Base Load Power Hub (BLPH)

BLPH Platform Transition Piece Load-out Analysis

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

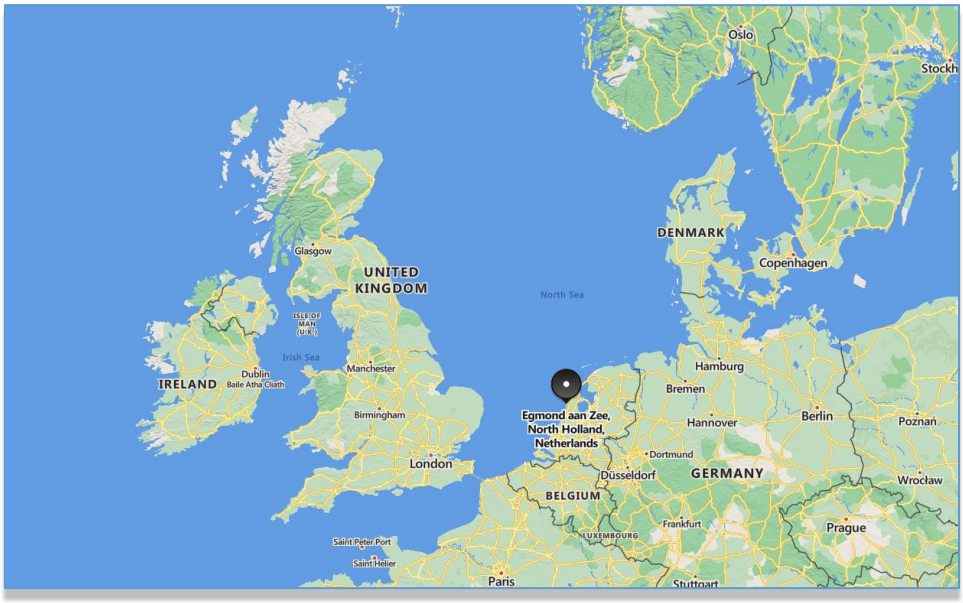


Figure 1.1 - HOLLANDSE KUST NOORD WIND PARK Location Map

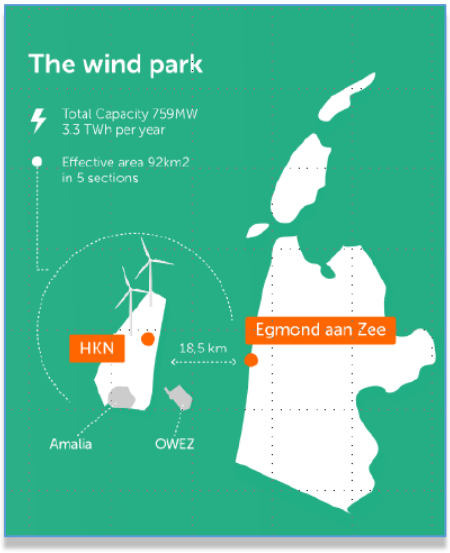


Figure 1.2 - Wind Park Details

The wind farm consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

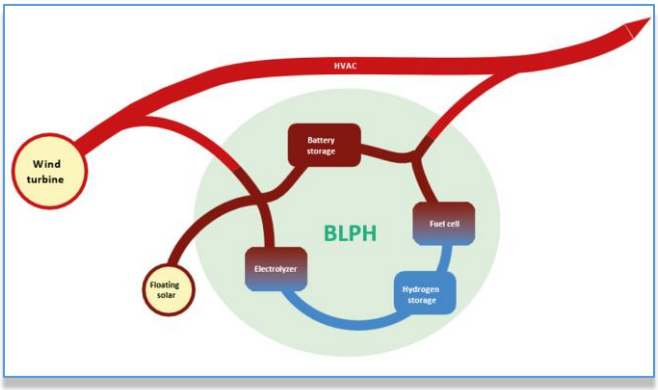


Figure 1.3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2 DOCUMENT SCOPE

The objective of this report is to present the results of the structural analysis performed on the BLPH Transition Piece structure for the load out conditions.

The analysis has been performed in compliance with the requirements, criteria and parameters reported in the Structural Design Premises, Ref./14/.

Loadout analysis is performed in accordance with DNV-ST-N001, Ref./9/.

Structural Code checks are performed according to EN ISO 19902 for tubular members and tubular joints, Ref./6/, and according to Eurocode 3 for non-tubular structural elements, Ref./8/.

All structural analyses have been carried out using the structural analysis program SACS, the proprietary software developed by Bentley, Ref. /24/.

The International System of Units (SI) has been used in all engineering assessments and calculations.

3 REFERENCES

3.1 CODES AND STANDARDS

Doc. No.	Description
/1/ BS EN ISO 19900	General requirements for offshore structures – 2019
/2/ BS EN ISO 19901-1	Specific requirements for offshore structures - Part 1: Metocean design and operating considerations - 2015
/3/ BS EN ISO 19901-3	Specific requirements for offshore structures – Part 3: Topsides structure - 2014
/4/ BS EN ISO 19901-5	Specific requirements for offshore structures – Part 5: Weight Management - 2021
/5/ BS EN ISO 19901-6	Specific requirements for offshore structures – Part 6: Marine Operations – 2009
/6/ BS EN ISO 19902	Petroleum and natural gas industries - Fixed steel offshore structures – 2020
/7/ ISO 19906:2019	Petroleum and natural gas industries – Arctic offshore structures
/8/ UNI EN 1993-1-1	Design of steel structures - Part 1-1: General rules and rules for buildings
/9/ DNV-ST-N001	DNV - Marine operation and marine warranty - 2021
/10/ DNV-RP-C201	DNV, Buckling Strength of Plated Structures, October 2010.

3.2 COMPANY SPECIFICATIONS

Doc. No.	Description
/11/ DEP 37.19.00.12	Gen - Offshore Topsides Structures
/12/ DEP 37.19.00.30	Gen - Fixed Steel Offshore Structures (Adoption of IOGP S-631-11, Amendments / Supplements to ISO 19902:2020).
/13/ DEP 37.81.10.19	Gen - Marine Operations Requirements – Loadout, Transportation and Installation of Offshore Structures (Amendments / Supplements to ISO 19901-6)

3.3 PROJECT DOCUMENTS

Doc. No.	Description
/14/ 123A90-DDL-ST-SP-90017	Structural Design Basis
/15/ 123A90-DDL-MD-RE-01006	Monthly Weight Report
/16/ 123A90-DDL-PP-DS-70070	Plot Plans
/17/ 123A90-DDL-ST-SP-90018	Structural Material Specification for Topside and TP
/18/ 123A90-DDL-ST-SP-90118	Structural Material Specification for Flange and Bolts
/19/ 123A90-DDL-ST-RE-90000	BLPH Platform – In service Analysis
/20/ 123A90-DDL-ST-RE-90009	TP – Transportation analysis Report
/21/ 123A90-DDL-TI-RE-99005	Loadout manual including ballast sequence
/22/ 123A90-DDL-TI-SP-99014	Specification for TP, Topside and Caissons Transportation and Installation
/23/ 123A90-DDL-ST-TN-90119	Evaluating ISO and DNV approaches

3.4 SOFTWARE

Doc. No.	Description
/24/ SACS	Structural Analysis Computer System – BENTLEY Inc. v15

4 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY)	Crosswind
CONTRACTOR (CTR)	ROSETTI MARINO S.p.A.
PROJECT	HOLLANDSE KUST NOORD WIND PARK Project
T&I CONTRACTOR	DEME
ALS	Accidental Limit State
BLPH	Base Load Power Hub
CL	Concentrated Load
CoG	Centre of Gravity
CW	CrossWind
DAF	Dynamic Amplification Factor
DLB	Ductility Level Blast
DNV	Det Norske Veritas
DP	Dynamic Positioning
El.	Elevation
EPCI	Engineering Procurement Construction and Installation
FEED	Front End Engineering Design
HAT	Highest Astronomical Tide
HKN	Hollandse Kust Noord
ICCP	Impressed Current Corrosion Protection
LAT	Lowest Astronomical Tide
LRFD	Load and Resistance Factor Design
MSL	Mean Sea Level
NTE	Not-to-Exceed
PAU	Pre-Assembled Unit (H2 Vessels)
PG	Plate Girder
SHL	Static Hook Load
T&I	Transport & Installation
ToS	Top of Steel

TP	Transition piece
UC	Unity Check
UDL	Uniformly Distributed Load
WTG	Wind Turbine Generator
W2W	Walk to Work
SPMT	Self-propelled modular Trailer
UG	Upper grillage

Table 4.1 - Definitions and Abbreviations

5 SUMMARY AND CONCLUSIONS

The analyses performed show that the Transition Piece, as configured, can withstand all possible combinations of imposed load out loads. The software SACS™, ref./24/, is used for all global analyses of the structures in the SOW. Structural model of TP is the same used for transportation analysis, Ref. /20/ with the following modifications:

- added SPMT spine beams to properly transfer the load to the structure based of SPMT stiffness;
- UG1 and UG2 grillage beams made by PG with Fymin = 420 MPa (>HEB1000 used in transport analysis) based on availability material in yard.

5.1 WEIGHT RESULTANTS

The TP weight considered in the analysis is presented here below and then it is compared with the weight defined in the WCR, ref. /15/. COG location comparison between SACS structural model for Loadout Analysis and WCR is reported in following tables.

- The TP weight during LO, including Upper grillage and pre laid slings, was 302 t according to WCR dated Feb.2024, and decreased to 290t in WCR dated June 2024. The max value in weight and updated position of CoG was considered in calculation.

WCR vs SACS	
Load Comb.	**Fz [t]**
WCR (expected weight)	-290
SACS (lcomb TPLO)	-302

Table 5.1 – SACS-WCR CoG comparison

COG NOMINAL POSITION			
CASE	x [m]	y [m]	z [m]
COG_WCR	-0.200	-0.500	5.70
COG_SACS (lcomb TPLO)	-0.350	-0.670	5.63
Δ	*0.15* *(1%)*	*0.17* *(1%)*	*0.07* *(1%)*

Table 5.2 – SACS-WCR CoG position comparison. Z measured from barge Deck in SACS ref. system (ref to section 9.1 for SACS ref system)

BLPH - TRANSITION PIECE (TP) - Summary by Phase

Phase Code	Phase Description	Base Wt. (t)	Center of Gravity			Factored Wt. (t)	Center of Gravity			Design Net Wt. (t)	Center of Gravity			Design Gross (Expected) Wt. (t)	Center of Gravity		
			Northing (m)	Easting (m)	Elevation (m)		Northing (m)	Easting (m)	Elevation (m)		Northing (m)	Easting (m)	Elevation (m)		Northing (m)	Easting (m)	Elevation (m)
LO	Loadout	263	19,8	8,5	20,1	290	19,8	8,5	18,2	290	19,8	8,5	20,1	290	19,8	8,5	20,1
ST	Sea Transport	263	19,8	8,5	20,1	290	19,8	8,5	18,2	290	19,8	8,5	20,1	290	19,8	8,5	20,1
OP	Operating weight (Dry + Contents)	253	19,9	8,5	20,3	280	19,9	8,5	18,3	280	19,9	8,5	20,3	280	19,9	8,5	20,3
L	Lifting	230	19,7	8,6	20,3	254	19,7	8,6	18,4	254	19,7	8,6	20,3	254	19,7	8,6	20,3

Table 5.3 – WCR weight and CoG during LO. X measured towards NORTH, Y measured towards EAST from C1, Z from LAT.

5.2 MAXIMUM HYDRAULIC CIRCUIT LOADS

In the table below are reported the max hydraulic circuit loads for the base case (gravity only). The loadout operation is planned to be performed using 16 axles of SPMTs located below the upper grillage in order to perform the transfer operation with bottom flange of UG at +1650mm (+/-300mm of SPMTs stroke) from the ground.

LOAD COMB	Hydraulic circuit 1 [t]	Hydraulic circuit 2 [t]	Hydraulic circuit 3 [t]
TEST	168.2	48	85.8
SPMT's self-weight (including PPU's)	38	20	20
TOT	**206**	**68**	**105.8**
N° AXLES	8	4	4
TOT/axle	*25.75*	*17*	*26.45*

Table 5.4 – SPMT's hydraulic circuit loads – ground loads / axles < 36 t/axle

5.3 MEMBER CHECKS

Structural members with maximum Unity Check (UC) are detailed in the following table. Th maximum UC of upper grillage results 0.20, while the max UC of transition piece is 0.17.

MEMBER	GROUP	DESCRIPTION	SECTION	COMBINATION	UC
R1L5-SP05	UG1	Upper Grillage	PG 1000	LOD1	0.20
SM15-SS08	UN2	Stairs stringer UPN220	UPN220	LOD1	0.17

Table 5.5 – Member UC Summary

5.4 PLATE CHECKS

Maximum Von Mises stress of plate elements in the lower part of main column (7m diameter, thickness 65mm) is 60 MPa and results below the design yield stress of 380 MPa (UC= 60 / 380 = 0.16).

5.5 TUBULAR JOINT CHECKS

Structural tubular joints with maximum Unity Checks (UC) for punching shear are all lower than 0.1.

6 TRANSITION PIECE DESCRIPTION

The connection of Topside with Monopile is realized through a **Transition Piece (TP)** structure. TP is composed by a central column with an outer diameter of 7m and Four (4) boxed girders with height ranging from 2.5 m to 1.4 m, oriented along the main diagonals of the TP.

TP main dimensions are 16m x 16m with height 7.9m.

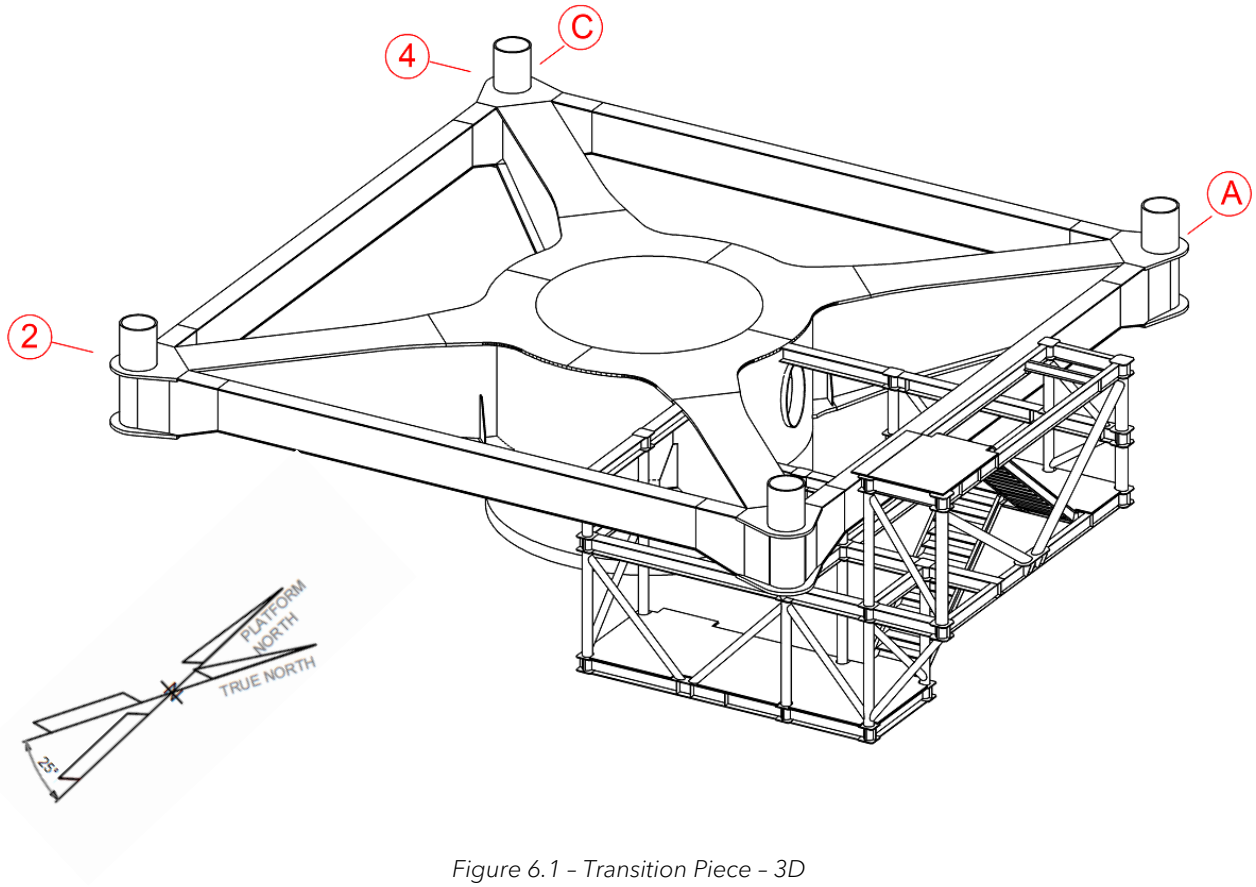


Figure 6.1 – Transition Piece – 3D

6.1 TP LOADOUT ARRANGEMENT

The loadout is assumed to be performed by means of SPMTs; the SPMT arrangement is considered to be isostatic (3 hydraulic circuits).

An overview of the loadout layout is shown in the following figure, the blue circles represent the center of the hydraulic circuits while the red square represent the location of the contact points between the UG and the SPMTs (in other words where the loads are applied).

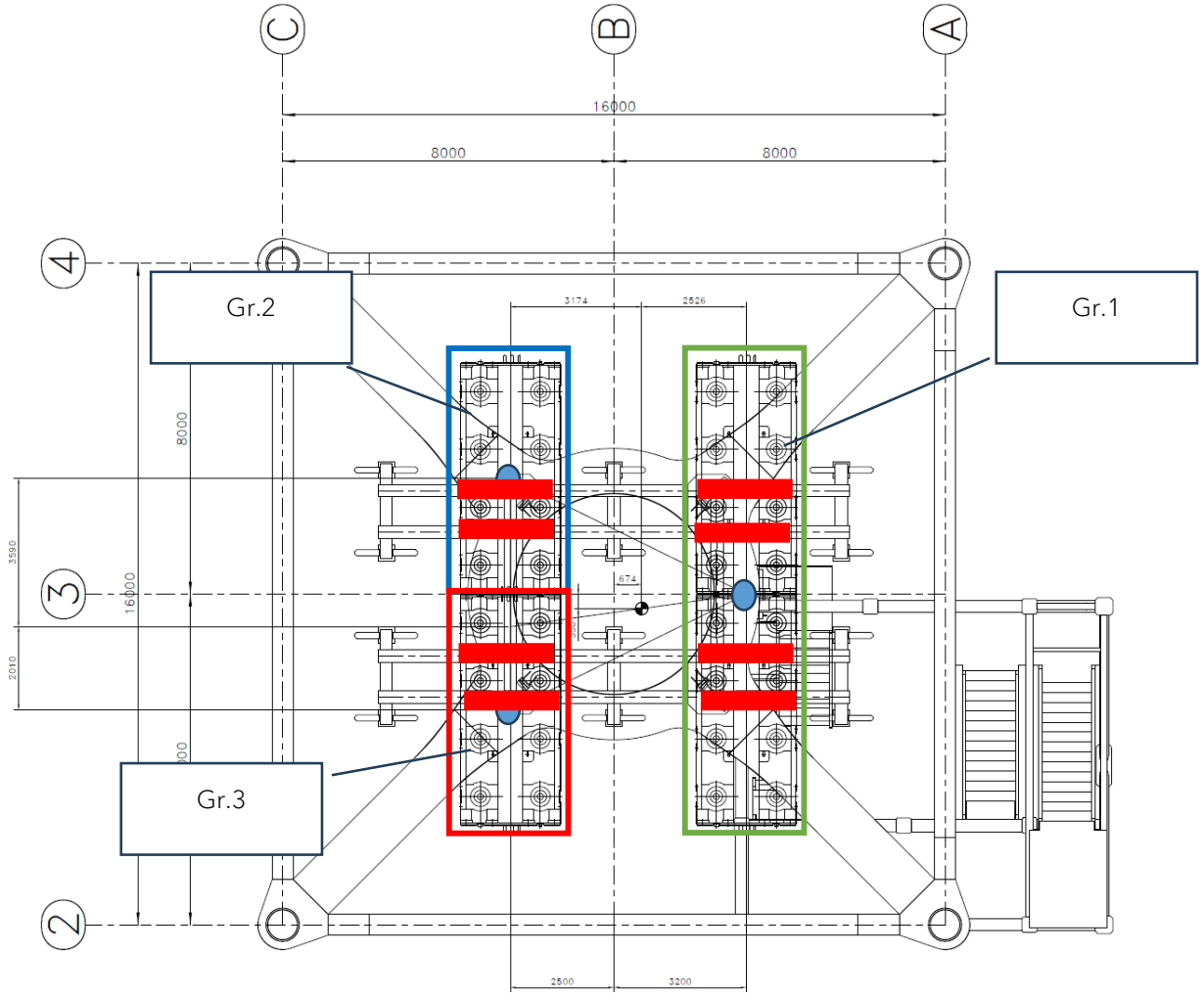


Figure 6.2 – Load out Arrangement and Group names

7 MATERIALS

7.1 STRUCTURAL STEEL PROPERTIES

For the structural analyses, steel types and grades to be used for the platform structures are summarised in Table 7.1 and specified in Ref. /17/. The material selection criteria are based on the requirements of ISO 19906:2019, ISO 19902:2020 and ISO 19901-3:2014. The materials are in accordance with the EN standard 10225:2019 and 10025:2019 and are suitable for plates, rolled sections and welded / seamless tubulars.

			EN10025-3	ISO EN 19902:2020						
Design Class	**Complexity**	**SQL**	**Hot rolled bar**	**Plates and Welded Tubular**	**Sections**	**SMLS pipes**	**THK**	**CVN inpact test**	**Material Designation**	**List of Options (EN10225-1 to -4) & EN10025-3**
DC1 TP to monopile flange connection	High	**I (Z properties)**	EN 10025 S420 NL	NA	NA	NA	t > 50	-40	DC1-I-420-40_Z	1, 2, 3, 4, 6, 12, 18, 24, 30
DC1 Complex lift-nodes and element connection to topside, Lift points, main complex joints	High	**I (Z properties)**	NA	EN 10225 S420 QLO / ML	NA	NA	25 < t <= 50	-40	DC1-I-420-40_Z	2, 7, 8, 11, 12, 17, 18
							t > 50	-40		
DC2 simple joints, primary deck girders and beams of Topside and TP, column and diagonal to lift points, main columns, Davit crane support, Bolts	Low	**II**	NA	EN 10225 S420 QLO / MLO	NA	NA	t < = 12	0	NA	-
							12 < t <= 25	-20	DC2-II-420-20	2, 7, 8, 11 17 for t > 40mm
							25 < t <= 50	-40	DC2-II-420-40	
							t > 50	-40		
DC3 all other columns and diagonals, stiffeners, Secondary deck beams, Grillage and sea fastening	High	**II**	NA	EN 10225 S355 NLO / MLO	EN 10025 S355 MLO	EN 10225 S355 NLHHO / QLHHO API 5L X52	t < = 12	0	DC3-II-355-0 / DC3-II-X52-0	2, 7, 8 11 for plate 17 for t > 40mm
							12 < t <= 25	-20	DC3-II-355-20 / DC3-II-X52-20	
							25 < t <= 50	-40	DC3-II-355-40 / DC3-II-X52-40	
							t > 50	-40		
DC4 Equipment and vessel supports, modules supports, equipment fixing bolts	Low	**III**	NA	EN 10025 S355 J2	EN 10025 S355 J2	API 5L X52 EN 10210 S355 J2H	t < = 12	0	DC4-III-355-0 / DC4-III-X52-0 / DC4-III-X60-0	-
							12 < t <= 25	0		
DC5 floor plating, grating, Walkways, stairs, handrails	Any	**IV**	NA	EN 10025 S235 JR EN 10025 S275 J0 EN 10025 S355 J0	EN 10025 S235 JR EN 10025 S275 J0 EN 10025 S355 J0	API 5L Gr.B EN 10210 S235 JRH / EN 10210 S275 J0H / EN 10210 S355 J0H	t < = 12	10	DC5-IV-235-10 / DC5-IV-275-10 / DC5-IV-355-10 / DC5-IV-GRB-10	-
							12 < t <= 25	10		

Table 7.1 - Material Selection, Ref /17/

Mechanical properties for structural materials are presented in Table 8-2, Table 8-3 and Table 8-4.

- Young's Modulus = 205,000 N/mm^2
- Density = 7850 kg/m^3
- Poisson's Ratio = 0.3

Thickness (mm)	Min. Tensile Strength (N/mm^2)	Min. Yield Strength (N/mm2)	Steel Type (1)
t ≤ 16	500	420	I & II
16 < t ≤ 40	500	400	I & II
40 < t ≤ 63	480	390	I & II
63 < t ≤ 100	480	380	I & II
Note: 1) Type I steel has Z (through the thickness) properties.			

Table 7.2 – Mechanical properties of Plates

Thickness (mm)	Min. Tensile Strength (N/mm²)	Min. Yield Strength (N/mm2)	Steel Type
t ≤ 20	460	355	III
20 < t ≤ 40	460	345	III

Table 7.3 – Mechanical properties of Structural Seamless Tubulars

Thickness (mm)	Min. Tensile Strength (N/mm2)	Min. Yield Strength (N/mm2)	Steel Type
t ≤ 16	460/360	355/275	IV
16 < t ≤ 40	460	345	IV

Table 7.4 – Mechanical properties for Structural Sections

7.2 PLATING

Plate thicknesses for primary structural steel starts at a minimum of 10 mm and increase in 5 mm steps Secondary steel lower and upper deck plates are 8 mm thick and 10mm for laydown areas for Dropped Object Protection (DOP).

Blast walls are not to be provided on a hydrogen processing facility, as free ventilation and free explosion venting is more important, and supportable, than obstruction walls.

7.3 GRATING

Gratings are characterized by bearing bars 30 mm x 5 mm and mesh 30 mm x 50 mm.

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8 DESIGN CRITERIA AND REQUIREMENTS

8.1 GENERAL

Structures in SOW are designed in accordance with limit states approach of ISO codes 19901 and 19902, Refs./2/, /3/and /6/. For non-tubular sections, Eurocode, Ref./8/, is adopted.

Member forces and moments derived from the global analyses are used for checking member strength and stability, and joint strength.

8.2 PARTIAL RESISTANCE FACTORS

8.2.1 Partial Resistance Factors for Tubular Sections:

The partial resistance factors for tubular sections from ISO 19902, Ref./6/, are listed below.

Resistance factor	Value	Definition
$\gamma_{R,t}$	1.05	Partial resistance factor for axial tensile strength
$\gamma_{R,c}$	1.18	Partial resistance factor for axial compressive strength
$\gamma_{R,b}$	1.05	Partial resistance factor for bending strength
$\gamma_{R,v}$	1.05	Partial resistance factor for shear strength
$\gamma_{R,h}$	1.25	Partial resistance factor for hoop buckling strength

Table 8.1- Resistance Factors for Tubular Sections

8.2.2 Partial Resistance Factors for Non-tubular Sections

The partial resistance factors for non-tubular sections from Eurocode 3, Ref./8/, are listed below.

Resistance factor	Value	Definition
Resistance of members and cross sections		
γ_{M0}	1.00	Cross-section resistance to excessive yield strain including local buckling
γ_{M1}	1.00	Resistance of unstable elements measured during element inspection
γ_{M2}	1.25	Tensile cross-section resistance to mechanical breakdown
Resistance of connections		
γ_{M2}	1.25	Bolts, rivets, pins, welds and slabs on supporting surface
γ_{M3}	1.25	Sliding resistance at Ultimate Limit State Category C

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$\gamma_{M3,SER}$	1.10	Sliding resistance at Serviceability Limit State
γ_{M4}	1.10	Injection bolt collapse resistance
γ_{M5}	1.10	Resistance of connections in open lattice trusses
$\gamma_{M6,SER}$	1.00	Resistance of pins at Serviceability Limit State
γ_{M7}	1.10	Preload of high strength bolts

Table 8.2- Resistance for Non Tubular Section

8.2.3 Partial Resistance Factors for Tubular Joints Check

The partial resistance factors for tubular joints checks are provided in following table.

Resistance factor	Value	Definition
$\gamma_{R,j}$	1.05	Partial resistance factor for joints
$\gamma_{z,j}$	1.17	Additional partial resistance factor for members during joint pre-strain collapse

Table 8.3 - Resistance Factors for Tubular Joints

8.3 LOAD CLASSIFICATIONS

Design loads are classified as either global or local within ISO 19901-3, Ref. /3/ and ISO 19902, Ref./6/ and summarized in Table 8.4.

Load Type	ISO Designation	Description
Permanent (Dead)	G1	Structure self-weight; Equipment & piping dry weight;
Permanent (Dead)	G2	permanent action imposed on the topsides structure by self-weight of equipment and other objects, bulk loads
Variable (Live)	Q1	Equipment & piping contents weight
Transient	T	Transient Loads for Pre-Service Analyses

Table 8.4 - ISO Loads Classification

8.4 PARTIAL ACTION FACTORS

8.4.1 Partial Action Factors for Pre-Service Analyses

Partial Action Factors for Pre-Service analysis (e.g. Lifting, Transportation, Load-out) conditions are shown in Table 8.5 with reference to three design situations, where:

- G_T are the permanent actions during the transient situation.
- Q_T are the variable actions during the transient situation.
- T represents the actions from the transient situation being considered.

SITUATION	ACTION		
	Permanent (GT)	Variable (QT)	Transient (T)
1	1.3	1.3	1.0
2	1.1	1.1	1.35
3	0.95	0.9	1.35

Table 8.5 – Partial action factors for Pre-service Analyses

8.5 ACCEPTANCE CRITERIA

The maximum member Unity Check (UC) will be less than unity.

9 STRUCTURAL ANALYSIS

9.1 STRUCTURAL MODEL

The software SACS™, ref./24/, is used for all global analyses of the structures in the SOW. The structural model of the Transition piece is shown here below, and it is based on transportation analysis model, ref. /20/.

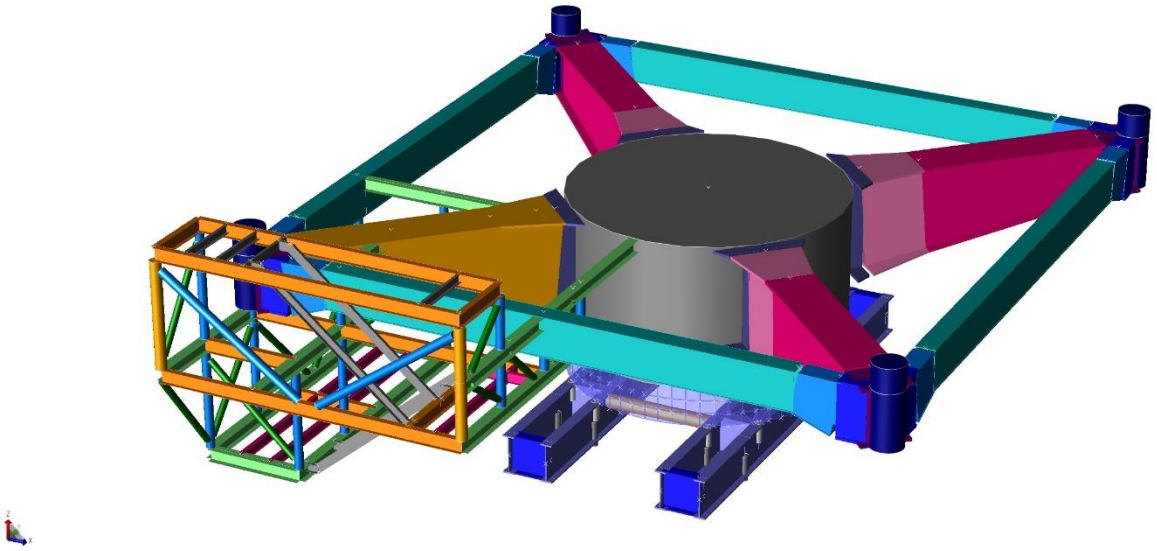


Figure 9.1 – Transition piece structural model

The SACS reference system is in the center of the TP with X dir along Row B and Y-dir along Rows A2/4. Z is measured from yard El.

9.1.1 Boundary Conditions

The SPMTS reactions are applied in Z-positive below the bottom flanges of upper grillages beams, according to the hydraulic scheme. To avoid numerical instability in vertical direction of the SACS model, n.4 soft vertical springs (k=100 kN/m) have been introduced at the top of the 4 main legs.

Horizontal (isostatic) restrains have been applied to avoid numerical instability too.

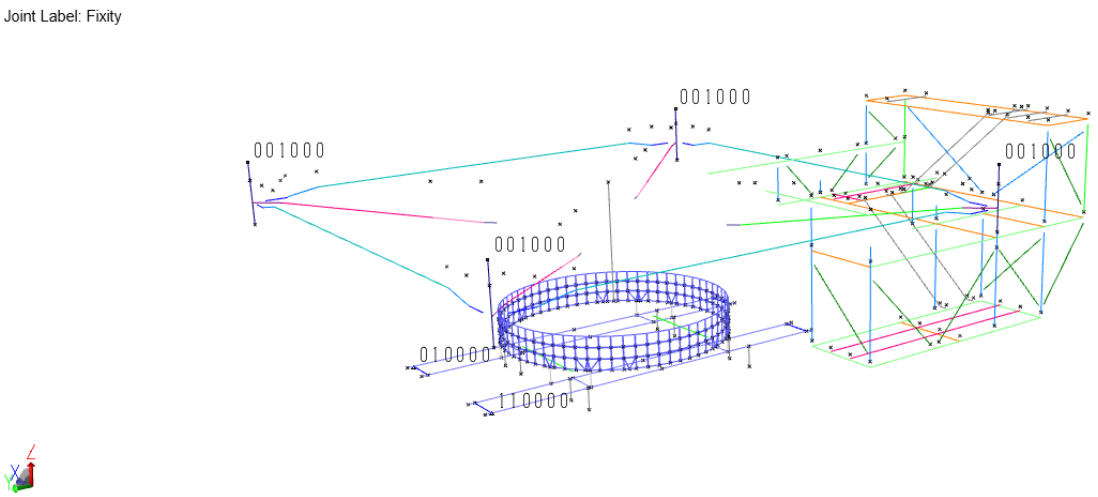


Figure 9.2 - TP fixity/restraints

JOINT ID	Fixity	Comment
TU04	001000	vertical spring Z-dir k=100 kN/m
TU03	001000	vertical spring Z-dir k=100 kN/m
TU02	001000	vertical spring Z-dir k=100 kN/m
TU01	001000	vertical spring Z-dir k=100 kN/m

Table 9.1 - TP springs

JOINT ID	Fixity	Comment
R101	110000	Fixed in X and Y
R401	010000	Fixed in Y

Table 9.2 - TP restraints

9.1.2 Transition Piece – Grillage Connection

The connection between TP and Upper Grillage is modelled as per following:

- 4 rigid dummy elements transmitting vertical loads only (Fz) through member release in correspondence of joints connected to shell elements of TP main column (011111). Dummy elements are located in correspondence of contact area of TP on upper grillage TOS (BLUE);
- 4 rigid dummy elements transmitting vertical loads and shears (Fz, Fy and Fz) through member release in correspondence of joints connected to shell elements of TP main column (- 000111). Dummy elements are located in correspondence of TP stoppers at upper grillage TOS (RED).

Dummy elements and respective end joints and releases are represented in following figure

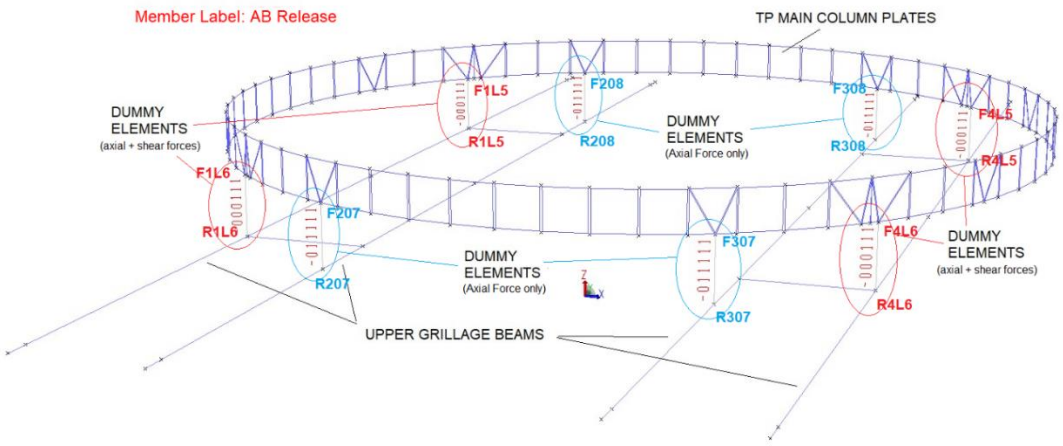


Figure 9-3 - TP-Upper Grillage connection - dummy elements (joint labels and member end release)

10 BASIC LOAD CASES

All the design loads have defined according to the Weight Control Report and Plot Plans, Ref./15/ and /16/, in terms of weights, CoG position and contingency factors. The datum for weight reporting is different to that for the SACS structural analysis. The origin for the weight reporting is at gridline intersection C1 at LAT.

10.1 PERMANENT ACTIONS

10.1.1 Modelled structural dead weights

Dead weights of the modelled structures have been automatically evaluated by SACS and included in following basic load conditions.

- Load condition DZTP: Modelled structures total weight

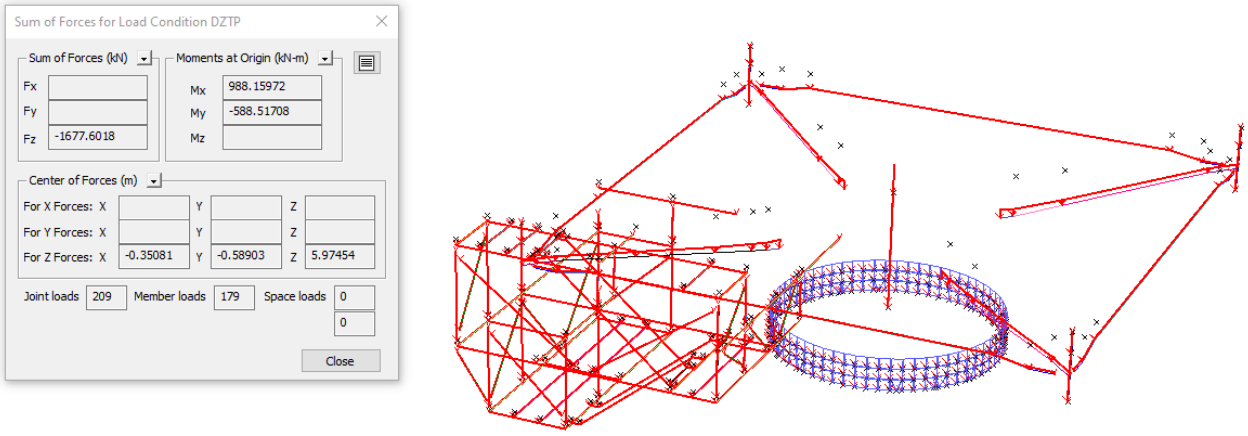


Figure 10.1 – TP basic load condition DZTP

- Load condition UPGR: dead weight of modelled structures of Upper Grillage

The dead weights of modelled structures of upper grillage are included within basic load condition UPGR.

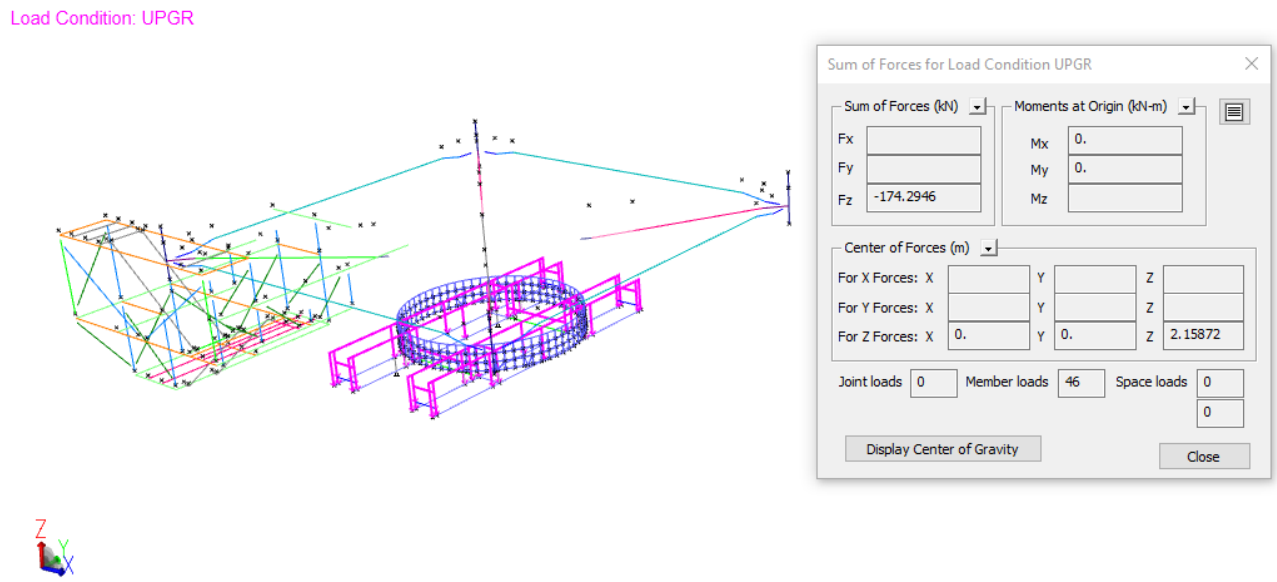


Figure 10.2 – TP basic load condition UPGR

10.1.2 Not modelled structural dead weights

Following basic Load conditions have been defined for not modelled structural dead weights.

- Load condition: WFLO FLOORING AND GRATING PERMANENT LOADS

Flooring and grating weights have been defined in SACS load combination WFLO

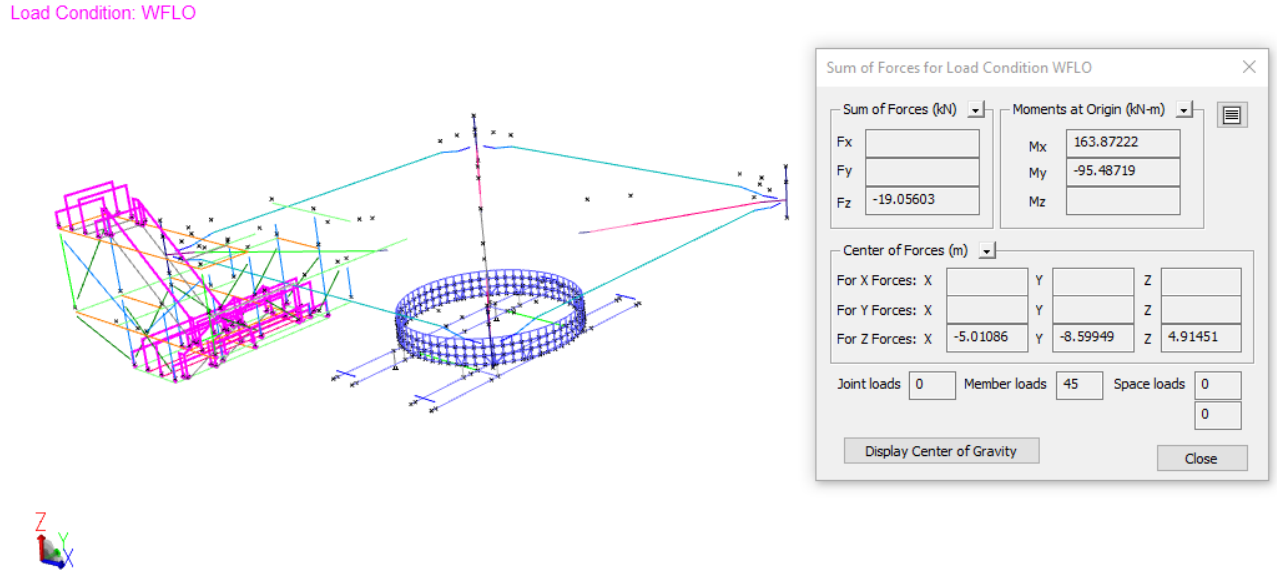


Figure 10.3 – TP basic load conditions WFLO

- Load condition WPER: SECONDARY STRUCTURES PERMANENT LOADS

Not modelled structural weights based on WCR, ref./15/.

PERMANENT STRUCTURAL WEIGHTS - WPER - TP		
LOAD ID	**W**	**Description**
[-]	**[kN]**	
ST_GUIDE	40	Stabbing Guides
HR_ST_TP	20	Hand Rails
PF_BOTFL	90	Bottom MP Flange Weight
ACCWLK_T	10	access stair to MP pltf
SACS LOAD COND.	**159.6**	**Not Modelled Permanent Structural Weights**

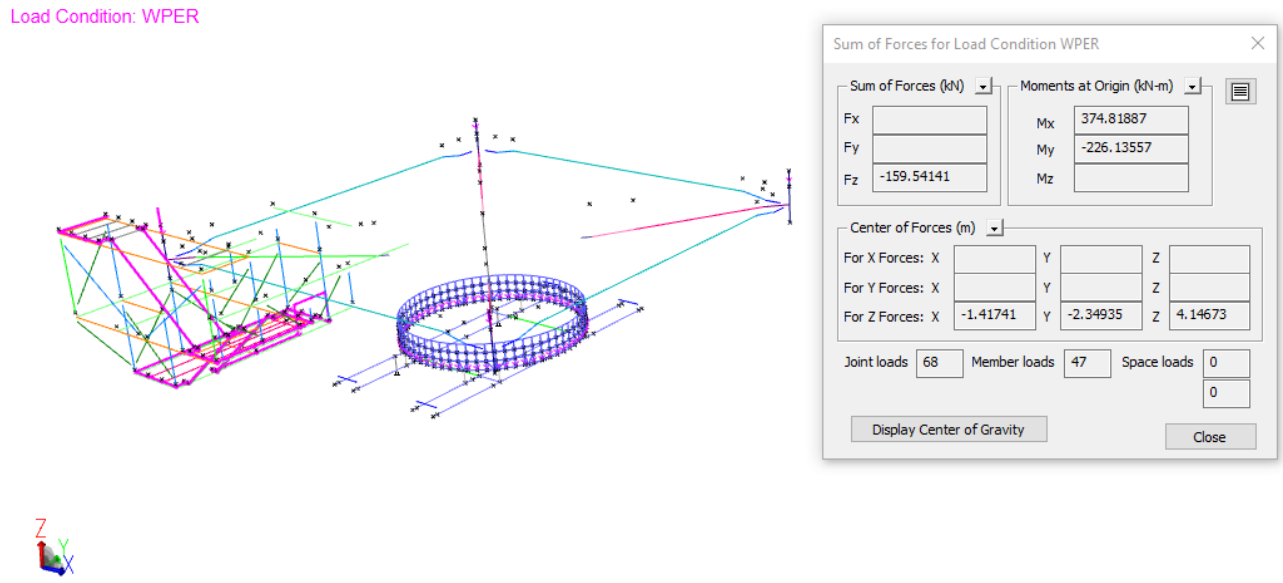


Figure 10.4 – Load Condition WPER

These loads include dry weight Transition Piece process/utility equipment and electrical & instrumentation equipment and other objects permanently mounted on the structure that do not change with the mode of operation.

- Load condition MECD: EQUIPMENT DRY WEIGHTS (contingency included)

Transition Piece's Equipment dry weights, already including 12% contingency have been included in load condition MECD.

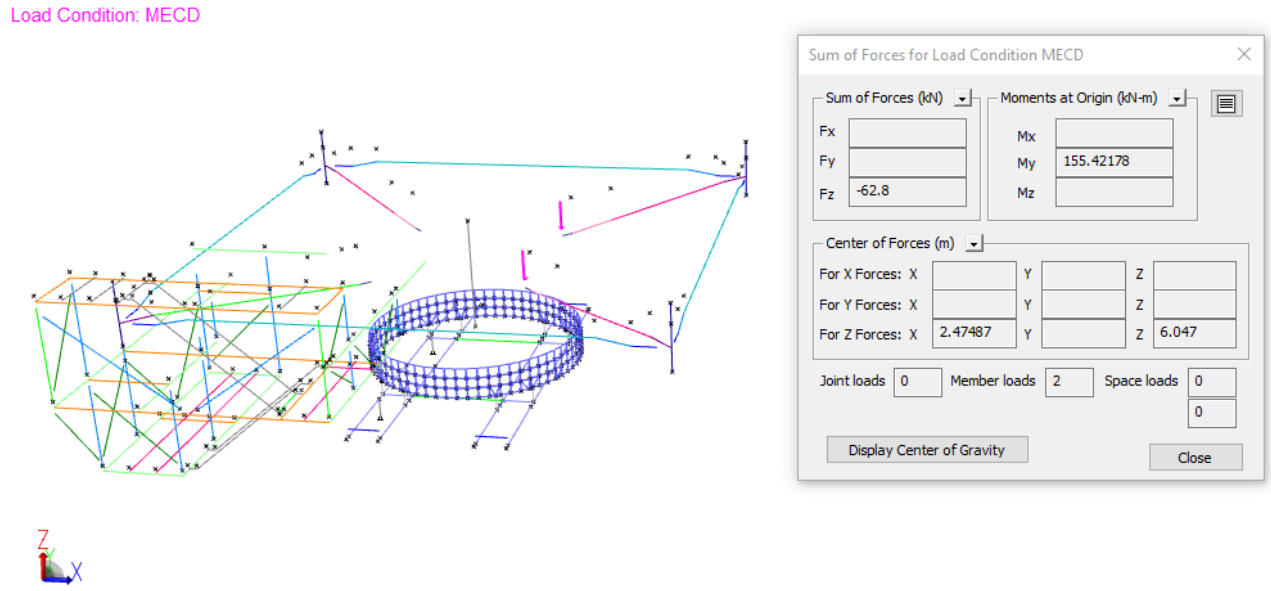


Figure 10.5 - Load Condition MECD

10.1.3 Installation aids and rigging weights

Basic load condition RIGG has been included in the structural model to account for installation aids and rigging weights (slings, shackles and temporary handrails):

PERMANENT STRUCTURAL WEIGHTS - RIGG - TP		
LOAD ID	**W**	**Description**
[-]	**[kN]**	
SHACKLES	12	Stabbing Guides
SLINGS	100	Slings
TMP_HANR	40	Bottom MP Flange Weight
SACS LOAD CONDITION	**152.0**	**Not Modelled Permanent Structural Weights**

- Load condition RIGG: installation aids and rigging weights

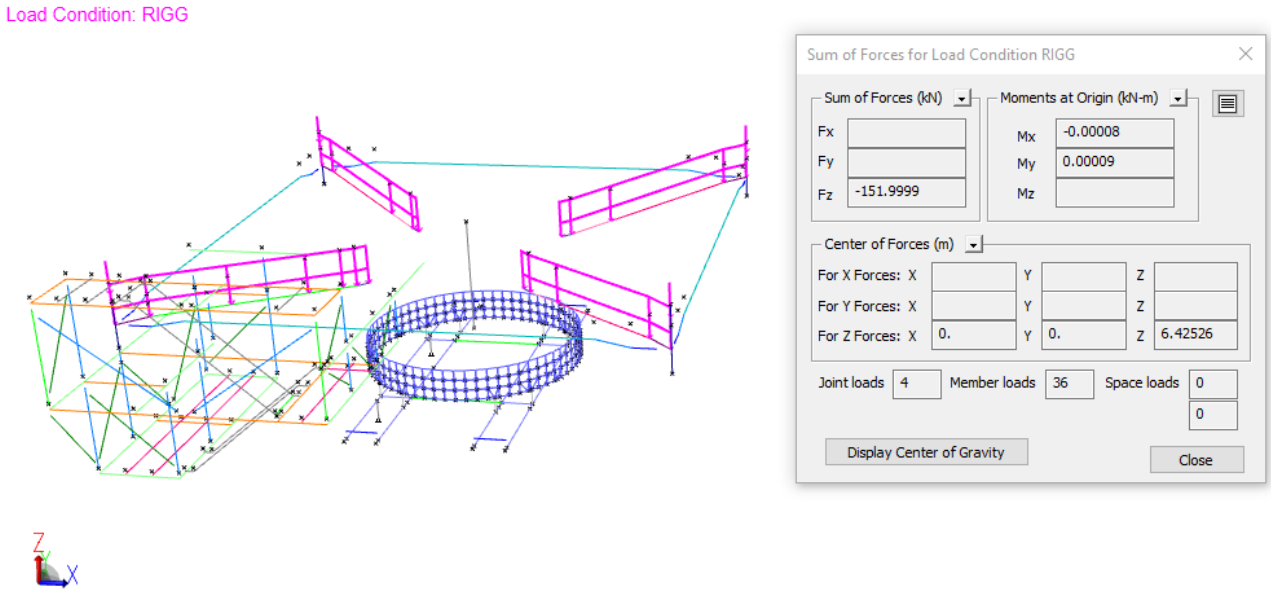


Figure 10.6 - TP basic load conditions RIGG

10.1.4 Permanent Actions Basic Load Combination

Permanent actions basic load cases have been combined in load combination G001 accounting for different weight contingencies of basic load conditions.

Permanent Loads – Basic Load combination G001		
Basic Load Cases	Description	Load Factors
DZTP	TP MODELLED STRUCTURE DEAD WEIGHTS	1.30
WFLO	FLOORING AND GRATING PERMANENT LOADS	1.10
WPER	SECONDARY STRUCTURES PERMANENTS LOADS	1.10
MECD	EQUIPMENT DRY WEIGHTS (cont. included)	1.00

Table 10.1 - Permanent Actions - Basic Load Combination

Following SACS excerpt details the basic load conditions and load combination G001 resultant, accounting for gross permanent weights.

```
                                   ************* SEASTATE LOAD CASE CENTER REPORT *************
                                                   RELATIVE TO STRUCTURAL ORIGIN
LOAD          ********* X - DIRECTION *********      ********* Y - DIRECTION *********      ********* Z - DIRECTION *********
LABEL         FORCE       X         Y         Z       FORCE       X         Y         Z       FORCE       X         Y         Z
                (KN)      (M)       (M)       (M)       (KN)      (M)       (M)       (M)       (KN)      (M)       (M)       (M)
```

DZTP	0.00	0.00	-1677.60	-0.35	-0.59	5.97
WFLO	0.00	0.00	-19.06	-5.01	-8.60	4.91
WPER	0.00	0.00	-159.54	-1.42	-2.35	4.15
MECD	0.00	0.00	-62.80	2.47	0.00	6.05
G001	0.00	0.00	-2440.14	-0.39	-0.77	5.84

10.2 WCR – STRUCTURAL MODEL COMPARISON

Load combination G002 includes maximum permanent loads summed up in G001 with grillage, installation aids and rigging weights for TP in loadout condition.

TP in Loadout conditions – Load combination G002		
Basic Load Cases	Description	Load Factors
G001	TP PERMANENT LOAD BASIC COMBINATION	1.00
RIGG	RIGGING AND INSTALLATION AIDS	1.10
UPGR	UPPER GRILLAGE WEIGHT	1.05

Table 10.2 – Loadout Basic Combination G002

TPLO combination is generated starting from G002 and it is defined as per following table to cross check the WCR report, using a multiplication factor of 1.062.

TP in Loadout conditions – Load combination TPLO		
G002	TP LOADOUT COMBINATION	1.062

Table 10.3 – Loadout Basic Combination TPLO

	********** SEASTATE LOAD CASE CENTER REPORT **********											
	RELATIVE TO STRUCTURAL ORIGIN											
LOAD	********* X - DIRECTION *********				********* Y - DIRECTION *********				********* Z - DIRECTION *********			
LABEL	FORCE (KN)	X (M)	Y (M)	Z (M)	FORCE (KN)	X (M)	Y (M)	Z (M)	FORCE (KN)	X (M)	Y (M)	Z (M)
G002	0.00				0.00				-2792.76	-0.34	-0.67	5.63
TPLO	0.00				0.00				-2965.91	-0.34	-0.67	5.63

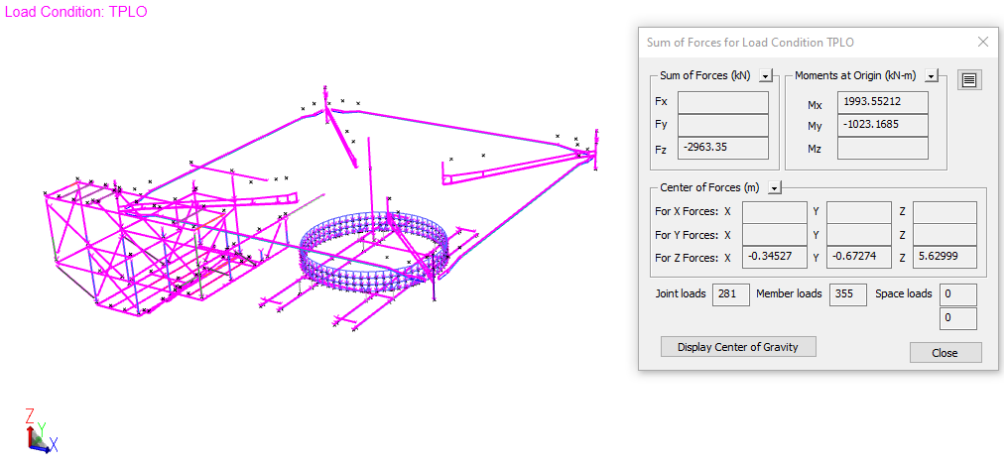


Figure 10.7 - TP basic load combination of permanent actions TPLO

COG location comparison between current structural model for Loadout Analysis and WCR is reported in following table.

WCR - TP in Loadout conditions				
WCR values	Fz	X	Y	Z
	[t]	[mm]	[mm]	[mm]
TP	246	-248	-559	5871
TP LOADOUT	285	-214	-483	5668
TP WCR	302	-300	-500	5800

SACS Model - TP in loadout conditions					
SACS Load comb.	Fz [kN]	Fz [t]	X [mm]	Y [mm]	Z [mm]
G001	2440.14	248.74	-390	-770	5840
G002	2785.39	283.93	-350	-670	5630
TPLO	2963.35	302.07	-350	-670	5630

SACS-WCR - TP in loadout conditions - Weight Comparison							
ΔFz [t]	ΔFz [%]	ΔX [mm]	ΔY [mm]	ΔZ [mm]	ΔX [%]	ΔY [%]	ΔZ [%]
2.56	1.04%	-142	-200	-34	-1%	-1%	0%
-2.25	-0.79%	-136	-180	-51	-1%	-1%	-1%
0.07	0.02%	-150	-170	-70	-1%	-1%	-1%

Table 10-4 – SACS-WCR CoG comparison

10.3 TRANSIENT LOADS

10.3.1 Wind loads

Loadout will be performed in good environmental conditions, with limited wind speed. This will be reflected in loadout manual. As per RM yard instruction wind speed is limited to 10 m/s.

10.4 SPMT'S LOADS

For each SPMT group (hydraulic circuit) the total amount of load is uniformly distributed along the SPMT's spine beam, consequently it is transferred to transition piece structure at connection points.

LOAD COMB	Hydraulic circuit 1 [t]	Hydraulic circuit 2 [t]	Hydraulic circuit 3 [t]
SPMT	168.2	48	85.8
Load T/m	*168.2/11.2m = 15*	*48/5.6 = 8.57*	*85.8/5.6 = 15.32*

Table 10.5 - Applied load to SPMT's spine beam. Spine beam modelled length = 11.2m

```
************* SEASTATE LOAD CASE CENTER REPORT ************
                RELATIVE TO STRUCTURAL ORIGIN

LOAD      ******** X - DIRECTION *********      ********* Y - DIRECTION *********      ********* Z - DIRECTION *******
LABEL     FORCE      X          Y          Z      FORCE      X          Y          Z      FORCE      X          Y          Z
            (KN)     (M)        (M)        (M)      (KN)     (M)        (M)        (M)      (KN)     (M)        (M)        (M)

HCG1       0.00                                    0.00                                 1649.98     0.00      -3.20       0.90
HCG2       0.00                                    0.00                                  470.96     2.80       2.50       0.90
HCG3       0.00                                    0.00                                  841.51    -2.80       2.50       0.90
```

- Load condition HCG1: HYDRAULIC CIRCUIT GROUP 1

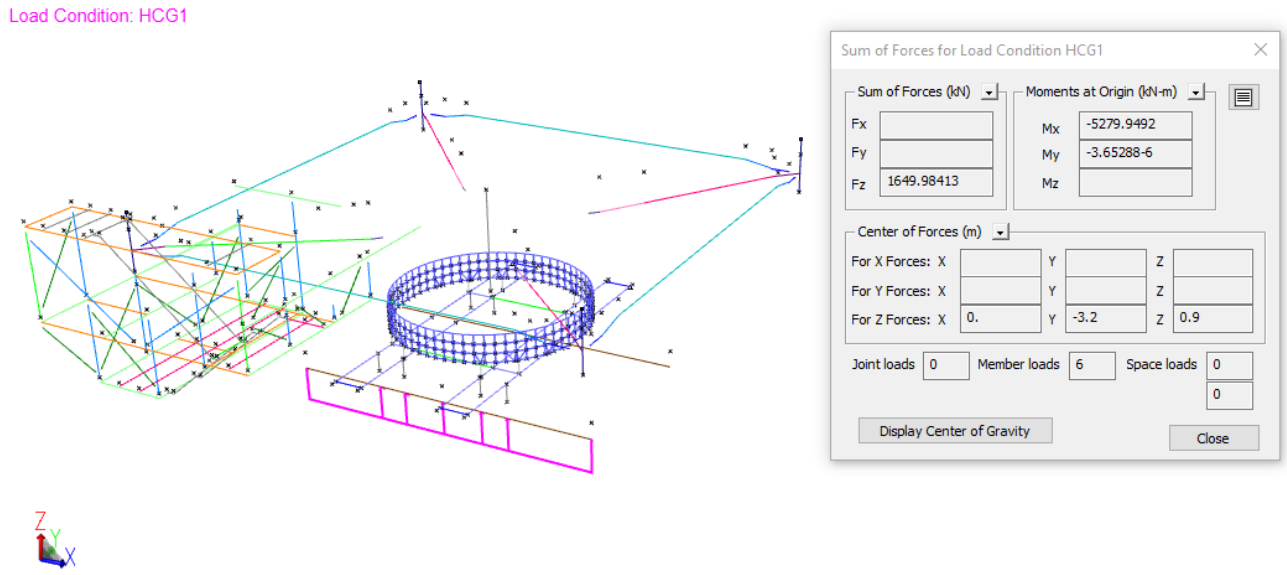


Figure 10.8 - HCG1 load case

- Load condition HCG2: HYDRAULIC CIRCUIT GROUP 2

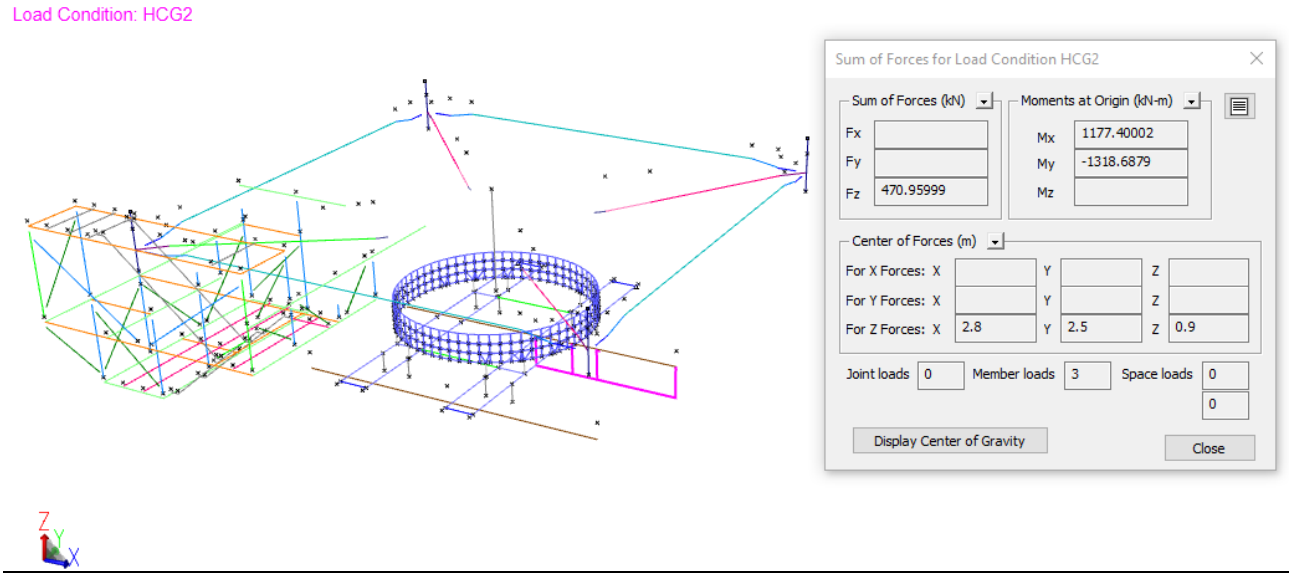


Figure 10.9 – HCG2 load case

- Load condition HCG3: HYDRAULIC CIRCUIT GROUP 3

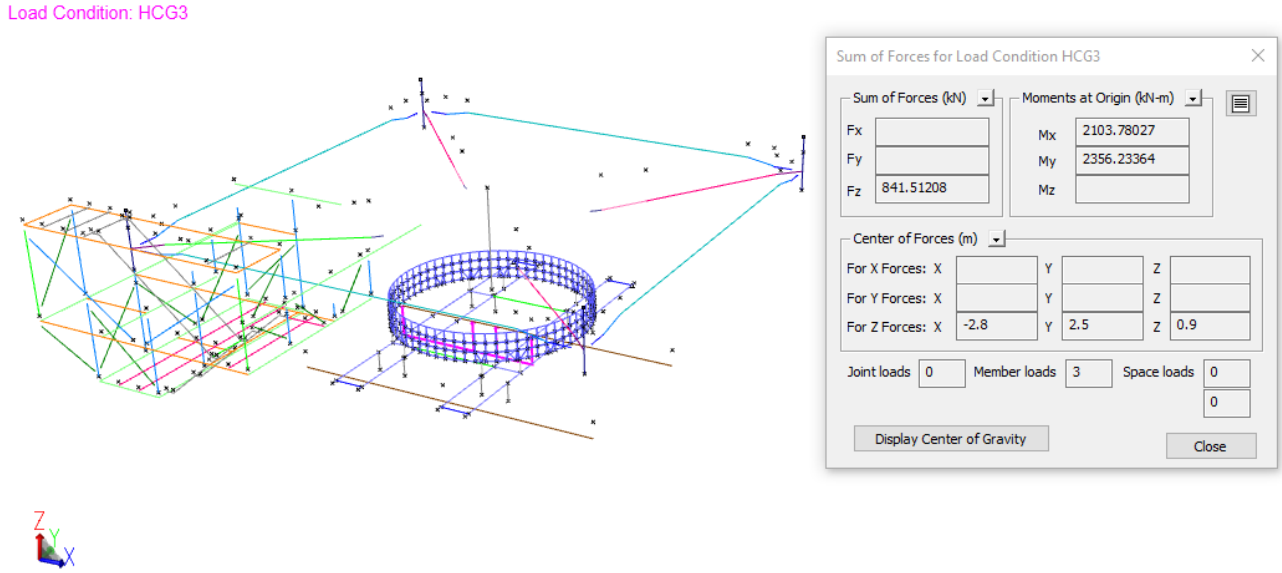


Figure 10.10 – HCG3 load case

11 LOAD COMBINATIONS

11.1 BASIC LOAD COMBINATIONS

The Transition Piece Weight Load Out combination (TPLO) accounts for all the vertical load to be moved out to the transportation barge, while SPMT combination summarizes the uplift forces generated by trailers.

Comb	TPLO	HCG1	HCG2	HCG3
SPMT	-	1.000	1.000	1.000
TEST	1.000	1.000	1.000	1.000

Following excerpt of SACS output provides the basic load combinations resultants, with combination TEST generated to verify the vertical resultant is null.

```
                    ************* SEASTATE LOAD CASE CENTER REPORT ************
                                   RELATIVE TO STRUCTURAL ORIGIN

LOAD      ********* X - DIRECTION ********      ********* Y - DIRECTION *******      ******** Z - DIRECTION *******
LABEL     FORCE      X         Y         Z      FORCE      X         Y         Z      FORCE      X         Y         Z
            (KN)     (M)       (M)       (M)      (KN)     (M)       (M)       (M)      (KN)     (M)       (M)       (M)


TPLO        0.00                                  0.00                                -2965.91    -0.34     -0.67      5.63
SPMT        0.00                                  0.00                                 2962.46    -0.35     -0.67      0.90
TEST        0.00                                  0.00                                   -3.45     4.16     -0.40   4061.88
```

11.2 LOAD OUT COMBINATIONS

The load out combinations were defined according to section 8.4.

Comb	TPLO	SPMT	
LOD1	1.300	1.300	Load out situation 1
LOD2	1.100	1.100	Load out situation 2
LOD3	0.900	0.900	Load out situation 3

Following excerpt from SACS output provide the Load out Combinations resultants.

```
                    ************* SEASTATE LOAD CASE CENTER REPORT ************
                                   RELATIVE TO STRUCTURAL ORIGIN

  LOAD      ******** X - DIRECTION *********      ********* Y - DIRECTION *********      ******** Z - DIRECTION *******
  LABEL     FORCE      X         Y         Z      FORCE      X         Y         Z      FORCE      X         Y         Z
              (KN)     (M)       (M)       (M)      (KN)     (M)       (M)       (M)      (KN)     (M)       (M)       (M)

LOD1        0.00                                  0.00                                  -4.49     4.16     -0.40   4061.82

LOD2        0.00                                  0.00                                  -3.80     4.16     -0.40   4061.86

LOD3        0.00                                  0.00                                  -3.11     4.16     -0.40   4061.91
```

Following excerpt from SACS output provide the horizontal restraints reactions and springs vertical reactions

SACS-IV SYSTEM FIXED JOINTS REACTION FORCES AND MOMENTS

JOINT NUMBER	LOAD CASE	FORCE(X) KN	FORCE(Y) KN	FORCE(Z) KN	MOMENT(X) KN-M	MOMENT(Y) KN-M	MOMENT(Z) KN-M
R101	LOD1	0.000	-0.000	0.000	0.000	0.000	0.000
	LOD2	-0.000	-0.000	0.000	0.000	0.000	0.000
	LOD3	0.000	-0.000	0.000	0.000	0.000	0.000
R401	LOD1	0.000	0.000	0.000	0.000	0.000	0.000
	LOD2	0.000	0.000	0.000	0.000	0.000	0.000
	LOD3	0.000	0.000	0.000	0.000	0.000	0.000

SACS-IV SYSTEM SPRING FORCES AND MOMENTS

JOINT	LOAD CASE	COORD. SYS.	FORCES X (KN)	FORCES Y (KN)	FORCES Z (KN)	MOMENTS X (KN-M)	MOMENTS Y (KN-M)	MOMENTS Z (KN-M)
TU04	LOD1	GLOB	0.000	0.000	-1.672	0.000	0.000	0.000
	LOD2	GLOB	0.000	0.000	-1.406	0.000	0.000	0.000
	LOD3	GLOB	0.000	0.000	-1.153	0.000	0.000	0.000
TU01	LOD1	GLOB	0.000	0.000	-0.465	0.000	0.000	0.000
	LOD2	GLOB	0.000	0.000	-0.387	0.000	0.000	0.000
	LOD3	GLOB	0.000	0.000	-0.318	0.000	0.000	0.000
TU03	LOD1	GLOB	0.000	0.000	-1.745	0.000	0.000	0.000
	LOD2	GLOB	0.000	0.000	-1.469	0.000	0.000	0.000
	LOD3	GLOB	0.000	0.000	-1.203	0.000	0.000	0.000
TU02	LOD1	GLOB	0.000	0.000	-0.614	0.000	0.000	0.000
	LOD2	GLOB	0.000	0.000	-0.513	0.000	0.000	0.000
	LOD3	GLOB	0.000	0.000	-0.420	0.000	0.000	0.000

SACS-IV SYSTEM SPRING FORCES AND MOMENTS SUMMARY

LOAD CASE	COORD. SYS.	FORCES X (KN)	FORCES Y (KN)	FORCES Z (KN)	MOMENTS X (KN-M)	MOMENTS Y (KN-M)	MOMENTS Z (KN-M)
LOD1	GLOB	0.000	0.000	-4.497			
LOD2	GLOB	0.000	0.000	-3.775			
LOD3	GLOB	0.000	0.000	-3.094			

12 ANALYSIS RESULTS

This section presents the results of the performed Load Out analysis in terms of:

- Structural checks of structural members.
- Structural checks of tubular connections.

12.1 STRUCTURAL CHECKS

The results of the performed analysis in terms of members' Unity Check (UC) and Joints' Punching Shear Unity Checks are detailed in the following.

12.1.1 Member checks

All members were checked according to ISO 19902 and Eurocode 3, Ref./6/and /8/, respectively for tubular and non-tubular elements. Members' code checks are reported in the following and show that the structure can withstand all load combinations, with utilization factors below 1.0.

```
     SACS-IV   MEMBER UNITY CHECK RANGE SUMMARY
GROUP II  - UNITY CHECKS GREATER THAN    0.70 AND LESS THAN    0.90
   ** NO UNITY CHECKS IN THIS GROUP **

     SACS-IV   MEMBER UNITY CHECK RANGE SUMMARY
GROUP III - UNITY CHECKS GREATER THAN    0.90 AND LESS THAN  999.00
   ** NO UNITY CHECKS IN THIS GROUP **
```

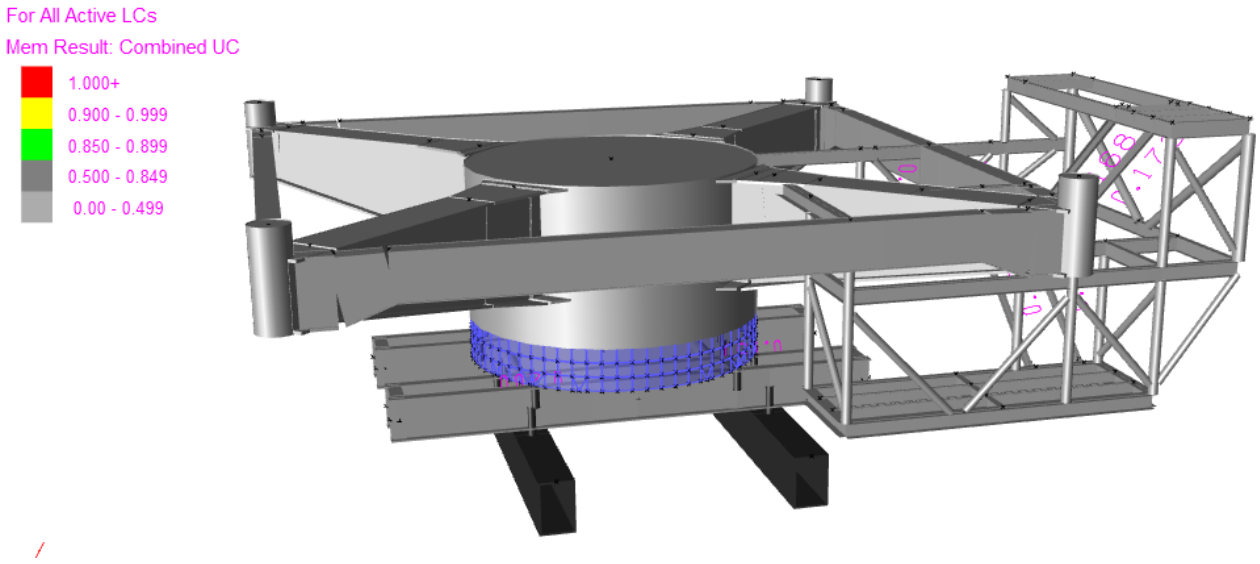


Figure 12.1 - TP Structural Model 3D view - UC>0.1

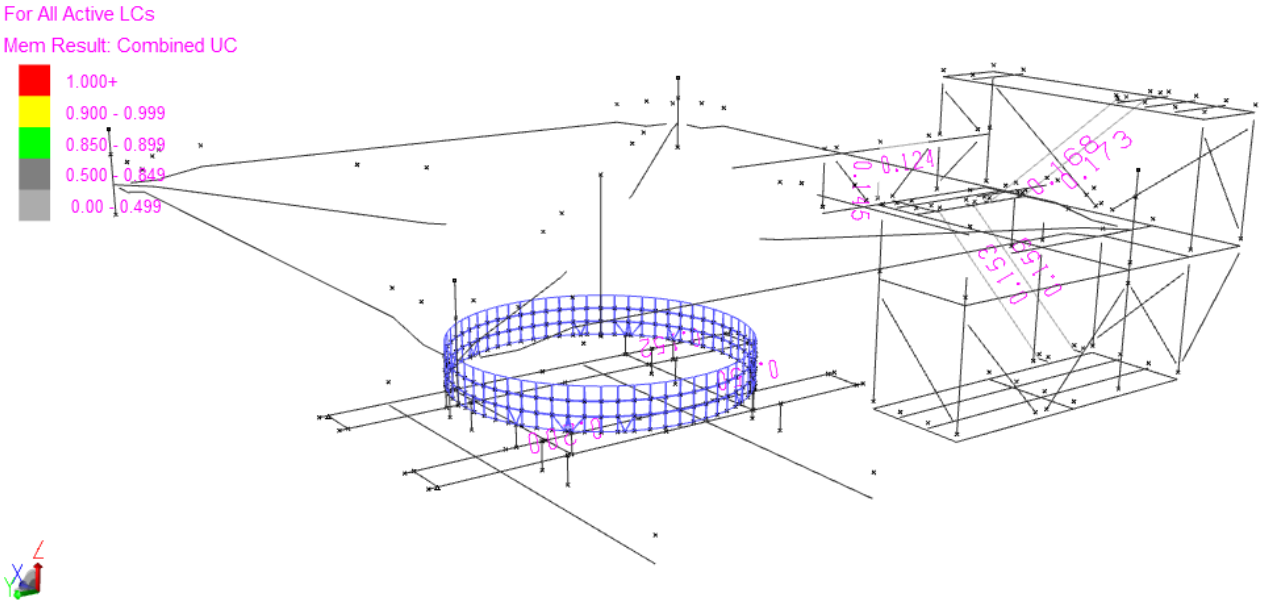


Figure 12.2 - TP Structural Model 3D view - UC>0.1

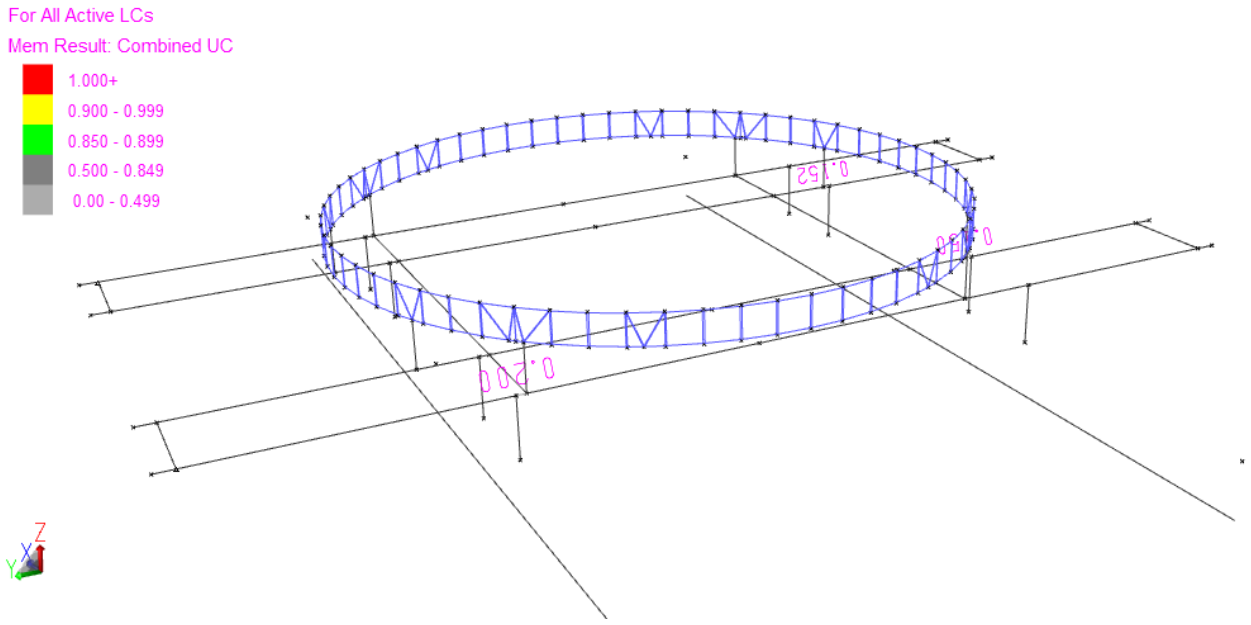


Figure 12.3 – Upper Grillage - UC>0.1

Maximum UC per member's group are reported in following SACS excerpt.

* * * M E M B E R G R O U P S U M M A R Y * * *
ISO 19902:2007 / EC3:2005
(EN 1993-1-1:2005/NA NONE)

GRUP ID	CRITICAL MEMBER	LOAD COND	MAX. UNITY CHECK	DIST FROM END M	* APPLIED STRESSES * AXIAL N/MM2	BEND-Y N/MM2	BEND-Z N/MM2	*** ALLOWABLE STRESSES *** AXIAL N/MM2	EULER N/MM2	BEND-Y N/MM2	BEND-Z N/MM2	CRIT COND	EFFECTIVE LENGTHS KLY M	KLZ M	CM * VALUES * Y	Z
HA3	SC09-SM35	LOD1	0.12	0.0	5.9	-24.6	16.1	322.7	764.3	338.6	487.7	BN+AX	1.65	3.84	0.00	0.00
IP2	SL08-SL09	LOD1	0.03	1.7	-0.4	5.3	0.0	88.9	121.5	217.7	493.1	BN+COM	3.47	3.47	1.00	1.00
IP3	SM18-SM17	LOD1	0.06	0.0	-0.0	11.9	11.1	322.7	1768.7	345.1	496.3	BN+AX	3.84	1.20	0.82	0.40
L15	SM15-SM14	LOD1	0.01	0.4	-0.1	-0.8	-0.5	190.5	673.5	249.9	249.7	BN+COM	1.20	1.20	0.00	0.00
M01	TMJ1-T000	LOD1	0.01	0.0	-2.3	-0.6	1.1	307.8	4865.8	366.6	366.6	ACBI	50.00	50.00	0.85	0.85
ST3	SM29-SM35	LOD1	0.06	1.6	-9.4	-13.0	3.0	300.8	2656.0	448.9	448.9	ACBI	1.57	1.57	0.85	0.85
ST4	SM31-SM32	LOD1	0.03	0.0	0.7	9.6	-6.8	338.1	8770.5	450.8	450.8	TN+BN	1.40	1.40	0.85	0.85
ST5	SC09-SM27	LOD1	0.14	0.4	12.8	16.0	-45.6	.3E+03	.2E+05	.5E+03	.5E+03	TN+BN	0.80	0.40	0.85	0.85
T00	T000-TA21	LOD1	0.04	0.0	-0.3	-9.9	-0.3	345.5	8109.7	363.1	589.3	WSHBUC	16.00	8.00	0.97	0.97
T01	SC09-T022	LOD1	0.04	0.0	1.3	13.9	-2.5	363.6	296.2	438.2	442.2	BN+AX	16.00	16.00	0.00	0.00
T02	TA41-TA42	LOD1	0.03	0.0	-0.5	-7.1	0.2	345.5	4689.9	365.1	589.7	WSHBUC	16.00	8.00	0.86	0.73
T03	TA42-TA43	LOD1	0.03	0.0	-0.6	-7.4	0.1	345.5	3809.8	380.2	524.8	WSHBUC	16.00	8.00	0.47	0.53
T04	TA23-TA24	LOD1	0.03	0.0	-0.6	1.3	0.5	345.5	2716.3	388.8	523.2	SHEAR	16.00	8.00	0.70	0.83
T05	T022-T019	LOD1	0.03	0.9	0.8	-11.9	0.8	363.6	281.6	447.9	436.2	BN+AX	16.00	16.00	0.00	0.00
T06	TA24-T028	LOD1	0.04	0.0	0.8	-9.0	2.7	345.5	260.3	345.5	345.5	BN+AX	16.00	16.00	0.00	0.00
T07	T028-T029	LOD1	0.04	0.0	0.7	-12.6	1.8	363.6	276.4	363.6	363.6	BN+AX	16.00	16.00	0.00	0.00
T2A	TA21-TA2A	LOD1	0.04	0.0	-0.5	-11.3	-0.3	345.5	6317.5	365.1	589.7	WSHBUC	16.00	8.00	0.96	0.95
T2B	TA2A-TA22	LOD1	0.04	0.0	-0.5	-11.5	-0.3	345.5	4538.4	368.6	580.8	WSHBUC	16.00	8.00	0.91	0.90
T3A	TA22-TA2B	LOD1	0.04	0.0	-0.7	-12.5	-0.3	345.5	4031.1	380.2	524.8	WSHBUC	16.00	8.00	0.76	0.71
T3B	TA2B-TA23	LOD1	0.03	0.0	-0.7	-6.8	-0.1	345.5	3320.6	391.5	524.1	WSHBUC	16.00	8.00	0.52	0.54
TPS	TL02-TA24	LOD1	0.00	1.4	1.5	-0.3	0.3	.4E+03	.7E+05	.5E+03	.5E+03	TN+BN	1.40	1.40	0.85	0.85
UG1	R1L5-SP05	LOD1	0.20	0.1	-0.1	-8.4	18.3	.4E+03	.1E+05	.4E+03	.6E+03	WSHBUC	5.70	0.10	0.68	0.49
UG2	R302-R402	LOD1	0.01	0.0	-0.0	0.0	1.8	313.6	8618.7	313.6	313.6	BN+AX	1.00	1.00	0.97	0.85
UG3	R206-R306	LOD1	0.03	1.5	-8.9	1.5	0.0	291.9	3308.7	446.0	446.0	ACBI	3.00	3.00	0.85	0.85
UN2	SM15-SS08	LOD1	0.17	2.3	-1.2	16.7	-0.3	132.7	266.4	101.6	526.5	LATBUC	5.13	2.00	0.96	0.44

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12.1.2 Plate checks

Maximum Von Mises stress of plate elements in the lower part of main column (7m diameter, thickness 65mm) is 60 MPa and results below the design yield stress of 380 MPa (UC= 60 / 380 = 0.16).

SACS-IV SYSTEM PLATE STRESS UNITY CHECK RANGE SUMMARY

GROUP II - UNITY CHECKS GREATER THAN 0.70 AND LESS THAN 0.90

** NO UNITY CHECKS IN THIS GROUP **

SACS-IV SYSTEM PLATE STRESS UNITY CHECK RANGE SUMMARY

GROUP III - UNITY CHECKS GREATER THAN 0.90 AND LESS THAN 999.00

** NO UNITY CHECKS IN THIS GROUP **

***** PLATE STRESS GROUP SUMMARY *****
N/MM2

GRUP	PLATE	CRIT. TYPE	MAX UNITY CHECK	LOAD COND NO.	**** MEMBRANE **** SX	SY	TXY	BENDING-UPPER SURF. ** SX	SY	TXY	MAX ** VM	X-STIFFENER S-TOP	S-BOT	Y-STIFFENER S-TOP	S-BOT
M65	A044	ISO	0.172	LOD1	-23.2	-21.1	-28.1	-0.9	-7.7	-2.5	59.3				

12.1.3 ULS Joint checks

All tubular joints punching shear checks and strength checks are detailed in following SACS excerpt and provide utilization factors lower than 1.0, according to ISO19902, ref./6/.

* * J O I N T C A N S U M M A R Y * *
(UNITY CHECK ORDER)

JOINT	ORIGINAL DIAMETER (CM)	ORIGINAL THICKNESS (CM)	ORIGINAL YLD STRS (N/MM2)	ORIGINAL LOAD UC	ORIGINAL STRN UC	LOAD DESIGN DIAMETER (CM)	LOAD DESIGN THICKNESS (CM)	LOAD DESIGN YLD STRS (N/MM2)	LOAD DESIGN LOAD UC	LOAD DESIGN STRN UC	*** STRENGTH ANALYSIS **** BRACE JOINT	LOAD CASE
SM30	21.910	1.031	355.000	0.078	0.091	21.910	1.031	355.000	0.078	0.091	SM33	LOD1
SM02	21.910	1.031	355.000	0.044	0.052	21.910	1.031	355.000	0.044	0.052	SL06	LOD1
SM01	21.910	1.031	355.000	0.043	0.051	21.910	1.031	355.000	0.043	0.051	SL02	LOD1
SL06	21.910	1.031	355.000	0.043	0.051	21.910	1.031	355.000	0.043	0.051	SM02	LOD1
SU01	21.910	1.031	355.000	0.021	0.024	21.910	1.031	355.000	0.021	0.024	SM04	LOD1
SU11	21.910	1.031	355.000	0.021	0.024	21.910	1.031	355.000	0.021	0.024	SM33	LOD1
SL18	21.910	1.031	355.000	0.016	0.018	21.910	1.031	355.000	0.016	0.018	SM03	LOD1
SU02	27.310	1.270	355.000	0.012	0.014	27.310	1.270	355.000	0.012	0.014	SM10	LOD1
SM03	21.910	1.031	355.000	0.008	0.009	21.910	1.031	355.000	0.008	0.009	SL18	LOD1
SM05	21.910	1.031	355.000	0.008	0.009	21.910	1.031	355.000	0.008	0.009	SL01	LOD1
SU12	27.310	1.270	355.000	0.005	0.006	27.310	1.270	355.000	0.005	0.006	SM11	LOD1
SL01	21.910	1.031	355.000	0.003	0.004	21.910	1.031	355.000	0.003	0.004	SM05	LOD1

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APPENDIX A – MEMBER GROUPS AND SECTION PROPERTIES

TECON - BLPH TRANSITION PIECE - LOADOUT

****** SEASTATE INITIAL GROUP DESCRIPTION ******

GROUP LABEL	SECTION LABEL	***** AREAS ***** CONST. (CM**2)	DISPL.	** DIAMETERS ** Y (CM)	Z	* SECTION * TYPE	LENGTH	* MATL. * DENSITY (TONNE/M**3)	* JOINT * THICK (M.)	FLOOD	** DRAG AND INERTIA COEFFICIENTS ** CDY	CDZ	CMY	CMZ	CDT	CMT
HA3	HEA340	133.50	133.50	33.00	30.00	WF		7.849	0.000		0.61	0.61	1.39	1.39	0.00	0.00
IP2	IPE240	39.12	39.12	24.00	12.00	WF		7.849	0.000		0.61	0.61	1.39	1.39	0.00	0.00
IP3	IPE330	62.61	62.61	33.00	16.00	WF		7.849	0.000		0.61	0.61	1.39	1.39	0.00	0.00
L15	L15	24.00	24.00	15.00	10.00	ANG		7.849	0.000		0.61	0.61	1.39	1.39	0.00	0.00
M01		14161.49	384845.1	700.00	700.00	TUB		7.850	0.000	NO	0.80	0.80	1.71	1.71	0.00	0.00
SD1		87.18	314.16	20.00	20.00	TUB		0.000	0.000	NO	0.61	0.61	1.39	1.39	0.00	0.00
SPI	SPINE	1900.00	9600.00	120.00	80.00	BOX		7.850	0.000	NO	0.72	0.68	1.45	1.42	0.00	0.00
ST3		36.00	222.46	16.83	16.83	TUB		7.849	0.000	NO	0.61	0.61	1.39	1.39	0.00	0.00
ST4		103.90	585.78	27.31	27.31	TUB		7.849	0.000	NO	0.61	0.61	1.39	1.39	0.00	0.00
ST5		67.63	377.03	21.91	21.91	TUB		7.849	0.000	NO	0.61	0.61	1.39	1.39	0.00	0.00
T00	TPBG02A	4262.55	22225.05	252.50	217.35	PGD	0.50	7.850	0.000	NO	0.78	0.77	1.68	1.64	0.00	0.00
T00	TPBG02B	3933.65	21896.15	252.50	192.05	PGD	0.50	7.850	0.000	NO	0.78	0.76	1.68	1.61	0.00	0.00
T01	TPBG01	630.00	4620.00	100.00	50.00	PGD		7.850	0.000	NO	0.70	0.65	1.43	1.40	0.00	0.00
T02	TPBG02B	3534.60	20977.72	245.57	164.55	PGD	0.50	7.850	0.000	NO	0.78	0.75	1.67	1.55	0.00	0.00
T02	TPBG03A	3065.40	19469.78	231.73	134.85	PGD	0.50	7.850	0.000	NO	0.78	0.73	1.66	1.48	0.00	0.00
T03	TPBG03A	2703.60	16998.60	203.60	120.00	PGD	0.50	7.850	0.000	NO	0.76	0.72	1.62	1.45	0.00	0.00
T03	TPBG03B	2449.20	13564.20	161.20	120.00	PGD	0.50	7.850	0.000	NO	0.74	0.72	1.55	1.45	0.00	0.00
T04	TPBG03B	2322.00	11847.00	140.00	120.00	PGD		7.850	0.000	NO	0.73	0.72	1.49	1.45	0.00	0.00
T05	TPBG01A	665.00	5022.50	108.75	50.00	PGD	0.50	7.850	0.000	NO	0.71	0.65	1.44	1.40	0.00	0.00
T05	TPBG01B	735.00	5827.50	126.25	50.00	PGD	0.50	7.850	0.000	NO	0.72	0.65	1.46	1.40	0.00	0.00
T06	TPBG01C	1158.00	6492.00	140.00	50.00	PGD		7.850	0.000	NO	0.73	0.65	1.49	1.40	0.00	0.00
T07	TPBG01B	735.00	5827.50	126.25	50.00	PGD	0.50	7.850	0.000	NO	0.72	0.65	1.46	1.40	0.00	0.00
T07	TPBG01A	665.00	5022.50	108.75	50.00	PGD	0.50	7.850	0.000	NO	0.71	0.65	1.44	1.40	0.00	0.00
T2A	TPBG02B	3700.84	21512.02	250.48	175.07	PGD	0.50	7.850	0.000	NO	0.78	0.75	1.67	1.58	0.00	0.00
T2A	TPBG02C	3564.11	21072.67	246.45	166.42	PGD	0.50	7.850	0.000	NO	0.78	0.75	1.67	1.56	0.00	0.00
T2B	TPBG02C	3329.51	20318.70	239.52	151.57	PGD	0.50	7.850	0.000	NO	0.78	0.74	1.67	1.52	0.00	0.00
T2B	TPBG03A	2997.04	19250.10	229.71	130.52	PGD	0.50	7.850	0.000	NO	0.78	0.73	1.65	1.47	0.00	0.00
T3A	TPBG03A	2766.87	17852.74	214.15	120.00	PGD	0.50	7.850	0.000	NO	0.77	0.72	1.64	1.45	0.00	0.00
T3A	TPBG03C	2639.01	16126.63	192.83	120.00	PGD	0.50	7.850	0.000	NO	0.76	0.72	1.61	1.45	0.00	0.00
T3B	TPBG03C	2511.81	14409.43	171.63	120.00	PGD	0.50	7.850	0.000	NO	0.75	0.72	1.57	1.45	0.00	0.00
T3B	TPBG03B	2385.27	12701.15	150.54	120.00	PGD	0.50	7.850	0.000	NO	0.74	0.72	1.52	1.45	0.00	0.00
TPS		955.04	5026.55	80.00	80.00	TUB		7.850	0.000	NO	0.68	0.68	1.42	1.42	0.00	0.00
UD1		87.18	314.16	20.00	20.00	TUB		0.000	0.000	NO	0.61	0.61	1.39	1.39	0.00	0.00
UG1	UG1000	424.00	424.00	100.00	30.00	PLG		7.850	0.000		0.70	0.61	1.43	1.39	0.00	0.00
UG2	UG1000	424.00	424.00	100.00	30.00	PLG		7.850	0.000		0.70	0.61	1.43	1.39	0.00	0.00
UG3		136.81	993.15	35.56	35.56	TUB		7.849	0.000	NO	0.62	0.62	1.39	1.39	0.00	0.00
UN2	UPN220	37.40	37.40	22.00	8.00	CHL		7.849	0.000		0.61	0.61	1.39	1.39	0.00	0.00

TECON - BLPH TRANSITION PIECE - LOADOUT

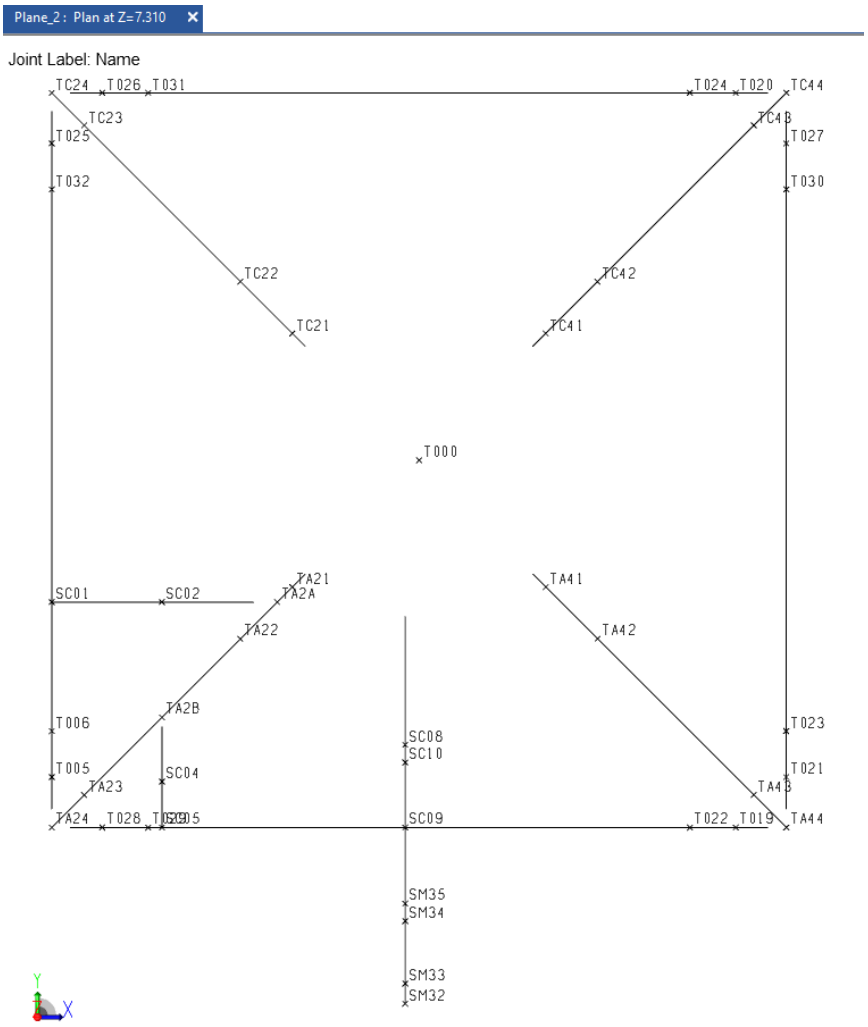
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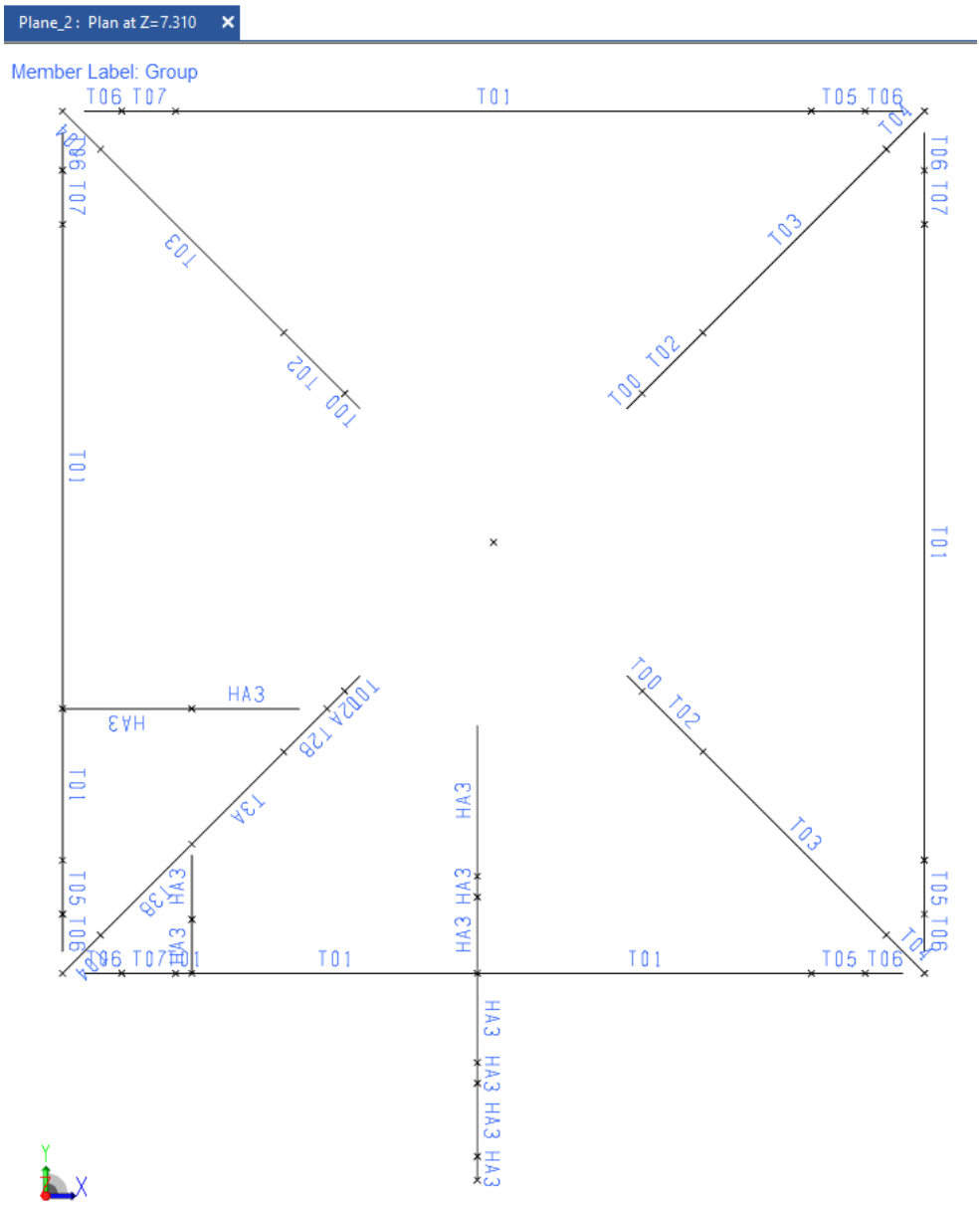
SECTION LABEL	TYPE	CROSS SECTION DETAILS * AREA (CM**2)	A (CM)	B (CM)	C (CM)	D (CM-CM**2)	E (CM-CM**2)	F (CM-CM**2)
L15	ANG	24.00	15.00	10.00	1.00	0.000	0.000	0.000
SPINE	BOX	1900.00	120.00	5.00	80.00	5.000	0.000	0.000
TPBG01	PGD	630.00	50.00	2.50	100.00	2.000	0.000	44.000
TPBG01A	PGD	630.00	50.00	2.50	100.00	2.000	0.000	44.000
TPBG01B	PGD	770.00	50.00	2.50	135.00	2.000	0.000	44.000
TPBG01C	PGD	1158.00	50.00	6.50	140.00	2.000	0.000	44.000
TPBG02A	PGD	4427.00	230.00	6.50	252.50	3.000	0.000	78.000
TPBG02B	PGD	3769.20	179.40	6.50	252.50	3.000	0.000	78.000
TPBG02C	PGD	3495.75	162.09	6.50	244.43	3.000	0.000	78.000
TPBG03A	PGD	2830.80	120.00	6.50	224.80	3.000	0.000	78.000
TPBG03B	PGD	2322.00	120.00	6.50	140.00	3.000	0.000	78.000
TPBG03C	PGD	2575.08	120.00	6.50	182.18	3.000	0.000	78.000
UG1000	PLG	424.00	30.00	4.00	100.00	2.000	0.000	0.000

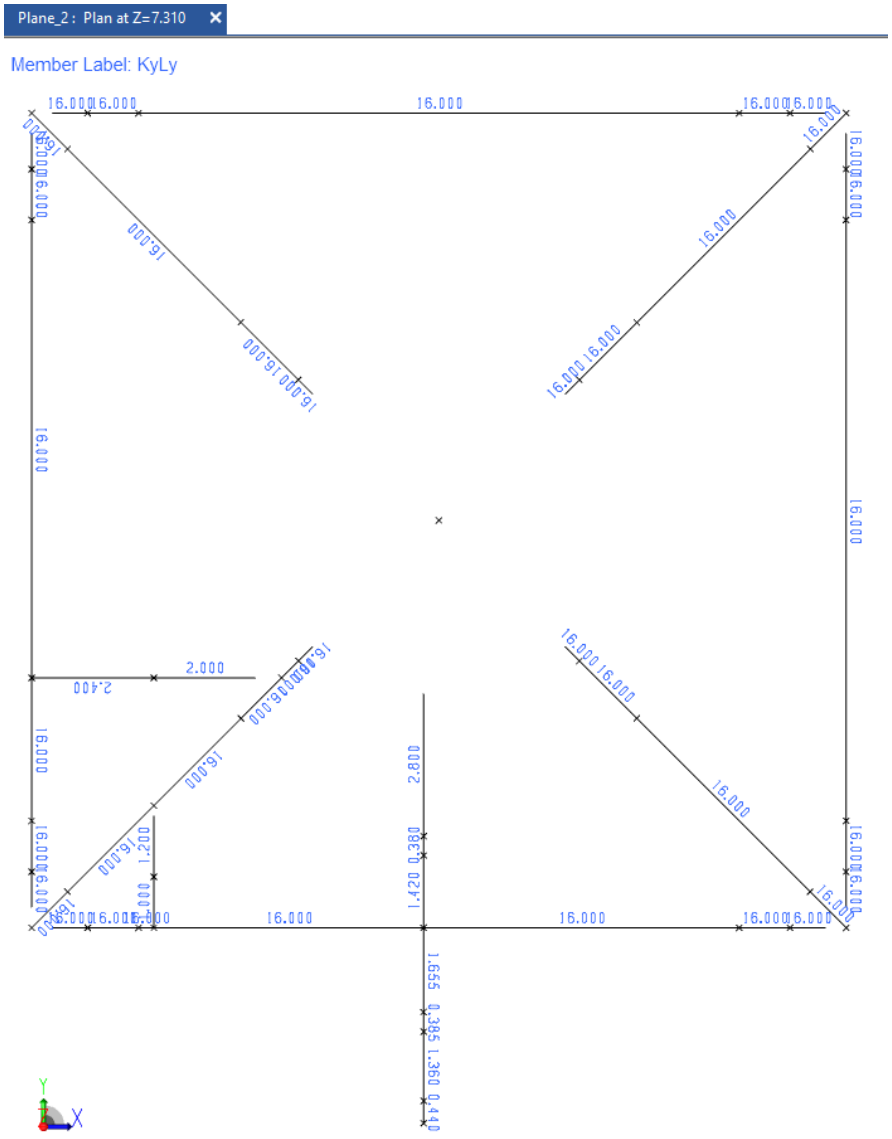
Plate Group Report

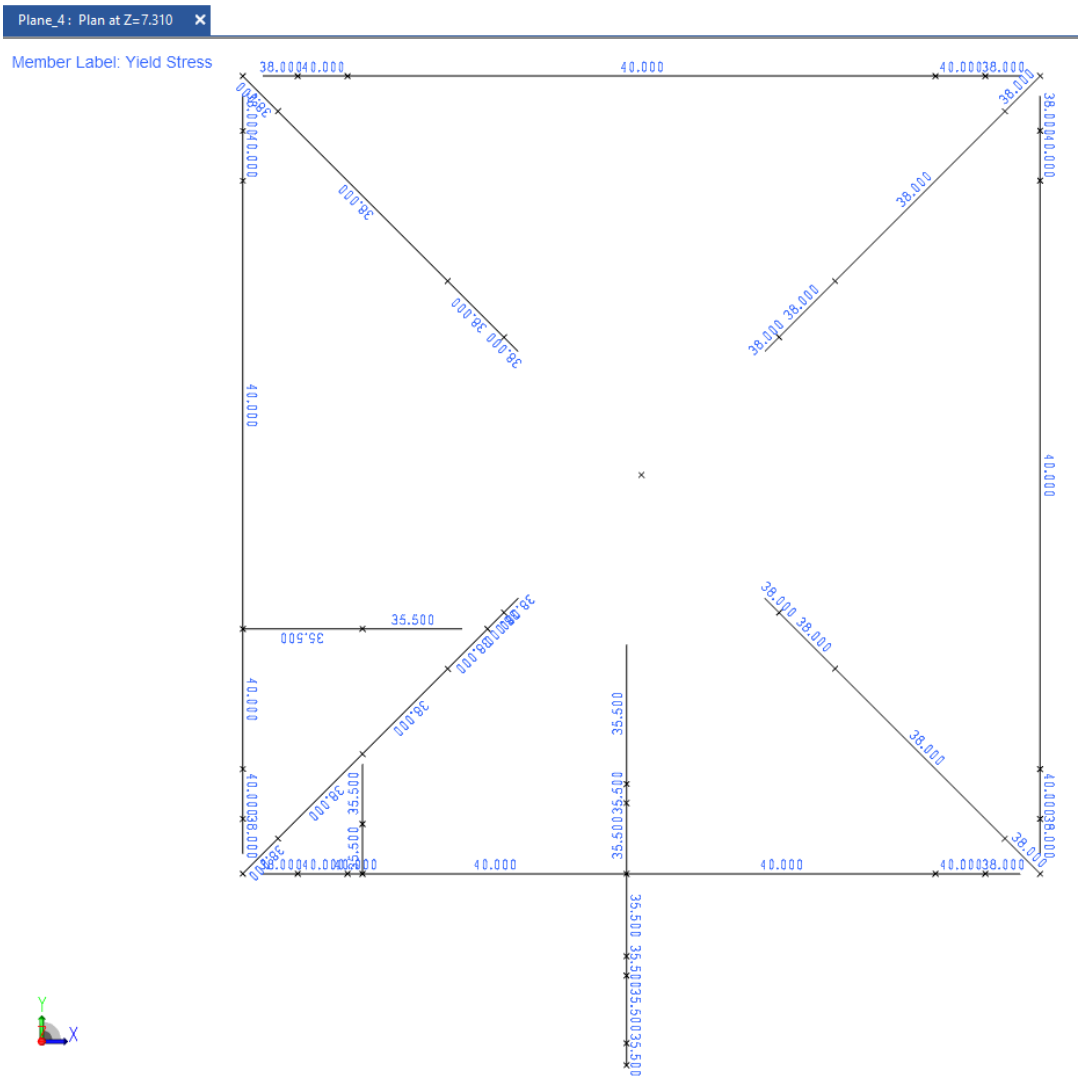
Name	Z Thickness (cm)	M	E (kN/cm2)	U	Fy (kN/cm2)	Z Offset (cm)	Section	Spacing (cm)	L	T	Density (tonne/m3)
M65	6.500	I	20500.000	0.300	38.000						7.850

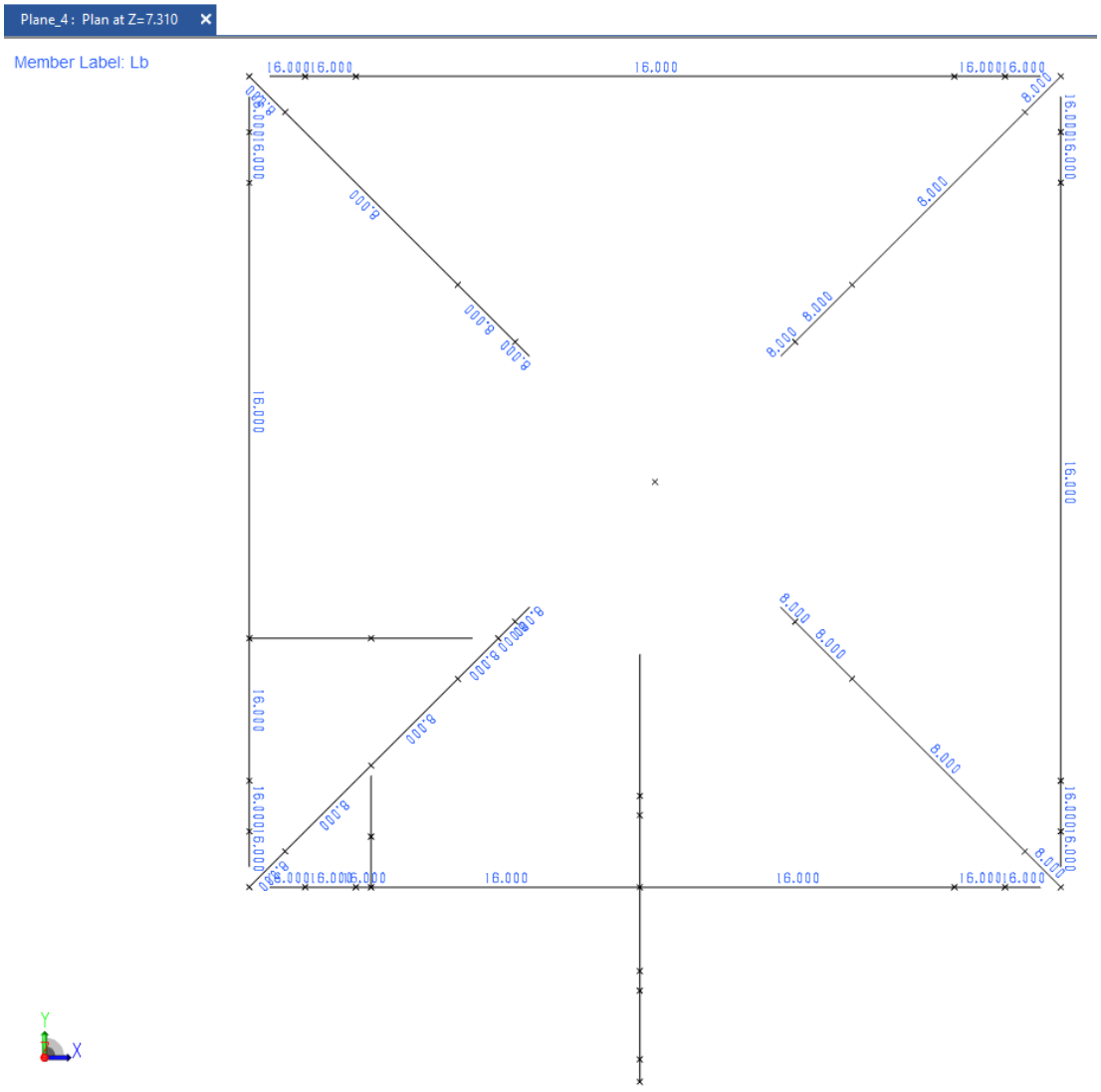
APPENDIX B - WIREFRAME SCHEMES

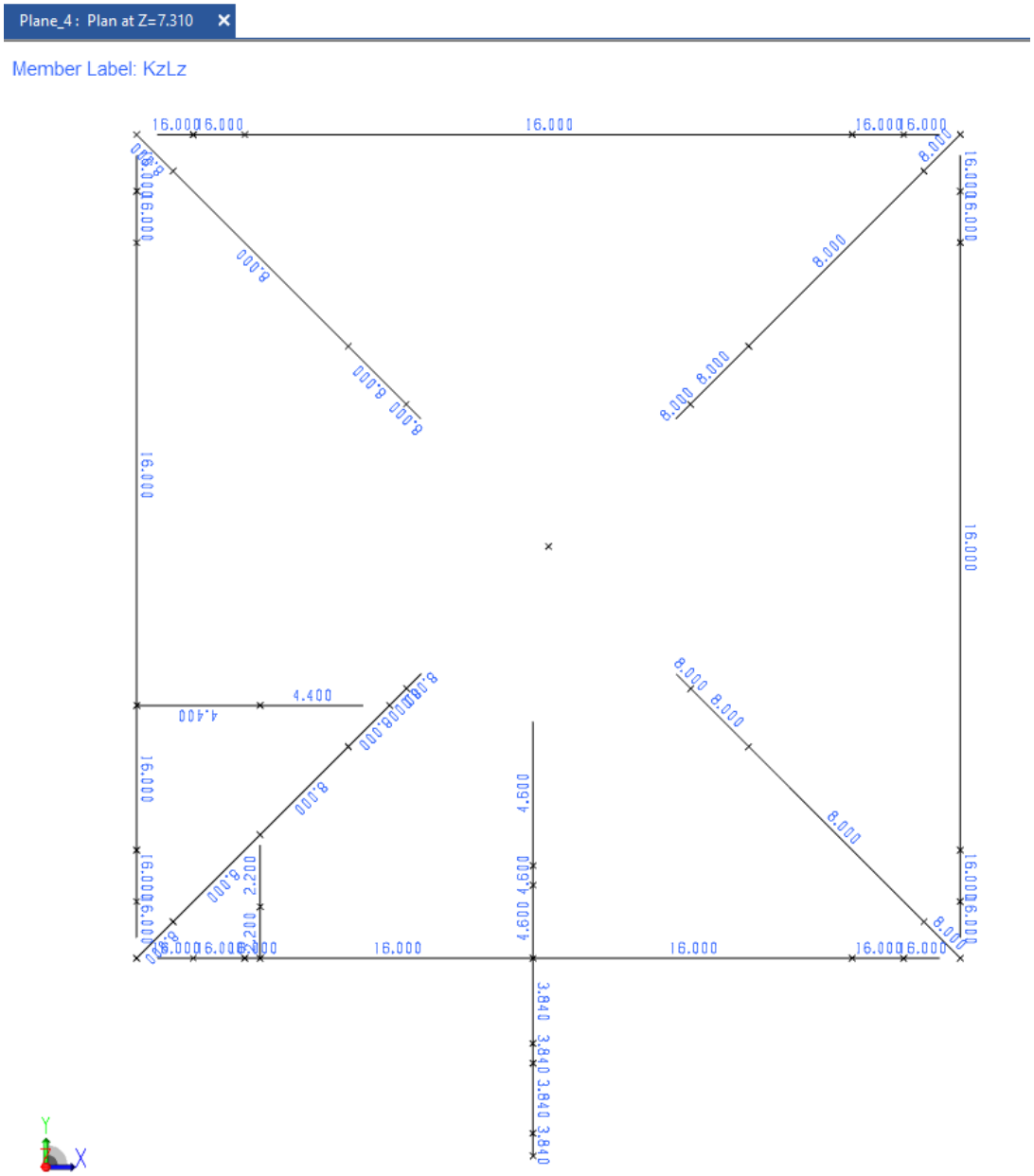


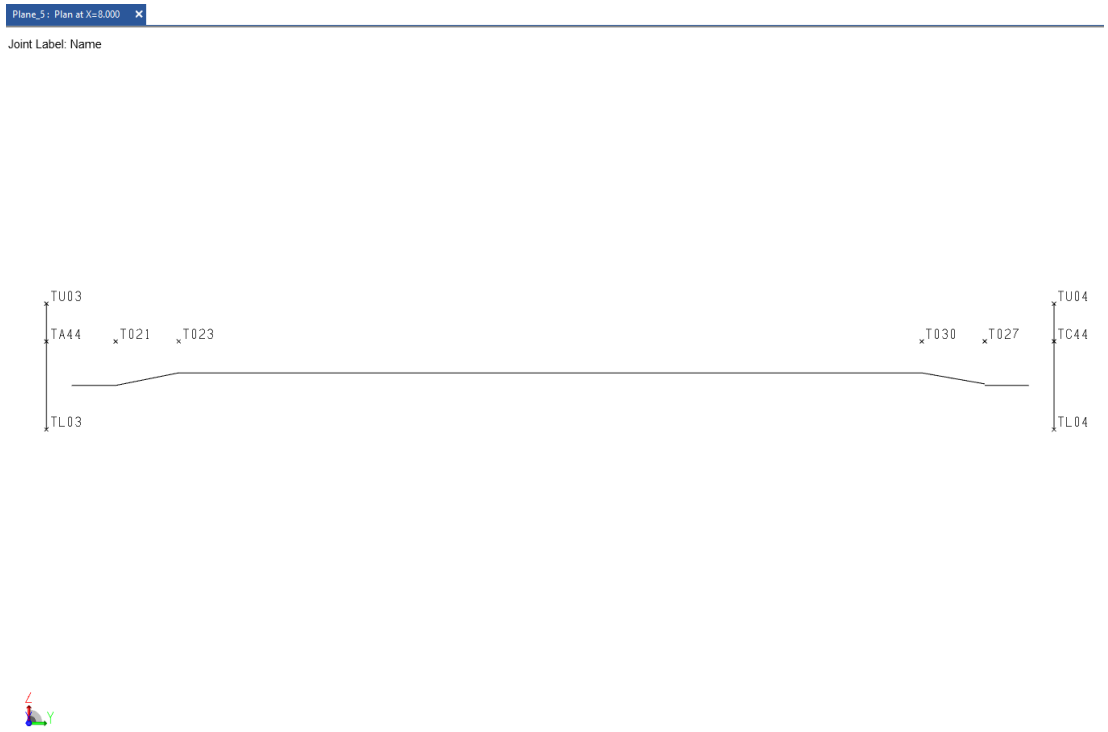

Plane_2 : Plan at Z=7.310
Member Label: Group
T06 T07
T01
T05 T06
T03
T00 T02
HA3
T01
T05 T06
T01
HA3 HA3
T01
T05 T06
HA3 HA3 HA3 HA3

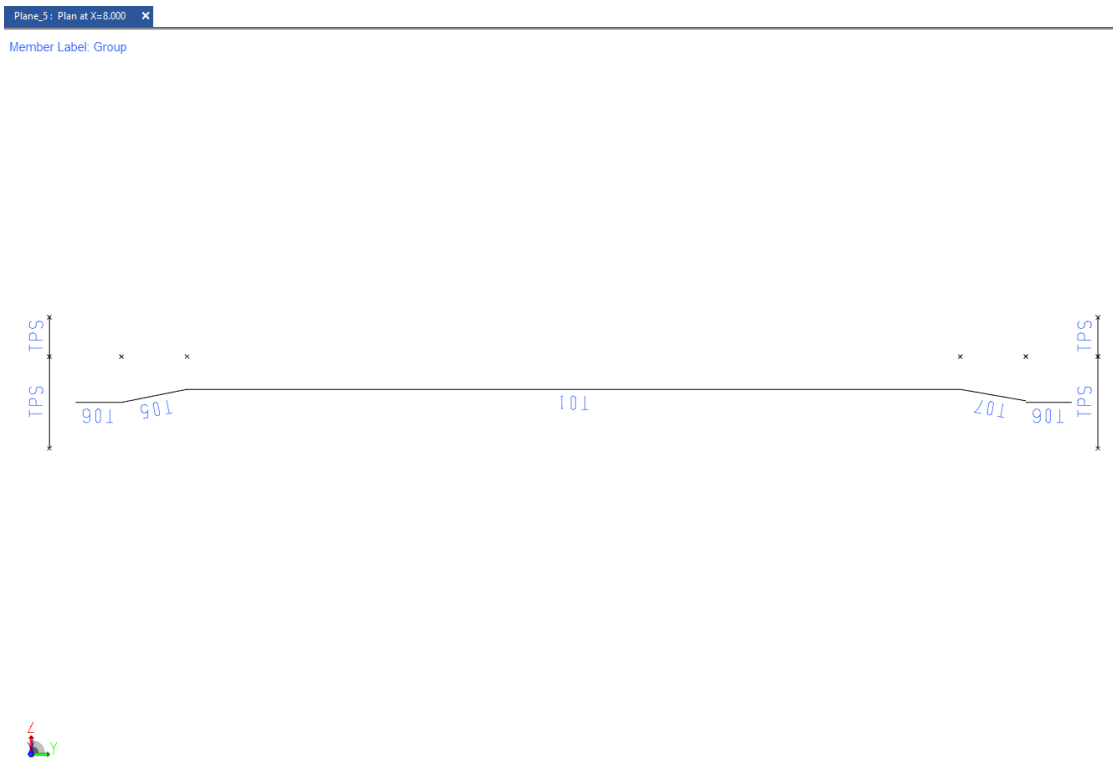

Plane_2 : Plan at Z=7.310
Member Label: KyLy

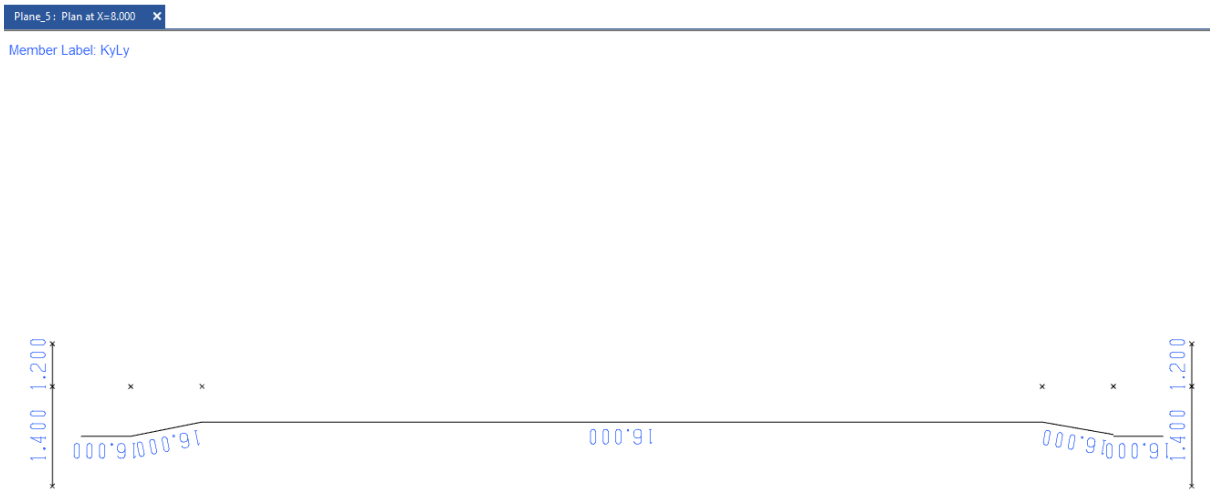

Plane_4 : Plan at Z=7.310
Member Label: Yield Stress
38.000
40.000
35.500

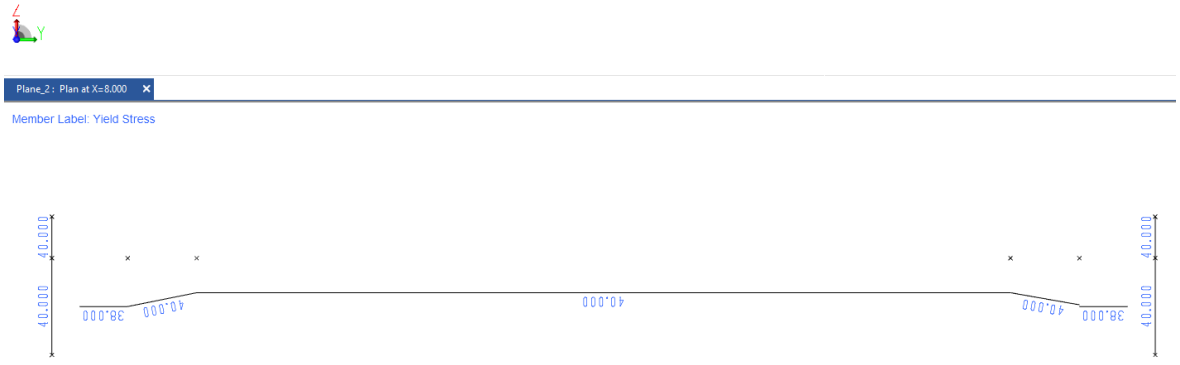

Plane_4 : Plan at Z=7.310
Member Label: Lb
16.000
8.000
Y
X

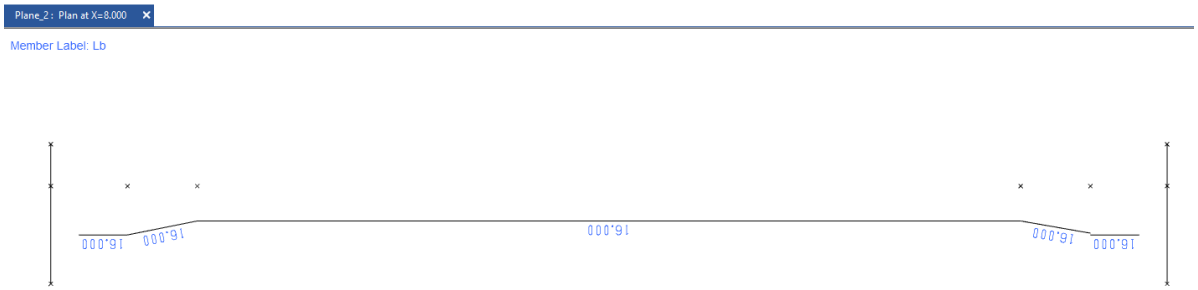

Plane_4 : Plan at Z=7.310
Member Label: KzLz
16.000
8.000
4.400
2.200
4.600
3.840
Y
X

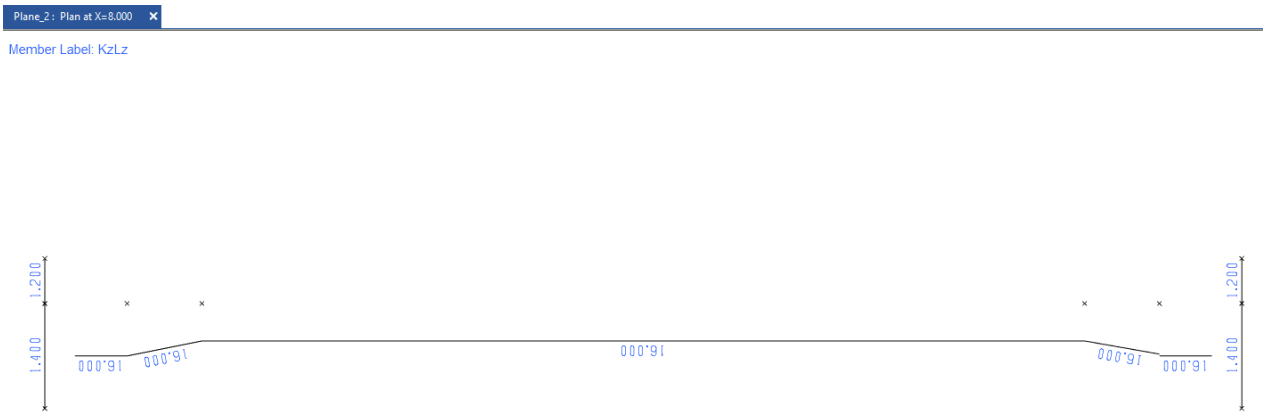

Plane_5 : Plan at X=8.000
Joint Label: Name
TU03
TA44
T021
T023
T030
T027
TU04
TC44
TL03
TL04
Z
Y

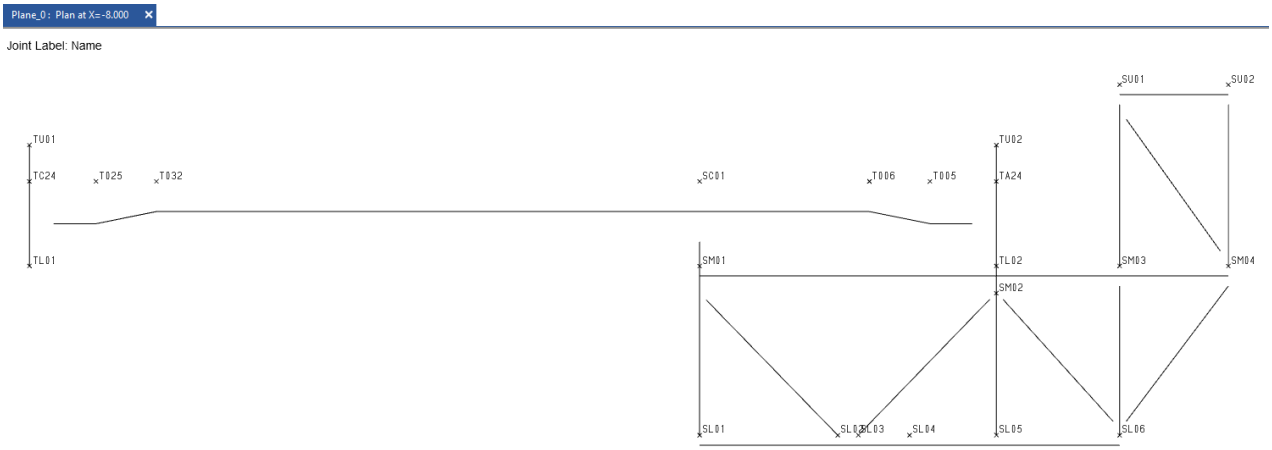

Plane_5 : Plan at X=8.000
Member Label: Group
TPS
TPS
TPS
TPS
T06
T05
T01
T07
T06
Z
Y

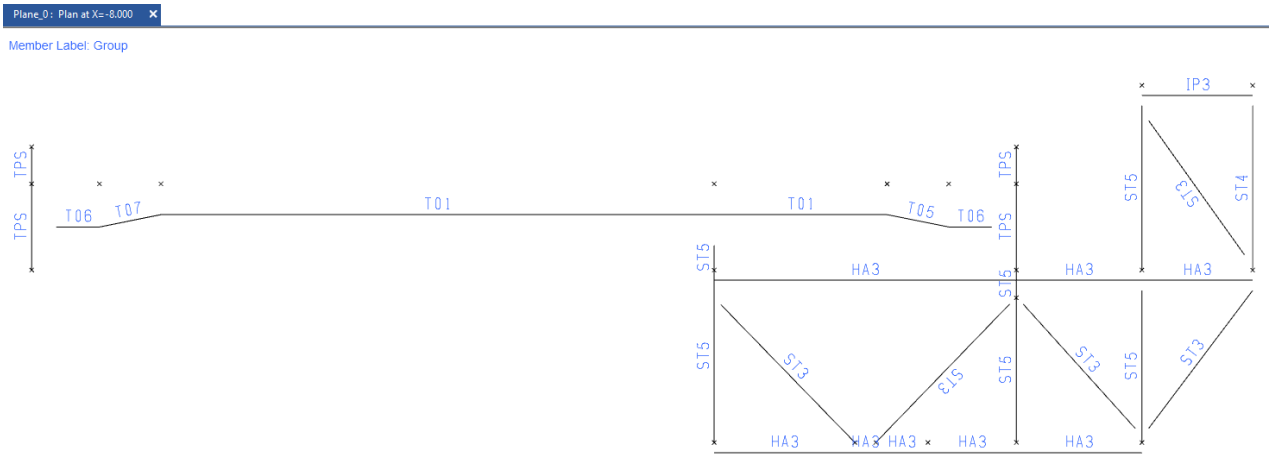

Plane_5 : Plan at X=8.000
Member Label: KyLy
1.400
1.200
16.000
16.000
16.000
16.000
1.400
1.200

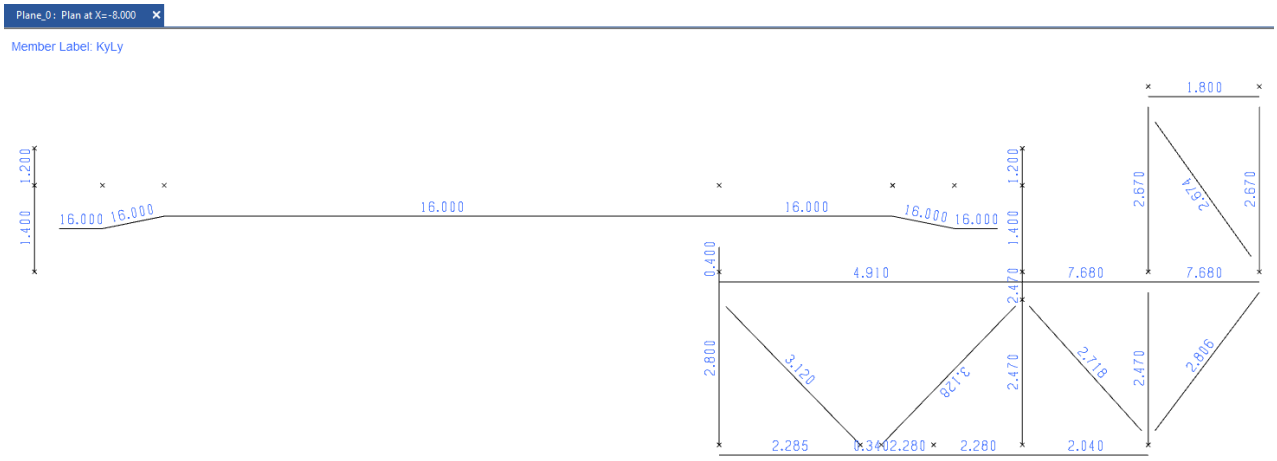

Plane_2 : Plan at X=8.000
Member Label: Yield Stress
40.000
40.000
38.000
40.000
40.000
40.000
38.000
40.000
40.000

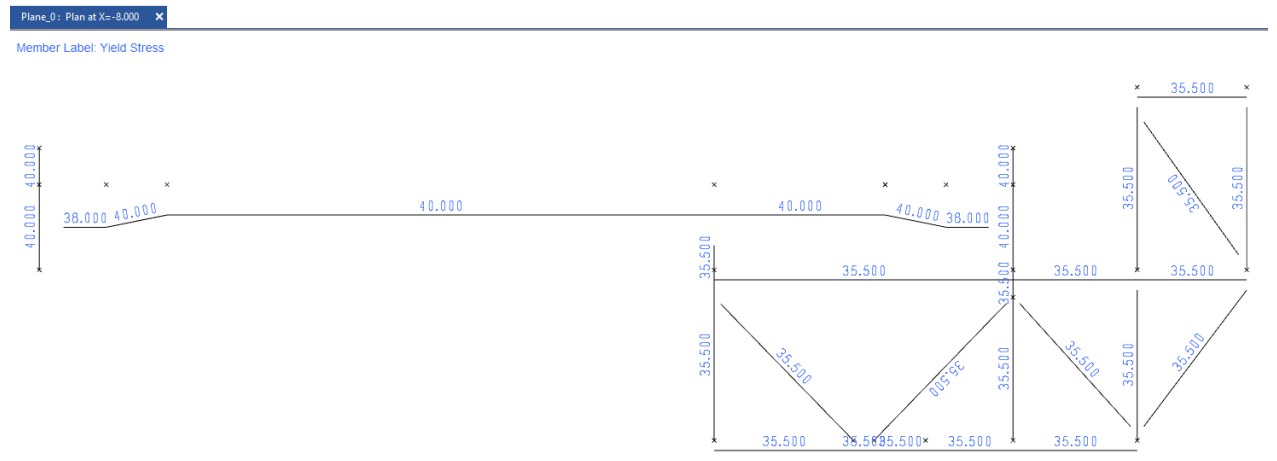

Plane_2 : Plan at X=8.000
Member Label: Lb
16.000
16.000
16.000
16.000
16.000

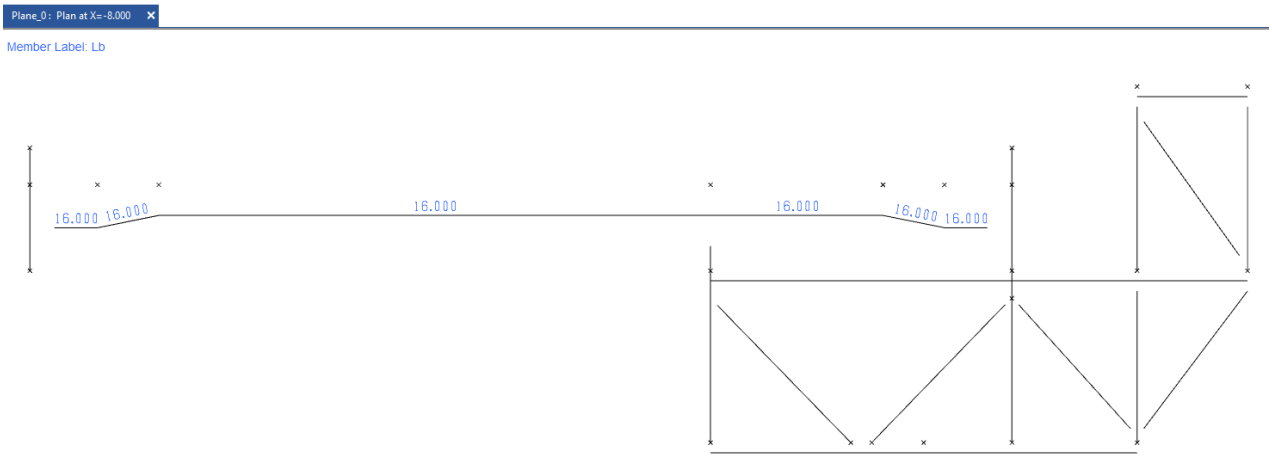

Plane_2 : Plan at X=8.000
Member Label: KzLz
1.200
1.400
16.000
16.000
16.000
16.000
16.000
1.200
1.400

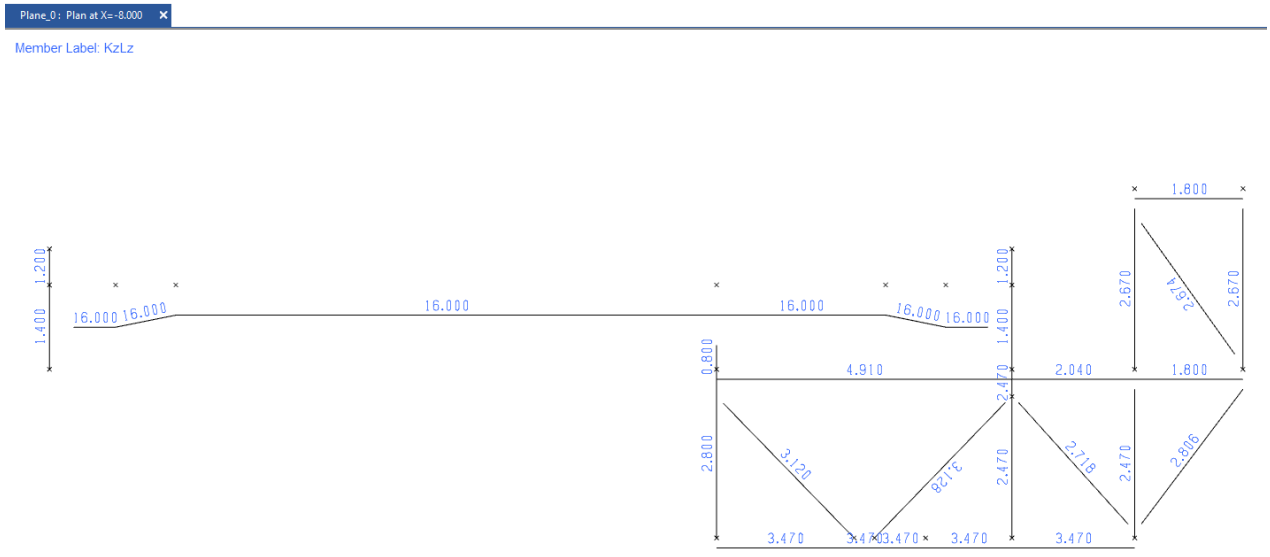

Plane_0 : Plan at X=-8.000
Joint Label: Name
TU01
TC24
T025
T032
SC01
T006
T005
TU02
TA24
SU01
SU02
TL01
SM01
TL02
SM03
SM04
SM02
SL01
SL02
SL03
SL04
SL05
SL06

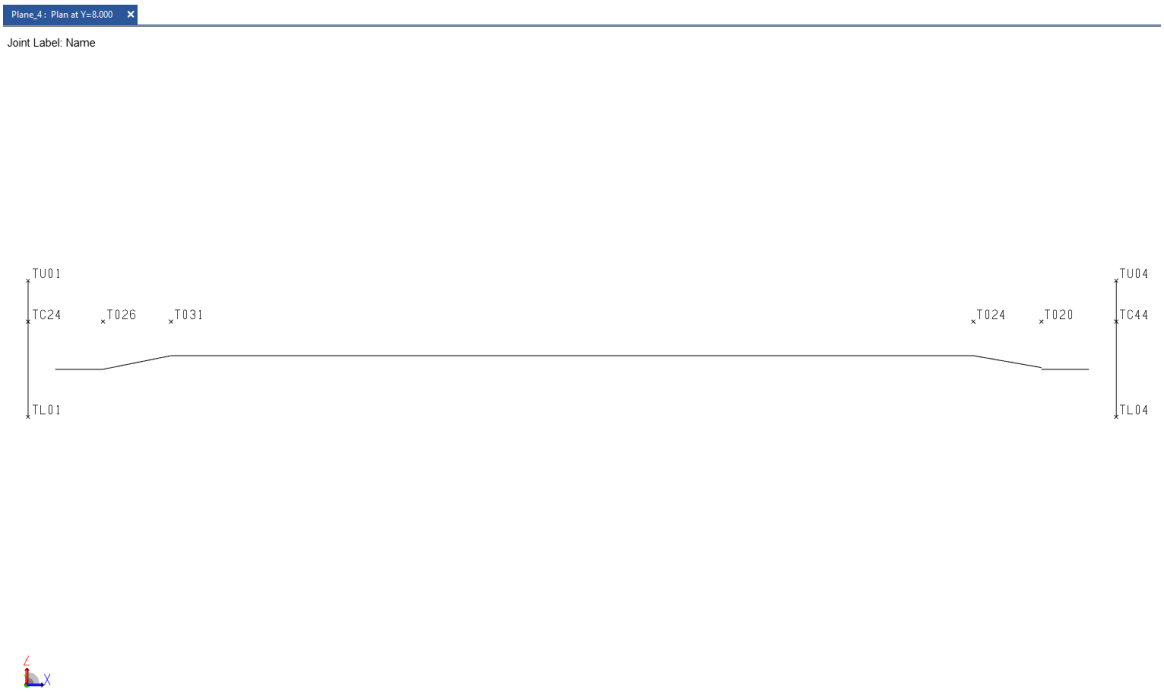

Plane_0 : Plan at X=-8.000
Member Label: Group
TPS
T06
T07
T01
T01
T05
T06
TPS
IP3
ST5
ST3
ST4
HA3
ST5
ST3
HA3


Plane_0 : Plan at X=-8.000
Member Label: KyLy
1.800
1.200
1.400
16.000
16.000
16.000
16.000
16.000
16.000
1.200
1.400
2.670
2.670
2.670
0.400
4.910
7.680
7.680
2.470
2.800
3.120
3.128
2.470
2.718
2.470
2.806
2.285
2.280
2.280
2.040

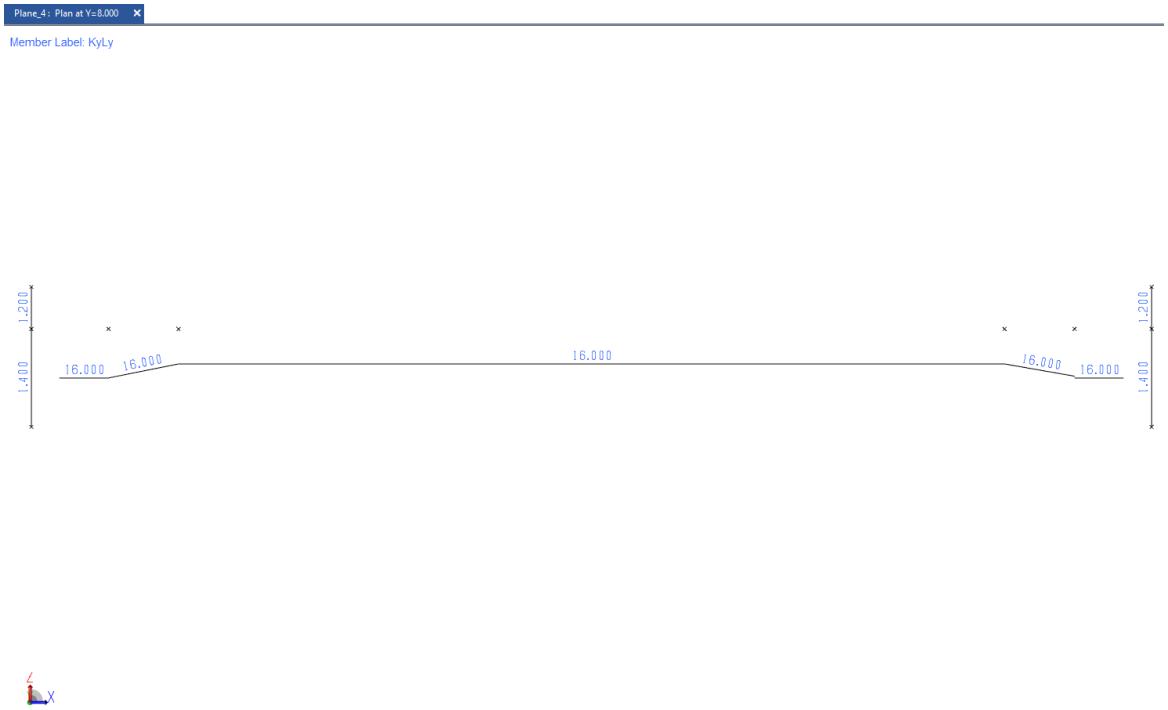

Plane_0 : Plan at X=-8.000
Member Label: Yield Stress
35.500
40.000
40.000
38.000
40.000
40.000
40.000
40.000
38.000
40.000
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500

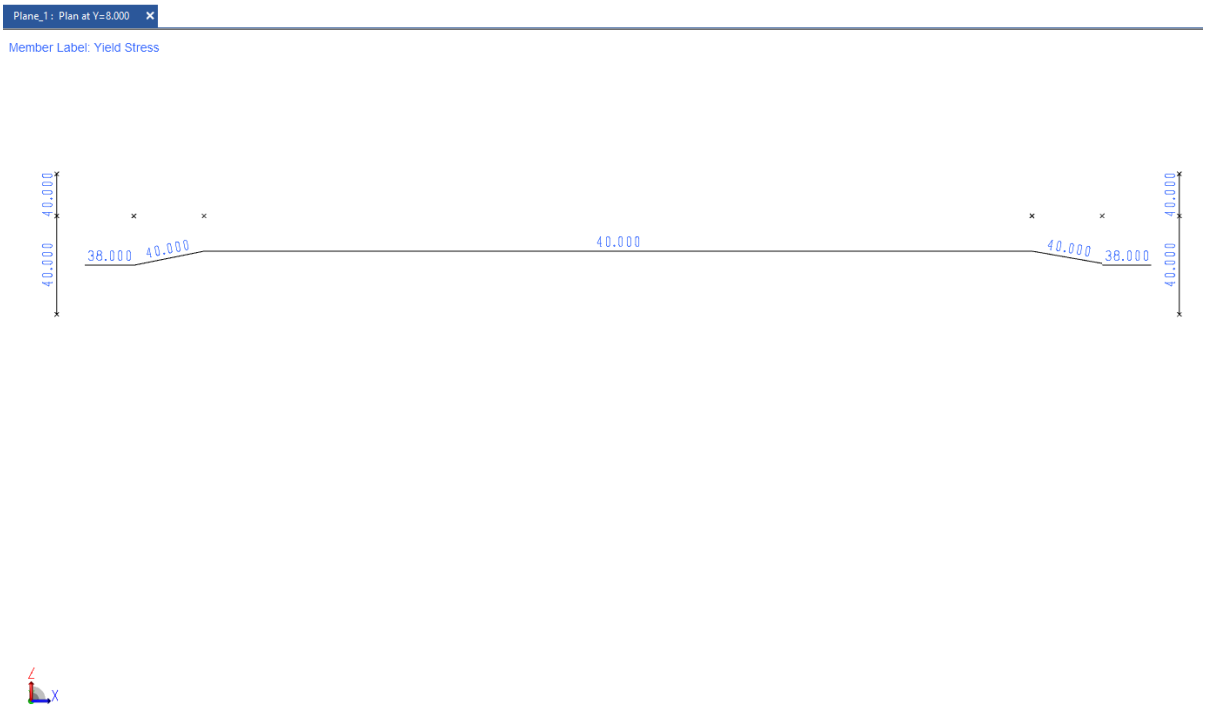

Plane_0 : Plan at X=-8.000
Member Label: Lb
16.000
16.000
16.000
16.000
16.000
16.000
16.000

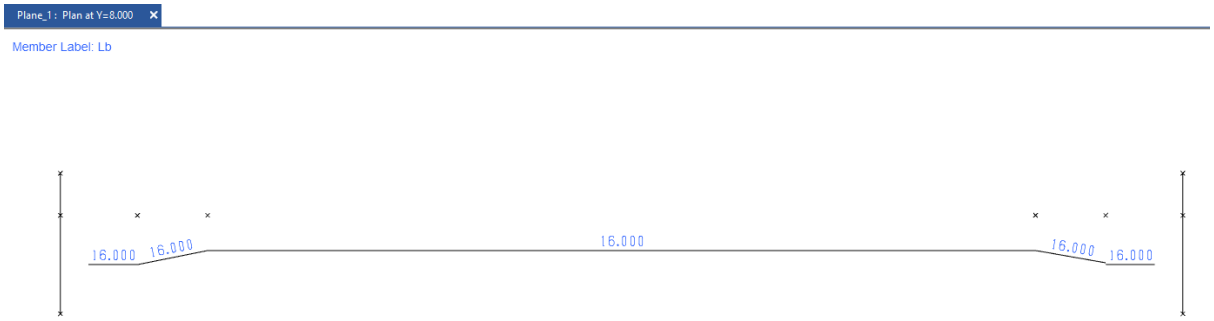

Plane_0 : Plan at X=-8.000
Member Label: KzLz
1.200
1.400
16.000
16.000
16.000
16.000
16.000
16.000
16.000
1.800
2.670
2.670
0.800
4.910
2.040
1.800
2.800
3.120
3.128
2.718
2.806
3.470
3.470
3.470
3.470
3.470

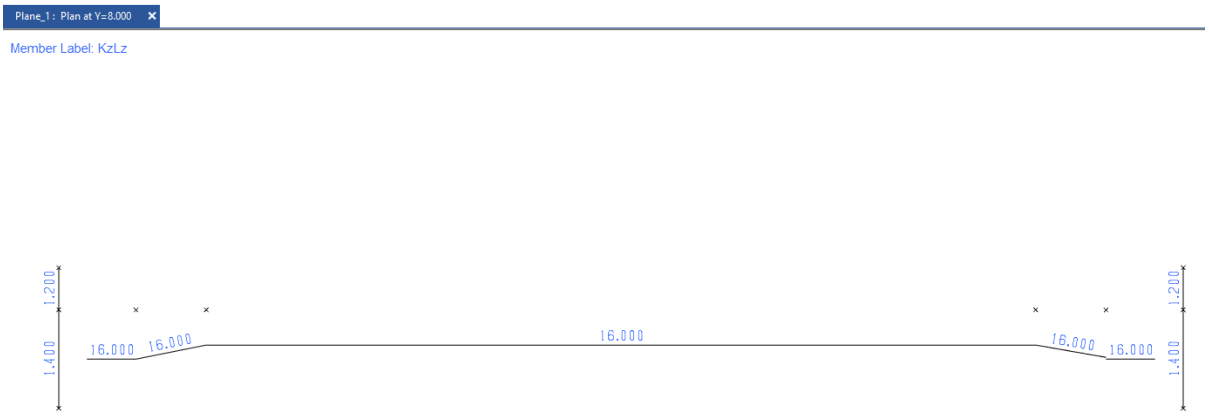

Plane_4 : Plan at Y=8.000
Joint Label: Name
TU01
TC24
T026
T031
T024
T020
TU04
TC44
TL01
TL04

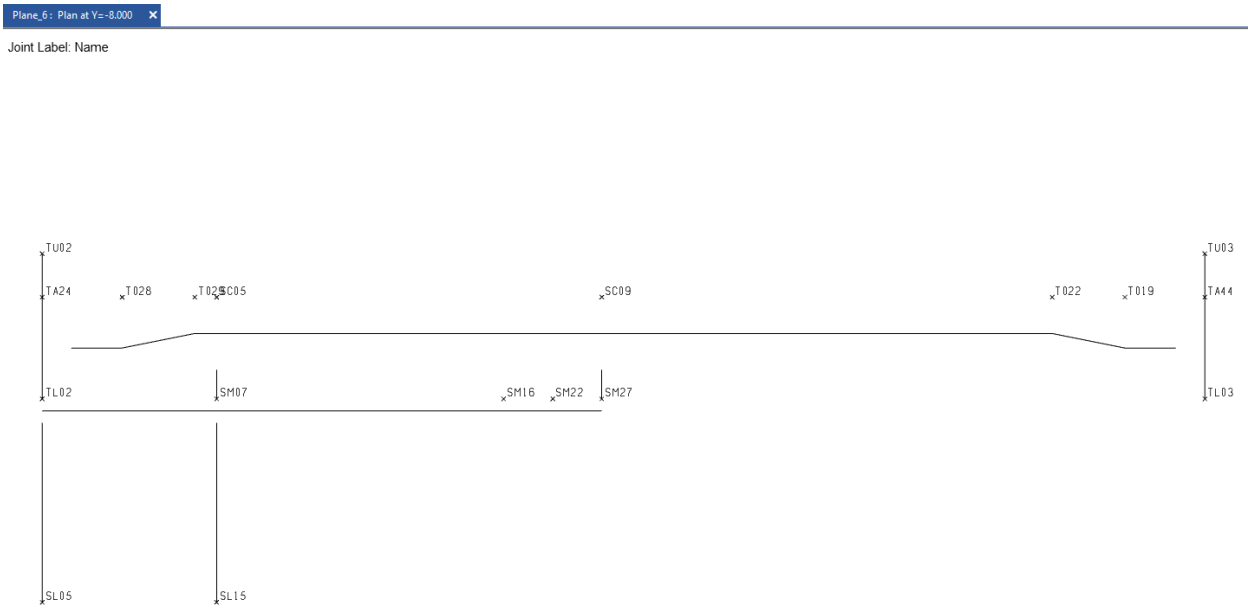

Plane_4 : Plan at Y=8.000
Member Label: Group
TPS
TPS
T06
T07
T01
T05
T06
TPS
TPS

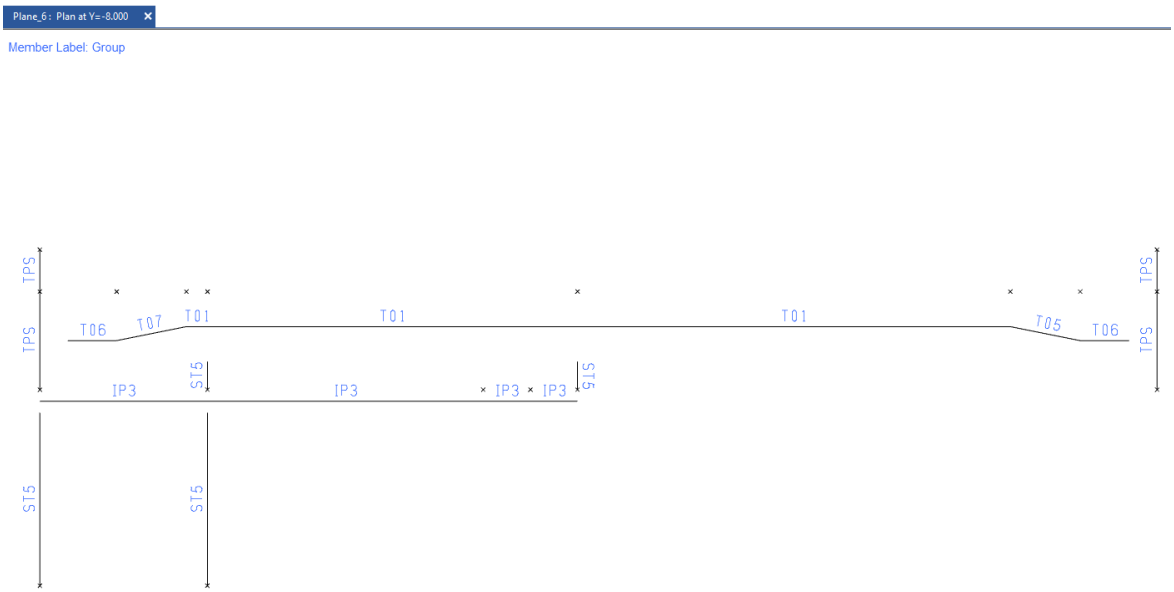

Plane_4 : Plan at Y=8.000
Member Label: KyLy
1.200
1.400
16.000
16.000
16.000
16.000
16.000
1.200
1.400
Z
X

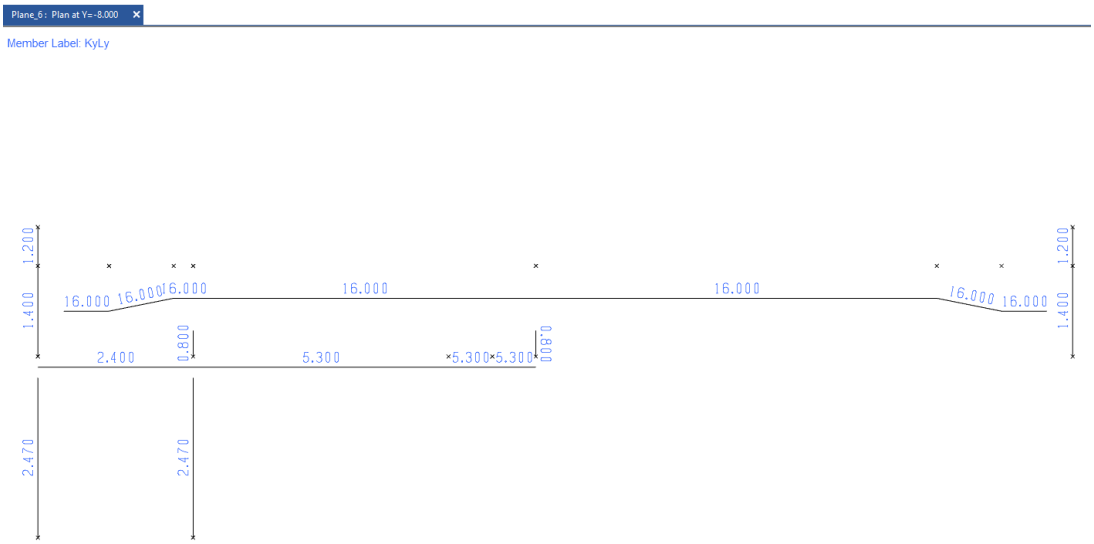

Plane_1 : Plan at Y=8.000
Member Label: Yield Stress
40.000
40.000
38.000
40.000
40.000
40.000
40.000
38.000
40.000
40.000
Z
X

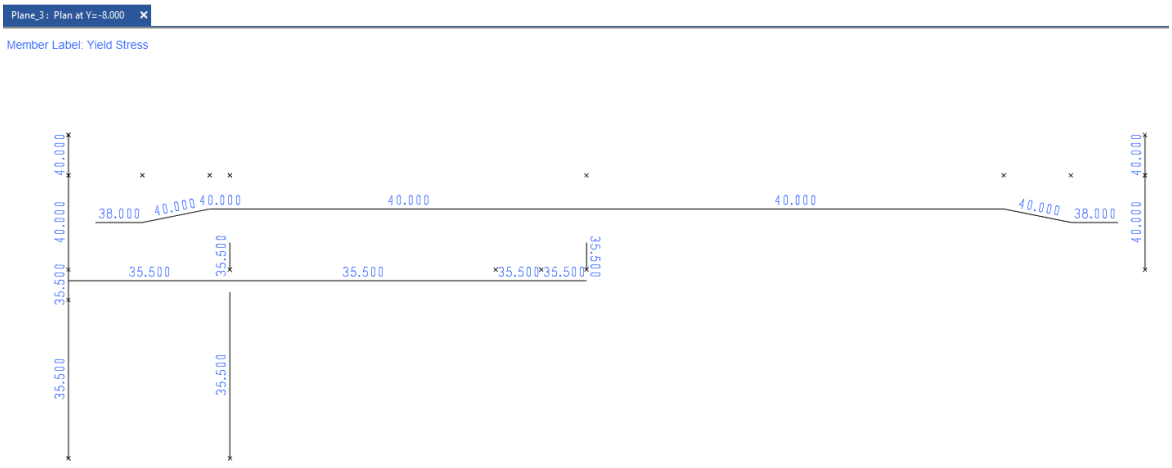

Plane_1 : Plan at Y=8.000
Member Label: Lb
16.000
16.000
16.000
16.000
16.000
Z
X

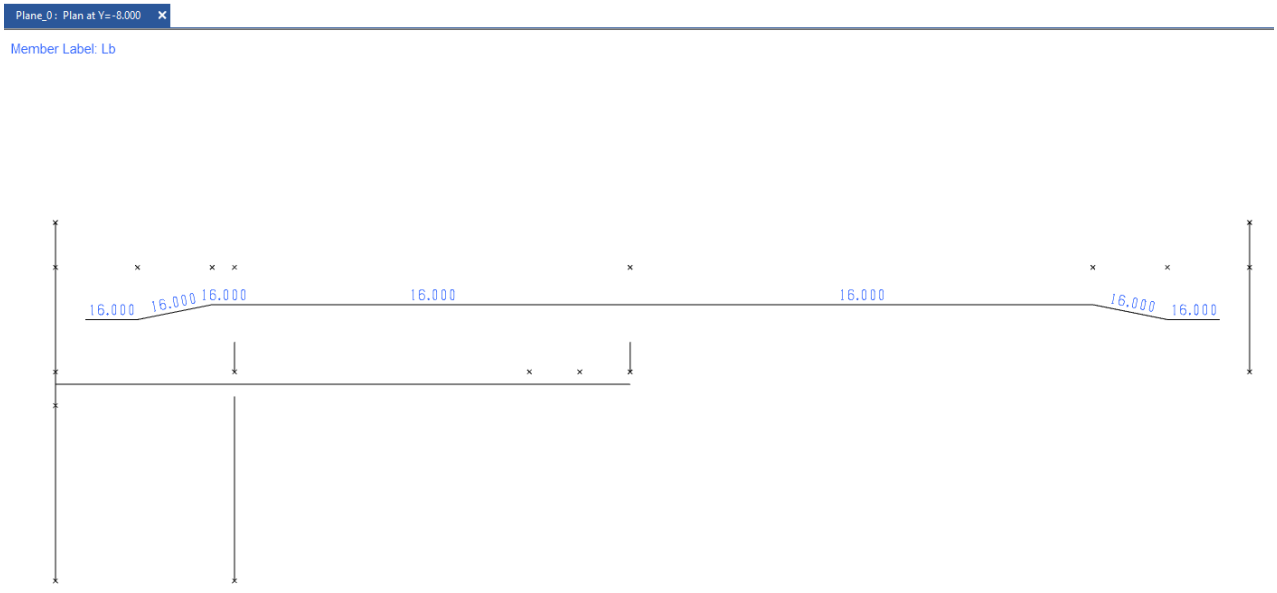

Plane_1 : Plan at Y=8.000
Member Label: KzLz
1.200
1.400
16.000
16.000
16.000
16.000
16.000
1.200
1.400
Z
X

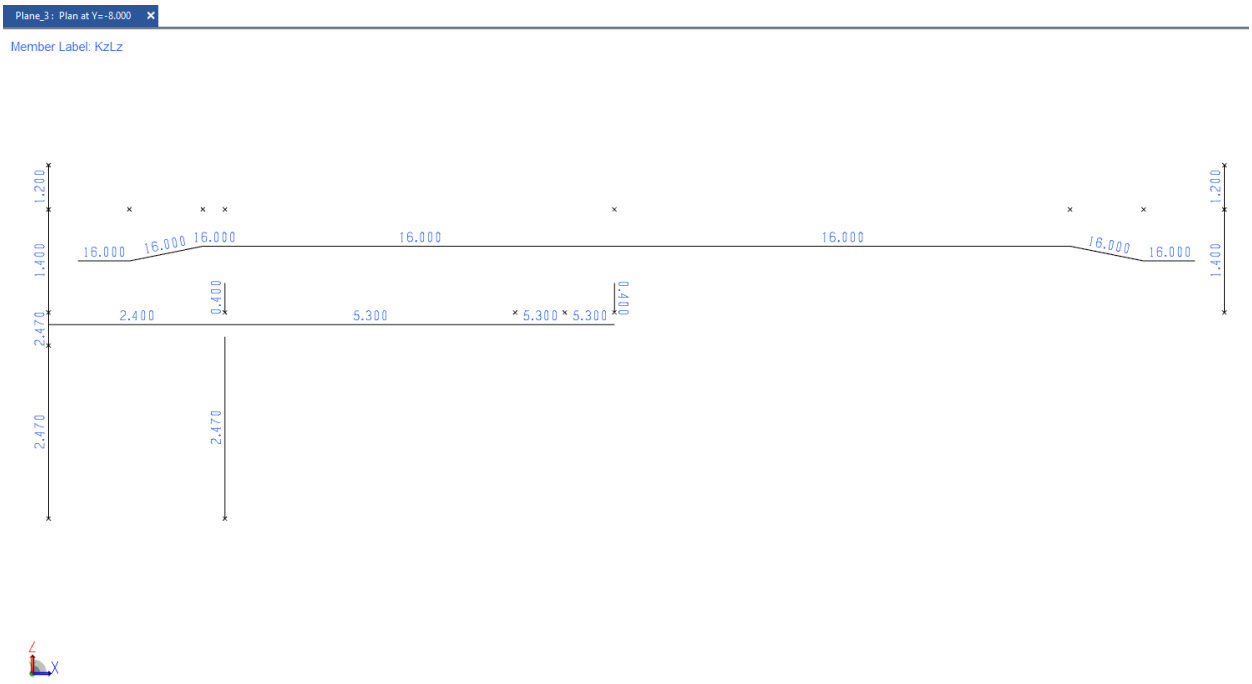

Plane_6 : Plan at Y=-8.000
Joint Label: Name
TU02
TA24
T028
T025
SC05
SC09
T022
T019
TU03
TA44
TL02
SM07
SM16
SM22
SM27
TL03
SL05
SL15

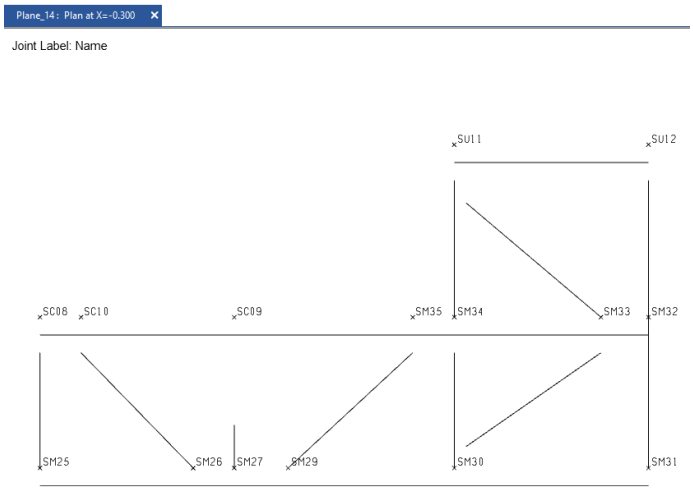

Plane_6 : Plan at Y=-8.000
Member Label: Group
TPS
TPS
T06
T07
T01
T01
T01
T05
T06
TPS
TPS
ST5
IP3
IP3
IP3
IP3
ST5
ST5
ST5

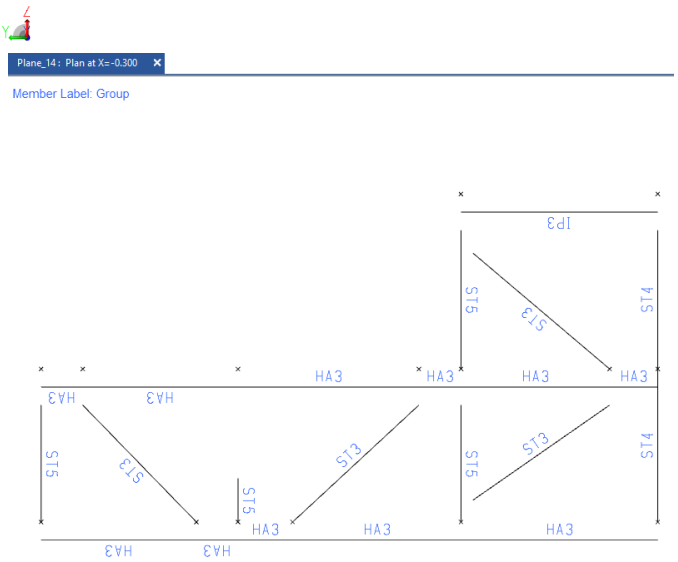

Plane_6 : Plan at Y=-8.000
Member Label: KyLy
1.200
1.400
16.000
16.000
16.000
16.000
16.000
16.000
16.000
1.200
1.400
0.800
2.400
5.300
5.300
5.300
0.800
2.470
2.470

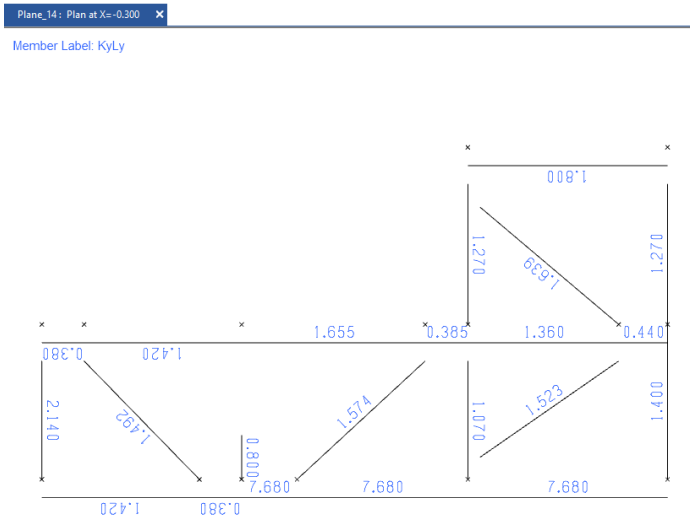

Plane_3 : Plan at Y=-8.000
Member Label: Yield Stress
40.000
40.000
40.000
38.000
40.000
40.000
40.000
40.000
38.000
40.000
40.000
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500

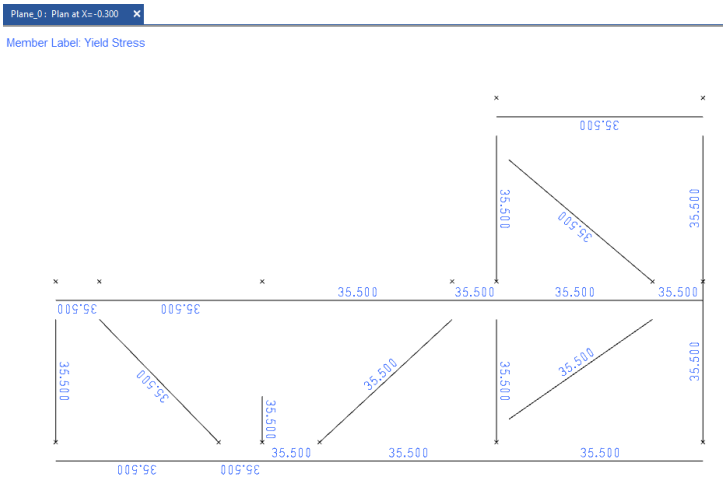

Plane_0 : Plan at Y=-8.000
Member Label: Lb
16.000
16.000
16.000
16.000
16.000
16.000
16.000
X

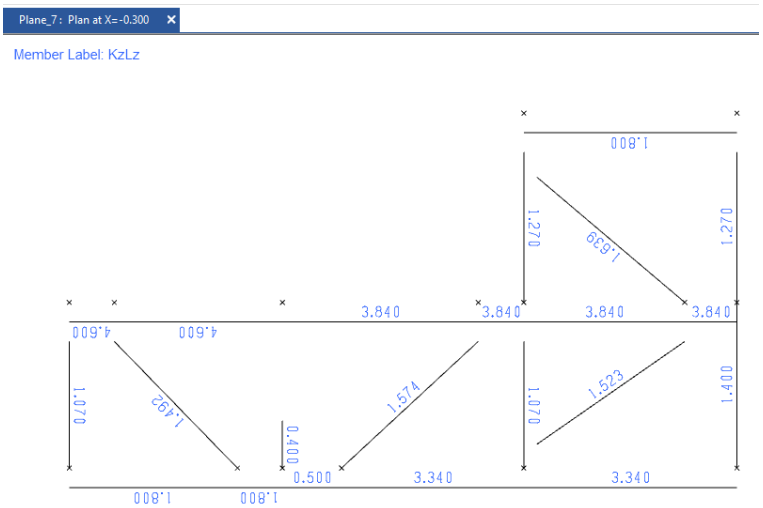

Plane_3 : Plan at Y=-8.000
Member Label: KzLz
1.200
1.400
2.470
2.470
16.000
16.000
16.000
16.000
16.000
16.000
16.000
1.200
1.400
2.400
0.400
5.300
5.300
5.300
0.400
2.470
X


Plane_14 : Plan at X=-0.300
Joint Label: Name
SU11
SU12
SC08
SC10
SC09
SM35
SM34
SM33
SM32
SM25
SM26
SM27
SM29
SM30
SM31

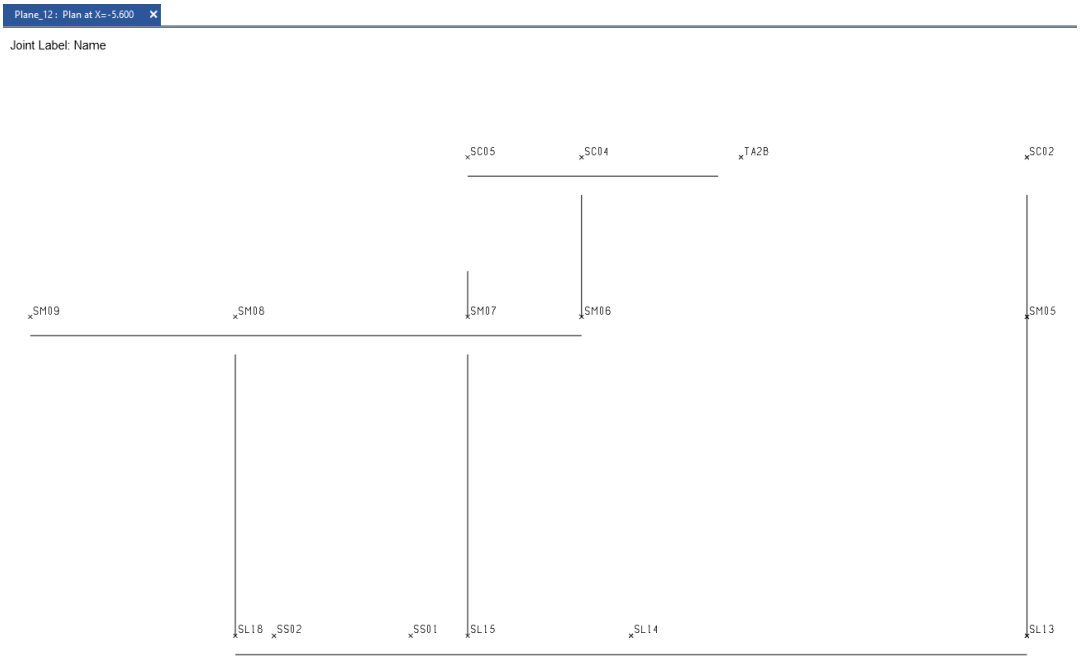

Plane_14 : Plan at X=-0.300
Member Label: Group
IP3
ST5
ST2
ST4
HA3
ST3

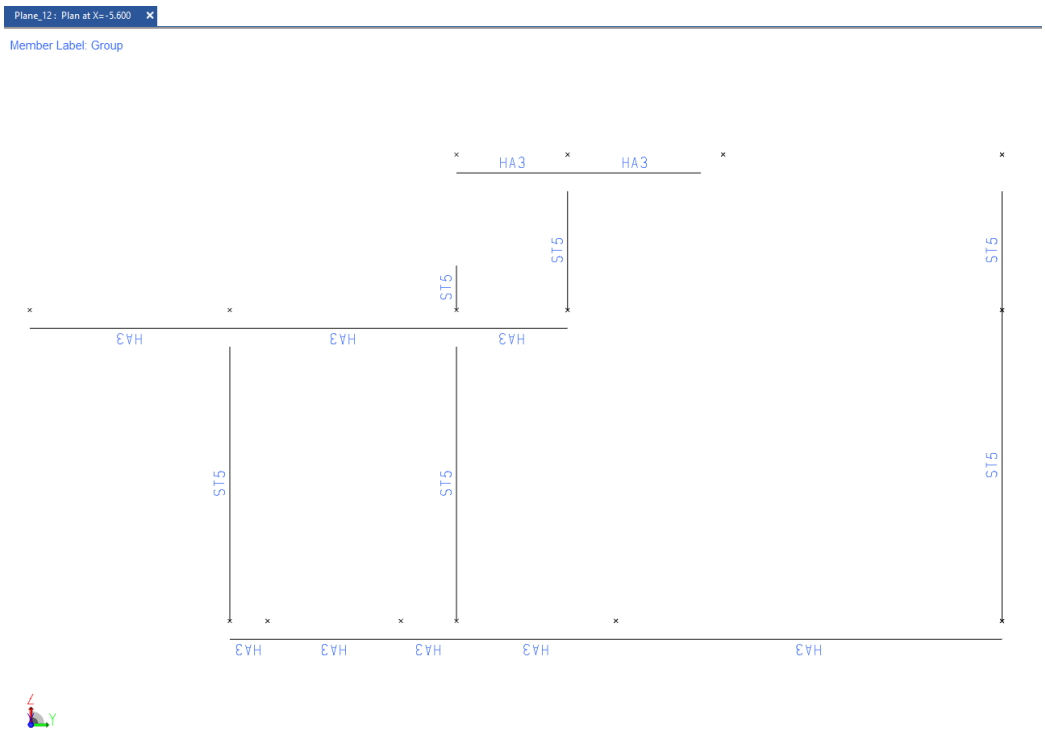

Plane_14 : Plan at X=-0.300
Member Label: KyLy
1.800
1.270
1.639
1.270
1.655
0.385
1.360
0.440
0.380
1.420
2.140
1.492
0.800
1.574
1.070
1.523
1.400
7.680
7.680
7.680
1.420
0.380

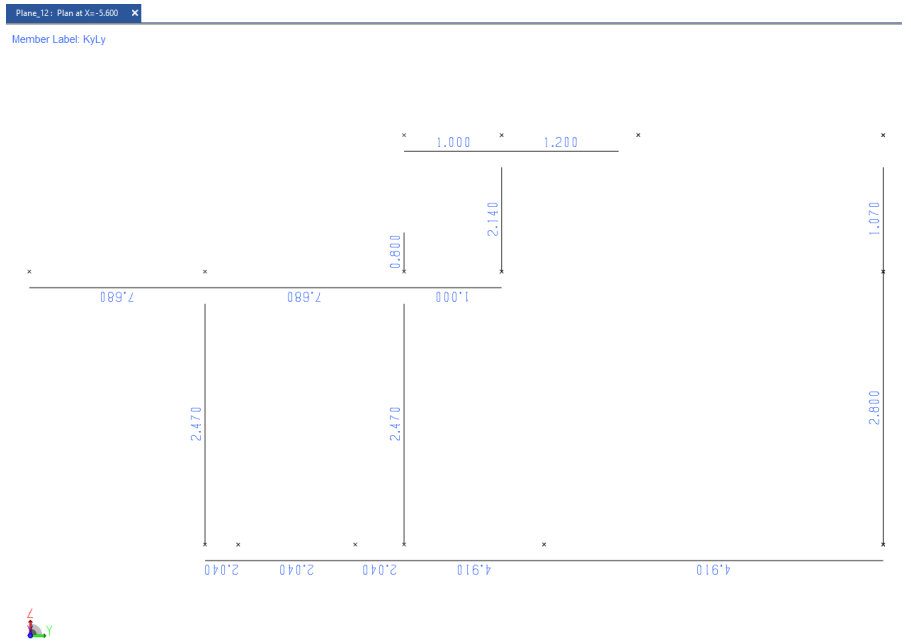

Plane_0 : Plan at X=-0.300
Member Label: Yield Stress
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500

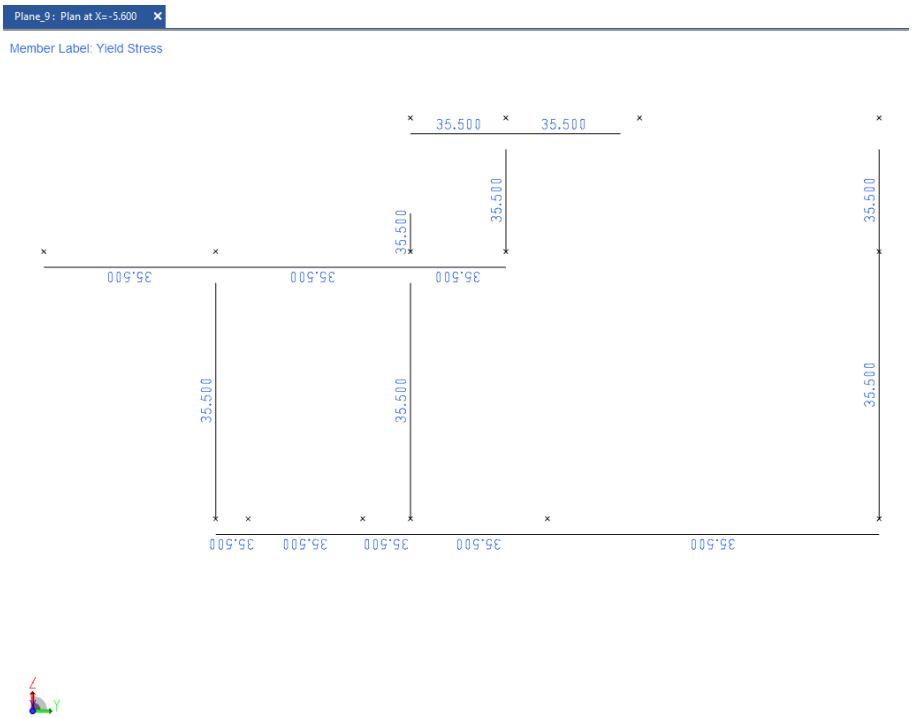

Plane_7 : Plan at X=-0.300
Member Label: KzLz
1.800
1.270
1.270
1.639
3.840
3.840
3.840
3.840
4.600
4.600
1.070
1.492
0.400
1.574
1.070
1.523
1.400
0.500
3.340
3.340
1.800
1.800

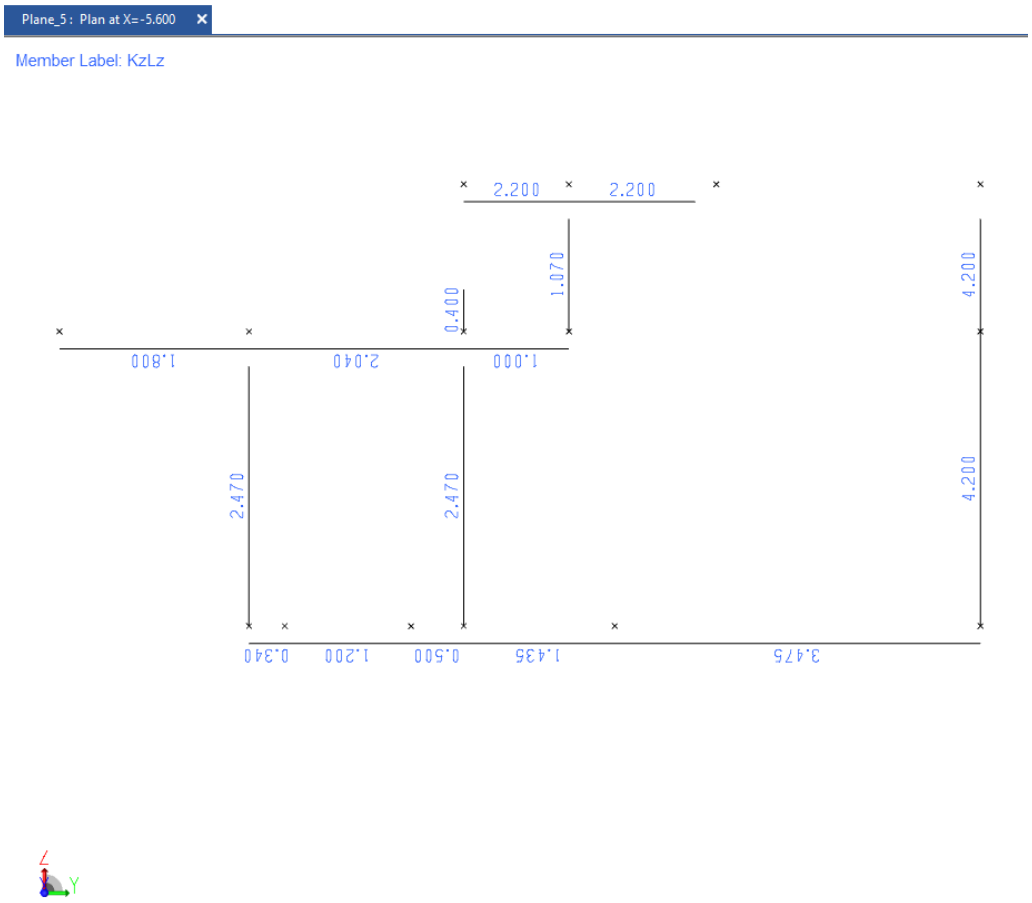


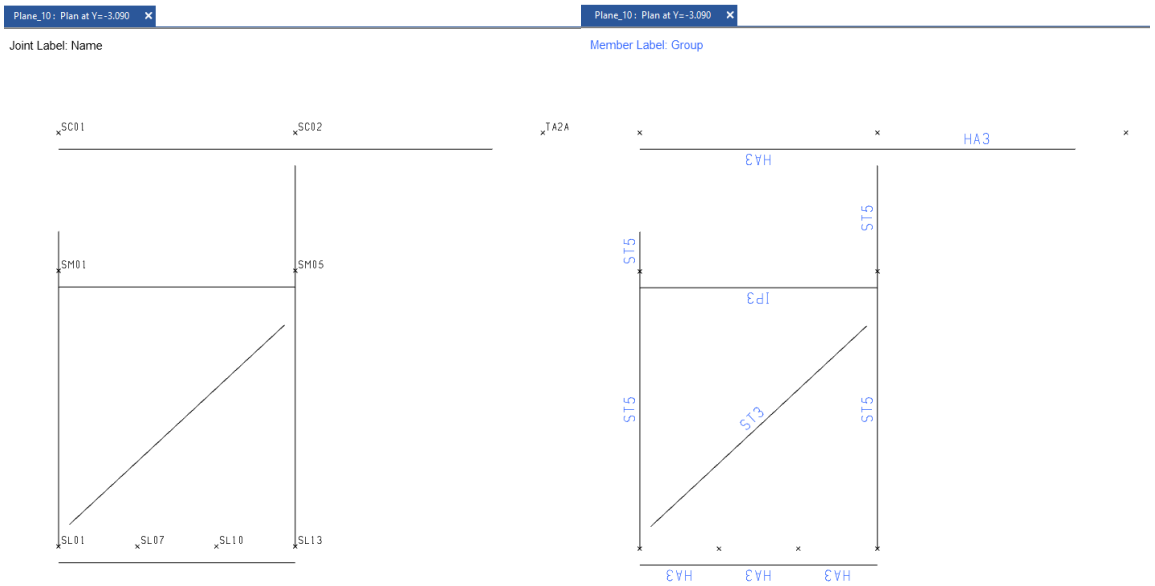

Plane_12 : Plan at X=-5.600
Joint Label: Name
SC05
SC04
TA2B
SC02
SM09
SM08
SM07
SM06
SM05
SL18
SS02
SS01
SL15
SL14
SL13

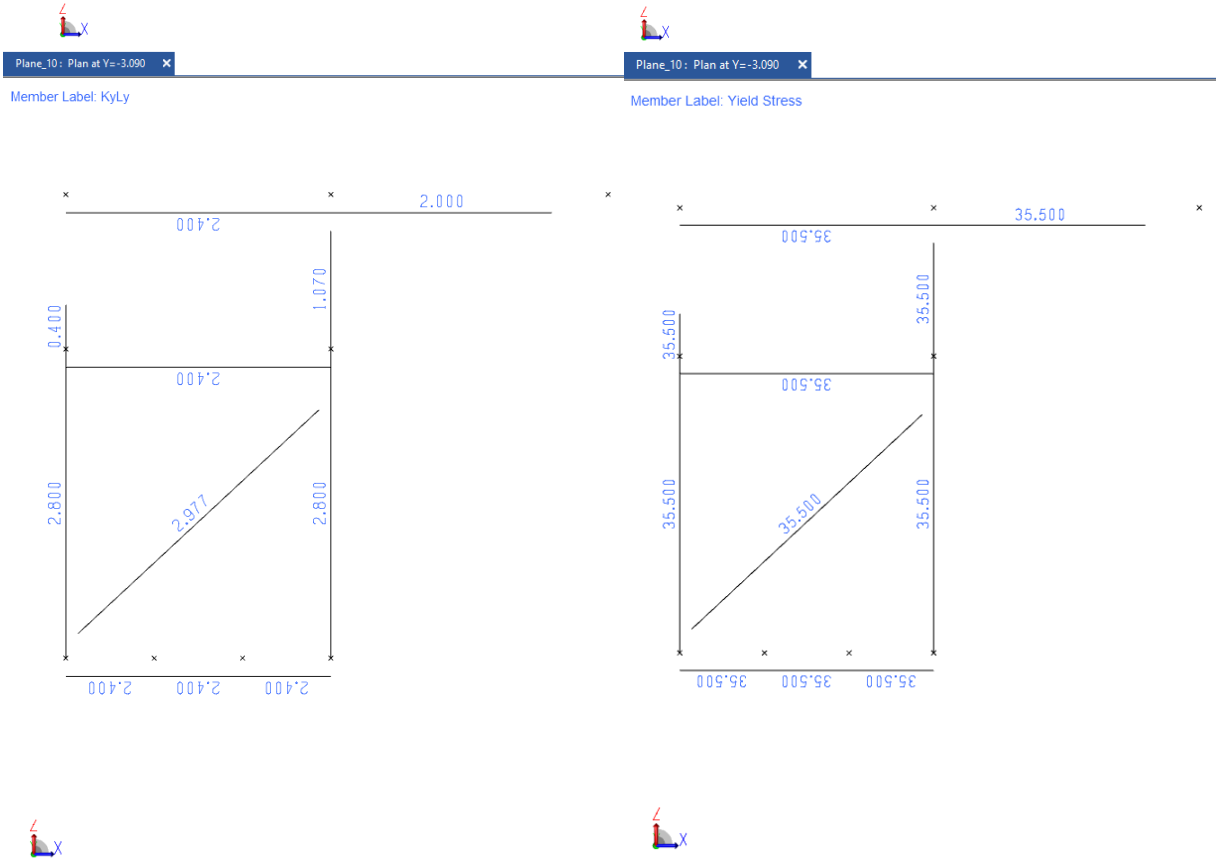

Plane_12 : Plan at X=-5.600
Member Label: Group
HA3
HA3
ST5
ST5
ST5
ST5
ST5
HA3
HA3
HA3
HA3
HA3
HA3
HA3
HA3

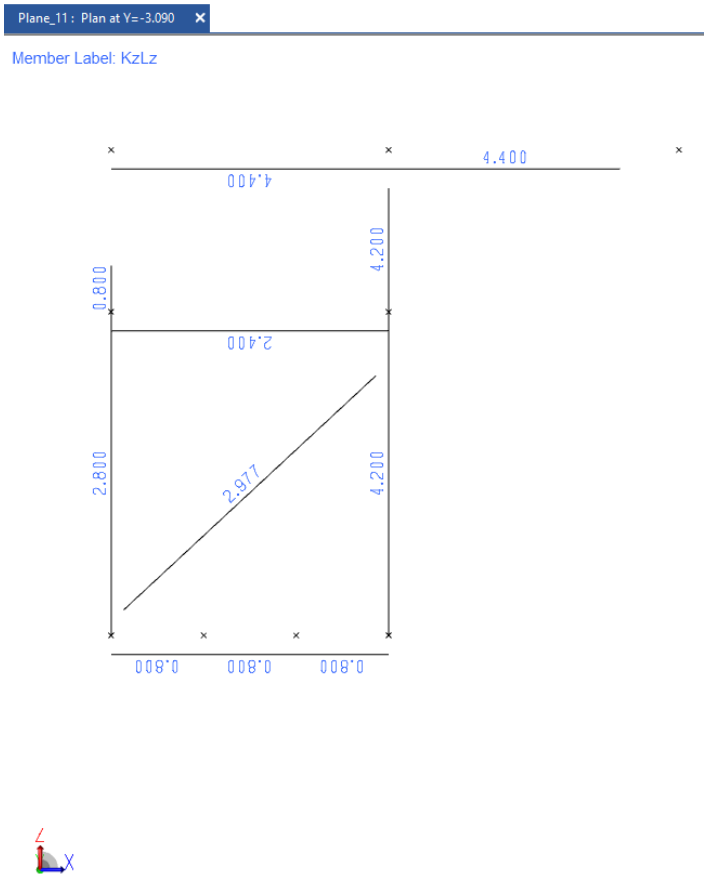

Plane_12 : Plan at X=-5.600
Member Label: KyLy
1.000
1.200
2.140
0.800
1.070
7.680
7.680
1.000
2.470
2.470
2.800
2.040
2.040
2.040
4.910
4.910

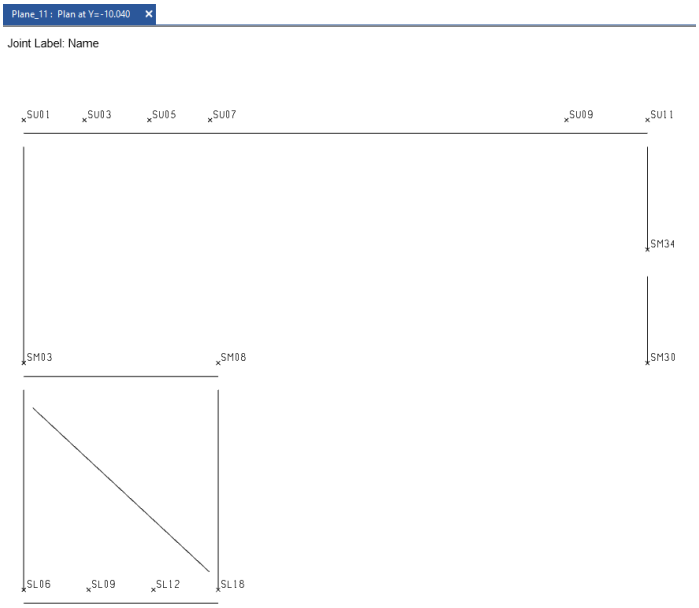

Plane_9 : Plan at X=-5.600
Member Label: Yield Stress
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500
35.500

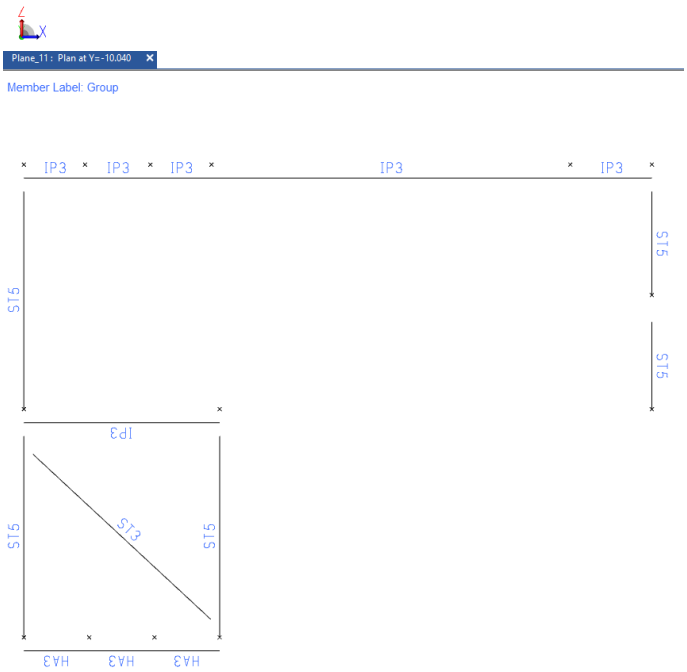

Plane_5 : Plan at X=-5.600
Member Label: KzLz
2.200
2.200
1.070
0.400
4.200
1.800
2.040
1.000
2.470
2.470
4.200
0.340
1.200
0.500
1.435
3.475
Z
Y

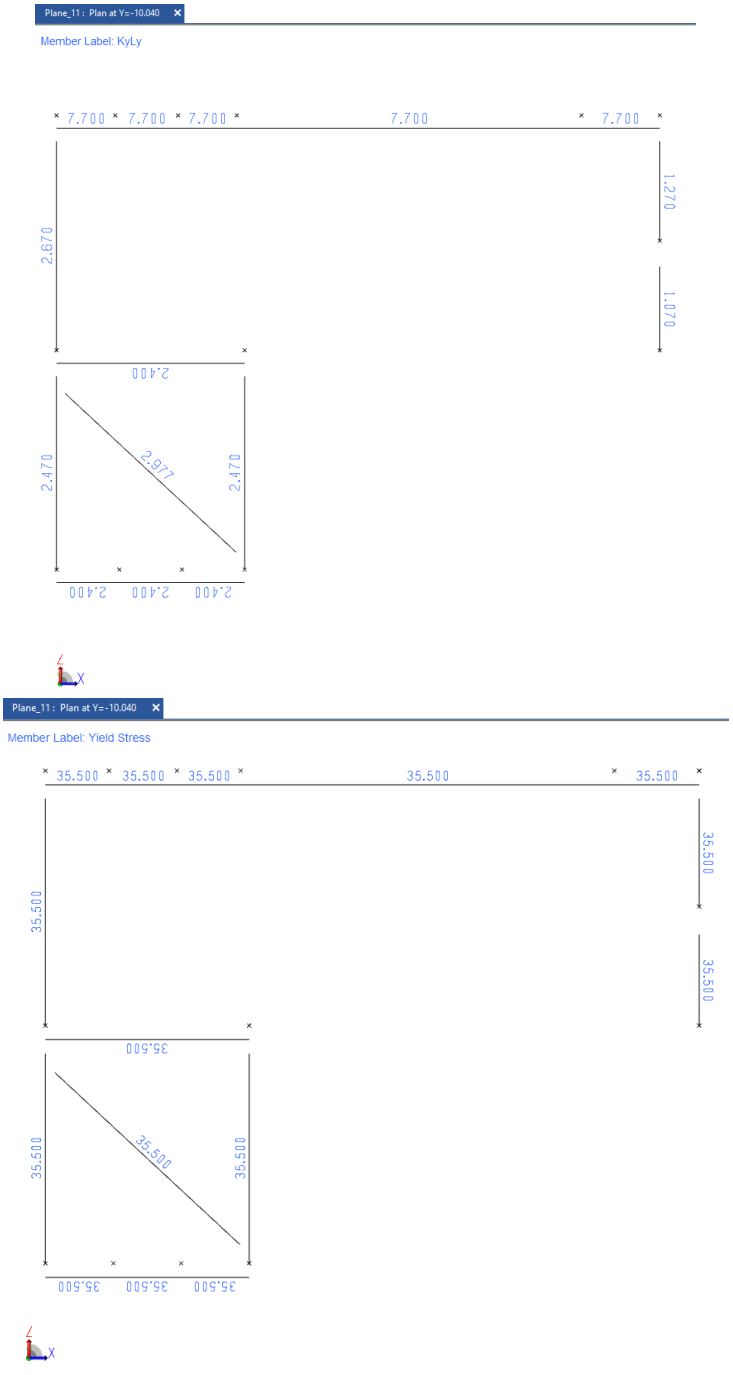

Plane_10 : Plan at Y=-3.090
Joint Label: Name
SC01
SC02
TA2A
SM01
SM05
SL01
SL07
SL10
SL13
Plane_10 : Plan at Y=-3.090
Member Label: Group
HA3
ST5
IP3
ST3

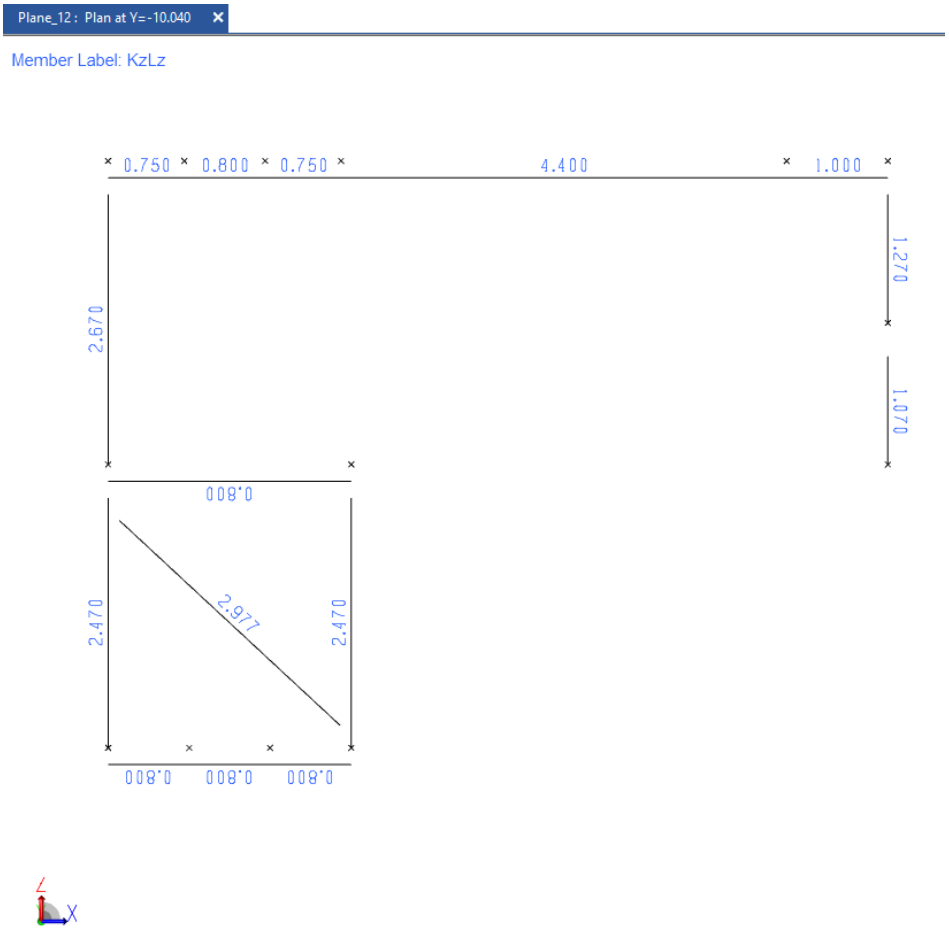

Plane_10 : Plan at Y=-3.090
Member Label: KyLy
2.000
2.400
1.070
0.400
2.800
2.977
Plane_10 : Plan at Y=-3.090
Member Label: Yield Stress
35.500

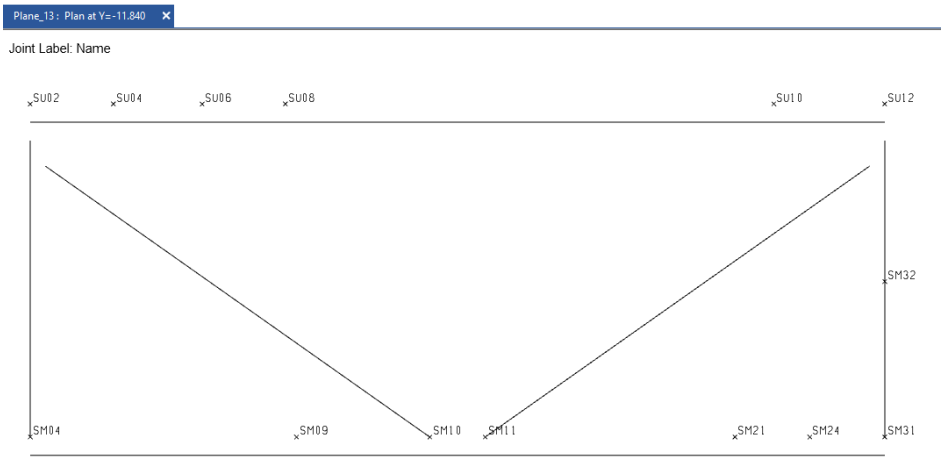

Plane_11 : Plan at Y=-3.090
Member Label: KzLz
4.400
4.400
4.200
0.800
2.400
2.977
2.800
4.200
0.800
0.800
0.800
Z
X

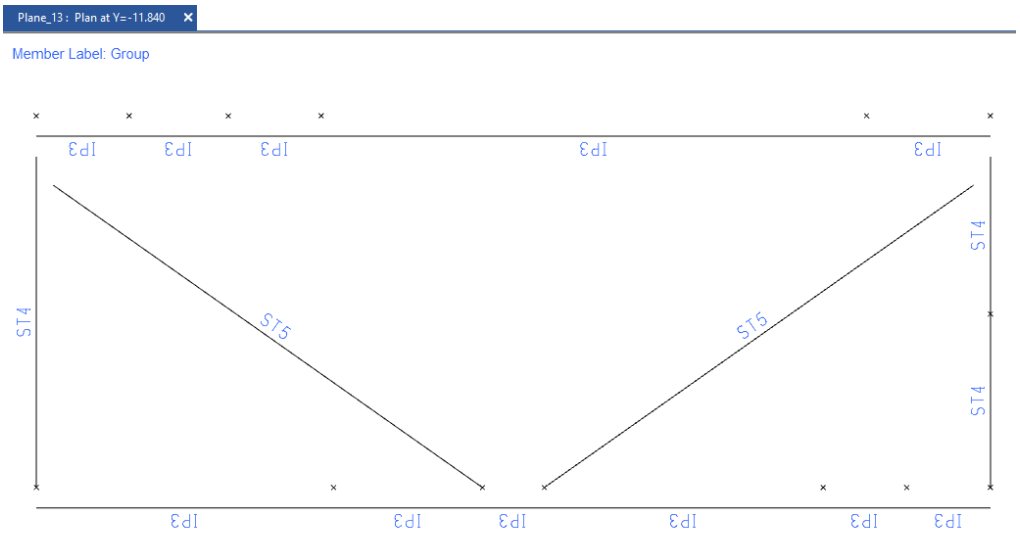

Plane_11 : Plan at Y=-10.040
Joint Label: Name
SU01
SU03
SU05
SU07
SU09
SU11
SM34
SM03
SM08
SM30
SL06
SL09
SL12
SL18

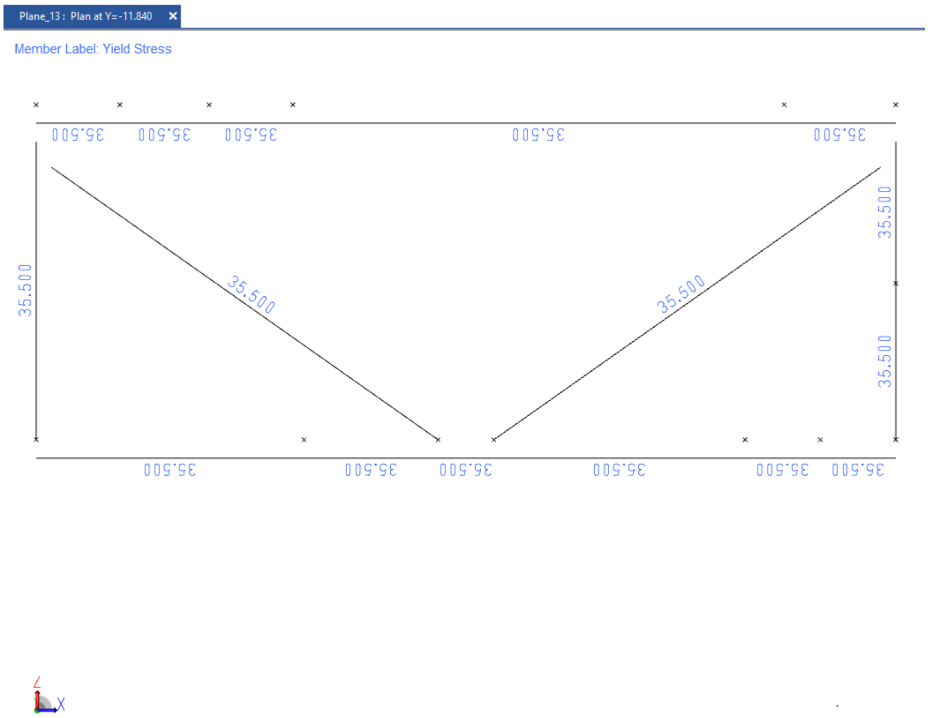

Plane_11 : Plan at Y=-10.040
Member Label: Group
IP3
IP3
IP3
IP3
IP3
ST5
ST5
ST5
ST5
HA3
HA3
HA3


Plane_11 : Plan at Y=-10.040
Member Label: KyLy
7.700
1.270
1.070
2.670
2.400
2.470
2.977
Plane_11 : Plan at Y=-10.040
Member Label: Yield Stress
35.500

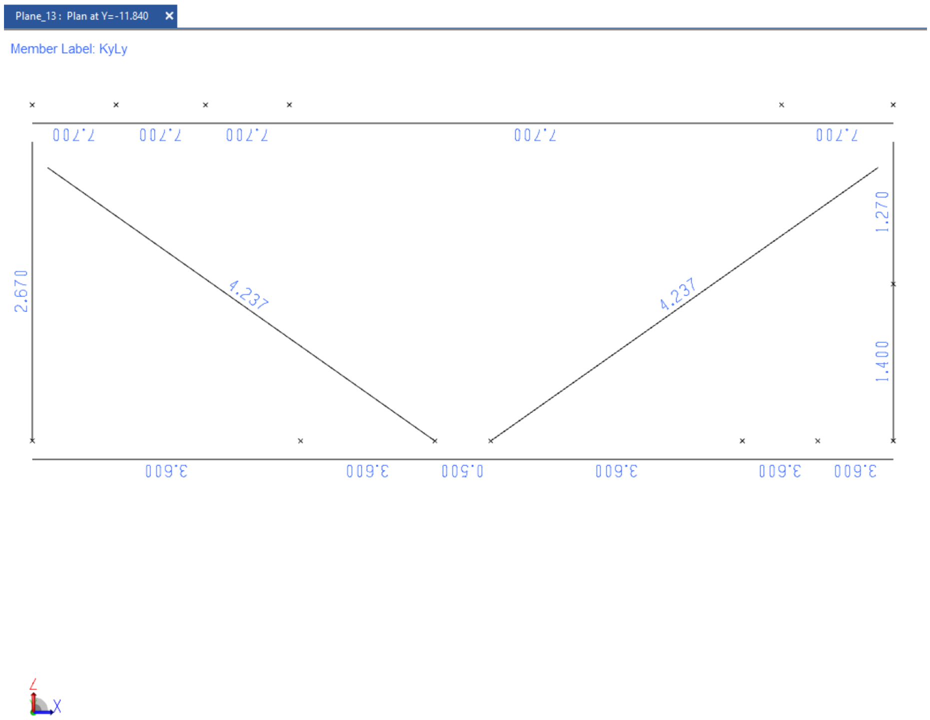

Plane_12 : Plan at Y=-10.040
Member Label: KzLz
0.750
0.800
0.750
4.400
1.000
2.670
1.270
1.070
0.800
2.470
2.977
2.470
0.800
0.800
0.800
Z
X


Plane_13 : Plan at Y=-11.840
Joint Label: Name
SU02
SU04
SU06
SU08
SU10
SU12
SM32
SM04
SM09
SM10
SM11
SM21
SM24
SM31

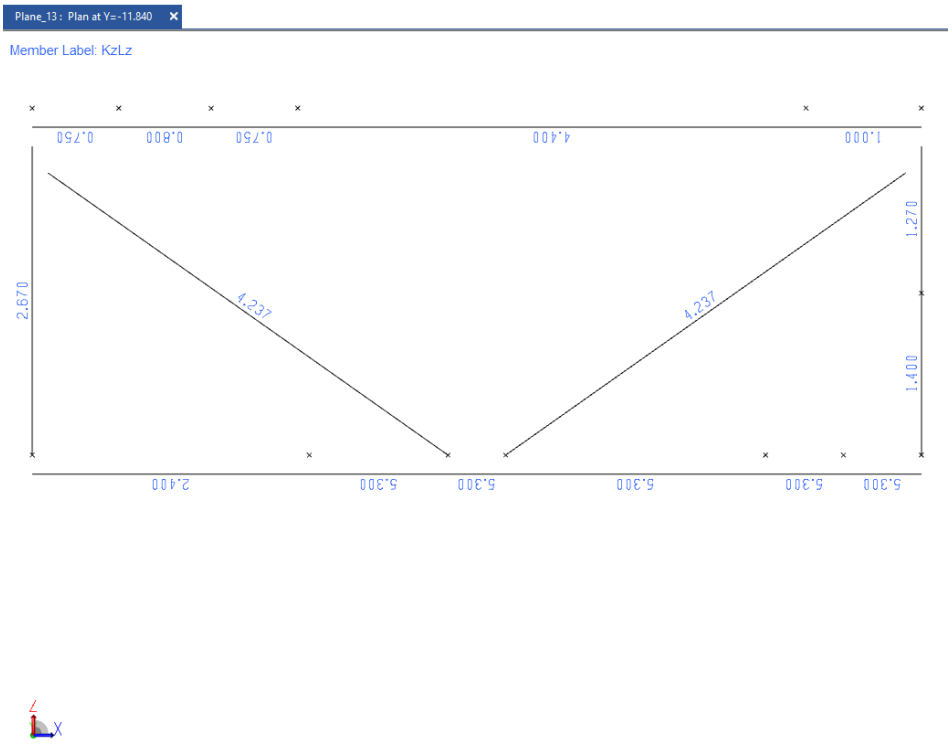

Plane_13 : Plan at Y=-11.840
Member Label: Group
IP3
ST4
ST5

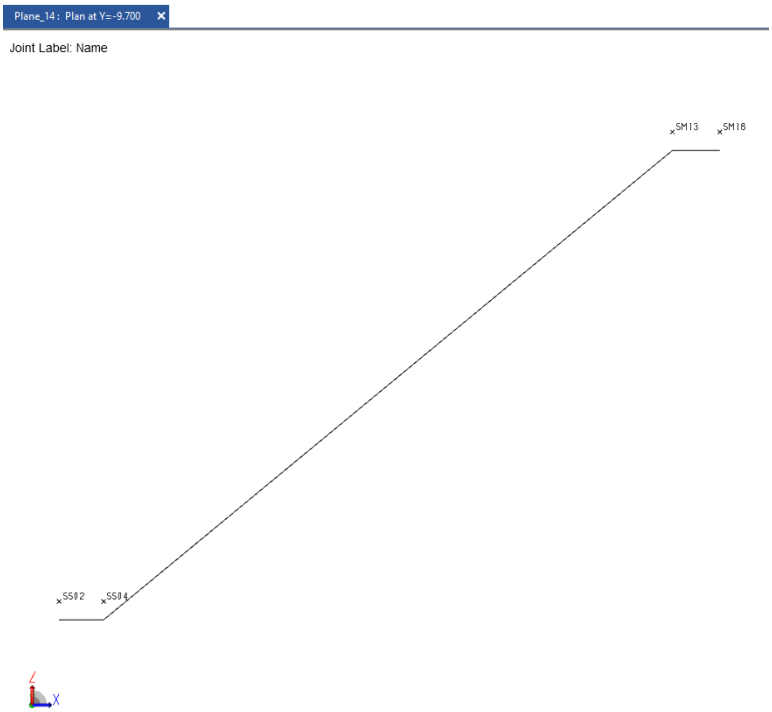


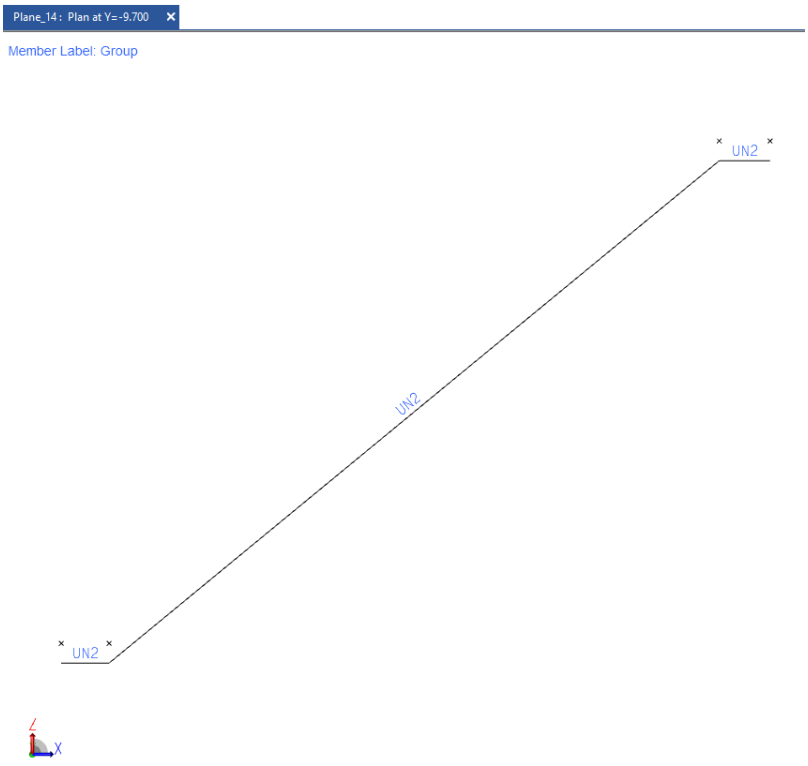
Plane_13 : Plan at Y=-11.840
Member Label: Yield Stress
35.500

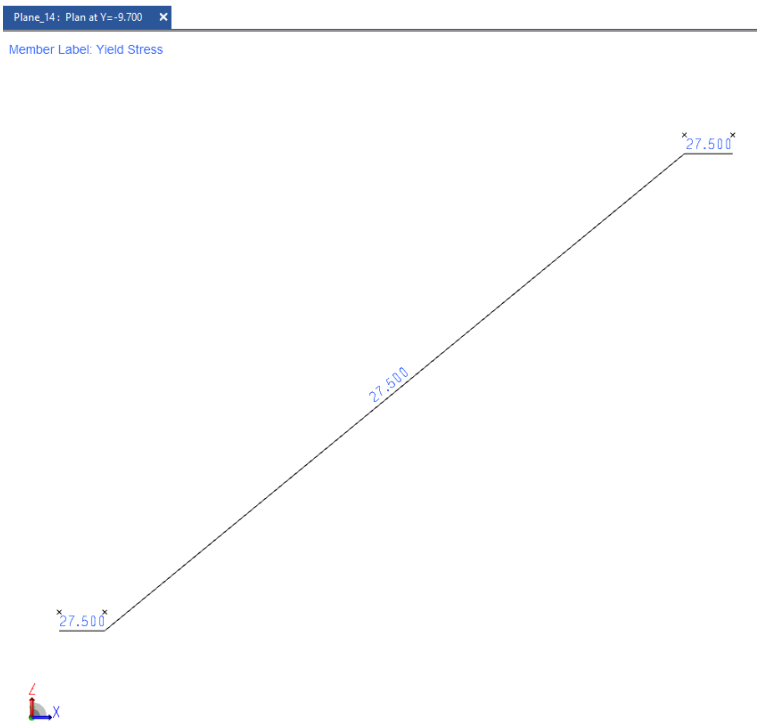


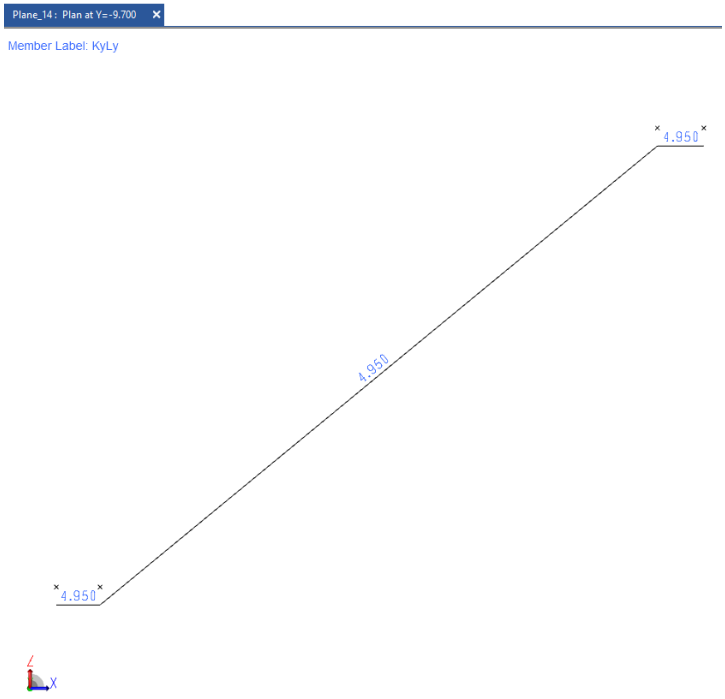
Plane_13 : Plan at Y=-11.840
Member Label: KyLy
2.700
2.670
4.237
1.270
1.400
3.600
0.500

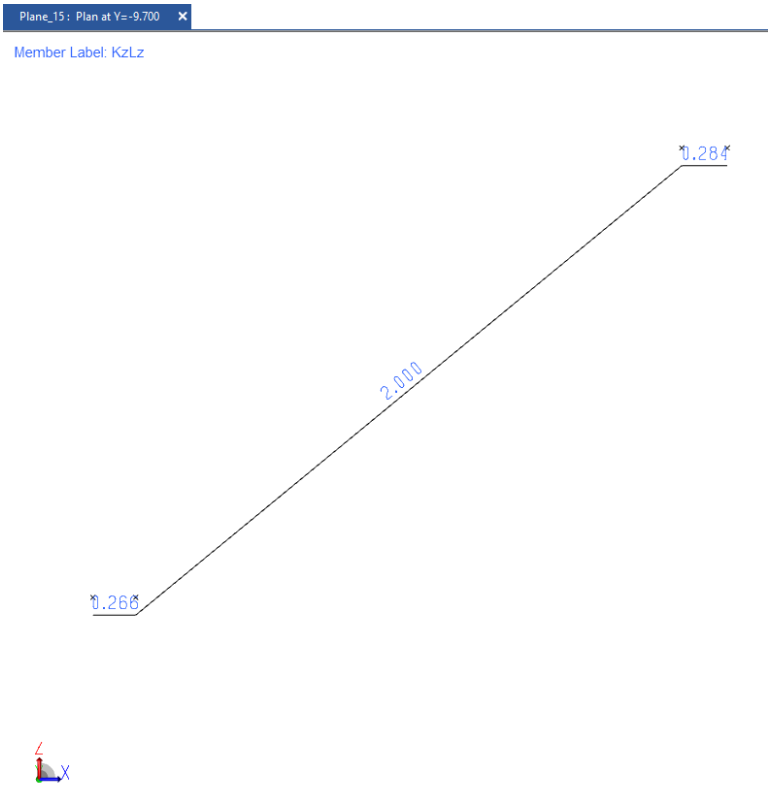

Plane_13 : Plan at Y=-11.840
Member Label: KzLz
0.750
0.800
0.750
4.400
1.000
1.270
1.400
2.670
4.237
4.237
2.400
5.300
5.300
5.300
5.300
5.300
Z
X

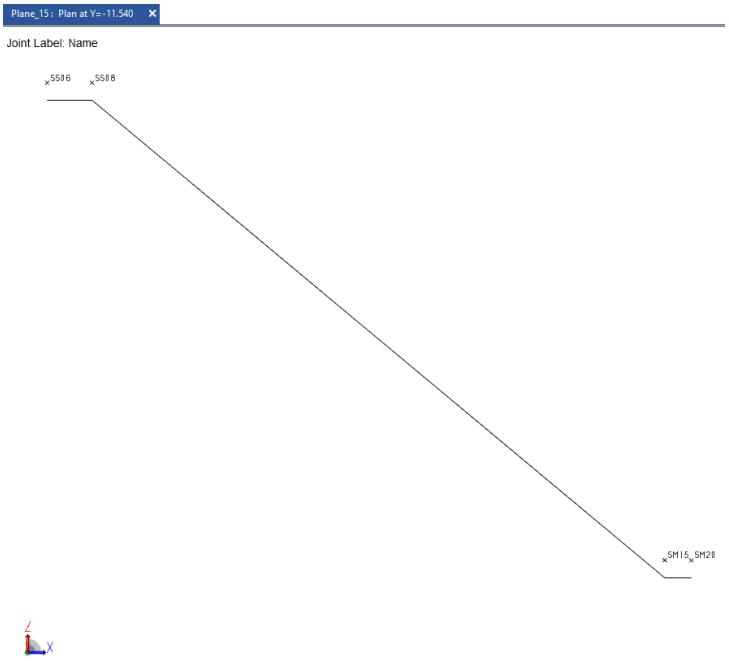

Plane_14 : Plan at Y=-9.700
Joint Label: Name
SM13
SM18
SS02
SS04
Z
X

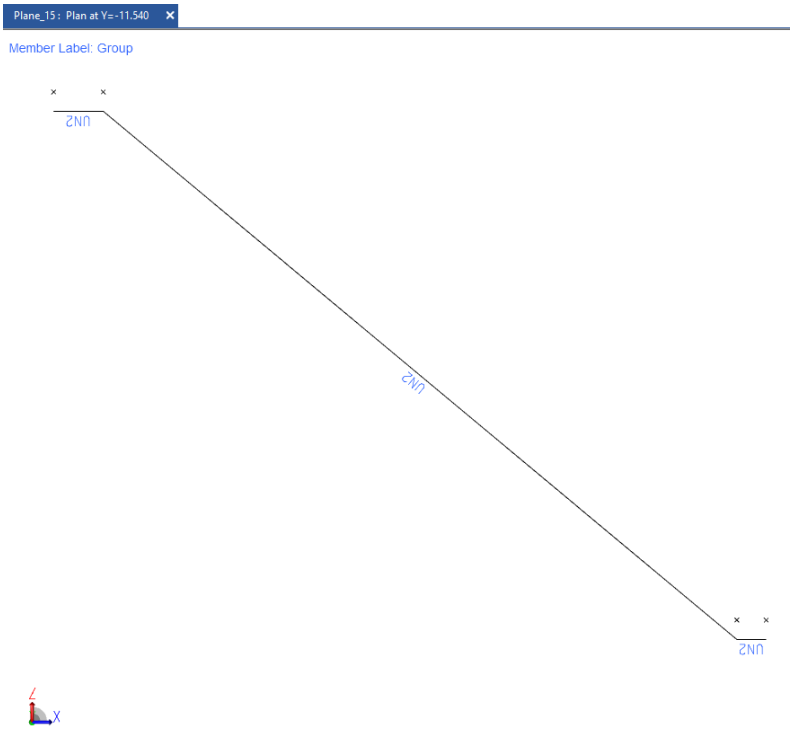

Plane_14 : Plan at Y=-9.700
Member Label: Group
UN2
UN2
UN2
Z
X

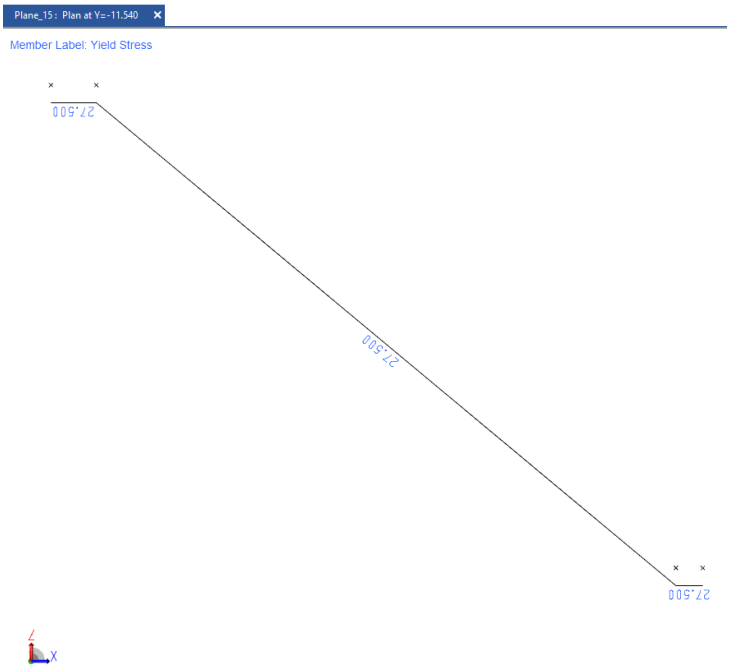

Plane_14 : Plan at Y=-9.700
Member Label: Yield Stress
27.500
27.500
27.500
Z
X

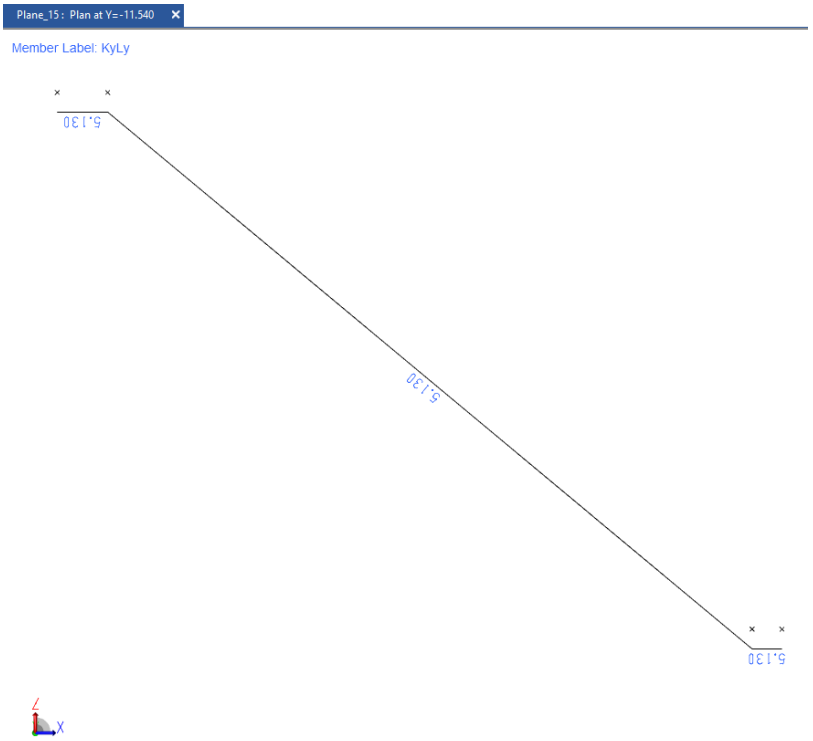

Plane_14 : Plan at Y=-9.700
Member Label: KyLy
4.950
4.950
4.950
Z
X

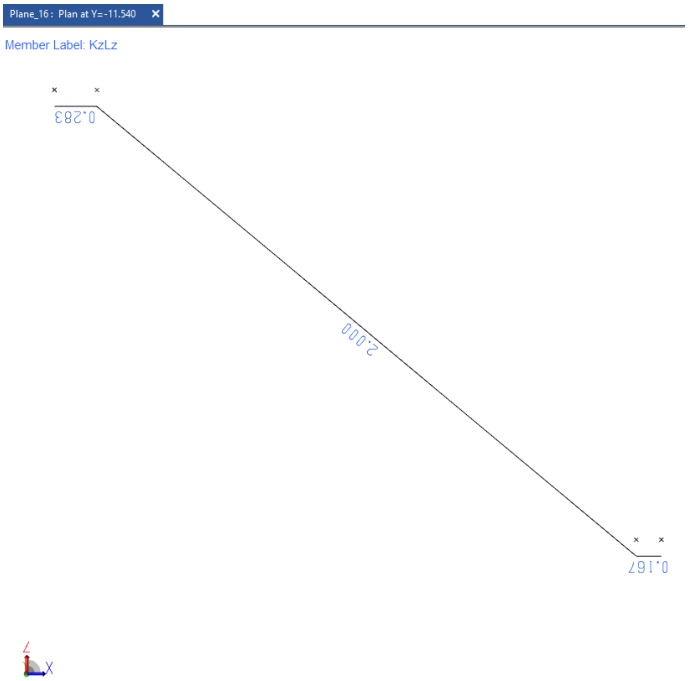

Plane_15 : Plan at Y=-9.700
Member Label: KzLz
0.284
2.000
0.268
Z
X

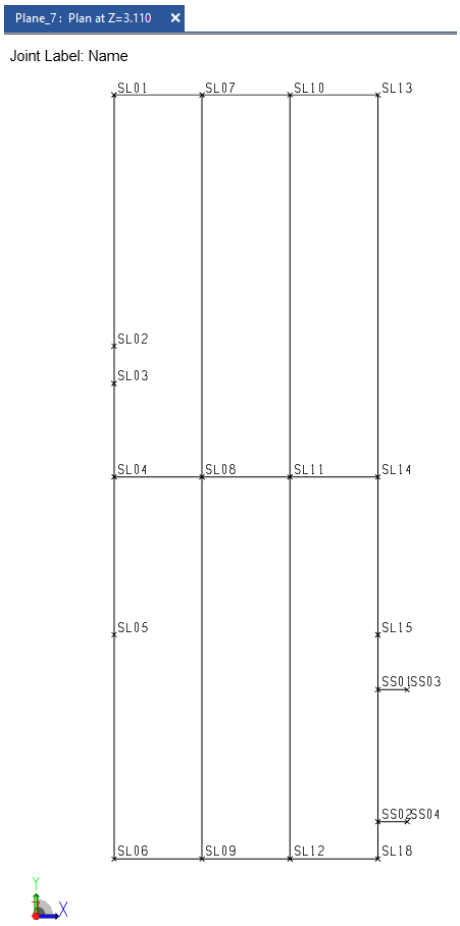

Plane_15 : Plan at Y=-11.540
Joint Label: Name
SS06
SS08
SM15
SM28
Z
X

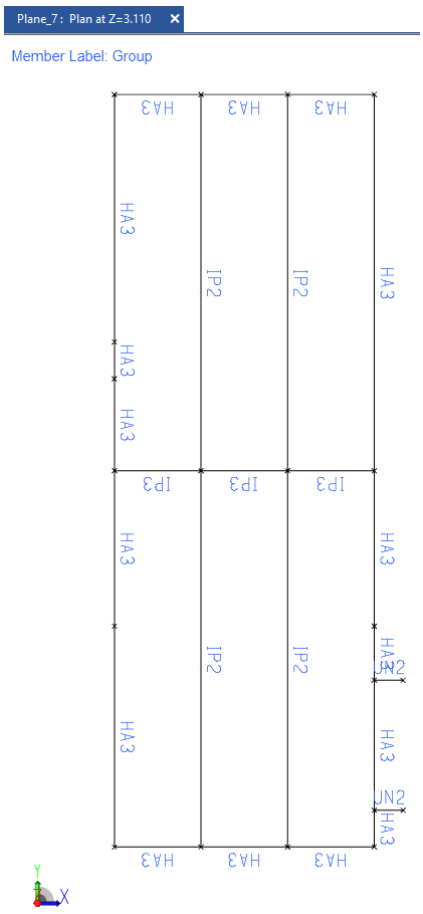

Plane_15 : Plan at Y=-11.540
Member Label: Group
UNS
UNS
UNS
Z
X

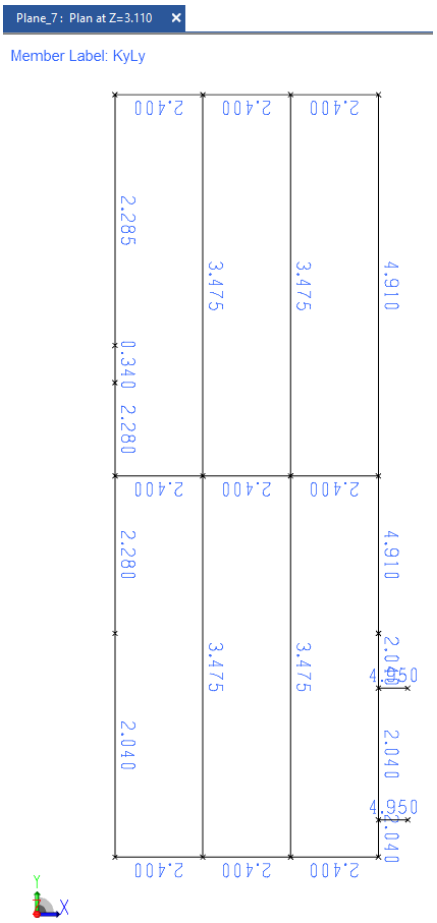

Plane_15 : Plan at Y=-11.540
Member Label: Yield Stress
27.500
27.500
27.500
Z
X

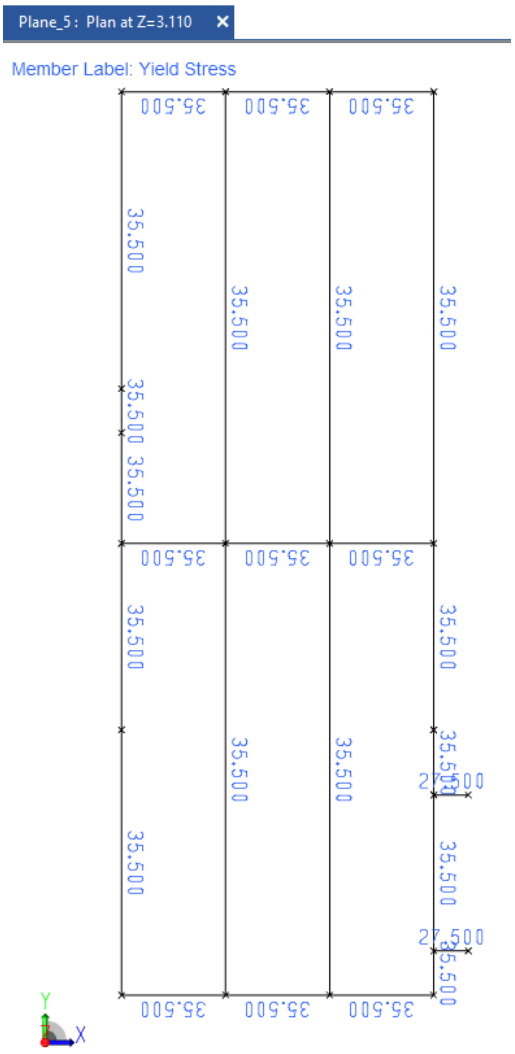

Plane_15 : Plan at Y=-11.540
Member Label: KyLy
5.130
5.130
5.130

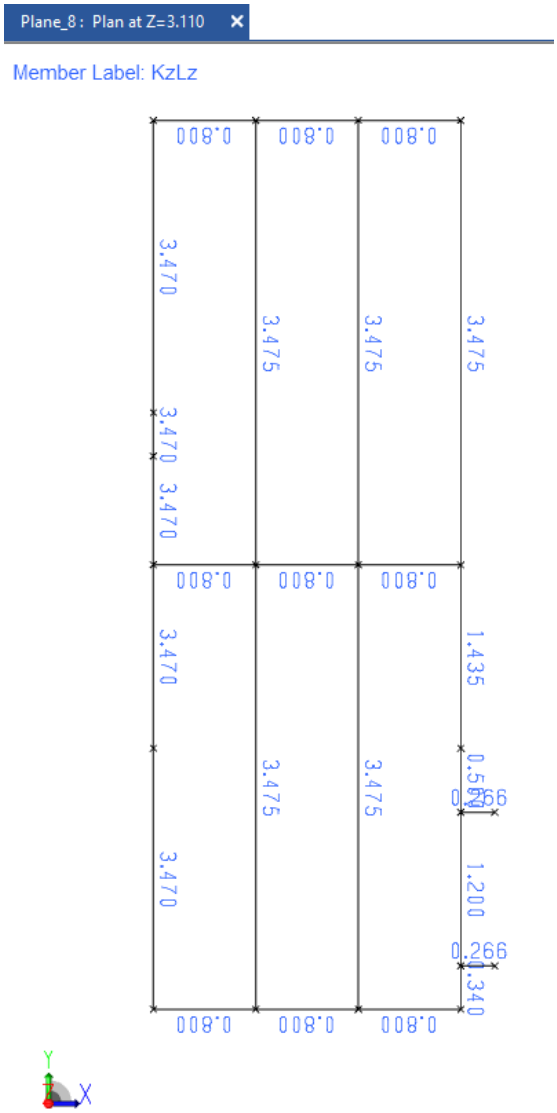

Plane_16 : Plan at Y=-11.540
Member Label: KzLz
0.283
2.000
0.167

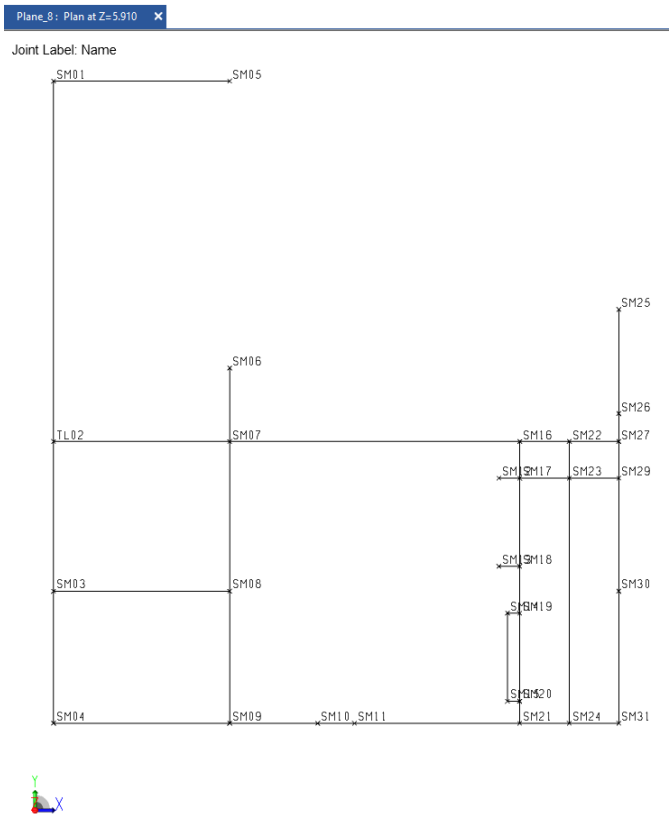

Plane_7 : Plan at Z=3.110
Joint Label: Name
SL01
SL07
SL10
SL13
SL02
SL03
SL04
SL08
SL11
SL14
SL05
SL15
SS01
SS03
SS02
SS04
SL06
SL09
SL12
SL18
Y
X

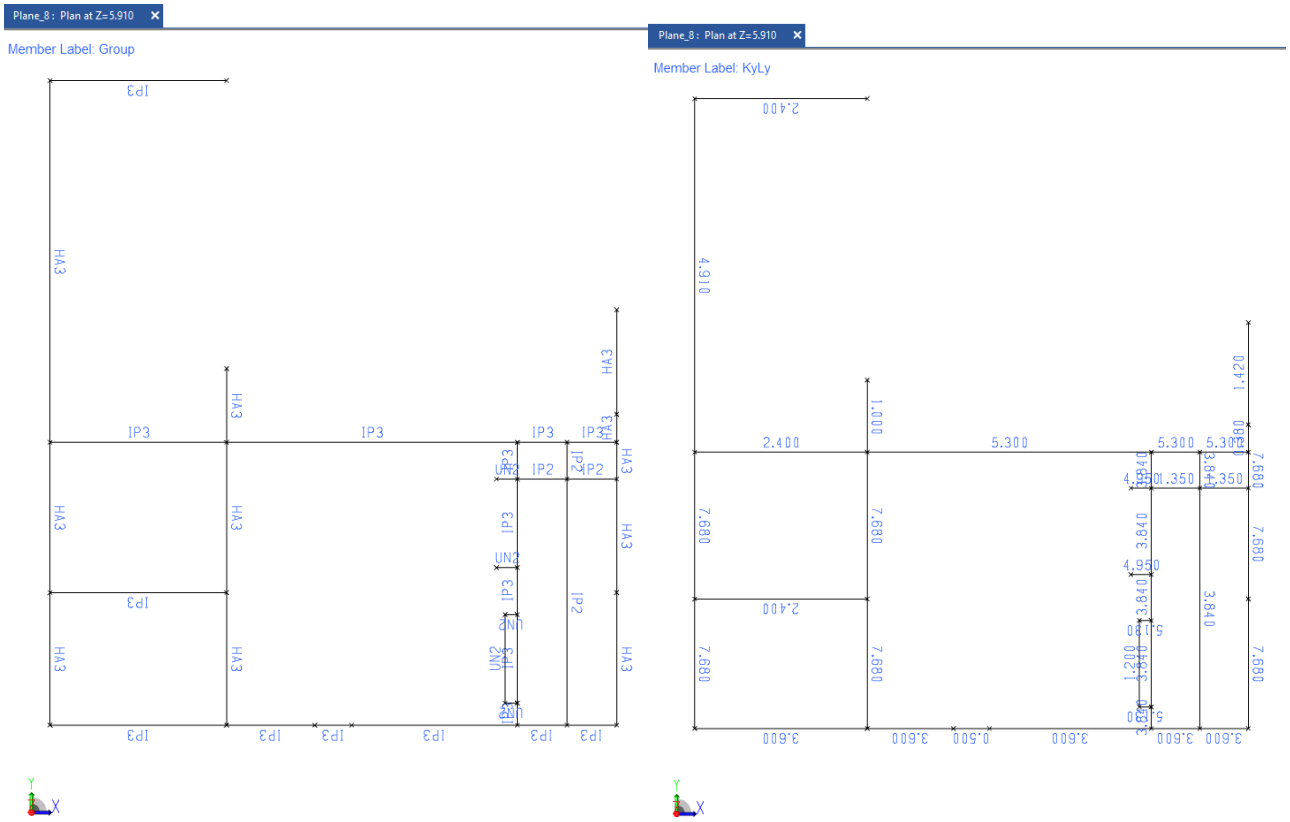

Plane_7 : Plan at Z=3.110
Member Label: Group
HA3
IP2
IP3
UN2
Y
X

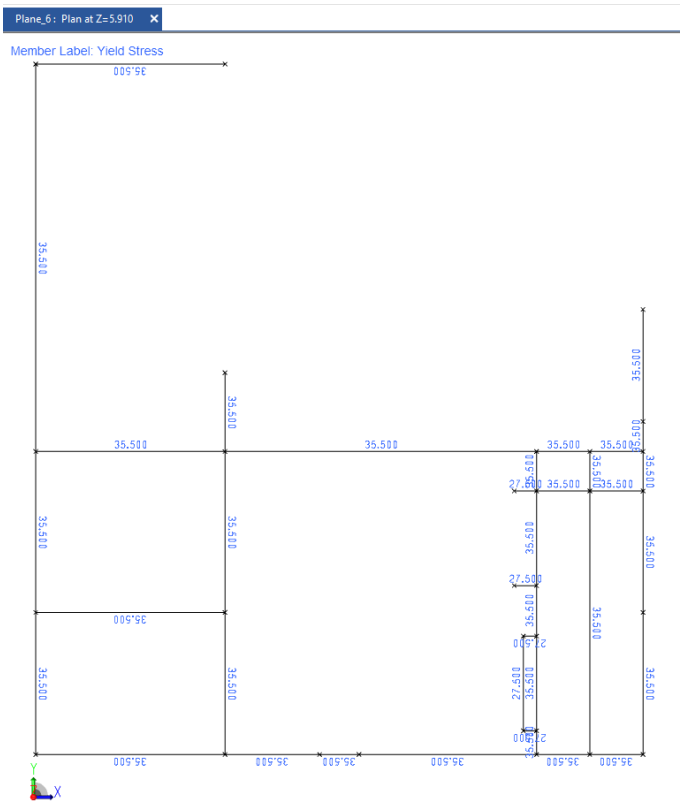

Plane_7 : Plan at Z=3.110
Member Label: KyLy
2.400
2.400
2.400
2.285
3.475
3.475
4.910
0.340
2.280
2.400
2.400
2.400
2.280
4.910
3.475
3.475
2.040
2.040
2.040
Y
X

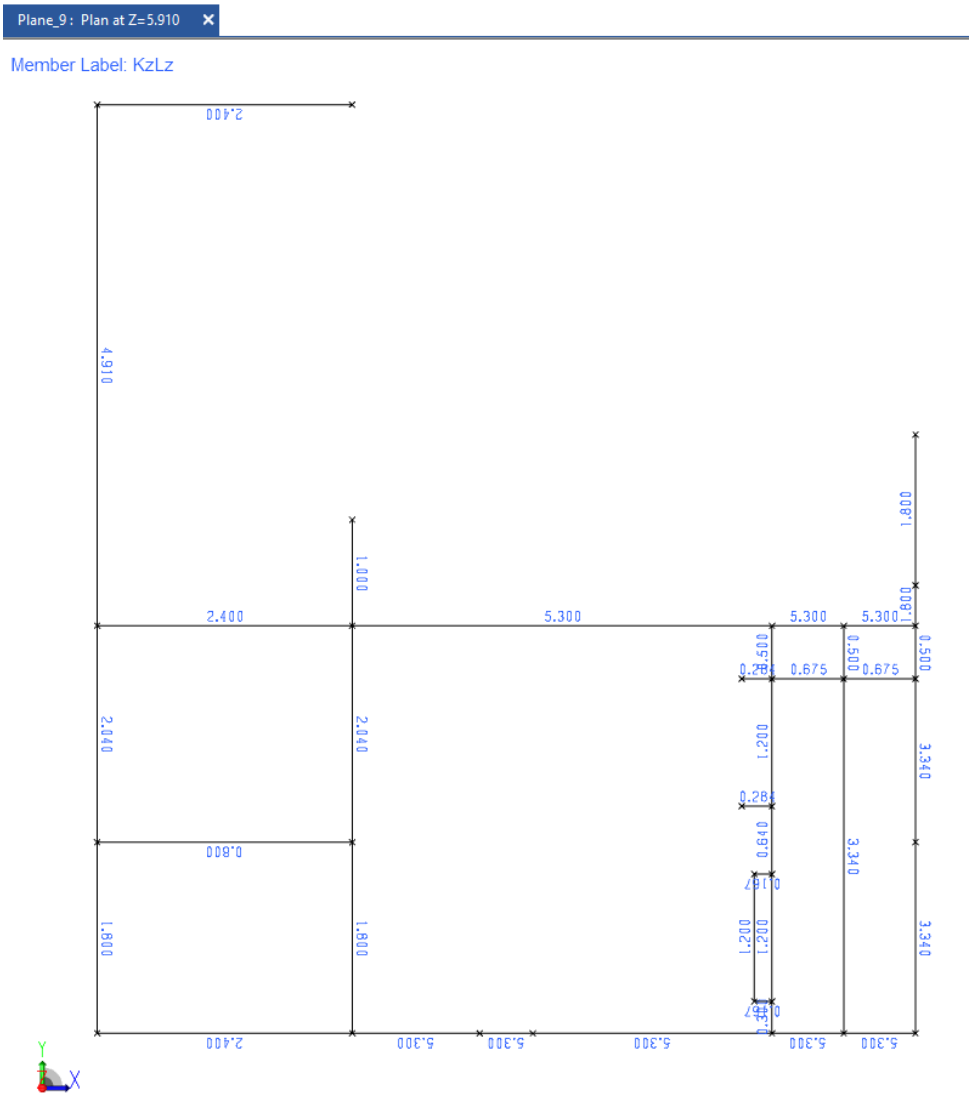

Plane_5 : Plan at Z=3.110
Member Label: Yield Stress
35.500
27.500

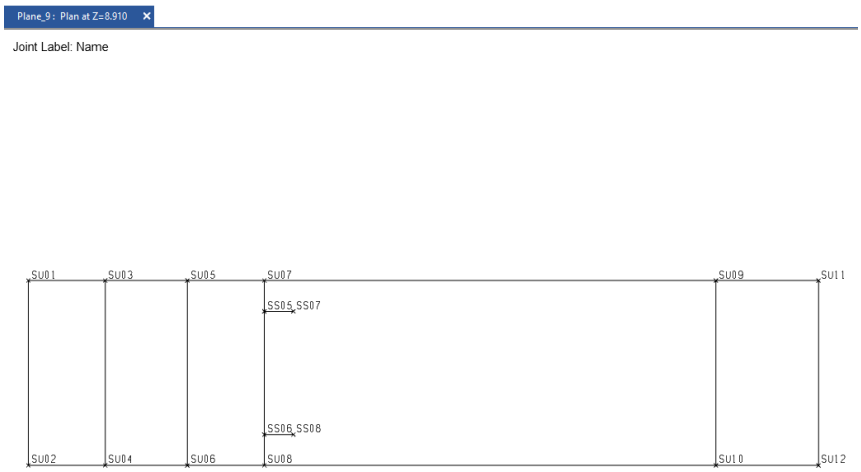

Plane_8 : Plan at Z=3.110
Member Label: KzLz
0.800
3.470
3.475
1.435
1.200
0.266
0.340

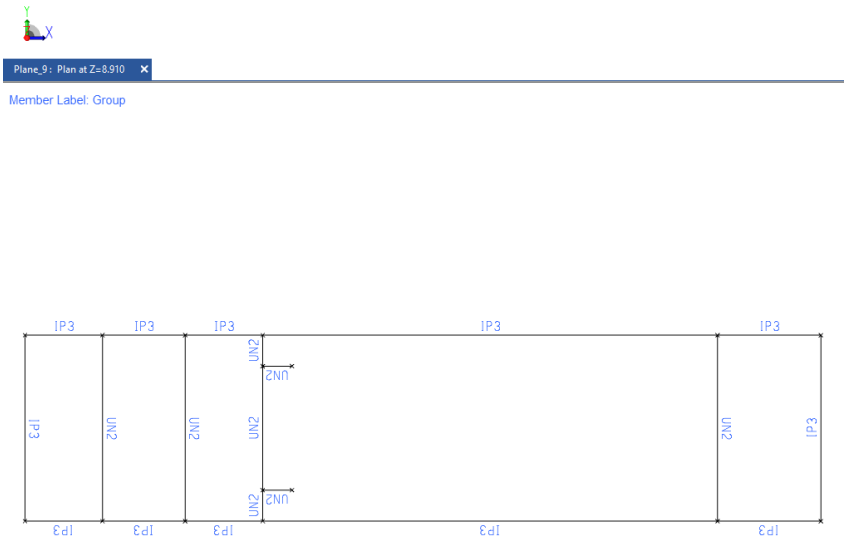

Plane_8 : Plan at Z=5.910
Joint Label: Name
SM01
SM05
SM06
SM25
SM26
TL02
SM07
SM16
SM22
SM27
SM17
SM23
SM29
SM18
SM03
SM08
SM30
SM19
SM20
SM04
SM09
SM10
SM11
SM21
SM24
SM31
Y
X


Plane_8 : Plan at Z=5.910
Member Label: Group
Plane_8 : Plan at Z=5.910
Member Label: KyLy

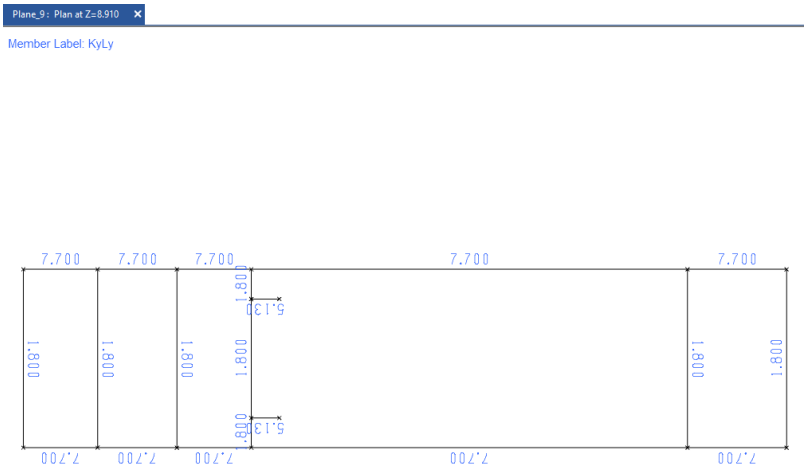

Plane_6 : Plan at Z=5.910
Member Label: Yield Stress
35.500
27.500
Y
X

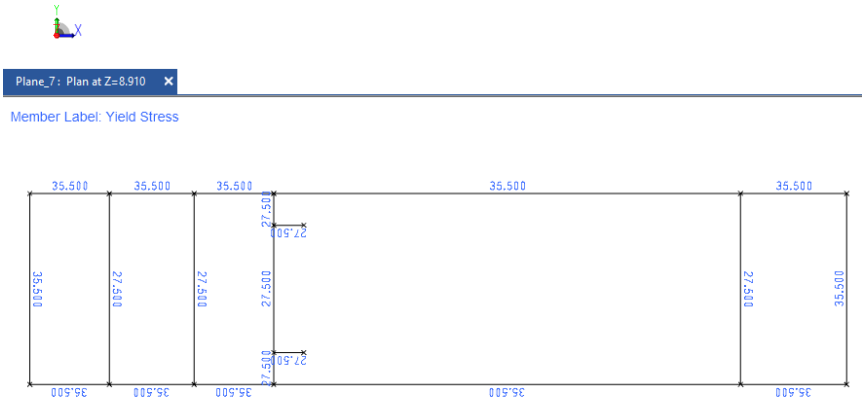

Plane_9 : Plan at Z=5.910
Member Label: KzLz
2.400
4.910
1.000
1.800
2.400
5.300
5.300
5.300
0.500
0.675
0.675
2.040
2.040
1.200
3.340
0.284
0.640
0.600
3.340
1.800
1.800
1.200
1.200
3.340
2.400
5.300
5.300
5.300
5.300
5.300
Y
X

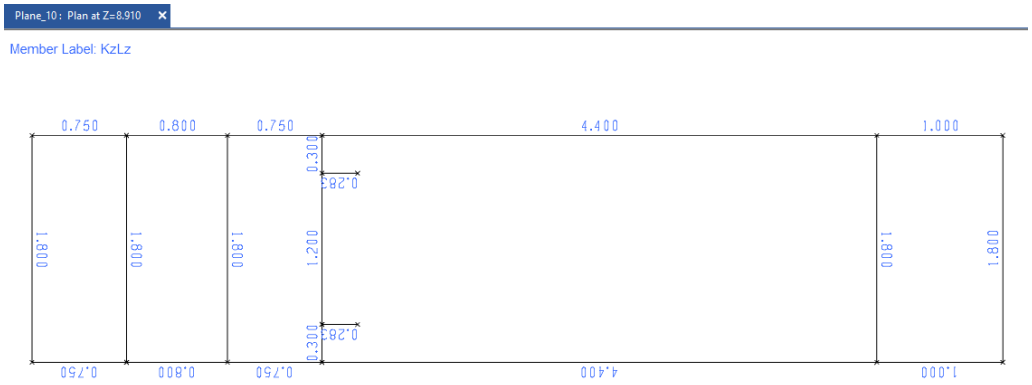




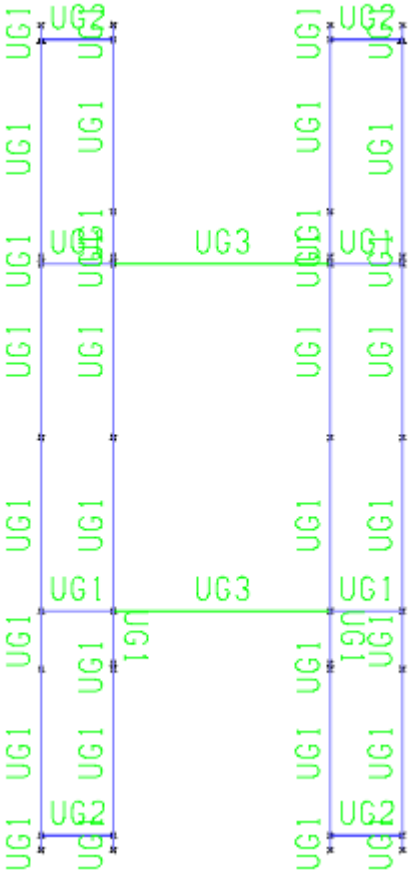
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Plane_9 : Plan at Z=8.910
Member Label: KyLy
7.700
1.800
5.133


Plane_7 : Plan at Z=8.910
Member Label: Yield Stress
35.500
27.500
27.500


Plane_10 : Plan at Z=8.910
Member Label: KzLz
0.750
0.800
0.750
4.400
1.000
0.300
0.283
1.800
1.800
1.800
1.200
1.800
1.800
0.300
0.283
0.750
0.800
0.750
4.400
1.000

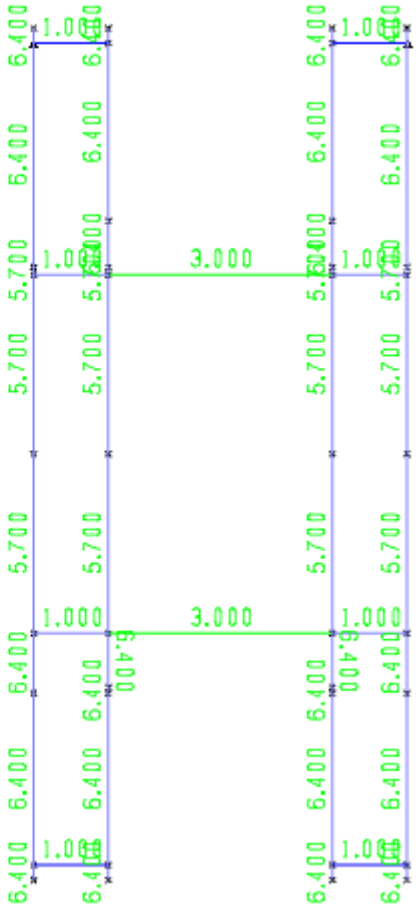

Y
X


UG1
UG2
UG3

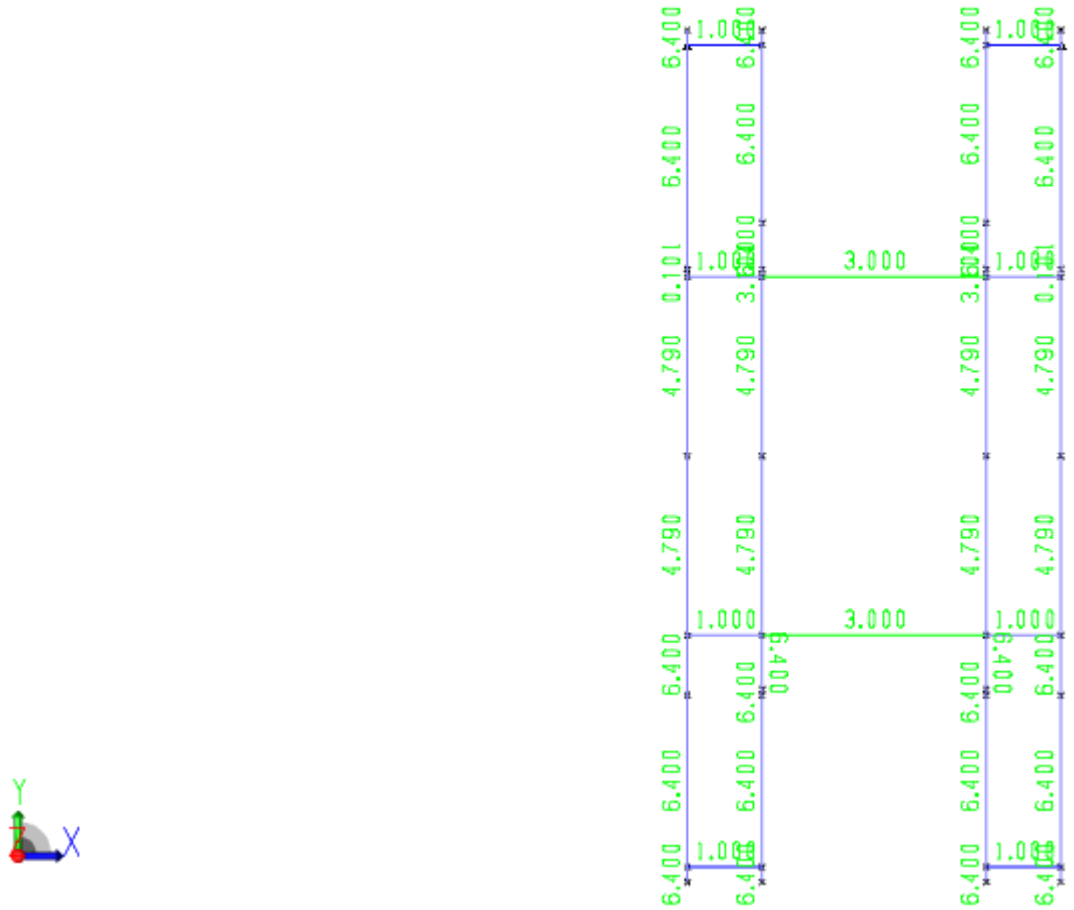

R208
R308
R100
R200
R300
R400
R1L6
R206
R306
R4L6
SP01
SP02

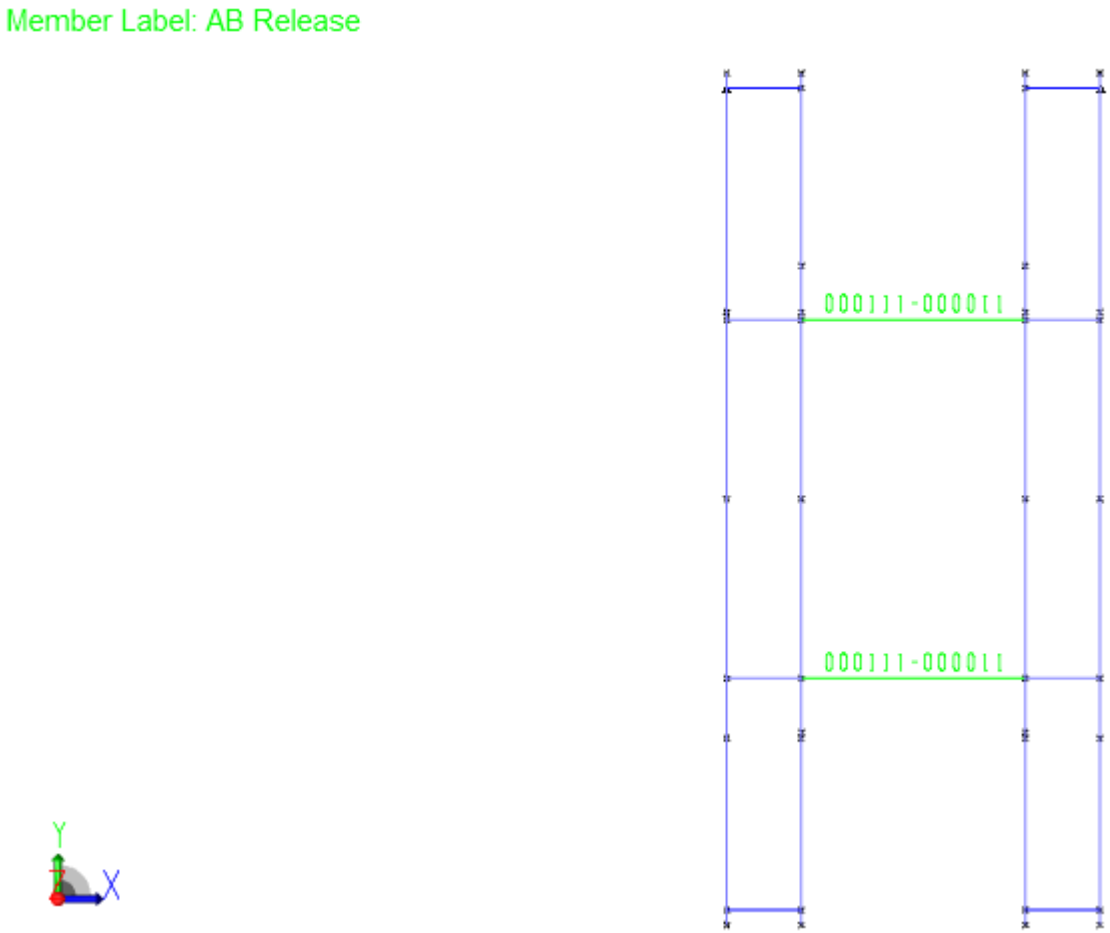
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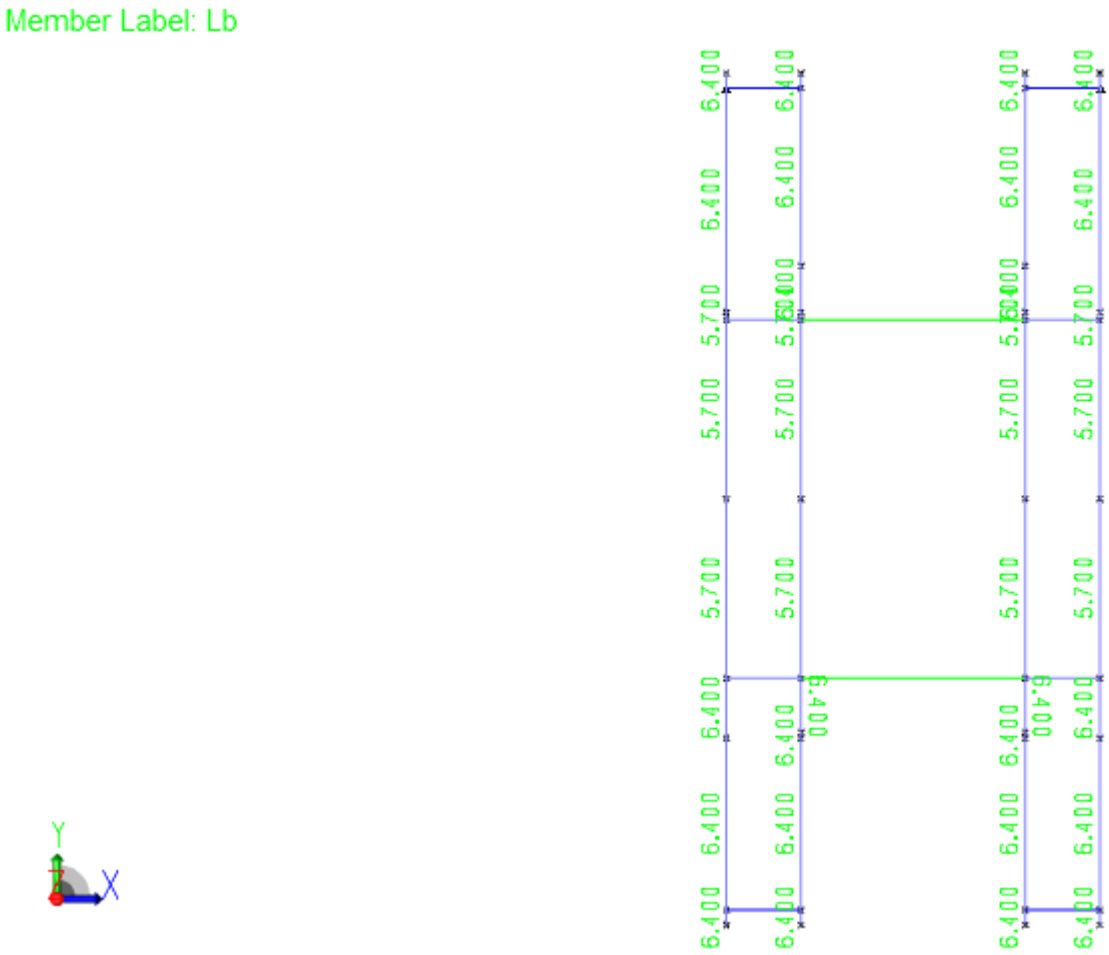


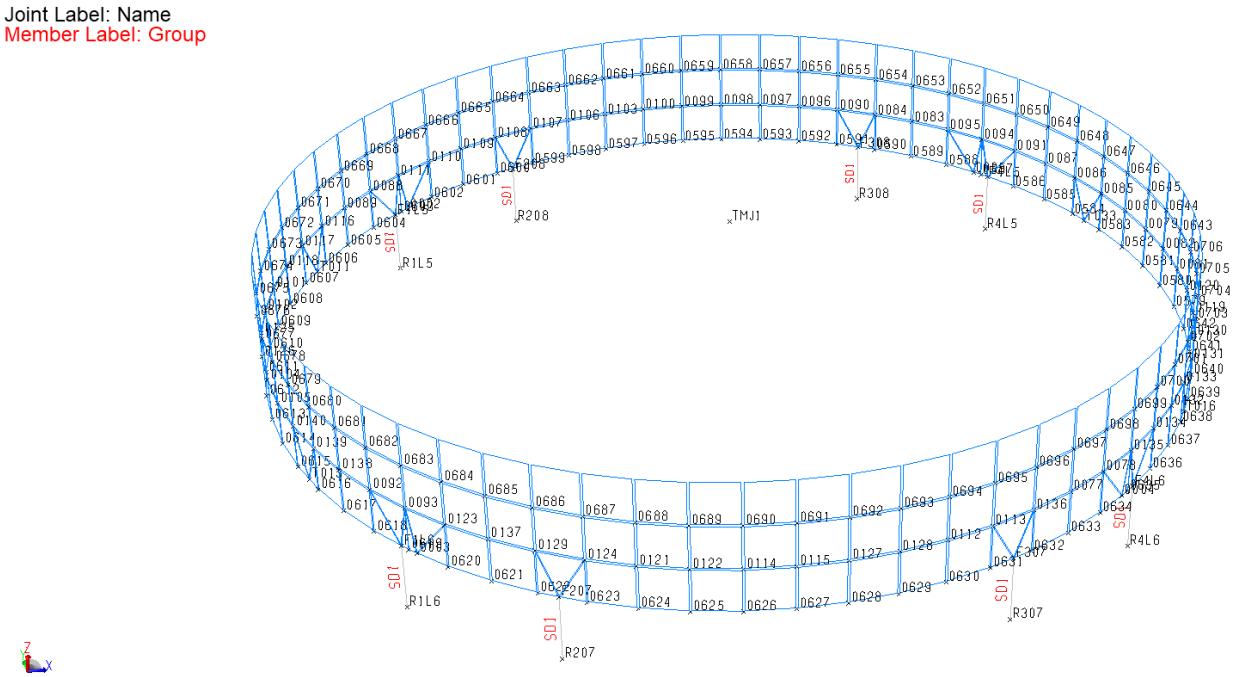


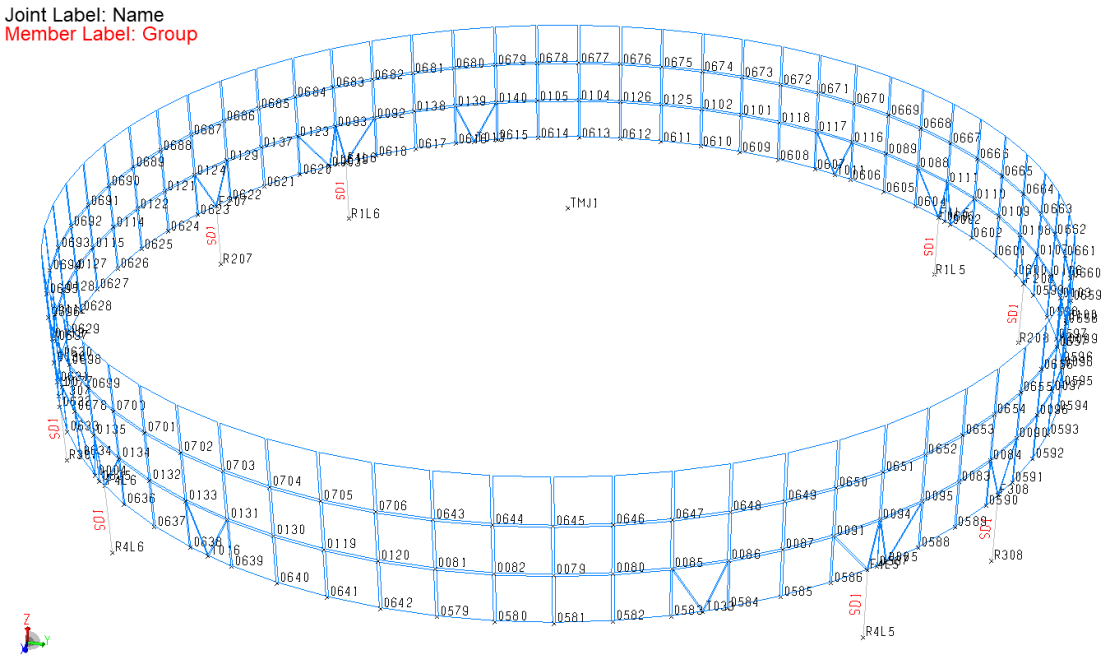
Member Label: KzLz




Member Label: AB Release
Y
X


Member Label: Lb
Y
X
6.400
5.700





All Plates / shells are Group M65