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INNWIND.EU – 10MW JACKET INTERFACE DOCUMENT FOR PRELIMINARY JACKET DESIGN

**INNWIND.EU – 10MW JACKET
INTERFACE DOCUMENT FOR PRELIMINARY JACKET
DESIGN**

Revision	Date	Made by	Checked by	Approved by	Description
0	2013-04-17	TVB	TIMF	TIMF	Issued for information and comments
1	2013-05-06	TVB	TIMF	TIMF	Update
2	2013-05-23	TVB	TIMF	TIMF	Description of Data to be exchanged

Ref 23001225/341_0001(2)

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1. INTRODUCTION

1.1 Objective

This technical report has been prepared by Ramboll for the InnWind.EU project.

The purpose of this document is to provide the InnWind partners with a *Super Element* of the preliminary Jacket substructure as well as the geometry and properties of the Jacket Structure. In addition, the first five clamped tower frequencies as modelled by Ramboll and the first five frequencies of the total structure are displayed.

In order to design a Jacket based on realistic wind load timeseries a load iteration process is conducted. For this purpose, Ramboll provides the Wind Turbine Manufacturer (WTM) with a preliminary design of the jacket structure. Based on this, the WTM will simulate the wind loads and provide Ramboll with the agreed wind load timeseries as described in section 2.2.

The preliminary design of the Jacket substructure has been based on the conditions provided in the tower document, see ref. [2]. Since no Fatigue Loads are provided, an assumption has been made by Ramboll in order to account for the fatigue impact on the jacket geometry. ULS loads have been applied based on the thrust at hub given in [2].

1.2 Revision Summary

1.2.1 Revision 0

Released for information and comments.

1.2.2 Revision 1

Update and extension of provided information

1.2.3 Revision 2

Information on data exchange added (data from WTM)

1.3 **ROSA Coordinate system**

Ramboll's in-house modelling tool ROSAP (Ramboll Offshore Structural Analysis Program Package) is applied for the foundation design. The reference level throughout this project will be taken as Lowest Astronomical Tide (LAT). The Z-axis (Blue) will be oriented upwards with respect to LAT. X-axis (Red) towards North and Y-axis (Green) towards West.

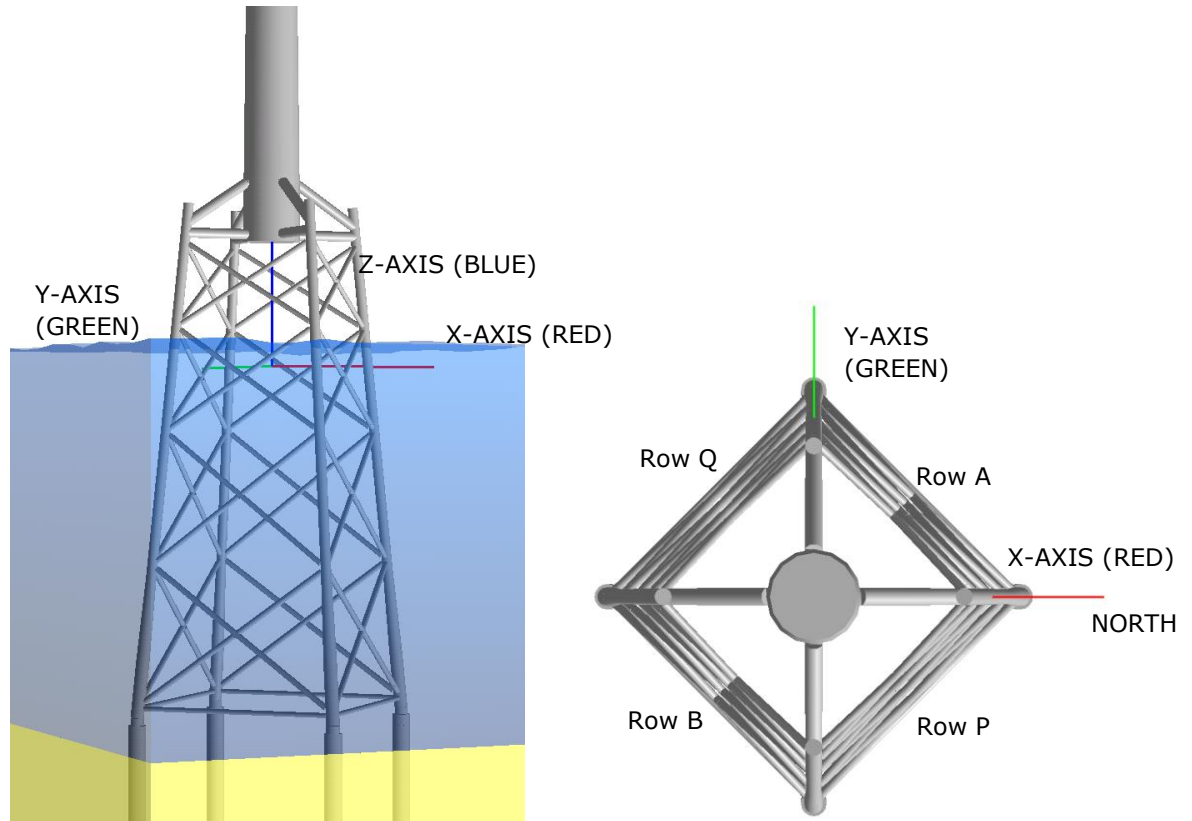


Figure 1-1 ROSA coordinate system

2. DATA EXCHANGE

2.1 **Data from Ramboll**

Ramboll provides a generalized representation of the foundation by interface stiffness, damping and mass matrices. These matrices are 6 X 6 symmetric matrices. The diagonal terms correspond to the degrees of freedom and coordinate system from Figure 1-1, i.e.

- (1,1) = translational stiffness in X-direction
- (2,2) = translational stiffness in Y-direction
- (3,3) = translational stiffness in Z-direction
- (4,4) = rotational stiffness around X-direction
- (5,5) = rotational stiffness around Y-direction
- (6,6) = rotational stiffness around Z-direction

Off diagonal terms are coupling terms.

The units are SI-units

- Mass matrix (kg, kg·m, kg·m²)
- Stiffness matrix (N/m, N, N·m)
- Damping matrix (kg/s, kg·m/s, kg·m²/s)

The generalized matrices for revision 0 are summarized in Appendix 1. The generalized matrices are derived by Guyan reduction, ref. [1]. Alternatively, Ramboll can provide the substructure's properties in terms of drawings and a description of the substructure, if required.

2.2 Data from the Wind Turbine Manufacturer

2.2.1 Time Series

The time series delivered must contain the following channels:

- @ tower top
 - Loads: Fx, Fy, Fz, Mx, My, Mz
 - Deformations: ux, uy, uz, PhiX, PhiY, PhiZ
- @ interface
 - Loads: Fx, Fy, Fz, Mx, My, Mz
 - Deformations: ux, uy, uz, PhiX, PhiY, PhiZ

The reference coordinate system should be displayed.

2.2.2 Load Cases

A 100 % availability of the turbine should be considered. Wind and wave are assumed to act aligned. The wind rose will be the reference in order to determine the directional probabilities.

For **ULS** the DLC 6.1 & 6.2 should be taken into account with 6 directions (half-cycle with 6 sectors and 30° steps).

For DLC 6.1 & 6.2 the following is needed:

- 6 load directions
- 1 wind speed
- Number of yaw errors (to be decided by WTM)
- 6 seeds per scenario
- Randomly varying seeds

For **FLS** the DLC 1.2 & 6.4 should be taken into account directional with a full cycle having 12 sectors and 30° steps.

For DLC 1.2 the following is needed:

- 12 load directions
- 11 wind speeds
- 3 yaw errors (0 degrees +)
- 2 seeds per scenario
- Randomly varying seeds
- A total of $12*11*3*2 = 792$ files

For DLC 6.4 the following is needed:

- 12 load directions
- 3 wind speeds
- 3 yaw errors (0 degrees +)
- 2 seeds per scenario
- Randomly varying seeds
- A total of $12*3*3*2 = 216$ files

2.2.3 Model Validation

For the purpose of model validation damage equivalents (total overturning moment) as a total for all directions, wind speeds load cases etc. should be provided at interface.

3. REFERENCES

- [1] Guyan, R.J.: Reduction of Stiffness and Mass Matrices. AIAA Journal, Vol. 3, No. 2, 1965.
- [2] DTU 10MW Reference Wind Turbine V1p01, Excel Sheet, 19/03/2013.

APPENDIX 1 INTERFACE MATRICES SUBSTRUCTURE REVISION 0

CLIENT:	InnWind				
Subject:	Superelement				
Date:	17.04.2013				
Revision:	0				
!Superlement at Interface					
!Height of Interface		!Hubheight	!Waterdepth	!Tower Length	
! (m)		! (m)	! (m)	! (m)	
26.00000 wrt LAT		119.00000 wrt LAT	50.00000 wrt LAT	89.63	
!Mass matrix (units kg, kgm, kgm²)					
! -- column 1 --	-- column 2 --	-- column 3 --	-- column 4 --	-- column 5 --	-- column 6 --
8.858886E+05	-6.638492E+01	-1.012105E+03	2.206603E+04	-1.027527E+07	-5.698532E+03
-6.638492E+01	8.858570E+05	-3.911807E+02	1.026985E+07	2.509194E+04	3.812361E+04
-1.012105E+03	-3.911807E+02	8.013757E+05	-9.374826E+02	-8.102586E+03	-4.228647E+04
2.206603E+04	1.026985E+07	-9.374826E+02	1.817163E+08	3.676741E+04	6.365817E+05
-1.027527E+07	2.509194E+04	-8.102586E+03	3.676741E+04	1.817684E+08	1.364895E+05
-5.698532E+03	3.812361E+04	-4.228647E+04	6.365817E+05	1.364895E+05	4.187886E+07
!Stiffness matrix (units N/m, N, Nm)					
! -- column 1 --	-- column 2 --	-- column 3 --	-- column 4 --	-- column 5 --	-- column 6 --
5.024274E+07	-7.432994E-02	4.203481E-06	2.548736E+06	-1.377790E+09	4.650472E-05
-7.432994E-02	5.024274E+07	5.222299E-06	1.377790E+09	2.548740E+06	-9.400340E-06
4.203481E-06	5.222299E-06	1.568139E+09	2.882008E-04	-2.119693E-04	-7.870335E+06
2.548736E+06	1.377790E+09	2.882008E-04	1.257520E+11	4.483948E+01	-1.084566E-05
-1.377790E+09	2.548740E+06	-2.119693E-04	4.483948E+01	1.257520E+11	-3.116570E-04
4.650472E-05	-9.400340E-06	-7.870335E+06	-1.084566E-05	-3.116570E-04	9.001803E+09
!Damping matrix (units kg/s, kgm/s, kgm²/s)					
! -- column 1 --	-- column 2 --	-- column 3 --	-- column 4 --	-- column 5 --	-- column 6 --
7.262842E+04	-9.589592E-01	-1.461895E+01	3.354034E+03	-1.789182E+06	-8.23E+01
-9.589592E-01	7.262796E+04	-5.650255E+00	1.789104E+06	3.397745E+03	5.51E+02
-1.461895E+01	-5.650255E+00	1.878755E+06	-1.354110E+01	-1.170346E+02	-9.98E+03
3.354034E+03	1.789104E+06	-1.354110E+01	1.523637E+08	5.311257E+02	9.19E+03
-1.789182E+06	3.397745E+03	-1.170346E+02	5.311257E+02	1.523644E+08	1.97E+03
-8.231018E+01	5.506614E+02	-9.983195E+03	9.194853E+03	1.971469E+03	1.13E+07
Damping Parameters (Rayleigh Damping)					
Alfa_1 =	1.4444E-02				
Alfa_2 =	1.1907E-03				

APPENDIX 2 MODEL VALIDATION

The following sections present the first five clamped natural frequencies of the tower and of the total structure.

3.1 **Beam Theory**

Ramboll's in-house modelling tool can use both *Euler-Bernoulli* and *Timoshenko* beam theory. *Timoshenko* beam theory is used when analysing support structures for wind turbines. This means that shear stiffness is taken into account in the analyses.

3.2 **Tower Elements**

The tower elements are modelled as cylindrical and/or conical tubular elements. In order to keep the original hub height of 119 m wrt LAT the original tower has been cut at 26m above the original tower bottom.

3.3 **Clamped Tower Frequencies**

The natural frequencies displayed below in Table 3-1 have been derived considering a clamped tower at the interface node INTERF (see Appendix 4).

Table 3-1 Natural frequencies of clamped tower model

Mode shape	Mode	ROSA Tower Frequency [Hz]
1 st bending modes	Mode 1 (side-side)	0.330
	Mode 2 (fore-aft)	0.331

3.4 **Natural Frequencies of Total Structure**

The first five natural frequencies of the total structure are shown in Table 3-2 accounting for the actual pile/soil interaction.

Table 3-2 Natural frequencies of total structure (piles and soil included in model)

Mode shape	Mode	ROSA Timoshenko Frequency [Hz]
1 st bending modes	Mode 1 (side-side)	0.294
	Mode 2 (fore-aft)	0.294
2 nd bending mode	Mode 3 (side-side)	1.050
	Mode 4 (fore-aft)	1.050
1 st torsion mode	Mode 5 (torsion)	1.637

The interface matrices are derived for the jacket using *Timoshenko* beam elements, thus representing the most correct and most flexible structure. In Figure 3-1 a jacket top view is shown along with the first five mode shapes of the total structure.

3.5 **Mass of the preliminary Jacket**

The weight of the jacket is currently 720 tons and the weight of the Transition Piece (TP) is 400 tons. In the mass matrix of the Superelement (see Appendix 1) only the part above mudline is considered and buoyancy is taken into account.

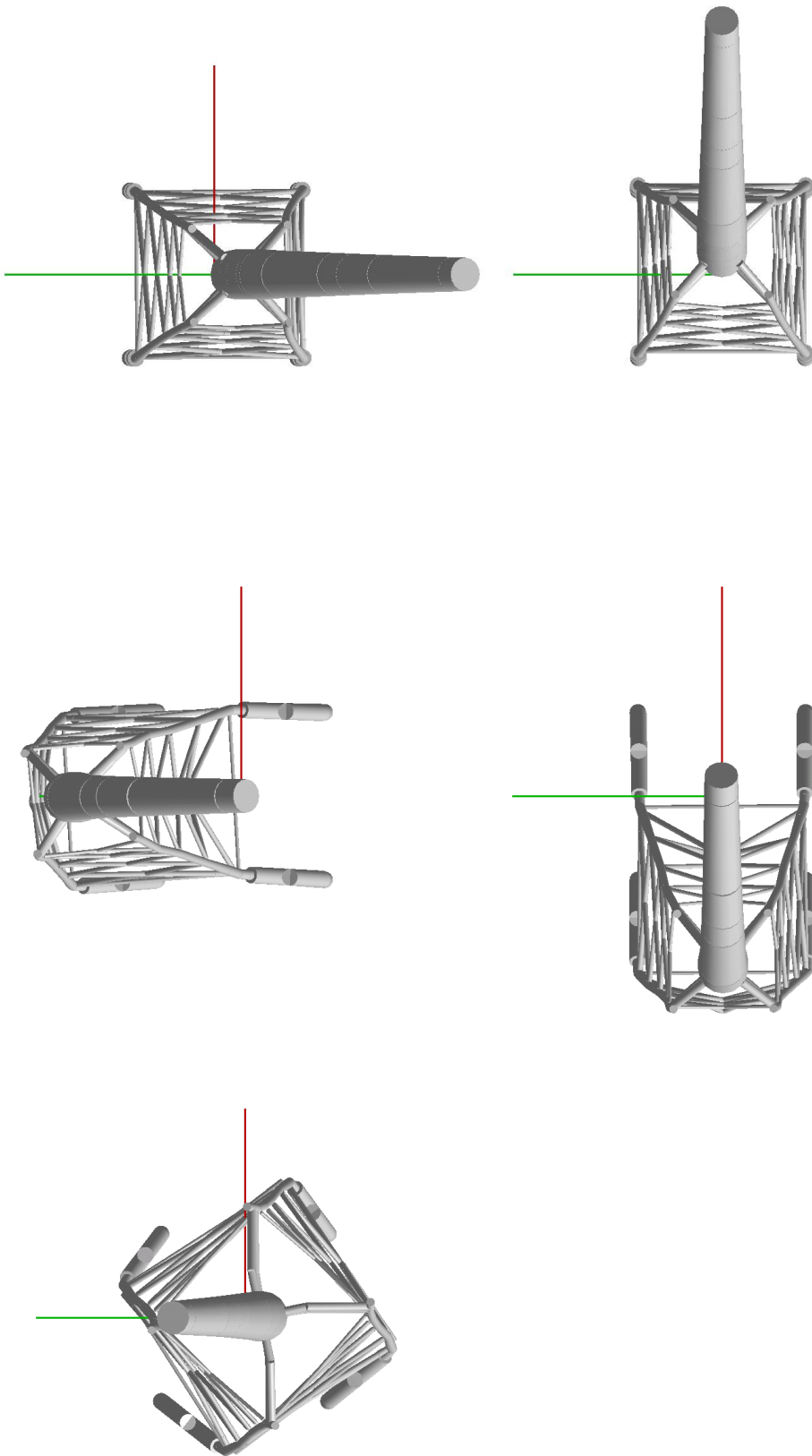


Figure 3-1 Jacket top view and first five mode shapes of total structure (coordinate system rotated by 45 degrees).

APPENDIX 3A

JACKET MODEL – SECTIONAL PROPERTIES

The following drawings give an overview of the sectional properties of the Jacket model. The base width of the Jacket is 36m, while the top width is 20m.

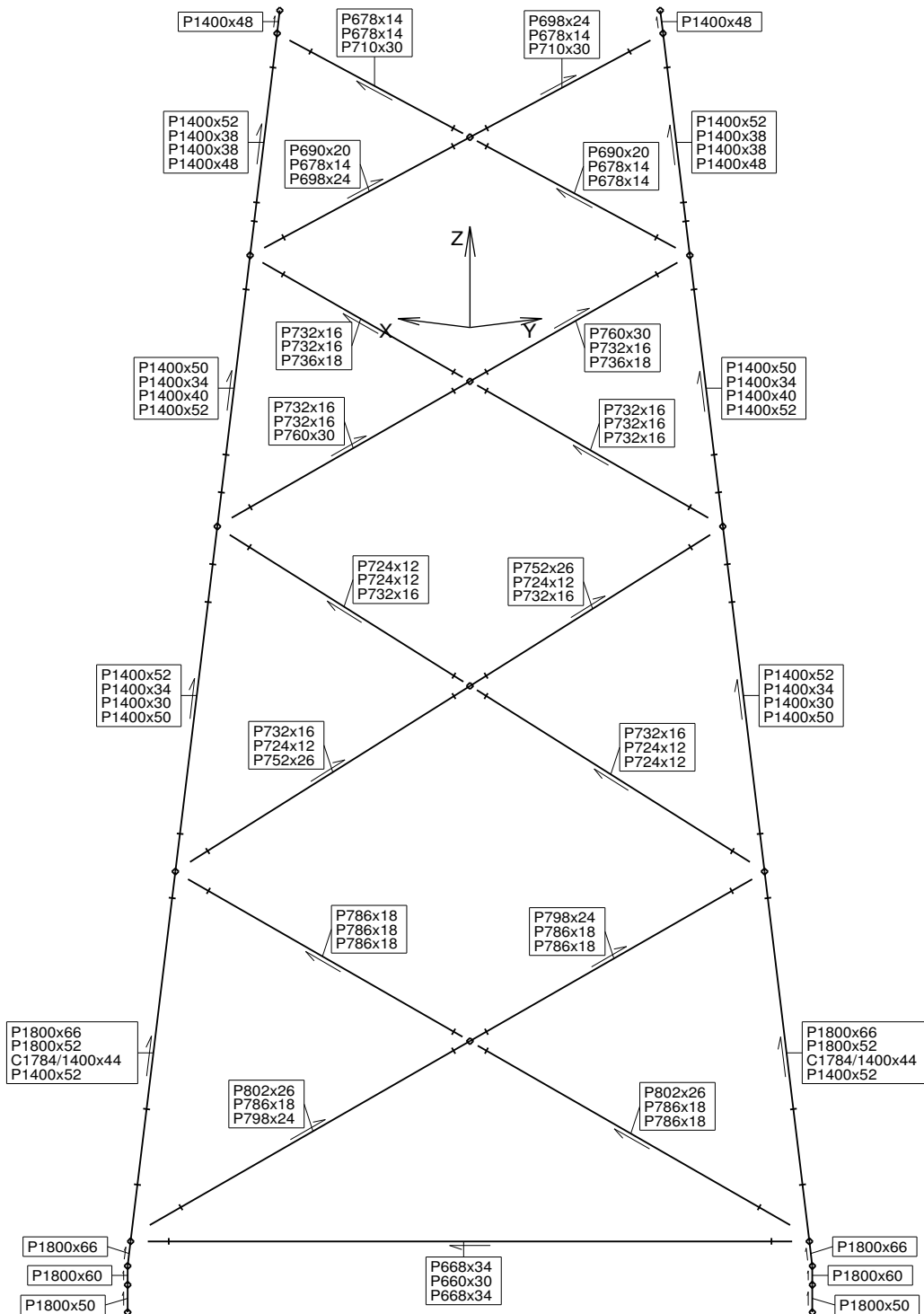
The dimensions of the Chord and Brace sections can be derived from the drawings.

The arrow next to each element indicates its defined orientation. Each leg element consists of 4 subelements, while each brace element consists of 3 subelements.

The boxes next to each element indicate its sectional properties. A "P" in front of the "*Diameter x Thickness*" defines a pipe section (sections with constant diameter).

A "C" means that the subelement is a conical section.

Note that the upper sectional property in the box denotes the first subelement, while the sectional property shown at the bottom of the box denotes the last subelement (arrow points in direction of the last element).



Jacket Row B

Ramboll Offshore Wind

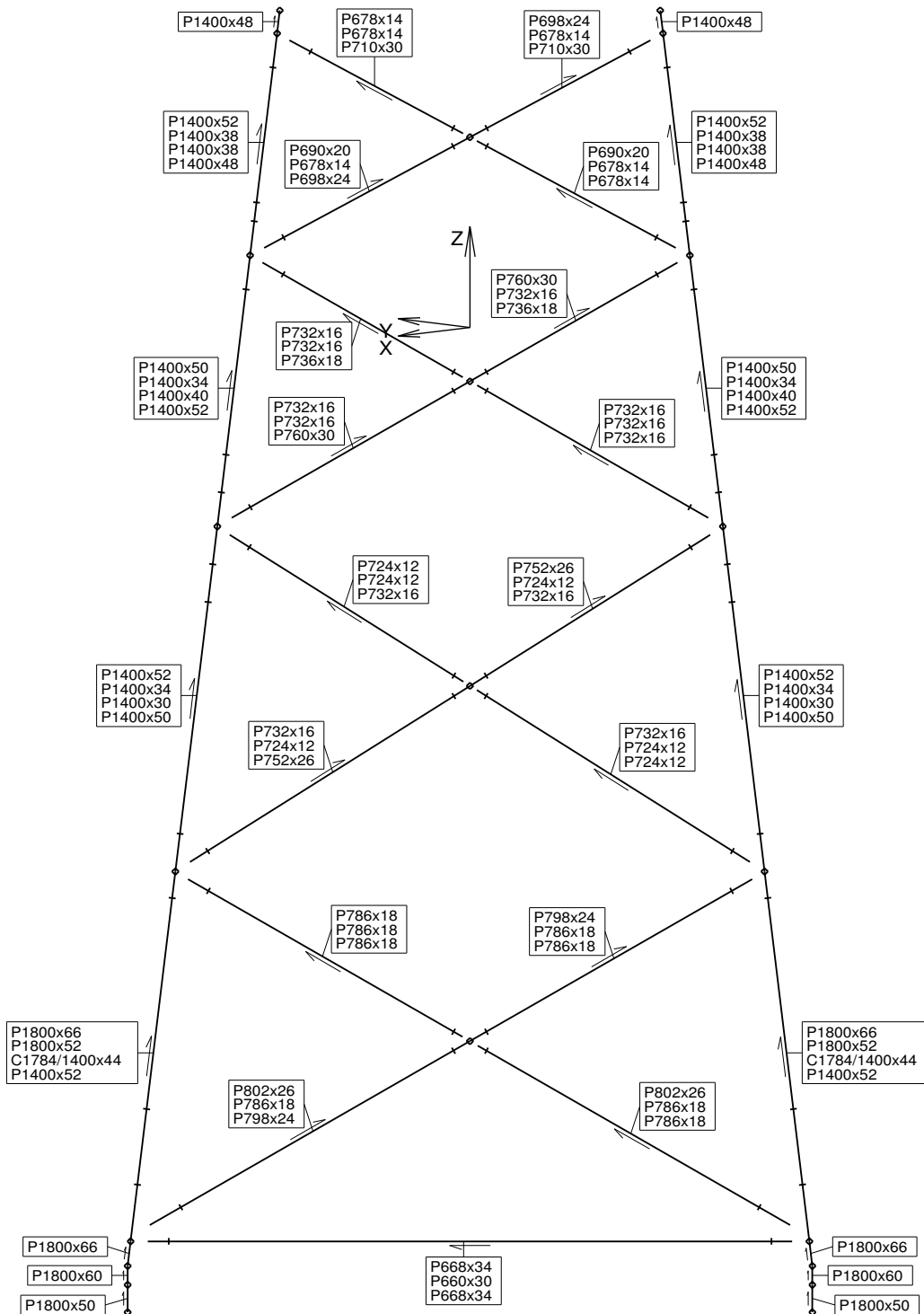
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Limits:	X(-25.456, -0.000)	Y(-25.456, 0.000)	Z(-49.950, 18.000)
Plot 2:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Jacket Row P

Ramboll Offshore Wind

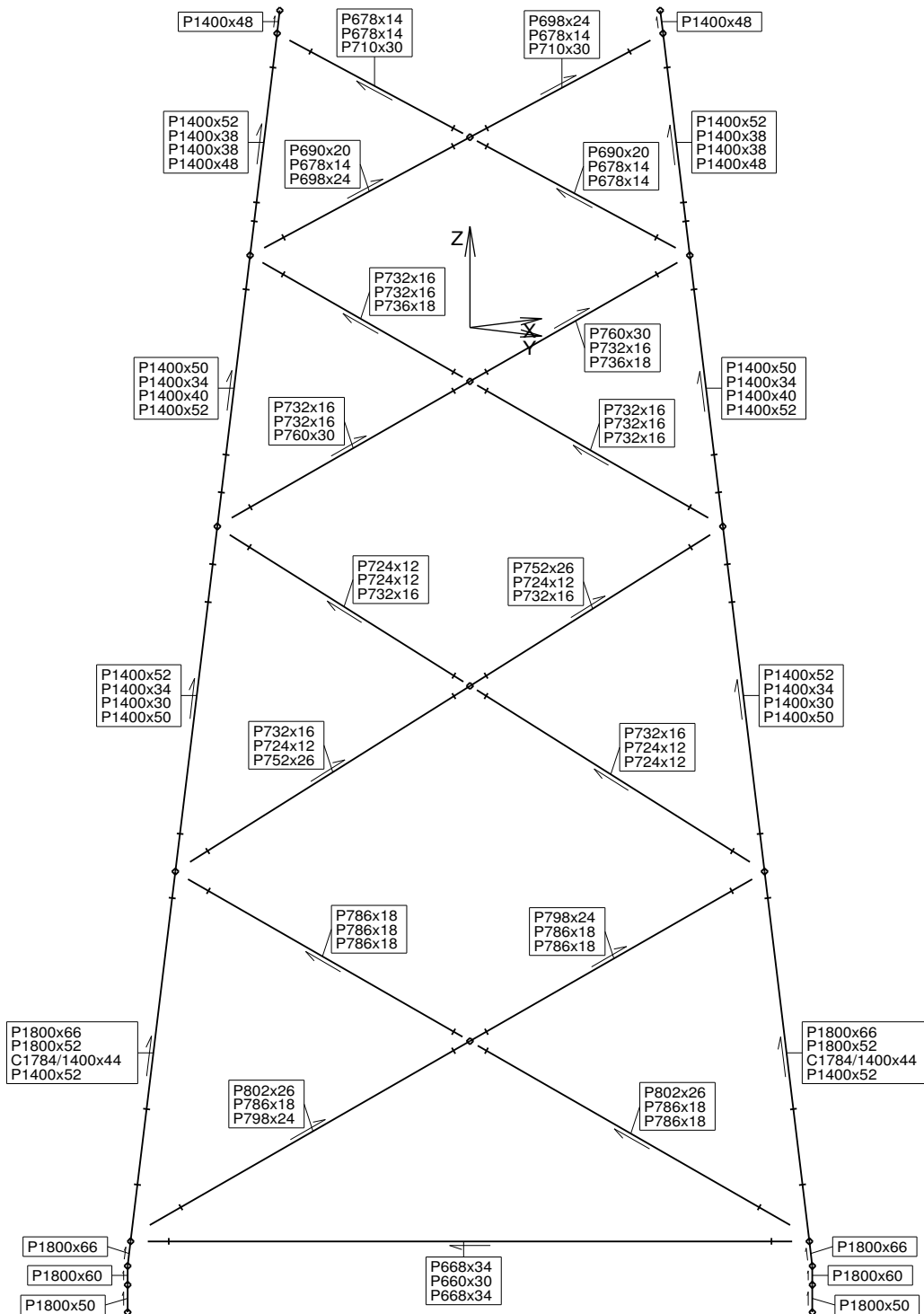
Direction:	X: 0.702	Y: -0.702	Z: 0.121
Limits:	X(-0.000, 25.456)	Y(-25.456, 0.000)	Z(-49.950, 18.000)
Plot 3:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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Jacket Row Q

Ramboll Offshore Wind

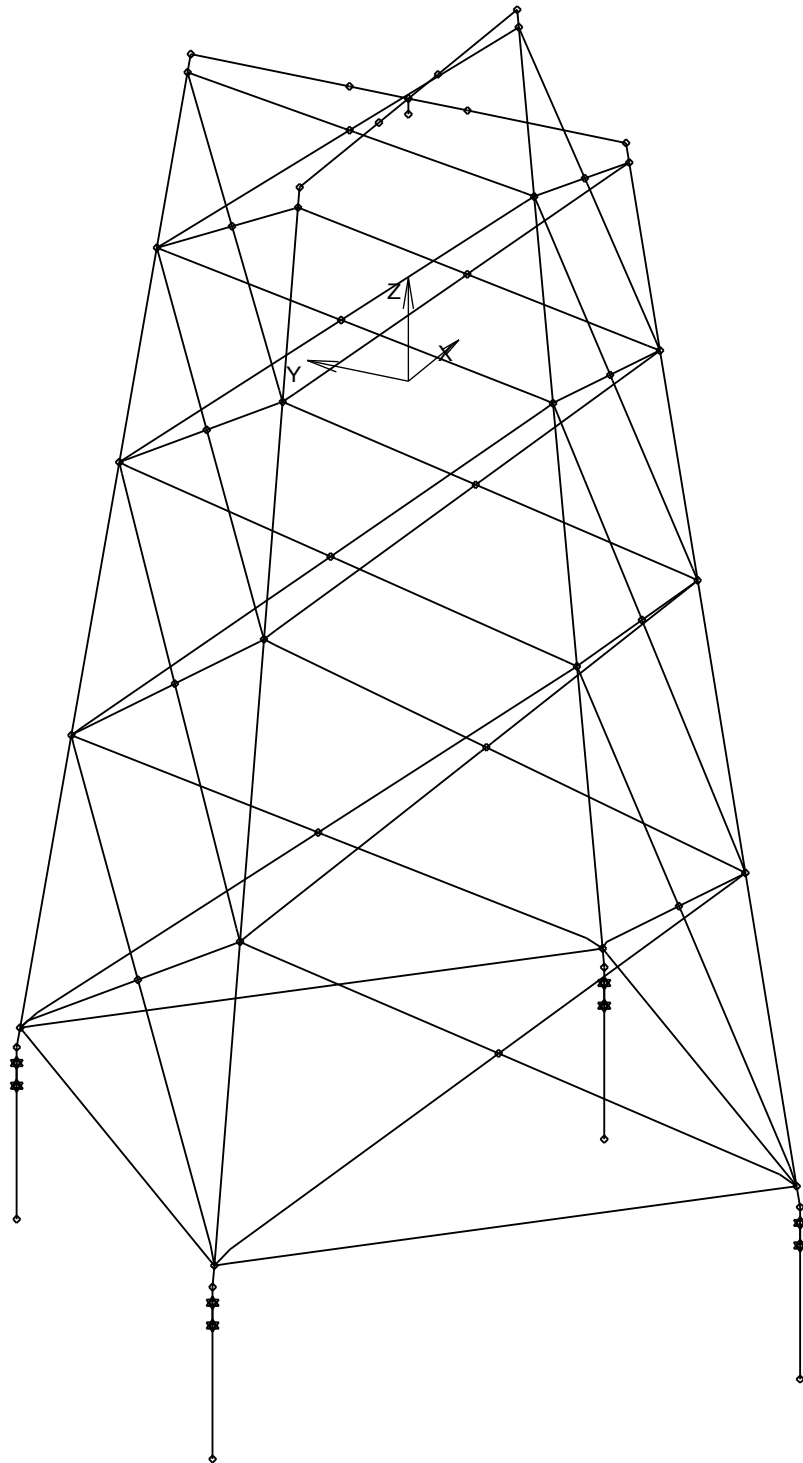
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Limits:	X(-25.456, 0.000)	Y(0.000, 25.456)	Z(-49.950, 18.000)
Plot 4:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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General view of Jacket

Ramboll Offshore Wind

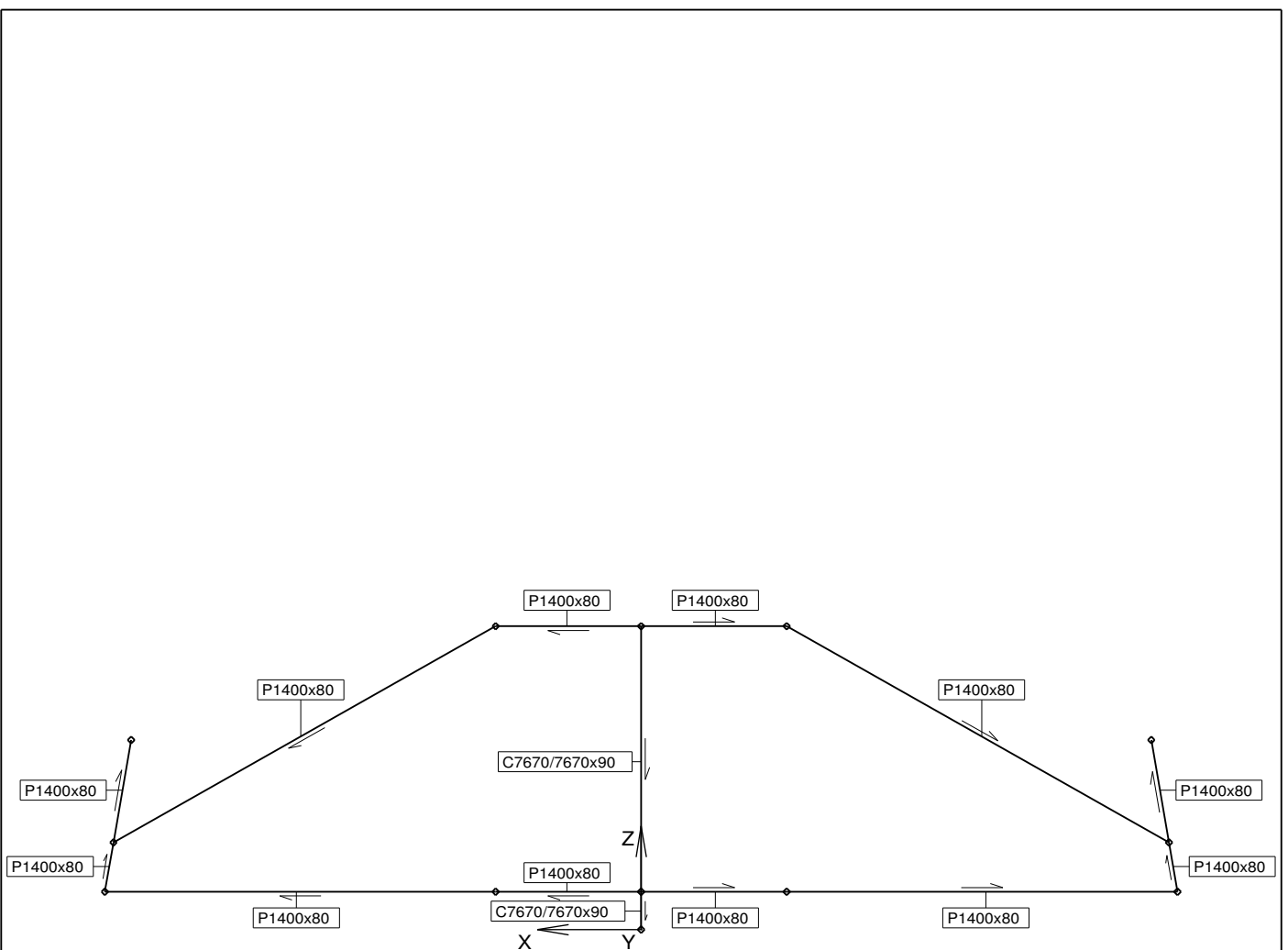
Direction:	X: 0.816	Y: 0.408	Z: -0.408
Limits:	X(-25.456, 25.456)	Y(-25.456, 25.456)	Z(-58.450, 18.000)
Plot 5:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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Transition Piece Strut Model - Diagonal 1

Ramboll Offshore Wind

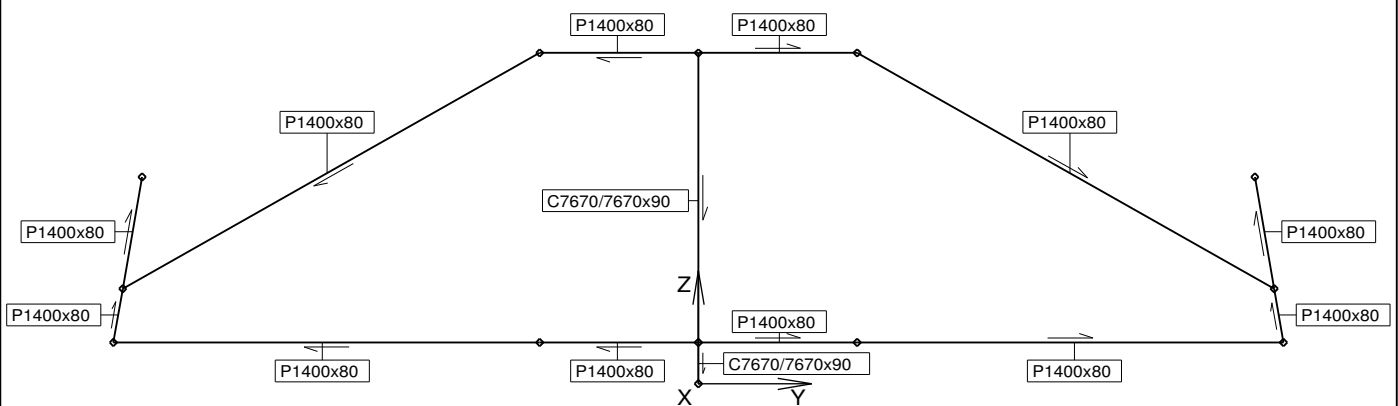
Direction:	X:-0.000	Y:-1.000	Z:-0.000
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Plot 9:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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Transition Piece Strut Model - Diagonal 2

Ramboll Offshore Wind

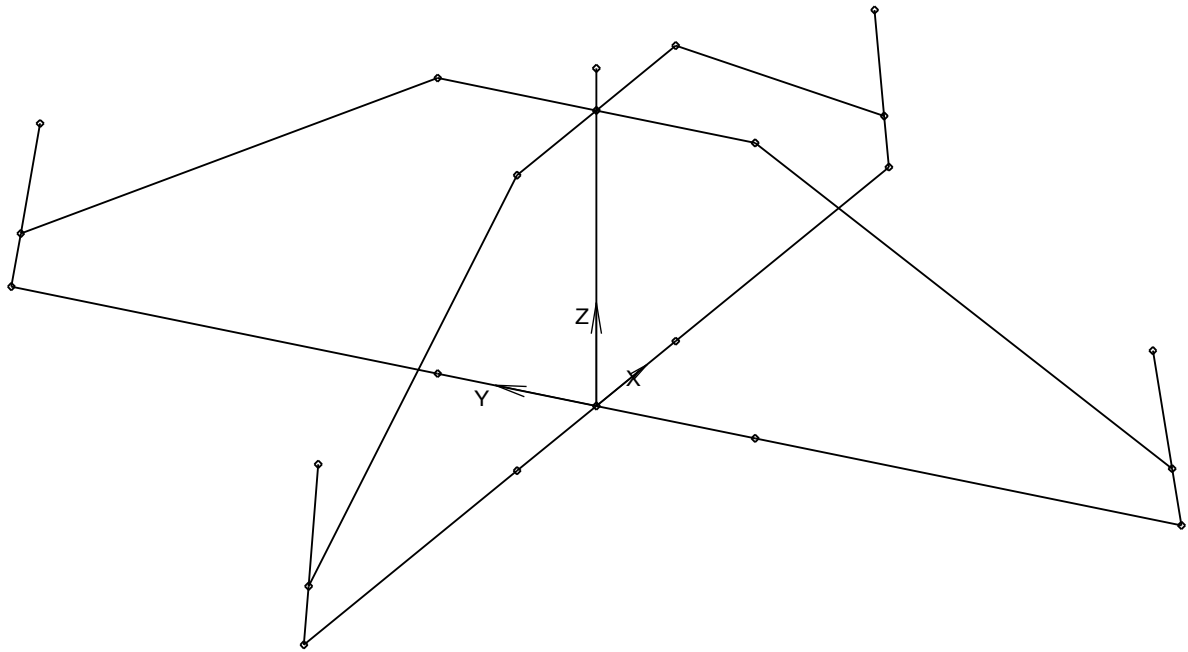
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Limits:	X(-0.000, 0.000)	Y(-14.142, 14.142)	Z(17.000, 25.000)
Plot 10:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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General view of Transition Piece

Ramboll Offshore Wind

Direction:	X: 0.816	Y: 0.408	Z: -0.408
Limits:	X(-14.142, 14.142)	Y(-14.142, 14.142)	Z(18.000, 26.000)
Plot 11:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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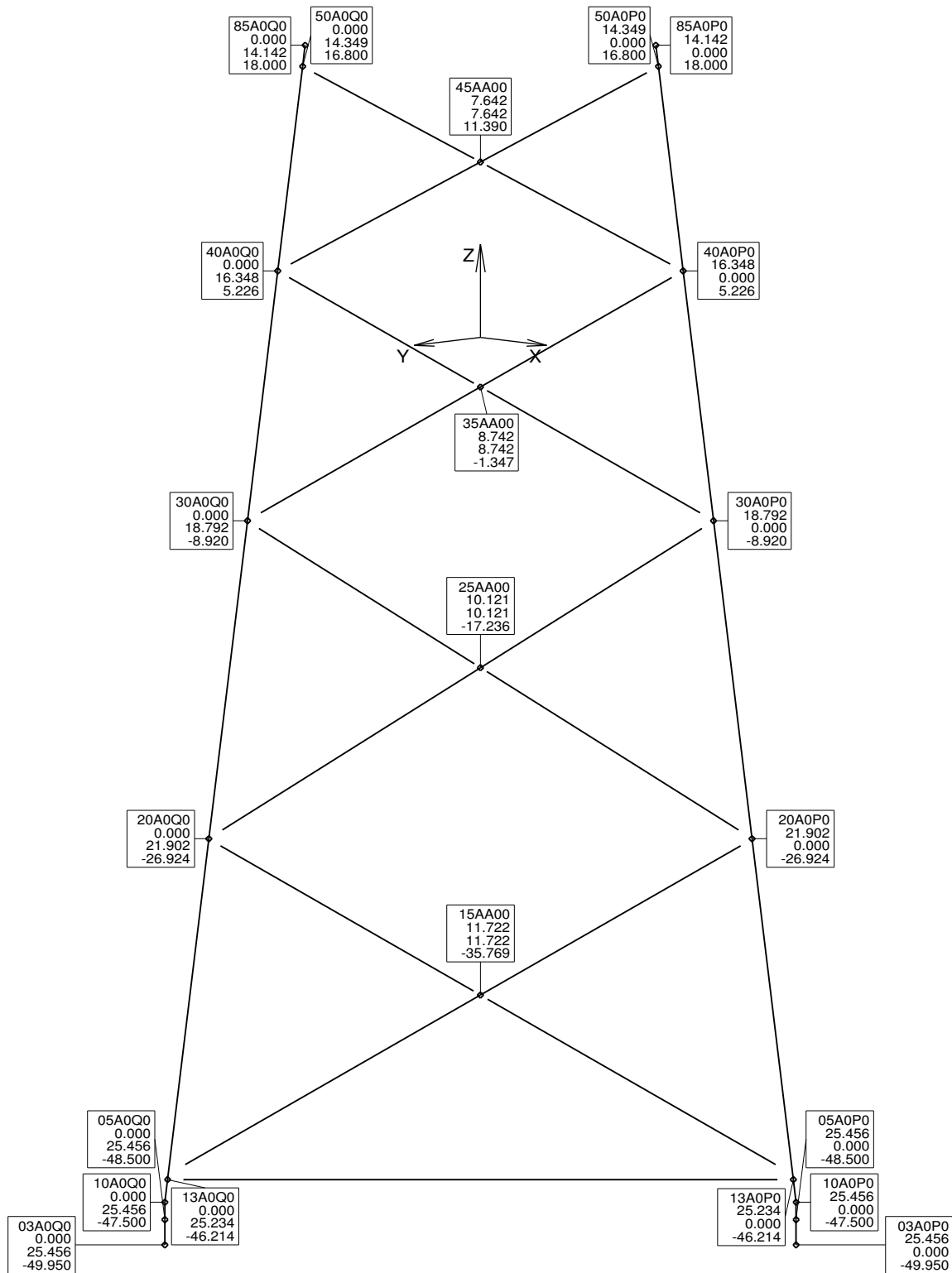
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APPENDIX 3B

JACKET MODEL – NODE COORDINATES

The following pages display the nodal coordinates of the Jacket. In general, every node is defined by 3 values representing the global x,y and z-coordinate of each node.

The upper value in the box denotes the x-coordinate, the value in the middle the y-coordinate and the value at the bottom of the box denotes the z-coordinate.



Node coordinates (m)

Jacket Row A

Ramboll Offshore Wind

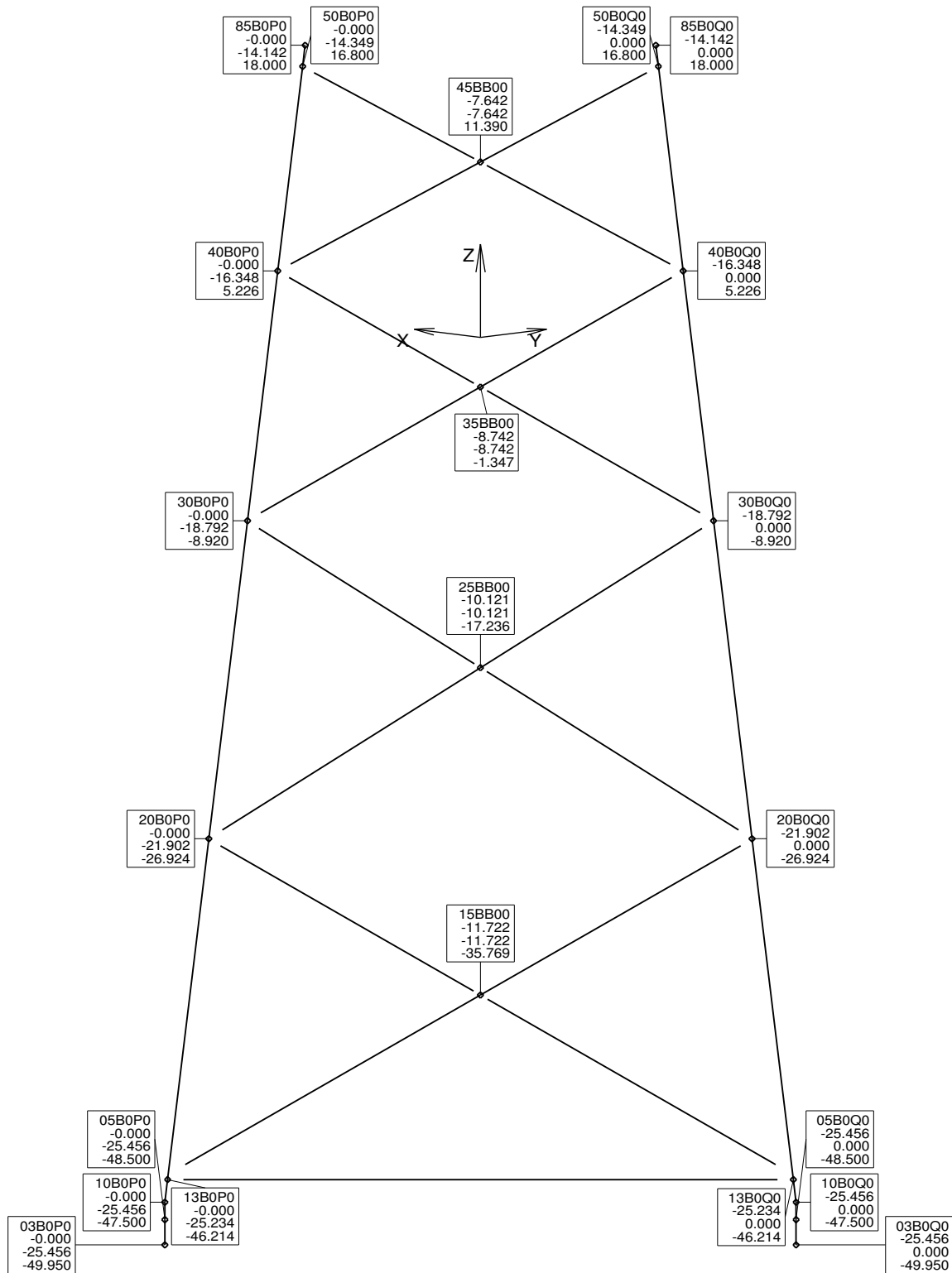
Direction:	X: 0.702	Y: 0.702	Z: 0.121
Limits:	X(0.000, 25.456)	Y(0.000, 25.456)	Z(-49.950, 18.000)
Plot 1:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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Node coordinates (m)

Jacket Row B

Ramboll Offshore Wind

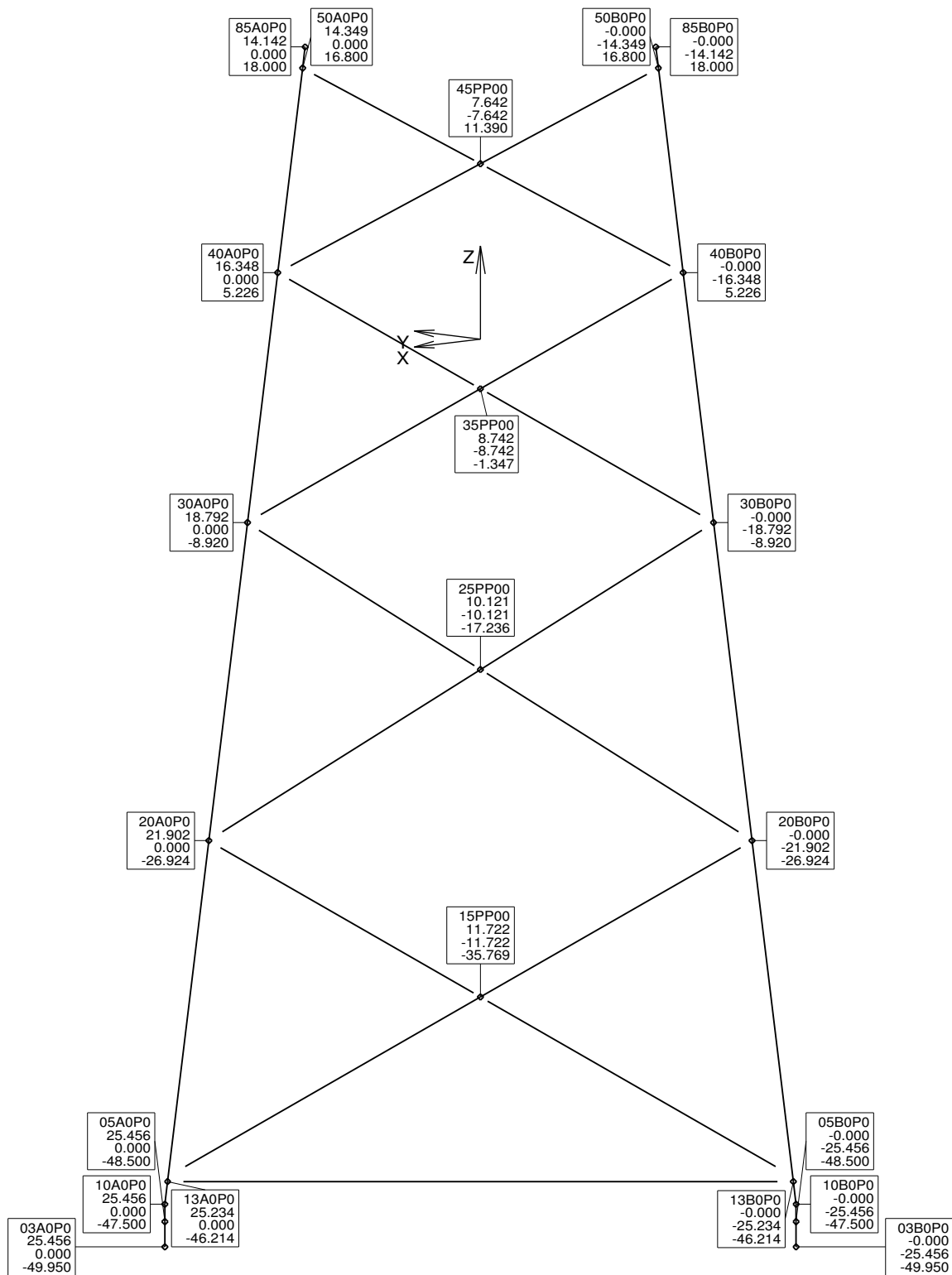
Direction:	X: -0.702	Y: -0.702	Z: 0.121
Limits:	X(-25.456, -0.000)	Y(-25.456, 0.000)	Z(-49.950, 18.000)
Plot 2:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
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Node coordinates (m)

Jacket Row P

Ramboll Offshore Wind

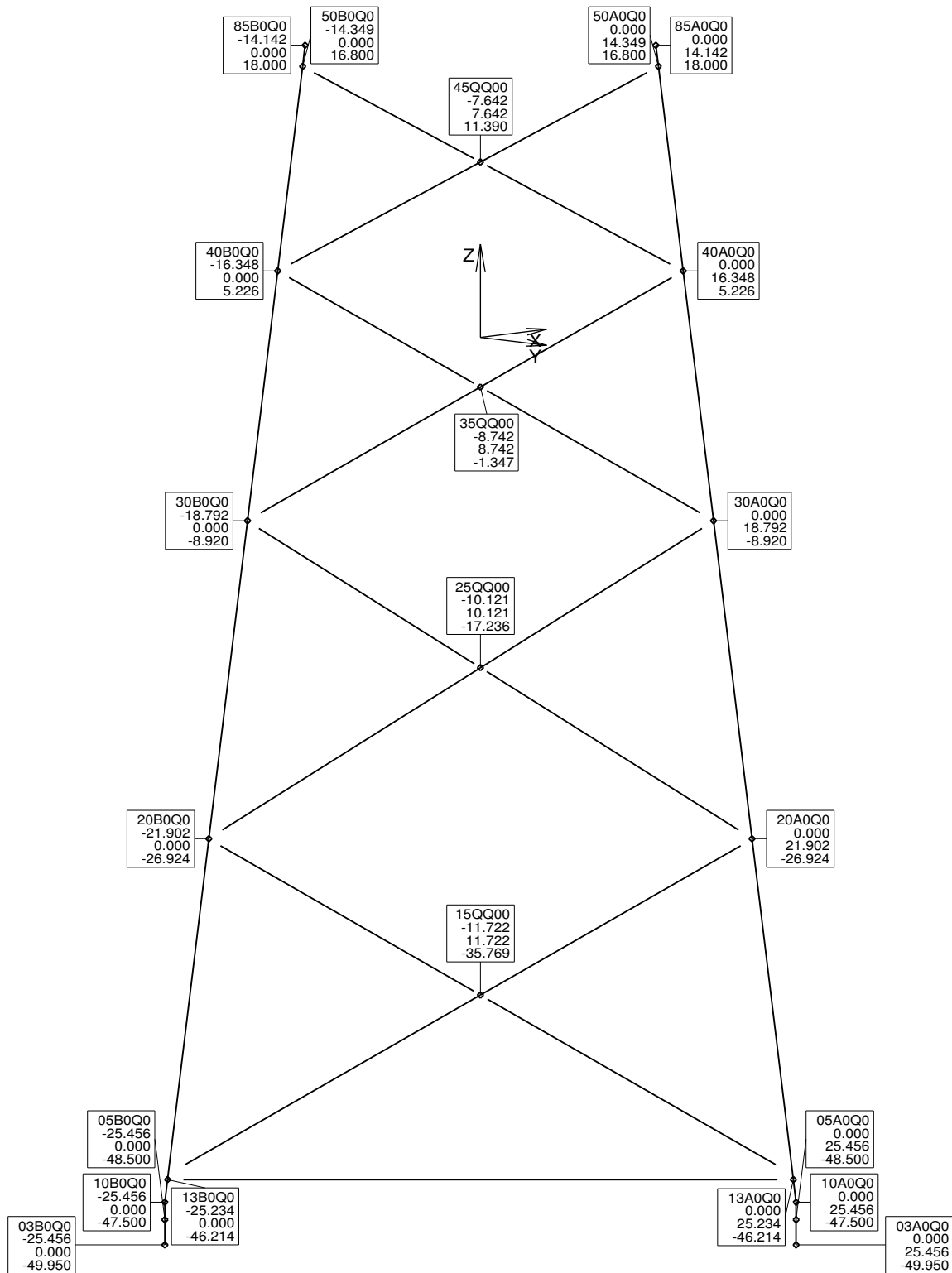
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Limits:	X(-0.000, 25.456)	Y(-25.456, 0.000)	Z(-49.950, 18.000)
Plot 3:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
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Node coordinates (m)

Jacket Row Q

Ramboll Offshore Wind

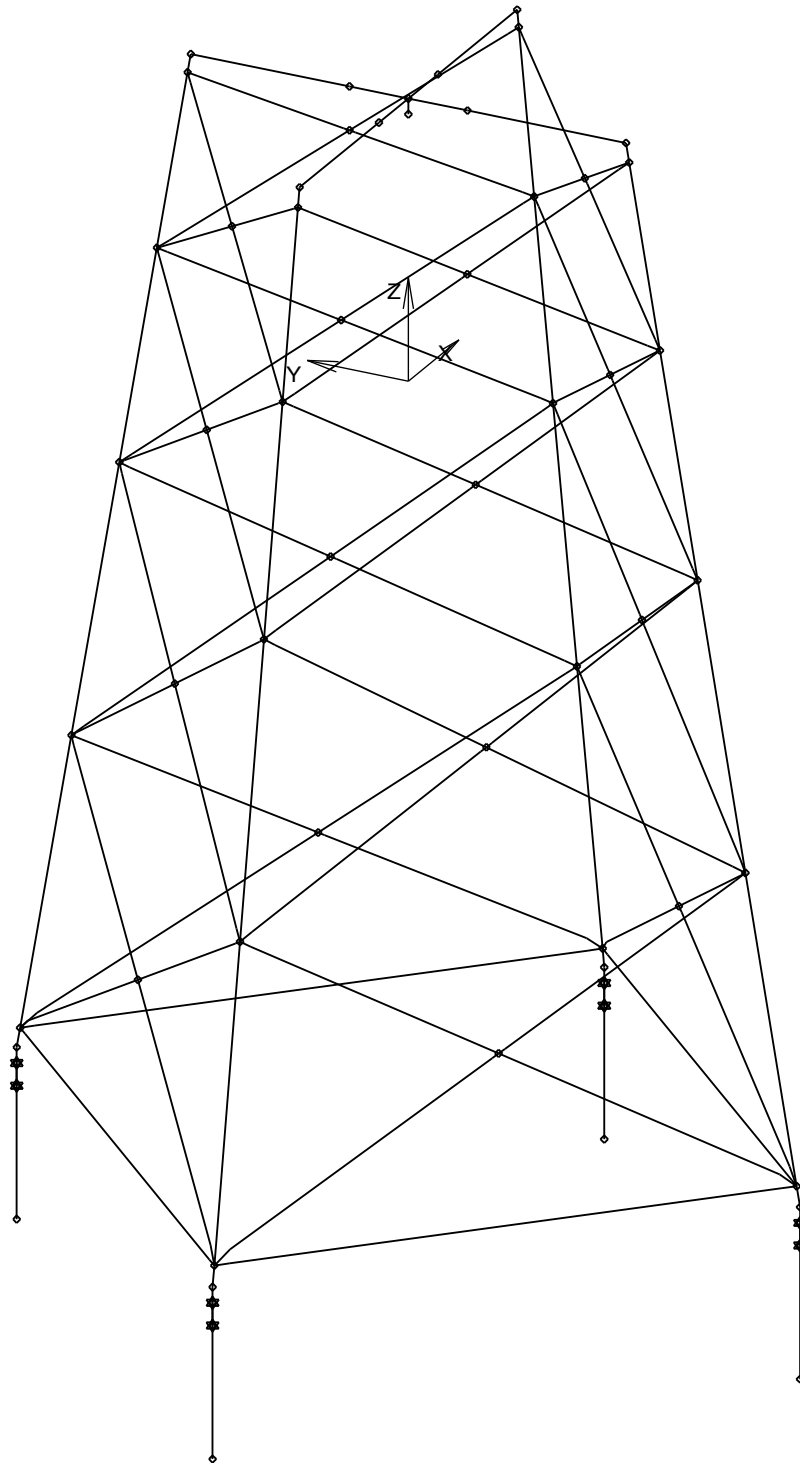
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Limits:	X(-25.456, 0.000)	Y(0.000, 25.456)	Z(-49.950, 18.000)
Plot 4:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
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General view of Jacket

Ramboll Offshore Wind

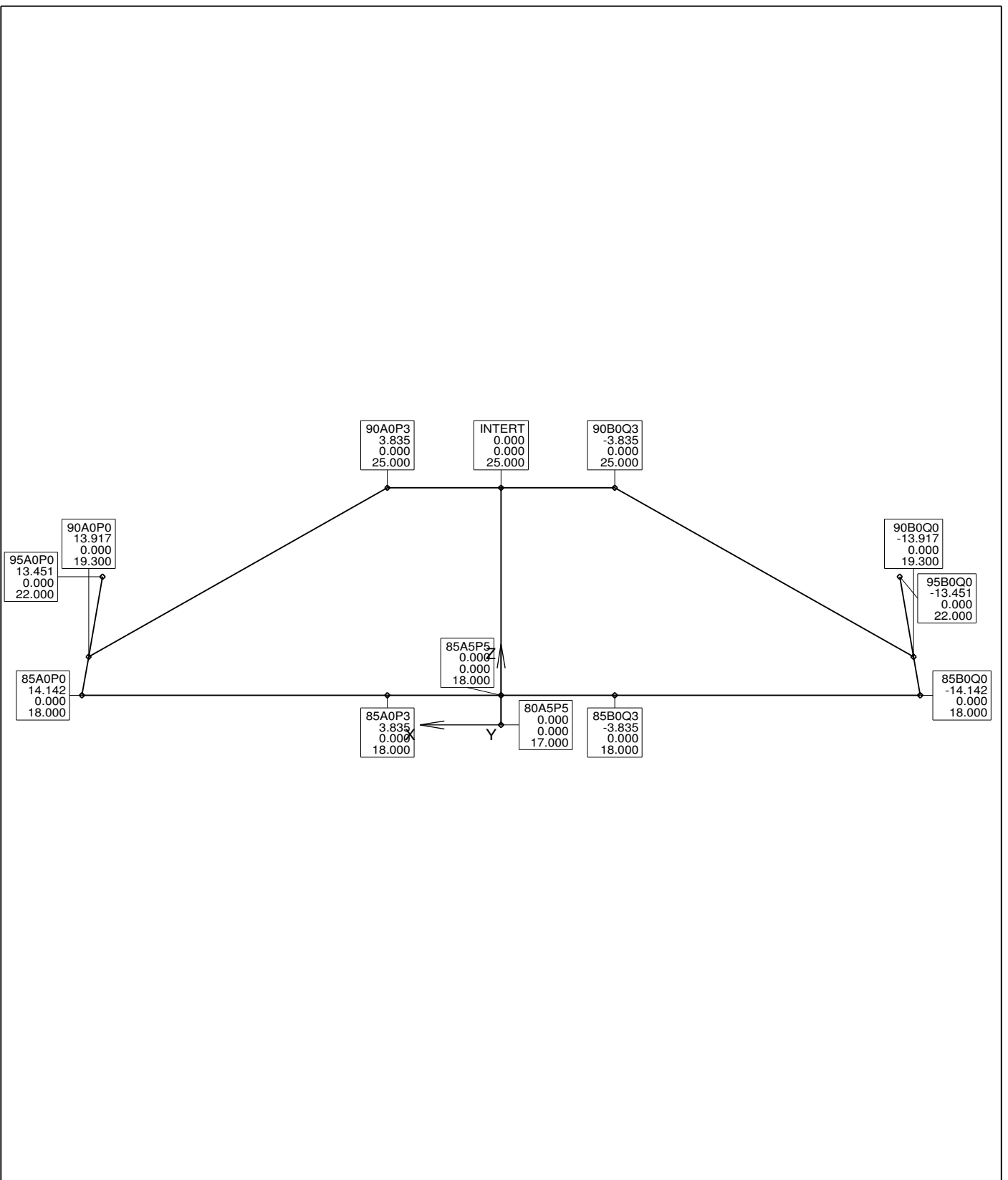
Direction:	X: 0.816	Y: 0.408	Z: -0.408
Limits:	X(-25.456, 25.456)	Y(-25.456, 25.456)	Z(-58.450, 18.000)
Plot 5:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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Node coordinates (m)

Transition Piece Strut Model - Diagonal 1

Ramboll Offshore Wind

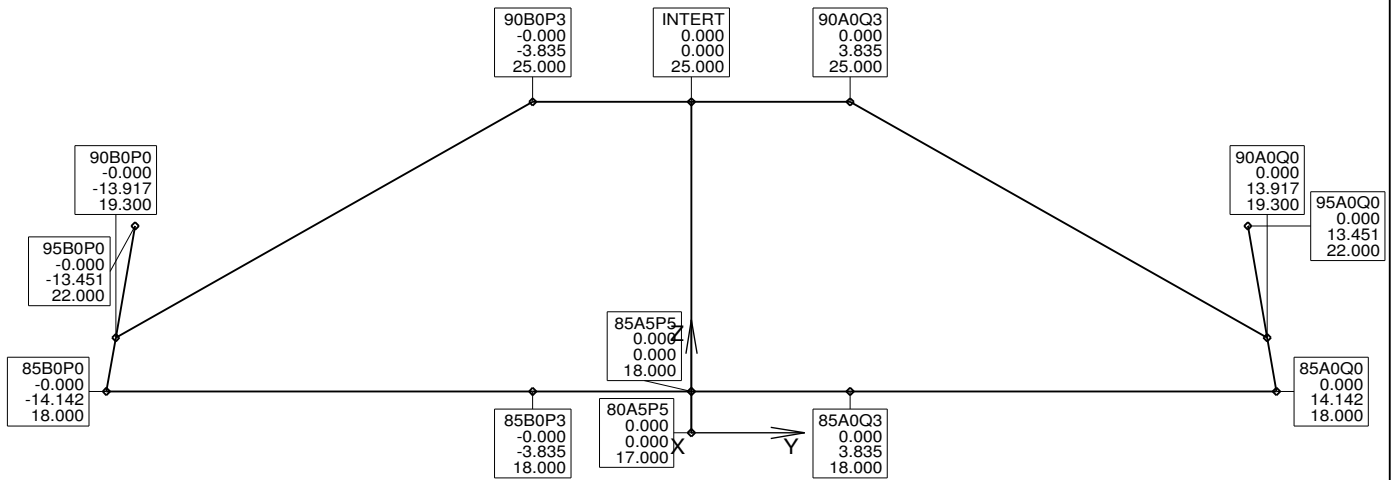
Direction:	X:-0.000	Y:-1.000	Z:-0.000
Limits:	X(-14.142, 14.142)	Y(0.000, 0.000)	Z(17.000, 25.000)
Plot 9:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

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Web: www.ramboll.com/wind
 E-mail: info@ramboll.com



Node coordinates (m)

Transition Piece Strut Model - Diagonal 2

Ramboll Offshore Wind

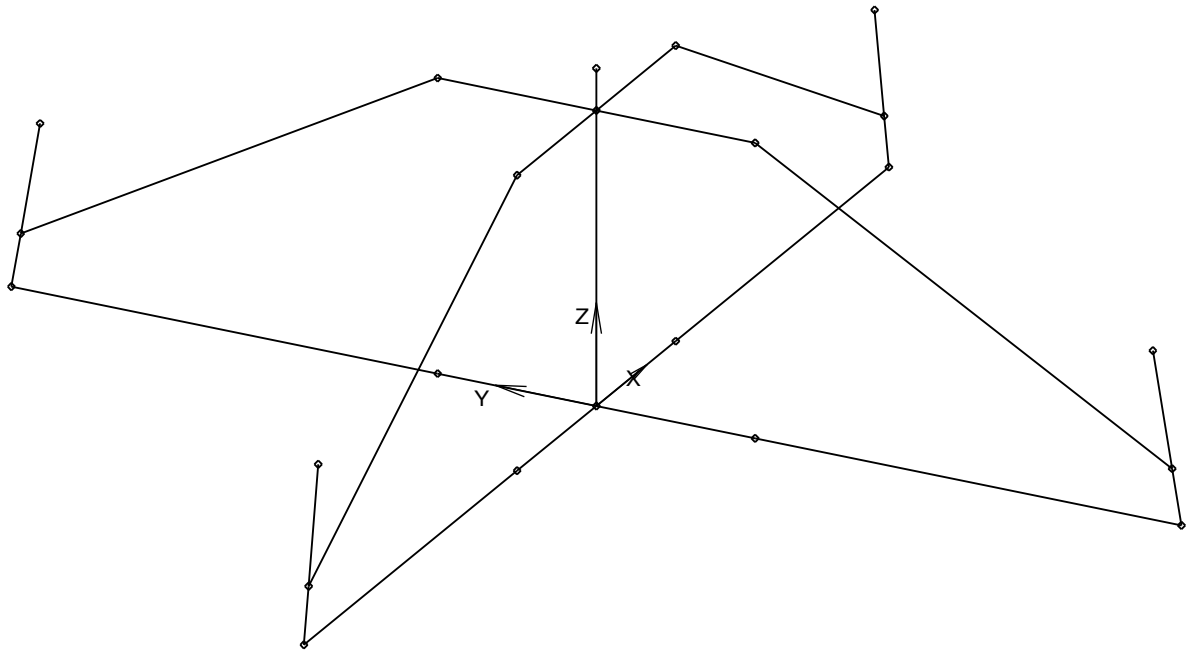
Direction:	X: -1.000	Y: 0.000	Z: 0.000
Limits:	X(-0.000, 0.000)	Y(-14.142, 14.142)	Z(17.000, 25.000)
Plot 10:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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General view of Transition Piece

Ramboll Offshore Wind

Direction:	X: 0.816	Y: 0.408	Z: -0.408
Limits:	X(-14.142, 14.142)	Y(-14.142, 14.142)	Z(18.000, 26.000)
Plot 11:	Date: 2013-04-16	Time: 17:31:31	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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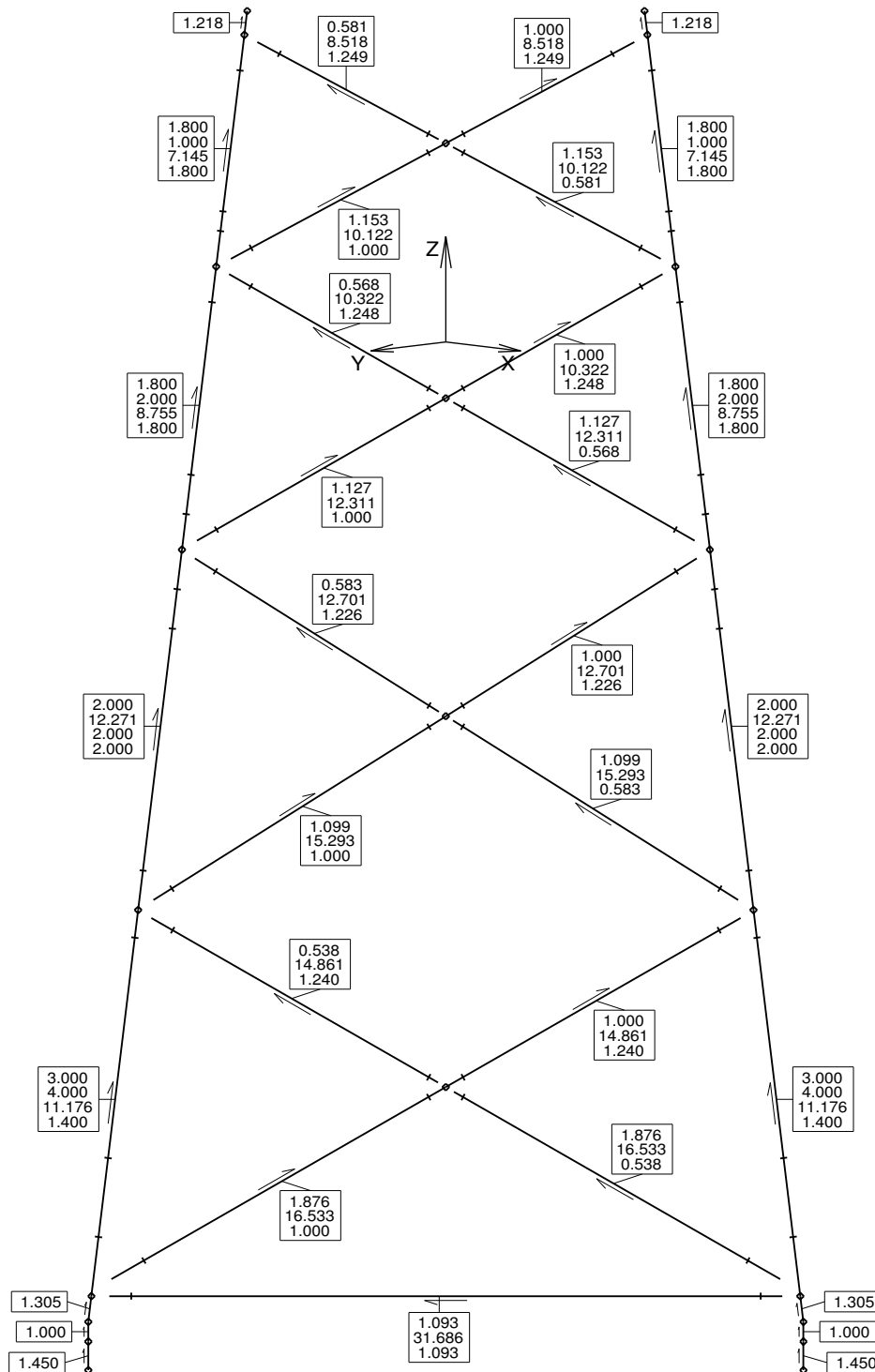
Web: www.ramboll.com/wind
 E-mail: info@ramboll.com

APPENDIX 3C

JACKET MODEL – ELEMENT LENGTHS

The following pages display the length of the elements. Please note that the length of the elements accounts for the actual length (profiled length) and not for the length from node to node.

However, for remodelling the jacket it is sufficient to model the elements from node to node, rather than accounting for the actual profiling and offsets.



Element Lengths
Jacket Row A

Ramboll Offshore Wind

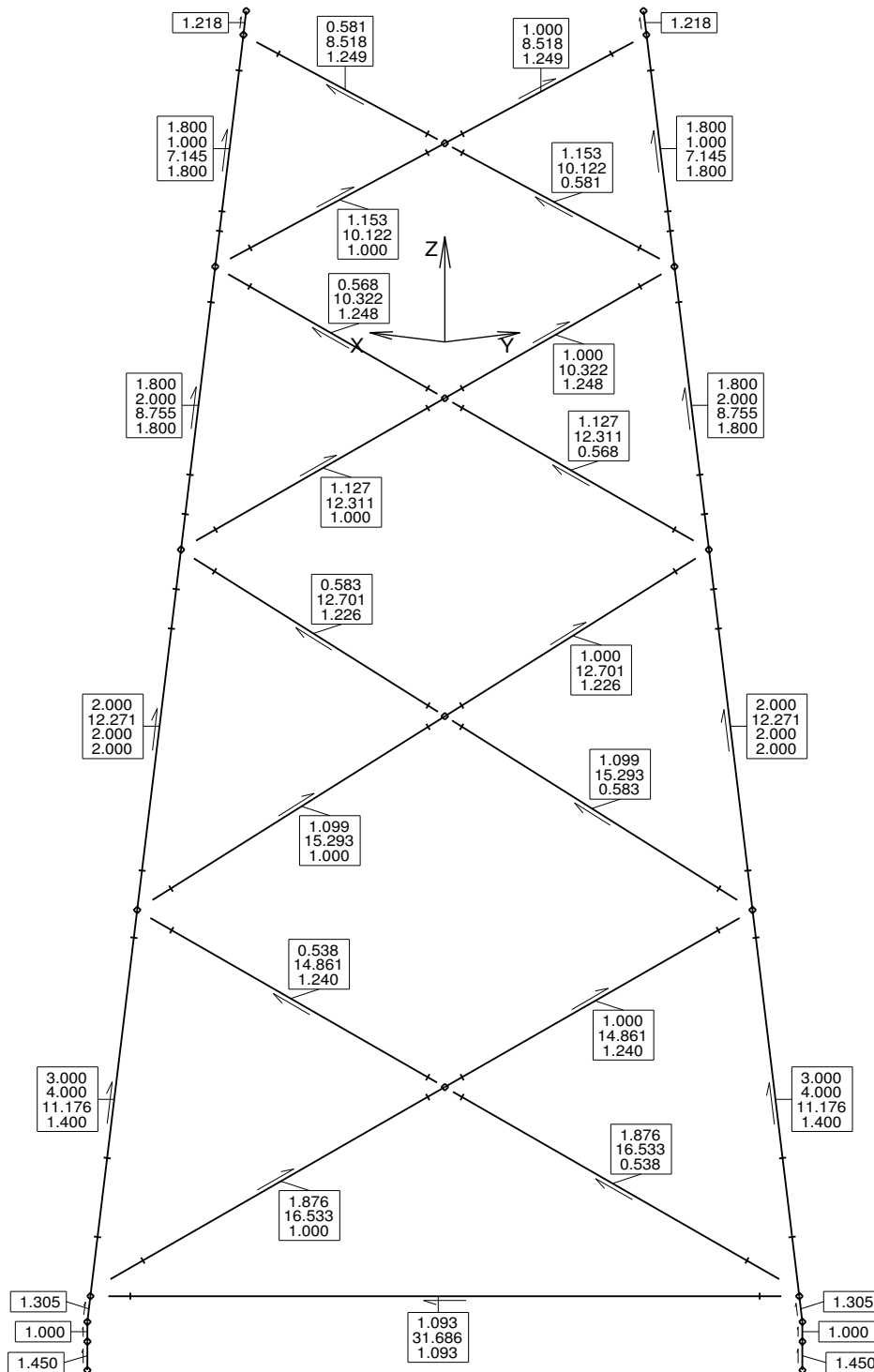
Direction:	X: 0.702	Y: 0.702	Z: 0.121
Limits:	X(0.000, 25.456)	Y(0.000, 25.456)	Z(-49.950, 18.000)
Plot 1:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
PROJECT: INNWIND JACKET
SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Element Lengths
Jacket Row B

Ramboll Offshore Wind

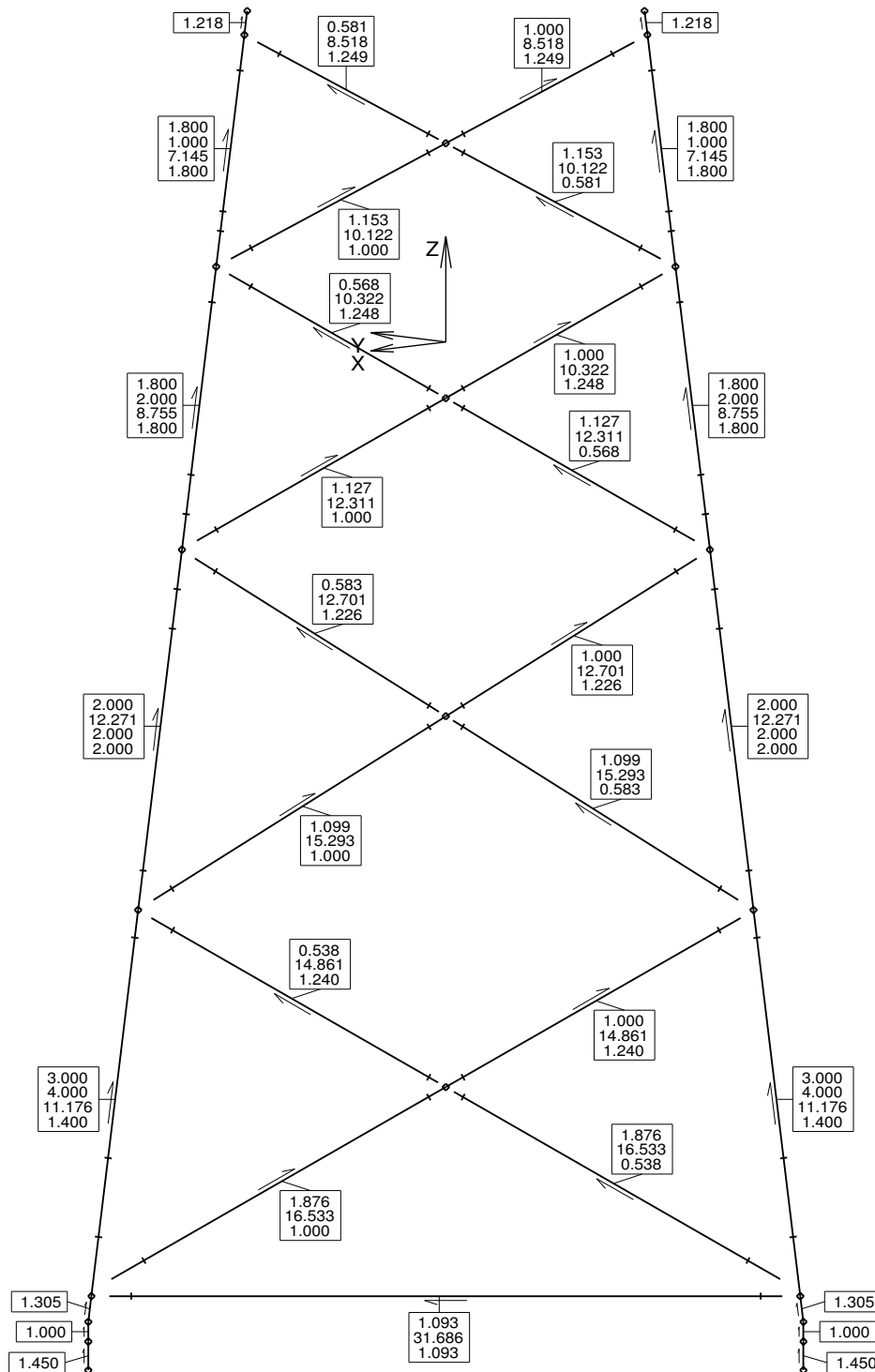
Direction:	X: -0.702	Y: -0.702	Z: 0.121
Limits:	X(-25.456, -0.000)	Y(-25.456, 0.000)	Z(-49.950, 18.000)
Plot 2:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
PROJECT: INNWIND JACKET
SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Element Lengths
Jacket Row P

Ramboll Offshore Wind

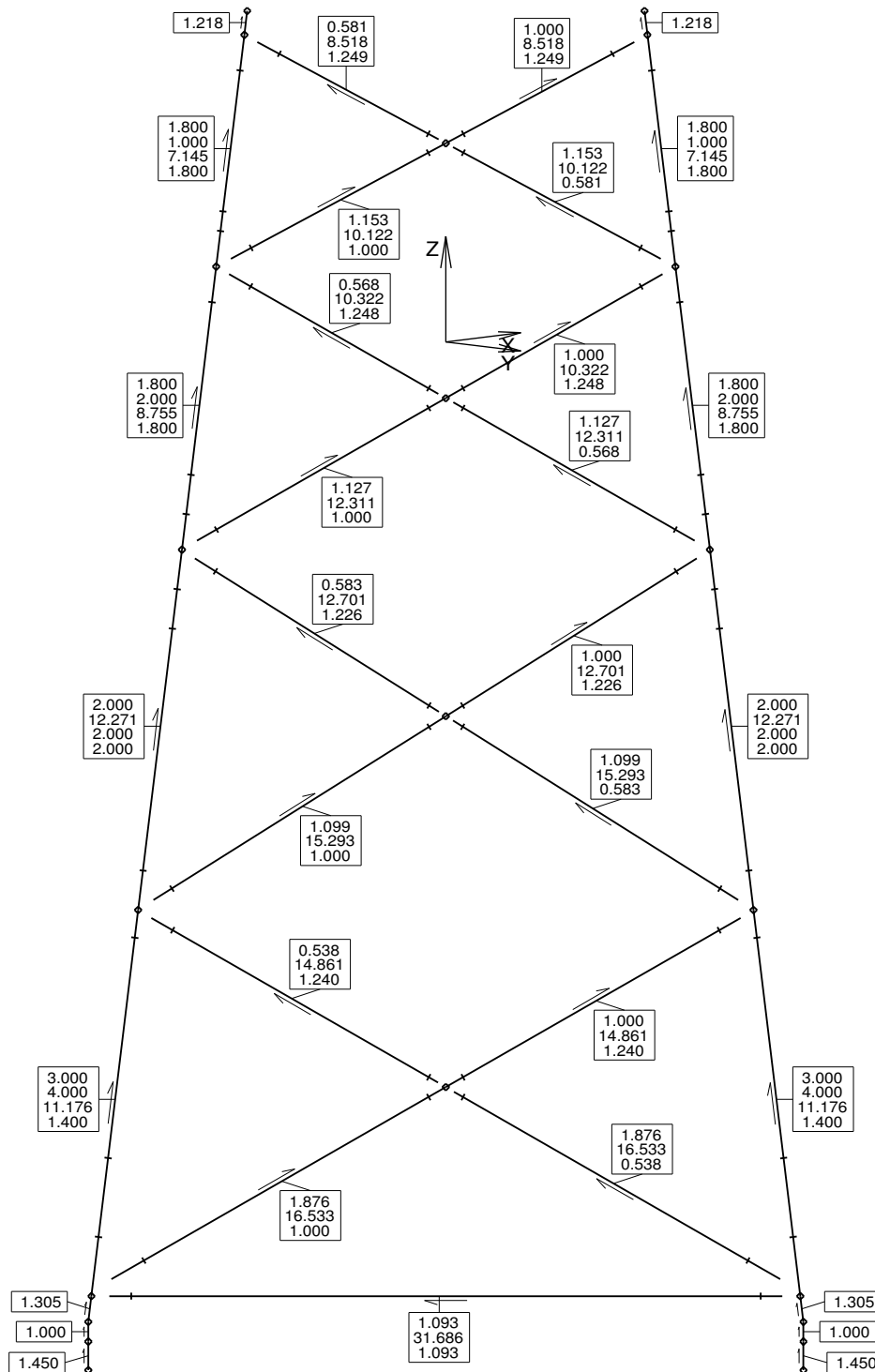
Direction:	X: 0.702	Y: -0.702	Z: 0.121
Limits:	X(-0.000, 25.456)	Y(-25.456, 0.000)	Z(-49.950, 18.000)
Plot 3:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
PROJECT: INNWIND JACKET
SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Element Lengths
Jacket Row Q

Ramboll Offshore Wind

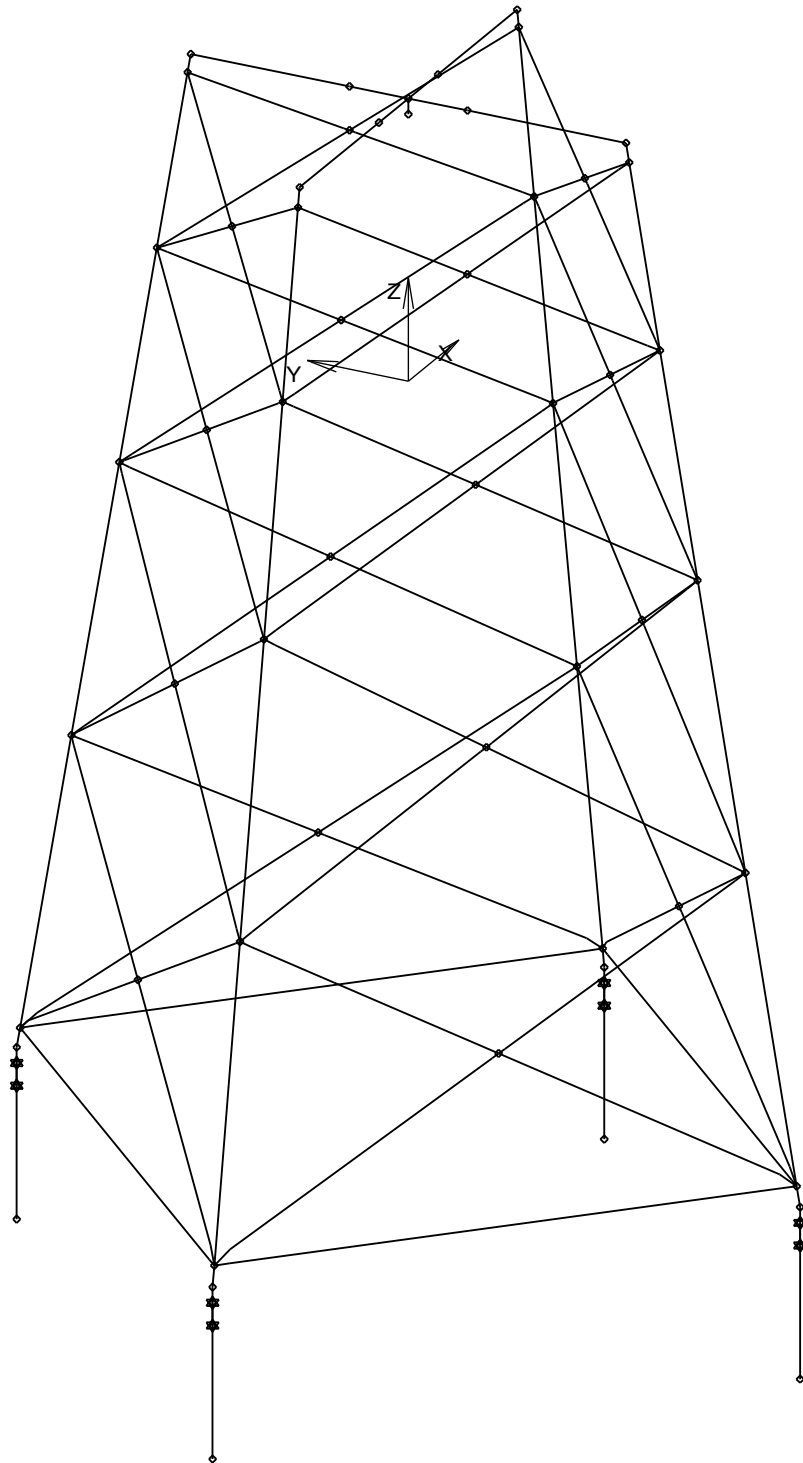
Direction:	X: -0.702	Y: 0.702	Z: 0.121
Limits:	X(-25.456, 0.000)	Y(0.000, 25.456)	Z(-49.950, 18.000)
Plot 4:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
PROJECT: INNWIND JACKET
SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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General view of Jacket

Ramboll Offshore Wind

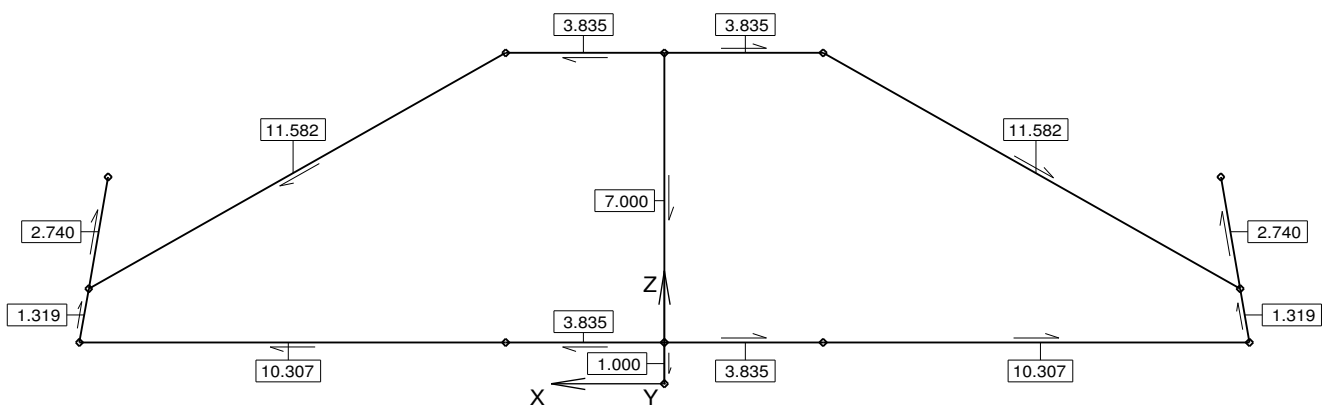
Direction:	X: 0.816	Y: 0.408	Z: -0.408
Limits:	X(-25.456, 25.456)	Y(-25.456, 25.456)	Z(-58.450, 18.000)
Plot 5:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Element Lengths

Transition Piece Strut Model - Diagonal 1

Ramboll Offshore Wind

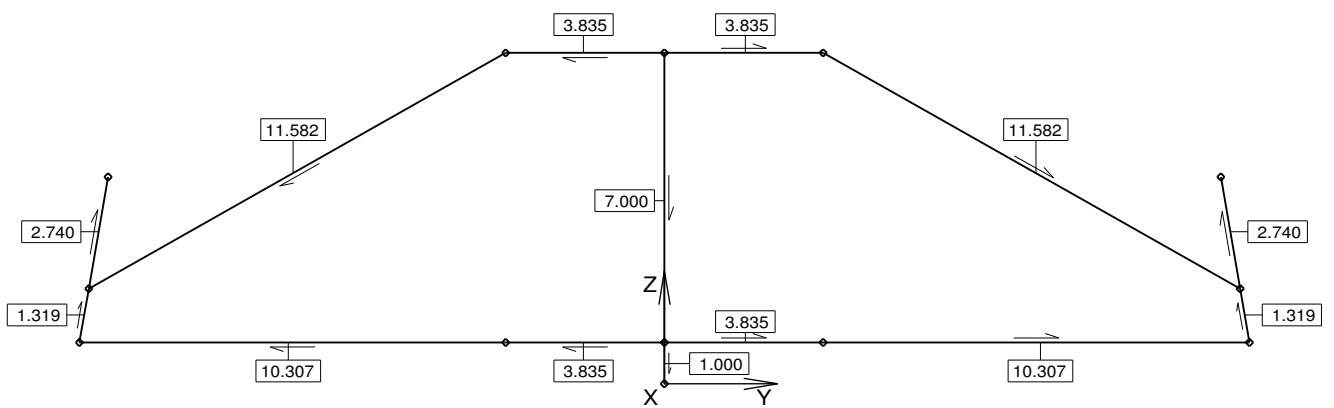
Direction:	X:-0.000	Y:-1.000	Z:-0.000
Limits:	X(-14.142, 14.142)	Y(0.000, 0.000)	Z(17.000, 25.000)
Plot 9:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Element Lengths

Transition Piece Strut Model - Diagonal 2

Ramboll Offshore Wind

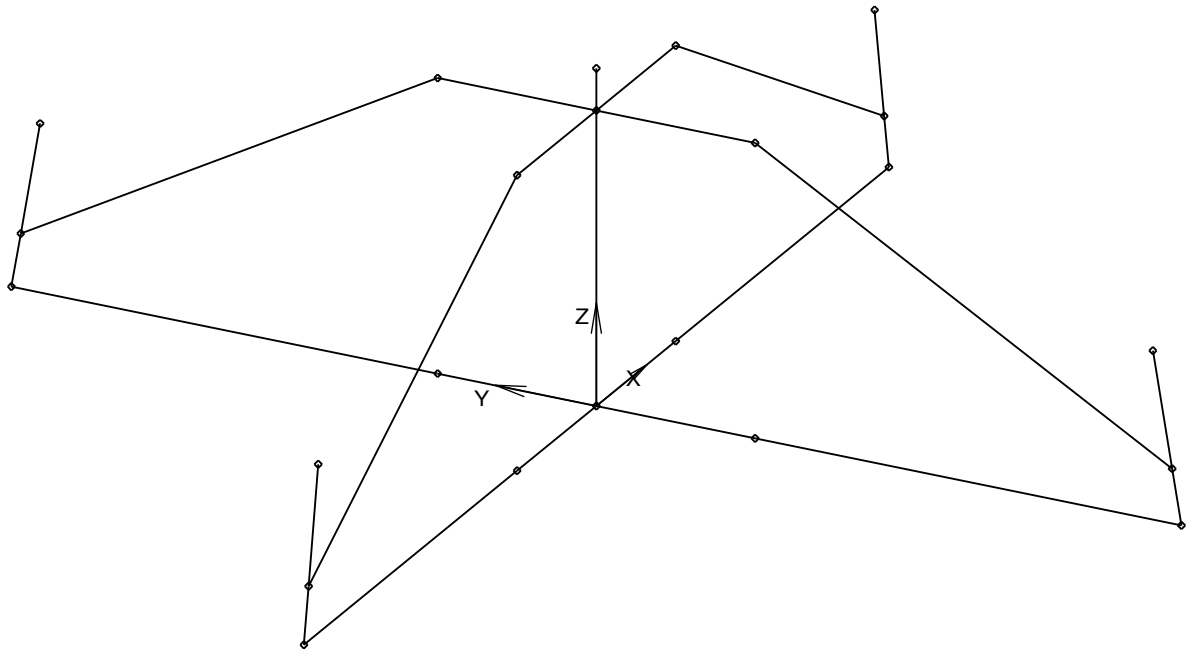
Direction:	X: -1.000	Y: 0.000	Z: 0.000
Limits:	X(-0.000, 0.000)	Y(-14.142, 14.142)	Z(17.000, 25.000)
Plot 10:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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General view of Transition Piece

Ramboll Offshore Wind

Direction:	X: 0.816	Y: 0.408	Z: -0.408
Limits:	X(-14.142, 14.142)	Y(-14.142, 14.142)	Z(18.000, 26.000)
Plot 11:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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 E-mail: info@ramboll.com

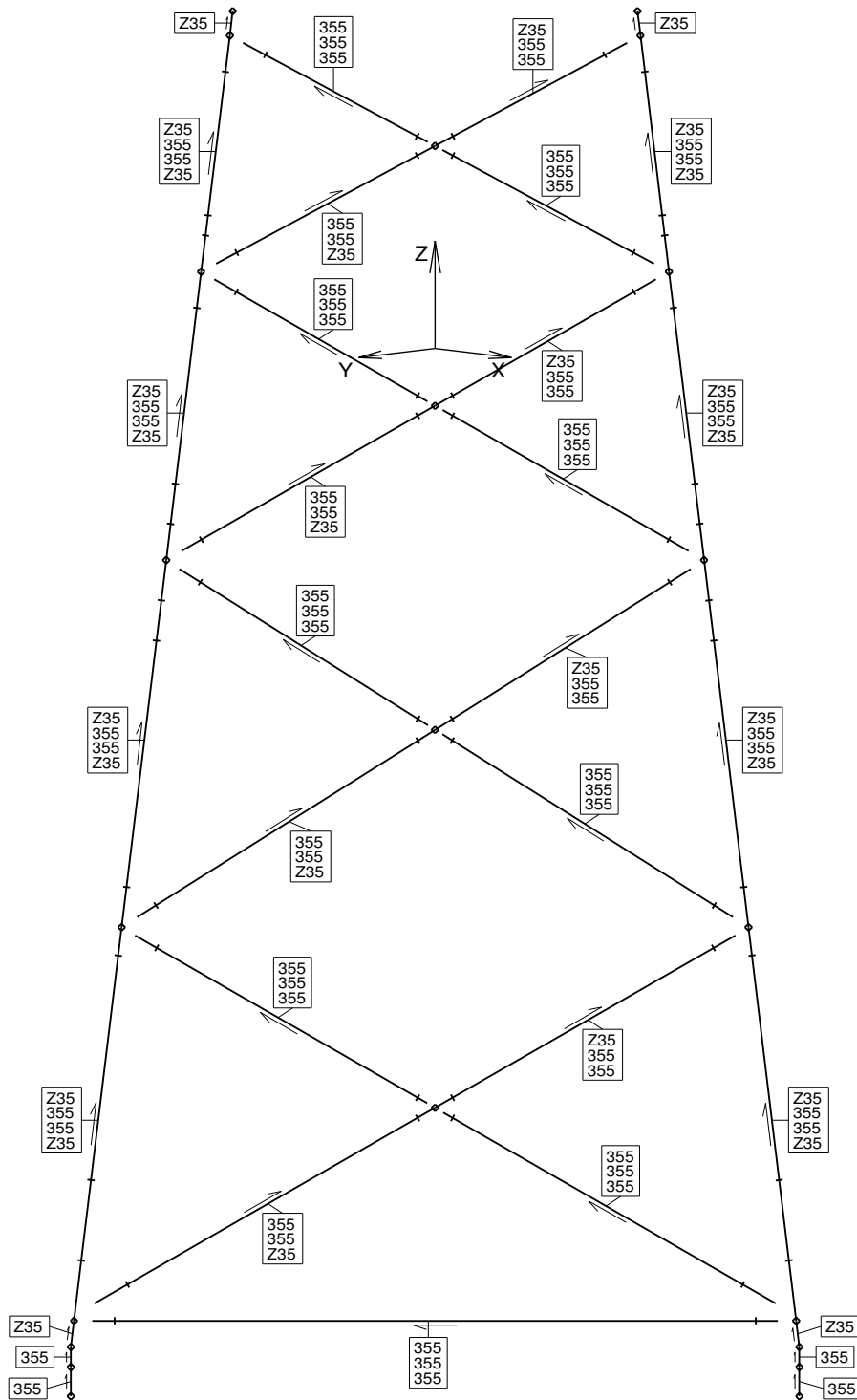
APPENDIX 3D

JACKET MODEL – MATERIAL PROPERTIES

The following pages display the material properties of the used elements.

In case of remodelling the structure please use an E-Modulus of 5 times 210000 MPa for the Transition Piece (TP) Elements. This is due to the fact that used model of the TP is a simplified representation.

For all other elements of the jacket an E-Modulus of 210000 MPa has been considered.



Material Names
Jacket Row A

Ramboll Offshore Wind

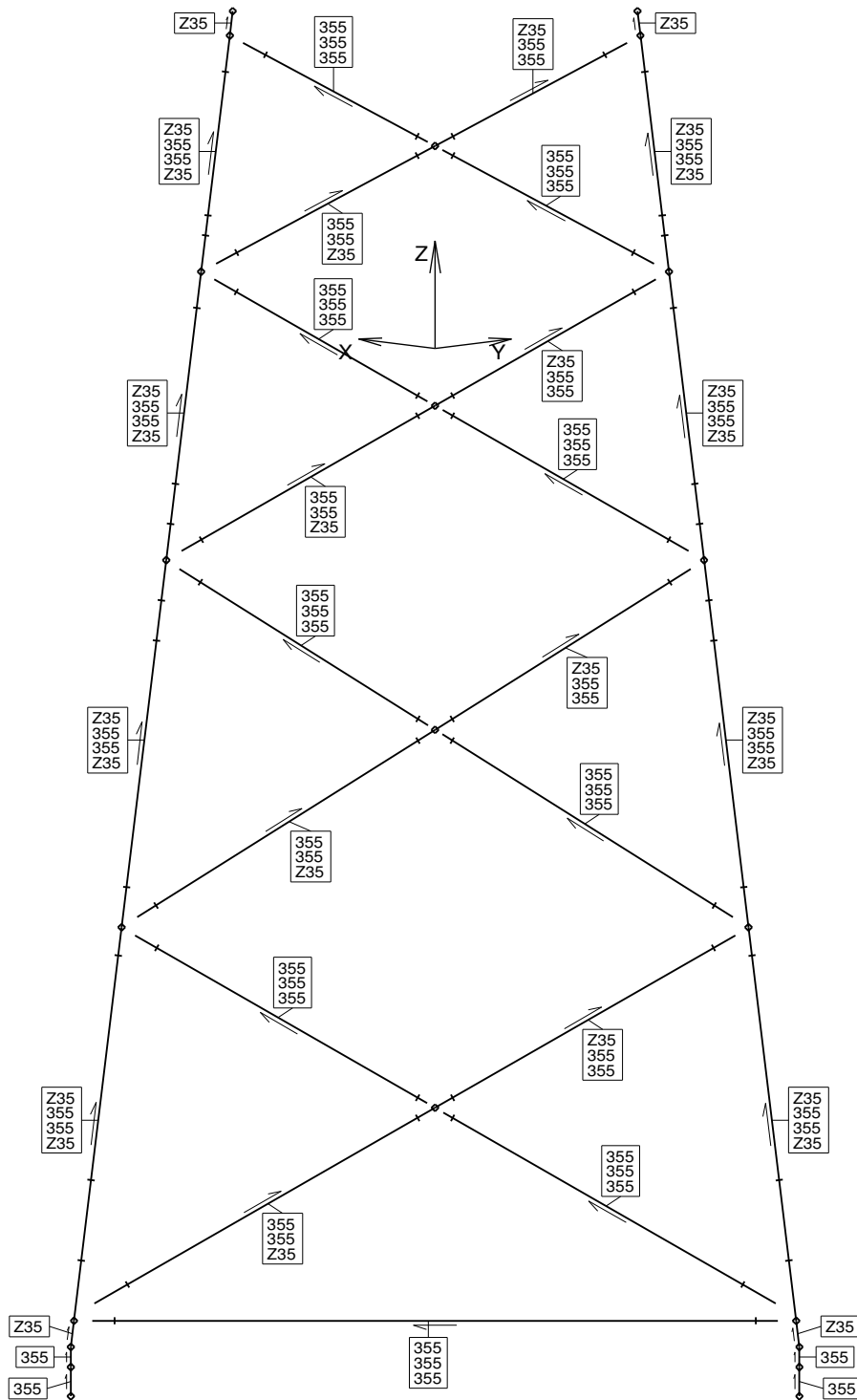
Direction:	X: 0.702	Y: 0.702	Z: 0.121
Limits:	X(0.000, 25.456)	Y(0.000, 25.456)	Z(-49.950, 18.000)
Plot 1:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
PROJECT: INNWIND JACKET
SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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E-mail: info@ramboll.com



Material Names
Jacket Row B

Ramboll Offshore Wind

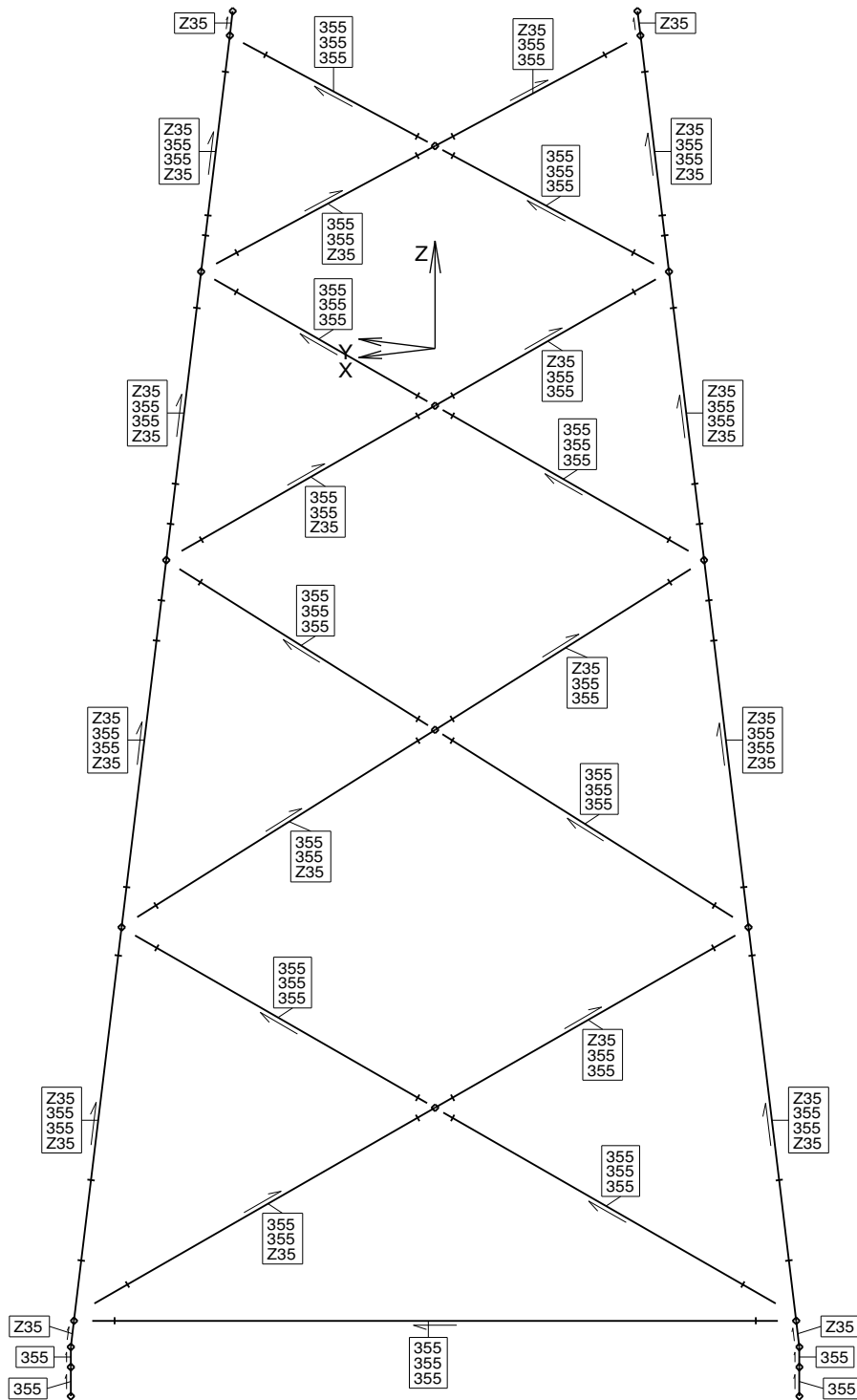
Direction:	X: -0.702	Y: -0.702	Z: 0.121
Limits:	X(-25.456, -0.000)	Y(-25.456, 0.000)	Z(-49.950, 18.000)
Plot 2:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
PROJECT: INNWIND JACKET
SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Web: www.ramboll.com/wind
E-mail: info@ramboll.com



Material Names

Jacket Row P

Ramboll Offshore Wind

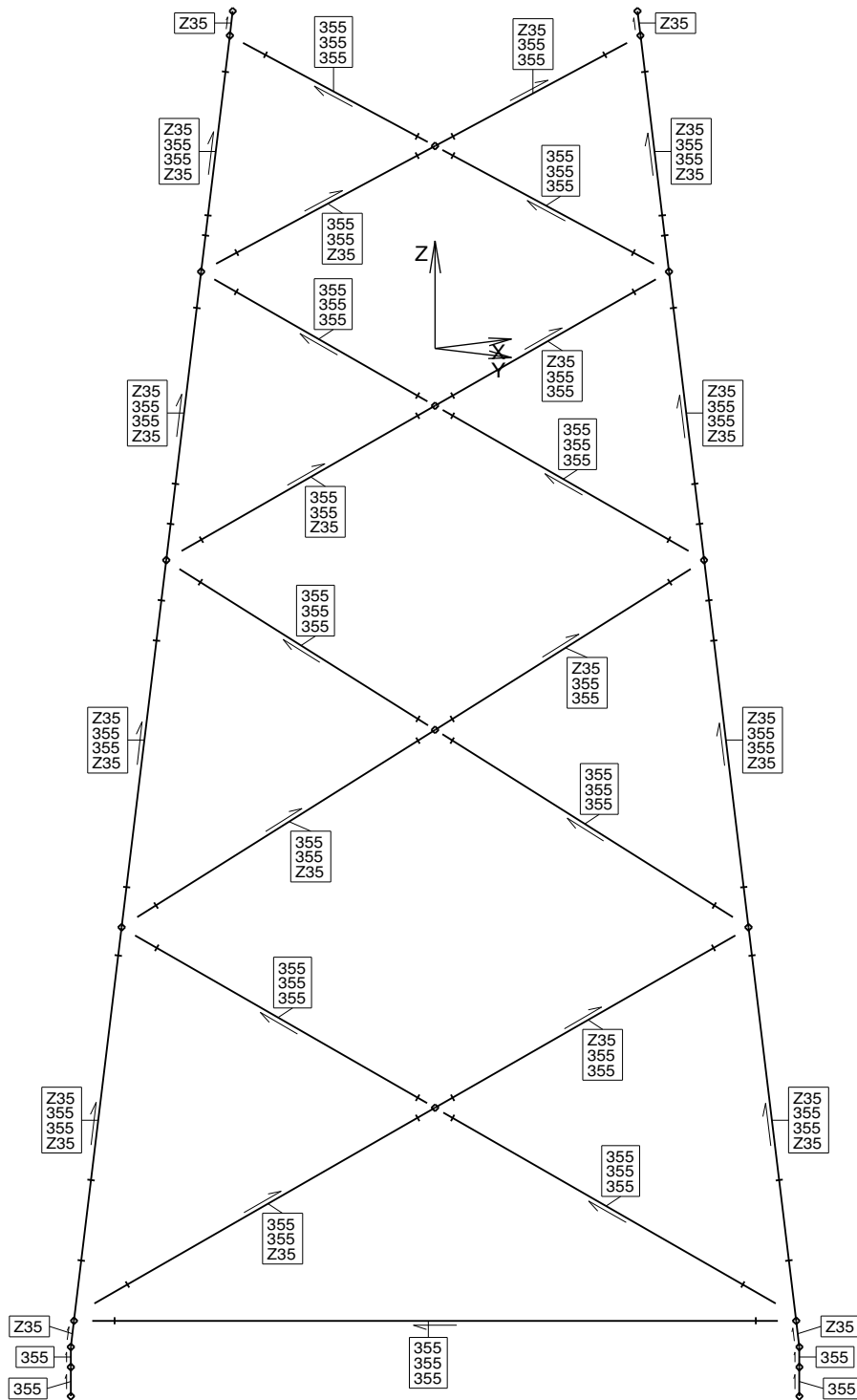
Direction:	X: 0.702	Y: -0.702	Z: 0.121
Limits:	X(-0.000, 25.456)	Y(-25.456, 0.000)	Z(-49.950, 18.000)
Plot 3:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Material Names
Jacket Row Q

Ramboll Offshore Wind

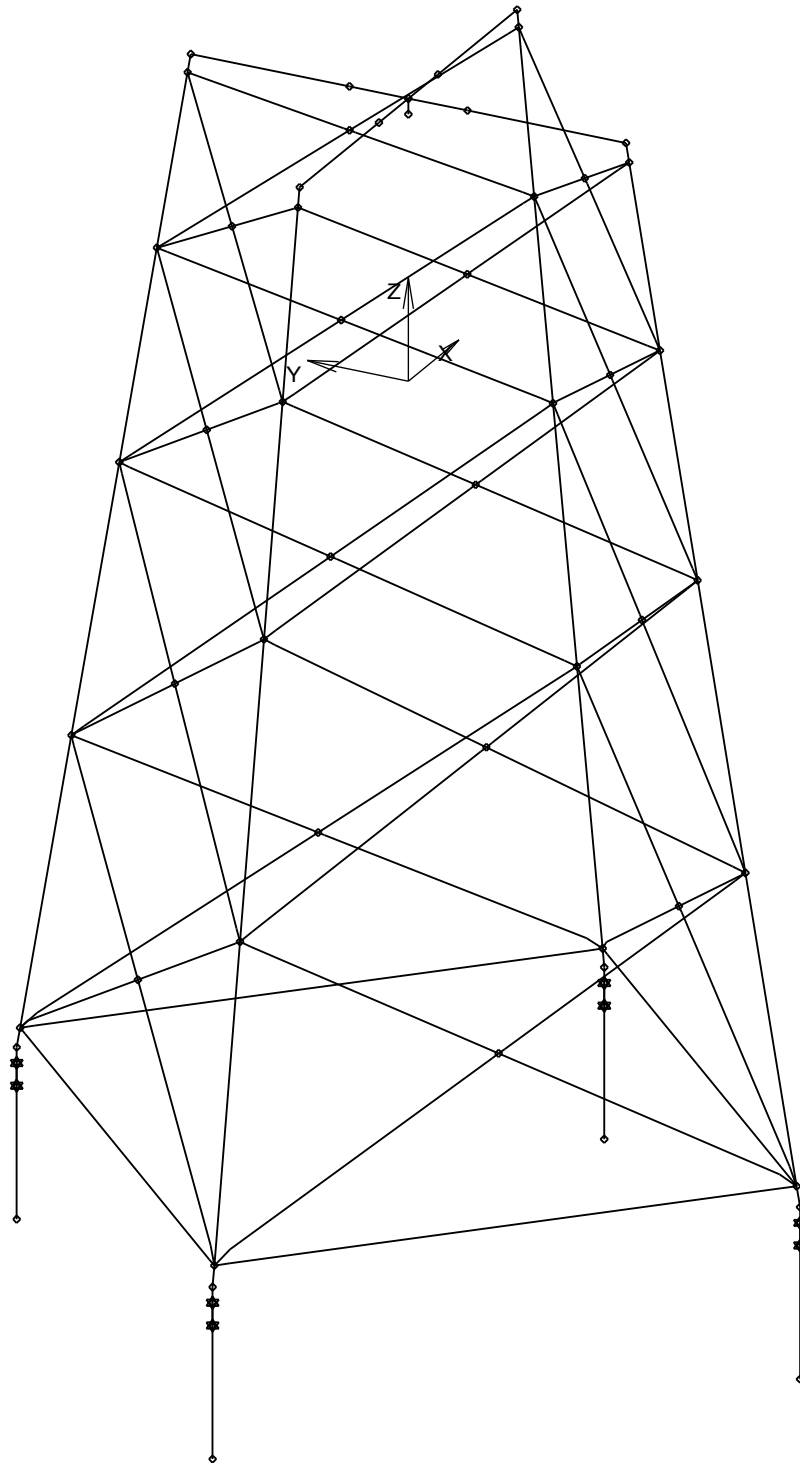
Direction:	X: -0.702	Y: 0.702	Z: 0.121
Limits:	X(-25.456, 0.000)	Y(0.000, 25.456)	Z(-49.950, 18.000)
Plot 4:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
PROJECT: INNWIND JACKET
SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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E-mail: info@ramboll.com



General view of Jacket

Ramboll Offshore Wind

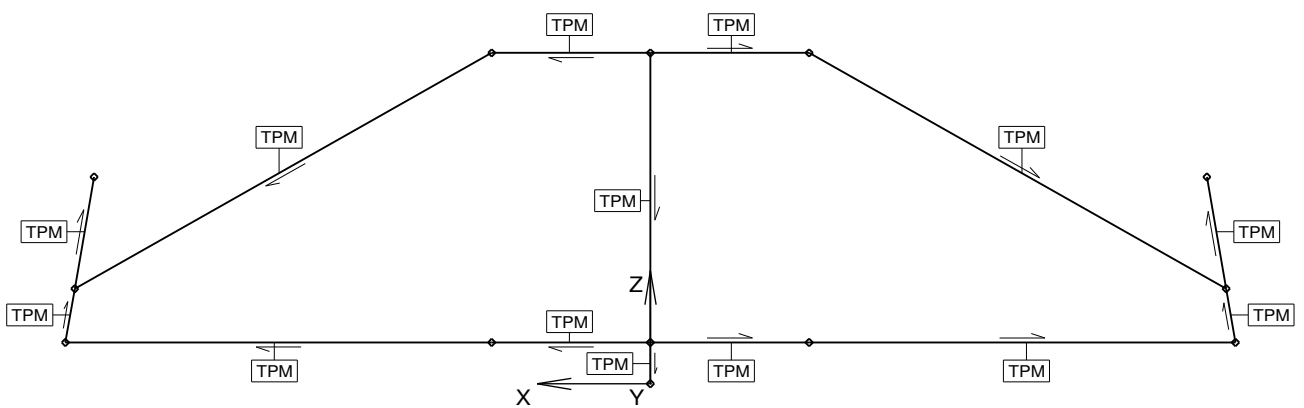
Direction:	X: 0.816	Y: 0.408	Z: -0.408
Limits:	X(-25.456, 25.456)	Y(-25.456, 25.456)	Z(-58.450, 18.000)
Plot 5:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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Web: www.ramboll.com/wind
 E-mail: info@ramboll.com



Material Names

Transition Piece Strut Model - Diagonal 1

Ramboll Offshore Wind

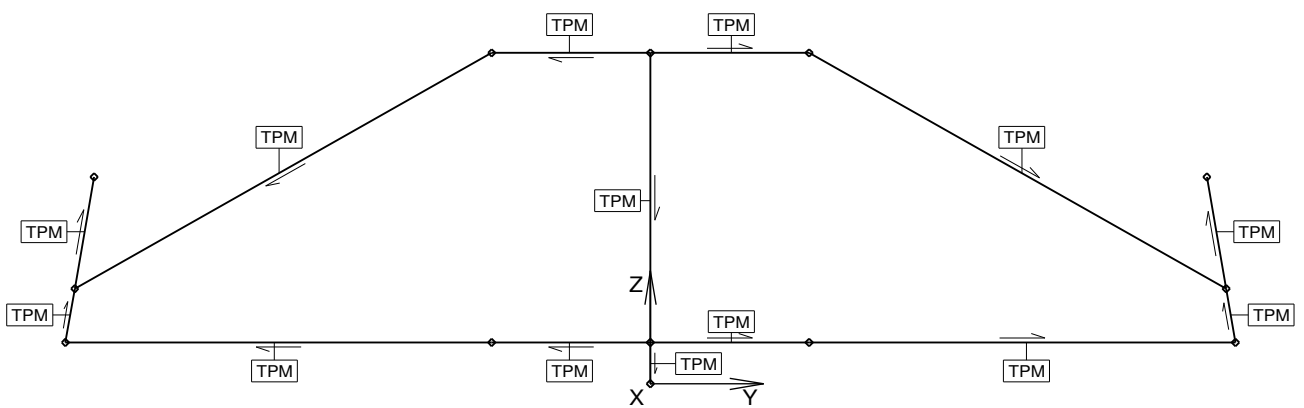
Direction:	X:-0.000	Y:-1.000	Z:-0.000
Limits:	X(-14.142, 14.142)	Y(0.000, 0.000)	Z(17.000, 25.000)
Plot 9:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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 Fax: +45 5161 1001

Web: www.ramboll.com/wind
 E-mail: info@ramboll.com



Material Names

Transition Piece Strut Model - Diagonal 2

Ramboll Offshore Wind

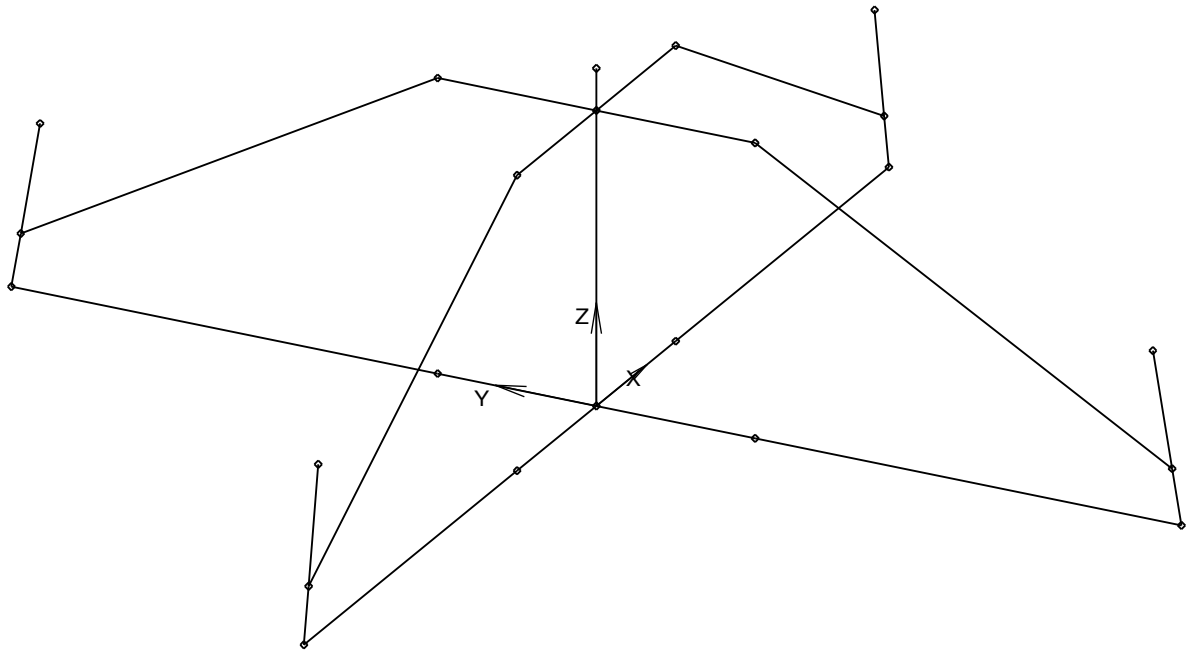
Direction:	X: -1.000	Y: 0.000	Z: 0.000
Limits:	X(-0.000, 0.000)	Y(-14.142, 14.142)	Z(17.000, 25.000)
Plot 10:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

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 Fax: +45 5161 1001

Web: www.ramboll.com/wind
 E-mail: info@ramboll.com



General view of Transition Piece

Ramboll Offshore Wind

Direction:	X: 0.816	Y: 0.408	Z: -0.408
Limits:	X(-14.142, 14.142)	Y(-14.142, 14.142)	Z(18.000, 26.000)
Plot 11:	Date: 2013-04-16	Time: 17:31:32	Job FIRNIK (STPLOT 4.7)

COMPANY: RAMBOLL WIND
 PROJECT: INNWIND JACKET
 SUBJECT: SOFTEST CO, 20m Base T, 36m Base B

Willemoesgade 2
 DK 6700 Esbjerg

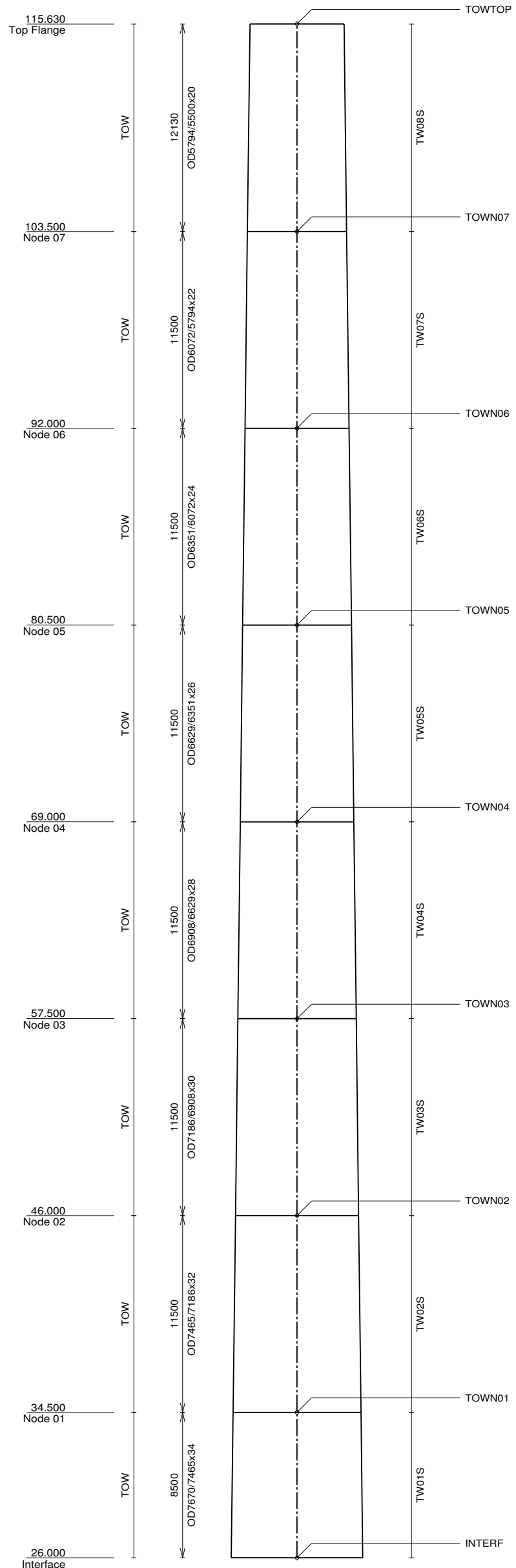
Tel: +45 5161 1000
 Fax: +45 5161 1001

Web: www.ramboll.com/wind
 E-mail: info@ramboll.com

APPENDIX 4

TOWER MODEL GEOMETRY

The following drawing gives an overview of the Tower Model dimensions. Note that the original tower has been cut at 26m above the original tower bottom level. The steel density for the drawing is set to 78.5 kN/m³ to account for the actual weight of the tower sections.



NOTES

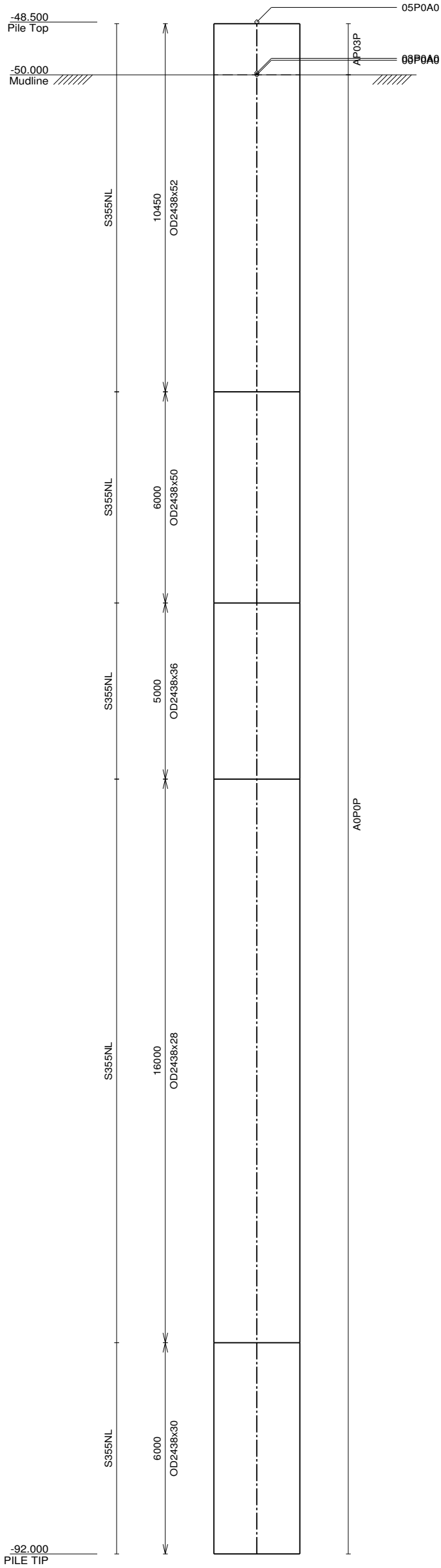
- 1. All dimensions in millimeters.
- 2. All levels in meters.
- 3. Nominal weight of steel on this drawing:
TOW 393.47 tonnes

0	2012.31.10	TVB	-	-	Issued for information
Rev.	Date	Drw.	Chkd.	Appr.	Description
Client					
RAMBOLL WIND					
Ramboll Offshore Wind					
INNWIND JACKET					
Title					
TOWER - COMPUTER MODEL					
Scale	Size	Drawing No.			Rev.
1:285	A3	For information			0

APPENDIX 5

JACKET PILE

The following drawing gives an overview of the Jacket pile dimensions.



NOTES

1. All dimensions in millimeters.
2. All levels in meters.
3. Nominal weight of steel on this drawing:
 S355NL 97.62 tonnes

0	2012.31.10	TVB	-	-	Issued for information
Rev.	Date	Drw.	Chkd.	Appr.	Description
Client					
RAMBOLL WIND					
Ramboll Offshore Wind					
INN WIND JACKET					
Title					
JACKET PILE					
Scale	Size	Drawing No.			Rev.
1:138	A3	For information			0