

2^e SPORTHAL TE GEMERTOPDRACHTGEVER : GEMEENTE GEMERTINGENIEURS-EN ARCHITECTENBURO NAGEL b.v.

Dorpsstraat 74

3732 HK De Bilt

ADVIES-EN KONSTRUKTIEBURO A.BOERKOEL

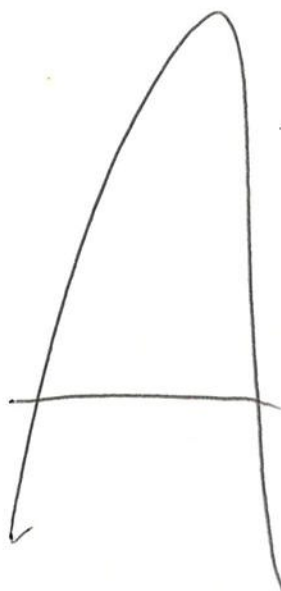
Maliesingel 72-73

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INHOUD

: STATISCHE BEREKENING VAN DE STAALKONSTRUKTIE
EN FUNDERING



B.W.T. GEMERT		
B.W.T. 275	16 JUN 1981	B.V.
GEZIEN	16-7-81	
VOOR DE DIR. G.W. HET HOOFD B.W.T.		

Belasting

Eternit dakplaten	=	18 kgf/m ²	✓
Opstalan	=	10 "	✓
Regels	=	1 "	✓
Stalen gordingen	=	9 "	✓
totaal	=	38 kgf/m ²	✓
Nuttige belasting	=	50 "	✓
totaal	=	88 kgf/m ²	✓

Gordingen h.o.h. 150 cm

$$q = 1,5 \times 88 = 132 \text{ kgf/m}^1 \quad \checkmark$$

$$M = 0,125 \times 132 \times 5,33^2 = 469 \text{ kgfm}$$

Profiel IPE 140

$$\sigma_b = \frac{46900 \times 1,5}{77,3} = 910 \text{ kgf/cm}^2$$

geen kipgevaar, gehouden door regels + opstalan ✓

$$f = \frac{6,2 \times 0,132 \times 5,33^4}{541} = 1,22 \text{ cm}$$

Eindvelden

$$M = 0,125 \times 132 \times 6,40^2 = 675 \text{ kgfm} \quad \checkmark$$

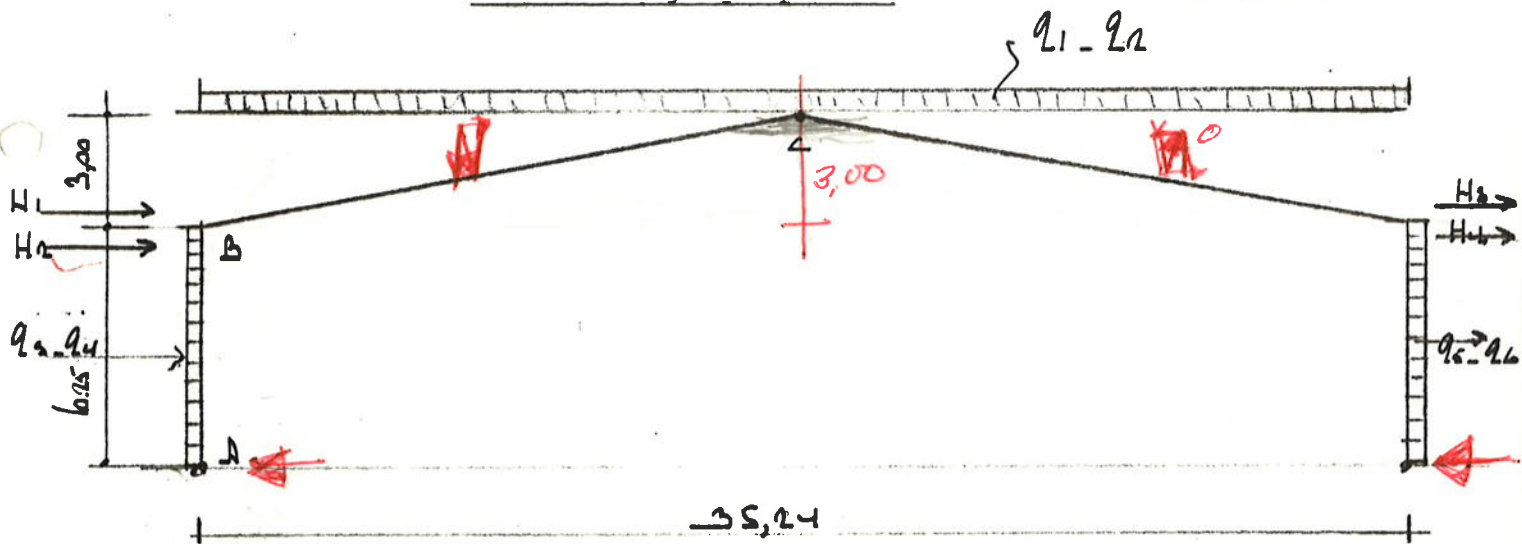
$$\sigma_b = \frac{67500 \times 1,5}{77,3} = 1315 \text{ kgf/cm}^2$$

$$f = \frac{6,2 \times 0,132 \times 6,40^4}{541} = 2,53 \text{ cm}$$

IPE 160 aanhouden

$$f = \frac{541}{869} \times 2,53 = 1,57 \text{ cm}$$

Belasting op spant



$$S = \frac{\sqrt{35,24^2 + 3^2}}{2} = 17,87 \text{ mtr.}$$

$$\text{as 2 - 9} \quad q_1 = \frac{5,53 \times 6,4}{2} \times 88 + 94 \times \frac{17,87}{17,62} = 610 \text{ kgf/m}^1$$

$$\text{as 3 t/m 8} \quad q_2 = (5,33 \times 88 + 94) \times \frac{17,87}{17,62} = 570 \text{ kgf/m}^1$$

$$q_{\text{wind 3}} = 71 \times 0,8 \times \frac{5,33 + 6,4}{2} = 333 \text{ kgf/m}^1$$

$$q_{\text{wind 4}} = 71 \times 0,8 \times 5,33 = 303 \text{ kgf/m}^1$$

$$q_{\text{wind 5}} = 167 \text{ kgf/m}^1$$

$$q_{\text{wind 6}} = 151 \text{ kgf/m}^1$$

320

$$H 1 = 71 \times 0,04 \times \left(\frac{5,33 + 6,4}{2} \right) \times \frac{17,87}{17,87} \times 17,62 +$$

$$0,4 \times \left(\frac{5,33 + 6,4}{2} \right) \times 17,87 \times 71 \times \frac{3}{17,62} \times \frac{17,62}{17,87} = 794 \text{ kgf} \quad \checkmark$$

$$H 2 = \frac{5,33}{6,4} \times 794 = 660 \text{ kgf} \quad \checkmark$$

$$H 3 = 794 \text{ kgf} \quad \checkmark$$

$$H 4 = 660 \text{ kgf} \quad \checkmark$$

$$0,4 \times 71 \times \frac{(5,33 + 6,4)}{2} \times 17,87 = 2976$$


$$\text{Ag } 2976 \times \sin \alpha = \underline{\underline{499 \text{ kgf}}}$$

 ADV BUR BOERKOEL
 DRIE SCHARNIER -
 SPANT

L=

35.24+

H=

6.25+

K=

3.00+

EIGENGEWICHT

Q=

610+

(5.865*

50)+

316.75

NUTTIGE BELAS -
 TING

Q=

5.865*

50+

293.25

WINDBELASTING

Q=

333+

P=

(794*

21

23 /

3+

1058.67

X=

6+

Y=

15+

.....
 E.G. + NUTTIG

VA=

10748.20 ✓

VE=

10748.20 ✓

HA=

10236.93

HE=

10236.93

MOMENTEN IN STYL

1

M=

-10663.47

2

M=

-21326.95

3

M=

-31990.42

4

M=

-42653.89

5

M=

-53317.37

6

M=

-63980.84

65763 MB

MOMENTEN REEL

1

M=

-53823.53

2

M=

-44507.92

3

M=

-36034.01

4

M=

-28401.81

5

M=

-21611.31

6

M=

-15862.51

7

M=

-10555.42

8

M=

-6290.03

9

M=

-2866.34

10

M=

-284.36

11

M=

1455.92

12

M=

2354.49

13

M=

2411.37

14

M=

1626.54

15

M=

.00

NORMAALKRACHTEN
 INREEL

0

N=

1804.04

1

N=

1603.77

2

N=

1563.50

3

N=

1443.23

4

N=

1322.96

5

N=

1202.69

6

N=

1082.42

7

N=

962.15

8

N=

841.88

9

N= 721.62

M= 7078.11

M= -5994.21

N= 10
601.35

M= 4
8714.82

M= 3
-9533.31

N= 11
481.08

M= 5
9990.20

M= 4
-13433.74

N= 12
360.81

M= 6
10904.26

M= 5
-17695.49

N= 13
240.54

M= MOMENTEN IN STYL
RECHTS 0

M= 6
-22318.58

N= 14
120.27

M= 0.00
1

M= STYL RECHTS 0
0.00

N= 15
0.00

M= 1914.43
2

M= 1
-7451.57

.....
WIND

M= 3648.19
3

M= 2
-14722.47

.....
VERTIKALE REAC -
TIES

M= 5201.29
4

M= 3
-21812.71

VA= -558.48

M= 6573.72
5

M= 4
-28722.28

VE= 558.48

HORIZONTALE REAC
TIES

M= 7765.49
6

M= 5
-35451.19

HA= -2785.31

HE= 1924.57

M= 8776.00

M= 6
-41999.44

MOMENTEN IN STYL
LINKS

M= 0

.....
MOMENTEN E.G. +
WIND

.....
REACTIES E.G. +
WIND

M= 1
2720.70

M= 0.00

M= 0
5022.65

M= 2
5080.07

M= 1

M= 6139.62

M= 3

M= -2816.44

M= 2530.35

M= 7240.22

=====

 ADV BUR BOERKOEL
 DRIE SCHARNIER -
 SPANT

L=

35.24+

H=

6.25+

K=

3.00+

EIGENGEWICHT

Q=

570-

(5.33*-

50)+

303.50

NUTTIGE BELAS -
 TING

Q=

5.33*

50+

266.50

WINDBELASTING

Q=

303+

P=

660*

2+

2+

3+

880.00

X=

6+

Y=

15+

.....
 E.G. + NUTTIG

.....
 VA=

10043.40

VE=

10043.40

HA=

9565.66

HE=

9565.66

MOMENTEN IN STYL

1

M=

-9964.23

2

M=

-19928.46

3

M=

-29892.69

4

M=

-39856.92

5

M=

-49821.15

6

M=

-59785.37

MOMENTEN REEL

1

M=

-50294.11

2

M=

-41589.36

3

M=

-33671.12

4

M=

-26539.39

5

M=

-20194.17

6

M=

-14635.46

7

M=

-9863.26

8

M=

-5877.57

9

M=

-2678.38

10

M=

-265.71

11

M=

1360.45

12

M=

2200.10

13

M=

2253.24

14

M=

1519.88

15

M=

.00

NORMAALKRACHTEN
 INREEL

0

N=

1685.74

1

N=

1573.36

2

N=

1460.98

3

N=

1348.59

4

N=

1236.21

5

N=

1123.83

6

N=

1011.44

7

N=

899.06

8

N=

786.60

9

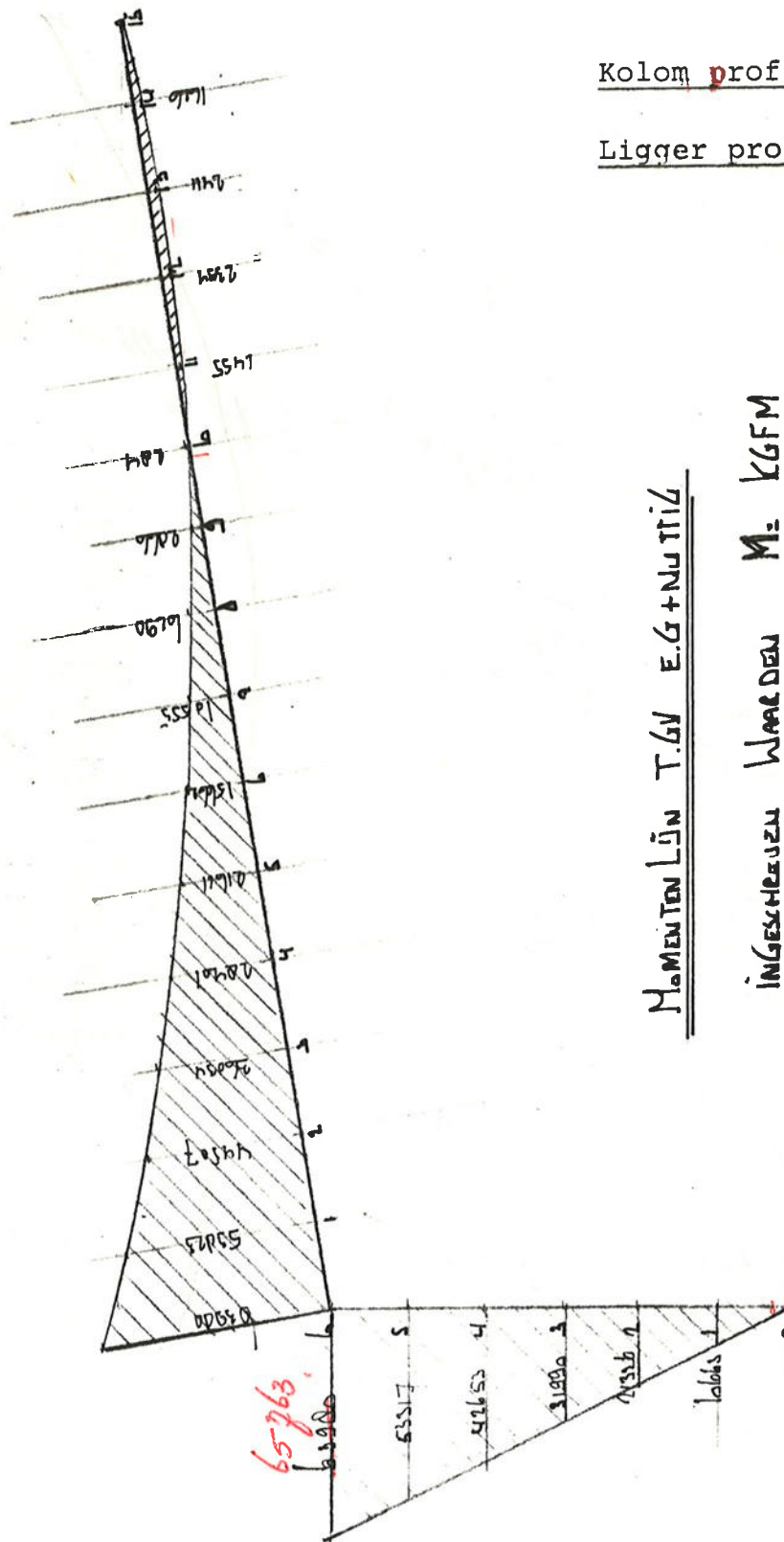
N=	674.30	M=	6224.12	M=	2
	10		4	M=	-6132.84
N=	561.91	M=	7641.28	M=	3
	11		5	M=	-9692.42
N=	449.53	M=	8729.65	M=	4
	12		6	M=	-13580.78
N=	337.15	M=	9489.26	M=	5
	13	MOMENTEN IN STYL		M=	-17797.92
N=	224.77	RECHTS	0	M=	6
	14	M=	0.00	M=	-22343.83
N=	112.38		1	STYL RECHTS	0
	15	M=	1683.92	M=	0.00
N=	0.00		2		1
.....		M=	3203.45	M=	-6989.43
WIND			3		2
.....		M=	4558.59	M=	-13814.48
VERTIKALE REAC -			4		3
TIES		M=	5749.35	M=	-20475.14
VA=	-486.01		5		4
VE=	486.01	M=	6775.72	M=	-26971.41
HORIZONTALE REAC			6		5
TIES		M=	7637.70	M=	-33303.29
HA=	-2465.16				6
HE=	1695.47	MOMENTEN E.G. +		M=	-39470.78
MOMENTEN IN STYL		WIND			
LINKS	0			REACTIES E.G. +	
M=	0.00	STYL LINKS	0	WIND	
	1		0.00		
M=	2403.48		1	VA=	4861.66
	2	M=		VE=	5833.60
M=	4478.19			HA=	2628.14
	3	M=	-2902.03	HE=	6788.70
				=====	

Stijl

$$M \text{ op } 3,00^+ = 10236 \times 3 = \underline{30708 \text{ kgfm}}$$

Kolom profiel He 450 A

Ligger profiel IPE 500



MOMENTEN LĪN T.G.V. E.G+NUITIL

INGESCHREVEN WAARDEN M: KGFM

Spanningsberekening

Ligger IPE 500

$A = 116$

$I_x = 48200$

$W_x = 1930$

$i_x = 23,4$

Stijl He 450 A

$A = 178$

$I_x = 63722$

$W_x = 2900$

$i_x = 18,9$

$$e = \frac{3 \times 48200 \times 625}{63720 \times 1787} = 0,80$$

$$L_K = \sqrt{\left(4 + \frac{10}{0,80}\right) \times 625^2} = 2538 \text{ cm}$$

$$\lambda = \frac{2538}{18,9} = 135$$

$$\omega = 3,52$$

$$\sigma_e = 1137 \text{ kgf/cm}^2$$

$$N_x = \frac{1137 \times 178}{10748 \times 1,5} = 12,55$$

op 3,00 mtr. vanaf voet

$$M = 10236 \times 3 = 30708 \text{ kgfm}$$

$$\sigma = \frac{10748 \times 3,52 \times 1,5}{178} + \frac{12,55}{11,55} \times \frac{3070800 \times 1,5}{2900} = 320 + 1725 =$$

$$\underline{\underline{2045 \text{ kgf/cm}^2}}$$

in hoekpunt

$$M = 63980 \text{ kgfm}$$

$$F = 10748 \text{ kgf}$$

Statische waarden

$$\frac{1}{2} \text{ He 450 A} \quad A = 89 \text{ cm}^2$$

$$I_x = 2820 \text{ cm}^4 \quad e_x = 3,94 \text{ cm}^2$$

verschmoring h = 85

$$\begin{aligned}
 I_x &= 2 \times 2820 &= 5640 \text{ cm}^4 \\
 &2 \times 89 \times (42,5 - 3,94)^2 &= 264664 \text{ " } \\
 &\frac{1}{12} \times 1,2 \times 41^3 &= 6892 \text{ " } \\
 I_x \text{ totaal} &&= 277196 \text{ cm}^4
 \end{aligned}$$

$$W_x = \frac{277196}{42,5} = 6522 \text{ cm}^3$$

$$A = 2 \times 89 + 41 \times 1,2 = 227,20 \text{ cm}^2$$

$$i = \sqrt{\frac{277196}{227,20}} = 34,92 \text{ cm} \quad \text{18,9}$$

$$\sigma = \frac{10748 \times 3,52 \times 1,5}{227,20} + \frac{12,55}{11,55} \times \frac{6398000 \times 1,5}{6522} =$$

$$\sigma \quad 250 + 1600 = 1850 \text{ kgf/cm}^2$$

$$\text{idem} \quad \frac{10748 \times 1,5}{227,20} + \frac{6398000 \times 1,5}{6522} = 70 + 1475 = 1545 \text{ kgf/cm}^2$$

Ligger

in hoekpunt

$h = 900$	$I_x = 187500 \text{ cm}^4$ $W_x = 4170 \text{ cm}^3$ $e_x = 3470 \text{ cm}^2$ $A = 156 \text{ cm}^2$	<i>zie Staal im Hochbau</i>
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$$N = 1804 \text{ kgf}$$

$$M = 63980 \text{ kgfm}$$

$$\sigma = \frac{1804 \times 1,5}{156} + \frac{6398000 \times 1,5}{4170} = 20 + 2300 = 2320 \text{ kgf/cm}^2$$

2365 2385

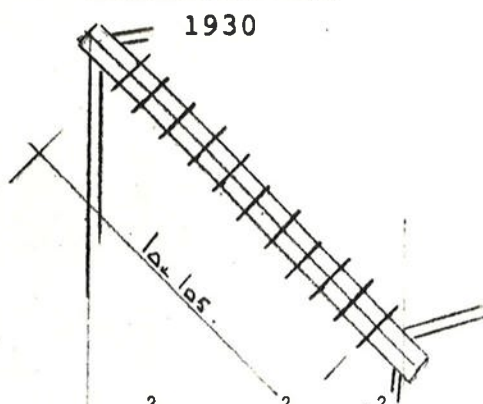
$$\text{op } 6,00 \text{ mtr.} \rightarrow \frac{17,87}{15} = 1,20 \rightarrow 5 \times 1,20 = 6,00 \text{ mtr.}$$

$$M = 21611 \text{ kgfm}$$

$$N = 1202 \text{ kgf}$$

Profiel IPE 500

$$\sigma = \frac{2161100 \times 1,5}{1930} = 1680 \text{ kgf/cm}^2$$



Houtverbinding

$$\Sigma x^2 = 8^2 + 18,5^2 + 29^2 + 39,5^2 + 50^2 + 60,5^2 + 71^2 + 81,5^2 + 91^2 + 102,5^2 + 113^2 = 52390$$

$$F \text{ per bout} = \frac{6398000 \times 113 \times 1,5}{2 \times 52390} = 10350 \text{ kgf}$$

$$\text{Bouten M 20} \quad A_s = 2,45 \text{ cm}^2$$

$$\sigma_{\perp} = \frac{10350}{2,45} = 4225 \text{ kgf/cm}^2 < 5600 \text{ kgf/cm}^2$$

$$\tau = \frac{10748 \times 1,5}{22 \times 0,7 \times 2,45} = 430 \text{ kgf/cm}^2$$

$$\sigma_i = \sqrt{4225^2 + 2 \times 430^2} = 4268 \text{ kgf/cm}^2 < 5600 \text{ kgf/cm}^2$$

Boutverbinding midden van ligger

$$F = 10236 \text{ kgf}$$

$$\text{prying force } M = 10236 \times 0,47 = 4810 \text{ kgfm}$$

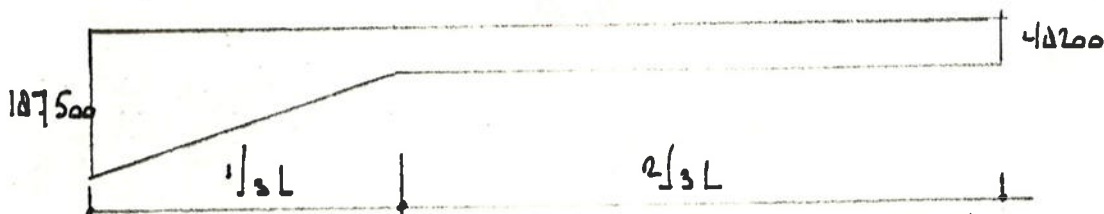
$$\sum x^2 = 12^2 + 26^2 + 40^2 = 2420$$

$$F \text{ in bout} = \frac{481000 \times 40 \times 1,5}{2420} = 11925 \text{ kgf}$$

$$F \text{ trek per bout} = \frac{11925}{2} + \frac{10236 \times 1,5}{6} = 8521 \text{ kgf}$$

toe te passen bouten M 24

$$\sigma_t = \frac{8521 \times 1,5}{3,53} = 3620 \text{ kgf/cm}^2 < 5600 \text{ kgf/cm}^2$$

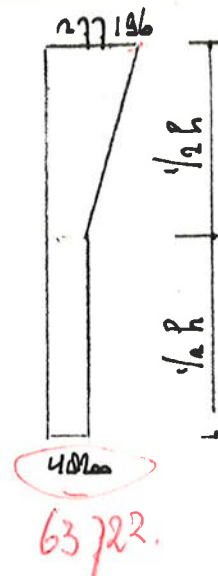
Verplaatsinginvloed verstijvingen

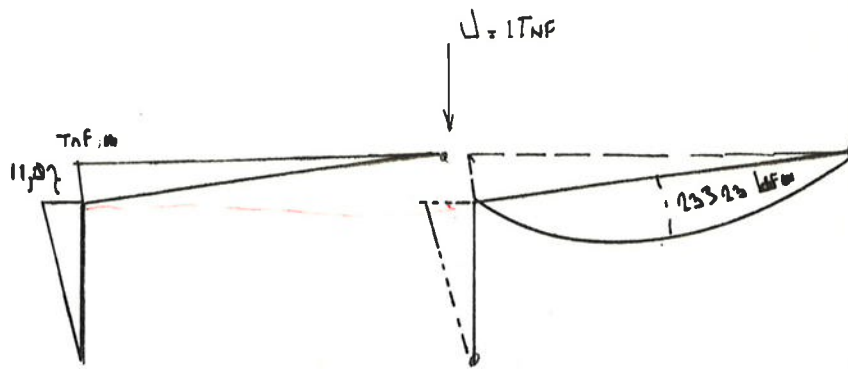
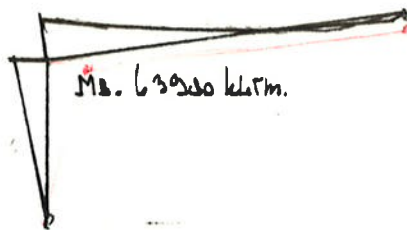
factor op stijl

$$1 + \frac{277196 - 48200}{2 \times 48200} = 1,68$$

factor ligger

$$2 \times 1 + \frac{187500 - 48200}{2 \times 4800} = 1,14$$



Verplaatsing

$$0,125 \times 601 \times 17,62 = 23323 \text{ kgfm}$$

t.g.v. 1 ton

$$H = \frac{17,62}{9,25} = 1,90$$

$$M_B = 1,90 \times 6,25 = 11,87 \text{ tfm}$$

$$E \delta C = + \frac{\frac{1}{3} \times 63980 \times 11,870 \times 6,25}{63720 \times 1,68} = + 14,779$$

$$+ \frac{\frac{1}{3} \times 63980 \times 11,870 \times 17,87}{48200 \times 1,14} = + 82,32$$

$$- \frac{\frac{1}{3} \times 23323 \times 11,870 \times 17,87}{48200 \times 1,14} = - 30,01$$

$$67,08$$

$$\delta e = \frac{67,08}{2100} = 0,32 \text{ mtr.}$$

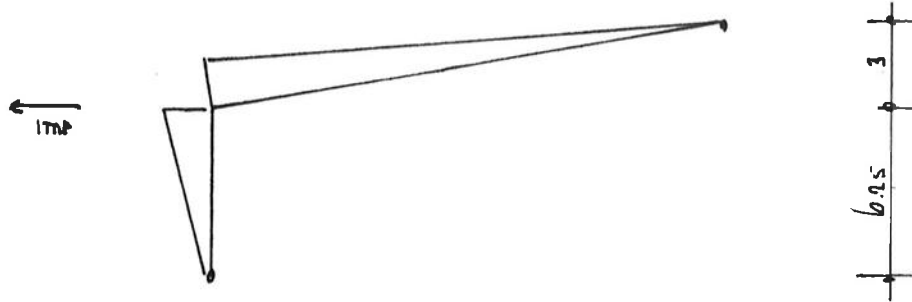
$$\text{t.g.v. eigengewicht} = \frac{316}{610} \times 32 = 16,5 \text{ cm}$$

108 mm. d.g.

n.l

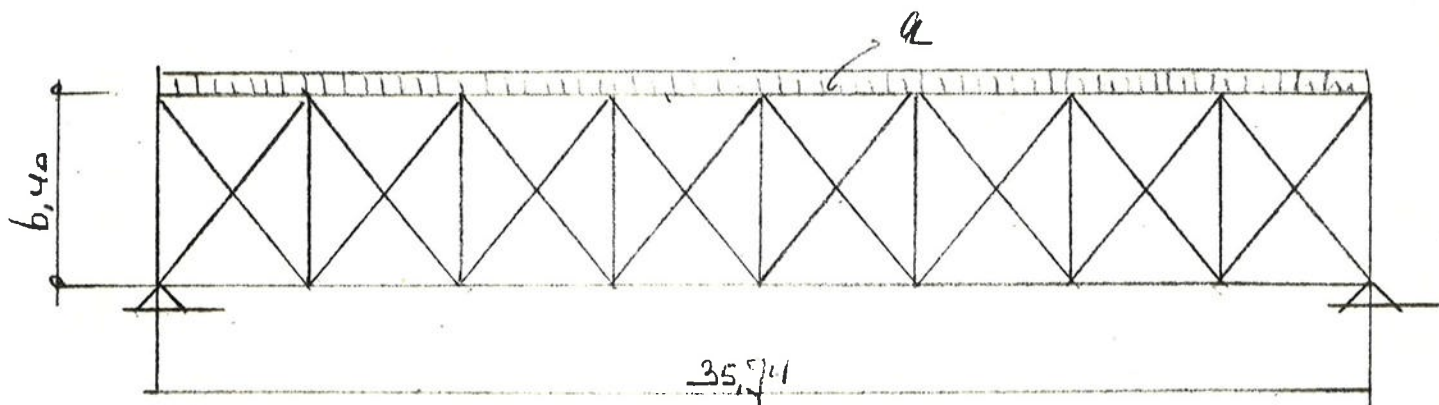
101 m

209 mm.

Horizontale verplaatsing

$$M = \frac{1 \times 3 \times 6,25}{9,25} = 2,027 \text{ tfm}$$

$$\delta b = \frac{2,027}{11,87} \times 16,8 = 2,86 \text{ cm}$$

Stabiliteit in langsrichting

$$q \text{ gem.} = 4,3 \times 71 \times 1,2 + 50 \times 71 \times 0,04 = 366 + 144 = 510 \text{ kgf/m}^1$$

$$\text{max. randstaafkrachten} = \frac{0,125 \times 510 \times 35,74^2}{2 \times 6,40} = 6360 \text{ kgfm}$$

2 verbanden.

$$D \text{ max.} = \frac{17,87}{2} \times 510 = 4556 \text{ kgf} \quad \checkmark$$

$$\text{max. diagonaal} \quad S = \sqrt{4,5^2 + 6,40^2} = 7,82 \text{ mtr.}$$

$$F \text{ in staaf} = \frac{4556 \times 7,82}{6,4} = 5570 \text{ kgf} \quad \checkmark$$

Profiel loodrecht tussen spanten He 140 A

$$\lambda = \frac{640}{5,73} = 112 \quad \omega = 2,424$$

$$\sigma_d = \frac{4556 \times 2,424 \times 1,5}{31,40} = 530 \text{ kgf/cm}^2$$

1360.

$$\begin{aligned} \text{uit dakbelasting} &= \frac{67500 \times 1,5}{155} = 653 \text{ " } \\ \sigma \text{ totaal} &= \frac{530 + 653}{2} = 1183 \text{ kgf/cm}^2 \end{aligned}$$

1360.

$$f = \frac{6,2 \times 0,132 \times 6,4^4}{1030} = 1,33 \text{ cm} \quad \checkmark$$

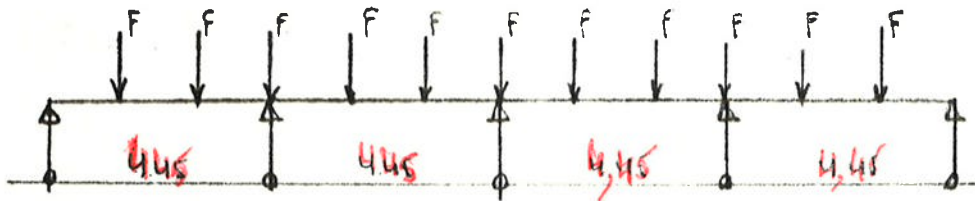
Diagonaal

Profiel L 70.70.7

$$A_n = 9,40 - 1,40 = 8 \text{ cm}^2$$

$$\sigma = \frac{5570 \times 1,5}{8} = 1045 \text{ kgf/cm}^2$$

Randstaaf



$$F = \frac{132 \times 6,4}{2} = 425 \text{ kgf} \quad \checkmark$$

$$M = 0,286 \times 425 \times 4,45 = 540 \text{ kgfm}$$

Profiel He 160 A

$$\lambda = \frac{445}{3,98} = 111$$

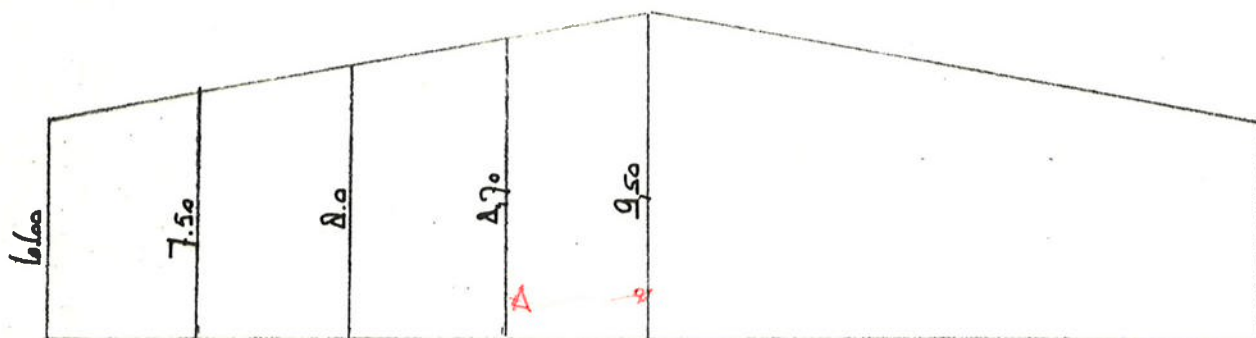
$$\omega = 2,382$$

$$\sigma_d = \frac{6360 \times 2,382 \times 1,5}{38,8} = 585 \text{ kgf/cm}^2$$

$$\sigma_b = \frac{54000 \times 1,5}{220} = 370 \text{ "}$$

$$\sigma_{\text{totaal}} = 955 \text{ kgf/cm}^2 \quad \checkmark$$

$$F_1 = 3,381 \times 425 = 1440 \text{ kgf}$$

Kolommen in kopgevelsKolommen D - E - F

$$q_{\text{wind}} = 71 \times 1,1 \times 4,45 = 348 \text{ kgf/m}^1$$

$$M = 0,125 \times 348 \times 9,50^2 = 3925 \text{ kgfm}$$

Profiel He 200 A

$$\lambda = \frac{950}{8,28} = 115$$

$$\omega = 2,55$$

$$\sigma_e = 1567 \text{ kgf/cm}^2$$

$$N_x = \frac{1567 \times 53,8}{1440 \times 1,5} = 39$$

$$\sigma = \frac{1440 \times 1,5 \times 2,55}{53,8} + \frac{39}{38} \times \frac{392500 \times 1,5}{389} = 105 + 1555 = 1660 \text{ kgf/cm}$$

$$f = \frac{6,2 \times 0,348 \times 9,5^4}{3690} = 4,67 \text{ cm} = 0,005 \text{ L} < 0,0057 \text{ L}$$

Kolom B - C - G - H

$$M = 0,125 \times 348 \times 8,00^2 = 2784 \text{ kgfm}$$

Profiel He 180 A

$$\lambda = \frac{800}{7,45} = 108 \quad \omega = 2,276 \quad \sigma_e = 1780 \text{ kgf/cm}^2$$

$$N_x = \frac{1780 \times 45,3}{1440 \times 1,5} = 37$$

$$\sigma = \frac{1440 \times 1,5 \times 2,276}{45,3} + \frac{37 \times 278400 \times 1,5}{36 \times 294} = 110 + 1460 = 1570 \text{ kgf/cm}^2$$

$$f = \frac{6,2 \times 0,348 \times 8^4}{2510} = 3,52 \text{ cm} = 0,0044 \text{ L} < 0,0057 \text{ L}$$

t.p.v. opvang metselwerk as 10

halfsteens + beplating.

$$q = 2,5 \times 400 + 3 \times (200 + 50) = 1750 \text{ kgf/m}^1$$

$$M = 0,125 \times 1750 \times 4,45^2 = 4330 \text{ kgfm}$$

Profiel He 220 A

$$\sigma = \frac{433000 \times 1,5}{515} = 1260 \text{ kgf/cm}^2$$

$$f = \frac{6,2 \times 1,75 \times 4,45^4}{5410} = 0,80 \text{ cm}$$

Profiel om praktische reden He 260 A aanhouden **t.b.v.** oplegging metselwerk.

$$F = 4,45 \times 1750 = 7787 \text{ kgf}$$

as D - E - F

Profiel He 200 A

uit wind.

$$\sigma = \frac{(1440 + 7787) \times 1,5 \times 2,55}{53,8} + 1555 = 2211 \text{ kgf/cm}^2$$

as B C - G - H

Profiel He 180 A

$$\sigma = \frac{(1440 + 7787) \times 1,5 \times 2,276}{45,3} + 1460 = 2155 \text{ kgf/cm}^2$$

Windbokken

$$H = 510 \times 17,87 = 9115 \text{ kgf} \quad \checkmark$$

op te nemen door 2 windbokken

$$S = 8,40 \text{ mtr.}$$

$$F \text{ in stijlen} + \frac{9115 \times 6,50}{2 \times 5,33} = 5560 \text{ kgf} \quad \checkmark$$

$$F \text{ in diagonaal} = \frac{8,40}{5,33} \times \frac{9115}{2} = 7180 \text{ kgf} \quad \checkmark$$

Profiel plat 100 x 10

$$A_n = 8 \text{ cm}^2$$

$$\sigma = \frac{7180 \times 1,5}{8} = 1350 \text{ kgf/cm}^2 \quad \checkmark$$

Regel in kopgevels

$$q \text{ wind} = 4,5 \times 71 \times 1,1 = 350 \text{ kgf/m}^1$$

$$M = 0,125 \times 350 \times 4,45^2 = 866 \text{ kgfm}$$

Profiel IPE 140

$$\sigma = \frac{86600 \times 1,5}{77,3} = 1680 \text{ kgf/cm}^2$$

$$f = \frac{6,2 \times 0,350 \times 4,5^4 \times 2/3}{541} = 1,09 \text{ cm}$$

Dakbalken in laagbouw

Liggers h.o.h. 5,33 mtr.

$$q = 5,33 \times 88 + 20 = 500 \text{ kgf/m}^1$$

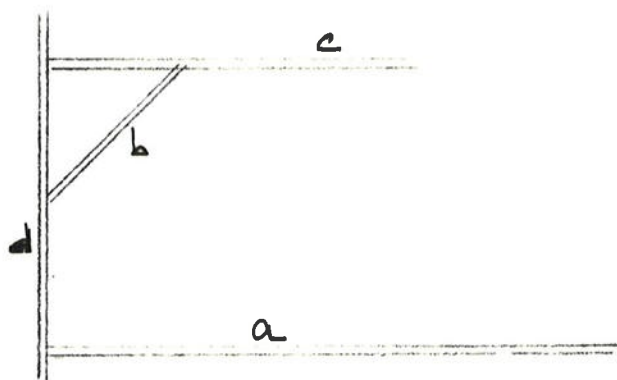
$$M = 0,125 \times 500 \times 5,85^2 = 2140 \text{ kgfm}$$

Profiel IPE 220

$$\sigma = \frac{214000 \times 1,5}{252} = 1275 \text{ kgf/cm}^2$$

$$f = \frac{6,2 \times 0,5 \times 5,85^4}{2770} = 1,31 \text{ cm} = 0,24 \text{ L}$$

Liggers t.p.v. creche



Balk A

Belasting

dakplaten + houten balklaag + dakbedekking	=	45 kgf/m ²	✓
plafond	=	15 "	
	totaal	=	60 kgf/m ²
nuttige belasting	=	100 "	
	totaal	=	160 kgf/m ² ✓

$$q = 3 \times 160 + 30 = 510 \text{ kgf/m}^1$$

Overspanning 6,00 mtr.

$$M = 0,125 \times 510 \times 6^2 = 2295 \text{ kgfm}$$

Profiel IPE 200

$$\sigma = \frac{229500 \times 1,5}{194} = 1775 \text{ kgf/cm}^2$$

$$f = \frac{6,2 \times 0,51 \times 6^4}{1940} = 2,12 \text{ cm}$$

zeeg van 20 mm ✓

Balk B

$$q = 160 + 20 = 180 \text{ kgf/m}^1$$

$$M = 0,125 \times 180 \times 2,8^2 = 176 \text{ kgfm}$$

Profiel He 100 ABalk C

$$F = 180 \times 1,40 = 252 \text{ kgf}$$



$$q = 2 \times 160 = 320 \text{ kgf/m}$$

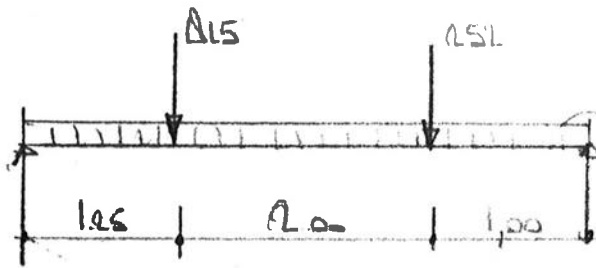
$$M = 0,125 \times 320 \times 4,25^2 + \frac{252 \times 2 \times 2,25^2}{4,25} = 722 + 268 = 990 \text{ kgfm}$$

Profiel He 140 A

$$\sigma = \frac{99000 \times 1,5}{155} = 960 \text{ kgf/cm}^2$$

$$f = \frac{6,2 \times 0,32 \times 4,25^4}{1030} + \frac{9,86 \times 0,252 \times 4,25^3}{1030} = 0,63 + 0,19 = 0,82 \text{ cm}$$

$$R A = \frac{4,25 \times 320}{2} + \frac{252 \times 2,25}{4,25} = 680 + 135 = 815 \text{ kgf}$$

Balk D

$$q = 5,33 \times 88 + 30 = 275 \text{ kgf/m}$$

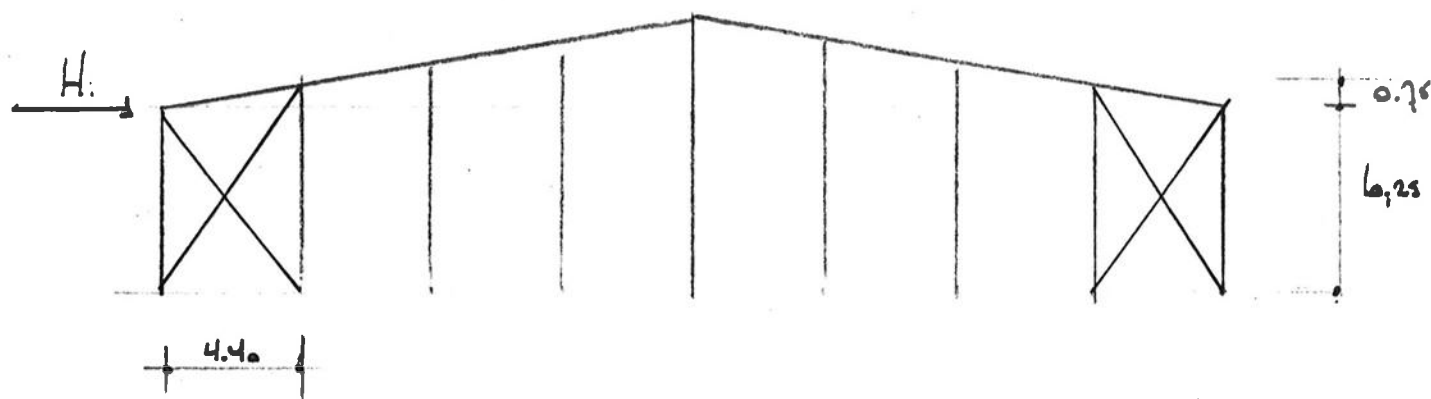
$$R_C = \frac{275 \times 4,25}{2} + \frac{815 \times 3}{4,25} + \frac{252 \times 1}{4,25} = 1220 \text{ kgf}$$

$$D_o = 1220 - (815 + X \times 2,75) \rightarrow X = 1,48 \text{ mtr.}$$

$$M = 1220 \times 1,48 - \frac{2,75 \times 1,48^2}{2} - 815 \times 0,23 = 2220 \text{ kgfm}$$

Profiel He 160 A

$$\sigma = \frac{222000 \times 1,5}{220} = 1510 \text{ kgf/cm}^2$$

Windbok in kopgevels

$$H = \left[\left(3 + \frac{6,25}{2} \right) \times 71 \times 1,2 \right] \times \left(\frac{6,42}{2} + 0,35 \right) = 1860 \text{ kgf}$$

$$F \text{ in stijlen} = \frac{1860 \times 7}{4,4 \times 2} = 1480 \text{ kgf}$$

in diagonaal

$$S = \sqrt{4,4^2 + 7^2} = 8,26 \text{ mtr.}$$

$$F = \frac{8,26}{4,4} \times \frac{1860}{2} = 1745 \text{ kgf}$$

Profiel plat 100 x 10

$$A_n = 8 \text{ cm}^2$$

$$\sigma t = \frac{1745 \times 1,5}{8} = 327 \text{ kgf/cm}^2$$

FUNDERINGBetonkwaliteit B 17⁵

Staalkwaliteit Fe 500

Toelaatbare gronddruk = 1 kgf/cm²Stroken in langsgevel 850 mm br.

$$\begin{array}{rcl}
 \text{Belasting} & = (1,3 + 5,85) \times 400 & = 2860 \text{ kgf/m}^1 \\
 \text{randkonstruktie} & & = 240 \text{ " } \\
 & \text{totaal} & = 3100 \text{ kgf/m}^1
 \end{array}$$

$$\sigma_{\text{gr.}} = \frac{3100}{85 \times 100} = 0,36 \text{ kgf/cm}^2$$

$$M = 0,36 \times 100 \times \frac{85}{2} \times \frac{0,85}{4} = 325 \text{ kgfm}$$

$$AA = 70 \text{ mm}^2 \quad \emptyset 8 - 150 \quad \checkmark$$

Stroken in kopgevel 850 mm br.

$$\text{Belasting} = (0,80 + 9,25) \times 400 = 4020 \text{ kgf/m}^1$$

$$\sigma_{\text{gr.}} = \frac{4020}{85 \times 100} = 0,48 \text{ kgf/cm}^2$$

Stroken t.p.v. kantine - creche 600 mm br.

$$\text{Belasting} = (3,30 + 0,7) \times 400 = 1600 \text{ kgf/m}^1$$

$$\sigma_{\text{gr.}} = \frac{1600}{60 \times 100} = 0,27 \text{ kgf/cm}^2$$

Uit staalkonstruktie

$$F = \frac{5,85 \times 500}{2} = 1465 \text{ kgf}$$

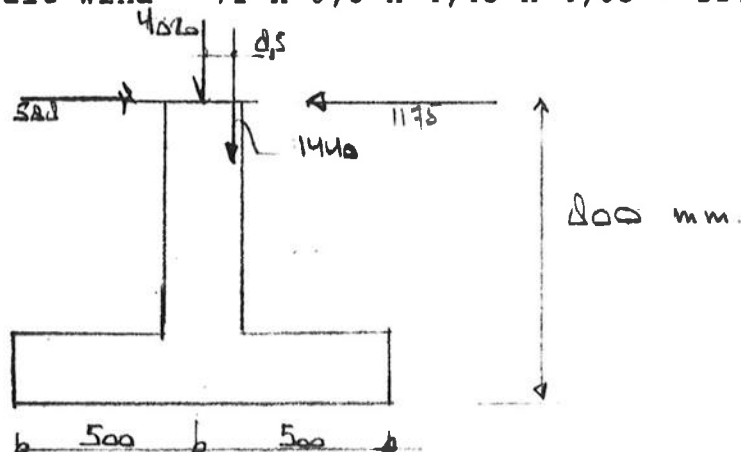
$$\sigma \text{ gr. max.} = 0,27 + \frac{1465}{60 \times 100} = 0,52 \text{ kgf/cm}^2$$

$$M = \frac{0,52 \times 325}{0,36} = 469 \text{ kgfm} \quad AA = 101 \text{ mm}^2 \quad \emptyset 8 - 150$$

Poeren in kopgevel as 1

$$F \text{ uit staalkonstruktie} = 1440 \text{ kgf}$$

$$H \text{ uit wind} = 71 \times 0,8 \times 4,45 \times 4,65 = 1175 \text{ kgf resp. } 588 \text{ kgf}$$



$$M 1 = + 1440 \times 8,5 + 588 \times 80 = 12240 + 47000 = + 59240 \text{ kgfm}$$

$$M 2 = + 1440 \times 8,5 - 1175 \times 80 = 12240 - 94000 = - 81760 \text{ kgfm}$$

$$e = \frac{81760}{5460} = 15 < \frac{100}{6} \quad 50 - 15 = 35 \text{ cm}$$

$$\sigma \text{ gr.} = \frac{5460}{100 \times 100} = 0,54 \text{ kgf/cm}^2$$

$$t.g.v. M = \frac{81760 \times 6}{100} = + 0,49 \quad "$$

$$\sigma \text{ gr.} = + 1,03 / + 0,05 \text{ kgf/cm}^2$$

Momenten zie Barés

$$y = 1 \quad a_1/a = \frac{260}{1200} = 0,21$$

$$q = 120 \times 100 \times 1,03 = 12360 \text{ kgf/m}^1$$

$$M = 0,154 \times 12360 \times 1,2^2 = 2740 \text{ kgfm} \quad AA = 631 \text{ mm}^2 \text{ dubb.net. } \emptyset 8-150$$

$$M_{xos} - M_{yos} = \frac{0,076}{0,154} \times 2740 = 1352 \text{ kgfm}$$

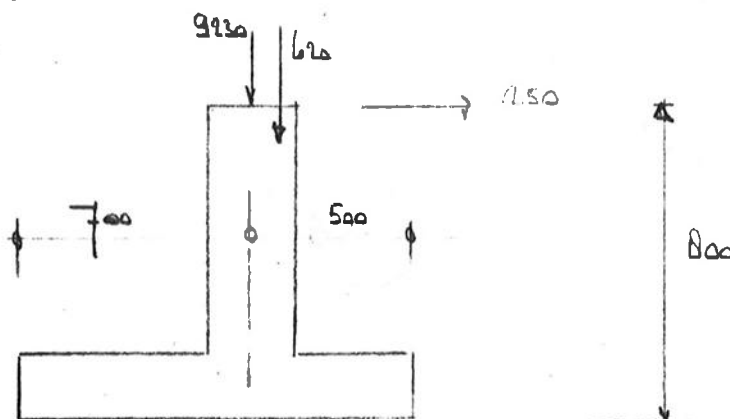
$$AA = 298 \text{ mm}^2 \text{ idem } \emptyset 8-75$$

Poeren op as 10

$$F \text{ uit staalkonstruktie} = 1440 + 4,45 \times 1750 = 9230 \text{ kgf}$$

$$H \text{ uit wind} = \frac{71 \times 0,4 \times 4,45 \times 6 \times 3}{9} = 250 \text{ kgf}$$

$$\text{Lijnlast} = 0,8 \times 400 + 3 \times 100 = 620 \text{ kgf/m}^1$$



$$M = 9230 \times 10 + 620 \times 18,5 + 250 \times 80 = 117570 \text{ kgfcm}$$

$$e = \frac{117570}{(9230 + 620)} = 11,90 \text{ cm} < \frac{120}{6}$$

$$\sigma_{gr.} = \frac{9850}{120 \times 120} = 0,68 \text{ kgf/cm}^2$$

$$t.g.v. M = \frac{117570 \times 6}{120^3} = \pm 0,40 \text{ ''}$$

$$\sigma_{gr.} = 1,08 / + 0,28 \text{ kgf/cm}^2$$

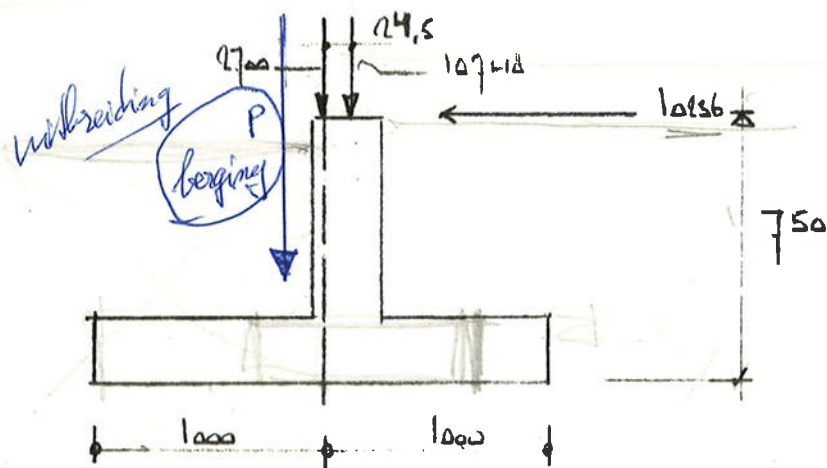
$$M = \frac{1,08}{1,03} \times 2740 = 2873 \text{ kgfm} \quad AA = 665 \text{ mm}^2 \quad \text{dubb.net } \emptyset 8-150$$

Poeren onder hoofdspanten as A - J

F uit staalkonstruktie = 10748 kgf

F uit metselwerk = 6,5 x 400 = 2700 kgf

H uit spatkracht eigengewicht + nuttig = 10236 kgf

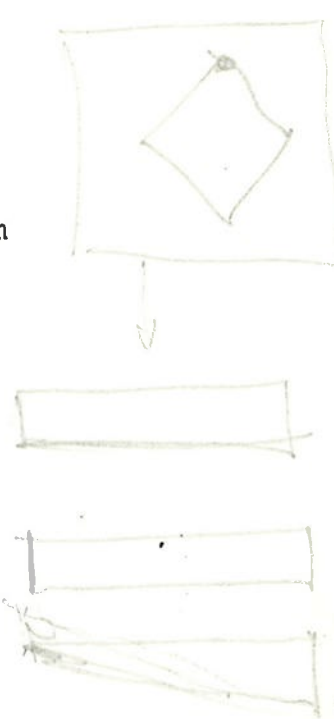


$$M = - 10748 \times 24,5 + 10236 \times 75 = 504374 \text{ kgfcm}$$

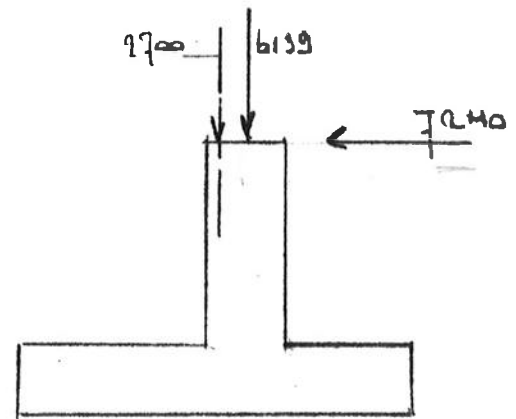
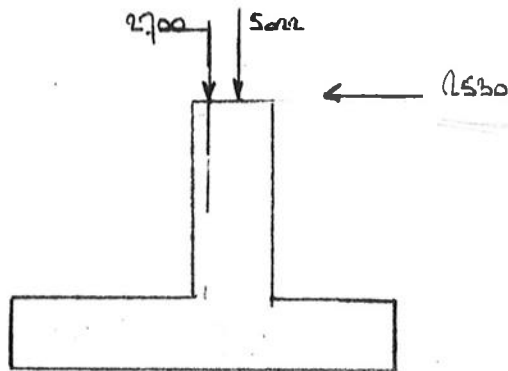
$$e = \frac{504374}{(10748 + 2700)} = 37,50 \text{ cm} > \frac{200}{6}$$

$$e_1 = 100 - 37,50 = 62,50 \text{ cm}$$

$$\sigma_{gr.} = \frac{(10748 + 2700) \times 2}{3 \times 62,50 \times 200} = 0,71 \text{ kgf/cm}^2$$



idem t.g.v. wind

Wind van links

$$M = 5022 \times 24,5 + 2530 \times 75 = 66711 \text{ kgfcm}$$

$$e = \frac{66711}{7722} = 8,63 \text{ cm}$$

$$\sigma_{gr.} = \frac{5022}{200 \times 200} + \frac{66711 \times 6}{200^3} = 0,125 \pm 0,05 = +0,175 / + 0,075 \text{ kgf/cm}^2$$

Wind van rechts

$$M = 6139 \times 24,5 - 7240 \times 75 = 392594 \text{ kgfcm}$$

$$e = \frac{392594}{8839} = 44,42 \text{ cm} > \frac{200}{6}$$

$$e_1 = 100 - 44,42 = 56,58 \text{ cm}$$

$$\sigma_{gr.} = \frac{8839 \times 2}{3 \times 200 \times 56,58} = 0,52 \text{ kgf/cm}^2$$

Voor momenten zie Barés

$$y = 1 \quad a_1/a = \frac{550}{200} = 0,275$$

$$q = 200 \times 100 \times 0,71 = 14200 \text{ kgf/m}^1$$

$$M = 0,112 \times 14200 \times 2^2 = 6361 \text{ kgfm}$$

$$AA = \frac{868}{2} = 434 \text{ cm}^2$$

dubb. net Ø 8-150

Kontrole t.p.v. windbokken

as A - J

$$F = + \frac{4556 \times 6,25}{5,33} = 5342 \text{ kgf}$$

$$\text{uit spant } 10748 \times \frac{316,75}{610} = 5581 \text{ kgf}$$

$$F 1 = 5342 + 5581 = 10923 \text{ kgf} \sim 10748$$

$$F 2 = - 5342 + 5581 = 239 \text{ kgf} < 10748$$

as 1 - 10

F V = 1480 kgf uit windbok

invloed nihil.

Plaat op 2900⁺

eigengewicht plaat

$= 432 \text{ kgf/m}^2$

nuttig

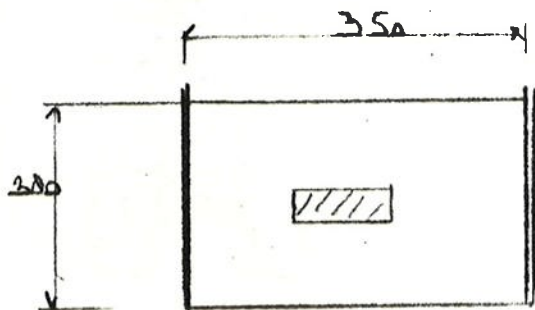
$= 400 \text{ "}$

afwerking

$= 68 \text{ "}$

totaal

$= 900 \text{ kgf/m}^2$



$$q = 1,9 \times 900 = 1710 \text{ kgf/m}^1$$

$$M = 0,125 \times 1710 \times 3,50^2 = 2618 \text{ kgfm}$$

Betonkwaliteit B 17⁵

Staalkwaliteit Fe 400

$$AA = \frac{733}{1,40} = 523 \text{ mm}^2/\text{m}^1$$

Ø 10 - 150

$$\frac{1}{8} \times 900 \times 3,5^2 =$$

$$w_0 = 0,26$$

$$A = \frac{1 \text{ cm}^2}{?}$$



1. PROGRAM : PLANE FRAME ANALYSIS1.1 JOB IDENTIFICATION SECTION

JOB NAME : DRIESCHARNIERSPANT

1.2 STRUCTURE PARAMETERS

NUMBER OF MEMBERS	22
NUMBER OF JOINTS	23
NUMBER OF FIXED SUPPORT JOINTS	2
NUMBER OF LOAD CASES	3
NUMBER OF LOAD COMBINATIONS	3

1.3 UNITS OF MEASURE

LENGTH	(m)
AREA	(cm ²)
FORCE	(kg)
MODULUS OF ELASTICITY	(kg/cm ²)
MOMENT OF INERTIA	(cm ⁴)
MOMENT	(kg.m)
DISPLACEMENT	(mm)
TEMPERATURE	(deg. C)
ANGLE	(rad)

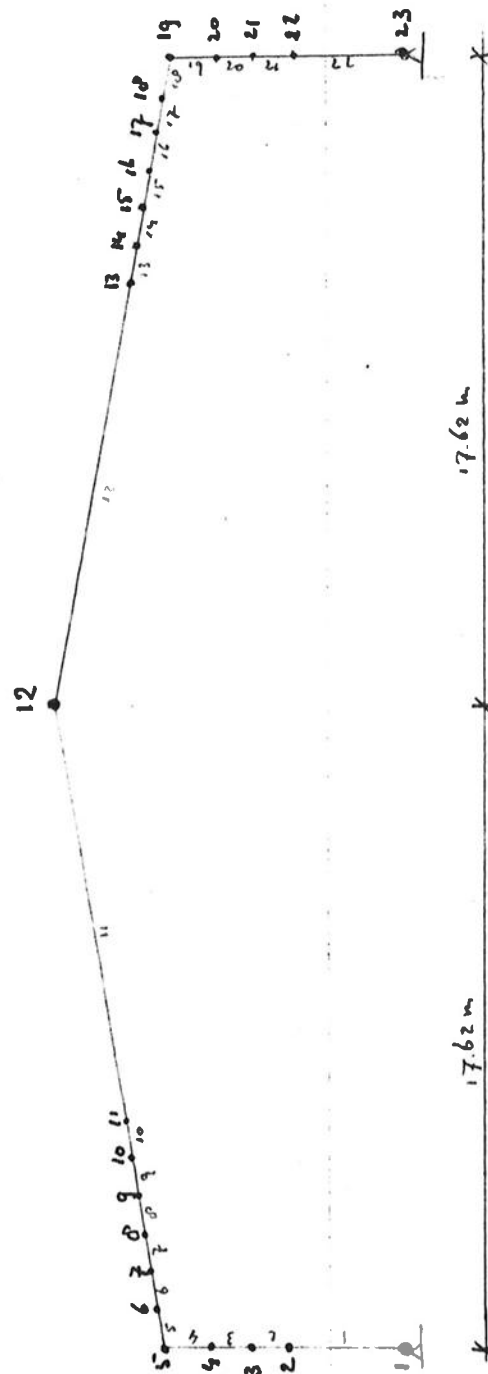
ir H.J.M. Lamers
Maeterlinckdreef 12
3146 BL Maassluis
tel. 01899-22003

blad: 1

werk:

dat.: 12-06-1981

- o knooppunt nummers
- staafnummers



Met oorspronkelijk punt
H.

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT1.4 JOINT CHARACTERISTICS

JOINT NO.	COORDINATES		SUPP. JOINT
	X (m)	Y (m)	
1	0.0000	0.0000	F
2	0.0000	3.0000	
3	0.0000	4.0000	
4	0.0000	5.0000	
5	0.0000	6.2500	
6	0.9900	6.4200	
7	1.9700	6.5900	
8	2.9600	6.7500	
9	3.9400	6.9200	
10	4.9300	7.0900	
11	5.9200	7.2600	
12	17.6199	9.2500	
13	29.3199	7.2600	
14	30.3099	7.0900	
15	31.2999	6.9200	
16	32.2798	6.7500	
17	33.2698	6.5900	
18	34.2497	6.4200	
19	35.2397	6.2500	
20	35.2397	5.0000	F
21	35.2397	4.0000	
22	35.2397	3.0000	
23	35.2397	0.0000	

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

1.5 MEMBER GEOMETRICAL DATA

MEMBER NO.	START INDEX	JOINT RELEASE	END INDEX	JOINT RELEASE	LENGTH (m)
1	1	MZ	2		.299999E+01
2	2		3		.999984E+00
3	3		4		.999987E+00
4	4		5		.125001E+01
5	5		6		.100448E+01
6	6		7		.994635E+00
7	7		8		.100284E+01
8	8		9		.994635E+00
9	9		10		.100447E+01
10	10		11		.100447E+01
11	11	MZ	12		.118679E+02
12	12		13		.118680E+02
13	13		14		.100447E+01
14	14		15		.100441E+01
15	15		16		.994571E+00
16	16		17		.100283E+01
17	17		18		.994571E+00
18	18		19		.100447E+01
19	19		20		.125001E+01
20	20		21		.999987E+00
21	21		22		.999984E+00
22	22		23	MZ	.299999E+01

1.6 MEMBER PROPERTIES

MEMBER NO.	MODULUS OF ELASTICITY	MOMENT OF INERTIA Z	AREA (cm ²)
1	.209999E+07	.637219E+05	.177999E+03
2	.209999E+07	.857199E+05	.185999E+03
3	.209999E+07	.140942E+06	.200999E+03
4	.209999E+07	.222220E+06	.217999E+03
5	.209999E+07	.150875E+06	.147999E+03
6	.209999E+07	.127040E+06	.141999E+03
7	.209999E+07	.105617E+06	.135999E+03
8	.209999E+07	.865073E+05	.129999E+03
9	.209999E+07	.696109E+05	.123999E+03
10	.209999E+07	.548289E+05	.117999E+03
11	.209999E+07	.481999E+05	.115999E+03
12	.209999E+07	.481999E+05	.115999E+03
13	.209999E+07	.548289E+05	.117999E+03
14	.209999E+07	.696109E+05	.123999E+03
15	.209999E+07	.865073E+05	.129999E+03
16	.209999E+07	.105617E+06	.135999E+03
17	.209999E+07	.127040E+06	.141999E+03
18	.209999E+07	.150875E+06	.147999E+03
19	.209999E+07	.222220E+06	.217999E+03

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

MEMBER NO.	MODULUS OF ELASTICITY	MOMENT OF INERTIA Z	AREA (cm ²)
20	.209999E+07	.140942E+06	.200999E+03
21	.209999E+07	.857199E+05	.185999E+03
22	.209999E+07	.637219E+05	.177999E+03

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

1.7 PRESCRIBED JOINT DISPLACEMENTS

+ LOAD CASE 1 +

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
--------------	------------------------	------------------------	---------------------

+ LOAD CASE 2 +

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
--------------	------------------------	------------------------	---------------------

+ LOAD CASE 3 +

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
--------------	------------------------	------------------------	---------------------

***** = FREE

1.8 JOINT and MEMBER LOADS

 † LOAD CASE 1 †

MEMBER LOADS

MEMBER NO.	LOAD CODE	DISTANCE (m)	LENGTH (m)	START VALUE	END VALUE
5	UNIFORM Y			-.31600E+03	
6	UNIFORM Y			-.31600E+03	
7	UNIFORM Y			-.31600E+03	
8	UNIFORM Y			-.31600E+03	
9	UNIFORM Y			-.31600E+03	
10	UNIFORM Y			-.31600E+03	
11	UNIFORM Y			-.31600E+03	
12	UNIFORM Y			-.31600E+03	
13	UNIFORM Y			-.31600E+03	
14	UNIFORM Y			-.31600E+03	
15	UNIFORM Y			-.31600E+03	
16	UNIFORM Y			-.31600E+03	
17	UNIFORM Y			-.31600E+03	
18	UNIFORM Y			-.31600E+03	

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

+ LOAD CASE 2 +

MEMBER LOADS

MEMBER NO.	LOAD CODE	DISTANCE (m)	LENGTH (m)	START VALUE	END VALUE
5	UNIFORM Y			-.29400E+03	
6	UNIFORM Y			-.29400E+03	
7	UNIFORM Y			-.29400E+03	
8	UNIFORM Y			-.29400E+03	
9	UNIFORM Y			-.29400E+03	
10	UNIFORM Y			-.29400E+03	
11	UNIFORM Y			-.29400E+03	
12	UNIFORM Y			-.29400E+03	
13	UNIFORM Y			-.29400E+03	
14	UNIFORM Y			-.29400E+03	
15	UNIFORM Y			-.29400E+03	
16	UNIFORM Y			-.29400E+03	
17	UNIFORM Y			-.29400E+03	
18	UNIFORM Y			-.29400E+03	

+ LOAD CASE 3 +

MEMBER LOADS

MEMBER NO.	LOAD CODE	DISTANCE (m)	LENGTH (m)	START VALUE	END VALUE
1	UNIFORM X			.33300E+03	

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

MEMBER NO.	LOAD CODE	DISTANCE (m)	LENGTH (m)	START VALUE	END VALUE
.2	UNIFORM X			.33300E+03	
3	UNIFORM X			.33300E+03	
.4	UNIFORM X			.33300E+03	
5	UNIFORM Y LOCA			-.16600E+03	
6	UNIFORM Y LOCA			-.16600E+03	
7	UNIFORM Y LOCA			-.16600E+03	
8	UNIFORM Y LOCA			-.16600E+03	
9	UNIFORM Y LOCA			-.16600E+03	
10	UNIFORM Y LOCA			-.16600E+03	
11	UNIFORM Y LOCA			-.16600E+03	
12	UNIFORM Y LOCA			.16600E+03	
13	UNIFORM Y LOCA			.16600E+03	
14	UNIFORM Y LOCA			.16600E+03	
15	UNIFORM Y LOCA			.16600E+03	
16	UNIFORM Y LOCA			.16600E+03	
17	UNIFORM Y LOCA			.16600E+03	
18	UNIFORM Y LOCA			.16600E+03	
19	UNIFORM X			.16600E+03	
20	UNIFORM X			.16600E+03	
21	UNIFORM X			.16600E+03	
22	UNIFORM X			.16600E+03	

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

1.9 LOAD COMBINATIONS

COMBINATION NO.	LOAD CASE NO.	COEFFICIENT VALUE
1	1	1.00000
	2	1.00000
2	1	1.00000
	3	1.00000
3	1	1.00000
	2	1.00000
	3	1.00000

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

2. JOINT DISPLACEMENTS

+ LOAD CASE 1 +

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
2	-12.79230000	-0.04468700	0.0030752700
3	-15.37660000	-0.05894190	0.0020442200
4	-17.03260000	-0.07213300	0.0012379800
5	-18.09920000	-0.08733670	0.0004389750
6	-18.10820000	-0.15252300	-0.0005403330
7	-17.94990000	-1.18418000	-0.0015325500
8	-17.64130000	-3.22551000	-0.0025552500
9	-17.13760000	-6.25681000	-0.0035916700
10	-16.45550000	-10.36440000	-0.0046618500
11	-15.59020000	-15.54460000	-0.0057528900
12	0.00035679	-108.81600000	-0.0080191300
13	15.59120000	-15.54290000	0.0057527200
14	16.45650000	-10.36280000	0.0046616200
15	17.13850000	-6.25577000	0.0035914500
16	17.64230000	-3.22487000	0.0025550600
17	17.95080000	-1.18376000	0.0015323400
18	18.10910000	-0.15236000	0.0005401720
19	18.10010000	-0.08733370	-0.0004391340
20	17.03340000	-0.07213060	-0.0012381400
21	15.37720000	-0.05894000	-0.0020443800
22	12.79280000	-0.04468550	-0.0030754300

+ LOAD CASE 2 +

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
2	-11.90180000	-0.04157590	0.0028611700
3	-14.30610000	-0.05483870	0.0019019000
4	-15.84680000	-0.06711140	0.0011517900
5	-16.83920000	-0.08125630	0.0004084150
6	-16.84750000	-0.14190400	-0.0005027150
7	-16.70020000	-1.10174000	-0.0014258600
8	-16.41320000	-3.00096000	-0.0023773500
9	-15.94450000	-5.82122000	-0.0033416200
10	-15.30990000	-9.64283000	-0.0043373000
11	-14.50490000	-14.46240000	-0.0053523700

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
12	0.00032257	-101.24100000	-0.0074608500
13	14.50570000	-14.46080000	0.0053522100
14	15.31000000	-9.64143000	0.0043370800
15	15.94530000	-5.82024000	0.0033414100
16	16.41400000	-3.00038000	0.0023771800
17	16.70100000	-1.10135000	0.0014256600
18	16.84830000	-0.14175500	0.0005025670
19	16.84000000	-0.08125350	-0.0004085600
20	15.84750000	-0.06710900	-0.0011519400
21	14.30660000	-0.05483680	-0.0019020500
22	11.90210000	-0.04157470	-0.0028613200

+ LOAD CASE 3 +

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
2	22.90770000	-0.00776730	-0.0071812000
3	29.91800000	-0.01024500	-0.0068280800
4	36.62290000	-0.01253780	-0.0065771400
5	44.70860000	-0.01518040	-0.0063567900
6	45.76600000	-6.16963000	-0.0060717300
7	46.76790000	-11.94250000	-0.0057051200
8	47.64350000	-17.35750000	-0.0052300500
9	48.48240000	-22.18920000	-0.0046269600
10	49.20350000	-26.38490000	-0.0038464900
11	49.77260000	-29.69530000	-0.0028400900
12	44.16060000	3.34527000	0.0062270000
13	48.71280000	30.25490000	-0.0030901200
14	48.10500000	26.72840000	-0.0040327000
15	47.35580000	22.37550000	-0.0047587400
16	46.49720000	17.43780000	-0.0053151600
17	45.60990000	11.95890000	-0.0057490800
18	44.60220000	6.16116000	-0.0060795800
19	43.54550000	0.01516500	-0.0063320900
20	35.51040000	0.01252510	-0.0065193800
21	28.88700000	0.01023460	-0.0067226200
22	22.02140000	0.00775944	-0.0069985800

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

↑ COMBINATION 1 ↓

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
2	-24.69420000	-0.08626290	0.0059364400
3	-29.68280000	-0.11378000	0.0039461200
4	-32.87930000	-0.13924400	0.0023897700
5	-34.93830000	-0.16859300	0.0008473900
6	-34.95560000	-0.29442700	-0.0010430400
7	-34.64990000	-2.28592000	-0.0029584100
8	-34.05430000	-6.22648000	-0.0049326000
9	-33.08200000	-12.07800000	-0.0069332900
10	-31.76530000	-20.00720000	-0.0089991500
11	-30.09510000	-30.00700000	-0.0111052000
12	0.00067936	-210.05800000	-0.0154799000
13	30.09700000	-30.00370000	0.0111049000
14	31.76710000	-20.00420000	0.0089987000
15	33.08390000	-12.07600000	0.0069328600
16	34.05620000	-6.22523000	0.0049322400
17	34.65170000	-2.28512000	0.0029580000
18	34.95750000	-0.29411600	0.0010427300
19	34.94010000	-0.16858700	-0.0008476940
20	32.88090000	-0.13923900	-0.0023900800
21	29.68390000	-0.11377600	-0.0039464300
22	24.69500000	-0.08626020	-0.0059367500

↑ COMBINATION 2 ↓

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
2	10.11530000	-0.05245420	-0.0041059300
3	14.54130000	-0.06918680	-0.0047838600
4	19.59020000	-0.08467060	-0.0053391600
5	26.60930000	-0.10251700	-0.0059178100
6	27.65770000	-6.32216000	-0.0066120600
7	28.81790000	-13.12660000	-0.0072376700
8	30.00220000	-20.58300000	-0.0077853000
9	31.34470000	-28.44600000	-0.0082186300
10	32.74770000	-36.74910000	-0.0085083400
11	34.18210000	-45.23990000	-0.00885929800
12	44.16090000	-105.47100000	-0.0017921300
13	64.30390000	14.71200000	0.0026626000
14	64.56150000	16.36550000	0.0006289200
15	64.49410000	16.11970000	-0.0011672900
16	64.13930000	14.21290000	-0.0027601000

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
17	63.56850000	10.77510000	-0.0042167400
18	62.71130000	6.00879000	-0.0055394000
19	61.64540000	-0.07216870	-0.0067712200
20	52.54350000	-0.05960540	-0.0077575200
21	44.26420000	-0.04870520	-0.0087670000
22	34.81420000	-0.03692590	-0.0100740000

+ COMBINATION 3 +

JOINT NO.	DISPLACEMENT X (mm)	DISPLACEMENT Y (mm)	ROTATION Z (rad)
2	-1.78643000	-0.09403010	-0.0012447600
3	0.23524400	-0.12402500	-0.0028819600
4	3.74355000	-0.15178200	-0.0041873700
5	9.77036000	-0.18377300	-0.0055094000
6	10.81030000	-6.46404000	-0.0071147700
7	12.11790000	-14.22840000	-0.0086635300
8	13.58920000	-23.58400000	-0.0101626000
9	15.40030000	-34.26710000	-0.0115602000
10	17.43820000	-46.39200000	-0.0128456000
11	19.67740000	-59.70230000	-0.0139452000
12	44.16120000	-206.71200000	-0.0092529000
13	78.80960000	0.25121600	0.0080147800
14	79.87220000	6.72416000	0.0049660000
15	80.43970000	10.29950000	0.0021741200
16	80.55340000	11.21260000	-0.0003829200
17	80.26170000	9.67383000	-0.0027910800
18	79.55980000	5.86703000	-0.0050368500
19	78.48560000	-0.15342200	-0.0071797800
20	68.39130000	-0.12671400	-0.0089094600
21	58.57090000	-0.10354200	-0.0106690000
22	46.71630000	-0.07850060	-0.0129353000

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

3. MEMBER END FORCES

↑ LOAD CASE 1 ↓

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
1	1	5567.98890	-5302.98857	0.00000
	2	-5567.98890	5302.98857	-15908.96828
2	2	5568.01963	-5307.97356	15906.47912
	3	-5568.01963	5307.97356	-21214.37803
3	3	5568.02684	-5302.55822	21212.16187
	4	-5568.02684	5302.55822	-26514.66169
4	4	5568.13644	-5306.22064	26512.55508
	5	-5568.13644	5306.22064	-33145.41956
5	5	6172.35462	4589.58839	33143.13190
	6	-6119.41358	-4281.26116	-28687.79911
6	6	6122.38340	4271.54341	28687.44667
	7	-6069.44869	-3966.42196	-24590.54666
7	7	6024.96832	4033.17756	24589.49374
	8	-5975.05924	-3724.34505	-20699.69745
8	8	6016.15632	3655.49827	20697.06662
	9	-5963.22161	-3350.37681	-17212.90902
9	9	5966.40700	3363.80027	17212.29500
	10	-5913.46597	-3055.47597	-13988.27961
10	10	5904.99062	3051.98674	13987.53505
	11	-5852.04959	-2743.66244	-11076.72995
11	11	5848.53990	2755.60480	11075.11522
	12	-5228.60152	889.24055	-0.07666
12	12	5227.81728	889.17264	0.00000
	13	-5847.75571	2755.68248	-11075.93056
13	13	5851.82553	-2745.77489	11076.35675
	14	-5904.76656	3054.09919	-13989.28378
14	14	5909.96178	-3048.76550	13992.53389
	15	-5962.90271	3357.07028	-17209.60650

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
15	15	5954.74743	-3354.69502	17211.58876
	16	-6007.68204	3659.79499	-20699.79900
16	16	5974.42832	-3722.99173	20701.03972
	17	-6024.33738	4031.82132	-24589.44238
17	17	6069.38796	-3966.00486	24591.34559
	18	-6122.32257	4271.10482	-28687.54793
18	18	6111.15164	-4282.89438	28687.21313
	19	-6164.09267	4591.21868	-33144.14503
19	19	5567.91318	5292.75185	33137.03879
	20	-5567.91318	-5292.75185	-26521.01052
20	20	5567.76953	5299.85947	26513.31233
	21	-5567.76953	-5299.85947	-21213.51123
21	21	5567.90058	5299.74788	21210.26526
	22	-5567.90058	-5299.74788	-15910.59190
22	22	5567.79901	5302.95467	15908.86659
	23	-5567.79901	-5302.95467	0.00000

↑ LOAD CASE 2 ↓

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
1	1	5180.34771	-4933.85548	0.00000
	2	-5180.34771	4933.85548	-14801.56884
2	2	5180.49175	-4930.65931	14802.98717
	3	-5180.49175	4930.65931	-19733.57715
3	3	5180.38266	-4939.64410	19732.25890
	4	-5180.38266	4939.64410	-24671.84859
4	4	5180.33936	-4939.33877	24665.04307
	5	-5180.33936	4939.33877	-30839.29908
5	5	5737.68385	4271.29931	30836.37370
	6	-5688.42850	-3984.43746	-26689.97772
6	6	5699.10582	3972.89931	26689.76521
	7	-5649.85636	-3689.02005	-22879.34407

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSEINGEL 3 3582 AC UTRECHT

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
7	7	5608.15684	3755.27948	22878.81021
	8	-5561.72237	-3467.94753	-19256.92175
8	8	5608.31134	3399.70001	19255.59060
	9	-5551.06188	-3115.82075	-16015.29572
9	9	5543.14363	3125.73233	16012.11250
	10	-5493.88829	-2838.87320	-13016.45081
10	10	5498.35898	2839.92173	13013.79568
	11	-5449.10364	-2553.06260	-10305.22484
11	11	5441.01958	2563.76119	10304.08004
	12	-4864.24058	827.33432	-0.09213
12	12	4864.07292	827.26877	0.00000
	13	-5440.85196	2563.83582	-10304.84584
13	13	5441.46877	-2554.50886	10305.18624
	14	-5490.72411	2841.36799	-13015.20981
14	14	5493.59896	-2842.99846	13015.19147
	15	-5542.85421	3129.83942	-16014.80836
15	15	5542.16948	-3114.98574	16016.25965
	16	-5591.41885	3398.84500	-19255.49887
16	16	5561.99756	-3467.83723	19257.84652
	17	-5608.43202	3755.16647	-22879.59041
17	17	5641.55909	-3691.52002	22878.47918
	18	-5690.80845	3975.37929	-26691.12367
18	18	5690.12578	-3983.76221	26690.49892
	19	-5739.38112	4270.62133	-30836.17805
19	19	5180.22773	4930.17065	30833.75559
	20	-5180.22773	-4930.17065	-24670.95989
20	20	5180.12535	4929.67103	24666.86211
	21	-5180.12535	-4929.67103	-19737.24538
21	21	5180.25364	4931.17826	19733.83662
	22	-5180.25364	-4931.17826	-14802.72770
22	22	5180.19580	4933.73023	14801.19309
	23	-5180.19580	-4933.73023	0.00000

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

+ LOAD CASE 3 +

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
1	1	967.80413	2403.00550	0.00000
	2	-967.80413	-1404.00582	5710.51791
2	2	967.80772	1407.47112	-5708.45626
	3	-967.80772	-1074.47597	6949.41236
3	3	967.81102	997.63457	-6984.10876
	4	-967.81102	-664.63840	7815.23609
4	4	967.80710	761.28253	-7837.16619
	5	-967.80710	-345.02716	8528.61898
5	5	-184.62847	1014.24393	-8509.97406
	6	184.62847	-847.49896	9445.02364
6	6	-105.06537	838.89254	-9443.55731
	7	105.06537	-673.78260	10195.84000
7	7	-166.78594	672.04182	-10197.84538
	8	166.78594	-505.56966	10788.32626
8	8	-153.41078	506.48625	-10790.62513
	9	153.41078	-341.37631	11212.28364
9	9	-185.78645	351.82000	-11209.50565
	10	185.78645	-185.07652	11479.15640
10	10	-158.52553	174.05458	-11476.61411
	11	158.52553	-7.31111	11567.70317
11	11	-157.45201	10.21050	-11569.41476
	12	157.45201	1959.88218	0.02839
12	12	501.24973	-1900.76074	0.00000
	13	-501.24973	-69.33693	-10867.72889
13	13	547.11208	71.42974	10868.35309
	14	-547.11208	-238.17322	-10712.85820
14	14	442.83307	223.35095	10706.87395
	15	-442.83307	-390.08445	-10398.80077
15	15	523.22371	402.42160	10390.89641
	16	-523.22371	-567.52057	-9908.55740
16	16	519.56643	562.84519	9907.02514
	17	-519.56643	-729.31586	-9259.11237

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
17	17	517.72667	732.60841	9257.09704
	18	-517.72667	-897.70738	-8446.36323
18	18	438.63152	877.36622	8433.38846
	19	-438.63152	-1044.10970	-7468.34696
19	19	-966.82477	719.28991	7484.82764
	20	966.82477	-926.79256	-6456.01234
20	20	-966.82036	774.77932	6430.62969
	21	966.82036	-940.77739	-5572.86078
21	21	-966.81956	1037.15019	5513.92280
	22	966.81956	-1203.14776	-4393.78958
22	22	-966.82430	1213.78848	4388.36580
	23	966.82430	-1711.78825	0.00000

 † COMBINATION 1 †

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
1	1	10748.31603	-10236.75497	0.00000
	2	-10748.31603	10236.75497	-30710.30664
2	2	10748.45211	-10238.56934	30709.33886
	3	-10748.45211	10238.56934	-40947.81288
3	3	10748.36139	-10242.15272	40944.21825
	4	-10748.36139	10242.15272	-51186.28691
4	4	10748.45211	-10245.50930	51177.43859
	5	-10748.45211	10245.50930	-63984.69051
5	5	11910.01050	8860.87436	63979.29857
	6	-11807.81623	-8265.67094	-55377.62549
6	6	11821.42399	8244.39747	55377.07247
	7	-11719.27507	-7655.40826	-47469.71600
7	7	11633.04723	7788.44680	47468.19519
	8	-11536.74965	-7192.29083	-39956.52453
8	8	11616.40040	7055.16997	39952.51514
	9	-11514.25148	-6466.18076	-33228.06845

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
9	9	11509.48877	6489.49538	33224.19731
	10	-11407.29449	-5894.33732	-27004.65788
10	10	11403.30288	5891.88792	27001.20150
	11	-11301.10860	-5296.68450	-21381.82703
11	11	11289.54201	5319.36410	21379.06193
	12	-10092.83023	1716.57356	-0.16879
12	12	10091.83233	1716.43749	0.00000
	13	-11288.58946	5319.50018	-21380.72099
13	13	11293.21610	-5300.26788	21381.41226
	14	-11395.41038	5895.42594	-27004.38137
14	14	11403.52968	-5891.75185	27007.69949
	15	-11505.72395	6486.86455	-33224.33556
15	15	11496.87891	-6469.67341	33227.65368
	16	-11599.02783	7058.61727	-39955.14198
16	16	11536.38677	-7190.79398	39958.73661
	17	-11632.72971	7786.94994	-47468.88647
17	17	11710.92897	-7657.49478	47469.71600
	18	-11813.07789	8246.43864	-55378.59327
18	18	11801.19378	-8266.62348	55377.48723
	19	-11903.43342	8861.82690	-63980.12810
19	19	10748.08924	10222.87506	63970.58850
	20	-10748.08924	-10222.87506	-51191.81711
20	20	10747.86244	10229.45214	51180.06543
	21	-10747.86244	-10229.45214	-40950.57798
21	21	10748.13460	10230.85828	40944.08000
	22	-10748.13460	-10230.85828	-30713.21000
22	22	10747.95316	10236.66426	30710.03013
	23	-10747.95316	-10236.66426	0.00000

† COMBINATION 2 †

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
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ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
1	1	6535.76177	-2899.93613	0.00000
	2	-6535.76177	3898.93622	-10198.33860
2	2	6535.76177	-3900.46029	10197.91001
	3	-6535.76177	4233.45578	-14264.73614
3	3	6535.80713	-4304.90106	14227.82205
	4	-6535.80713	4637.88748	-18699.26526
4	4	6535.89785	-4544.90112	18675.20889
	5	-6535.89785	4961.16250	-24616.71752
5	5	5987.68656	5603.81165	24633.03161
	6	-5934.75237	-5128.71938	-19242.74567
6	6	6017.26075	5110.39427	19243.71345
	7	-5964.32657	-4640.20080	-14394.55758
7	7	5858.09532	4705.20053	14391.51597
	8	-5808.20020	-4229.91323	-9911.34887
8	8	5862.67660	4161.98329	9906.41317
	9	-5809.74241	-3691.74900	-6000.59881
9	9	5780.57645	3715.61701	6002.68646
	10	-5727.64226	-3240.54743	-2509.06557
10	10	5746.42097	3226.03702	2510.91818
	11	-5693.48678	-2750.96744	490.97392
11	11	5691.03739	2765.81351	-494.30310
	12	-5071.11320	2849.12021	-0.04826
12	12	5729.00304	-1011.58727	0.00000
	13	-6348.97258	2686.33965	-21943.55709
13	13	6398.86770	-2674.34214	21944.66313
	14	-6451.80189	2815.92182	-24702.02085
14	14	6352.73740	-2825.41096	24699.25575
	15	-6405.67158	2966.98156	-27608.27921
15	15	6477.92879	-2952.27157	27602.33424
	16	-6530.86298	3092.27274	-30608.13620
16	16	6493.94059	-3160.13918	30607.85969
	17	-6543.88107	3302.50356	-33848.41863
17	17	6587.06302	-3233.39428	33848.28038
	18	-6639.99721	3373.39546	-37133.77220
18	18	6549.73240	-3405.52338	37120.36146
	19	-6602.71195	3547.10305	-40612.26800

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
19	19	4601.05581	6011.99909	40621.66934
	20	-4601.05581	-6219.51743	-32976.85911
20	20	4600.91973	6074.54942	32943.81617
	21	-4600.91973	-6240.56410	-26786.21498
21	21	4601.05581	6336.86168	26724.13848
	22	-4601.05581	-6502.83099	-20304.26756
22	22	4600.96509	6516.71090	20297.21655
	23	-4600.96509	-7014.70956	0.00000

+ COMBINATION 3 +

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
1	1	11716.09992	-7833.71528	0.00000
	2	-11716.09992	8832.70630	-24999.68387
2	2	11716.23600	-8831.07337	25000.78991
	3	-11716.23600	9164.05525	-33998.28705
3	3	11716.14528	-9244.47712	33959.99042
	4	-11716.14528	9577.50436	-43371.00827
4	4	11716.23600	-9484.20049	43340.17740
	5	-11716.23600	9900.46187	-55456.01607
5	5	11725.35320	9875.10607	55469.28855
	6	-11623.15892	-9113.16223	-45932.59691
6	6	11716.32672	9083.27052	45933.42644
	7	-11614.17780	-8329.17382	-37273.82451
7	7	11466.21609	8460.44334	37270.22988
	8	-11369.91851	-7697.81911	-29168.07212
8	8	11462.95023	7561.65080	29161.85064
	9	-11360.80131	-6807.55410	-22015.72620
9	9	11323.69748	6841.30134	22014.62016
	10	-11221.50321	-6079.40286	-15525.48348
10	10	11244.77248	6065.93118	15524.51570
	11	-11142.57820	-5303.98733	-9814.11413

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

MEMBER NO.	JOINT NO.	AXIAL FORCE X	SHEAR FORCE Y	BENDING MOMENT Z
11	11	11132.05486	5329.56992	9809.63467
	12	-9935.34309	3676.45388	-0.14039
12	12	10593.05149	-184.32301	0.00000
	13	-11789.80862	5250.14596	-32248.39352
13	13	11840.29341	-5228.82714	32249.63781
	14	-11942.48769	5657.24478	-37717.20830
14	14	11846.32619	-5668.35779	37714.44320
	15	-11948.52046	6096.77543	-43623.04713
15	15	12020.09728	-6067.24659	43618.48472
	16	-12122.24620	6491.08296	-49863.60132
16	16	12055.93105	-6627.93166	49865.67515
	17	-12152.27399	7057.61936	-56727.96207
17	17	12228.61352	-6924.85299	56726.71778
	18	-12330.76244	7348.68935	-63824.86773
18	18	12239.81725	-7389.24048	63810.76572
	19	-12342.05688	7817.70348	-71448.38669
19	19	9781.25789	10942.13589	71455.29944
	20	-9781.25789	-11149.65423	-57647.77259
20	20	9781.03109	11004.18728	57610.58199
	21	-9781.03109	-11170.20195	-46523.36052
21	21	9781.30325	11267.99639	46457.96591
	22	-9781.30325	-11433.96570	-35106.95390
22	22	9781.12181	11450.43109	35098.38209
	23	-9781.12181	-11948.42975	0.00000

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

4. SUPPORT REACTIONS

↑ LOAD CASE 1 ↑

JOINT NO.	FORCE X (kg)	FORCE Y (kg)	MOMENT Z (kg.m)
1	5302.94407	5567.97788	0.00000
23	-5302.94407	5567.79644	0.00000

↑ LOAD CASE 2 ↑

JOINT NO.	FORCE X (kg)	FORCE Y (kg)	MOMENT Z (kg.m)
1	4933.81090	5180.33815	0.00000
23	-4933.72018	5180.15672	0.00000

↑ LOAD CASE 3 ↑

JOINT NO.	FORCE X (kg)	FORCE Y (kg)	MOMENT Z (kg.m)
1	-2403.00341	967.80203	0.00000
23	-1711.78817	-966.82228	0.00000

↑ COMBINATION 1 ↑

JOINT NO.	FORCE X (kg)	FORCE Y (kg)	MOMENT Z (kg.m)
1	10236.75497	10748.31603	0.00000

ADVIES- EN KONSTRUKTIEBUREAU A. BOERKOEL
TOLSTEEGSINGEL 3 3582 AC UTRECHT

JOINT NO.	FORCE X (kg)	FORCE Y (kg)	MOMENT Z (kg.m)
23	-10236.66426	10747.95316	0.00000

+ COMBINATION 2 +

JOINT NO.	FORCE X (kg)	FORCE Y (kg)	MOMENT Z (kg.m)
1	2899.93613	6535.76177	0.00000
23	-7014.70956	4600.96509	0.00000

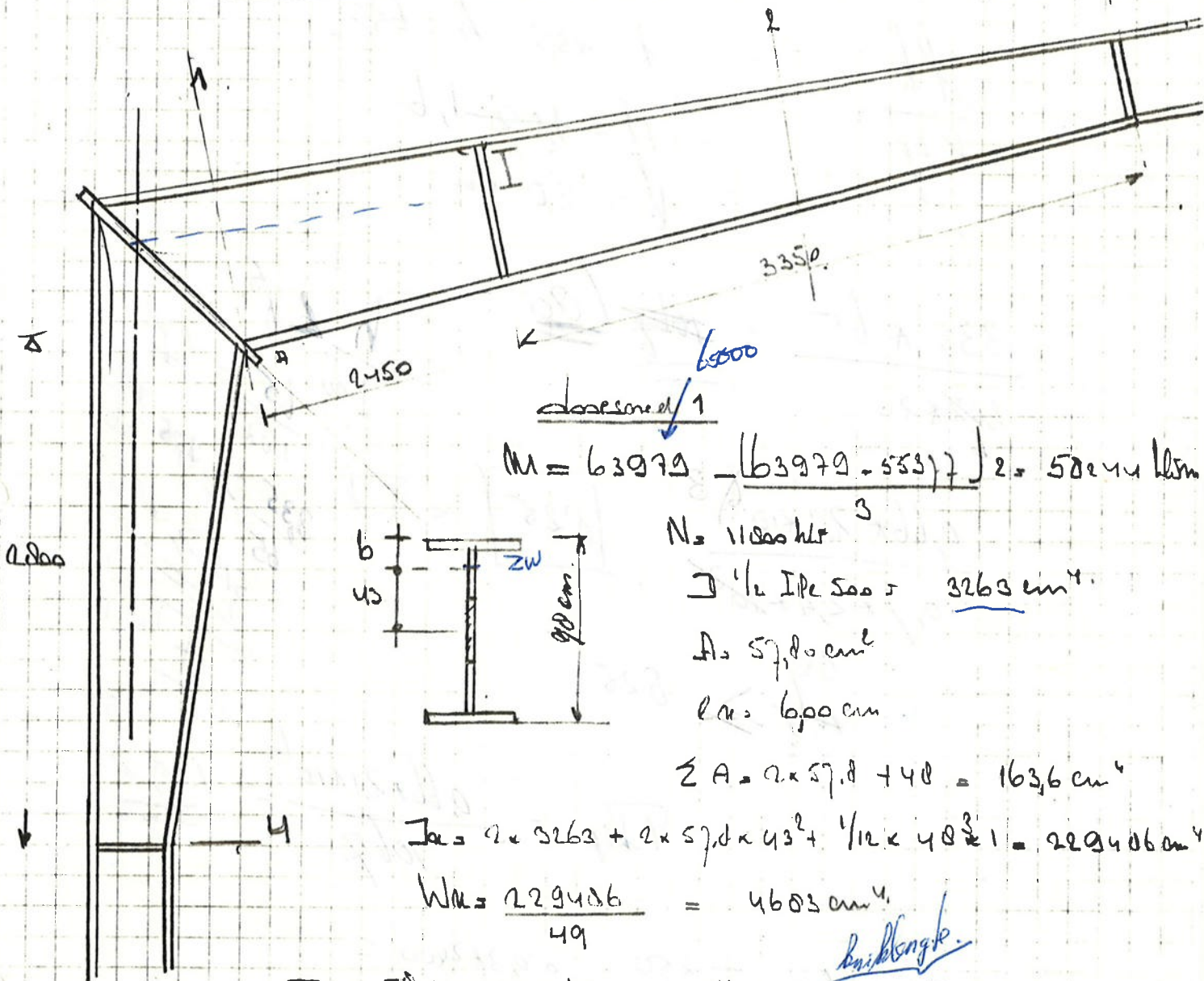
+ COMBINATION 3 +

JOINT NO.	FORCE X (kg)	FORCE Y (kg)	MOMENT Z (kg.m)
1	7833.71528	11716.09992	0.00000
23	-11948.42975	9781.12181	0.00000

2^e Spertitel Gerüst

Detail berechnung 2.4m

①



$$M = 63979 - \frac{(63979 - 55377)}{2} = 58244 \text{ Nm}$$

$$N = 11000 \text{ kN}$$

$$I_z = 3263 \text{ cm}^4$$

$$A_z = 57,80 \text{ cm}^2$$

$$e_z = 6,90 \text{ cm}$$

$$\Sigma A = 2 \times 57,8 + 40 = 163,6 \text{ cm}^2$$

$$I_z = 2 \times 3263 + 2 \times 57,8 \times 40^2 + \frac{1}{12} \times 40^3 = 229406 \text{ cm}^4$$

$$W_z = \frac{229406}{49} = 4683 \text{ cm}^3$$

$$\sigma = \frac{5824400 \times 1,5}{4683} + \frac{11000 \times 1,5}{163,6} = 1865 + 100 = 1965 \text{ kg/cm}^2$$

$$\text{Stab. Flans} = 2 \times 16 \times 40,2 = 1542,40$$

$$A = 32 \text{ cm}^2$$

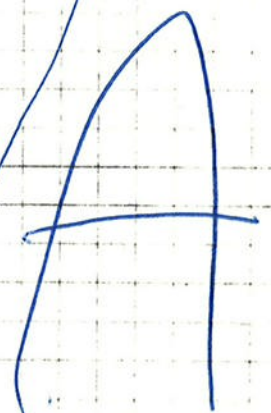
$$\text{Dir. Flans} = \frac{401}{49} \left(\frac{5824400 \times 1542,43}{229406} \right) + \frac{11000 \times 32}{163,6} = 40735 \text{ kgf}$$

$$I_z \text{ Flans} = \frac{1}{12} \times 16 \times 20^3 = 1066 \text{ cm}^4$$

$$e_y \text{ Flans} = \sqrt{\frac{1066}{32}} = 5,77 \text{ cm}$$

$$\sigma_{d. \text{ in } A} = \frac{40735 \times 1,5}{32} = 1909 \text{ kgf/cm}^2$$

$$1973 = \frac{1,6}{49} \times 1973^3$$



Door 5 mull 2

ligger length = 650 mm

$$I_{xx} = 2 \times 560 + 2 \times 590 + 12 \times 15^2 \times 1 = 27909 \text{ cm}^4$$

$$W_x = \frac{I_{xx}}{32.5} = 2707$$

$$M_x = (9 - 10) = 33874 - 0.3 (33204 - 29000) = 31356 \text{ kNm}$$

$$N_x = 11400 \text{ kN}$$

$$f_{m \text{ Flus}} = \frac{317}{32} \times \frac{3135600 \times 3205}{27909} = 35072 \text{ kN}$$

(Kombi aus 20 kN/m² mit 10 kN/m² an der Flans)

$$\lambda = \frac{335}{577} = 58 \quad \lambda_0 = 132$$

$$W_x N_x = \frac{11400}{120.60} \times 32 = 2790 \text{ kN}$$

$$G_{01} = (55072 + 2790) \times 120 \times 12 = 2390 \text{ kNm}^2$$

Door 5 mull 3

$$M_x = 21399 \text{ kNm} \quad N_x = 11210 \text{ kN}$$

Rechteck 18500

$$G_{01} = \frac{213900 \times 12}{1930} + \frac{11210 \times 12}{116} = 1660 + 147 = 1807 \text{ kNm}^2$$

$$D_{m \text{ Flus}} = \frac{242}{250} \left(\frac{1660 \times 32}{15} + \frac{147 \times 32}{15} \right) = 30517 \text{ kN}$$

$$f_{m \text{ Flus}} = \frac{30517}{478} = 478 \text{ kN}$$

$$M_x = 18000 = 478 \times 0.65 = 311 \text{ kNm}$$

$$G_{01} = \frac{31100 \times 15}{1930} + 910 = 1315 \text{ kNm}^2$$

$$f_{m \text{ Flus}} = \frac{31100}{478} = 2220 \text{ kN}$$

$$F_s = \frac{150 \times 5.33}{2} = 350 \text{ kN}$$

$$A_s = 157 \text{ mm}^2$$

$$C_{II} = \frac{220 \times 15}{1.57} = 210 \text{ kN/m}^2 \text{ c} \quad \frac{350 \times 15}{2 \times 0.7 \times 1.57} = 240 \text{ kN/m}^2$$

$$C_{II} = \sqrt{2.10^2 + 3 \times 240^2} = 2160 \text{ kN/m}^2$$

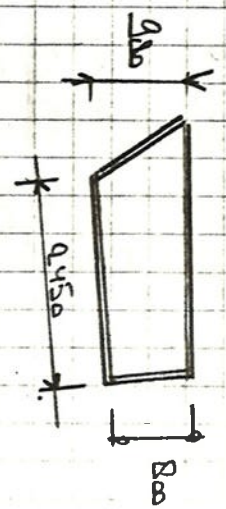
Euro spread

$$\lambda = \frac{215}{5.77} = 38 \quad \lambda = 1.84$$

berdasarkan in order kelas

$$C_{ed} = \frac{[40735 + 35072] \times 1.134 \times 1.5}{32 \times 1.84} = 2086 \text{ kN/m}^2$$

Kontrolasi of Plat



$$d = \frac{2450}{890} = 2.75$$

$$\phi = 1 \rightarrow k = 22.9$$

$$R_{ed} \text{ Plat} = \frac{1865 \times 47.4}{409} = 1804 \text{ kN/m}^2$$

$$T = \frac{8860 \times 1.5}{2450 \times 102} = 137 \text{ kN/m}^2$$

$$k_{ed} \text{ plat} = 5.55 + \frac{4}{2.75} = 2.03$$

$$C_{ed} = \frac{180 \times [100 \times 10.5]^2}{0.90} = 264 \text{ kN/m}^2$$

$$C_{ed} = 264 \times 23.3 = 6200 \text{ kN/m}^2 > 1804 \text{ kN/m}^2$$

$$T_{ed} = 2.03 \times 264 = 947 \text{ kN/m}^2 > 137 \text{ kN/m}^2$$

STYL

in front of

A. Flum: $30 \times 21 = 630 \text{ cm}^2$

B. Flum: 227.20 cm^2

$$\begin{aligned} \text{Fin Flum} &= 63 \times 6398000 \times 41117 = 277196 \\ \text{Abi N.} &= \frac{10741 \times 63}{227120} = 2980 \text{ kbf} \end{aligned}$$

Fluxes: 63.252 kbf

of same amount of void

$$\begin{aligned} \text{Fin Flum} &= 63 \times 3078800 \times 1091 = 63604 \text{ kbf} \\ \text{Abi N.} &= \frac{10741 \times 63}{63712} = 3006 \text{ kbf} \end{aligned}$$

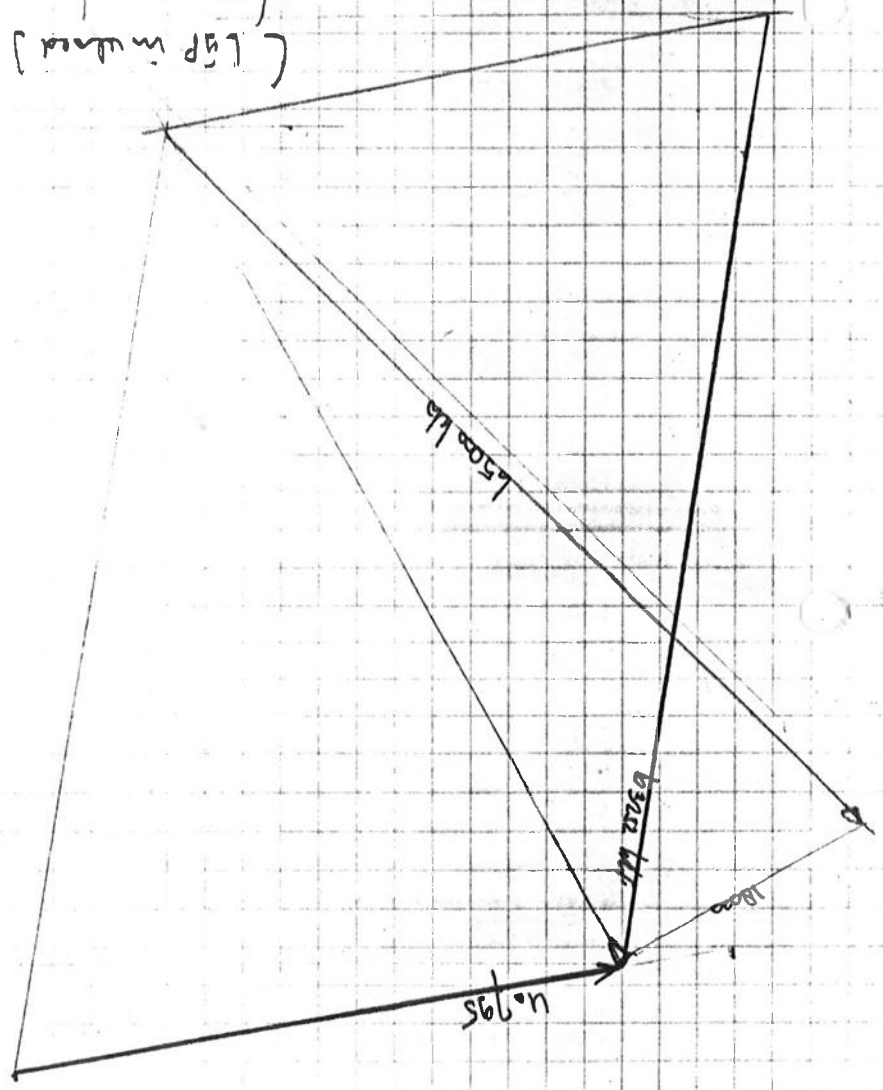
Fluxes: 69410 kbf

$$\begin{aligned} \text{Fin Flum} &= 11221 \times 30^3 = 498000 \\ \text{Abi N.} &= \sqrt{\frac{498000}{63}} = 276 \text{ cm} \end{aligned}$$

$$\lambda = \frac{230}{266} = 33, \quad W = 1.094$$

$$\text{Ca.} = \frac{69410 \times 1.094 \times 15}{63} = 195 \text{ kbf/cm}^2$$

These are buildings



Mitflans > 65000 kPa

(LSP in wheel)

$$\text{Wt. load} = \left(\frac{49 \times 100}{2} \right) \times \frac{6397900 \times 49.4}{0.29486} = 35000 \text{ kPa}$$

$$\text{Wt. Wt.} = (495 - 41) \times 1.1 \times 6397900 \times 49.4 = 46000 \text{ kPa}$$

$$\text{Fin. load} = 65000 + 16000 - 35000 = 46000 \text{ kPa}$$

$$\text{Cap. load} = \frac{18000 \times 1.5}{30 \times 3} - 1200 \text{ kPa}$$