMENT

## 7.1 Final Digital As-Built Model

This is the stage of the BIM implementation process where the as-built model transitions management from the CM to the Illinois Tollway for record and asset management. All the associated data such as updated specifications, approved shop drawing models, as-built supplemental documents, and a copy of all the model versions will be provided to the Illinois Tollway Asset Management.

Digital As-built electronic data files will be submitted to Illinois Tollway Asset Management in the format indicated in **Section 6.3.**

### 7.1.1. File Types and Naming Convention

The naming convention directed by the current Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual will carry over through to asset management.

### 7.1.2. File Size Limit

The electronic data file size provided for a BIM implemented project is not to exceed 128 MB or as requested by the Illinois Tollway Asset Management.

## 7.2 How to Submit to Illinois Tollway

All file deliverables identified in **Subsection 4.10.1** shall be submitted in the project directory on e-builder in the subdirectory for asset management.

## 7.3 Post-Construction Model and Specification Modifications

To continue BIM implementation for the future projects, Illinois Tollway will monitor the maintenance projects that occur in between cycles. Using the as-built model, the maintenance management will update the model to reflect the current state of reality. It will be the Illinois Tollway's responsibility to update the specifications when the IDOT standards and specifications update that affect any of the Illinois Tollway's specifications and standards.

## 7.4 Model Documentation for Maintenance

Starting from the beginning of the operation and maintenance stage, all the revisions due to any maintenance work regardless of any changes from the contract model and specifications will be documented. The revision numbering will begin from the start date of maintenance. The Illinois Tollway's asset management will identify which file(s) are updated, location of the updates within the affected models, and brief description of the updates. The Illinois Tollway will develop a workspace where all the maintenance documentation will reside and inform the GEC. The suggested workspace will be a digital twin software to allow for an efficient avenue of tracking real time data.

# APPENDIX A LOD BASED ON THE AIA DEFINITION

LOD based on the AIA definition

| LOD | Phase | Description |
|---|---|---|
| L100 | Concept Design | A conceptual model where parameters like area, height, volume, location and orientation are defined. |
| L200 | Schematic Design | A general model where elements are modeled with approximate quantities, size, shape, location and orientation. We can also attach non- geometric information to the model elements. |
| L300 | Detailed Design/Design Development | Accurate modeling and shop drawings where elements are defined with specific assemblies, precise quantity, size, shape, location and orientation. Here too we can attach non- geometric information to the model elements. |
| L350 | Construction Documentation | LOD 350 includes model detail and elements that represent how building elements interface with various systems and other building elements with graphics and written definitions. |
| L400 | Fabrication & Assembly | Model elements are modeled as specific assemblies, with complete fabrication, assembly, and detailing information in addition to precise quantity, size, shape, location and orientation. Non- geometric information to the model elements can also be attached. |
| L500 | As-Built | Elements are modeled as constructed assemblies for Maintenance and operations. In addition to actual and accurate size, shape, location, quantity, and orientation, non-geometric information is attached to modeled elements. |

# APPENDIX B LOD SCOPING DOCUMENT FOR PROJECT MANAGEMENT

**Scoping Document - Model as a Legal Document Delivery**

LOD MDD of Project Elements at Each Milestone Identified in the DSE Manual

| Earthwork & Environmental | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Existing Ground | YES | 100 | 100 | 200 | 300 | 300 | 350 | 350 | 350 | 500 |
| Grading (Final Surface) | YES | N/A | N/A | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Grading (Construction Stages) | YES | N/A | N/A | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Topsoil | YES | N/A | N/A | 100 | 100 | 200 | 200 | 200 | 400 | 500 |
| Select Backfill | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Cut/Fill & Embankment | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Landscaping & Reforestation | no | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Erosion Control | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Environmental Soil Classification (Tollway Specific) | YES | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Environmental “Regulated” Soil Waste Classification (IDOT Specific) | no | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **Stormwater Drainage** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Drainage Structures | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Roadway Curb and Gutter | YES | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Storm Sewer | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Pipe Underdrain | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Bathymetry | no | 100 | 100 | 200 | 200 | 200 | 200 | 200 | 200 | 500 |
| Detention Ponds | no | N/A | 100 | 200 | 200 | 200 | 200 | 200 | 200 | 500 |
| Water Surface | no | 100 | 100 | 200 | 200 | 200 | 200 | 200 | 200 | 500 |
| **Utilities, ITS, Electrical** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Underground Utilities | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Above Ground Utilities | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Distribution Systems & Above Ground Cabinetries | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Roadway Lighting | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Traffic Signals | no | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Tolling Equip. & Devices | no | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Intelligent Transportation System (ITS) | no | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| **Signage** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Signage (Overhead) | YES | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Signage (Roadside) | YES | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |

| Roadway (Pavement & Geometrics) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Roadway Pavement | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Pavement Markings | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Geometrics | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Superelevations | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Intersections & Driveways | no | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 300 | 500 |
| Sidewalks | no | 100 | 100 | 200 | 200 | 300 | 300 | 300 | 300 | 500 |
| Guardrail | YES | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Rigid (Concrete) Barriers | YES | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| **Roadway (MOT, Site, Plaza)** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Temporary MOT Elements (Roadway Only) | no | N/A | N/A | 100 | 100 | 200 | 200 | 200 | 200 | 500 |
| Temporary MOT Elements (Typical Sections) | no | N/A | N/A | 100 | 100 | 200 | 200 | 200 | 200 | 500 |
| Site Work Plans | no | 100 | 100 | 100 | 200 | 200 | 200 | 200 | 200 | 500 |
| Toll Plaza Plans & Details | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| **Structural (Bridge - Deck & Approach)** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Deck, Approach, Transition, and Sleeper Slabs | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Parapets, Sidewalk and Median | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Bridge Railing and Traffic Barrier | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Light Pole Foundation and Parapet Conduit | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Bridge Mounted Sign Support | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Expansion Joints | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Deck Drains and Drainage Scuppers | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Drain Pipes and Support | no | 100 | 100 | 200 | 200 | 300 | 350 | 350 | 400 | 500 |
| **Structural (Bridge - Superstructure)** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Bridges Prestressed Concrete Beams | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Bridge Girder Steel | no | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Steel Diaphragms / Cross-Frames | no | 100 | 100 | 100 | 200 | 300 | 300 | 300 | 400 | 500 |
| Bearings | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| **Structural (Bridge - Substructure Part 1)** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Concrete Pier and Crashwall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Concrete Abutment and Wingwall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| MSE Abutment | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Embankment and Slopewalls | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Waterways | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |

| Structural (Bridge - Substructure Part 2) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Shallow Foundation | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Drilled Shaft | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Pile Foundation | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| **Structural (Retaining Walls)** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Cast-In-Place T-Type | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| MSE Wall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Soldier Pile Wall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Permanent Sheet Pile Wall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Soil Nail Wall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Moment Slab on Retaining Wall, Parapet, Noisewall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Pipe Railing | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Light Pole Mounting | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| **Structural (Noise Abatement Walls)** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Precast Concrete Panel | YES | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Steel Posts and Supports | YES | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Ground Mounted NAW Foundation (Drilled Shaft) | YES | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| **Structural (Temporary Structures)** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Temporary Soil Retention System | no | N/A | N/A | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Temporary Geotextile Walls and Temporary MSE Systems | no | N/A | N/A | 100 | 200 | 200 | 200 | 200 | 400 | 500 |
| Cofferdams and Seal Coats | no | N/A | N/A | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| **Structural (Culverts)** | | | | | | | | | | |
| **Element** | **Contractual** | **Master Plan - Final** | **Pre-Concept** | **Concept (30%)** | **Preliminary (60%)** | **Pre-Final (95%)** | **Final (100%)** | **Advertisement** | **Construction** | **As-Built** |
| Cast-in-Place Culvert | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Precast Culvert | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 350 | 500 |
| Permanent Sheet Pile Wingwall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |
| Soldier Pile Wing Wall | no | 100 | 100 | 100 | 200 | 300 | 350 | 350 | 400 | 500 |

# APPENDIX C LOD MDD MASTER TABLE

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.1** Earthwork & Environmental

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Earthwork | Existing Ground * | Simplified as-built topographic surface is provided. Existing ground must meet surveying requirements. Refer to IDOT's Surveying Manual. | Actual surveyed and verified detailed surface modeled using Triangulation method. (3D) | Actual surveyed and verified detailed surface modeled using Triangulation method. Higher level of precision of the surveyed and verified surface elevations. | Areas where roadway and structural items are to be designed will contain geotechnical strata model within 30 feet of the influence area. | |
| | Grading (Final Surface) | General areas where existing elevations will be affected on the existing ground. Identify key elevation points of proposed work in coordination with applicable categories. | Key elevation points confirmed. Priority is on identifying vertical depths at the elevation points (i.e. high points and low points) and general slope directions. (3D) | Key elevation points and the vertical depths and slope directions confirmed and coordinated with drainage. Priority is on model surface precision. | Smoothing of model surface elements (i.e. ramp gores, bridge abutments, etc.) | Proposed grading for contractors to use for automated machine guidance. |
| | Grading (Construction Stages) | Proposed areas of each stage shown as a plane. Identify key elevation points of each stage in coordination with applicable categories. | Proposed areas and key elevation points of each stage confirmed. Priority is on identifying vertical depths at the elevation points (i.e. high points and low points) and general slope directions. (3D) | Key elevation points and the vertical depths and slope directions confirmed and coordinated with drainage. Priority is on model surface precision. Each stage shall be modeled separately. | | Stockpile, mass hauls located and modeled.<br><br>A-Forms (Tollway) & BDE-Forms (IDOT) tagged by Agency Representative Field Manager in issued model. Agency Representative Field Manager to identify destination of hauled off soils. |
| | Topsoil | General areas where existing elevations will be affected on the existing ground. Identify key elevation points of proposed work in coordination with applicable categories. | Key elevation points confirmed. Priority is on identifying vertical depths at the elevation points (i.e. high points and low points) and general slope directions. Earthwork quantities available. (3D) | | | Stockpile, mass hauls located and modeled.<br><br>Proposed grading for contractors to use for automated machine guidance. |
| | Select Backfill | Proposed areas of select backfill shown as a plane. | Proposed areas confirmed. Priority is on approximate depth range of proposed select backfill. (3D) | Proposed areas and approximate depth range confirmed. Priority is on precision of select backfill volume. | | |
| | Cut/Fill & Embankment<br><br>*Tollway Specific requires Zone A & Zone B | Proposed Areas of cut/fill & embankment shown as a plane. | Proposed areas confirmed. Priority is on approximate depth range of cut/fill & embankment. (3D) | Depict zones of Embankment on the overall Earthwork model only if embankments of each side of the roadway/substructure require different embankment data. If embankment data on both sides are the same, Zone A and B depiction will not apply. | | Stockpile, mass hauls located and modeled. |
| Environmental | Landscaping & Reforestation | 2D layout of approximate locations of existing and proposed tree/shrubs. | 2D layout of tree/shrub locations confirmed. Priority on general heights. | 2D / 3D layout of tree/shrub locations. Tree type(s) identified. Priority on stem diameter and approximate canopy diameter. | | |
| | Erosion Control (blankets, fiber rolls, rip-rap, buffer strips, silt fence, etc.) | Area/perimeter of erosional control identified on plan.<br><br><u>EC Blankets</u>, <u>Fiber Rolls</u>, <u>Buffer Strips</u> are sufficient for L100. | <u>Silt Fence:</u> generic model along perimeter of area of work. (3D)<br><br><u>Riprap:</u> Confirmed Location. Priority is on approximate depth range. (3D) | Riprap: Location and approximate depth range confirmed. Priority is on the precision of volume of riprap and rock size to be used. Show location of wetlands and prairie areas and related protection measures. | | |
| | Environmental Soil Classification (disposal, reuse and construction worker precaution) *Tollway Specific | Identify areas of excavation on the plan. Identify initial boring locations within the excavation areas. | 2D proposed plan of classifying non-special soil wastes to be hauled off and/or treated. Soil borings actually taken in field. | Actual surveyed and verified detailed surface modeled using Triangulation method. Higher level of precision of the surveyed and verified surface elevations. Extents of modeled depth based on soil boring logs. | Proposed grading; areas where proposed grading overlaps with existing or excavated areas. 3D modeled box of each type of terrain modeled with the associated combination of disposal (Hazardous Waste, Type 1, 2, 3, 4) and reuse (A, B, C) types and construction worker precaution areas. Construction worker precaution zone shall be provided. | A-Forms (A-51 & A-53) tagged by Agency Representative Field Manager in issued model. Agency Representative Field Manager to identify destination of hauled off soils. |
| | Environmental "Regulated" Soil Waste Classification *IDOT Specific | Identify areas of excavation on the plan. Identify initial boring locations within the excavation areas. | 2D proposed plan of individual properties. Indicate those identified as Recognized Environmental Conditions (REC) sites. Indicate soil borings taken in the field. | Actual surveyed and verified detailed surface modeled using Triangulation method. Higher level of precision of the surveyed and verified surface elevations. Extents of modeled depth based on soil boring logs. Excavation length, width, and depth detailed for each property with ISGS site numbers. | Individual properties identified with ISGS site numbers and corresponding section of the specification or special provision that governs management of the soil due to regulated substances. Construction worker precaution zone shall be provided. | BDE Forms (BDE-2730 & BDE-2733) tagged by Agency Representative Field Manager in issued model. Agency Representative Field Manager to identify destination of hauled off soils. |

(3D) = element's L200 requiring deliverables to be 3D modeled.

* = Refer to Section 4.1.3 in the BIM Implementation Manual for specifics on multi-location design contracts or mult-design contracts within adjacent locations.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.2** Stormwater Drainage

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Stormwater Drainage | Drainage Structures (Manholes, catch basins, headwalls, junction chambers) | Priority is on the location of drainage structures. | Model of the drainage structure assembly as a generic element. Structure type, shape, orientation, dimensions, and wall thicknesses are modeled. Drainage Profile Alignments identified. (3D) | Modeled as specific structure. Openings for drains and other services modeled. Frames and grates modeled. Rim elevations and inverts are accurately located and modeled. | Reinforcements, safety grates, restrictor plates, energy dissipaters, check valves, etc. are identified and modeled. | Element modeling to include reinforcements, lifting loops, anchor bars, slots for grate, etc. |
| | Roadway Curb and Gutter (including concrete flumes) | Priority is on the location of the curb & gutters. | Model of the curb and gutter type being used. (3D) | Full extents of curb and gutters (bedding and base course aggregate materials and thicknesses) modeled. Distinguish between the elements. | Transitions between different type of curbs (regular to depressed curb transitions) modeled. | Reinforcements, pour stops, and expansion joints modeled. |
| | Culvert (between x>4' but 20'>x in width) | See culvert category for LOD requirements | | | | |
| | Storm Sewer (including trench drains, slotted drains, slope drains) | Priority is on the location of the storm sewer and associated pipelines and drains. | Model of the drainage structure assembly as a generic element. Pipe shape, vertical & horizontal alignment, dimensions, and wall thicknesses are modeled. Drainage Profile Alignments identified. (3D) | Modeled as specific structure. Pipe inverts are accurately located and modeled. Trench backfill modeled. | | Reinforcements, pour stops, and expansion joints modeled. |
| | Pipe Underdrain | Priority is on the location of the pipe underdrain(s). | Model of the drainage structure assembly as a generic element. Pipe size and vertical & horizontal alignment are modeled. Drainage Profile Alignments identified. (3D) | Modeled as specific structure. Pipe underdrain headwalls to be modeled. Pipe underdrain inverts are accurately located and modeled. | Fabric lined trench identified and modeled. | |
| | Bathymetry (non-man made bodies of water) | Priority is on the location and top-surface area of the bodies of water. Extents of depiction to be established. | Modeling of body of water grading. Drainage Profile Alignments and freeboard requirements identified. Stage volume relationship identified with the grading. (3D) | Proposed Surface: Complete and accurate surface definition based on defined fine grading, grade breaks, swales, surface shoreline materials, etc. | | |
| | Detention Ponds | Priority is on the location and top-surface area of the detention pond(s). | Modeling of body of water grading. Drainage Profile Alignments and freeboard requirements identified. Stage volume relationship identified with the grading. (3D) | Proposed Surface: Complete and accurate surface definition based on defined fine grading, grade breaks, swales, surface shoreline materials, overflow weir, BMPs, etc. | | |
| | Water Surface (bridges, culverts, curb and gutter, storm sewers, detention ponds, ditches) | Preliminary modeling of design WSE and HWL for bridges, culverts, and detention ponds. | Accurate modeling of design WSE and HWL for bridges, culverts, and detention ponds. (3D)<br><br>Preliminary modeling of HGL for storm sewers and design WSE ditches. Preliminary modeling of spread. (3D) | Accurate modeling of HGL for storm sewers and design WSE for ditches.<br><br>Accurate modeling of spread. | | |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.3** Utilities, ITS, Electrical

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Utilities/ITS/ Electrical | Underground Utilities (sanitary, water main, gas, fiber, electric) & Above Ground | Indication of approximate locations, lengths, and extents of the existing and proposed underground utilities. | Locations, lengths, and extents confirmed.<br>Modeled elements to include:<br>- approximate size, shape, and location of the pipes/conduits<br>- approximate access/code clearance requirements modeled<br>- Approximate elevations<br>- Existing utilities modeled focusing on vertical/horizontal location.<br>(3D) | Modeled elements to include:<br>- Design-specified size of the pipes/conduits<br>- Identification of pipe material<br>- Existing utilities modeled with higher level of precision focusing pipe sizes. | Element modeling to include:<br>- Pipe hanger and Clamp and Anchors<br>- Exact sloping of pipes<br>- Pipe connection and bends details<br>- Expansion reducer and Collar<br>- Finishes i.e. painting, galvanization etc<br>- Splash block | Utility data collection following requirements in CM Utility Collection Guide & Special Provision |
| | Above Ground Utilities (water main, gas, fiber, electric, temporary lines) | Indication of approximate locations, lengths, and extents of the existing and proposed above ground utilities. | Locations, lengths, and extents confirmed.<br>Modeled elements to include:<br>- approximate size, shape, and location of the pipe/conduits<br>- approximate access/code clearance requirements modeled<br>- Approximate elevations<br>- Existing utilities modeled focusing on vertical/horizontal location.<br>(3D) | Element 3D modeling to include:<br>- Design-specified size of the pipes/conduits<br>- Identification of pipe material<br>- Existing utilities modeled with higher level of precision pipe sizes. | Element modeling to include:<br>- Pipe hanger and Clamp and Anchors<br>- Exact sloping of pipes<br>- Pipe connection and bends details<br>- Expansion reducer and Collar<br>- Finishes i.e. painting, galvanization etc<br>- Splash block | Utility data collection following requirements in CM Utility Collection Guide & Special Provision |
| | Distribution Systems and Above Ground Cabinetries (electrical services, cabinets for controlling ITS & Tolling Devices, IPDC Building) | Priority is on the location of the existing and proposed distribution systems and the above ground cabinetries. | Locations confirmed. Generic mass of each element to include information about depth, length and width. (3D) | Modeled elements to include:<br>- length width and height of the elements<br>- associated foundations | | |
| | Roadway Lighting | Priority is on the location of the existing and proposed roadway lighting. | Locations confirmed. Generic mass of each element to include information about width and height and associated foundation. (3D) | Modeled elements to include:<br>- exact shape of the light poles<br>- associated foundations<br>- Anchor rods and bolts<br>- Conduit | | |
| | Traffic Signals | Priority is on the location of existing and proposed traffic signals. | Locations of traffic signals and control cabinet confirmed. Generic mass of each element to include information about width and height and associated foundation. (3D) | Modeled elements to include:<br>- exact shape of the signal supports<br>- associated foundations, traffic signal control cabinet pad<br>- Anchor rods and bolts<br>- Conduit | | |
| | Tolling Equipment & Devices (payment sensor loops, cameras, conduits that feed CAT-5 cables & devices) *Tollway Spacific | Priority is on the location of the existing and proposed tolling equipment & associated devices. Included is also the length and extents of associated cables. | Locations confirmed. Generic mass of each element to include information about depth, length and width.<br><br>Indicate approximate elevations of the associated cables.<br>(3D) | Modeled elements to include:<br>- length width and height and overall geometries of the tolling equipment and devices | | Utility data collection following requirements in CM Utility Collection Guide & Special Provision |
| | Intelligent Transportation Systems (ITS) | Indication of approximate locations, lengths, and extents of the existing and proposed ITS. | Locations, lengths, and extents confirmed.<br>Modeled elements to include:<br>- approximate size, shape, and location of the pipes/conduits<br>- approximate access/code clearance requirements modeled<br>- Approximate elevations<br>(3D) | Modeled elements to include:<br>- Design-specified size of the pipes/conduits<br>- Identification of pipe material and any foundation or concrete pads<br>- Anchor rods and bolts<br>- Conduit | Element modeling to include:<br>- Pipe hanger and Clamp and Anchors<br>- Exact sloping of pipes<br>- Pipe connection and bends details<br>- Expansion reducer and Collar<br>- Finishes i.e. painting, galvanization etc<br>- Splash block | Utility data collection following requirements in CM Utility Collection Guide & Special Provision |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.4** Signage

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Signage | Signage (Overhead) | Priority is on the type of signs and horizontal location of the overhead signs. Existing with action to be taken and proposed signs identified. | The sign panel layout/legend format and size to be provided<br><br>Identify if foundation is needed. If so, show depth/volume of foundation. Identify number of posts of the sign. Model of the sign support as a generic element: Model of the sign structure as a generic element:<br>- Butterfly Type<br>- Cantilever Type<br>- Span Truss Type<br>- Monotube Type<br>(3D) | Modeled as specific sign structure, length, substructure, bedding material and base course aggregate and thicknesses identified.<br><br>- Actual elevations and location of member connections where applicable<br>- Correct width, height and diameter of steel end supports.<br>- Correct size of all truss members and chords.<br>- Correct foundation type and size with grade beam and drilled shaft.<br>- Signage materials identifed. | Element modeling to include:<br>- Welds<br>- Coping of members<br>- Cap plates<br>- Washers, nuts, etc.<br>- All assembly elements<br>- Anchor bolts<br>- Base plates<br>- Main elements of typical connections applied if applicable<br>- Any miscellaneous members with correct size, shape, orientation, and material. | Element modeling to include:<br>- Joints |
| | Signage (Roadside ) | Priority is on the type of signs and horizontal location of the roadside signs. Existing with action to be taken and proposed signs identified. | The sign panel layout/legend format and size to be provided<br><br>Identify if foundation is needed. If so, show depth/volume of foundation. Identify number of posts of the sign. Model of the sign support as a generic element:<br>- Bridge Mounted<br>- Barrier Assembly Mounted<br>- Breakaway Steel Mounted<br>- Canopy Mounted<br>- Gantry Column Mounted<br>- Light Pole Mounted<br>- Noisewall Mounted<br>- Structure Mounted<br>- Truss column Mounted<br>- Telescoping Steel Mounted<br>- Wood Post Mounted<br>(3D) | Full extent of sign support used. Support size, support height, foundations (for breakaway steel supports).<br><br>- Actual elevations of mounting support members.<br>- Main elements of mounting supports.<br>- Signage materials identified. | Modeled element to include:<br><br>- Mounting brackets<br>- Anchor bolts<br>- Base plates<br>- Any miscellaneous members with correct size, shape, orientation, and material. | Element modeling to include:<br>- Joints |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.5a** Roadway Pavement Design **& Geometrics**

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Pavement Design & Geometrics | Roadway Pavement (cross section templates - includes typical cross-sections, temporary pavement sections, and permanent pavement sections) | Indicate lengths, widths, and extents of the pavement. Identify existing and proposed right-of-way (ROW) | Horizontal dimensions confirmed. Model of the pavement type assembly as an element. Typical sections applied as cross-section templates in 3D model. (3D) | Modeled as specific layer of each pavement (i.e. thickness, bedding material and base course aggregate). All cross-slopes modeled. | | Proposed pavement for contractors to use for automated machine guidance. |
| | Pavement Markings (includes temporary pavement markings and permanent pavement markings) | Identify existing pavement markings; proposed preliminary pavement markings indicated. | Finalized proposed pavement markings. | Overlay finalized pavement markings on 3D modeled pavement. | | |
| | Geometrics | Existing horizontal alignment, proposed preliminary horizontal alignment project limits to be indicated; existing vertical alignment to be identified. | Proposed horizontal alignment(s) project extents confirmed; Preliminary proposed vertical alignment(s) to be indicated. (3D) | Finalized proposed horizontal, Finalized proposed vertical alignments. | | |
| | Superelevation | Existing superelevations identified; Preliminary superelevations and superelevation transitions to be indicated. | Proposed superelevations and superelevation transitions. (3D) | Finalized proposed superelevations and superelevation transitions. | | |
| | Intersections & Driveways | Indicate lengths, widths, and extents of the intersections & driveways. | Horizontal dimensions confirmed. Generic of the pavement type thickness (3D) | Modeled as specific layer of each pavement (i.e. thickness, bedding material and base course aggregate). All cross-slopes modeled. | Modeled 3D connections to crossing elements and transitions. | |
| | Sidewalks | Indicate location, lengths, widths, and extents of the sidewalks. | Horizontal dimensions confirmed. Generic of the pavement type thickness. Identify locations of ADA ramps. (3D) | Modeled as specific layer of each pavement (i.e. thickness, bedding material and base course aggregate). ADA ramp and ramp transitions to be modeled. All cross-slopes modeled. | Modeled 3D connections to crossing elements and complex transitions (i.e. sidewalk and any existing or proposed features around it like sidecurbs or existing non-roadway pavements) | |
| | Guardrail | 2D general location of guardrail based on a Barrier Warrant Analysis. Proper location and orientation of obstacles and Area of Concerns shown. Anticipated type of barrier and terminals identified. | Foreslopes and backslopes based on 3D grading model used for guardrail analysis. Length of need for guardrail based on a Barrier Warrant Analysis confirmed. (3D) Lengths of and types of barriers correctly depicted with all connections, blockouts and general terminals located and identified. (3D) | Attenuators modeled. Grading in front of and behind terminals shown in 3D model. | | Proprietary guardrail end-terminal systems modeled to use for Construction. |
| | Rigid (Concrete) Barriers | 2D general location of barrier based on a Barrier Warrant Analysis. Proper location and orientation of obstacles and Area of Concerns shown. Anticipated type of barrier and terminals identified. | Coordination with structural elements. Final location of barrier(s) based on a Barrier Warrant Analysis confirmed. (3D) Lengths of and types of barriers correctly depicted with all connections and terminals located and identified. Transition(s) type identified. (3D) | Barrier elements properly located in 3D model and roadway templates. Full extents of traffic barrier material, footing, bedding material and base course aggregate and thicknesses identified and modeled based on coordination with structural design and the Barrier Warrant Analysis. When differentials on either side of barrier, identify and model applicable barrier type. Attenuators modeled. | Designed and finalized reinforcement (non-standard barriers only). Add dowel bars at the curb & gutter connection point. | |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.5b** Roadway MOT, Sitework & Tollway Plaza Plans

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Maintenance of Traffic (MOT) | Temporary MOT Elements (Roadway Only) | Provide overall traffic flow patterns and number of lanes for each stage. Include: Lane widths and extents | Traffic patterns confirmed. Depict traffic control delineation devices (drums or barricades) and positive protection devices (TCB, impact attenuators, TMA's), lane tapers & shifts, positive protective elements, temporary median crossovers, ramp configurations (3D) | | | |
| | Temporary MOT Elements (Typical Sections) | Provide typical roadway cross section locations of each traffic stage. Include: Lane numbers & widths, identified work area, delineation devices, positive protective devices (TCB, guard rail), pavement markings, special conditions (such as rollovers or drop-offs). Depict conditions outside of travelled way (medians, slopes, structural elements, hazards, etc.). Provide sections at bridge structures, ramps and uniquely configured areas. | Typical cross-sections applied in cross-section templates and modeled as 3D elements. (3D) | | | |
| Site & Plaza Plans | Site work Plans (Oases, Maintenance Areas, parking areas, rest areas) | Identify existing site location(s); preliminary proposed layout depicting areas and horizontal extents. | Confirm horizontal extents. 3D generic model(s) of buildings with correct geometry where applicable. Refer to AIA LOD table for building details and associated property site. (3D) | | | |
| | Toll Plaza Plans and Details<br>*Tollway Specific | Priority is on the horizontal location of the gantries. | Identify if foundation is needed. If so, show depth/volume of foundation. Model of the structure as a generic element. Loop locations to be indicated. (3D) | Modeled as specific structure, length, substructure, bedding material and base course aggregate and thicknesses identified.<br><br>- Correct size of all truss members and chords.<br>- Correct foundation type and size with grade beam and drilled shaft. | Element modeling to include:<br>- Actual elevations and location of member connections where applicable<br>- Correct width, height and diameter of steel end supports.<br>- Main elements of typical connections applied if applicable<br>- Any miscellaneous members with correct size, shape, orientation, and material. | Element modeling to include:<br>- Welds<br>- Coping of members<br>- Cap plates<br>- Washers, nuts, etc.<br>- All assembly elements<br>- Anchor bolts<br>- Base plates<br>- Joints |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.6a** Bridge Design Project Elements Model Detail Display Requirements at Each LOD

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Bridge Design (Deck and Approach Slab) | Deck, Approach , Transition, and Sleeper Slabs | Priority is on the location, rough length and width, extents of each slab type. | Horizontals confirmed. Approximate slab thickness to be determined. (3D) | Element modeling to include:<br>- Accurate size and shape of decks<br>- Expansion joint with priority on location<br>- Drip notch and corner chamfers<br>- Exact sloping of concrete surfaces<br>- Fillets over girders<br>- Deck notches at abutments<br>- Openings for Deck drainage<br>- Reinforcement bars, Reinf. Bars (Epoxy coated) | Element modeling to include:<br>- Pour joints<br>- Expansion , construction and stage-construction joints<br>- Bar splicers | |
| | Parapets, Sidewalk and Median | Priority is on the location, rough length and width, extents of the parapets, sidewalk, and median. | Horizontal dimensions confirmed. Generic mass of members including information about depth, length, and width. (3D) | Element modeling to include:<br>- Accurate size and shape of parapets<br>- Expansion joint with priority on location<br>- Corner chamfers<br>- Exact sloping of concrete surfaces<br>- Reinforcements bars and lap splices | Element modeling to include:<br>- Expansion and construction joints<br>- Cork Joint Filler, Polyurethane sealant and Aluminum sheet at joints | |
| | Bridge Railing and Traffic Barrier | Basic mass w/o form or identification of material. Priority is on the horizontal extents of the railing and barriers. | Horizontal dimensions confirmed. Generic mass of members including information about depth, length, and width. (3D) | Element modeling to include<br>- Railing structural members<br>- Base / Connection plate locations<br>- Slotted holes in railing member elements | Element modeling to include:<br>- Anchor bolts and Studs<br>- Locknuts and bolts.<br>- Fabric reinforced elastomeric pad<br>- Rail splice<br>- Welds<br>- Coping of members<br>- Washers, nuts, etc. | |
| | Light Pole Foundation and Parapet Conduit | Indication of approximate locations of Light Poles. | Locations confirmed. Generic mass of light pole base support including information about depth, length, and width. (3D) | Light pole foundation sized and formed to be constructed.<br>Also included in model are:<br>- Rebar<br>- Conduit<br>- Anchor rods and bolts | Element modeling to include:<br>- Light pole base plate<br>- Vibration isolation pad<br>- Junction box blockout(s)<br>- Washers, nuts, etc. | |
| | Bridge Mounted Sign Support | Indication of approximate locations of these itemized elements. | Horizontal dimensions confirmed. Generic mass of members including information about depth, length, and width of the support structures. (3D) | Element modeling to include<br>- Steel structural members<br>- Member connections | Element modeling to include:<br>- Anchor bolts, Grout<br>- Stiffener plate<br>-Connection plate/angle with anchor bolts holes<br>- PVC sleeve if applicable<br>- Welds<br>- Coping of members<br>- Washers, nuts, etc. | |
| | Expansion Joints | Indicate potential locations of expansion joints. | Horizontal dimensions confirmed. Generic mass of expansion joint including information about depth, length, and width. (3D) | Element modeling to include<br>- Locking edge rails with bends<br>- Parapet / Sidewalk sliding plate<br>- Neoprene glands | Element modeling to include:<br>- Studs and embedment<br>- Expansion anchors if applicable<br>- Welds<br>- Joints and bends details<br>- Studs | Add finishes such as painting or hot-dip galvanizing. |
| | Deck Drains and Drainage Scuppers | Indication of approximate locations of the drains and scuppers. | Horizontal dimensions confirmed. Generic model of the drains and scuppers including information about depth, length, and width. (3D) | Element modeling to include<br>- Precise location and actual size of the drains/scupper<br>- Scupper frames and downspouts<br>- Finishes i.e. painting, galvanization etc | Element modeling to include:<br>- Bolts, Anchor rods, nuts and washers<br>- Modified reinforcement details in the concrete deck<br>- Welds<br>- Joints and bends details | |
| | Drain Pipes and Support | Indication of approximate locations, lengths, and extents of the pipes. | Horizontal dimensions confirmed. - Schematic diagram showing the pipe network. Generic model of the pipe with approximate diameter and locations of supports (3D) | Element modeling to include<br>- Size of the pipes<br>- Identification of pipe material<br>- Finishes i.e. painting, galvanization etc<br>- Exact sloping of pipes | Element modeling to include:<br>- Pipe hanger and Clamp and Anchors<br>- Pipe connection and bends details<br>- Expansion reducer and Collar<br>- Splash block<br>- Welds<br>- Washers, nuts etc | |

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.6b** Bridge Design Project Elements Model Detail Display Requirements at Each LOD

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Bridge Design (Superstructure) | Bridges Prestressed Concrete Beams | Basic mass w/o specific form or identification of material. Anticipated locations of girders and beams. | Element modeling to include:<br>- Type of structural concrete system<br>- Approximate geometry (e.g. depth) of structural elements<br>(3D) | Element modeling to include:<br>- Bridge frame modeled to show girder layout and diaphragm location.<br>- Concrete defined per spec (strength, etc.)<br>- Modeled girder elements with accurate flange and web dimensions, corners, and chamfers. | Element modeling to include:<br>- Strands profile and locations<br>- Reinforcement and Lap splices<br>- Welded Wire Reinforcement (WWR)<br>- Fillets<br>- Lifting devices<br>- Embeds and anchor rods, plate assembly<br>- Penetration for any utility item | Contractor to provide strand cutting sequence,<br>concrete pour dates for each beam |
| | Bridge Girder Steel | Basic mass w/o specific form or identification of material. Anticipated locations of girders and beams. | Generic mass of Girder including information about Girder Depth, Web Plate Length and Flange Plate Width<br>(3D) | Element modeling to include<br>- Thicknesses of Flanges and Web plates<br>- Finishes, i.e. painted, galvanized etc<br>- Framing section properties data integrated with framing model<br>- Grade of Steel identified | Element modeling to include:<br>- Stiffeners<br>- Welds<br>- Sloping of members and camber<br>- Diaphragm connection members<br>- Field and shop splices<br>- Shear studs<br>- Anchors for any utility item<br>- Top of beam elevations | Element modeling to include fabrication level information:<br>- Welds<br>- Coping of members<br>- Washers, nuts, etc.<br>- Field and shop splices |
| | Steel Diaphragms / Cross-frames | Basic mass w/o specific form or identification of material. Anticipated locations of diaphragms and other cross-frames. | Generic mass of members including information about depth, length and flange plate width<br>(3D) | Element modeling to include<br>- Complete size of diaphragm steel members<br>- Finishes, i.e. painted, galvanized etc<br>- Grade of steel identified | Element modeling to include:<br>- Connection Plates, bolt holes<br>- Welds<br>- Sloping of members<br>- Anchors for any utility item | Element modeling to include fabrication level information:<br>- Welds<br>- Coping of members<br>- Washers, nuts, etc. |
| | Bearings | Approximate horizontal locations of the bearings. | Horizontal locations confirmed. Generic mass of the bearings including information about depth, length, and width.<br>(3D) | Element modeling to include<br>- Finishes, i.e. painted, galvanized etc<br>- Grade of steel identified<br>- Bearing type identified | | |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.6c** Bridge Design Project Elements Model Detail Display Requirements at Each LOD

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Bridge Design (Substructure) | Concrete Pier and Crashwall | Priority is on the horizontal location of the concrete pier and crashwall. | Horizontal placements confirmed. Element modeling to include:<br><br>- Approximate size and shape of pier elements e.g. Column, Cap, Crashwall etc.<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of the pier cap, columns, pier wall, crashwall, and pedestals<br>- Sloping surfaces.<br>- Reinforcements<br>- Opening for utilities | Element modeling to include:<br>- Lap splices, Hooks and Bends, spiral spacers<br>- PJF<br>- Construction joints<br>- Aesthetic treatments | |
| | Concrete Abutment and Wingwall | Priority is on the horizontal location of the abutment and wingwall. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate size and shape of abutment and wingwall<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of the backwall, abutment pile cap, wing walls, and pedestals<br>- Sloping surfaces.<br>- Reinforcements<br>- Opening for utilities<br>- Limits of structural excavation and Porous Granular backfill | Element modeling to include:<br>- Reinforcements, Lap splices, Hooks and Bends<br>- Bar splicer assembly<br>- Water seal, PJF<br>- Expansion / construction joints | |
| | MSE Abutment | Priority is on the horizontal location of the abutment and wingwall. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate size and shape of abutment, MSE panels and wingwall<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of each element<br>- Sloping surfaces.<br>- Openings for utilities<br>- Limit of estimated (0.7h or 8 feet minimum - verify width with SGR) reinforced soil mass/backfill<br>- Leveling pad<br>- MSE Wall Reinforcement Details<br>- Any conflicts to drainage structure identified. | Specialty/customized aesthetic design of panel face | Element Modeling to include:<br>- MSE wall Soil Reinforcement<br>- Abutment Soil Reinforcement<br>- Reinforcements and Lap splices<br>- PJF<br>- Openings for utilities<br>- Limits of reinforce soil mass and select backfill |
| | Embankment and Slopewalls | Priority is on the location, length and width of he embankment and slopewalls. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate geometry of elements and locations<br>- Identification of slopewall material<br>(3D) | Element modeling to include:<br>- Actual cross sectional size and area of the system<br>- Embankment limits<br>- Accurate sloping of the elements<br>- Stone riprap and bedding if applicable<br>- streambed (refer to bathymetry) | Element modeling to include:<br>- Reinforcement details<br>- PJF if applicable<br>- Streambed<br>- Filter fabric<br>- Joint details | |
| | Waterways (refer to Bathymetry for water data) | Priority is on the locations of these itemized elements. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate coverage area of the waterways<br>(3D) | Element modeling to include:<br>- Accurate coverage area of the waterways<br>- Vertical clearance information | Element modeling to include:<br>- Estimated Water Surface Elevation (EWSE)<br>- Streambed elevation<br>- Depth to bearing stratum<br>- Penetration into bearing stratum<br>- Locations of lap splices<br>- Rebar including hooks and lap splices | |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.6d** Bridge Design Project Elements Model Detail Display Requirements at Each LOD

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Bridge Design (Foundations) | Shallow Foundations | Priority is on the location and horizontal extents of the foundation. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate size and shape of foundation element<br>(3D) | Element modeling to include:<br>- Overall size and geometry of the foundation element<br>- Depth of foundation, soil cover, and frost depth according to SDM 22.5.3<br>- External dimensions of the members<br>- Geotechnical bearing strata elevation is modeled from geotechnical report.<br>- Reinforcements<br>- Limits of structural excavation and Porous Granular backfill | Element modeling to include:<br>- Lap splices, Hooks and Bends<br>- Construction joints | |
| | Drilled Shafts | Priority is on the location and horizontal extents of the drilled shafts. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate geometry (e.g. depth) of the drilled shafts<br>(3D) | Element modeling to include:<br>- Assumed bearing depth per geotechnical report<br>- Top and Bottom of shaft<br>- Actual top of shaft, expected bottom of shaft and estimated top of rock<br>- Size of shaft<br>- Permanent casing, when required<br>- Reinforcements | Element modeling to include:<br>- Lap splices including bundles bars<br>- Pipes for Crosshole Sonic Logging<br>- Depth to bearing stratum<br>- Penetration into bearing stratum<br>- Locations of lap splices<br>- Rebar including hooks and lap splices | |
| | Pile Foundations | Priority is on the location and horizontal extents of the piles. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate geometry (e.g. depth) of the piles<br>(3D) | Element modeling to include:<br>- Accurate Size and geometry of pile cap<br>- Assumed bearing depth per geotechnical report<br>- Top of Pile, Top of Pile Cap, Pile Cap Size, Expected bottom of pile<br>- Pile size and cross-sectional geometry<br>- Pile shoes, when required<br>- Precoring requirements<br>- Backfilling of precored holes requirements<br>- Reinforcements | Element modeling to include:<br>- Lap splices in Pilecap<br>- Concrete Encasement<br>- Pile casing if applicable<br>- Depth to bearing stratum<br>- Penetration into bearing stratum<br>- Pile splices<br>- Rebar including hooks and lap splices | |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.6e** Retaining Wall Project Elements Model Detail Display Requirements at Each LOD

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Retaining Wall | Cast-In-Place T-Type | Priority is on the location and horizontal extents of the CIP concrete T-type wall. | Element modeling to include:<br>- Approximate limits of concrete walls indicating earth retention and approximate grade on each side<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of the element<br>- Earthwork surfaces for wall<br>- Limits of structural excavation and Porous Granular backfill<br>- Reinforcements<br>- Openings for utilities | Element modeling to include:<br>- Lap splices, Hooks and Bends<br>- Water seal, PJF<br>- Expansion / construction joints<br>- Weep holes if applicable | |
| | MSE Wall | Priority is on the location and horizontal extents of the wall. | Element modeling to include:<br>- Approximate limits of MSE walls indicating earth retention and approximate grade on each side<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of each element<br>- Earthwork surfaces for wall<br>- Openings for utilities<br>- Limit of estimated (0.7h or 8 feet minimum - verify width with SGR) reinforced soil mass/backfill<br>- Leveling pad | Element modeling to include:<br>- MSE Wall straps<br>- Conflicts with drainage structures and pipes identified.<br>- Specialty/customized aesthetic design of panel face. | Element Modeling to include:<br>- MSE wall Soil Reinforcement<br>- Reinforcements and Lap splices<br>- PJF<br>- Openings for utilities<br>- Limits of reinforce soil mass and select backfill |
| | Moment Slab on Retaining Wall, Parapet, Noisewall | Priority is on the location and horizontal extents of the wall. | Element modeling to include:<br>- Approximate size and shape of elements<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of the moment slab, parapet and noise wall<br>- Earthwork surfaces for wall<br>- Opening for utilities<br>- Reinforcement | Element modeling to include:<br>- Lap splices, Hooks and Bends<br>- PJF<br>- Expansion / construction joints | |
| | Pipe Railing | Basic mass w/o form or identification of material. Horizontal extents to be determined. | Horizontal location confirmed. Element modeling to include:<br>- Approximate size and shape of elements<br>(3D) | Element modeling to include<br>- Railing structural members<br>- Base / Connection plates<br>- Slotted holes in railing member elements | Element modeling to include:<br>- Anchor bolts and Studs<br>- Locknuts and bolts.<br>- Fabric reinforced elastomeric pad<br>- Rail splice | Element modeling to include fabrication level information:<br>- Welds<br>- Coping of members<br>- Washers, nuts, etc. |
| | Light Pole Mounting | Indication of approximate locations of Light Poles. | Generic mass of light pole base support including information about Depth, Length and Width<br>(3D) | Light pole foundation sized and formed to be constructed.<br>Also included are:<br>- Anchor rods and bolts<br>- Conduit, Pole Foundations<br>- Rebars | Element modeling to include:<br>- Light pole base plate<br>- Vibration isolation pad<br>- Washers, nuts, etc. | |
| | Soldier Pile Wall | Priority is on the location and horizontal extents of the wall. | Element modeling to include:<br>- Approximate limits of walls indicating earth retention and approximate grade on each side<br>- Identification of type of wall e.g. Drilled or Driven soldier pile wall<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of each element<br>- Wall facing and type of facing e.g. CIP vs Precast<br>- Earthwork surfaces for wall<br>- Accurate geometry of the soldier pile with encasement if applicable<br>- Estimated embedment of soldier pile from Geotechnical report | Element Modeling to include:<br>- Reinforcements and Lap splices<br>- Shear studs<br>- Controlled low strength material (CLSM)<br>- Timber Lagging<br>- Openings for utilities<br>- Gutter at top of wall<br>- Indication of existing ground surface<br>- Limits of soil removal | Element modeling to include fabrication level information:<br>- Accurate geometry of Timber lagging |
| | Permanent Sheet Pile Wall | Priority is on the location and horizontal extents of the wall. | Element modeling to include:<br>- Approximate limits of walls indicating earth retention and approximate grade on each side<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of each element<br>- CIP facing or CIP cap if applicable<br>- Estimated embedment of sheet pile from Geotechnical report | Element Modeling to include:<br>- Reinforcements and Lap splices<br>- Shear studs if applicable<br>- Openings for utilities<br>- Indication of existing ground surface<br>- Limits of soil removal | Element modeling to include fabrication level information:<br>- Accurate size of the sheet piles and splices |
| | Soil Nail Wall | Priority is on the location and horizontal extents of the wall. | Element modeling to include:<br>- Approximate limits of walls indicating earth retention and approximate grade on each side<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of each element<br>- Drainage system behind the wall<br>- Temporary and Permanent facing material | Element Modeling to include:<br>- Reinforcements and Lap splices<br>- Openings for utilities<br>- Bearing plate, studs and washers<br>- Indication of existing ground surface<br>- Grout | Element modeling to include fabrication level information:<br>- Accurate size and spacing of soil nails |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.6f** Noise Abatement Wall Project Elements Model Detail Display Requirements at Each LOD

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Noise Abatement Wall | Precast Concrete Panel | Priority is on the location and horizontal extents of the panels. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate limits of concrete walls indicating earth retention and approximate grade on each side<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of the element<br>- Sloping surfaces.<br>- Openings for utilities | Specialty/customized aesthetic design of panel face | Element modeling to include:<br>- Reinforcements, Lap splices, Hooks and Bends<br>- PJF<br>- Construction joints |
| | Steel Posts and Supports | Basic mass w/o form or identification of material. Priority is on length and extents. | Length and extents confirmed. Generic mass of members including information about Depth, Length and Flange Plate Width<br>(3D) | Element modeling to include<br>- Complete size of steel members.<br>- Finishes, i.e. painted, galvanized etc<br>- Grade of Steel to be used | | Element modeling to include:<br>- Connection Plates, bolt holes, anchor bolts<br>- Welds<br>- Exact sloping of members<br>- Permanent stabilizers<br>- Fabric pad when expansion panel is involved<br>- Welds<br>- Coping of members<br>- Washers, nuts, etc. |
| | Ground Mounted NAW Foundation (Drilled Shaft) | Priority is on the location and horizontal extents of the drilled shafts. | Horizontal placements confirmed. Element modeling to include:<br>- Approximate geometry (e.g. depth) of structural elements<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of the element<br>- Sloping surfaces. | | Element modeling to include:<br>- Assumed bearing depth per geotechnical report<br>- Top and Bottom of shaft<br>- Actual top of shaft and expected bottom of shaft.<br>- Size of shaft<br>- Post embedment<br>- Reinforcements and Lap splices including bundles bars<br>- Pipes for Crosshole Sonic Logging |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.6g** Temporary Structures Project Elements Model Detail Display Requirements at Each LOD

| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Temporary Structures | Temporary Soil Retention System | Priority is on the location and extents of the soil retention system. | Location and extents confirmed. Element modeling to include:<br>- Approximate geometry of elements and locations<br>- Identification of type of system (e.g. Temporary Sheet Piling, Temporary Soil Retention System or Braced Excavation) based on the recommendation in the Geotechnical report<br>(3D) | Element modeling to include:<br>- Accurate geometry and locations of the elements<br>- Geotechnical bearing strata elevation from geotechnical report. | Element modeling to include:<br>- Sheetings, wales, deadman, piles or any other potential retention system components. | Element modeling to include:<br>- Complete geometry of elements with precise locations<br>- Identification of type of system (e.g. Temporary Sheet Piling, Temporary Soil Retention System or Braced Excavation) based on the recommendation in the Geotechnical report |
| | Temporary Geotextile Walls and Temporary MSE Systems | Priority is on the location and extents of the geotextile walls and temporary MSE Systems. | Element modeling to include:<br>- Approximate geometry of elements and locations<br>- Identification of type of system (e.g. Temporary Geotextile Walls, Temporary MSE Systems) based on the recommendation in the Geotechnical report<br>(3D) | Element modeling to include:<br>- Accurate geometry and locations of the elements<br>- Geotechnical bearing strata elevation from geotechnical report. | | For Temporary MSE Systems: the geometry of each of the panels, reinforcement lengths, locations, and materials, any additional mesh or fabric to be used, bedding requirements, and select fill requirements<br>- Identification of type of system (e.g. Temporary Geotextile Walls, Temporary MSE Systems) based on the recommendation in the Geotechnical report |
| | Cofferdams and Seal Coats | Priority is on the location and extents of the cofferdams and seal coats. | Element modeling to include:<br>- Approximate geometry of elements and locations<br>(3D) | Element modeling to include:<br>- Accurate geometry and locations of the elements<br>- Geotechnical bearing strata elevation from geotechnical report. | Element modeling to include:<br>- EWSE<br>- Streambed elevation<br>- Estimated bottom of sheeting<br>- Estimated bottom of seal coat | Element modeling to include:<br>- Complete geometry of elements with precise locations |

(3D) = element's L200 requiring deliverables to be 3D modeled.

# IDOT / Illinois Tollway - LOD MDD Table

**Appendix C.6h** Bridge Design Project Elements Model Detail Display Requirements at Each LOD

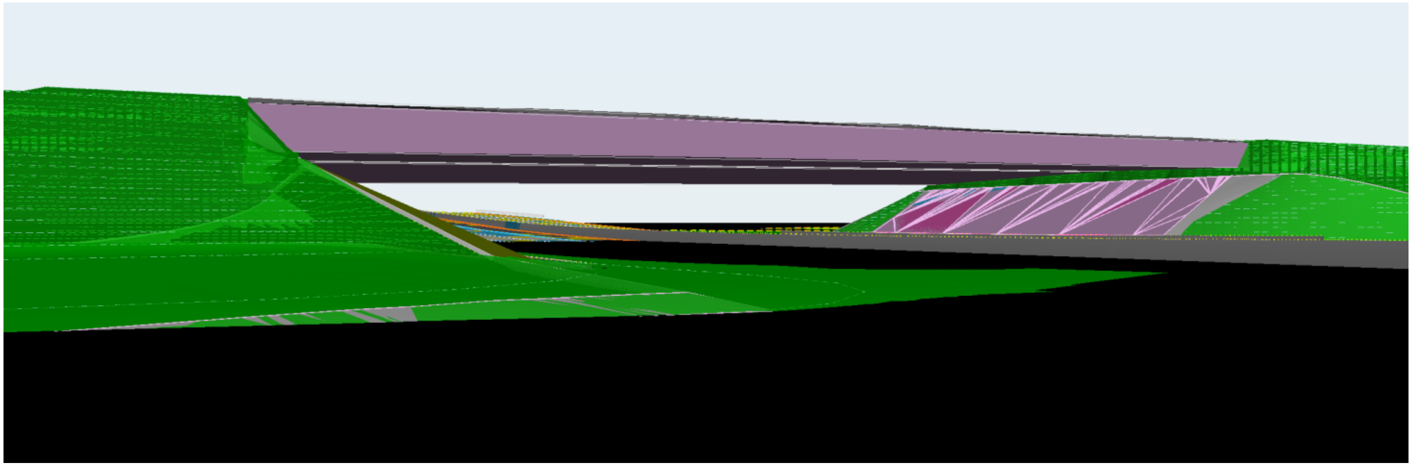
| Category | Element | L100 | L200 | L300 | L350 | L400 |
|---|---|---|---|---|---|---|
| Culverts | Cast-in-Place Culvert | Priority is on the location and horizontal extents of the culvert and cast-in-place wingwalls (if applicable). | Location confirmed. Element modeling to inlcude:<br>-Approximate size and number of barrels of culvert.<br>-Approximate limits of wingwalls indicating earth retention and approximate grade on each side.<br>- Drainage Profile Alignments identified.<br>(3D) | Element modeling to include:<br>- Overall size and geometry of the culvert barrels and cast-in-place wingwalls<br>- Sheet pile wall and cast-in-place wingwalls<br>- Accurate size and geometry of culvert and cast-in-place wingwalls.<br>-Weep holes and drains accurately represented.<br>- Strength of concrete material identified<br>- Reinforcement<br>- Limits of structure excavation and porous granular backfill | Element modeling to include:<br>- Lap splices, Hooks and Bends<br>- Construction joints<br>- Chamfers and drip notches. | |
| | Precast Concrete Culvert | Priority is on the location, rough length, width, and height of barrels. | Location confirmed. Element modeling to include:<br>-Approximate size and number of barrels of precast concrete culvert panels.<br>-Size and type of end section (cast-in-place or precast)<br>- Drainage Profile Alignments identified.<br>(3D) | Element modeling to include:<br>- Accurate size and geometry of the culvert barrels.<br>- Accurate size of end sections.(cast-in-place or precast)<br>-Weep holes and drains accurately represented.<br>- Strength of concrete material identified<br>- Reinforcements<br>-Limits of structure excavation and porous granular backfill | Element modeling to include:<br>- Lap splices in cast-in-place components. | Element modeling to include:<br>- fabrication level information.<br>- welded wire fabric layout |
| | Permanent Sheet Pile Wingwall | Priority is on the location and horizontal extents of the wingwall. | Element modeling to include<br>-Approximate limits of wingwalls indicating earth retention and approximate grade on each side.<br>(3D) | Element modeling to include:<br>-Accurate size and geometry of each wingwall and sheet pile<br>-CIP or steel cap if applicable.<br>-Estimated embedment of sheet pile from Geotechnical report.<br>- Grade of steel identified<br>-Reinforcement | Element modeling to include:<br>- Lap splices<br>-Shear studs if applicable.<br>- Indication of existing ground surface<br>- Limits of soil removal | Element modeling to include fabrication level information:<br>- Accurate size of the sheet piles and splices |
| | Soldier Pile Wingwall | Priority is on the location and horizontal extents of the wingwall. | Element modeling to include:<br>-Approximate limits of wingwalls indicating earth retention and approximate grade on each side.<br>-Identification of type of wall e.g. drilled or driven soldier pile wall.<br>(3D) | Element modeling to include:<br>-Accurate size and geometry of each wingwall and soldier pile<br>-Wall facing and type of facing.<br>-Exact sloping surfaces.<br>-Accurate geometry of the soldier pile with encasement, if applicable.<br>- Estimated embedment of soldier pile from Geotechnical Report.<br>- Grade of steel pile/concrete strength/minimum timber lagging strength identified<br>-Reinforcement | Element modeling to include:<br>- Lap splices<br>-Shear studs<br>- Controlled low strength material (CLSM)<br>- Schematic of timber lagging<br>- Indication of existing ground surface.<br>- Limits of soil removal. | Element modeling to include fabrication level information:<br>- Accurate geometry of timber lagging. |

(3D) = element's L200 requiring deliverables to be 3D modeled.

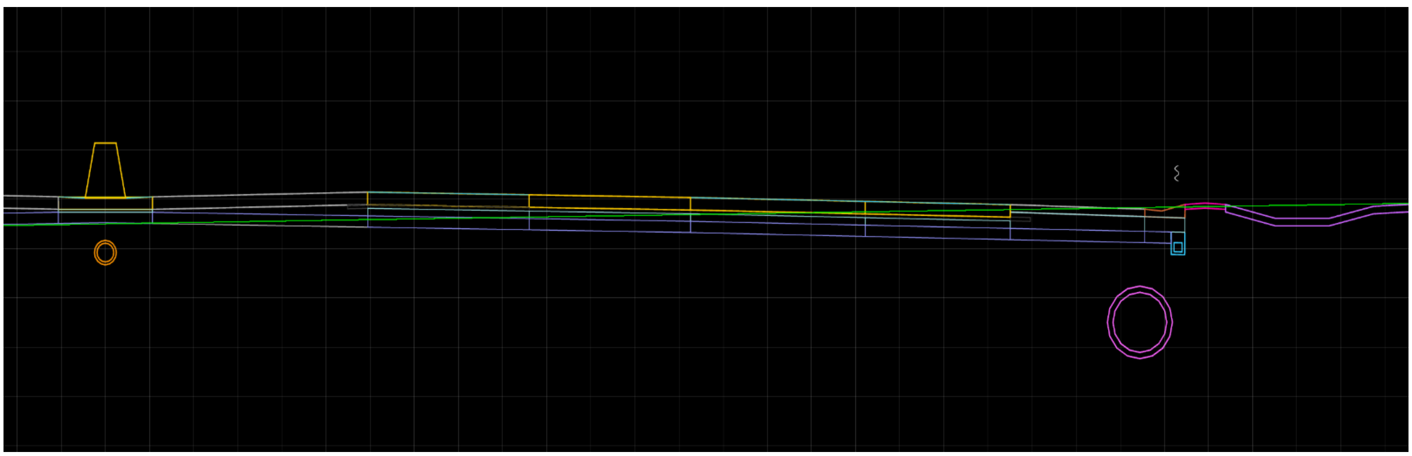
# APPENDIX D LOD GRAPHIC EXAMPLES

**Appendix D** LOD Graphic Examples

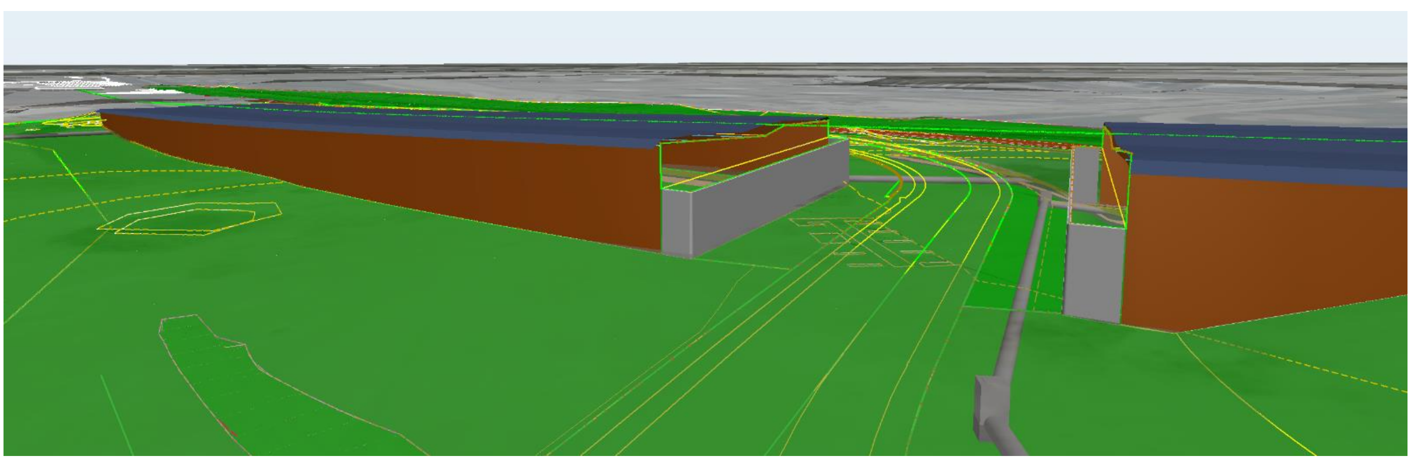
L200 bridge and L200 cut/fill embankment and L200 slope walls



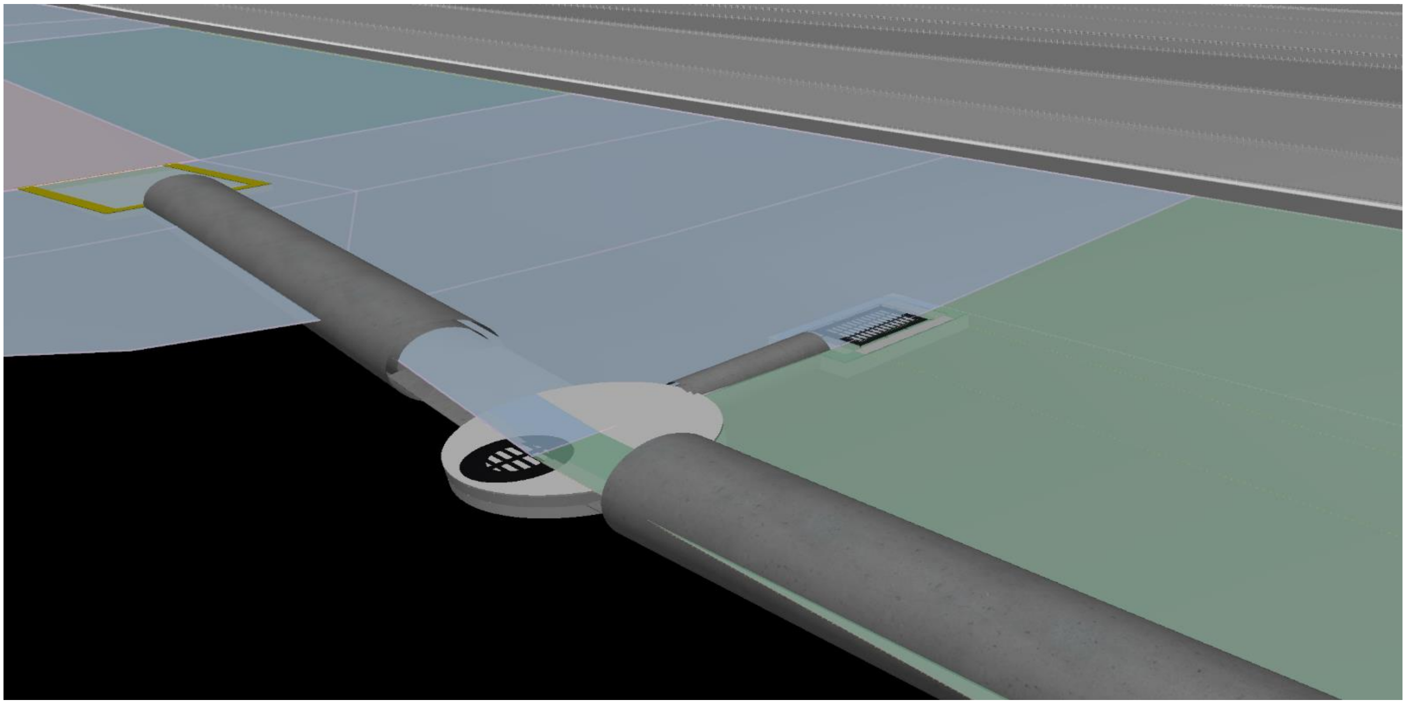
L200 guardrail, L300 concrete barrier, L300 roadway pavement, L300 pipe underdrains



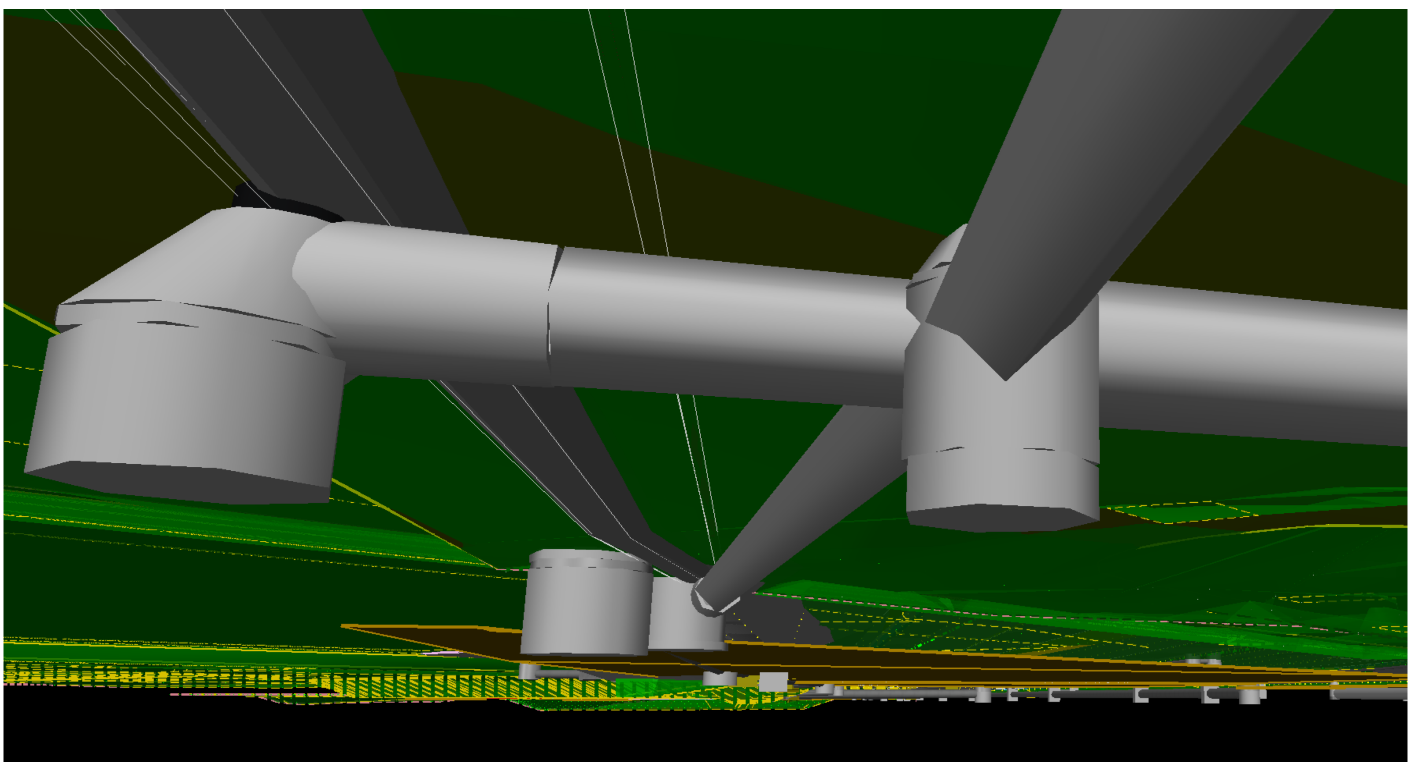
L200 roadway pavement, L200 MSE wall, L300 grading, L300 underground utilities



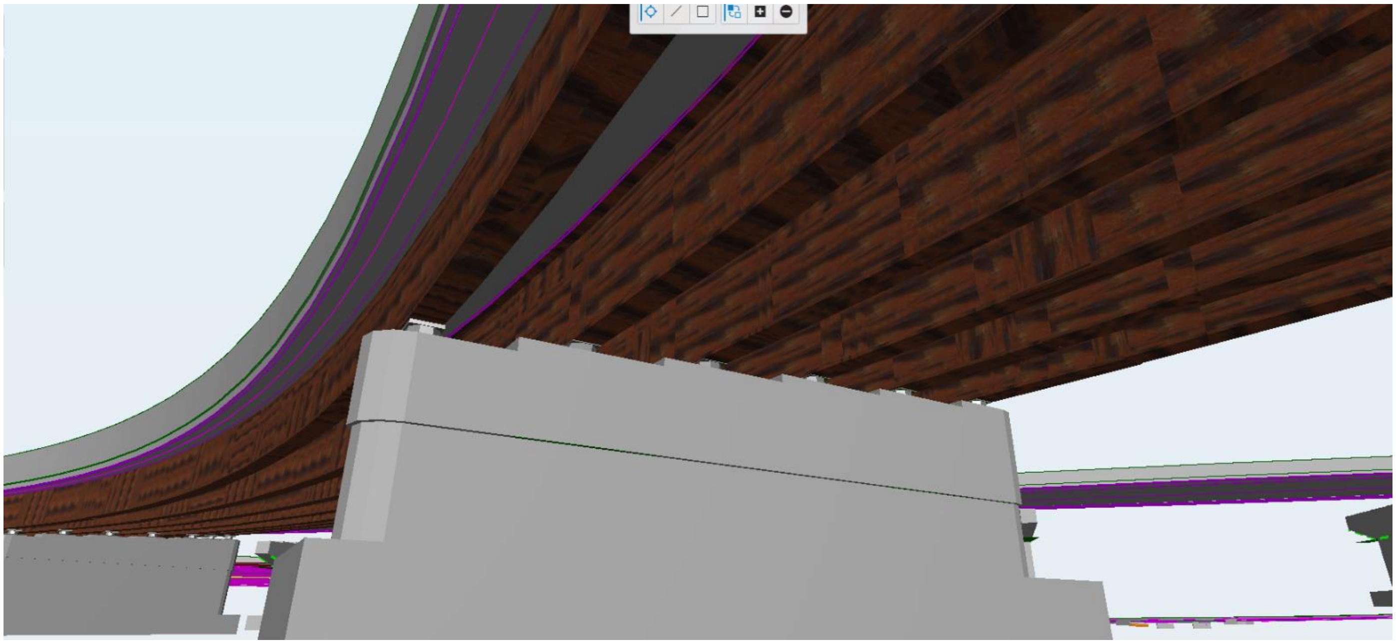
L350 storm sewer



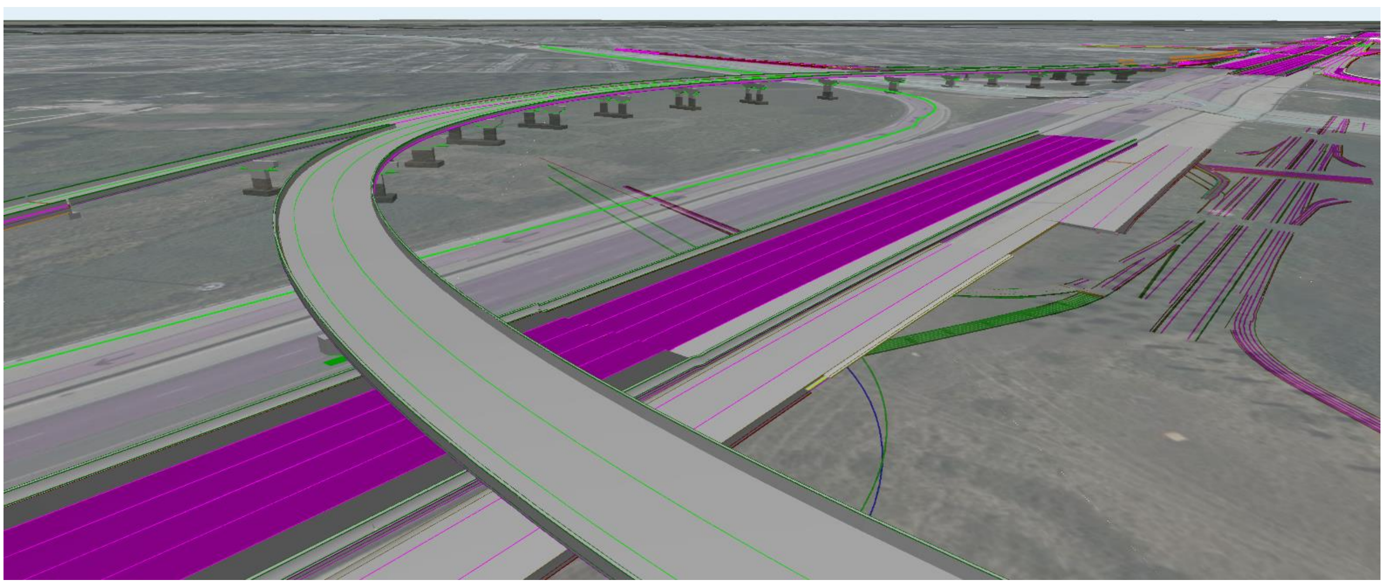
L300 drainage structures, L350 storm sewer



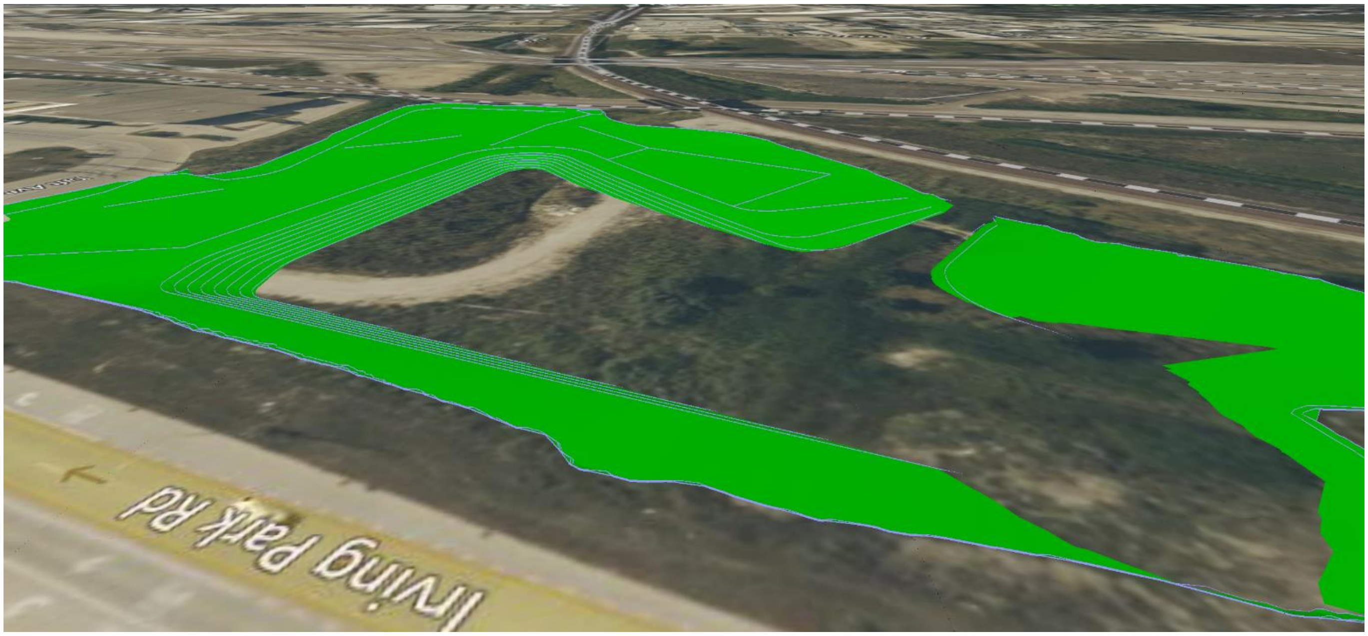
L350 superstructure and L350 substructure



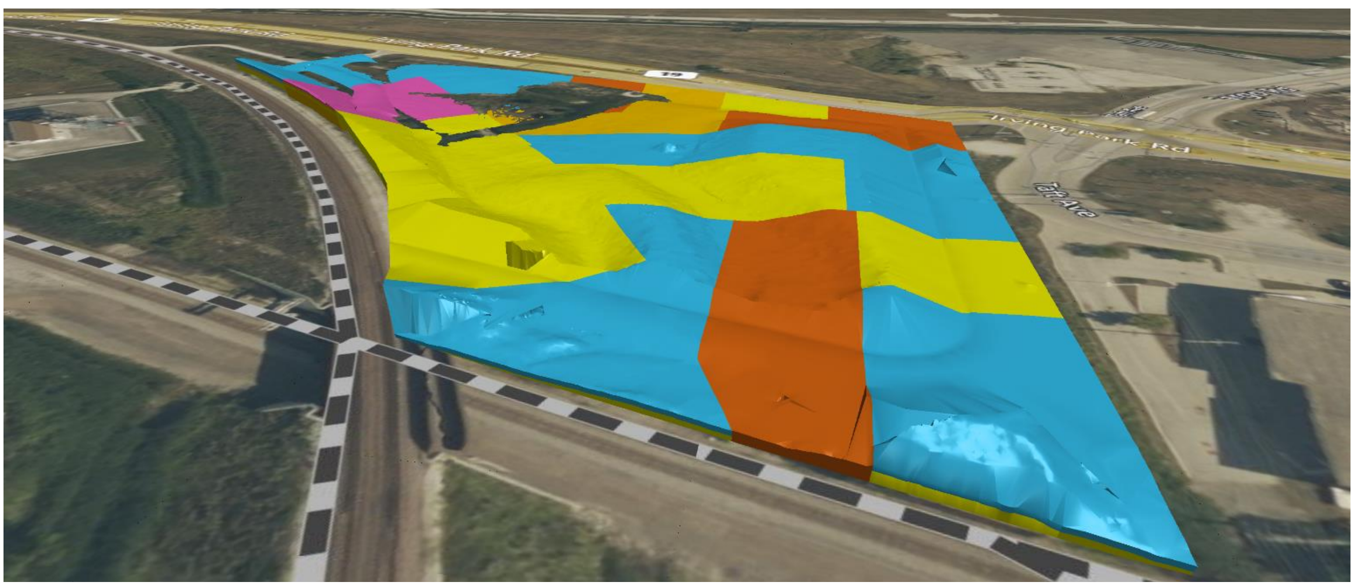
L350 deck and parapet



L300 grading (final surface)



L350 environmental soil classification



# APPENDIX E DESIGN REVIEW CHECKLISTS (FOR REFERENCE)

| Category | Documentation/Task | Verified |
|---|---|---|
| **General** | | |
| Feature Definitions | All point and components have the correct feature definition applied. | Choose an item. |
| Station consistency | Stations are continuous within each corridor and assigned to one alignment. Stations can be read in container file when cutting cross-sections. | Choose an item. |
| Station identification | Confirm if stations can be read in container file when cutting cross-sections. | Choose an item. |
| Template Gaps | No template gaps for design elements (i.e., missing driveways). Templates are being correctly applied per the design criteria. | Choose an item. |
| Easements / ROW Display | Model clearly displays existing and proposed easements / ROW extents. | Choose an item. |
| Surface Model Consistency* | No grading “spikes” in surface model (i.e., triangulation errors to incorrect feature points). Surfaces are created from correct features (i.e., the proposed terrain matches the 3D model). | Choose an item. |
| Existing Ground | Corridor boundaries tie into existing ground surface model file. | Choose an item. |
| Active Profile | Confirm the correct profile is set to active for each alignment (based on design criteria) and that it ties into the adjacent features. | Choose an item. |
| Elements within project boundary limits | All modeled elements are within project construction limits and not exceeding beyond the permitted limitations. | Choose an item. |
| Civil Cells (if applicable) | Civil cells are integrated into the model and accurately depict the design. | Choose an item. |
| *Includes existing terrain outside of the corridor boundary (tie-downs), proposed terrain, excavation, topsoil, corridor) | | |
| | | |
| **Horizontal Alignment** | | |
| Alignment Data | Model data is consistent with the design criteria. | Choose an item. |
| Minimum Radius | Curve radii meets the design criteria. | Choose an item. |
| Kinks in Alignment | Alignment has no kinks and has a consistent continuity. Complex elements do not double back. | Choose an item. |
| Minimum Curve Length | Curve lengths meet the design criteria. | Choose an item. |
| Maximum Compound Curve Ratio | Maximum compound ratios meet the design criteria. | Choose an item. |
| Minimum Tangent Between Curves | Tangents between curves meet minimum agency standard. | Choose an item. |
| Spiral Curves | Spiral curves meet the design criteria. | Choose an item. |
| | | |

| Category | Documentation/Task | Verified |
|---|---|---|
| **Superelevations (SE)** | | |
| Rates and Transitions | Rates and transitions in the superelevation file meet the design criteria and are input correctly into the superelevation section of the model. | Choose an item. |
| Rates and Model | The SE is applied correctly to the active corridor and associated lanes/shoulders. | Choose an item. |
| Diagrams | SE diagrams displayed correctly and match the model. | Choose an item. |
| Rollover Transitions | Rollover transitions for shoulders meet the design criteria. | Choose an item. |
| | | |
| **Vertical Alignment** | | |
| Vertical Grade | Meets minimum and maximum design criteria. | Choose an item. |
| Minimum Tangent Between Curves | Tangents between curves meet minimum agency standard. | Choose an item. |
| Kinks in Alignment | Alignment has no kinks and has a consistent continuity. Complex elements do not double back. | Choose an item. |
| Minimum Curve Length | Curve lengths meet minimum design criteria. | Choose an item. |
| Curve K-value | K-values meet minimum design criteria. | Choose an item. |
| | | |
| **Cross-Sectional Elements** | | |
| Earthwork Layer Depths | Modeled layers of earthwork reflect depths of surveyed soil layers (i.e., topsoil depth, select backfill soil layers, etc.). | Choose an item. |
| Pavement Thickness / Aggregate Depths | Pavement thickness and aggregate depths meet the design criteria. Templates are consistent with design. | Choose an item. |
| Component Widths | Pavement lane widths for corridor and shoulders meet the design criteria and typical sections. | Choose an item. |
| Lane Cross-Slopes and Rollovers | Cross slopes and rollover criteria meet the design criteria. | Choose an item. |
| Sideslopes | Foreslopes and backslopes within the model meet the design criteria. | Choose an item. |
| Gore Cross-Slope | Gore area cross-slope and rollover criteria meet the design criteria. Corridors match in modeled transition area. | Choose an item. |
| Backslope (Top) to ROW | The top of backslope to proposed ROW is displayed in model. | Choose an item. |
| Pavement Flat Spots | There are no flat spots within the corridor (potential risk of ponding). Profiles, SE transitions and grading coincide to have positive drainage. | Choose an item. |

| Category | Documentation/Task | Verified |
|---|---|---|
| Transitions | Transition cross-sectional element elevations from corridor-to-corridor and/or template to template match. | Choose an item. |
| Ancillary Roadway Features | Intersections, driveway aprons, sidewalks, median crossovers, and bike paths have adequate slopes. The intersection between each main road and ancillary feature transition is smooth and aligned in model. | Choose an item. |
| Guardrail / Barriers / End Terminals | Guardrail / barriers / end terminals meet the design criteria. | Choose an item. |
| Underdrain Locations | Model shows pipe underdrains below surface at aggregate. | Choose an item. |
| | | |
| **Curb & Gutter** | | |
| Dimensions | Width of the curb and gutter system meets the design criteria and report. | Choose an item. |
| Transition | Foreslope, backslope and longitudinal slope meet minimum design criteria and report. | Choose an item. |
| Curb Types | Correct curb type modeled, curb slopes towards storm structures (i.e., catch basin). | Choose an item. |
| | | |
| **Utilities** | | |
| Conduit Locations | Existing and proposed underground utilities are modeled so that underground conflicts can be identified. | Choose an item. |
| Consistency | Utility depths meet the design criteria and the model does not extrude from below the surface. | Choose an item. |
| SUE Model | Existing underground utility locations are shown. | Choose an item. |
| | | |
| **Pipes & Structures** | | |
| Rim Alignment | Rims are aligned with surface model. | Choose an item. |
| Structure Components | Drainage structures have the correct components shown. Endwalls (if present) are accurately modeled. | Choose an item. |
| Connection Points | Pipe connections to structures are located correctly. Slope direction is correct. | Choose an item. |
| Pipe Continuity | Pipe’s end at the outer edge of the structure is in line instead of extending past the structure’s wall. | Choose an item. |
| Pipe Types and Sizes | Pipe type and size meet the design criteria and drainage report. | Choose an item. |
| Pipe Slopes | Pipe slope percentage meets minimum design criteria. | Choose an item. |
| | | |
| **Culverts** | | |

| Category | Documentation/Task | Verified |
|---|---|---|
| Dimensions | Culvert depth and widths are in coordination with load calculations. Design meets hydraulic size requirements from drainage report. | Choose an item. |
| Embedment Depth | Buried depth incorporated based on perennial stream type. | Choose an item. |
| Top of Culvert | Top of culverts are below the pavement surface. No elements overlap the pavement. Minimum cover requirements are met. | Choose an item. |
| | | |
| **Ditches** | | |
| Dimensions | Open channel flow ditch area meets the design criteria and drainage design calculations. | Choose an item. |
| Ditch Material | Utilized proposed erosion control measures and material types. | Choose an item. |
| Slope | Foreslope, backslope and longitudinal slope meet minimum design criteria and report. | Choose an item. |
| Location | Ditches are provided in areas where standing water is likely to occur. | Choose an item. |
| Special Ditches | Special ditches are displayed and profiled. They should target the correct profile and tie into adjacent grading. | Choose an item. |
| Side Slope Transitions | Slope transition over traversable distance meet Roadside Design Guide standards. | Choose an item. |
| Sideslopes | Foreslopes and backslopes meet the design criteria. | Choose an item. |
| | | |
| **Retaining Walls *(Permanent and Temporary)*** | | |
| Dimensions | Depth and widths of retaining wall(s) and associated appurtenances (i.e. railings) meets the design criteria. | Choose an item. |
| Top of Wall with Surface Transition | Length along the top of retaining wall is accurate, per tie-ins and quantities. | Choose an item. |
| Earthwork | Appropriate material defined for wall type(s). | Choose an item. |
| | | |
| **Noise Abatement Walls** | | |
| Dimensions | Depth and widths of noise abatement wall(s) meets the design criteria. | Choose an item. |
| Height | Height of noise abatement wall(s) meets the design criteria and is coordinated with surface model. | Choose an item. |
| | | |
| **Bridges (ORD)** | | |

| Category | Documentation/Task | Verified |
|---|---|---|
| Geometry | Stations and profile grade line (PGL) elevations of approach bents, abutments, and piers align. Span lengths, bridge widths, skew angles, and radius of curvature matches the bridge plans. | Choose an item. |
| Vertical and Horizontal Clearance Under Bridges | Horizontal and vertical curve data match the alignment calculations and associated data. | Choose an item. |
| Approach Slab Extents | Approach slab extents and depths match the bridge plans. The slabs are vertically aligned with top of pavement surface model. | Choose an item. |
| | | |
| **Bridges (OBM)** | | |
| Abutment Geometry | Abutment cap beam dimensions match the bridge plans. Cap beams are supported by piles. Backwall dimensions align (if applicable). | Choose an item. |
| Pile Definitions | Pile type, depths, embedment's, orientation, batter, and spacing match the bridge plans. Existing piles are shown in the model. No conflicts shown between existing and new piles. | Choose an item. |
| Drilled Shaft Definitions | Drilled shaft diameter and top of drilled elevation match the bridge plans. Drilled shaft reinforcement size, spacing, hooks, conflicts, and connections align with column / footing. | Choose an item. |
| Foundation Geometry | Foundation size and depths match the bridge plans. Bottom of foundation is below frost depth specified in structure design manual. Reinforcement size spacing and any conflicts with piles / drilled shafts is documented. | Choose an item. |
| Pier Geometry | Pier geometry, type, dimensions match the bridge plans. No overlapping modeled elements. | Choose an item. |
| Parapet Dimensions | Parapet dimensions match the bridge plans. | Choose an item. |
| Deck Geometry | Top of deck at PGL is at the same elevation as the profile grade line. Deck cross slope, width and thickness matches the bridge plans. | Choose an item. |
| Girder Definition | Girder's material (steel, concrete), shape (I-girder, box-girder, etc.) spacings, and overhang dimensions match the bridge plans. Spot check flange and web dimension to ensure conformance with the bridge plans. Girders are connected to slab through haunch and sit on top of bearings. | Choose an item. |

| Category | Documentation/Task | Verified |
| --- | --- | --- |
| Diaphragms / Cross-Frames | Material, type, and size match the bridge plans. Spot check spacing of diaphragms to ensure conformance with the bridge plans. | Choose an item. |
| Bearings | Bearings are modeled to the width and length specified in the bridge plans. Spot check the bearing height and pedestal elevation. | Choose an item. |

# APPENDIX F BIM EXECUTION PLAN FORM (FOR REFERENCE)

# BIM EXECUTION PLAN

[Date]

Contract No.: [PSB xx-x] [contract number]

Prepared by [firm name] for the
Illinois State Toll Highway Authority

[NOTES: throughout document, items in RED are what will need to be adjusted as necessary. Blank tables will need to be filled in by contracted prime firm/entity. Cover page graphic is NOT restricted to be shown as displayed in template. Once these are accounted for, please delete this note.]

# Table of Contents

# 1.0 INTRODUCTION/OVERVIEW

To successfully implement Building Information Modeling (BIM) on this project, the following detailed BIM Execution Plan has been developed. This execution plan is a guide developed specifically for this project to define BIM uses and the procedures for executing each use, roles and responsibilities, model structure, quality control procedures, and deliverables.

## 1.1 BIM GOALS/OBJECTIVE

The primary goal of BIM is to streamline the project delivery process using the model as a legal document.

# 2.0 PROJECT INFORMATION

- **Project Owner:** Illinois Tollway
- **Project Name:** [project name]
- **Project Number:** [PSB xx-x] [contract number]
- **Contract Type/Delivery Method:** [x (i.e. Traditional, Design-Build, CMAR, etc.)]
- **Project Description:** [description (i.e. I-(xx) & (x) Road ramp addition)]

## 2.1 SCHEDULE AND MILESTONES

| Project Phase/Milestone | Estimated Start Date | Estimated Completion Date |
|---|---|---|
| **Concept Design (30%)** | | |
| **Preliminary Design (60%)** | | |
| **Pre-Final Design (95%)** | | |
| **Final Check (100%)** | | |

# 3.0 PROJECT CONTACTS

## 3.1 PROJECT CONTACTS

| Role | Name | Company | Email | Phone Number |
|---|---|---|---|---|
| **Project Manager** | | | | |
| Project Engineer | | | | |
| Lead Roadway Engineer | | | | |
| Lead Structural Engineer | | | | |
| Document Control Coordinator | | | | |
| QC/QA Roadway | | | | |
| QC/QA Structures | | | | |

## 3.2 DESIGN TEAM PROJECT CONTACTS

| Role | Name | Company | Email | Phone Number |
|---|---|---|---|---|
| **Project Manager** | | | | |
| Project Engineer | | | | |
| Lead Civil/Roadway Engineer | | | | |
| **Lead BIM Modeler** | | | | |
| Lead Drainage Engineer | | | | |
| Lead Structural Engineer | | | | |
| Document Control Coordinator | | | | |
| Geotechnical Lead | | | | |
| Erosion Control and Landscaping | | | | |
| Environmental Lead | | | | |
| Survey Lead | | | | |

# 4.0 MODEL STRUCTURE

## 4.1 FILE NAMING STRUCTURE

All model files will follow the file naming convention outlined in the current Illinois Tollway Computer Aided Design and Drafting (CADD) Standards Manual.

## 4.2 MODEL STRUCTURE/BREAKDOWN

The model for the site will be broken down into segments as follows. See attached exhibit (x) for a visual of the model breakdown.

| Model Type | Description |
|---|---|
| Grading/Surface | Describe what files will be included in surface model (i.e. existing grounds, proposed, environmental, etc.) |
| Roadway Pavement | Describe what files will be included in roadway model (i.e. direction of travel, corridor, etc.) |
| Alignment | Describe what files will be included in roadway model (i.e. direction of travel, corridor, etc.) |
| Drainage | Describe what files will be included in drainage model |
| Bridge | Describe what files will be included in bridge model |

## 4.3 NON-CONTRACTUAL ITEMS

Refer to the Level of Development (LOD) Appendix B from current BIM Implementation, Exhibit 1, for non-contractual items included in the electronic data files.

## 4.4 MODEL EXCLUSIONS

For objects that are excluded from the design model, refer to the LOD Tables (Exhibit 1).

## 4.5 MEASUREMENT AND COORDINATE SYSTEM

Imperial Units, Georeferenced Coordinates provided based on the NAD83 Illinois State Plane, East Zone Coordinate System

## 4.6 DIMENSIONAL TOLERANCES

The following elements will account for tolerances

[Insert table if applicable]

# 5.0 DELIVERABLES

| BIM Submittal Item | Stage | Format | Notes |
|---|---|---|---|
| 3D Engineered Models | Concept | .dgn | For reference only |
| 3D Engineered Models | Preliminary | .dgn | For reference only |
| 3D Engineered Models | Pre-Final | .dgn | For reference only |
| Surfaces<br>• Existing Ground<br>• Proposed<br>• Stripped<br>• Top of Clay<br>• Unsuitable Materials | Pre-Final | .dtm | For reference only |
| 3D Engineered Models | Final | .dgn | For reference only |
| Surfaces<br>• Existing Ground<br>• Proposed<br>• Stripped<br>• Top of Clay<br>• Unsuitable Materials | Final | .dtm | Signed and sealed as MALD |
| Alignments | Final | .dtm & .xml | Signed and sealed as MALD |
| Profiles | Final | .dtm & .xml | Signed and sealed as MALD |
| Surfaces<br>• Existing Ground<br>• Proposed<br>• Stripped<br>• Top of Clay<br>• Unsuitable Materials | Advertisement | .dtm | Signed and sealed as MALD |
| Alignments | Advertisement | .dtm & .xml | Signed and sealed as MALD |
| Profiles | Advertisement | .dtm & .xml | Signed and sealed as MALD |

[NOTE TO DSE: Refer to DSE Manual for assistance on file type deliverables. Once you do, you may delete this note]

# 6.0 QUALITY CONTROL

## 6.1 OVERALL STRATEGY / QUALITY CONTROL CHECKS

Quality Control and Assurance strategies are utilized to prevent, detect, and correct problems in the quality of services provided for this project. The following checks will be performed to assure quality throughout the project.

| Checks | Definition | Responsible Party | Software Program | Frequency |
|---|---|---|---|---|
| **Visual Check** | Verify that there are no unintended model components and the design intent has been followed. | | | At each submittal |
| **Design Criteria Check** | Verify that the design models follow the design manual guidelines | | | At each submittal |
| **Interference Check** | Detect problems in the model where two elements are clashing, including soft and hard conflicts. | | | At each submittal |
| **Model Integrity Check** | Verify no incorrectly defined or duplicated elements. | | | At each submittal |

## 6.2 QUALITY REPORTING REQUIREMENTS

The quality control process should be documented using the 3D Model Review Checklist provided in the exhibits.

# 7.0 EXHIBITS

1. Level of Design (LOD) Table [Attach Appendix B from BIM Manual]
2. Site Exhibit/Model Breakdown [Attach aerial map of area of work]
3. 3D Model Review QA/QC Checklist [Attach Appendix E from BIM Manual]
4. [Other Exhibits as required]