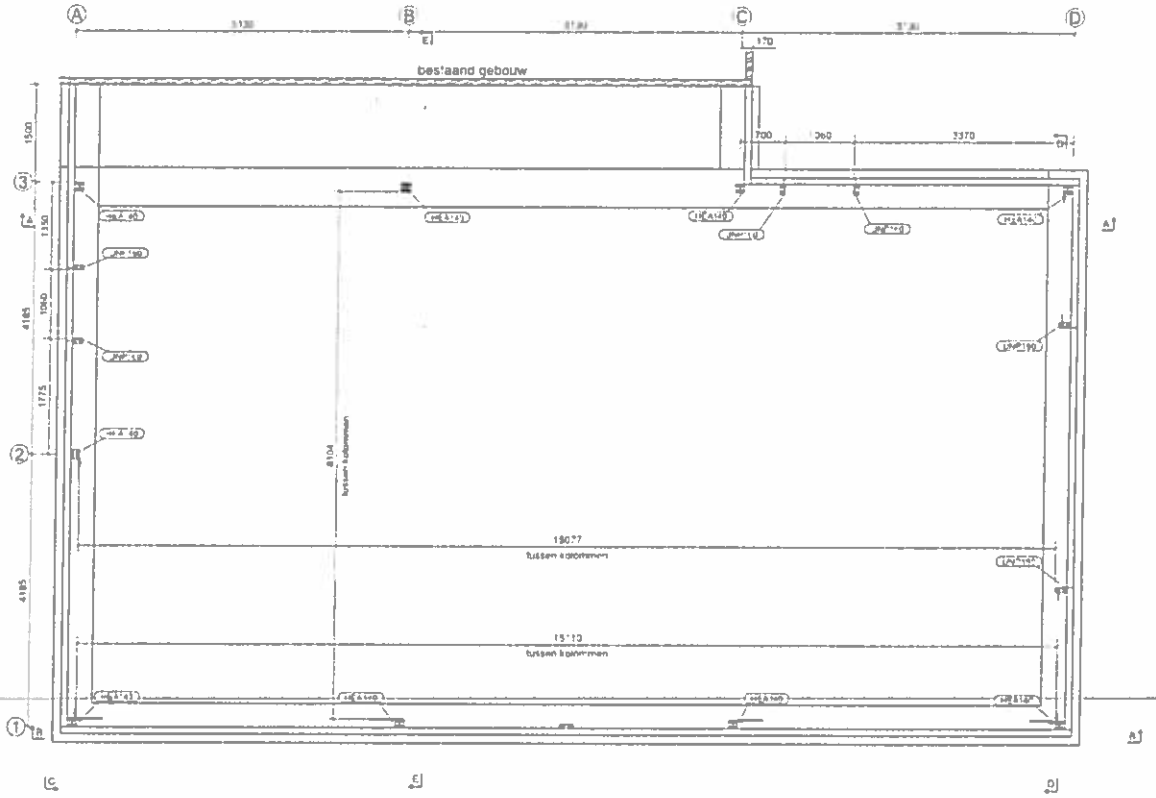
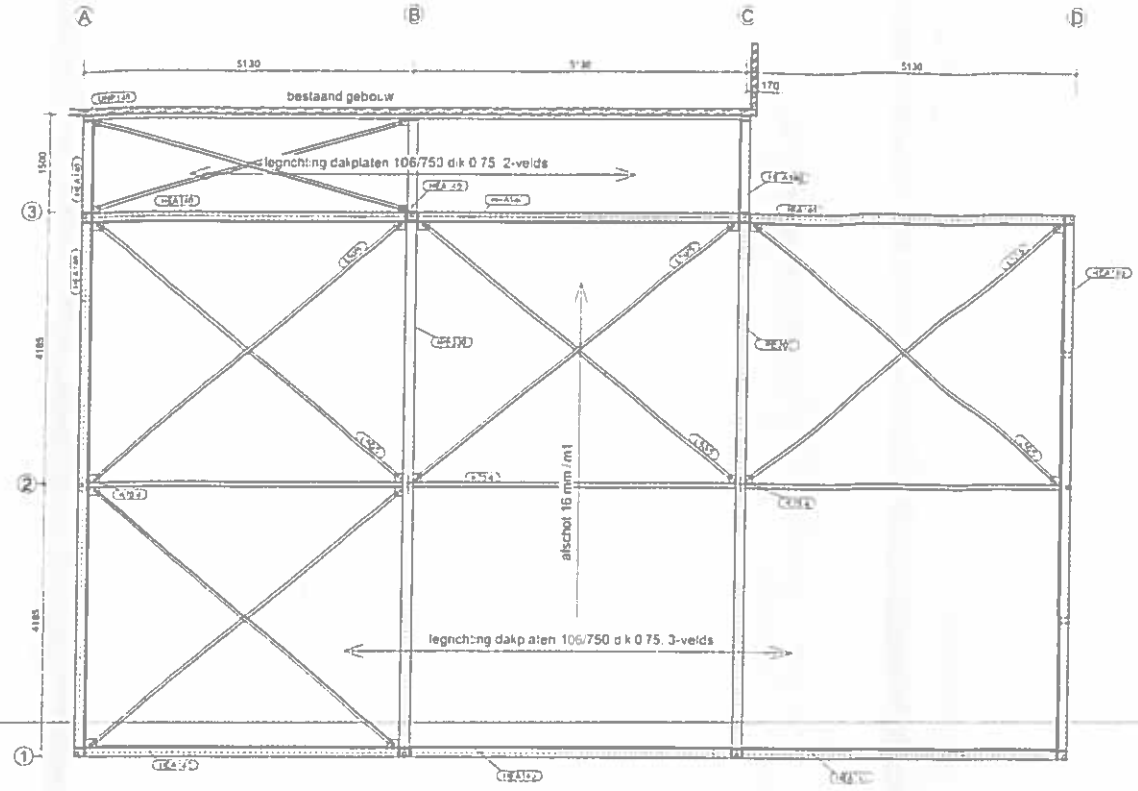
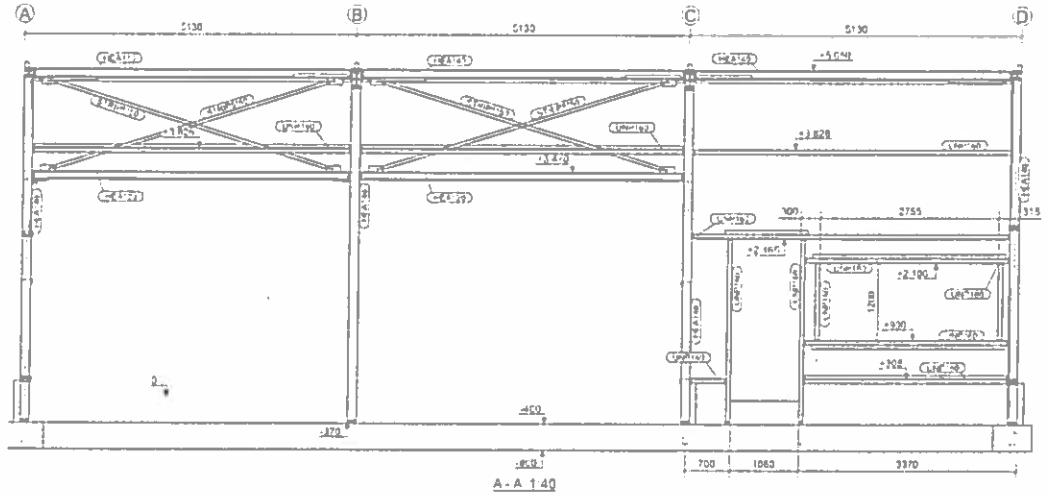


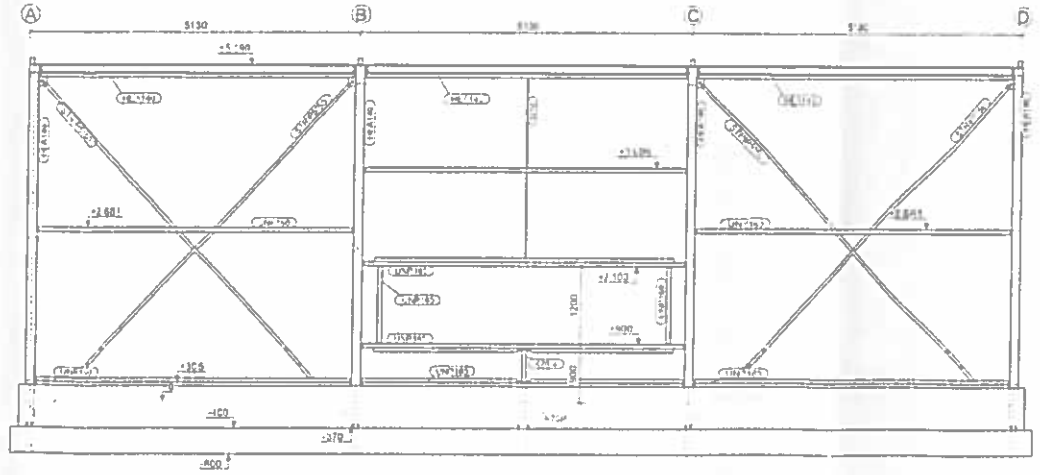
BOVENAANZICHT VLOERNIVO 1:40



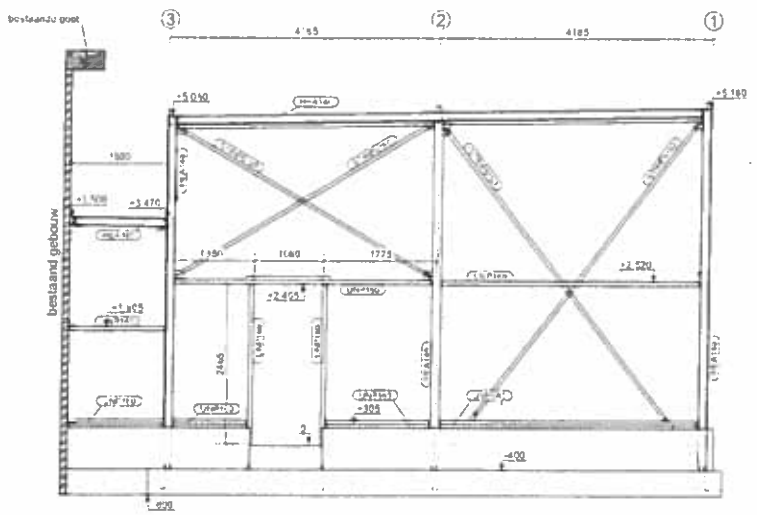
BOVENAANZICHT DAKNIVO 1:40



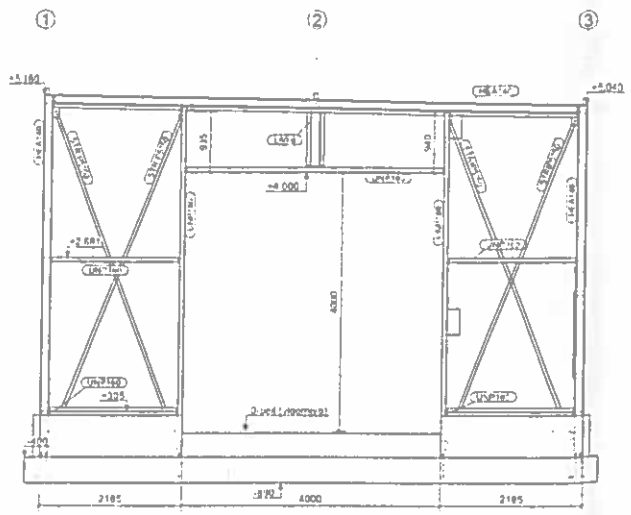
A - A 1:40



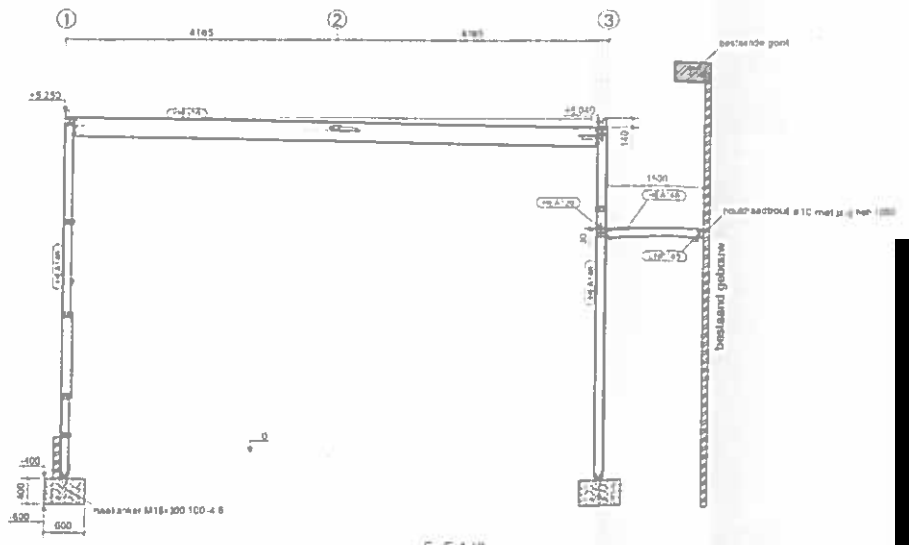
B - B 1:40



C - C 1:40



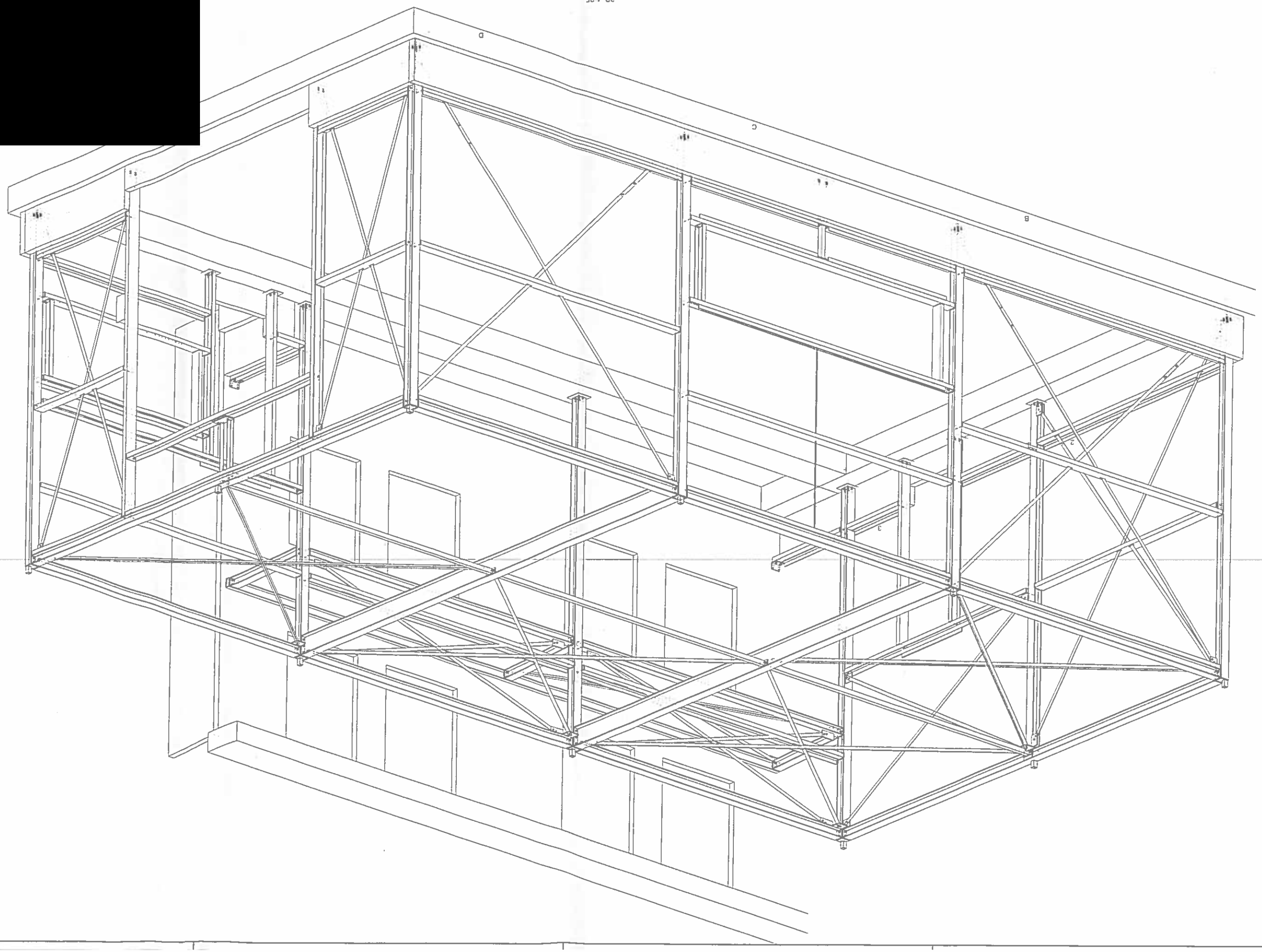
D - D 1:40

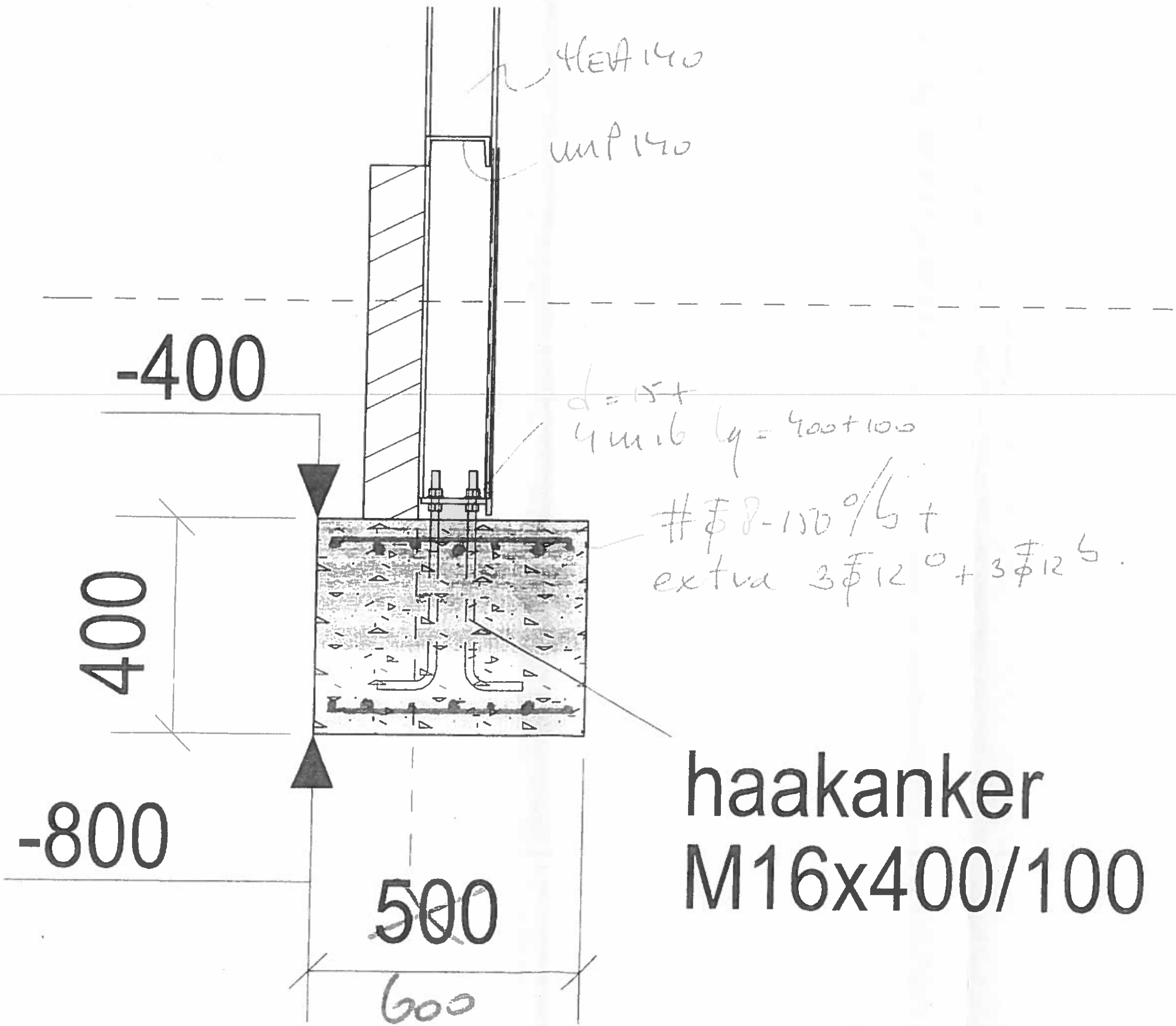


E - E 1:40

[redacted]

[redacted]




HEA 140
UNP 140
-400
d = 15+
4 M16 lg = 400+100
#Ø8-150 o/b +
extra 3Ø12 o + 3Ø12 b.
400
-800
500
600
haakanker
M16x400/100

[redacted]

beton-staal-hout-steen adviseurs bouwconstructies

[redacted]

Opdrachtnr. : 8147

Omschrijving : BEDRIJFSHAL AZC TE BUDEL

Onderdeel : Constructie

Datum : 15 september 2015

BEREKENING

[redacted]

INHOUDSOPGAVE STATISCHE BEREKENING

Betreft Opdracht : 8147
Omschrijving : BEDRIJFSHAL AZC TE BUDEL

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01	Inhoudsopgave
02	Belastingen volgens NEN-EN 1991
03 t/m 04	Stabiliteit
05 t/m 09	Kipsteunen + randliggers
10	Dakliggers
11 t/m 14	Gevelregels
15 t/m 20	Kolommen
21 t/m 22	Fundering
23	Ankerbouten

[redacted]

Belastingen

Gevolgklasse	CC1	$\gamma_{f;g}$=	1.2 /1,35/0,9
	Bijlage B 1990NB	$\gamma_{f;q}$=	1.5
		K_{Fi}=	0.9

PD1 — Platdak — dakhelling < 10°

G: eg=	staaldak, isolatie, dakbedekking e.d.		0.40 kN/m²
	afwerking		0.00 kN/m²
		g_k=	0.40 kN/m²

Q:
wind : zuiging niet maatgevend

sneeuw : vlgs 1991-1-3NB

dakhelling aansluitend dakvlak =			0 °	
μ_s=	0.00			
l_s=	n.v.t. m	h=	n.v.t. m	
B_1= hoge dak	n.v.t. m	B_2 = lage dak	n.v.t. m	
μ_w=	0.80	μ_1=	0.80	
μ_2=	0.80	S_k =	0.7 kN/m²	art 4 1 1991-1-3-NB

indien l_s>B_2, moet gerekend zijn met μ'_2

μ'_2=	n.v.t.	μ_{gem}=	0.80	
C_e en C_t =1 art 5 2 1991-1-3		q_{sk} = μ_{gem} x C_e x C_t x S_k =		0.56 kN/m²

Regenwater :

Dakopstand =	50 mm	q_k=	0.50 kN/m²

personen i.v.m. werkzaamheden	Q_k=	(in de bouwfase)	2.00 kN
art 6 3 4 2 1991-1-1 NB	Q_k=		1.50 kN
	q_k=		0.00 kN/m²

ψfactor=	ψ_0=	0.00	q_k maatgevend=	0.56 kN/m²
art. A1.2.2 1990NB	ψ_2=	0.00		

Belastingcombinaties : vlgs tabel A1 2(B) 1990NB verg 6 10a en 6 10b

q_{Ed}= 1,2 x K_{Fi} x G + 1,5 x K_{Fi} x Q =	1.19 kN/m²
q_{Ed}= 1,35 x K_{Fi} x G + 1,5 x K_{Fi} x Q x ψ_0 =	0.49 kN/m²
q_k= G + Q =	0.96 kN/m²

GV — Gevelbeplating

q_{Ed}= 1,2 x K_{Fi} x G =	0.32 kN/m²
q_{Ed}= 1,35 x K_{Fi} x G =	0.36 kN/m²
q_k= G =	0.30 kN/m²

M100 — 1/2-steensmuur

q_{Ed}= 1,2 x K_{Fi} x G =	2.16 kN/m²
q_{Ed}= 1,35 x K_{Fi} x G =	2.43 kN/m²
q_k= G =	2.00 kN/m²

FS — Funderingsstrook

q_{Ed}= 1,2 x K_{Fi} x G =	10.80 kN/m²
q_{Ed}= 1,35 x K_{Fi} x G =	12.15 kN/m²
q_k= G =	10.00 kN/m²

Stabiliteit

De horizontale krachten worden via verbanden in het dak en de gevels naar de fundering afgevoerd

WI — Wind

Q:
wind :

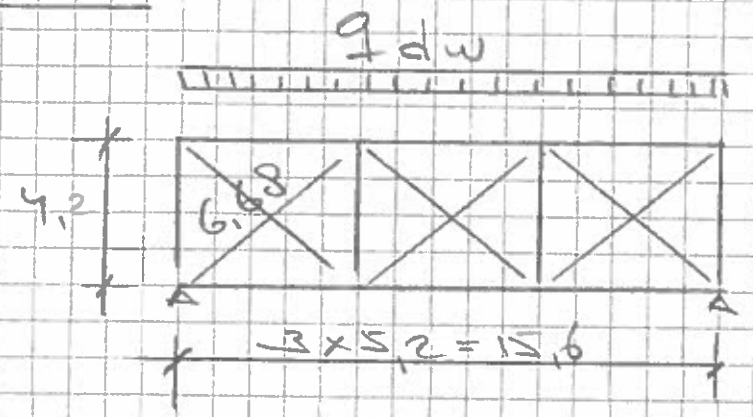
hoogte(z) =	5.50	c_0=	1.00 art 4 3 3 1991-1-4	correlatiefactor =	1.00	
Terreincat.	onbebouwd	$c_t c_d$=	1.00 art 6 3 1 1991-1-4	art 7 2 2 1991		
Windgebied	3	c_r=	0.69 art 4 3 2 1991-1-4NB			
z_o=	0.200	$v_m(z)$=	17.00 art 4 2 1991-1-1NB			
z_{min}=	4	$I_v(z)$=	0.302	$q_p(z)$=	0.56	

Belastingcombinaties : vlgs tabel A1 2(B) 1990NB verg 6 10a en 6 10b

q_{Ed}= 1,5 x K_{Fi} x Q =	0.76 kN/m²
q_k= Q =	0.56 kN/m²

Stabiliteit

Data



$$
\begin{aligned}
q_{dw} &= 1{,}5 \times 0{,}76 \times 2{,}6 &&= 2{,}57 \\
&+ 0{,}04 \times 0{,}76 \times 8{,}4 &&= 0{,}26 \\
&+ 1/250\ Q &&= \underline{0{,}17} \\
& &&\quad 3{,}00\ \text{kN/m}'
\end{aligned}
$$

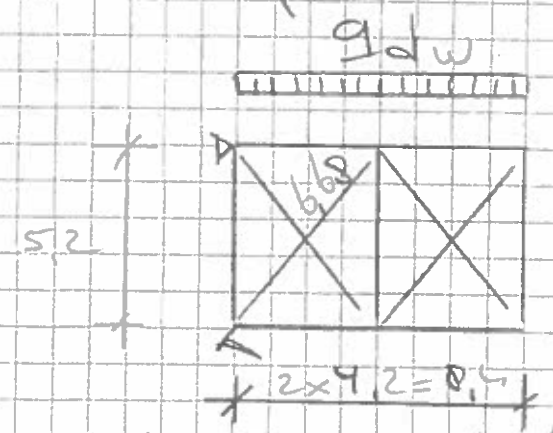
$$R_d = \frac{15{,}6}{2} \times 3 = 23{,}4\ \text{kN}$$

$$V_{d\,max} = 23{,}4 - \frac{5{,}2}{2} \times 3 = 15{,}6\ \text{kN}$$

$$\text{diag. } F_{td} = 15{,}6 \times \frac{6{,}68}{4{,}2} = 24{,}8\ \text{kN}$$

L 50 x 50 x 5 + 2 m 12 (41)

$$\text{o/b-vegal } F_{td} = +/- 21{,}7\ \text{kN}$$



$$q_{dw} = 3{,}3\ \text{kN/m}'$$

$$R_d = 27{,}7\ \text{kN}$$

$Vd = 27,7 - \frac{4,2}{2} \times 3,3 = 20,8$ kN

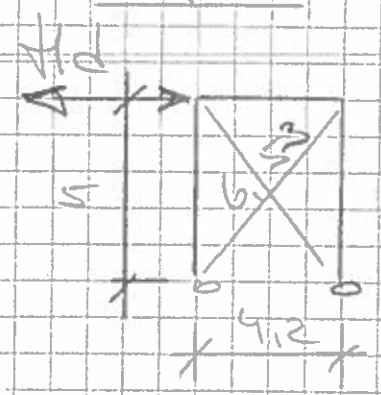
diag. $Ftd = 20,8 \times \frac{6,68}{5,2} = 26,7$ kN

$+ 50 \times 26 \times 5 + 2$ m 12 (41)

o/b-vegel $Ftd = +/- 22,4$ kN

Gevels

As A



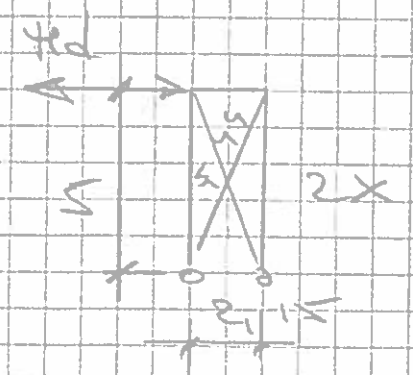
$Ftd = 23,4$ kN

diag. $Ftd = 23,4 \times \frac{6,53}{4,2} = 36,4$ kN

$+ 50 \times 5 + 2$ m 12 (41)

$Vd = +/- 27,9$ kN

As D



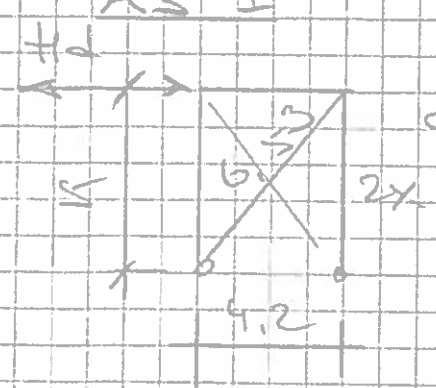
$Ftd = 23,4$ kN

diag. $Ftd = \frac{23,4}{2} \times \frac{5,44}{2,15} = 29,6$ kN

$+ 50 \times 5 + 2$ m 12 (41)

$Vd = +/- 27,2$ kN

As 1



$Ftd = 27,7$ kN

diag. $Ftd = \frac{27,7}{2} \times \frac{6,53}{4,2} = 21,5$ kN

$+ 50 \times 5 + 2$ m 12 (41)

$Vd = +/- 16,5$ kN

Kipsteun | Dak

Profiel					K60x60x4
$W_{pl,y}$ =	18.4 cm³	I_y =	45.9 cm⁴		
$W_{pl,z}$ =	18.4 cm³	I_z =	45.9 cm⁴		
A =	8.8 cm²	t_f =	4.0 mm		
h =	60.0 mm	t_w =	4.0 mm		
b =	60.0 mm				
i_y =	2.28 cm	It =	71.7 cm⁴		
i_z =	2.28 cm	$f_{y,d}$ =	235 N/mm²		
N_{Ed} =	Uit dakverband				22.00 kN
$L_{y,cr}$ =					5.20 m
$L_{z,cr}$ =					5.20 m
L_{kip} =					5.20 m
e_{oy} =	2.00 cm	e_{oz} =	2.00 cm		
extra moment t.g.v. wind:					
$M_{y,Ed}$ =	0.00 kNm	$M_{z,Ed}$ =	0.00 kNm		
totaal moment:					
$M_{y,Ed}$ =					0.44 kNm
$M_{z,Ed}$ =					0.44 kNm
$M_{y,pl,d}$ =					4.34 kNm
$M_{z,pl,d}$ =					4.34 kNm
$N_{pl,d}$ =					207 kN
C_1 =	1.750	C_2 =	0.000	λ_{vrel} =	2.429
S =	38.7	C =	5.50	λ_{zrel} =	2.429
K_{red} =	1.00	M_{ke} =	79.11 kNm	λ_{LTrel} =	0.234
α_y =	0.49	Φ_y =	3.996	χ_y =	0.139
α_z =	0.49	Φ_z =	3.996	χ_z =	0.139
α_{LT} =	0.21	Φ_{LT} =	0.531	χ_{LT} =	0.992
γ_{M0} =	1.00	γ_{M1} =	1.00		

Uiterste grenstoestanden volgens NEN-EN 1993-1-1:

$$\frac{N_{Ed}}{\chi_y N_{Rk}/\gamma_{M1}} = \mathbf{0.761} < 1 \quad \text{(Formule) (6.46 en 6.47)}$$

$$\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}} = \mathbf{0.10} < 1 \quad \text{(Formule) (6.54 en 6.55)}$$

$$\frac{N_{Ed}}{\chi_z N_{Rk}/\gamma_{M1}} = \mathbf{0.761} < 1 \quad \text{(6.46 en 6.47)}$$

$$\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}} = \mathbf{0.10} < 1 \quad \text{(6.54 en 6.55)}$$

$C_{my} = 0{,}6$ $\quad k_{yy}$ = 0.965 $\quad k_{zy}$ = 0.579

$C_{mz} = 0{,}6$ $\quad k_{yz}$ = 0.743 $\quad k_{zz}$ = 1.239

$$\frac{N_{Ed}}{\chi_y N_{Rk}/\gamma_{M1}} + k_{yy}\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}} + k_{yz}\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}} = \mathbf{0.94} < 1 \quad (6.61)$$

$$\frac{N_{Ed}}{\chi_z N_{Rk}/\gamma_{M1}} + k_{zy}\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}} + k_{zz}\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}} = \mathbf{0.95} < 1 \quad (6.62)$$

Doorbuiging

$$\delta_{max,y} = \frac{M_{y,rep}\, l^2}{16\, E\, I} = 6.43 \text{ mm} \qquad \delta_{max,y} = \frac{M_{z,rep}\, l^2}{16\, E\, I} = 6.43 \text{ mm}$$

Randliggers As 1+3

L(t)=						5.20 m
Profiel			A = 31.4 cm²			HEA140
			W_y = 155 cm³			
			I_y = 1033 cm⁴			
Wind	PD			GV	Totaal inclusief eigen gewicht	
0.98	1.19			0.32	q_{Ed}= 1.2*K_{Fi}*G + 1.5*K_{Fi}*Q =	4.24 kN/m'
0.00	0.49			0.36	q_{Ed}= 1.35*K_{Fi}*G + 1.5*K_{Fi}*Q*ψ_0 =	2.12 kN/m'
0.73	0.96			0.30	$q_{k\ (eind)}$ =	3.49 kN/m'
0.73	0.56			0.00	$q_{k\ (bijk)}$ =	1.75 kN/m'
2.40				5.00	→ "draagvlak"	

Sterkte:

M_{Ed} = 0.125 x 4.24 x 5.20 ² = 14.33 kNm

M_{el} = 0.235 x 155.0 = 36.43 kNm

factor I.v.m. A-symmetrisch profiel = 1.00

Doorsnede controle : 1.00 x 14.33 / 36.43 u.c. = 0.39

< 1

Doorbuiging:

w_{eind} = 1.00 x 6.20 x 3.49 x 5.20 ^4) / 1033 = 15.33 mm

w_{eind} toelaatbaar = 0.004 x 5200 = 20.80 mm

w_{bij} = 1.00 x 6.20 x 1.75 x 5.20 ^4) / 1033 = 7.67 mm

w_{bij} toelaatbaar = 0.004 x 5200 = 20.80 mm

Oplegging :

oplegreactie = eg = 4.54 kN

vb = 4.54 kN N_{Ed}= 11.0 kN

Randligger	As 1+3

Profiel					HEA120
$W_{pl,y}$ =	119.0 cm³	I_y =	606 cm⁴		
$W_{pl,z}$ =	58.9 cm³	I_z =	231 cm⁴		
A =	25.30 cm²	t_f =	8.0 mm		
h =	114.0 mm	t_w =	5.0 mm		
b =	120.0 mm				
i_y =	4.89 cm	It =	5.96 cm⁴		
i_z =	3.02 cm	$f_{y,d}$ =	235 N/mm²		
N_{Ed} =	Uit dakverband				27.70 kN
$L_{y,cr}$ =					5.20 m
$L_{z,cr}$ =					5.20 m
L_{kip} =					5.20 m
e_{oy} =	0.00 cm	e_{oz} =	0.00 cm		
extra moment t.g.v. dak en gevel (zie balk berek.):					
$M_{y,Ed}$ =	14.33 kNm	$M_{z,Ed}$ =	0.00 kNm		
totaal moment:					
$M_{y,Ed}$ =					14.33 kNm
$M_{z,Ed}$ =					0.00 kNm
$M_{y,pl,d}$ =					27.97 kNm
$M_{z,pl,d}$ =					13.84 kNm
$N_{pl,d}$ =					595 kN
C_1 =	1.750	C_2 =	0.000	λ_{vrel} =	1.132
S =	571.4	C =	5.82	λ_{zrel} =	1.834
K_{red} =	1.00	M_{kz} =	54.13 kNm	λ_{LTrel} =	0.719
α_y =	0.34	Φ_y =	1.300	χ_y =	0.516
α_z =	0.49	Φ_z =	2.582	χ_z =	0.227
α_{LT} =	0.21	Φ_{LT} =	0.813	χ_{LT} =	0.839
γ_{M0} =	1.00	γ_{M1} =	1.00		

Uiterste grenstoestanden volgens NEN-EN 1993-1-1:

			(Formule)				(Formule)
$\frac{N_{Ed}}{\chi_y N_{Rk}/\gamma_{M1}}$	=	**0.090**	< 1	(6.46 en 6.47)	$\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}}$	= **0.61**	< 1 (6.54 en 6.55)
$\frac{N_{Ed}}{\chi_z N_{Rk}/\gamma_{M1}}$	=	**0.205**	< 1	(6.46 en 6.47)	$\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}}$	= **0.00**	< 1 (6.54 en 6.55)

C_{my} = 0.6 k_{yy} = 0.643 k_{zy} = 0.941
C_{mz} = 0.6 k_{yz} = 0.463 k_{zz} = 0.772

$$\frac{N_{Ed}}{\chi_y N_{Rk}/\gamma_{M1}} + k_{yy}\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}} + k_{yz}\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}} = \mathbf{0.48} < 1 \qquad (6.61)$$

$$\frac{N_{Ed}}{\chi_z N_{Rk}/\gamma_{M1}} + k_{zy}\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}} + k_{zz}\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}} = \mathbf{0.78} < 1 \qquad (6.62)$$

Doorbuiging

$$\delta_{max,y} = \frac{M_{y,ren}\, l^2}{16\, E\, I} = 15.86 \text{ mm} \qquad \delta_{max,y} = \frac{M_{z,ren}\, l^2}{16\, E\, I} = 0.00 \text{ mm}$$

Randliggers As A+D

L(t)=						4.20 m
Profiel			A = 31.4 cm²			HEA140
			W_y = 155 cm³			
			I_y = 1033 cm⁴			
Wind	PD			GV	Totaal inclusief eigen gewicht	
0.98	1.19			0.32	q_{Ed}= 1.2*K_{fi}*G + 1.5*K_{fi}*Q=	4.98 kN/m¹
0.00	0.49			0.36	q_{Ed}= 1.35*K_{fi}*G + 1.5*K_{fi}*Q*ψ_0 =	3.39 kN/m¹
0.73	0.96			0.30	$q_{k\ (eind)}$ =	4.24 kN/m¹
0.73	0.56			0.00	$q_{k\ (bij\ k)}$ =	1.46 kN/m¹
	2.60			5.00	⟶ "draagvlak"	

Sterkte:

M_{Ed} = 0.125 x 4.98 x 4.20 ² = 10.97 kNm

M_{el} = 0.235 x 155.0 = 36.43 kNm

factor l.v.m. A-symmetrisch profiel = 1.00

Doorsnede controle : 1.00 x 10.97 / 36.43 u.c. = 0.30

< 1

Doorbuiging:

w_{eind} = 1.00 x 6.20 x 4.24 x 4.20 ^4) / 1033 = 7.92 mm

w_{eind} toelaatbaar = 0.004 x 4200 = 16.80 mm

w_{bij} = 1.00 x 6.20 x 1.46 x 4.20 ^4) / 1033 = 2.72 mm

w_{bij} toelaatbaar = 0.004 x 4200 = 16.80 mm

Oplegging :

oplegreactie = eg = 5.85 kN

vb = 3.06 kN N_{Ed}= 10.4 kN

Randligger	As A+D					
Profiel						HEA140
$W_{pl,y}$ =	173.0 cm³	I_y =	1033 cm⁴			
$W_{pl,z}$ =	84.9 cm³	I_z =	389 cm⁴			
A =	31.40 cm²	t_f =	8.5 mm			
h =	133.0 mm	t_w =	5.5 mm			
b =	140.0 mm					
i_y =	5.73 cm	It =	8.03 cm⁴			
i_z =	3.52 cm	$f_{y,d}$ =	235 N/mm²			
N_{Ed} =	Uit dakverband					23.40 kN
$L_{y,cr}$ =						4.20 m
$L_{z,cr}$ =						4.20 m
L_{kip} =						4.20 m
e_{oy} =	0.00 cm	e_{oz} =	0.00 cm			
extra moment t.g.v. wind:						
$M_{y,Ed}$ =	11.00 kNm	$M_{z,Ed}$ =	0.00 kNm			
totaal moment:						
$M_{y,Ed}$ =						11.00 kNm
$M_{z,Ed}$ =						0.00 kNm
$M_{y,pl,d}$ =						40.66 kNm
$M_{z,pl,d}$ =						19.95 kNm
$N_{pl,d}$ =						738 kN
C_1 =	1.750	C_2 =	0.000		λ_{vrel} =	0.781
S =	745.3	C =	6.29		λ_{zrel} =	1.271
K_{red} =	1.00	M_{kc} =	109.24 kNm		λ_{LTrel} =	0.610
α_y =	0.34	Φ_y =	0.903		χ_y =	0.736
α_z =	0.49	Φ_z =	1.570		χ_z =	0.401
α_{LT} =	0.21	Φ_{LT} =	0.729		χ_{LT} =	0.886
γ_{M0} =	1.00	γ_{M1} =	1.00			

Uiterste grenstoestanden volgens NEN-EN 1993-1-1:

			(Formule)					(Formule)
$\frac{N_{Ed}}{\chi_y N_{Rk}/\gamma_{M1}}$	=	**0.043**	< 1	(6.46 en 6.47)	$\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}}$	= **0.31**	< 1	(6.54 en 6.55)
$\frac{N_{Ed}}{\chi_z N_{Rk}/\gamma_{M1}}$	=	**0.079**	< 1	(6.46 en 6.47)	$\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}}$	= **0.00**	< 1	(6.54 en 6.55)

C_{my} = 0,6 k_{yy} = 0.615 k_{zy} = 0.977
C_{mz} = 0,6 k_{yz} = 0.400 k_{zz} = 0.666

$$\frac{N_{Ed}}{\chi_y N_{Rk}/\gamma_{M1}} + k_{yy}\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}} + k_{yz}\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}} = \mathbf{0.23} < 1 \qquad (6.61)$$

$$\frac{N_{Ed}}{\chi_z N_{Rk}/\gamma_{M1}} + k_{zy}\frac{M_{y,Ed}}{\chi_{LT} M_{y,pl,d}/\gamma_{M1}} + k_{zz}\frac{M_{z,Ed}}{M_{z,pl,d}/\gamma_{M1}} = \mathbf{0.38} < 1 \qquad (6.62)$$

Doorbuiging

$$\delta_{max,y} = \frac{M_{y,ren}\, l^2}{16\, E\, I} = 4.66 \text{ mm} \qquad \delta_{max,y} = \frac{M_{z,ren}\, l^2}{16\, E\, I} = 0.00 \text{ mm}$$

1	Dakligger

L(t) =	8.40 m
Profiel	IPE300
h =	300 mm
b =	150 mm
t_w =	7.1 mm
t_f =	10.7 mm
r_c =	15.0 mm
A =	53.8 cm^2
I_y =	8356 cm^4
i_y =	12.50 mm
I_z =	604 cm^4
i_z =	3.35 mm
$W_{y,pl}$ =	628.0 cm^3
I_t =	19.76 cm^4

PD	GV	Totaal inclusief eigen gewicht	
1.19	0.32	q_{Ed} = 1.2*K_{FI}*G + 1.5*K_{FI}*Q =	7.56 kN/m'
0.49	0.36	q_{Ed} = 1.35*K_{FI}*G + 1.5*K_{FI}*Q*ψ_0 =	3.42 kN/m'
0.96	0.30	$q_{k\ (eind)}$ =	6.16 kN/m'
0.56	0.00	$q_{k\ (bij\ k)}$ =	3.35 kN/m'
5.98		→ "draagvlak"	

Sterkte:

$V_{zpl.Rd}$ =	2566.97	x	235	/	√3	=	348.28 kN
$M_{pl.Rd}$ =	628.0	x	235			=	147.58 kNm
M_{Ed} =	0.125	x	7.56	x	8.40 ²	=	66.68 kNm

Doorsnede controle : M_{Ed} / $M_{pl.Rd}$ = 66.68 / 147.58 = **0.45** < 1

Stabiliteitscontrole : (vlgs NEN 6771, art. 12.2.1)

C1 = 1.13 ongesteunde lengte (L_{kip}) = 4.20 m
C2 = -0.45 (NEN 6771, art. 12.2.5.3)

S = 1335.31 mm C = 7.34 K_{red} = 1.00

M_{ke} = 124.49 kNm λ_{LT} = 1.09

NEN-EN 1993-1-1 art. 6.3.2.1
α_{LT} = 0.21 Φ_{LT} = 1.186 χ_{LT} = 0.604

$M_{b.Rd}$ = χ_{LT} $W_{y,pl}$ f_y = 89.09 kNm M_{Ed} / $M_{b.Rd}$ = 66.68 / 89.09 = **0.75** < 1

Doorbuiging:

w_{eind} =	1.00	x	6.20	x	6.16	x	8.40	^4) /	8356	=	22.77 mm
w_{bij} =	1.00	x	6.20	x	3.35	x	8.40	^4) /	8356	=	12.37 mm
			< w_{bij} toelaatbaar =				0.004	x	8400	=	33.60 mm
w_{on} =	22.77	-	12.37	=	10.40				Zeeg	=	0.00 mm
$w_{eind,tot}$ =	22.77	-	0.00							=	22.77 mm
			< w_{eind} toelaatbaar =				0.004	x	8400	=	33.60 mm

Oplegging :

oplegreactie = eg = 11.82 kN
vb = 14.06 kN oplegreactie= F_{Ed} = V_{Ed} = 31.8 kN

Tussenregels gevel

L(t)=						5.20 m
Profiel			A = 24.0 cm²			UNP160
			W_y = 116 cm³			
			I_y = 925 cm⁴			
Wind	PD			GV	Totaal inclusief eigen gewicht	
0.98	1.19			0.32	q_{Ed}= 1.2*K_H*G + 1.5*K_F*Q =	3.03 kN/m'
0.00	0.49			0.36	q_{Ed}= 1.35*K_H*G + 1.5*K_H*Q*ψ_0 =	0.23 kN/m'
0.73	0.96			0.30	$q_{k\ (eind)}$ =	2.29 kN/m'
0.73	0.56			0.00	$q_{k\ (bijk)}$ =	2.10 kN/m'
2.88					→ "draagvlak"	

Sterkte:

M_{Ed} = 0.125 x 3.03 x 5.20 ² = 10.23 kNm

M_{el} = 0.235 x 116.0 = 27.26 kNm

factor l.v.m. A-symmetrisch profiel = 1.25

Doorsnede controle : 1.25 x 10.23 / 27.26 u.c. = 0.47

< 1

Doorbuiging:

w_{eind} = 1.25 x 6.20 x 2.29 x 5.20 ^4) / 925 = 14.00 mm

w_{eind} toelaatbaar = 0.004 x 5200 = 20.80 mm

w_{bij} = 1.25 x 6.20 x 2.10 x 5.20 ^4) / 925 = 12.84 mm

w_{bij} toelaatbaar = 0.004 x 5200 = 20.80 mm

Oplegging :

oplegreactie = eg = 0.49 kN

vb = 5.45 kN N_{Ed} = 7.9 kN

Tussenregels gevel

L(t)=						2.60 m
Profiel			A = 24.0 cm²			UNP160Z
			W_z = 18.3 cm³			
			I_z = 85.3 cm⁴			
Wind	PD			GV	Totaal inclusief eigen gewicht	
0.98	1.19			0.32	$q_{Ed} = 1.2*K_{fi}*G + 1.5*K_{fi}*Q =$	1.82 kN/m¹
0.00	0.49			0.36	$q_{Ed} = 1.35*K_{fi}*G + 1.5*K_{fi}*Q*\psi_0 =$	2.05 kN/m¹
0.73	0.96			0.30	$q_{k\ (eind)} =$	1.69 kN/m¹
0.73	0.56			0.00	$q_{k\ (bijk)} =$	0.00 kN/m¹
				5.00	→ "draagvlak"	

Sterkte:

M_{Ed} = 0.125 x 2.05 x 2.60 ² = 1.73 kNm
M_{el} = 0.235 x 18.3 = 4.30 kNm

factor I.v.m. A-symmetrisch profiel = 1.25
Doorsnede controle : 1.25 x 1.73 / 4.30 u.c. = 0.50
< 1

Doorbuiging:

w_{eind} = 1.25 x 6.20 x 1.69 x 2.60 ^4) / 85 = 7.01 mm
w_{eind} toelaatbaar = 0.004 x 2600 = 10.40 mm

w_{bij} = 1.25 x 6.20 x 0.00 x 2.60 ^4) / 85 = 0.00 mm
w_{bij} toelaatbaar = 0.004 x 2600 = 10.40 mm

Oplegging :

oplegreactie = eg = 2.19 kN
vb = 0.00 kN
N_{Ed} = 2.7 kN

Tussenregels gevel

Controle dubbele buiging:

Sterkte:

M_{Eyd} = 10.23 kNm
M_{Ezd} = 1.73 kNm

factor I.v.m. A-symmetrisch profiel = 1.25
Doorsnede controle : 1.25 x 10.23 / 27.26 u.c. = 0.47
1.25 x 1.73 / 4.30 u.c. = 0.50
u.c.tot. = 0.97
< 1

Onderregels gevel

L(t)=						5.20 m
Profiel			A = 20.4 cm²			UNP140
			W_y = 86.4 cm³			
			I_y = 605 cm⁴			
Wind	PD			GV	Totaal inclusief eigen gewicht	
0.98	1.19			0.32	q_{Ed}= 1.2*K_{FI}*G + 1.5*K_{FI}*Q =	1.54 kN/m¹
0.00	0.49			0.36	q_{Ed}= 1.35*K_{FI}*G + 1.5*K_{FI}*Q*ψ_0 =	0.19 kN/m¹
0.73	0.96			0.30	$q_{k\ (eind)}$ =	1.18 kN/m¹
0.73	0.56			0.00	$q_{k\ (bijk)}$ =	1.02 kN/m¹
1.40					→ "draagvlak"	

Sterkte:

M_{Ed} = 0.125 x 1.54 x 5.20 ² = 5.22 kNm

M_{el} = 0.235 x 86.4 = 20.30 kNm

factor l.v.m. A-symmetrisch profiel = 1.25

Doorsnede controle : 1.25 x 5.22 / 20.30 u.c. = 0.32

< 1

Doorbuiging:

w_{eind} = 1.25 x 6.20 x 1.18 x 5.20 ^4) / 605 = 11.05 mm

w_{eind} toelaatbaar = 0.004 x 5200 = 20.80 mm

w_{bij} = 1.25 x 6.20 x 1.02 x 5.20 ^4) / 605 = 9.55 mm

w_{bij} toelaatbaar = 0.004 x 5200 = 20.80 mm

Oplegging :

oplegreactie = eg = 0.42 kN

vb = 2.65 kN

N_{Ed} = 4.0 kN

Onderregels gevel

L(t)=						2.60 m
Profiel		A =	20.4	cm^2		UNP140Z
		W_z =	14.8	cm^3		
		I_z =	62.7	cm^4		
Wind	PD			GV	Totaal inclusief eigen gewicht	
0.98	1.19			0.32	q_{Ed}= 1.2*K_{fi}*G + 1.5*K_{fi}*Q =	0.63 kN/m¹
0.00	0.49			0.36	q_{Ed}= 1.35*K_{fi}*G + 1.5*K_{fi}*Q*ψ_0 =	0.70 kN/m¹
0.73	0.96			0.30	$q_{k\ (eind)}$ =	0.58 kN/m¹
0.73	0.56			0.00	$q_{k\ (bijk)}$ =	0.00 kN/m¹
				1.40	→ "draagvlak"	

Sterkte:

M_{Ed} =	0.125 x	0.70 x	2.60 ² =			0.60 kNm
M_{el} =	0.235 x	14.8 =	3.48 kNm			
factor l.v.m. A-symmetrisch profiel =			1.25			
Doorsnede controle :		1.25 x	0.60 /	3.48	u.c. =	0.21
						< 1

Doorbuiging:

w_{eind} =	1.25 x	6.20 x	0.58	x	2.60	^4) /	63	=	3.28 mm
		w_{eind} toelaatbaar =		0.004	x	2600		=	10.40 mm
w_{bij} =	1.25 x	6.20 x	0.00	x	2.60	^4) /	63	=	0.00 mm
		w_{bij} toelaatbaar =		0.004	x	2600		=	10.40 mm

Oplegging :

oplegreactie =	eg =	0.75 kN		
	vb =	0.00 kN	N_{Ed} =	0.9 kN

Onderregels gevel

Controle dubbele buiging:

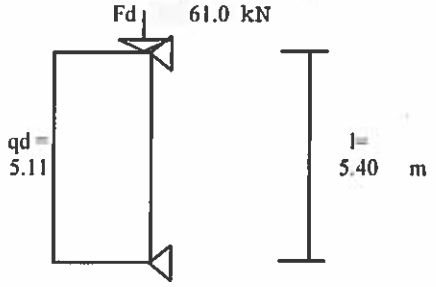
Sterkte:

M_{Eyd} =						5.22 kNm
M_{Ezd} =						0.60 kNm
factor l.v.m. A-symmetrisch profiel =			1.25			
Doorsnede controle :		1.25 x	5.22 /	20.30	u.c. =	0.32
		1.25 x	0.60 /	3.48	u.c. =	0.21
					u.c.tot. =	0.54
						< 1

Stalen kolom | Gevels algemeen

Windbelasting : qd =	C	*	Pw	*	breedte	*	factor		
	1.30	*	0.56	*	5.20	*	1.35	=	5.11 kN/m

Uit dak+gevel+wind+eg =
Fd 61.0 kN



Profiel	HEA140
Wypl=	173 cm^3
Wzpl=	85 cm^3
Iy=	1033 cm^4
Iz=	389 cm^4
A =	31 cm^2
h =	133 mm
b =	140 mm
tf=	5.5 mm
tw=	8.5 mm
r=	12.0 mm
iy=	57.3 mm
iz=	35.2 mm
It=	8.03 cm^4
fy;d =	235 N/mm^2

Lky=	5.40 m
Lkz=	5.40 m
lmax=	5.40 m

Extra moment t.g.v. wind:

M_{dy}=							18.6 kNm
M_{dz}=							0.0 kNm
$V_{z.s.d}$=							13.8 kN
$V_{z.pl.d}$ =	0.58	*	235	*	1958	=	265.4 kN
$N_{pl.d}$=	3140	*	235			=	737.9 kN
$M_{y.pl.d}$=	173.00	*	235			=	40.7 kNm
$M_{z.pl.d}$=	84.90	*	235			=	20.0 kNm

Sterkte : vlgs art. 11.3 NEN6770

$V_{z.s.d}$ <= 0,5*$V_{z.pl.d}$
a1 = 0.500 $N_{s.d}$<=0,5a_1*$N_{pl.d}$ ja

0.46
u.c. akkoord

Stabiliteitskontrole : vlgs art. 12.3.1.2.1 NEN6771

C_1 =	1.13	C_2 =	-0.45
S =	745	C =	3.24
K_{red}=	1.00	M_{ke}=	43.71 kNm
lrel=	0.96	W_{kip}=	0.69
$F_{v.E}$=	734.23 kN	n_v=	12.04
$F_{z.E}$=	276.49 kN	n_z=	4.53
l_{vrel}=	1.00	e_v=	15.03 mm
l_{zrel}=	1.63	e_z=	18.99 mm
a_{kv}=	0.34		
a_{kz}=	0.49		
l_o=	0.20		

$N_{c.s.d}/N_{c.u.d} + (n_v/(n_v-1)) * (M_{v.equ.s.d} + F_{vtot.s.d}*ey)/(M_{v.u.d} * w_{kip}) + (n_z/(n_z-1)) * (c_v*M_{zequ.s.d})/M_{z.u.d} < 1$

0.08 + 1.09 * 0.70 + 1.28 * 0.00 = **0.84**
u.c. akkoord

$N_{c.s.d}/N_{c.u.d} + (n_v/(n_v-1)) * (C_z*M_{v.equ.s.d})/(M_{v.u.d} * w_{kip}) + (n_z/(n_z-1)) * (M_{zequ.s.d} + F_{z.tot.s.d}*e_z)/M_{z.u.d} < 1$

0.08 + 1.09 * 0.66 + 1.28 * 0.06 = **0.88**
u.c. akkoord

Doorsnede kontrole t.b.v. torsieknikstabiliteit : vlgs art. 12.3.3 NEN6770

(My;s;d/Wkip/My;pl;d)<=1 **0.66**
u.c. akkoord

Doorbuiging :

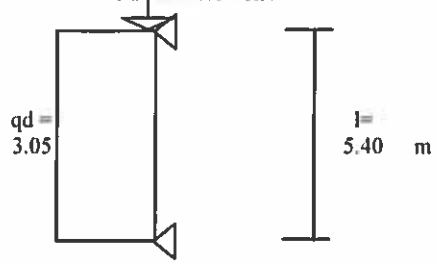
Ubij = 6.20 * 3.79 * 5.40 ^4 / 1033 = **19.32** mm

Ubij toelaatbaar = 0.004 * 5400 = 21.60 mm

Stalen kolom	Tpv overheaddeuren

Windbelasting : qd =	C	*	Pw	*	breedte	*	factor		
	1.30	*	0.56	*	3.10	*	1.35	=	3.05 kN/m

Uit dak+gevel+wind+eg =
Fd 47.0 kN



Profiel	UNP180
Wypl=	179 cm^3
Wzpl=	43 cm^3
Iy=	1354 cm^4
Iz=	114 cm^4
A =	28 cm^2
h =	180 mm
b =	70 mm
tf=	8.0 mm
tw=	11.0 mm
r=	11.0 mm
iy=	69.6 mm
iz=	20.1 mm
It=	9.53 cm^4
fy;d =	235 N/mm^2

Lky=	5.40 m
Lkz=	5.40 m
lmax=	5.40 m

Extra moment t.g.v. wind:

M_{dy}=							11.1 kNm
M_{dz}=							0.0 kNm
$V_{z.s.d}$=							8.2 kN
$V_{z.pl.d}$=	0.58	*	235	*	2205	=	299.0 kN
$N_{pl.d}$=	2797	*	235			=	657.3 kN
$M_{y.pl.d}$=	179.00	*	235			=	42.1 kNm
$M_{z.pl.d}$=	42.90	*	235			=	10.1 kNm

Sterkte : vlgs art. 11.3 NEN6770

$V_{z.s.d}$ <= 0,5*$V_{z.pl.d}$
al = 0.500 $N_{l.d}$<=0,5a_l*$N_{pl.d}$ ja

0.26
u.c. akkoord

Stabiliteitskontrole : vlgs art. 12.3.1.2.1 NEN6771

C_1 =	1.13	C_2 =	-0.45	
S =	500	C =	3.26	
K_{red}=	1.00	M_{ke}=	25.91	kNm
lrel=	1.27	W_{kip}=	0.49	
$F_{v.E}$=	962.39	kN	n_v=	20.48
$F_{z.E}$=	80.67	kN	n_z=	1.72
l_{vrel}=	0.83		e_v=	8.42 mm
l_{zrel}=	2.85		e_z=	13.84 mm
a_{kv}=	0.21			
a_{kz}=	0.34			
l_o=	0.20			

$N_{c.s.d}/N_{c.u.d} + (n_v/(n_v-1)) * (M_{v.eau.s.d} + F_{vtot.s.d}*ey)/(M_{v.u.d} * w_{kip}) + (n_z/(n_z-1)) * (c_v*M_{zeau.s.d})/M_{z.u.d} < 1$

0.07 + 1.05 * 0.56 + 2.40 * 0.00 = **0.66**
u.c. akkoord

$N_{c.s.d}/N_{c.u.d} + (n_v/(n_v-1)) * (C_z*M_{v.eau.s.d})/(M_{v.u.d} * w_{kip}) + (n_z/(n_z-1)) * (M_{zeau.s.d} + F_{z.tot.s.d}*e_z)/M_{z.u.d} < 1$

0.07 + 1.05 * 0.54 + 2.40 * 0.06 = **0.80**
u.c. akkoord

Doorsnede kontrole t.b.v. torsieknikstabiliteit : vlgs art. 12.3.3 NEN6770

(My;s;d/Wkip/My;pl;d)<=1 **0.54**
u.c. akkoord

Doorbuiging :

Ubij = 6.20 * 2.26 * 5.40 ^4 / 1354 = **8.79** mm

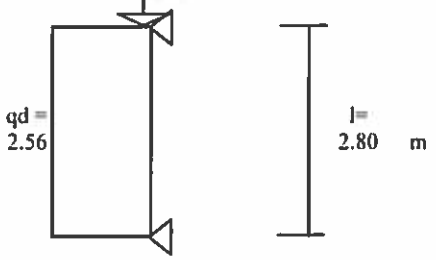
Ubij toelaatbaar = 0.004 * 5400 = 21.60 mm

Stalen kolom	Tpv loopdeuren

Windbelasting : qd =	C	*	Pw	*	breedte	*	factor		
	1.30	*	0.56	*	2.60	*	1.35	=	2.56 kN/m

Uit dak+gevel+eg =

Fd 16.0 kN



Profiel	UNP160
Wypl=	138 cm^3
Wzpl=	35 cm^3
Iy=	925 cm^4
Iz=	85 cm^4
A =	24 cm^2
h =	160 mm
b =	65 mm
tf=	7.5 mm
tw=	10.5 mm
r=	10.5 mm
iy=	62.1 mm
iz=	18.8 mm
It=	7.44 cm^4
fy;d =	235 N/mm^2

Lky=	2.80 m
Lkz=	2.80 m
lmax=	2.80 m

Extra moment t.g.v. wind:

M_{dy}=							2.5 kNm
M_{dz}=							0.0 kNm
$V_{z.s.d}$=							3.6 kN
$V_{z.pl.d}$ =	0.58	*	235	*	1899	=	257.4 kN
$N_{pl.d}$=	2401	*	235			=	564.2 kN
$M_{y.pl.d}$=	138.00	*	235			=	32.4 kNm
$M_{z.pl.d}$=	35.20	*	235			=	8.3 kNm

Sterkte : vlgs art. 11.3 NEN6770

$V_{z.s.d}$ <= 0,5*$V_{z.pl.d}$

al = 0.500 $N_{s.d}$<=0.5a_l*$N_{pl.d}$ ja

0.08
u.c. akkoord

Stabiliteitskontrole : vlgs art. 12.3.1.2.1 NEN6771

C_1 =	1.13	C_2 =	-0.45	
S =	435	C =	3.25	
K_{red}=	1.00	M_{ke}=	38.04	kNm
lrel=	0.92	W_{kip}=	0.72	
$F_{v.E}$=	2444.58 kN	n_v=	152.79	
$F_{z.E}$=	224.82 kN	n_z=	14.05	
l_{vref}=	0.48	e_v=	3.38	mm
l_{zref}=	1.58	e_z=	6.90	mm
a_{kv}=	0.21			
a_{kz}=	0.34			
l_o=	0.20			

$N_{c.s.d}/N_{c.u.d} + (n_v/(n_v-1)) * (M_{v.eau.s.d} + F_{vtot.s.d}*ey)/(M_{v.u.d} * w_{kip}) + (n_z/(n_z-1)) * (c_v*M_{zeau.s.d})/M_{z.u.d} < 1$

0.03 + 1.01 * 0.11 + 1.08 * 0.00 = **0.14**
u.c. akkoord

$N_{c.s.d}/N_{c.u.d} + (n_v/(n_v-1)) * (C_z*M_{v.eau.s.d})/(M_{v.u.d} * w_{kip}) + (n_z/(n_z-1)) * (M_{zeau.s.d} + F_{z.tot.s.d}*e_z)/M_{z.u.d} < 1$

0.03 + 1.01 * 0.11 + 1.08 * 0.01 = **0.15**
u.c. akkoord

Doorsnede kontrole t.b.v. torsieknikstabiliteit : vlgs art. 12.3.3 NEN6770

(My;s;d/Wkip/My;pl;d)<=1 **0.11**
u.c. akkoord

Doorbuiging :

Ubij = 6.20 * 1.89 * 2.80 ^4 / 925 = **0.78** mm

Ubij toelaatbaar = 0.004 * 2800 = 11.20 mm

Funderingsbelastingen

F-last	Wind	PD				GV	M100	S300		FS	qrep	qrep	qdmax	B	'smax:d
eg	1.00	0.40				0.30	2.00	4.00		10.00	g_k	q_k	q_{fd}		
vb		0.56									in kN	in kN		in mm	in kN/m²
1		28.7				26.0	2.0			2.00	43.27	16.05	68.40	1200	57.00
2	22.9	5.5				22.5	2.0			2.00	55.80	3.06	69.45	1200	57.88
3	-22.9	5.0				20.3	1.8			1.80	6.76	0.00	8.21	1200	6.84
4											0.00	0.00	0.00	300	0.00
5											0.00	0.00	0.00	300	0.00
6											0.00	0.00	0.00	300	0.00
7											0.00	0.00	0.00	300	0.00
8											0.00	0.00	0.00	300	0.00
9											0.00	0.00	0.00	300	0.00
10											0.00	0.00	0.00	300	0.00
11											0.00	0.00	0.00	300	0.00
12											0.00	0.00	0.00	300	0.00
13											0.00	0.00	0.00	300	0.00
14											0.00	0.00	0.00	300	0.00
15											0.00	0.00	0.00	300	0.00
16											0.00	0.00	0.00	300	0.00

De kolommen staan op gewapende funderingstroken, afm. bxh=600x400mm2
De belastingen uit de kolommen worden over de funderingstroken gespreid over een lengte van >2m
Fd1 is Fdmax uit kolommen
Fd2 is Fdmax tpv gevelverbanden
Fd3 is Fdmin tpv gevelverbanden

Wapening	Stroken								
q_{Ed} =	(69.45/5.2) =							13.5	kN/m
L(t) =								5.20	m
B =								600	mm
H =								400	mm
dekking c_{nom} =								35	mm
d=								353	mm
betonkwaliteit =								C 20	/25
betonstaalkwaliteit =								B 500	B
f_{yd} =								435	N/mm²
f_{cd} =								13.33	N/mm²
M_{Ed} =	0.100	x	14	x	5.20 ²		=	36.50	kNm
M_{Ed}/bd^2 =								488	
ρ_l =								0.115	
A_s =								243	mm²
V_{Ed} =	0.50	x	14	x	5.20		=	35	kN
v_{Ed} =	35100	/	(600	x	353)		=	0.17	N/mm²
				k =	1.75	$v_{Rd,c}$ =	=	0.36	N/mm²
								geen beugels nodig	
								# o 8	-150 o/b +
								3 o 12	o/b
								(= 490mm2)	

Ankerbouten

Voor krachten zie stabiliteits berekening

Hd;max = 27.7kN , Hrep = 20.5kN

Vd;max = 27.9kN

4M16 (4.6):Vu;rep=4x7.88=31.5kN > 27.7 Ftu;d= 4x44.6 = 178.4kN >>27.9

Hd;max = 23.4kN , Hrep = 17.4kN

Vd;max = 27.2kN

2M20 (4.6):Vu;rep=2x12=24kN > 17.4 Ftu;d= 2x70.3 = 140.6kN >>27.2