Appendix B – Bentley Software

Bentley Software

There are many individual software packages included in the Bentley family of softwares. These include Open Roads Designer (ORD), Open Bridge Designer (OBD), Open Bridge Modeler (OBM), MicroStation and other specialty specific softwares such as ProStructures, OpenRail & OpenTunnel. MicroStation is a computer aided drafting (CAD) package that can do all basic detailing oriented work including both two dimensional (2D) linework and three dimensional (3D) solids and visualization. Open Roads Designer builds special roadway oriented abilities on top of the basic MicroStation capabilities such as corridor work, roadway design, etc. The Open Bridge Modeler CADD package adds 3D structural modeling capabilities to the basic MicroStation capabilities. It provides intelligence and is currently tied to the design packages associated with Open Bridge Designer. Open Bridge Modeler may be a standalone product in the future. ProStructures can model structural steel and reinforced concrete structures. Since most of the packages are based on the basic MicroStation capabilities, any of them may be utilized to do CAD drawing and plan production. Each software has its own cost implications for licensing. The current configuration is set up to support ORD & OBD/OBM. 3D modeling has benefits for visualization, interference checks and communication but is not necessary for all projects. 3D modeling and deliverables will be evaluated on a project by project basis. The majority of the information contained in this appendix is based on basic MicroStation capabilities and can be used in most of the Bentley packages.

B.1 Configuration

Training materials, manuals, workflows, video tutorials and other resources can be accessed online at:

https://www.codot.gov/business/designsupport/cadd/

The training videos cover assorted subjects. There are also a number of CDOT workflows in pdf format for the Bentley software user that address specific drafting issues.

The Bridge Detailer should become familiar with all the available information posted online at the above mentioned web locations. In addition, this information is available through the Help and CDOT Help links available on the menu bar.

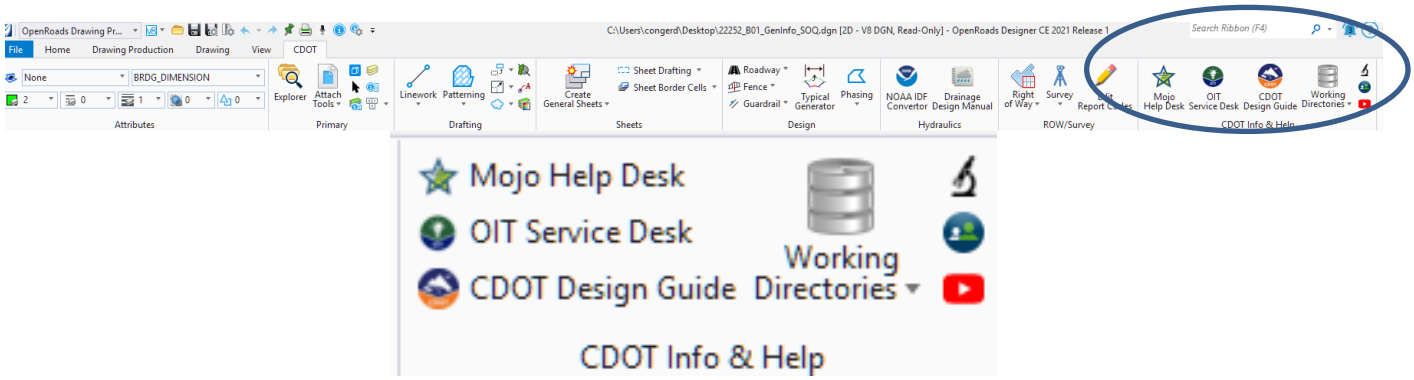


Fig. B.1-1 Help and CDOT Help in ORD 10.xx

In addition to the CDOT Help, the search ribbon allows the user to find commands.

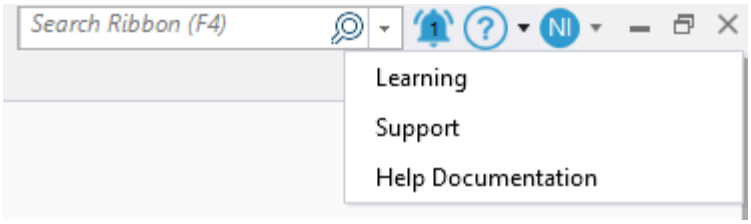
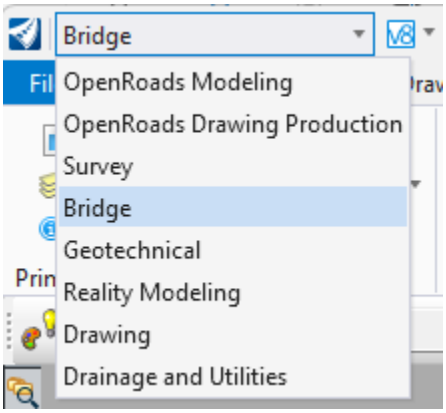
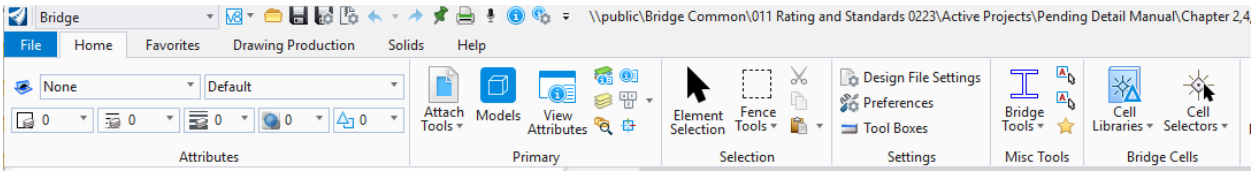
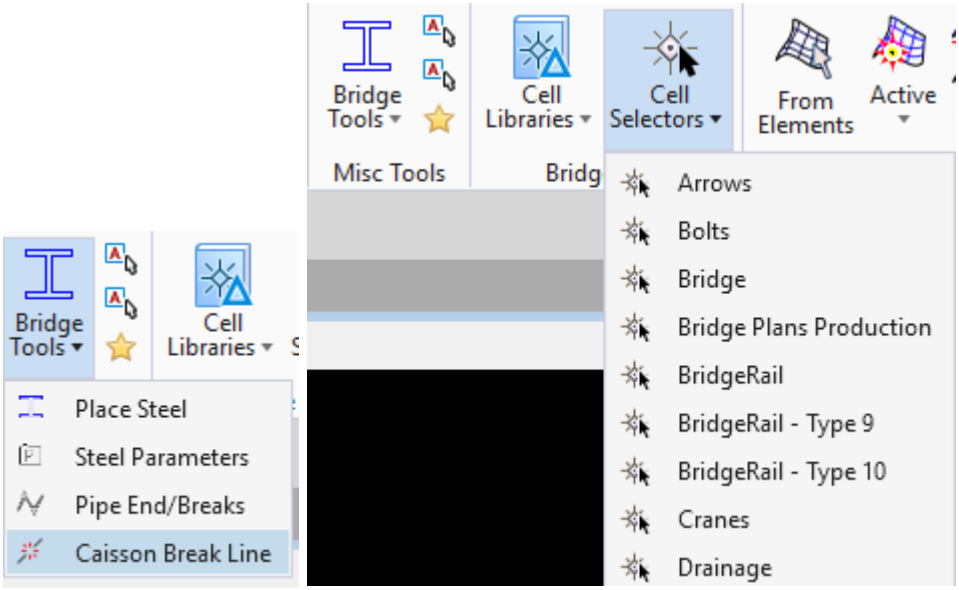


Fig. B.1-2 Search Ribbon and Bentley Help in the Top Right

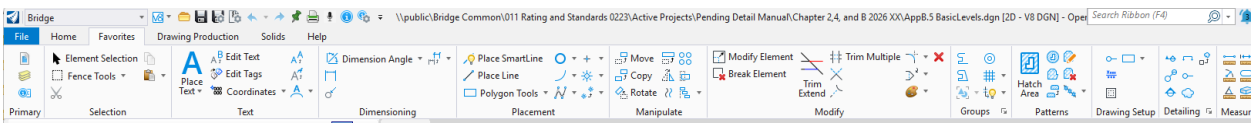
In the Bridge Workflow (top left), several ribbon tabs have been provided to make production easier. The Home tab contains some miscellaneous tools including a steel shape generator as well as cell selectors for the available cell libraries.







The Favorites Tab is intended to provide most commonly used drafting commands and tools.



B.2 Seed Files

When working in ORD and OBM, the Bridge Detailer has the option of opening an existing drawing or starting a new one based on the existing bridge templates. Drawing templates are called “seed files” and are included in the configuration files.

Three seed files are available for the preparation of bridge drawings. They are named *Bridge-2D-Seed_CDOT.dgn* , *Bridge-3D-Seed_CDOT.dgn* and *Bridge-ModelSeed-CDOT.dgn*.

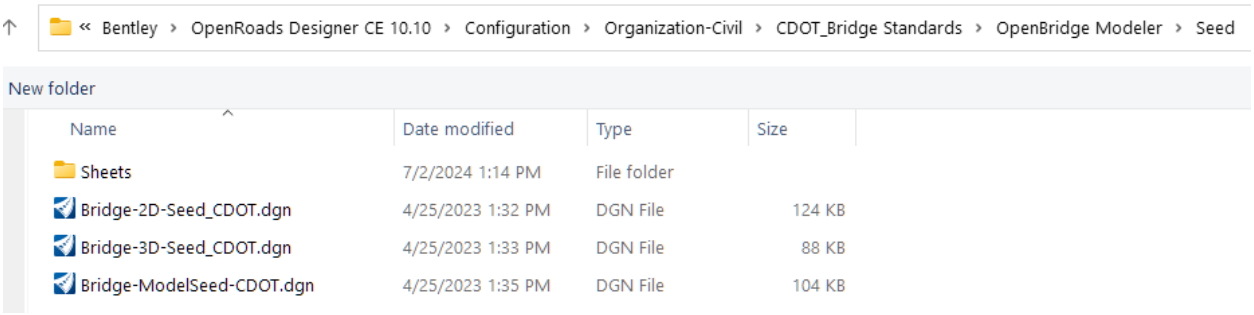


Fig. B.2-1 Bridge Seed Files in ORD 10.10 (as an example)

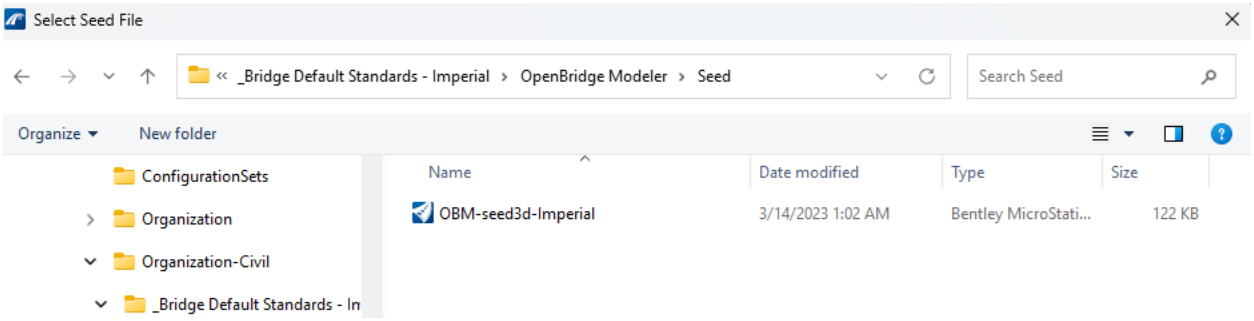


Fig. B.2-2 Bridge Seed File in OBD 10.12

These seed files are located at *C:\ProgramData\Bentley\OpenRoads Designer CE 10.xx\Configuration\Organization-Civil\CDOT_Bridge Standards\OpenBridge Modeler.*

There is also a seed file for the Sheet or Border called *Bridge-2D-Seed_CDOT_Sheet.dgn* located at *C:\ProgramData\Bentley\OpenRoads Designer CE 10.xx\Configuration\Organization-Civil\CDOT_Bridge Standards\OpenBridge Modeler\Seed\Sheets*.

The Bridge 2D seed file contains one 2D model named CDOT Default where the detailer will create all line work for details at full scale (1:1). This model cannot be deleted. It is preferred to use this seed file when 3D information is not available or not needed. In order to avoid display depth, global origin and other 3D issues, it is

recommended that the 2D seed file be used for all drawings that do not require 3D presentation.

The Bridge 3D seed file contains one 3D model named CDOT Default where the detailer will create all line work for details at full scale (1:1). This model cannot be deleted.

It is also recommended that a 2D model be used for the Sheet.

The Sheet model will contain the information from the CDOT Default model referenced at the appropriate scale to be displayed in a readable manner on the plan sheet.

There are 3 model types available in ORD: design models, drawing models, and sheet models (see ORD Help for definition). By default, in the bridge seed files the CDOT Default model is a design model. The Sheet model is set up so the detailer can switch to sheet type if so preferred. One of the benefits of sheet models is they can be selected specifically by the Print Organizer utility.

You can open the Model Properties dialog box by selecting Models icon in the Primary tab of the Home ribbon in the Bridge workflow.(see Fig. B.2-1)

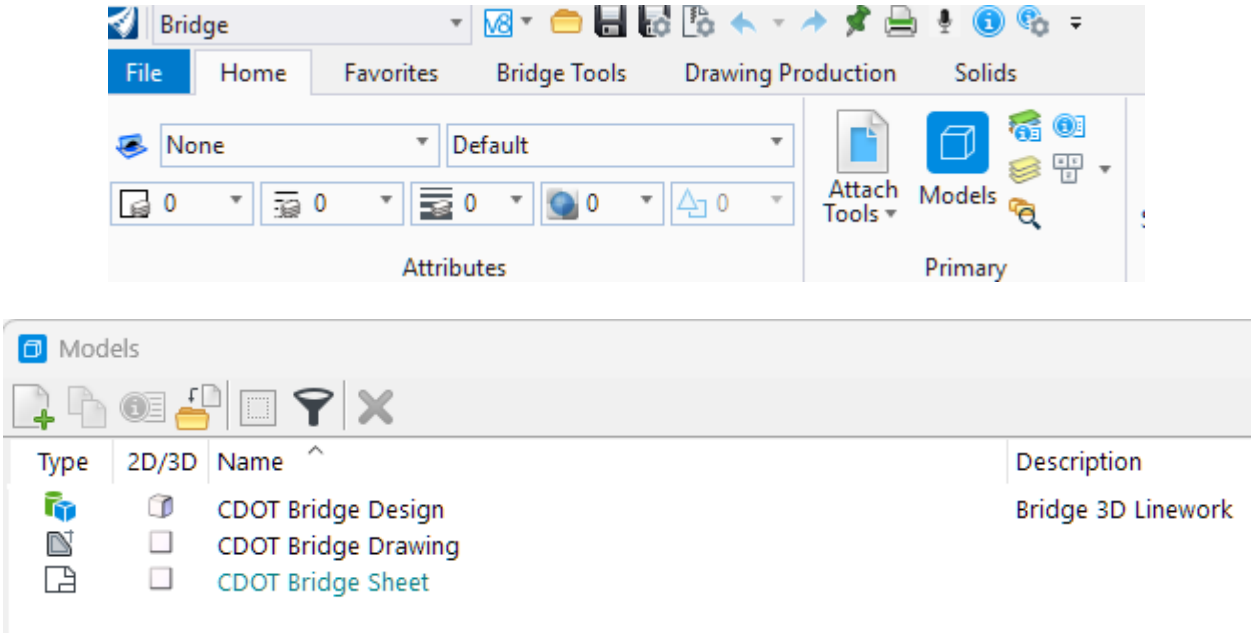


Fig. B.2-1 Models Icon and Models in the Bridge Model Seed File

B.3 Borders

There are two cells for bridge borders: Plan & Plan-Profile. Most of the time we'll just use the Plan border. Sheet borders can be automatically generated by using some of the drawing generation tools

The CDOT border is typically plotted on 11" x 17" paper at scale 1"=1" and it is a cell named Bridge - Plan located in Sheets – Bridge.cel library file.

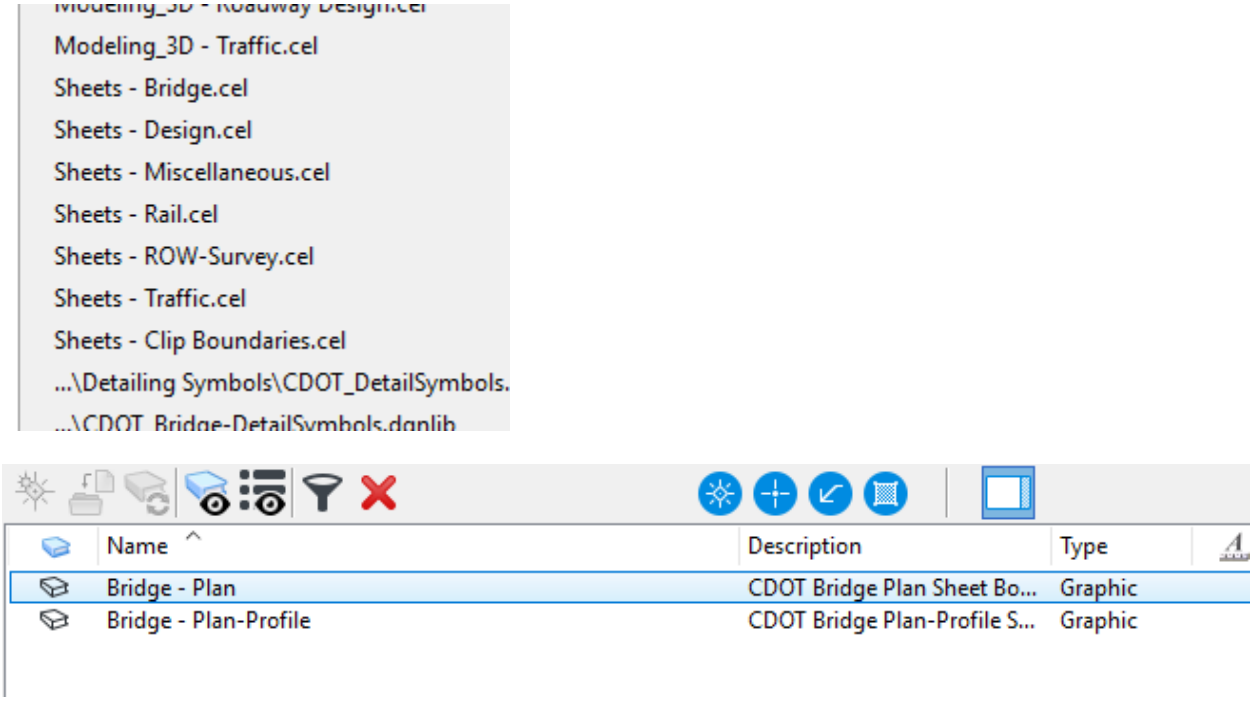


Fig. B.3-1 Border Selection

The middle part of the border requires the insertion of a cell for the Resident Engineer/Bridge Unit information but this may be automatically generated using workset printing options in the future.

B.4 Reference Files

A Reference is a model that is attached to and displayed with the active model for printing or construction purposes. You can reference/attach a model from a different dgn file or a model from the same dgn file (like attaching Linework model into the Border Model of the same dgn file). For that, go to File > References and then select Tools > Attach… and browse for the dgn file that you want to reference.

In order for the objects in a reference to be printed with the appropriate line weights, make sure to check the Line Weights box in the Reference Presentation dialog box

(References > Settings > Presentation). Check the Use View Flags box, click on Line Weights, then de-select the View Flags check box and select OK.

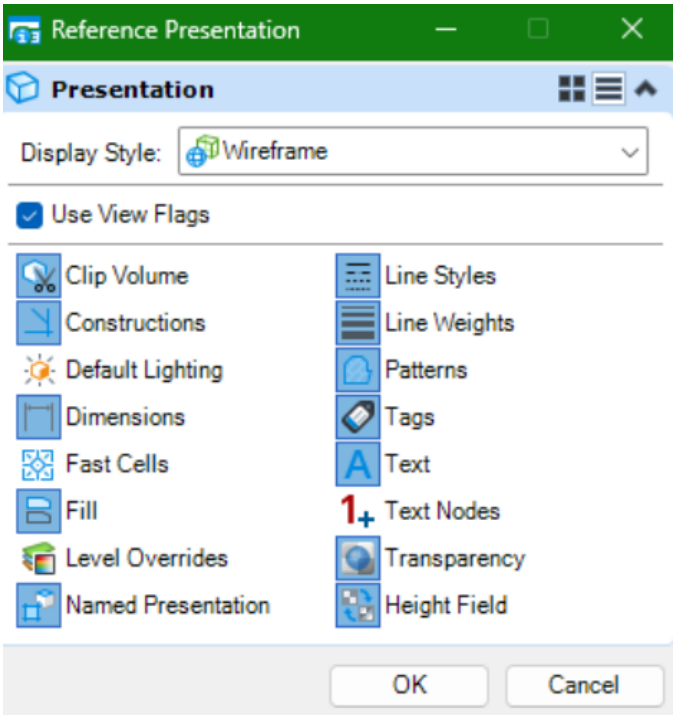


Fig. B.4-1 Reference Presentation Dialog Box

Container files can be created on projects where all needed references are added to one empty dgn so you can reference one file which references the multiple specialty groups instead of referencing multiple files. This is done through nesting. Nesting should be kept to a minimum since multiple levels of nesting can reference the same file twice.

B.5 Levels

Levels in MicroStation are defined in the CDOT configuration by Color, Style, and Weight. Currently, there are 13 general bridge levels (see table below) and over 150 specific bridge levels defined in the CDOT configuration.

The specific bridge levels mimic the general bridge levels, that is, most “Outline” levels print the same as the general Outline level, having the same line style and line weight, but a different color. The purpose of the additional levels is to help in turning the levels off/on in different views and provide additional information for the detailer when developing linework. Additional levels are available in Open Bridge Modeler to support three dimensional modeling.

The following table indicates the MicroStation general levels to be used to comply with the requirements described in Chapter 2 of the Bridge Detail Manual:

Level Name	Color	Line Style	Line Weight	How it prints in ORD/OBM
BRDG_BREAK	7	0	0	
BRDG_CENTER	7	4	0	
BRDG_CONSTRUCT	4	0	1	
BRDG_CONTROL	3	0	3	
BRDG_DASHED	2	3	1	
BRDG_DIMENSION	2	0	1	
BRDG_FROZEN	2	0	0	
BRDG_HIDDEN	5	5	1	
BRDG_OUTLINE	3	0	2	
BRDG_PATTERN	6	0	1	
BRDG_REBAR	1	0*	3	*
BRDG_TEXT	4	0	1	
BRDG_TITLE	1	0	3	

* BRDG_Rebar linestyle can be applied to elements on level as desired. Dash length is dependent on linestyle scale.

The addition or modification of bridge levels requires concurrence within the Bridge Users Group (BUG) committee at CDOT. The detailer is advised to use the levels defined in the configuration but can manipulate element symbology to achieve the desired drafting requirement, e.g. changing to the Rebar linestyle.

There are various ways to view and select an active level, as follows:

- Select the level from the Attributes tool box, as shown in Fig. B.5-1.

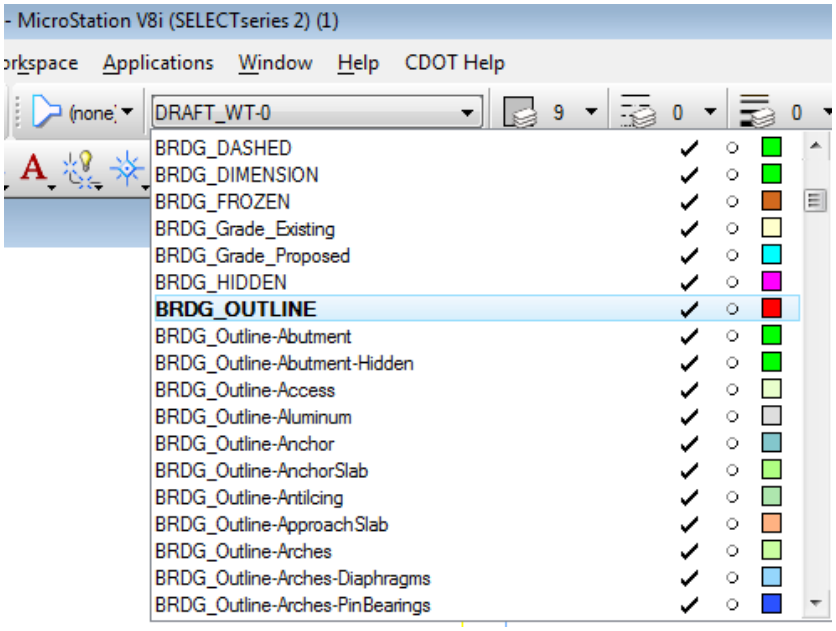


Fig. B.5-1 Active Level Selection

- Double click on a level in the level display window. (Fig. B.5-3)

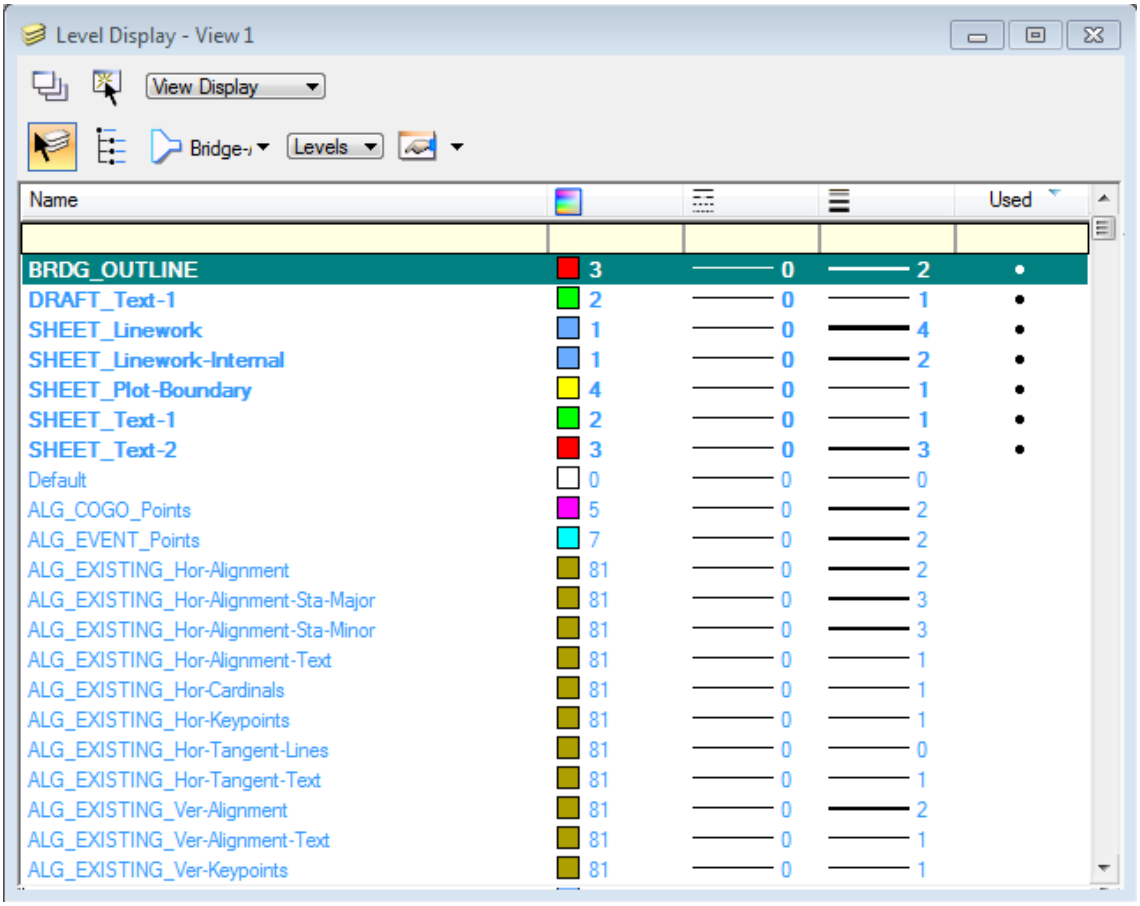


Fig. B.5-3 - Bridge Level Selection from the Level Display

Level filters are a useful way to group associated levels for the purposes of viewing or removing unneeded levels from view. Filters can be used in both the Attributes tool box and the Level Display window. There are several predefined filters available that cannot be modified by the user. (see Fig. B.5-4)

“On the fly” filters can be created in the Level Display window. To do that, first click on the Level Display icon on the Primary Tools tool box, then click the List Filter icon and select Untitled, then enter the desired filter criteria in the appropriate categories (Name, Color, Line Style etc.) in the top row. The example in Fig. B.5-5 shows a filter created “on the fly” with “brdg” in the name, a line style value of “0” and a line weight value of “3”. This filter can be toggled on/off by clicking the List Filter icon and selecting None. The filter remains until you exit MicroStation.

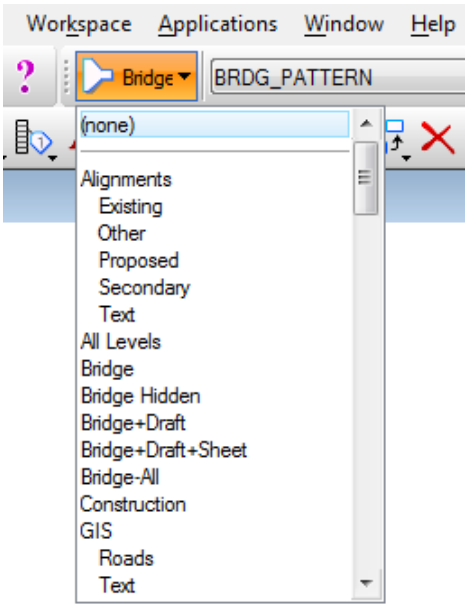


Fig. B.5-4 – Some of the CDOT Predefined filters

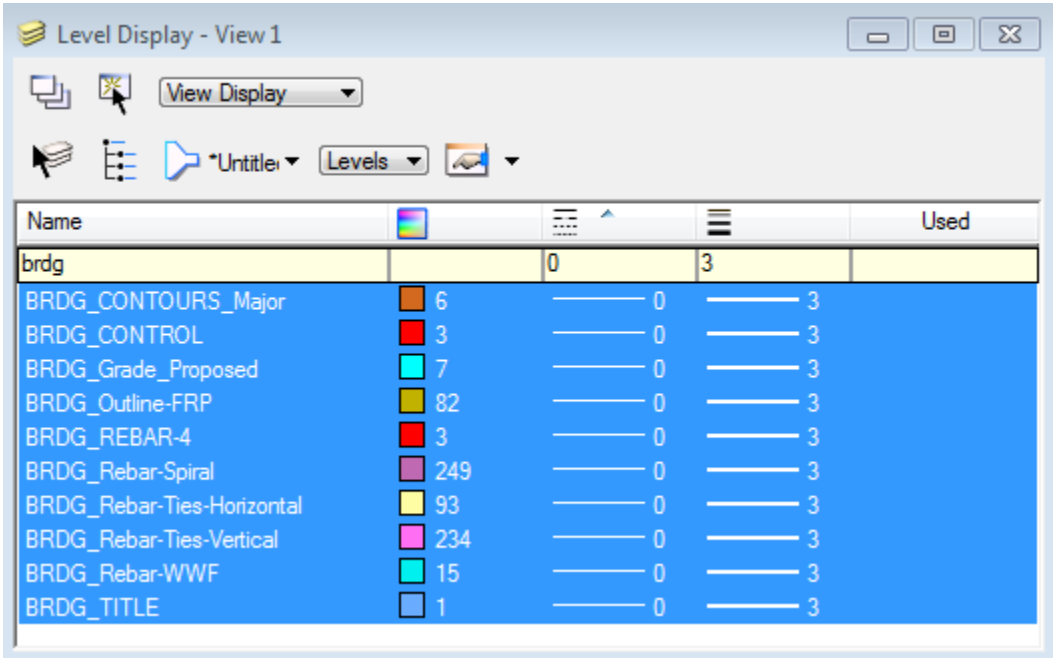


Fig. B.5-5 – Example of filters “on the fly”

All the configuration levels have an assigned color associated with the level. Although the color number of the level can't be changed, its appearance to individual user can. The user can personalize the color table without affecting the plot styles: Settings > Color Table…> Select the color you want to change, click on Change, pick the color you want to replace with and click OK, then select Attach.

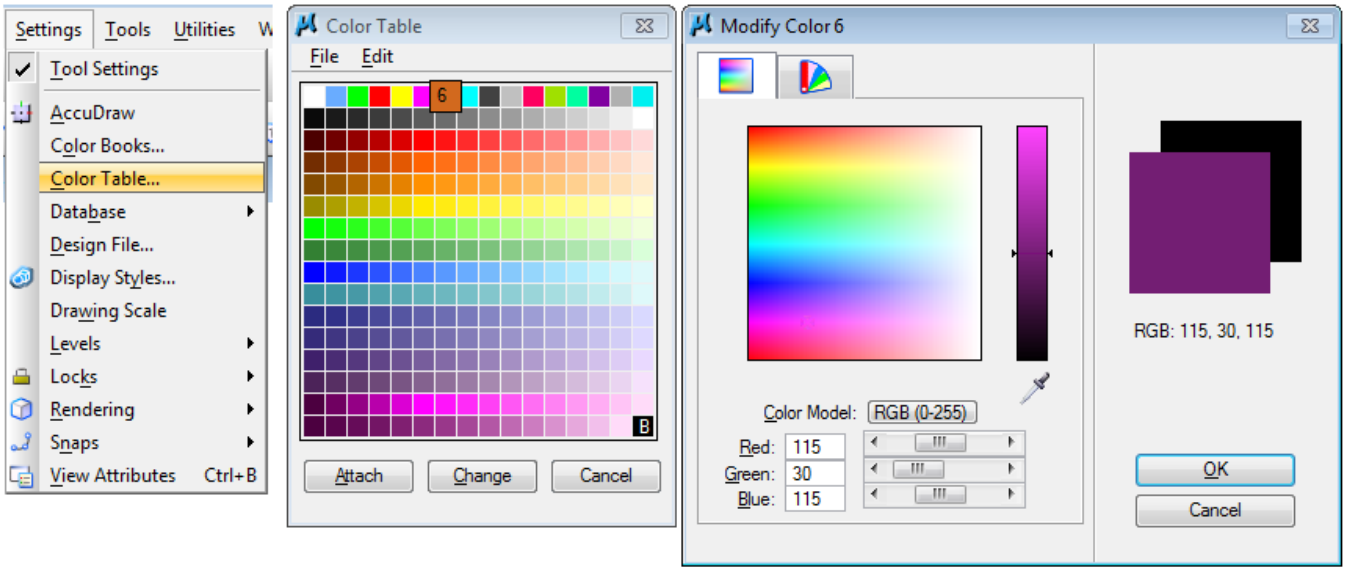


Fig. B.5-6 - Personalizing the Color Table

Many levels have been provided for the depiction of reinforcing, several of which are shown in Fig. B.5-7. Except for BRDG_Rebar-1 through BRDG_Rebar-4, most of the reinforcing levels are configured to show as a heavy weight continuous line as described in Chapter 2. The BRDG_Rebar linestyle can be assigned to elements on these levels to mimic the historical depiction of reinforcing. BRDG_Rebar-1 through BRDG_Rebar-4 levels have been provided for additional detailing opportunities when double line depiction is required or alternate weights are needed to adequately detail the reinforcing.

BRDG_REBAR
BRDG_Rebar-1
BRDG_Rebar-2
BRDG_Rebar-3
BRDG_Rebar-4

Fig. B.5-7 – Generic Reinforcing Levels

B.6 Cell Libraries

Cell libraries are ordinary MicroStation design files that have a .cel extension, with multiple models, one for each cell.

Staff Bridge has created cell libraries containing useful details for use in detailing CDOT bridge projects. Those library files are named Bridge.cel, Bridge Repair.cel, Bridge Reinforcing.cel and Bridge Piping.cel. There are also local developmental cell libraries for testing new cells prior to incorporating them into the configuration.

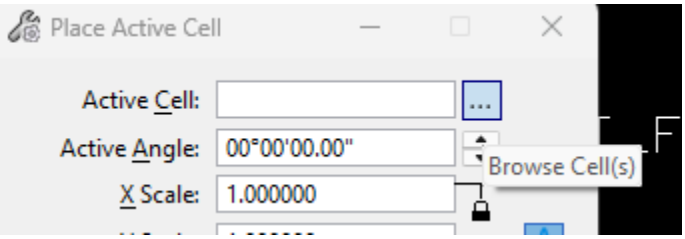
To view all cells contained in a library, open the Cell Library dialog box by selecting Element > Cells and then File > Attach File.

MicroStation provides other methods of accessing the cell libraries, including customized toolboxes, cell selector tools, etc.

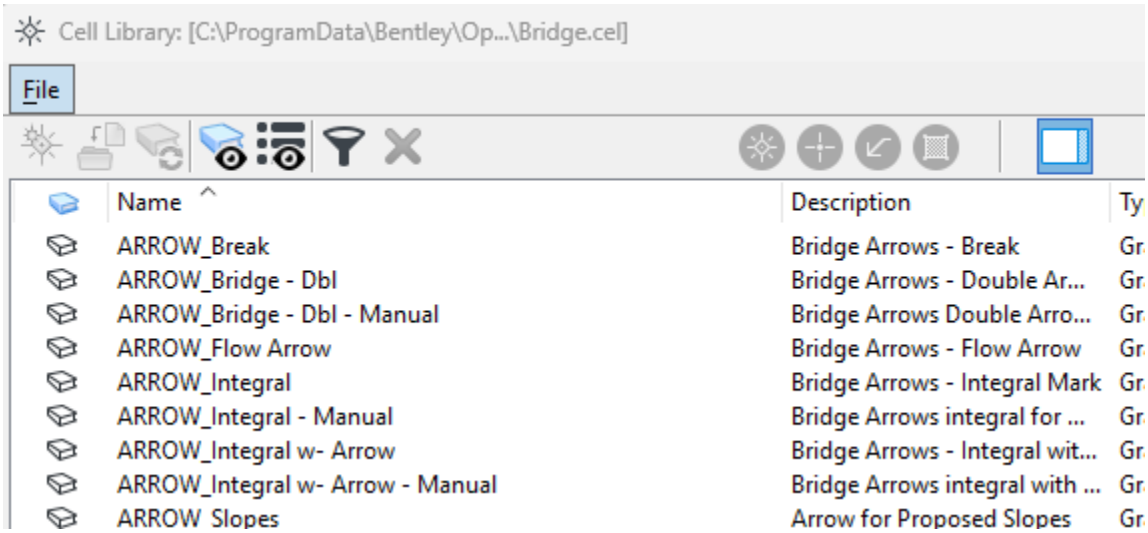
The detailer may choose to create his or her own cells and cell libraries. It is important to place the cell origin in a useful location and to place each element of the cell in the appropriate level. The cell can then be saved in one of the existing developmental libraries (located on \\ \\public\Bridge Common\002 Bridge Program Support\006 Subject Matter Expert SME\SME Software\Bentley\MicroStation Basic and SS4\CELLS) so everyone has access to it. The Staff Bridge development library is DesignCells.cel (\\public\Bridge Common\002 Bridge Program Support\006 Subject Matter Expert SME\SME Software\Bentley\MicroStation Basic and SS4\CELLS\DesignCells.cel). New cells are kept here until they are incorporated into the configuration and then deleted.

The steps to attach this cell library (or any cell library) are:

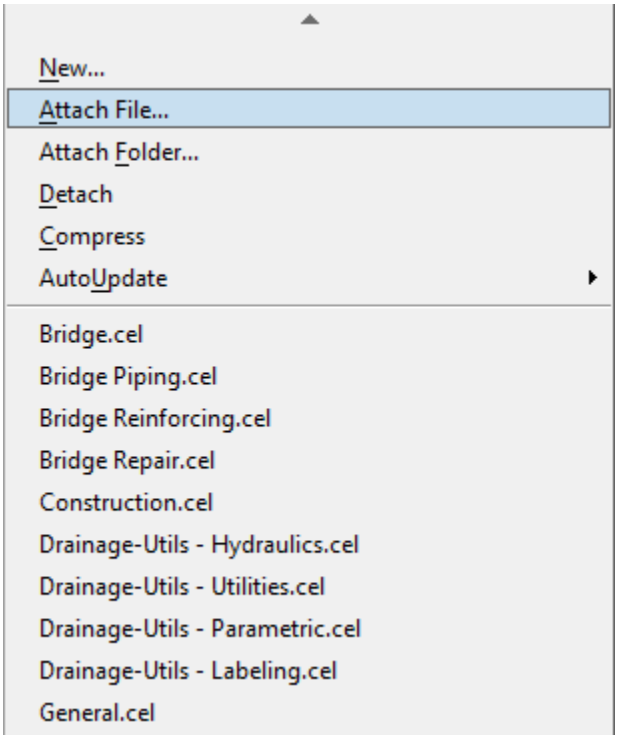
From the place active cell window you can pick on the three dots to browse the cell selection possibilities



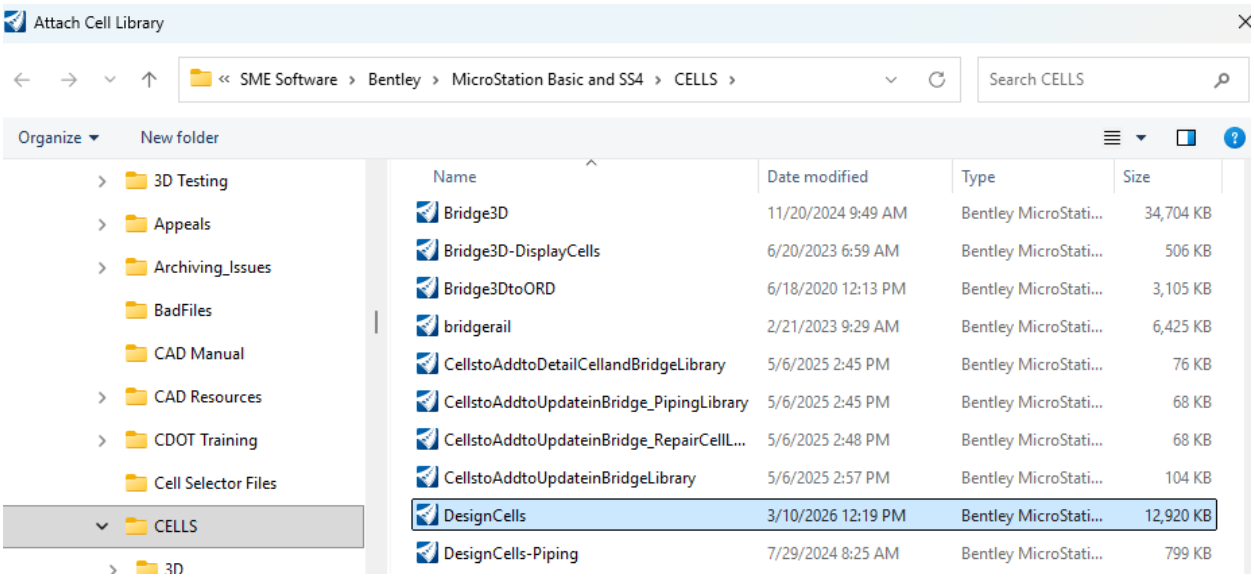
From this Cell library window you can select “File” in the upper left



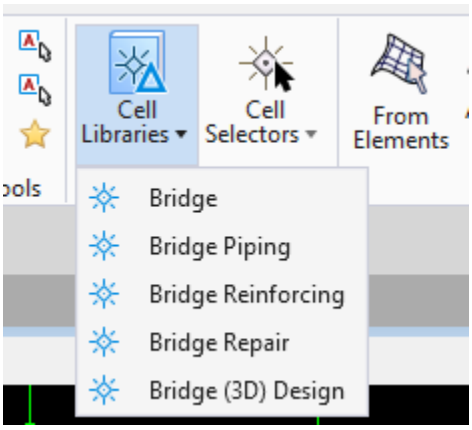
This will bring up a list of attached cell libraries from the configuration which can be selected or you can select “Attach File” to attach a cell library manually.



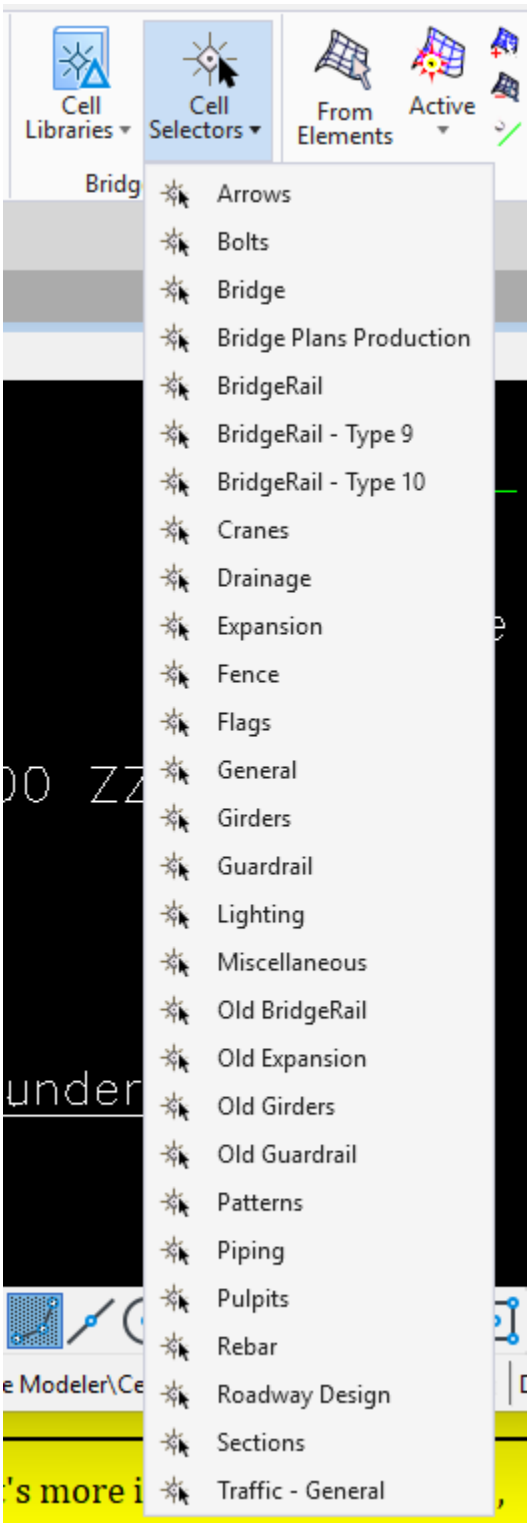
You can then path to the location of the DesignCells library or any other cell library available.



The bridge cell libraries can be attached through the ribbon as well.



Cells can be selected using the Cell Selectors in the ribbon as an alternative as mentioned above.



For more information on how to create a cell library and cells, see the MicroStation Help.

B.7 Annotation / Text Styles

The following table describes the text styles used on bridge drawings:

Text Style	Use
07_ENG-100	General notes and detailing text
07_ENG-80	Reduced width font for use in conserving space on plan sheet
10_ENG-100	Title Text
05_ENG-100	Rebar dimensioning normal
05_ENG-80	Rebar dimensioning – conserving space

Unfortunately, outdated text styles that should no longer be used can still be found in archived drawings and they should be replaced with the new styles from the table. For that, the methodology is: *Element* > *Text Styles* > Select style to change and right click > *Remap Elements…*> Pick the new style in the Destination box, then click *OK*. Once replaced, the old text styles can and should be purged (deleted). A note of caution: remapping might cause unwanted changes in the text appearance that need to be addressed.

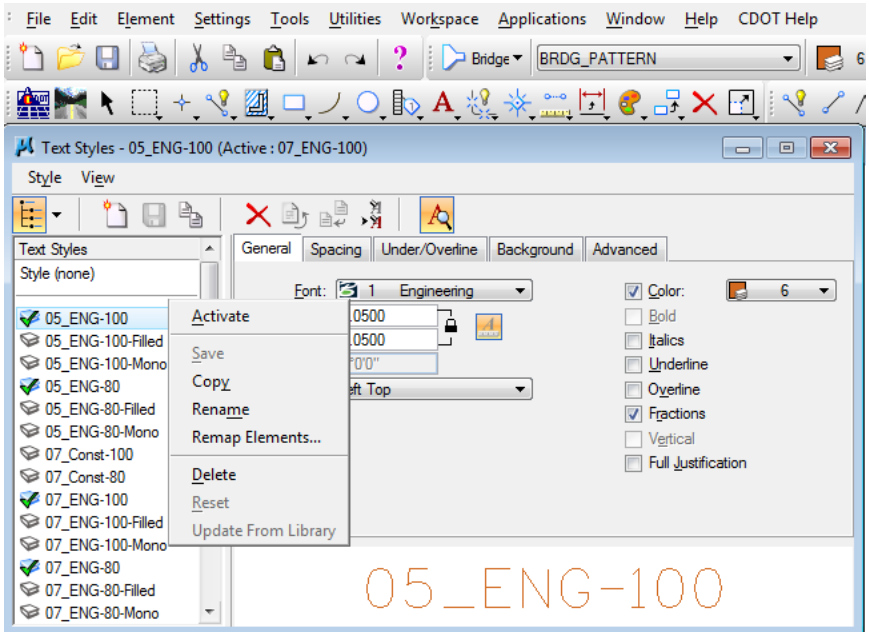


Fig. B.7-1 - Replacing old text styles

Text notes are controlled by the dimension styles and they should be put in the level Text.

B.8 Dimension Styles

The MicroStation Dimension Style for most details should be CDOT 3. This style is a normal architectural style (feet and inches).

Dimension style CDOT 5 should be used for the footing & piling layout plan. It shows dimensions in decimal feet, which is more appropriate for the surveying required to locate the piles and footings.

The dimension style dialog box can be accessed from Element – Dimension Styles.

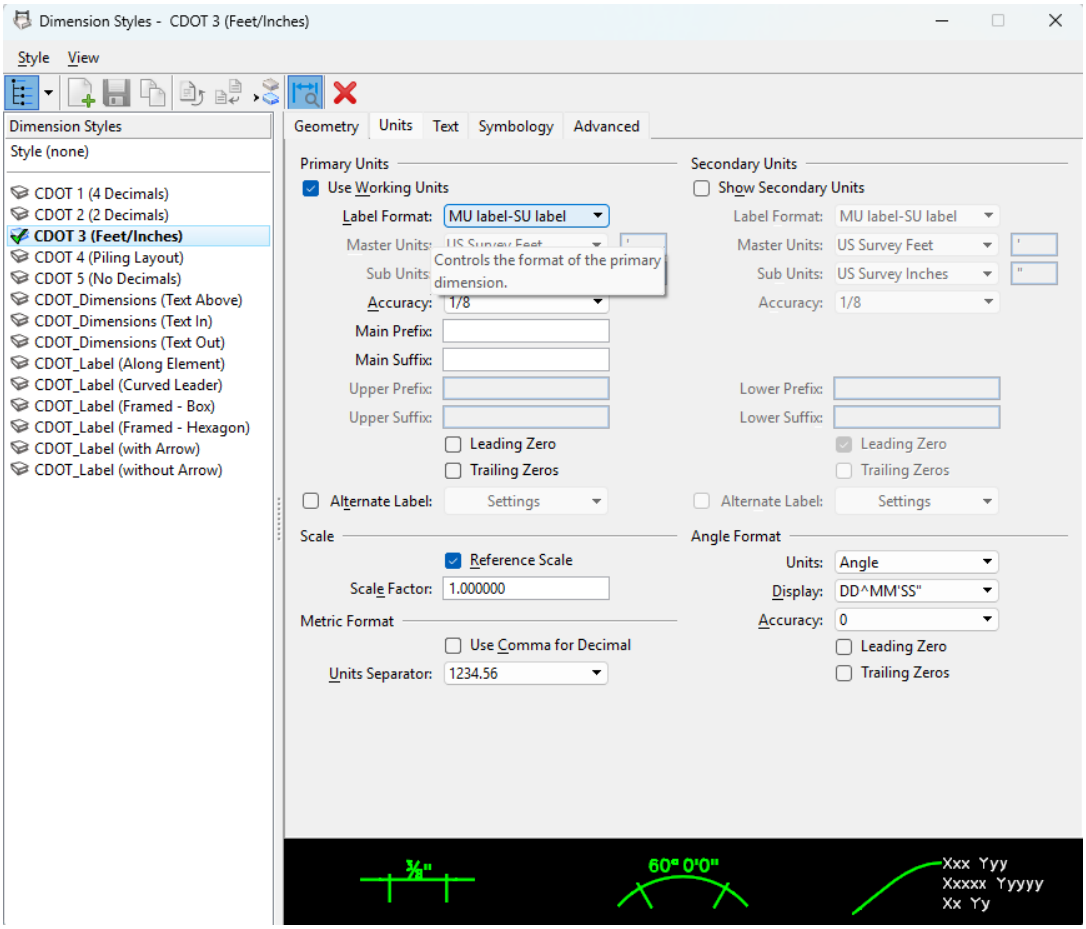


Fig. B.8-1 Dimension Style Dialog Box - Units

The orientation of the dimension text can be modified from Dimension Styles settings – Text – Orientation – Horizontal/Aligned.

Changes can be made to the dimension style as the need arises during detailing, i.e., when using angular dimensioning, angle format can be changed from units “Angle” to units “Length” to show arc size length in feet and inches instead of the angle value in degrees/ minutes/ seconds.

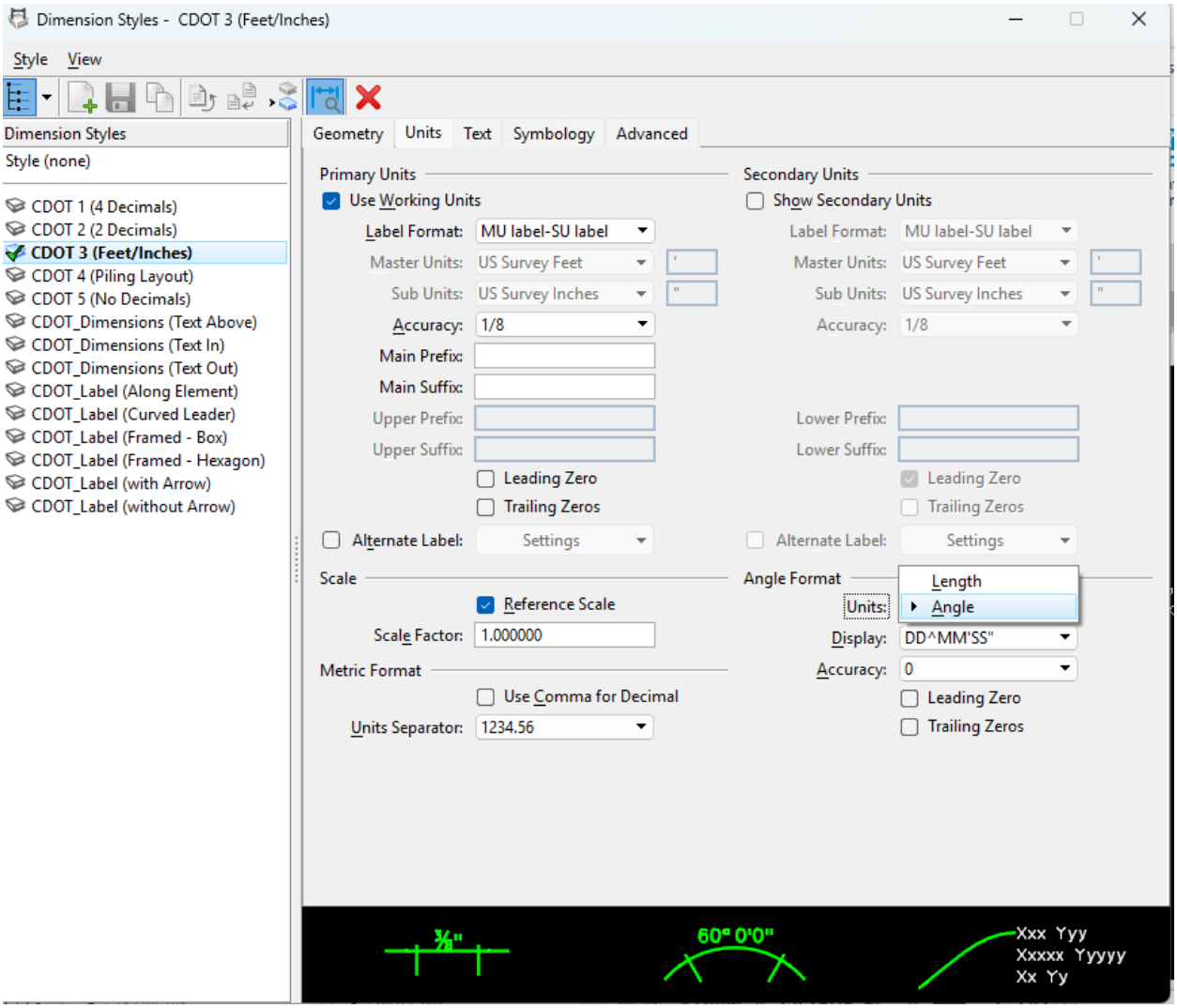
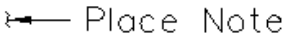


Fig. B.8-2 Dimension Style Dialog Box – Changing Angle Format

Text notes are drawn by default with just an arrow. You can change the terminator by selecting a cell or symbol (Element > Dimension Styles > Geometry > Terminators > Symbols > Note: select Cell or Symbol). The symbols are not set up currently. The default cell is set up to be the integral arrow cell that looks like this (see Fig. B.8-3).



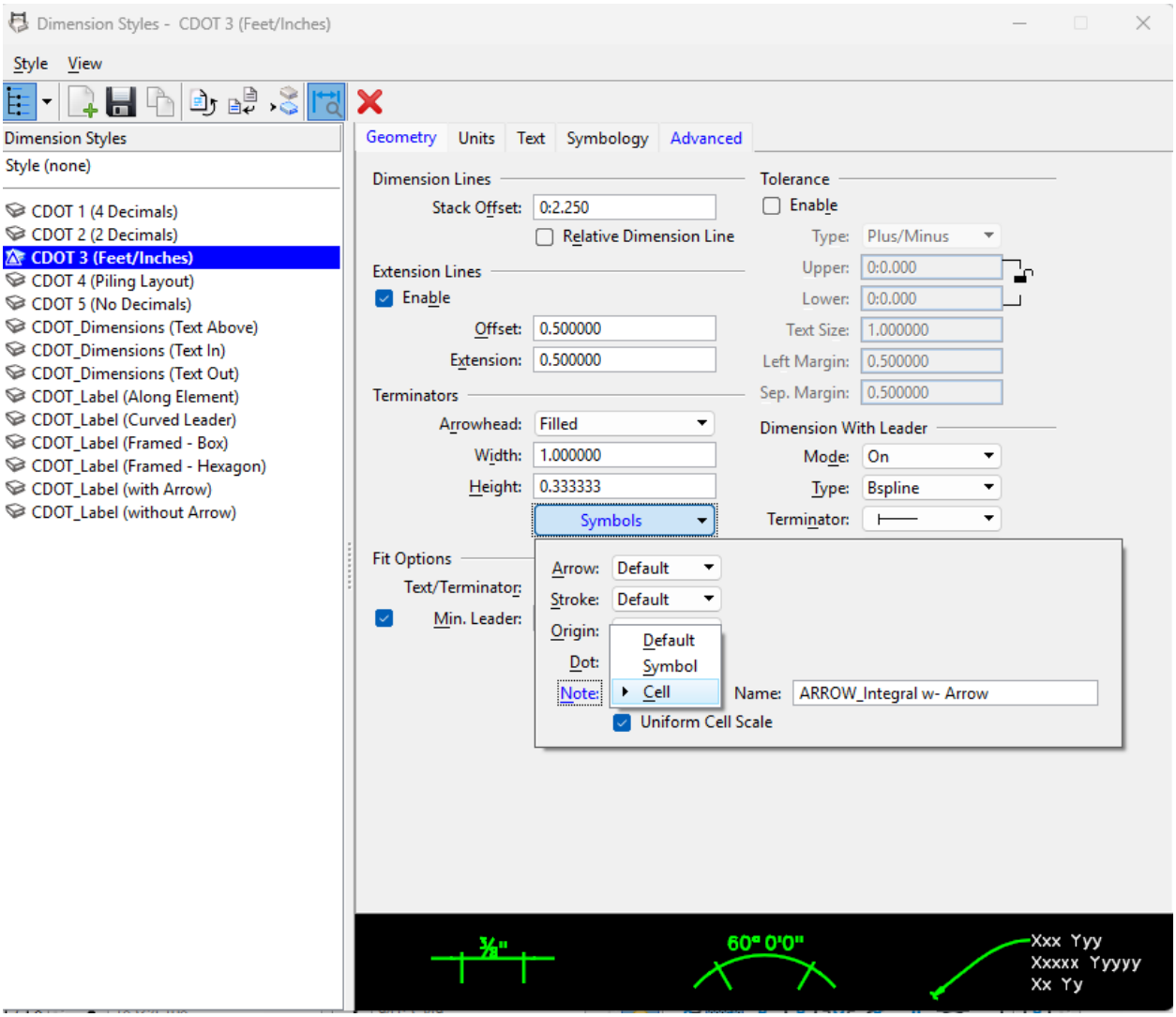
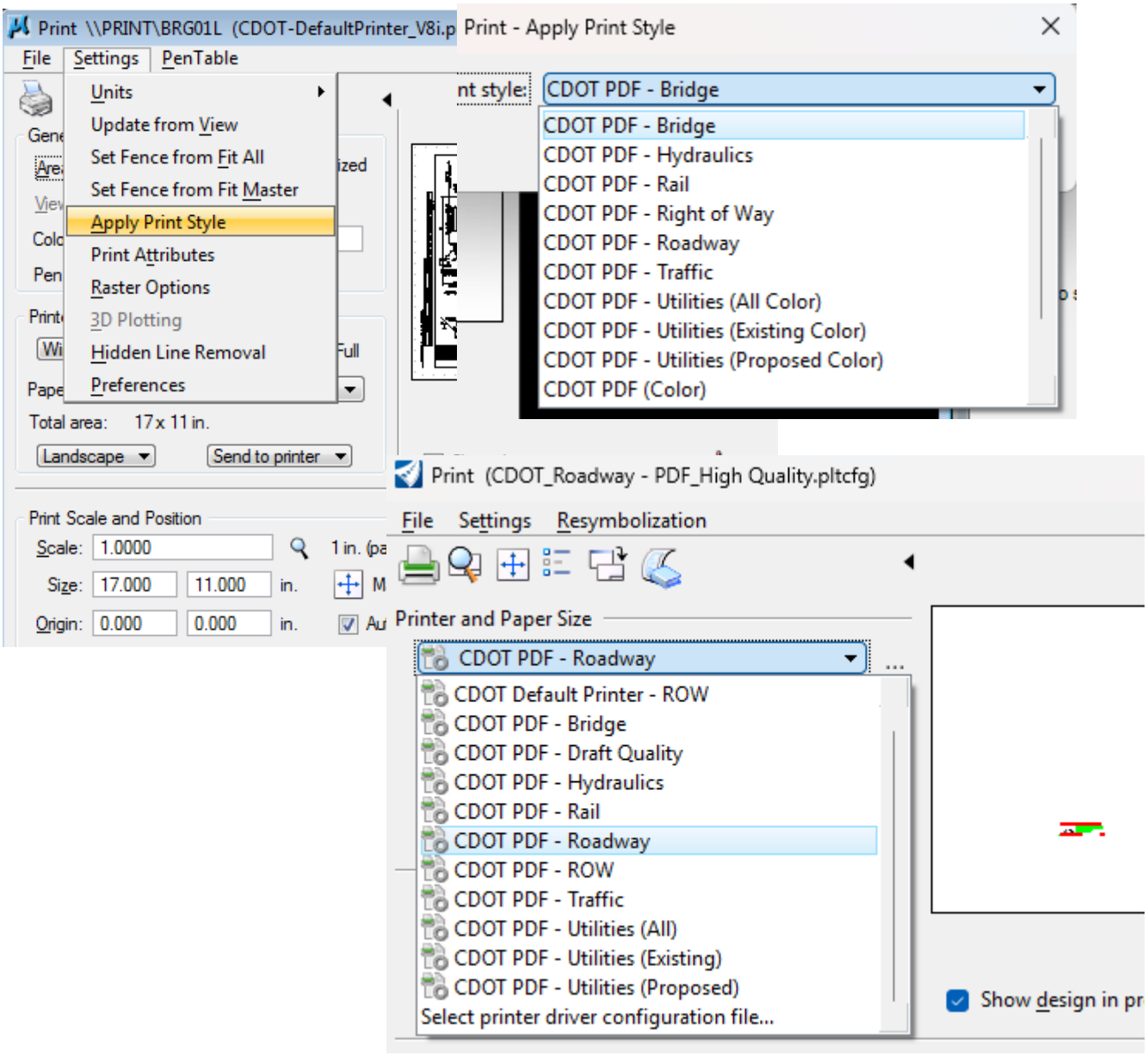


Fig. B.8-3 Selecting Integral Arrow style for Note leaders

B.9 Printing

Before printing the drawing it is important to apply the print style, whether it is a hard print or a pdf print. In order to do that, from the Print menu > Settings > Apply Print Style select the printer/plotter desired. It can also be selected using the printer selections. By default, the CDOT Default Printer - ROW is the one that is used for printing to a physical printer. In the 10.10 & 12 configuration, you usually have to open a file twice in succession in order for the linestyles to appear correctly when printing.



Currently, there are several CDOT printer drivers available. The printer drivers control plotting devices, plot sizes, pen tables etc. The standard plot size for all bridge drawings is 11x17. The default pen tables assigned to the different pdf options print all bridge levels in black/white. If a color print is desired, the detailer will go to Print > PenTable > Attach and select one of the color pen tables available. (see Fig. B.9-2) The available pen tables are dependent on the version used.

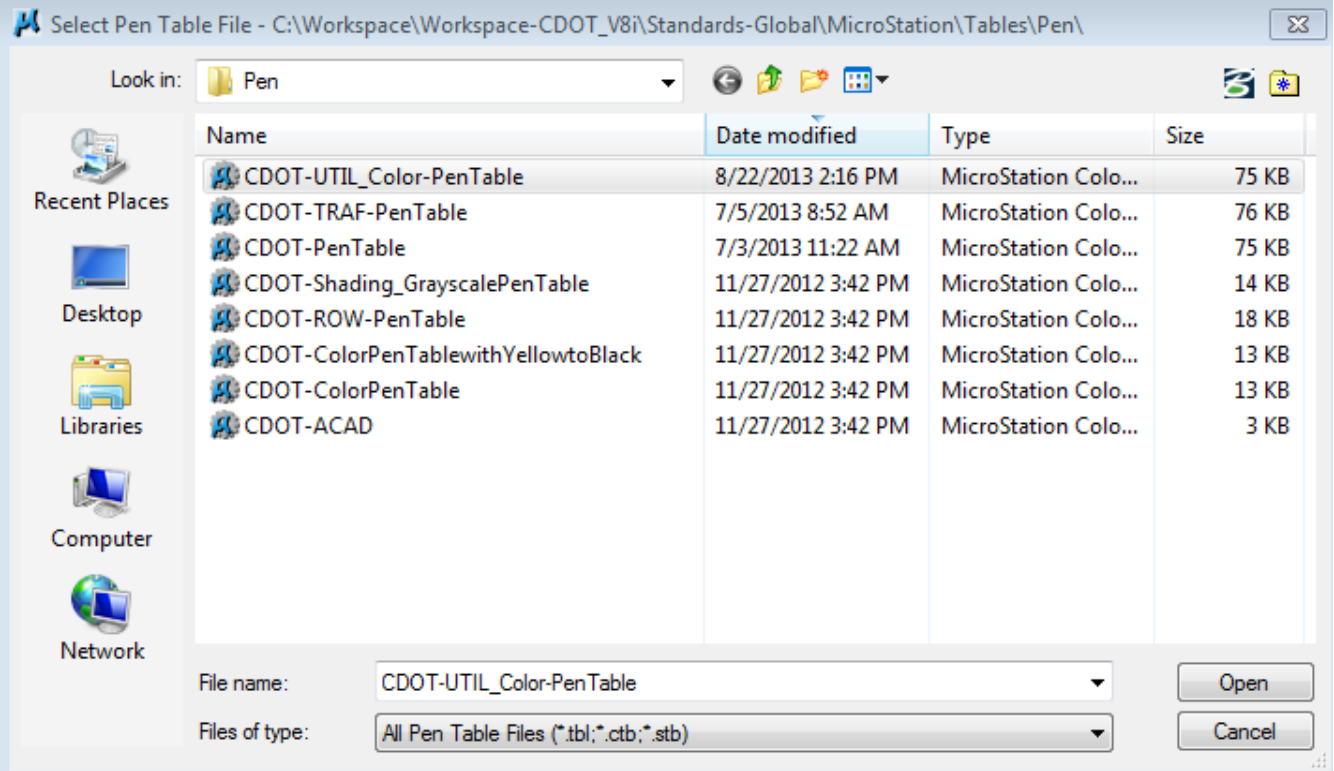
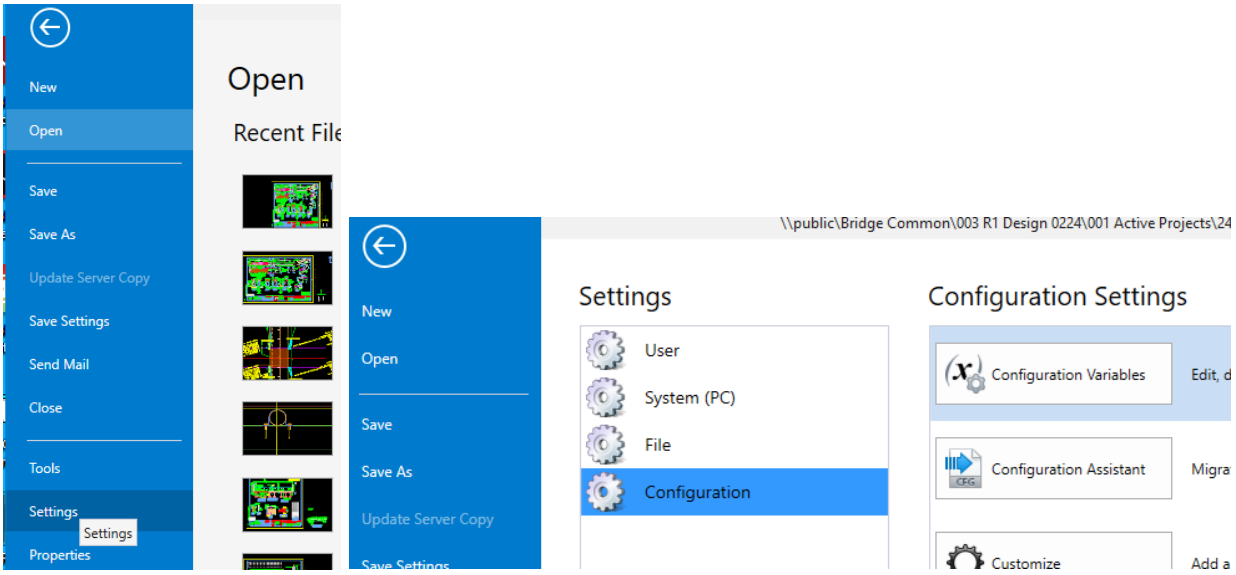
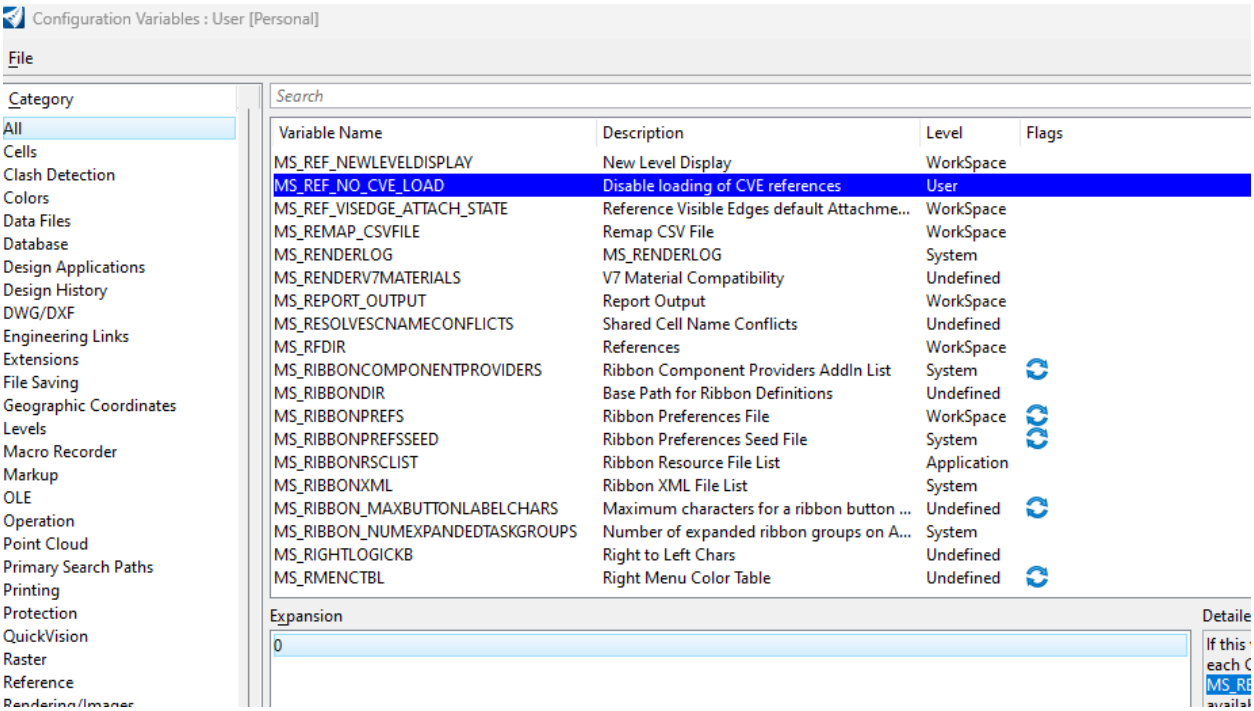


Fig. B.9-2 Pen Table Selection

Printing 3D Isometrics

When isometrics are printing in color and the cache is lost or red, a configuration variable may need to be changed (at least temporarily). The variable is MS_REF_NO_CVE_LOAD. By default it is set to 1. Setting it to 0 and closing and reopening file should fix the issue. This variable may affect how other 3D operations work so should be reset to 0 after printing is accomplished. This variable may be found in the settings and configuration variables. This may change in the 2024 configuration.





B.10 Minimum Electronic Standards for ORD/OBM Drawings

See Chapter 3.10 and 3.11 for best practices.

B.11 ORD Things that are Good to Know

1) A practice that seems to work well for copying from one file to another: Reference in the item to be copied, select and copy the element of interest. You can detach the reference when you're finished with it. **WARNING!!!** Do not copy intelligent elements from ORD files to OBD/OBM files or vice versa. This may cause corruption of the files.

2) The drawing border should be placed at 0,0,0. A trick for finding this location is to take the following steps:

    - select the "Place SmartLine" tool,
    - data on the beginning point,
    - type p,
    - type "0,0,0" (zero, zero, zero, including commas), click enter,
    - data end point.

    You will have created an arrow (of sorts) that points to the 0,0,0 coordinate. Consistently placing line work at this location will help preclude the loss of drawings in the vast expanses of MicroStation.

3) When adding dimensions it is helpful to open the Dimension Styles window (Element\Dimension Styles) so that you can make changes on the fly in placement and symbols.

4) Draw line work in "default" model and change the model name to "linework". The default model is the Master model, that can't be deleted by mistake. If the Bridge seed file is used, the linework model is already set up as the default.

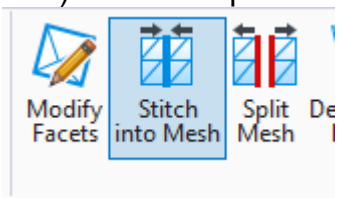
5) If menus/windows disappear off your screen or are halfway off, making them unusable, change your screen resolution to a different setting, reposition the menu/window and then go back to default screen resolution. To get to the screen resolution, right-click the mouse in your desktop screen.

6) When the Sheet Border is created using 1" = 1", and the Annotation Scale is locked ON and is 1"=1", life is good and text is always the right size for the drawing.

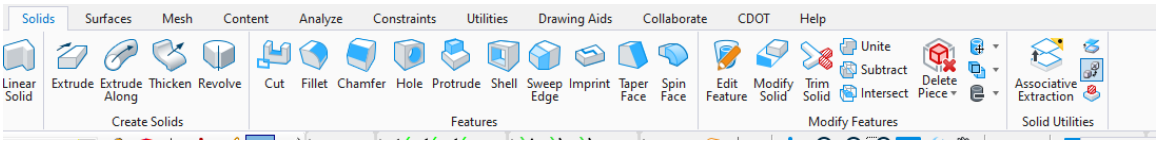
    ORD COMPATIBILITY BETWEEN VERSIONS – LINE STYLE UPDATE

B.12 3D Stuff

1) To create a solid from shapes
   a) Stitch shapes into a mesh in modeling/mesh tab



   b) Convert to smart solid in solid utilities

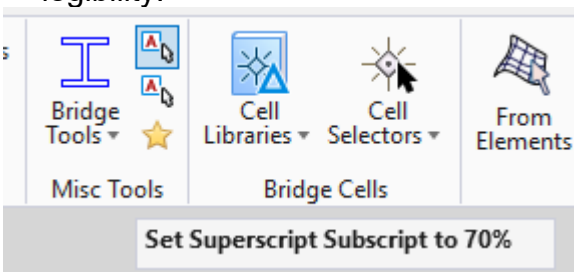


2) If solids don't merge with the merge command, you may need to convert them to smart solids. Common extrusion commands sometimes create parametric solids which are more difficult to deal with.

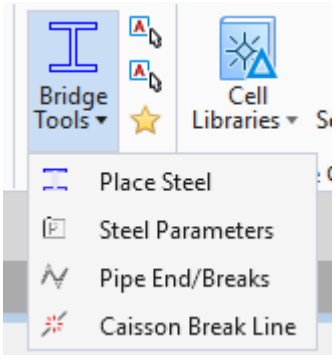
3) For printing issues of 3D isometrics see Section B.9

B.13 Handy Tools

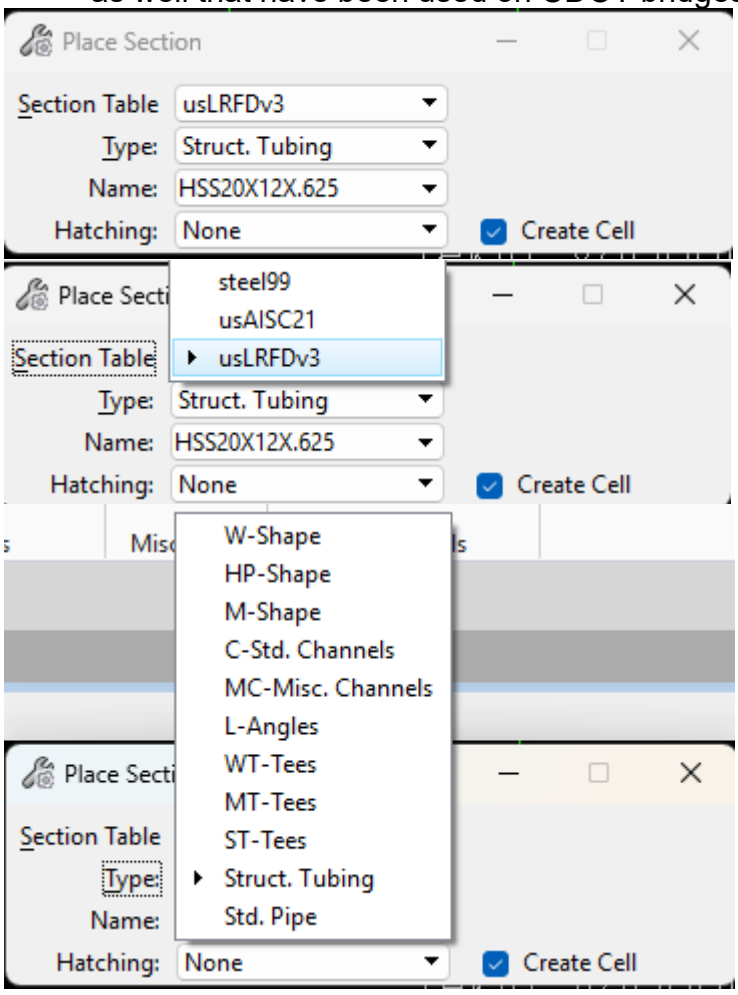
1) A tool exists to set superscript and subscript to 75% of the text height attaining approximately a text height similar to 05_ENG-100 for the superscripts and subscripts when used. The default is 30% which is generally too small for legibility.



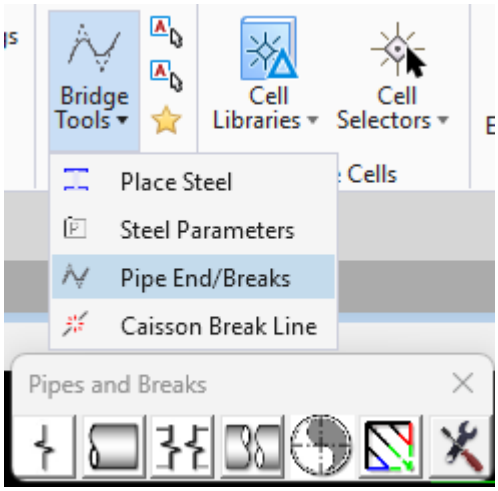
2) Several detailing tools exist which can be accessed from the Bridge Tools drop down. These include:



a) Place Steel – This tool will place a cell or linework for most steel shapes. Several libraries are included in the library. Many old WF sections are included as well that have been used on CDOT bridges.



b) Pipe End/Breaks – This tool allows breaking linework to show different types of end breaks and mid-breaks for for several shapes.



c) Caisson Break Line – Adds curved end breaks for round sections

3) Other tools (TBD)