

MINISTRY OF TRANSPORTATION

OpenRoads Designer CONNECT Edition User Guide

Prepared by:

Highway Design Office Standards and Contracts Branch

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1.0 General Introduction

This document provides an introduction to MTO workspace configuration for Bentley OpenRoads Designer CONNECT Edition (ORD). The configuration and customization have been updated to and tested with OpenRoads Designer CONNECT Edition 2021 Release 2 (10.10.21.04).

The MTO customized workspace for ORD is available for MTO and Service Provider staff working on MTO highway projects. MTO ORD workspace files and resources are provided "As Available" without any warranty, and subject to change with future updates and enhancements.

1.1 OpenRoads Designer CONNECT Edition

ORD CONNECT Edition is a new application that replaces the capabilities of all applications in the InRoads, GEOPAK, MX, PowerCivil for Civil, and GeoMacao product lines in a single offering.

Upgrade to OpenRoads Designer was a huge leap. Although most of the basic concepts of the program had been retained, the underlying data structures, the workspace, and the workflow had been dramatically changed. OpenRoads Designer is built on OpenRoads modeling technology and provides significant new design modeling, analytical modeling and project collaboration capabilities.

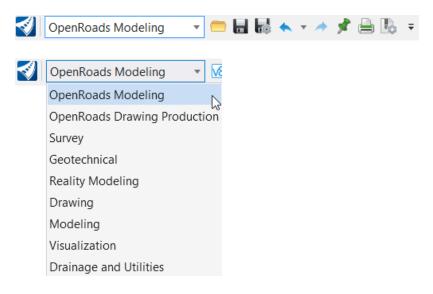
1.2 User Interface

ORD's user interface has been redesigned. It now features ribbons, context menus, headsup display, graphical and dynamic edits. ORD uses the Startup screen to select or create the WorkSpaces and WorkSets, open existing files, and create new files.

Recent WorkSets	OpenRoads Designer CE	(0) - <i></i> - ×
You haven't opened any files from a WorkSet recently.	WorkSpace WorkSet No WorkSpace - No WorkSet	
Browse for files, create a new file, or select another WorkSpace or WorkSet from the drop- down menus. No WorkSpace No WorkSet	Recent Files You haven't opened any files recently. To browse for a file, start by clicking on Browse. Image: Browse Image: Browse	 No WorkSet Copen files without a WorkSpace or WorkSet Only certain configuration levels are applied

The graphical user interface of ORD is now based on ribbon design. Ribbons are organized by workflow. Each workflow consists of multiple tabs, which are organized by tasks.

The workflows are activated from the Quick Access Toolbar in the upper left corner.



Select a workflow will load a series of tabs containing relevant tools in groups at the top of the ribbon.

The ribbon menu of the OpenRoads Modeling workflow is organized into similar categores called Ribbon Tabs as the InRoads Explorer menus.

🜍 🛛 OpenRoads Modeling 💿 💀 🖛 🕶 🔚 🔚 🐁 🐟 🔹	A 📌 🚔 =	Te	errain.dgn [3D - V8 DGN] - OpenRoads Designe	er CE 2021 Release 2 Search
File Home Terrain Geometry Site Corrid	ors Model Detailing Draw	ving Production Drawing Uti	ilities Collaborate View Help	
✓ None ▼ Default ▼ ✓ 0 ▼ 30 ▼ 30 ▼ 0 ▼ 0 ▼	Explorer Attach	Element	Reports Civil Corridor Dynamic	Terrain Import Import Export
Attributes	Tools • 🐔 • 😰 • Primary	Selection Tools • 💼 • Selection	 Analysis Reports Plan View Model Analysis and Reporting 	Import • Geometry • IRD to IFC Model Import/Export

The ribbon tabs included in the OpenRoads Modeling workflow are:

Home Attributes, primary (commonly used) tools, element select tools, model analysis and reporting, and import/export tools	
Terrain Element selection, terrain modeling, editing, and analysis	
Geometry	Element selection, horizontal and vertical geometry tools, and general tools (standards, civil accudraw, etc.).
Site	Element selection and site optimization tools.
Corridors	Element selection, template, corridor, and superelevation modeling tools.

Model Detailing	Element selection, civil cells, and 3D tools (linear template, surface templates, etc.).
Drawing Production	Element selection, clip volume, saved views, tables, notes, text, labels, annotations, and named boundaries(plans production) tools.
Drawing	Commonly used MicroStation drawing tools.
Utilities	Geographic, item type tools.
Collaborate	Collaboration, clash detection and markup tools.
View	Commonly used view control tools.

1.3 Backstage Functionality

The File tab opens the backstage view where you can set user preferences and change design file-specific settings, manage documents, import and export files, access help, and so on.

$\overline{\mathbf{\Theta}}$		Terrain.dgn (3D - V8 DGN) - OpenRoads Designer CE 2021 Release 2	Search Ribbon (F4)	P - 1 (P - 8
lew	Tools			
ipen	Compress File	Compress the design file size and remove unused element types		
ave				
we As	Compress Options	Compress the design file with options		
re Settings nd Mail	File Associate	Associate file types with their proper extension		
se				
ols	Packager	Create a WorkSet package with design files, references and workspace files		
ttings operties	Protection	Set passwords or other security features on the design file		
nt port	License Management	Manage and checkout Bentley product licenses that are under concurrent license control of the Subscription Entitlement Service to workstations, Iz	sptops, and portables	
port /il Tools	Batch Converter	Convert individual files, or entire directories of files, from any of the MicroStation DGN file formats to any other supported format		
ublish iModel	Batch Process	Create and run a script on individual files or entire directories of files.		
lelp				
eedback	HTML Author	Create HTML files from Cell Libraries, Design File Saved Views or Design File Snapshots		

The seed and library files in MTO workspace are set to confirm MTO AutoCAD standards. The configuration files contain MTO workspace and workset configuration variables. Caution must be exercised when change the settings for these files.

1.4 File Types

In ORD, all civil data is stored within the DGN file, minimizing or eliminating the use of external files. Surfaces, geometry, corridors, etc. are all stored in DGN files.

The legacy file types such as .dtm, .alg, .ird, etc. used in InRoads/Power InRoads can be imported into ORD.

The InRoads XIN file which contains feature styles, symbologies, annotations, preferences, and other settings is replaced with the MicroStation dgn library file (.dgnlib).

1.5 WorkSpace Configuration

ORD uses MicroStation as its CAD platform. The WorkSpace has been changed and enhanced. The ORD workspace configuration contains resources, configuration files, configuration variables, Workspaces, and WorkSets. This multi-level configuration file structure provides a flexible way to configure the work environment.

A WorkSpace is a container for grouping WorkSets, standard files and associated configuration files that are used for specific projects or disciplines.

Under WorkSpace, there are WorkSets. A WorkSet is a container for grouping project files, associated data, and project specific resources and standards that will supplement the workspace standards.

1.6 Feature Definition

OpenRoads Designer is a feature based design environment. OpenRoads Designer uses feature in design to represent a real world thing that can be seen or located. Feature definition is used to define options when creating features. Feature definitions take the place of **Styles** in SS2 to control how a feature is to be displayed, annotated, and computed.

There are different types of feature definitions in OpenRoads Designer and each has different properties. Below is a list of feature definition types in the roadway modeling:

- Alignment
- Terrain
- Corridor
- Superelevation
- Linear Template
- Surface Template
- Linear
- Point
- Mesh
- Trace Slope
- Aquaplaning
- Sight Visibility

2.0 OpenRoads Designer Workspace Configuration

MTO workspace for OpenRoads Designer contains WorkSets, resources that are used in designs, standards files, and associated configuration files. It was developed based on MTO AutoCAD standards and Power InRoads V8i (SS2) standards. Most of the SS2 styles are brought into ORD, however, many new feature definitions have been created to use the feature and rule based new design environment.

The workspace can be further customized to fit into organization's workspace or modified to meet specific project requirements.

Download MTO's OpenRoads Designer workspace from the following internet address: https://www.xfer.mto.gov.on.ca/

The default location for the workspace is *C*:*MTO ORD Standards*. Modify the configuration file if you have a different location.

2.1 Configuration Files

OpenRoads Designer uses the configuration files and variables to set up the work environment. Configuration file *WorkSpaceSetup.cfg* contains variable to specify the workspace location. It is located in the following folder:

C:\ProgramData\Bentley\OpenRoads Designer CE 10.10\Configuration\

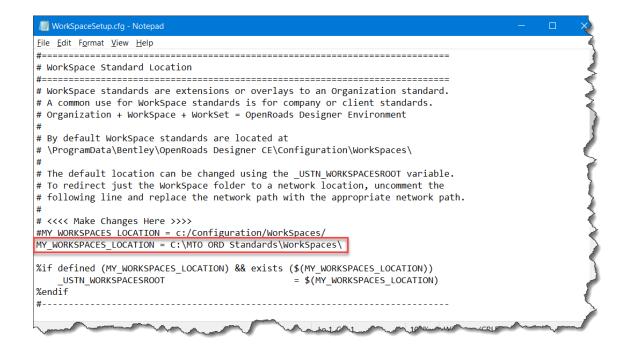
To use MTO ORD configuration from the default location *C:\MTO ORD Standards*, copy the *WorkSpaceSetup.cfg* from the downloaded zip file to above mentioned location.

To use the standards from a different location, modify the *WorkSpaceSetup.cfg* file to point to the user selected location.

Open the configuration file with Notepad or other text editor. Modify the following variables with the appropriate path.

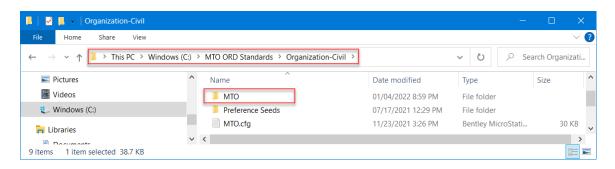
MY_CIVIL_ORGANIZATION_ROOT MY_WORKSPACES_LOCATION

I WorkSpaceSetup.cfg - Notepad -		ı ×
Eile Edit Format View Help		}
# # Civil Organization Standard Location #		
<pre># Organization standards are base standards for a country or region or a # large asset owner such as a DOT. These standards should be the base that # provide most of the settings needed for OpenRoads Designer. Additional # company specific and project specific standards can be layered onto the # the Organizational standards using the WorkSpace and WorkSet respectively. #</pre>		
# By default Organization standards are located at		~ ~
<pre># \ProgramData\Bentley\OpenRoads Designer CE\Configuration\Organization-Civil\ # # The default location can be changed using the MY_CIVIL_ORGANIZATION_ROOT variable. # To redirect the entire configuration folder to a network location, uncomment the # MY_CIVIL_ORGANIZATION_ROOT line and replace the network path with the appropriate network #</pre>	path	
# <<<< Make Changes Here >>>>		}
<pre>#MY_CIVIL_ORGANIZATION_ROOT = c:/Configuration/Organization-Civil/ MY_CIVIL_ORGANIZATION_ROOT = C:\MTO_ORD_Standards\Organization-Civil\</pre>		
%if defined (MY_CIVIL_ORGANIZATION_ROOT) && exists (\$(MY_CIVIL_ORGANIZATION_ROOT)) CIVIL_ORGANIZATION_ROOT = \$(MY_CIVIL_ORGANIZATION_ROOT) %else		
CIVIL_ORGANIZATION_ROOT = \$(_USTN_CONFIGURATION)Organization-Civil/		2
%endif		
#		₹

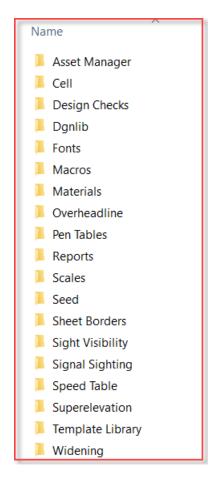


MTO ORD WorkSpace is customized at the organizational level and MTO ORD standard files are located in the following folder:

 $\dots .. Organization-Civil \ MTO \ \\$



In this folder, there are series folders as shown below. Some of them also contain subfolders.



The default workset loaction for MTO workspace is located at *C:\MTO ORD Standards\WorkSpaces\MTO* (see **WorkSpaceSetup.cfg**).

The default workspace configuration file **MTO.cfg** located in the folder *C:\MTO ORD Standards\WorkSpaces* will define which ORD standard (the *"CIVIL_ORGNIZATION_NAME"*) to be loaded for current workspace.

MTO.cfg - Notepad -	
File Edit Format View Help	
## Workspace for using the MTO ORD standards.	
<pre>#USTN_WORKSPACEDESCR = Uses MTO ORD Standards</pre>	
#=====================================	
<pre>#====================================</pre>	
<pre># When a ProjectWise Managed Workspace is used this variable is not required. # The Organization or Customer standards will be defined using a Customer # Configuration Settings Block in the ProjectWise Managed Workspace. # # Do NOT include .cfg file extension in the variable definition.</pre>	
<pre># <<<< Make Changes Here >>>> CIVIL_ORGANIZATION_NAME = MTO #</pre>	5

To Find the Location of your Active WorkSpace and WorkSets,

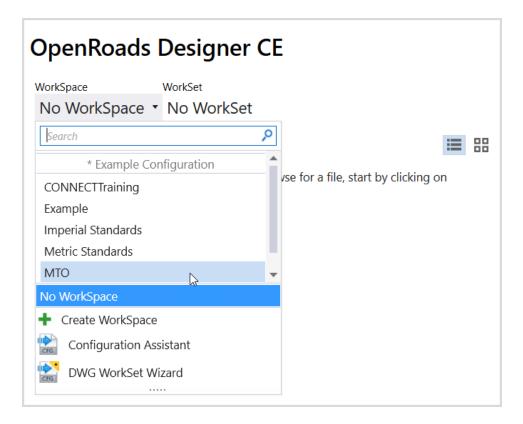
Select File > Settings > Configuration > About Configuration.

The *About Configuration* window opens, displaying information about the active WorkSpace and its components.

About Configuration				×
WorkSpace: C:\MTO ORD Stand	Uses MTO ORD Standards lards\WorkSpaces\MTO.cfg			
WorkSet: C:\MTO ORD Stand	2021R2 lards\WorkSpaces\MTO\WorkSets\2021R2.cfg			
Preferences: C:\Users\Iuoand\A	CONNECT Edition Preferences ppData\Local\Bentley\OpenRoadsDesigner\10.0.0\prefs\OpenRoadsDe	esigner	_Metric.	upf
CONNECTED Project:	No Project			
About Workmode:				
You are in DGN Workn The full functionality of - DWG referencing and - AccuSnap and AutoL - Visual Basic for Appl - Design History - View Volumes - Level Filters - DGN Libraries - Associations across r	f OpenRoads Designer is available, including: d editing ocate ications			
			<u>C</u> lose	

2.2 WorkSpace and WorkSet

The MTO workspace is accessed from the OpenRoads Designer menu as shown below:



After selecting the WorkSpace, click on the **Create a WorkSet** button to create a new WorkSet.

OpenRoads Designer CONNECT Edition
MTO *
You have no WorkSets. Create one now?

Create WorkSet		×
Name: Description:	Hwy 401	
Template:	None Create Folders C	
+ Add a Custom Property 🔹		
Folder locations		
Root Folder:	C:\MTO ORD Standards\WorkSpaces\MTO\WorkSets\Hwy 401	Browse
Design Files:	C:\MTO ORD Standards\WorkSpaces\MTO\WorkSets\Hwy 401\dgn	Browse
Standard Files:	C:\MTO ORD Standards\WorkSpaces\MTO\WorkSets\Hwy 401\Star	Browse
Standards Subfolders:	Cell;Data;Seed;Symb;Macros;Sheet Borders;Superelevation;Template	
ProjectWise Projects		
(click Browse to attach a Project) Br	owse ×
	OK	Cancel

Once the WorkSet has been created, it will appear on the WorkSet list.

If there are worksets in the current workspace, select a Workset from the list or use the **Create WorkSet** command on the bottom of the WorkSet list to create a new Workset.

MTO •	Hwy 401 -
Recent	Search 👂
You haven	Hwy 401
You naven	е, :
P	
Brov	
	+ Create WorkSet
	Kr

2.3 Project Folder

By default, the project folder (the workset) has a simple file folder structure, one for design files, one for design outputs, and one for the project specific standards.

Name	~
📕 dgn	
Standards	

Additional folders may be created to organize files in disciplines or categories such as survey, structure, drainage, terrain, geometry, superelevation, corridors, reports, sheets, etc. especially when work on large, complex projects.

2.4 Seed Files

In order to use the full functionality of OpenRoads Designer, DGN design files are required. Seed files are templates used to create DGN files. They contain settings and configurations. According to MTO CAD standards, two seed files *MTO_Seed2D Design.dgn* and *MTO_Seed3D Design.dgn* are provided in the following folder:

 $\dots \Organization-Civil MTO \Seed \$

These seed files are set to use the standard AutoCAD color table. This is in consistence with MTO CAD standards and provides the consistency in graphic display, file sharing and plotting.

Generally, the 3D seed file is only needed for survey and terrain workflows.

MTO uses metric units for highway design. The working units are defined in the seed files as shown below.

🔇 Design File Settings		
<u>Category</u> Active Angle Active Scale Angle Readout Axis Civil Formatting Color Fence Grid Isometric Locks Snaps Stream Views Working Units	Linear Units Format: MU Master Unit: Meters Sub Unit: Millimeters Accuracy: 0.12345 Custom Advanced Settings Resolution: 10000 per Distance Meter Working Area: 9.0072E+08 Kilometers Solids Area: 1 Kilometers Solids Accuracy: 1E-08 Meters <u>E</u> dit	
	Focus Item Description	
	Set linear unit display format. Set to master unit only(MU), master and sub unit(MU:SU), or master, sub and positional units(MU:SU:PU).	
	<u>O</u> K Cancel	

MTO custom line styles are defined from MTO CAD standards (IESCAD). They are created at a scale of 1:1 for drafting at a scale of 1:1000 (1 drawing unit = 1m).

The Line Style Scale settings are shown as below.

General	^
Is Active	False
Name	Default
Description	Master Model
Ref Logical	
Туре	Design
Design Dimension	2D
Is Markup	False
Annotation Scale	1:1000
Design Scale	1000.0000
Paper Scale	1.0000
Propagate Annotation Scale	On
Line Style Scale	Global Line Style Scale
Global Line Style Scale Factor	1.0000
Update Fields Automatically	Irue

2.5 Levels

The following groups of levels based on MTO AutoCAD Standards (IESCAD) are included in ORD library:

```
Planning and Design (PD - *)
Surveys and Plans (SP - *)
Photogrammetry (PH - *)
Structural Design (ST - *)
Traffic (TR - *)
```

Additional levels are defined for element templates, feature symbologies, feature definitions, and ORD specific features or functions.

2.6 Fonts & Text Styles

The text styles, text favorites are defined in **MTO_Text Favorites_Text Styles_Dimension Styles.dgnlib** in the folder:

.....\Organization-Civil\MTO\Dgnlib\Feature Definitions\

All text styles in MTO workspace use standard true type font Arial.

Standard text sizes (heights) have been defined. The following sizes are used: 0.0001, 0.0005, 0.001, 0.002, 0.0025, 0.003, 0.004 & 0.005.

) Text Styles - Civil - Existing Contours (Active	e : Cross Section - Annotation - Center Bottom) — 🛛 🔍 🗙
Style View	
Text Styles Civil - Existing Contours Civil - Existing Contours - EL Label Civil - Proposed Civil - Proposed Contours Civil - Proposed Contours - EL Label Civil - Proposed Contours - EL Label Civil - Title Cross Section - Annotation - Box Featu Cross Section - Annotation - Box Value Cross Section - Annotation - Box Value Cross Section - Annotation - Center Bc Cross Section - Annotation - Center To Cross Section - Annotation - Center To Cross Section - Annotation - Left Cross Section - Annotation - Left Cross Section - Annotation - Cipt EL Lal Cross Section - Annotation - Right	General Spacing Under/Overline Background Advanced Font: Arial Justification: Left Top Height: 0.00200 Width: 0.00200 Slant: 0°0'0" General Spacing Under/Overline Bold Italics Underline Overline Fractions Vertical Full Justification
Cross Section - Annotation - Right Des Cross Section - Annotation - Slope Lak Cross Section - Annotation - Title Curve Label	Civil - Existing Contours

3.0 Feature Definition DGN Library

Feature Definitions, Feature Symbologies, Annotation Definitions & Groups, levels and Element Templates are provided in the dgn library **MTO_Features_Annotations_Levels_ElemTemp.dgnlib** in the folder:

 $\dots \label{eq:constraint} Organization-Civil \MTO \Dgnlib \Feature Definitions \label{eq:constraint}$

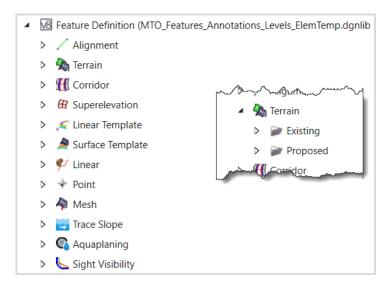
3.1 Feature Definitions

Feature Definitions are used to control symbology, annotation, and various other properties that are applied to the geometric elements. A Feature Definition defines what an item is and links to Feature Symbology to define how the item is displayed.

Each feature definition type has different properties but has three in common: **Name**, **Description** and **Name Seed**.

Feature Definition	*
Name	MTO_Alignment_PD
Description	Centerline Alignment
Name Seed	Geom_PD_Ali

MTO ORD feature definitions are based on MTO AutoCAD Standards Guide and MTO InRoads Preference and Standards (SS2). The feature definitions are defined with specific names and organized into categories according to the element type. Some categories are further grouped into subcategories.

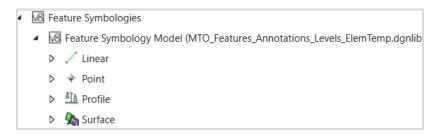


Feature definitions corresponding to the SS2 styles that are named with the IESCAD layer names in Planning and Design, Photogrammetry, Surveys and Plans sections, and SS2 specific styles are defined and organized under subcategories with a prefix SS2 in the category name. These feature definitions can be used to help to import SS2 projects.



3.2 Feature Symbologies

Feature Symbologies are used to define how the items are displayed. There are four categories are supported including Linear, Point, Profile and Surface with subcategories similar to the Feature Definitions. Each of these categories has different parameters.



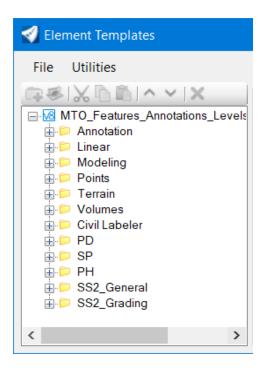
Feature Symbologies refer to Element Templates and Annotation Group when required for detailed display setting.

Properties (OpenRoads St	andards) — 🗌	×	
Selection (1)			
🐓 Geom_Alignment_	MTO		
Defaults		*	
Default Element Template	Linear\Alignment\Geom_Alignment_PD		
Plan		*	
Annotation Group Element Template Arc Element Template Spiral Element Template	MTO_Stationing None None None		
Profile Intersection		*	
Element Template	Modeling\Points\Intersecting Profile		
3D		*	
Annotation Group Element Template	None None		
Dynamic Cross Section			
Crossing Point Element Temp None			

Both Feature Definitions and Feature Symbologies are accessed through the **OpenRoads Standards** tab on *Explorer* dialog.

3.3 Element Templates

Element Templates define properties of elements. An element template has a set of properties (level, color, line style, line weight, text style, material etc.) that can be preconfigured for element placement or applied to existing elements. ORD Element Templates are used to set up the symbologies, define detailed display settings for both MicroStation elements and civil features. The Element Templates can be accessed through **Home > Attributes**:



4.0 Template Library

MTO standard template library **MTO_STD_Templates.itl** is located in the following folder:

 \dots \Organization-Civil \MTO \Template Library \

This library contains typical section templates, linear templates, surface templates, components and end conditions with predefined point names that are associated with MTO OpenRoads Designer standard feature definitions. It can be used to facilitate the creation of new components/templates on any project library.



4.1 Point Name List

The standard template library contains a predefined point name list where point names are assigned feature definitions defined in dgn library:

MTO_Features_Annotations_Levels_ElemTemp.dgnlib

Point Nan	ne List	X
Name:		Add
Feature:	Linear\Bridge\Bridge_Abutment	Close
		Change
Points:		
Name	Feature Definition	
AUX	Linear\Template Points\TL_Auxiliary Point	
BA	Linear\Template Points\TL_Barrier	
BC	Linear\Template Points\TL_Ditch	
BR	Linear\Template Points\TL_Rounding Breakpoint	
BRK	Linear\Template Points\TL_Rock	=
СН	Linear\Template Points\TL_Channel	=
CL	Linear\Template Points\TL_Centerline Alignment	
CU	Linear\Template Points\TL_Curb and Gutter (Concrete	e) CU
CUA	Linear\Template Points\TL_Curb and Gutter (Asphalt)	CUA
DI	Linear\Template Points\TL_Ditch Inside	
DO	Linear\Template Points\TL_Ditch Outside	
EB	Linear\Template Points\TL_Earth Bench	
EBI	Linear\Template Points\TL_Earth Bench Inside	
EBO	Linear\Template Points\TL_Earth Bench Outside	
EP	Linear\Template Points\TL_Edge of Pavement	
EPS	Linear\Template Points\TL_Edge of Paved Shoulder	
ER	Linear\Template Points\TL_Edge of Rounding	
ES	Linear\Template Points\TL_Edge of Shoulder	
GR	Linear\Template Points\TL_Granular Rounding	
GS	Linear\Template Points\TL_Granular Shoulder	*
		Delete

Employ the standard **Point Name List** and supplement as needed before creating project templates. Apply prefix, suffix and layer identifier to the point names and keep the points linked to predefined feature styles.

4.2 Point Naming Convention:

- 1. The first component will identify which side of the centerline which needs to be set up using template options when creating templates.
- 2. The second component will indicate the layer/surface.
- 3. The third component will be the point feature name.

Example: for point edge of pavement, L_TP-EP, L_TA-EP, and L_TB-EP.

Where:

L	identifies left of centerline.
TP, TA or TB	identifies the layer and/or surface.
EP	identifies the point feature name.

4.3 Template Options

The template options have been set to "**Apply Affixes**" for default preference **MTO**. The affixes are prefixes $L_{and} R_{d}$. The affixes will be applied to point and component names when the components are placed or created in the template.

Template Options	×
Naming Options Component Seed Name: O From Feature Definition	OK Cancel
Specify: Point Seed Name: Apply Affixes Prefix Suffix	Preferences
Left L Right R	
Step Options X: 0.00000 Y: 0.00000 Slope: 0.00%	

For more complicated templates, suffixes can also be added to the point names.

4.4 Parametric Constraints

Parametric constraints can be used to change one or more labeled constraint values of a template while the template is being processed in the corridor modeling. This allows designers to use only one template to handle a number of different conditions. When use **Parametric Constraints**, designers should consider the constraint types and the design features to assign descriptive names for the labels.

Typical label names are combinations of abbreviations such as:

Constraint Types:

WidthHorizontal ConstraintDepth/Thickness/HeightVertical ConstraintSlope/SlpSlope Constraint

Design Features:

Rdwy	Roadway
Shld	Shoulder
SW	Sidewalk
Lane	Travel Lane
Blvd	Boulevard
Pavt	Pavement
Drive	Driveway
Curb	Curb
Ditch	Ditch
Median	Median

Material/Surface Layer

Asph	Asphalt
Conc	Concrete
GranA	Granular A
GranB	Granular B
Sand	Sand
WC	Wearing Course
BC	Binder Course
Base	Base Course
SG	Subgrade

Suffix

Lt	Left
Rt	Right

Some Example Labels:

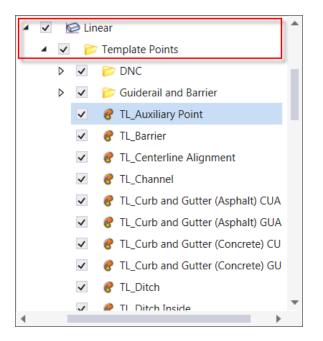
Lt_Shld_Asph_Depth	Left Shoulder Asphalt Depth
Rt_Shld_Slp	Right Shoulder Slope
Rt_Pavt_Width	Right Pavement Width
GranA_Depth	Granular A Depth

4.5 Feature Definitions

Feature definitions defined in ORD Standards dgn library are to be applied to the points, components.

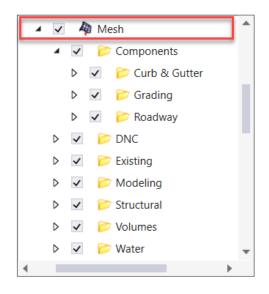
The feature definitions for points can be found under folder:

..... Linear\Template Points\



The feature definitions for components can be found under folder:

 $\dots\dots Mesh \backslash$



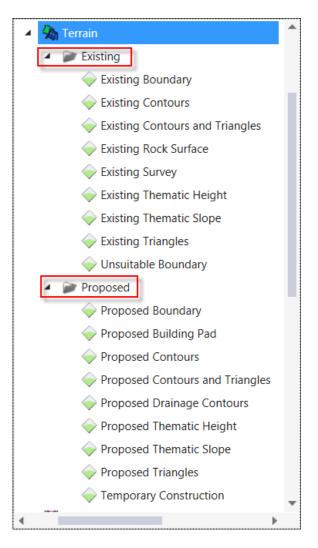
5.0 Terrain

Terrain model (similar to InRoads surface) is a three-dimensional DGN element defined by points, breaklines, voids, holes, contours to model a surface on the earth. Terrain model is stored in 3D design (dgn) file similar to InRoads DTM file.

A boundary is used to constrain the external boundary of the terrain model. No triangles are created outside the boundary.

5.1 Terrain Feature Definitions

The display of a terrain model is controlled by feature definition and its associated feature symbology and element template. Both Existing and Proposed terrain features definitions are defined in the workspace.

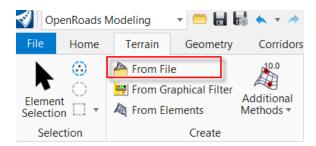


5.2 Import Terrain from DTM Files

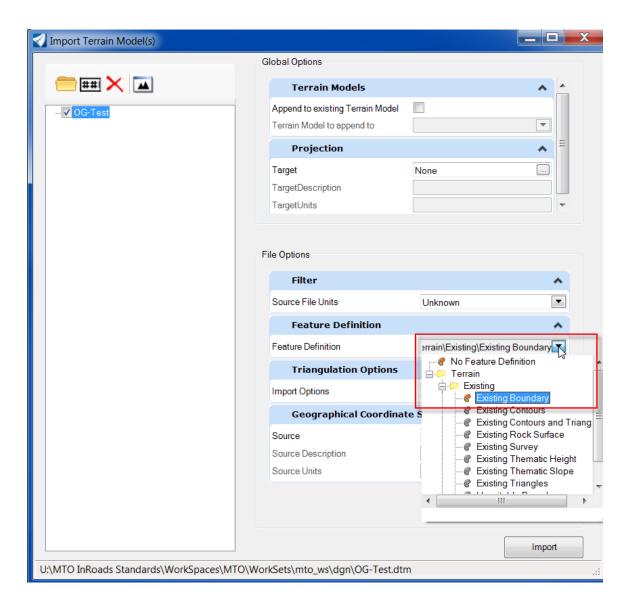
Existing Terrain Model can be created from the digital terrain model (DTM) provided by survey. ORD supports the following file types:

All Files	
XYZ (*.xyz)	
Lidar (*.las)	
InRoads DTM (*.dtm)	
GEOPAK TIN (*.tin)	
GEOPAK DAT (*.dat)	
LandXML (*.xml)	
MX (*.fil)	
DDF File (*catd.ddf)	
TIF File (*.tif)	
DTED0 File (*.dt0)	
DTED1 File (*.dt1)	
DTED2 File (*.dt2)	
USG DEM File (*.dem)	
Spot Dimap File (*.dim)	
Erdas IMG File (*.img)	
HGT File (*.hgt)	
12dXML (*.12dxml)	
MX Genio (*.txt; *.inp)	
All Files (*.*)	

Create a design file with the 3D seed file. Select **From File** command from the *Terrain* tab *Create* group on the OpenRoads Modeling workflow ribbon.

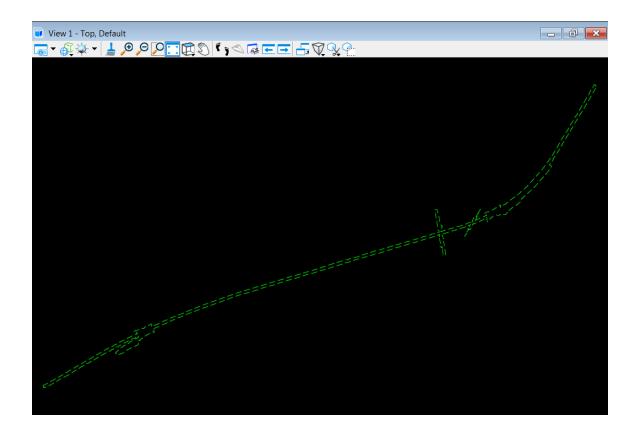


On the *Select Files To Import* dialog, browse to the location where the DTM file located. Select the file and confirm. The *Import Terrain Model(s)* dialog will appear. Set the *Feature Definition* to Terrain\Existing\Existing Boundary and set the *Import Options* to **Import Terrain Only**.



Triangulation Options		^
Import Options	Import Terrain Only	-
Geographical Coordinate	Import Terrain Only Import Features Only	
Source	Import Both	
Source Description		
Source Units		

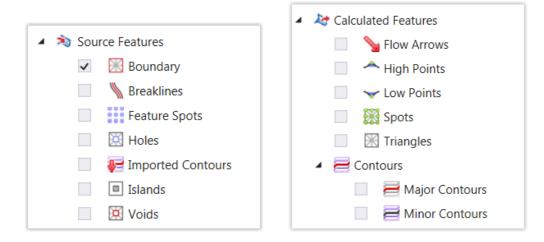
Select **Import** to start the process. Use the **Fit View** tool on the *Import Terrain Model(s)* dialog or the active view's quick access toolbar to place the entire terrain model within the active view.



5.3 Display Terrain (Model) Data

Terrain model contains both Source Features and Calculated Features. Source Features include the data used to create the terrain model, such as boundary, points and breaklines. Calculated Features are items that are calculated from the data in the terrain model, such as triangles, contours, and high/low points.

The display of a terrain model can be controlled by using feature definition or individual parameter setting.



Terrain Properties

Select **Home > Primary** > **Properties** to open the *Properties* dialog. Use the Element Selection tool to select the terrain model to display the properties in the dialog.

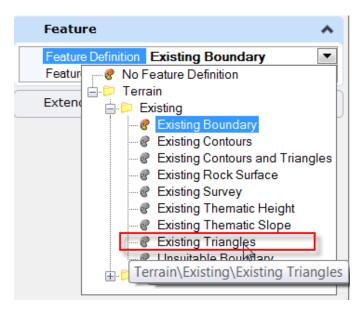
Toggle on and off features or change the parameter values on the dialog will change the terrain display.

Properties -	×
 ん Elements (1) 	^
🔺 🦓 Terrain Model: OG-Test	
 A Arrow Calculated Features 	
📃 💊 Flow Arrows	
High Points	
Low Points	
Spots	
Triangles	
🖌 🚝 Contours	
Major Contours	
Minor Contours	
🔺 🔊 Source Features	
 Boundary 	
📃 📉 Breaklines	
Feature Spots	
Holes	
📃 🛛 🐺 Imported Contours	
Islands	
Voids	-
	•
General	~
Information	~
Edge Method	*
Calculated Features Display	*
Source Features Display	*
Feature	*
Extended	* *

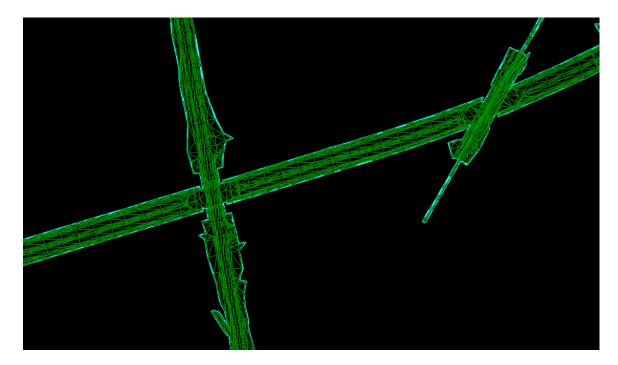
Properties					
A Clements (1	.)		1		
Terrain Model: OG-Test					
Calculated Features					
Source Features					
•			•		
General	*	Information	^		
Element Descrip	otic Terrain Model: OG-Tes	Number of Points 9.3	384		
Name	Terrain Model: OG-Tes	Number of Point Fe 5			
Level	SP-E-Terrain_Exterior	Number of Islands 0			
Color	ByLevel (92)	Number of Voids 3			
Line Style	😂 ByLevel (3)	Number of Feature 19	.919		
Weight	😂 ByLevel (1)	Number of Contour 0			
Class	Primary	Number of Breaklir 19			
Template	(None)	Number of Triangle 17	.614		
Transparency	0				
Edge Method	^	Calculated Featur	es Display 🛛 🔺		
Edge Method	From Boundary	Major Contours Off Minor Contours Off Triangles Off Spots Off Flow Arrows Off Low Points Off High Points Off	f f f f f f		
Source Featu	res Display 🔥	Feature	^		
Breaklines	Off	Feature Definition Ex	cisting Boundary		
Boundary	On		G-Test		
Imported Contou					
Islands	Off				
Holes	Off				
Voids	Off				
Feature Spots	Off				
r cuture opoits					
Extended	^				
	▲ Default				
Extended					
Extended Model	Default				
Extended Model Last Modified	Default 12/06/2018 2:03:12 PM				
Extended Model Last Modified Snappable	Default 12/06/2018 2:03:12 PM Snappable				

Change Feature Definition

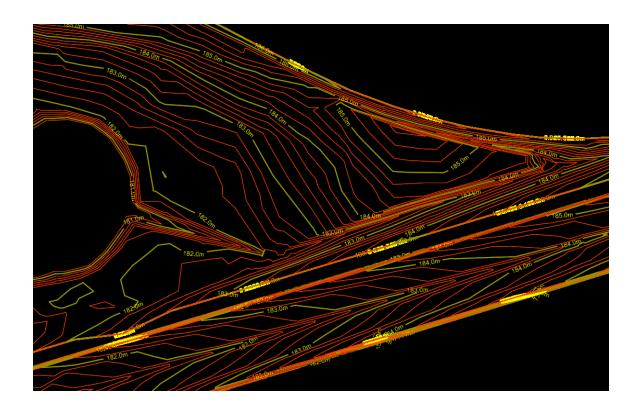
Using the feature definition is a quick way to change the display of a terrain model with a set of predefined parameters.

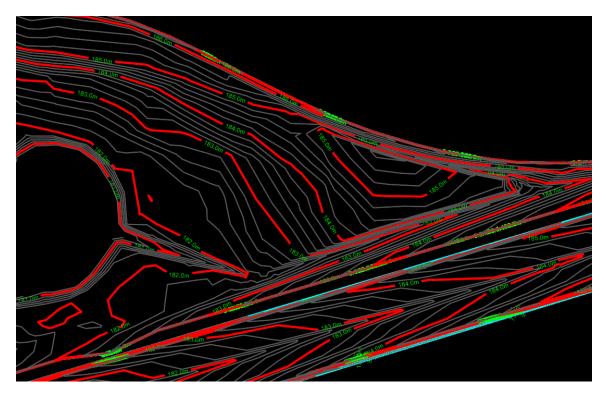


Shown below is terrain displayed with Existing Triangles.



Shown below are terrain displayed with **Existing Contours** and **Proposed Contours**.





Change Individual Setting

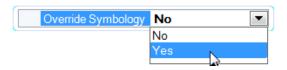
Turn on and off the features or change the parameters to control the terrain display.

	-						_
Major Contours	On			🔣 🕅 Triar	ngles		
Minor Contours	On				2		
Triangles	Off		▲ ⊂	Contours			
Spots	Off		_		Major Contou	ure	
Flow Arrows	Off			•	wajor contou	115	
Low Points	Off			 Image: A mail of the second sec	Minor Contou	urs.	
High Points	Off		•				•
High Points Source Featu		^	Cont				•
2		~	Cont		None		•
Source Featu	res Display	^	Cont Max S	ours			•
Source Featu Breaklines	res Display Off On	^	Conto Max S Max S	ours Slope Option	None 0.0000		
Source Featu Breaklines Boundary	res Display Off On	~	Conto Max S Max S	ours Slope Option Slope Value our Label Preci	None 0.0000	Ì	
Source Featu Breaklines Boundary Imported Contou	res Display Off On ITS Off	~	Cont Max S Max S Conto Smoo Major	ours Slope Option Slope Value our Label Preci	None 0.0000 s 1	Ì	

5.4 Modify the Display of Referenced Terrain Model

In OpenRoads Designer common workflow, the terrain models are stored in 3D design files and referenced into the design or project 2D files. The referenced terrain model allows the override of symbology and element templates to change the display of the terrain model without modifying the source file.

Use the **Element Selection** tool to select the referenced terrain model to open the *Properties* dialog and display the properties in the dialog. Set the *Override Symbology* option to **Yes**.



The *Calculated Features Display, Source Features Display and the Element Templates* fields are now accessible, and the display of the terrain model can be changed as in a 3D terrain model file.

Name	Terrain Model: OG-Te	
Number of Points Number of Point F Number of Islands Number of Voids Number of Feature Number of Contou Number of Breakli Number of Triangl	5 0 3 19,919 0 19,794	
Edge Method	From Boundary	
Major Contours Minor Contours Triangles Spots Flow Arrows Low Points High Points	Off Off Off Off Off Off Off	
Breaklines Boundary Imported Contours Islands Holes Voids Feature Spots	Off On Off Off Off Off Off	
Feature Name Feature Definition	OG-Test Existing Boundary	
Override Template (None) Override Symbology Yes		

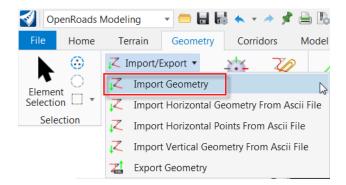
6.0 Geometry

OpenRoads Designer stores all geometric data directly in the dgn file. Civil geometry tools are provided for creating, importing and exporting, manipulating, and modifying the civil geometry. MicroStation Manipulate tools are disabled for civil elements.

6.1 Import/Export Geometry

OpenRoads Designer provides tools to import geometry from or export to native products (InRoads, GEOPAK and MX). The *Import Geometry* tool is used to import InRoads ALG files.

Create a design file with the 2D seed file. Select **Import Geometry** command from the *Geometry* tab *General Tools* group on the OpenRoads Modeling workflow ribbon.

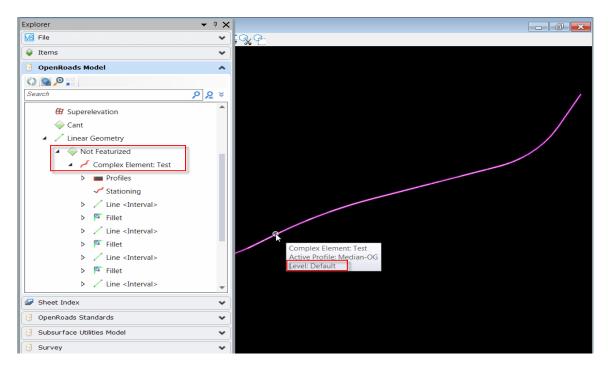


Browse to the location where the ALG file located. Select the file and confirm. On the *Import Geometry* dialog, select the horizontal with or without the vertical alignment(s) to import.

Import Geometry		
Image: Constraint of the second state of the second st	an-OG	
Assign Feature Definition	s from Table	
Feature Definitions Table:		
Assign Feature Definition		
Linear Features:	No Feature Definition	\sim
Point Features:	No Feature Definition	\sim
Create Civil Rules		
	Import	Cancel

There are two options to assign the Feature Definitions, **Assign Feature Definitions from Table and Assign Feature Definition**. The table used here is an Excel spreadsheet that maps the Style/Symbology values coming from the imported file to feature definitions in ORD. The Assign Feature Definition will assign all selected elements to the same feature definition selected in the combo boxes. When both options are selected, ORD will look for a match in the table first. If no match is found, the combo box selection will be used.

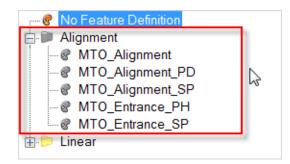
When both options are not used, the alignment(s) will be imported as *Not Featurized* (no Feature Definition assigned) Linear Geometry into level Default. Then the feature definition can be assigned to each of the imported alignments individually.



Select each alignment and set the Feature Definition on the Properties dialog.

Feature Name	Test	Ρ	roperties	- 4 ×
Feature Definition	No Feature Definiti		Elements (1)	
Start Point End Point	319426.68897m,48562 330017.45265m,48610		🖌 🌈 Complex Element: Test	-
Length	11923.10541m		General	*
	0.02000m 0.02000m		Feature	*
Stroking Step Met			Feature Definition No Feature Definition Feature Name Test	Ţ,

Alignment feature definitions have been setup based on MTO CAD Standard (**IESCAD**) for **Planning and Design, Surveys and Plans** and **Photogrammetry** alignment as shown below.



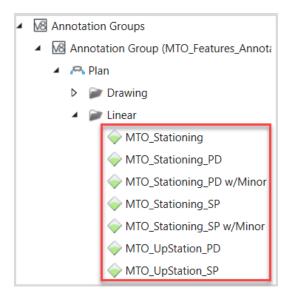
Select or change the feature definition will change the geometry to the level assigned to the feature definition.

🔺 🎤 Com	plex Element: Test
General	*
Element Des	criptic Complex Element: Test
Level	PD-N-ALI-CL
Color	ByLevel (20)
Line Style	ByLevel (0)
Weight	ByLevel (4)
Class	Primary
Number of el	ement 11
Template	(None)
Transparence	y 0
Priority	500
Feature	^
Feature Defir	nition MTO_Alignment_PD
Feature Nam	e Test

6.2 View Horizontal Alignment Annotation

Horizontal alignment annotation includes both curve set annotation and stationing annotation. They are defined in annotation groups and attached to the alignment feature definitions.

There are different setups for station annotation for new (P&D) and existing (S&P) alignment stationing. The following annotation groups are available:



Annotation group **MTO_Stationing** is similar as annotation group **MTO_Stationing_PD** with different offsets from the center line.

Both annotation groups **MTO_Stationing_PD** and **MTO_Stationing_SP** are set up with *Down Station* (looking down the alignment). **MTO_UpStation_PD** and **MTO_UpStation_SP** are options for *Up Station* (looking up the alignment).

Manage Annotations	
Annotation Group: MTO_Stationing 🕂 🗶	🕂 슈 문 💾 🖏
Station Ticks Major Location	
Station Labels Major Location	Stations
Station Ticks Minor Annotate	
Curve Label Right Arc With Template	Line Annotation\Sheets\Plan\\$
Curve Label Left Arc Leader	
PI Station Triangle Place Leader	False
PI Station Label Offset Begin Offset End	0.0000 0.0000
PI Back Tangent Line Arrow Size	0.0000
PI Ahead Tangent Line Arrow Width Circle Size	0.0000 0.0000
Spiral Label Right Spiral Square Size Triangle Size	0.0000
Spiral Label Left Spiral Extension Siz Template	
Station Equation Placement	
Cardinal Circles Rotation Option	
Cardinal Station Lines Rotation Perpendicular	00*00'00.0" Offset O Offset Value
	r Offset -0.0015 fset Optic Offset Value
Cardinal Station LT Label Tangential Of	
POB / POE Station Line Line	
POB Station Label	0.0030
POE Station Label Cell	

Annotation with both major and minor stations are provided as annotation groups **MTO_Stationing_PD w/Minor** and **MTO_Stationing_SP w/Minor**.

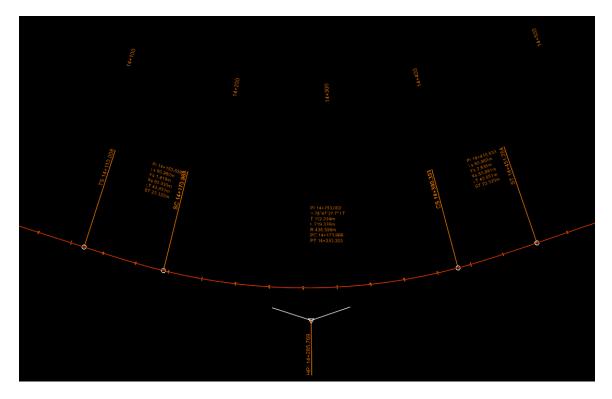
Annotation groups are assigned to the feature definitions for alignment elements through feature symbologies. Select **Annotation Element** command from the *Drawing Production* tab *Annotations* group on the OpenRoads Modeling workflow ribbon.



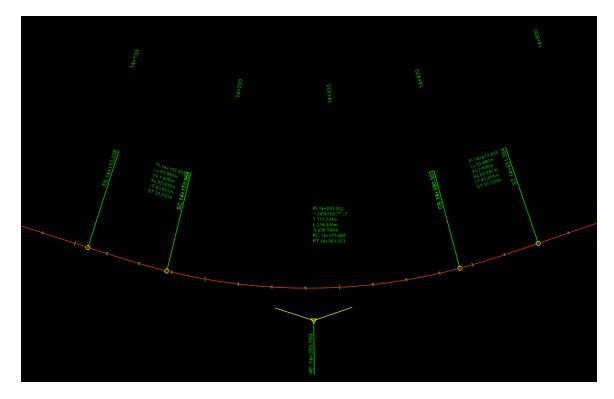
By default, the annotation group associated to the feature symbology that the alignment is assigned to will be used for the annotation. Follow the prompt to select the alignment and reset to complete the command with default annotation group. The curve set information, major stations, major and minor ticks, PI stations and cardinal stations are displayed along the alignment. Use the Annotation Group **Override** option on the *Annotate Element* dialog to annotate the alignment with different annotation settings.

🔏 Annotate Element	—		
Parameters			•
All Elements in Model			
Override			
overnde		*	•
Override Annotation Group			•

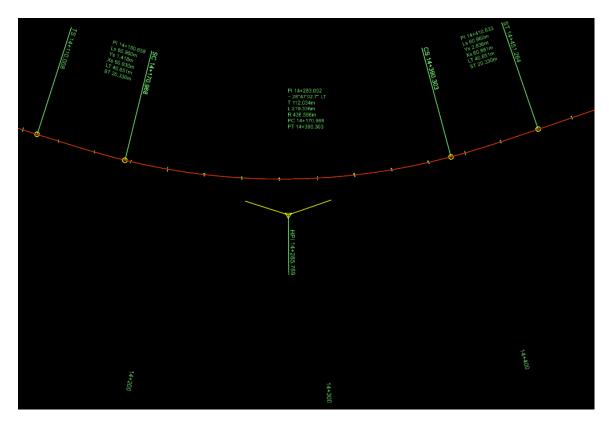
Shown below are alignment with feature definition **MTO_Alignment_PD** and annotation group **MTO_Stationing_PD**.



Change the feature definition will automatically change the annotation. Shown below are alignment with feature definition **MTO_Alignment_SP** and annotation group **MTO_Stationing_SP**.



The feature definition **MTO_Alignment_SP** with *Up Station* annotation group **MTO_UpStation_SP** is shown below.



Annotation is placed with the *Annotation Scale Lock* on. Change the scale (Drawing Production > Drawing Scales) will change the annotation automatically.

1:1000 *
🔀 ACS Plane Lock
Annotation Scale Lock
Drawing Scales

6.3 Import profiles

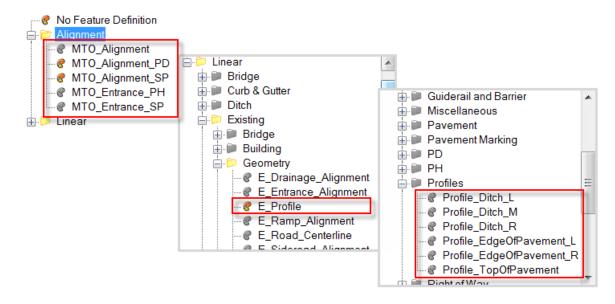
When import profile(s) from native product InRoads ALG files, the horizontal geometry which the profile(s) associated with will be imported at the same time if it is not presented in the current drawing. The Feature Definitions can be assigned during the Import process with one selected feature definition applied to both horizontal and vertical geometry or can be assigned individually after the import.

To assign feature definition to vertical geometry, expand the horizontal geometry the vertical geometry associated with on *Explorer* dialog, then select the vertical geometry and set the **Feature Definition** on the *Properties* dialog.

Properties (OpenRoads Model)) 🔻 🕂 🗙	Explorer	- 🕂 🕆 🗙
 Selection (1) 		M File	*
🗠 Profile: FGCenter		📦 Items	*
		📙 OpenRoads Model	*
General	^	(2) Sol (0)	
Element Descripti Profile: F	GCenterType: Com	Search	¢ ٍ ∢
Level Default			
Color 0		🔺 🔾 test geometry 2d file.dgn (Default)	
Line Style 0		A ARTING AND A	
Weight 0		Alignments	
Class Primary		MTO_Alignment_PD	
Number of elemer 111		v	
Template (None)		🖌 🎺 Complex Element: Test_21	
Transparency 0		t www.Des.Else	
Priority 0		Profiles	
Feature	^	🔺 🗠 Profile: FGCenter	
Feature Definition No Featu	ure Definition	> 🤨 Depends On	
Feature Name FGCente		► Profile:	

Select the profile and set the **Feature Definition** on the *Properties* dialog in Feature section. Feature definitions for profile are available in both Alignment and Linear folders.

Feature	•
Feature Definition MTO_Alignment_PD	-
F 8 No Feature Definition	٦
📥 📂 Alignment	
Linear	



6.4 Profile Settings

When working with vertical geometry, the vertical curve parameters need to be set based on the project requirements. Default Profile Settings are shown as below:

Design File Settings		×
<u>C</u> ategory Active Angle Active Scale	Format Delimiter + Precision 0.12 Equation By	23 Name
Angle Readout	Radius Settings	^
Axis	Degree Of Curve Method Arc	
Civil Formatting		.00000m
Color	Radius Toggle Char d	
Fence	Spiral Settings	•
Grid	. ,	
Isometric	Spiral Type Clo	thoid
Locks	Profile Settings	^
Snaps	Elevation Precision 0.12	23
Stream	Slope Format Per	centage
Views	Slope Precision 0.12	
Working Units		n:Rise
Working onits	Ratio Precision 0.1	
	Vertical Curve Parameter Format Kva	lue = Length / (Grade2 - Grade1)
	Speed Settings	^
	Format kph	· · · · · · · · · · · · · · · · · · ·
	Focus Item Description	
	-	
	Select category to view.	
		OK Cancel

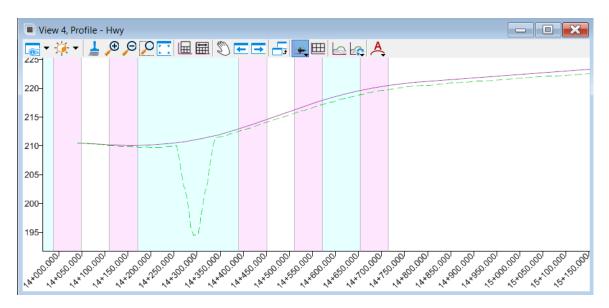
6.5 Profile Model View

To create vertical geometry, a profile model view must be opened with the Open Profile Model tool. The view presents a desired feature in profile thus enabling the vertical geometry tools to interact with the chosen feature.

Access the **Open Profile Model** command from the *Geometry* tab *Vertical* group on the OpenRoads Modeling workflow ribbon.

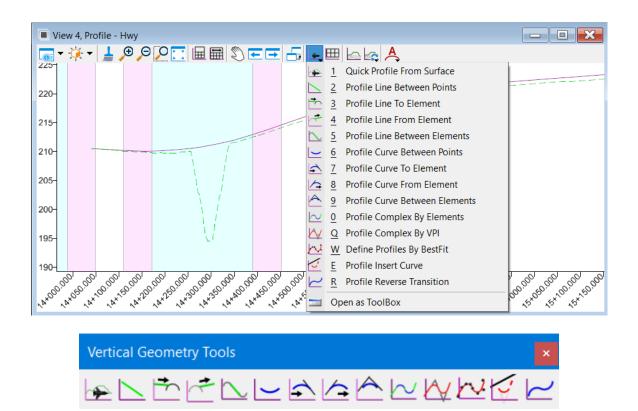
Geometry > Vertical > Open Profile Model

Select the element wish to work in profile then follow the prompt to select or open a view.



The selected horizontal geometry name is shown in the title bar of the view.

The Profile Model View also provides easy access to the vertical geometry tools. The tools can be docked as a toolbox.



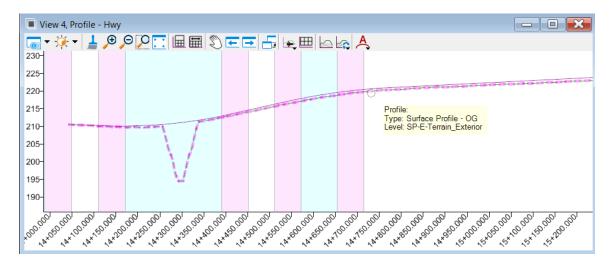
Each of the vertical tools has a **Feature Definition** field on its dialog. Feature definitions for profile are available in both Alignment and Linear folders.

🄏 Profile Curve Between P	oints 🗖 🗖 🗮 🗙
Placement Method	Start\End\Pass-through
Length	0.00000
Start Grade	0.00%
End Grade	0.00%
Vertical Curve Parameter	0.000
Vertical Curve Type	Parabola 💌
Feature	^
Feature Definition	No Feature Definition
Name	 In Feature Definition

The feature definition has name seed (prefix) assigned. Different name can be assigned on the dialog.

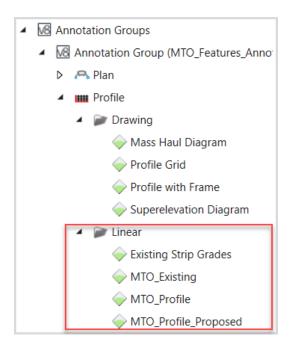
Feature	^
Feature Definition	Profile_TopOfPavement
Name	PrCL

The surface profile (profile from surface) will apply the terrain feature definition. See terrain section for available terrain feature definitions.



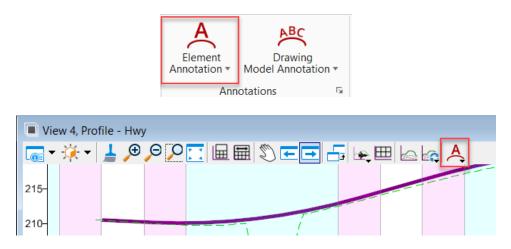
6.6 View Profile Annotation

The Annotate Element command can be used to annotate vertical geometry in the Profile Model. Feature Definitions have been set up to annotate profile elements using Feature Symbologies with assigned Annotation Groups. Shown below are available Annotation Groups.



🞻 Manage Annotations																	-	-			×
Annotation Group: MTO_Profile_Pro	oposed 🕂 🗙 금 🔂 🖓			Display	/ 🛋	_ >	€,⊖	0	\$ ℃	· 🎝 [Hic	e Sel	ected	٦H	lighli	ight S	Selec	ted			
Profile Tangent Slope Annotation	Location	^	^																		
Profile Cardinal Circles	Location	In Vertical Components																			
Profile VPI Triangle	Annotate	^																			
Profile VPI Back Tangent Label	With Template	Text Annotation\Sheets\Profile\Draft_																			
Profile VPI Ahead Tangent Label	Leader	*	í l																		
Profile VPI Parabola Crest Sta /	Place Leader	False	1											24.84%							
Profile VPI Arc Crest Sta / Elev A	Offset Begin Offset End	0.0000																			
rofile VPI Parabola Sag Sta / El	Arrow Size Arrow Width	0.0000																			
rofile VPI Arc Sag Sta / Elev An	Circle Size	0.0100										0+798. EL 408.									
rofile VPC Crest Labels	Square Size Triangle Size	0.0000 0.0000				<u>905.78(</u> 285.955															
ofile VPT Crest Labels	Extension Size Template	0.0000				/PC 0+					_								PT 1+2! EL 2		
rofile VPC Sag Labels	Placement	^																/	~		
rofile VPT Sag Labels	Rotation Option	Tangent		+243	14.7L								0+772.68 43.942							-	/
rofile Low / High Circles	Rotation Vertical Offset Option	00°00'00.0" Offset Value																			
rofile Low Pnt Sta / Elev Line	Vertical Offset Horizontal Offset Option	0.0010 Offset Value																			
rofile Low Pnt Sta / Elev Annotat	Horizontal Offset	0.0000																			
rofile High Pnt Sta / Elev Line	Perpendicular Offset Option Perpendicular Offset	0.0000	5	9 9	6 62 6	19	97		52	110		43				182		989	101		
rofile High Pnt Sta / Elev Annot	Tangential Offset Option Tangential Offset	Offset Value 0.0000	22,420	234	259.679 259.679	272.	296.4		330.7	336.0		343.7	342.			323.4		194	268.4		240.
rofile Strip Grade Annotation	Line	^																			
Profile Start / End Triangle	Length	0.0000	1 ~ 1																		

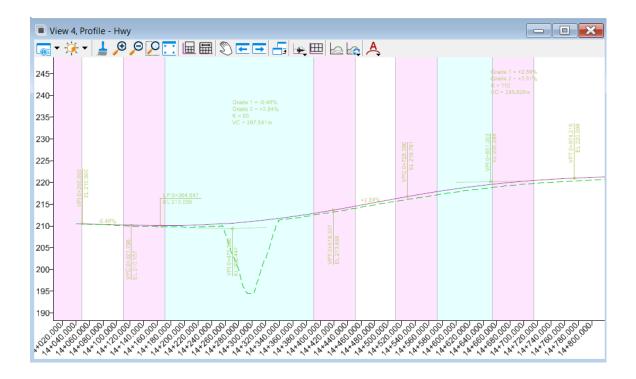
Select Annotation Element command from the *Drawing Production* tab *Annotations* group on the OpenRoads Modeling workflow ribbon or from the Profile Model View.



By default, Annotation Group associated to the Feature Symbology that the profile elements are assigned to will be used for the annotation. The Annotation Group **Override** option is provided on the *Annotate Element* dialog.

hnnotate Ele		×
Parameters		*
All Elements in Model		
Override		~
Override Annotation Group		

Select the profile elements and reset or check the **All Elements in Model** option to complete. Annotation is placed with the *Annotation Scale Lock* on. Change the scale (Drawing Production > Drawing Scales) will change the annotation automatically.



7.0 Corridor Modeling

OpenRoads Designer uses the Corridor civil object to model roadway. The 3D model is then used to create terrain models, cross sections and generate quantities.

ORD corridors are created directly in the MicroStation views. The corridor information is stored in 2D design (dgn) file. The corridor is started in 2D and the 3D model is automatically generated and attached to the 2D model. A minimum of one horizontal and one vertical civil geometry elements are required to create a corridor.

The corridor modeling toolset includes tools for creating, modifying, managing and reporting corridors. These tools can be accessed from the *Corridors* tab on the OpenRoads Modeling workflow ribbon.

7.1 Corridor Modeling Workflow

The general workflow for corridor modeling is listed below:

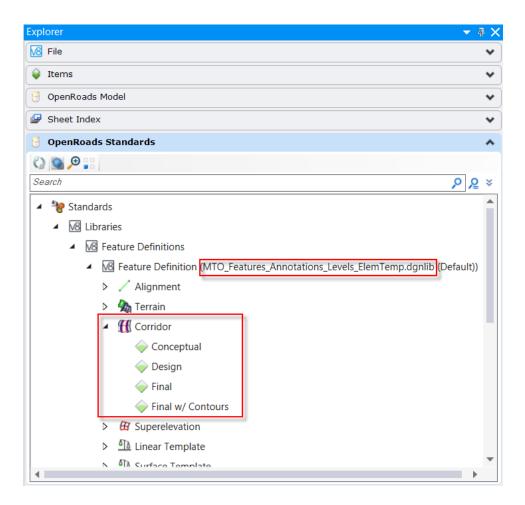
- 1. Create a 2D design (dgn) file.
- 2. Attach existing terrain model as a reference file and set the active terrain.
- 3. Attach geometry dgn as a reference (both horizontal and vertical geometry are required)
- 4. Create a corridor.
- 5. Add template drop(s).
- 6. Add horizontal and vertical controls to template points (as needed).
- 7. Define transitions (as needed)
- 8. Assign superelevation (as needed).
- 9. Review 3D model and dynamic cross sections
- 10. Make adjustments or add additional controls.

7.2 Design Stages

OpenRoads uses corridor feature definitions (also referred to as design stages) to save commonly used settings for a corridor. Each corridor can have its own design stage within a project and can be changed at any time.

The corridor feature definitions are defined and stored in dgn library **MTO_Features_Annotations_Levels_ElemTemp.dgnlib** under Feature Definitions > Corridor.

The design stage is selected when creating a corridor. Once used, the design stage is copied into the design file and can be adjusted based on the project need. Set the design stage based on the design phase and change it as the design progresses. This will help to manage the mount of detail needed to improve the processing speed/performance.



The design stage has five sections define a variety of settings and options. They are Feature Definitions, Item Type, Processing and Critical Sections, Display Settings and Manipulator Settings.

Right-click on a Design Stage and select Properties from the context sensitive menu to open the *Properties* (Element Information) dialog. The settings of the selected design stage will be populated. Shown below are the settings for Final stage.

Coloritory (1)			
Selection (1)			
🔶 Final			
Feature Definition	~	Item Type 🔹 🔨	Processing & Critical Sections
Name Final Description Final Phase Name Seed Corridor		Item Type No Item Type	Template Drop 1.0000 Horizontal Card True Vertical Cardinz True External Contro True Densify Horizor True Densify Horizor 0.0200 Densify Vertica False Densify Vertica 0.0200 Enable Clipping True
Display Settings	*	Manipulator Settings	
Top Mesh Displ False Top Mesh Feat: Top Mesh Bottom Mesh D False Bottom Mesh F Bottom Mesh Components Di True		Corridor Elemer Modeling\Corridor Graph Corridor Handle 0.2000 Corridor Handle 100.0000 Template Drop Modeling\Corridor Graph Template Drop 0.9000 Single Station [Modeling\Corridor Graph Single Station [0.9000	

Template drop and critical sections settings:

Feature Definition Name	Conceptual	Design	Final	Final w/ Contours
Template Drop Interval Multiplier	5	2	1	1
Critical Sections				
Horizontal Cardinal Points Display	False	True	True	True
Vertical Cardinal Points Display	False	True	True	True
External Control Points Display	False	False	True	True
Densify Horizontal	False	True	True	True
Densify Vertical	False	False	False	False

7.3 Superelevation

In OpenRoads Designer, the superelevation data can be created and stored in its own 2D design (dgn) file, or it can be created in the geometry or corridor files. Tools are provided for creating, calculating and editing superelevation.

To create superelevation, the minimum requirements are one horizontal alignment geometry and superelevation rate and transition values calculated using XML-based superelevation rule file or imported through a CSV file.

The superelevation rules file has been defined for MTO ORD WorkSpace. It is in the following folder:

 $\dots \\ Organization-Civil \\ MTO \\ Superelevation \\ \\$

The rules file is defined based on TAC Geometric Design Guide for Canadian Roads – June 2017. As the file name **MTO_TAC_06.xml** indicated, the max superelevation rate e = 6%. Settings for each category are shown below.

<u>General</u>

File Import			
=			
General Tables Equations Runout and Transition Options	Units Length: Meters	 Station Rounding: Cross Slope Rounding(%): 	0
Curve Overlap Adjustments Custom Key Stations	Creation By Corridor Settings	(optional)	
Runtime Variables	e Max Method:	MTO_TAC SUP 6%	~
	Runoff Length Method:	Speed Table	~
	Pivot Method:	Crown	\sim
	Design Speed:	100 ~	
		-	

Options of creation on this page (above) can be changed at the time of superelevation calculation. See below *Calculate Superelevation* dialog.

🔏 Calculate S	uperelevation			×
Paramete	rs			*
Rules File Name	C:\MTO ORD Standards\WorkSpaces\MTO\WorkSets	\Demo\	dgn\MTO_	TAC ···
e Selection	MTO_TAC SUP 6%			\sim
L Selection	Speed Table			~
Design Speed	60			\sim
Pivot Method	Crown			\sim
Open Editor				

Tables

🔡 Create / Edit Superelevatio	on Rules File (C:\MTO C	RD Standards\WorkSpace	es\MTO\WorkSets\De	_	\Box \times
File Import					
📛 🔚 🗭 🔢					
General Tables	Rate Tables				
Equations	Name	MTO_TAC SUP 6%			~
Runout and Transition Options Curve Overlap Adjustments	Design Speed	🔜 Edit Rate Table	- 0	×	~
Custom Key Stations Runtime Variables		Name	MTO_TAC SUP 6%		Delete
	Transition Tables Design Speed	Design Speed	100		~
	Rotated Lanes	Radius	eRate	^	
	Rotated Lanes	7000	NC		~
		5000	NC		Delete
		4000	RC		
		3000	RC		
		2000	0.026		
		1500	0.032		
		1200	0.038	\sim	
			Save Canc	el	
				-	1

🖳 Create / Edit Superelevatio	on Rules File (C:\MTO (ORD Standards\WorkSpa	ces\MTO\WorkSets\De	_	
File Import					
General Tables Equations Runout and Transition Options Curve Overlap Adjustments Custom Key Stations Runtime Variables	Rate Tables Name Design Speed	MTO_TAC SUP 6%	New Edi	t	✓Delete
Runtime Variables	Transition Tables Design Speed Rotated Lanes	1 Edit Transition 1 1 Design Speed Number of Rotated L	100	×	✓✓Delete
		eRate 0.015 0.02 0.026 0.032 0.038 0.043 0.045	Length 0 57 57 57 57 56 57 56 57 57 58 20 20 20 20 20 20 20 20 20 20 20 20 20	ncel	
,,					

The table 3.2.6 of Chapter 3 - Alignment and Lane Configuration, TAC Geometric Design Guide for Canadian Roads – June 2017 is used to populate the rate and transition lookup tables of this superelevation rules file **MTO_TAC_06.xml**.

Runout and Transition Options

Runout Options:

The default option is set to *Fixed Length*. The tangent runout must be calculated and inputted into the rules file for superelevation calculation. According to MTO (TAC) standards, the tangent runout length is based on a 1:400 slope.

For example, a roadway has a normal cross slope of 2% and 7m cross section to be superelevated, the length of runout will be:

L = 400 * 0.02 (NC) * 7.0 (pavement width) = 56m

When this option is disabled, the runout length is calculated using the same gradient as the runoff section.

Transition Options:

By default, the *Use Spiral Length* option is enabled. If a spiral exists, the spiral length will be used as the transition (runoff) length rather than the calculated transition length. In this situation, the *Percent on Tangent* value will be ignored. For curve without spirals, 60% of the runoff occurs will be on the tangent approach and 40% on the curve.

🔡 Create / Edit Superelevatio	on Rules File (C:\MTO ORD Standa	rds\WorkSpaces\MTO\Wc	orkSets\De —		\times
File Import					
General Tables Equations	Runout Options	0			
Runout and Transition Optio Curve Overlap Adjustments Custom Key Stations Runtime Variables	Transition Options Transition Type: Non-Linear Curve Length: Half Lane Width: Use Spiral Length Start Inside Lane Rotation With O Lengths are Total Transition Interpolate Tables	Linear 0 0	Percent on Tangent:	0.6	
< >					

Curve Overlap Adjustments

The options on this page define how superelevation stations are adjusted when the exit transition from one curve overlaps the entry transition for the next curve.

The *Planar* option is enabled. With this option the road will transition planer from Full Super to Full Super. The Zero Crown and Normal Crown Stations are eliminated.

If multiple options (Slide, Shorten, etcetera) are defined for a curve type (reverse curve or curve curve) the one with smallest Minimum Transition Gap that is larger than the actual gap will be used.

🛃 Create / Edit Superelevati	on Rules File (C:\MTO O	RD Standards\WorkSpaces\MTO\WorkSets\Demo\dgn\MTO	—	
File Import				
😑 🔒 🕞 🧾				
General Tables Equations Runout and Transition Options Curve Overlap Adjustments Custom Key Stations Runtime Variables	Curve Type: Adjustment Type Slide Shorten Reverse Crown Custom	Minimum Transition Gep.		

Custom Key Stations

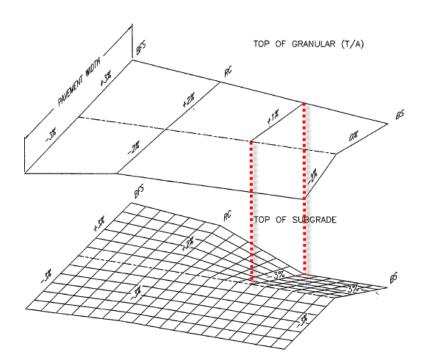
Custom key stations have been defined to add points where the outside lane is at 1%. These points are used for subgrade superelevation.

🔜 Create / Edit Superelevatio	on Rules File (C:\MTO C	ORD Standards\WorkSpaces\MTO\WorkSets\De — 🛛 🗙
File Import		
= 🔚 🕞 📰 🌌		
General	Create Custom Key	Station Equation(s)
Tables Equations	Description:	MTO 1% Superelevation Points
Runout and Transition Options Curve Overlap Adjustments	Criteria:	
Custom Key Stations Runtime Variables	Stations:	Custom = , crossSlopeEquation = 1%
	Equation: Type: Description:	Variables New Edit Delete

Station	Cross Slope	Point Type	Transition Type
10+500.000	-2.00%	Normal Crown	
10+555.563	-2.00%	Normal Crown	Linear
10+611.563	0.00%	Level Crown	Linear
10+628.545	1.00%	Undefined	Linear
10+645.528	2.00%	Reverse Crown	Linear
10+708.363	5.70%	Full Super	Linear
10+786.102	5.70%	Full Super	Linear
10+848.937	2.00%	Reverse Crown	Linear
10+865.919	1.00%	Undefined	Linear
10+882.902	0.00%	Level Crown	Linear
10+938.902	-2.00%	Normal Crown	Linear
11+000.000	-2.00%	Normal Crown	Linear

7.4 Subgrade Transition Into Superelevation

The following diagram illustrates the subgrade transition in superelevated sections.



8.0 Quantities and Earthwork Volume

OpenRoads Designer provides various tools and methods to compute and report quantities and earthwork volume.

8.1 Volumes

OpenRoads Designer uses 3D mesh elements to represent the cut and fill volumes between the existing terrain model and the bottom mesh of the design elements. The earthwork quantities are calculated from the 3D mesh solids using true prismoidal method.

The **Create Cut and Fill Volumes** tool creates a 3D mesh solid for cut and a 3D mesh solid for fill. The tool calculates cut and fill volumes between two surfaces. Vertical edges are drawn from the Design Surface to the Existing Surface and the volume (in master units) is calculated directly from the closed 3D solid. No longer need to create a set of cross sections to get the cut and fill volumes.

This tool can be accessed from both the OpenRoads Modeling and OpenRoads Drawing Production workflow ribbon.

OpenRoads Modeling > Terrain > Analysis > Volumes

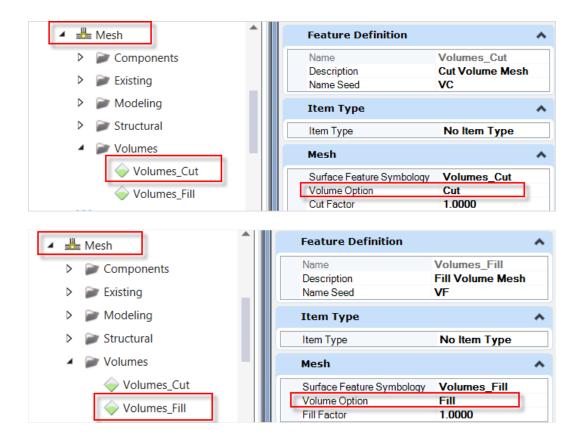
OpenRoads Modeling > Home > Model Analysis and Reporting > Civil Analysis

OpenRoads Drawing Production > Home > Model Analysis and Reporting > Civil Analysis

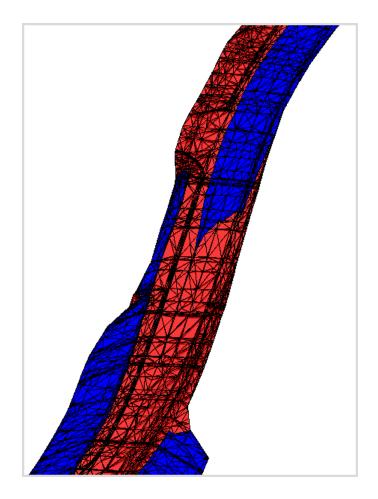
Two feature definitions Volumes_Cut and Volumes_Fill are used for this calculation.

🔏 Crea 📃	
Parameters	*
Cut Feature Definition	Volumes_Cut 🖂
Fill Feature Definition	Volumes_Fill 🖂
Compute Unsuitable	
Compute Custom	
Compute Substrata	

They are defined under **Mesh** > **Volumes** with the *Volume Option* set to **Cut** and **Fill** respectively.



This tool will create the cut/fill 3D mesh elements to display where the cut and fill are located in the model. The blue 3D mesh element indicates fill and the red 3D mesh element indicated cut.



The volumes of the 3D solids can be viewed in Quick Properties (accessed from the context sensitive menu) or *Properties* dialog.

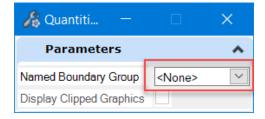
Feature Definition	Volumes_Fill
Feature Name	VF
Top Sloped Area	21685.23791 Sq.m
Planar Area	20667.94758 Sq.m
Volume	28331.06583 Cu.m
Description Volume Option	Fill

I Properties		×
Elements (1)		
🝠 VF		
General		^
Element Description Level Color Line Style Weight Class Template Transparency	VF Volumes_Fill ByLevel (5) ByLevel (0) ByLevel (4) Construction (None) 0	
Feature		~
Feature Definition Feature Name	Volumes_Fill VF	
Civil Quantities		*
Top Sloped Area Planar Area Volume	21685.23791 Sq.m 20667.94758 Sq.m 28331.06583 Cu.m	
Component Laye	er	~
Description Volume Option	Fill	

8.2 Quantities and Volumes Report

The **Quantities Report By Named Boundary** tool allows to report the corridor quantities and volumes for the entire corridor model or for specific station ranges and/or sheet clipping.

The cut and fill volumes are determined from the 3D mesh solids using the Create Cut Fill Volume tool. The other material quantities are computer from the 3D corridor models. When a Named Boundary does not exist or no **Named Boundary Group** is selected on the *Quantities Report By Named Boundary* dialog, the quantities are the total quantities from the entire 3D model.

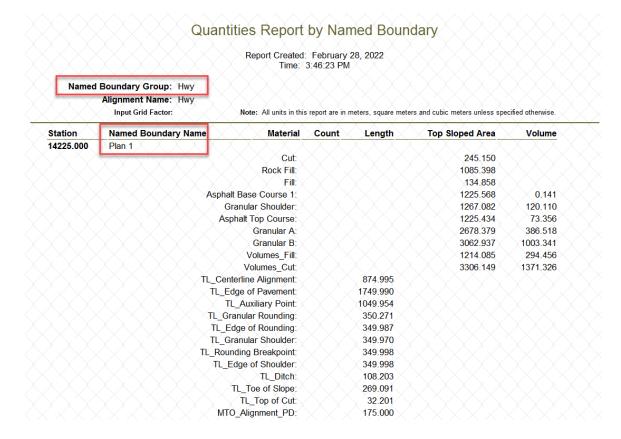


	Report Creat	ed: February e: 2:06:21 Pl			
Named Boundary Group: <no< th=""><th>one></th><th></th><th></th><th></th><th></th></no<>	one>				
Alignment Name: Input Grid Factor:	Note: All units in	this report are in	ı meters, square met	ers and cubic meters unless sp	ecified otherwise.
Station Named Boundary Name	Material	Count	Length	Top Sloped Area	Volume
Totals					
	Rock Fill:			9626.361	
	Cut: Fill:			2806.283	
	Asphalt Base Course 1:			134.910 8053.517	322,504
	Granular Shoulder:			8338,380	787.902
$\times \times \times \times \times \times \times \times \mathbf{k}$	Asphalt Top Course:			8053.517	483,501
$\mathbf{X} \times \mathbf{X} \times \mathbf{X} \times \mathbf{X}$	Granular B:			19964.364	6337.531
	Granular A:			17627.157	2541.400
\times \times \times \times \times k	Volumes Cut:			10467.465	3063,165
x	Volumes_Fill:			21685.238	28331.066
	TL_Centerline Alignment:		5749.972		\times
	TL_Edge of Pavement:		11499.943		
	TL_Auxiliary Point:		6899.760		
	TL_Granular Rounding:		2301.386		
	TL_Edge of Rounding:		2299.930		
	TL_Granular Shoulder:		2299.842		
	L_Rounding Breakpoint:		2299.989		
	TL_Edge of Shoulder:		2299.989		
	TL_Ditch:		971.605		
	TL_Toe of Slope:		1483.194		
	TL Top of Cut:		508.707		

The **Place Named Boundary** tool is used to create custom boundary shape along the corridor, quantities can then be calculated within a Named Boundary using the Quantities Report by Named Boundary tool.

The sheet definitions have been setup for creating the named boundary and drawings in MTO workspace. Select a drawing seed will automatically populate the *Place Named Boundary* dialog with a set of predefined values.

🔏 Place Named Boundary Civil Plan 🛛 🚽 🕹							
	P 🖿 📖 🔇 🖍 📝 🖾						
Drawing Seed:	Plan - Full Size 🔹						
Detail Scale:	1:1000	Name					
Name:	Plan	(none)					
Description:		Plan - Full Size					
Group:	(New)	Plan - Half Size Plan-Profile - Full Size - Plan Port					
Name:	Hwy	Plan-Profile - Half Size - Plan Port					
Description:							
Start Location:	14+391.211						
Stop Location:	12+400.000						
Length:	700.000000						
Left Offset:	-200.000000	-200.000000					
Right Offset:	200.000000						
Overlap:	0.000000						
Boundary Chords:	10						
	Create Drawing Show Dialog						

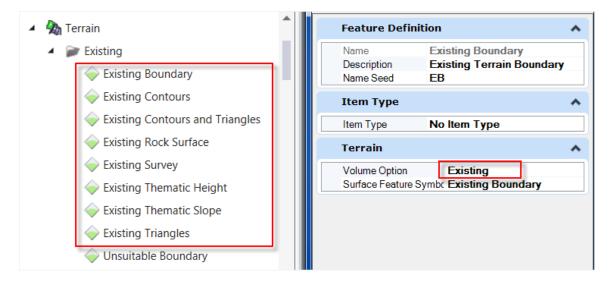


8.3 Feature Definition Volume Options

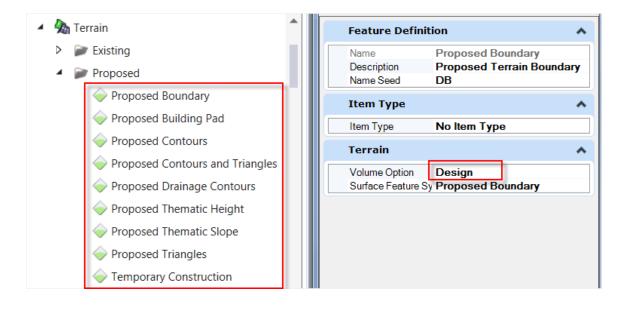
Feature Definitions are used to define various properties of the geometric elements. The mesh feature definition has a volume option which controls how earthwork will be classified and calculated, as well as the display of the 3D meshes. Options include None, Design, Existing, Subgrade, Substrata, Cut, Fill, Unsuitable and Custom.

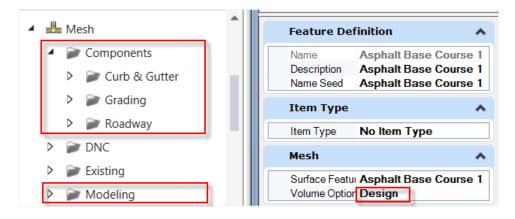
Design
Existing
None
Subgrade
Substrata
Cut
Fill
Unsuitable
Custom

To create and calculated the cut and fill volumes, the Existing and Design volume option must be defined between any two terrains or corridors. All the feature definitions for existing terrain except the **Unsuitable Boundary** have volume option set to **Existing or Substrata**.



All the feature definitions for proposed terrain and proposed corridor components have volume option set to **Design**.





Under Mesh > Existing, feature definitions have volume option set to **Substrate** or **Unsuitable**.

🔺 🔽 彦 Existing	Feature Definition	^
🔽 🛛 🧬 Existing Pavt	Name Existing Pavt	
V 🔗 Milling	Description Existing Pavement	
Muskeg Excavation	Name Seed Existing Pavt	
Rock Surface	Item Type	^
 Stripping 	Item Type No Item Type Mesh	•
🗸 🔗 Unsuitable Material	Surface Feature Symbology Existing Pavt	~
👂 🔽 📂 Modeling	Volume Option Unsuitable	
🕨 🔽 📂 Volumes	Cut Factor 1.0000 Split True	
Trace Slope	Remove Only Feature Symbo Volumes_Unsuitable_Remove Only Feature Symbol Volumes_Unsuitable_Remove Feature Symbol Sym	

The Unsuitable material is able to be split into Remove Only and Remove & Replace.

8.4 End-Area Volume

The End Area Volumes Report tool is used to extract the traditional end-area volume using a series of cross sections defined with the cross section named boundaries along an alignment. The terrain model for existing conditions and proposed 3D model are required for this volume calculation. You can also add unsuitable material to calculations and/or add volume exceptions. The quantities are reported on a station-by-station basis.

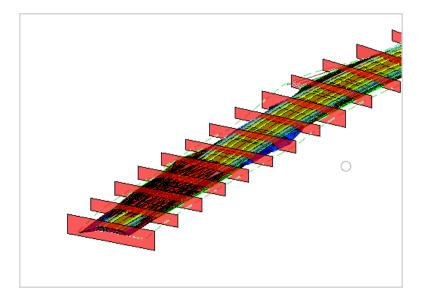
Refer to Plan Production section for (cross section) Named Boundary creation.

There are three predefined drawing seeds for placing cross section named boundaries in MTO workspace. Depending on the drawings to be produced, select a drawing seed from the *Drawing Seed* drop drown list to place the cross section named boundaries.

http://www.commons.com/ary-articles/art							
	R 🖓 🎟 🔯 🖍 💋 🗔 💢						
Drawing Seed:	(none) 🔻						
Detail Scale:	Name						
Group:	(none)						
Name:	XS - Half Size						
Name:	XS - Roll Plot						
Description:	XS Stacked						
Start Location:							

Adjust the left and right offset and the top and bottom clearance to fit the 3D model elements inside the named boundaries.

The Cross Section Named Boundaries will be placed in the 3D model.



Select Home > Model Analysis and Reporting > Civil Analysis > End Area Volumes Report

Follow the heads-up prompts to select the named boundary group and decide the volume exceptions, the *Bentley Civil Report Browser* will be displayed with calculated volumes. By default, the **EndAreaVolume.xsl** style sheet is used. Select other style sheet from the *Evaluation* folder on the left panel of the browser will present the data in different format.

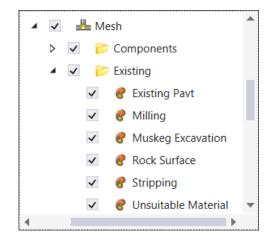
File Tools Help											
C:\Program Files\Bentley\OpenRoads Designer CONNEC	$\times \times \times$				End	Area V	olume R	eport			
Cant Civil Terrain CivilGeometry CivilGeometry CivilGeometry						port Create	ed: March-11- 1:26:15 AM	ХХХ			
CorridorModeling	Cr	oss Section	n Set Name:	Example2							
Evaluation	(XX)		ment Name:	V V							
EarthworkQuantities.xsl ElementsComponentQuantitiesReport.xsl	\bigtriangleup	- X - X = X	ut Grid Factor:		All units in this rep	ort are in me	ters, square meter	s and cubic met	ers unless spe	cified otherwise.	
ElementsComponentQuantitiesReportSummary.x: EndAreaVolume.xs MassHaulToTIW.xsl Quantities by Named Boundary Report.xsl	Baseline Station	×	Cut			- Fill		Cut		Fill	Mass Adjusted Ordinate
SightVisibilityAlternateReport.xsl	10+500.001	1.000 0.0	000.0 000	0.000	1.000 34.341	0.000	0.000	~~~	Ň		0.000
	10+525 000	1 000 22 3	258 278.214	278.214	1.000 0.000	429.242	429.242				-151.028
SightVisibilityReport.xsl	10+525.000										
SightVisibilityReport.xsl TerrainCheck.xsl	10+525.000	1.000 47.1	143 867.512	867.512	1.000 0.000	0.000	0.000				716.484
SightVisibilityReport.xsl TerrainCheck.xsl Volumes.xsl	10+550.000		143 867.512 118 1265.761		1.000 0.000 1.000 0.000		0.000 0.000				716.484 1982.245
SightVisibilityReport.xsl TerrainCheck.xsl Volumes.xsl images	10+550.000	1.000 54.1		1265.761		0.000					1982.245
SightVisibilityReport.xsl TerrainCheck.xsl Volumes.xsl images LegalDescription	10+550.000 10+575.000	1.000 54.	118 1265.761 538 1183.203	1265.761 1183.203	1.000 0.000	0.000	0.000				1982.245 3165.448
SightVisibilityReport.xsl TerrainCheck.xsl Volumes.xsl LegalDescription MapCheck	10+550.000 10+575.000 10+600.000	1.000 54. 1.000 40.5 1.000 1.	118 1265.761 538 1183.203 124 520.777	1265.761 1183.203 520.777	1.000 0.000 1.000 0.000	0.000 0.000 129.388	0.000 0.000 129.388				
SightVisibilityReport.xsl TerrainCheck.xsl	10+550.000 10+575.000 10+600.000 10+625.000	1.000 54.3 1.000 40.5 1.000 1.3 1.000 0.0	118 1265 761 538 1183 203 124 520 777 000 14.048	1265.761 1183.203 520.777 14.048	1.000 0.000 1.000 0.000 1.000 10.351	0.000 0.000 129.388 676.379	0.000 0.000 129.388				1982.245 3165.448 3556.837

8.5 Unsuitable materials

OpenRoads Designer is able to calculate the unsuitable materials like topsoil and pavement removal. When the *Volume* is set to **Unsuitable** in the feature definition, the material can be quantified as removed only or removed and replaced with fill material. If the *Split* option is set to **True**, the calculation will differentiate the quantities from what is to be removed only and what is to be removed and replaced.

The feature definitions for unsuitable material are located at:

.....Mesh\Existing\



Some of these feature definitions are set to split. Change the *Split* option as per the project requirements.

Mesh	~
Surface Feature Symbology	Existing Pavt
Volume Option	Unsuitable
Cut Factor	1.0000
Split	True
Remove Only Feature Symb	Volumes_Unsuitable_Remove Only
Remove/Replace Feature Sy	Volumes_Unsuitable_Remove Replace

To calculate the Unsuitable Materials volume, a surface template is to be applied to a terrain model representing the top surface of the unsuitable material. Then the terrain model can be attached to the file used for volume calculation.

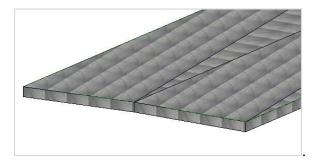
MTO standard template library contains predefined surface templates in the following folder:

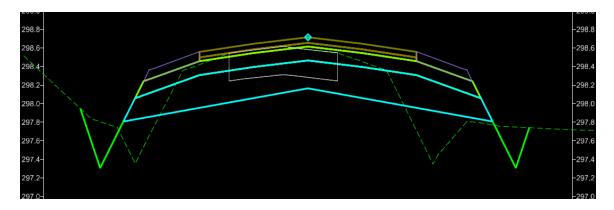
MTO Library\Surface Templates\

🔁 Surface Templates
🛏 Asphalt Pavement
🛏 Concrete Median
🛏 Concrete Pavement w/ Agg Base
≻ Dirt
🛏 Existing Pavement
🛏 Granular A
🛏 Granular B
🛏 Grass
🖂 Grass Burnt
🛏 Grass w/ Topsoil
🛏 Milling
🛏 Muskeg
🛏 Riprap
🛏 Stripping
≻ Water

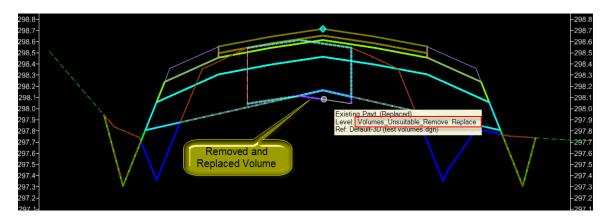
Use the surface template to apply a material thickness to the unsuitable material terrain model. Change the depth of the template as required.

Shown below existing pavement.





Once attached the unsuitable material terrain model, use the *Create Cut and Fill Volumes* tool to create 3D cut and fill meshes. When prompt "*Use Unsuitable*", select **Yes**. The calculation will take into account the unsuitable material's volumes.

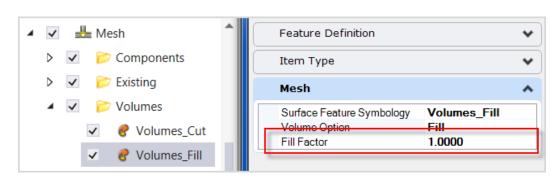


Use the *Quantities Report By Named Boundary* tool to create a report of the quantities and volumes for the corridor model. Select Volumes.xsl to change the report type. Shown below the existing pavement volume is split into *Replaced and Removed (not replaced)*.

Alignment N Input Grid		ote: All	units in this r	report are i	n meters, squ	are meters and cubic n specifi	neters unle ed otherwis
Station	Туре	Area	Volume	Factor	Adjusted Volume	Included in Mass Ordinate?	Mass Ordina
0+000.000	$\mathbf{X}\mathbf{X}$	$\times \times$	$\overline{\mathbf{X}}$	X X	$\propto \times$	X X X X	2210.6
X X X Va	olumes_Cut:		5982.043	1.000	5982.043	Yes	
v v	olumes_Fill:		3771.370	1.000	3771.370	Yes	
Existing Pavt	(replaced):	XX	62.979	1.000	62.979	No	
Existing Pavt (no	t replaced):		922.650	1.000	922.650	No	
Total E	xisting Pavt:	X	985.629	1.000	985.629		
Asphalt Bas	e Course 1:		278.313	1.000	278.313	No	
Asphalt]	Fop Course:		417.325	1.000	417.325	No	
	Granular A:		1625.955	1.000	1625.955	No	
	Granular B:		3588.838	1.000	3588.838	No	
\checkmark \checkmark \checkmark	Shoulder	\sim	343 047			Non	$\vee \ \vee$

8.6 Cut/Fill Factor

To account for any swell or shrinkage that may occur when remove/place material, a factor can be applied to the cut or fill volume.



The Volumes_Cut and Volumes_Fill have a setting to define the cut/fill factors.

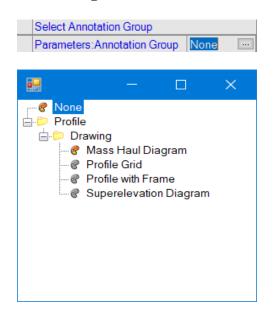
8.7 Mass Haul Diagram

This command generates a Mass Haul diagram representing the cumulative total of cut and fill volumes along a horizontal alignment or defined plan or cross section boundary group. Before you generate a Mass-Haul diagram, have the 3D Cut Fill meshes created.

Select Home > Model Analysis and Reporting > Civil Analysis > Mass-Haul Diagram

Follow the heads up prompts to select and input values.

When prompt for *Annotation Group*, press and hold <ALT> Down Arrow and select **Profile > Drawing > Mass Haul Diagram**

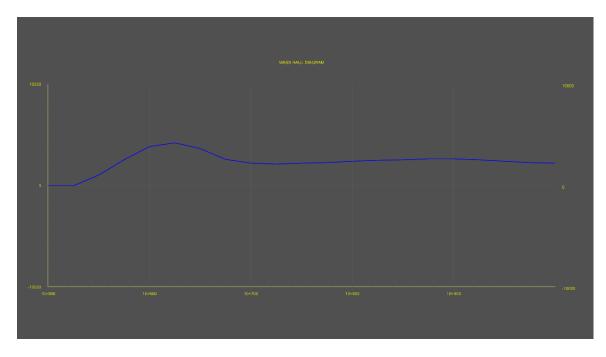


The eccented velves are	displayed in the	Maga Haul Diagnam	dialog og shown halow
The accepted values are	displayed in the I	Mass naui Diagram	dialog as shown below.

🔏 Mass Haul Diagram	– 🗆 🗙
Parameters	^
Method	Interval 🗸
Lock To Start	\checkmark
Start	10+500.000
Lock To End	
Stop	11+000.000
Left Offset	-30.00000
Right Offset	30.00000
🗹 Interval	25.00000
Vertical Exaggeration	0.01000
Annotation Group	Mass Haul Diagram 🔛
Mass Haul Model Name	Example Mass Haul
Display Clipped Graphics	

The Mass Haul Diagram will be created and opened in a separate Drawing Model.

Models				_ 🗆 🗙	
📮 🗅 🞯 🗙 🚰 🗐 🍞					
Type 2D/3D Name	Description	*	Design File	Sheet Numt	
Default	Master Model	×	C:\MTO InR\test volumes_MH.o	dgn	
📑 🗍 Default-3D		×	✓ C:\MTO InR\test volumes_MH.dgn		
Example Mass Haul	C:\MTO InR\test volumes_MH.dgn				
•	111			۱.	



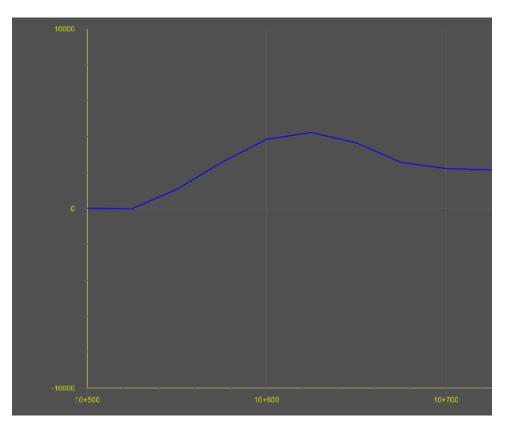
The Mass Haul report is displayed in the Bentley Civil Report Browser.

🛃 Bentley Civil Report Browser - C:\Users\Juoand\AppData\Local\Temp\RPTrhuthnrn.xml					
File Tools Help					
C:\Program Files\Bentley\OpenRoads Designer CONNEC	* Station Mass Ordinate	^			
Cant Civil Terrain Civil Cerrain Civil Cerrain Civil Cerrain Civil Survey Civil Survey Corridor Modeling	10+525.000 -9.754	=			
 Evaluation EarthworkQuantities.xsl ElementsComponentQuantitiesReport.xsl ElementsComponentQuantitiesReportSummary.xs 	10+550.000 1063.701				
EndAreaVolume.xsl MassHauIToTIW.xsl Quantities by Named Boundary Report.xsl SightVisibilityAlternateReport.xsl	10+575.000 2558.073				
SightVisibilityReport.xsl TerrainCheck.xsl	10+600.000 3864.929				

The major grid of the annotation group **Mass Haul Diagram** is set to 100 for the Horizontal Interval and 10000 for the Vertical Interval.

	Major Grid Properties	*
	Horizontal Interval	100.0000
	Horizontal Tick Position	Outside
	Horizontal Tick Location	Bottom
	Horizontal Tick Length	0.0040
	Horizontal Template	Annotation\Sheets\Profile\Draft_I
	Vertical Interval	10000.0000
	Vertical Tick Position	Outside
	Vertical Tick Location	All
	Vertical Tick Length	0.0040
	Vertical Template	Annotation\Sheets\Profile\Draft_F

Each horizontal major grid is 100m and each vertical major grid is 10000 m^3 . With vertical exaggeration of 0.01, each grid is 100 x 100 drawing master unit.



9.0 Drawing Production

OpenRoads Designer provides drawing production workflow and tools for automated Plan, Profile, and cross section sheet creation.

Named Boundaries are used to define the extent of what is to be displayed on the sheet, and to create and manage the sheets. Seed files and sheet seed definitions are created for generating the customized sheets.

9.1 Seed Files

The Drawing Seed and Sheet Seed are required to generate customized sheets. Two seed files *MTO_SheetSeed.dgn* and *MTO_DrawingSeed.dgn* are provided in the following folder:

 \dots \Organization-Civil \MTO \Seed \Sheets \

The following 4 variables are set with these seed files for the sheet creation.

MS_DRAWINGMODELSEED

MS_DRAWINGMODELSEEDNAME

MS_SHEETMODELSEED

MS_SHEETMODELSEEDNAME

9.2 Sheet Seed Definitions

The following sheet definitions have been setup for creating the named boundary and drawings. Each of this sheet definition has a set of predefined values. Chang settings on the *Place Named Boundary* dialog to meet project specific requirements.

- Civil Plan

Plan - Full Size Plan - Half Size Plan-Profile - Full Size (Plan Port) Plan-Profile - Half Size (Plan Port)

- Civil Profile

Profile - Full Size Profile - Half Size Plan-Profile - Full Size (Profile Port) Plan-Profile - Half Size (Profile Port) Profile-Profile - Half Size (Top Port) - Civil Cross Section

Cross Section - Half Size Cross Section - Roll Plot Cross Section - Stacked

9.3 Named Boundaries

Select the **Place Named Boundary** command from the *Drawing Production* tab *Named Boundaries* group on the OpenRoads Modeling workflow ribbon, or on the OpenRoads Drawing Production workflow ribbon.

Drawing Production > Named Boundaries > Named Boundary

<u>Civil Plan</u>

For plan named boundaries, select Civil Plan mode,

🔏 Place Named Boundary Civil Plan 🛛 🚽 🗙			
	<mark> k</mark> î 🖮 🕅 🎵		
Drawing Seed:	Plan - Full Size 🔹		
Detail Scale:	1:1000 👻		
Name:	Plan 1		
Description:			
Group:	(New) 🔻		
Name:	Multi-Select Mode		
Description:			
Start Location:		◀	
Stop Location:		▶	
Length:	700.000000		
Left Offset:	-200.000000	00	
Right Offset:	200.000000	oo	
Overlap:	0.000000	oo	
Boundary Chords:	10		
	Create Drawing Show Dialog		

Select a sheet definition from the **Drawing Seed** drop drown list. There are four drawing seeds (two for plan and profile) are available in the workspace.

Drawing Seed:	(none)
Detail Scale:	Name
Name:	(none)
Description:	Plan - Full Size
Description.	Plan - Half Size
Group:	Plan-Profile - Full Size - Plan Port
Name:	Plan-Profile - Half Size - Plan Port

Some of the settings on the dialog have been set for each of these drawing seed. They can be changed for project specific requirements. Some of the fields need to be filled by user.

Civil Profile

For profile named boundaries, select Civil Profile mode,

🔏 Place Named Boundary	Civil Profile — 🗌	×
	R 🖓 🏢 🌒 🖍 📝 🗐 💢	
Drawing Seed:	Profile - Full Size 🔹	
Detail Scale:	1:1000 👻	
Name:	Profile 1	
Description:		
Method:	Station Limits 🔹	
Group:	(New) 🔻	
Name:	Multi-Select Mode	
Description:		
Start Location:	0.000000	◀
Stop Location:	0.000000	▶
Length:	700.000000	00
Vertical Exaggeration:	10.00000	
Available Profile Height:	40.000000	00
Top Clearance:	0.500000	
Bottom Clearance:	0.500000	
Elevation Datum Spacing:	2.000000	
Station Datum Spacing:	100.000000	
Profile Shifts:	Datum Stations 🔹	
	Use Terrains	
	Use Active Vertical	
	Whole Conduits Only	
	Create Drawing	
	Show Dialog	

Select a sheet definition from the **Drawing Seed** drop drown list. There are five drawing seeds (two for plan and profile) are available in the workspace. Change the default values if desired.

Drawing Seed:	(none) 👻
Detail Scale:	Name
Name:	(none)
	Plan-Profile - Full Size - Profile Port
Description:	Plan-Profile - Half Size - Profile Port
Method:	Profile - Full Size
Group:	Profile - Half Size
Name:	Profile-Profile - Half Size - Top Port

Civil Cross Section

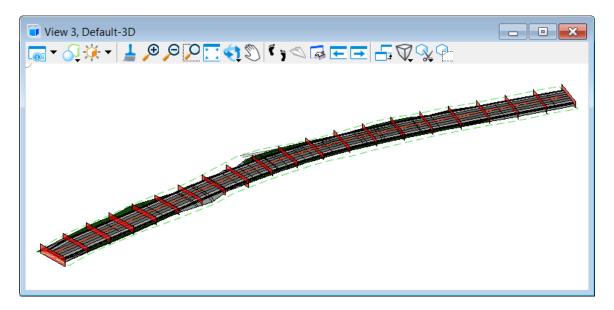
To place cross section named boundaries, the 3D model must be open and available. Select **Civil Cross Section** mode.

🔏 Place Named B	Boundary	Civil Cross Section — 🗌	×
		~ P 🖩 🕥 🖊 🗾 🗍	
Drawii	ng Seed:	XS - Half Size 🔻	
Deta	ail Scale:	1:100 👻	
	Group:	(New) 👻	
	Name:	Multi-Select Mode	
Des	cription:		
Start L	ocation:		◀
Stop L	ocation:		
Let	ft Offset:	-15.000000	oo
Righ	t Offset:	15.000000	0-0
	Interval:	25.00000	oo
Vertical Exago	geration:	1.000000	
Top Cl	earance:	3.000000	
Bottom CI	earance:	0.500000	
Elevation Datum	Spacing:	1.000000	
Event P	oint List:	(None) 🔻	
		Include Event Points Only	
		Include Control Points	
		Backward Facing	
		Create Drawing	
		Show Dialog	

Select a sheet definition from the **Drawing Seed** drop drown list. There are three drawing seeds are available in the workspace. Each drawing seed has a set of default values such as offsets, intervals, and clearances that can be changed for project specific needs when creating the cross section named boundaries.

Drawing Seed:	(none) 🔻
Detail Scale:	Name
Group:	(none)
	XS - Half Size XS - Roll Plot
Description:	

Shown below, cross section name boundaries created and displayed in 3D model.



9.4 Sheet Creation

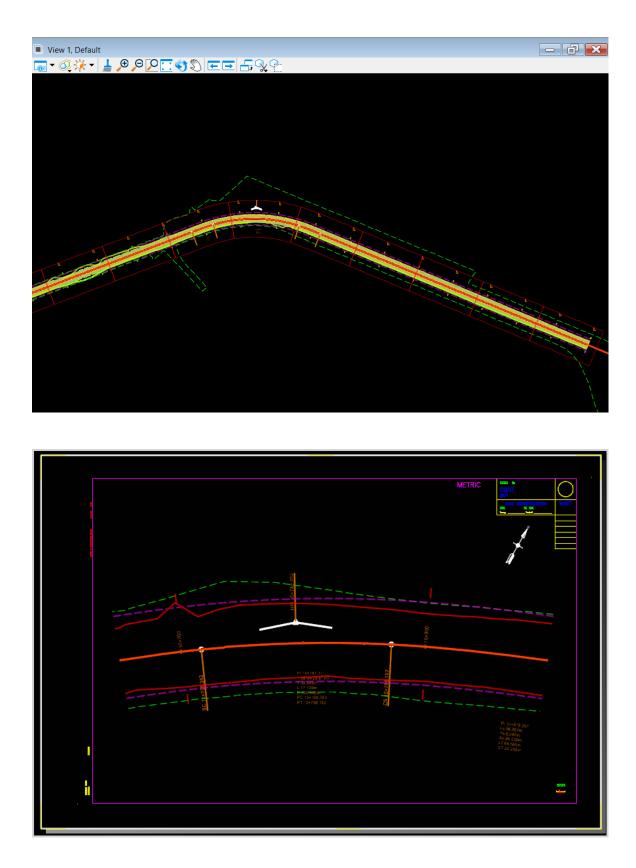
The **Create Drawing** tool is used to create Drawing models and Sheet models. The tool can be activated through the *Place Named Boundary* dialog once the Named Boundaries are created, or from the *Named Boundaries* manager (dialog) after the Named Boundaries have been placed.

One Drawing model is created for each Named Boundary. One or more Drawing models is then referenced onto a Sheet model for sheet creation. The drawing model and the sheet model will be automatically updated as the model changes.

On the *Create Drawing* dialog, there are additional settings for both Drawing Model and Sheet Model (e.g., Annotation Group, scales, etc.). The default options and values on this dialog can be changed if desired when creating the sheets.

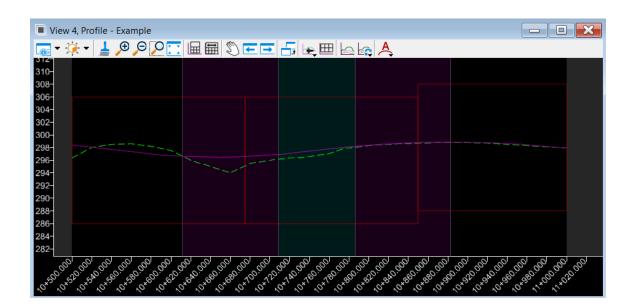
🞻 Create Drawing	×
Mc	ode: Plan
View Name: Drawing Seed: View Type: Discipline: Purpose:	Plan - Plan 1 Plan - Half Size Civil Plan Civil Plan View
Model Name: Seed Model:	Drawing Model Plan - Plan 1 MTO_Plan-Half Size Sheet Definition.dgnlib (Active File) 1:500 Plan Annotation
Model Name: Seed Model: Sheets: Drawing Boundary:	Sheet Model Plan - Plan 1 MTO_Plan-Half Size Sheet Definition.dgnlib (Active File) (New) Full Size 1 = 1 Plan - Half Size
Detail Scale :	1:500 (By Named Boundary) ▼ Add To Sheet Index □ Make Sheet Coincident □ Open Model □ OK Cancel

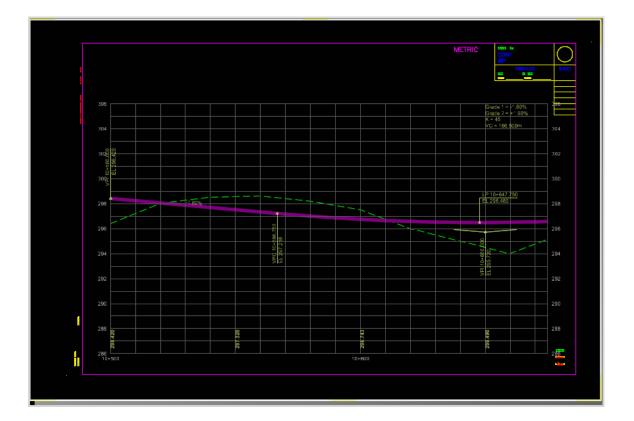
Plan Named Boundaries and sheet:



📢 Create Drawing	×
Mo One Sheet Per D	vde: Profile
View Name: Drawing Seed: View Type: Discipline: Purpose:	Profile - Profile Profile - Half Size Civil Profile Civil Elevation View
Model Name: Seed Model: Filename: Annotation Group:	Drawing Model Profile - Profile MTO_Profile-Half Size Sheet Definition.dgn (Active File) 1:500 Profile Grid
Model Name: Seed Model: Filename: Sheets: Drawing Boundary: Detail Scale :	Sheet Model Profile - Profile MTO_Profile-Half Size Sheet Definition.dgn (Active File) (New) Full Size 1 = 1 Profile - Half Size 1:500
	 Add To Sheet Index Make Sheet Coincident ✓ Open Model OK Cancel

Profile Named Boundaries and sheet:





For Plan and Profile sheet, the *Create Drawing* dialog has settings for both *Plan* and *Profile*:

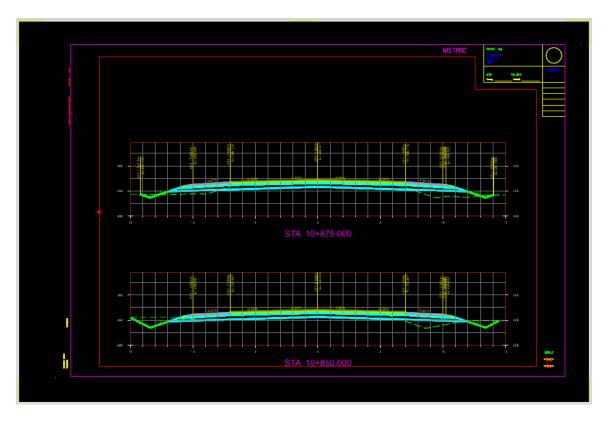
📢 Create Drawing					×
Mo	ode: Plan and Profile	•			
View Type: Discipline:	Plan-Profile - Half Size - Plan Port		View Name: Drawing Seed: View Type: Discipline: Purpose:	Plan and Profile Example - Profile Plan-Profile - Half Size - Profile Port Civil Profile Civil Elevation View	
Model Name: Seed Model: Filename: Annotation Group:	Drawing Model Plan and Profile Example - Plan MTO_Plan-Profile-Half Size Sheet Definitior (Active File) 1:500 Plan Annotation	-	Model Name: Seed Model: Filename: Annotation Group:	Drawing Model Plan and Profile Example - Profile MTO_Plan-Profile-Half Size Sheet Definitior (Active File) 1:500 • Profile Grid •	•
Model Name: Seed Model: Filename: Sheets: A Drawing Boundary: Detail Scale :	(Active File) (New) • Full Size 1 = 1 • Plan-Profile - Half Size - Plan Port •	•	Filename: Sheets:	Full Size 1 = 1	-
	Add To Sheet Index Make Sheet Coincident Open Model			<u>O</u> K	Cancel

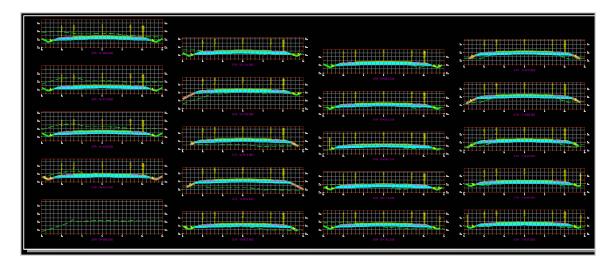


Cross Section *Create Drawing* dialog:

🞻 Create Drawing		×
Mo One Sheet Per D	Ide: Cross Section	
View Name: Drawing Seed: View Type: Discipline: Purpose:	Example - 10+500.000 XS - Half Size Civil Cross Section Civil Section View	
Model Name: Seed Model: Filename: Annotation Group:	Drawing Model Example - 10+500.000 MTO_XS-Half Size Sheet Definition.dgnlib, (Active File) 1:100 XS Grid w/ Annotation	
Model Name: Seed Model: Filename: Sheets: Drawing Boundary: Detail Scale :	Sheet Model Create Sheet Model Example - 10+500.000 MTO_XS-Half Size Sheet Definition.dgnlib, (Active File) (New) Full Size 1 = 1 XS -Half Size 1:100 Add To Sheet Index	
	Make Sheet Coincident Open Model	

Cross Sections generated in sheet and roll:





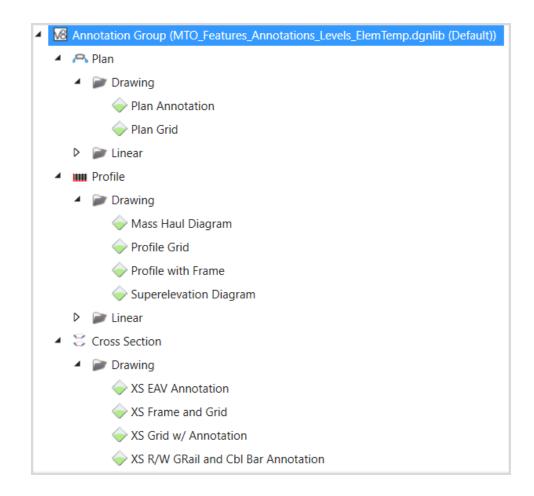
9.5 Drawing Annotation

Annotation Groups are defined for Plan, Profile and Cross Sections annotations. When an annotation group is assigned on the *Create Drawing* dialog, sheets will be created and annotated automatically. Annotation can also be added after the sheets are created. For project specific requirements, the annotation groups can be modified with additional annotation definitions either from other annotation groups or created by users, or use multiple annotation groups.

🞻 Create Drawing		×
One Sheet Per D	ode: Cross Section]
View Name: Drawing Seed: View Type: Discipline: Purpose:	Example - 10+500.000 XS - Half Size Civil Cross Section Civil Section View	
Model Name: Seed Model: Filename: Annotation Group	Drawing Model Example - 10+500.000 MTO_XS-Half Size Sheet Definition.dgnlib, (Active File) 1:100 XS Grid w/ Annotation	
Model Name: Seed Model: Filename: Sheets: Drawing Boundary: Detail Scale :	Sheet Model Create Sheet Model Example - 10+500.000 MTO_XS-Half Size Sheet Definition.dgnlib, 3 (Active File) (New) Full Size 1 = 1 XS -Half Size II:100 Add To Sheet Index Make Sheet Coincident	4
	Open Model OK Cance	:I

Each sheet seed definition in the workspace has an annotation group assigned. This annotation group can be removed or replaced with a different available annotation group on the *Create Drawing* dialog. Annotation groups can also be applied after sheets are created.

Shown below are available drawing annotation groups.



9.6 Cross Sections Annotation and Report

The cross section annotation can be placed automatically with assigning an annotation group when creating cross section sheets or manually placed in the drawing model after the cross sections are generated.

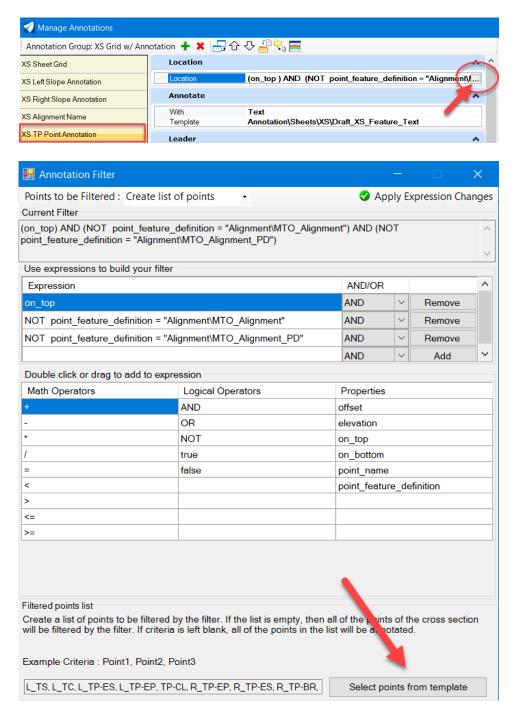
9.6.1 Point Annotation

The annotation group *XS Grid w/ Annotation* can be used to annotate cross section points and segments. This annotation group contains annotation definitions to annotate the top layer slope and points.

The points listed in the annotation definition **XS TP Point Annotation** are from a template in MTO's template library. Check the point list and make necessary adjustment so all the points to be annotated are included. It may be necessary to recreate the point list by selecting points from the project cross section templates.

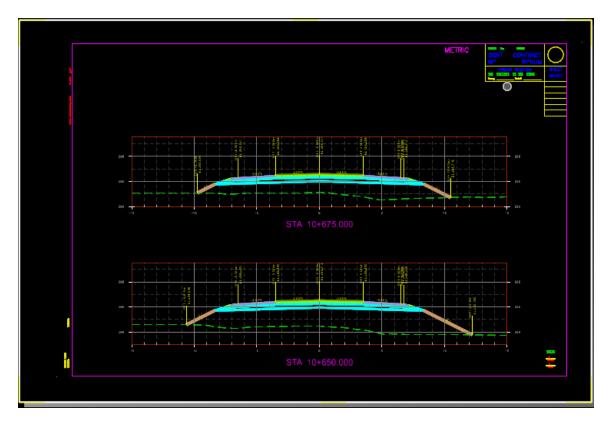
Expand the *Annotation Groups* category from the **OpenRoads Standards** tab on *Explorer* dialog, right click on the annotation group and select **Manage** to open the *Manage Annotations* dialog.

Select the **XS TP Point Annotation** definition and click on the ellipsis button at the end of the location field to open the *Annotation Filter* dialog. The point list is at the bottom of the page.

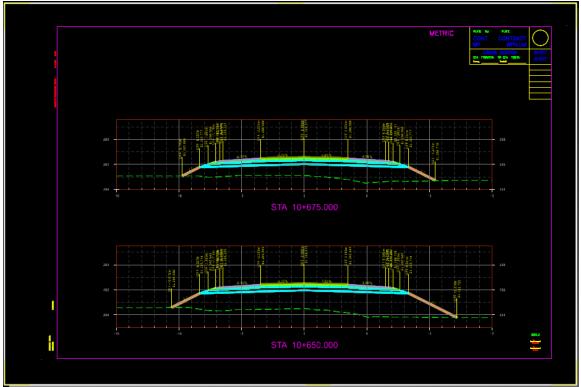


When the **Points to be Filtered** option on the *Annotation Filter* dialog is set to *Use all points*, all the points from specified location will be annotated (no list required).

🔡 Annotation Filter		- 🗆 🗙
Points to be Filtered : Use all points	•	Apply Expression Changes
Current Filter		

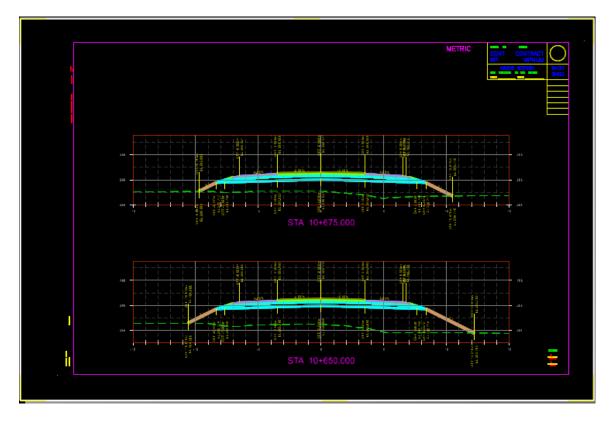


Shown below Annotation for top layer with selected points and with all points.

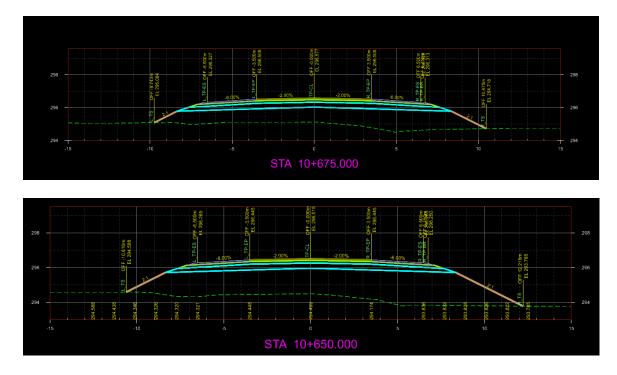


The **Point Annotation** definition can be modified to annotate point from different layers (e.g. subgrade) and/or for existing features (e.g. existing ES, EP etc.).

Shown below Annotation for both top and subgrade layers.



Additional Annotation Definitions can be added to the annotation group from other annotation group or user defined annotation group/definition. Shown below annotation with point names and existing ground elevation.



9.6.2 End Area Volume Annotation

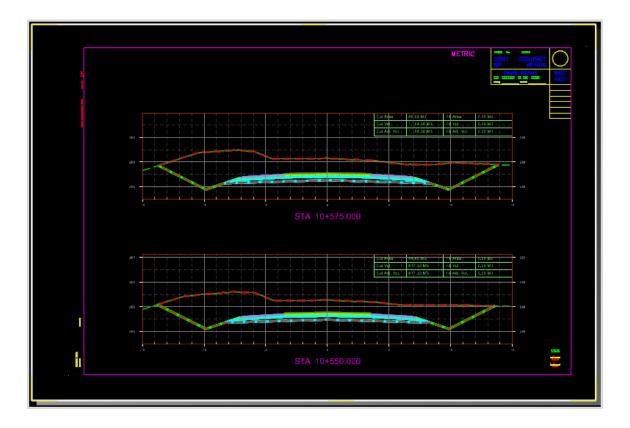
The annotation group *XS EAV Annotation* can be used to annotate EAV on cross sections.

The annotation group can be applied on the *Create Drawing* dialog when create the cross section drawings or using the *Annotate Drawing Model* tool after the drawings are created.

hnnota			\times
Parameters	;		~
All Drawing Models	\checkmark		
Annotation Group	XS EAV	Annotatio	on 📖

The default cut/fill annotation is set to be at the top right corner of the cross section.

Cut Area	20 92 M2	Fil Area	0.00 M2	
Cut Vol.	261.54 M3	Fill Vol.	357.14 M3	
Cut Adj. Vol.	261.54 M3	Fill Adj. Vol.	357.14 M3	- 300



9.6.3 Cross Section Report

The Cross Section Report tool creates a station, offset, and elevation report for a specified cross section *Named Boundary Group*.

The *Bentley Civil Report Browser*, along with the style sheet are used to view and print the reports. Select **Evaluation > CrossSectionGradebook.xsl**, **CrossSectionGradebookfromCL.xsl** (design surface) or **CrossSectionGradebookWide.xsl** (subsurface).

	Report Created: May 25, 2022 Time: 4:43:02 PM																
	Set Name: Example2 Alignment Name: Example2 Input Grid Factor: Note: All units in this report are in meters unless specified otherwise.																
Surface:	Example2																
	10+500.0																
Feature	L- SG- GR	L-TB- GS	L-TA- ER	L-TP- BR	L-TP- ES	L-TP- EPS	L-TP- EP1	TP- CL	R-TP- EP	R-TP- EPS	R- TP- ES	R- TP- BR	R- TA- ER	R- TB- GS	R- SG- GR		
Offset	-7.874	-7.128	-6.579	-6.250	-6.000	-4.000	-3.500	0.000	3.500	4.000	6.000	6.250	6.579	7.128	7.874		
Elevation	297.644	297.892	298.075	298.185	298.200	298.320	298.350	298.420	298.350	298.320	298.200	298.185	298.075	297.892	297.644		
Slope	-0.333	-0.333	-0.333	-6.000%	-6.000%	-6.000%	-2.000%		-0.020	-0.060	-0.060	-0.060	-0.333	-0.333	-0.333		
Station:	10+525.0	00															
Feature	L- TC1	L-BC	L- SG- GR	L-TB- GS	L-TA- ER	L-TP- BR	L-TP- ES	L-TP- EPS	L-TP- EP	L-TP- EP1	TP- CL	R- TP- EP1	R- TP- EP	R- TP- EPS	R- TP- ES	R- TP- BR	F T/ E
Offset	-12.426	-10.127	-8.627	-7.857	-7.308	-6.979	-6.729	-4.729	-4.229	-3.500	0.000	3.500	4.229	4.729	6.729	6.979	7.3
	297.821	296 671	297 171	297 428	297.611	297.720	297 735	297.855	297.885	297.900	297.970	297.900	297.885	297.855	297.735	297.720	297.6

Cross Section Gradebook Report Report Created: May 25, 2022 Time: 4:43:51 PM																		
				ame: Exa ame: Exa factor:							Note:	All units in t	nis report are	in meters u	nless specifie	d otherwise.		
Surface:																		
	10+500.0																	
Elevation: Offset:	297.644 -7.874	-7.128	298.075 -6.579	298.185 -6.250	298.200 -6.000	298.320 -4.000	298.350 -3.500	298.420 0.000	298.350 3.500	298.320 4.000	298.200 6.000	298.185 6.250	298.075 6.579	297.892 7.128	297.644 7.874			
Station:	10+525.0	00																
Elevation:	297.821	296.671	297.171	297.428	297.611	297.720	297.735	297.855	297.885	297.900	297.970	297.900	297.885	297.855	297.735	297.720	297.611	29
Offset:	-12.426	-10.127	-8.627	-7.857	-7.308	-6.979	-6.729	-4.729	-4.229	-3.500	0.000	3.500	4.229	4.729	6.729	6.979	7.308	
Station:	10+550.0	D0																
Elevation:	297.974	296.199	296.699	296.963	297.146	297.256	297.271	297.391	297.421	297.450	297.520	297.450	297.421	297.391	297.271	297.256	297.146	29
Offset:	-14.431	-10.880	-9.380	-8.586	-8.038	-7.708	-7.458	-5.458	-4.958	-3.500	0.000	3.500	4.958	5.458	7.458	7.708	8.038	
Station:	10+575.0	00																
Elevation:	297.297	295.727	296.227	296.558	296.738	296.861	296.875	296.981	297.003	297.032	297.078	297.008	296.964	296.934	296.814	296.799	296.689	2
Offset:	-14.978	-11.839	-10.339	-9.349	-8.808	-8.438	-8.188	-6.188	-5.688	-3.500	0.000	3.500	5.688	6.188	8.188	8.438	8.767	

9.7 Print/Plot

Two pen table files *MTO_monochrome_Full_Size.tbl* & *MTO_monochrome_Half_Size.tbl* are provided. They are equivalent to the IESCAD plot styles *MTO_monochrome_Full_Size.ctb* and *MTO_monochrome_Half_Size.ctb* with Construction Class elements excluded from printing.

These files are located at:

...\MTO ORD Standards\Organization-Civil\MTO\Pen Tables\

The printer driver configuration file *MTO_PDF.pltcfg* provides a "Roll" paper size with maximum 5000 x 580mm usable area.

Print (MTO_pdf.pltcfg)		- 🗆 🗙
File Settings Resymbolization		
늘 ♀ ⊕ ☷ 📑 🎸	4	
Printer and Paper Size		
MTO_pdf.pltcfg	•	
Bentley PDF printer driver		
Roll	•	
Usable area is 5000 x 580 mm		
Landscape 🔻		

9.8 Export to DWG

DGN file in ORD can be exported to common file types including DWG drawing file.

Select the **File** tab to open the backstage view then select **Export > Common File Types** > **DWG** (*.dwg).

This will open the *Export File* dialog.

🛃 Export File			×
← → ✓ ↑ 📜 « MTO > Works	iets > HWY 11 > DWG	ン の Search DWG	
Organize 🔻 New folder			≣ - ?
3D Objects	^ Name	^ Date modified	Туре
E Desktop			
Documents		No items match your search.	
Downloads			
ESSM			
Music			
Pictures			
Videos			
🐛 Windows (C:)	~ <		>
File name:			~
Save as type: Autodesk(R) DWG	Files (*.dwg)		~
Directory 🔻			
∧ Hide Folders		Options Save	Cancel

Click *Options* button on the bottom of the dialog will open the *Save As DWG/DXF Options* dialog to allow user more precisely to define what and how the DGN file will be exported to DWG format. Controls are grouped in tabbed sections.

Save As DWG/DXF Options	>				
General Remap References Filter					
<u> </u>					
Name	Value				
🖃 Basic					
DWG Version:	2018/2019/2020/2021/2022				
Source of Level Display:	Global				
Viewport Freeze per View Level Display	Viewports & Global Layers				
Units:	Master Units				
Line Code Scale (Design Units/Cycle):	0.00000				
Use Level Symbology Overrides					
Preserve OpenRoads Designer Settings					
DWG Seed File:	C:\Program Files\\seed.dwg				
± Advanced					
References					
Line Weights					
🗄 Entity Mapping					
Classes					
H Cells					
H Fonts					
Dimensions					
<	>				
	OK Cancel				
	<u></u>				

The General tab contains basic options for saving to DWG/DXF files. The Reference tab controls how references are handled when the DGN file is saved to a DWG/DXF file. The Filter tab is used to filter the data that is saved to the output file.

The annotation group *XS EAV Annotation* is used for the cross-section quantity annotation and the *End Area Volumes* are annotated with the **XS_EAV_Table** cell. To export the cross sections with the quantity annotation to DWG, the annotation group properties of the **XS_EAV_Table** cell need to be removed in order for the annotated quantities to be properly exported to DWG format.

Select all the **XS_EAV_Table** cells, then select **Drop Element** command from the *Drawing* tab Groups on the OpenRoads Modeling workflow ribbon to drop their annotation group properties.

On the *Drop Element* dialog, check the **Complex** option and follow the prompt to Accept.

🔏 Drop Element	- 🗆 🗙
Complex	
Line Strings/Sha	pes
Multi-lines	
Text	
<u>Application Eler</u>	nents
Dimensions:	To Geometry 🔹
Shared Cells:	To Geometry 🔹
Use Fence:	Overlap 🔹

10.0 Deliverables

Electronic Design Data is required for all MTO design projects. The ORD design submission shall include ALL files and data used in the preparation of the cross-section drawings, quantities, and reports. Project data should be identical to the contents presented in the contract book.

These may include but not limited to:

- a. Surface file (.tin, .dtm)
- b. 2D & 3D individual design models (terrain, geometry, superelevation, corridors, drainage, bridge, etc.) (.dgn)
- c. Master model (contain all terrain, geometry, corridors, superelevation, etc. for plan sheets, cross section, quantities, reports) (.dgn)
- d. Exported data from design models (.xml, .imodel, .ifc, .dwg)
- e. ORD project Template file (.itl)
- f. Superelevation rule file (.xml)
- g. Reports (.xml, .xlsx, .docx, .pdf, .txt)
- h. Project drawing sheets (.dwg, .dgn, .pdf)
- i. Supporting, import/export, data exchange files (various format)

A project content/summary file should also be submitted along with the ORD project data set. This file contains specific project information, software used in design process and their version, special settings and customizations, and descriptions of the files and data contained in the submitted project data set. This file is an important reference for MTO staff and contractors who may use the information to identify the design files and use the project data for construction, quantities, and asset management.