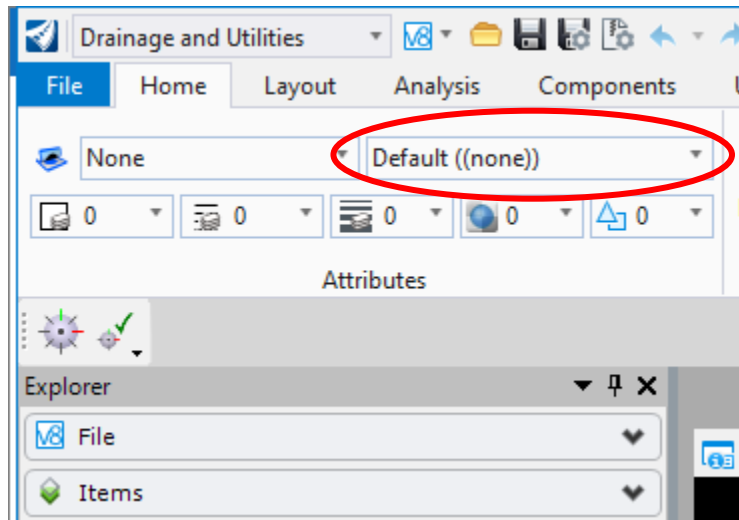


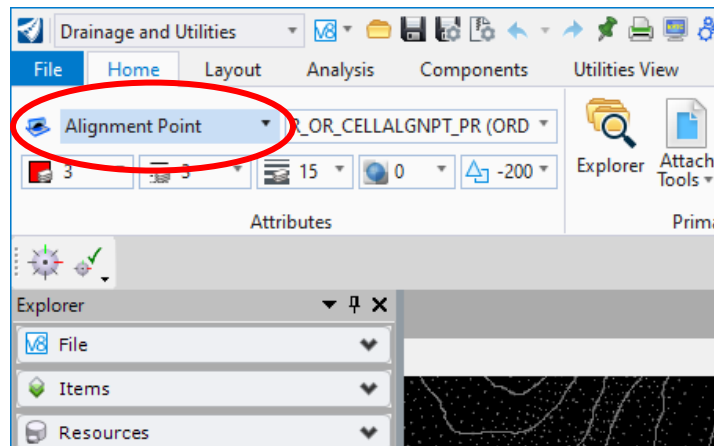
1. Create the 2D Cell for Plan View
  - a. If you can find something in a cell library that already exists (close to what you are making), may be best to copy over and modify.
  - b. Make sure it looks close to what the Standard Drawing or Detail Drawing looks like
  - c. KYTCDrainage.cel is with KYTC CADD Standards. This will get overwritten when new standards are released, so we do NOT recommend placing your new cell here.
    - i. Suggest creating a new \*.cel library in:  
C:\KYTC\_Standards\Organization-Civil\KYTC\_Standards\_OC\\_Roadway\\_Drainage\Cell
  - d. Make sure the cell is on the default level, and that the color, line weight, and line type are on 'By Level' for the cell you are creating. To do this through the 'Element Template'.
    - i. Go to the 'Home' tab, then to 'Attributes'



- ii. The image above shows the level set to 'default', and the color, line weight, and line type set to 'By Level'
- e. Each cell must have:
  - i. An 'alignment point'. This is the point you want the cell to rotate about when you place it.

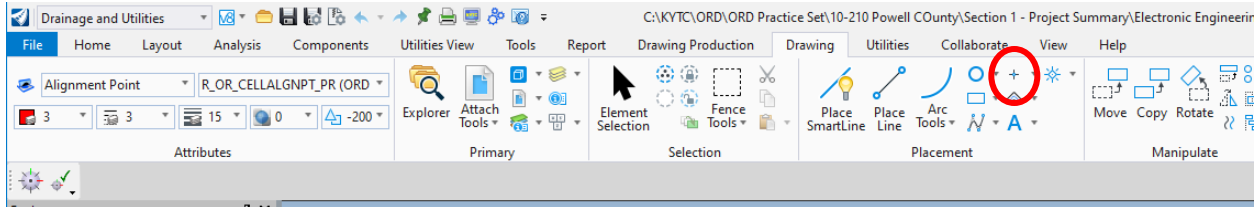
1. Use the Element Template

- a. Go to 'Drainage' > 'Element Template' > 'Alignment Point'.



- b. This will place the attributes on a line style and color of 3 (red).

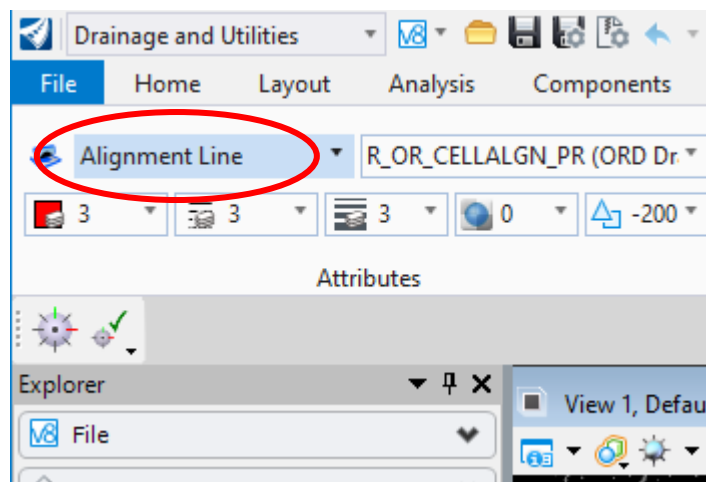
2. Now go to 'Drawing' > 'Placement' and select the 'Point' icon



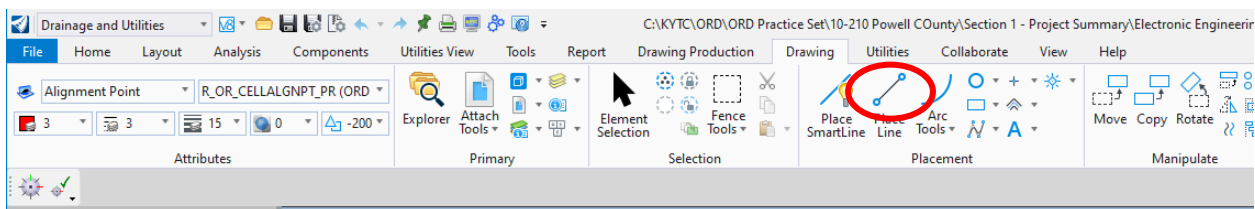
3. Place the Alignment Point.

ii. Next, place an 'alignment line'. This is the point and line that the 2-D 'Plan View' cell will reference to determine how the cell is rotated.

1. Go to 'Drainage' > 'Element Template' > 'Alignment Line'. This also on a line style and color of 3 (red).



2. Now go to 'Drawing' > 'Placement' and select the 'Place Line' icon

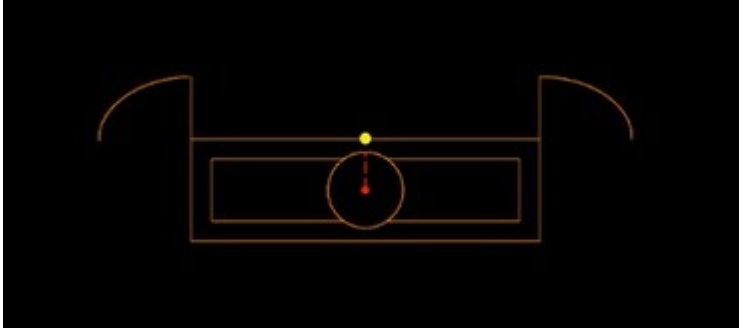


3. Place the Alignment Line. Note that this should be drawn in the direction you want the cell to face at zero rotation.

iii. A 'node location point'. This is the point that the 2-D 'Plan View' cell will be placed (centered) about – i.e. the position defined by the coordinates used when the node is placed.

1. Go to 'Drainage' > 'Element Template' > 'Node Location Point'. This is on line style 4 and color 4 (yellow).
2. Now go to 'Drawing' > 'Placement' and select the 'Point' icon.
3. Place the node location point

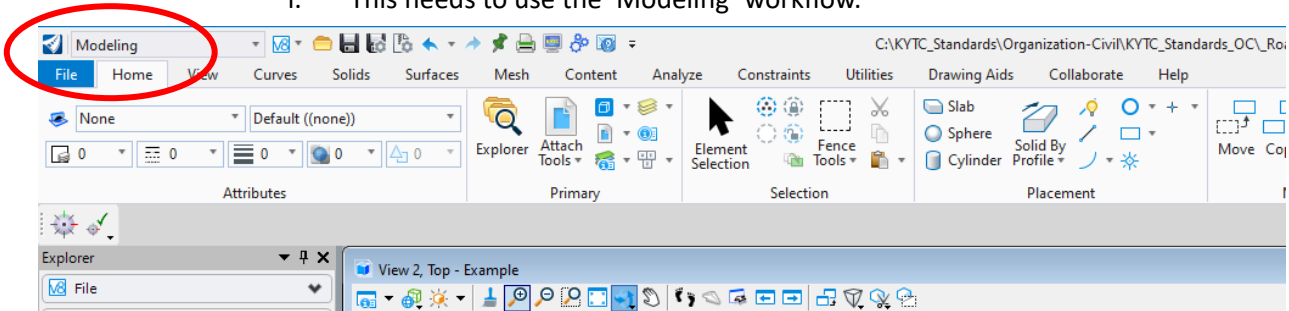
iv. An example of all 3 is shown below:



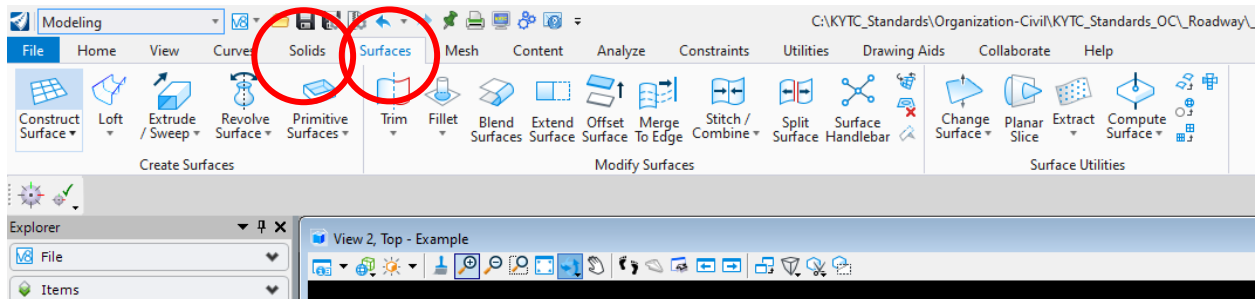
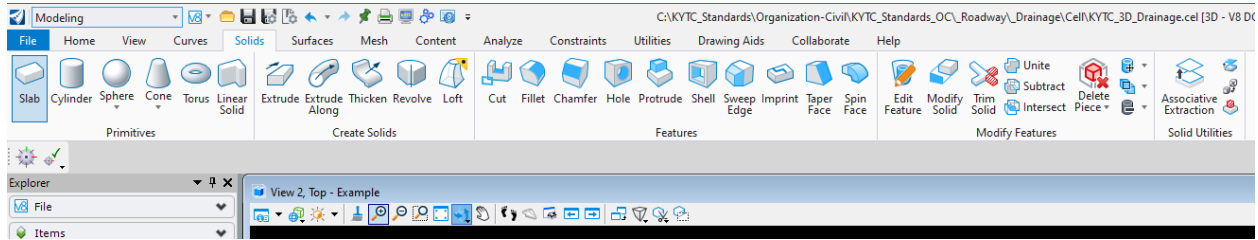
1. Please note that in 10.12, the lines that represent the pipe vault for drainage structures will have to be drawn into the 2D plan view after the design is complete.

2. Create the 3D Top Phase

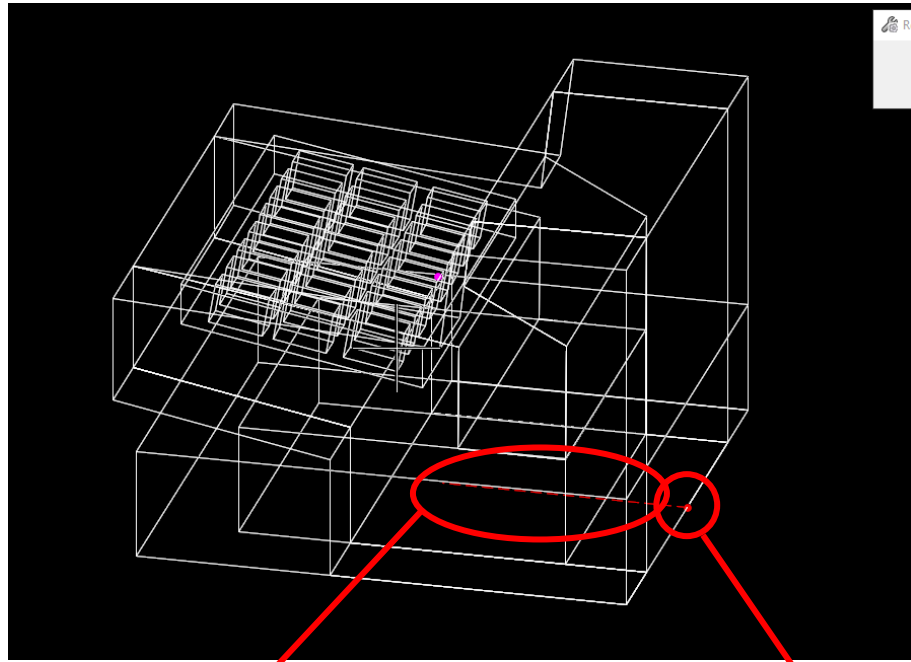
- a. The 3D drainage drawings are in KYTC\_3D\_Drainage.cel. Remember, if this is something you intend to use again, it might be a good idea to start a new 3D file or copy this file over to another name, so it doesn't get overwritten when new KYTC CADD Standards come out.
- b. You will need to know how to draw in 3D.
  - i. This needs to use the 'Modeling' workflow.



- ii. You will need to become familiar with how to use design groups such as the 'Solids' and 'Surfaces' groups. Make the cell look reasonably close to the detail or Standard Drawing you are using.



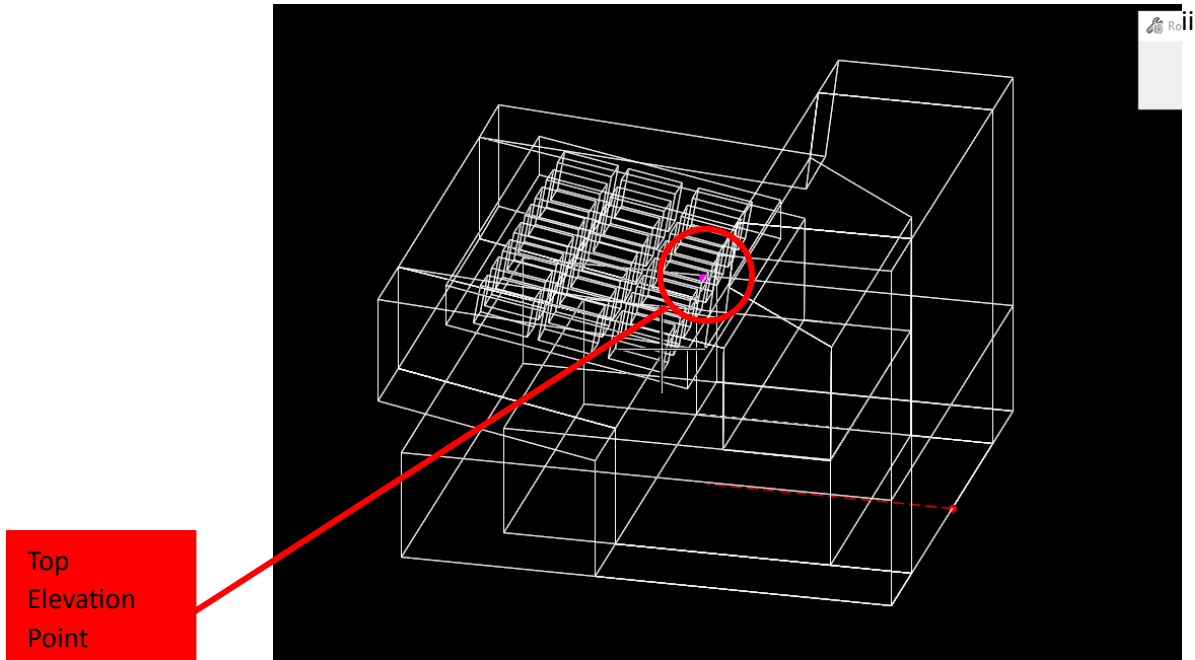
- iii. As you develop the cell, it is recommended that elements, solids and surfaces be drawn on the 'default level', and 'by level' for color and line weight.
- c. Once you have drawn the cell, you will need to place:
  - i. The 'alignment point' and 'alignment line'.
    1. Use the 'Element Template' command to place as in the 2D cell.
    2. The 'alignment point' should be located where the 3D top phase and 3D bottom phase cells will connect.
    3. The 'alignment line' needs to be in the same direction as the 2D cell.



Alignment Line

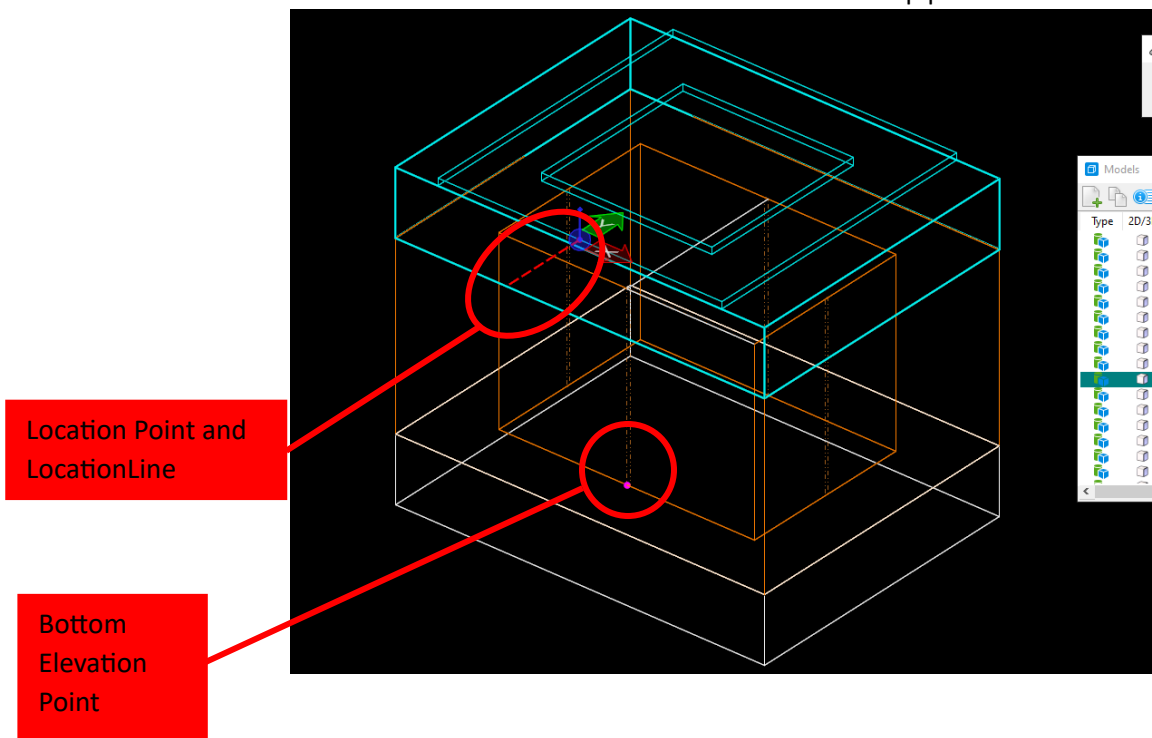
Alignment Point

- ii. Top elevation point
  - 1. This will be the point that is placed relative to the proposed terrain/corridor. For instance, this will be the gutter point on the curb inlet.
  - 2. On line style 5 (level 5 and color 5 as well).

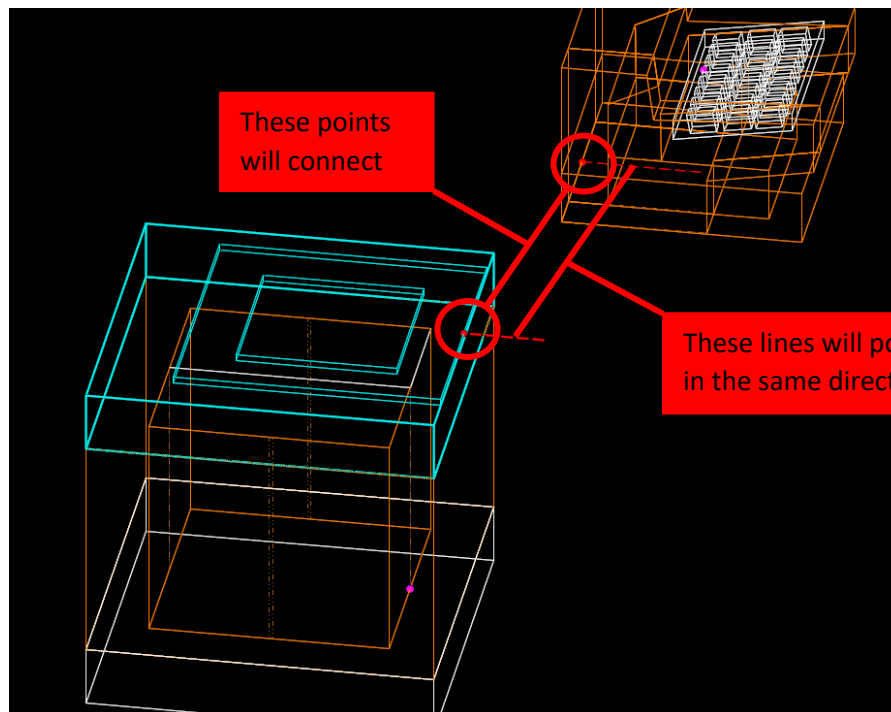


3. Create the 3D Bottom Phase

- a. This is usually a vault.
  - i. Needs to be on 'default level', and 'by level' for color and line weight.
  - ii. Has x,y,z dimensions.
  - iii. Make sure the inside and OUTSIDE dimensions are accounted for. This should cover wall thickness.
  - iv. Consider height requirements/minimum depth requirements of the vault (e.g., Standard Drawing RDB-410).
  - v. Make sure the thickness of the top of the vault, side walls, and bottom slab is accounted for per the standard or detail drawing.
  - vi. Standard Drawing RDB-410 is a good start. KYTC already has these in the KYTC Standards, so you may want to start with one of these, and if modification is necessary, copy over and change accordingly.
- b. Once the lower phase is created you will need to place:
  - i. The 'alignment point', 'alignment line', and the 'bottom elevation point'
  - ii. This is done in the same manner as the top phase.

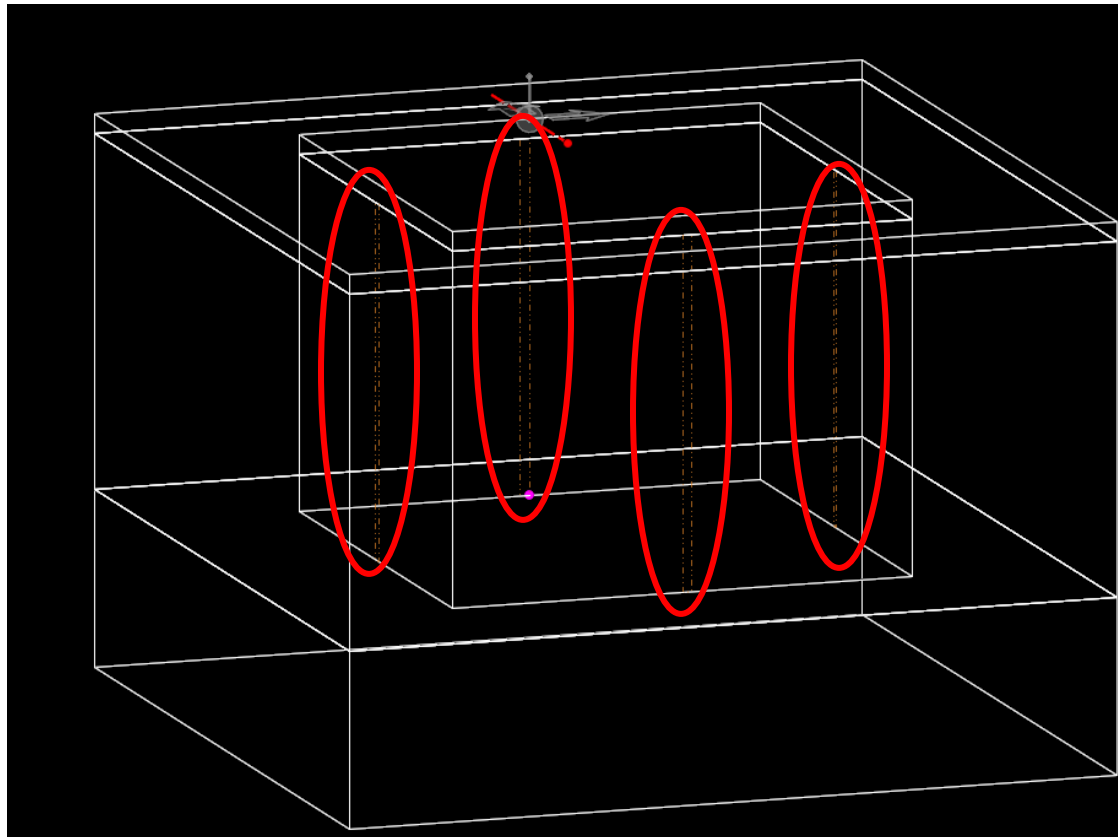


- iii. Note that the location point and location line are placed in the  $Z = 0$  plane. This is the element that will be extruded up, which emulates stretching the vault or stretching a riser from a vault to the top phase. Extrusion is covered later in this section.
- iv. The location of the 'alignment point' and 'alignment line' should be so that the bottom phase will fit to the point and be rotated relative to the top phase.
- v. The elevation point for the bottom 3D cell will be used for the 'invert elevation' for the drainage structure.





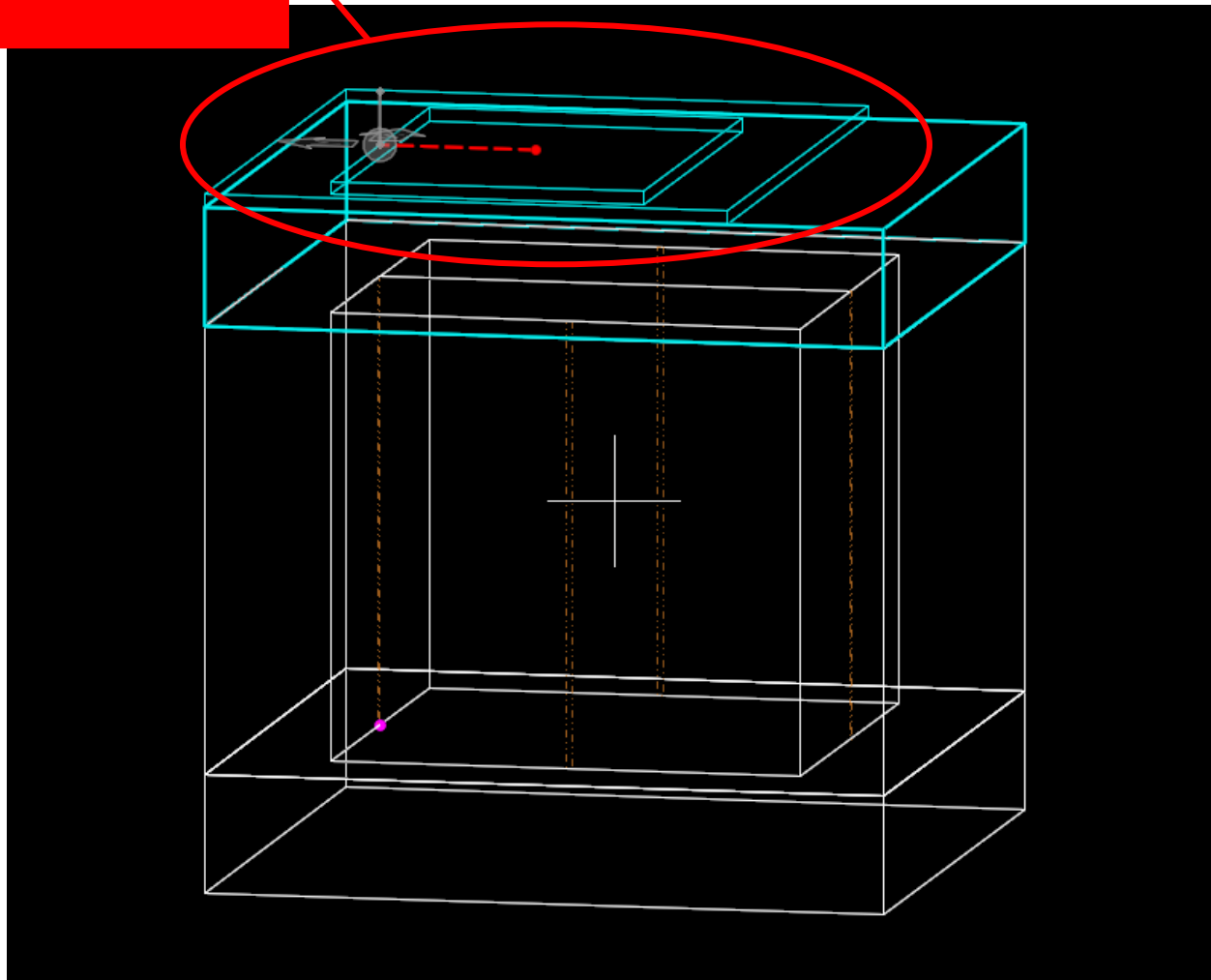
- c. Connection regions
  - i. To be able to connect pipes, the bottom 3D cell must have connection regions.
    - 1. These will be placed at the point in the vault (or headwall) where the pipes will attach.
    - 2. Use the Element Template for 'Connection Region' (placed on color 6 and line style 6)
    - 3. A thin rectangle should be used.
      - a. Placed at the INSIDE of the vault or headwall.
      - b. Centered on wall where the end of the pipe attaches.
      - c. Bottom of square/rectangle should be be at the invert/floor of the vault.
      - d. The height and width of the rectangle is up to the user, however the insertion of the pipe will slide along the bottom width of the square, so the thinner it is, the less likely the pipe will be off the chamber center.



- d. Extrusion (stretching one of the cells up or down to the other one).
  - i. Bentley default has it set where the bottom cell extrudes UP. You can change this in the KYTC\_Standards\_OC.cfg file, found in C:\KYTC\_Standards\Organization-Civil.
  - ii. It is in the #SU\_3D\_Structure\_Extrude (Line 496). You will see the line is commented out with a hashtag symbol. This sets the default for the bottom cell to extrude up. If the hashtag is removed, then the top cell extrudes down.
  - iii. Note that the face/plane that is on the Z=0 plane will be the item that is stretched.
    - 1. Since KYTC prefers stretching the bottom phase up to the top phase, the very top of element in this cell is placed in the z=0 plane.

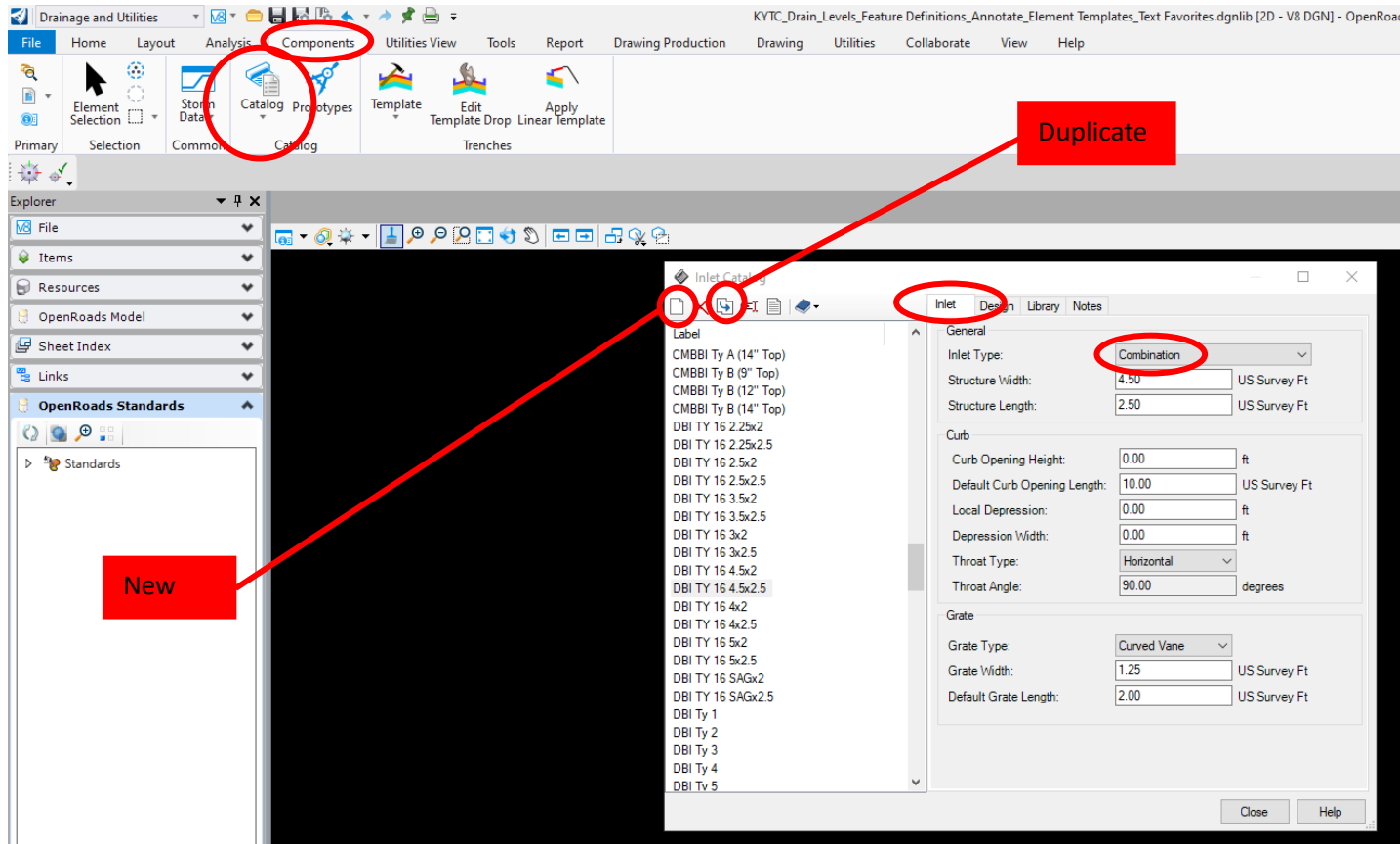
2. This will also be the plane where the 'location point' and 'location line' will be located.
3. In the example below, a small height of a riser for the inlet is drawn on top of the main chamber. The top of this element is placed on the  $z=0$  plane, meaning the top face of the riser will stretch that element so the location point and line intercepts the location point and line on the top phase.

Very Short Riser Part of Bottom Cell/Vault. This is drawn on the  $Z=0$  plane, and extrudes up to the connection point of the top cell



4. Create a Catalog Entry for Feature Definition

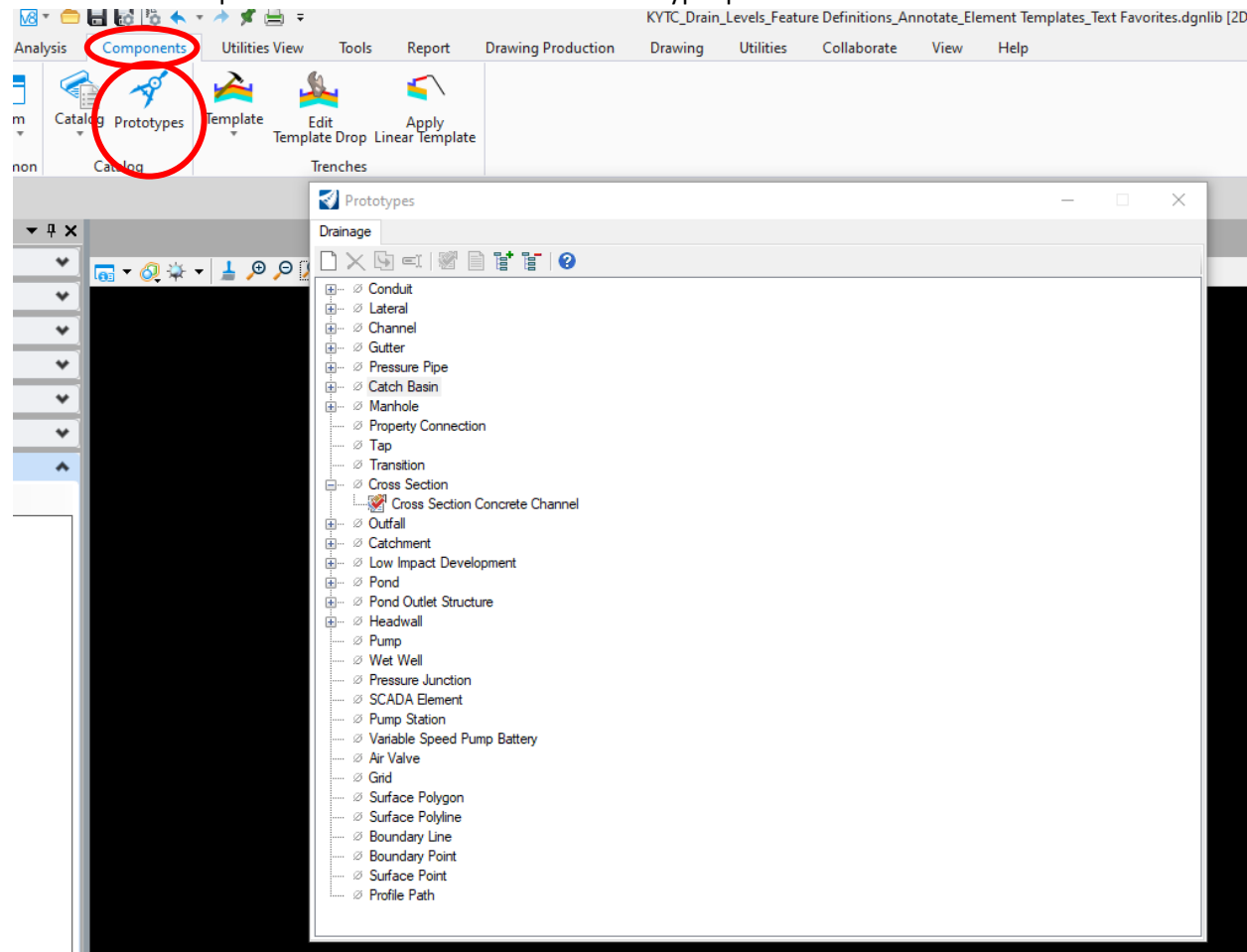
- a. This is only necessary for inlet feature definitions. Manholes don't need this.
  - i. Physical data used to determine hydraulic functionality of these structures is located here.
- b. **This must be done in a 2-D file as well.** KYTC recommends creating a new 2D design file using the C:\KYTC\_Standards\Organization-Civil\KYTC\_Standards\_OC\KYTC\Seed\KYTC\_ORD\_2D\_Seed.dgn
- c. Click on the 'Components' ribbon and select the 'Catalog' pulldown. Select 'Inlet Catalog'



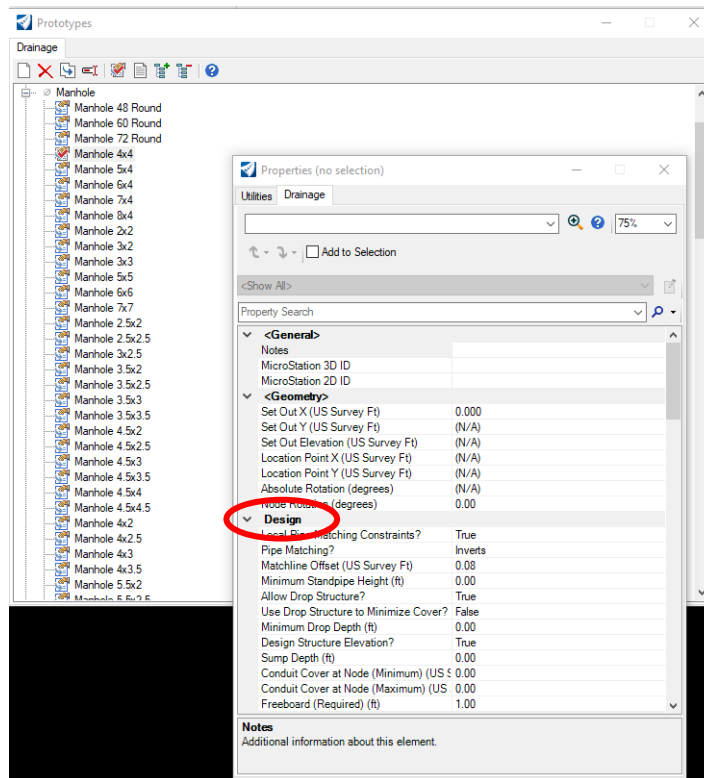
- d. If there is an inlet similar to the one being created, it is recommended to 'Duplicate' the one that exists and modify it. Otherwise, select 'New'. Name (or rename if duplicated) logically so you know what it is and can find this later in the process.
- e. For KYTC, there are 3 basic types of inlets:
  - i. Grate
  - ii. Curb
  - iii. Combination
  - iv. This is selected under the 'Inlet' tab, with the 'Inlet Type' Button
- f. The 'Structure Width' and 'Structure Length' refer to the inner dimensions of the structure vault.
  - i. For KYTC inlet vaults, the 'Structure Length' is the X dimension in Standard Drawing RDB-410. This is the longitudinal dimension, which runs parallel to the centerline of the road.
  - ii. The 'Structure Width' is the Y dimension in Standard Drawing RDB-410. This is the cross-sectional dimension, which runs perpendicular to the centerline of the road.

- g. Dimensions for curb heights, throats, local gutter depressions and gutter depression widths, and grate widths and lengths can be found in the KYTC Standard Drawings
- h. The 'Design' Tab next to the 'Inlet' tab allows the user to specify the lengths of throated inlets, such as KYTC Type A and Type B inlets (5, 10, 15, and 20 feet).

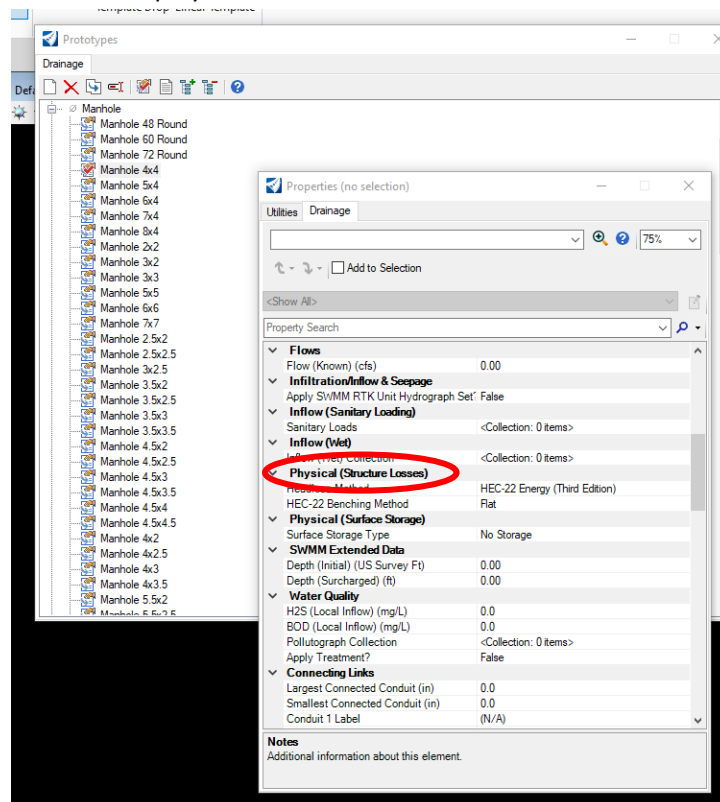
5. Create the 'Prototype' for the structure.
  - a. Click on the 'Components' ribbon and select the 'Prototype' pulldown.



- i. As you can see, there are several structure types to choose from, including:
  1. Conduits
  2. Channels
  3. Gutters
  4. Catch Basins
  5. Manholes
  6. Headwalls
- ii. Select the type of structure you want to create.
  1. Again, it is generally easier to copy over a similar structure to the one you are creating.
  2. As before, 'Duplicate' the one that exists and modify it. Otherwise, select 'New'.
  3. Again, name logically so you know what it is and can find this later in the process.
  4. Note: In the currently used version of ORD (10.12), the user is not able to rearrange the prototypes in the list. The order they are created is the order they are displayed.

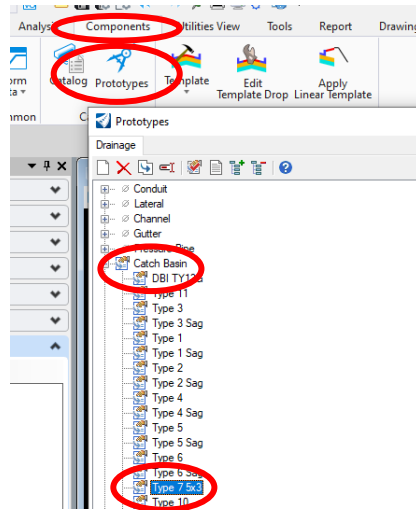


- iii. Double click on the prototype you just created. The 'Properties' dialog will appear for that prototype.
  1. Under 'Design', set the parameters as displayed above.
  2. Make sure under 'Physical (Structure Losses), the settings are as displayed below.

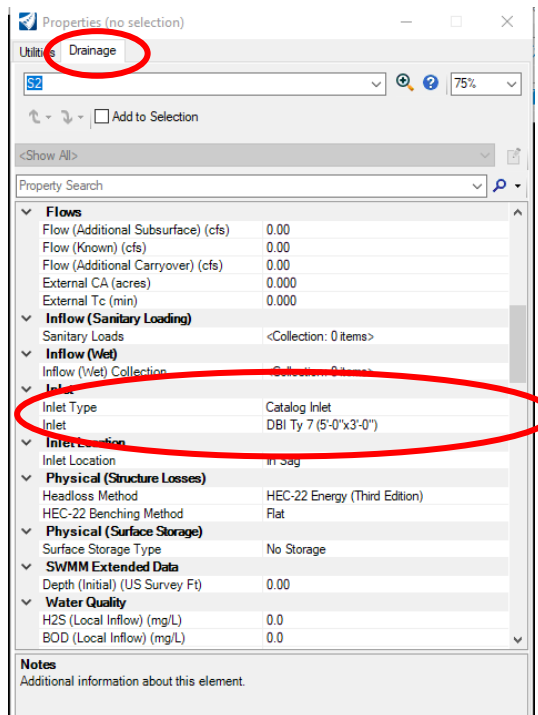


3. Make sure the properties under the 'Physical' section are correct for your structure.

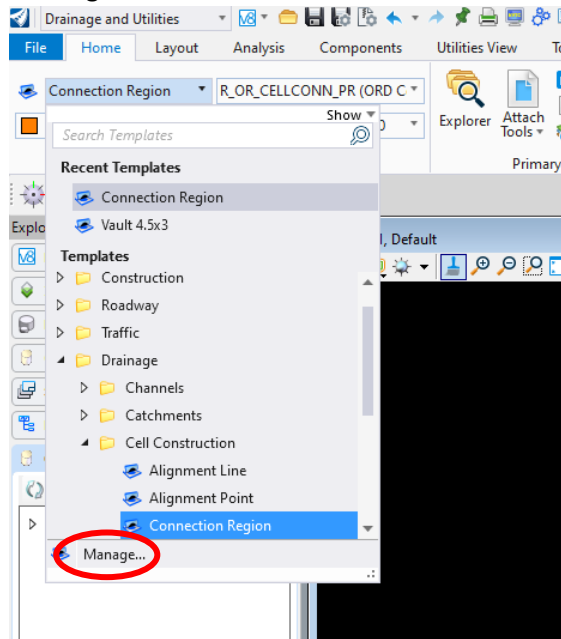
6. Assign the catalog entries to the prototypes (for inlets, gutters, conduits, and culverts only).
  - a. You should still be in 'Components' ribbon, in the 'Prototypes' interface.
  - b. Under 'Catch Basin', then go to the 'Catch Basin' subcategory'.
  - c. Double click on the prototype you created in the previous step.



- d. Under the 'Drainage Properties' tab, go to the 'Inlet' section
- e. Under 'Inlet Type' Select 'Catalog Inlet'
- f. Under 'Inlet', select the inlet you just created. This is selecting the catalog entry

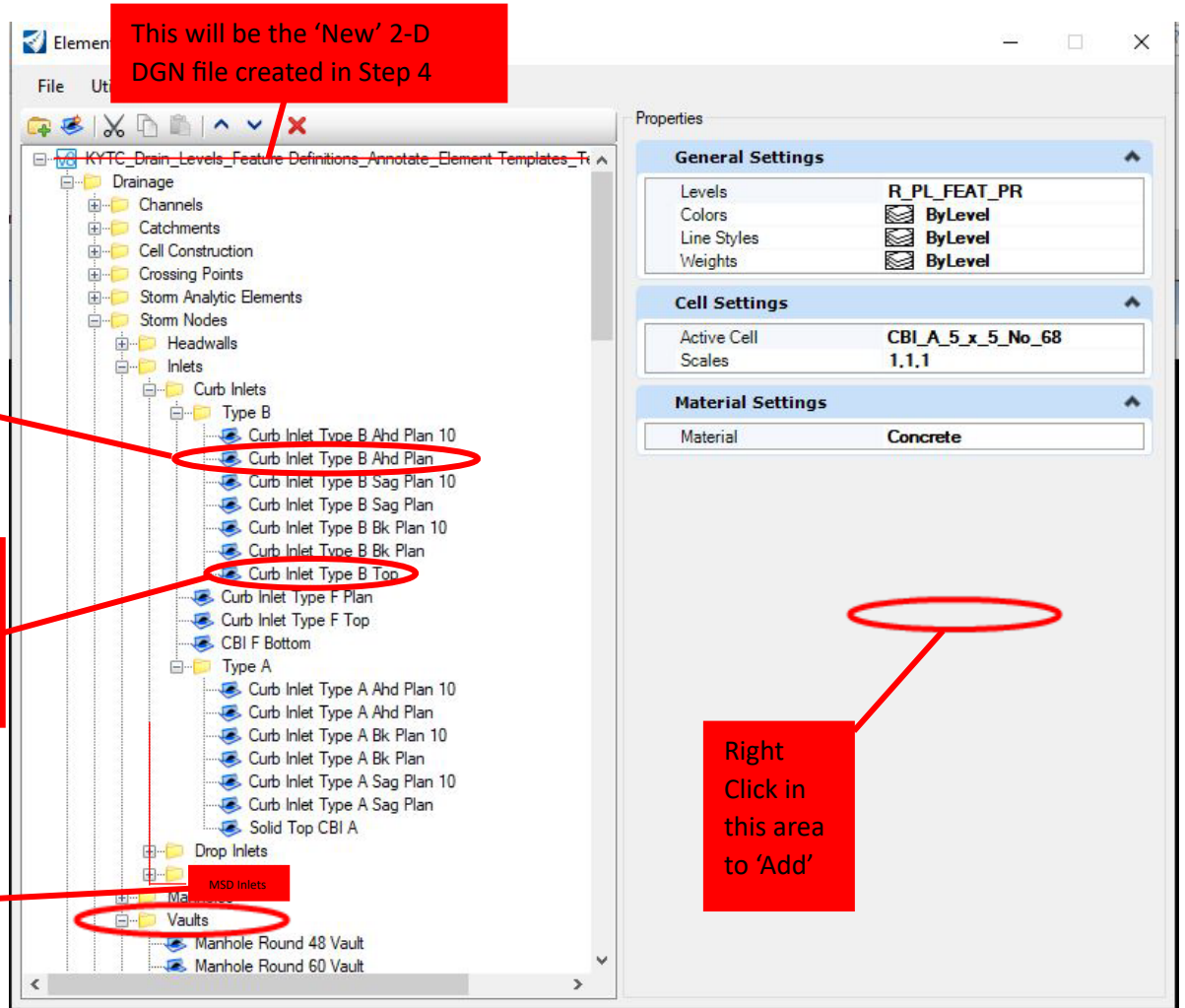


7. Create the Element Templates
  - a. Make sure you are still in the new 2D design file you created in Step 4 – ‘Create a Catalog Entry for Feature Definition.’
  - b. Go to ‘Element Template Manager’
    - i. Same place we found the default color and line style for the location points and lines. At the very bottom of that pulldown, you will see a button that says ‘Manage’.



- ii. Select the new DGN file that was created in Step 4.
- iii. Select the group you want to put the feature definition will be in
  1. E.g. A curb inlet Type ‘B’ would be under ‘Drainage>Storm Nodes’>‘Inlets’>‘Curb Inlets’>‘Type B’
  2. A new group can be created at whatever level you deem necessary. For instance, you may want a ‘Non-KYTC’ inlets or ‘MSD Inlets’ grouping.





3. Again, use naming convention that relates back to the structure you are creating (e.g. 'CBI TY B Ahd Plan 10' for a CBI Type B that intercepted flow going up station and had 10-foot throat).
4. You will need an element template for the
  - a. Plan view,
  - b. the top phase in 3D (this is not required for headwalls), and
  - c. the bottom phase in 3D
  - d. Note that in the figure above, the plan view and top phase for a curb box inlet are shown. The bottom phase is shown in the 'Vaults' Section as shown on the next page.

The screenshot shows the 'Element Templates' window with a 'File Utilities' toolbar and a 'Properties' panel on the right. The main area displays a tree view of templates under the 'Vaults' folder. The 'Vault 68' entry is circled in red. The 'Properties' panel on the right is divided into three sections: 'General Settings', 'Cell Settings', and 'Material Settings'.

General Settings	
Levels	R_PL_FEAT_PR
Colors	ByLevel
Line Styles	ByLevel
Weights	ByLevel

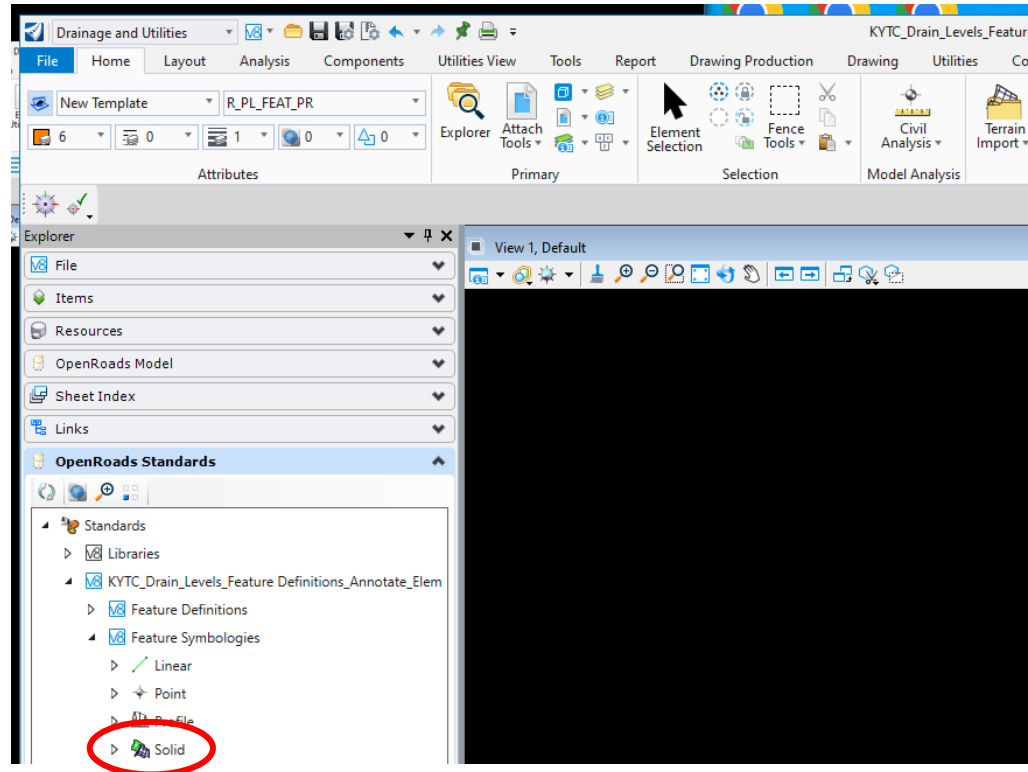
Cell Settings	
Active Cell	CBI_A_5_x_5_No_68
Scales	1,1,1

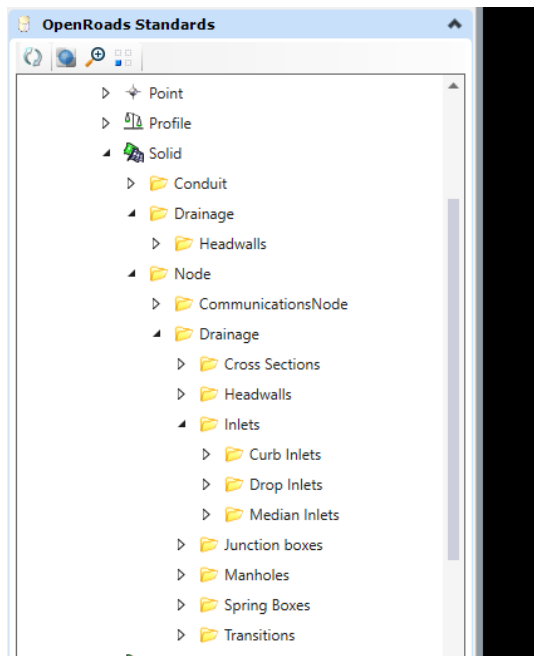
Material Settings	
Material	Concrete

5. Go to the Element Template for the plan view. We are going to tell it which cell to point to.
  - a. Right click under the 'General Settings' box and click on the 'Add' button.
    - i. Click on 'Cell'>'Cell Name.'
      1. Click on Active Cell pulldown and select the 2-D cell created in Step 1
      2. If \*.cel file is in the right location, it should be available in the pulldown.
      3. Tip - if at this point, you cannot find your cell name, and your Cell file is in the correct location, go back to your cell file, and check the properties of the Model the cell resides in, make sure the property "Place as Cell" is set to "True" otherwise you will not see it in the list, this goes for 2D and 3D This is mostly for new cells created with the seed files, because the KYTC set the default model to not be placed as a cell.
    - ii. Right click on the same area and click 'Add'>'Cell'>'Cell Scale'. Keep on 1,1,1
    - iii. Can also right click and add material.
      1. Have a predefined list of materials to pick from
6. Do the same for the Element Templates for the 3D Top Phase and Bottom Phase (bottom phase only for headwalls).
  - a. Note for Inlets like the CBI Type A and Type B, the bottom Phase Element Templates are in the 'Vault' subdirectory. The point??? Tops, Bottoms and plan view Element Templates can be in different subdirectories.

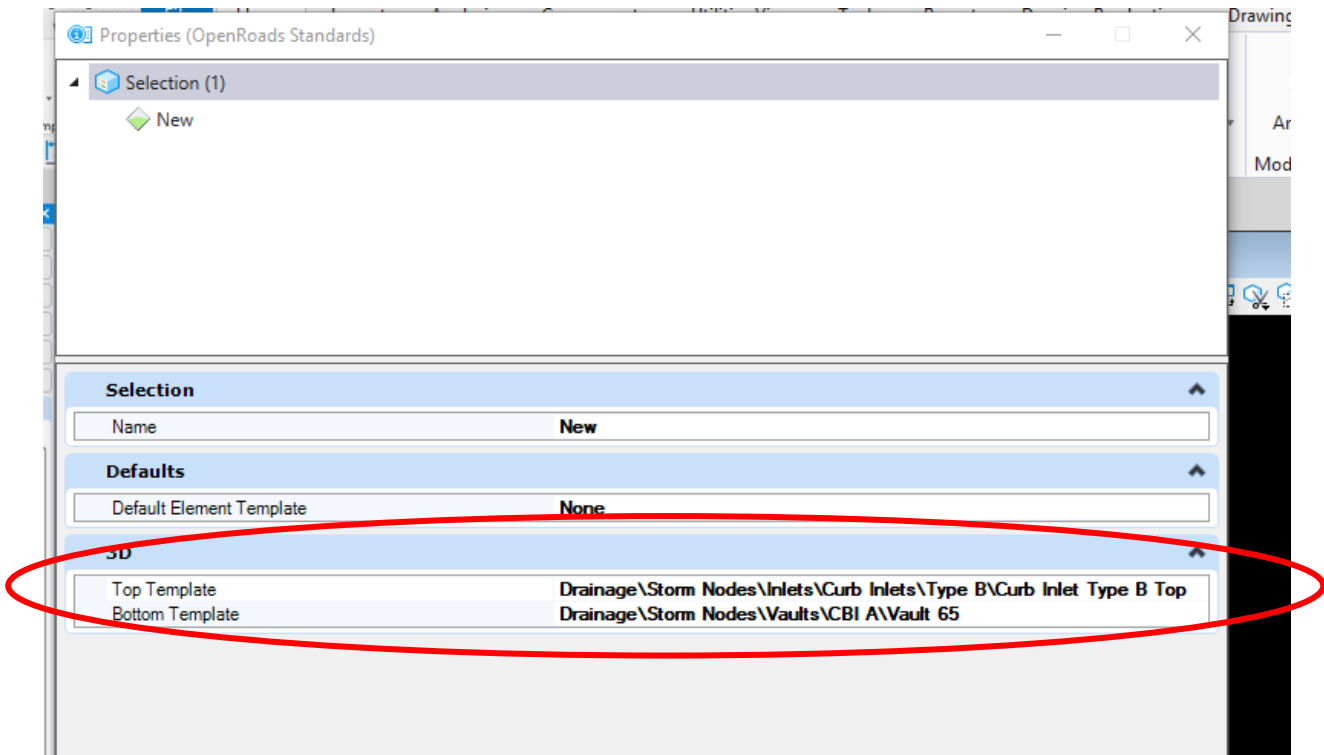
- 8. Set the Solid Symbologies (sets the 3D part of Feature Definition)
  - a. Under the ORD 'Explorer', under 'OpenRoads Standards', go to 'Feature Symbologies' > 'Solid'



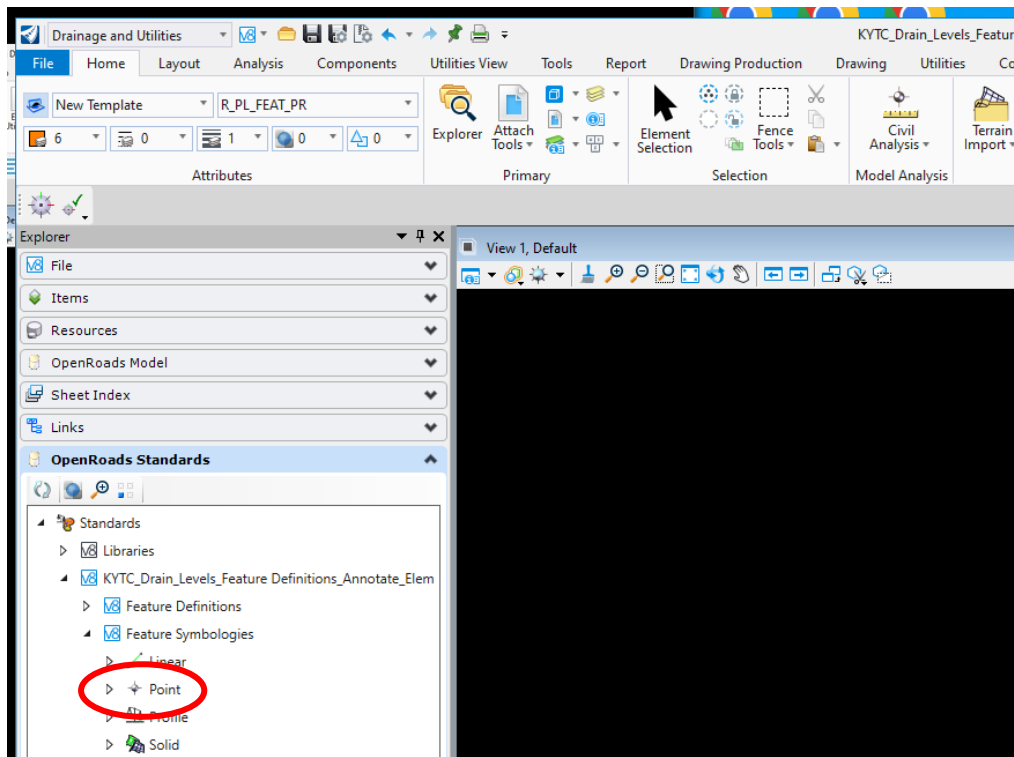
- b. There are several subcategories under 'Solid'



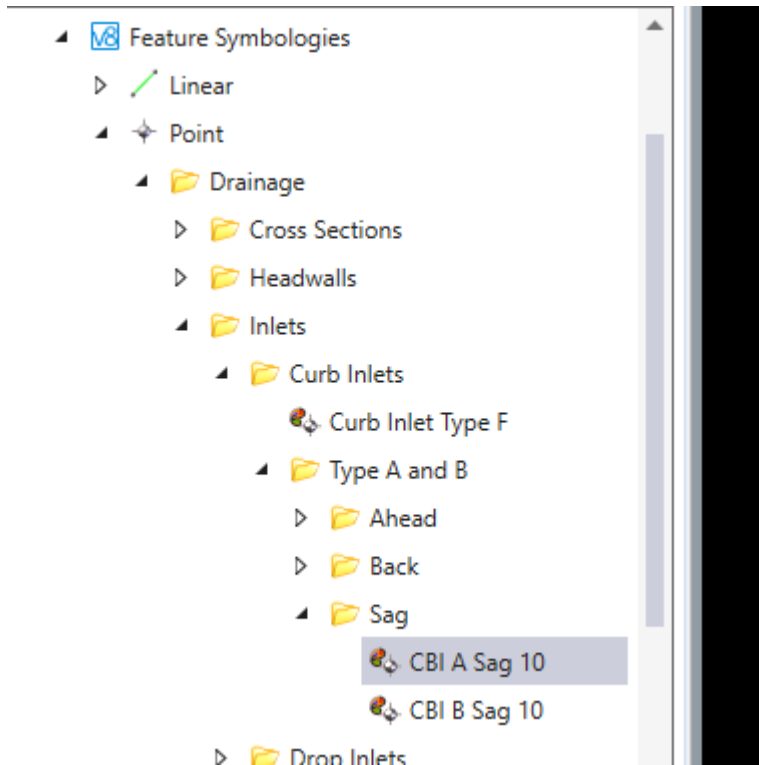
- c. Headwalls are under 'Solid'>'Drainage'>'Headwalls'.
  - i. Everything else in drainage is in 'Solids'>'Node'>'Drainage.'
  - ii. There are Solid Symbolologies for other elements that are non-drainage related as well (e.g. utilities)
- d. Once you have selected the desired subcategory, right click on it and select 'New Feature Symbology'.
  - i. Right click on this new feature symbology and select 'Properties'.
  - ii. Go to the '3D' section.
    - 1. For 'Top Template', select the template you created in the previous section of this document (Section 6)
    - 2. Do the same thing for the bottom element.
    - 3. Headwalls should only have a Bottom Template. Top template should be set to 'None'



9. Set the Point Symbology (sets the 2D part of Feature Definition)



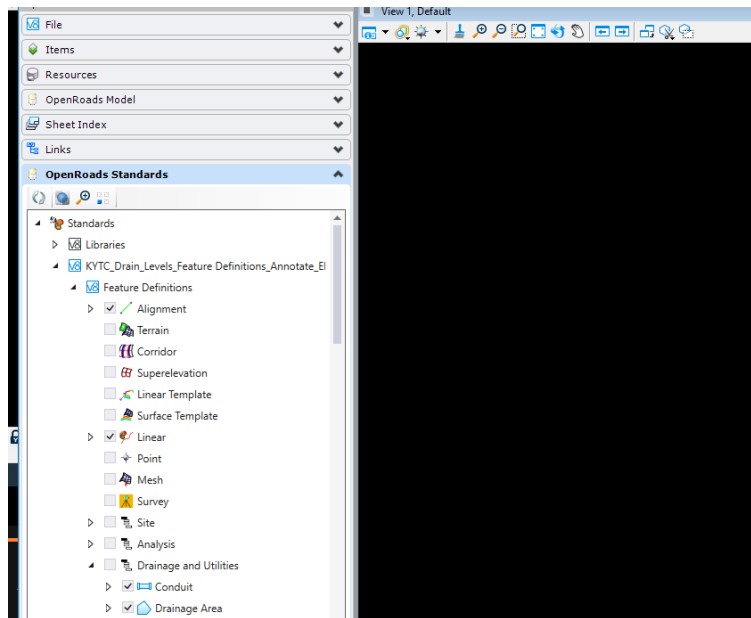
a. Again, there are several subcategories under this category



- b. Once you have selected the desired subcategory, right click on it and select 'New Feature Symbology'.
  - i. Right click on this new feature symbology and select 'Properties'.
  - ii. Go to the Plan and select the 2D Plan Element Template from the previous section of this document (Section 6).

10. Create Feature Definition

- a. Under the ORD 'Explorer', under 'OpenRoads Standards', go to 'Feature Definitions'
  - i. Again, there are several categories and subcategories where feature definitions can be located.



- ii. For drainage structures, they are generally under 'Drainage and Utilities' > 'StormWaterNode'
  - 1. Subcategories under this include.
    - a. 'Channel Nodes'
    - b. 'Headwalls'
    - c. 'Inlets'
    - d. 'Junction Boxes'
    - e. 'Manholes'
    - f. 'Outfalls'
    - g. 'Spring Boxes'
- iii. Once you determine where the feature definition will be located, right click on this subcategory, and select 'New Feature Definition'



- iv. Right click on the new feature definition you created.
  1. Under Feature Definition, give:
    - a. a logical description
    - b. A seed name (under 'Name Seed'). This will allow for numbering structures that are the same (such as MH-1, MH-2 for manholes).
  2. Under 'Node':
    - a. Select a default height (default depth of structure)
    - b. Make sure Structure Type is correct (Inlet Grate, Manhole, whatever best describes the feature definition).
  3. Under 'Hydraulic Prototype' – pick the 'Prototype' that was created in step 5
  4. Ignore 'Items (this is for Item Types, which KYTC is still working on with Bentley).
  5. Under 'Symbology':
    - a. Point Feature Symbology – Select the 2D Feature Symbology that was created in Step 8
    - b. Connection Regional Feature Symbology
      - i. Select pulldown
      - ii. Select 'Linear'
      - iii. Select 'Connection Region Feature Symbology'
    - c. Solid Symbology – Select the 3D 'Solid Symbology' that was created in Step 7.

11. The feature definition is now ready to be placed in your ORD design DGN!