



ligboxenstal type F 1980

STATISCHE BEREKENINGEN



CEBECO - HANDELSRAAD

DEVENTER

landbouwbedrijfsuitrusting

5.1.2e

postbus 223

telefoon

5.1.2e

GORDINGEN 6³ x 15 cm

dakbelasting: sneeuw 50 kg/m²
golfplaten : 14
gordingen : $\frac{6}{20}$ kg/m²

$$\text{n.b. : } 1,15 \times 50 = 57,5 \text{ kg/m}^1$$

$$\text{e.g. : } 1,15 \times 20 = 23 \text{ kg/m}^1$$

$$M \text{ n.b.} = 1/8 \times 57,5 \times 3,3^2 = 78,2 \text{ kgm.}$$

$$M \text{ e.g.} = 1/8 \times 23,0 \times 3,3^2 = 31,3 \text{ kgm.}$$

$$Mx \text{ n.b.} = 0,951 \times 78,2 = 74,3 \text{ kgm.}$$

$$Mx \text{ e.g.} = 0,951 \times 31,3 = 29,7 \text{ kgm.}$$

$$My \text{ n.b.} = 0,309 \times 78,2 = 24,1 \text{ kgm.}$$

$$My \text{ e.g.} = 0,309 \times 31,3 = 9,6 \text{ kgm.}$$

$$\text{dakhelling } 18^\circ : \sin 18^\circ = 0,309$$

$$\cos 18^\circ = 0,951$$

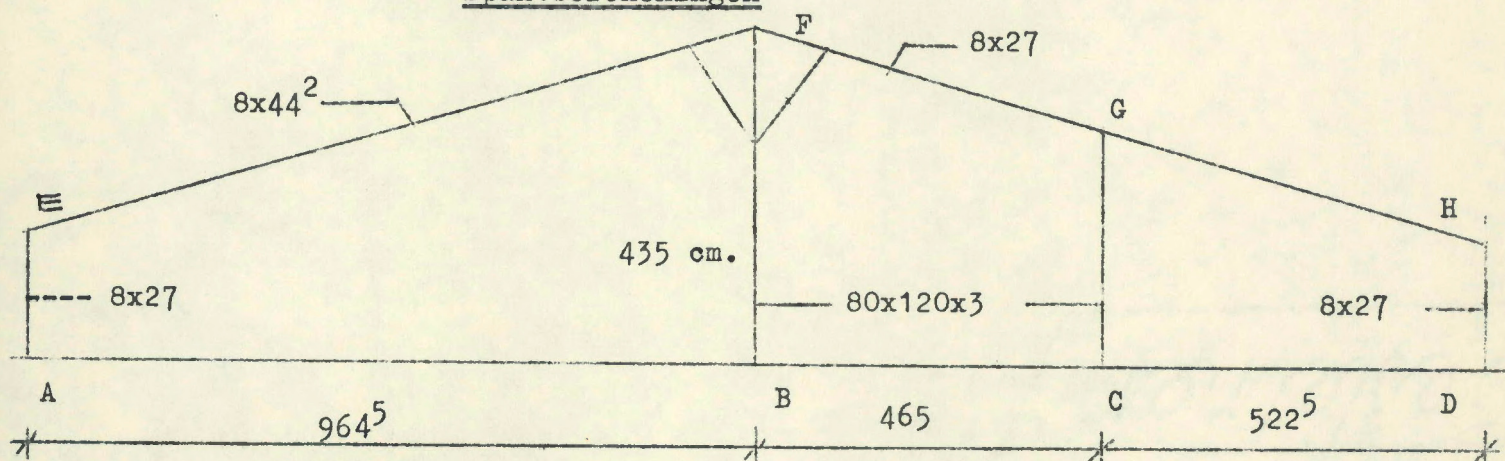
$$6^3 \times 15 \text{ cm} \quad Wx = 236 \text{ cm}^3$$

$$Wy = 99 \text{ cm}^3$$

$$\sigma \text{ n.b.} = 0,85 \times \left(\frac{7430}{236} + \frac{2410}{99} \right) = 47,3$$

$$\sigma \text{ e.g.} = \frac{3130}{236} + \frac{960}{99} = \frac{22,8}{70,1} \text{ kg/cm}^2$$

Spantberekeningen



belastingen:

$$\begin{aligned} 1) \text{ eigen gewicht golfplaten} &= 17 \\ \text{gordingen} &= \underline{\underline{6}} \\ &\underline{23 \text{ kg/m}^2} \quad \text{grondvlak} = 24,2 \\ &0,951 \end{aligned}$$

$$\begin{aligned} \text{per m' spant} \quad 3,3 \times 24,2 &= 79,8 \text{ kg/m' grondvlak} \\ \text{eigen gewicht spant} &= \underline{15,2} \\ &95,0 \text{ kg/m' grondvlak} \end{aligned}$$

$$\begin{aligned} 2) \text{ nuttige belasting} \quad 0,85 \times 50 &= 42,5 \text{ kg/m}^2 \text{ grondvlak} \\ \text{per m' spant} \quad 3,3 \times 42,5 &= 140 \text{ kg/m' grondvlak} \end{aligned}$$

Stijl A - E

$$\begin{aligned} \text{afmeting stijl} \quad 8 \times 27 \text{ cm} \quad A &= 216 \text{ cm}^2 \\ W &= 972 \text{ cm}^3 \end{aligned}$$

$$RE = \pm 1250 \text{ kg}$$

$$M \text{ toel.} = \left(100 - \frac{100}{75} \times \frac{1250}{216}\right) \times 972$$

$$M \text{ toel.} = 895 \text{ kgm}$$

$$RF = 4,82 \times 235 - \frac{895}{9,645}$$

$$RF = 1133 - 93$$

$$RF = 1040 \text{ kg}$$

$$RE = 9,645 \times 235 - 1040$$

$$RE = 2270 - 1040$$

$$RE = 1230 \text{ kg}$$

$$\sigma = \frac{89500}{972} = 92 \text{ kg/cm}^2$$

Regel E - F

afmeting 8 x 44,2

$$A = 354 \text{ cm}^2$$

$$W = 2604 \text{ cm}^3$$

$$M_{E-F \text{ max}} = \frac{1040}{235} \times 1040 \times \frac{1}{2}$$

$$M_{E-F \text{ max}} = 2300 \text{ kgm}$$

$$\sigma = \frac{230000}{2604} = 88 \text{ kg/cm}^2$$

Regel F - G - H

afmeting 8 x 27 cm

$$W = 972 \text{ cm}^3$$

$$M = \frac{1}{8} \times 235 \times 4,65^2$$

$$M = 635 \text{ kgm}$$

$$\sigma = \frac{63500}{972} = 65 \text{ kg/cm}^2$$

$$RF = 2325 \times 235$$

$$RF = 546 \text{ kg}$$

$$RG = 1,25 \times 4,94 \times 235$$

$$RG = 1450 \text{ kg}$$

Kolom B - F

$$RF = 1040 \times 546$$

$$RF = 1586 \text{ kg}$$

$$lk = 435 \text{ cm}$$

$$\phi 80.120.3 \text{ mm}$$

$$ix = 4,58 \text{ cm}$$

$$A = 11,48 \text{ cm}^2$$

$$\lambda = \frac{435}{4,53} = 96 \quad \alpha = 0,456$$

$$\begin{aligned} F \text{ toel.} &= 0456 \times 11,48 \times 1600 \\ &= 8400 \text{ kg} \end{aligned}$$

Kolom C - G

$$RG = 1450 \text{ kg}$$

$$\text{buis } \varnothing 80 . 120 . 3 \text{ mm}$$

$$lk = 290 \text{ cm}$$

$$ix = 4,53 \text{ cm}$$

$$A = 11,48 \text{ cm}^2$$

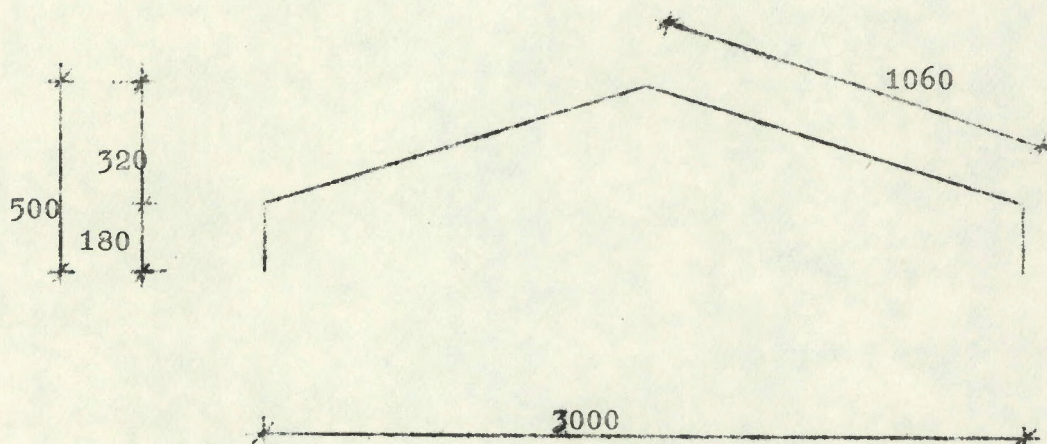
$$\lambda = \frac{290}{44,53} = 64$$

$$\alpha = 0,720$$

$$F. \text{ toel.} = 0,720 \times 1600 \times 11,48$$

$$F \text{ toel.} = 1325,0 \text{ kg} \quad 1450 \text{ kg}$$

W I N D V E R B A N D



Berekeningen volgens T.G.B. - '72 . Hout

Gemiddelde kopgevelhoogte: $180 + \frac{320}{2} = 340$ cm

Stallengte: 35 m

Tabel 6 - bladzijde 41

Stuw-drukwaarde = 71,0

reduktie volgens 2.3.6.4. : $4 \times (7 - 3,4) = \underline{14,4}$
56,6 kg/m²

Coëfficiënten blz. 19 : $c_d = + 0,8$
 $c_z = - 0,4$

$c_{d+z} \times q = 1,2 \times 56,6$
 $= 67,9$ kg/m²

$c_w = 0,04$

$c_w \times q = 0,04 \times 56,6$
 $= 2,26$ kg/m²

K O P G E V E L

$$A_{d+z} = 20 \times 3,4 = 68 \text{ m}^2$$

$$\begin{aligned} P_{d+z} &= 68 \times 67,9 \\ &= 4620 \text{ kg} \end{aligned}$$

$$\text{Kracht op de kap: } \frac{4620}{2} = 2310 \text{ kg}$$

$$\text{Per m' dakrand: } \frac{2310}{2 \times 10,6} = 108 \text{ kg/m'}$$

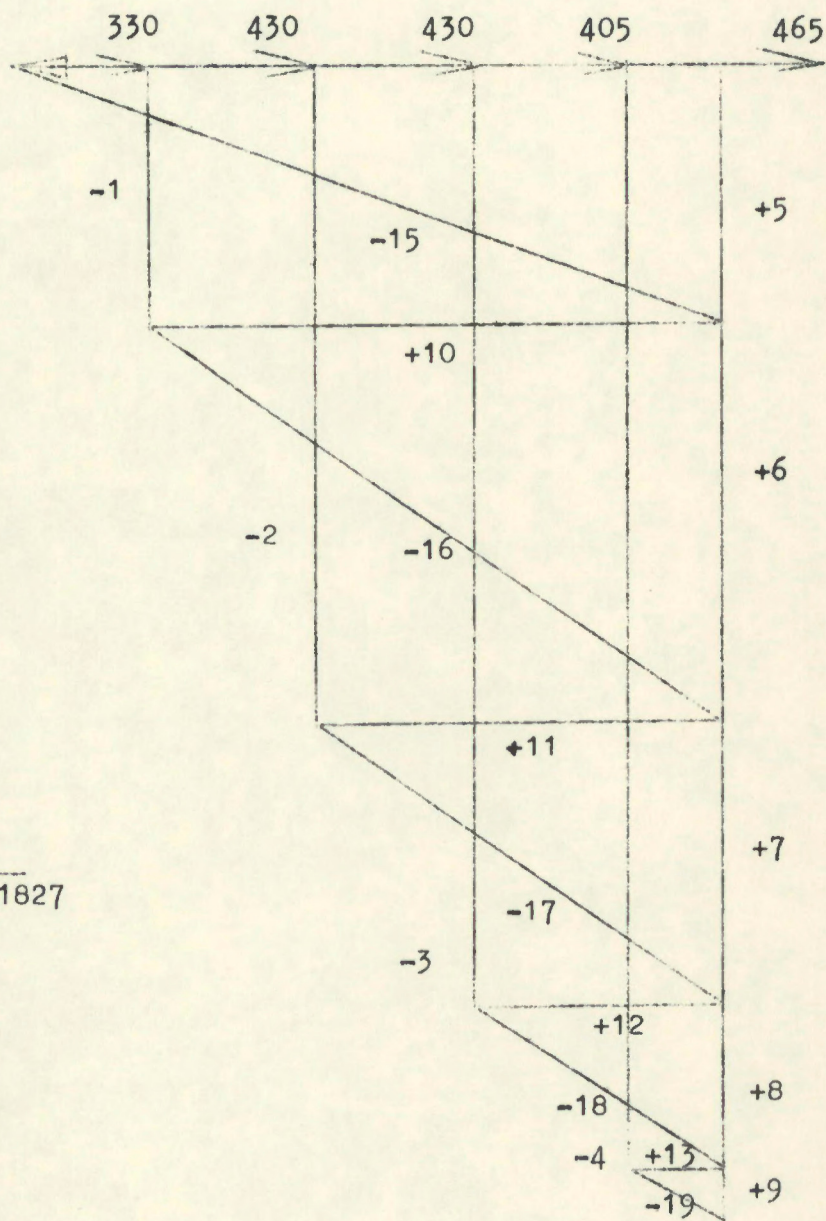
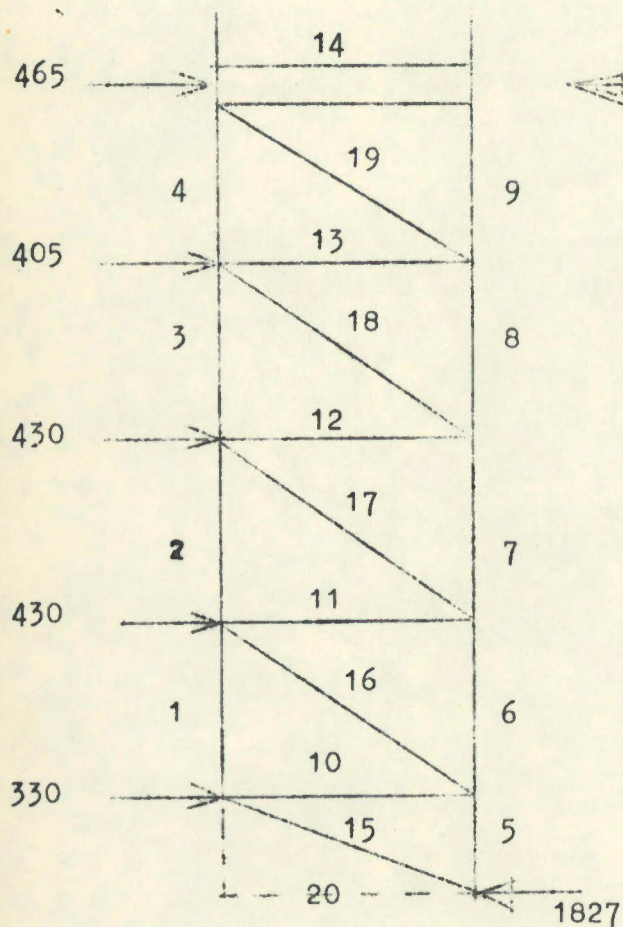
D A K V L A K

$$A_w = 2 \times (10,6 \times 35,0) = 740 \text{ m}^2$$

$$\begin{aligned} P_w &= 740 \times 2,26 \\ &= 1670 \text{ kg} \end{aligned}$$

$$\text{Per m' dakrand: } \frac{1670}{2 \times 10,6} = 78 \text{ kg/m'}$$

$$\begin{aligned} \text{Totale windbelasting per m' dakrand: } q &= 108 \times 78 \\ q &= 186 \text{ kg/m'} \end{aligned}$$



P1 = 1,77 x 186 = 330 kg
 P2 = 2,30 x 186 = 430 kg
 P3 = 2,30 x 186 = 430 kg
 P4 = 2,17 x 186 = 405 kg
 P5 = 2,50 x 186 = 465 kg

	druk bovenrand	trek onderrand	trek gordingen	druk diagonalen
1.	670 kg	670 kg	1500 kg	1940 kg
2.	1720 kg	1720 kg	1060 kg	1630 kg
3.	2460 kg	2460 kg	630 kg	1290 kg
4.	2900 kg	2900 kg	230 kg	770 kg
5.			-	260 kg
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				

Diagonalen $9^5 \times 12$ en $7^5 \times 10$

Diagonaal 15

1940 kg druk

afmeting $9^5 \times 12$

lk = 350 cm

$$i_{\min} = \sqrt{\frac{1/12 \times 12 \times 9,5^2}{12 \times 9,5}} = 3,47 \text{ cm}$$

$$\lambda = \frac{350}{3,47} = 101 \quad \bar{\sigma}_d = 16 \text{ kg/cm}^2$$

$$\sigma = 0,7 \times \frac{2946}{9,5 \times 12} = 11,9 \text{ kg/cm}^2 < 16 \text{ kg/cm}^2$$

Diagonalen 16, 17, 18 en 19

Max. druk 1630 kg

Afmeting $7^5 \times 10$

lk = 200 cm

$$i_{\min} = \sqrt{\frac{1/12 \times 10 \times 7,5^3}{10 \times 7,5}} = 2,17 \text{ cm}$$

$$\lambda = \frac{200}{2,17} = 92 \quad \bar{\sigma}_d = 19 \text{ kg/cm}^2$$

$$\sigma = 0,7 \times \frac{1630}{7,5 \times 10} = 15,3 \text{ kg/cm}^2 < 19 \text{ kg/cm}^2$$

Afschuiving

Houtdraadbouten $\emptyset 10$ $d = 10 \text{ mm}$
 $l = 65 \text{ mm}$
 $l_h = 60 \text{ mm}$

modifikatie factoren: $M_2 = 0,8$ (asymmetrisch)

$$M_4 = \frac{l_h}{5 \times d} = \frac{60}{5 \times 10} = 1,2$$

Belasting per bout: $0,8 \times 1,2 \times 230$
221 kg

$$\text{Staaft 15} \quad M = 0,7 \times \frac{670}{221} = 3 \text{ bouten } \varnothing 10$$

$$\text{Staaft 16} \quad M = 0,7 \times \frac{1050}{221} = 4 \text{ bouten } \varnothing 10$$

$$\text{Staaft 17} \quad M = 0,7 \times \frac{740}{221} = 3 \text{ bouten } \varnothing 10$$

$$\text{Staaft 18} \quad M = 0,7 \times \frac{440}{221} = 2 \text{ bouten } \varnothing 10$$

$$\text{Staaft 19} \quad M = 0,7 \times \frac{140}{221} = 1 \text{ bout } \varnothing 10$$

Gordingen 5 x 15

Houtdraadbouten $\varnothing 10$

F toel. = 221 kg

$$\text{Staaft 10} \quad M = 0,7 \times \frac{1500}{221} = 5 \text{ bouten}$$

$$\text{Staaft 11} \quad M = 0,7 \times \frac{1060}{221} = 4 \text{ bouten}$$

$$\text{Staaft 12} \quad M = 0,7 \times \frac{630}{221} = 2 \text{ bouten}$$

$$\text{Staaft 13} \quad M = 0,7 \times \frac{230}{221} = 1 \text{ bout}$$

$$\text{Staaft 14} \quad M = 0,7 \times \frac{-}{221} = -$$

$$\text{Staaft 20} \quad M = 0,7 \times \frac{1827}{221} = 6 \text{ bouten}$$

Bovenrand 8 x 44²

Grootste drukkracht is 2900 kg

$$l_{kx} = 1/2 \times 964 \times \sqrt{2} = 680 \text{ cm}$$

$$l_{ky} = 115 \text{ cm}$$

$$i_x = 0,289 \times 44,2 = 12,80 \text{ cm}$$

$$i_y = 0,289 \times 8,0 = 2,32 \text{ cm}$$

$$\lambda_x = \frac{680}{12,8} = 53 \quad \sigma_d = 40,5 \text{ kg/cm}^2$$

$$\lambda_y = \frac{115}{2,32} = 50 \quad \sigma_d = 42 \text{ kg/cm}^2$$

Moment

$$M_{e.q} = \frac{95}{235} \times 2300 = 928 \text{ kgm}$$

$$\sigma_b = \frac{92800}{1/6 \times 8 \times 44,2^2} = 35,5 \text{ kg/cm}^2$$

$$\sigma_x = 0,7 \times \frac{2900}{8 \times 44,2} + \frac{40,5}{100} \times 35,5$$

$$\sigma_x = 5,7 + 14,4 = 20,1 \text{ kg/cm}^2 < 40,5 \text{ kg/cm}^2$$

$$\sigma_y = 0,7 \times \frac{2900}{8 \times 44,2} + \frac{42}{100} \times \frac{1}{2} \times 35,5$$

$$\sigma_y = 5,7 + 7,5 = 13,2 \text{ kg/cm}^2 < 42 \text{ kg/cm}^2$$

Onderrand 8 x 44²

Max. trekkracht 3040 kg in de nok

draadnagels $\emptyset$ 3,4 mm d = 3,4 mm

l = 65 mm

lh = 60 mm (18 x d)

belasting per nagel is 40 kg

$$M = 0,7 \times \frac{3040}{40} = 53 \text{ nagels}$$

$$\sigma = 0,7 \times \frac{3040}{6,5 \times 17,5} = 18,6 \text{ kg/cm}^2$$

schetsplaten 19 mm dik

$$\sigma = 0,7 \times \frac{3040}{2 \times 1,9 \times 17,5} = 32 \text{ kg/cm}^2$$

Windverband langsgevels

$$R_a = 1827 \text{ kg}$$

passen in 2 spantvakken een windverband toe

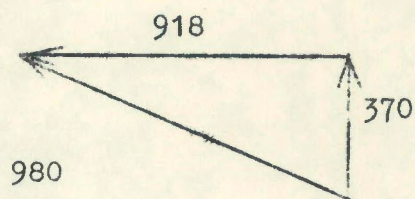
$$\text{Per nok: } \frac{1827}{2} = 913 \text{ kg}$$

$$A = \frac{980}{1600} = 0,61 \text{ cm}^2$$

bouten M-10 $A = 0,78 \text{ cm}^2$

Strip 32×3

$$A_{\text{netto}} = (32 - 11) \times 3 = 0,63 \text{ cm}^2 > 0,61 \text{ cm}^2$$



Drukkracht in de gevelkolom

De gevelkolommen worden verankerd door zelfborgende ankerbouten M-10

Toelaatbare trekkracht per bouw: 2130 kg

Afgezien van de vertikaal naar beneden gerichte kolombelasting ten gevolge van het gewicht van de stal, is de verankering ruim voldoende.

Aanvullende berekening

Betonvloeren

Max. puntlast door spantpoot: 1586 kg

Verdelen deze belasting over een gedeelte betonvloer van $60 \times 60 \text{ cm}$

Belasting spantbeen 1586 kg

$$p \text{ grond} = \frac{1586}{60 \times 60} = 0,44 \text{ kg/cm}^2$$

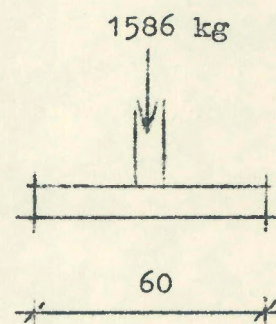
Moment betonvloer

$$M = 1/2 \times 4400 \times 0,26^2$$

$$M = 153 \text{ kgm}$$

Staal QR - 48

Beton K - 225



M	h	h _o	h _a	A
153	7,7	2,6	26,2	0,76 cm ²

Toe te passen wapening: $\emptyset 4 \cdot 15 \cdot 15$

$$A = 0,84 \text{ cm}^2$$

Windbelasting op de kopgevels

T.G.B. 1972.

Gemiddelde kopgevelhoogte: $\frac{580 + 170}{2} = 375 \text{ cm}$

Tabel 2 T.G.B. 1972.

Stuwdrukwaarde: $= 71$

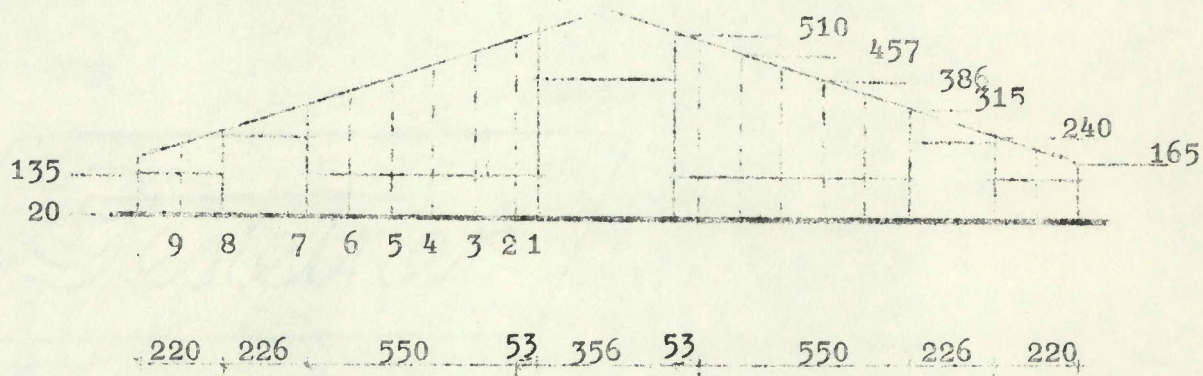
Reduktie $:: (7 - 3,75) \times 4 = \underline{13}$ (art. 2.3.6.4.)
 $q = 58 \text{ kg/m}^2$

Coëfficiënten: $c_d = + 0,8$
 $c_z = \underline{\underline{-0,4}}$
 $c_{d+z} = 1,2$

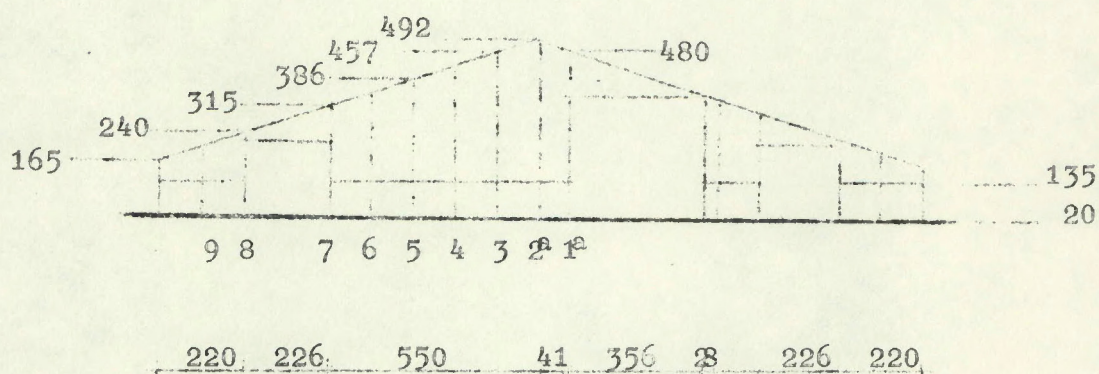
Uiteindelijke winddruk per m²: $c_{d+z} \times q = 1,2 \times 58 = 70 \text{ kg/m}^2$

F.2460 - stal

Elementen van 110 breed



F.1980 - stal



Bepaling deurstijlmomenten

Stijl	Breedte kopgevel	q wind	l.	$M_{\max} = 1/8 \times q \times l^2$	$M_{\max}$ op 135 ⁺ $0,575 \times q \times (l-115)$
1	2,04	143	4,90	430 kgm	$0,575 \times 143 \times 3,75 = 309$
1a	1,98	139	4,60	365 kgm	$0,575 \times 139 \times 3,45 = 276$
2	0,82	57	4,72	158 kgm	$0,575 \times 57 \times 3,57 = 118$
2a	0,76	56	4,72	155 kgm	$0,575 \times 56 \times 3,57 = 115$
3	1,10	77	4,37	182 kgm	$0,575 \times 77 \times 3,22 = 142$
4	1,10	77	4,01	155 kgm	$0,575 \times 77 \times 2,86 = 127$
5	1,10	77	3,66	130 kgm	$0,575 \times 77 \times 2,51 = 111$
6	1,10	77	3,30	105 kgm	$0,575 \times 77 \times 2,15 = 95$
7	1,68	118	2,95	130 kgm	$0,575 \times 118 \times 1,80 = 122$
8	1,68	118	2,29	72 kgm	$0,575 \times 118 \times 1,05 = 71$
9	1,10	77	1,82	75 kgm	$0,575 \times 77 \times 0,67 = 30$

Deurstijlen 1 en 1a

Boven 135⁺

$$M_{\max} = 430 \text{ kgm} \quad l = 4,90 \text{ m}$$

$$a = 10 \text{ cm} \quad k = 600 \text{ kg/cm}$$

$$A_1 = 6 \times 12 = 72 \text{ cm}^2$$

$$A_2 = 10,5 \times 15,2 = 160 \text{ cm}^2$$

Bepaling l_w (art. 4.3.3.3.)

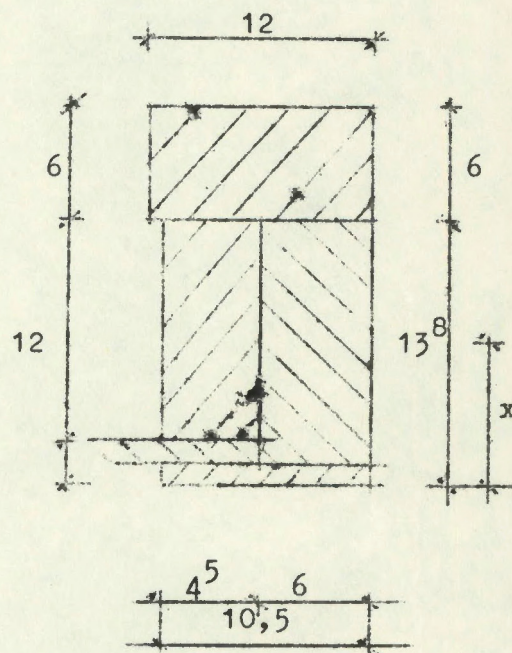
$$p = \frac{\pi^2 \times E}{l^2} \times \frac{a}{k} \times \frac{A_1 \times A_2}{A_1 + A_2}$$

$$p = \frac{3,14^2 \times 100000}{190^2} \times \frac{10}{600} \times \frac{72 \times 160}{72 + 160}$$

$$p = 4,18 \times 0,0167 \times 49,5$$

$$p = 3,4$$

$$\gamma = \frac{1}{1 + p} = \frac{1}{1 + 3,4} = \frac{1}{4,4} = 0,228$$



Bepaling zwaartepunt

$$x = \frac{6 \times 12 \times 18,2 + 10,5 \times 15,2 \times 17,6}{72 + 160}$$

$$x = \frac{2540}{232} = 10,9 \text{ cm} \quad e = 21,2 - 10,9 - 10,3 \text{ cm}$$

$$A1 = 72 \text{ cm}^2 \quad e = 7,3 \text{ cm} \quad A x e^2 = 72 \times 7,3^2 = 3800 \text{ cm}^4$$

$$A2 = 160 \text{ cm}^2 \quad e = 3,3 \text{ cm} \quad A x e^2 = 160 \times 3,3^2 = 1750 \text{ cm}^4$$

$$I_w = I_e + \sum (A \times e^2)$$

$$I_w = 1/12 \times 12 \times 6^3 + 0,228 \times 3800 + 1/12 \times 10,5 \times 15,2^3 + 0,228 \times 1750$$

$$I_w = 216 + 865 + 3000 + 400$$

$$I_w = 4481 \text{ cm}^4$$

Weerstandsmoment is

$$W_w = \frac{I}{e} = \frac{4481}{10,3} = 435 \text{ cm}^3$$

$$\text{Houtspanning: } \sigma = 0,7 \times \frac{430}{435} = 69 \text{ kg/cm}^2 \quad (\text{art. 3.1.1.2.})$$

Deurstijlen 1 en 1a onder 135⁺

$$M = 309 \text{ kgm} \quad l = 490 \text{ cm} \quad a = 10 \text{ cm} \quad k = 600 \text{ kg/cm}$$

$$A1 = 6 \times 12 = 72 \text{ cm}^2$$

$$A2 = 6 \times 13,8 = 83 \text{ cm}^2$$

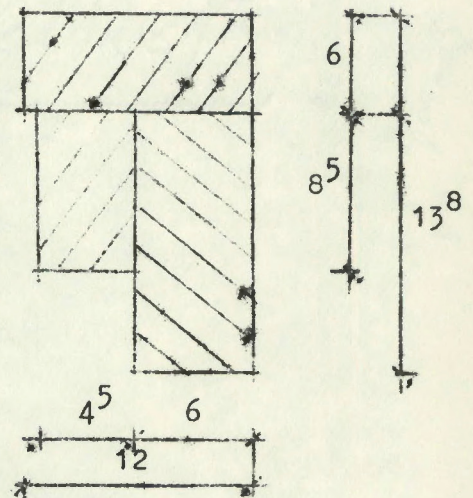
$$A3 = 4,5 \times 8,5 = 38 \text{ cm}^2$$

$$p = \frac{3,14^2 \times 100000}{4902} \times \frac{10}{600} \times \frac{72 \times 121}{72 + 121}$$

$$p = 4,18 \times 0,0167 \times 45$$

$$p = 3,14$$

$$\delta = \frac{1}{1 + p} = \frac{1}{1 + 3,14} = \frac{1}{4,14} = 0,24$$



Zwaartepunt bepaling

$$x = \frac{6 \times 12 \times 16,8 + 13,8 \times 6 \times 6,9 + 4,5 \times 8,5 \times 9,2}{72 + 83 + 38}$$

$$x = \frac{2135}{193} = 11 \text{ cm}$$

$$A_1 = 72 \text{ cm}^2 \quad e = 16,8 \text{ cm} \quad A \times e^2 = 72 \times 16,8^2 = 2020 \text{ cm}^4$$

$$A_2 = 83 \text{ cm}^2 \quad e = 6,9 \text{ cm} \quad A \times e^2 = 83 \times 6,9^2 = 3950 \text{ cm}^4$$

Traagheidsmoment

$$I_x = 1/12 \times 12 \times 6^3 + 0,24 \times 2020 + 1/12 \times 6 \times 13,8^3 + 0,24 \times 3950 + 1/12 \times 4,5 \times 8,5^3 + 0,24 \times 3280$$

$$I_w = 216 + 458 + 1320 + 950 + 230 + 790$$

$$I_w = 3991 \text{ cm}^4$$

$$W_w = \frac{3991}{11} = 362 \text{ cm}^3$$

Houtspanning is:

$$\sigma = \frac{30900}{362} \times 0,7 = 60 \text{ kg/cm}^2 \quad (\text{art. 3.1.1.2.})$$

STIJL no. 3

T.p.v. het maximum moment $M_{\max} = 182 \text{ kgm}$

Rekenen: 2 stijlen. Moment per stijl: 91 kgm

$$l = 437 \text{ cm}$$

$$a = 10 \text{ cm}$$

$$k = 600 \text{ kg/cm}$$

$$A1 = 5 \times 3 = 15 \text{ cm}^2$$

$$A2 = 9,7 \times 4,5 = 43,5 \text{ cm}^2$$

$$p = \frac{3,14^2 \times 100000}{437^2} \times \frac{10}{600} \times \frac{15 \times 43,5}{15 + 43,5}$$

$$p = 5,29 \times 0,0167 \times 11,1$$

$$p = 0,98$$

$$\delta = \frac{1}{1 + p} = \frac{1}{1 + 0,98} = \frac{1}{1,98} = 0,52$$

$$x = \frac{15 \times 11,2 + 43,5 \times 4,85}{15 + 43,5} = \frac{37,8}{58,5} = 6,5$$

$$A1 = 15 \text{ cm}^2 \quad e = 4,7 \text{ cm} \quad A \times e^2 = 15 \times 4,7^2 = 335 \text{ cm}^4$$

$$A2 = 43,5 \text{ cm}^2 \quad e = 1,7 \text{ cm} \quad A \times e^2 = 43,5 \times 1,7^2 = 126 \text{ cm}^4$$

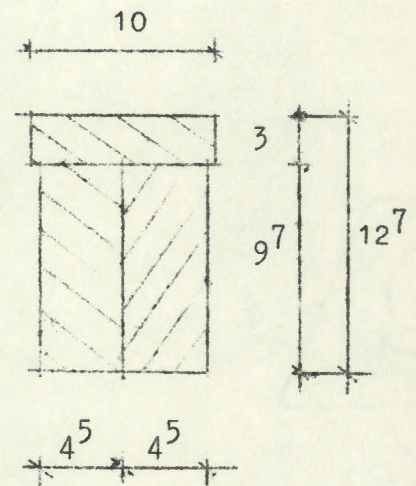
$$lw = \frac{1}{12} \times 5 \times 3^3 + 0,52 \times 335 + \frac{1}{12} \times 4,5 \times 9,7^3 + 0,52 \times 126$$

$$lw = 11 + 174 + 340 + 65$$

$$lw = 590 \text{ cm}^4$$

$$Ww = \frac{590}{6,5} = 91 \text{ cm}^3$$

$$\text{Houtspanning: } \sigma = 0,7 \times \frac{9100}{91} = 70 \text{ kg/cm}^2$$



STIJL no. 3

Beneden 135⁺

$$M_{\text{tot}} = 142 \text{ kgm}$$

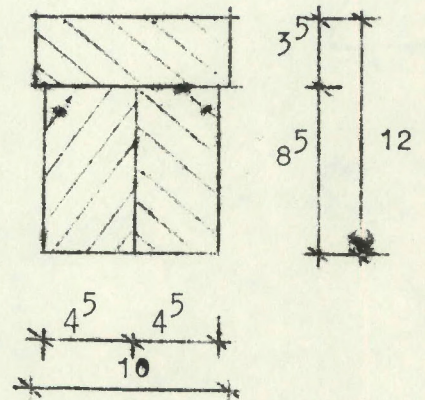
$$M_{\text{per stijl}} = 71 \text{ kgm}$$

$$A_1 = 3,5 \times 5 = 17,5 \text{ cm}^2$$

$$A_2 = 8,5 \times 4,5 = 38,4 \text{ cm}^2$$

$$a = 10 \text{ cm}$$

$$k = 600 \text{ kg/cm}$$



$$p = \frac{3,14^2 \times 100000}{437^2} \times \frac{10}{600} \times \frac{17,5 \times 38,4}{17,5 + 38,4} =$$

$$p = 5,29 \times 0,017 \times 12$$

$$p = 1,07$$

$$\chi = \frac{1}{1 + 1,07} = 0,48$$

$$X = \frac{4,5 \times 8,5 \times 4,3 + 3,5 \times 5 \times 10,2}{38,4 + 17,5}$$

$$X = \frac{334}{55,9}$$

$$X = 6,2 \text{ cm}$$

$$A_1 = 17,5 \text{ cm}^2 \quad e = 4 \text{ cm} \quad A \times e^2 = 17,5 \times 4^2 = 280 \text{ cm}^4$$

$$A_2 = 38,4 \text{ cm}^2 \quad e = 2 \text{ cm} \quad A \times e^2 = 38,4 \times 2^2 = 153 \text{ cm}^4$$

$$I_w = \frac{1}{12} \times 4,5 \times 8,5^3 + 0,48 \times 153 + \frac{1}{12} \times 5 \times 3,5^3 + 0,48 \times 280$$

$$I_w = 229 + 73 + 18 + 134$$

$$I_w = 454 \text{ cm}^4$$

$$W_w = \frac{454}{6,2} = 74,5 \text{ cm}^3$$

$$\text{Houtspanning: } \sigma = 0,7 \times \frac{7100}{74,5} = 67 \text{ kg/cm}^2$$

ST IJL no. 4 onder 135⁺

$$M = 127 \text{ kgm}$$

$$\text{Per stijl: } M = 63 \text{ kgm}$$

$$A1 = 7 \text{ cm}^2$$

$$A2 = 38,4 \text{ cm}^2$$

$$p = 5,29 \times 0,017 \times \frac{7 \times 38,4}{45,4}$$

$$p = 0,53$$

$$\chi = \frac{1}{1,53} = 0,65$$

$$X = \frac{7 \times 9,2 + 38 \times 4,2}{7 + 38} = \frac{224}{45} = 4,95$$

$$A1 = 7 \text{ cm}^2 \quad e = 4,2 \text{ cm} \quad A \times e^2 = 7 \times 4,2^2 = 124 \text{ cm}^4$$

$$A2 = 38,4 \text{ cm}^2 \quad e = 0,8 \text{ cm} \quad A \times e^2 = 38,4 \times 0,8^2 = 25 \text{ cm}^4$$

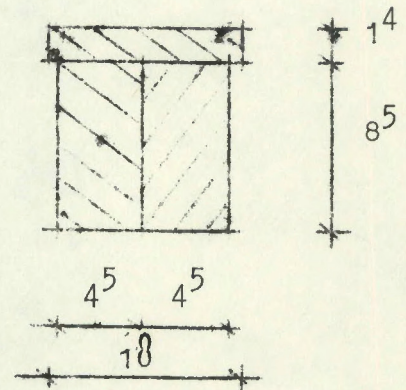
$$I_w = \frac{1}{12} \times 5 \times 1,4^3 + 0,65 \times 124 + \frac{1}{12} \times 4,5 \times 8,5^2 + 0,65 \times 25$$

$$I_w = 1,15 + 80 + 234 + 16$$

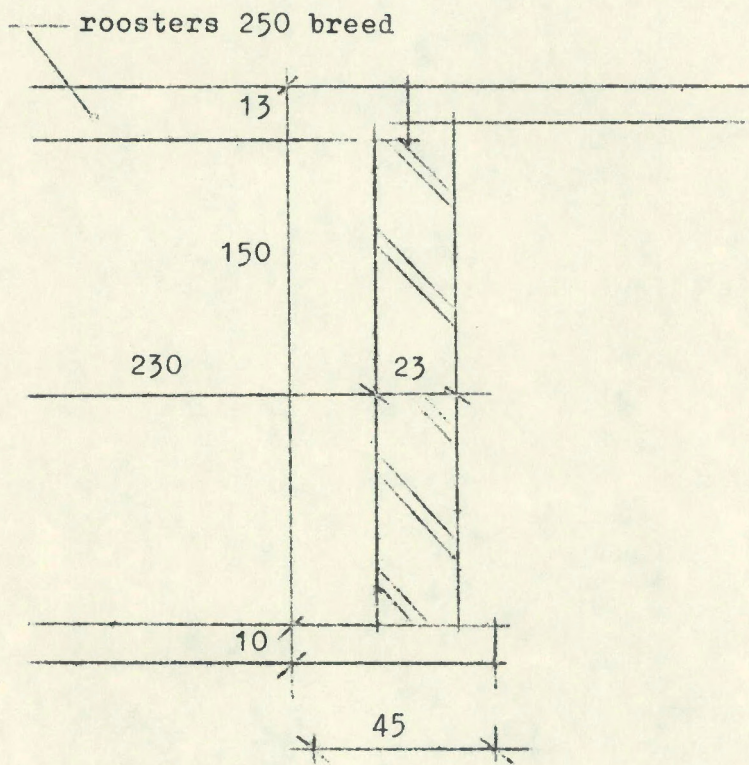
$$I_w = 331 \text{ cm}^4$$

$$W_w = \frac{331}{4,95} = 67 \text{ cm}^3$$

$$\text{Houtspanning: } \sigma = 0,7 \times \frac{6300}{67} = 66 \text{ kg/cm}^2$$



Drijfmestkelders



nb roosters = 400
 eg roosters = 190
 590 kg/m²

staal QR- 48
 beton K 225

strookbelasting.

roosters : 1,25 x 590 = 738
 eg muur : 1,5 x 400 = 600
 1338 kg/m.

$$O \text{ grond} = \frac{1338}{45 \times 100} = 0,30 \text{ kg/cm}^2$$

$$M = 1/2 \times 3000 \times 0,225^2 = 76 \text{ kgm.}$$

M	h	ko	ka	A
76	7,7	1,3	26,4	0,37 cm ²

wapening : $\varnothing$ 4 - 15 - 15

$$A = 0,84 \text{ cm}^2$$

Aanvullende berekeningBetonbalk ter ondersteuning van de roosters

$$l_t = 200 + 11 = 211 \text{ cm}$$

beton: K - 225

staal: QR - 40

$$h = 25 - 2,5 - 1,5 = 21 \text{ cm}$$

Roosters: n.b. = 400

$$\text{e.g.} = \frac{240}{\text{---}}$$

640 kg/cm²

Belasting per m' balk is

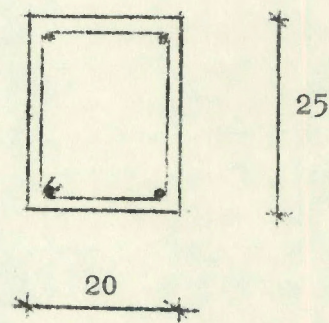
$$\frac{1}{2} \times (2,50 + 2,22) \times 640 = 1510$$

$$\text{e.g. balk: } 0,2 \times 0,25 \times 2400 = \frac{120}{\text{---}}$$

$$q = 1630 \text{ kg/m'}$$

$$M = \frac{1}{8} \times 1630 \times 2,11^2$$

$$M = 905 \text{ kgm}$$



M	b	h	ko	ka	
905	0,20	21,0	10,2	20,4	2,10 cm ²

onderwapening :	2 ϕ 12	A = 226	cm ²
bovenwapening :	2 ϕ 8	A = 1,01	cm ²
beugels :	ϕ 8 - 30	QR = 24	

Legenda toegepaste uitzonderingsgrondslagen

In dit document zijn gegevens geanonimiseerd op grond van:

Wet	Artikel	Omschrijving	Pagina's
Wet open overheid	Art. 5.1 lid 2 sub e	De eerbiediging van de persoonlijke levenssfeer	1