BUSSEL ENGINEERING

5.1, 2, e
5.1, 2, e
8802 NL Franeker (NL)
Tel: 5.1, 2, e
mob. 5.1, 2, e
5.1, 2, e @busselengineering.nl

Project: LOFI Amsterdam
Statische Calculaties relevante objecten

Document: LL-2025-02

Datum: 09-03-2026 *vervangt rapport 04-11-2025*

Opdrachtgever: LOFI
Basisweg 63
1043 AN Amsterdam

Opmerking: As built fotos toegevoegd ivm de controleerbaarheid van de calculaties

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Op alle advieswerkzaamheden, engineeringsopdrachten en/of tekenopdrachten en eventuele vervolgopdrachten zijn van toepassing de voorwaarden als genoemd in BUSENG/ 2020-00, alsmede de voorwaarden als opgesteld in de “Regeling van de verhouding tussen opdrachtgever en adviserend ingenieursbureau” (RVOI-2001, gedeponeerd 29/06/2001 bij de Arrondissementsrechtbank te Den Haag). Deze kan op verzoek door Bussel Engineering ter beschikking worden gesteld of worden gedownload:
http://www.busselengineering.nl/AV/AlgemeneVoorwaarden-BusselEngineering-2020.pdf

Kamer van Koophandel: 01056964 (sinds 1988) BTWnr: NL001466154B82

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Software:

Matrix Frame 6.2
ANSYS Mechanical 2025/R1

1 Inleiding

Betreft berekeningen van containeropstellingen op een festival terrein

2 Ontwerpuitgangspunten

2.1 Belastingcombinaties

NEN-EN 1990-1-1 beschrijft hoe de belastingen gecombineerd dienen te worden,
voor de uiterste en de bruikbaarheidsgrenstoestand.

2.1.2 Uiterste grenstoestanden (UGT)

Volgens NEN-EN 1990-1-1, art. 6.4.1 kunnen de volgende uiterste grenstoestanden getoetst te worden

EQU : verlies aan statisch evenwicht in de constructie
STR : intern bezwijken of excessieve vervormingen van de constructie of een constructieonderdeel
GEO : bezwijken ten gevolge van excessieve deformatie van de ondergrond

2.1.3 Fundamentele combinaties (blijvende en tijdelijke ontwerpsituaties)

EQU	:	$\Sigma_{j\geq 1}\gamma_{G,j}G_{k,j} + \gamma_{Q,1}Q_{k,1} + \Sigma_{i>1}\gamma_{Q,i}\Psi_{0,i}Q_{k,i}$	vgl.(6.10)
STR/GEO (Groep B)	:	$\Sigma_{j\geq 1}\gamma_{G,j}G_{k,j} + \gamma_{Q,1}\Psi_{0,1}Q_{k,1} + \Sigma_{i>1}\gamma_{Q,i}\Psi_{0,i}Q_{k,i}$	vgl.(6.10a)
STR/GEO (Groep B)	:	$\Sigma_{j\geq 1}\xi\gamma_{G,j}G_{k,j} + \gamma_{Q,1}\Psi_{0,1}Q_{k,1} + \Sigma_{i>1}\gamma_{Q,i}\Psi_{0,i}Q_{k,i}$	vgl.(6.10b)
STR/GEO (Groep C)	:	$\Sigma_{j\geq 1}\gamma_{G,j}G_{k,j} + \gamma_{Q,1}Q_{k,1} + \Sigma_{i>1}\gamma_{Q,i}\Psi_{0,i}Q_{k,i}$	vgl.(6.10)

2.1.4 Bruikbaarheidsgrenstoestanden (BGT)

Karakteristieke combinaties (onomkeerbare grenstoestanden):

$\Sigma j \geq 1\ G_{k,j} + Q_{k,1} + \Sigma i>1 \Psi_{0,i} Q_{k,i}$ NEN-EN 1990-1-1, vgl.(6.14b)

Frequente combinaties (omkeerbare grenstoestanden):

$\Sigma j \geq 1\ G_{k,j} + Q_{k,1} + \Sigma i>1 \Psi_{1,1} Q_{k,1} + \Sigma i>1\ \Psi_{2,i} Q_{k,i}$ NEN-EN 1990-1-1, vgl.(6.15b)

Quasi-blijvende combinaties (lange termijn effecten en uiterlijk van de constructie):

$\Sigma j \geq 1\ G_{k,j} + \Sigma i>1\ \Psi_{2,i} Q_{k,i}$ NEN-EN 1990-1-1, vgl.(6.16)

2.2 Veiligheidsklasse en referentieperiode

Gebruiksklasse:	publiek toegankelijk - ref. periode 50 jaar
Gevolgklasse:	RC2

6.10.a

UGT:	Permanente belasting	γ;f;g;ongunstig	1,35 x G
UGT:	Permanente belasting	γ;f;g;gunstig	0,9 x G

6.10.b

UGT:	Permanente belasting	γ;f;g;ongunstig	1,2 x G
UGT:	Permanente belasting	γ;f;g;gunstig	0,9 x G
UGT:	Veranderlijke belasting overheersend	γ;f;q	1,5 x Q

Voor de vervorming van de hoofdbalkstructuur wordt aangenomen w_{eind} = L/250

3 Belastingen

2.1 Gewicht constructiedelen

Scheepscontainer 10"	1300 kg
Scheepscontainer 20"	2180 kg
Scheepscontainer 40"	3700 kg
Profielen	Computerberekend

2.2 Sneeuwbelasting

Niet relevant

2.3 Permanente belasting

Terrassen (hout)	0,2 kN/m^2

2.3 Variabele belasting

Vloerbelasting

Volgens NEN-EN 1991-1-1/NB C3	qk = 5 kN/m^2 Qk = 7kN
Leuningbelasting	qk = 3 kN/m

2.4 Windbelasting

P_w waarden volgens NEN-EN 1991-1-4_NB, tabel NB.5
CsCd = 1
h = 5 m: qp(z) = 0,58 kN/m^2 GebII - bebouwd
h = 8 m: qp(z) = 0,62 kN/m^2 GebII - bebouwd

4 Constructieve gegevens

Uitgangspunt is gebruik van zeecontainers, waarin openingen zijn aangebracht.

De containers worden aan de hoekpunten verbonden met officiële twistlocks (bij vertikaal stapelen). Bij horizontale verbindingen worden de cornerblokken aan elkaar gelast.

Een aantal containers zijn voorzien van een openbaar terras.
Hiertoe is een aanvullende staalconstructie op de containers vastgelast.

4.1 Materialen

Hoofdconstructie

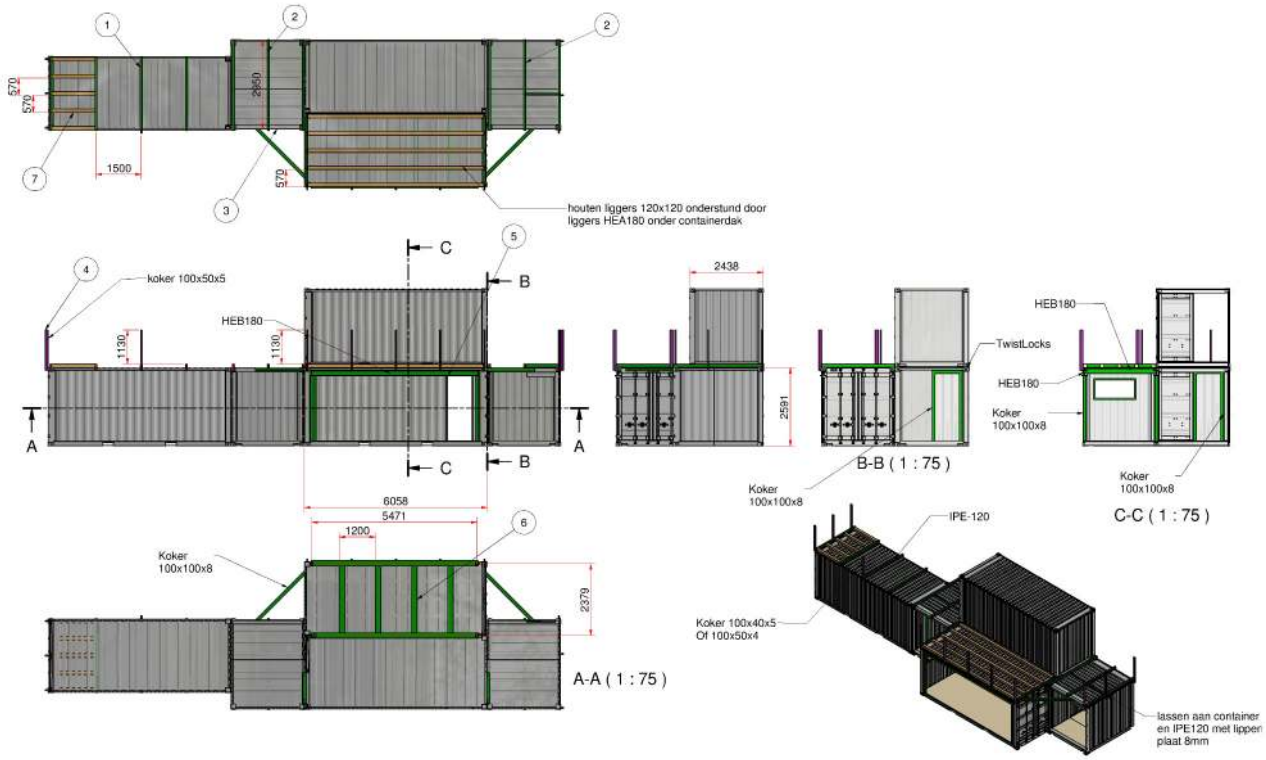
Balken 120x120mm	C18 tuinhout
Balken 190x70	C24
Constructiestaal	S 235
Containers	S 355
Moeren	8.8 therm. verz
Bouten	8.8 therm. verz

5 Calculaties

Overzichtsfoto



5.1 DJ Booth

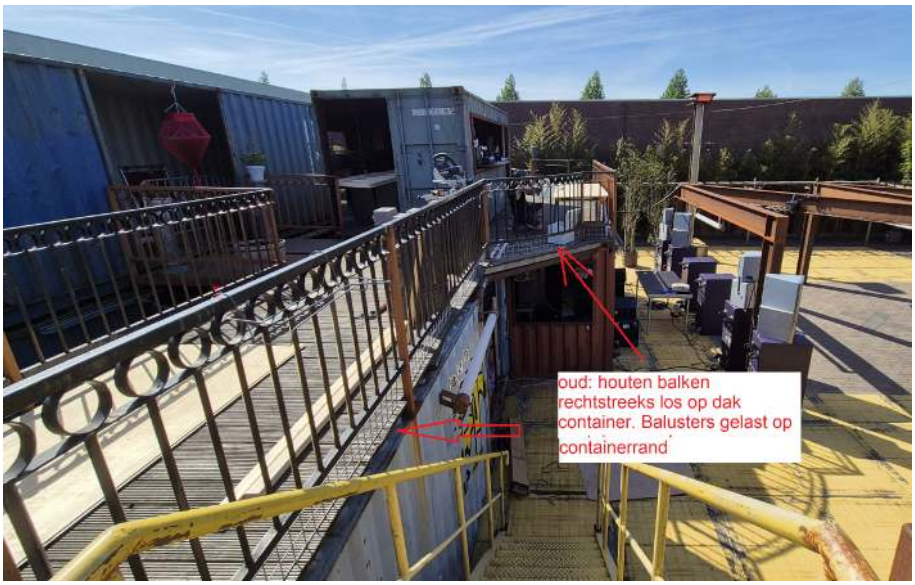


Ma
atg

evend:

pos 1	Liggers IPE-120 Lsys = 2,35m	5.1.1
pos 2	Liggers IPE 120 Lsys = 2,90 m	5.1.2
pos 3	Kozijnbalk container (koker 140x140x5 - S235)	5.1.3
pos 4	Baluster. Railinghoogte boven dek 1100mm	5.1.4
pos 5	Portaal HEA 180	5.1.5
pos 6	Tussenliggers HEA 180	5.1.6
pos 7	Houten tussenliggers tuinhout 120x120 C18	5.1.7
	Achterliggende containerwand met bruggetjes	5.1.8
	Windbelasting	5.1.9

5.1.1 Liggers IPE-120 Lsys = 2,35m





hoh = 1,5m
Invoer matrix
qg: 0,2 * 1,5 = 0,3 kN/m
qk =5 * 1,5 - 7,5 kN/m

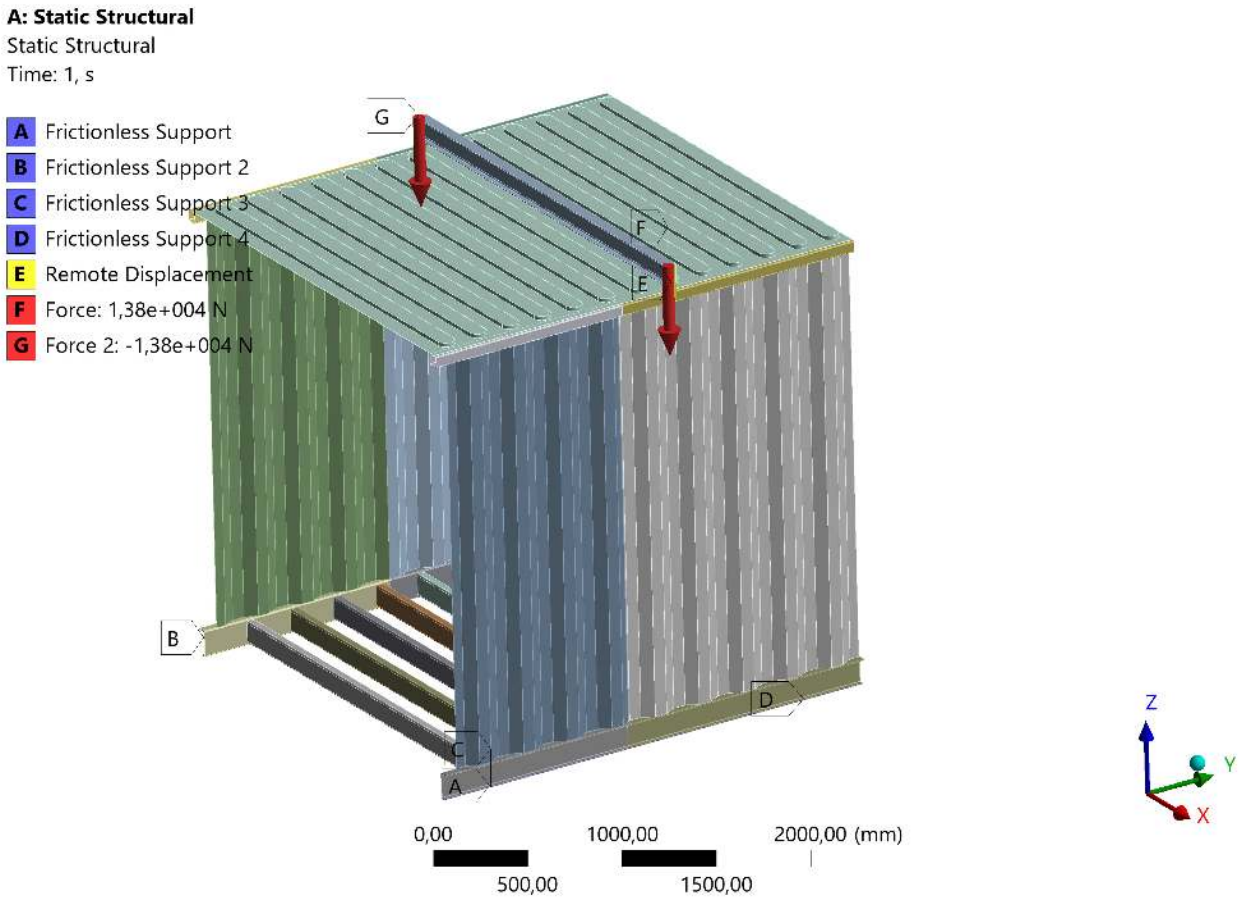
Zie Matrixberekening bijlage 7: UC = 0,83 Voldoet

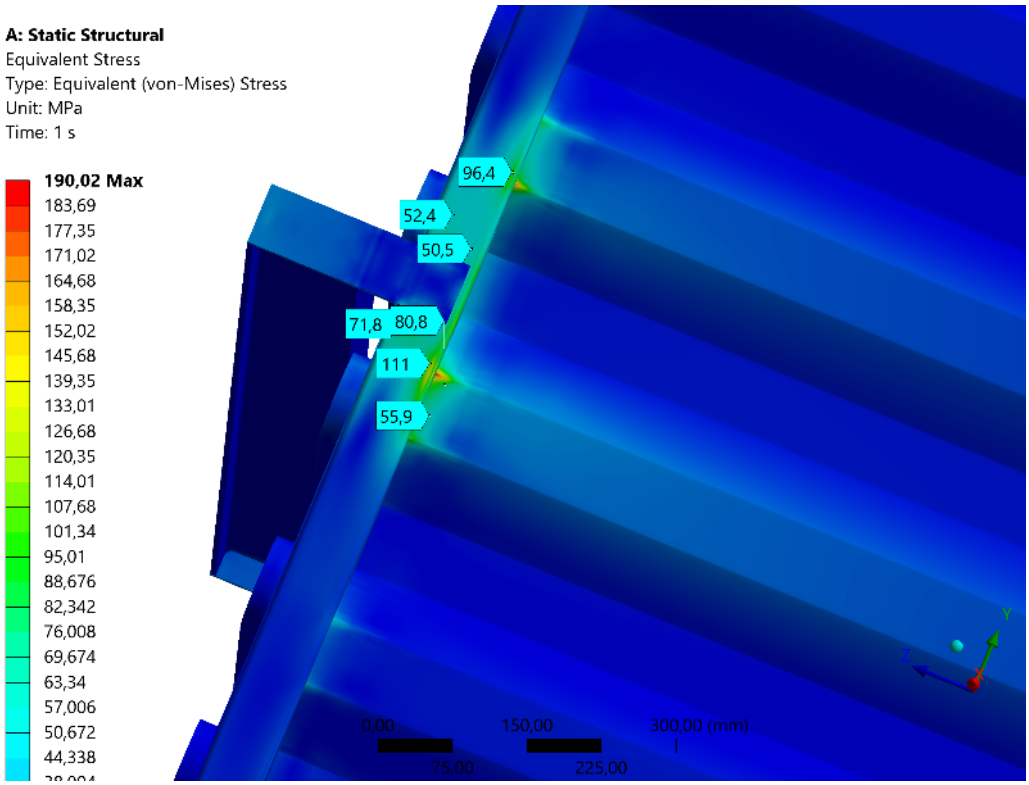
De liggers worden deels bevestigd aan de zijrand (gelast)
Oplegreactie op de rand: Fed = 13,79 kN

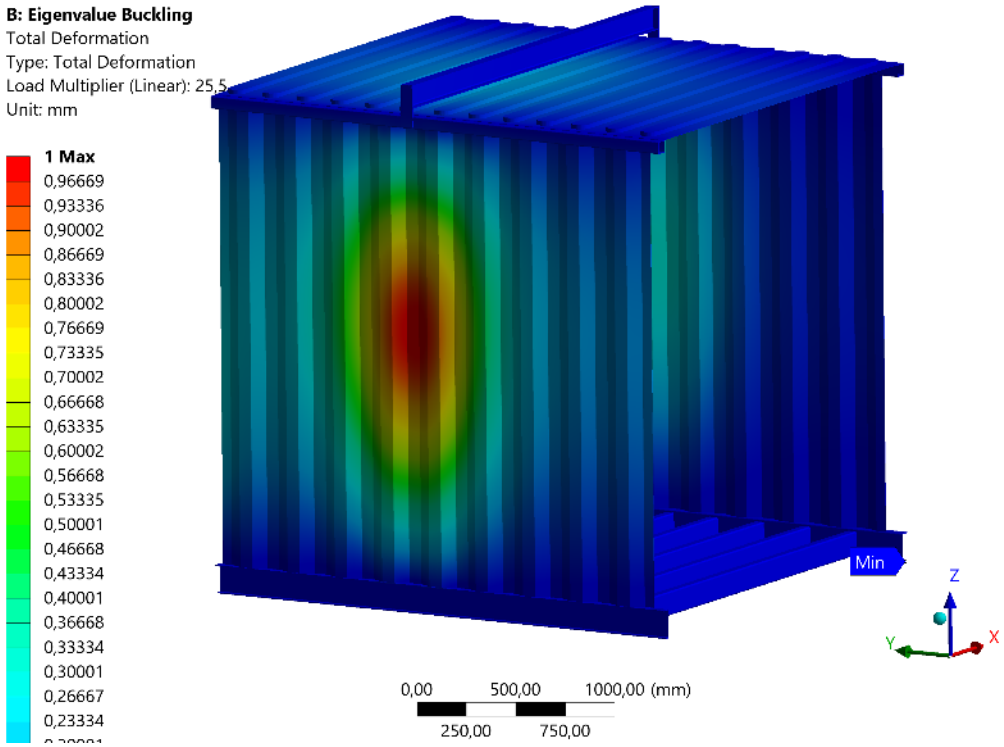
Hiervan is een FEM analyse uitgevoerd.
Zowel de optredende spanning (von Mises) als de plaatplooi

Conclusie:

Spanning: UC = 111/355 = 0,31 Voldoet
Plooivermenigvuldigingsfactor (moet zijn >= 1): 25,5 Geen kans op plaatplooi.




A: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1 s
190,02 Max
183,69
177,35
171,02
164,68
158,35
152,02
145,68
139,35
133,01
126,68
120,35
114,01
107,68
101,34
95,01
88,676
82,342
76,008
69,674
63,34
57,006
50,672
44,338
96,4
52,4
50,5
71,8
80,8
111
55,9
0,00
150,00
300,00 (mm)
75,00
225,00
Y
Z


B: Eigenvalue Buckling
Total Deformation
Type: Total Deformation
Load Multiplier (Linear): 25,5
Unit: mm
1 Max
0,96669
0,93336
0,90002
0,86669
0,83336
0,80002
0,76669
0,73335
0,70002
0,66668
0,63335
0,60002
0,56668
0,53335
0,50001
0,46668
0,43334
0,40001
0,36668
0,33334
0,30001
0,26667
0,23334
Min
Z
Y
X
0,00
500,00
1000,00 (mm)
250,00
750,00

5.1.2 Liggers IPE-120 Lsys = 2,90m

hoh = 1,16m
Invoer matrix
qg: 0,2 * 1,5 = 0,23 kN/m
qk =5 * 1,16 = 5,8 kN/m

Zie Matrixberekening bijlage 2: UC = 0,74 Voldoet

5.1.3 Kozijnbalk container (koker 140x140x5 - S235)



In het midden rust het liggereinde uit 5.1.2 op de balk.

Fed = 13,2 kN

Doorsnede balk: Wb = 112937 mm^3
Buigend moment (balklengte 2,1 m): Mbed = 13,2/2 * 2,1/2 = 6,93 kN

σed = Med/W = 6930000 / 112937 = 61,4 N/mm^2

U.C. = 61,4 / 355 = 0,17 Voldoet

5.1.4 Baluster. Railinghoogte boven dek 1100mm

Balusters vastgelast aan IPE 120 profielen

Hoh <= 1500mm
Grootste hoogte boven voetbevestiging: h = 1340mm
Moment op baluster:

Med = qk * stramien * h * Yq = 3 * 1,5 * 1,34 * 1,5 = 9 kNm

Kokerprofiel 100x50x5 - S235: σed = M/W = 9000000 / 40841 = 220 N/mm^2

U.C. = 220/235 = 0,94 Voldoet

5.1.5 Portaal HEA 180



Overspanning: 5,47 m
Stramien 2,38m

qg (incl dwarsliggers) 0,45 * 2,38/2 = 0,54 kN/m
qk 5 * 2,38/2 = 5,95 kN/m

Zie Matrixberekening bijlage 3: UC = 0,49 Voldoet

5.1.6 Liggers HEA-180 Lsys = 2,35

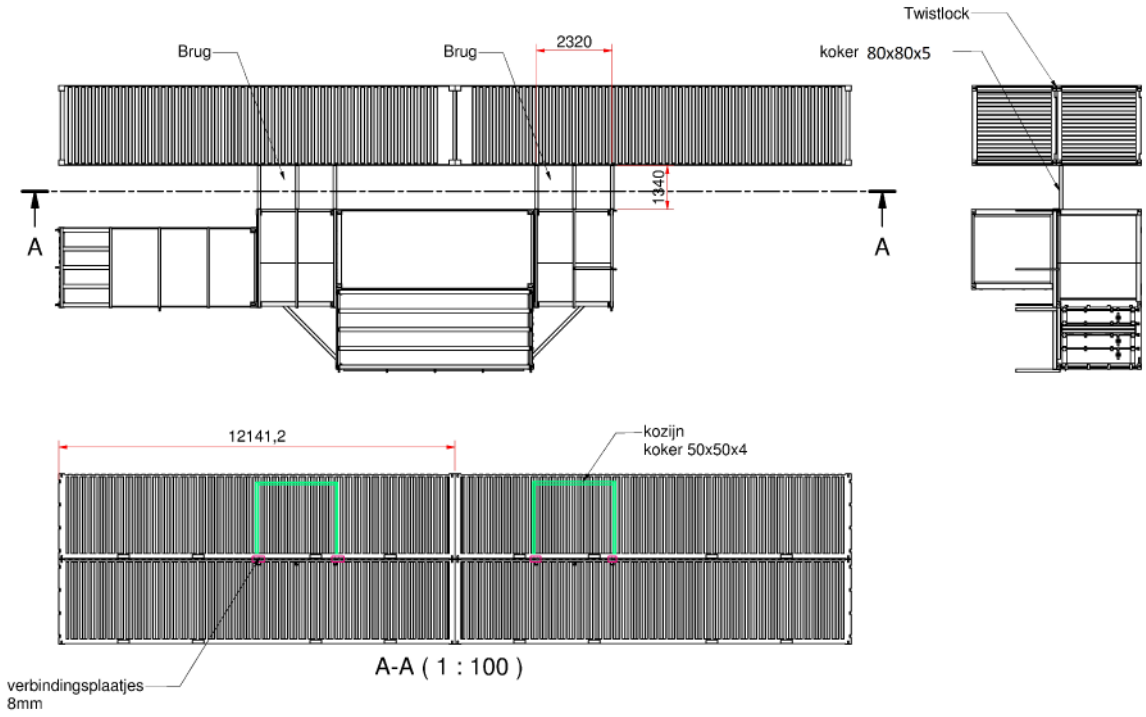
De belasting is lager dan die van ligger IPE-120 (par. 5.1.1)
De ligger is veel zwaarder: Voldoet

5.1.7 Houten tussenliggers tuinhout 120x120 C18

Lsys = 1,5 m
hoh = 0,6m
Qk = 5 kN/m^2

Zie Matrixberekening bijlage 4: UC = 0,89 Voldoet

5.1.8 DJ Booth achterliggende containerwand met bruggetjes





Kozijn



Container 40ft gestapeld

Zie bijlage 1, gegevens containers

Laadvermogen: 27100 kg bij 12 x 2,35 = 28,2 m^2
gmax = 960 kg/m^2

U.C. = 5 / 9,6 = 052

De drukkracht op de cornerblokken: max toegestaan 848 kN

U.C. = 12 x 2,35 x 5 / 848 = 0,17 Voldoet

Bruggen

3 liggers, koker 80 x 80 x 5 gelast tussen containers, waarop tranenplaat 6mm gelast

Med = 1/8 x ql x L^2 * Yq
ql = 5 * 3,2/2 = 8 kN/m L = 1,34m Yq = 1,5

Med = 2,7 kNm Wb = 32860 mm^3 σed = Med/W = 82 N/mm^2

U.C. = 82/ 235 = 0,35 Voldoet

5.1.9 Windbelasting

Criterium: wind recht op achterwand.

De 6 kokers 80x80x5 verbinden deze containerwand met de voorliggende constructie.

Winddruk:

Fed = qp(z) * A * cp * Yq = 0,66 * 12 * 5,2 * 1,3 * 1,5 = 80 kN

Criterium: verschuiven

Totaalgewicht: 28880 kg (288 kN)

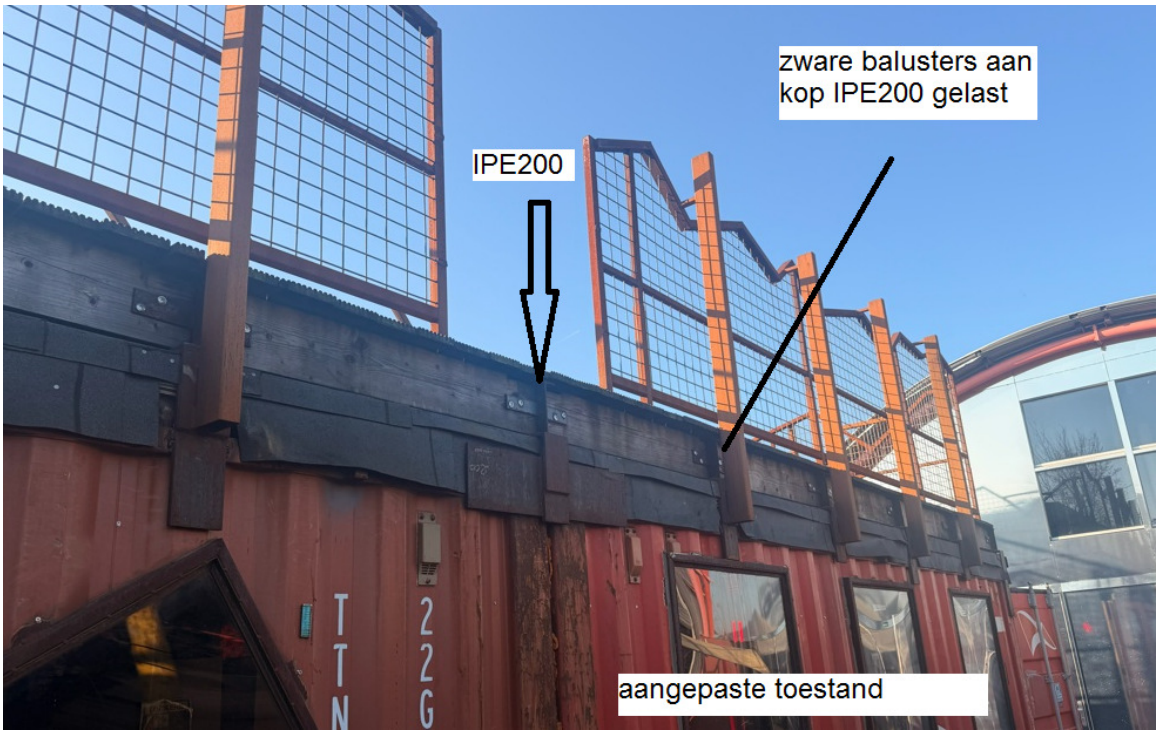
Weerstand: u = 0,5 (wrijvingscoëfficiënt)

Frd = G * u * Yg = 288 * 0,5 * 0,9 = 129,6 kN

U.C. = 80 / 129,6 = 0,62 Voldoet

5.2 Container met Lockers





5.2.1 Baluster. Railinghoogte boven dek 1100mm

Balusters vastgelast aan IPE 200 profielen

Hoh <= 2m

Grootste hoogte boven voetbevestiging: h = 1130mm

Moment op baluster:

Med = qk * stramien * h * Yq = 3 * 2 * 1,13 * 1,5 = 10,2 kNm

Kokerprofiel 100x80x5 - S235 *: σed = M/W = 10200000 / 45187 = 226 N/mm^2

* (koker 100 x 100 x 5 - S235 als alternatief)

U.C. = 226/235 = 0,96 Voldoet

5.2.2 Houten dek

Balken 190 x 70 - hoh 800mm

Zie Matrixberekening bijlage 5: UC = 0,76 Voldoet

5.2.3 Liggers IPE-200

hoh = 2m
Invoer matrix
qg: 0,2 * 2 = 0,4 kN/m
qk =5 * 2 = 10 kN/m

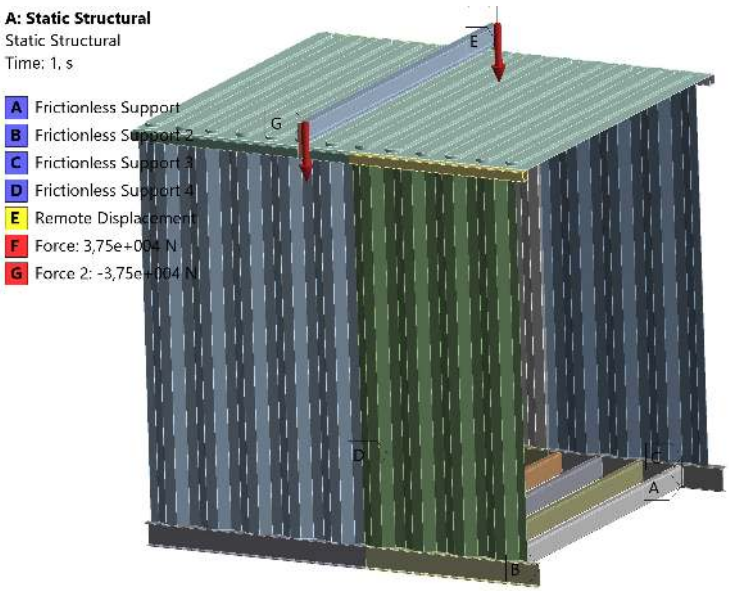
Zie Matrixberekening bijlage 6: UC = 0,86 Voldoet

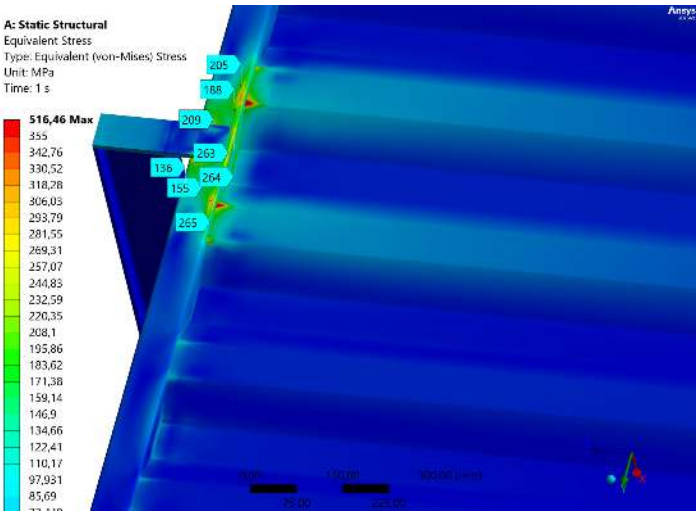
De liggers worden deels bevestigd aan de zijrand (gelast)
Oplegreactie op derand: Red = 37,48 kN

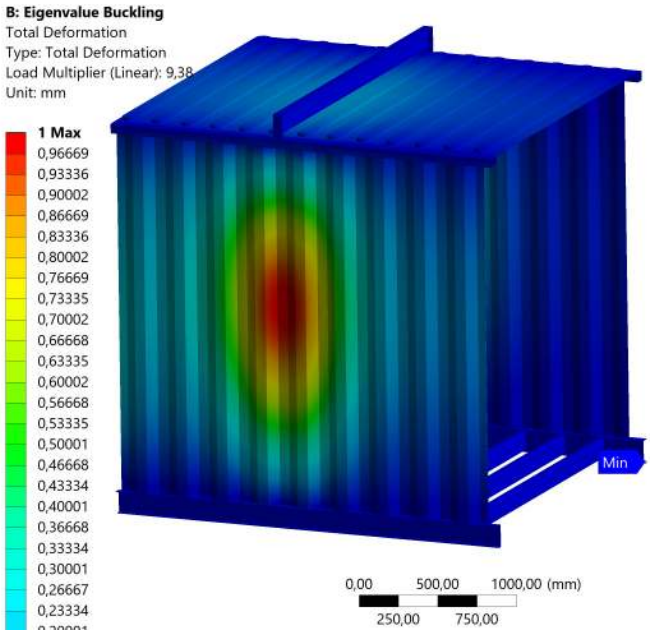
Hiervan is een FEM analyse uitgevoerd.
Zowel de optredende spanning (von Mises) als de plaatplooi

Conclusie:

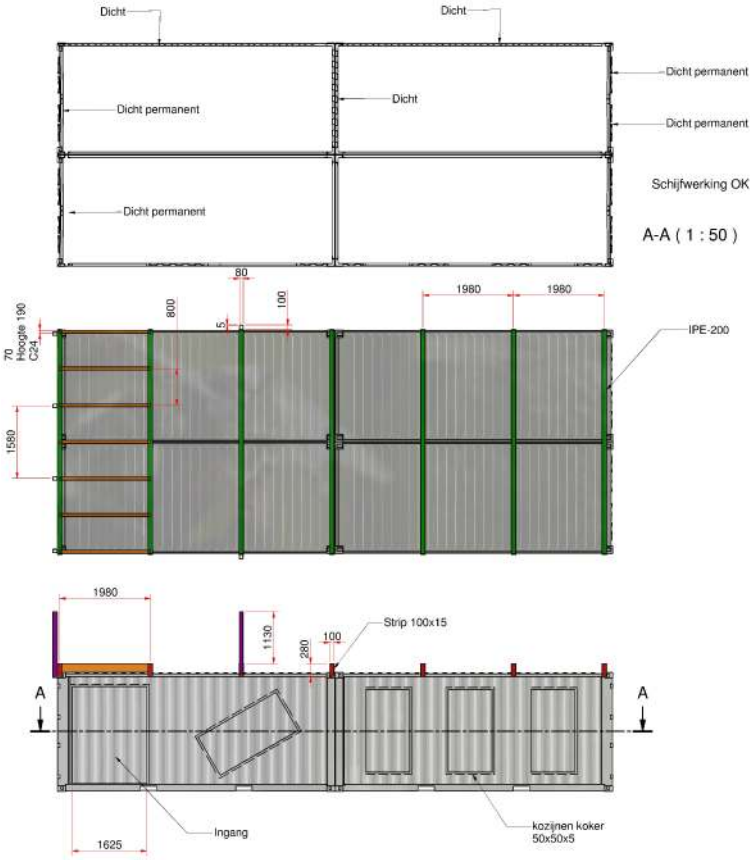
Spanning: UC = 263/355 = 0,74 Voldoet
Plooivermenigvuldigingsfactor (moet zijn >= 1): 9,4 Geen kans op plaatplooi.

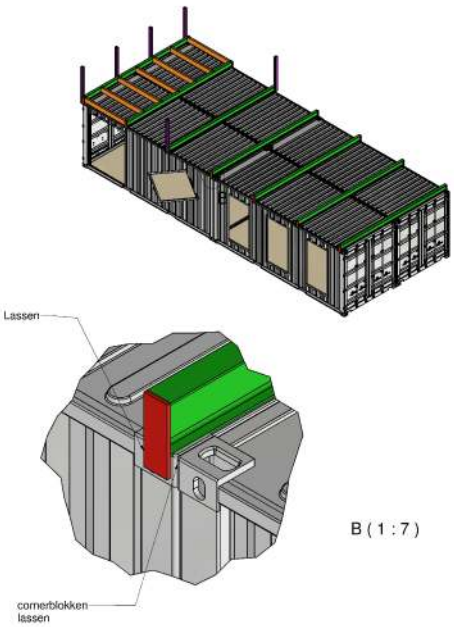

A: Static Structural
Static Structural
Time: 1, s
A Frictionless Support
B Frictionless Support 2
C Frictionless Support 3
D Frictionless Support 4
E Remote Displacement
F Force: 3,75e+004 N
G Force 2: -3,75e+004 N
E
G
D
C
A
B


A: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1 s
516,46 Max
355
342,76
330,52
318,28
306,03
293,79
281,55
269,31
257,07
244,83
232,59
220,35
208,1
195,86
183,62
171,38
159,14
146,9
134,66
122,41
110,17
97,931
85,69
205
188
209
263
136
264
155
265


B: Eigenvalue Buckling
Total Deformation
Type: Total Deformation
Load Multiplier (Linear): 9,38
Unit: mm
1 Max
0,96669
0,93336
0,90002
0,86669
0,83336
0,80002
0,76669
0,73335
0,70002
0,66668
0,63335
0,60002
0,56668
0,53335
0,50001
0,46668
0,43334
0,40001
0,36668
0,33334
0,30001
0,26667
0,23334
Min
0,00
500,00
1000,00 (mm)
250,00
750,00

5.2.4 Stabiliteit





De schijfwerking voldoet.

5.3 Trappen



De DJBooth en Lockerroom hebben dezelfde toegangstrappen

Opgebouwd uit DEJO roostertreden breed 800mm,
trapbomen UNP 200

hoh = 0,8
Invoer matrix
qg: 0,12 * 0,4 = 0,05 kN/m
qk =5 * 0,4 = 2 kN/m

Zie Matrixberekening bijlage 8: UC = 0,7 Voldoet

Belastingtabel bij maaswijdte 33

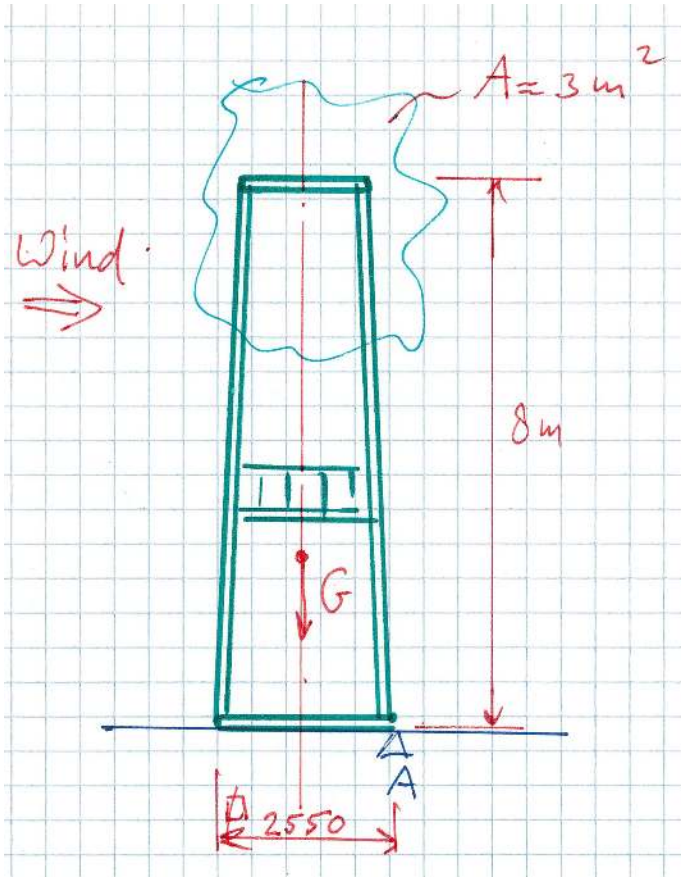
Rooster met een maaswijdte van 33 mm													
Draag staaf-	Be- las- ting	Vrije overspanning in m											
		500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
20 x 2	Fv	18,23	12,66	9,30	7,12	5,63	4,56	3,77	3,16	2,70	2,33	2,03	1,78
	f	1,94	2,80	3,81	4,97	6,29	7,77	9,40	11,19	13,13	15,23	17,49	19,89
	Fp	1,77	1,41	1,18	1,01	0,88	0,78	0,71	0,64	0,59	0,54	0,50	0,47
	f1	1,80	2,55	3,42	4,41	5,53	6,78	8,14	9,64	11,25	12,99	14,86	16,85
	f2	1,53	2,71	4,36	6,56	9,40	12,96	17,30	22,52	28,68	35,88	44,19	53,68
25 x 2	Fv	28,48	19,78	14,53	11,13	8,79	7,12	5,89	4,95	4,21	3,63	3,16	2,78
	f	1,55	2,24	3,05	3,98	5,04	6,22	7,52	8,95	10,51	12,19	13,99	15,92
	Fp	2,73	2,19	1,82	1,56	1,37	1,22	1,09	0,99	0,91	0,84	0,78	0,73
	f1	1,44	2,04	2,74	3,53	4,43	5,42	6,52	7,71	9,00	10,39	11,89	13,48
	f2	0,79	1,40	2,25	3,39	4,86	6,69	8,93	11,63	14,81	18,53	22,82	27,72
30 x 1,7	Fv	34,87	24,21	17,79	13,62	10,76	8,72	7,20	6,05	5,16	4,45	3,87	3,40
	f	1,30	1,90	2,50	3,30	4,20	5,20	6,30	7,50	8,80	10,20	11,70	13,30
	Fp	3,32	2,66	2,21	1,90	1,66	1,48	1,33	1,21	1,11	1,02	0,95	0,89
	f1	1,20	1,70	2,30	2,90	3,70	4,50	5,40	6,40	7,50	8,70	9,90	11,20
	f2	0,50	1,00	1,50	2,30	3,30	4,60	6,10	8,00	10,20	12,70	15,70	19,00
30 x 2	Fv	41,02	28,48	20,93	16,02	12,66	10,25	8,47	7,12	6,07	5,23	4,56	4,01
	f	1,30	1,87	2,54	3,32	4,20	5,18	6,27	7,46	8,76	10,15	11,66	13,26
	Fp	3,90	3,12	2,60	2,23	1,95	1,74	1,56	1,42	1,30	1,20	1,12	1,04
	f1	1,20	1,70	2,28	2,94	3,69	4,52	5,43	6,42	7,50	8,66	9,91	11,23
	f2	0,46	0,82	1,31	1,98	2,83	3,91	5,21	6,79	8,65	10,82	13,32	16,18

Legenda:
1 kN = 1000 N = ca 100 kg
Fv = Verdeelde last
Fp = puntlast

Draagvermogen treden: 16 kN/m^2 Voldoet

5.4 Toren





De toren wordt gevormd door een bestaande masttop van een zware scheepskraan van de ADM werf op een skid te lassen.
Het skid is opgebouwd uit HEB160 profielen.
De hoofdbalken van de mast; Koker 130x130x10 (opgebouwd uit 2 hoeklijnen)

In de top zijn op artistieke wijze plaatelementen aangebracht.

Berekend gewicht: G = 2680 kg

Moment A tgv wind (gebied2 - bebouwd)

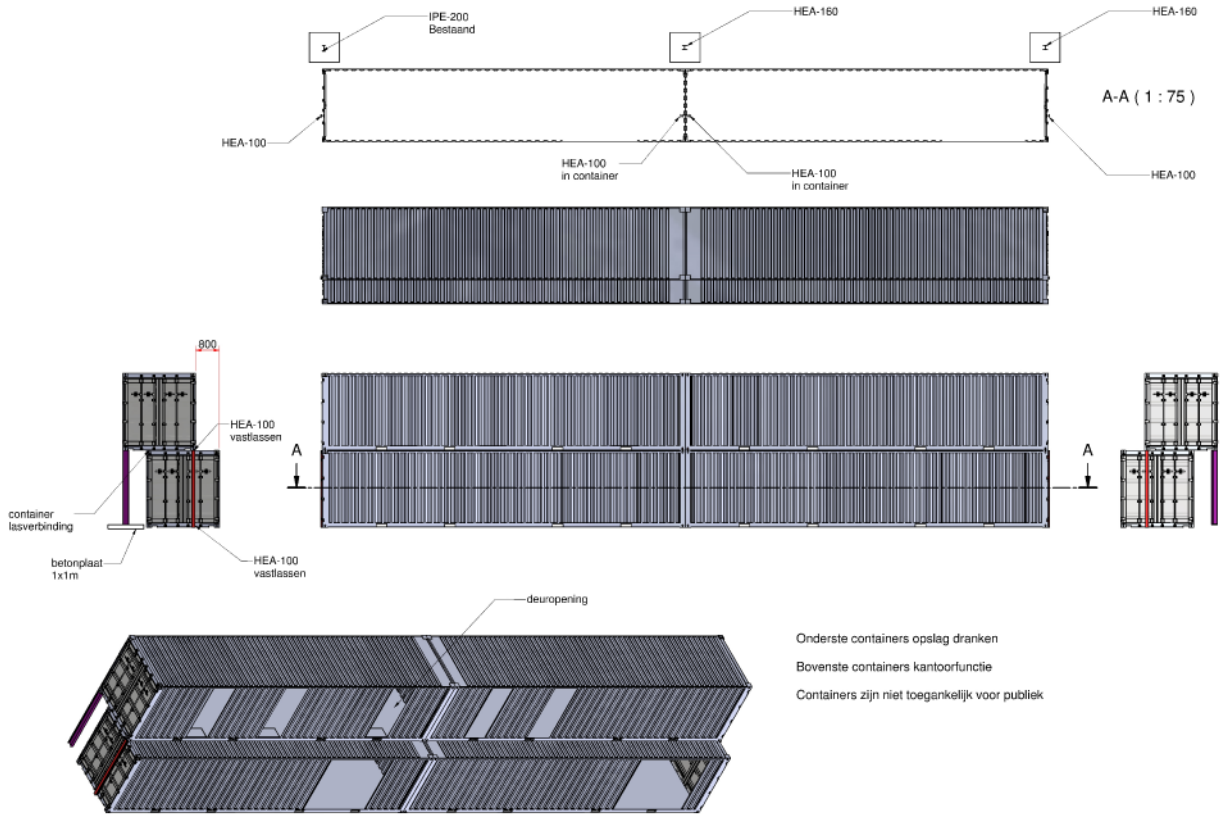
Med = qp(8m) * A * cf * h * Yq = 0,62 * 3 * 1,3 * 8 * 1,5 = 29 kNm

Weerstandsmoment

Mrd = G * a * Yg = 26,8 * 2,55/2 * 0,9 = 30,8 kNm

U.C. = 29 / 30,8 = 0,94 Voldoet

5.5 Kantoor / Opslag



Deze opstelling is niet toegankelijk voor publiek.
De bovenste containers hebben een kantoorfunctie (qk = 2,5 kN/m^2)

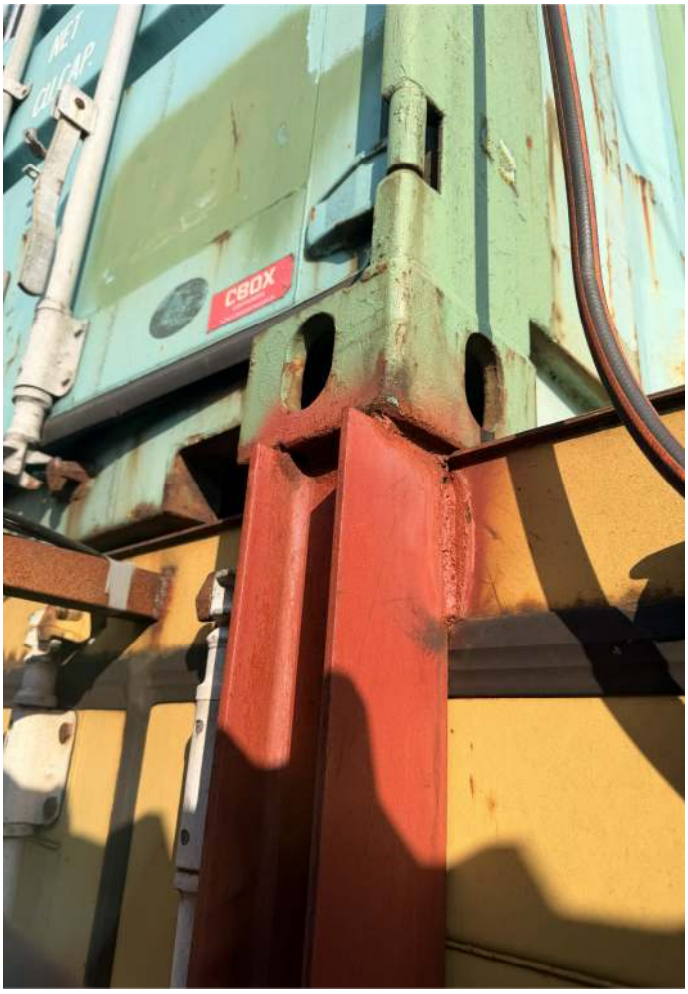
De onderste containers fungeren als drankopslag.

Voor de stabiliteit is het noodzakelijk de aangegeven kolommen toe te passen, met onder de buitenste kolommen een betonplaat van 1x1 m.
Ook dienen de containerblokken te worden vastgelast om verschuiven van de bovenste containers te voorkomen.
Winddruk van achteren is niet mogelijk; de opstelling staat geplaatst voor een hoger gebouw.

Winddruk van voren is geen bezwijkcriterium; de onderste containers staan vol biertanks en kratten met drankflessen.

Met de relatief kleine deuropeningen in de bovenste container blijft ruim voldoende schijfwerking over voor de vloerbelasting van max 2,5 kN/m^2

Bovenstaande werkzaamheden zijn uitgevoerd


CBOX








Sparkling
EARTH

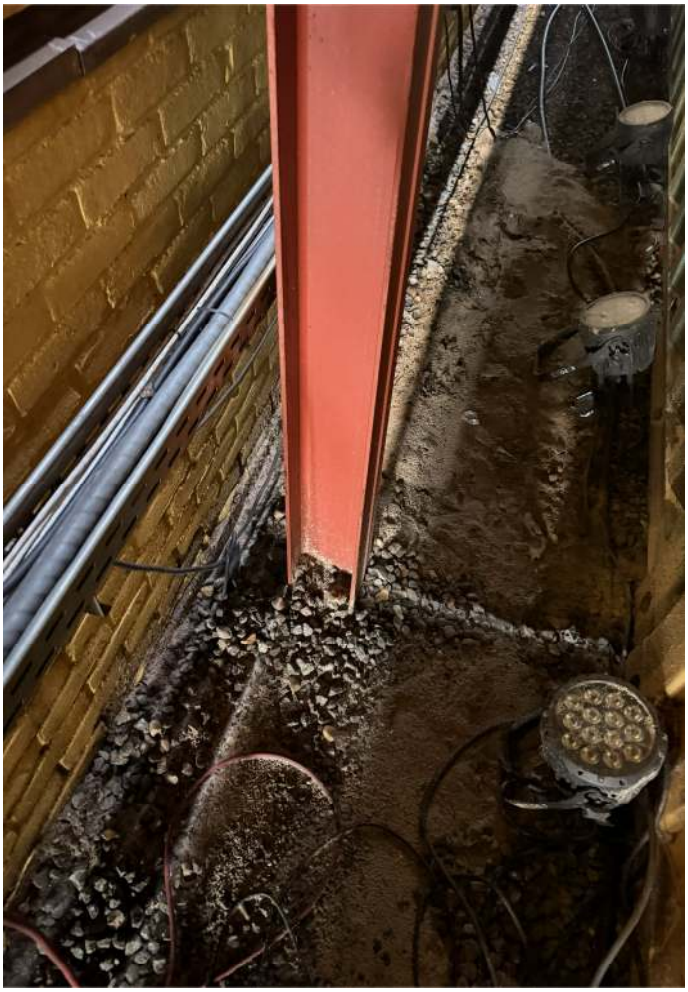








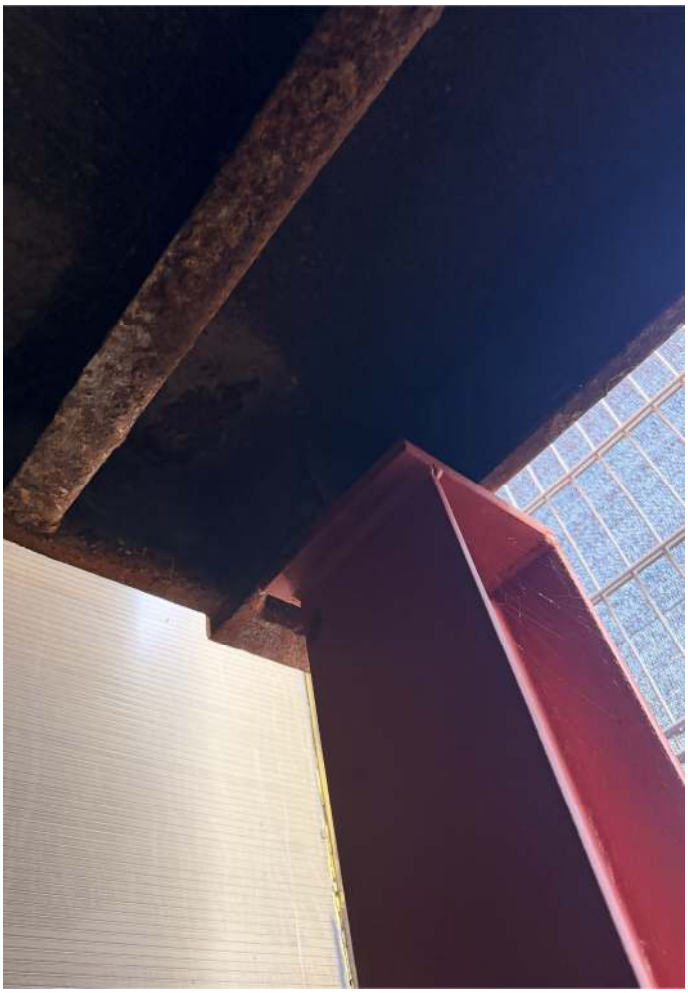












5.6 Helicopteropstelling

De huidige opstelling is instabiel; de containers zijn ontdaan van schijfwerking.
Op het dak wordt het casco van een helicopter gemonteerd,
Gewicht: 1200 kg

Voor een stabiele opstelling wordt voorzien in een inwendige staalconstructie.





Stabiliteit

Windbelasting van voren, kantellijn A-A

Windoppervlak heli 12 m^2 (opgemeten op locatie; De op de tekening geprojecteerde helicopter is niet de werkelijke helicopter)

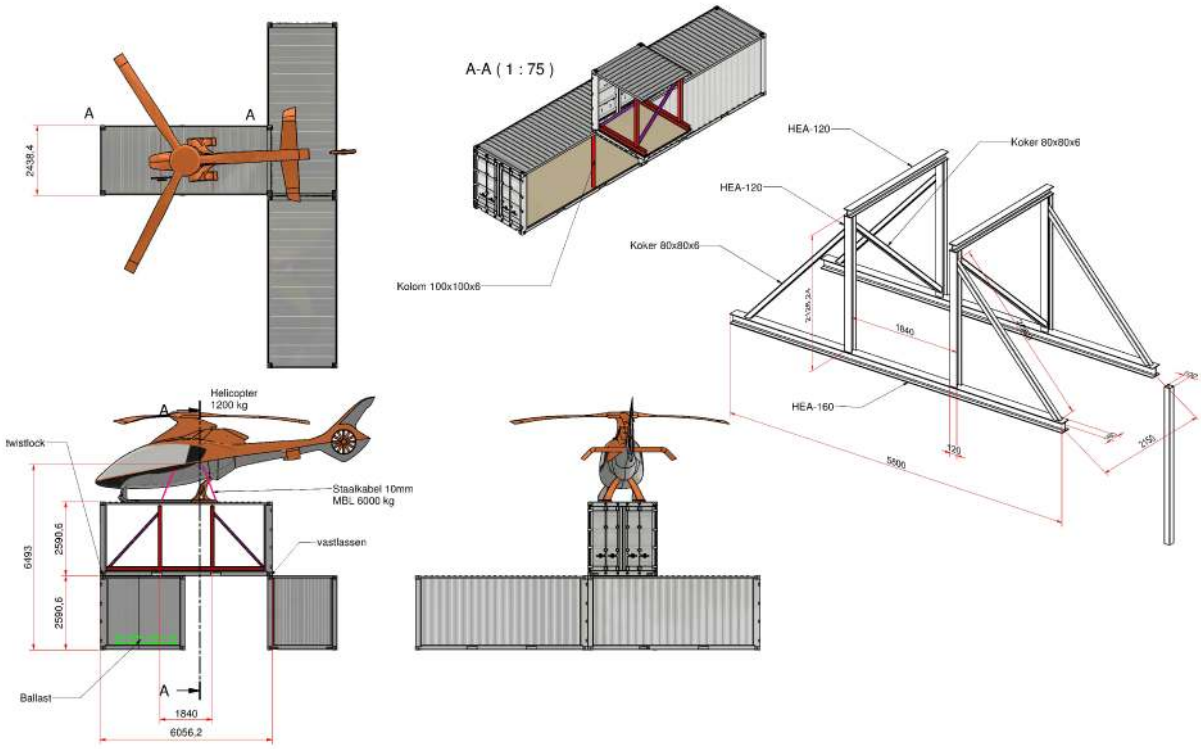
Kantelmoment

Med = qp(8) * cp * Yq * A * hz = 0,62 * 1,3 * 1,5 * (2,6*3*1,3 + 2,6*6,1*3,9 + 12*6,5) = 181 kNm

Trekkracht op cornerblokken

Fted = 181 / (2 *2,26) = 40 kN
UC = 40/250 = 0,16 Voldoet (Frd = 250 kN zie Bijlage 1)

(Twistlocks kunnen een trekkracht SWL 500 kN hebben)



Gewicht staalconstructie 870 kg
Gewicht Helicopter 1200 kg
Gewicht 10ft container 1300 kg
Gewicht 20ft container zonder zijwand 2060 kg

Totaal 5430 kg

Kantelmoment op te vangen door 10ft container; de windkracht grijpt
daarop voor het grootste gedeelte aan.

Mged = G * arm * Yg = (54,3 + Ballast) * 1,2 * 0,9 >= 181

Betekent voor ballast: Ballast = 113 kN (11,3 ton = 9 stelconplaten a 1340 kg)

Staalframe

Invoer Matrix;

Maatgevend:
Horizontale kracht op top staalconstructie

Qh = qp(8) * cp * A = 0,62 * 1,3 * 12 = 9,67 kN (heli)
Qh = 0,62 * 1,3 * 2,6 * 6,1/ 2 = 6,4 kN (container)
Qv = 12 kN (gewicht heli)

Zie Matrixberekening bijlage 9: UC = 0,1 Voldoet

6 Fundering

Gegevens van de locatie uit het DINO loket



De ondergrond is opgebouwd uit een zandpakket met kleilagen.

Uit de Richtlijn voor Steigers

De grondconditie is ongeveer “kleilaag op draagkrachtige onderlagen”

Een maximaal aan te houden gronddruk van 0,1 N/mm^2 is een veilige aanname
(= 100 kN/m^2)



3.2.3 Toelaatbare gronddrukken

Figuur 3.2.3 geeft een indicatie van de maximaal toelaatbare gronddruk op vaak voorkomende grondsoorten.

Indicatie toelaatbare druk σd op bouwgrond in N/mm^2	
Grondsoort	σd N/mm^2
Ingewaterd zand van grondverbetering naar gelang van de dikte van de zandlaag en de draagkracht van de ondergrond	0,05 - 0,1
Vaste zandbodem, nabij riviermonden en zeearmen	0,15 - 0,3
Vaste zandbodem, op draagkrachtige onderlagen	0,2 - 0,4
Zeer vast zand op grote diepte onder maaiveld	0,3 - 0,6
Leemhoudende gronden	0,08 - 0,16
Kleilaag, op draagkrachtige onderlagen	0,1 - 0,2
Mergel	0,3 - 0,8
Zachte krijtlaag	0,1 - 0,2
Grindlaag, op draagkrachtige onderlagen	0,3 - 0,8
Niet-verweerde rotsgrond	0,5 - 2,5

Figuur 3.2.3 Indicatieve toelaatbare druk op bouwgrond

De verschillende objecten:

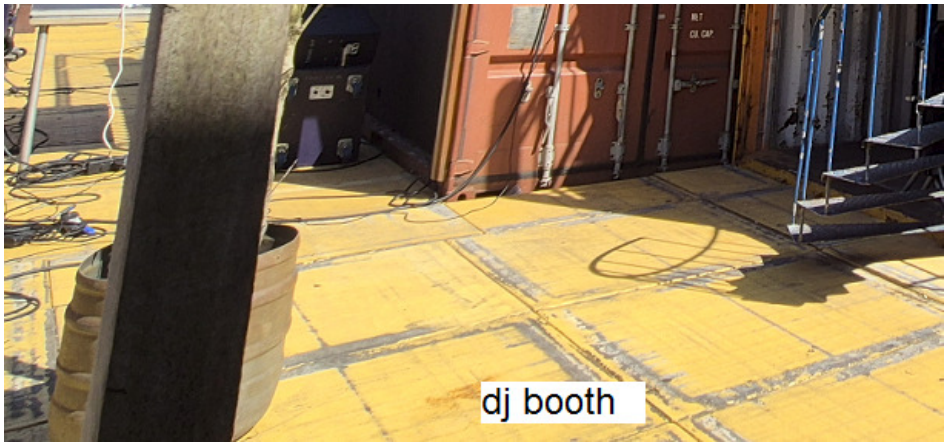
Containers

Het risico voor schuin wegzakken is niet aanwezig; de verschillende containerconstructies worden gevormd door aan elkaar gelaste containers.
De containers staan op de bestaande klinkerbestrating
De FJ Booth staat op stelconplaten

Maatgevend:

20ft container met 500kg/m^2 var. bel. op het dak (72 kN totaal)
Totaalbelasting Fed = 15 * 1,2 + 72 * 1,5 = 126 kN
Steunoppervlak: 22 * 0,085 = 1,9 m^2
Gronddruk: 126 / 1,9 = 66 kN/m^2 voldoet



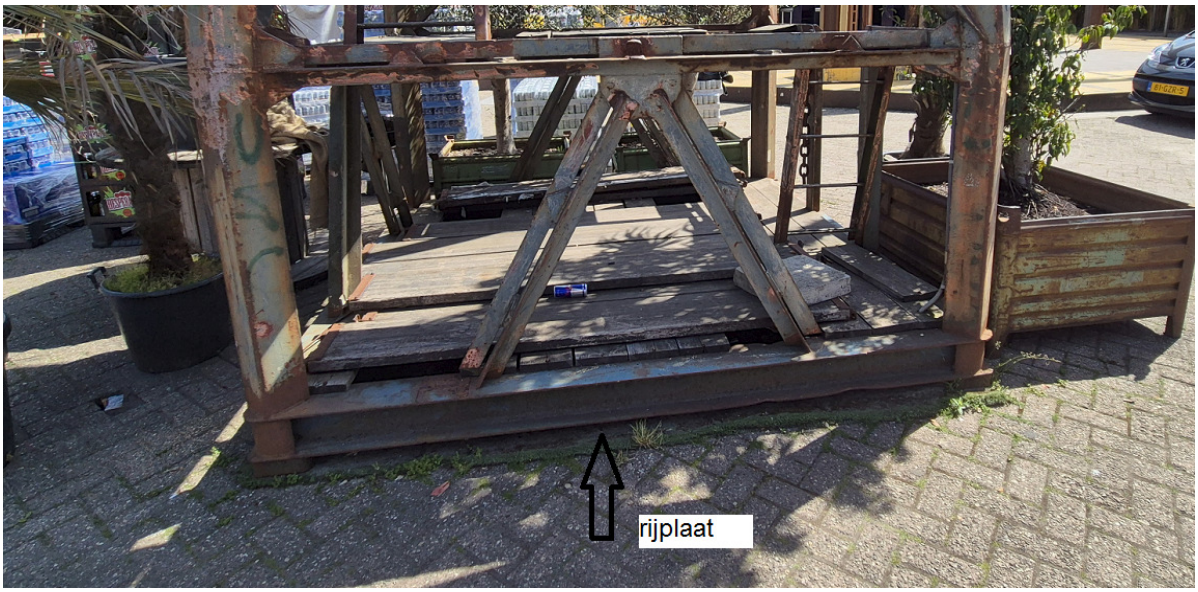


Toren (zie par. 5.4)

Grondoppervlak: 2,55 * 2,55 = 6,5 m^2
Gewicht: 26,8 kN
Kantelmoment op voetplaat Med = 29 kNm

Zie funderingsberekening Bijlage 10

Voldoet.



BUSSEL ENGINEERING

BIJLAGE 1

Rules for Classification and Construction

I Ship Technology

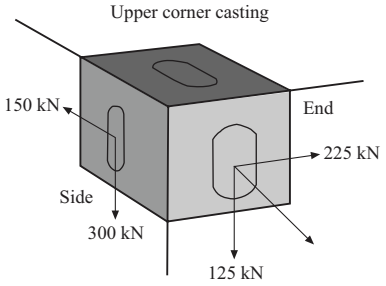
1 Seagoing Ships

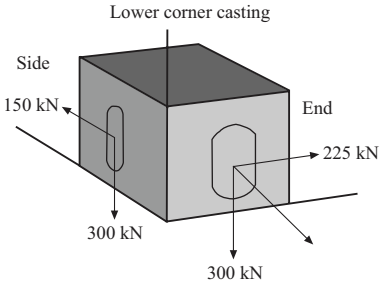


20 Stowage and Lashing of Containers

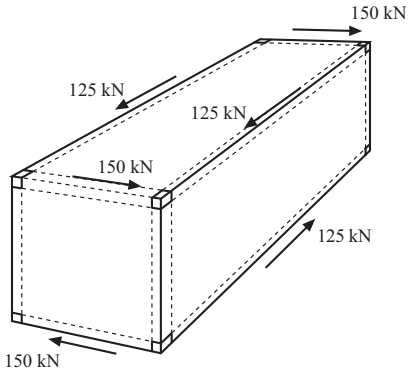
Edition 2013

Annex I Maximum Allowable Forces on ISO-Container

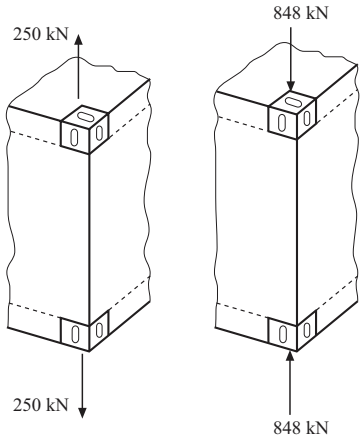




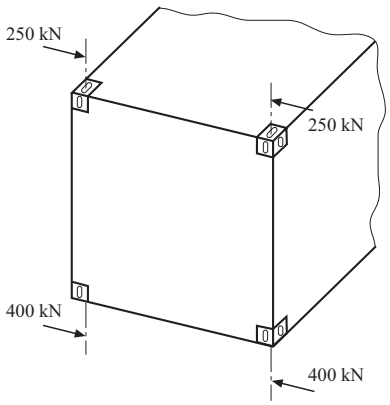
a) Corner casting lashing loads



b) Racking Loads



c) Max. vertical corner lifting and compressive forces



d) Transverse compressive forces

40FT Zeecontainer nieuw

Nieuwe standaard 40ft. zeecontainer van zware kwaliteit. Deze containers zijn standaard met geldige C.S.C. certificering uitgevoerd. Nieuwe containers zijn altijd eenmalig vanaf de fabriek naar Nederland verscheept.

Specificaties

Technische informatie

Staalsoort	Corten Staal
Wanden	1,50 mm dik plaatstaal met damwandprofiel
Dak	2,00 mm dik geprofileerde uitvoering
Spuitwerk	Chlorinated Rubber of Arcylic
Vloer	Plywood, dikte 28 mm
Deuren	2-delige deur met 2 gegalvaniseerde deurstangen per deur

Buitenmaten

Lengte	12192 mm
Breedte	2438 mm
Hoogte	2591 mm

Binnenmaten

Lengte	12032 mm
Breedte	2352 mm
Hoogte	2393 mm

Deuropening

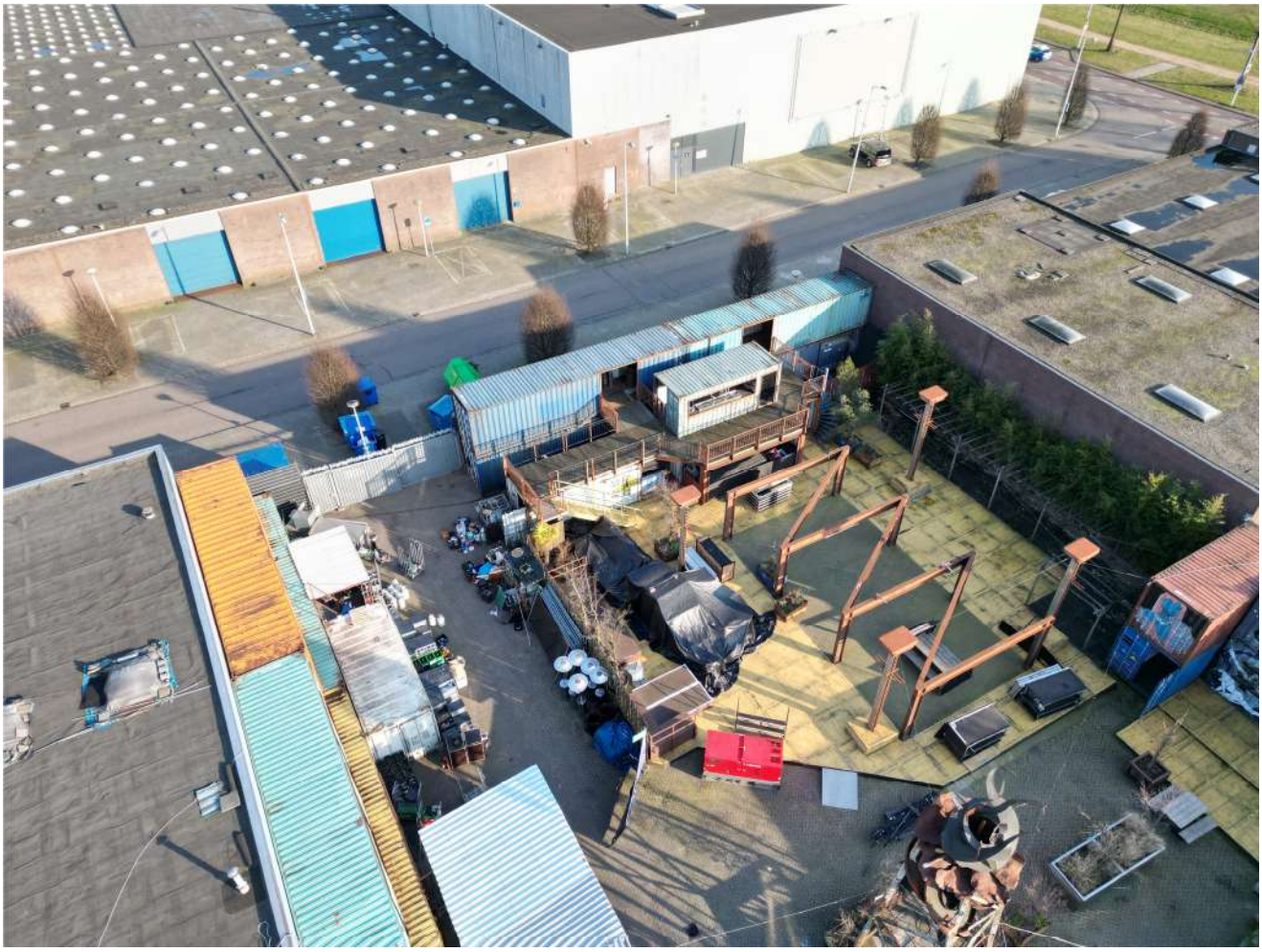
Breedte	2343 mm
Hoogte	2280 mm

Gewichten

Ledig gewicht (tara)	3380 kg
Laadvermogen	27100 kg
Max. gewicht	30480 kg

Overige

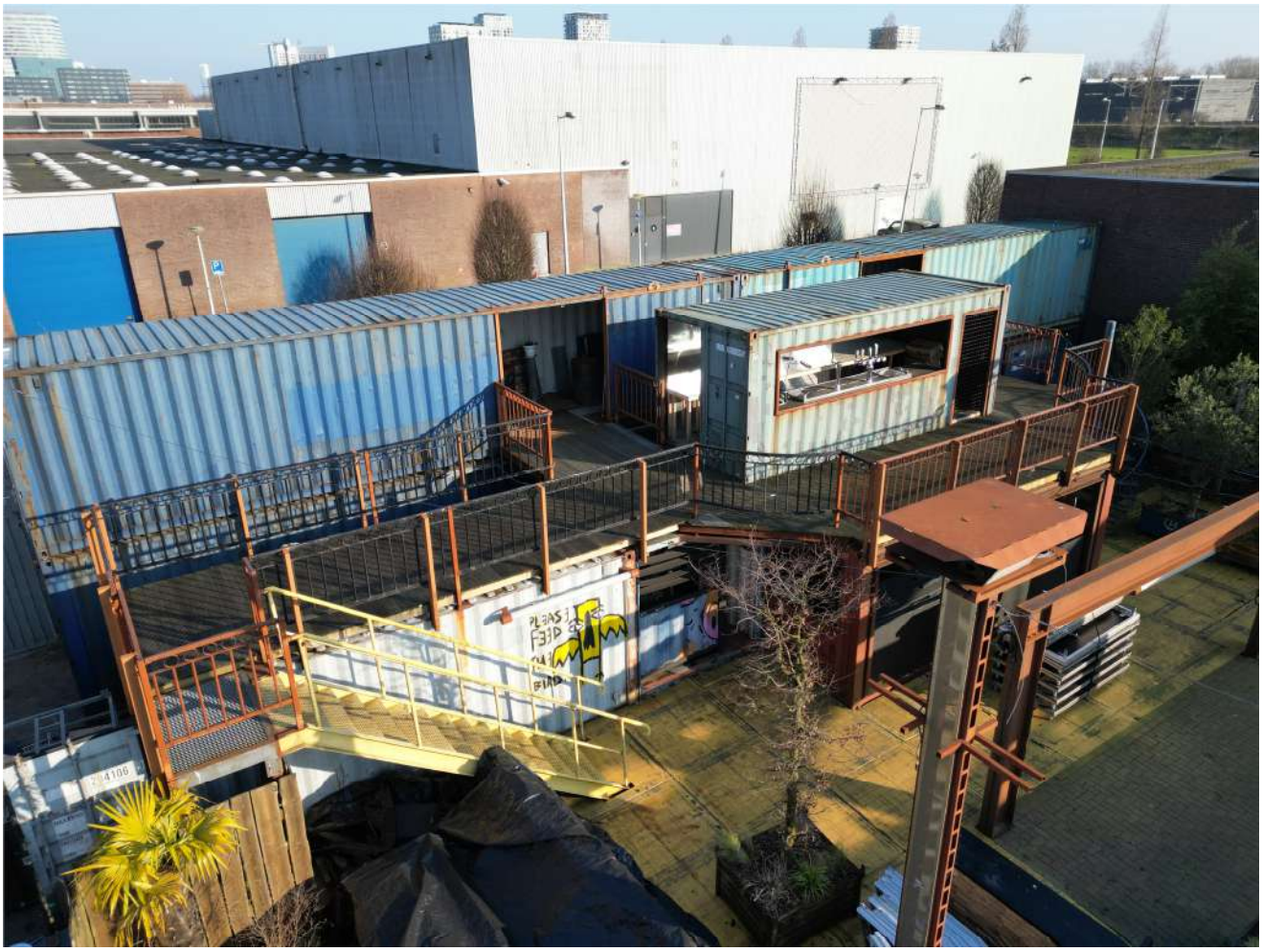
Volume	67 m3
Vloeroppervlak	28.3 m2
Stapelbaar (niveaus)	9 hoog
C.S.C. Certificering	Niet mogelijk

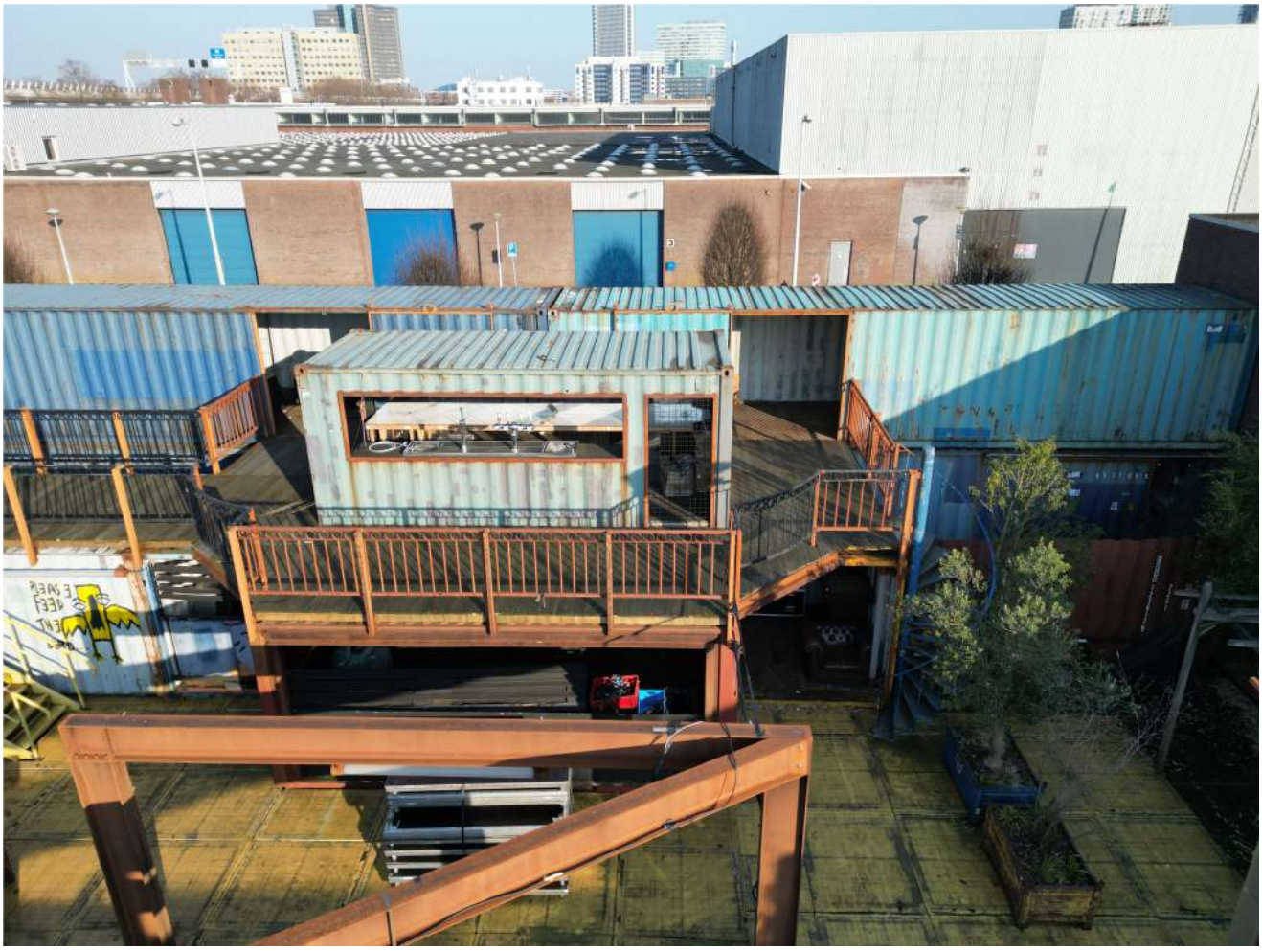


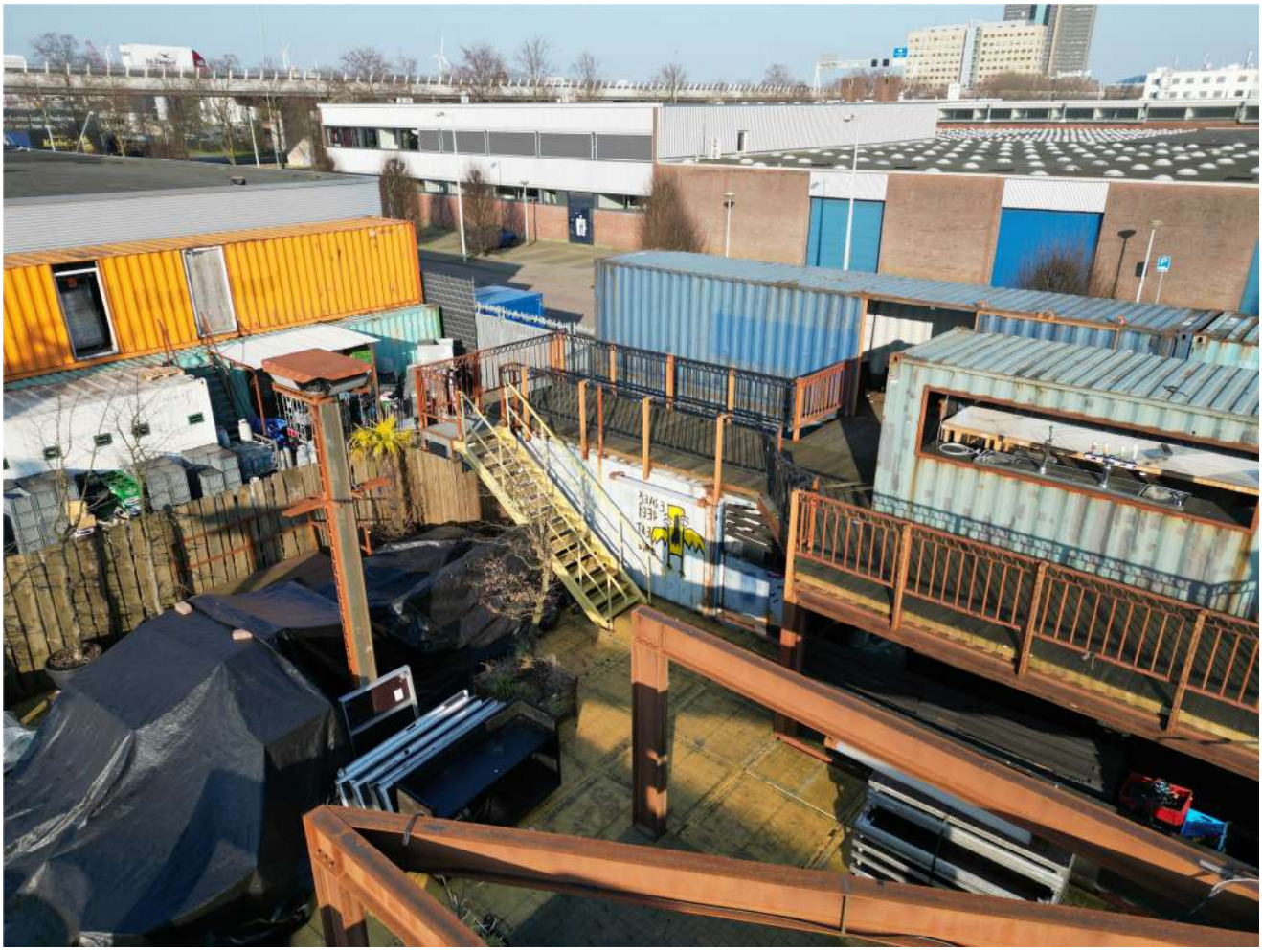






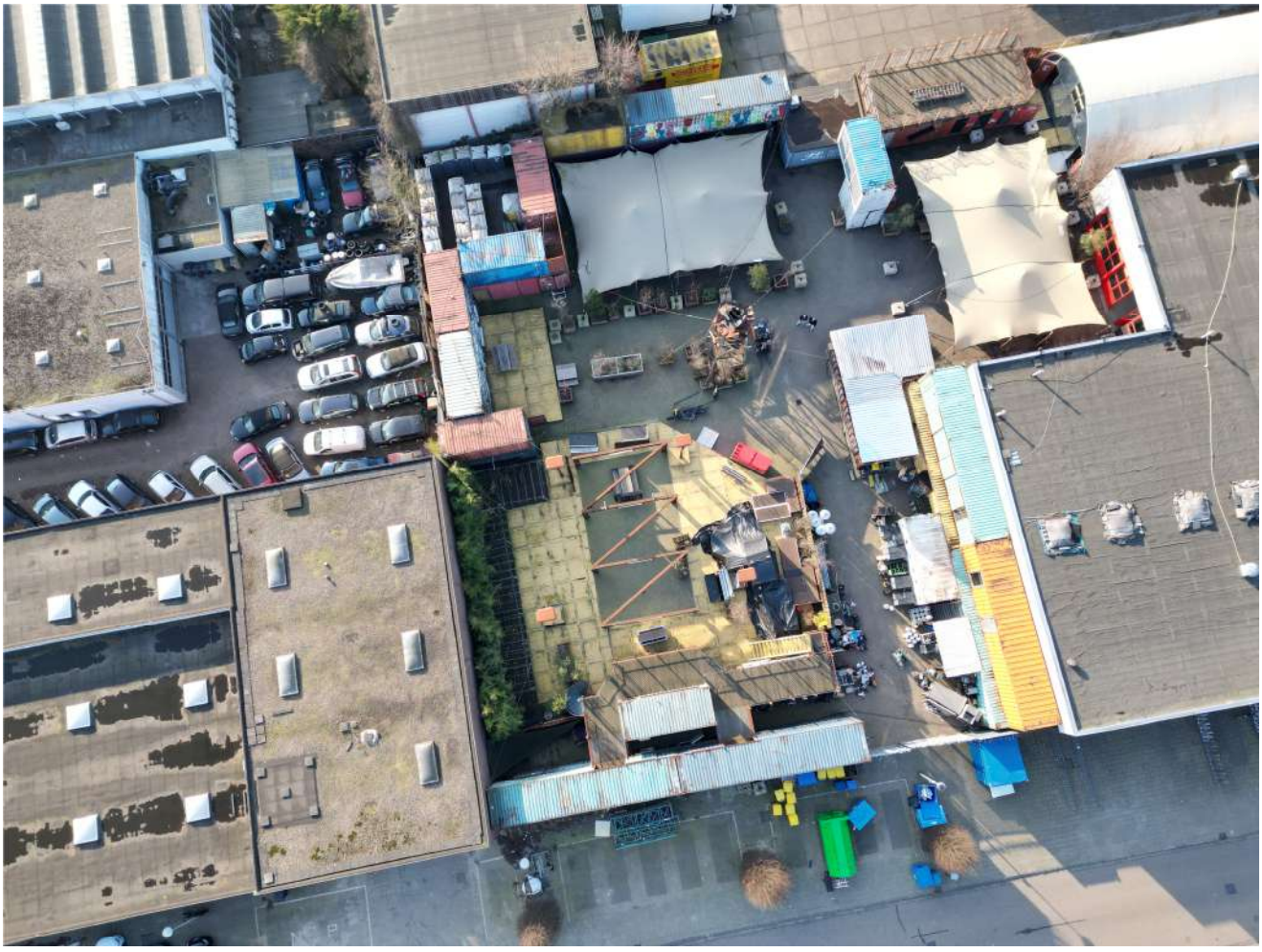












BUSSEL ENGINEERING

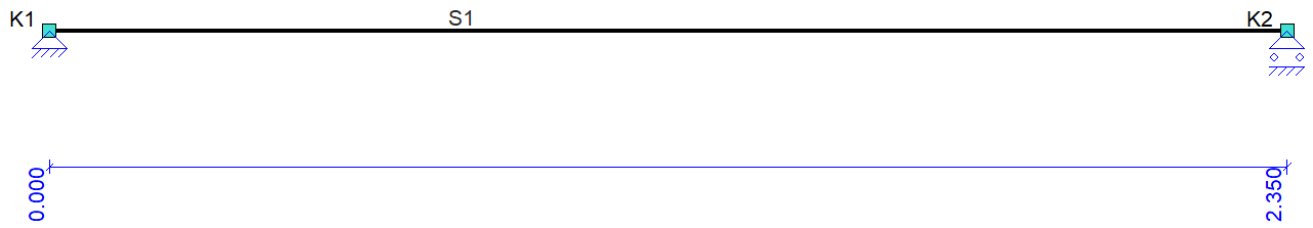
BIJLAGE 2

Project name	**LOFI**	**Project number**	**LOFI-2025**
Part description	**Ligger-1 DJBooth**	**Structural engineer**	5.1, 2, e
Client	**LOFI**	**Units**	**m, mm, kN, kNm**
File	**C:\Users\Michiel\Desktop\Lofi\Ligger-DJBooth.mxf**		

STRUCTURE INFO

Project Type	Nodes	Members	Supports	Sections	Loads Cases	Loads Combinations
2D-Frame	2	1	2	1	2	9

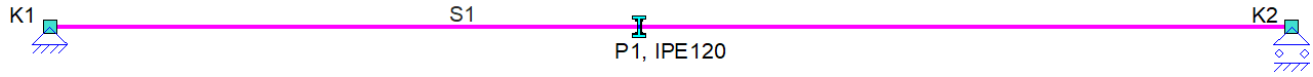
Structure



MEMBERS

Member	Node-B	Node-E	X-B	X-E	Z-B	Z-E	Length	Section	Position
S1	K1	K2	0.000	2.350	0.000	0.000	2.350	P1	0.000 - 2.350 (L)
			m	**m**	**m**	**m**	**m**		**m**

Sections



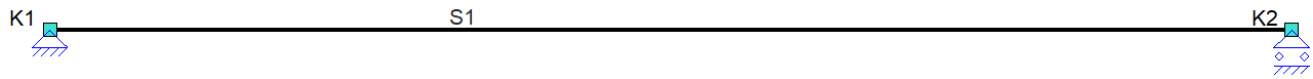
SECTIONS

Section	Section Name	Area	Iy	Material	Angle
P1	IPE120	1321	3.1775e+06	S235	0
		mm²	**mm⁴**		**°**

MATERIALS

Material Name	Poison	Density	Youngs mod.	Lin. Exp.
S235	0.30	78.50	2.1000e+05	12.0000e-06
		kN/m³	**N/mm²**	**C°m**

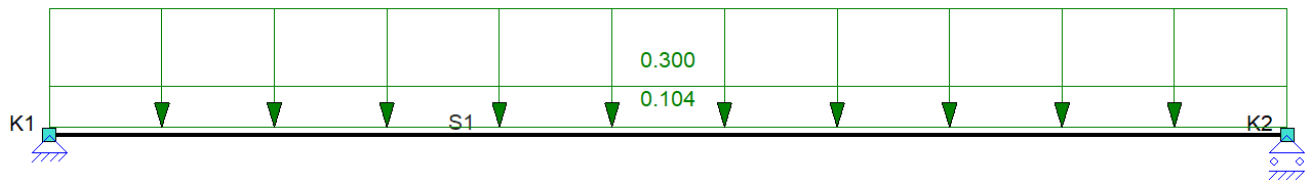
Restraints



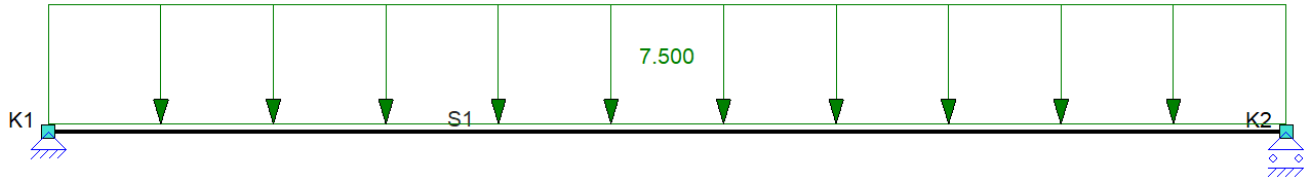
SUPPORTS

Support	Object	Position	X	Z	Yr	Angle Yr
O1	K1	K1	Fixed	Fixed	Free	0
O2	K2	K2	Free	Fixed	Free	0
		m	**kN/m**	**kN/m**	**kNm/rad**	**°**

B.G.1: Permanent



B.G.2: Verdeelde veranderlijke belasting



LOADS COMBINATIONS

Fundamenteel

L.C.	Description	Fu.C.1	Fu.C.2
B.G.1	Permanent	1.20	1.35
B.G.2	Verdeelde veranderlijk…	1.50	0.60

Karakteristiek

L.C.	Description	Ka.C.(w1)	Ka.C.1	Ka.C.2
B.G.1	Permanent	1.00	1.00	1.00
B.G.2	Verdeelde veranderlijk…		1.00	0.40

Frequent

L.C.	Description	Fr.C.(w1)	Fr.C.1
B.G.1	Permanent	1.00	1.00
B.G.2	Verdeelde veranderlijk…		0.50

Quasi-permanent

L.C.	Description	Qu.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	0.30

Massa

L.C.	Description	Ma.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	

LOADS COMBINATIONS

Fundamenteel

Fu.C.1 = 1.20*B.G.1 + 1.50*B.G.2
Fu.C.2 = 1.35*B.G.1 + 0.60*B.G.2

Karakteristiek

Ka.C.(w1) = B.G.1
Ka.C.1 = B.G.1 + B.G.2
Ka.C.2 = B.G.1 + 0.40*B.G.2

Frequent

Fr.C.(w1) = B.G.1
Fr.C.1 = B.G.1 + 0.50*B.G.2

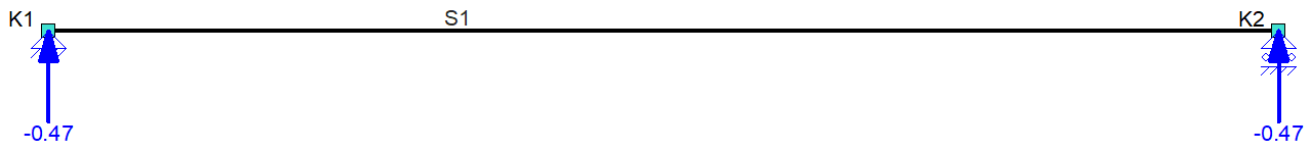
Quasi-permanent

Qu.C.1 = B.G.1 + 0.30*B.G.2

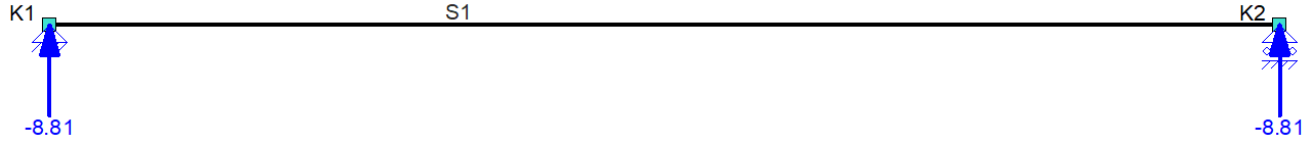
Massa

Ma.C.1 = B.G.1

B.G.1 Support Reactions



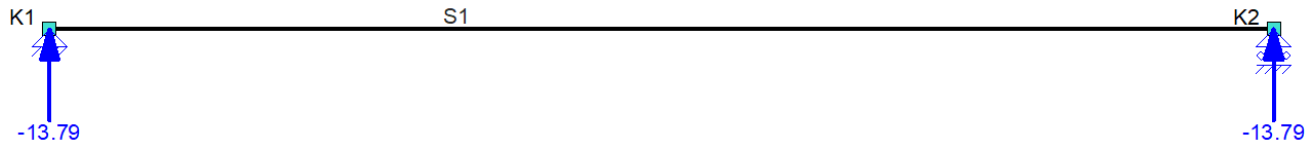
B.G.2 Support Reactions



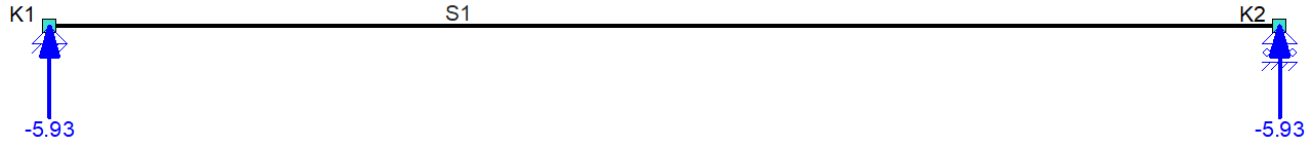
EXTREME SUPPORT REACTIONS (LOAD CASES)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					B.G.2	0.00	**-8.81**	0.00				
O2	K2					B.G.2	-0.00	**-8.81**	0.00				
Global extreme values													
O1	K1					B.G.2	0.00	**-8.81**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Fu.C.1 Support Reactions



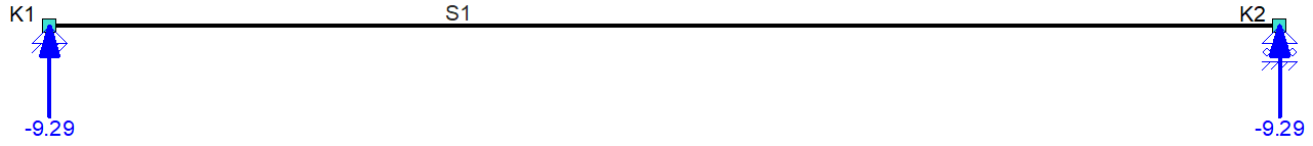
Fu.C.2 Support Reactions



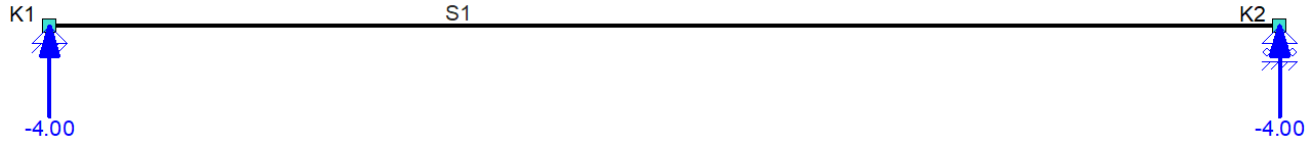
EXTREME SUPPORT REACTIONS (PERSISTENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Fu.C.1	0.00	**-13.79**	0.00				
O2	K2					Fu.C.1	0.00	**-13.79**	0.00				
Global extreme values													
O1	K1					Fu.C.1	0.00	**-13.79**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Ka.C.1 Support Reactions



Ka.C.2 Support Reactions

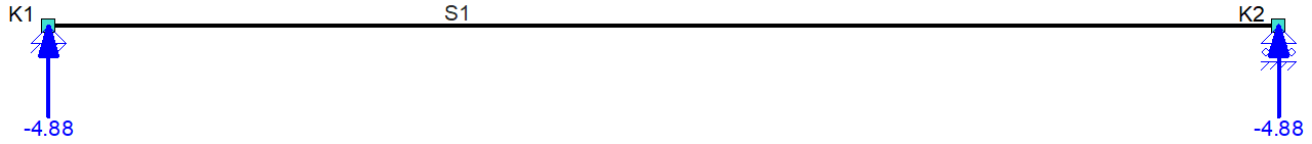


EXTREME SUPPORT REACTIONS (CHARACTERISTIC)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Ka.C.1	0.00	**-9.29**	0.00				
O2	K2					Ka.C.1	0.00	**-9.29**	0.00				
Global extreme values													
O1	K1					Ka.C.1	0.00	**-9.29**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

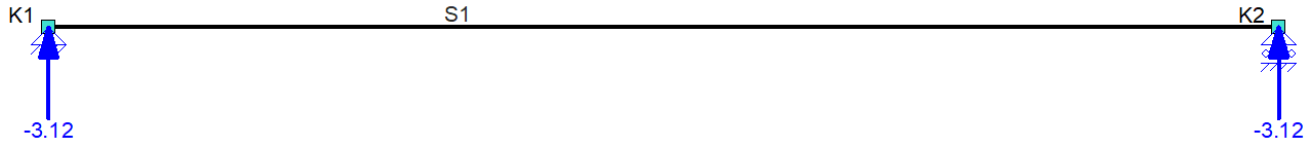
Fr.C.1 Support Reactions



EXTREME SUPPORT REACTIONS (FREQUENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Fr.C.1	0.00	**-4.88**	0.00				
O2	K2					Fr.C.1	0.00	**-4.88**	0.00				
Global extreme values													
O1	K1					Fr.C.1	0.00	**-4.88**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Qu.C.1 Support Reactions



EXTREME SUPPORT REACTIONS (QUASI-PERMANENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Qu.C.1	0.00	**-3.12**	0.00				
O2	K2					Qu.C.1	0.00	**-3.12**	0.00				
Global extreme values													
O1	K1					Qu.C.1	0.00	**-3.12**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

STEEL CODECHECK RESULTS

NEN-EN1993-1-1:2016/NB:2016

Assumptions of Analysis for steel codecheck
Alpha;cr = 0.00 < 10; GNL analysis required

CROSS-SECTION (#6.2)

Member C1-V1 (0.000-2.350)

Decisive combination		Fu.C.1		Section class			1
Decisive position		1.175	m				
Axial force	N_{Ed}	0.00	kN	Design resistance	(6.6)	N_{Rd}	310.44 kN
Bending moment	$M_{y,Ed}$	8.10	kNm	Design resistance	(6.13)	$M_{y,Rd}$	14.27 kNm
Bending moment	$M_{z,Ed}$	0.00	kNm	Design resistance	(6.13)	$M_{z,Rd}$	3.19 kNm
Shear force	$V_{y,Ed}$	0.00	kN	Design resistance	(6.18)	$V_{y,Rd}$	115.12 kN
Shear force	$V_{z,Ed}$	-0.00	kN	Design resistance	(6.18)	$V_{z,Rd}$	85.55 kN

Type	Axis	Reference	Load combination	Position	Calculation	UC
Decisive cut						
Tension		NEN-EN1993-1-1(6.5)	Fu.C.1	1.175	0.00 / 310.44	0.00
Bending	Y	NEN-EN1993-1-1(6.12)	Fu.C.1	1.175	8.10 / 14.27	0.57
Bending	Z	NEN-EN1993-1-1(6.12)	Fu.C.1	1.175	0.00 / 3.19	0.00
Shear	Y	NEN-EN1993-1-1(6.17)	Fu.C.1	1.175	0.00 / 115.12	0.00
Shear	Z	NEN-EN1993-1-1(6.17)	Fu.C.1	1.175	-0.00 / 85.55	0.00
				m		

LATERAL BUCKLING (#6.3.2)

Member C1-V1 (0.000-2.350)

Equivalent section	IPE120		Section class	1	
$M_{y,Rd}$	14.27	kNm	$M_{z,Rd}$	3.19	kNm
Decisive combination	Fu.C.1		Load attachment position from center	0.000	m
Lateral buckling supports	None				

Field

Field begin		0.000	m	Moment (begin)	M_y	0.00	kNm
Field end		2.350	m	Moment (end)	M_y	0.00	kNm
Length	L	2.350	m	Moment (max)	M_y	8.10	kNm
Decisive flange		Upper		Moment (max)	M_z	0.00	kNm

Elastic critical moment for lateral-torsional buckling (NEN-EN 1993-1-1+C2+A1:2016 NB.NB.4)

Table used		NB.NB.1 (2)		Length		L_{st}	2.350 m
Length	L_{kip}	2.350	m		(NB.NB.12)	S	0.365 m
Coefficient	C_1	1.130		Coefficient		C_2 (Table)	0.450
Coefficient	C_2 (Calculated)	0.000		Length		L_g	2.350 m
Coefficient	(NB.NB.11) C	3.950		Reduction factor	(NB.NB.7)	K_{red}	1.000
	(NB.NB.6) M_{cr}	15.17	kNm				

Lateral torsional buckling curve #6.3.2.2

Slenderness		λ_{LT}	0.970	Buckling curve	Table 6.4		a
Imperfection factor	Table 6.3	α_{LT}	0.210			Φ_{LT}	1.051
Reduction factor	(6.56)	$\chi_{LT,y}$	0.687				
Reduction factor		$\chi_{LT,z}$	1.000				
Design resistance	(6.55)	$M_{b,Rd,y}$	9.80 kNm				
Design resistance	(6.55)	$M_{b,Rd,z}$	3.19 kNm				

NEN-EN1993-1-1(6.54): UC = 0.83

DEFLECTIONS

Member C1-V1 (0.000-2.350)

Structure type	Floor	Camber function	3Point
Check Type	General	Camber w_c	0 mm

w_{max}

Axis	Position	w_1	L.C.	w_3	L.C.	w_{tot}	w_c	w	Limit (L/250)	UC
Z'	1.175	0.2	Fr.C.(w1)	1.3	Qu.C.1	1.6	0.0	1.6	9.4	0.17
Z''	1.175	0.2	Fr.C.(w1)	1.3	Qu.C.1	1.6	0.0	1.6	9.4	0.17
	m	**mm**		**mm**		**mm**	**mm**	**mm**	**mm**	

(w_2+w_3)

Axis	Position	w_3	L.C.	w	Abs. limit	Limit (L/333)	UC
Z'	1.175	2.2	Fr.C.1	2.2	0.0	7.1	0.32
Z''	1.175	2.2	Fr.C.1	2.2	0.0	7.1	0.32
	m	**mm**		**mm**	**mm**	**mm**	

EXTREME UNITY CHECK

Label	Check Type	Combination	Formula	Unity Check
C1-V1 (0.000-2.350)	Lat.Buck.	Fu.C.1	NEN-EN1993-1-1(6.54)	0.83

BUSSEL ENGINEERING

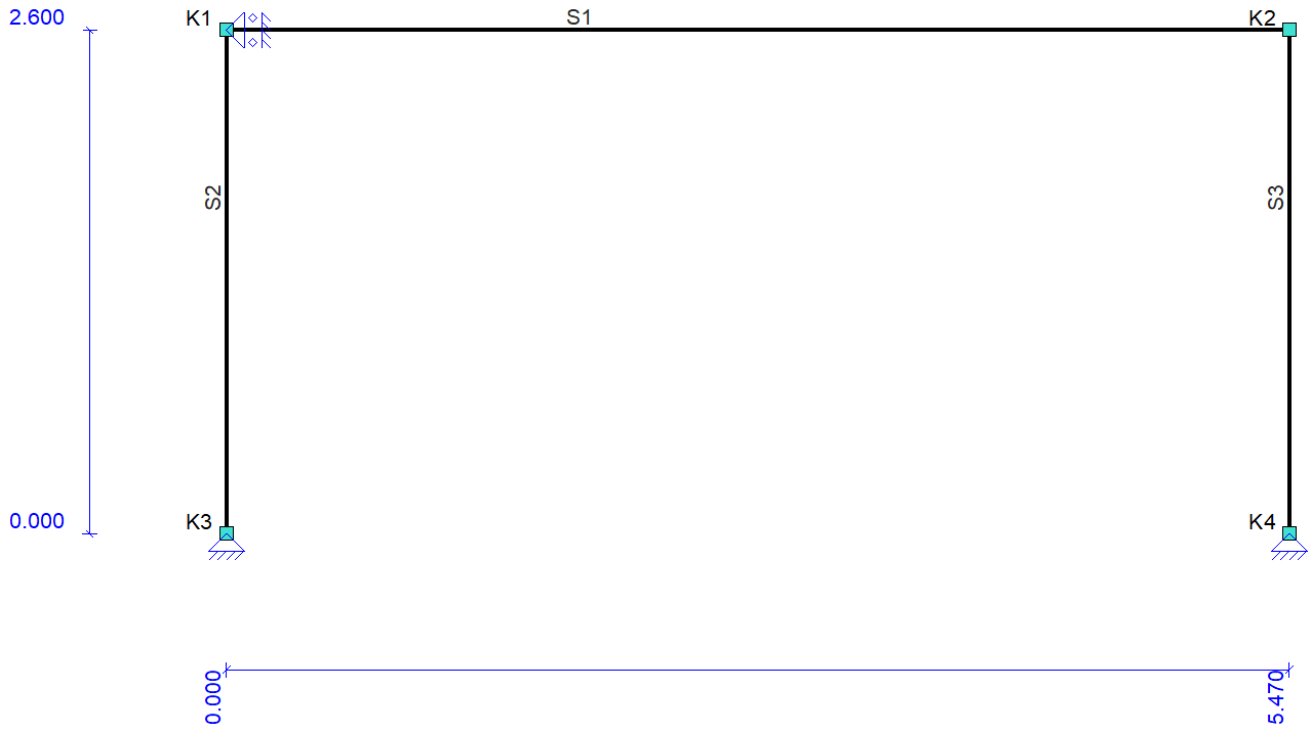
BIJLAGE 3

Project name	**LOFI**	**Project number**	**LOFI-2025**
Part description	**Ligger-1 DJBooth**	**Structural engineer**	5.1, 2, e
Client	**LOFI**	**Units**	**m, mm, kN, kNm**
File	**C:\Users\Michiel\Desktop\Lofi\DJBooth-Portaal.mxf**		

STRUCTURE INFO

Project Type	Nodes	Members	Supports	Sections	Loads Cases	Loads Combinations
2D-Frame	4	3	3	2	2	9

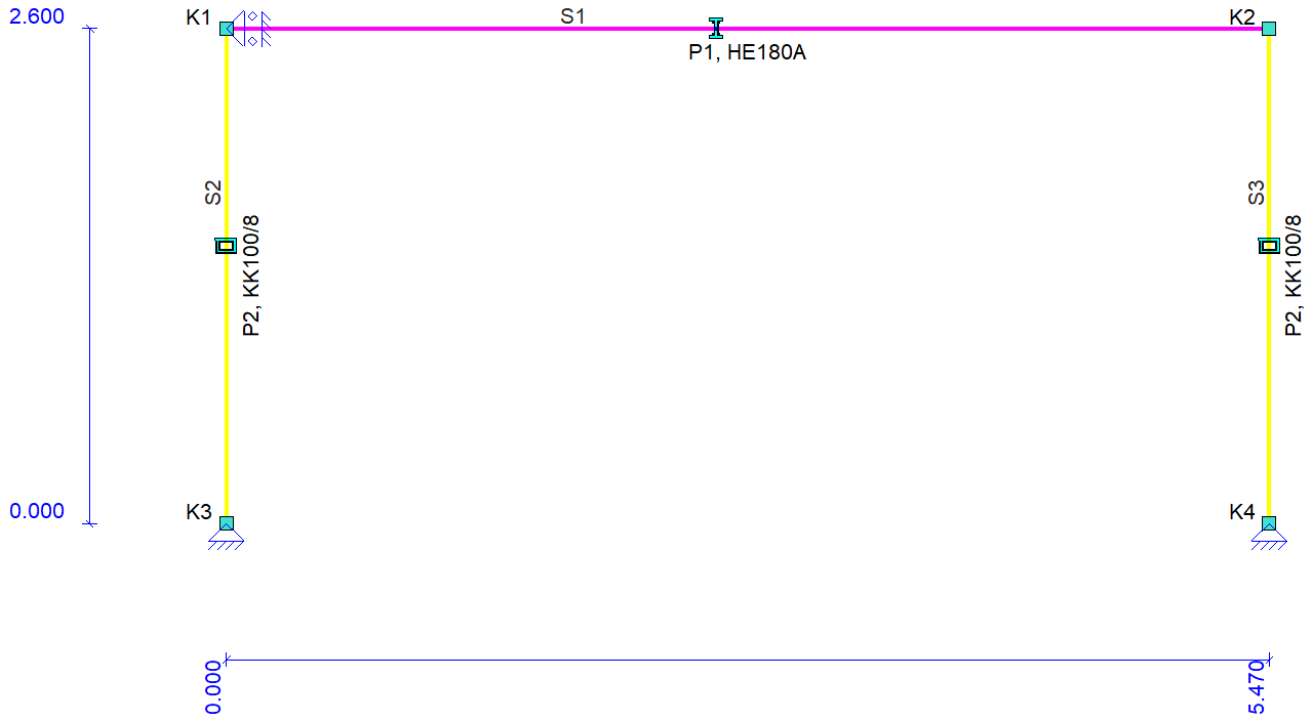
Structure



MEMBERS

Member	Node-B	Node-E	X-B	X-E	Z-B	Z-E	Length	Section	Position
S1	K1	K2	0.000	5.470	-2.600	-2.600	5.470	P1	0.000 - 5.470 (L)
S2	K1	K3	0.000	0.000	-2.600	-0.000	2.600	P2	0.000 - 2.600 (L)
S3	K2	K4	5.470	5.470	-2.600	-0.000	2.600	P2	0.000 - 2.600 (L)
			m	**m**	**m**	**m**	**m**		**m**

Sections



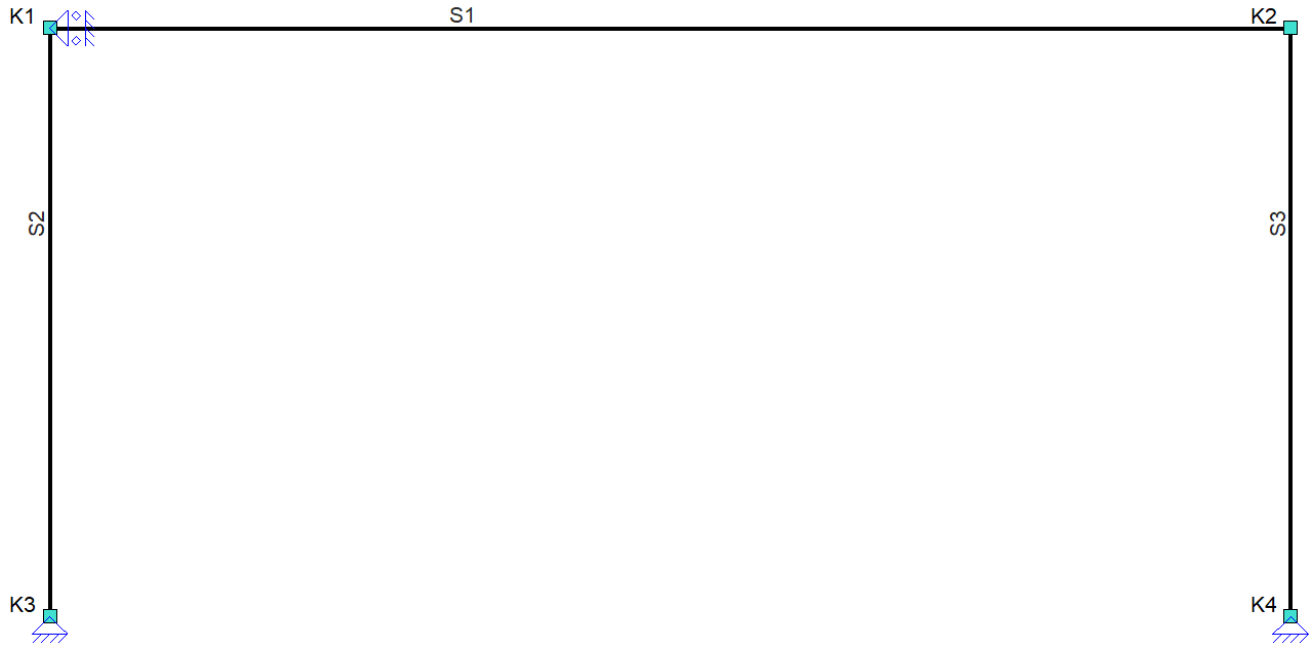
SECTIONS

Section	Section Name	Area	Iy	Material	Angle
P1	HE180A	4525	2.5103e+07	S235	0
P2	KK100/8	2724	3.6594e+06	S355H(EN10219-1)	0
		mm²	mm⁴		°

MATERIALS

Material Name	Poison	Density	Youngs mod.	Lin. Exp.
S235	0.30	78.50	2.1000e+05	12.0000e-06
S355H(EN10219-1)	0.30	78.50	2.1000e+05	12.0000e-06
		kN/m³	N/mm²	C°m

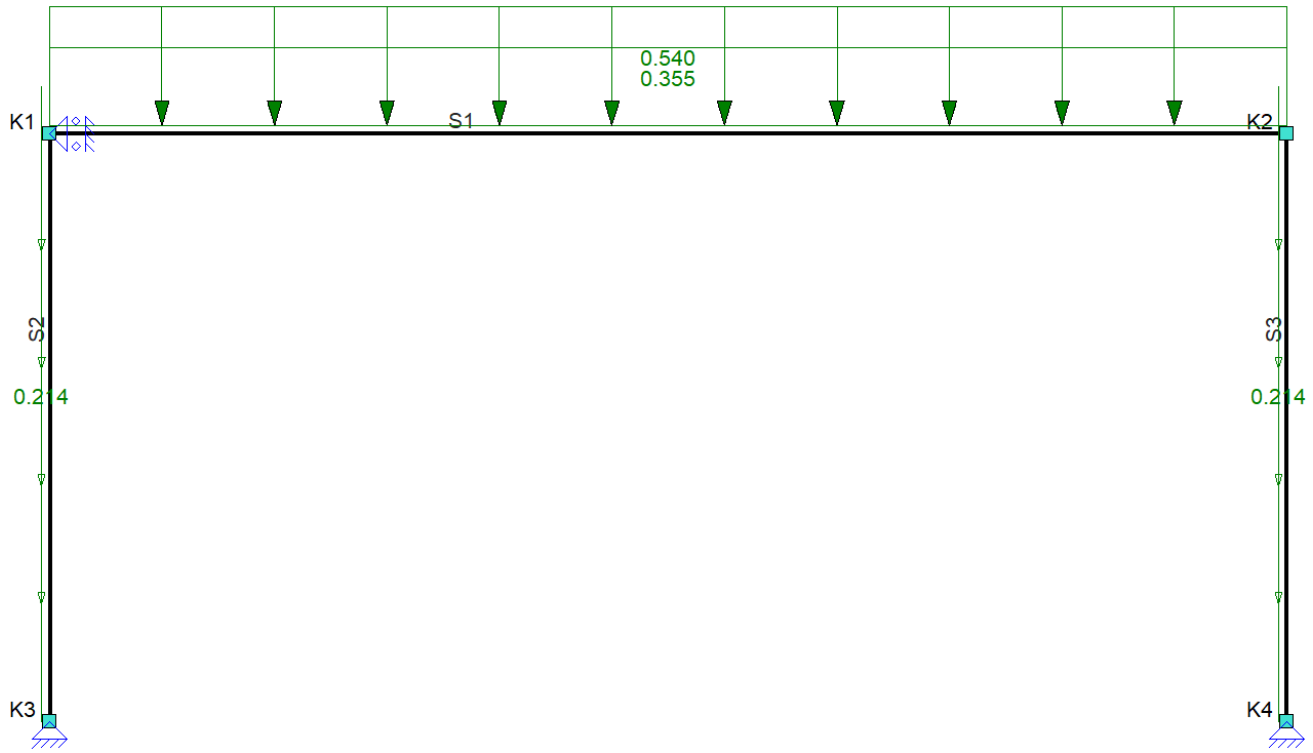
Restraints



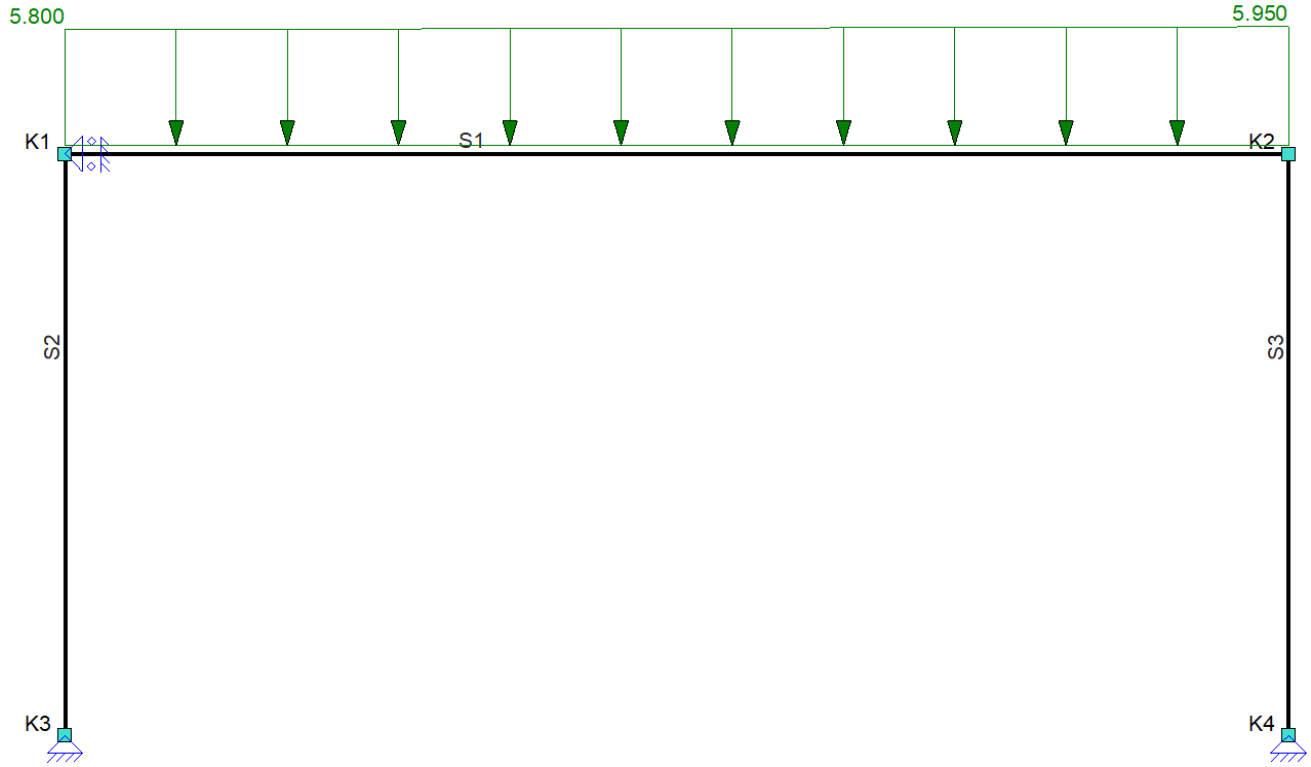
SUPPORTS

Support	Object	Position	X	Z	Yr	Angle Yr
O3	K3	K3	Fixed	Fixed	Free	0
O4	K4	K4	Fixed	Fixed	Free	0
O5	K1	K1	Fixed	Free	Free	0
		m	**kN/m**	**kN/m**	**kNm/rad**	**°**

B.G.1: Permanent



B.G.2: Verdeelde veranderlijke belasting



LOADS COMBINATIONS

Fundamenteel

L.C.	Description	Fu.C.1	Fu.C.2
B.G.1	Permanent	1.20	1.35
B.G.2	Verdeelde veranderlijk…	1.50	0.60

Karakteristiek

L.C.	Description	Ka.C.(w1)	Ka.C.1	Ka.C.2
B.G.1	Permanent	1.00	1.00	1.00
B.G.2	Verdeelde veranderlijk…		1.00	0.40

Frequent

L.C.	Description	Fr.C.(w1)	Fr.C.1
B.G.1	Permanent	1.00	1.00
B.G.2	Verdeelde veranderlijk…		0.50

Quasi-permanent

L.C.	Description	Qu.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	0.30

Massa

L.C.	Description	Ma.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	

LOADS COMBINATIONS

Fundamenteel

Fu.C.1 = 1.20*B.G.1 + 1.50*B.G.2
Fu.C.2 = 1.35*B.G.1 + 0.60*B.G.2

Karakteristiek

Ka.C.(w1) = B.G.1

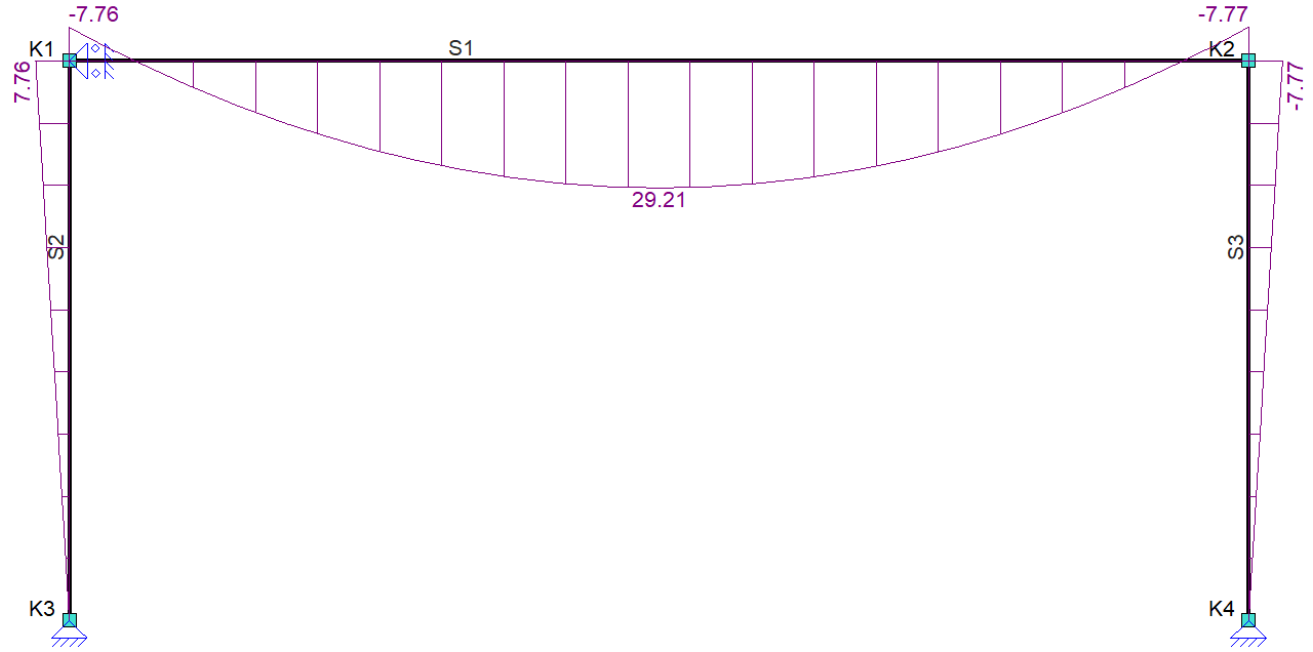
Ka.C.1 = B.G.1 + B.G.2
Ka.C.2 = B.G.1 + 0.40*B.G.2

Frequent
Fr.C.(w1) = B.G.1
Fr.C.1 = B.G.1 + 0.50*B.G.2

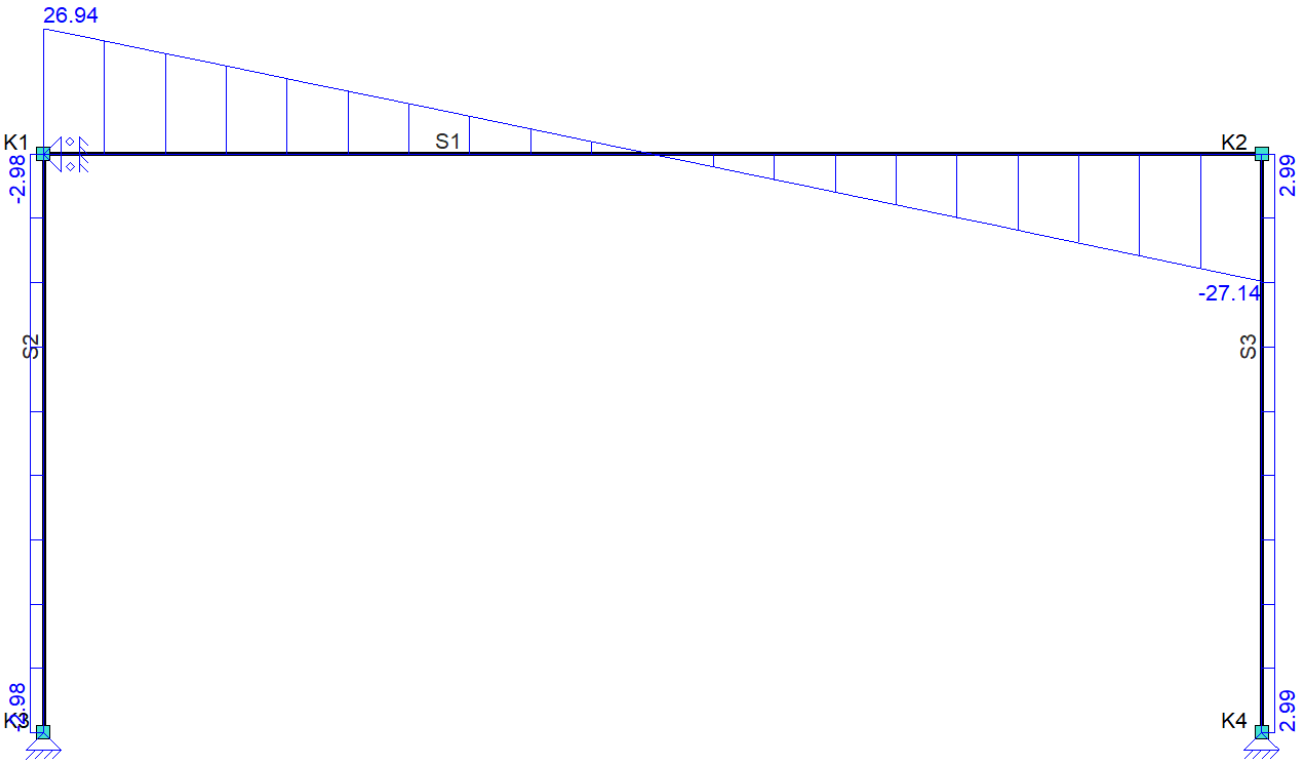
Quasi-permanent
Qu.C.1 = B.G.1 + 0.30*B.G.2

Massa
Ma.C.1 = B.G.1

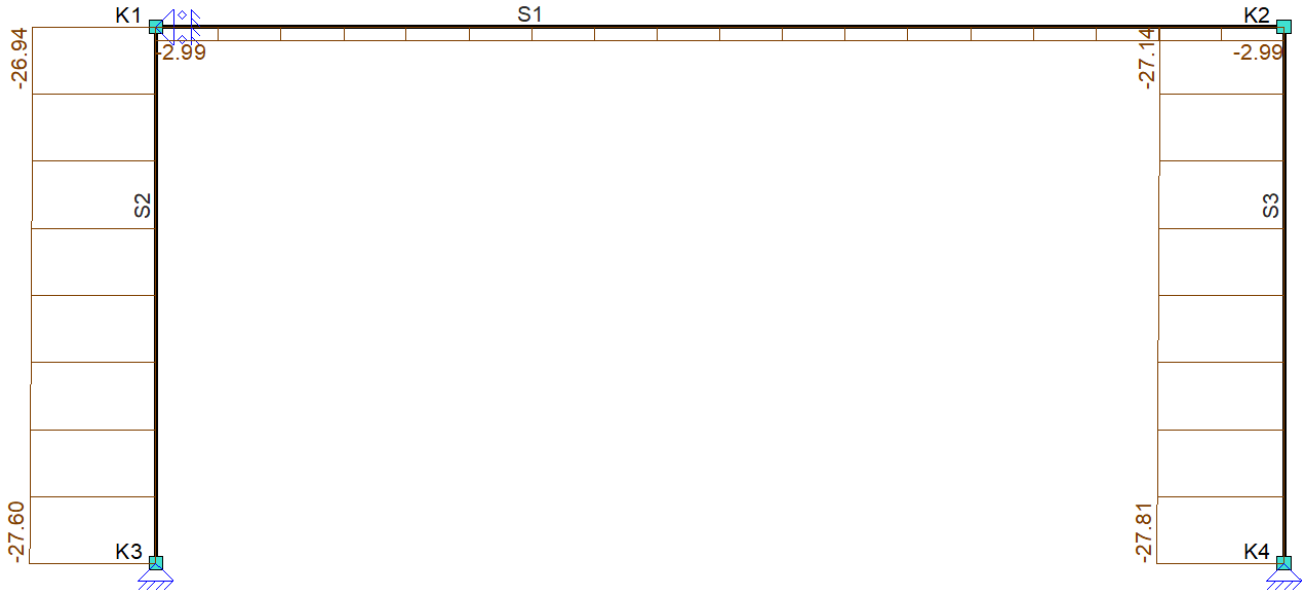
Fu.C. Omhullende Bending moments (My)



Fu.C. Omhullende Shear forces (Vz)



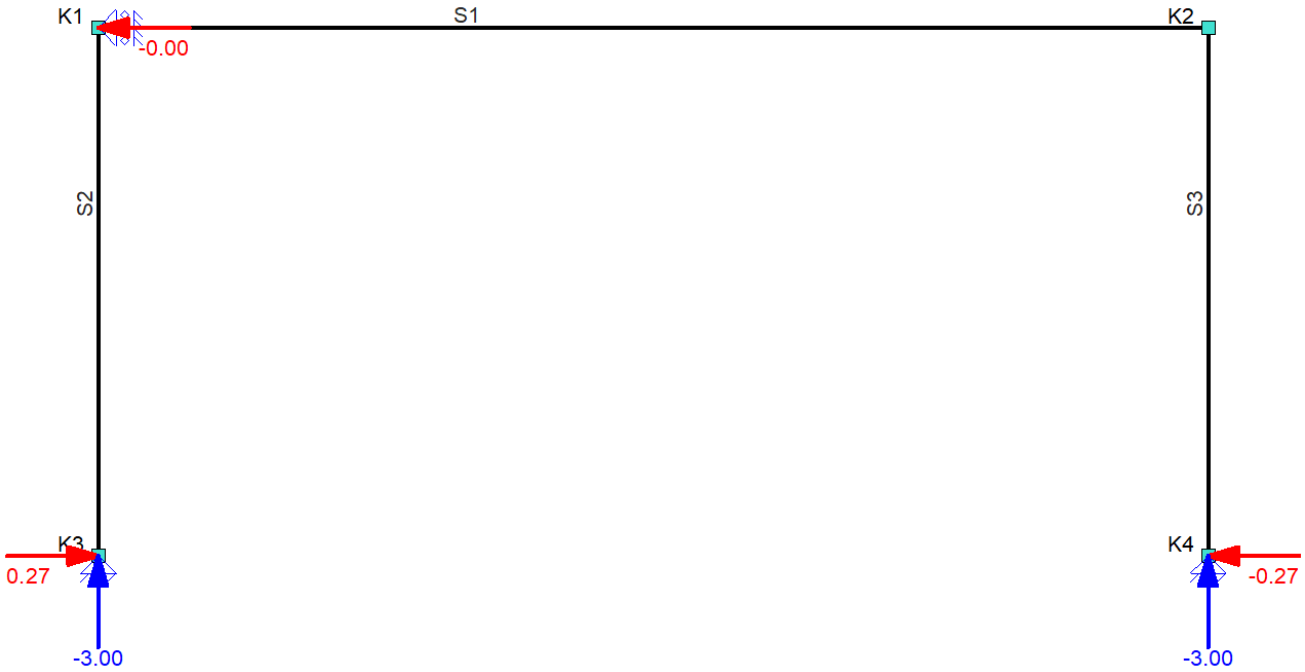
Fu.C. Omhullende Axial forces (Nx)



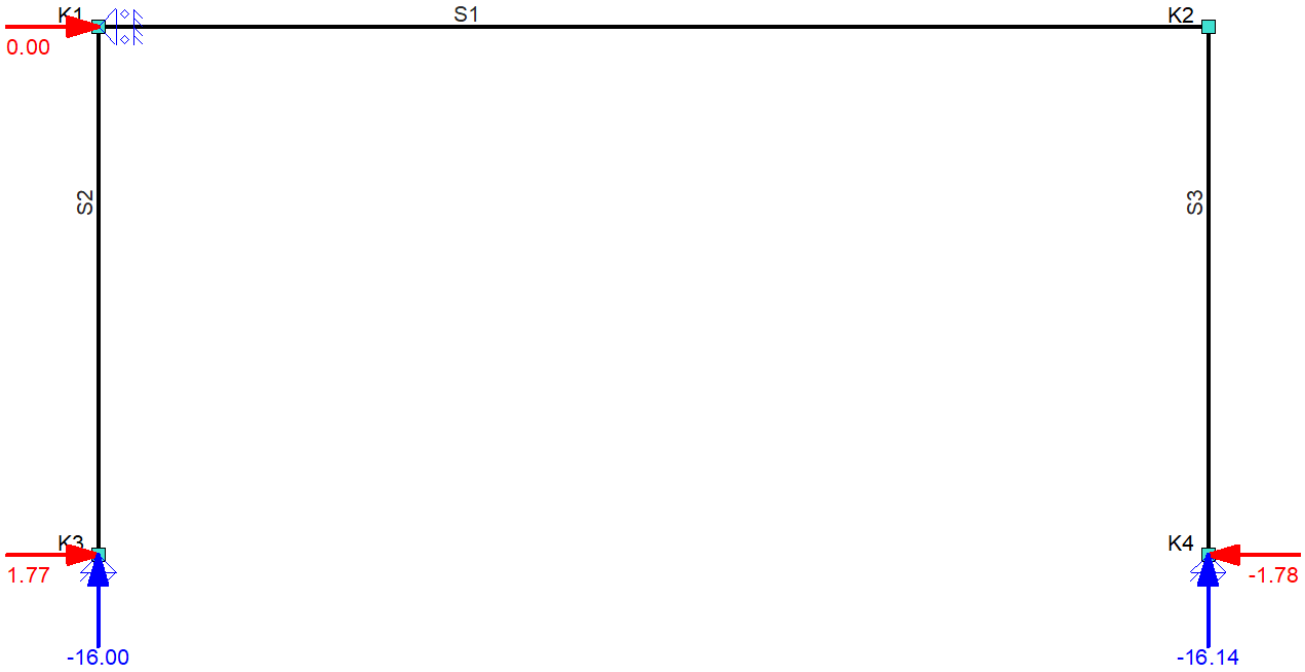
ENVELOPE (PERSISTENT)

Member	Nx-	Nx+	$Nx\text{-}_{max}$	$Nx+_{min}$	Vz-	Vz+	My-	My+
S1	-2.99	0.00	-1.43	0.00	**-27.14**	**26.94**	-7.77	**29.21**
S2	-27.60	0.00	-12.90	0.00	-2.98	0.00	-0.00	7.76
S3	**-27.81**	0.00	**-12.99**	0.00	0.00	2.99	**-7.77**	0.00
	kN	**kN**	**kN**	**kN**	**kN**	**kN**	**kNm**	**kNm**

B.G.1 Support Reactions



B.G.2 Support Reactions

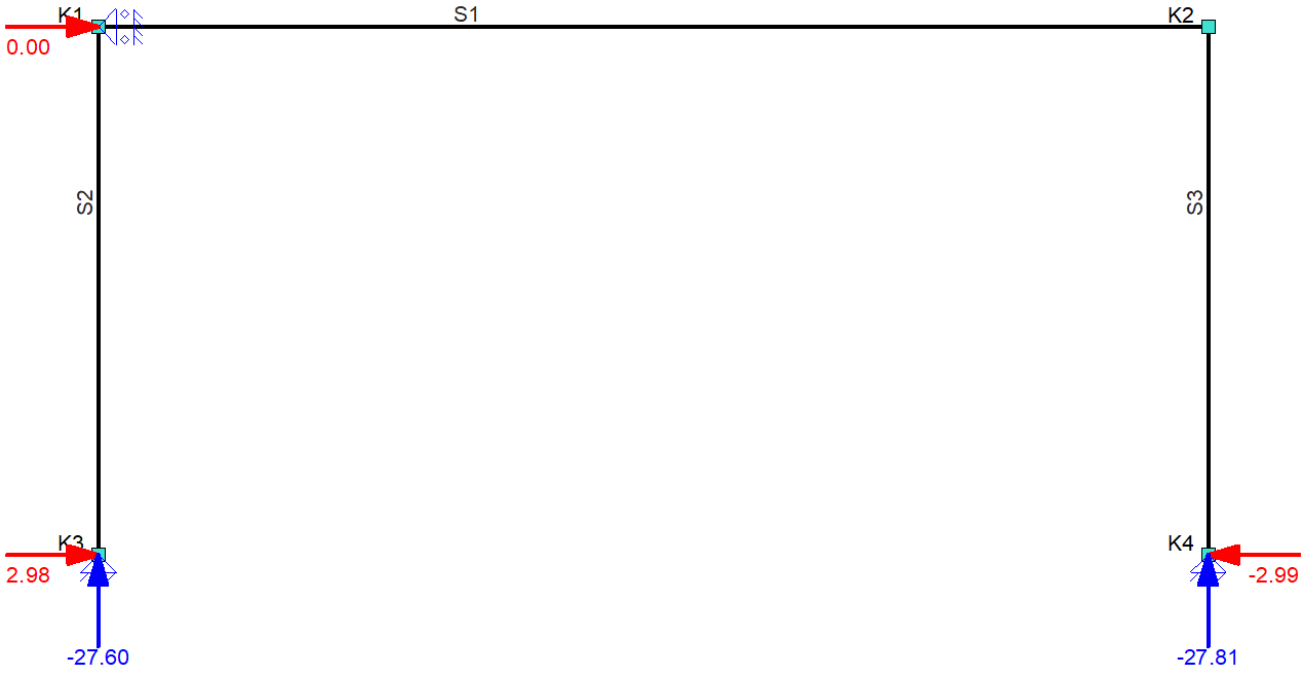


EXTREME SUPPORT REACTIONS (LOAD CASES)

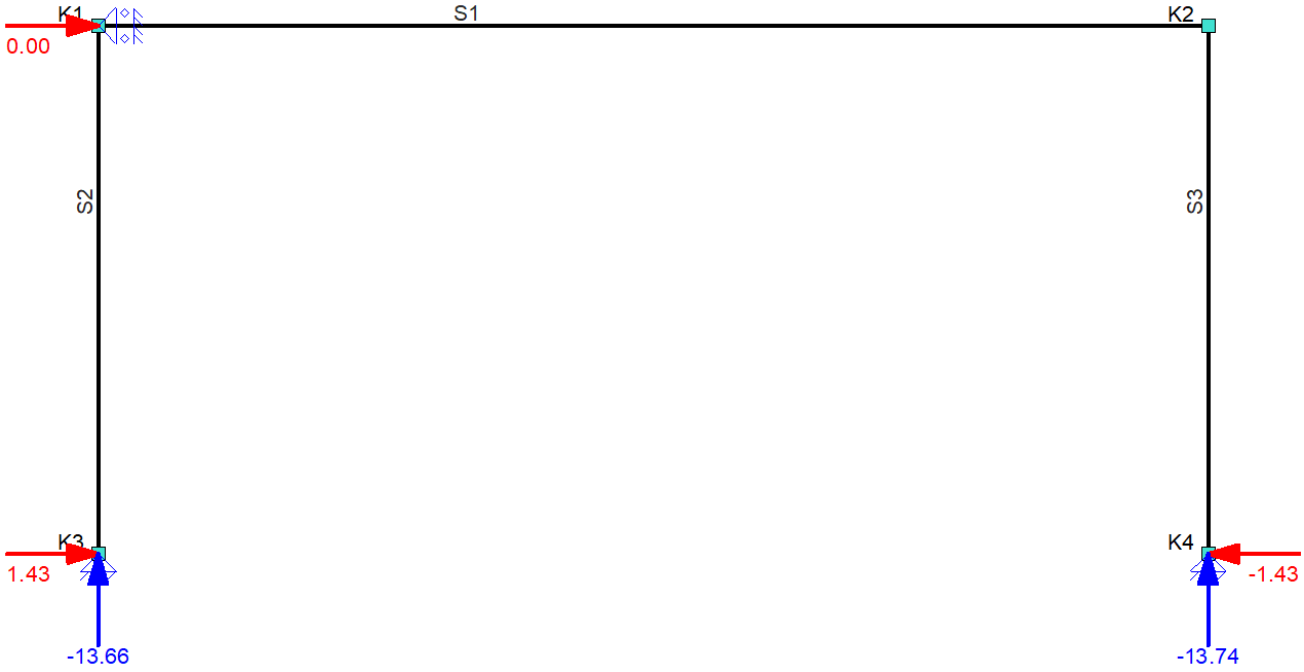
Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O3	K3	B.G.2	**1.77**	-16.00	0.00								
						B.G.2	1.77	**-16.00**	0.00				
O4	K4	B.G.2	**-1.78**	-16.14	0.00	B.G.2	-1.78	**-16.14**	0.00				
O5	K1	B.G.2	**0.00**	0.00	0.00								
		B.G.1	**-0.00**	0.00	0.00								
Global extreme values													
O4	K4	B.G.2	**-1.78**	-16.14	0.00	B.G.2	-1.78	**-16.14**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O3	K3	B.G.2	**1.77**	-16.00	0.00								
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Fu.C.1 Support Reactions



Fu.C.2 Support Reactions

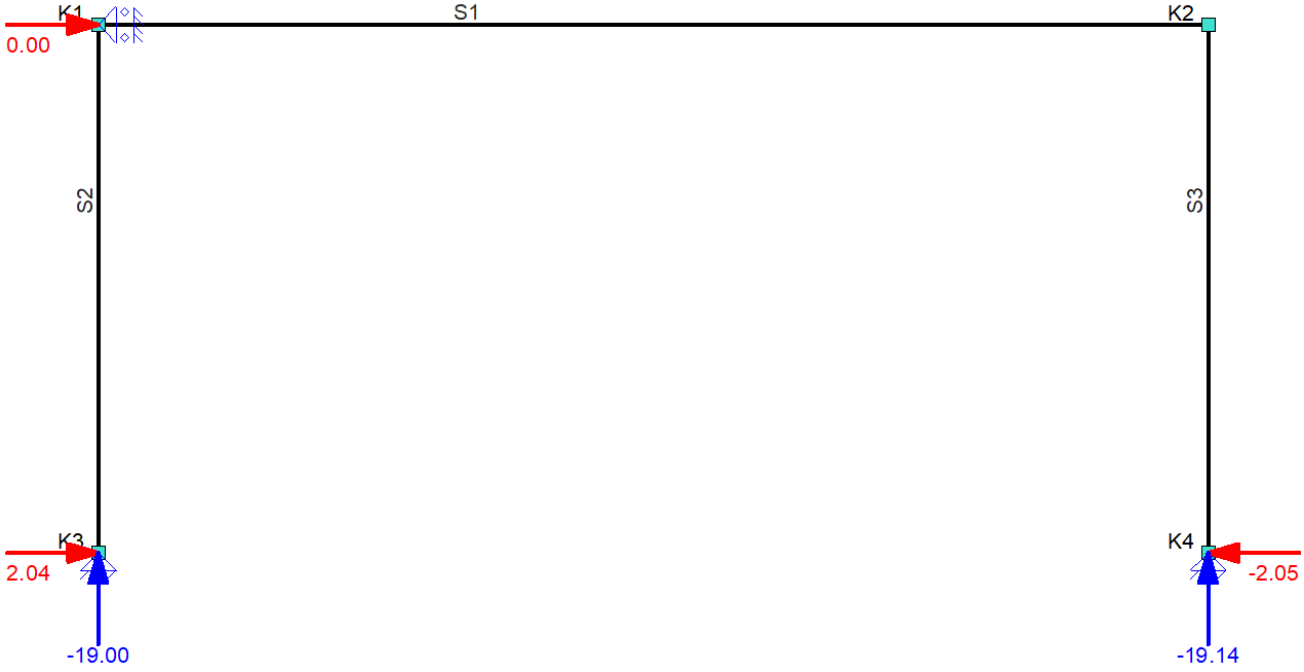


EXTREME SUPPORT REACTIONS (PERSISTENT)

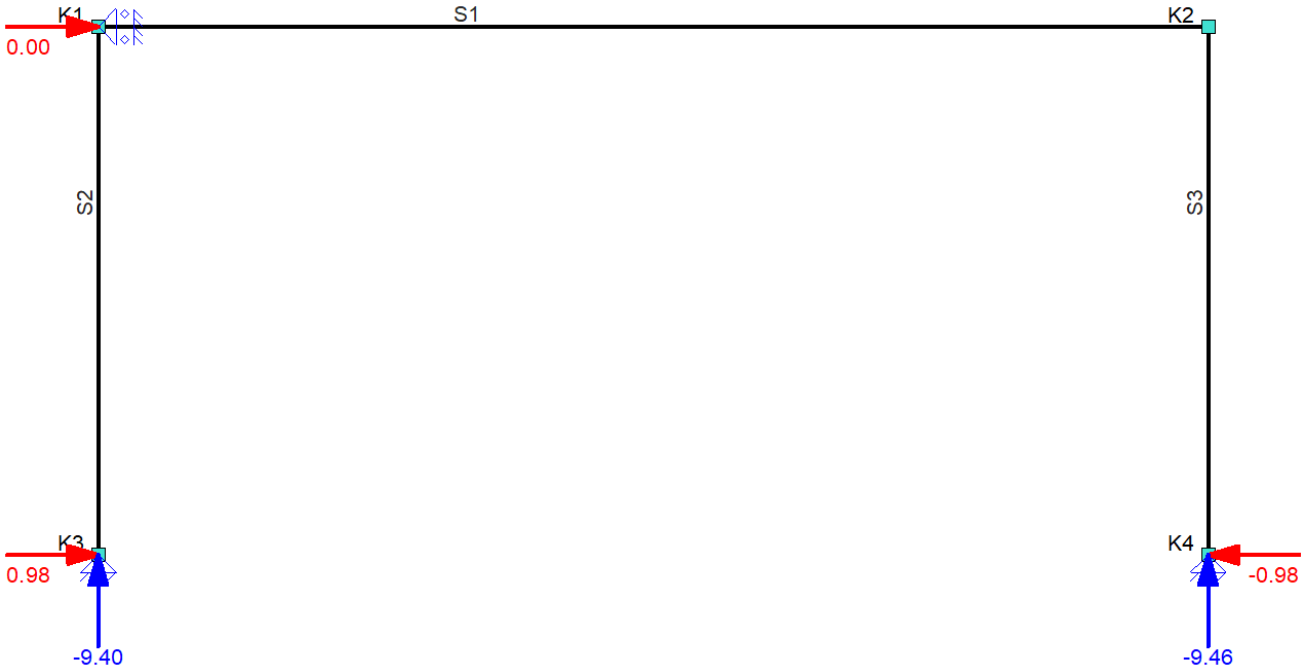
Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O3	K3	Fu.C.1	**2.98**	-27.60	0.00								
						Fu.C.1	2.98	**-27.60**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O4	K4	Fu.C.1	**-2.99**	-27.81	0.00	Fu.C.1	-2.99	**-27.81**	0.00				
O5	K1	Fu.C.1	**0.00**	0.00	0.00								
Global extreme values													
O4	K4	Fu.C.1	**-2.99**	-27.81	0.00	Fu.C.1	-2.99	**-27.81**	0.00				
O3	K3	Fu.C.1	**2.98**	-27.60	0.00								
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Ka.C.1 Support Reactions



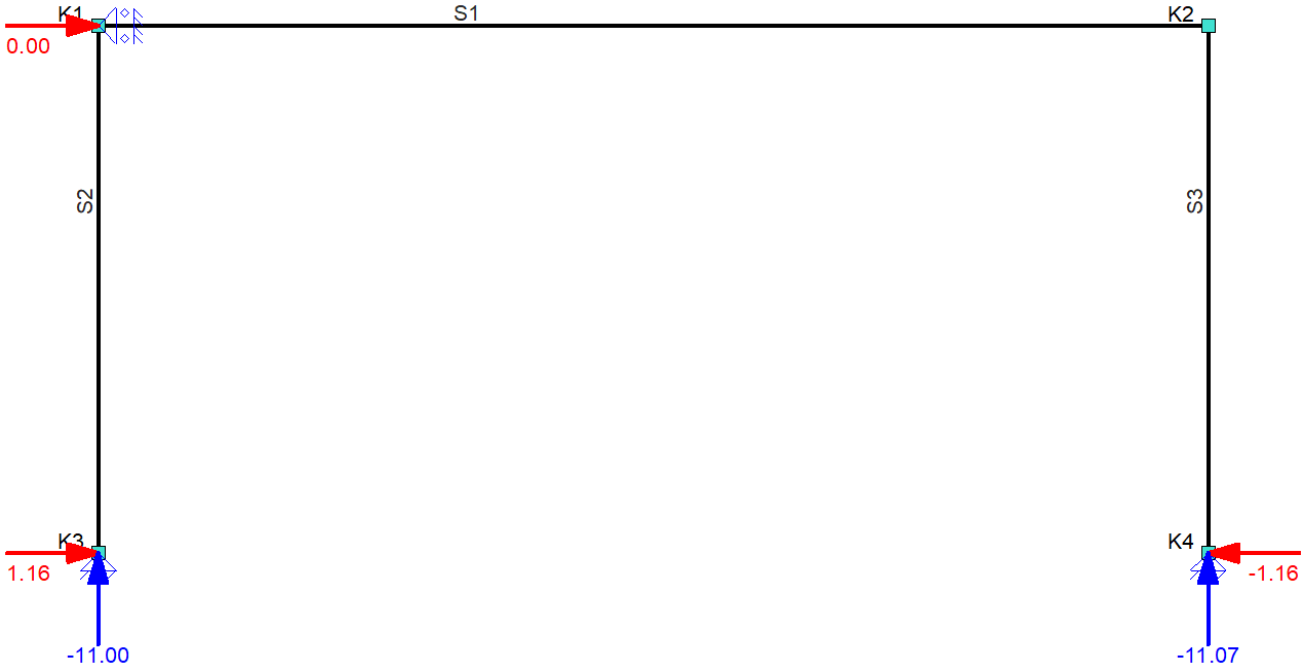
Ka.C.2 Support Reactions



EXTREME SUPPORT REACTIONS (CHARACTERISTIC)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O3	K3	Ka.C.1	**2.04**	-19.00	0.00								
						Ka.C.1	2.04	**-19.00**	0.00				
O4	K4	Ka.C.1	**-2.05**	-19.14	0.00	Ka.C.1	-2.05	**-19.14**	0.00				
O5	K1	Ka.C.1	**0.00**	0.00	0.00								
		Ka.C.(w1)	**-0.00**	0.00	0.00								
Global extreme values													
O4	K4	Ka.C.1	**-2.05**	-19.14	0.00	Ka.C.1	-2.05	**-19.14**	0.00				
O3	K3	Ka.C.1	**2.04**	-19.00	0.00								
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

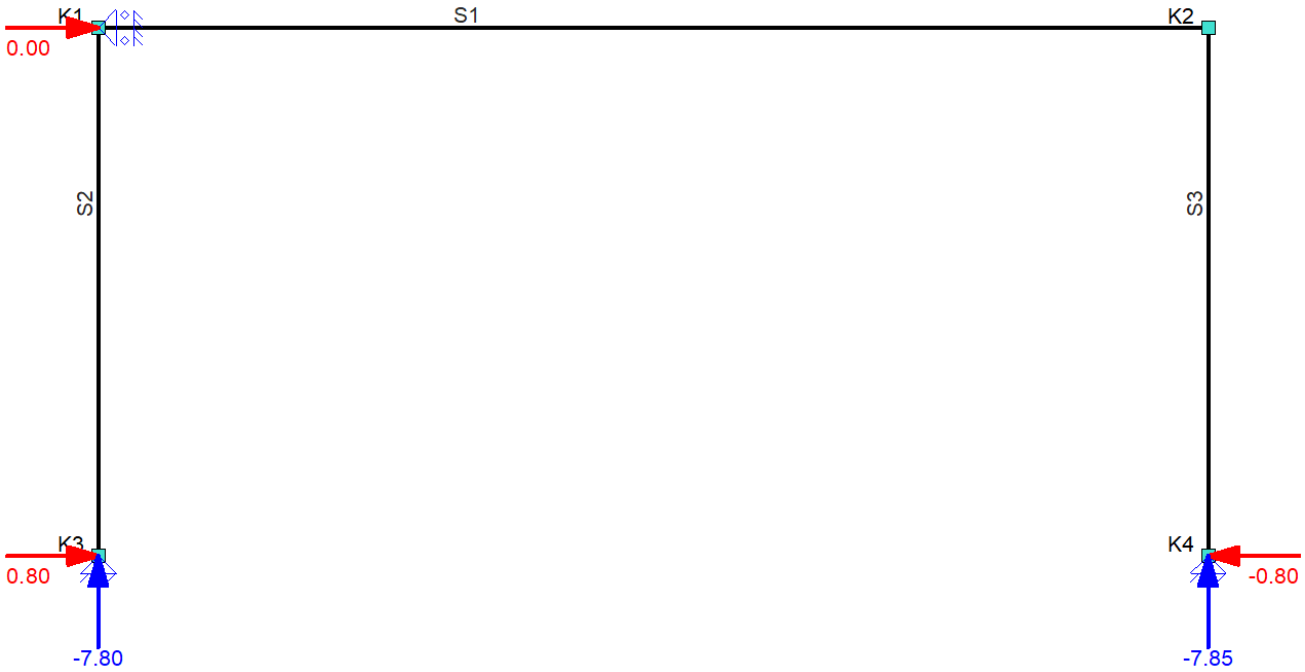
Fr.C.1 Support Reactions



EXTREME SUPPORT REACTIONS (FREQUENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O3	K3	Fr.C.1	**1.16**	-11.00	0.00								
						Fr.C.1	1.16	**-11.00**	0.00				
O4	K4	Fr.C.1	**-1.16**	-11.07	0.00	Fr.C.1	-1.16	**-11.07**	0.00				
O5	K1	Fr.C.1	**0.00**	0.00	0.00								
		Fr.C.(w1)	**-0.00**	0.00	0.00								
Global extreme values													
O4	K4	Fr.C.1	**-1.16**	-11.07	0.00	Fr.C.1	-1.16	**-11.07**	0.00				
O3	K3	Fr.C.1	**1.16**	-11.00	0.00								
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Qu.C.1 Support Reactions



EXTREME SUPPORT REACTIONS (QUASI-PERMANENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O3	K3	Qu.C.1	**0.80**	-7.80	0.00								
						Qu.C.1	0.80	**-7.80**	0.00				
O4	K4	Qu.C.1	**-0.80**	-7.85	0.00	Qu.C.1	-0.80	**-7.85**	0.00				
O5	K1	Qu.C.1	**0.00**	0.00	0.00								
Global extreme values													
O4	K4	Qu.C.1	**-0.80**	-7.85	0.00	Qu.C.1	-0.80	**-7.85**	0.00				
O3	K3	Qu.C.1	**0.80**	-7.80	0.00								
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

STRUCTURAL MEMBERS

Structural member	Member (s)
C1	S1
C2	S2
C3	S3

STEEL CODECHECK RESULTS

NEN-EN1993-1-1:2016/NB:2016

Assumptions of Analysis for steel codecheck
Alpha;cr = 65.15 > 10;

CROSS-SECTION (#6.2)

Member C1-V1 (0.000-5.470)

Decisive combination		Fu.C.1		Section class			1	
Decisive position		2.735	m					
Axial force	N_{Ed}	-2.99	kN	Design resistance	(6.10)	N_{Rd}	1063.41	kN
Bending moment	$M_{y,Ed}$	29.21	kNm	Design resistance	(6.13)	$M_{y,Rd}$	76.34	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm	Design resistance	(6.13)	$M_{z,Rd}$	36.78	kNm
Shear force	$V_{y,Ed}$	0.00	kN	Design resistance	(6.18)	$V_{y,Rd}$	490.22	kN
Shear force	$V_{z,Ed}$	0.05	kN	Design resistance	(6.18)	$V_{z,Rd}$	196.34	kN

Bending and shear #6.2.8

Ratio	0.0 %	Ratio	0.0 %
Is reduction needed?	No	Is reduction needed?	No

Bending and axial force #6.2.9

Is reduction needed?	No	Is reduction needed?	No

Type	Axis	Reference	Load combination	Position	Calculation	UC
Decisive cut						
Compression		NEN-EN1993-1-1(6.9)	Fu.C.1	2.735	-2.99 / 1063.41	0.00
Bending	Y	NEN-EN1993-1-1(6.12)	Fu.C.1	2.735	29.21 / 76.34	0.38
Bending	Z	NEN-EN1993-1-1(6.12)	Fu.C.1	2.735	0.00 / 36.78	0.00
Shear	Y	NEN-EN1993-1-1(6.17)	Fu.C.1	2.735	0.00 / 490.22	0.00
Shear	Z	NEN-EN1993-1-1(6.17)	Fu.C.1	2.735	0.05 / 196.34	0.00
				m		

BUCKLING (#6.3.1)

Member C1-V1 (0.000-5.470)

Section			HE180A	Section class			1
Decisive combination			Fu.C.1				
Field			0.000 - 5.470 m	Field			0.000 - 5.470 m
Axial force		$N_{Ed,y}$	-2.99 kN	Axial force		$N_{Ed,z}$	-2.99 kN
Length		$L_{cr,y}$	5.470 m	Length		$L_{cr,z}$	5.470 m
Elastic critical force		$N_{cr,y}$	1738.87 kN	Elastic critical force		$N_{cr,z}$	640.47 kN
Slenderness		λ_y	0.782	Slenderness		λ_z	1.289
Buckling curve	Table 6.2		b	Buckling curve	Table 6.2		c
Imperfection factor	Table 6.1	α_y	0.340	Imperfection factor	Table 6.1	α_z	0.490
		Φ_y	0.905			Φ_z	1.597
Reduction factor	(6.49)	χ_y	0.735	Reduction factor	(6.49)	χ_z	0.394
Design resistance	(6.47)	$N_{b,Rd,y}$	782.12 kN	Design resistance	(6.47)	$N_{b,Rd,z}$	418.65 kN

NEN-EN1993-1-1(6.46): UC = 0.01

LATERAL BUCKLING (#6.3.2)

Member C1-V1 (0.000-5.470)

Equivalent section	HE180A	Section class	1
$M_{y,Rd}$	76.34 kNm	$M_{z,Rd}$	36.78 kNm
Decisive combination	Fu.C.1	Load attachment position from center	0.000 m
Lateral buckling supports	None		

Field

Field begin			0.000 m	Moment (begin)		M_y	-7.76 kNm
Field end			5.470 m	Moment (end)		M_y	-7.77 kNm
Length		L	5.470 m	Moment (max)		M_y	29.21 kNm
Decisive flange			Upper	Moment (max)		M_z	0.00 kNm

Elastic critical moment for lateral-torsional buckling (NEN-EN 1993-1-1+C2+A1:2016 NB.NB.4)

Table used			NB.NB.4	Moment		M	7.77 kNm
Load		q	9.89 kN/m	Length		L_{st}	5.470 m
		B*	-0.17	Length		L_{st}	5.470 m
		β	0.999	Length		L_{kip}	5.470 m
	(NB.NB.12)	S	1.029 m				
Coefficient		C_1	1.162	Coefficient		C_2 (Table)	0.600
Coefficient		C_2 (Calculated)	0.000	Length		L_g	5.470 m
Coefficient	(NB.NB.11)	C	4.240	Reduction factor	(NB.NB.7)	K_{red}	1.000
	(NB.NB.6)	M_{cr}	118.07 kNm				

Lateral torsional buckling curve #6.3.2.2

Slenderness		λ_{LT}	0.804	Buckling curve	Table 6.4		a
Imperfection factor	Table 6.3	α_{LT}	0.210			Φ_{LT}	0.887
Reduction factor	(6.56)	$\chi_{LT,y}$	0.793				
Reduction factor		$\chi_{LT,z}$	1.000				
Design resistance	(6.55)	$M_{b,Rd,y}$	60.57 kNm				
Design resistance	(6.55)	$M_{b,Rd,z}$	36.78 kNm				

NEN-EN1993-1-1(6.54): UC = 0.48

BENDING AND AXIAL COMPRESSION (#6.3.3)

Member C1-V1 (0.000-5.470)

Section	HE180A	Section class	1
Decisive combination	Fu.C.1		

Equivalent uniform moment factors (Table B.3)

C_{my}		**C_{mz}**		**C_{mLT}**	
M	-7.77 kNm	M	0.00 kNm	M	-7.77 kNm
ψM	-7.76 kNm	ψM	0.00 kNm	ψM	-7.76 kNm
M_s	29.21 kNm	ψ	1.000	M_s	29.21 kNm
ψ	0.999	Load	Concentrated	ψ	0.999
α_h	-0.266	C_{mz}	1.000	α_h	-0.266
Load	Uniform			Load	Uniform
C_{my}	0.937			C_{mLT}	0.937

Interaction factors (Table B.2)

	k_{yy}	0.939		k_{yz}	0.606
	k_{zy}	0.999		k_{zz}	1.010

Field			0.000 - 5.470 m	Field			0.000 - 5.470 m
Axial force		$N_{y,Ed}$	-2.99 kN	Axial force		$N_{z,Ed}$	-2.99 kN
Length		$L_{y,cr}$	5.470 m	Length		$L_{z,cr}$	5.470 m
Reduction factor	(6.49)	χ_y	0.735	Reduction factor	(6.49)	χ_z	0.394
Design resistance		N_{Rk}	1063.41 kN				
Field			0.000 - 5.470 m	Field			0.000 - 5.470 m
Bending moment		$M_{y,Ed}$	29.21 kNm	Bending moment		$M_{z,Ed}$	0.00 kNm
Bending moment		$\Delta M_{y,Ed}$	0.00 kNm	Bending moment		$\Delta M_{z,Ed}$	0.00 kNm
Design resistance		$M_{y,Rk}$	76.34 kNm	Design resistance		$M_{z,Rk}$	36.78 kNm
Reduction factor		χ_{LT}	0.793				

NEN-EN1993-1-1(6.61): UC = 0.46
NEN-EN1993-1-1(6.62): UC = 0.49

DEFLECTIONS

Member C1-V1 (0.000-5.470)

Structure type	Floor	Camber function	Parabolic
Check Type	General	Camber	w_c 0 mm

w_{max}

Axis	Position	w_1	L.C.	w_3	L.C.	w_{tot}	w_c	w	Limit (L/250)	UC
Z'	2.736	1.5	Fr.C.(w1)	2.9	Qu.C.1	4.4	0.0	4.4	21.9	0.20
Z''	2.736	1.5	Fr.C.(w1)	2.9	Qu.C.1	4.4	0.0	4.4	21.9	0.20
	m	**mm**		**mm**		**mm**	**mm**	**mm**	**mm**	

(w_2+w_3)

Axis	Position	w_3	L.C.	w	Abs. limit	Limit (L/333)	UC
Z'	2.739	4.9	Fr.C.1	4.9	0.0	16.4	0.30
Z''	2.735	4.9	Fr.C.1	4.9	0.0	16.4	0.30
	m	mm		mm	mm	mm	

CROSS-SECTION (#6.2)

Member C2-V1 (0.000-2.600)

Decisive combination			Fu.C.1		Section class			1
Decisive position			0.000	m				
Axial force		N_{Ed}	-26.94	kN	Design resistance	(6.10)	N_{Rd}	967.11 kN
Bending moment		$M_{y,Ed}$	7.76	kNm	Design resistance	(6.13)	$M_{y,Rd}$	32.32 kNm
Bending moment		$M_{z,Ed}$	0.00	kNm	Design resistance	(6.13)	$M_{z,Rd}$	32.32 kNm
Shear force		$V_{y,Ed}$	0.00	kN	Design resistance	(6.18)	$V_{y,Rd}$	279.18 kN
Shear force		$V_{z,Ed}$	-2.98	kN	Design resistance	(6.18)	$V_{z,Rd}$	279.18 kN

Bending and shear #6.2.8

5.1, 2, e			.1	%	Ratio			0.0 %
Is reduction needed?			No		Is reduction needed?			No

Bending and axial force #6.2.9

Is reduction needed?			Yes		Is reduction needed?			No
		n	0.028					
		a	0.413					
Design resistance		$M_{pl,y,Rd}$	32.32	kNm				
Design resistance	(6.39)	$M_{N,y,Rd}$	32.32	kNm				

Type	Axis	Reference	Load combination	Position	Calculation	UC
Decisive cut						
Compression		NEN-EN1993-1-1(6.9)	Fu.C.1	0.000	-26.94 / 967.11	0.03
Bending	Y	NEN-EN1993-1-1(6.12)	Fu.C.1	0.000	7.76 / 32.32	0.24
Bending	Z	NEN-EN1993-1-1(6.12)	Fu.C.1	0.000	0.00 / 32.32	0.00
Shear	Y	NEN-EN1993-1-1(6.17)	Fu.C.1	0.000	0.00 / 279.18	0.00
Shear	Z	NEN-EN1993-1-1(6.17)	Fu.C.1	0.000	-2.98 / 279.18	0.01
Bending, axial	Y	NEN-EN1993-1-1(6.31)	Fu.C.1	0.000	7.76 / 32.32	0.24
				m		

BUCKLING (#6.3.1)

Member C2-V1 (0.000-2.600)

Section			KK100/8		Section class			1
Decisive combination			Fu.C.1					
Field			0.000 - 2.600	m	Field			0.000 - 2.600 m
Axial force		$N_{Ed,y}$	-27.60	kN	Axial force		$N_{Ed,z}$	-27.60 kN
Length		$L_{cr,y}$	2.600	m	Length		$L_{cr,z}$	2.600 m
Elastic critical force		$N_{cr,y}$	1121.98	kN	Elastic critical force		$N_{cr,z}$	1121.98 kN
Slenderness		λ_y	0.928		Slenderness		λ_z	0.928
Buckling curve	Table 6.2		c		Buckling curve	Table 6.2		c
Imperfection factor	Table 6.1	α_y	0.490		Imperfection factor	Table 6.1	α_z	0.490
		Φ_y	1.109				Φ_z	1.109
Reduction factor	(6.49)	χ_y	0.582		Reduction factor	(6.49)	χ_z	0.582
Design resistance	(6.47)	$N_{b,Rd,y}$	563.31	kN	Design resistance	(6.47)	$N_{b,Rd,z}$	563.31 kN

NEN-EN1993-1-1(6.46): UC = 0.05

LATERAL BUCKLING (#6.3.2)

Member C2-V1 (0.000-2.600)

Equivalent section			KK100/8		Section class		1
$M_{y,Rd}$			32.32 kNm		$M_{z,Rd}$		32.32 kNm
Decisive combination			Fu.C.2		Load attachment position from center		0.000 m
Lateral buckling supports			None				

Field

Field begin			0.000 m		Moment (begin)	M_y	3.72 kNm
Field end			2.600 m		Moment (end)	M_y	-0.00 kNm
Length		L	2.600 m		Moment (max)	M_y	3.72 kNm
Decisive flange			Upper		Moment (max)	M_z	0.00 kNm

Elastic critical moment for lateral-torsional buckling (NEN-EN 1993-1-1+C2+A1:2016 NB.NB.4)

Table used			NB.NB.1 (1)			β	-0.00
Length		L_{st}	2.600 m			β	-0.000
Length		L_{kip}	2.600 m		(NB.NB.12)	S	0.057 m
Coefficient		C_1	1.750		Coefficient	C_2 (Table)	0.000
Coefficient		C_2 (Calculated)	0.000		Length	L_g	2.600 m
Coefficient	(NB.NB.11)	C	5.511		Reduction factor	K_{red}	0.000
	(NB.NB.6)	M_{cr}	0.00 kNm				

Design resistance	(6.55)	$M_{b,Rd,y}$	32.32 kNm
Design resistance	(6.55)	$M_{b,Rd,z}$	32.32 kNm

Lat.buc.N/A: hollow section NEN-EN 1993-1-1 #6.3.2.1(2)
NEN-EN1993-1-1(6.54): UC = 0.00

BENDING AND AXIAL COMPRESSION (#6.3.3)

Member C2-V1 (0.000-2.600)

Section	KK100/8	Section class	1
Decisive combination	Fu.C.1		

Equivalent uniform moment factors (Table B.3)

C_{my}		**C_{mz}**		**C_{mLT}**	
M	7.76 kNm	M	0.00 kNm	M	7.76 kNm
ψM	-0.00 kNm	ψM	0.00 kNm	ψM	-0.00 kNm
M_s	3.88 kNm	ψ	1.000	M_s	3.88 kNm
ψ	-0.000	Load	Concentrated	ψ	-0.000
α_s	0.500	C_{mz}	1.000	α_s	0.500
Load	Uniform			Load	Uniform
C_{my}	0.600			C_{mLT}	0.600

Interaction factors (Table B.1)

		k_{yy}	0.621			k_{yz}	0.621
		k_{zy}	0.373			k_{zz}	1.036
Field			0.000 - 2.600 m	Field			0.000 - 2.600 m
Axial force		$N_{y,Ed}$	-27.60 kN	Axial force		$N_{z,Ed}$	-27.60 kN
Length		$L_{y,cr}$	2.600 m	Length		$L_{z,cr}$	2.600 m
Reduction factor	(6.49)	χ_y	0.582	Reduction factor	(6.49)	χ_z	0.582
Design resistance		N_{Rk}	967.11 kN				
Field			0.000 - 2.600 m	Field			0.000 - 2.600 m
Bending moment		$M_{y,Ed}$	7.76 kNm	Bending moment		$M_{z,Ed}$	0.00 kNm
Bending moment		$\Delta M_{y,Ed}$	0.00 kNm	Bending moment		$\Delta M_{z,Ed}$	0.00 kNm
Design resistance		$M_{y,Rk}$	32.32 kNm	Design resistance		$M_{z,Rk}$	32.32 kNm
Reduction factor		χ_{LT}	1.000				

NEN-EN1993-1-1(6.61): UC = 0.20
NEN-EN1993-1-1(6.62): UC = 0.14

DEFLECTIONS

Member C2-V1 (0.000-2.600)

Structure type	Column
Check Type	1 level

Axis	u	L.C.	$u_{i,max}$ Limit (H/300)	UC
X	0.0 mm	Ka.C.1	8.7 mm	0.00

CROSS-SECTION (#6.2)

Member C3-V1 (0.000-2.600)

Decisive combination			Fu.C.1		Section class			1
Decisive position			0.000	m				
Axial force		N_{Ed}	-27.14	kN	Design resistance	(6.10)	N_{Rd}	967.11 kN
Bending moment		$M_{y,Ed}$	-7.77	kNm	Design resistance	(6.13)	$M_{y,Rd}$	32.32 kNm
Bending moment		$M_{z,Ed}$	0.00	kNm	Design resistance	(6.13)	$M_{z,Rd}$	32.32 kNm
Shear force		$V_{y,Ed}$	0.00	kN	Design resistance	(6.18)	$V_{y,Rd}$	279.18 kN
Shear force		$V_{z,Ed}$	2.99	kN	Design resistance	(6.18)	$V_{z,Rd}$	279.18 kN
Bending and shear #6.2.8								
Ratio			1.1	%	Ratio			0.0 %
Is reduction needed?			No		Is reduction needed?			No
Bending and axial force #6.2.9								
Is reduction needed?			Yes		Is reduction needed?			No
		n	0.028					
		a	0.413					
Design resistance		$M_{pl,y,Rd}$	32.32	kNm				
Design resistance	(6.39)	$M_{N,y,Rd}$	32.32	kNm				

Type	Axis	Reference	Load combination	Position	Calculation	UC
Decisive cut						
Compression		NEN-EN1993-1-1(6.9)	Fu.C.1	0.000 m	-27.14 / 967.11	0.03
Bending	Y	NEN-EN1993-1-1(6.12)	Fu.C.1	0.000 m	-7.77 / 32.32	0.24
Bending	Z	NEN-EN1993-1-1(6.12)	Fu.C.1	0.000 m	0.00 / 32.32	0.00
Shear	Y	NEN-EN1993-1-1(6.17)	Fu.C.1	0.000 m	0.00 / 279.18	0.00
Shear	Z	NEN-EN1993-1-1(6.17)	Fu.C.1	0.000 m	2.99 / 279.18	0.01
Bending, axial	Y	NEN-EN1993-1-1(6.31)	Fu.C.1	0.000 m	7.77 / 32.32	0.24

BUCKLING (#6.3.1)

Member C3-V1 (0.000-2.600)

Section			KK100/8		Section class			1
Decisive combination			Fu.C.1					
Field			0.000 - 2.600	m	Field			0.000 - 2.600 m
Axial force		$N_{Ed,y}$	-27.81	kN	Axial force		$N_{Ed,z}$	-27.81 kN
Length		$L_{cr,y}$	2.600	m	Length		$L_{cr,z}$	2.600 m
Elastic critical force		$N_{cr,y}$	1121.98	kN	Elastic critical force		$N_{cr,z}$	1121.98 kN
Slenderness		λ_y	0.928		Slenderness		λ_z	0.928
Buckling curve	Table 6.2		c		Buckling curve	Table 6.2		c
Imperfection factor	Table 6.1	α_y	0.490		Imperfection factor	Table 6.1	α_z	0.490

		Φ_y	1.109			Φ_z	1.109
Reduction factor	(6.49)	χ_y	0.582	Reduction factor	(6.49)	χ_z	0.582
Design resistance	(6.47)	$N_{b,Rd,y}$	563.31 kN	Design resistance	(6.47)	$N_{b,Rd,z}$	563.31 kN

NEN-EN1993-1-1(6.46): UC = 0.05

LATERAL BUCKLING (#6.3.2)

Member C3-V1 (0.000-2.600)

Equivalent section	KK100/8	Section class	1
$M_{y,Rd}$	32.32 kNm	$M_{z,Rd}$	32.32 kNm
Decisive combination	Fu.C.2	Load attachment position from center	0.000 m
Lateral buckling supports	None		

Field

Field begin			0.000 m	Moment (begin)		M_y	-3.72 kNm
Field end			2.600 m	Moment (end)		M_y	-0.00 kNm
Length		L	2.600 m	Moment (max)		M_y	-0.00 kNm
Decisive flange			Upper	Moment (max)		M_z	0.00 kNm

Elastic critical moment for lateral-torsional buckling (NEN-EN 1993-1-1+C2+A1:2016 NB.NB.4)

Table used			NB.NB.1 (1)			β	0.00
Length		L_{st}	2.600 m			β	0.000
Length		L_{kip}	2.600 m		(NB.NB.12)	S	0.057 m
Coefficient		C_1	1.750	Coefficient		C_2 (Table)	0.000
Coefficient		C_2 (Calculated)	0.000	Length		L_g	2.600 m
Coefficient	(NB.NB.11)	C	5.511	Reduction factor		K_{red}	0.000
	(NB.NB.6)	M_{cr}	0.00 kNm				
Design resistance	(6.55)	$M_{b,Rd,y}$	32.32 kNm				
Design resistance	(6.55)	$M_{b,Rd,z}$	32.32 kNm				

Lat.buc.N/A: hollow section NEN-EN 1993-1-1 #6.3.2.1(2)

NEN-EN1993-1-1(6.54): UC = 0.00

BENDING AND AXIAL COMPRESSION (#6.3.3)

Member C3-V1 (0.000-2.600)

Section	KK100/8	Section class	1
Decisive combination	Fu.C.1		

Equivalent uniform moment factors (Table B.3)

C_{my}		C_{mz}		C_{mLT}	
M	-7.77 kNm	M	0.00 kNm	M	-7.77 kNm
ψM	-0.00 kNm	ψM	0.00 kNm	ψM	-0.00 kNm
M_s	-3.89 kNm	ψ	1.000	M_s	-3.89 kNm
ψ	0.000	Load	Concentrated	ψ	0.000
α_s	0.500	C_{mz}	1.000	α_s	0.500
Load	Uniform			Load	Uniform
C_{my}	0.600			C_{mLT}	0.600

Interaction factors (Table B.1)

	k_{yy}	0.622		k_{yz}	0.622
	k_{zy}	0.373		k_{zz}	1.036

Field			0.000 - 2.600 m	Field			0.000 - 2.600 m
Axial force		$N_{y,Ed}$	-27.81 kN	Axial force		$N_{z,Ed}$	-27.81 kN
Length		$L_{y,cr}$	2.600 m	Length		$L_{z,cr}$	2.600 m
Reduction factor	(6.49)	χ_y	0.582	Reduction factor	(6.49)	χ_z	0.582

Design resistance	N_{Rk}	967.11	kN				
Field		0.000 - 2.600	m	Field		0.000 - 2.600	m
Bending moment	$M_{y,Ed}$	7.77	kNm	Bending moment	$M_{z,Ed}$	0.00	kNm
Bending moment	$\Delta M_{y,Ed}$	0.00	kNm	Bending moment	$\Delta M_{z,Ed}$	0.00	kNm
Design resistance	$M_{y,Rk}$	32.32	kNm	Design resistance	$M_{z,Rk}$	32.32	kNm
Reduction factor	χ_{LT}	1.000					

NEN-EN1993-1-1(6.61): UC = 0.20
NEN-EN1993-1-1(6.62): UC = 0.14

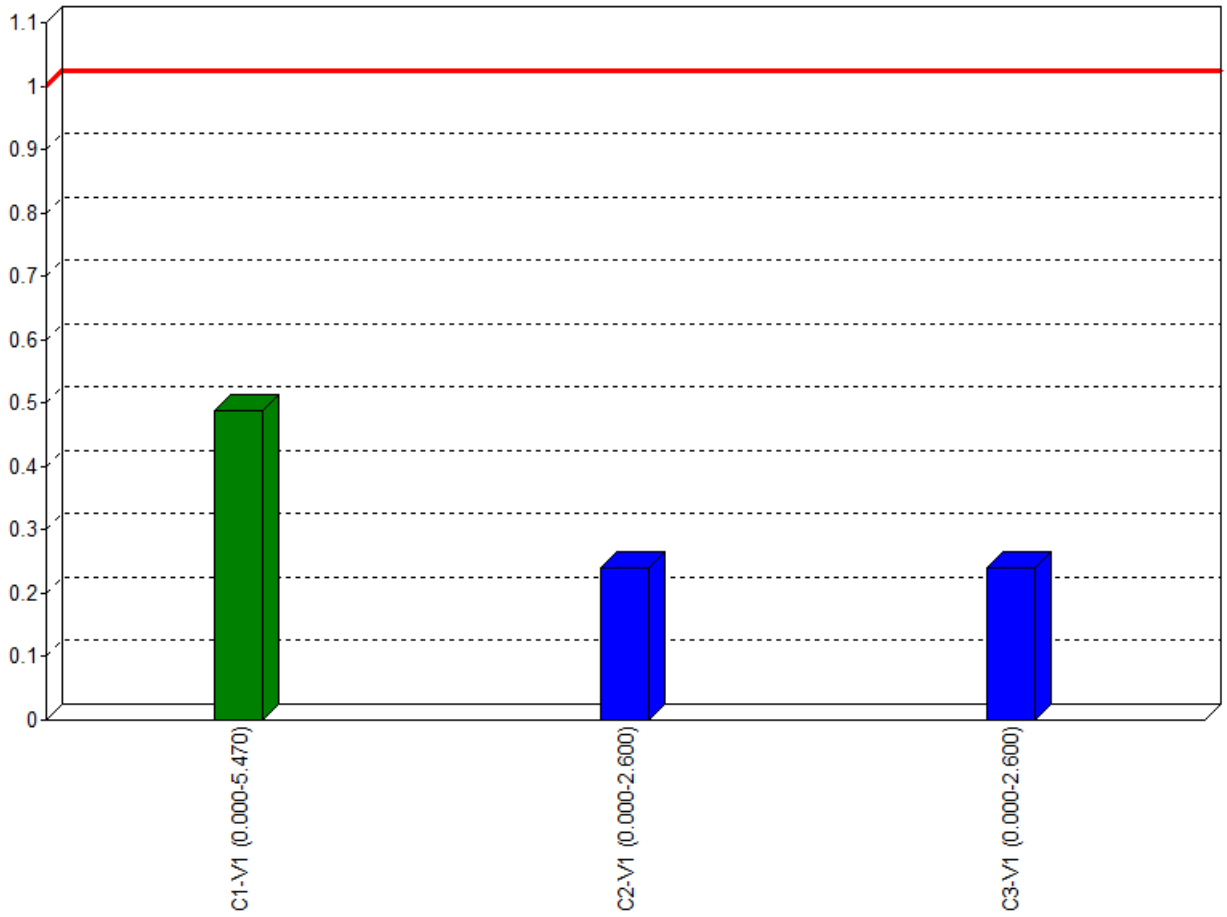
DEFLECTIONS

Member C3-V1 (0.000-2.600)

Structure type	Column
Check Type	1 level

Axis	u	L.C.	$u_{i,max}$ Limit (H/300)	UC
	mm		mm	
X	0.0	Ka.C.1	8.7	0.00

Pic. Steel UC Chart



EXTREME UNITY CHECK

Label	Check Type	Combination	Formula	Unity Check
C1-V1 (0.000-5.470)	Bending & Compression	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.49

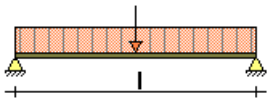
Label	Check Type	Combination	Formula	Unity Check
C2-V1 (0.000-2.600)	Cross	Fu.C.1	NEN-EN1993-1-1(6.31)	0.24
C3-V1 (0.000-2.600)	Cross	Fu.C.1	NEN-EN1993-1-1(6.31)	0.24

BUSSEL ENGINEERING

BIJLAGE 4

			5.1, 2, e
Projectomschrijving	**LOFI**	**Projectnummer**	
Onderdeel	**Dakliggers hout**	**Constructeur**	
Opdrachtgever	**LOFI**	**Eenheden**	**m, mm, kN, kNm**
Bestand	**C:\Users\Michiel\Desktop\Lofi\Liggers-hout.mxft**		

1. VLOER (NEN-EN1995:2011/NB:2013)



PROFIELGEGEVENS: HT-VR 120 X 120

Breedte	b	120	mm	Oppervlak	A	14400	mm²
Hoogte	h	120	mm				
				Traagheidsmoment	I_{tor}	2920e+04	mm⁴
Weerstandsmoment	W_y	2880e+02	mm³	Traagheidsmoment	I_y	1728e+04	mm⁴
Weerstandsmoment	W_z	2880e+02	mm³	Traagheidsmoment	I_z	1728e+04	mm⁴
Sterkte klasse		C18					
	$f_{m,0,k}$	18.0	N/mm²		$f_{c,0,k}$	18.0	N/mm²
	$f_{t,0,k}$	10.0	N/mm²		$f_{v,0,k}$	3.4	N/mm²
Elasticiteitsmodulus	$E_{0,mean}$	9000.0	N/mm²		G_{mean}	560.0	N/mm²
Klimaatklasse		II					
	k_h	1.05		I (Permanent)	k_{mod}	0.60	
	γ_M	1.30		II (Lange termijn)	k_{mod}	0.70	
	β_c	0.2		III (Middellange termijn)	k_{mod}	0.80	
Ontwerplevensduur		50	Jaar	IV (Korte termijn)	k_{mod}	0.90	
Betrouwbaarheidsklasse		2		V (Onmiddellijk)	k_{mod}	1.10	
Staaflengte	L_{sys}	1.500	m	Beschot kwaliteit		C24	
hoh afstand	L_t	0.600	m	Beschot dikte		18	mm
Zeeg		0	mm				
Doorbuigingen beschouwen		Ja					
Stootbelasting		Nee					
Reductiefactor spreiding		0.74					

LASTENGENERATOR OPTIES

Gebouwtype: GEBOUWEN MET MIDDELMATIG RISICO (CC2)
Referentieperiode: 50
Betrouwbaarheidsklasse: 2
Combinatieregels:
NEN-EN 1990 (6.10) N.v.t.
NEN-EN 1990 NB.4-A1.2(B) (6.10a+6.10b)
NEN-EN 1990 NB.7-A1.3 (Brand) (6.11 a/b)

BELASTINGEN

Permanent	Eigen gewicht	0.09	kN/m²	
	beschot	0.15	kN/m²	
	Totaal	**0.24**	**kN/m²**	
Opgelegd	q_k	5.00	kN/m²	(c_{prob} = 1.000)
	ψ_0	0.40		
	ψ_1	0.70		
	ψ_2	0.60		
	Q_k	7.00	kN	
Bijzonder	$F_{bijzonder}$	0.00	kN	

$p_{bijzonder}$	0.00 kN/m²	

BELASTINGSCOMBINATIES VOOR UITERSTE GRENSTOESTAND (6.10a + 6.10b)

Fu.C.1	p = γG·G_rep+γQ·Q_rep	1.35·0.24+0.60·5.00	3.33 kN/m²
Fu.C.2	p = γG·G_rep+γQ·Q_rep	1.20·0.24+1.50·5.00	7.79 kN/m²
Fu.C.3	p = γG·G_rep	1.35·0.24	0.33 kN/m²
	F = γQ·F_rep	0.60·7.00	4.20 kN
Fu.C.4	p = γG·G_rep	1.20·0.24	0.29 kN/m²
	F = γQ·F_rep	1.50·7.00	10.50 kN
Bi.C.1	p = γG·G_rep+γQ·Q_rep	1.00·0.24+0.60·5.00	3.24 kN/m²

MAATGEVENDE SNEDEKRACHTEN

Comb.	$N_{c,Ed}$ | $N_{t,Ed}$	$V_{y,Ed}$	$V_{z,Ed}$	$M_{y,Ed}$	$M_{z,Ed}$
Fu.C.1	0.00	0.00	1.50	0.56	0.00
Fu.C.2	0.00	0.00	3.51	1.31	0.00
Fu.C.3	0.00	0.00	4.35	1.23	0.00
Fu.C.4	0.00	0.00	10.63	2.97	0.00
Bi.C.1	0.00	0.00	1.46	0.55	0.00
	kN	**kN**	**kN**	**kNm**	**kNm**

MAX UC SNEDEKRACHT

Comb.	$N_{c,Ed}$ | $N_{t,Ed}$	$V_{y,Ed}$	$V_{z,Ed}$	$M_{y,Ed}$	$M_{z,Ed}$
Fu.C.1	0.00	0.00	0.00	0.56	0.00
Fu.C.2	0.00	0.00	0.00	1.31	0.00
Fu.C.3	0.00	0.00	1.56	1.23	0.00
Fu.C.4	0.00	0.00	3.90	2.97	0.00
Bi.C.1	0.00	0.00	0.00	0.55	0.00
	kN	**kN**	**kN**	**kNm**	**kNm**

REKENSPANNING

Comb.	$\sigma_{c,0,d}$ | $\sigma_{t,0,d}$	$\sigma_{m,y,d}$	$\sigma_{m,z,d}$	$\tau_{v,y,d}$	$\tau_{v,z,d}$
Fu.C.1	0.00	1.95	0.00	0.00	0.00
Fu.C.2	0.00	4.56	0.00	0.00	0.00
Fu.C.3	0.00	4.25	0.00	0.00	0.16
Fu.C.4	0.00	10.33	0.00	0.00	0.41
Bi.C.1	0.00	1.90	0.00	0.00	0.00
	N/mm²	**N/mm²**	**N/mm²**	**N/mm²**	**N/mm²**

REKENSTERKTE

Comb.	$f_{v,0,d}$	$f_{m,y,d}$	$f_{m,z,d}$	$f_{c,0,d}$	$f_{t,0,d}$	Belasting duurklasse
Fu.C.1	2.09	11.58	11.58	11.08	6.43	III (Middellange termijn)
Fu.C.2	2.09	11.58	11.58	11.08	6.43	III (Middellange termijn)
Fu.C.3	2.09	11.58	11.58	11.08	6.43	III (Middellange termijn)
Fu.C.4	2.09	11.58	11.58	11.08	6.43	III (Middellange termijn)
Bi.C.1	2.09	11.58	11.58	11.08	6.43	III (Middellange termijn)
	N/mm²	**N/mm²**	**N/mm²**	**N/mm²**	**N/mm²**	

UC DOORSNEDE PER BELASTINGSCOMBINATIE

Fu.C.1	NEN-EN1995-1-1#6.1.6 (6.11)	1.949 / 11.582+0.700·0.000 / 11.582	0.17	Ok
Fu.C.2	NEN-EN1995-1-1#6.1.6 (6.11)	4.564 / 11.582+0.700·0.000 / 11.582	0.39	Ok
Fu.C.3	NEN-EN1995-1-1#6.1.6 (6.11)	4.255 / 11.582+0.700·0.000 / 11.582	0.37	Ok
	NEN-EN1995-1-1#6.1.7 (6.13) (V_Z)	0.163 / 2.092	0.08	Ok
Fu.C.4	NEN-EN1995-1-1#6.1.6 (6.11)	10.329 / 11.582+0.700·0.000 / 11.582	0.89	Ok
	NEN-EN1995-1-1#6.1.7 (6.13) (V_Z)	0.406 / 2.092	0.19	Ok
Bi.C.1	NEN-EN1995-1-1#6.1.6 (6.11)	1.899 / 11.582+0.700·0.000 / 11.582	0.16	Ok

BELASTINGSCOMBINATIES VOOR BRUIKBAARHEIDSGRENSTOESTAND

Ka.C.1	p = γG·G_rep+γQ·Q_rep	1.00·0.24+0.40·5.00	2.24 kN/m²
Ka.C.2	p = γG·G_rep+γQ·Q_rep	1.00·0.24+1.00·5.00	5.24 kN/m²
Qu.C.1	p = γG·G_rep+γQ·Q_rep	1.00·0.24+0.60·5.00	3.24 kN/m²
Ka.C.(w_1)	p = γG·G_rep	1.00·0.24	0.24 kN/m²

UC DOORBUIGINGEN PER BELASTINGSCOMBINATIE

L/250	Limiet w_{max}	6.0 mm	L/300	Limiet w_2+w_3	5.0 mm
E_{mean}	$E_{0,ser,d,inst}$	9000.0 N/mm²	E_{mean} / k_{def}	$E_{0,ser,d,cr}$	11250.0 N/mm²
			E-Mod / $E_{0,ser,d,cr}$		0.80
Ka.C.(w_1)	w_1	0.1 mm		w_c	0.0 mm
Qu.C.1	w_2	0.7 mm			

Comb.	w_3	w_{tot}	w_{max}	w_2+w_3	UC (w_{max})	UC (w_2+w_3)
Ka.C.1	0.5	1.2	1.2	1.2	0.20	0.23
Ka.C.2	1.3	2.0	2.0	1.9	0.33	0.39
	mm	**mm**	**mm**	**mm**		

MAATGEVENDE KRACHTEN (FU.C.4)

Normaalkracht	$N_{t,Ed}$	0.00 kN
Dwarskracht	$V_{y,Ed}$	0.00 kN
Dwarskracht	$V_{z,Ed}$	3.90 kN
Torsie	$M_{x,Ed}$	0.00 kNm
Moment	$M_{y,Ed}$	2.97 kNm
Moment	$M_{z,Ed}$	0.00 kNm

MAATGEVENDE DOORBUIGINGEN (KA.C.2)

Ka.C.(w_1)	w_1	0.1 mm
Qu.C.1	w_2	0.7 mm
Ka.C.2	w_3	1.3 mm
	w_{tot}	2.0 mm
	w_{max}	2.0 mm
	w_2+w_3	1.9 mm
	Limiet w_{max}	6.0 mm
	Limiet w_2+w_3	5.0 mm
	UC (w_{max})	0.33
	UC (w_2+w_3)	0.39

UITGEVOERDE CONTROLES

Doorsnede	NEN-EN1995-1-1#6.1.7 (6.13) (V_z)	1.107 / 2.092	0.53	Ok
Doorsnede	NEN-EN1995-1-1#6.1.6 (6.11)	10.329 / 11.582+0.700·0.000 / 11.582	0.89	Ok
Doorbuigingen	NEN6760#11.1: Nd >=0 ^ Md = 0	1.9 / 5.0	0.39	Ok

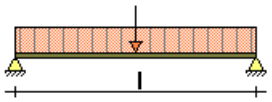
Ligger gecontroleerd op sterkte en doorbuiging
Ligger Ok

BUSSEL ENGINEERING

BIJLAGE 5

Projectomschrijving	**LOFI**	**Projectnummer**	
Onderdeel	**Dakliggers hout**	**Constructeur**	
Opdrachtgever	**LOFI**	**Eenheden**	**m, mm, kN, kNm**
Bestand	**C:\Users\Michiel\Desktop\Lofi\Liggers-hout.mxft**		

2. VLOER (NEN-EN1995:2011/NB:2013)



PROFIELGEGEVENS: HT-GS 69 X 194

Breedte	b	69	mm	Oppervlak	A	13386	mm²
Hoogte	h	194	mm				
				Traagheidsmoment	I_{tor}	1649e+04	mm⁴
Weerstandsmoment	W_y	4328e+02	mm³	Traagheidsmoment	I_y	4198e+04	mm⁴
Weerstandsmoment	W_z	1539e+02	mm³	Traagheidsmoment	I_z	5311e+03	mm⁴
Sterkte klasse		C24					
	$f_{m,0,k}$	24.0	N/mm²		$f_{c,0,k}$	21.0	N/mm²
	$f_{t,0,k}$	14.5	N/mm²		$f_{v,0,k}$	4.0	N/mm²
Elasticiteitsmodulus	$E_{0,mean}$	11000.0	N/mm²		G_{mean}	690.0	N/mm²
Klimaatklasse		II					
	k_h	1.00		I (Permanent)	k_{mod}	0.60	
	γ_M	1.30		II (Lange termijn)	k_{mod}	0.70	
	β_c	0.2		III (Middellange termijn)	k_{mod}	0.80	
Ontwerplevensduur		50	Jaar	IV (Korte termijn)	k_{mod}	0.90	
Betrouwbaarheidsklasse		2		V (Onmiddellijk)	k_{mod}	1.10	
Staaflengte	L_{sys}	2.000	m	Beschot kwaliteit		C24	
hoh afstand	L_t	0.800	m	Beschot dikte		18	mm
Zeeg		0	mm				
Doorbuigingen beschouwen		Ja					
Stootbelasting		Nee					
Reductiefactor spreiding		0.90					

LASTENGENERATOR OPTIES

Gebouwtype: GEBOUWEN MET MIDDELMATIG RISICO (CC2)
Referentieperiode: 50
Betrouwbaarheidsklasse: 2
Combinatieregels:
NEN-EN 1990 (6.10) N.v.t.
NEN-EN 1990 NB.4-A1.2(B) (6.10a+6.10b)
NEN-EN 1990 NB.7-A1.3 (Brand) (6.11 a/b)

BELASTINGEN

Permanent	Eigen gewicht	0.07	kN/m²	
	beschot	0.20	kN/m²	
	Totaal	**0.27**	**kN/m²**	
Opgelegd	q_k	5.00	kN/m²	(c_{prob} = 1.000)
	ψ_0	0.40		
	ψ_1	0.70		
	ψ_2	0.60		
	Q_k	7.00	kN	
Bijzonder	$F_{bijzonder}$	0.00	kN	

$p_{bijzonder}$	0.00 kN/m²	

BELASTINGSCOMBINATIES VOOR UITERSTE GRENSTOESTAND (6.10a + 6.10b)

Fu.C.1	p = γG·G_rep+γQ·Q_rep	1.35·0.27+0.60·5.00	3.36 kN/m²
Fu.C.2	p = γG·G_rep+γQ·Q_rep	1.20·0.27+1.50·5.00	7.82 kN/m²
Fu.C.3	p = γG·G_rep	1.35·0.27	0.36 kN/m²
	F = γQ·F_rep	0.60·7.00	4.20 kN
Fu.C.4	p = γG·G_rep	1.20·0.27	0.32 kN/m²
	F = γQ·F_rep	1.50·7.00	10.50 kN
Bi.C.1	p = γG·G_rep+γQ·Q_rep	1.00·0.27+0.60·5.00	3.27 kN/m²

MAATGEVENDE SNEDEKRACHTEN

Comb.	$N_{c,Ed}$ | $N_{t,Ed}$	$V_{y,Ed}$	$V_{z,Ed}$	$M_{y,Ed}$	$M_{z,Ed}$
Fu.C.1	0.00	0.00	2.69	1.35	0.00
Fu.C.2	0.00	0.00	6.26	3.13	0.00
Fu.C.3	0.00	0.00	4.49	2.04	0.00
Fu.C.4	0.00	0.00	10.76	4.87	0.00
Bi.C.1	0.00	0.00	2.62	1.31	0.00
	kN	**kN**	**kN**	**kNm**	**kNm**

MAX UC SNEDEKRACHT

Comb.	$N_{c,Ed}$ | $N_{t,Ed}$	$V_{y,Ed}$	$V_{z,Ed}$	$M_{y,Ed}$	$M_{z,Ed}$
Fu.C.1	0.00	0.00	0.00	1.35	0.00
Fu.C.2	0.00	0.00	0.00	3.13	0.00
Fu.C.3	0.00	0.00	1.90	2.04	0.00
Fu.C.4	0.00	0.00	4.74	4.87	0.00
Bi.C.1	0.00	0.00	0.00	1.31	0.00
	kN	**kN**	**kN**	**kNm**	**kNm**

REKENSPANNING

Comb.	$\sigma_{c,0,d}$ | $\sigma_{t,0,d}$	$\sigma_{m,y,d}$	$\sigma_{m,z,d}$	$\tau_{v,y,d}$	$\tau_{v,z,d}$
Fu.C.1	0.00	3.11	0.00	0.00	0.00
Fu.C.2	0.00	7.23	0.00	0.00	0.00
Fu.C.3	0.00	4.72	0.00	0.00	0.21
Fu.C.4	0.00	11.25	0.00	0.00	0.53
Bi.C.1	0.00	3.02	0.00	0.00	0.00
	N/mm²	**N/mm²**	**N/mm²**	**N/mm²**	**N/mm²**

REKENSTERKTE

Comb.	$f_{v,0,d}$	$f_{m,y,d}$	$f_{m,z,d}$	$f_{c,0,d}$	$f_{t,0,d}$	Belasting duurklasse
Fu.C.1	2.46	14.77	17.25	12.92	8.92	III (Middellange termijn)
Fu.C.2	2.46	14.77	17.25	12.92	8.92	III (Middellange termijn)
Fu.C.3	2.46	14.77	17.25	12.92	8.92	III (Middellange termijn)
Fu.C.4	2.46	14.77	17.25	12.92	8.92	III (Middellange termijn)
Bi.C.1	2.46	14.77	17.25	12.92	8.92	III (Middellange termijn)
	N/mm²	**N/mm²**	**N/mm²**	**N/mm²**	**N/mm²**	

UC DOORSNEDE PER BELASTINGSCOMBINATIE

Fu.C.1	NEN-EN1995-1-1#6.1.6 (6.11)	3.110 / 14.769+0.700·0.000 / 17.251	0.21	Ok
Fu.C.2	NEN-EN1995-1-1#6.1.6 (6.11)	7.231 / 14.769+0.700·0.000 / 17.251	0.49	Ok
Fu.C.3	NEN-EN1995-1-1#6.1.6 (6.11)	4.719 / 14.769+0.700·0.000 / 17.251	0.32	Ok
	NEN-EN1995-1-1#6.1.7 (6.13) (V_Z)	0.213 / 2.462	0.09	Ok
Fu.C.4	NEN-EN1995-1-1#6.1.6 (6.11)	11.254 / 14.769+0.700·0.000 / 17.251	0.76	Ok
	NEN-EN1995-1-1#6.1.7 (6.13) (V_Z)	0.531 / 2.462	0.22	Ok
Bi.C.1	NEN-EN1995-1-1#6.1.6 (6.11)	3.022 / 14.769+0.700·0.000 / 17.251	0.20	Ok

BELASTINGSCOMBINATIES VOOR BRUIKBAARHEIDSGRENSTOESTAND

Ka.C.1	p = γG·G_rep+γQ·Q_rep	1.00·0.27+0.40·5.00	2.27 kN/m²
Ka.C.2	p = γG·G_rep+γQ·Q_rep	1.00·0.27+1.00·5.00	5.27 kN/m²
Qu.C.1	p = γG·G_rep+γQ·Q_rep	1.00·0.27+0.60·5.00	3.27 kN/m²
Ka.C.(w_1)	p = γG·G_rep	1.00·0.27	0.27 kN/m²

UC DOORBUIGINGEN PER BELASTINGSCOMBINATIE

L/250	Limiet w_{max}	8.0 mm	L/300	Limiet w_2+w_3	6.7 mm	
E_{mean}	$E_{0,ser,d,inst}$	11000.0 N/mm²	E_{mean} / k_{def}	$E_{0,ser,d,cr}$	13750.0 N/mm²	
			E-Mod / $E_{0,ser,d,cr}$		0.80	
Ka.C.(w_1)	w_1	0.1 mm		w_c	0.0 mm	
Qu.C.1	w_2	0.9 mm				

Comb.	w_3	w_{tot}	w_{max}	w_2+w_3	UC (w_{max})	UC (w_2+w_3)
Ka.C.1	0.7	1.8	1.8	1.7	0.22	0.25
Ka.C.2	1.8	2.8	2.8	2.7	0.36	0.41
	mm	**mm**	**mm**	**mm**		

MAATGEVENDE KRACHTEN (FU.C.4)

Normaalkracht	$N_{t,Ed}$	0.00 kN
Dwarskracht	$V_{y,Ed}$	0.00 kN
Dwarskracht	$V_{z,Ed}$	4.74 kN
Torsie	$M_{x,Ed}$	0.00 kNm
Moment	$M_{y,Ed}$	4.87 kNm
Moment	$M_{z,Ed}$	0.00 kNm

MAATGEVENDE DOORBUIGINGEN (KA.C.2)

Ka.C.(w_1)	w_1	0.1 mm
Qu.C.1	w_2	0.9 mm
Ka.C.2	w_3	1.8 mm
	w_{tot}	2.8 mm
	w_{max}	2.8 mm
	w_2+w_3	2.7 mm
	Limiet w_{max}	8.0 mm
	Limiet w_2+w_3	6.7 mm
	UC (w_{max})	0.36
	UC (w_2+w_3)	0.41

UITGEVOERDE CONTROLES

Doorsnede	NEN-EN1995-1-1#6.1.7 (6.13) (V_z)	1.206 / 2.462	0.49	Ok
Doorsnede	NEN-EN1995-1-1#6.1.6 (6.11)	11.254 / 14.769+0.700·0.000 / 17.251	0.76	Ok
Doorbuigingen	NEN6760#11.1: Nd >=0 ^ Md = 0	2.7 / 6.7	0.41	Ok

Ligger gecontroleerd op sterkte en doorbuiging
Ligger Ok

BUSSEL ENGINEERING

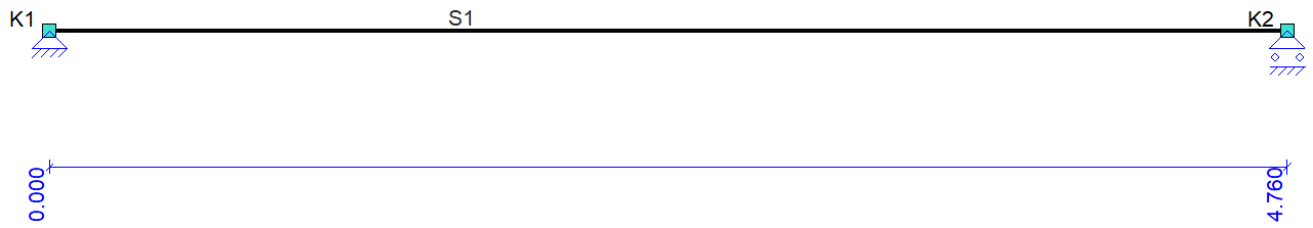
BIJLAGE 6

Project name	**LOFI**	**Project number**	**LOFI-2025**
Part description	**Ligger-Lockerroom**	**Structural engineer**	5.1, 2, e
Client	**LOFI**	**Units**	**m, mm, kN, kNm**
File	**C:\Users\Michiel\Desktop\Lofi\Ligger-locker.mxf**		

STRUCTURE INFO

Project Type	Nodes	Members	Supports	Sections	Loads Cases	Loads Combinations
2D-Frame	2	1	2	1	2	9

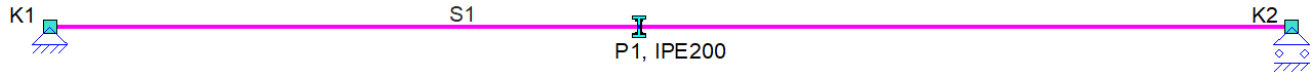
Structure



MEMBERS

Member	Node-B	Node-E	X-B	X-E	Z-B	Z-E	Length	Section	Position
S1	K1	K2	0.000	4.760	0.000	0.000	4.760	P1	0.000 - 4.760 (L)
			m	**m**	**m**	**m**	**m**		**m**

Sections



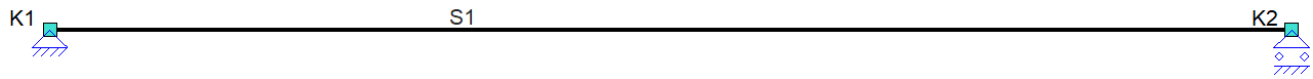
SECTIONS

Section	Section Name	Area	Iy	Material	Angle
P1	IPE200	2848	1.9432e+07	S235	0
		mm²	**mm⁴**		**°**

MATERIALS

Material Name	Poison	Density	Youngs mod.	Lin. Exp.
S235	0.30	78.50	2.1000e+05	12.0000e-06
		kN/m³	**N/mm²**	**C°m**

Restraints



SUPPORTS

Support	Object	Position	X	Z	Yr	Angle Yr
O1	K1	K1	Fixed	Fixed	Free	0
O2	K2	K2	Free	Fixed	Free	0
		m	**kN/m**	**kN/m**	**kNm/rad**	**°**

LOADS COMBINATIONS

Fundamenteel

L.C.	Description	Fu.C.1	Fu.C.2
B.G.1	Permanent	1.20	1.35
B.G.2	Verdeelde veranderlijk…	1.50	0.60

Karakteristiek

L.C.	Description	Ka.C.(w1)	Ka.C.1	Ka.C.2
B.G.1	Permanent	1.00	1.00	1.00
B.G.2	Verdeelde veranderlijk…		1.00	0.40

Frequent

L.C.	Description	Fr.C.(w1)	Fr.C.1
B.G.1	Permanent	1.00	1.00
B.G.2	Verdeelde veranderlijk…		0.50

Quasi-permanent

L.C.	Description	Qu.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	0.30

Massa

L.C.	Description	Ma.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	

LOADS COMBINATIONS

Fundamenteel
Fu.C.1 = 1.20*B.G.1 + 1.50*B.G.2
Fu.C.2 = 1.35*B.G.1 + 0.60*B.G.2

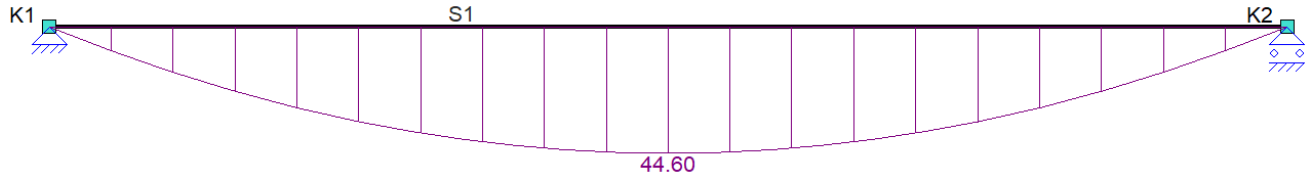
Karakteristiek
Ka.C.(w1) = B.G.1
Ka.C.1 = B.G.1 + B.G.2
Ka.C.2 = B.G.1 + 0.40*B.G.2

Frequent
Fr.C.(w1) = B.G.1
Fr.C.1 = B.G.1 + 0.50*B.G.2

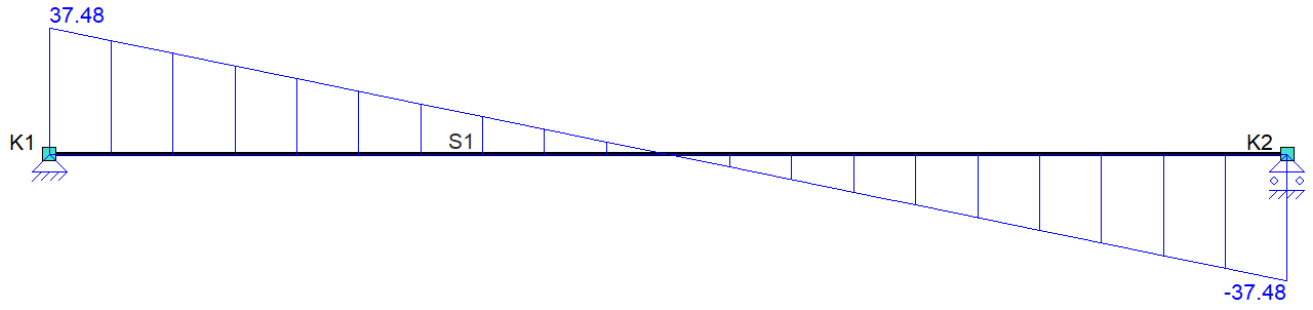
Quasi-permanent
Qu.C.1 = B.G.1 + 0.30*B.G.2

Massa
Ma.C.1 = B.G.1

Fu.C. Omhullende Bending moments (My)



Fu.C. Omhullende Shear forces (Vz)



ENVELOPE (PERSISTENT)

Member	Nx-	Nx+	$Nx-_{max}$	$Nx+_{min}$	Vz-	Vz+	My-	My+
S1	0.00	0.00	0.00	0.00	**-37.48**	**37.48**	**-0.00**	**44.60**
	kN	**kN**	**kN**	**kN**	**kN**	**kN**	**kNm**	**kNm**

Fu.C.1 Support Reactions



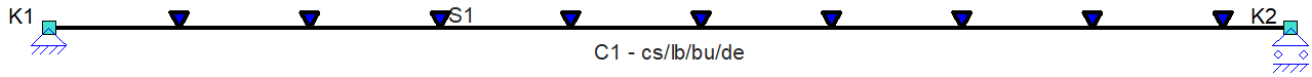
Fu.C.2 Support Reactions



EXTREME SUPPORT REACTIONS (PERSISTENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Fu.C.1	0.00	**-37.48**	0.00				
O2	K2					Fu.C.1	0.00	**-37.48**	0.00				
Global extreme values													
O2	K2					Fu.C.1	0.00	**-37.48**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Steel definition



STEEL CODECHECK RESULTS

NEN-EN1993-1-1:2016/NB:2016

Assumptions of Analysis for steel codecheck
Alpha;cr = 0.00 < 10; GNL analysis required

CROSS-SECTION (#6.2)

Member C1-V1 (0.000-4.760)

Decisive combination		Fu.C.1		Section class			1	
Decisive position		2.380	m					
Axial force	N_{Ed}	0.00	kN	Design resistance	(6.6)	N_{Rd}	669.38	kN
Bending moment	$M_{y,Ed}$	44.60	kNm	Design resistance	(6.13)	$M_{y,Rd}$	51.85	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm	Design resistance	(6.13)	$M_{z,Rd}$	10.48	kNm
Shear force	$V_{y,Ed}$	0.00	kN	Design resistance	(6.18)	$V_{y,Rd}$	247.42	kN
Shear force	$V_{z,Ed}$	-0.00	kN	Design resistance	(6.18)	$V_{z,Rd}$	189.95	kN

Type	Axis	Reference	Load combination	Position	Calculation	UC
Decisive cut						
Tension		NEN-EN1993-1-1(6.5)	Fu.C.1	2.380	0.00 / 669.38	0.00
Bending	Y	NEN-EN1993-1-1(6.12)	Fu.C.1	2.380	44.60 / 51.85	0.86
Bending	Z	NEN-EN1993-1-1(6.12)	Fu.C.1	2.380	0.00 / 10.48	0.00
Shear	Y	NEN-EN1993-1-1(6.17)	Fu.C.1	2.380	0.00 / 247.42	0.00
				m		

Type	Axis	Reference	Load combination	Position	Calculation	UC
Shear	Z	NEN-EN1993-1-1(6.17)	Fu.C.1	2.380	-0.00 / 189.95	0.00
				m		

LATERAL BUCKLING (#6.3.2)

Member C1-V1 (0.000-4.760)

Equivalent section		IPE200	Section class		1
$M_{y,Rd}$		51.85 kNm	$M_{z,Rd}$		10.48 kNm
Decisive combination		Fu.C.2	Load attachment position from center		0.000 m
Lateral buckling supports	0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 m				

Field

Field begin		4.500 m	Moment (begin)	M_y	4.00 kNm
Field end		4.760 m	Moment (end)	M_y	-0.00 kNm
Length	L	0.260 m	Moment (max)	M_y	4.00 kNm
Decisive flange		Upper	Moment (max)	M_z	0.00 kNm

Elastic critical moment for lateral-torsional buckling (NEN-EN 1993-1-1+C2+A1:2016 NB.NB.4)

Table used			NB.NB.4	Moment		M	4.00 kNm
Load		q	6.84 kN/m	Length		L_{st}	0.260 m
		B*	0.99	Length		L_{st}	0.260 m
		β	-0.000	Length		L_{kip}	0.364 m
	(NB.NB.12)	S	0.696 m				
Coefficient		C_1	1.767	Coefficient		C_2 (Table)	0.010
Coefficient		C_2 (Calculated)	0.000	Length		L_g	4.760 m
Coefficient	(NB.NB.11)	C	441.775	Reduction factor	(NB.NB.7)	K_{red}	1.000
	(NB.NB.6)	M_{cr}	3810.35 kNm				

Lateral torsional buckling curve #6.3.2.2

Slenderness		λ_{LT}	0.200	Buckling curve	Table 6.4		a
Imperfection factor	Table 6.3	α_{LT}	0.210			Φ_{LT}	0.520
Reduction factor	(6.56)	$\chi_{LT,y}$	1.000				
Reduction factor		$\chi_{LT,z}$	1.000				
Design resistance	(6.55)	$M_{b,Rd,y}$	51.85 kNm				
Design resistance	(6.55)	$M_{b,Rd,z}$	10.48 kNm				

Lat.buc.N/A: $\bar{\lambda}_{LT} \leq 0.4$ NEN-EN1993-1-1 #6.3.2.2(4)

NEN-EN1993-1-1(6.54): UC = 0.00

DEFLECTIONS

Member C1-V1 (0.000-4.760)

Structure type	Floor	Camber function	Parabolic
Check Type	General	Camber	w_c 0 mm

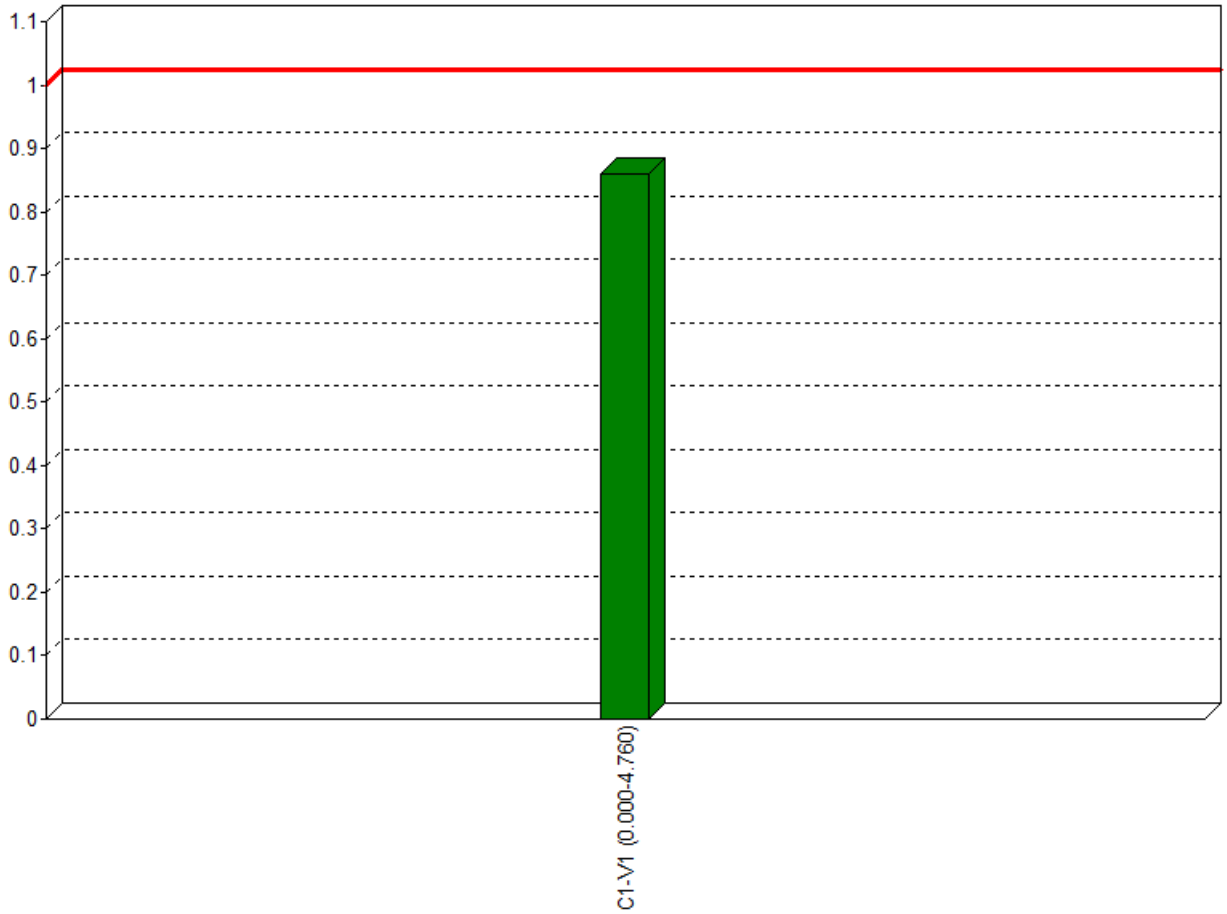
w_{max}

Axis	Position	w_1	L.C.	w_3	L.C.	w_{tot}	w_c	w	Limit (L/250)	UC
Z'	2.380	1.0	Fr.C.(w1)	4.9	Qu.C.1	5.9	0.0	5.9	19.0	0.31
Z''	2.380	1.0	Fr.C.(w1)	4.9	Qu.C.1	5.9	0.0	5.9	19.0	0.31
	m	mm		mm		mm	mm	mm	mm	

(w_2+w_3)

Axis	Position	w_3	L.C.	w	Abs. limit	Limit (L/333)	UC
Z'	2.380	8.2	Fr.C.1	8.2	0.0	14.3	0.57
Z''	2.380	8.2	Fr.C.1	8.2	0.0	14.3	0.57
	m	mm		mm	mm	mm	

Pic. Steel UC Chart



EXTREME UNITY CHECK

Label	Check Type	Combination	Formula	Unity Check
C1-V1 (0.000-4.760)	Cross	Fu.C.1	NEN-EN1993-1-1(6.12)	0.86

BUSSEL ENGINEERING

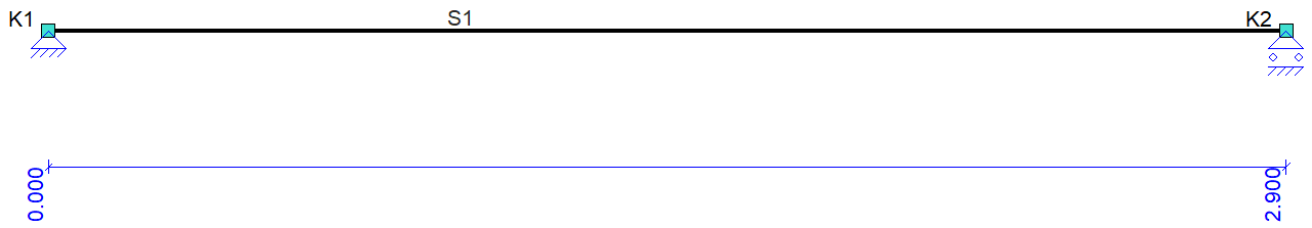
BIJLAGE 7

Project name	**LOVI**	**Project number**	**LOVI-2025**
Part description	**Ligger-1 DJBooth**	**Structural engineer**	5.1, 2, e
Client	**LOVI**	**Units**	**m, mm, kN, kNm**
File	**C:\Users\Michiel\Desktop\Lofi\Ligger-DJBooth-2,9m.mxf**		

STRUCTURE INFO

Project Type	Nodes	Members	Supports	Sections	Loads Cases	Loads Combinations
2D-Frame	2	1	2	1	2	9

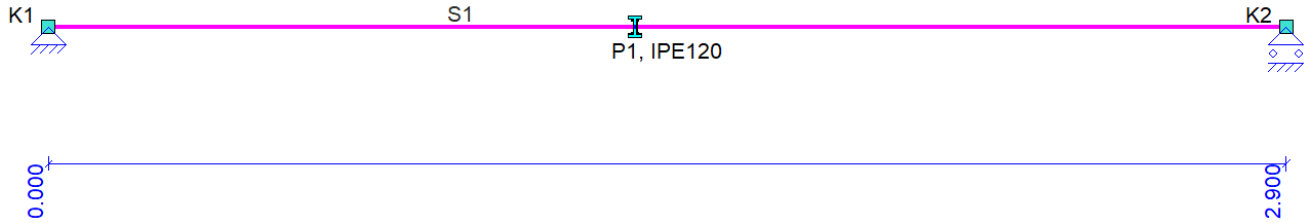
Structure



MEMBERS

Member	Node-B	Node-E	X-B	X-E	Z-B	Z-E	Length	Section	Position
S1	K1	K2	0.000	2.900	0.000	0.000	2.900	P1	0.000 - 2.900 (L)
			m	**m**	**m**	**m**	**m**		**m**

Sections



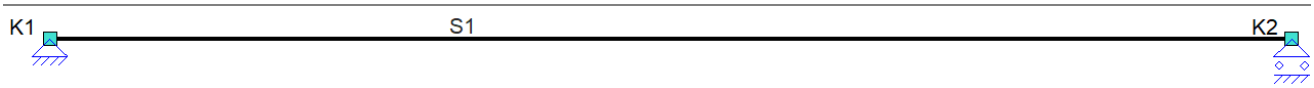
SECTIONS

Section	Section Name	Area	Iy	Material	Angle
P1	IPE120	1321	3.1775e+06	S235	0
		mm²	**mm⁴**		**°**

MATERIALS

Material Name	Poison	Density	Youngs mod.	Lin. Exp.
S235	0.30	78.50	2.1000e+05	12.0000e-06
		kN/m³	**N/mm²**	**C°m**

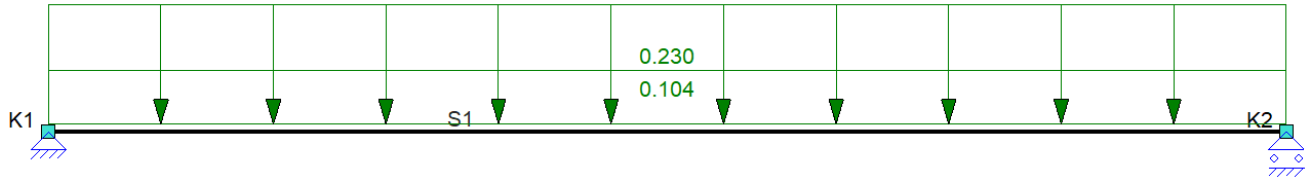
Restraints



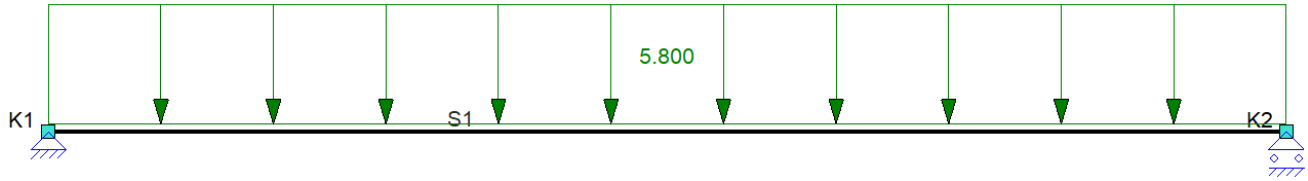
SUPPORTS

Support	Object	Position	X	Z	Yr	Angle Yr
O1	K1	K1	Fixed	Fixed	Free	0
O2	K2	K2	Free	Fixed	Free	0
		m	**kN/m**	**kN/m**	**kNm/rad**	**°**

B.G.1: Permanent



B.G.2: Verdeelde veranderlijke belasting



LOADS COMBINATIONS

Fundamenteel

L.C.	Description	Fu.C.1	Fu.C.2
B.G.1	Permanent	1.20	1.35
B.G.2	Verdeelde veranderlijk…	1.50	0.60

Karakteristiek

L.C.	Description	Ka.C.(w1)	Ka.C.1	Ka.C.2
B.G.1	Permanent	1.00	1.00	1.00
B.G.2	Verdeelde veranderlijk…		1.00	0.40

Frequent

L.C.	Description	Fr.C.(w1)	Fr.C.1
B.G.1	Permanent	1.00	1.00
B.G.2	Verdeelde veranderlijk…		0.50

Quasi-permanent

L.C.	Description	Qu.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	0.30

Massa

L.C.	Description	Ma.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	

LOADS COMBINATIONS

Fundamenteel

Fu.C.1 = 1.20*B.G.1 + 1.50*B.G.2
Fu.C.2 = 1.35*B.G.1 + 0.60*B.G.2

Karakteristiek

Ka.C.(w1) = B.G.1
Ka.C.1 = B.G.1 + B.G.2
Ka.C.2 = B.G.1 + 0.40*B.G.2

Frequent

Fr.C.(w1) = B.G.1
Fr.C.1 = B.G.1 + 0.50*B.G.2

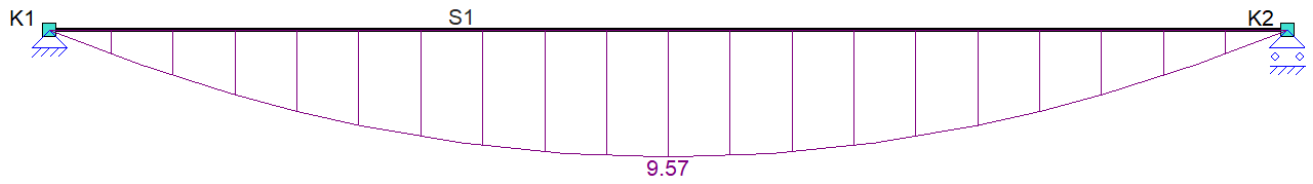
Quasi-permanent

Qu.C.1 = B.G.1 + 0.30*B.G.2

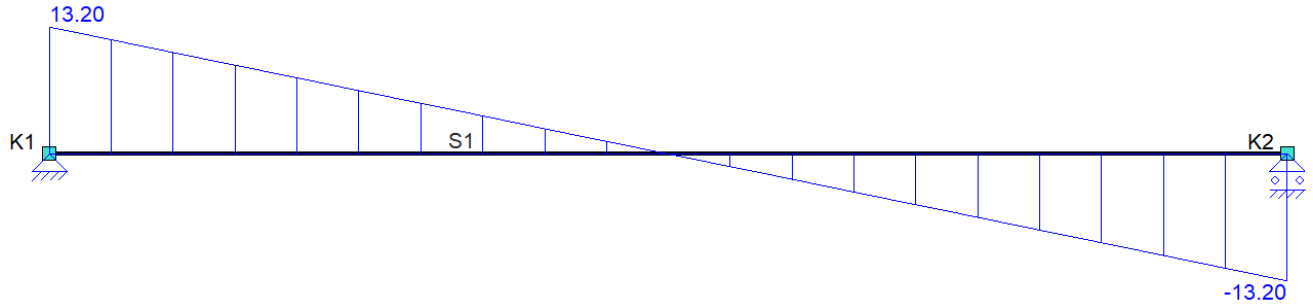
Massa

Ma.C.1 = B.G.1

Fu.C. Omhullende Bending moments (My)



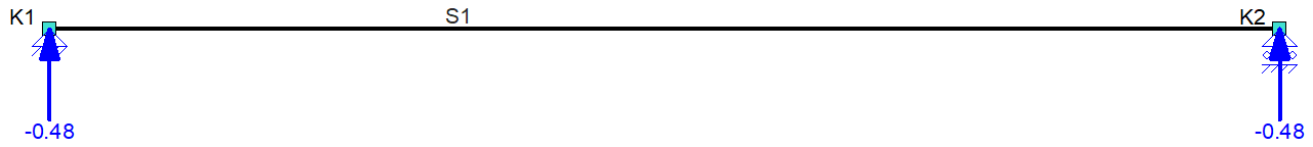
Fu.C. Omhullende Shear forces (Vz)



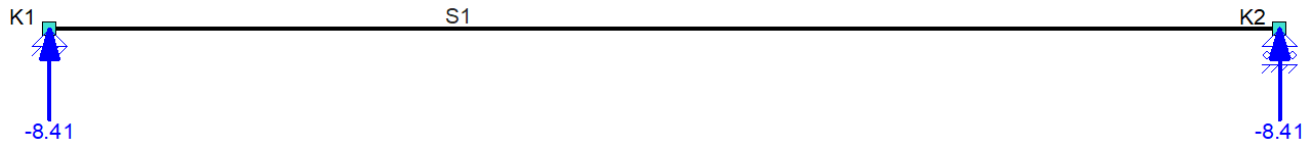
ENVELOPE (PERSISTENT)

Member	Nx-	Nx+	Nx_{max}	$Nx+_{min}$	Vz-	Vz+	My-	My+
S1	0.00	0.00	0.00	0.00	**-13.20**	**13.20**	0.00	**9.57**
	kN	**kN**	**kN**	**kN**	**kN**	**kN**	**kNm**	**kNm**

B.G.1 Support Reactions



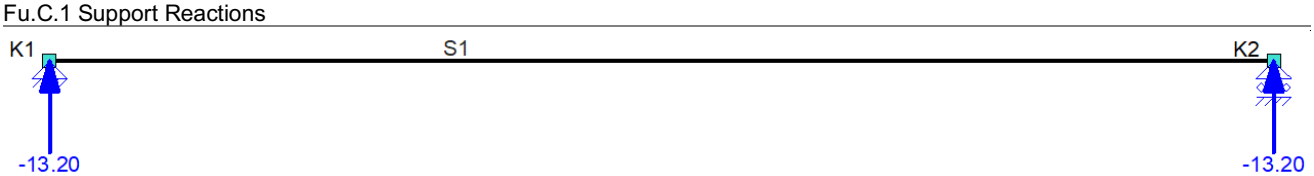
B.G.2 Support Reactions



EXTREME SUPPORT REACTIONS (LOAD CASES)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					B.G.2	0.00	**-8.41**	0.00				
O2	K2					B.G.2	-0.00	**-8.41**	0.00				
Global extreme values													
O1	K1					B.G.2	0.00	**-8.41**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Fu.C.1 Support Reactions



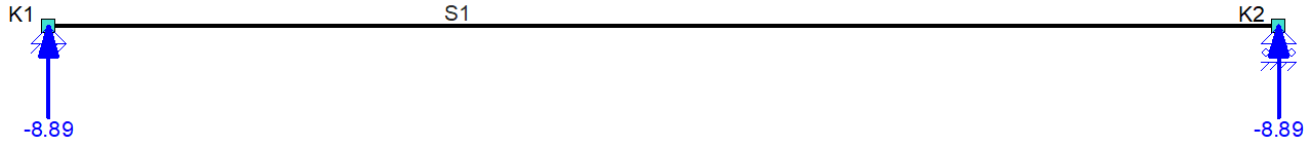
Fu.C.2 Support Reactions



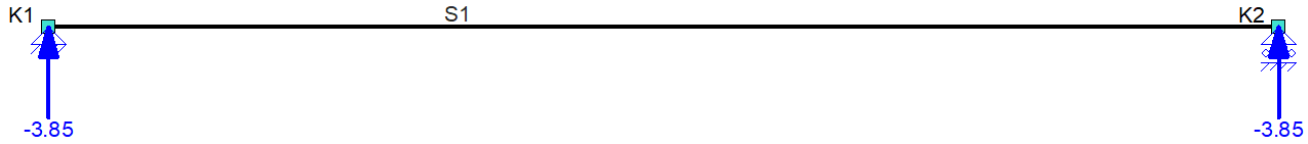
EXTREME SUPPORT REACTIONS (PERSISTENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Fu.C.1	0.00	**-13.20**	0.00				
O2	K2					Fu.C.1	0.00	**-13.20**	0.00				
Global extreme values													
O1	K1					Fu.C.1	0.00	**-13.20**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Ka.C.1 Support Reactions



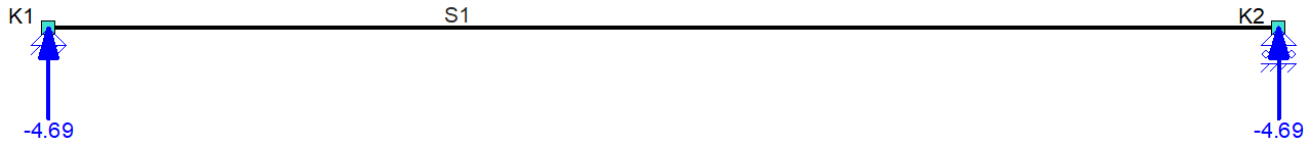
Ka.C.2 Support Reactions



EXTREME SUPPORT REACTIONS (CHARACTERISTIC)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Ka.C.1	0.00	**-8.89**	0.00				
O2	K2					Ka.C.1	0.00	**-8.89**	0.00				
Global extreme values													
O1	K1					Ka.C.1	0.00	**-8.89**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

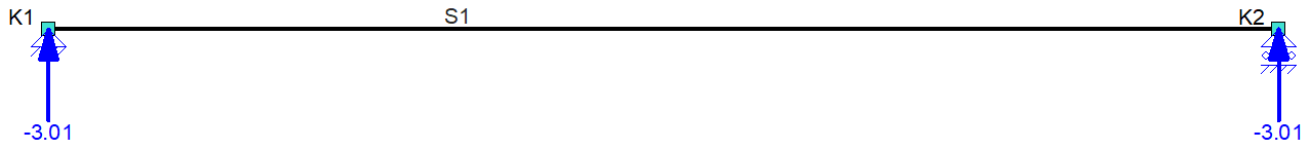
Fr.C.1 Support Reactions



EXTREME SUPPORT REACTIONS (FREQUENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Fr.C.1	0.00	**-4.69**	0.00				
O2	K2					Fr.C.1	0.00	**-4.69**	0.00				
Global extreme values													
O1	K1					Fr.C.1	0.00	**-4.69**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

Qu.C.1 Support Reactions



EXTREME SUPPORT REACTIONS (QUASI-PERMANENT)

Support	Placement	L.Comb.	X_{max}	Z	Yr	L.Comb.	X	Z_{max}	Yr	L.Comb.	X	Z	Yr_{max}
O1	K1					Qu.C.1	0.00	**-3.01**	0.00				
O2	K2					Qu.C.1	0.00	**-3.01**	0.00				
Global extreme values													
O1	K1					Qu.C.1	0.00	**-3.01**	0.00				
			kN	**kN**	**kNm**		**kN**	**kN**	**kNm**		**kN**	**kN**	**kNm**

STRUCTURAL MEMBERS

Structural member	Member (s)
C1	S1

STEEL CODECHECK RESULTS

NEN-EN1993-1-1:2016/NB:2016

Assumptions of Analysis for steel codecheck
Alpha;cr = 0.00 < 10; GNL analysis required

CROSS-SECTION (#6.2)

Member C1-V1 (0.000-2.900)

Decisive combination		Fu.C.1		Section class			1
Decisive position		1.450	m				
Axial force	N_{Ed}	0.00	kN	Design resistance	(6.6)	N_{Rd}	310.44 kN
Bending moment	$M_{y,Ed}$	9.57	kNm	Design resistance	(6.13)	$M_{y,Rd}$	14.27 kNm
Bending moment	$M_{z,Ed}$	0.00	kNm	Design resistance	(6.13)	$M_{z,Rd}$	3.19 kNm
Shear force	$V_{y,Ed}$	0.00	kN	Design resistance	(6.18)	$V_{y,Rd}$	115.12 kN
Shear force	$V_{z,Ed}$	-0.00	kN	Design resistance	(6.18)	$V_{z,Rd}$	85.55 kN

Bending and shear #6.2.8

Ratio	0.0	%	Ratio	0.0 %
Is reduction needed?	No		Is reduction needed?	No

Type	Axis	Reference	Load combination	Position	Calculation	UC
Decisive cut						
Tension		NEN-EN1993-1-1(6.5)	Fu.C.1	1.450	0.00 / 310.44	0.00
Bending	Y	NEN-EN1993-1-1(6.12)	Fu.C.1	1.450	9.57 / 14.27	0.67
Bending	Z	NEN-EN1993-1-1(6.12)	Fu.C.1	1.450	0.00 / 3.19	0.00
Shear	Y	NEN-EN1993-1-1(6.17)	Fu.C.1	1.450	0.00 / 115.12	0.00
Shear	Z	NEN-EN1993-1-1(6.17)	Fu.C.1	1.450	-0.00 / 85.55	0.00
				m		

LATERAL BUCKLING (#6.3.2)

Member C1-V1 (0.000-2.900)

Equivalent section	IPE120		Section class		1
$M_{y,Rd}$	14.27	kNm	$M_{z,Rd}$	3.19	kNm
Decisive combination	Fu.C.1		Load attachment position from center	0.000	m
Lateral buckling supports	1, 2	m			

Field

Field begin			1.000 m	Moment (begin)		M_y	8.65 kNm
Field end			2.000 m	Moment (end)		M_y	8.19 kNm
Length		L	1.000 m	Moment (max)		M_y	9.57 kNm
Decisive flange			Upper	Moment (max)		M_z	0.00 kNm

Elastic critical moment for lateral-torsional buckling (NEN-EN 1993-1-1+C2+A1:2016 NB.NB.4)

Table used			NB.NB.4	Moment		M	8.65 kNm
Load		q	9.10 kN/m	Length		L_{st}	1.000 m
		B*	0.88	Length		L_{st}	1.000 m
		β	0.947	Length		L_{kip}	1.000 m
	(NB.NB.12)	S	0.365 m				
Coefficient		C_1	1.029	Coefficient		C_2 (Table)	0.049
Coefficient		C_2 (Calculated)	0.000	Length		L_g	2.900 m
Coefficient	(NB.NB.11)	C	14.265	Reduction factor	(NB.NB.7)	K_{red}	1.000
	(NB.NB.6)	M_{cr}	44.39 kNm				

Lateral torsional buckling curve #6.3.2.2

Slenderness		λ_{LT}	0.567	Buckling curve	Table 6.4		a
Imperfection factor	Table 6.3	α_{LT}	0.210			Φ_{LT}	0.699
Reduction factor	(6.56)	$\chi_{LT,y}$	0.902				
Reduction factor		$\chi_{LT,z}$	1.000				
Design resistance	(6.55)	$M_{b,Rd,y}$	12.87 kNm				
Design resistance	(6.55)	$M_{b,Rd,z}$	3.19 kNm				

NEN-EN1993-1-1(6.54): UC = 0.74

DEFLECTIONS

Member C1-V1 (0.000-2.900)

Structure type	Floor	Camber function	Parabolic
Check Type	General	Camber	w_c 0 mm

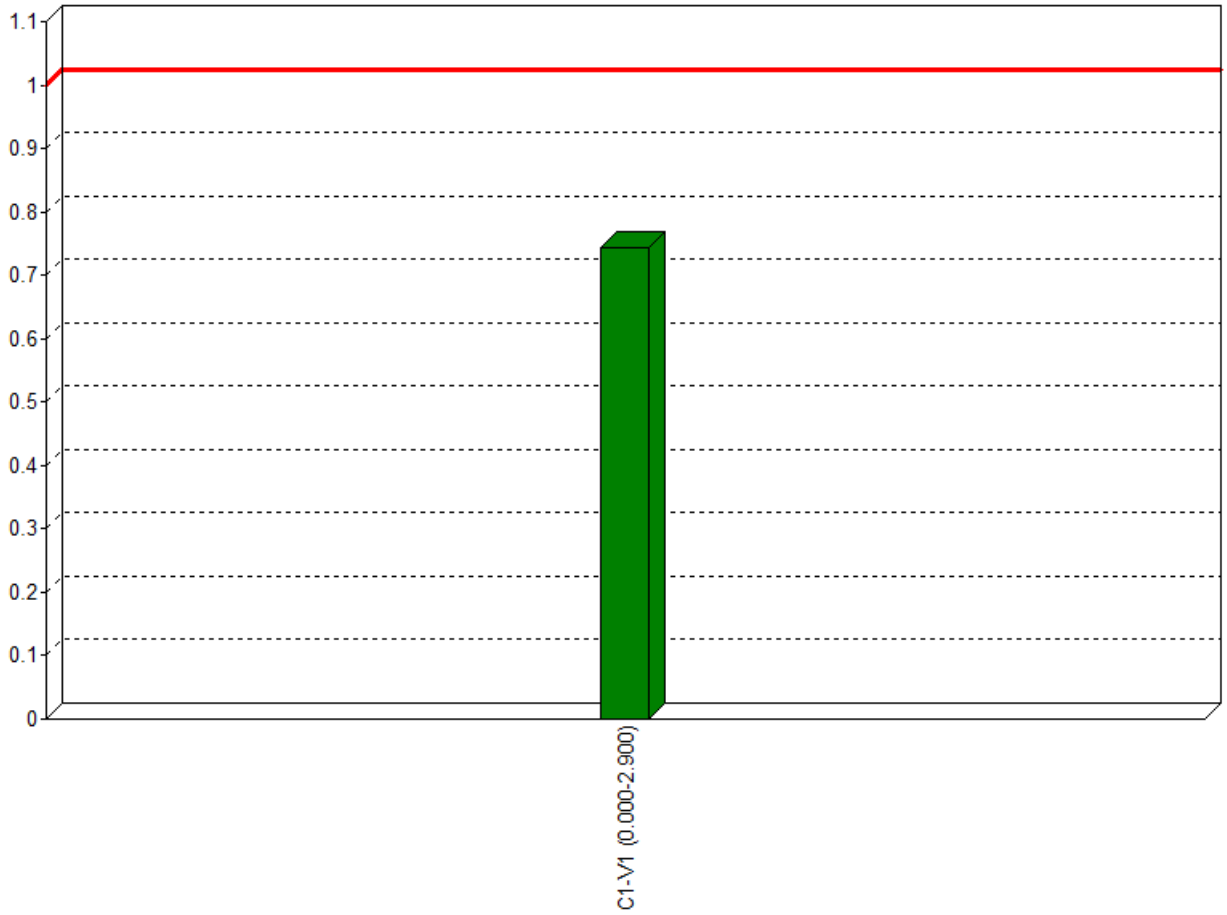
w_{max}

Axis	Position	w_1	L.C.	w_3	L.C.	w_{tot}	w_c	w	Limit (L/250)	UC
Z'	1.450	0.5	Fr.C.(w1)	2.4	Qu.C.1	2.9	0.0	2.9	11.6	0.25
Z''	1.450	0.5	Fr.C.(w1)	2.4	Qu.C.1	2.9	0.0	2.9	11.6	0.25
	m	mm		mm		mm	mm	mm	mm	

(w_2+w_3)

Axis	Position	w_3	L.C.	w	Abs. limit	Limit (L/333)	UC
Z'	1.450	4.0	Fr.C.1	4.0	0.0	8.7	0.46
Z''	1.450	4.0	Fr.C.1	4.0	0.0	8.7	0.46
	m	mm		mm	mm	mm	

Pic. Steel UC Chart



EXTREME UNITY CHECK

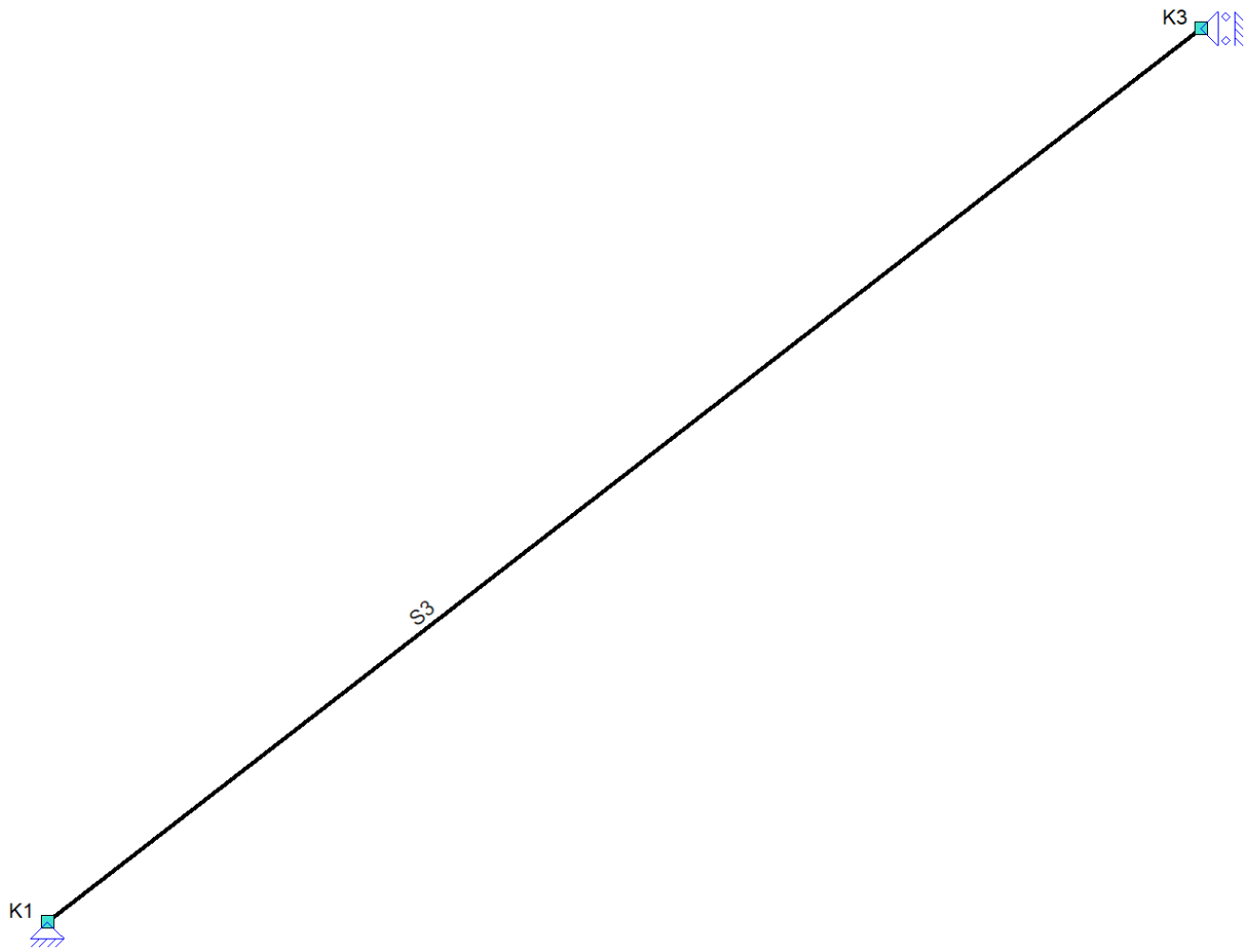
Label	Check Type	Combination	Formula	Unity Check
C1-V1 (0.000-2.900)	Lat.Buck.	Fu.C.1	NEN-EN1993-1-1(6.54)	0.74

BUSSEL ENGINEERING

BIJLAGE 8

Project name	**LOFI**	**Project number**	**LOFI-2025**
Part description		**Structural engineer**	5.1, 2, e
Client	**LOFI**	**Units**	**m, mm, kN, kNm**
File	**C:\Users\Michiel\Desktop\Lofi\Trap.mxf**		

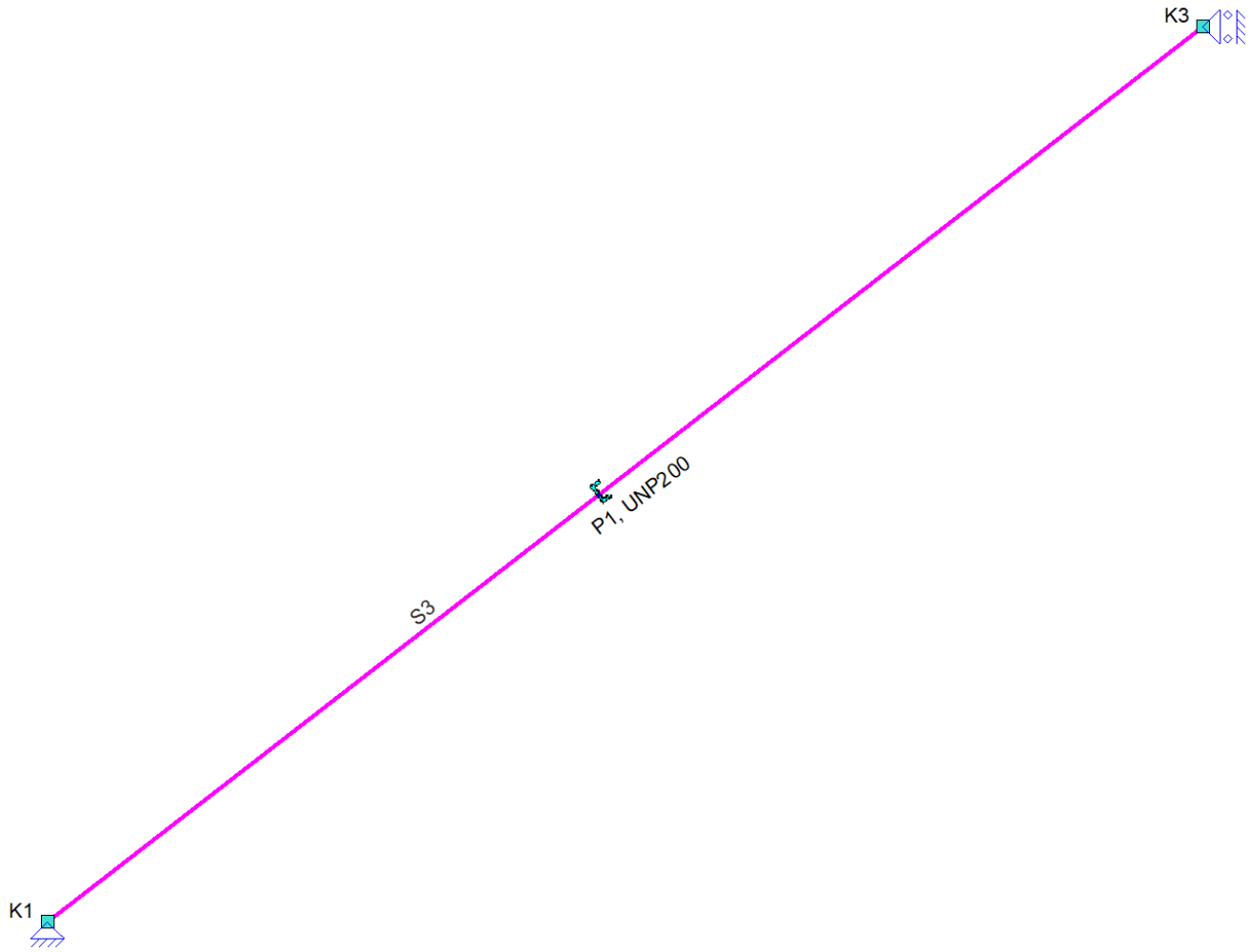
Structure



MEMBERS

Member	Node-B	Node-E	X-B	X-E	Z-B	Z-E	Length	Section	Position
S3	K1	K3	0.000	4.000	0.000	-3.100	5.061	P1	0.000 - 5.061 (L)
			m	**m**	**m**	**m**	**m**		**m**

Sections



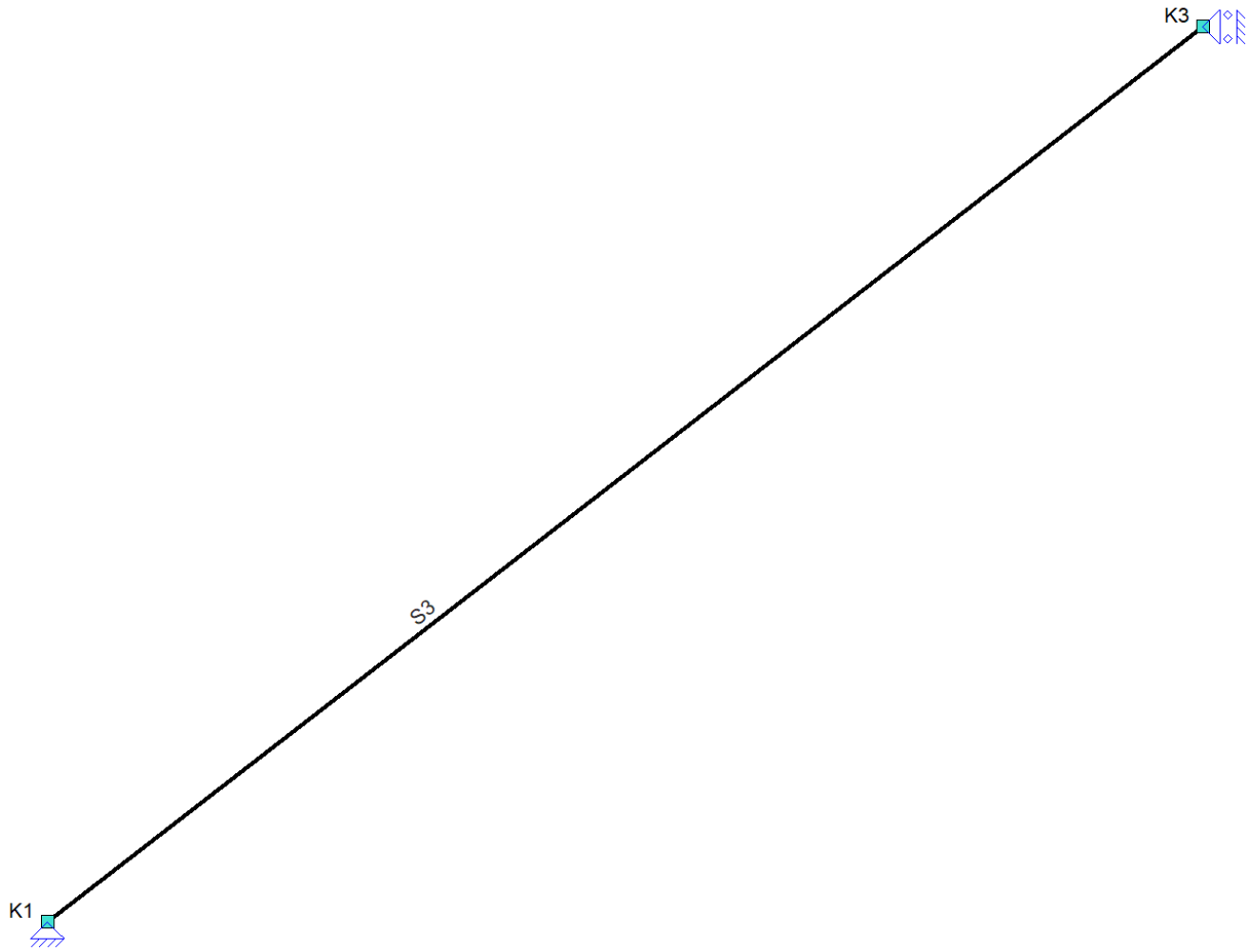
SECTIONS

Section	Section Name	Area	Iy	Material	Angle
P1	UNP200	3218	1.9105e+07	S235	0
		mm²	mm⁴		°

MATERIALS

Material Name	Poison	Density	Youngs mod.	Lin. Exp.
S235	0.30	78.50	2.1000e+05	12.0000e-06
		kN/m³	N/mm²	C°m

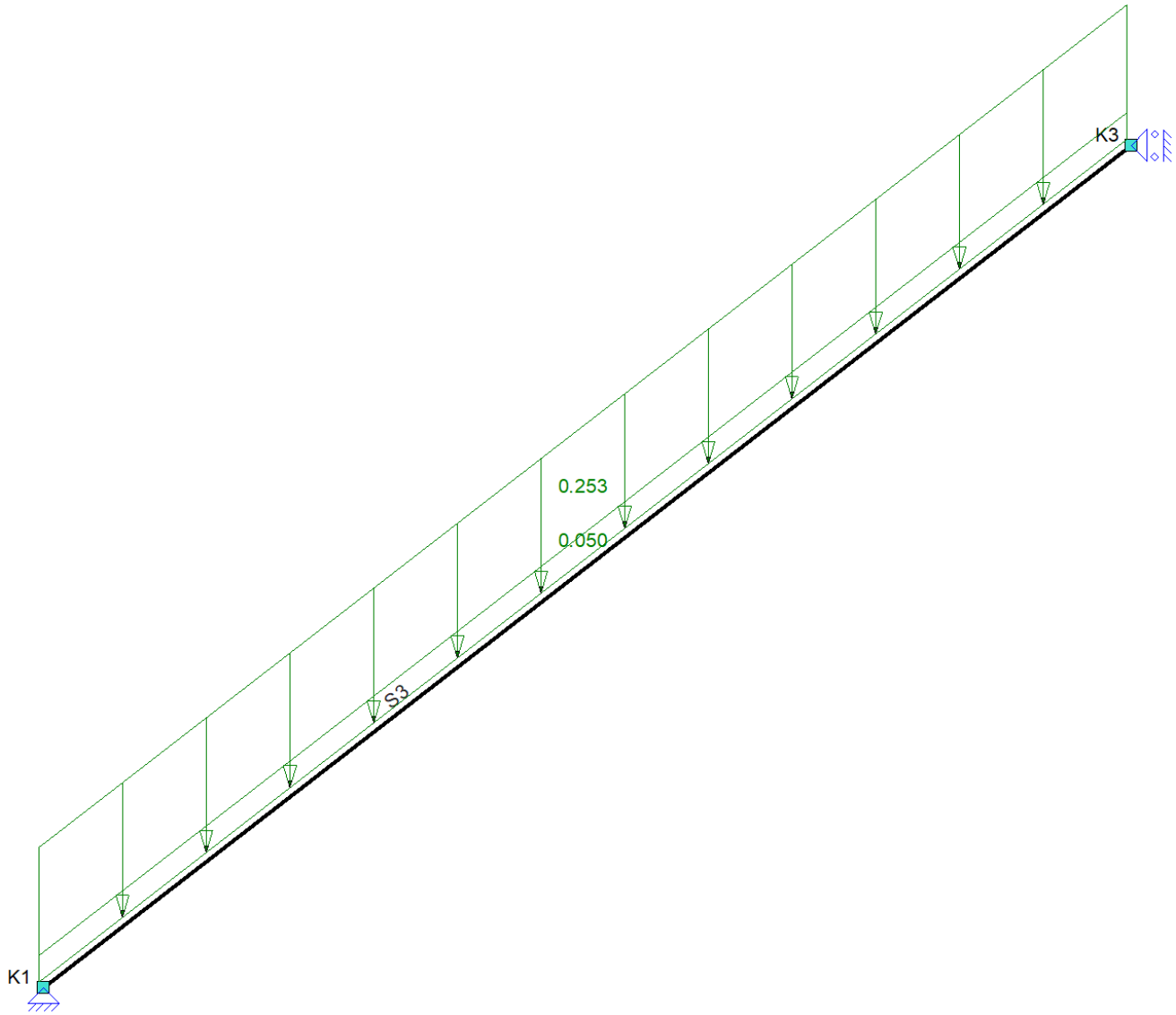
Restraints



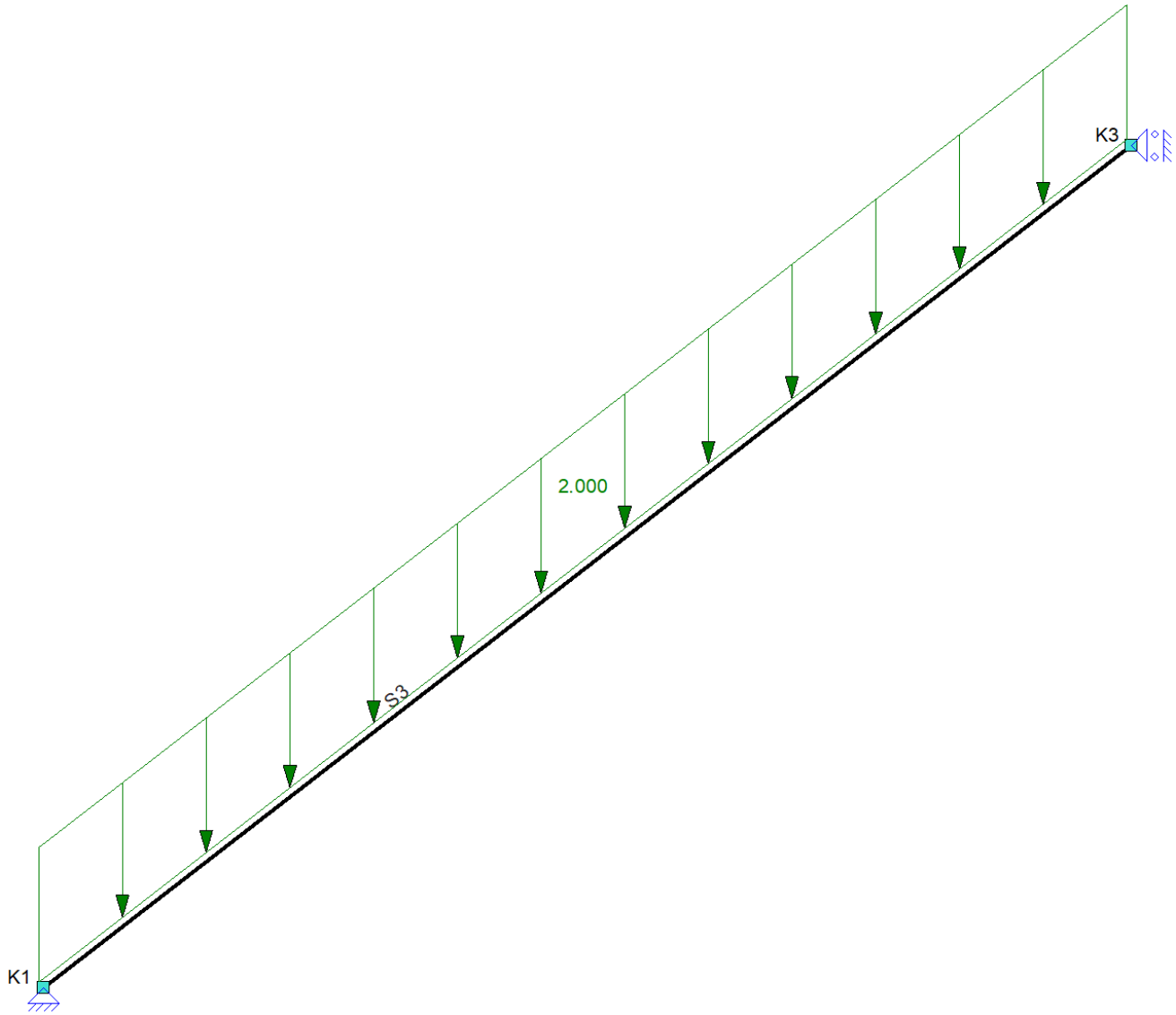
SUPPORTS

Support	Object	Position	X	Z	Yr	Angle Yr
O1	K1	K1	Fixed	Fixed	Free	0
O2	K3	K3	Fixed	Free	Free	0
		m	**kN/m**	**kN/m**	**kNm/rad**	**°**

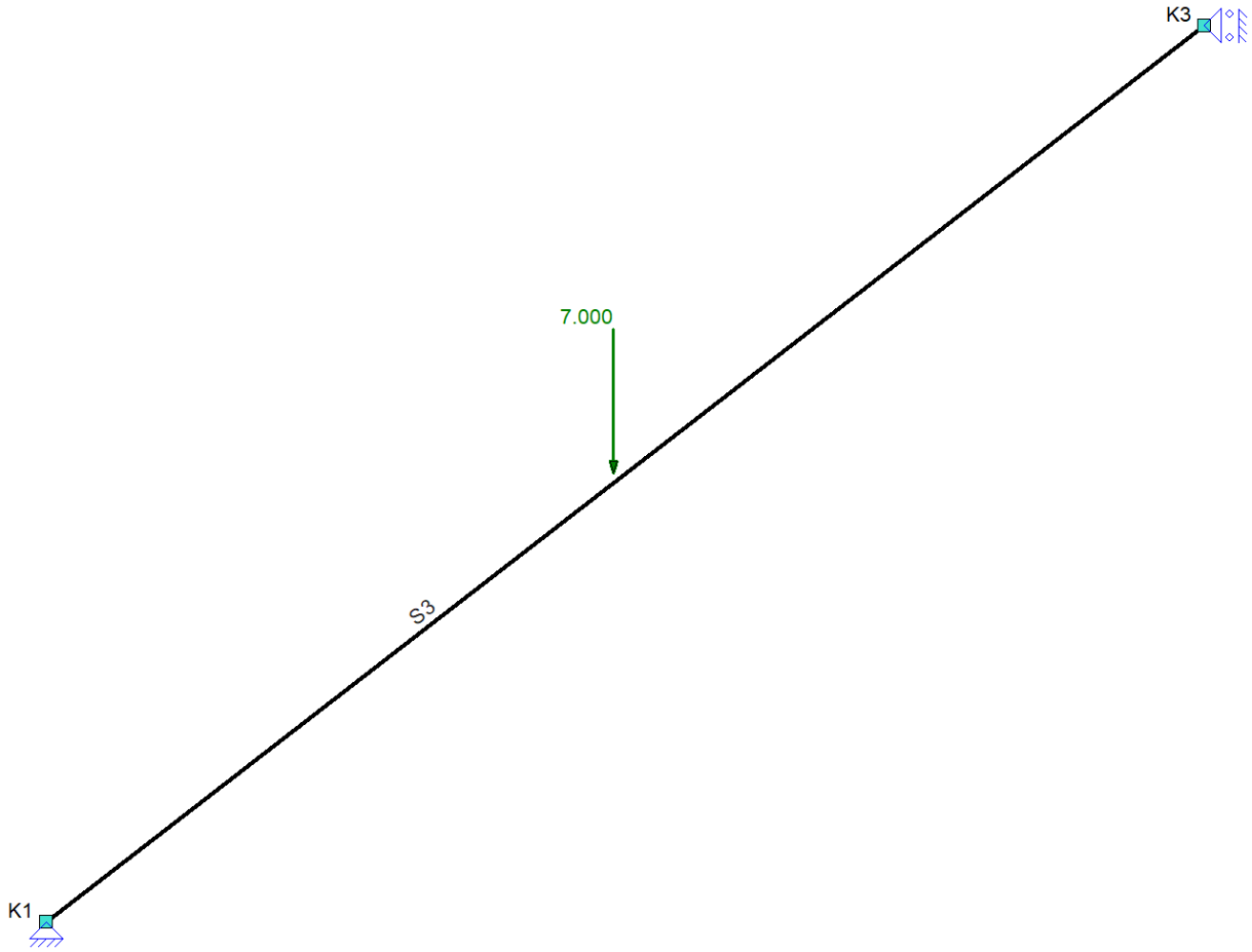
B.G.1: Permanent



B.G.2: Verdeelde veranderlijke belasting



B.G.3: Geconcentreerde veranderlijke belasting



LOADS COMBINATIONS

Fundamenteel

L.C.	Description	Fu.C.1	Fu.C.2	Fu.C.3	Fu.C.4
B.G.1	Permanent	1.20	1.20	1.35	1.35
B.G.2	Verdeelde veranderlijk…	1.50		0.60	
B.G.3	Geconcentreerde vera…		1.50		0.60

Karakteristiek

L.C.	Description	Ka.C.(w1)	Ka.C.1	Ka.C.2
B.G.1	Permanent	1.00	1.00	1.00
B.G.2	Verdeelde veranderlijk…		1.00	0.40
B.G.3	Geconcentreerde vera…			

Frequent

L.C.	Description	Fr.C.(w1)	Fr.C.1
B.G.1	Permanent	1.00	1.00
B.G.2	Verdeelde veranderlijk…		0.50
B.G.3	Geconcentreerde vera…		

Quasi-permanent

L.C.	Description	Qu.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	0.30
B.G.3	Geconcentreerde vera…	

Massa

L.C.	Description	Ma.C.1
B.G.1	Permanent	1.00
B.G.2	Verdeelde veranderlijk…	
B.G.3	Geconcentreerde vera…	

LOADS COMBINATIONS

Fundamenteel
Fu.C.1 = 1.20*B.G.1 + 1.50*B.G.2
Fu.C.2 = 1.20*B.G.1 + 1.50*B.G.3
Fu.C.3 = 1.35*B.G.1 + 0.60*B.G.2
Fu.C.4 = 1.35*B.G.1 + 0.60*B.G.3

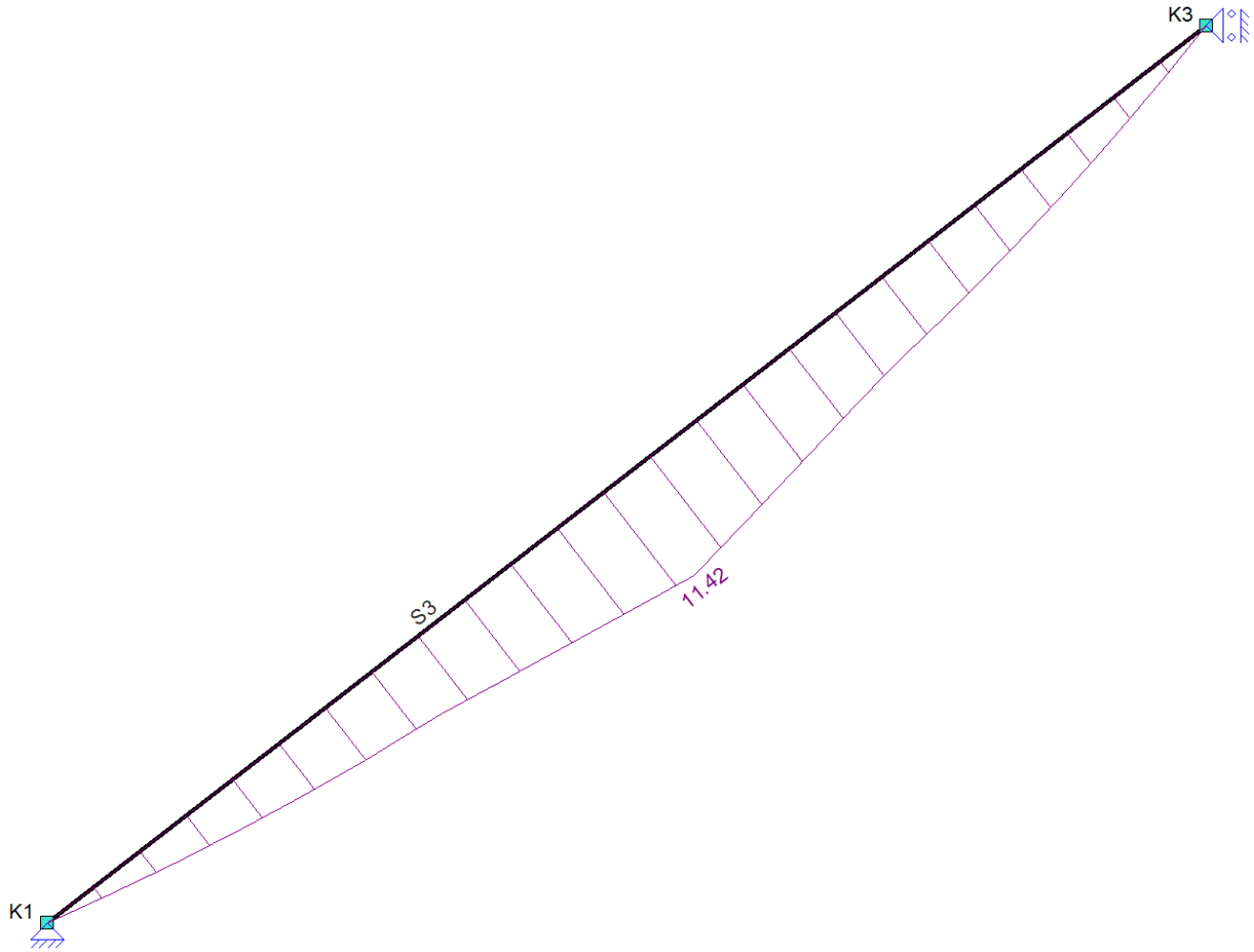
Karakteristiek
Ka.C.(w1) = B.G.1
Ka.C.1 = B.G.1 + B.G.2
Ka.C.2 = B.G.1 + 0.40*B.G.2

Frequent
Fr.C.(w1) = B.G.1
Fr.C.1 = B.G.1 + 0.50*B.G.2

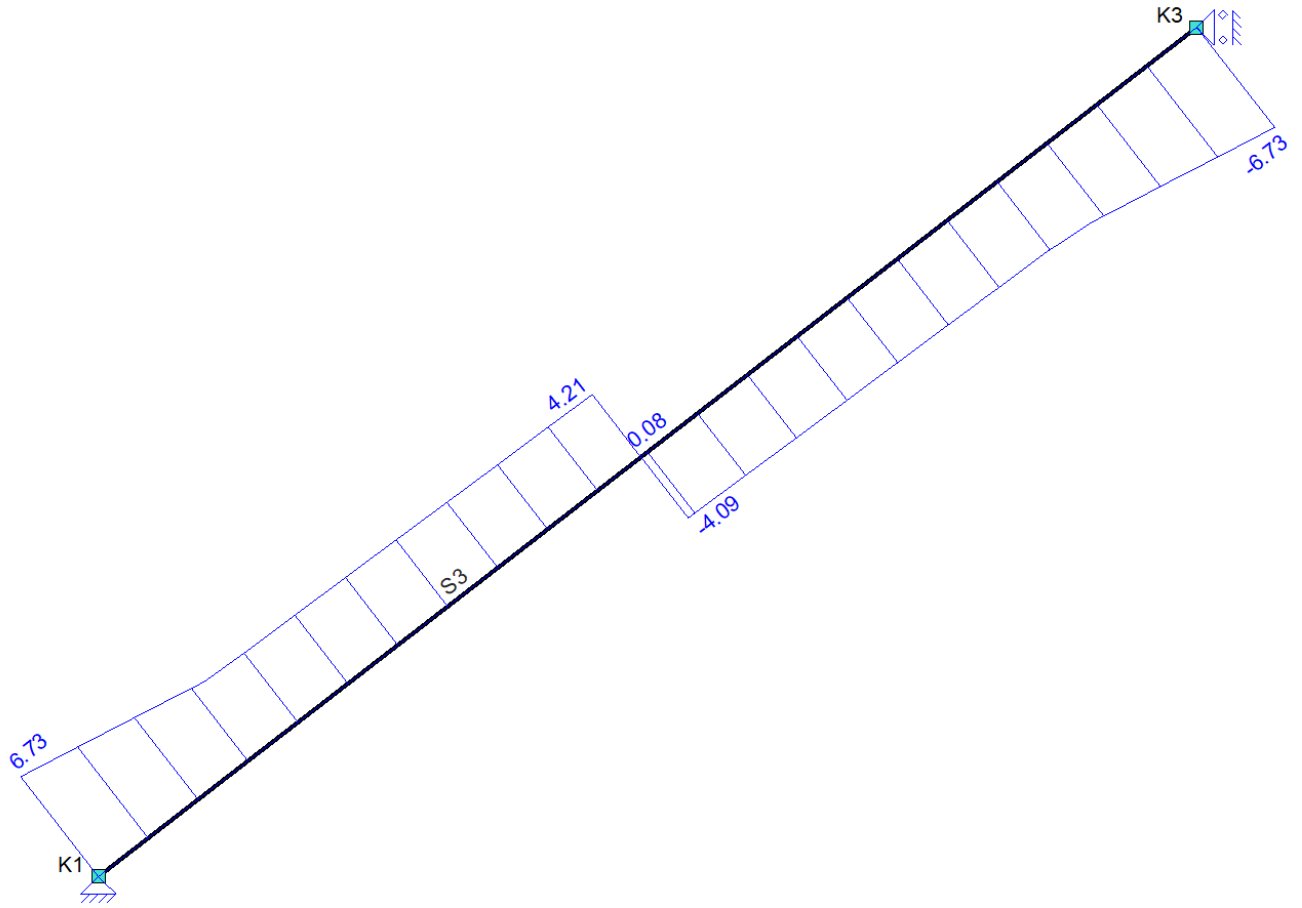
Quasi-permanent
Qu.C.1 = B.G.1 + 0.30*B.G.2

Massa
Ma.C.1 = B.G.1

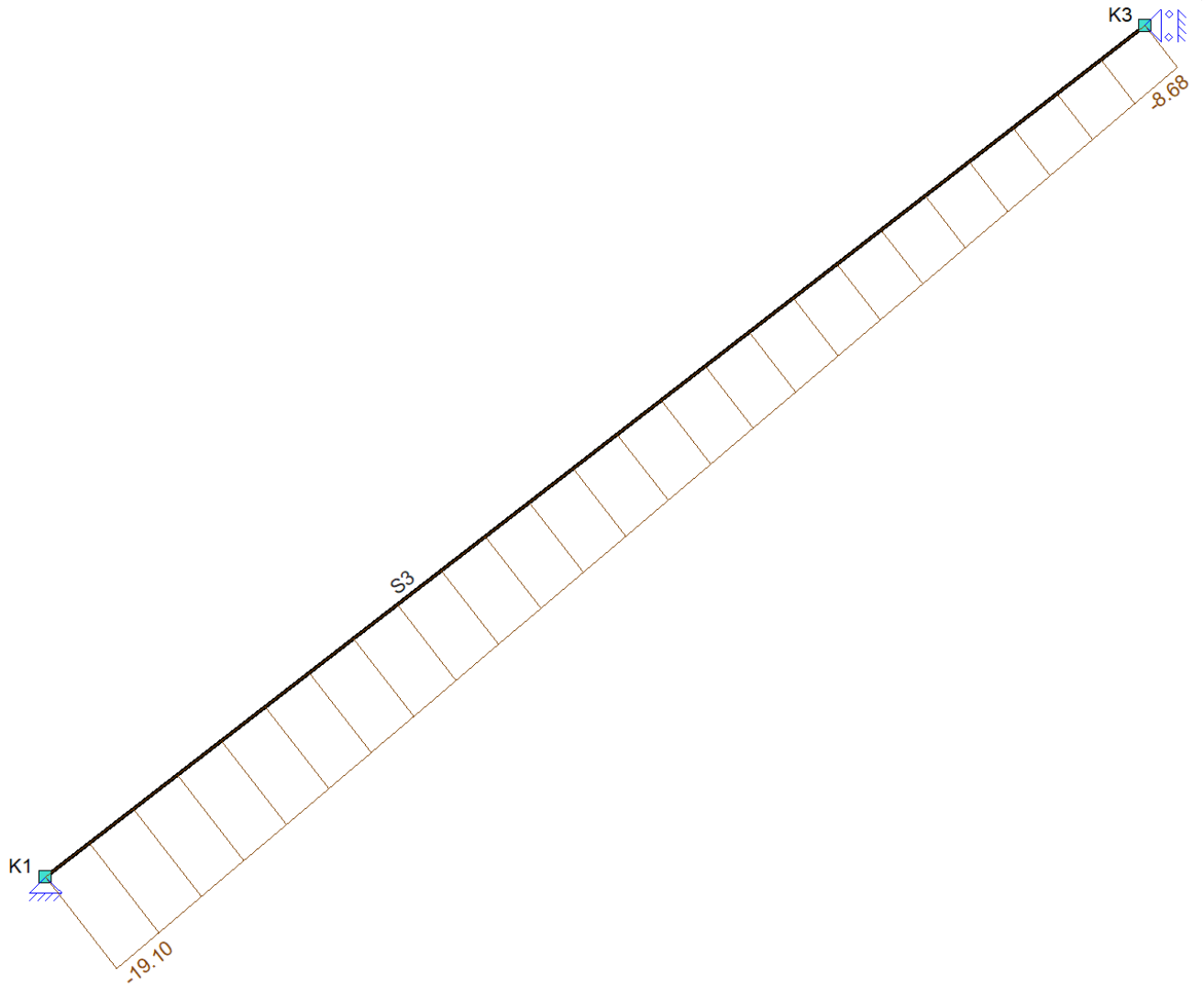
Fu.C. Omhullende Bending moments (My)



Fu.C. Omhullende Shear forces (Vz)



Fu.C. Omhullende Axial forces (Nx)



ENVELOPE (PERSISTENT)

Member	Nx-	Nx+	$Nx-_{max}$	$Nx+_{min}$	Vz-	Vz+	My-	My+
S3	**-19.10**	0.00	**-3.17**	0.00	**-6.73**	**6.73**	**-0.00**	**11.42**
	kN	**kN**	**kN**	**kN**	**kN**	**kN**	**kNm**	**kNm**

STEEL CODECHECK RESULTS

NEN-EN1993-1-1:2016/NB:2016

Assumptions of Analysis for steel codecheck
Alpha;cr = 101.11 > 10;

CROSS-SECTION (#6.2)

Member C3-V1 (0.000-5.061)

Decisive combination		Fu.C.2		Section class			1	
Decisive position		2.500	m					
Axial force	N_{Ed}	-13.23	kN	Design resistance	(6.10)	N_{Rd}	756.20	kN
Bending moment	$M_{y,Ed}$	11.42	kNm	Design resistance	(6.13)	$M_{y,Rd}$	53.51	kNm
Bending moment	$M_{z,Ed}$	0.00	kNm	Design resistance	(6.13)	$M_{z,Rd}$	12.20	kNm
Shear force	$V_{y,Ed}$	0.00	kN	Design resistance	(6.18)	$V_{y,Rd}$	232.47	kN

Shear force		$V_{z,Ed}$	4.21 kN	Design resistance	(6.18)	$V_{z,Rd}$	233.76 kN

Bending and shear #6.2.8

5.1, 2, e	.8 %	Ratio	0.0 %
Is reduction needed?	No	Is reduction needed?	No

Type	Axis	Reference	Load combination	Position	Calculation	UC
Decisive cut						
		NEN-EN1993-1-1(6.1)	Fu.C.2	2.500		0.23
Compression		NEN-EN1993-1-1(6.9)	Fu.C.2	2.500	-13.23 / 756.20	0.02
Bending	Y	NEN-EN1993-1-1(6.12)	Fu.C.2	2.500	11.42 / 53.51	0.21
Bending	Z	NEN-EN1993-1-1(6.12)	Fu.C.2	2.500	0.00 / 12.20	0.00
Shear	Y	NEN-EN1993-1-1(6.17)	Fu.C.2	2.500	0.00 / 232.47	0.00
Shear	Z	NEN-EN1993-1-1(6.17)	Fu.C.2	2.500	4.21 / 233.76	0.02
				m		

BUCKLING (#6.3.1)

Member C3-V1 (0.000-5.061)

Section			UNP200	Section class			1
Decisive combination			Fu.C.2				
Field			0.000 - 5.061 m	Field			0.000 - 5.061 m
Axial force		$N_{Ed,y}$	-13.79 kN	Axial force		$N_{Ed,z}$	-13.79 kN
Length		$L_{cr,y}$	5.061 m	Length		$L_{cr,z}$	5.061 m
Elastic critical force		$N_{cr,y}$	1546.17 kN	Elastic critical force		$N_{cr,z}$	119.62 kN
Slenderness		λ_y	0.699	Slenderness		λ_z	2.514
Buckling curve	Table 6.2		c	Buckling curve	Table 6.2		c
Imperfection factor	Table 6.1	α_y	0.490	Imperfection factor	Table 6.1	α_z	0.490
		Φ_y	0.867			Φ_z	4.228
Reduction factor	(6.49)	χ_y	0.725	Reduction factor	(6.49)	χ_z	0.131
Design resistance	(6.47)	$N_{b,Rd,y}$	548.32 kN	Design resistance	(6.47)	$N_{b,Rd,z}$	99.15 kN

NEN-EN1993-1-1(6.46): UC = 0.14

LATERAL BUCKLING (#6.3.2)

Member C3-V1 (0.000-5.061)

Equivalent section	UNP200		Section class		1
$M_{y,Rd}$	53.51 kNm		$M_{z,Rd}$		12.20 kNm
Decisive combination	Fu.C.2		Load attachment position from center		0.000 m
Lateral buckling supports	None				

Field

Field begin		0.000 m	Moment (begin)	M_y	0.00 kNm
Field end		5.061 m	Moment (end)	M_y	-0.00 kNm
Length	L	5.061 m	Moment (max)	M_y	11.42 kNm
Decisive flange		Upper	Moment (max)	M_z	0.00 kNm

Elastic critical moment for lateral-torsional buckling (NEN-EN 1993-1-1+C2+A1:2016 NB.NB.4)

Table used			NB.NB.2	Load		q	0.29 kN/m
Force		F	8.30 kN	Length		L_{st}	5.061 m
		A***	0.08			B***	0.92
Length		L_{st}	5.061 m	Length		L_{kip}	5.061 m
	(NB.NB.12)	S	0.513 m				
Coefficient		C_1	1.332	Coefficient		C_2 (Table)	0.542
Coefficient		C_2 (Calculated)	0.000	Length		L_g	5.061 m
Coefficient	(NB.NB.11)	C	4.392	Reduction factor	(NB.NB.7)	K_{red}	1.000
	(NB.NB.6)	M_{cr}	44.28 kNm				

Lateral torsional buckling curve #6.3.2.2

		λ_M	1.099			λ_T	0.111
		λ_{MT}	1.210	Buckling curve	Table 6.4		d
Imperfection factor	Table 6.3	α_{LT}	0.760			Φ_{LT}	1.617
Reduction factor	(6.56)	$\chi_{LT,y}$	0.372				
Reduction factor		$\chi_{LT,z}$	1.000				
Design resistance	(6.55)	$M_{b,Rd,y}$	19.91 kNm				
Design resistance	(6.55)	$M_{b,Rd,z}$	12.20 kNm				

NEN-EN1993-1-1(6.54): UC = 0.57

BENDING AND AXIAL COMPRESSION (#6.3.3)

Member C3-V1 (0.000-5.061)

Section	UNP200	Section class	1
Decisive combination	Fu.C.2		

Equivalent uniform moment factors (Table B.3)

C_{my}		**C_{mz}**		**C_{mLT}**	
M	-0.00 kNm	M	0.00 kNm	M	-0.00 kNm
ψM	0.00 kNm	ψM	0.00 kNm	ψM	0.00 kNm
M_s	11.29 kNm	ψ	1.000	M_s	11.29 kNm
ψ	-0.000	Load	Concentrated	ψ	-0.000
α_h	-0.000	C_{mz}	1.000	α_h	-0.000
Load	Uniform			Load	Uniform
C_{my}	0.950			C_{mLT}	0.950

Interaction factors (Table B.2)

		k_{yy}	0.962			k_{yz}	0.667
		k_{zy}	0.980			k_{zz}	1.111
Field			0.000 - 5.061 m	Field			0.000 - 5.061 m
Axial force		$N_{y,Ed}$	-13.79 kN	Axial force		$N_{z,Ed}$	-13.79 kN
Length		$L_{y,cr}$	5.061 m	Length		$L_{z,cr}$	5.061 m
Reduction factor	(6.49)	χ_y	0.725	Reduction factor	(6.49)	χ_z	0.131
Design resistance		N_{Rk}	756.20 kN				
Field			0.000 - 5.061 m	Field			0.000 - 5.061 m
Bending moment		$M_{y,Ed}$	11.42 kNm	Bending moment		$M_{z,Ed}$	0.00 kNm
Bending moment		$\Delta M_{y,Ed}$	0.00 kNm	Bending moment		$\Delta M_{z,Ed}$	0.00 kNm
Design resistance		$M_{y,Rk}$	53.51 kNm	Design resistance		$M_{z,Rk}$	12.20 kNm
Reduction factor		χ_{LT}	0.372				

NEN-EN1993-1-1(6.61): UC = 0.58
NEN-EN1993-1-1(6.62): UC = 0.70

DEFLECTIONS

Member C3-V1 (0.000-5.061)

Structure type	Roof	Camber function	Parabolic
Check Type	General	Camber	w_c 0 mm

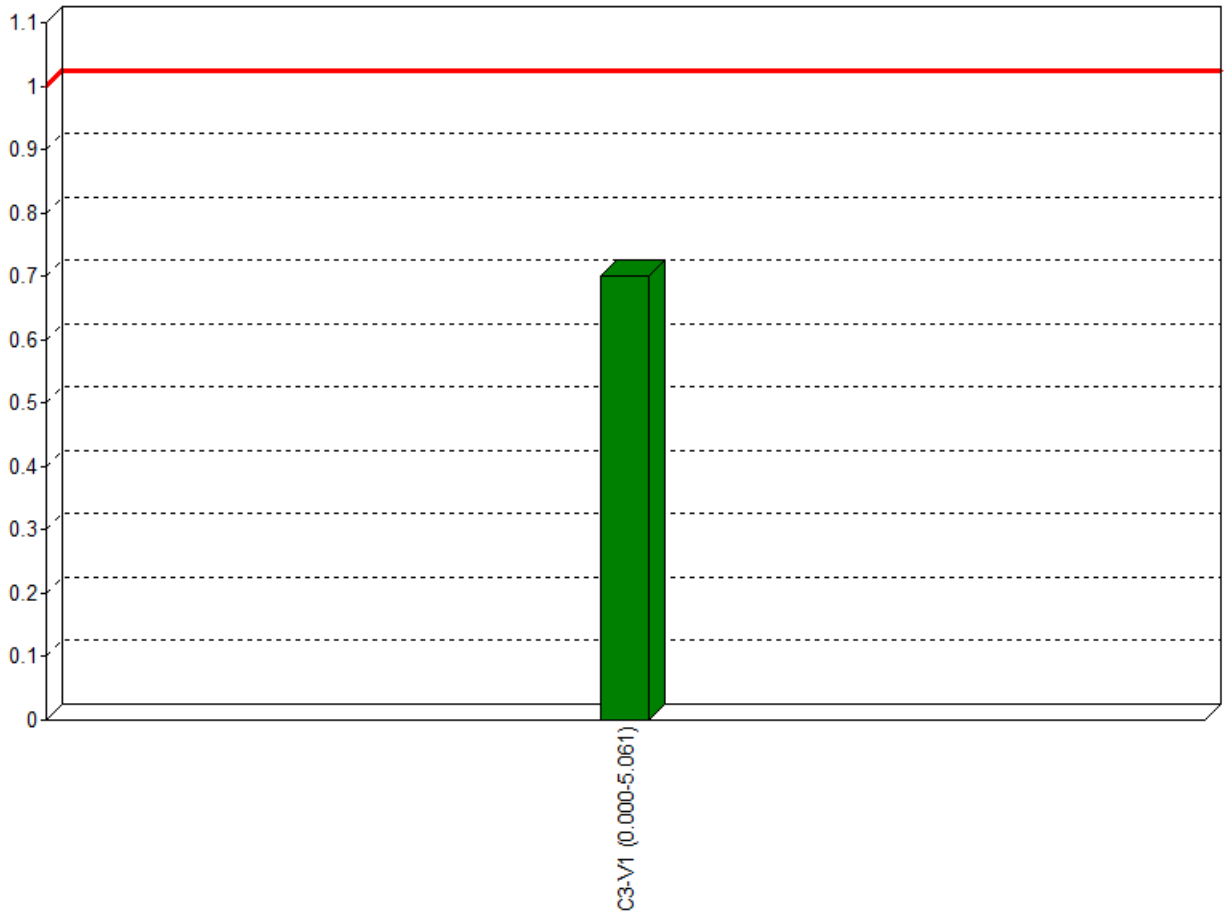
w_{max}

Axis	Position	w_1	L.C.	w_3	L.C.	w_{tot}	w_c	w	Limit (L/250)	UC
Z'	2.530	0.5	Ka.C.(w1)	3.4	Ka.C.1	3.9	0.0	3.9	20.2	0.19
Z''	2.530	0.6	Ka.C.(w1)	4.3	Ka.C.1	4.9	0.0	4.9	20.2	0.24
	m	**mm**		**mm**		**mm**	**mm**	**mm**	**mm**	

(w_2+w_3)

Axis	Position	w_3	L.C.	w	Abs. limit	Limit (L/250)	UC
Z'	2.530	3.4	Ka.C.1	3.4	0.0	20.2	0.17
Z''	2.530	4.3	Ka.C.1	4.3	0.0	20.2	0.21
	m	mm		mm	mm	mm	

Pic. Steel UC Chart



EXTREME UNITY CHECK

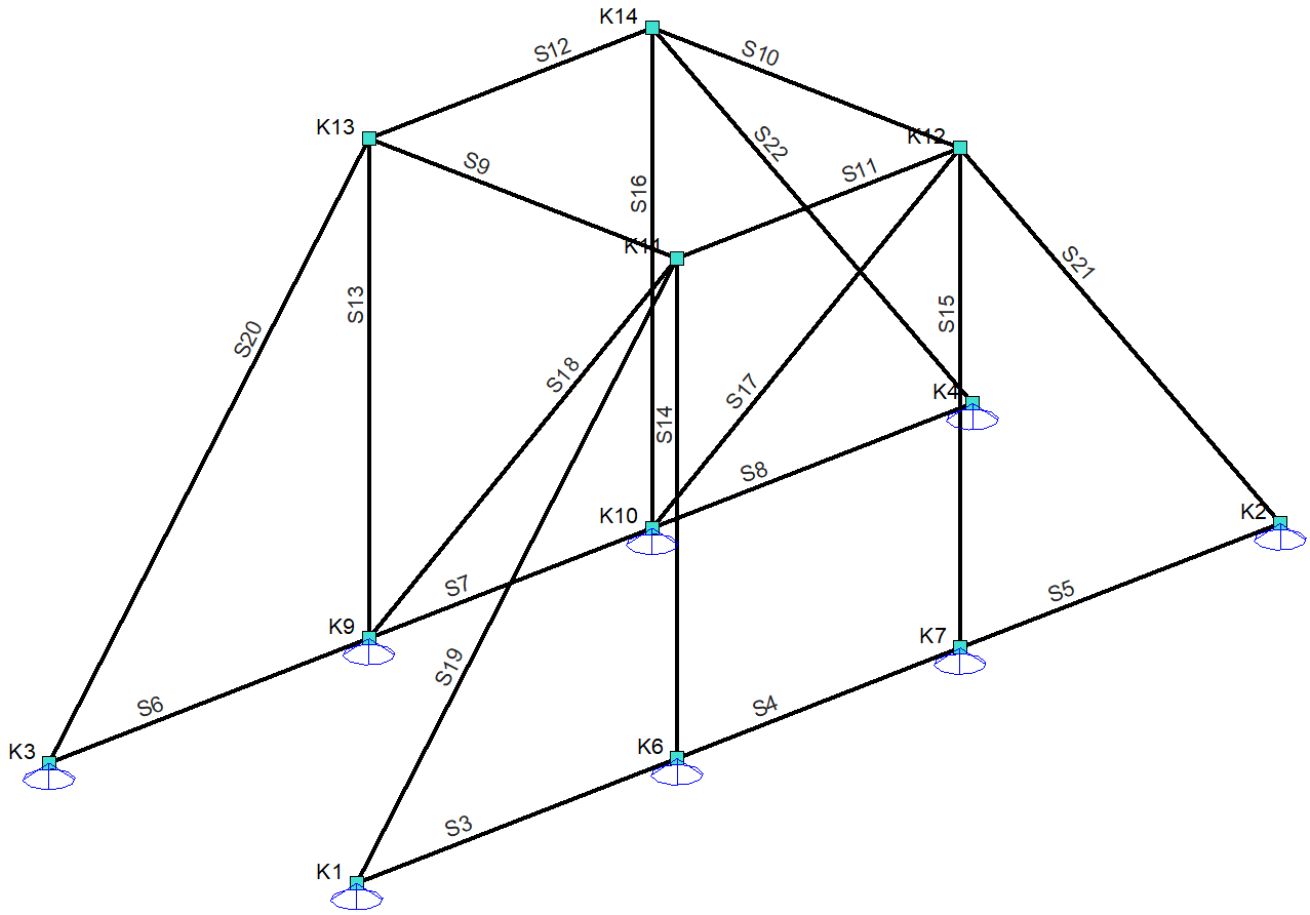
Label	Check Type	Combination	Formula	Unity Check
C3-V1 (0.000-5.061)	Bending & Compression	Fu.C.2	NEN-EN1993-1-1(6.61&6.62)	0.70

BUSSEL ENGINEERING

BIJLAGE 9

Projectomschrijving	**LOFI**	**Projectnummer**	**LOFI-2025**
Onderdeel	**Heliframe**	**Constructeur**	5.1, 2, e
Opdrachtgever	**LOFI**	**Eenheden**	**m, mm, kN, kNm**
Bestand	**C:\Users\Michiel\Desktop\Lofi\Heliframe.mxf**		

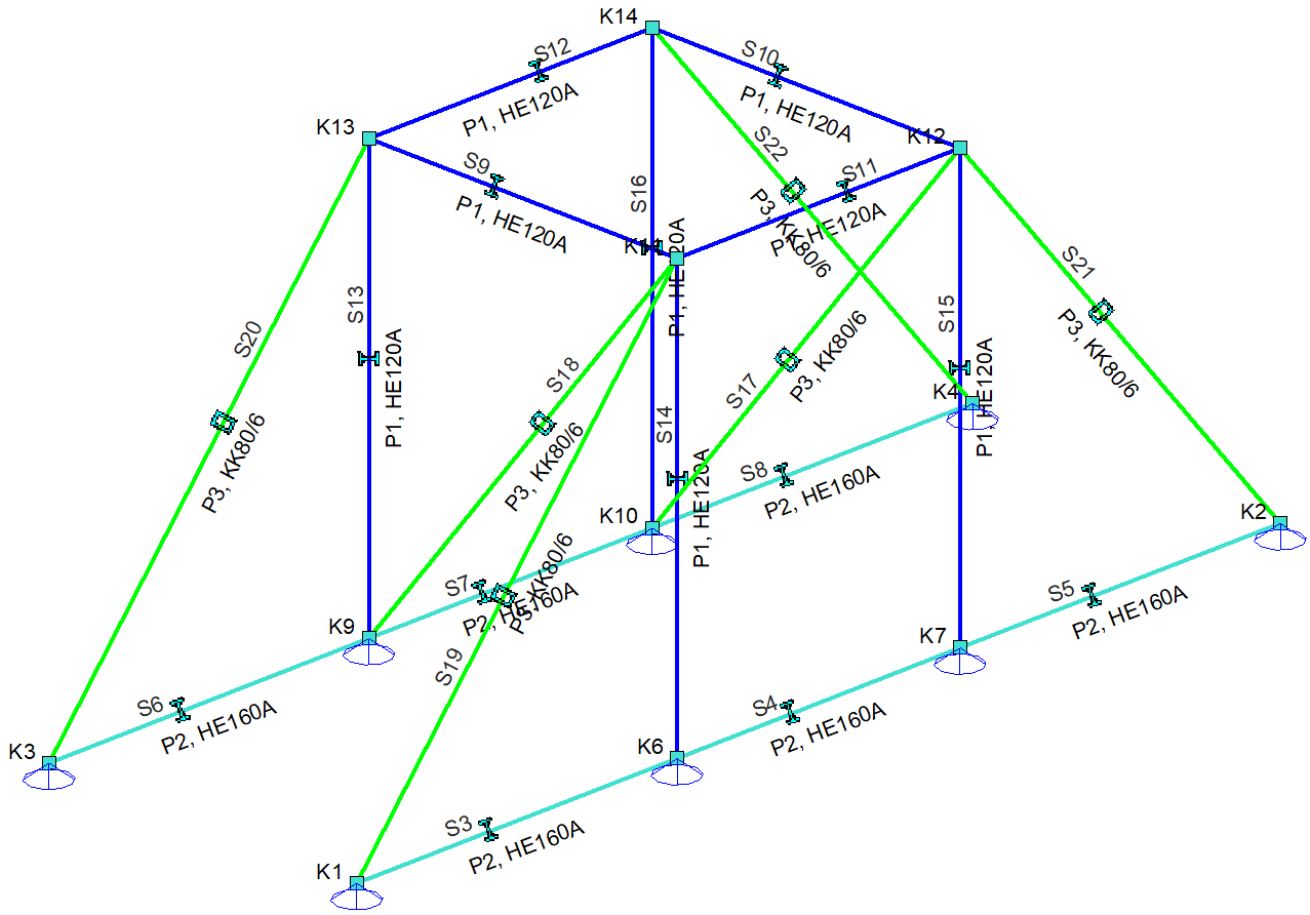
Constructie



STAVEN

Staaf	Knoop-B	Knoop-E	X-B	X-E	Y-B	Y-E	Z-B	Z-E	Lengte	Gamma	Profiel	Positie
S3	K1	K6	0.000	2.080	0.000	0.000	0.000	0.000	2.080	0.0	P2	0.000 - 2.080 (L)
S4	K6	K7	2.080	3.920	0.000	0.000	0.000	0.000	1.840	0.0	P2	0.000 - 1.840 (L)
S5	K7	K2	3.920	6.000	0.000	0.000	0.000	0.000	2.080	0.0	P2	0.000 - 2.080 (L)
S6	K3	K9	0.000	2.080	-2.000	-2.000	0.000	0.000	2.080	0.0	P2	0.000 - 2.080 (L)
S7	K9	K10	2.080	3.920	-2.000	-2.000	0.000	0.000	1.840	0.0	P2	0.000 - 1.840 (L)
S8	K10	K4	3.920	6.000	-2.000	-2.000	0.000	0.000	2.080	0.0	P2	0.000 - 2.080 (L)
S9	K13	K11	2.080	2.080	-2.000	0.000	-2.500	-2.500	2.000	0.0	P1	0.000 - 2.000 (L)
S10	K14	K12	3.920	3.920	-2.000	0.000	-2.500	-2.500	2.000	0.0	P1	0.000 - 2.000 (L)
S11	K12	K11	3.920	2.080	0.000	0.000	-2.500	-2.500	1.840	0.0	P1	0.000 - 1.840 (L)
S12	K14	K13	3.920	2.080	-2.000	-2.000	-2.500	-2.500	1.840	0.0	P1	0.000 - 1.840 (L)
S13	K13	K9	2.080	2.080	-2.000	-2.000	-2.500	0.000	2.500	0.0	P1	0.000 - 2.500 (L)
S14	K11	K6	2.080	2.080	0.000	0.000	-2.500	0.000	2.500	0.0	P1	0.000 - 2.500 (L)
S15	K12	K7	3.920	3.920	0.000	0.000	-2.500	0.000	2.500	0.0	P1	0.000 - 2.500 (L)
S16	K14	K10	3.920	3.920	-2.000	-2.000	-2.500	0.000	2.500	0.0	P1	0.000 - 2.500 (L)
S17	K10	K12	3.920	3.920	-2.000	0.000	0.000	-2.500	3.202	0.0	P3	0.000 - 3.202 (L)
S18	K11	K9	2.080	2.080	0.000	-2.000	-2.500	0.000	3.202	0.0	P3	0.000 - 3.202 (L)
S19	K1	K11	0.000	2.080	0.000	0.000	0.000	-2.500	3.252	0.0	P3	0.000 - 3.252 (L)
S20	K13	K3	2.080	0.000	-2.000	-2.000	-2.500	0.000	3.252	0.0	P3	0.000 - 3.252 (L)
S21	K12	K2	3.920	6.000	0.000	0.000	-2.500	0.000	3.252	0.0	P3	0.000 - 3.252 (L)
S22	K14	K4	3.920	6.000	-2.000	-2.000	-2.500	0.000	3.252	0.0	P3	0.000 - 3.252 (L)
			m	**m**	**m**	**m**	**m**	**m**	**m**	**°**		**m**

Profielen



PROFIELEN

Profiel	Profielnaam	Oppervlakte	It	Iy	Iz	Materiaal	Hoek
P1	HE120A	2534	5.9942e+04	6.0615e+06	2.3090e+06	S235	0
P2	HE160A	3877	1.2194e+05	1.6730e+07	6.1557e+06	S235	0
P3	KK80/6	1683	2.4313e+06	1.4918e+06	1.4918e+06	S355H(EN10219-1)	0
		mm²	mm⁴	mm⁴	mm⁴		°

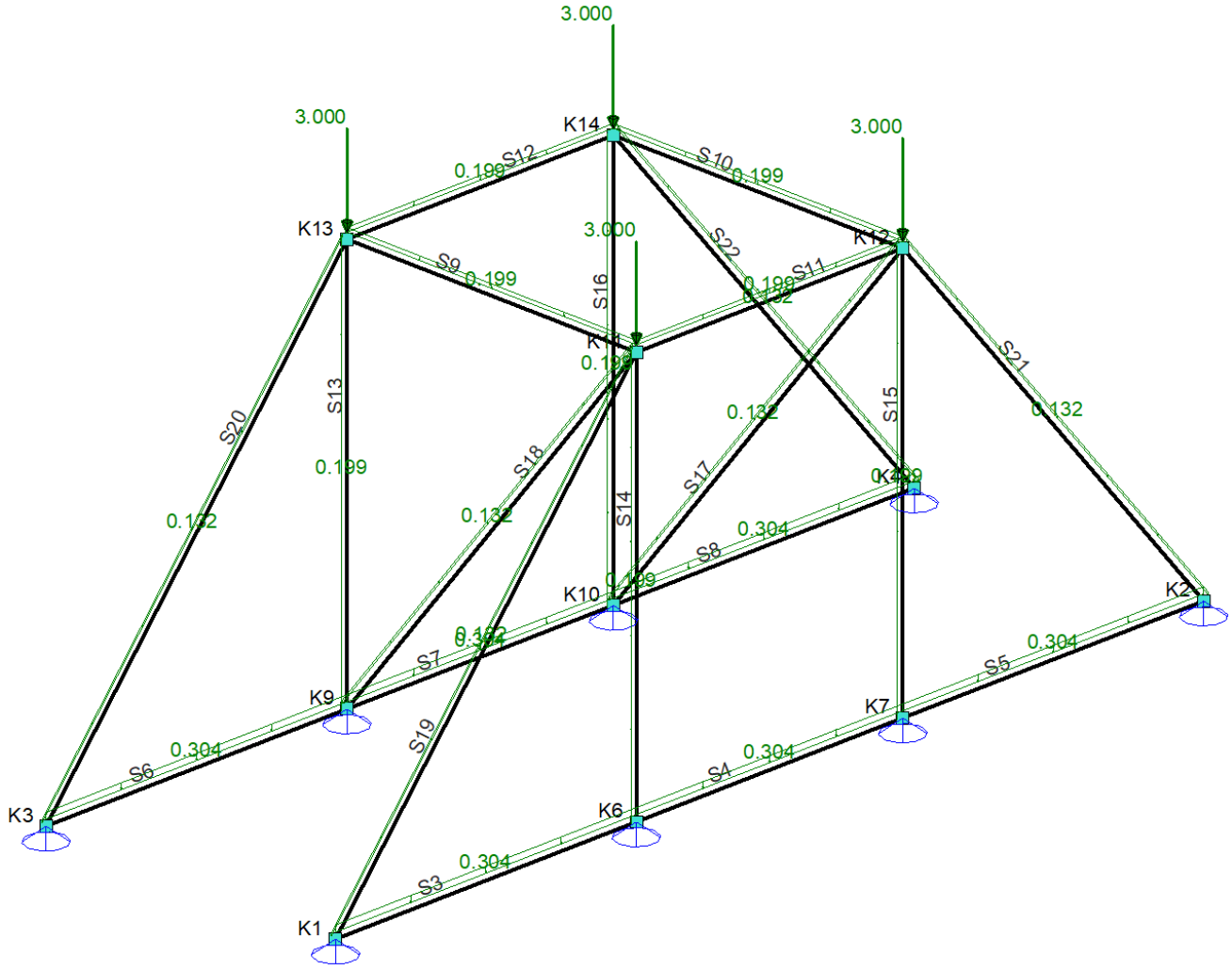
MATERIALEN

Materiaalnaam	Poison	Dichtheid	E-Modulus	Uitzettingcoeff
S235	0.30	78.50	2.1000e+05	12.0000e-06
S355H(EN10219-1)	0.30	78.50	2.1000e+05	12.0000e-06
		kN/m³	N/mm²	C°m

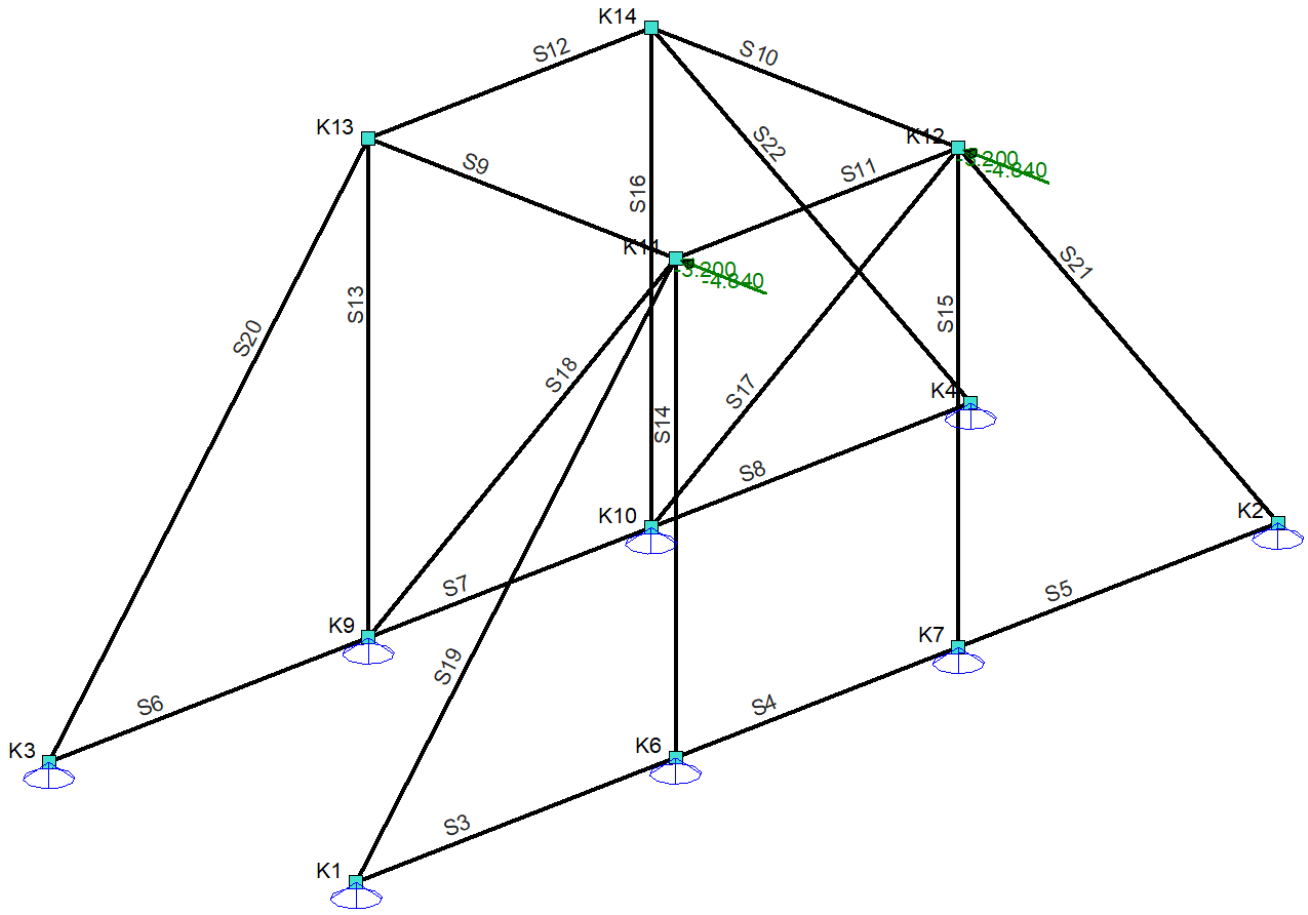
OPLEGGINGEN

Oplegging	Object	Positie	X	Y	Z	Xr	Yr	Zr	Hoek Xr	Hoek Yr	Hoek Zr
O1	K3	K3	Vast	Vast	Vast	Vrij	Vrij	Vrij	0	0	0
O2	K4	K4	Vast	Vast	Vast	Vrij	Vrij	Vrij	0	0	0
O3	K2	K2	Vast	Vast	Vast	Vrij	Vrij	Vrij	0	0	0
O4	K1	K1	Vast	Vast	Vast	Vrij	Vrij	Vrij	0	0	0
O5	K6	K6	Vast	Vast	Vast	Vrij	Vrij	Vrij	0	0	0
O6	K7	K7	Vast	Vast	Vast	Vrij	Vrij	Vrij	0	0	0
O7	K10	K10	Vast	Vast	Vast	Vrij	Vrij	Vrij	0	0	0
O8	K9	K9	Vast	Vast	Vast	Vrij	Vrij	Vrij	0	0	0
		m	kN/m	kN/m	kN/m	kNm/rad	kNm/rad	kNm/rad	°	°	°

B.G.1: Permanent



B.G.2: Permanent

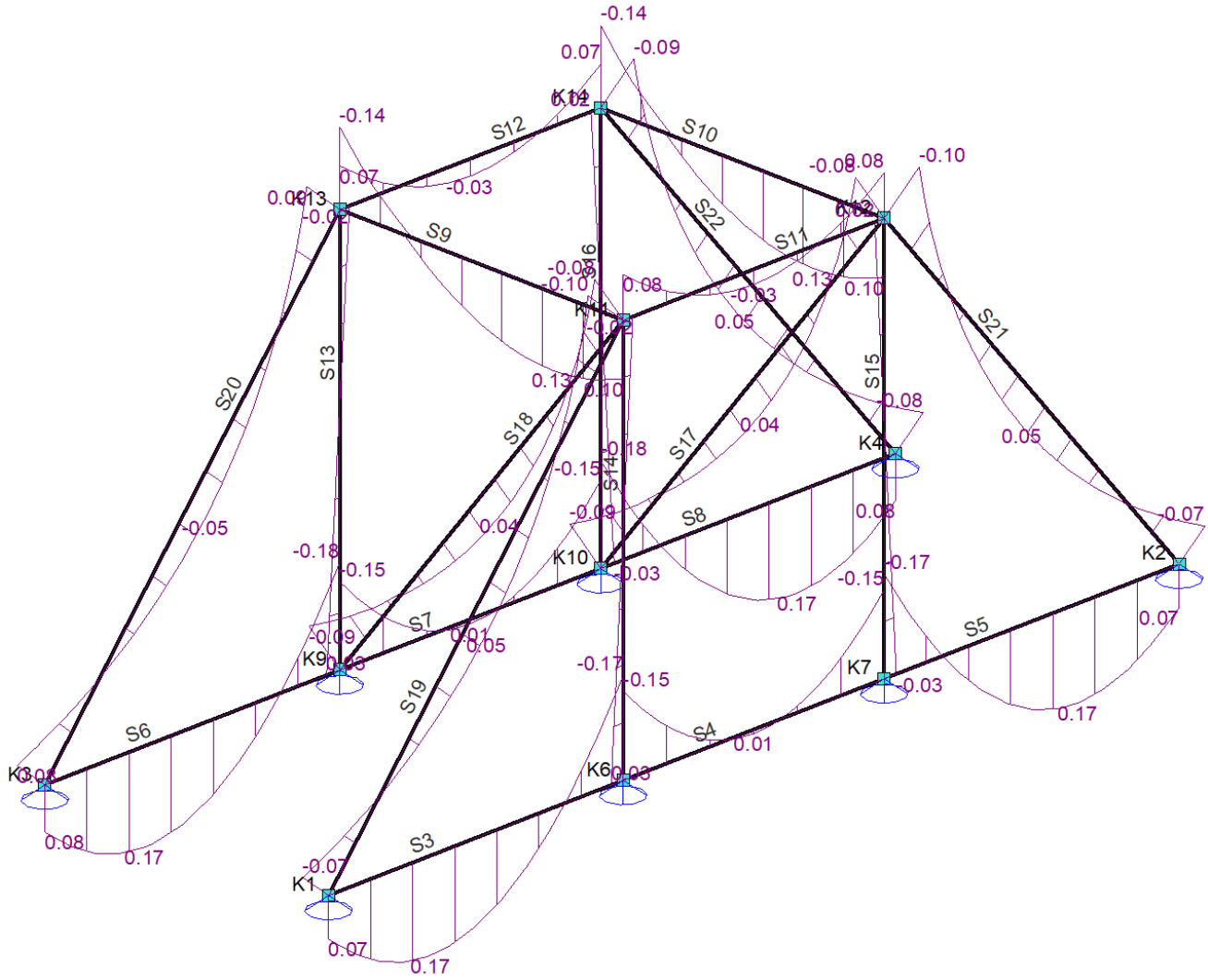


BELASTINGSCOMBINATIES

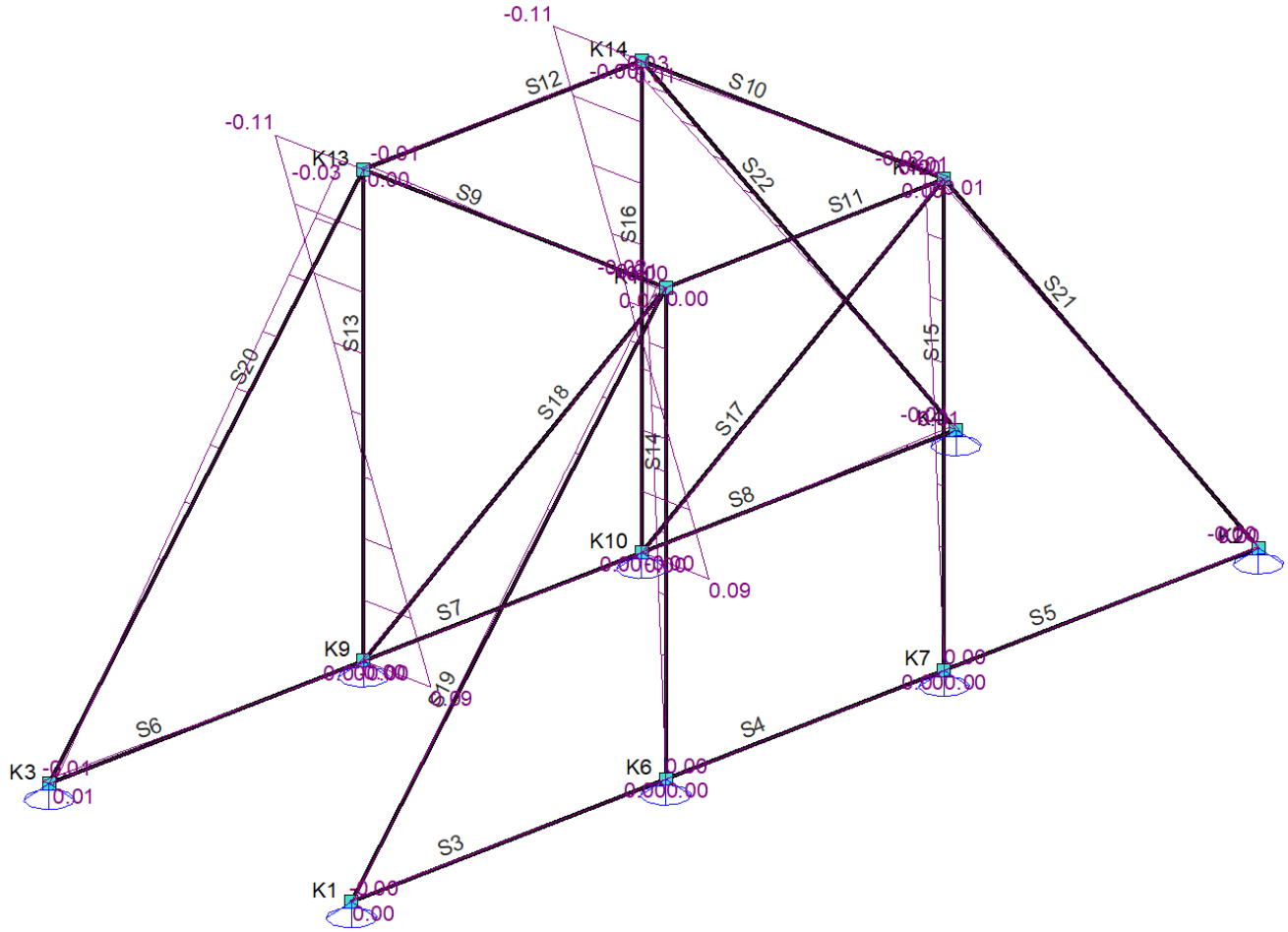
Fundamenteel

B.G.	Omschrijving	Fu.C.1	Fu.C.2
B.G.1	Permanent	1.20	0.90
B.G.2	Permanent	1.50	1.50

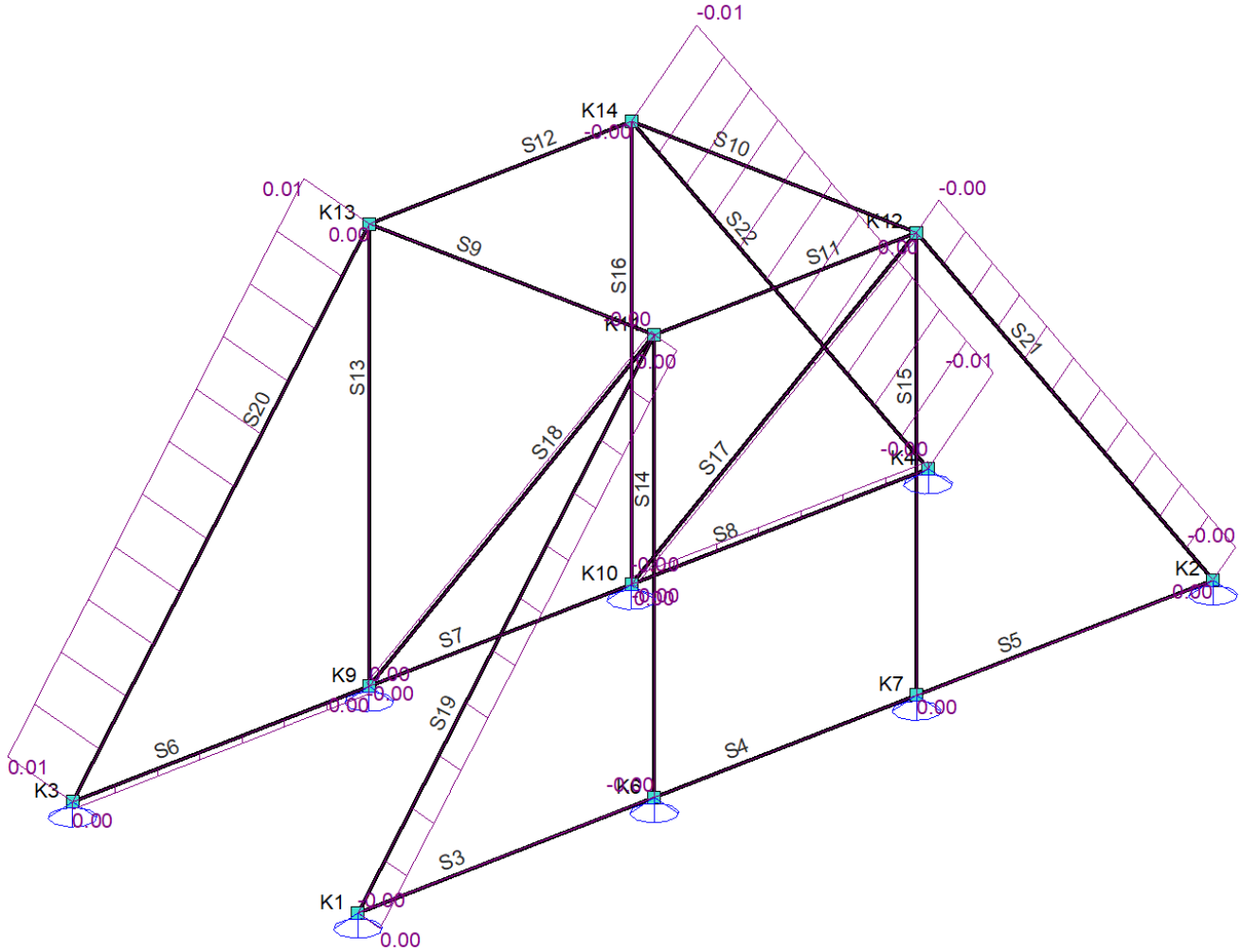
Fu.C. Omhullende Momenten (My)



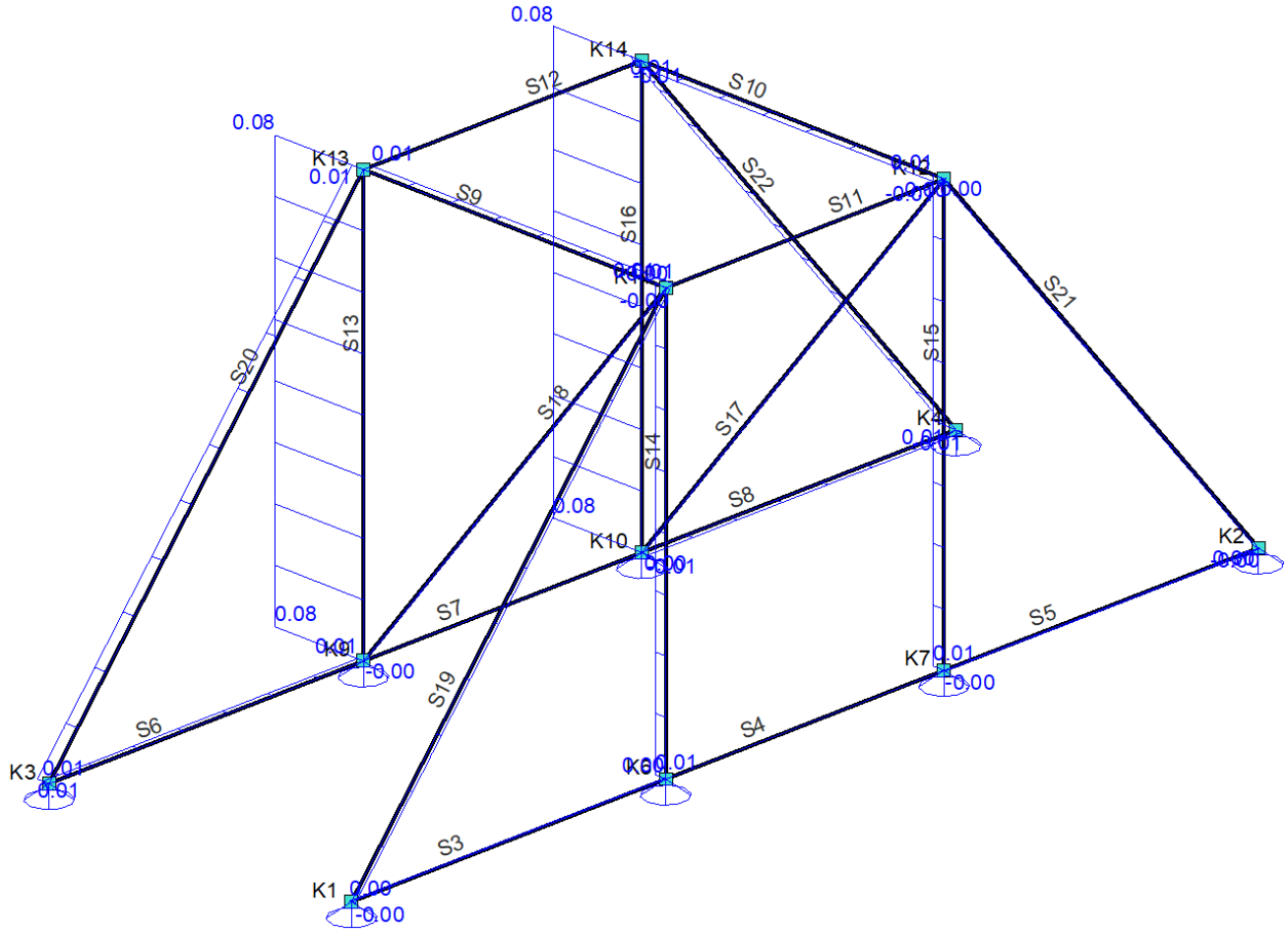
Fu.C. Omhullende Momenten (Mz)



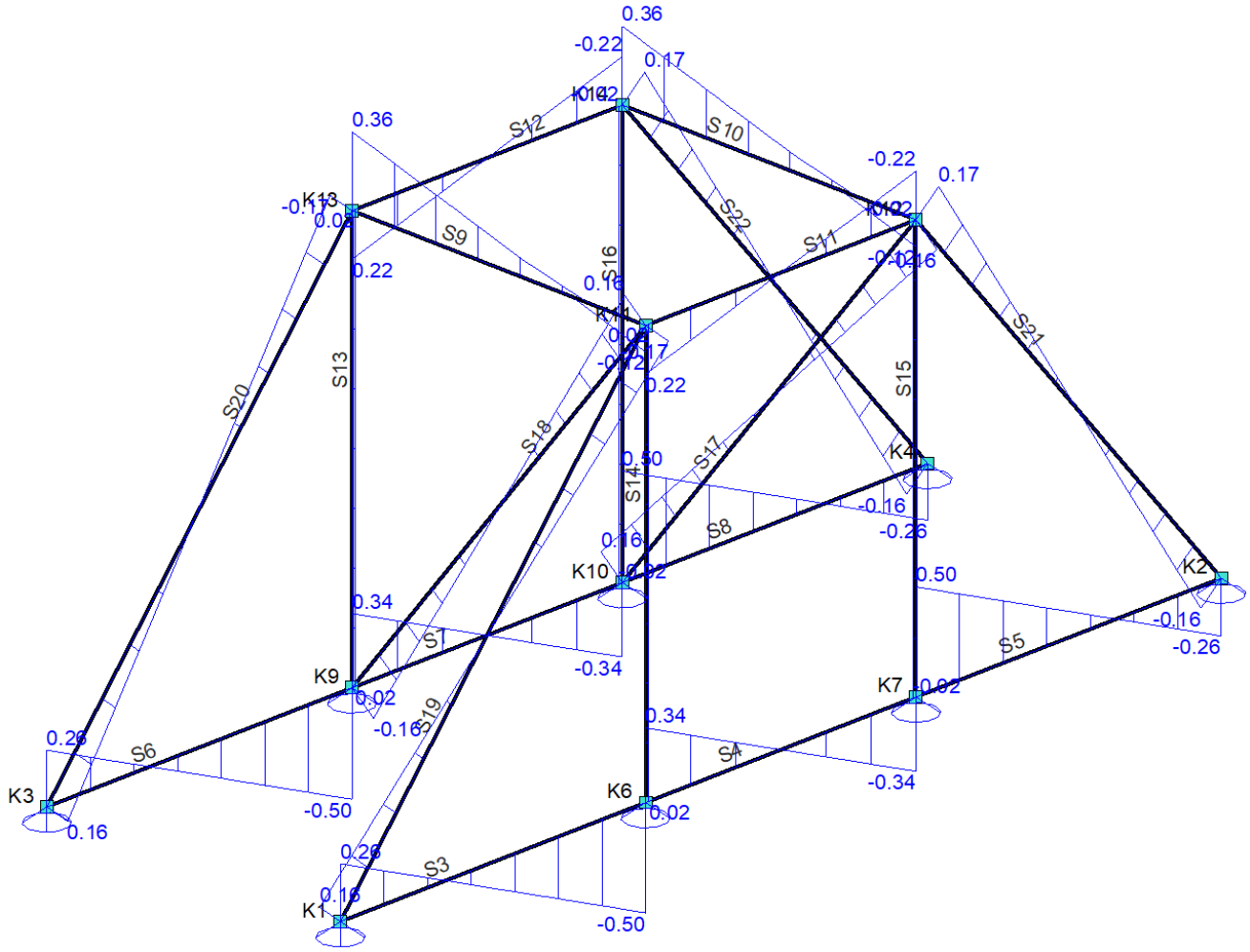
Fu.C. Omhullende Torsiemomenten



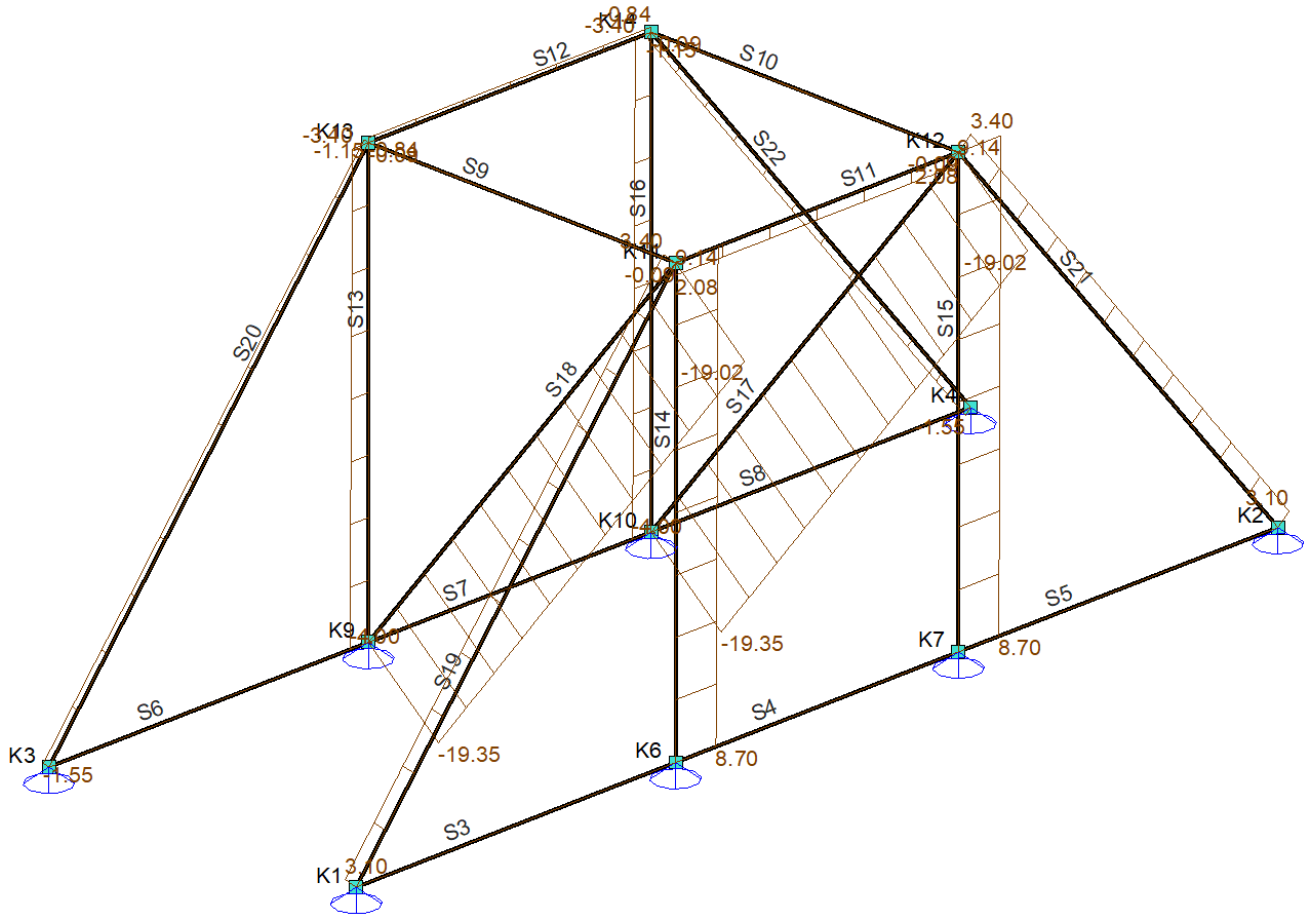
Fu.C. Omhullende Dwarskracht (Vy)



Fu.C. Omhullende Dwarskracht (Vz)



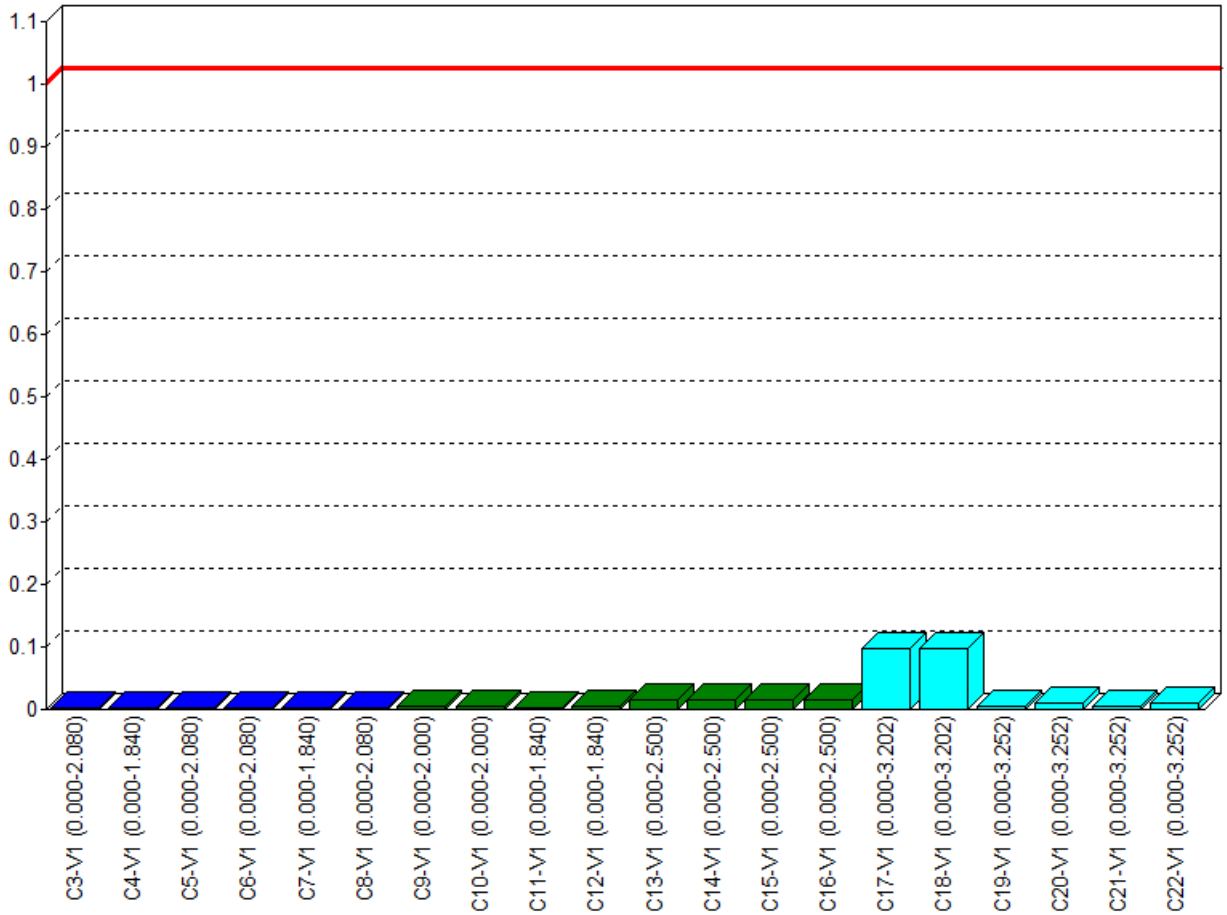
Fu.C. Omhullende Normaalkracht (Nx)



OMHULLENDE (FUNDAMENTEEL)

Staaf	Nx-	Nx+	$Nx-_{max}$	$Nx+_{min}$	Vy-	Vy+	Vz-	Vz+	Mx-	Mx+	My-	My+	Mz-	Mz+
S3	0.00	0.00	0.00	0.00	0.00	0.00	-0.50	0.26	-0.00	0.00	-0.17	0.17	-0.00	0.00
S4	0.00	0.00	0.00	0.00	0.00	0.00	-0.34	0.34	0.00	0.00	-0.15	0.01	0.00	0.00
S5	0.00	0.00	0.00	0.00	-0.00	0.00	-0.26	0.50	0.00	0.00	-0.17	0.17	-0.00	0.00
S6	0.00	0.00	0.00	0.00	0.00	0.01	**-0.50**	0.26	0.00	0.00	**-0.18**	**0.17**	-0.01	0.00
S7	0.00	0.00	0.00	0.00	0.00	0.00	-0.34	0.34	0.00	0.00	-0.15	0.01	0.00	0.00
S8	0.00	0.00	0.00	0.00	-0.01	0.00	-0.26	**0.50**	-0.00	0.00	-0.18	0.17	-0.01	0.00
S9	-0.09	0.00	-0.08	0.00	0.00	0.01	-0.12	0.36	0.00	0.00	-0.14	0.13	-0.01	0.01
S10	-0.09	0.00	-0.08	0.00	**-0.01**	0.00	-0.12	0.36	-0.00	0.00	-0.14	0.13	-0.01	0.01
S11	0.00	2.08	0.00	1.86	0.00	0.00	-0.22	0.22	0.00	0.00	-0.03	0.08	-0.00	0.00
S12	-0.84	0.00	-0.63	0.00	0.00	0.00	-0.22	0.22	0.00	0.00	-0.03	0.07	-0.00	0.00
S13	-4.00	0.00	-2.56	0.00	0.00	**0.08**	0.00	0.02	0.00	0.00	-0.02	0.03	**-0.11**	**0.09**
S14	0.00	**9.14**	0.00	**7.67**	0.00	0.01	0.00	0.02	-0.00	0.00	-0.02	0.03	-0.02	0.00
S15	0.00	9.14	0.00	7.67	0.00	0.01	-0.02	0.00	-0.00	0.00	-0.03	0.02	-0.02	0.00
S16	-4.00	0.00	-2.56	0.00	0.00	0.08	-0.02	0.00	-0.00	0.00	-0.03	0.02	-0.11	0.09
S17	**-19.35**	0.00	**-18.95**	0.00	0.00	0.00	-0.16	0.16	0.00	0.00	-0.09	0.04	-0.00	0.00
S18	-19.35	0.00	-18.95	0.00	-0.00	0.00	-0.16	0.16	-0.00	0.00	-0.09	0.04	-0.00	0.00
S19	0.00	3.40	0.00	2.71	-0.00	0.00	-0.17	0.16	0.00	0.00	-0.10	0.05	-0.01	0.00
S20	-1.55	0.00	-0.87	0.00	0.00	0.01	-0.17	0.16	0.00	**0.01**	-0.05	0.09	-0.03	0.01
S21	0.00	3.40	0.00	2.71	0.00	0.00	-0.16	0.17	-0.00	0.00	-0.10	0.05	-0.01	0.00
S22	-1.55	0.00	-0.87	0.00	0.00	0.01	-0.16	0.17	**-0.01**	0.00	-0.09	0.05	-0.03	0.01
	kN	**kN**	**kN**	**kN**	**kN**	**kN**	**kN**	**kN**	**kNm**	**kNm**	**kNm**	**kNm**	**kNm**	**kNm**

Afb. Staal UC Diagram



UNITY CHECK

Label	Toetsing	Combinatie	Artikel	Unity Check
C10-V1 (0.000-2.000)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.00
	Kiptoetsing	Fu.C.1	NEN-EN1993-1-1(6.54)	0.01
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.01
C11-V1 (0.000-1.840)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0.00
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
C12-V1 (0.000-1.840)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.00
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.00
C13-V1 (0.000-2.500)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.01
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.01
	Kiptoetsing	Fu.C.1	NEN-EN1993-1-1(6.54)	0.01
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.02
C14-V1 (0.000-2.500)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0.02
	Kiptoetsing	Fu.C.1	NEN-EN1993-1-1(6.54)	0.00
C15-V1 (0.000-2.500)	Doorsnede	Fu.C.2	NEN-EN1993-1-1(6.5)	0.02
	Kiptoetsing	Fu.C.1	NEN-EN1993-1-1(6.54)	0.00
C16-V1 (0.000-2.500)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.01
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.01
	Kiptoetsing	Fu.C.1	NEN-EN1993-1-1(6.54)	0.01
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.02
C17-V1 (0.000-3.202)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.9)	0.03
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.09
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00

Label	Toetsing	Combinatie	Artikel	Unity Check
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.10
C18-V1 (0.000-3.202)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.9)	0.03
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.09
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.10
C19-V1 (0.000-3.252)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.31)	0.01
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
C20-V1 (0.000-3.252)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.31)	0.01
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.01
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.01
C21-V1 (0.000-3.252)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.31)	0.01
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
C22-V1 (0.000-3.252)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.31)	0.01
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.01
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.01
C3-V1 (0.000-2.080)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Kiptoetsing	Fu.C.1	NEN-EN1993-1-1(6.54)	0.00
C4-V1 (0.000-1.840)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
C5-V1 (0.000-2.080)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Kiptoetsing	Fu.C.1	NEN-EN1993-1-1(6.54)	0.00
C6-V1 (0.000-2.080)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
C7-V1 (0.000-1.840)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
C8-V1 (0.000-2.080)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Kiptoetsing	Fu.C.2	NEN-EN1993-1-1(6.54)	0.00
C9-V1 (0.000-2.000)	Doorsnede	Fu.C.1	NEN-EN1993-1-1(6.12)	0.00
	Stabiliteit	Fu.C.1	NEN-EN1993-1-1(6.46)	0.00
	Kiptoetsing	Fu.C.1	NEN-EN1993-1-1(6.54)	0.01
	Buiging & Druk	Fu.C.1	NEN-EN1993-1-1(6.61&6.62)	0.01