CADD STANDARDS

POLICY MANUAL

Version 4.4

Updated December 15, 2022

Chapter 1. **Contents**

Introduction

The following **CADD Standards for Highway Plans (version 4.X)** establishes the required standards for all electronic files representing submittals of Contract Plans and Proposals to the Kentucky Department of Highways (KDOH). The primary goal of these standards is to insure the best possible use of this **Electronic Engineering Data (EED)** in the review, publication, bidding, construction and archive processes. The standards presented in this Appendix represent the minimum requirements that shall be met for the development of Highway Plans.

The Contract Plans are the Highway Plans that are awarded through the letting process. The Contract Plan Sets are the product of the Project Development Process and are comprised of the Roadway, Structures, Traffic, and/or Utility Relocation Plans.

It must be stressed that while the CADD Standards for Highway Plans are to be applied to the deliverable files for Contract Plans and Proposals, they should not be used to restrict the format of plans submitted for inspections, public meetings, or interim reviews. If the Project Team agrees to hold a digital project review, all efforts shall be made to accommodate the needs of the Team without paper copies of the plans and any supporting Engineering documents.

General Parameters

The following general parameters for the submittal of EED for Highway Plans have been established:

> • EED representing the Contract Plans and Proposal will be delivered to the Project Manager for submittal to Central Office via ProjectWise. ProjectWise will also be used for internal Cabinet deliveries to the Project Manager.
> • EED shall conform to a predetermined file naming and file structure methodology as detailed in this Appendix.
> • <u>ALL</u> CADD files shall be created and submitted in OpenRoads Designer or MicroStation CONNECT (DGN) format in the version most recently recognized by the Department.
> • All submittals shall utilize a Master Reference file system, detailed later in this policy.
> • For latest software version information, refer to the CADD Standards web page at https://transportation.ky.gov/CADD_Standards/Pages/default.aspx
> • Design files shall comply with the Department's graphic standards as detailed in this Appendix and shall use the Department's standard configuration files.
> • Each sheet of the Plan Set that is scalable shall have a graphical scale located on that sheet.

Embedded civil data that conveys design intent, which maintains the relationship with the underlying data, referred to as "Intelligent" within this Appendix, shall maintain that intelligence throughout the submittal process.

Unintelligent data files are files that do not contain civil data embedded into the file. These include, but are not limited to; Layout sheet, Typical Sections, Summary Sheets, Coordinate Control, Note Sheets (General, MOT…) etc. and are referred to as "non-intelligent" in this Appendix.

(MicroStation CONNECT, OpenRoads Designer, and ProjectWise are registered trademarks of Bentley Systems.)
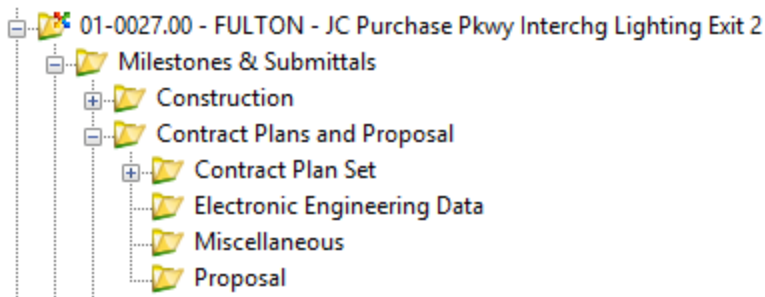
ELECTRONIC DELIVERY

Electronic Engineering Data (EED) representing the Contract Plans and Proposal will be delivered to the Project Manager for submittal to Central Office via ProjectWise. ProjectWise will also be used for internal Cabinet deliveries to the Project Manager. These electronic files will be shared and referenced by many different individuals and disciplines in order to reduce work duplication and improve the revision process. Therefore, this policy has been established for disciplines that share in the project's development and outlines the minimum standards, conventions and formats necessary to ensure usable EED for the downstream customer.

Delivery Folder Structure

The delivery folder structure is a list of the required directories. These directories are required in the hierarchy as shown and none shall be deleted. Even when a directory is not used in a specific project, the directory shall remain.

The electronic plans shall consist of a project directory containing a "Contract Plans and Proposal" directory with four subordinate directories as shown below:

- 01-0027.00 - FULTON - JC Purchase Pkwy Interchg Lighting Exit 2
  - Milestones & Submittals
    - Construction
    - Contract Plans and Proposal
      - Contract Plan Set
      - Electronic Engineering Data
      - Miscellaneous
      - Proposal

Project Directory Name

The project directory name will be the KYTC Project Identification Number (Item Number), County, and Project Description and is standardized to achieve proper sorting. The project directory name should be in the following format:

AA-BBBBB.CC – County – Project Description

Where "**AA**" represents the District Number and should consist of two digits. "**BBBBB**" represents the Parent Number and should consist of up to five digits. "**CC**" represents the Parent Number breakout and should consist of two digits.

Examples: 01_0115.00 – BALLARD – US 60 Improvements
                        11_0273.01 – CLAY – US 421 W Bypass of Manchester
                        03_10010.00 – LOGAN – US 79 Safety and Bridge Improvements

Under the project directory, the "Contract Plans and Proposal" directory shall contain subdirectories for Contract Plan Set, Electronic Engineering Data, Miscellaneous and Proposal.

Contract Plan Set

The "Contract Plan Set" shall contain bookmarked PDF files. There shall be a PDF file representing each applicable discipline in the Contract Plan Set, as outlined later in this Appendix. Each PDF must contain bookmarked pages corresponding with each sheet in the Plan Set.

The "Contract Plan Set" directory shall contain subdirectories for the following divisions: Roadway, Structures, Traffic, and Utilities (an example is below).
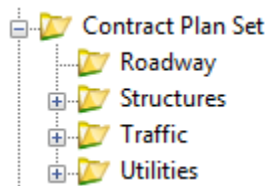
Roadway

The Roadway directory shall contain two (2) PDF files consisting of all the sheets representing the roadway plan set. Roadway plan sheets shall be contained in one PDF file and cross section sheets shall be contained in the other PDF file.

This folder will no longer contain DGN files. All DGN's will be in the Electronic Engineering Data (EED) folder as described below.
An example folder is below.


Roadway

Structures

The Structures directory shall contain subdirectories for each structure within the project. Each subdirectory will be named for the five-digit drawing number representing the structure, as seen here:

Structures
25677
25678
25679
26551
26552
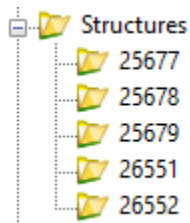
The Structure subdirectory shall contain one (1) PDF file consisting of all the sheets representing the corresponding structure plan set. Also, within the Structure Subdirectory shall reside the Bentley design file (DGN) as outlined in the section on Project Master Reference Files. These files must maintain the intelligent civil data embedded within and remain referenced to one another throughout the submittal of the project.

Traffic

The Traffic directory shall contain subdirectories for Lighting, Signals, and Signs. Below is an example of this directory structure:
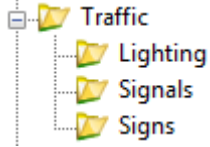

The Traffic subdirectories shall contain one (1) PDF file consisting of all the sheets representing the corresponding lighting, signals, or signs plan set. Also, within the Traffic Subdirectory shall reside the Bentley design file (DGN) as outlined in the section on Project Master Reference Files. These files must maintain the intelligent civil data embedded within and remain referenced to one another throughout the submittal of the project. For additional information concerning traffic plan development (i.e. traffic sheet order), please visit:

https://transportation.ky.gov/TrafficOperations/Pages/Design_Services_Branch_Standards_and_Tools.aspx

Utilities

The Utilities directory shall contain Utility Relocation Sheets. The Utility Relocation Sheets shall represent utility work that will occur during construction of the roadway. Each Utility directory shall contain a PDF file consisting of all the sheets representing the utility relocation plan set. Below is an example of this directory structure:
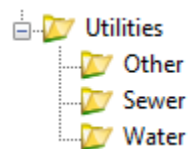
Miscellaneous

The "Miscellaneous" directory shall contain any documentation, correspondence, or special information relating to the project. Project documentation will include: submittal forms, Design Executive Summaries (DES), the environmental checklist, the final estimate file from Trns•port Estimator **in EST Format**, project construction schedule documentation (Gantt Charts, etc.), final production-hour worksheet (for consultant projects), and any other documentation the Project Manager deems pertinent.

Proposal

The "Proposal" directory shall contain any documentation, correspondence, or special information relating to the project's proposal. Proposal documentation will include, if required:

- The Best Management Practices (BMP) document
- Topographic Map of Discharge Points for Electronic Notice of Intent (eNOI) Submittal (.pdf format)
- Draft eNOI
- Special Note for Filing eNOI for KPDES
- The Communicating All Promises (CAP) report (even when there are no entries in the CAP)
- Traffic Management Plan
- Pavement Adjustment Note
- Pre-Bid Notification
- Project Development Checklist (PODI Projects)
- General Utility Notes and any specifications necessary
- Right of Way Certification
- Special provisions for protection of railroad interest
- Project specific special notes or specifications
- Permit/water quality certification
- Tree Removal Note
- Liquidated Damages note

This directory is also reserved for the eventual inclusion of the electronic proposal document currently distributed by the Division of Contract Procurement.

Electronic Engineering Data Folder Structure and File Names

Along with the PDF contract documents to be delivered for the Letting, Electronic Engineering Data (EED) shall also be submitted for all projects where 3D modeling is required. For a list of project types and associated modeling requirements, refer to the KYTC OpenRoads Designer FAQ.

Master Reference System

Within the Electronic Engineering Data folder are subfolders that will house the intelligent Bentley design files (DGN) and other supporting files. These files must maintain the intelligent civil data embedded within and remain referenced to one another throughout the submittal of the project. The Department will utilize a Master Reference file system as shown in the image below and on subsequent pages.
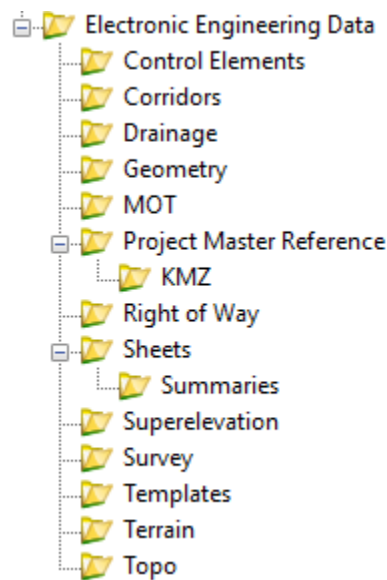

The Master Reference File concept is a way to organize the EED for a project into a logical file referencing system. Within the root folder there shall exist a Project Master Reference file that has of all the other Container files referenced. The Corridors, Geometry, Superelevation, Terrains and Control Elements folders shall contain individual DGN files for corridors, alignments, superelevation control lines, terrains and control elements. These individual DGN files shall be referenced into their respective Container files. For example, all of the individual Geometry DGN files are referenced into the 05_01234_56_Geom_Container.dgn file and stored in the Geometry folder. Container files should only contain reference files and no data itself. Should an instance occur where additional files are necessary, utilize the base concept for file naming and reference into the Master Reference file.

In addition to the aforementioned files, other supporting DGN files shall be placed in their corresponding folders, as illustrated on the following pages.

Control Element(s)

The Control Element(s) folder shall house DGN files containing elements which the corridor is to target for control, per the designer's discretion. These elements may exist as horizontal elements with profiles to be recognized by the corridor. Refer to the KYTC OpenRoads Designer FAQ for an example of a control element and how it shall be used. Below is an example of the files included in the control elements folder and a hierarchy of the folder/file structure:

05_01234_56_CE_Approach.dgn
05_01234_56_CE_Container.dgn
05_01234_56_CE_Mainline.dgn
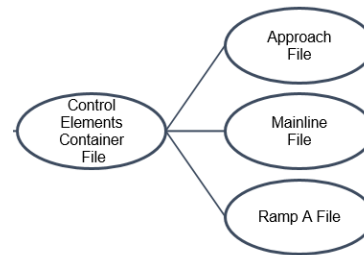
Corridor

The Corridor folder shall house corridor graphics, such as DGN files containing the Mainline, Ramp, Approach, etc. An example of Corridor DGN file naming and hierarchy folder structure can be seen below:

05_01234_56_Corr_Container.dgn
05_01234_56_Corr_Mainline.dgn
05_01234_56_Corr_Quarles Rd.dgn
05_01234_56_Corr_Ramp A.dgn
05_01234_56_Corr_Ramp B.dgn
05_01234_56_Corr_Ramp C.dgn
05_01234_56_Corr_Ramp D.dgn
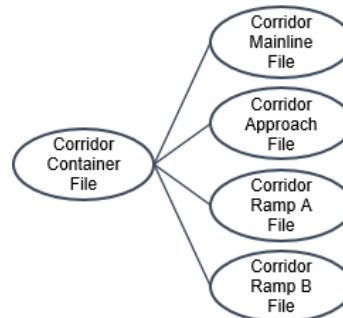
Drainage

The drainage folder shall contain any drainage elements such as, but not limited to:
- Inlets
- Pipes
- Culverts
- Junction Boxes
- Manholes

These elements can be stored in one DGN Manuscript file. It need not to contain bridges that are modeled as part of the Corridor. Below is an example of the files to be included:

05_01234_56_Drain_Approach.dgn
05_01234_56_Drain_Container.dgn
05_01234_56_Drain_Mainline.dgn

Geometry

The Geometry folder shall house DGN files containing geometry graphics for the Mainline, Ramp, Approach, etc. An example of Geometry DGN file naming and hierarchy folder structure can be found below:

MOT

The MOT folder shall contain Corridor, Geometry, Superelevation and Control Element files that pertain to Traffic Control Plans. These files shall utilize the Master Reference system but can all be housed within the MOT folder. An example of MOT DGN file naming is pictured here:

Project Master Reference

The Project Master Reference folder shall house one DGN file that containing all other container files. This will quickly and easily allow the end user to see the entire project. An example of file naming is pictured here:
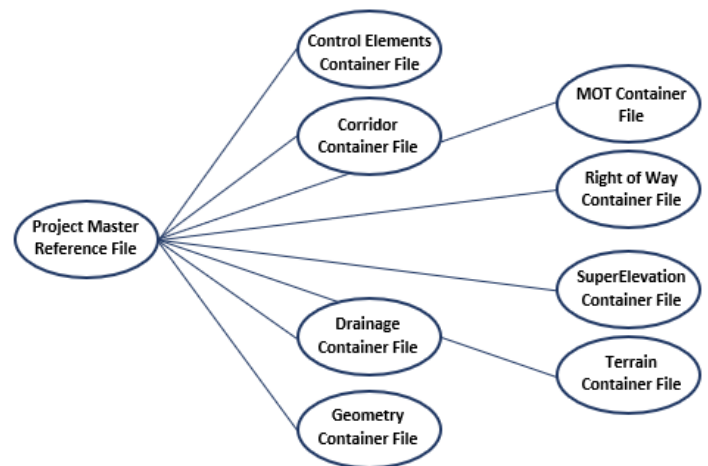
The folder will also contain two Google Earth Files. The Google Earth Files shall include custom line styles and shall contain, but not be limited to:

Proposed Manuscript

Corridor Container File - including all Pavement, guardrail, sidewalk, curb and gutter, removal of pavement, and disturb limits.
Drainage Container File - All Drainage Features
Geometry Container File - All Geometries with stationing
Right of Way Container file – including all Proposed and Existing Right of Way, Existing Property Lines, and Parcel Information

Existing Manuscript

All existing graphics, including utilities, drainage features, and control points

Right of Way

The Right of Way folder shall house DGN files containing property lines and Proposed and Existing R/W and Easements. An example of R/W DGN file naming is pictured here:

05_01234_56_ROW_Container.dgn
05_01234_56_ROW_EX ROW.dgn
05_01234_56_ROW_PR ROW.dgn
05_01234_56_ROW_Property Lines.dgn
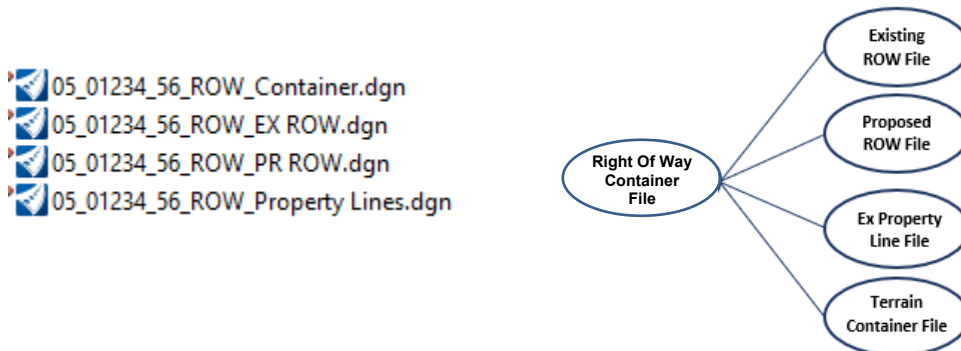
Sheets

The Sheets folder shall house all DGN files containing both "intelligent" and "non-intelligent" plan sheets, along with corresponding documents (Excel Files, Word Documents, Layout Maps, etc.). Each file will contain one or more drawing model and sheet model, representing the individual "sheets" of the Plan Set.

Intelligent plan sheets shall include the embedded civil data that conveys design intent, which maintains the relationship with the underlying data. These may include Plan Sheets, Profile Sheets, MOT Sheets, Coordinate Control Sheets, etc.

Unintelligent data files are files that do not contain civil data embedded into the file. These include, but are not limited to; Layout sheet, Typical Sections, Summary Sheets, Note Sheets (General, MOT…) etc.
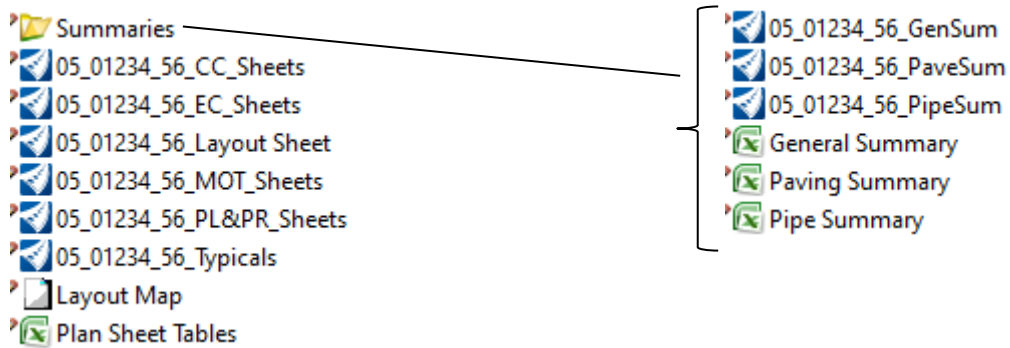
Superelevation

The Superelevation folder shall house DGN files containing the Mainline, Ramp, Approach, etc. superelevation graphics. This folder shall also contain the Superelevation report in XML format. An example of Superelevation DGN file naming and folder structure hierarchy can be found below:
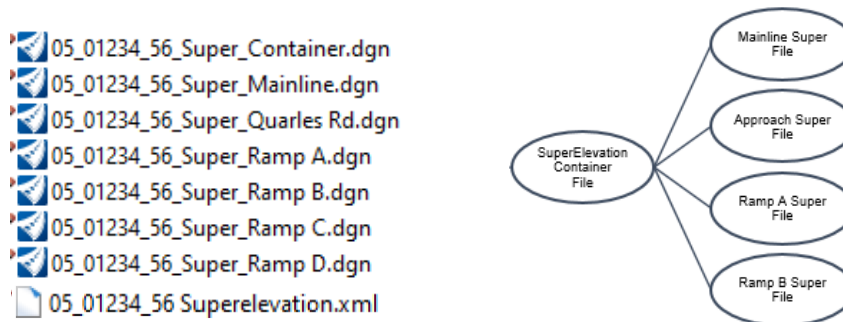
Survey

This folder shall contain the Existing Manuscript and Proposed Corridors plan graphics in DXF file format for use in data collectors, as well as coordinate data, including but not limited to: Control Points, geometry points (PC, PT, PI, etc.) and R/W monument points. This folder shall also contain LandXML files for all alignments (geometry) for the project, as well as proposed corridor elements for the finished grade and subgrade along with the existing terrain. An example of survey file naming is pictured here:
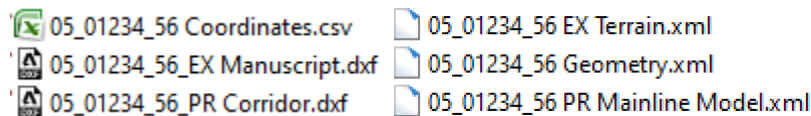
Templates

This folder shall contain the OpenRoads Designer Template Library file(s) (ITL File) used for the project. The designer should delete any unused components and templates before submittal. An example of the template file naming is pictured here:
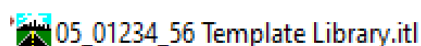
Terrain

The Terrain folder shall contain DGN files for the Existing and Proposed Terrain Models. If a merged Existing and Proposed Terrain is requested, utilize the base concept for file naming and reference into the Master Reference file. Versions of these Terrains in LandXML format shall also be delivered here. See the FAQ for naming conventions. An example of the Terrain DGN file naming and folder structure hierarchy can be found below:

05_01234_56_Terrain_Container.dgn
05_01234_56_Terrain_Existing.dgn
05_01234_56_Terrain_Proposed.dgn
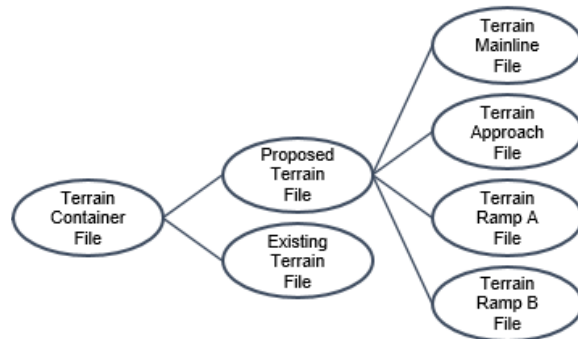
Topo

The Topo folder shall contain the existing topo or manuscript file in DGN format. This should be the same file that was delivered from Survey when the project began, and any updates or pickups obtained over the life of the project. An example of file naming is below:

05_01234_56_EX_Manuscript.dgn

Standard DGN File Names

Roadway, Traffic, and Utility Design Files

The Roadway DGN design files should abide by the following naming convention:

AA_BBBBB_CC_X_EEEE.dgn

Where "**AA**" represents the District Number and should consist of two digits. "**BBBBB**" represents the Parent Number and should consist of up to five digits. "**CC**" represents the Parent Number breakout and should consist of two digits. **"X"** represents the sheet type (Roadway, Traffic or Utilities). "**EEEE**" represents plan type.

Examples Roadway: 05_01234_56_R_Plan.dgn,

"Drawing"	Layout Sheet
"Sheet"	Layout Sheet
"Drawing"	Plan Sta. 100+00 to 250+00
"Sheet"	Plan Sta. 100+00 to 250+00 [Sheet]
"Drawing"	Profile Sta. 100+00 to 250+00
"Sheet"	Profile Sta. 100+00 to 250+00 [Sheet]
"Drawing"	Plan Sta. 250+00 to 500+00
"Sheet"	Plan Sta. 250+00 to 500+00 [Sheet]
"Drawing"	Profile Sta. 250+00 to 500+00
"Sheet"	Profile Sta. 250+00 to 500+00 [Sheet]

05_01234_56_R_CrossSection.dgn

"Drawing"	Sta. 100+00
"Sheet"	Sta. 100+00 [Sheet]
"Drawing"	Sta. 100+00 to 100+50
"Sheet"	Sta. 100+00 to 100+50 [Sheet]

05_01234_56_R_Auxiliary.dgn

"Drawing"	Typical Section
"Sheet"	Typical Section
"Drawing"	General Summary
"Sheet"	General Summary

Examples Traffic: 05_01234_56_T_Lighting.dgn

"Drawing"	Roadway Lighting Est. of Quantities
"Sheet"	Roadway Lighting Est. of Quantities [Sheet]
"Drawing"	Highmast Lowering Device Detail
"Sheet"	Highmast Lowering Device Detail [Sheet]
"Drawing"	Lighting Plans Sta. 100+00 to Sta. 250+00
"Sheet"	Lighting Plans Sta. 100+00 to Sta. 250+00 [Sheet]

05_01234_56_T_Signals.dgn

"Drawing"	Traffic Signal Quantities
"Sheet"	Traffic Signal Quantities [Sheet]
"Drawing"	Controller Cabinet Detail
"Sheet"	Controller Cabinet Detail [Sheet]

"Drawing"	US 60 @ KY 136/KY 425
"Sheet"	US 60 @ KY 136/KY 425 [Sheet]

05_01234_56_T_Signs.dgn

"Drawing"	Signing Quantity Sheet
"Sheet"	Signing Quantity Sheet [Sheet]
"Drawing"	Panel Signs Detail Sheet
"Sheet"	Panel Signs Detail Sheet [Sheet]
"Drawing"	1_75 Signing Plan Sta. 100.00 to Sta. 250+00
"Sheet"	1_75 Signing Plan Sta. 100.00 to Sta. 250+00 [Sheet]

Example Utilities: 05_01234_56_U_Water.dgn
05_01234_56_U_Sewer.dgn

Structure Design Files

The Structure Design Files should abide by the following naming convention:

AA_BBBBB_CC_S00000.dgn

Where "**AA**" represents the District Number and should consist of two digits. "**BBBBB**" represents the Parent Number and should consist of up to five digits. "**CC**" represents the Parent Number breakout and should consist of two digits. "**S**" is the sheet type and **00000** = the five digit drawing number.

Examples: 01_0115_00_S25500.dgn,

"Drawing"	001 Title Sheet
"Sheet"	001 Title Sheet [Sheet]
"Drawing"	002 General Notes
"Sheet"	002 General Notes [Sheet]

11_0273_01_S25501.dgn,

"Drawing"	001 Title Sheet
"Sheet"	001 Title Sheet [Sheet]
"Drawing"	002 Layout
"Sheet"	002 Layout [Sheet]

Standard PDF File Names

The following file naming conventions shall be used for all PDF files. In the event a particular file type is needed for the project and it is not addressed by this document, use the file naming convention as a template for selecting an appropriate name.

Roadway, Traffic, and Utilities PDF Files

These PDF files should abide by the following naming convention:

00_00000_00_XXXXXXX.pdf

Where **00_00000_00** represents the Item No. and **XXXXXXX** represents the discipline.

Examples: 05_01234_56_Roadway.pdf
05_01234_56_CrossSections.pdf
05_01234_56_Lighting.pdf
05_01234_56_Signals.pdf
05_01234_56_Signing.pdf
05_01234_56_Utilities.pdf

Structure PDF Files

Structure PDF files should abide by the following naming convention:

00_00000_00_SXXXXX.pdf

Where 00_00000_00 represents the Item No. and XXXXX represents the five digit drawing number.

Example: 05_01234_56_S25500.pdf

Naming Convention for Pages in the PDF File

Each page in the PDF file shall be bookmarked and the bookmark name shall be in the following format for Roadway, Traffic, Utilities, and Cross Sections.

<div align="center">

AAA_BBB_CCCCCCC

</div>

Where **AAA** is a sequential number starting at 001, **BBB** is the sheet number (ex. R2A, R3, R101), and **CCCCCCC** is the description of the sheet as shown on the title block of the sheet. Below is an example of the naming convention:
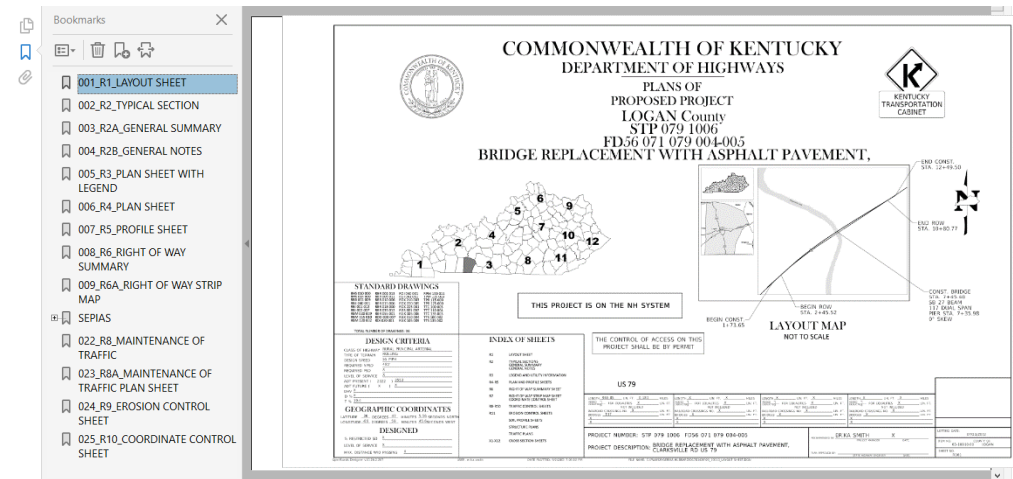
For structural plans, the bookmark names shall be in the following format.

<div align="center">

AAA_BBBBB_CCCC_DDDDDDD

</div>

Where **AAA** is a sequential number starting at 001, **BBBBB** is the drawing number (ex. 26611), **CCCC** is the sheet number (ex. S001), and **DDDDDDD** is the description of the sheet as shown in the index of sheets on the title sheet. Below is the naming convention illustrated for structural plans:
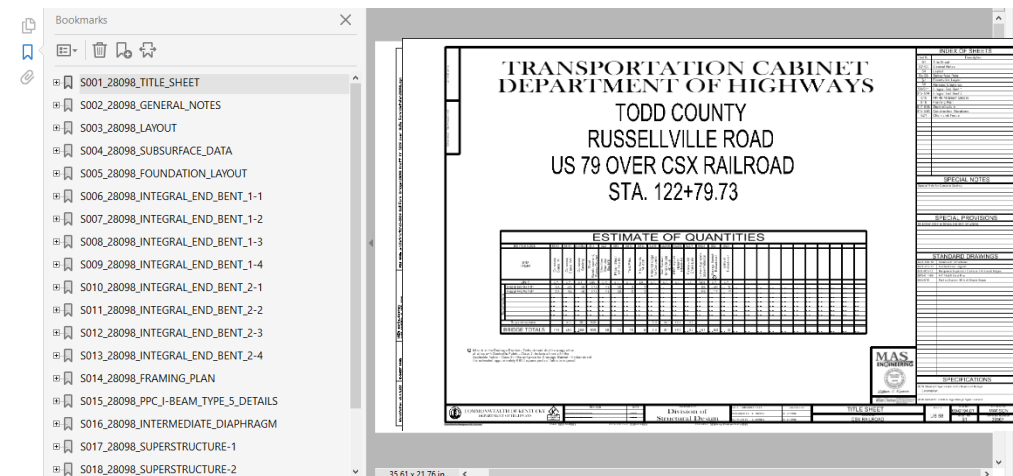
Electronic and Digital Signatures

The following sheets from the Plan Set shall have Digital and/or Electronic Signatures if designed by a Consultant Engineering Firm:

1. Roadway and Cross Section Layout Sheets
2. First Roadway Plan Sheet w/Legend and Utility Owners
3. First Plan Sheets of Traffic (Signal, Lighting and/or Signing Plans) Plan Sets
4. First Plan Sheet of the Structure Plan Set

Layout Sheet (Roadway and Cross Sections)
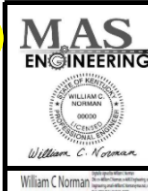
The layout sheet is the designated location for the authorization signatures for plan sets. Final contract plans prepared by State Forces shall bear the electronic signature of the State Highway Engineer. Final contract plans prepared by Consulting Engineering Firms shall bear the additional electronic signature and electronic stamp of the seal of a professional engineer (Civil or Highway) licensed in the Commonwealth of Kentucky. For projects designed by consultants, digital signatures will be required per 201 KAR 18:104. When engineering work is completed by a sub consultant, the prime consultant shall be responsible for determining whether the prime or sub shall affix the digital signature.

1. The Project Manager's name (typed name is sufficient)
2. The State Highway Engineer's signature (will be submitted electronically)
3. Consultant Firm's Name or Logo
4. Consultant Professional Engineer's electronic stamp and electronic signature
5. Consultant Project Engineer's digital signature

Structural Plan Sheet

The first structural plan sheet is the designated location for the authorization signatures for structural plans.

1. Consultant Firm's Name and Logo and Consultant Professional Engineer's electronic stamp and electronic signature and digital Signature
2. Project Item Number

Traffic (Signal, Lighting, Signing)

The project title block should appear on the first plan sheet. *Digital Signature is required.*

1. The name of the perspective designer, along with the date the plans are submitted to Plan Processing Branch
2. Consultant Project Engineer's Digital signature
3. The county along with State and Federal project numbers, when applicable

GRAPHIC STANDARDS

All CADD files shall be in Bentley design file (DGN) format and shall comply with the KDOH graphics standards. Raster components within CADD files are acceptable on a limited basis (i.e. map portion of the Layout sheet, photo backdrop portion of R/W strip map). File name extensions shall be .DGN for all CADD files.

CADD file Working Units shall be set as follows:

<u>Working Units for Roadway, Traffic, and Utilities plans shall be</u>
Master Unit = US Survey Feet (Label = '), Sub Unit = US Survey Tenths (Label = tn), Resolution = 10000 per US Survey Foot

<u>Working Units for Structure plans shall be</u>
Master Unit = Feet (Label = '), Sub Unit = Inches (Label =") Resolution = 12000 per Foot

As per the Department's Surveying Standards, the Kentucky Single Zone, as it relates to State Plane Coordinates, is being used on projects in lieu of Kentucky North or South Zone. The Kentucky Single Zone provides a consistent coordinate system on a statewide basis that minimizes ground to grid distortions and convergence angles.

All mapping submitted to the Department shall comply with the CADD Standards. The survey deliverables shall be a 3D DGN file and a separate Terrain file, current version, as recognized by the Department. Furthermore, field located elements shall adhere to the survey codes delivered with the configuration.

Standard Files

Design files should be based on the standard seed files:

2D seed file	KYTC_ORD_2D_Seed.dgn
3D seed file	KYTC_ORD_3D_Seed.dgn
2D seed file Structures	kytc_structures_2d.dgn
3D seed file Structures	kytc_structures_3d.dgn

All new DGN files must be created from a delivered seed file!

The Standard Cell Library should be used whenever possible and all sheet cells must be taken from the Sheet Cell Library.

Bentley 3D Cells Imperial.cel
Cross Section Labeling.cel
Dynamic XS Labels.cel
KYTC_3D_End_Treatments.cel
KYTC_Construction.cel
KYTC_Drainage.cel
KYTC_Geotech.cel
KYTC_Roadway.cel
KYTC_Sheet.cel
KYTC_Structures.cel
KYTC_Traffic.cel
KYTC_TrafficSign.cel
Plan View Labeling.cel
Profile View Labeling.cel
Subsurface Feature Definitions.cel
Subsurface Utilities Labeling.cel

Symbology

Contract Plans for all KDOH projects shall adhere to the standard level structure as delivered by the Graphics Standards. No additional levels shall be allowed.

CADD files representing the contract plan set must be capable of producing greyscale plots (black and grey lines) without any special plotting routines. With the exception of color, a one to one relationship (WYSIWYG) between the design file content and the plotted sheets shall be maintained. No additional information should be contained in the design file and no information should be placed outside the sheet border of the electronic contract plan sheet.

All Contract Plan design files for Roadway, Structures, Traffic, and Utilities **shall generate plots that are greyscale** with the following line widths and text sizes for the full size sheets (36" X 22") and half size sheets (18" x 11") as outlined in the following two graphics, on the next page:

Line Widths for Full Size Plans	
MicroStation Line Weight	**Plotted Line Width**
WT	Inches
0	0.006
1	0.010
2	0.016
3	0.022
4	0.028
5	0.034
6	0.040
7	0.050
8	0.060
9	0.070
10	0.080

Line Widths for Half Size Plans	
MicroStation Line Weight	**Plotted Line Width**
WT	Inches
0	0.003
1	0.005
2	0.008
3	0.011
4	0.014
5	0.017
6	0.020
7	0.030
8	0.040
9	0.050
10	0.060

PDF Files

The goal is to provide an intelligent and consistent PDF file to the end user to allow as much functionality as possible. In order to do this, the PDF file shall be created with the following settings in the Printer Driver Configuration (seen here and the next 3 pages):

General:	
Automatic Centering	True
Automatic Open Plot File After Creation	True
Default Color Mode	Greyscale
Default Line Cap	Flat
Default Line Join	Round
Default Output Mode	No Preference
Default Print to 3D	False

Default Pen Table	KYTC_Full_Greyscale.tbl
Print Style Name	KYTCPrintStyle.dgnlib
Driver Properties:	
PDF Version	PDF 1.7 (Acrobat 8 and later)
PDF Standard	
Precision	Standard
Enable Bookmarks	On
Enable Bookmark Hierarchy	On
Enable Links	Off
Enable Optional Content	Off
Print Optional Content	As Displayed
Enable Measuring	On
Enable Georeferencing	Off
Enable Searchable Text	On
Model Label	
Level Label	Level Description
Allow Changes	Allow unrestricted changes
Allow Printing	Allow high resolution printing
Initial View Navigation	
RGB Raster Compression	Zipped
Enable Plot to 3D	Off
Enable Provenance Metadata	
Set Page from Plot Size	On
Document Title	$(basename(_DGNFILE))_$(MS_PLTMODELNAME)
Author	
Keywords	
Subject	
Owner Password	
User Password	
Default Print file Name:	
File Name	$(MS_PLTFILES)$(basename(_DGNFILE))
Extension	Pdf
Auto Increment Extension	False
Auto Overwrite File	False

Print Border:	
Border On	False
Border Outline On	True
Include File Name in Border Text	False
Include Model Name in Border Text	False

Include Date/Time in Border Text	False
Border comment	
Border Text Offset (cm)	0.0
Border Pen	1
Border Text Height (cm)	0.2540
Border Width (cm)	0.0250
Fence Outline On	False
Fence Outline Pen	1
Raster Printing:	
Raster Quality Factor (0_100%)	100
Raster Brightness	0
Raster Contrast	0
Print Raster	True
Print Raster in Grayscale	False
Ignore Color Rules for Monochrome Raster	False
Advanced:	
Driver Resolution (Dots/Unit)	300,300
Driver Resolution Units	Inches
Automatic Rotation Direction	Rotate 90 cw
Enable Driver Clipping	Not defined
Enable Path Support	Not defined
Level of Detail Mode	Show Range
Minimum Level of Detail	10
Maximum Miter Angle (degrees)	90
Optimize Raster Color Depth	True
Print Points	True
Rasterized Quality Factor (0_100%)	100
Scale Adjustment Factor	1,1
Enable Merging of Background Rasters	True

Size:	
Paper Size	22 x 36 in.
PDF Size	22 x 36 in.
Weight Maps:	
Design Weight:	Print Width:
0	0.006 in.
1	0.01 in.
2	0.016 in.
3	0.022 in.
4	0.028 in.
5	0.034 in.
6	0.04 in.
7	0.05 in.
8	0.06 in.
9	0.07 in.
10	0.08 in
11_31	0.10 in

Level Naming Convention

Level names will be ≤ 32 characters. The level name will use the under bar as a separator (no commas, parentheses, etc.) The level name scheme is as follows:

A_BC_acronym_DE

Where "**A**" = the sheet type, "**BC**" = the sheet code, "acronym" = an abbreviation of the item's name and "**DE**" = the data type.

Sheet Types

E – Environmental
G – Geotechnical
R – Roadway
S – Structures
SB – Sheet Border
T – Traffic

Data Types

EX – Existing Data
PR – Proposed Data
ET – Existing Text
PT – Proposed Text

Sheet Codes

LS – Layout Sheet
TS – Typical Sections
SU – Summaries
PL – Plan Sheets
PF – Profiles
RW – Right of Way Summaries and Strip Maps
DS – Detail Sheets
MT – Maintenance of Traffic Sheets
EC – Erosion Control Sheets
CC – Coordinate Control Sheets
GT – Geotechnical and Soil Profiles Sheets
MP – Mitigation Plan Sheets
PD – Pipe Drainage Sheets
XS – Cross Sections
OR – OpenRoads Graphics

Level Overrides

Level overrides shall be turned off for the delivery of the Contract Plan Set.

Color Table

Colors used in design files should be based on color.tbl (the MicroStation default color table).

Graphical vs. Symbolic Representation

Some features give the designer the option of displaying the feature on the plans using either a graphical or a symbolic representation. For example, an 18" water main may be graphically displayed by drawing parallel lines 18" apart representing the edges of the 18" pipe and labeling as an 18" water line. Instead of displaying the 18" water main graphically the designer may choose to display the 18" water main symbolically by using the water main line style to draw a line representing the center of the 18" water main and labeling the line as an 18" water main.

Appendix A

KYTC OpenRoads Designer FAQ

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Frequently Asked Questions

What is OpenRoads Designer?

Bentley Systems is a software vendor that provides, among many things, civil design and CADD software. State DOTs and their industry partners utilize some sort of Bentley software in their workflows to deliver their transportation program. Historically, KYTC has used MicroStation for their CADD software and InRoads for their civil design software. Along with Design Files (DGN), users would produce the following database files that store the civil data associated with their work:

- Geometry files (ALG)
- Digital Terrain Model files (DTM)
- InRoads Template Library files (ITL)
- InRoads Roadway Designer files (IRD)
- InRoads Storm & Sanitary files (SDB)

As the software has evolved, an emphasis has been placed on integrating this civil data into the CADD files. With OpenRoads Designer (ORD), Bentley Systems has combined InRoads and MicroStation to provide one product for designing civil projects, along with storing and exchanging civil data downstream.

This data exists as CADD elements within the DGN file without relying on the database files of InRoads. These 3D elements have properties that convey how they are to be displayed, how they were created in relation to other elements and how they will be used for building the 3D model. Expected benefits of developing and delivering projects in this manner include:

- Better reflection of the engineer's design intent in areas traditionally not well defined in plan sets (e.g. between cross sections, pavement transitions and intersections).
- Delivering a higher quality product to the contractor with an accurate project footprint related to earthwork and construction limits, with the goal of reduced change orders by better communication design intent.
- Creating a better visualization tool for engineering analysis (e.g. sight distance, clear zone) and coordination with other design disciplines.
- Creating a product to facilitate clash detection.

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KYTC OpenRoads Designer FAQ

Why is KYTC upgrading to ORD?

As the transportation industry worldwide adapts to new technology, DOTs must ascertain their readiness to adapt to these industry trends. FHWA has elevated 3D modeling through its Everyday Counts initiative and has encouraged DOTs to adopt policy for delivering a digital product in lieu of a set of plans (paper, mylar or PDF). When a project is designed using current civil design software, it is created within a 3D model. Contractors across the world are utilizing 3D models for Automated Machine Guidance to perform activities such as grading, paving and drainage installation. In between these steps, projects are often flattened to convey design intent in a 2D medium such as a PDF or paper plan set. During this conversion, data is lost, precision is reduced, and design intent is nullified. Looking forward, ORD will allow designers to produce a product that retains the civil data and design intent through construction. This data, also known as Electronic Engineering Data (EED), could possibly be consumed further downstream in Asset Management and Maintenance. However, for now, KYTC recognizes that the contract document shall remain a PDF set of plans.

Furthermore, Bentley Systems is phasing out support for legacy products such as InRoads, as well as MicroStation SS4 and earlier. This means that although it will still function in its current configuration, Bentley will not continue to certify it on future versions of the Windows Operating System. It is also understood that in the near future, licensing of the legacy products could cease. DOTs across the country are testing, piloting and implementing ORD as a response.

So, what is the new terminology that I need to learn for ORD?

ORD uses some different terms from its predecessors. Below are some of the new terms and how they relate back to InRoads:

- **Geometry**: Horizontal and Vertical alignments, what used to be contained in the ALG files.
- **Terrain**: Surface model that represents existing ground, the proposed design or other items that were referred to as digital terrain models (DTMs)
- **Corridor**: Objects that make up the proposed roadway, such as template drops, point controls, end condition exceptions, parametric constraints, etc.
- **Workflows:** ORD's way to organize the ribbon interface into logical tasks, like Surveying, Modeling, Plan Production, etc.
- **Configuration, Workspace, Workset:** <u>Configuration</u> can be equated to the previous Workspace, or a collective of resource files that are standardizing the software for KYTC. <u>Workspace</u> is now used to set an Agency's standards. A <u>Workset</u> sets standards at the project level, such as automated placement of text like the item number, county, etc. on the Sheet Borders. KYTC provides updated executables through the CADD Standards website that will set the Workspace and will standardize the Workset when it is created for the project.
- **Model Annotation:** This is how ORD handles "intelligent" annotation, such as geometry stationing and bearings/distances, survey elements like pipes, buildings and trees, as well as cross section elevations, dimensions and volumes.

Appendix A

KYTC OpenRoads Designer FAQ

When will I be required to use ORD?

All **NEW** project starts after November 1, 2019 with a construction letting after November 1, 2020 **shall** comply with the CADD Standards for Highway Plans (version 4.X) policy. The Project Manager shall decide whether to convert current projects with consideration to project schedule and budget.

Do I have to do 3D Modeling on my new ORD project?

ORD creates a 3D model from your 2D design, storing the civil data in the DGN files. These DGN files will be required for projects that typically include substantial grade and drain operations. Examples of such project types include, but are not limited to:

- Roadway New/Existing w/ substantial grade and drain
- Widening
- Bridge replacements to add capacity and/or with approach grading
- Grade separations
- Interchange reconstructions
- Roundabouts
- Turn lanes
- Passing lanes

3D model files may not be required for projects that do not propose earthwork/grading operations, unless the Project Manager for KYTC indicates otherwise; examples of such project types include:

- Lighting
- Maintenance
- Bridge Rehabilitation without approach grading and paving
- Resurfacing without significant grading operations
- Landscaping
- Signal upgrades
- Signing/striping upgrades
- Streetscapes
- Drainage improvements
- ATMS/ITS
- Noise walls

Appendix A

KYTC OpenRoads Designer FAQ

What is with all these seed files?

ORD utilizes seed files a little differently than our users are accustomed to seeing. To understand this change, it is important to categorize a few different types of seed files.

Some seed files are used to create new design files. They contain a default coordinate system and working units and have no pre-existing civil data. **It is imperative that all new design files are created from a KYTC delivered seed file**. This ensures that newly created files do not contain civil data that could compromise our users' design process. Below are the four (4) delivered seed files used for creating new DGNs:

KYTC_ORD_2D_Seed.dgn

KYTC_ORD_3D_Seed.dgn

kytc_structures_2d.dgn

kytc_structures_3d.dgn

There are also seed files used exclusively for creating new models within a DGN file. As models become more important to how we will design and submit projects, it is important to know the distinction. The three (3) types of seeds for this are **Design, Drawing and Sheet**. More on those in the next section.

The third type of seed file is used for OpenRoads Drawing Production. A new tool within ORD and MicroStation CONNECT helps to automate the creation of plottable sheets. In order to do this, scaling seeds were created for the various plotting scenarios that users may require. For more information on how Drawing Production tools function, it is suggested to take one of the ORD and/or MicroStation CONNECT Upgrade classes through ACEC.

What is the difference between Design, Drawing and Sheet Models?

ORD utilizes three different types of models, Design, Drawing and Sheet.

- **Design**: Consists of design geometry, can be 2D or 3D, and contains the elements that represent what is built, drawn at full scale (1:1). It is also not intended for publication, only active editing. This model typically has a black background.
- **Drawing**: This type of model is used to apply annotation. It stores a subset of a 2D or 3D design model or design composition. It is always 2D and has a grey background.
- **Sheet**: *This model is for plotting purposes only*. It serves as an electronic drawing sheet and is used to define printed output, ready for printing or publishing. The sheet model includes a boundary, sheet information, and additional sheet annotation. A sheet model has a white background.

All mapping and design features that have coordinate location values associated with them shall maintain those coordinate values within the CADD files. Do not rotate or translate design file elements. View rotation should be used to obtain the appropriate orientation of the sheet. Detail sheets do not have to be shown in true coordinate location.

What is different with my fonts?

Engineering Fonts are no longer used in MicroStation CONNECT and ORD for KYTC's configuration. Instead, the designer will notice only true-type fonts now exist. Text Styles are being used to set the properties of the text, including font size and justification. Additionally, all text for Existing conditions will be italicized and controlled through the Text Styles.

A new feature called Text Favorites is utilized to harvest intelligent data from the design file. These are pre-set to label stations and offsets, cut and fill areas and volumes, as well as standard notes.

How will this initiative affect survey collection and processing?

KYTC has revamped its list of survey codes to reflect changes in how our surveyors work and the software that they will be using to process the field work. An updated list of codes can be found within the ORD Configuration in PDF and FXL file formats.

One major difference in data collection is how ORD processes points and lines. There are four (4) main Terrain Model Attributes in ORD:

- **Break Line**: A linear element that consists of points linked by a Start Code (ST). These elements will triangulate by default. These lines are generally displayed by a linear element.
- **Spot**: A point that will triangulate by default. This replaces the Random point in InRoads. These points are generally displayed using a cell.
- **Not Included**: These elements are either points or linear features that will not triangulate when the Terrain Model is created. This replaces the Do Not Contour (DNC) terminology of InRoads.
- **Void Break**: This type of element is a shape that does not allow triangulation across its perimeter. These are typically used for buildings and ponds.

Another difference is what must be delivered to the designer. With InRoads, the deliverable was a DGN file (3D) containing the post-processed survey data as a manuscript, along with the existing DTM and ALG. In ORD, the deliverable will be a 3D DGN file containing DGN graphics exported from the original Field Book and a separate DGN file containing only the Existing Terrain. It is critical that the survey file be created from KYTC's delivered 3D seed file. The raw data collector file (CSV, FWD, etc.) will also be required if additional survey corrections are necessary, as the exported DGN graphics file is detached from the Field Book.

There is also a slight change to the types of codes that can be used for things like joining points or closing a shape. ORD has two types, Link Codes and Control Codes. Link Codes are things like ST and CL (Start and Close, respectively). Control Codes contains the Join Point code, among others. For more detailed information, you can attend an ORD Survey training class through ACEC or by contacting KYTC CADD Support.

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KYTC OpenRoads Designer FAQ

What is changing in my workflow and deliverables?

ORD relies heavily on embedded civil data in lieu of the database files from previous versions of InRoads. In order to maintain the integrity of the civil data used for design, KYTC will no longer accept stand-alone "cut sheets", a.k.a. eSheets. Previously, KYTC policy required each sheet of the plan set have a corresponding DGN file with reference files either detached or merged into the master file. Moving forward, KYTC recognizes the importance of maintaining the civil data contained in the DGN files. Thus, DGN files shall be classified in two ways, either intelligent or non-intelligent. Intelligent files contain embedded civil data such as Horizontal and Vertical Geometry, Corridor Objects and Terrains. This also includes files created for ORD's Drawing Production workflow. Plan, Profile and Cross Section sheets are now created through automated tools and retain civil data, or intelligence. "Sheets" are now housed in Drawing and Sheet models within ORD or MicroStation CONNECT. It is the intent of KYTC to maintain their intelligence, which requires that reference files remain linked throughout the submittal process. KYTC has developed a logical folder structure for working within ProjectWise and for final project submittal. This structure will ensure that the DGN files are named logically for the downstream consumer.

Furthermore, a "container" file system shall be used for submittals. A "container" file is an empty DGN file that has other DGN files referenced into it of the same civil data type. For example, it is strongly recommended to keep your geometry files in separate DGN files. To make it easier to maintain the necessary reference links, the "container" file would have all of the different geometry types referenced in, such as Mainline, Approach X, Approach Y, Ramp A, Ramp B, stream centerline, etc. See the CADD Policy for more details on the types of "container" files required for submittal and the naming system.

Other types of "sheets" that do not require civil data can be considered non-intelligent. These include, but are not limited to:

- Typical Section Sheets
- Summary Sheets
- Notes Sheets
- Sepias and other Detail Sheets

These types of "sheets" do not require Plan, Profile nor Cross Sections and will be delivered in a separate DGN file in individual models, named according to CADD Standards Policy V4.X. Please see the Appendix of this document for specifics on file naming, model naming and the delivery process.

The above information applies to only the DGN files in the final project submittal. The contract document will remain a PDF set of plans. If you are a consulting firm doing work for KYTC, you will continue to submit a signed and sealed PDF plan set, with separate files for Roadway, Cross Sections, Structures, Traffic and Utility Relocation.

Note that index files are no longer required. Please see the Appendix of this document for specifics on file naming, model naming and the delivery process.

As with CADD Standards V3.X, Land XML files will be included in the final submittal:

1. **ItemNumber_EX_Terrain.xml**: containing the complete existing ground surface
2. **ItemNumber_PR_MainlineModel.xml**: containing the single merged finished grade of the proposed corridor
3. **ItemNumber_PR_Subgrade.xml**: containing the single merged subgrade of the proposed corridor
4. **ItemNumber_Geometry.xml**: containing all linear geometry
5. **ItemNumber_Superelevation.xml**: report containing superelevation station ranges

There are no changes to the required earthwork files to be submitted at final plans; earthwork quantities in Excel format should be submitted using the average end area method (Earthwork.xlsx).

Also, the coordinate control file (CSV format) is still required at submittal. See Appendix for locations of these files.

What are Control Features?

In order to target certain elements within the DGN file, ORD needs them to be linear geometry. An existing edge of pavement can often be a designer's controlling element when widening to the outside. Perhaps the designer wishes to target a retaining or extended wing wall with their fill slopes. These elements are called Control Features and should be stored in a separate DGN file and referenced into the working file. The designer can then target them as needed to refine their model.

Where are my Drafting Notes?

Bentley introduced Drafting Notes with the XM product line with the intent of adding the ability to harvest design information when placing notes. One could automate station and offset or pipe length and slope in a construct note. In ORD, Drafting Notes are replaced with Text Labels. A text label will utilize a cell to harvest the design data from the element you are annotating/noting. Label cells were created for most situations. Should the designer need additional note cells, they can create them or let KYTC CADD Support know that a particular label is being utilized frequently and they will include it in a future release for others to also use.

How will I produce Summary Sheets?

Using a Master Excel File (Summary_Template.xlsx) provided as part of the KYTC delivered configuration for ORD, and containing pre-made tables for the General Summary, Paving Summary, Right of Way Summary, etc., one can create summary sheets with interactively-linked tables. The tables in the Master Excel File are already formatted, meaning only the data will have to be input. The tables can then be attached to the DGN file and updated as needed with changes to the aforementioned Master Excel File. Note that if the Excel file is housed in ProjectWise, the links to the DGN file will persist. If using the Excel file on a shared network drive or local drive, moving the Excel file will break the link. Upon submittal, embed the tables in the DGN file. Summary tables should only be created in the Drawing Model for the respective sheet. The boundary in the Drawing Model will

indicate the space in which the designer has to place the table. The Drawing Model is referenced into the Sheet Model for plotting purposes.

Why are Master Reference Files important to the Deliverables?

The Master Reference File concept was adopted to ensure that the design intent and intelligence from EED is delivered downstream for Construction Engineering and Inspection (CEI) activities. In the past, KYTC policy has stated that the InRoads database files (ALG, DTM, etc.) shall be delivered as supplemental information. The inspector and/or the contractor could use these files for Automated Machine Guidance (AMG) and project inspection, or documenting change orders or even re-engineering an issue that arose once Construction had started.

In ORD, this information is stored in the DGN file and can be reviewed in the OpenRoads Model in Project Explorer. In the example below, the Corridor is expanded to see what information it contains:
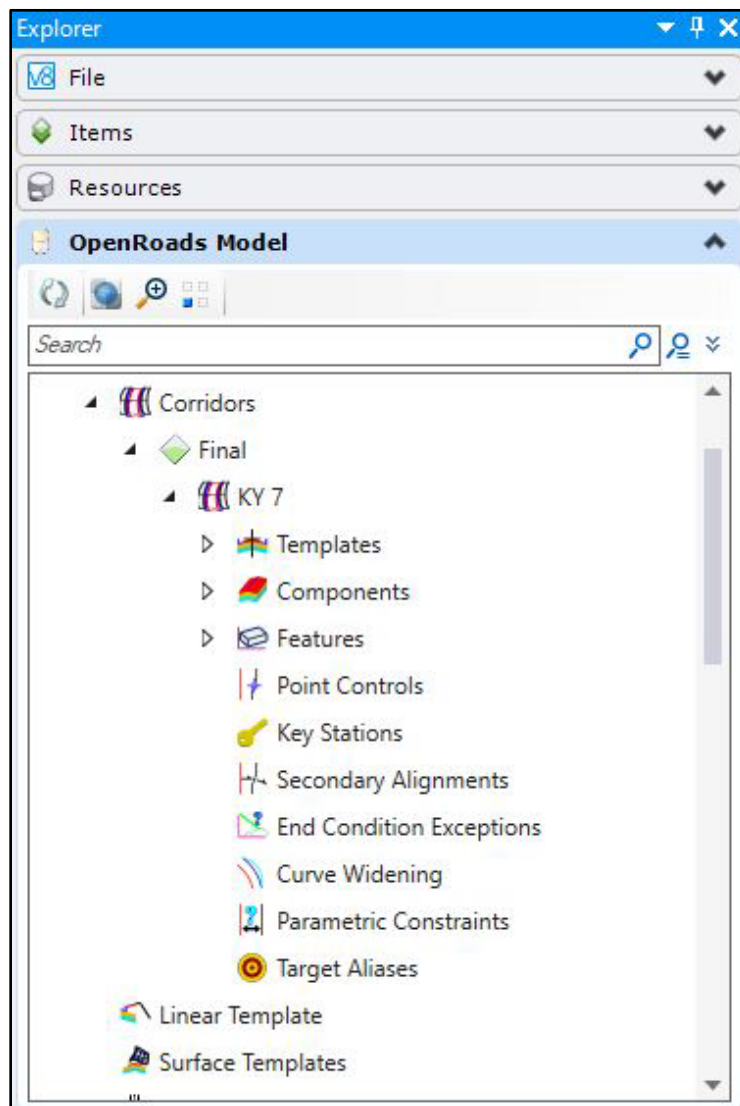
Within the Corridor, the designer can review the templates that were used, what components are associated to the templates, what point controls and end condition exceptions were used, etc. Terrain Model, Superelevation, Civil Cell, Linear Geometry and Alignment information can also be reviewed in this manner.

Model information can also be edited from this list if it resides within the DGN file. Referenced model information can be reviewed but not edited.

The intent of the Master Reference File system is to ensure that this information is passed downstream. Plan Sheets are created from the model information as well. With ORD, reference files are not only permitted, they are required to maintain the integrity of the Plan Sheets. Thus, the importance of maintaining the proper reference system for the lifecycle of the project.

Much like the parent/child relationship within and ALG file, DGN files must have a similar relationship amongst themselves. Note the examples below. On the left, we see the older InRoads ALG hierarchy of Geometry Project, Horizontal Alignment and Vertical Alignment. Next to that is an example of a Container file and the Geometry files for various alignments on a project.
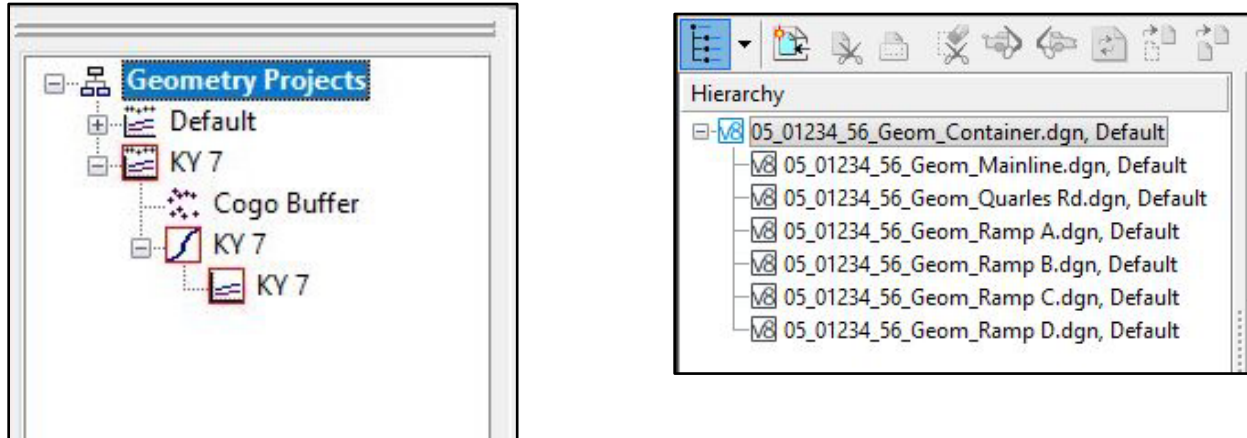
By referencing the individual geometry files, the designer can attach the Container File to other working files and have access to the civil data in each file. This will not only make it easier on the downstream user to understand the relationship of each file and thus each civil object but will make it easier for the designer to use them when creating other design elements. More information on the naming scheme of Container Files and the folder structure can be found in the current CADD Policy.

How can I show my utility lines on my cross sections?

It is expected most projects will have overhead and/or underground utility lines in potential conflict with proposed construction. KYTC adopted ASCE Quality Level designations of underground utilities to convey the accuracy of their locations on our plans. As such, ORD has Feature Definitions specifically to label these underground facilities appropriately. Each underground category has a Feature Definition for Quality Level (QL) A-C. KYTC assumes that the accuracy of a locate for QL D is not different enough from QL C, and therefore does not need its own designation (further explained below).

If the designer assigns the appropriate QL Feature Definition when featurizing the utility graphics from survey, the crossing lines will be properly labeled in both dynamic and plottable cross sections. There are three types of cells for each utility type, each representing a Quality Level:

QL A: this utility has been vacuum excavated or otherwise exposed and a survey shot taken on the actual line or casing. This will provide survey-grade accuracy on X, Y & Z, or known elevation. The cell on the plottable cross sections will automatically display the crossing elevation. Note that dynamic cross sections cannot label the elevations automatically, thus a separate cell was created without the elevation value.

QL B: this utility has been located using non-invasive means, such as a tracer wire or ground penetrating radar. The X & Y are very accurate, but the Z value will vary somewhat. Therefore, the cell will display a minimum depth or range. The designer will need to assume a minimum depth based on QL B elevations and create the profile of the utility accordingly.

QL CD: this utility has been located via facility mapping or surface locations (i.e. pedestals, boxes, meters, etc.) or via word of mouth from a property owner or utility company representative. This will not have a known nor approximated Z value and will be draped on the surface.

Also note that the Quality Level may be upgraded or downgraded based on the designer's or other SME's judgement. Once the source of the information is considered, assign the Feature Definition appropriately.

Do I still need to make Situation Survey Sheets for large pipes and culverts?

Situation Survey Sheets are an amalgam of a pipe sheet, stream profile and cross sections through the pipe or culvert. Historically they were produced for hydraulic analysis, structural design and bid plans. A "situation" size structure is a circular pipe with a 54" or greater diameter or a box culvert.

How can I stay up to date on what is happening with the ORD Standards?

If you are looking for the latest version of the CADD Standards Configuration for ORD (Version 4.X), you can download it from KYTC's CADD Standards website. If you want to stay in the loop on ORD, you should subscribe to KYTC's CADD Support Listserv. Go to the CADD Standards website at the link below and click the Subscribe button at the top. Fill in your info and you will start to receive updates with news on ORD, details on updates to the Standards, version changes for ORD, etc.

https://transportation.ky.gov/CADD-Standards/Pages/default.aspx

Also, for all questions/comments on ORD, please contact:

KYTCCaddSupport@ky.gov