

Project: Model: Skills 2024 - 10x8m + 9x7m skærm

Date: 27/03/2024

STRUCTURAL ANALYSIS

PROJECT

24-1776
Skills 2024

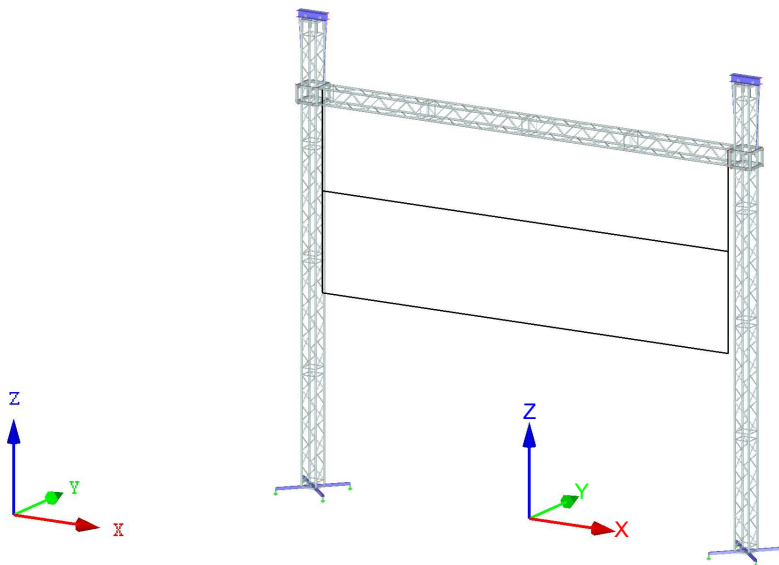
CLIENT

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MHN

Isometric



Project: Skills 2024 - 10x8m + 9x7m skærm Model: Skills 2024 - 10x8m + 9x7m skærm Date: 27/03/2024

CONTENTS

1	Model - General Data	2	Graphic	LC3 - Ballast - 3.1 Nodal Loads - By	5
1.3	Beregningsforudsætninger	2		Components - Coordinate System	
1.13	Model			LC3 - LC3: Ballast, Isometric	6
Graphic	Materials	3		LC4 - Vindlast, y+ - 3.15 Generated Loads	6
2	Cross-Sections	3	4	Results - Load Cases, Load	
2.1	Overordnede dimensioner, Isometric	4		Combinations	
2.5	Load Cases and Combinations		Graphic	Support Reactions, CO2: 0.9*LC1 + 0.9*LC3 +	7
3	Load Cases	4		1.5*LC4 + 0.9*LC2, Isometric	
	Load Combinations	4	4.1	Nodes - Support Forces	7
	Loads			RF-ALUMINUM	
	LC2 - Skærmvægt - 3.2 Member Loads	5		CA1 - Design of aluminum members	
	LC2 - Skærmvægt - 3.2/1 Member Loads - Load	5		according to Eurocode 9	
	Eccentricity		Graphic	RF-ALUMINUM CA1 - Design Ratio, Isometric	8
Graphic	LC2 - LC2: Ballast - 4 tons pr. fod, Isometric	5			

MODEL - GENERAL DATA

General	Model name	: Skills 2024 - 10x8m + 9x7m skærm
	Type of model	: 3D
	Positive direction of global axis Z	: Upward
	Classification of load cases and combinations	: According to Standard: EN 1990 National Annex: DK - Denmark
	Options	☐ RF-FORM-FINDING - Find initial equilibrium shapes of membrane and cable structures ☐ RF-CUTTING-PATTERN ☐ Piping analysis ☐ Use CQC Rule ☐ Enable CAD/BIM model
Standard Gravity		g : 10.00 m/s ²

BEREGNINGSFORUDSÆTNINGER

Konstruktionsbeskrivelse:

Portalen opbygges af standard Eurotruss HD44 elementer i aluminium EN-AW 6082 T6, samt to sleeveblocks og to headblocks. De to tårne står på standard fødder, hvor der placeres 4 tons ballast på hver fod.

Konstruktionens truss-sammensætning er ikke vigtig, så længe de ydre mål ikke overskrides. I beregningsmodellen er tårnene opbygget af 4x2,5 m truss-sektioner og bjælken er opbygget af 4x2,5 m sektioner.

Det ophængte i portalen er ikke en del af nærværende beregninger, kun lasten herfra. Vægten af denne antages at være 1500 kg. Skærmen regnes som værende 10m bred og 4,5m høj.

Vindlast:

Konstruktionen er regnet i terrænkategori I og med en formfaktor på 1,8 på Skærmen og en samlet formfaktor på trussene i tårnene på 2,4, fordelt rundt på hovedrørene. Det beregnede vindtryk er 0,45 kN/m².

Det forventes at den ophængte skærm bliver fastgjort i bunden for at hindre at skærmen vil svinge i vinden, hvorfor halvdelen af vindlasten angriber i bunden af skærmen og der er derfor kun last på de øverste 3,5 m af skærmen.

De maksimale tilladelige vindhastigheder ved toppen af tårnene er:

Middelvindhastighed - 16,6 m/s

Vindstød - 25,3 m/s

Konklusion:

Beregningerne viser at den maksimale udnyttelse af aluminiumskonstruktionen er 94% og forefindes i bunden af tårnene. Konstruktionen er regnet iht. DS/EN 1999-1-1 og styrkereduktion af elementerne fra svejsning i aluminium.

Project: Skills 2024 - 10x8m + 9x7m skærm

Date: 27/03/2024

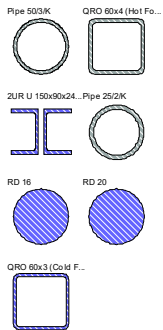
BEREGNINGSFORUDSÆTNINGER

1.3 MATERIALS

Matl. No.	Modulus E [MPa]	Modulus G [MPa]	Poisson's Ratio ν [-]	Spec. Weight γ [kN/m ³]	Coeff. of Th. Exp. α [1/°C]	Partial Factor γ_M [-]	Material Model
1	Aluminum EN-AW 70000.0	6082 T6 EN 1999-1-1:2007 27000.0	0.296	27.00	2.30E-05	1.00	Isotropic Linear Elastic
2	Steel S 235 DIN EN 210000.0	1993-1-1:2010-12 80769.2	0.300	78.50	1.20E-05	1.00	Isotropic Linear Elastic

1.13 CROSS-SECTIONS

Section No.	Matl. No.	J [cm ⁴]	I _y [cm ⁴]	I _z [cm ⁴]	Principal Axes α [°]	Rotation α' [°]	Overall Dimensions [mm]	
		A [cm ²]	A _y [cm ²]	A _z [cm ²]			Width b	Height h
1	Pipe 50/3/K 1	24.56 4.43	12.28 2.21	12.28 2.21	0.00	0.00	50.0	50.0
2	QRO 60x4 (Hot Formed) 1	72.50 8.79	45.40 3.79	45.40 3.79	0.00	0.00	60.0	60.0
3	2UR U 150x90x24-20/10 2	135.41 60.80	2324.00 37.18	1631.13 15.44	0.00	0.00	200.0	150.0
4	Pipe 25/2/K 1	1.93 1.45	0.96 0.72	0.96 0.72	0.00	0.00	25.0	25.0
5	RD 16 2	0.64 2.01	0.32 1.69	0.32 1.69	0.00	0.00	16.0	16.0
6	RD 20 2	1.57 3.14	0.79 2.64	0.79 2.64	0.00	0.00	20.0	20.0
7	QRO 60x3 (Cold Formed) 2	57.10 6.61	35.10 2.89	35.10 2.89	0.00	0.00	60.0	60.0



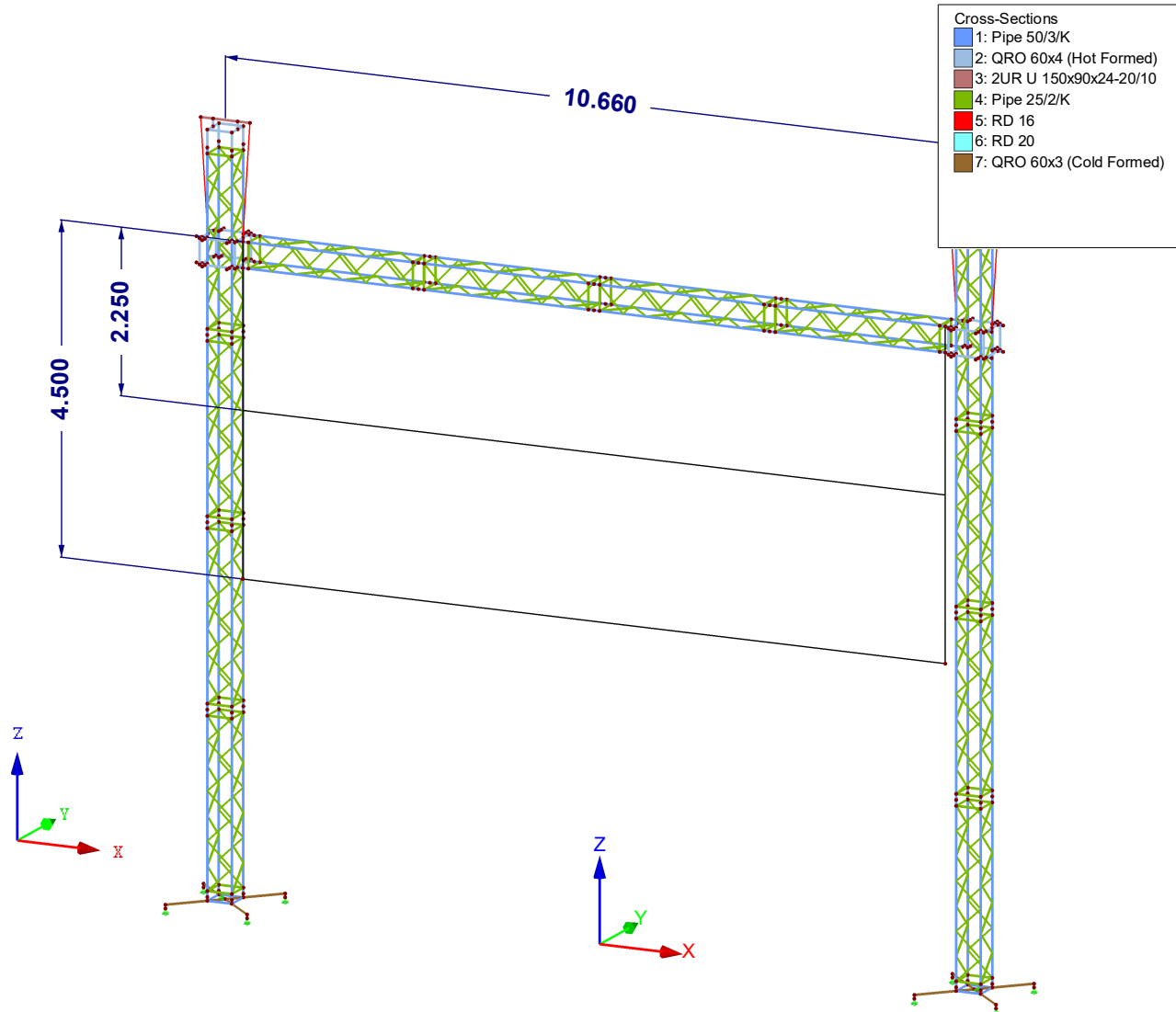
Project: Skills 2024 - 10x8m + 9x7m skærm

Date: 27/03/2024

OVERORDNEDE DIMENSIONER

LC1 : Egenlast

Isometric



2.1 LOAD CASES

Load Case	Load Case Description	EN 1990 DK Action Category	Self-Weight - Factor in Direction			
			Active	X	Y	Z
LC1	Egenlast	Permanent	☒	0.000	0.000	-1.000
LC2	Skærmvægt	Permanent	☐			
LC3	Ballast	Permanent/Imposed	☐			
LC4	Vindlast, y+	Wind	☐			

2.5 LOAD COMBINATIONS

Load Combin.	DS	Load Combination Description	No.	Factor	Load Case	
CO1		LC1 + LC3 + 1.5*LC4 + LC2	1	1.00	LC1	Egenlast
			2	1.00	LC3	Ballast
			3	1.50	LC4	Vindlast, y+
			4	1.00	LC2	Skærmvægt
CO2		0.9*LC1 + 0.9*LC3 + 1.5*LC4 + 0.9*LC2	1	0.90	LC1	Egenlast
			2	0.90	LC3	Ballast
			3	1.50	LC4	Vindlast, y+
			4	0.90	LC2	Skærmvægt

Project: Model: Skills 2024 - 10x8m + 9x7m skærm

Date: 27/03/2024

LC2
Skærmvægt

3.2 MEMBER LOADS

LC2: Skærmvægt

No.	Reference to	On Members No.	Load Type	Load Distribution	Load Direction	Reference Length	Symbol	Load Parameters Value	Unit
1	Members	280,284,288,328,332,336,424,428,432,667,671,675	Force	Uniform	ZL	True Length	p	-1.500	kN/m

3.2/1 MEMBER LOADS - LOAD ECCENTRICITY

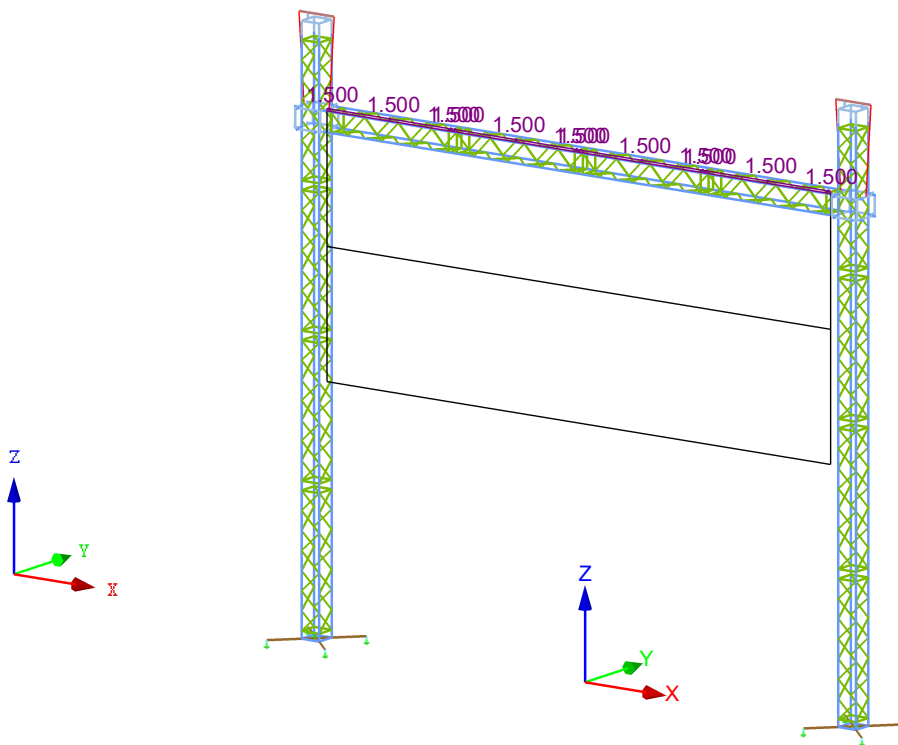
LC2: Skærmvægt

No.	Reference to	On Members No.	Absolute Offset		Absolute Offset		Relative Offset		Relative Offset	
			Mbr. Start	Mbr. Start	Mbr. End	Mbr. End	Mbr. Start	Mbr. Start	Mbr. End	Mbr. End
			e _y [mm]	e _z [mm]	e _y [mm]	e _z [mm]	y-Axis	z-Axis	y-Axis	z-Axis
1	Members	280,284,288,328,332,336,424,428,432,667,671,675	0.0	0.0	0.0	0.0	Middle	Middle	Middle	Middle

LC2: BALLAST - 4 TONS PR. FOD

LC2 : Skærmvægt
Loads [kN/m]

Isometric



LC3
Ballast

3.1 NODAL LOADS - BY COMPONENTS - COORDINATE SYSTEM

LC3: Ballast

No.	On Nodes No.	Coordinate System	Force [kN]			Moment [kNm]		
			P _x / P _u	P _y / P _v	P _z / P _w	M _x / M _u	M _y / M _v	M _z / M _w
1	1,2,4,6,8,10,12,14	0 Global XYZ	0.000	0.000	-10.000	0.000	0.000	0.000

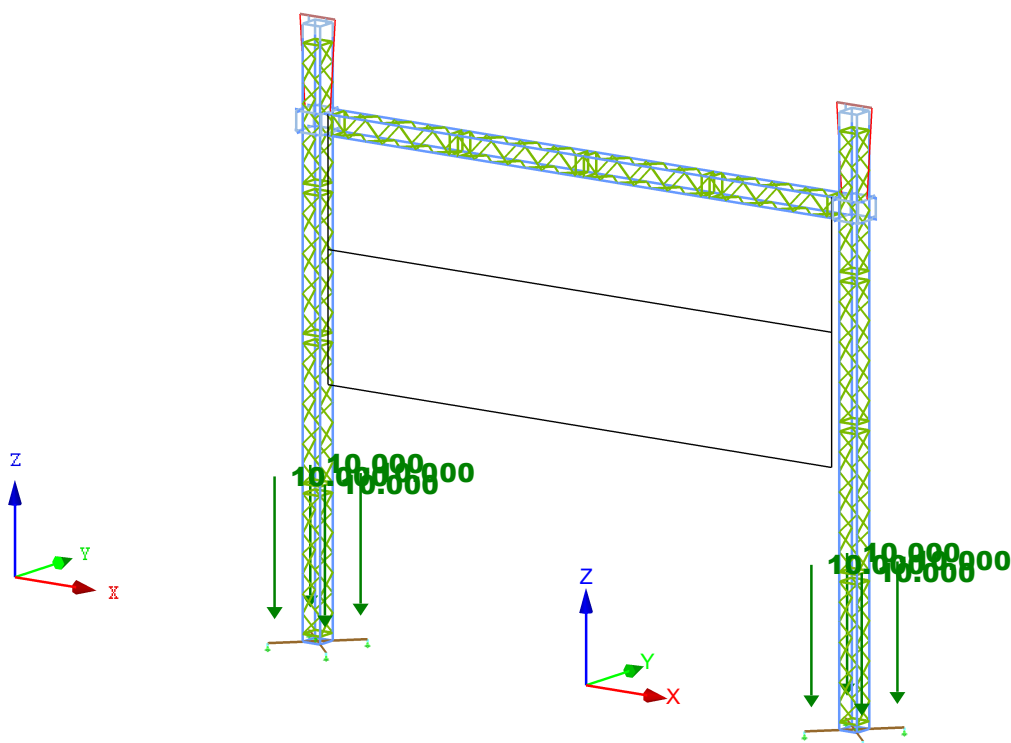
Project: Model: Skills 2024 - 10x8m + 9x7m skærm

Date: 27/03/2024

- **LC3: BALLAST**

LC3 : Ballast
Loads [kN]

Isometric



LC4
Vindlast, y+

■ 3.15 GENERATED LOADS

LC4: Vindlast, y+

No.	Load Description		
1	From Area Loads via Plane		
	Area load direction	Global relative to the projected area:	: ☒ YP
	Area of load application	☒ Empty, on members only	
	Area load magnitude	☒ Constant	: 2.40 kN/m ²
	Boundary of the area load plane	Corner nodes	: 3,5,200,203; 96,447,450,414,71
		Note	: Each row in the drop down list box denotes one plane
	Remove influence from	Members parallel to member	: 250,254,255
	Generated loads	In X-direction	: 0.000 kN
		In Y-direction	: 4.762 kN
		In Z-direction	: 0.000 kN
		Convert loads to members No.	: 136,139,140,143,144, 147,184,187,188,191, 192,195,232,235,236, 239,376,379,380,383, 384,387,527,530,531, 534,535,538,575,578, 579,582,715,718,719, 722,723,726,763,766, 767,770,771,774
2	From Area Loads via Plane		
	Area load direction	Global relative to the projected area:	: ☒ YP
	Area of load application	☒ Empty, on members only	
	Area load magnitude	☒ Constant	: 1.80 kN/m ²
	Boundary of the area load plane	Corner nodes	: 633,44,496,634
		Note	: Each row in the drop down list box denotes one plane
	Remove influence from	Members parallel to member	: 342,353,354
	Generated loads	In X-direction	: 0.000 kN
		In Y-direction	: 1.800 kN
		In Z-direction	: 0.000 kN
		Convert loads to members No.	: 280,283,284,287,288, 291,328,331,332,335,3

Project: Model: Skills 2024 - 10x8m + 9x7m skærm

Date: 27/03/2024

3.15 GENERATED LOADS

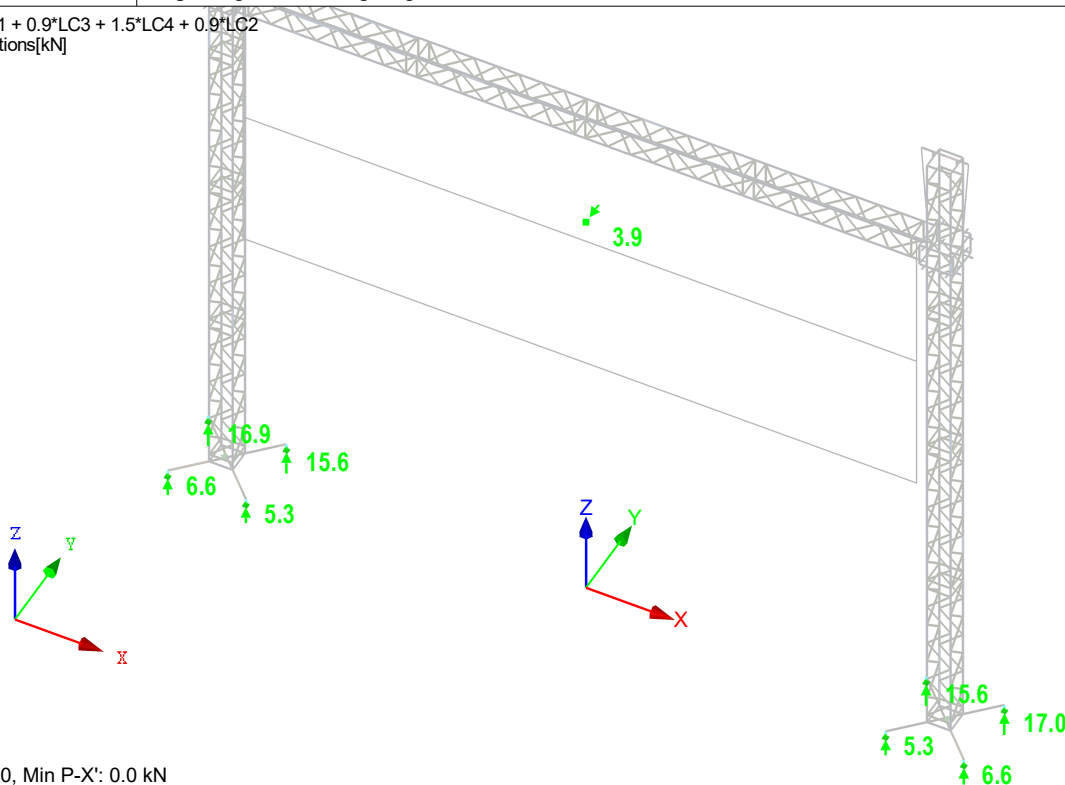
LC4: Vindlast, y+

No.	Load Description
	336,339,424,427,428, 431,432,435,667,670, 671,674,675,678

SUPPORT REACTIONS

CO2 : 0.9*LC1 + 0.9*LC3 + 1.5*LC4 + 0.9*LC2
Support Reactions[kN]

Isometric



Max P-X': 0.0, Min P-X': 0.0 kN
Max P-Y': 0.0, Min P-Y': 0.0 kN
Max P-Z': -5.3, Min P-Z': -17.0 kN

4.1 NODES - SUPPORT FORCES

Node No.	LC/CO	Support Forces [kN]			Support Moments [kNm]		
		P _x	P _y	P _z	M _x	M _y	M _z
383	CO1	0.0	0.0	-8.0	0.0	0.0	0.0
	CO2	0.0	0.0	-6.6	0.0	0.0	0.0
385	CO1	0.0	0.0	-18.3	0.0	0.0	0.0
	CO2	0.0	0.0	-16.9	0.0	0.0	0.0
478	CO1	0.0	0.0	-7.9	0.0	0.0	0.0
	CO2	0.0	0.0	-6.6	0.0	0.0	0.0
483	CO1	-1.1	2.0	0.0	0.0	0.0	0.0
	CO2	-1.0	2.0	0.0	0.0	0.0	0.0
486	CO1	0.0	0.0	-18.3	0.0	0.0	0.0
	CO2	0.0	0.0	-17.0	0.0	0.0	0.0
489	CO1	0.0	0.0	-6.4	0.0	0.0	0.0
	CO2	0.0	0.0	-5.3	0.0	0.0	0.0
491	CO1	0.0	0.0	-16.8	0.0	0.0	0.0
	CO2	0.0	0.0	-15.6	0.0	0.0	0.0
495	CO1	1.1	2.0	0.0	0.0	0.0	-0.1
	CO2	1.0	2.0	0.0	0.0	0.0	-0.1
499	CO1	0.0	0.0	-6.4	0.0	0.0	0.0
	CO2	0.0	0.0	-5.3	0.0	0.0	0.0
501	CO1	0.0	0.0	-16.8	0.0	0.0	0.0
	CO2	0.0	0.0	-15.6	0.0	0.0	0.0
Σ Supp.	CO1	0.0	3.9	-98.8			
Σ Supp.	CO1	0.0	3.9	-98.8			
Σ Supp.	CO2	0.0	3.9	-88.9			
Σ Supp.	CO2	0.0	3.9	-88.9			

Project: Model: Skills 2024 - 10x8m + 9x7m skærm

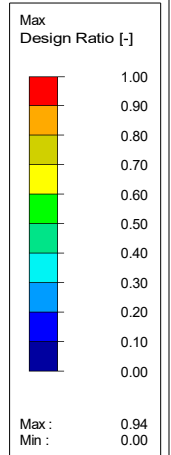
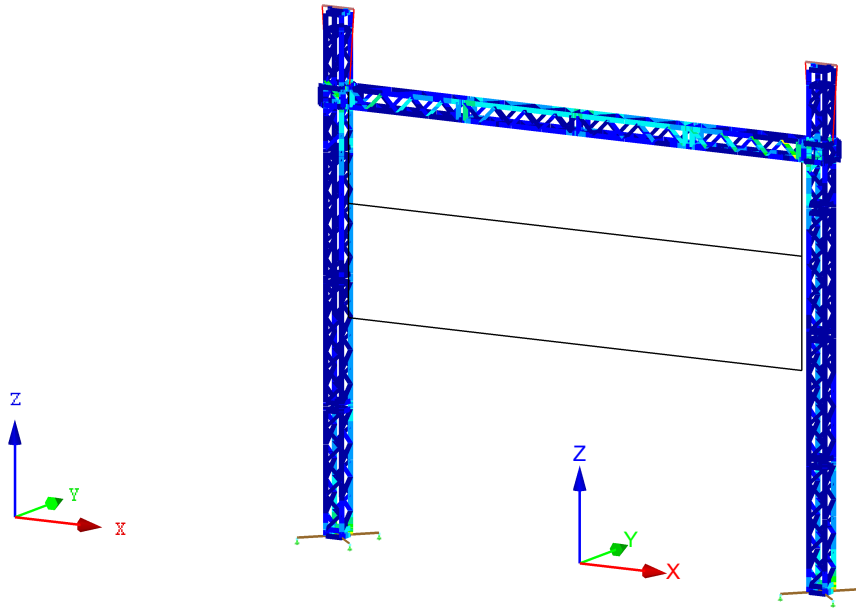
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DESIGN RATIO

RF-ALUMINUM CA1

Ultimate Limit State: Cross-Section Design, Stability Design

Isometric



Max Design Ratio: 0.94