TEN TECH
DESIGN AND ENGINEERING OF LIGHTWEIGHT STRUCTURES

Content:	**Tentbook (according to EN 13782)**
Object:	**10m stretchtent and alternatives**
Owner object:	**Eurostretch B.V.**
Document code:	**26.03.00007.2**
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Object:	10m stretchtent and alternatives
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A. Introduction

Eurostretch B.V. has commissioned Tentech B.V. to perform a static analysis of a stretch tent. Eurostretch B.V. is a Dutch company that specializes in rental and selling of tent structures made of a stretchable membrane, so called Stretch Tents or Bedouin tents. The stretchable membrane enables a freedom of form as there is not a pre-described shape necessary. Depending on the location, the number of poles, length of the poles, and the placement of the poles, number and type of ties can be varied. This results in a custom canopy at each location.

The freedom of form is enabled by a stretchable fabric, as the desired form is stretched from a rectangular fabric. The drawback of this flexibility in shape is the difficulty of investigating all the different possibilities and generalizing them for a static analysis.

This report presents the static analysis of a 10m stretch tent series which consists of different sizes – **10x10, 10x15, 10x20, 10x12 and 9x12m**. The report shows the static analysis of the decisive sizes – 10x10m, 10x15m and 10x20m. The static analysis of tent 10x15m is valid for smaller sizes of 10x12m and 9x12m due to the application of the **scaling principle**. All models and variants are investigated in a “floating” set-up – membrane corners and sides are connected above ground, primarily to poles.

Scaling principle: A tent with a similar arrangement of poles and ties but smaller in size or having a more favourable shape is automatically verified when the calculation of the less favourable or bigger tent has been approved, provided that the spacing between the poles and ties of the scaled tent is similar or smaller than the original tent. While constructing smaller tent sizes of different shapes, it is significant to use similar (or more favourable) arrangements of poles and ties based on a ratio of distances (to ensure correct pole and tie spacing).

This document contains the data required for a tent book, according to EN 13782, for the 10m tent series of Eurostretch B.V., including:

- Ownership data;
- Drawings of the different variants of the tent, including dimensions, indications of elements and required anchoring/ballast;
- Permitted live load;
- Maximum wind speeds (according to EN 1991-1-4:2005);
- Structural analysis (according to EN 13782:2015);
- Material certificates (strength properties and fire properties).

Utrecht, S. Banga, 10.08.2026

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C. Codes and standards

- EN 1990 Eurocode, Basis of structural Design
- EN 1991 Eurocode 1, Part 1-4: General actions - wind actions.
- EN 1995 Eurocode 5, Design of wooden structures
- EN 13782 Temporary Structures – Tents - Safety
- EN 12195-2 Belts made from synthetic fibres
- ISO 1141 Fibre ropes – Polyester
- CTS French standard - Chapiteaux, Tentes, Structures

D. Summary

Manufacturer:	Eurostretch B.V. Spoorstraat 25 7061 ZA Terborg Nederland info@eurostretch.com

This document is valid for five tent sizes: 10x10m, 10x15m, 10x20m, 10x12m and 9x12m. Although no separate calculation is made for 10x12m and 9x12m sizes, all elements, sizes and anchoring forces can be based on 10x15m model.

General information:				
Main dimensions:		**10x10m**	**10x15m / 10x12m / 9x12m**	**10x20m**
	Width:	10m	10m / 9m	10m
	Length:	10m	15m / 12m	20m
	Side height of membrane:	3m	3m	3m
	Max. height:	4m	4m	4m
	Main poles: *	4.0m Ø100 mm [Spruce,C18]	4.0m Ø100 mm [Spruce,C18]	4.0m Ø100 mm [Spruce, C18]
	Side poles: *	3.0m Ø 70 mm [Spruce, C18]	3.0m Ø 75 mm [Spruce, C18]	3.0m Ø 75 mm [Spruce, C18]
	Corner poles: *	2.5m Ø 70 mm [Spruce, C18]	2.5m Ø 75 mm [Spruce, C18]	2.5m Ø 70 mm [Spruce, C18]
	Stormbelts:	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN
	Guy ropes:	Ø 8mm polyester, breaking strength ≥ 900 daN **	Ø 8mm polyester, breaking strength ≥ 900 daN **	Ø 8mm polyester, breaking strength ≥ 900 daN **
	Long side – combined:	4 sections	4 sections	4 sections
	Long side - V-ropes:	3 sections	3 sections	3 sections
	Short side – combined:	-------	4 sections	4 sections
	Short side - V-ropes:	-------	3 sections	3 sections
	Belts:	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN
	Fasteners:	Carabine 180x14 M16 & M12 Eye bolt Ratchet, BL = 3.5 kN	Carabine 180x14 M16 & M12 Eye bolt Ratchet, BL = 3.5 kN	Carabine 180x14 M16 & M12 Eye bolt Ratchet, BL = 3.5 kN
	Side & corner pole base plate	25x25cm	25x25cm	25x25cm
	Main pole base plate	35x35cm	35x35cm	35x35cm

User load:	A maximum of 25 kg per main mast may be used for decorations, sound or lighting installations. The load must be applied centrally.
Snow load:	A snow load of 0.1 kN/m² (4 cm) has been considered in accordance with the French CTS standard.
Wind load:	According to EN 13782 The following pressure values have been used: h < 5m: 0.50kN/m² This value corresponds to wind force 8 on the Beaufort scale. Above this wind force (starting at wind force 9), the safety of the structure can no longer be guaranteed, and it must be evacuated.

* The average diameter, as a minimum required at the middle of the pole.

** The required breaking load (BL_{tot}) may be achieved by using multiple rope sections (n): $BL_{rope} = BL_{tot} / n$, see page 57

Wind speeds for default European terrain categories (not Country specific)

	Out of service (1)				
	Coast	Flattened, open area	Rural area	Village	City
10 min. average wind speed (2)	> 17.94 m/s > 64.57 km/h	> 18.89 m/s > 67.99 km/h	> 21.08 m/s > 75.88 km/h	> 24.99 m/s > 89.97 km/h	> 26.08 m/s > 93.89 km/h
Beaufort (3)	> 7 BFT	> 7 BFT	> 8 BFT	> 9 BFT	> 9 BFT
Peak wind speed (4)	> 113 km/h	> 113 km/h	> 113 km/h	> 113 km/h	> 113 km/h

(1) 'Out of service' means: above the given wind speed the structure is no longer guaranteed regarding strength and/or stability.

(2) 10min average wind speed at 10m height measured at the nearest weather stations.

(3) wind data in Beaufort (BFT) are indicative values.

(4) 3 second peak wind speed measured on site at 10m height.

Safety against sliding, overturning and uplifting:

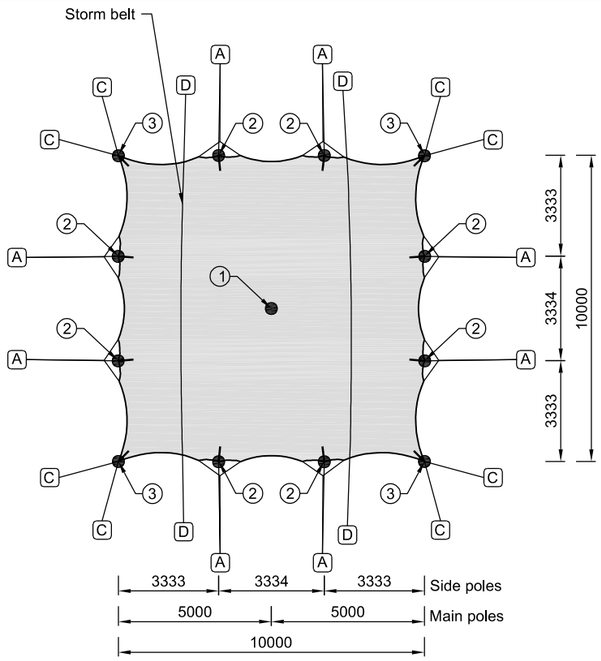
Anchor forces:	Assumptions: angle of 45 degrees The following design resistance of the anchor forces is required: (See H.8.3, page 67 for Anchor tests according to EN 13782)			
		10x10m	**10x15m / 10x12m / 9x12m**	**10x20m**
	Long side guy ropes: Short side guy ropes: Corner ties: Stormbelt:	6.05 kN (γ = 1.2) 4.73 kN (γ = 1.2) 6.74 kN (γ = 1.2)	6.24 kN (γ = 1.2) 6.28 kN (γ = 1.2) 5.06 kN (γ = 1.2) 7.21 kN (γ = 1.2)	6.92 kN (γ = 1.2) 6.70 kN (γ = 1.2) 5.32 kN (γ = 1.2) 7.12 kN (γ = 1.2)
Required anchors:	Based on dense, non-cohesive soil (e.g. sandy soils). In the case anchors **Ø30mm x 1000mm** (effective length) are being used:			
		10x10m	**10x15m / 10x12m / 9x12m**	**10x20m**

	Long side guy ropes: Short side guy ropes: Corner ties: Stormbelt:	2 anchors 1 anchor 2 anchors	2 anchors 2 anchors 1 anchor 2 anchors	2 anchors 2 anchors 1 anchor 2 anchors
Required ballast:	Ballast calculation is performed for 2 different situations: - Concrete on concrete – concrete ballasts are placed on concrete - Concrete on wood or rubber – concrete ballasts are placed on wood, or an anti-slip mat is placed underneath the ballast			
	10x10m			
			Concrete on concrete	Concrete on wood or rubber
	Long side guy ropes: Corner ties: Stormbelt:		1280 kg 1000 kg 1430 kg	1140 kg 890 kg 1270 kg
	10x15m / 10x12m / 9x12m			
			Concrete on concrete	Concrete on wood or rubber
	Long side guy ropes: Short side guy ropes: Corner ties: Stormbelt:		1320 kg 1330 kg 1070 kg 1530 kg	1180 kg 1180 kg 960 kg 1360 kg
	10x20m			
			Concrete on concrete	Concrete on wood or rubber
	Long side guy ropes: Short side guy ropes: Corner ties: Stormbelt:		1470 kg 1420 kg 1130 kg 1510 kg	1310 kg 1260 kg 1000 kg 1340 kg

E. Drawings: main dimensions and anchoring

Drawings for the following sizes are presented in this chapter:

- 10x10m model
- 10x15m model
- 10x20m model
- 10x12m model (based on 10x15m model)
- 9x12m model (based on 10x15m model)



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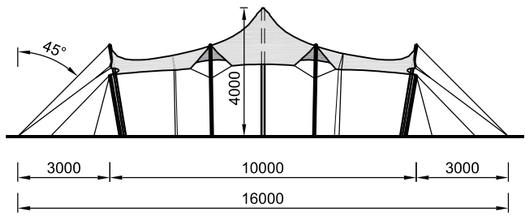

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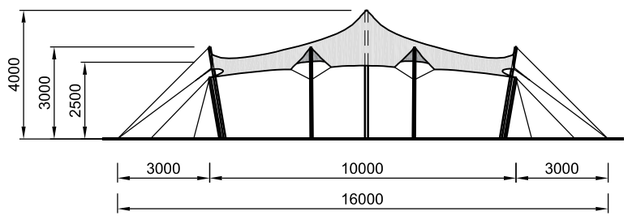

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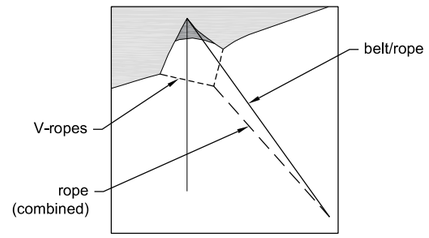

GUYING DIAGRAM
[1:100]

Safety against sliding, overturning and uplifting

Based on dense, non-cohesive soil (e.g. sandy soils).

		Anchors (Ø30x1000mm)	Ballast (concrete on concrete)	Ballast (concrete on wood or rubber)
A	Guying - long side	2x anchors	1280 kg	1140 kg
B	Guying - short side	-	-	-
C	Guying - corner	1x anchors	1000 kg	890 kg
D	Storm belt *(per end)*	2x anchors	1430 kg	1270 kg

All belts/ropes and storm belts of the membrane must be placed under a 45° angle of ≥ 45° be attached to the anchors.

Poles

Main poles 4.0m:
1 - Ø100mm [C18, Spruce]
Side poles 3.0m:
2 - Ø70mm [C18, Spruce]
Corner poles 2.5m:
3 - Ø70mm [C18, Spruce]

Guying

Storm belt: [PES] BL 3000 daN = LC 1000 daN

Guying belt: [PES] BL 3000 daN = LC 1000 daN
Guying rope: rope: Ø 8mm polyester, breaking strength ≥ 900 daN

Combined & v-ropes:	Rope
n - number of sections	n
Guying - long side (combined)	4x
Guying - long side (v-ropes)	3x
Guying - short side (combined)	-
Guying - short side (v-ropes)	-

Belts (alternative rope):	Belt	Rope
n - number of sections	(number)	n
Guying - long side	1x	1x
Guying - short side	1x	1x
Guying - corner	1x	3x

Alternative configuration

10 x 10 m 10 x 15 m 10 x 20 m ** Basic configurations*	10 x 12 m 9 x 12 m

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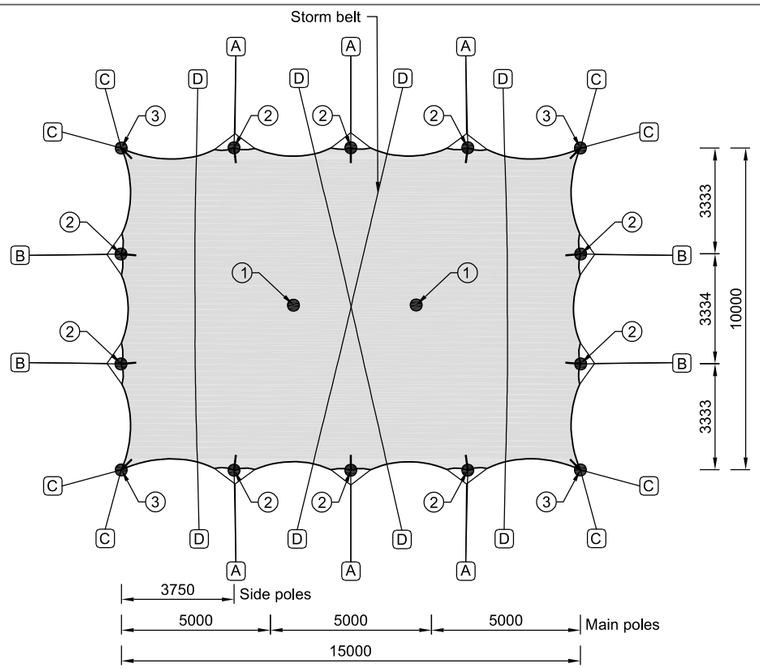

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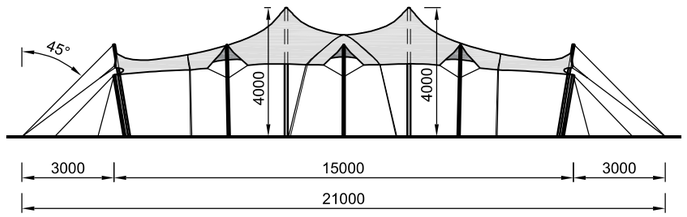

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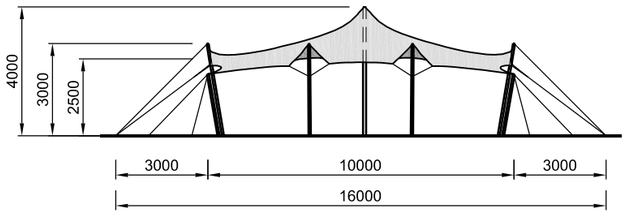

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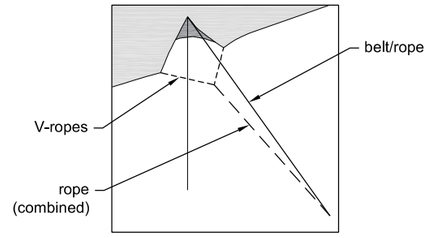

GUYING DIAGRAM
[1:100]

Safety against sliding, overturning and uplifting

Based on dense, non-cohesive soil (e.g. sandy soils).

	Anchors (Ø30x1000mm)	Ballast (concrete on concrete)	Ballast (concrete on wood or rubber)
A Guying - long side	2x anchors	1320 kg	1180 kg
B Guying - short side	2x anchors	1330 kg	1180 kg
C Guying - corner	1x anchors	1070 kg	960 kg
D Storm belt *(per end)*	2x anchors	1530 kg	1360 kg

All belts/ropes and storm belts of the membrane must be placed under a 45° angle of ≥ 45° be attached to the anchors.

Poles

Main poles 4.0m:
1 - Ø100mm [C18, Spruce]
Side poles 3.0m:
2 - Ø75mm [C18, Spruce]
Corner poles 2.5m:
3 - Ø75mm [C18, Spruce]

Guying

Storm belt: [PES] BL 3000 daN = LC 1000 daN

Guying belt: [PES] BL 3000 daN = LC 1000 daN
Guying rope: rope: Ø 8mm polyester, breaking strength ≥ 900 daN

Combined & v-ropes:	Rope
n - number of sections	n
Guying - long side (combined)	4x
Guying - long side (v-ropes)	3x
Guying - short side (combined)	4x
Guying - short side (v-ropes)	3x

Belts (alternative rope):	Belt	Rope
n - number of sections	(number)	n
Guying - long side	1x	1x
Guying - short side	1x	1x
Guying - corner	1x	3x

Alternative configuration

10 x 10 m 10 x 15 m 10 x 20 m * *Basic configurations*	10 x 12 m 9 x 12 m

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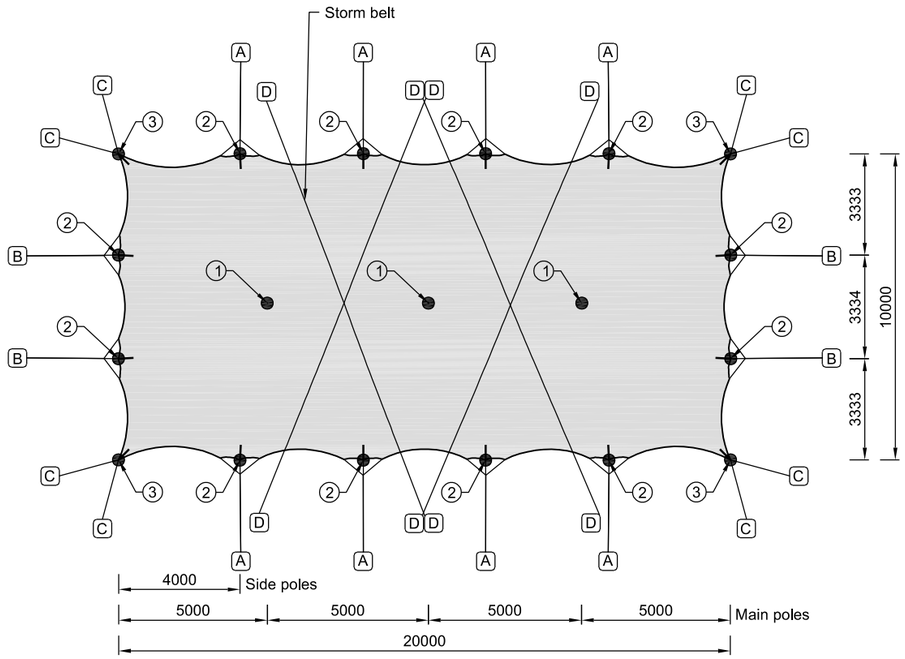

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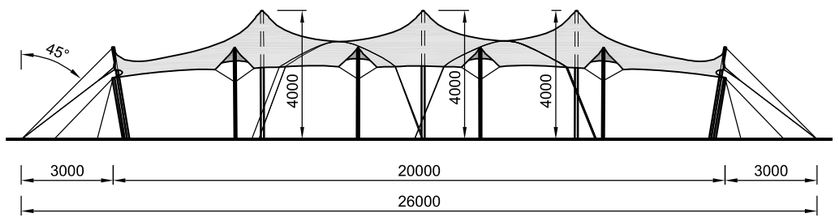

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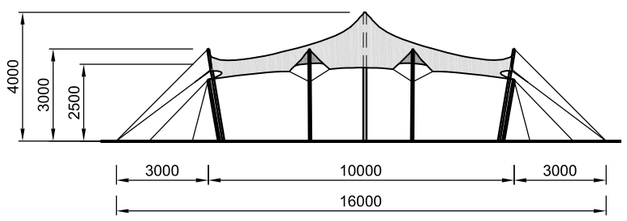

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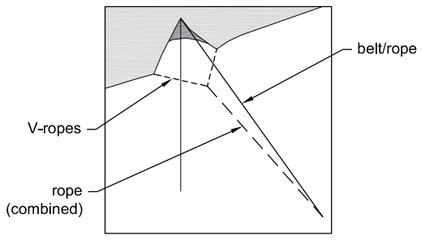

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Safety against sliding, overturning and uplifting

Based on dense, non-cohesive soil (e.g. sandy soils).

		Anchors (Ø30x1000mm)	Ballast (concrete on concrete)	Ballast (concrete on wood or rubber)
A	Guying - long side	2x anchors	1470 kg	1310 kg
B	Guying - short side	2x anchors	1420 kg	1260 kg
C	Guying - corner	1x anchors	1130 kg	1000 kg
D	Storm belt *(per end)*	2x anchors	1510 kg	1340 kg

All belts/ropes and storm belts of the membrane must be placed under a 45° angle of ≥ 45° be attached to the anchors.

Poles

Main poles 4.0m:
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Corner poles 2.5m:
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Guying

Storm belt: [PES] BL 3000 daN = LC 1000 daN

Guying belt: [PES] BL 3000 daN = LC 1000 daN
Guying rope: rope: Ø 8mm polyester, breaking strength ≥ 900 daN

Combined & v-ropes:	Rope
n - number of sections	n
Guying - long side (combined)	4x
Guying - long side (v-ropes)	3x
Guying - short side (combined)	4x
Guying - short side (v-ropes)	3x

Belts (alternative rope):	Belt	Rope
n - number of sections	(number)	n
Guying - long side	1x	1x
Guying - short side	1x	1x
Guying - corner	1x	3x

Alternative configuration

10 x 10 m 10 x 15 m 10 x 20 m * *Basic configurations*	10 x 12 m 9 x 12 m

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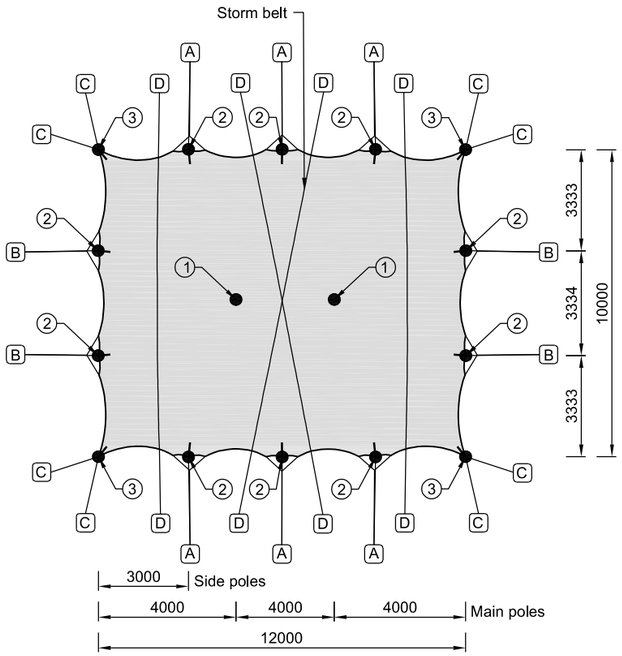

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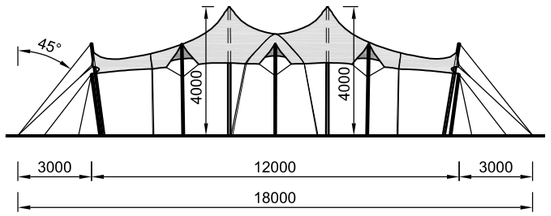

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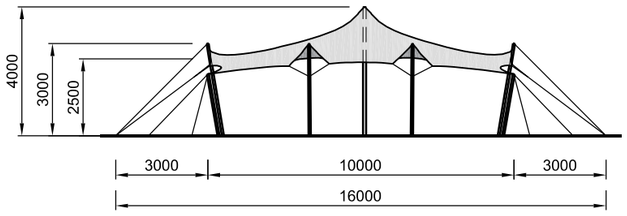

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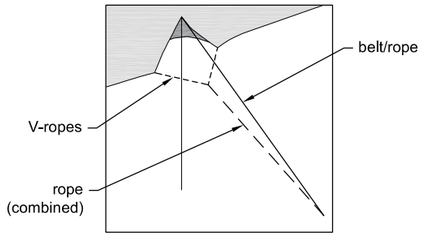

GUYING DIAGRAM
[1:100]

Safety against sliding, overturning and uplifting

Based on dense, non-cohesive soil (e.g. sandy soils).

	Anchors (Ø30x1000mm)	Ballast (concrete on concrete)	Ballast (concrete on wood or rubber)
A Guying - long side	2x anchors	1320 kg	1180 kg
B Guying - short side	2x anchors	1330 kg	1180 kg
C Guying - corner	1x anchors	1070 kg	960 kg
D Storm belt *(per end)*	2x anchors	1530 kg	1360 kg

All belts/ropes and storm belts of the membrane must be placed under a 45° angle of ≥ 45° be attached to the anchors.

Poles

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Side poles 3.0m:
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Corner poles 2.5m:
3 - Ø75mm [C18, Spruce]

Guying

Storm belt: [PES] BL 3000 daN = LC 1000 daN

Guying belt: [PES] BL 3000 daN = LC 1000 daN
Guying rope: rope: Ø 8mm polyester, breaking strength ≥ 900 daN

Combined & v-ropes:	Rope
n - number of sections	n
Guying - long side (combined)	4x
Guying - long side (v-ropes)	3x
Guying - short side (combined)	4x
Guying - short side (v-ropes)	3x

Belts (alternative rope):	Belt	Rope
n - number of sections	(number)	n
Guying - long side	1x	1x
Guying - short side	1x	1x
Guying - corner	1x	3x

Alternative configuration

10 x 10 m 10 x 15 m 10 x 20 m * *Basic configurations*	10 x 12 m 9 x 12 m

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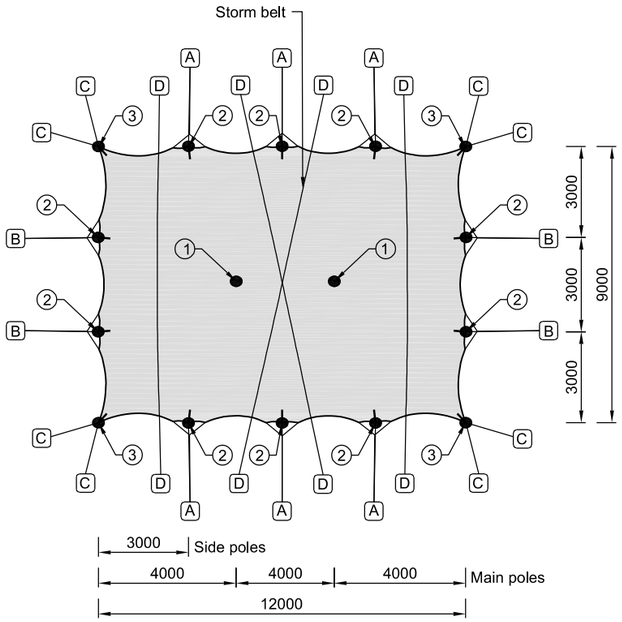
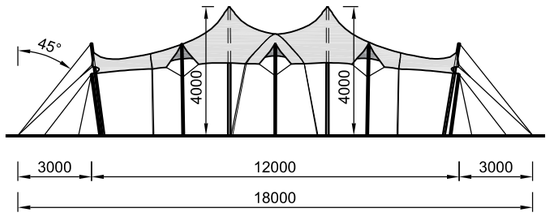
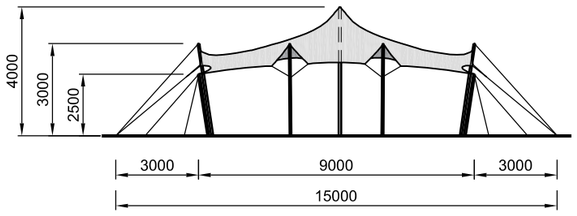


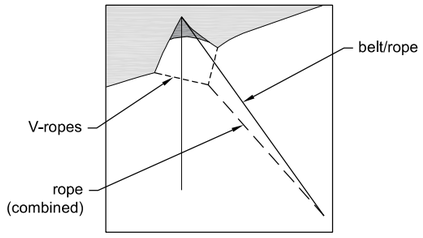
TOP VIEW
[1:200]



FRONT VIEW
[1:200]



SIDE VIEW
[1:200]



GUYING DIAGRAM
[1:100]

Safety against sliding, overturning and uplifting

Based on dense, non-cohesive soil (e.g. sandy soils).

	Anchors (Ø30x1000mm)	Ballast (concrete on concrete)	Ballast (concrete on wood or rubber)
A Guying - long side	2x anchors	1320 kg	1180 kg
B Guying - short side	2x anchors	1330 kg	1180 kg
C Guying - corner	1x anchors	1070 kg	960 kg
D Storm belt *(per end)*	2x anchors	1530 kg	1360 kg

All belts/ropes and storm belts of the membrane must be placed under a 45° angle of ≥ 45° be attached to the anchors.

Poles

Main poles 4.0m:
1 - Ø100mm [C18, Spruce]
Side poles 3.0m:
2 - Ø75mm [C18, Spruce]
Corner poles 2.5m:
3 - Ø75mm [C18, Spruce]

Guying

Storm belt: [PES] BL 3000 daN = LC 1000 daN

Guying belt: [PES] BL 3000 daN = LC 1000 daN
Guying rope: rope: Ø 8mm polyester, breaking strength ≥ 900 daN

Combined & v-ropes:	Rope
n - number of sections	n
Guying - long side (combined)	4x
Guying - long side (v-ropes)	3x
Guying - short side (combined)	4x
Guying - short side (v-ropes)	3x

Belts (alternative rope):	Belt	Rope
n - number of sections	(number)	n
Guying - long side	1x	1x
Guying - short side	1x	1x
Guying - corner	1x	3x

Alternative configuration

10 x 10 m 10 x 15 m 10 x 20 m * *Basic configurations*	10 x 12 m 9 x 12 m

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F. Important terms and conditions

This document applies to the built structure if the following principles and conditions are met:

- The used materials, parts and sections (membrane, poles, ties, anchoring) are in accordance with this document.
- The dimensions of the built structure match the dimensions stated in this document.
- Parts (poles, ties, anchors) may not be removed.
- Obstacles should be placed at least 0.5m from the membrane (measured perpendicular to the fabric); The fabric needs a certain freedom to deform in all directions to prevent damages caused by collision with objects located closely to the fabric (see also EN 13782, article 8.7).
- Above the maximum allowable wind speeds (see D) the structure should be evacuated and access for the public must be denied.
- Only decorations, music- and light installations of less than 25 kg per pole, can be attached to the structure. They must be attached centrically.
- A conventional load of 0.1 kN/m^2 is considered according to EN 13782, which corresponds with the required snow load (4cm) according to the French CTS.
- Anchoring is based on dense, non-cohesive soil. When soil differs, additional anchoring might be necessary, or anchor tests need to be performed.
- Poles must be stored dry. If they become wet, there needs to be a possibility for them to dry.
- All water accumulation must be removed as soon as possible.

G. Allowed wind speeds

The maximum wind speed is converted into a basic wind speed for a coastal area, flattened/open area, rural area, village and city according to EN 1991-1-4. Terrain roughness is taken according to the recommended general values for the different terrain categories for Europe. (not country specific) Illustrations of these terrain categories are presented on page 18.

	Full wind load	
Wind pressure p_w	500 N/m²	At **5m** height
Corresponding peak wind pressure $p_{w,peak}$	605 N/m²	At **10m** height

Peak wind speed at 10m height

Equation:

$$605 = {}^{1}/_{2} \times \rho \times v^2 = {}^{1}/_{2} \times 1.25 \times v^2 \rightarrow v = 31.1\ m/s \rightarrow \pm 113\ km/h$$

Eq. 4.10 EN 1991-1-4
Basic wind pressure

Wind speed coastal area at 10m height

$$K_r = 0.19 \times \left(\frac{z_0}{0.05}\right)^{0.07} = 0.19 \times \left(\frac{0.003}{0.05}\right)^{0.07} = 0.156$$

Eq. 4.5 EN 1991-1-4
Terrain factor for coastal area

$$C_r = K_r \times \ln\left(\frac{z}{z_0}\right) = 0.156 \times \ln\left(\frac{4.0}{0.003}\right) = 1.123$$

Eq. 4.4 EN 1991-1-4
Roughness factor
Z = 4.0 > Z_{min} = 1

$$V_m = C_r \times V_b = 1.123 \times V_b$$

Eq. 4.3 EN 1991-1-4
Average wind speed at height

$$\sigma_v = K_r \times V_b = 0.141 \times V_b$$

Eq. 4.6 EN 1991-1-4
Standard deviation of turbulence

$$L_v = \frac{\sigma_v}{V_m} = \frac{0.156 \times V_b}{1.158 \times V_b} = 0.139$$

Eq. 4.7 EN 1991-1-4
Turbulence intensity

$$Q_p = (1 + 7 \times L_v) \times {}^{1}/_{2} \times \rho \times {V_m}^2 = 1.554 \times {V_b}^2$$

Eq. 4.8 EN 1991-1-4
Extreme wind pressure

Equation:

$$500 = 1.554 \times {V_b}^2 \rightarrow solving\ gives \rightarrow V_b = 17.94\ m/s$$

Characteristic wind speed

Wind speed flattened, open area at 10m height

$$K_r = 0.19 \times \left(\frac{z_0}{0.05}\right)^{0.07} = 0.19 \times \left(\frac{0.01}{0.05}\right)^{0.07} = 0.170$$

Eq. 4.5 EN 1991-1-4
Terrain factor for coastal area

$$C_r = K_r \times \ln\left(\frac{z}{z_0}\right) = 0.170 \times \ln\left(\frac{4.0}{0.01}\right) = 1.017$$

Eq. 4.4 EN 1991-1-4
Roughness factor at 3.5m height
Z = 4.0 > Z_{min} = 1

$$V_m = C_r \times V_b = 1.017 \times V_b$$

Eq. 4.3 EN 1991-1-4
Average wind speed at height

$$\sigma_v = K_r \times V_b = 0.170 \times V_b$$

Eq. 4.6 EN 1991-1-4
Standard deviation of turbulence

$$L_v = \frac{\sigma_v}{V_m} = \frac{0.170 \times V_b}{1.017 \times V_b} = 0.167$$

Eq. 4.7 EN 1991-1-4
Turbulence intensity

$$Q_p = (1 + 7 \times L_v) \times {}^{1}/_{2} \times \rho \times {V_m}^2 = 1.402 \times {V_b}^2$$

Eq. 4.8 EN 1991-1-4
Extreme wind pressure

Equation:

$$500 = 1.402 \times {V_b}^2 \rightarrow solving\ gives \rightarrow V_b = 18.89\ m/s$$

Characteristic wind speed

Wind speed rural area at 10m height

$$K_r = 0.19 \times \left(\frac{z_0}{0.05}\right)^{0.07} = 0.19 \times \left(\frac{0.05}{0.05}\right)^{0.07} = 0.190$$

Eq. 4.5 EN 1991-1-4
Terrain factor for unbuilt area

$$C_r = K_r \times \ln\left(\frac{z}{z_0}\right) = 0.190 \times \ln\left(\frac{4.0}{0.05}\right) = 0.833$$

Eq. 4.4 EN 1991-1-4
Roughness factor at 4m height
Z = 4.0 > Z_{min} = 2

$$V_m = C_r \times V_b = 0.833 \times V_b$$

Eq. 4.3 EN 1991-1-4
Average wind speed at height

$$\sigma_v = K_r \times V_b = 0.190 \times V_b$$

Eq. 4.6 EN 1991-1-4
Standard deviation of turbulence

$$L_v = \frac{\sigma_v}{V_m} = \frac{0.190 \times V_b}{0.833 \times V_b} = 0.228$$

Eq. 4.7 EN 1991-1-4
Turbulence intensity

$$Q_p = (1 + 7 \times L_v) \times {}^1/_2 \times \rho \times {V_m}^2 = 1.125 \times {V_b}^2$$

Eq. 4.8 EN 1991-1-4
Extreme wind pressure

Equation:

$$500 = 1.125 \times {V_b}^2 \rightarrow solving\ gives \rightarrow V_b = 21.08\ m/s$$

Characteristic wind speed

Wind speed village at 10m height

$$K_r = 0.19 \times \left(\frac{z_0}{0.05}\right)^{0.07} = 0.19 \times \left(\frac{0.3}{0.05}\right)^{0.07} = 0.215$$

Eq. 4.5 EN 1991-1-4
Terrain factor for unbuilt area

$$C_r = K_r \times \ln\left(\frac{z}{z_0}\right) = 0.215 \times \ln\left(\frac{5}{0.3}\right) = 0.606$$

Eq. 4.4 EN 1991-1-4
Roughness factor at 7m height
Z = Z_{min} = 5

$$V_m = C_r \times V_b = 0.606 \times V_b$$

Eq. 4.3 EN 1991-1-4
Average wind speed at height

$$\sigma_v = K_r \times V_b = 0.215 \times V_b$$

Eq. 4.6 EN 1991-1-4
Standard deviation of turbulence

$$L_v = \frac{\sigma_v}{V_m} = \frac{0.215 \times V_b}{0.606 \times V_b} = 0.355$$

Eq. 4.7 EN 1991-1-4
Turbulence intensity

$$Q_p = (1 + 7 \times L_v) \times {}^1/_2 \times \rho \times {V_m}^2 = 0.801 \times {V_b}^2$$

Eq. 4.8 EN 1991-1-4
Extreme wind pressure

Equation:

$$500 = 0.801 \times {V_b}^2 \rightarrow solving\ gives \rightarrow V_b = 24.99\ m/s$$

Characteristic wind speed

Wind speed city at 10m height

$$K_r = 0.19 \times \left(\frac{z_0}{0.05}\right)^{0.07} = 0.19 \times \left(\frac{1}{0.05}\right)^{0.07} = 0.234$$

Eq. 4.5 EN 1991-1-4
Terrain factor for unbuilt area

$$C_r = K_r \times \ln\left(\frac{z}{z_0}\right) = 0.234 \times \ln\left(\frac{10}{1}\right) = 0.540$$

Eq. 4.4 EN 1991-1-4
Roughness factor at 7m height
Z = Z_{min} =10

$$V_m = C_r \times V_b = 0.540 \times V_b$$

Eq. 4.3 EN 1991-1-4
Average wind speed at height

$$\sigma_v = K_r \times V_b = 0.234 \times V_b$$

Eq. 4.6 EN 1991-1-4
Standard deviation of turbulence

$$L_v = \frac{\sigma_v}{V_m} = \frac{0.234 \times V_b}{0.540 \times V_b} = 0.434$$

Eq. 4.7 EN 1991-1-4
Turbulence intensity

$$Q_p = (1 + 7 \times L_v) \times {}^1/_2 \times \rho \times {V_m}^2 = 0.735 \times {V_b}^2$$

Eq. 4.8 EN 1991-1-4
Extreme wind pressure

Equation:

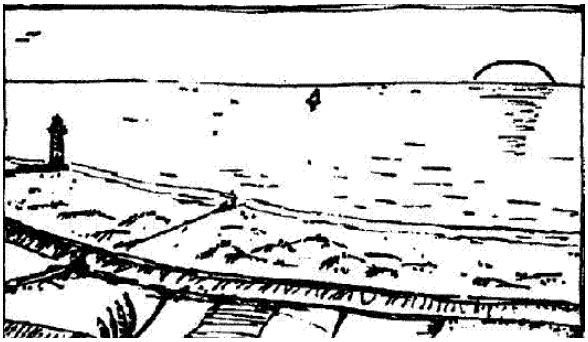
$$500 = 0.735 \times {V_b}^2 \rightarrow solving\ gives \rightarrow V_b = 26.08\ m/s$$

Characteristic wind speed

Terrain categories

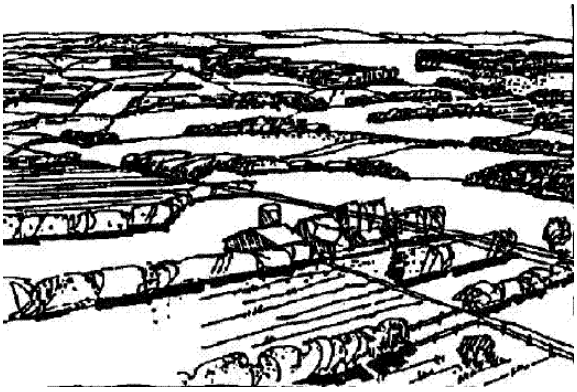
Default European terrain categories (not Country specific)

0: Coastal area:

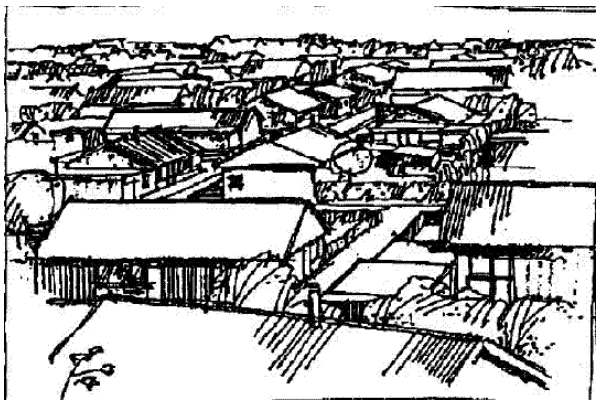


I: Flattened, open area:

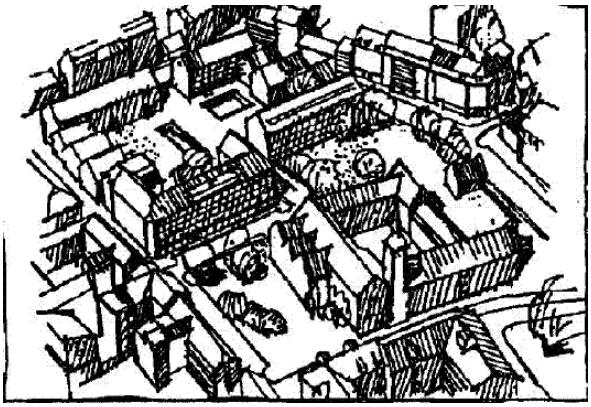
II: Rural area



III: Village



IV: City



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H.1. Project description

The principle of a stretchtent is based on a rectangular piece of stretchable membrane with a reinforcement along the boundary. The membrane is supported by poles, both at the edge and under the membrane. The side poles are stabilized by guy ropes and belts. The poles do not require a fixed position which ensures a freedom of shape.

Tentech B.V. has performed a static analysis of three tents – 10x10m, 10x15m and 10x20m always assumed to have stormbelts. Further chapters include material and cross-section description, calculation method, load cases and combinations, results, element checks, anchor and ballast calculations. These chapters present calculation results valid for Europe according to EN 13782.

As an exception, two additions to the static analysis are made (see I and J on pages 70 and 80 respectively):

1. For use only in Netherlands – element check for reduced wind speeds.

2. For use in France or countries following French CTS – element check for combined wind and snow loads

For use in other countries than Netherlands or France, the statical analysis must be considered without its additions. When relevant information is mentioned for these specific cases either [NL] or [FR] immediately follows this information. This information is not considered while making the base calculations. Addition J on page 80 must always be considered for use in France.

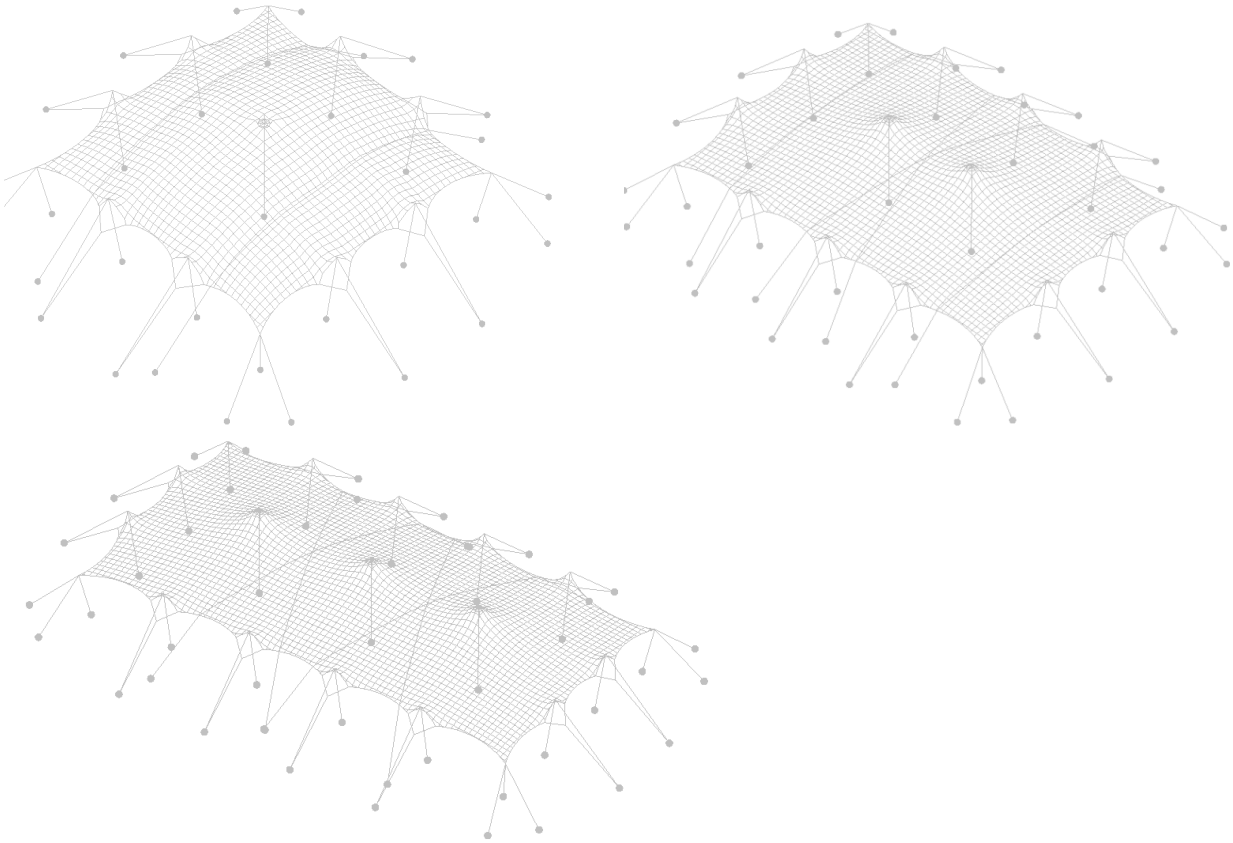


Figure 1. 10x10m, 10x15m and 10x20m models

H.2. Materials

H.2.1 Fabric

Design tensile strength	f_d	f_{tk} / γ_m	art 8.6 EN 13782
Characteristic tensile strength (warp)	$f_{tk,\ warp}$		
Characteristic tensile strength (weft)	$f_{tk,\ weft}$		
Material factor – global, permanent load	γ_m	2.5	tbl 4. EN13782
Material factor – global, short duration load	γ_m	2.0	tbl 4. EN13782

Table 1. Used symbols, codes and standard for fabric materials

Material	Type	Weight	$f_{rd;warp;perm}$	$f_{rd;\ weft;perm}$	$f_{rd;\ warp;short}$	$f_{rd:\ weft;short}$
Sioen RP5639	-	≈ 730 gr/m^2	9.6 kN/m	7.2 kN/m	12.0 kN/m	9.0 kN/m

Table 2. Used fabrics

H.2.2 Guy ropes

Design resistance	F_{rd}	R_m / γ_{m1}	art 10.2. EN13782
Characteristic tensile strength	R_m		art 10.2. EN13782
Material factor	$\gamma_{m1 < 12mm}$ $\gamma_{m1 > 12mm}$	4.0 3.3	art 10.3. EN13782 art 10.3. EN13782

Table 3. Used symbols, codes and standard for rope materials

Material	Cross section	Breaking strength	Rm	F_{rd}
8mm Polyester Braid rope	ø 8 mm	≥ 900 daN	9.0 kN	2.25 kN

Table 4. Used guy ropes

H.2.3 Belts

Design resistance	F_{rd}	R_m / γ_{m1}	art 10.2. EN13782
Characteristic breaking strength	R_m	LC x γ_{m2}	art 10.2. EN13782
Lashing capacity	LC		Conform EN 12195-2
Material factor	γ_{m1}	2.0	art 10.2. EN13782
Material factor	γ_{m2}	3.0	EN1492-1

Table 5. Used symbols, codes and standard for belt materials

Material	LC	Rm	F_{rd}
Belt [PES] EN 12195-2, 50mm	1000 daN 10 kN	3000 daN 30 kN	15 kN

Table 6. Used belts

H.2.4 Wood

Material	γ_{m1}	1.3	tbl. 2.3. EN 1995-1-1

Table 7. Used material factors

Material	Weight	$E_{0.05}$	F_{c0k}	F_{mk}
Wood, Spruce, C18	320 kg/m^3	6.0 kN/m^2	18 N/mm^2	18 N/mm^2

Table 8. Used wooden materials

H.3. Cross sections

Profile	Material	Ø mm	G kg/m	A mm^2	I_y mm^4	$W_{el;y}$ mm^3
Ø ≈ 100 mm *	Wood C18	100	2.51	7854	49087839	98175
Ø ≈ 75 mm *	Wood C18	75	1.41	4418	1553156	41417
Ø ≈ 70 mm *	Wood C18	70	1.23	3848	1178588	33674

Table 9. Used cross sections

* the average diameter, as a minimum required at the middle of the pole.

H.4. Calculation method

H.4.1 Modelling

The analysis of the structure is performed with the software package EASY FCS supplied by TECHNET GmbH, Berlin. This software is specially developed for structures with large deformability, such as membrane structures. The performed analysis is a full non-linear second order analysis.

The membrane structure is modelled in 3D. The membrane is modelled as a cable net structure and is supported by poles. These centre poles will be stabilized by the tensioned membrane. The side poles are stabilized and tied down by tension belts or ropes, which are attached to ground anchors or ballast.

The membrane edges are reinforced. They consist of multiple layers of fabric about 10cm wide with additional patches where the lugs are placed. Storm belts are required constantly and placed in the valleys between the centre poles.

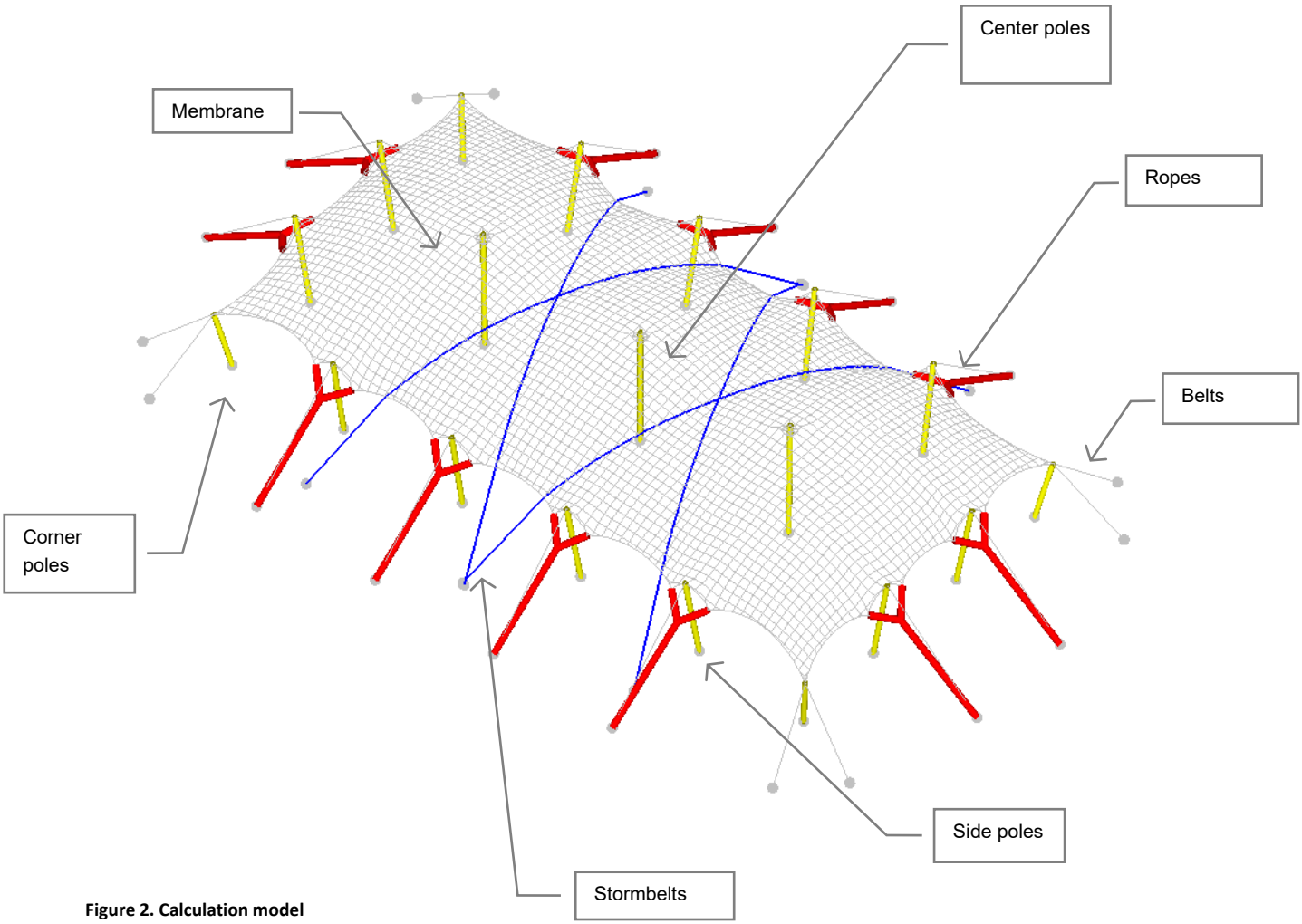


Figure 2. Calculation model

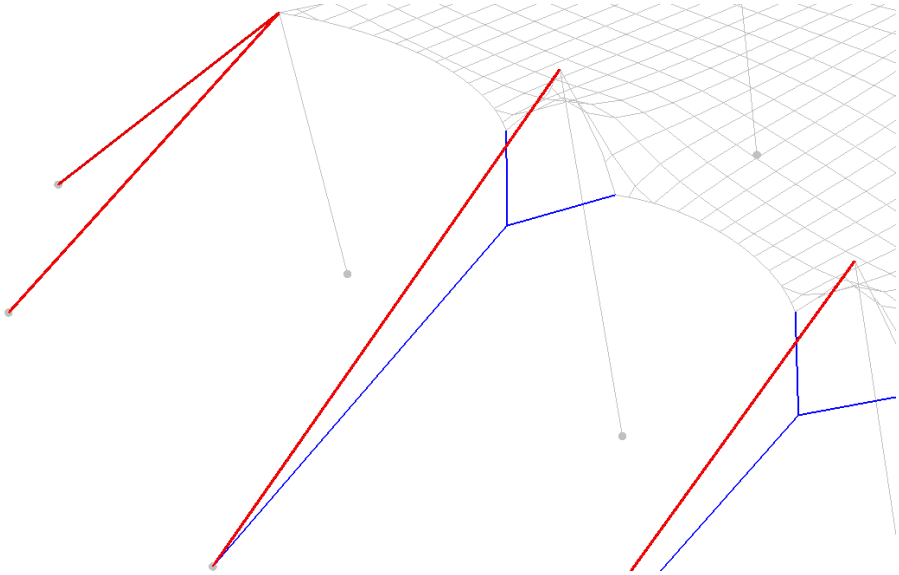


Figure 3. Principle of ties

Ties stabilize the tent and create the shape of the stretchable membrane. Guy ropes (see blue above) transfer the forces to the ground when wind suction is present. Belts (see red above) help transfer the pressure forces.

H.4.2 Structural behaviour of membrane structures

Since the fabric is a highly deformable material, it is only possible to calculate stresses and deformations with a non-linear method. FEM-software EASY is used to perform these calculations. Because of the non-linearity of the calculations the partial safety factors are not applied beforehand, since the deformations will be greater due to these safety factors, resulting in lower stresses in the fabric. See figure below.

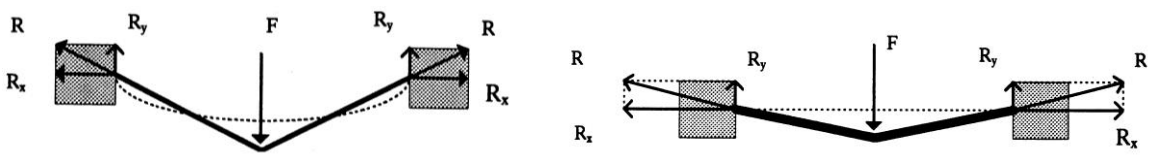


Figure 4. membrane behavior

As a membrane structure is a form-active structure, article 6.3 (4) b) of the EN-1990:2002 applies:

> *When the action effect increases less than the action, the partial factor γ_F should be applied to the action effect of the representative value of the action.*

This means that no load factors are applied on the load beforehand, but afterwards.

H.4.3 Load combinations

H.4.3.1 Fundamental - Ultimate limit state

For determination of strength and to check elements and connections ultimate limit state is used.

	One variable load	Multiple variable loads
Unfavorable permanent load	$1.35 \times G + 1.5 \times Q$	$1.35 \times G + \sum 1.35 \times Q_i$
Favorable permanent load	$1.0 \times G + 1.5 \times Q$	$1.0 \times G + \sum 1.35 \times Q_i$

Table 10. Load combinations according to EN 13782

This means that the following load combinations will be checked/calculated:

1. 1.35 x Own weight + 1.5 x Wind load
2. 1.35 x Own weight + 1.5 x Snow load
3. 1.35 x Own weight + 1.35 x Wind load + 1.35 x Snow load [FR]

H.4.3.2 Safety against overturning, sliding and uplifting - Ultimate limit state

For determination and check of the needed ballast weight and/or anchors ultimate limit state is used

	One or multiple variable loads
Unfavorable permanent load	$1.1 \times G + 1.2 \times Q_{wind} + \sum 1.3 \times Q_i$
Favorable permanent load	$1.0 \times G + 1.2 \times Q_{wind} + \sum 1.3 \times Q_i$

Table 11. Load combinations according to EN 13782

This means the following load combinations will be checked/calculated:

1. 1.0 x Own weight + 1.2 x Wind load
2. 1.0 x Own weight + 1.2 x Wind load + 1.3 x Snow load [FR]

H.5. Load cases

H.5.1 Own weight

The own weight of the fabric is 730 g/m^2 = 0.0073 kN/m^2 and is considered automatically within EASY software.

H.5.2 Pretension

The structure will be pretensioned with guy ropes and belts. With a ratchet it is possible to achieve 2-3 kN force in corner belts. Approximately 2kN force is achieved in side ropes. The tensile force in ropes and belts results in a membrane stress of approximately 0.50 kN/m^2. Higher membrane forces can be present near connection points due to the stretchable nature of the fabric.

H.5.3 Conventional / snow load

Conventional load according to EN 13782: The stability shall be checked with a conventional vertical load of 0.1 kN/m^2. This can be seen as a snow load of 0.1 kN/m^2 (4cm) according to the French CTS, where snow load must be combined with wind load. This condition is tackled in J. Addition 2 – element check for combined wind and snow load on page 80.

H.5.4 User load

A user defined load (for light, sound and/or decoration purposes) is 25 kg per pole and is added after the analysis while performing element checks.

H.5.5 Wind load

H.5.5.1 Wind pressure

Wind load according to EN 13782, 7.4.2.2:
q_p (z_e) of 0.50 kN/m^2 if the height of the structure does not exceed 5m.

Wind load can be reduced for use in the Netherlands. A reduction factor α=0.7 is applied, which leads to **q_p (z_e) of 0.25 kN/m^2 [NL],** this is tackled in I. Addition 1 – element check for reduced wind speeds [NL]

H.5.5.2 Wind shape values (Cp-factors)

Two different wind situations are reviewed for the membrane:

1. The whole tent is subjected to wind suction (Cp values given in EN 13782)
2. The whole tent is subjected to wind pressure (Cp values given in EN 13782)

<u>Wind suction</u>

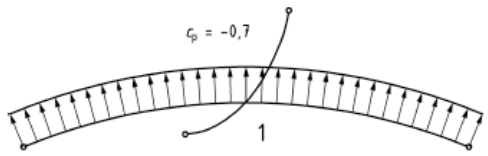


Figure 5. C_p values for rectangle structures EN 13782

P_w	$p_{w,rep}$	
500 N/m^2	-0.7 x 0.500 = **-0.350 kN/m^2**	
350 N/m^2	-0.7 x 0.250 = **-0.175 kN/m^2**	[NL]

<u>Wind pressure</u>

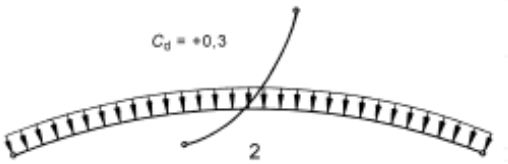


Figure 6. C_p values for rectangle structures EN 13782

P_w	$p_{w,rep}$
500 N/m^2	0.3 x 0.500 = **0.150 kN/m^2**

H.6. Calculation results

H.6.1 Listing of calculated load combinations

LC1 = Pretension
LC2 = Own weight
LC3 = Snow load
LC4 = Wind pressure
LC5 = Wind suction
LC6 = Wind suction reduced

The following load combinations are considered:
partial safety factors are added after the static analysis (see H.4.2).

	LC1	LC2	LC3	LC4	LC5	LC6 [NL]
CO1	1 x	1 x				
CO2	1 x	1 x	1 x			
CO3	1 x	1 x		1 x		
CO4	1 x	1 x			1 x	
CO5 [NL]	1 x	1 x				1 x
CO6 [FR]	1 x	1 x	1 x	1 x		

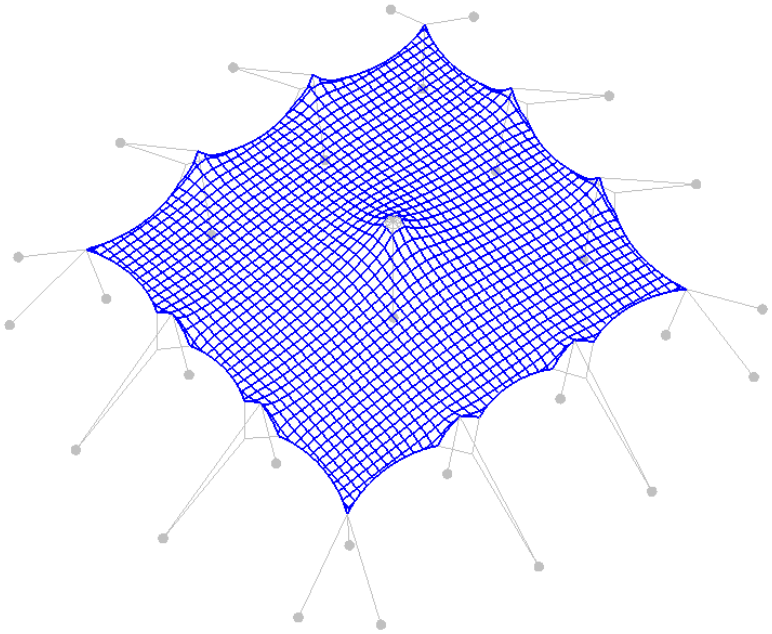
Table 12. Combinations (CO)

The results for load combinations CO5 and CO6 are mentioned in the upcoming chapter but considered in calculations only in chapters I and J on pages 70 and 80 respectively.

H.6.2 Overview: Global results of static analysis

H.6.2.1 Membrane

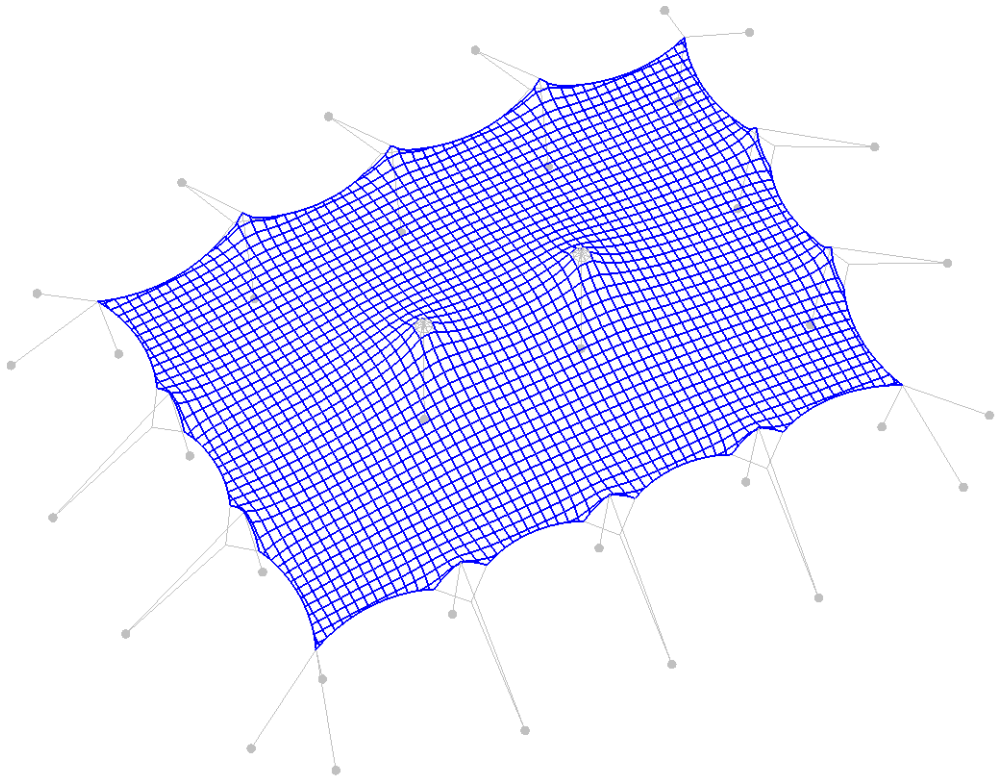
H.6.2.1.1. 10x10m model



		Load combination	F_{rep}	Pag.
Warp		CO1. Own weight + pretension	0.95 kN/m	119
		CO2. Own weight + pretension + snow	2.42 kN/m	123
		CO3. Own weight + pretension + wind pressure	3.09 kN/m	127
	Max	CO4. Own weight + pretension + wind suction	3.39 kN/m	131
		CO5. Own weight + pretension + wind suction reduced [NL]	2.49 kN/m	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.55 kN/m	139
Weft		CO1. Own weight + pretension	0.91 kN/m	119
		CO2. Own weight + pretension + conventional / snow	2.11 kN/m	123
	Max	CO3. Own weight + pretension + wind pressure	2.62 kN/m	127
		CO4. Own weight + pretension + wind suction	2.18 kN/m	131
		CO5. Own weight + pretension + wind suction reduced [NL]	1.99 kN/m	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.79 kN/m	139
Edge		CO1. Own weight + pretension	1.76 kN	119
		CO2. Own weight + pretension + conventional / snow	2.13 kN	123
		CO3. Own weight + pretension + wind pressure	2.44 kN	127
	Max	CO4. Own weight + pretension + wind suction	3.41 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	2.68 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	2.85 kN	139

Table 13. Leading forces in membrane – 10x10m

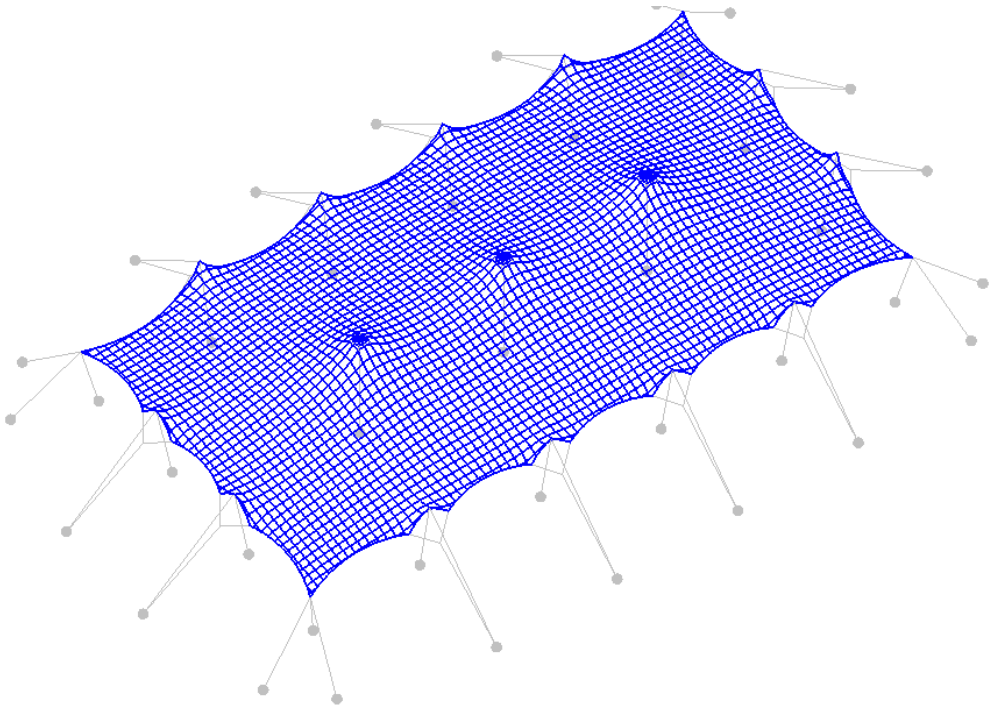
H.6.2.1.2. 10x15m model



		Load combination	F_{rep}	Pag.
Warp		CO1. Own weight + pretension	0.91 kN/m	143
		CO2. Own weight + pretension + snow	2.59 kN/m	147
	Max	CO3. Own weight + pretension + wind pressure	3.35 kN/m	151
		CO4. Own weight + pretension + wind suction	3.13 kN/m	155
		CO5. Own weight + pretension + wind suction reduced [NL]	2.51 kN/m	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.97 kN/m	163
Weft		CO1. Own weight + pretension	0.89 kN/m	143
		CO2. Own weight + pretension + conventional / snow	2.18 kN/m	147
	Max	CO3. Own weight + pretension + wind pressure	2.93 kN/m	151
		CO4. Own weight + pretension + wind suction	2.27 kN/m	155
		CO5. Own weight + pretension + wind suction reduced [NL]	2.48 kN/m	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.24 kN/m	163
Edge		CO1. Own weight + pretension	1.90 kN	143
		CO2. Own weight + pretension + conventional / snow	2.35 kN	147
		CO3. Own weight + pretension + wind pressure	2.74 kN	151
	Max	CO4. Own weight + pretension + wind suction	3.55 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	3.17 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.19 kN	163

Table 14. Leading forces in membrane – 10x15m

H.6.2.1.3. 10x20m model

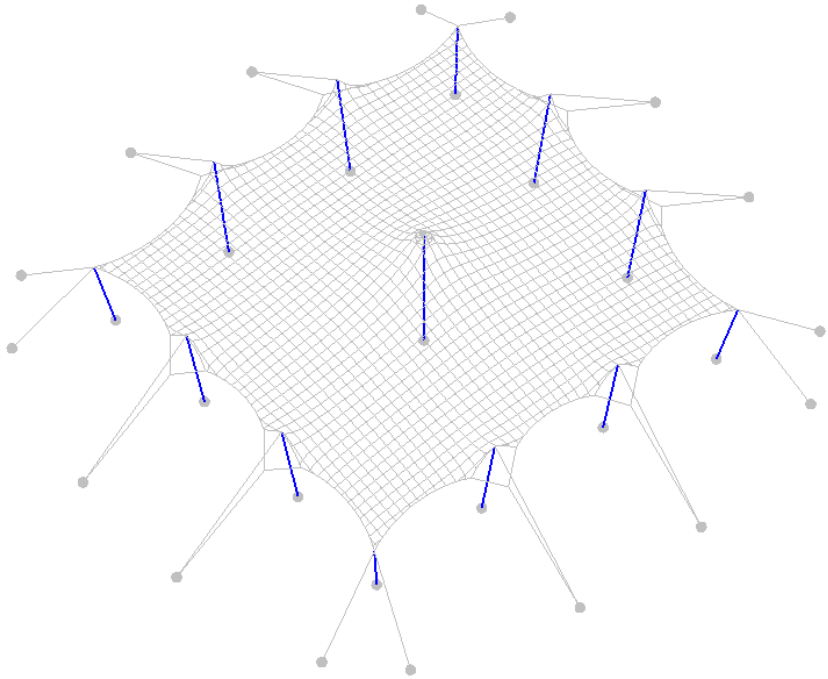


		Load combination	F_{rep}	Pag.
Warp		CO1. Own weight + pretension	0.95 kN/m	167
		CO2. Own weight + pretension + snow	2.63 kN/m	171
		CO3. Own weight + pretension + wind pressure	3.41 kN/m	175
	Max	CO4. Own weight + pretension + wind suction	4.45 kN/m	179
		CO5. Own weight + pretension + wind suction reduced [NL]	2.53 kN/m	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	5.01 kN/m	187
Weft		CO1. Own weight + pretension	0.88 kN/m	167
		CO2. Own weight + pretension + conventional / snow	2.16 kN/m	171
	Max	CO3. Own weight + pretension + wind pressure	2.94 kN/m	175
		CO4. Own weight + pretension + wind suction	2.89 kN/m	179
		CO5. Own weight + pretension + wind suction reduced [NL]	2.68 kN/m	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.20 kN/m	187
Edge		CO1. Own weight + pretension	1.80 kN	167
		CO2. Own weight + pretension + conventional / snow	2.26 kN	171
		CO3. Own weight + pretension + wind pressure	2.67 kN	175
	Max	CO4. Own weight + pretension + wind suction	4.43 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	3.43 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.16 kN	187

Table 15. Leading forces in membrane – 10x20m

H.6.2.2 Poles

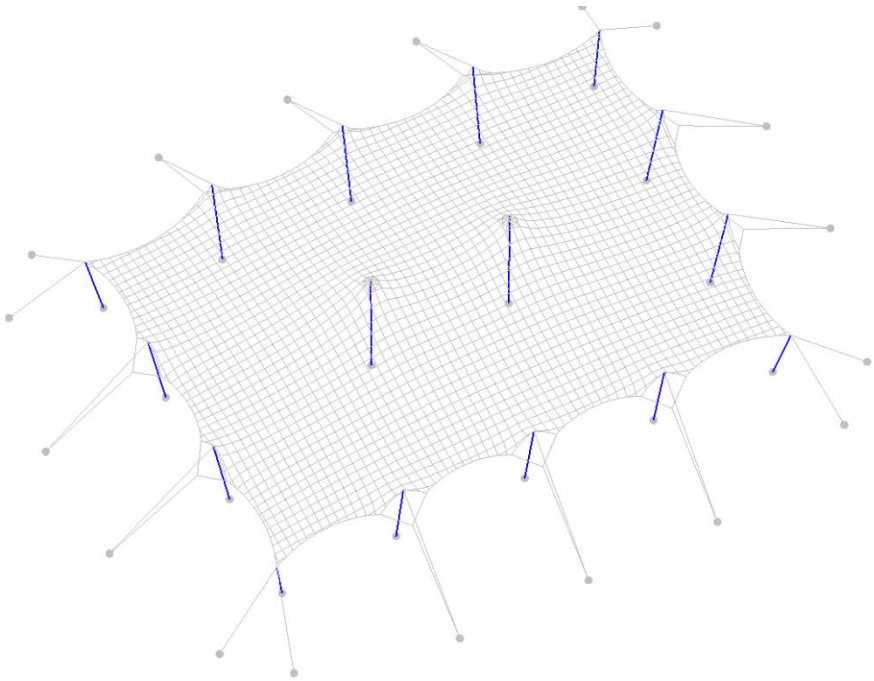
H.6.2.2.1. 10x10m model



		Load combination	F_{rep}	Pag.
Main poles		CO1. Own weight + pretension	-2.12 kN	119
		CO2. Own weight + pretension + snow	-5.41 kN	123
	Max	CO3. Own weight + pretension + wind pressure	-6.95 kN	127
		CO4. Own weight + pretension + wind suction	-0.05 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	-0.08 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	-10.32 kN	139
Side poles		CO1. Own weight + pretension	-1.30 kN	119
		CO2. Own weight + pretension + conventional / snow	-2.43 kN	123
	Max	CO3. Own weight + pretension + wind pressure	-3.13 kN	127
		CO4. Own weight + pretension + wind suction	-2.02 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	-0.83 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	-4.33 kN	139
Corner poles		CO1. Own weight + pretension	-2.64 kN	119
		CO2. Own weight + pretension + conventional / snow	-3.38 kN	123
		CO3. Own weight + pretension + wind pressure	-3.95 kN	127
	Max	CO4. Own weight + pretension + wind suction	-4.52 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	-3.43 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	-4.75 kN	139

Table 16. Leading forces in poles – 10x10m model

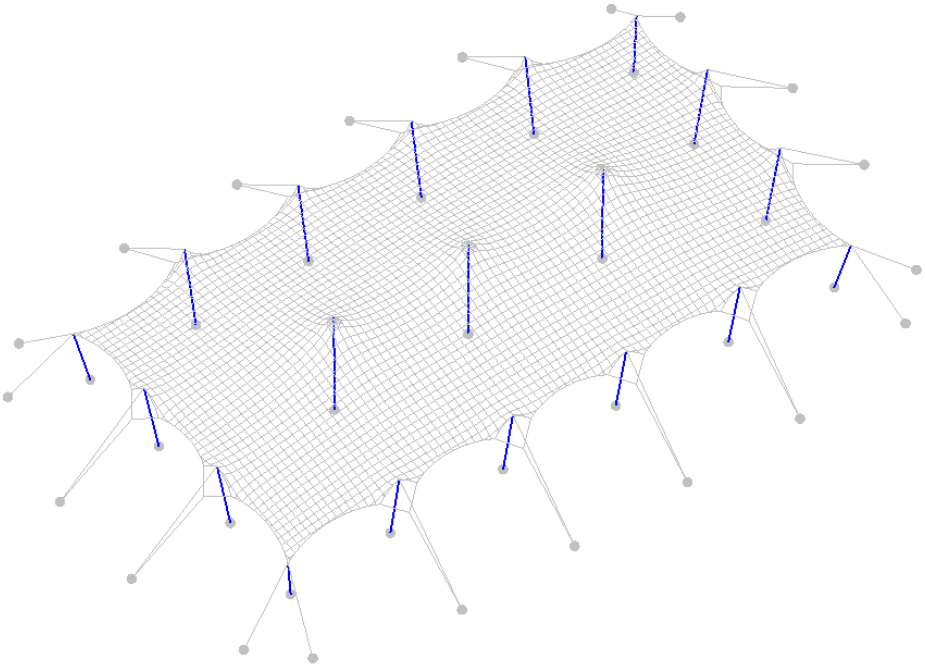
H.6.2.2.2. 10x15m model



		Load combination	F_{rep}	Pag.
Main poles		CO1. Own weight + pretension	-1.74 kN	143
		CO2. Own weight + pretension + snow	-4.96 kN	147
	Max	CO3. Own weight + pretension + wind pressure	-6.49 kN	151
		CO4. Own weight + pretension + wind suction	0.06 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	-0.02 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	-9.78 kN	163
Side poles		CO1. Own weight + pretension	-1.37 kN	143
		CO2. Own weight + pretension + conventional / snow	-2.74 kN	147
	Max	CO3. Own weight + pretension + wind pressure	-3.60 kN	151
		CO4. Own weight + pretension + wind suction	-2.47 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	-0.84 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	-4.99 kN	163
Corner poles		CO1. Own weight + pretension	-2.86 kN	143
		CO2. Own weight + pretension + conventional / snow	-3.81 kN	147
		CO3. Own weight + pretension + wind pressure	-4.56 kN	151
	Max	CO4. Own weight + pretension + wind suction	-4.77 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	-3.87 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	-5.50 kN	163

Table 17. Leading forces in poles – 10x15m model

H.6.2.2.3. 10x20m model

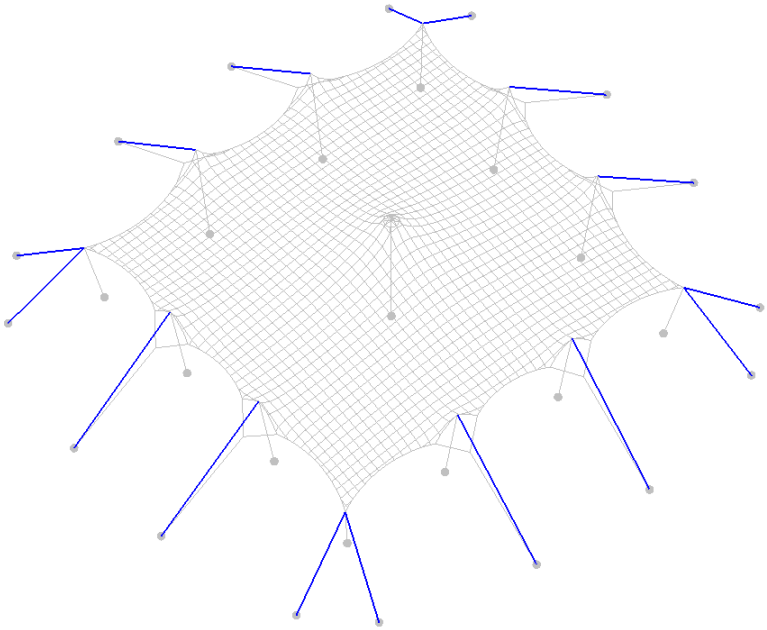


		Load combination	F_{rep}	Pag.
Main poles		CO1. Own weight + pretension	-1.84 kN	167
		CO2. Own weight + pretension + snow	-5.15 kN	171
	Max	CO3. Own weight + pretension + wind pressure	-6.75 kN	175
		CO4. Own weight + pretension + wind suction	-0.06 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	0.03 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	-10.07 kN	187
Side poles		CO1. Own weight + pretension	-1.35 kN	167
		CO2. Own weight + pretension + conventional / snow	-2.69 kN	171
	Max	CO3. Own weight + pretension + wind pressure	-3.55 kN	175
		CO4. Own weight + pretension + wind suction	-2.21 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	-0.80 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	-4.88 kN	187
Corner poles		CO1. Own weight + pretension	-2.73 kN	167
		CO2. Own weight + pretension + conventional / snow	-3.67 kN	171
	Max	CO3. Own weight + pretension + wind pressure	-4.43 kN	175
		CO4. Own weight + pretension + wind suction	-4.31 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	-3.63 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	-5.40 kN	187

Table 18. Leading forces in poles – 10x20m model

H.6.2.3 Belts

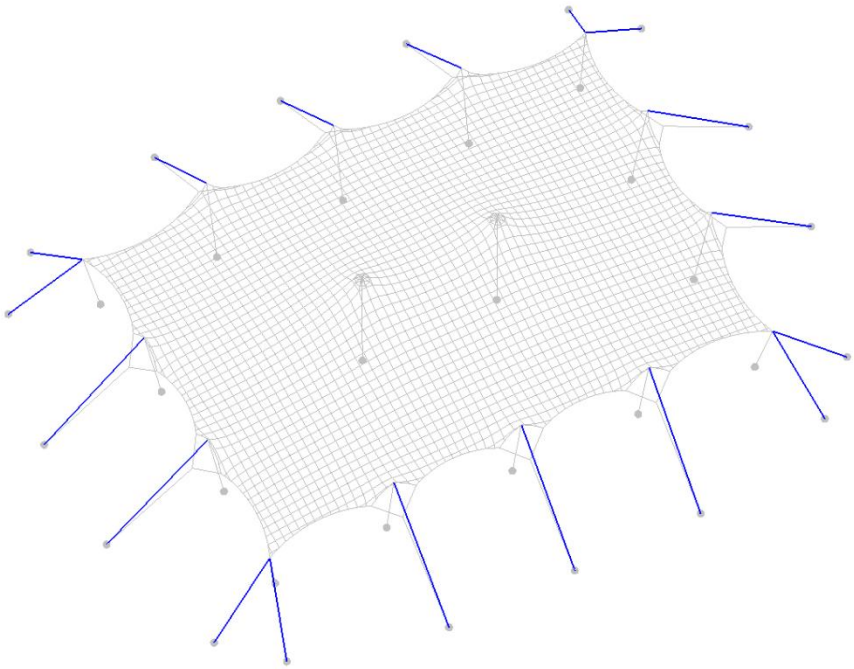
H.6.2.3.1. 10x10m model



		Load combination	F_{rep}	Pag.
Corner belts		CO1. Own weight + pretension	2.10 kN	119
		CO2. Own weight + pretension + snow	2.50 kN	123
		CO3. Own weight + pretension + wind pressure	2.86 kN	127
	Max	CO4. Own weight + pretension + wind suction	3.94 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	3.19 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.33 kN	139
Belts – side		CO1. Own weight + pretension	0.12 kN	119
		CO2. Own weight + pretension + conventional / snow	0.47 kN	123
	Max	CO3. Own weight + pretension + wind pressure	0.70 kN	127
		CO4. Own weight + pretension + wind suction	0.35 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	0.16 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	1.13 kN	139

Table 19. Leading forces in belts – 10x10m model

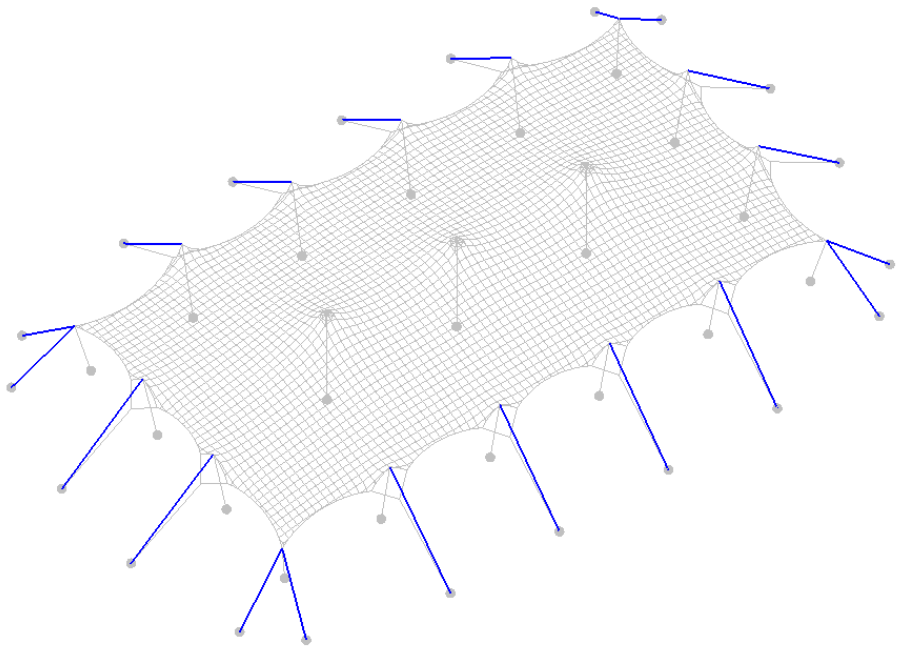
H.6.2.3.2. 10x15m model



		Load combination	F_{rep}	Pag.
Corner belts		CO1. Own weight + pretension	2.31 kN	143
		CO2. Own weight + pretension + snow	2.85 kN	147
		CO3. Own weight + pretension + wind pressure	3.28 kN	151
	Max	CO4. Own weight + pretension + wind suction	4.22 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	3.51 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.81 kN	163
Belts – long side		CO1. Own weight + pretension	0.14 kN	143
		CO2. Own weight + pretension + conventional / snow	0.51 kN	147
	Max	CO3. Own weight + pretension + wind pressure	0.81 kN	151
		CO4. Own weight + pretension + wind suction	0.50 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	0.18 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	1.30 kN	163
Belts – short side		CO1. Own weight + pretension	0.12 kN	143
		CO2. Own weight + pretension + conventional / snow	0.56 kN	147
	Max	CO3. Own weight + pretension + wind pressure	0.84 kN	151
		CO4. Own weight + pretension + wind suction	0.22 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	0.18 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	1.37 kN	163

Table 20. Leading forces in belts – 10x15m model

H.6.2.3.3. 10x20m model

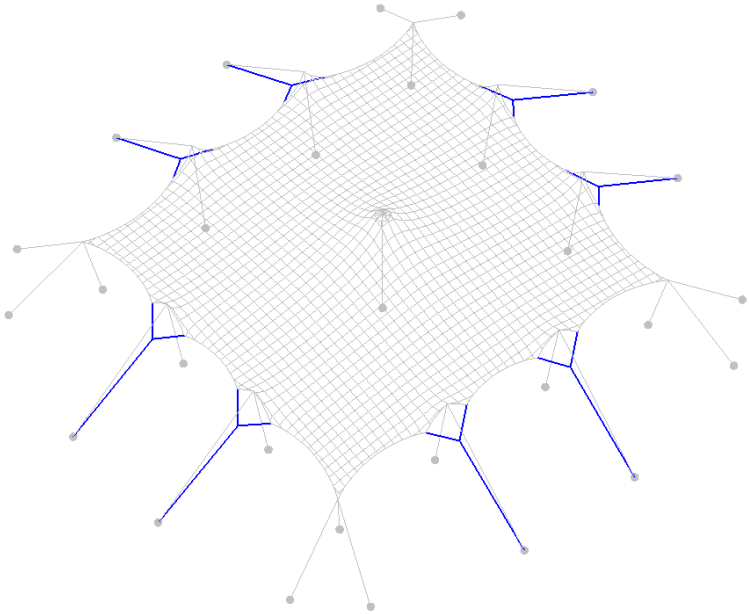


		Load combination	F_{rep}	Pag.
Corner belts		CO1. Own weight + pretension	2.33 kN	167
		CO2. Own weight + pretension + snow	2.95 kN	171
		CO3. Own weight + pretension + wind pressure	3.44 kN	175
	Max	CO4. Own weight + pretension + wind suction	4.43 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	3.44 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.01 kN	187
Belts – long side		CO1. Own weight + pretension	0.22 kN	167
		CO2. Own weight + pretension + conventional / snow	0.70 kN	171
	Max	CO3. Own weight + pretension + wind pressure	1.01 kN	175
		CO4. Own weight + pretension + wind suction	0.57 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	0.26 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	1.50 kN	187
Belts – short side		CO1. Own weight + pretension	0.13 kN	167
		CO2. Own weight + pretension + conventional / snow	0.55 kN	171
	Max	CO3. Own weight + pretension + wind pressure	0.85 kN	175
		CO4. Own weight + pretension + wind suction	0.13 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	0.13 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	1.35 kN	187

Table 21. Leading forces in belts – 10x20m model

H.6.2.4 Guy ropes

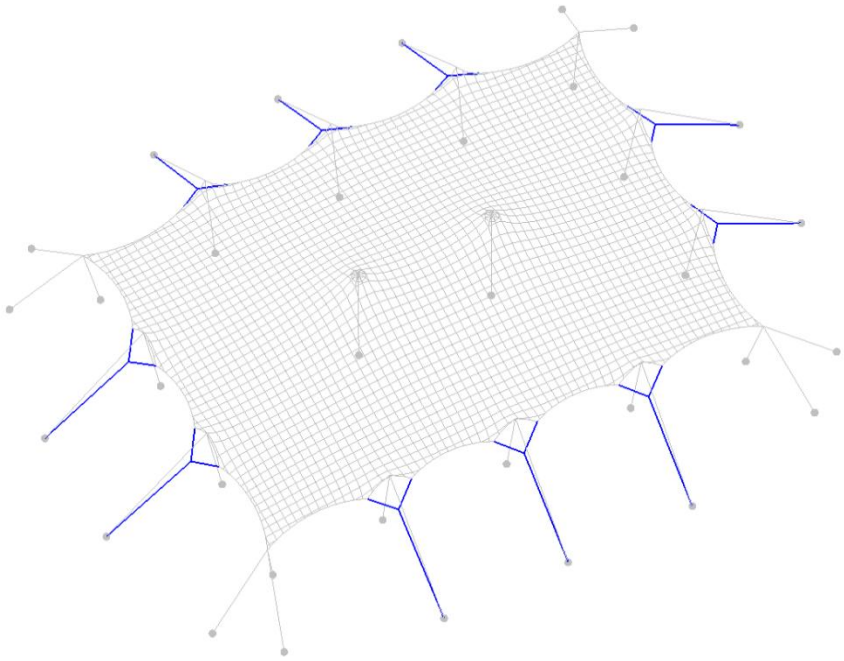
H.6.2.4.1. 10x10m model



		Load combination	F_{rep}	Pag.
Combined rope – side		CO1. Own weight + pretension	1.83 kN	119
		CO2. Own weight + pretension + snow	2.12 kN	123
		CO3. Own weight + pretension + wind pressure	2.41 kN	127
	Max	CO4. Own weight + pretension + wind suction	4.83 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	3.64 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	2.76 kN	139
V-ropes –side		CO1. Own weight + pretension	1.40 kN	119
		CO2. Own weight + pretension + conventional / snow	1.63 kN	123
		CO3. Own weight + pretension + wind pressure	1.84 kN	127
	Max	CO4. Own weight + pretension + wind suction	3.51 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	2.72 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	2.10 kN	139

Table 22. Leading forces in ropes – 10x10m model

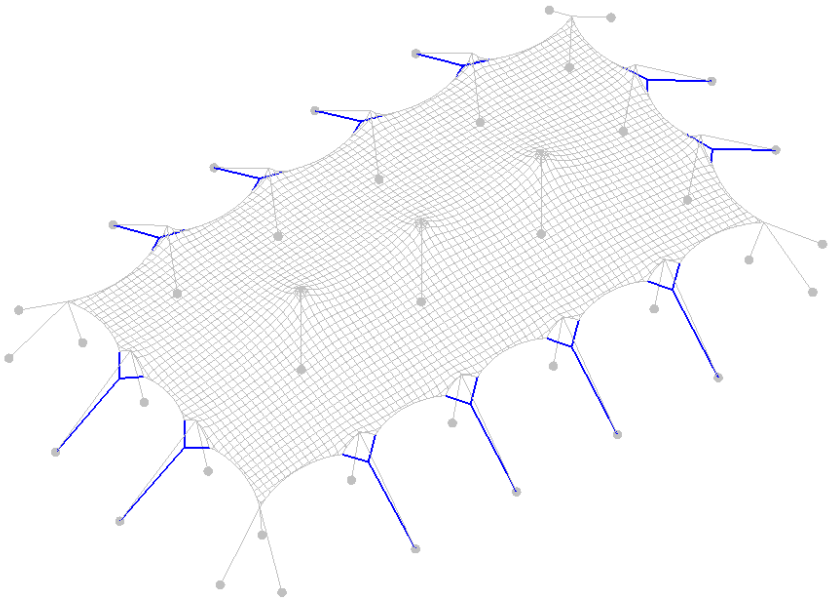
H.6.2.4.2. 10x15m model



		Load combination	F_{rep}	Pag.
Combined rope – long side		CO1. Own weight + pretension	2.11 kN	143
		CO2. Own weight + pretension + snow	2.59 kN	147
		CO3. Own weight + pretension + wind pressure	3.04 kN	151
	Max	CO4. Own weight + pretension + wind suction	4.70 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	4.66 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.50 kN	163
V-ropes – long side		CO1. Own weight + pretension	1.53 kN	143
		CO2. Own weight + pretension + conventional / snow	1.83 kN	147
		CO3. Own weight + pretension + wind pressure	2.11 kN	151
	Max	CO4. Own weight + pretension + wind suction	3.38 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	3.30 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	2.39 kN	163
Combined rope – short side		CO1. Own weight + pretension	1.92 kN	143
		CO2. Own weight + pretension + conventional / snow	2.38 kN	147
		CO3. Own weight + pretension + wind pressure	2.77 kN	151
	Max	CO4. Own weight + pretension + wind suction	5.01 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	4.04 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.21 kN	163
V-ropes – short side		CO1. Own weight + pretension	1.45 kN	143
		CO2. Own weight + pretension + conventional / snow	1.80 kN	147
		CO3. Own weight + pretension + wind pressure	2.09 kN	151
	Max	CO4. Own weight + pretension + wind suction	3.64 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	2.94 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	2.41 kN	163

Table 23. Leading forces in ropes – 10x15m model

H.6.2.4.3. 10x20m model

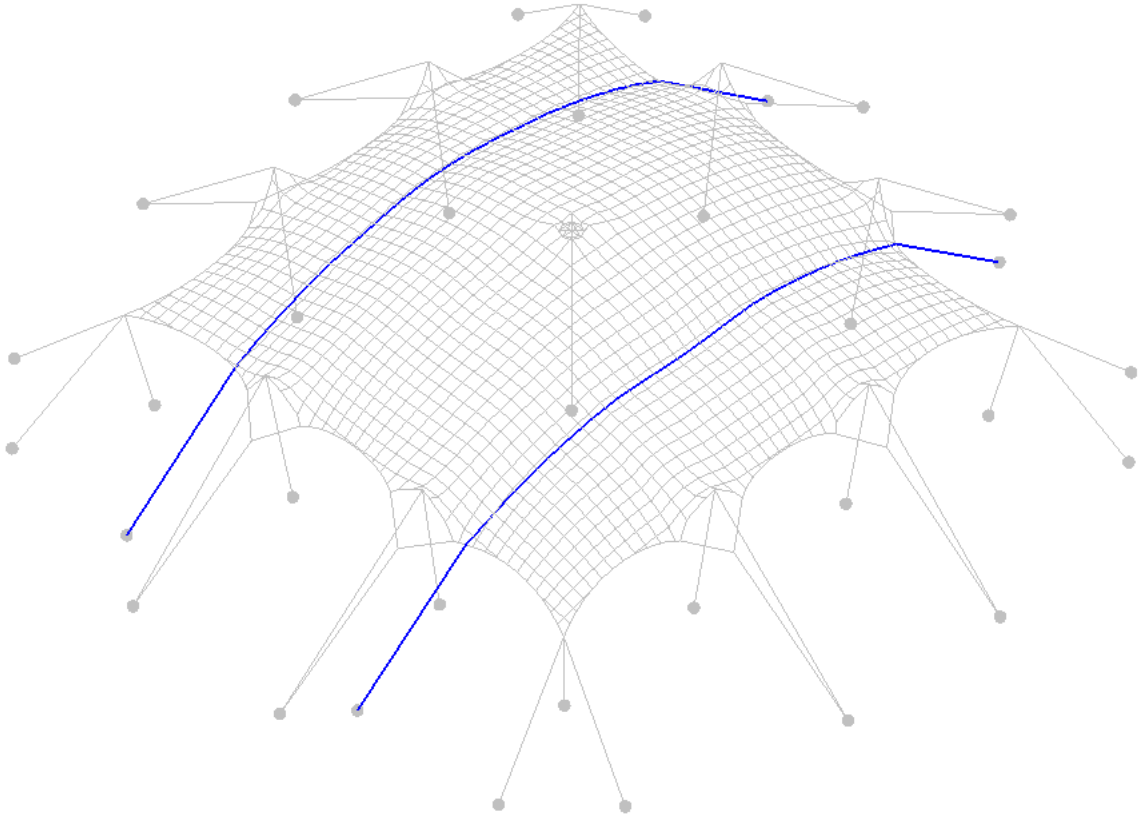


		Load combination	F_{rep}	Pag.
Combined rope – long side		CO1. Own weight + pretension	2.16 kN	167
		CO2. Own weight + pretension + snow	2.48 kN	171
		CO3. Own weight + pretension + wind pressure	2.91 kN	175
	Max	CO4. Own weight + pretension + wind suction	5.43 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	5.46 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.34 kN	187
V-ropes – long side		CO1. Own weight + pretension	1.50 kN	167
		CO2. Own weight + pretension + conventional / snow	1.76 kN	171
		CO3. Own weight + pretension + wind pressure	2.05 kN	175
	Max	CO4. Own weight + pretension + wind suction	3.91 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	3.68 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	2.28 kN	187
Combined rope – short side		CO1. Own weight + pretension	1.87 kN	167
		CO2. Own weight + pretension + conventional / snow	2.42 kN	171
		CO3. Own weight + pretension + wind pressure	2.89 kN	175
	Max	CO4. Own weight + pretension + wind suction	5.46 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	3.52 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.39 kN	187
V-ropes – short side		CO1. Own weight + pretension	1.37 kN	167
		CO2. Own weight + pretension + conventional / snow	1.80 kN	171
		CO3. Own weight + pretension + wind pressure	2.14 kN	175
	Max	CO4. Own weight + pretension + wind suction	3.83 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	2.54 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	2.51 kN	187

Table 24. Leading forces in ropes – 10x20m model

H.6.2.5 Stormbelts

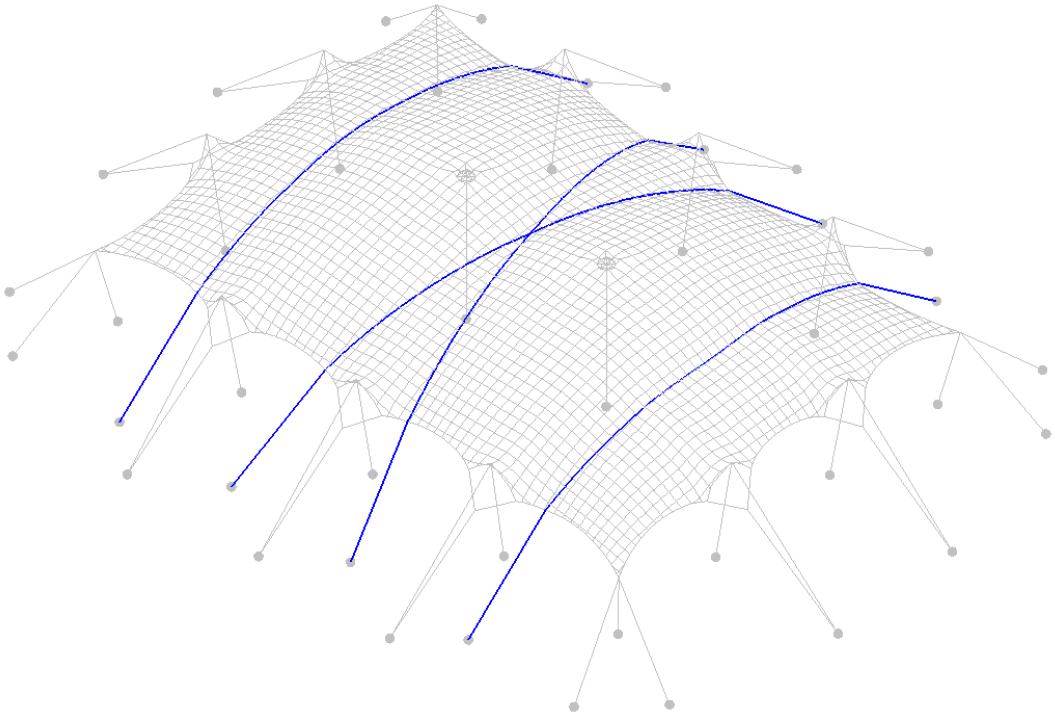
H.6.2.5.1. 10x10m model



		Load combination	F_{rep}	Pag.
Stormbelts		CO1. Own weight + pretension	0.00 kN	119
		CO2. Own weight + pretension + snow	0.00 kN	123
		CO3. Own weight + pretension + wind pressure	0.00 kN	127
	Max	CO4. Own weight + pretension + wind suction	5.62 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	0.00 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	0.00 kN	139

Table 25. Leading forces in stormbelts – 10x10m model

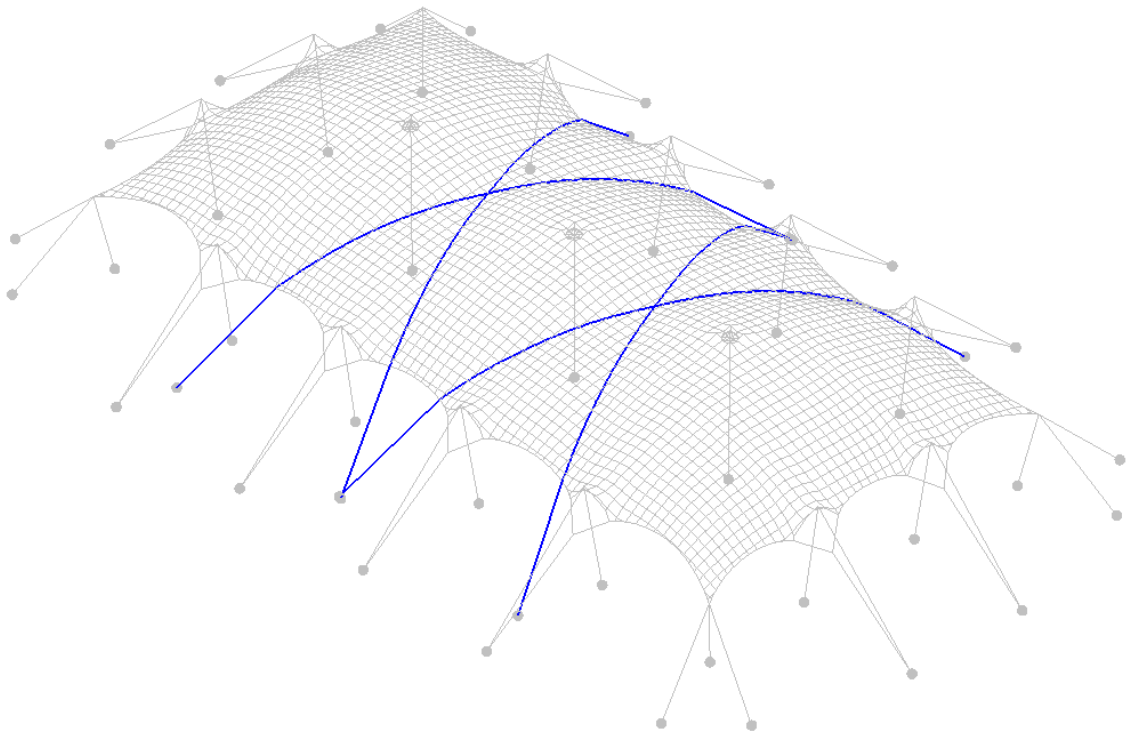
H.6.2.5.2. 10x15m model



		Load combination	F_{rep}	Pag.
Stormbelts		CO1. Own weight + pretension	0.00 kN	143
		CO2. Own weight + pretension + snow	0.00 kN	147
		CO3. Own weight + pretension + wind pressure	0.00 kN	151
	Max	CO4. Own weight + pretension + wind suction	6.01 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	0.00 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	0.00 kN	163

Table 26. Leading forces in stormbelts – 10x15m model

H.6.2.5.3. 10x20m model

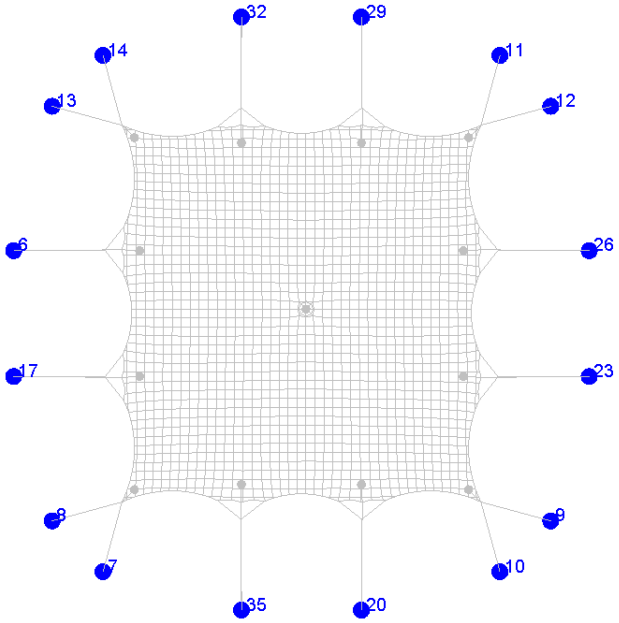


		Load combination	F_{rep}	Pag.
Stormbelts		CO1. Own weight + pretension	0.00 kN	167
		CO2. Own weight + pretension + snow	0.00 kN	171
		CO3. Own weight + pretension + wind pressure	0.00 kN	175
	Max	CO4. Own weight + pretension + wind suction	5.93 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	0.00 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	0.00 kN	187

Table 27. Leading forces in stormbelts – 10x20m model

H.6.2.6 Reaction forces

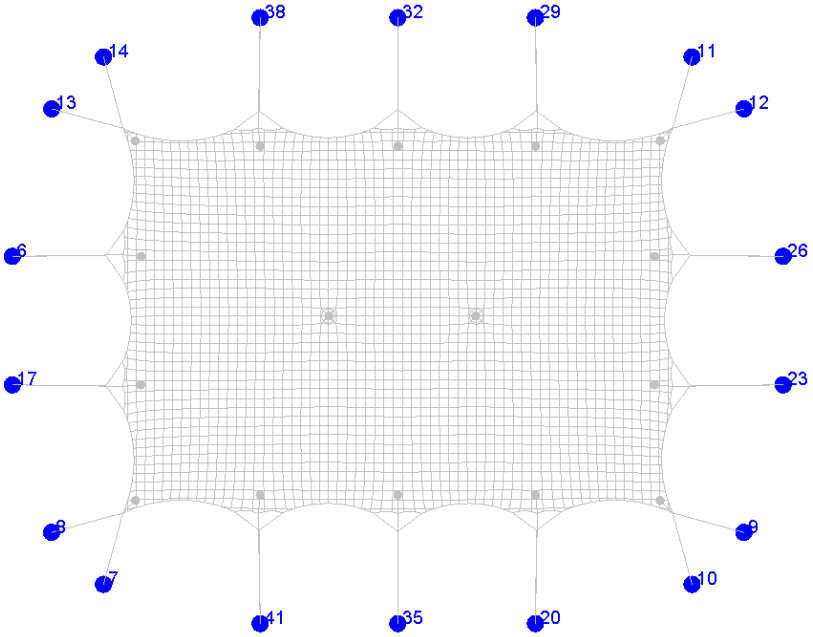
H.6.2.6.1. 10x10m model



		Load combination	F_{rep}	Pag.
Side		CO1. Own weight + pretension	1.94 kN	119
		CO2. Own weight + pretension + snow	2.59 kN	123
		CO3. Own weight + pretension + wind pressure	3.10 kN	127
	Max	CO4. Own weight + pretension + wind suction	5.04 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	3.80 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.94 kN	139
Corner		CO1. Own weight + pretension	2.10 kN	119
		CO2. Own weight + pretension + conventional / snow	2.50 kN	123
		CO3. Own weight + pretension + wind pressure	2.86 kN	127
	Max	CO4. Own weight + pretension + wind suction	3.94 kN	131
		CO5. Own weight + pretension + wind suction reduced [NL]	3.19 kN	135
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.36 kN	139

Table 28. Leading reaction forces – 10x10m model

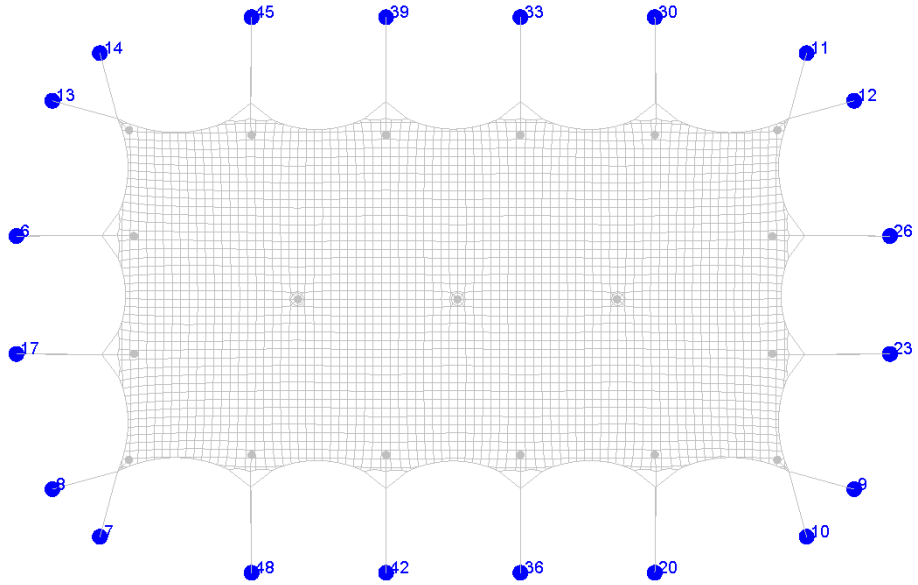
H.6.2.6.2. 10x15m model



		Load combination	F_{rep}	Pag.
Long side		CO1. Own weight + pretension	2.22 kN	143
		CO2. Own weight + pretension + snow	3.08 kN	147
		CO3. Own weight + pretension + wind pressure	3.83 kN	151
	Max	CO4. Own weight + pretension + wind suction	5.20 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	4.82 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.83 kN	163
Short side		CO1. Own weight + pretension	2.04 kN	143
		CO2. Own weight + pretension + conventional / snow	2.92 kN	147
		CO3. Own weight + pretension + wind pressure	3.60 kN	151
	Max	CO4. Own weight + pretension + wind suction	5.23 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	4.22 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.62 kN	163
Corner		CO1. Own weight + pretension	2.31 kN	143
		CO2. Own weight + pretension + conventional / snow	2.85 kN	147
		CO3. Own weight + pretension + wind pressure	3.28 kN	151
	Max	CO4. Own weight + pretension + wind suction	4.22 kN	155
		CO5. Own weight + pretension + wind suction reduced [NL]	3.51 kN	159
		CO6. Own weight + pretension + wind pressure + snow [FR]	3.85 kN	163

Table 29. Leading reaction forces – 10x15m model

H.6.2.6.3. 10x20m model



		Load combination	F_{rep}	Pag.
Long side		CO1. Own weight + pretension	2.31 kN	167
		CO2. Own weight + pretension + snow	3.16 kN	171
		CO3. Own weight + pretension + wind pressure	3.87 kN	175
	Max	CO4. Own weight + pretension + wind suction	5.77 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	5.71 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.82 kN	187
Short side		CO1. Own weight + pretension	1.99 kN	167
		CO2. Own weight + pretension + conventional / snow	2.95 kN	171
		CO3. Own weight + pretension + wind pressure	3.72 kN	175
	Max	CO4. Own weight + pretension + wind suction	5.58 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	3.65 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.81 kN	187
Corner		CO1. Own weight + pretension	2.33 kN	167
		CO2. Own weight + pretension + conventional / snow	2.95 kN	171
		CO3. Own weight + pretension + wind pressure	3.44 kN	175
	Max	CO4. Own weight + pretension + wind suction	4.43 kN	179
		CO5. Own weight + pretension + wind suction reduced [NL]	3.44 kN	183
		CO6. Own weight + pretension + wind pressure + snow [FR]	4.05 kN	187

Table 30. Leading reaction forces – 10x20m model

H.6.3 Summary of forces

H.6.3.1 10x10m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.95	2.42	3.09	3.39	2.49	4.55
Weft	0.91	2.11	2.62	2.18	1.99	3.79
Edge	1.76	2.13	2.44	3.41	2.68	2.85
Main pole	-2.12	-5.41	-6.95	0.05	-0.08	-10.32
Side pole	-1.30	-2.43	-3.13	-2.02	-0.83	-4.33
Corner pole	-2.64	-3.38	-3.95	-4.52	-3.43	-4.75
Corner belt	2.10	2.50	2.86	3.94	3.19	3.33
Belts - long side	0.12	0.47	0.70	0.35	0.16	1.13
Stormbelts	0.00	0.00	0.00	5.62	0.00	0.00
Combined rope - long side	1.83	2.12	2.41	4.83	3.64	2.76
V-ropes - long side	1.40	1.63	1.84	3.51	2.72	2.10
Reaction - long side	1.94	2.59	3.10	5.04	3.80	3.94
Reaction - corner	2.10	2.50	2.86	3.94	3.19	3.36

Table 31. Summary of forces for 10x10m model

H.6.3.2 10x15m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.91	2.59	3.35	3.13	2.51	4.97
Weft	0.89	2.18	2.93	2.27	2.48	4.24
Edge	1.90	2.35	2.74	3.55	3.17	3.19
Main pole	-1.74	-4.96	-6.49	0.06	-0.02	-9.78
Side pole	-1.37	-2.74	-3.60	-2.47	-0.84	-4.99
Corner pole	-2.86	-3.81	-4.56	-4.77	-3.87	-5.50
Corner belt	2.31	2.85	3.28	4.22	3.51	3.81
Belts - long side	0.14	0.51	0.81	0.50	0.18	1.30
Belts - short side	0.12	0.56	0.84	0.22	0.18	1.37
Stormbelts	0.00	0.00	0.00	6.01	0.00	0.00
Combined rope - long side	2.11	2.59	3.04	4.70	4.66	3.50
V-ropes - long side	1.53	1.83	2.11	3.38	3.30	2.39
Combined rope - short side	1.92	2.38	2.77	5.01	4.04	3.21
V-ropes short side	1.45	1.80	2.09	3.64	2.94	2.41
Reaction - long side	2.22	3.08	3.83	5.20	4.82	4.83
Reaction - short side	2.04	2.92	3.60	5.23	4.22	4.62
Reaction - corner	2.31	2.85	3.28	4.22	3.51	3.85

Table 32. Summary of forces for 10x15m model

H.6.3.3 10x20m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.95	2.63	3.41	4.45	2.53	5.01
Weft	0.88	2.16	2.94	2.89	2.68	4.20
Edge	1.80	2.26	2.67	4.43	3.43	3.16
Main pole	-1.84	-5.15	-6.75	0.06	0.03	-10.07
Side pole	-1.35	-2.69	-3.55	-2.21	-0.80	-4.88
Corner pole	-2.73	-3.67	-4.43	-4.31	-3.63	-5.40
Corner belt	2.33	2.95	3.44	4.43	3.44	4.01
Belts - long side	0.22	0.70	1.01	0.57	0.26	1.50
Belts - short side	0.13	0.55	0.85	0.13	0.13	1.35
Stormbelts	0.00	0.00	0.00	5.93	0.00	0.00
Combined rope - long side	2.16	2.48	2.91	5.43	5.46	3.34
V-ropes - long side	1.50	1.76	2.05	3.91	3.68	2.28
Combined rope - short side	1.87	2.42	2.89	5.46	3.52	3.39
V-ropes short side	1.37	1.80	2.14	3.83	2.54	2.51
Reaction - long side	2.31	3.16	3.87	5.77	5.71	4.82
Reaction - short side	1.99	2.95	3.72	5.58	3.65	4.81
Reaction - corner	2.33	2.95	3.44	4.43	3.44	4.05

Table 33. Summary of forces for 10x20m model

H.7. Element check

H.7.1 Membrane

	Load combination	Element	Representative stress	Design value stress	Pag.
10x10m	CO1. Own weight + pretension	Long term warp	0.95 kN/m	1.28 kN/m (γ = 1.35)	51
10x10m	CO1. Own weight + pretension	Long term weft	0.91 kN/m	1.23 kN/m (γ = 1.35)	51
10x20m	CO4. Own weight + pretension + wind suction	Short term warp	4.45 kN/m	6.68 kN/m (γ = 1.5)	52
10x20m	CO3. Own weight + pretension + wind pressure	Short term weft	2.94 kN/m	4.41 kN/m (γ = 1.5)	52

Sioen RP5639 fabric is being used.

UC.1a	Long term warp	S_{Ed} / S_{rd} < 1	1.28 / 9.6 = 0.13 < 1	OK
UC.1b	Long term weft	S_{Ed} / S_{rd} < 1	1.23 / 7.2 = 0.17 < 1	OK
UC.1c	Short term warp	S_{Ed} / S_{rd} < 1	6.68 / 12.0 = 0.56 < 1	OK
UC.1d	Short term weft	S_{Ed} / S_{rd} < 1	4.41 / 9.0 = 0.49 < 1	OK

For capacity of membrane see H.2.1, page 24

H.7.2 Main poles

	Load combinations	Element	Representative force	Design value force	Pag.
10x10m	CO3. Own weight + pretension + wind pressure	Main pole 4.0m	-6.95 kN	-10.43 kN (γ = 1.5)	51

User load of max. 25 kg is applied, loaded centrically.

4.0m pole Ned = -6.95 x 1.50 + (-0.25 x 1.35) = -10.76 kN

H.7.2.1 4.0m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 100 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 4.00m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.2	4.0m	$\sigma_{c,0,d} / (f_{c,0,d} \times k_{cy}) = 1.37 / (12.46 \times 0.120) = 0.92 \leq 1$	OK

See Annex G.1 Main pole 4.0m – Wood, on page 191 for the elaborate check

H.7.3 Side poles

H.7.3.1 10x10m model

	Load combinations	Element	Representative force	Design value force	Pag.
10x10m	CO3. Own weight + pretension + wind pressure	Side pole 3.0m	-3.13 kN	-4.70 kN (γ = 1.5)	51

User load of max. 25 kg is applied, loaded centrically.
3m pole Ned = -3.13 x 1.50 + (-0.25 x 1.35) = -5.03 kN

H.7.3.1.1. 3m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 70 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 3.0m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.3	3m	$\sigma_{c,0,d}$ / ($f_{c,0,d}$ x k_{cy}) = 1.31 / (12.46 x 0.105) = 1.00 ≤ 1	OK

See Annex G.2 Side pole 3m – Wood, Spruce C18, on page 192 for the elaborate check

H.7.3.2 10x15m and 10x20m model

	Load combinations	Element	Representative force	Design value force	Pag.
10x15m	CO3. Own weight + pretension + wind pressure	Side pole 3.0m	-3.60 kN	-5.40 kN (γ = 1.5)	51

User load of max. 25 kg is applied, loaded centrically.
3m pole Ned = -3.60 x 1.50 + (-0.25 x 1.35) = -5.74 kN

H.7.3.2.1. 3m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 75 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 3.0m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.3	3m	$\sigma_{c,0,d}$ / ($f_{c,0,d}$ x k_{cy}) = 1.30 / (12.46 x 0.120) = 0.87 ≤ 1	OK

See Annex G.2 Side pole 3m – Wood, Spruce C18, on page 192 for the elaborate check

H.7.4 Corner poles

H.7.4.1 10x10 and 10x20m model

	Load combinations	Element	Representative force	Design value force	Pag.
10x10m	CO4. Own weight + pretension + wind suction	Corner pole 2.5m	-4.52 kN	-6.78 kN (γ = 1.5)	51

User load of max. 25 kg is applied, loaded centrically.

2.5m corner pole Ned = -4.52 x 1.50 + (-0.25 x 1.35) = -7.12 kN

H.7.4.1.1. 2.5m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 70 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 2.5m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.4	2.5m	$\sigma_{c,0,d} / (f_{c,0,d} \times k_{cy})$ = 1.85 / (12.46 x 0.149) = 1.00 ≤ 1	OK

See Annex G.3 Corner pole 2.5m - Wood, C18, on page 194 for the elaborate check

H.7.4.2 10x15m model

	Load combinations	Element	Representative force	Design value force	Pag.
10x15m	CO4. Own weight + pretension + wind suction	Corner pole 2.5m	-4.77 kN	-7.16 kN (γ = 1.5)	51

User load of max. 25 kg is applied, loaded centrically.

2.5m corner pole Ned = -4.77 x 1.50 + (-0.25 x 1.35) = -7.49 kN

H.7.4.2.1. 2.5m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 75 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 2.5m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.4	2.5m	$\sigma_{c,0,d} / (f_{c,0,d} \times k_{cy})$ = 1.70 / (12.46 x 0.170) = 0.80 ≤ 1	OK

See Annex G.3 Corner pole 2.5m - Wood, C18, on page 194 for the elaborate check

H.7.5 Guy ropes

	Load combination	Element	Representative force	Design value force	Pag.
10x10m	CO4. Own weight + pretension + wind suction	side - combined	4.83 kN	7.25 kN (γ = 1.5)	51
10x15m	CO4. Own weight + pretension + wind suction	long side - combined	4.70 kN	7.05 kN (γ = 1.5)	51
10x20m	CO4. Own weight + pretension + wind suction	long side - combined	5.43 kN	8.15 kN (γ = 1.5)	52
10x10m	CO4. Own weight + pretension + wind suction	side – V-ropes	3.51 kN	5.27 kN (γ = 1.5)	51
10x15m	CO4. Own weight + pretension + wind suction	long side – V-ropes	3.38 kN	5.07 kN (γ = 1.5)	51
10x20m	CO4. Own weight + pretension + wind suction	long side – V-ropes	3.91 kN	5.87 kN (γ = 1.5)	52
10x15m	CO4. Own weight + pretension + wind suction	short side - combined	5.01 kN	7.52 kN (γ = 1.5)	51
10x20m	CO4. Own weight + pretension + wind suction	short side - combined	5.46 kN	8.19 kN (γ = 1.5)	52
10x15m	CO4. Own weight + pretension + wind suction	short side – V-ropes	3.64 kN	5.46 kN (γ = 1.5)	51
10x20m	CO4. Own weight + pretension + wind suction	short side – V-ropes	3.83 kN	5.75 kN (γ = 1.5)	52

Synthetic rope Ø8mm, BL 900 daN. Is being used → $F_{rd,8mm}$ = 2.25 kN.

In a case of using individual guy ropes made of multiple sections, the ropes need to be tied back, creating multiple rope sections that together will take the load.

10x10m model

UC.5a	side - combined	1 individual rope made of 4 sections Ø8mm	F_d / F_{rd} < 1	7.25 / (1 x 4 x 2.25) = 0.81 < 1	OK
UC.5b	side – V-ropes	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	5.27 / (1 x 3 x 2.25) = 0.78 < 1	OK

For capacity of ropes see H.2.2, page 24

10x15m model

UC.5e	long side - combined	1 individual rope made of 4 sections Ø8mm	F_d / F_{rd} < 1	7.05 / (1 x 4 x 2.25) = 0.78 < 1	OK
UC.5f	long side – V-ropes	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	5.07 / (1 x 3 x 2.25) = 0.75 < 1	OK

UC.5g	short side - combined	1 individual rope made of 4 sections Ø8mm	F_d / F_{rd} < 1	7.52 / (1 x 4 x 2.25) = 0.84 < 1	OK
UC.5h	short side – V-ropes	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	5.46 / (1 x 3 x 2.25) = 0.81 < 1	OK

For capacity of ropes see H.2.2, page 24

10x20m model

UC.5e	long side - combined	1 individual rope made of 4 sections Ø8mm	F_d / F_{rd} < 1	8.15 / (1 x 4 x 2.25) = 0.91 < 1	OK
UC.5f	long side – V-ropes	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	5.87 / (1 x 3 x 2.25) = 0.87 < 1	OK
UC.5g	short side - combined	1 individual rope made of 4 sections Ø8mm	F_d / F_{rd} < 1	8.19 / (1 x 4 x 2.25) = 0.91 < 1	OK
UC.5h	short side – V-ropes	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	5.75 / (1 x 3 x 2.25) = 0.85 < 1	OK

For capacity of ropes see H.2.2, page 24

It is also possible to use alternative **ropes** with a higher breaking strength (BL_{rope}) and less rope sections (n), as long as $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq BL_{required}}$

Required breaking loads for ropes:

10x10m model

Side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2900}$ **kg**
Side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2108}$ **kg**

10x15m model

Long side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2820}$ **kg**
Long side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2028}$ **kg**
Short side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 3008}$ **kg**
Short side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2184}$ **kg**

10x20m model

Long side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 3260}$ **kg**
Long side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2348}$ **kg**
Short side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 3276}$ **kg**
Short side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2300}$ **kg**

H.7.6 Belts

	Load combination	Element	Representative force	Design value force	Pag.
10x20m	CO4. Own weight + pretension + wind suction	Corner belt	4.43 kN	6.65 kN (γ = 1.5)	52
10x20m	CO3. Own weight + pretension + wind pressure	Belt – long side	1.01 kN	1.52 kN (γ = 1.5)	52
10x20m	CO3. Own weight + pretension + wind pressure	Belt – short side	0.85 kN	1.28 kN (γ = 1.5)	52

H.7.6.1 Belt capacity check

PES belt with a breaking strength of 3000kg is being used.

UC.6a	Corner belt	1 PES belt with minimum BL = 3000 kg	F_d / F_{rd} < 1	6.65 / (1 x 15) = 0.44 < 1	OK
UC.6b	Belt – long side	1 PES belt with minimum BL = 3000 kg	F_d / F_{rd} < 1	1.52 / (1 x 15) = 0.10 < 1	OK
UC.6c	Belt – short side	1 PES belt with minimum BL = 3000 kg	F_d / F_{rd} < 1	1.28 / (1 x 15) = 0.09 < 1	OK

For capacity of belts see H.2.3, page 24

H.7.6.2 Alternative – rope capacity check

It is possible to use either a rope or a belt. Synthetic rope Ø8mm, BL 900 daN. Is being used → $F_{rd,8mm}$ = 2.25 kN.

In a case of using individual guy ropes, the ropes need to be tied back, creating multiple rope sections that together will take the load.

UC.6d	Corner rope	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	6.65 / (1 x 3 x 2.25) = 0.99 < 1	OK
UC.6e	Rope – long side	1 individual rope made of 1 section Ø8mm	F_d / F_{rd} < 1	1.52 / (1 x 1 x 2.25) = 0.68 < 1	OK
UC.6f	Rope – short side	1 individual rope made of 1 section Ø8mm	F_d / F_{rd} < 1	1.28 / (1 x 1 x 2.25) = 0.57 < 1	OK

For capacity of ropes see H.2.2, page 24

It is also possible to use alternative **ropes** with a higher breaking strength (BL_{rope}) and less rope sections (n), as long as $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq BL_{required}}$

Required breaking loads for ropes:

Corner rope: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2660}$ **kg**

Rope – long side: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 608}$ **kg**

Rope – long side: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 512}$ **kg**

H.7.7 Stormbelts

	Load combination	Element	Representative force	Design value force	Pag.
10x15m	CO4. Own weight + pretension + wind suction	Stormbelt	6.01 kN	9.02 kN (γ = 1.5)	51

PES belt with a breaking strength of 3000kg is being used.

UC.7	Storm belt	1 PES belt with minimum BL = 3000 kg	F_d / F_{rd} < 1	9.02 / (1 x 15) = 0.60 < 1.0	OK

For capacity of belts see H.2.3, page 24

H.7.8 Fasteners

Force acting on fasteners is equal to the force in belts or ropes. See these values in chapters H.7.6 and H.7.5.

H.7.8.1 Corner belt connection

H.7.8.1.1. M16 Eye bolt, DIN580

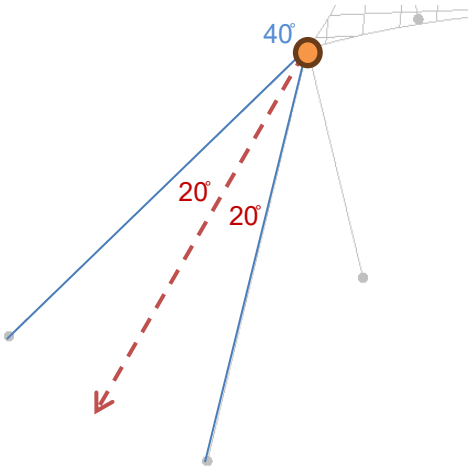
For ≤45°:

M16, WLL 700kg → BL = 6 x 7 kN = 42 kN → Frd = BL / γ_m = 42 / 2 =21 kN

$F_d = 2 \times F_{corner\ belt} \times \cos 20° = 2 \times 6.65 \times \cos 20° = 12.65\ kN$

UC.8a	Corner eye bolt	F_d / F_{rd} < 1	12.65 / 21 = 0.60 < 1.0	OK

For capacity of eye bolts see K.3 Capacity of Eye bolts on page 94.



H.7.8.1.2. Corner belt connection

A similar connection can be used if the capacity of it is at least 12.7 kN.

Orange Pin D-sluiting, WLL 1.0 t → BL = 6 x 10 kN = 60 kN → Frd = BL / γm = 60 kN / 2 = 30 kN

UC.8b	D-sluiting	F_d / F_{rd} < 1	12.65 / 30 = 0.42 < 1.0	OK

For capacity of D-sluiting see K.4 Capacity of Orange Pin 1 Ton D-sluiting, DIN EN 13889 on page 94.

H.7.8.1.3. Rope ratchet – for alternative corner connection with ropes

Ratchet, BL = 3.5 kN → Frd = BL / γm = 3.5 kN / 1.5 = 2.33 kN

F_d=6.65 kN (Instead of corner belts corner ropes are used.

UC.8c	Corner ropes (alternative)	**F_d / F_{rd} < 1**	**6.65 / 3*x2.33= 0.95 < 1**	**OK**

For capacity of rope ratchet see K.6 Rope ratchet, page 95

* Number of cross sections making a rope. Ratchet is applied only on one cross-section.

H.7.8.2 Side belt connection

H.7.8.2.1. M12 Eye bolt, DIN580

For ≤45°:

M12, WLL 340kg → BL = 6 x 3.4 kN = 20.4 kN → Frd = BL / γ_m = 20.4 / 2 = 10.2 kN

F_d=1.52 kN

UC.8d	Corner eye bolt	F_d / F_{rd} < 1	1.52 / 10.2 = 0.15 < 1.0	OK

For capacity of eye bolts see K.3 Capacity of Eye bolts on page 94.

H.7.8.2.2. Carabine, DIN5299C

Carabine 180x14, WLL 580kg → BL = 2 x 5.8 kN = 11.6 kN → Frd = BL / γm = 11.6 kN / 2 = 5.8 kN

F_d=1.52 kN

UC.8e	**F_d / F_{rd} < 1**	**1.52 / 5.80 = 0.26 < 1**	**OK**

For capacity of carabines see K.5 Carabine, DIN 5299C, page 95

H.7.8.3 Side rope connection

H.7.8.3.1. Carabine, DIN5299C

Carabine 180x14, WLL 580kg → BL = 2 x 5.8 kN = 11.6 kN → Frd = BL / γm = 11.6 kN / 2 = 5.8 kN

F_d=5.87 kN

UC.8f	**F_d / F_{rd} < 1**	**5.87 / 5.80 = 1.01 ~ 1**	**Acceptable**

For capacity of carabines see K.5 Carabine, DIN 5299C, page 95

H.7.8.3.2. Rope ratchet

Ratchet, BL = 3.5 kN → Frd = BL / γm = 3.5 kN / 1.5 = 2.33 kN

10x10m	UC.8g	Side – combined rope	**F_d / F_{rd} < 1**	**7.25 / 4*x2.33= 0.78 < 1**	**OK**
10x15m	UC.8h	Long side – combined rope	**F_d / F_{rd} < 1**	**7.05/ 4*x2.33= 0.76 < 1**	**OK**
10x20m	UC.8i	Long side – combined rope	**F_d / F_{rd} < 1**	**8.15 / 4*x2.33= 0.87 < 1**	**OK**
10x15m	UC.8j	Short side – combined rope	**F_d / F_{rd} < 1**	**7.52 / 4*x2.33= 0.81 < 1**	**OK**
10x20m	UC.8k	Short side – combined rope	**F_d / F_{rd} < 1**	**8.19 / 4*x2.33= 0.88 < 1**	**OK**

For capacity of rope ratchet see K.6 Rope ratchet, page 95

* Number of cross sections making a rope. Ratchet is applied only on one cross-section.

H.7.8.4 Base plate

H.7.8.4.1. Side pole & corner pole

See H.6.3 for the highest design pressure force. Poles are subjected only to compressive force.

The worst case is assumed – pole is located on soil:

- Soil (base plate size 25x25 cm, p_{soil} = 125 kN/m^2)

UC.8l	Soil	$\frac{F_d}{A}/p \leq 1$	**7.49 / (0.25*0.25) / 125 = 0.96 < 1**	**OK**

H.7.8.4.2. Main pole

See H.6.3 for the highest design pressure force. Poles are subjected only to compressive force.

The worst case is assumed – pole is located on soil:

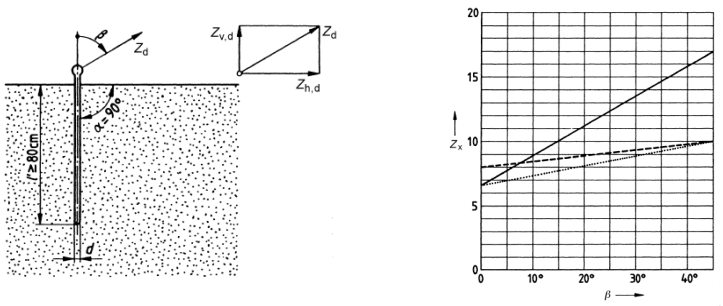
- Soil (base plate size 35x35 cm, p_{soil} = 175 kN/m^2)

UC.8m	Soil	$\frac{F_d}{A}/p \leq 1$	**10.76 / (0.35*0.35) / 175 = 0.50 < 1**	**OK**

H.8. Safety against overturning, sliding and uplifting

The calculations in this chapter provide a guideline for dense cohesionless soil, in case no anchor tests have been performed. Anchor tests on location can show that a different number of anchors or different size of anchors have sufficient capacity for the specific soil conditions. (see paragraph H.8.3)

H.8.1 Anchor capacity



Angle of pull	Load bearing capacity N
$\beta = 0$	Z_d = 6,5 dl' for stiff cohesive and for dense cohesion less soils
$\beta = 0$	Z_d = 8 dl' for very stiff cohesive soils
$\beta \geq 45$	Z_d = 10 dl' for cohesive soils of at least medium to stiff consistency
$\beta \geq 45$	Z_d = 17 dl' for dense cohesion less soils
$0 < \beta < 45$	The load bearing capacity for the soil types shall be determined by interpolation

Z_d is the anchor service load (service load), in N;

$Z_{h,d}$ is the horizontal anchor service load, in N;

$Z_{v,d}$ is the vertical anchor service load, in N;

d is the anchor diameter, in cm;

l' is the depth of penetration in cm;

α is the angle of penetration;

ß is the angle of acting tensile force to the vertical

figure 7. Taken from EN 13782: Figures 4 & 5, table 5

Anchors **of Ø30mm** are used, considering an **effective length of at least 1000 mm.** If multiple anchors are placed at the same location, the anchors need to be at least 5xØ apart to use the full capacity of the anchors.

<u>Anchor capacity for anchors based in dense cohesionless soil (sandy soil)</u>

		Ø30 x 1000 mm
Angle	β	≥ 45
Effective length anchor	l'	100 cm
Diameter anchor	d	3.0 cm
Anchor capacity*	Z_d	5.10 kN

H.8.2 Required anchor pins

	Load combination	Element	Representative force	Design value force	Pag.
10x10m	CO4. Own weight + pretension + wind suction	Side anchor point	5.04 kN	6.05 kN (γ = 1.2)	51
10x15m	CO4. Own weight + pretension + wind suction	Long side anchor point	5.20 kN	6.24 kN (γ = 1.2)	51
10x20m	CO4. Own weight + pretension + wind suction	Long side anchor point	5.77 kN	6.92 kN (γ = 1.2)	52
10x15m	CO4. Own weight + pretension + wind suction	Short side anchor point	5.23 kN	6.28 kN (γ = 1.2)	51
10x20m	CO4. Own weight + pretension + wind suction	Short side anchor point	5.58 kN	6.70 kN (γ = 1.2)	52
10x10m	CO4. Own weight + pretension + wind suction	Corner anchor point	3.94 kN	4.73 kN (γ = 1.2)	51
10x15m	CO4. Own weight + pretension + wind suction	Corner anchor point	4.22 kN	5.06 kN (γ = 1.2)	51
10x20m	CO4. Own weight + pretension + wind suction	Corner anchor point	4.43 kN	5.32 kN (γ = 1.2)	52
10x10m	CO4. Own weight + pretension + wind suction	Stormbelt	5.62 kN	6.74 kN (γ = 1.2)	51
10x15m	CO4. Own weight + pretension + wind suction	Stormbelt	6.01 kN	7.21 kN (γ = 1.2)	51
10x20m	CO4. Own weight + pretension + wind suction	Stormbelt	5.93 kN	7.12 kN (γ = 1.2)	52

Required anchor amount for dense cohesionless soil – **10x10m model**

Side guy ropes	2x	Ø30 x 1000 mm	F_d / F_{rd} = 6.05 / (2 x 5.10) = 0.59 ≤ 1	OK
Corner ties	1x	Ø30 x 1000 mm	F_d / F_{rd} = 4.73 / (1 x 5.10) = 0.93 < 1	OK
Stormbelt	2x	Ø30 x 1000 mm	F_d / F_{rd} = 6.74 / (2 x 5.10) = 0.66 < 1	OK

Required anchor amount for dense cohesionless soil – **10x15m model**

Long side guy ropes	2x	Ø30 x 1000 mm	F_d / F_{rd} = 6.24 / (2 x 5.10) = 0.61 < 1	OK
Short side guy ropes	2x	Ø30 x 1000 mm	F_d / F_{rd} = 6.28 / (2 x 5.10) = 0.62 < 1	OK
Corner ties	1x	Ø30 x 1000 mm	F_d / F_{rd} = 5.06 / (1 x 5.10) = 0.99 < 1	OK
Stormbelts	2x	Ø30 x 1000 mm	F_d / F_{rd} = 7.21 / (2 x 5.10) = 0.71 < 1	OK

Required anchor amount for dense cohesionless soil – **10x20m model**

Long side guy ropes	2x	Ø30 x 1000 mm	F_d / F_{rd} = 6.92 / (2 x 5.10) = 0.68 < 1	OK
Short side guy ropes	2x	Ø30 x 1000 mm	F_d / F_{rd} = 6.70 / (2 x 5.10) = 0.66 < 1	OK
Corner ties	1x	Ø30 x 1000 mm	F_d / F_{rd} = 5.32 / (1 x 5.10) = 1.04 ~ 1	Acceptable
Stormbelt	2x	Ø30 x 1000 mm	F_d / F_{rd} = 7.12 / (2 x 5.10) = 0.70 < 1	OK

H.8.3 Anchor tests according to BS-EN 13782

It is advised to perform anchor test on location when there is a reason to doubt the “pull-out force” of the anchors, which could be when ground conditions differ from dense, non-cohesive soil.

Anchor tests should be carried out according to the following procedure:
Three anchors spread throughout the terrain should be put perpendicular into the ground. The anchors should be pulled out with the aid of a spring balance in the direction of the force acting on the anchor. The lowest of the three measured values should be used.

A safety factor of v = 1.6 regarding ultimate limit load is to apply for the lowest test value to determine the load bearing capacity in subsequent calculation. The load bearing capacity determined in this manner shall not result in anchor movement which would result in stresses, deformations or instability inadmissible for the structure.
If the foundation conditions are comparable, test loadings carried out in another location may be adduced for substantiation purposes.

<u>For example:</u>
Force in belts: Frep = 5.20 kN
Fsd_{belt} = 1.2 x Frep = 1.2 x 5.20 = 6.24 kN

The partial safety factor γ = 1.6 is applied on the ultimate limit load:
$Z_{u,d,test}$ > 1.6 x Fsd = 1.6 x 6.24 = 9.98 kN

If for example the anchor test point has a minimal anchor capacity of 5.5 kN (550 kg), then 2 anchors are needed: 2x5.5 = 11 kN > $Z_{u,d,test}$

H.8.4 Required ballast

The safety against sliding shall be calculated from:

$\sum \mu * \gamma * N_k \geq \sum \gamma * H_k$ (eq. 5. NEN-EN 13782)

where

μ the coefficient of friction according to table 3

γ The safety factor according to Table 2, γ = 1.2 (unfavorable wind load)

N the vertical load components (characteristic value), corresponds to the required ballast

H the horizontal load components (characteristic value).

The safety against lifting shall be calculated from:

$\sum \gamma * N_{Rk,stb} \geq \sum \gamma * N_{Ek,dst}$ (eq. 7. NEN-EN 13782)

where

$N_{Rk,stb}$ are the vertical stabilizing load components (characteristic value);

$N_{Ek,dst}$ are the vertical lifting destabilizing load components (characteristic value).

For load calculations against sliding and lifting, Frep is split into the horizontal (Fh) and vertical (Fv) forces. If the separate reaction force factors are not known:

$F_h = F_{rep} \times \cos \alpha$ and $F_v = F_{rep} \times \sin \alpha$

Where α is equal to the angle between F_{rep} and the ground plane.

It follows from the above equation:

Required load (against sliding): $B_h = (\gamma F_h) / \mu$

Required load (against lifting): $B_v = \gamma F_v$

$B_{tot} = B_h + B_v$

B_{tot} = total required load

B_h = required load due to horizontal forces

B_v = required load due to vertical forces

10x10m model

Location	F_{rep} (γ = 1.2)	F_H	F_V	α	Ballast for μ = 0.5 (concrete on concrete)	Ballast for μ = 0.6 (concrete on rubber or wood)
	(kN)	(kN)	(kN)	°	(KG)	(KG)
Long side guy ropes	6.05	4.28	4.28	*45*	*1280*	*1140*
Corner ties	4.73	3.34	3.34	*45*	*1000*	*890*
Stormbelts	6.74	4.77	4.77	45	*1430*	*1270*

10x15m model

Location	F_{rep} (γ = 1.2)	F_H	F_V	α	Ballast for μ = 0.5 (concrete on concrete)	Ballast for μ = 0.6 (concrete on rubber or wood)
	(kN)	(kN)	(kN)	°	(KG)	(KG)
Long side guy ropes	6.24	4.41	4.41	*45*	*1320*	*1180*
Short side guy ropes	6.28	4.44	4.44	*45*	*1330*	*1180*
Corner ties	5.06	3.58	3.58	*45*	*1070*	*960*
Stormbelts	7.21	5.10	5.10	45	*1530*	*1360*

10x20m model

Location	F_{rep} (γ = 1.2)	F_H	F_V	α	Ballast for μ = 0.5 (concrete on concrete)	Ballast for μ = 0.6 (concrete on rubber or wood)
	(kN)	(kN)	(kN)	°	(KG)	(KG)
Long side guy ropes	6.92	4.90	4.90	*45*	*1470*	*1310*
Short side guy ropes	6.70	4.73	4.73	*45*	*1420*	*1260*
Corner ties	5.32	3.76	3.76	*45*	*1130*	*1000*
Stormbelts	7.12	5.03	5.03	45	*1510*	*1340*

I. Addition 1 – element check for reduced wind speeds [NL]

For stretchtent use in the Netherlands, a reduction of maximal allowable wind speeds is specified. As a result, the stretchtent is calculated for two wind scenarios – full wind and reduced wind. Maximal wind speeds are specified and if the structure exceeds them, the tent must be evacuated and access must be denied. For these wind speeds no stormbelts are necessary.

A reduction factor α=0.7 is applied, which leads to **q_p (z_e) of 0.25 kN/m^2 [NL]. No stormbelts are required.**

I.1. Summary of results – low wind in Netherlands

This document is valid for five tent sizes: 10x10m, 10x15m, 10x20m, 10x12m and 9x12m. Although no separate calculation is made for 10x12m and 9x12m sizes, all elements, sizes and anchoring forces can be based on 10x15m model.

Changes that come from lower wind and no stormbelts are highlighted in orange.

General information:				
Main dimensions:		**10x10m**	**10x15m / 10x12m / 9x12m**	**10x20m**
	Width:	10m	10m / 9m	10m
	Length:	10m	15m / 12m	20m
	Side height of membrane:	3m	3m	3m
	Max. height:	4m	4m	4m
	Main poles: *	4.0m Ø100 mm [Spruce,C18]	4.0m Ø100 mm [Spruce,C18]	4.0m Ø100 mm [Spruce, C18]
	Side poles: *	3.0m Ø 70 mm [Spruce, C18]	3.0m Ø 75 mm [Spruce, C18]	3.0m Ø 75 mm [Spruce, C18]
	Corner poles: *	2.5m Ø 70 mm [Spruce, C18]	2.5m Ø 75 mm [Spruce, C18]	2.5m Ø 70 mm [Spruce, C18]
	Guy ropes:	Ø 8mm polyester, breaking strength ≥ 900 daN **	Ø 8mm polyester, breaking strength ≥ 900 daN **	Ø 8mm polyester, breaking strength ≥ 900 daN **
	Long side – combined:	**3 sections**	**3 sections**	4 sections
	Long side - V-ropes:	**2 sections**	3 sections	3 sections
	Short side – combined:	-------	**3 sections**	**3 sections**
	Short side - V-ropes:	-------	**2 sections**	**2 sections**
	Belts:	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN
	Fasteners:	Carabine 180x14 M16 & M12 Eye bolt Ratchet, BL = 3.5 kN	Carabine 180x14 M16 & M12 Eye bolt Ratchet, BL = 3.5 kN	Carabine 180x14 M16 & M12 Eye bolt Ratchet, BL = 3.5 kN

	Side & corner pole base plate Main pole base plate	25x25cm 35x35cm	25x25cm 35x35cm	25x25cm 35x35cm
User load:	A maximum of 25 kg per main mast may be used for decorations, sound or lighting installations. The load must be applied centrally.			
Snow load:	A snow load of 0.1 kN/m² (4 cm) has been considered in accordance with the French CTS standard.			
Wind load:	According to EN 13782 The following pressure values have been used: h < 5m: 0.25kN/m²			

* The average diameter, as a minimum required at the middle of the pole.

** The required breaking load (BL_{tot}) may be achieved by using multiple rope sections (n): $BL_{rope} = BL_{tot} / n$, see page 74

Safety against sliding, overturning and uplifting:				
Anchor forces:	Assumptions: angle of 45 degrees The following design resistance of the anchor forces is required: (See H.8.3, page 67 for Anchor tests according to EN 13782)			
		10x10m	**10x15m / 10x12m / 9x12m**	**10x20m**
	Long side guy ropes: Short side guy ropes: Corner ties:	**4.56 kN** (γ = 1.2) **3.83 kN** (γ = 1.2)	**5.78 kN** (γ = 1.2) **5.06 kN** (γ = 1.2) **4.21 kN** (γ = 1.2)	**6.85 kN** (γ = 1.2) **4.38 kN** (γ = 1.2) **4.13 kN** (γ = 1.2)
Required anchors:	Based on dense, non-cohesive soil (e.g. sandy soils). In the case anchors **Ø30mm x 1000mm** (effective length) are being used:			
		10x10m	**10x15m / 10x12m / 9x12m**	**10x20m**
	Long side guy ropes: Short side guy ropes: Corner ties:	**1 anchor** 1 anchor	2 anchors **1 anchor** 1 anchor	2 anchors **1 anchor** **1 anchor**
Required ballast:	Ballast calculation is performed for 2 different situations: - Concrete on concrete – concrete ballasts are placed on concrete - Concrete on wood or rubber – concrete ballasts are placed on wood, or an anti-slip mat is placed underneath the ballast			
	10x10m			
			Concrete on concrete	Concrete on wood or rubber
	Long side guy ropes: Corner ties:		**970 kg** **810 kg**	**860 kg** **720 kg**
	10x15m / 10x12m / 9x12m			

	Concrete on concrete	Concrete on wood or rubber
Long side guy ropes: Short side guy ropes: Corner ties:	**1230 kg** **1070 kg** **980 kg**	**1090 kg** **960 kg** **790 kg**
10x20m		
	Concrete on concrete	Concrete on wood or rubber
Long side guy ropes: Short side guy ropes: Corner ties:	**1450 kg** **950 kg** **880 kg**	**1290 kg** **840 kg** **780 kg**

I.2. Summary of forces

Further chapters include the calculation only for highlighted elements in the CO5 [NL] column if they show higher values than calculated in the previous chapters or if recalculating them show a clear difference in results. Other element checks can be looked up in H.7.

I.2.1 10x10m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.95	2.42	3.09	3.39	2.49	4.55
Weft	0.91	2.11	2.62	2.18	1.99	3.79
Edge	1.76	2.13	2.44	3.41	2.68	2.85
Main pole	-2.12	-5.41	-6.95	0.05	-0.08	-10.32
Side pole	-1.30	-2.43	-3.13	-2.02	-0.83	-4.33
Corner pole	-2.64	-3.38	-3.95	-4.52	-3.43	-4.75
Corner belt	2.10	2.50	2.86	3.94	3.19	3.33
Belts - side	0.12	0.47	0.70	0.35	0.16	1.13
Stormbelts	0.00	0.00	0.00	5.62	0.00	0.00
Combined rope - side	1.83	2.12	2.41	4.83	3.64	2.76
V-ropes - side	1.40	1.63	1.84	3.51	2.72	2.10
Reaction - side	1.94	2.59	3.10	5.04	3.80	3.94
Reaction - corner	2.10	2.50	2.86	3.94	3.19	3.36

Table 34. Summary of forces for 10x10m model

I.2.2 10x15m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.91	2.59	3.35	3.13	2.51	4.97
Weft	0.89	2.18	2.93	2.27	2.48	4.24
Edge	1.90	2.35	2.74	3.55	3.17	3.19
Main pole	-1.74	-4.96	-6.49	0.06	-0.02	-9.78
Side pole	-1.37	-2.74	-3.60	-2.47	-0.84	-4.99
Corner pole	-2.86	-3.81	-4.56	-4.77	-3.87	-5.50
Corner belt	2.31	2.85	3.28	4.22	3.51	3.81
Belts - long side	0.14	0.51	0.81	0.50	0.18	1.30
Belts - short side	0.12	0.56	0.84	0.22	0.18	1.37
Stormbelts	0.00	0.00	0.00	6.01	0.00	0.00
Combined rope - long side	2.11	2.59	3.04	4.70	4.66	3.50
V-ropes - long side	1.53	1.83	2.11	3.38	3.30	2.39
Combined rope - short side	1.92	2.38	2.77	5.01	4.04	3.21
V-ropes short side	1.45	1.80	2.09	3.64	2.94	2.41
Reaction - long side	2.22	3.08	3.83	5.20	4.82	4.83
Reaction - short side	2.04	2.92	3.60	5.23	4.22	4.62
Reaction - corner	2.31	2.85	3.28	4.22	3.51	3.85

Table 35. Summary of forces for 10x15m model

I.2.3 10x20m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.95	2.63	3.41	4.45	2.53	5.01
Weft	0.88	2.16	2.94	2.89	2.68	4.20
Edge	1.80	2.26	2.67	4.43	3.43	3.16
Main pole	-1.84	-5.15	-6.75	0.06	0.03	-10.07
Side pole	-1.35	-2.69	-3.55	-2.21	-0.80	-4.88
Corner pole	-2.73	-3.67	-4.43	-4.31	-3.63	-5.40
Corner belt	2.33	2.95	3.44	4.43	3.44	4.01
Belts - long side	0.22	0.70	1.01	0.57	0.26	1.50
Belts - short side	0.13	0.55	0.85	0.13	0.13	1.35
Stormbelts	0.00	0.00	0.00	5.93	0.00	0.00
Combined rope - long side	2.16	2.48	2.91	5.43	5.46	3.34
V-ropes - long side	1.50	1.76	2.05	3.91	3.68	2.28
Combined rope - short side	1.87	2.42	2.89	5.46	3.52	3.39
V-ropes short side	1.37	1.80	2.14	3.83	2.54	2.51
Reaction - long side	2.31	3.16	3.87	5.77	5.71	4.82
Reaction - short side	1.99	2.95	3.72	5.58	3.65	4.81
Reaction - corner	2.33	2.95	3.44	4.43	3.44	4.05

Table 36. Summary of forces for 10x20m model

I.3. Element check - low wind in Netherlands

I.3.1 Guy ropes

	Load combination	Element	Representative force	Design value force	Pag.
10x10m	CO5. Own weight + pretension + wind suction reduced	side - combined	3.64 kN	5.46 kN (γ = 1.5)	72
10x15m	CO5. Own weight + pretension + wind suction reduced	long side - combined	4.66 kN	6.99 kN (γ = 1.5)	73
10x20m	CO5. Own weight + pretension + wind suction reduced	long side - combined	5.46 kN	8.19 kN (γ = 1.5)	73
10x10m	CO5. Own weight + pretension + wind suction reduced	side – V-ropes	2.72 kN	4.08 kN (γ = 1.5)	72
10x15m	CO5. Own weight + pretension + wind suction reduced	long side – V-ropes	3.30 kN	4.95 kN (γ = 1.5)	73
10x20m	CO5. Own weight + pretension + wind suction reduced	long side – V-ropes	3.68 kN	5.52 kN (γ = 1.5)	73
10x15m	CO5. Own weight + pretension + wind suction reduced	short side - combined	4.04 kN	6.06 kN (γ = 1.5)	73
10x20m	CO5. Own weight + pretension + wind suction reduced	short side - combined	3.52 kN	5.28 kN (γ = 1.5)	73
10x15m	CO5. Own weight + pretension + wind suction reduced	short side – V-ropes	2.94 kN	4.41 kN (γ = 1.5)	73
10x20m	CO5. Own weight + pretension + wind suction reduced	short side – V-ropes	2.54 kN	3.76 kN (γ = 1.5)	73

Synthetic rope Ø8mm, BL 900 daN. Is being used → $F_{rd,8mm}$ = 2.25 kN.

In a case of using individual guy ropes made of multiple sections, the ropes need to be tied back, creating multiple rope sections that together will take the load.

10x10m model

UC.5a	side - combined	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	5.46 / (1 x 3 x 2.25) = 0.81 < 1	OK
UC.5b	side – V-ropes	1 individual rope made of 2 sections Ø8mm	F_d / F_{rd} < 1	4.08 / (1 x 2 x 2.25) = 0.91 < 1	OK

For capacity of ropes see H.2.2, page 24

10x15m model

UC.5e	long side - combined	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	6.99 / (1 x 3 x 2.25) = 1.04 ~ 1	OK
UC.5f	long side – V-ropes	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	4.95 / (1 x 3 x 2.25) = 0.73 < 1	OK
UC.5g	short side - combined	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	6.06 / (1 x 3 x 2.25) = 0.90 < 1	OK
UC.5h	short side – V-ropes	1 individual rope made of 2 sections Ø8mm	F_d / F_{rd} < 1	4.41 / (1 x 2 x 2.25) = 0.98 < 1	OK

For capacity of ropes see H.2.2, page 24

10x20m model

UC.5e	long side - combined	1 individual rope made of 4 sections Ø8mm	F_d / F_{rd} < 1	8.19 / (1 x 4 x 2.25) = 0.91 < 1	OK
UC.5f	long side – V-ropes	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	5.52 / (1 x 3 x 2.25) = 0.82 < 1	OK
UC.5g	short side - combined	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	5.28 / (1 x 3 x 2.25) = 0.78 < 1	OK
UC.5h	short side – V-ropes	1 individual rope made of 2 sections Ø8mm	F_d / F_{rd} < 1	3.76 / (1 x 2 x 2.25) = 0.84 < 1	OK

For capacity of ropes see H.2.2, page 24

It is also possible to use alternative **ropes** with a higher breaking strength (BL_{rope}) and less rope sections (n), as long as $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq BL_{required}}$

Required breaking loads for ropes:

10x10m model

Side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2184}$ **kg**
Side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 1632}$ **kg**

10x15m model

Long side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2796}$ **kg**
Long side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 1900}$ **kg**
Short side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2424}$ **kg**
Short side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 1764}$ **kg**

10x20m model

Long side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 3276}$ **kg**
Long side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2208}$ **kg**
Short side - combined: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2112}$ **kg**
Short side – V-ropes: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 1504}$ **kg**

I.3.2 Fasteners

Force acting on fasteners is equal to the force in belts or ropes. See these values in chapter I.3.1.

I.3.2.1 Side rope connection

I.3.2.1.1. Carabine, DIN5299C

Carabine 180x14, WLL 580kg → BL = 2 x 5.8 kN = 11.6 kN → Frd = BL / ɣm = 11.6 kN / 2 = 5.8 kN
F_d=5.52 kN

UC.3a	**F_d / F_{rd} < 1**	**5.52 / 5.8 = 0.95 ≤ 1**	**OK**

For capacity of carabines see K.5 Carabine, DIN 5299C, page 95

I.3.2.1.2. Rope ratchet

Ratchet, BL = 3.5 kN → Frd = BL / ɣm = 3.5 kN / 1.5 = 2.33 kN

10x10m	**UC.3b**	Side – combined rope	**F_d / F_{rd} < 1**	**5.46 / 3*x2.33= 0.78 < 1**	**OK**
10x15m	**UC.3c**	Long side – combined rope	**F_d / F_{rd} < 1**	**6.99 / 3*x2.33= 1.00 < 1**	**OK**
10x20m	**UC.3d**	Long side – combined rope	**F_d / F_{rd} < 1**	**8.19 / 4*x2.33= 0.88 < 1**	**OK**
10x15m	**UC.3e**	Short side – combined rope	**F_d / F_{rd} < 1**	**6.06 / 3*x2.33= 0.87 < 1**	**OK**
10x20m	**UC.3f**	Short side – combined rope	**F_d / F_{rd} < 1**	**5.28 / 3*x2.33= 0.76 < 1**	**OK**

For capacity of rope ratchet see K.6 Rope ratchet, page 95

* Number of cross sections making a rope. Ratchet is applied only on one cross-section.

I.4. Safety against overturning, sliding and uplifting - low wind in Netherlands

The calculation in this chapter provides a guideline for dense cohesion less soil, in case no anchor tests have been performed. Anchor tests on location can show that a different number of anchors or different size of anchors have sufficient capacity for the specific soil conditions. (see paragraph H.8.3)

Assumed anchor capacity Frd=5.1 kN (see H.8.1)

I.4.1 Required anchor pins

	Load combination	Element	Representative force	Design value force	Pag.
10x10m	CO5. Own weight + pretension + wind suction reduced	Side anchor point	3.80 kN	4.56 kN (γ = 1.2)	72
10x15m	CO5. Own weight + pretension + wind suction reduced	Long side anchor point	4.82 kN	5.78 kN (γ = 1.2)	73
10x20m	CO5. Own weight + pretension + wind suction reduced	Long side anchor point	5.71 kN	6.85 kN (γ = 1.2)	73
10x15m	CO5. Own weight + pretension + wind suction reduced	Short side anchor point	4.22 kN	5.06 kN (γ = 1.2)	73
10x20m	CO3. Own weight + pretension + wind pressure	Short side anchor point	3.72 kN	4.46 kN (γ = 1.2)	73
10x10m	CO5. Own weight + pretension + wind suction reduced	Corner anchor point	3.19 kN	3.83 kN (γ = 1.2)	72
10x15m	CO5. Own weight + pretension + wind suction reduced	Corner anchor point	3.51 kN	4.21 kN (γ = 1.2)	73
10x20m	CO5. Own weight + pretension + wind suction reduced	Corner anchor point	3.44 kN	4.13 kN (γ = 1.2)	73

Required anchor amount for dense cohesionless soil – **<u>10x10m model</u>**

Side guy ropes	1x	Ø30 x 1000 mm	F_d / F_{rd} = 4.56 / (1 x 5.10) = 0.89 ≤ 1	OK
Corner ties	1x	Ø30 x 1000 mm	F_d / F_{rd} = 3.83 / (1 x 5.10) = 0.75 < 1	OK

Required anchor amount for dense cohesionless soil – **<u>10x15m model</u>**

Long side guy ropes	2x	Ø30 x 1000 mm	F_d / F_{rd} = 5.78 / (2 x 5.10) = 0.57 < 1	OK
Short side guy ropes	1x	Ø30 x 1000 mm	F_d / F_{rd} = 5.06 / (1 x 5.10) = 0.99 < 1	OK
Corner ties	1x	Ø30 x 1000 mm	F_d / F_{rd} = 4.21 / (1 x 5.10) = 0.83 < 1	OK

Required anchor amount for dense cohesionless soil – **10x20m model**

Long side guy ropes	2x	Ø30 x 1000 mm	F_d / F_{rd} = 6.85 / (2 x 5.10) = 0.67 < 1	OK
Short side guy ropes	1x	Ø30 x 1000 mm	F_d / F_{rd} = 4.46 / (1 x 5.10) = 0.87 < 1	OK
Corner ties	1x	Ø30 x 1000 mm	F_d / F_{rd} = 4.13 / (1 x 5.10) = 0.81 < 1	OK

I.4.2 Required ballast

For calculation method see H.8.4.

10x10m model

Location	F_{rep} (γ = 1.2) (kN)	F_H (kN)	F_V (kN)	α °	Ballast for μ = 0.5 (concrete on concrete) (KG)	Ballast for μ = 0.6 (concrete on rubber or wood) (KG)
Long side guy ropes	4.56	3.22	3.22	*45*	*970*	*860*
Corner ties	3.83	2.71	2.71	*45*	*810*	*720*

10x15m model

Location	F_{rep} (γ = 1.2) (kN)	F_H (kN)	F_V (kN)	α °	Ballast for μ = 0.5 (concrete on concrete) (KG)	Ballast for μ = 0.6 (concrete on rubber or wood) (KG)
Long side guy ropes	5.78	4.09	4.09	*45*	*1230*	*1090*
Short side guy ropes	5.06	3.58	3.58	*45*	*1070*	*960*
Corner ties	4.21	2.98	2.98	*45*	*890*	*790*

10x20m model

Location	F_{rep} (γ = 1.2)	F_H	F_V	α	Ballast for μ = 0.5 (concrete on concrete)	Ballast for μ = 0.6 (concrete on rubber or wood)
	(kN)	(kN)	(kN)	°	(KG)	(KG)
Long side guy ropes	6.85	4.85	4.85	*45*	*1450*	*1290*
Short side guy ropes	4.46	3.10	3.10	*45*	*930*	*830*
Corner ties	4.13	2.92	2.92	*45*	*880*	*780*

J. Addition 2 – element check for combined wind and snow load [FR]

For stretchtent use in France, the static analysis must include a load combination including snow and wind loads, corresponding to article 7 of CTS. This addition represents changes in element checks and anchor and ballast determination if this load combination is considered. Stormbelts are always required.

J.1. Summary of results – snow+wind in France

This document is valid for five tent sizes: 10x10m, 10x15m, 10x20m, 10x12m and 9x12m. Although no separate calculation is made for 10x12m and 9x12m sizes, all elements, sizes and anchoring forces can be based on 10x15m model.

Changes that come from snow and wind combination are highlighted in orange.

General information:				
Main dimensions:		**10x10m**	**10x15m / 10x12m / 9x12m**	**10x20m**
	Width: Length: Side height of membrane: Max. height:	10m 10m 3m 4m	10m / 9m 15m / 12m 3m 4m	10m 20m 3m 4m
	Main poles: *	4.0m Ø105 mm [Spruce,C18]	4.0m Ø105 mm [Spruce,C18]	4.0m Ø105 mm [Spruce, C18]
	Side poles: *	3.0m Ø 75 mm [Spruce, C18]	3.0m Ø 80 mm [Spruce, C18]	3.0m Ø 80 mm [Spruce, C18]
	Corner poles: *	2.5m Ø 75 mm [Spruce, C18]	2.5m Ø 75 mm [Spruce, C18]	2.5m Ø 70 mm [Spruce, C18]
	Stormbelts:	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN
	Guy ropes:	Ø 8mm polyester, breaking strength ≥ 900 daN **	Ø 8mm polyester, breaking strength ≥ 900 daN **	Ø 8mm polyester, breaking strength ≥ 900 daN **
	Long side – combined:	4 sections	4 sections	4 sections
	Long side - V-ropes:	3 sections	3 sections	3 sections
	Short side – combined:	-------	4 sections	4 sections
	Short side - V-ropes:	-------	3 sections	3 sections
	Belts:	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN	50mm PES [EN 12195-2], LC=1000 daN
	Fasteners:	Carabine 180x14 M16 & M8 Eye bolt Ratchet, BL = 3.5 kN	Carabine 180x14 M16 & M8 Eye bolt Ratchet, BL = 3.5 kN	Carabine 180x14 M16 & M8 Eye bolt Ratchet, BL = 3.5 kN

	Side & corner pole base plate Main pole base plate	25x25cm 35x35cm	25x25cm 35x35cm	25x25cm 35x35cm
User load:	A maximum of 25 kg per main mast may be used for decorations, sound or lighting installations. The load must be applied centrally.			
Snow load:	A snow load of 0.1 kN/m² (4 cm) has been considered in accordance with the French CTS standard.			
Wind load:	According to EN 13782 The following pressure values have been used: h < 5m: 0.50kN/m² This value corresponds to wind force 8 on the Beaufort scale. Above this wind force (starting at wind force 9), the safety of the structure can no longer be guaranteed, and it must be evacuated.			

* The average diameter, as a minimum required at the middle of the pole.

** The required breaking load (BL_{tot}) may be achieved by using multiple rope sections (n): $BL_{rope} = BL_{tot} / n$, see page 57

Safety against sliding, overturning and uplifting:				
Anchor forces:	Assumptions: angle of 45 degrees The following design resistance of the anchor forces is required: (See H.8.3, page 67 for Anchor tests according to EN 13782)			
		10x10m	**10x15m / 10x12m / 9x12m**	**10x20m**
	Long side guy ropes: Short side guy ropes: Corner ties: Stormbelt:	6.05 kN (γ = 1.2) 4.73 kN (γ = 1.2) 6.74 kN (γ = 1.2)	6.24 kN (γ = 1.2) 6.28 kN (γ = 1.2) 5.06 kN (γ = 1.2) 7.21 kN (γ = 1.2)	6.92 kN (γ = 1.2) 6.70 kN (γ = 1.2) 5.32 kN (γ = 1.2) 7.12 kN (γ = 1.2)
Required anchors:	Based on dense, non-cohesive soil (e.g. sandy soils). In the case anchors **Ø30mm x 1000mm** (effective length) are being used:			
		10x10m	**10x15m / 10x12m / 9x12m**	**10x20m**
	Long side guy ropes: Short side guy ropes: Corner ties: Stormbelt:	2 anchors 1 anchor 2 anchors	2 anchors 2 anchors 1 anchor 2 anchors	2 anchors 2 anchors 1 anchor 2 anchors
Required ballast:	Ballast calculation is performed for 2 different situations: - Concrete on concrete – concrete ballasts are placed on concrete - Concrete on wood or rubber – concrete ballasts are placed on wood, or an anti-slip mat is placed underneath the ballast			
	10x10m			
			Concrete on concrete	Concrete on wood or rubber

Long side guy ropes: Corner ties: Stormbelt:	1280 kg 1000 kg 1430 kg	1140 kg 890 kg 1270 kg
10x15m / 10x12m / 9x12m		
	Concrete on concrete	Concrete on wood or rubber
Long side guy ropes: Short side guy ropes: Corner ties: Stormbelt:	1320 kg 1330 kg 1070 kg 1530 kg	1180 kg 1180 kg 960 kg 1360 kg
10x20m		
	Concrete on concrete	Concrete on wood or rubber
Long side guy ropes: Short side guy ropes: Corner ties: Stormbelt:	1470 kg 1420 kg 1130 kg 1510 kg	1310 kg 1260 kg 1000 kg 1340 kg

J.2. Cross sections

Profile	Material	Ø mm	G kg/m	A mm^2	I_y mm^4	$W_{el;y}$ mm^3
Ø ≈ 105 mm *	Wood C18	105	2.77	8659	5966602	113649
Ø ≈ 80 mm *	Wood C18	80	1.61	5026	2010619	50265
Ø ≈ 75 mm *	Wood C18	75	1.41	4418	1553156	41417

Table 37. Used cross sections

* The average diameter, as a minimum required at the middle of the pole.

J.3. Summary of forces

Further chapters include the calculation only for highlighted elements in the CO6 [FR] column if they show higher values than calculated in the previous chapters or if recalculating them show a clear difference in results. Other element checks can be looked up in H.7.

J.3.1 10x10m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.95	2.42	3.09	3.39	2.49	4.55
Weft	0.91	2.11	2.62	2.18	1.99	3.79
Edge	1.76	2.13	2.44	3.41	2.68	2.85
Main pole	-2.12	-5.41	-6.95	0.05	-0.08	-10.32
Side pole	-1.30	-2.43	-3.13	-2.02	-0.83	-4.33
Corner pole	-2.64	-3.38	-3.95	-4.52	-3.43	-4.75
Corner belt	2.10	2.50	2.86	3.94	3.19	3.33

Belts - side	0.12	0.47	0.70	0.35	0.16	1.13
Stormbelts	0.00	0.00	0.00	5.62	0.00	0.00
Combined rope - side	1.83	2.12	2.41	4.83	3.64	2.76
V-ropes - side	1.40	1.63	1.84	3.51	2.72	2.10
Reaction - side	1.94	2.59	3.10	5.04	3.80	3.94
Reaction - corner	2.10	2.50	2.86	3.94	3.19	3.36

Table 38. Summary of forces for 10x10m model

J.3.2 10x15m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.91	2.59	3.35	3.13	2.51	4.97
Weft	0.89	2.18	2.93	2.27	2.48	4.24
Edge	1.90	2.35	2.74	3.55	3.17	3.19
Main pole	-1.74	-4.96	-6.49	0.06	-0.02	-9.78
Side pole	-1.37	-2.74	-3.60	-2.47	-0.84	-4.99
Corner pole	-2.86	-3.81	-4.56	-4.77	-3.87	-5.50
Corner belt	2.31	2.85	3.28	4.22	3.51	3.81
Belts - long side	0.14	0.51	0.81	0.50	0.18	1.30
Belts - short side	0.12	0.56	0.84	0.22	0.18	1.37
Stormbelts	0.00	0.00	0.00	6.01	0.00	0.00
Combined rope - long side	2.11	2.59	3.04	4.70	4.66	3.50
V-ropes - long side	1.53	1.83	2.11	3.38	3.30	2.39
Combined rope - short side	1.92	2.38	2.77	5.01	4.04	3.21
V-ropes short side	1.45	1.80	2.09	3.64	2.94	2.41
Reaction - long side	2.22	3.08	3.83	5.20	4.82	4.83
Reaction - short side	2.04	2.92	3.60	5.23	4.22	4.62
Reaction - corner	2.31	2.85	3.28	4.22	3.51	3.85

Table 39. Summary of forces for 10x15m model

J.3.3 10x20m model

kN or kN/m	CO1	CO2	CO3	CO4	CO5 [NL]	CO6 [FR]
Warp	0.95	2.63	3.41	4.45	2.53	5.01
Weft	0.88	2.16	2.94	2.89	2.68	4.20
Edge	1.80	2.26	2.67	4.43	3.43	3.16
Main pole	-1.84	-5.15	-6.75	0.06	0.03	-10.07
Side pole	-1.35	-2.69	-3.55	-2.21	-0.80	-4.88
Corner pole	-2.73	-3.67	-4.43	-4.31	-3.63	-5.40
Corner belt	2.33	2.95	3.44	4.43	3.44	4.01
Belts - long side	0.22	0.70	1.01	0.57	0.26	1.50
Belts - short side	0.13	0.55	0.85	0.13	0.13	1.35
Stormbelts	0.00	0.00	0.00	5.93	0.00	0.00
Combined rope - long side	2.16	2.48	2.91	5.43	5.46	3.34
V-ropes - long side	1.50	1.76	2.05	3.91	3.68	2.28
Combined rope - short side	1.87	2.42	2.89	5.46	3.52	3.39
V-ropes short side	1.37	1.80	2.14	3.83	2.54	2.51
Reaction - long side	2.31	3.16	3.87	5.77	5.71	4.82

Reaction - short side	1.99	2.95	3.72	5.58	3.65	4.81
Reaction - corner	2.33	2.95	3.44	4.43	3.44	4.05

Table 40. Summary of forces for 10x20m model

J.4. Element check – snow + wind in France

J.4.1 Membrane

	Load combination	Element	Representative stress	Design value stress	Pag.
10x10m	CO1. Own weight + pretension	Long term warp	0.95 kN/m	1.28 kN/m (γ = 1.35)	82
10x10m	CO1. Own weight + pretension	Long term weft	0.91 kN/m	1.23 kN/m (γ = 1.35)	82
10x20m	CO6. Own weight + pretension + wind pressure + snow	Short term warp	5.01 kN/m	6.76 kN/m (γ = 1.35)	83
10x15m	CO6. Own weight + pretension + wind pressure + snow	Short term weft	4.24 kN/m	5.72 kN/m (γ = 1.35)	83

Sioen RP5639 fabric is being used.

UC.1a	Long term warp	S_{Ed} / S_{rd} < 1	1.28 / 9.6 = 0.13 < 1	OK
UC.1b	Long term weft	S_{Ed} / S_{rd} < 1	1.23 / 7.2 = 0.17 < 1	OK
UC.1c	Short term warp	S_{Ed} / S_{rd} < 1	6.76 / 12.0 = 0.56 < 1	OK
UC.1d	Short term weft	S_{Ed} / S_{rd} < 1	5.72 / 9.0 = 0.64 < 1	OK

For capacity of membrane see H.2.1, page 24

J.4.2 Main poles

	Load combinations	Element	Representative force	Design value force	Pag.
10x10m	CO6. Own weight + pretension + wind pressure + snow	Main pole 4.0m	-10.32 kN	-13.93 kN (γ = 1.35)	82

User load of max. 25 kg is applied, loaded centrically.

4.0m pole Ned = -10.32 x 1.35 + (-0.25 x 1.35) = -14.27 kN

J.4.2.1 4.0m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 105 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 4.00m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.2	4.0m	$\sigma_{c,0,d}$ / ($f_{c,0,d}$ x k_{cy}) = 1.65 / (12.46 x 0.132) = 1.01 ~ 1	Acceptable

See Annex G.4 Main pole 4.0m – Wood, Spruce C18 – for snow and wind combination [FR], on page 196 for the elaborate check

J.4.3 Side poles

J.4.3.1 10x10m model

	Load combinations	Element	Representative force	Design value force	Pag.
10x10m	CO6. Own weight + pretension + wind pressure + snow	Side pole 3.0m	-4.33 kN	-5.85 kN (γ = 1.5)	83

User load of max. 25 kg is applied, loaded centrically.
3m pole Ned = -4.33 x 1.35 + (-0.25 x 1.35) = -6.18 kN

J.4.3.1.1. 3m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 75 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 3.0m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.3	3m	$\sigma_{c,0,d}$ / ($f_{c,0,d}$ x k_{cy}) = 1.40 / (12.46 x 0.120) = 0.94 ≤ 1	OK

See Annex G.5 Side pole 3.0m – Wood, Spruce C18 – for snow and wind combination [FR], on page 197 for the elaborate check

J.4.3.2 10x15m and 10x20m model

	Load combinations	Element	Representative force	Design value force	Pag.
10x15m	CO6. Own weight + pretension + wind pressure + snow	Side pole 3.0m	-4.99 kN	-6.74 kN (γ = 1.5)	83

User load of max. 25 kg is applied, loaded centrically.
3m pole Ned = -4.99 x 1.35 + (-0.25 x 1.35) = -7.07 kN

J.4.3.2.1. 3m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 80 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 3.0m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.3	3m	$\sigma_{c,0,d}$ / ($f_{c,0,d}$ x k_{cy}) = 1.41 / (12.46 x 0.136) = 0.83 ≤ 1	OK

See Annex G.5 Side pole 3.0m – Wood, Spruce C18 – for snow and wind combination [FR], on page 197 for the elaborate check

J.4.4 Corner poles

	Load combinations	Element	Representative force	Design value force	Pag.
10x15m	CO6. Own weight + pretension + wind pressure + snow	Corner pole 2.5m	-5.50 kN	-7.43 kN (γ = 1.35)	83

User load of max. 25 kg is applied, loaded centrically.

2.5m corner pole Ned = -5.50 x 1.35 + (-0.25 x 1.35) = -7.76 kN

J.4.4.1 2.5m pole - Wood, Spruce C18

Profile = Pole, Ø ≈ 75 mm
average diameter, as a minimum required at the middle of the pole
Length = max. 2.5m
Quality = C18

The poles are considered as hinged poles; the buckling length is equivalent to the pole length.

UC.4	2.5m	$\sigma_{c,0,d} / (f_{c,0,d} \times k_{cy}) = 1.76 / (12.46 \times 0.170) = 0.80 < 1$	OK

See Annex G.6 Corner pole 2.5m – Wood, Spruce C18 – for snow and wind combination [FR], on page 199 for the elaborate check

J.4.5 Belts

	Load combination	Element	Representative force	Design value force	Pag.
10x20m	CO4. Own weight + pretension + wind suction	Corner belt	4.43 kN	6.65 kN (γ = 1.5)	83
10x20m	CO6. Own weight + pretension + wind pressure + snow	Belt – long side	1.50 kN	2.03 kN (γ = 1.35)	83
10x15m	CO6. Own weight + pretension + wind pressure + snow	Belt – short side	1.37 kN	1.85 kN (γ = 1.35)	83

J.4.5.1 Belt capacity check

PES belt with a breaking strength of 3000kg is being used.

UC.5a	Corner belt	1 PES belt with minimum BL = 3000 kg	F_d / F_{rd} < 1	6.65 / (1 x 15) = 0.44 < 1	OK
UC.5b	Belt – long side	1 PES belt with minimum BL = 3000 kg	F_d / F_{rd} < 1	2.03 / (1 x 15) = 0.14 < 1	OK
UC.5c	Belt – short side	1 PES belt with minimum BL = 3000 kg	F_d / F_{rd} < 1	1.85 / (1 x 15) = 0.12 < 1	OK

For capacity of belts see H.2.3, page 24

J.4.5.2 Alternative – rope capacity check

It is possible to use either a rope or a belt. Synthetic rope Ø8mm, BL 900 daN. Is being used → $F_{rd,8mm}$ = 2.25 kN.
In a case of using individual guy ropes, the ropes need to be tied back, creating multiple rope sections that together will take the load.

UC.5d	Corner rope	1 individual rope made of 3 sections Ø8mm	F_d / F_{rd} < 1	6.65 / (1 x 3 x 2.25) = 0.99 < 1	OK
UC.5e	Rope – long side	1 individual rope made of 1 section Ø8mm	F_d / F_{rd} < 1	2.13 / (1 x 1 x 2.25) = 0.95 < 1	OK
UC.5f	Rope – short side	1 individual rope made of 1 section Ø8mm	F_d / F_{rd} < 1	1.85 / (1 x 1 x 2.25) = 0.82 < 1	OK

For capacity of ropes see H.2.2, page 24

It is also possible to use alternative **ropes** with a higher breaking strength (BL_{rope}) and less rope sections (n), as long as $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq BL_{required}}$
Required breaking loads for ropes:
Corner rope: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 2660}$ **kg**
Rope – long side: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 852}$ **kg**
Rope – long side: $\mathbf{BL_{rope} \times n_{sections} \times n_{ropes} \geq 740}$ **kg**

J.4.6 Fasteners

Force acting on fasteners is equal to the force in belts or ropes. See these values in chapters H.7.6 and H.7.5.

J.4.6.1 Side belt connection

J.4.6.1.1. M12 Eye bolt, DIN580

For ≤45°:

M12, WLL 340kg → BL = 6 x 3.4 kN = 20.4 kN → Frd = BL / γ_m = 20.4 / 2 = 10.2 kN

F_d=2.13 kN

UC.6a	Corner eye bolt	F_d / F_{rd} < 1	2.13 / 10.2 = 0.21 < 1.0	OK

For capacity of eye bolts see K.3 Capacity of Eye bolts on page 94.

J.4.6.1.2. Carabine, DIN5299C

Carabine 180x14, WLL 580kg → BL = 2 x 5.8 kN = 11.6 kN → Frd = BL / γm = 11.6 kN / 2 = 5.8 kN

F_d=2.13 kN

UC.6b	**F_d / F_{rd} < 1**	**2.13 / 5.80 = 0.78 < 1**	**OK**

For capacity of carabines see K.5 Carabine, DIN 5299C, page 95

J.4.6.2 Base plate

J.4.6.2.1. Side pole & corner pole

See J.3 for the highest design pressure force. Poles are subjected only to compressive force.

The worst case is assumed – pole is located on soil:

- Soil (base plate size 25x25 cm, p_{soil} = 125 kN/m^2)

UC.6c	Soil	$\frac{F_d}{A}/p \leq 1$	**7.76 / (0.25*0.25) / 125 = 0.99 < 1**	**OK**

J.4.6.2.2. Main pole

See J.3 for the highest design pressure force. Poles are subjected only to compressive force.

The worst case is assumed – pole is located on soil:

- Soil (base plate size 35x35 cm, p_{soil} = 175 kN/m^2)

UC.6d	Soil	$\frac{F_d}{A}/p \leq 1$	**14.27 / (0.35*0.35) / 175 = 0.63 < 1**	**OK**

K. Material certificates

K.1. Fabric specifications

SIOEN FABRICS

Z.I. du Blanc Ballot, Avenue Urbino 6, B-7700 Mouscron - Tel +32(0)56 85 68 80 - Fax +32(0)56 34 61 31
sioenfabrics@sioen.be - http://www.sioen.com

Technical Data Sheet

RP5639

FLEXITENT SINGLE M2 (fiche provisoire) - Width 153 cm

Total weight / Poids total	730 [+/-10%] g/m²	ISO 3801/5 1977
Weight of fabric [PES] / Poids tissu [PES]	280 [+/-10] g/m²	ISO 3801/5 1977
Weight of coating [PU/PVC] / Poids enduction [PU/PVC]	450 [+/-10%] g/m²	ISO 3801/5 1977
Breaking strength warp Force de rupture chaîne	1200 N/5cm	ISO 13934 1999
Breaking strength weft Force de rupture trame	900 N/5cm	ISO 13934 1999
Breaking extension warp Allongement à la rupture chaîne	110 %	ISO 13934 1999
Breaking extension weft Allongement à la rupture trame	110 %	ISO 13934 1999
Tear strenght warp Résistance à la déchirure chaîne	100 N	ISO 4674A1 1977
Tear strenght weft Résistance à la déchirure trame	180 N	ISO 4674A1 1977
Adhesion warp / Adhérence chaîne	23 N/5cm	D41 1015
Adhesion weft / Adhérence trame	23 N/5cm	D41 1015
Waterproofness before washing Imperméabilité avant lavage	OK:2000 G M D mm	ISO 811 1981
Waterproofness after washing Imperméabilité après lavage	OK:2000 G M D mm	ISO 811 1981
Flammability / Inflammabilité	OK:M2 -	NF P 92-507 (2004)

May be cleaned with mild, PH neutral, non-ionogenic detergents. Certainly avoid solvent containing cleaning agents (alcohols, polar solvents,etc.). Testing is always advised before using cleaning agents.
After surface cleaning, please let air dry.

All our technical characteristics are indicative
Rev. 10/2012

K.2. Fabric fire certificate

INSTITUT TECHNOLOGIQUE
FCBA
Laboratoire d'essais feu
10 rue Galilée - 77420 Champs-sur-Marne

INSTITUT TECHNOLOGIQUE

Laboratoire agréé par le Ministère de l'Intérieur et de l'Aménagement du Territoire
JO du 10 février 2007
PROCES-VERBAL DE CLASSEMENT DE REACTION AU FEU
D'UN MATERIAU PREVU A L'ARTICLE 5
DE L'ARRETE DU 21 NOVEMBRE 2002

Page 1

N° CM - 21 - P - 096

et 1 annexe de 4 pages.

Valable 5 ans à compter du mardi 13 juillet 2021

Matériau présenté par : **SIOEN FABRICS SA**
Avenue Urbino 6

7700 MOUSCRON

Marque commerciale : **F5639**

Description sommaire:

Type de textile enduit tricot polyester enduit de PVC ignifugé

Composition support textile/ fabric 100% polyester (280 g/m²) + enduction/ coating PVC ignifugé (450 g/m²)

Masse surfacique 730 g/m²

Epaisseur 0,75 mm

Coloris tous coloris/ all colors

Nature de l'essai : Essai au brûleur électrique
Essai de persistance de flamme
Essai de gouttes

Classement : **M2**

Observations : /

Durabilité du classement (l'annexe 22) : Non limitée a priori

Usage : Revêtement de murs tendus, voilages, rideaux,… **Conditions d'entretien :** selon préconisations du client

Compte tenu des critères résultant des essais annexés décrits dans le(s) rapport(s) d'essais N° : *FE 21-0216-1182*

Ce procès-verbal atteste uniquement des caractéristiques de l'échantillon soumis aux essais et ne préjuge pas des caractéristiques de produits similaires. Il ne constitue donc pas une certification de produits au sens de l'article L.115-27 du code de la consommation et de la loi du 3 juin 1994.
NOTA : Seules sont autorisées les reproductions intégrales et par photocopies du présent procès-verbal de classement ou de l'ensemble du procès-verbal de classement et rapport(s) d'essais annexé(s).Ces conclusions ne portent que sur les performances de résistance / réaction au feu de l'élément objet du présent procès verbal de classement. Elles ne préjugent, en aucun cas, des autres performances liées à son incorporation à un ouvrage"

"Non valable pour toute application couverte par l'article AM 18 (Arrêté du 6 mars 2006) concernant les sièges rembourrés"

Champs-sur-Marne, le vendredi 23 juillet 2021

Technicien d'essais du Laboratoire Feu
Bilel HAMILA

Responsable Technique du laboratoire Feu du Pôle Ameublement
Clotilde ETIEMVRE

INSTITUT TECHNOLOGIQUE FCBA · LABORATOIRE ESSAIS ET MESURES · CHAMPS-SUR-MARNE

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APE 7219 Z
Code TVA CEE : FR 14 775 680 903

Institut technologique FCBA : Forêt, Cellulose, Bois - construction, Ameublement

INSTITUT TECHNOLOGIQUE
FCBA
Fire Laboratory
10 rue Galilée - 77420 Champs-sur-Marne

Laboratory approved by the Ministry for the Interior
JO of February 10, 2007
OFFICIAL REPORT OF CLASSIFICATION OF FIRE PERFORMANCE
Of A MATERIAL ENVISAGED IN ARTICLE 5
DECREE OF November 21, 2002

N° CM - 21 - P - 096

et 1 annexe de 4 pages.

Valid 5 years as from mardi 13 juillet 2021

Material presents by : **SIOEN FABRICS SA**
Avenue Urbino 6
7700 MOUSCRON

Trade mark: **F5639**

Summary description

Kind of coating fabric tricot polyester enduit de PVC ignifugé
Composition support textile/ fabric 100% polyester (280 g/m²) + enduction/ coating PVC ignifugé (450 g/m²)

Mass per unit area 730 g/m²
Tickness 0,75 mm
Color tous coloris/ all colors

Nature of the test : Electrical burner test
Flame persistence
Dripping test

Classification : **M2**

Observations : /

Durability of the classification (Article 5 de l'annexe 2) Not limited

Usual term Walls hung covering, sheers, curtains,… **Cleaning conditions** Recommendation of Customer

Taking into account the criteria resulting from the tests annexed described in the test report N° *FE 21-0216-1182*

This official report attests only characteristics of the sample submitted for testing and does not prejudge similar characteristics of products. It thus does not constitute a certification of products within the meaning of the L.115-27 article of the code of the consumption and the law of June 3rd, 1994.
NOTE: The integral reproductions and by photocopy of this official report of classification are only authorized or the official report unit of classification and report of annexed test. These conclusions relate only to the resistance / reaction to fire performance of the element that is the subject of the present classification report. They do not prejudge, in any case, other performances related to its incorporation to a work *

"Not legally acceptable for any use under the pretence of the article AM 18 (Decree of March 6th, 2006) for upholstered seat"

Champs-sur-Marne, le vendredi 23 juillet 2021

Technicien d'essais du Laboratoire Feu
Bilel HAMILA

Responsable Technique du laboratoire Feu du Pôle Ameublement
Clotilde ETIEMVRE

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Only the french version remains valid
Institut technologique FCBA : Forêt, Cellulose, Bois - construction, Ameublement

K.3. Capacity of Eye bolts

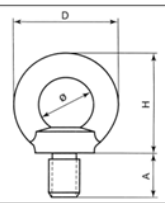
Karta techniczna Nr 2GM/KAR

1. Nazwa dostawcy: **„GÓRALMET" M. i J. Góral Sp. J.** Adres dostawcy: **ul. Krakowska 68, 32-860 Czchów, tel/fax 014 6635260**

2. Nazwa wyrobu: **GM580 Śruba z uchem**

3. Opis i przeznaczenie: Śruba stalowa kuta z uchem, z gwintem metrycznym zwykłym prawym, do wykorzystania jako punkt mocujący do podnoszenia przedmiotów, materiałów i towarów, a także do innych zastosowań, w zakresie parametrów technicznych podanych w punkcie 5 i wymagań Dyrektywy 2006/42/WE

4. Dopuszczalne obciążenia robocze w kolumnie 11 i punkcie 6 podano dla normalnych warunków użytkowania. Przy zastosowaniu wyrobu w wyjątkowo niebezpiecznych warunkach, zakres zastosowania i redukcję dopuszczalnego obciążenia roboczego należy uzgodnić z dostawcą. Przechowywanie i montaż - zgodnie z instrukcją montażu i stosowania elementów osprzętu do podnoszenia.



5. Parametry techniczne wyrobu:

LP.	Rozmiar	Wymiary nominalne [mm]							Masa [kg/szt]	WLL Obciążenie robocze [t]*	MPF Siła próby [kN]	BF Siła niszcząca [min. kN]	Materiał	Powłoki
		D	Ø	H	A	-	-	-						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**M6**	36	20	36	13	-	-	-	0,052	0,09	1,77	5,3	C15	Ocynk elektrolityczny
2	**M8**	36	20	36	13	-	-	-	0,054	0,14	2,75	8,2		
3	**M10**	45	25	45	17	-	-	-	0,099	0,23	4,51	13,5		
4	**M12**	54	30	53	20,5	-	-	-	0,164	0,34	6,67	20,0		
5	**M14**	54	30	53	20,5	-	-	-	0,171	0,50	9,81	29,4		
6	**M16**	63	35	62	27	-	-	-	0,288	0,70	13,73	41,2		
7	**M18**	63	35	62	27	-	-	-	0,300	0,93	18,24	54,7		
8	**M20**	72	40	71	30	-	-	-	0,457	1,20	23,54	70,6		
9	**M22**	72	40	71	30	-	-	-	0,463	1,50	29,42	88,3		
10	**M24**	90	50	90	36	-	-	-	0,874	1,80	35,30	105,9		
11	**M27**	90	50	90	36	-	-	-	0,936	2,50	49,03	147,1		
12	**M30**	108	60	109	45	-	-	-	1,626	3,60	70,61	211,8		

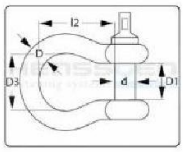
6. Informacje dodatkowe:

- Współczynnik bezpieczeństwa – 6 (*dla obciążenia wzdłuż osi gwintu). Dopuszczalne obciążanie siłą równoległą do płaszczyzny ucha pod kątem do 45° od osi gwintu pod warunkiem redukcji WLL o 30%, lub pod kątem 45° do 90° przy redukcji WLL o 50%. Zabrania się obciążania śruby prostopadle do płaszczyzny ucha. Podane obciążenia są ważne tylko dla prawidłowo zamontowanego wyrobu, tj. gdy gwint śruby jest całkowicie wkręcony w otwór montażowy, a kołnierz śruby spoczywa na powierzchni nośnej
- MPF=2,0 x g x WLL, BF =6,0 x g x WLL gdzie g - przyspieszenie ziemskie w m/s² (tj. 9,80665)
- Kod identyfikacyjny producenta i produktu: GM580
- Cechowanie: symbol producenta – GMG; CE ; kod materiału – C15; rozmiar; WLL....T
- Informacje dodatkowe – etykieta: CE ; nazwa wyrobu; rozmiar; ilość szt.; numer dostawy; dane producenta i adres strony internetowej.

K.4. Capacity of Orange Pin 1 Ton D-sluiting, DIN EN 13889

Orange Pin®

50001



DIN EN 13889
U.S. Fed. Spec. RR-C-271
Quality class = 6

	name	Ident Nr.	materiaal	kleur	oppervlakte	d in mm	D in mm	D inch	D1 in mm	D3 in mm	l2 in mm	SWL /WLL daN	gewicht g	VE			
	50001-00,50	933729	HS	orange pin	fe	8	6,5	1/4	11	19	28	500	48	25	1.00	stuks	aanvragen
	50001-00,75	933730	HS	orange pin	fe	10	8	5/16	12	21	31	750	78	25	1.00	stuks	aanvragen
	50001-01,00	933731	HS	orange pin	fe	11	10	3/8	17	26	35	1000	136	1	1.00	stuks	aanvragen
	50001-01,50	933732	HS	orange pin	fe	12	13	7/16	18	30	42	1500	178	1	1.00	stuks	aanvragen
	50001-02,00	933733	HS	orange pin	fe	16	13,5	1/2	20	32	47	2000	300	1	1.00	stuks	aanvragen

K.5. Carabine, DIN 5299C

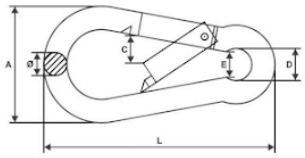
Karta Techniczna Nr 10GM/KAR

1. Nazwa dostawcy: **„GÓRALMET" M. i J. Góral Sp. J.** Adres dostawcy: **ul. Krakowska 68, 32-860 Czchów, tel/fax 014 6635260**

2. Nazwa wyrobu: **Karabińczyk do lin 5299C**

3. Opis i przeznaczenie: Zatrzaśniki stalowe, służące jako elementy łączące w zakończeniach lin, łańcuchów gospodarczych, oraz do innych zastosowań ogólnych. Do stosowania w zakresie parametrów technicznych podanych w punkcie 5.

4. Karabińczyki do lin nie mogą być użyte w zastosowaniach posiadających inne - uregulowane prawem czy normami wymagania bezpieczeństwa, np. do podnoszenia ładunków, jako środek do ochrony indywidualnej przed upadkiem z wysokości, lub osprzęt alpinistyczny. Nie przeciążać ponad wartość WLL (kG) podaną w kolumnie 13.



5. Parametry techniczne wyrobu:

LP.	Rozmiar [mm]	Wymiary nominalne [mm]									Masa [kg/szt]	WLL Obciążenie robocze [kG]	BF Siła niszcząca [min. kG]	Materiał	Powłoki
		A [mm]	C min [mm]	D [mm]	E min [mm]	Ø [mm]	L [mm]	---	---	---					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	**4**	19,5	4,5	6	4,5	3,9	40	---	---	---	0,008	70	140	C10 ~ C15	Ocynk elektrolityczny
2	**5**	24	5,5	7,5	5,5	4,8	50	---	---	---	0,015	100	200		
3	**6**	29	8	8,5	6	5,5	60	---	---	---	0,023	120	240		
4	**7**	34	9	10,5	8,5	6,7	70	---	---	---	0,040	180	360		
5	**8**	39	10	11,5	9	7,4	80	---	---	---	0,056	230	460		
6	**9**	44	11	13,5	10	8,4	90	---	---	---	0,083	250	500		
7	**10**	48	11,5	14,5	11	9,4	100	---	---	---	0,115	350	700		
8	**11**	57	17	17,5	13	10,7	120	---	---	---	0,179	400	800		
9	**12**	67	22	20	15	11,5	140	---	---	---	0,246	450	900		
10	**13**	80	26	21	17	12,6	160	---	---	---	0,343	530	1060		
11	**14**	87	28	24	20	13,6	180	---	---	---	0,443	580	1160		
12	**15**	98	32	24	20	14,7	200	---	---	---	0,563	700	1400		

6. Informacje dodatkowe:
- Współczynnik bezpieczeństwa - 2
- BF =2,0 x WLL
- Cechowanie: symbol producenta – GM lub GMG; kod rozmiaru
- Informacje dodatkowe – etykieta: nazwa wyrobu; rozmiar; ilość szt.; numer dostawy; dane producenta i adres strony internetowej.

K.6. Rope ratchet

3/8" Rope Ratchet

Carolina North Manufacturing

10022

$10.89 ~~$12.89~~

Maximum load limit 250 lbs. Outer casings are made from #6-33% glass filled nylon with interior mechanisms of die cast zinc. Perfect for large jobs:

- heavy loads for transport
- hoisting items
- straightening items
- securing objects under tension
- product weight 0.16 lbs

Product is compatible with our 3/8" S-hooks and 3/8" solid braided rope.

Bulk purchasing options available.

ADD TO CART | BUY IT NOW

Share:

Collections: Bulk Rope Ratchets

Type: Bulk Ratchet

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Annex A. Software input (load combination) – 10x10m model

Annex A.1. CO1. Own weight + pretension

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.7115        0.009063
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0291        0.000371
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4864       97.285966
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4836       96.722595
-----------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -1.7107
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------------------
       SUM                                            0.0000         0.0000         0.0000
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------
       SUM     AREA-LOADS                0.0000         0.0000         0.0000
-----------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===================================================================================
                                          SUM_X          SUM_Y          SUM_Z
===================================================================================
                                         0.0000         0.0000        -1.7107
===================================================================================
```

```
Inner Energy=            1.574062


StatikD:  Sum of external loads:       0.000000       0.000000      -1.710614
StatikD:  Sum of support forces:       0.000004       0.000011       1.710763
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x10\CO1_OW+VO
StatikD: Time of calculation:       0.24s
StatikD: Version 2025.38 done.
```

Annex A.2. CO2. Own weight + pretension + conventional / snow

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.7115        0.009063
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0291        0.000371
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4864       97.285966
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4836       96.722595
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -1.7107
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1000      1.00         0.0000         0.0000        -9.4121          94.12
-----------------------------------------------------------------------------------------------------------------------
       SUM                                                        0.0000         0.0000        -9.4121
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------------
       SUM         SCHNEE                 0.0000         0.0000        -9.4121
-----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------
       SUM     AREA-LOADS                 0.0000         0.0000        -9.4121
-----------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===================================================================================
                                          SUM_X          SUM_Y          SUM_Z
===================================================================================
                                         0.0000         0.0000       -11.1227
===================================================================================
```

```
Inner Energy=            2.607481


StatikD:  Sum of external loads:       0.000000       0.000000     -11.122765
StatikD:  Sum of support forces:       0.000003       0.000012      11.124678
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x10\CO2_OW+VO+SNOW
StatikD: Time of calculation:       0.27s
StatikD: Version 2025.38 done.
```

Annex A.3. CO3. Own weight + pretension + wind pressure

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.7115        0.009063
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0291        0.000371
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4864       97.285966
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4836       96.722595
-----------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -1.7107
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------
         1           WIND   -0.1500      1.00        -0.0000         0.0000       -14.1181          98.07
-----------------------------------------------------------------------------------------------------------------
       SUM                                           -0.0000         0.0000       -14.1181
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM          WIND                 -0.0000         0.0000       -14.1181
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS                -0.0000         0.0000       -14.1181
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                         -0.0000         0.0000       -15.8288
===============================================================================
```

```
Inner Energy=            3.515106


StatikD:  Sum of external loads:      -0.000001       0.000001     -15.828783
StatikD:  Sum of support forces:       0.000007       0.000009      15.829106
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x10\CO3_OW+VO+WD
StatikD: Time of calculation:       0.28s
StatikD: Version 2025.38 done.
```

Annex A.4. CO4. Own weight + pretension + wind suction

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.7115        0.009063
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0385        0.000491
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4864       97.285966
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4836       96.722595
-------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -1.7200
-------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------------
         1           WIND    0.3500      1.00        -0.0013        -0.0041        32.9139          98.05
-------------------------------------------------------------------------------------------------------------------
       SUM                                           -0.0013        -0.0041        32.9139
-------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM          WIND                 -0.0013        -0.0041        32.9139
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS                -0.0013        -0.0041        32.9139
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                        -0.0013        -0.0041        31.1939
===============================================================================
```

```
Inner Energy=            7.087801


StatikD:  Sum of external loads:      -0.001328      -0.004069      31.193895
StatikD:  Sum of support forces:       0.001270       0.004033     -31.194731
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x10\CO4_OW+VO+WU
StatikD: Time of calculation:       0.99s
StatikD: Version 2025.38 done.
```

Annex A.5. CO5. Own weight + pretension + wind suction reduced [NL]

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.7115        0.009063
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0291        0.000371
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4864       97.285966
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4836       96.722595
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -1.7107
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------------
         1           WIND    0.1750      1.00         0.0000        -0.0000        16.4711          98.07
-------------------------------------------------------------------------------------------------------------------
       SUM                                            0.0000        -0.0000        16.4711
-------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM          WIND                 0.0000        -0.0000        16.4711
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS                0.0000        -0.0000        16.4711
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                         0.0000        -0.0000        14.7605
===============================================================================
```

```
Inner Energy=            4.086116


StatikD:  Sum of external loads:      -0.000003      -0.000004      14.760512
StatikD:  Sum of support forces:       0.000000       0.000005     -14.760568
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x10\CO5_OW+VO+WU_red
StatikD: Time of calculation:       1.98s
StatikD: Version 2025.38 done.
```

Annex A.6. CO6. Own weight + pretension + wind pressure + snow [FR]

Annex A.6.1. For element check

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.7115        0.009063
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0291        0.000371
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4864       97.285966
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4836       96.722595
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -1.7107
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1000      1.00         0.0000         0.0000        -9.4121          94.12
         1           WIND   -0.1500      1.00        -0.0000         0.0000       -14.1181          98.07
-----------------------------------------------------------------------------------------------------------------------
       SUM                                           -0.0000         0.0000       -23.5302
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------------------
                LOADMODE                    SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------------------
       SUM         SCHNEE                   0.0000         0.0000        -9.4121
-----------------------------------------------------------------------------------------
       SUM           WIND                  -0.0000         0.0000       -14.1181
-----------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
       SUM     AREA-LOADS                  -0.0000         0.0000       -23.5302
-----------------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=========================================================================================
                                            SUM_X          SUM_Y          SUM_Z
=========================================================================================
                                          -0.0000         0.0000       -25.2409
=========================================================================================
```

```
Inner Energy=            5.265614


StatikD:  Sum of external loads:      -0.000001       0.000001     -25.240880
StatikD:  Sum of support forces:       0.000009       0.000008      25.240553
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x10\CO6_OW+VO+WD+SNOW
StatikD: Time of calculation:       0.30s
StatikD: Version 2025.38 done.
```

Annex A.6.2. For anchor and ballast calculation

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.7115        0.009063
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0291        0.000371
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4864       97.285966
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.4836       96.722595
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -1.7107
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1083      1.00         0.0000         0.0000       -10.1961          94.12
         1           WIND   -0.1500      1.00        -0.0000         0.0000       -14.1181          98.07
-------------------------------------------------------------------------------------------------------------------
       SUM                                           -0.0000         0.0000       -24.3142
-------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------
       SUM         SCHNEE                 0.0000         0.0000       -10.1961
-----------------------------------------------------------------------------
       SUM           WIND                -0.0000         0.0000       -14.1181
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
       SUM     AREA-LOADS                -0.0000         0.0000       -24.3142
-----------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=============================================================================
                                          SUM_X          SUM_Y          SUM_Z
=============================================================================
                                         -0.0000         0.0000       -26.0249
=============================================================================
```

```
Inner Energy=            5.420759


StatikD:  Sum of external loads:      -0.000001       0.000001     -26.024883
StatikD:  Sum of support forces:       0.000009       0.000009      26.026117
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x10\CO6a_OW+VO+WD+SNOW_anchors
StatikD: Time of calculation:       0.24s
StatikD: Version 2025.38 done.
```

Annex B. Software input (load combination) – 10x15m model

Annex B.1. CO1. Own weight + pretension

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.9460        0.012051
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0393        0.000500
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7673      153.469253
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7628      152.565787
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -2.5155
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------------------------------------
       SUM                                          0.0000         0.0000         0.0000
-------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
       SUM     AREA-LOADS                 0.0000         0.0000         0.0000
-----------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=============================================================================
                                          SUM_X          SUM_Y          SUM_Z
=============================================================================
                                         0.0000         0.0000        -2.5155
=============================================================================
```

```
Inner Energy=            2.345706


StatikD:  Sum of external loads:       0.000000       0.000000      -2.515503
StatikD:  Sum of support forces:      -0.002219      -0.001612       2.515072
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x15\CO1_OW+VO
StatikD: Time of calculation:       0.68s
StatikD: Version 2025.38 done.
```

Annex B.2. CO2. Own weight + pretension + conventional / snow

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.9460        0.012051
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0393        0.000500
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7673      153.469253
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7628      152.565787
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -2.5155
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1000      1.00         0.0000         0.0000       -14.8990         148.99
-------------------------------------------------------------------------------------------------------------------
       SUM                                            0.0000         0.0000       -14.8990
-------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM         SCHNEE                 0.0000         0.0000       -14.8990
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS                 0.0000         0.0000       -14.8990
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                         0.0000         0.0000       -17.4145
===============================================================================
```

```
Inner Energy=            4.245182


StatikD:  Sum of external loads:       0.000000       0.000000     -17.414544
StatikD:  Sum of support forces:      -0.002619       0.001603      17.415259
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x15\CO2_OW+VO+SNOW
StatikD: Time of calculation:       1.13s
StatikD: Version 2025.38 done.
```

Annex B.3. CO3. Own weight + pretension + wind pressure

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.9460        0.012051
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0393        0.000500
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7673      153.469253
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7628      152.565787
-----------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -2.5155
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------
         1           WIND   -0.1500      1.00         0.0042         0.0084       -22.3486         154.64
-----------------------------------------------------------------------------------------------------------------
       SUM                                            0.0042         0.0084       -22.3486
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------
       SUM          WIND                 0.0042         0.0084       -22.3486
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
       SUM     AREA-LOADS                0.0042         0.0084       -22.3486
-----------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=============================================================================
                                          SUM_X          SUM_Y          SUM_Z
=============================================================================
                                         0.0042         0.0084       -24.8641
=============================================================================
```

```
Inner Energy=            5.886284


StatikD:  Sum of external loads:       0.004168       0.008447     -24.864059
StatikD:  Sum of support forces:      -0.005342      -0.006802      24.865402
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x15\CO3_OW+VO+WD
StatikD: Time of calculation:       1.23s
StatikD: Version 2025.38 done.
```

Annex B.4. CO4. Own weight + pretension + wind suction

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.9460        0.012051
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0586        0.000747
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7673      153.469253
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7628      152.565787
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -2.5349
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------------------
         1           WIND    0.3500      1.00        -0.0091        -0.0203        52.0521         154.58
-------------------------------------------------------------------------------------------------------------------------
       SUM                                           -0.0091        -0.0203        52.0521
-------------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM           WIND                -0.0091        -0.0203        52.0521
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS                -0.0091        -0.0203        52.0521
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                        -0.0091        -0.0203        49.5172
===============================================================================
```

```
Inner Energy=           11.014835


StatikD:  Sum of external loads:      -0.009041      -0.020279      49.517238
StatikD:  Sum of support forces:       0.009277       0.019985     -49.516573
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x15\CO4_OW+VO+WU
StatikD: Time of calculation:       2.25s
StatikD: Version 2025.38 done.
```

Annex B.5. CO5. Own weight + pretension + wind suction reduced [NL]

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.9460        0.012051
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0393        0.000500
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7673      153.469253
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7628      152.565787
-----------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -2.5155
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------
         1           WIND    0.1750      1.00        -0.0049        -0.0098        26.0733         154.64
-----------------------------------------------------------------------------------------------------------
       SUM                                           -0.0049        -0.0098        26.0733
-----------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM          WIND                -0.0049        -0.0098        26.0733
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS               -0.0049        -0.0098        26.0733
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                        -0.0049        -0.0098        23.5579
===============================================================================
```

```
Inner Energy=            7.521792


StatikD:  Sum of external loads:      -0.004882      -0.009859      23.557848
StatikD:  Sum of support forces:       0.006997       0.018128     -23.596153
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x15\CO5_OW+VO+WU_red
StatikD: Time of calculation:       2.12s
StatikD: Version 2025.38 done.
```

Annex B.6. CO6. Own weight + pretension + wind pressure + snow [FR]

Annex B.6.1. For element check

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.9460        0.012051
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0393        0.000500
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7673      153.469253
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7628      152.565787
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -2.5155
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1000      1.00         0.0000         0.0000       -14.8990         148.99
         1           WIND   -0.1500      1.00         0.0042         0.0084       -22.3486         154.64
-----------------------------------------------------------------------------------------------------------------------
       SUM                                            0.0042         0.0084       -37.2476
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------------------
                LOADMODE                   SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------------------
       SUM         SCHNEE                 0.0000         0.0000       -14.8990
-----------------------------------------------------------------------------------------
       SUM           WIND                 0.0042         0.0084       -22.3486
-----------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
       SUM     AREA-LOADS                 0.0042         0.0084       -37.2476
-----------------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=========================================================================================
                                           SUM_X          SUM_Y          SUM_Z
=========================================================================================
                                          0.0042         0.0084       -39.7631
=========================================================================================
```

```
Inner Energy=            8.975232


StatikD:  Sum of external loads:       0.004168       0.008447     -39.763095
StatikD:  Sum of support forces:      -0.006145      -0.008567      39.762601
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x15\CO6_OW+VO+WD+SNOW
StatikD: Time of calculation:       1.43s
StatikD: Version 2025.38 done.
```

Annex B.6.2. For anchor and ballast calculation

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE     FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.9460        0.012051
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0393        0.000500
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7673      153.469253
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.7628      152.565787
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -2.5155
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1083      1.00         0.0000         0.0000       -16.1401         148.99
         1           WIND   -0.1500      1.00         0.0042         0.0084       -22.3486         154.64
-----------------------------------------------------------------------------------------------------------------------
       SUM                                            0.0042         0.0084       -38.4887
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------------------
                 LOADMODE                    SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------------------
       SUM         SCHNEE                   0.0000         0.0000       -16.1401
-----------------------------------------------------------------------------------------
       SUM           WIND                   0.0042         0.0084       -22.3486
-----------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
       SUM     AREA-LOADS                   0.0042         0.0084       -38.4887
-----------------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=========================================================================================
                                            SUM_X          SUM_Y          SUM_Z
=========================================================================================
                                           0.0042         0.0084       -41.0042
=========================================================================================
```

```
Inner Energy=            9.248682


StatikD:  Sum of external loads:       0.004168       0.008447     -41.004176
StatikD:  Sum of support forces:      -0.005850      -0.008439      41.004555
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x15\CO6a_OW+VO+WD+SNOW_anchors
StatikD: Time of calculation:       1.46s
StatikD: Version 2025.38 done.
```

Annex C. Software input (load combination) – 10x20m model

Annex C.1. CO1. Own weight + pretension

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -1.1806        0.015039
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0494        0.000629
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9720      194.398401
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9663      193.267579
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -3.1683
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------------------------------
       SUM                                            0.0000         0.0000         0.0000
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------------
-----------------------------------------------------------------------------------
       SUM     AREA-LOADS                0.0000         0.0000         0.0000
-----------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===================================================================================
                                          SUM_X          SUM_Y          SUM_Z
===================================================================================
                                         0.0000         0.0000        -3.1683
===================================================================================
```

```
Inner Energy=            2.667523


StatikD:  Sum of external loads:       0.000000       0.000000      -3.168216
StatikD:  Sum of support forces:      -0.001067      -0.000072       3.167956
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x20\CO1_OW+VO
StatikD: Time of calculation:       0.93s
StatikD: Version 2025.38 done.
```

Annex C.2. CO2. Own weight + pretension + conventional / snow

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -1.1806        0.015039
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0494        0.000629
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9720      194.398401
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9663      193.267579
-----------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -3.1683
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1000      1.00         0.0000         0.0000       -18.8287         188.29
-----------------------------------------------------------------------------------------------------------------
       SUM                                            0.0000         0.0000       -18.8287
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------
       SUM         SCHNEE                 0.0000         0.0000       -18.8287
-----------------------------------------------------------------------------
-----------------------------------------------------------------------------
       SUM     AREA-LOADS                 0.0000         0.0000       -18.8287
-----------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=============================================================================
                                          SUM_X          SUM_Y          SUM_Z
=============================================================================
                                         0.0000         0.0000       -21.9970
=============================================================================
```

```
Inner Energy=            4.932091


StatikD:  Sum of external loads:       0.000000       0.000000     -21.996996
StatikD:  Sum of support forces:      -0.003667      -0.001001      21.997637
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x20\CO2_OW+VO+SNOW
StatikD: Time of calculation:       1.35s
StatikD: Version 2025.38 done.
```

Annex C.3. CO3. Own weight + pretension + wind pressure

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -1.1806        0.015039
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0494        0.000629
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9720      194.398401
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9663      193.267579
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -3.1683
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------
         1           WIND   -0.1500      1.00         0.0004         0.0148       -28.2431         195.79
-------------------------------------------------------------------------------------------------------------
       SUM                                            0.0004         0.0148       -28.2431
-------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM           WIND                 0.0004         0.0148       -28.2431
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS                 0.0004         0.0148       -28.2431
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                         0.0004         0.0148       -31.4113
===============================================================================
```

```
Inner Energy=            6.986727


StatikD:  Sum of external loads:       0.000460       0.014788     -31.411354
StatikD:  Sum of support forces:      -0.002743      -0.011967      31.411551
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x20\CO3_OW+VO+WD
StatikD: Time of calculation:       1.54s
StatikD: Version 2025.38 done.
```

Annex C.4. CO4. Own weight + pretension + wind suction

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -1.1806        0.015039
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0688        0.000877
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9720      194.398401
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9663      193.267579
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -3.1877
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------------
         1           WIND    0.3500      1.00        -0.0032        -0.0323        65.8053         195.75
-------------------------------------------------------------------------------------------------------------------
       SUM                                           -0.0032        -0.0323        65.8053
-------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM          WIND                -0.0032        -0.0323        65.8053
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS               -0.0032        -0.0323        65.8053
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                        -0.0032        -0.0323        62.6176
===============================================================================
```

```
Inner Energy=           14.312429


StatikD:  Sum of external loads:      -0.003195      -0.032267      62.617612
StatikD:  Sum of support forces:      -0.001255       0.032404     -62.605597
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x20\CO4_OW+VO+WU
StatikD: Time of calculation:       2.71s
StatikD: Version 2025.38 done.
```

Annex C.5. CO5. Own weight + pretension + wind suction reduced [NL]

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -1.1806        0.015039
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0494        0.000629
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9720      194.398401
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9663      193.267579
-----------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -3.1683
-----------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-------------------------------------------------------------------------------------------------------------
         1           WIND    0.1750      1.00        -0.0005        -0.0172        32.9503         195.79
-------------------------------------------------------------------------------------------------------------
       SUM                                          -0.0005        -0.0172        32.9503
-------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-------------------------------------------------------------------------------
                LOADMODE                  SUM_X          SUM_Y          SUM_Z
-------------------------------------------------------------------------------
       SUM          WIND                -0.0005        -0.0172        32.9503
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
       SUM     AREA-LOADS               -0.0005        -0.0172        32.9503
-------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
===============================================================================
                                          SUM_X          SUM_Y          SUM_Z
===============================================================================
                                        -0.0005        -0.0172        29.7820
===============================================================================
```

```
Inner Energy=            9.377589


StatikD:  Sum of external loads:      -0.000487      -0.017266      29.782032
StatikD:  Sum of support forces:      -0.001501       0.018529     -29.791202
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x20 - final\CO5_OW+VO+WU_red
StatikD: Time of calculation:       3.07s
StatikD: Version 2025.38 done.
```

Annex C.6. CO6. Own weight + pretension + wind pressure + snow [FR]

Annex C.6.1. For element check

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -1.1806        0.015039
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0494        0.000629
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9720      194.398401
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9663      193.267579
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -3.1683
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1000      1.00         0.0000         0.0000       -18.8287         188.29
         1           WIND   -0.1500      1.00         0.0004         0.0148       -28.2431         195.79
-----------------------------------------------------------------------------------------------------------------------
       SUM                                            0.0004         0.0148       -47.0718
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------------------
                LOADMODE                    SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------------------
       SUM         SCHNEE                  0.0000         0.0000       -18.8287
-----------------------------------------------------------------------------------------
       SUM           WIND                  0.0004         0.0148       -28.2431
-----------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
       SUM     AREA-LOADS                  0.0004         0.0148       -47.0718
-----------------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=========================================================================================
                                            SUM_X          SUM_Y          SUM_Z
=========================================================================================
                                           0.0004         0.0148       -50.2401
=========================================================================================
```

```
Inner Energy=           10.819541


StatikD:  Sum of external loads:       0.000460       0.014788     -50.240093
StatikD:  Sum of support forces:      -0.004591      -0.012770      50.240338
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x20\CO6_OW+VO+WD+SNOW
StatikD: Time of calculation:       1.56s
StatikD: Version 2025.38 done.
```

Annex C.6.2. For anchor and ballast calculation

```
EXTERNAL LOADS (AUTOMATIC SELFWEIGHT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
     LOADGROUP       LOADMODE    FACTOR  VOLUME/AREA(P.U)          SUM_X          SUM_Y          SUM_Z     VOLUME/AREA
-----------------------------------------------------------------------------------------------------------------------
        STRUTS     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -1.1806        0.015039
        CABLES     SELFWEIGHT      1.00         78.500000         0.0000         0.0000        -0.0494        0.000629
 MEM-LINKS1000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9720      194.398401
 MEM-LINKS2000     SELFWEIGHT      1.00          0.005000         0.0000         0.0000        -0.9663      193.267579
-----------------------------------------------------------------------------------------------------------------------
           SUM                                                   0.0000         0.0000        -3.1683
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADGROUPS
-----------------------------------------------------------------------------------------------------------------------
 LOADGROUP       LOADMODE      LOAD    FACTOR          SUM_X          SUM_Y          SUM_Z    LOADED AREA
-----------------------------------------------------------------------------------------------------------------------
         1         SCHNEE    0.1083      1.00         0.0000         0.0000       -20.3972         188.29
         1           WIND   -0.1500      1.00         0.0004         0.0148       -28.2431         195.79
-----------------------------------------------------------------------------------------------------------------------
       SUM                                            0.0004         0.0148       -48.6403
-----------------------------------------------------------------------------------------------------------------------


EXTERNAL LOADS (AREA-DEPENDENT)
ORDERED BY LOADMODES
-----------------------------------------------------------------------------------------
                LOADMODE                    SUM_X          SUM_Y          SUM_Z
-----------------------------------------------------------------------------------------
       SUM         SCHNEE                   0.0000         0.0000       -20.3972
-----------------------------------------------------------------------------------------
       SUM           WIND                   0.0004         0.0148       -28.2431
-----------------------------------------------------------------------------------------
-----------------------------------------------------------------------------------------
       SUM     AREA-LOADS                   0.0004         0.0148       -48.6403
-----------------------------------------------------------------------------------------


EXTERNAL LOADS: SUM OF ALL EXTERNAL LOADS
=========================================================================================
                                            SUM_X          SUM_Y          SUM_Z
=========================================================================================
                                           0.0004         0.0148       -51.8085
=========================================================================================
```

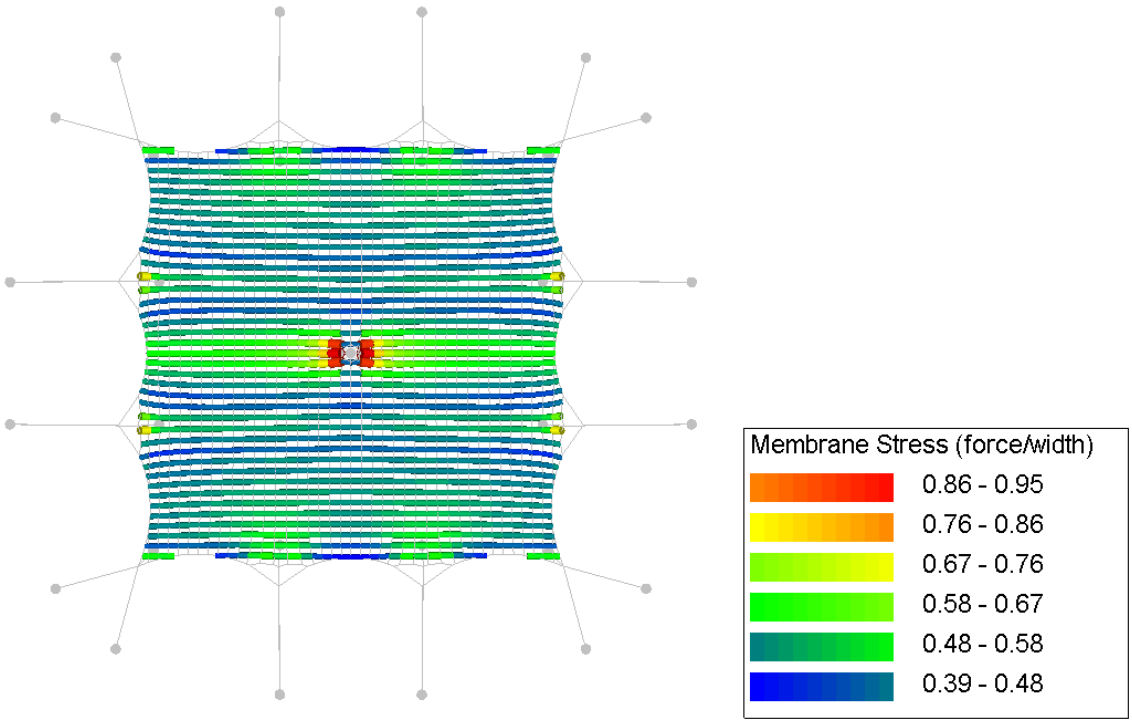
```
Inner Energy=           11.160164


StatikD:  Sum of external loads:       0.000460       0.014788     -51.808511
StatikD:  Sum of support forces:      -0.005047      -0.013400      51.808345
StatikD:  P:\2026\TTP20260008\06. Constructie - hoofdberekeningen\Boek2\10x20\CO6a_OW+VO+WD+SNOW_anchors
StatikD: Time of calculation:       1.55s
StatikD: Version 2025.38 done.
```

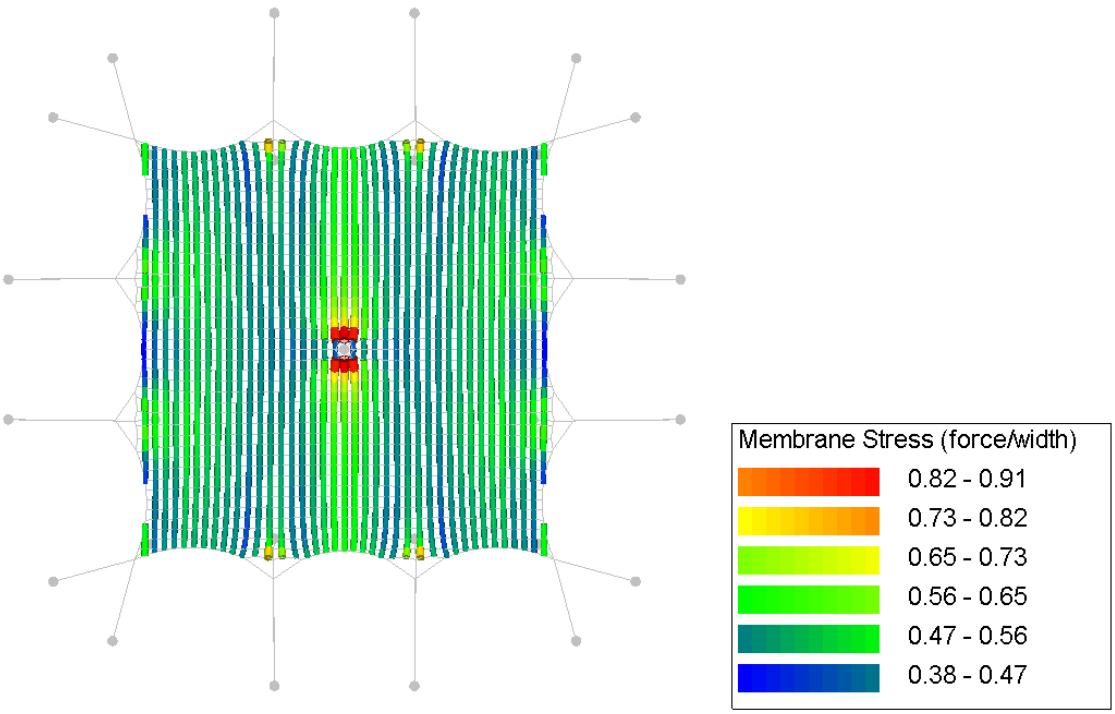
Annex D. Results per load combination – 10x10m model

Annex D.1. CO1. Own weight + pretension

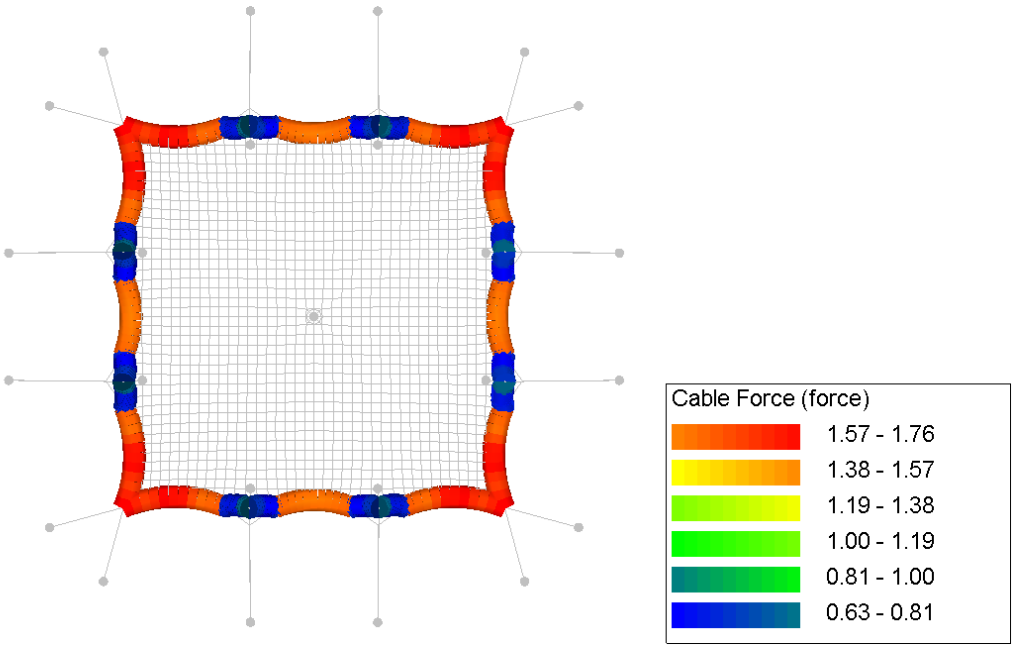
Annex D.1.1. Membrane stress (warp)



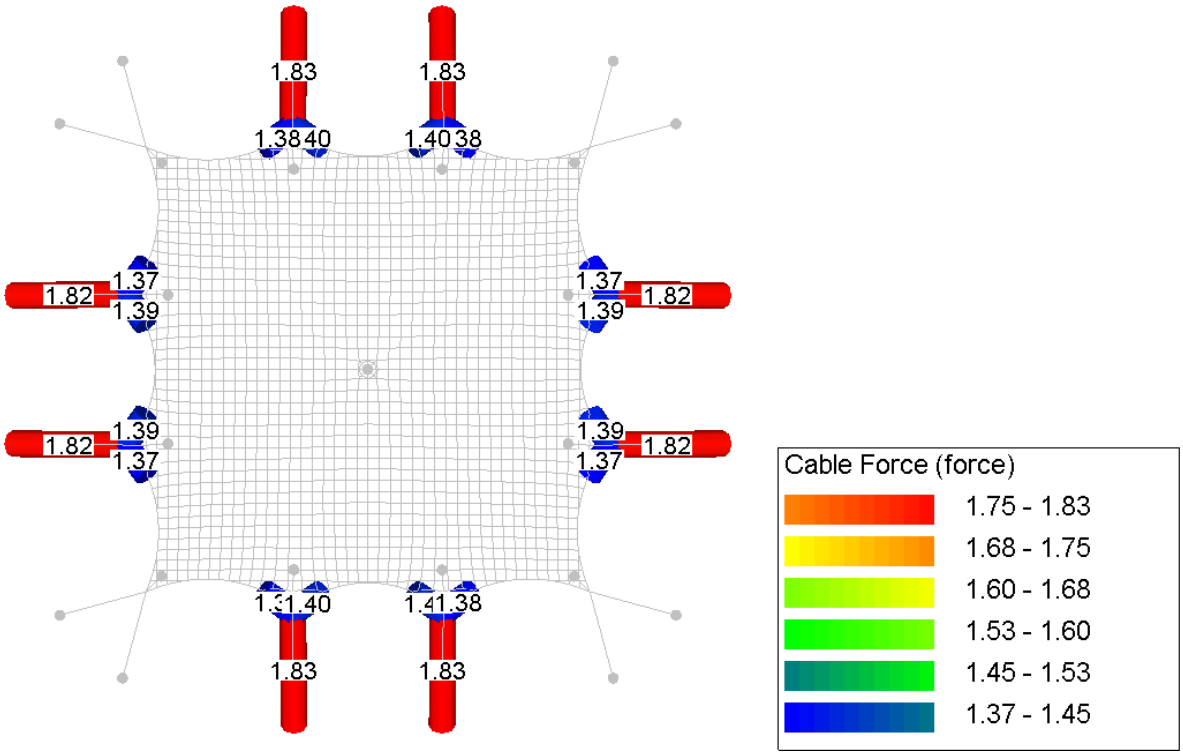
Annex D.1.2. Membrane stress (weft)



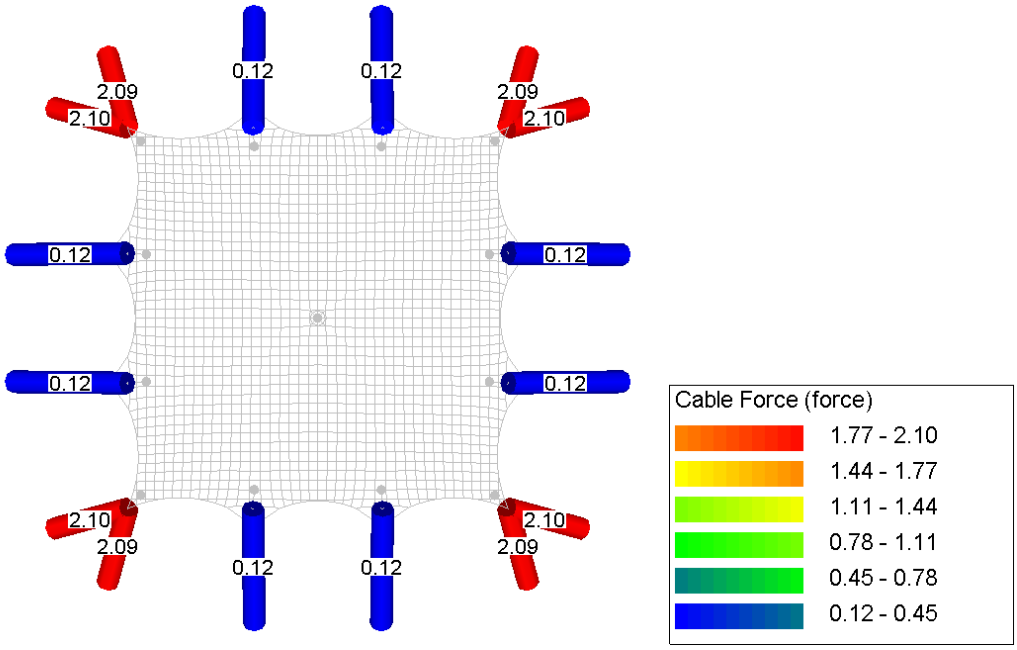
Annex D.1.3. Circumference rope forces



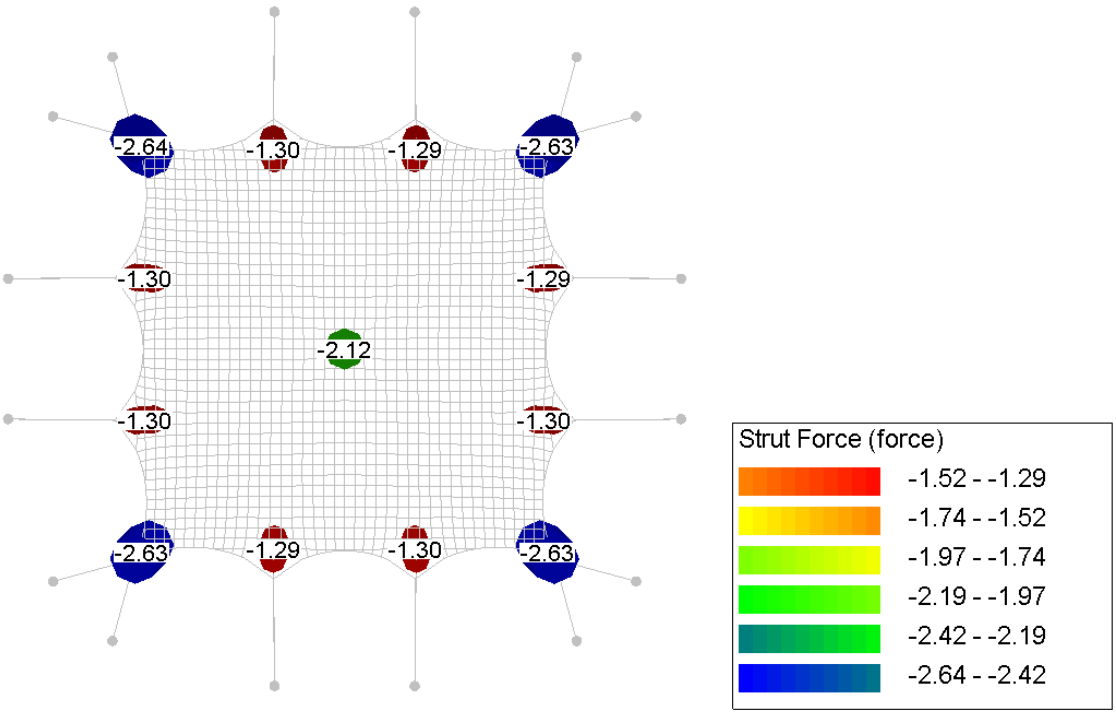
Annex D.1.4. Rope forces



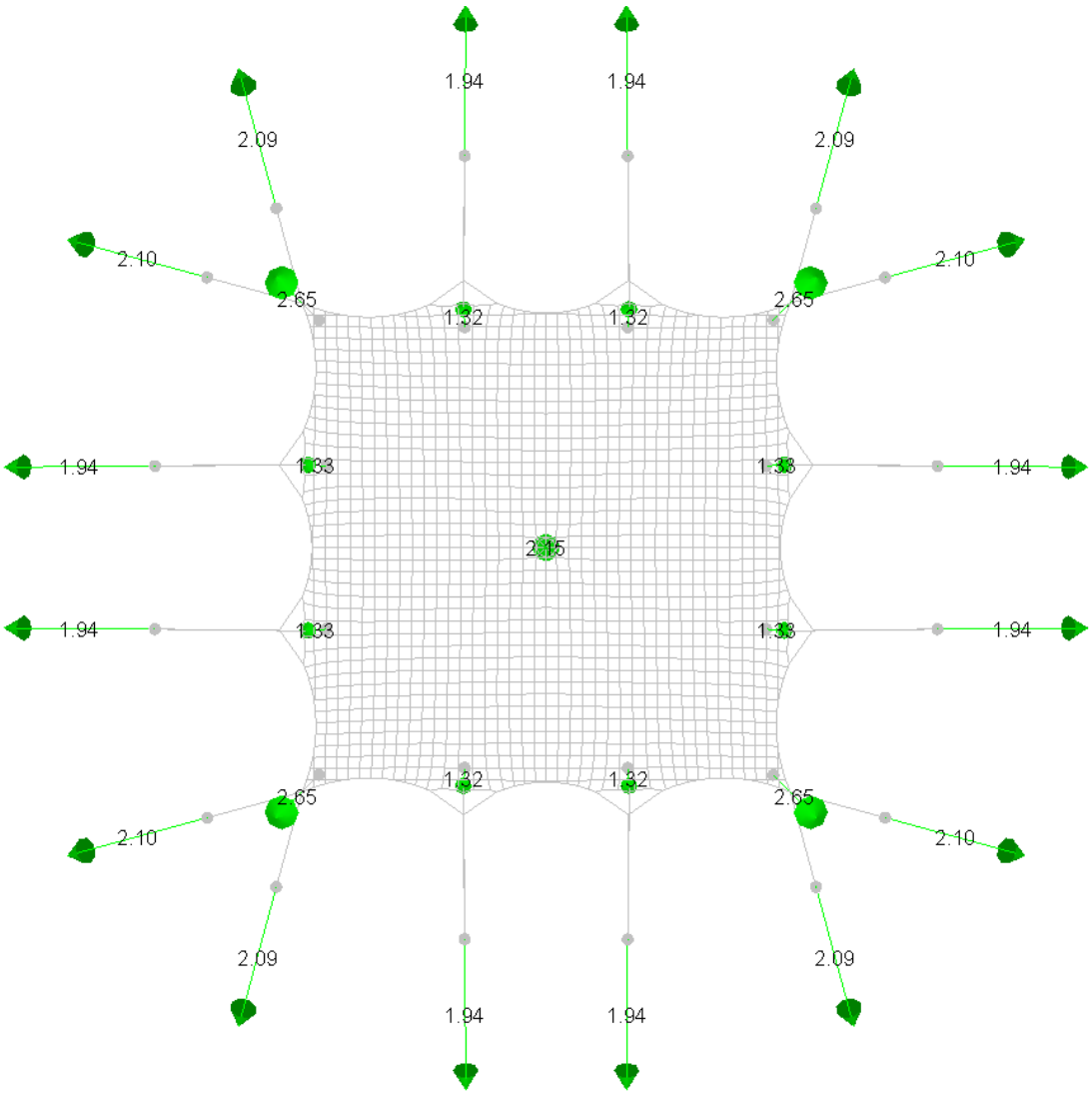
Annex D.1.5. Belt forces



Annex D.1.6. Pole forces

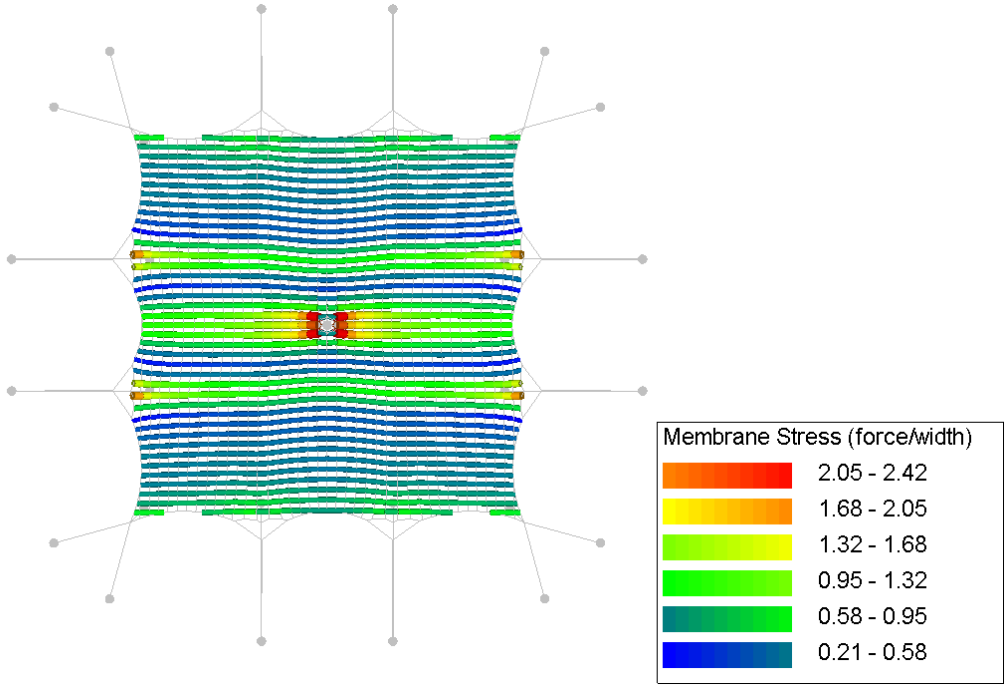


Annex D.1.7. Reaction forces

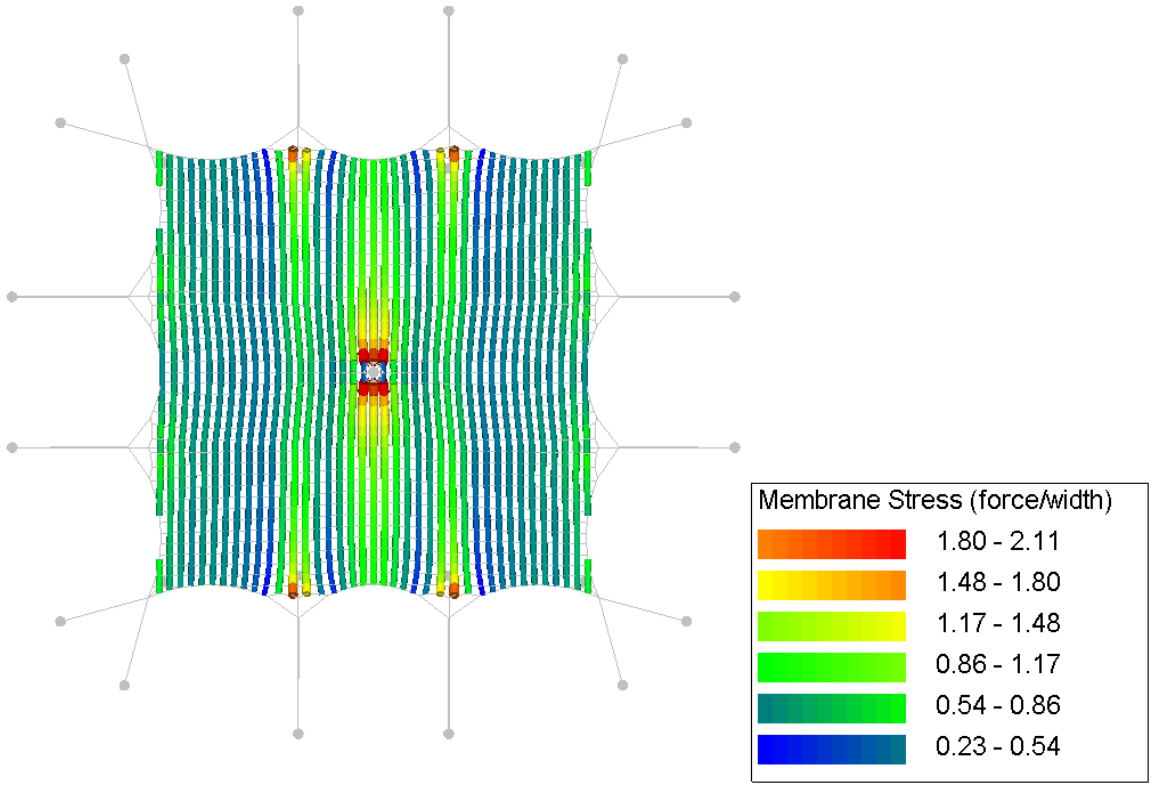


Annex D.2. CO2. Own weight + pretension + snow

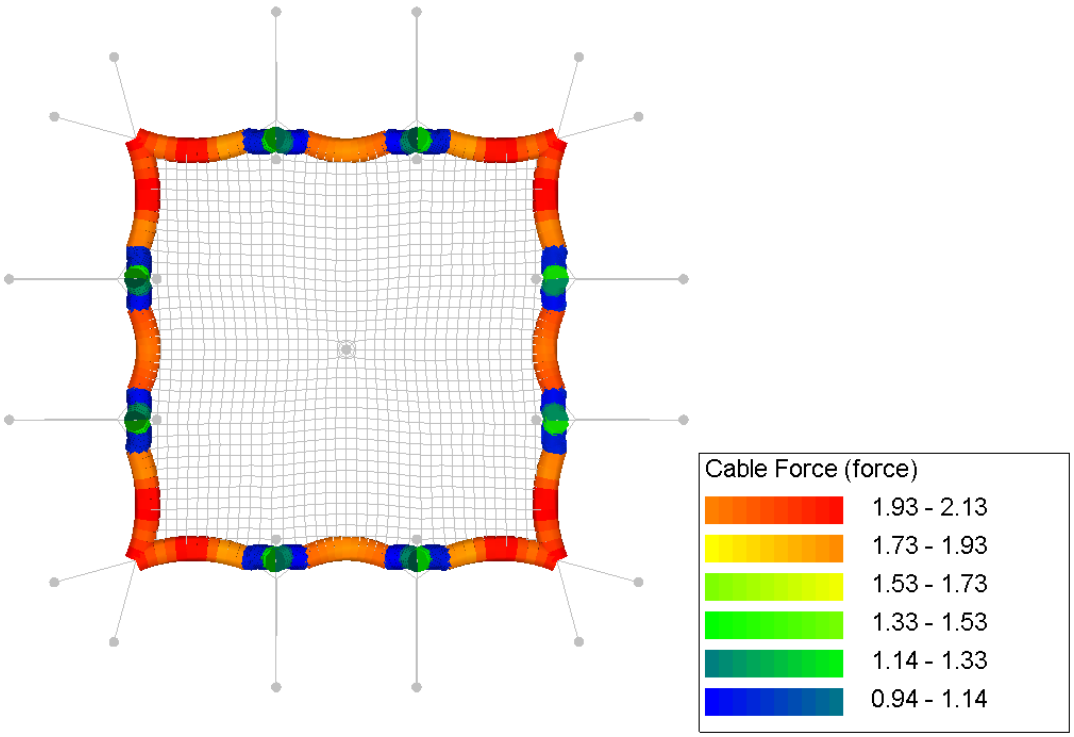
Annex D.2.1. Membrane stress (warp)



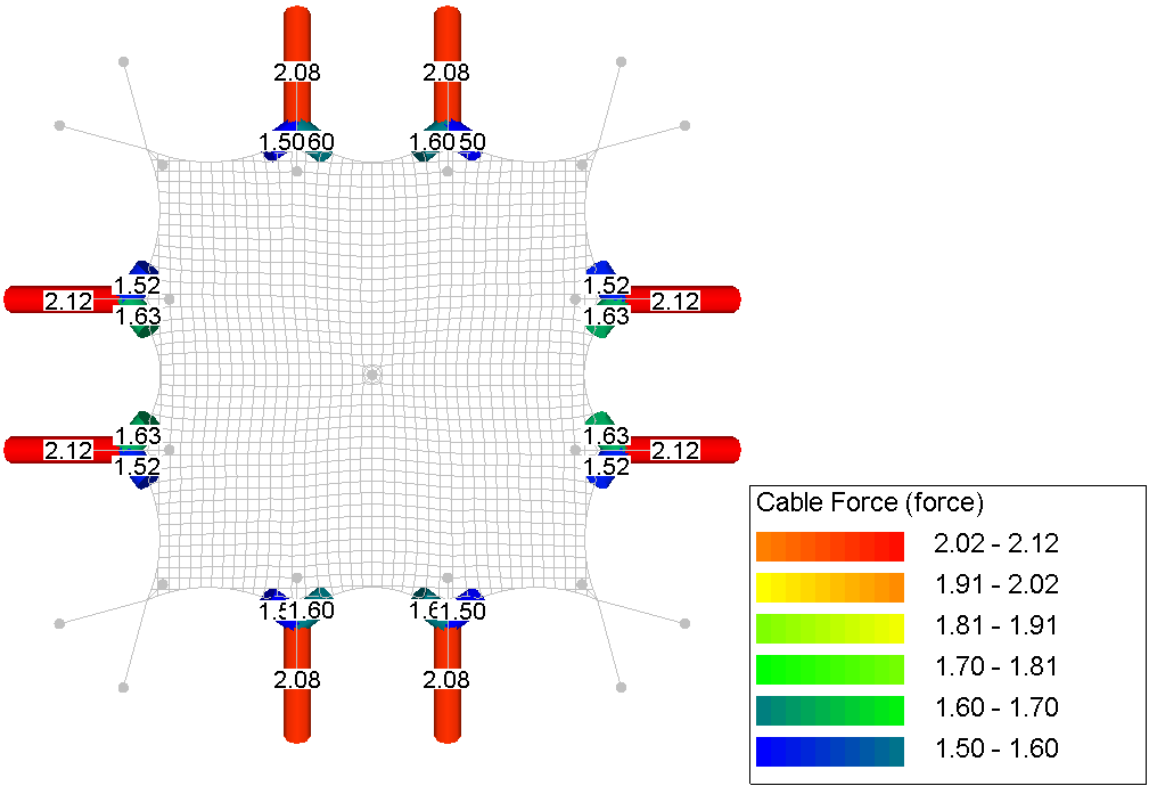
Annex D.2.2. Membrane stress (weft)



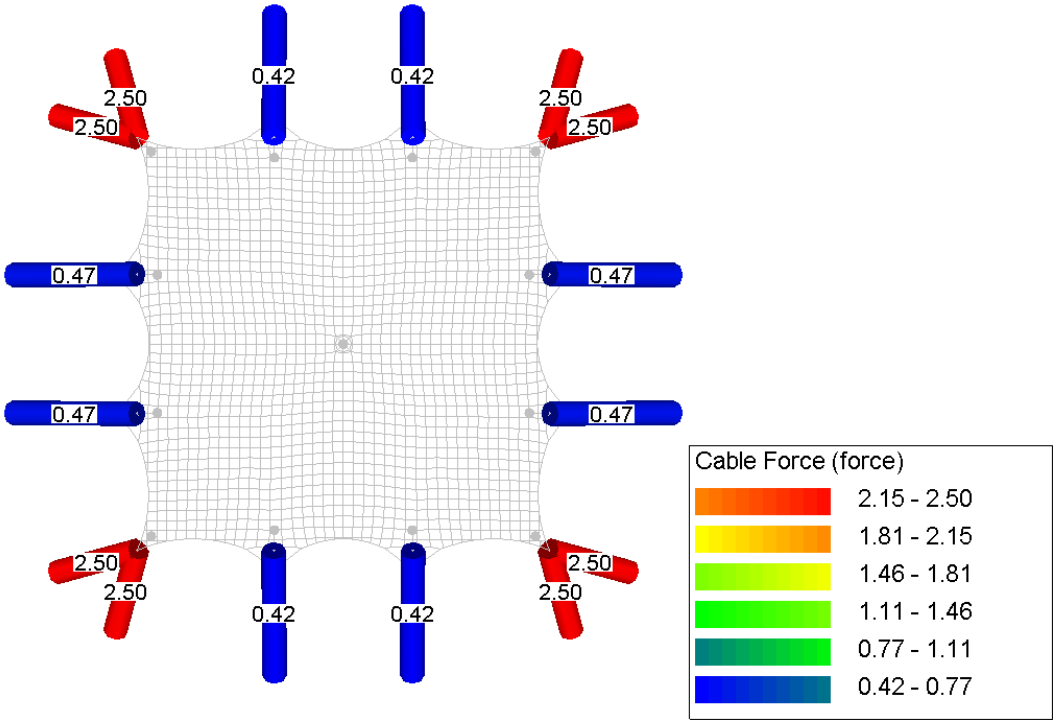
Annex D.2.3. Circumference rope forces



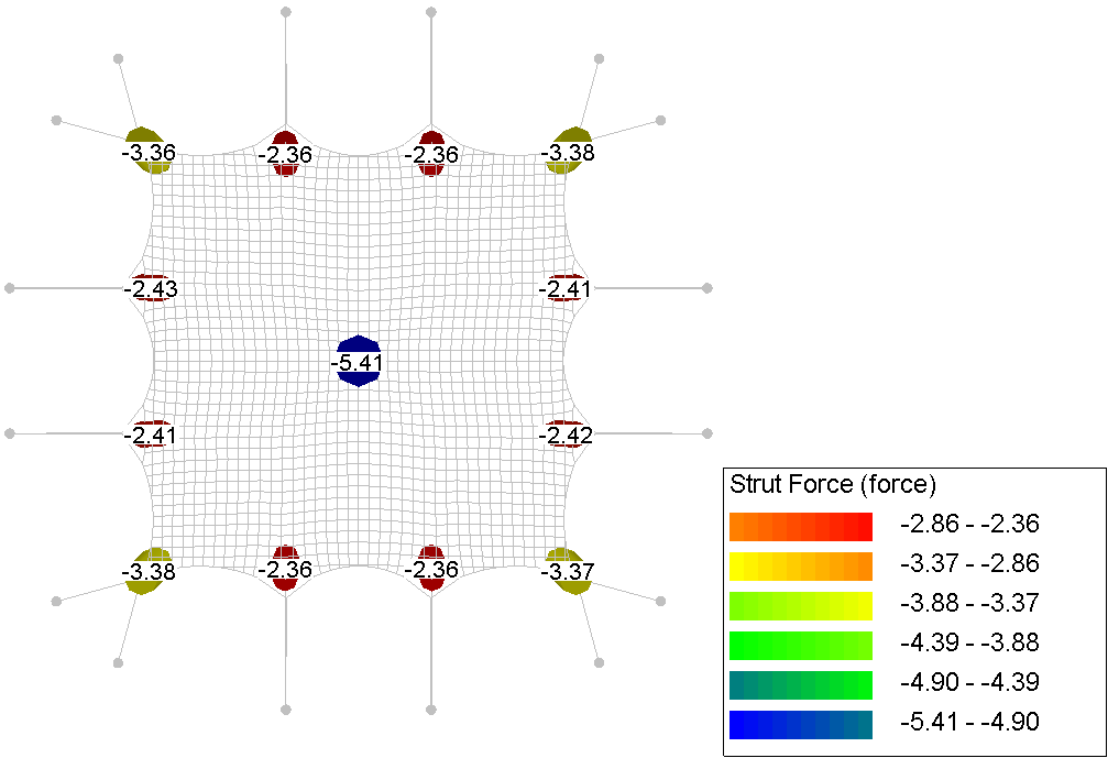
Annex D.2.4. Rope forces



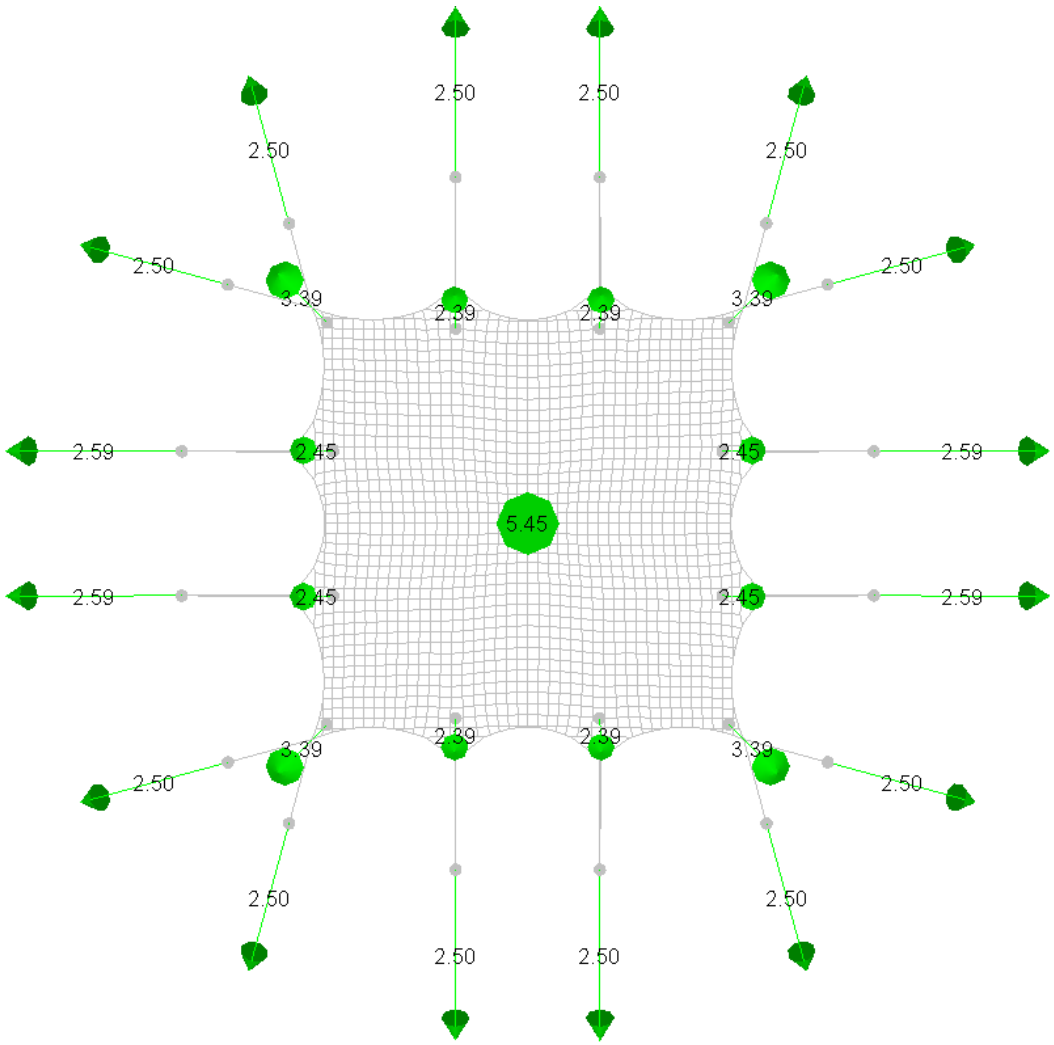
Annex D.2.5. Belt forces



Annex D.2.6. Pole forces

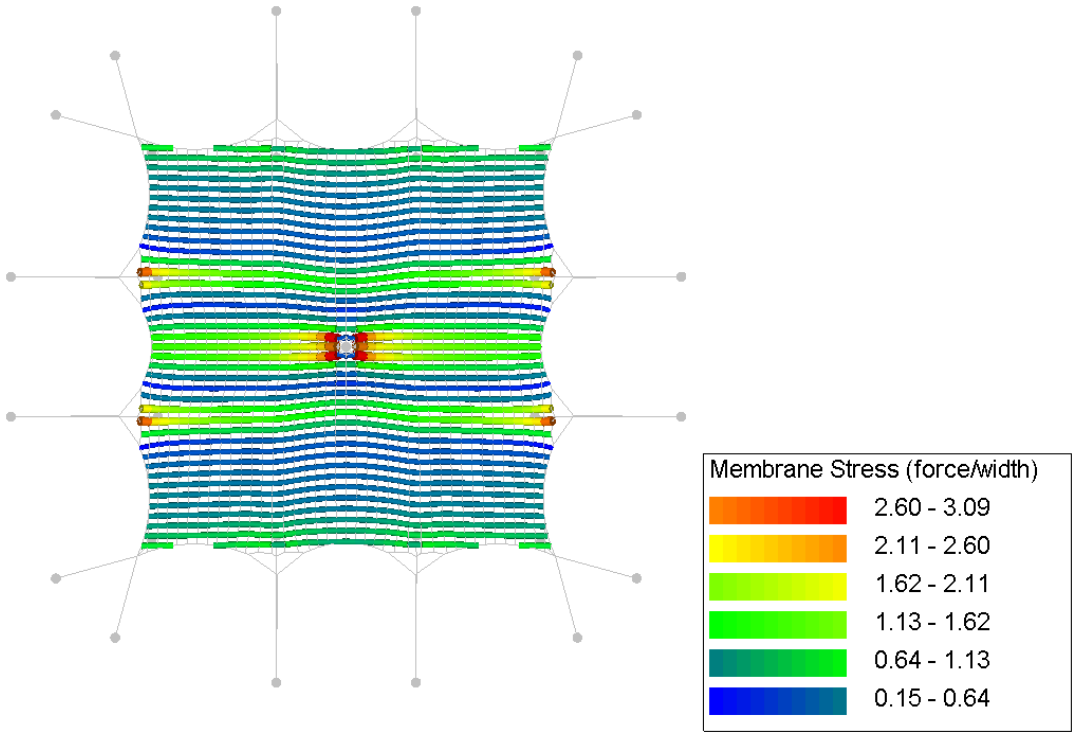


Annex D.2.7. Anchor forces

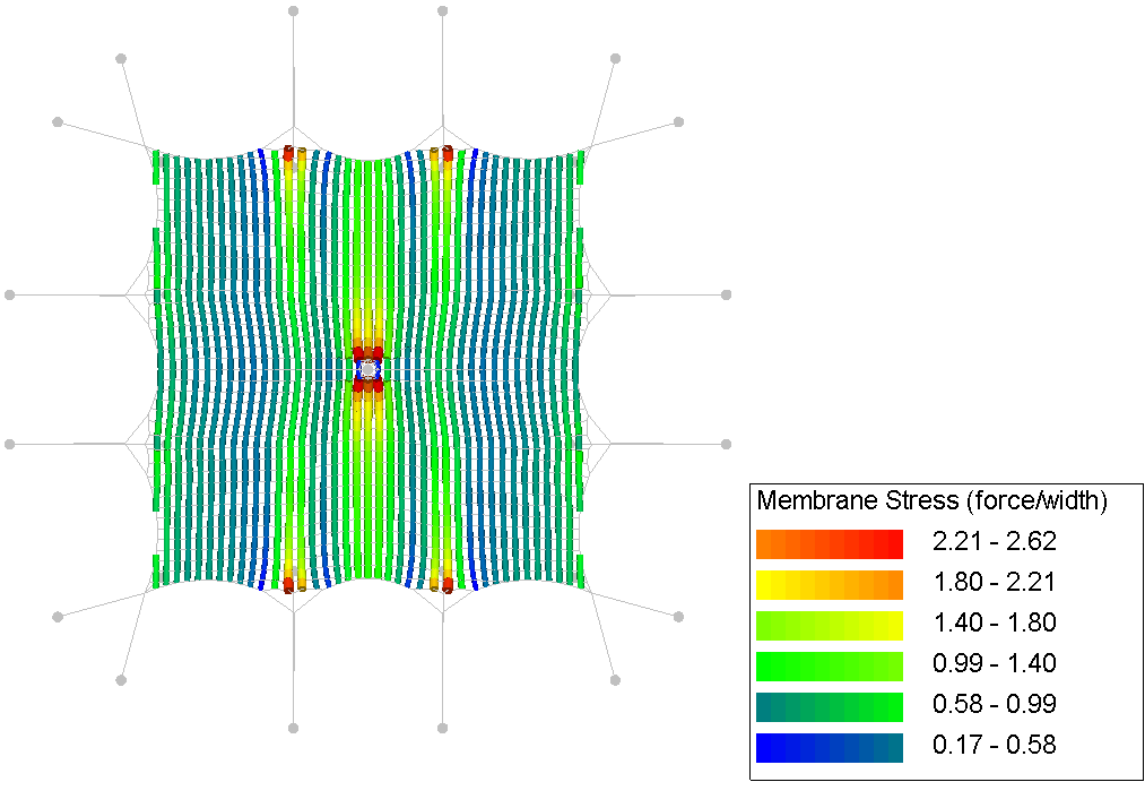


Annex D.3. CO3. Own weight + pretension + wind pressure

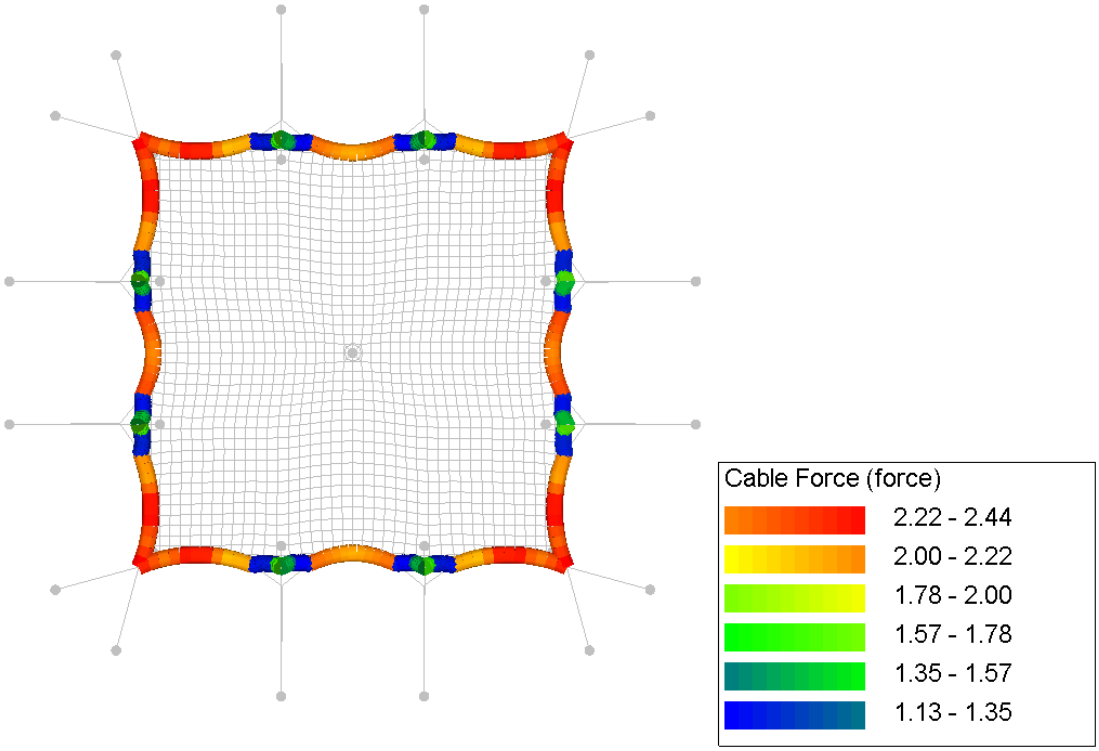
Annex D.3.1. Membrane stress (warp)



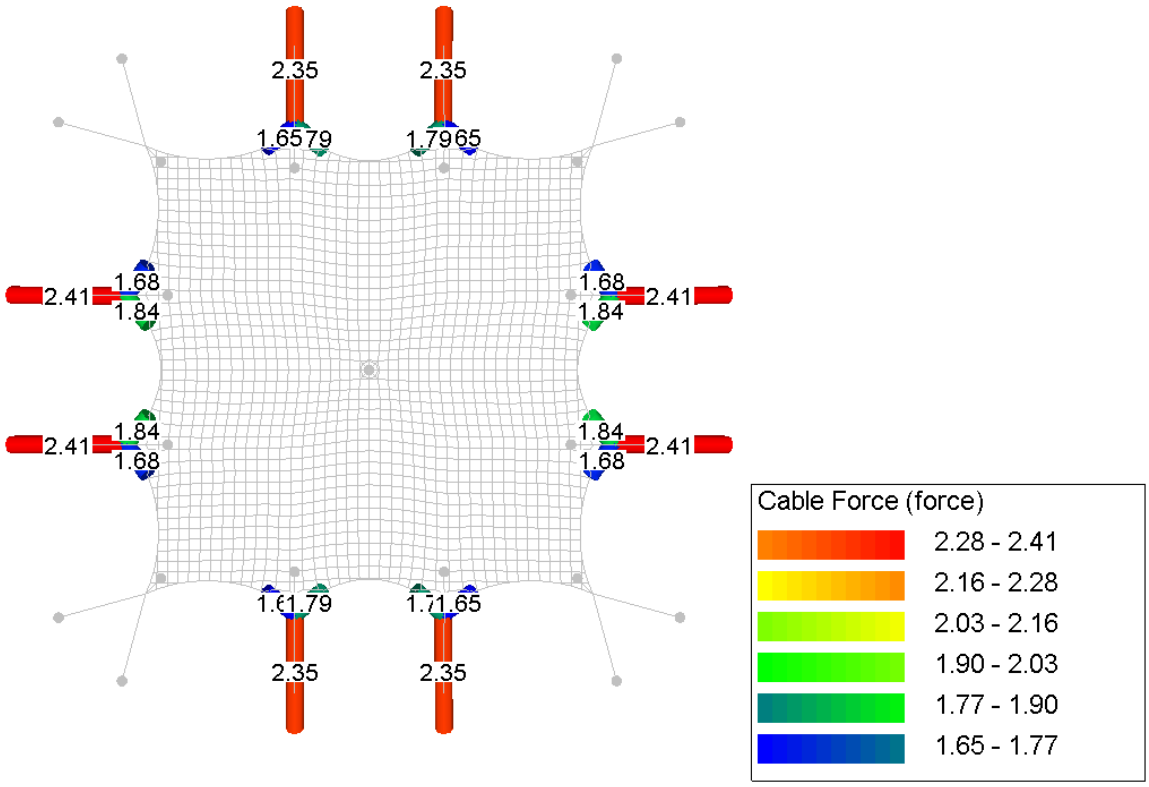
Annex D.3.2. Membrane stress (weft)



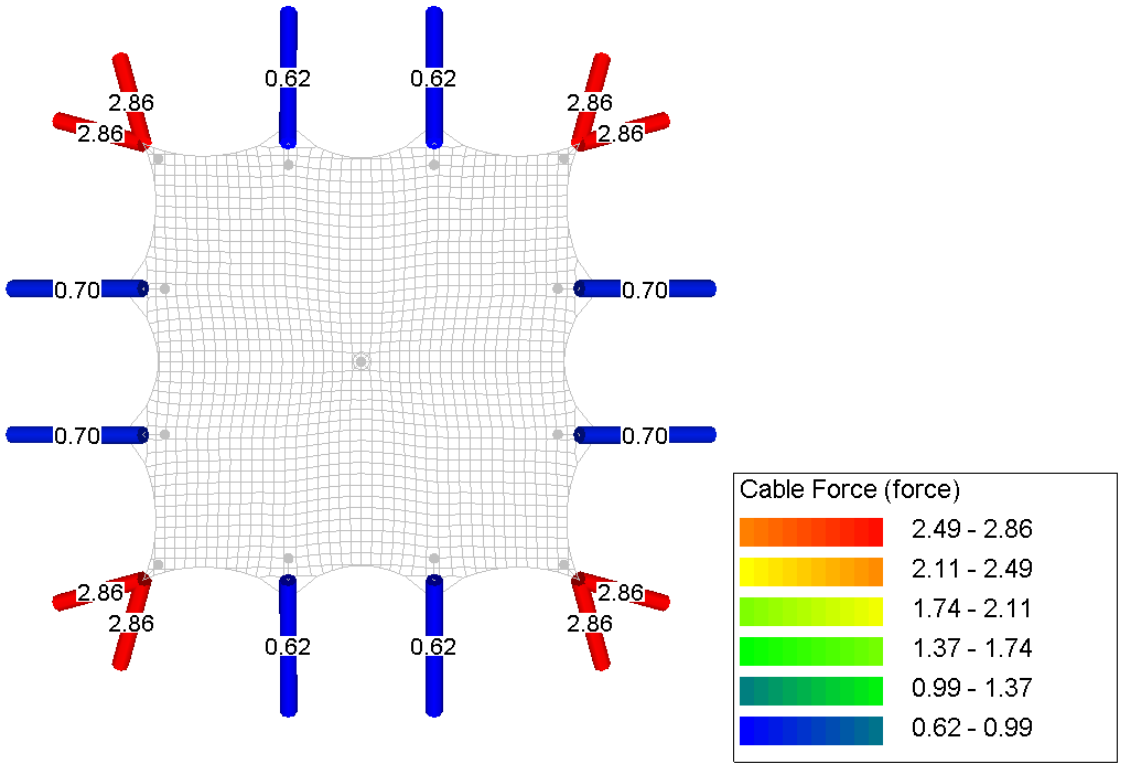
Annex D.3.3. Circumference rope forces



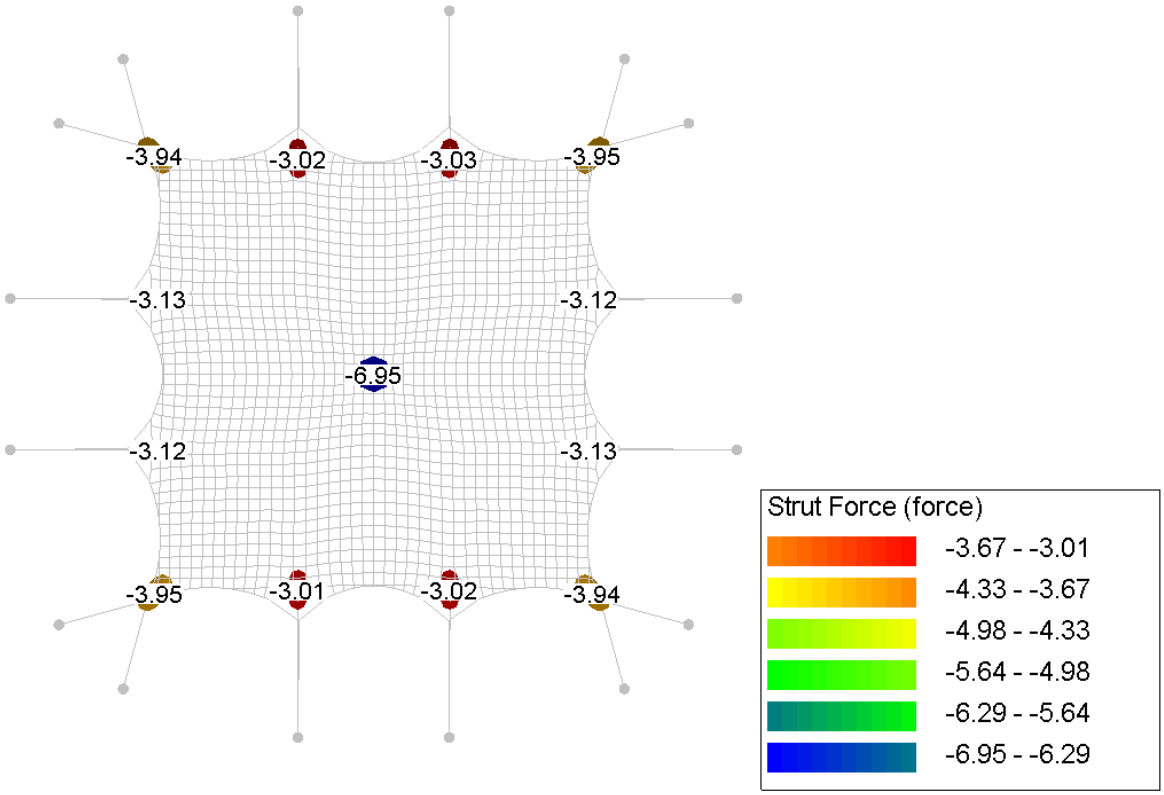
Annex D.3.4. Rope forces



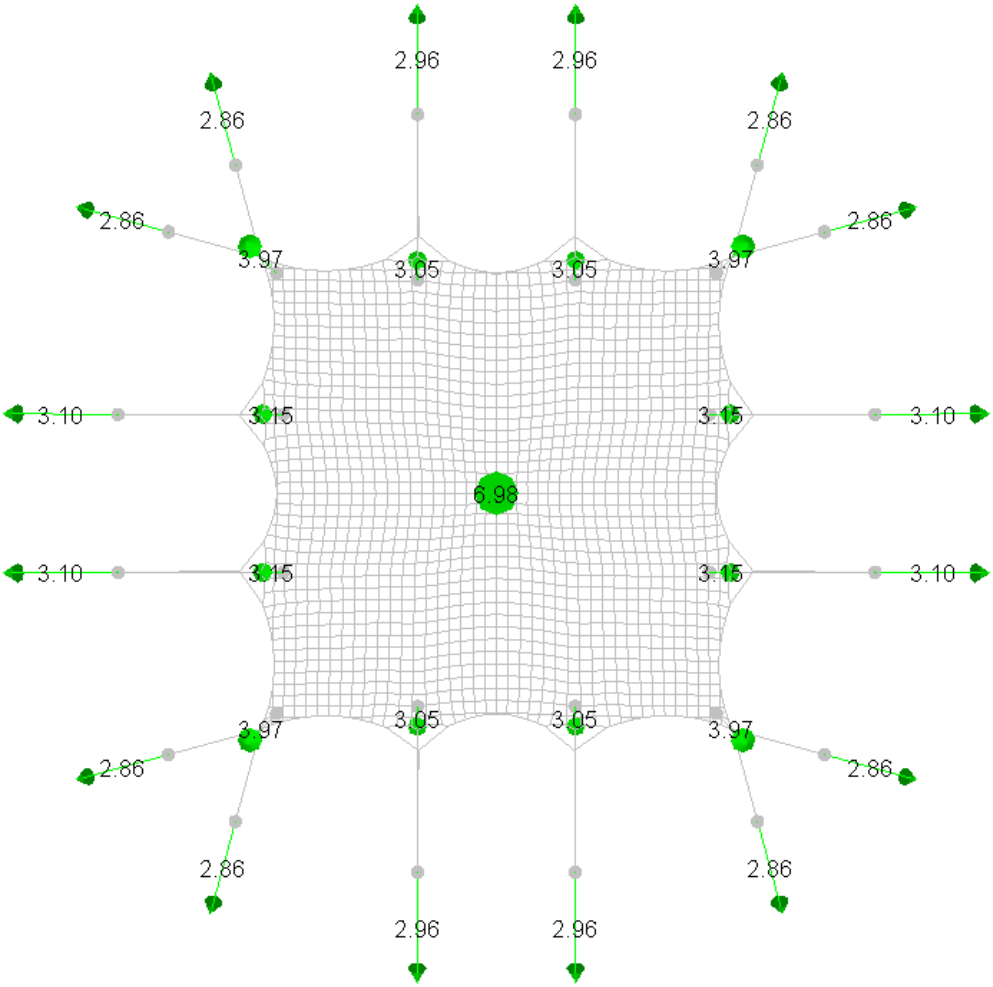
Annex D.3.5. Belt forces



Annex D.3.6. Poles forces

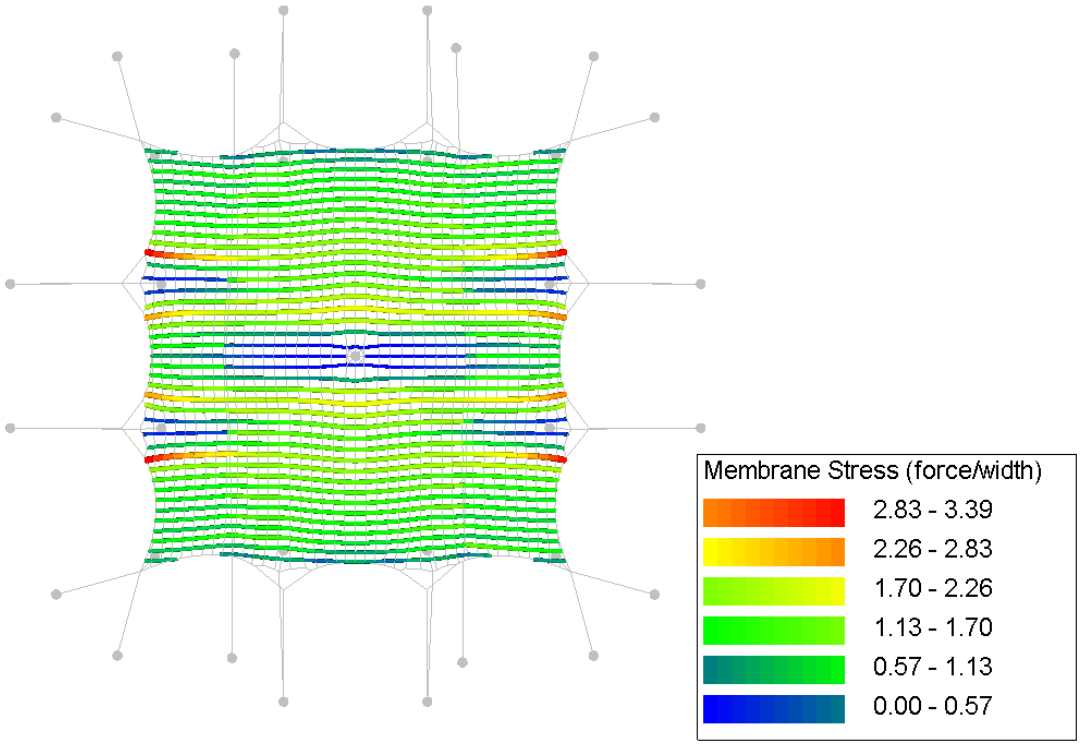


Annex D.3.7. Reaction forces

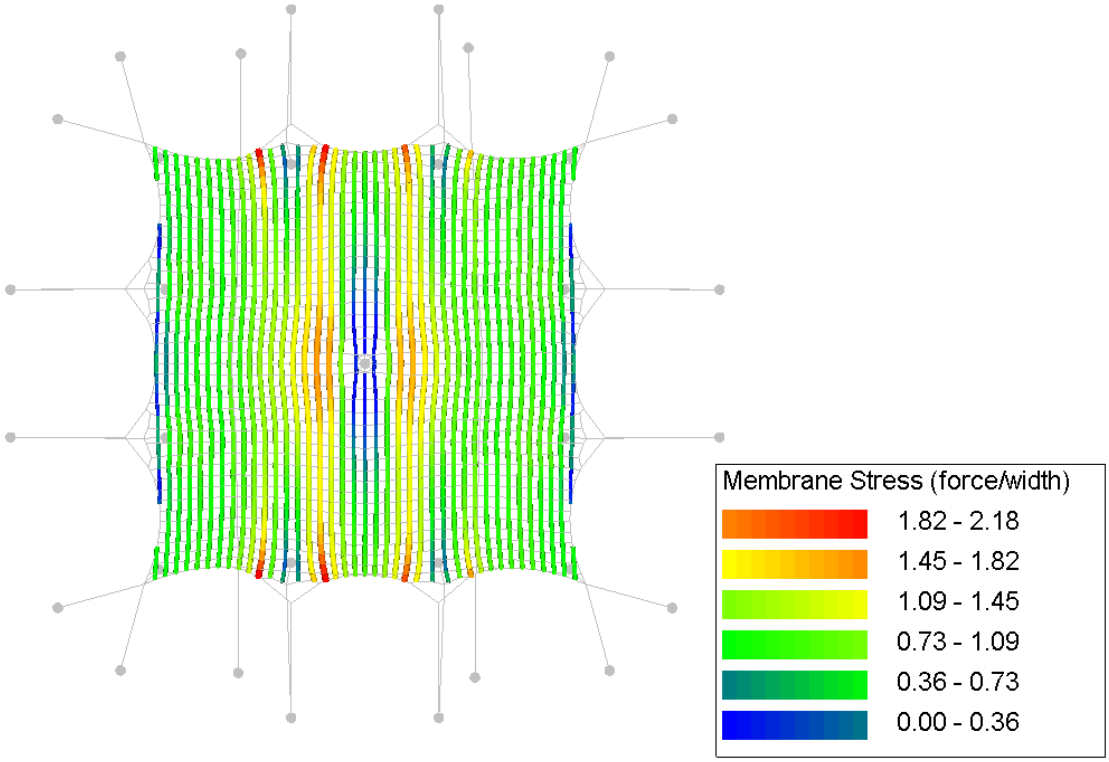


Annex D.4. CO4. Own weight + pretension + wind suction

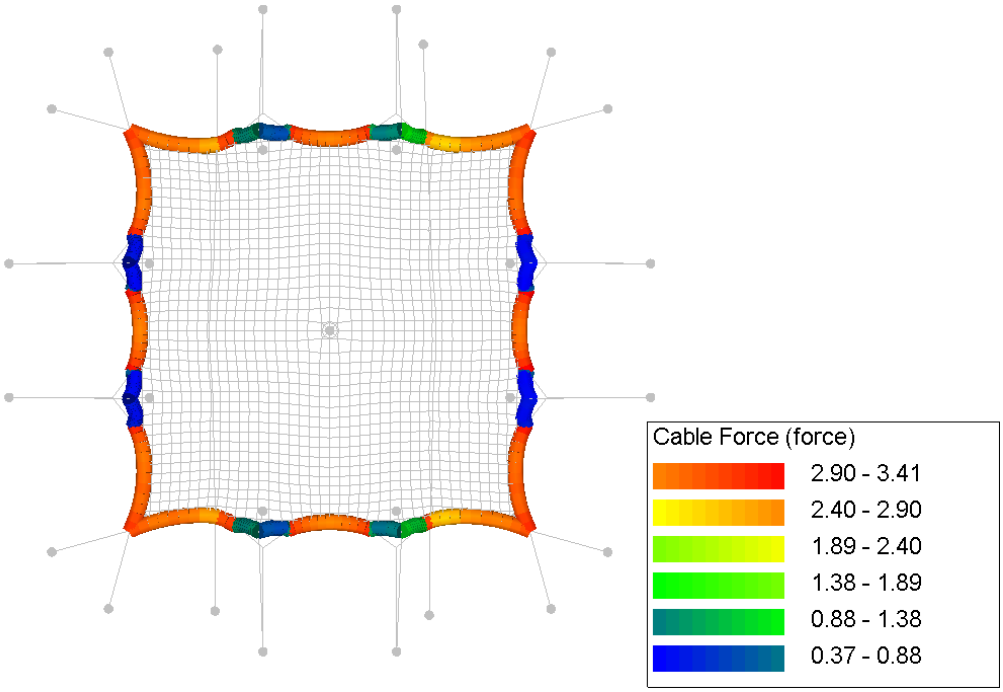
Annex D.4.1. Membrane stress (warp)



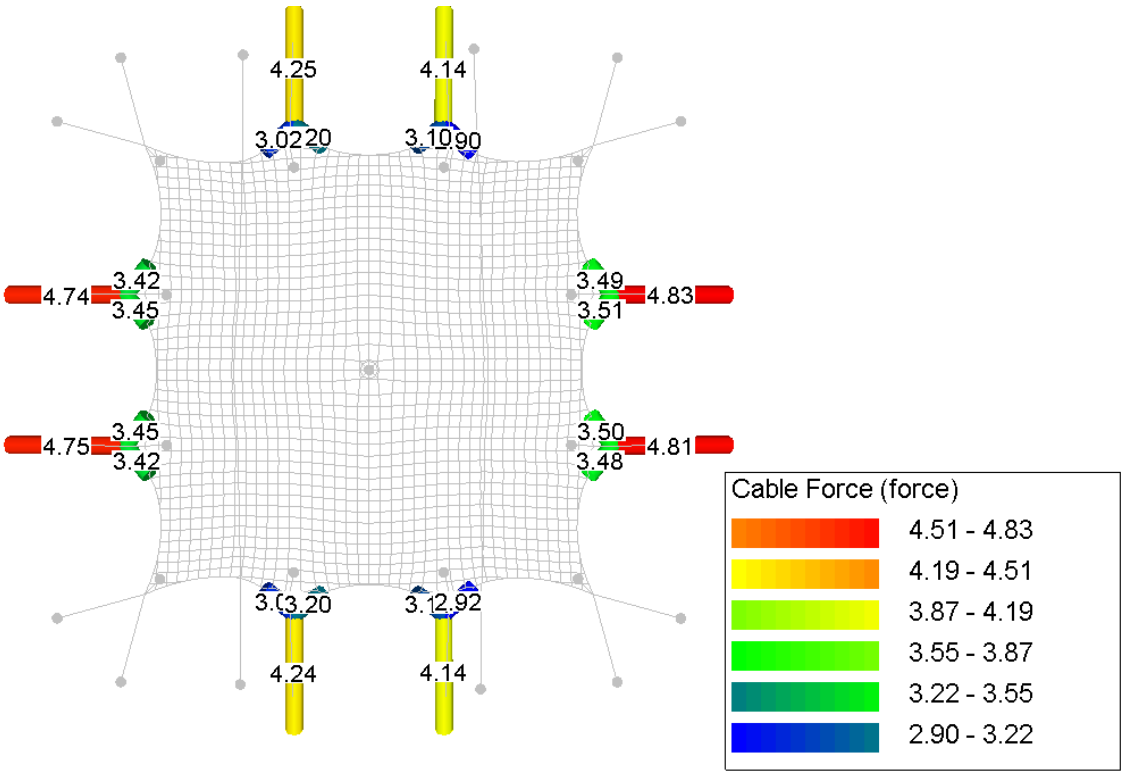
Annex D.4.2. Membrane stress (weft)



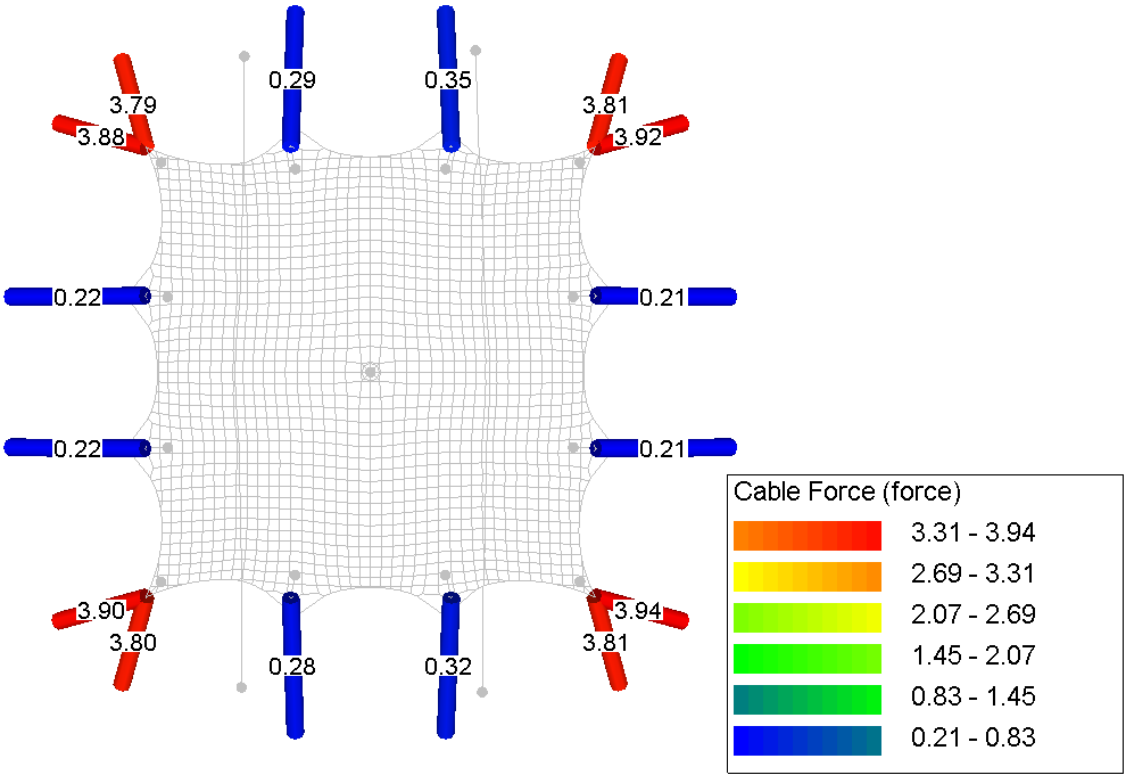
Annex D.4.3. Circumference rope forces



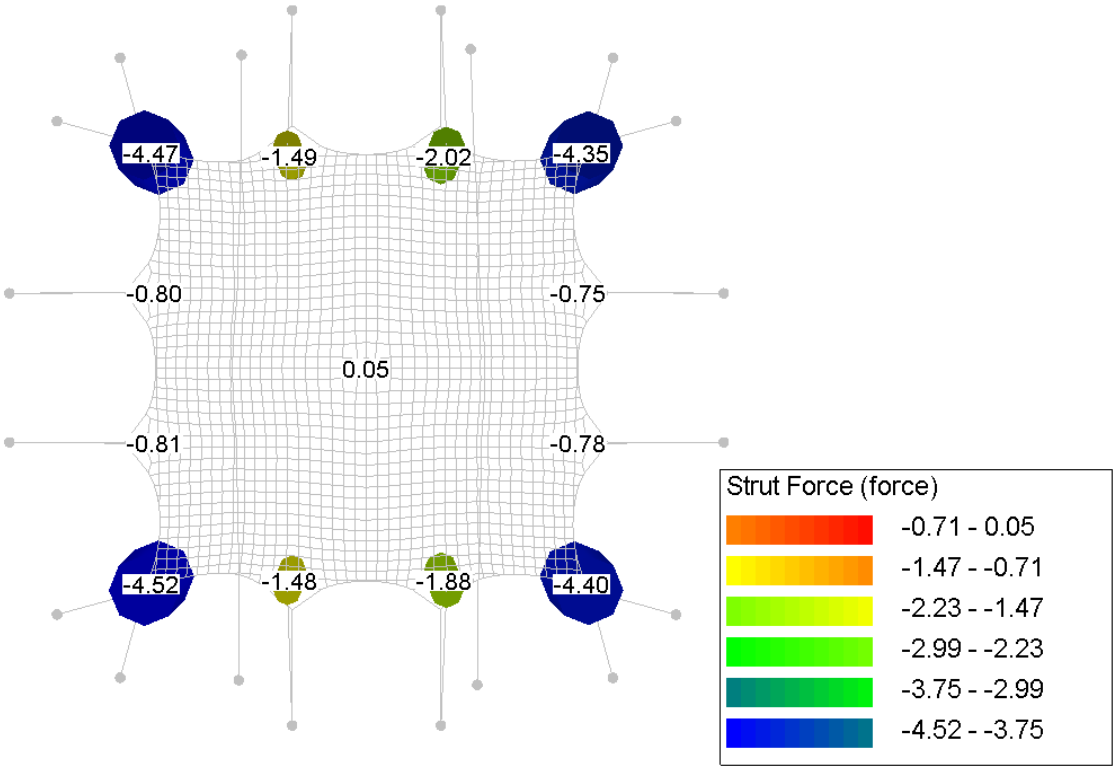
Annex D.4.4. Guy rope forces



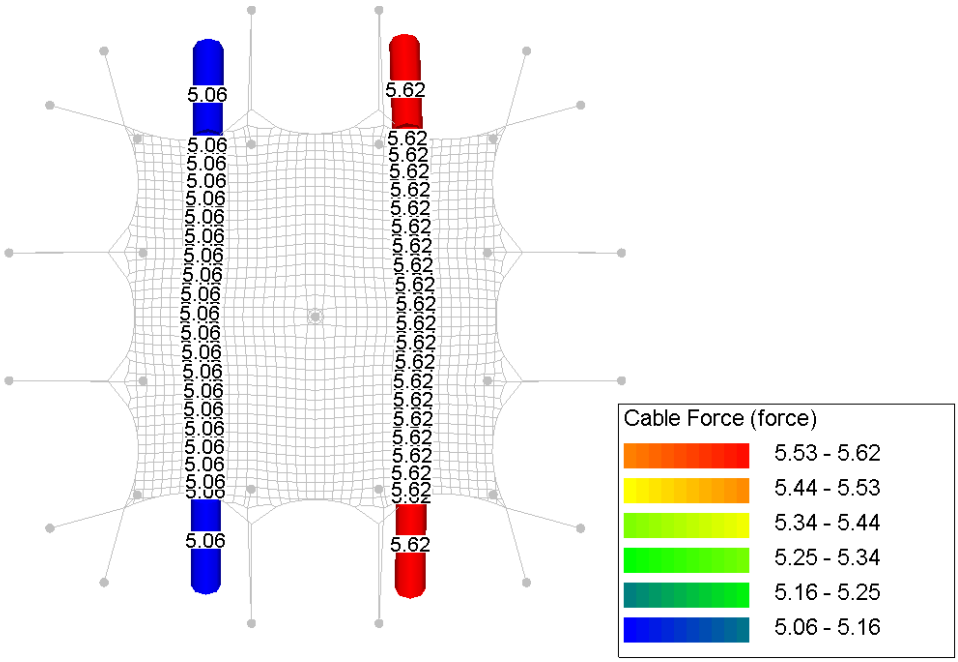
Annex D.4.5. Belt forces



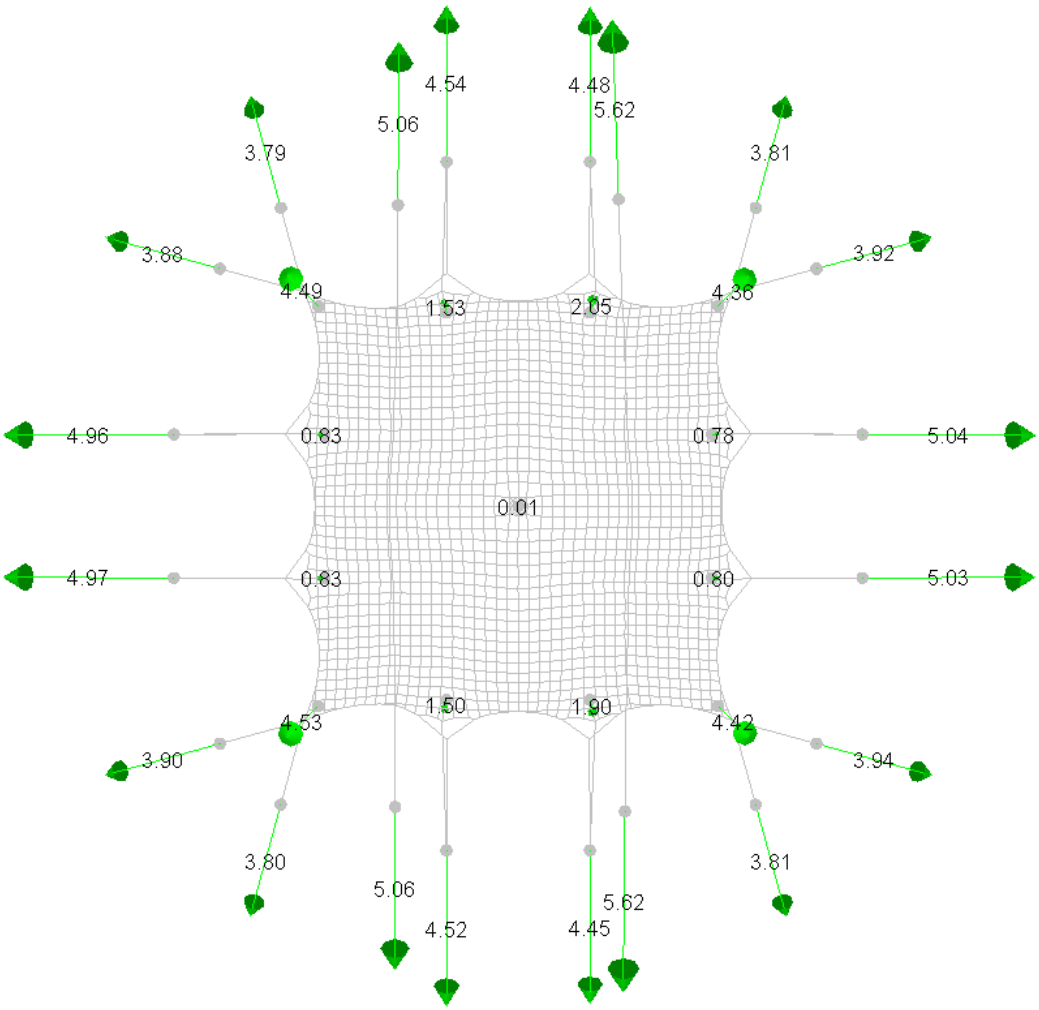
Annex D.4.6. Poles forces



Annex D.4.7. Storm belt forces

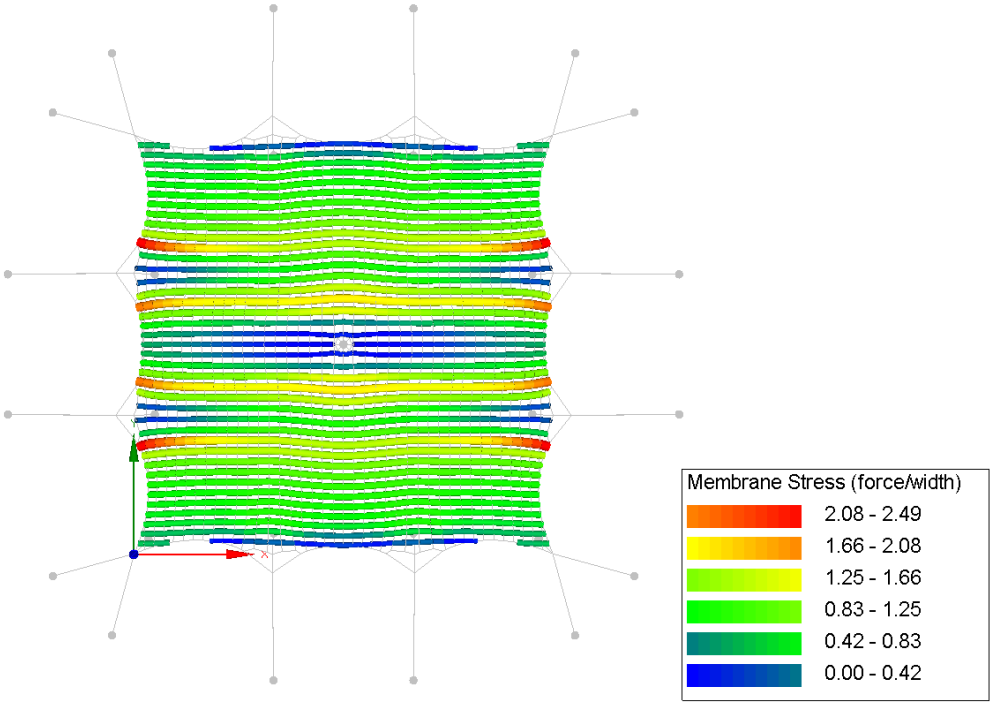


Annex D.4.8. Reaction forces

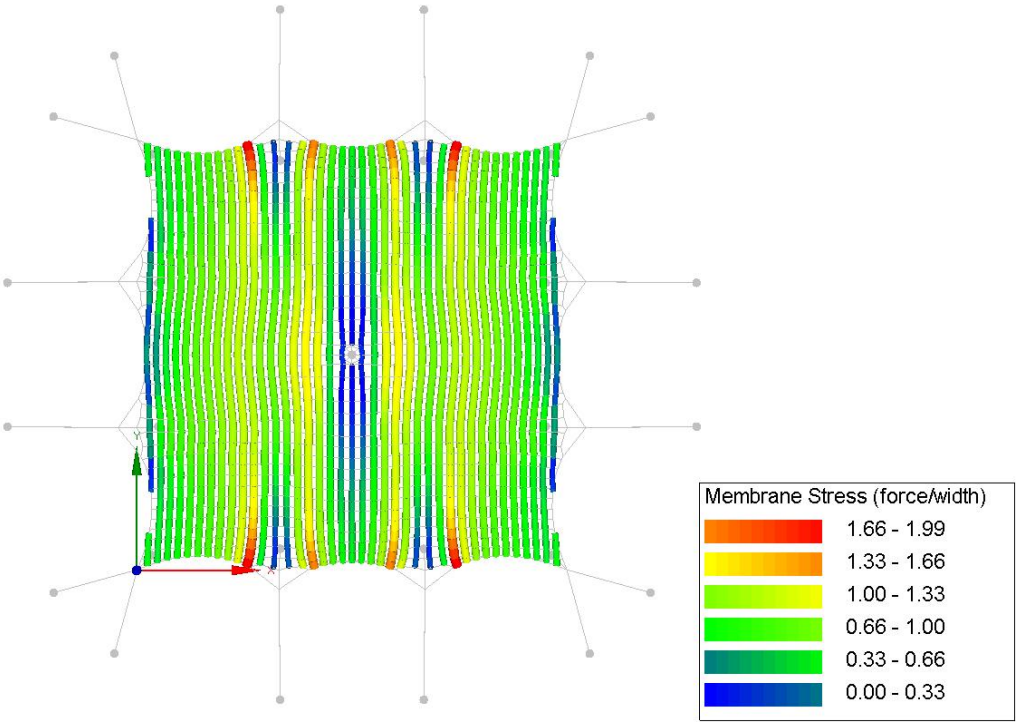


Annex D.5. CO5. Own weight + pretension + wind suction reduced [NL]

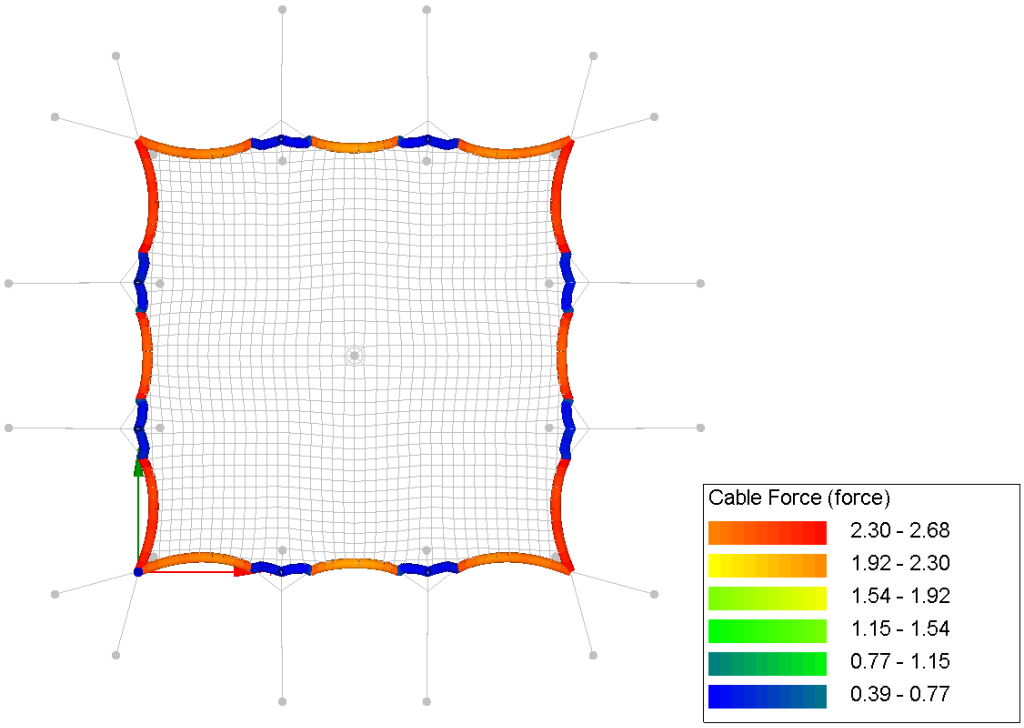
Annex D.5.1. Membrane stress (warp)



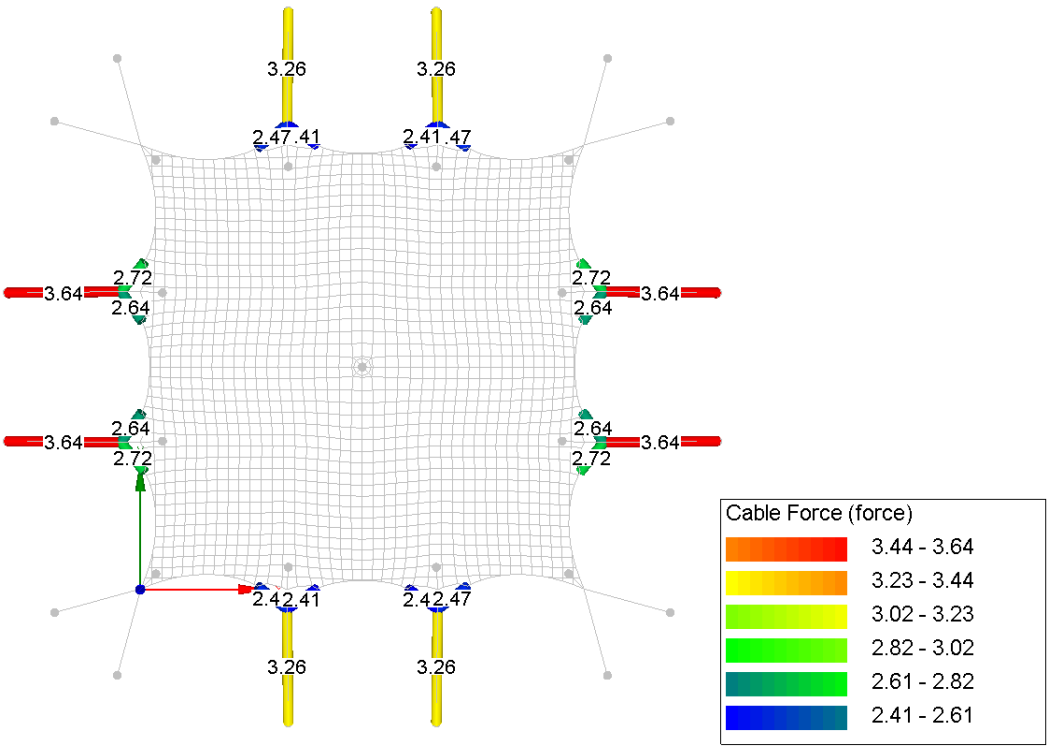
Annex D.5.2. Membrane stress (weft)



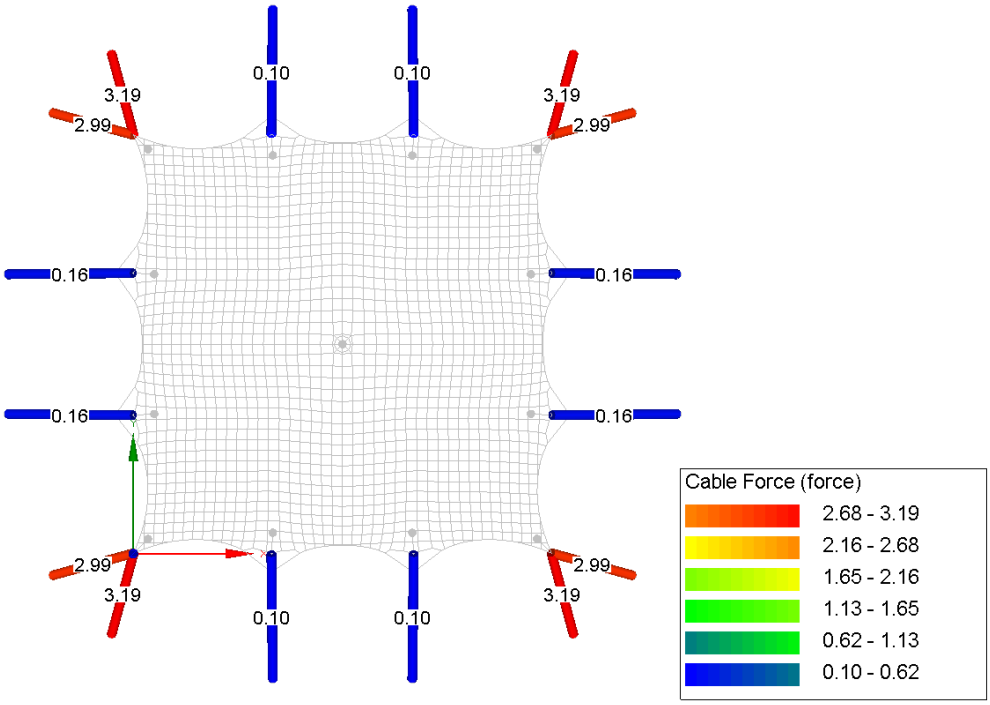
Annex D.5.3. Circumference rope forces



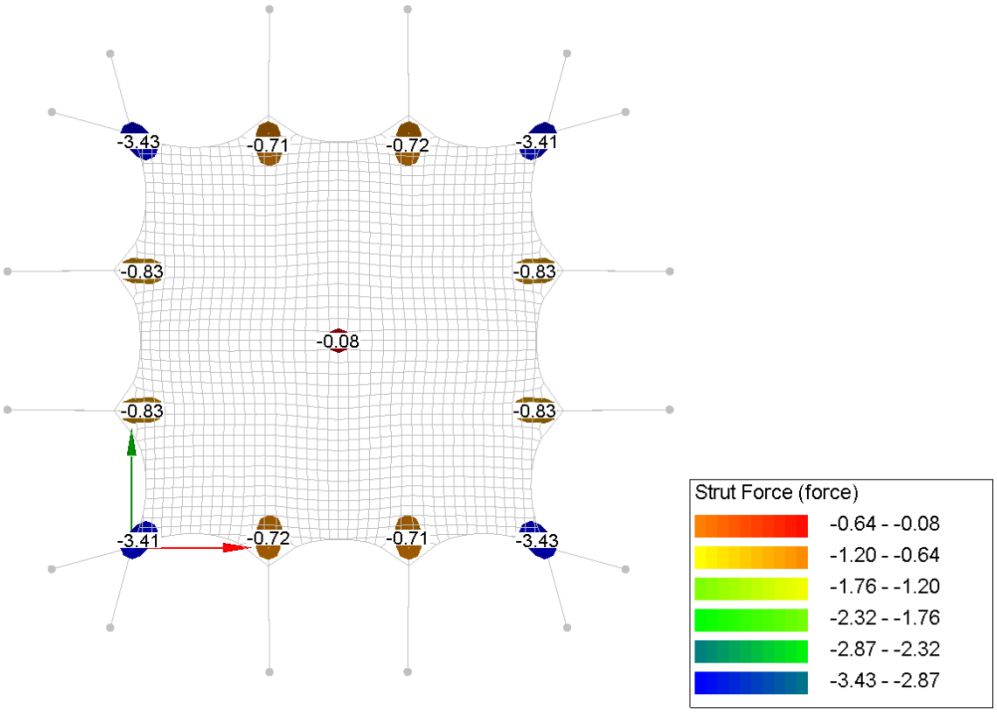
Annex D.5.4. Rope forces



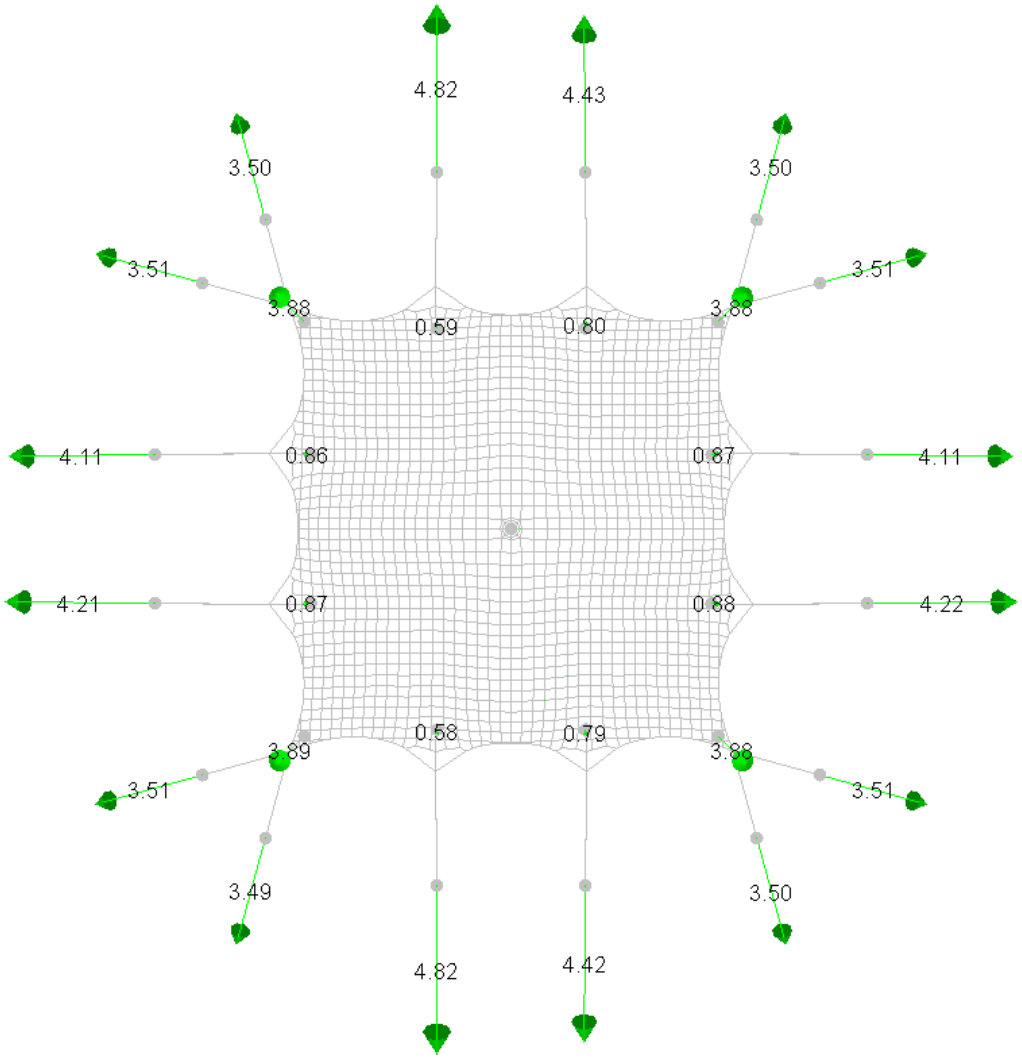
Annex D.5.5. Belt forces



Annex D.5.6. Poles forces

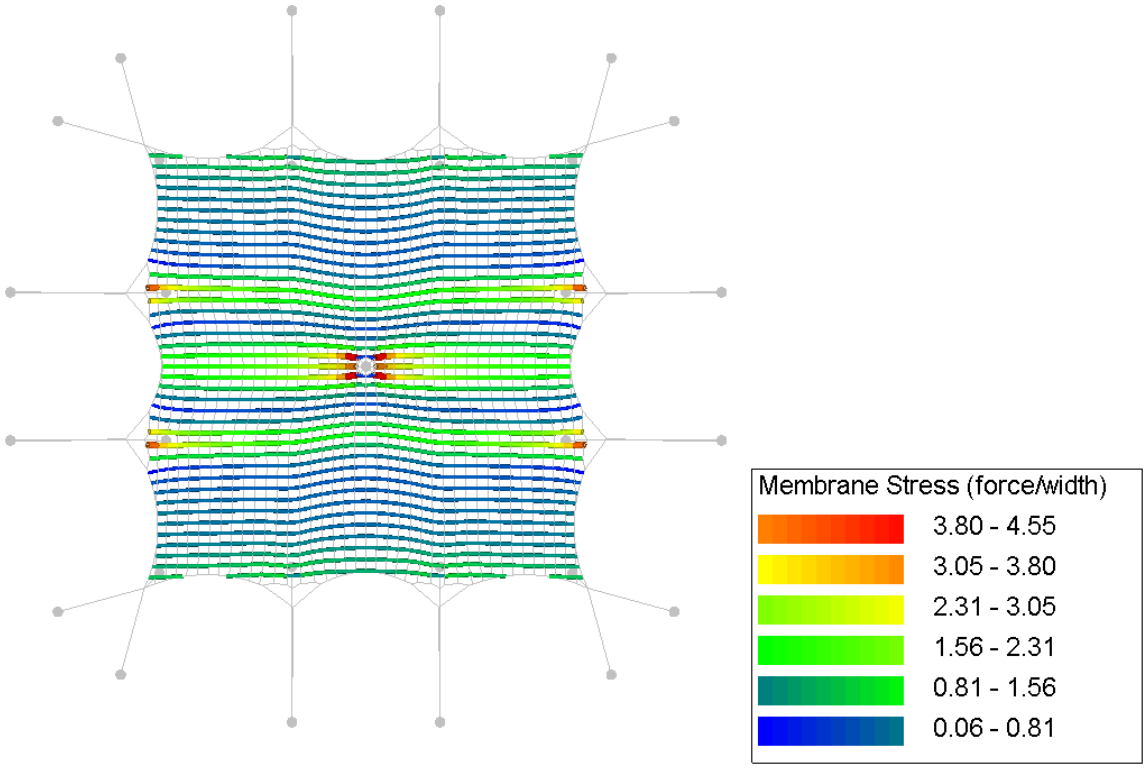


Annex D.5.7. Reaction forces

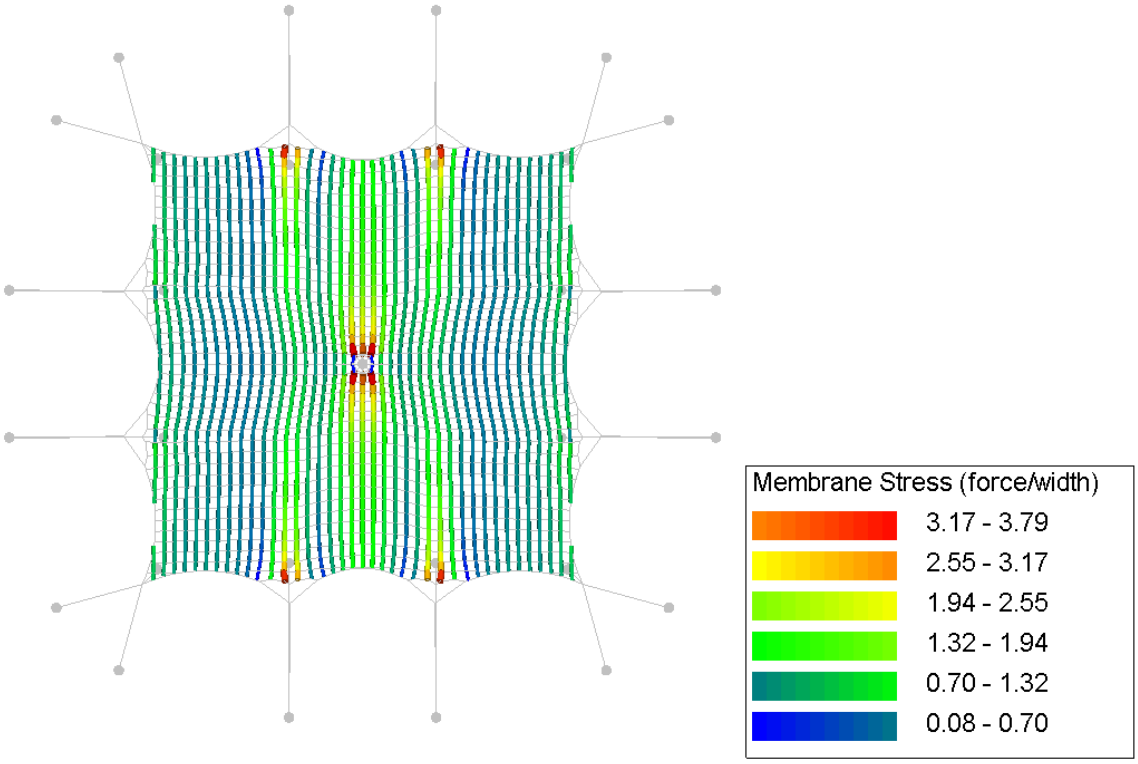


Annex D.6. CO6. Own weight + pretension + wind pressure + snow [FR]

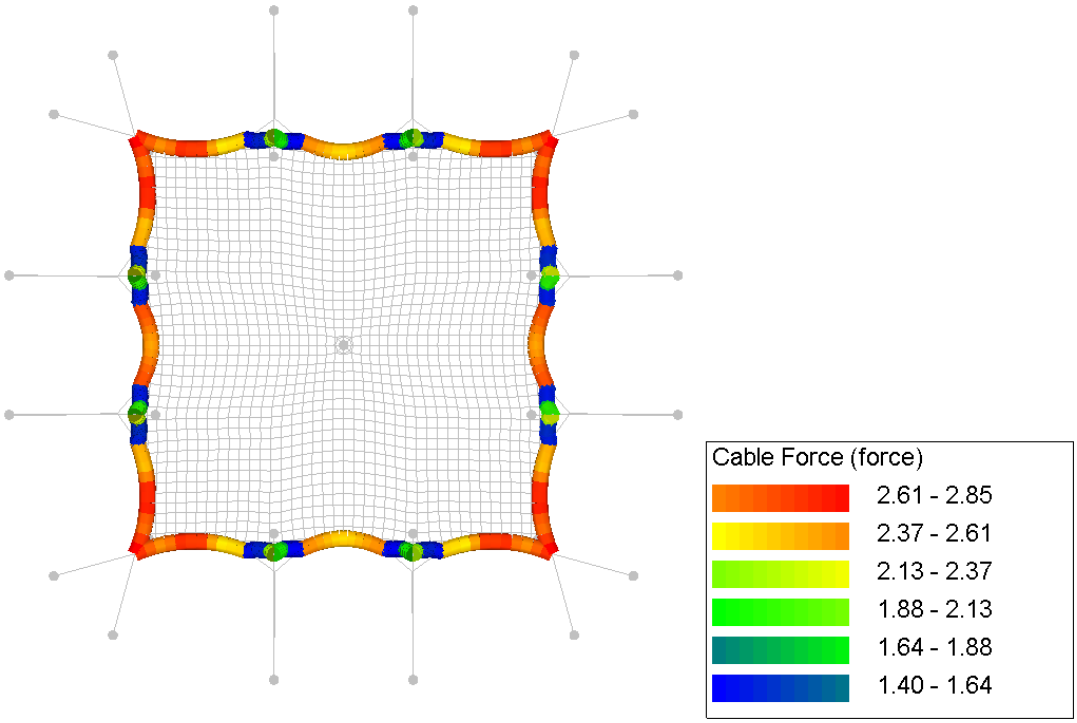
Annex D.6.1. Membrane stress (warp)



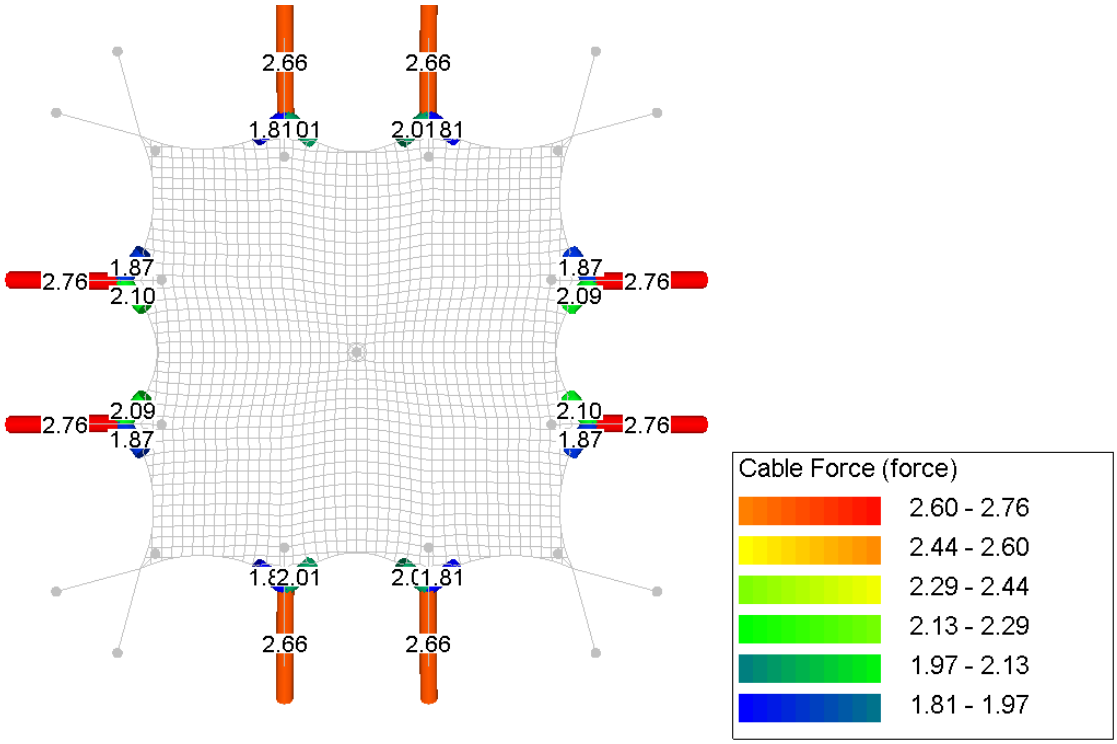
Annex D.6.2. Membrane stress (weft)



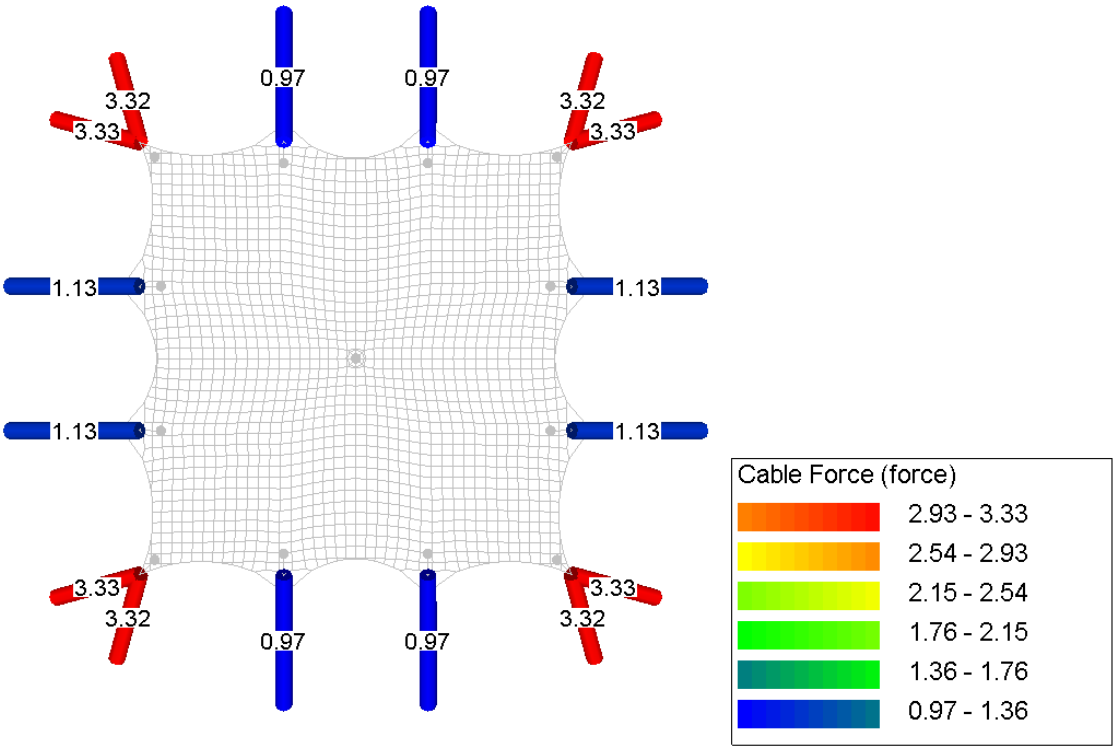
Annex D.6.3. Circumference rope forces



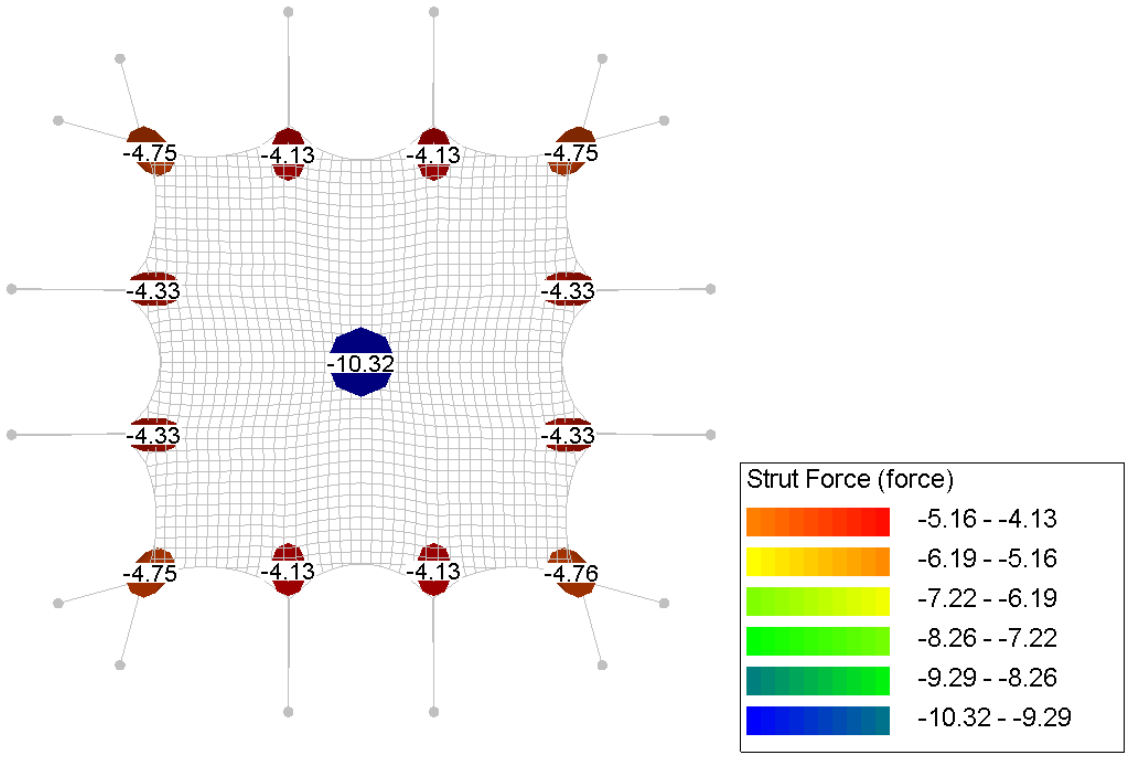
Annex D.6.4. Guy rope forces



Annex D.6.5. Belt forces

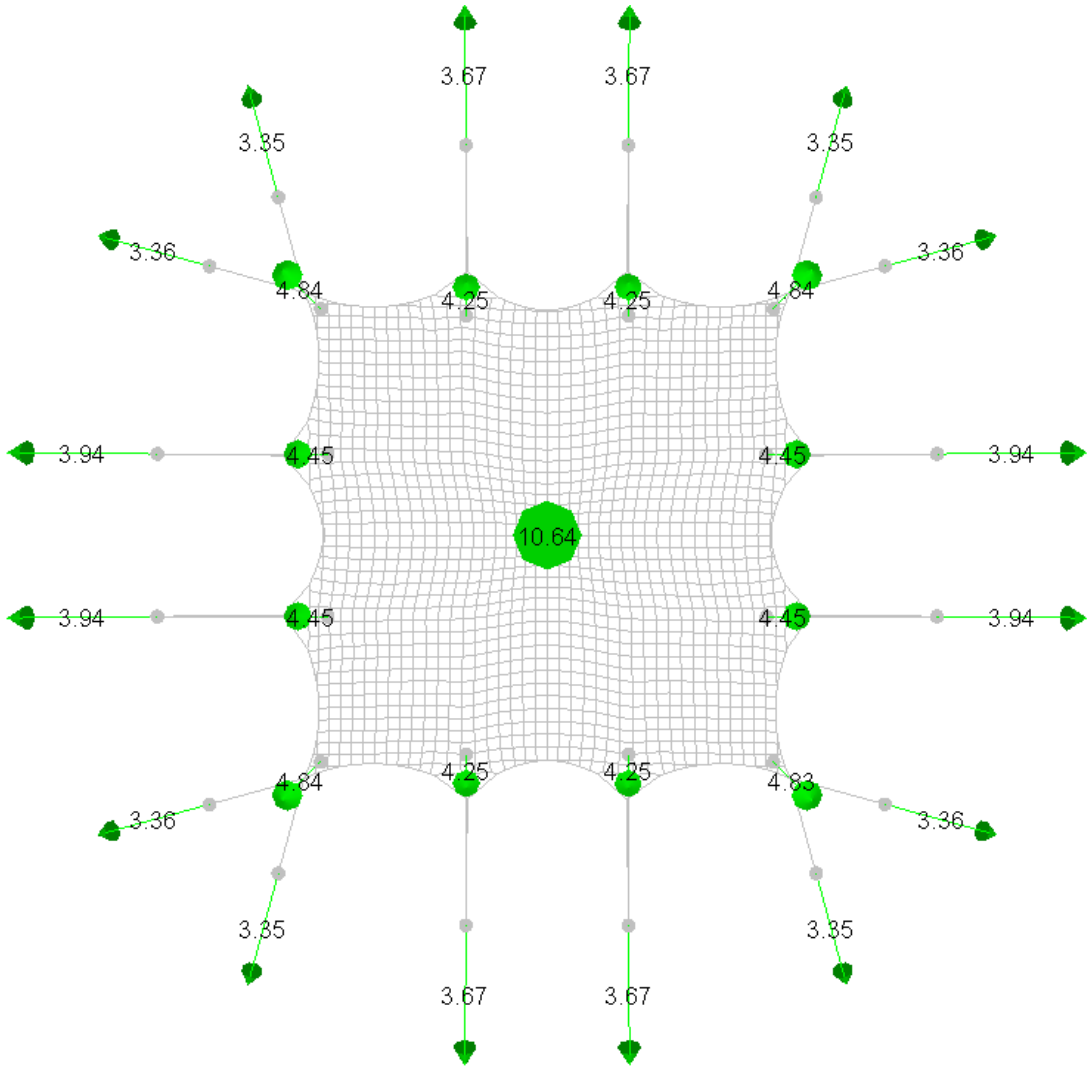


Annex D.6.6. Poles forces



Annex D.6.7. Reaction forces

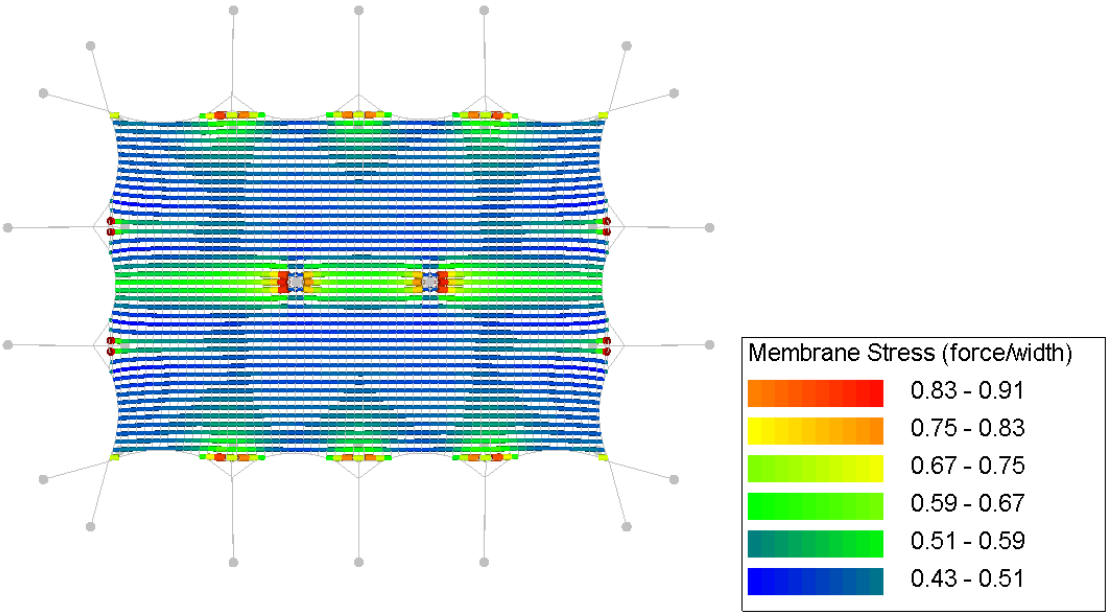
Increased snow load of 0.1 x 1.5/1.35=0.1083 kN/m2 is applied for ballast and anchor calculation



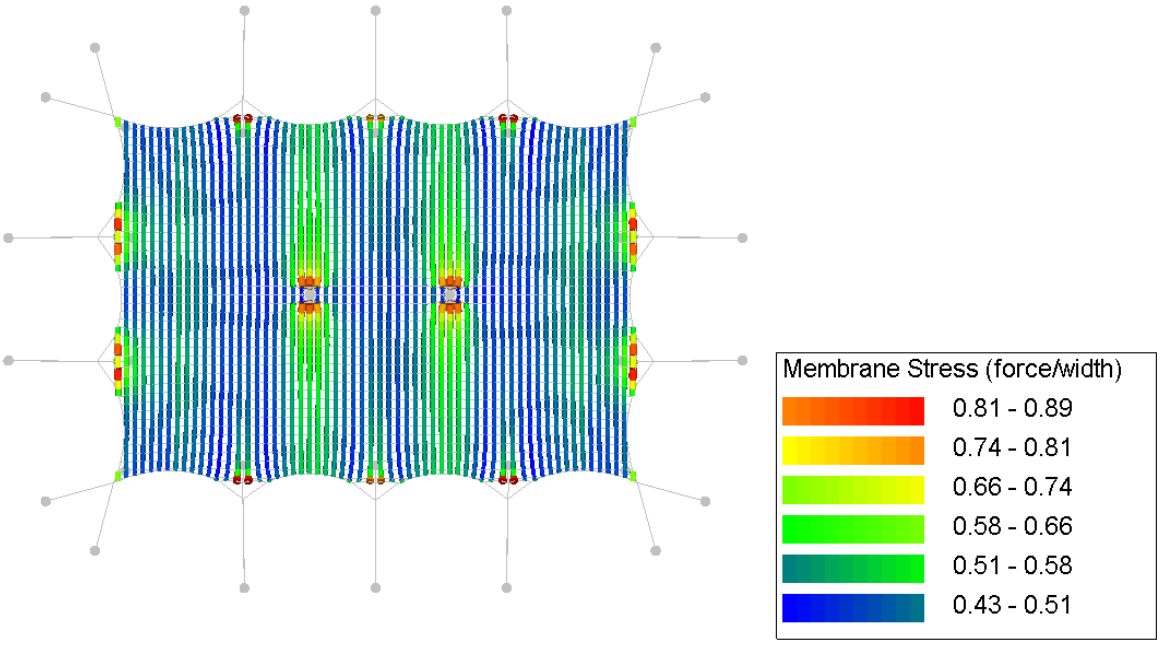
Annex E. Results per load combination – 10x15m model

Annex E.1. CO1. Own weight + pretension

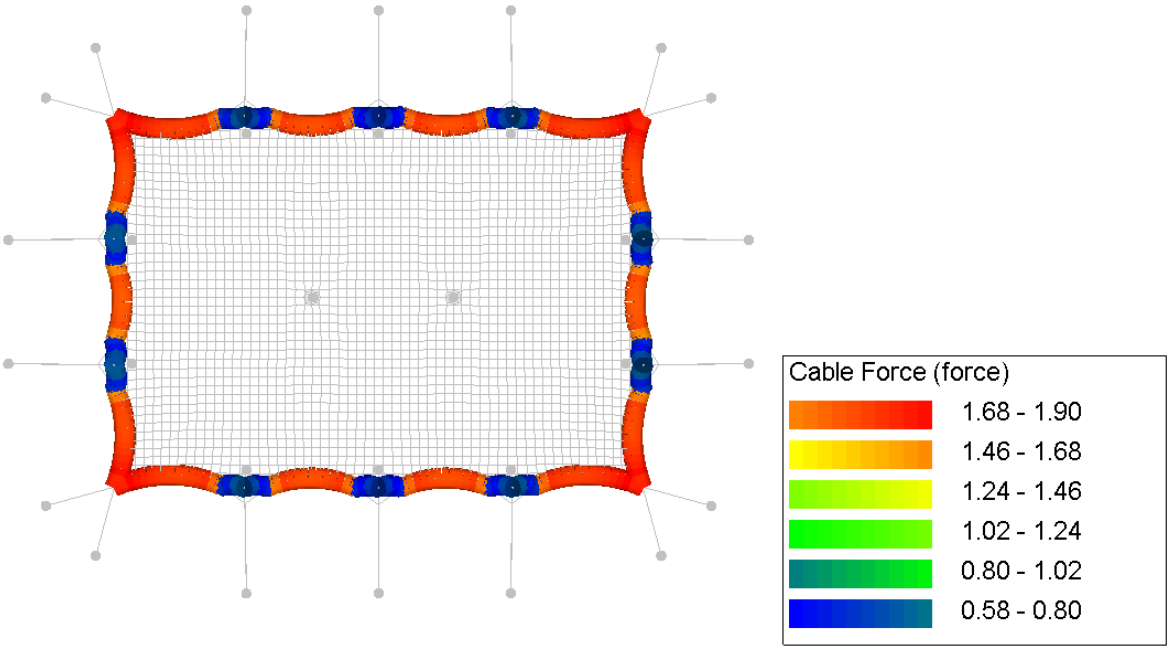
Annex E.1.1. Membrane stress (warp)



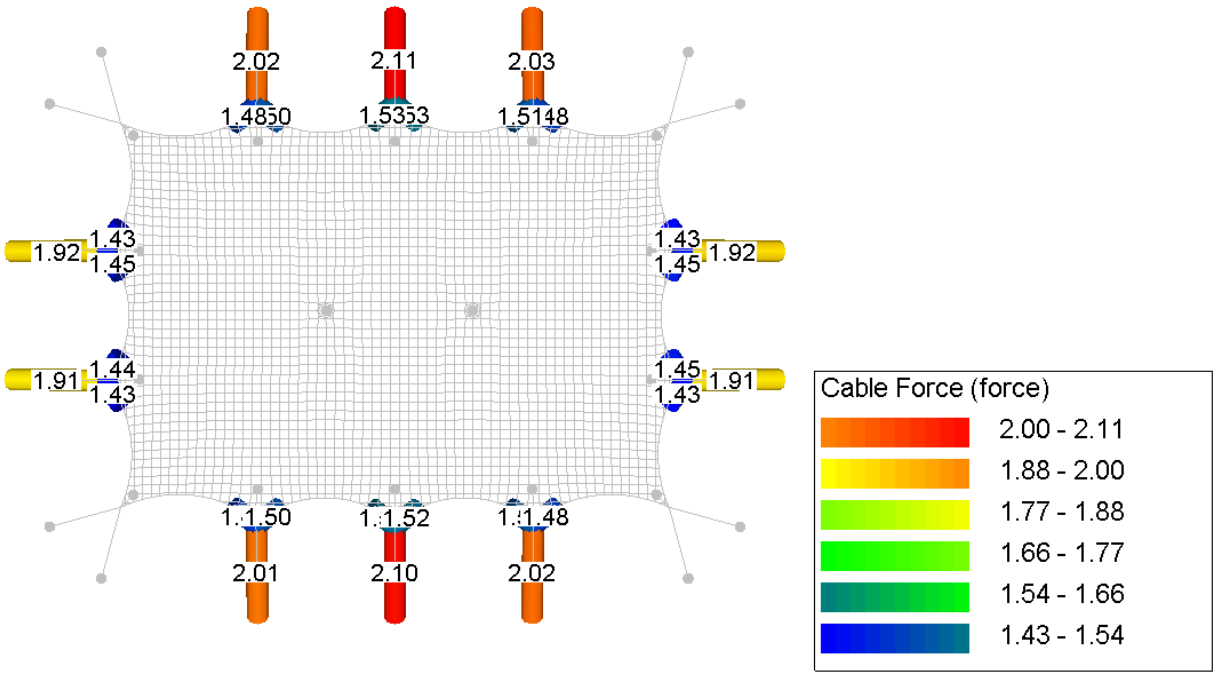
Annex E.1.2. Membrane stress (weft)



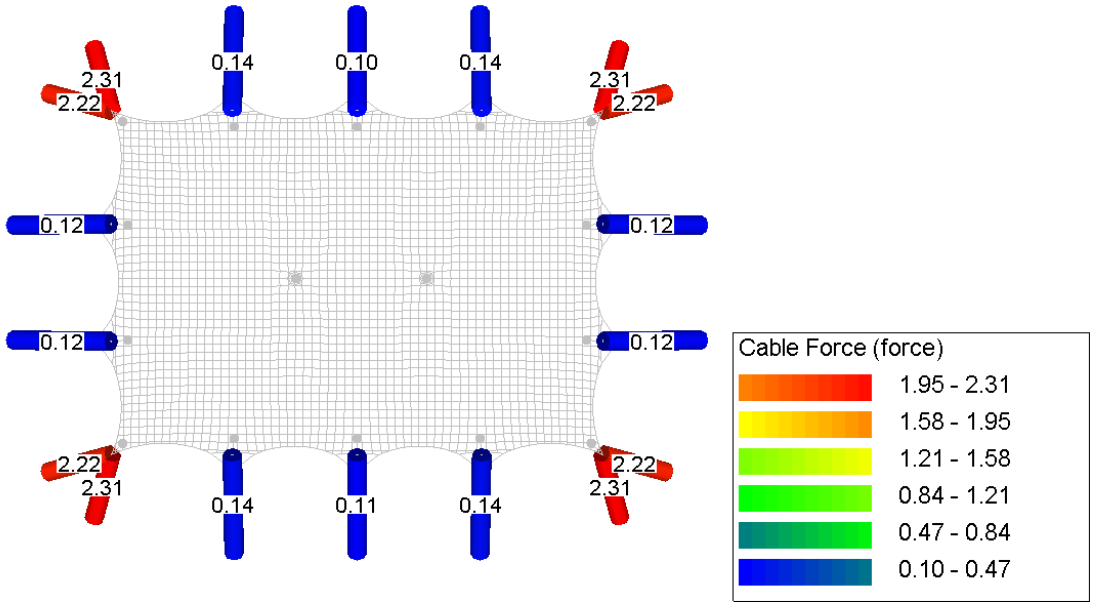
Annex E.1.3. Circumference rope forces



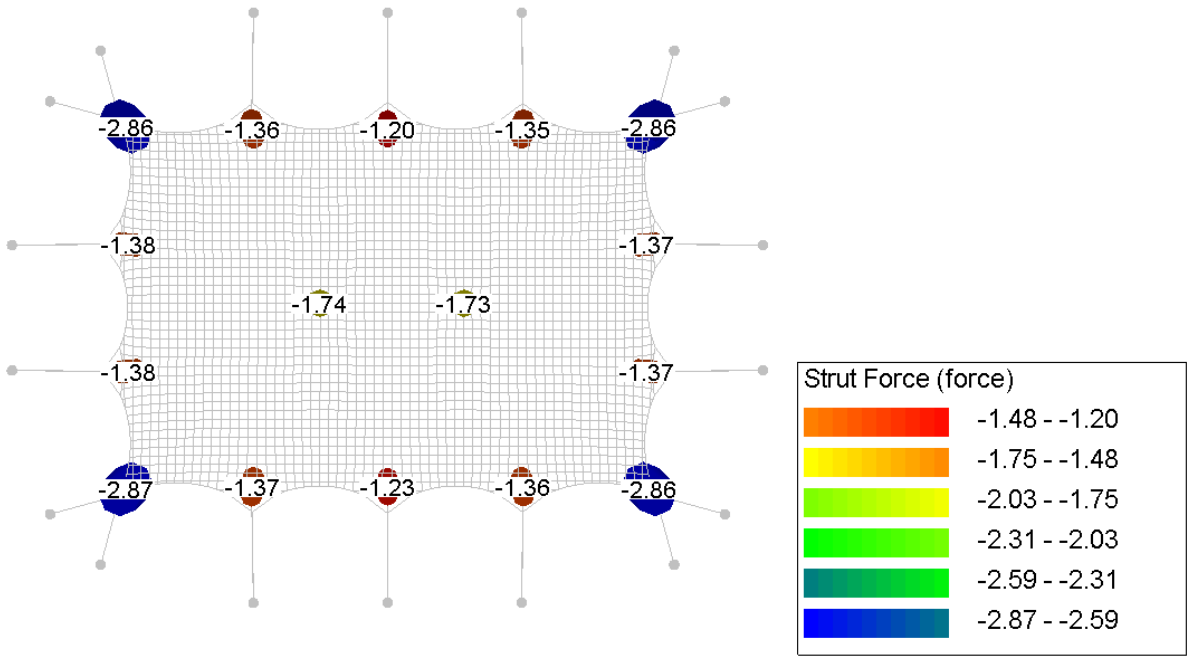
Annex E.1.4. Rope forces



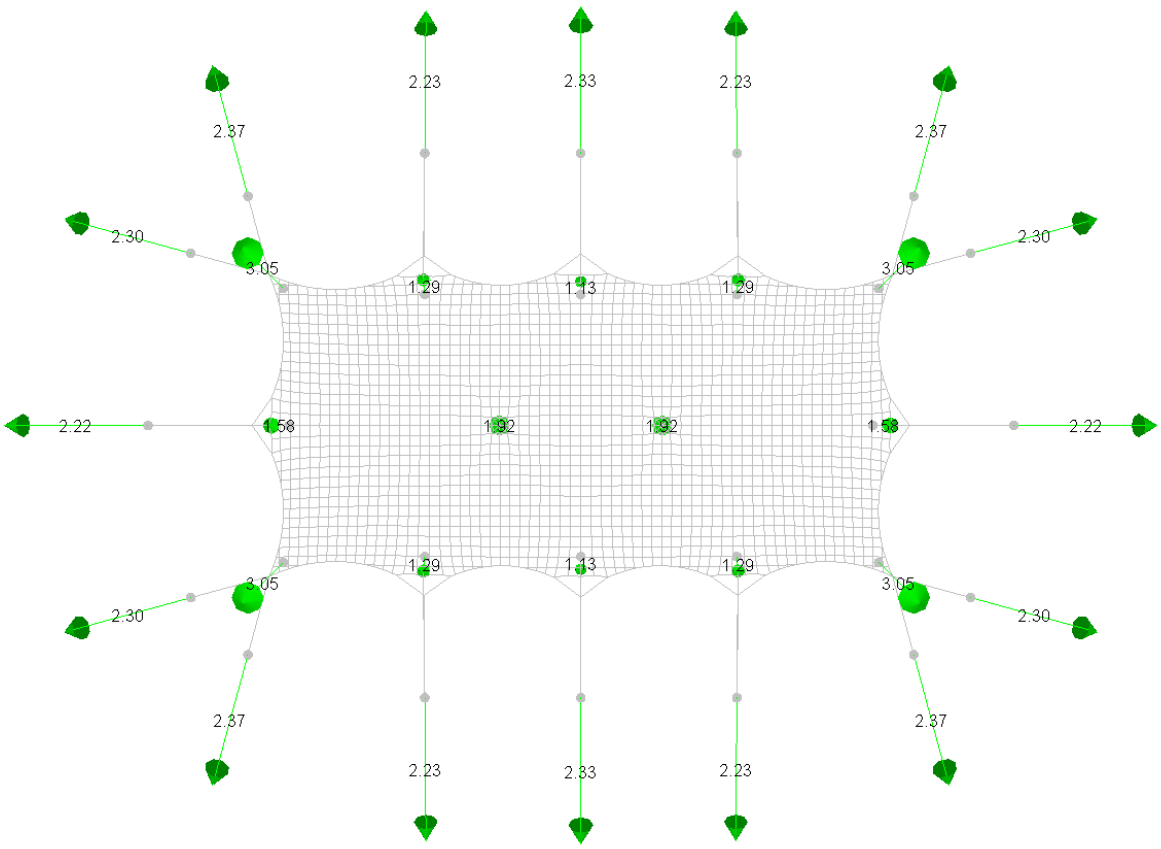
Annex E.1.5. Belt forces



Annex E.1.6. Pole forces

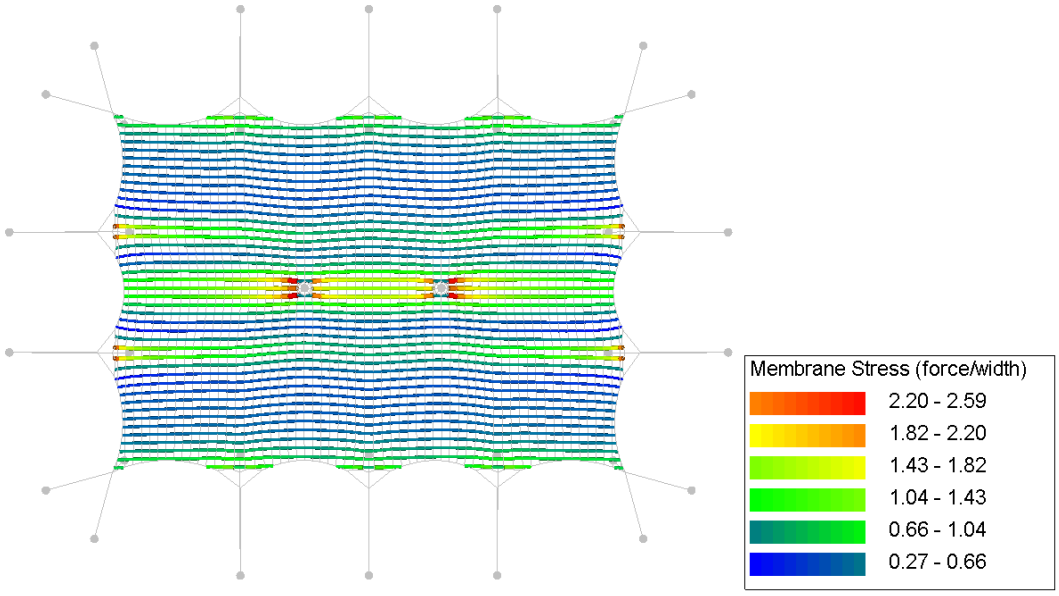


Annex E.1.7. Reaction forces

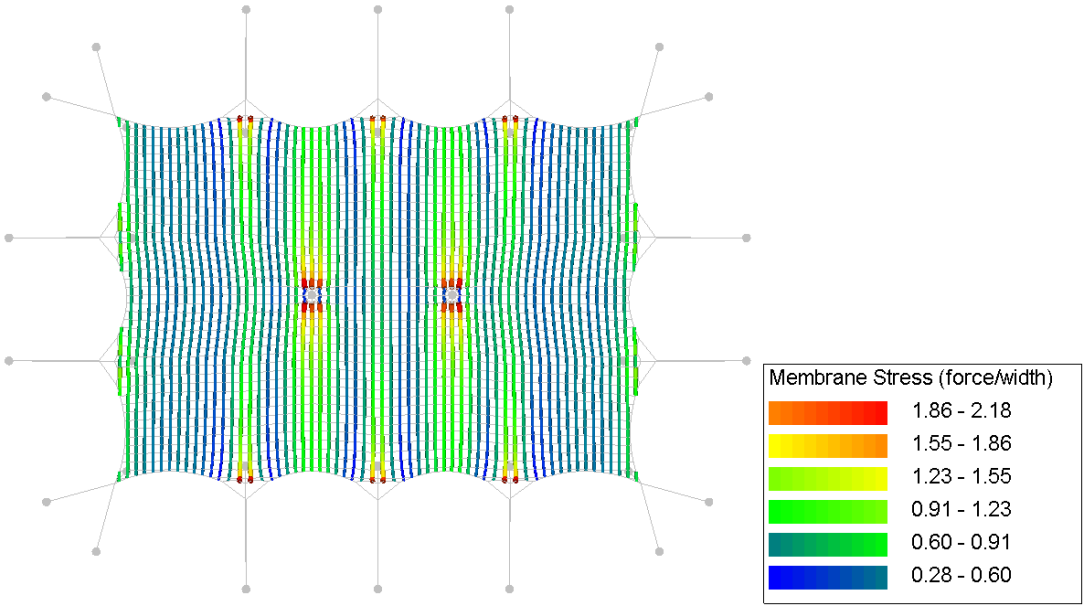


Annex E.2. CO2. Own weight + pretension + snow

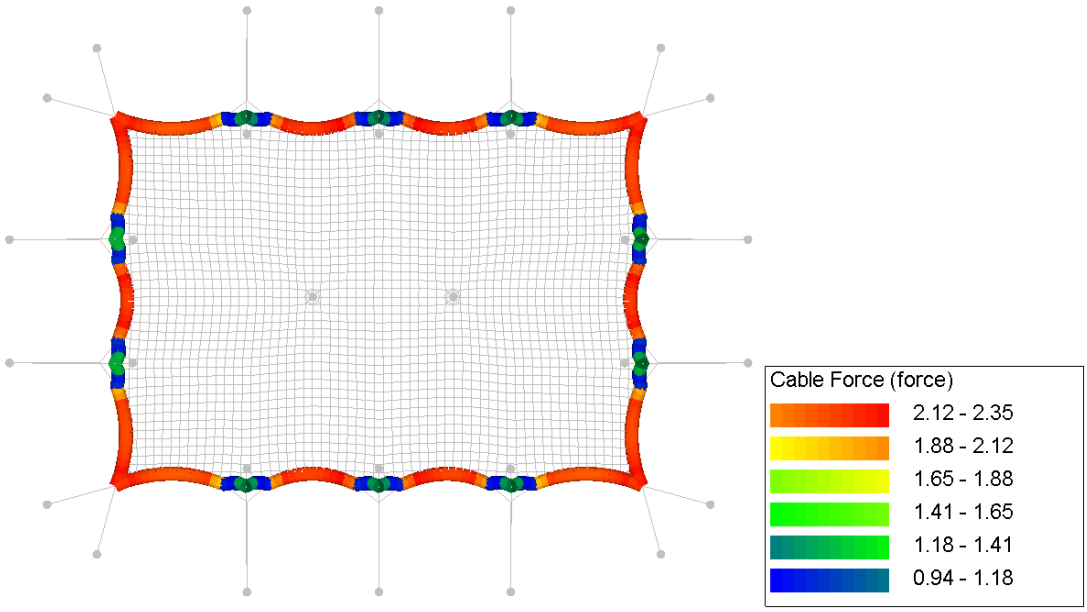
Annex E.2.1. Membrane stress (warp)



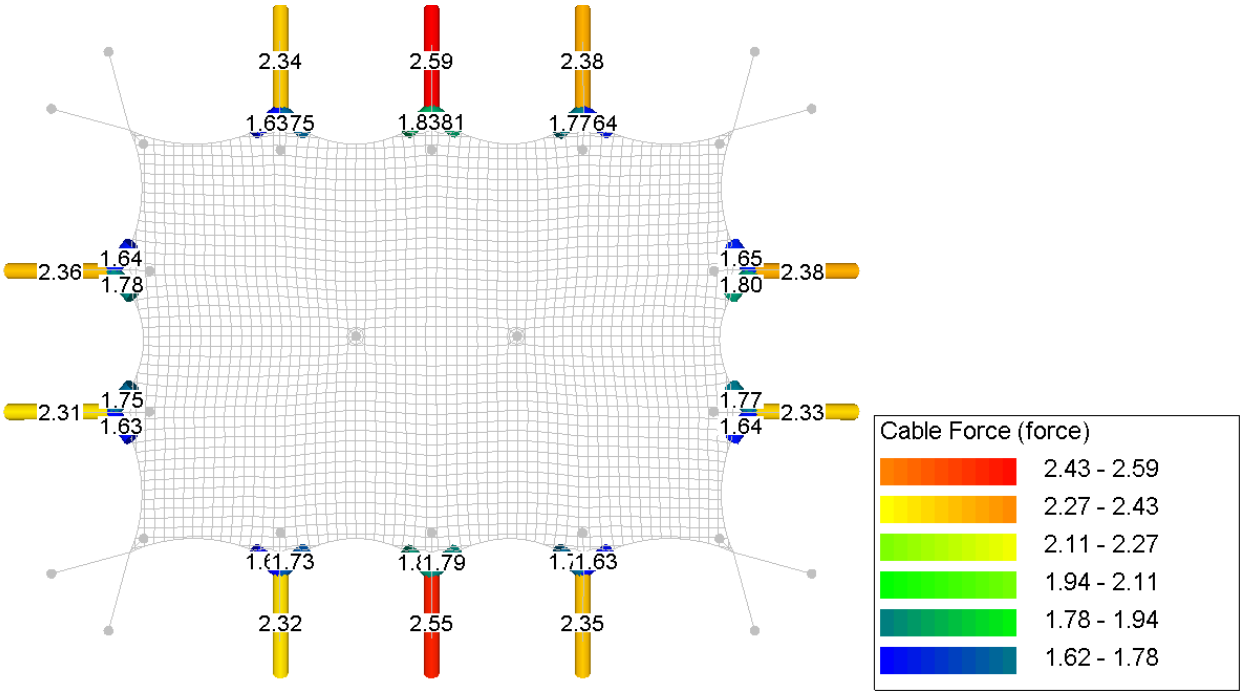
Annex E.2.2. Membrane stress (weft)



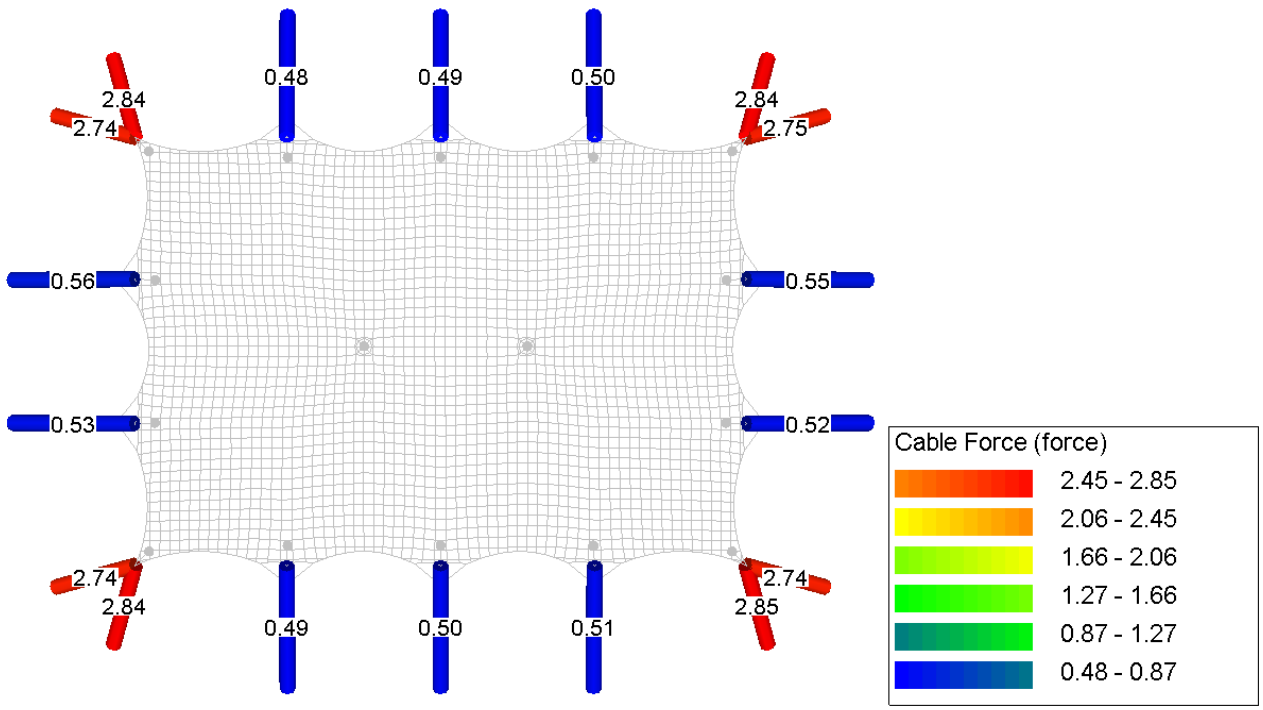
Annex E.2.3. Circumference rope forces



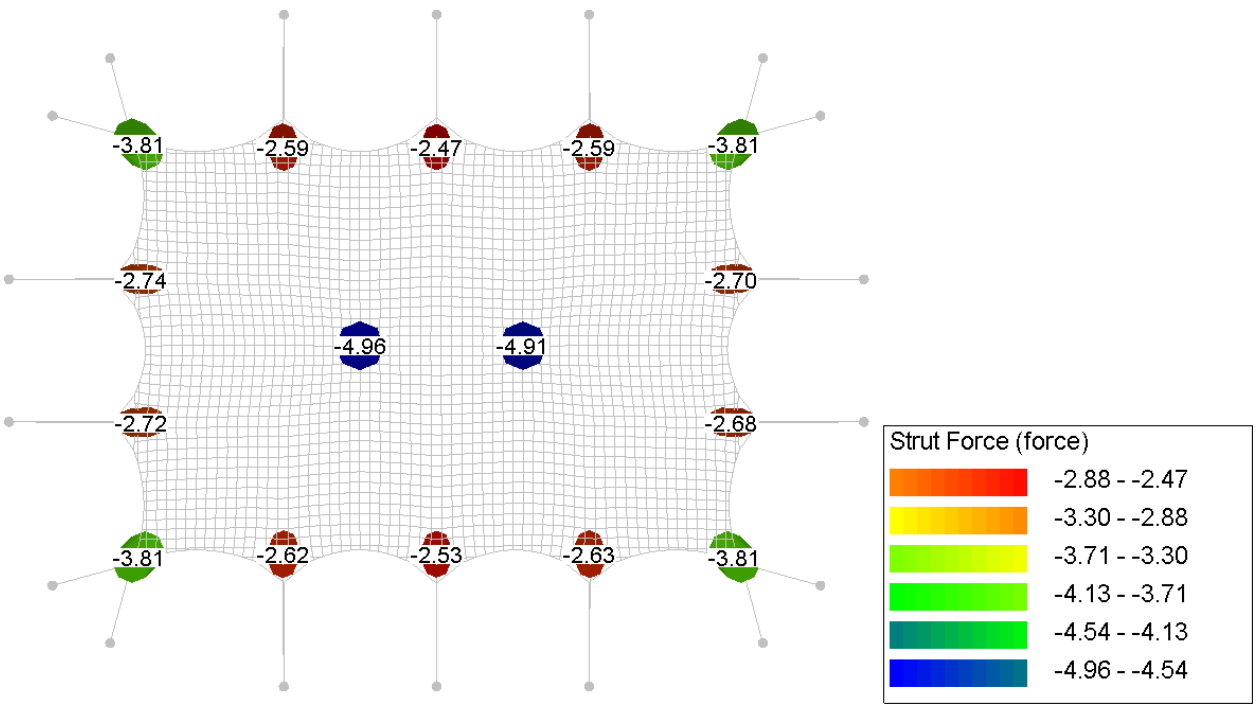
Annex E.2.4. Rope forces



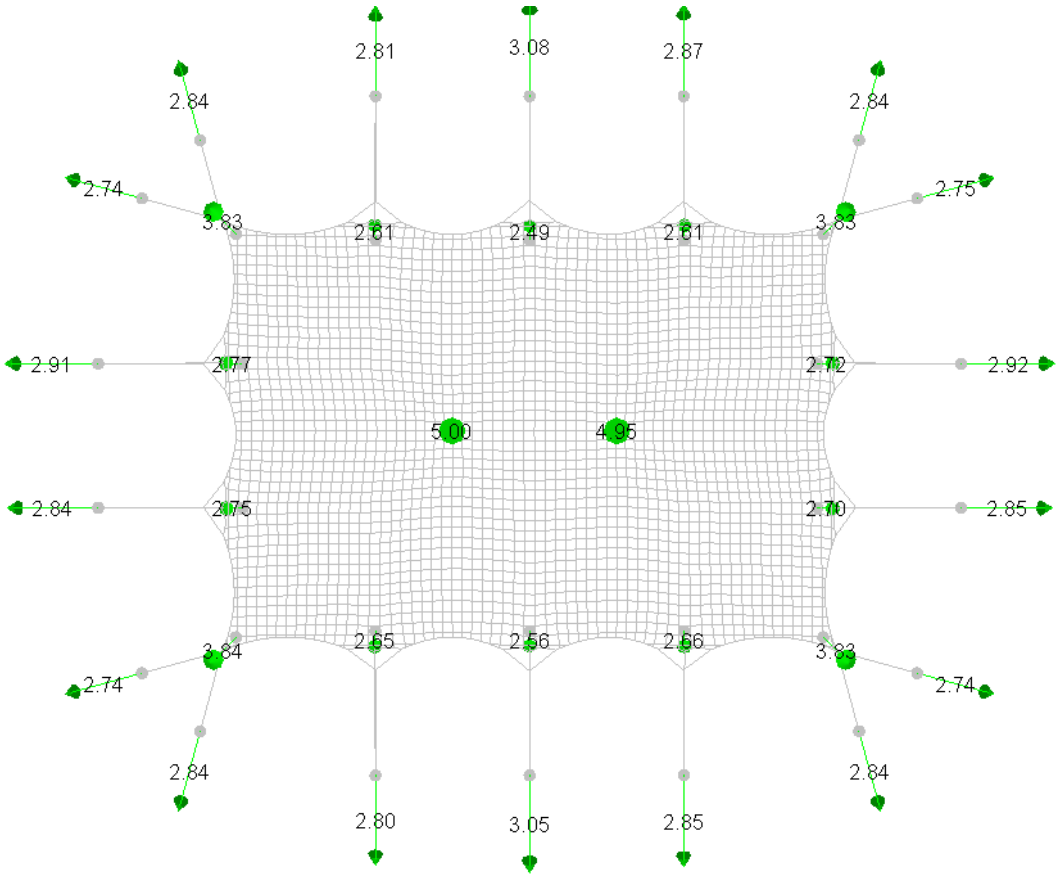
Annex E.2.5. Belt forces



Annex E.2.6. Pole forces

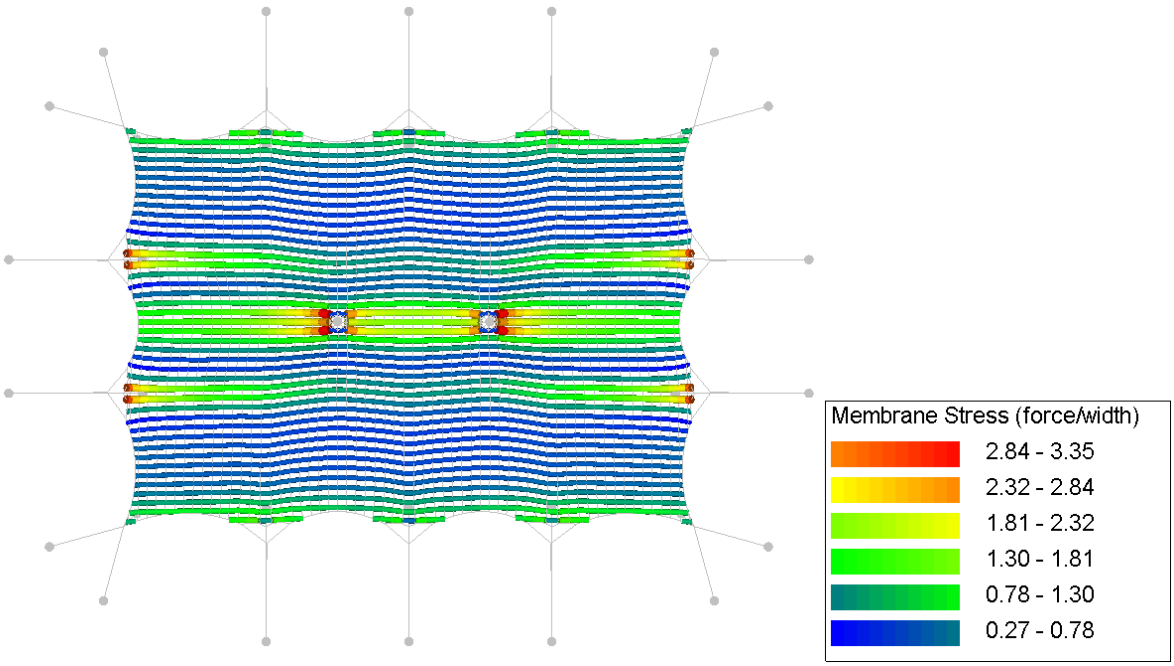


Annex E.2.7. Anchor forces

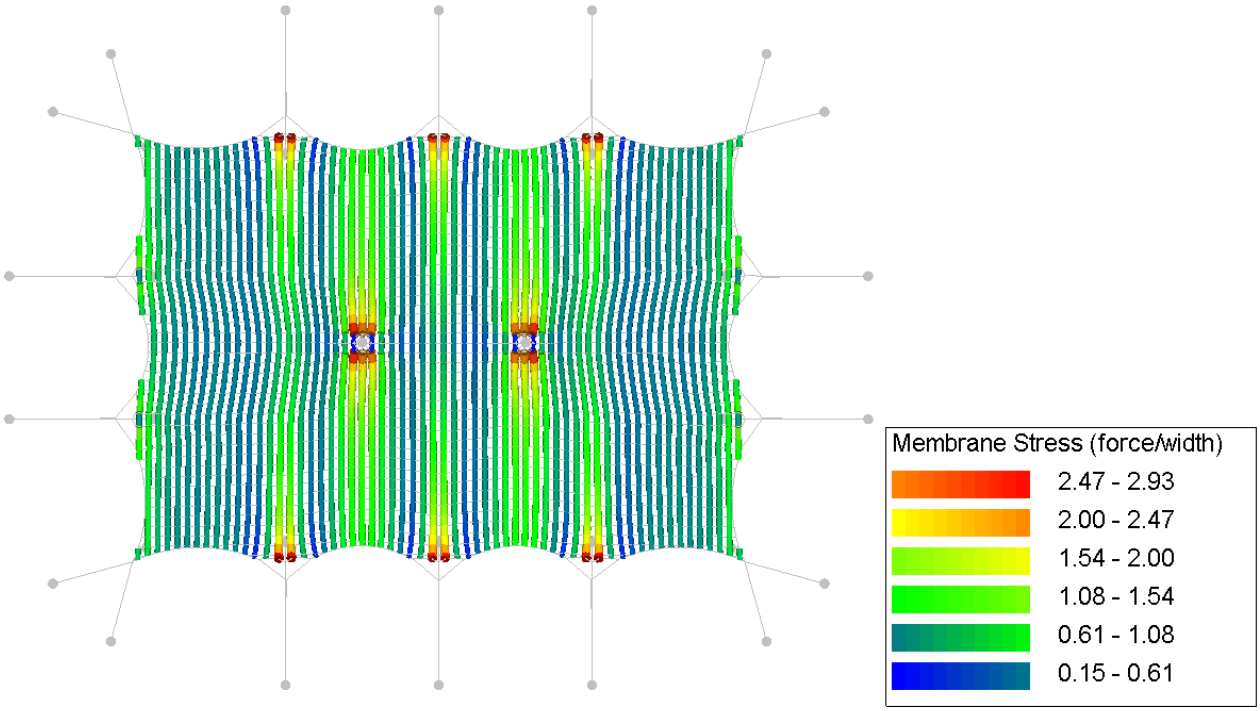


Annex E.3. CO3. Own weight + pretension + wind pressure

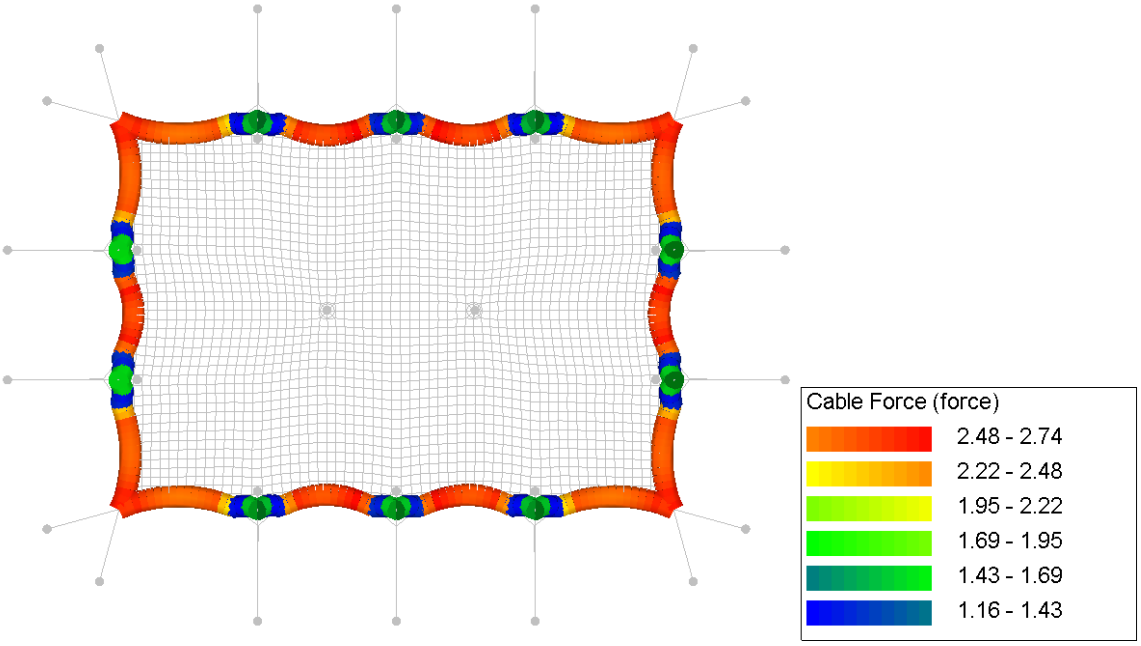
Annex E.3.1. Membrane stress (warp)



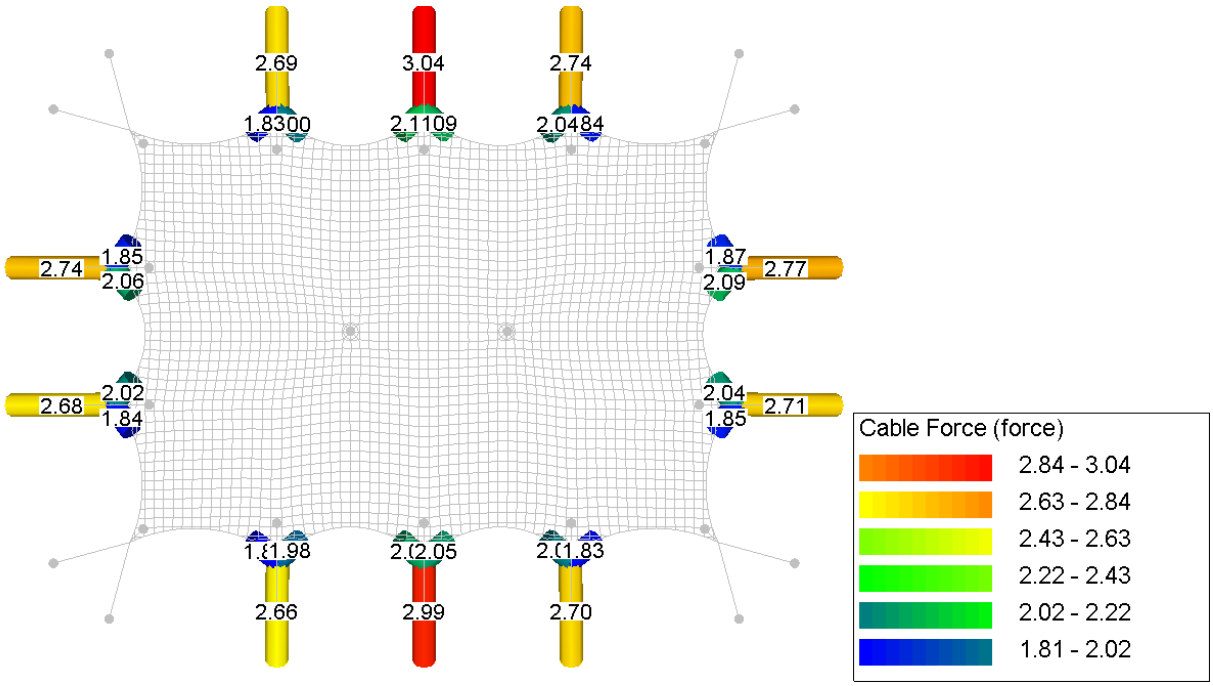
Annex E.3.2. Membrane stress (weft)



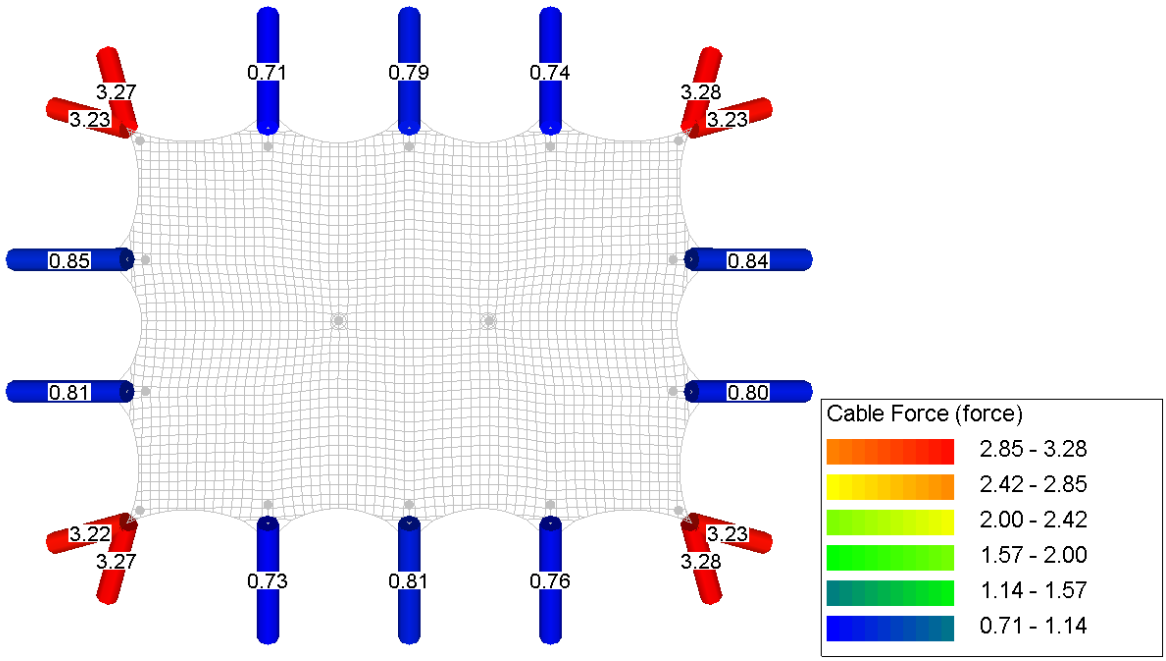
Annex E.3.3. Circumference rope forces



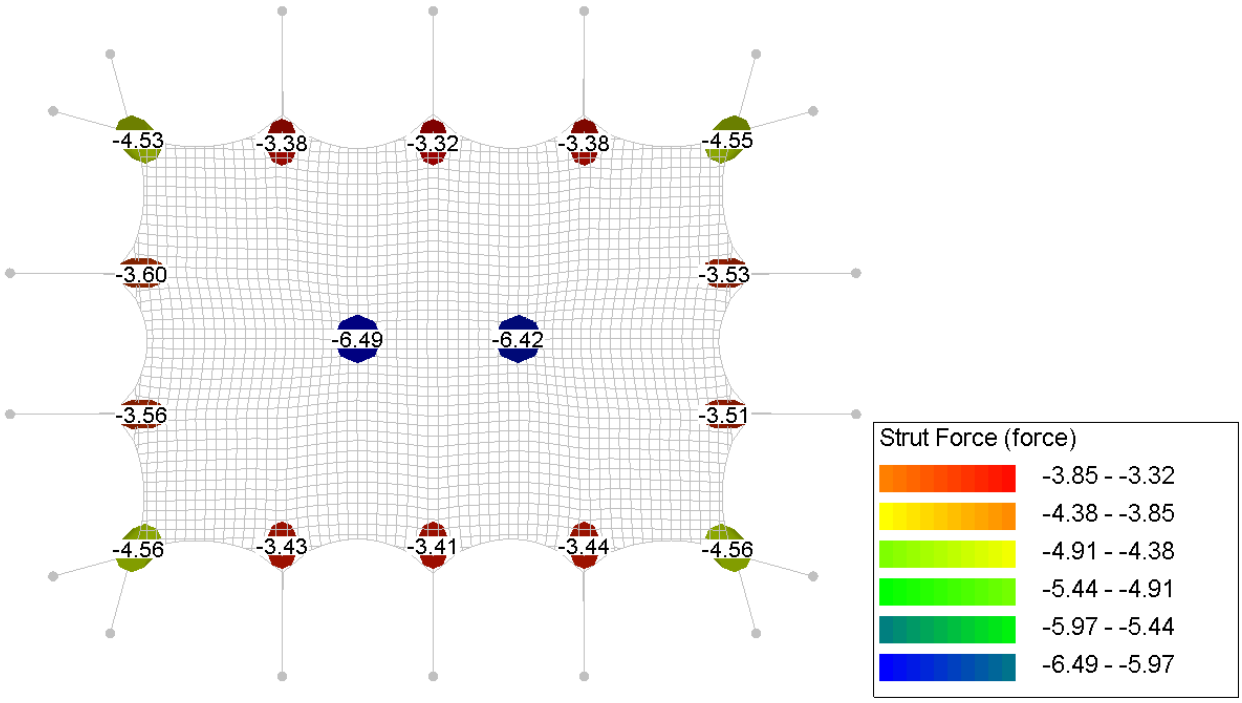
Annex E.3.4. Rope forces



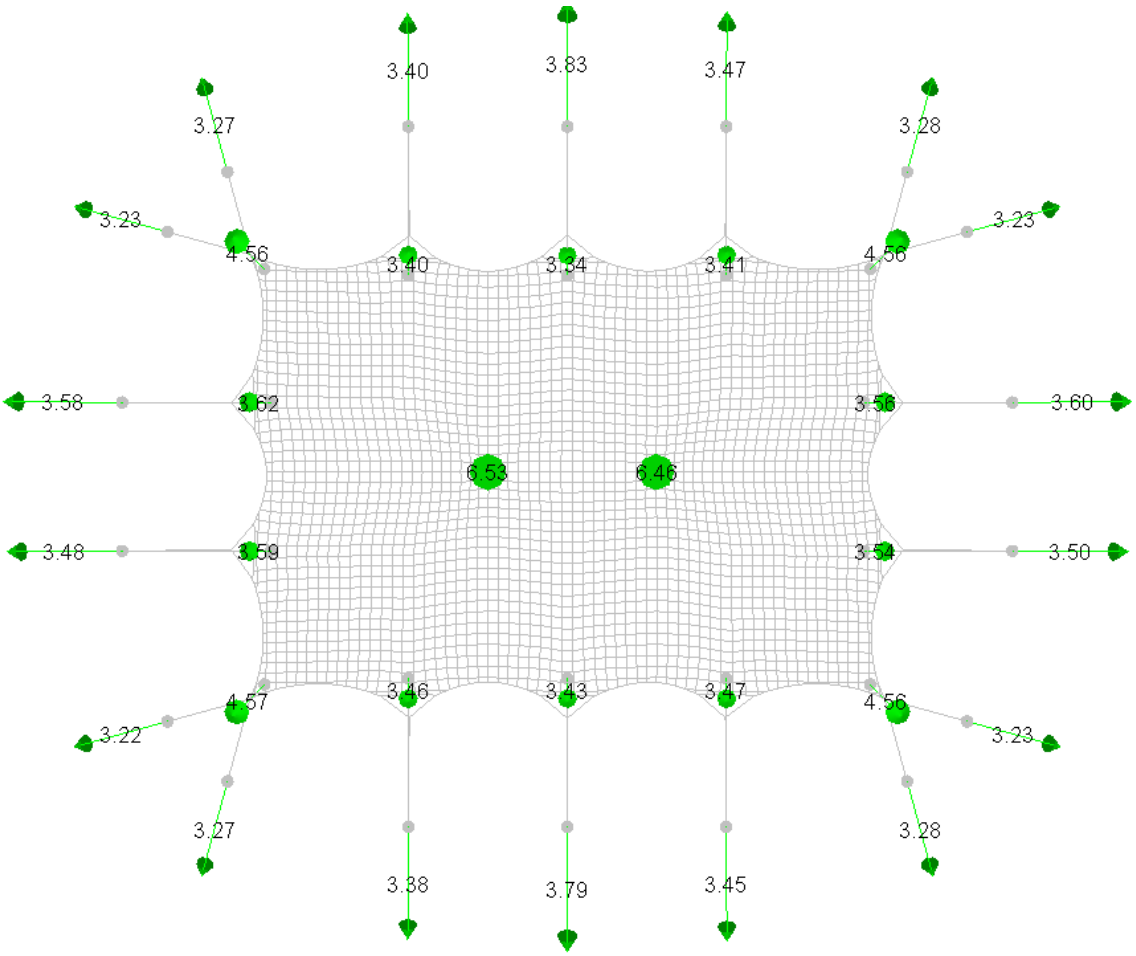
Annex E.3.5. Belt forces



Annex E.3.6. Poles forces

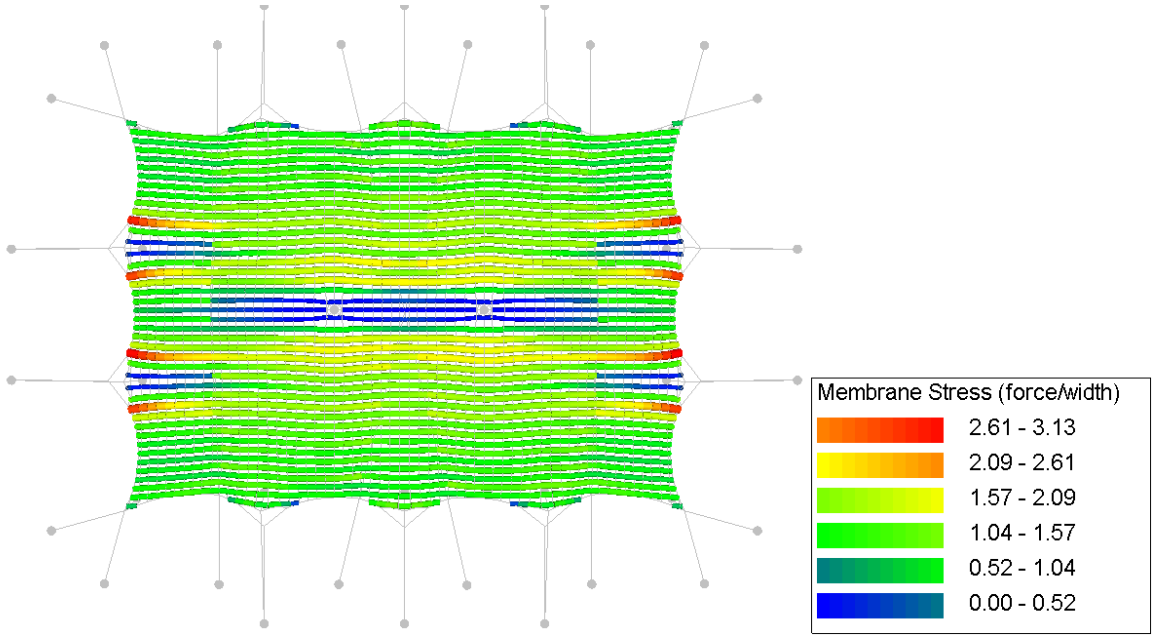


Annex E.3.7. Reaction forces

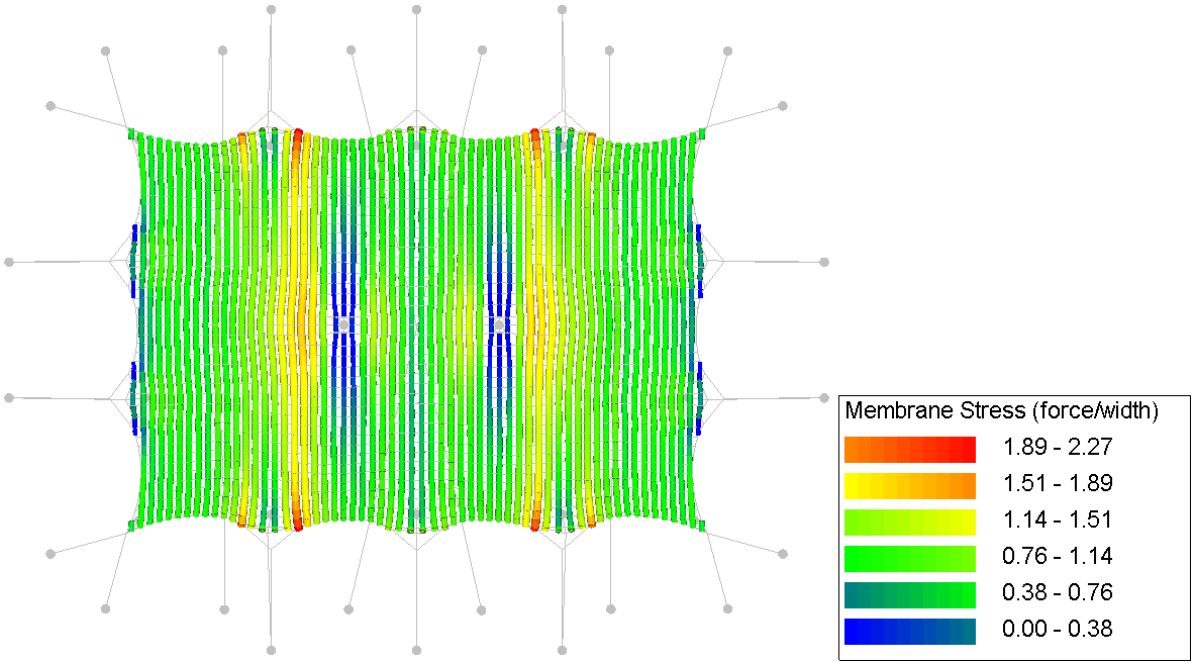


Annex E.4. CO4. Own weight + pretension + wind suction

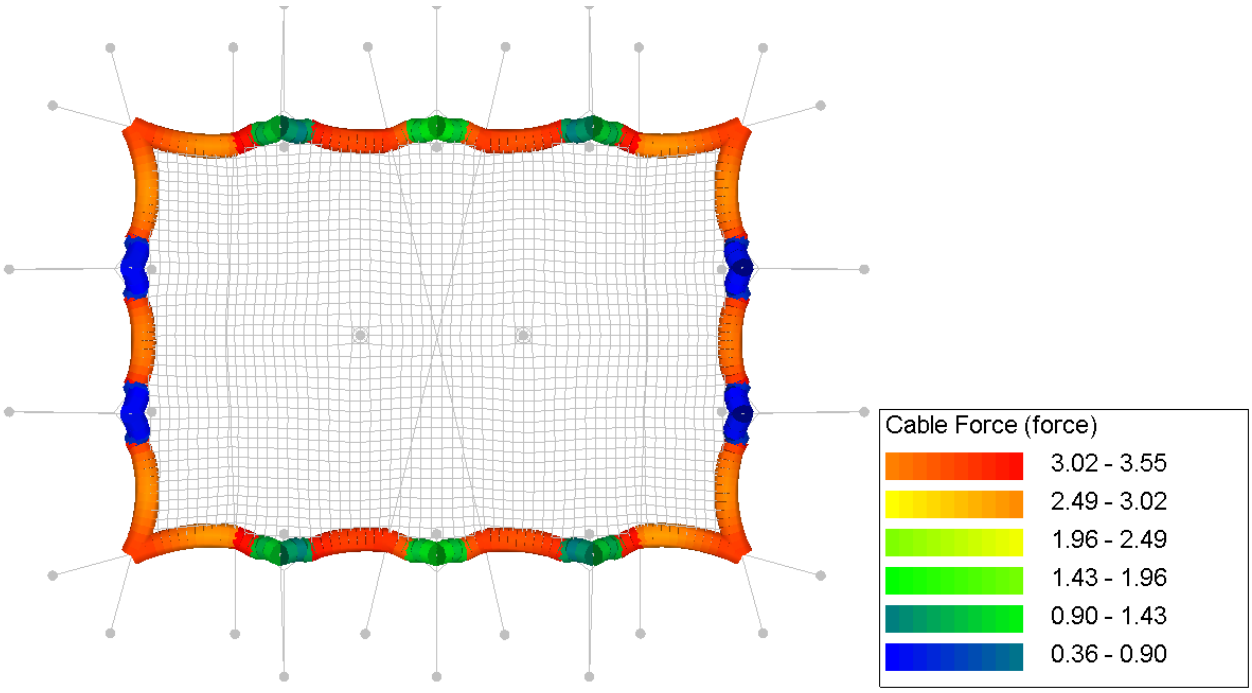
Annex E.4.1. Membrane stress (warp)



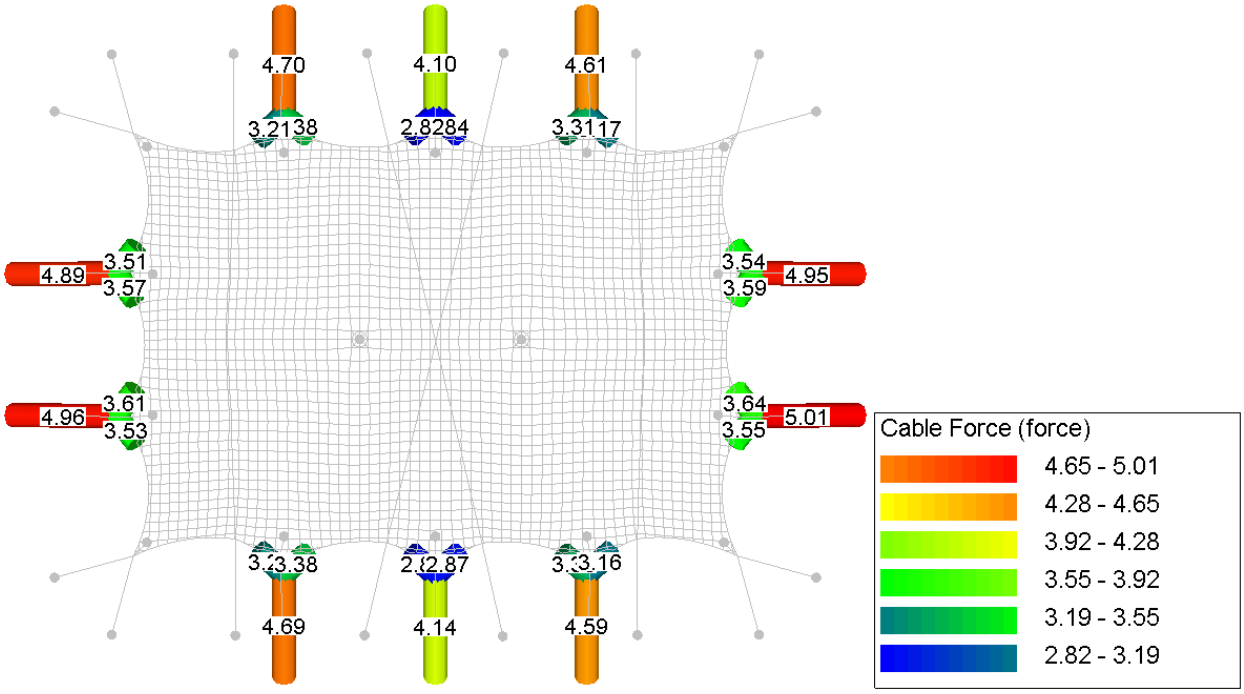
Annex E.4.2. Membrane stress (weft)



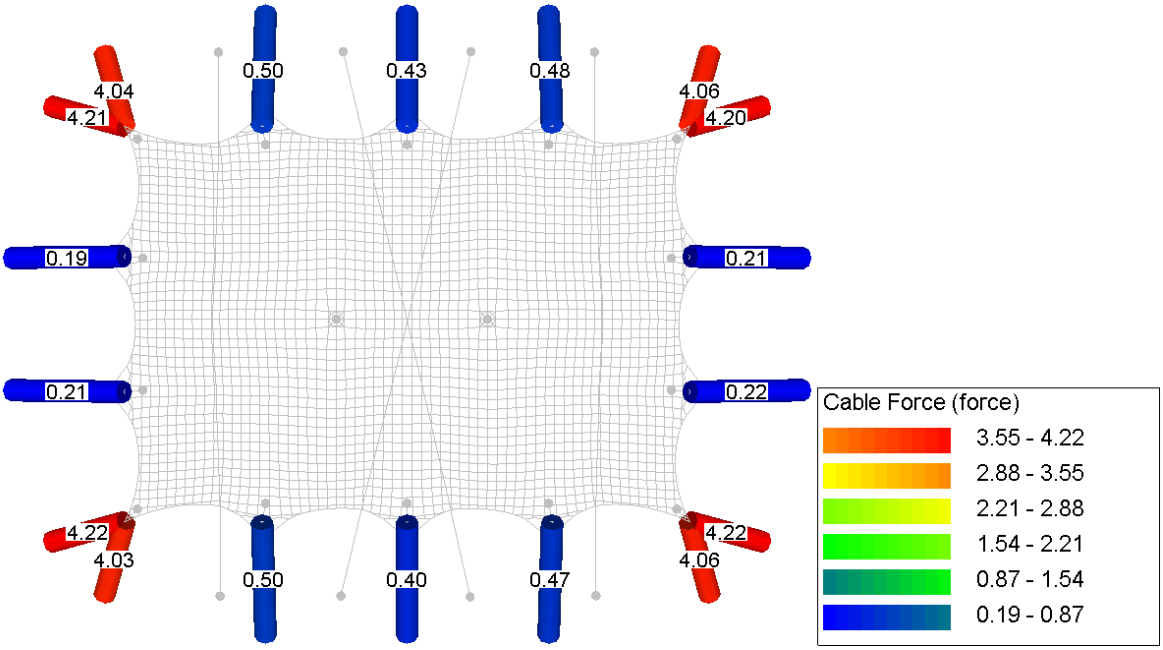
Annex E.4.3. Circumference rope forces



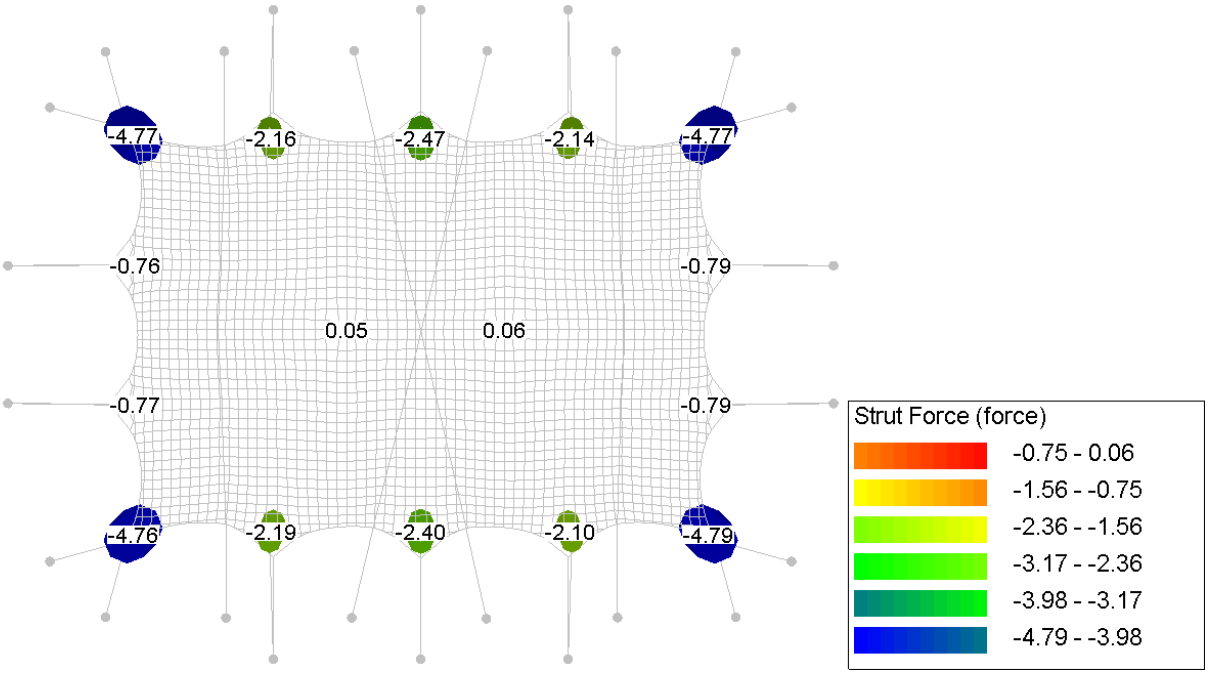
Annex E.4.4. Guy rope forces



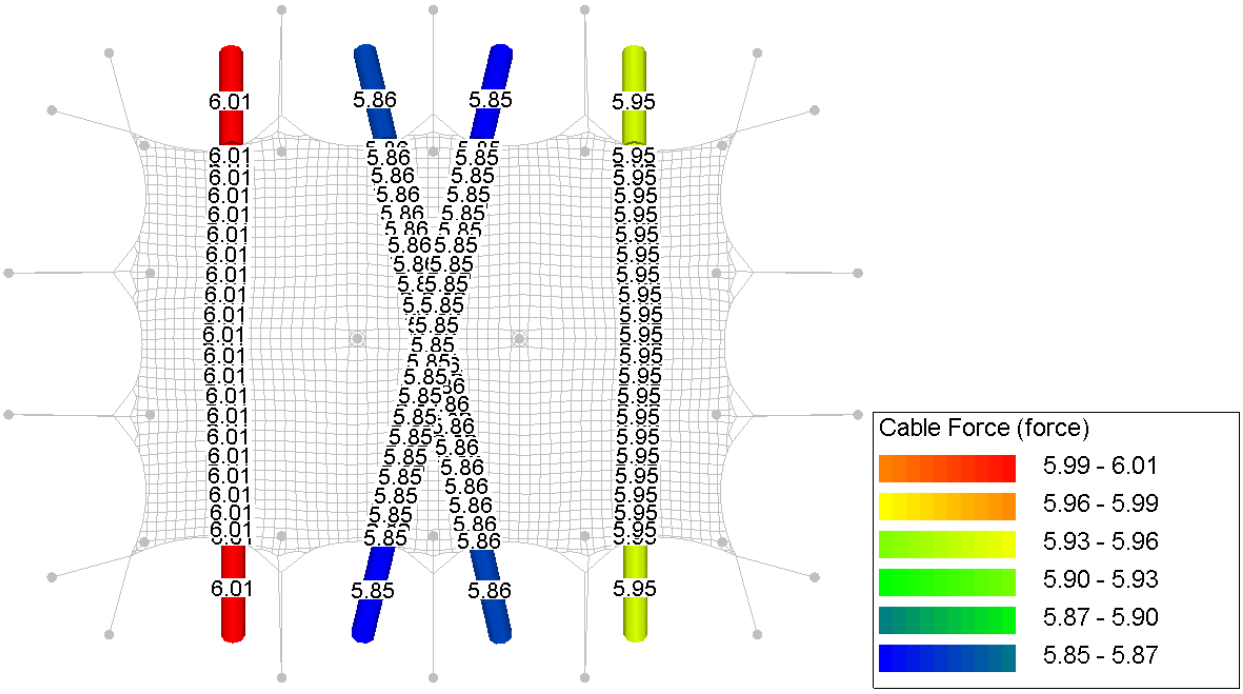
Annex E.4.5. Belt forces



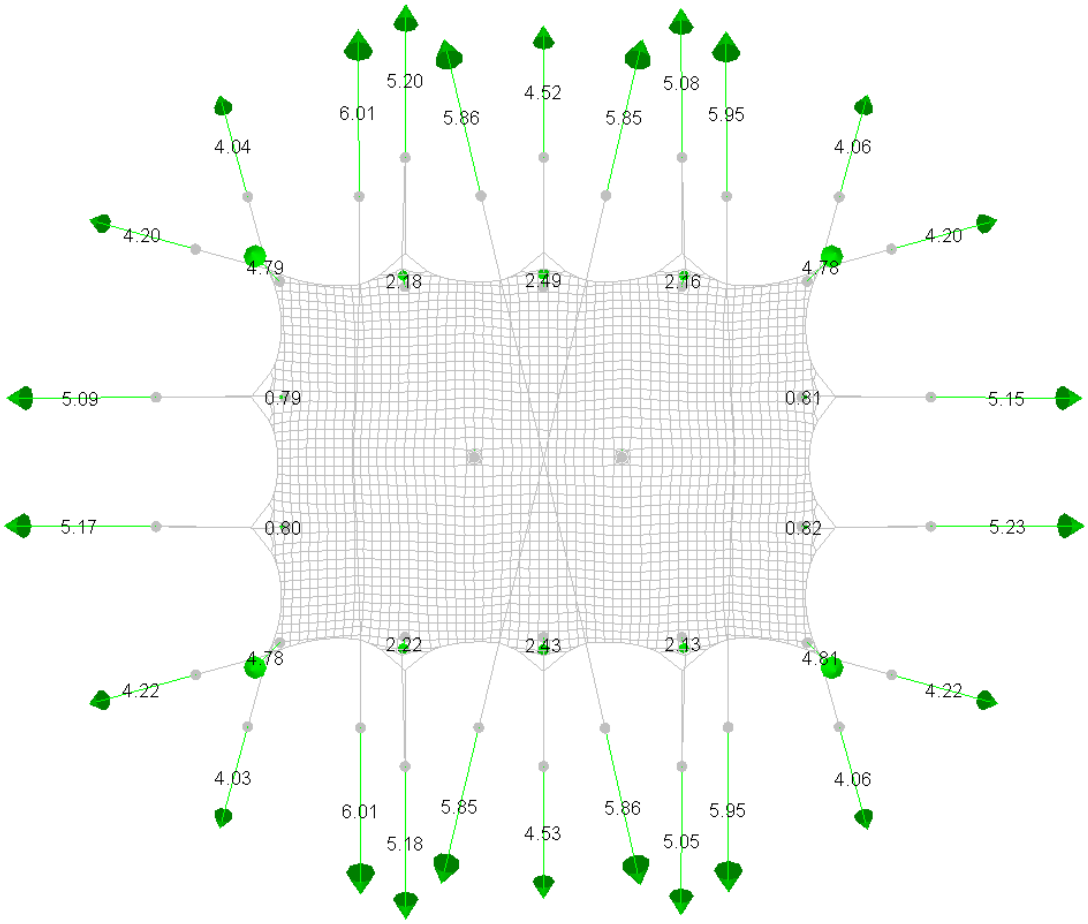
Annex E.4.6. Poles forces



Annex E.4.7. Storm belt forces

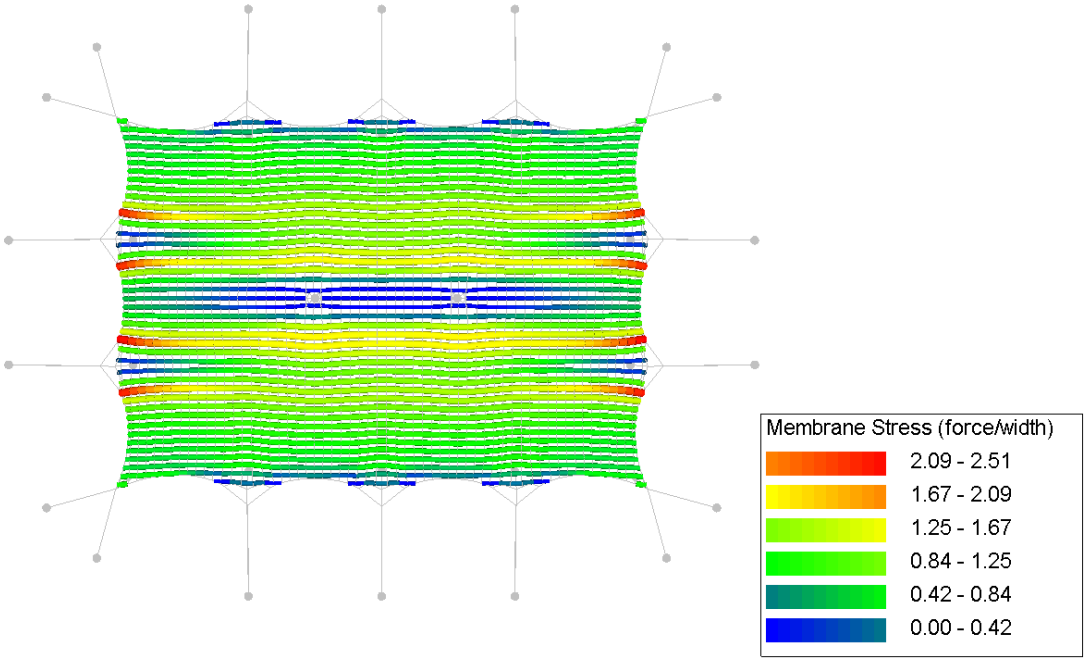


Annex E.4.8. Reaction forces

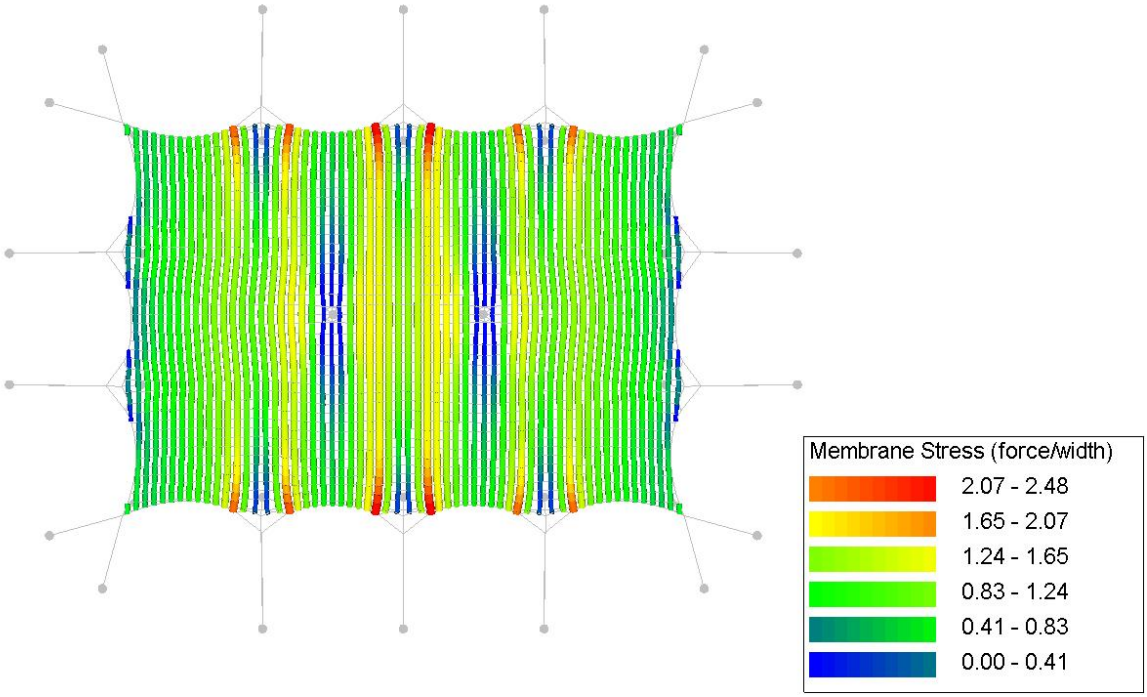


Annex E.5. CO5. Own weight + pretension + wind suction reduced [NL]

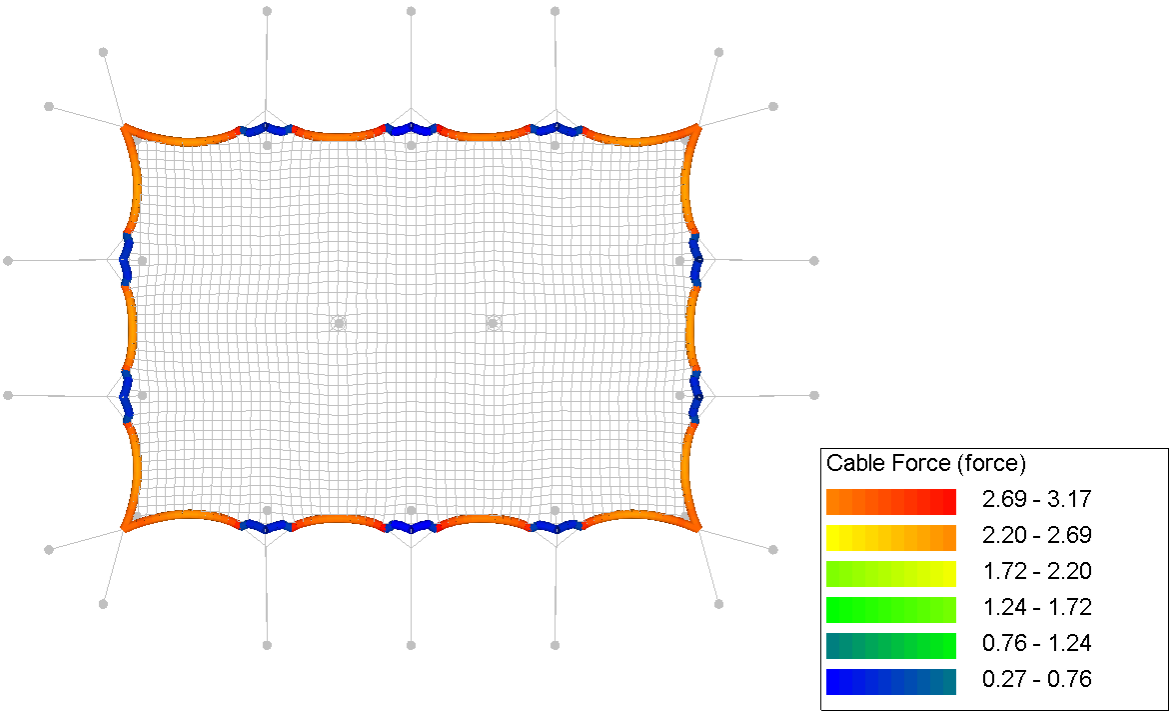
Annex E.5.1. Membrane stress (warp)



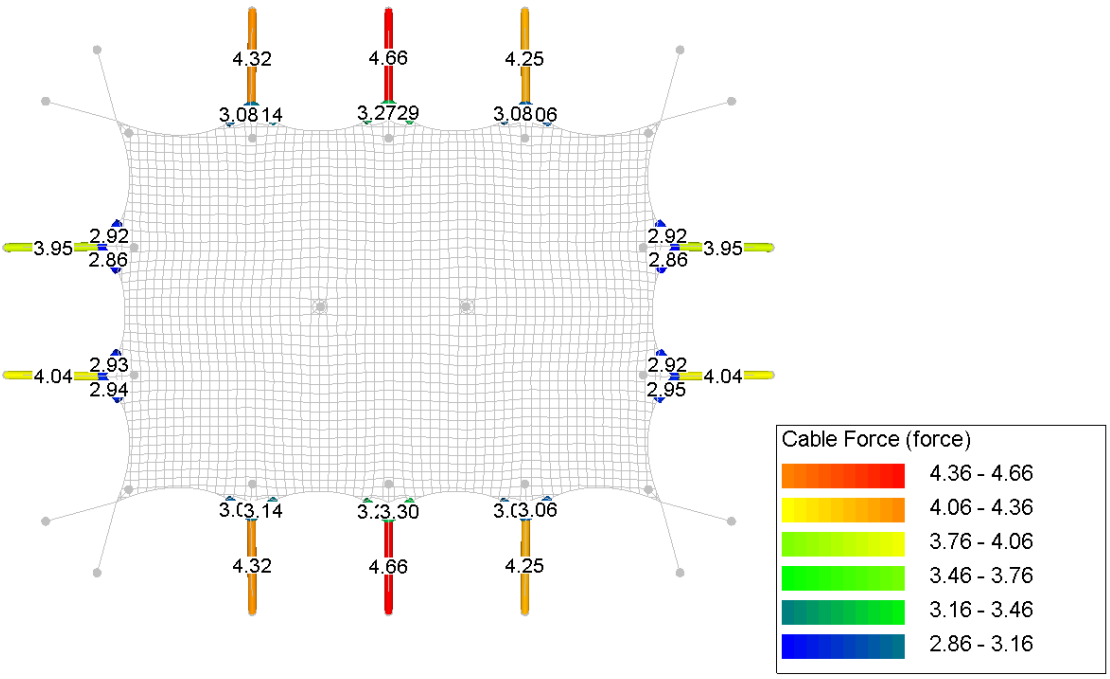
Annex E.5.2. Membrane stress (weft)



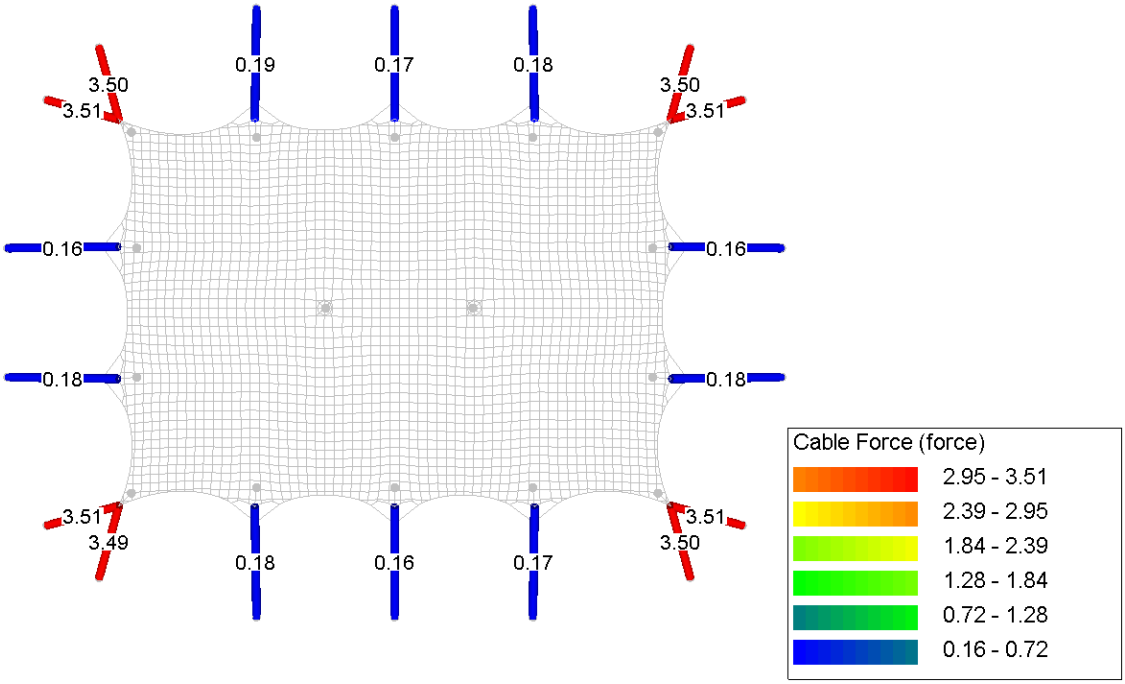
Annex E.5.3. Circumference rope forces



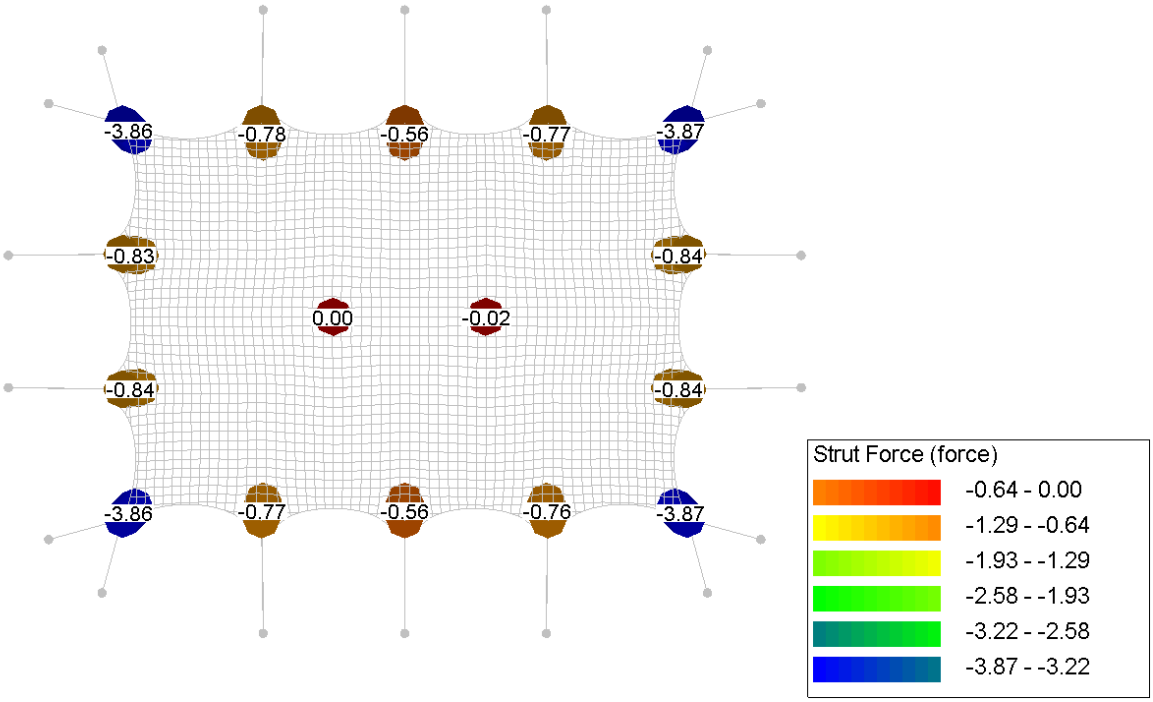
Annex E.5.4. Rope forces



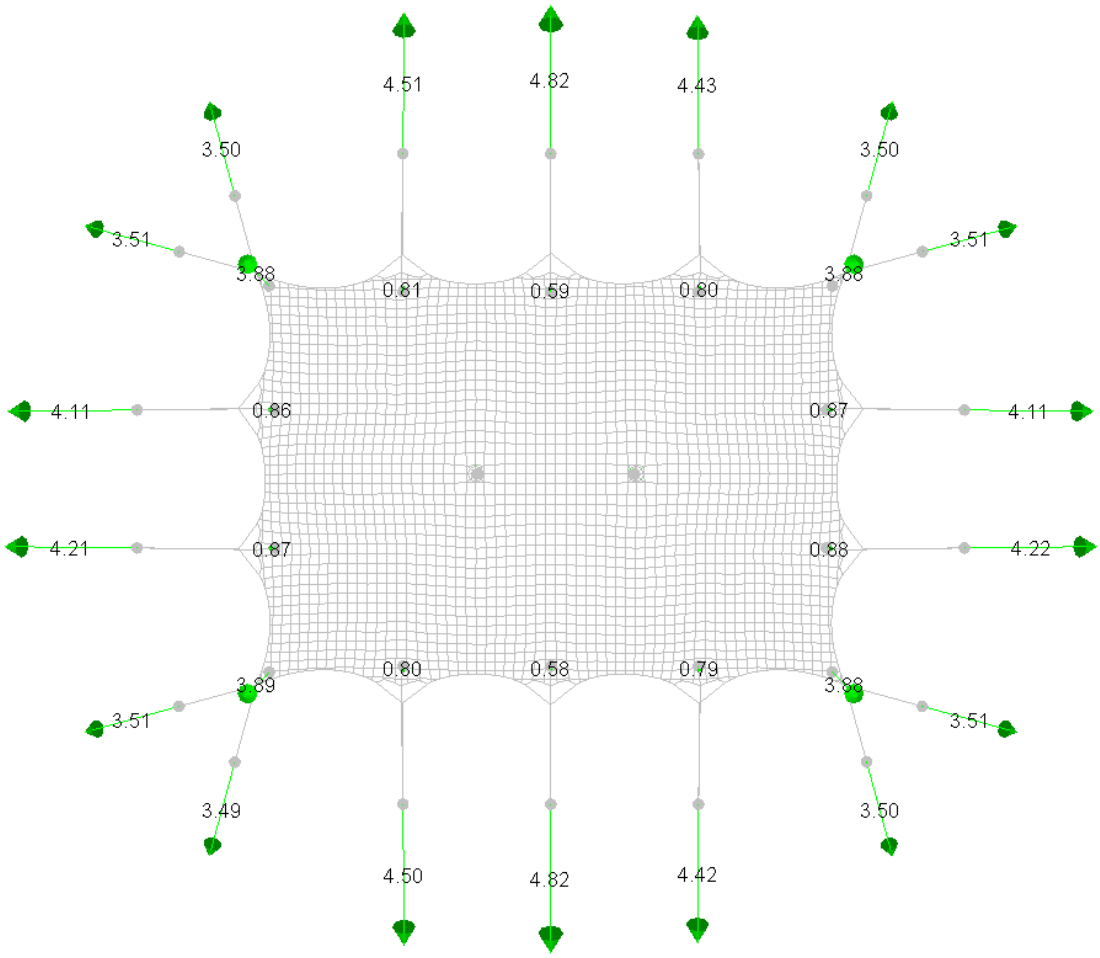
Annex E.5.5. Belt forces



Annex E.5.6. Poles forces

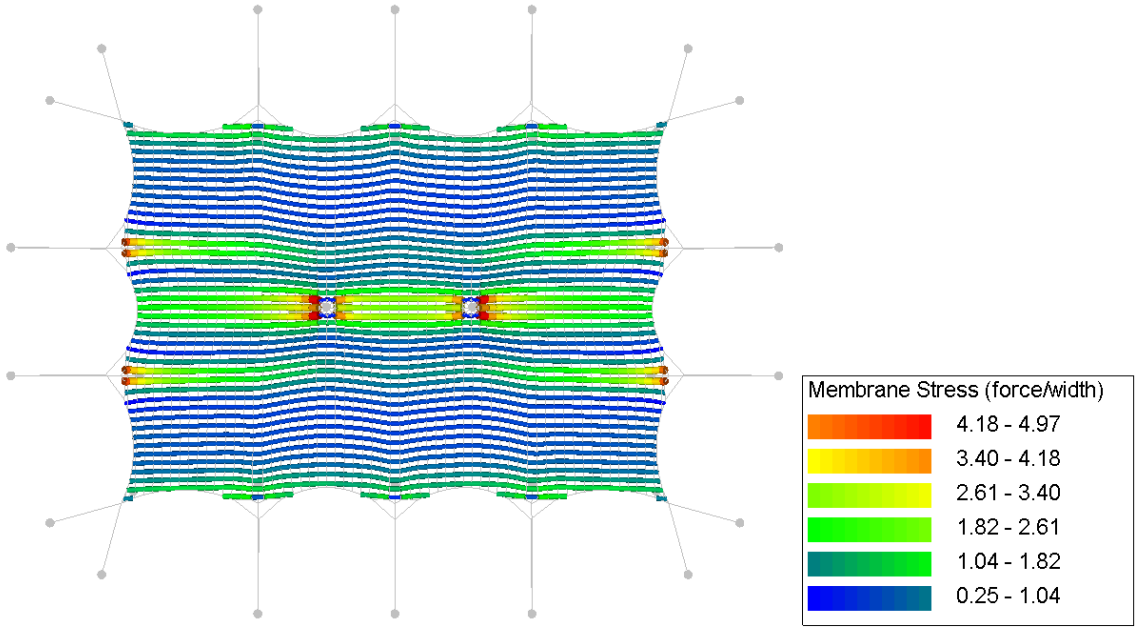


Annex E.5.7. Reaction forces

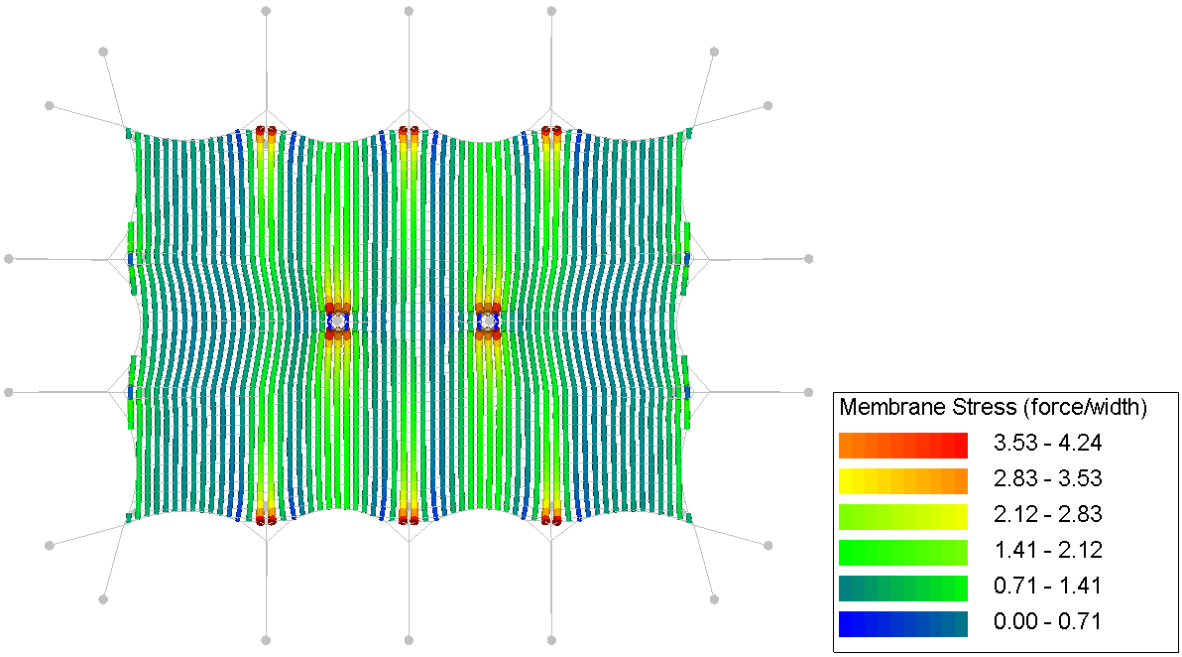


Annex E.6. CO6. Own weight + pretension + wind pressure + snow [FR]

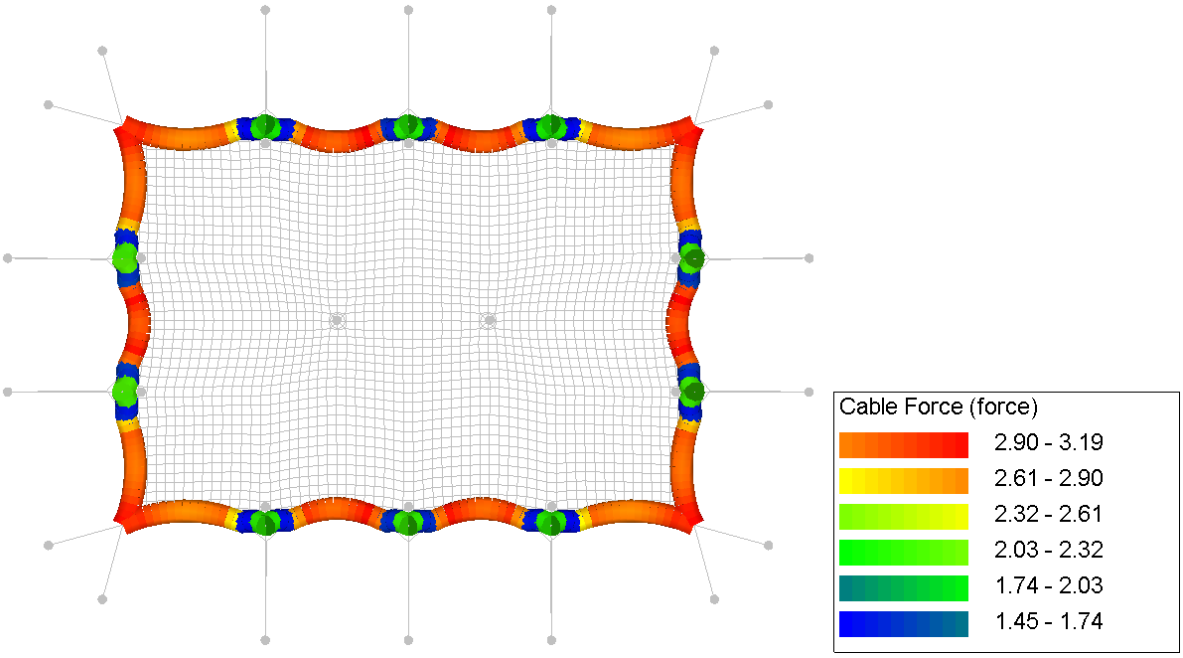
Annex E.6.1. Membrane stress (warp)



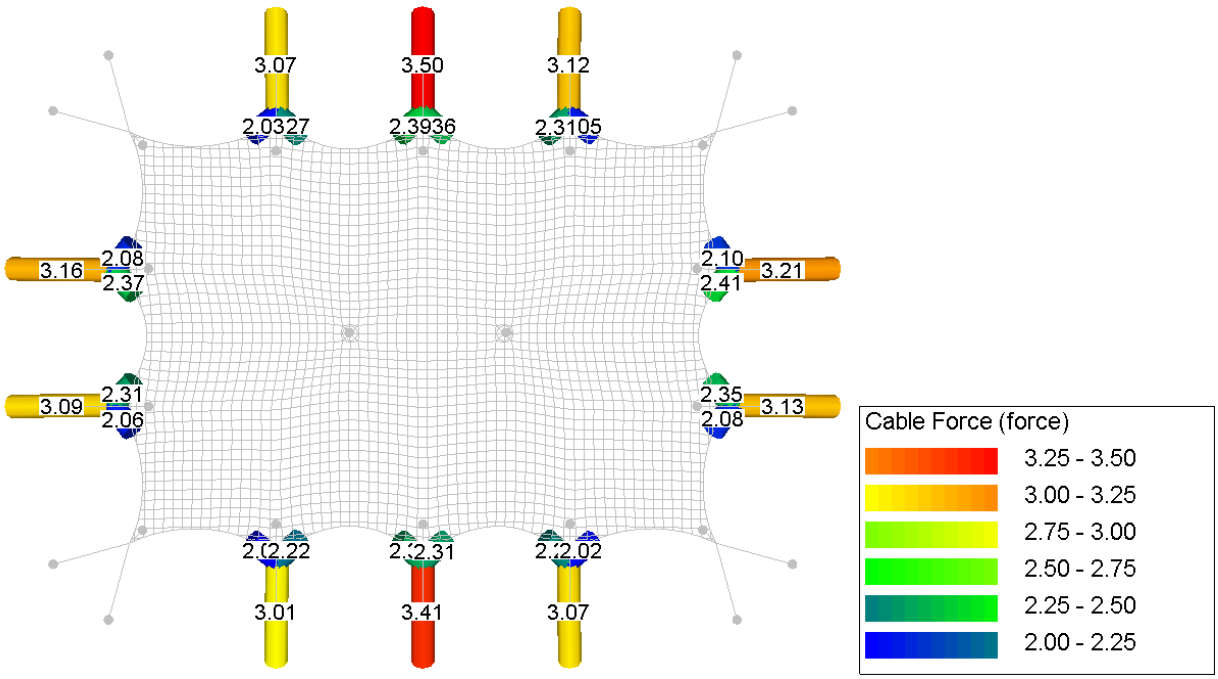
Annex E.6.2. Membrane stress (weft)



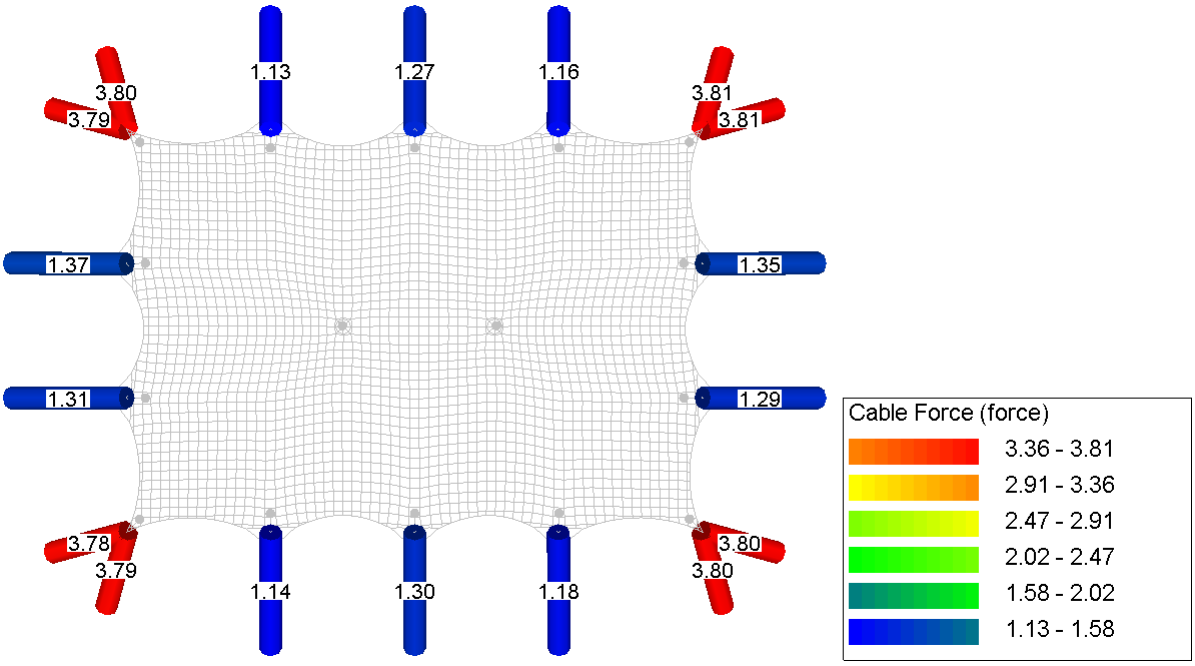
Annex E.6.3. Circumference rope forces



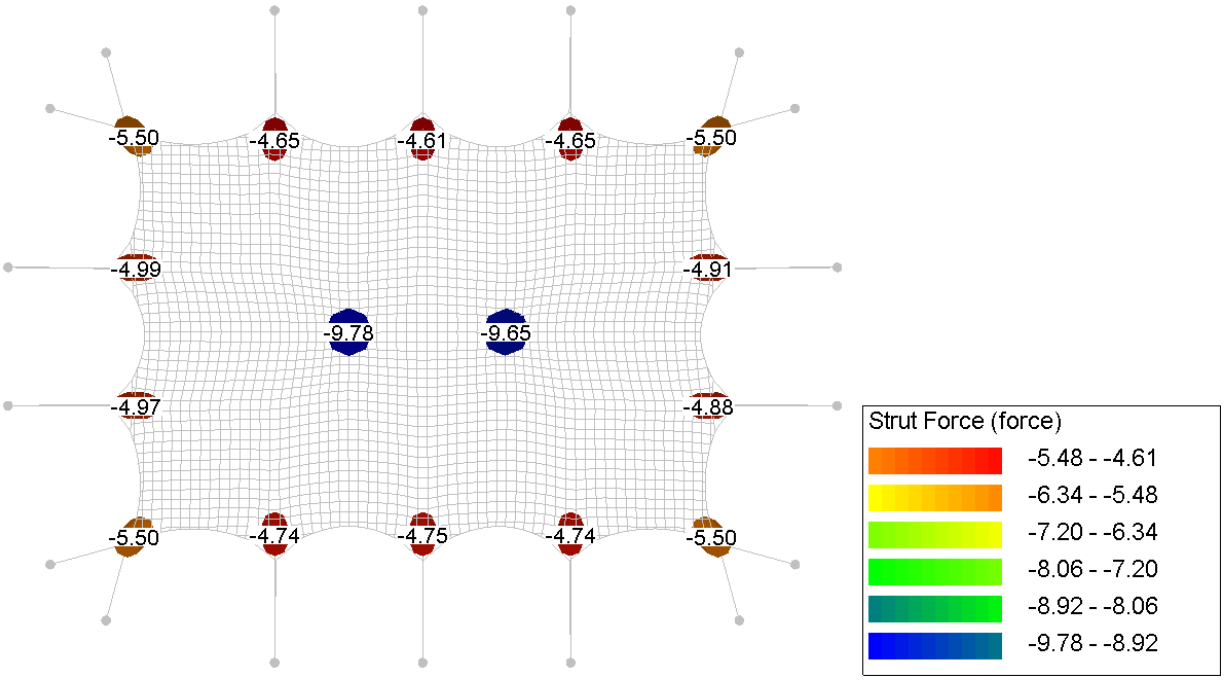
Annex E.6.4. Guy rope forces



Annex E.6.5. Belt forces

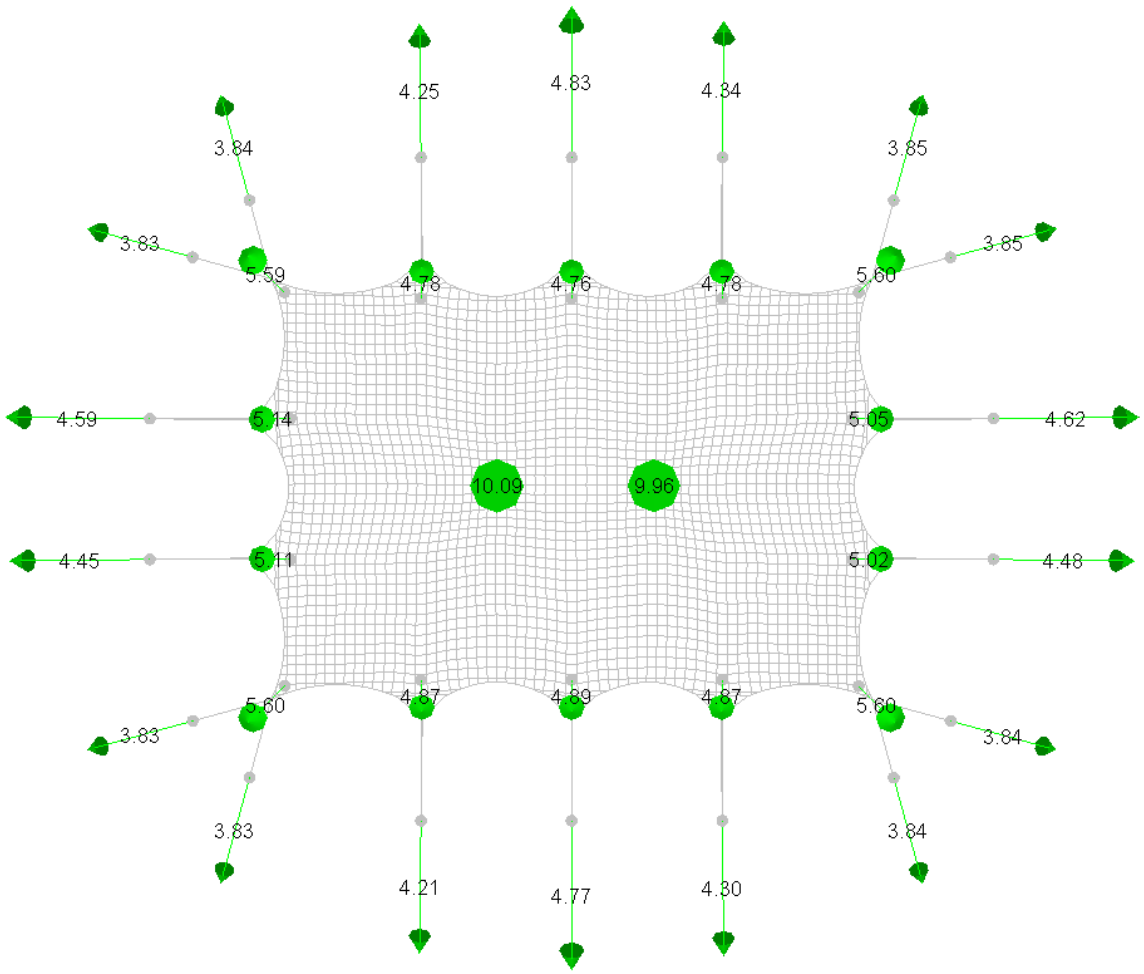


Annex E.6.6. Poles forces



Annex E.6.7. Reaction forces

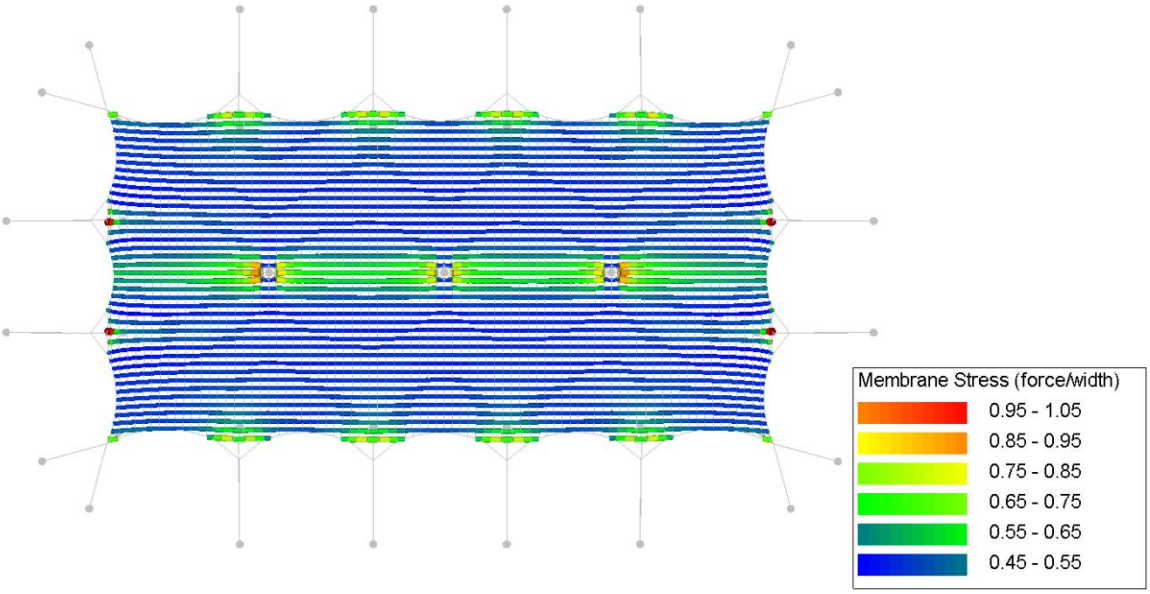
Increased snow load of 0.1 x 1.5/1.35=0.1083 kN/m2 is applied for ballast and anchor calculation



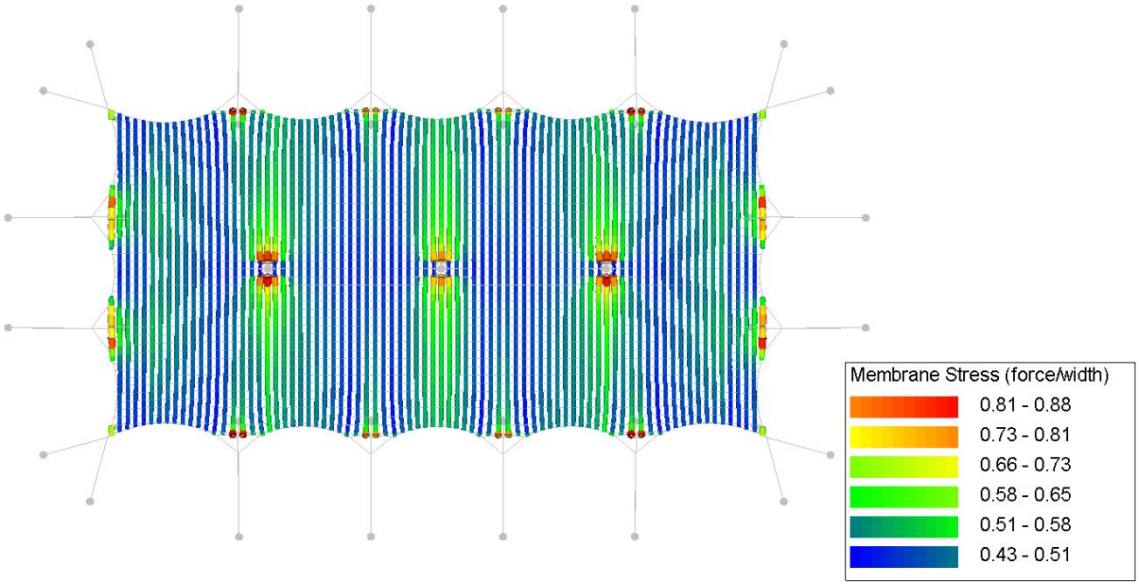
Annex F. Results per load combination – 10x20m model

Annex F.1. CO1. Own weight + pretension

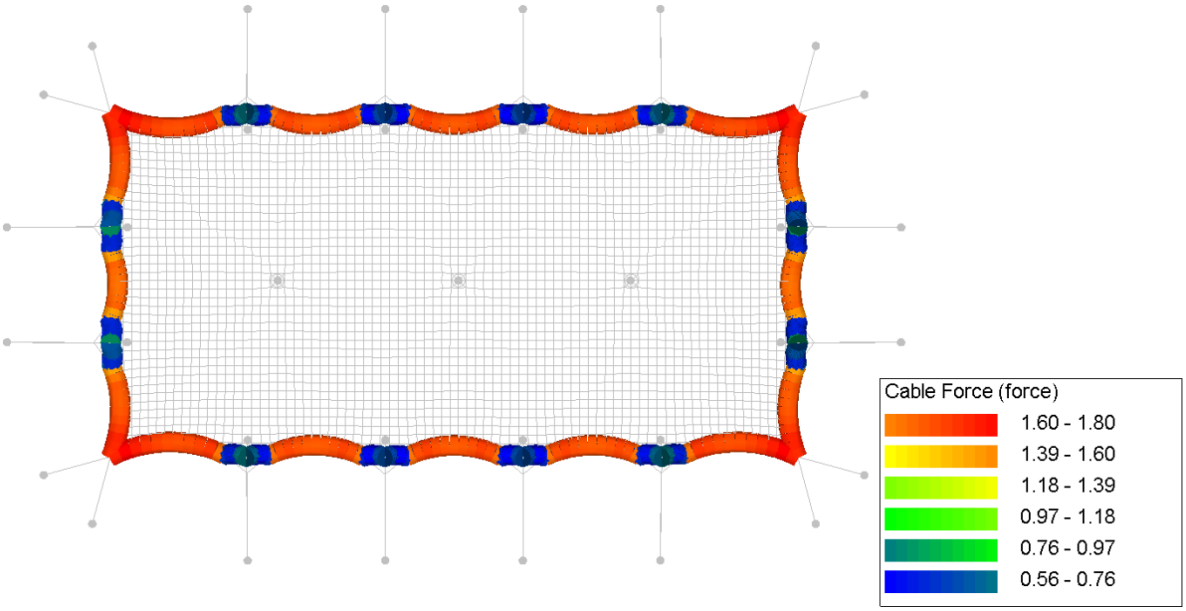
Annex F.1.1. Membrane stress (warp)



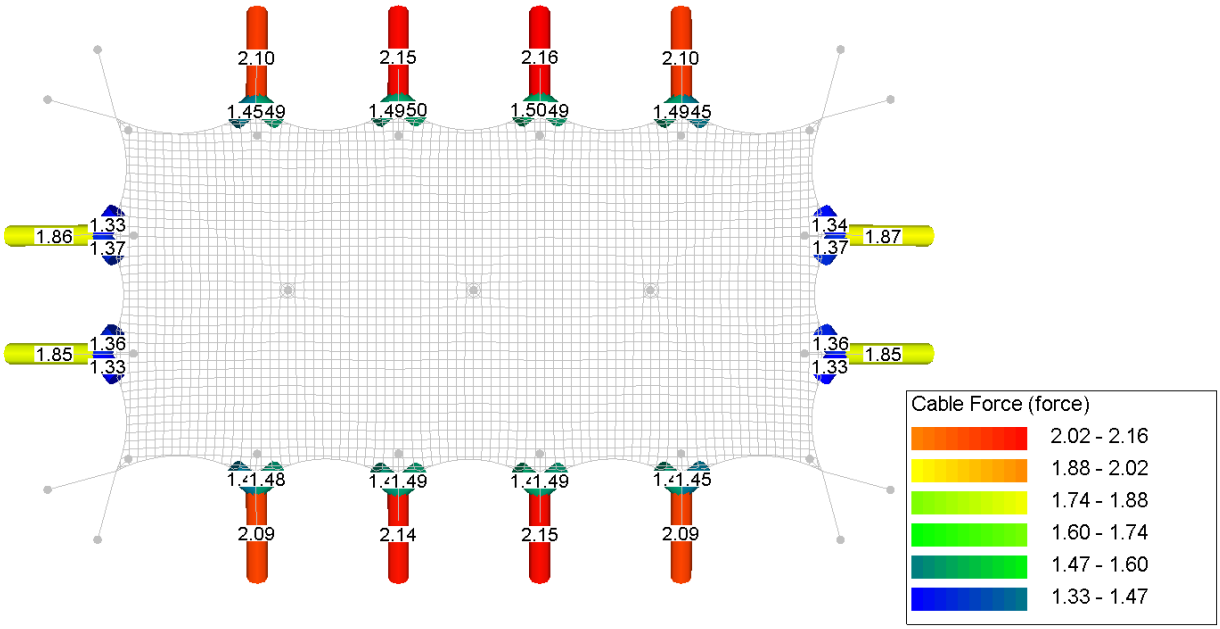
Annex F.1.2. Membrane stress (weft)



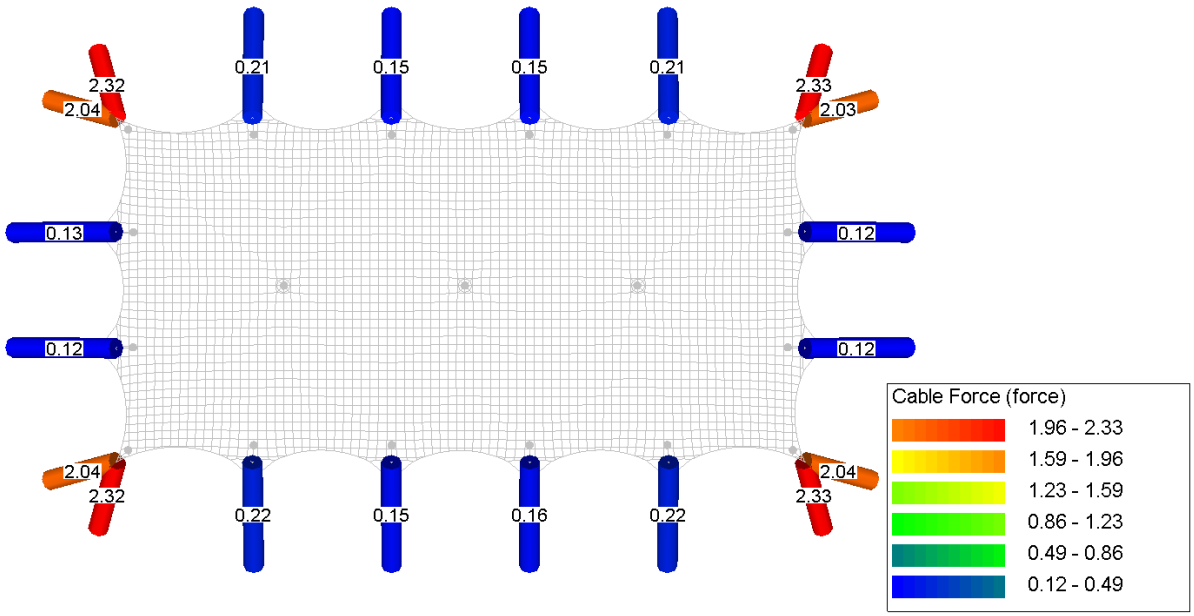
Annex F.1.3. Circumference rope forces



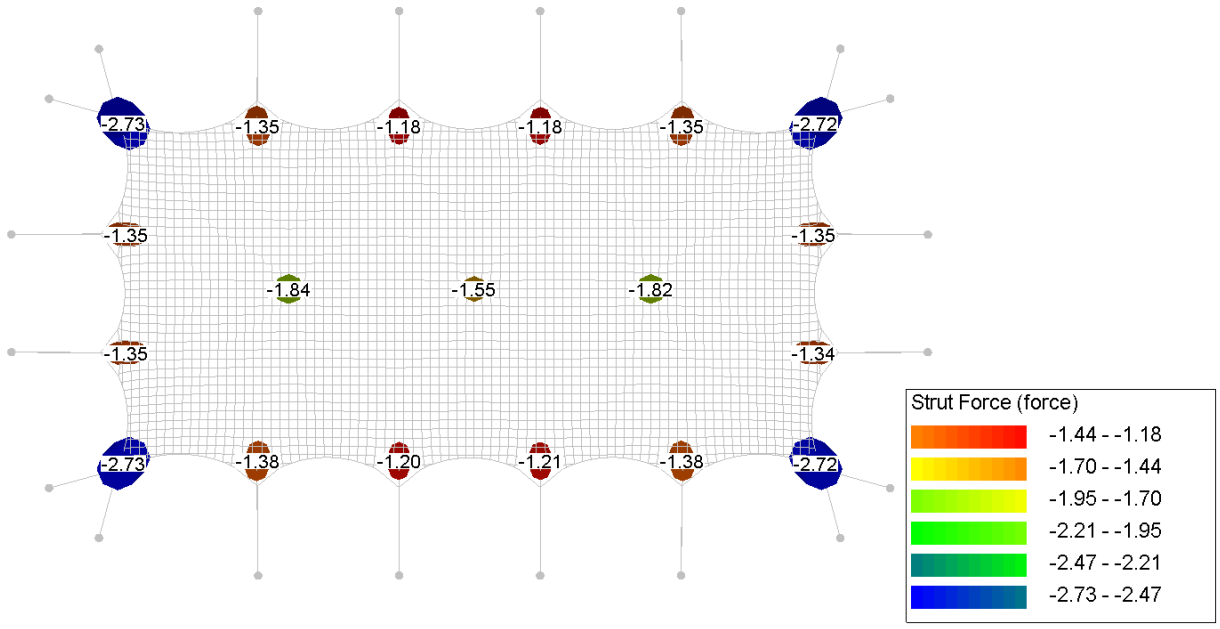
Annex F.1.4. Rope forces



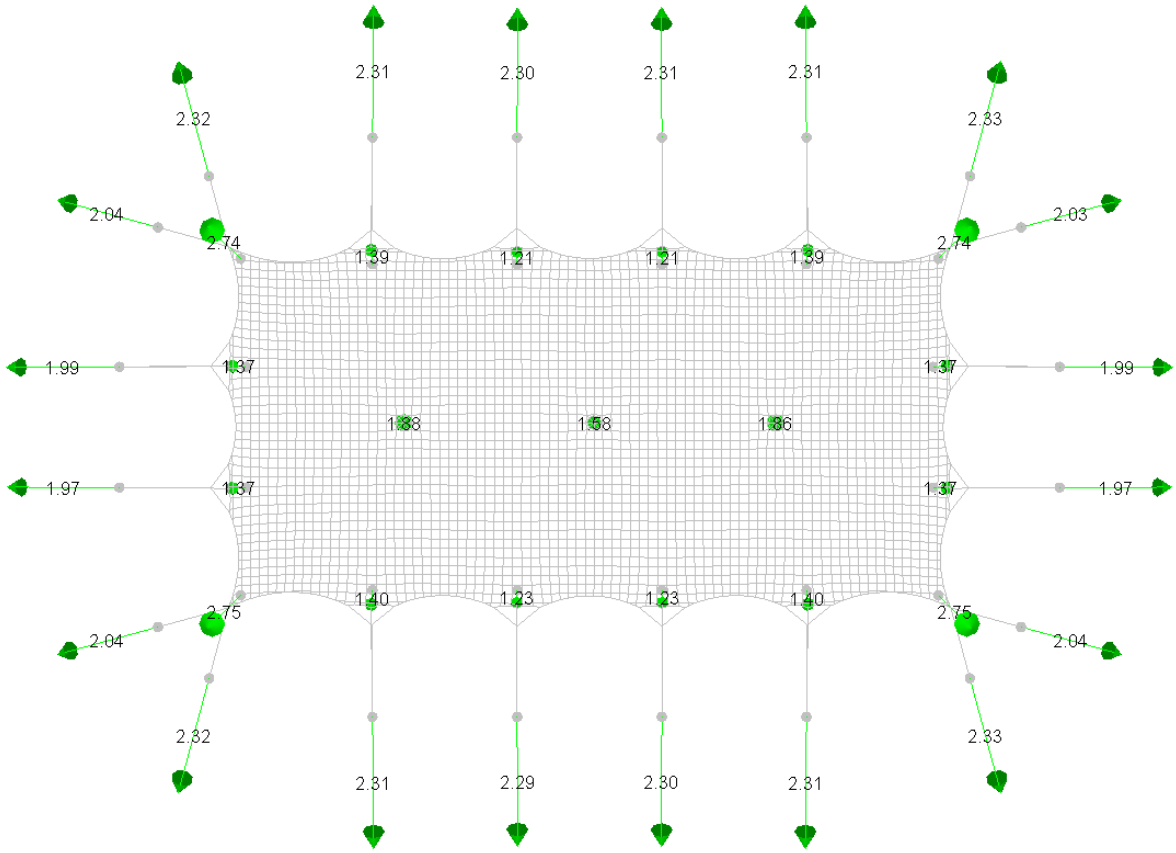
Annex F.1.5. Belt forces



Annex F.1.6. Pole forces

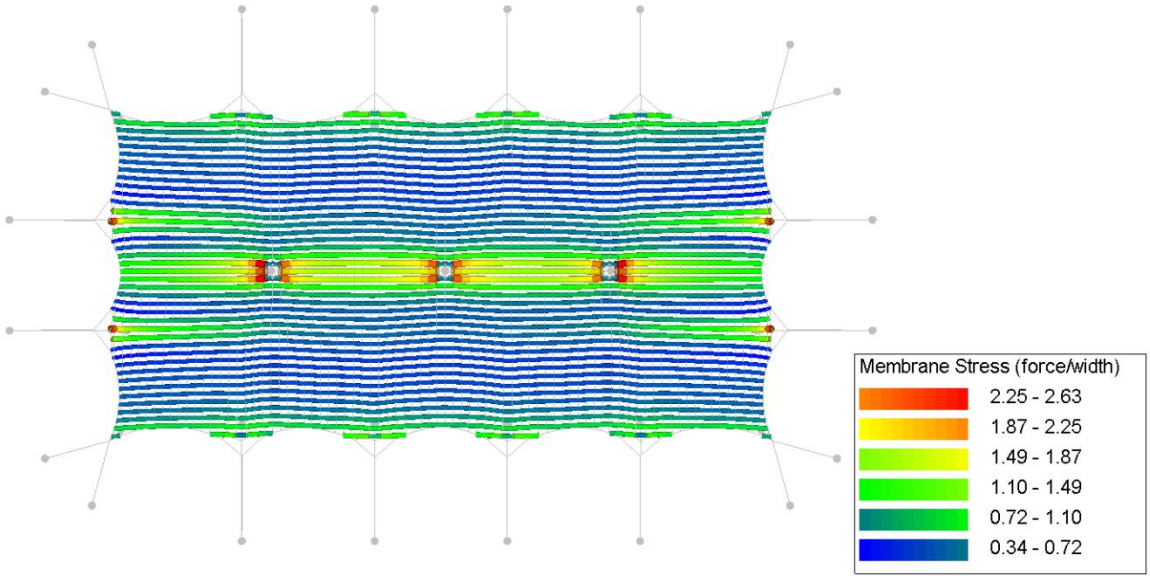


Annex F.1.7. Reaction forces

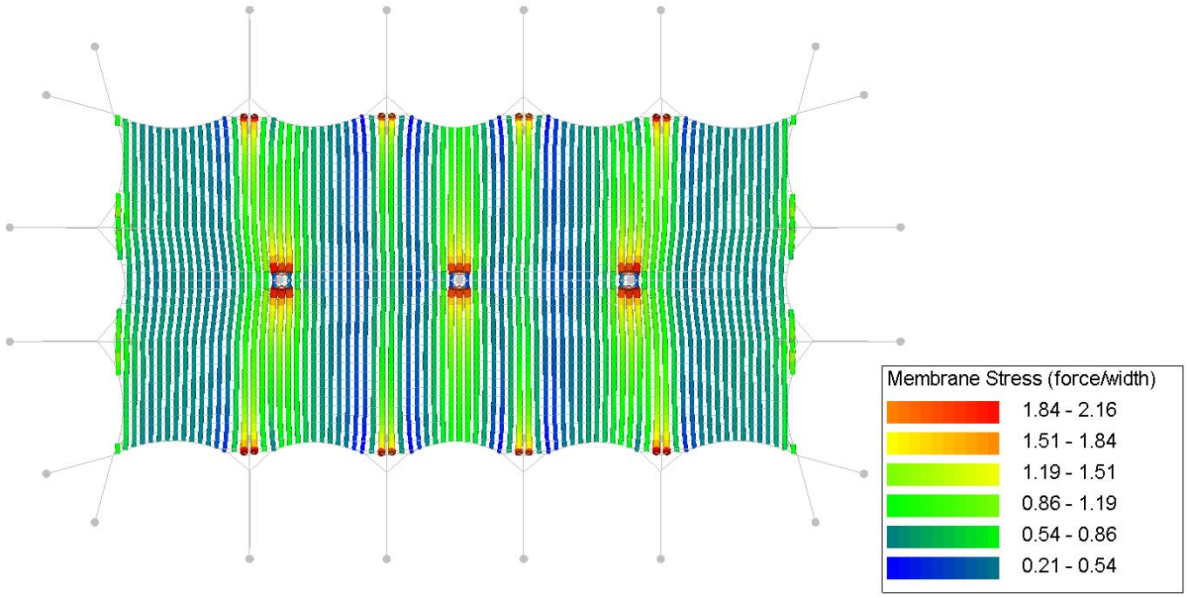


Annex F.2. CO2. Own weight + pretension + snow

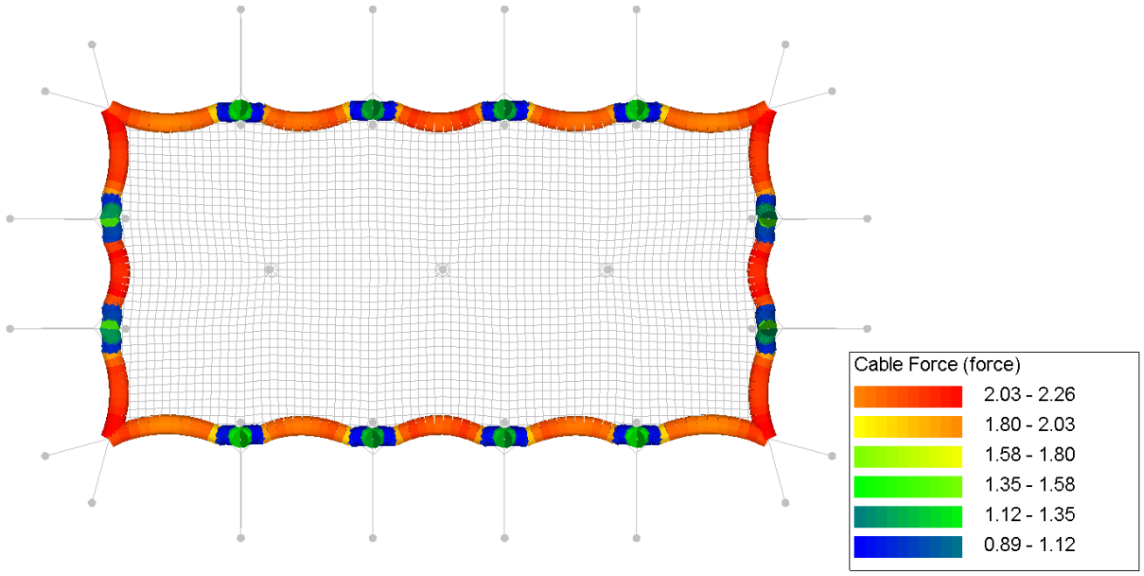
Annex F.2.1. Membrane stress (warp)



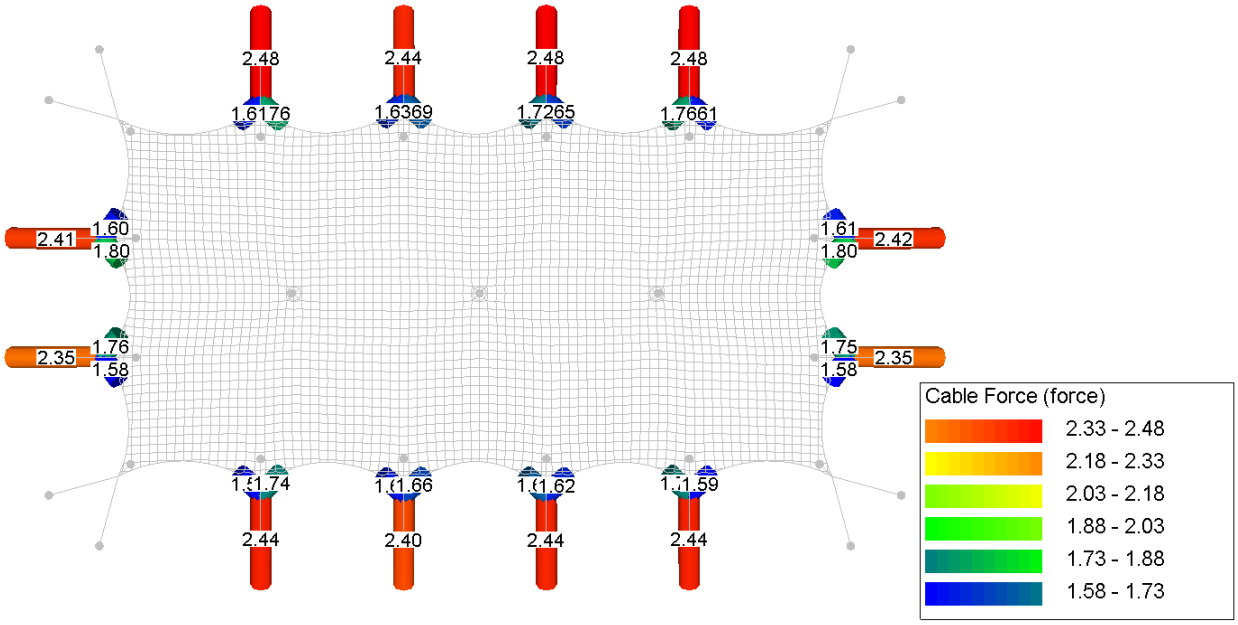
Annex F.2.2. Membrane stress (weft)



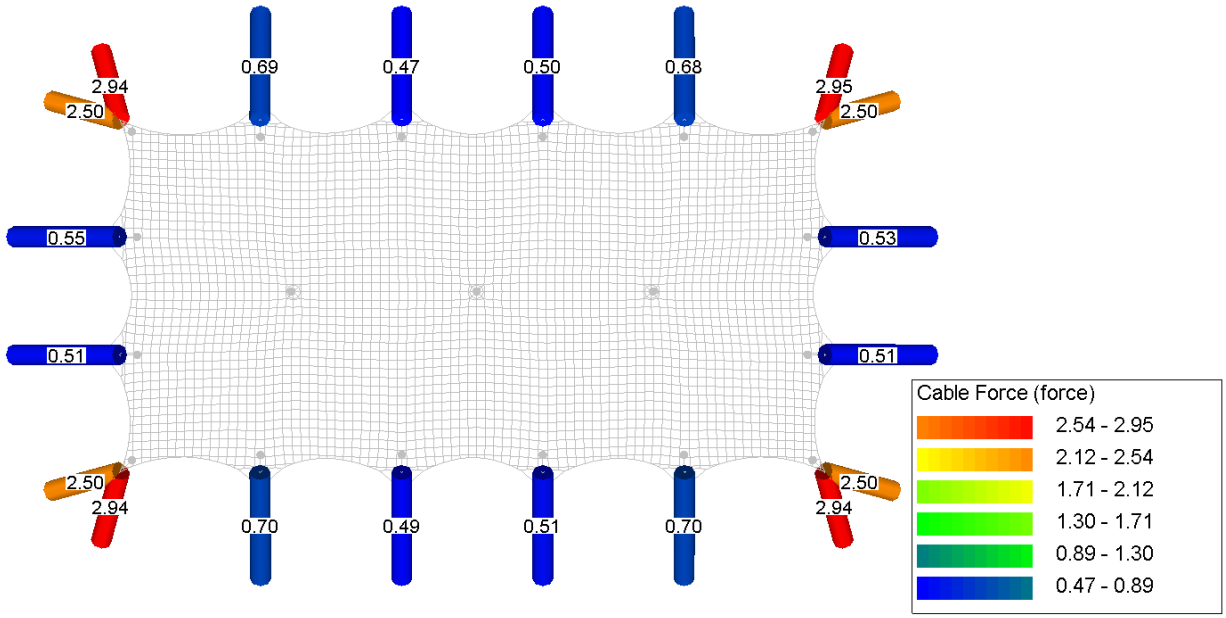
Annex F.2.3. Circumference rope forces



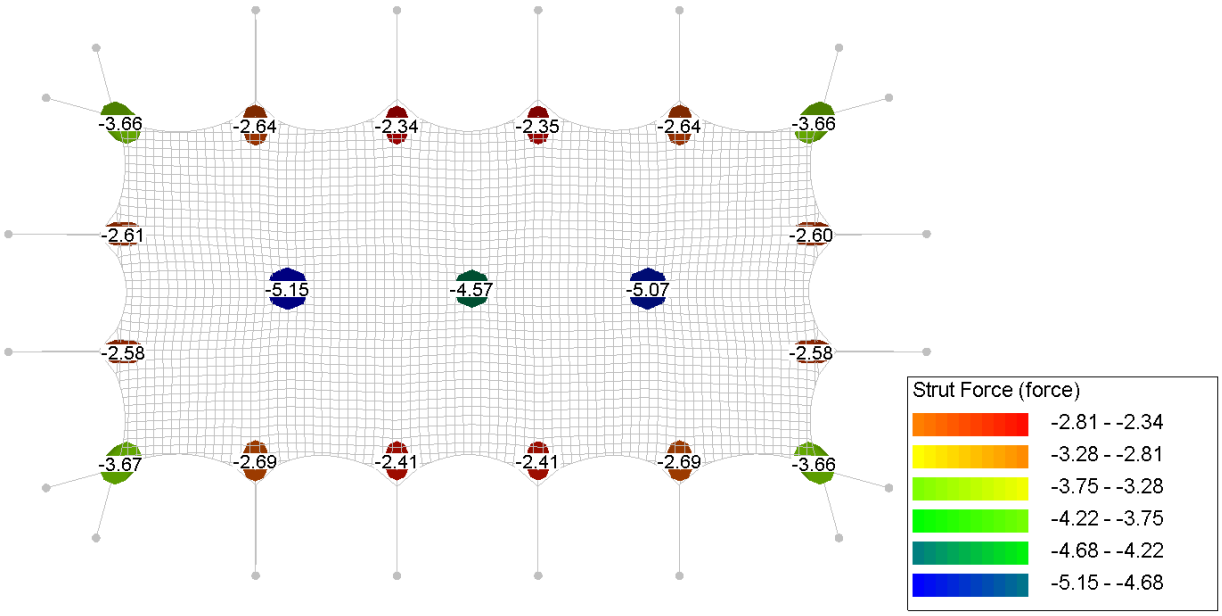
Annex F.2.4. Rope forces



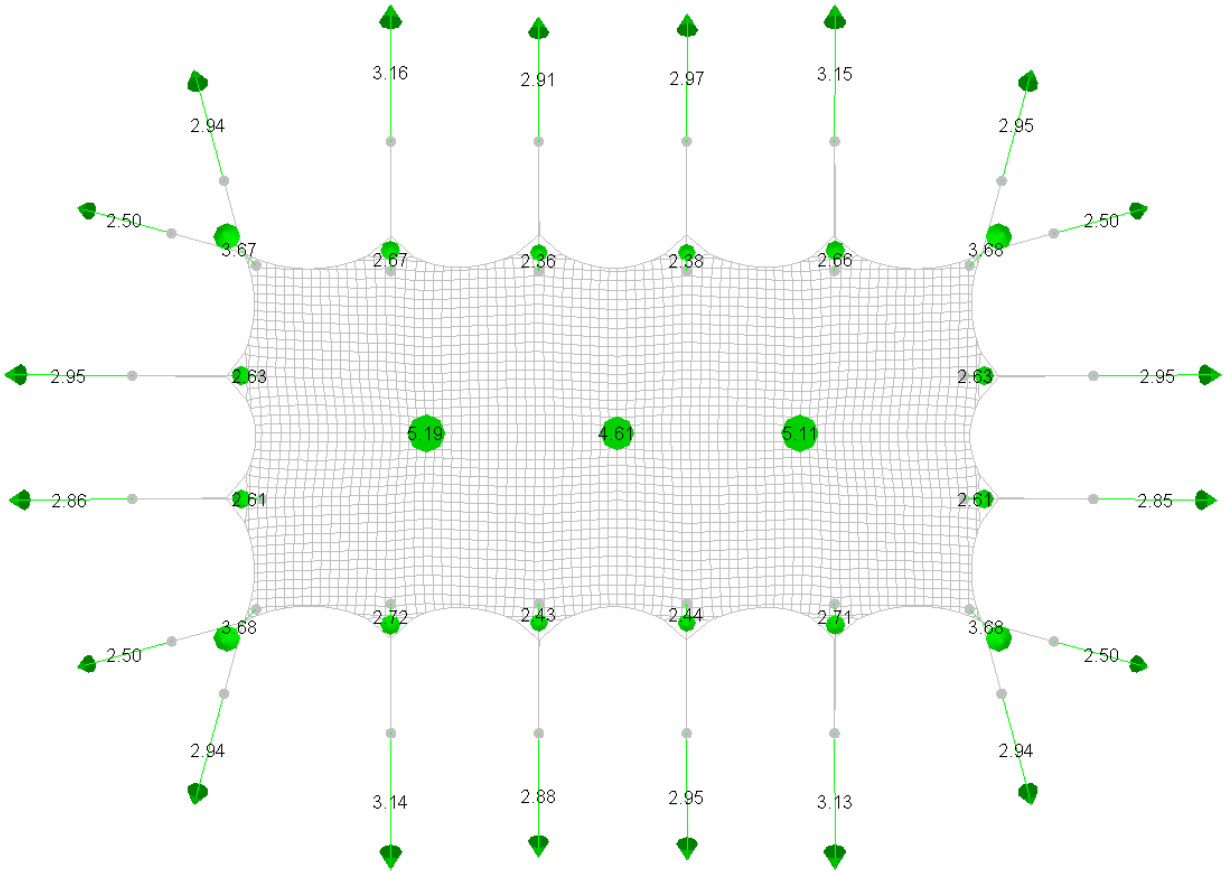
Annex F.2.5. Belt forces



Annex F.2.6. Pole forces

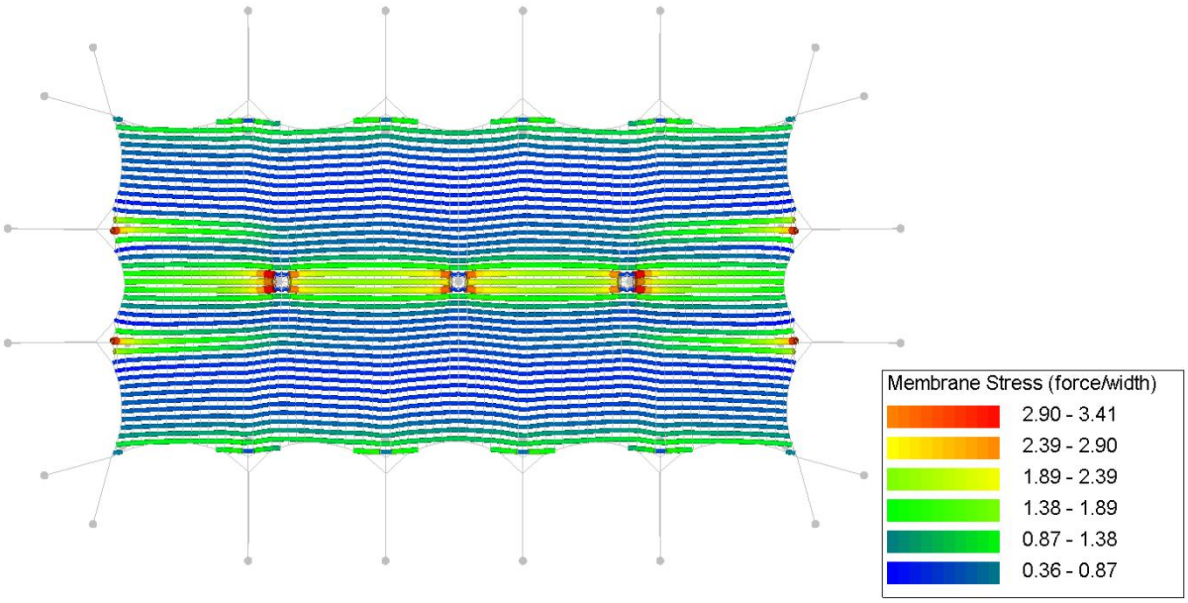


Annex F.2.7. Anchor forces

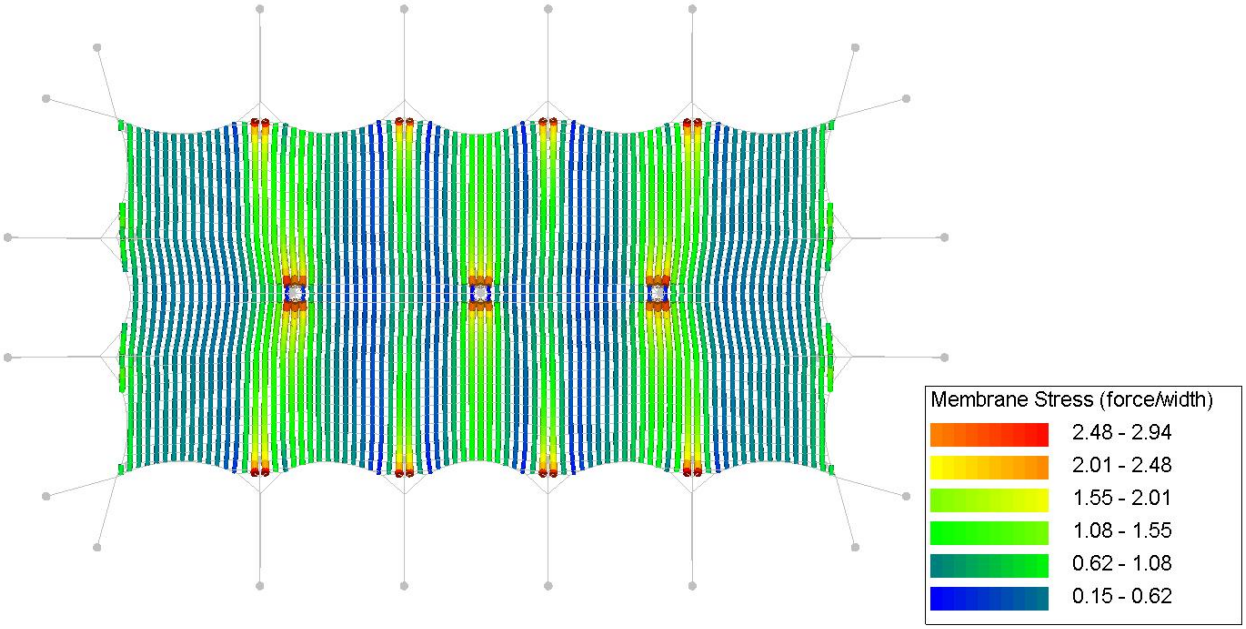


Annex F.3. CO3. Own weight + pretension + wind pressure

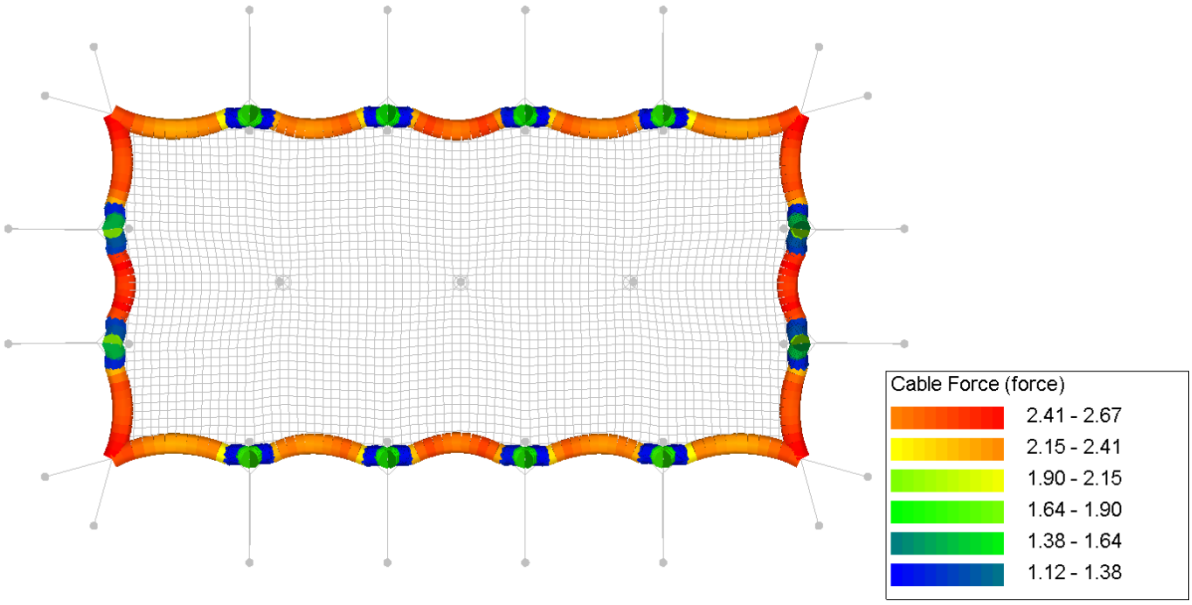
Annex F.3.1. Membrane stress (warp)



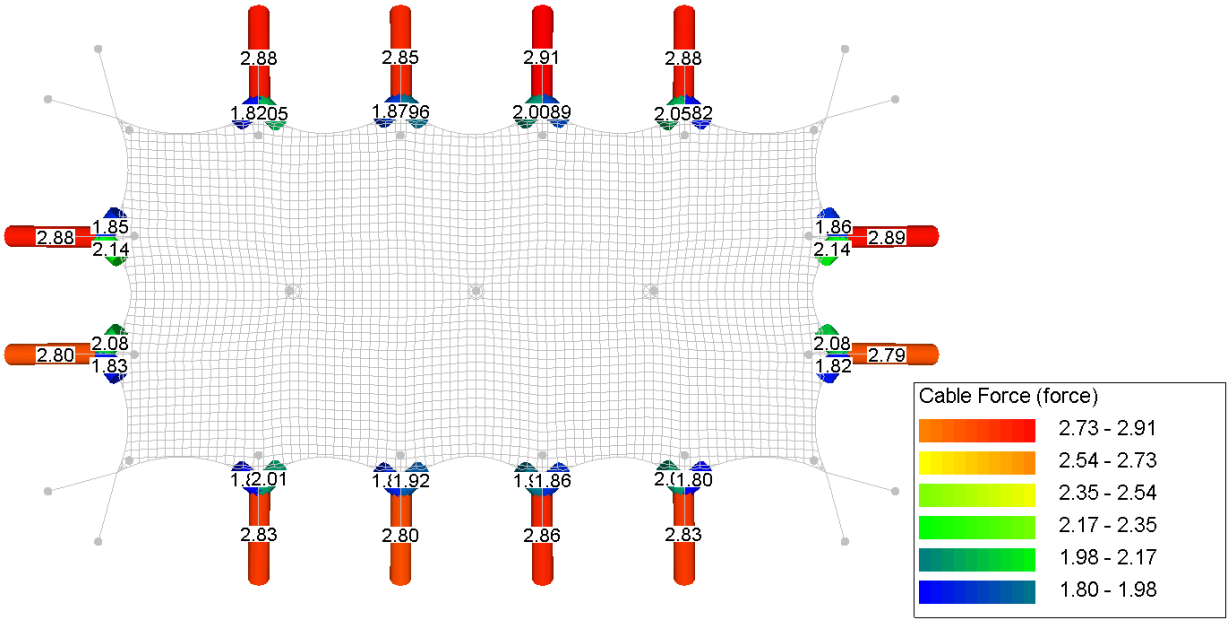
Annex F.3.2. Membrane stress (weft)



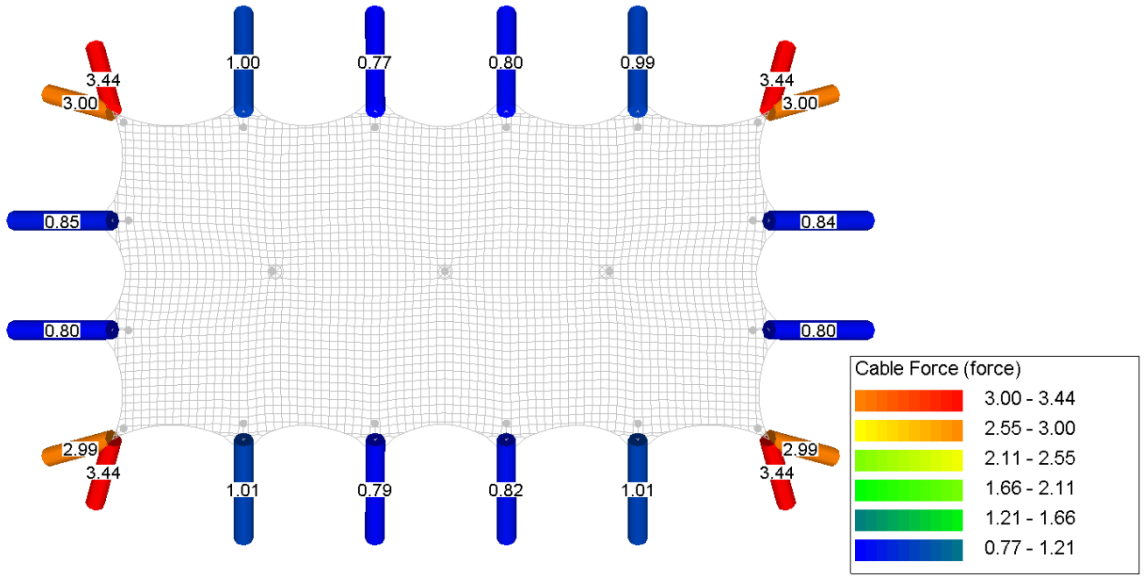
Annex F.3.3. Circumference rope forces



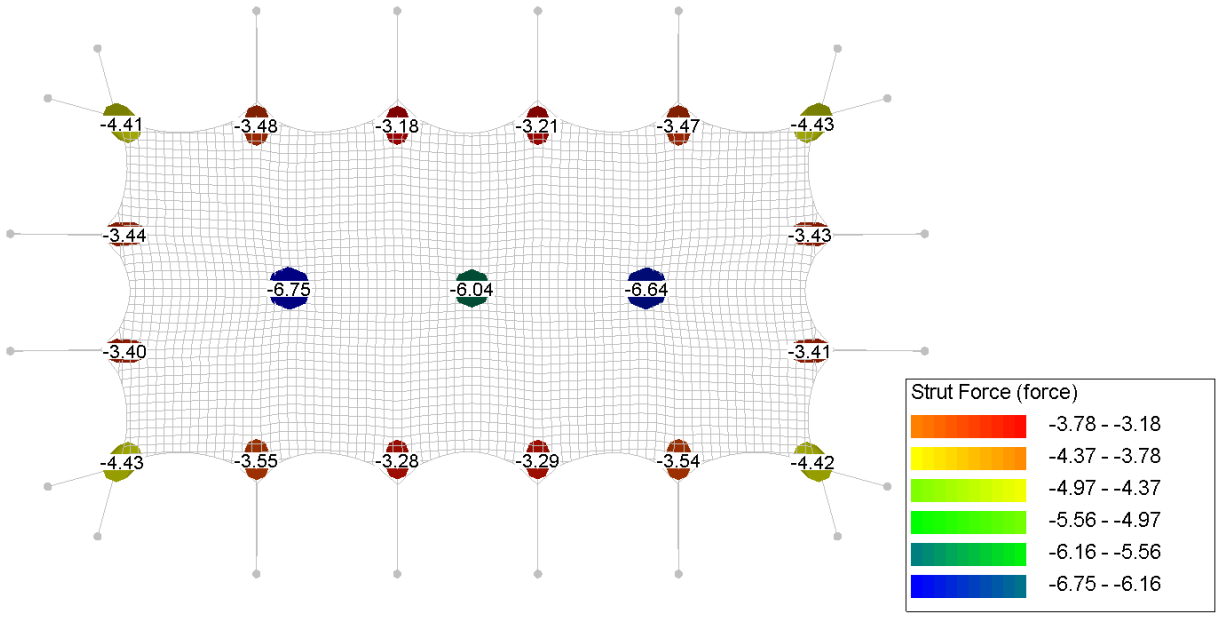
Annex F.3.4. Rope forces



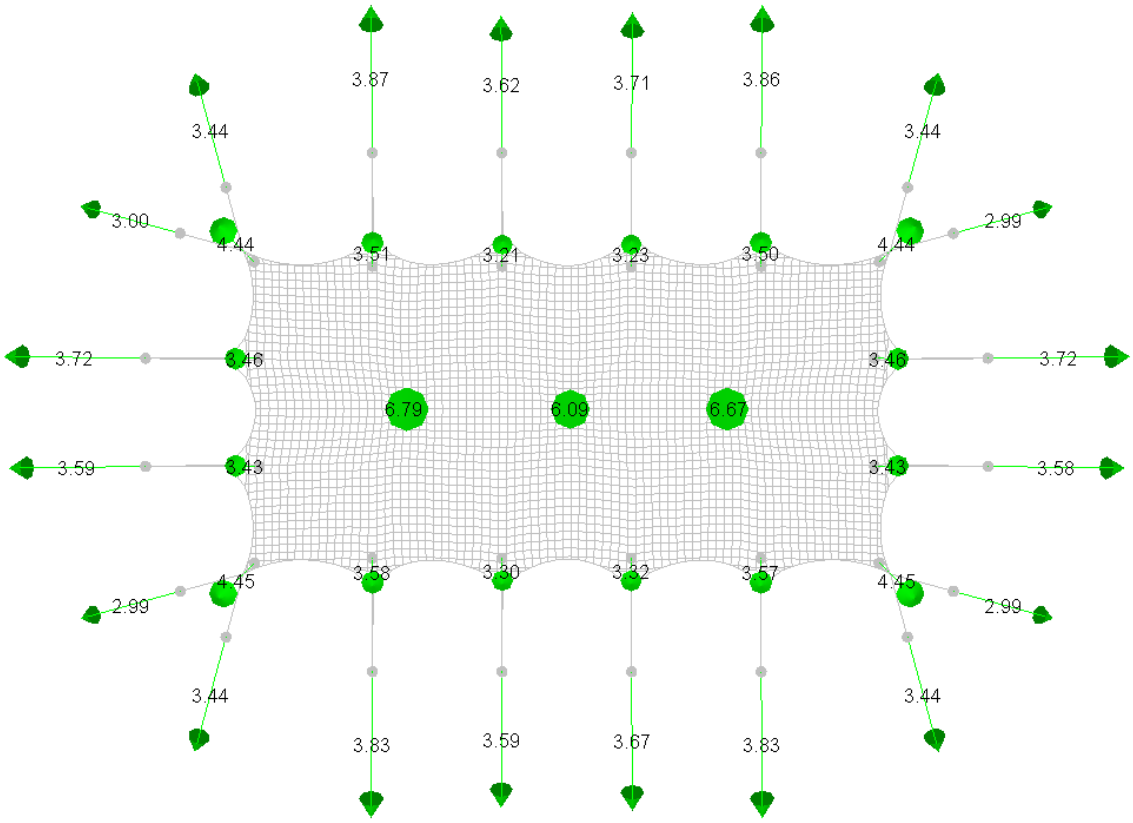
Annex F.3.5. Belt forces



Annex F.3.6. Poles forces

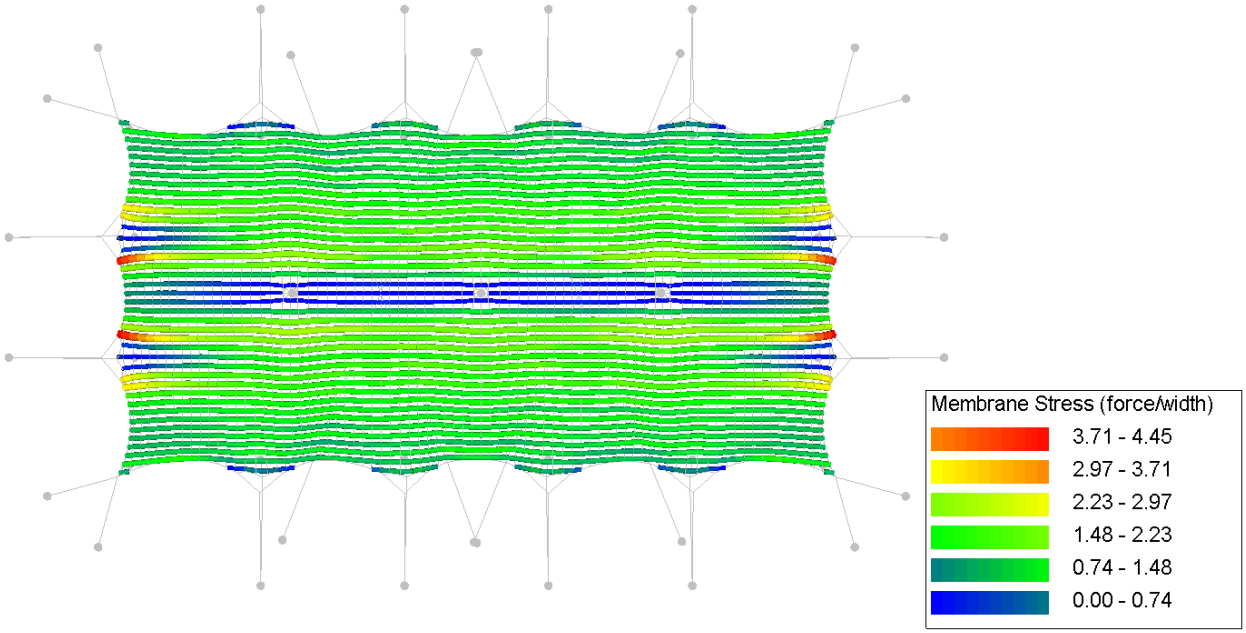


Annex F.3.7. Reaction forces

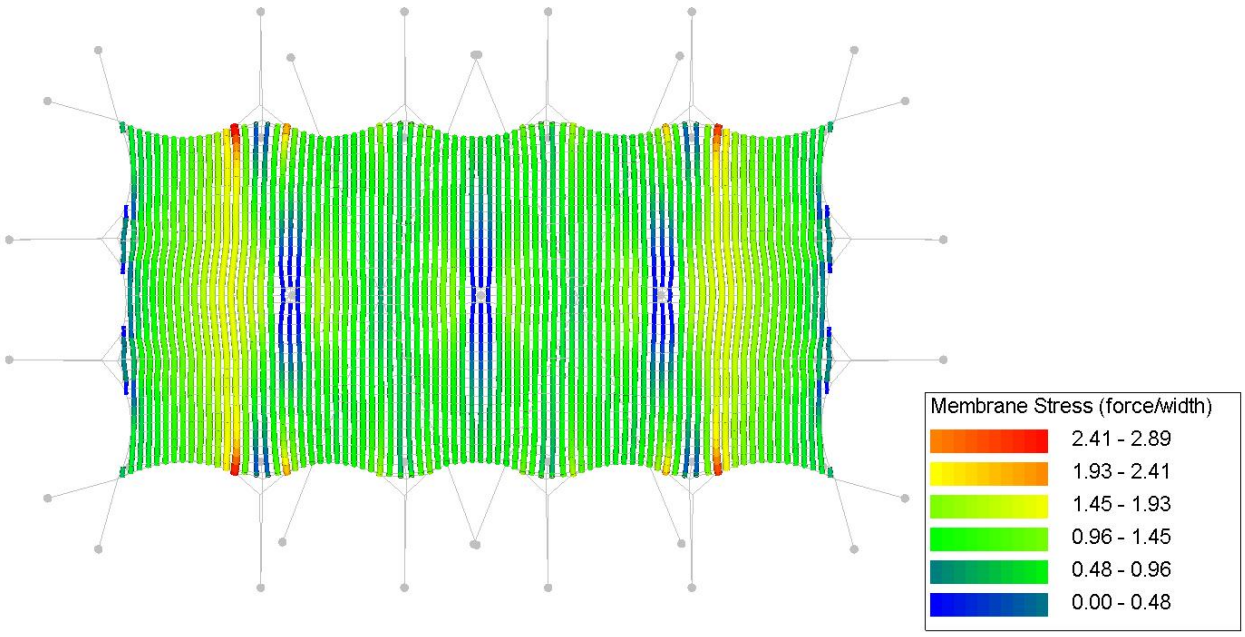


Annex F.4. CO4. Own weight + pretension + wind suction

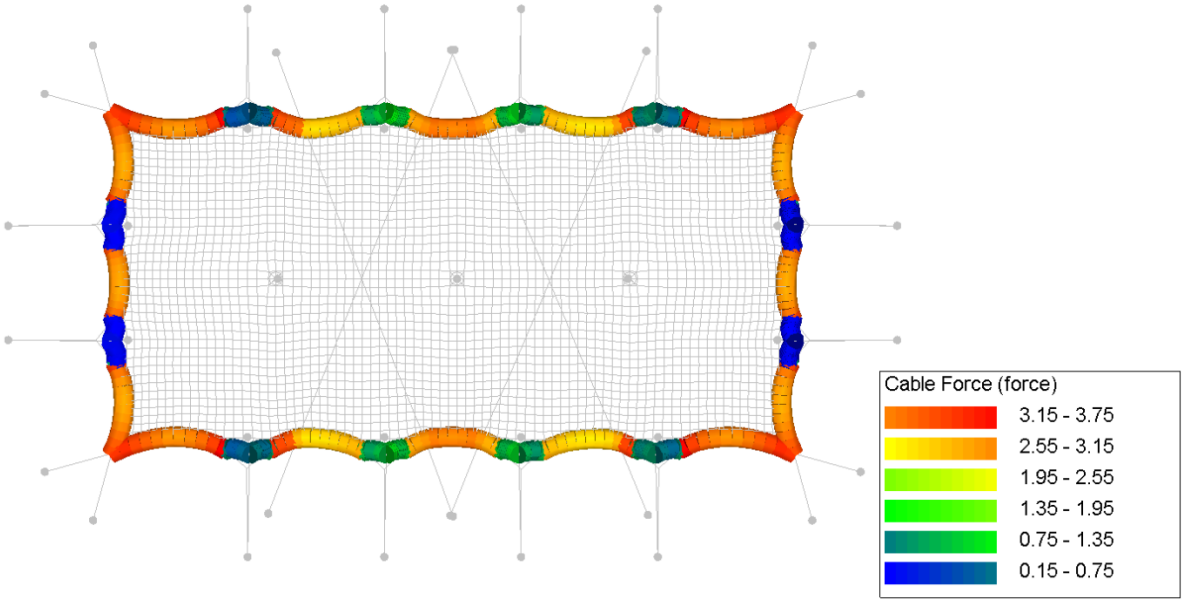
Annex F.4.1. Membrane stress (warp)



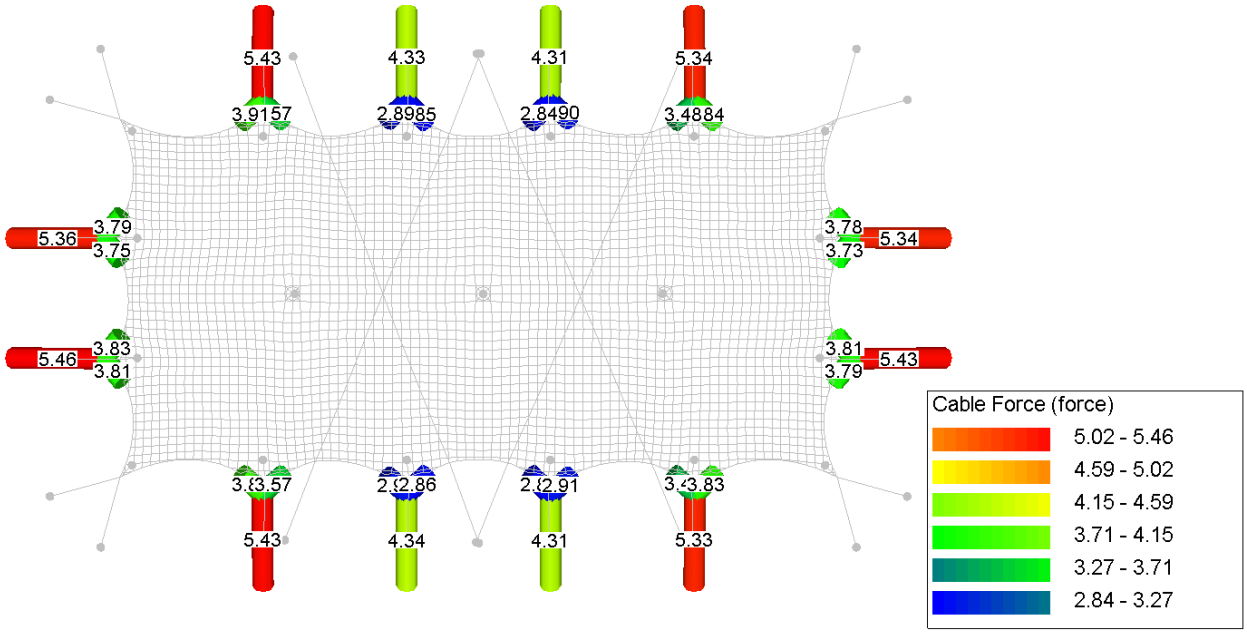
Annex F.4.2. Membrane stress (weft)



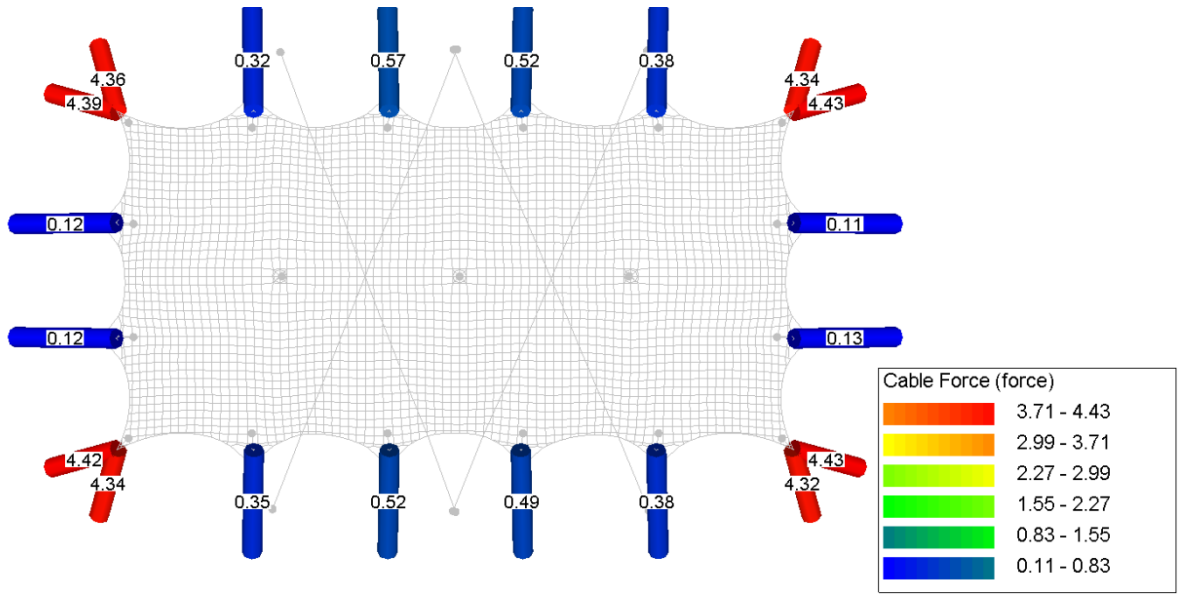
Annex F.4.3. Circumference rope forces



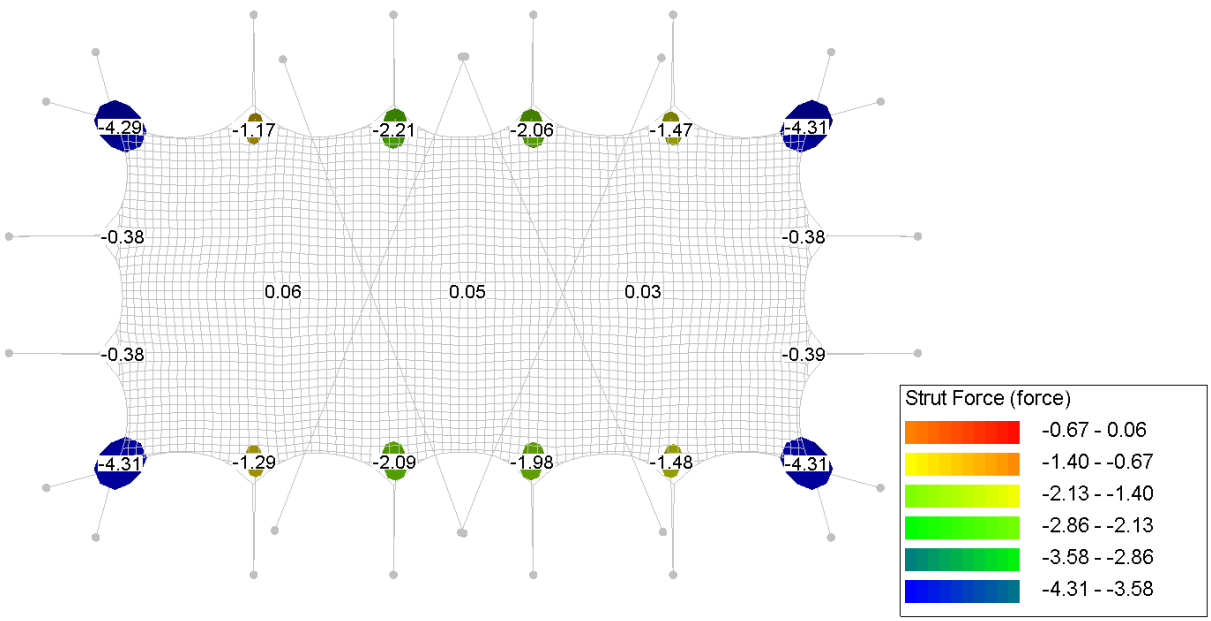
Annex F.4.4. Guy rope forces



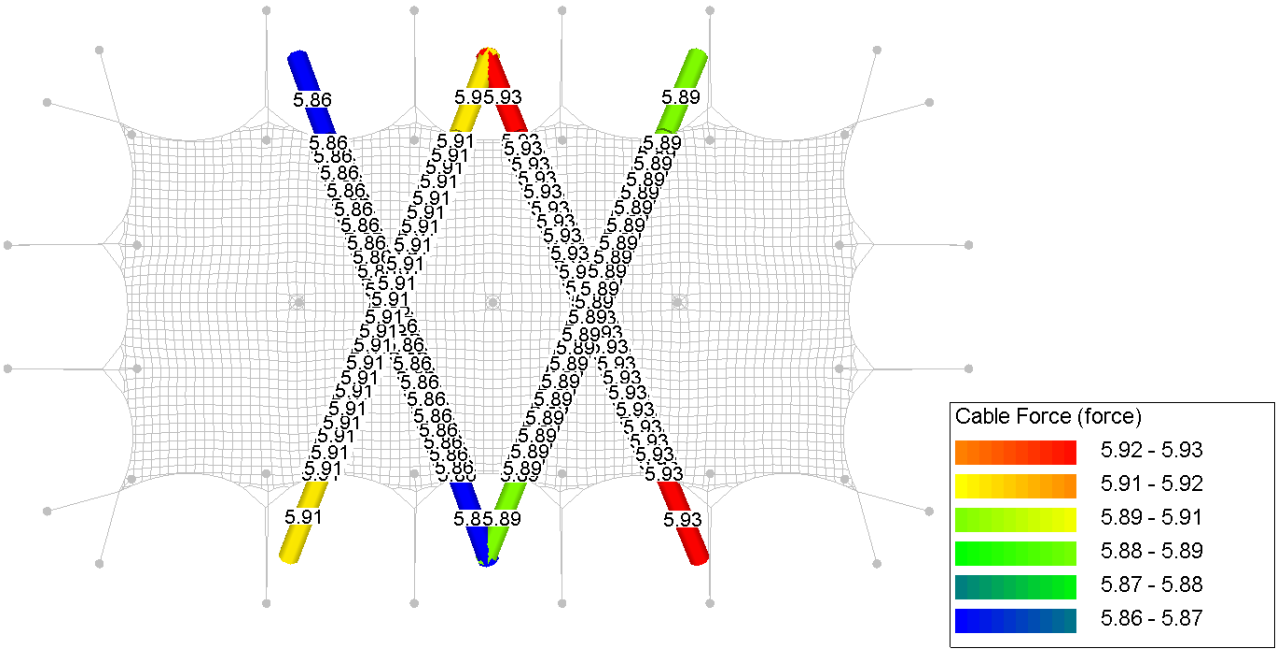
Annex F.4.5. Belt forces



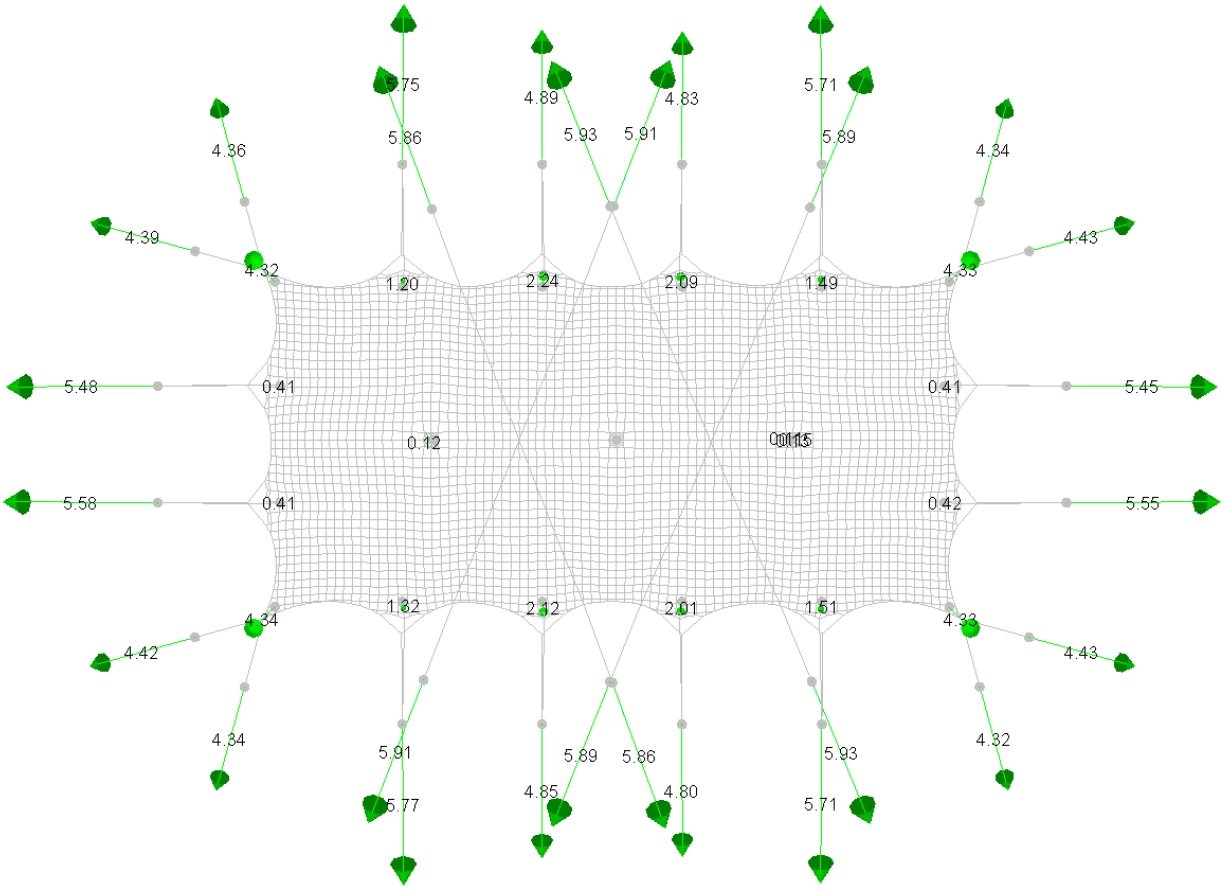
Annex F.4.6. Poles forces



Annex F.4.7. Storm belt forces

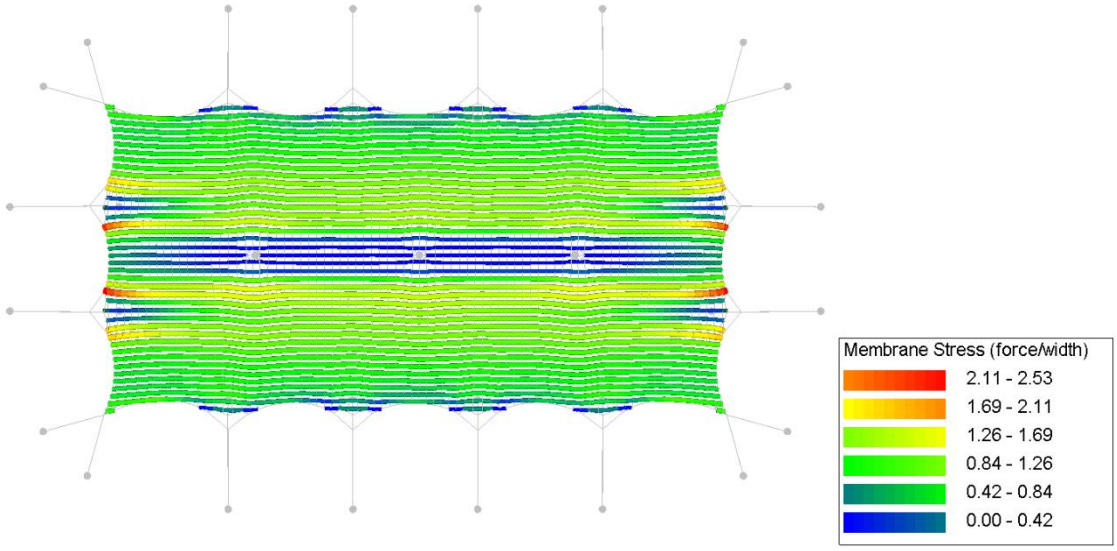


Annex F.4.8. Reaction forces

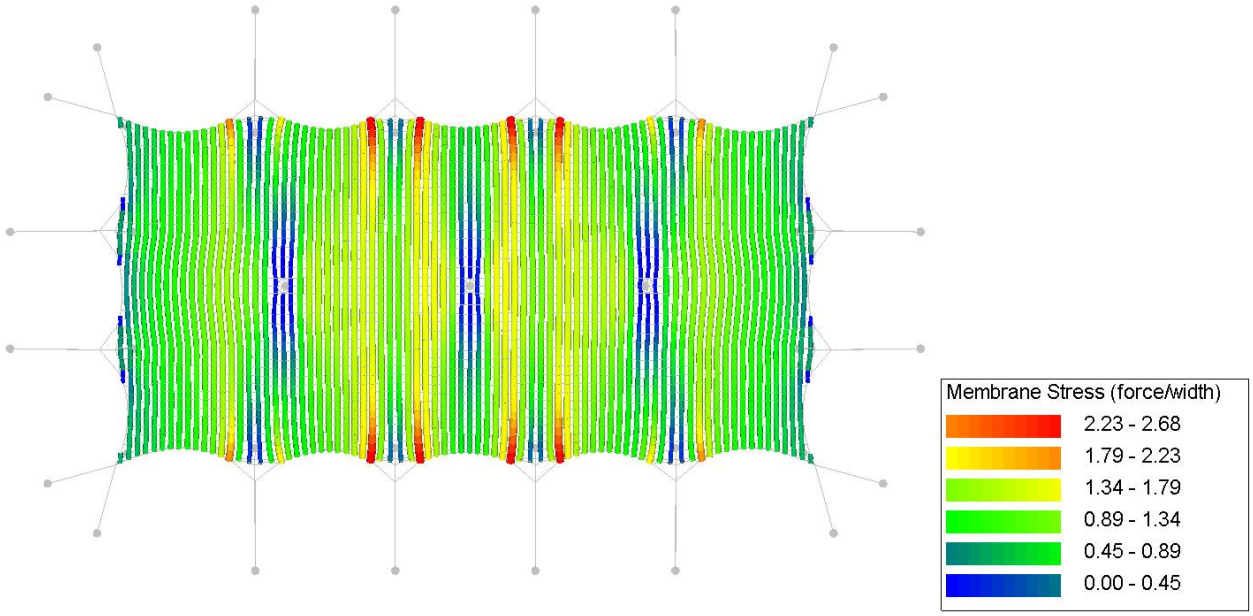


Annex F.5. CO5. Own weight + pretension + wind suction reduced [NL]

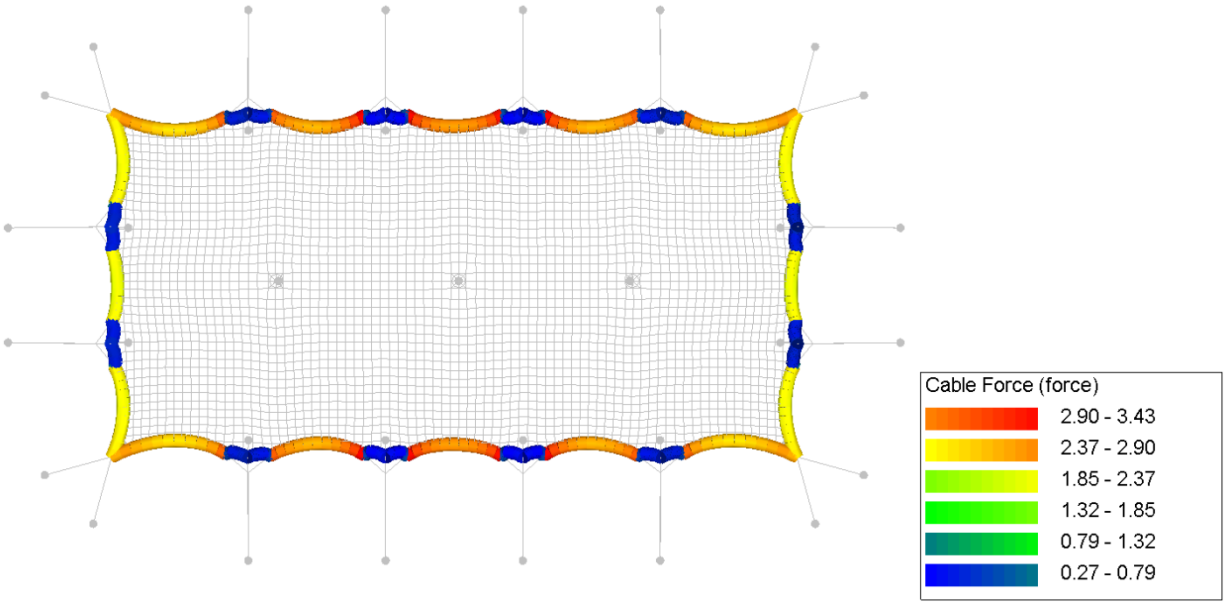
Annex F.5.1. Membrane stress (warp)



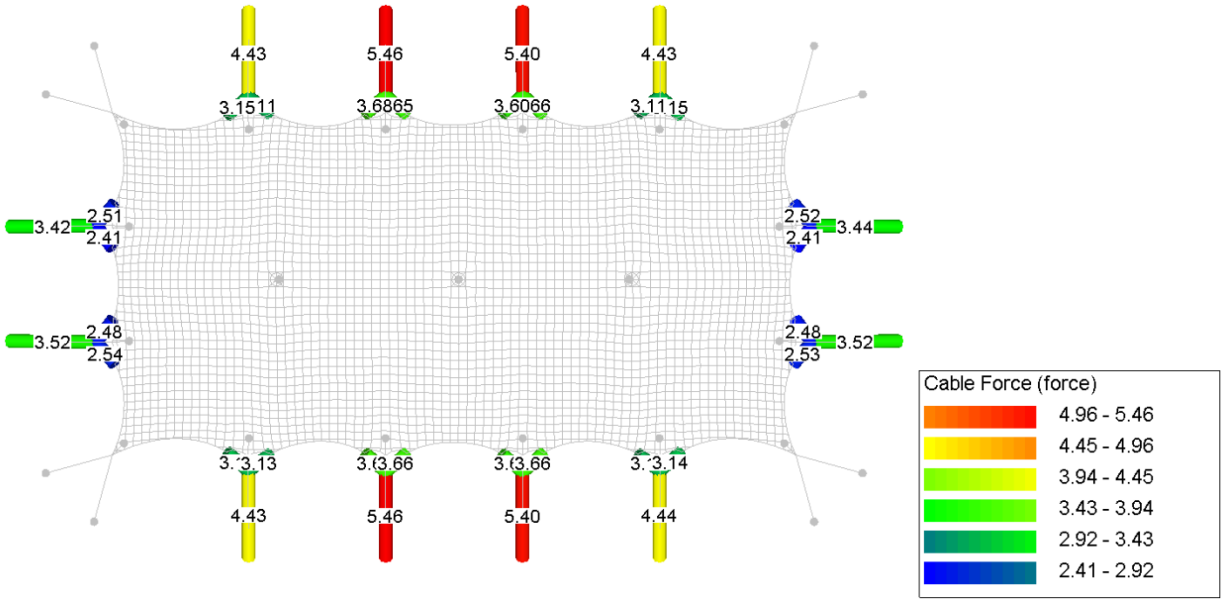
Annex F.5.2. Membrane stress (weft)



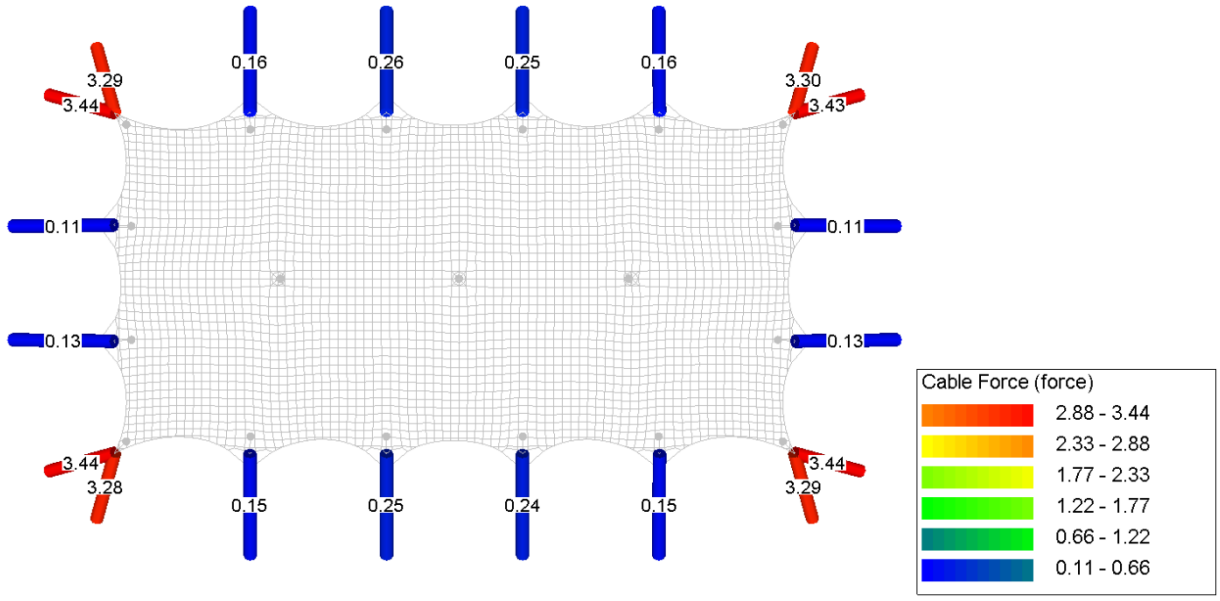
Annex F.5.3. Circumference rope forces



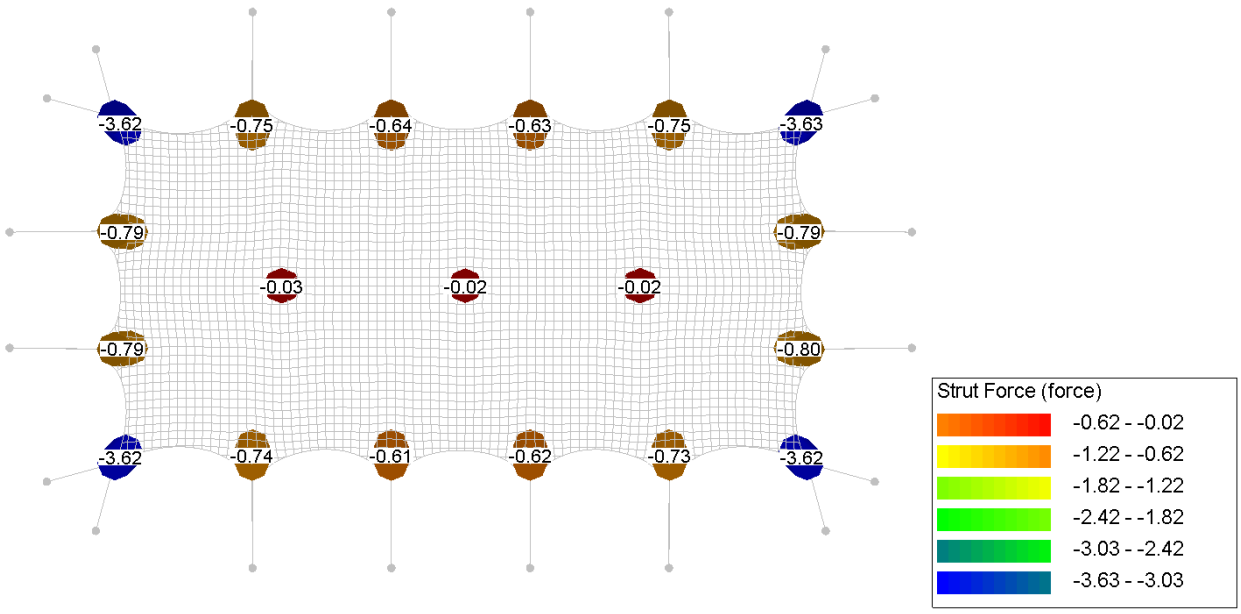
Annex F.5.4. Rope forces



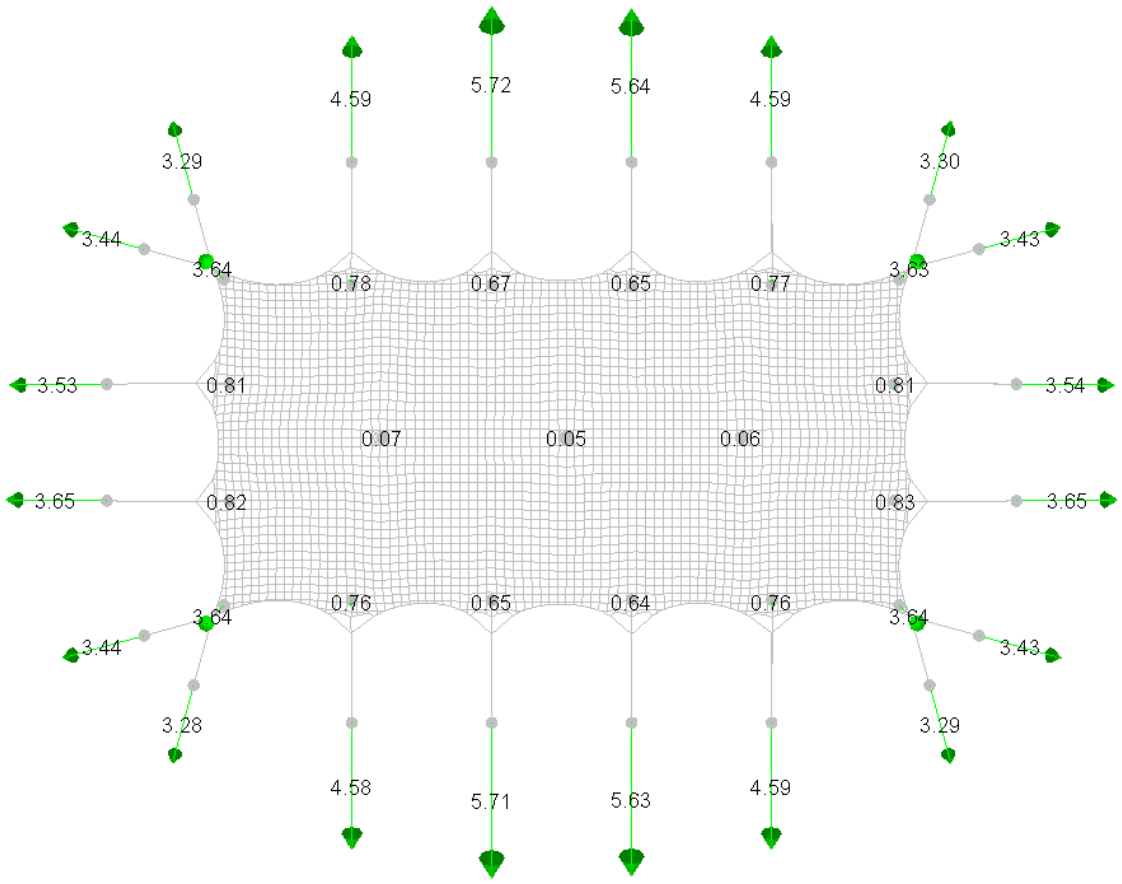
Annex F.5.5. Belt forces



Annex F.5.6. Poles forces

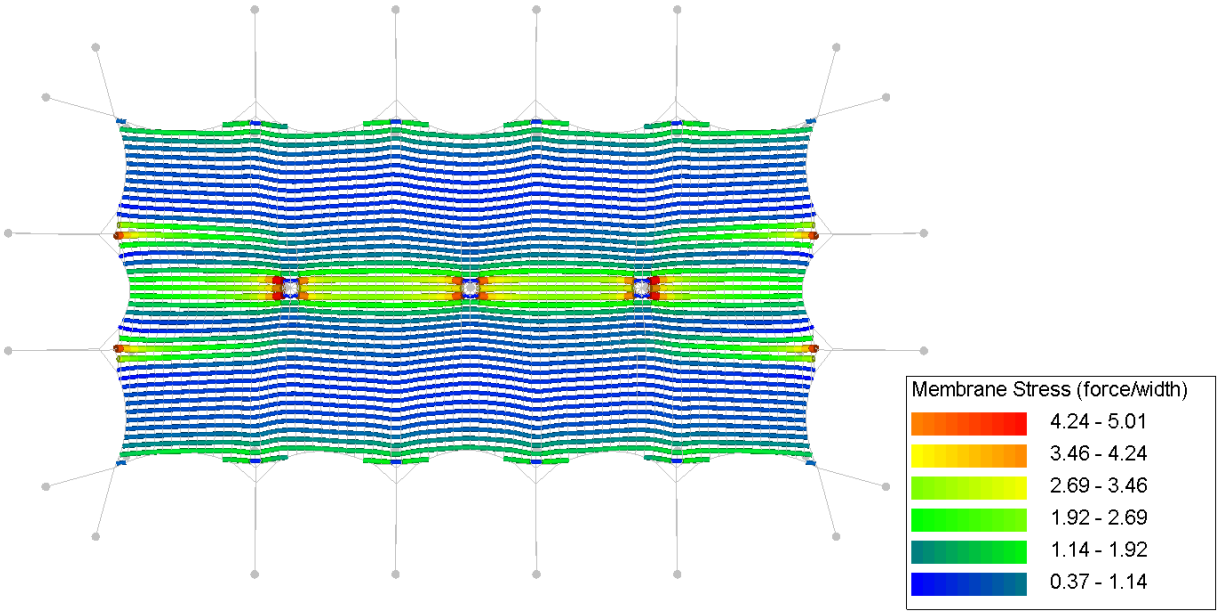


Annex F.5.7. Reaction forces

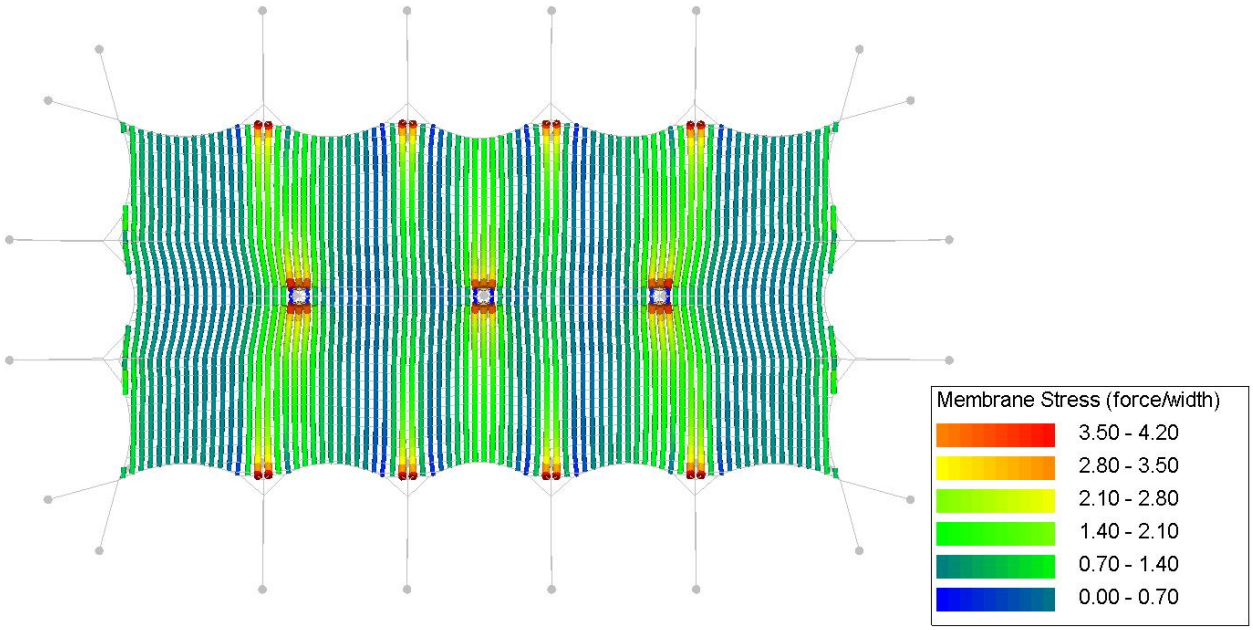


Annex F.6. CO6. Own weight + pretension + wind pressure + snow [FR]

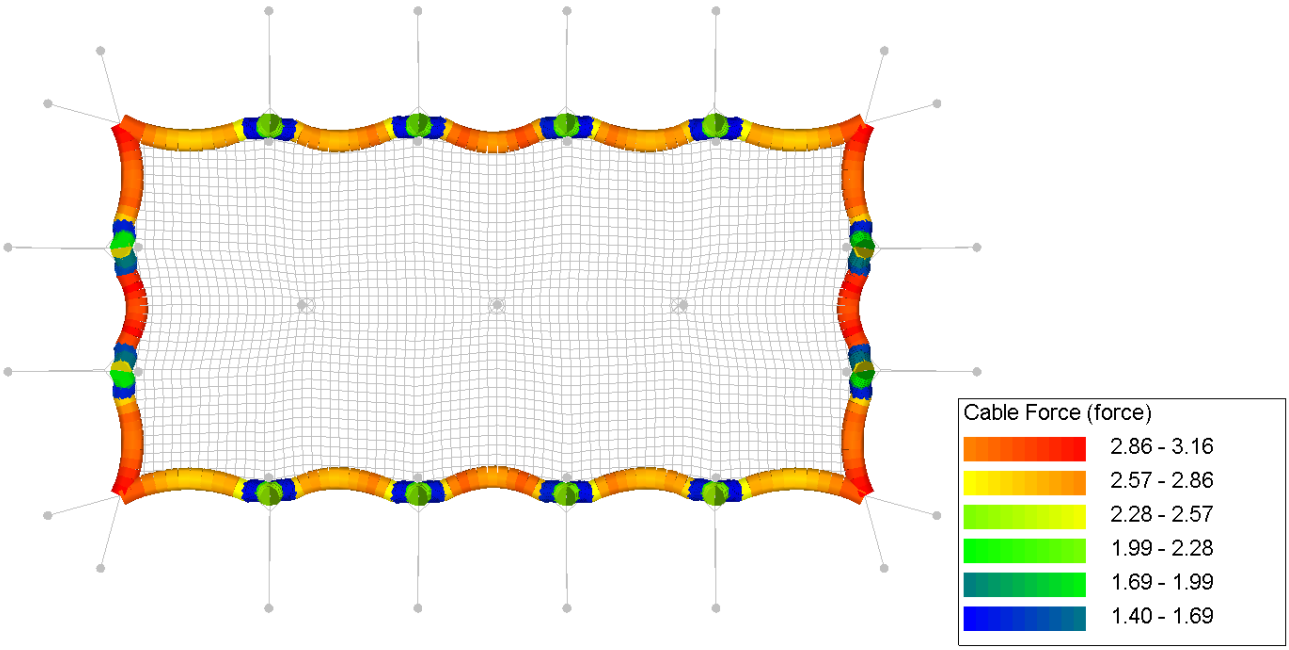
Annex F.6.1. Membrane stress (warp)



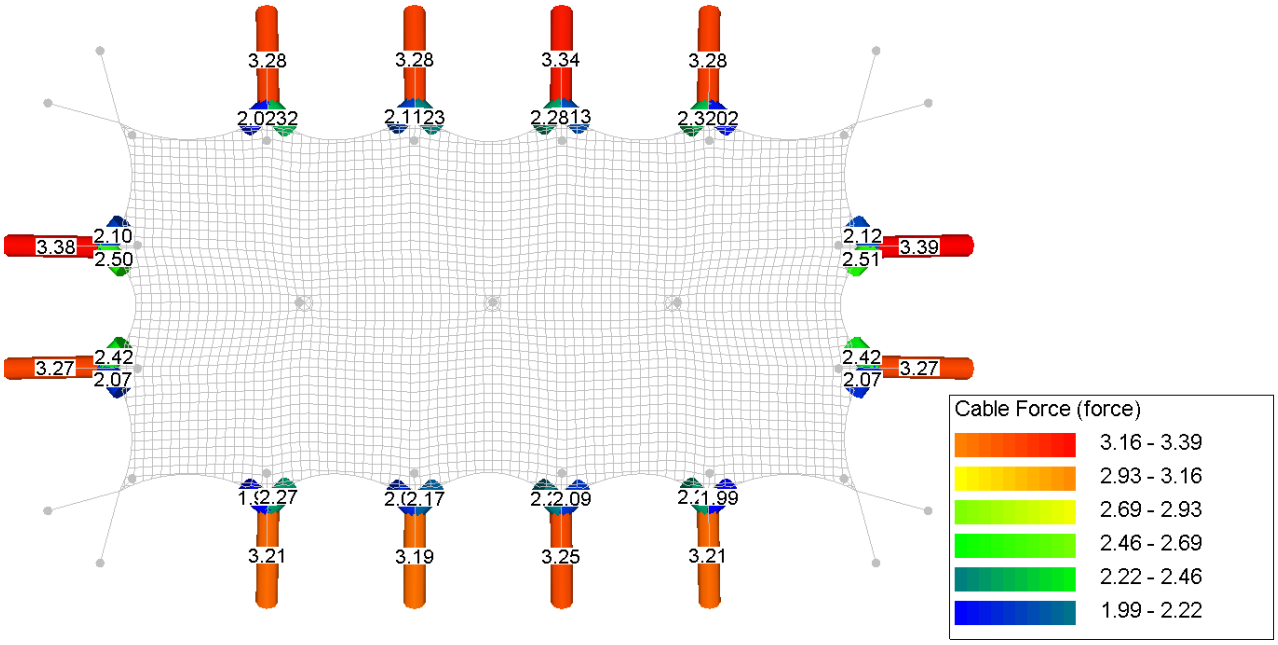
Annex F.6.2. Membrane stress (weft)



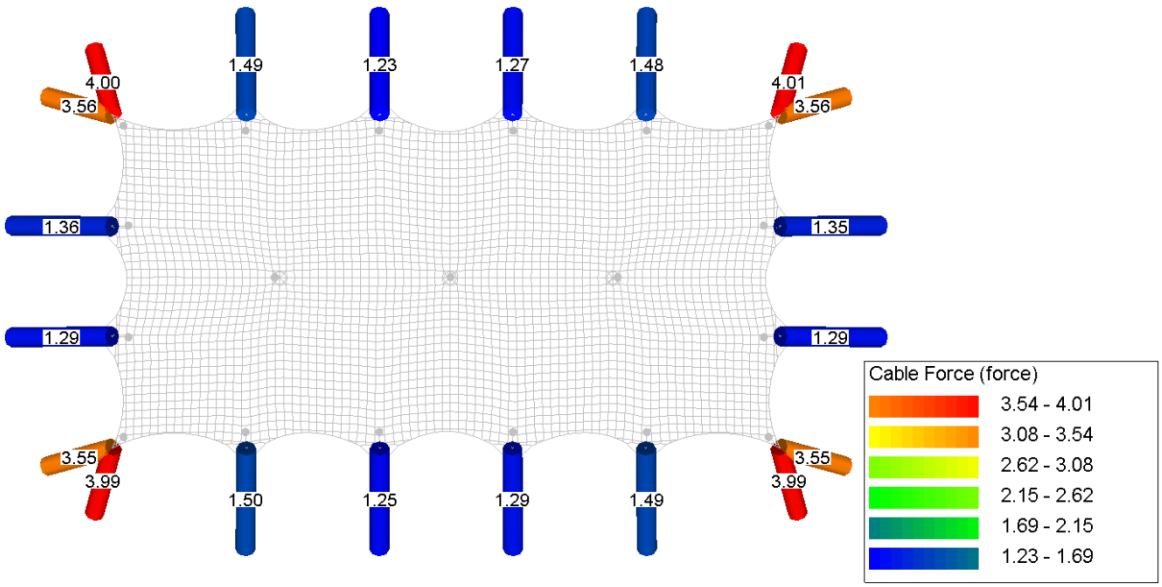
Annex F.6.3. Circumference rope forces



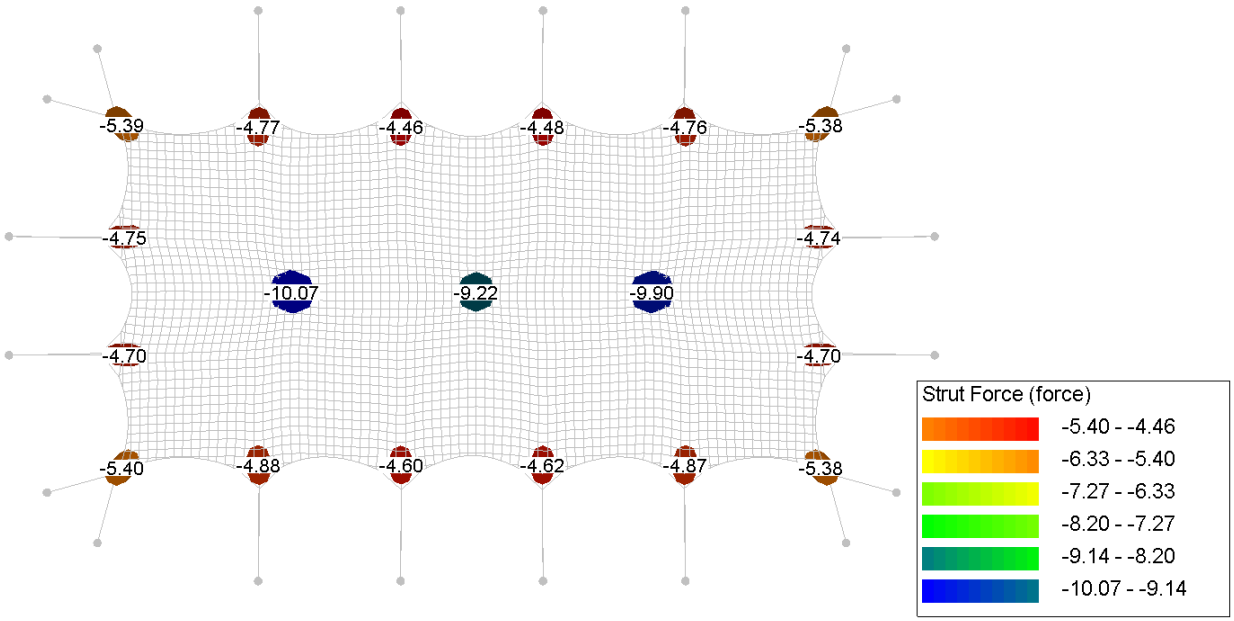
Annex F.6.4. Guy rope forces



Annex F.6.5. Belt forces

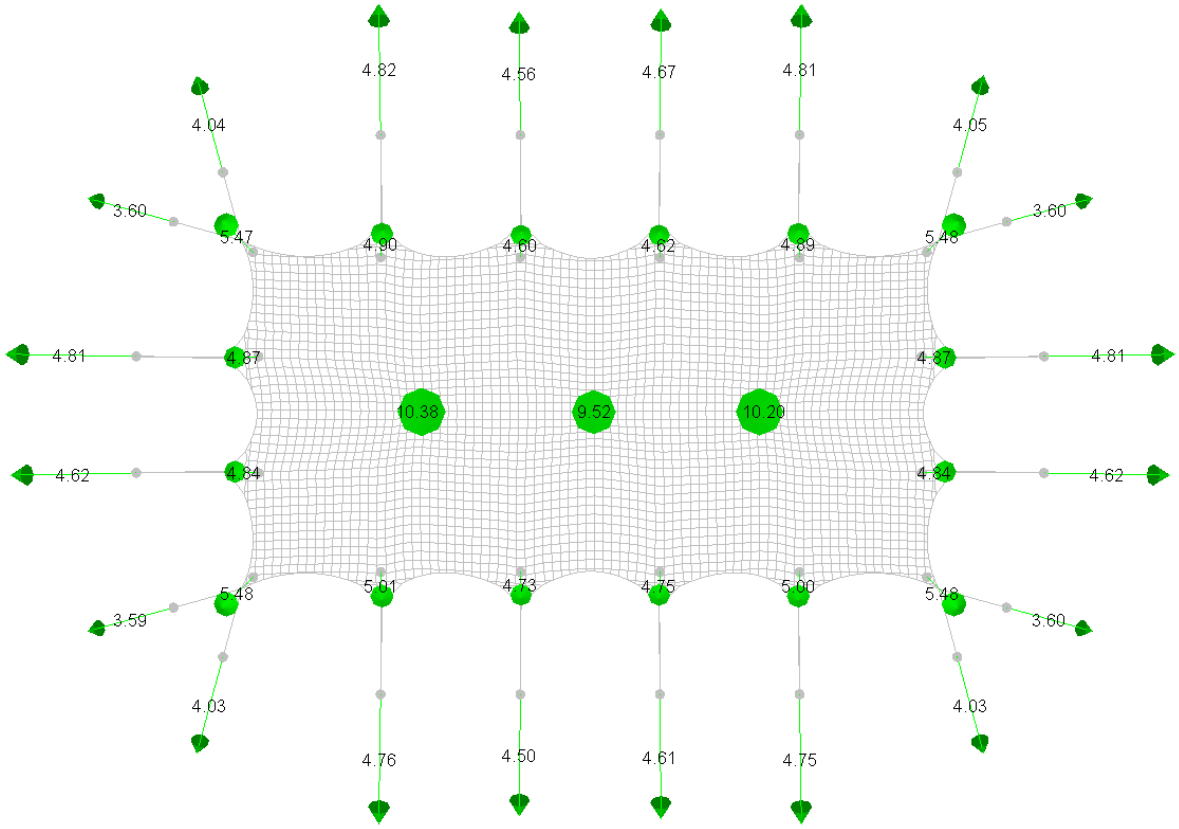


Annex F.6.6. Poles forces



Annex F.6.7. Reaction forces

Increased snow load of 0.1 x 1.5/1.35=0.1083 kN/m2 is applied for ballast and anchor calculation



Annex G. Member checks

Annex G.1. Main pole 4.0m – Wood, Spruce C18

Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	100	mm	
Length (buckling)	$l_{buc,y}$	4	m	
Effective area	A	7853.981634	mm^2	
Moment of innertia	I_y	4908738.521	mm^4	
Elastic modulus	$W_{el,y}$	98174.77042	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modulus of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	25.0	mm	
Slenderness	λ_y	160.0		
Relative slenderness	λ_{rely}	2.79		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	4.64		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.120		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	10.76	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.37	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		**0.92**		NEN-EN 1995-1-1:2005 equ. 6.23

Annex G.2. Side pole 3m – Wood, Spruce C18

Annex G.2.1.10x10m model

Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	70	mm	
Length (buckling)	$l_{buc,y}$	3	m	
Effective area	A	3848.451001	mm^2	
Moment of innertia	I_y	1178588.119	mm^4	
Elastic modules	$W_{el,y}$	33673.94626	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modules of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	17.5	mm	
Slenderness	λ_y	171.4		
Relative slenderness	λ_{rely}	2.99		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	5.24		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.105		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	5.03	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.31	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		**1.00**		NEN-EN 1995-1-1:2005 equ. 6.23

Annex G.2.2.10x15 and 10x20m model

Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	75	mm	
Length (buckling)	$l_{buc,y}$	3	m	
Effective area	A	4417.864669	mm^2	
Moment of innertia	I_y	1553155.548	mm^4	
Elastic modules	$W_{el,y}$	41417.48127	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modules of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	18.8	mm	
Slenderness	λ_y	160.0		
Relative slenderness	λ_{rely}	2.79		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	4.64		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.120		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	5.74	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.30	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		**0.87**		NEN-EN 1995-1-1:2005 equ. 6.23

Annex G.3. Corner pole 2.5m - Wood, C18

Annex G.3.1.10x10 and 10x20m model

Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	70	mm	
Length (buckling)	$l_{buc;y}$	2.5	m	
Effective area	A	3848.451001	mm^2	
Moment of innertia	I_y	1178588.119	mm^4	
Elastic modules	$W_{el;y}$	33673.94626	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modules of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	17.5	mm	
Slenderness	λ_y	142.9		
Relative slenderness	λ_{rely}	2.49		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	3.82		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.149		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	7.12	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.85	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		**1.00**		NEN-EN 1995-1-1:2005 equ. 6.23

Annex G.3.2.10x15m model

Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	75	mm	
Length (buckling)	l_{bucy}	2.5	m	
Effective area	A	4417.864669	mm^2	
Moment of innertia	I_y	1553155.548	mm^4	
Elastic modules	$W_{el,y}$	41417.48127	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modules of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	18.8	mm	
Slenderness	λ_y	133.3		
Relative slenderness	λ_{rely}	2.32		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	3.40		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.170		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	7.49	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.70	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		**0.80**		NEN-EN 1995-1-1:2005 equ. 6.23

Annex G.4. Main pole 4.0m – Wood, Spruce C18 – for snow and wind combination [FR]

Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	105	mm	
Length (buckling)	$l_{buc,y}$	4	m	
Effective area	A	8659.014751	mm^2	
Moment of innertia	I_y	5966602.352	mm^4	
Elastic modules	$W_{el,y}$	113649.5686	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modules of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	26.3	mm	
Slenderness	λ_y	152.4		
Relative slenderness	λ_{rely}	2.66		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	4.26		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.132		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	14.27	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.65	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		**1.01**		NEN-EN 1995-1-1:2005 equ. 6.23

Annex G.5. Side pole 3.0m – Wood, Spruce C18 – for snow and wind combination [FR]

Annex G.5.1.10x10m model

Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	75	mm	
Length (buckling)	l_{bucy}	3	m	
Effective area	A	4417.864669	mm^2	
Moment of innertia	I_y	1553155.548	mm^4	
Elastic modules	$W_{el,y}$	41417.48127	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modules of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	18.8	mm	
Slenderness	λ_y	160.0		
Relative slenderness	λ_{rely}	2.79		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	4.64		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.120		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	6.18	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.40	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		0.94		NEN-EN 1995-1-1:2005 equ. 6.23

Annex G.5.2.10x15 and 10x20m model

Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	80	mm	
Length (buckling)	$l_{buc,y}$	3	m	
Effective area	A	5026.548246	mm^2	
Moment of innertia	I_y	2010619.298	mm^4	
Elastic modules	$W_{el,y}$	50265.48246	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modules of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	20.0	mm	
Slenderness	λ_y	150.0		
Relative slenderness	$\lambda_{rel,y}$	2.62		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	4.15		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.136		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	7.07	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.41	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		**0.83**		NEN-EN 1995-1-1:2005 equ. 6.23

Annex G.6. Corner pole 2.5m – Wood, Spruce C18 – for snow and wind combination [FR]

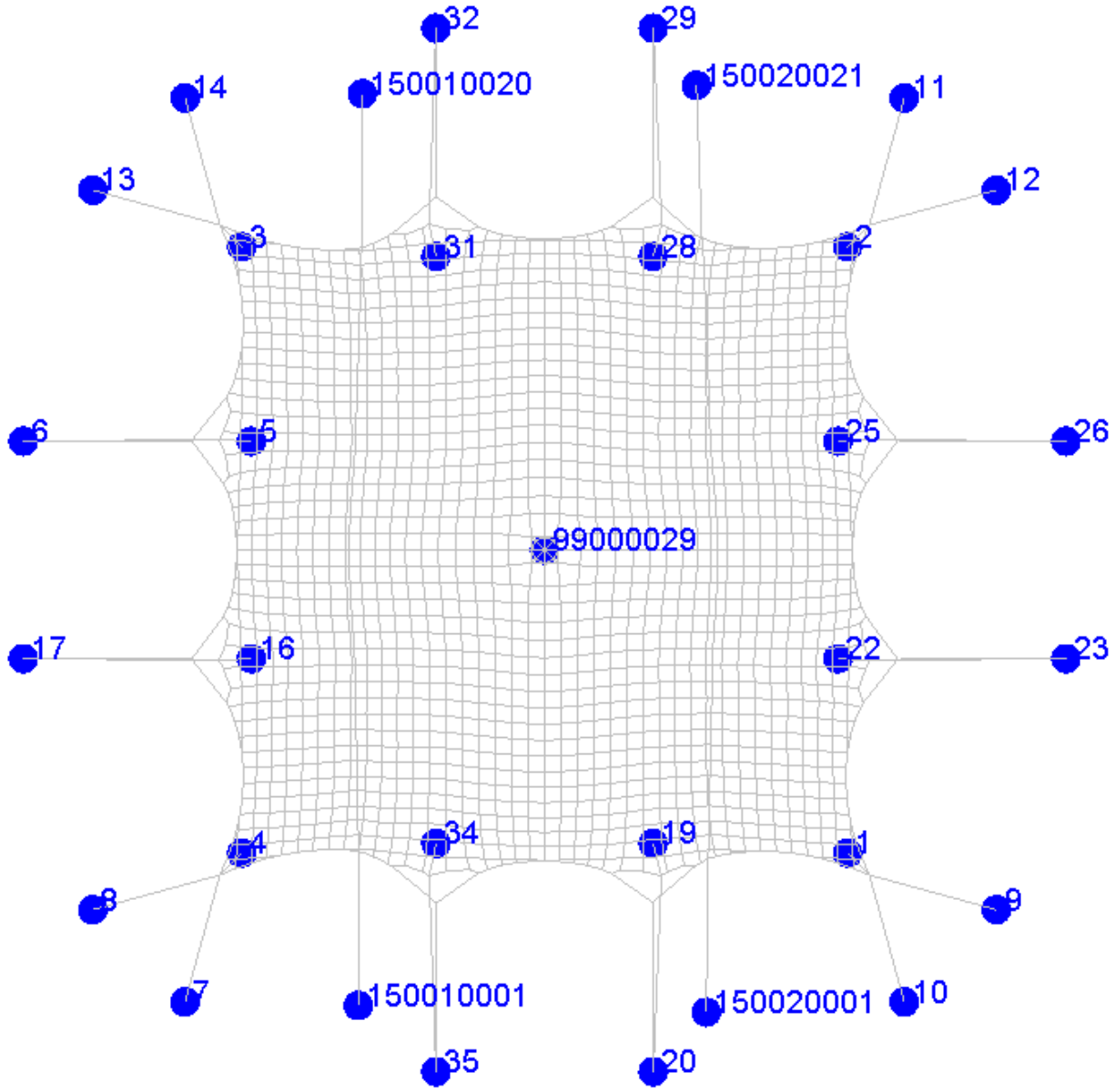
Woodtype		Spruce		
Strenght type		C18		
Material factor	γ_M	1.3		NEN-EN 1995-1-1:2005 table 2.3
Climate class		2		NEN-EN 1995-1-1:2005 article 2.3.1.3
Straightness factor	β_c	0.2		NEN-EN 1995-1-1:2005 equ. 6.29
Height	D	75	mm	
Length (buckling)	$l_{buc,y}$	2.5	m	
Effective area	A	4417.864669	mm^2	
Moment of innertia	I_y	1553155.548	mm^4	
Elastic modules	$W_{el,y}$	41417.48127	mm^3	
Charistic pressure strenght	f_{c0k}	18	N/mm²	
Charistic bending strenght	f_{c0k}	18	N/mm²	
Modules of elasticity	$E_{0.05}$	6	kN/m²	
	i_y	18.8	mm	
Slenderness	λ_y	133.3		
Relative slenderness	λ_{rely}	2.32		NEN-EN 1995-1-1:2005 equ. 6.21
	k_y	3.40		NEN-EN 1995-1-1:2005 equ. 6.21
Buckling factor	k_{cy}	0.170		NEN-EN 1995-1-1:2005 equ. 6.25

Strength check

Pressure force	F_d	7.76	kN	
Bending moment	M_d	0.00	kNm	
Pressure stress	σ_{c0d}	1.76	N/mm²	
Bending stress	σ_{c0d}	0.00	N/mm²	
Load duration		short		NEN-EN 1995-1-1:2005 table 2.1
Modificationfactor	k_{mod}	0.90		NEN-EN 1995-1-1:2005 table 3.1
Design pressure strenght	f_{c0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Design bending strenght	f_{m0d}	12.46	N/mm²	NEN-EN 1995-1-1:2005 equ. 2.14
Strength check		**0.83**		NEN-EN 1995-1-1:2005 equ. 6.23

Annex H. Reaction forces model 10x10m

Annex H.1. Point numbers



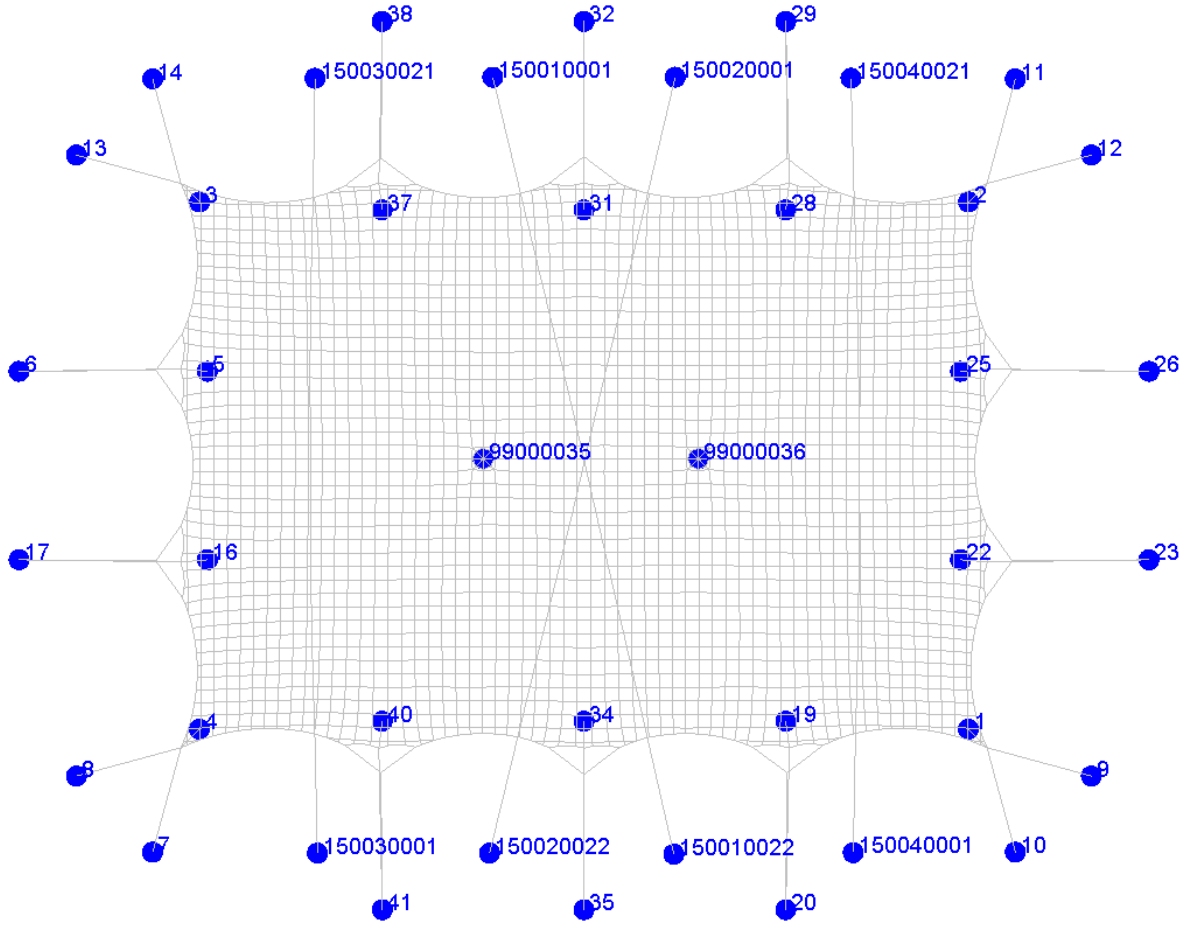
Annex H.2. Reaction forces

Reaction forces are shown in kilonewtons [kN] without any safety factor (1.35, 1.5, 1.2). A load combination especially for anchors and ballast calculation for snow and wind combined is CO6a.

				CO1			CO2			CO3			CO4			CO5			CO6			CO6a		
Att	Node	Koor X	Koor Y	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz
Tie	6	-3.00	6.67	-1.55	-0.01	-1.18	-2.04	0.00	-1.59	-2.44	0.01	-1.91	-3.98	-0.02	-2.97	-3.04	-0.03	-2.27	-3.04	0.03	-2.41	-3.08	0.03	-2.44
Tie	17	-3.00	3.33	-1.55	0.01	-1.18	-2.04	0.00	-1.59	-2.44	-0.01	-1.91	-3.98	0.02	-2.97	-3.04	0.03	-2.28	-3.04	-0.03	-2.41	-3.08	-0.03	-2.44
Tie	20	6.67	-3.00	-0.01	-1.55	-1.18	0.00	-1.98	-1.53	0.01	-2.34	-1.82	0.00	-3.58	-2.66	-0.03	-2.69	-2.02	0.02	-2.84	-2.24	0.02	-2.88	-2.27
Tie	23	13.00	3.33	1.55	0.01	-1.18	2.04	0.00	-1.59	2.44	-0.01	-1.91	4.03	0.02	-3.01	3.04	0.03	-2.27	3.04	-0.03	-2.41	3.08	-0.03	-2.44
Tie	26	13.00	6.67	1.55	-0.01	-1.18	2.04	0.00	-1.59	2.44	0.01	-1.91	4.04	-0.02	-3.02	3.04	-0.03	-2.28	3.04	0.03	-2.41	3.08	0.03	-2.44
Tie	29	6.67	13.00	-0.01	1.55	-1.18	0.00	1.98	-1.53	0.01	2.34	-1.82	0.00	3.60	-2.67	-0.03	2.69	-2.02	0.02	2.84	-2.24	0.02	2.88	-2.27
Tie	32	3.33	13.00	0.01	1.55	-1.18	0.00	1.98	-1.53	-0.01	2.34	-1.82	0.00	3.64	-2.71	0.03	2.69	-2.02	-0.02	2.84	-2.24	-0.02	2.88	-2.27
Tie	35	3.33	-3.00	0.01	-1.55	-1.18	0.00	-1.98	-1.53	-0.01	-2.34	-1.82	0.00	-3.63	-2.70	0.03	-2.69	-2.02	-0.02	-2.84	-2.24	-0.02	-2.88	-2.27
Tie	7	-0.52	-1.93	-0.39	-1.43	-1.47	-0.46	-1.71	-1.76	-0.53	-1.96	-2.02	-0.71	-2.60	-2.68	-0.59	-2.18	-2.25	-0.62	-2.27	-2.34	-0.63	-2.29	-2.36
Tie	8	-1.93	-0.52	-1.43	-0.39	-1.48	-1.71	-0.46	-1.76	-1.96	-0.53	-2.02	-2.67	-0.73	-2.75	-2.04	-0.56	-2.11	-2.28	-0.62	-2.34	-2.30	-0.63	-2.37
Tie	9	11.93	-0.52	1.43	-0.39	-1.48	1.71	-0.46	-1.76	1.96	-0.53	-2.02	2.69	-0.74	-2.77	2.04	-0.56	-2.11	2.28	-0.62	-2.34	2.30	-0.63	-2.37
Tie	10	10.52	-1.93	0.39	-1.43	-1.47	0.46	-1.71	-1.76	0.53	-1.96	-2.01	0.72	-2.61	-2.68	0.59	-2.18	-2.25	0.62	-2.27	-2.34	0.63	-2.29	-2.36
Tie	11	10.52	11.93	0.39	1.43	-1.47	0.46	1.71	-1.76	0.53	1.96	-2.02	0.72	2.61	-2.68	0.59	2.18	-2.25	0.62	2.27	-2.34	0.63	2.29	-2.36
Tie	12	11.93	10.52	1.43	0.39	-1.48	1.71	0.46	-1.76	1.96	0.53	-2.02	2.68	0.74	-2.76	2.04	0.56	-2.11	2.28	0.62	-2.34	2.30	0.63	-2.37
Tie	13	-1.93	10.52	-1.43	0.39	-1.48	-1.71	0.46	-1.76	-1.96	0.53	-2.02	-2.66	0.73	-2.73	-2.04	0.56	-2.11	-2.28	0.62	-2.34	-2.30	0.63	-2.37
Tie	14	-0.52	11.93	-0.39	1.43	-1.47	-0.46	1.71	-1.76	-0.53	1.96	-2.02	-0.71	2.60	-2.67	-0.59	2.18	-2.25	-0.62	2.27	-2.34	-0.63	2.29	-2.36
Pole	1	9.65	0.35	0.44	-0.44	2.58	0.56	-0.56	3.29	0.65	-0.65	3.86	0.72	-0.72	4.30	0.57	-0.56	3.34	0.78	-0.78	4.64	0.79	-0.79	4.70
Pole	2	9.65	9.65	0.44	0.44	2.58	0.56	0.56	3.29	0.65	0.65	3.86	0.71	0.71	4.25	0.57	0.56	3.34	0.78	0.78	4.64	0.79	0.79	4.71
Pole	3	0.35	9.65	-0.44	0.44	2.58	-0.56	0.56	3.29	-0.65	0.65	3.86	-0.73	0.73	4.37	-0.57	0.56	3.34	-0.78	0.78	4.64	-0.79	0.79	4.70
Pole	4	0.35	0.35	-0.44	-0.44	2.58	-0.56	-0.56	3.29	-0.65	-0.65	3.86	-0.74	-0.74	4.41	-0.57	-0.56	3.34	-0.78	-0.78	4.64	-0.79	-0.79	4.71
Pole	5	0.50	6.67	-0.21	0.01	1.31	-0.39	0.01	2.41	-0.51	0.01	3.11	-0.13	0.01	0.82	-0.14	0.01	0.85	-0.70	0.00	4.30	-0.71	-0.01	4.39
Pole	16	0.50	3.33	-0.21	-0.01	1.31	-0.39	-0.01	2.41	-0.51	-0.01	3.11	-0.13	-0.01	0.82	-0.14	-0.01	0.85	-0.70	0.00	4.30	-0.71	0.01	4.39
Pole	19	6.67	0.50	0.01	-0.21	1.31	0.01	-0.38	2.35	0.01	-0.49	3.01	0.08	-0.31	1.87	0.01	-0.12	0.74	0.00	-0.67	4.10	-0.01	-0.68	4.19
Pole	22	9.50	3.33	0.21	-0.01	1.31	0.39	-0.01	2.41	0.51	-0.01	3.11	0.13	-0.01	0.79	0.14	-0.01	0.85	0.70	0.00	4.30	0.71	0.01	4.39
Pole	25	9.50	6.67	0.21	0.01	1.31	0.39	0.01	2.41	0.51	0.01	3.11	0.12	0.01	0.77	0.14	0.01	0.85	0.70	0.00	4.30	0.71	-0.01	4.39
Pole	28	6.67	9.50	0.01	0.21	1.31	0.01	0.38	2.35	0.01	0.49	3.01	0.09	0.33	2.02	0.01	0.12	0.74	0.00	0.67	4.10	-0.01	0.68	4.19
Pole	31	3.33	9.50	-0.01	0.21	1.31	-0.01	0.38	2.35	-0.01	0.49	3.01	-0.05	0.25	1.51	-0.01	0.12	0.74	0.00	0.67	4.10	0.01	0.68	4.19
Pole	34	3.33	0.50	-0.01	-0.21	1.31	-0.01	-0.38	2.35	-0.01	-0.49	3.01	-0.05	-0.24	1.48	-0.01	-0.12	0.74	0.00	-0.67	4.10	0.01	-0.68	4.19
Pole	99000029	5.00	5.00	0.00	0.00	2.15	0.00	0.00	5.45	0.00	0.00	6.98	0.00	0.00	-0.01	0.00	0.00	0.12	0.00	0.00	10.36	0.00	0.00	10.64
Stormbelt	150010001	2.14	-1.99										-0.01	-3.80	-3.35									
Stormbelt	150010020	2.21	12.00										0.02	3.80	-3.34									
Stormbelt	150020001	7.48	-2.09										-0.04	-4.22	-3.72									
Stormbelt	150020021	7.33	12.12										-0.14	4.19	-3.75									

Annex I. Reaction forces model 10x15m

Annex I.1. Point numbers



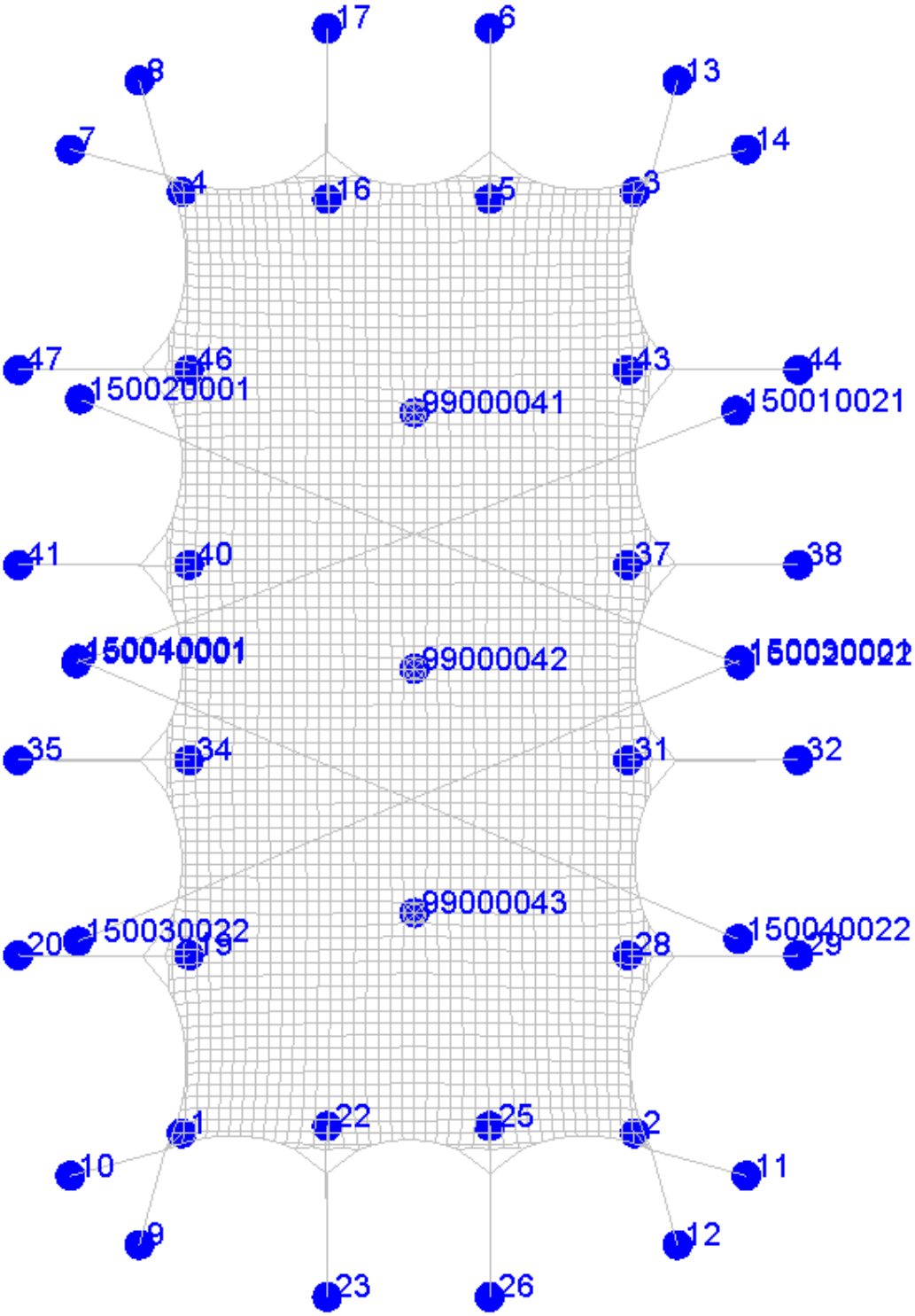
Annex I.2. Reaction forces

Reaction forces are shown in kilonewtons [kN] without any safety factor (1.35, 1.5, 1.2). A load combination especially for anchors and ballast calculation for snow and wind combined is CO6a.

				CO1			CO2			CO3			CO4			CO5			CO6			CO6a		
Att	Node	Koor X	Koor Y	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz
Tie	6	-3.00	7.00	-1.62	-0.01	-1.24	-2.30	0.00	-1.79	-2.82	0.02	-2.21	-4.07	-0.02	-3.05	-3.29	-0.04	-2.47	-3.54	0.04	-2.80	-3.60	0.04	-2.84
Tie	17	-3.00	3.50	-1.61	0.01	-1.23	-2.24	0.00	-1.74	-2.74	-0.02	-2.14	-4.14	0.02	-3.10	-3.37	0.03	-2.53	-3.44	-0.04	-2.72	-3.49	-0.04	-2.76
Tie	20	11.25	-3.00	-0.02	-1.71	-1.31	0.00	-2.25	-1.75	0.02	-2.72	-2.13	-0.02	-4.05	-3.02	-0.03	-3.52	-2.67	0.04	-3.32	-2.62	0.04	-3.37	-2.66
Tie	23	18.00	3.50	1.62	0.01	-1.23	2.24	-0.01	-1.75	2.75	-0.02	-2.15	4.18	0.02	-3.14	3.38	0.04	-2.53	3.46	-0.04	-2.73	3.52	-0.04	-2.78
Tie	26	18.00	7.00	1.62	-0.01	-1.24	2.31	0.01	-1.80	2.84	0.02	-2.22	4.12	-0.02	-3.09	3.29	-0.04	-2.47	3.57	0.04	-2.82	3.63	0.04	-2.87
Tie	29	11.25	13.50	-0.02	1.72	-1.32	0.00	2.26	-1.76	0.02	2.74	-2.14	-0.02	4.07	-3.04	-0.03	3.52	-2.68	0.04	3.36	-2.65	0.04	3.41	-2.69
Tie	32	7.50	13.50	0.00	1.74	-1.37	0.00	2.41	-1.92	0.00	3.00	-2.38	0.00	3.59	-2.75	0.00	3.78	-3.00	0.00	3.72	-2.97	0.00	3.77	-3.02
Tie	35	7.50	-3.00	0.00	-1.73	-1.37	0.00	-2.39	-1.90	0.00	-2.97	-2.36	0.00	-3.60	-2.74	0.00	-3.78	-2.99	0.00	-3.67	-2.94	0.00	-3.72	-2.98
Tie	38	3.75	13.50	0.02	1.71	-1.31	0.00	2.22	-1.73	-0.02	2.68	-2.09	0.02	4.16	-3.11	0.03	3.59	-2.73	-0.04	3.29	-2.59	-0.04	3.33	-2.63
Tie	41	3.75	-3.00	0.02	-1.71	-1.30	0.00	-2.21	-1.72	-0.02	-2.66	-2.08	0.02	-4.16	-3.10	0.03	-3.59	-2.72	-0.03	-3.26	-2.57	-0.04	-3.30	-2.61
Tie	7	-0.52	-1.93	-0.43	-1.58	-1.63	-0.53	-1.94	-2.00	-0.61	-2.24	-2.30	-0.76	-2.76	-2.84	-0.65	-2.39	-2.46	-0.71	-2.59	-2.67	-0.72	-2.62	-2.70
Tie	8	-1.93	-0.52	-1.52	-0.41	-1.56	-1.87	-0.51	-1.93	-2.21	-0.60	-2.27	-2.89	-0.79	-2.97	-2.40	-0.66	-2.47	-2.59	-0.71	-2.66	-2.62	-0.72	-2.69
Tie	9	16.93	-0.52	1.52	-0.41	-1.56	1.88	-0.51	-1.94	2.21	-0.60	-2.28	2.89	-0.79	-2.97	2.40	-0.66	-2.48	2.60	-0.71	-2.68	2.63	-0.72	-2.71
Tie	10	15.52	-1.93	0.43	-1.58	-1.63	0.53	-1.95	-2.01	0.61	-2.24	-2.31	0.77	-2.78	-2.86	0.65	-2.39	-2.46	0.71	-2.60	-2.68	0.72	-2.63	-2.70
Tie	11	15.52	12.43	0.43	1.58	-1.63	0.53	1.95	-2.01	0.61	2.24	-2.31	0.76	2.78	-2.86	0.66	2.40	-2.47	0.71	2.61	-2.68	0.72	2.63	-2.71
Tie	12	16.93	11.02	1.52	0.41	-1.56	1.88	0.51	-1.94	2.21	0.60	-2.28	2.88	0.79	-2.96	2.40	0.66	-2.48	2.61	0.71	-2.68	2.64	0.72	-2.71
Tie	13	-1.93	11.02	-1.52	0.41	-1.57	-1.88	0.51	-1.94	-2.21	0.60	-2.28	-2.88	0.79	-2.96	-2.40	0.66	-2.47	-2.59	0.71	-2.67	-2.62	0.72	-2.70
Tie	14	-0.52	12.43	-0.43	1.58	-1.63	-0.53	1.94	-2.00	-0.61	2.24	-2.31	-0.76	2.76	-2.84	-0.66	2.39	-2.47	-0.71	2.60	-2.67	-0.72	2.63	-2.70
Pole	1	14.65	0.35	0.48	-0.48	2.81	0.63	-0.63	3.73	0.75	-0.75	4.44	0.78	-0.78	4.68	0.63	-0.64	3.78	0.90	-0.90	5.38	0.91	-0.91	5.45
Pole	2	14.65	10.15	0.48	0.48	2.80	0.63	0.63	3.72	0.75	0.75	4.43	0.77	0.78	4.65	0.63	0.63	3.77	0.90	0.90	5.37	0.91	0.91	5.45
Pole	3	0.35	10.15	-0.48	0.48	2.81	-0.63	0.63	3.73	-0.75	0.75	4.44	-0.78	0.78	4.66	-0.63	0.63	3.78	-0.90	0.90	5.37	-0.91	0.91	5.44
Pole	4	0.35	0.35	-0.48	-0.48	2.81	-0.63	-0.63	3.73	-0.75	-0.75	4.44	-0.77	-0.78	4.65	-0.64	-0.64	3.78	-0.90	-0.90	5.37	-0.91	-0.91	5.45
Pole	5	0.50	7.00	-0.23	0.02	1.39	-0.45	0.02	2.73	-0.58	0.01	3.57	-0.12	0.01	0.78	-0.14	0.01	0.85	-0.80	-0.01	4.96	-0.82	-0.01	5.07
Pole	16	0.50	3.50	-0.23	-0.02	1.39	-0.44	-0.01	2.71	-0.58	0.00	3.55	-0.13	-0.01	0.79	-0.14	-0.01	0.86	-0.80	0.01	4.93	-0.82	0.02	5.04
Pole	19	11.25	0.50	0.02	-0.22	1.37	0.02	-0.43	2.62	0.01	-0.56	3.42	0.06	-0.34	2.10	0.01	-0.13	0.78	-0.02	-0.76	4.70	-0.02	-0.78	4.81
Pole	22	14.50	3.50	0.22	-0.02	1.38	0.44	-0.01	2.67	0.57	0.00	3.49	0.13	-0.01	0.81	0.14	-0.01	0.87	0.78	0.01	4.85	0.80	0.01	4.96
Pole	25	14.50	7.00	0.22	0.02	1.38	0.44	0.02	2.69	0.57	0.01	3.51	0.13	0.01	0.80	0.14	0.01	0.86	0.79	-0.01	4.88	0.81	-0.01	4.99
Pole	28	11.25	10.00	0.02	0.22	1.36	0.02	0.42	2.58	0.01	0.55	3.36	0.06	0.35	2.13	0.01	0.13	0.79	-0.02	0.75	4.62	-0.02	0.76	4.72
Pole	31	7.50	10.00	0.00	0.20	1.21	0.00	0.40	2.46	0.00	0.54	3.30	0.00	0.40	2.46	0.00	0.09	0.59	0.00	0.74	4.59	0.00	0.76	4.69
Pole	34	7.50	0.50	0.00	-0.20	1.23	0.00	-0.41	2.52	0.00	-0.55	3.39	0.00	-0.39	2.40	0.00	-0.09	0.57	0.00	-0.76	4.72	0.00	-0.78	4.83
Pole	37	3.75	10.00	-0.02	0.22	1.36	-0.02	0.42	2.58	-0.01	0.55	3.36	-0.06	0.35	2.15	-0.01	0.13	0.80	0.02	0.75	4.61	0.02	0.77	4.72
Pole	40	3.75	0.50	-0.02	-0.22	1.37	-0.02	-0.43	2.62	-0.01	-0.56	3.42	-0.07	-0.36	2.19	-0.01	-0.13	0.79	0.02	-0.76	4.70	0.02	-0.78	4.80
Pole	99000035	5.63	5.38	-0.01	0.00	1.77	-0.01	-0.01	5.00	0.00	-0.02	6.53	0.00	0.00	-0.01	0.00	0.00	0.04	0.01	-0.05	9.82	0.02	-0.05	10.09
Pole	99000036	9.63	5.38	0.01	0.00	1.77	0.00	-0.01	4.95	-0.03	-0.02	6.46	0.00	0.00	-0.02	0.00	0.00	0.05	-0.08	-0.05	9.69	-0.09	-0.05	9.96
Stormbelt	150010001	5.80	12.46										-1.00	4.25	-3.91									
Stormbelt	150010022	9.17	-1.97										0.96	-4.26	-3.91									
Stormbelt	150020001	9.19	12.46										0.99	4.24	-3.90									
Stormbelt	150020022	5.75	-1.95										-1.01	-4.24	-3.90									
Stormbelt	150030001	2.55	-1.95										0.00	-4.54	-3.95									
Stormbelt	150030021	2.50	12.44										-0.02	4.54	-3.95									
Stormbelt	150040001	12.50	-1.94										0.01	-4.48	-3.91									
Stormbelt	150040021	12.46	12.45										-0.01	4.48	-3.91									

Annex J. Reaction forces model 10x20m

Annex J.1. Point numbers



Annex J.2. Reaction forces

Reaction forces are shown in kilonewtons [kN] without any safety factor (1.35, 1.5, 1.2). A load combination especially for anchors and ballast calculation for snow and wind combined is CO6a.

				CO1			CO2			CO3			CO4			CO5			CO6			CO6a		
Att	Node	Koor X	Koor Y	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz	Fx	Fy	Fz
275	6	-8.00	7.17	-1.57	-0.01	-1.22	-2.32	0.02	-1.83	-2.92	0.04	-2.30	-4.35	-0.03	-3.32	-2.81	-0.03	-2.14	-3.70	0.06	-2.94	-3.76	0.07	-2.99
275	17	-8.00	3.83	-1.56	0.01	-1.21	-2.24	-0.02	-1.77	-2.81	-0.04	-2.22	-4.44	0.02	-3.38	-2.91	0.03	-2.21	-3.56	-0.06	-2.83	-3.61	-0.07	-2.88
275	20	11.00	-2.50	-0.02	-1.83	-1.41	0.00	-2.46	-1.94	0.03	-3.01	-2.38	-0.04	-4.56	-3.43	-0.01	-3.65	-2.78	0.05	-3.66	-2.92	0.05	-3.71	-2.97
275	23	18.00	3.83	1.56	0.01	-1.21	2.24	-0.02	-1.77	2.81	-0.04	-2.22	4.42	0.02	-3.37	2.91	0.03	-2.21	3.56	-0.06	-2.83	3.61	-0.07	-2.88
275	26	18.00	7.17	1.57	-0.01	-1.22	2.32	0.02	-1.82	2.92	0.04	-2.30	4.33	-0.03	-3.31	2.82	-0.03	-2.15	3.70	0.06	-2.94	3.76	0.06	-2.99
275	29	11.00	13.50	-0.02	1.83	-1.41	0.01	2.48	-1.95	0.03	3.03	-2.40	-0.04	4.56	-3.44	-0.01	3.64	-2.79	0.06	3.71	-2.96	0.06	3.76	-3.00
275	32	7.00	13.50	0.00	1.81	-1.44	0.01	2.32	-1.86	0.02	2.88	-2.32	0.01	3.81	-2.97	0.00	4.41	-3.53	0.03	3.58	-2.90	0.03	3.63	-2.94
275	35	7.00	-2.50	0.00	-1.80	-1.43	0.01	-2.30	-1.85	0.02	-2.86	-2.30	0.01	-3.79	-2.94	0.00	-4.40	-3.51	0.03	-3.52	-2.86	0.03	-3.58	-2.90
275	38	3.00	13.50	0.00	1.80	-1.43	-0.01	2.26	-1.82	-0.02	2.82	-2.27	-0.01	3.86	-3.00	0.00	4.47	-3.57	-0.03	3.49	-2.83	-0.03	3.54	-2.87
275	41	3.00	-2.50	0.00	-1.79	-1.43	-0.01	-2.25	-1.81	-0.02	-2.79	-2.25	-0.01	-3.84	-2.97	0.00	-4.46	-3.55	-0.03	-3.45	-2.80	-0.03	-3.50	-2.84
275	44	-1.00	13.50	0.02	1.83	-1.41	-0.01	2.48	-1.96	-0.03	3.03	-2.40	0.04	4.59	-3.47	0.01	3.64	-2.79	-0.05	3.71	-2.96	-0.06	3.77	-3.01
275	47	-1.00	-2.50	0.02	-1.83	-1.41	0.00	-2.46	-1.94	-0.03	-3.01	-2.38	0.04	-4.61	-3.47	0.01	-3.65	-2.78	-0.05	-3.67	-2.93	-0.05	-3.72	-2.97
600	7	-5.52	-1.43	-0.43	-1.59	-1.64	-0.55	-2.01	-2.07	-0.64	-2.35	-2.42	-0.82	-2.97	-3.06	-0.62	-2.25	-2.31	-0.75	-2.73	-2.81	-0.75	-2.76	-2.84
600	8	-6.93	-0.02	-1.39	-0.38	-1.44	-1.71	-0.47	-1.76	-2.05	-0.56	-2.11	-3.03	-0.83	-3.11	-2.35	-0.64	-2.42	-2.43	-0.67	-2.50	-2.46	-0.68	-2.53
600	9	16.93	-0.02	1.39	-0.38	-1.44	1.71	-0.47	-1.76	2.05	-0.56	-2.11	3.03	-0.83	-3.12	2.35	-0.64	-2.42	2.43	-0.67	-2.50	2.46	-0.68	-2.53
600	10	15.52	-1.43	0.43	-1.59	-1.64	0.55	-2.01	-2.07	0.64	-2.35	-2.42	0.81	-2.96	-3.04	0.62	-2.25	-2.32	0.75	-2.73	-2.81	0.75	-2.76	-2.84
600	11	15.52	12.43	0.43	1.59	-1.64	0.55	2.02	-2.08	0.64	2.36	-2.43	0.82	2.97	-3.05	0.62	2.26	-2.32	0.75	2.75	-2.82	0.76	2.77	-2.85
600	12	16.93	11.02	1.39	0.38	-1.44	1.71	0.47	-1.76	2.05	0.56	-2.11	3.03	0.83	-3.12	2.35	0.64	-2.42	2.43	0.67	-2.51	2.46	0.68	-2.54
600	13	-6.93	11.02	-1.39	0.38	-1.44	-1.71	0.47	-1.77	-2.05	0.56	-2.11	-3.01	0.83	-3.09	-2.35	0.64	-2.42	-2.44	0.67	-2.51	-2.47	0.68	-2.54
600	14	-5.52	12.43	-0.43	1.59	-1.64	-0.55	2.01	-2.07	-0.64	2.35	-2.42	-0.82	2.98	-3.07	-0.62	2.25	-2.32	-0.75	2.74	-2.82	-0.76	2.77	-2.85
48160	1	14.65	0.85	0.46	-0.45	2.67	0.61	-0.60	3.58	0.73	-0.73	4.33	0.70	-0.70	4.22	0.60	-0.60	3.54	0.89	-0.88	5.26	0.90	-0.89	5.33
48160	2	14.65	10.15	0.46	0.45	2.66	0.61	0.60	3.57	0.73	0.72	4.32	0.70	0.70	4.21	0.59	0.60	3.54	0.89	0.88	5.26	0.90	0.89	5.33
48160	3	-4.65	10.15	-0.46	0.45	2.66	-0.61	0.60	3.57	-0.73	0.72	4.32	-0.70	0.70	4.20	-0.59	0.60	3.54	-0.89	0.87	5.25	-0.90	0.89	5.33
48160	4	-4.65	0.85	-0.46	-0.45	2.67	-0.61	-0.60	3.58	-0.74	-0.73	4.33	-0.70	-0.70	4.22	-0.60	-0.60	3.54	-0.89	-0.88	5.26	-0.90	-0.89	5.33
48160	5	-4.50	7.17	-0.22	0.01	1.35	-0.42	0.00	2.60	-0.56	-0.01	3.42	-0.06	0.00	0.40	-0.13	0.01	0.80	-0.76	-0.03	4.71	-0.78	-0.03	4.81
48160	16	-4.50	3.83	-0.22	-0.01	1.35	-0.42	0.00	2.57	-0.55	0.01	3.39	-0.06	0.00	0.41	-0.13	-0.01	0.81	-0.76	0.04	4.67	-0.77	0.04	4.78
48160	19	11.00	1.00	0.02	-0.22	1.38	0.01	-0.44	2.68	-0.01	-0.57	3.53	-0.03	-0.24	1.49	0.00	-0.12	0.75	-0.04	-0.78	4.83	-0.04	-0.80	4.93
48160	22	14.50	3.83	0.22	-0.01	1.35	0.42	0.00	2.58	0.55	0.01	3.39	0.06	-0.01	0.42	0.13	-0.01	0.81	0.76	0.04	4.67	0.77	0.04	4.78
48160	25	14.50	7.17	0.22	0.01	1.35	0.42	0.00	2.59	0.56	-0.01	3.41	0.06	0.00	0.41	0.13	0.01	0.80	0.76	-0.04	4.70	0.78	-0.04	4.81
48160	28	11.00	10.00	0.02	0.22	1.37	0.01	0.43	2.62	-0.01	0.56	3.45	-0.03	0.24	1.47	0.00	0.12	0.76	-0.04	0.76	4.72	-0.04	0.78	4.83
48160	31	7.00	10.00	0.00	0.19	1.19	0.00	0.38	2.35	-0.01	0.52	3.19	-0.05	0.34	2.06	0.00	0.10	0.65	-0.02	0.72	4.45	-0.03	0.74	4.56
48160	34	7.00	1.00	0.00	-0.20	1.21	0.00	-0.39	2.41	-0.01	-0.53	3.28	-0.04	-0.32	1.98	0.00	-0.10	0.63	-0.02	-0.74	4.58	-0.03	-0.76	4.69
48160	37	3.00	10.00	0.00	0.19	1.19	0.00	0.38	2.33	0.01	0.52	3.17	0.04	0.36	2.21	0.00	0.10	0.66	0.02	0.72	4.43	0.03	0.73	4.54
48160	40	3.00	1.00	0.00	-0.20	1.21	0.00	-0.39	2.39	0.01	-0.53	3.25	0.04	-0.34	2.09	0.00	-0.10	0.64	0.02	-0.74	4.56	0.03	-0.76	4.67
48160	43	-1.00	10.00	-0.02	0.22	1.37	-0.01	0.43	2.63	0.01	0.56	3.46	0.02	0.19	1.18	0.00	0.12	0.77	0.04	0.76	4.73	0.04	0.78	4.84
48160	46	-1.00	1.00	-0.02	-0.23	1.38	-0.01	-0.44	2.69	0.01	-0.57	3.54	0.02	-0.21	1.31	0.00	-0.12	0.75	0.04	-0.78	4.84	0.04	-0.80	4.95
48160	99000041	-0.12	5.63	-0.01	0.00	1.88	0.06	-0.01	5.19	0.15	-0.02	6.78	0.00	0.00	-0.02	0.00	0.00	0.07	0.32	-0.05	10.10	0.34	-0.05	10.38
48160	99000042	5.13	5.63	0.00	0.00	1.58	-0.01	-0.01	4.61	-0.01	-0.02	6.09	0.00	0.00	-0.01	0.00	0.00	0.05	-0.03	-0.05	9.26	-0.03	-0.06	9.52
48160	99000043	10.13	5.63	0.01	0.00	1.86	-0.05	-0.01	5.11	-0.14	-0.02	6.67	0.00	0.00	0.01	0.00	0.00	0.06	-0.30	-0.05	9.93	-0.32	-0.05	10.20
5900001	150010001	5.01	-1.32										1.52	-4.17	-3.82									
5900001	150010021	-0.16	12.22										-1.51	4.10	-3.90									
5900002	150020001	-0.40	-1.24										-1.59	-4.10	-3.94									
5900002	150020022	5.05	12.30										1.61	4.18	-3.85									
5900003	150030001	4.95	12.30										-1.68	4.17	-3.87									
5900003	150030022	10.71	-1.28										1.67	-4.08	-3.96									
5900004	150040001	4.93	-1.29										-1.66	-4.14	-3.85									
5900004	150040022	10.67	12.27										1.67	4.05	-3.94									