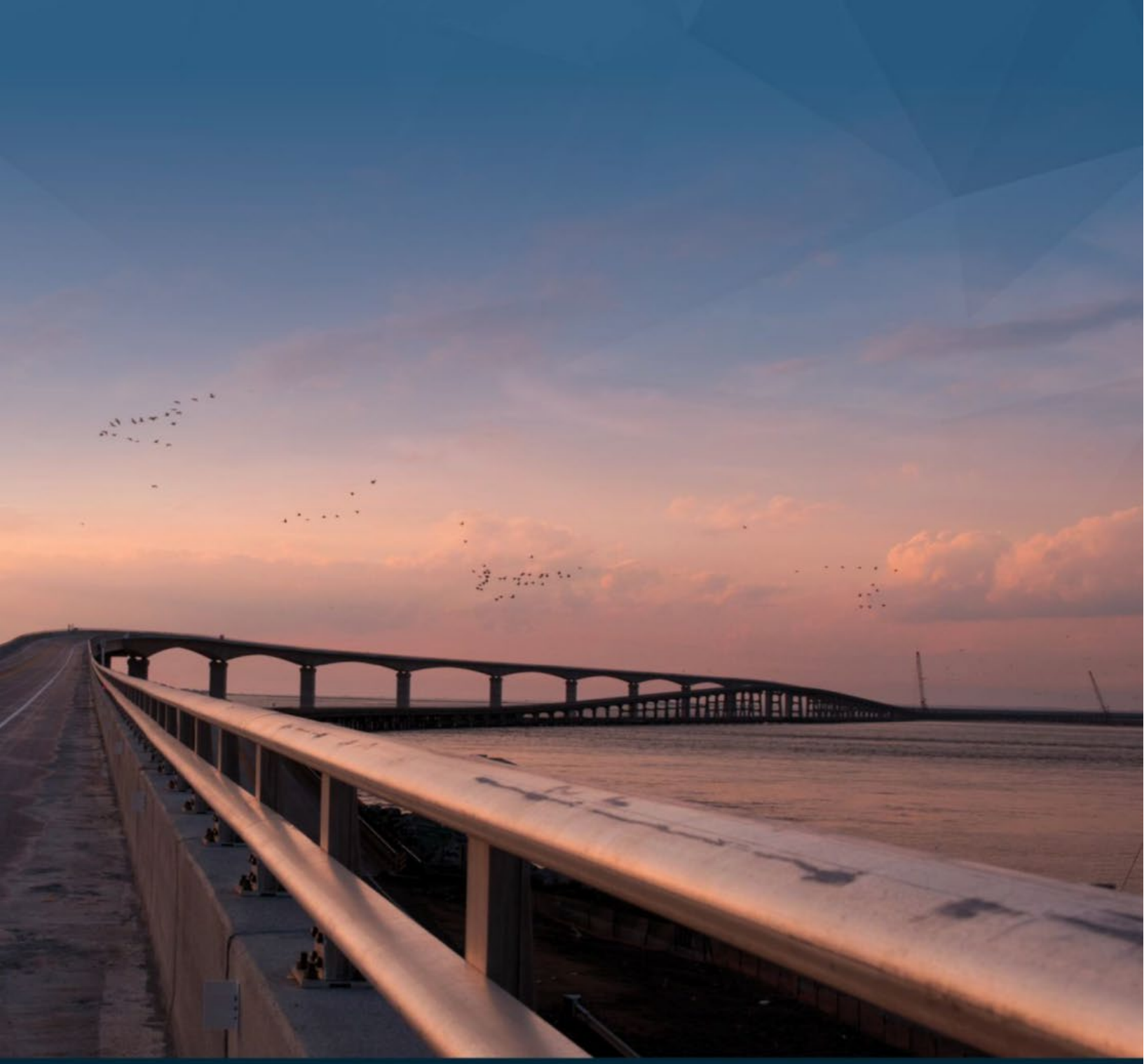

2024

Structures Management Unit
OpenBridge Designer Manual

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CHAPTER 1
GENERAL

1.1 NCDOT STRUCTURES MANAGEMENT OPENBRIDGE MANUAL

This manual is intended to be a guidance manual, providing Engineers and Technicians guidance in current Structures Management Unit (SMU) practice using OpenBridge software. To preserve the autonomy of Engineers and Technicians and encourage the application of new ideas and advancements in the technology, this manual does not attempt to address all possible scenarios that may arise in the use of OpenBridge software in the design and of modeling highway structures. It is assumed that many of these guidelines contained within will necessarily continue to evolve as the software continues to evolve.

The users of this manual are encouraged to present ideas that may vary from those contained herein. These suggestions will be considered and implemented as deemed appropriate.

This manual does not attempt to reproduce information that is adequately addressed in the Bentley training documents and/or their other publications.

1.2 NCDOT MIGRATION PLAN

In July of 2021, North Carolina Department of Transportation (NCDOT) started the process of migrating its computer-aided design and drafting (CADD) software from Bentley MicroStation V8i and Geopak to Bentley OpenX. OpenX is a comprehensive multi-discipline three-dimensional (3D) modeling application that can be used in the delivery of projects from concept through construction.

To transition to ORD, NCDOT has developed a Migration Plan with milestone activities and associated targets for each Unit within NCDOT to utilize OpenX in the production of designs and plans for new projects. In July of 2021, SMU converted projects that were less than 75% complete in v8 to OpenX. In January of 2022, SMU transitioned all projects to OpenBridge.

1.3 STRUCTURES MANAGEMENT UNIT MIGRATION PLAN

Under NCDOT's Migration Plan, each Unit has unique activities and associated targets as part of their migration plan. SMU has a three-phase migration plan for transitioning to the use of Bentley OpenBridge Designer (OBD), the transportation structural component of ORD.

SMU's three-phase migration plan is as follows:

- **Phase 1** – Transition Staff and Consultants to the use of OBD for 2D plan production.
- **Phase 2** – Transition Staff and Consultants to producing 3D models to be used in reference with other Unit's models and to create 2D plans.
- **Phase 3** – Transition Staff and Consultants to producing 3D models for complete digital delivery.

1.4 ACRONYMS AND ABBREVIATIONS

2D	Two dimensional
3D	Three dimensional
4D	Four dimensional
ALG	NCDOT Roadway Alignment File
BrIM	Bridge Information Modeling
CADD	Computer-aided design and drafting
ETM	Electronic terrain model
LOD	Level of Detail
NCDOT	North Carolina Department of Transporation
ORD	OpenRoads Designer
OBD	OpenBridge Designer
OBM	OpenBridge Modeler
PGD	Preliminary General Drawing
PW	ProjectWise
SMU	Structures Management Unit

1.5 DEFINITIONS

Two-Dimensional (2D) Drawing

A geometric representation containing only two axes (typically X and Y) drawn on one plane, or lacking depth.

Three-Dimensional (3D) Model

A geometric representation containing 3 axes (X, Y and Z) containing width, depth and height.

Four-Dimensional (4D) Model

The addition of time to a three-dimensional model, often used for modeling the construction process/workflow.

Bridge Information Modeling (BrIM)

A process supported by various tools, technologies for generation and management of a digital representation of a highway structure from concept, planning, design, and construction to evaluation and maintenance operations.

Digital Twin

A three-dimensional representation created to match the design intent of a proposed structure.

Level of Detail (LOD)

A term first used by the American Institute of Architects (AIA) as part of the BIM process to define the amount of detailing/precision required to match the design intent with respect to Digital Twin creation (3D modeling).

LOD 100 = Concept Design

A concept model with parameters like area, height, volume, location, orientation.

LOD 200 = General Modeling with Schematic Design

A general model with elements modeled as approximate quantities, size, shape, location, and orientation.

LOD 300 = Accurate Modeling and Detailed Design

Accurate modeling and shop drawings where element shells are defined with specific assemblies, quantities, size, shape, location, and orientation.

LOD 350 = Greater Detail and Construction Documentation

Modeling providing more detail to the element shells, such as interface connections and reinforcement.

LOD 400 = Fabrication and Assembly Documentation

Modeling providing element shells with fabrication details in addition to LOD 350, such as reinforcement and prestressing strands.

LOD 500 = As-Built Models

Elements are modeled as constructed for future evaluation and maintenance operations.

1.6 DRAFTING/MODEL REQUIREMENTS

All elements shall be drawn/modeled full scale (1:1) in their geospatially correct location for both 2D and 3D DGNs to ensure plans accurately depict the intended design. Drawing and modeling full scale will avoid design errors and capture potential construction conflicts.

1.6.1 2D Drawings

Each plan sheet in a plan set should be its own DGN file. 2D drawing DGNs shall include Design, Drawing and Sheet Models (see Chapter 4 for more details about DGN models). Use of the correct element templates is important to ensure elements can be easily identified within the DGN.

All final plan sheets should be in the Sheet Model.

Draw details 1:1 in the design model and scale views on sheet model as needed to provide clarity.

1.6.2 3D Models

Create 3D models in the Design Model (see Chapter 4 for more details about DGN models). Each structure model shall be its own DGN file.

Use and modify the 3D element templates in the libraries as needed. Copy and save the element templates to the project Bridge Templates folder to modify.

In order to share information in the 3D model with Construction and Asset Management, Item Types should be attached to each element on the structure.

2D drawings created from the 3D model will be created by referencing the 3D model into the appropriately named DGN file's design model and use the Drawing Creation tools to send saved views of the selected element to the drawing and sheet models to create the final plan sheet.

1.7 DETAILING REQUIREMENTS

Before starting the plans, determine which details should be included in the plans and present them in a logically grouped order. Avoid scattering details throughout the plans and overcrowding a sheet with details and notes. Use standard line styles, line weights, lettering, reference notes, etc., to produce plans that are consistent from project to project.

Arrange drawings and details by determining what information needs to be placed on each plan sheet, the scales of the details shown, the number of sheets and sequence of sheets based on information found in Chapters 1, 4 and 5 of the *NCDOT Structures Management Design Manual*.

1.7.1 Scales

Drafting scales information found in Chapters 1, 4 and 5 of the *NCDOT Structures Management Design Manual*.

1.7.2 Line Styles and Line Weights

Use the appropriate Element Templates for the structure element being drawn. The Element Templates will set the line level, style, weights and feature definitions.

When the correct Element Templates are used, the SMU pentable will plot the "Existing" element line styles at a reduced intensity and "Proposed" element line styles bold intensity to display importance.

1.7.3 Dimensioning

Show dimensions less than 1-inch in fractions of an inch without a leading zero (e.g. ½")

Show dimensions in units of inches and fractions of an inch for dimensions less than 12-inches (e.g. 1½") .

For dimensions 12-inches or greater, show dimension units as feet and inches with fractions of an inch (e.g. 1'-1½").

Place horizontal dimension lines so they can be read from the bottom of the plan sheet.

Place vertical dimension lines so they can be read from the right side of the plan sheet.

Place inclined dimension lines so they can be read horizontally by rotating the plan sheet through the smallest angle possible.

1.7.3.1 Dimensioning Precision

For dimensioning precision, see Figure 1-02 of the *NCDOT Structures Management Design Manual*.

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CHAPTER 2
PROJECT MANGEMENT

2.1 PROJECT MANAGEMENT CONSIDERATIONS

2.1.1 Project Scoping (PDN 2ST1)

As NCDOT and SMU continue to advance use of the OpenX software, it is important the project team is aware of what the project expectations are for the project task during the project scoping meeting. Some projects will be selected as pilot projects with 3D models as part of the deliverables during the phase 2 migration period.

2.1.2 Project Workflow

Each project scoping meeting should include project team members for all disciplines of work involved with the design to determine the following:

- The stage in the design process where the structure model/PGD is required.
- How ProjectWise will be used to share live DGN files between disciplines.
- How culverts will be modeled and who is responsible for creating the stream alignment.
- How the bridge slopes and slope protection will be created by either Roadway or Hydraulics.
- If there are retaining walls in-front of and/or beside the structure, who (Roadway or Geotechnical) will create models for them based on Structures provided cap/wing wall elevations and offsets.

2.1.3 Project Deliverables

The NCDOT Project Manager responsible for the entire project should make the project team members aware of what project deliverables are, and if a 3D Structural Model is required and what level of detail (LOD) for the 3D model is required for each structure. Project Teams should leave scoping meetings knowing what types of the following deliverables are required (note: all PDFs are submitted via SharePoint and all DGNs should be submitted in ProjectWise):

PDN 2ST2 Preliminary General Drawings Submittal

First Submittal

- 2D PGD (PDF).
- Preliminary 3D Structural Digital Twin (DGN) (if applicable).
- Preliminary Header Elevations (if applicable).
- Vertical Abutment Wall Envelopes (if applicable).

Final Submittal

- 2D PGD (PDF & DGN).
- Preliminary 3D Structural Digital Twin (DGN) (if applicable).
- Preliminary Header Elevations (if applicable).
- Vertical Abutment Wall Envelopes (if applicable).

PDN 3ST1 Complete Structures Design

- Geotechnical Foundation Loads.
- Access Drawings.
- Coast Guard Permit Sketches (if applicable).
- Railroad Easement Sketches (if applicable).
- Permit Impacts.

90% Structures Design Submittal

- Final 2D Structure Plans (PDF).
- Final 3D Structural Digital Twin (DGN) (if applicable)
- Project Special Provisions Package (PDF).
- Working Day Calculations (PDF).

PDN 4ST1 Finalize Structure Design PS&E

100% Structure Design

First Submittal

- 2D Structure Plan Sheets Combined (PDF).
- 3D Structural Digital Twin (DNG) (if applicable).
- Structures Project Special Provisions Package (PDF).
- Structure Pay Items & Quantities (PIQ).

Final Submittal

- PE Sealed and E-Signatures, 2D Individual Structure Plan Sheets (PDF).
- 2D Structure Plan Files without PE Seals (DGN).
- Final 3D Structural Digital Twin (DNG) (if applicable).
- PE Sealed and E-Signatures Structure Design Calculations (PDF).
- PE Sealed and E-Signatures Structures Project Special Provisions Package (PDF).
- Bridge Construction Elevations (PDF).

PDN 5ST1 Structure Construction Support

- Perform construction revisions to address identified 3D model (if applicable)/2D plan errors or field changes initiated by NCDOT or the Contractor.

2.2 FILE STORAGE

Moving forward all project files, other than confidential documents, should be stored within the "Structures" folder under its respective project folder within NCDOT's ProjectWise Explorer. Files should be created using the SMU naming convention and include the appropriate metadata to make the file searchable in the future.

https://connect.ncdot.gov/site/preconstruction/Preconstruction%20Help/NCDOT_Use_of_ProjectWise.pdf

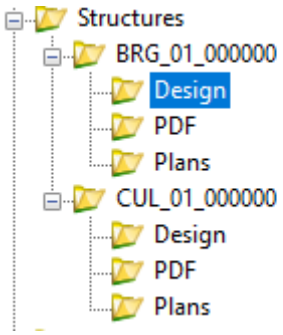
2.2.1 ProjectWise Explorer Guidance

ProjectWise guidance documents for creating, saving, searching and exporting documents can be found here https://connect.ncdot.gov/resources/CADD/Pages/ProjectWise.aspx.

All ProjectWise project folders will be set up by the NCDOT Project Manager through SharePoint. Adding structures on the project in SharePoint will generate a folder for each structure under the "Structures" main folder overnight. If a project does not have the correct structure folders in ProjectWise, contact the NCDOT Project Manager.

2.2.2 Structures ProjectWise Folder Structure

The folder structure for the "Structures" project work has been predetermined and set to allow the Department of Information Technology (DIT) to manage and maintain it from an administrative level. When the project folder is created the template will create a "Structures" folder which will have the structures folders listed (such as "BRG" and "CUL" folders) with three subfolders; "Design," "PDF," and "Plans."



The structure folders, such as "BRG" and "CUL," may not be copied to create additional structure folders for a project, this must be done using SharePoint. If edits need to be made to a project folder, such as adding or removing structures from a project, this should be done in SharePoint and the corresponding updates will be made overnight within ProjectWise. Project Engineers should make sure that the correct structure type ID's are being used within SharePoint and ProjectWise to ensure correct workflow when the project is moved from PreConstruction to Construction within SharePoint. Also, the "Design" "PDF" and "Plans" subfolders should not have their names edited, nor should other subfolders be added.

2.2.3 Structures Folder Naming Convention

When the project is created in SharePoint, the ProjectWise structure folders will be automatically generated the following day. If the folder naming convention does not match the following, contact dot.pwsupport@ncdot.gov

Naming convention: **Structure Type ID_##_SMU 6-digit NBI ID**

Structure Type ID =

Bridge	BRG
Culvert	CUL
High Mast Lighting	HML
Noise Wall	NW
Other	OT
Overhead Sign	OS
Penstock	PS
Retaining Wall	RW
Temporary Structure	TMP

= the structure numbering used on the plans for multiple structures on a project (i.e. STR#01, STR#02, etc.). Construction uses these to identify the structures in the field and our folders will now roll over to the Construction side of SharePoint.

SMU 6-digit NBI ID = the structure ID SI&A gives a structure that is inspected and reported to FHWA for NBIS compliance

2.2.4 Storing Files within the Structure Folder

Files should be stored within the Structure project folder structure as follows:

- **Structures Folder**
  - Overall Project Correspondence
  - Correspondence Documents involving all/more than one structure on the project
  - **Structure Type Folder (BRG/CUL_00_000000)**
    - Structure Related Correspondence
    - Misc. Structure Related Documents that don't fit under the "Design," "PDF," or "Plans" folders.
    - Reference Materials (ie. Clipped AASHTO sections for special designs, BSR, Foundation Recs)
    - **Design Folder**

      SMU
      - Design program Input & Output files (NCBDS, RCPier, Descus, etc.)
      - Excel design files (includes Quantity Estimates, Working Days)
      - Design DGN files
      - Checked PDF design output files
      - Scanned design documents of handwritten materials
      - Draft Project Special Provisions (PSPs) documents
      - Design Criteria/Notes (a document with notes as to why a design decision was made)

      PEF & SMU
      - PE Sealed and E-Signature Final Design Calculations (PDF)
    - **PDF Folder**
      - Final Electronically Sealed PDF Plan Sheets
      - Final Electronically Sealed PDF PSPs
      - Final PDF'd Construction Elevations
      - Final Quantity Estimates
      - PDF'd Plan Sheets for Review (25%, etc.)
      - Reviewed PDF Plan Sheets with comments
    - **Plans Folder**
      - All final structure DGN files

- Documents related to plan production (ie. Quantity calculations, Excel files or scanned documents)

2.3 FILE NAMING CONVENTIONS

Each plan sheet shall be its own DGN and PDF file and follow this naming convention:

Models shall be named **4XX_000_TIP#_SMU_BR#_MODEL_6digitStrID**

TIP Number with no hyphenations (“-”) ie. B5121

Plan sheet number, ie. Sheet 1 of structure 1 would be S1-01

4XX_###_TIP#_SMU_FileDescript_Sheet#_6digitStrID

Abbreviation of the drawing type using the file descriptions

All Structure files are in the 400 series of files:

- Master Project Structure’s Title Sheets and Index Sheets are 400, note leave off the 6-digit structure ID off these files
- Bridges: STR#1 thru STR#9 on the project start 401 thru 409
- Culverts: CU#1 thru CU#9 on the project start at 410 thru 419, unless there are more than 9 structures on the project…then use the next available number
- Walls: W#1 thru W#9 on the project start at 420-429 unless there are more bridges or culverts

Electronic page number for the particular bridge (each bridge set starts at 001 and successive numbers are all odd, ie. 001, 003, 005…) to allow for any future addendums

FILE DESCRIPTIONS			
1MR	ONE BAR METAL RAIL SHEETS	GRD	GIRDER REPAIR DETAIL SHEETS
2MR	TWO BAR METAL RAIL SHEETS	IM	INCIDENTIAL MILLING SHEETS
3MR	THREE BAR METAL RAIL SHEETS	IS	INDEX OF MULTI-STRUCTURE PROJECTS SHEETS
AB	ABUTMENT SHEETS	JD	BRIDGE JACKING DETAIL SHEETS
AR	ALASKA RAIL SHEETS	JS	JOINT SEAL SHEETS
AS	APPROACH SLAB SHEETS	JT	JOINT DETAIL SHEETS
B1, B2…B#	BENT SHEETS	LC	LONG CORD LAYOUT SHEETS
BB	BOX BEAM SHEETS	LS	LOCATION SKETCH SHEETS
BG	BEARING SHEETS	MD	CONCRETE MEDIAN SHEETS
BK	BULKHEAD SHEETS	OR	OREGON RAIL SHEETS
BM	SUPERSTRUCTURE BILL OF MATERIAL SHEETS	PC	STAGE OF PHASE CONSTRUCTION SHEETS
BR	BARRIER RAIL SHEETS	PGD	PRELIMINARY GENERAL DRAWING SHEETS
CG	COAST GUARD PERMIT SHEETS	PP	PRESTRESSED CONCRETE PILE SHEETS
CS	CORED SLAB SHEETS	RF	RAIL RETROFIT SHEETS
CU	CULVERT SHEETS	RR	RIP-RAP SHEETS
DL	DEAD LOAD DEFLECTION TABLE SHEETS	RW	RETAINING WALL DETAIL SHEETS
DP	PRESTRESSED DECK PANEL SHEETS	S1, S2…S#	PLAN OF SPAN SHEETS
DSR	DECK SURFACE REPAIR SHEETS	SN	STANDARD NOTES SHEET
DT	DETOUR SHEETS	SP	SLOPE PROTECTION SHEETS
DUR	DECK UNDERSIDE REPAIR SHEETS	SS	STRUCTURAL STEEL DETAIL SHEETS
E1, E2…E#	END BENT SHEETS	SSR	STRUCTURAL STEEL REPAIR SHEETS
FL	FOUNDATION LAYOUT SKETCH SHEETS	SW	SIDEWALK DETAIL SHEETS
FP	FRAMING PLAN LAYOUT SHEETS	TA	TEMPORARY ACCESS SHEETS
G1, G2…G#	PRESTRESSED CONCRETE GIRDER SHEETS	TS	SUPERSTRUCTURE TYPICAL SECTION SHEETS
GD	GENERAL DRAWING SHEETS	UT	UTILITIES DETAILS SHEETS
GR	GUARDRAIL ATTACHMENT SHEETS		

6-digit structure ID's XX####

XX =County Number + #### Structure Number

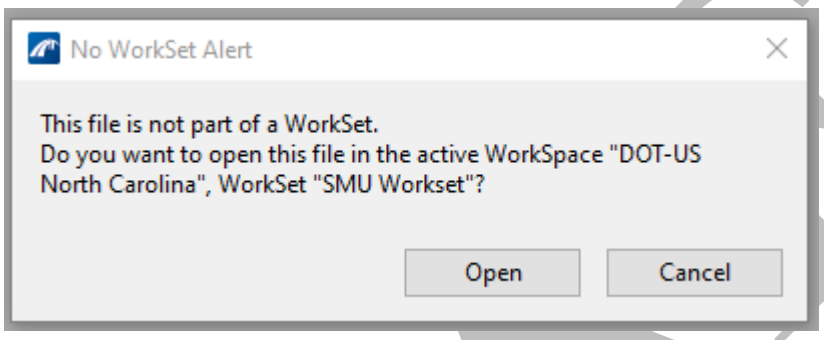
XX - County Numbers		
00 - ALAMANCE	34 - FRANKLIN	68 - PAMLICO
01 - ALEXANDER	35 - GASTON	69 - PASQUOTANK
02 - ALLEGHANY	36 - GATES	70 - PENDER
03 - ANSON	37 - GRAHAM	71 - PERQUIMANS
04 - ASHE	38 - GRANVILLE	72 - PERSON
05 - AVERY	39 - GREENE	73 - PITT
06 - BEAUFORT	40 - GUILFORD	74 - POLK
07 - BERTIE	41 - HALIFAX	75 - RANDOLPH
08 - BLADEN	42 - HARNETT	76 - RICHMOND
09 - BRUNSWICK	43 - HAYWOOD	77 - ROBESON
10 - BUNCOMBE	44 - HENDERSON	78 - ROCKINGGHAM
11 - BURKE	45 - HERTFORD	79 - ROWAN
12 - CABARRUS	46 - HOKE	80 - RUTHERFORD
13 - CALDWELL	47 - HYDE	81 - SAMPSON
14 - CAMDEN	48- IREDELL	82 - SCOTLAND
15 - CARTERET	49 - JACKSON	83 - STANLY
16 - CASWELL	50 - JOHNSTON	84 - STOKES
17 - CATAWBA	51 - JONES	85 - SURRY
18 - CHATHAM	52 - LEE	86 - SWAIN
19 - CHEROKEE	53 - LENOIR	87 - TRANSYLVANIA
20 - CHOWAN	54 - LINCOLN	88 - TYRRELL
21 - CLAY	55 - MACON	89 - UNION
22 - CLEVELAND	56 - MADISON	90 - VANCE
23 - COLUMBUS	57 - MARTIN	91 - WAKE
24 - CRAVEN	58 - MCDOWELL	92 - WARREN
25 - CUMBERLAND	59 - MECKLENBURG	93 - WASHINGTON
26 - CURRITUCK	60 - MITCHELL	94 - WATAUGA
27 - DARE	61 - MONTGOMERY	95 - WAYNE
28 - DAVIDSON	62 - MOORE	96 - WILKES
29 - DAVIE	63 - NASH	97 - WILSON
30 - DUPLIN	64 – NEW HANOVER	98 - YADKIN
31 - DURHAM	65 - NORTHHAMPTON	99 - YANCEY
32 - EDGECOMBE	66 - ONSLOW	
33 - FORSYTH	67- ORANGE	

2.4 V8 FILE CONVERSIONS AND EXPECTATIONS

During the migration period, there will be project files that need to be converted from the v8 format to OpenBridge format. This section is intended to provide guidance and expectations for those project files.

2.4.1 DGN Plan Conversion

V8 files can be opened in the OpenBridge software without loss of data. When a V8 file is opened in OpenBridge, the following message will appear:



Click "Open" and the file will be migrated to the current SMU workspace. The file will now be in the SMU OpenBridge workspace with the old v8 line styles, text styles, borders, and features.

2.4.2 GEOPAK File Incorporation

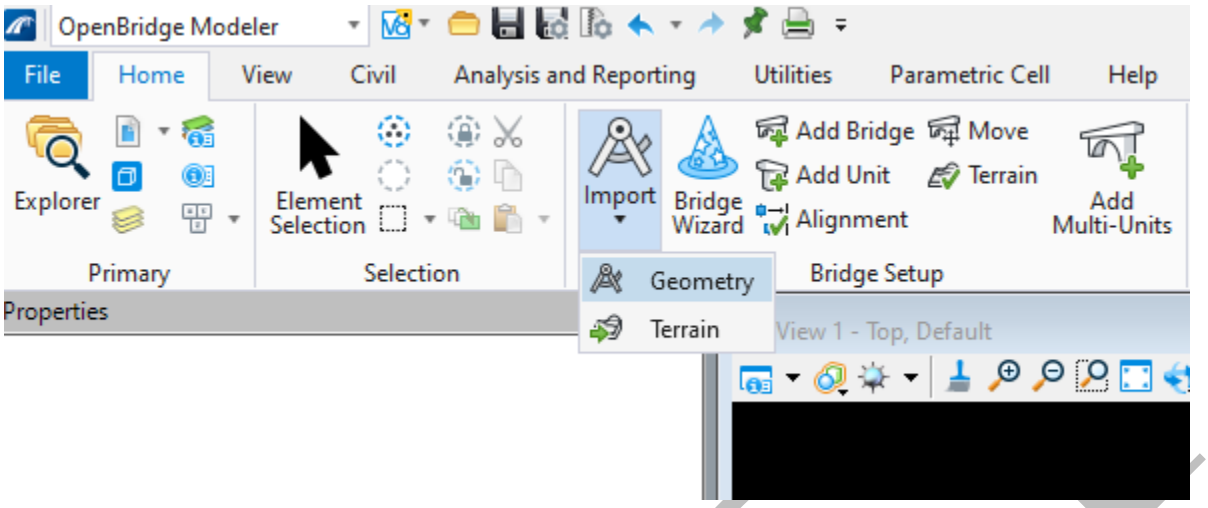
Projects that originated in V8i and Geopak can be incorporated into OpenBridge Designer files by importing the geometry (.gdk files) and terrain (.tin files).

To incorporate an alignment from projects that used older versions of MicroStation and Geopak, take the following steps:

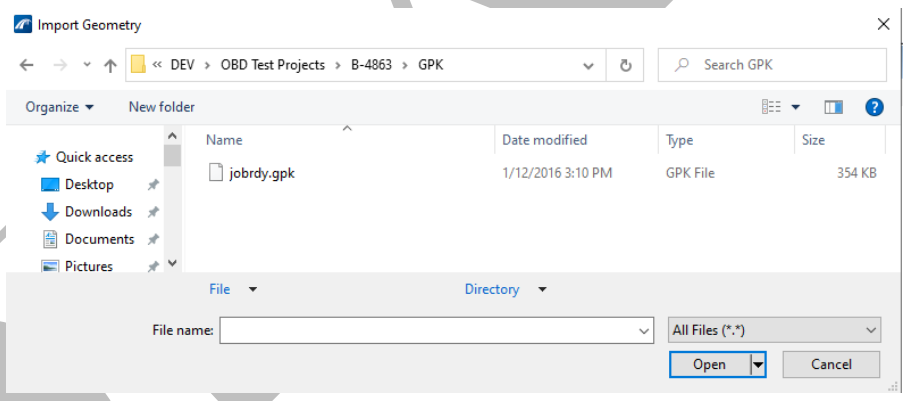
1st Locate the gpk file from the previous project and make a copy. Save the copy in your OBD project folder.

2nd Create an OBD "Model" file in your project folder.

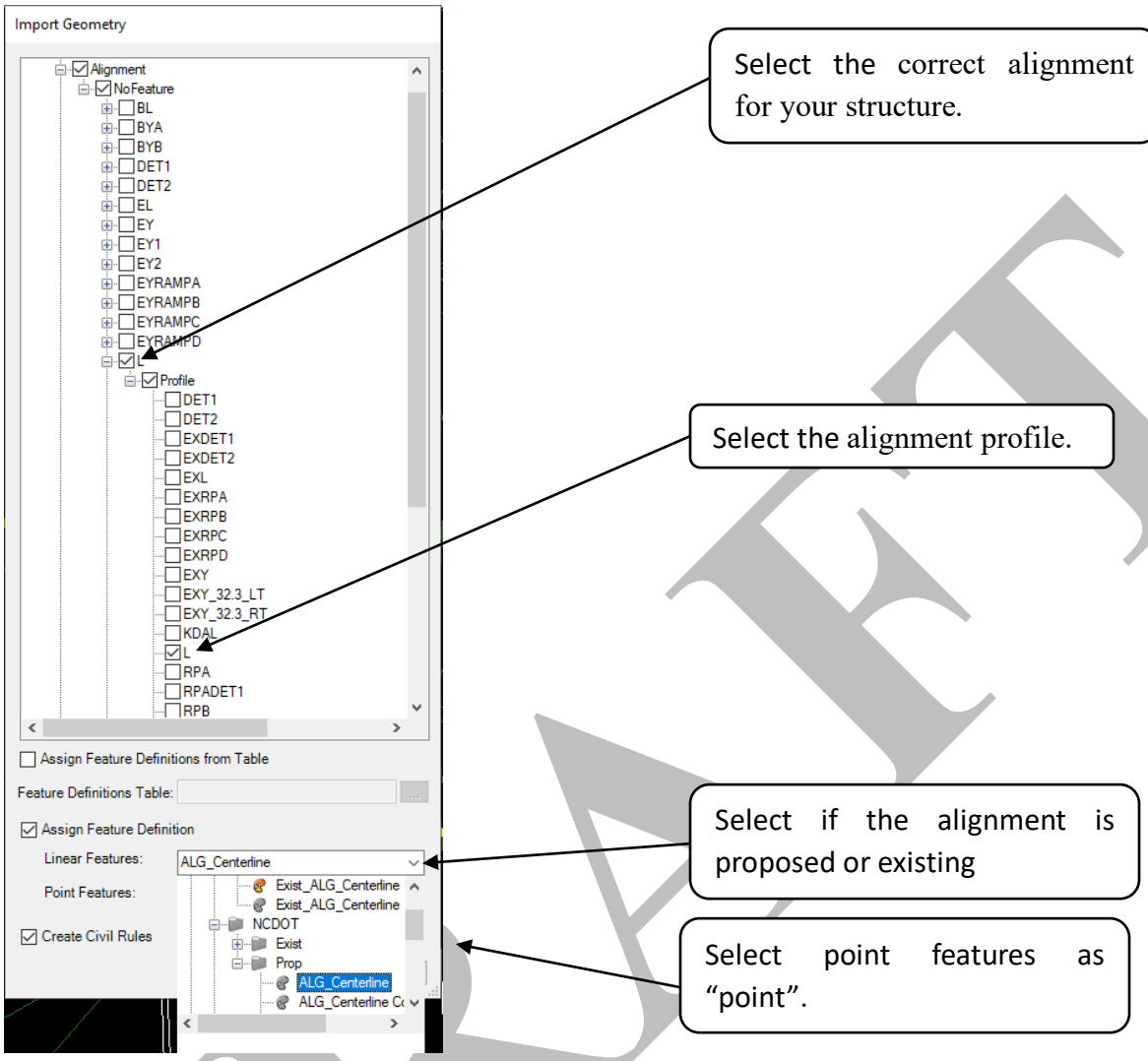
3rd In the "Model" file, click on the "Import" icon and drop down to "Geometry".



4th Locate the saved copy of the gpk file from step 1.

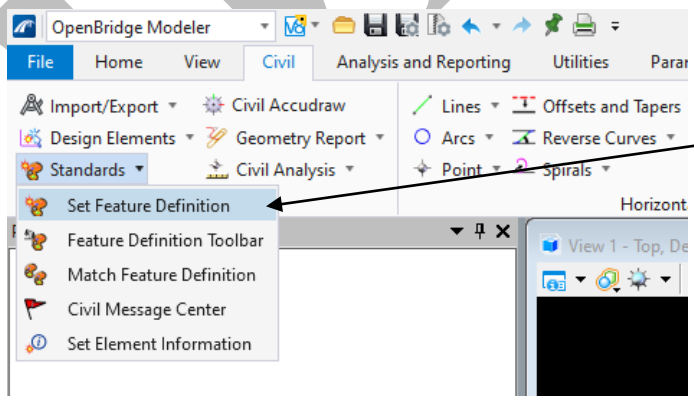


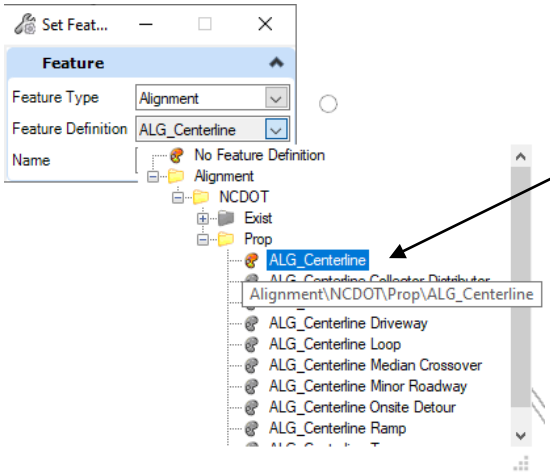
5th Select the alignment and feature definitions for the alignment. Select each alignment and its profile one at a time and assign the correct features for each one. This will require repeating this step for each alignment needed for your project.



2.4.2.1 Set Feature Definition Tool

If you didn't check the "Assign Feature Definition" box, take the following steps:





Select the features for the alignment selected above.

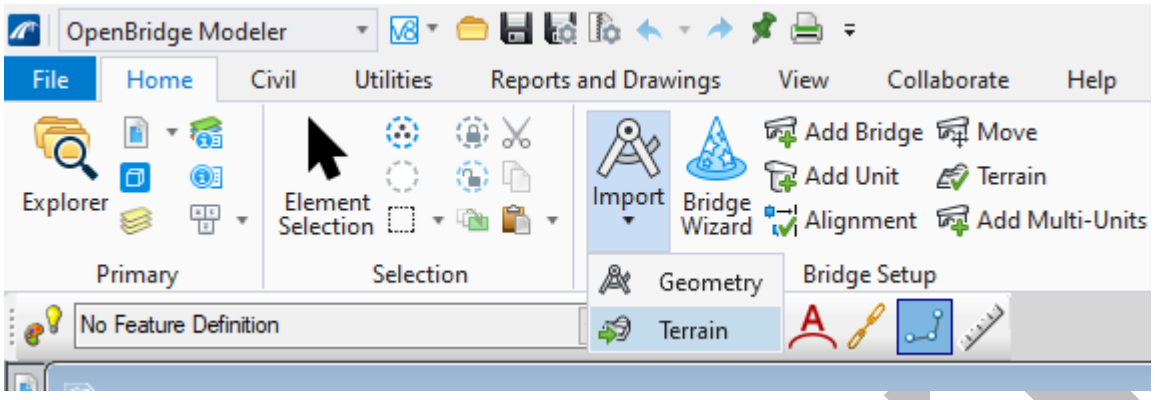
Use the curser to select the alignment to set feature definition.

2.4.3 Adding the Terrain

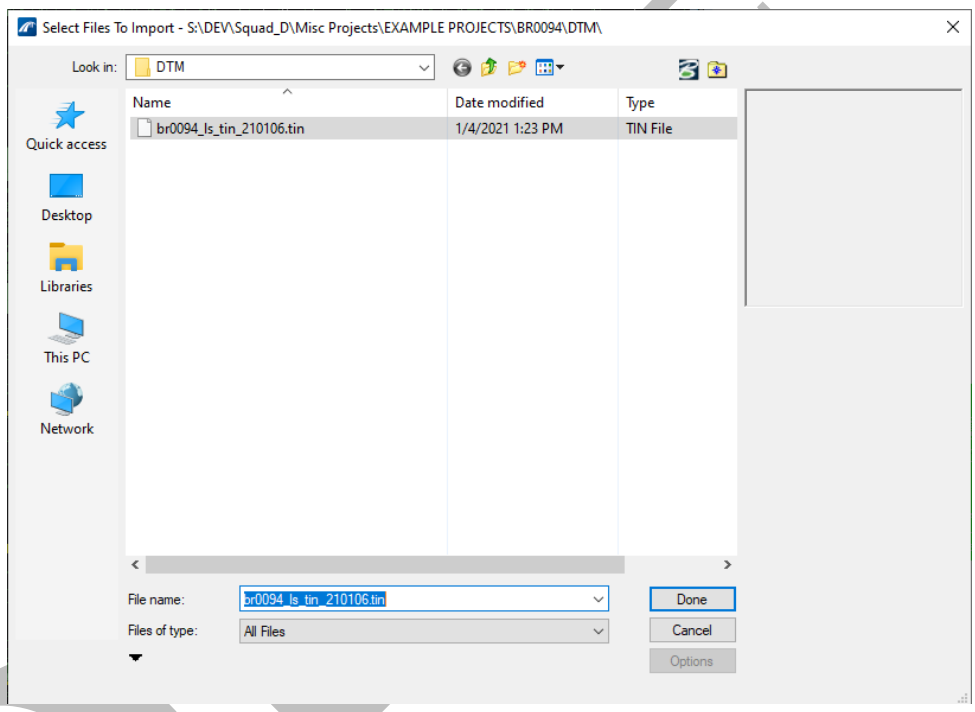
To incorporate a terrain from projects that used older versions of MicroStation and Geopak, take the following steps:

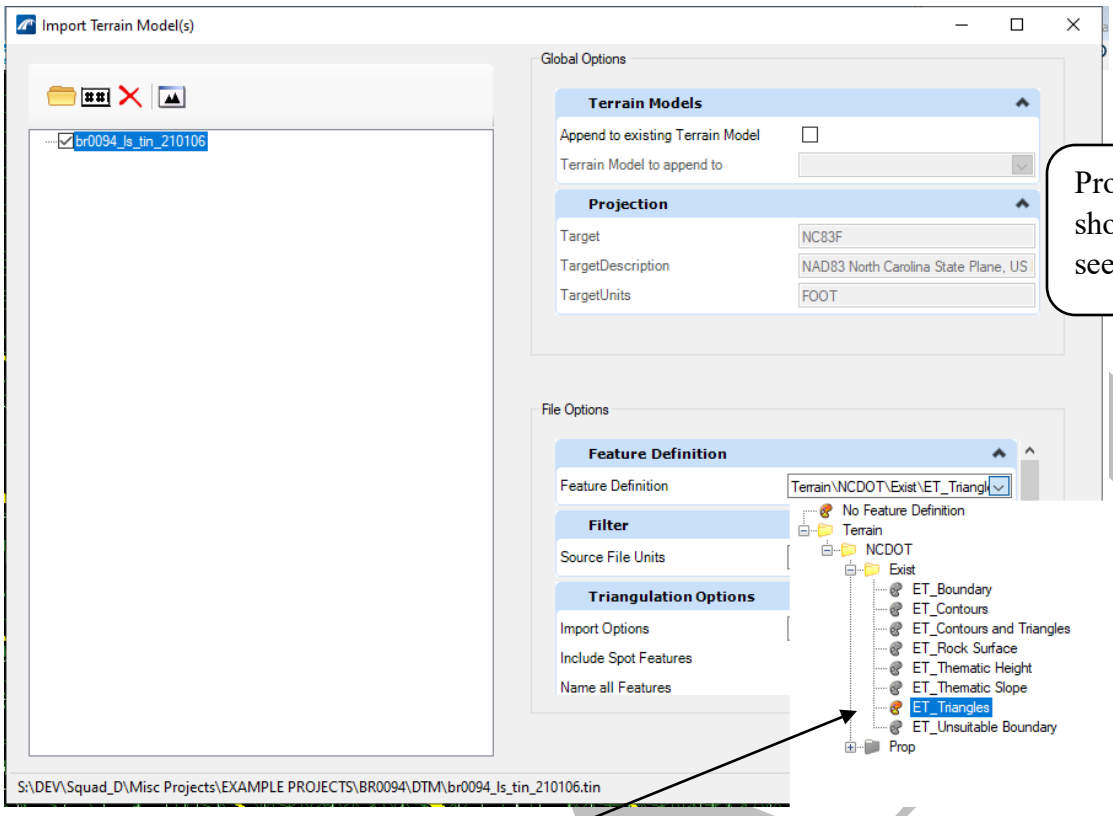
1st Locate the .tin file from the previous project and make a copy. Save the copy in your OBD project folder.

2nd Click on the "Import" icon and drop down to "Terrain".



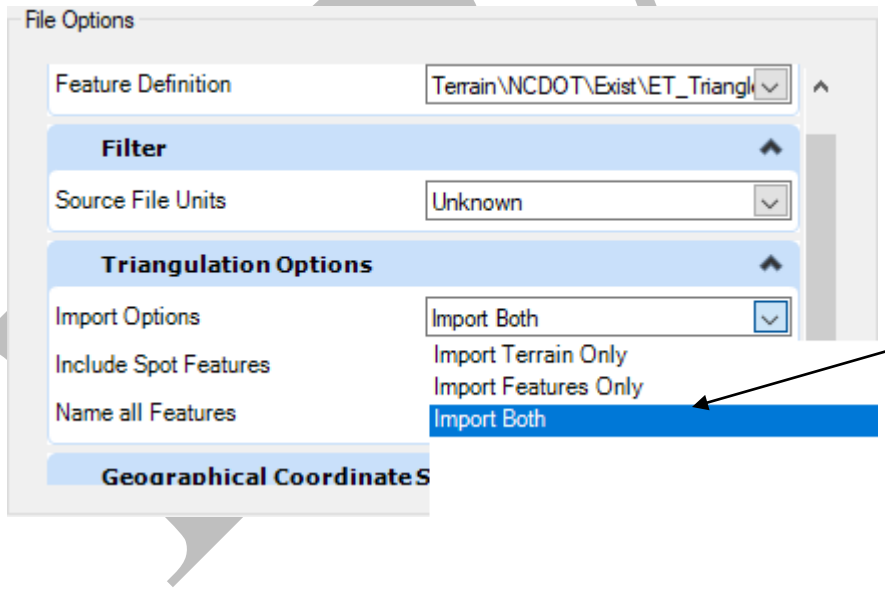
3rd Locate the saved .tin file from Step 1.





Projection Targets should be set from the seed file.

Select "ET_Triangles"



Leave File Units as "Unknown"

Select "Import Both"

4Th Click on "Import"

2.4.4 DGN Migration Expectations

V8 files can be opened in the OpenBridge software without loss of data. When a V8 file is opened in OpenBridge, a message will appear asking if the user would like to update the file. Accept the update to convert the drawing to the OpenBridge format. When a drawing is converted, the V8 levels, attributes, and format will be brought forward in the updated file, however these attributes will not be converted to match the Structure Management Unit's (SMU) OpenBridge workspace. Once updated to OpenBridge, there is no need to change the text and line styles to the new OpenBridge format or move to the use of sheet models. Note, because the V8 attributes have not been updated to the OpenBridge workspace, text fonts will appear different from the text displayed in the OpenBridge drawings. If no modifications to the drawing content are required, the drawing may be printed (on paper or PDF) as usual.

Modifying Converted v8 Drawings

When V8 drawings are converted to OpenBridge and a note or dimension needs to be added, copy and paste existing text then edit the new note or dimension. If a drawing detail needs modification, the user should proceed as usual. Note if new lines are placed in the drawing, their naming convention will utilize the OpenBridge workspace and will appear the same as the existing lines when printed.

Adding Drawings to a Plan Set

When additional drawings are needed for an existing plan set, use OpenBridge to develop the new drawings and save them as separate files using SMU's file naming convention. These drawings will utilize the OpenBridge workspace and the text will appear different from the converted or modified drawings. During the OpenBridge transition period, SMU plan sets with differing text fonts will be acceptable.

Standard Drawings and Standard Plans

SMU's Standard Drawings and Plans have been converted to the OpenBridge format using the procedures described above. The Standards will not be updated for consistency with the OpenBridge workspace until revisions to the content are required. During plan development, always use standard drawings and plans available on SMU website.

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3.3.3 Feature Definitions 3–3
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CHAPTER 3
WORKSPACE

3.1 GENERAL

NCDOT is in the process of transitioning its computer-aided draft and design (CADD) software to the comprehensive multi-disciplinary three-dimensional (3D) modeling application Bentley OpenX. In this process, Structures Management has chosen to transition to Bentley's structural operating system OpenBridge Designer (OBD). OBD is compatible with OpenX allowing for structures to be built on top of referenced OpenX files and includes Bentley's LEAP design software package.

3.2 CONSULTANTS

As part of NCDOT's transition to project file storage on ProjectWise, Structures Management's OBD workspace is incorporated into a managed workspace in ProjectWise. Consultants will need to use ProjectWise to work in Structures Management's OBD workspace.

Consultants can find ProjectWise guidance documents for creating, saving, searching and exporting documents can be found here:

https://connect.ncdot.gov/resources/CADD/Pages/ProjectWise.aspx.

Consultants can find the latest software version of OpenBridge being used by the Department here:

https://connect.ncdot.gov/resources/CADD/CADD_Documents/NCDOT_CADD_Software_Versions.pdf

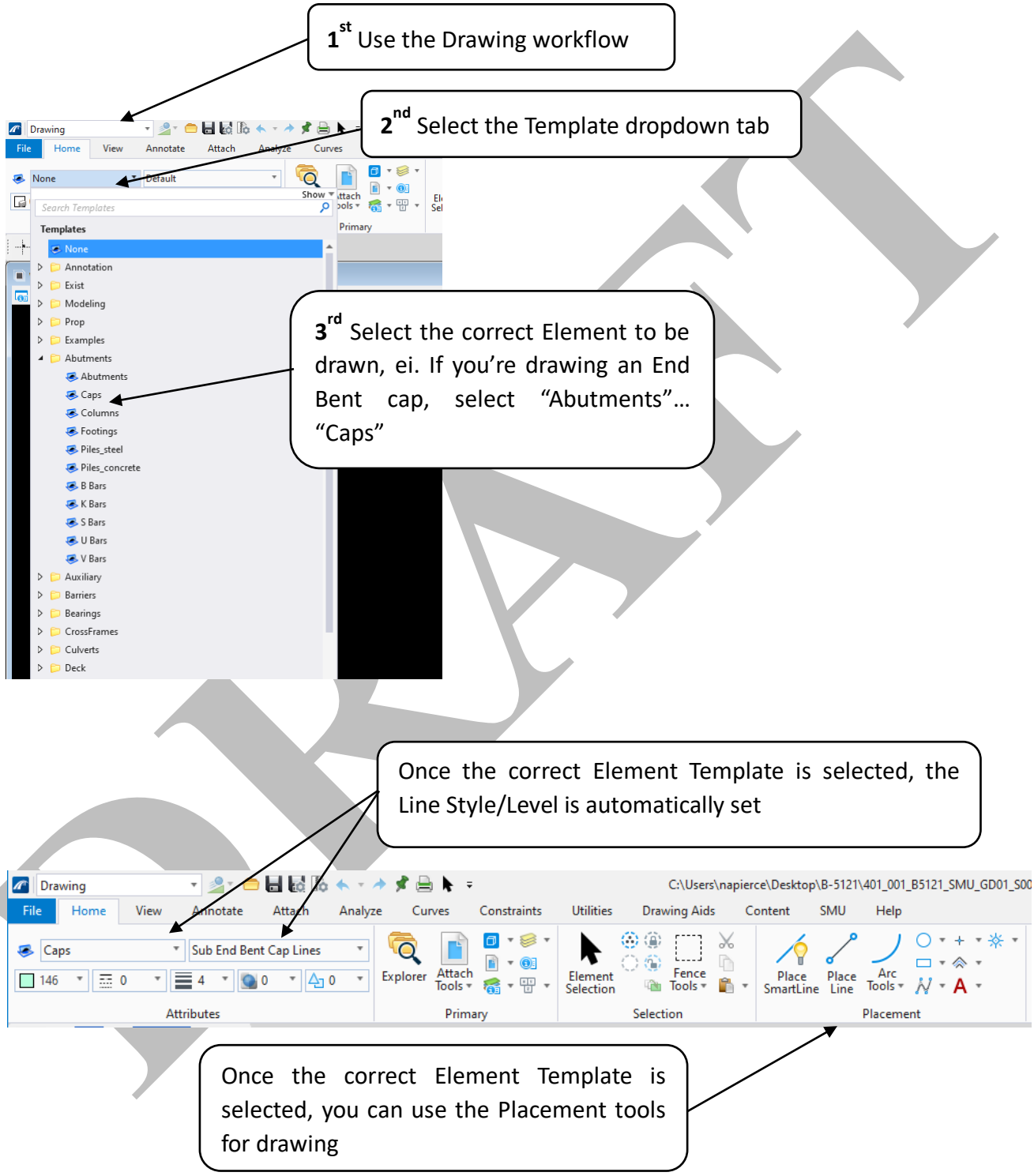
3.3 SMU WORKSPACE

Similar to previous versions of MicroStation, in an effort to maintain consistency amongst contract plans and now 3D models Structures Management will continue to produce and maintain a custom workspace for OBD.

OpenBridge uses element templates, level names, feature symbology and feature definitions. The current workspace has incorporated all of SMU's previous workspace properties and continues to evolve with 3D templates and libraries.

3.3.1 2D Element Templates

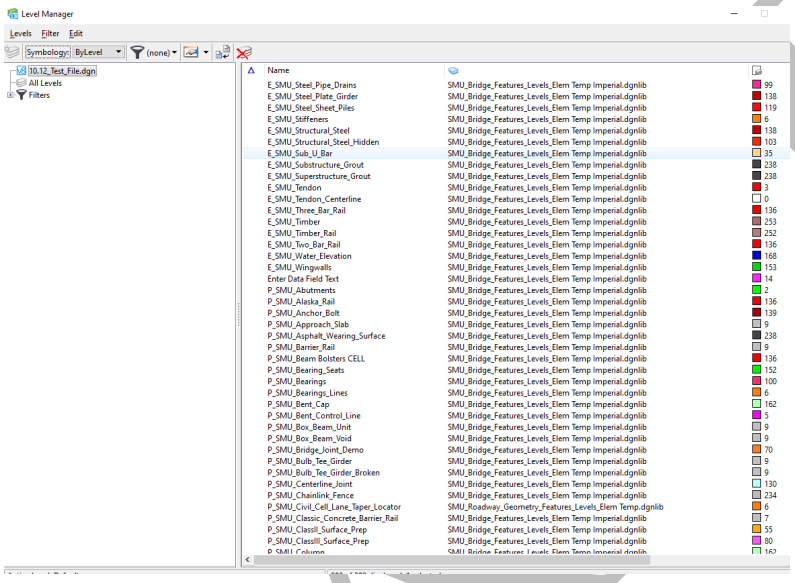
Line styles are now assigned to Element Templates, which must be selected before use. Using the correct Drawing Line Styles is important in OBD to capture accurate quantities.



Note: Do not place dimensions and text in the Design Model.

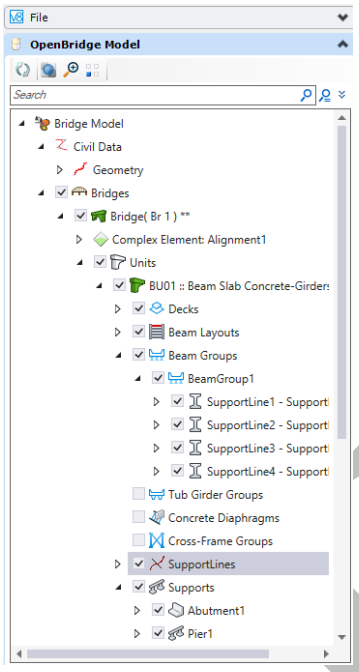
3.3.2 Level Names

Level names in the SMU OBD workspace have been updated to reflect the NCDOT policy of "E_" for existing elements and "P_" for proposed elements.



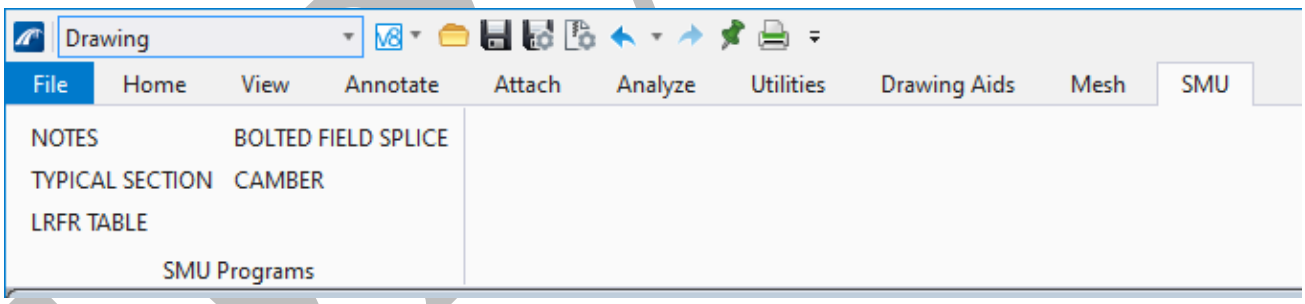
3.3.3 Feature Definitions

SMU OBD workspace has feature definitions defined for many of the commonly used proposed bridge elements.



3.3.4 SMU Tools

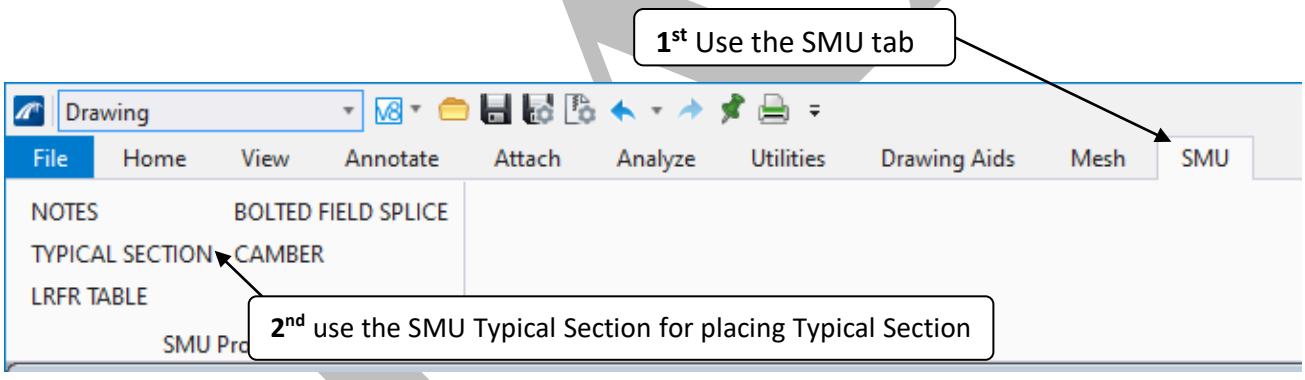
The SMU OBD workspace has a "SMU" tab under the Drawing workflow, where the in-house SMU NCBDS tools are located.

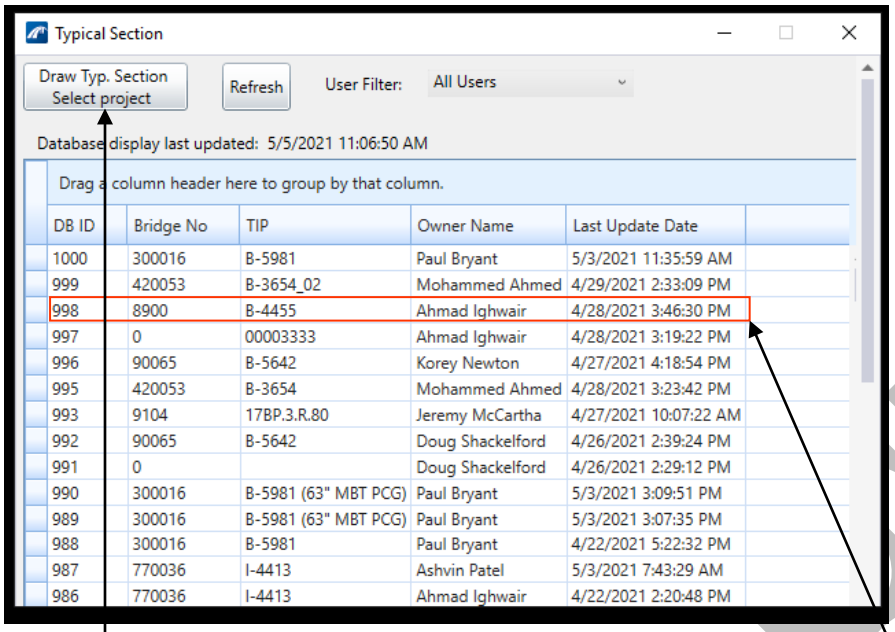


The SMU Program tools are for SMU Staff use with NCBDS design software. These tools can be used in the Sheet Model and used like the SMU Standard Plans.

3.3.4.1 Placing Typical Section From NCBDS

To place Typical Section Drawing, follow these steps.



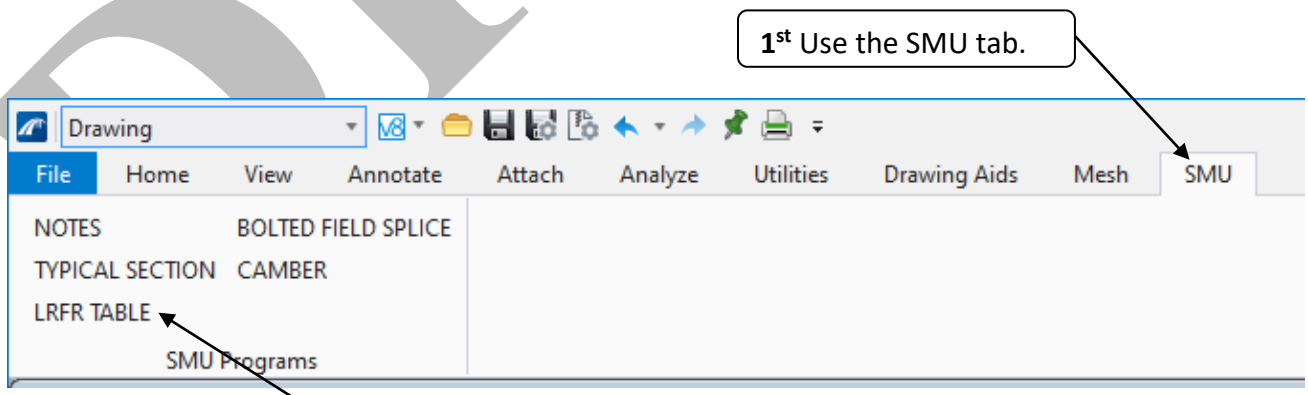


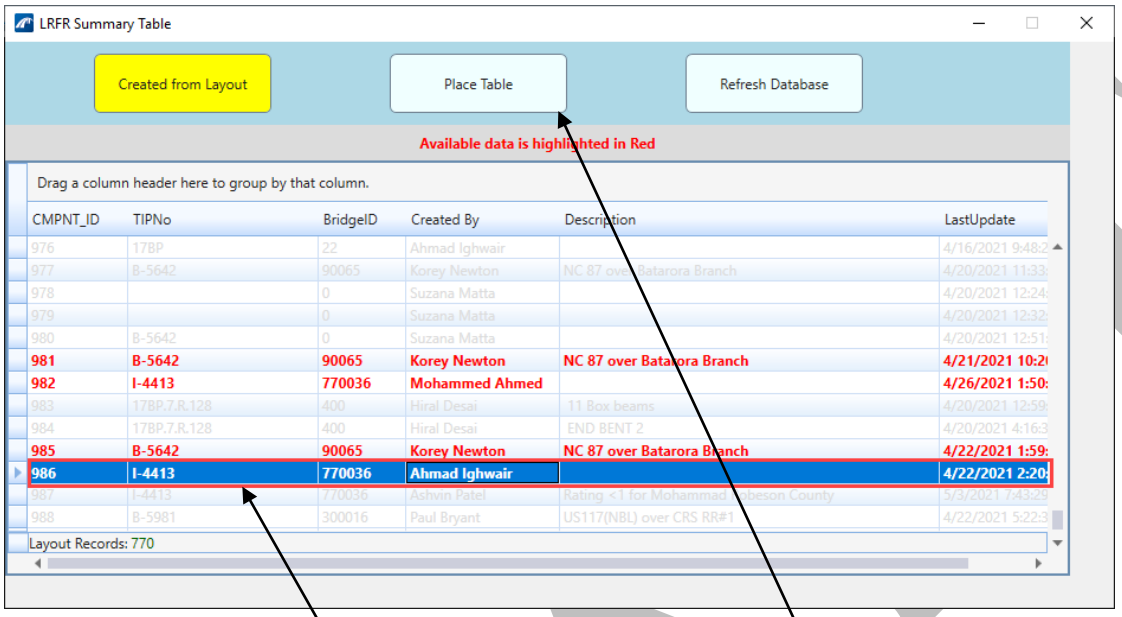
4th Use the "Draw Typ. Section Select Project" button to place the selected typical section in your dgn.

3rd select the desired project from the table.

3.3.4.2 Placing LRFR Summary Table From NCBDS

To place LRFR Table Drawing, follow these steps.





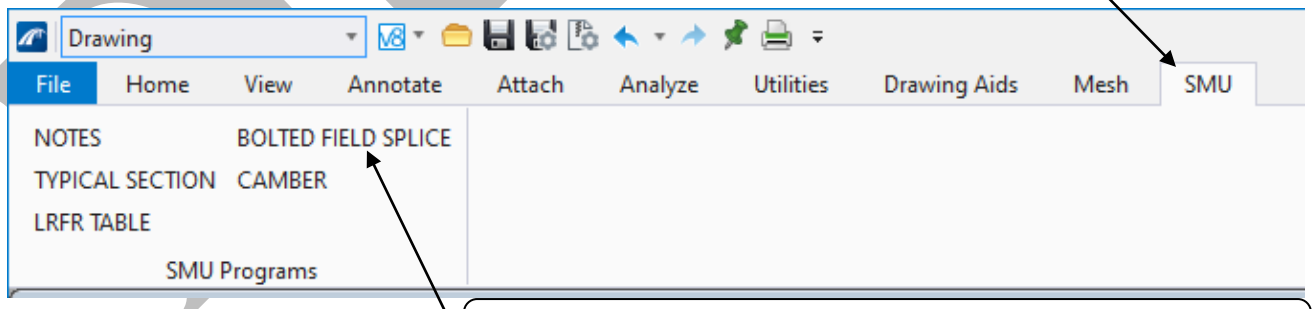
3rd select the desired project from the table.

4th Use the "PLACE TABLE" button to place the latest LRFR table created for the selected project in your dgn.

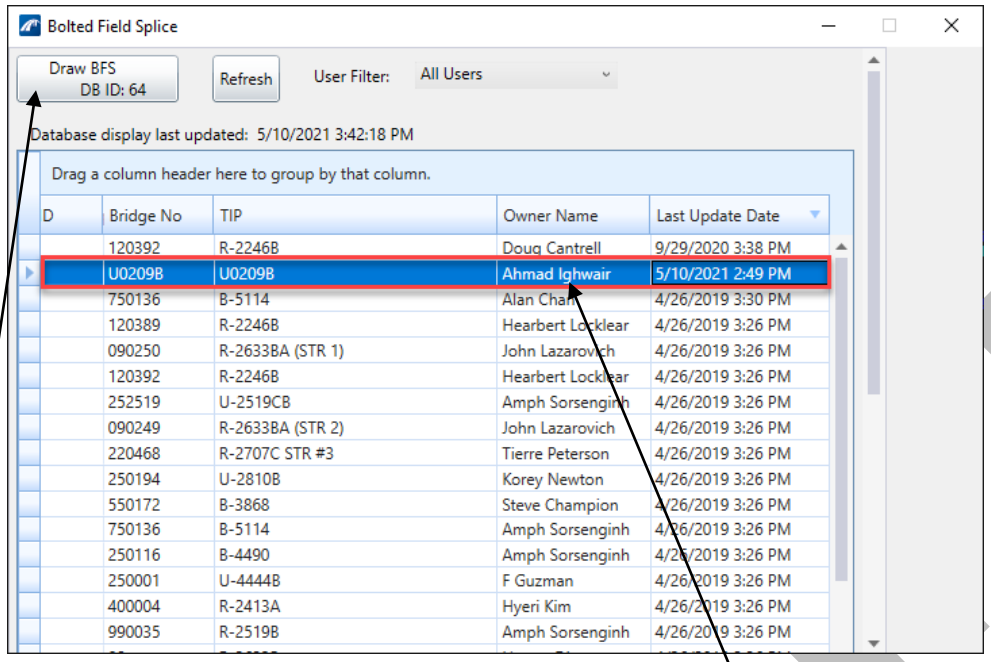
3.3.4.3 Placing Bolted Field Splice From NCBDS

To place Bolted Field Splice Drawing, follow these steps.

1st Use the SMU tab.



2nd use the "BOLTED FIELD SPLICE" for placing bolted field splice Sketch.



4th Use the "Draw BFS" button to place the selected bolted field splice in your dgn.

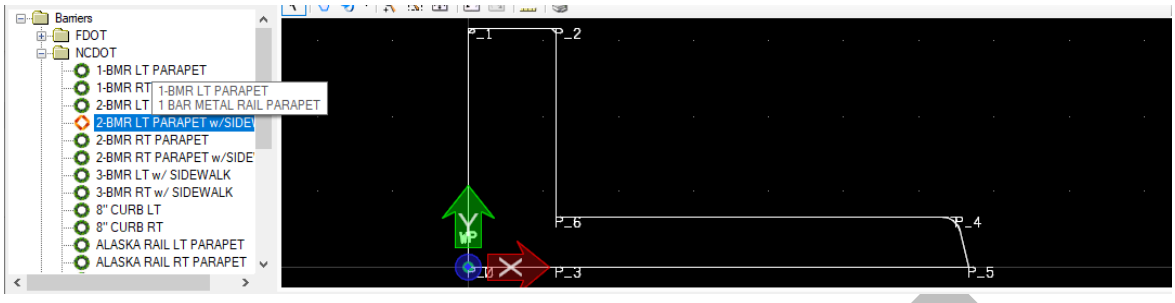
3rd select the desired project from the table.

3.3.5 3D Element Templates

SMU OBD workspace includes 3D Element Templates for many of the commonly used bridge elements.

Deck

Barriers


Barriers
FDOT
NCDOT
1-BMR LT PARAPET
1-BMR RT
2-BMR LT
2-BMR LT PARAPET w/SIDE
2-BMR RT PARAPET
2-BMR RT PARAPET w/SIDE
3-BMR LT w/ SIDEWALK
3-BMR RT w/ SIDEWALK
8" CURB LT
8" CURB RT
ALASKA RAIL LT PARAPET
ALASKA RAIL RT PARAPET
1-BMR LT PARAPET
1 BAR METAL RAIL PARAPET
P_1
P_2
P_3
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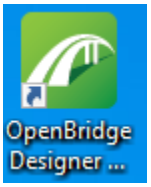
CHAPTER 4
OPENBRIDGE DESIGNER

4.1 OPENING OPENBRIDGE DESIGNER

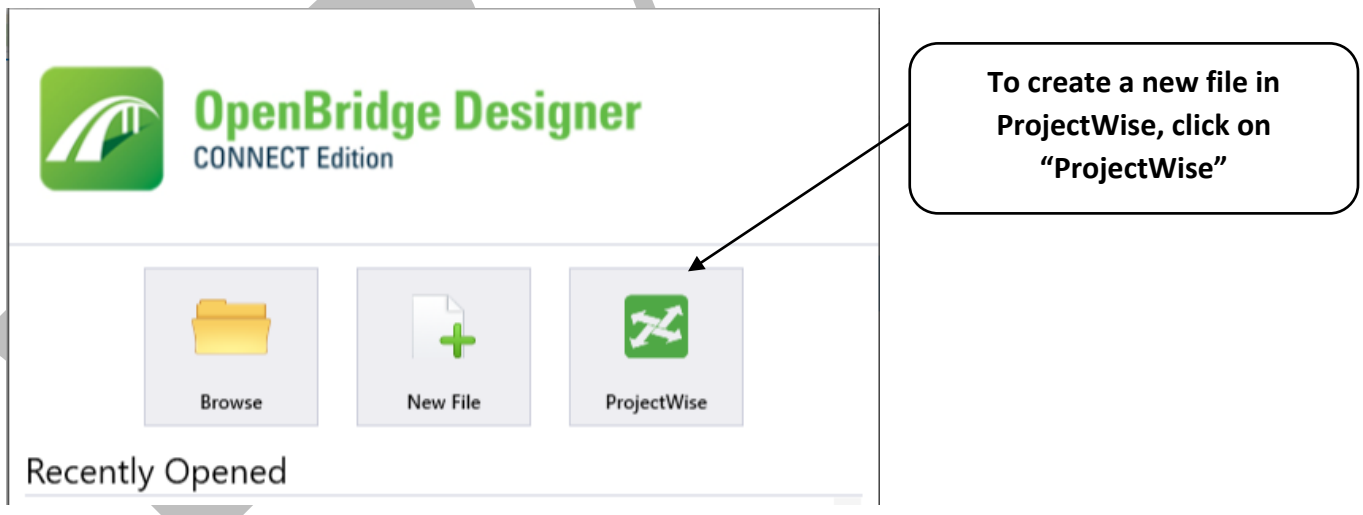
To use OpenBridge Designer (OBD), the desktop icon must be clicked to open the software



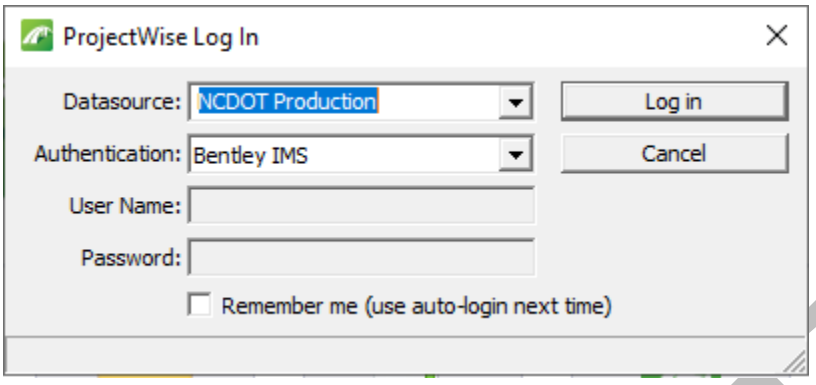
4.2 OBD FILE CREATION IN PROJECTWISE

Prior to creating a dgn file, a project folder must be created in ProjectWise for storage.

4.2.1 Connecting OBD to ProjectWise



A prompt for ProjectWise will open at this step



Make sure the Datasource is set to "NCDOT Production" and Authentication is "Bentley IMS", then click on "Log in"

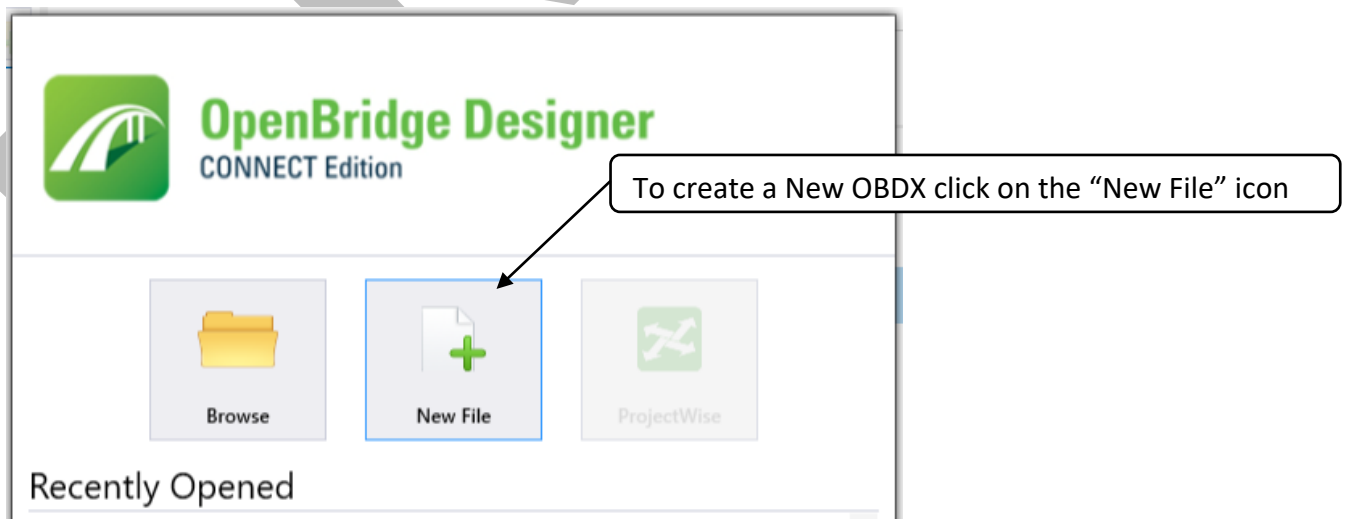
For how to create files and use ProjectWise, look at CADD Services' website

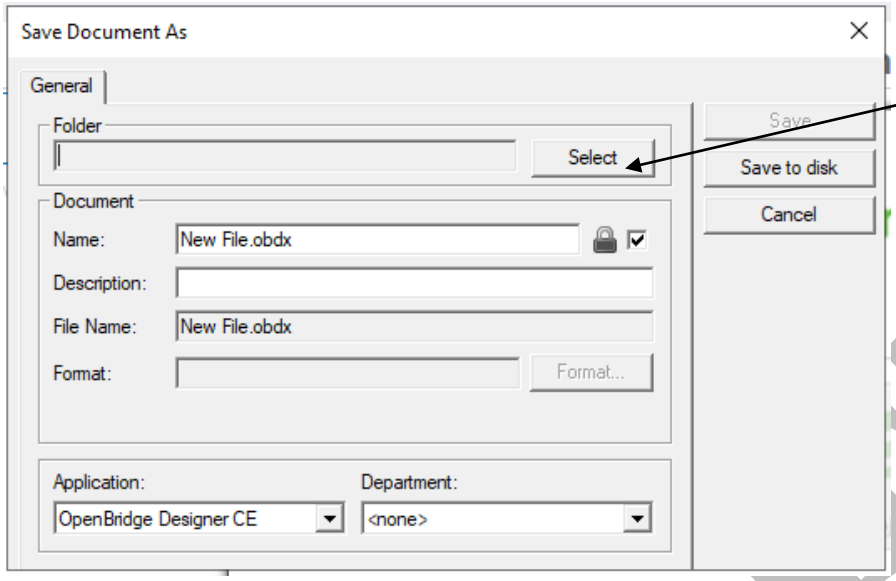
https://connect.ncdot.gov/resources/CADD/Pages/ProjectWise.aspx

To continue creating a file outside of ProjectWise click on the "Cancel" button and move to the next section.

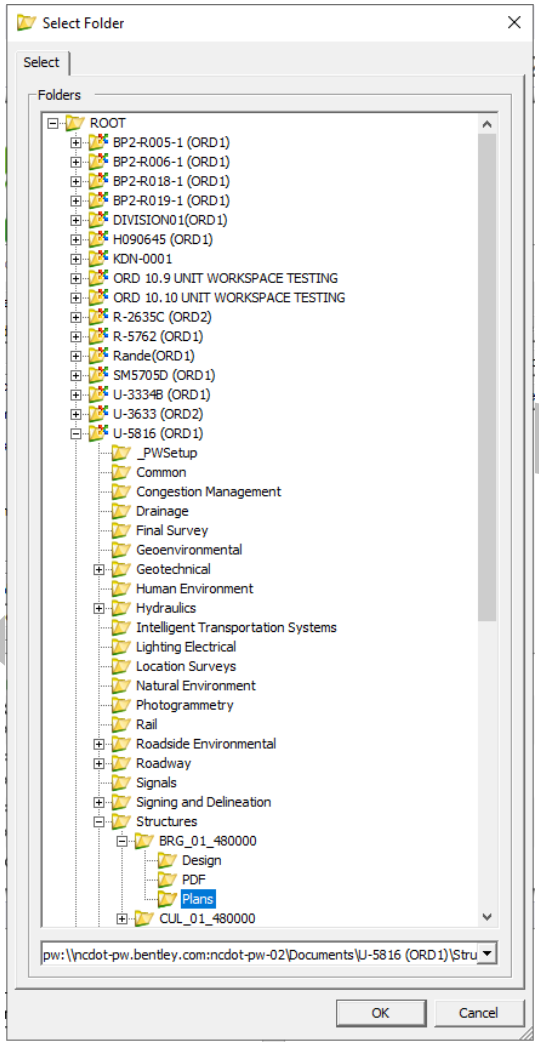
4.2.2 Creating a New OBDX File

Once OBD is logged into ProjectWise you will see the following window.

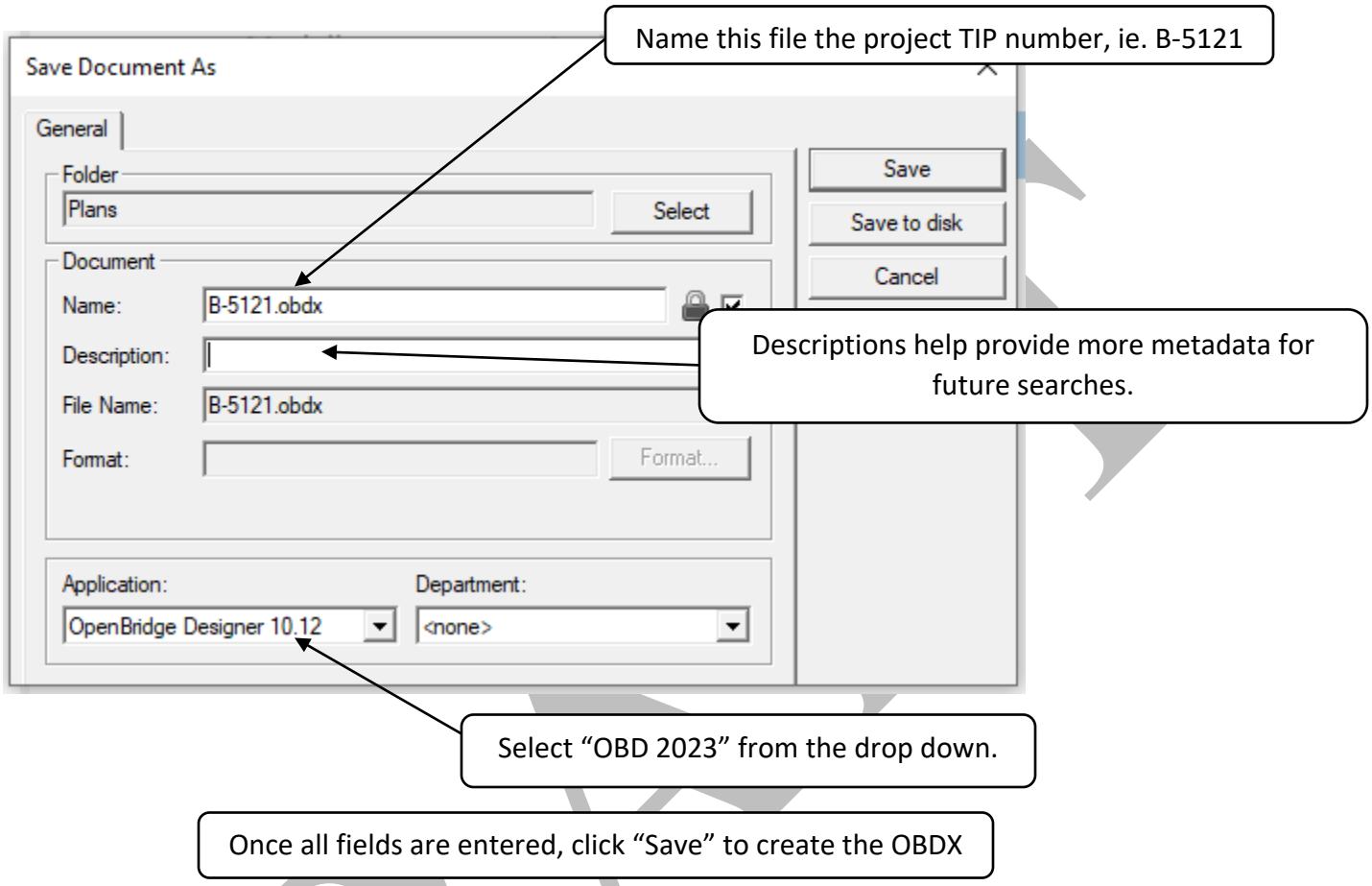




Click on "Select"



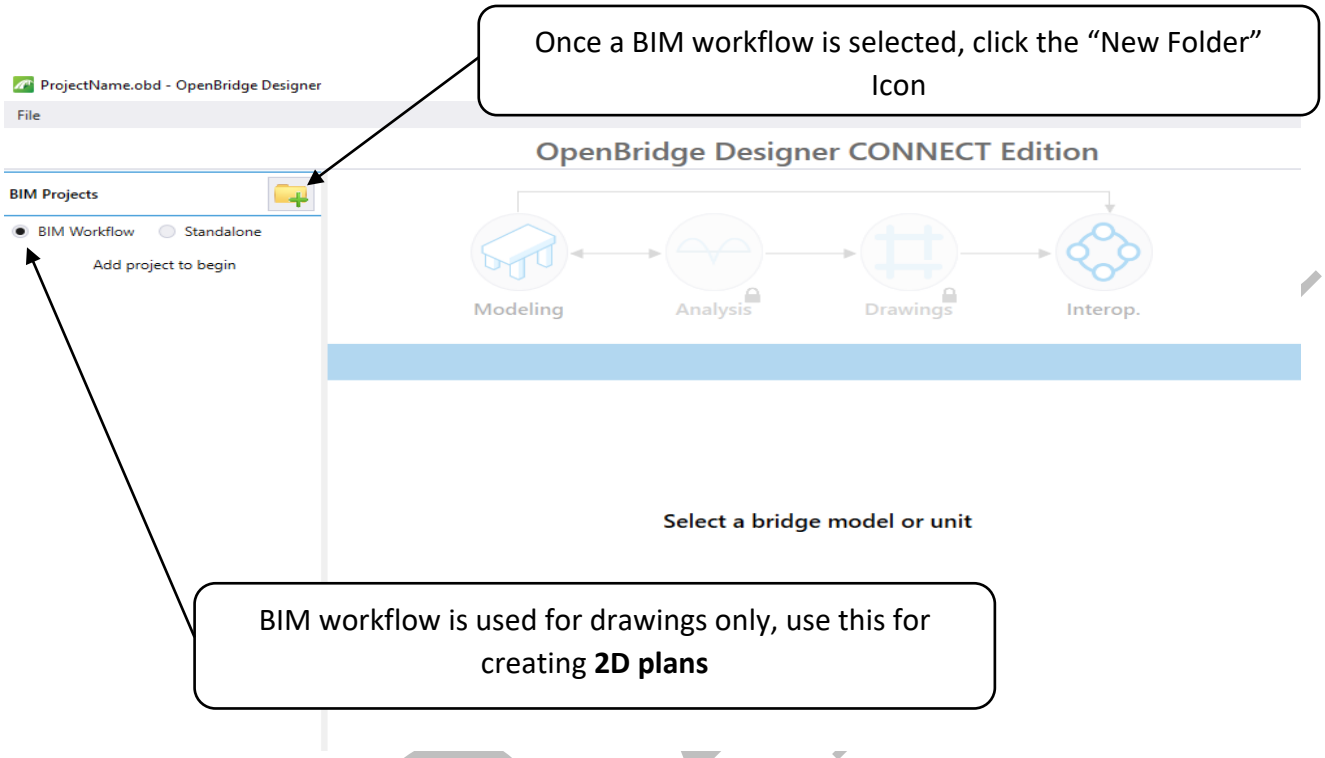
Navigate to and select the project folder, and click "OK"



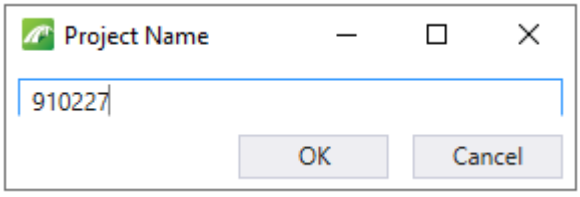
Note: Each structure on the project will have a OBDX file for both the design and the plans that will need to be created.

4.2.3 DGN Creation In ProjectWise

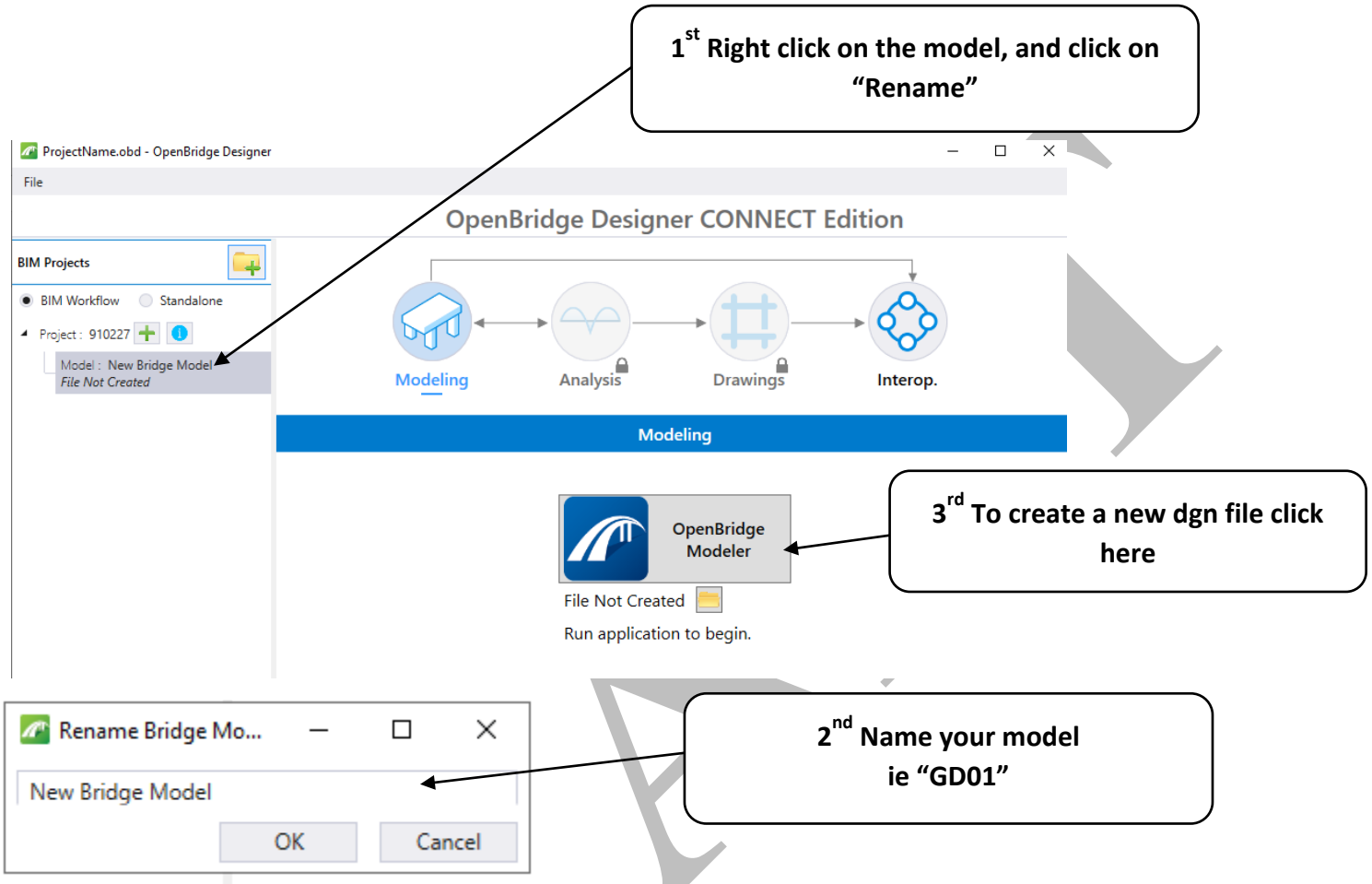
4.2.3.1 BIM Project Workflow (2D Plans)



Name the subfolder for DGN’s the structure number:

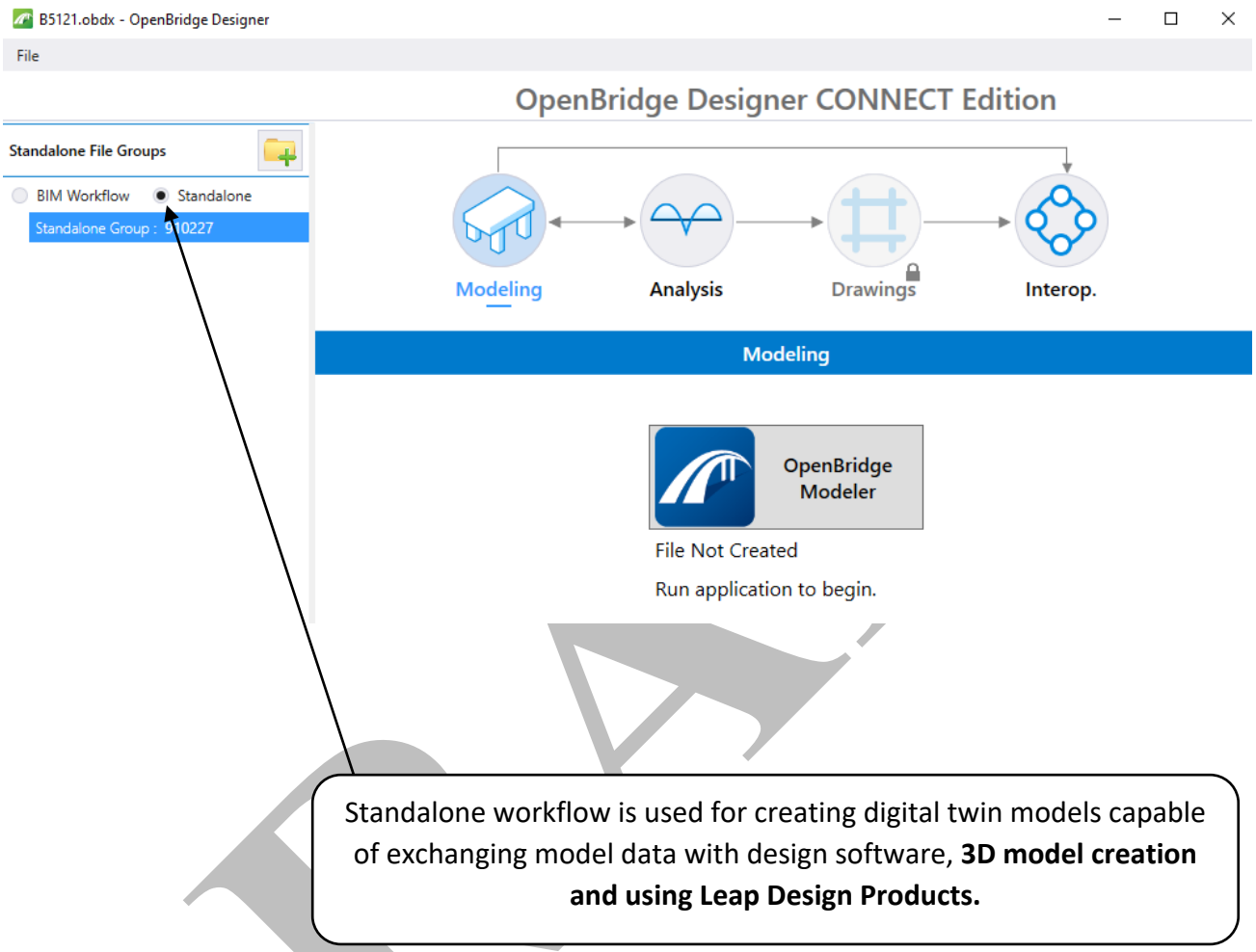


4.2.3.2 Creating a DGN in BIM Workflow



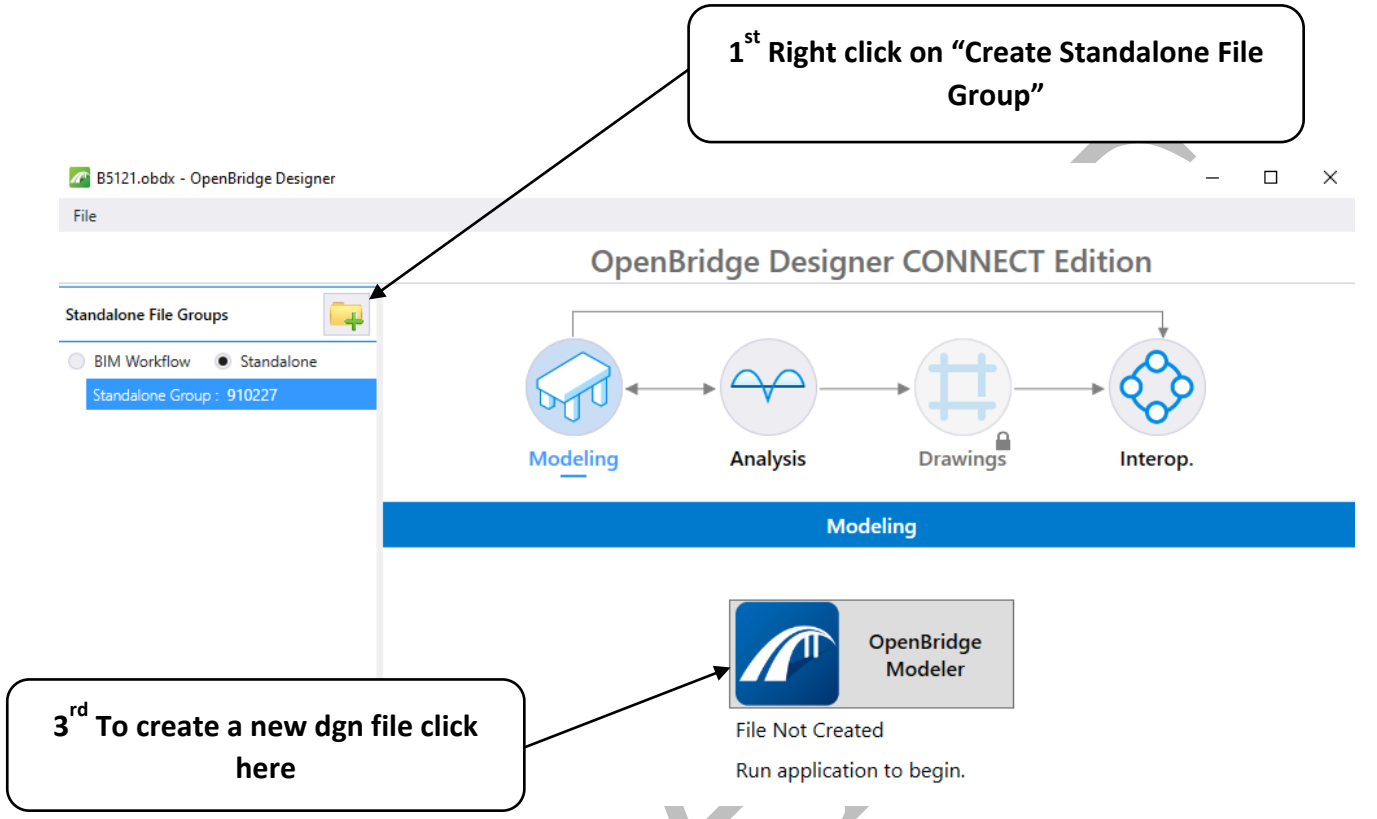
Continue creating a DGN with Sections 4.2.7-4.2.9

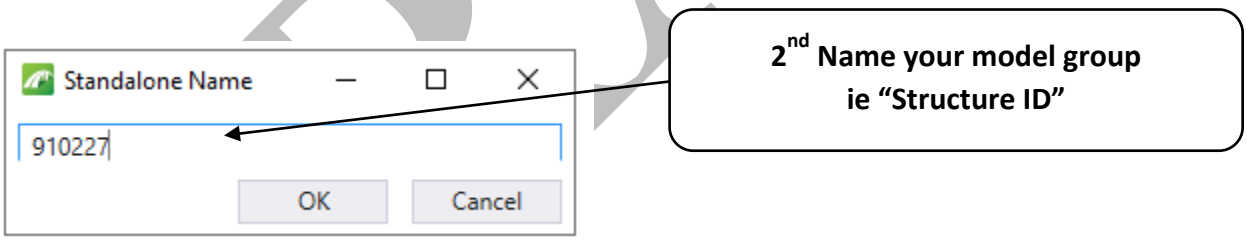
4.2.3.3 Standalone Project Workflow (2D Drawings & 3D Model)



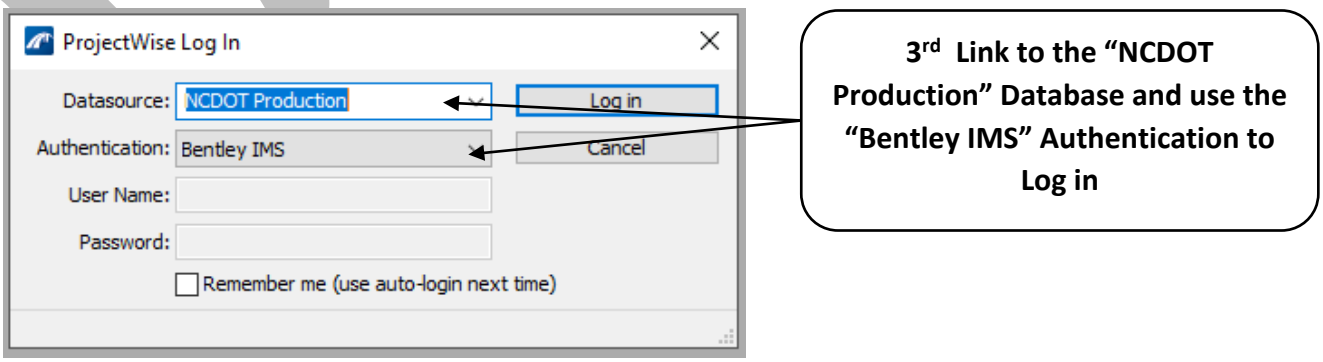
Standalone workflow is used for creating digital twin models capable of exchanging model data with design software, **3D model creation and using Leap Design Products.**

4.2.3.4 Creating a DGN in Standalone Workflow





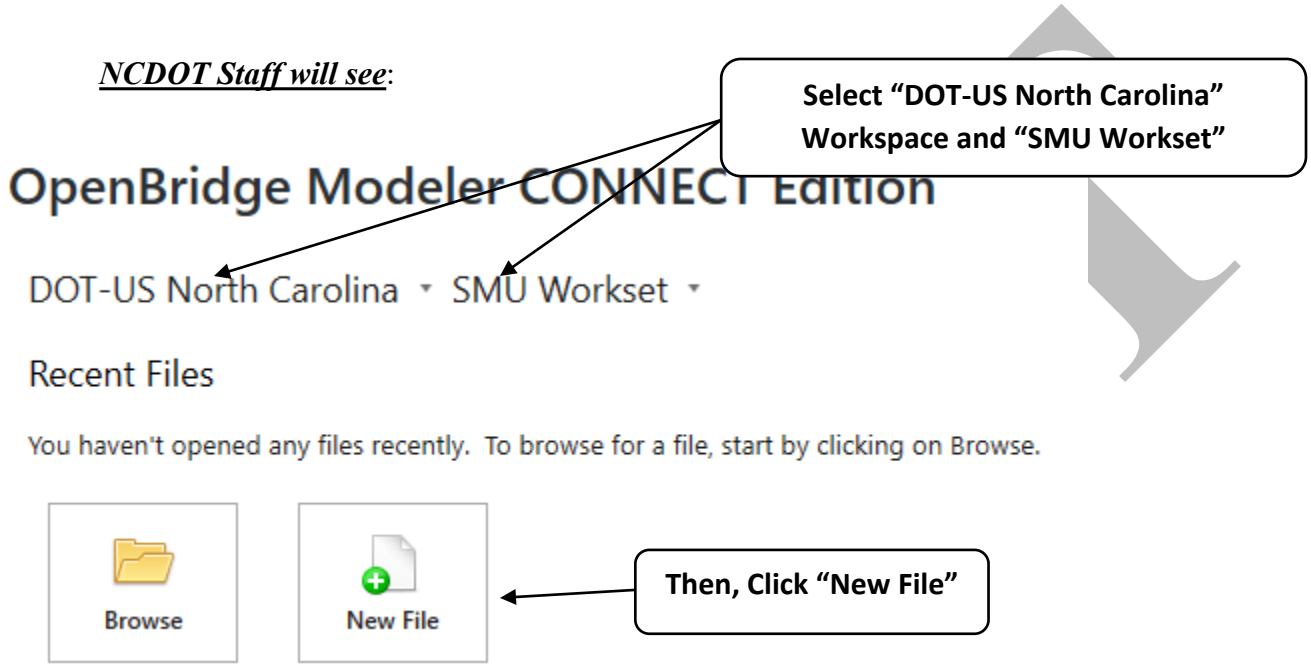
The following window will pop-up:



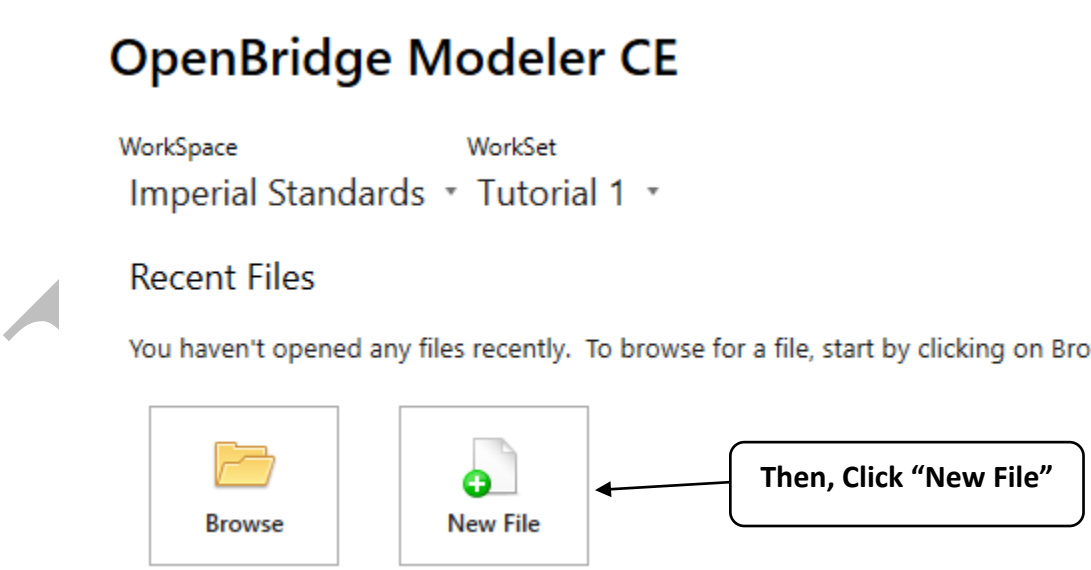
Continue creating a DGN with Sections 4.2.8-4.2.10.

4.2.4 DGN Creation in ProjectWise

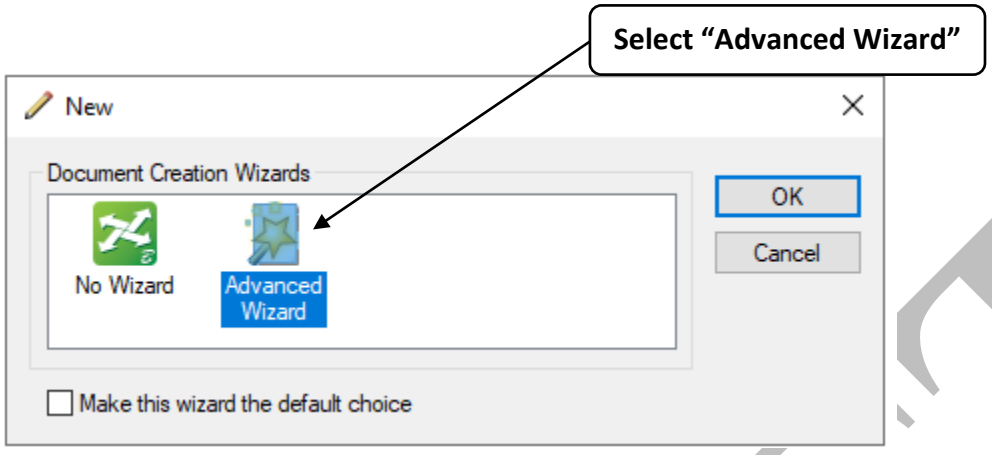
NCDOT Staff will see:



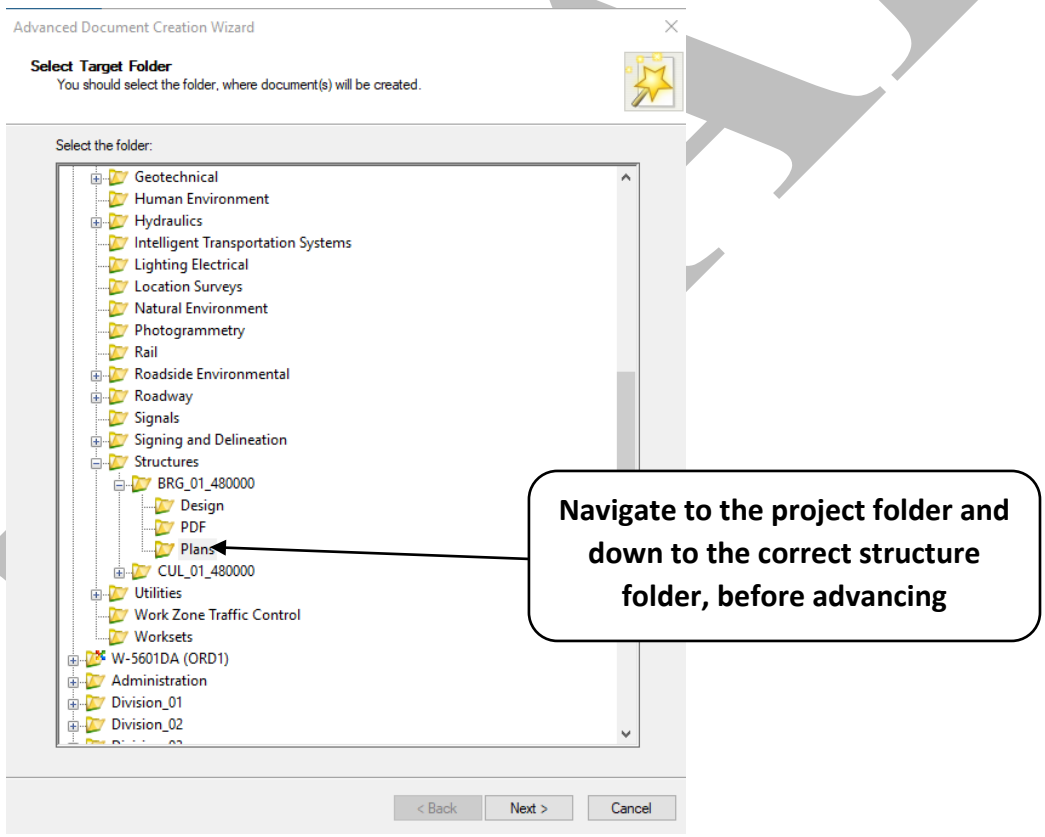
Consultants will see:

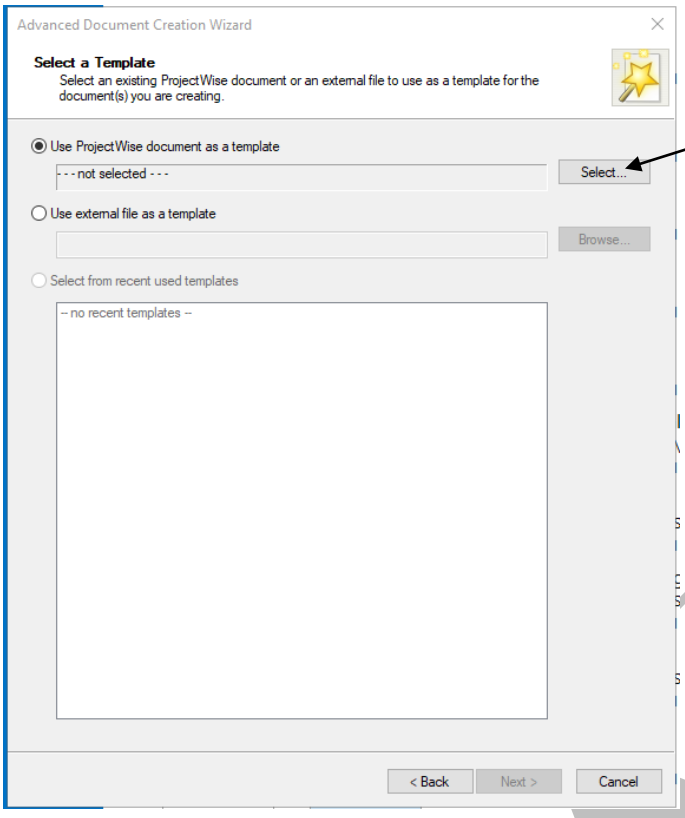


The following window will pop-up:



Note: The Advanced Wizard has replaced the NCDOT Design File Generator

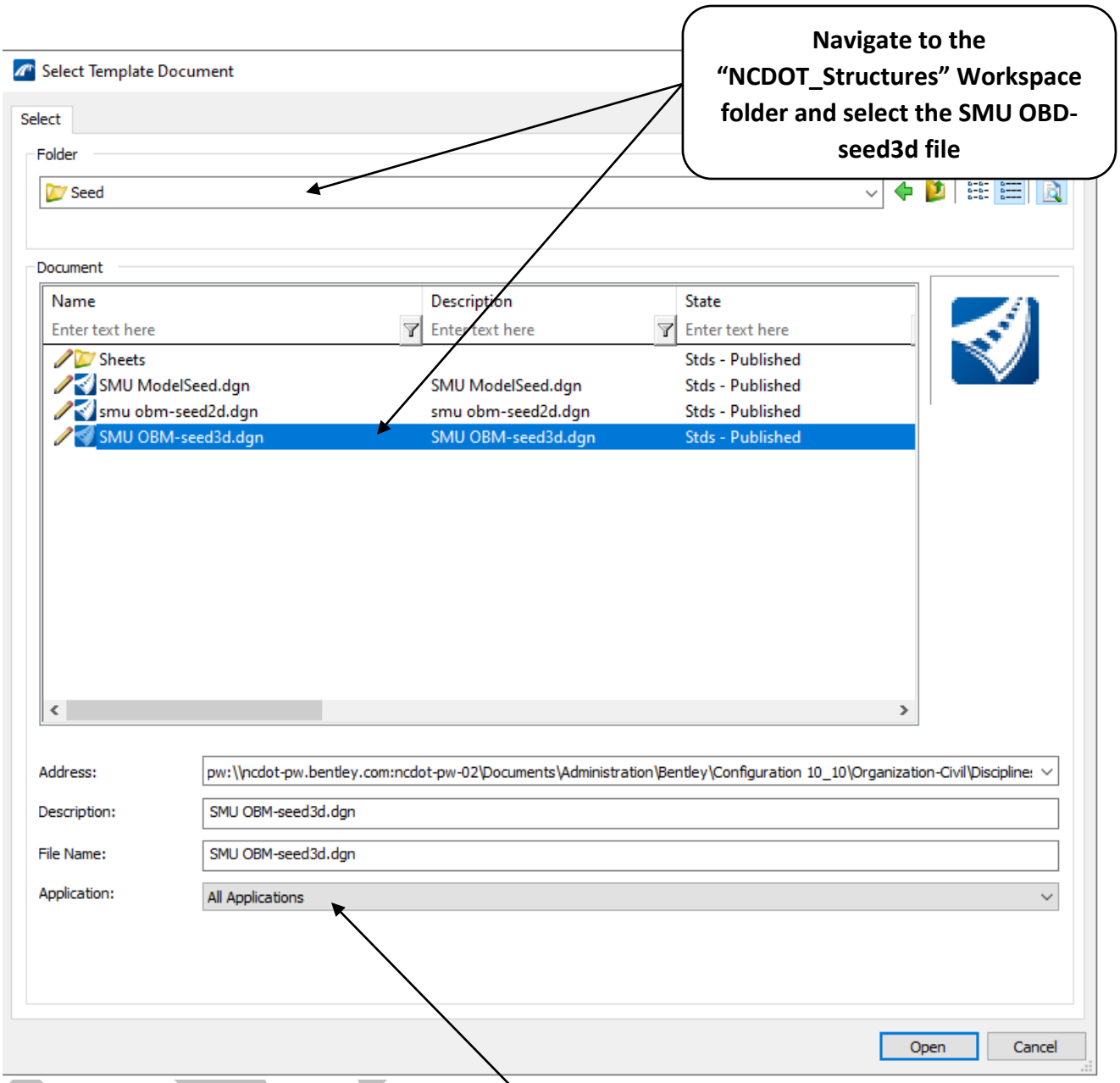


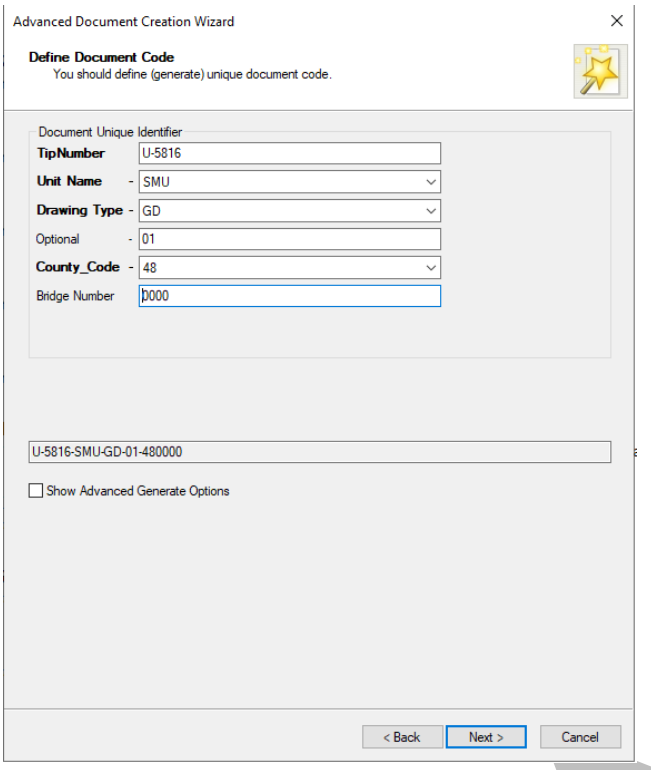


Use the ProjectWise document template.

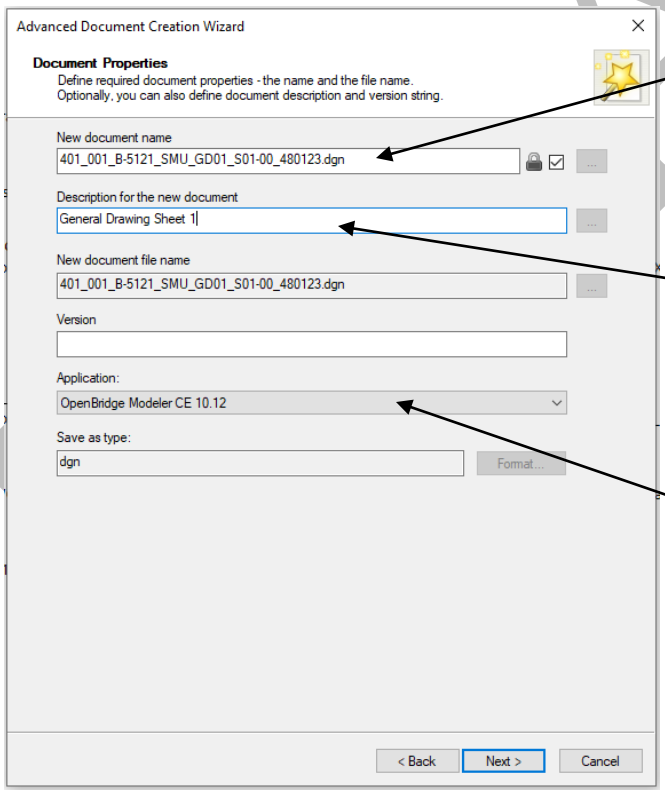
The SMU seed file is located here with ProjectWise: NCDOTProduction/Documents/Administration/WorkspaceGroups/NCDOTWorkspaces/Configuration_2023/Workspaces/DOT-US North Carolina/Roles/NCDOT_Structures/Standards/Seed

Note: The user only needs to select this one time, after that the seed file path will show up in the bottom "Select from recent used templates" box. To use it, just select the button next to "Select from recent used templates" and highlight the seed file.


Navigate to the "NCDOT_Structures" Workspace folder and select the SMU OBD-seed3d file
Select Template Document
Select
Folder
Seed
Document
Name
Description
State
Enter text here
Sheets
Stds - Published
SMU ModelSeed.dgn
SMU ModelSeed.dgn
Stds - Published
smu obm-seed2d.dgn
smu obm-seed2d.dgn
Stds - Published
SMU OBM-seed3d.dgn
SMU OBM-seed3d.dgn
Stds - Published
Address:
pw:\\ncdot-pw.bentley.com:ncdot-pw-02\Documents\Administration\Bentley\Configuration 10_10\Organization-Civil\Discipline
Description:
SMU OBM-seed3d.dgn
File Name:
SMU OBM-seed3d.dgn
Application:
All Applications
Open
Cancel
For now, leave as "All Applications"



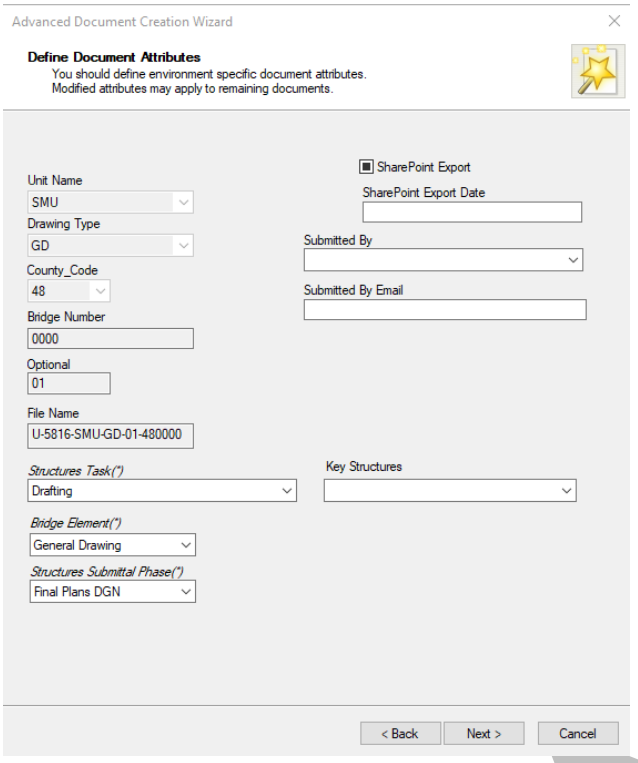
Fill out the metadata fields for the file being

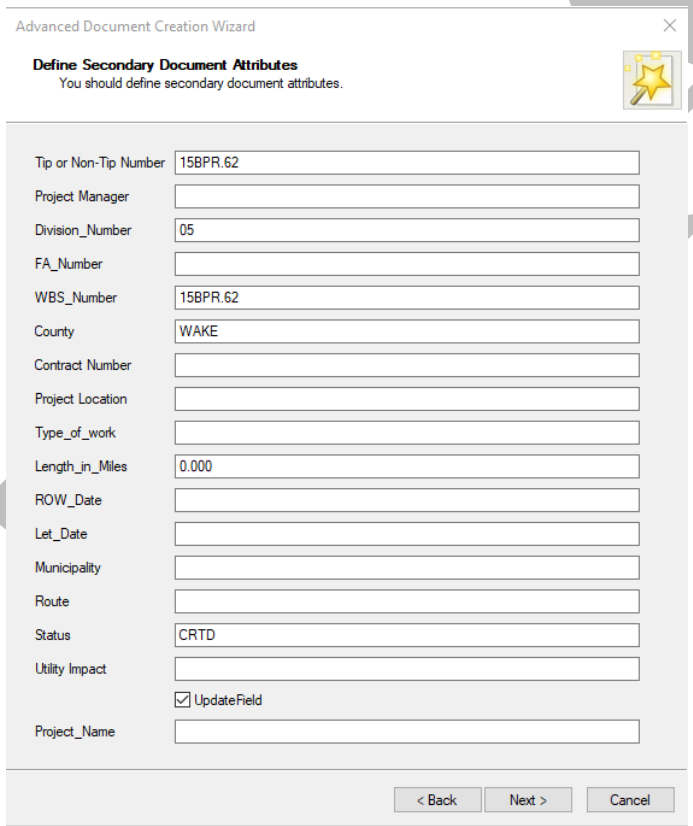


Complete the file name following the guidelines in Chapter 2, note the metadata entered earlier will partially create file name.

Update the Description to match dgn

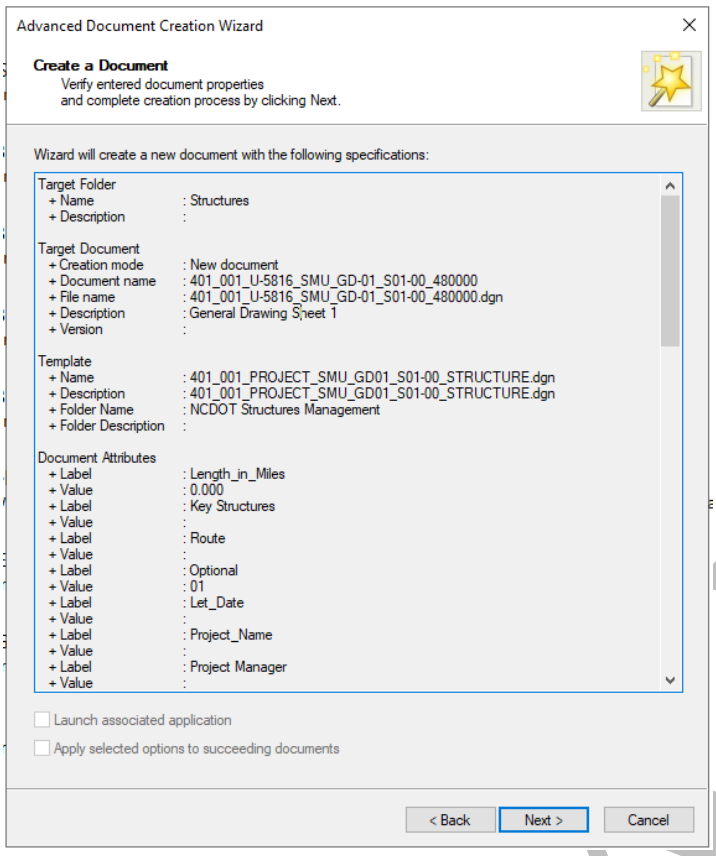
Select “OBM 2023” as the application.



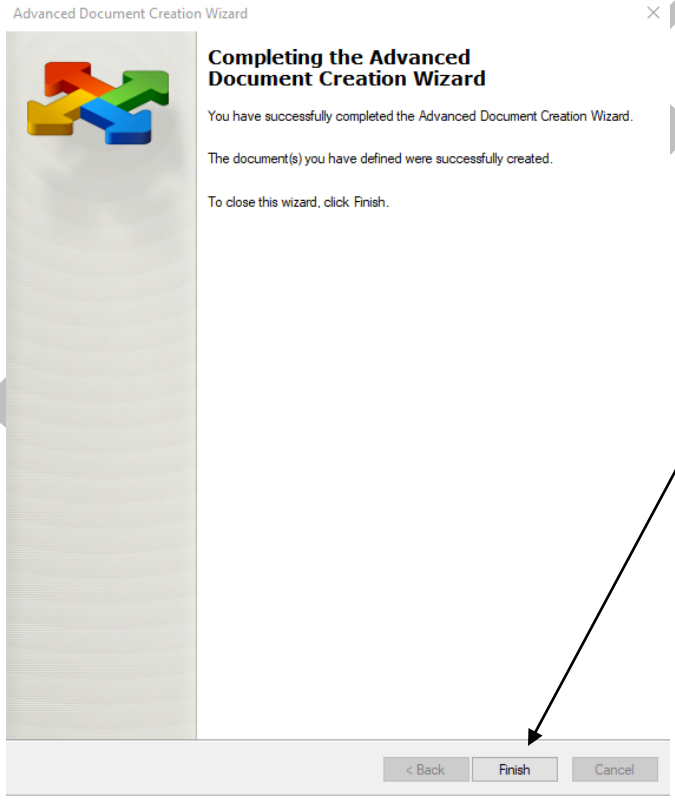


Select the metadata for the remaining fields, if one or more does not apply leave blank

Fill out the metadata fields that are blank that you can, otherwise leave input fields blank



Verify metadata fields are correct, otherwise use the "Back" button to revise as needed

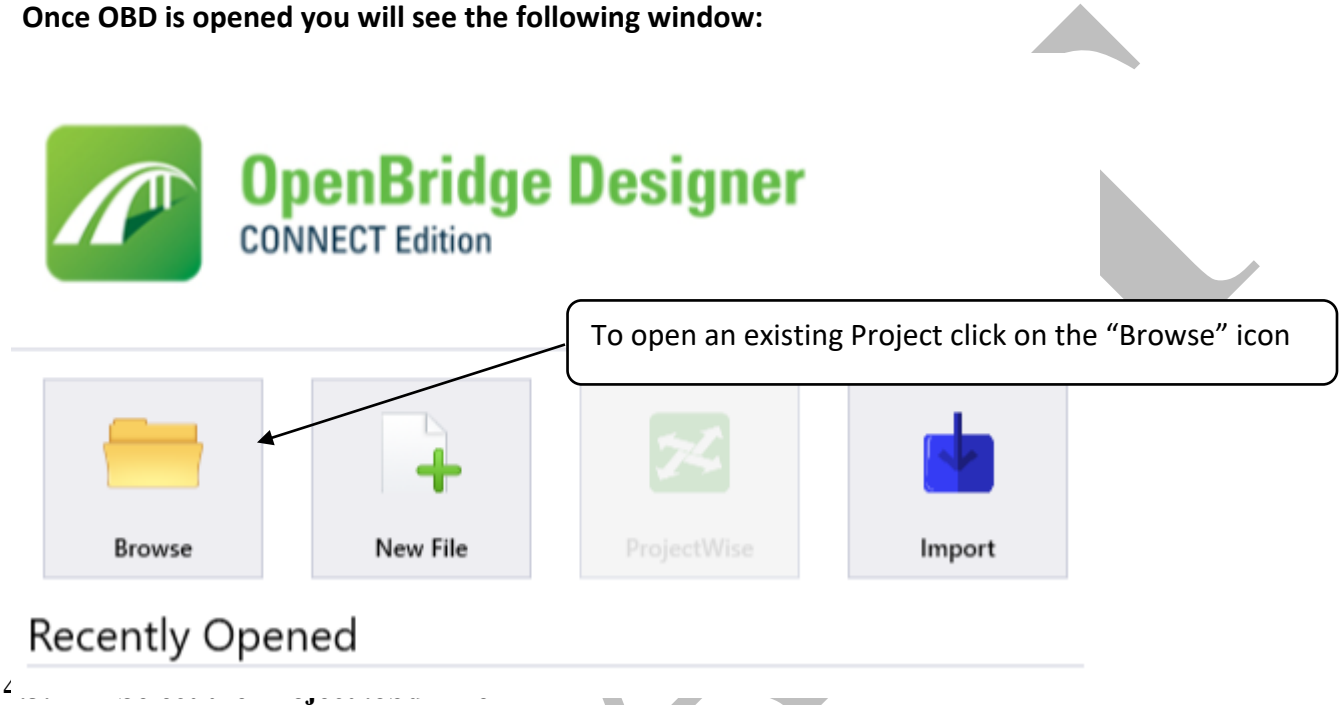


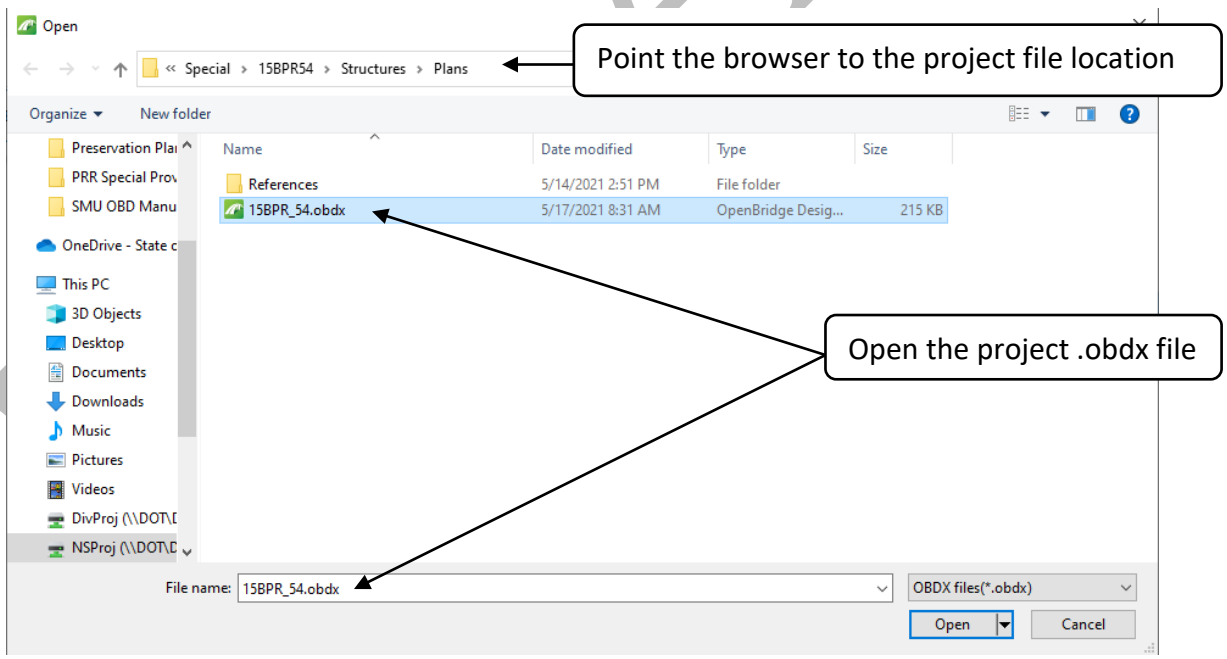
Use the "Finish" button to create the DGN

4.3 OPENING AN EXISTING DGN IN BIM WORKFLOW

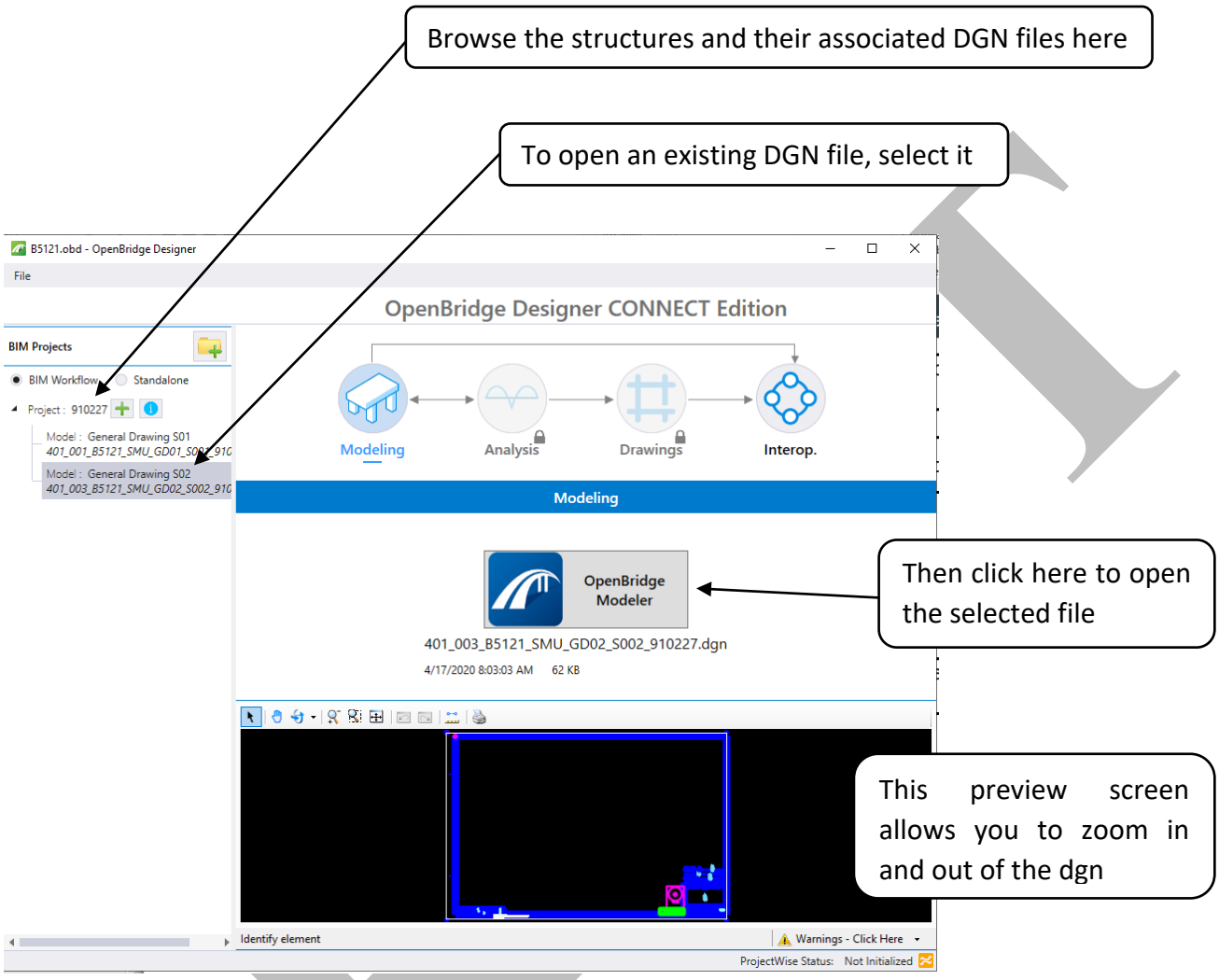
4.3.1 Open OBD file Browser

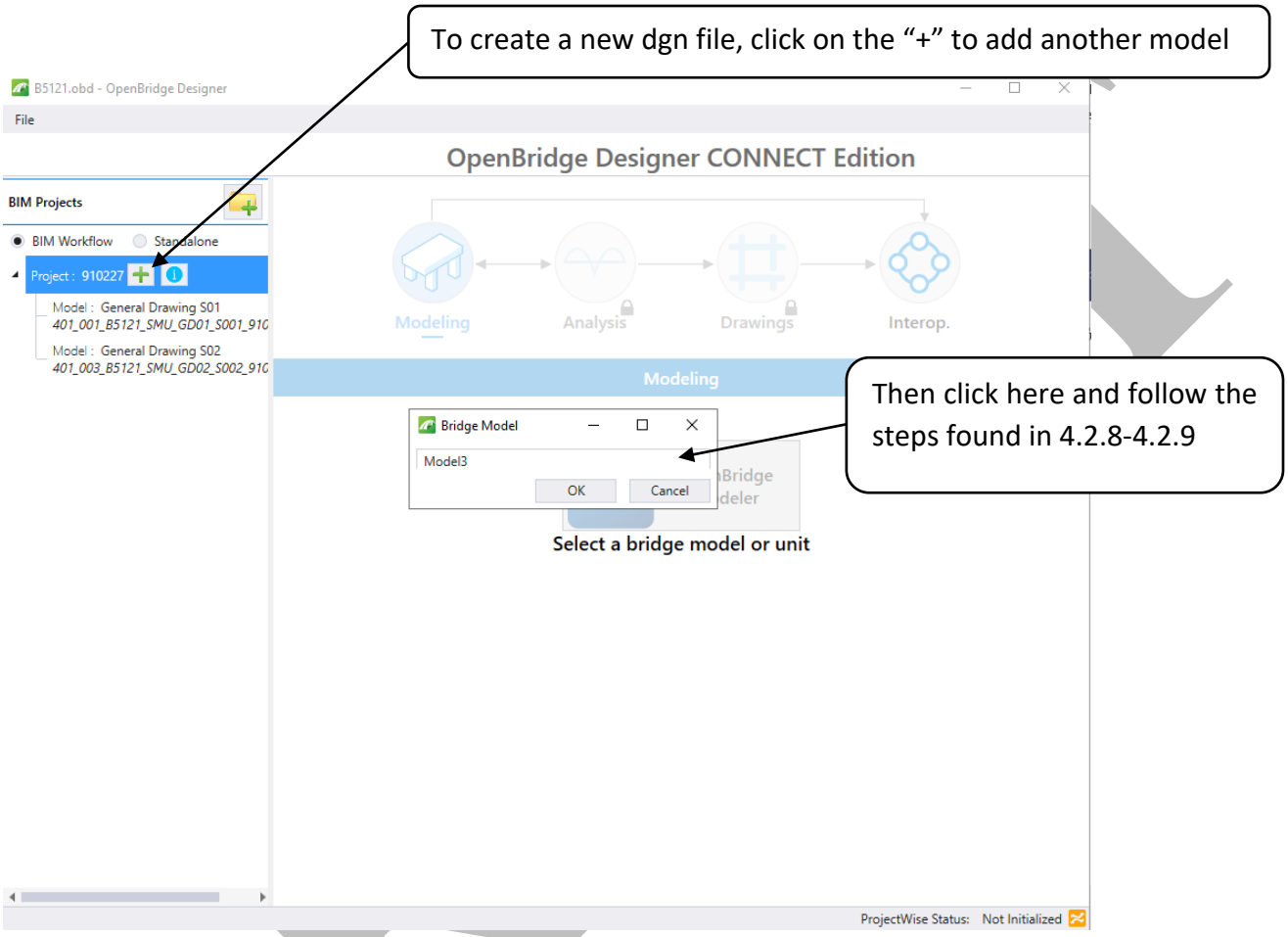
Once OBD is opened you will see the following window:





4.3.3 Select and Open Existing DGN

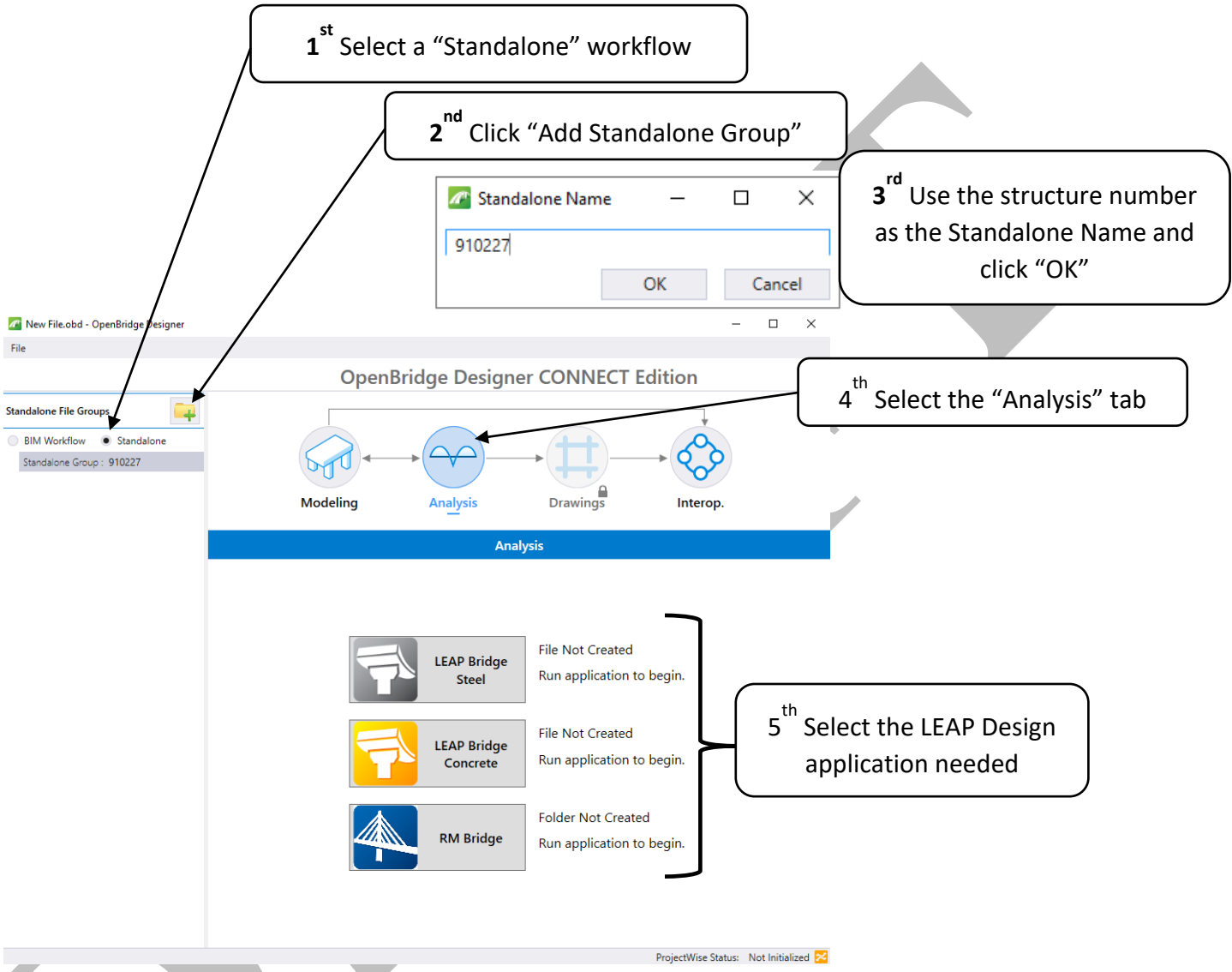




To attach the dgn created to the new bridge model, see 4.3.

4.5 OPENING LEAP DESIGN SOFTWARE

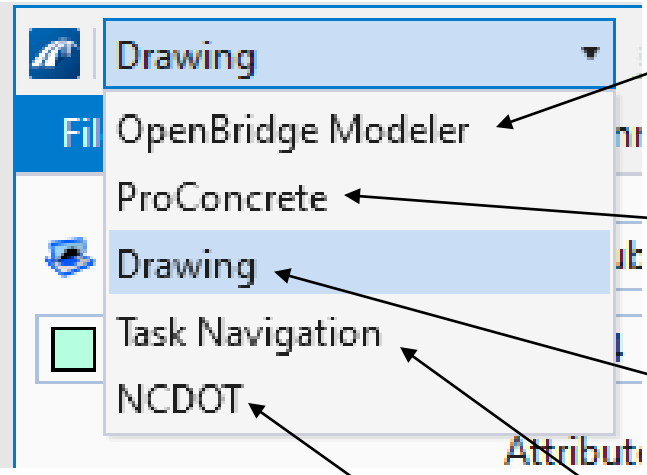
Follow the steps outlined in 4.2.8-4.2.9, then



Be sure to name and save Leap Design files to their appropriate project folders.

4.6 OBD DGN WORKFLOW

Once in OBD, selecting the correct workflow for the file is important.



"OpenBridge Modeler" workflow is used for using templates in 3D digital-twin creation

"ProConcrete" workflow is used for detailing reinforcing steel in 3D concrete members

"Drawing" workflow is used for both drawing in both 2D and 3D, and is the main workflow for 2D

"Task Navigation" workflow is used for drawing functions in both 2D and 3D

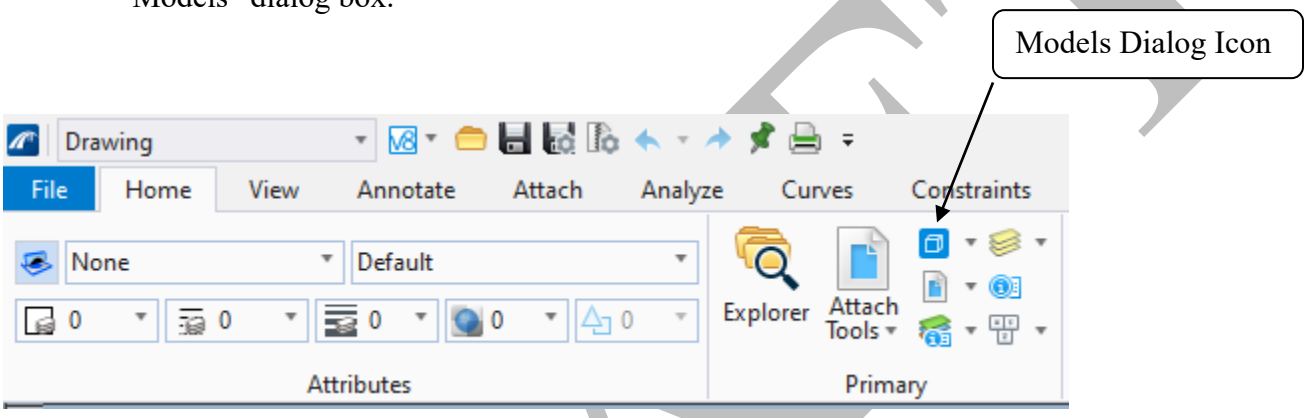
"NCDOT" workflow is used for connecting to NCDOT OneMAP tools

4.7 DGN MODELS

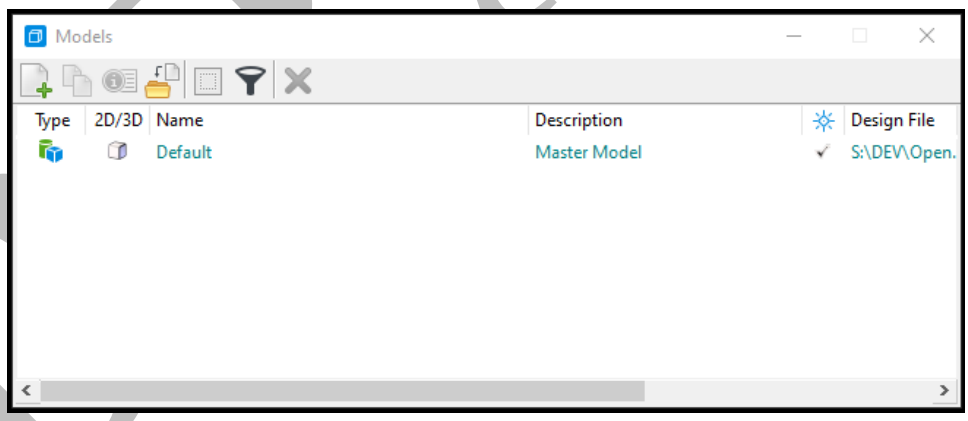
Once the DGN file is created following the SMU Naming Convention and saved to the correct project folder, the file will need to be set up for plan production. The following sections will cover the three model types and what they are used for. For further use of the models, see Chapters 5 and 6.

4.7.1 Setting Up the DGN

Once the DGN is created and saved in the correct folder, open the DGN and open the "Models" dialog box.



The default Models Dialog Box will look like this:



There are three different types of models that can be created within a DGN; a Design Model, a Drawing Model, and a Sheet Model.

4.7.1.1 Design Models

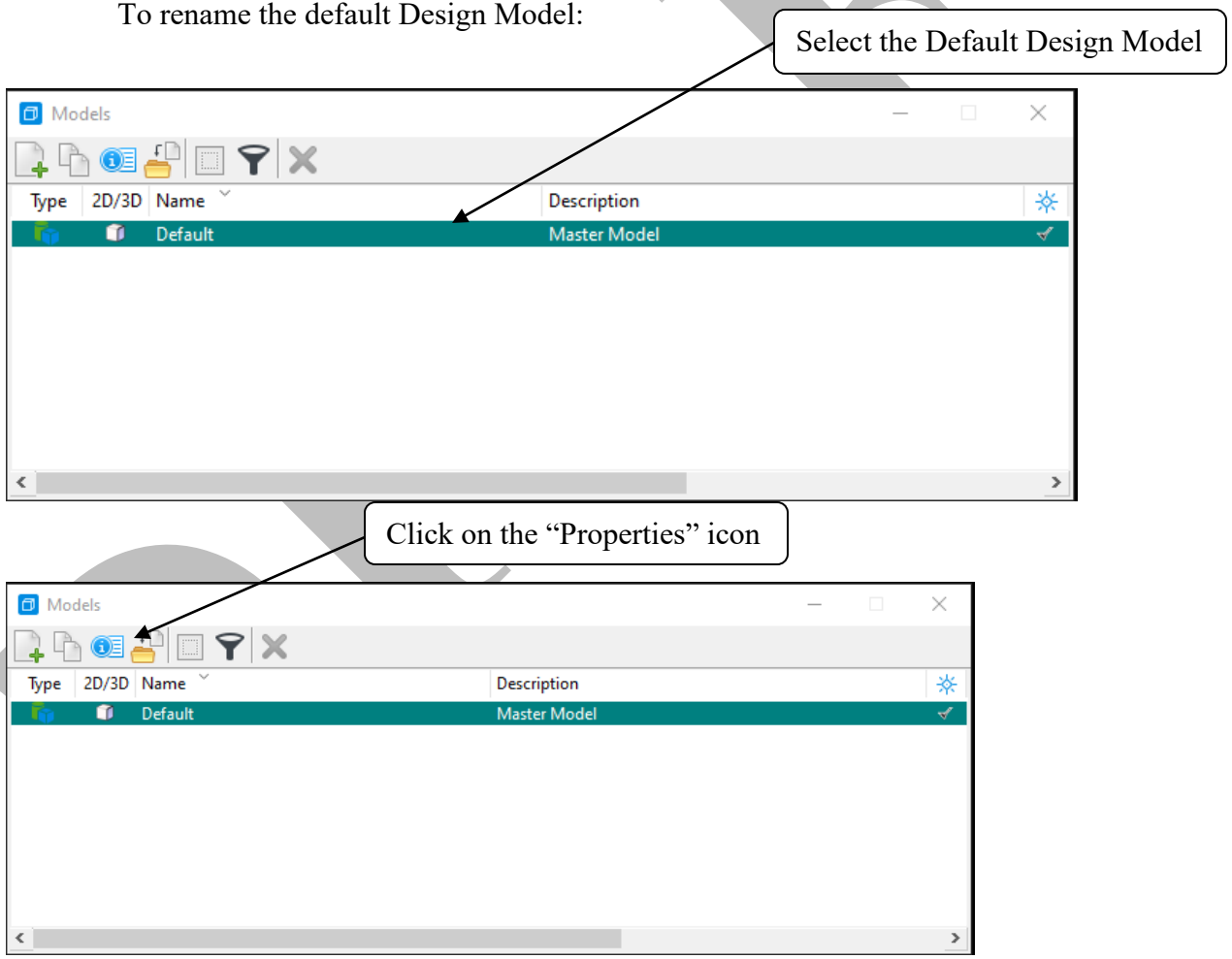
Design Models have default black backgrounds and can be either 2D 

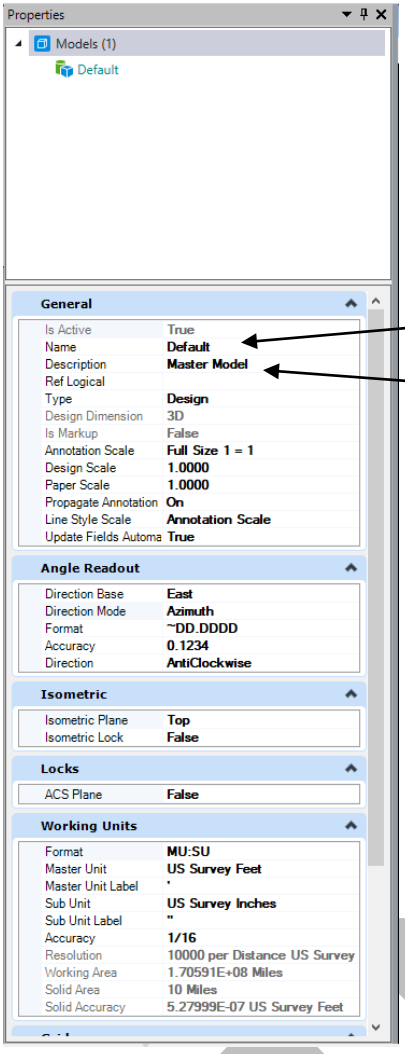
or 3D 

. The default design model in SMU's seed file is 3D and will remain as a 3D model, the user can close the view 2 window and save settings to remove the isometric view and make the model feel like a 2D model. A Design Model is meant to contain the following information:

- 3D digital twin that represents what is to be built or an existing structure, drawn full size (1:1) or,
- 2D elements that represent what is to be built or is existing, drawn full scale (1:1)
- Not intended for publication, only for editing
- Can be a part of a complex design, where multiple design models can be referenced to each other to form a design composition.

To rename the default Design Model:





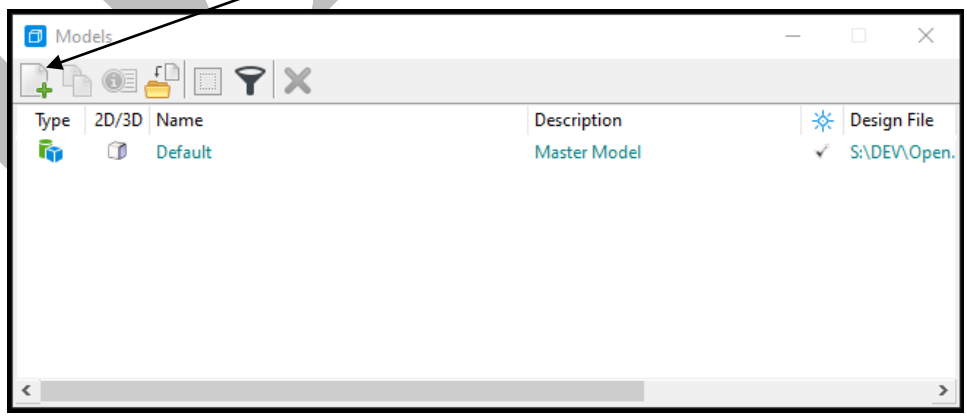
Change Model Name

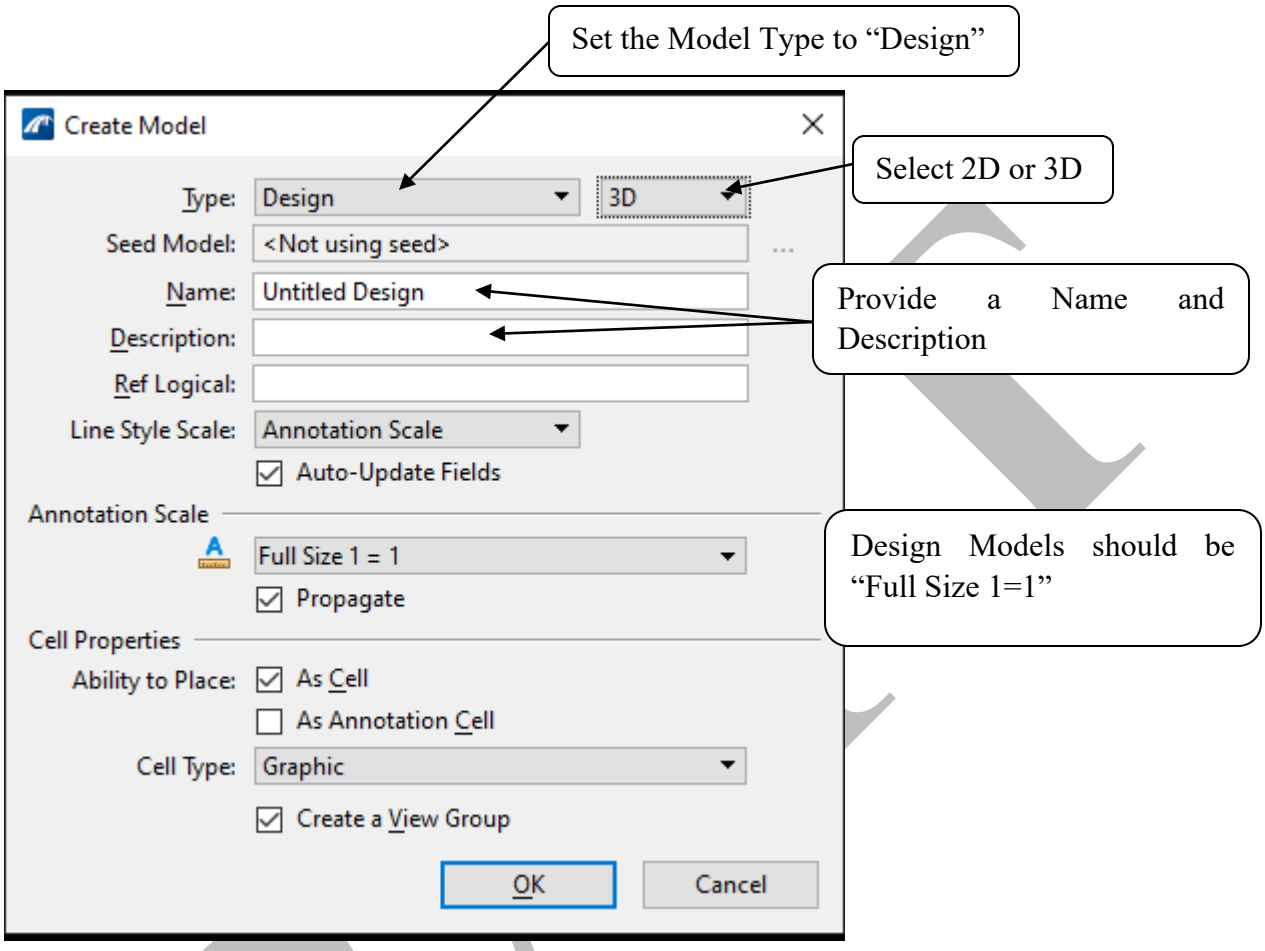
Change Description

Once the Properties are updated as needed, save the file and close the Properties dialog box.

To create a new Design Model

Click on "Create New Model"





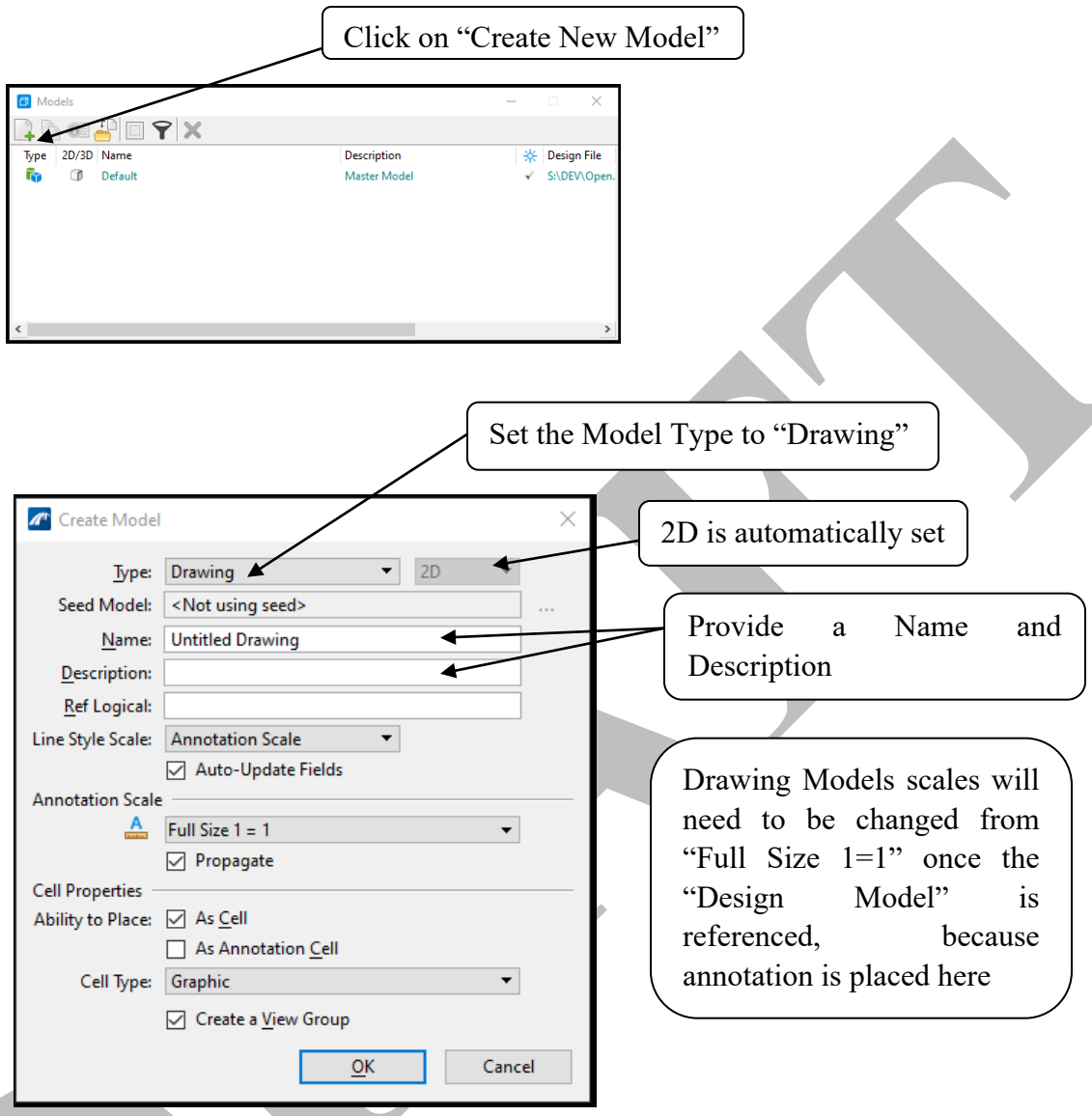
4.7.1.2 Drawing Models

Drawing Models have a default grey background and are always 2D 

. A Drawing Model is meant to contain the following information:

- An area for attaching Design Models 1:1 as references (typically done with the drawing tools cutting views of the 3D digital twin)
- Used as the location where non-sheet specific annotation is applied (dimensions, callouts, etc.)

To create a new Drawing Model, without using a drawing tool (such as the Place Named Boundary tool).



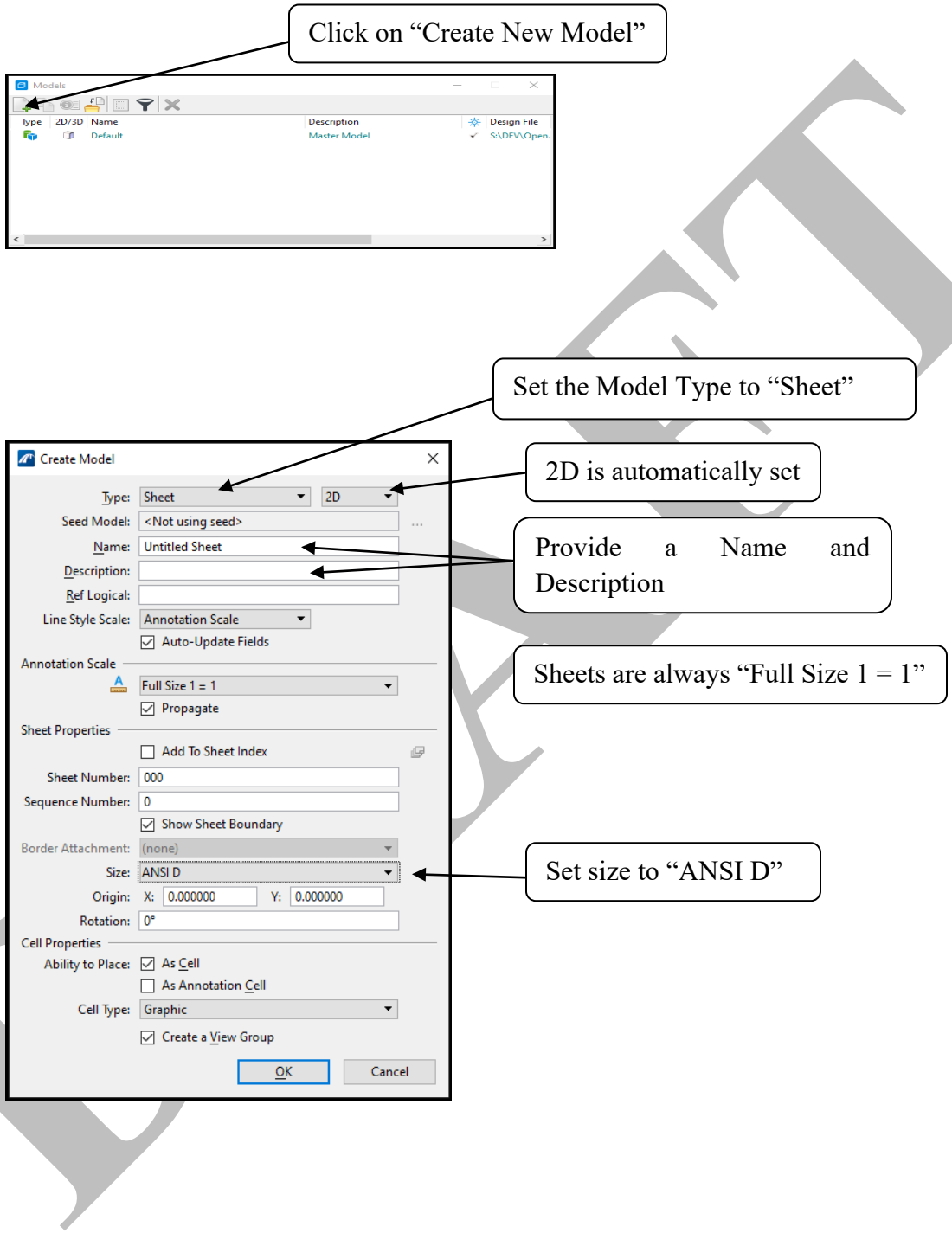
4.7.1.3 Sheet Models

Sheet Models have a default white background and are always 2D 

. A Sheet Model is meant to contain the following information:

- Used to define the ready for printing document
- An area where the Drawing Models are referenced and attached at their own scale to create a final plan sheet
- Has defined printing output settings (like ANSI D paper size)
- Includes a sheet boundary which defines the printing area

To create a new Sheet Model, without using a drawing tool

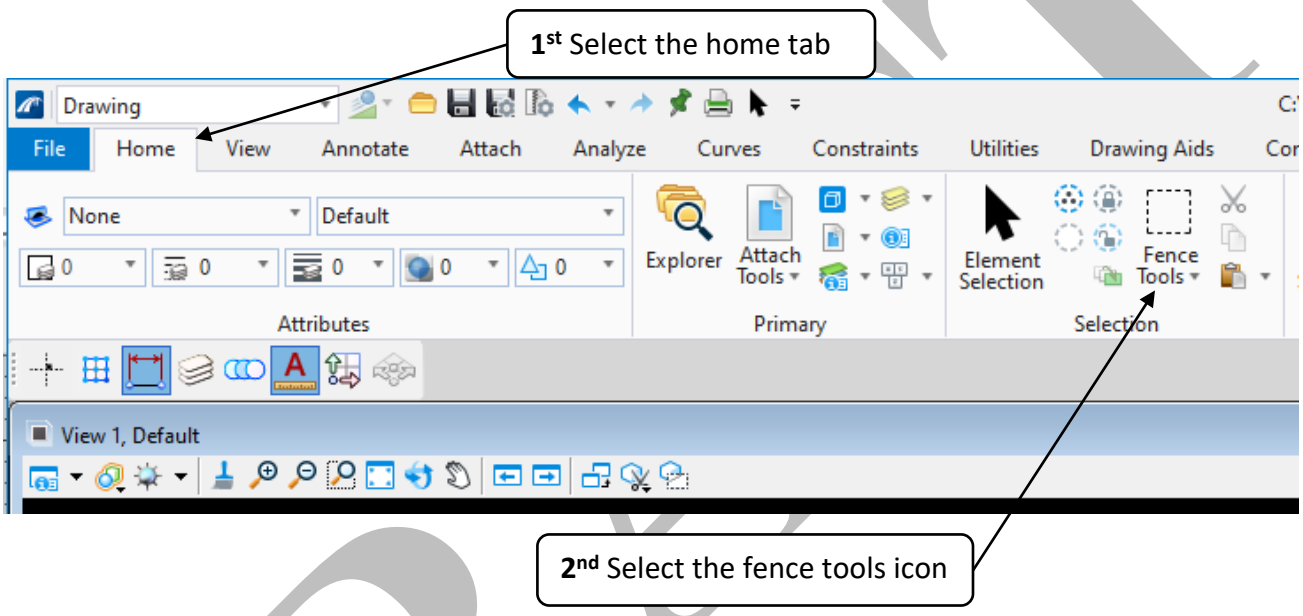


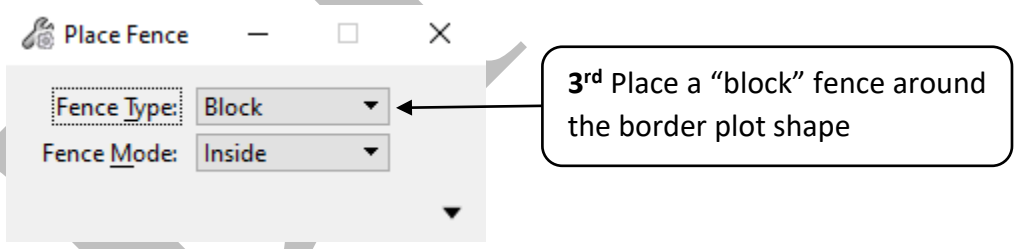
4.8 PRINTING PDF'S

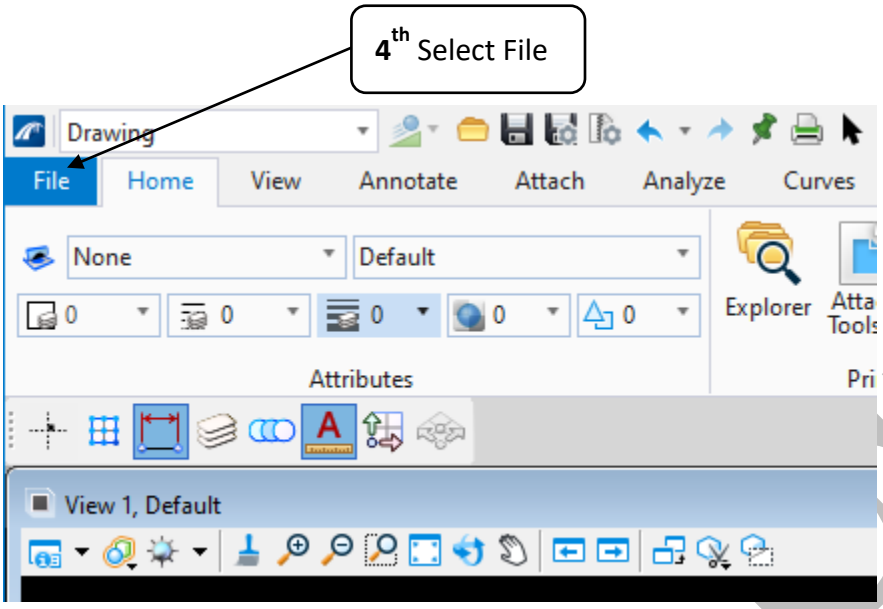
All printing should be generating full scale (ANSI D, 34x22) PDFs, which can be physically printed to any size paper when printing from your PDF viewing software.

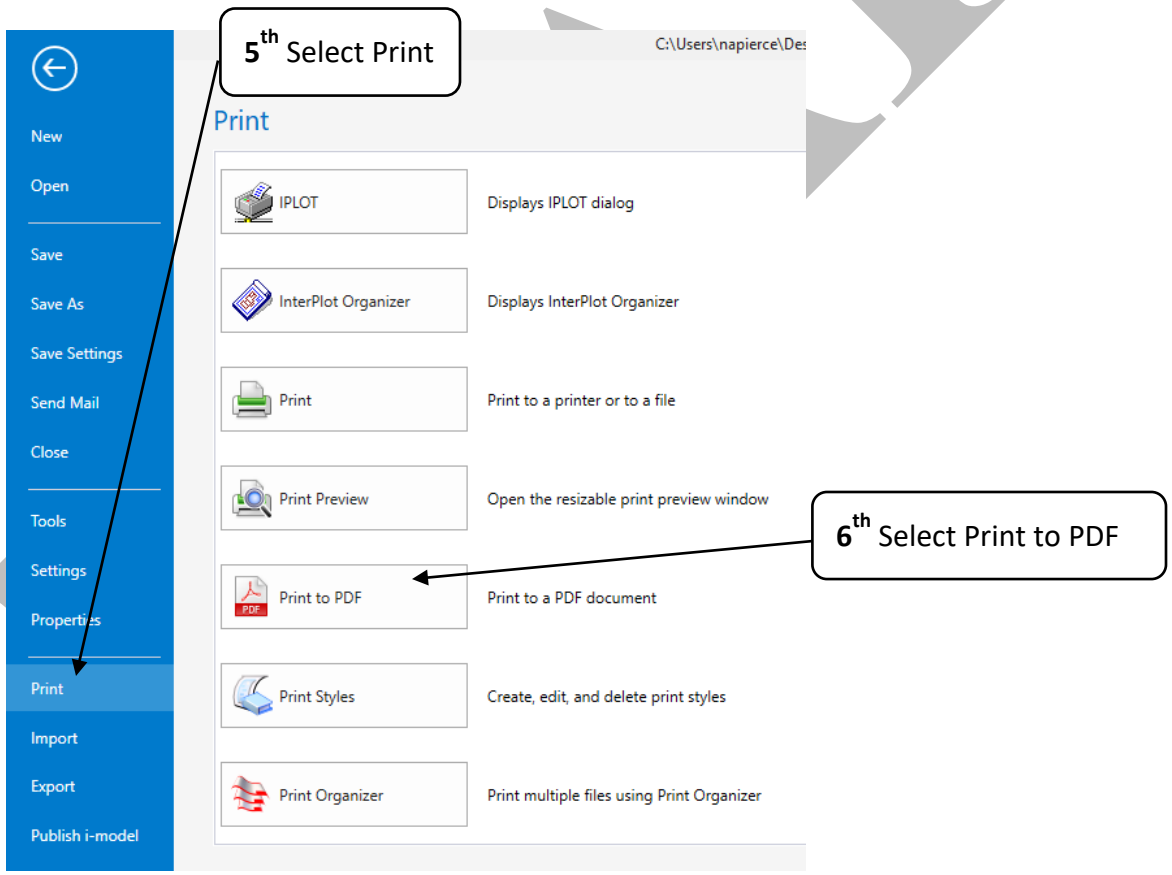
4.8.1 Creating a PDF Document from a Single DGN Converted from a V8i DGN

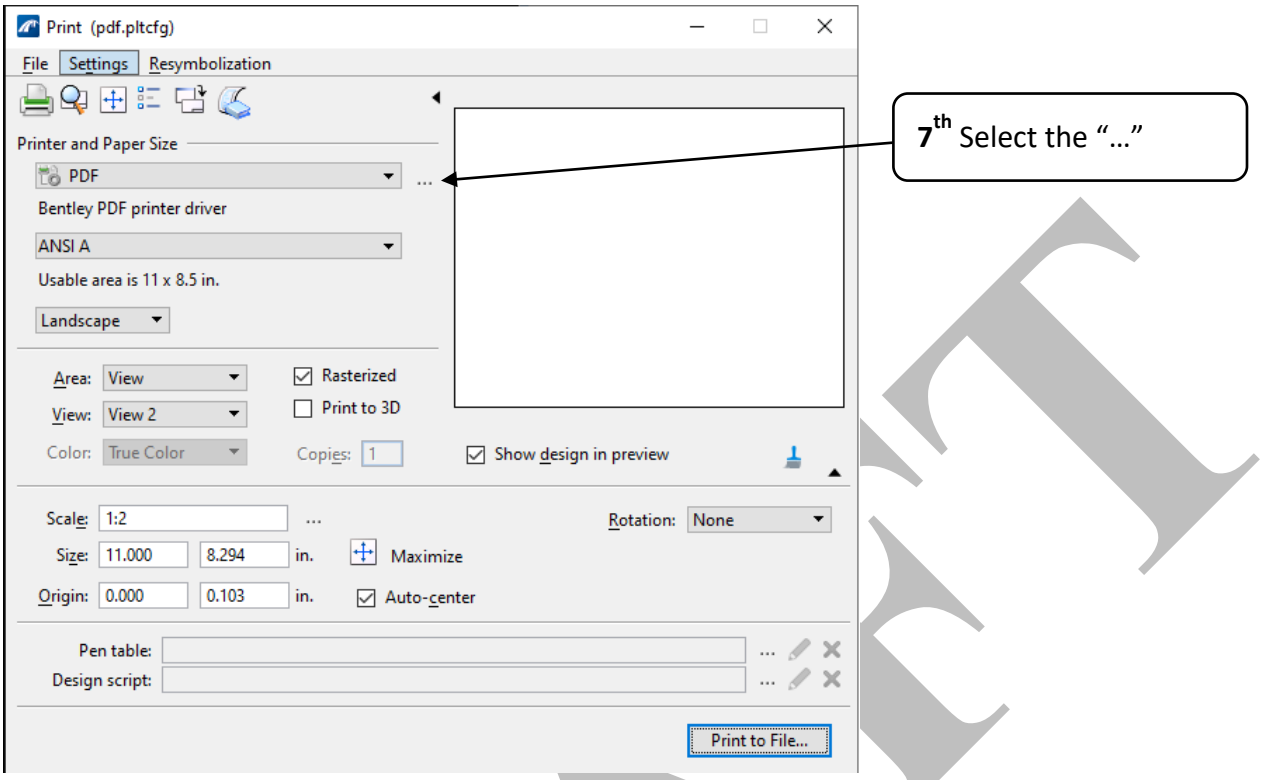
To PDF a single plan sheet file, follow these steps:





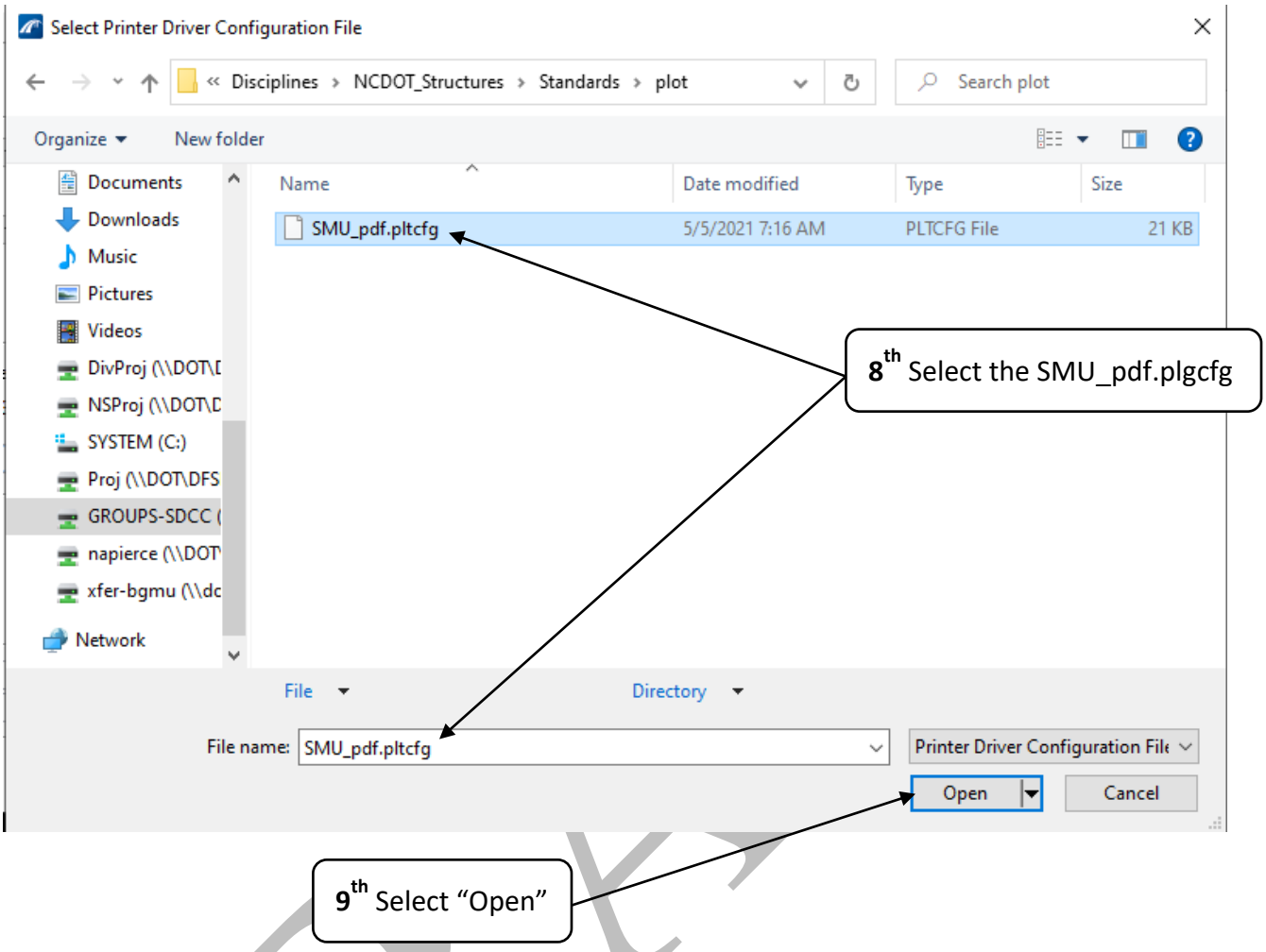

4th Select File
Drawing
File
Home
View
Annotate
Attach
Analyze
Curves
None
Default
Explorer
Attributes
View 1, Default

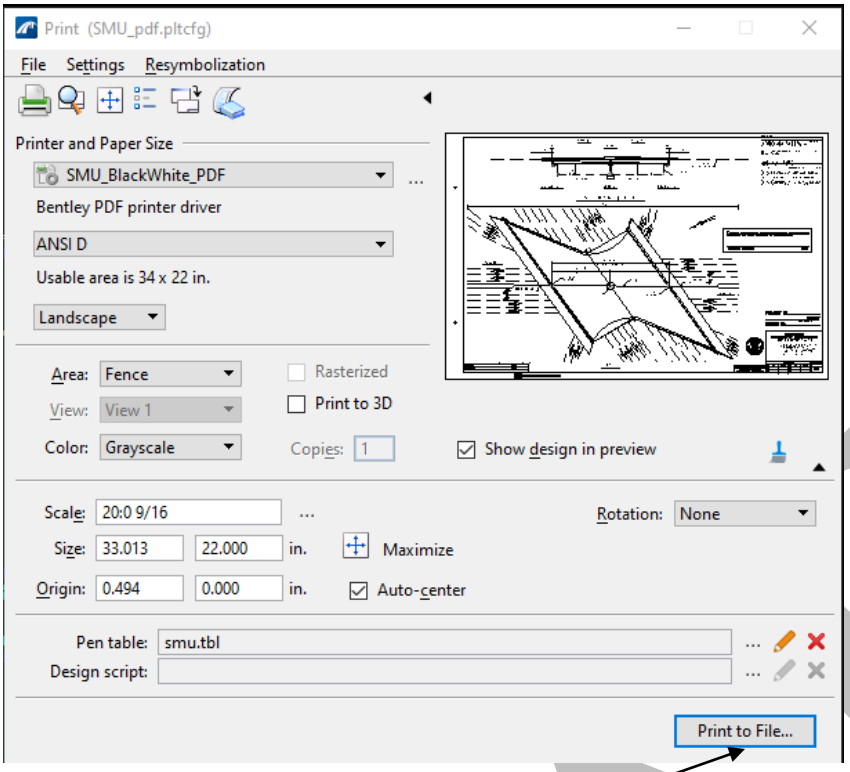

5th Select Print
6th Select Print to PDF
New
Open
Save
Save As
Save Settings
Send Mail
Close
Tools
Settings
Properties
Print
Import
Export
Publish i-model
Print
IPLOT
Displays IPLOT dialog
InterPlot Organizer
Displays InterPlot Organizer
Print
Print to a printer or to a file
Print Preview
Open the resizable print preview window
Print to PDF
Print to a PDF document
Print Styles
Create, edit, and delete print styles
Print Organizer
Print multiple files using Print Organizer



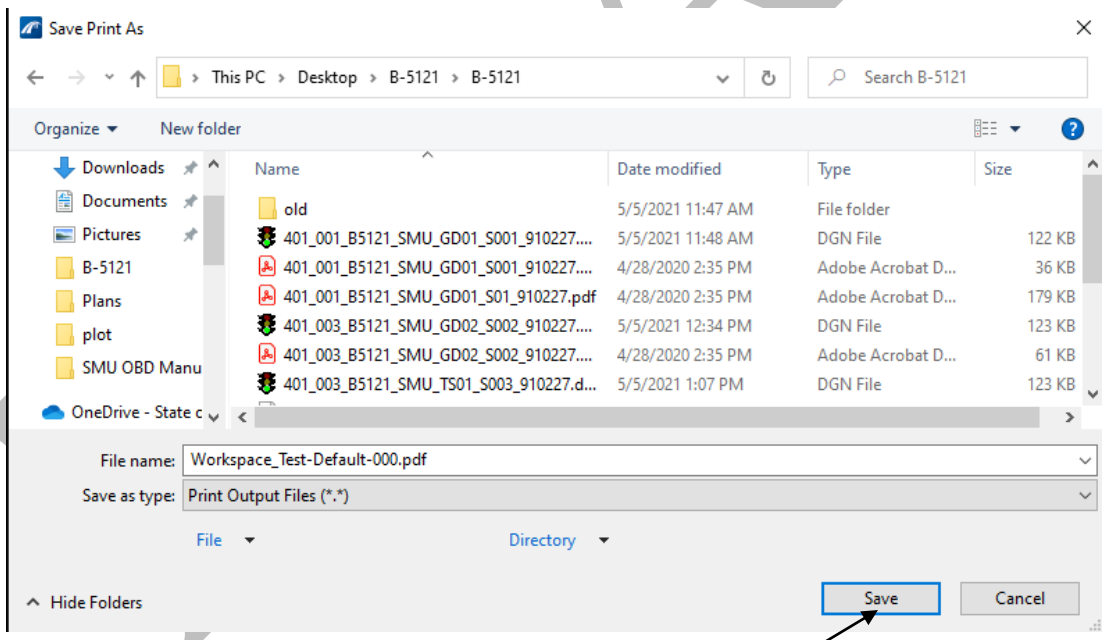
Direct the Select Printer Driver Configuration File tool to the following path:

NCDOTProduction/Documents/Administration/WorkspaceGroups/NCDOTWorkspaces/Configuration_2023/Workspaces/DOT-US North Carolina/Roles/NCDOT_Structures/Standards/plot


Select Printer Driver Configuration File
Disciplines › NCDOT_Structures › Standards › plot
Search plot
Organize
New folder
Documents
Downloads
Music
Pictures
Videos
DivProj (\\DOT\D
NSProj (\\DOT\D
SYSTEM (C:)
Proj (\\DOT\DFS
GROUPS-SDCC (
napierce (\\DOT
xfer-bgmu (\\dc
Network
Name
Date modified
Type
Size
SMU_pdf.pltcfg
5/5/2021 7:16 AM
PLTCFG File
21 KB
File
Directory
File name:
SMU_pdf.pltcfg
Printer Driver Configuration File
Open
Cancel
8th Select the SMU_pdf.plgcfg
9th Select "Open"



10th Print to File

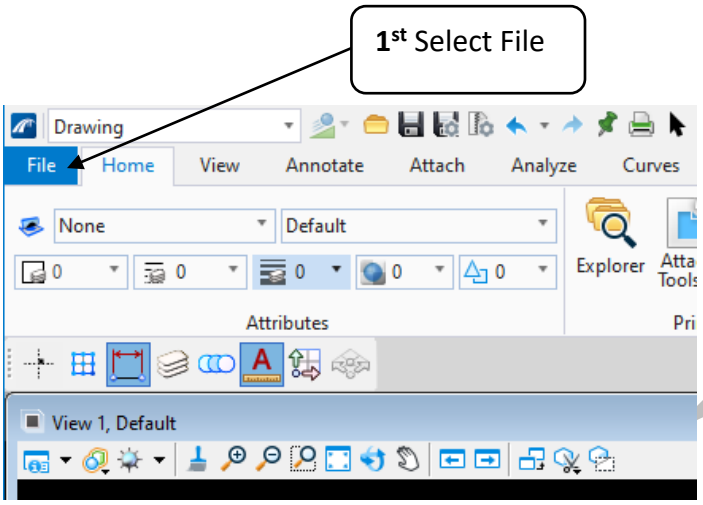


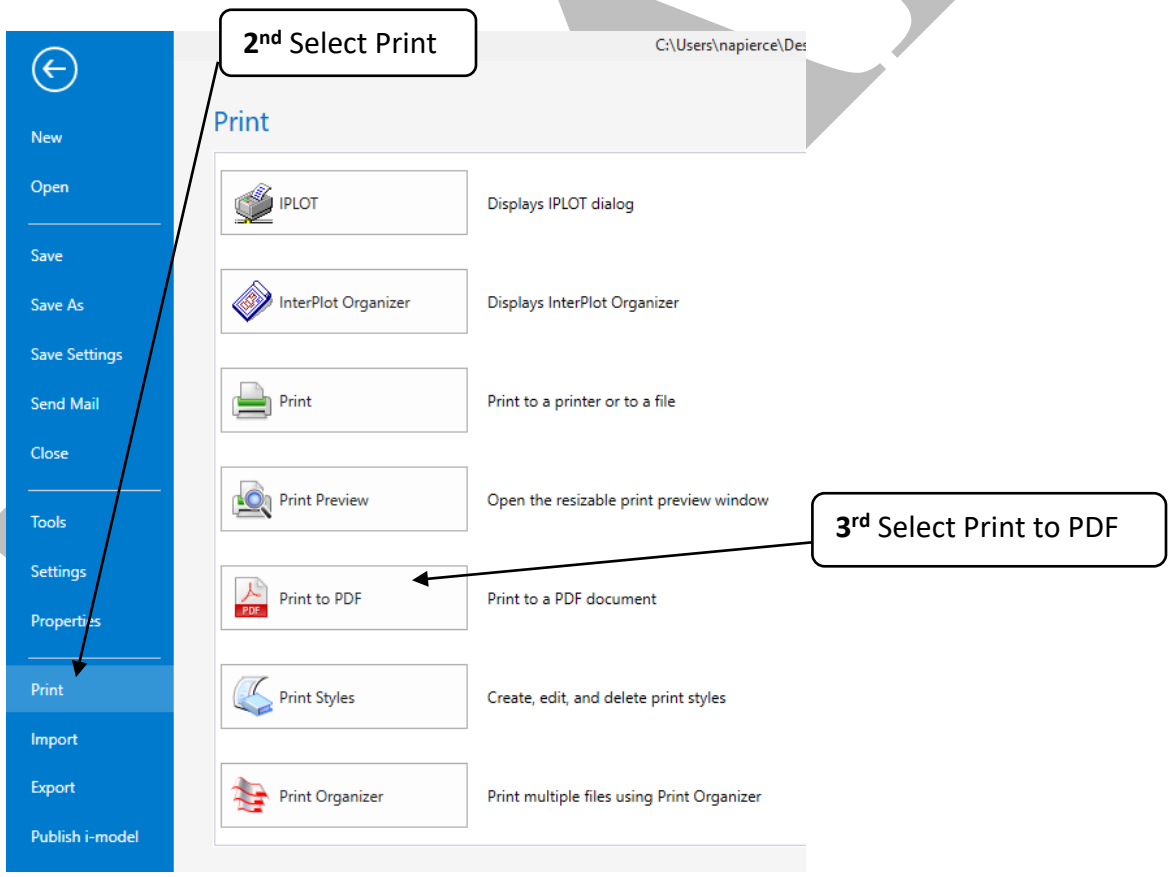
11th Save the file in the Project Folder

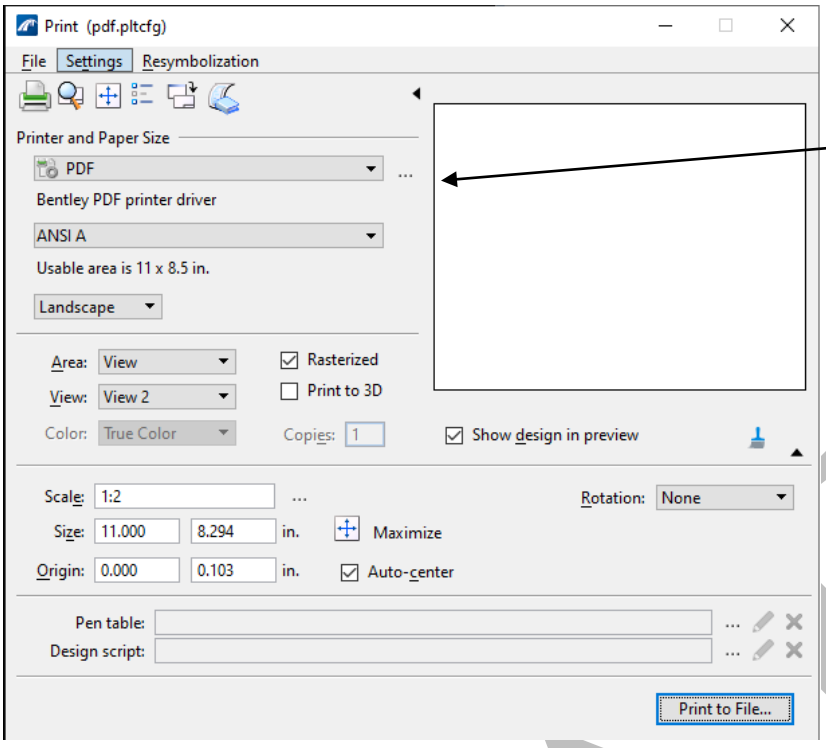
To print to paper, open the file in Adobe or BlueBeam and print from there.

4.8.2 Creating a PDF Document from a Single DGN

To PDF a single plan sheet file, from the Sheet Model follow these steps:

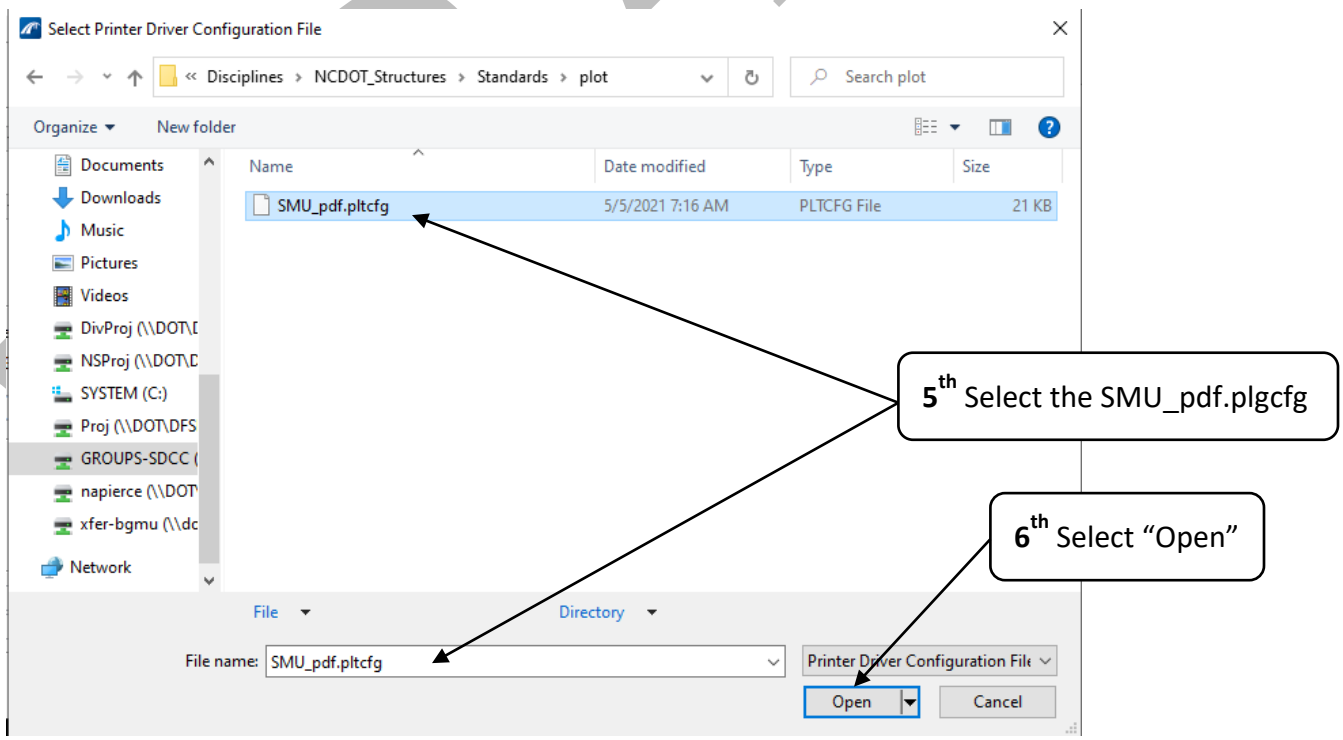


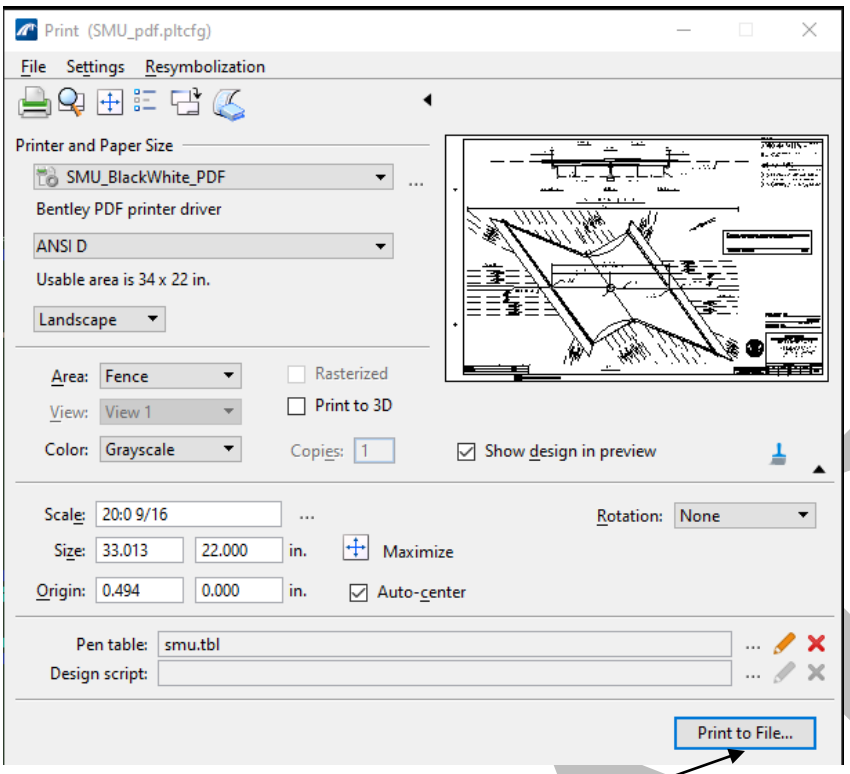




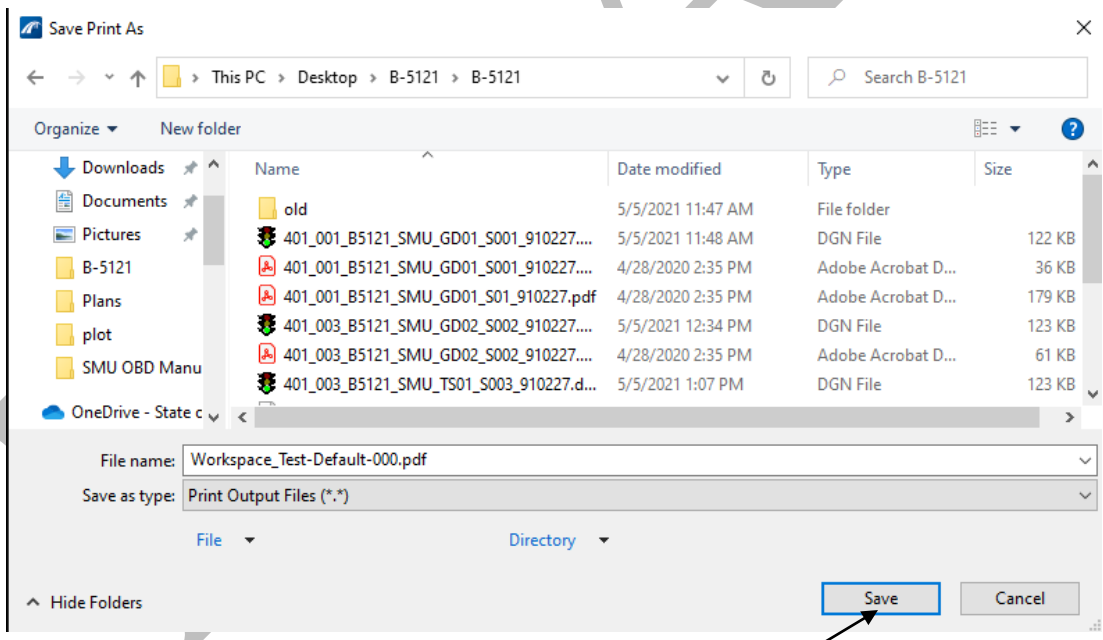
Direct the Select Printer Driver Configuration File tool to the following path:

NCDOTProduction/Documents/Administration/WorkspaceGroups/NCDOTWorkspaces/Configuration_2023/Workspaces/DOT-US North Carolina/Roles/NCDOT_Structures/Standards/plot





7th Print to File

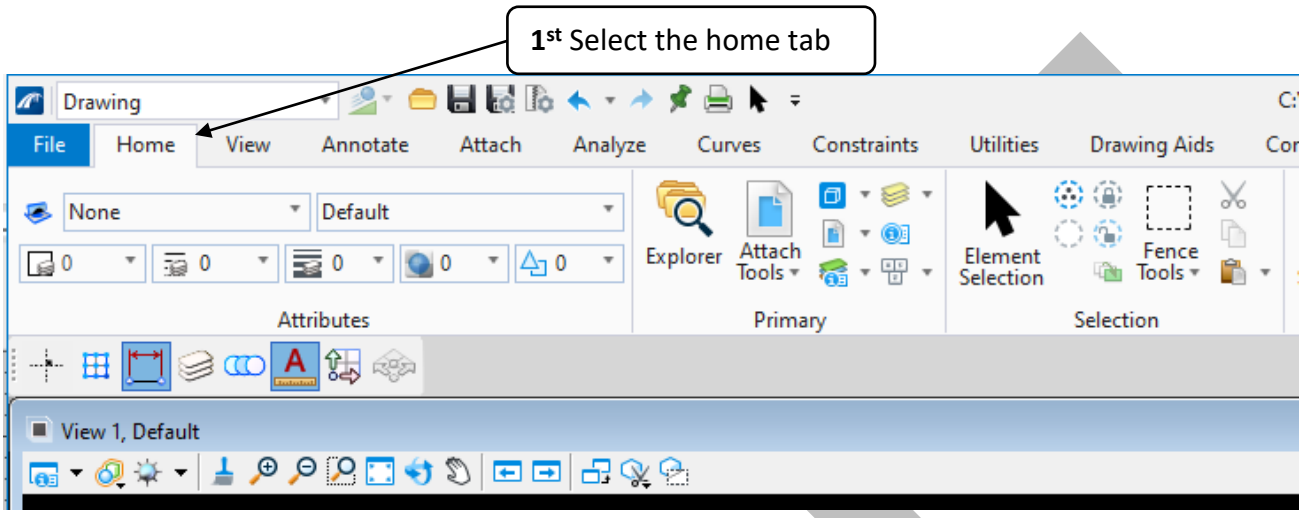


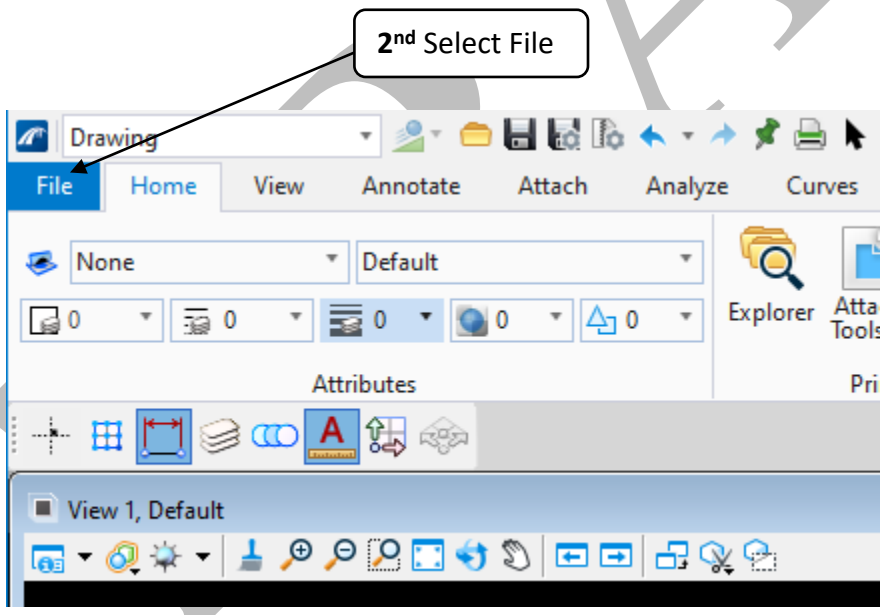
8th Save the file in the Project Folder

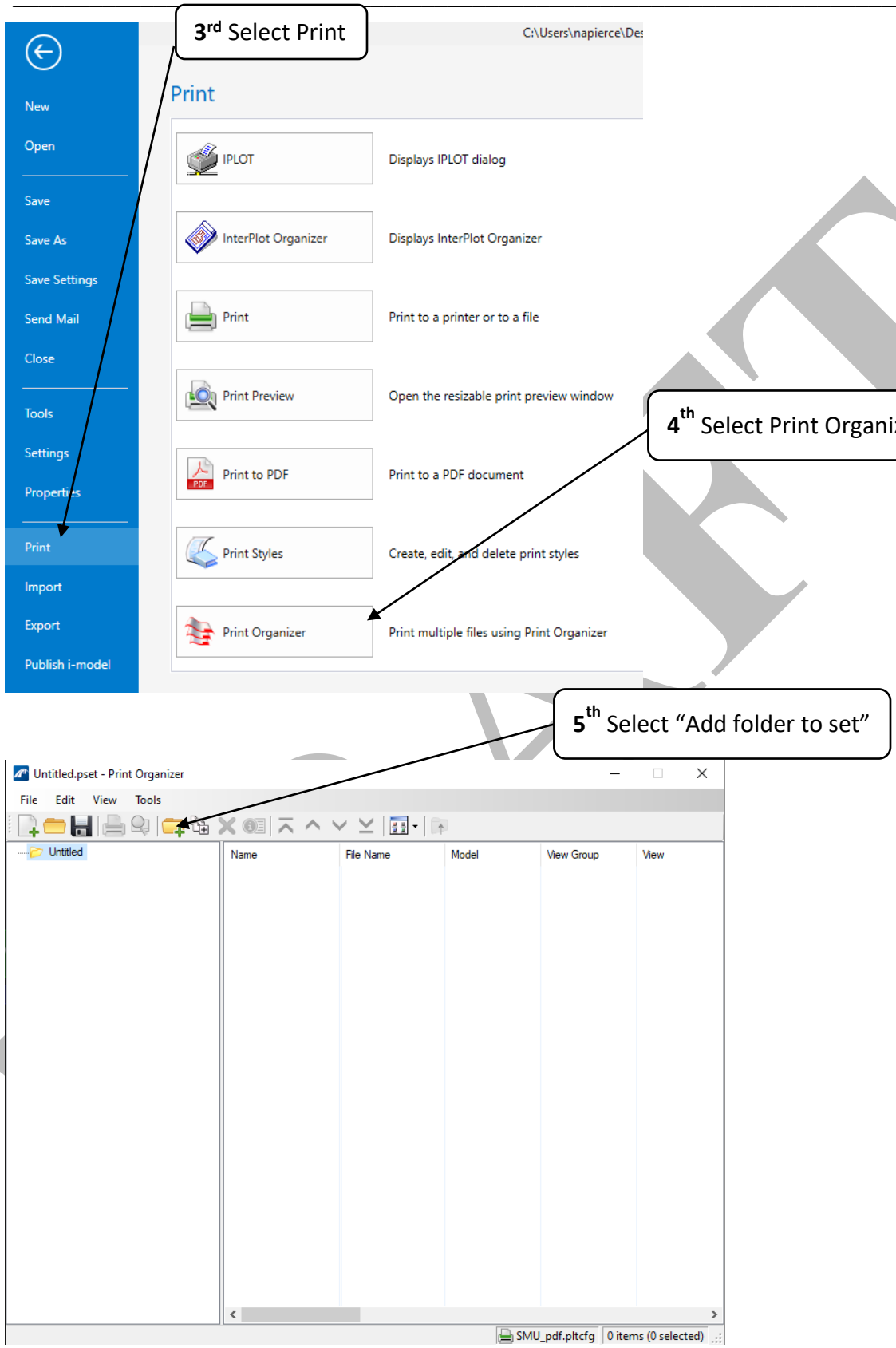
To print to paper, open the file in Adobe or BlueBeam and print from there.

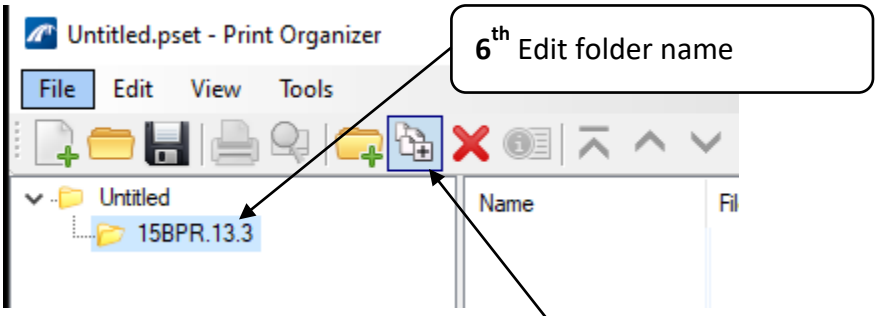
4.8.3 Using Print Organizer for PDF Creation of Multiple Converted V8i DGN's

To PDF your plan sheet set DGN files, follow these steps:



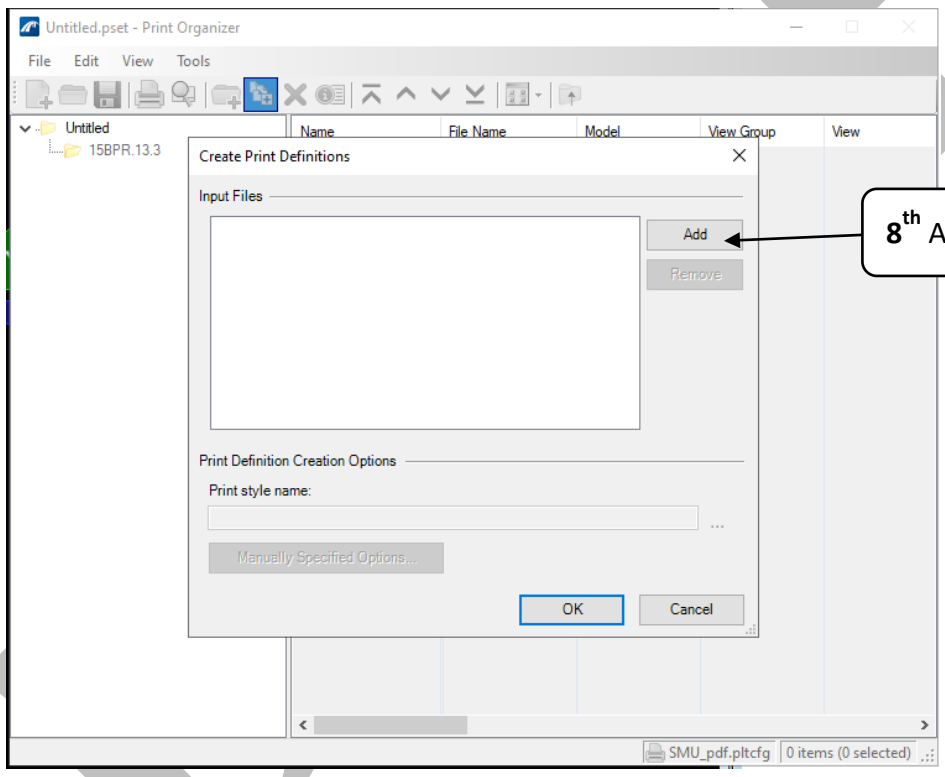



3rd Select Print
C:\Users\napierce\Des
New
Open
Save
Save As
Save Settings
Send Mail
Close
Tools
Settings
Properties
Print
Import
Export
Publish i-model
Print
IPLOT
Displays IPLOT dialog
InterPlot Organizer
Displays InterPlot Organizer
Print
Print to a printer or to a file
Print Preview
Open the resizable print preview window
Print to PDF
Print to a PDF document
Print Styles
Create, edit, and delete print styles
Print Organizer
Print multiple files using Print Organizer
4th Select Print Organizer
5th Select "Add folder to set"
Untitled.pset - Print Organizer
File
Edit
View
Tools
Untitled
Name
File Name
Model
View Group
View
SMU_pdf.pltcfg
0 items (0 selected)

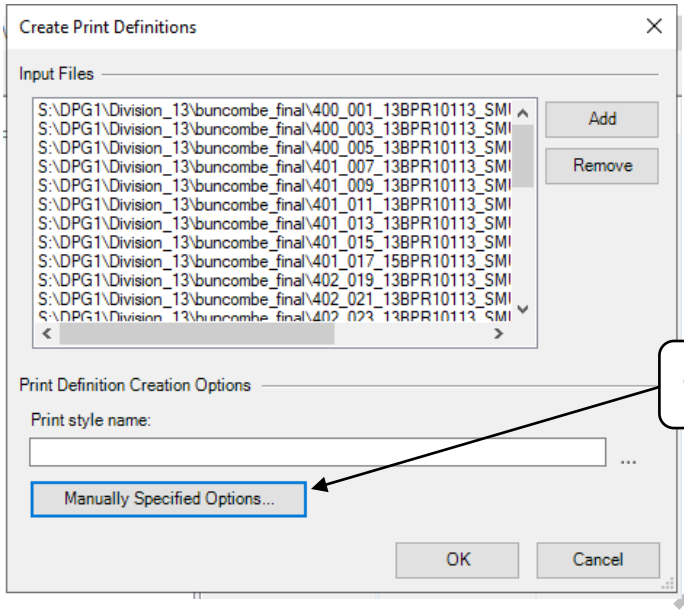


6th Edit folder name

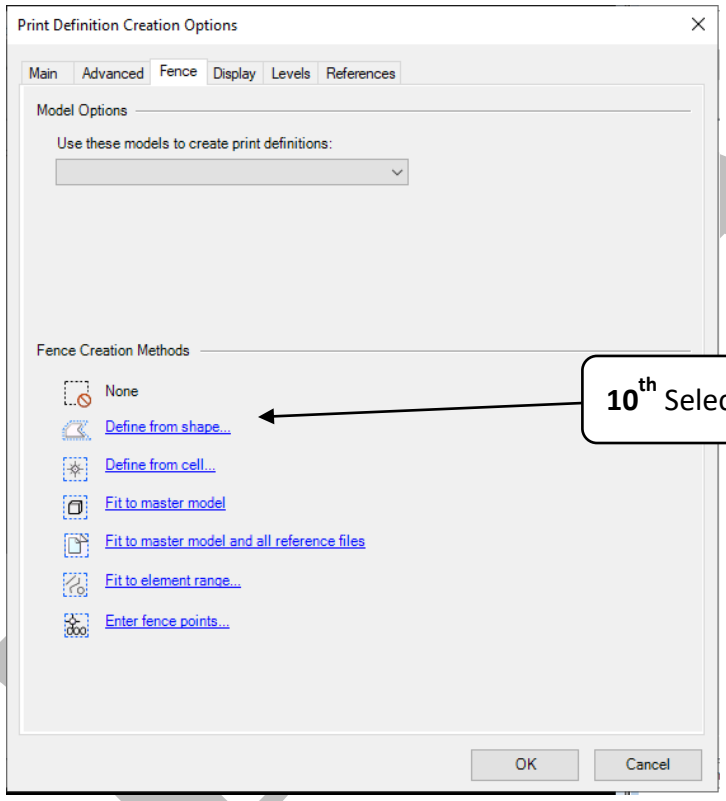
7th Select "Add files to set"



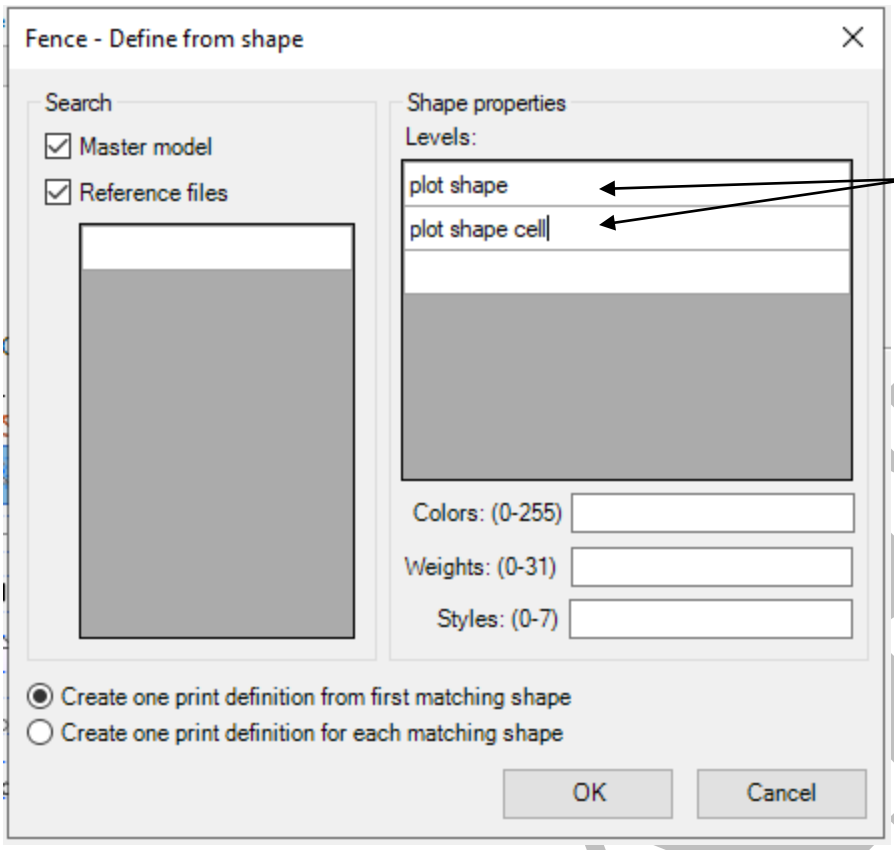
8th Add files to print



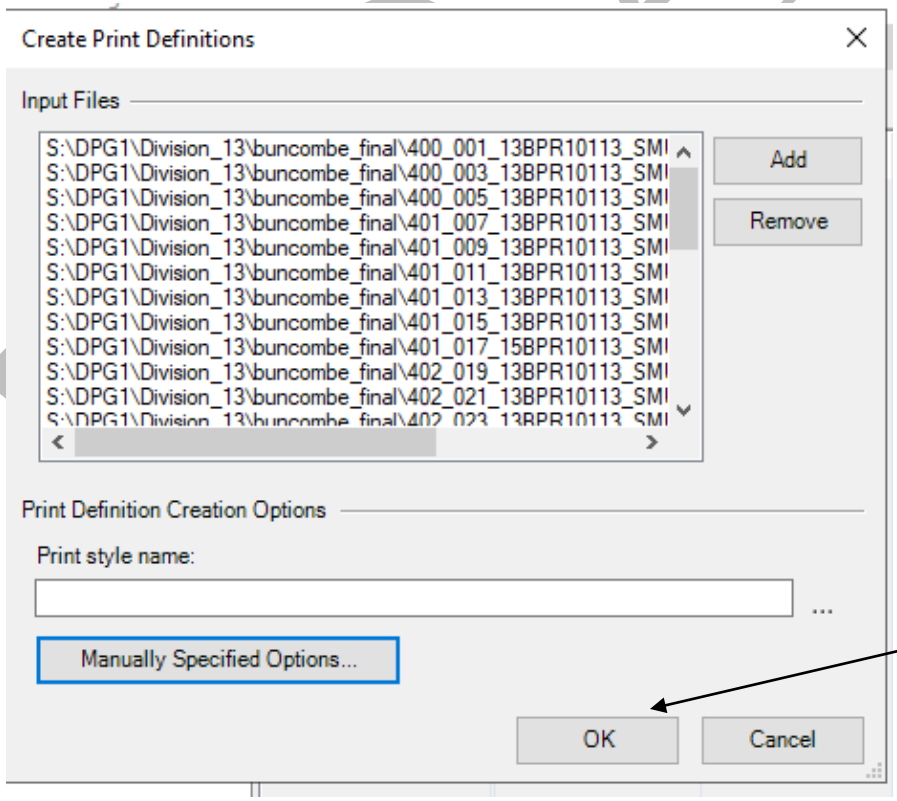
9th Select "Manually Specified Options"



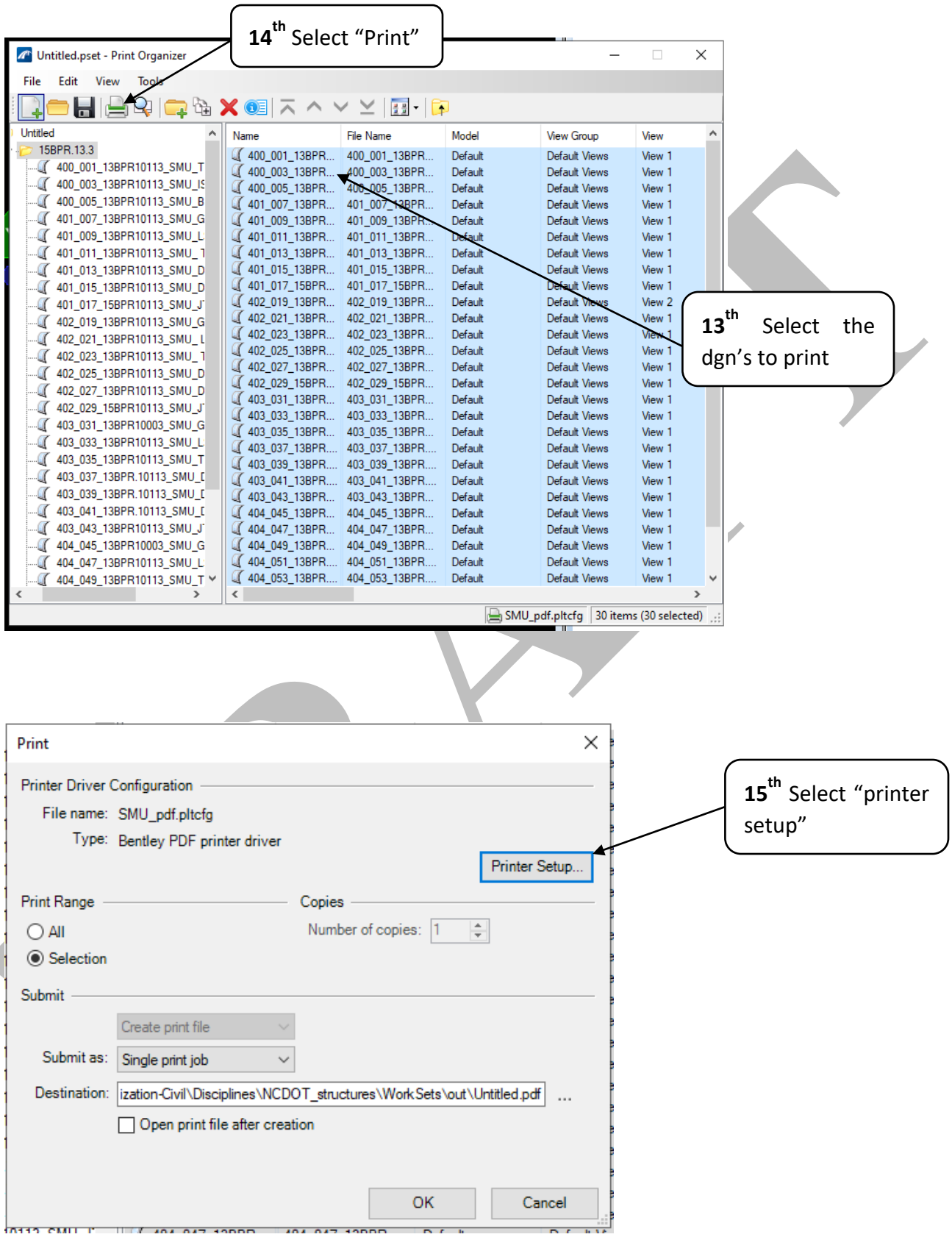
10th Select "Define from shape"

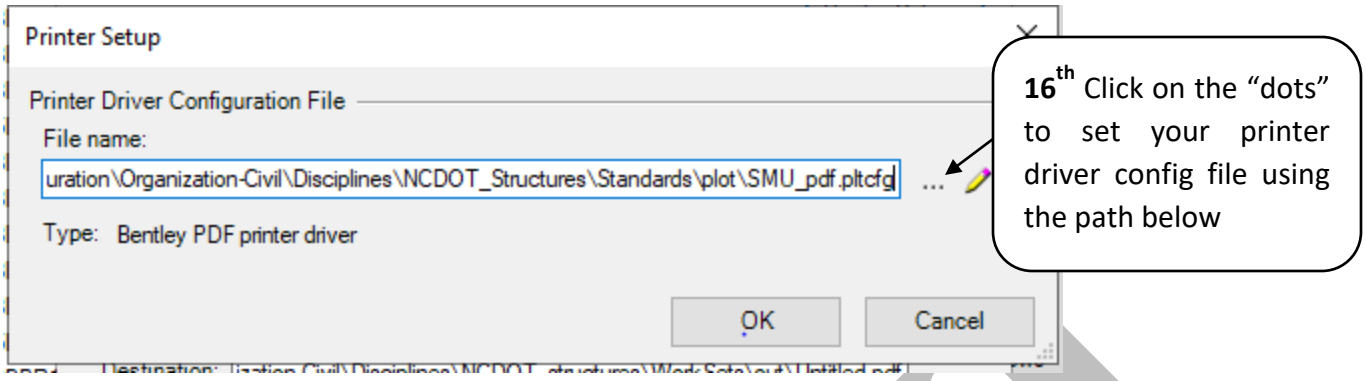


11th Add "plot shape" and "plot shape cell"

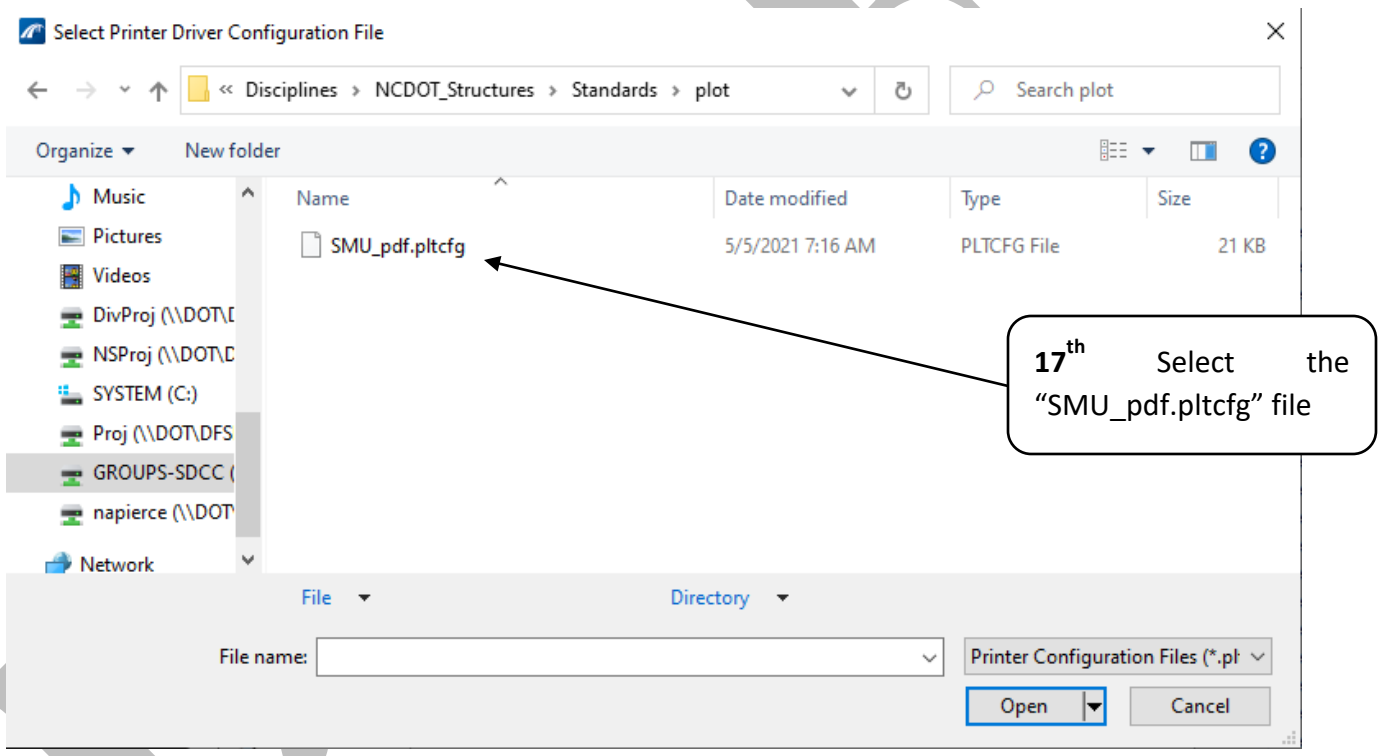


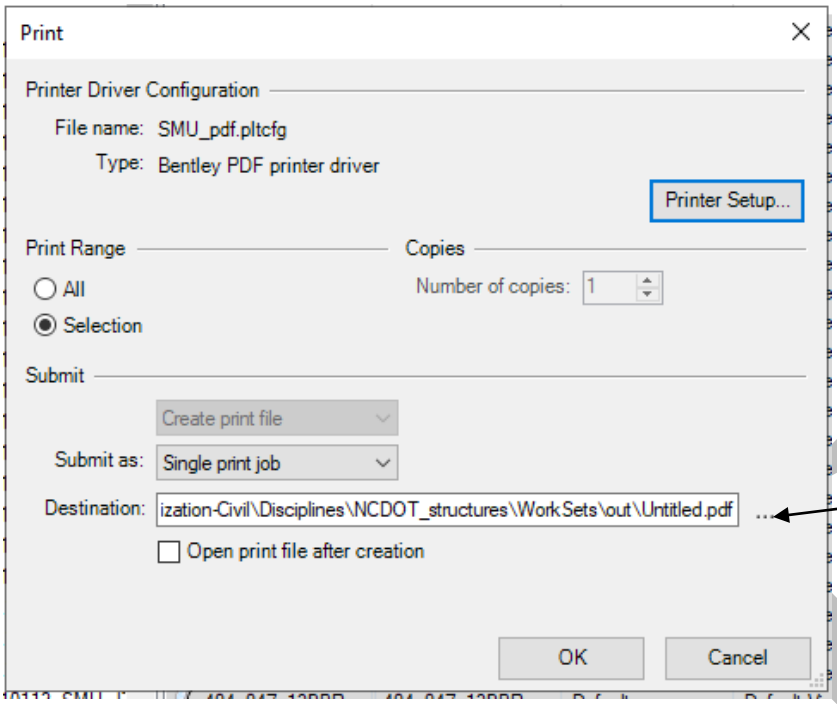
12th Select "OK"


14th Select "Print"
Untitled.pset - Print Organizer
File Edit View Tools
13th Select the dgn's to print
Print
Printer Driver Configuration
File name: SMU_pdf.pltcfg
Type: Bentley PDF printer driver
Printer Setup...
15th Select "printer setup"
Print Range
All
Selection
Copies
Number of copies: 1
Submit
Create print file
Submit as: Single print job
Destination: ization-Civil\Disciplines\NCDOT_structures\WorkSets\out\Untitled.pdf
Open print file after creation
OK
Cancel

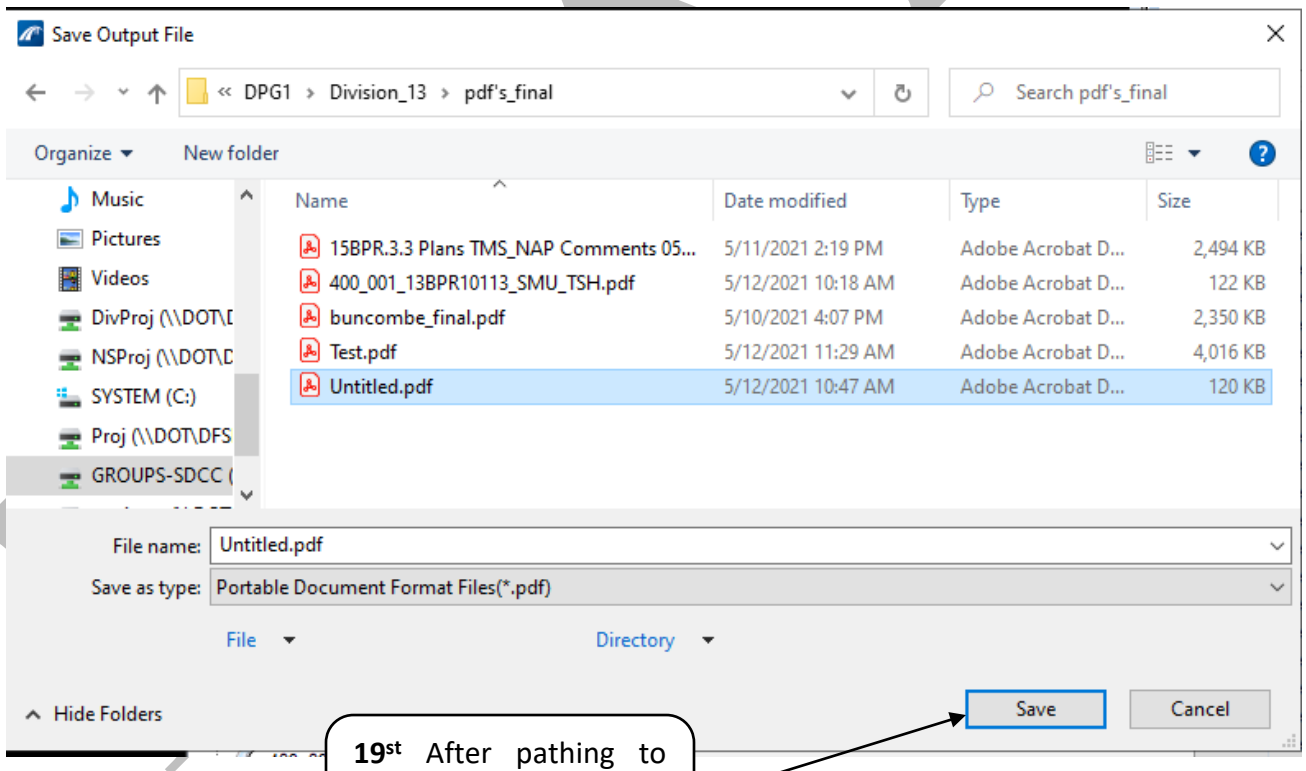


NCDOTProduction/Documents/Administration/WorkspaceGroups/NCDOTWorkspaces/Configuration_2023/Workspaces/DOT-US North Carolina/Roles/NCDOT_Structures/Standards/plot

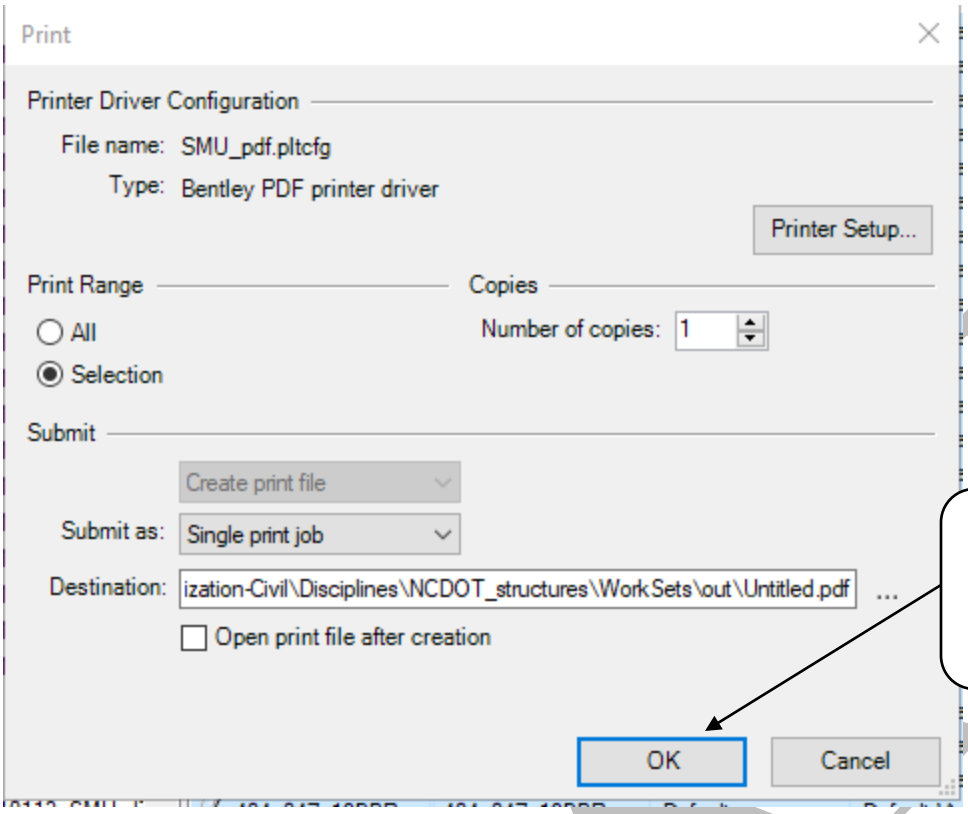




18th Set your "destination" to save the files to your project folder

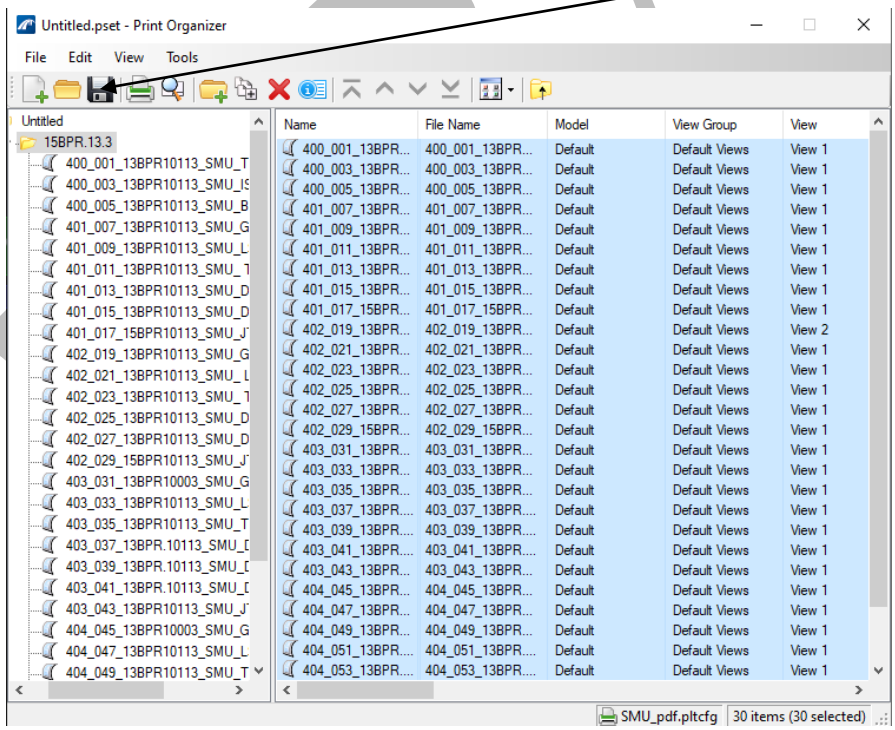


19st After pathing to your project folder, name the file and save



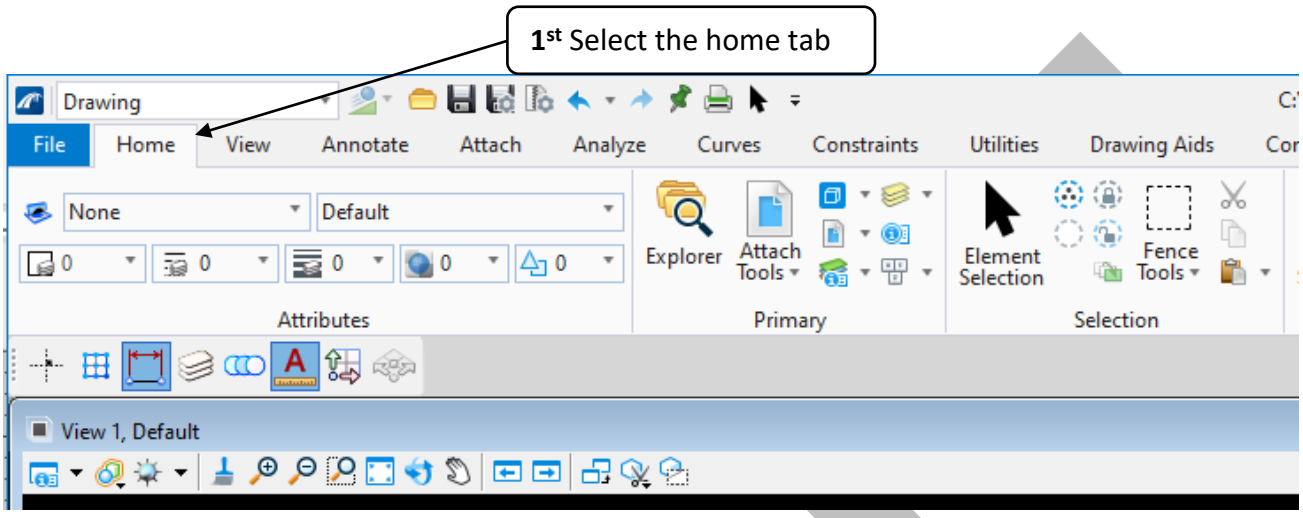
20th Click "OK" to create the PDF in the location you pointed it to fo the destination

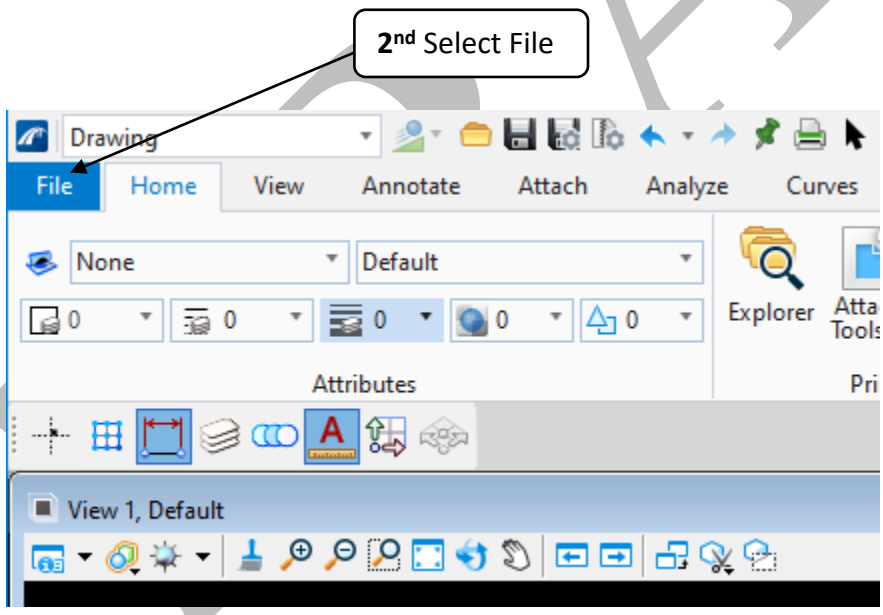
21st Save your PSet file with your project.

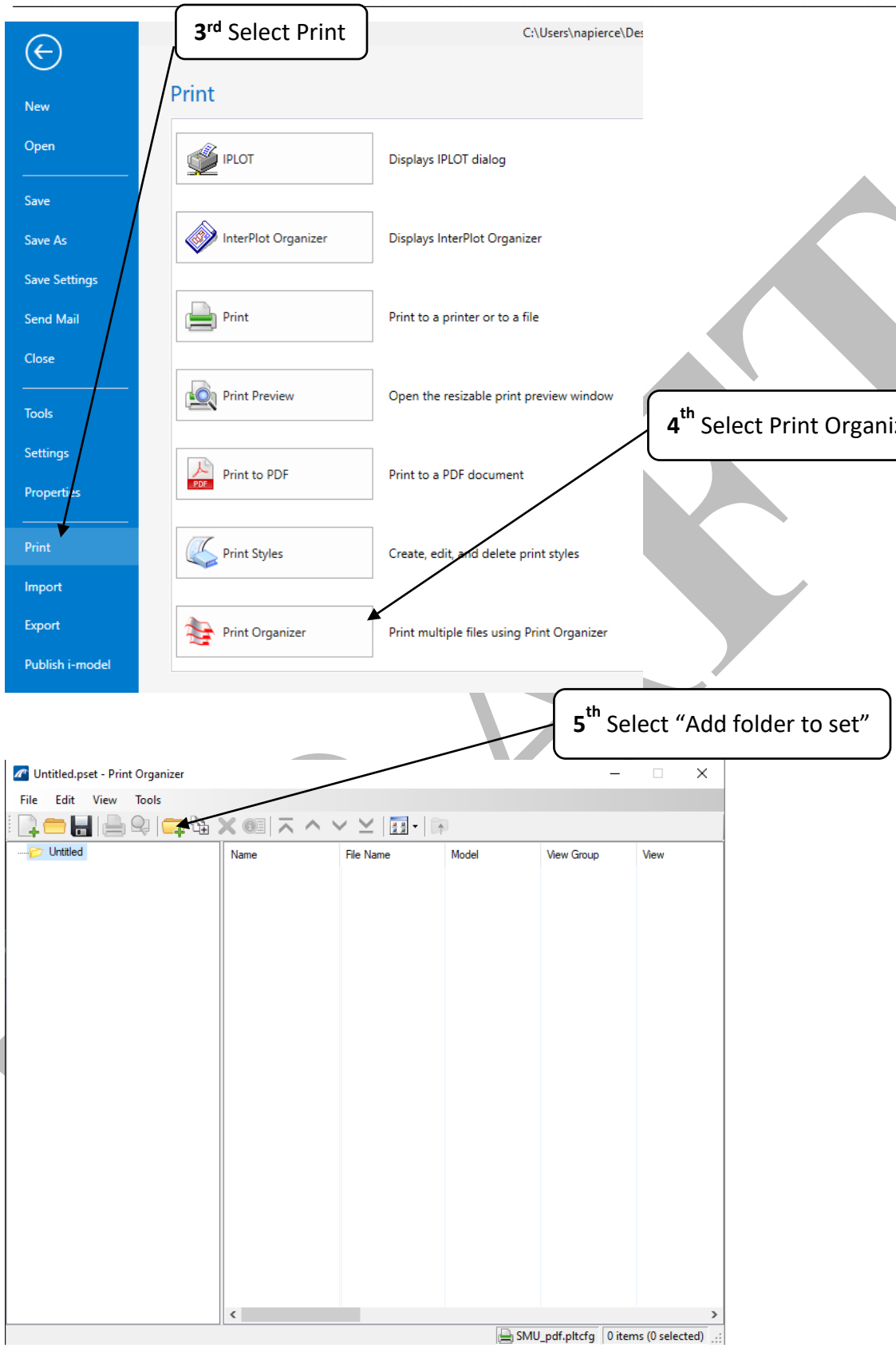


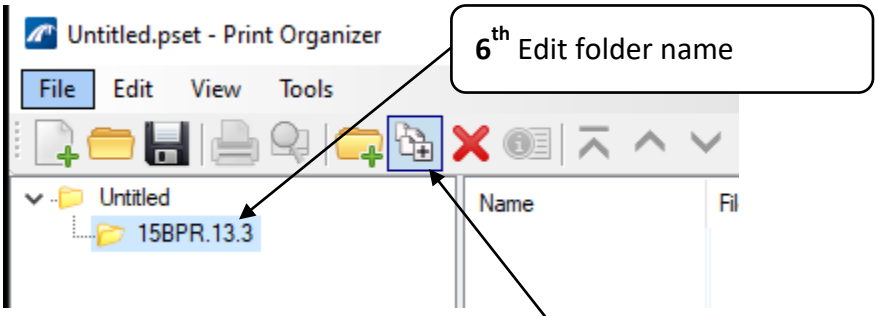
4.8.4 Using Print Organizer for PDF Creation of Multiple DGN's

To PDF your plan sheet set DGN files, follow these steps:






3rd Select Print
C:\Users\napierce\Des
New
Open
Save
Save As
Save Settings
Send Mail
Close
Tools
Settings
Properties
Print
Import
Export
Publish i-model
Print
IPLOT
Displays IPLOT dialog
InterPlot Organizer
Displays InterPlot Organizer
Print
Print to a printer or to a file
Print Preview
Open the resizable print preview window
Print to PDF
Print to a PDF document
Print Styles
Create, edit, and delete print styles
Print Organizer
Print multiple files using Print Organizer
4th Select Print Organizer
5th Select "Add folder to set"
Untitled.pset - Print Organizer
File
Edit
View
Tools
Untitled
Name
File Name
Model
View Group
View
SMU_pdf.pltcfg
0 items (0 selected)


Untitled.pset - Print Organizer
File
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Name
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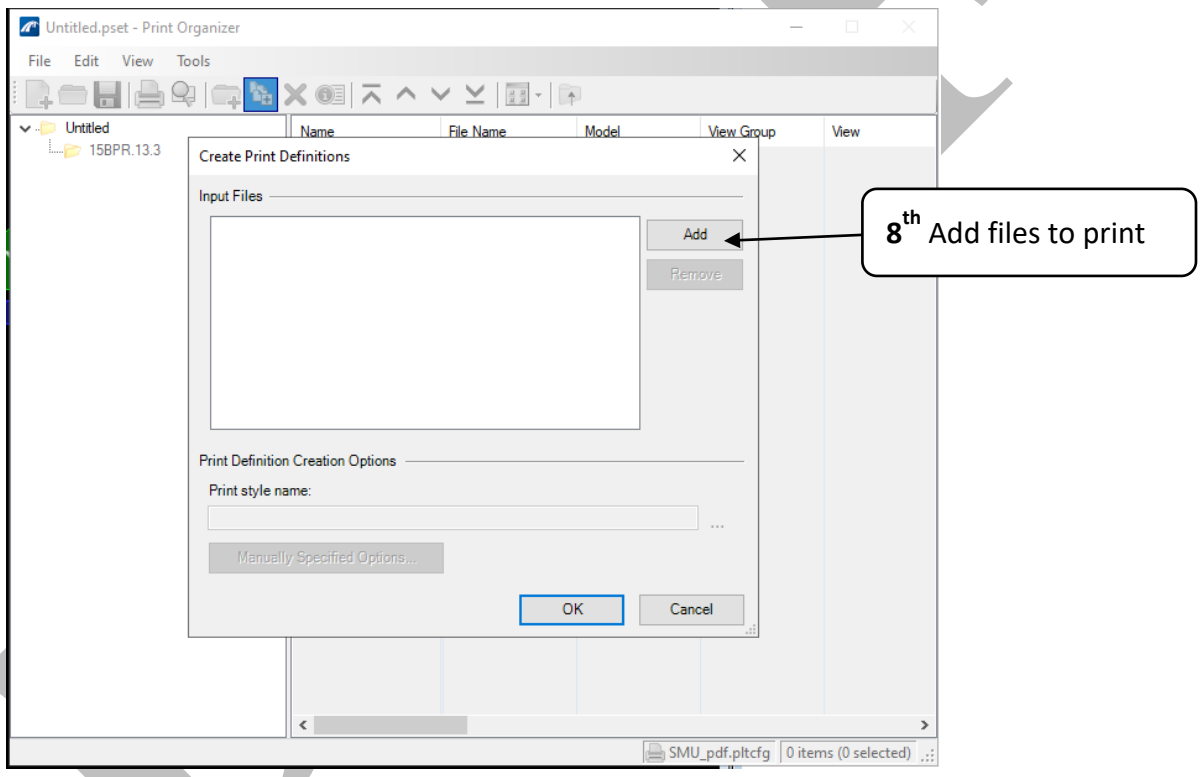
6th Edit folder name
7th Select "Add files to set"


Untitled.pset - Print Organizer
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Tools
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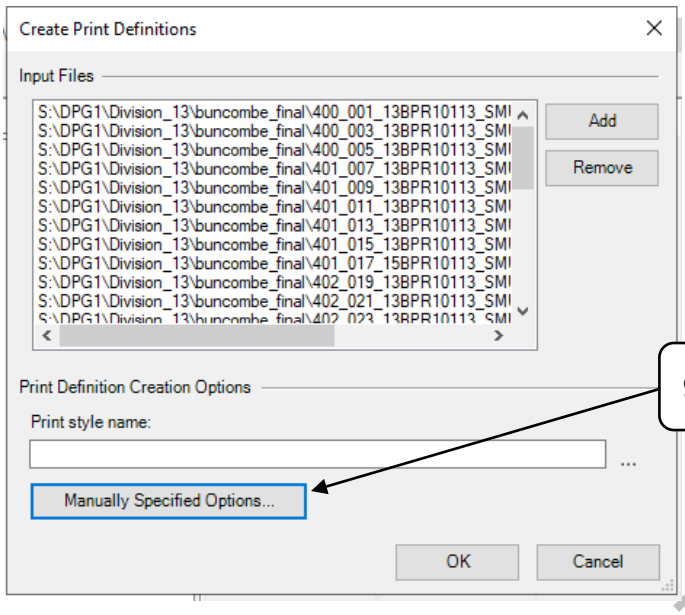
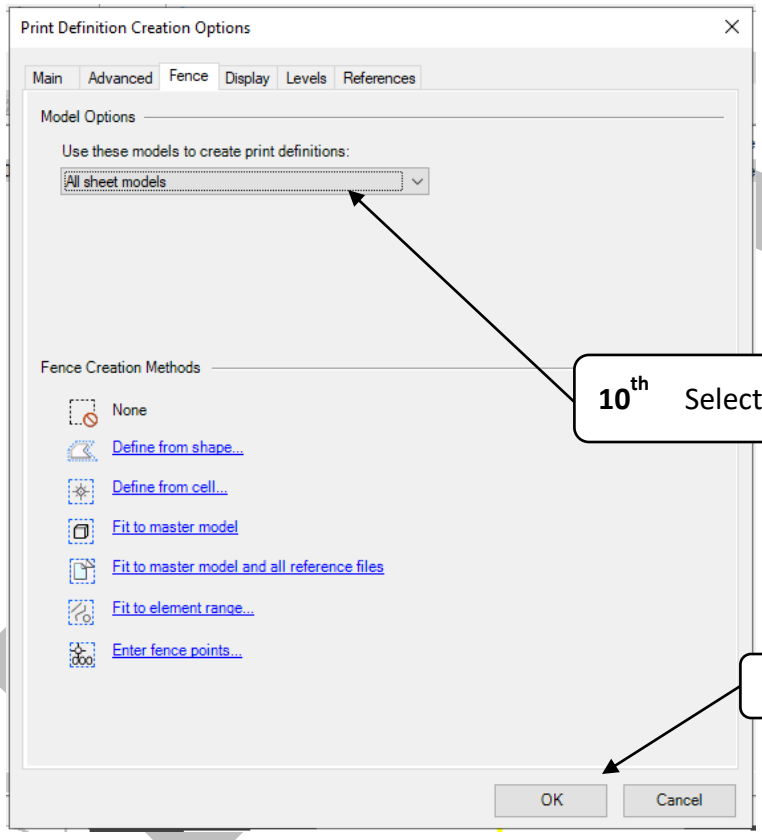
15BPR.13.3
Name
File Name
Model
View Group
View
Create Print Definitions
Input Files
Add
Remove
Print Definition Creation Options
Print style name:
Manually Specified Options...
OK
Cancel
SMU_pdf.pltcfg
0 items (0 selected)
8th Add files to print

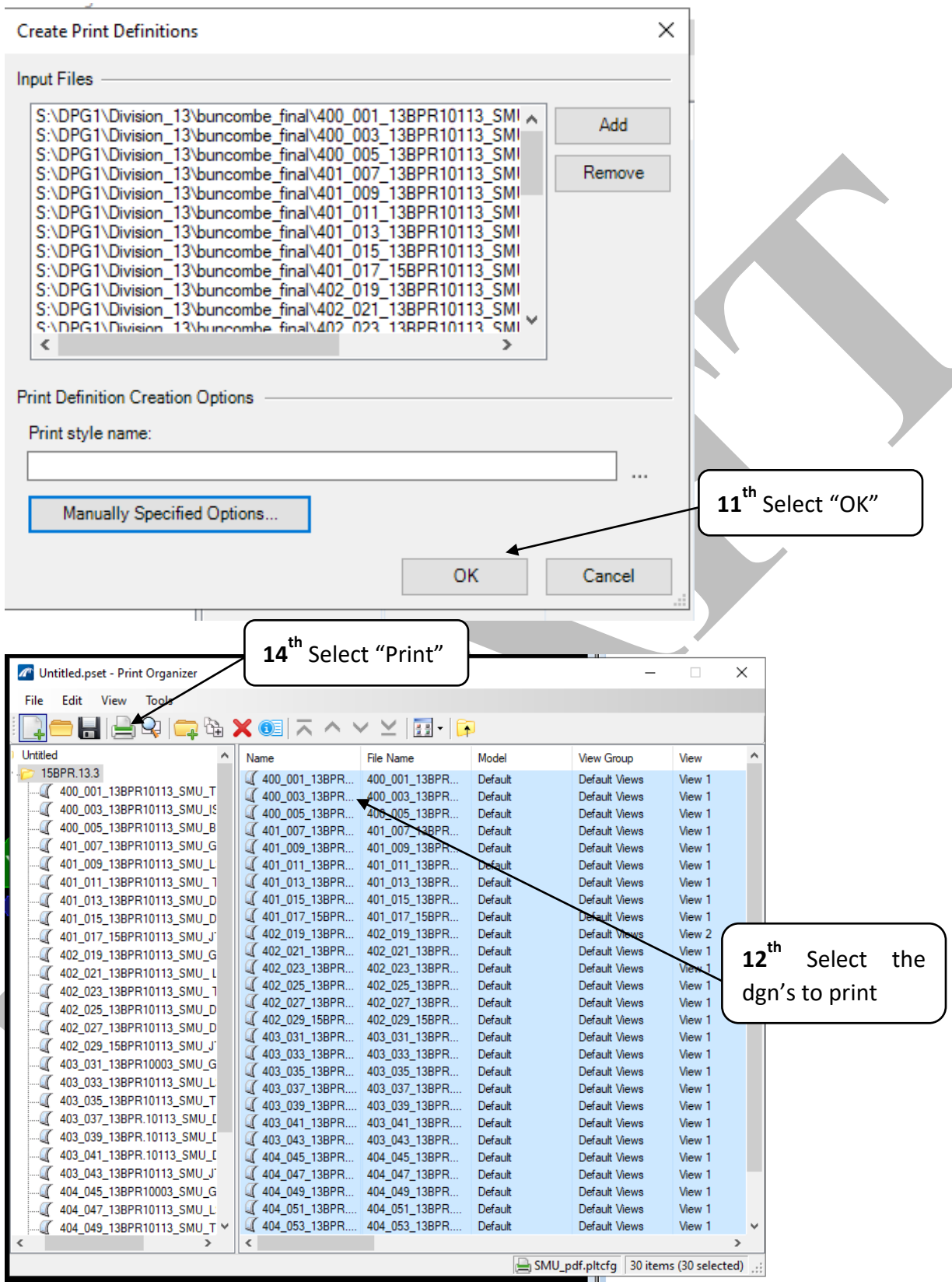


9th Select "Manually Specified Options"



10th Select "All Sheet Models" from

"OK"


Create Print Definitions
Input Files
S:\DPG1\Division_13\buncombe_final\400_001_13BPR10113_SMU
S:\DPG1\Division_13\buncombe_final\400_003_13BPR10113_SMU
S:\DPG1\Division_13\buncombe_final\400_005_13BPR10113_SMU
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S:\DPG1\Division_13\buncombe_final\402_021_13BPR10113_SMU
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Remove
Print Definition Creation Options
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Manually Specified Options...
OK
Cancel
11th Select "OK"
14th Select "Print"
Untitled.pset - Print Organizer
File
Edit
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Name
File Name
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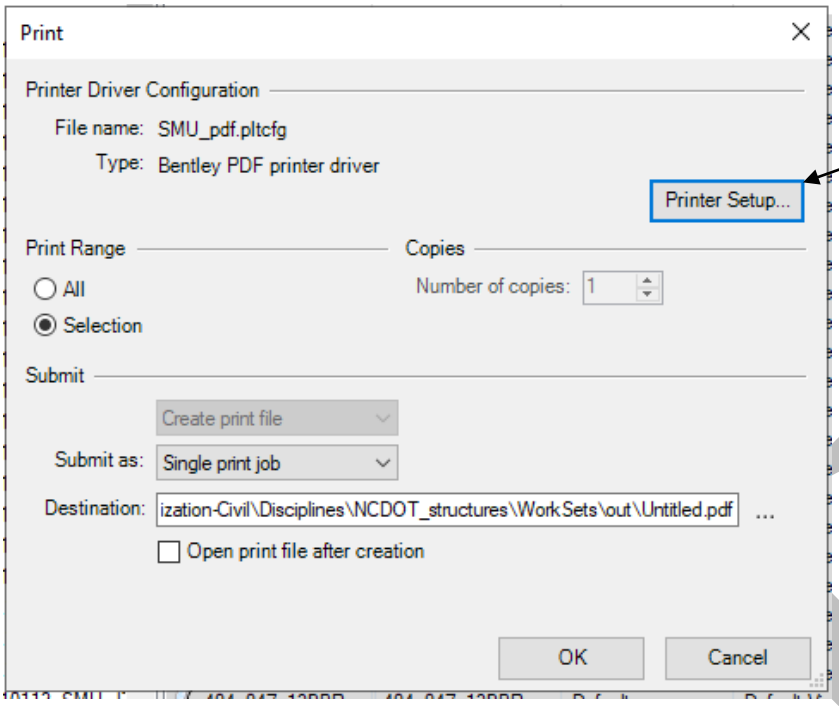
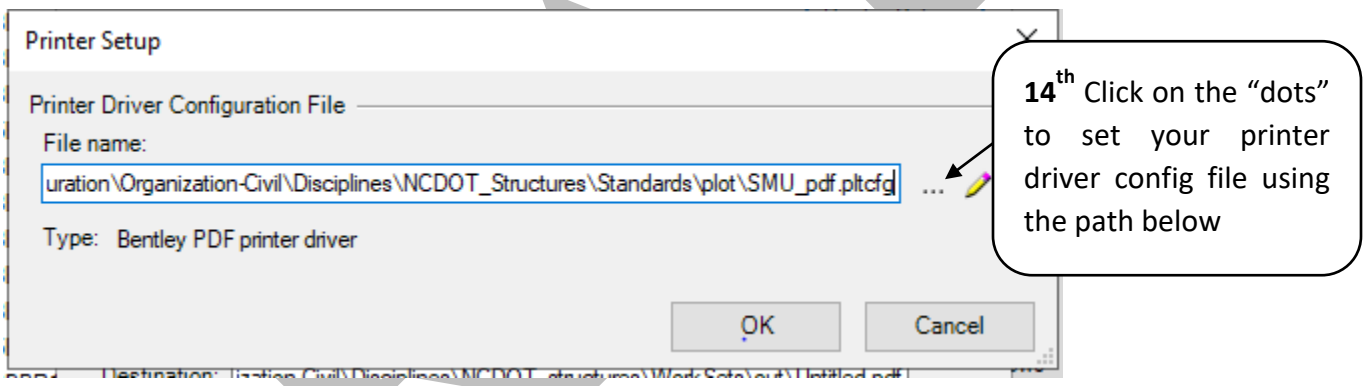
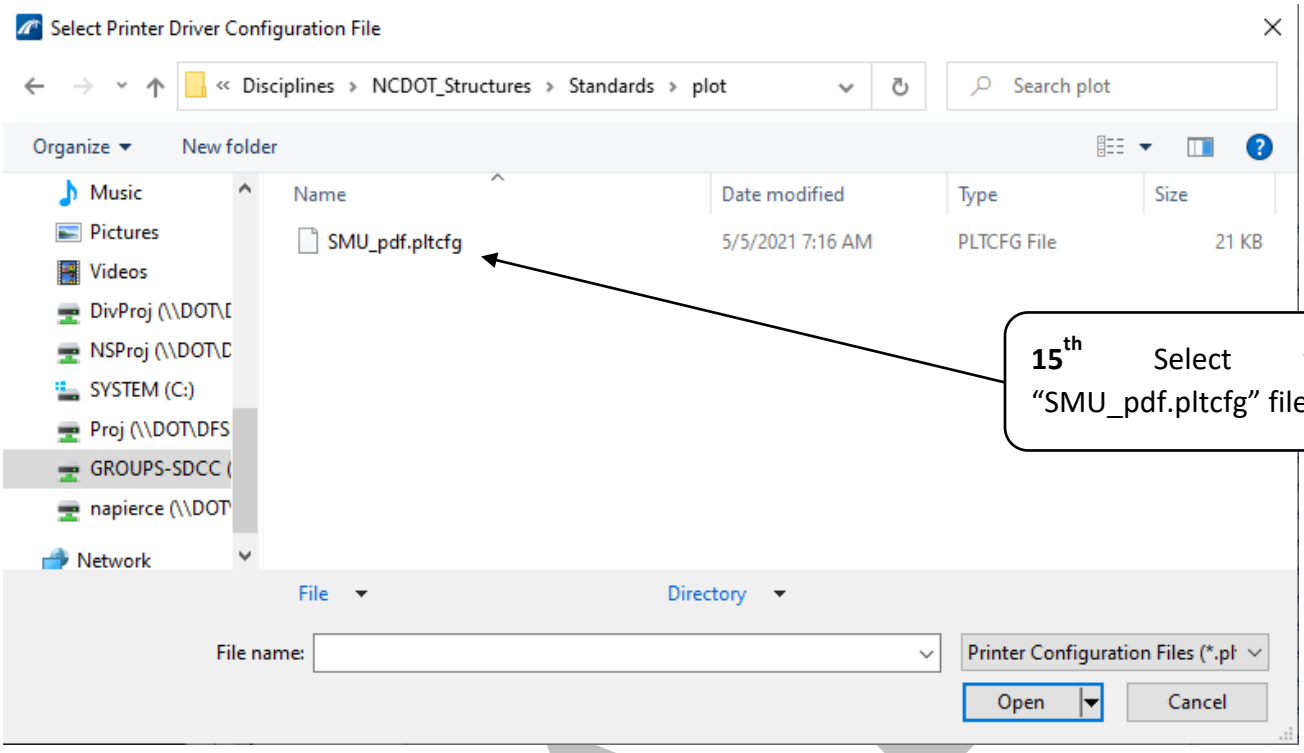
SMU_pdf.pltcfg
30 items (30 selected)
12th Select the dgn's to print





NCDOTProduction/Documents/Administration/WorkspaceGroups/NCDOTWorkspaces/Configuration_2023/Workspaces/DOT-US North Carolina/Roles/NCDOT_Structures/Standards/plot


Select Printer Driver Configuration File
Disciplines › NCDOT_Structures › Standards › plot
Search plot
Organize
New folder
Music
Pictures
Videos
DivProj (\\DOT\D
NSProj (\\DOT\D
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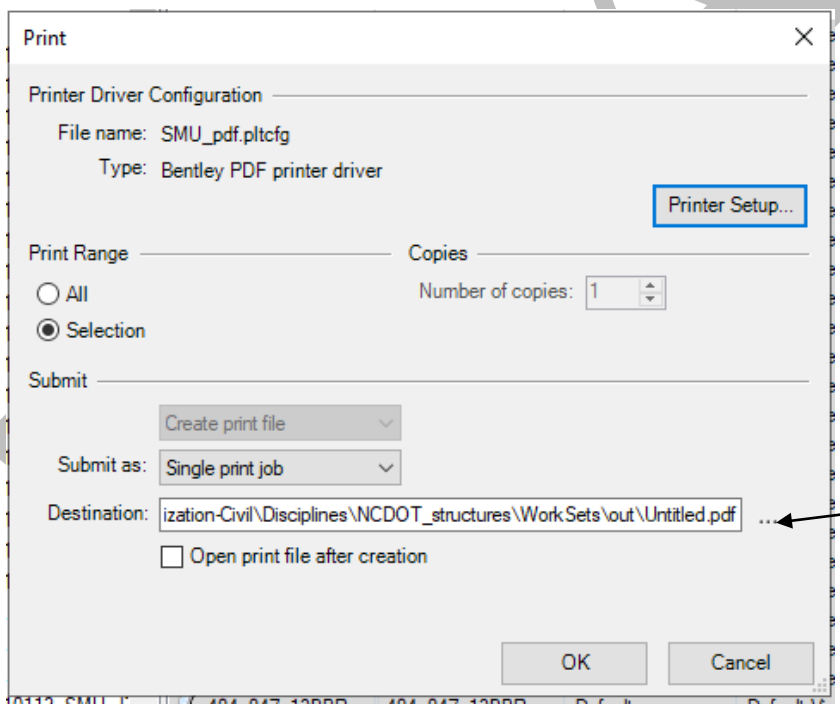
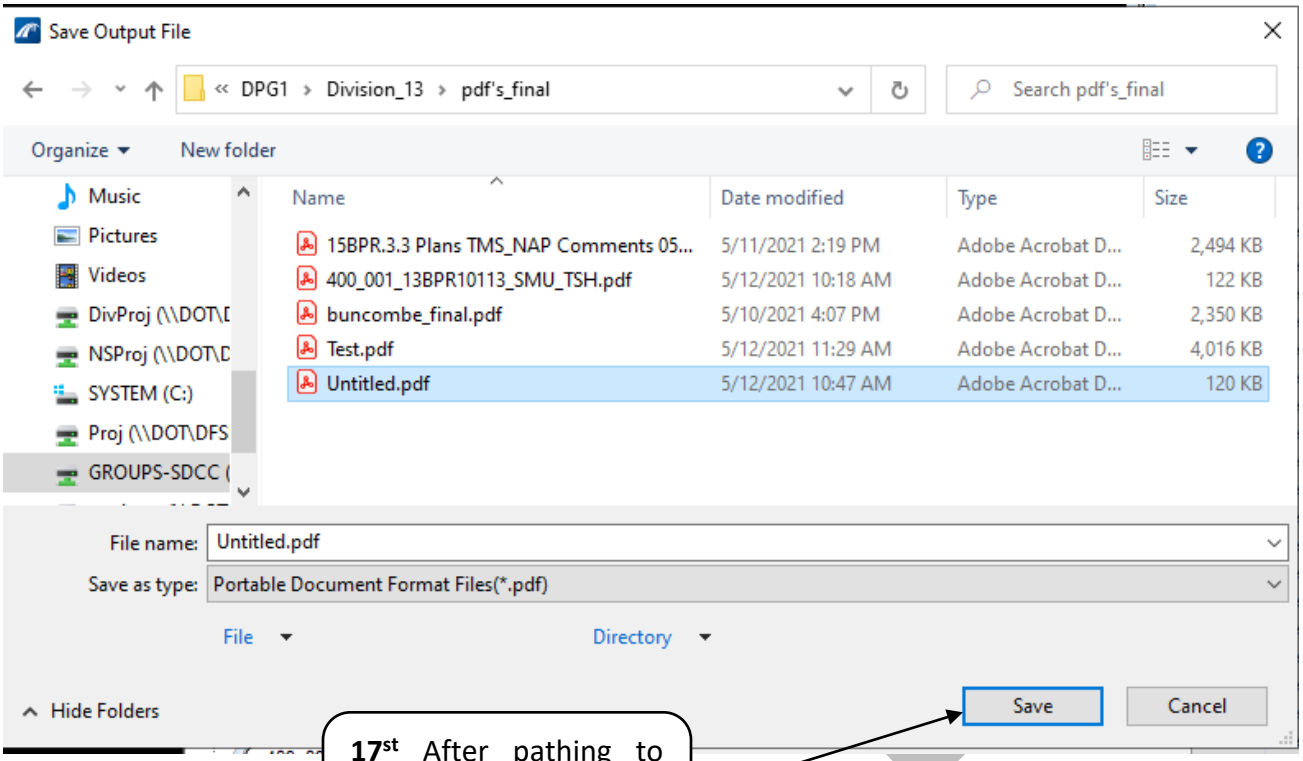
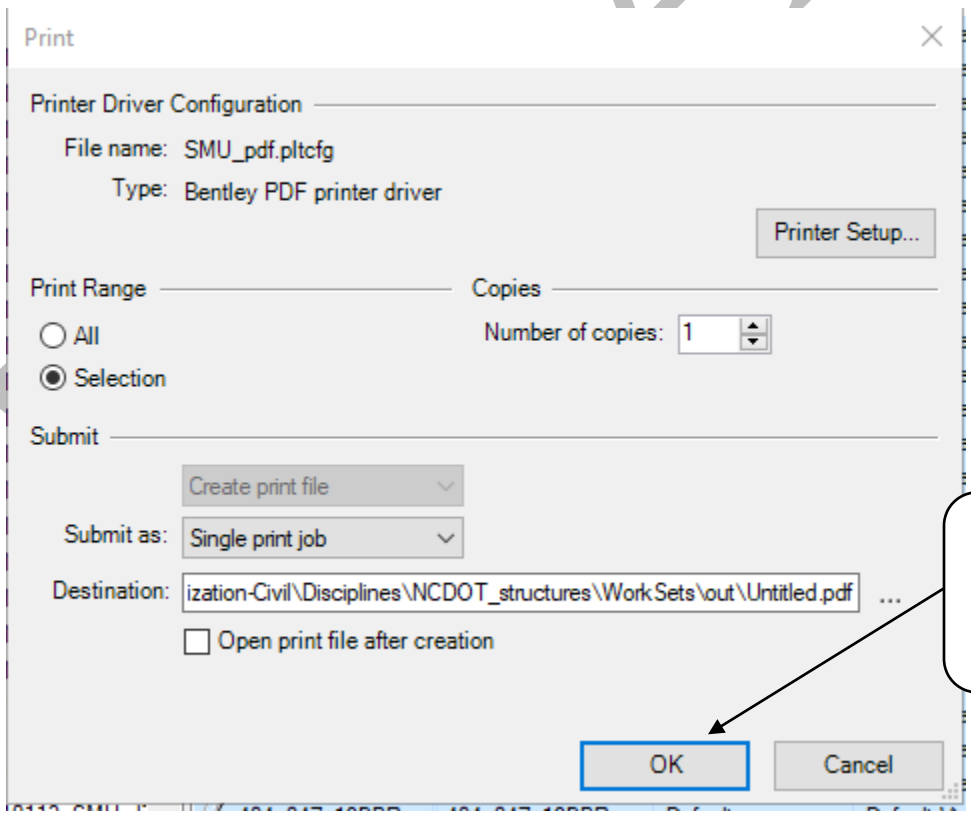
SMU_pdf.pltcfg
5/5/2021 7:16 AM
PLTCFG File
21 KB
15th Select the "SMU_pdf.pltcfg" file
File
Directory
File name:
Printer Configuration Files (*.pl
Open
Cancel

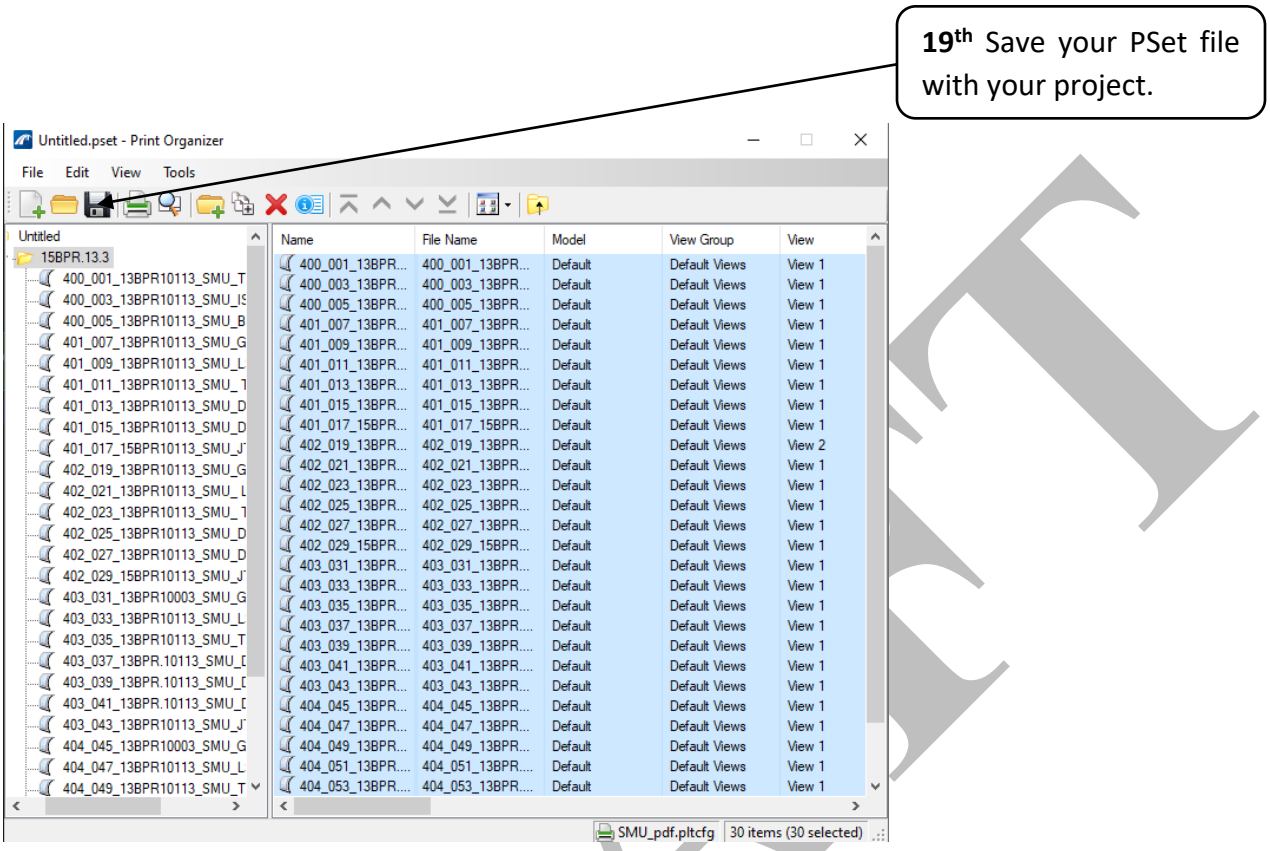

Print
Printer Driver Configuration
File name: SMU_pdf.pltcfg
Type: Bentley PDF printer driver
Printer Setup...
Print Range
All
Selection
Copies
Number of copies: 1
Submit
Create print file
Submit as: Single print job
Destination: ization-Civil\Disciplines\NCDOT_structures\WorkSets\out\Untitled.pdf
Open print file after creation
OK
Cancel
16th Set your "destination" to save the files to your project folder



17st After pathing to your project folder, name the file and save



18th Click "OK" to create the PDF in the location you pointed it to fo the destination

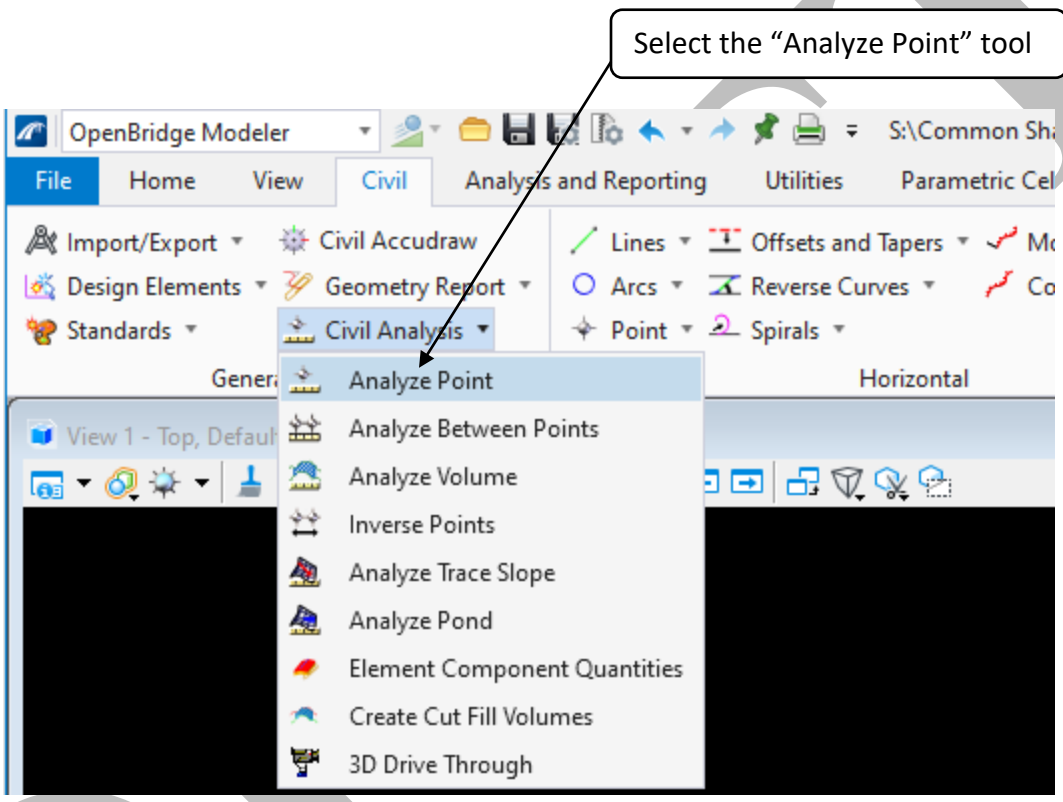

19th Save your PSet file with your project.
Untitled.pset - Print Organizer
File
Edit
View
Tools
Untitled
15BPR.13.3
Name
File Name
Model
View Group
View
SMU_pdf.pltcfg
30 items (30 selected)

4.9 CIVIL TOOLS

The Civil tools are an application designed to provide Civil/Site functions

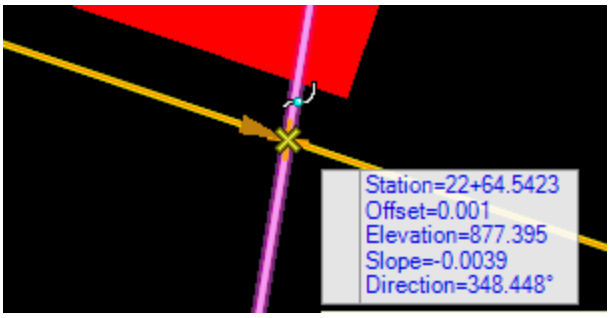
4.9.1 Civil Analysis Point Tool

To find stations, elevations, and offsets of locations along the -L- or other alignments, use the following tools:



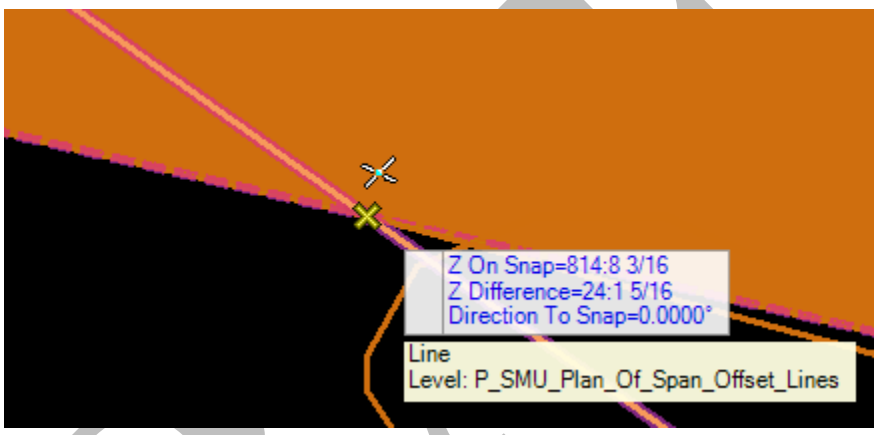
4.9.1.1 Finding Stations, Elevations and Offsets along an Alignment

To find the station, elevation and offsets of a location along an alignment, after selecting the Analyze Point tool, Click on the alignment to which you want to find the station, elevation and/or offset from, then click on the point which you want the info for and the information will be displayed in a box beside the curser.

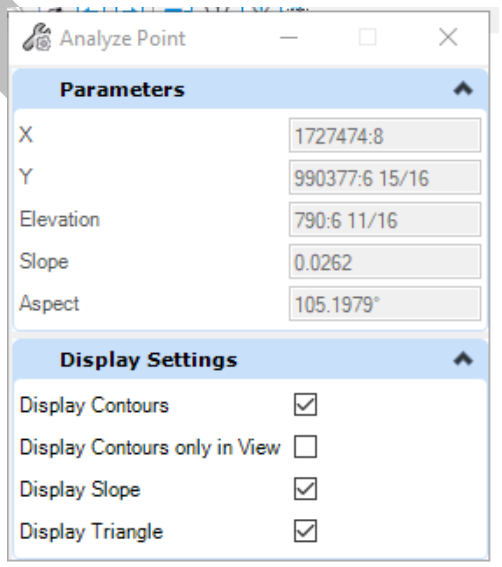


4.9.1.2 Finding Elevations along the Terrain

To find an elevation on the terrain, select the Analyze Point tool. Select a leg of the terrain triangle nearest to your point of interest and then click on the point of interest to get the exact elevation at that point.

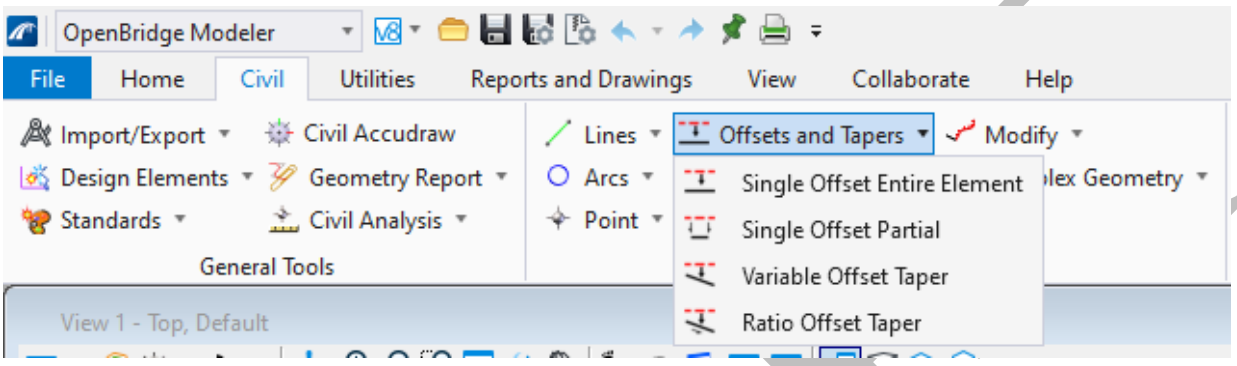


The elevation will appear in a display window beside the curser as you move along the leg of the traingle, but will also be displayed in the Analyse Point toolbox window when the point is selected.

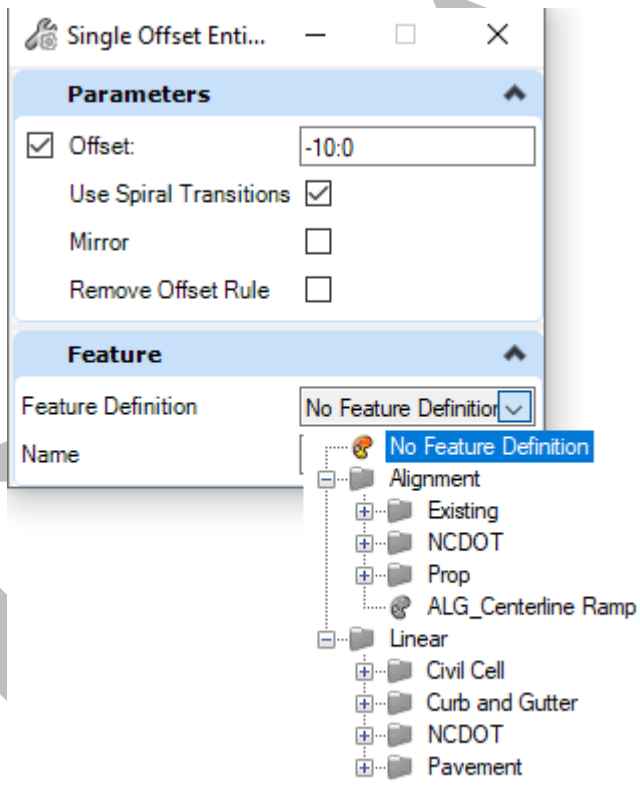


4.9.2 Horizontal Offsets and Tapers Tool

Copying Roadway alignments to establish horizontal clearances and offsets requires using the Offsets and Tapers tools. Copying Roadway alignments without using these tools can cause an OpenBridge file to become "read only" due to the civil data linked with the alignment.

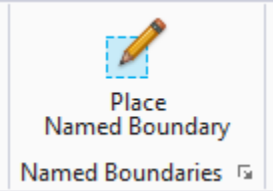


Once a tool is selected, provide the offset and any other necessary information.

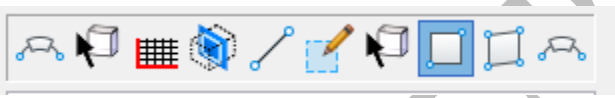


4.10 PLACE NAMED BOUNDARY TOOL

The Place Named Boundary tool can be used in both 2D and 3D plan production for creating views used in plans.



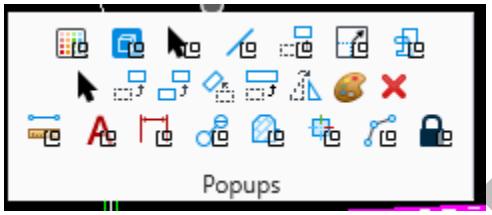
Place Named Boundary tool options from left to right:



- **Civil Plan:** 3D modeling tool allows the user to select a horizontal alignment with which to associate the named boundary for a plan view by defining the boundary scale, length, left and right offsets.
- **Civil Plan by Element:** 3D modeling tool allows the user to select a horizontal alignment with which to associate the named boundary, along with an existing element as a boundary for a plan view.
- **Civil Profile:** 3D modeling tool allows the user to select an alignement's vertical profile with which to associate the named boundary by selecting the boundary limits from an existing civil plan boundary or by station definitions.
- **Civil Cross Section:** 3D modeling tool allows the user to select the horizontal alignment with which to associate the named boundary by defining left and right offets and the intervals at which to create the cross sections. (*not preferred for creating bridge typical sections*)
- **Civil Cross Section by 2 Points:** 3D modeling tool allows the user to select the horizontal alignment with which to associate the named boundary by clicking a point either side of the selected alignment to form a line crossing the alignment which creates a cross section at that location.
- **From Drawing Boundary:** 2D drawing tool allows the user to select one of the predefined drawing scales and fit the boundary view box around an area to create a plan view.
- **By Element:** 2D drawing tool allows the user to select an existing element as a boundary.
- **By 2 Points:** 2D drawing tool allows the user to select two points that define a rectangular boundary. *This is the most preferred method for 2D workflow*.
- **By Polygon:** 2D drawing tool allows the user to click several points to create a non-uniform multi-sided closed shape (must contain at least 3 sides) as a boundary.
- **By Length:** 2D drawing tool allows the user to select a path element along which to place a boundary by then defining the left and right offsets and boundary length.

4.11 SPACEBAR

A quick way to get to commonly used tools is to click on the spacebar, the following popup will appear near where your curser is at for your selection.

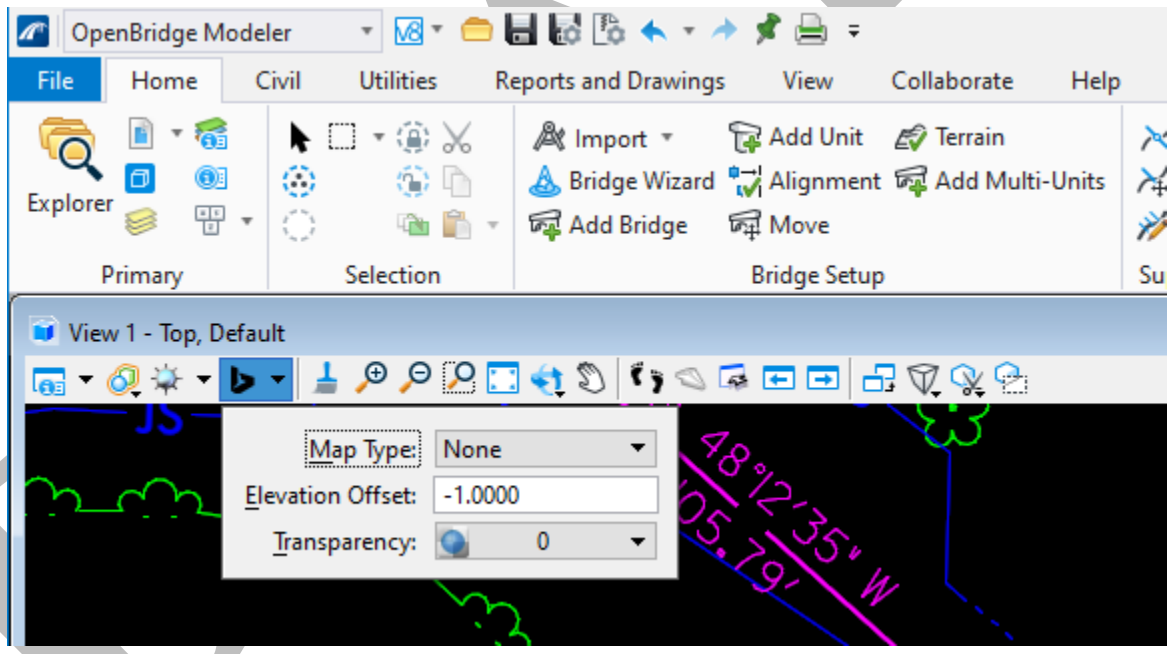


4.12 BACKGROUND MAP

To place a street or aerial map in your drawing background, take the following steps:

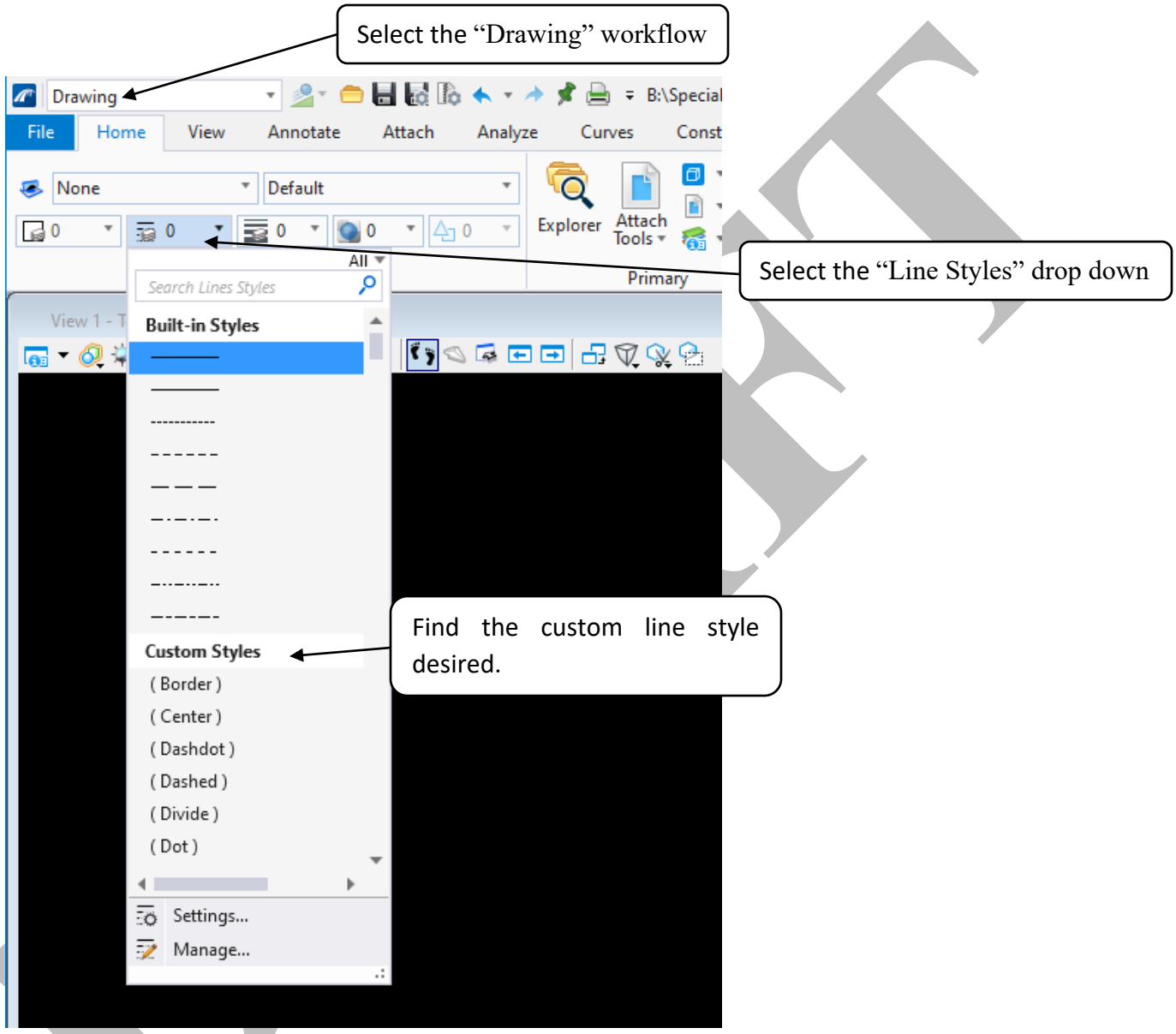
1st In the window View, click on "Select Background Map"

2nd Drop down to "Map Type" and select the map style desired.



4.13 CUSTOM LINE STYLES

To use the NCDOT custom line styles for both 2D and 3D, follow these steps:



4.14 DRAWING SCALES

SMU drawing scales and ratios

Drawing Scales			
English Scales		**Engineering Scales**	
Full Size 1=1	1:1	1" = 5'	60:1
6" = 1'-0"	2:1	1" = 10'	120:1
3" = 1'-0"	4:1	1" = 15'	180:1
2" = 1'-0"	6:1	1" = 20'	240:1
1 ½" = 1'-0"	8:1	1" = 30'	360:1
1" = 1'-0"	12:1	1' = 40'	480:1
7/8" = 1'-0"	13.7:1	1" = 50'	600:1
¾" = 1'-0"	16:1	1" = 60'	720:1
5/8" = 1'-0"	19.2:1	1" = 100'	1200:1
½" = 1'-0"	24:1	1" = 200'	2400:1
7/16" = 1'-0"	27.4:1	1" = 300'	3600:1
3/8" = 1'-0"	32:1	1" = 400'	4800:1
5/16" = 1'-0"	38.4:1	1" = 500'	6000:1
¼" = 1'-0"	48:1	1" = 600'	7200:1
3/16" = 1'-0"	64:1	1" = 1000'	12000:1
1/8" = 1'-0"	96:1	-	-
1/16" = 1'-0"	192:1	-	-
1/32" = 1'-0"	384:1	-	-

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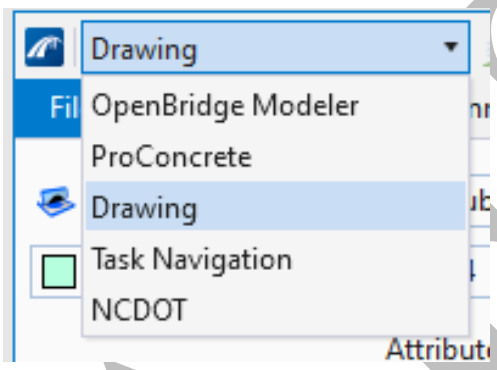
5.12.1 Placing Structure Standards ..... **Error! Bookmark not defined.**

CHAPTER 5

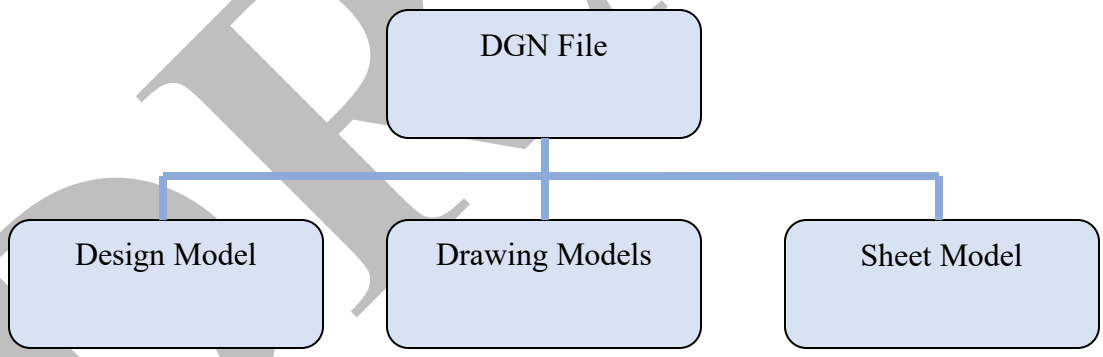
2D Plan Production

5.1 DRAWING WORKFLOW

Once the DGN file is created as laid out in Chapter 4, for 2D drawing creation set OBD to the Drawing Workflow.



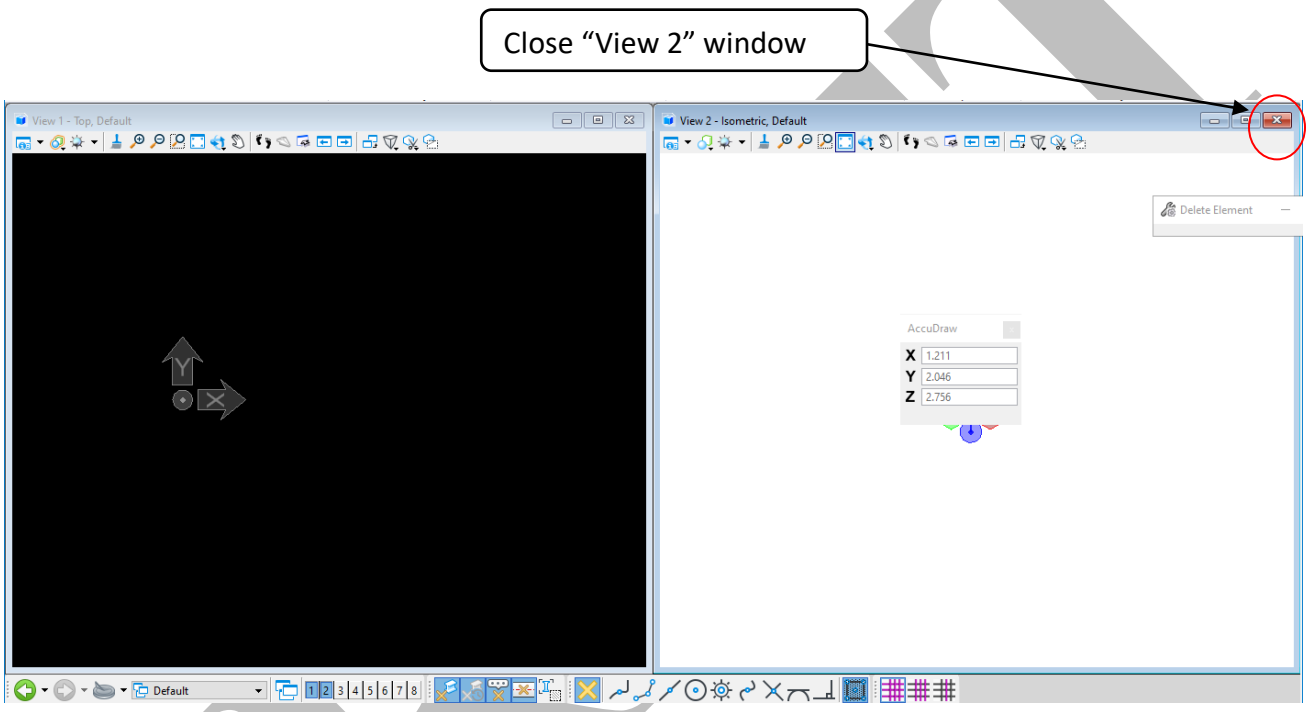
All DGN files will be set up with three modes with them:



5.2 2D DESIGN MODEL

For 2D drawings the Design Model will be used to draw proposed or existing structure elements in a 2D view at full scale (1:1) in their correct geographical locations. Reference the SMU Design Manual for all required content for the plan sheet being created.

To set the DGN to look like it did in v8, in the Design Model close the "View 2" window and maximize the "View 1" window, then use the save settings tool. (Note: View 2 is utilized for 3D views.)



Leave the Drawing Scale at "Full Size 1=1" and draw all elements at their true dimensions.

5.3 2D DRAWING MODEL

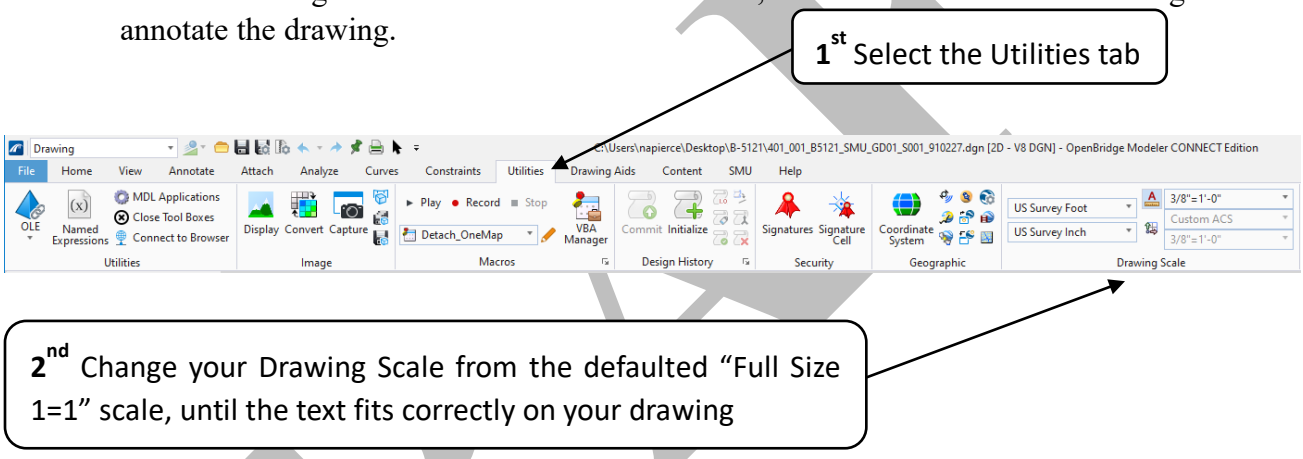
For 2D drawings, the Drawing Model is used to annotate the drawings done in the Design Model. This can be achieved by referencing the drawing done in the Design Model or using the drawing tools to place a view of the drawing in the Design Model into the Drawing Model.

5.3.1 Dimensioning

After the Design Model has been referenced, it is time to set the Drawing Scale based on the reference view scale used in the Sheet Model for the drawing view.

5.3.2 Drawing Scale

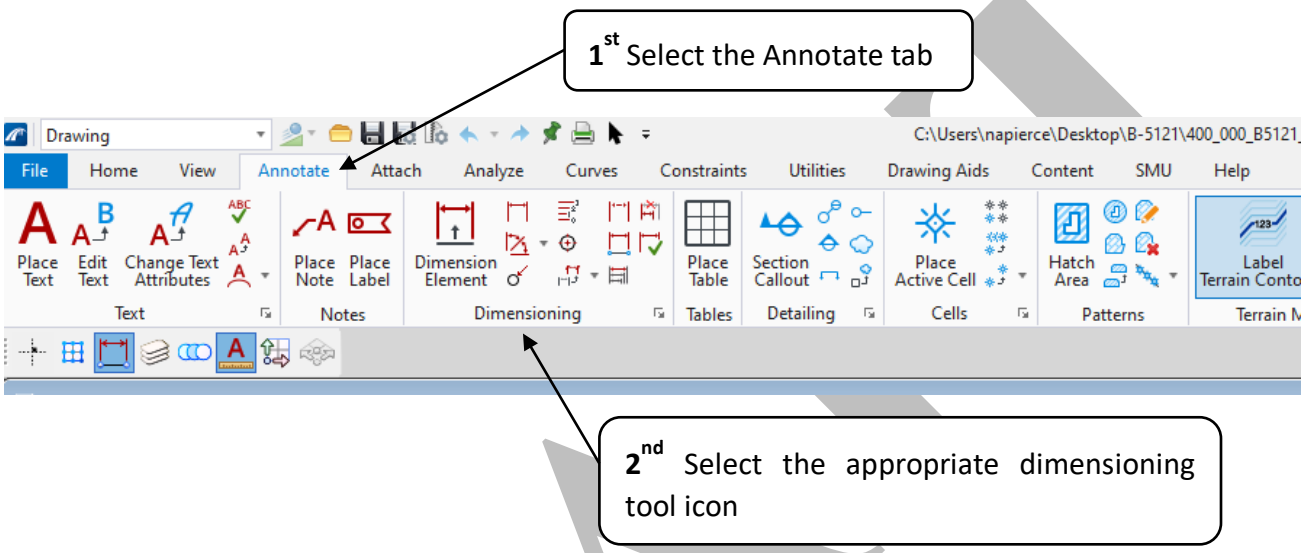
Once the Design Model has been referenced in, it's time to select the drawing scale to annotate the drawing.



Your scale is now set for this Drawing Model, save settings and do not change it! Now you can place your text.

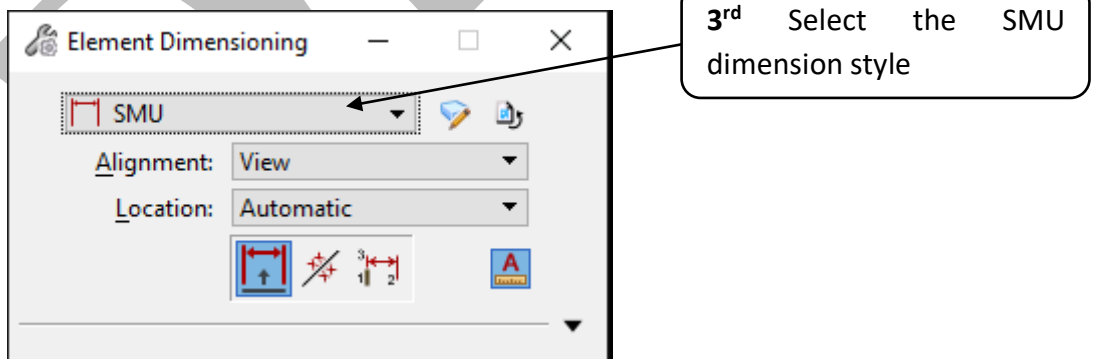
Once the Drawing Scale matches the Sheet Model reference view scale, it's time to start placing dimensions. Follow these steps to place dimensions:

5.3.2.1 Placing Dimensions



Now use the selected dimensioning tool as normal to dimension your drawing.

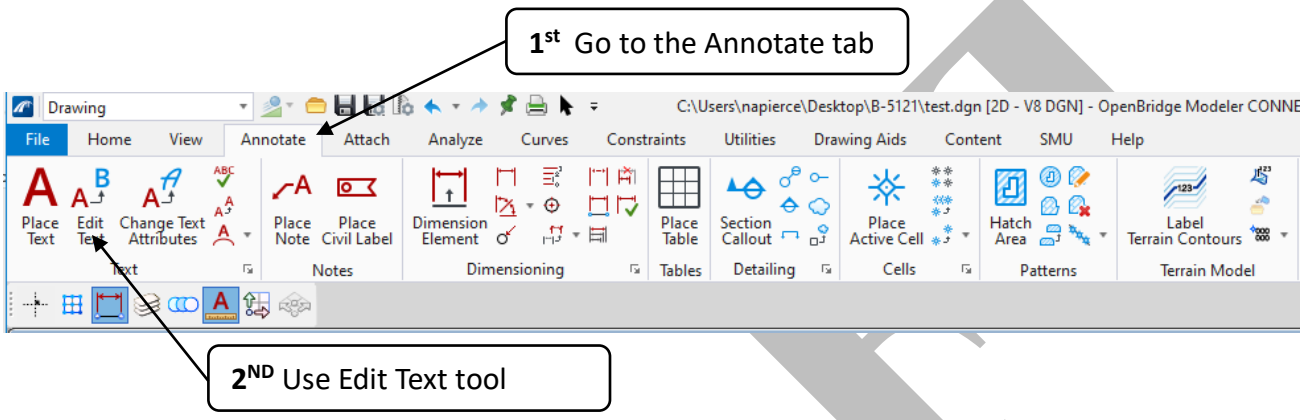
Make sure to select the SMU dimensioning style



Now use the tool to dimension the item(s) in the dgn.

5.3.2.2 Editing Dimensions

When editing dimensions, follow these steps:

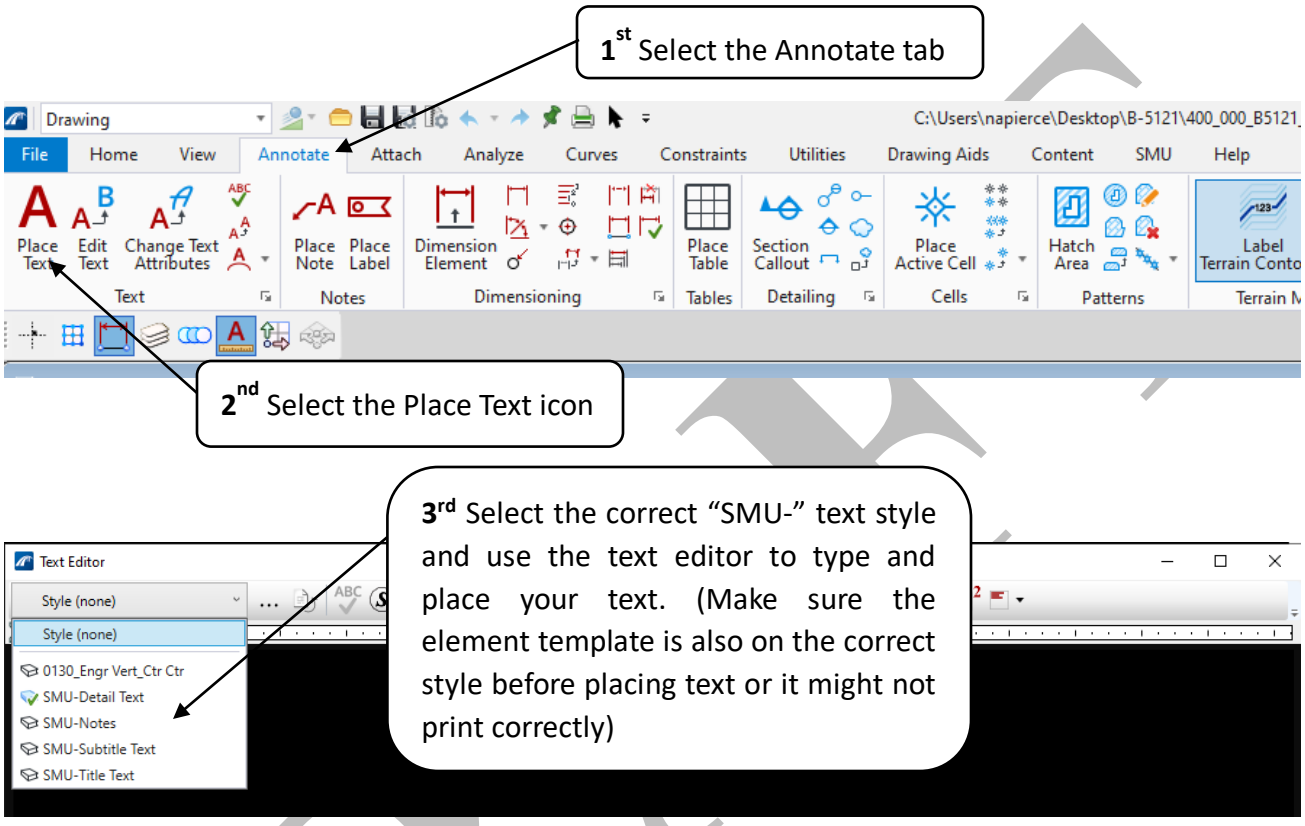


Click on the desired dimension to be edited and edit the text.

5.3.3 Text

5.3.3.1 Placing Text

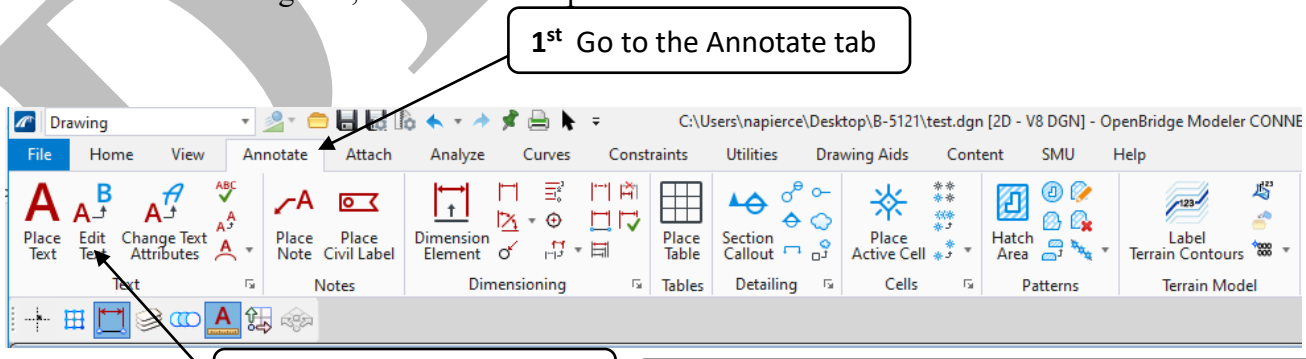
After the drawing scale has been set for the Drawing Model, it's time to start placing text.



Note: Changing the drawing scale may be required to see the text as desired, the text will automatically scale to the drawing scale.

5.3.3.2 Editing Text

When editing text, follow these steps:



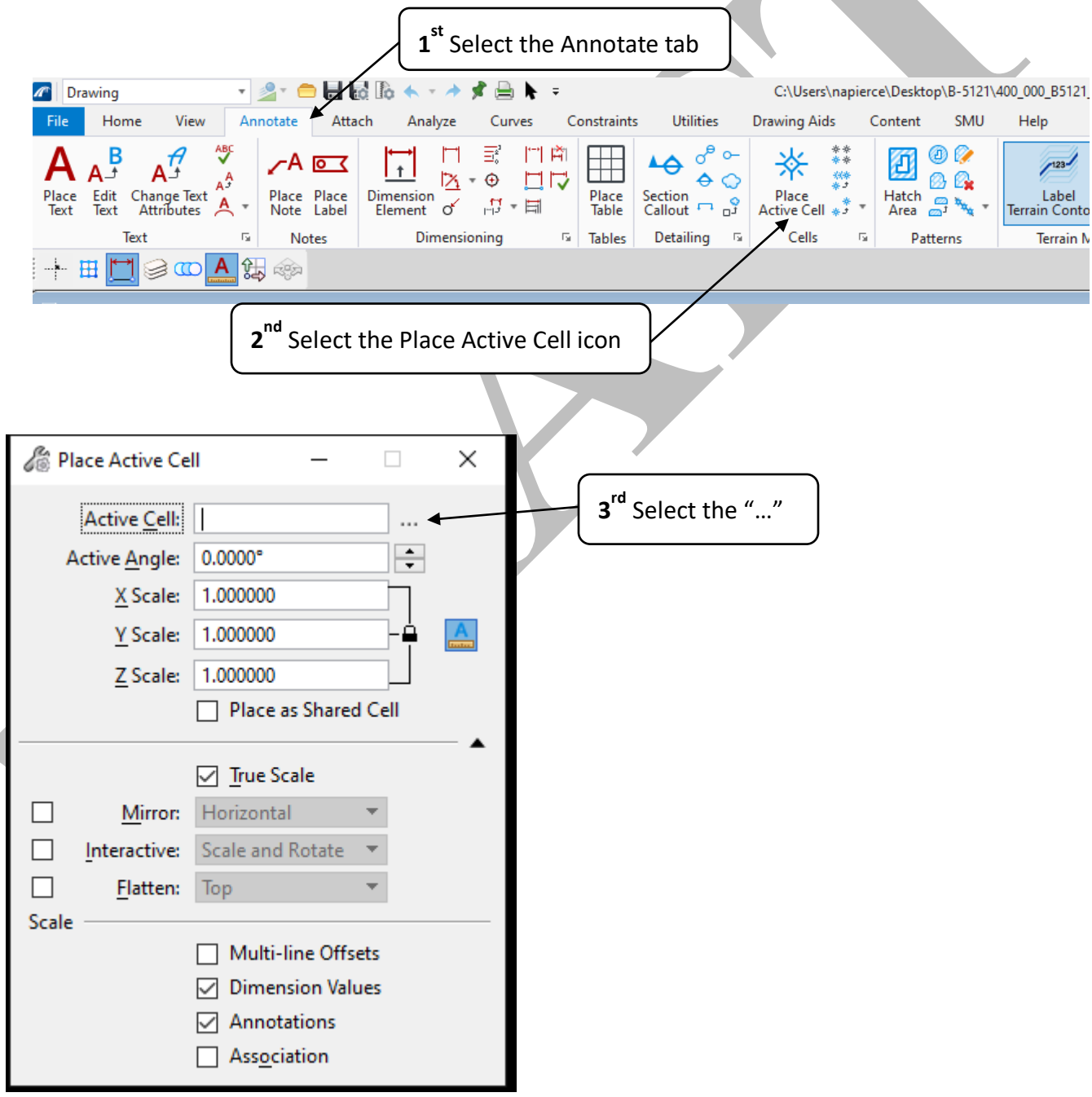
NOTE: When editing SMU text style, leave the style at "None" while editing. The text will remain as the SMU text style it was placed as.

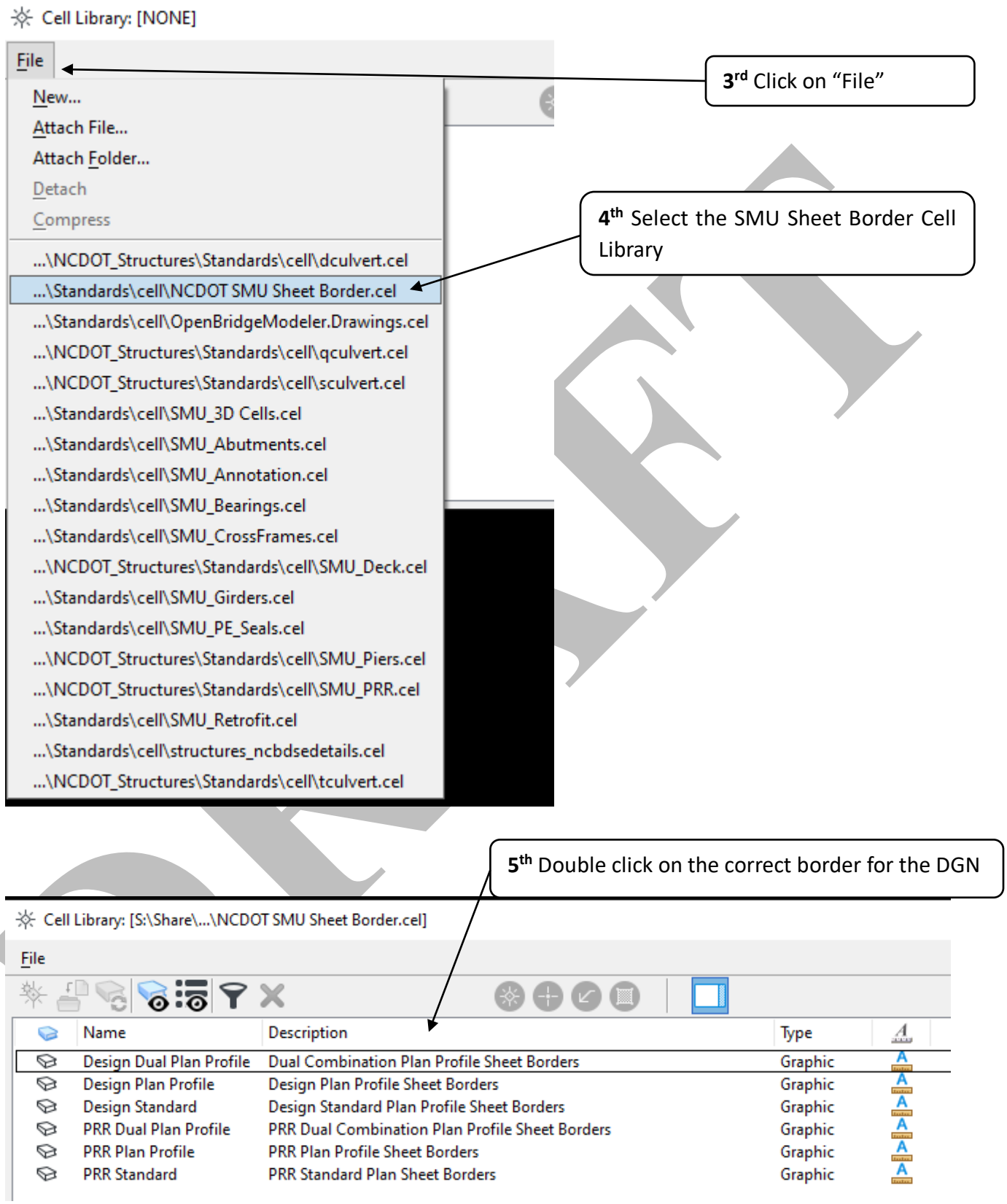
5.4 2D SHEET MODEL

For 2D drawings, the Sheet Model is used to place the Plan Sheet Border with it's labels, plan sheet notes and bill of material tables.

5.4.1 Individual Plan Sheet Borders

Once the Sheet Model is set up and ready for a border, follow these steps to place an individual sheet border in the Sheet Model:





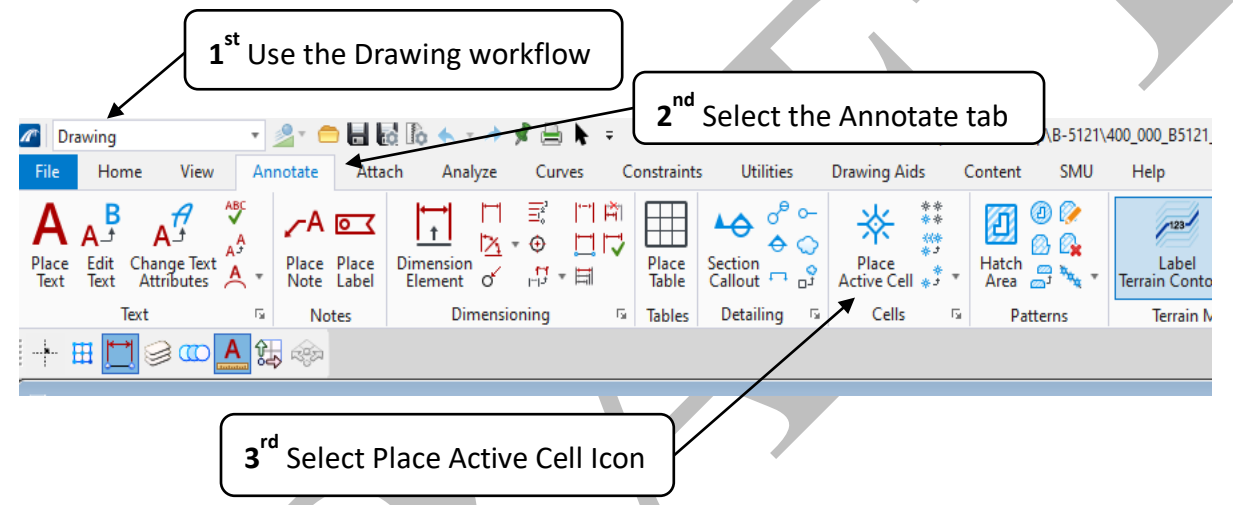
The border can now be placed as a cell in the sheet model.

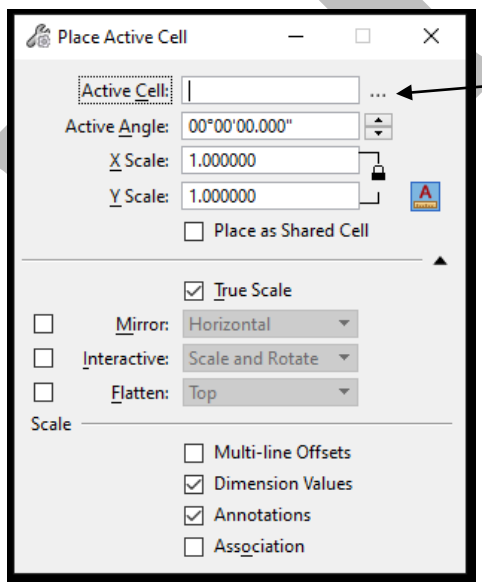
5.4.2 Referencing A Structure Primary Border

This method allows the user to set up a primary border for each structure on the project, so that the users only has to go into one file to fill out the project number, county, and station/bridge number as well as place a PE seal and Total Number of sheets for the entire project. To use this method, create a Master Border DGN file for each structure on a project following the steps found in Chapter 4, which will be later referenced in your plan sheets.

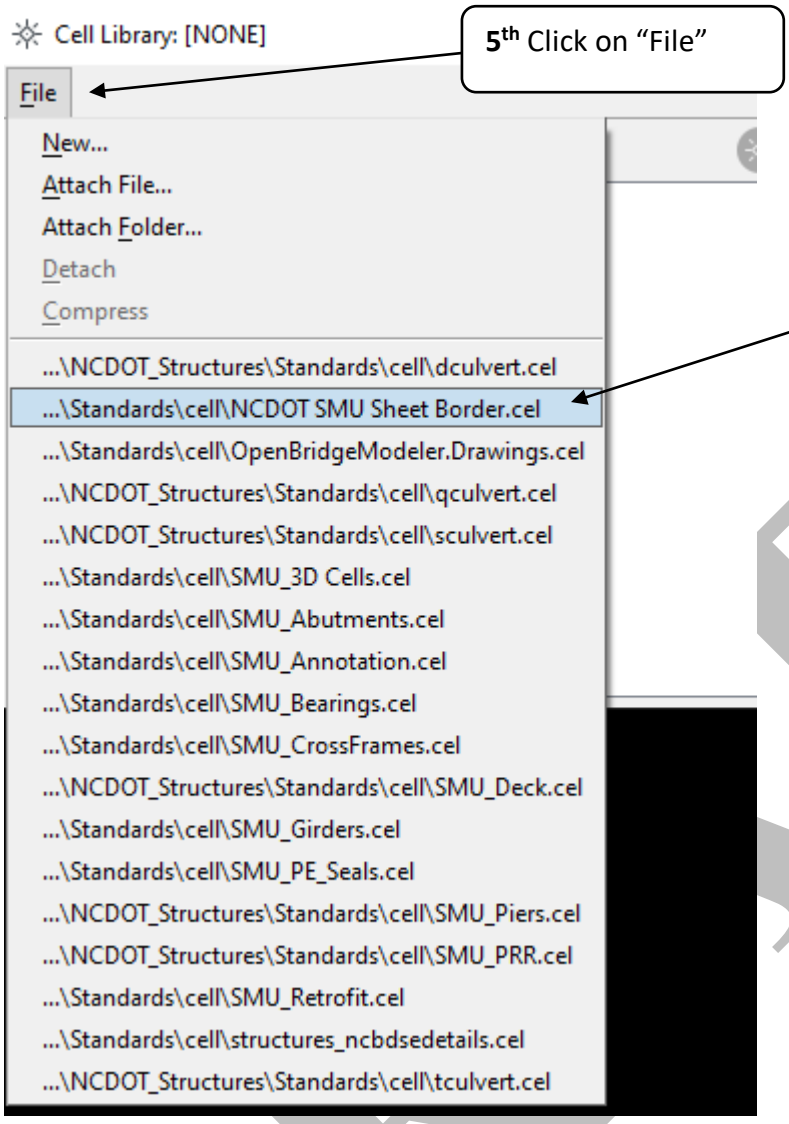
5.4.2.1 Creating a Primary Border DGN File

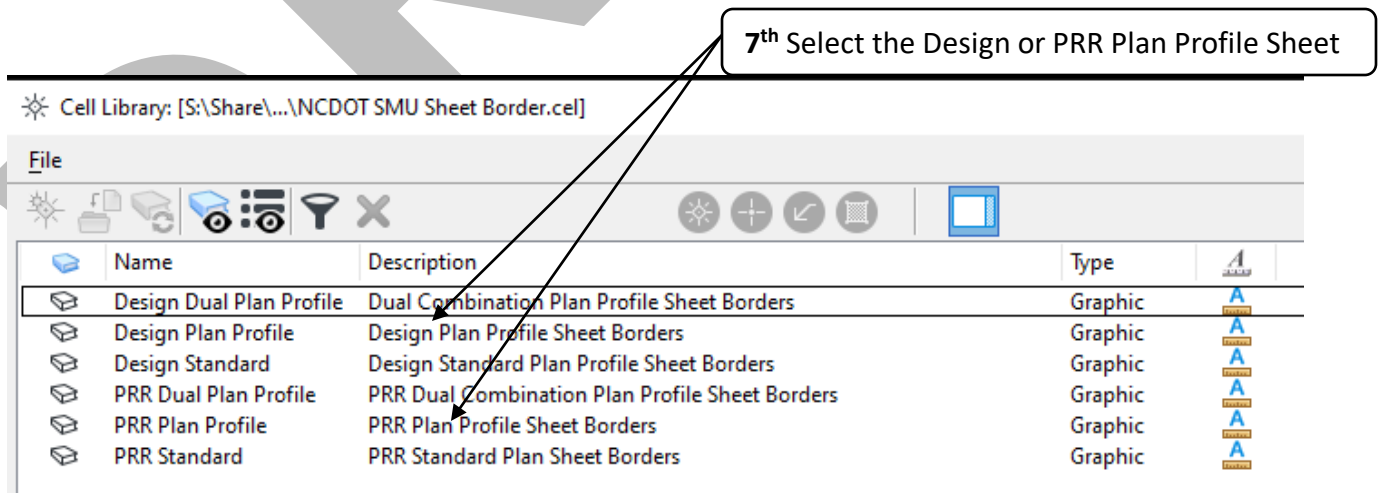
Create a new DGN file without adding Drawing and Sheet Models, in the Design Model follow these steps:



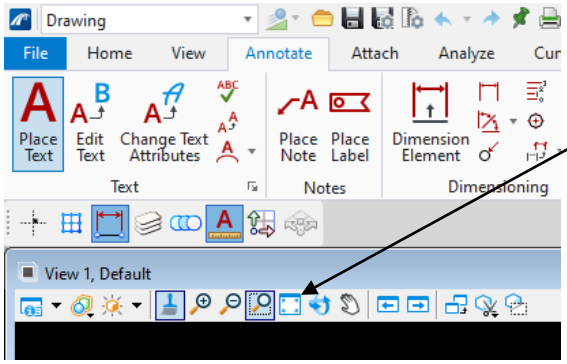


4th Click on the dots to find the cell library


Cell Library: [NONE]
5th Click on "File"
File
New...
Attach File...
Attach Folder...
Detach
Compress
...\NCDOT_Structures\Standards\cell\dculvert.cel
...\Standards\cell\NCDOT SMU Sheet Border.cel
...\Standards\cell\OpenBridgeModeler.Drawings.cel
...\NCDOT_Structures\Standards\cell\qculvert.cel
...\NCDOT_Structures\Standards\cell\sculvert.cel
...\Standards\cell\SMU_3D Cells.cel
...\Standards\cell\SMU_Abutments.cel
...\Standards\cell\SMU_Annotation.cel
...\Standards\cell\SMU_Bearings.cel
...\Standards\cell\SMU_CrossFrames.cel
...\NCDOT_Structures\Standards\cell\SMU_Deck.cel
...\Standards\cell\SMU_Girders.cel
...\Standards\cell\SMU_PE_Seals.cel
...\NCDOT_Structures\Standards\cell\SMU_Piers.cel
...\NCDOT_Structures\Standards\cell\SMU_PRR.cel
...\Standards\cell\SMU_Retrofit.cel
...\Standards\cell\structures_ncbdsedetails.cel
...\NCDOT_Structures\Standards\cell\tculvert.cel
6th Select "SMU Sheet Border.cel"


7th Select the Design or PRR Plan Profile Sheet
Cell Library: [S:\Share\...\NCDOT SMU Sheet Border.cel]
File
Name
Description
Type
Design Dual Plan Profile
Dual Combination Plan Profile Sheet Borders
Graphic
Design Plan Profile
Design Plan Profile Sheet Borders
Graphic
Design Standard
Design Standard Plan Profile Sheet Borders
Graphic
PRR Dual Plan Profile
PRR Dual Combination Plan Profile Sheet Borders
Graphic
PRR Plan Profile
PRR Plan Profile Sheet Borders
Graphic
PRR Standard
PRR Standard Plan Sheet Borders
Graphic

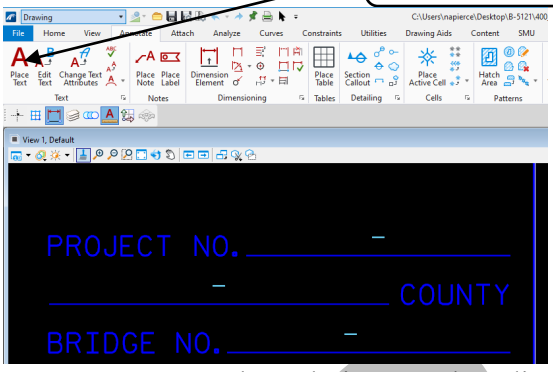
Place the border in the dgn Design Model at the axis origin point. Note the border will come in small, use the "Fit View" icon to zoom in.



8th "Fit View"

Edit the Project No., County and either Bridge No. or Station for the Structure

9th Use the Place Text icon on the Annotate tab



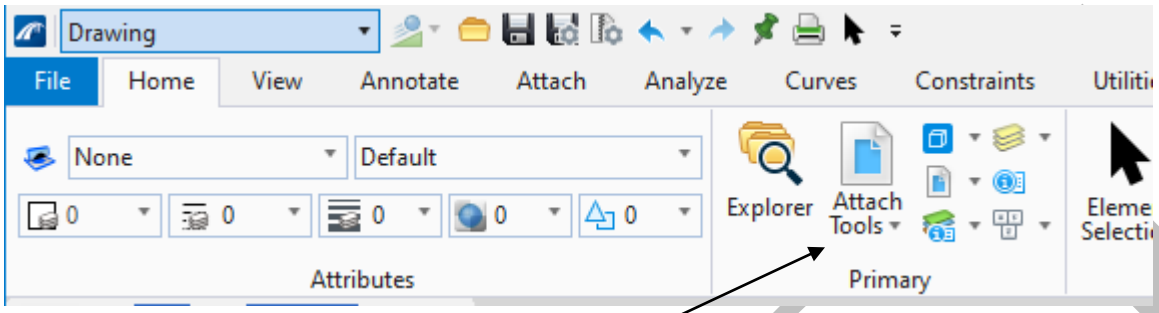
Note: The only items to be edited in a Master Border should be:
Project No.
County
Station/Bridge No.
Total Sheets

PE Seal

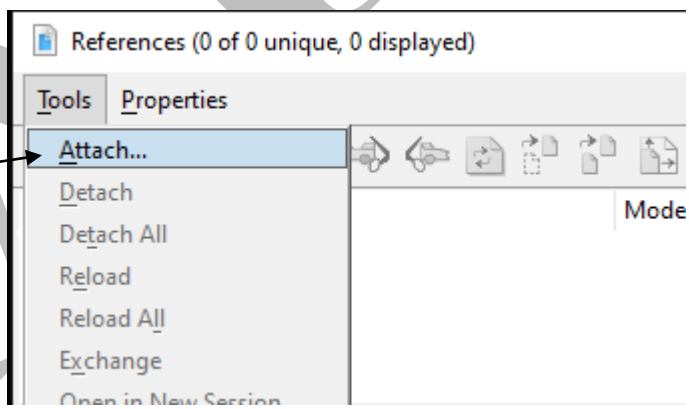
Save settings and exit file.

5.4.2.2 Referencing a Project Primary Border

Once the Sheet Model for each project DGN file is set up and ready for a border, follow these steps to reference in the Master sheet border into the Sheet Model:

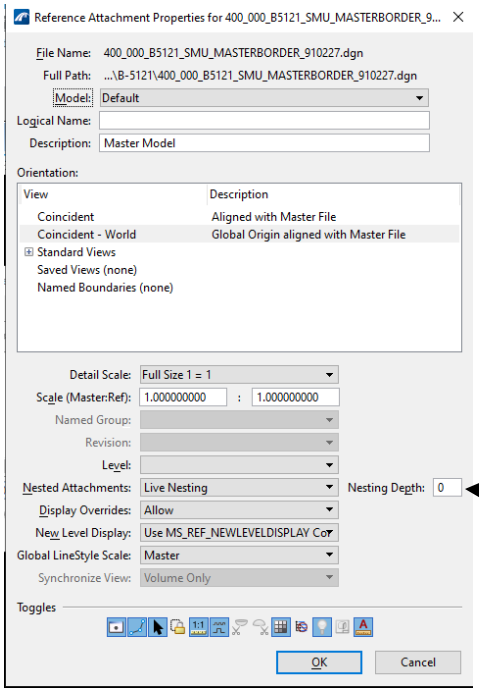


1st Select the Attach Tools icon



2nd Select Tools, Attach…

3rd Locate the Primary Border in the project folder created for the structure being drawn



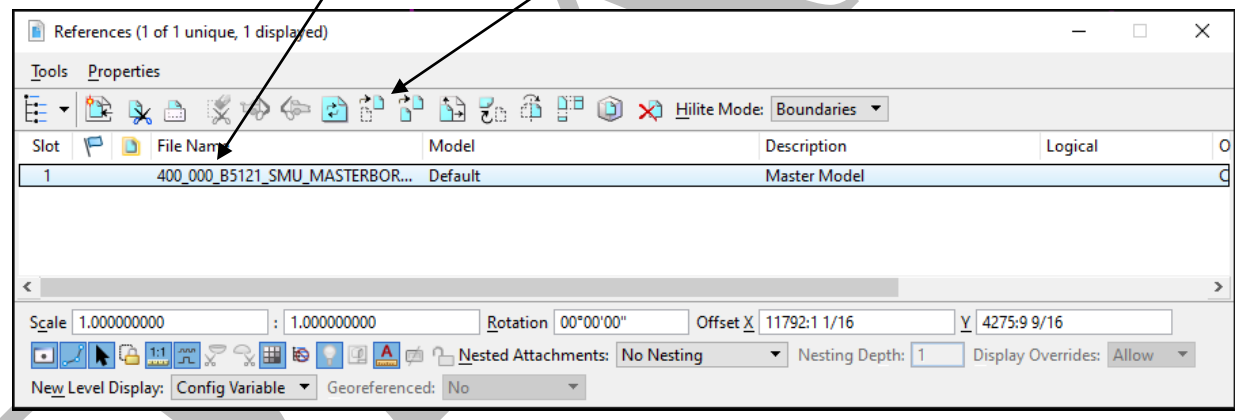
The reference should come in with the correct settings and not need changing.

The border will sometimes be off of the set sheet, and often not be in view of the set sheet. Use the "Fit View" icon to find stray referenced borders. To move it using the "Move Reference" tool…

Change Nesting Depth to 99

4th Select the attached file

5th Use the Move Reference tool to move the border on to the set print fence



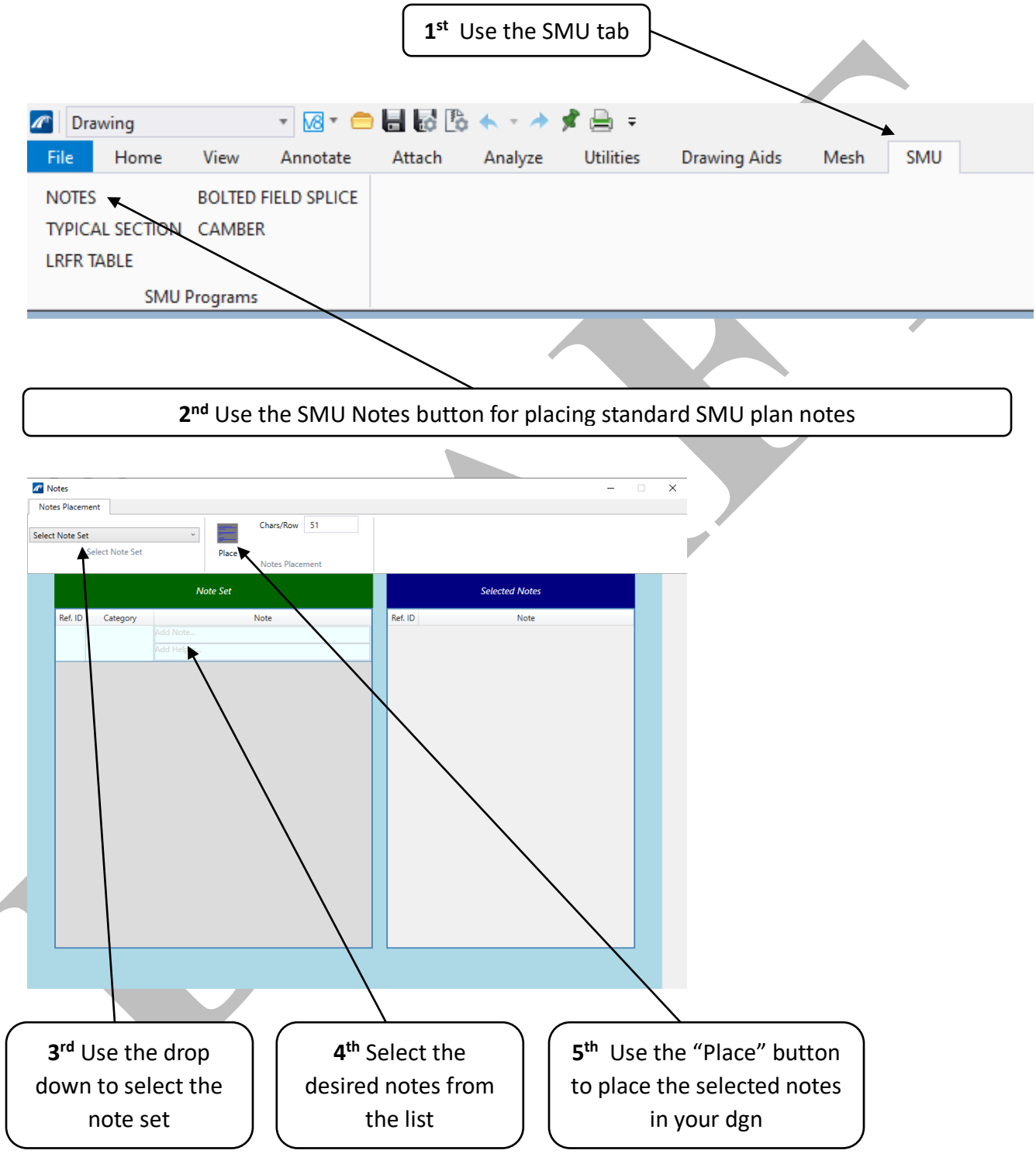
The Sheet Model scale should be left at "Full Size 1=1".

6th Once the border is placed, the following items need to be placed in each DGN file on the referenced Master Border:

- Drawn By & Date
- Checked By & Date
- Engineer of Record
- Title
- Sheet Number
- Sheet _ of __

5.4.3 Placing Plan Notes With SMU Notes Tool

To place standard SMU plan notes on the Sheet Model, follow these steps



Note that you can change the number of characters per row by editing the number.

5.5 TITLE SHEET

SMU Title Sheet should be placed in the Sheet Model as a cell from either the Annotation Cell Library or from the PRR Standard Drawing tool. The Sheet Model drawing scale can be changed with the use of this cell. For required title sheet content, refer to Chapter 1 of the SMU Design Manual.

5.6 INDEX SHEET

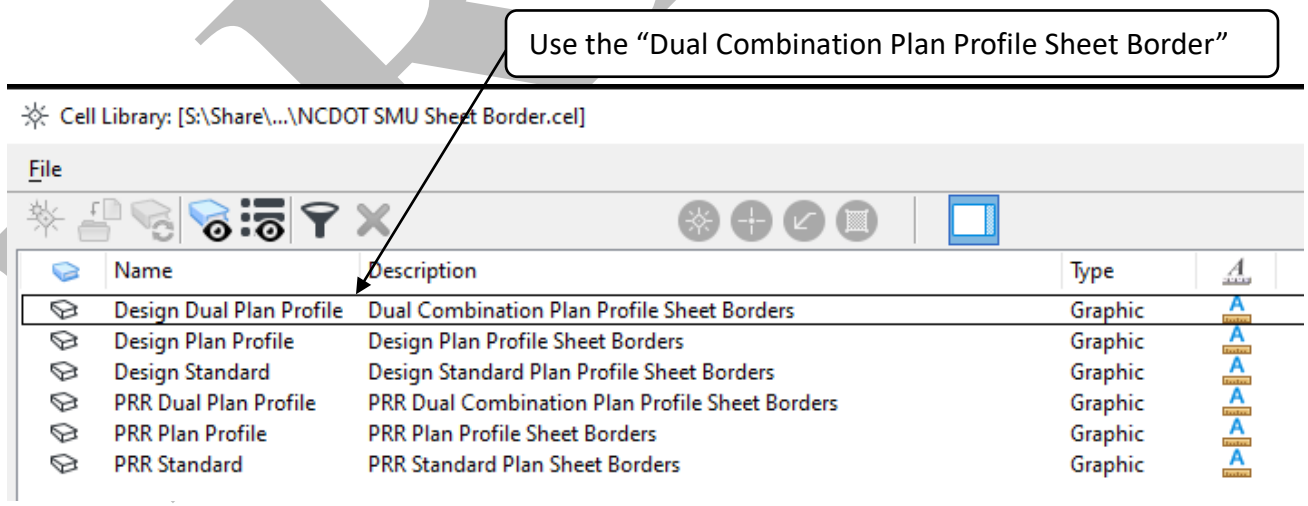
SMU Index Sheet should be placed in the Sheet Model as a cell from either the Annotation Cell Library or from the PRR Standard Drawing tool. The Sheet Model drawing scale can be changed with the use of this cell. For required title sheet content, refer to Chapter 1 of the SMU Design Manual.

5.7 PRELIMINARY GENERAL DRAWING

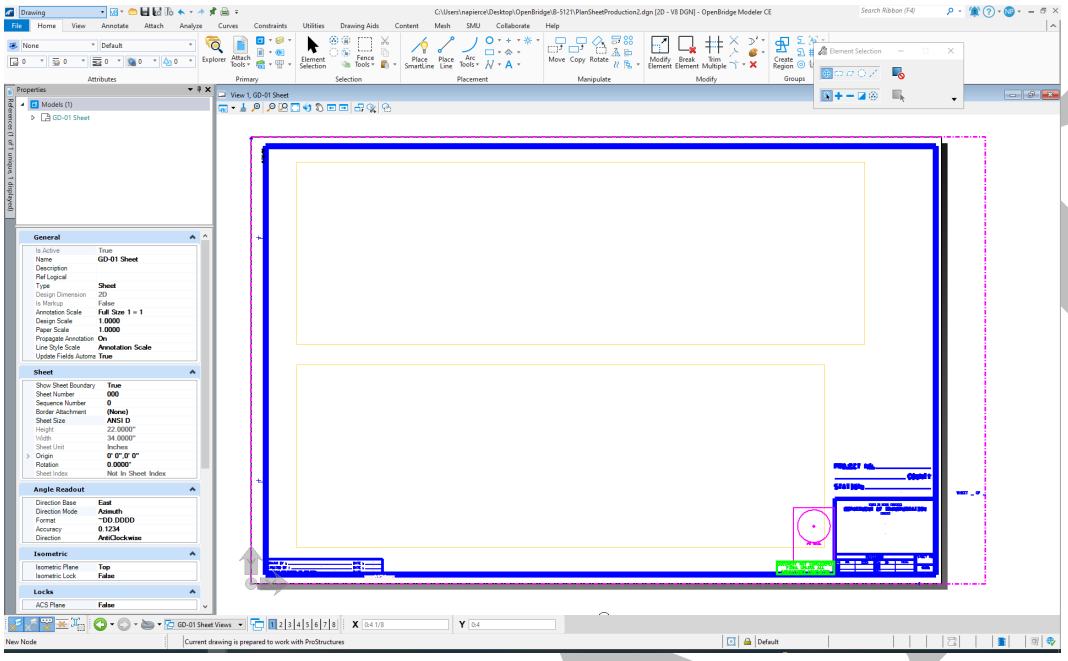
Preliminary General Drawings (PGD) depict the basic layout of the proposed structure and involve the use reference files, such as the Hydraulics Units BSR file or the Roadway alignment file and cross section files. Reference Chapter 4 the SMU Structure Design Manual for guidance on requirements of a PGD. The following is how to generate a plan and cross section drawing in OBD.

5.7.1 DGN File Set Up

Once the DGN is setup with the Design, Drawing and Sheet Models, take the following steps to set up the Sheet Model.

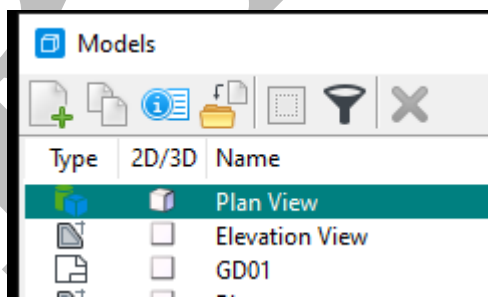


The Sheet Model should look like this:

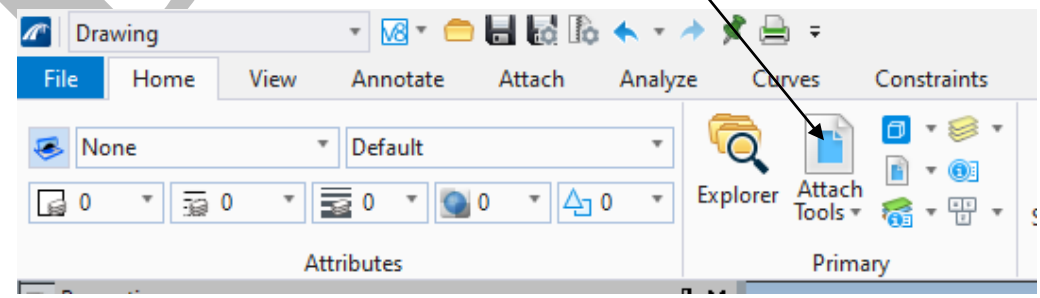


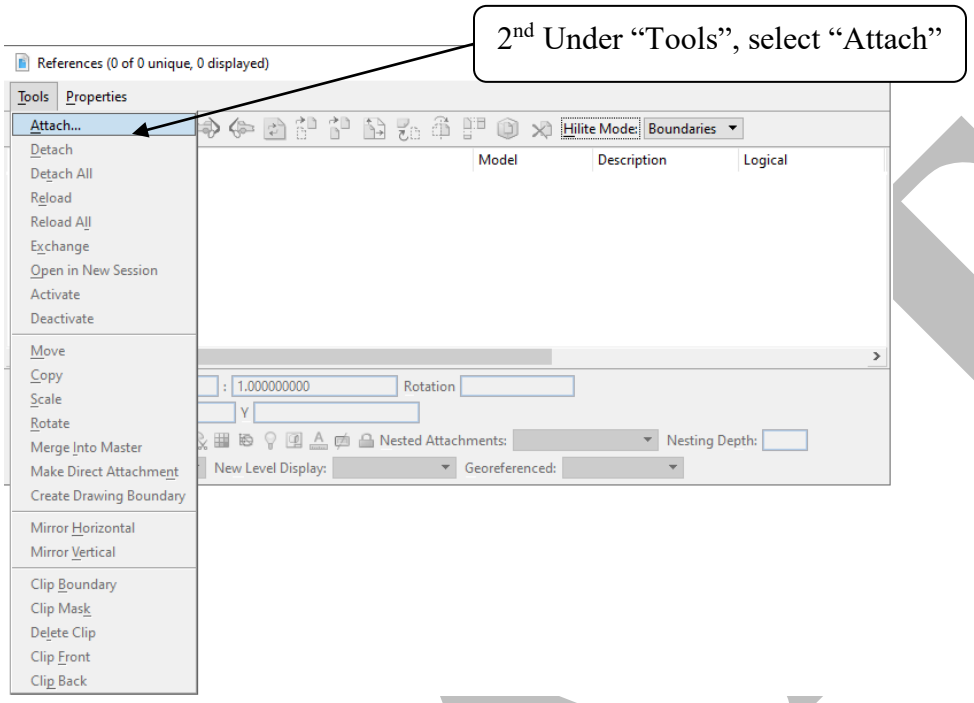
5.7.2 Referencing Other DGN's

In the "Plan View" (Design Model) take the following steps to reference in other disciplines DGN's:

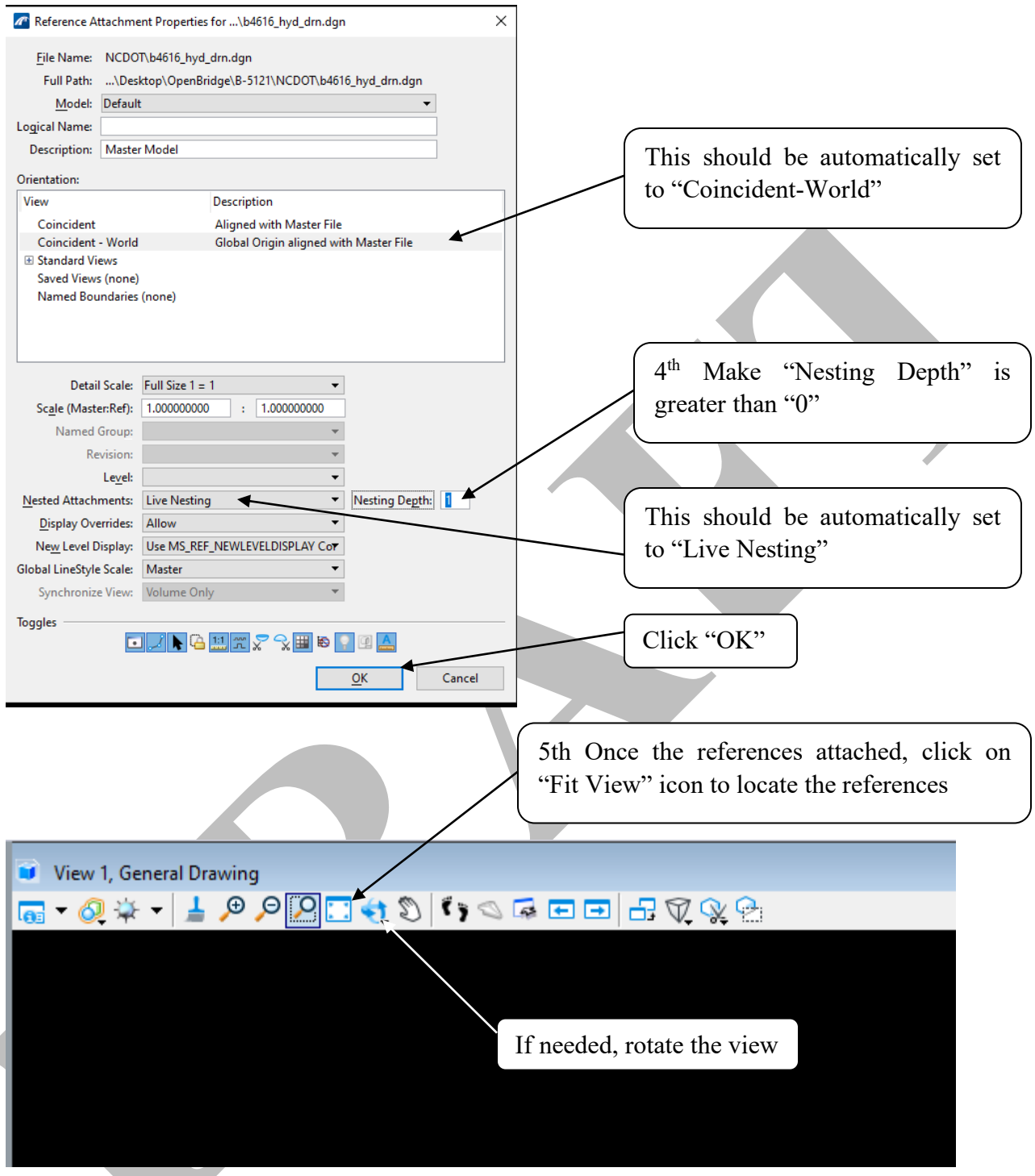


1st Select "Attach Tools"





3rd Navigate to the project folder and find the plan view file(s) to be referenced, such as the HYD_rpt_brg or Rdy_dsn. For elevation views, use files like HYD_rpt_brg or rdy_pfl.



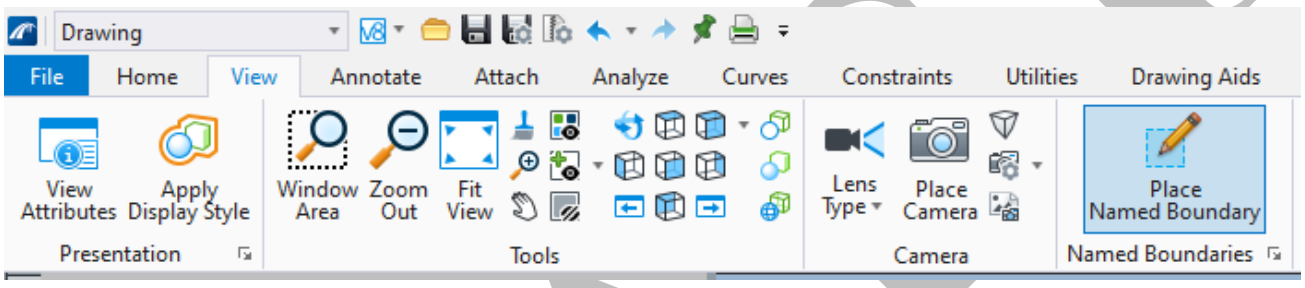
Note, the view might also need to be rotated to get the structure to appear horizontally left to right. Take similar steps in the Elevation View drawing model to reference DGN's such as a BSR.

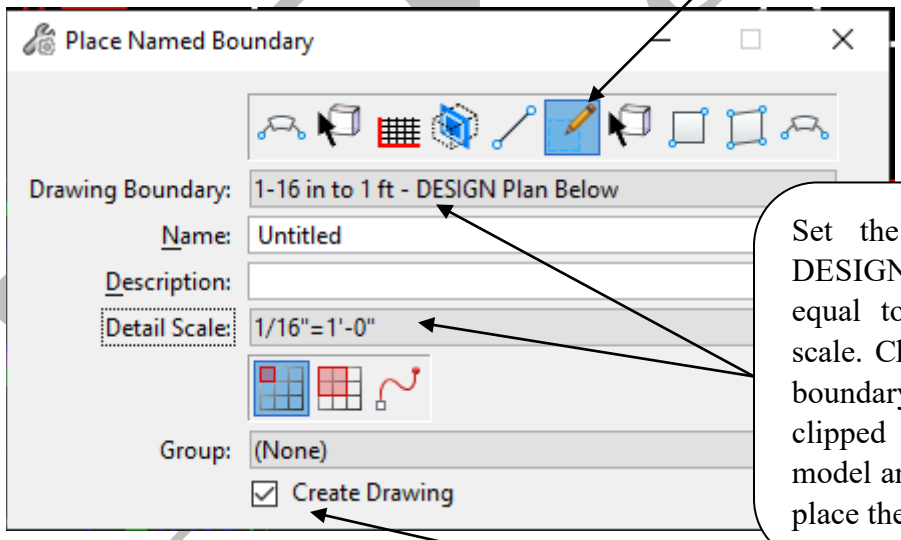
5.7.3 Using the Place Named Boundary Tool

5.7.3.1 Plan View

Take the following steps in the plan view design model:

- Use Level Display tool to drop all unnecessary levels that restrict view of existing and proposed structures
- Draft proposed substructure elements in their correct locations on top of the referenced file(s). Do not add dimensions, call-outs or text here, they will be added at a later stage.
- Use the "Place Named Boundary" tool



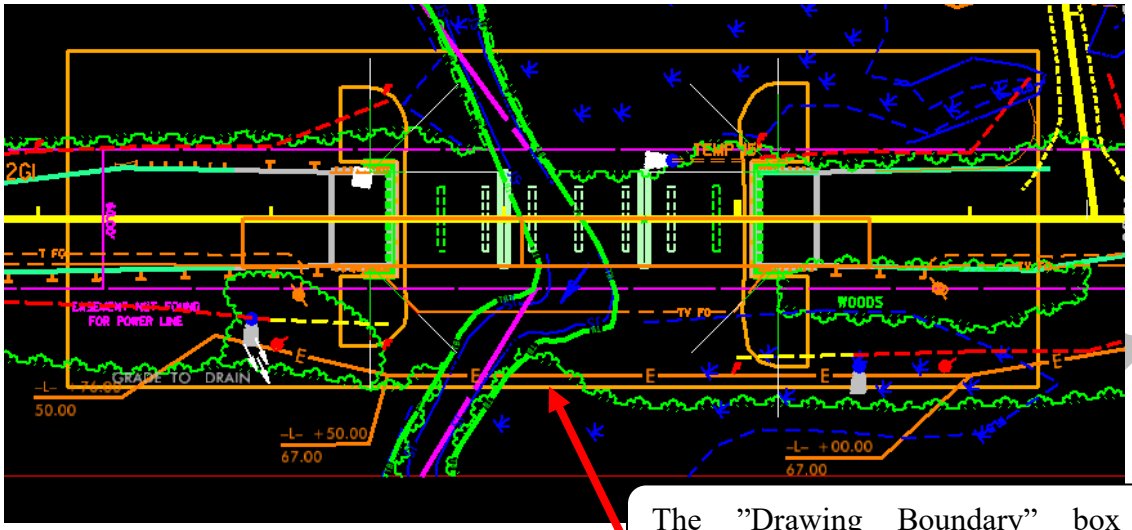


Select the "From Drawing Boundary" tool

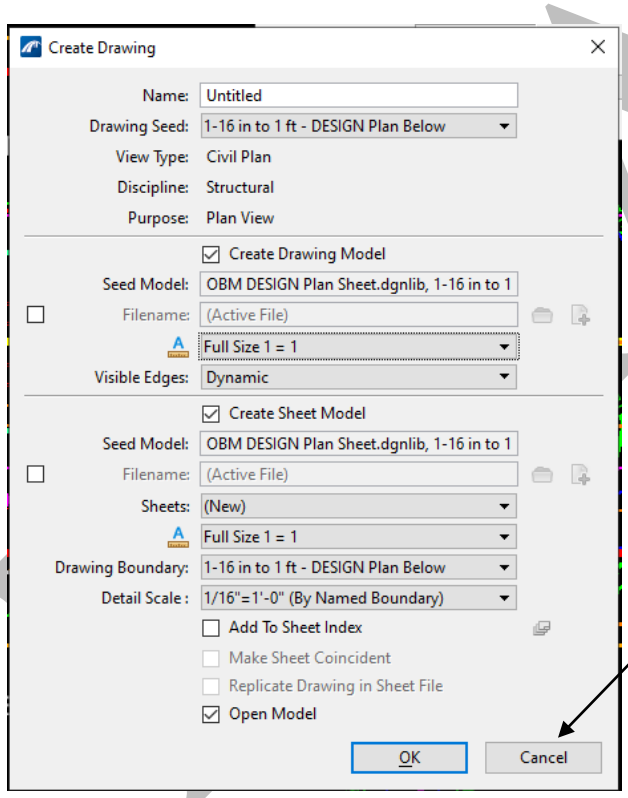
Set the "Drawing Boundary" to "…-DESIGN Plan Below" and "Detail Scale" equal to the selected drawing boundary scale. Change the scale until the generated boundary box fits the area intended to be clipped for the plan view on the sheet model and double click within the model to place the boundary

Make sure the "Create Drawing" box is checked

Note, the Drawing Boundary box is placed by the center of the left vertical leg. To center the plan view in the box, place the box on the alignment with the placement point before double clicking to place it.



The "Drawing Boundary" box placed centered over the desired plan view

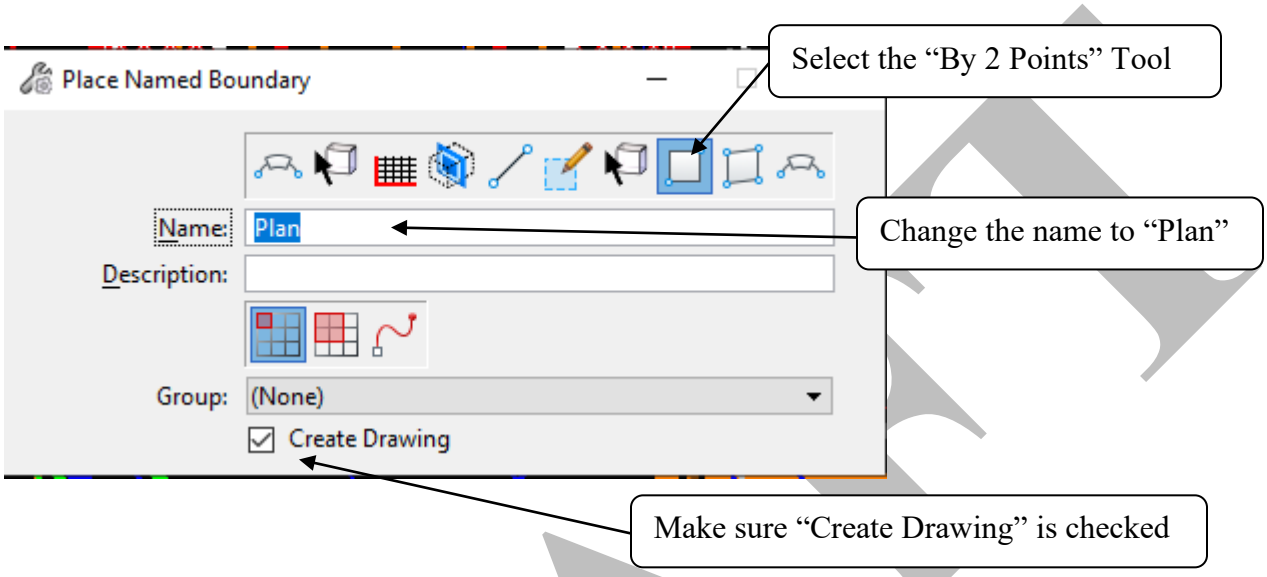


Select the "Cancel"

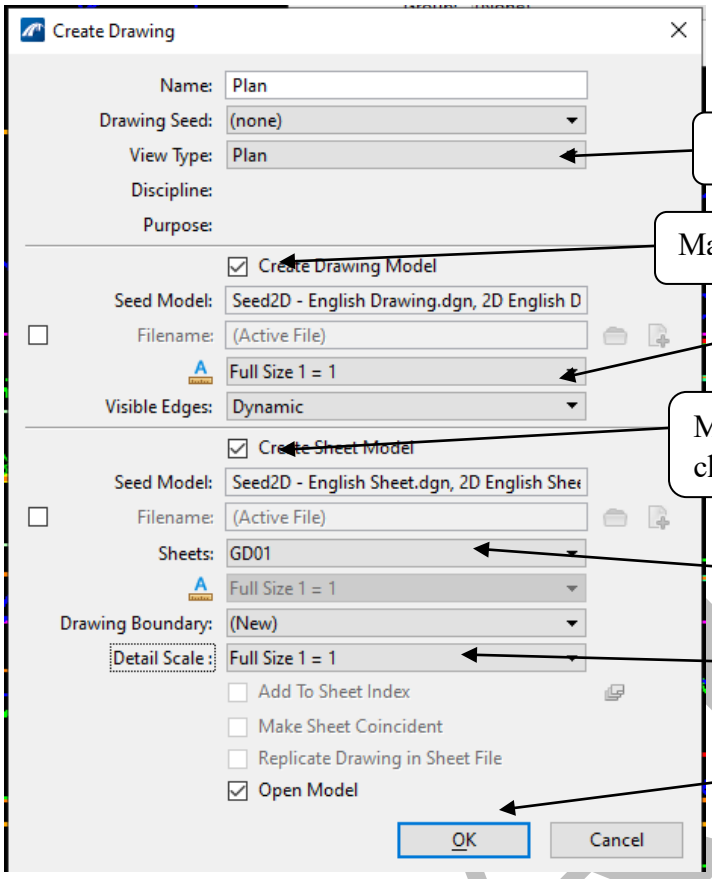
Because the Sheet Model is always at Drawing Scale "Full Size 1=1", if the "From Drawing Boundary" is used at the scale that best fits around the plan view desired, the same issue as placing the border within the design model space and changing the Drawing Scale happens. All the custom line styles and other annotavite items within the referenced files

will scale to the scale selected, which can cause them to move off the area selected. To "cheat" this from happening, cancel out of using the tool which leaves the Drawing Boundary box on your plan view drawing.

Open the "Place Named Boundary" tool again.



Using the already placed "Drawing Boundary" box in the drawing, select oposite corners of the box and double click.



Change the View Type to "Plan"

Make sure "Create Drawing" is checked

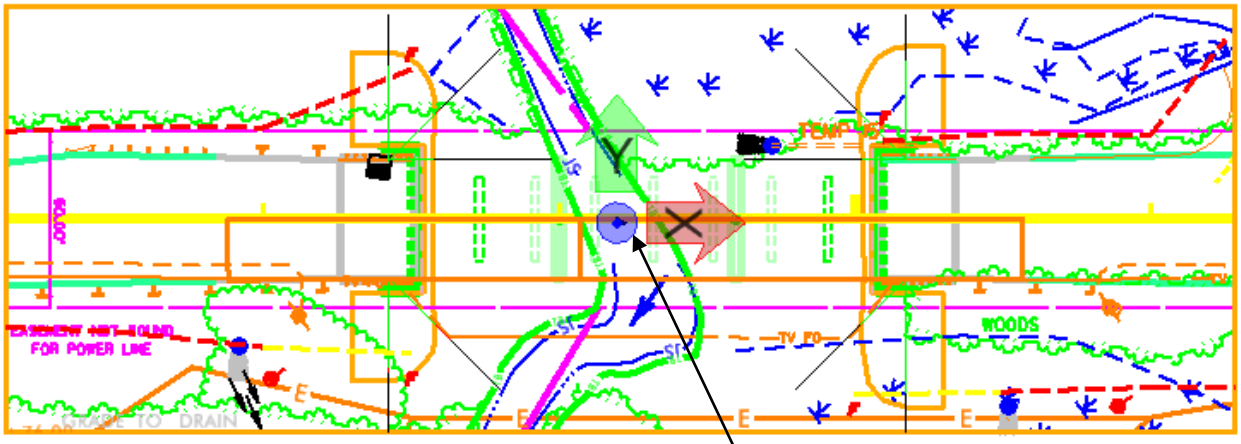
Set the scale to "Full Size 1=1"

Make sure "Create Sheet Model" is checked

Select the named Sheet Model

Set the scale to "Full Size 1=1"

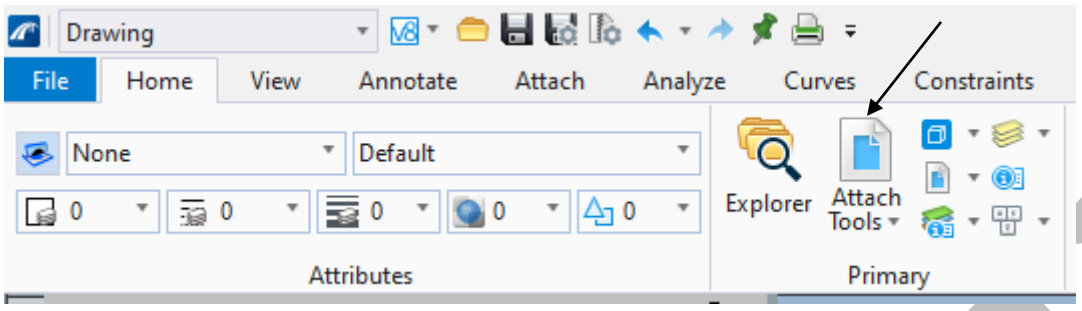
Select the "OK"



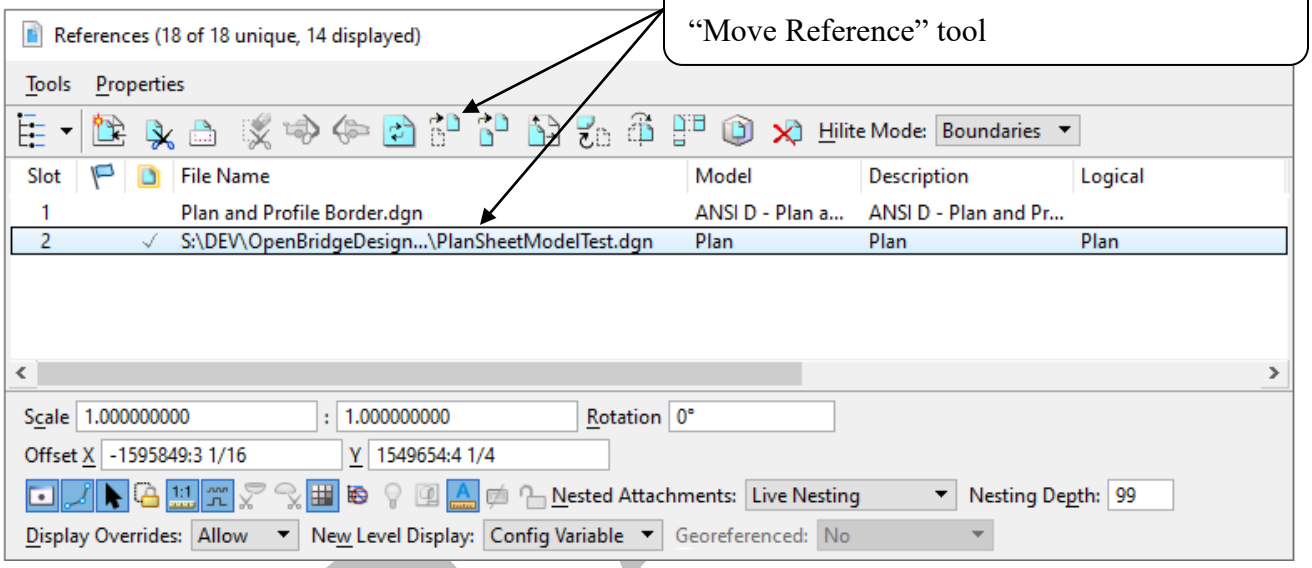
The sheet border is here, if zoomed in

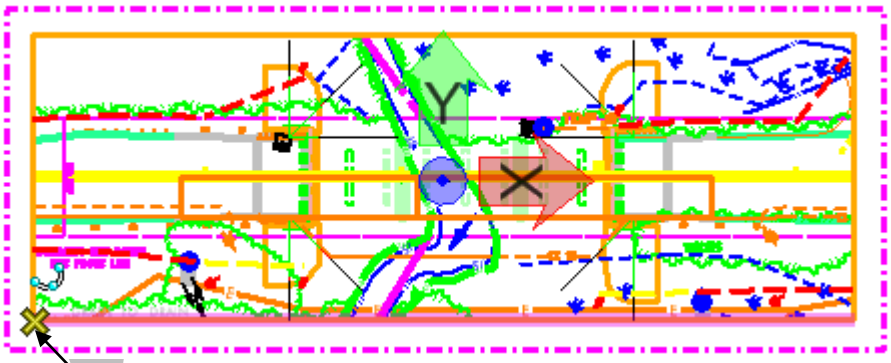
The drawing will come into the sheet model space larger than the sheet border.

Go to "Attach Tools"

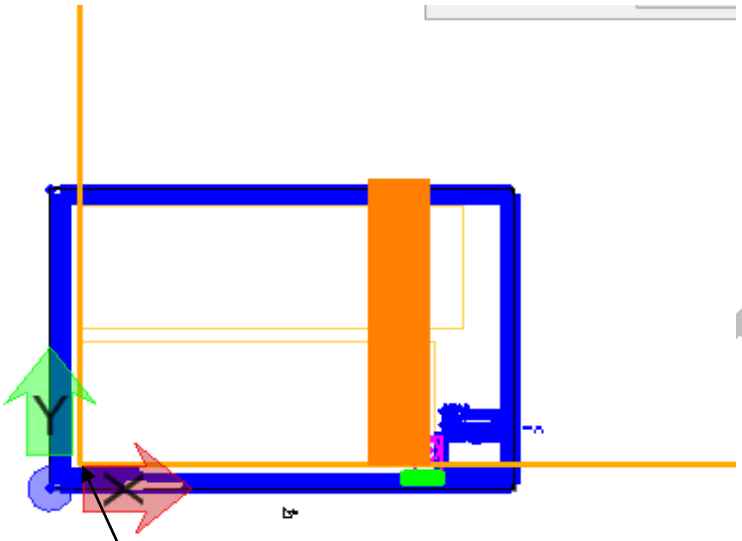


Click on the referenced view and use the "Move Reference" tool



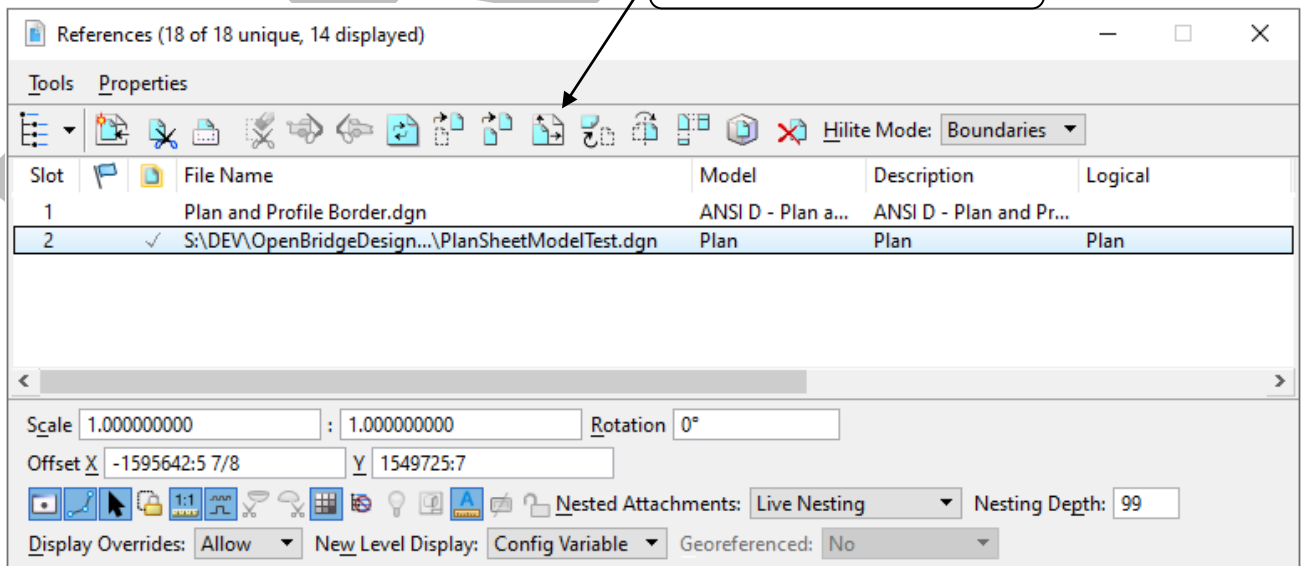


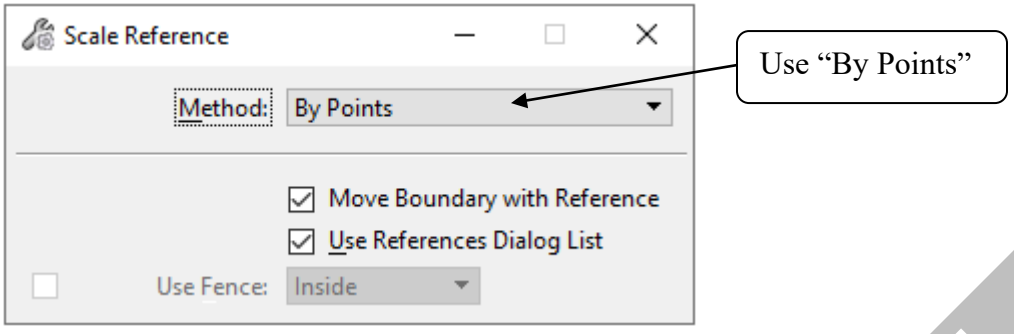
Grab the referenced file by the boundary box, not the reference fence



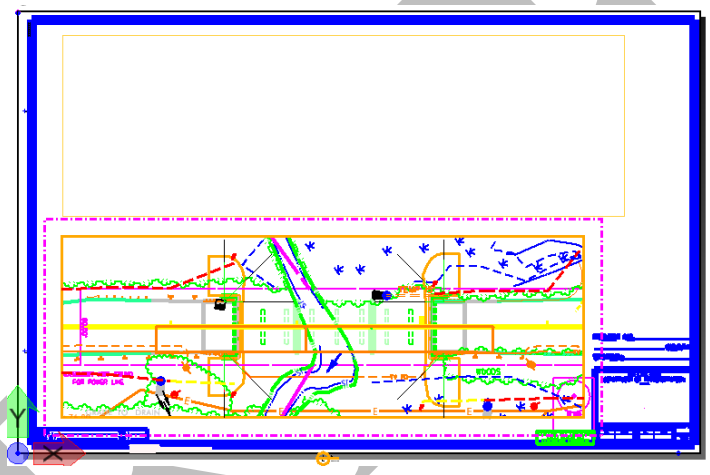
Move the referenced boundary box to the lower box in the border

Use the "Scale Reference"





Grab the referenced file by the Boundary Box (not the reference fence) starting in the lower bottom left corner, then the diagonal top right corner. Reduce the box to fit the bottom box on the border sheet.

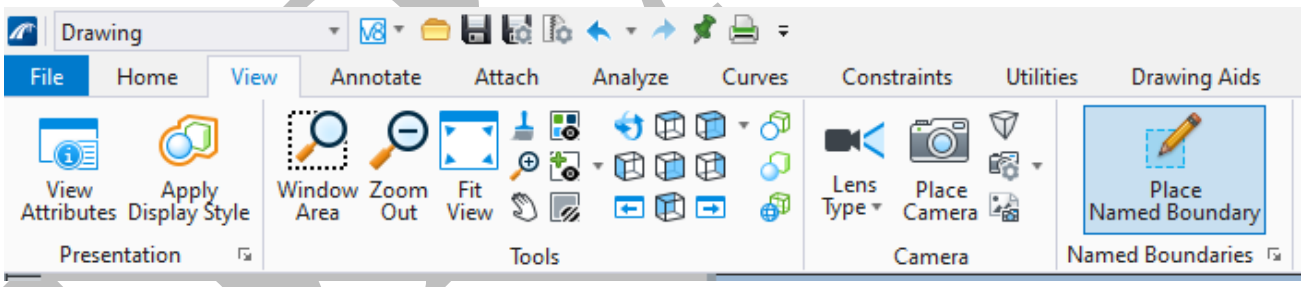


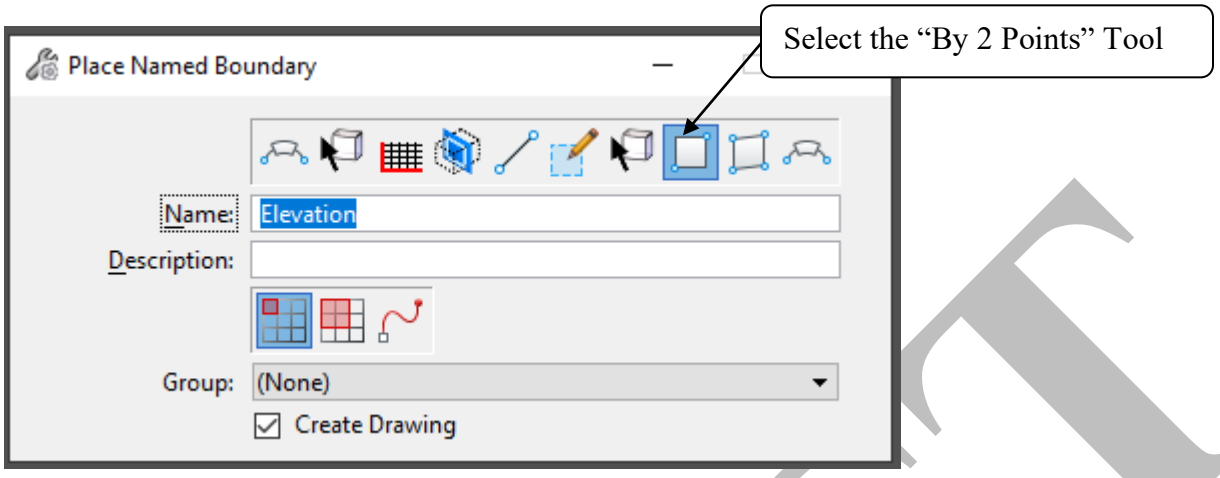
All annotation (text, dimensions, etc.) will happen in the sheet model.

5.7.3.2 Elevation View

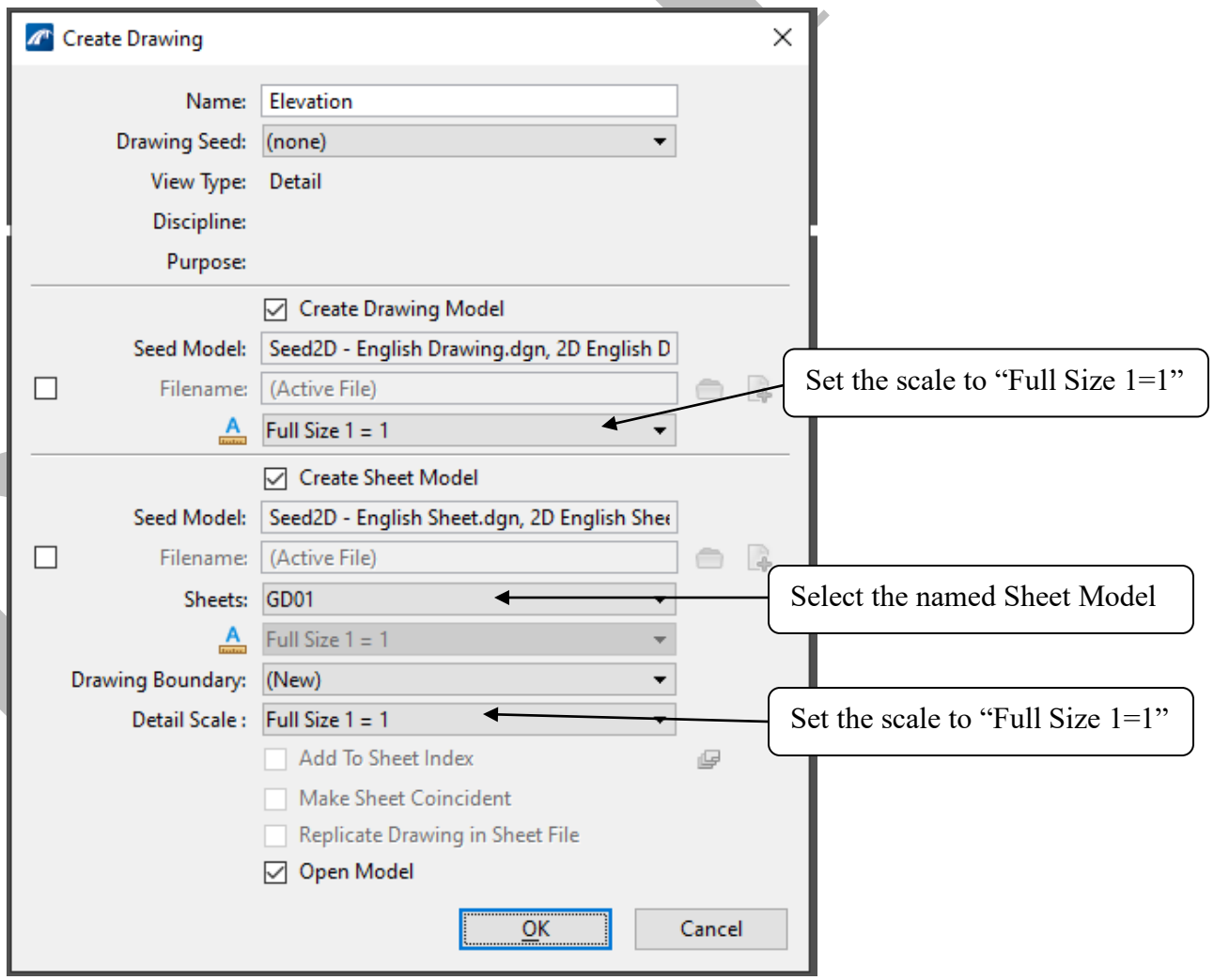
Take the following steps in the elevation view drawing model:

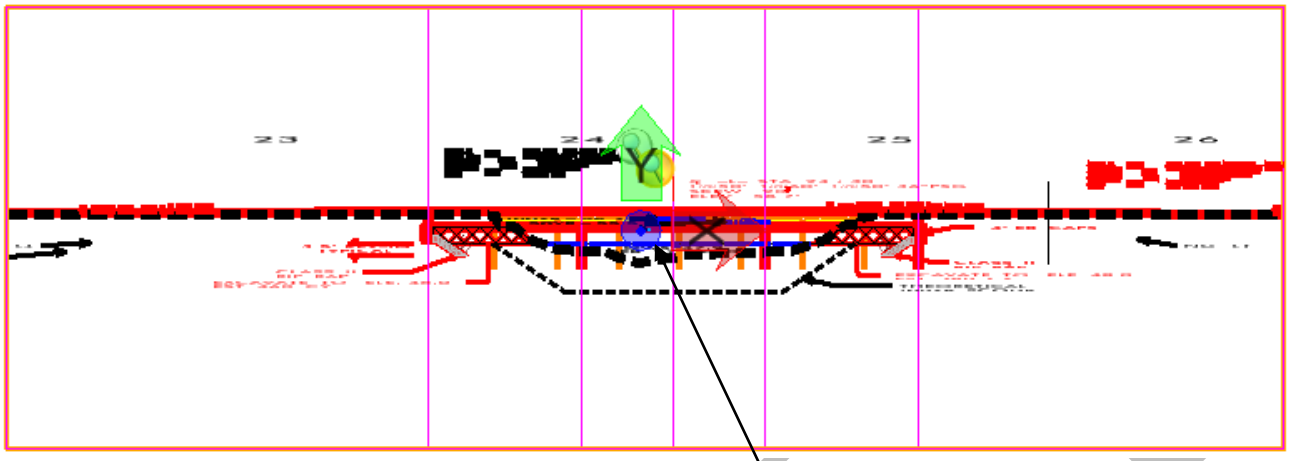
- Reference in the "Plan View"
- For stream crossings, reference in the HYD_rpt_brg file if it's not in your referenced "Plan View". Copy the elevation view and paste it vertically below the referenced file. Note the ground line might need to be selected separately because it might extend beyond the graph. Use the scale tool to change the y-scale to 0.2, this will make the drawing 1:1. Make sure to keep the drawing vertically in-line with the plan view. Clip the elevation and station lines back that restrict view of existing and proposed structures, use them later to establish the elevations and stations on your plan sheet.
- For grade separations, reference in the rdy_pfl file, make sure the profile is vertically in-line or on top of the referenced Plan View so the stations are matching. Use the Level Display tool to turn off levels not needed.
- Draft proposed substructure elements, slope protection, excavations, etc. in their correct locations on top of the copied view
- Once the elevation view has been drafted, go back up to the referenced "Plan View" file and copy the "Boundary Box" and move it vertically over the elevation view keeping the stations the same in both views.
- Use the "Place Named Boundary" tool



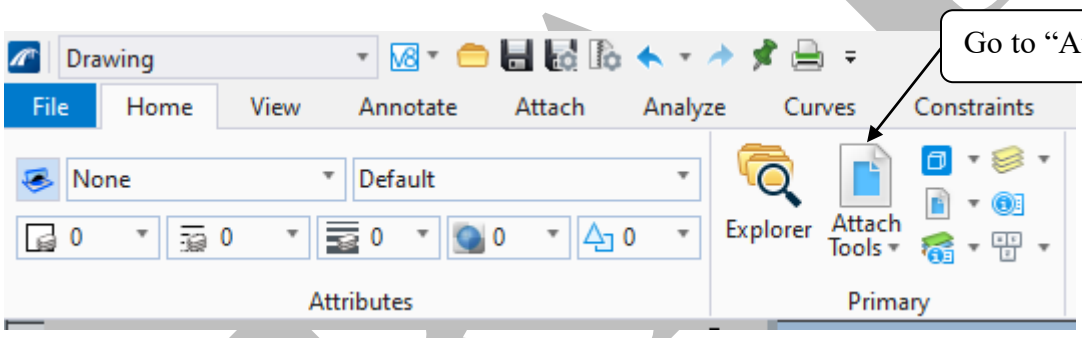


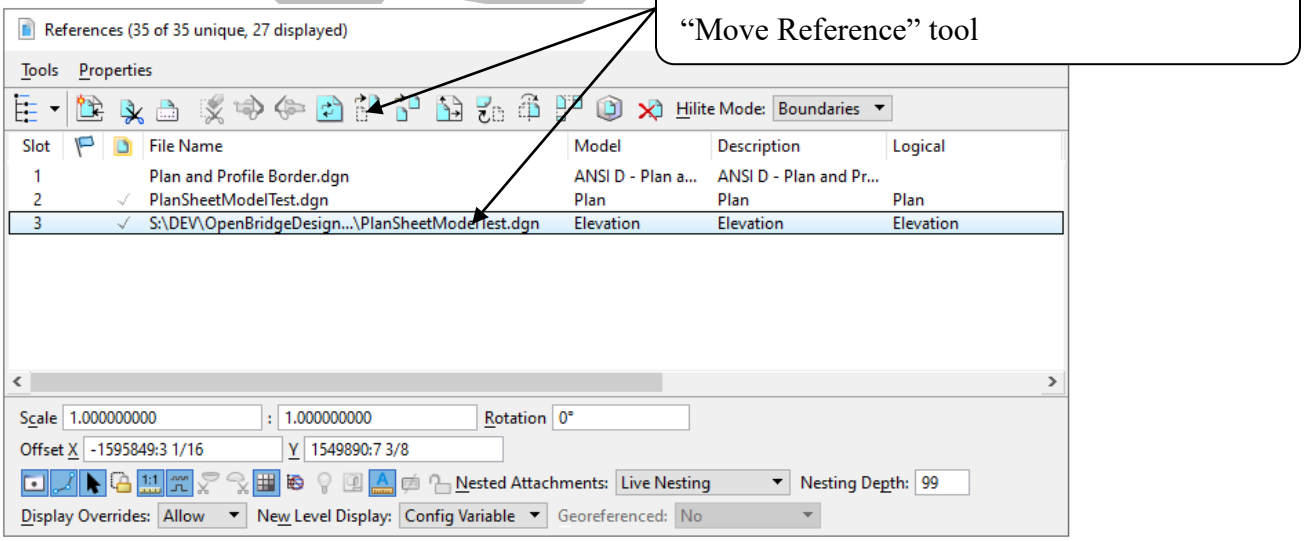
Using the copied "Drawing Boundary" box in the drawing, select oposite corners of the box and double click.

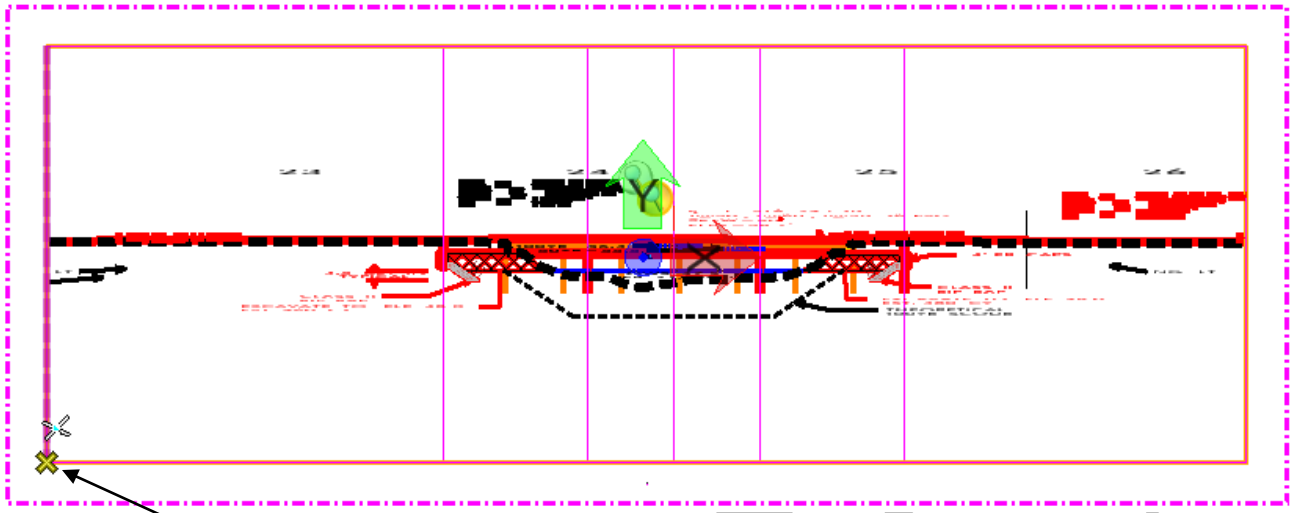




The drawing will come into the sheet model space larger than the sheet border.

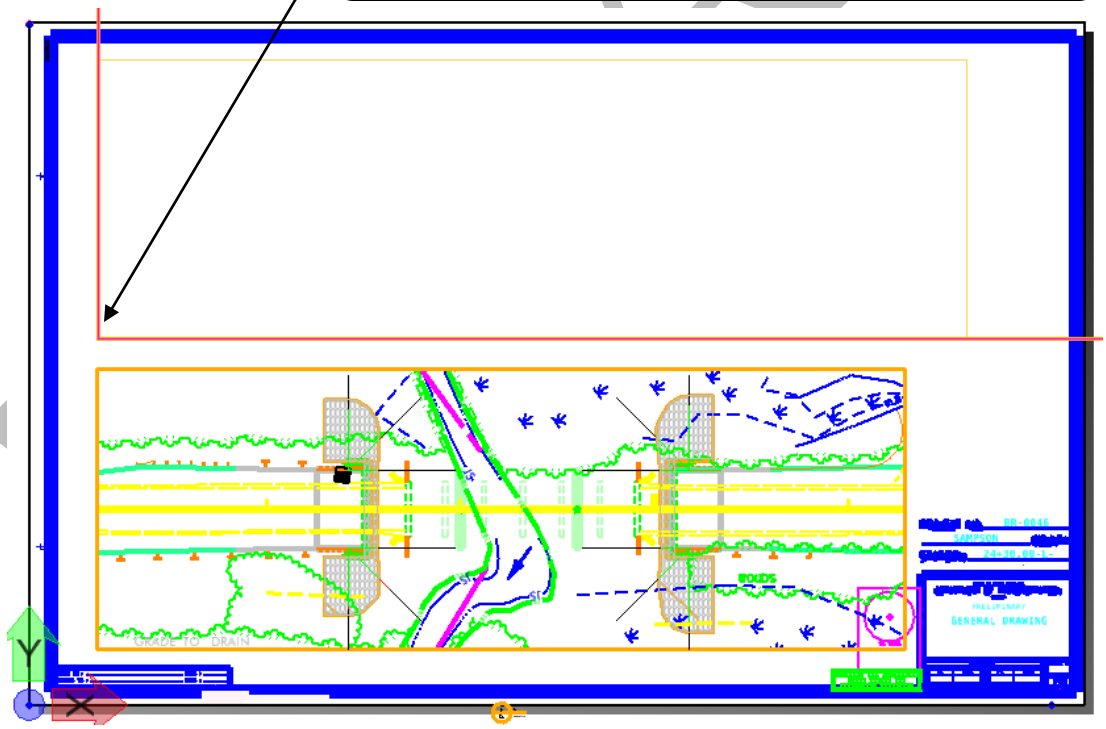


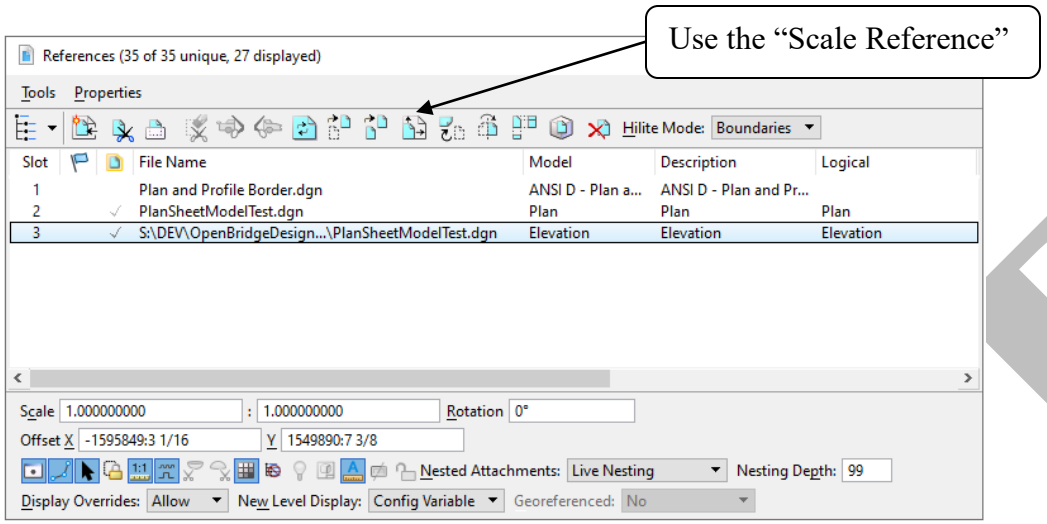


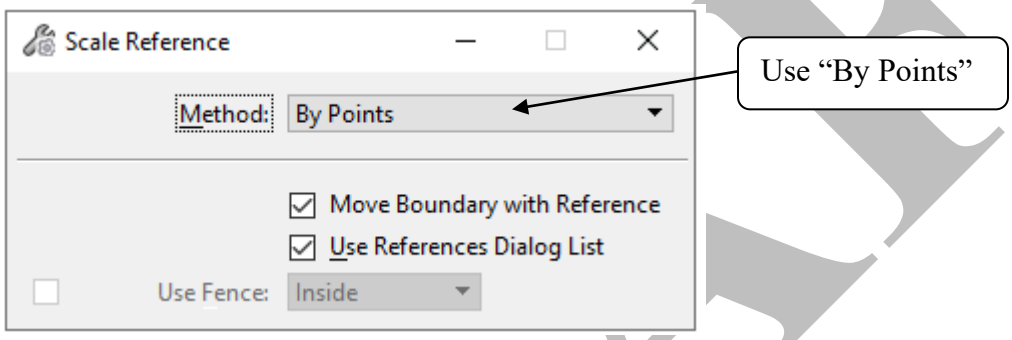


Grab the referenced file by the boundary box, not the reference fence

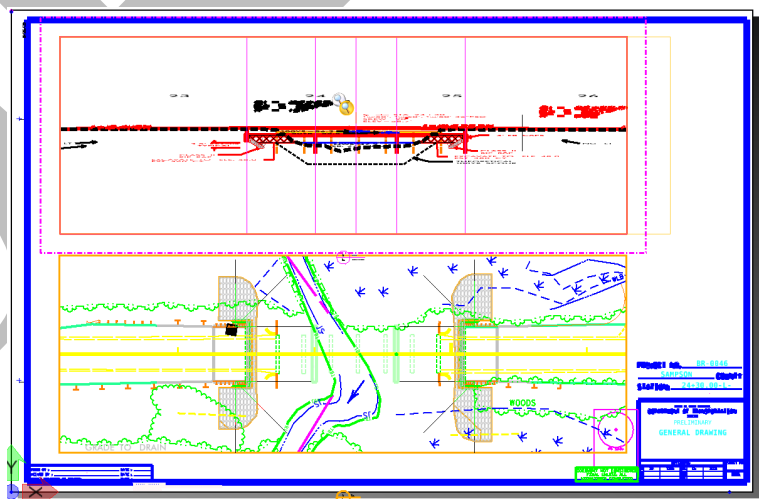
Move the referenced boundary box to the upper box in the border







Grab the referenced file by the Boundary Box (not the reference fence) starting in the lower bottom left corner, then the diagonal top right corner. Reduce the box to fit the height of upper box on the border sheet. Note it will not be the full width of the box, but the elevation view will match up with the plan view.



All annotation (text, dimensions, callouts, etc.) will happen in the Drawing Model. Labels, such as "Plan" and "Section Along Centerline Bridge" can be placed in the Sheet Model.

5.8 GENERAL DRAWING SHEETS

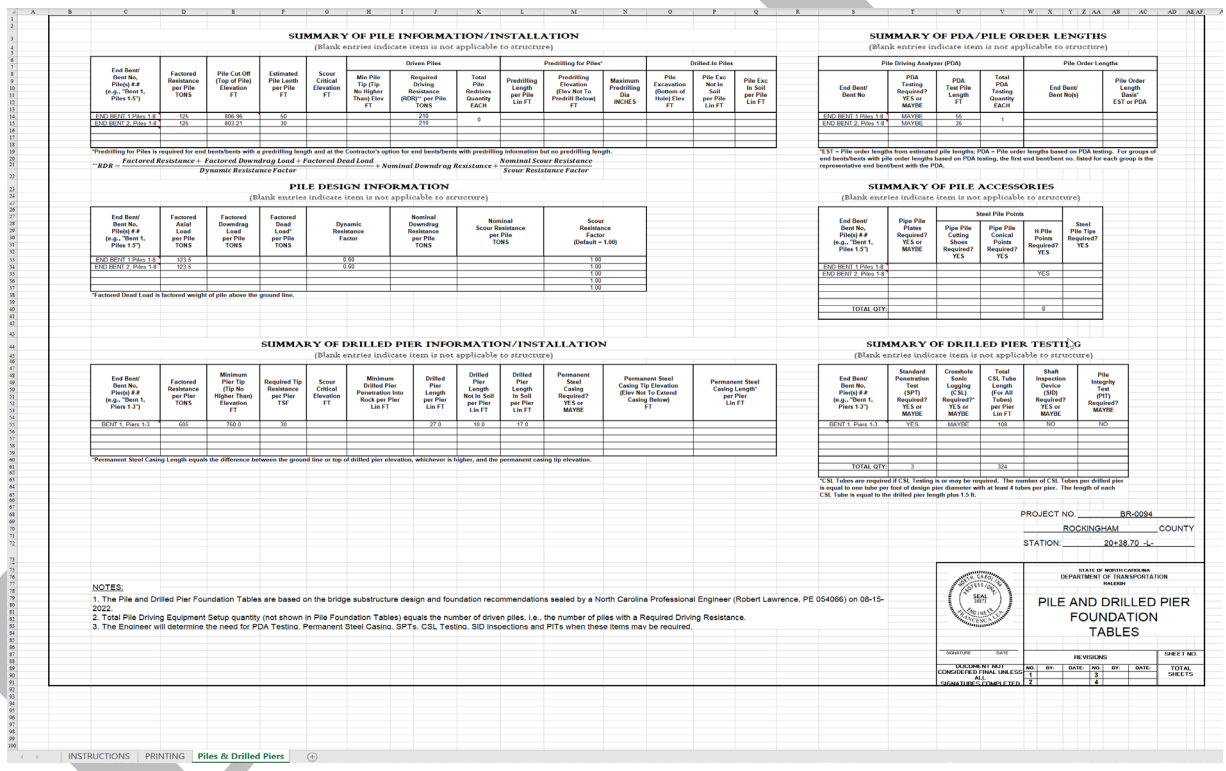
The Preliminary General Drawing should be transformed into the General Drawing following the guidelines in Chapter 5 of the SMU Design Manual.

5.9 FOUNDATION TABLE SHEETS

Geotech provides foundation recommendations in an Excel spreadsheet format where the data is included in tables on one single sheet or multiple sheets depending on the size of the structure. The purpose of this section is to show how to incorporate these tables into a DGN file to be included in the structure plan set.

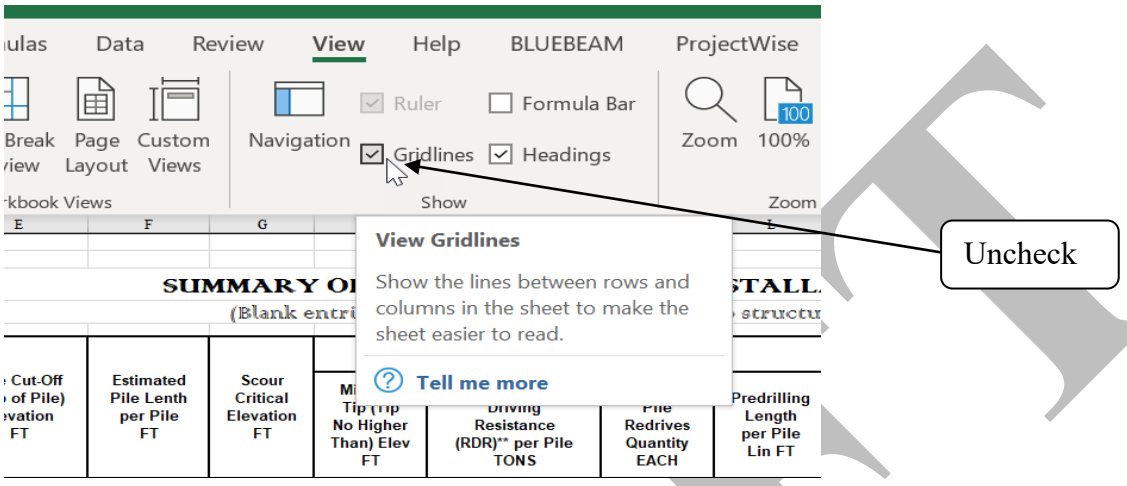
5.9.1 Foundation Tables Excel File

Once the Excel file has been received from GEU and saved in the project folder, open the file, to identify which table tab(s) have been used for the recommendations and will need to be incorporated into the DGN file.. Most likely it will look like the sheet below.



5.9.2 Turn Off the Gridlines

In the Excel file, go to the View menu, uncheck Gridlines so it doesn't show when the spreadsheet is imported into OBD.



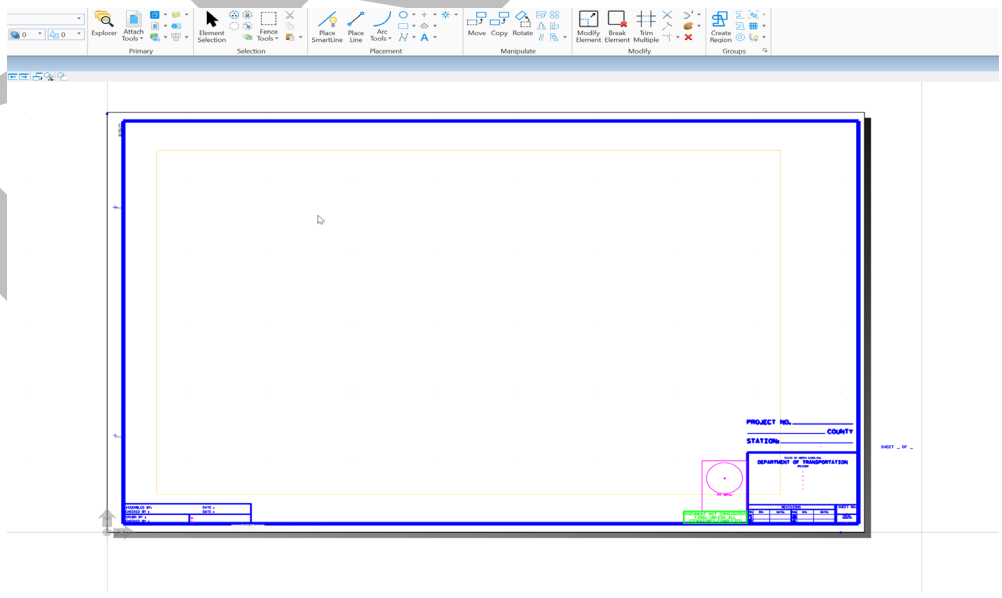
5.9.3 Link Spreadsheet Into The OBD File

Create or open the 4XX_###_TIP#_SMU_FT##_Sheet#_6digitStrID DGN file following Chapter 4.

5.9.4 Setting Up the DGN

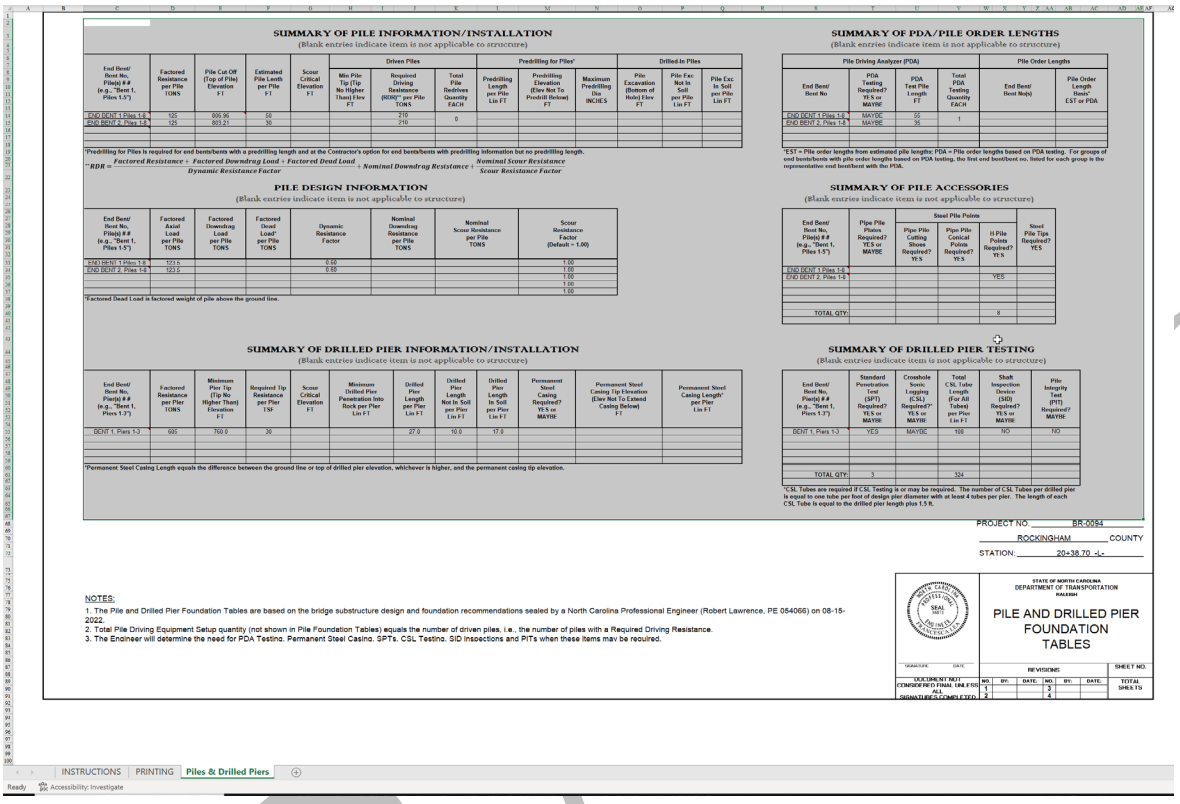
Once the DGN is created and saved in the correct folder, open the DGN and open the "Models" dialog box.

Create a new sheet model and add the appropriate plan sheet border as described in Section 5.4.



5.9.5 Copy from The Excel File

In the Excel file, select the tables from the spreadsheet.



SUMMARY OF PILE INFORMATION/INSTALLATION
(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No., Pile(s) # # (e.g., "Bent 1, Piles 1-3")	Factored Resistance per Pile TONS	Pile Cut Off (Top of Pile) Elevation FT	Estimated Pile Length per Pile FT	Scour Critical Elevation FT	Driven Piles: Min Pile Tip (Tip No Higher Than) Elev FT	Driven Piles: Required Driving Resistance (RDR)* per Pile TONS	Driven Piles: Total Pile Redrives Quantity EACH	Predrilling for Piles*: Predrilling Length per Pile Lin FT	Predrilling for Piles*: Predrilling Elevation (Elev Not To Predrill Below) FT	Predrilling for Piles*: Maximum Predrilling Dia INCHES	Drilled-In Piles: Pile Excavation (Bottom of Hole) Elev FT	Drilled-In Piles: Pile Exc Not In Soil per Pile Lin FT	Drilled-In Piles: Pile Exc In Soil per Pile Lin FT
END BENT 1,Piles 1-8	125	606.96	50			210	0						
END BENT 2, Piles 1-8	125	603.21	50			210							

*Predrilling for Piles is required for end bents/bents with a predrilling length and at the Contractor's option for end bents/bents with predrilling information but no predrilling length.

$$*RDR = \frac{Factored\ Resistance + Factored\ Downdrag\ Load + Factored\ Dead\ Load}{Dynamic\ Resistance\ Factor} + \frac{Nominal\ Downdrag\ Resistance + Nominal\ Scour\ Resistance}{Scour\ Resistance\ Factor}$$

SUMMARY OF PDA/PILE ORDER LENGTHS
(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No	Pile Driving Analyzer (PDA): PDA Testing Required? YES or MAYBE	PDA Test Pile Length FT	Total PDA Testing Quantity EACH	Pile Order Lengths: End Bent/ Bent No(s)	Pile Order Length Basis* EST or PDA
END BENT 1,Piles 1-8	MAYBE	55	1		
END BENT 2, Piles 1-8	MAYBE	55			

*EST = Pile order lengths from estimated pile lengths; PDA = Pile order lengths based on PDA testing. For groups of end bents/bents with pile order lengths based on PDA testing, the first end bent/bent no. listed for each group is the representative end bent/bent with the PDA.

PILE DESIGN INFORMATION
(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No., Pile(s) # # (e.g., "Bent 1, Piles 1-5")	Factored Axial Load per Pile TONS	Factored Downdrag Load per Pile TONS	Factored Dead Load* per Pile TONS	Dynamic Resistance Factor	Nominal Downdrag Resistance per Pile TONS	Nominal Scour Resistance per Pile TONS	Scour Resistance Factor (Default = 1.00)
END BENT 1,Piles 1-8	123.5			0.65			1.00
END BENT 2, Piles 1-8	123.5			0.65			1.00
							1.00
							1.00
							1.00

*Factored Dead Load is factored weight of pile above the ground line.

SUMMARY OF PILE ACCESSORIES
(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No., Pile(s) # # (e.g., "Bent 1, Piles 1-5")	Pipe Pile Plates Required? YES or MAYBE	Steel Pile Points: Pipe Pile Cutting Shoes Required? YES	Steel Pile Points: Pipe Pile Conical Points Required? YES	H Pile Points Required? YES	Steel Pile Tips Required? YES
END BENT 1,Piles 1-8					
END BENT 2, Piles 1-8				YES	
TOTAL QTY:				8	

SUMMARY OF DRILLED PIER INFORMATION/INSTALLATION
(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No., Pile(s) # # (e.g., "Bent 1, Piles 1-3")	Factored Resistance per Pier TONS	Minimum Pier Tip (Tip No Higher Than) Elevation FT	Required Tip Resistance per Pier TSF	Scour Critical Elevation FT	Minimum Drilled Pier Penetration Into Rock per Pier Lin FT	Drilled Pier Length per Pier Lin FT	Drilled Pier Length Not In Soil per Pier Lin FT	Drilled Pier Length In Soil per Pier Lin FT	Permanent Steel Casing Required? YES or MAYBE	Permanent Steel Casing Tip Elevation (Elev Not To Extend Casing Below) FT	Permanent Steel Casing Length* per Pier Lin FT
BENT 1, Piers 1-3	605	760.0	30			27.0	10.0	17.0			

*Permanent Steel Casing Length equals the difference between the ground line or top of drilled pier elevation, whichever is higher, and the permanent casing tip elevation.

SUMMARY OF DRILLED PIER TESTING
(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No., Pile(s) # # (e.g., "Bent 1, Piers 1-3")	Standard Penetration Test (SPT) Required? YES or MAYBE	Crosshole Sonic Logging (CSL) Required?* YES or MAYBE	Total CSL Tube Length (For All Tubes) per Pier Lin FT	Shaft Inspection Device (SID) Required? YES or MAYBE	Pile Integrity Test (PIT) Required? MAYBE
BENT 1, Piers 1-3	YES	MAYBE	108	NO	NO
TOTAL QTY:	3		324		

*CSL Tubes are required if CSL Testing is or may be required. The number of CSL Tubes per drilled pier is equal to one tube per foot of design pier diameter with at least 4 tubes per pier. The length of each CSL Tube is equal to the drilled pier length plus 1.5 ft.

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NOTES:
1. The Pile and Drilled Pier Foundation Tables are based on the bridge substructure design and foundation recommendations sealed by a North Carolina Professional Engineer (Robert Lawrence, PE 054066) on 08-15-2022.
2. Total Pile Driving Equipment Setup quantity (not shown in Pile Foundation Tables) equals the number of driven piles, i.e., the number of piles with a Required Driving Resistance.
3. The Engineer will determine the need for PDA Testing, Permanent Steel Casing, SPTs, CSL Testing, SID Inspections and PITs when these items may be required.

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

PILE AND DRILLED PIER FOUNDATION TABLES

SIGNATURE DATE
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

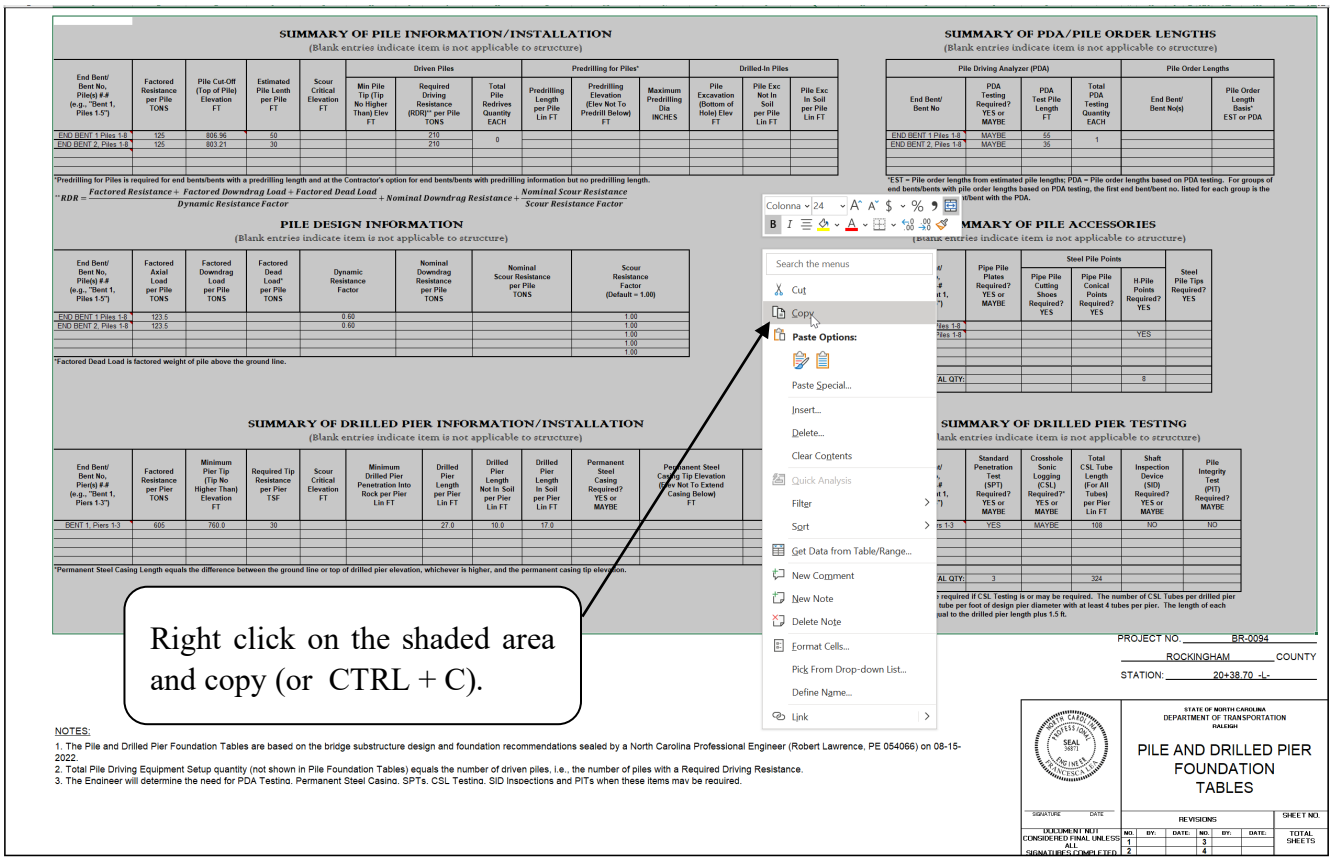
REVISIONS

NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

SHEET NO.
TOTAL SHEETS

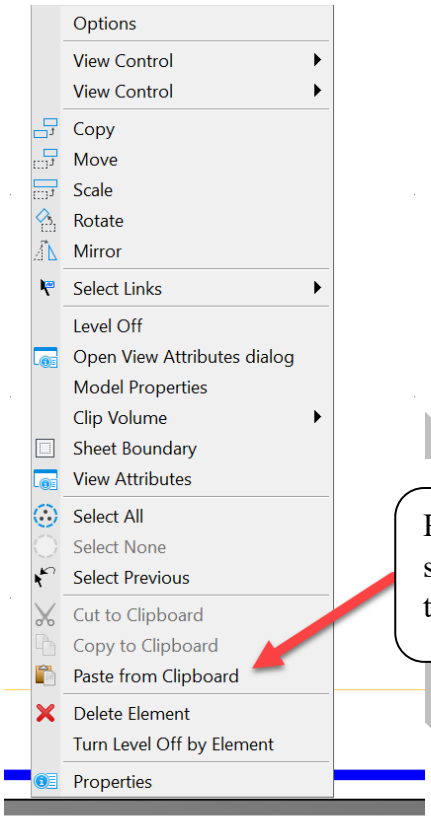
INSTRUCTIONS | PRINTING | Piles & Drilled Piers

Ready | Accessibility: Investigate



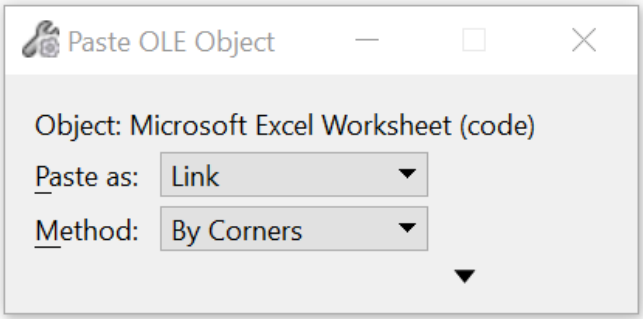
5.9.6 Paste From Clipboard Into OBD

In the sheet model, right click and hold to access the menu and select “Paste from Clipboard”. Then select from the pop-up menu to paste as “Link” and method “By Corners”.

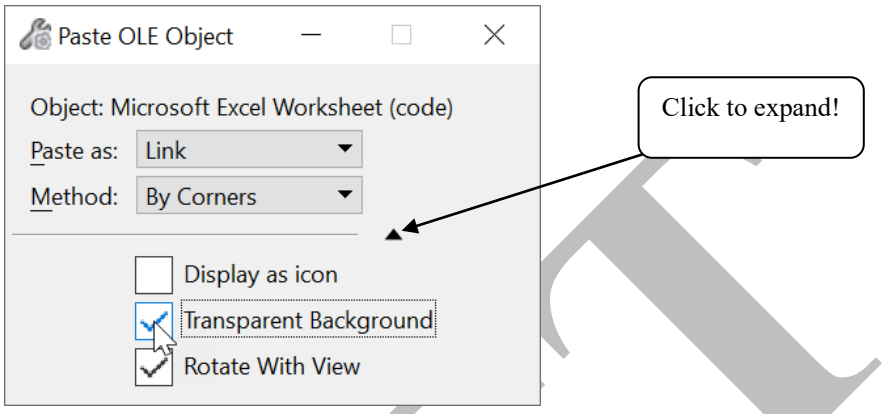


Right click and hold anywhere in the sheet to access this menu and choose to "Paste from Clipboard".

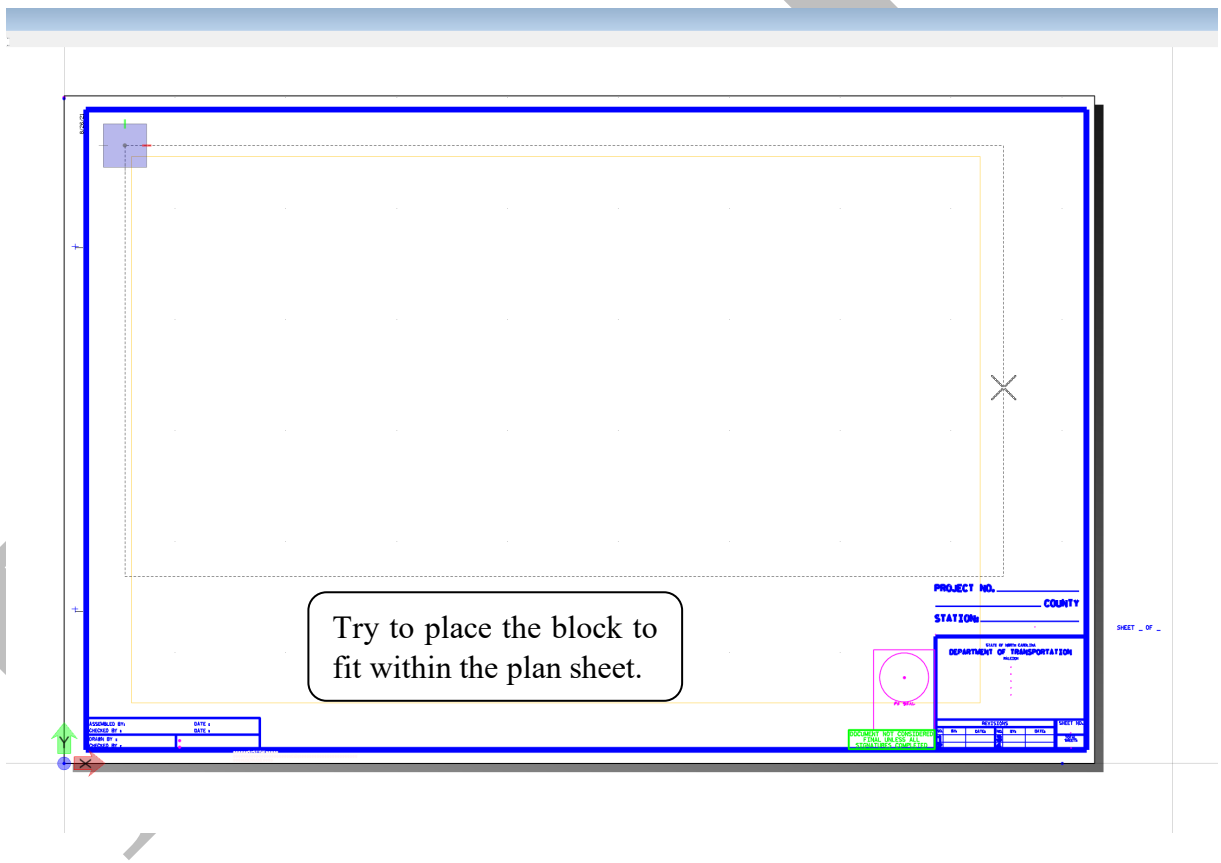
Paste as shown below:



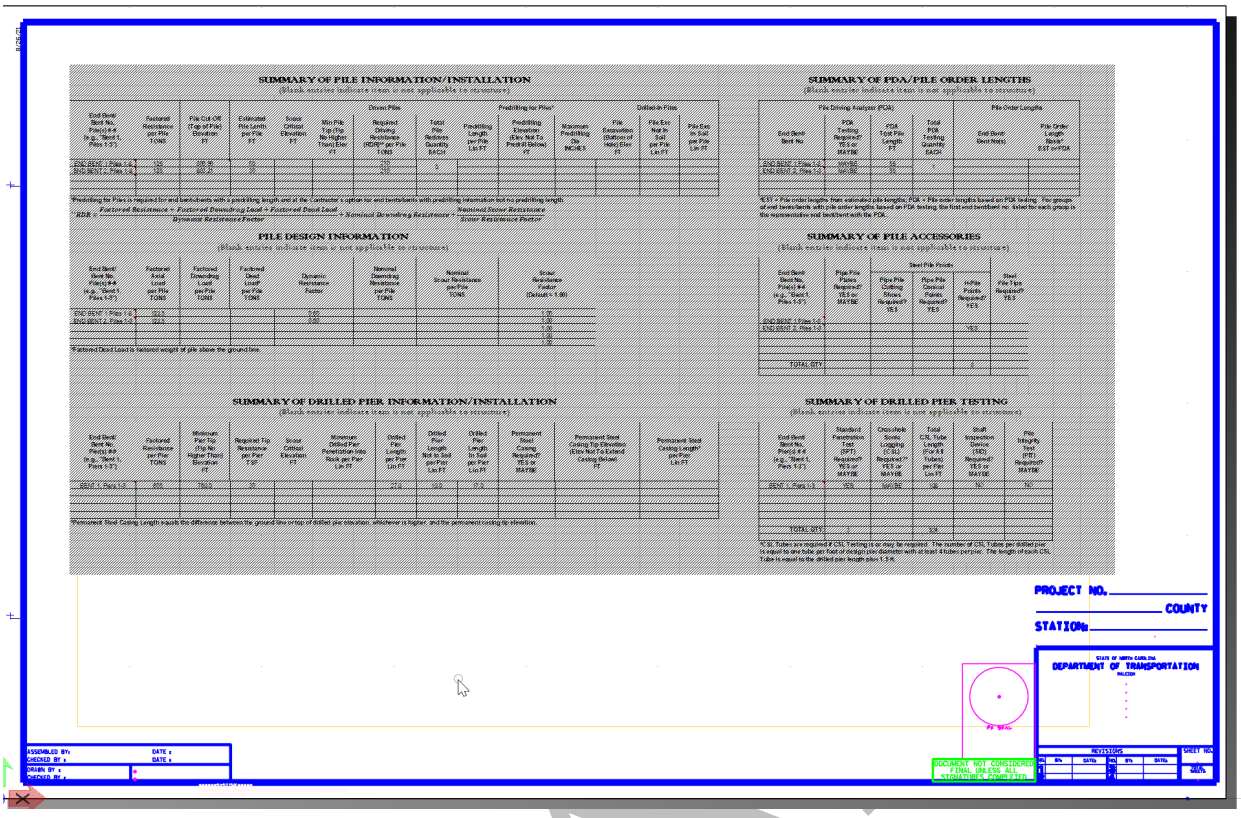
Make sure you select “Transparent Background”.



Place the tables by corners as shown below.

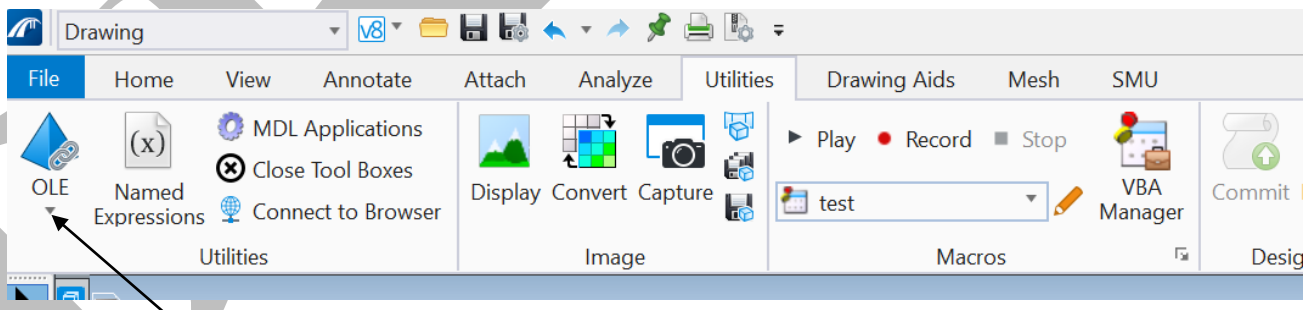


Copied tables are now linked.



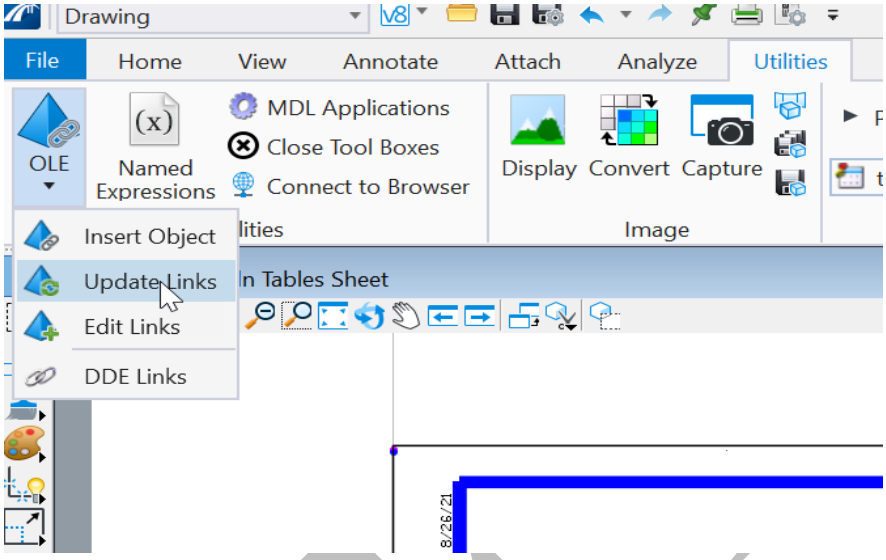
5.9.7 Properties of the Linked Tables in OBD

Excel files linked in OBD will be live and can be updated to reflect any changes made in the original files. Follow the steps to update links in OBD:

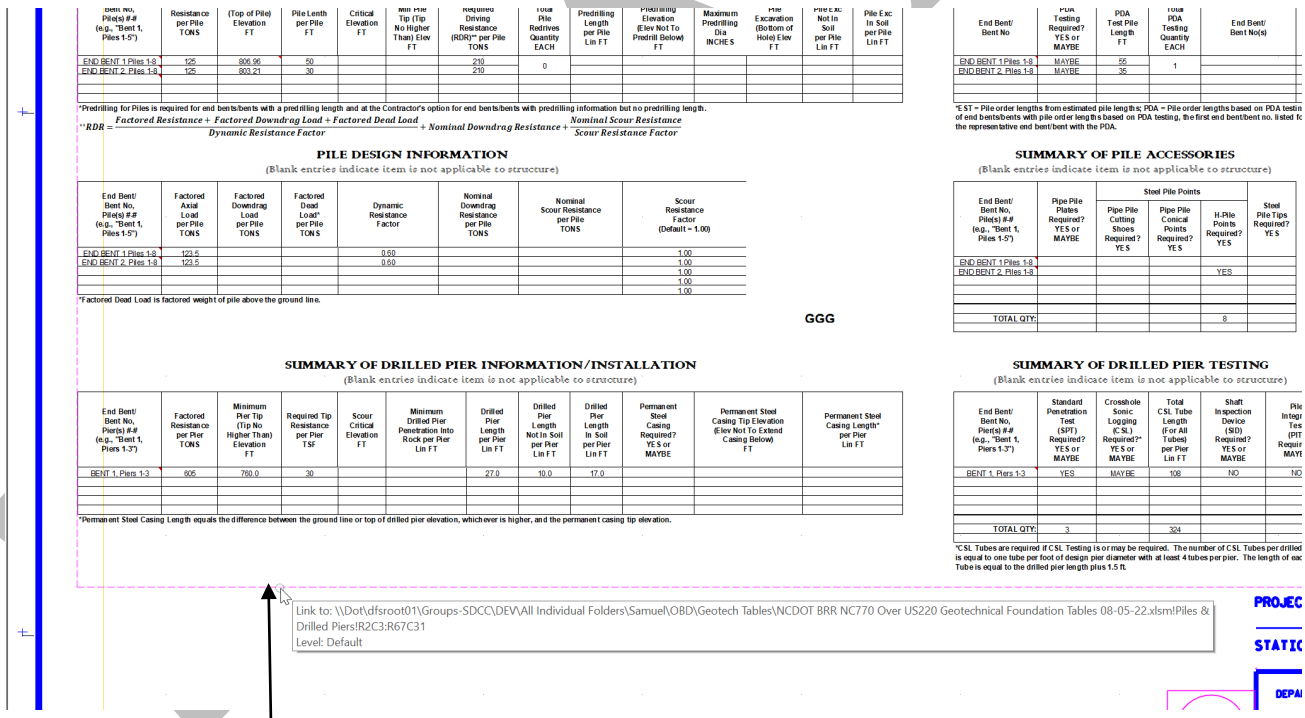


From the Utilities menu, click the drop-down list of OLE.

Click on “Update Links”.



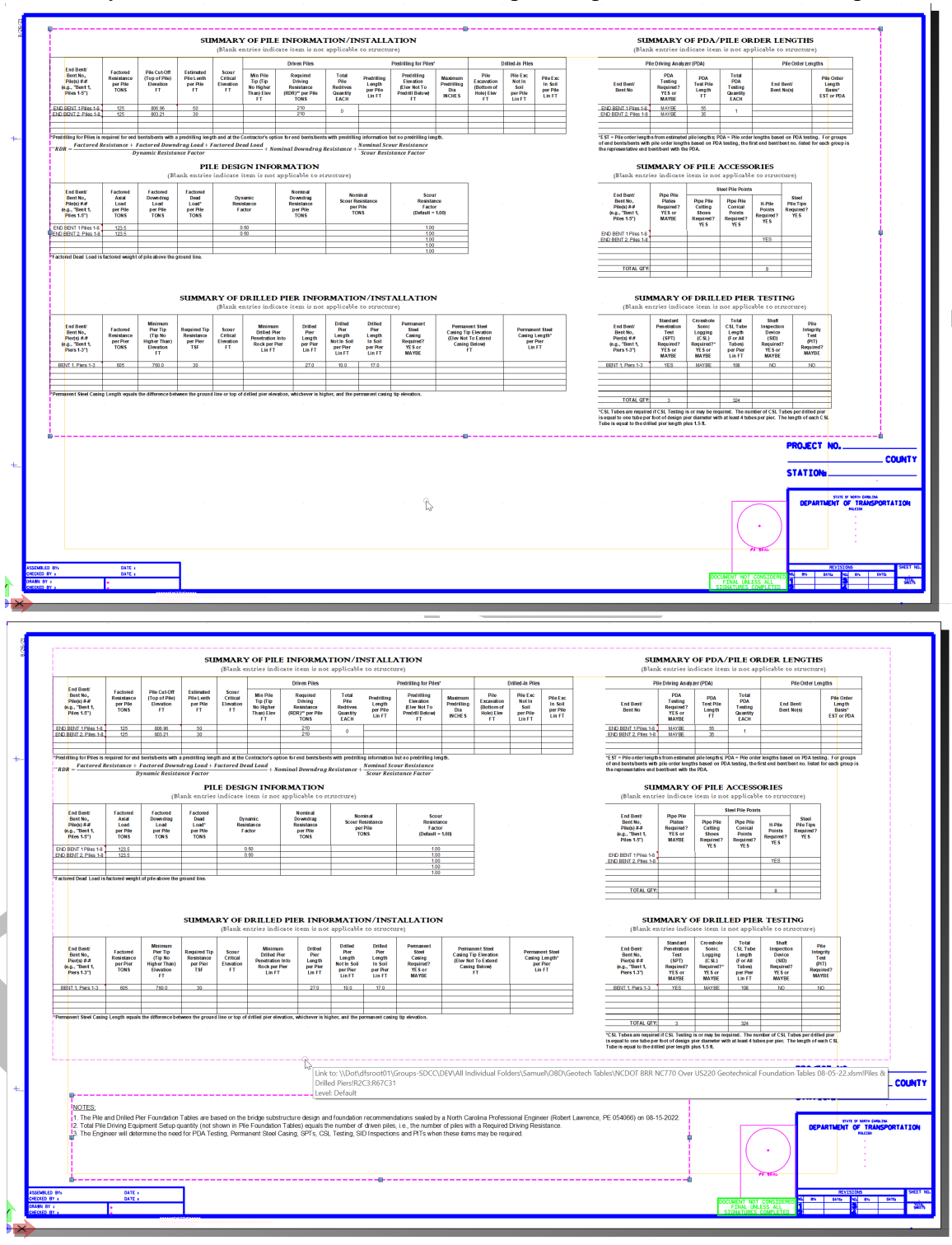
This action will update the values (cells) of the spreadsheet, but won’t affect the properties or size of the linked tables.



Double click on the link border to open the linked Excel File.

5.9.8 Multiple Links

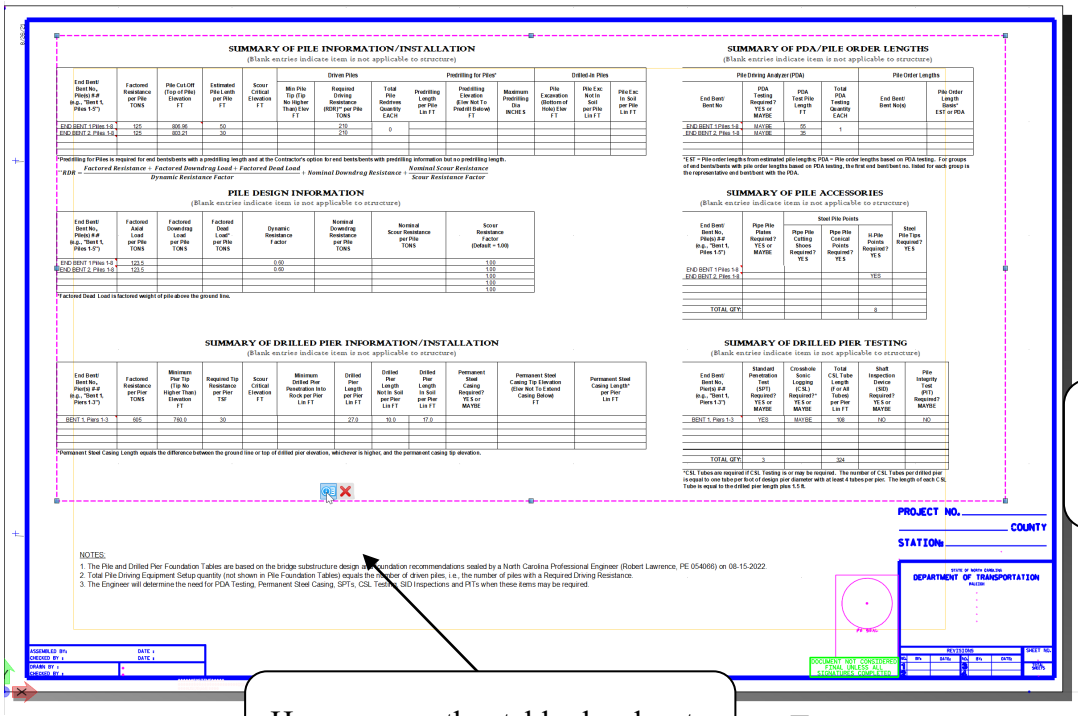
You may link different tables or notes from separate spreadsheets on the same plan sheet.

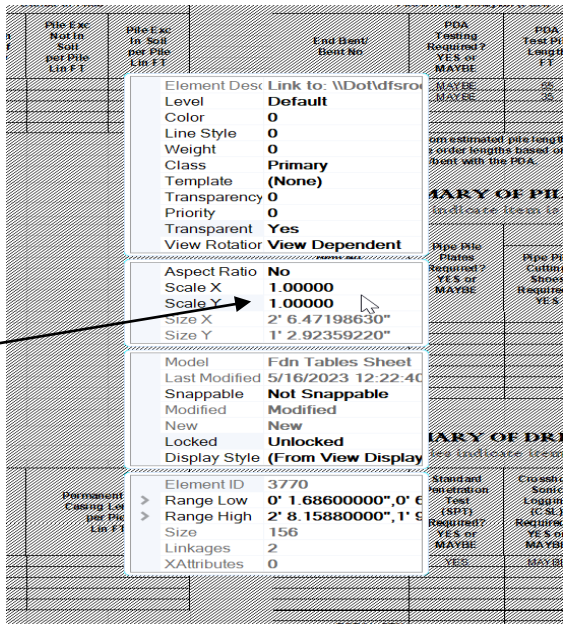


Any part of the spreadsheet can be linked as a separate link on this plan sheet. Remember to add the needed Foundation Notes from the SMU Notes tab in OBD.

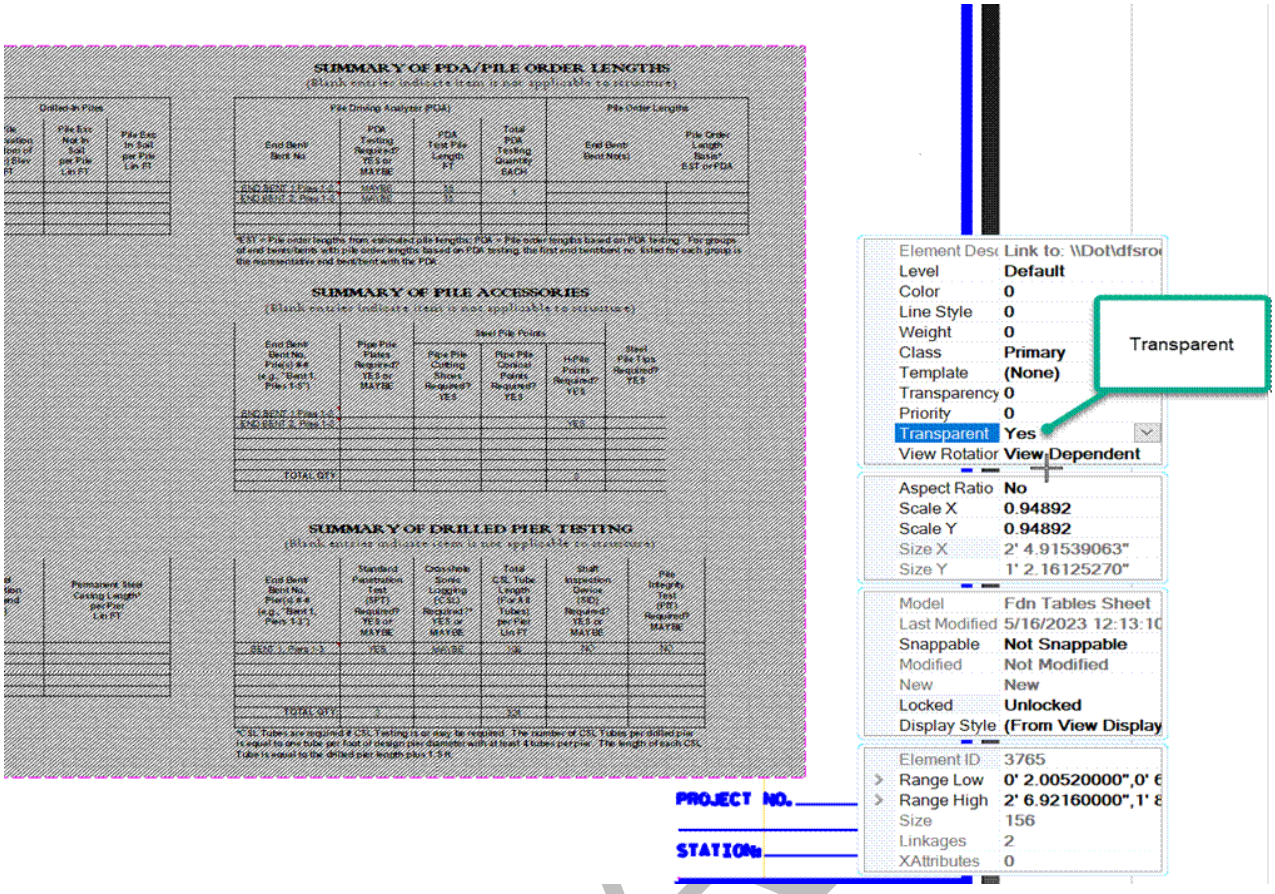
5.9.9 Edit Link Properties

You may resize the tables either by adjusting the handles/borders or by changing the scale in properties as shown below:





If you forget to select Transparent Background, you may change that from properties by choosing YES for Transparent.



NOTE: To see the transparent background after changing the properties of the linked file, you may need to close the OBD file and reopen it.

5.10 SUPERSTRUCTURE SHEETS

Superstructure sheets include the typical section throughout the superstructure, plan of spans, bridge framing plan, girder/beam details, diaphragm details, expansion joint details, barrier rails details, and bearing detail sheets. For detailed guidance on what is required in those plan sheets, see Chapter 6 of the SMU Design Manual.

Superstructure elements should be drawn full scale 1:1 in the Design Model, and dimensioned in the Drawing Model, with final plan sheet assembly in the Sheet Model. Superstructure sheets will commonly use the “Design Plan Profile” or “PRR Plan Profile” SMU borders in the Sheet Model. Use the SMU Element Templates to match the corresponding line styles, weights, levels, features, and material properties to the elements being drawn. Use SMU’s Standard Plans as appropriate, following the steps in Section 5.12.

5.11 SUBSTRUCTURE SHEETS

Substructure sheets detail end bent caps, bent caps, columns, piles, drilled piers, footings, pile caps, and wing walls. For detailed guidance on what is required in substructure plan sheets, see chapter 7 of the SMU Design Manual.

Substructure elements should be drawn full scale 1:1 in the Design Model, and dimensioned in the Drawing Model, with final plan sheet assembly in the Sheet Model. Substructure sheets will commonly use the "Design Plan Profile" or "PRR Plan Profile" SMU borders in the Sheet Model. Use the SMU Element Templates to match the corresponding line styles, weights, levels, features, and material properties to the elements being drawn. Use SMU's Standard Plans as appropriate, following the steps in Section 5.12.

5.12 SMU STANDARD DRAWINGS & PLANS

SMU Standard Drawings and Plans are available on the SMU website for external users and on the SMU server for internal users to download to the project folder. Once downloaded to the project folder, they can be referenced into the Sheet Model of the DGN.

Structure standard drawings and plans should be pulled into their own DGN files, named according to Section 2.3, where they can be edited as needed.

The Drawing Scale of the Sheet Model will need to be changed from "Full Size 1=1" to match the scale noted above the referenced drawing.

At this point in time many of the standard drawings and plans contain outdated fonts and levels, SMU will update these features as standards are revised. Users are **not required to update** standard drawing content to current workspace fonts and levels within the drawing's field, only the title block content to match other plan sheets within a plan set. Each standard drawing used should be its own DGN file set to the scale noted above the plan sheet.

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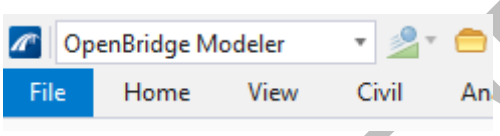
CHAPTER 6

3D MODEL CREATION

6.1 DRAWING WORKFLOW

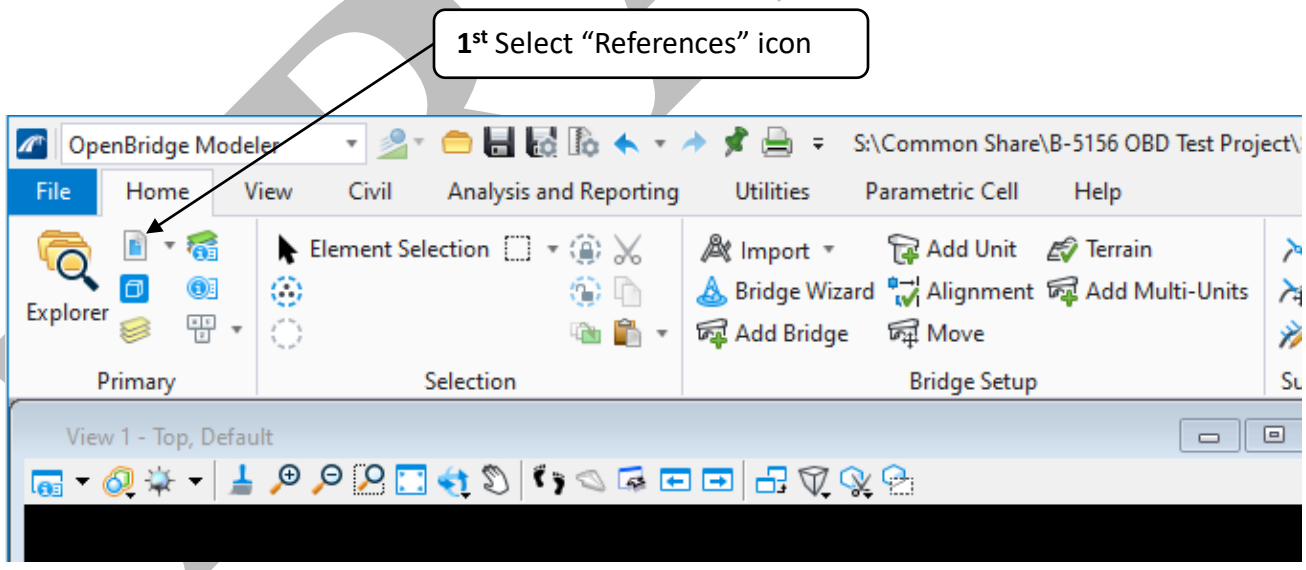
Once the DGN file is created following the guidelines in Chapter 4, for 3D drawing creation set OBD to the "OpenBridge Modeler" Workflow.

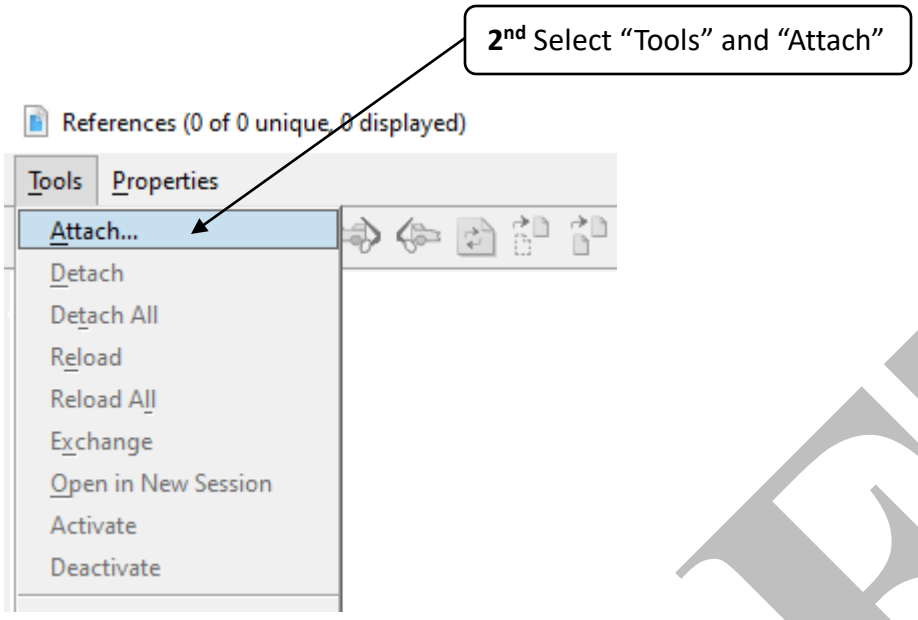


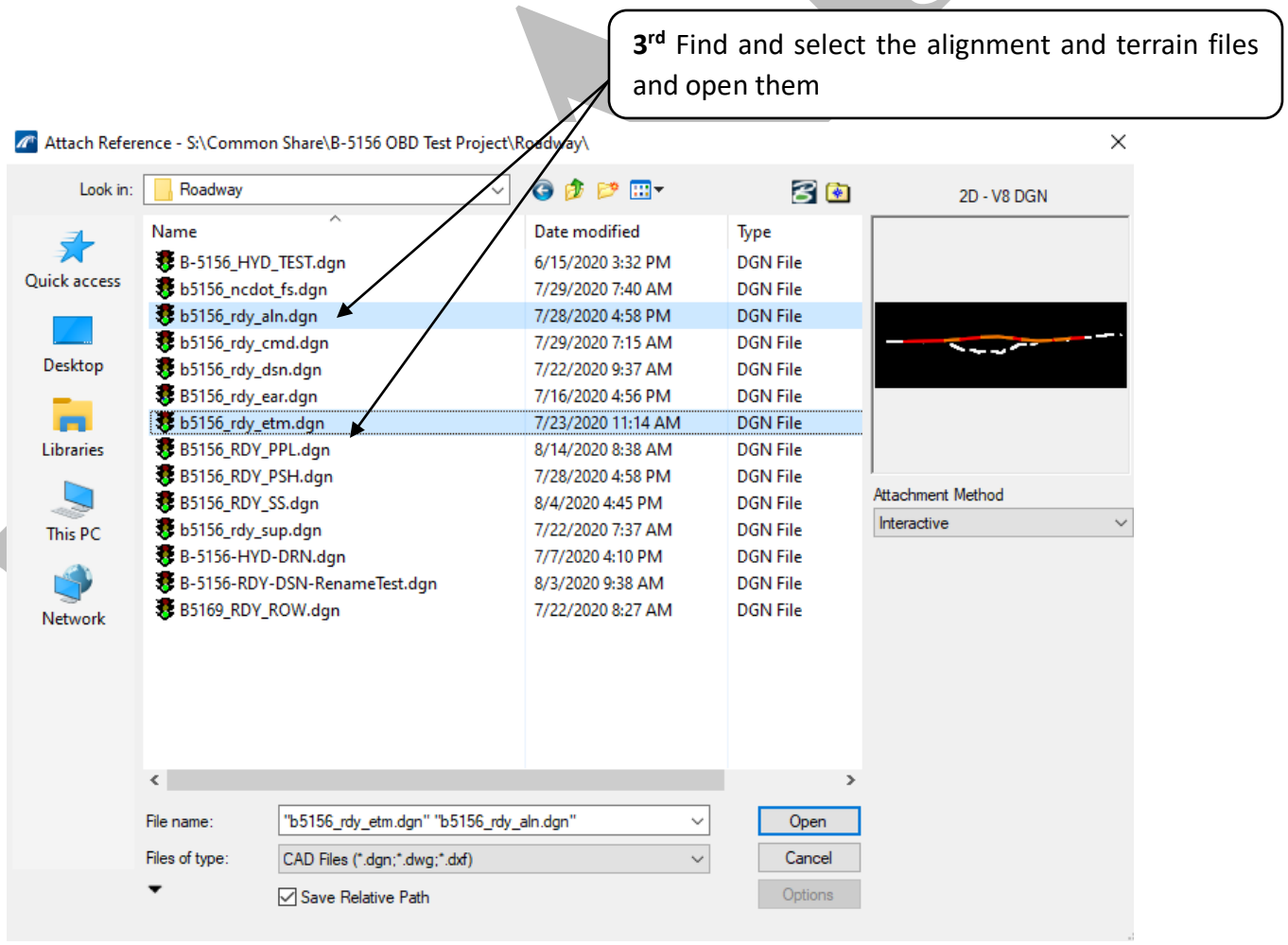
Note Drawing Models and Sheet Models are the same process as described in Chapter 5.

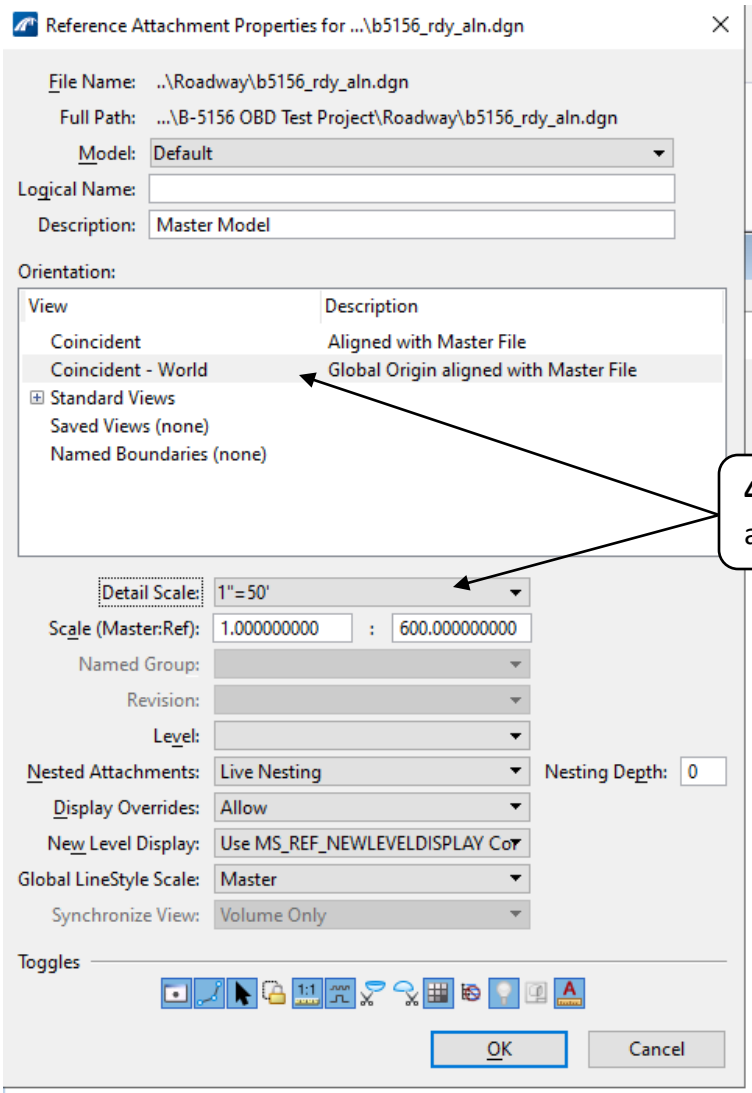
6.2 REFERENCING FILES

To reference the Geometry (Alignment (rdy_alg.dgn), Alternates (rdy_alt.dgn) for NCDOT) and Terrain (rdy_etm.dgn for NCDOT) files. If you are using an older project, see Chapter 7.5.



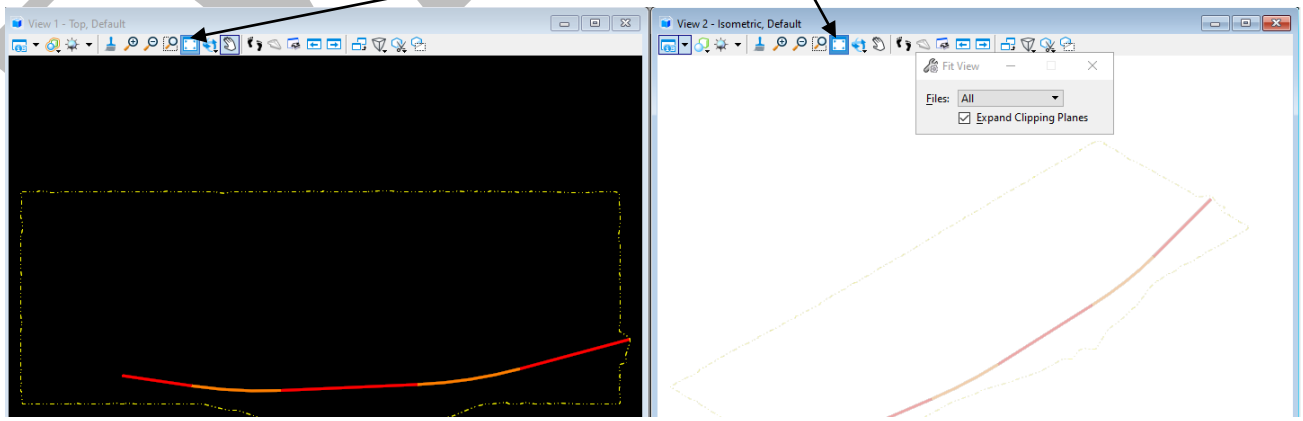

2nd Select “Tools” and “Attach”
References (0 of 0 unique, 0 displayed)
Tools
Properties
Attach...
Detach
Detach All
Reload
Reload All
Exchange
Open in New Session
Activate
Deactivate


3rd Find and select the alignment and terrain files and open them
Attach Reference - S:\Common Share\B-5156 OBD Test Project\Roadway\
Look in:
Roadway
Quick access
Desktop
Libraries
This PC
Network
Name
Date modified
Type
B-5156_HYD_TEST.dgn 6/15/2020 3:32 PM DGN File
b5156_ncdot_fs.dgn 7/29/2020 7:40 AM DGN File
b5156_rdy_aln.dgn 7/28/2020 4:58 PM DGN File
b5156_rdy_cmd.dgn 7/29/2020 7:15 AM DGN File
b5156_rdy_dsn.dgn 7/22/2020 9:37 AM DGN File
B5156_rdy_ear.dgn 7/16/2020 4:56 PM DGN File
b5156_rdy_etm.dgn 7/23/2020 11:14 AM DGN File
B5156_RDY_PPL.dgn 8/14/2020 8:38 AM DGN File
B5156_RDY_PSH.dgn 7/28/2020 4:58 PM DGN File
B5156_RDY_SS.dgn 8/4/2020 4:45 PM DGN File
b5156_rdy_sup.dgn 7/22/2020 7:37 AM DGN File
B-5156-HYD-DRN.dgn 7/7/2020 4:10 PM DGN File
B-5156-RDY-DSN-RenameTest.dgn 8/3/2020 9:38 AM DGN File
B5169_RDY_ROW.dgn 7/22/2020 8:27 AM DGN File
2D - V8 DGN
Attachment Method
Interactive
File name:
"b5156_rdy_etm.dgn" "b5156_rdy_aln.dgn"
Files of type:
CAD Files (*.dgn;*.dwg;*.dxf)
Save Relative Path
Open
Cancel
Options



4th Set references to "Coincident-World" and scale to 1"=50'

5th Fit your view in both View 1 and View 2



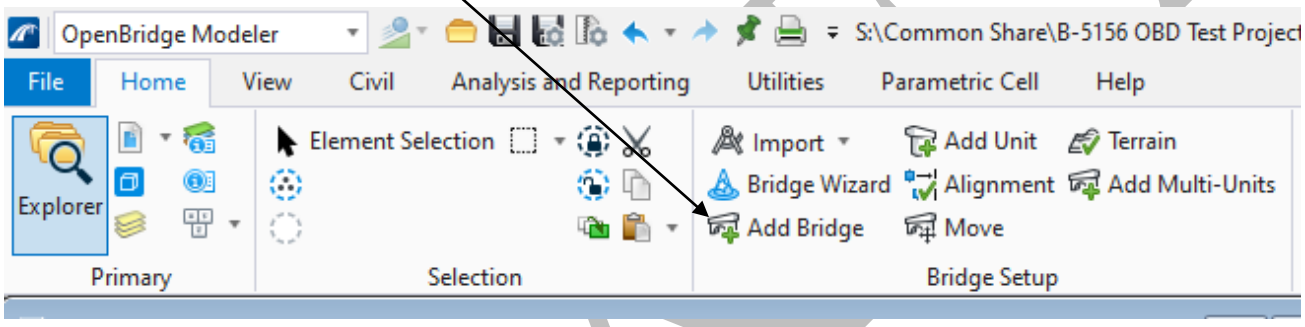
6.3 3D MODEL BY ELEMENTS

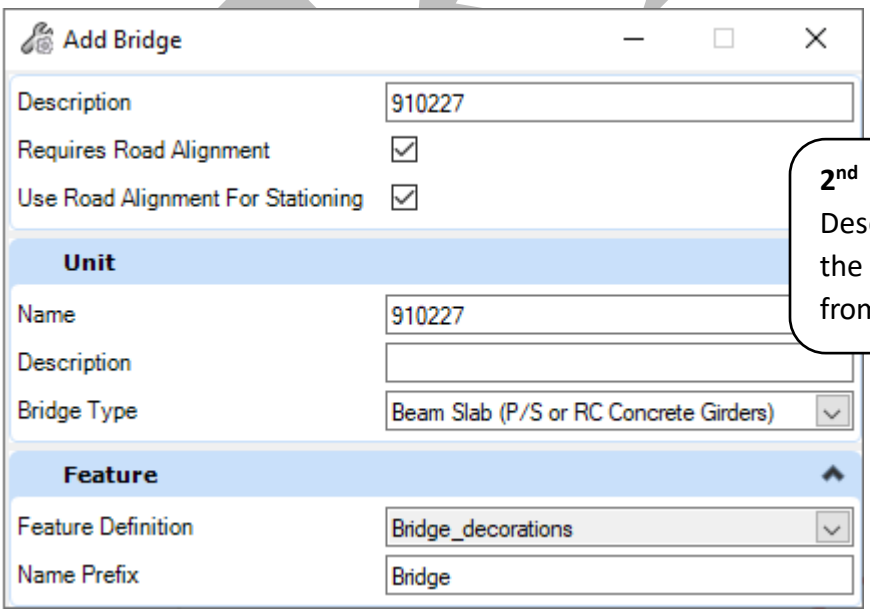
For 3D digital twins the Design Model will be used to create the proposed or existing structure elements in a 3D view at full scale (1:1) in their correct geospatial locations. Leave the Drawing Scale at "Full Size 1=1" and create all elements at their true dimensions.

6.3.1 Adding A Bridge

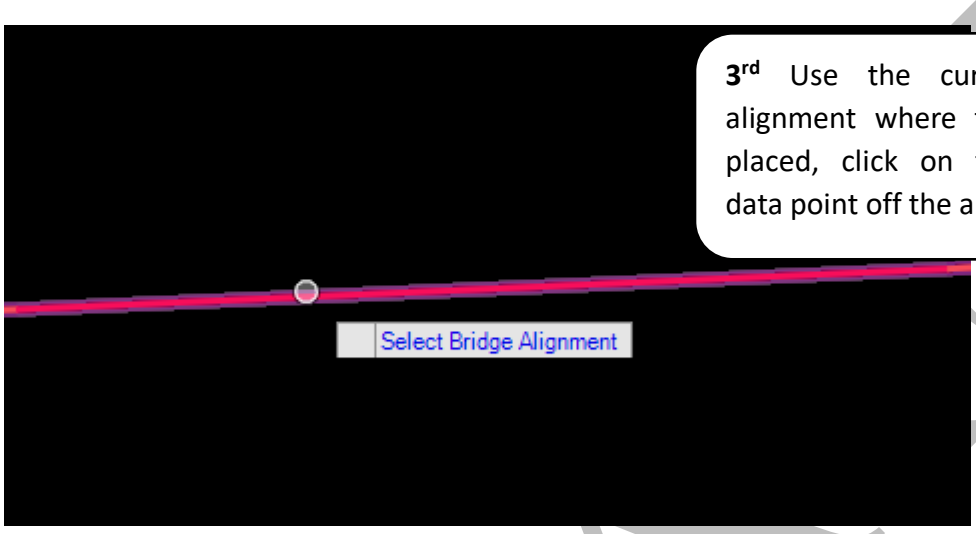
After referencing the alignment and terrain files into the bridge model dgn, use the following steps to add a bridge. If multiple bridges are present on the project, create separate dgn files and reference the alignment for each structure.

1st Use the "Add Bridge" icon



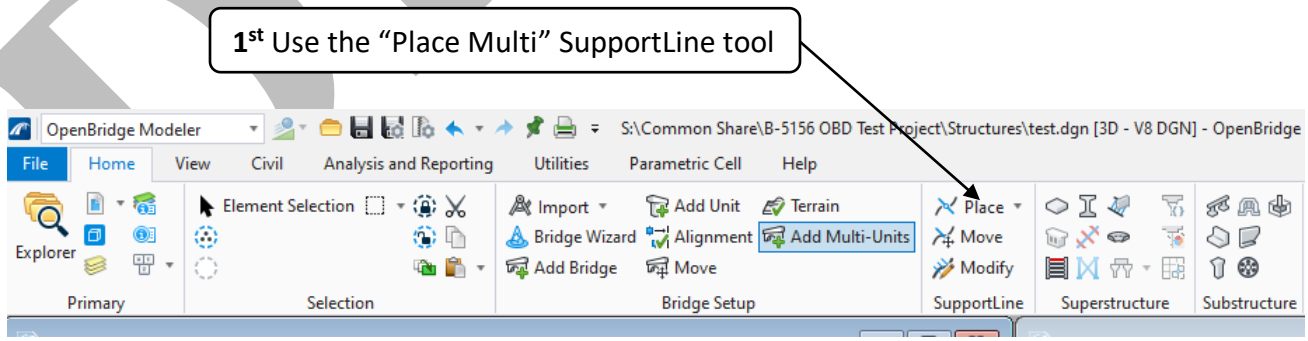


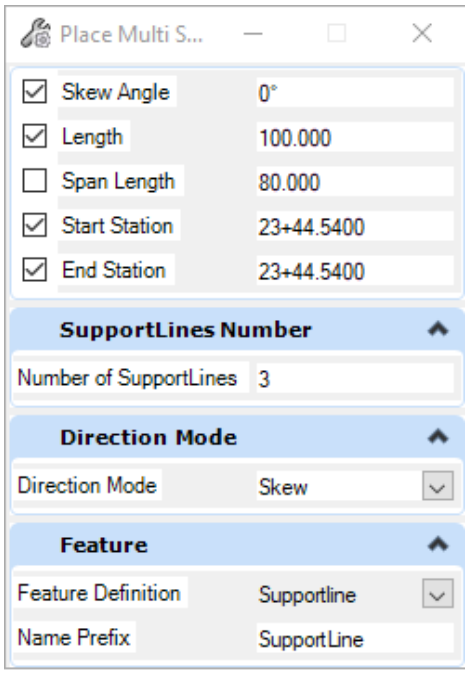
2nd Fill in your Structure ID in the Description and Name boxes and select the bridge type and feature definitions from the drop downs



6.3.2 Adding Supportlines

After adding a bridge, use the following steps to add the end bent and bent supportlines. Supportlines will also need to be placed at the begin approach slab and end approach slab stations to add an approach slab deck.

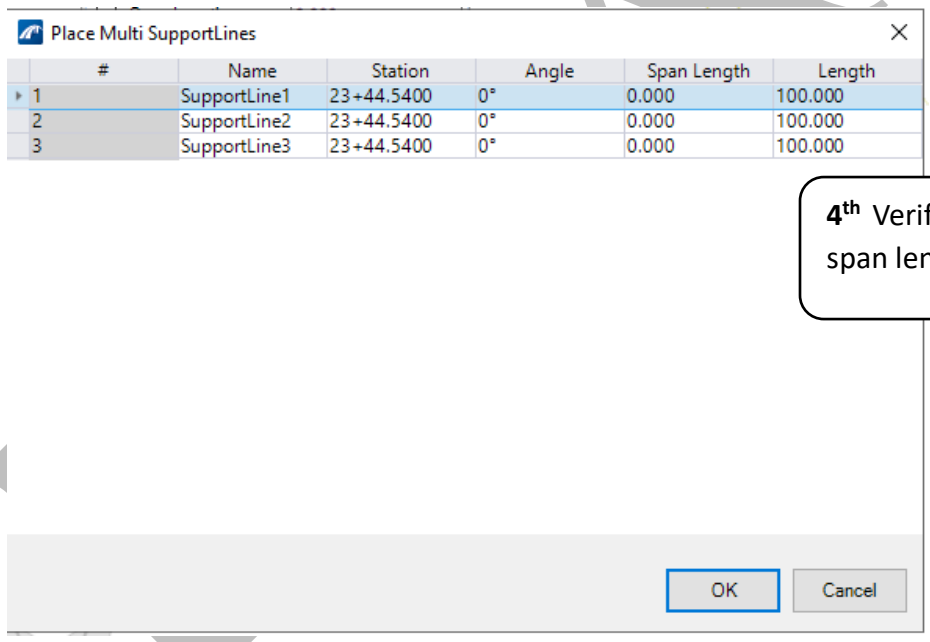




2nd Input your bridges' skew angle, start and end bridge stations, number of supportlines (note each end bent and bent has a supporline)

3rd Select the alignment near the start station, then near the end station.

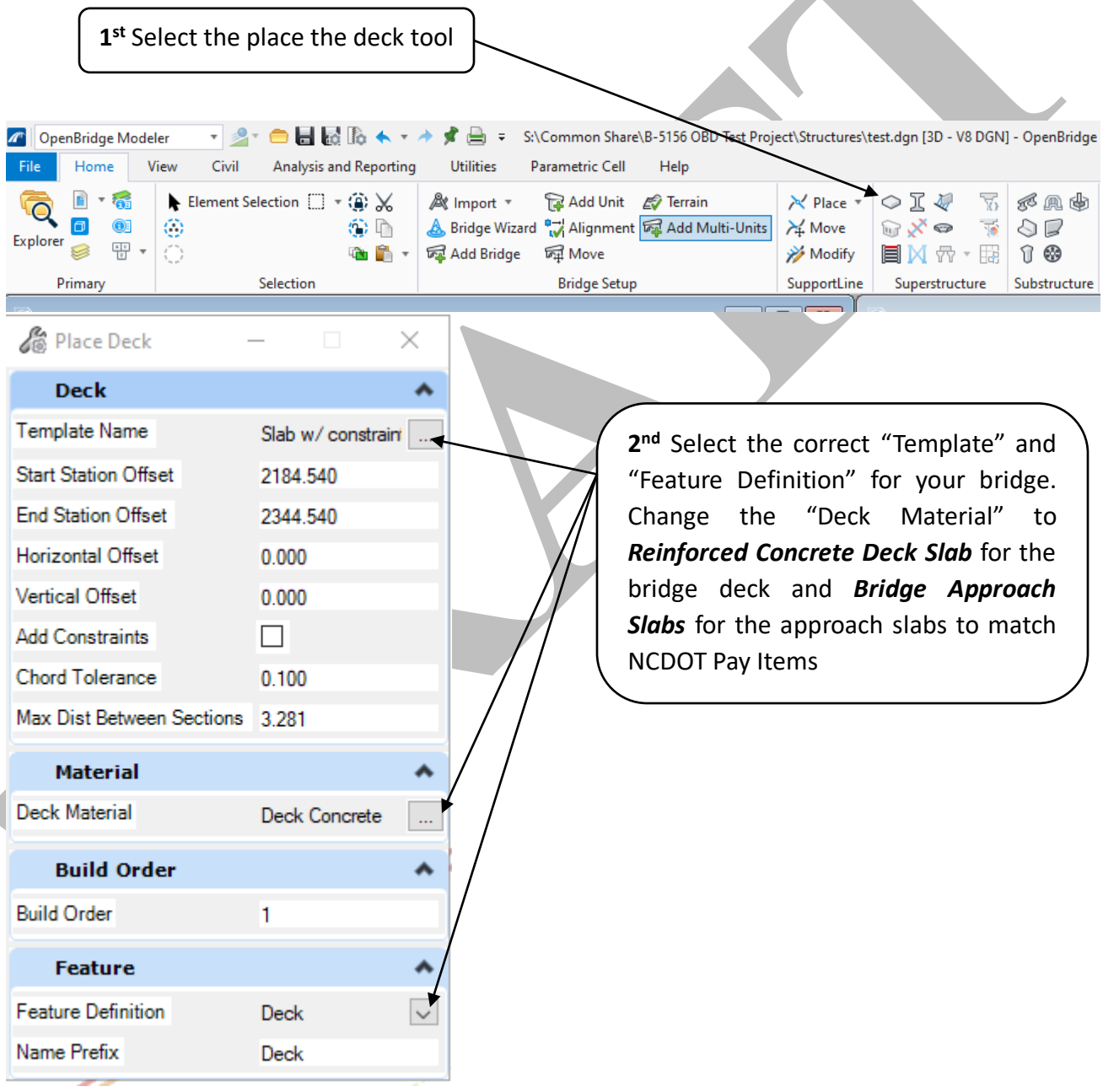
Note: The "Length" in this box is the length of the SupportLine, so if you have a wide bridge make sure the length is long enough to preject beyond your bridge model. Also OBD uses the skew angle as ahead and to the left as a negative value, unlike SMU that does ahead and to the right.



4th Verify the stations, skew angles, and span lengths

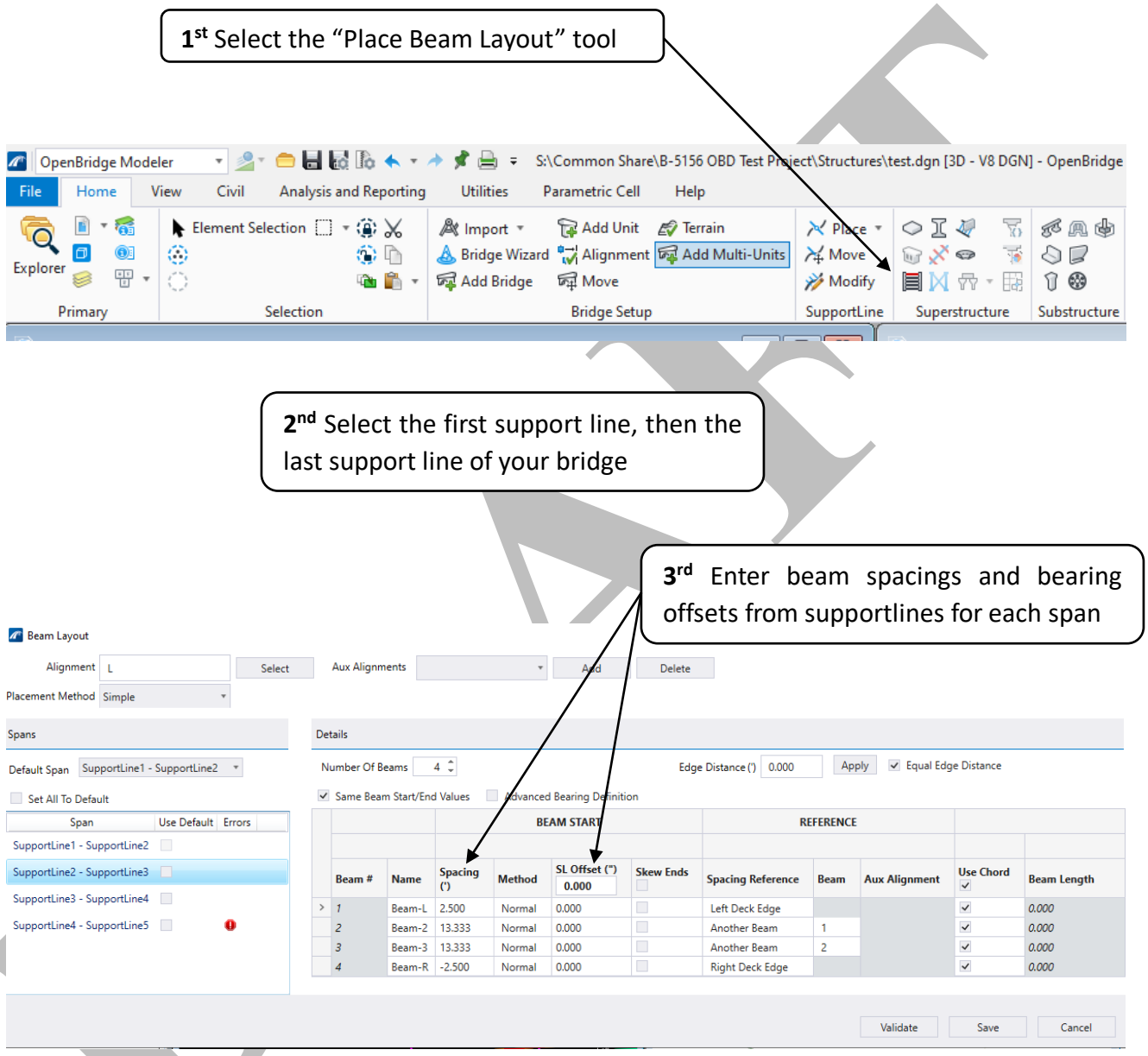
6.3.3 Adding the Deck

After placing your supportlines, use the following steps to place the deck. There can be different deck templates used or multiple placements of the same template to create a bridge. An example of where multiple placements might be used is when including the approach slabs in your model you would place it from the begin approach slab supportline to the end bent 1 supportline and then the bridge deck would go from end bent 1 support line to end bent 2 supportline.



6.3.4 Adding the Beam Layout

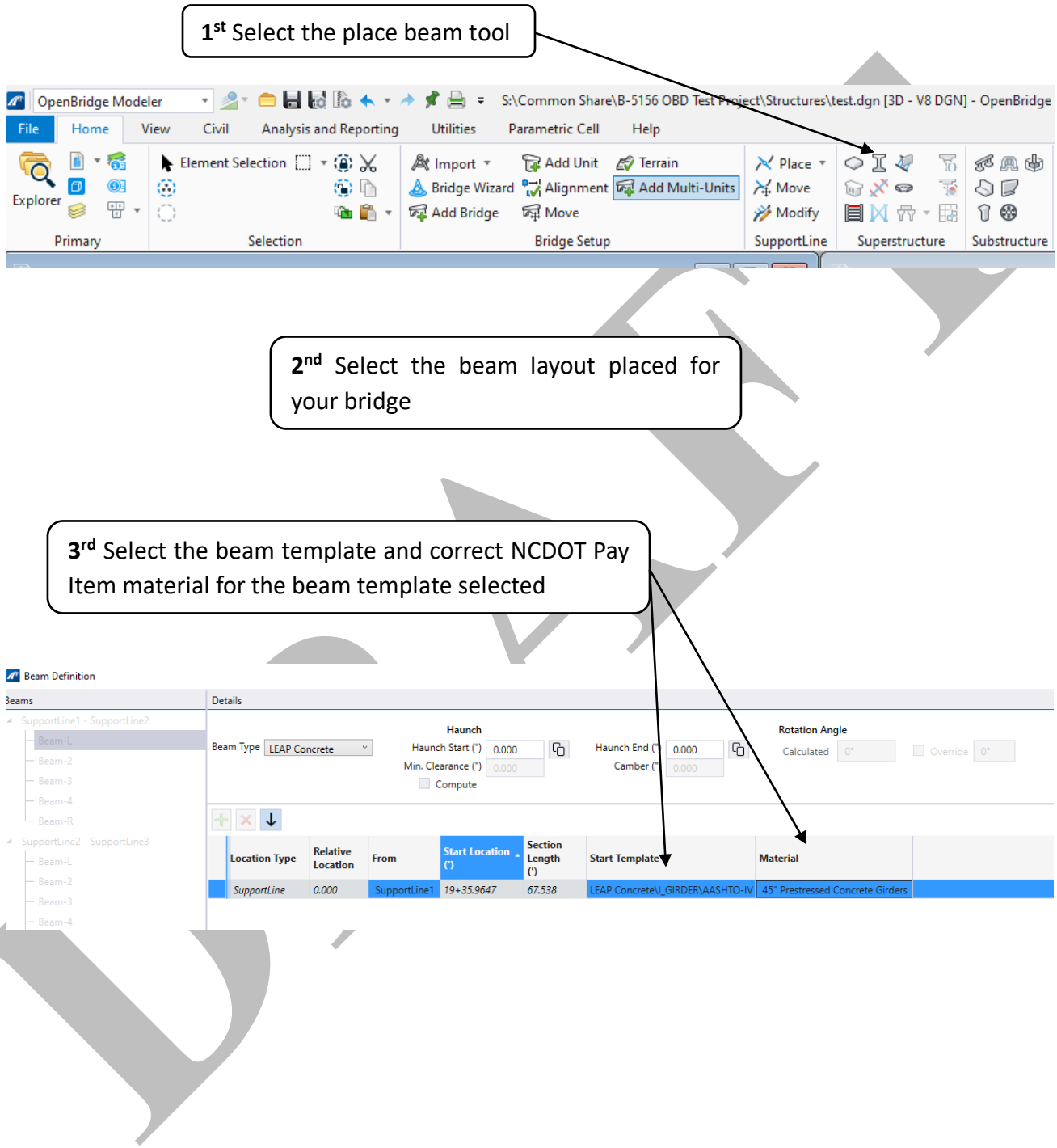
After adding the deck, use the following steps to place the bridge's beam layout. Be sure to follow the Design Manual for overhang and beam spacing requirements.



Note: the first and last beam spacing is the distance from the edge of deck and the last beam's spacing is a negative value.

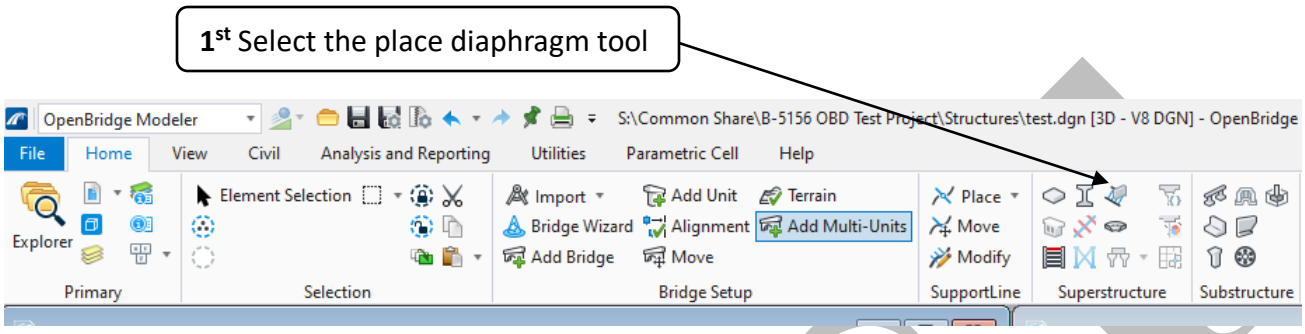
6.3.5 Adding the Beams

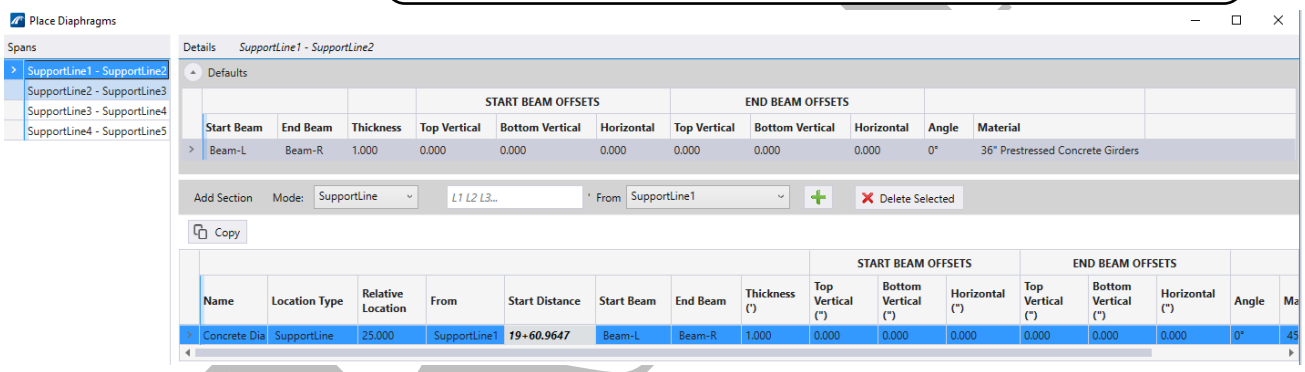
Once the beam layout is placed, use the following steps to attach the beam types.



6.3.6 Adding Diaphragms

Once the beam layout is placed, use the following steps to attach the diaphragms.

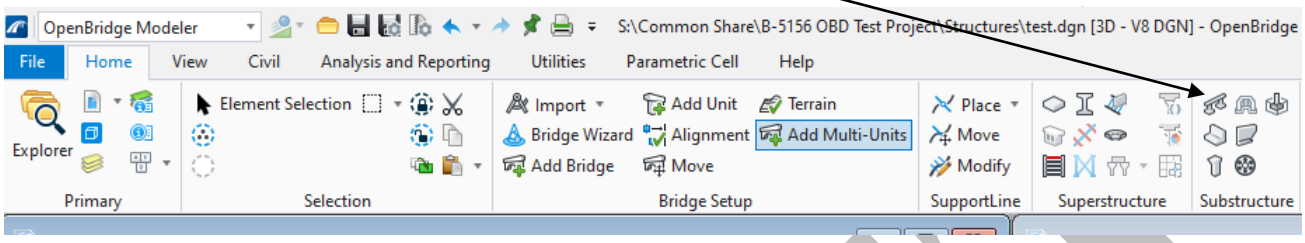




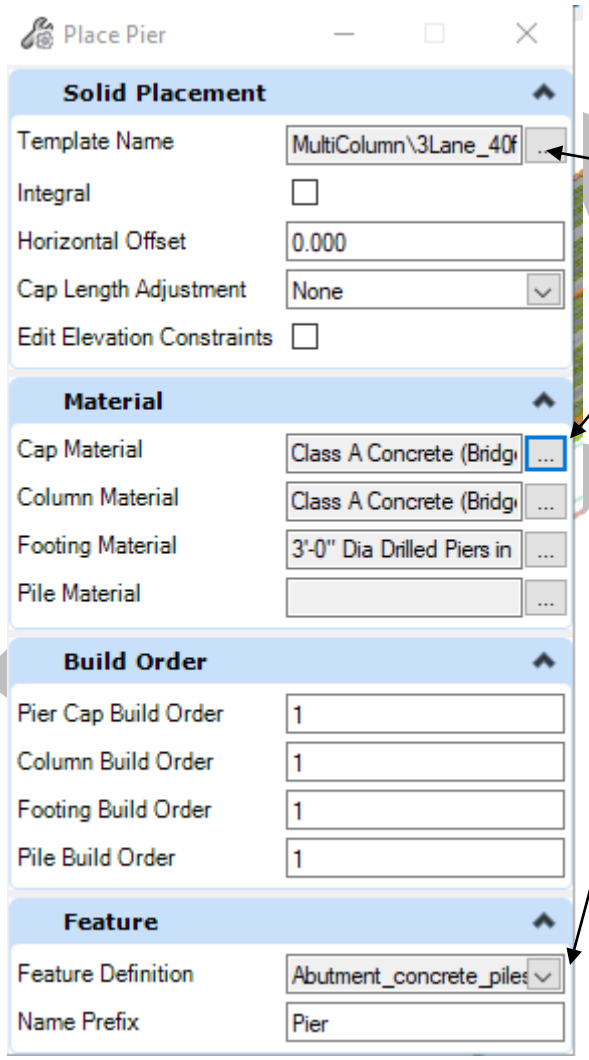
6.3.7 Adding Bents

Once the superstructre is placed, use the following steps to place the bents.

1st Select the place pier tool



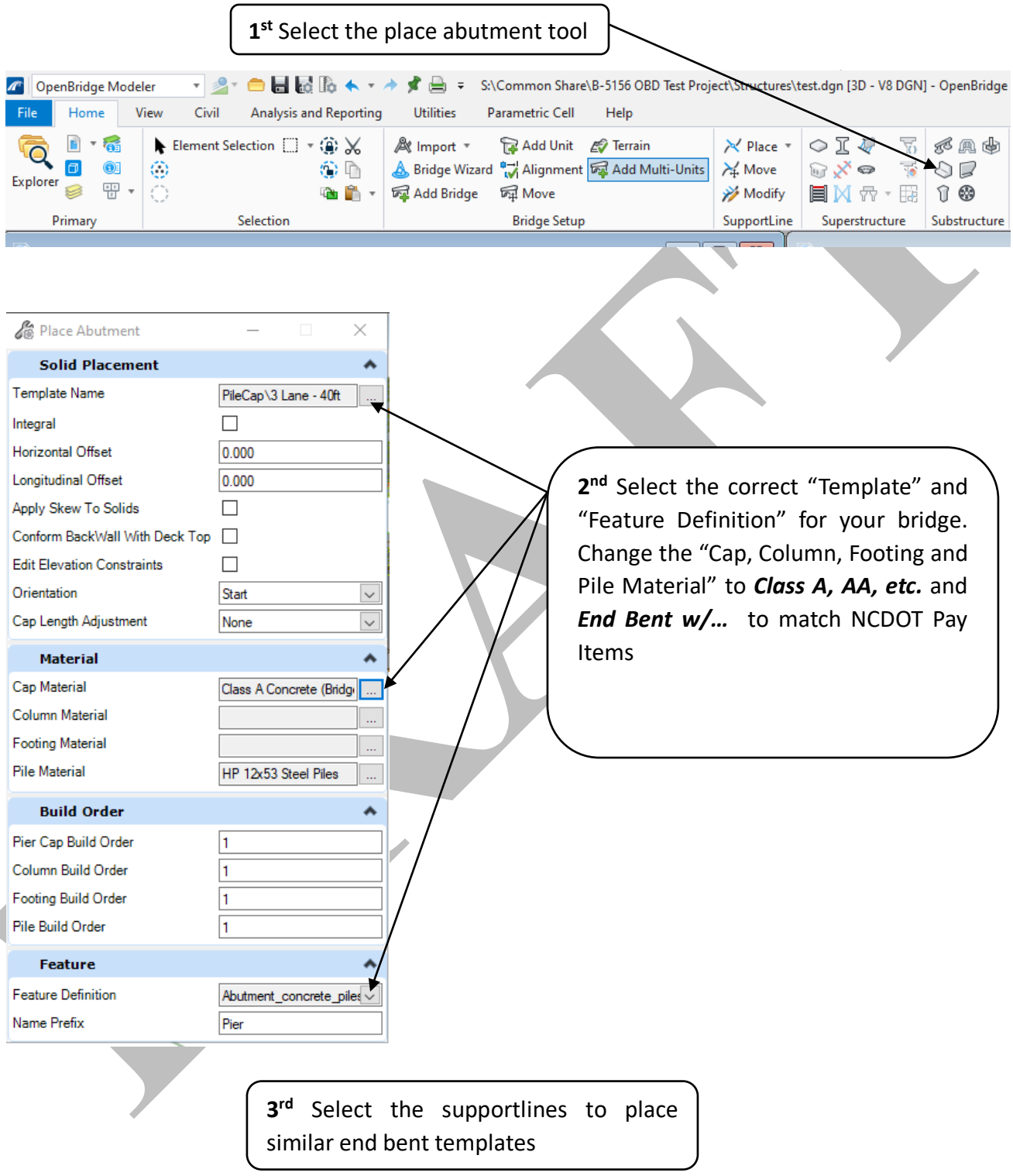
2nd Select the supportlines to place similar bents templates



3rd Select the correct "Template" and "Feature Definition" for your bridge. Change the "Cap Material" to ***Class A or AA*** for the bridge deck and ***Bent w/…*** to match NCDOT Pay Items

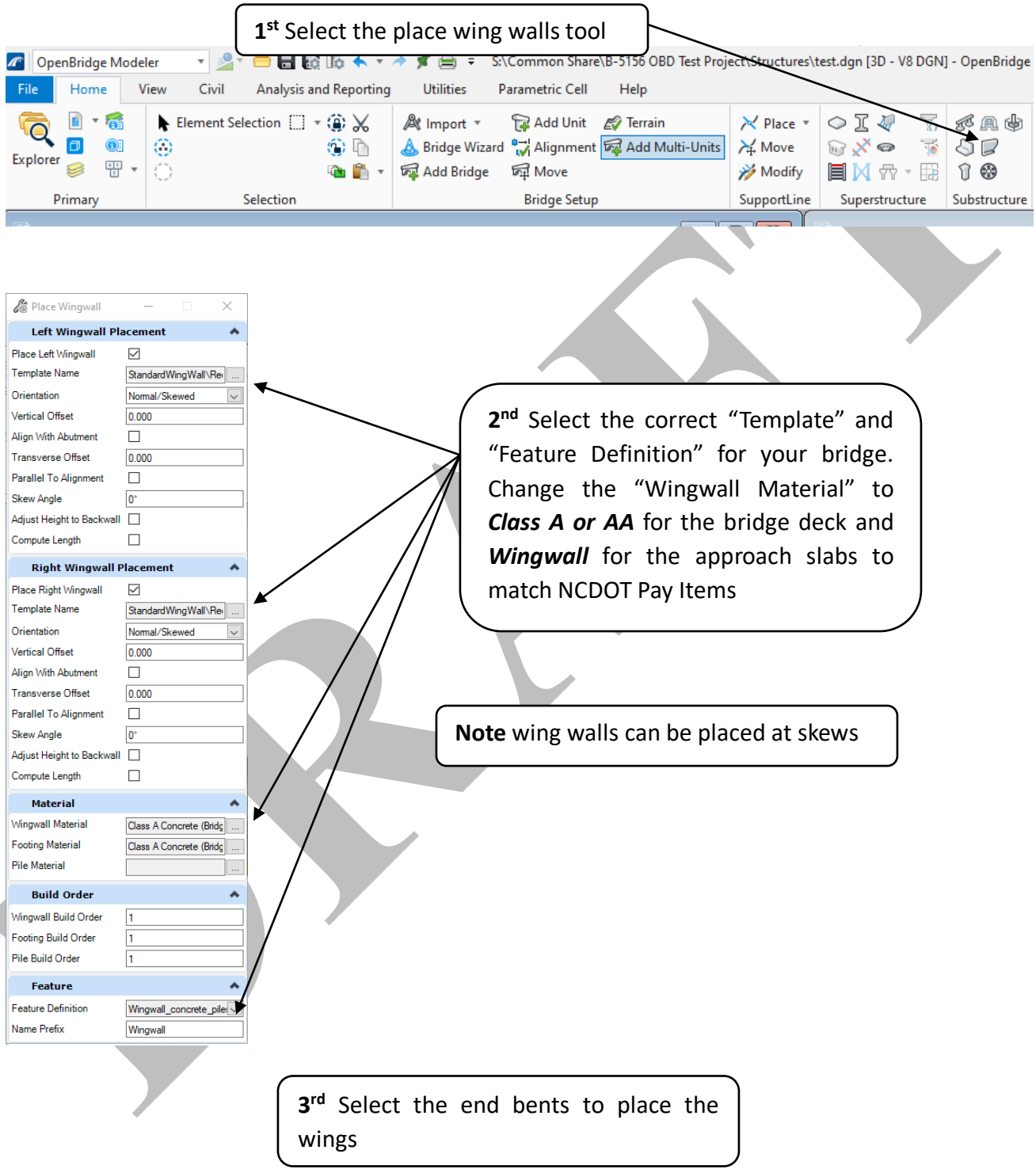
6.3.8 Adding End Bents

To place the end bents, use the following steps:



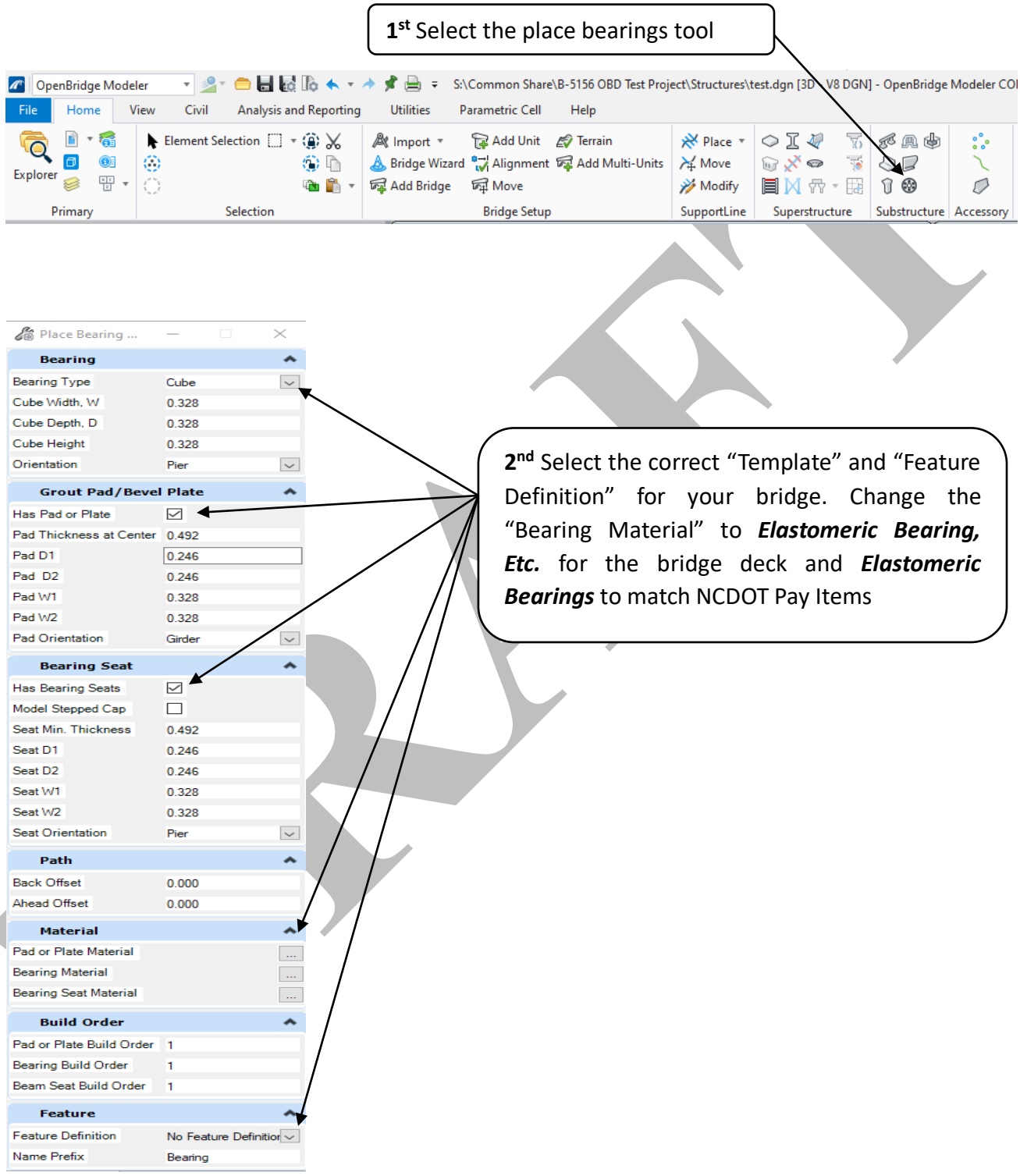
6.3.9 Adding Wing Walls

To place the wing walls, use the following tool:



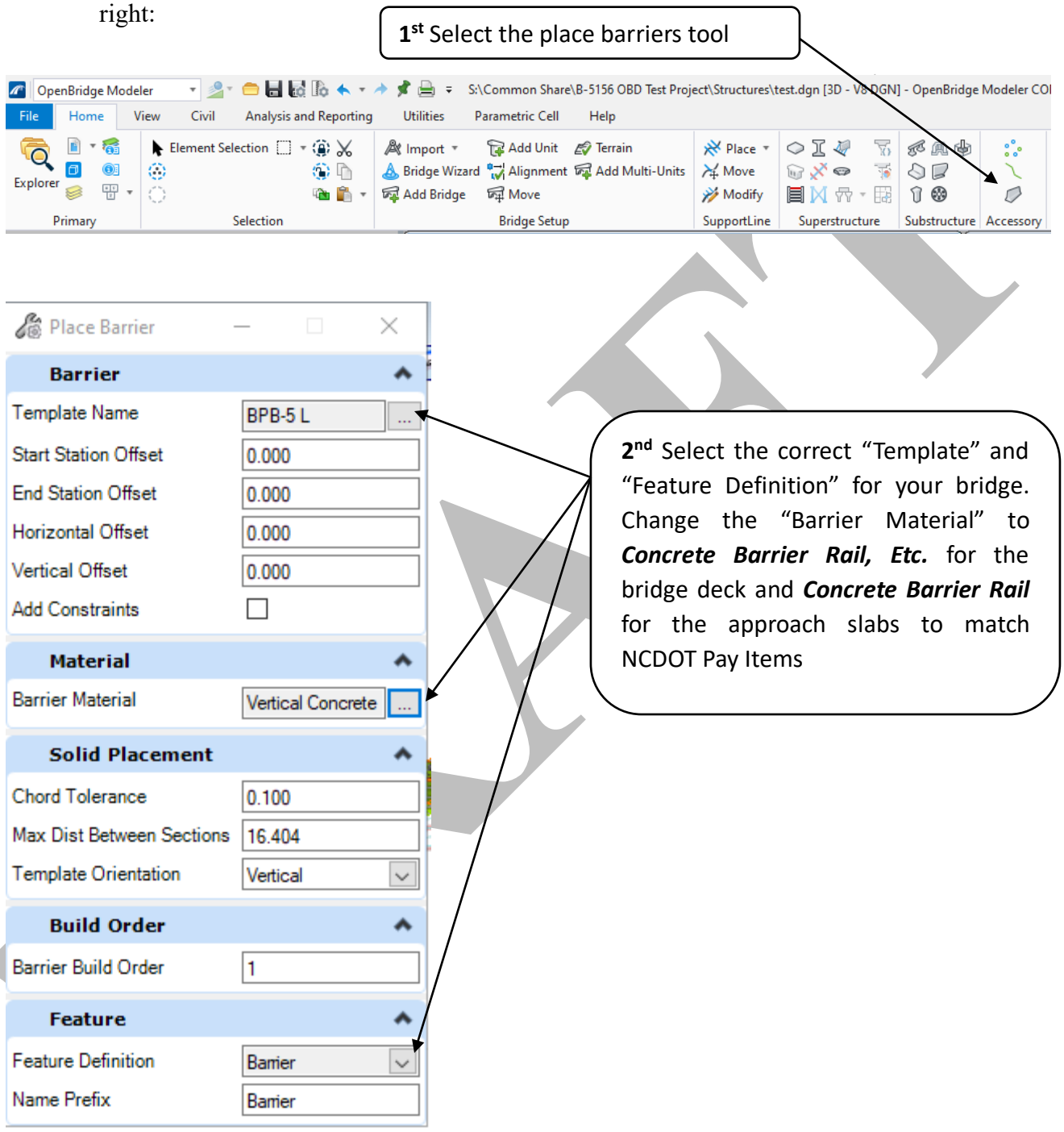
6.3.10 Adding Bearings

To place bearings, use the following tool:

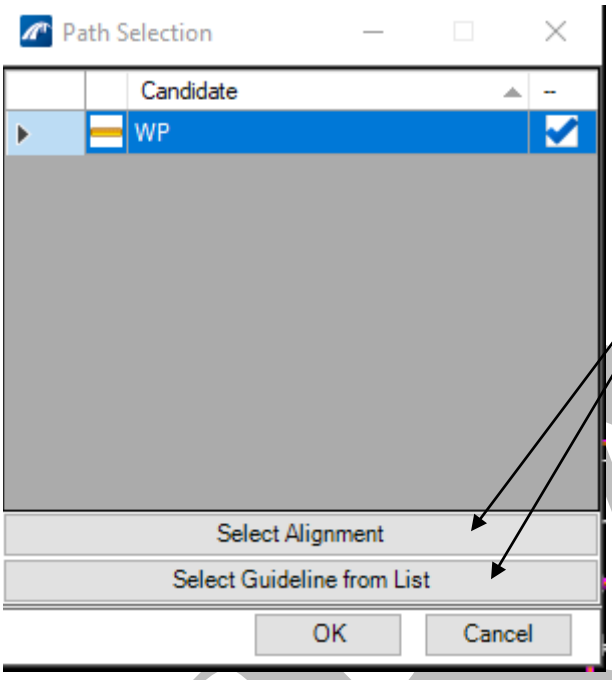


6.3.11 Adding Barrier Rails

To place the barrier rails, use the following tool, once for the left rail and again for the right:



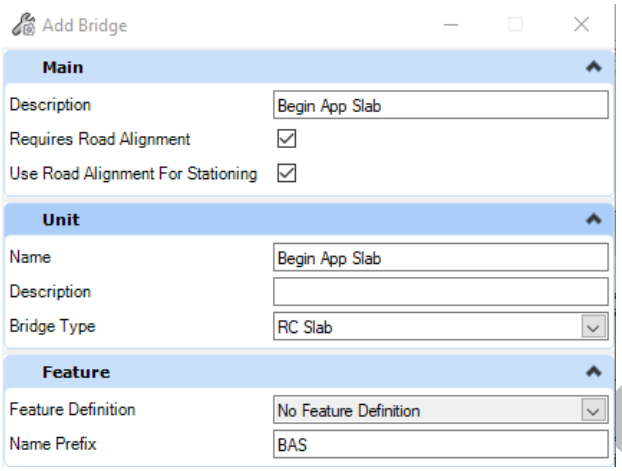
3rd Select the structure, then data point off



4th Click on "select alignment" then click on the alignment of the structure, then click on "select guideline from list" and select the point which to place the rail on the deck…..repeat for other rail

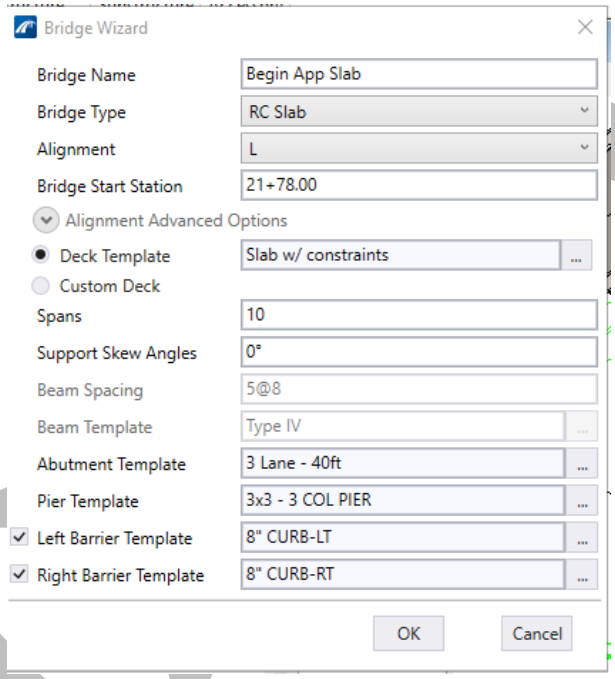
6.3.12 Adding Approach slabs

To place approach slabs in the model, add a single span bridge at the beginning of the bridge and the end of the bridge using the steps found in 6.1.2 through 6.1.4.



Enter "Begin/End App Slab" for bridge name, "RC Slab" for bridge type, select alignment, then follow the steps in section 6.1.2-6.1.4 and 6.1.12.

or using the "bridge wizard" as found in section 6.2



Enter "Begin/End App Slab" for bridge name, "RC Slab" for bridge type, select alignment, enter the start station, select deck template, enter the approach slab length for span, leave the abutment and pier templates as defaulted, select the appropriate left and right curbs for barrier templates

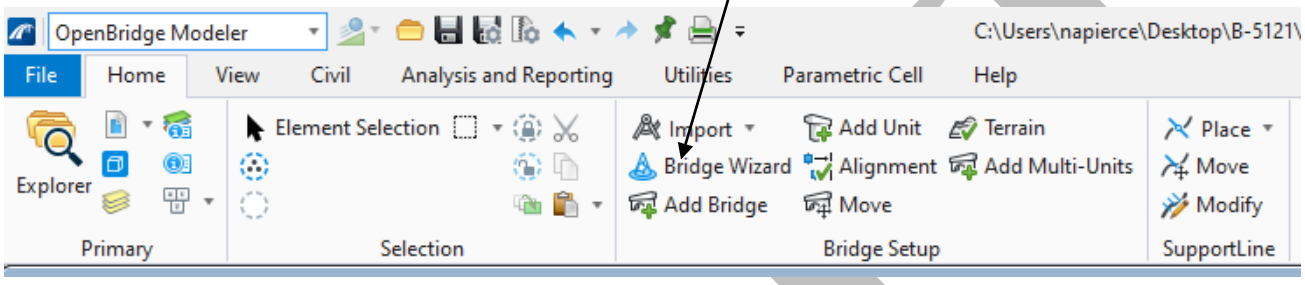
Note: once the bridge is placed with the bridge wizard, use the edit model techniques found in section 6.3 to DELETE the abutments placed in the model.

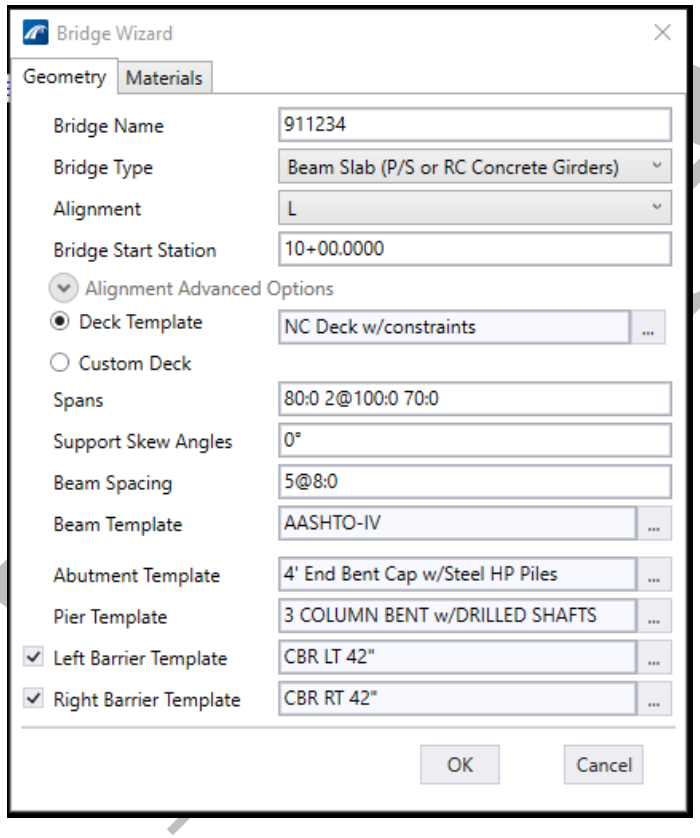
6.4 3D MODEL WITH THE BRIDGE WIZARD

A quick way to place a 3D bridge model is using the bridge wizard. Here are the steps.

1st Attach required reference files as covered in Section 6.1.1

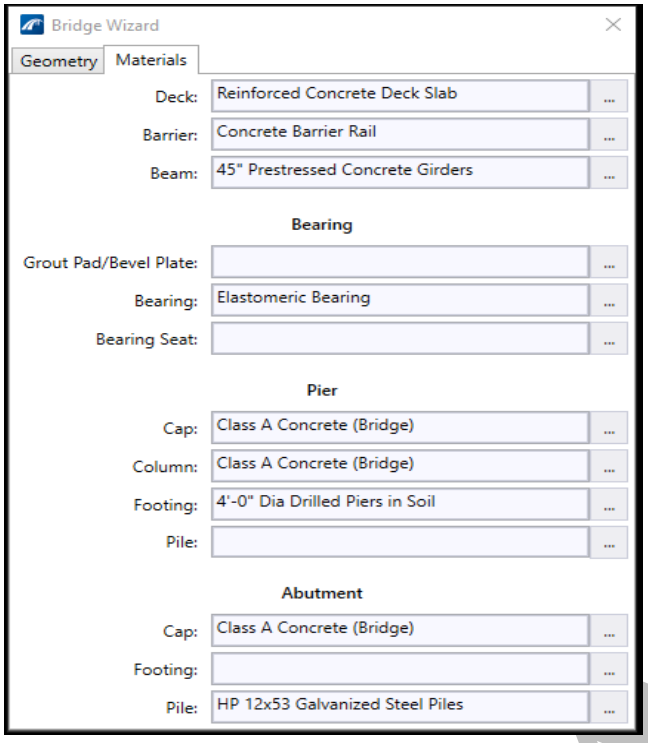
2nd Click on the "Bridge Wizard" icon





3rd Enter the bridge name, select the bridge type, select the alignment which the bridge is to be placed on, enter the bridge start station (work point 1 station), select the deck template to be used, enter the span arrangements, the skew, number and spacing of beams, and select the templates to be used for the beams, abutment, piers, left and right barrier rails

NOTE: Span lengths and Beam Spacing are entered as feet**:**inches, so 6'-3 ½" beam spacing would be 6**:**3.5. Span lengths are also separated by a space between them.



4th Select the "Materials" tab and select the pay items that match the elements. Once completed, go back the "Geometry" tab and click "OK."

The model should be built in your DGN, but bearings will need to be edited to display the correct type and dimensions and wing walls will still need to be added. The model will also need properties edited to display the correct material properties when reports are generated. If multiple Element Templates need to be changed, rather than editing each element, it may be easier to delete the existing 3D bridge model and start over with the Bridge Wizard. To quickly delete the existing bridge, use the Select All button to highlight the bridge and then hit Delete.

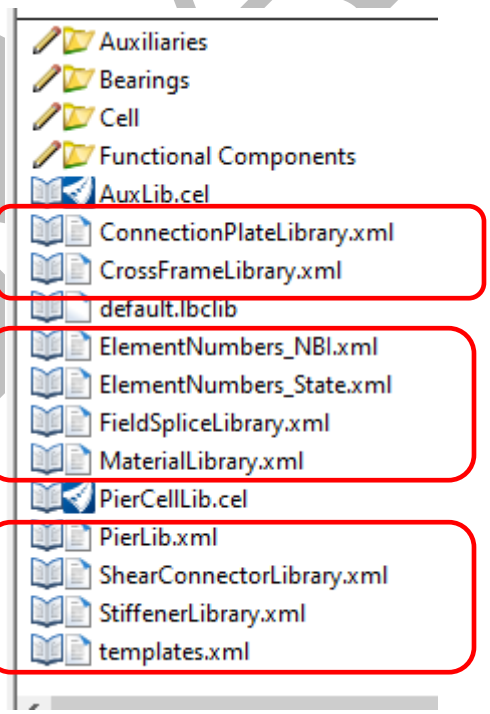
6.5 EDITING 3D ELEMENT TEMPLATES

If the Element Templates provided in the workspace are not adequate for the bridge being designed, the User may copy and edit the Element Templates before creating a structure as follows.

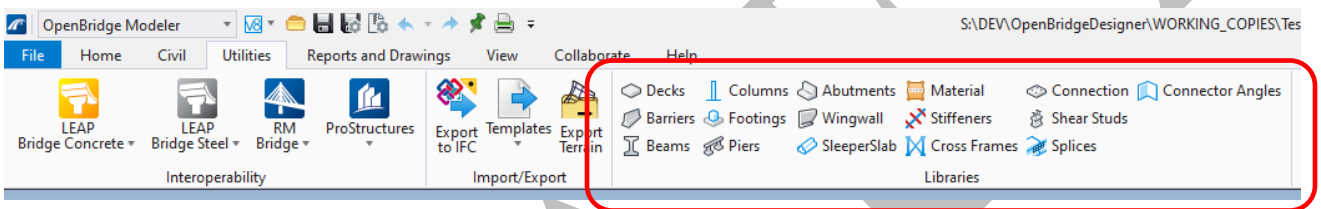
1st Go to the following folder SMU workspace in ProjectWise

Documents\Administration\WorkspaceGroups\NCDOTWorkspaces\Configuration_2023\WorkSpaces\DOT-USNorth Carolina\Roles\NCDOT_Structures\Standards\Bridge Templates\

2nd Copy all the Template ".xml" files



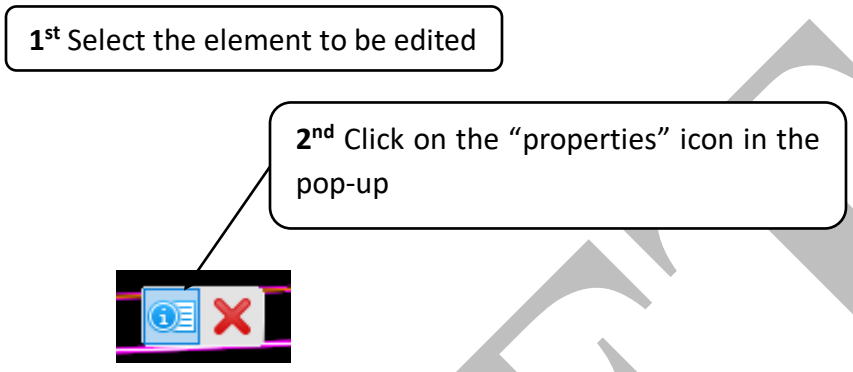
3rd Paste the Template ".xml" files in the project Bridge Templates folder



4th Edit the appropriate Templates using the Libraries tools

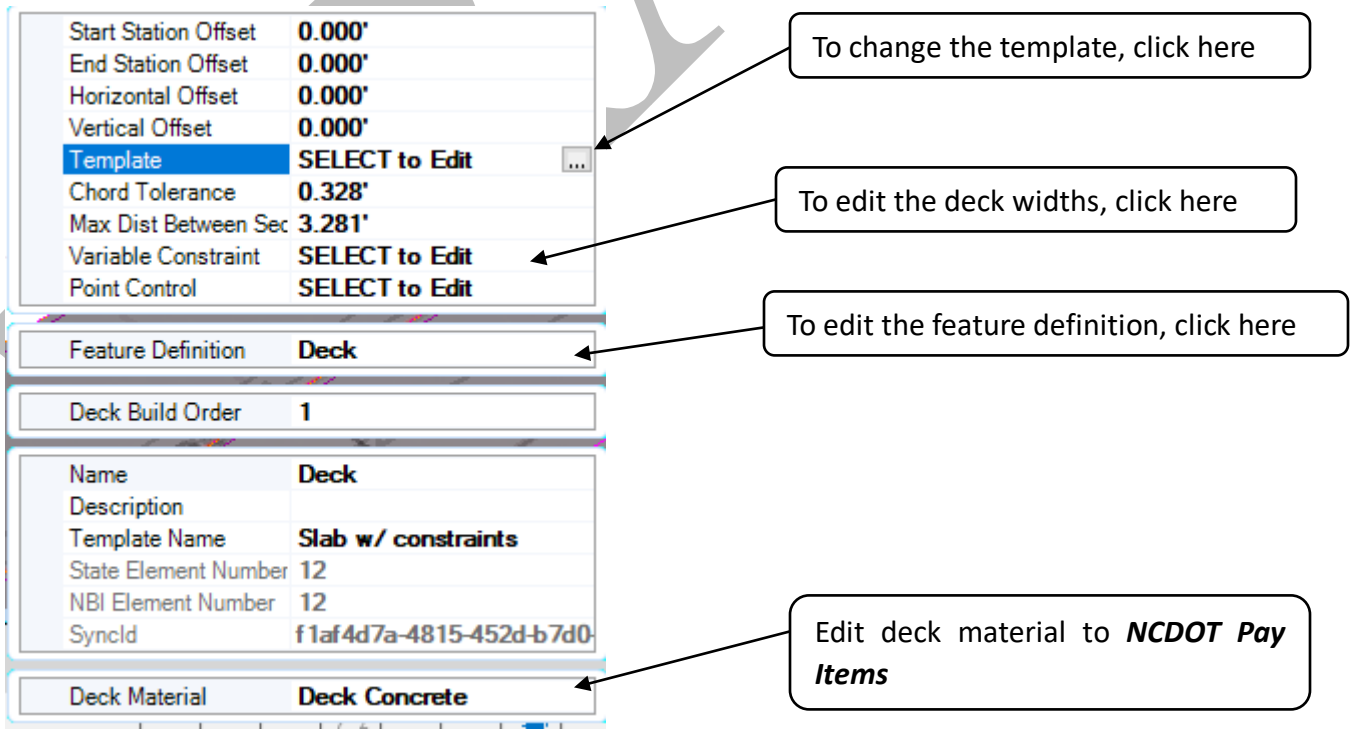
6.6 EDITING A 3D MODEL

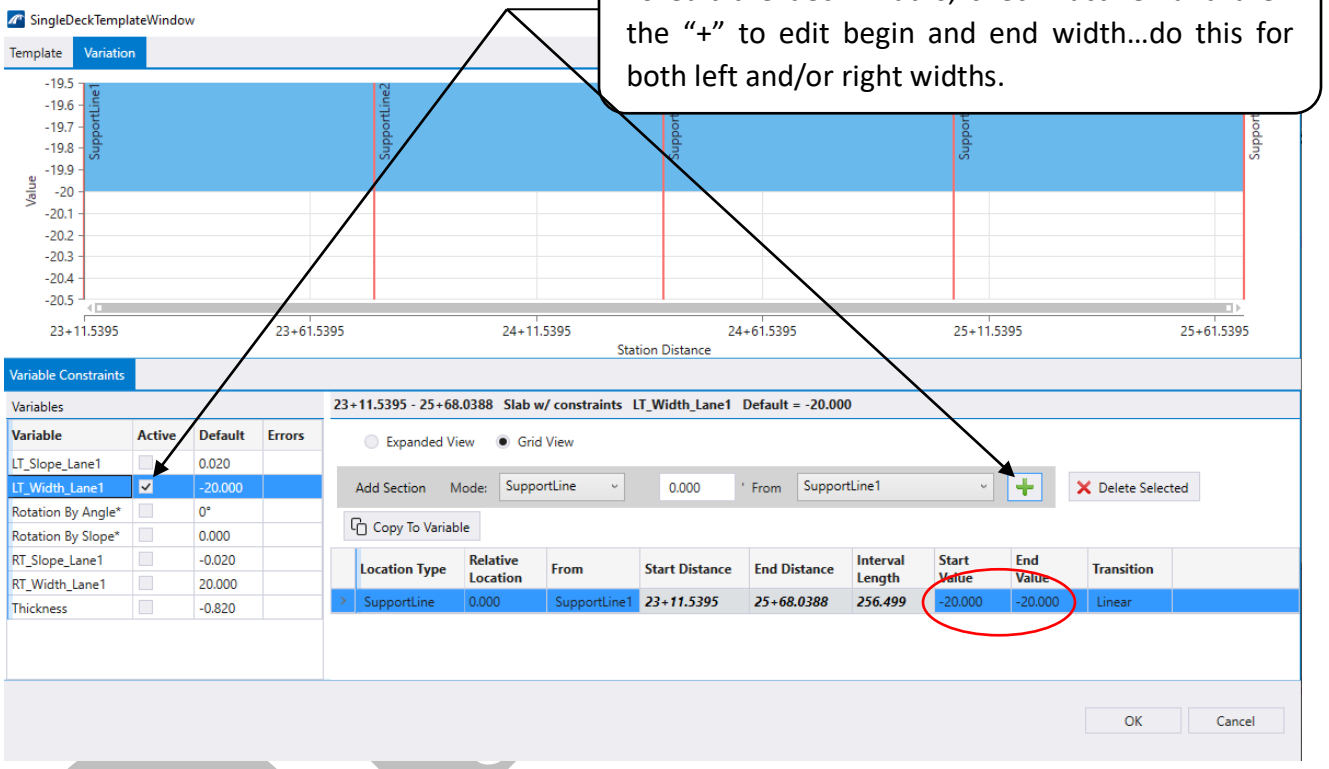
Changes happen in bridge design, to edit an existing model use the steps for the elements below. For each element listed below, the following steps are required:



6.6.1 Editing the Bridge Deck

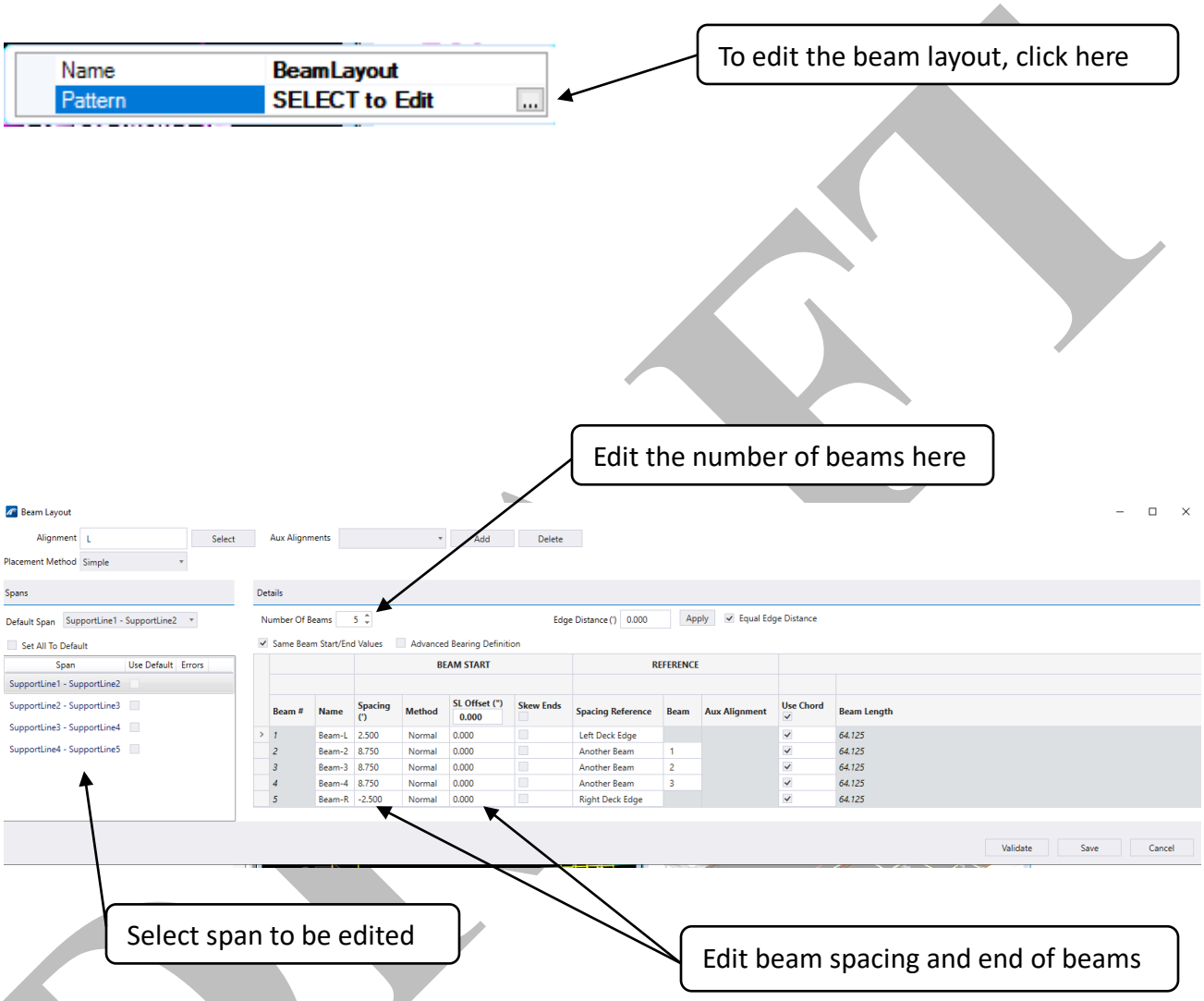
The bridge deck can be edited to change the template (super elevation left or right, or normal crown) or to edit the template constraints (left and right widths) and material type.




To edit the deck widths, check “active” and then the “+” to edit begin and end width…do this for both left and/or right widths.
SingleDeckTemplateWindow
Template
Variation
SupportLine1
SupportLine2
Value
-19.5
-19.6
-19.7
-19.8
-19.9
-20
-20.1
-20.2
-20.3
-20.4
-20.5
23+11.5395
23+61.5395
24+11.5395
24+61.5395
25+11.5395
25+61.5395
Station Distance
Variable Constraints
Variables
Variable
Active
Default
Errors
LT_Slope_Lane1
0.020
LT_Width_Lane1
-20.000
Rotation By Angle*
0°
Rotation By Slope*
0.000
RT_Slope_Lane1
-0.020
RT_Width_Lane1
20.000
Thickness
-0.820
23+11.5395 - 25+68.0388 Slab w/ constraints LT_Width_Lane1 Default = -20.000
Expanded View
Grid View
Add Section
Mode:
SupportLine
0.000
From
SupportLine1
Delete Selected
Copy To Variable
Location Type
Relative Location
From
Start Distance
End Distance
Interval Length
Start Value
End Value
Transition
SupportLine
0.000
SupportLine1
23+11.5395
25+68.0388
256.499
-20.000
-20.000
Linear
OK
Cancel

6.6.2 Editing the Beam Layout

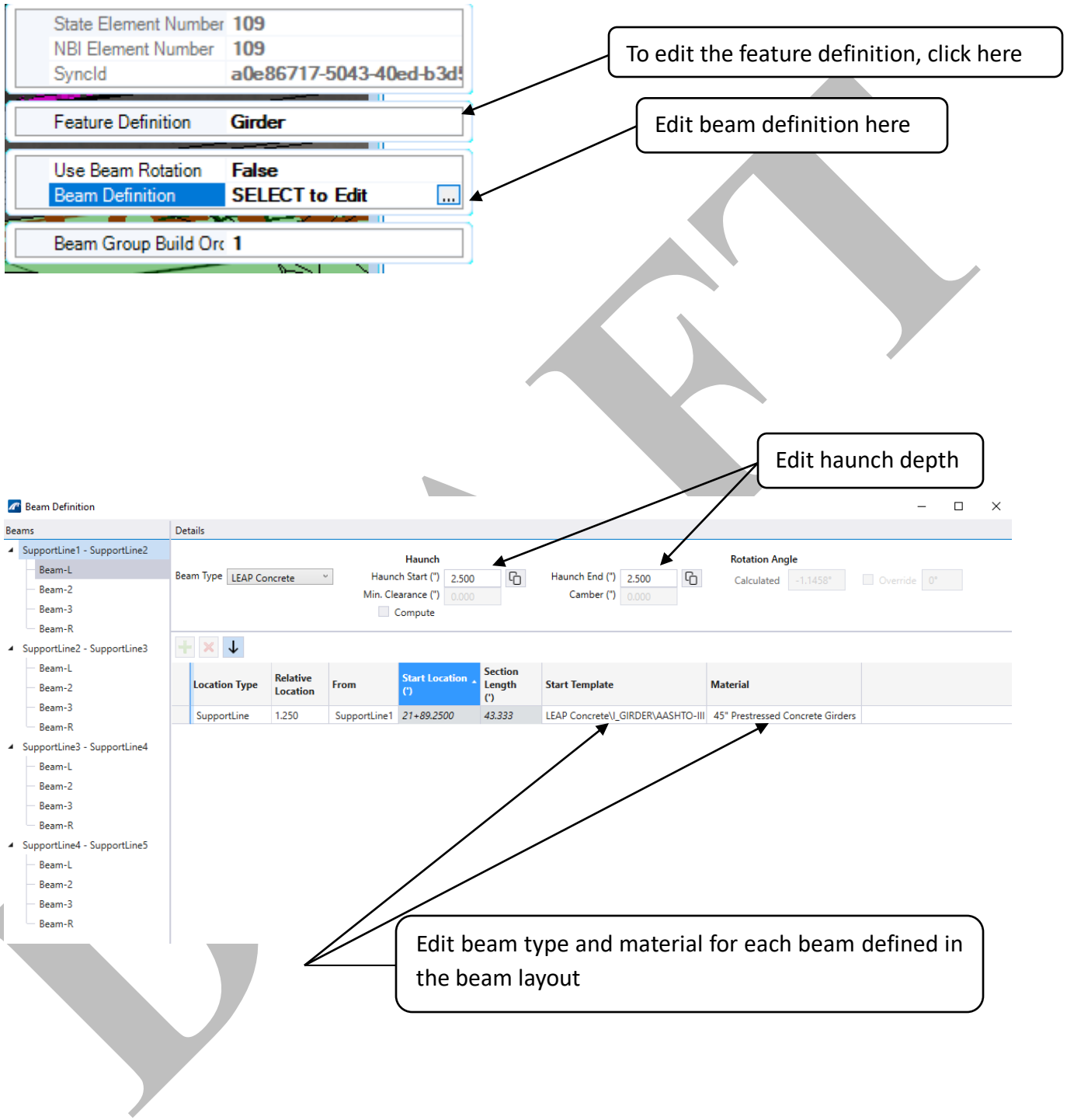
Beam Layout controls the number of beams, beam spacing and beam lengths



Note: The first and last beam spacing is the distance from the outside edge of the deck and the last beam's spacing should be negative from the right outside edge of deck.

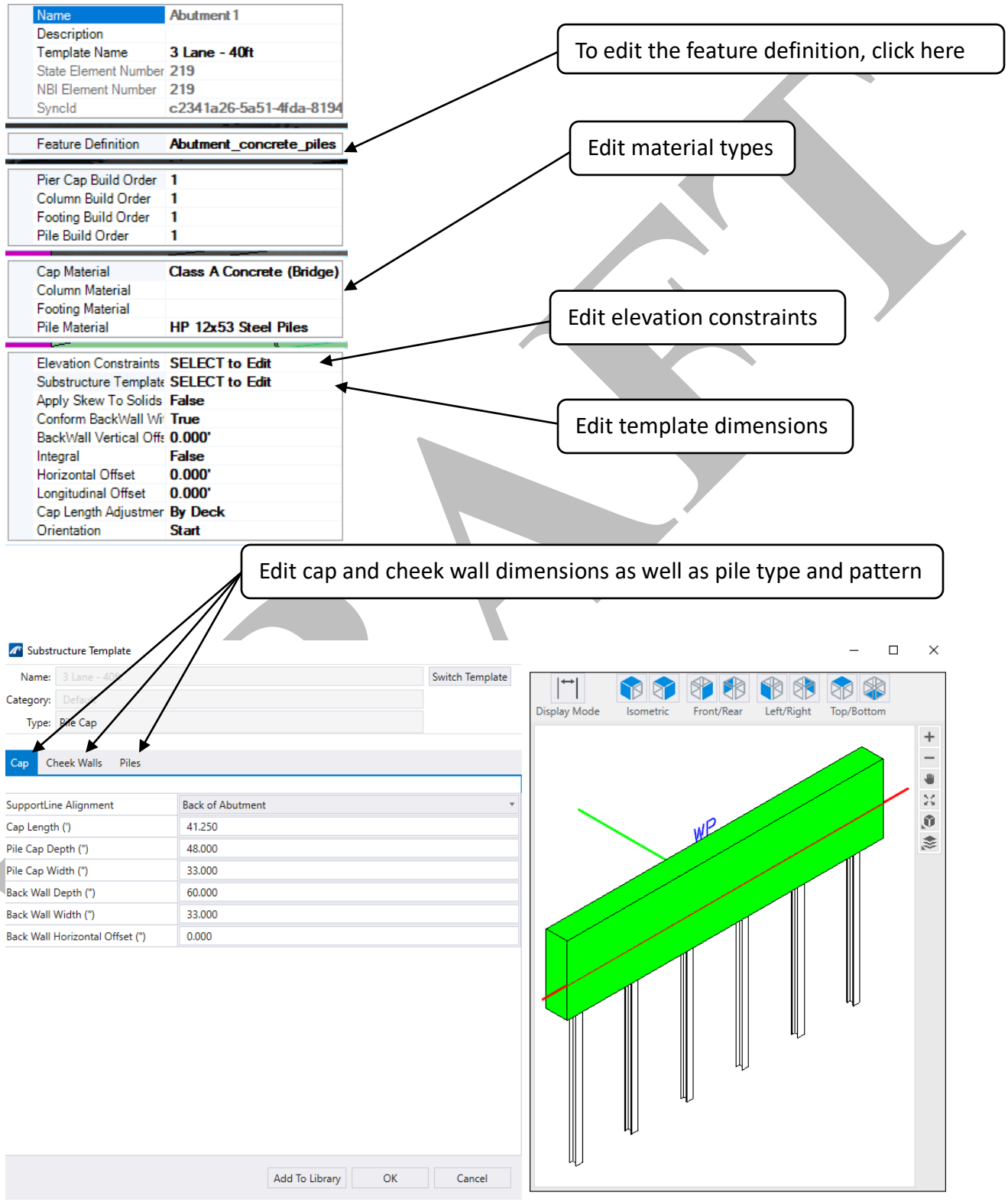
6.6.3 Editing the Beam Definitions

Editing the beam definitions allows changing beam types and material



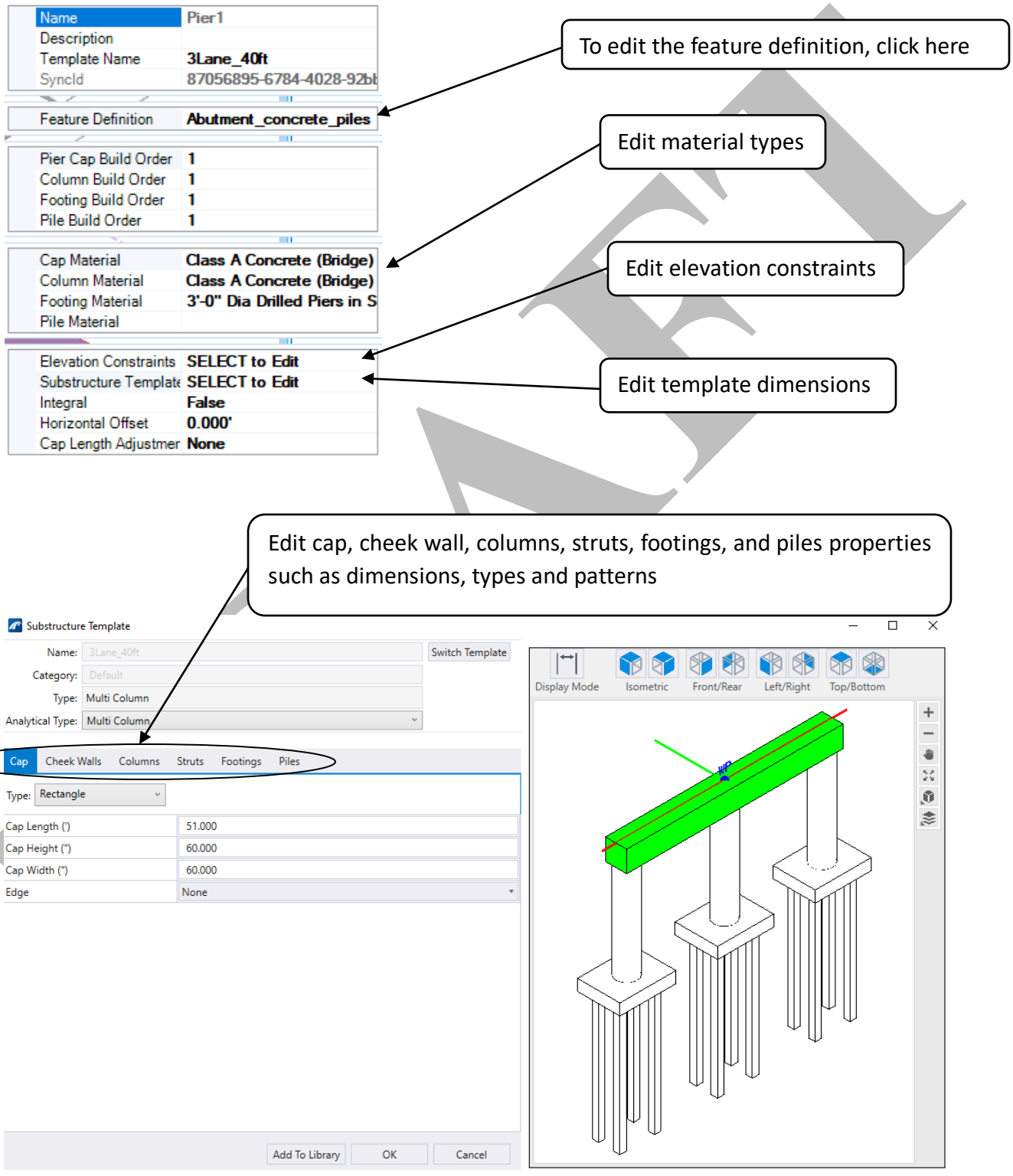
6.6.4 Editing the End Bent

End Bents properties can be edited for material types, elevation constraints and template properties such as cap dimensions, pile type/size and pattern.



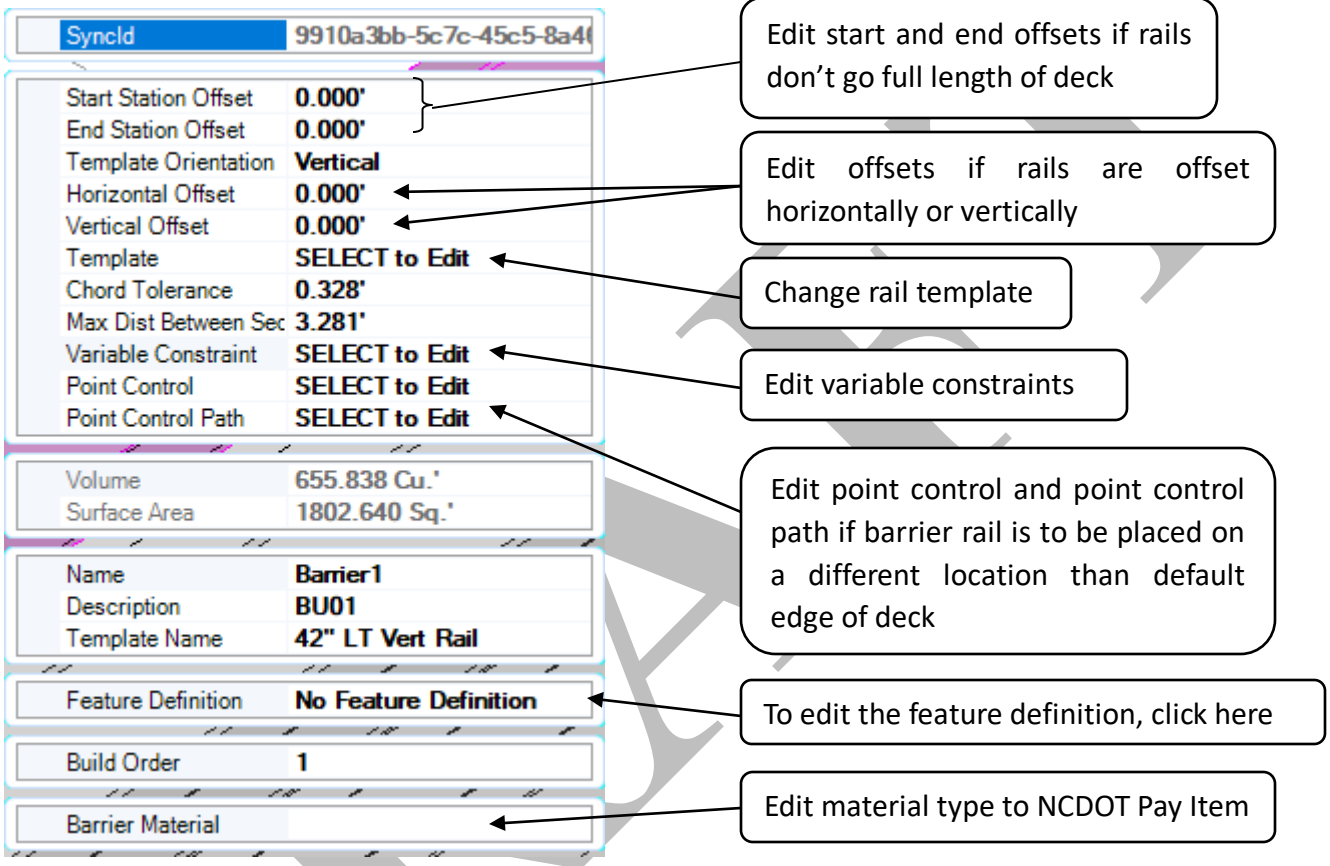
6.6.5 Editing the Bent

Bent properties can be edited for material types, elevation constraints and template properties, such as cap dimensions, column/pile type and size and pattern.



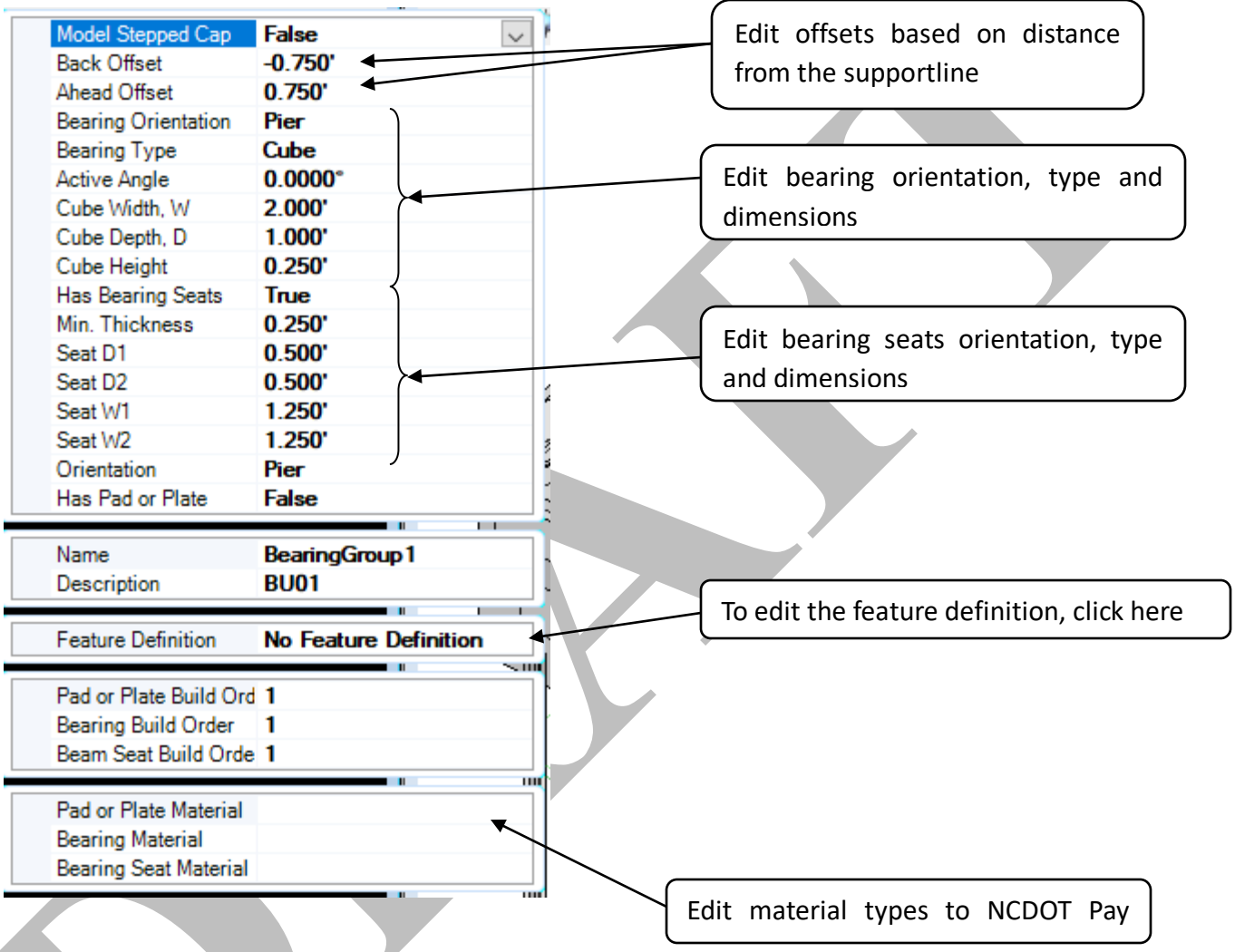
6.6.6 Editing Barrier Rails

Barrier rail properties can be edited for start and end station offsets, template orientation, horizontal and vertical offsets, rail template, variable constraints, point control, point control path, feature definitions and material type.



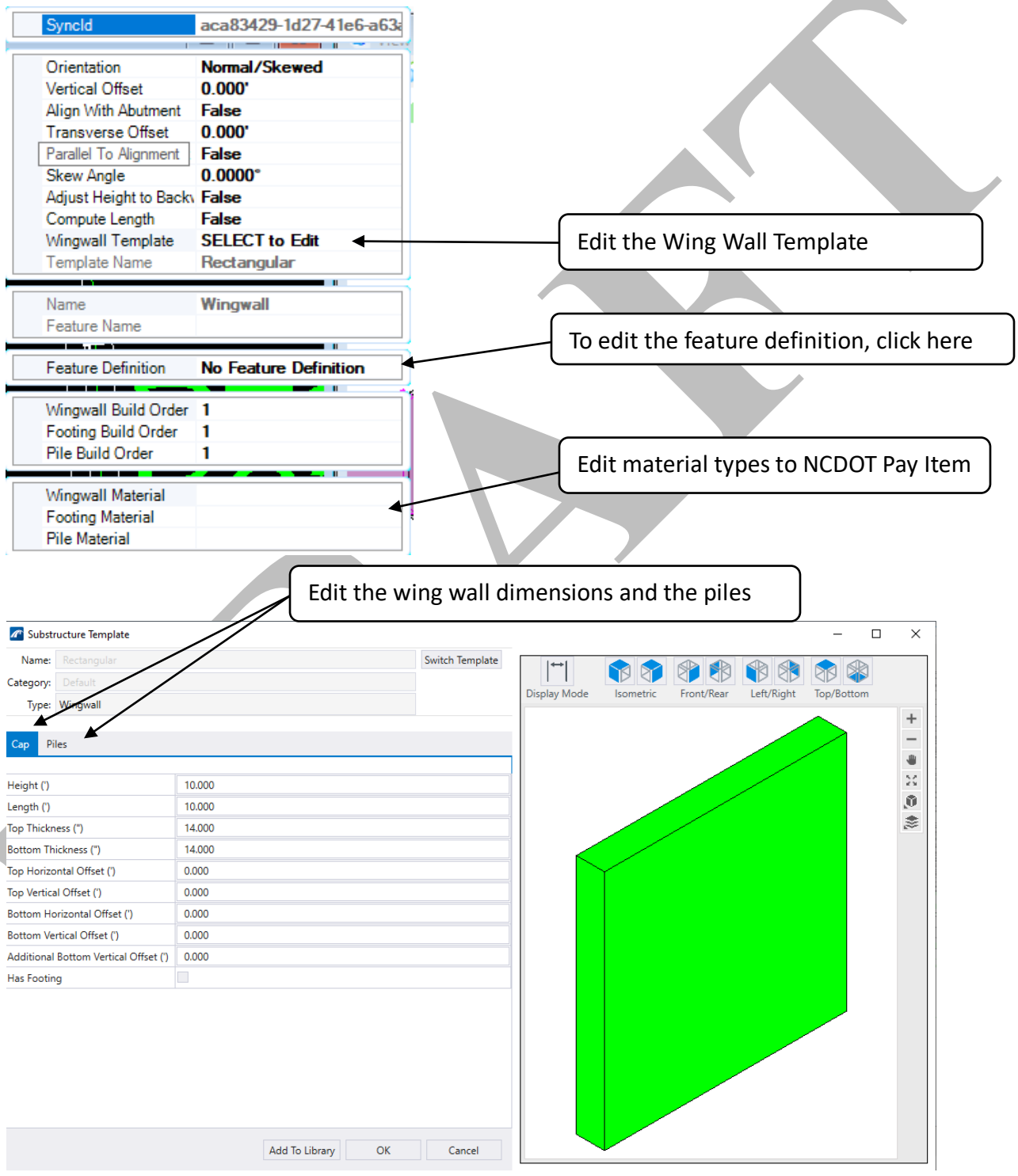
6.6.7 Editing Bearings

Bearing properties can be edited for cap steps, offsets from supportline, orientation, type, skew angle, dimensions, if it has a bridge seat or not and its dimensions, if it has a plate/pad and its dimensions and the material properties.



6.6.8 Editing Wing Walls

Editing wing wall properties can be edited to change the vertical offset, alignment with abutment, transverse offset, skew angle, template and material properties.



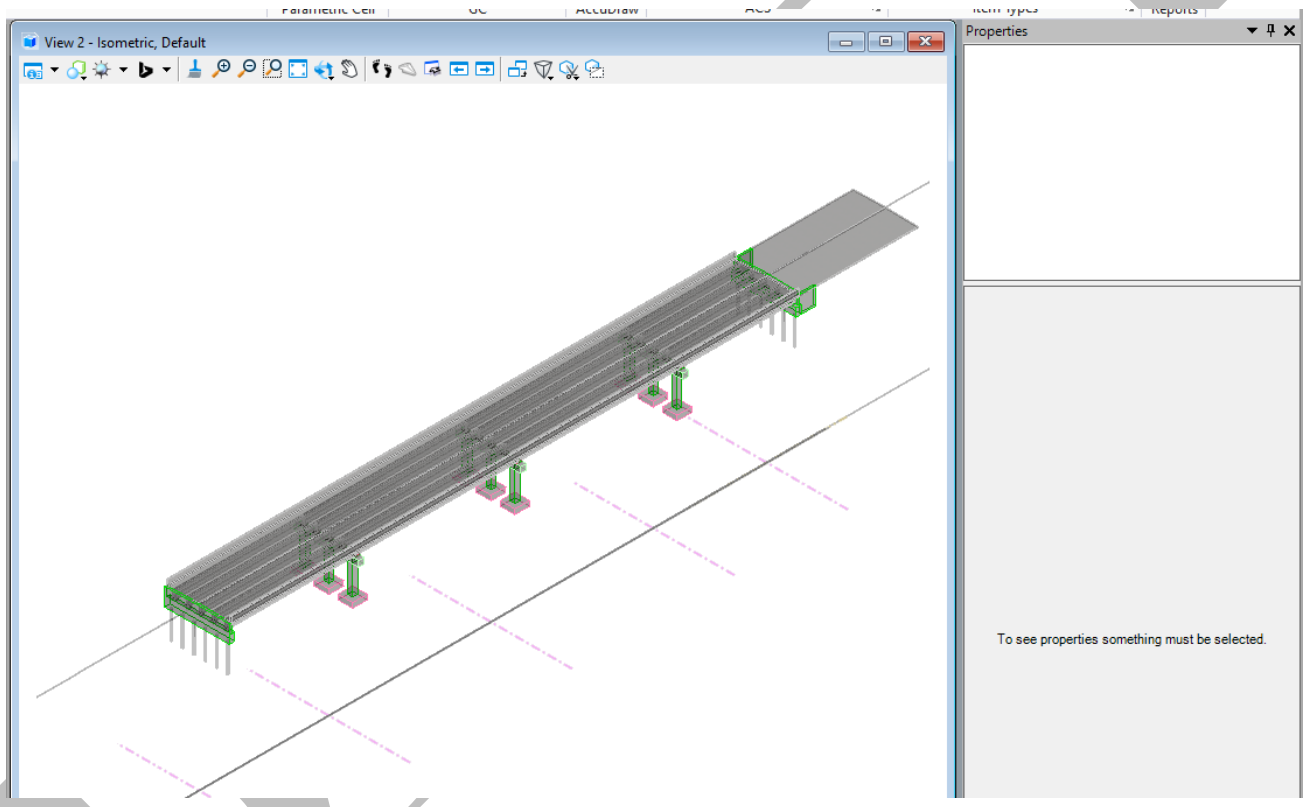
6.7 ITEM TYPES

Once the 3D model has been generated, Item Types should be attached to the various elements to convey metadata to be shared with various Stakeholders of the structure model.

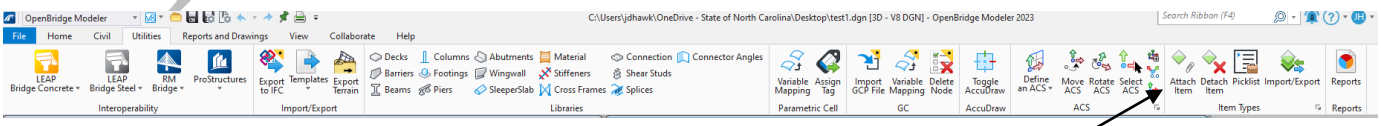
6.7.1 Attaching Item Types

The following steps should be followed to attach Item Types:

Below is a view of the 3D model before any element is selected. There are no properties displayed until an element is selected.

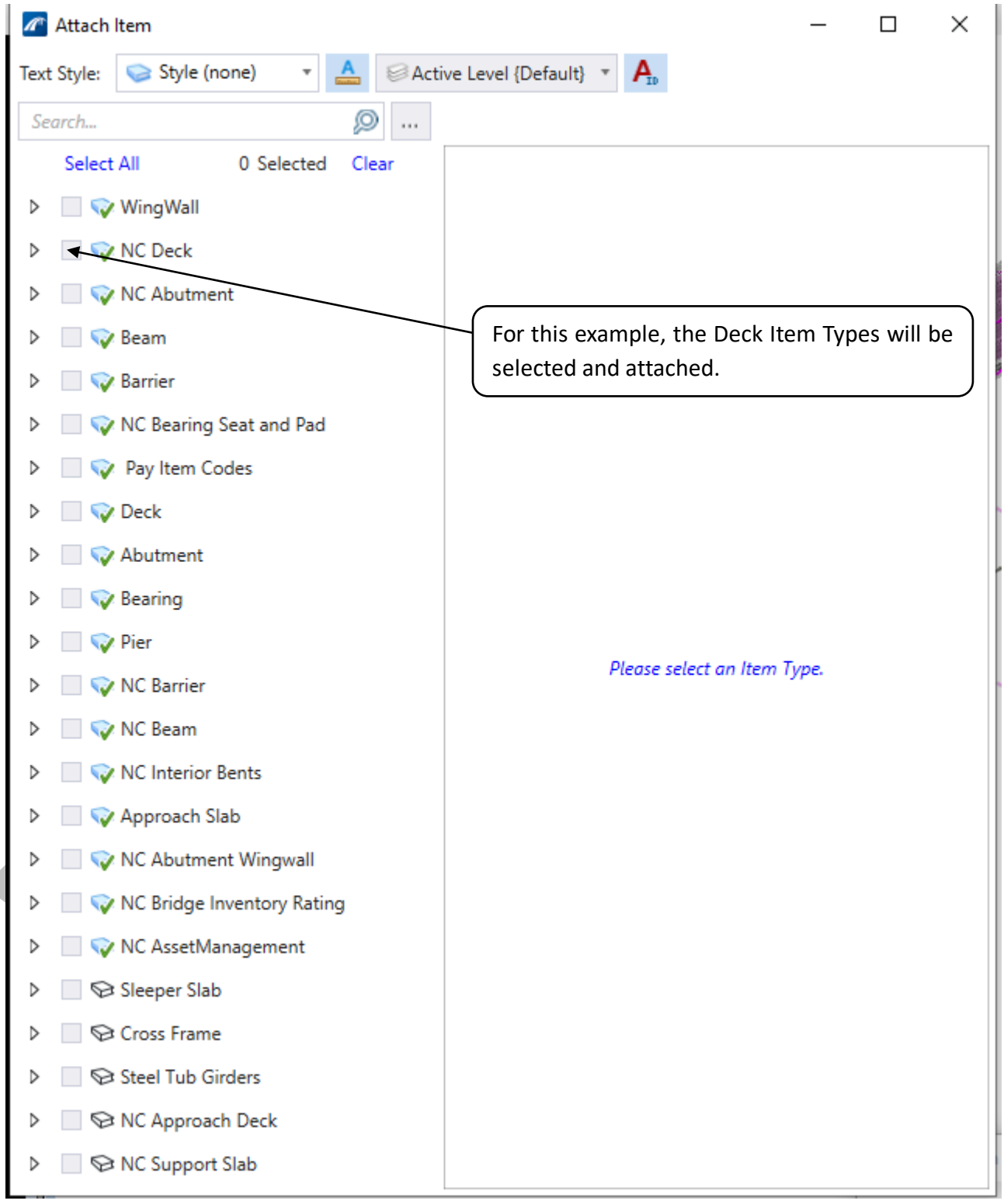


Under the OpenBridge Modeler workflow, go to Utilites tab and find Item Types Group on the ribbon.

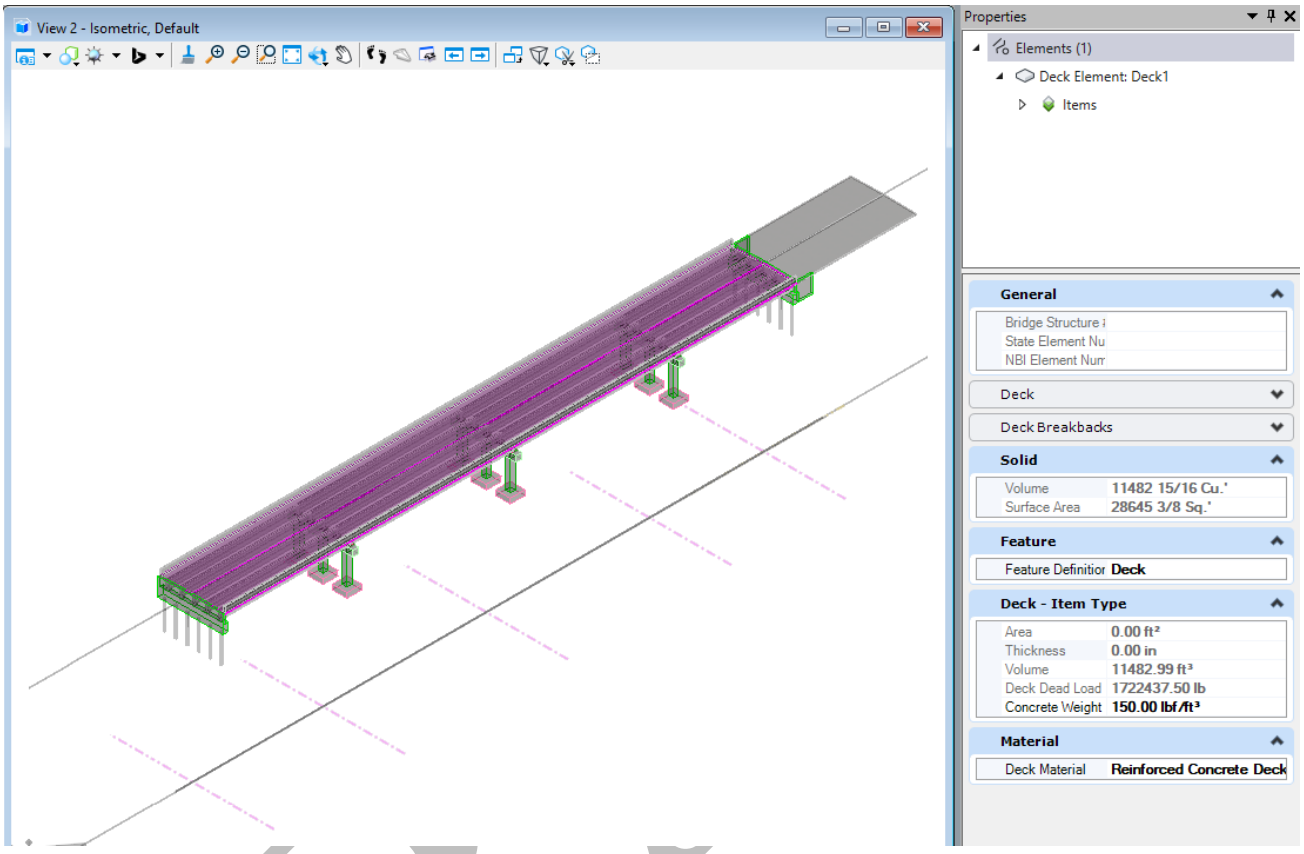


Click on the Attach Item icon

After clicking on the Attach Item icon, the Attach Item dialog box below will appear. Select the appropriate toggle for the Element to be attached.



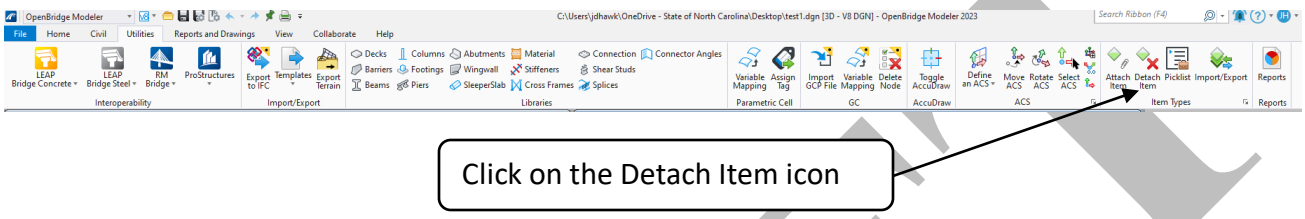
Use the Element Selection tool to select the Element to attach the Item Type to (eg the Deck for this example).



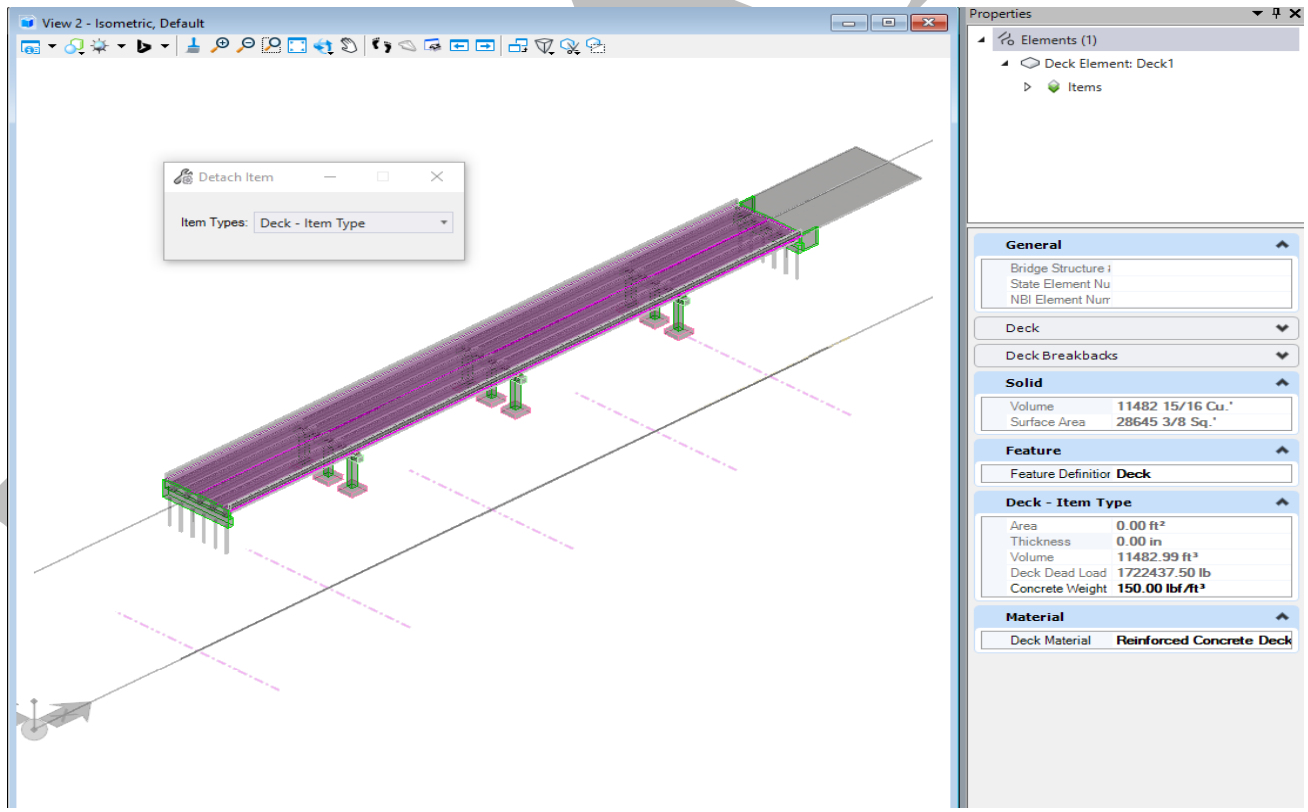
6.7.2 Detaching Item Types

The following steps should be followed to detach Item Types:

Under the OpenBridge Modeler workflow, go to Utilites tab and find Item Types Group on the ribbon.



Select the Item Type from the drop down and select the element that you want to detach items from.



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CHAPTER 7

QUALITY CONTROL & QUALITY ASSURANCE

7.1 2D FILE QUALITY CONTROL

The Drafter of the 2D files needs to create PDF renditions of all DGN files. PDF check plans should be stored in the Plans folder under the structure from which they were generated, along with what percentage review plans they are within the name and metadata. Files should then be assigned to the Checker for review through ProjectWise by the Drafter or a Supervisor.

7.1.1 File Management

The Checker should verify that each plan sheet is its own DGN file as well as each DGN file has the correct file name following the SMU naming conventions and assigned metadata.

Checkers shall notify the Project Manager/Supervisor about files that are not following SMU policies for file management.

7.1.2 PDF's

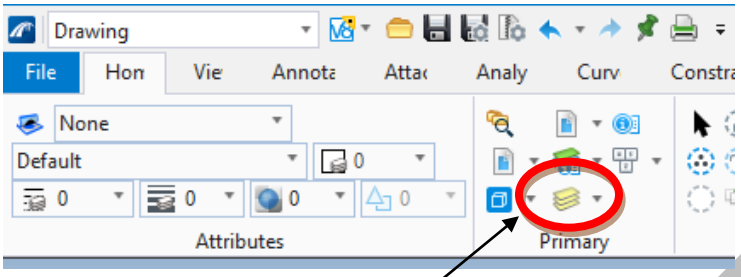
2D PDF plans should continue to be checked for accuracy as to the structure's design, AASHTO and NCDOT policies and specifications using electronic document review software, such as BlueBeam or Adobe Acrobat.

7.1.3 DGN's

2D DGN files should be assigned and checked at the same time as the PDF's so that comments can be placed on the PDF plan sheet about that sheet's DGN file. The Checker should create their own DGN file and reference the original DGN files in to review it. DGN files should be checked for correct use of SMU element templates, line styles, and annotation styles.

Level Display Tool 

A quick way to see if the correct element templates have been used is to check the "Level Display" tool. Using this tool, a Checker can quickly see if the levels used make sense for the DGN being checked. For example, if checking an End Bent plan sheet does the "SMU_End Bent Cap Lines" level appear in the list as being used?

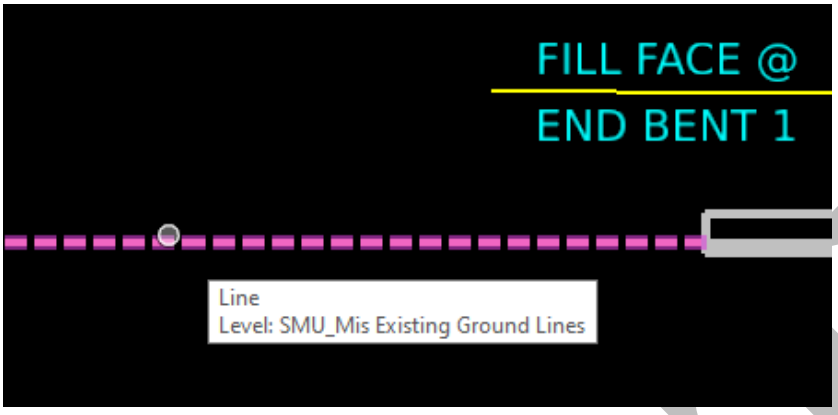


Select the "Level Display" tool

Check the "Used" Levels for use of appropriate levels for the element(s) drawn. Levels used in the file have a "dot" next to them, un-used do not.

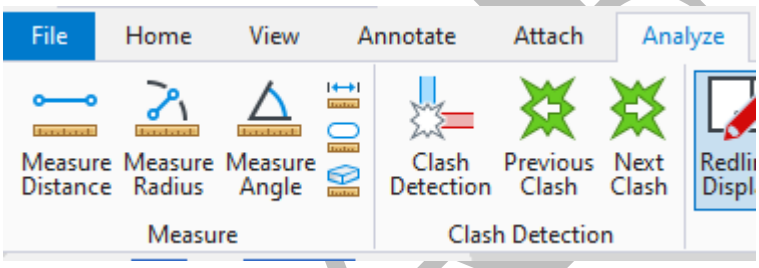
Element Selection Tool

Another way to check a dgn for correct element template usage is to use the element selection tool. Select the Element Selection tool and hover over elements within the dgn to see what level they are on. Verify the levels match the element drawn.



Measurement Tools

The measurement tools, under the "Analyze" tab, can be used inside the DGN to verify element dimensions.



7.2 3D MODEL QUALITY CONTROL

The first step in reviewing the 3D model is to know the level of detail (LOD) to which the model is supposed to detailed to. The next step is for the Drafter or Supervisor to create a copy of the model and name it **4XX_QC#_TIP#_SMU_BR#_MODEL_6digitStrID** and assign the file to the designated Checker. If the structure is large or if the review is to be broken up into superstructure and substructure reviews, create multiple QC copies of the model changing the QC# in the name and assign the QC versions to the designated checkers. Checkers will need to check, but not limited to, the following items.

7.2.1 File Management

The Checker should verify that the 3D model DGN follows the SMU naming conventions and has been assigned metadata. All 2D plans DGNs created from the 3D model should also follow the SMU naming convention and have metadata assigned.

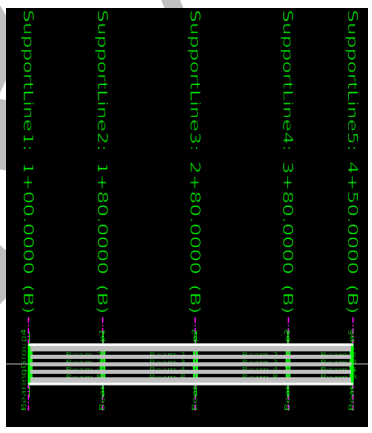
Checker shall notify the Project Manager/Supervisor about files that are not following SMU policies for file management.

7.2.2 Bridge Layout

The structure layout QC is a macro check against the design, AASHTO and NCDOT policies and specifications. The Checker will need to verify:

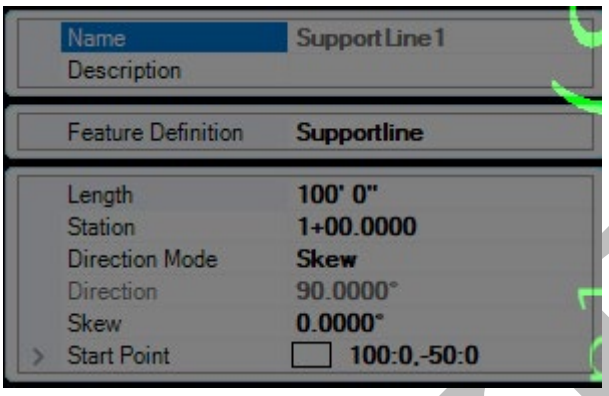
- Support Line stations

  View 1 (plan view) shows the support line stations.



- Support Line skew angles

  Click on the support lines and clicking on the “Properties” icon.



- Horizontal Clearance clashes to roadways, rail roads, utilities, etc.
- Vertical Clearance clashes to roadways, rail roads, etc.

7.2.3 Bridge Deck

The Checker will use the steps in Sections 6.5.1 and 6.5.6 of this manual to review the bridge deck element properties using the same tools as editing them.

The deck should be checked against the design for:

LOD 300

- Feature Definitions
- Deck Materials

Verify:

- Deck width
- Deck thickness
- Haunch width
- Haunch thickness
- Left overhang width
- Right overhang width
- Left gutterline offset from proposed -L-
- Right gutterline offset from proposed -L-
- Rail Section properties
- Left rail offset from left outside deck edge
- Right rail offset from right outside deck edge

LOD 350 (LOD 300 plus the following)

- Reinforcing steel size
- Reinforcing steel spacing/layout (includes clearances)
- Reinforcing steel bar lengths
- Reinforcing steel bar splices

LOD 400 (LOD 350 plus the following)

- Prestressing strand sizes
- Prestressing strand spacing/layout

7.2.4 Bridge Superstructure

The Checker will use the steps in Sections 6.5.2, 6.5.3 and 6.5.7 of this manual to editing element properties as a way to review the superstructure elements. The superstructure elements should be checked against the design for:

LOD 300

- Girder section properties
- Girder lengths
- Girder end offsets/clearances
- Girder spacing
- Diaphragm locations
- Diaphragm section properties
- Bearing locations on girders
- Bearing dimensions

LOD 350 (LOD 300 plus the following)

- Girder reinforcing steel sizes
- Girder reinforcing steel spacing/layout (includes clearances)
- Girder reinforcing steel splice lengths
- Girder shear stud sizes
- Girder shear stud spacing

LOD 400 (LOD 300 plus the following)

- Girder prestressing strand sizes
- Girder prestressing strand spacing/layout (includes clearances)

7.2.5 Bridge Substructure

The Checker should use steps shown in Sections 6.5.4, 6.5.5 and 6.5.8 of this manual for editing substructure elements as a way to review the substructure elements. The substructure elements should be checked against the design for:

LOD 300

- Cap Dimensions
    - Length
    - Height
    - Width
    - Overhangs with Columns/Piles
    - Bearing edge distances
- Bridge Seats
    - Bearing edge distances
    - Seat width
    - Seat height
    - Seat Elevations
- Columns/Piles
    - Size
    - Spacing
    - Lengths
- Footings
    - Spacing
    - Lengths/Widths/Height
- Elevations (top of cap, footings, pile tips, etc.)

LOD 350 (LOD 300 plus the following)

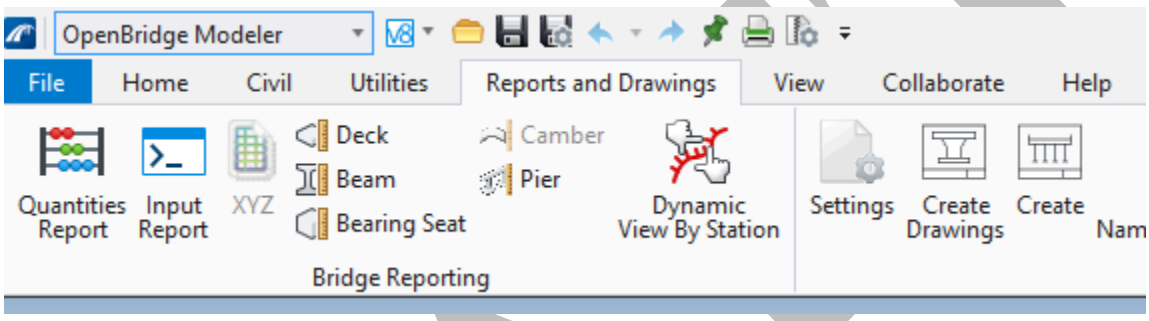
- Caps/Bridge Seats/Columns/Piles/Footings Reinforcement
    - Bar Sizes
    - Bar Spacing/Layout (includes clearances)
    - Bar Lengths
    - Bar Splices

LOD 400 (LOD 300 plus the following)

- Caps/Bridge Seats/Columns/Piles/Footings Prestressing
    - Bar Sizes
    - Bar Spacing/Layout (includes clearances)

7.2.6 Reports

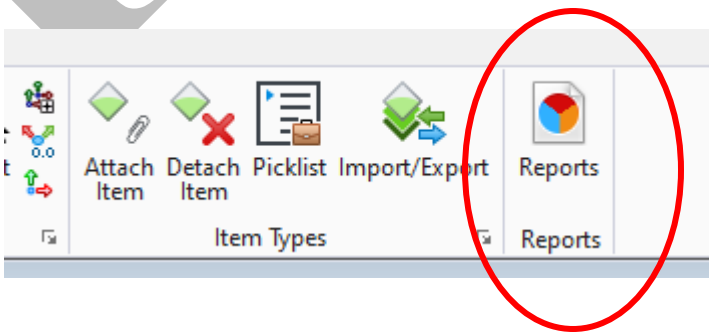
When checking 3D models, the Bridge Reporting tools should be used to verify the structure's element properties such as quantities and elevations from the model. The reporting tools can be found here:

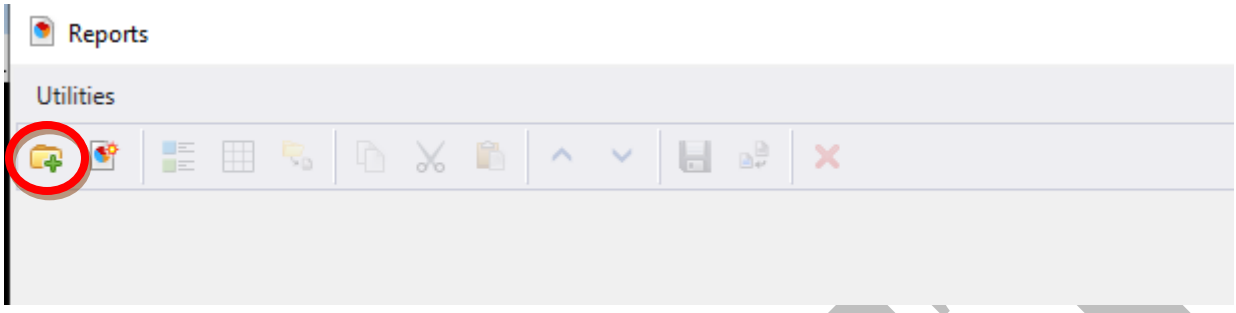


Checkers should continue to use NCBDS, spreadsheets, and other tools that are currently used to verify structure designs, layouts, and quantities.

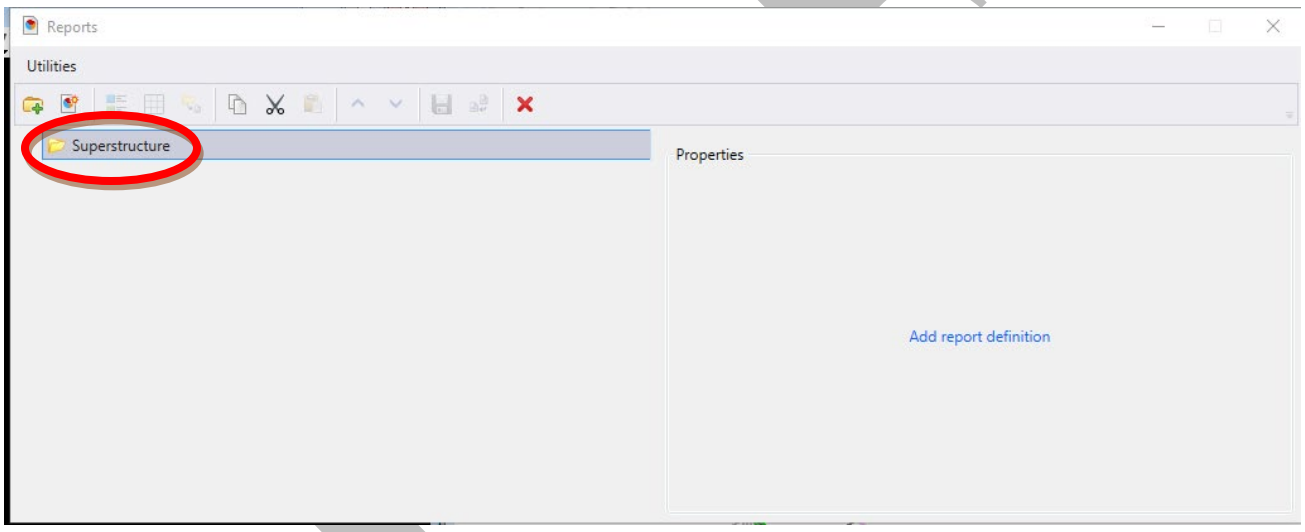
Item Type Reports

To generate an Item Type report, under the OpenBridge Modeler workflow and Utilities tab, find the Reports Icon on the ribbon.

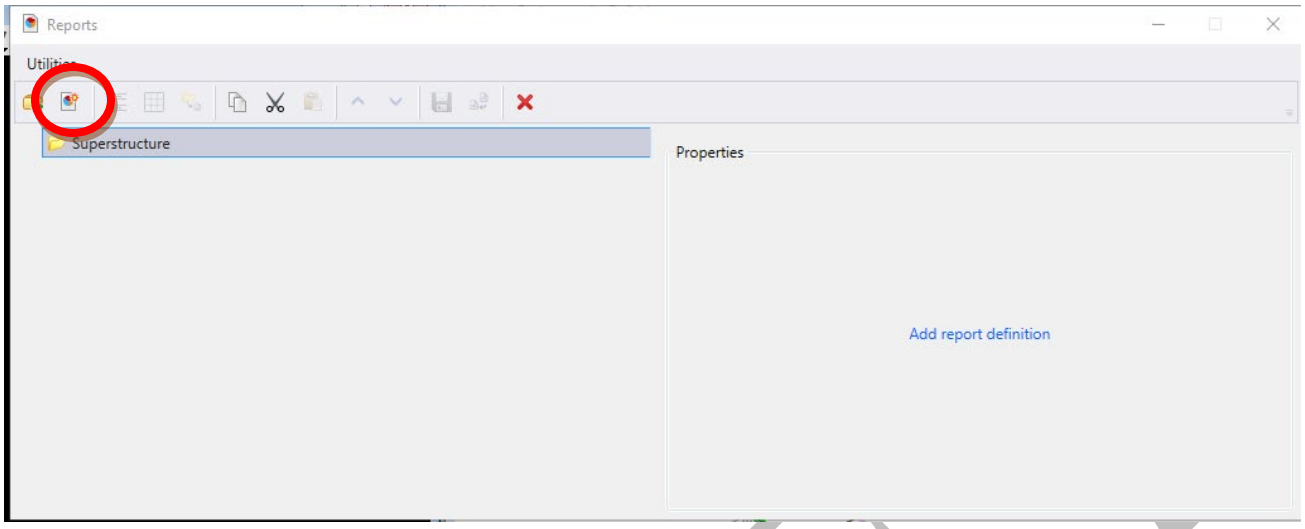




To create a new category, find the add New Category icon on the ribbon.



Give the new Category a name.



To add report definition, find the New report definition icon on the ribbon.