Texas Department of Transportation

Digital Delivery Program

Model Development Standards (MDS) Guidance

DRAFT- April 2025

This documentation is in draft form and is currently being piloted by TxDOT's Digital Delivery Program. For any questions, comments, or feedback please send to digital-delivery@txdot.gov.

Texas Department of Transportation

Contents

Chapter 1
Introduction

Purpose of the Document

In 2018, Texas Department of Transportation (TxDOT) established the expectation of 3D design models on roadway and bridge projects and reiterated in the 2022 Expectations Memo. TxDOT's Digital Delivery Program developed this document as part of its initiative to standardize advanced 3D modeling and provide data-rich designs through model deliverables for letting, construction, maintenance and planning.

This document provides guidelines on the development and delivery of models, also known as digital design files, and data by defining Level of Development (LOD) and detailed modeling guidance. Models have various use cases such as model-based quantity take-offs, interdisciplinary clash detection, communication of design intent, model-based construction methods such as automated machine guidance (AMG), and asset management.

The Model Development Standards (MDS) strives to create consistent modeling practices in order achieve the benefits identified in FHWA's Advancing BIM for Infrastructure: National Strategic Roadmap:

1. **Time savings** through improved collaboration, faster quantity determination, reduced time and effort to prepare bids, and faster construction due to automation of equipment.
2. **Lower transaction costs** through lower bids due to improved communication of design intent, reduced number of change orders due to improved clash detection analysis, design maturity, and constructability assessments, as well as early identification of errors and omissions.
3. **Risk mitigation** through improved construction interfacing and planning. Models have various use cases such as model-based quantity take-offs, interdisciplinary clash detection, communication of design intent, model-based construction methods such as automated machine guidance (AMG), and asset management.

Background

The April 2025 release of this document focuses roadway, drainage, and traffic model elements with additional disciplines forthcoming. The development of modeling guidance & LOD designation was prioritized based on various factors such as:

- Capability of the TxDOT CAD workspace for modeling with 3D dimensional confidence.
- Known risks and/or opportunities for advanced modeling requirements that reduce errors and omission and result in accurate and consistent models.
- Design elements within the model can be used for letting, construction, or asset management.
- Coordination with adjacent TxDOT initiatives.

The detailed modeling guidance in Chapter 3 will change as the TxDOT CAD workspace evolves with additional model capabilities, lessons learned from pilot projects are incorporated, and new agency requirements.

Table 1.1 provides a summary of the progress of each discipline to define LOD for their associated model elements in the LOD spreadsheet as defined in Chapter 2. The disciplines have been organized based on TxDOT's PS&E Prep Manual and the Digital Delivery Program's working groups.

Table 1.1 Status of Guidance Development by Discipline

Discipline	TxDOT Spec Item Group(s)*	LOD Spreadsheet Status	Development Notes
Traffic Control	500	Complete	Future pilot investigation is needed to determine phased modeling requirements.
Roadway	100, 200, 300, 500	Complete	Detailed modeling guidance provided in MDS draft.
Retaining Wall	400	In Progress	
Drainage	400	Complete	Detailed modeling guidance provided in MDS draft.
Utility	400, 600	Complete	
Bridge	400	In Progress	
Traffic	600	Complete	Future pilot investigation is needed to determine phased modeling requirements.
Environmental	100	Complete	
Landscape	100, 500	Complete	
Survey			Refer to TxDOT's Surveyor's toolkit for modeling requirements

**Lists the common Spec Item Group(s) associated with a given discipline and may not be all inclusive of applicable spec items.*

Model Deliverables

The TxDOT Digital Delivery Program is transitioning traditional project delivery to digital delivery methods with the *models as the legal document* (MALD). Select TxDOT projects will be designated to have model deliverables provided to the contractor for use at letting and construction.

TxDOT will incrementally move towards Digital Delivery through these steps:

1. **Internal quality review of models** to provide feedback to district and design teams on areas to improve and inform the Digital Delivery Program on additional training and process improvements.
2. **Interim model deliverables as for-information-only (FIO)** will apply to select projects and select model files with a focus on providing the contracting community access to model files for letting. Refer to TxDOT's Digital Delivery QC Checklist and Instructions for the list of model deliverables required.
3. **Model deliverables as for-information-only (FIO)** will incorporate step 2 with addition of a 3D review solution for TxDOT Plan Reviewers and the use of this document to develop model deliverables.
4. **Models as the legal document (MALD)** on select projects.

The LOD spreadsheet will be a communication tool to assist in the model delivery process in conjunction with digital signing and sealing best practices.

References

This document defines specific requirements for creating design model elements. It is used as a supplement document to the current general project delivery references.

General Project Delivery References

This document complements other TxDOT publications and provide additional context to define specific requirements related to digital delivery and 3D modeling standards. Existing TxDOT publications are the primary reference for any information relating to design standards and specifications, procedures, or deliverables, unless explicitly identified as a deviation in this guideline. Examples of these types of resources are linked in Appendix A.

TxDOT Digital Delivery Website

For additional communication, resources, and information on the program, visit the TxDOT Digital Delivery Program website.

Glossary of Common Terms

Note: Many terms and acronyms are used throughout this document that may not be familiar. Please refer to the TxDOT’s Digital Delivery Glossary as needed.

Chapter 2
Level of Development (LOD)

LOD Introduction

Level of Development (LOD) is intended to be used as a communication tool for designers and contractors to set clear expectations on the dimensional and information confidence of a given model element and the dependency on additional details required for construction. LOD is a way to manage risk by transparently conveying confidence and accuracy during the letting process and standardize modeling practices during design development.

In TxDOT's LOD Spreadsheet a Model Element Breakdown (MEB) groups model elements corresponding to TxDOT's specifications. Design teams should refer to the LOD spreadsheet during model development to ensure model elements meet minimum LOD and provide project specific documentation to the contractor when model files are included as part of the construction package.

For additional information on the history and background national LOD practices, see Appendix A for references to AASHTO and Pooled Fund guidance.

Table 2.1 defines LOD to generally clarify the following characteristics:

- The dimensional representation of an object (2D/3D)
- Measurement attributes (size, shape, orientation, bid code, specification number)
- Reliability of how it interfaces with other objects
- Exchange Information Requirements typically included as properties and attributes
- Element Analysis
- Fabrication Information as applicable

Table 2.1 – LOD Definition Matrix

LOD	LRS Location	2D Planar Location	3D Location	Size	Shape	Orientation	Interfaces with other objects (Parametrics)		Fabrication Information	As-Built Information	Exchange Information Requirements	Element Analysis
							External	Internal				
400	•	•	•	•	•	•	•	•	•		•	•
300	•	•	•	•	•	•	•				•	•
200	•	•		•	•	•					•	•
100	•										•	

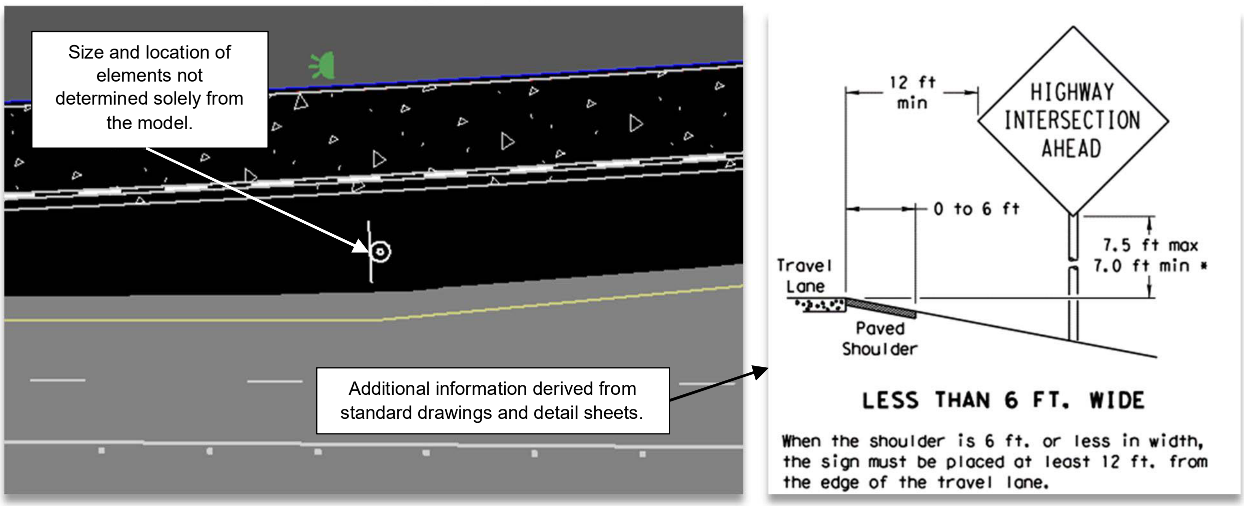
It is important to understand that LOD is NOT:

- Only level of detail
- Only about geometry
- Only accuracy
- A measure of quality
- An excuse to deliver less when you have more

LOD 100

The modeled element is graphically represented in the model as a generic line, point, symbol typically derived from a Linear Referencing System (LRS) database. Size, shape, and orientation cannot be derived reliably from the model. Only historical agency asset information is included in the element and does not include analysis.

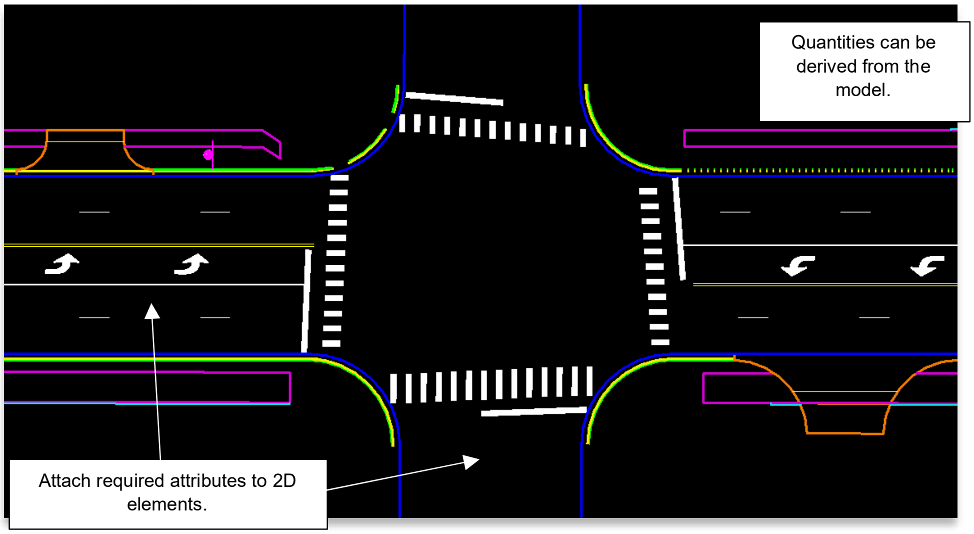
Figure 2.1 – Graphical Example for LOD 100 Design Element (Signing)



LOD 200

The modeled element is graphically represented within the model as a specific system in the 2-dimensional plane. Size, shape, and orientation can be derived directly from the modeled element in **two dimensions** with minimal need for notes or dimensions. Some of the agency's exchange information requirements are included as noted in the element and may include analysis.

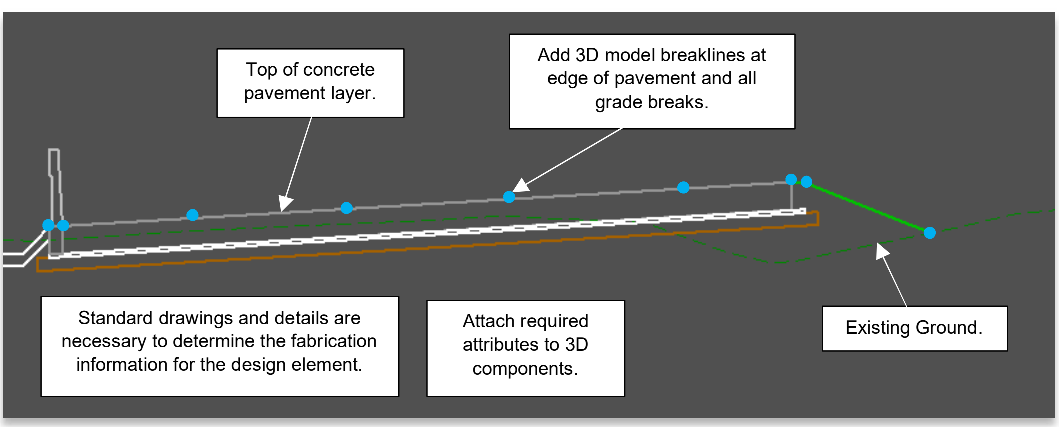
Figure 2.2 – Graphical Example for LOD 200 Design Element (Traffic)



LOD 300

The modeled element is graphically represented within the model as a specific system in the 3-dimensional plane. Size, shape, orientation, and interfaces with other external objects can be derived directly from the modeled element in 3 dimensions. The agency's exchange information requirements are included as noted for the element and includes typical standard of care analysis for that element.

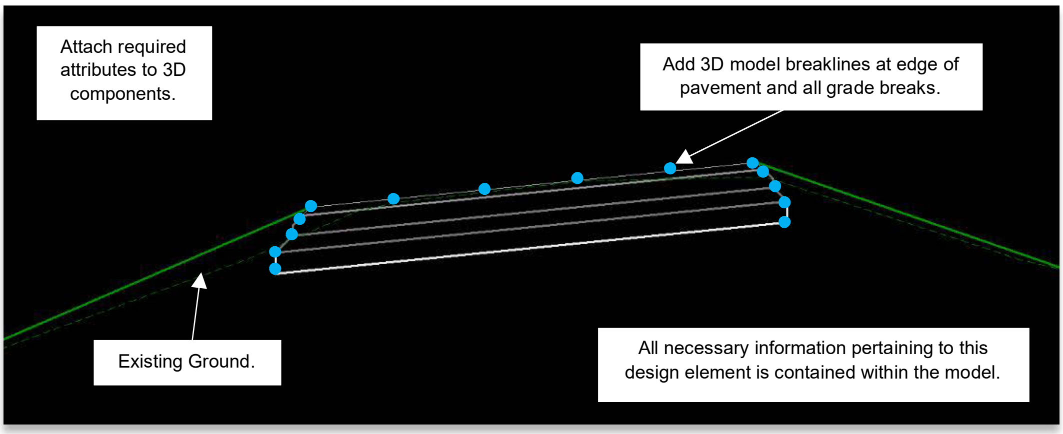
Figure 2.3 – Graphical Example for LOD 300 Design Element (Roadway)



LOD 400

The modeled element is graphically represented within the model as a specific system in the 3-dimensional plane. Size, shape, orientation, interfaces with other internal and external objects, and fabrication instructions can be derived directly from the modeled element. The agency’s asset information requirements are included for the element.

Figure 2.4 – Graphical Example for LOD 400 Design Element (Flexbase)



Chapter 3
Modeling Guidance

General Information

General Notes

Model elements include any project features designed in CAD software such as 2D geometry, 3D geometry, or a combination of both. These model elements are created using the TxDOT CAD workspace configuration. Items considered 2D geometry include 2D cells, lines, and polygons. Items considered 3D geometry include alignments with vertical profiles, 3D model breaklines, 3D components and objects, and surfaces created from design modeling tools, solids, and 3D cells and line styles.

The TxDOT Digital Delivery website offers additional training resources for modeling and project delivery. This document was developed to accompany TxDOT's Digital Delivery Toolbox which includes but is not limited to: Digital Delivery QC guidelines, 3D Model Breakline creation process, discipline-specific design guidance, and workspace set up.

Item Types

The TxDOT workspace has developed Item Types which are a Bentley Design Software tool that can be used to attach design data to elements in DGN files. Item Types attribute model elements with data to communicate the design intent and pay item information associated with the feature. Currently, the minimum data guidelines for model elements is focused solely on the bid code information. Additional data requirements will evolve through the asset management and the development of a comprehensive data dictionary.

Corridor Modeling Requirements

Any model element created from a corridor modeling template is accurate only at the specific template drop location. The template is applied perpendicular to the alignment, and the modeling software interpolates proposed conditions between template drops. Therefore, it is important to note that any interpolated data such as ties to existing ground might not be correct between template drops.

Corridor modeling may be used for a variety of design applications including but not limited to:

- roadway pavement and ditch design
- drainage channel and pond design, and
- structural retaining walls and bridge design.

The information in Table 3.1 provides general standards for corridor modeling for final design deliverables.

Table 3.1 – General Guidelines for Corridor Modeling

Situation	Minimum Modeling Requirements
Corridors	Template drops: 10 feet
Horizontal and Vertical Curves	Stroking tolerances (feet): Linear stroking = 10 Profile stroking = 0.07 Curve stroking = 0.07 **Note:** Template drops might occur too frequently depending on radii values. These tolerances may be modified at the discretion of the Engineer.
Critical Locations	Apply template drops to corridor region start/end, superelevation transitions, horizontal and vertical cardinal points, start/end of pavement tapers, start/end of side slope transitions, both sides of pedestrian accesses, and any additional key stations needed to clearly relay the design intent at the discretion of the Engineer.
Intersections	Apply template drops along curb returns between two and five feet, and where proposed pavement ties into existing conditions.

Corridor Templates

Corridor templates have been developed for roadway, drainage, and structure modeling. Roadway templates provide template points that are necessary to develop consistent 3D model breaklines. Standard structure and roadway templates allow designers to streamline 3D modeling by using typical geometry parameters. See TxDOT's OpenBridge Designer/Modeler Training Manual for additional bridge modeling requirements.

Model Development Characteristics

Table 3.2 identifies the model development characteristics and deliverable expectation for common model elements. At a minimum, the tables collectively denote the desired LOD and whether the element should be represented by the following geometry:

- top and/or sub-surface terrains,
- 3D Model Breaklines,
- 3D volume mesh,
- 3D cell,
- 2D lines or geometry,
- 2D shape or polygon.

The breakdown also identifies model elements that have additional modeling guidance provided in sections for Roadway Modeling Guidance and Drainage Modeling Guidance. Designers may find the need to develop elements beyond the minimum characteristics identified below.

Table 3.2 – General Model Development Characteristics

Model Element	Desired LOD	Top Surface	Subsurface	3D model Breaklines	Volume Mesh	3D Solid/Cell	2D Lines	2D Shape
Alignments	400	●		●			●	
ROW	200						●	●
Embankment	300			●	●			
Backfill	300			●	●			
Excavation	300			●	●			
Non-Reinforced Pavement	400	●		●			●	●
Reinforced Pavement	300	●		●			●	●
Surface treatments	200						●	●
Geotextile	200						●	●
Curb and Gutter	300	●		●			●	
Misc Flatwork	300	●		●			●	●
Granular Base	300		●	●				
Barrier	300	●		●			●	●
Fencing	200						●	●
Walls and Structures	300	●	●	●	●		●	●
Pond Design	400	●		●	●			

Table 3.2 – General Model Development Characteristics (continued)

Model Element	Desired LOD	Top Surface	Subsurface	3D model Breaklines	Volume Mesh	3D Solid/Cell	2D Lines	2D Shape
Storm Drain and Culverts	300					●	●	
Safety End Treatments and Headwalls	300					●		●
Manholes, Junction Boxes and Inlets	300					●		●
Riprap	200			*		*		●
Gabions	200			*		*		●
Excavation and Backfill for Structures	300			*				*
Trench Excavation Protection	200			*			●	
Adjusting Manholes and Inlets	100					**		●
Removing and Relaying Culvert	200						●	
Cleaning Existing Culverts	200						●	
Linear Drains and Pipe for Drains	200						●	
Drainage Removals	200			*			●	●

* When justified by complexity, constraints, or impacts.

** When included in hydraulic model

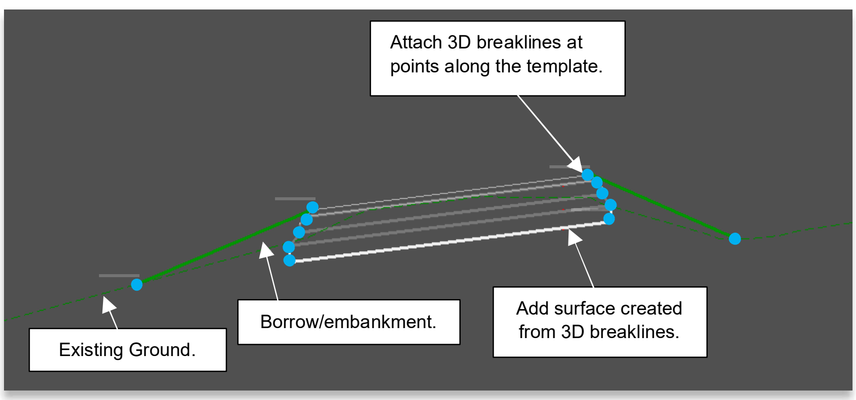
Roadway Modeling Guidance

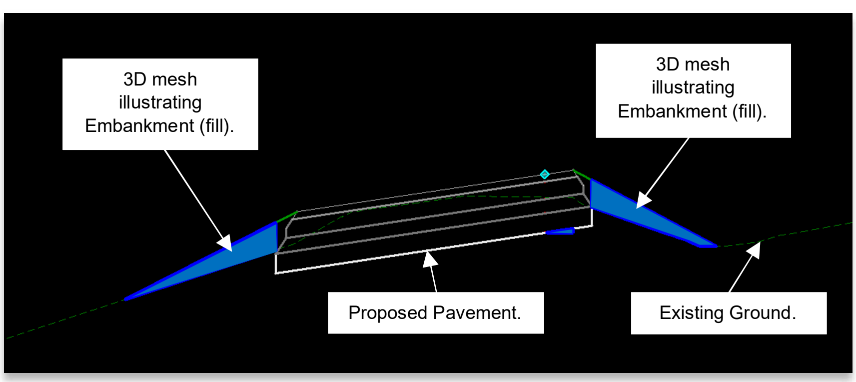
Embankment and Backfill

Embankment and backfill elements are developed during the corridor design using roadway design templates. The outputs from the design include 3D model breaklines and triangulated surfaces. Triangulated surfaces are used to measure quantities. All design elements under this work category are represented with a 2D polygon shape in the plan view and 3D model breaklines along the top of the model element.

- Represent points delineating the 3D mesh as 3D model breaklines along the subgrade surface.
- Design 3D model breaklines to delineate boundaries for generating the surface used for measuring volumes between the existing and proposed conditions.
- Remove existing pavement and stripping of topsoil if applicable.
- Represent the embankment for the structure with 3D model breaklines along the top of the model element.

Figure 3.1 – Modeling Criteria for Roadway Embankment and Backfill



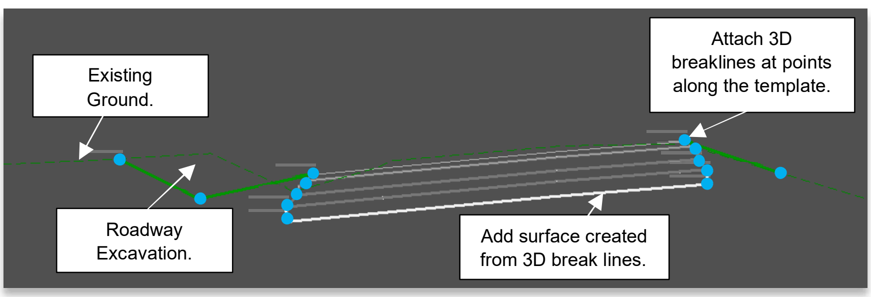


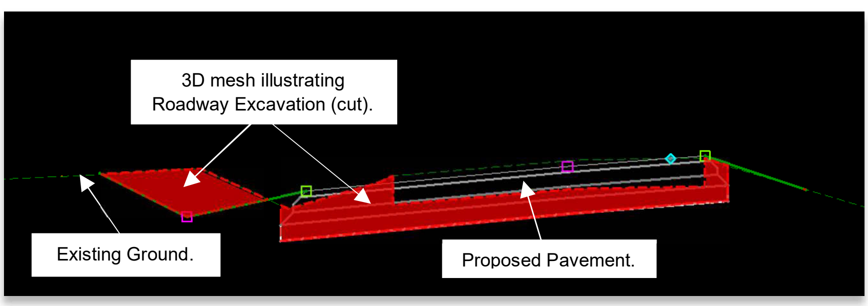
Roadway and/or Ditch Excavation

Roadway and ditch excavation design elements are developed during the corridor design using roadway design templates. The outputs from the design include 3D model breaklines and triangulated surfaces. Triangulated surfaces are used to measure quantities. All design elements under this work category are represented with a 2D polygon shape in the plan view and 3D model breaklines along the top of the model element.

- Show the outer linear limits (i.e., cut line) in the plan view to display the limits of roadway or ditch excavation.
- Exclude unusable material such as existing asphalt.
- Design 3D lines to delineate boundaries for generating the surface used for measuring volumes between the existing terrain and top of embankment for bridge.
- Remove existing pavement and stripping of topsoil if applicable.

Figure 3.2 – Modeling Criteria for Roadway and/or Ditch Excavation





Roadway Pavements

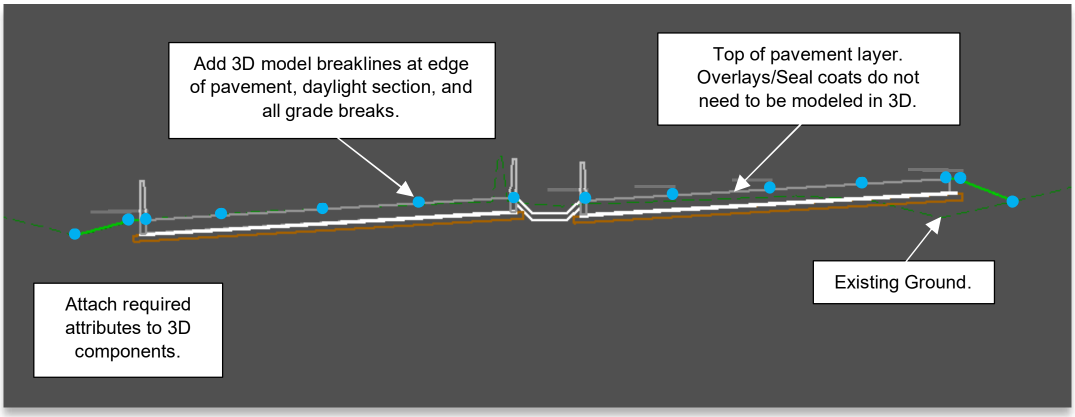
The elements described in this section include 2D and 3D model elements that define the roadway pavement structure, which includes traffic lanes and shoulder pavement layers as established by the pavement design and the typical sections.

Full Depth Pavement Materials

- Provide a 2D polygon shape in plan view from edge of pavement to edge of pavement (do not include the pavement wedge).

- Generate 3D model breaklines representing the edge of structural pavement and shoulder and each lane along the top of each pavement layer.

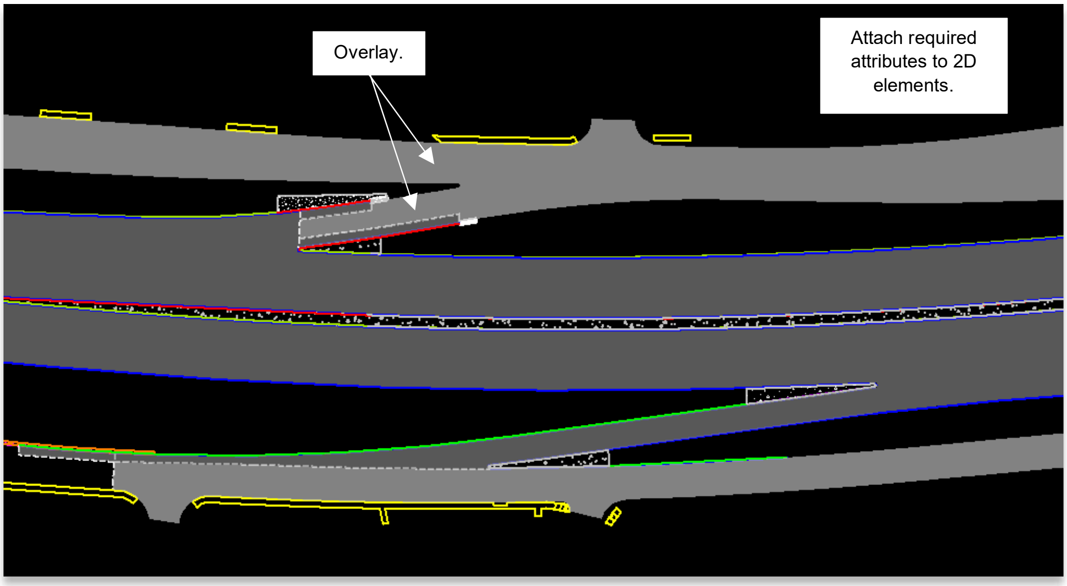
Figure 3.3 – Modeling Criteria for Roadway Full Depth Pavement



Overlay and Seal Coat Pavement Materials

These elements are designed as 2D model elements and define the roadway pavement surface area and length of road to be restored using a variety of pavement treatments. Attributes are attached to 2D geometry shown in the plan view.

Figure 3.4 – Modeling Criteria for Overlay and Seal Coat Pavement



Miscellaneous Concrete Flatwork

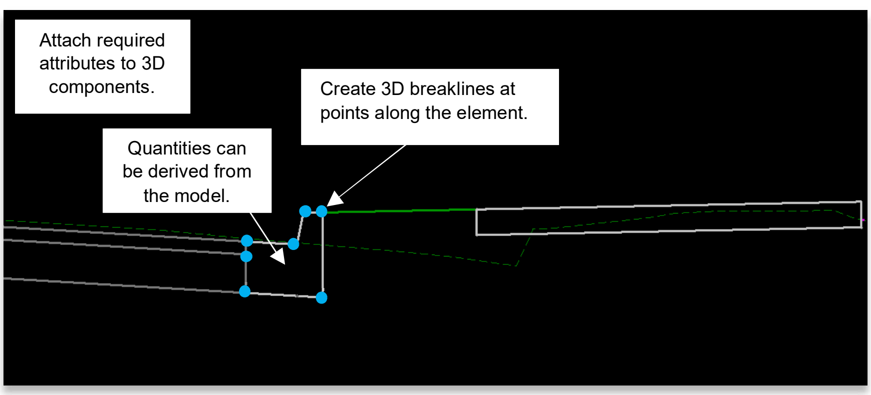
The elements described in this section include 2D and 3D model elements that define the flatwork components in specific lined ditches, sidewalks, miscellaneous flatwork, curb and gutter, and driveways as established by the typical sections. Flatwork elements are represented by the 3D model breaklines created as an output of the 3D points that define the component mesh.

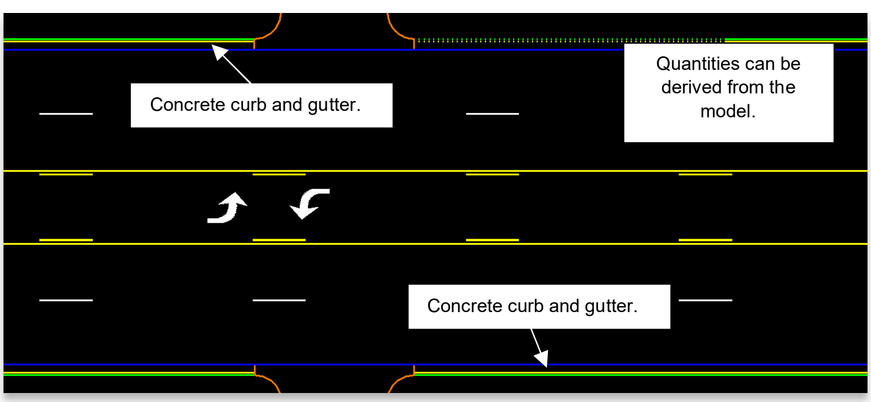
- Show the 2D lines in the plan view to display the exterior boundaries of the concrete flatwork.
- Use 3D model breaklines to represent the top of the concrete flatwork and untreated base course components.

Concrete Curb and/or Gutter

- Curb and gutter transitions through driveways and pedestrian ramps:
  - Use 3D components only to estimate quantities and determine feasibility.
  - Verify all dimensions, slopes, and elevations in the 3D model against standard drawings and construction specifications.
  - Provide details as needed for final construction documents.

Figure 3.5 – Modeling Criteria for Curb and Gutter

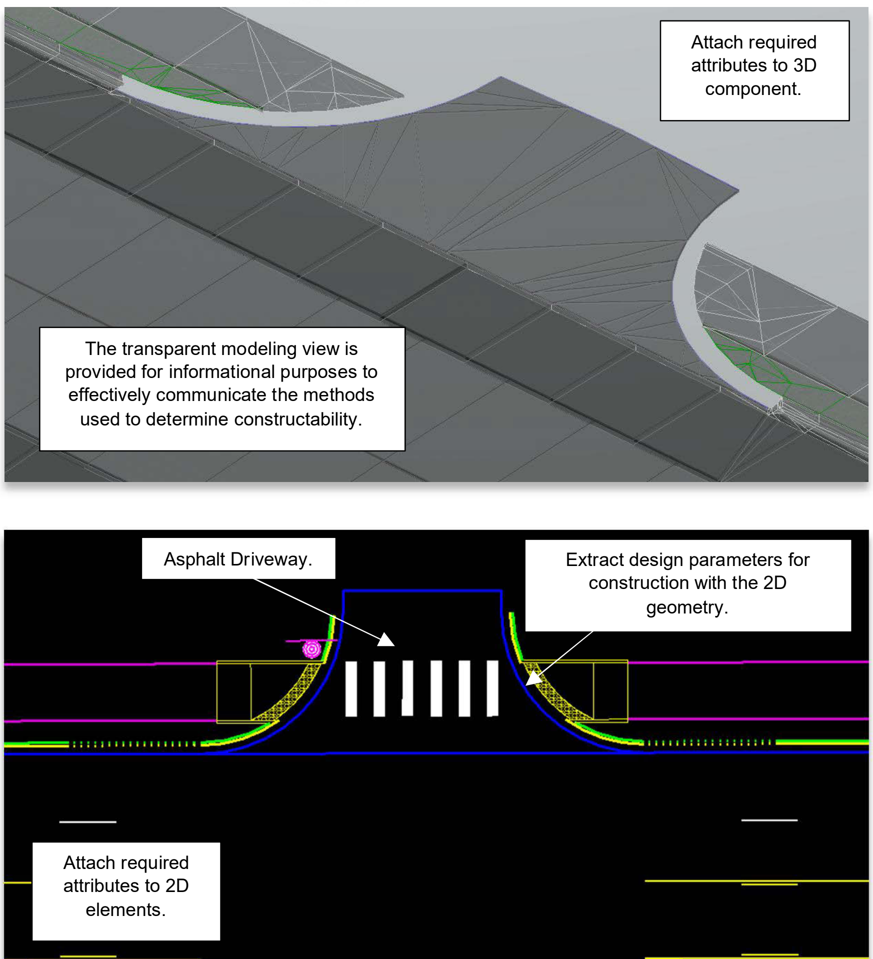




Driveways

- Provide all design parameters for construction in the 2D graphic.
- Use 3D components to estimate quantities and determine feasibility.
- Verify all dimensions, slopes, and elevations in the 3D model against standard drawings and construction specifications.
- Provide details as needed for final construction documents.

Figure 3.6 – Modeling Criteria for Driveways

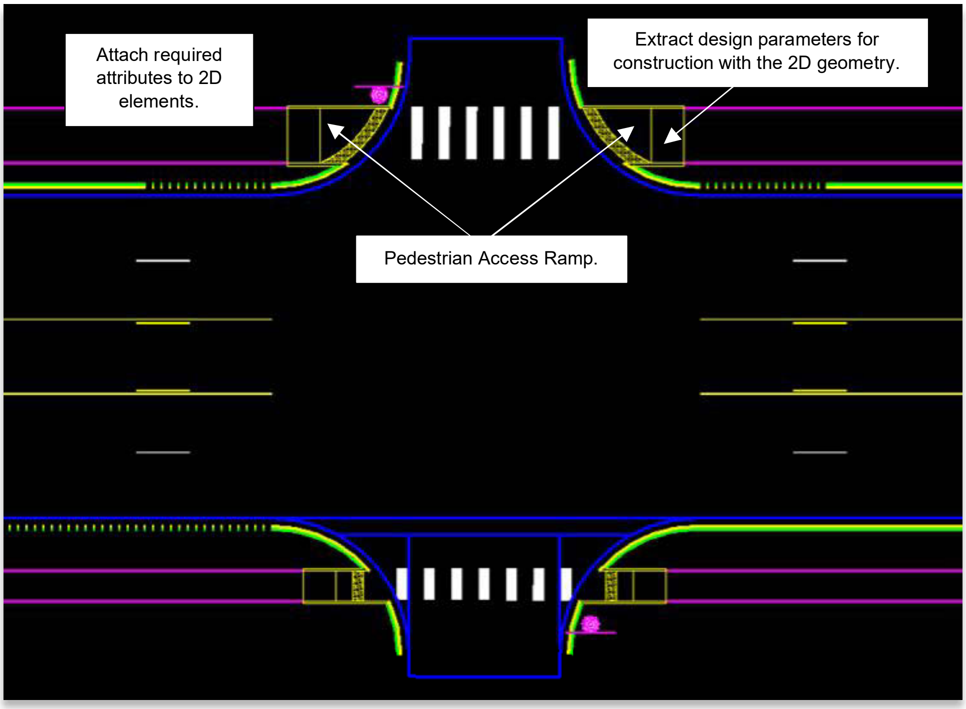


Americans with Disabilities Act (ADA) Pedestrian Access Ramps

ADA pedestrian access ramps are represented with 2D geometry in the plan view. These 2D lines delineate the boundaries used to measure areas and quantify items.

- Do not group elements. This creates a custom cell that often results in translation issues when converting between software platforms.
- Extract all design parameters from the 2D graphic.
- Use 3D components only to determine feasibility.
- Provide details as needed for final construction documents.

Figure 3.7 – Modeling Criteria for ADA Pedestrian Access Ramps



Removals

These model elements are represented with 2D geometry such as lines, cells, or polygons in the plan view. These 2D lines, cells, or polygons delineate or identify locations and are also used to measure areas or lengths and quantify items. Attributes are attached to 2D geometry shown in the plan view.

Drainage Modeling Guidance

Drainage Structures

Junction boxes, manholes, inlets, headwalls, and safety end treatments are Drainage & Utilities (DU) features represented by 2D and 3D cells. Drainage nodes are point features in the drainage database that contain many attributes and hydraulic analysis results.

Storm Drain Pipes and Culverts

Drainage pipes and culverts are DU features represented by 2D lines and 3D solids in ORD. Drainage conduits are features in the drainage database. Drainage conduits linear features in the drainage database that contain many attributes and hydraulic analysis results.

- Attribute culvert feature if it is required to be installed using trenchless installation methods (jacking, boring or tunneling).

Linear Drains

Slotted Drain

Slotted drains are DU node features represented as 2D and 3D cells and interception can be analyzed for flow capture.

Trench Drain

Trench drains are represented by 2D lines that are not DU features. The hydraulic analysis will need to be performed independent of ORD.

Riprap and Gabions

Riprap and gabions are represented by 2D polygons in the plan view. Attributes such as thickness are attached to the 2D polygon.

- If the location and impacts justify the need, then riprap and gabions can be represented as 3D solids.

Excavation and Backfill for Structures

If the location and potential impact justify the need or is excavation and backfill is a separate pay item than the drainage structure or pipe.

- Generate 3D model breaklines for the bottom of the excavation and top of cut.

Bridge Modeling Guidance

Bridge Division is excited to contribute to the Digital Delivery Program and has provided initial guidance below. Additional resources are currently under development and will be supplied when available. Please reach out for any support or questions in the interim

Bridge Modeling

Bridge Models are created in OpenBridge Modeler (OBM) then incorporated with the rest of the project in OpenRoads Designer (ORD) when complete. This Bridge Modeling Guidance serves to direct the user to OBM resources and specify the Bridge Digital Delivery program.

Open Bridge Modeler (OBM) Resources

The OBM Resources list can be found on the TxDOT 3D Bridge Modeling Site linked below.
https://www.txdot.gov/business/resources/highway/bridge/3d-bridge-modeling.html

Training

OpenBridge Designer/Modeler Training Manual

TxDOT Bridge Division developed the OpenBridge Designer/Modeler Training Manual to provide an explanation on how to create bridge models from start to finish. Some topics include.

- File Creation/Opening
- Creating a Bridge Model with Precast Girders
- Creating a bridge Model with Steel Girders
- Placing Riprap
- Generating Reports
- Creating and Manipulating Bridge Templates
- Sheet Creation
- Interoperability, assumptions and limitations with LEAP Concrete, LEAP Steel and RM Bridge Connect.

OBM Class

BRG300 is available as in person or self-paced class to supplement the OpenBridge Designer/Modeler Training Manual.

Contact for Questions/Information

Email ` for user questions/information related to OBM.

Appendix

Appendix A: List of References

TxDOT Digital Delivery Website

Roadway Design Manual

Hydraulic Design Manual

Bridge Project Development Manual

Bridge Detailing Guide

Project Development Process Manual

Plans, Specifications, and Estimates (PS&E) Manual

Access Management Manual

Landscape and Aesthetics Design Manual

TxDOT Roadway Standards

TxDOT Bridge Standards

TxDOT Traffic Standards

TxDOT OpenBridge Designer/Modeler Training Manual

TxDOT ORD – DU Introductions and Workflows

AASHTO's JTCEES Fundamental Level of Development Definitions

AASHTO's JTCEES Model Element Breakdown and Level of Development Intended Use

BIM for Infrastructure Transportation Pooled Fund

Appendix B: LOD History Memo

MEMORANDUM

Date: October 23, 2024

To: Jacob Tambunga, P.E.

From: Kimley-Horn and Associates

Topic: Level of Development (LOD) History

Overview

This document summarizes the historical developments related to Level of Development (LOD). The AASHTO JTCEES efforts started in 2018 working with ACEC, BIM Forum (representing AIA LOD Specification), vendors, and contractors to develop the AASTHO JTCEES LOD Fundamental Definitions. The AASHTO JTCEES determined that with the goal of Model as Legal Document (MALD) the BIMForum_LOD_2019 was primarily focused on geometric detail but did not adequately define information needs and the other needs required for linear elements. The AIA LOD Specification originated in 2008 with a primary focus on design-to-design collaboration and as supplemental information delivered to construction. The engineer/architect functioning as a 'master builder' similar to a Design Build (DB) contract is an important differentiation between the vertical industry and linear infrastructure. The development of Level of Information Need (LOIN) in the United Kingdom overlapped the AASHTO JTCEES LOD Framework documents and was subsequently incorporated into an ISO standard. In general LOIN was driven by the same need to incorporate information into the LOD.

The reference table on pages 5-11 provides a list of LOD references. The TxDOT Digital Delivery Program (DDP) team recognizes other organizations not included in this list may be contributing to these practices and will continue to collect related documentation.

National and International Developments

National and international findings are best for comparing approaches among the DOTs. Key national and international organizations that are informed and working on LOD related topics include:

- American Association of State Highway and Transportation Officials (AASHTO)
- ISO 19650 LOIN
- National Institute of Building Sciences (NIBS)
- BuildingSMART
- Highway Engineering Exchange Program (HEEP)

AASHTO's Joint Technical Committee on Electronic Engineer Standards facilitated the development of a LOD framework for agencies to use to help align LOD efforts around common fundamental definitions for transportation projects. The framework includes the following tools:

- AASHTO JTCEES LOD Status Report provides an explanation of the LOD framework tools.

- MEB and LOD Intended Use explains how the LOD framework is intended to be used.
- JTCEES LOD Fundamental Definitions provides an initial grouping of fundamental definitions as a starting point for states.
- JTCEES-ACEC MEB Template can be used as a starting point to communicate the LOD to a downstream user while also grouping elements into categories and classes.
- BIM for Infrastructure Webinar Series which includes a webinar on the Level of Development Document.

The ISO 19650 LOIN was developed in the United Kingdom around a mature BIM standard built around the Organizational Information Requirements (OIR). The following constructs support the OIR per ISO 19650:

- Asset Information Requirements (AIR) that relate to the operation and maintenance of an asset.
- Project Information Requirements (PIR) that contribute to
- Exchange Information Requirements (EIR) that relate to the information needs of a particular exchange (i.e. Design to Construction).

As noted previously the LOIN concept was developed in parallel with the AASHTO JTCEES LOD framework to incorporate the information needs into the geometric and accuracy needs of an element. As states mature through the FHWA Advancing BIM for Infrastructure National Strategic Roadmap it is anticipated that the above Information Requirements will become further developed and further clarify the AIR for a particular exchange or EIR.

NIBS has developed the updated NBIMS Version 4 that leans into the international concepts and separates LOD into level of accuracy, level of detail and level of information like the LOIN concept.

BIMFourm has become part of the Building Committee of the BuildingSMART USA chapter and continues to update and maintain their LOD Specification. The more recent LOD-Spec-2023 has incorporated some feedback from AASHTO JTCEES but was determined to still be challenging to provide Model asl Legal Document (MALD) deliverables. Further collaboration is anticipated as states pilot the AASHTO JTCEES LOD Fundamental Definitions.

State Developments

State specific LOD developments focuses on the implementation of LOD to support digital delivery standards developed by the DOT. These LOD developments provide a practical approach to communicating 3D modeling, digital delivery, digital construction, and asset management. The following states participated in the AASHTO JTCEES LOD:

- Arizona (ADOT)
- Connecticut (CTDOT)
- Florida (FDOT)
- Georgia (GDOT)
- Iowa (IowaDOT)
- Kansas (KDOT)
- Maine (MaineDOT)
- Michigan (MDOT)
- North Carolina (NCDOT)
- Pennsylvania (PennDOT)
- Tennessee (TDOT)
- Texas (TxDOT)
- Utah (UDOT)

A comparison was also performed to other states that are developing or have implemented LOD standards. The follow table summarizes those efforts and how they are communicated.

TxDOT Interpretation and Adjustments of JTCEES LOD Framework

LOD 100

Currently TxDOT has directly adopted the AASHTO JTCEES definition.

LOD 200

Currently TxDOT has directly adopted the AASHTO JTCEES definition.

LOD 300

Currently the AASHTO JTCEES phrase “without the need for plan sheet notes or dimensions” is omitted to allow for a degree of uncertainty in the z plane as the model maturity develops. The AASHTO JTCEES definition was intended to represent an agency that has reached a MALD maturity level 3 which is delivering contracts with minimal or no plans.

LOD 400

Currently the AASHTO JTCEES phrase “means and methods” is omitted to allow the contractor community to determine the necessity through pilot projects. This phrase was included in the AASTHO JTCEES definition to show a higher level of maturity when LOD 400 is provided.

LOD 500

Currently TxDOT does not include this level.

Conclusion

Throughout the industry, there are numerous efforts to advance LOD as a communication tool as agencies advance through Digital Delivery with a focus on feeding Asset Management. At a national and international level, existing AASTHO, federal, state and industry guidance as well as the ongoing TPF projects will serve as a link between TxDOT’s program goals and national best practices. As a member of AASHTO JTCEES, TxDOT has based their initial LOD on the AASHTO JTCEES Fundamental Definitions.

The research collected in this memo will serve as the foundation for developing a standard Level of Development (LOD) for digital delivery workflows as part of the TxDOT Digital Delivery Project.

References

Agency	Org. Level	Document Name	Source	Website	Description
AASTHO	National	JTCEES LOD Fundamental Definitions	Website	Link	Provides an initial grouping of fundamental definitions as a starting point for states.
AASTHO	National	JTCEES LOD Status Report	Website	Link	Provides an explanation of the LOD framework tools.
AASTHO	National	JTCEES MEB and LOD Intended Use	Website	Link	Explains how the LOD framework is intended to be used
AASTHO	National	JTCEES-ACEC MEB Template	Website	Link	Can be used as a starting point to communicate the LOD to a downstream user while also grouping elements into categories and classes.
AASTHO	National	JTCEES MEB and LOD Intended Use	Website	Link	Explains how the LOD framework is intended to be used

Agency	Org. Level	Document Name	Source	Website	Description
AASHTO	National	AASHTO's Joint Technical Committee on Electronic Engineering Standards	Website	link	AASHTO's Joint Technical Committee on Electronic Engineering Standards Mostly webinars and DOT information from 2021-2022, good resource (similar to FHWA's) on the development of BIM/LOD/DD processes and tools
BIMForum	National	BIMForum_LOD_2019	Website	BIMForum_LOD_2019	Version of the AIA and BIMForum LOD Specification originally referenced during development of the AASHTO JTCEES LOD Fundamental Definitions.
buildingSMART USA BIMForum	National	LOD-Spec-2023-Part 1	PDF	LInk	Current version of the BIMForum LOD Specification used by the vertical industry
FHWA	National	FHWA Advancing BIM for Infrastructure National Strategic Roadmap	PDF	Link	National Strategic Roadmap for states to use as the mature in BIM for Infrastructure.

Agency	Org. Level	Document Name	Source	Website	Description
NIBS	National	NBIMS Version 4	Website	Link	Current version of the NBIMS standards and guidance that can be used for the adoption of BIM practices.
TRB	National	3D Models for Contract Documents	PDF	link	Identified DOTs that are using 3D models and how.
United BIM	National	LOD Definitions	PDF	link	Level of development for model elements
HEEP	International	HEEP's Training Resources - Webinars	Website	link	Presentations on the advances in DD and BIM services. Data Standardization, DD, etc.

Agency	Org. Level	Document Name	Source	Website	Description
HEEP	International	3D Models as Legal Documents and Open Data Standards: Paving the Way Forward to Digital Delivery	PDF	link	Benefits of BIM. IFC adoptions. BIM for Infrastructure Pooled Fund. States with MALD.
CALTRANS	State	Project Delivery (PD) Directives	Website	link	Caltrans webpage on Project Delivery Directives; issued to provide direction and guidance on project delivery policies, standards and best practices.
FDOT	State	FDOT Digital Delivery Training Manual	PDF	link	Digital Delivery Program and Process. Digital Certificate
IowaDOT	State	3D Model-based Planning-Design-Construction-O&M for Transportation Project Delivery: Structures Perspective	PDF	link	Transition to 3D based delivery, Road & Bridge Design Best Practice Workflows, project implementation, CIM 3D Modeling

Agency	Org. Level	Document Name	Source	Website	Description
IowaDOT	State	BIM for Bridges and Structures	Website	link	The purpose of the TPF-5(372) BIM for Bridges and Structures Pooled Fund.
IowaDOT	State	Statewide Strategy for Digital Delivery of Infrastructure	Website	link	Focus on developing consistent digital deliverables, supporting new tools, leveraging existing technology, managing assets, and implementing data management processes
IowaDOT	State	Creating New Open Standards to Allow for Widespread Use of BIM in the U.S. Bridge Industry	Website	link	Developing a process and standards for designers to export their plans and pass to contractors
MDOT	State	BIM for Infrastructure – Michigan DOT's Path to Digital Delivery	PDF	link	Presentation on MDOT's DD efforts; includes level of development, software needs, model details/information provided to contractor, etc.

Agency	Org. Level	Document Name	Source	Website	Description
NYSDOT	State	NYS DOT Delivers First Model-based Contracting 3D Project in Its History; Delivered the Project Under Budget and Restored a Critical Bridge to the Community	Website	link	New York State DOT's success with Digital Delivery and construction on NYS Route 28
NYSDOT	State	East 138th Street Bridge Replacement Project: A Marriage of ABC and Digital Delivery at NYSDOT	Website	link	BIM contracting to design and successfully bid the project with information models as the legal contract document
PennDOT	State	Digital Delivery Directive 2025	Website	link	Overview of Digital Delivery initiative by 2025; webpage discusses design quality improvements, reduced risks, costs and delays, construction efficiencies and improve as-builts
PennDOT	State	Digital Delivery Directive 2025 Final Strategic Plan	PDF	link	This strategic plan to implement the processes, technology, and workforce development needed to execute the Digital Delivery Directive 2025 (3D2025).

Agency	Org. Level	Document Name	Source	Website	Description
PennDOT	State	PennDOT Digital Delivery Directive 2025	Website	link	Strategic Planning, Development and Deployment.
PennDOT	State	Transportation's Digital Design Future - Lessons from PennDOT's Digital Delivery Directive 2025 Initiative	Website	link	Article discussing the benefits and challenges of PennDOT's DD initiative, and the national shift toward Digital Delivery and data/asset management
UDOT	State	UDOT Model Development Standards	PDF	link	Model development and delivery standards for roadway design.
UDOT	State	LOD Standards Spreadsheet	Excel	link	Standards level of development (LOD) for design elements.