Ohio Department of Transportation

CADD Engineering Standards Manual (OHDOT)

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Table of Contents

100 GENERAL

101 Introduction

Computer-Aided Drafting and Design (CADD) is the preferred method of preparing plans for the Ohio Department of Transportation (ODOT). The requirements presented in this manual ensure that CADD files can be used by the entire project team (surveyors, planners, environmentalists, designers, reviewers, contractors, etc.) throughout all phases of project development.

ODOT has adopted MicroStation CONNECT Edition (CE) and OpenRoads Designer CONNECT Edition (ORD) as its standard drafting and design software packages, respectively. The standards referenced in this manual have been developed and tested using the MicroStation CE and ORD software versions listed on the ODOT CADD Services webpage.

The April 2019 update to ODOT's CADD Standards included new "OHDOT" Standards for use with MicroStation CE and ORD. The new Standards are compatible with MicroStation CE and ORD and are not backwards compatible with previous software versions. The new Standards replace the previous "ODOTcadd" standards for all projects developed using MicroStation CE and ORD.

All new projects started after April 1, 2020 using Bentley software must use MicroStation CE or ORD using the OHDOT Standards. Projects started after April 1, 2020 are not permitted to use the ODOTcadd standards. Information about ODOT's transition from MicroStation and GEOPAK SELECTseries 4 to MicroStation CE and ORD is available on the ODOT CADD Services webpage.

This manual supersedes all CADD standards previously published in the Bridge Design Manual, the Right-of-Way Manual, and the Location and Design Manual, Volume 3.

This manual is not a textbook and does not exempt the professional from performing responsible engineering and/or surveying. It is intended to provide uniform procedures and standards for ODOT staff and organizations that perform CADD related services for ODOT. The professional shall have final responsibility for the accuracy of all input and output of computer-based applications.

101.1 Software

ODOT operates internally using MicroStation CONNECT Edition (CE) and OpenRoads Designer CONNECT Edition (ORD) software only.

ODOT will accept electronic deliverables generated from Autodesk tools; however, the CADD design software to be used on a project shall be mutually agreed upon by the District and consultant and shall be explicitly stated in the project's scope of services. Once the decision has been made to use either MicroStation CE, OpenRoads Designer, or Autodesk, there shall be no deviation from the agreed upon design package, and the same one shall be used until the project's completion.

This document is specific to ODOT's use of MicroStation CE and ORD. ODOT will provide no support, standards, documentation, or guidance of any kind with respect to design and delivery of projects developed using Autodesk tools. All CADD related documentation, training, supporting files, and customization provided by ODOT shall be MicroStation CE and ORD based only.

A Civil3D State Kit for use with Autodesk software is available for ODOT projects. A link to download the State Kit is provided on the ODOT CADD Services webpage.

ODOT offers no support for the Autodesk Civil3D State Kit.

The final deliverables of an Autodesk designed project in printed or electronic format shall mimic that of a project designed and delivered using MicroStation CE/ORD. The electronic deliverables for projects designed using Autodesk tools shall be delivered in the native Autodesk format, and not converted to MicroStation CE/ORD format.

102 Distribution

This manual, in its entirety, may be freely copied and distributed for the purpose of providing a consistent guide to the CADD requirements of the Ohio Department of Transportation. The manual, Standard CADD files and other support files can be downloaded from the ODOT CADD Services webpage.

For ODOT CADD Users, MicroStation CE and ORD CADD Standards are located inside ProjectWise and are configured to be used inside the ProjectWise environment.

103 Revisions and Updates

The **Office of CADD and Mapping Services**, CADD Section, with input from ODOT's District Offices, technical offices, and the consultant and construction community, will develop, and maintain procedures and standards for the Department's CADD related activities. CADD Manual holders are encouraged to submit comments and suggestions for improvements to the manual or ODOT's CADD Standards. Any errors found should be brought to the attention of the ODOT **Office of CADD and Mapping Services** via the following online support request:

https://odot.formstack.com/forms/cadd_servicerequest

The Ohio Department of Transportation strives to stay current with state-of-the-art trends in the market. However, impacts on project delivery schedules and the resources necessary to provide future support for new features must be considered prior to any change.

Updating this manual is intended to be a continuous process and revisions will be issued periodically per the release dates stated on the **Design Reference Resource Center (DRRC)** web page at the following address:

http://www.dot.state.oh.us/drrc/Pages/default.aspx

The DRRC web page also provides the option to subscribe to an email list for notification of updates to ODOT's Standard CADD Files. Once you have subscribed to the ODOT CADD Standards mailing list, it is your responsibility to notify ODOT of a change of email address by unsubscribing your old email address and re-subscribing using your new email address. See the DRRC web page for instructions on subscribing and unsubscribing.

Revisions to the manual are noted in red text.

104 Trademarks

MicroStation CONNECT and OpenRoads Designer are registered trademarks of Bentley Systems, Incorporated. © 2019 Bentley Systems, Incorporated.

Autodesk is a registered trademark of Autodesk, Incorporated.

Other trade names, computer protocols, and file formats mentioned in this manual are the trademarks of their respective owners. In no event will the appearance of any graphic, description of any graphic, picture, screen display, or any other method of conveying meaning be considered to impair the rights of the respective owners.

200 CADD STANDARDS

201 Installation and Configuration

201.1 General

This section outlines the setup for a typical installation of MicroStation CE and ORD at ODOT. The configuration files discussed in this section are available from the ODOT CADD Standards website.

The OHDOT Standards can be downloaded from the ODOT CADD Services webpage.

201.2 Installation

For a typical ODOT installation, MicroStation CE and ORD software is installed in the default location.

201.3 CADD Standards Directory

The configuration and associated files for MicroStation Connect and OpenRoads Designer that are used for plan development at ODOT are located within ProjectWise at the following location:

Ohio DOT Projects\Documents\03 Standards\CADD Standards\CONNECT_Config\Workspaces\OHDOTCEv01\

Configuration information for users external to ODOT can be found on the ODOT CADD Services webpage.

201.4 Configuration Variables and Files

Configuration variables are defined in two locations within the OHDOT CADD Standards environment:

- OHDOT_WorkSpace.cfg defines configuration variables and standards that apply to apply to all projects developed using the OHDOT Workspace.

- Project specific variables are defined in a WorkSet Configuration file.

The OHDOT Workspace does not define a custom location for user configuration files. User configuration files are in the default directory as defined by Bentley software.

202 Level Assignments

202.1 General

ODOT has developed a standard set of levels to be used with all design files submitted to or exchanged with the Department. The levels are defined in a MicroStation DGN Library, OHDOT_Feature_Definitions.dgnlib.

Users shall not create their own levels for use in any design files submitted or exchanged with ODOT.

See the **Appendix - Levels**, for a complete list of the ODOT levels.

202.2 Level Naming Convention

ODOT level names use the following naming convention:

<div align="center">

Classification_Disposition_Logical Name

</div>

The **Classification** consists of two (2) uppercase characters used to group the levels into categories. The Classification names are listed in the table below:

Classification	Description	Classification	Description
AP	Airports	PF	Profiles
BD	Buildings	PM	Pavement Markings
BR	Bridge	PV	Pavement
CL	Centerline	RC	Recreational
CM	Corridor Modeling	RD	Roadway
DR	Drainage	RS	Raster Files
DT	Digital Terrain Models	RW	Right-of-Way
DV	Divisions	SC	Scratch
EV	Environmental	SG	Signals
FL	Flight Mapping	SH	Sheets
GE	Geometry	SN	Signing
GK	GEOPAK	SV	Survey
GT	Geotechnical	TR	Truck Turning Paths
HY	Hydraulics	TX	Text
LT	Lighting	UT	Utilities
MD	Modeling	VG	Vegetation
MT	Maintenance of Traffic	VL	Volume
PC	Point Clouds	XS	Cross Section

The **Disposition** is used to identify the level for placement of either **X** (existing) or **P** (proposed) information.

The **Logical Name** is used as a description of the element contents. Where appropriate, common industry abbreviations are used.

All ODOT levels names use alphanumeric characters only. No spaces or special characters are used other than the underscore "_" character.

202.3 ByLevel Considerations

In general, to facilitate use of MicroStation's ByLevel attributes, the ODOT levels have been established such that each curvilinear feature will have its own level. In order to keep the overall number of levels manageable, there are cases where similar features will be placed on the same

level making it impossible to use ByLevel attributes for those features. Some exceptions are noted below:

- Standard ODOT cells are placed on the level in which they were created. Each cell is not placed on its own level, rather, like cells are grouped on one level. For example, existing electric utility cells are all placed on the level UT_X_Electric_Cells.

- Storm Sewer Lines – Each proposed storm sewer line 12" and above will be placed using the custom line style "stormline", which shall be scaled, based on the pipe size. All proposed storm sewer lines will be placed on the level DR_P_Storm_Sewer.

- Culvert Lines – Each proposed culvert line will be placed using a custom line style based on the culvert size. All proposed culvert lines will be placed on the level DR_P_Culvert.

- Maintenance of Traffic Drums – Multiple line styles have been created to represent various typical drum spacing's. These lines are placed on level MT_P_Drums.

202.4 Filters

ODOT's level library, found in **OHDOT_Feature_Definitions.dgnlib**, has been configured with a set of default level filters that can be used to control the display of levels based on their attributes. Users shall not edit or delete the default filters.

202.5 Priority and Transparency

The levels defined in **OHDOT_Feature_Definitions.dgnlib** utilize MicroStation's Element Priority and Transparency functions. The priorities and transparencies are preset and based on what level is being used and should not be changed. See the **Appendix – Levels,** for a complete list of Priority and Transparency values.

203 Colors

203.1 General

Standard colors are specified to ensure consistency and to enable users to easily identify plan elements in shared files. For uniformity, the ODOT color table must be used and shall not be altered. See the **Appendix – Colors,** for a complete list of ODOT's color table values.

Note: The color values may vary or appear different on screen due to the difference in graphics cards, monitors display capability, etc.

204 Line Styles

204.1 General

Line styles are used to differentiate curvilinear elements in the design file and on the plotted sheet. ODOT uses Bentley's default line styles, zero (0) through seven (7), along with ODOT's developed set of Custom Line Styles. The line styles must be used to provide consistency and uniformity across plans.

The custom line style definitions are stored in a MicroStation DGN Library, OHDOT_Feature_Definitions.dgnlib.

Users shall not create their own custom line styles for use on ODOT plan sheets.

Standard line codes and custom line styles for plan graphics are specified in the **Appendix – Levels** and displayed in **Appendix – Line Styles.**

204.2 Line Style Scales

The location and dimensions of all plan view basemap design file information shall be drawn in the Design model using real world dimensions at a 1:1 scale. Custom Line Styles are to be placed in the basemap at a scale of one (1) so the Drawing Scale feature can be used.

Referenced basemap design files when referenced into another file should have the line style scale set to Annotation Scale for proper scaling inside the new file.

204.2.1 Survey Processing using OpenRoads

Survey data processed using OpenRoads Survey is drawn at real world dimensions. Line Styles are according to the current MicroStation Drawing Scale setting and will respond to changes in the Drawing Scale value.

For more detailed information processing survey data using OpenRoads Designer, see the **ODOT OpenRoads Survey training guide.**

204.2.2 Sheet Files

For basemap design files referenced into sheet files, the global line style scale must be set to Master for proper scaling to match the sheet file.

204.2.3 Bridge Levels

Several line styles have been developed specifically for use on Bridge plans that are not always placed at a specific scale relative to the plotting scale. The line styles listed in the table below shall be scaled as necessary to produce a legible detail. These line styles are assigned to the appropriate level by use of ByLevel attributes.

Line Style Name	Description
bcenterline	Centerline
bconstruction	Construction Joint / Phase Construction Line
bexisting	Existing Objects (all existing lines except existing reinforcement bars)
bhiddenpr	Hidden Line Proposed
brebarpr	Proposed Reinforcement Bars
brebarex	Existing Reinforcement Bars

204.3 Plotting

The dash and gap lengths of the MicroStation default line codes 0-7 are defined by the plotting software. See **Section 400 - Plotting** for the ODOT plotting values for line codes 0-7.

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205 Line Weights

205.1 General

Line weights are used to differentiate graphical elements in the design file and on the plotted sheet. Line Weight width ranges from weight zero (narrowest) to weight 31 (widest) and designate the thickness of the line used to draw or plot a graphic element.

Default line weights per level are specified in the **Appendix – Levels**.

205.2 Plotting

See **Section 400 - Plotting** for information on line weight plotting thickness values.

206 Cell Libraries

206.1 General

For plan consistency, ODOT provides standard cell libraries containing cells representing items that will be repeatedly placed in a design file. Several ODOT standard cell libraries are available as detailed in **Section 206.2 - Cell Libraries**.

206.2 Cell Libraries

The following cell libraries are available to facilitate the drawing of commonly used symbols and sheet borders as described below:

Cell Library	Description
OHDOT_Bridge.cel	Cells used for bridge plans
OHDOT_Drainage.cel	Cells used for 2D standard drainage structures
OHDOT_DrainageAndUtilities.cel	Cells used for standard drainage structures for SUDA
OHDOT_Geotech.cel	Cells used for geotechnical information
OHDOT_Labels.cel	Cells used for ORD plan labels
OHDOT_RW.cel	Cells used for right-of-way plans
OHDOT_Sheets.cel	Cells used for standard plan sheet borders
OHDOT_Symbols.cel	Cells representing standard plan symbols

Additionally, a set of cell libraries including standard signs from the **Office of Roadway Engineering**, Sign Designs and Markings Manual is included in the OHDOT CADD Standards. These sign cells are easily placed using a custom application, also provided in the OHDOT CADD Standards.

207 Fonts

207.1 General

The TrueType font Arial will be used for all plans developed using the OHDOT CADD Standards.

To supplement the use of font Arial, the OHDOT Workspace includes a custom symbol font, **OHDOTSymbols.ttf**, containing commonly used engineering symbols.

207.2 Text Size

Standard text sizes have been defined to ensure uniform legibility of all plan sheets. Standard text size refers to the size of the text on a full sized (22"x34") sheet, not the text size in the design file.

Text Type	Plotted Text Size
Normal	0.14"
Subtitle	0.17"
Title	0.20"
Main Title	0.25"

Text sizes smaller than the Normal text size are not acceptable.

For all ODOT plans, the preferred method to set the text size is by use of the Model Annotation Scale parameter. See **Section 207.4 - Text Styles** for more information.

207.3 Text Line Spacing

In general, Text Line Spacing should be one-half (0.50") the text height.   The spacing between lines on summary, sub-summary, general note sheets and charts is generally equal to the minimum text size. If needed, it is permissible to use Text Line Spacing equal to the minimum text size.

207.4 Text Styles

ODOT's standard text styles are defined in a MicroStation DGN Library, **ODOT_Styles_TextDim.dgnlib**.

The following Text Styles have been configured for use on ODOT plans:

Text Style	Text Size*	Spacing*	Font
Slanted - Normal Fixed Spacing	0.14	1.00	Arial
Slanted - Normal LS=0.50	0.14	0.50	Arial
Slanted - Normal LS=0.50 Masked	0.14	0.50	Arial
Slanted - Normal LS=0.75	0.14	0.75	Arial
Slanted - Normal LS=1.00	0.14	1.00	Arial
Slanted – Sub Title	0.17	0.50	Arial
Slanted – Title	0.20	1.00	Arial
Straight – Normal Fixed Spacing	0.14	1.00	Arial
Straight – Normal LS=0.50	0.14	0.50	Arial
Straight – Normal LS=0.50 Masked	0.14	0.50	Arial
Straight – Normal LS=0.75	0.14	0.75	Arial
Straight – Normal LS=1.00	0.14	1.00	Arial
Straight – Sub Title	0.17	1.00	Arial
Straight – Title	0.20	1.00	Arial

Title	0.20	0.50	Arial Black
Title – Main	0.25	0.50	Arial Black
Title - Sub	0.17	0.50	Arial Black

*Text size and Line Spacing units are Master Units.

Note: There are additional text styles included in the OHDOT CADD Standards. These text styles, which are not listed above, are configured for specific ORD labeling tasks and are not normally selected by the user for general plan preparation annotation purposes.

All text placed on Bridge sheets, excluding text contained in standard border cells, shall use the "**Slanted**" text styles.

See the Location and Design Manual, Volume 3, the Bridge Design Manual, and the Specifications for Geotechnical Explorations (SGE) for recommended sheet scales.

207.5 Dimension Styles

ODOT has configured a set of dimension styles to be used on ODOT plans. These styles are defined in the ODOT Standard DGN Library, **OHDOT_Text_Dimension_Styles.dgnlib**, which can be obtained from the ODOT CADD Standards website.

The following dimension styles have been defined in **OHDOT_Text_Dimension_Styles.dgnlib**:

Dimension Style	Font	Text Size*	Description
Dec-0, Masked, Slanted	Arial	0.14	Decimal Feet, No decimal places
Dec-0, Masked, Straight	Arial	0.14	Decimal Feet, No decimal places
Dec-1, Masked, Slanted	Arial	0.14	Decimal Feet, 1 decimal places
Dec-1, Masked, Straight	Arial	0.14	Decimal Feet, 1 decimal places
Dec-2, Masked, Slanted	Arial	0.14	Decimal Feet, 2 decimal places
Dec-2, Masked, Straight	Arial	0.14	Decimal Feet, 2 decimal places
Dec-Multiline, Masked, Slanted	Arial	0.14	Decimal Feet, 0.01 accuracy
Dec-Multiline, Masked, Straight	Arial	0.14	Decimal Feet, 0.01 accuracy
Fract, Masked, Slanted	Arial	0.14	Fractions, 1/16" accuracy
Fract, Slanted	Arial	0.14	Fractions, 1/16" accuracy
Fract-Multiline, Masked, Slanted	Arial	0.14	Fractions, 1/16" accuracy

*Text size units are Master Units.

Note: There are additional dimension styles included in the OHDOT CADD Standards. These dimension styles, which are not listed above, are configured for specific ORD labeling tasks and are not normally selected by the user for general plan preparation annotation purposes.

Line Terminators shall be a filled arrow created with a width to height ratio of 2.5:1. The terminator width shall equal the text height.

Leader Lines may be broken when crossing dimension lines. In order to keep broken lines to a minimum, it is recommended that the user relocate the dimension callout or reposition the dimension. Leader lines and terminators shall be a weight of zero (0) and shall be placed on the same level as required for text notes and callouts.

Like Text Styles, the text size for Dimension Styles is set by use of the Model Annotation Scale parameter.

Bridge plans shall use the "**Fract, Slanted**", "**Fract-Multiline, Slanted**" or **"Masked Fract, Slanted", "Masked Fract-Multiline, Slanted"** dimension styles. All Bridge dimensions shall be placed associated.

Dimensions shall not have their status dropped.

208 Seed Files

208.1 General

MicroStation uses a "seed file" to create all design files. A seed file is a template in which standard parameters are set. Seed files do not typically contain elements, but like other design files they do contain settings like working units and view configurations. Using a standard, customized seed file helps maintain uniformity and keeps the user from having to adjust design file settings each time a file is created.

The following seed files are included with the OHDOT CADD Standards download.   The Geographic Coordinate System (GCS) for each seed file is defined as shown in the table below:

Dimension	Seed File Name	Geographic Coordinate System
2D	OHDOT_Seed2d.dgn	None
2D	OHDOT_Seed2d_OH83-2011-NF.dgn	OH83-2011-NF
2D	OHDOT_Seed2d_OH83-2011-SF.dgn	OH83-2011-SF
2D	OHDOT_Seed2d_OH83-NF.dgn	OH83-NF
2D	OHDOT_Seed2d_OH83-SF.dgn	OH83-SF
3D	OHDOT_Seed3d.dgn	None
3D	OHDOT_Seed3d_OH83-2011-NF.dgn	OH83-2011-NF
3D	OHDOT_Seed3d_OH83-2011-SF.dgn	OH83-2011-SF
3D	OHDOT_Seed3d_OH83-NF.dgn	OH83-NF
3D	OHDOT_Seed3d_OH83-SF.dgn	OH83-SF
2D	OHDOT_DrawingSeed2d.dgn	None
2D	OHDOT_SheetSeed2d.dgn	None

208.2 Models

ODOT's seed files are defined to include only one MicroStation Model. The seed files are defined with a Design, Sheet, or Drawing model according to the intended usage file.

209 Working Units

209.1 General

The OHDOT CADD Standards include a standard unit definition file, **ODOT_Units.def**, to define the U.S. Survey Foot as the standard Master Unit.

MicroStation design files used in plan preparation shall use the following standard working units as defined in the ODOT seed files and in **ODOT_Units.def**:

Unit Names	Label
Master Unit: Survey Feet	'
Sub Unit: Inches	"

The ODOT seed files have been defined with a standard resolution setting of 12000 per Survey Foot. This setting shall not be changed by the user.

ODOT's seed files are set up with the standard working units described above. <u>Deviation from these working units is not permitted</u>.

210 Global Origin

210.1 General

Elements in the design file are drawn by placing data points. Each data point placed in the design plane has associated X (easting), Y (northing) and Z (elevation, 3D files only) positions or coordinates. The design plane is simply a Cartesian coordinate system upon which your design model lies.

In the ODOT Seed files, the point called the Global Origin is set to the design plane's exact center and assigned the coordinates 0,0 (2D files) and 0,0,0 (3D files).

The Global Origin is defined in ODOT's Seed Files and should never be changed for ODOT projects.

211 Custom Applications

211.1 General

ODOT has written several programs to assist the user with specific CADD related functions. Each application can be accessed from the MicroStation CE or ORD Ribbon by selecting the OHDOT workflow.

212 OpenRoads Standards

212.1 General

The OHDOT Standards include several new standard files defined for use with Bentley's OpenRoads Designer.

212.2 DGN Libraries

Several MicroStation DGN Libraries have been configured within the OHDOT workspace, for use with MicroStation CE and ORD, as detailed below.

ODOT_DesignStandards.dgnlib
This DGN Library defines the Design Standards for Horizontal and Vertical alignments according to various standards defined in the **Location and Design Manual, Volume 1 - Roadway Design**.

ODOT_Feature_Definitions.dgnlib
This DGN Library defines OpenRoads features for design and survey, as well as the MicroStation levels and element templates. The DGN Library also defines the default Survey Settings for OpenRoads.

OHDOT_Features_DrainageAndUtilities.dgnlib
This DGN Library defines OpenRoads features for subsurface utility modeling, computation, and analysis.

212.3 Template Libraries

ODOT provides a template library, **OHDOT_Templates.itl**, with several templates and components that can be used as a starting point to design the typical sections for the proposed roadway corridor.

300 FILE MANAGEMENT

301 General

301.1 General

File management refers to how documents are organized and stored. Its primary purpose is to provide a safe repository for information and to minimize the possibility of that information being lost.

The folder structure details listed below are for use on ODOT projects developed with MicroStation CE or ORD. All plans using either program must follow the folder structure established by ODOT.

302 Project Directory Structure

302.1 Standard Directory Structure

A standard project directory shall be used to house all project related data for the various workflows involved in the project development process throughout the lifecycle of the project.

Alphanumeric characters, a dash "-", an underscore "_", or a period "." are the only characters permitted in folder names. No other special characters, or spaces, are permitted in any folder name.

Internally, ODOT projects developed using MicroStation CE or ORD will be stored in ProjectWise. Projects are stored in the following dataset within the ProjectWise environment:

> Ohio DOT Projects\01 Active Projects\District ##\County\PID Number\

A template folder structure is used for all projects, starting from the PID number. This template folder structure is used for all projects, both internal and external to ODOT. See **Appendix – Project Folders** for the documented template folder structure.

A template folder structure is provided in the OHDOT CADD Standards in the following location:

> ..\OHDOT\Standards\WorkSetTemplates\000000_OHDOT_Template

In MicroStation CE and ORD the project folder structure is also referred to as a "WorkSet".

302.2 OHDOTCreateWorkSet.exe

The OHDOT WorkSet Creation Tool is a standalone resizable C# Windows Presentation Form application that is fully integrated with ProjectWise.

This application is used to assist in creating new project "Worksets" and can be launched from within the standards:

> ..\OHDOT\Standards\Applications\OHDOTCreateWorkSet.exe

It can also be launched from the MicroStation CE or ORD ribbon within the OHDOT Workflow > Apps tab.

For more information on using the OHDOT Workset Creation Tool please refer to our tutorial videos.

https://communities.bentley.com/communities/user_communities/ohio_dot__consultants/w/ohio dot---wikis/46259/create-workset

303 References

303.1 General

References are used to display the contents of one design file in another design file to facilitate the design process (i.e. display the existing survey data in the proposed right-of-way basemap).

303.2 Models

303.2.1 Model Types
MicroStation CE and ORD provide three types of models, intended for different uses. ODOT uses these model types for the following purposes:

- **Design** models are used for creating design geometry that can be either 2D or 3D. All basemap information shall be drawn in a design model.

- **Drawing** models are used in the ORD sheet clipping process to reference the design model which in turn references various basemap design files. The drawing model is also used to place the annotations that will be displayed on the sheets. A drawing model is always a 2D model.

- **Sheet** models are used to assemble the plan sheets that are used for plotting a set of plans that can be either 2D or 3D. Sheet border cells are placed in the Sheet model.

303.3 Basemap Design Files

Basemap design files are used to draw existing and proposed plan view information for the entire length of the project for both Roadway and Bridge projects.

Plan view information is separated into multiple discipline-specific basemap design files as listed below:

Allowable Plan View Basemap Files	
Aerial Mapping	Lighting
Bridge	Maintenance of Traffic
Drainage	Proposed Roadway
Environmental	Right-of-Way
Existing Ground Survey	Signals
Geometry	Traffic Control
Geotechnical	Utilities

Landscaping	Walls

All basemap information shall be drawn in the **Design** model.

The location and dimensions of all plan view basemap design file information shall be drawn using real world dimensions at a 1:1 scale. If a bridge basemap is used, a separate basemap design file is required for each bridge on the project.

A separate cross section basemap should be used for each alignment in the project. Cross sections should always be plotted in their own design file and never combined with any other basemap.

All basemap design files shall be stored in the appropriate discipline specific basemaps sub-directory and shall not be copied into another sub-directory for editing or referencing.

303.4 Sheet Design Files

Sheet design files are used to assemble the plan sheets that are used for plotting a set of plans.

Sheet design files can be generated using OpenRoads tools or generated manually using MicroStation reference tools.

When sheets are generated using the OpenRoads tools, the Drawing model is used to place all annotation for the sheet. The Sheet model contains the sheet border information and references the related drawing model(s).

When sheets are generated manually, the sheet design files are assembled by referencing Design models from the various basemap design files to the sheet model of the sheet file. Sheet border cells and annotation are typically placed in the sheet model.

For Bridge sheets, a single design file may include both existing and proposed plan view information.

Final plan sheets shall be in the Sheet Model. No items other than what is shown on the final plotted sheet can be shown in the Sheet Model. Any detail shown in the final plotted sheet shall be represented at a 1:1 scale in either the Design model, Drawing model, or Sheet model of the corresponding file.

Each plan sheet shall be contained within the Sheet Model. Only one plan sheet per model is permissible for all file types, including cross sections. Users may elect to create multiple sheet models in a sheet design file. 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.

When sheet design files are submitted to the Department, no other graphics are permitted in the Sheet model other than the graphics representing the final plotted sheet. All extra graphics used to generate the sheet, or old versions of the sheet, should be deleted or moved to a design model. No extra reference attachments that are not a part of the final sheet are permitted to be attached to the sheet model.

To ensure that reference file attachments are maintained when moving project files from the original project directory to another location, references shall be attached using relative paths. The user shall not use MicroStation option to "Save Full Path" for reference attachments.

All completed sheet design files submitted to or exchanged with ODOT shall use references where applicable. It is not recommended that users copy referenced graphics into the sheet files for the completed sheet design files submitted to ODOT.

304 File Naming Conventions

304.1 General

The efficient sharing and transfer of information from consultants/contractors to ODOT and vice versa relies on the use of a systematic file naming convention. This section outlines a consistent, comprehensive file naming convention for graphic and associated files used in the CADD environment, which shall be used for all projects.

With such large quantities of data being created, it is essential that operators create their new files with names that signify the content of each. Therefore, each sheet of the plan shall be contained in its own separate design file.

Standard naming conventions shall be used for all design files. Document all file names, both standard and project specific, in the Project Index file (For information on the **Project Index File,** see **ODOT's Guidelines for Electronic Deliverables)**. In the event a particular file type for the project is not addressed by this manual, use the file naming convention as a template for selecting an appropriate name or contact the **Office of CADD and Mapping Services' CADD Services** section for assistance.

In order to avoid conflicting attachments of reference files, there shall be no duplicate file names within the project directory structure or copies of the same file within the project directory. It is not permissible to copy the same basemap design files into multiple discipline specific sub-directories.

304.2 File Extensions

Standard file name extensions for information submitted to, or exchanged with, ODOT shall be as follows:

File Type	Extension
Bentley Design File	.dgn
Bentley Cell Libraries	.cel
Portable Document Format	.pdf
Microsoft Word Documents	.doc or .docx
Microsoft Excel Spreadsheets	.xls or .xlsx
XML Files	.xml

For file types not listed above, the default file extension defined by the software shall be used.

304.3 File Name Format

ODOT has defined the following naming convention to be used on all design files submitted to or exchanged with the Department.

Files shall be named as follows:

Design File Naming Format
---

nnnnnn_aa###.dgn

nnnnnn	=	Five (5) or Six (6) digit PID Number
aa	=	Two (2) letter code identifying the plan sheet type (see **Figure 304-1 - File Name Type Codes**)
###	=	Three (3) digit number identifying the number of drawings of the same type. The three-digit number is required even if there is only one drawing of a type in the plan set.

Examples:
> 123456_BE001.dgn
> 123456_GP005.dgn

Bridge, culvert and wall design files have unique file naming requirements, as detailed below:

Bridge Design File Naming Format
---

nnnnnn_SFNyyyyyyy_aa###.dgn

nnnnnn	=	Five (5) or Six (6) digit PID Number
yyyyyyy	=	Seven (7) digit SFN number of the structure
aa	=	Two (2) character bridge plan sheet type (see **Figure 304-1 - File Name Type Codes**)
###	=	Three (3) digit number identifying the number of drawings of the same type. The three-digit number is required even if there is only one drawing of a particular type in the plan set.

Examples:
> 123456_SFN1234567_SD002.dgn

Culvert Design File Naming Format
---

nnnnnn_CFNyyyyyyy_aa###.dgn

nnnnnn	=	Five (5) or Six (6) digit PID Number
yyyyyyy	=	Seven (7) digit CFN number of the culvert
aa	=	Two (2) character drainage plan sheet type (see **Figure 304-1 - File Name Type Codes**)
###	=	Three (3) digit number identifying the number of drawings of the same type. The three-digit number is required even if there is only one drawing of a particular type in the plan set.

Examples:
> 123456_CFN1234567_DC006.dgn

Wall Design File Naming Format

nnnnnn_WALLyyy_aa###.dgn

nnnnnn = Five (5) or Six (6) digit PID Number

yyy = Three (3) digit wall number (three digits required and maximum).

aa = Two (2) digit wall plan sheet type (see **Figure 304-1 - File Name Type Codes**)

= Three (3) digit number identifying the number of drawings of the same type. The three-digit number is required even if there is only one drawing of a particular type in the plan set.

Examples:

123456_WALL001_WP005.dgn

123456_WALL002_WS001.dgn

304.4 Supplemental Description Guidelines

ODOT allows users to provide supplemental description information by use of MicroStation's File Properties. The intent of the supplemental description is to provide additional descriptive information to aid the designer in identifying a file.

The following properties are available in a MicroStation Design File: Title, Subject, Client, Keywords, and Comments.

For ODOT projects, the following properties shall be used for design files submitted to or exchanged with the Department:

Title

The Title property can be used to specify the file type description. If used, the description shall correspond to the file descriptions for each file type shown in **Figure 304-1 - File Name Type Codes**, prefixed with the Discipline name (see the examples on the following page).

Comments

The Comments property can be used to provide additional descriptive information to aid the designer in identifying a particular file. Comments are user definable with the following guidelines:

For Roadway design files the comment should start with the route name/number, where applicable, using the route name as follows:

IR###	Interstate route with three-digit number, e.g. IR071 for Interstate route 71.
US###	United State route with three-digit number, e.g. US033 for US route 33.
SR###	State route with three-digit number, e.g. SR315 for State route 315.
CR###	County Road with three-digit number, e.g. CR056 for County road 56.
RAMP###	Ramp with up to three-character name/number, e.g. RAMP2S for ramp 2-S.
ROADNAME	Road name, e.g. Paris for Paris road. Note, directions (N, S, E, W) can be used on projects where plans exist for two different directions of the same roadway, e.g. Paris N for Paris road north.

Following the route name/number, the Comment property can contain additional information to help identify the specific sheet of the plan.

For Bridge design files, a brief description of the plan sheet contents should be included.

Figure 304-1 File Name Type Codes

Basemap Design Files	
3D Model	KB
3D Modeling	KM
Aerial and Ground Combined	BC
Aerial Mapping	BA
Bridge	BS
Digital Terrain Model	KD
Drainage	BD
Field Digital Terrain Model	FD
Geometry	BK
Geotechnical	BI
Landscaping	BL
Lighting	BH
MOT	BM
Point Cloud	PC
Right-of-Way	BR
Roadway	BP
Signals	BG
Superelevation	KS
Survey Field Book	FB
Traffic Control	BT
Utilities	BU
Wall	BW

Bridge Sheets	
Bearing	SB
Deck Plan	SD
Estimated Quantities	SQ
Expansion Device Details	SX
Forward Abutment	SF
Foundation Plan	SO
General Notes	SN
General Plan	SG
Miscellaneous Details	SM
Piers	SI
Railing	SA
Rear Abutment	SR
Reinforcing Steel List	SL
Removal	SV
Sheeting	SH

Site Plan	SP
Staged Construction Details	SC
Superstructure Details	SS
Transverse Section	ST

Drainage Sheets	
Channel Cross Sections	XD
Culvert Details	DC
Details	DD
Erosion Control	DE
Miscellaneous Details	DM
Notes	DN
Plan and Profile or Plan	DP
Profile	DF
Quantity Table	DQ
Schematic Plan	DB
Sub-Summary	DS

Geotechnical Sheets	
Geohazard Boring Logs	YL
Geohazard Cover	YC
Geohazard Cross Sections	YX
Geohazard Lab Data	YD
Geohazard Plan and Profile	YP
Geohazard Profile	YF
Soil Profile Cover	IC
Soil Profile Cross Sections	IX
Soil Profile Lad Data	ID
Soil Profile, Plan and Profile or Plan	IP
Soil Profile, Profile Only	IF
Structure Foundation Exploration Boring Logs	ZL
Structure Foundation Exploration Cover	ZC
Structure Foundation Exploration Lab Data	ZD
Structure Foundation Exploration Plan and Profile	ZP
Structure Foundation Exploration Profile	ZF

Landscaping Sheets	
Details	PD
Miscellaneous Details	PM
Notes	PN
Plan	PP
Schematic Plan	PB
Sub-Summary	PS

Lighting Sheets	
Circuit Diagrams	LC
Details	LD
Elevation Views	LE

General Summary	LG
Miscellaneous	LM
Notes	LN
Plan	LP
Quantity Table	LQ
Schematic Plan	LB
Sub-Summary	LS

Maintenance of Traffic Sheets	
Cross Sections	XM
Detour Plan	MD
Miscellaneous	MM
Notes	MN
Phase Plan and Profile or Plan	MP
Phase Details	MH
Profile	MF
Quantity Table	MQ
Schematic Plan	MB
Sub-Summary	MS
Typical Sections	MY

Right-of-Way Sheets	
Centerline Plat	RC
Legend	RL
Property Map	RM
Railroad Plat	RR
RW Boundary	RB
RW Detail	RD
RW Topo	RT
Summary of Additional RW	RS

Roadway Sheets	
Calculations/Computations	GC
Cross Sections	XS
Drive Details	GD
Fencing Plan	GX
General Notes	GN
General Summary	GG
Grading Plan	XG
Guardrail/Barrier Details	GR
Intersection/Interchange Details	GI
Maintenance Data	GJ
Miscellaneous	GM
Pavement Details	GA
Plan and Profile or Plan	GP
Profile	GF
Quantity Table	GQ
Schematic Plan	GB

Sub-Summary	GS
Superelevation Table	GE
Title Sheet	GT
Typical Sections	GY

Signal Sheets	
Details	CD
General Summary	CG
Miscellaneous	CM
Notes	CN
Plan	CP
Quantity Table	CQ
Sub-Summary	CS

Traffic Control Sheets	
Calculations/Computations	TC
Details	TD
Elevation Views	TE
General Notes	TN
General Summary	TG
Miscellaneous	TM
Plan	TP
Quantity Table	TQ
Schematic Plan	TB
Sub-Summary	TS

Utility Sheets	
Calculations/Computations	UC
Details	UD
Elevation Views	UE
General Summary	UG
Miscellaneous	UM
Notes	UN
Plan and Profile or Plan	UP
Profile	UF
Quantity Table	UQ
Schematic Plan	UB
Sub-Summary	US

Wall Sheets	
Calculations/Computations	WC
Cross Sections	WX
Details	WD
Elevation	WE
Estimated Quantities	WQ
Foundation	WT
Miscellaneous	WM
Notes	WN

Plan and Profile or Plan	WP
Profile	WF
Schematic Plan	WB
Sheeting	WH
Steel List	WL
Sub-Summary	WS
Typical Section	WY

For additional information see **Appendix – File Naming Format**.

305 Geographic Coordinate Systems

305.1 General

A Geographic Coordinate System (GCS) is used to specify the position of the design contents on the earth´s surface. A library of standard GCSs is provided with MicroStation CE and ORD. Additionally, a custom system can be defined for ODOT projects mapped to ground coordinates.

The GCS shall be appropriately defined for all design files exchanged with the department.

See ODOT's training material for OpenRoads Survey for information about assigning the GCS to the Seed files for a project.

See the **ODOT Survey and Mapping Specifications Manual, Section 300** for information on positioning and control specifications.

306 OpenRoads Designer

306.1 Federated Files

OpenRoads data is stored in multiple discipline specific basemap design files as summarized below.

306.1.1 Alignment Design Files
For projects with more than one alignment a federated file approach will be used, where each alignment and corridor are stored in its own design file, the BK Geometry Basemap. Each file is numbered consecutively using a three-digit number as detained in section 304 of this manual. The BK000 file shall be used as a collector file with each subsequently numbered BK file attached as a reference.

306.1.2 Corridor Modeling Design Files
Each OpenRoads corridor shall be stored in its own design file, the KM Corridor Modeling file. Each file is numbered consecutively using a three-digit number as detained in section 304 of this manual. The KM000 file shall be used as a collector file with each subsequently numbered BK file attached as a reference.

306.1.3 Survey Design Files
OpenRoads Survey information is process in its own design file. (i.e. the FB basemap file)

306.1.4 OpenRoads Subsurface Utilities Files

The OpenRoads Subsurface Utility commands require that a utility database is created in the design file. For this reason, subsurface utility information should be placed in its own design file. (i.e. the BD basemap file)

306.2 Alignment Names for OpenRoads Designer

To facilitate the efficient sharing and transfer of Alignment information between consultants, ODOT, and contractors, the OpenRoads Designer Element Names detailed below have been established.

The following element names for horizontal and vertical alignments have been established for OpenRoads Civil Geometry elements.

Horizontal Alignments	
Alternates Existing	AX#_rddd%%
Alternates Proposed	AP#_rddd%%
Baseline Existing	BLX_rddd%%
Baseline Proposed	BLP_rddd%%
Centerline Existing	CLX_rddd
Centerline Proposed	CLP_rddd
Centerline MOT Existing	CLX_MOT_rddd
Centerline MOT Proposed	CLP_MOT_rddd
Centerline Right of Way Existing	CLX_RW_rddd
Centerline Right of Way Proposed	CLP_RW_rddd
Centerline of Survey	CLX_SV_rddd
Where:	
r = Route Type	
C = County Road	
I = Interstate Route	
R = Ramp	
S = State Route	
T = Township Road	
U = U.S. Route	
ddd = 3 digit route number 020, 270, 142, etc.	
%% = 1-2 digit ramp number A, 2S, 3A, etc.	
# = 1 digit number 1, 2, . . .	

Note: If the route type is unknown or the road is a local street, the "rddd" code should be replaced with the street name ensuring that the resulting horizontal alignment name is no longer than 12 characters.

For projects where multiple alternates are considered, once the alignment and profile have been selected, they should be renamed and given the name of the proposed elements. This will ensure that the proposed alignments are named uniquely rather than just being one of the many alternatives.

Vertical Alignments	
Existing Profile	XGL_name
Proposed Profile	PGL_name
Proposed Profile Alternates	A#_name
Where:	
name =	The name of the horizontal alignment the profile is associated with
# =	1-digit number 1, 2, 3, etc.

The following element names have been established for OpenRoads Geometry elements used to define right-of-way.

Right of Way Parcels	
Parent Tract	##
Types of Title	##-ppppnz
where:	
## =	2 or more-digit number 01, 02, 03, . . . Note: The number for the Types of Title shall match the number of the Parent Tract.
pppp =	1 to 4-character parcel identification code as shown below.

Fee Simple Title	
Acquired Fee Simple Excess Land	EL
Excess Land Sold or Swapped	ES
Fee Simple Excess Land	E
Fee Simple Uneconomic Remnant	ER
Property Right Fee Simple	PRW
Limitation of Access	WL
Reservation of Access	WD
Easements	
Aerial	A
Channel	CH
Flowage	FL
Limited Access	LA
Property Right	PRE
Railroad or Public Utility	U
Scenic Easement	SC
Standard Highway	SH
Sewer	S
Slope	SL
Temporary Easement	T
Agreements	
Work	WA
Others	
Present Road Occupied (PRO)	PRO
PRO Inside	PROI

		PRO Total	PROT
n	=	When the parent tract has multiple types of title of the same type, a 1-digit number is used to identify each Type of Title.	
z	=	Additional Modifiers: In the name of another State agency, LPA, etc.	V
		Special Reservation	R

Examples:

       03 (parent tract)

       03-LA (easement for parent tract 03)

       03-WD1 (taking for parent tract 03)

       03-PRO (occupied area for parent tract 03)

306.3 Survey Point Names

The following point name prefixes have been established for OpenRoads survey points.

Point Name Prefix	Usage
AT	Aerial Mapping Control (including targets and picture points)
BM	Benchmarks (Permanent Benchmarks Only)
CP	Control Points (this includes Geodetic and Primary Control
MV	Monument Points (Centerline, RW, Property Pins…)
SV	Survey Points (All mapping/topo)

400 PLOTTING

401 General

401.1 General

ODOT requires multi-page PDF files for plan submissions. PDF printing is facilitated using the MicroStation Print Organizer.

Print Organizer is a MicroStation utility for printing and reprinting a set of design files, models, or Project Explorer links. The files that are to be printed are saved as a print set, (PSET), file.

ODOT includes a template PSET file, OHDOT_seed.pset, prepopulated with folders to organize the design files that will make up the print. The PSET folder structure mimics the plan set structure from **Section 1300** of the **Location and Design Manual, Volume 3**. Additional directories can be added if needed. When the PDF is generated, the empty directories will not be included. The PSET folder names become the multi-page PDF bookmarks.

In the OHDOT_Styles_Printing.dgnlib, Print Styles are defined that control the output from Print Organizer. Print Styles include ODOT standard Plot Configuration Files and Pen Tables and enable generation of PDF files as well as printed output. The OHDOT_Styles_Printing.dgnlib also defines a named expression, ODOT_SheetName, which can be applied to the plot set. This reads the model description from the model property and applies it to the name of the page in the PSET. The template PSET file uses this named expression as the default. If the Sheet Name in Model Properties is blank, then the Model Name from the Model Properties dialog is used as the default page name.

ODOT uses pen tables that are applied to the graphical elements when the design file is plotted. The pen tables translate various elements in the design file to the final output version.

Elements should be plotted in color. The major grid level is set to a lower priority, so it will plot under most plan sheet details. Cross section and profile grids should be plotted as shown in the **Location and Design Manual, Volume 3, Figure 1202-1**.

Standard MicroStation plotting files are included in ODOT's CADD Standards download, available on the **Office of CADD and Mapping Services, CADD Services** web page. The files available for download include user documentation. Also, see **PDF Printing with Print Organizer** in the **Project Management with the OHDOT Standards** Training Guide for additional details.

401.2 Plotting

MicroStation pen tables and Printer Driver Configuration files for use with MicroStation Connect and OpenRoads Designer are located in the following directory for ODOT users:

> ..\OHDOT_CONNECT\WorkSpaces\OHDOT\Standards\Pltcfg\

Plotting documentation is located here:

> ..\OHDOT_CONNECT\WorkSpaces\OHDOT\Standards\OHDOTUtilities\Documentation\Plotting\

The plotting documentation has detailed settings and usage information. The following briefly describes the Printer Configuration Files.

Printer Driver Files	Description	Default Page Size
OHDOT.pltcfg	Used for printing to windows print queue	17" x 11"
OHDOT_PDF.pltcfg	Used for printing in black to PDF file format	34" x 22"
OHDOT_PDF_Color.pltcfg	Used for printing in color to PDF file format	34" x 22"
OHDOT_PDF_Levels.pltcfg	Used for printing levels to PDF file format	34" x 22"

Pen Table Files	Description
OHDOT_Pen.tbl	Used to print in black
OHDOT_PenC.tbl	Used to print in color

Note: Elements not handled by the Shading or Masking sections of the OHDOT_Pen.tbl are plotted in black. Elements not handled by the Shading or Masking sections of the OHDOT_PenC.tbl are plotted in color.

401.2.1 Line Weights

The Printer Driver Files specify the MicroStation element weight to output line thickness. Line weights in the configuration files are defined as below for 22"x34" Prints. The configuration files set the Weight Scale to 0.5 for 11"x17" and 8 ½"x11" prints, so the thickness is one-half the values shown in the table. The Style Scale is also set to 0.5 for 11"x17" and 8 ½"x11" prints, reducing the dash and gap lengths of standard MicroStation line styles by one half. Though line thicknesses are defined to weight 10, only weights 0-5 are used in ODOT's level standards:

Element Weight	Thickness (approximate inches)
WT = 0	0.006"
WT = 1	0.014"
WT = 2	0.026"
WT = 3	0.036"
WT = 4	0.046"
WT = 5	0.056"
WT = 6	0.066"
WT = 7	0.076"
WT = 8	0.086"
WT = 9	0.096"
WT = 10	0.106"

Due to the variation in plotting accuracy of various printers, the thicknesses shown in the table above can be modified as deemed necessary to achieve the desired results.

401.2.2 Priority and Transparency

Plotting priorities are determined by the MicroStation level and the assigned element Priority values in the **ODOT_Feature_Definitions.dgnlib**. Priority and Transparency are not handled in the ODOT standard pen tables.

401.2.3 Shading

The following functionality to shade various plan sheet elements is included in the OHDOT_Pen.tbl and OHDOT_PenC.tbl:

Cross Section Grid

The pen tables shade the Major Cross Section grid using the following settings:

Major Grid – uses Color = 42 (RGB Value = 176, 176, 176)

Shading Filled Shapes

Shading levels were created to fill shapes with varying shades of Gray. The pen table fills shapes based on the following shading levels:

SC_Shading1 – uses Color = 41 (RGB Value = 160, 160, 160)
SC_Shading2 – uses Color = 43 (RGB Value = 192, 192, 192)
SC_Shading3 – uses Color = 45 (RGB Value = 224, 224, 224)

Shading Reference(s)

To gray shade a reference, the Logical Name must begin with gray, for example gray1, gray2, etc. Color 41 (RGB Value = 160, 160, 160) is used to gray shade references. When plotting a reference using a logical name beginning with gray, the pen table will gray shade the entire reference.

Title Sheet Shading

Corporation boundaries and route shields fill on the Title Sheet Area Map are handled in the pen table.

401.2.4 Masking

Masking is an <u>option</u> to hide specific areas on a plan sheet. No elements will show underneath.

The Masking level plots all elements, or filled shapes, as <u>White</u> to mask any elements underneath. The pen table processes elements on the following masking level:

SH_Masking – uses Color = 255 (Background Color)

401.2.5 Text Substitution

The pen tables handle text replacement on sheet borders to insert information such as file name, model name, date, time, etc. The text replacement string is located on a sheet border on the left side. See the table below for the text replacement settings.

Text String	Default Settings
``	File Name, Model Name, Date, Time, Username
``	Model Name, Paper Size, Date, Time, Username
``	File Name

401.2.6 Color Plotting

The **OHDOT_PenC.tbl** is used for producing color output of an ODOT plan sheet. This pen table does the Major Cross Section shading and Reference shading the same as above. Some text on the SH_Data level is changed from White to Black by the pen table, so that it will display. Text substitution is handled as above. All other elements are plotted in their display colors.