

Bureau ir. M. Klijnsstra

civiel ingenieursbureau

Deventerweg 12

7245 AX Laren

tel: (0573) 40 20 46

fax: (0573) 40 23 58

Behoort bij besluit van burgemeester en wethouders

van de gemeente Bronckhorst d.d.

nr.

De daartoe aangewezen ambtenaar:

Laren 22 juni 2005

Project:

Uitbreiding Ligboxenstal dhr. Luesink

Muizengatweg 7 Toldijk

opdrachtgever: AR bouwkundig bureau
Beltrum

Berekening statische berekening

tekening: zie berekening

constructeur: M. Klijnsstra

projectnr:

5067

Werk: Uitbreiding Ligboxenstal v.dhr. G.J. Leusink
Muizengatweg 7 7227 DN Toldijk

Werknummer 5067

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1 Uitgangspunten

voorschriften volgens de serie NEN6700

materiaalkwaliteiten	beton	wapening	staal	bouten/ankers	hout
			S235	8.8/4.6	C18
			FeB500		
sterkteklasse B25	milieuklasse 5d				

De staalconstructie wordt getoetst, overeenkomstig de afspraak met de opdrachtgever, op het veiligheids criterium.

2 Algemeen

De voor u liggende berekening betreft de statische berekening van het bovenvermeld werk. De berekening is uitgevoerd aan de hand van de bouwkundige tekening W1 d.d. gew: 15-05-2005 van bureau AR te Beltrum

Het bouwwerk valt in klasse 2 met een referentieperiode van 15 jaar

De in rekening gebrachte belastingfactoren zijn;
 $\gamma_{g/p} = 1.2/1.3$
 correctiefactor $\psi_t = 1 + \left(\frac{1+\psi}{9}\right) \cdot \ln \frac{t}{50}$

3 Belasting

Algemeen	Nokhoogte	6.80 m
sneeuw	gebied	III
Wind	onbebouwd	open
	stuwdruk	$p_w = 0.62 \text{ kN/m}^2$
	overdruk	$w_1 = 0.37$ „
	onderdruk	$w_2 = 0.25$ „
Dak	helling 20°	
Permanent	vezelcementplaten	
-gordingen		0.15 kN/m^2
		0.07 „
	0.22 kN/m² dakvlak	
	$g_1 =$	0.24 kN/m^2 grondvlak

sneeuw	factoren C_1	0.80	$s_1 =$	0.56 kN/m^2
	C_2	0.93	$s_2 =$	0.65 „
wind	loef C_1	-0.70	$w_3 =$	-0.44 kN/m^2
	lei C_1	-0.55	$w_4 =$	-0.34 „

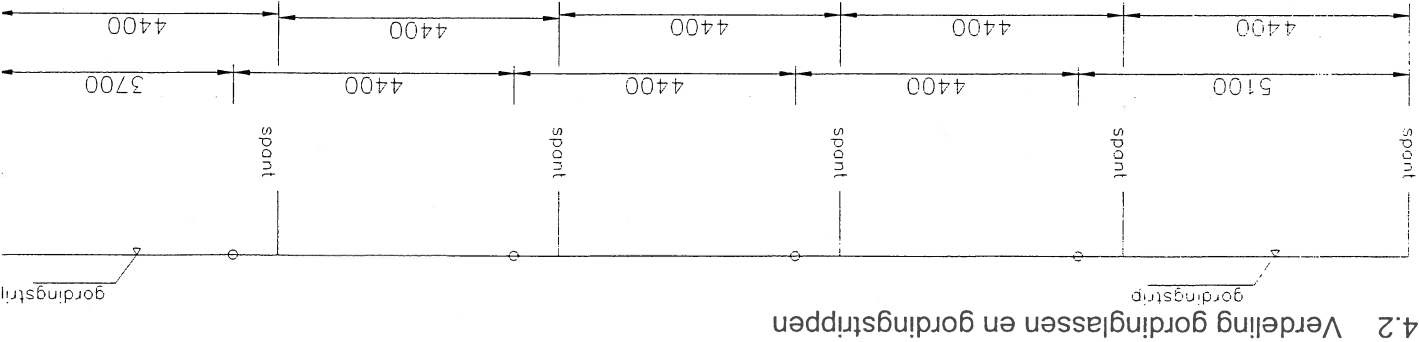
Vloeren	ligplaats	perm.	verand.	$p_1 = 5.00$ „	$g_2 = 3.75 \text{ kN/m}^2$
	roosters	perm.	verand.	$p_2 = 5.00$ „	$g_3 = 2.50 \text{ kN/m}^2$
	keldervoer	perm.	verand.	$p_3 = 20.00$ „	$g_4 = 3.60 \text{ kN/m}^2$
	Voerdeel	perm.	verand.	$p_4 = 5.00$ „	$g_4 = 5.00 \text{ kN/m}^2$
		As-last		$p_5 = 150.00 \text{ kN}$	
Gevels	-metseelwerk	$\frac{1}{2}$ steens	spouw	$g_6 = 2.00 \text{ kN/m}^2$	$g_6 = 4.00 \text{ kN/m}^2$
	wind	loef C_1	0.80	$w_1 = 0.50 \text{ kN/m}^2$	$w_2 = 0.25$ „
	Kelder	$d = 0.20$ m	$H = 2.00$ „	$g_5 = 4.80 \text{ kN/m}^2$	
veranderlijk					15.00 kN/m^2 op maaiveld
grond	schoon zand	consistent!			
	met vaste e				
	volume gewicht $\gamma_d =$	17.3 kN/m^3			
	wrijvingshoek $\phi_d =$	30°			
	cohesie $c =$	0 kN/m^2			
	bedding $k =$	5000 kN/m^3			

$$K_{\gamma a} = 0.27$$

4 Gordingen

4.1 Algemeen

De gordingen worden over de spanen gelegd en uitgevoerd als een zgn. "Gerberligger". In het eerste en laatste spantvak wordt over de gordingen een gordingstrip aangebracht.



4.3 Belasting

perm: = 0.24 kN/m² loodrecht grondvlak
sneeuw = 0.64 "
wind = 0.81 "
dakvlak "

4.4 Krachten verdeling

Belastingsfactoren perm: 1.20
veranderlijk 1.13

Loodrecht dakvlak

spt-vak	Lc	Ni	Di	Mi	Nj	Dj	Mj	x	D(M=0)	x	Mv,max
1-1	1	0	0.74	0.00	0.00	0.96	-0.50	3.81	-0.74	1.91	0.70
"	2	0	2.32	0.00	0.00	3.04	-1.58	3.81	-2.32	1.91	2.21
"	3	0	-1.70	0.00	0.00	-2.23	1.15	3.81	1.70	1.91	-1.62
2-2	1	0	0.85	0.50	0.00	-0.58	0.00	0.35	0.71	0.35	-0.23
"	2	0	2.68	1.58	0.00	-1.83	0.00	0.35	2.25	0.35	-0.71
"	3	0	-1.96	-1.15	0.00	1.34	0.00	0.35	-1.65	0.35	0.52
2-3	1	0	0.58	0.00	0.00	0.85	-0.50	3.00	-0.58	1.50	0.43
"	2	0	1.83	0.00	0.00	2.68	-1.59	3.00	-1.83	1.50	1.37
"	3	0	-1.34	0.00	0.00	-1.97	1.16	3.00	1.34	1.50	-1.00
3-4	1	0	0.85	0.50	0.00	-0.58	0.00	0.35	0.72	0.35	-0.23
"	2	0	2.70	1.59	0.00	-1.84	0.00	0.35	2.27	0.35	-0.72
"	3	0	-1.97	-1.16	0.00	1.35	0.00	0.35	-1.66	0.35	0.53
3-5	1	0	0.58	0.00	0.00	0.84	-0.48	3.03	-0.58	1.51	0.44
"	2	0	1.84	0.00	0.00	2.67	-1.52	3.03	-1.84	1.51	1.39
"	3	0	-1.35	0.00	0.00	-1.95	1.11	3.03	1.35	1.51	-1.02
4-6	1	0	0.82	0.48	0.00	-0.55	0.00	0.35	0.69	0.35	-0.22

Evenwijdig dakvlak

5-8	1	0	0.98	0.59	0.00	-0.71	0.00	0.35	0.85	0.35	0.35	0.35	-0.27
5-9	3	0	0.71	0.00	0.00	0.71	0.00	0.00	0.00	0.35	0.35	0.35	0.63
5-9	1	0	0.71	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.66
5-9	2	0	2.25	0.00	0.00	2.25	0.00	0.00	0.00	0.00	0.00	0.00	2.09
5-9	3	0	-1.65	0.00	0.00	-1.65	0.00	0.00	0.00	0.00	0.00	0.00	-1.53
1-1	1	0.00	0.14	0.00	0.00	0.17	-0.04	1.95	-0.14	0.97	0.97	0.07	0.07
1-2	2	0.00	0.43	0.00	0.00	0.54	-0.12	1.95	-0.43	0.97	0.97	0.21	0.06
1-2	1	0.00	0.09	0.04	0.00	0.22	-0.18	1.10	-0.07	0.64	0.64	-0.01	-0.01
1-2	2	0.00	0.28	0.12	0.00	0.69	-0.58	1.10	-0.21	0.64	0.64	-0.03	-0.03
1-2	3	0.00	0.08	0.03	0.00	0.20	-0.16	1.10	-0.06	0.64	0.64	-0.01	-0.01
2-3	1	0.00	0.31	0.18	0.00	-0.21	0.00	0.35	0.26	0.35	0.35	-0.08	-0.08
2-3	2	0.00	0.98	0.58	0.00	-0.67	0.00	0.35	0.82	0.35	0.35	-0.26	-0.26
2-3	3	0.00	0.28	0.16	0.00	-0.19	0.00	0.35	0.23	0.35	0.35	-0.07	-0.07
2-4	1	0.00	0.21	0.00	0.00	0.31	-0.18	3.02	-0.21	1.51	1.51	0.16	0.16
2-4	2	0.00	0.67	0.00	0.00	0.97	-0.56	3.02	-0.67	1.51	1.51	0.50	0.50
2-4	3	0.00	0.19	0.00	0.00	0.27	-0.16	3.02	-0.19	1.51	1.51	0.14	0.14
3-5	1	0.00	0.30	0.18	0.00	-0.21	0.00	0.35	0.25	0.35	0.35	-0.08	-0.08
3-5	2	0.00	0.96	0.56	0.00	-0.65	0.00	0.35	0.80	0.35	0.35	-0.25	-0.25
3-5	3	0.00	0.27	0.16	0.00	-0.18	0.00	0.35	0.23	0.35	0.35	-0.07	-0.07
3-6	1	0.00	0.21	0.00	0.00	0.32	-0.20	2.92	-0.21	1.46	1.46	0.15	0.15
3-6	2	0.00	0.65	0.00	0.00	0.99	-0.64	2.92	-0.65	1.46	1.46	0.47	0.47
3-6	3	0.00	0.18	0.00	0.00	0.28	-0.18	2.92	-0.18	1.46	1.46	0.13	0.13
4-7	1	0.00	0.34	0.20	0.00	-0.24	0.00	0.35	0.29	0.35	0.35	-0.09	-0.09
4-7	2	0.00	1.07	0.64	0.00	-0.76	0.00	0.35	0.92	0.35	0.35	-0.29	-0.29
4-7	3	0.00	0.30	0.18	0.00	-0.21	0.00	0.35	0.26	0.35	0.35	-0.08	-0.08
4-8	1	0.00	0.24	0.00	0.00	0.28	-0.07	1.85	-0.02	1.72	1.72	0.21	0.21
4-8	2	0.00	0.76	0.00	0.00	0.88	-0.22	1.85	-0.06	1.72	1.72	0.65	0.65
4-8	3	0.00	0.21	0.00	0.00	0.25	-0.06	1.85	-0.02	1.72	1.72	0.18	0.18
5-9	1	0.00	0.15	0.07	0.00	-0.05	0.00	0.35	0.10	0.35	0.35	-0.03	-0.03
5-9	2	0.00	0.47	0.22	0.00	-0.16	0.00	0.35	0.31	0.35	0.35	-0.08	-0.08
5-9	3	0.00	0.13	0.06	0.00	-0.04	0.00	0.35	0.09	0.35	0.35	-0.02	-0.02
5-10	1	0.00	0.05	0.00	0.00	-0.05	0.08	0.75	0.05	0.75	0.75	0.04	0.04
5-10	2	0.00	0.16	0.00	0.00	-0.16	0.24	0.75	0.16	0.75	0.75	0.12	0.12
5-10	3	0.00	0.04	0.00	0.00	-0.04	0.07	0.75	0.04	0.75	0.75	0.03	0.03
5-11	1	0.00	-0.03	-0.08	0.00	0.03	0.00	1.10	-0.03	1.10	1.10	0.04	0.04
5-11	2	0.00	-0.11	-0.24	0.00	0.11	0.00	1.10	-0.11	1.10	1.10	0.12	0.12
5-11	3	0.00	-0.03	-0.07	0.00	0.03	0.00	1.10	-0.03	1.10	1.10	0.03	0.03

Controle op spanningen
Bepalend is spant vak 1

$M_{lr} = 2.21 \text{ kNm}$
 $M_{//} = 0.12$

Spanningrelatief $2.21/4.4 + 0.12/1.8 = 0.60 < 1$ akkoord

4.5 Vervorming

Belastingsfactoren perm: 1.50
veranderlijk 0.87

Loodrecht dakvlak

spt-vak	Lc	ui	wi	hi	uj	wj	hj	x	wv	x	h(w=0)
1-1	1	0	0.0000	-0.0038	0	0.0000	0.0024	2.07	-0.0048	2.20	0.0003
"	2	0	0.0000	-0.0119	0	0.0000	0.0076	2.07	-0.0152	2.20	0.0011
"	3	0	0.0000	0.0087	0	0.0000	-0.0055	2.07	0.0112	2.20	-0.0008
2-2	1	0	0.0000	0.0024	0	0.0014	0.0018	0.35	0.0007	0.35	0.0019
"	2	0	0.0000	0.0076	0	0.0044	0.0056	0.35	0.0024	0.35	0.0061
"	3	0	0.0000	-0.0055	0	-0.0032	-0.0041	0.35	-0.0017	0.35	-0.0044
2-3	1	0	0.0014	-0.0023	0	0.0000	0.0004	1.90	-0.0012	0.65	-0.0019
"	2	0	0.0044	-0.0072	0	0.0000	0.0011	1.90	-0.0039	0.65	-0.0059
"	3	0	-0.0032	0.0052	0	0.0000	-0.0008	1.90	0.0028	0.65	0.0043
3-4	1	0	0.0000	0.0004	0	0.0000	-0.0003	0.23	0.0000	0.51	-0.0002
"	2	0	0.0000	0.0011	0	-0.0001	-0.0008	0.23	0.0001	0.52	-0.0007
"	3	0	0.0000	-0.0008	0	0.0001	0.0006	0.23	-0.0001	0.52	0.0005
3-5	1	0	0.0000	-0.0019	0	0.0000	0.0008	1.67	-0.0020	1.85	0.0003
"	2	0	-0.0001	-0.0061	0	0.0000	0.0027	1.67	-0.0064	1.85	0.0009
"	3	0	0.0001	0.0045	0	0.0000	-0.0019	1.67	0.0047	1.85	-0.0007
4-6	1	0	0.0000	0.0008	0	0.0003	0.0002	0.35	0.0002	0.35	0.0004
"	2	0	0.0000	0.0027	0	0.0010	0.0008	0.35	0.0006	0.35	0.0012
"	3	0	0.0000	-0.0019	0	-0.0007	-0.0006	0.35	-0.0005	0.35	-0.0009
4-7	1	0	0.0003	-0.0018	0	0.0000	0.0002	1.66	-0.0015	1.85	0.0003
"	2	0	0.0010	-0.0056	0	0.0000	0.0007	1.66	-0.0047	1.85	0.0008
"	3	0	-0.0007	0.0041	0	0.0000	-0.0005	1.66	0.0035	1.85	-0.0006
5-8	1	0	0.0000	0.0002	0	-0.0002	-0.0005	0.11	0.0000	0.22	-0.0002
"	2	0	0.0000	0.0007	0	-0.0006	-0.0016	0.11	0.0000	0.23	-0.0006
"	3	0	0.0000	-0.0005	0	0.0004	0.0012	0.11	0.0000	0.23	0.0004
5-9	1	0	-0.0002	-0.0030	0	0.0000	0.0031	1.83	-0.0036	1.85	0.0001
"	2	0	-0.0006	-0.0095	0	0.0000	0.0098	1.83	-0.0115	1.85	0.0002
"	3	0	0.0004	0.0070	0	0.0000	-0.0072	1.83	0.0084	1.85	-0.0001

Evenwijdig dakvlak

spt-vak	Lc	ui	wi	hi	uj	wj	hj	x	wv	x	h(w=0)
1-1	1	0	0.0000	-0.0008	0	0.0000	0.0005	1.045	-0.0005	1.100	0.0001
"	2	0	0.0000	-0.0030	0	0.0000	0.0021	1.045	-0.0019	1.100	0.0002
"	3	0	0.0000	-0.0012	0	0.0000	0.0008	1.045	-0.0008	1.100	0.0001
1-2	1	0	0.0000	0.0005	0	0.0000	-0.0014	1.432	0.0004	1.100	0.0002
"	2	0	0.0000	0.0021	0	0.0000	-0.0054	1.433	0.0017	1.100	0.0008
"	3	0	0.0000	0.0008	0	0.0000	-0.0021	1.432	0.0006	1.100	0.0003
2-3	1	0	0.0000	-0.0014	0	-0.0014	-0.0024	0.350	-0.0006	0.350	-0.0021
"	2	0	0.0000	-0.0054	0	-0.0055	-0.0091	0.350	-0.0024	0.350	-0.0082
"	3	0	0.0000	-0.0021	0	-0.0021	-0.0035	0.350	-0.0009	0.350	-0.0032
2-4	1	0	-0.0014	-0.0026	0	0.0000	0.0016	1.522	-0.0039	1.850	0.0008
"	2	0	-0.0055	-0.0101	0	0.0000	0.0063	1.522	-0.0152	1.850	0.0032
"	3	0	-0.0021	-0.0039	0	0.0000	0.0024	1.522	-0.0059	1.850	0.0012
3-5	1	0	0.0000	0.0016	0	0.0007	0.0007	0.350	0.0004	0.350	0.0009
"	2	0	0.0000	0.0063	0	0.0027	0.0027	0.350	0.0017	0.350	0.0035
"	3	0	0.0000	0.0024	0	0.0010	0.0010	0.350	0.0006	0.350	0.0014
3-6	1	0	0.0007	-0.0030	0	0.0000	0.0006	1.711	-0.0024	1.850	0.0003
"	2	0	0.0027	-0.0114	0	0.0000	0.0021	1.712	-0.0093	1.850	0.0012
"	3	0	0.0010	-0.0044	0	0.0000	0.0008	1.712	-0.0036	1.850	0.0005
4-7	1	0	0.0000	0.0006	0	-0.0001	-0.0005	0.202	0.0001	0.437	-0.0004
"	2	0	0.0000	0.0021	0	-0.0005	-0.0020	0.202	0.0002	0.440	-0.0015
"	3	0	0.0000	0.0008	0	-0.0002	-0.0008	0.202	0.0001	0.440	-0.0006
4-8	1	0	-0.0001	-0.0041	0	0.0000	0.0034	1.788	-0.0046	1.850	0.0002
"	2	0	-0.0005	-0.0157	0	0.0000	0.0133	1.788	-0.0179	1.850	0.0008
"	3	0	-0.0002	-0.0061	0	0.0000	0.0052	1.788	-0.0070	1.850	0.0003
5-9	1	0	0.0000	0.0034	0	0.0022	0.0031	0.350	0.0012	0.350	0.0032
"	2	0	0.0000	0.0133	0	0.0087	0.0120	0.350	0.0044	0.350	0.0122
"	3	0	0.0000	0.0052	0	0.0034	0.0047	0.350	0.0017	0.350	0.0048
5-10	1	0	0.0022	-0.0018	0	0.0000	-0.0009	0.750	0.0010	0.750	-0.0016
"	2	0	0.0087	-0.0069	0	0.0000	-0.0034	0.750	0.0037	0.750	-0.0061
"	3	0	0.0034	-0.0027	0	0.0000	-0.0013	0.750	0.0014	0.750	-0.0024
5-11	1	0	0.0000	-0.0009	0	0.0000	0.0004	0.931	-0.0004	1.100	0.0001
"	2	0	0.0000	-0.0034	0	0.0000	0.0017	0.930	-0.0015	1.100	0.0004
"	3	0	0.0000	-0.0013	0	0.0000	0.0007	0.931	-0.0006	1.100	0.0002

Controle op vervorming

Bepalend is Spantvak 1

wlr = 15.2 mm
wll = 1.9 "

toelaatbaar w = 4*4.4 = 17.6 mm w = 15.3 mm uitnutting = 15.3/17.6 = 0.87 < 1 akkoord

Gordingen uitleveeren als gerberligger in de afmeting

71x171 mm² (C18) hoh 1.35 m gemeten in het dakvlak voldoet

5 Spanten

5.1 Belastingen

H.o.h. Spanten 4.40 m

$$\text{perm dak} \quad 0.22 \times 4.40 = 0.98 \text{ kN/m}$$

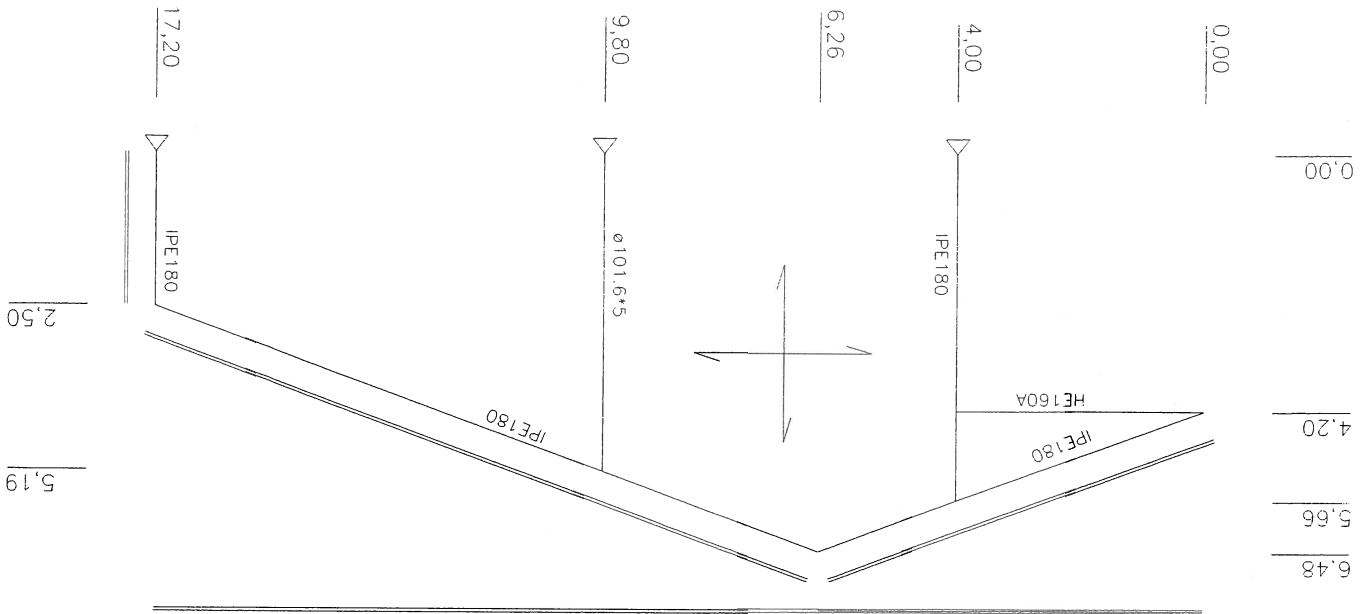
$$\text{sneeuw} \quad s_1 = 0.56 \times 4.40 = 2.46 \text{ kN/m}$$

$$s_2 = 0.65 \times 4.40 = 2.87 \text{ „}$$

$$\begin{aligned} \text{wind met overdruk} \quad \text{dak} \quad \text{loef} \quad & (-0.37 - 0.44) \times 4.40 = -3.56 \text{ kN/m} \\ \text{wind met overdruk} \quad \text{dak} \quad \text{lei} \quad & (-0.37 - 0.34) \times 4.40 = -3.12 \text{ „} \\ \text{wind met overdruk} \quad \text{wand} \quad \text{loef} \quad & (-0.37 + 0.50) \times 4.40 = 0.57 \text{ „} \\ \text{wind met overdruk} \quad \text{wand} \quad \text{lei} \quad & (-0.37 - 0.25) \times 4.40 = -2.73 \text{ „} \end{aligned}$$

$$\begin{aligned} \text{wind met onderdruk} \quad \text{dak} \quad \text{loef} \quad & (0.25 - 0.44) \times 4.40 = -0.84 \text{ kN/m} \\ \text{wind met onderdruk} \quad \text{dak} \quad \text{lei} \quad & (0.25 - 0.34) \times 4.40 = -0.40 \text{ „} \\ \text{wind met onderdruk} \quad \text{wand} \quad \text{loef} \quad & (0.25 + 0.50) \times 4.40 = 3.30 \text{ „} \\ \text{wind met onderdruk} \quad \text{wand} \quad \text{lei} \quad & (0.25 - 0.25) \times 4.40 = 0.00 \text{ „} \end{aligned}$$

5.2 Geometrie



5.3 Berekening

De berekening is op numerieke wijze uitgevoerd en hieronder weergegeven

Vervormingen en krachtenverdeling

==== knoop coördinaten ===== verplaatsingen == hoek assen ==
nr. X-coord. Y-coord.[m] Xrt. Yrt. Zrt. [gr]

1	0.000	4.200			
2	4.000	5.660			
3	6.260	6.480			
4	9.800	5.190			
5	17.200	2.500			
6	17.200	0.000			
7	4.000	0.000			
8	4.200	0.000			
9	9.800	0.000			

==== materiaal eigenschappen =====

nr.	code	drsn.	trghm.	elast. [mm;N]
1	IPB180	2390.E+0	1317.E+4	210000
2	B101.6*5	1517.E+0	1775.E+3	210000
3	HEA160	3140.E+0	1033.E+4	210000

==== staven =====

nr.	knpl	knpl	mat.nr.	N(i)	D(i)	M(i)	N(j)	D(j)	M(j)	Bedding	stlengte
1	1	2	1	1	1	1	1	1	1	0	4.258
2	2	3	1	1	1	1	1	1	1	0	2.404
3	3	4	1	1	1	1	1	1	1	0	3.768
4	4	5	1	1	1	1	1	1	1	0	7.874
5	5	6	1	1	1	1	1	1	1	0	2.500
6	7	8	1	1	1	1	1	1	1	0	4.200
7	8	2	1	1	1	1	1	1	1	0	1.460
8	9	4	1	1	1	1	1	1	1	0	5.190
9	1	8	1	1	1	1	1	1	1	0	4.000

==== belastingen =====

nr.	Belastingen	mom.fac.	krulpfac.	red.fac	bel.fac.
1	permanent	1.00	0.00	1.00	1.20
2	sneeuw links	0.00	1.00	.87	1.13
3	sneeuw rechts	0.00	1.00	.87	1.13
4	wind links	0.00	1.00	.87	1.13
5	wind rechts	0.00	0.00	.87	1.13

==== staabelastingen =====
nr. stf code Q(ki) Q(kj) dx(ki) dx(kj)

1	permanent	8	-0.98	-0.98	0.00	0.00
2	1	8	-0.98	-0.98	0.00	0.00
3	2	8	-0.98	-0.98	0.00	0.00
4	3	8	-0.98	-0.98	0.00	0.00
1	sneeuw links	8	-2.46	-2.46	0.00	0.00
2	1	8	-2.46	-2.46	0.00	0.00
3	2	8	-2.46	-2.46	0.00	0.00
4	3	8	-2.87	-2.87	0.00	0.00
1	sneeuw rechts	8	-2.87	-2.87	0.00	0.00
2	1	8	-2.87	-2.87	0.00	0.00
3	2	8	-2.87	-2.87	0.00	0.00
4	3	8	-2.46	-2.46	0.00	0.00
1	wind links	4	3.56	3.56	0.00	0.00
2	1	4	3.56	3.56	0.00	0.00
3	2	4	3.12	3.12	0.00	0.00
4	3	4	3.12	3.12	0.00	0.00
1	wind rechts	4	0.40	0.40	0.00	0.00
2	1	4	0.40	0.40	0.00	0.00
3	2	4	0.84	0.84	0.00	0.00
4	3	4	0.84	0.84	0.00	0.00
5	4	4	-3.30	-3.30	0.00	0.00

===== belastingcombinatie =====
 spanningen

nr	1	2	3	4	5	1	2	3	4	5
1	1.35	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
2	1.20	1.13	0.00	0.00	0.00	1.00	0.87	0.00	0.00	0.00
3	1.20	0.00	1.13	0.00	0.00	1.00	0.00	0.87	0.00	0.00
4	1.20	0.00	0.00	1.13	0.00	1.00	0.00	0.00	0.87	0.00
5	1.20	0.00	0.00	0.00	1.13	1.00	0.00	0.00	0.00	0.87

=== oplegreactie per belasting [kN,m] ===

belast knp Fx Fy Mom.z

permanent 6 0.71 3.57 0.00

Som opl.kr. 23.51 23.51 0.00

sneeuw links 8.05 0.98 0.00

Som opl.kr. 46.80 46.80 0.00

Som belast. 0.00 0.00 0.00

sneeuw rechts 1.32 6.54 0.00

Som opl.kr. 20.05 20.05 0.00

Som belast. 0.00 0.00 0.00

wind links 6 -12.63 -5.22 0.00

Som opl.kr. 1.50 -24.54 -26.67 0.00

Som belast. -11.13 -56.42 -56.42 0.00

wind rechts 6 5.46 -2.45 0.00

Som opl.kr. 5.82 -11.69 -11.69 0.00

Som belast. 5.82 -11.69 -11.69 0.00

lastcom knp Fx Fy Mom.z

1 0.96 4.82 0.00

Som opl.kr. 31.73 31.73 0.00

Som belast. 0.00 0.00 0.00

2 6 1.96 13.38 0.00

Som opl.kr. 31.73 31.73 0.00

Som belast. 0.00 0.00 0.00

3 6 2.35 11.67 0.00

Som opl.kr. 78.92 78.92 0.00

Som belast. 0.00 0.00 0.00

4 6 -13.41 -1.61 0.00

Som opl.kr. 0.00 0.00 0.00

Som opl.kr. -12.57 -35.54 0.00

Som belast. -12.57 -35.54 0.00

Som opt.kr. 6.58 14.99 0.00
Som belast. 6.58 14.99 0.00

==== staafvervormingen gebruikssituatie (lokaal in m/rad) =====
stf L.C. Uxi Uyi Rotzi Uxv Uyv Uxj Uyj Rotzj

2 1 -0.015 0.005 0.004 0.015 0.009 0.000
2 -0.042 0.015 0.009 -0.042 0.024 0.001
3 -0.041 0.014 0.010 -0.041 0.024 0.000
4 0.062 -0.022 -0.011 -0.062 0.038 -0.002
5 -0.016 -0.010 0.006 -0.016 0.009 0.000

3 1 -0.017 -0.009 0.001 0.017 -0.003 -0.003
2 -0.048 -0.009 0.001 0.048 -0.009 -0.009
3 -0.046 -0.008 0.000 0.046 -0.008 -0.008
4 0.071 0.011 -0.002 -0.071 0.010 0.010
5 -0.018 -0.003 0.000 0.018 -0.003 -0.002

4 1 -0.017 -0.006 -0.003 0.017 -0.016 -0.017
2 -0.048 -0.018 -0.009 0.048 -0.047 -0.017
3 -0.046 -0.017 -0.008 0.046 -0.044 -0.017
4 0.071 0.026 0.010 -0.071 0.054 0.026
5 -0.018 -0.007 -0.002 0.018 -0.012 -0.018

5 1 0.000 -0.018 0.007 0.000 0.000 0.007
2 0.000 -0.051 0.019 0.000 0.000 0.021
3 0.000 -0.049 0.018 0.000 0.000 0.020
4 0.000 0.076 -0.024 0.000 0.000 -0.034
5 0.000 -0.019 0.006 0.000 -0.019 0.009

6 1 0.000 0.000 0.002 0.000 0.010 0.004
2 0.000 0.000 0.005 0.000 0.029 0.010
3 0.000 0.000 0.005 0.000 0.027 0.010
4 0.000 0.000 -0.011 0.000 -0.047 -0.013
5 0.000 0.000 0.002 0.000 0.012 0.004

7 1 0.000 0.010 0.004 0.000 0.016 0.004
2 0.000 0.029 0.010 0.000 0.045 0.009
3 0.000 0.027 0.010 0.000 0.043 0.010
4 0.000 -0.047 -0.013 0.000 -0.065 -0.011
5 0.000 0.012 0.004 0.000 0.017 0.003

8 1 0.000 0.000 0.003 0.000 0.018 0.003
2 0.000 0.000 0.010 0.000 0.051 0.010
3 0.000 0.000 0.010 0.000 0.049 0.010
4 0.000 0.000 -0.015 0.000 -0.076 -0.015
5 0.000 0.000 0.004 0.000 0.019 0.004

9 1 -0.010 -0.016 0.004 0.010 -0.016 -0.010
2 -0.029 -0.043 0.010 0.029 -0.043 -0.029
3 -0.027 -0.044 0.011 0.027 -0.044 0.011
4 0.047 0.050 -0.013 -0.047 0.000 -0.012
5 -0.012 -0.015 0.003 0.012 -0.015 -0.004

==== staafkrachten bezwijkssituatie (lokaal in kN/m) =====
stf L.C. Nj Dj Mj

1 1 -7.26 1.93 0.00 7.97 1.33 9.45 4.06 -4.54
2 -15.76 5.11 0.00 17.63 3.53 21.52 10.66 -11.81
3 -17.57 5.77 0.00 19.68 4.05 23.96 11.74 -12.71
4 -8.67 -3.80 0.00 -8.04 5.05 6.62 -2.61 -8.00
5 -4.48 1.00 0.00 5.05 0.62 6.43 2.41 -3.01

2 1 0.83 5.11 10.04 -0.22 -4.92 0.40 -1.72 -1.83
2 2.67 13.09 24.91 -1.05 -11.85 0.57 -4.17 -4.16
3 2.64 14.16 26.42 -0.85 -12.38 0.95 -4.25 -4.29

4	5	-7.15	-4.97	-17.96	7.15	0.55	-3.86	1.10	-1.30	-1.69	14.02
3	1	-1.41	1.07	1.83	1.02	-1.42	-0.53	4.24	-7.81		
2	2	-3.12	2.83	4.16	2.08	-3.18	-2.53	12.67	-22.70		
3	3	-3.46	2.65	4.29	2.50	-3.34	-1.63	11.32	-20.61		
4	4	-7.41	-4.00	-14.02	6.60	10.50	5.69	-4.56	15.08		
5	5	-1.67	0.29	1.72	1.24	-1.58	-0.05	0.85	-2.78		
4	1	-3.51	6.85	7.81	1.02	8.81	-0.53	4.25	2.40		
2	2	-9.25	19.71	22.70	2.08	24.50	-2.54	12.71	4.90		
3	3	-9.02	17.96	20.61	2.50	22.89	-1.59	11.24	5.86		
4	4	1.03	-13.90	-15.08	-3.81	-27.41	-4.61	-4.00	-23.89		
5	5	-1.10	2.30	2.78	-2.34	5.90	-2.49	0.10	5.89		
5	1	4.18	-0.96	-2.40	-4.50	1.20	-4.82	0.96	0.00		
2	2	12.81	-1.96	-4.90	-13.09	2.45	-13.38	1.96	0.00		
3	3	11.10	-2.35	-5.86	-11.39	2.93	-11.67	2.35	0.00		
4	4	-2.18	5.70	23.89	1.90	-14.36	1.61	-13.41	0.00		
5	5	0.94	2.31	-5.89	-1.08	6.60	-1.51	7.02	0.00		
6	1	14.28	0.96	0.00	-13.74	2.01	-13.20	-0.96	4.03		
2	2	32.50	1.96	0.00	-32.02	4.11	-31.54	-1.96	8.22		
3	3	35.35	2.35	0.00	-34.87	4.93	-34.39	-2.35	9.85		
4	4	-15.03	-0.84	0.00	15.51	-1.77	15.99	0.84	-3.54		
5	5	9.39	0.44	0.00	-8.91	0.93	-8.43	-0.44	1.86		
7	1	12.52	-6.53	-4.03	-12.34	-0.74	-12.15	6.53	-5.50		
2	2	30.94	-14.60	-8.22	-30.78	-2.44	-30.61	14.60	-13.10		
3	3	33.79	-16.14	-9.85	-33.62	-1.93	-33.46	16.14	-13.71		
4	4	-16.59	8.61	3.54	16.76	2.75	16.92	-8.61	9.03		
5	5	7.83	-4.11	-1.86	-7.66	-1.14	-7.50	4.11	-4.14		
8	1	12.64	0.00	0.00	-12.22	0.00	-11.80	0.00	0.00		
2	2	35.21	0.00	0.00	-34.84	0.00	-34.46	0.00	0.00		
3	3	31.90	0.00	0.00	-31.53	0.00	-31.15	0.00	0.00		
4	4	-18.90	0.00	0.00	19.27	0.00	19.65	0.00	0.00		
5	5	4.10	0.00	0.00	-3.72	0.00	-3.35	0.00	0.00		
9	1	7.49	0.68	0.00	-7.49	0.68	-7.49	0.67	0.00		
2	2	16.56	0.60	0.00	-16.56	0.60	-16.56	0.60	0.00		
3	3	18.48	0.60	0.00	-18.48	0.60	-18.48	0.60	0.00		
4	4	-9.45	0.60	0.00	9.45	0.60	9.45	0.60	0.00		
5	5	4.55	0.60	0.00	-4.55	0.60	-4.55	0.60	0.00		

5.4 Controle op spanningen en vervormingen

1-orde controle op staalspanning volgens NEN 6770 & 6771

1-orde	stb	doorsn	L.C.	N	Nr	D	Dr	M	Mr	comb
1	IPe180	3	24.0	0.028	11.7	0.066	-12.7	0.324	0.324	0.324
2	IPe180	3	-2.6	0.005	14.2	0.080	26.4	0.674	0.674	0.674
3	IPe180	2	-2.5	0.005	12.7	0.071	-22.7	0.579	0.579	0.579
4	IPe180	4	-3.8	0.007	0.0	0.000	-27.4	0.699	0.699	0.699
5	IPe180	4	2.2	0.003	5.7	0.032	23.9	0.609	0.609	0.609
6	IPe180	3	-34.4	0.061	-2.4	0.013	9.9	0.251	0.251	0.251
7	IPe180	3	-33.5	0.060	16.1	0.091	-13.7	0.350	0.350	0.350
8	B101.6*5	2	-35.2	0.099	0.0	0.000	0.0	0.000	0.020	0.020
9	HEA140	3	-18.5	0.025	0.6	0.004	0.0	0.000	0.000	0.000

2-orde kip	stb	doorsn	L.C.	Lz	Mke	Lr	M	Wkip	SP.kip
1	IPe180	3	3.350	38.9	4.1	1.004	0.663	0.663	0.156
2	IPe180	4	3.350	88.5	13.5	0.666	0.863	0.863	0.399
3	IPe180	4	2.900	96.3	10.5	0.638	0.875	0.875	0.306
4	IPe180	4	2.900	62.8	27.4	0.790	0.801	0.801	0.872
5	IPe180	4	2.500	83.6	14.4	0.685	0.855	0.855	0.428
6	IPe180	3	4.200	55.9	4.9	0.838	0.773	0.773	0.163
7	IPe180	4	1.460	171.3	2.8	0.479	0.931	0.931	0.075
8	B101.6*5	2							
9	HEA140	1	4.000	60.3	0.7	0.825	0.781	0.781	0.021

2-orde knik									
stl	doorsn	L.C.	Lrz	wzbuc	Ksp.z	Lry	wybuc	Ksp.y	
1	IPe180	4	1.74	0.27	0.057	6.45	0.02	0.663	
2	IPe180	2	1.74	0.27	0.018	0.50	0.92	0.005	
3	IPe180	4	trek	0.34	0.006	0.91	0.73	0.003	
4	IPe180	5	1.50	0.43	0.053	1.33	0.01	0.980	
5	IPe180	2	1.29	0.18	0.321	2.38	0.16	0.358	
6	IPe180	2	2.18	0.75	0.080	2.42	0.16	0.386	
7	IPe180	3	0.76	0.33	0.302	1.62	0.33	0.302	
8	B101.6*5	2	1.62	0.43	0.058	1.32	0.00	0.649	
9	HEA160	3	1.21						
combinatie									
stl	doorsn	L.C.	Ex	Megu.	ny	Sp.com			
1	IPe180	4	0.092	7.6	1.7	0.681			
2	IPe180	3	0.004	22.5	2766.5	0.681			
3	IPe180	4							
4	IPe180	4	0.011	27.4	157.7	0.885			
5	IPe180	5	0.029	6.6	107.4	0.226			
6	IPe180	3	0.024	8.4	4.6	0.442			
7	IPe180	3	0.033	11.7	2.8	0.605			
8	B101.6*5	2	0.007	0.0	3.9	0.138			
9	HEA160	5	0.233	0.6	1.0	1.356			

6 Windverband

6.1 Afmeting en belasting stal

afmeting grondvlak $L \cdot B = 22 \cdot 18 \text{ m}^2$
nokhoogte 6.50m
goot „ 3.35m
dakhelling 20.0°
Belasting wind kopgevel $q = 0.62 \text{ kN/m}^2$

druk+zuiging $C = 1.2$
wrijving $C = 0.01$
1% e.g. dak = 0.35 „
belastingfactor $\gamma_p = 1.13$
 $F_1 = 32.98 \text{ kN}$
 $F_2 = 3.53 \text{ „}$
 $F_4 = 1.47 \text{ „}$
 $\Sigma F_{\delta \text{ hor}} = 37.98 \text{ kN}$
 $\Sigma F_{\theta \text{ hor}} = 2.38 \text{ kN/m}$

6.2 Windverband langsgevels

Windverband
windverband 1 -zijdig
aantal 2 stuks per zijde
hoogte 2.50m
breedte 4.40 „
Last per windverband 21.46kN
draad $\varnothing 20 \text{ mm}$
bouts 1 M12 (8.8) $A_{\text{netto}} = 314.2 \text{ mm}^2$
 $F_{\text{toel}} = 75 \text{ kN}$
 $EA = 0.066 \text{ kNm}^2$
afmeting $L_{\text{diag.}} = 5.06 \text{ m}$
 $F_{\text{diag.}} = 24.68 \text{ kN}$
spanning
Uitnutting = 0.33 < 1 akkoord

6.3 In dakvlak

Windverband
windverband gevel
h.o.h.spanten
h.o.h.koppelingen

1 -zijdig
4.40 m
3.73 "

diagonaal

ø20

eigen gew: = 0.00kN/m
buiten 2 M12 (8.8) A_{netto} = 314.2mm²
F_{toel} = 75.4kN
M_{toel} = 0.2kNm

afmeting L_{diag} = 5.77m

F_{diag} = 33kN

σ_{trek,rel} = 0.44

t.p.v. buiten

σ_{trek,rel} = 0.44

t.p.v. moment

M_{diag} = 0.00kNm

σ_{mom,rel} = 0.00

Uitnutting = 0.44 < 1 akkoord

controle

boutverbinding

F_{toel} = 30.00 kN

F_{bout} = 16.59 "

Uitnutting = 0.28 < 1 akkoord

koppelingen

K70*70*3.6

eigen gew: = 0.75kN/m

L_{kopp.} = 4.40 m

belasting wind

21.46 kN

Aantal dakliggers tot vastpunt

3

stuk

22.67 kN

uitnutting 1°-orde

σ_{rel} = 0.12

ω_{buc,y} = 0.19

σ_{n,knik} = 0.62 < 1 akkoord

7 Kelder

7.1 Kelderwanden

Onderdeel	Verdeelde last					Lijnlast rep.		
	perm.	veran.	L	aand.	perm.	veran.		
ligplaats	3.75	5.00	2.70	0.50	5.06	6.75		
-metseiwerk	2.00	0.00	1.50	1.00	3.00	0.00		
-dak	0.25	0.93	17.20	0.25	1.76	6.56		
-vloer meikstal	3.75	5.00	3.00	0.00	0.00	0.00	9.83	13.31
Lijnlast	$f_u = 27.00 \text{ kN/m}$							

Gronddruk	grond	schoon	zand	met vaste	consistente	volume gewicht $\gamma_d = 17.3 \text{ kN/m}^3$	wrijvingshoek $\phi^d = 30^\circ$	$K_a = 0.40$	cohesie $c = 0 \text{ kN/m}^2$	bedding $k = 5000 \text{ kN/m}^3$
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Op numerieke wijze is bepaald

t.p.v. keldervloer $M = 11.05 \text{ kNm/m}$.

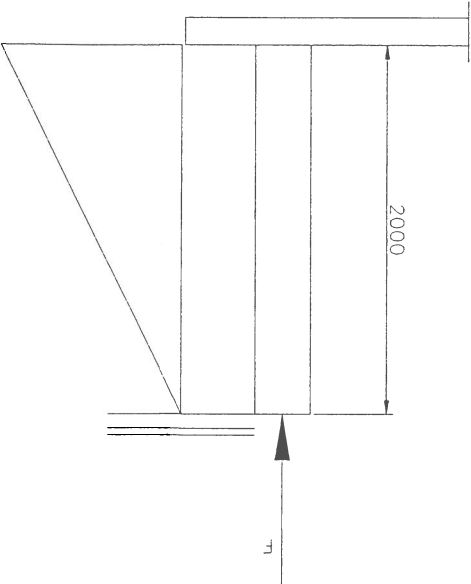
In wand op 1.17 m + keldervloer

$M = 13 \text{ kNm/m}$

De normaallast bedraagt 27 kN/m

Wanddikte 300 mm

Volgens de TGB 1990 10.2 c
is $A_s = 450 \text{ mm}^2/\text{m}$



Materialen	
Beton	sterktekl.
B25	millieukl.
	(b/o 5)

Constructie	plaat	$c_b = 25 \text{ mm}$	$c_o = 25 \text{ „}$
Plaat		$h = 170 \text{ mm}$	overstek = 200 mm
			net

Belasting	Plaat
Fv = 40kN/m	D ^{pl} = 15.0kN/m
M = 12kNm/m	M ^d = 8.5kNm/m
	u ^{gr.d} = 12.6kN/m ²
	u ^{itn.} = 0.13 <
	u ^{itn.} = 0.49
	u ^{itn.} = 0.18

grondwater	1.30 m-peil				
kelder	dik	0.20m			
	wanden	0.30,,			
vloer	,,	2.00,,			
	hoog	0.17,,			
	dik	3.00,,			
	lengte	0.20,,			
belastingen					
	opwaartse druk				
beton	wanden				
	vloer				

grond

oor 7.20 „

grondkegel 9.65 „

38.18kN/m

evenwicht $\gamma_{pv} = 0.9/1.2$

18.7 kN/m > 0 akkoord

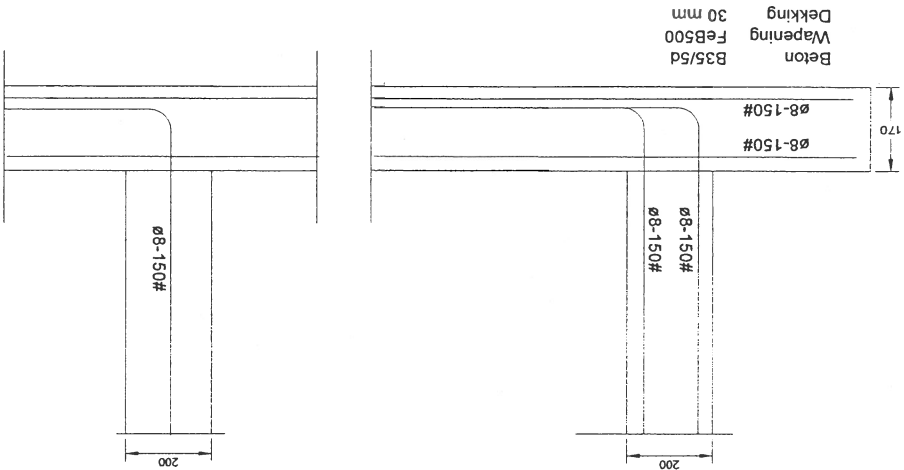
moment

M = 6.78kNm/m = $8.7 \times 1.2 \times 3^2/8$

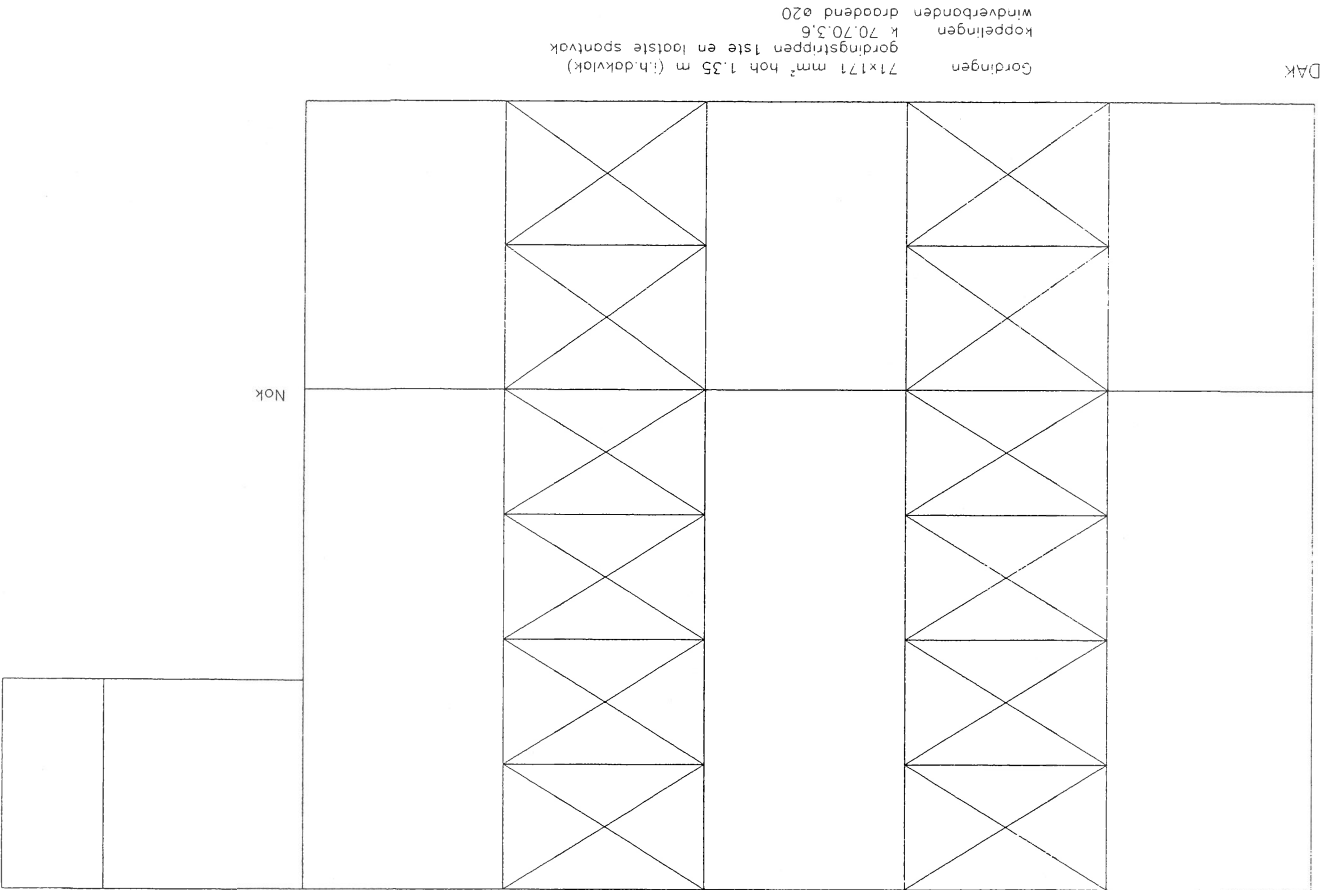
Q = 13.05kN/m = $8.7 \times 1.2 \times 3/2$

$A_s = 250\text{mm}^2/\text{m}$

A Resultaat



MESTKELDER/WANDEN



DAK