WHEN TRUST MATTERS

SESAM USER COURSE

GENIE WORKSHOP

PLN EXPORT – FOWT FOUNDATION

Training Workshop

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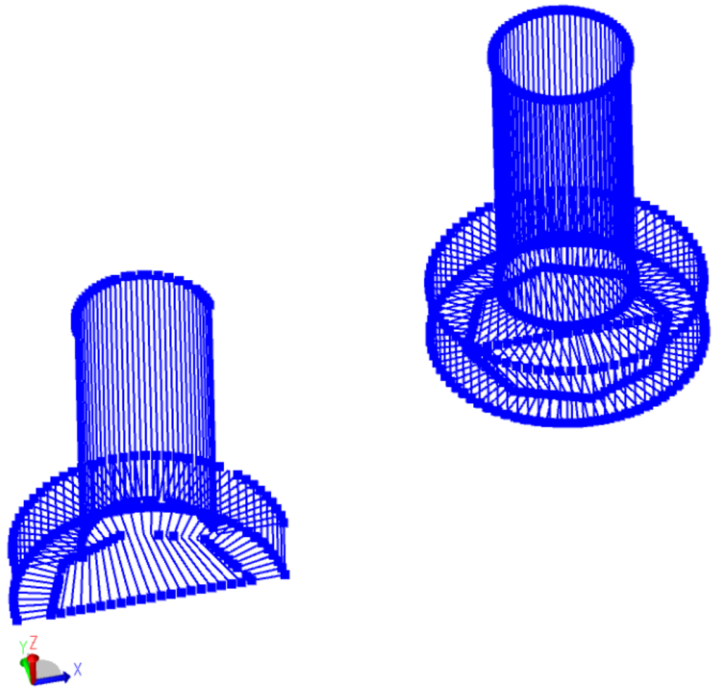


This workshop will guide you through how to create a section model .pln file from a floating offshore wind turbine (FOWT) foundation model in GeniE. The following steps will be explained:

- Create curves from existing surfaces in GeniE
- Prepare curves and export .pln file
- Optional: Import the section model .pln file into HydroD

The following files will be needed:

- FOWT_Model.js
- Optional: FOWT_PLN_Export.js
  (Note: Contains all command lines of all steps described in this workshop)

2 CREATE CURVES

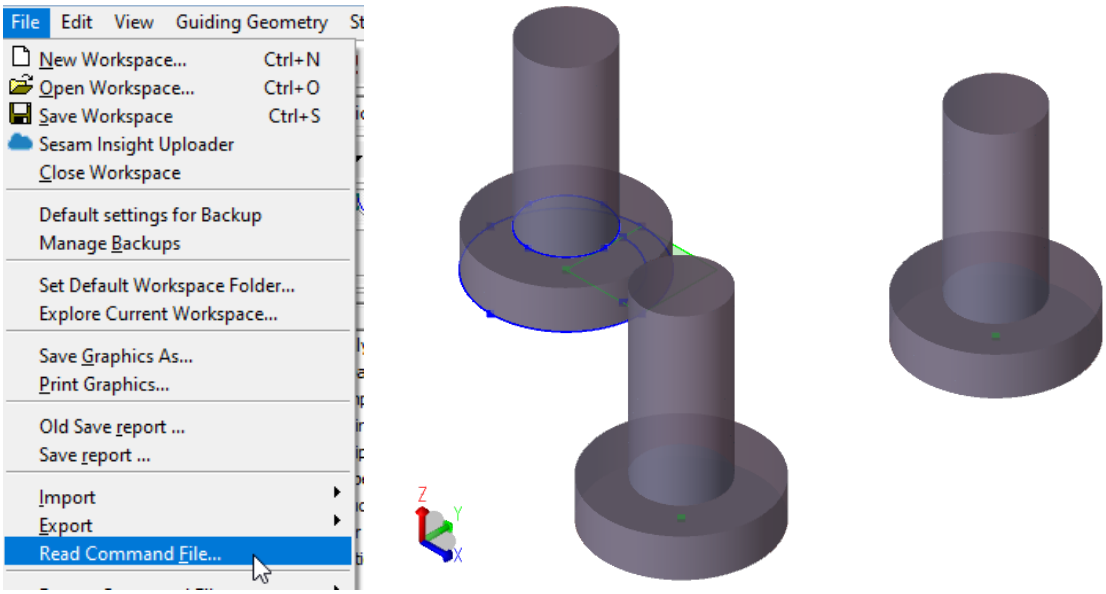
A .pln file consists of several patches, where each patch contains a set of curves, and each curve contains a set of point coordinates. These point coordinates are retrieved from the Guide Curves which will be created in this chapter.

The number of curves will influence the quality of the .pln file. Patches are assumed to be linear between each point, thus curved edges and surfaces require a sufficient discretization.

2.1 GeniE workspace

The first step is to create a new GeniE workspace and prepare the FOWT foundation model.

- Open GeniE V8.11 and create a new GeniE workspace. Make sure to set the user interface mode as full mode.
- Select **File > Read Command File** and browse the FOWT_Model.js file to create the FOWT foundation model.



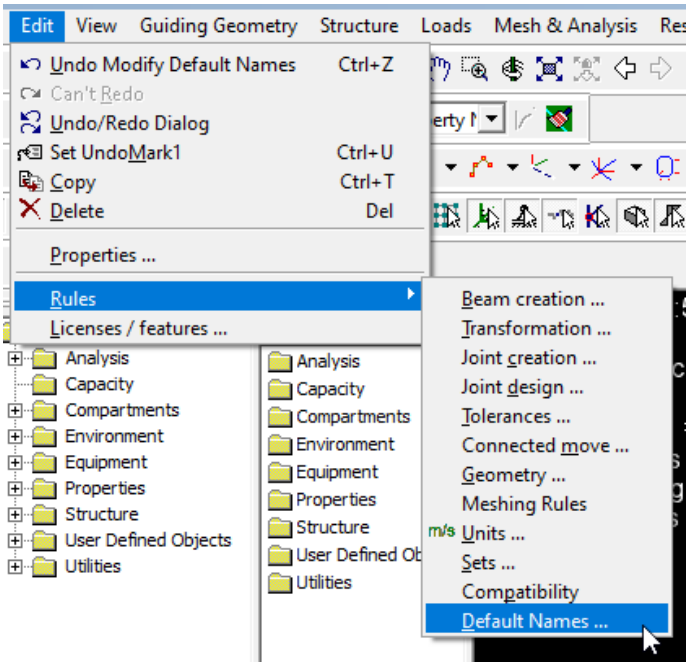
2.2 Create curves for upper column

(This sub-section explains the line 1~81 in the optional file FOWT_PLN_Export.js)

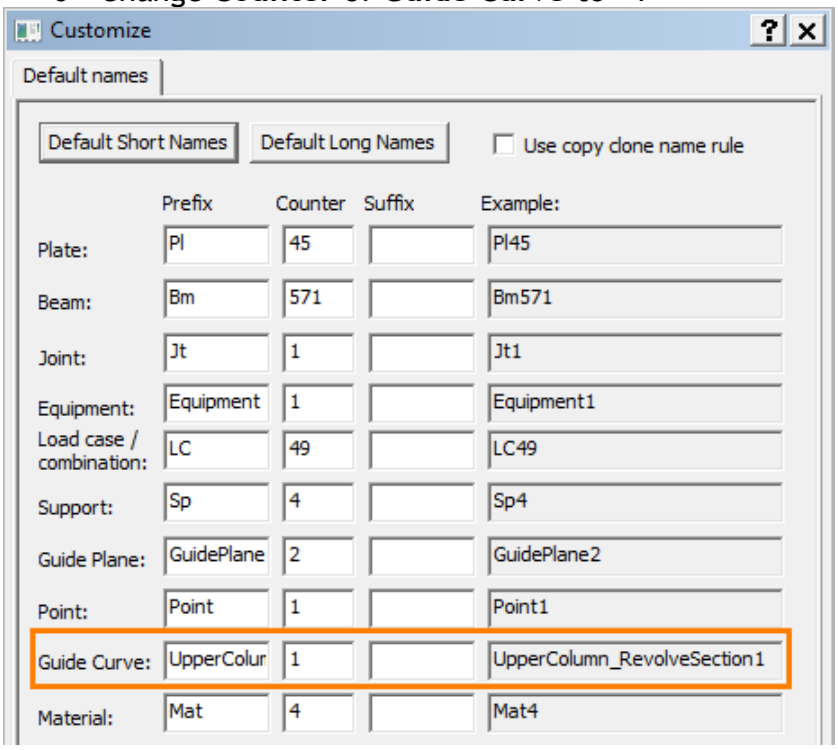
2.2.1 Change default names for guide curves

Before creating the curves, it is better to change the default names of new Guide Curves. This is for easy categorization of existing curves.

- Select **Edit > Rules > Default Names**



- In Customize dialog:
  - Change **Prefix** of **Guide Curve** to "UpperColumn_RevolveSection"
  - Change **Counter** of **Guide Curve** to "1"

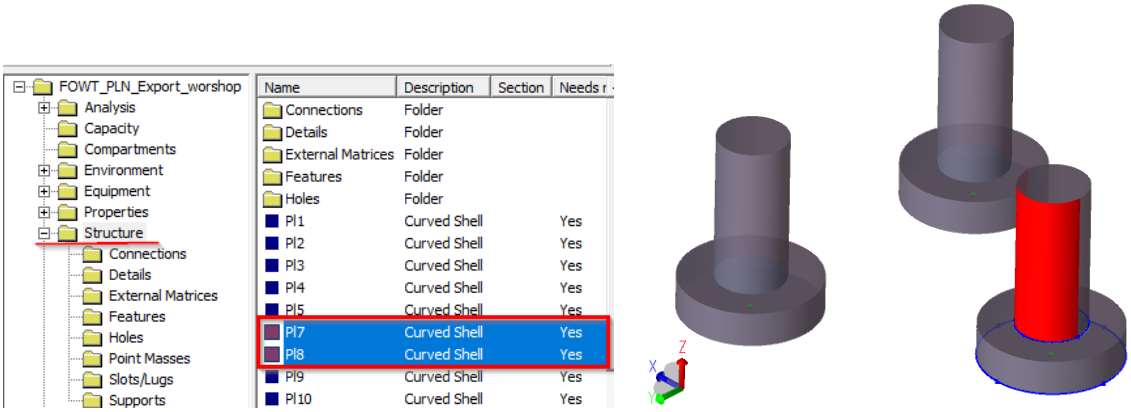


- Click **OK**

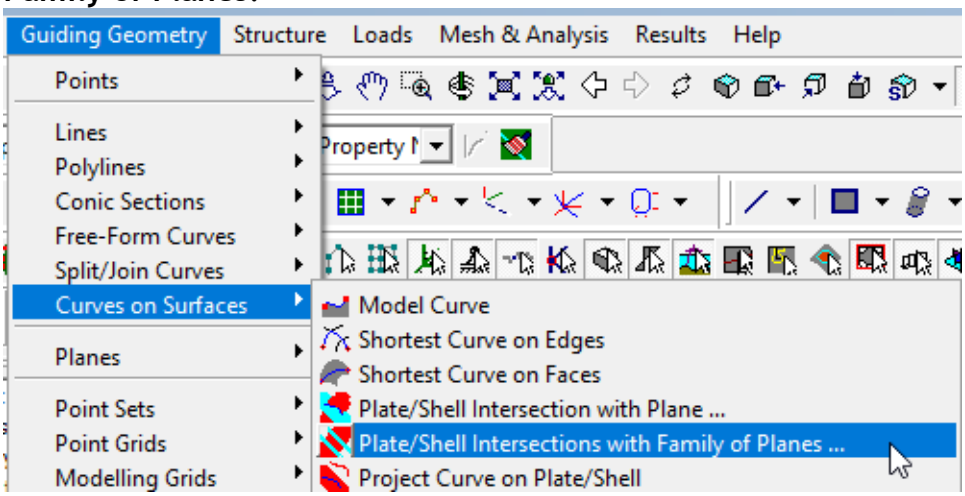
2.2.2 Create curves

Create the curves of the upper column of set *Column_1*.

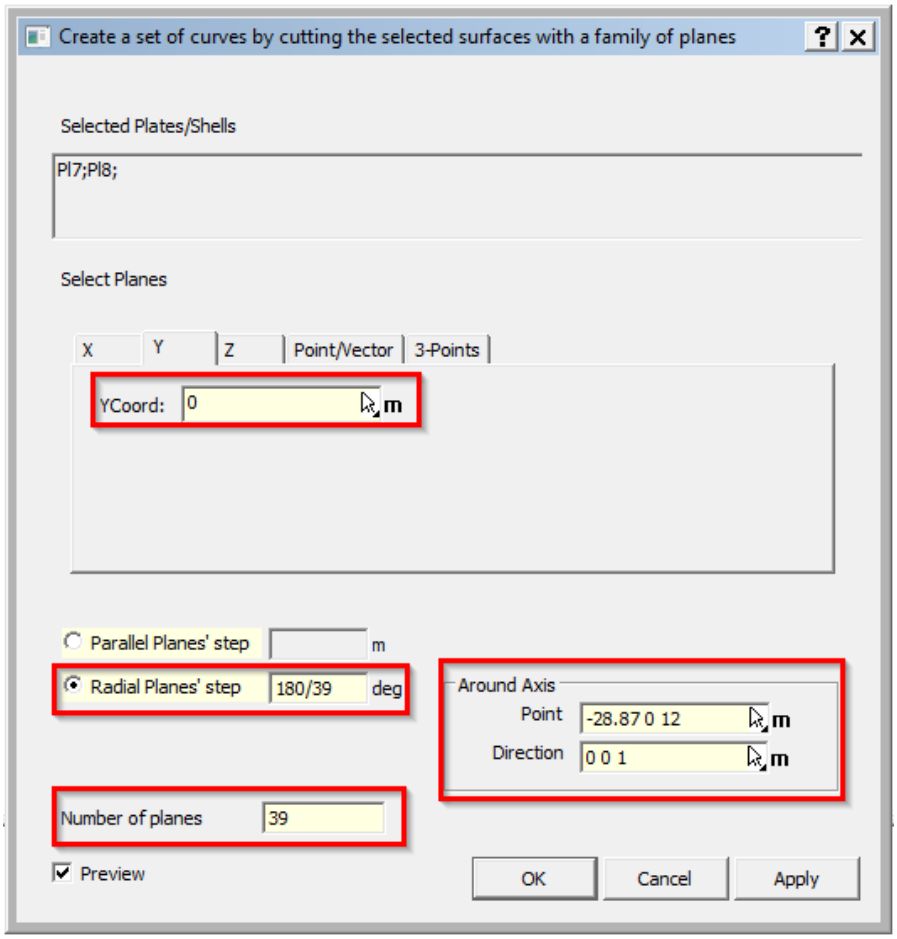
- Select **Pl7**and **Pl8** (i.e. the highlighted shells/plates in picture below) or select them in the Browser folder.



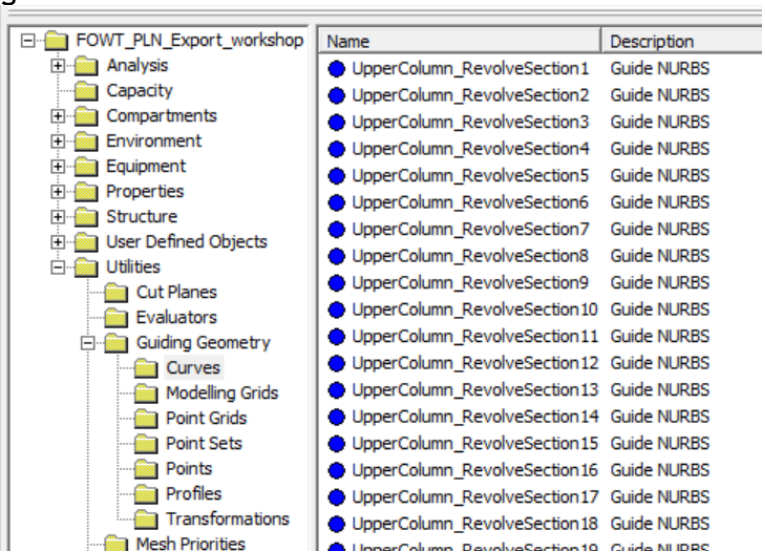
- Select **Guiding Geometry > Curves on Surfaces > Plate/Shell Intersections with Family of Planes.**



- In the opened dialog, set the parameters as given below:
  - Select **Y Plane**
  - **YCoord** = 0 m
  - **Radial Planes' step**: 180/39
  - **Number of planes**: 39
  - **Around Axis Point**: Point(-28.87 m,0 m,12 m)
  - **Around Axis Direction**: 0 0 1



- Toggle the **Preview** option to show the preview
- Click **OK**
- Go to browser folder **Utilities - Guiding Geometry - Curves**, observe that 40 new guide curves (Guide NURBS) named as *UpperColumn_RevolveSection1~40* are generated.

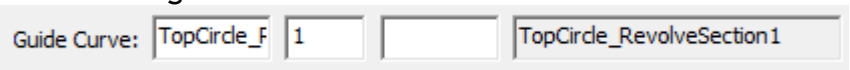


2.3 Create curves for lower column

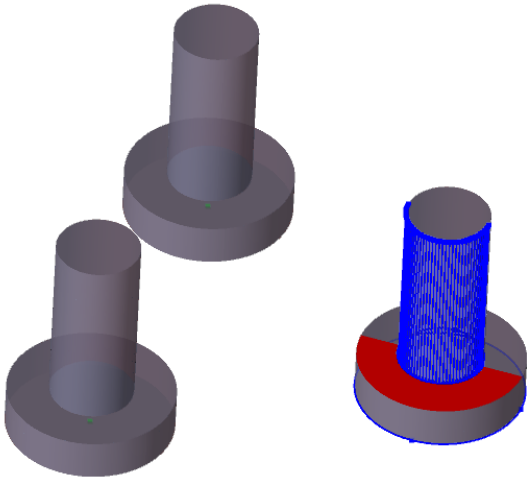
2.3.1 Create curves for top circle of lower column

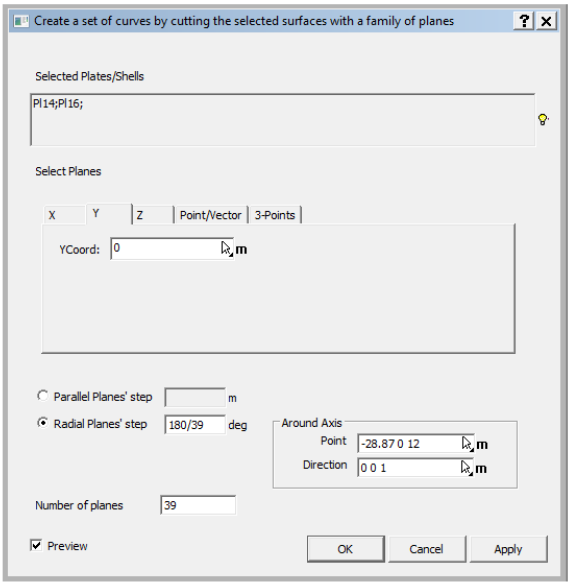
(Line 83~163 in FOWT_PLN_Export.js)

- Change default names of guide curve to set appropriate prefix and counter
  - Change **Prefix** of **Guide Curve** to “TopCircle_RevolveSection”
  - Change **Counter** of **Guide Curve** to “1”



- Select **Pl14** and **Pl16**.
- Create curves using the **Plate/Shell Intersections with Family of Planes** again. (Note: No need to change settings in the dialog, since previous settings are remembered.)





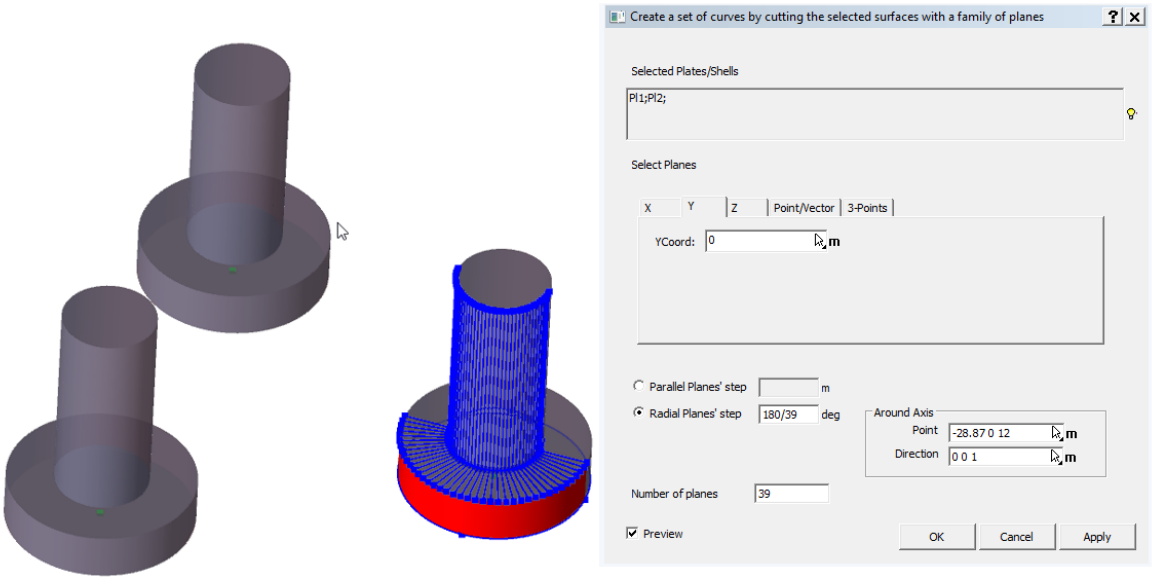
- In browser folder **Utilities - Guiding Geometry - Curves**, observe that 40 new guide curves named as *TopCircle_RevolveSection1~40* are generated.

2.3.2 Create curves for side plates of lower column

(Line 165~245 in FOWT_PLN_Export.js)

- Change default names of guide curve to set appropriate prefix and counter
  - Change **Prefix** of **Guide Curve** to “LowerColumn_RevolveSection”
  - Change **Counter** of **Guide Curve** to “1”

- Select **Pl1** and **Pl2.**
- Create curves using **Plate/Shell Intersections with Family of Planes** (Note: No need to change settings in plate/shell intersections with family of planes dialog, since previous settings are remembered.)



- In browser folder **Utilities - Guiding Geometry - Curves**, observe that 40 new guide curves named as *LowerColumn_RevolveSection1~40* are generated.

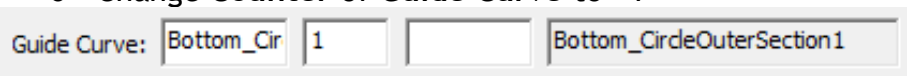
2.4 Create curves for bottom plate

Guide curves for bottom plate will be divided into outer part and inner part of the circle.

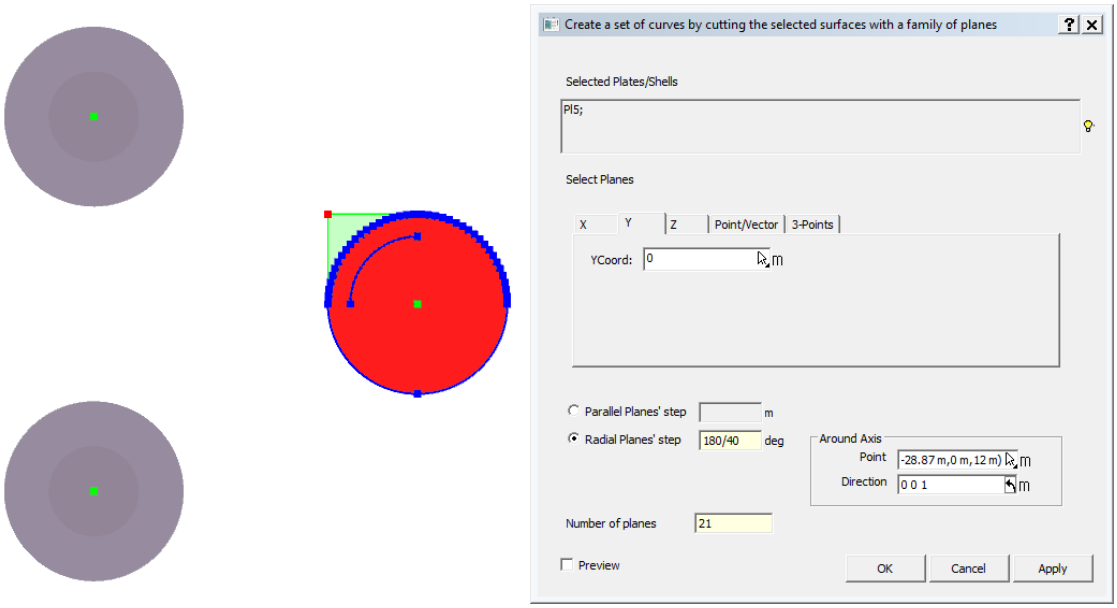
2.4.1 Create curves for circle outer part of bottom plate

(Line 247~355 in FOWT_PLN_Export.js)

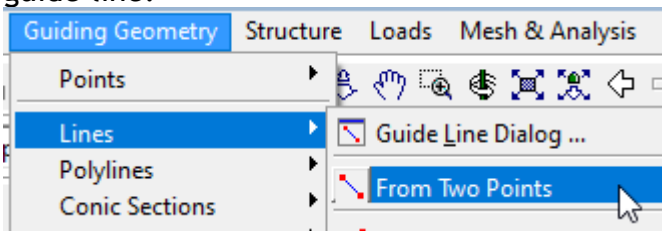
- Change default names of guide curves to set appropriate prefix and counter
  - Change **Prefix** of **Guide Curve** to “Bottom_CircleOuterSection”
  - Change **Counter** of **Guide Curve** to “1”



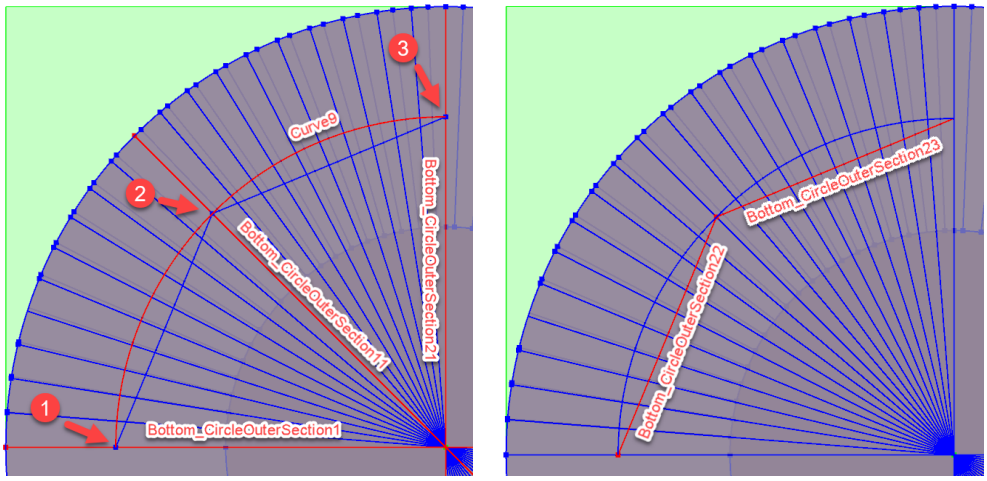
- Select **Pl5**.
- Create curves using **Plate/Shell Intersections with Family of Planes** and change parameters as given below.
  - **Radial planes’ step**: 180/40
  - **Number of planes**: 21
- Click **OK**.



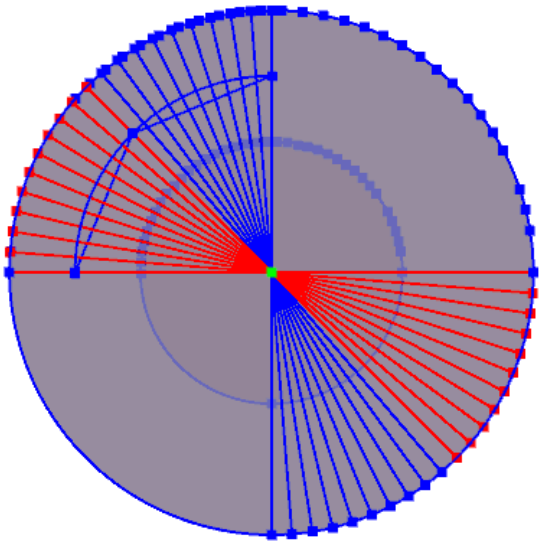
- In browser folder **Utilities - Guiding Geometry - Curves**, observe that 21 new guide curves named as *Bottom_CircleOuterSection1~21* are generated.
- Create two guide lines using the intersections points between Curve9 and Bottom_CircleOuterSection1, 11, and 21, respectively.
    - Click on **Guiding Geometry > Lines > From Two Points** to create a new guide line.

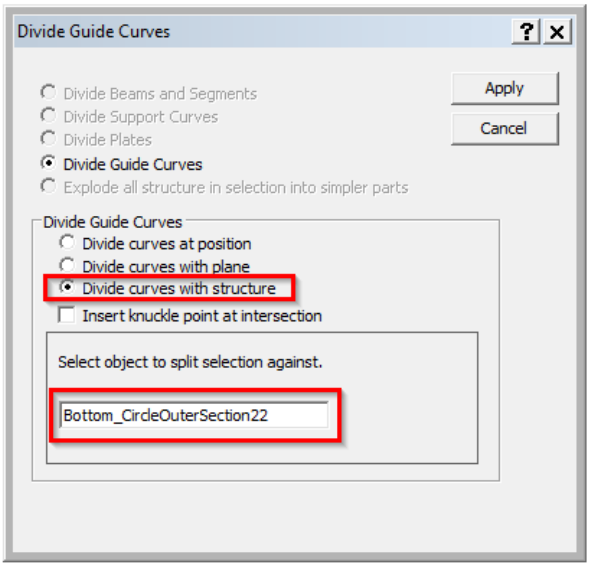


    - Create guide line "Bottom_CircleOuterSection22" from **Point(-19.87 m,0 m,-20 m)** to **Point(-22.50603897 m,6.363961031 m,-20 m)** (i.e. intersection points of *Curve9* with *Bottom_CircleOuterSection1* and *11* marked with 1 and 2 in the image below. Only show these curves for easier point snapping.)
    - Create another guide line "Bottom_CircleOuterSection23" from **Point(-22.50603897 m,6.363961031 m,-20 m)** to **Point(-28.87 m,9 m,-20 m)** (i.e. intersection points of *Curve9* with *Bottom_CircleOuterSection11* and *21* marked with 2 and 3 in the image below)

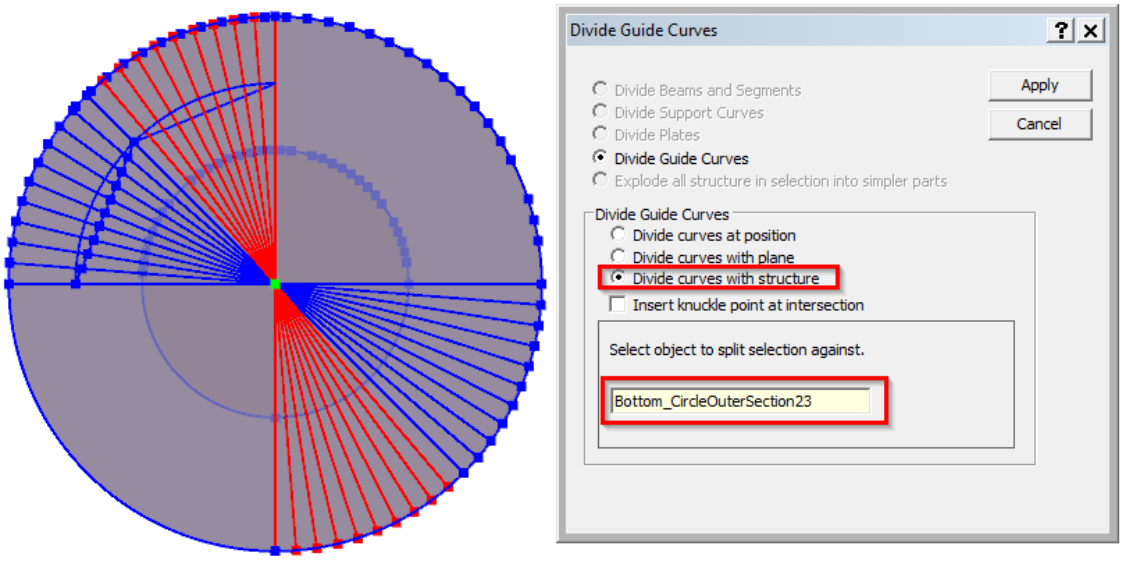


- Select *Bottom_CircleOuterSection1~11* and **right-click** one of them. Then select **Divide.**
- Use **Divide curves with structure** method, divide against *Bottom_CircleOuterSection22*.

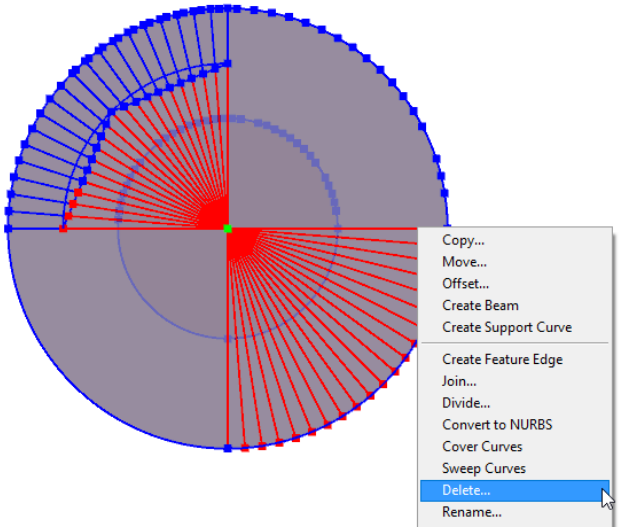




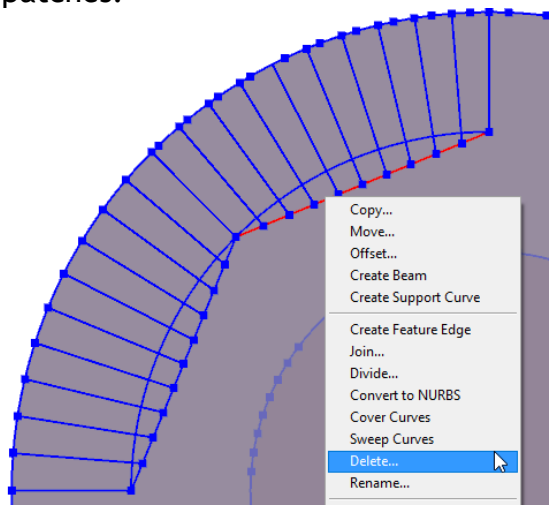
- Select *Bottom_CircleOuterSection12~21* and **right-click > Divide**.
- Use **Divide curves with structure** method, divide against *Buttom_CircleOuterSection23*.



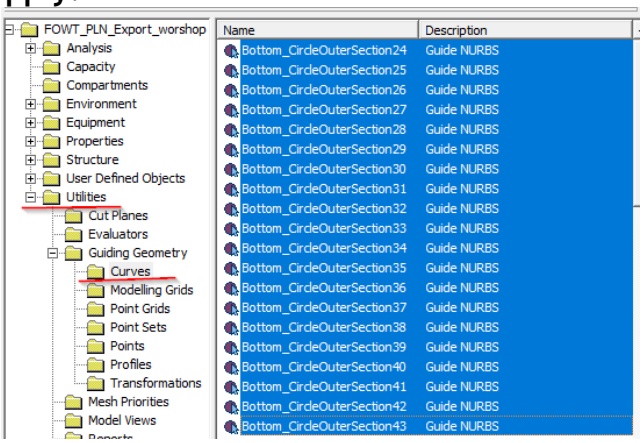
- Select curves *Bottom_CircleOuterSection1~21* and **right-click > Delete** to keep only the shorter curves after the divide operation.

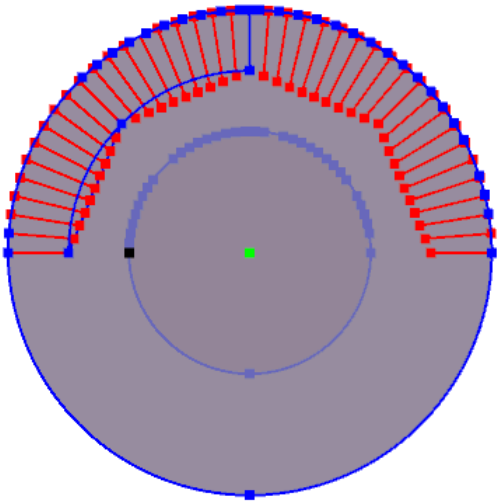


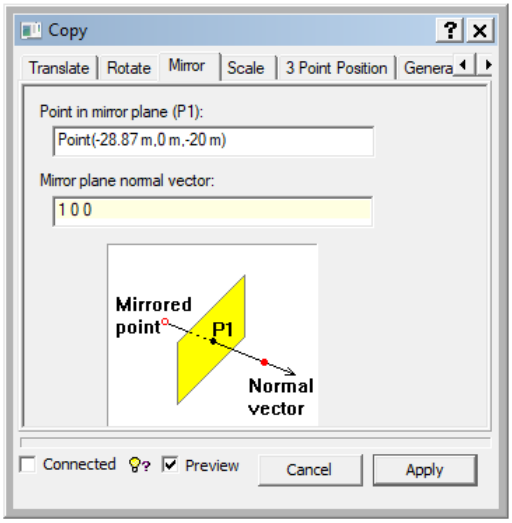
- Also delete curve *Bottom_CircleOuterSection23*, since it will not be part of the patches to export. Deleting it can avoid possible mistake in creating sets of patches.



- Select curves *Bottom_CircleOuterSection24~43* in Browses, **right-click > Copy**;
- Select **Mirror** tab, set parameters as given below:
  - **Point in mirror plane (P1)**: -28.87 0 -20
  - **Mirror plane normal vector**: 1 0 0
  - Toggle **Preview**
- Click **Apply**.







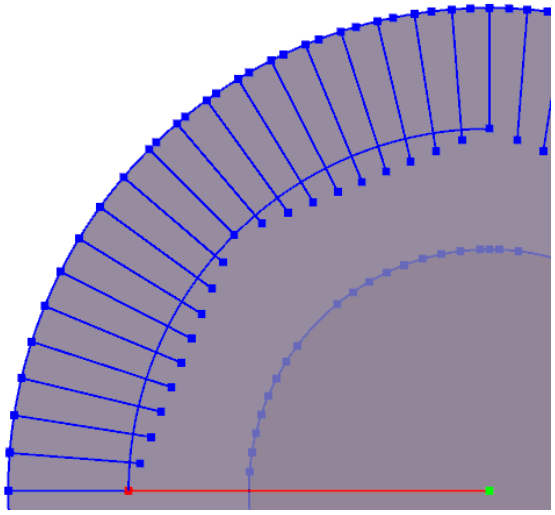
- *Bottom_CircleOuterSection24~64* now form the outer circle patch.

2.4.2 Create curves for circle inner part of bottom plate

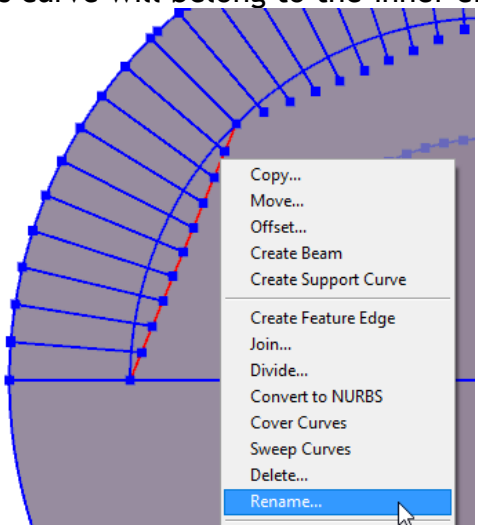
(Line 357~393 in FOWT_PLN_Export.js)

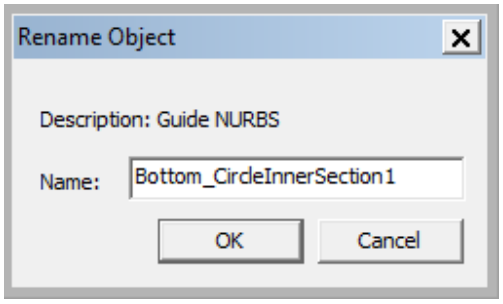
- Change default names of guide curves to set appropriate prefix and counter
  - Change **Prefix** of **Guide Curve** to "Bottom_CircleInnerSection"
  - Change **Counter** of **Guide Curve** to "0"

- Create a guide line "Bottom_CircleInnerSection0" from **Point(-19.87 m,0 m,-20 m)** to **Point(-28.87 m,0 m,-20 m)**
  (i.e. End point of *Bottom_CircleOuterSection24* and the center of the bottom plate)

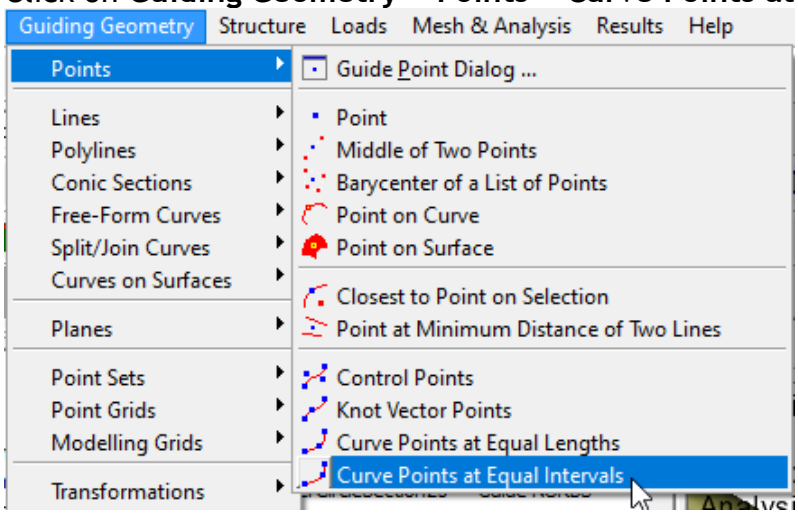


- Rename *Bottom_CircleOuterSection22* to “Bottom_CircleInnerSection1”, since this curve will belong to the inner circle patch

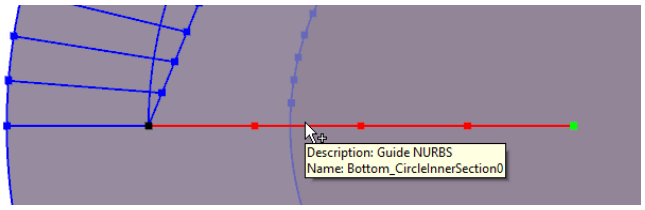




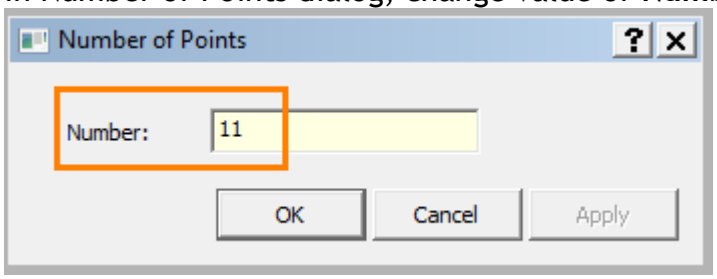
- Create guide points along *Bottom_CircleInnerSection0*
  - Click on **Guiding Geometry > Points > Curve Points at Equal Intervals**



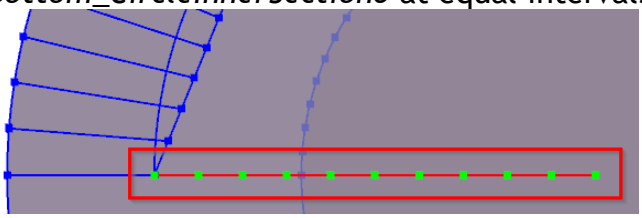
  - Click on the curve *Bottom_CircleInnerSection0*



- In Number of Points dialog, change value of **Number** to "11" and click **OK.**

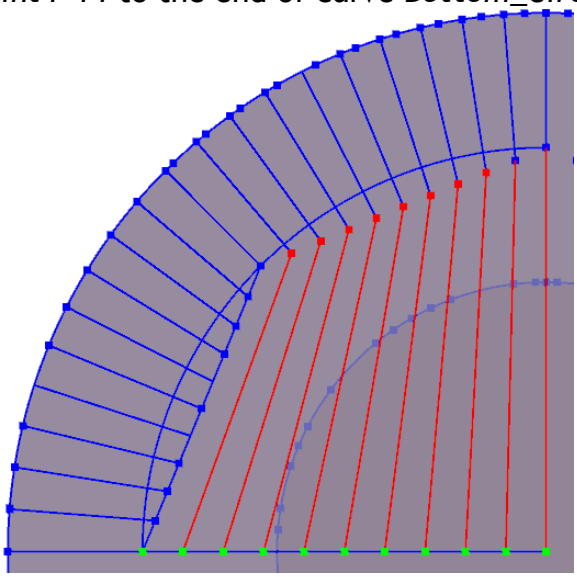


- Press Esc key to exit current creation function.
- Observe that *Point4~14* are created along the curve *Bottom_CircleInnerSection0* at equal intervals.

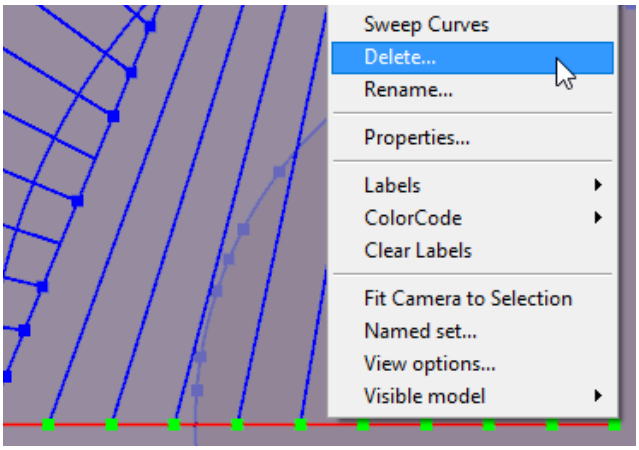


- To make snap to points in the following steps easier, change the selection switches of different item types:
  - Beam selection: OFF
  - Plate selection: ON
  - GuidePoint selection: ON

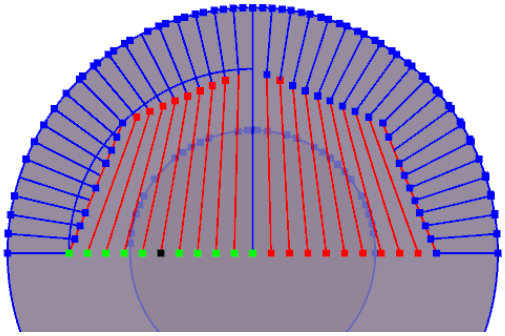
- Create ten guide lines as shown in red below. Each guide line is created from *Point4~14* to the end of curve *Bottom_CircleOuterSection35~44*, respectively.

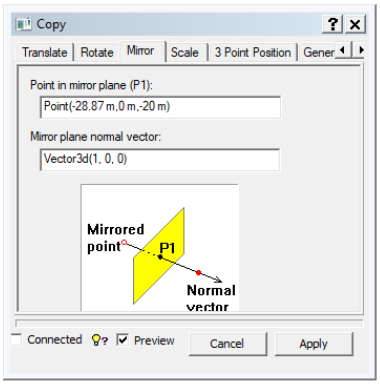


- Delete curve *Bottom_CircleInnerSection0* since it will not be part of the patches to export. Deleting it can avoid possible mistake in creating sets of patches



- Copy mirror curves *Bottom_CircleInnerSection1~10*
  (Note: No need to change settings in copy dialog, since previous settings are remembered.)





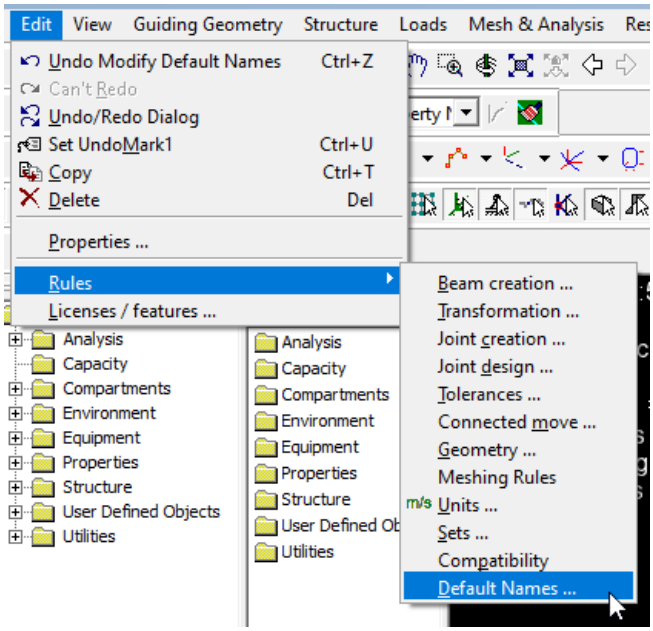
- *Bottom_CircleInnerSection1~21* now forms the inner circle patch.

3 COPY CURVES AND CREATE SETS

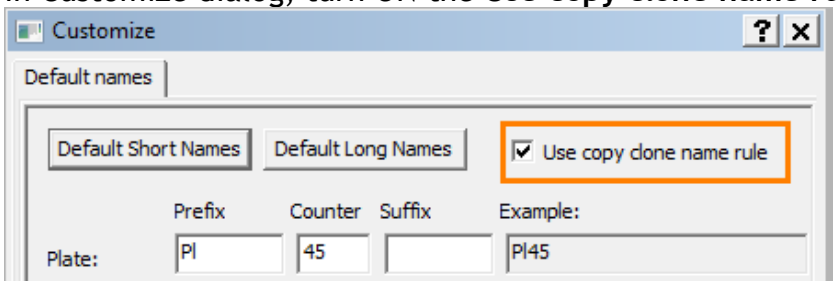
3.1 Copy curves

(Line 395~760 in FOWT_PLN_Export.js)

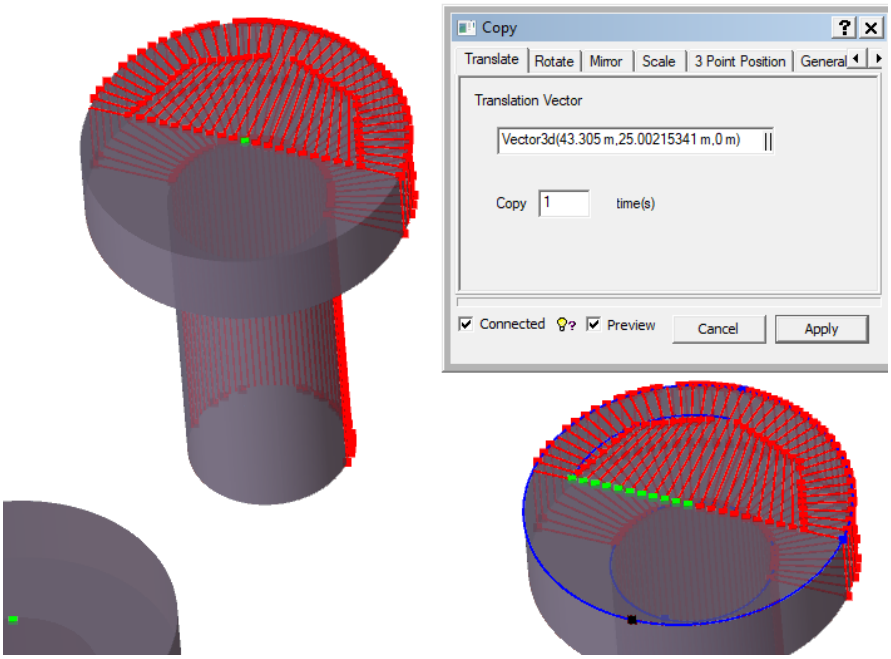
- Before copying the curves, it's better to set copy clone name rule. This way, curves created by copying will still be named after their original curves.
  - Open **Edit > Rules > Default Names**



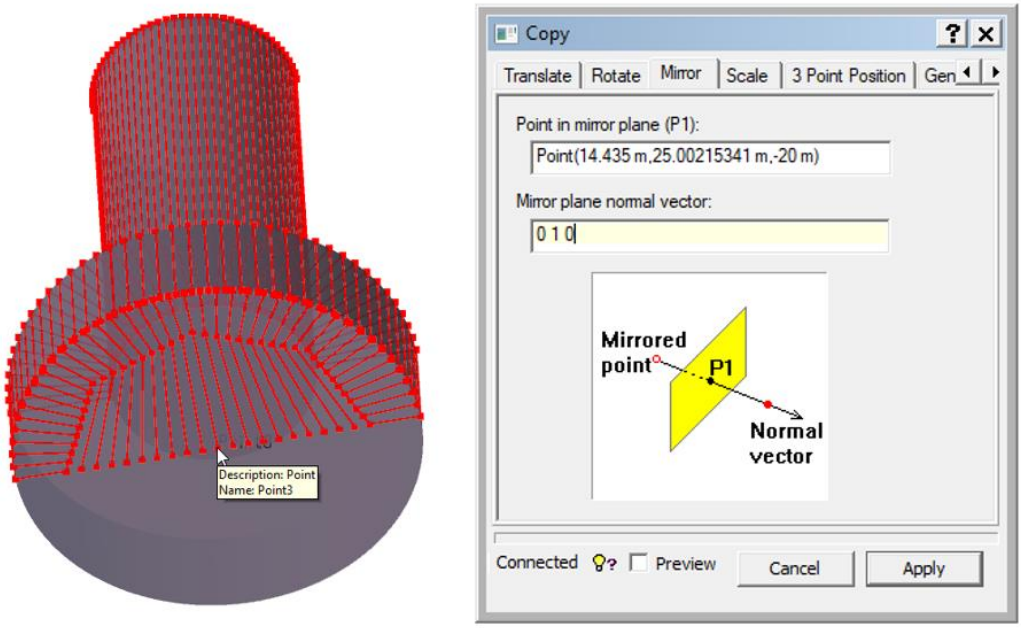
- In Customize dialog, turn ON the **Use copy clone name rule,** and click **OK**



- Select all curves created in Chapter 2, i.e., all curves named with the following prefixes:
  - UpperColumn_RevolveSection
  - TopCircle_RevolveSection
  - LowerColumn_RevolveSection
  - Bottom_CircleOuterSection
  - Bottom_CircleInnerSection
- **Copy translate** all selected curves with **Vector3d(43.305 m,25.00215341 m,0 m)** or by picking Guiding points: ***point 1 and point 3***
  (i.e. Vector from center of *Column_1* to *Column_2*)



- Select all the copied curves in above step, i.e., all curves named with suffix "_1", then
  copy mirror with parameters given below
  - **Point in mirror plane**: Point(14.435 m,25.00215341 m,-20 m) (i.e. Point3)
  - **Mirror plane normal vector**: 0 1 0



  - Curves created by this step will be named with suffix "_1_1"

3.2 Create sets

(Line 762~777 in FOWT_PLN_Export.js)

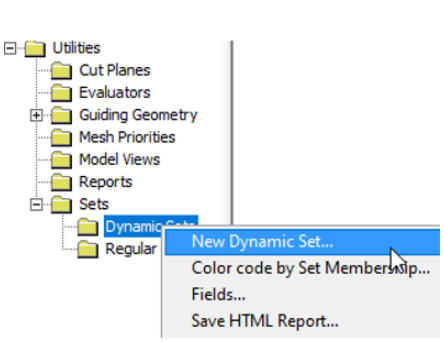
In the .pln file, each patch is equivalent to a *Set* in GeniE. It is therefore important that the curves are stored in the correct Sets before they are read into HydroD.

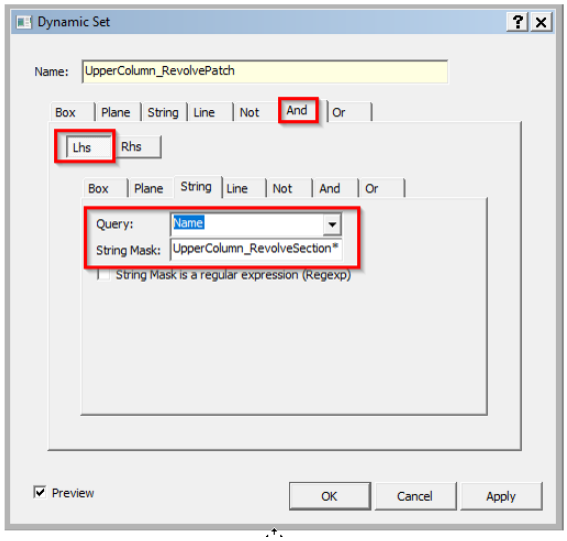
A total of **15 dynamic sets** should be created. The name and content of each set is given in table below:

Curves	Set
UpperColumn_RevolveSection1~40	UpperColumn_RevolvePatch
UpperColumn_RevolveSection1_1~40_1	UpperColumn_RevolvePatch_1
UpperColumn_RevolveSection1_1_1~40_1_1	Mirror_UpperColumn_RevolvePatch
TopCircle_RevolveSection1~40	TopCircle_RevolvePatch
TopCircle_RevolveSection1_1~40_1	TopCircle_RevolvePatch_1
TopCircle_RevolveSection1_1_1~40_1_1	Mirror_TopCircle_RevolvePatch
LowerColumn_RevolveSection1~40	LowerColumn_RevolvePatch
LowerColumn_RevolveSection1_1~40_1	LowerColumn_RevolvePatch_1
LowerColumn_RevolveSection1_1_1~40_1_1	Mirror_LowerColumn_RevolvePatch
Bottom_CircleOuterSection24~64	Bottom_CircleOuterPatch
Bottom_CircleOuterSection24_1~64_1	Bottom_CircleOuterPatch_1
Bottom_CircleOuterSection24_1_1~64_1_1	Mirror_Bottom_CircleOuterPatch
Bottom_CircleInnerSection1~21	Bottom_CircleInnerPatch
Bottom_CircleInnerSection1_1~21_1	Bottom_CircleInnerPatch_1
Bottom_CircleInnerSection1_1_1~21_1_1	Mirror_Bottom_CircleInnerPatch

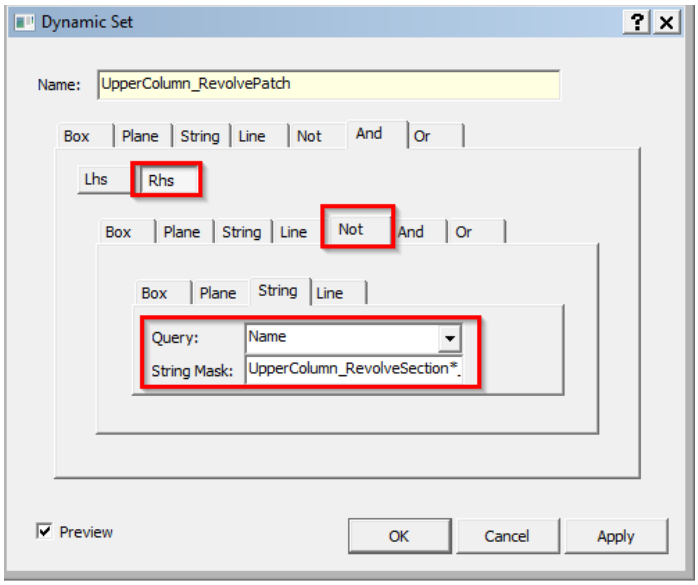
Taking *UpperColumn_RevolvePatch* as an example, follow these steps to create the dynamic set:

- Go to browser folder, right-click **Sets - Dynamic Sets** and select **New Dynamic Set**.
- Give the name as ***UpperColumn_RevolvePatch***
- Select **And** and **Lhs**
- Select **String** and set Query as **Name**
- Fill String Mask with ***UpperColumn_RevolveSection****

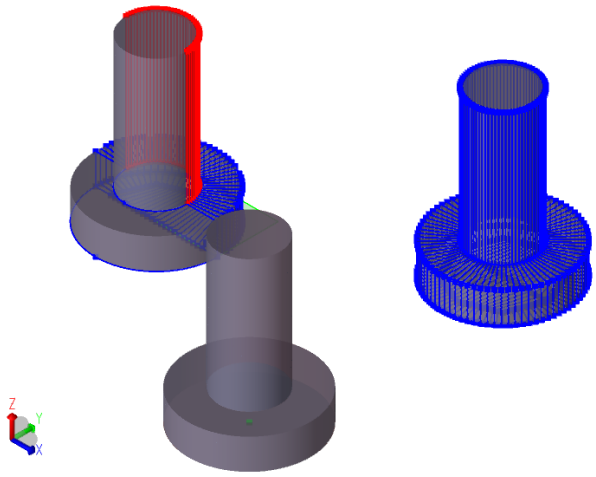




- Select **Rhs** and **Not**, fill String Mask with ***UpperColumn_RevolveSection*_1***



- Toggle the **Preview** option to show the preview



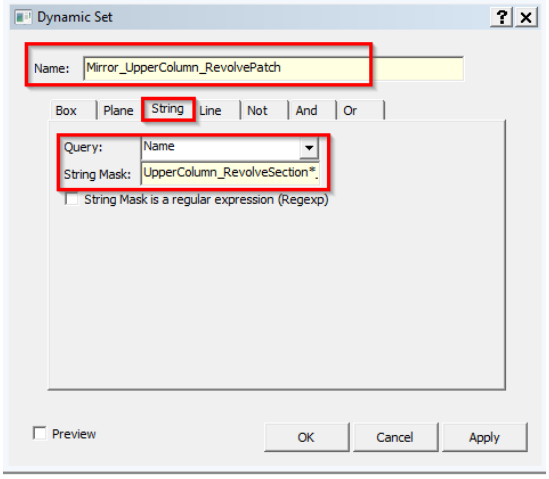
- Click **OK**

Repeat the steps above to create remaining dynamic sets as described in the following table. **Note:** Dynamic Set *UpperColumn_RevolvePatch* (marked red in the table) is already created by executing the steps above.

Dynamic Set Name	Conditions:	
	And	
	Lhs > String	Rhs > Not > String
UpperColumn_RevolvePatch	UpperColumn_RevolveSection*	UpperColumn_RevolveSection*_1
UpperColumn_RevolvePatch_1	UpperColumn_RevolveSection*_1	UpperColumn_RevolveSection*_1_1
TopCircle_RevolvePatch	TopCircle_RevolveSection*	TopCircle_RevolveSection*_1
TopCircle_RevolvePatch_1	TopCircle_RevolveSection*_1	TopCircle_RevolveSection*_1_1
LowerColumn_RevolvePatch	LowerColumn_RevolveSection*	LowerColumn_RevolveSection*_1
LowerColumn_RevolvePatch_1	LowerColumn_RevolveSection*_1	LowerColumn_RevolveSection*_1_1
Bottom_CircleOuterPatch	Bottom_CircleOuterSection*	Bottom_CircleOuterSection*_1
Bottom_CircleOuterPatch_1	Bottom_CircleOuterSection*_1	Bottom_CircleOuterSection*_1_1
Bottom_CircleInnerPatch	Bottom_CircleInnerSection*	Bottom_CircleInnerSection*_1
Bottom_CircleInnerPatch_1	Bottom_CircleInnerSection*_1	Bottom_CircleInnerSection*_1_1

The dynamic sets start with “Mirror” can be created by following steps:

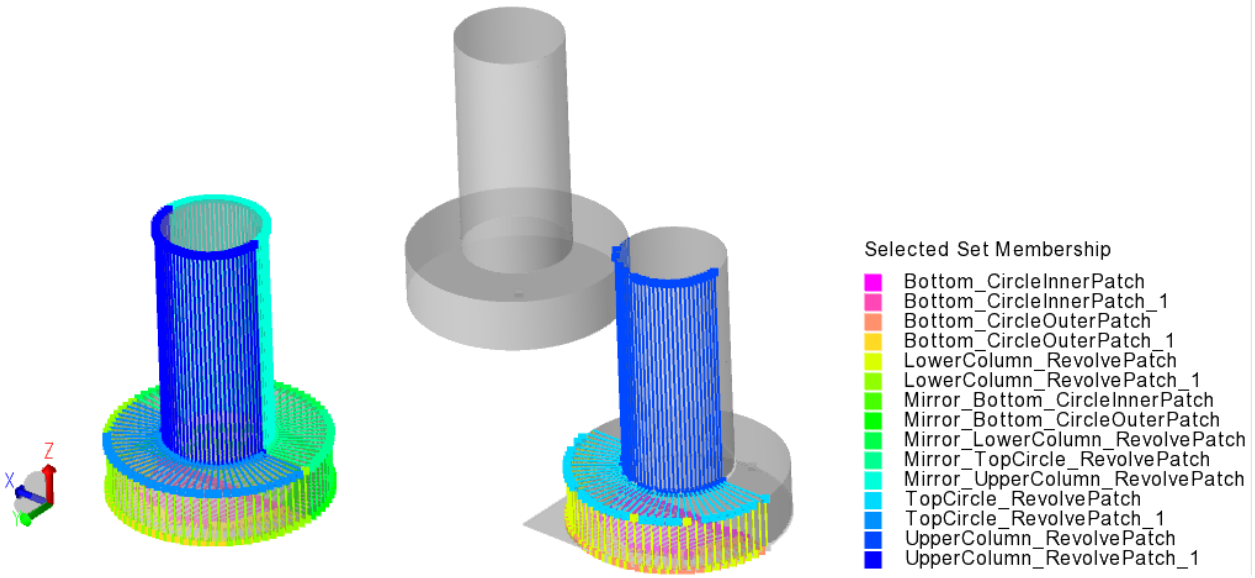
- Create a new dynamic set and fill name as ***Mirror_UpperColumn_RevolvePatch***
- Select **String** and set Query as **Name**
- Fill **String Mask** as ***UpperColumn_RevolveSection*_1_1***
- Click **OK**



Repeat the steps above to create remaining dynamic sets as shown in the following table.
Note: Dynamic Set *Mirror_UpperColumn_RevolvePatch* (marked red in the table) is already created by executing the steps above.

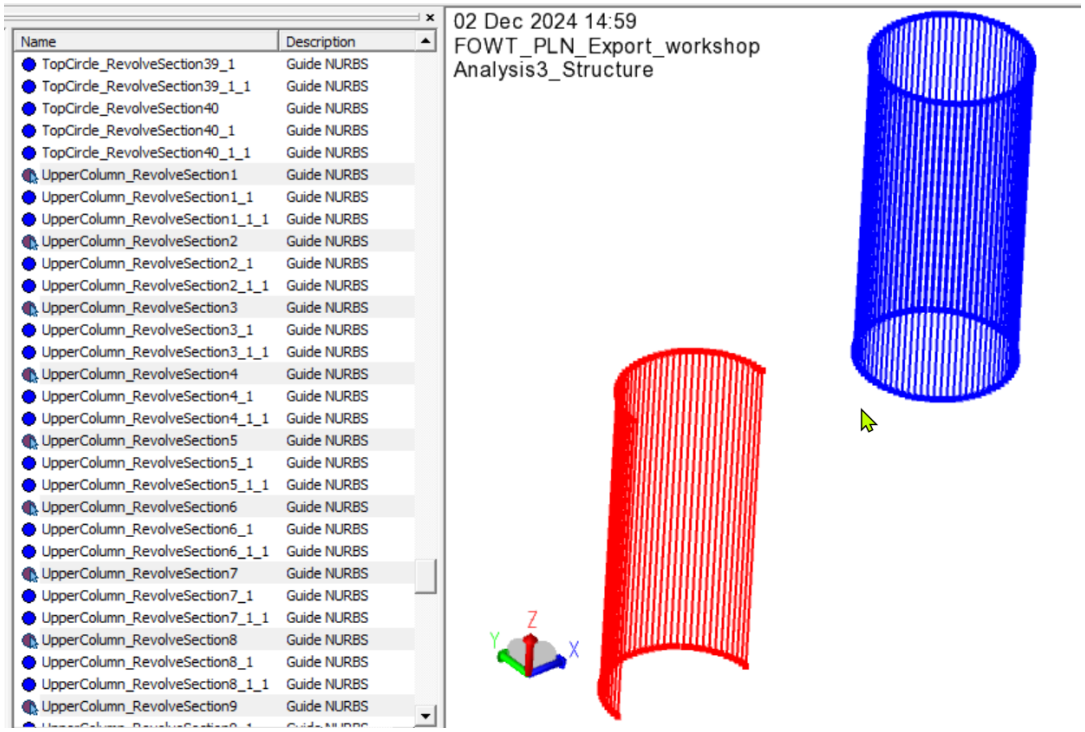
Dynamic Set Name	Conditions: String
Mirror_UpperColumn_RevolvePatch	UpperColumn_RevolveSection*_1_1
Mirror_TopCircle_RevolvePatch	TopCircle_RevolveSection*_1_1
Mirror_LowerColumn_RevolvePatch	LowerColumn_RevolveSection*_1_1
Mirror_Bottom_CircleOuterPatch	Bottom_CircleOuterSection*_1_1
Mirror_Bottom_CircleInnerPatch	Bottom_CircleInnerSection*_1_1

Verify all dynamic sets have been created correctly.



Note: Another way to create sets is by using Regular Set, first select the curves by their

name in the browser. For example, *UpperColumn_RevolveSection1, 2*, and so on. Then, press **Alt+S** to show only the selected curves to verify the selection. Finally, right-click one of them to add them to named sets.

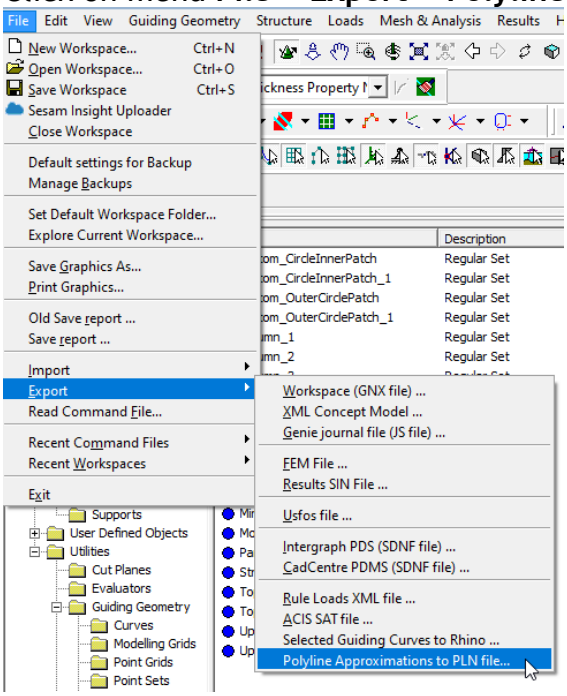


4 EXPORT PLN FILE

(Line 779~782 in FOWT_PLN_Export.js)

After all curves have been placed in sets, we can export the .pln file.

- Click on menu **File > Export > Polyline Approximations to PLN file**



- Set values in the “Set – IWET – Join” table as given below:

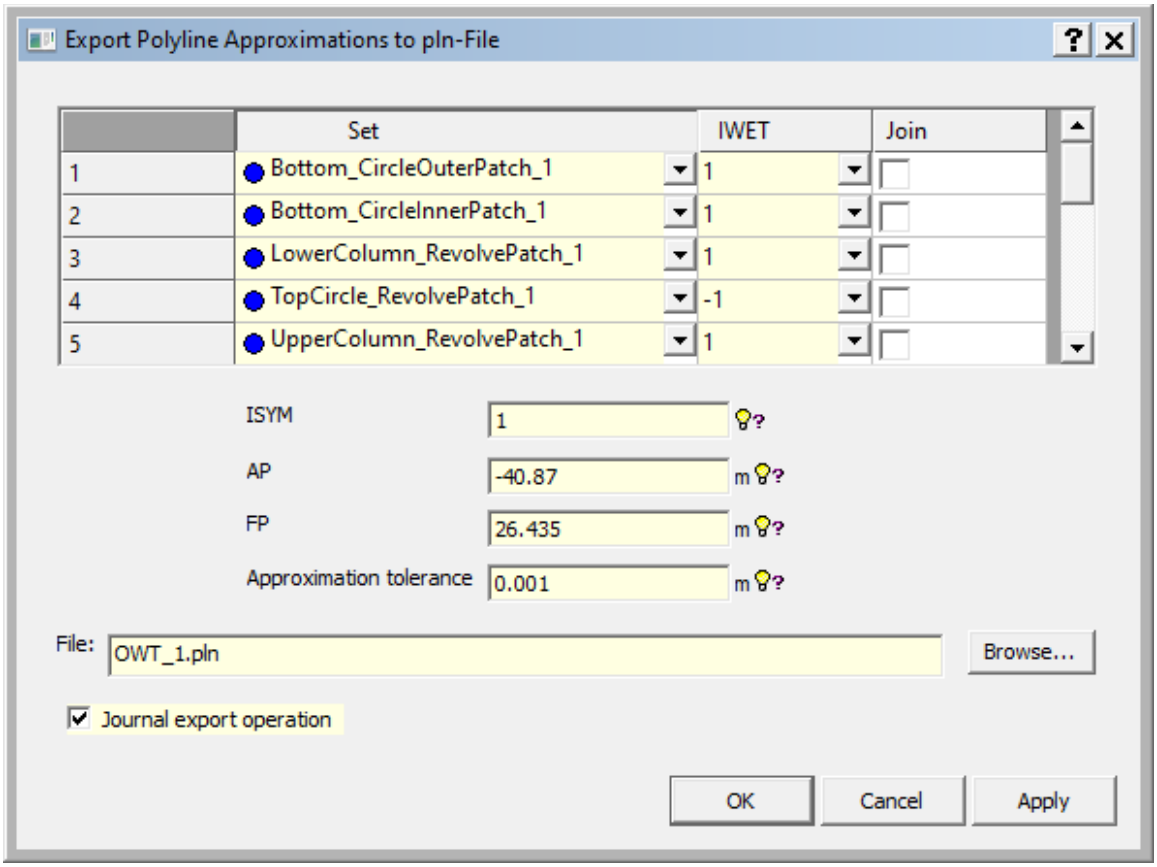
(Note: Use Tab key or Down arrow key to insert new rows in the table)

Patch	Set	IWET	Join
1	Bottom_CircleOuterPatch_1	1	FALSE
2	Bottom_CircleInnerPatch_1	1	FALSE
3	LowerColumn_RevolvePatch_1	1	FALSE
4	TopCircle_RevolvePatch_1	-1	FALSE
5	UpperColumn_RevolvePatch_1	1	FALSE
6	Mirror_Bottom_CircleOuterPatch	-1	FALSE
7	Mirror_Bottom_CircleInnerPatch	-1	FALSE
8	Mirror_LowerColumn_RevolvePatch	-1	FALSE
9	Mirror_TopCircle_RevolvePatch	1	FALSE
10	Mirror_UpperColumn_RevolvePatch	-1	FALSE
11	Bottom_CircleOuterPatch	1	FALSE
12	Bottom_CircleInnerPatch	1	FALSE
13	LowerColumn_RevolvePatch	1	FALSE
14	TopCircle_RevolvePatch	-1	FALSE
15	UpperColumn_RevolvePatch	1	FALSE

- Specify other parameters in the dialog as given below
  - **ISYM**: 1
  - **AP**: -40.87
  - **FP**: 26.435
  - **Approximation tolerance**: 0.001
- Set **File name**, for example, to “OWT_1.pln”
- Click **OK**

Note that the IWET starboard (left) and port (right) sides are local for each pontoon/column, not the global left or right side. The description of the IWET values corresponding to patch types in HydroD is shown below:

IWET	Description
-10	WetLeftNoWaterline
-1	WetLeft
1	WetRight
10	WetRightNoWaterline



- OWT_1.pln file will be exported and saved in the current GeniE workspace folder.

Note: Completed model is also provided as FOWT_PLN_Complete.gnx and FOWT_PLN_Complete.xml files for reference.

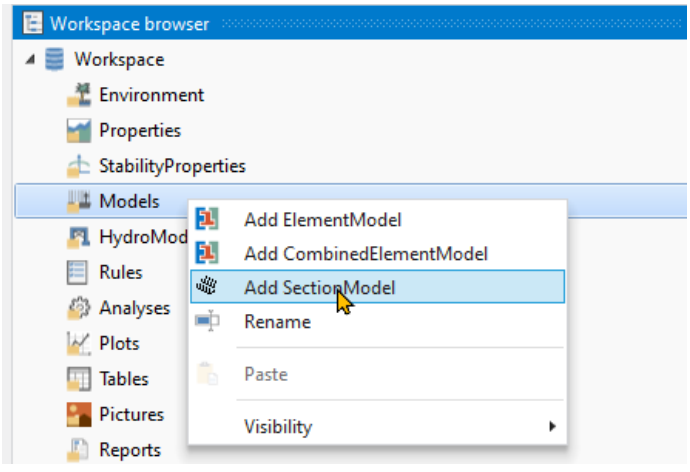
5 OPTIONAL: IMPORTING PLN FILE INTO HYDROD

This last step illustrates how to import the .pln file into HydroD.

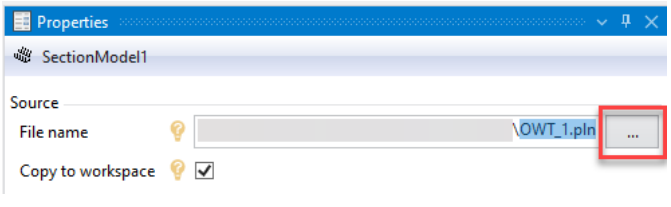
- Start **HydroD V7.2** and create a new workspace by selecting **File > New**.

5.1 Create section model

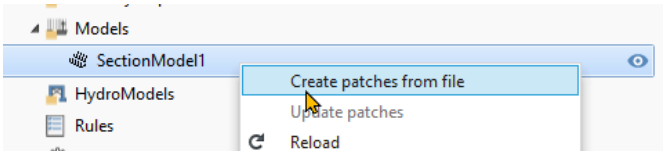
- Right-click the **Models** folder and select **Add SectionModel**.

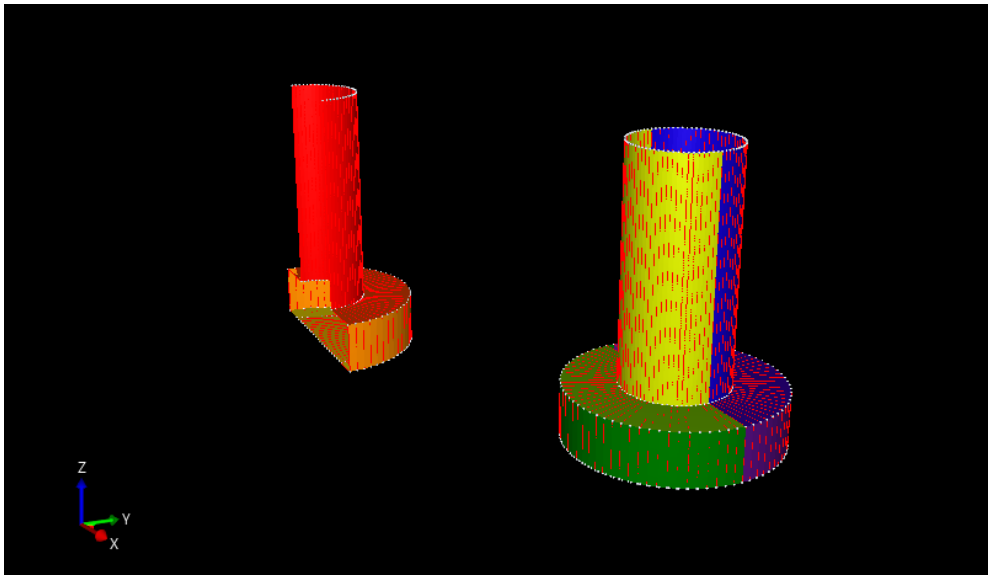


- In the Properties view of the newly created **SectionModel1**, select OWT_1.pln as file name. (click the three dots button to browse the file)



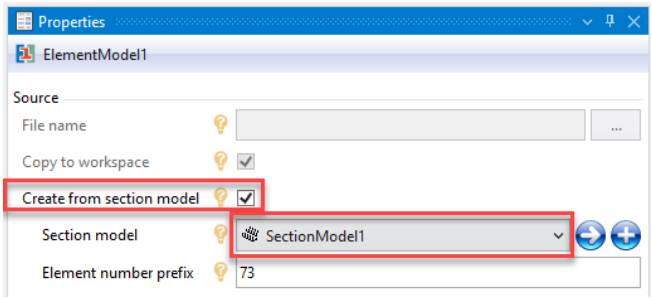
- Right-click **SectionModel1 > Create patches from file**. The section model should be visible in the 3D view.



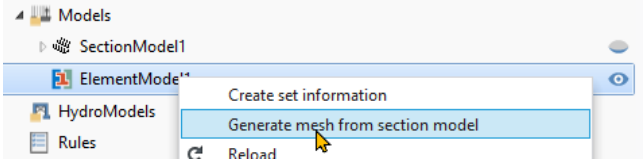


5.2 Create element model

- Right-click the **Models** folder and select **Add ElementModel**.
- In the Properties view of the newly created **ElementModel1**, tick **Create from section model** and select **SectionModel1**.



- Right-click **ElementModel1 > Generate mesh from section model**.

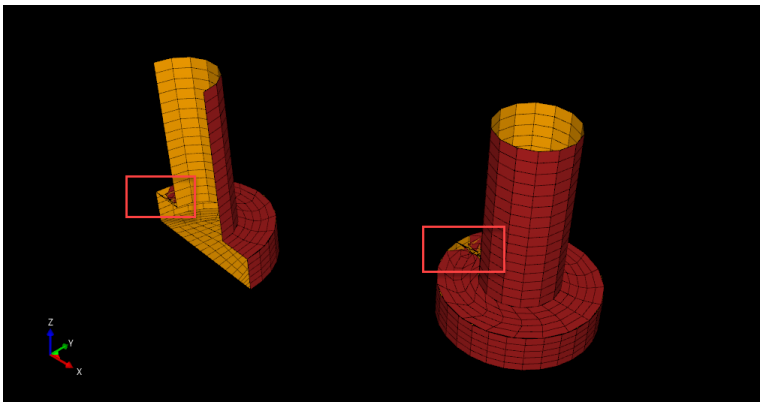


5.3 Verify and correct element model

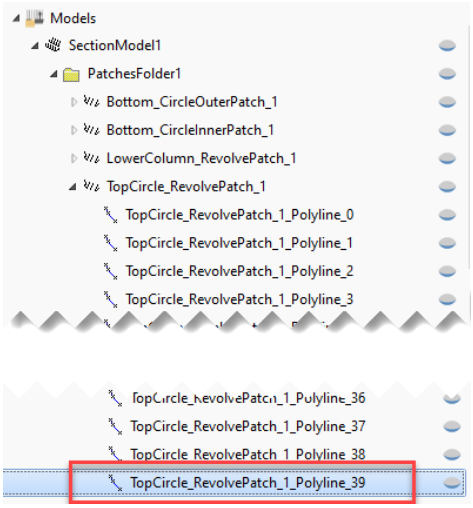
- Check the generated mesh by activating/deactivating the eye icons in the

workspace browser so that only the **ElementModel1** is shown.

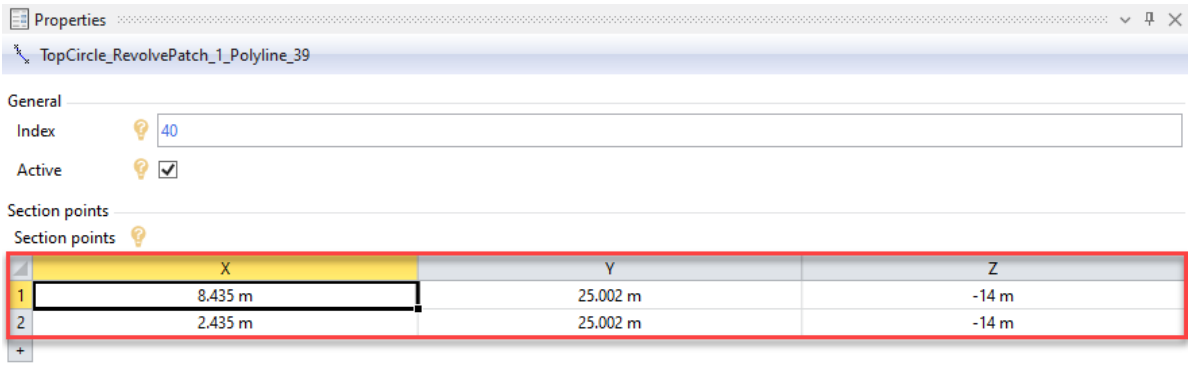
- If the mesh edge is not shown, in **ElementModel1 Properties** view click **Style** tab and check **Plates** > **Show edges.**
- Notice the mesh of the *TopCircle* patches is not good as shown below. The reason is that the last curve in the patch is reversed.



- Expand **SectionModel1** folder, expand **PatchesFolder1**, expand **TopCircle_RevolvePatch_1**, and select **TopCircle_RevolvePatch_1_Polyline_39**.

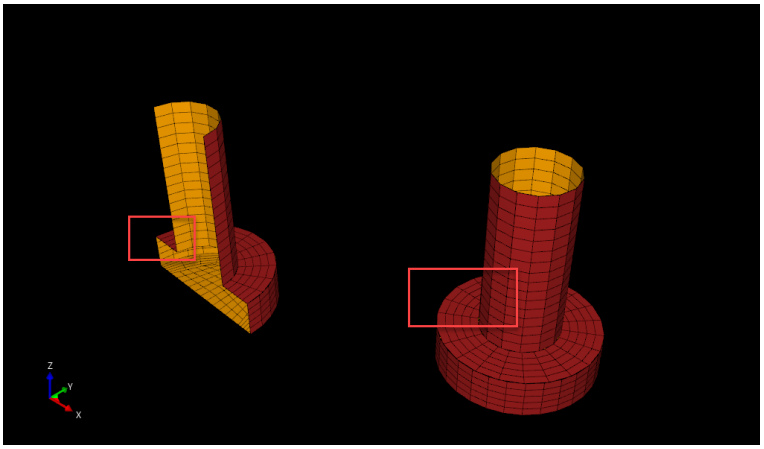


- Reverse the points by copying the first row to the third row and then deleting the first row. The table should be as shown below after the operation:



- Repeat the operation for **Mirror_TopCircle_RevolvePatch_Polyline_39** and **TopCircle_RevolvePatch_Polyline_39**.

- Right-click **ElementModel1 > Generate mesh from section model** again. The mesh should be corrected now.



Note: For more details on the settings of section model's mesh generation, refer to HydroD example 4 "Wadam and Wasim analysis of a ship"

About DNV

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