



COMPUTER AIDED DESIGN DRAFTING, MODELING AND DELIVERABLES MANUAL



Illinois Department
of Transportation



STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PROPOSED HIGHWAY PLANS

FAP ROUTE 595 (IL 5)
SECTION (18Z) RS-6
PROJECT NHPP-PFJS(650)
ROCK ISLAND COUNTY
FROM 24TH ST. TO 0.1 M
SMART RESURFACING A

C-92-102-23



Computer Aided Design, Drafting, Modeling and Deliverables Manual

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The Illinois Department of Transportation
Office of Highways Project Implementation

Bureau of Design and Environment

Bureau of Bridges and Structures

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Document Control and Revision History

The Illinois Department of Transportation *Computer Aided Design, Drafting, Modeling and Deliverables Manual* is owned by the Illinois Department of Transportation Bureau of Design and Environment. The manual is reviewed during use and updated by the Bureau of Design and Environment, as necessary.

This manual (April 2025 version) is a substantial re-write of the previous manual version to incorporate the use of the Bentley CONNECT OpenX platform of software. This manual and all subsequent revisions are a consolidation of, and therefore supersede, all versions of the *CADD Roadway Drafting Reference Guide*, *CADD Structures Drafting Reference Guide*, and the *CADD Roadway and Structures Project Deliverables Policy*. The manual will be updated by the Department on an as needed basis.

Electronic copies of this policy can be downloaded at the websites below. Interim changes are communicated through the IDOT CADD Support subscription service; see Chapter 6.

<https://idot.illinois.gov/doing-business/procurements/engineering-architectural-professional-services/consultant-resources/highways/cadd.html>



Archived versions of this manual are available for examination at the IDOT Policy and Research Library, 2300 S. Dirksen Parkway, Room 320, Springfield, IL.

This manual is not distributed in hard copy format. Users of this manual who choose to print a copy are responsible for ensuring use of the most current version.

The latest revisions are indicated in the left margin by the bold double line as seen in next paragraphs.

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CHAPTER 1 INTRODUCTION

The Illinois Department of Transportation (IDOT), also known as 'The Department,' has established this Computer Aided Design, Drafting (CADD), Modeling, and Deliverables policy manual to promote consistent and efficient highway improvement project development.

The Department has several publications, available on our website, that provide instruction and guidelines to be used in the preparation of roadway plans and surveys. The primary publications are this manual, the *Survey Manual*, the *Bureau of Design and Environment Manual*, the *Land Acquisition Manual*, the *Bureau of Bridges and Structures Manual*, the *Drainage Manual*, and the *Unmanned Aircraft Systems (UAS) Program Manual*.

This manual consolidates and supersedes all previous versions of the:

- *IDOT CADD Roadway and Structures Deliverables Policy*
- *IDOT CADD Roadway Drafting Reference Guide*
- *IDOT CADD Structures Drafting Reference Guide*

The policies within this manual provide information utilizing the Bentley CONNECT Platform software for:

- The preparation of roadway plans for the Illinois Department of Transportation.
- The preparation of structure plans for the Illinois Department of Transportation.
- The preparation of three-dimensional (3D) models used for measurements and Automated Machine Guidance (AMG) in construction projects of the Illinois Department of Transportation.
- The preparation of deliverable files to various units within the Illinois Department of Transportation at various stages in the project lifecycle.

This policy manual ensures that IDOT will receive CADD drawings and 3D models in a standard and consistent format for any given project. It defines requirements for providing acceptable deliverables throughout the project phases in a uniform format.

The Department aims to leverage technology to develop a process for 3D electronic plan development and submission. Consistency in drafting, modeling, and file management is essential for this process to be effective. The end-product must be a deliverable that the Department, its consultants, and contractors can use and that is compatible with all other associated processes the Department manages.

Adherence to this policy manual is a term of all IDOT projects involving CADD, whether completed in-house or by consultant contract.

1-1 PURPOSE

This manual represents a significant update to the IDOT's CADD policy and standards. It incorporates the latest advancements in technology and addresses the evolving methods in modern roadway and bridge project design and construction.

Specifically, the requirements in this manual are intended to address the current ongoing shift from printed design documents towards growing demand for 3D models and the Department's transition to a workflow where 3D models are an integral component during every stage of the project's life cycle - including tasks from survey, planning, design, geotechnical investigation, utility coordination, and land acquisition activities within program development; conflict mitigation, Automated Machine Guidance (AMG), and as-built plan retention during construction; and field maintenance, inventory, and asset management activities during facility operation. Creating these models efficiently and consistently is a primary motivator in the development of this manual.

This manual is not a training guide for performing design functions or building 3D models. A reader of this manual who lacks training in the use of the various software referenced herein may not fully comprehend every nuance of the details of requirements. Therefore, it is strongly recommended that some portion of every internal and external project team be fully versed in the technical capabilities of the software referenced in this manual.

This manual is not a training guide in the use of the IDOT workspace, which enables the production of models and plans generated by the design software. While this manual includes significant discussion of various components of the workspace, the discussion herein shall not be construed as complete instruction in the use of the workspace. For more information regarding the Department's current CADD workspace, including downloads, sample plans, and an ever-expanding CADD and GIS how-to video library, see Chapter 6, "Internet and Reference Information".

1-2 MANUAL OVERVIEW

Sections of this manual are defined as follows:

Chapter 1 – Introduction: Overview of the manual's purpose and scope.

Chapter 2 – Level of Development: General information regarding the level of development (LOD) detail required for modeling at various project phases.

Chapter 3 – Deliverables Policy: Requirements for exchanging data between IDOT units, consultants, and contractors at various project phases, including a detailed list of electronic deliverables, file naming, folder structure, and reference file structure.

Chapter 4 – Design Time Workspace: CADD and Modeling Standards for IDOT roadway and structures projects, including relevant tools and workflow steps.

Chapter 5 – Plans Production Workspace: Requirements for preparing contract plan documents in both electronic and hard copy form, including annotation, sheeting, and quantities reporting requirements.

Chapter 6 – Internet and Reference Information: Miscellaneous business information for IDOT employees, consultants, and contractors, including a link to the main IDOT CADD Support Website and Online Resources page.

1-3 ABBREVIATIONS AND DEFINITIONS

The following are descriptions of various terminologies, as used in this manual:

3D Model: A digital representation of any three-dimensional object. In the IDOT workspace, this is typically in a .DGN file format. A 3D model may consist of any of the following 3D element types: lines, meshes, terrain models, and / or solids. For the Department's purposes, a 3D model is a digital representation of a specific project, or components of a project, in various 3D file formats; see Section 3-4.02, "Files and Formats".

4D Model: The dimension of time is added to a 3D model. A 4D model combines the 3D model with a project schedule, including construction phasing and Maintenance of Traffic (MOT) issues, to create a simulation of all proposed construction activities on a project. Although the development of 4D models is not currently discussed in this manual, this is an area which is established in the construction industry and for which it is expected that future versions of this manual will address.

5D Model: The dimensions of both cost and time are added to a 3D model. A 5D model combines the 3D model with both a 4D project schedule and a 5D estimate of cost over time, which can help forecast or predict the flow of finance for a project from initialization through completion. Although the development of 5D models is not currently discussed in this manual, this is an area which is being quickly established in the construction industry and for which it is expected that future versions of this manual will address.

Alignment: A series of tangents and curves representing the centerline or baseline of a design feature. Alignments are crucial for horizontal and vertical geometry in road and bridge design.

Asset: Existing or proposed component(s) or feature(s) that make up, or are part of, the project.

Auto-annotation: A feature in CADD software that automatically generates text, labels, and dimensioning for design elements based on predefined rules.

Automated Machine Guidance (AMG): The use of advanced technology to assist construction equipment, such as bulldozers, graders, and excavators, in performing tasks with high precision and accuracy. AMG systems use geospatial positioning system (GPS), 3D modeling, and other sensors to guide equipment in real-time, ensuring that the work aligns precisely with the design specifications, such as grading, paving, etc.

BIM / CIM: An acronym for Building Information Modeling / Civil Information Modeling. BIM is the holistic process of creating and managing digital information for a built asset in the architecture, engineering, or construction industry across its lifecycle, from planning and design to construction and operations. CIM, more specifically, applies this same process to the civil engineering and construction industry.

Breakline: A line that represents a significant change in elevation in a surface model, such as the edge of a curb or a drainage ditch.

Consultant: A company or individual contracted by IDOT to perform engineering services.

Container File: Blank electronic design files that contain referenced DGNs of common project files, utilized to create either the necessary Sheet Files or other required 3D deliverables. For example, all centerlines for a job would be referenced into the master centerline DGN. Container files are used to organize design file content while reducing general file size and the risk for file corruption.

Contractor: A company or individual contracted by IDOT to perform construction activities on an IDOT project.

Corridor: A 3D model of a roadway or other curvilinear infrastructure, typically consisting of a combination of alignment(s), templates, and surfaces.

Cut and Fill: The process of removing earth (cut) or adding earth (fill) to create the desired grade for a road or other infrastructure project.

Curve Data: Information describing the geometric properties of curves in a roadway alignment, such as radius, degree of curvature, and transition length.

Design Surveys: The survey function performed for mapping and modeling of existing features for use of developing proposed roadways or structures design(s).

Designer: Any IDOT or Consultant technician or engineer working on survey, planning, modeling, or design aspects of a project. For specific responsibilities of the Designer; see *Bureau of Design and Environment Manual* Section 63-1.01.

Design File (DGN): A file format used by the Bentley CONNECT Platform software for CADD drawings.

DGN WorkSet File (DGNWS): The DGNWS is a Bentley CONNECT Platform file that contains WorkSet properties, custom properties, WorkSet sheet index, and the WorkSet Link Set. Each of these, other than the sheet index, involves some initial data input. As a project proceeds, the sheet index will build up automatically.

Drainage and Utilities (DU): The specialization of engineering and surveying, utilizing the Bentley CONNECT Platform software, concerned with the location and depiction of underground utility assets using a variety of direct measure and remote sensing technologies.

Element: A basic building block of a design, such as a line, curve, or arc in a CADD file.

Feature Definition: A predefined set of attributes in the Bentley CONNECT Platform software that controls how symbology, annotation, and various other properties are applied to the elements of the design.

File Federation: A concept used with the Bentley CONNECT Platform software to group or organize files. When using file federation, geometry, such as the alignment(s), is stored in one design file while terrain model(s), corridor(s), bridge(s), etc. shall be in other discipline specific files.

Geographic Information Systems (GIS): A system that captures, stores, analyzes, and displays data that is linked to a specific location.

Georeferencing: The process of aligning a CADD model to real-world geographic coordinates, often using GIS or survey data.

Hydraulic Design: The process of designing drainage and stormwater systems to ensure proper water flow and prevent flooding, typically involving culverts, ditches, and pipes.

Illinois Coordinate System (ICS): A collection of various coordinate reference sub-systems which define and state the position or location of points on the surface of the earth within the State of Illinois.

iModel: A digital representation of a design project that integrates various types of data and project information into a single, cohesive, and shareable model. They are used to store, manage, and share data from multiple software applications in the Bentley CONNECT Software Platform, GIS, and other project-specific tools. They serve as a centralized repository of project data that can be accessed by stakeholders for review, analysis, and collaboration, ensuring consistency and accuracy across all stages of the design and construction process.

Industry Foundation Class (IFC): A standardized, digital file type of the design project. It is an open, international standard and promotes vendor-neutral, or agnostic, and usable capabilities across a wide range of hardware devices, software platforms, and interfaces.

Item Types: Custom data attached to design elements, such as material types, pay-item(s), or feature-specific attributes In the Bentley CONNECT Platform software.

Level of development (LOD) / Model detail display (MDD): 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 each element or set of elements of each category in 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 phases will have a lower level of development, which then affects the model detail display (MDD) 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. MDD therefore means to what extent of totality and precision the 3D geometry matches the real world or design intent.

Light Detection and Ranging (LiDAR): A remote sensing technology that collects high-resolution 3D data about terrain and surface features, often used in roadway and infrastructure design.

Model as a Legal Document (MALD): An acronym used when the digitally signed 3D model is used as the contract document in the construction plan legal hierarchy instead of the historical practice of using signed and sealed paper construction plans.

Mesh: A closed 3D shape generated from design elements, typically used for volumetric calculations, topographic and design features.

Phase I: The time during a project's life when planning and study activities are performed. Major activities during Phase I may include design survey, geometric studies, and conceptual design. It should be noted that the use of computer methods, especially 3D design workflows, enable the Designer to shift many activities typically completed in Phase II earlier to Phase I. For example, the workflow to produce corridor designs also produces geometric layouts of the pavement and lane edge lines. Because of this, it is reasonable to expect that more complete 3D models will exist in Phase I even though these are not required deliverables in Phase I.

Phase II: The time during a project's life when contract plans are developed. Major activities during Phase II are roadway design, structures design, and right-of-way acquisition.

Phase III: The construction phase of a roadway or structures project, including letting activities.

Phase IV: The post-construction phase of a project which includes various activities related to maintenance, operations, and asset management.

Point Cloud: A collection of 3D points collected from a scanner or sensor that represents a physical object or area of interest.

Project Content File: An electronic document which lists and describes the files used to build a complete project dataset. The dataset usually consists of various DGN CADD files used to perform engineering and modeling calculations. This file will also describe the contents of each file, especially the location of alignments and profiles and the components which compose 3D models. The Project Content File may be in spreadsheet form or a text document.

Project Design Files: Electronic design files (DGN) that contain engineering data specifically related to the project, such as strip maps, alignments, survey, etc. Files will be discipline specific, georeferenced and properly federated for referencing design data into the Container File.

Project Engineer: The IDOT Engineer in the district Design Section who oversees the work of one or more Designers and is directly responsible for the project's development.

Project Files: Any electronic files that contain project related data. Files will be discipline specific and properly federated.

Project Manager: The IDOT district representative who is directly responsible for the project's management and coordination. This is often the main liaison between the Project Engineer or Consultant and other units within the Department.

Sheet File: A file that contains the data and elements needed to create a series of sheets and the resulting Sheet Models for printing.

Surface: Similar to a Mesh, but without volume. It is a 3D element representing the topography of a design area, including features such as pavement, grass, and other details.

Strip Map File: DGN files used for various design or surveying purpose used in the development of a roadway project. These files are prepared in long strips which follow the roadway alignments and are generally not segmented at sheet match lines. For example, the topography strip map will generally contain all the topography for the entire project's length and a defined width. Likewise, the rights of way and property line information will be contained in a single long strip. For very long projects, it may be desired to divide the length of the project into two or more strip maps per type. Strip Map Files shall be developed using the Illinois Coordinate System (ICS) with appropriate geographic coordinate system assigned to the DGN files.

Terrain Model: A digital element type representing ground surface elevation with reference to a coordinate system; typically created using survey or LiDAR data and used as the basis for project design.

WorkSet: Defines individual project specific standards used by the Bentley CONNECT Platform software. It is a method for organizing and managing different aspects of a project.

WorkSpace: Defines overall Department CADD Standards utilized in the Bentley CONNECT Platform software.

1-4 IDOT ORGANIZATIONAL UNITS

The following are descriptions of the various organizational units within the Department, as used in this manual. It is noted that the specific arrangement of these units may vary by district. The Designer will coordinate with the Project Manager to ascertain the specific embodiment of these functions for each project:

Construction Unit: Those persons or groups charged with the execution and management of construction activities, including but not limited to staking, earth moving, paving, and installation of drainage structures, as well as the administrative tasks associated with these activities.

Design Survey Unit: Those persons or groups charged with developing the topographic maps and terrain models of the existing conditions of a proposed project.

Drainage (Hydraulic) Design Unit: Those persons or groups charged with the design of and review of the drainage aspects associated with a project. In some districts the design function is performed by the Roadway Design Unit with review being performed by the Drainage Unit.

Environmental Studies Unit: Those persons or groups which perform the environmental investigations required for a project. As a part of this process, this unit will define the required design adjustments or mitigations resulting from any environmental findings and manage the permitting process for the project.

Geometrics Design Unit: Those persons or groups which provide the geometric details for a project and any associated studies. A typical example of this unit's work is the development of the required geometries (horizontal and vertical alignments, radii, storage lengths, etc.) of intersection or interchange layouts.

Geotechnical Unit: Those persons or groups which investigate sub-surface characteristics and suitability for project construction.

Land Acquisition Unit: Those persons or groups which define the existing property and right of way boundaries and manage the process of acquiring additional rights of way when needed.

Lighting Design Unit: Those persons or groups which provide the design and layout of the roadway lighting needed on a project.

Roadway Design Unit: Those persons or groups assigned the tasks of developing contract plans as well as the 2D and 3D models of the designed features. In some districts this unit will also perform the design functions related to drainage.

Signal Design Unit: Those persons or groups which provide the design and layout of the traffic signal equipment needed on a project.

Structures Design Unit: Those persons or groups which provide the design and layout of the bridges, box culverts, retaining walls, and sign structures on a project.

Utilities Unit: Those persons or groups which coordinate with utility owners to provide information for development of maps of existing utilities and to manage any required utility relocations.

1-5 PRESCRIPTIVE LANGUAGE

In this manual, prescription language definitions are used and intended as follows:

- If the word “shall” or “must” is used, the described action or policy is a requirement to be followed by all internal and consultant designers.
- If the word “should” is used, the described action or policy is a recommended best practice. The Designer is strongly encouraged to use the described action or policy, but substitutes will be accepted if the intent of the requirement is achieved.
- If the word “may” is used, the described action or policy has been found to produce a satisfactory result. An action described as “may” will sometimes appear in this manual to accompany a “should” declaration. In this case, either described action is considered equally valid.

1-6 BENEFITS OF CADD STANDARDS

With the increased use of 3D models and the growing complexity of IDOT projects, it is crucial to maintain and follow CADD and modeling standards to ensure efficient project progression through each phase. Efficiency is realized when all participants of an IDOT project, both internal and external, can expect that all projects will follow a consistent policy format for CADD and 3D modeling across all districts. This consistency also builds a foundation for future modeling needs and asset management activities which may develop with further advancements in technology.

When creating printed plan sets, it was usually enough to follow basic symbology guidelines. Blunders in implementation of a CADD standard with paper as its final product could tolerate

some failure in following the prescribed standards since there was still a failsafe check of the printed plan set.

With the increased complexity of 3D modeling, however, a stricter adherence to CADD standards is necessary. CADD elements have become much more than simple graphics on the computer screen. Today, those elements contain large amounts of “intelligent” information that dictate not only the appearance of the elements, but also how each is used to create the final 3D model. In such a design and modeling paradigm, it is important that consumers of the data be able to efficiently review and retrace the survey and design data and be able to construct workflows to parse the data for construction and eventual asset management workflows in a predictable manner.

The standards documented herein, when used consistently, result in CADD files and models which will produce both the printed plan documents as well as properly constructed 3D models. When properly applied, these standards will result in:

- An efficient single standard used throughout IDOT, the Illinois State Toll Highway Authority (ISTHA, a.k.a. the Illinois Tollway), and each agency’s consultants and contractors.
- Reduced design and quantity errors.
- Properly constructed 3D models required to feed Automated Machine Guidance (AMG) for more efficiency in construction.
- Simplified Quality Assurance /Quality Control (QA/QC) processes.
- A streamlined construction bid process using 3D models.
- Data integrity preserved throughout the entire life cycle of projects.
- Compliance with the Federal Highway Administration (FHWA) and industry’s best practices.

1-7 BENEFITS OF 3D MODELS

Many contractors have been utilizing automated machine guidance for many years. In order to generate the necessary data, traditional 2D plans are converted by the contractor into 3D files required to operate the automated machinery. While it started as a tool to increase construction productivity, contractors learned that it also had the additional benefits of providing more accurate bids and identifying errors and omissions in the engineering documents.

Technological advancements in roadway and structure surveying, design, and construction processes are driving the transportation industry toward the development of 3D models by agency personnel during the planning and design phases, and the utilization of these geospatial models by both agency field personnel and the contractor, using global positioning system (GPS) survey equipment and automated machine guidance (AMG), respectively, during construction activities.

Beyond automated machine guidance, 3D models are an enabling technology for a variety of activities including conflict detection, improved QA/QC, and stakeholder review. As a result, many Departments of Transportation, including IDOT, have set goals for developing 3D models for road and structures designs. Incorporating 3D models into the design process provides the following additional benefits to that of the list shown in Section 1-6, “Benefits of CADD Standards”:

- Enables cost savings during construction by utilizing Automated Machine Guidance.
- Improves construction documents, which provides more detailed information to the construction team.
- Increases efficiency when conducting construction measurement tasks.
- Details visualization for stakeholder buy-in on projects.
- Enhances identification and resolution of conflicts, issues, design errors, and omissions prior to construction.
- Offers intuitive subsurface visualization, thereby reducing utility conflicts and delays.
- Optimizes material usage and increased bid quantity accuracy.
- Increases productivity during the design and bidding phases, by relaying the information in a more efficient manner.
- Allows for efficient incorporation of detailed as-built information into the asset management system.

The primary goal of a Department generated 3D model is to fully convey the design intent of the specific project, especially in areas traditionally not well-defined in 2D plans and cross sections.

The primary customers for the 3D model are the Designer (to define and validate the design), the contractor (to construct the proposed asset), the Department's field personnel (to pay the contractor for field quantities and verify plan adherence), and asset management personnel (who will consume plan data and as-built 3D models from the field into a comprehensive agency asset inventory).

1-8 CONCEPT STATEMENT

It is the desire of the Illinois Department of Transportation to implement 3D Engineered Modeling from project conception and initiation through maintenance and operations. At a high level, this concept of "cradle to grave" model-based electronic design data involves the following key steps:

1. Collection and development of geospatially located survey data for development of an accurate existing terrain model.
2. Utilization of the survey model in design, with design software capable of 3D model output.
3. Output of critical electronic deliverables for use in bidding and letting the project.
4. Utilization of the electronic deliverables in constructing components of the asset(s) in the project in an automated fashion when applicable. (i.e., automated machine guidance, stakeless paving, etc.).
5. Field collection of as-constructed (as-built) and inspection measurements using modern surveying tools, relative to the model.
6. Archiving of the electronic model for future use, including asset preservation and management.

This manual will reflect the Department's move to 3D modeled design and will be updated as technology and need evolve.

1-9 STANDARDS DOWNLOADS AND SUBSCRIPTIONS

The files, configuration, and other standard files which are needed to satisfy the requirements of this policy manual are available on the IDOT CADD Support Site listed in Chapter 6, "Internet and Reference Information". The current Bentley CONNECT Platform software versions used by IDOT are also shown on these pages along with additional resources. On these web pages, the Designer can also subscribe to be notified of both updates to this manual and IDOT's CADD workspace, view sample roadways and structures plans, and access an ever-expanding CADD and GIS how-to video library.

1-10 CONCLUSION

In summary, this CADD Modeling and Deliverables Manual is designed to ensure consistency, efficiency, and accuracy in the development of highway improvement projects for the Illinois Department of Transportation (IDOT). By adhering to the standards and policies outlined in this manual, all stakeholders, including IDOT employees, consultants, and contractors, can contribute to the successful implementation of 3D modeling and CADD practices.

The manual highlights the importance of:

- Utilizing advanced technology to enhance project development and execution.
- Maintaining a uniform approach to drafting, modeling, and file management.
- Ensuring that deliverables are compatible and useful across all stages of a project's lifecycle.

As technology continues to evolve, this manual will be updated to reflect new advancements and best practices. The goal is to create a seamless workflow that integrates 3D models from project conception through construction and maintenance, ultimately improving the quality and efficiency of IDOT projects.

By following the guidelines and standards set forth in this manual, we can achieve greater accuracy, reduce errors, and enhance the overall quality of our transportation infrastructure.

CHAPTER 2 LEVEL OF DEVELOPMENT

2-1 GENERAL INFORMATION

This chapter outlines the required level of development (LOD) details for 3D modeling.

Chapter 3, “Deliverables Policy”, defines the requirements for delivery of electronic files, the workflows for submittal of electronic files, including electronic versions of sheets, and the file and folder structure to be used on IDOT projects.

For specific CADD requirements related to design and modeling, see Chapter 4, “Design Time Workspace”.

For requirements related to plans production, see Chapter 5, “Plans Production Workspace”.

2-2 LEVEL OF DEVELOPMENT (LOD) OVERVIEW

As defined in Section 1-3, “Abbreviations and Definitions”, the Level of Development (LOD) is a measurement of how complete the modeled 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. The conceptual phase will have a lower level of development, which then affects the model detail display (MDD) 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. Figure 2-2.A below shows this progression of MDD, and thus LOD, during typical project development.

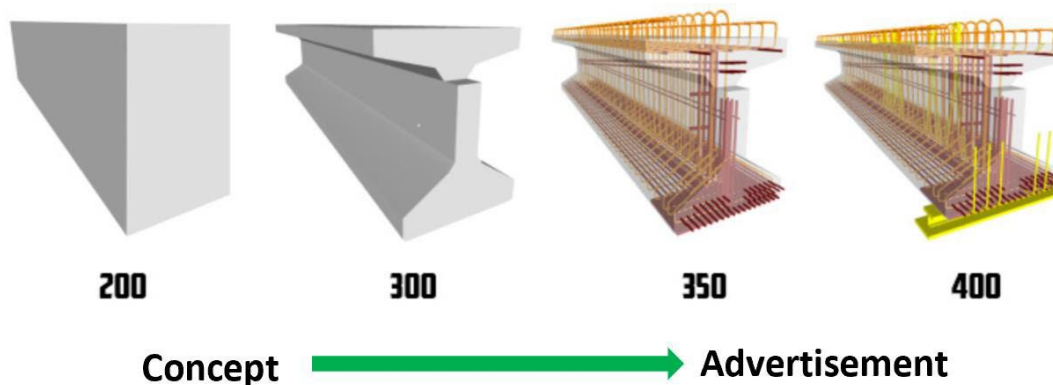


Figure 2-2.A – LOD Overview Visual

2-3 LOD PHASE DEFINITIONS

Based on the American institute of Architects (AIA), the LOD is defined based on the stage of the design specifically for buildings and their respective sites. The following LOD Phase definitions are adapted from the AIA standards, with modifications for roadway and transportation design projects. Adjustments to these definitions may occur in the future based on AASHTO development of similar tables.

L100: Concept Design - A conceptual model where parameters like area, height, volume, location, and orientation are defined. Alternative alignments and profiles are researched in more detail. Right-of-way (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. Non-geometric information can also be attached 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. Non-geometric information can further be attached 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)

2-4 MODEL DETAIL DISPLAY

As defined in Section 1-3, “Abbreviations and Definitions”, 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. MDD refers to the graphic representation of elements, which varies based on the assigned LOD at 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 (see Section 2-5, “LOD Expectations Per Milestone”), the Designer is to not exceed L350.

L400 is the transition between design and construction. The Construction Manager/Resident Engineer 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 Construction Manager/Resident Engineer for the L500 deliverables. When LOD reaches L400, the shop drawings will 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 Designer 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.

Figures 2-4.A through 2-4.D visually demonstrate how the model detail display (MDD) would read at each LOD throughout a modeled project:

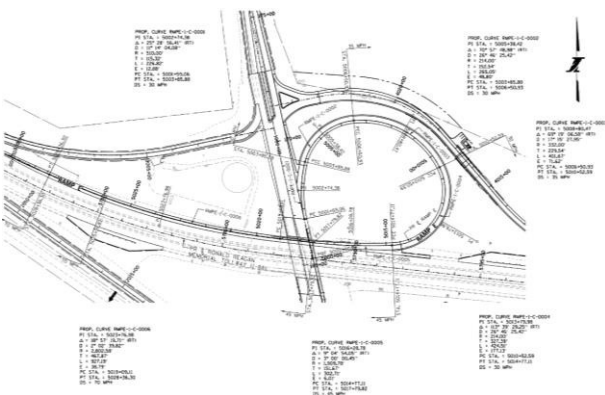


Figure 2-4.A – L000-L100 Visual

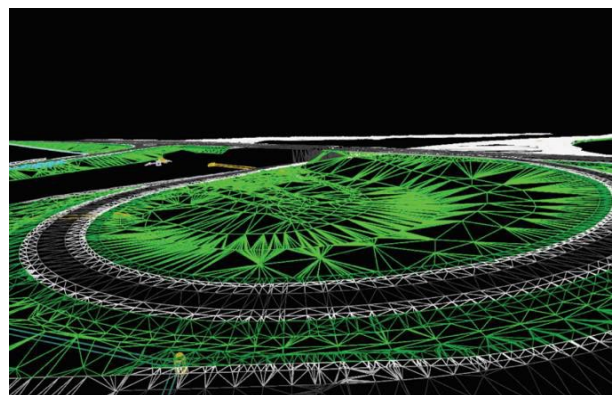


Figure 2-4.B – L200 Visual

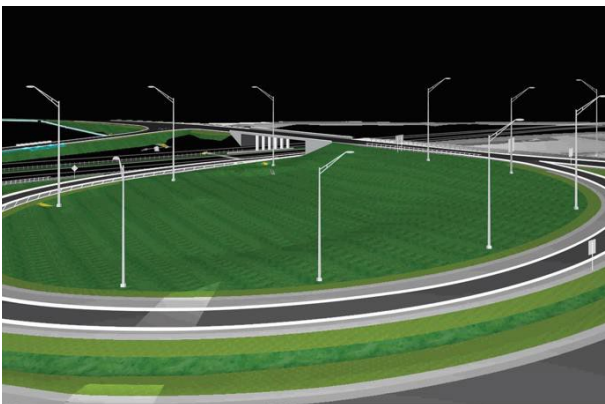


Figure 2-4.C – L300-L350 Visual



Figure 2-4.D – L400-L500 Visual

2-5 LOD EXPECTATIONS PER MILESTONE

The tables in this section and in Section 2-6, “Master LOD MDD Table”, are intended to assist the Project Manager in setting measurable expectations for deliverables at each milestone for modeled projects, those both developed in-house or submitted to the department. These tables are intended to communicate what LOD each element should be at by each milestone. The tables in this Section are provided as a base example for discussion during initial project coordination and kick-off and are used to set typical expectations. All projects are unique, and a specific project may have LOD requirements below or above these typical expectations. The Project Manager is responsible for defining expectations below or above these typical expectations during the initial project scoping and kick-off.

Table 2-5.A serves as an example scoping document for a typical project with each item assigned an LOD per milestone. The expectations are then set by using the “Master LOD MDD Table”, defining each item’s LOD to coordinate with the milestones provided in the scoping document. The LOD assigned in the scoping document directs the user of this manual to review the “Master LOD MDD Table” as a guide for the model detail display requirements for the milestone deliverables of each element. Additional discussion of the specific project goals may be necessary to further refine and set modeling requirements. For a printable unpopulated PDF of Table 2-5.A to fill out for your specific project, see the Department’s CADD Support website, *Online Resources* section as described in Chapter 6, “Internet and Reference Information”.

When an item reaches a certain LOD for a milestone, it does not alleviate the design completely from updates and revisions. This also does not negate the potential need for another field verification for minor but important information of existing elements surveyed at a L300 LOD. 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. Depending on the milestone, the items may be developed enough to be scoped out for the Contractor 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.

Level of Development (LOD) Scoping Tables Example – Roadway Elements



Earthwork & Environmental										
Element	Contractual	Master Plan - Final	Pre-Concept	Concept (30%)	Preliminary (60%)	Pre-Final (95%)	Final (100%)	Advertisement	Construction	As-Built
Existing Grounds	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	3350	400	500

Table 2-5.A – Level of Development (LOD) Scoping Tables Example
(Sheet 1 of 2)

Level of Development (LOD) Scoping Tables Example – Structural Elements



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)										
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 Slope Walls	No	100	100	100	200	300	350	350	350	500
Waterways	No	100	100	100	200	300	350	350	350	500
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, Noise Wall	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

Table 2-5.A – Level of Development (LOD) Scoping Tables Example
(Sheet 2 of 2)

2-6 MASTER LOD MDD TABLE

The Master LOD MDD Table is a coordinated effort between both the Illinois Tollway and IDOT. The vision for IDOT and the Illinois Tollway is to provide more efficient and sustainable digital project delivery practices for future construction projects. This table is for respective users of the model to review each category's LOD MDD needs, and their associated elements with the details, that 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, it may have different specific requirements depending on the size and scope of work.

The Master LOD MDD Tables are organized based on 16 categories and then followed by elements associated with them. With each element comes the LOD phase from L100-L400 with each respective LOD describing the amount of detail to be displayed in the model. L000 and L500 are intentionally left out since L000 dictates what from the overall table will need to be scoped, making L100 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 amount of data and it may cause the model to malfunction. Therefore, it is important for the Designer to decide 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 Designer may need to break up the model into separate files.

For a printable PDF in 11x17 format of Table 2-6.A, see the Department's CADD Support website, *Online Resources* section as described in Chapter 6, "Internet and Reference Information".

TABLE 2-6.A: IDOT / Illinois Tollway - LOD MDD Table

TABLE 2-6.A.1 – EARTHWORK & ENVIRONMENTAL PROJECT ELEMENTS



Category	Item	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. 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. 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 *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. <u>EC Blankets, Fiber Rolls, Buffer Strips</u> are sufficient for L100.	<u>Silt Fence</u> : generic model along perimeter of area of work. (3D) <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.	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.	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.

TABLE 2-6.A.2 – STORMWATER DRAINAGE PROJECT ELEMENTS



Category	Item	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. Bedding material and base course aggregate and thicknesses are identified. 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. Bedding material and base course aggregate and thicknesses are identified. 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-manmade 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) 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. Accurate modeling of spread.		

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

TABLE 2-6.A.3 – UTILITIES, ITS, & ELECTRICAL PROJECT ELEMENTS



Category	Item	L100	L200	L300	L350	L400
Utilities/ITS/ Electrical	Underground Utilities (sanitary, water main, gas, fiber, electric)	Indication of approximate locations, lengths, and extents of the existing and proposed underground utilities. Existing utilities modeled as QL-C	Locations, lengths, and extents confirmed. Modeled elements to include: - approximate size, shape, and location of the pipes/conduits - approximate access/code clearance requirements modeled - Approximate elevations - Existing utilities modeled at QL-B - (3D)	Modeled elements to include: - Design-specified size of the pipes/conduits - Identification of pipe material - Schematic diagram showing the pipe network - Existing utilities modeled at QL-A	Element modeling to include: - Pipe hanger and Clamp and Anchors - Exact sloping of pipes - Pipe connection and bends details - Expansion reducer and Collar - Finishes i.e. painting, galvanization etc. - 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. Existing utilities modeled as QL-C	Locations, lengths, and extents confirmed. Modeled elements to include: - approximate size, shape, and location of the pipe/conduits - approximate access/code clearance requirements modeled - Approximate elevations - Existing utilities modeled at QL-B - (3D)	Element 3D modeling to include: - Design-specified size of the pipes/conduits - Identification of pipe material - Schematic diagram showing the pipe network - Existing utilities modeled at QL-A	Element modeling to include: - Pipe hanger and Clamp and Anchors - Exact sloping of pipes - Pipe connection and bends details - Expansion reducer and Collar - Finishes i.e. painting, galvanization etc. - 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: - length width and height of the elements - 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: - exact shape of the light poles - associated foundations - Anchor rods and bolts - 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: - exact shape of the signal supports - associated foundations, traffic signal control cabinet pad - Anchor rods and bolts - Conduit		
	Tolling Equipment & Devices (payment sensor loops, cameras, conduits that feed CAT-5 cables & devices) *Tollway Specific	Priority is on the location of the existing and proposed tolling equipment & associated devices. Included is also the length and extents of associated cables. Existing utilities modeled as QL-C	Locations confirmed. Generic mass of each element to include information about depth, length and width. Indicate approximate elevations of the associated cables. Existing utilities modeled at QL-B (3D)	Modeled elements to include: - length width and height and overall geometries of the tolling equipment and devices - Existing utilities modeled at QL-A		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. Modeled elements to include: - approximate size, shape, and location of the pipes/conduits - approximate access/code clearance requirements modeled - Approximate elevations - (3D)	Modeled elements to include: - Design-specified size of the pipes/conduits - Identification of pipe material and any foundation or concrete pads - Schematic diagram showing the pipe network - Anchor rods and bolts - Conduit	Element modeling to include: - Pipe hanger and Clamp and Anchors - Exact sloping of pipes - Pipe connection and bends details - Expansion reducer and Collar - Finishes i.e. painting, galvanization etc. - Splash block	Utility data collection following requirements in CM Utility Collection Guide & Special Provision

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

TABLE 2-6.A.4 – SIGNAGE PROJECT ELEMENTS



Category	Item	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.	<p>The sign panel layout/legend format and size to be provided</p> <p>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:</p> <ul style="list-style-type: none"> - Butterfly Type - Cantilever Type - Span Truss Type - Monotube Type - (3D) 	<p>Modeled as specific sign structure, length, substructure, bedding material and base course aggregate and thicknesses identified.</p> <ul style="list-style-type: none"> - Actual elevations and location of member connections where applicable - Correct width, height and diameter of steel end supports. - Correct size of all truss members and chords. - Correct foundation type and size with grade beam and drilled shaft. - Signage materials identified. 	<p>Element modeling to include:</p> <ul style="list-style-type: none"> - Welds - Coping of members - Cap plates - Washers, nuts, etc. - All assembly elements - Anchor bolts - Base plates - Main elements of typical connections applied if applicable - Any miscellaneous members with correct size, shape, orientation, and material. 	<p>Element modeling to include:</p> <ul style="list-style-type: none"> - 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.	<p>The sign panel layout/legend format and size to be provided</p> <p>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:</p> <ul style="list-style-type: none"> - Bridge Mounted - Barrier Assembly Mounted - Breakaway Steel Mounted - Canopy Mounted - Gantry Column Mounted - Light Pole Mounted - Noisewall Mounted - Structure Mounted - Truss column Mounted - Telescoping Steel Mounted - Wood Post Mounted - (3D) 	<p>Full extent of sign support used. Support size, support height, foundations (for breakaway steel supports).</p> <ul style="list-style-type: none"> - Actual elevations of mounting support members. - Main elements of mounting supports. - Signage materials identified. 	<p>Modeled element to include:</p> <ul style="list-style-type: none"> - Mounting brackets - Anchor bolts - Base plates - Any miscellaneous members with correct size, shape, orientation, and material. 	<p>Element modeling to include:</p> <ul style="list-style-type: none"> - Joints

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

TABLE 2-6.A.5 – ROADWAY PAVEMENT DESIGN & GEOMETRICS PROJECT ELEMENTS



Category	Item	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.

TABLE 2-6.A.6 – ROADWAY MOT, SITEWORK & TOLLWAY PLAZA PLANS PROJECT ELEMENTS



Category	Item	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 *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. - Correct size of all truss members and chords. - Correct foundation type and size with grade beam and drilled shaft.	Element modeling to include: - Actual elevations and location of member connections where applicable - Correct width, height and diameter of steel end supports. - Main elements of typical connections applied if applicable - Any miscellaneous members with correct size, shape, orientation, and material.	Element modeling to include: - Welds - Coping of members - Cap plates - Washers, nuts, etc. - All assembly elements - Anchor bolts - Base plates - Joints

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



TABLE 2-6.A.7 – BRIDGE DESIGN PROJECT ELEMENTS (DECK AND APPROACH SLABS)

Category	Item	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: - Accurate size and shape of decks and parapets where applicable - Expansion joint with priority on location - Drip notch and corner chamfers - Exact sloping of concrete surfaces - Fillets over girders - Deck notches at abutments - Openings for Deck drainage - Reinforcement bars, Reinforcement bars (Epoxy coated)	Element modeling to include: - Pour joints - Expansion, construction and stage-construction joints - 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: - Accurate size and shape of decks and parapets - Expansion joint with priority on location - Drip notch and corner chamfers - Exact sloping of concrete surfaces - Reinforcements bars and lap splices	Element modeling to include: - Expansion and construction joints - 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: - Railing structural members - Base / Connection plate locations - Slotted holes in railing member elements	Element modeling to include: - Anchor bolts and studs - Locknuts and bolts. - Fabric reinforced elastomeric pad - Rail splice - Welds - Coping of members - 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. Also included in model are: - Rebar - Conduit - Anchor rods and bolts	Element modeling to include: - Schematic of light pole base plate - Schematic of Vibration isolation pad - Junction box blackout(s) - 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: - Steel structural members - Member connection locations	Element modeling to include: - Anchor bolts, Grout - Stiffener plate - Connection plate/angle with anchor bolts holes - PVC sleeve if applicable - Welds - Coping of members - 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: - Locking edge rails with bends - Parapet / Sidewalk sliding plate - Neoprene glands	Element modeling to include: - Studs and embedment - Expansion anchors if applicable - Welds - Joints and bends details - 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: - Precise location and actual size of the drains/scupper - Scupper frames and downspouts - Finishes i.e. painting, galvanization etc.	Element modeling to include: - Bolts, Anchor rods, nuts and washers - Modified reinforcement details in the concrete deck - Welds - Joints and bends details	
	Drain Pipes and Support	Indication of approximate locations, lengths, and extents of the pipes.	Horizontal dimensions confirmed. Generic model of the pipe with approximate diameter and locations of supports (3D)	Element modeling to include: - Size of the pipes - Identification of pipe material - Finishes i.e. painting, galvanization etc. - Schematic diagram showing the pipe network - Exact sloping of pipes	Element modeling to include: - Pipe hanger and Clamp and Anchors - Pipe connection and bends details - Expansion reducer and Collar - Splash block - Welds - Washers, nuts etc.	

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

TABLE 2-6.A.8 – BRIDGE DESIGN PROJECT ELEMENTS (SUPERSTRUCTURE)



Category	Item	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: <ul style="list-style-type: none"> - Type of structural concrete system - Approximate geometry (e.g. depth) of structural elements - (3D) 	Element modeling to include: <ul style="list-style-type: none"> - Specific sizes and locations of main concrete structural members modeled per defined structural grid with correct orientation - Concrete defined per spec (strength, etc.) - All sloping surfaces included in model element with exception of elements affected by manufacturer selection 	Element modeling to include: <ul style="list-style-type: none"> - Strands profile and locations - Reinforcement and Lap splices - Welded Wire Reinforcement (WWR) - Fillets - Lifting devices - Embeds and anchor rods, plate assembly - Penetration for any utility item 	Contractor to provide strand cutting sequence, 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 (3D)	Element modeling to include: <ul style="list-style-type: none"> - Thickness of Flange and Web plate - Finishes, i.e. painted, galvanized etc. - Framing section properties data integrated with framing model - Grade of Steel identified 	Element modeling to include: <ul style="list-style-type: none"> - Stiffeners - Welds - Sloping of members, Camber, Flange Transitions - Diaphragm connection members - Field and shop splices - Shear studs - Penetration for any utility item - Top of beam elevations 	Element modeling to include fabrication level information: <ul style="list-style-type: none"> - Welds - Coping of members - Washers, nuts, etc. - 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 (3D)	Element modeling to include: <ul style="list-style-type: none"> - Complete size of diaphragm steel members - Finishes, i.e. painted, galvanized etc. - Grade of steel identified 	Element modeling to include: <ul style="list-style-type: none"> - Connection Plates, bolt holes - Welds - Sloping of members - Penetration for any utility item 	Element modeling to include fabrication level information: <ul style="list-style-type: none"> - Welds - Coping of members - 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. (3D)	Element modeling to include: <ul style="list-style-type: none"> - Bearing plates, elastomers, anchor bolts etc. - Finishes, i.e. painted, galvanized etc. - Grade of steel identified 	Element modeling to include: <ul style="list-style-type: none"> - Bolts and anchor bolts - Sloping of members - Side Retainers - Elastomer reinforcement - Pintles - Neoprene pads - Shims 	Element modeling to include fabrication level information: <ul style="list-style-type: none"> - Welds - Coping of members - Washers, nuts, etc.

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

TABLE 2-6.A.9 – BRIDGE DESIGN PROJECT ELEMENTS (SUBSTRUCTURE)



Category	Item	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: - Approximate size and shape of pier elements e.g. Column, Cap, Crashwall etc. - (3D)	Element modeling to include: - Accurate size and geometry of the element - Sloping surfaces. - Reinforcements - Opening for utilities	Element modeling to include: - Lap splices, Hooks and Bends, spiral spacers - PJF - Expansion / construction joints	
	Concrete Abutment and Wingwall	Priority is on the horizontal location of the abutment and wingwall.	Horizontal placements confirmed. Element modeling to include: - Approximate size and shape of abutment and wingwall - (3D)	Element modeling to include: - Accurate size and geometry of the element - Sloping surfaces. - Reinforcements - Opening for utilities - Limits of structural excavation and Porous Granular backfill	Element modeling to include: - Reinforcements, Lap splices, Hooks and Bends - Bar splicer assembly - Water seal, PJF - Expansion / construction joints	
	MSE Abutment and Wingwall	Priority is on the horizontal location of the abutment and wingwall.	Horizontal placements confirmed. Element modeling to include: - Approximate size and shape of abutment, MSE panels and wingwall - (3D)	Element modeling to include: - Accurate size and geometry of each element - Sloping surfaces. - Openings for utilities - Limit of estimated (0.7) reinforced soil mass/backfill	Specialty/customized aesthetic design of panel face	Element Modeling to include: - MSE wall Soil Reinforcement - Abutment Soil Reinforcement - Reinforcements and Lap splices - PJF - Openings for utilities - Limits of reinforce soil mass and select backfill
	Embankment and Slopewalls	Priority is on the location, length and width of the embankment and slopewalls.	Horizontal placements confirmed. Element modeling to include: - Approximate geometry of elements and locations - Identification of slopewall material - (3D)	Element modeling to include: - Actual cross-sectional size and area of the system - Embankment cones - Accurate sloping of the elements - Stone riprap and bedding if applicable - streambed (refer to bathymetry)	Element modeling to include: - Reinforcement details - PJF if applicable - Streambed - Filter fabric - 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: - Approximate coverage area of the waterways - (3D)	Element modeling to include: - Accurate coverage area of the waterways - Vertical clearance information	Element modeling to include: - EWSE - Streambed elevation - Depth to bearing stratum - Penetration into bearing stratum - Locations of lap splices - Rebar including hooks and lap splices	

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

TABLE 2-6.A.10 – BRIDGE DESIGN PROJECT ELEMENTS (FOUNDATIONS)



Category	Item	L100	L200	L300	L350	L400
Foundations	Bridge Substructure Foundation (Shallow foundation)	Priority is on the location and horizontal extents of the foundation.	Horizontal placements confirmed. Element modeling to include: - Approximate size and shape of foundation element - (3D)	Element modeling to include: - Overall size and geometry of the foundation element - Sloping surfaces. - External dimensions of the members - Geotechnical bearing strata elevation is modeled from geotechnical report. - Reinforcements - Limits of structural excavation and Porous Granular backfill	Element modeling to include: - Lap splices, Hooks and Bends - Construction joints	
	Bridge Substructure Foundation (Drilled Shaft)	Priority is on the location and horizontal extents of the drilled shafts.	Horizontal placements confirmed. Element modeling to include: - Approximate geometry (e.g. depth) of the drilled shafts - (3D)	Element modeling to include: - Assumed bearing depth per geotechnical report - Top and Bottom of shaft - Actual top of shaft, expected bottom of shaft and estimated top of rock - Size of shaft - Permanent casing, when required - Reinforcements	Element modeling to include: - Lap splices including bundles bars - Pipes for crosshole Sonic Logging - Depth to bearing stratum - Penetration into bearing stratum - Locations of lap splices - Rebar including hooks and lap splices	
	Bridge Substructure Foundation (Pile Foundation)	Priority is on the location and horizontal extents of the piles.	Horizontal placements confirmed. Element modeling to include: - Approximate geometry (e.g. depth) of the piles - (3D)	Element modeling to include: - Accurate Size and geometry of pile cap - Assumed bearing depth per geotechnical report - Top of Pile, Top of Pile Cap, Pile Cap Size, Expected bottom of pile - Pile size and cross-sectional geometry - Pile shoes, when required - Pre-coring requirements - Backfilling of pre-cored holes requirements - Reinforcements	Element modeling to include: - Lap splices in pilecap - Concrete encasement - Pile casing if applicable - Depth to bearing stratum - Penetration into bearing stratum - Pile splices - Rebar including hooks and lap splices	

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

TABLE 2-6.A.11 – RETAINING WALL PROJECT ELEMENTS



Category	Item	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: - Approximate limits of concrete walls indicating earth retention and approximate grade on each side - (3D)	Element modeling to include: - Accurate size and geometry of the element - Earthwork surfaces for wall - Limits of structural excavation and Porous Granular backfill - Reinforcements - Openings for utilities	Element modeling to include: - Lap splices, Hooks and Bends - Water seal, PJF - Expansion / construction joints - Weep holes if applicable	
	MSE Wall	Priority is on the location and horizontal extents of the wall.	Element modeling to include: - Approximate limits of MSE walls indicating earth retention and approximate grade on each side - (3D)	Element modeling to include: - Accurate size and geometry of each element - Earthwork surfaces for wall - Openings for utilities - Limit of estimated (0.7) reinforced soil mass/backfill	Specialty/customized aesthetic design of panel face	Element Modeling to include: - MSE wall Soil Reinforcement - Reinforcements and Lap splices - PJF - Openings for utilities - Limits of reinforce soil mass and select backfill
	Moment Slab on Retaining Wall	Priority is on the location and horizontal extents of the wall.	Element modeling to include: - Approximate size and shape of elements - (3D)	Element modeling to include: - Accurate size and geometry of the element - Earthwork surfaces for wall - Opening for utilities - Reinforcement	Element modeling to include: - Lap splices, Hooks and Bends - PJF - 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: - Approximate size and shape of elements - (3D)	Element modeling to include: - Railing structural members - Base / Connection plates - Slotted holes in railing member elements	Element modeling to include: - Anchor bolts and studs - Locknuts and bolts - Fabric reinforced elastomeric pad - Rail splice	Element modeling to include fabrication level information: - Welds - Coping of members - 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 (3D)	Light pole foundation sized and formed to be constructed. Also included are: - Anchor rods and bolts - Conduit, Pole Foundations - Rebars	Element modeling to include: - Schematic of light pole base plate - Schematic of Vibration isolation pad - Washers, nuts, etc.	
	Soldier Pile Wall	Priority is on the location and horizontal extents of the wall.	Element modeling to include: - Approximate limits of walls indicating earth retention and approximate grade on each side - Identification of type of wall e.g. Drilled or Driven soldier pile wall - (3D)	Element modeling to include: - Accurate size and geometry of each element - Wall facing and type of facing e.g. CIP vs Precast - Earthwork surfaces for wall - Accurate geometry of the soldier pile with encasement if applicable - Estimated embedment of soldier pile from Geotechnical report	Element Modeling to include: - Reinforcements and Lap splices - Shear studs - CLSM - Schematic of Timber Lagging - Openings for utilities - Gutter at top of wall - Indication of existing ground surface - Limits of soil removal	Element modeling to include fabrication level information: - Accurate geometry of Timber lagging
	Permanent Sheet Pile Wall	Priority is on the location and horizontal extents of the wall.	Element modeling to include: - Approximate limits of walls indicating earth retention and approximate grade on each side - (3D)	Element modeling to include: - Accurate size and geometry of each element - CIP facing or CIP cap if applicable - Estimated embedment of sheet pile from Geotechnical report	Element Modeling to include: - Reinforcements and Lap splices - Shear studs if applicable - Openings for utilities - Indication of existing ground surface - Limits of soil removal	Element modeling to include fabrication level information: - 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: - Approximate limits of walls indicating earth retention and approximate grade on each side - (3D)	Element modeling to include: - Accurate size and geometry of each element - Drainage system behind the wall - Temporary and Permanent facing material	Element Modeling to include: - Reinforcements and Lap splices - Openings for utilities - Bearing plate, studs, and washers - Indication of existing ground surface - Grout	Element modeling to include fabrication level information: - Accurate size and spacing of soil nails

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

TABLE 2-6.A.12 – NOISE ABATEMENT WALL PROJECT ELEMENTS



Category	Item	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: - Approximate limits of concrete walls indicating earth retention and approximate grade on each side - (3D)	Element modeling to include: - Accurate size and geometry of the element - Sloping surfaces. - Openings for utilities	Specialty/customized aesthetic design of panel face	Element modeling to include: - Reinforcements, Lap splices, Hooks and Bends - PJF - 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 (3D)	Element modeling to include: - Complete size of steel members. - Finishes, i.e. painted, galvanized etc. - Grade of Steel to be used		Element modeling to include: - Connection Plates, bolt holes, anchor bolts - Welds - Exact sloping of members - Permanent stabilizers - Fabric pad when expansion panel is involved - Welds - Coping of members - 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: - Approximate geometry (e.g. depth) of structural elements - (3D)	Element modeling to include: - Accurate size and geometry of the element - Sloping surfaces.		Element modeling to include: - Assumed bearing depth per geotechnical report - Top and Bottom of shaft - Actual top of shaft and expected bottom of shaft. - Size of shaft - Post embedment - Reinforcements and Lap splices including bundles bars - Pipes for Crosshole Sonic Logging

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

TABLE 2-6.A.13 – TEMPORARY STRUCTURES PROJECT ELEMENTS



Category	Item	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: - Approximate geometry of elements and locations - 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 - (3D)	Element modeling to include: - Accurate geometry and locations of the elements - Geotechnical bearing strata elevation from geotechnical report.	Element modeling to include: - Sheetings, wales, deadman, piles or any other potential retention system components.	Element modeling to include: - Complete geometry of elements with precise locations
	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: - Approximate geometry of elements and locations - Identification of type of system (e.g. Temporary Geotextile Walls, Temporary MSE Systems) based on the recommendation in the Geotechnical report - (3D)	Element modeling to include: - Accurate geometry and locations of the elements - 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
	Cofferdams and Seal Coats	Priority is on the location and extents of the cofferdams and seal coats.	Element modeling to include: - Approximate geometry of elements and locations - (3D)	Element modeling to include: - Accurate geometry and locations of the elements - Geotechnical bearing strata elevation from geotechnical report.	Element modeling to include: - EWSE - Streambed elevation - Estimated bottom of sheeting - Estimated bottom of seal coat	Element modeling to include: - Complete geometry of elements with precise locations

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

TABLE 2-6.A.14 – CULVERTS PROJECT ELEMENTS



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

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

CHAPTER 3 DELIVERABLES POLICY

3-1 GENERAL INFORMATION ABOUT DELIVERABLES

This chapter defines the requirements for delivery of electronic files, the workflows for submittal of electronic files, including electronic versions of sheets, and the file and folder structure to be used on IDOT projects.

For general information regarding level of development (LOD) detail required for modeling, see Chapter 2, “Level of Development”.

For specific CADD requirements related to design and modeling, see Chapter 4, “Design Time Workspace”.

For requirements related to plans production, see Chapter 5, “Plans Production Workspace”.

For files, configuration, and other information needed to satisfy the requirements of this policy manual, see the Department’s CADD Support website, *Online Resources* section, as described in Chapter 6, “Internet and Reference Information”.

For additional information regarding survey types and accuracy, see the *IDOT Survey Manual*.

For additional information regarding LiDAR (Light Detection and Ranging), see the *IDOT Survey Manual*.

At each stage in the lifecycle of a project is a need to exchange data between various groups involved in the project development and to pass data forward for the next stage in the process. The intent of this chapter is to define required data formats for exchanging data and to outline the workflows for each type of exchange.

3-1.01 PROJECT CONTENT FILE

The Project Content File ensures that all data exchanges are well-documented and easily traceable, facilitating smooth project progression and collaboration among all parties involved. A Project Content File shall be transmitted every time data is exchanged. This file serves as a comprehensive record of all submitted files and their contents, ensuring transparency and consistency in data exchanges.

The Project Content File shall include the following details:

1. The content of every file, including sheet number, area, and stationing, if applicable.
2. For files which contain 3D models:
 - a. List all centerlines, baseline, and associated proposed profiles of all roadways, ditches, or tops of retaining walls and bottoms of retaining walls contained in the DGN files. This list shall include the names of these alignments and a short description.
 - b. For each corridor, the Project Content File shall list:
 - The name of the corridor(s).

- The template library and names of the templates used.
- 3. For structures models, the Project Content File shall list the files which form the 3D structure model and a general description of the contents of each file.
- 4. For LiDAR models, the Project Content file shall list the file names containing each point cloud tile.

The information included in this Project Content File shall be required for every data exchange even when the exchange occurs between units, sections, bureaus, offices, or districts within IDOT, or its project development consultants, and even when there is no physical exchange of files, such as when the data is stored on shared servers.

Acceptable formats for the Project Content File are:

- Text file
- Microsoft Excel
- Microsoft Word

Methods for submittal of electronic files are defined in Section 6-4, "File Transfer".

3-1.02 FREQUENCY OF SUBMITTALS

The frequency of submittals for electronic project files should be established at the beginning of the project to ensure timely reviews and approvals. The Project Manager has the authority to request copies of these files at any time in addition to designated review stages.

3-2 COORDINATION

After review of this and other relevant manuals and coordination with internal staff, the IDOT Project Manager shall determine at the beginning of the project:

1. How files are to be delivered at each phase of the project life cycle and the procedures to be followed.
2. The types and limits of survey.
3. The anticipated needs of data exchange based on the following:
 - a. Project type/scope
 - b. Project complexity
 - c. Whether design will be completed in-house, by a consultant(s), or a hybrid of both.
4. Whether roadway 3D models will be required, and for which portions of the project 3D roadway models will be developed.
5. Whether bridge 3D models will be required, and for which portions of the project 3D bridge models will be developed. Note the decision of whether to produce 3D bridge models will be determined upon coordination with the IDOT Bureau of Bridges and Structures.

6. If 3D models are required, the LOD scoping table (see Chapter 2) shall be reviewed and completed to set the expectations for the project and included in the scoping documents. Scoping documents shall be provided by the Project Manager.
7. Maximum length of any corridor in a DGN file to optimize for performance and files size. See Section 4-17.01(c), “Length of Corridors”.

For projects with consultant involvement, these communications should be included in the scope of services meeting.

3-3 DATA EXCHANGE AT VARIOUS LIFECYCLE STAGES

During each phase of the project, there is a need to exchange data for both review and for downstream activities within the project life. It is important to note that this section attempts to describe all potential data exchanges during the life of any given project. Not every data exchange described here will be part of every project. As such, the remaining portions of this section should be seen as a statement of need for the most complex of projects. For a given project, there may be additional required transfer of data which is not defined in this manual. Key individuals involved in the hand-off of project development data, including the CADD Manager, Surveyor, and Designer should discuss data exchange needs with the Project Manager.

See *Bureau of Design and Environment Manual*, Section 63-1.03a, for a description of the criteria which is used to determine whether a 3D model will be required for a particular project.

The following extreme examples are offered for guidance:

Example 1 – A project which is a major relocation of alignment with significant amounts of earthwork:

- This project is ideally suited for full 3D modeling of the roadway corridors.
- If there are many existing utilities along the project route, then there are benefits in fully modeling the utilities. However, there may be other recipients for the project data that may not be ready to accept or produce such models and may request other delivered formats.

Example 2 – 3P and SMART projects are, by their nature, less benefited by production of 3D models. For these projects, the deliverables may typically be more oriented to 2D deliverables at most phases of the project life.

- If 2D is agreed upon as the deliverable, the plans shall still be georeferenced to the coordinate reference system defined by the District Survey Unit, for incorporation into the Department’s asset management solution(s).

The CADD Standards in Chapter 4, “Design Time Workspace”, and Chapter 5, “Plans Production Workspace”, are developed to satisfy both 2D and 3D deliverables.

The following sections describe which files may be required for exchange during the project life and the workflow to exchange and / or produce those files. The naming of the organizational units

throughout this section has been generalized and may include in-house and/or consultant personnel. For projects involving consultants, the appropriate project submittal to the Department is generally at key project milestones to the CADD Manager or Project Manager, as determined during the scope of services meeting.

It should be noted that the use of computer methods, especially 3D design workflows, enable the designer to shift many activities typically completed in Phase II earlier to Phase I. For example, the workflow to produce corridor designs also produces geometric layouts of the pavement and lane edge lines. Because of this, it is reasonable to expect that more complete 3D models will exist in Phase I even though these are not required deliverables in Phase I.

Possible exchanges / handoffs during each Phase

Phase I (Studies)

- Roadway Design deliverables for Surveys
- Data exchange between Design Surveys and Roadway Design and / or Structures
- Data exchange between Roadway Design and Structures
- Geometrics Design deliverables to Roadway Design
- Geometrics Design deliverables for preliminary Signal Design
- Deliverables from Environmental Studies

Phase II (Plan Design)

- Data exchange between Roadway Design and Land Acquisition
- Data exchange between Roadway Design and Utilities
- Data exchange between Roadway Design and Drainage (Hydraulics) Design
- Data exchange between Roadway Design and Structures
- Geotechnical design deliverables to Roadway Design
- Materials design deliverables to Roadway Design
- Operations design deliverables (traffic signals, signing, striping, traffic control plans, and / or detour route plans) to Roadway Design
- Deliverables from Roadway / Structures Design to Bureau of Design and Environment

Phase III (Construction)

- Deliverables from Roadway Design to Construction
- Deliverables from Construction to Design

Phase IV (Maintenance and Operations)

- As-Built Models – As of this writing, Phase 4 is recognized ONLY as a future desire to collect as-built information for use in various asset management workflows. However, the documentation of collecting and delivering as-built information is NOT defined in this manual and is reserved for future study.

The *Bureau of Design and Environment Manual* Section 63-1.02 contains additional information about the various plan development activities in the various phases.

3-3.01 PHASE I DELIVERABLES

3-3.01(a) FROM ROADWAY DESIGN TO SURVEYS

For general survey needs, the Project Manager shall submit a survey request to the district Surveys Unit early in Phase I, which defines the type of survey needed and general limits of the project. Additional pickup survey requests may become necessary throughout Phase I and Phase II and shall be initiated by the Project Manager.

The survey request shall include the decisions made during project coordination discussions, as described in Section 3-2, "Coordination", including whether the design shall/shall not be fully modeled, and whether any design shall match existing pavement cross-slopes or reprofile/correct cross slopes. In general, 3D models require denser survey data collection than 2D designs and matching of cross-slopes requires denser survey data than when correcting cross-slopes.

If requested by the Surveys Unit, any existing electronic files which contain information in the project area shall be transmitted to the Surveys Unit along with the request. This information may consist of DGN files, terrain models, geometric layouts, alignments, digital images, point cloud data, or miscellaneous other information.

3-3.01(b) FROM DESIGN SURVEYS TO ROADWAY AND / OR STRUCTURES DESIGN

When delivering survey information, the package of deliverables shall consist of all DGN files which contain the final processed survey map, topography, and/or terrain model information. Survey data shall adhere to the LOD standards approved by the Project Manager during initial project coordination.

The following description of deliverables from Surveys to Roadway Design is only for the purpose of advancing the project development and design. There are additional deliverables requirements for the surveyor for purposes of review by the Surveys Unit. See the "Electronic Survey Data Requirements Appendix" in the *IDOT Survey Manual* for these additional requirements. A link to the *Survey Manual* can be found on the Department's CADD Support website.

At the completion of Design Surveys activities, or at intervals as defined by the Project Manager, the following information shall be provided to the Roadway and/or Structures Designer:

1. A full description of the geographic coordinate system which is used for the survey and any project specific adjustment factors (such as elevation factor or combined scale/elevation factor, if required).
2. Container File(s) which are comprised of the following:
 - a. A single file containing all alignments referenced to it.
 - b. A single file containing references to the final topographic information, complex terrain model(s) and any property or right of way information located in the survey process.

Note the following:

- i. Topographic information shall be contained in 3D DGN files.
 - ii. If existing utilities and drainage systems are collected, the following information is required:
 - 3D line strings showing the position of existing underground utility lines, cross-drain pipes, and storm sewer pipes. The position of this line string is presumed to be the top of conduit for non-gravity systems and invert (flow line) of the gravity systems, unless otherwise designated.
 - 3D points marking the top (rim) elevation of any node structures such as manholes, catch basins, valves, meters, and such.
 - 3D points marking the extreme bottom elevation of node structures where feasible and practical to collect.
3. One or more existing terrain models, with the following expectations:
- a. There will be a terrain model of the existing ground surface which covers the entire project, or as necessary for the scope of the project.
 - b. There may be instances when an existing surface and LiDAR surface shall be merged into a complex terrain model.
 - c. There may also be additional terrain models used to depict auxiliary surfaces such as bridge decks.
 - d. There may be additional terrain models for subsurface layers of earth, such as rock layers, caves, or mines.

Topographic information shall be delivered in the Bentley CONNECT Platform software terrain model format.

3-3.01(c) SURVEY DELIVERABLES WHEN LIDAR IS USED

LiDAR (Light Detection and Ranging) technology uses laser scanners to collect a cloud of surveyed points on a project. These point clouds are made up of hundreds of thousands, or even millions, of points. The collection of these points is non-discriminatory; anything within the visual field of the scanner is collected. Because of these data characteristics, survey data collected using LiDAR technology requires special handling by the surveyor and specialized discussion of required deliverables.

This sub-section and the following three sub-sections describe only the required deliverables when LiDAR technology is used on IDOT projects. For required field procedures and accuracy standards when performing field collection of LiDAR data, see the *IDOT Survey Manual*:

All LiDAR data, including survey control, shall be verified by the Department both at the time of collection and before proposed use. Please contact the Surveys, Mapping and Modeling Section of the Bureau of Design and Environment and the appropriate district Survey Chief to discuss coordinate systems, accuracy, and survey control standards for a particular project before data collection. If work is completed by a consultant and found in error, it shall be corrected by the consultant to the satisfaction of the Department at the consultant's expense.

It should be understood that the survey deliverables described in preceding sections are not changed in any substantial way, even if LiDAR is used. The surveyor is still required to deliver terrain model(s), topographic maps, alignments, and property/right-of-way information. There may be additional DGN files containing this information, as described below. Additionally, the LiDAR point cloud data itself shall be made available to both Roadway and Structures Design Units.

3-3.01(d) ACCURACY AND COORDINATE SYSTEMS OF LIDAR DATA

All deliverables of LiDAR data, or data derived from LiDAR, from Surveys to Design shall maintain the same absolute accuracy and coordinate system as the rest of the project's survey data.

Any LiDAR data which is consumed from statewide, county-wide, or public sources shall be transformed to match the coordinate system and accuracy of the project as a whole.

These accuracy and coordinate system requirements shall apply regardless if the source of LiDAR data is collected by fixed wing aircraft, helicopter, Unmanned Aerial Systems (UAS, a.k.a. drone), or mobile or terrestrial scanners.

3-3.01(e) LIDAR POINT CLOUD DELIVERABLES

The 'raw data' product created by LiDAR scanning is known as a point cloud. The form and function of these point clouds are consistent, whether the field collection is performed by terrestrial, mobile, UAS, or aircraft-mounted scanners. The volume of information collected results in very large computer files, which demand significant processing speed from the computer."

While these large datasets are expected, certain measures can be taken to minimize downstream impacts on design processes. These measures include:

1. Data Tiling – Breaking the project into multiple adjacent point clouds.
2. Noise removal – Removing points from the cloud which are not relevant to the project. For example, passing cars are often seen in the point cloud and can be removed.
3. Point filtering – Using filtering algorithms to reduce the total number of points in the point clouds while retaining the overall accuracy of derived terrain models.
4. Point classification – Assigning a classification to some or all points which allows toggling the visibility of points in a similar fashion as a level is used in a CADD file.

Additionally, the surveyor shall extract information from the point cloud which allows the Designer to completely ignore the point cloud itself, if desired. The extracted deliverables are discussed later in this Chapter.

However, the point cloud is the official raw data source, and as such, its delivery shall be standardized throughout the Department. Please deliver all point clouds using the following guidelines:

Data Tiling

A point cloud for a project can easily exceed 50 GB in total file size, making it unmanageable as a single file. Therefore, the delivered point clouds shall be tiled or segmented into multiple individual files. Each file shall be small enough to be opened, viewed, and edited without overly taxing the computer system.

Point clouds will be used for editing and viewing activities by the Surveyor, Designer and other downstream consumers. To accommodate these activities and potential hardware limitations of downstream users, it is recommended that individual point cloud files not exceed 2 GB in size. Typical tile sizes should generally not exceed 1000 feet in length measured along the project's main centerline.

Noise in the Point Cloud

Laser scanning captures points on all surfaces within the distance, surface reflectivity, and/or angle of incidence limits for the system. Points on surfaces such as pedestrians and passing vehicles, or false points caused by the distortion of the laser signal return are considered noise and must be removed.

Point Filtering

As part of the post processing effort of the point cloud, the surveyor should consider applying elevation filters to reduce the total number of points in the cloud. Most modern post processing software provide filtering capabilities in which the surveyor inputs desired final vertical accuracy parameters and the software applies algorithms to adjacent points such that points which fit within the defined envelopes are removed. Often, total numbers of points can be drastically reduced. While the surveyor may wish to retain the unfiltered cloud for archive, a filtered point cloud can somewhat reduce some downstream issues when handling the large files.

Point Classification

Since LiDAR data is managed as a cloud of millions of points, it is necessary to enable the cloud with additional capabilities to distinguish different types of points. In a single cloud, there will be points representing surfaces such as pavement, curbs, grass areas, trees, signs, walls, and other objects within the field of view. Viewing all these types of points at once can be difficult. By assigning a classification to each point in the point cloud, classifications can be toggled on or off, like how levels are toggled in a CADD file.

Table 3-3.A shows the standard point cloud classifications as defined by the American Society for Photogrammetry and Remote Sensing (ASPRS), updated July 9th, 2019.

While it is beneficial to classify all points within a point cloud, the effort can be laborious. Therefore, the only required classifications for IDOT Roadway and Structures projects are 'Ground,' 'Building,' 'Road Surface,' and 'Bridge Deck.' All points representing these surfaces shall generally be classified. All other points may remain unclassified. However, discuss all classification requirements with the data requestor prior to data collection to ensure specific project needs are met.

Table 3-3.A - ASPRS Standard Point Cloud Classifications	
Classification value	Meaning
0	Never classified
1	Unclassified
2	Ground (For IDOT, this includes all points which are not road surface which help constitute the existing ground terrain model)
3	Low Vegetation
4	Medium Vegetation
5	High Vegetation
6	Building
7	Low Point (noise)
8	Reserved
9	Water
10	Rail
11	Road Surface (For IDOT projects this includes all paved or unpaved road surfaces, including curbs and sidewalks.)
12	Reserved
13	Wire - Guard (Shield)
14	Wire - Conductor (Phase)
15	Transmission Tower
16	Wire-Structure Connector (for example Insulator)
17	Bridge Deck (For IDOT projects, this also includes bridge abutments, beams, piers and other substructure.)
18	High Noise
19	Overhead Structures
20	Ignored Ground
21	Snow
22	Temporal Exclusion
23-63	Reserved
64	Retaining Walls. (Classification value 64 is listed as “user definable by ASPRS.”)
65-255	User Definable

Other Point Cloud Attributes

When collected in the field, each point within the point cloud can also include the following attributes:

Intensity – Brightly lit objects within view of the scanner will return a signal of greater intensity than dull objects. This intensity value shall be collected, preserved, and delivered as part of the point cloud.

Color – Modern scanners can also capture photography through the same lens used for the laser signal. This photography is used to determine the true-life color of the measured point. These color values (Red, Green, Blue) provide very high value to down-stream consumers of the point cloud because the point cloud will appear more like a photograph rather than a cloud of points. Interpreting the point cloud is thus greatly simplified.

However, collecting RGB values can increase field time and result in larger file sizes. In some projects, such as those collecting data only along an interstate, the color value may not provide much enhancement for the consumer of the point cloud data. Therefore, the surveyor shall balance the value of the collected color values against the increased file size and the greater time exposed to traffic when determining whether to collect color values in the point cloud. Discuss all attribute requirements with the data requestor prior to data collection to ensure specific project needs are met.

Format of Delivered Point Clouds

Point clouds shall be delivered in one of the following formats.

1. LAS file format is an industry standard format for point clouds and can be created and read by all point cloud processing and viewing software. It is recommended that binary LAS be used since it results in a smaller file size than American Standard Code for Information Interchange (ASCII) LAS. LAS format is 1.4 for the Bentley CONNECT Platform software.
2. E57 file format is a newer format and includes the capability to include images along with the point cloud. Use of E57 is not currently recommended since not all products can yet read this format. If and when used, each separate setup should be individually provided in order to view the complete data in the appropriate software.
3. One or more DGN file(s) with the point cloud(s) attached.
 - a. The process of attaching the point clouds will create Bentley POD format files which shall also be delivered.
 - b. The DGN files shall be named in accordance with Section 3.5.02(a), "Naming of Roadway Design files", below.
4. DOT is a file format specific to TopoDOT software which takes all the LAS files for a project and converts them into individual DOT files, which allows for increased processing speed within TopoDOT. This file type is not mandatory for use within TopoDOT but is recommended.

The IDOT District Project Manager, Designer, and Survey Chief should coordinate the format of the Point Cloud deliverables. For additional guidance, contact the Surveys, Mapping, and Modeling Section. Regardless of the format delivered, all the above requirements for the data apply.

3-3.01(f) LIDAR DERIVED DELIVERABLES

Point clouds cannot be used directly for design or mapping workflows. To support traditional workflows for design, various information must be extracted from the point cloud. The outcome of such extraction results in a group of deliverables which are derived from the point cloud, but in every other respect will match data which is created from more traditional survey processes.

For example, terrain models and topographic features can be extracted from the point cloud data. These derived features shall be delivered in the same formats and file naming conventions as the conventional field survey.

Additionally, other feature types can also be extracted because of the extreme data density of the point cloud. These additional feature types include mesh features, which are useful for tunnels and vertical faces, and solid features, which can be useful for bridge and wall structures.

The following information shall be extracted from the point cloud and delivered to Design, except when the Design Unit has specified a point cloud only delivery or a smaller subset of these deliverables:

1. Existing ground terrain model – A terrain model which represents the existing surface of the ground. This terrain model will consist of the points in the point cloud which are classified as ground, road surface or wall. This terrain model will usually be merged with terrain models produced from traditional survey information. On some projects, the terrain model from a point cloud will not provide any additional useful information and need not be produced.
2. Linear Features – Linear features shall be extracted from the point cloud corresponding to all usual topographic features, pavement striping, low wires and break lines. These features shall be assigned appropriate feature definitions as shown in the Feature Definition listing available on the *Online Resources* section of the Department's CADD Support Website. These features shall be stored in a DGN file with appropriate strip file naming, as shown in Section 3.5.02(a), "Naming of Roadway Design files", below. The linear features extracted from point clouds may be in a separate file from the features collected by traditional survey methods.
3. Point features – Point features shall be extracted from the point cloud for identifiable topographic features such as hydrants, poles, inlets, manholes, signs, etc. The surveyor may find that the effort to extract these point features is greater than the effort of collecting them in the field using traditional survey methods. This can happen because there will almost always be a necessary survey effort in the field to collect utilities, drainage, and other similar information not evident in the point cloud. It may often be easier to collect everything in the field survey pass rather than extracting from the point cloud. In any case, it is the intent that the end result of traditional survey combined with point cloud processing

produces a final map with all relevant point features displayed in the topographic strip map file(s).

4. Solids – As directed by the Project Manager or requested by the Bridge Unit, solid objects shall be extracted from the point clouds representing the bridge deck slab, abutments, piers and retaining walls. These solids shall be stored in DGN files with strip file names as defined in Section 3.5.02(a), “Naming of Roadway Design files”, below.
5. Mesh Surfaces – Mesh surface objects shall be extracted from the point clouds and stored in DGN files with strip file names as defined in Section 3.5.02(a), “Naming of Roadway Design files”, below. The mesh elements shall be assigned an appropriate feature definition from the lists shown in the Feature Definition listing available on the *Online Resources* section of the Department’s CADD Support Website. These mesh surfaces can be used by Design in similar fashion as terrain models, such as for targeting of cut/fill slopes. Mesh surfaces shall be extracted from the point cloud for:
 - a. The inside surface of tunnels.
 - b. Vertical or over-hanging existing cut slopes or cliffs.

3-3.01(g) BETWEEN ROADWAY DESIGN AND STRUCTURES DESIGN

OpenBridge Designer (OBD) or OpenBridge Modeler (OBM) will be utilized for all Bridge designs, OpenRoads Designer (ORD) will be utilized for all Roadway designs. Both platforms fully integrate with each other to produce the 3D model.

The Roadway Design team shall make available to the Structures Design team, for reference into the structure design, the following:

1. Existing ground terrain model, if one has been developed, in the Bentley CONNECT Platform software terrain model format.
2. Proposed terrain model, if one has been developed, in the Bentley CONNECT Platform software terrain model format, showing the existing ground merged with the proposed finish grade surface of the roadway design.
3. A full package of DGN files showing the proposed roadway design, if developed, including all curvilinear elements, grades and 3D models associated with the proposed design.
4. Existing and proposed project alignment(s) and profile(s) that encompass the entire bridge project. Since the profile grade line mutually affects the roadway design and structures design, there will often be multiple exchanges between these units until a final profile grade line is determined. The Roadway Designer should anticipate multiple iterations of submittal of the above files followed by receipt of a revised grade line from the Structures Design Unit.
5. Any DGN files which contain models of existing and proposed underground utilities and drainage features, if developed. Each utility feature is properly designated for Quality Level according to Chapter 11 of the *IDOT Survey Manual*.

3-3.01(h) BETWEEN GEOMETRIC DESIGN AND ROADWAY DESIGN

In the districts, the Geometric Design Unit is responsible for the geometric layout of intersections and interchanges during Phase I. When required for a project, the Geometric Design Unit's involvement typically marks the initial design work. Therefore, these geometric designs shall be conducted using the Bentley CONNECT Platform software geometry commands and the correct geometry feature definitions from the IDOT workspace. This approach maximizes efficiency as the project progresses, allowing the Roadway Designer to immediately utilize the intelligence embedded in prior work. It also minimizes the possibility of design errors caused by misinterpretation of data or annotations.

When the Geometric Design Unit performs design functions, the Roadway Design Unit shall make available the information provided from Design Surveys as described in Section 3-3.01(b), "Deliverables from Design Surveys to Roadway and/or Structures Design", above.

At the conclusion of Geometric Design, the following alternatives for submittals of geometric designs are provided:

1. DGN file – For projects with the Geometric Design Unit's involvement, there is always a DGN file(s) which shows the geometric design. This DGN file(s) will be in Strip Map form.

Note the DGN file(s) shall follow the feature definition standards of the roadway design workspace. The DGN file(s) shall contain sufficient annotation to eliminate ambiguity in the specifics of the geometry.

2. IDS Sheet files – When an intersection design study (IDS) is performed, the IDS sheet file(s) in DGN format shall be provided.

3-3.01(i) FOR SIGNAL DESIGN

The Roadway Design Unit or Geometrics Unit shall make available to the Signal Design Unit:

- DGN files containing all geometric layouts.
- All other DGN files which are referenced to the layouts including any terrain models or proposed models.

At the conclusion of the preliminary traffic signal design, the following shall be provided to Roadway Design:

- DGN files containing the positions of signals and accompanying equipment.
- DGN files containing any preliminary signal design plans sheets.

3-3.01(j) FROM ENVIRONMENTAL STUDIES

During the course of developing environmental studies, there may be various CADD and / or GIS files produced as a part of the reports, and which show the spatial extents of the various environmental features. All such CADD and GIS files shall be provided to the Project Manager along with submittal of the report.

3-3.02 PHASE II DELIVERABLES

3-3.02(a) BETWEEN ROADWAY DESIGN AND LAND ACQUISITION

Note: Some of the information in this sub-section may be requested in Phase I due to time constraints and to help eliminate project delays and extra costs in Phase II.

The Roadway Designer shall make available the following files for purposes of conducting the processes of land acquisition, utilizing the Bentley CONNECT Platform software:

1. DGN file(s) containing centerline and all geometric layouts, limits of construction, location of proposed right-of-way, permanent easements, or temporary construction easements necessary for construction of the project,
2. DGN file(s) containing any preliminary existing property boundaries and rights of way which may have been extracted from records information during Phase I of the project development.

As needed during project development, the Land Acquisition Unit shall make available to the Roadway Designer the following, utilizing the Bentley CONNECT Platform software:

1. One or more DGN files containing final existing property lines and existing right of way lines.
2. One or more DGN files containing the final proposed rights of way and right of way plans for the project.

The DGN files above will contain all annotations as shown in the example plans. The data created by the Land Acquisition Unit shall be produced in accordance with Chapter 4, "Design Time Workspace" and the *IDOT Land Acquisition Manual*, including the proper use of CADD Standards and Bentley CONNECT Platform software feature definitions.

3-3.02(b) BETWEEN ROADWAY DESIGN AND UTILITIES UNIT

The Roadway Designer shall provide the following minimum information to the Utilities Unit for purposes of performing utility coordination activities:

- Preferred:
 - DGN model showing horizontal and vertical locations of existing utilities from Phase I survey operations, along with all referenced DGN files.
- Acceptable:
 - Hard copy equivalents of these DGN files, if agreed upon by the Utilities Unit and Project Manager.

Additionally, the following should be made available when they exist. Note if these files are desired by the Utilities Unit and Project Manager, request should be made early in the project life to provide adequate time to prepare these models:

1. DGN file(s) showing 3D models of existing utilities as determined during survey operations in Phase I, along with all additional DGN files which are referenced.
2. Existing ground terrain model in the Bentley CONNECT Platform software terrain model format.
3. Proposed / final terrain model, in the Bentley CONNECT Platform software terrain model format, showing the existing ground merged with the proposed finish grade surface.
4. And / or a full package of DGN files showing the proposed roadway and structures design including all curvilinear elements, grades, and 3D models associated with the proposed design.

For all the above files, proper feature definitions from the IDOT workspace shall be used.

All existing utilities shall be marked with an indicator of the reliability and certainty of the true position of the utility asset according to Chapter 11 of the *IDOT Survey Manual*.

At the conclusion of utilities coordination work, or at intervals as required, the Utilities Unit shall provide to Roadway Design any of the following which are available:

1. DGN files of proposed utility relocations.
2. DGN files showing horizontal alignment of proposed utility relocations.
3. DGN files showing vertical alignments of proposed utility relocations.
4. PDF files provided by utility owners showing supposed positions of existing utilities or corrections to positions of utilities previously shown in roadway or survey data.
5. SHP files – GIS data format containing utility assets.

3-3.02(c) FROM ROADWAY DESIGN TO HYDRAULICS UNIT

As required by the Hydraulics Unit, the following information shall be provided to the Hydraulics Unit for review or design purposes:

1. Existing ground terrain model in the Bentley CONNECT Platform software terrain model format.
2. Proposed terrain model, in the Bentley CONNECT Platform software terrain model format, showing the existing ground merged with the proposed finish grade surface.
3. A full package of DGN files, if developed, showing the proposed roadway and structures design including all curvilinear elements, grades, and 3D models associated with the proposed design.
4. Stream cross-sections, profiles and similar data as requested by the Hydraulics Unit,
5. When the storm drainage design is performed by a designer which is not a part of the Hydraulics Unit (such as a consultant designed project), a Hydraulic Report as defined in the *IDOT Drainage Manual* shall be included in the submittal.

6. In District 1, additional Hydraulic Report information will be required as defined in the *Manual of Procedures of the Metropolitan Water Reclamation District of Greater Chicago*.

If any design function is performed by the Hydraulics Unit, such as ditch geometry (horizontal or vertical) design or hydraulic analysis, the Hydraulics Unit shall deliver back to the Roadway Design Unit:

1. DGN files showing the horizontal and vertical alignments.
2. DGN files showing ditch typical sections.
3. DGN files showing any drainage structures or piping layouts, along with any generated 3D models.

3-3.02(d) FROM STRUCTURES DESIGN TO ROADWAY DESIGN

OpenBridge Designer (OBD) or OpenBridge Modeler (OBM) will be utilized for all Bridge designs, OpenRoads Designer (ORD) will be utilized for all Roadway designs. Both platforms fully integrate with each other to produce the 3D model.

At the conclusion of the structures design, or at reasonable intervals as requested, the Structures Design team shall make available the following to Roadway Design team:

- 2D designs or 3D models of all structures that allow for incorporation in the contract. This information is generally only provided to the district at the pre-final stage. Final structure plan sheets and / or models are delivered directly from the Central Bureau of Bridges and Structures to the Central Bureau of Design and Environment; see Section 3-3.02(g), “Deliverables from Roadway and/or Structures Design to Central Bureau of Design and Environment”, below. Any models released to the Contractor shall come from the Structures designer of record.

It is common practice for the Roadway Designer to prepare generically derived models of bridge structures when the Structures Designer was preparing only 2D plans. For example, the Roadway Designer can produce a basic model of a bridge deck by extruding a simple roadway corridor. These models have value for non-construction activities such as public hearings. However, these generic models shall not be included in the package of models provided to the contractor.

3-3.02(e) BETWEEN GEOTECHNICAL DESIGN AND ROADWAY OR STRUCTURES DESIGN

The Roadway Designer shall make available the following to the Geotechnical Designer or Geotechnical Unit:

1. DGN files of all geometric layouts.
2. DGN files showing proposed 3D models:
 - a. Terrain Model of the proposed roadway finish grade.
 - b. Terrain Model of the existing ground surface.

- c. Bentley CONNECT Platform software component meshes for all corridors showing roadway finish grade and subgrade surfaces.

At the conclusion of the geotechnical investigation and design process, Geotechnical Design shall provide to Roadway Design the following:

1. A Roadway Geotechnical Report in electronic or hard copy format prepared according to Chapter 7 of the *IDOT Geotechnical Manual*.
2. For the portions of the Roadway Geotechnical Report which are spatial in nature (such as profiles, cross-sections, and designations of special soils considerations) it is encouraged to deliver these items in DGN files which accompany the report, and
3. It is encouraged that the boring plan and soil profile be delivered in DGN format to accompany the report.

As the department continues to utilize 3D modeling, it is desired that as the various districts and consultants become more proficient in 3D modeling workflows, the following items will be delivered. It is highly encouraged that workflows and practices be developed to provide these deliverables and that such workflows will be shared across all districts for inclusion in a future revision of this manual:

- A 3D DGN file containing a Terrain Model which depicts the uppermost surface of subsurface soils and rock strata, and
- A 3D DGN file which contains 3D depictions of the soil borings.

3-3.02(f) BETWEEN OPERATIONS DESIGN AND ROADWAY DESIGN

The Roadway Designer shall make available the following to the designer or reviewer of traffic signals, striping, signing, and lighting:

1. DGN files of all geometric layouts and their associated 3D models.
2. DGN files showing geometry and associated models for traffic control and detour plans.

At the conclusion of the design process for traffic signals, striping, and signing, the following shall be provided to Roadway Design:

1. DGN files containing the positions of signals, signs, and striping.
2. Bentley SignCAD files of all proposed highway signs.
3. If available, 3D models of the signals and signs features.
4. DGN files containing the finished sheets for signals, signs, lighting, striping, traffic control and detour route plans.

In District 1, lighting design is handled by the district Bureau of Operations. In all other districts, lighting design is managed by the Bureau of Design and Environment, Electrical and Mechanical Unit.

3-3.02(g) FROM ROADWAY AND / OR STRUCTURES DESIGN TO CENTRAL BUREAU OF DESIGN AND ENVIRONMENT

At the end of the roadway and / or structures design phase, the plans and / or models for the project shall be submitted electronically to the Project Manager or CADD Manager in the appropriate district. The Project Manager (or CADD Manager, depending on district) then submits the following electronically to the Bureau of Design and Environment (BDE), after district personnel have completed their review:

For all in-house 2D plan sets, electronically provide:

1. Final sheet files of all contract plan sheets in PDF format; see Section 3-5.02(g), "Naming Convention of PDF Sheet Files", below.
2. Summary of Quantities Spreadsheet in PDF format; see Section 5-7 Quantities.

For all consultant developed 2D plan sets, electronically provide:

1. Final sheet files of all contract plan sheets in PDF format; see Section 3-5.02(g), "Naming Convention of PDF Sheet Files", below.
2. Summary of Quantities Spreadsheet in PDF format; see Section 5-7, "Quantities".

For all 3D modeled plans, in addition to items 1-2 above, electronically provide:

1. Existing ground terrain model.
2. Proposed terrain model.
3. A full package of DGN files used to create the proposed design, including all curvilinear elements, grades, 3D models, and any files associated with the design.
4. Any DGN files which contain models of existing and proposed underground utilities and drainage features. Each utility feature is properly designated for Quality Level according to Chapter 11 of the *IDOT Survey Manual*.

The Bureau of Bridges and Structures shall submit structures designed in-house directly to the Bureau of Design and Environment.

In addition to the electronic submission, scanned PDF copies of any sheets containing original signatures shall also be submitted electronically to the Bureau of Design and Environment. PDF sheets that commonly include signatures are the plan cover sheet, the plan general note sheet, the storm water pollution prevention plan sheet, and any structure general plan and elevation sheets.

The files and/or models mentioned above are used in the bid letting process.

3-3.02(h) FROM ROADWAY AND / OR STRUCTURES DESIGN TO DISTRICT CONSTRUCTION

1. For designs delivered in 2D:

- a. A project content file identifying, by name, all alignments and profiles such that Construction personnel can easily locate the correct file name and feature definition name where the alignments exist; see the General Information About Deliverables section.
 - b. Final DGN sheet files – See Section 3-5.02(h), “Naming of Contract Sheet Files”, below, and Chapter 5, “Plans Production Workspace” for more information.
 - c. A full package of final DGN files showing the proposed roadway and structures design including all lines and grades associated with the proposed design.
2. For designs delivered in 3D:
- a. A project content file identifying all alignments, profiles, surfaces, components, and linear features. These are listed by name, file location and feature definition names are clearly described such that Construction personnel can easily locate the correct information; see the General Information About Deliverables section.
 - b. Final DGN sheet files – See Section 3-5.02(h), “Naming of Contract Sheet Files”, below, and Chapter 5, “Plans Production Workspace” for more information.
 - c. A full package of DGN files showing the proposed design, including all curvilinear elements, grades, and any 3D models associated with the proposed design; see Section 3-4.02(e), “Automated Machine Guidance Required Model Elements”, below, for a more complete description of the following:
 - i. All geometry elements.,
 - ii. Terrain Model of the proposed subgrade.
 - iii. Terrain Model of the proposed finish grade.
 - iv. Terrain Model of the existing ground surface.
 - v. Bentley CONNECT Platform software component meshes for all corridors showing finish grade and subgrade surfaces.
 - vi. 3D curvilinear features for all corridors representing the roadway finish grade and subgrade.
 - vii. Terrain models or mesh surfaces of structure excavation surfaces.

These final design CADD files should be stored in ProjectWise at a location that is readily available and easily identified by the Department’s construction staff; see Section 3-5, “File Naming and Reference File Structure”, below, for information on required file naming and preferred folder structure.

Designers shall anticipate that these CADD files will be used by the Department’s inspection staff to facilitate contract administration activities in accordance with developing 3D CADD and e-construction processes. Designers shall also anticipate that these CADD files will be used by contractors to facilitate their construction activities, including, but not limited to, automated machine guidance. Thus, it is of the utmost importance that the final design CADD files and models are in complete agreement with the contract PDF sheets. It is further emphasized that the contractor and the Department’s construction inspection staff must check and confirm that the CADD files are in agreement with the contract PDF sheets.

The PDF sheet files contained within the contract are the controlling contract drawings unless specified by a Special Provision. If any discrepancy exists between the CADD files and the PDF contract drawings, the PDF contract drawings shall take precedence unless specified by a Special Provision and be verified by the Department's staff for accuracy.

3-3.03 PHASE III DELIVERABLES

3-3.03(a) FROM DISTRICT CONSTRUCTION TO DISTRICT DESIGN - CADD

At the completion of all contract work, the Department's construction staff shall store all electronic CADD files developed or revised during construction, along with any marked-up as-built PDF files, in ProjectWise. These files should be placed in an "as-built folder" corresponding to the appropriate contract number, ensuring they can be easily identified by the Department's Operations and Program Development staff for future use.

3-4 PROCESSES AND METHODOLOGY FOR DATA EXCHANGE

As described above, during various stages of the project life cycle, one or more of the following file types and formats shall be delivered from one unit to another unit within the Department, from a consultant and / or contractor to the Department, or from the Department to a consultant and / or contractor. Data is exchanged at various times among staff of any of the following groups: Design Surveys, Roadway Design, Structures, Land Acquisition, Utilities, Geometrics, Hydraulics, Geotechnical, Operations, Construction, the Bureau of Design & Environment, consultants, and contractors. In the future, collection and delivery of as-built models is also expected.

The following sections provide additional information about the above-described exchange methods and files.

3-4.01 DATA EXCHANGE PROCESSES AND METHODS

3-4.01(a) INTERNAL EXCHANGE

Bentley ProjectWise is currently the Department's standardized CADD project data repository software. Projects are typically categorized under each office by Contract or Structure Number and each discipline has its own sub-folder within the Contract or Structure Number folder, with appropriate user rights assigned by the district CADD Manager and the CADD Support Unit within the Bureau of Design and Environment.

1. All data pertaining to the specific project shall be kept in the proper folder within ProjectWise. See Section 3-5.01, "Design File Folder Structure", below.
2. Within ProjectWise, files shall remain in the native format and not be compressed (zipped).
3. All References shall be verified for path accuracy. All file(s) not specifically associated with the final content of the project file(s) shall be removed prior to being delivered.

3-4.01(b) EXTERNAL EXCHANGE

The Department utilizes a CONNECTED project folder on the Bentley ProjectWise365 portal to transfer data from a consultant or contractor to the Department, or from the Department to a

consultant or contractor. Consultants and contractors must register for an account on the CADD Support website, as noted in Chapter 6 “Internet and Reference Information”, utilizing the same email address as their Bentley IMS account, and have previously setup a Bentley IMS account through Bentley’s methods on their website. Consultants and contractors are not registered per Business name; only one registration per individual email address is required for access to the Project File Exchange. Additional requests utilizing the same email address will be denied. Once the registration has been received and setup, the individual requesting the account will be notified via email with a link to access the Project File Exchange portal. The portal is hosted on the Department’s ProjectWise datasource through Bentley, with access from most web browsers and an internet connected computer.

Other methods of exchanging data are highly discouraged. Any other proposed method must be approved in writing from the Project Manager and CADD Manager responsible for the project, prior to the submittal.

1. Files shall remain in the native format and not be compressed (zipped).
2. The *WorkSet* folder shall be included with all submittals and shall include the *WorkSet.cfg* and *WorkSet.dgnws* files.
3. All References shall be verified for path accuracy. All file(s) not specifically associated with the final content of the project file(s) shall be removed prior to being delivered.

3-4.02 FILES AND FORMATS

3-4.02(a) FILE FEDERATION

The Department enforces file federation for all projects to facilitate multiple users working simultaneously. Federation helps protect against data loss if an individual file is compromised or deleted. Federating files allows design teams to work efficiently with greater ease.

1. Files are split into discipline specific content and that content is then referenced into the Container file for that discipline.
2. The discipline specific file(s) are then referenced into the master container file for the project along with all other discipline specific files.
3. The project container file is then referenced into any Sheet File(s) used to cut sheets or other files utilized to create the final model.

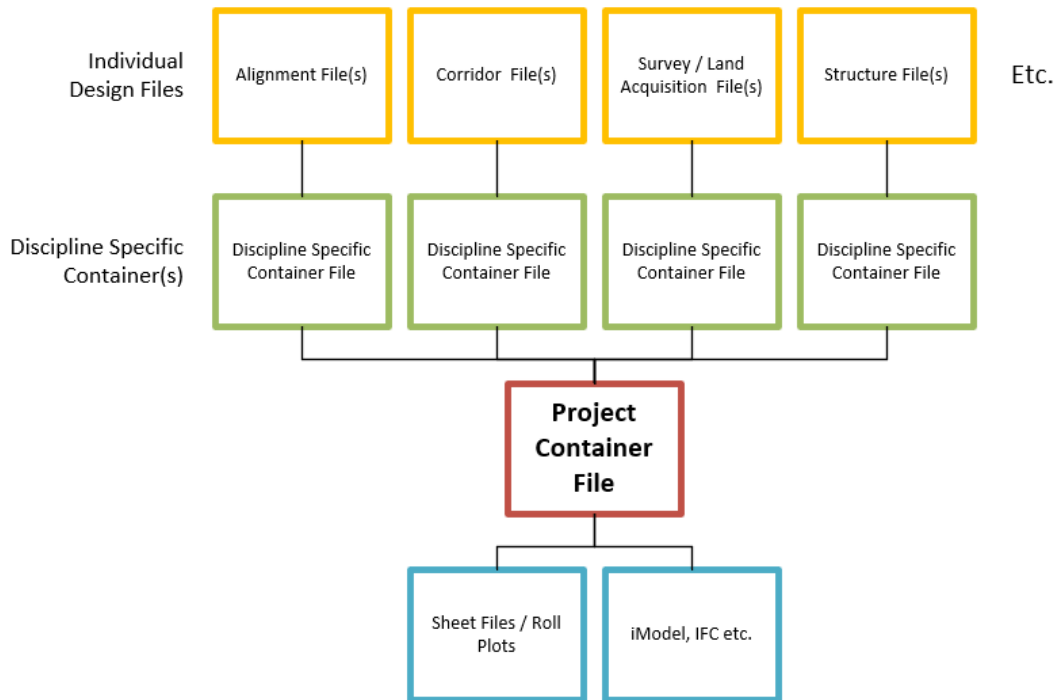


Figure 3-4.A – File Federation Example

3-4.02(b) BENTLEY CONNECT PLATFORM SOFTWARE DGN FILES

Bentley CONNECT Platform software DGN files constitute the bulk of data exchange for most workflows. Survey, Roadway and Structure Design processes store all information into the DGN file so that the packaging of additional external files is reduced as compared to historic workflows.

All project plans shall be developed and delivered in the Bentley CONNECT Platform software DGN format. Design file extensions shall be DGN only; other extensions will not be accepted. Project design (.dgn) files may contain 2D or 3D content, as described in the deliverables above. See Chapter 6, “Internet and Reference Information” for links to IDOT web pages which define current required versions of roadway and structures design software. Generally, the following is expected:

1. The 3D models needed for roadway design are automatically generated by OpenRoads software and require no separate 3D files to be created. These OpenRoads DGN files will contain both 2D and 3D models within a single DGN file. This is normal and expected.
2. Terrain models produced using OpenRoads tools will be contained in 3D files.
3. Survey data will be delivered in 3D DGN files, except for property and right of way information which will be contained in 2D DGN files.
4. Structures 3D models will be contained in OpenBridge 3D DGN files.
5. Sheet files will be delivered as 2D DGN files. Multiple sheet models may exist in a single DGN file.

6. Geometric elements such as alignments, property lines, rights of way and roadway geometry will be contained in 2D DGN files. As noted above, these 2D elements will often exist alongside the 3D models which are managed by OpenRoads.

All files shall be validated prior to delivery using the standards as defined in Section 3-5, “File Naming and Reference File Structure”, below.

The placement of all elements and text within a design file shall conform to IDOT CADD Standards as defined in Chapter 4, “Design Time Workspace” and Chapter 5, “Plans Production Workspace” and as described in the Example Plans.

3-4.02(c) I-MODEL FILES

For some deliverables, or as requested, the use of i-model files may be appropriate. I-models are a specialized form of the DGN file which is read-only in nature and serves a specific purpose for the published design data complete with attributes for a specific purpose. When used, i-model files will contain the same information as described in Section 3-4.02(b), “Bentley CONNECT Platform software DGN Files” above. However, in the process of creating the i-model file, the information exported from the Bentley CONNECT Platform software may be filtered to isolate certain aspects of the model or the contents of multiple files may be combined into a single i-model file.

3-4.02(d) INDUSTRY FOUNDATION CLASS (IFC) FILES

Industry Foundation Class files (IFC) are standardized digital files designed for transferring 3D civil model information downstream. When used, IFC files will contain the same information as described in Section 3-4.02(b), “Bentley CONNECT Platform software DGN Files”. However, the information exported may be filtered to isolate certain aspects of the model or combine multiple files into a single IFC file.

There are no required deliverables of IFC files in this version of this manual. However, upon request, and when the delivery of IFC is in the benefit of the project, as determined by the Project Manager, IFC may be a useful deliverable to subsequent Phases.

3-4.02(e) AUTOMATED MACHINE GUIDANCE REQUIRED MODEL ELEMENTS

As described in Section 3-3.02(h), “Deliverables from Roadway / Structures Design to District Construction” above, the contents of the 3D models which will be used for automated machine guidance must contain all the 3D model elements created for the project, including:

1. Terrain Model of the proposed roadway subgrade:
 - The designer shall produce and include a terrain model as part of the Phase III deliverables to Construction, depicting the subgrade surface of the project. As viewed in cross-section, this surface is depicted by the red line as seen in Figure 3-4.B. The file format for delivery shall be as described at beginning of Section 3-4.02(b), “Bentley CONNECT Platform software DGN Files”, above.

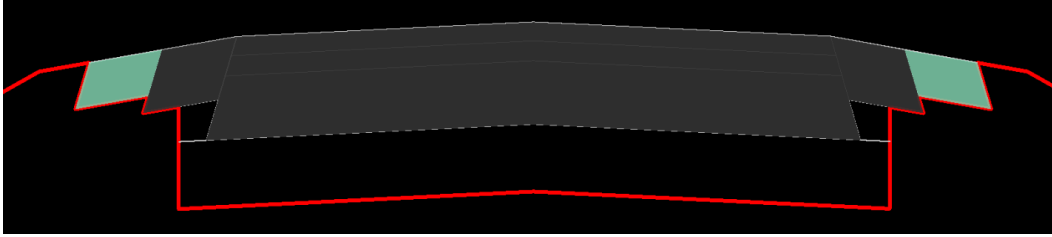


Figure 3-4.B – Subgrade Terrain Model Surface

2. Terrain Model of the proposed roadway finish grade:
- The designer shall produce and include a terrain model as part of the Phase III deliverables to Construction, which depicts the finished grade surface of the project. As viewed in cross-section, this surface is depicted by the red line as seen in Figure 3-4.C. The file format for delivery shall be as described at beginning of Section 3-4.02(b), “Bentley CONNECT Platform software DGN Files”, above.

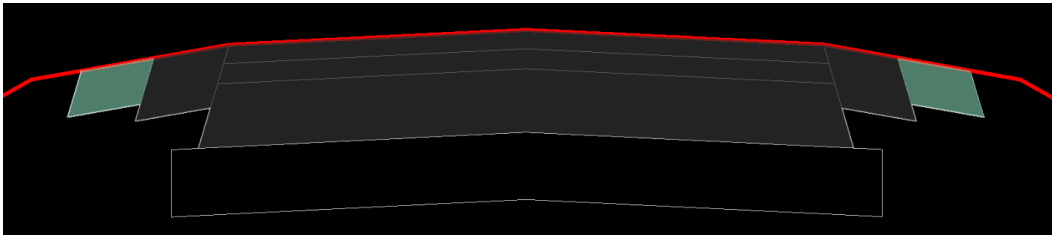


Figure 3-4.C – Finished Grade Terrain Model Surface

3. Bentley CONNECT Platform software component meshes for all corridors showing roadway finish grade and subgrade surfaces:
- The designer shall produce and include the roadway components in the Phase III deliverables to Construction, which depict the various roadway paving components including pavement layers, curbs, sidewalks, and other volume quantifiable items. Figure 3-4.D and Figure 3-4.E show examples of these components as viewed in cross-section and in 3D. The file format for delivery shall be as described at beginning of Section 3-4.02(b), “Bentley CONNECT Platform software DGN Files”, above. These meshes will normally be included in the same file(s) as the 3D linear features described below.

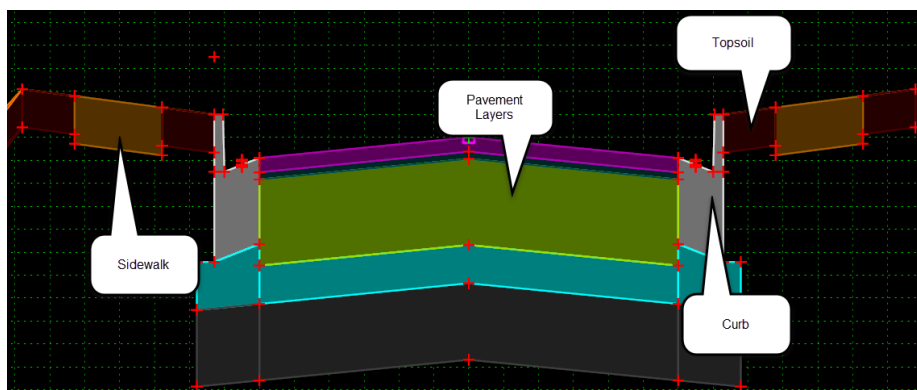


Figure 3-4.D – Roadway Components in Cross-section

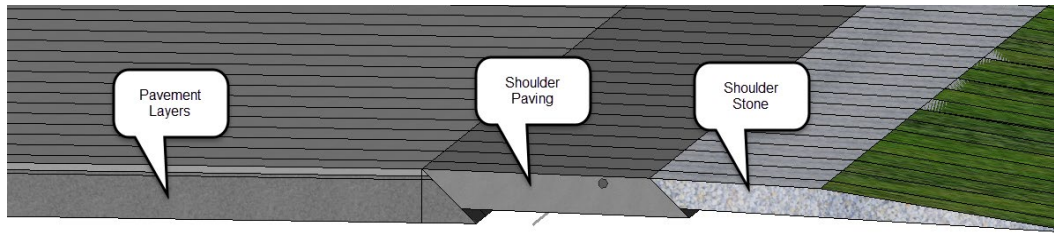


Figure 3-4.E – Roadway Components in 3D

4. 3D linear features for all corridors representing the roadway finish grade and subgrade:
- The designer shall produce 3D linear features which depict the top edges of the various components and include them in the Phase III deliverables to Construction. These linear features are often a more efficient means of loading the 3D model to automated machine guidance equipment because their smaller size (compared to a terrain model) is more compatible with the limited storage space. Figure 3-4.F shows the corresponding cross-section points which generate the 3D linear features. Figure 3-4.G shows an example of the linear features in a 3D model with the line weight enhanced for clarity. The file format for delivery shall be as described at beginning of Section 3-4.02(b), “Bentley CONNECT Platform software DGN Files”, above. These linear features will normally be included in the same file(s) as the component mesh features described above.

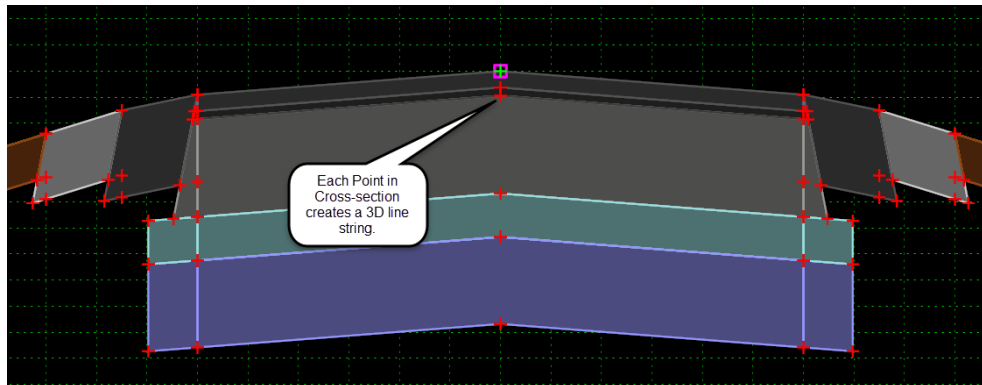


Figure 3-4.F – Points in Cross-section Generate 3D Linear Features

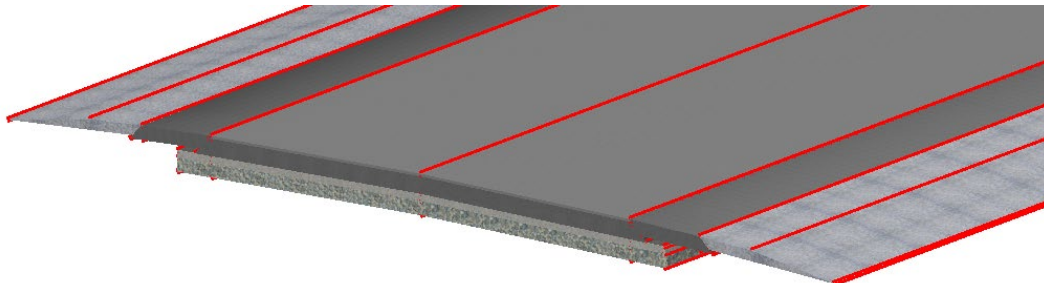


Figure 3-4.G – Example of 3D Linear Features in Model

5. Terrain models or mesh surfaces of structure excavation surfaces:
 - For all structures on the project, there shall also be delivered terrain models, mesh components and 3D linear features for the excavation required at any footings, bridge piers, bridge abutments and retaining walls. It is noted that many retaining wall excavation surfaces will be naturally included as a part of the roadway deliverables described above. The preparation of these structures' excavation surfaces shall be prepared by the appropriate Roadway or Structures Designer. Figure 3-4.H shows an example of an excavation surface required for a footing.

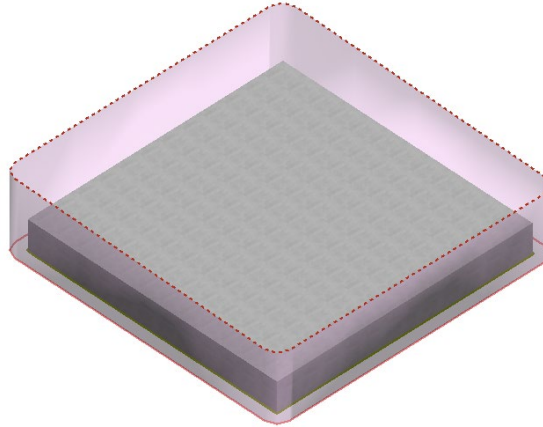


Figure 3-4.H – Example of Structure Excavation Surface Terrain Model for a Footing

6. When maintenance of traffic (MOT) or other phased construction sequences generate an interim design need for a model (e.g., when a later phase depends on an earlier phase to determine slopes), then:
 - Road models must be created for the interim phases.
 - These interim construction phases must be delivered to Construction just as if they were a final construction model.

3-4.03 SHEET MODELS

Sheet files submitted shall have the associated container files referenced and appropriately documented in the Project Content File, as defined in the General Information About Deliverables section above.

Only sheets of a like type are permitted in a multi-model sheet design file. For example, it is not permissible to create a design file containing the title sheet in one model and the schematic plan in a second model.

The preferred method is to provide a single DGN per type of sheet, including named boundaries and drawing/sheet models. All DGN sheet files, including cross sections, shall be submitted on standard sheet border format of the appropriate type as defined in the IDOT workspace cell libraries for roadway or structure plans.

In addition to full size DGN format sheet files, the project shall also be delivered as PDF files at various stages of the project life cycle, including the plan review stage, submission of final contract plan sheets to the Bureau of Design and Environment for placement on a letting, and other stages as requested by the Project Manager. Sheet PDF files shall be delivered in two forms:

- An individual PDF for each sheet shall be created.
- One or more multi-page PDF files containing all contract plan sheets shall be submitted. Multi-page PDF files generally should not exceed 100 sheets per file.

See Section 3-5.02(g), “Naming Convention of PDF Sheet Files” and Section 3-5.02(h), “Naming of Contract Sheet Files”, below, for details on file naming of these PDF sheet files.

PDF sheet files shall conform to the following submittal requirements:

1. Sheets in the PDF files shall be full size (ANSI D).
2. The PDF files should be generated in grayscale. Coordinate with the Project Manager and CADD Manager if monochrome or color PDF files are indicated for a specific project.
3. The PDF files shall NOT have layers. Coordinate with the Project Manager if the needs of a specific project would benefit from the use of layers in the PDF file.
4. Sheets in the PDF files shall be created with landscape orientation, except for narrow cross-sections, which may be portrait orientation.
5. Signed sheets shall be submitted both as a PDF and as a paper document. The signed paper sheets shall be 11” x 17” in size.

Print styles, plot configuration files, and pen tables are included with the IDOT CADD configuration and detailed in Section 5-8, “Printing”. These files shall be used to assist in the creation of PDF files that meet the above requirements.

3-5 FILE NAMING AND REFERENCE FILE STRUCTURE

See also: *Bureau of Design and Environment Manual* Section 63-2.04.

To ensure consistency and efficiency in review and data exchange, a standardized naming convention is required for all files exchanged during the project lifecycle. The combined folder path and file name length shall not exceed 200 characters. Spaces or special characters, other than dashes and underscores, should not be used in file or folder names. Duplicate file names within a project are not allowed.

The contract may require several project submittals for review, therefore, folder or file renaming during the project life shall not be allowed. For each required submittal, the Department will overwrite or update the current project copy located in ProjectWise to allow for quick response to any project questions.

All CADD and design files shall be named according to the file naming conventions described in Section 3-5.02, “File Naming Convention”, below.

All PDF files used for contract plan sheets shall be named according to the file naming conventions shown in Section 3-5.02(g), “Naming Convention of PDF Sheet Files”, below.

A recommended reference file method is detailed in Section 3-5.03, “Reference File Method for Design Files”, below.

3-5.01 DESIGN FILE FOLDER STRUCTURE

The following is the Department’s folder structure for project files:






Table 3-5.A - Project Folder Structure	
Project Folder Name	Folder Content
 _PWSetup	<u>Only present in ProjectWise:</u> Project WorkSets and project specific CFG file for the Bentley CONNECT Platform software. See Table 3.5.B
 _ProjectStandards	<u>Only present on Local Hard Drive or Server:</u> Project standards such as Seed File(s) and Template Library. See Table 3.5.C
 CADDData	Discipline specific sub-folders. See Table 3.5.D
 ConsultantData	Consultant data submittals in individual sub-folders, named by Consultant and Date submitted.
 Reviews	Project review files in submittal stage sub-folders. See Table 3.5.E







Table 3-5.B - _PWSetup Sub and Sub-Sub Folder Structure	
Folder Name	Folder Content
 WorkSets	Project Standards folder and project specific CFG file for the Bentley CONNECT Platform software and a TXT file outlining the Standards setup.
-- Sub-Folders under WorkSets --	
 Standards	Specific Project Standards folders
-- Sub-Folders under Standards --	
 Assemblies	Project specific assemblies utilized in OpenBridge
 GC Packages	Project specific Generative Components utilized in OpenBridge
 Seed	Project specific Seed Files with Geographic Coordinate system set, based off current Department Seed Files.
 Template Library	Project specific Template Library (ITL) copied from the current Department seed ITL file















Table 3-5.C - _ProjectStandards Sub Folder Structure	
Folder Name	Folder Content
 Assemblies	Project specific assemblies utilized in OpenBridge
 GC Packages	Project specific Generative Components utilized in OpenBridge
 Seed	Project specific Seed Files with Geographic Coordinate system set, based off current Department Seed Files.
 Template Library	Project specific Template Library (ITL) copied from the current Department seed ITL file

Table 3-5.D – CADDData Sub and Sub-Sub Folder Structure	
Folder Name	Folder Content
 Aerial Survey	Aerial Photography from any source, and DGN files from aerial or mobile source provided by the Aerial Mapping section in Surveys, Mapping and Modeling in Springfield.
 CADdrawings	Scratch drawing location for DGN(s) used to assist project design but not part of the deliverables.
 CADsheets	DGN sheet files used for contract. Includes structures sheets when consultant designs the structure. Includes cross-section sheets.
 Construction	Files prepared for Construction for use in staking, inspection, or automated machine guidance. These may include various XML files terrain models, and other files prepared exclusively for construction.
 Design	DGN strip map files containing design information such as corridors, profiles, etc. Ancillary DGN files which are part of the roadway design process such as cross-sections produced only for computing phased quantities. If the roadway design includes multiple alternatives, subfolders may be used.
 Documents	Supporting documentation such as the Project Content File and / or other required documents, spreadsheets, and reports.
 Electrical	Lighting and other electrical design strip map files.
 Geometrics	DGN files prepared by Geometrics Design Unit.
-- Two Sub-Folders under Geometrics --	
 IDS	Final Intersection Design Studies DGN files
 Preliminary	Preliminary Intersection Design Studies DGN files
















 Hydraulics	Drainage design and layout strip map files.
 LandAcq	Right of way and property strip map files.
 Lettings	Read-Only location for submittals to the Lettings unit in the Bureau of Design and Environment in Springfield.
 Structures	Structures 3D Models and all DGN files.
 Studies	Planning strip map files and sheets.
 Surveys	Existing survey data, Complex Terrain Model(s), Complex Topo and all other Survey related files.
 Traffic	Pavement marking and signals strip map files.
 Utilities	Utilities strip map files.
 ViewOnly	Read-Only location for historical or consultant provided data utilized in the design process. Data is managed by the CADD Manager.
-- Optional Folders that can be added as needed --	
 Environment	Environmental and wetlands strip map files.
 Exhibits	Exhibits prepared for stakeholder engagement.
 Geotechnical	Geotechnical strip map files.

Table 3-5.E - Reviews Sub-Folder Structure	
Folder Name	Folder Content
 Documentation	Project specific transmittals, spreadsheets, communications, etc. for the review process
 Plan Plots	PDF's sets of DGN plan sheets
 Special Provisions	Project specific special provision information

3-5.02 FILE NAMING CONVENTION

3-5.02(a) NAMING FOR ROADWAY DESIGN FILES

The names of DGN files used for roadway design shall be of the form *D\$12345-type.dgn* where:

D\$ = District number

12345 = Contract number

type = the strip map type as shown below, Table 3-5.F.

For example, D605555-alignSurvey.dgn is used for the DGN file which contains horizontal alignment as defined by the Surveys Unit for project 05555 in District 6.

Recognizing that using this naming convention may not cover all circumstances, if unique file names are required or for large projects that may have a large number of design sections, the file naming may be modified to accommodate the situation. Any revised naming convention shall be requested of and approved by the Project Manager / CADD Manager.

3-5.02(b) NAMING FOR STRUCTURES DESIGN FILES

The names of DGN files used for structure design shall be of the form *Structure-D\$12345-Description.dgn* where:

Structure = Structure Number

D\$ = District number

12345 = Contract number

Description = If needed. Examples: TSL, 3D_Model, Sheets

For example, 0840165-D605555-3D_Model.dgn is used for the DGN file which contains the Design 3D Model for Structure Number 0840165 for project 05555 in District 6.

Recognizing that using this naming convention may not cover all circumstances, if unique file names are required or for large projects that may have a large number of design sections, the file naming may be modified to accommodate the situation. Any revised naming convention shall be requested of and approved by the Project Manager / CADD Manager.

3-5.02(c) NAMING FOR MULTIPLE MODELS WITHIN A SINGLE STRUCTURES DGN

When creating structure sheets in a single DGN file with multiple models, the individual model names shall be the sheet number, with a description of what the model contains in the Description field.

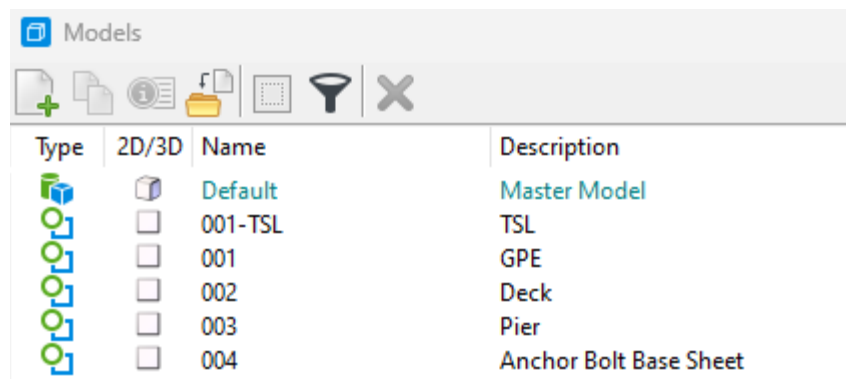


Figure 3-5.A – Example of multiple models in a single DGN file.

3-5.02(d) NAMING FOR FILES USED ON ALTERNATIVE DESIGNS

For alternate designs an alpha character shall be added to the end of the file name (A=first alternate, B=second alternate, etc.). For example, two alternates for a design plan would be named:

- Alternate A - D\$12345-DesignA.dgn
- Alternate B - D\$12345-DesignB.dgn

3-5.02(e) NAMING FOR MULTIPLE FILES OF SAME TYPE

If there is a continued sequence of files for a large project, or a project contains multiple sections to which multiple files are required for each section, a numeric character shall be added to the end of the file name. For example, two files that contain the design plan for two adjacent segments of a given project would be:

- Segment 1 - D\$12345-Design1.dgn
- Segment 2 - D\$12345-Design2.dgn

Another valid reason for segmenting a project is to allow multiple designers to simultaneously work on the same project and for the same file types.

3-5.02(f) NAMING OF MULTIPLE ALTERNATES OF SAME TYPE

It is possible that a need may arise for naming of files when alternate designs are also sufficiently complex to merit breaking into multiple segments. In this case, the naming conventions for alternatives and segments shall be combined. For example:

1. Alternate A, Segment 1 – D\$12345-DesignA1.dgn
2. Alternate A, Segment 2 – D\$12345-DesignA2.dgn
3. Alternate B, Segment 1 – D\$12345-DesignB1.dgn
4. Alternate B, Segment 2 – D\$12345-DesignB2.dgn

3-5.02(g) NAMING OF ROADWAY DGN FILES

Table 3-5.F defines the naming convention that shall be used for files covering the roadway portions of a project. When combined, a filename which appropriately reflects the combined contents shall be used.

Section 3-5.02(c), “Naming for Files Used on Alternative Designs” thru Section 3-5.02(e), “Naming of Multiple Alternates of Same Type”, above, apply when there are multiple alternates for the project or there is a need to segment the project into sections.

Table 3-5.F - File Naming Requirements (1 of 3)

File Name	Description
Structures DGN files	See the Section 3-5.02(b), "Naming for Structures Design Files", above.
D\$12345-AlignSurvey.dgn	Alignments produced by Surveys Unit
D\$12345-AlignDesign.dgn	Alignments produced or modified by the Design Unit. It is acceptable to have multiple design alignment files. Some designers prefer one file per alignment. Add name of roadway or other identifier as part of file name.
D\$12345-AlignMaster.dgn	Master alignment file which contains no data and serves only as a container for efficient referencing. See the Section 3-5.03(a), "Alignment DGN Files References", below.
D\$12345-TopoSurvey.dgn	Existing topographic conditions produced by the Surveys Unit. This file also includes the terrain model which results from the calculations of the survey data. In many cases, this terrain model will be the only terrain model and the file "D\$12345TerrainExist" will no longer be required.
D\$12345-TopoDesign.dgn	Topographic conditions augmented by the Design Unit
D\$12345-Survey.dgn	Survey data owned by Surveys Unit. The survey data contained in this file can be exported to D\$12345topoSurvey.dgn to protect survey raw data or shared directly with Design.
D\$12345-Survey point cloud.dgn	Used for attaching point cloud files. Apply suffixes as appropriate when multiple files are required.
D\$12345-Survey extracted meshes and solids.dgn	Used for storage of solid objects and mesh elements which are extracted from point clouds.
D\$12345-CADD.dgn	CADD Unit proposed compiled data file
D\$12345-Planning.dgn	Phase 1 Study work file
D\$12345-Environ.dgn	Environmental study work file
D\$12345-Cor.dgn	OpenRoads Corridor Model files. There will be multiple corridor files. It is recommended that each DGN file contain only a single corridor and that for longer alignments that the length of corridor in a single DGN be limited to less than 2 miles. Add name of roadway or other identifier as part of the file name.
D\$12345-CorMaster.dgn	Master corridor file which contains no data and serves only as a container for efficient referencing; see Section 3-5.03(b), "Corridor DGN Files References", below.
D\$12345-Super.dgn	Superelevation objects for OpenRoads corridors.

Table 3-5.F - File Naming Requirements (2 of 3)

Strip File Name	Description
D\$12345-Design.dgn	Phase 2 Design Plans work file. Includes proposed corridor geometry to accommodate widening and similar. It is acceptable to have multiple design files. Some designers prefer one file per alignment. Add name of roadway or other identifier as part of file name.
D\$12345-Geom.dgn	Geometrics IDS work file
D\$12345-Hyd.dgn	Hydraulics Unit work file
D\$12345-Prof.dgn	Phase 2 Profiles work file. Since OpenRoads stores design profiles in the same file as the alignment, this file will only be used for legacy workflows or for profile plans production.
D\$12345-Drain.dgn	Drainage work file. It is acceptable to have multiple drainage work files. Some designers prefer one drainage network file. Add suffix to file name as needed.
D\$12345-ROW.dgn	Land Acquisition work file
D\$12345-Soil.dgn	Geotechnical Soils work file
D\$12345-TS.dgn	Traffic Signal work file
D\$12345-signs.dgn	Roadway Signing work file
D\$12345-light.dgn	Roadway Lighting work file
D\$12345-Indscp.dgn	Landscaping work file
D\$12345-eros.dgn	Erosion Control work file
D\$12345-staging.dgn	Traffic Staging and Traffic Control work file
D\$12345-wetland.dgn	Wetlands work file
D\$12345-pmk.dgn	Pavement Marking work files
D\$12345-TerrainExist.dgn	<p>Existing complex terrain models which can be created from survey data and other forms of data. It is acceptable to have multiple existing terrain files, especially to limit file sizes. Add suffix to file name as needed. As noted above, if the existing terrain model is fully described by the terrain model automatically generated from survey data, this file is no longer needed.</p> <p>This file will contain terrain models which originate from sources external to processing of the survey raw data, for example downloaded data from USGS, and the result of merging the survey generated terrain with these external sources.</p>
D\$12345-TerrainProp.dgn	Proposed terrain models. It is acceptable to have multiple proposed terrain files, especially to limit file sizes. Add suffix to file name as needed.

Table 3-5.F - File Naming Requirements (3 of 3)

Strip File Name	Description
D\$12345-util.dgn	Utility company survey
D\$12345-D_U.dgn	Drainage and Utility Engineering
D\$12345-xscTSG_ml.dgn	Cross sections after initial run of the TSG - Mainline
D\$12345-xsc_ml.dgn	Completed cross section - Mainline
D\$12345-xscTSG_sr.dgn	Cross sections after initial run of the TSG - Side Roads
D\$12345-xsc_sr.dgn	Completed cross section - Side Roads

3-5.02(h) NAMING CONVENTION OF PDF SHEET FILES

Final contract plan sheets shall be submitted to the Project Coordination & Implementation Section of the Bureau of Design & Environment in PDF format. The submittal shall include PDF files for each individual sheet and one or more multi-page PDF sheet files containing not more than 100 sheets each.

- Naming for Individual Sheet Files:
 - Format: Contract Number-plan sheet number.pdf
 - Example: 72111-001.pdf.
 - If a, b, or c sheets are needed, use the following naming convention:

Table 3-5.G - Naming for a,b,c Sheets	
Plan sheet	File name
50a	72111-050a
50b	72111-050b
50c	72111-050c

- Naming for Multi-Page PDF Sheet Files:
 - The multi-page PDF files shall not contain more than 100 sheets each.
 - If the entire contract plan set can be contained in a single PDF file of 100 sheets or less, then the naming convention for the multi-page PDFs shall be as follows:
 - Format: PLcontract#.pdf
 - Example: PL72111.pdf
 - If the entire contract plan set contains more than 100 sheets, break the group files at logical points by sheet content. Use the Index of Sheets to help determine break points. When submitting multiple multi-page PDF files, the naming convention shall be:
 - Format: PLcontract#-beginSheetNo-endSheetNo.pdf
 - Example: PL72111-001-100.pdf; PL72111-101-180; PL72111-181-222.pdf

3-5.02(i) NAMING OF CONTRACT SHEET FILES

Table 3-5.H defines the naming system that shall be used for DGN sheet files of the roadway plans. Section 3-5.02(c), “Naming for Files Used on Alternative Designs” thru Section 3-5.02(e), “Naming of Multiple Alternates of Same Type”, above, apply to this list.

Structures sheet file naming is described in Section 3-5.02(b), “Naming for Structures Design Files”.

Table 3-5.H - Sheet File Naming Requirements (1 of 2)	
Sheet Name	Description
D\$12345-sht-cover.dgn	Cover sheet
D\$12345-sht-gennote.dgn	Index of sheets, general notes sheets
D\$12345-sht-SOQ.dgn	Summary of quantities
D\$12345-sht-typical.dgn	Typical sections
D\$12345-sht-schedule.dgn	Schedule of quantities sheets
D\$12345-sht-ATB.dgn	Alignment, ties, and benchmarks sheets
D\$12345-sht-plnprf.dgn	Design plan & profile sheets
D\$12345-sht-plan.dgn	Design plan sheets
D\$12345-sht-profile.dgn	Design profile sheets
D\$12345-sht-elev.dgn	Elevation details sheets
D\$12345-sht-staging.dgn	Staging and traffic control plan sheets
D\$12345-sht-eros.dgn	Erosion and sediment control sheets
D\$12345-sht-drain.dgn	Drainage sheets
D\$12345-sht-rowplan.dgn	R.O.W. plan sheets
D\$12345-sht-parcel.dgn	R.O.W. plat sheets
D\$12345-sht-intersec.dgn	Intersection details sheets
D\$12345-sht-pvtjoint.dgn	Design pavement joint details
D\$12345-sht-pmk.dgn	Pavement marking plan sheets
D\$12345-sht-lndscp.dgn	Landscaping sheets
D\$12345-sht-ts.dgn	Traffic signal plan sheets
D\$12345-sht-light.dgn	Roadway lighting sheets
D\$12345-sht-sign.dgn	Signing plan sheets
D\$12345-sht-wetland.dgn	Wetlands details sheets
D\$12345-sht-removal.dgn	Design removal sheets
D\$12345-sht-details.dgn	Detail drawings sheets
D\$12345-sht-soil.dgn	Soil report plan sheets

Table 3-5.H - Sheet File Naming Requirements (2 of 2)	
Sheet Name	Description
D\$12345-sht-blog.dgn	Boring Log Sheets
D\$12345-sht-xssht.dgn	Cross section sheets
D\$12345-sht-misc.dgn	Miscellaneous designs (non-highway work)
D\$12345-sht-bcr.dgn	Bridge condition report
D\$12345-sht-ids.dgn	Geometrics IDS sheets
D\$12345-sht-rpt.dgn	Project report sheets

3-5.03 REFERENCE FILE METHOD FOR DESIGN FILES

All References shall be verified for path accuracy. All file(s) not specifically associated with the final content of the project file(s) shall be removed prior to being delivered.

The following diagrams show one suggested option for referencing various files together which will facilitate adherence to the standards in this manual and maximize the efficiency of the OpenRoads software workflow.

It must be noted that this section covers only the most common needs of a roadway corridor project. It is not the intent here to define how and where every file of every type will be referenced. Instead, these reference file diagrams describe the general intent for most projects and most file types.

Beyond the recommendations described herein, the designer is instructed to attach files as reference wherever needed so that for any given work file type the necessary information is attached.

This section does not define a reference file methodology for structures files. When constructing 3D structures models, the designer is advised to use a logical method of referencing files together.

When needing to reference the structure design files to the roadway design, the Roadway Designer is advised to use a logical method of referencing the necessary structures DGN file(s) into the roadway files so that appropriate information is shown in the roadway design.

3-5.03(a) ALIGNMENT DGN FILES REFERENCES

Using the Alignment Master file as shown in Figure 3-5.B:

- Attach all other alignment files as references with nest depth of zero.
- Attach TopoSurvey / TerrainExist and TopoDesign (as required) with nest depth of zero.

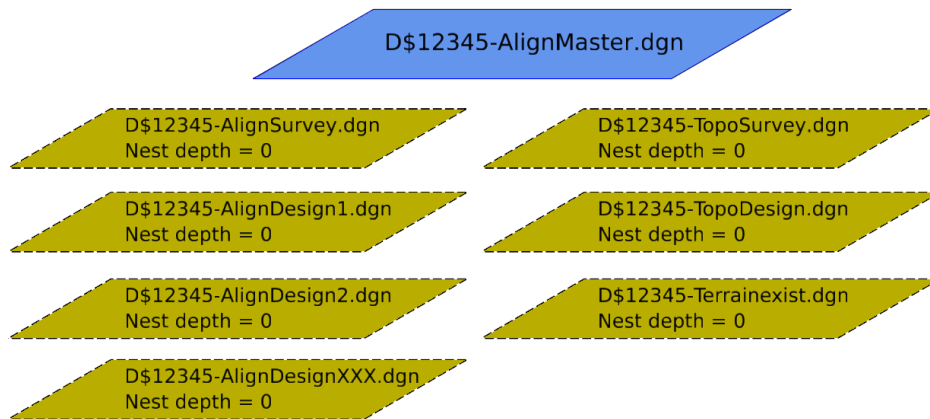


Figure 3-5.B – Alignment Master Reference Structure

Then for every individual alignment file for the various roadways:

- Attach alignment master with a nest depth of 1.

The intent of this recommended structure is to allow attachment of all reference files which contain information pertinent to developing centerlines or may impact the centerline design decisions. Thus, for any specific project there may be additional references from other working groups. For example, for some projects you may need to also reference the wetlands file or other files if they impact the alignment development process.

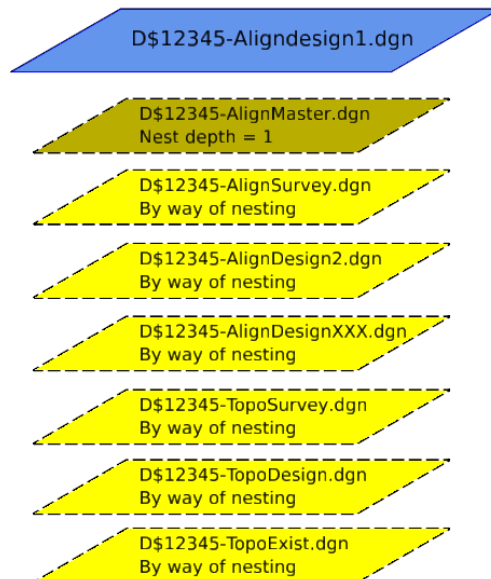


Figure 3-5.C – Reference Structure for Individual Alignment Files

3-5.03(b) CORRIDOR DGN FILES REFERENCES

Using the Corridor Master file as shown in Figure 3-5.D, attach all other corridor files as references with a nest depth of zero.

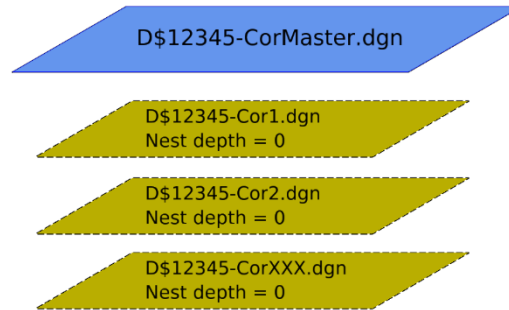


Figure 3-5.D – Reference Structure for Corridor Master

Then for each individual corridor file:

- Attach the Corridor Master with nest depth of 1.
- Attach the Alignment Master with nest depth of 1.

The intent of this recommended structure is to allow attachment of all reference files which contain information pertinent to developing corridor models. Thus, for any specific project there may be additional references from other working groups. If other files are needed, add as references with nest depth of zero.

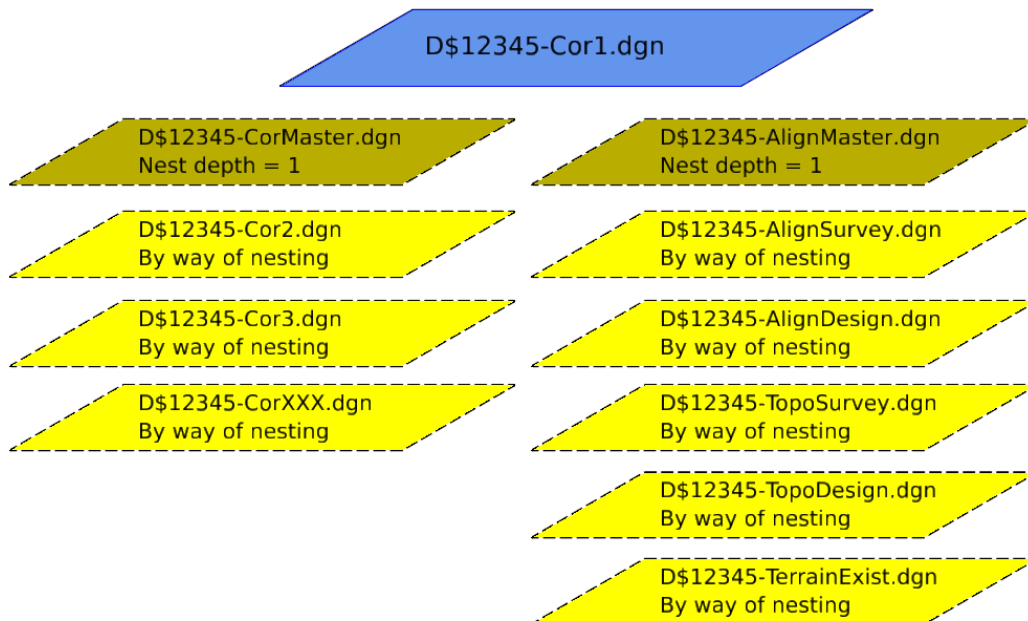


Figure 3-5.E – Reference File Structure for Individual Corridors

3-5.03(c) SHEET LAYOUT FILE REFERENCES

When referencing the various files into the sheet layout file(s), it is recommended to follow the same referencing structure as outlined for corridors in Section 3-5.03(b), “Corridor DGN Files References”, above, and then add any additional needed references with nest depth of zero.

3-5.03(d) OTHER WORKING FILES

The reference structure shown in Figure 3-5.E is also used for:

- Any of the other types listed in Figure 3-5.C.
- DGN files used to set up cross-section sheet files.

Thus, for any particular working file:

- Attach the Corridor Master with nest depth of 1.
- Attach the Alignment Master with nest depth of 1.

And for any of the D\$12345-xsc____.dgn files:

- Attach the Corridor Master with nest depth of 1.
- Attach the Alignment Master with nest depth of 1.

The resultant reference structure would then be the same, in form, as Figure 3-5.E.

CHAPTER 4 DESIGN TIME WORKSPACE

This section defines requirements for producing strip maps and models using CADD and the related portions of the IDOT workspace environment used during design time. For requirements related to plans production, see Chapter 5, “Plans Production Workspace”.

For requirements related to submittal of electronic files, including electronic versions of plan sheets, see Chapter 3, “Deliverables Policy”.

For requirements related to file and folder structure and naming, see Chapter 3, “Deliverables Policy”.

4-1 CADD SOFTWARE PACKAGE

For roadway and structures design, IDOT has selected a variety of software for department-wide computer-aided drafting and design.

- Bentley’s family of CONNECTED products are used as the basis of all computer-aided drafting activities. The DGN format is the native format for the CADD files produced.
- OpenRoads Designer CONNECT Edition is the advanced toolset that our CADD users will be using and replaces GEOPAK. These tools are used to develop the roadway plans and models.
- OpenBridge Modeler can also be used to develop 3D models of structures.
- A variety of MicroStation compatible software is used for analytical aspects of structures design. Regardless of the analytical software used, the plans and 3D structures models (if required) are delivered in DGN format.

All CADD files and 3D models developed by or for the Department shall be developed using versions of these software products as adopted by the Department; see *Bureau of Design and Environment Manual*, Section 63-2.03.

The IDOT workspace and this manual have been developed specifically for these CADD software products. Using the workspace settings described below allows the following benefits:

1. All project participants are able to work on the same set of plans without interfering with other’s design work.
2. The resulting CADD and engineering files will follow a common and consistent form.
3. The files can continue to be used for production of plans and other processes throughout the life cycle of the project.
4. The resulting 3D models can consistently and reliably be used for automated machine guidance and other 3D enabled processes.
5. Calculation of the quantities and other business information can be completed more efficiently.

4-2 LOADING THE CADD WORKSPACE CONFIGURATION

The Bureau of Design and Environment has created a CADD environment for the CONNECTED platform which defines the configuration and the files necessary for the preparation of roadway and structure plans.

To use this environment, internal IDOT users are required to open DGN files from ProjectWise, which will launch the associated Bentley CONNECTED product.

For external users, the workspace environment is available for download at the links shown in Chapter 6, “Internet and Reference Information” under the Support tab as a single download entitled “IDOTCAD CONNECTED platform.zip”. Instructions on configuration and its use are included in the download package.

Before starting a new project, verify that the latest configuration files are installed. This can be accomplished via a comparison of installed files to those currently available from the IDOT CADD Support web page.

The best way to stay informed about the latest IDOT configuration is to be an active participant in the IDOT CADD Support Subscription Service. Subscribers are notified through e-mail whenever changes are made to the contents of the CADD Support websites or this manual. See Section 6-3, “Subscription Services” for instructions to subscribe to the various notification services.

4-3 SEED FILES

The IDOT CADD environment includes Roadway and Structure specific seed files and defines the default seed file.

4-3.01 ROAD SEED FILES

The seed files required for the preparation of roadway plans are shown in Table 4-3.A.

Table 4-3.A - Roadway Seed Files	
Seed File Name	Description
IDOTeng.dgn	Imperial Units 2D seed file. No coordinate system assigned.
IDOTeng3D.dgn	Imperial Units 3D seed file. No coordinate system assigned.

It is usually most efficient to start roadway design files with a 2D seed file with the appropriate coordinate system assigned. See Section 4-3.06, “Geographic Coordinate Systems (GCS)”, below, for more information on coordinate systems.

It is required to start survey files and terrain models files using a 3D seed file with the appropriate coordinate system assigned.

The file naming requirements for design files and models are discussed in Section 3-5, “File Naming and Reference File Structure”.

4-3.02 STRUCTURES SEED FILES

The seed files available for the preparation of structure plans and models are shown in Table 4-3.B.

Table 4-3.B - Structures Seed Files	
Seed File Name	Description
IDOTModelSeed.dgn	Contains sheet, drawing and design seed models. Additional models intended for sheets and full scale details may be added or removed as required. Use this seed file when a single design file is to be employed for an entire project.
IDOTBridge-3D.dgn	Used for generating the 3D models of structures. Similar to the Roadway seed file defined in Section 4-3.01, "Road Seed Files", it is appropriate for use on 3D bridge models which need to be geographically aligned with the roadway models.
IDOTBridge-2D.dgn	Used for plan production purposes only.

For the structures seed files which contain sheet borders, the borders are placed with the lower left-hand corner of the inner border (working area) at $xy = 0,0$.

The file naming requirements for design files and models are discussed in Section 3-5, "File Naming and Reference File Structure".

Model names and descriptions are easily changed by slowly double-clicking on a model name in the model's dialog or else they may be changed in the **Edit Model Properties** dialog.

The structure seed files are the same in both OpenBridge and MicroStation.

For more information concerning the borders used in these seed files; see Section 5-5.02, "Structures Sheets and Borders".

4-3.03 MODELS USED IN SEED FILES

There are three types of models available: Design, Drawing, and Sheet. Design and sheet models can be two- or three-dimensional, while the drawing models are limited to two dimensions, IDOT only uses and accepts two-dimensional models for plan sheets.

The roadway design elements will be contained in a mix of 2D and 3D models which are managed by the OpenRoads software. It is highly recommended that most roadway design graphics, including OpenRoads geometry, corridors, and other elements be created within two-dimensional models. OpenRoads automatically creates the three-dimensional model when you use the OpenRoads modeling tools.

Survey information and terrain models are developed in 3D models.

Structures design elements will be a mix of 2D and 3D models. The Bureau of Bridges and Structures uses the model concept by creating each sheet of a set of design plans in its own model.

4-3.04 GLOBAL ORIGIN IN SEED FILES

The Department sets the global origin to $x = 0$, $y = 0$ and $z = 0$ in all IDOT seed files.

4-3.05 WORKING UNITS

The seed files delivered in the IDOT workspace define appropriate working units of Survey Feet as the master units and Survey Inches as the sub-units within the IDOT seed files. The working units are defined in all IDOT seed files and are extremely important in long distance design file measurements. The resolution is defined as 10000 units per Survey Foot, which provides for the ability to measure and design to an accuracy of 0.001 Survey Feet. It is important to note the Solids Area is defined as 10 miles. This setting is important for the accurate generation of 3D solids and should not be changed.

The Working Units Format defined for the structures seed file(s) is set to MU:SU rather than MU as in the roadway seed file(s). This has no effect on the design models whatsoever and only affects how units are presented to the user in various commands. The result of these settings in the roadway and structures seed files is that the Structures Designer will see distances presented in the form “feet: inches” which is most convenient for them, and the Roadway Designer will see distances presented in the form of decimal feet. However, in both cases the storage units are the same.

4-3.06 GEOGRAPHIC COORDINATE SYSTEMS (GCS)

Assigning a coordinate system to every DGN file aligns the project to its real-world location and facilitates the easy exchange of information to external systems such as ESRI or Google Earth. It also simplifies the referencing of files which exist in disparate coordinate systems.

The correct coordinate system and any additional transformation parameters used for the project are part of the deliverables from Design Surveys to Roadway/Structures Design. Contact the appropriate District Surveys Unit for details on the geographic coordinate system, if needed.

For some projects, there may be an additional modifier applied to the coordinate system to account for elevation and scale factor. The appropriate District Surveys Unit will advise whether an adjustment factor is used.

When attaching a reference that uses a different coordinate system than the master file, use the attachment method Geographic-Reprojected. When this is done, the reference file is transformed on the fly so that alignment of the two coordinates systems is automatic. The “Geographic” attachment methods are only shown when both the active and the reference file have been configured with a coordinate system. In all other cases use Coincident World when attaching references.

4-3.07 HYDRAULIC FILE

Whenever a Drainage and Utilities command is launched in a DGN file which lacks a hydraulic model the hydraulic contents of the hydraulic seed are copied to the active DGN. No user interaction is required for selecting the hydraulic seed file nor does the user need to make a conscious decision of when to create the hydraulic model. It is created automatically as needed. The creation of a hydraulic model in the active DGN is preceded by this informational message.

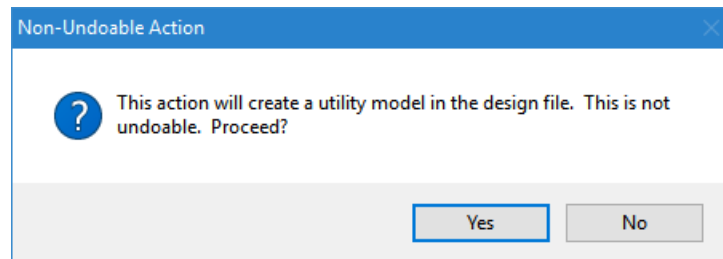


Figure 4-3.A – Message Notifying of Utility Model Creation

Properties copied to the model(s) are:

1. Storm definitions for the Illinois regions – Time-depth and IDF curves are configured for zones 1 through 10 and for return periods between 2 years and 100 years.
2. Hydraulic design constraints – these define minimums and maximums for slopes, velocities, and other design constraints.
3. Hydraulic definitions for grates, curb inlets and manholes, including the various special inlets as defined per district.
4. Runoff factors for various land use as defined in the Department's Drainage Manual.
5. Calculation Options for analysis and design of storm sewer network including culverts.
6. Preconfigured Design Scenarios covering each storm return period for each storm zone.

4-4 LEVELS

Levels are now used only to show or hide features within the design. Feature Definitions are utilized during element creation and apply all necessary symbology, including levels.

Level Filters have been set up to make it easier to locate a particular discipline's group of levels. The **Active Level Filter** dialog allows users to select the set of levels viewed within the **Level Manager** or **Level Display** dialogs.

See the Department's CADD Support website, Online Resources section as described in Chapter 6, "Internet and Reference Information", for a listing of Levels in the IDOT Environment.

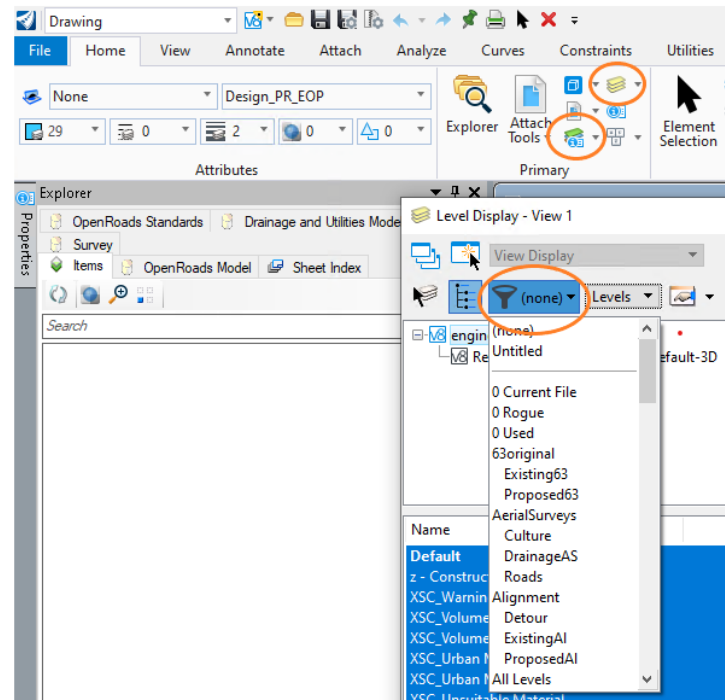


Figure 4-4.A - Active Level Filter

4-5 COLOR TABLE

The IDOT workspace contains standard color definitions for use in roadway and structure plans preparation. See the Department's CADD Support website, *Online Resources* section as described in Chapter 6, "Internet and Reference Information" for the red-green-blue color definitions in the default color table.

4-6 FEATURE DEFINITIONS

The IDOT CADD environment defines OpenRoads feature definitions for roadway, utilities and drainage plans, and model production. Feature definitions are used in conjunction with Element Templates to define element symbology, annotations, and other design information. The use of Feature Definitions is required to ensure that all design graphics adhere to Department standards.

For a complete list of feature definitions, as defined for the IDOT workspace, see the Department's CADD Support website, *Online Resources* section as described in Chapter 6, "Internet and Reference Information".

4-7 ELEMENT TEMPLATES

OpenRoads element templates are used in a feature definition to control graphical symbology. These element templates typically define required level, color, line style, line weight, class, and transparency for the presentation of a feature in the context of plan, profile, 3D, and cross-section. For point geometry, the element template may also define a cell for display of the point. For 3D context, the element template may also define a material for rendering the 3D view. These templates are defined in the feature definition library.

4-8 MATERIALS DEFINITIONS

The IDOT workspace defines materials for visualization. These materials are integrated with the feature definitions and element templates to assist in rendering of the 3D models.

4-9 FONTS AND TEXT STYLES

The IDOT CADD environment defines the true type fonts to be used on all IDOT projects. Effective with this manual, IDOT has transitioned away from the use of traditional fonts stored in .rsc files. The various text styles defined in the workspace only make use of true type fonts. The use of Text Styles is required to ensure that all design annotation adhere to Department standards.

The various fonts are defined in text styles which are used throughout the OpenRoads configuration. The text styles take advantage of annotation scales as defined in Section 4-11, “Annotation Scales”, below.

When placing text, selecting a text style will automatically adjust the text settings. When text styles are used, it is not necessary to manually change font, text height, text width, line spacing or other properties independently. It is only necessary to identify the drawing scale and turn on the Annotation Scale lock when placing a text element.

See the Department’s CADD Support website, *Online Resources* section as described in Chapter 6, “Internet and Reference Information” for a list of available Text Styles. This, in conjunction with the example plans, should be used in identifying what text styles shall be used throughout the plans.

The roadway text styles use font “Arial” which is a vertical sans serif font preferred for use on roadway plans. The bridge text styles use a font named “Engineering Regular” which is a slanted sans serif font preferred for structures plans.

The symbol selector is used to select special characters, circled in Figure 4-9.A.

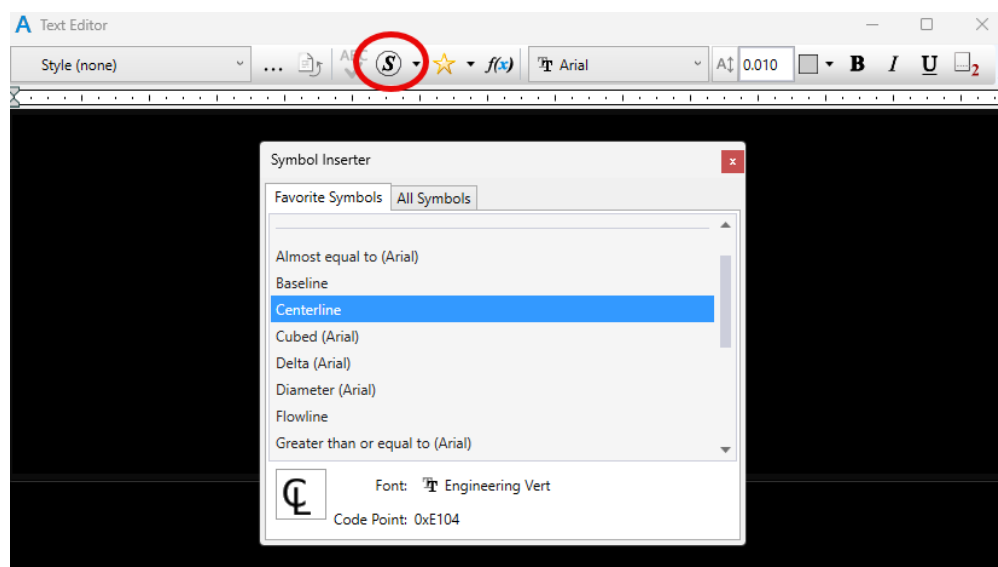


Figure 4-9.A – Special Characters Favorite Symbols

4-10 DIMENSION STYLES

The IDOT CADD environment also defines dimension styles. Dimension styles simplify placement of dimensions and promotes uniformity. Like text styles, dimension style settings are pre-defined inside the Departments CADD Environment. The fonts, as defined in Section 4-9, “Fonts and Text Styles”, above, are utilized in these dimension styles and annotation scale, as defined in Section 4-11, “Annotation Scales”, below, applies to these dimension styles. When placing dimensions, set the drawing scale as appropriate and turn on annotation scale lock. Then, the sizes of text and dimensions will be appropriate for scale. The use of Dimension Styles is required to ensure that all design annotation adhere to Department standards. See the Department’s CADD Support website, *Online Resources* section as described in Chapter 6, “Internet and Reference Information” for current listing of Dimension Styles.

4-11 ANNOTATION SCALES

As part of the 3D modeling workflows, the use of annotation scale for design has been implemented to be consistent with the expectations of the Bentley CONNECT Platform software for roadway and structures design. The modern interpretations of scale account for the differing units of scale used in the United States. For example, a typical scale for projects in the U.S. is 1in. = 50ft. Historically, engineers and software have ignored the difference in units and treated the scale as a simple multiplier. But a rigorous usage of scale requires the recognition that the mixed units actually result in a ratio which is 12 times larger resulting in an actual ratio which is 1:600 (or 1 inch = 600 inches).

The IDOT CADD environment defines the scales shown in Table 4-11.A which are used for development of roadway and structure plans and models:

Table 4-11.A - Annotation Scales					
Roadway Scales			Structures Scales		
Scale		Ratio	Scale		Ratio
1"	= 500'	1:6000	1/32"	= 1'-0"	1:384
1"	= 200'	1:2400	1/16"	= 1'-0"	1:192
1"	= 100'	1:1200	1/8"	= 1'-0"	1:96
1"	= 60'	1:720	3/16"	= 1'-0"	1:64
1"	= 50'	1:600	1/4"	= 1'-0"	1:48
1"	= 40'	1:480	3/8"	= 1'-0"	1:32
1"	= 30'	1:360	1/2"	= 1'-0"	1:24
1"	= 25'	1:300	3/4"	= 1'-0"	1:16
1"	= 20'	1:240	1"	= 1'-0"	1:12
1"	= 10'	1:120	1½"	= 1'-0"	1:8
1"	= 5'	1:60	3"	= 1'-0"	1:4
1"	= 2.5'	1:30	6"	= 1'-0"	1:2
1"	= 2'	1:24			

These scale factors are pre-defined within the IDOT CADD configuration. The ratios shown above are utilized automatically. The designer does not need to make any calculations for sizes since the various cell, text and dimensions libraries have been constructed to utilize these scale definitions. See the various other sections of this manual (text styles dimension styles, cell library, etc.) for specifics related to annotation scale in the context of using those libraries.

4-11.01 DRAWING SCALES USED IN ROADWAY PLANS

The following presents the recommended drawing scales that should be used when developing a set of plans:

1. Cover Sheet. For the layout map, use 1 in. = 1 mile. Layout maps for urban areas may use a larger scale for better clarity.
2. Typical Sections. The scale for the typical section figures is generally at the designer's discretion. The scale may vary from typical section to typical section. The vertical scale should be exaggerated to adequately show the pavement cross section.
3. Plan and Profile Sheets. Plan and profile sheets can be either shown on separate sheets or together on one sheet. The following scales are typically used on plan and profile sheets:
 - a. Layout Maps. For those plans where it is determined that a layout map is required, use 1 in. = 200 ft scale.
 - b. Plan View (Rural). For most projects, use a scale of 1 in. = 50 ft. However, for simple resurfacing projects, 1 in. = 100 ft or 1 in. = 200 ft may be used.
 - c. Plan View (Urban). Depending upon the complexity of the location and work to be accomplished, a scale of 1 in. = 20 ft is normally used.
 - d. Profile View (Horizontal). The horizontal profile scale is the same scale as the plan view.
 - e. Profile View (Vertical). The vertical profile scale is a multiple of the profile horizontal scale to provide a vertical exaggeration factor of 10:1 or 5:1 depending on the complexity of the project. For example, a horizontal scale of 1 in. = 50 ft will have a 1 in. = 5 ft vertical scale.
 - f. Other scales, as necessary, may be used to provide better clarity or more practical layouts. Include a graphic bar scale on all plan sheets drawn to scale.
4. Detail Sheets. Detail sheets will vary according to the element shown. For special intersection or approach drawings, a plan view scale of 1 in. = 20 ft is generally used.
5. Cross Sections. The horizontal cross section scale will typically be prepared using 1 in. = 5 ft or 1 in. = 10 ft scale. A larger scale may be used where a greater cross section width or height is required. The vertical scale should be a 2:1 proportion of the horizontal scale. For example, a horizontal scale of 1 in. = 10 ft will have a 1 in. = 5 ft vertical scale.

4-11.02 DRAWING SCALES USED IN STRUCTURE PLANS

2D plan sets are to be comprised of one or more of the following:

1. Sheet Models comprised of “Base Sheets”.
2. Sheet Models containing referenced views or models from 2D full scale model(s).
3. Sheet Models created in conjunction with Drawing Model(s) generated from 3D georeferenced models of structure or structural component.

For the first method, the base sheets are generally created by the Bureau of Bridges and Structures using the common engineering or architectural scale factors listed in Section 4-11, “Annotation Scales”, above. The desired base sheets are to be placed in individual Sheet Models containing an American National Standards Institute (ANSI) D-sized bridge border at a scale of 1:1.

For the second method, desired full-scale views or models are referenced into individual Sheet Models containing ANSI D-sized bridge borders using the appropriate engineering or architectural scale factor listed in Section 4-11, “Annotation Scales”, above.

For the third method, Drawing Models are generated from the 3D georeferenced model and referenced into individual Sheet Models containing ANSI D-sized bridge borders using the appropriate engineering or architectural scale factor listed in Section 4-11, “Annotation Scales”, above.

For both the second and third methods of generating 2D views or details on plan sheets, careful consideration must be made to select the scale(s) that will provide sufficient clarity for the contractor when printing a Sheet Model to an ANSI B-sized sheet of paper.

4-12 CELL LIBRARIES

The Department provides several cell libraries that contain commonly used symbols representing design elements utilized on projects. The cells have been defined to facilitate scale changes as described in Section 4-11, “Annotation Scales”, above. See the Department’s CADD Support website, *Online Resources* section as described in Chapter 6, “Internet and Reference Information”, for a complete listing Roadway and Structure cell libraries.

4-13 TEMPLATE LIBRARY

Standard roadway templates for use in IDOT roadway design are stored in the workspace in a file named IDOT.itl.

The standard Template Library shall be copied into each project, so that any local changes to templates can be made without introducing changes to the master library.

Some items of note:

- There is a folder at the top of the template library which describes the date when the standard library was last edited. No information should be stored in this folder. It is for informational purposes only.
- The Project Templates folder should be used to store the templates used on the project.

- Everything stored under the IDOT Standard folder are to be used as a starting point to build the project specific templates needed that will then be stored in the Project Templates folder. The Templates contained in IDOT.itl are not a solution for every project. No project is the same and the designer may use the supplied components to build specific templates to meet the needs of the project.

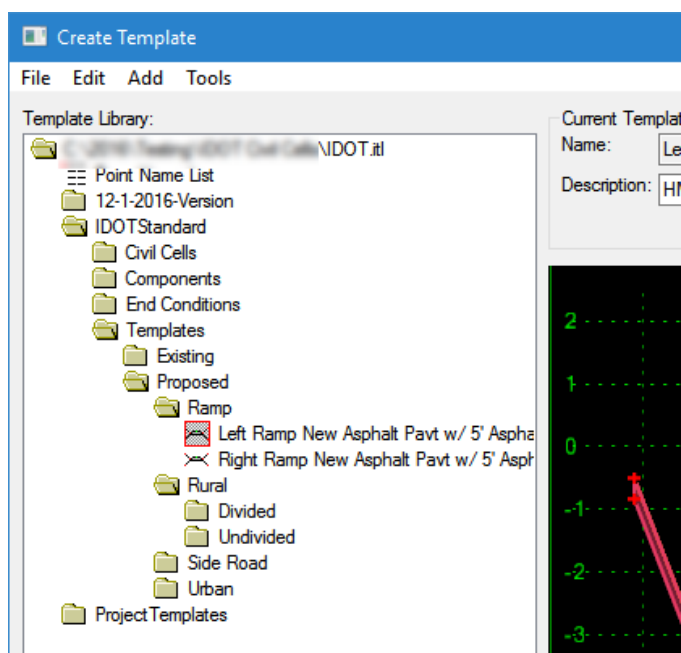


Figure 4-13.A – Template Library

4-14 SUPERELEVATION TABLES

IDOT uses the AASHTO Method 5 radius tables to calculate the superelevation rate (e) and length of superelevation runoff (L). When used with the OpenRoads tools, this file defines various options for the superelevation method, superelevation runoff length, tangent runout length, adjustment factors, distributions, rotation, compound curves, and short curves.

These files are configured in the IDOT workspace and are integrated with the OpenRoads corridor superelevation tools.

For more information regarding superelevation design, see the *IDOT Bureau of Design and Environment Manual* or the *IDOT Bureau of Local Roads and Streets Manual*.

4-15 CIVIL CELLS

Civil Cells allow the quick creation and reuse of complex geometry layouts, such as various intersection configurations, median crossover configurations, and freeway entrance and exit ramp terminals. Civil Cells should not be confused with MicroStation Cells. Civil cells are dynamic groups of OpenRoads geometric elements, that can be easily modified after placement, while

MicroStation cells are static groups of graphical elements. While similar in appearance, the usage of and tools used for these complex elements is very different.

For a listing of current Civil Cells delivered in the IDOT workspace and proper usage videos, see the Department's CADD Support website, *Online Resources* section as described in Chapter 6, "Internet and Reference Information".

4-16 DESIGN STANDARDS

The OpenRoads geometry commands allow the user to evaluate geometric design standards, such as minimum radius, which are driven by design speed. The IDOT workspace delivers the following preconfigured design standards.

Table 4-16.A – Design Standards	
Design Standard Library Name	Description
AASHTO Design Standards 2018 – Imperial.dgnlib	Horizontal and vertical design standards for use with OpenRoads geometry commands. (2018 version)

4-17 PROJECT WORKSPACE SETTINGS

OpenRoads controls the processing of survey and corridors by way of project workspace settings which are stored in DGNLIB files.

4-17.01 CORRIDOR SETTINGS

4-17.01(a) CORRIDOR MODELING TOLERANCES

The following variables are defined in the IDOT workspace and define the tolerances used by OpenRoads modeling tools. These tolerances control the algorithms in OpenRoads corridor tools by driving the density of the model when design stages are configured to automatically densify the model.

- Civil_Default_Profile_Stroking = 0.07
- Civil_Default_Curve_Stroking = 0.07

The Civil_Default_Linear_Stroking variable is utilized to define the template drop interval on Linear Templates.

- Civil_Default_Linear_Stroking = 5.0

Units for the values defined by these variables are master units of the active DGN file.

4-17.01(b) CORRIDOR DENSITY

The 3D models delivered from Roadway Design to the contractor shall have sufficient density such that no portion of the designed surfaces exceed the following acceptable levels of accuracy:

- Horizontal and vertical accuracy at all points in the model shall match the true location to a tolerance of ± 0.05 feet.

Using a maximum template drop interval of 5 for all conditions, should be sufficient to meet this tolerance. This tolerance applies to the portions of the model between OpenRoads template drop locations. At the locations of the template drops, the accuracy is expected to be exact, but in the areas between drops the chorded offset between the model and true location shall not exceed the tolerance defined above.

This accuracy level can generally be obtained by utilizing the IDOT workspace files in accordance with the practices defined in Section 4-14.01, "Corridor Settings", above. However, the designer is instructed to define the model appropriately based on project specific requirements.

When delivering the models for construction ensure that the corridor Feature Definition is set to Final.

4-17.01(c) LENGTH OF CORRIDORS

In order to maximize performance and stability of the design files, the designer should limit the size and length, respectively, of any corridor stored in a single DGN file to no more than 10 MB and approximately 2 miles.

4-17.01(d) WORKSPACE CORRIDOR DESIGN STAGES

The IDOT workspace defines multiple feature definitions to set the design stage, which are used to control the density and appearance of corridor models. The Project Engineer or consultant may change the design stage to satisfy the requirements of the project. The IDOT workspace defines the corridor settings to provide progressively higher model resolution and control display of model feature types as described in the name:

Table 4-17.A – Corridor Design Stages	
Design Stage Name	Description
1 – Design (Medium-High resolution display of corridor components for better performance)	Template drop multiplier = 5 Critical Sections – densify vertical off 3D Output – Linear Features and Components Enable Clipping – True
2 – Design_No_Clippling (Medium-High resolution display of corridor components for better performance)	Template drop multiplier = 5 Critical Sections – densify vertical off 3D Output – Linear Features and Components Enable Clipping – False
3 – Final (High resolution display of corridor components)	Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features and Components Enable Clipping – True

Table 4-17.A – Corridor Design Stages

Design Stage Name	Description
4 – Final_Breaklines (High resolution display of corridor components)	Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features and Components Enable Clipping – True
5 – Final_w/Contours (High resolution display of corridor components)	Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features, Components and Contours Enable Clipping – True
6 – Final_w/Meshes (High resolution display of corridor components, top mesh, and bottom mesh)	Template drop multiplier = 1 Critical Sections – all on 3D Output – Linear Features, Components, Top Mesh, Bottom Mesh

Linear templates are a special case of a corridor and as such the Linear Template Design stages settings are similar. Linear templates should be managed using the same as the Corridor Design Stage above.

4-17.02 SURVEY SETTINGS AND POINT CODES

The methods used for processing of survey data are defined in survey settings. These settings control such things as processing methods, linking codes and whether to automatically create terrain models. The survey settings are loaded with the workspace and copied into the active DGN file when a Field Book is created.

For a listing of current Survey Settings and Point Codes delivered in the IDOT workspace, see the Department's CADD Support website, *Online Resources* section as described in Chapter 6, "Internet and Reference Information".

4-18 TERRAIN FILTERS

The OpenRoads Terrain Model tools contain functionality that can automate the building of terrain models from graphical data when the data is available in a predictable form. Standard filters have been configured in the workspace.

For a listing of current Terrain Filters delivered in the IDOT workspace, see the Department's CADD Support website, *Online Resources* section as described in Chapter 6, "Internet and Reference Information".

CHAPTER 5 PLANS PRODUCTION WORKSPACE

5-1 PLANS PRODUCTION

This section defines required content for the roadway and structures contract plan sheets and the related portions of the IDOT workspace.

For requirements related to design and modeling, see Chapter 4, “Design Time Workspace”.

For requirements related to submittal of electronic files including electronic versions of plan sheets, see Chapter 3, “Deliverables Policy”.

For requirements for file and folder structure of the electronic files, see Chapter 3, “Deliverables Policy”.

5-2 EXAMPLE PLANS

Example plans have been prepared to guide the designer in the requirements for plan sheet production and are posted for download. They are to be used as an aid in the preparation of roadway and structures construction plans in proper IDOT format. For each possible sheet type, there is a page containing general comments pertaining to it, followed by an example of how that sheet type should appear.

Sample plans for roadways and structures can be downloaded from the Department’s CADD Support website, *Online Resources* section as described in Chapter 6, “Internet and Reference Information”.

5-3 ROADWAY ANNOTATION

In order to accomplish roadway annotation, the following features will be labeled utilizing the proper annotation groups, in accordance with the list below:

1. Geometry – the following geometry will need to be labeled accordingly:
 - a. All road centerlines and baselines:
 - Proposed profiles corresponding to these centerlines.
 - Existing ground profiles for roadway centerlines.
 - b. Baselines for retaining walls and noise walls:
 - Proposed ground profiles for top and bottom of wall.
 - Existing ground profile along the wall baseline.
 - c. Baselines for ditches and channels:
 - Proposed profile.
 - Existing ground profile.
 - If requested by Land Acquisition, any proposed right of way lines and property lines created in OpenRoads.
2. Drainage nodes and links created in the OpenRoads Drainage and Utilities.

All final alignment and profile elements within the OpenRoads design file shall be listed in the Project Content File according to Section 3-1.01, “Project Content File”.

5-3.01 ROADWAY PLAN AND PROFILE SHEET LABELING

The IDOT CONNECT workspace defines the files and settings needed to utilize the Civil Labeler tool. This Civil Labeler contains preconfigured settings for labeling of plan and profile view annotations as defined in the example plans.

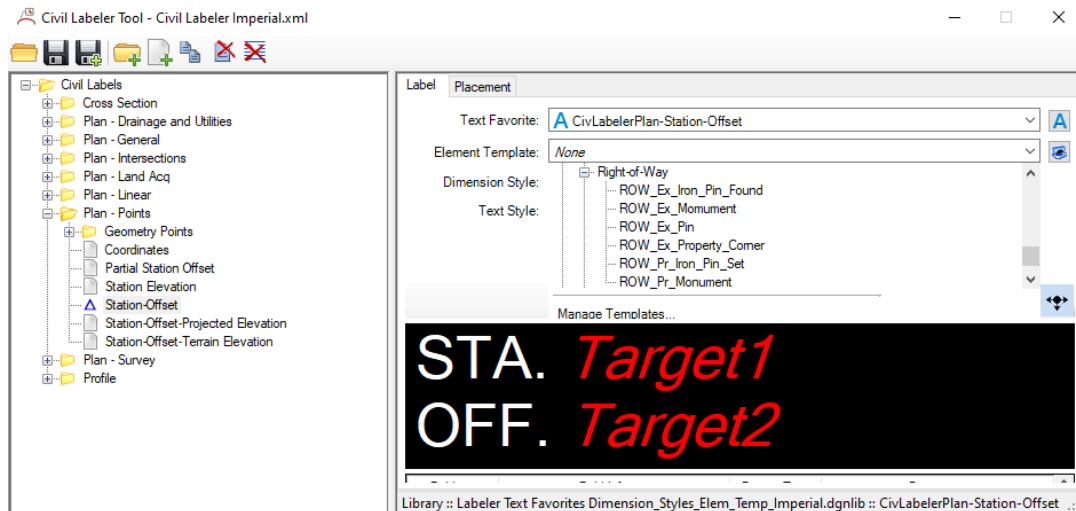


Figure 5-3.A – Civil Labeler

5-3.02 CROSS SECTION LABELING

The preferred workflow for producing cross-sections and cross-section sheets is to develop OpenRoads 3D models and then use the OpenRoads create cross-sections process. Labeling of OpenRoads cross-sections is accomplished as a part of this process which is described more fully in Section 5-5.01(d), “Roadway Cross Section Sheet Layout”, below.

For the example plans showing Cross Section labeling, see the Department’s CADD Support website, *Online Resources* section as described in Chapter 6, “Internet and Reference Information”.

5-3.03 LEGAL DESCRIPTIONS

5-3.03(a) OPENROADS DESIGNER LEGAL REPORT

The OpenRoads Designer Legal Report tool may be used to create Right of Way legal descriptions utilizing coordinate geometry and features.

For further information on the use of the ORD Legal Report tool, the designer is directed to IDOT’s Survey Training documentation on the CADD Support Website.

Property Description	
Report Created: Friday, May 29, 2020 Time: 8:59:07 AM	
Project: Default	
Description:	
File Name: C:\Basic Road Design Modeling\Hwy72\row-tc added\Hwy72_Prow.dgn	
Last Revised: 5/29/2020 08:46:22	
Input Grid Factor:	Note: All units in this report are in feet unless specified otherwise.

Alignment Name: Parcel 7
Alignment Description:
Beginning at a point 0.000 feet right of Parcel 7 at Station 0+00.00 thence N32°50'05.4"E a distance of 381.533 feet to a point 0.000 feet right of Parcel 7 at Station 3+81.53 thence S71°51'52.5"E a distance of 397.001 feet to a point 0.000 feet right of Parcel 7 at Station 7+78.53 thence S35°15'02.9"W a distance of 344.671 feet to a point 0.000 feet right of Parcel 7 at Station 11+23.20 thence N59°02'44.9"W a distance of 141.949 feet to a point 0.000 feet right of Parcel 7 at Station 12+65.15 thence S33°08'47.9"W a distance of 136.748 feet to a point 0.000 feet right of Parcel 7 at Station 14+01.90 thence N56°16'55.0"W a distance of 226.888 feet to a point 0.000 feet right of Parcel 7 at Station 0+00.00 and the POINT OF BEGINNING.
The above described parcel contains ± 3.270 acres (142461.597 sq. ft.)

Figure 5-3.B – Sample Legal Report

5-3.03(b) OPENROADS DESIGNER PARCEL REPORT

Parcels are created in OpenRoads geometry by creating a “closed” complex geometric element. Once the parcel geometry is created, a legal report or map check report can be produced from the OpenRoads tasks menu. Reports can be saved to several file formats such as XML, Word, Excel and HTML for final document preparation.

Map Check Report				
Report Created: Friday, May 29, 2020 Time: 9:01:49 AM				
Project: Default				
Description:				
File Name: C:\Basic Road Design Modeling\Hwy72\row-tc added\Hwy72_Prow.dgn				
Last Revised: 5/29/2020 08:46:22				
Input Grid Factor:				
Note: All units in this report are in feet unless specified otherwise.				
Alignment Name: Parcel 7				
Alignment Description:				
Type	Point Name/ Direction	Northing/ Length	Easting	Elevation
START	()	1767698.798	1993284.588	0.000
	N32°50'05.4"E	381.533		
HPI	()	1768019.376	1993491.463	0.000
	S71°51'52.5"E	397.001		
HPI	()	1767895.804	1993868.742	0.000
	S35°15'02.9"W	344.671		
HPI	()	1767614.334	1993669.813	0.000
	N59°02'44.9"W	141.949		
HPI	()	1767687.346	1993548.080	0.000
	S33°08'47.9"W	136.748		
HPI	()	1767572.851	1993473.309	0.000
	N56°16'55.0"W	226.888		
END	()	1767698.798	1993284.588	0.000
Northing Error:		0.000 ft		
Easting Error:		0.000 ft		
Closing Direction:		N00°00'00.0"W		
Closing Distance:		0.000 ft		
Closed Area:		142461.597 sq ft	3.270 ac	
Perimeter:		1628.788 ft		
Precision:				

Figure 5-3.C – Sample Map Check Report

5-3.04 ANNOTATION GUIDES

The text styles, as discussed in Section 4-9, “Fonts and Text Styles”, shall be used in the preparation of roadway and structure plans to provide uniformity in appearance and adherence to standards.

Annotations placed for roadway or structure plans shall be placed according to the following:

- If the active angle when placing text is between 90 degrees and 105 degrees, the text shall be placed such that it can be read from the right of the sheet. See Figure 5-3.D.
- If the angle is greater than 105 degrees, the text shall be placed such that it can be read from the left or bottom. See Figure 5-3.D.

- All dimensions shall be in U.S. Customary units. Do not use dual units.
- A north arrow shall be shown on every sheet and on every inset of a sheet where the inset is rotated differently than the master sheet.
- A graphic scale shall be placed on all sheets which are drawn to scale.

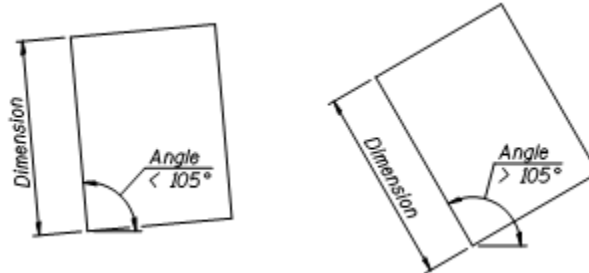


Figure 5-3.D - Annotation Rotation

As configured in the Annotation Groups, specific annotation formatting shall be:

- U.S. Customary stationing set to an interval of 100 ft.
- Provide a space between the number and symbol (for example, 12 ft).
- Use a comma for numbers greater than three digits (for example, 12,000 ft²).
- Cross-slopes, superelevation slopes, and vertical grades shall be shown in percent format to the second decimal place, for example 6.00%.
- Side slopes shall be shown as ratio format V:H. For example, 1:2 indicates a ratio of 1 vertical per every 2 feet of horizontal offset.
- Angles shall be expressed in degrees, minutes, and seconds, for example 55°12'14". Directions shall be expressed as a bearing, for example N55°12'14"W.

All survey information (for example, offsets and elevations) shall be shown in feet and decimals of a foot. For items that will be constructed (for example box culvert dimensions and pavement thickness), use feet, inches, and fractions of an inch.

Where all or most of the units are shown in one set of dimensions (for example feet or inches), a footnote can be added to the sheet stating this fact. For example, "ALL DIMENSIONS ARE IN INCHES (IN) EXCEPT AS NOTED". Removing the inch or foot symbol from the plans improves the sheet clarity.

Number all sheets sequentially, with the sheet numbers in the lower right-hand corner, except the cover sheet, which is numbered in the upper right-hand corner. Do not number *IDOT Highway Standards*.

Sheets that are added after the sheet numbers have been placed on the plans should be numbered A, B, C, etc., and noted in the index. The additional sheets are not included in the total number of sheets.

5-3.04(a) CAPITALIZATION

Roadway and Structural plans shall capitalize the first letter of the first word of a note or sentence as well as proper names. There are two common exceptions:




- Contractual parties such as ENGINEER and CONTRACTOR, which should be capitalized.
- The entire pay item description should be capitalized.

5-3.04(b) ABBREVIATIONS

Abbreviations should be avoided whenever possible. The word should be completely spelled out whenever possible. Periods do not need to be placed within acronyms of proper names such as AASHTO.

The IDOT Highway Standard 000001-08 (“Standard Symbols, Abbreviations, and Patterns”) presents common abbreviations that are used where it is necessary to abbreviate words. The standard drawings are available for download on the Departments Website.

Table 5-3.A contains a basic list of acceptable abbreviations that may be used on structures plans. Spell out any words which are not listed in these two sources.

Table 5-3.A – Abbreviations for Structure Plans			
Abbreviation	Full Text	Abbreviation	Full Text
abut.	abutment	B.F.	back face
	baseline	brg.	bearing
	centerline	cl.	clearance
const.	construction	∅	diameter
E.F.	each face	elev.	elevation
exist.	existing		flowline
F.F.	front face	I.F.	inside face
jt.	joint	long.	longitudinal
max.	maximum	min.	minimum
no.	number	O.F.	outside face
PJF	preformed joint filler	PJS	preformed joint
PG	profile grade	prop.	proposed
req'd.	required	rte.	route
sect.	section	spa.	spaces
spec.	specification	sta.	station
std.	standard	struct.	structure
typ.	typical		

5-3.04(c) TEXT GUIDES FOR STRUCTURE PLANS

The following is information regarding how text should be placed in structure plans ONLY:

1. Words that are abbreviated are not capitalized or put in parentheses. Examples are “typ.”, “min.” and “max.”
2. When using asterisks for a reference note, place the asterisk as a separate text entity to the left of the note as follows: “*Tightly fasten the #8 bars together with No. 9 wire ties.”
3. When placing a note under a title of a section which applies to that section, do not use “Note:”. Only use “Note:” for a block of notes that are grouped or listed together in one location on a sheet.
4. The words “wingwall,” “streambed,” and “headwall” should always be shown as single words.
5. The plus-or-minus symbol (“±”) shall be placed after approximate dimensions unless showing a specific tolerance. A specific tolerance should be shown in parentheses following the dimension.
6. Avoid circular references, such as “Work this sheet with sheet...” Use of a note such as this can become cumbersome and usually provides little benefit.
7. Do not call out the route number within a job unless it is the centerline of a divided highway. Call out the centerline of roadway (and Profile Grade Line (PGL), if applicable).
8. Notes that are a part of any of the base sheets should generally remain on the base sheet. For example, the note “A distance of half the length of the wingwall but not less than six feet of the barrel shall be poured monolithically with the wingwalls” is occasionally moved or reworded on the General Plan and Elevation. This note should not be moved or reworded unless a unique situation requires it.
9. All notes should be left justified. An exception is when a multi-line callout is placed between arrows of a dimension. In this case, it can either be left or center justified. If it is left justified, try to make each line of text approximately the same length.
10. The Bill of Material for individual elements, such as superstructure, abutment, pier, etc., should contain only the pay items that are listed in BBS base sheets. Showing all pay items for each of the structure elements on these sheets is unnecessary. All pay items are shown on the total bill of material.
11. For appearance, the reinforcement bars should be listed in the bill of material with a blank line between the bar groupings, e.g., show a blank line between b bars and d bars.
12. When referencing sheets, do not write “see sheet #3 of #15”, instead use “see sheet 3 of 15.”

13. Generally, span numbers do not need to be called out. An exception to this could be a large structure with many spans.
14. When calling out the centerline of a pier, do not call it out as centerline bearing pier __. There are instances when the centerline bearing, and centerline pier are not the same. It is preferable to either use two separate labels or to write "Centerline bearing and centerline pier."
15. Callouts for reinforcement bar spacing, steel plates, and bearing plates may be shown in inches. However, plan view dimensions for reinforcement bars and bearing plate details shall be shown in feet and inches.
16. Concrete dimensions shall be shown in feet and inches. If a concrete dimension is less than 1'-0", it shall be shown in inches.

5-3.04(d) DIMENSIONING USED IN STRUCTURE PLANS

Dimension styles, shown in Section 4-10, "Dimension Styles", have been created for use on Structure plans.

Guidelines for the placement of dimensions or callouts are as follows:

1. Dimension stack spacing should be 1/2", although 3/8" is acceptable if there are space constraints. The extension lines should extend 1/16" beyond the dimension line; see Detail "A" in Figure 5-3.E, below.
2. Dimension lines should not be broken unless passing through another dimension or text; see Detail "B" in Figure 5-3.E, below.
3. Generally, do not break or mask object lines for dimension lines unless there is interference with an arrowhead or text; see Detail "C" in Figure 5-3.E, below.
4. If there is no skew on a structure, there is no need to dimension a 90° angle throughout the job. This angle should only be shown on the Type, Sizing and Location and General Plan and Elevation.
5. Avoid causing callouts to pass through lines of dimensions; see Figure 5-3.F, below.

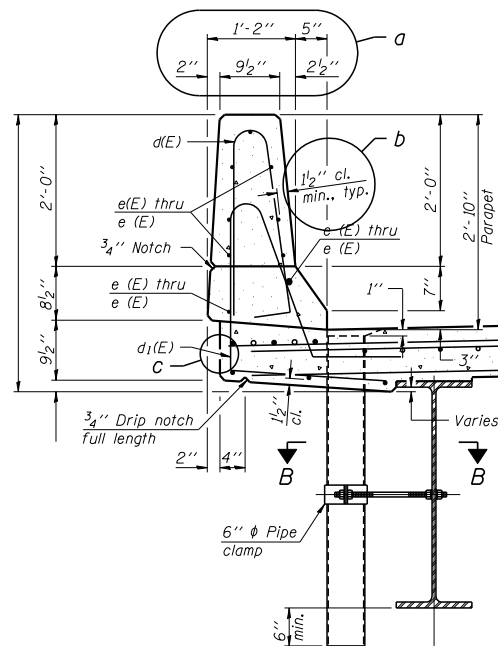


Figure 5-3.E - Dimensioning Example

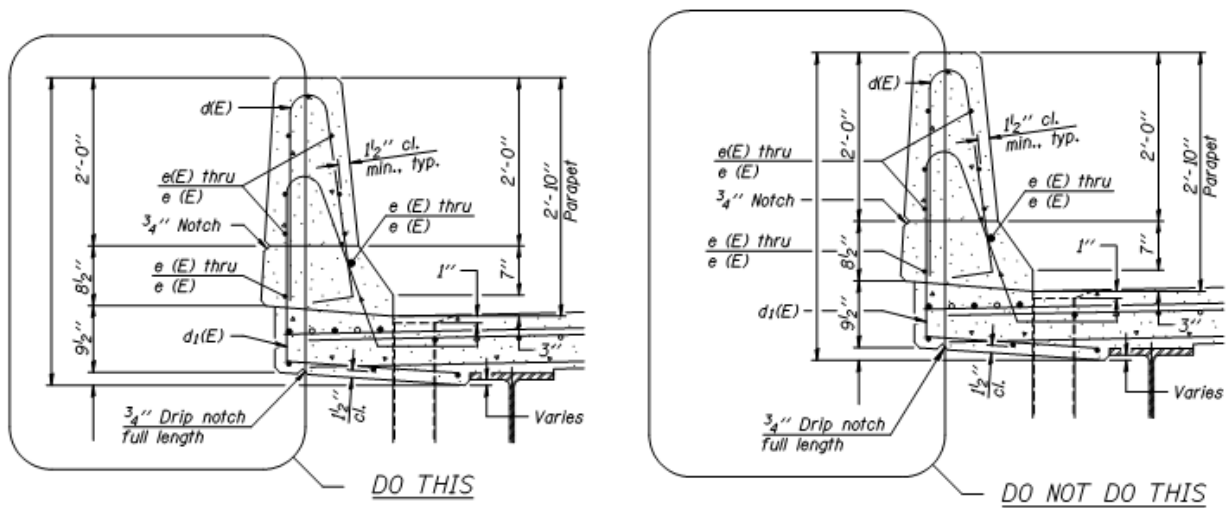


Figure 5-3.F - Proper Dimension Placement

5-3.04(e) PATTERNING USED IN STRUCTURE PLANS

Several different area patterns exist for general use on section cuts.

Table 5-3.B – Structures Pattern Cells	
Pattern Cell Name	Description
B00010	Aluminum Hatch Pattern
B00011	Concrete Hatch Pattern
B00012	Porous Material Hatch Pattern
B00013	Regular Hatch Pattern
B00014	Riprap Hatch Pattern
B00015	Sand Hatch Pattern
B00016	Steel Hatch Pattern
B00017	Wood Hatch Pattern

Placement of patterns shall be as follows:

- Whenever a section is cut through any material, the surfaces touched by the cutting plane shall be patterned using the proper pattern (stipple or hatching).
- End views shall not be patterned as if they are sections.

5-4 SHEET ORGANIZATION AND CONTENT

Sheets should be prepared as simply as practical. The use of duplicated data and cross references should be avoided.

See *Bureau of Design and Environment Manual* Section 63-4 for a detailed discussion of the required contents of each sheet type and Section 63-6 for a checklist of sheet contents.

5-4.01 SHEET SIZES

The following sheet sizes are generally used during project development:

1. 22 in. x 34 in. (ANSI D). This sheet size is considered a full-size sheet. It should be used for design layouts on most projects. A border around the sheet should be provided with a 2 in. left-binding margin, 0.5 in. right margin, and 1 in. top and bottom margins.
2. 11 in. x 17 in. (ANSI B). For Department purposes, this sheet size is considered a half-size sheet.
3. 8.5 in. x 11 in. (ANSI A). This sheet size is generally only used on projects that do not require a significant amount of detail, such as, simple resurfacing projects. These types of projects typically contain only a plan view. This sheet should show centerline, culverts, entrances, side roads, utilities, and existing right-of-way. If a project contains significant other amounts of information, use one of the larger sheet sizes.

For the preliminary and pre-final design stages, and for the final plans, print all sheets on white paper. See Section 3-3.03, “Phase III Deliverables” for required final deliverables.

5-4.02 SHEET ORGANIZATION

To provide consistency from project to project, the plan sheets should be assembled in the recommended sequence below. Note that not all plans will have all sheets and that several sheets can be combined. For detailed discussions on the required contents of each roadway sheet type, refer to the *Bureau of Design and Environment Manual* Section 63-4. For a checklist of roadway sheet contents, see Section 63-6. For details and contents of structures sheets, see *Bureau of Bridges and Structures Bridge Manual* Section 3.1.

1. Cover Sheet
2. Index of Sheets, Listing of applicable Highway Standards, General Notes, Commitments
3. Summary of Quantities
4. Typical Sections
5. Schedules of Quantities
6. Alignment, Ties, and Benchmarks
7. Plan and Profile Sheets
8. Suggested Stages of Construction and Traffic Control
9. Erosion and Sediment Control Details
10. Drainage and Utilities Sheets
11. Right-of-Way Sheets
12. Intersection Details
13. Pavement Marking Details
14. Landscaping Details
15. Traffic Signal Details
16. Lighting Details
17. Structural Sheets in the following order:
 - a. General Plan and Elevation (GP&E)
 - b. General Data (except for simple structures)
 - c. Footing Layout (if required)
 - d. Stage Construction Details (if required)
 - e. Temporary Barrier or Temporary Railing Details (if required)
 - f. Top of Slab Elevations
 - g. Top of Approach Slab Elevations
 - h. Superstructure (Plan and Cross Section)
 - i. Superstructure Details
 - j. Diaphragm Details (for bridges with integral or semi-integral abutments)
 - k. Bridge Approach Slab Details
 - l. Bridge Railing Details
 - m. Expansion Joint Details
 - n. Drainage Scuppers
 - o. Girder and Framing Details (Steel or Concrete)
 - p. Bearing Details
 - q. Abutment Details
 - r. Pier Details

- s. Foundation Details (includes piles)
 - t. Bar Splicer Assembly Details
 - u. Cantilever Forming Brackets
 - v. Soil Boring Logs
- 18. Wetland Details
 - 19. Culvert Details
 - 20. District Details
 - 21. Cross Sections; and.
 - 22. Highway Standards

5-4.03 SHEET TITLES

5-4.03(a) ROADWAY SHEET TITLES

The designer shall include the following information on every sheet, except for the IDOT Highway Standards included in the back of the plans:

1. Sheet Title blocks are provided in the lower right corner (upper right for cover sheet) and contains the following information:
 - a. Project route number(s)
 - b. Section number(s)
 - c. County the project is located in
 - d. Total number of sheets for the project, including the cover sheet and excluding the highway standards sheets
 - e. Sheet number
 - f. Stationing shown on the sheet, if applicable.
 - g. Contract number.
 - h. Consulting firm logo (if applicable), see Figure 5-4.C, below.
2. Project numbers will be determined and placed on the plans by the Central Office.
3. On the cover sheet, provide the consultant's company name (if applicable), professional engineer's signature, date of their license expiration, and their professional stamp in the lower right-hand corner to the left of the State approval box.

5-4.03(b) STRUCTURE SHEET TITLES

Both the planning Type Size & Location (TS&L) sheet(s) and the design General Plans & Elevation (GP&E) must show the sheet name, crossing, route, section, county, station, and structure number. The title is to be placed as shown in Figure 5-4.A using the text style "BR_200_CC_Underlined."

<p style="text-align: center;"> <u>GENERAL PLAN & ELEVATION</u> <u>ILLINOIS ROUTE 23 OVER VERMILION RIVER</u> <u>F.A.P. RTE. 68 - SEC. 102-BR</u> <u>LIVINGSTON COUNTY</u> <u>STATION 25+10.18</u> <u>STRUCTURE NO. 053-0177</u> </p>					
	F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
	68	102-BR	LIVINGSTON	65	31
ETS	ILLINOIS FED. AID PROJECT CONTRACT NO. 66104				

Figure 5-4.A - Structures Sheet Titles

For all other sheets of the structures design plans, only the sheet name and structure number are shown within the title block. Data fields exist within the borders for this information. They are to appear as shown in Figure 5-4.B using the data fields provided.

ILLINOIS TRANSPORTATION	SUPERSTRUCTURE DETAILS STRUCTURE NO. 053-0177			F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
				68	102-BR	LIVINGSTON	65	36
	SHEET NO. 6 OF 23 SHEETS			CONTRACT NO. 66104				
				ILLINOIS FED. AID PROJECT				

Figure 5-4.B - Structures Sheet Titles

The titles for individual details within a set of plans are to be placed using the text style "BR_200_CC_Underlined". By using this text style, the justification, spacing, text size, and underlining will appear correctly.

Consultant names and / or logos shall be included in the lower left block of structure borders as shown in Figure 5-4.C. The "File name =" text may be removed if desired.

OPTIONAL – MAY BE REMOVED	
FILE NAME =	USER NAME =
CONSULTANT NAME AND / OR LOGO HERE	
	PLOT SCALE =
	PLOT DATE =

Figure 5-4.C - Placement of Consultant Name

5-5 SHEET LAYOUT

Sheet layout is the process of segmenting a design project into pieces that will fit at a set scale onto a standard ANSI D (22"x34") sheet. Roadways uses the automated process of sheet creation, whereas Structures uses the automated process combined with manual processes. It is important to note the outer perimeter is intended to be the edge of the paper or image.

5-5.01 ROADWAY SHEETS

The IDOT workspace defines the settings needed to lay out roadway sheets using the Place Named Boundary tool. The Place Named Boundary tool provides an automated method for generating IDOT standard sheets. For a list of the Roadway drawing seeds see the Department's CADD Support website, *Online Resources* section as described in Chapter 6, "Internet and Reference Information".

5-5.01(a) ROADWAY PLAN SHEET LAYOUT

Plan sheets are laid out using the Civil Plan sheet method in the Place Name Boundaries dialog box.

5-5.01(b) ROADWAY PROFILE SHEET LAYOUT

Profile sheets are laid out using the Civil Profile sheet method in the Place Name Boundaries dialog box.

5-5.01(c) ROADWAY PLAN-PROFILE SHEET LAYOUT

Like the above, with the additional step of laying out both plan and profile; then create the sheets once both parts are laid out.

5-5.01(d) ROADWAY CROSS SECTION SHEET LAYOUT

Cross section sheets are laid out using the Civil Cross Section sheet method in the Place Name Boundaries dialog box. Make sure that you have both the 2D and 3D models in open views prior to starting the layout process. Odd and skewed sections can be added using Place Named Boundary - Civil Cross Section 2 Point.

When creating cross-sections, under no circumstance shall existing features or proposed features extend beyond the limits of the cross-section grid. Match lines are permitted where necessary to match two adjoining alignments; however, they may not be placed where they dissect a superelevation shape.

- Each set of cross section sheets will be for a single alignment in a separate file.
- Divided highways shall have both lanes shown on the same set of cross section sheets.
- The proper symbology settings for cross-section elements are defined in the IDOT CADD Configuration. The designer shall insure proper usage of feature definitions and specified element symbology throughout the design process.

5-5.01(e) STAGED CONSTRUCTION CROSS-SECTIONS

When staged earthwork or cross sections are required, a separate construction phase cross section file shall be provided for each project stage where earthwork is to be computed.

5-5.02 STRUCTURES SHEETS AND BORDERS

When using the base sheets in the structures cell library, there may be required changes or additions before being included with a set of design plans. When a base sheet's original content is changed, the base sheet name and date shall be removed. This signals to the reviewers that modifications were made to the base sheet. If information is added to a base sheet (such as adding dimension values), then the base sheet name and date shall remain. When base sheets contain details that do not apply to a project (such as the pile base sheets), the details that are not applicable shall not be crossed out.

For a list of drawing seeds with sheet borders that have been created in the IDOT workspace for structure plans, see the Department's CADD Support website, *Online Resources* section as described in Chapter 6, "Internet and Reference Information".

5-6 DRAINAGE ANNOTATION AND PROFILES

The new Drainage and Utilities (DU) workflow replaces the Subsurface Utility Design and Analysis (SUDA) toolset. These new elements can be incorporated into the 2D and 3D design models.

The OpenRoads Designer Drawing Production tools now support Subsurface Utilities elements in plan, profile, and cross section drawings. The Civil Labeler, Element Annotation, and Model Annotation tools now support these drainage features.

The Drainage and Utilities workflow is based on the Haestad CONNECT Edition, so data created in Subsurface Utilities is compatible with all Bentley Connect software. It is not backwards compatible with previous versions of Subsurface Utilities.

Drainage sheets can be created using the Place Name Boundary Tool the same way Roadway Plan-Profile sheets and cross section sheets were created in Section 5-5.01(a-e).

5-7 QUANTITIES

Project quantities shall be delivered to Project Development and Implementation Unit in a standard spreadsheet form as defined by the Bureau of Design and Environment. The spreadsheet is updated as needed for every letting. The designer shall download the correct version of the spreadsheet from the Department's CADD Support website, as described in Chapter 6, "Internet and Reference Information".

This spreadsheet contains macros which may be disabled by your spreadsheet software applications. Enable the macros according to the instructions of your spreadsheet application.

This spreadsheet contains all coded pay items. The macros take the selected items and generate Summary of Quantities table(s), including the grid(s), in the file while removing the unselected coded pay items. The resulting tables can be linked into the Departments design software using the integrated table tools.

Include the spreadsheet with the submittal to the Bureau of Design and Environment's Project Coordination and Implementation Section.

5-7.01 ITEM TYPES

An Item type is a set of properties used to describe an element. Item Types attach the information to objects or elements within a DGN file from a feature definition or by manually assigning them to an element or group of elements. In OpenRoads Designer, the item type can contain information based on Civil properties. After the item type is placed on an element, the item type data is displayed in the Properties dialog along with the other properties of the object or element.

Item Types have been introduced in OpenRoads Designer and their use can simplify the way we add attributes to the model. Project quantities may be delivered using Item Types, with the approval of the Project Manager and the Project Development and Implementation Unit in the Bureau of Design and Environment.

5-7.02 ITEM TYPE REPORTS

Once Item Types have been assigned to the elements in a model a report can be generated, and the data presented in the DGN file in a tabular format.

5-7.03 EARTHWORK

Earthwork shall be processed utilizing the means and methods present in the OpenRoads / OpenBridge software. All items utilized to calculate earthwork quantities shall be included along with the quantities tables.

- Per the BDE Manual: Show the earthwork end areas for cuts and fills, above or beside the cross section. For complex projects involving stage construction, list the end areas by stages.

5-7.04 SUMMARY OF QUANTITY SHEET REQUIREMENTS

The minimum requirements for all Summary of Quantities sheets:

1. A grid must be used such as that generated by the spreadsheet described in Section 5-7, “Quantities”, above.
2. Coded pay item numbers, descriptions, units, and quantities must use the text style 140_Left-Center.
3. The full description (not the abbreviated description) of the pay items must be used in the Summary of Quantities.

Reference the Summary of Quantities in the example plans for the desired appearance.

5-8 PRINTING

The IDOT workspace delivers plot configurations to aid in developing printing workflows for internal and consultant designers. The files delivered in the workspace are specific to the printing hardware used by the Department. However, the settings within the workspace files are useful for guiding the development of user-customized files for the designer’s hardware. The plot configurations in Table 5-8.A define the settings for various printing formats.

Table 5-8.A - Plotter Configurations	
Configuration File	Description
PRINTER.pltcfg	Used when plotting to a laser or inkjet device.
IDOT_PDF_ANSI-B_BW.pltcfg	Used when plotting Color to an ANSI B PDF File.
IDOT_PDF_ANSI-B_Color.pltcfg	Used when plotting Black and White to an ANSI B PDF File.
IDOT_PDF_ANSI-D_BW.pltcfg	Used when plotting Color to an ANSI D PDF File.
IDOT_PDF_ANSI-D_Color.pltcfg	Used when plotting Black and White to an ANSI D PDF File.

The plotter configurations in Table 5-8.B define the following line thicknesses for plot output that shall be used on full-size (ANSI D) prints. The line weights for quarter-size (ANSI B) plans shall be set to one-half of these values.

Table 5-8.B - Plotted Line Thickness			
Line Weight	Thickness (in.)	Thickness (mm)	Pen Size
0	0.010	0.25	000
1	0.014	0.35	0
2	0.020	0.500	1
3	0.024	0.600	2
4	0.031	0.800	3
5	0.047	1.200	4

The plotter configurations in Table 5-8.C also define the following line strokes that shall be used on full-size (ANSI D) prints for defining MicroStation's built-in line codes. The line strokes for quarter-size (ANSI B) plans shall be set to one-half of these values.

Table 5-8.C - Internal Line Code Plotting Dimensions						
Line Code	Line (in.)	Space (in.)	Line (in.)	Space (in.)	Line (in.)	Space (in.)
1	0.015	0.0394				
2	0.0788	0.0788				
3	0.1574	0.0788				
4	0.1574	0.0788	0.0236	0.0788		
5	0.0552	0.0522				
6	0.1574	0.0522	0.0394	0.0552	0.0394	0.0552
7	0.1574	0.0552	0.0552	0.0552		

5-8.01 PEN TABLE

The delivered pen table (tbl) performs several symbology adjustments at plot time. Element processing is performed in the following order:

Table 5-8.D - Pen Tables	
Element Section	Action
No_Constructions	Turns off display of Construction Class elements.
Grid	Sets border grid lines to color 161.
White_Out	Sets all closed shapes using color 250 to solid fill, priority 50. Used in conjunction with Hide_Sheet_on_White_Out.
Shading10	Sets all closed shapes using color 110 to solid fill, 10% black.
Shading20	Sets all closed shapes using color 120 to solid fill, 20% black.
Shading30	Sets all closed shapes using color 130 to solid fill, 30% black.
Shading40	Sets all closed shapes using color 140 to solid fill, 40% black.
Shading50	Sets all closed shapes using color 150 to solid fill, 50% black.
Shading60	Sets all closed shapes using color 160 to solid fill, 60% black.
Shading70	Sets all closed shapes using color 170 to solid fill, 70% black.
NoFillSigns	Sets all closed shapes using color 188 to no fill.
Hide_Sheet_on_White_Out	Set all elements except those using colors 19 and 35 to priority 100. Used in conjunction with White_Out.

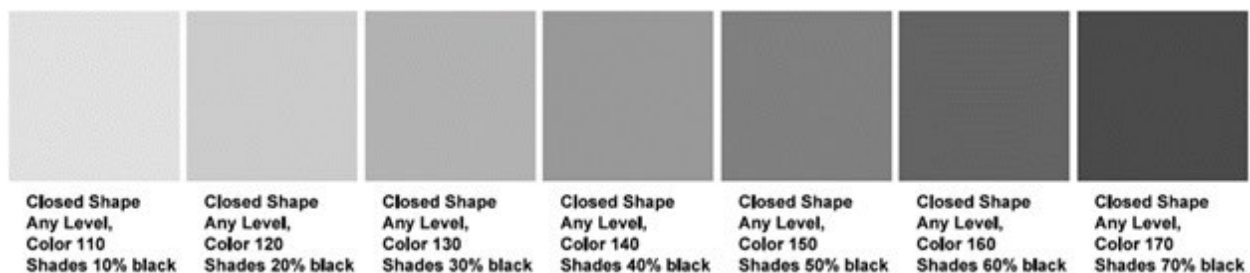


Figure 5-8.A – Shading Levels from Pen Table

The pen table also makes the following text substitutions:

Table 5-8.E - Pen Table Text Substitutions	
Actual Text	Replacement
DGN-SPEC	_FILE_
DATE-TIME	_DATE_
\$DATE\$	_DATE_
\$FILEL\$	_FILEL_
\$SCALE\$	_SCALE_
\$USER\$	\$(USERNAME)
\$TIME\$	_TIME_
USER	\$(_USTN_USERINTNAME)
\$FILES\$	_FILES_
\$MODELNAME\$	_MODELNAME_

5-8.02 PRINT STYLES

While internally IDOT does not use print styles, several are defined in the delivered DGN Library.

These Standard print styles are provided as a starting point for companies and organizations to use when setting up print styles for their own use.

5-9 ADDENDUMS

See also: *Bureau of Design and Environment Manual*, Section 63-1.03(b).

If revisions or changes to the contract plans are required after plans have been posted for bidding, but prior to the letting, an “Addendum” may be required.

Approval for all addendums shall be coordinated with the Project Manager, who will solicit all required review and approval authorities within IDOT.

If an addendum is approved, all required deliverables that are affected by the addendum, including 3D models, shall be resubmitted to the Project Implementation Unit. See Section 3-3.03, “Phase III Deliverables”, for requirements. The Project Content File shall also be amended to include a description of the changes which have occurred in each file.

For structures sheets, any element or detail that is changed shall be denoted on the sheets by placing a shape around the affected area. Attached to this shape shall be a triangle with a number indicating the addendum number, as shown in Figure 5-9.A. In the revision block of the sheet, the symbol with the revision number shall follow “Revised”, along with the date of the revision and the initials of the person making the revision. If an entire sheet is added or revised, do not place a shape around the perimeter of the sheet. Place an additional addendum symbol near the revision

block with the text “Added sheet” or “Entire sheet revised” following the symbol. Cells are available in the cell library to simplify symbol placement.

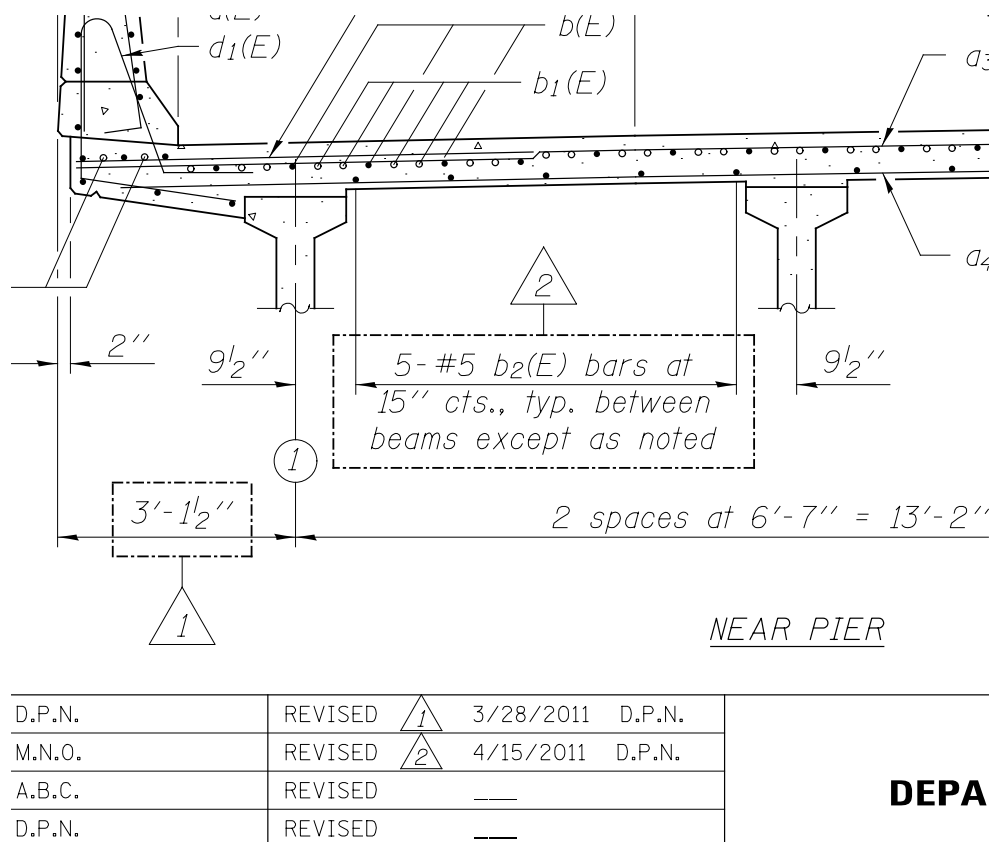


Figure 5-9.A - Addendum Notation

5-10 CONSTRUCTION CHANGES

See also: *Bureau of Design and Environment Manual* Section 63-1.03(b).

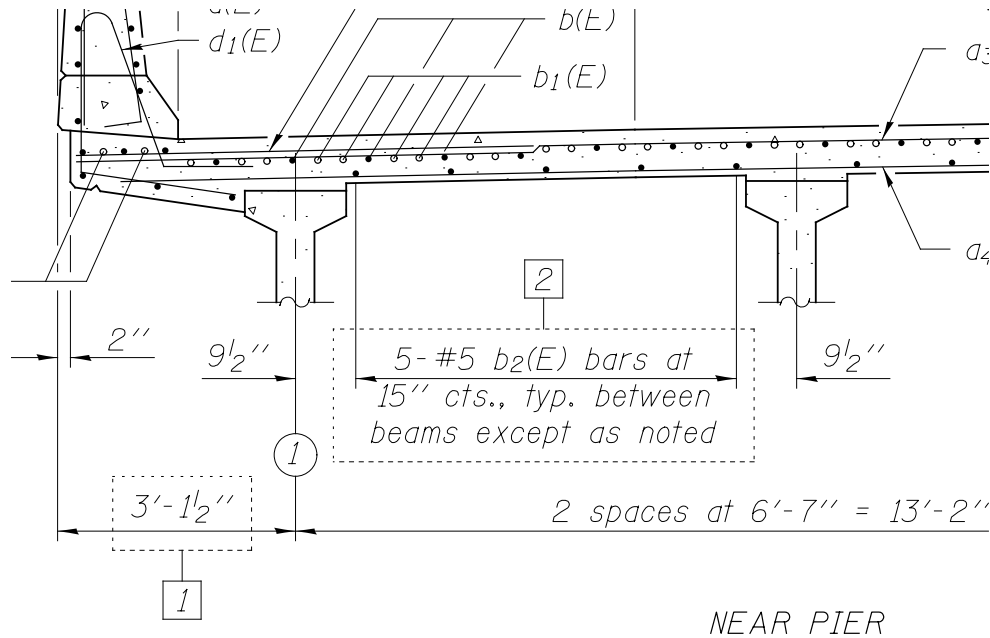
If revisions or changes to the contract plans are required after letting, a *construction change* to the contract plans is required to be prepared and distributed.

Approval for all construction changes shall be coordinated with the Project Manager, who will solicit all required review and approval authorities within IDOT.

If a *construction change* is approved, all required deliverables that are affected by the addendum, including 3D models, shall be resubmitted to the Project Implementation Unit. See Section 3-3.03, “Phase III Deliverables” for requirements. Coordinate all required deliverable files with the Project Manager. The Project Content File shall also be amended to include a description of the changes which have occurred in each file.

If a *construction change* is required for a bridge project, any element or detail that is changed shall be denoted on the sheets by placing a shape around the affected area. Attached to this

shape shall be a $\frac{1}{4}$ " square and a number indicating the construction change number, as shown in Figure 5-10.A. In the revision block of the sheet, the symbol with the construction change number shall follow "Revised," along with the date of the revision and the initials of the person making the revision. If an entire sheet is added or revised, do not place a shape around the perimeter of the sheet. Place an additional construction change symbol near the revision block with the text "Added sheet" or "Entire sheet revised" following the symbol. Cells are available in the cell library to simplify symbol placement.



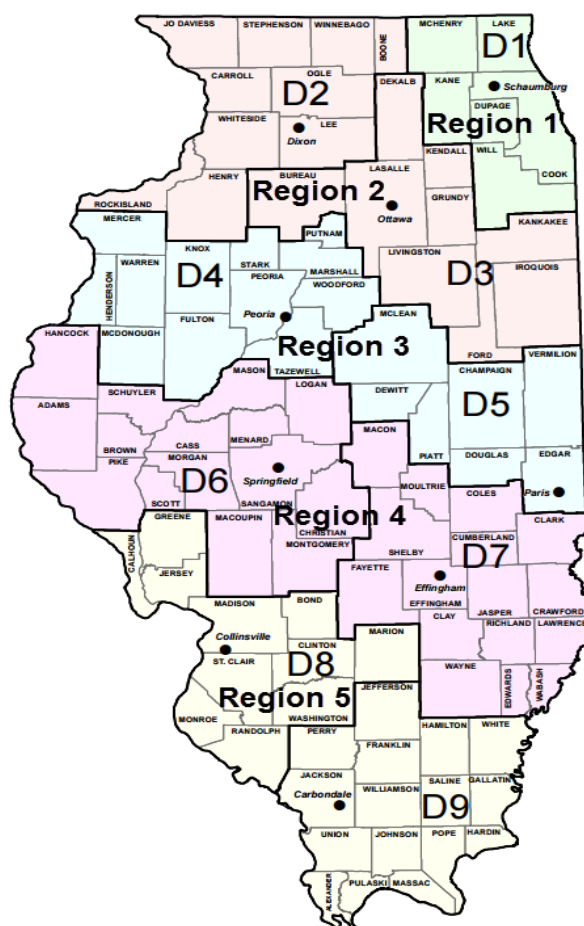
D.P.N.	REVISED	1	5/27/2011	D.P.N.	DEPA
M.N.O.	REVISED	2	6/15/2011	D.P.N.	
A.B.C.	REVISED	---	---	---	
D.P.N.	REVISED	---	---	---	

Figure 5-10.A - Construction Change Notation

CHAPTER 6 INTERNET AND REFERENCE INFORMATION

Appendices, charts, and tables have been relocated to the Department's [CADD Support](#) website under the 'Online Resources' section. These include Bridge Dimension / Text Styles, Bridge Levels, Dimension / Text Styles, Feature Definitions, Levels / Filters, Linestyles, and Survey Point Codes.

6-1 DEPARTMENT REGIONAL AND DISTRICT MAP



6-2 WEB PAGES

Electronic copies of this policy and the workspace files documented herein can be downloaded at the website below, or by using the QR code:

<https://idot.illinois.gov/doing-business/procurements/engineering-architectural-professional-services/consultant-resources>

Under the Standard Specifications / Supplemental Specifications and Recurring Special Provisions banner you can select one of the hyperlinks as described below for additional information and resources.



- Standard Specifications
 - Manuals and Guides
 - Links to Standard Specifications by adoption date
- Highways
 - Manuals and Guides
 - a. *Bureau of Design and Environment Manual*
 - b. *CREATE Program* Manuals
 - c. District Specific Standards
 - d. Illinois Construction Scheduling Expert System (ICSSES)
 - e. Highway Standards
 - f. Survey Manual
 - g. Transitional Approaches to Channelized Intersections
 - h. Project Websites
 - Materials
 - a. Approved Labs
 - b. Pay Item/Material Conversion Report
 - c. Qualified Product List
 - Letting Specific Items
 - a. BDE Special Provisions
 - b. Coded Pay Items
 - Environmental
 - a. Environment Protection Practices
 - b. Environmental Survey Forms
 - c. Roadside Maintenance
 - Forms
 - a. Phase I Work Forms
 - b. Phase II Work Forms
 - Pavement Life-Cycle Cost Analysis (LCCA)
 - a. Approved LCCA's
 - CADD
 - a. IDOT CADD Downloads and Guidelines
 - This Manual
 - Example Plans
 - Bridge Model Sample
 - Bridge Individual File Sample
 - OBM Generative Components
 - b. Need Help?
 - Email questions to: IDOT CADD Support
 - Support
 - Online Resources
 - IDOT CONNECTED CADD Environment
 - IDOT CADD & GIS Video Library
 - Summary of Quantities
 - ProjectWise

- Stay Connected
 - Need Help?
 - Email questions to: IDOT CADD Support
- Bridge Cell Libraries
 - PDF copies of Bridge cell libraries
- Geotechnical Memorandums
- Bridges and Structures
 - Bridge Manual
 - Sign Structures Manual
 - Guide Bridge Special Provisions (GBSP)

6-3 SUBSCRIPTION SERVICES

Interim changes to various policies are communicated through various subscription services. Signing up for these services is strongly encouraged. Notifications are sent via e-mail whenever changes are made to items on the “Consultant Resources” web page shown above in Section 6-2, “Web Pages.”

IDOT CADD Support subscription service – [Subscribe](#) to this service by clicking on “Stay Connected” under the Support heading on the “CADD” tab on the page shown above in Section 6-2, “Web Pages”.

Bureau of Design and Environment – [Subscribe](#) to policy changes by clicking on “Bureau of Design and Environment Manual” under the “Highways” tab on the web page shown above in Section 6-2, “Web Pages”.

Standard Drawings – [Subscribe](#) to policy changes by clicking on Highway Standards under the “Highways” tab on the web page shown above in Section 6-2, “Web Pages”. Next click on the “click here” which will take you to a page with the subscription link under the “Stay Connected” heading.

Structures – [Subscribe](#) to the Structures notification service by clicking on Bridge Support under the Stay Connected heading on the “Bridges and Structures” tab on the web page shown above in the Section 6-2, “Web Pages”.

National Bridge Inventory – [Subscribe](#) to the NBI notification service by clicking on National Bridge Inventory under the Stay Connected heading on the “Bridges and Structures” tab on the web page shown above in Section 6-2, “Web Pages”.

6-4 FILE TRANSFER

Files shall be posted to the project’s specified ProjectWise location, and files placed in the appropriate folder structure, as directed by the Project Manager and/or District CADD Manager. Deliverables shall be submitted by using the IDOT ProjectWise Server located at:

<https://infrastructurecloud.bentley.com/>

To request a ProjectWise login for access to the ProjectWise Server see the “*ProjectWise*” section on the CADD Support page noted above in Section 6-2, “Web Pages”.