C1	21/03/08	EMISSIONE PER APPROVAZIONE E A SEGUITO COMMENTI CVN	JRA	LB	YE
C0	01/10/04	EMISSIONE PER APPROVAZIONE	JRA	MN	YE
REVISIONE		DESCRIZIONE	EL.	CON.	APP.

MINISTERO DELLE INFRASTRUTTURE

MAGISTRATO ALLE ACQUE

NUOVI INTERVENTI PER LA SALVAGUARDIA DI VENEZIA

CONVENZIONE REP. 7191 DEL 04-10-1991
ATTO ATTUATIVO REP. 8249 DEL 28-12-2007

INTERVENTI ALLE BOCCHE LAGUNARI PER LA REGOLAZIONE DEI FLUSSI DI MAREA

CUP: D51B02000050001

PROGETTO ESECUTIVO

WBS: MA.E1.14.PE

BOCCA DI MALAMOCCO
CONCA DI NAVIGAZIONE
PORTE E OPERE ELETTROMECCANICHE

STRUTTURA DELLE PORTE
RELAZIONE DI CALCOLO DETTAGLI
ALLEGATI – TOMO 3 di 3

ELABORATO	CONTROLLATO	APPROVATO
J.R. Augustijn	L. Bottigelli	Y. Eprim
N. ELABORATO	CODICE FILE	DATA
MV036P-PE-MAR-4003-C1	MV036P-PE-MAR-4003-C1.DOC	21 Marzo 2008

CONSORZIO “VENEZIA NUOVA”

COORDINAMENTO PROGETTAZIONE

VERIFICATO: S. Dalla Villa

CONTROLLATO: M. Brotto

CONSORZIO VENEZIA NUOVA

PROGETTAZIONE

TECHNITAL

IL RESPONSABILE : Ing. A. SCOTTI

CONSULENZA SPECIALISTICA

ORDINE DEGLI INGEGNERI DELLA PROVINCIA DI MILANO — DOTT. ING. ALBERTO SCOTTI — Sez. A Settori: a) civile e ambientale b) industriale c) dell'informazione — n° A 9782

Addendum I General access structures

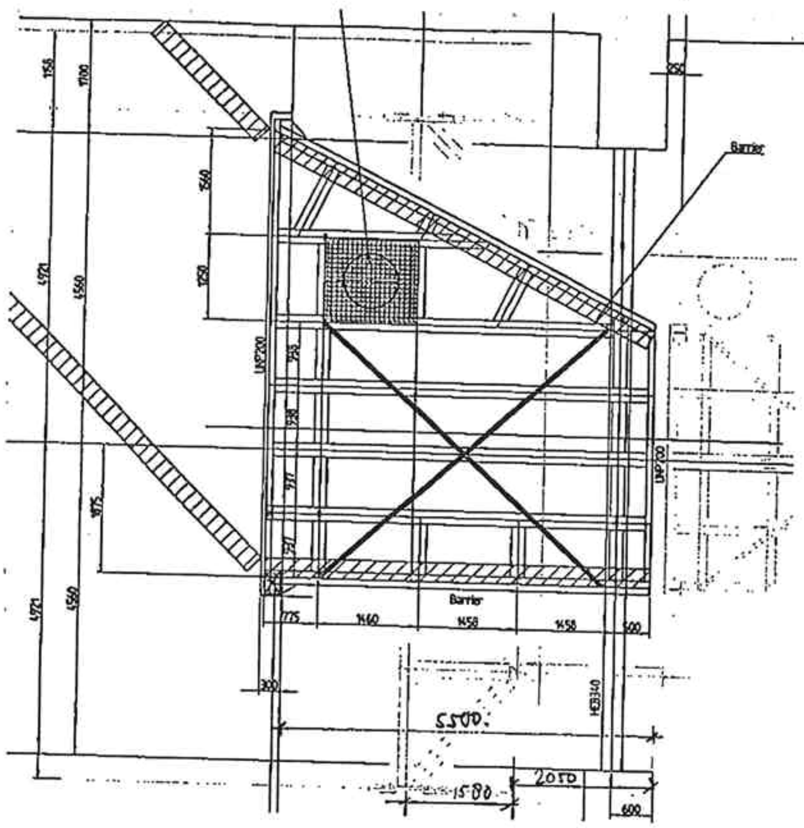
Contents

Note: - check roadstructure members on wave-slam load is considered in the pipe-rack calc. [I4-9]
- connections roadramp, see ref. [H2]

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

I1 / 1. REMOVABLE ROAD ACCES FRAME AT GATE CHAMBER. /



CALCULATION OF REMOVABLE ROAD ACCES FRAME FOR CONNECTION BETWEEN CIVIL WORKS AND ROADSTRUCTURE OF GATE. SETUP OF STRUCTURE IS EQUAL TO ROAD TOPSIDE STRUCTURE : - HEB 200 ; BEAMS l=5500 mm.
- GRATING ; 87 kg/m²
- BARRIERS.

FOR MAIN CALCULATION REFERE TO CALCULATION OF ROAD TOPSIDE, I_2/I_3.

THE ROADSTRUCTURE IS SUPPORTED ON THE CONCRETE ONE SIDE AND ON A HEB 340 ON THE OTHER.

ADDITIONAL CALCULATION INDIVIATION TO ROAD TOPSIDE.

Opgesteld : MPI
Datum : 14-5-'04
Bladnummer : I1-2
Rev. : 0

Project	: MALAMOCCO NAV LOCK GATE
Onderdeel	: SECONDARY STEEL

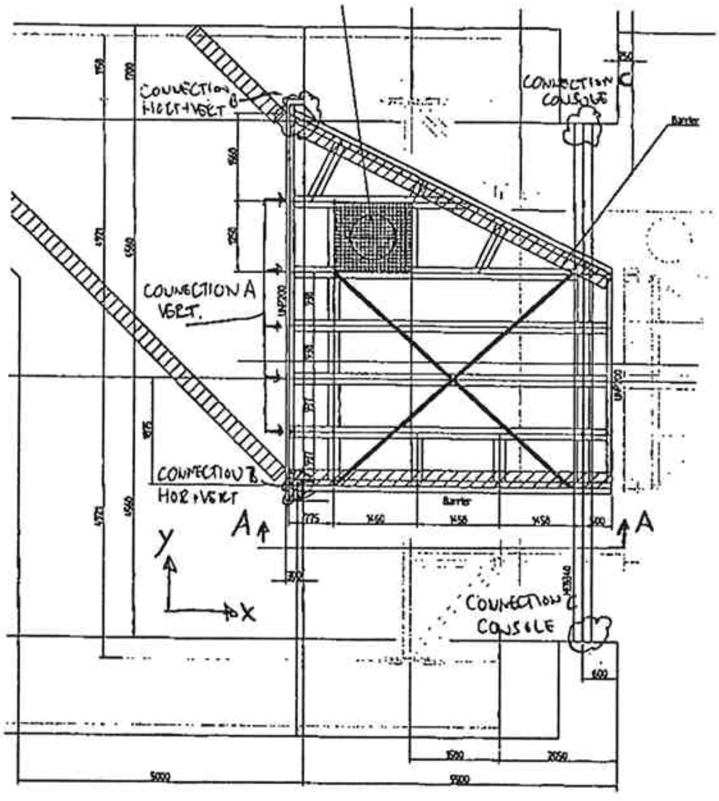
LOADS acc. TO ADDENDUM I_2.

VERT. LOAD:

* DEAD LOAD : - GRATING (0,87 kN/m²).
  - WEIGHT OF PROFILES.
* LIFE LOAD : - UNIFORM LOAD ; 4,0 kN/m²
  - VEHICLE ; F = 50 kN.

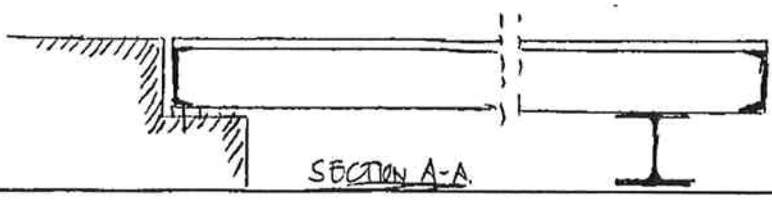
HOR. LOAD :

* BRACKING / ACCELERATION LOAD : $F_B = 30$ kN → $F_{B;d} = 1{,}5 \times 30 = 45$ kN.
* COLLISION FORCE : $F_{coll;d} = 60$ kN.



FORCES ON CONNECTIONS: (HORIZONTAL).

	X	Y
A	—	—
B	45 (kN)	30 (kN)
C	45 (kN)	30 (kN)



SECTION A-A.

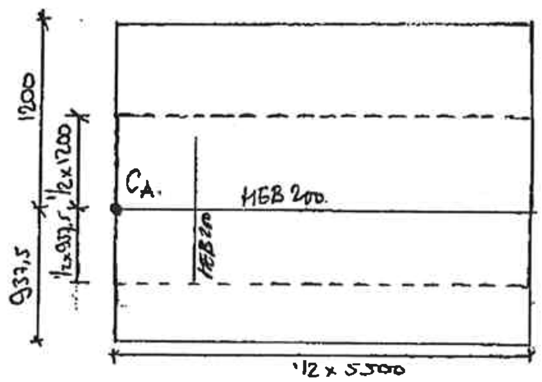
Opgesteld :	Datum :	Bladnummer :	Rev. :
MPI	14-5-'04	I1-3	0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

DEFINITION OF LOADS ON SUPPORTS

SUPPORT A (CONNECTION A; VERTICAL)



* DEAD LOAD:

- GRATING : 0,87 kN/m² ⇒ F = 0,87 × 2,75 × (0,60 + 0,468) = 2,56 kN
- SELF WEIGHT; HEB 200 ⇒ F = 0,61 kN/m' × (2,75 + 0,60 + 0,468) = 2,33 kN.

* LIFE LOAD:

- UNIFORM LOAD : 4,0 kN/m² ⇒ F = 4,0 × 2,75 × (0,60 + 0,468) = 12 kN.
- VEHICLE : F = 50 kN / 2 ⇒ F = 25 kN.
  (DYNAMIC FACTOR: 1,4).

Fd ON SUPPORT = 1,35 × 2,56 + 1,35 × 2,33 + 1,5 × 12, + 1,5 × 1,4 × 25 = 80 kN.

SUPPORT B (CONNECTION B; VERT. AND HOR.)

FOR SUPPORT B, IS THE HORIZONTAL LOAD GOVERNING

Opgesteld : MPI Datum : 14-5-'04 Bladnummer : I1-4 Rev. : 0

Project	:	MALAMOCCO NAV. LOCK GATE
Onderdeel	:	SECONDARY STEEL

SUPPORT C (SUPPORT BEAM HEB 340)

FOR DETERMINATION OF SUPPORT LOADS SEE DETERMINATION FOR HEB 340.

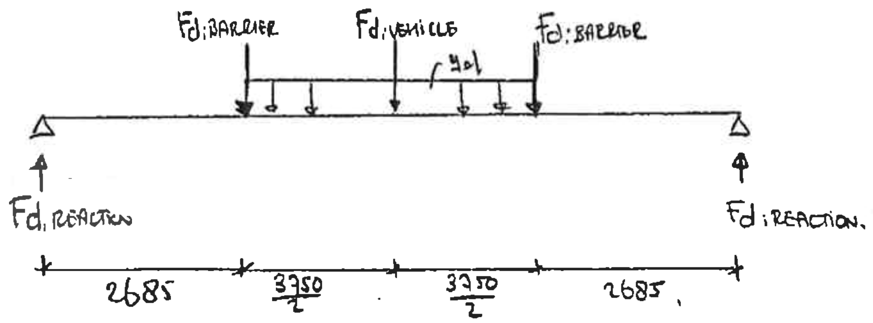
DETERMINATION OF LOADS FOR HEB 340

* DEAD LOAD : GRATING : 0,87 kN/m² ⇒ q = 0,87 × 2,75 = 2,4 kN/m'
  HEB 340 : 1,34 kN/m' ⇒ q = 1,34 kN/m'
  HEB 200 : 0,61 kN/m' ⇒ F = 0,61 × 2,75 = 1,68 kN
  BARRIER : 0,72 kN/m' ⇒ $F_{BARRIER}$ = 0,72 × 2,75 = 1,98 kN.

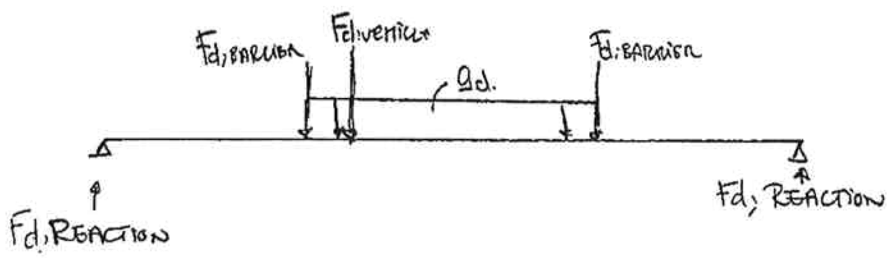
* LIFE LOAD : UNIFORM LOAD : 4,0 kN/m² × 2,75 = 11 kN/m'
  VEHICLE ⇒ $F_{VEHICLE}$ = 50 kN.

$F_{d;REACTION}$ = 111 kN ... (SEE NEXT PAGE ; CHECK HEB 340).

* UNFAVOURABLE SITUATION FOR BENDING MOMENT.



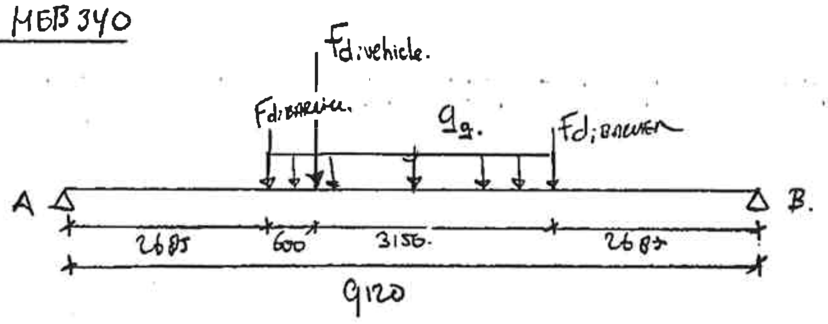
* UNFAVOURABLE SITUATION FOR SUPPORT REACTION.



Opgesteld :	Datum :	Bladnummer :	Rev. :
MPI	14-5-'04	I1-5	0

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: SECONDARY STEEL.

CHECK HEB 340



q_d = 1,35 x (2,4 + 1,34) + 1,5 x 11 = 22,1 kN/m'

$Fd_{VEHICLE}$ = 50 x 1,5 x 1,4 = 105 kN.

$Fd_{BARRIER}$ = 1,35 x 1,9d = 3,1 kN.

R_A = 111 kN

R_B = 81 kN

(UNFAVOURABLE POSITION OF VEHICLE ; SEE SKETCH ABOVE).

DEFLECTION

THE MAXIMUM DEFLECTION u_z = 19 mm (UNIFORM LOAD COMBINED WITH VEHICLE).

ALLOWABLE DEFLECTION = 1/250 L = 1/250 x 9120 = 36,5 mm > 19 mm OK

NOTE: ON THE NEXT PAGE IS A COMPUTER CALCULATION FOR THE HEB 340 INCLUDING LATERAL-TORSIONAL BUCKLING.

Opgesteld :	Datum :	Bladnummer :	Rev. :
MPI	14-5-'04	I1-6	0

EC3 Code Check

Macro 1 Member 1 HEB340 S 355 Ult comb 1 0.73

Basic data EC3	
partial safety factor Gamma M0 for resistance of cross-sections	1.10
partial safety factor Gamma M1 for resistance to buckling	1.10
partial safety factor Gamma M2 for resistance of net sections	1.25

Material data		
yield strength fy	355.00	MPa
tension strength fu	510.00	MPa
fabrication	rolled	

SECTION CHECK
Width-to-thickness ratio for webs (Tab.5.3.1. a).
ratio 20.25 on position 0.91 m

ratio		
maximum ratio	1	58.58
maximum ratio	2	67.53
maximum ratio	3	100.89

==> Class cross-section 1

Width-to-thickness ratio for outstand flanges (Tab.5.3.1. c).
ratio 6.98 on position 0.91 m

ratio		
maximum ratio	1	8.14
maximum ratio	2	8.95
maximum ratio	3	12.27

==> Class cross-section 1

The critical check is on position 4.56 m

Internal forces		
NSd	0.00	kN
Vy.Sd	0.00	kN
Vz.Sd	-52.41	kN
Mt.Sd	0.00	kNm
My.Sd	392.54	kNm
Mz.Sd	0.00	kNm

Only elastic check

Shear check (Vz)
according to article 5.4.6. and formula (5.20)
Section classification is 3.

Table of values		
Vpl.Rd	1045.11	kN
unity check	0.05	

Combined bending, axial force and shear force check
according to article 5.4.9. and formula (5.37)
Section classification is 3.

Table of values		
sigma N	0.00	MPa
sigma Myy	182.03	MPa
sigma Mzz	0.00	MPa

ro 0.00 place 13
unity check 0.56
Element satisfies the section check !

STABILITY CHECK

Buckling parameters	yy	zz	
type	non-sway	non-sway	
Slenderness	62.27	121.12	
Reduced slenderness	0.81	1.59	
Buckling curve	b	c	
Imperfection	0.34	0.49	
Reduction factor	0.72	0.29	
Length	9.12	9.12	m
Buckling factor	1.00	1.00	
Buckling length	9.12	9.12	m
Critical Euler load	9135.74	2414.64	kN

LTB check
according to article 5.5.2. and formula (5.48)

Table of values		
Mb.Rd	537.77	kNm
Beta W	0.90	
reduction	0.77	
imperfection	0.21	
Mcr	1088.18	kNm

LTB		
LTB length	9.12	m
k	1.00	
kw	1.00	
C1	1.35	
C2	0.55	
C3	1.73	

load in center of gravity
unity check =0.73

Compression and bending check
according to article 5.5.4. and formula (5.53)

Table of values	
ky	1.00
kz	1.00
muy	-1.14
muz	-0.63
BetaMy	1.30
BetaMz	1.80

unity check = 0.00 + 0.56 + 0.00 = 0.56

Compression, bending and LTB check
according to article 5.5.4. and formula (5.54)

Table of values	
klt	1.00
kz	1.00
mult	0.16
muz	-0.63
BetaMlt	1.30
BetaMz	1.80

unity check =0.00 + 0.73 + 0.00 = 0.73

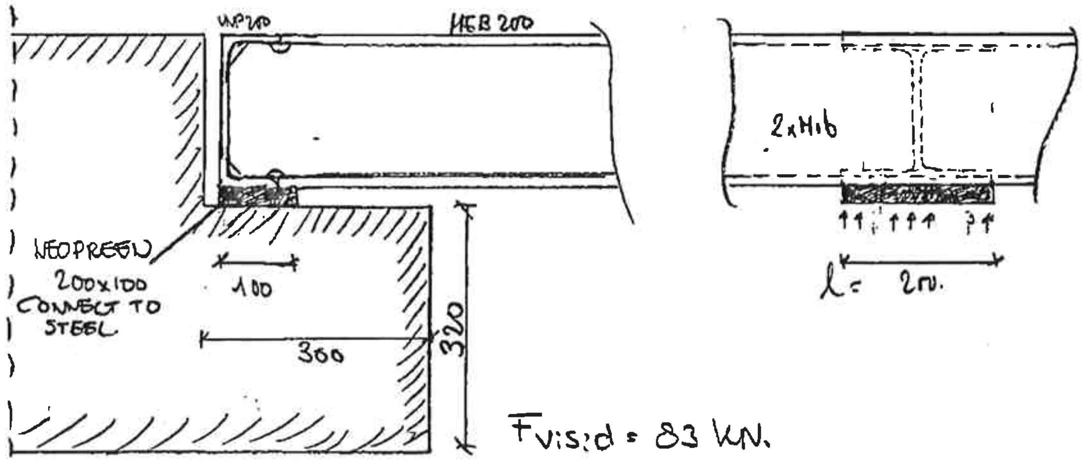
Element satisfies the stability check !

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

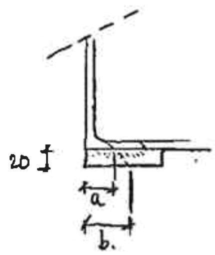
DETAIL: CONNECTION ON CONCRETE "BRIDGE"

~~INNER SUPPORT~~ CONNECTION A.



$F_{v;s;d}$ = 83 kN.

COMPRESSION AREA



a = b_{eff} FOR RUBBER CHECK. = $t_w + R + t_f$ = 8,5 + 11,5 + 11,5 = 31,5 mm

b = b_{eff} FOR CONCRETE CHECK. = a + d_{rubber} = 31,5 + 20 = 51,5 mm.

$$\sigma_a = \frac{F}{A} = \frac{83 \cdot 10^3}{a \times l} = \frac{83 \cdot 10^3}{31{,}5 \times 200} = 13{,}2 \text{ N/mm}^2 < 20 \text{ N/mm}^2$$

$$u.c. = \frac{13{,}2}{20} = 0{,}66 < 1{,}0 \quad \underline{O.K.}$$

CONCRETE C 30/37

$$f_{j;u;d} = \frac{2/3 \times 1{,}0 \times 30}{1{,}5} = 13{,}33 \text{ N/mm}^2 \qquad (\sigma_a < f_{j;u;d} \Rightarrow \underline{O.K.})$$

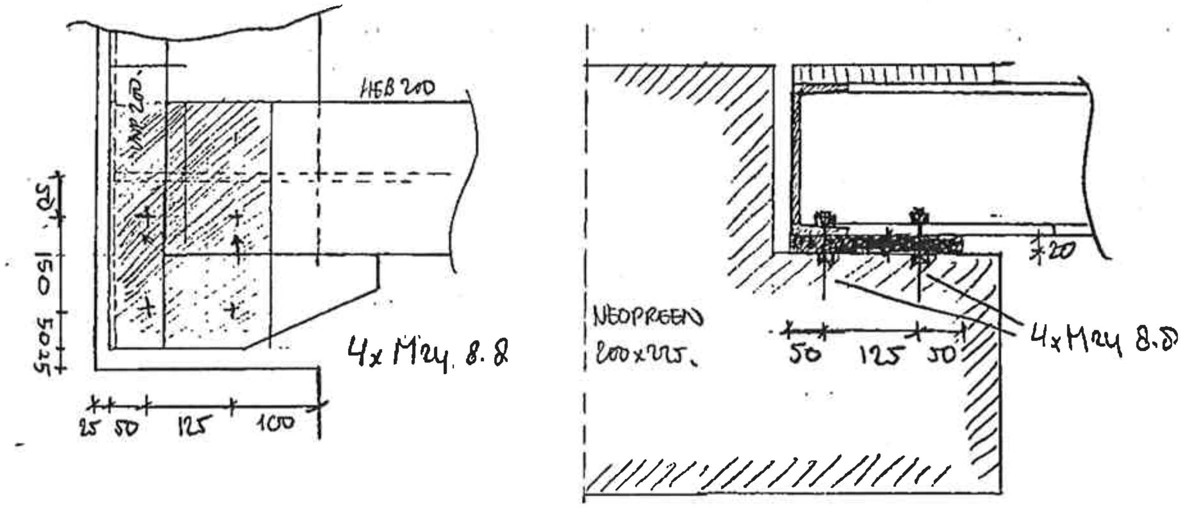
RUBBER STRESS, σ_{rubber} = 13,2 N/mm², IS LOWER THAN THE MAXIMUM CONCRETE STRESS. THE COMPRESSION AREA ON THE CONCRETE IS BIGGER THAN THE COMPRESSION AREA OF THE RUBBER. THE STRESS IN THE CONCRETE WILL BE LOWER THAN 13,2, SO CHECK OF CONCRETE IS O.K.

Opgesteld : MM | Datum : 14-5-'04 | Bladnummer : F1-10 | Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

ENDSUPPORT CONNECTION B.



FULL BRACKING / ACCELERATION OF THE VEHICLE AS SHEAR FORCE ACTIVE ON THE SUPPORT. THE BRACKING / ACCELERATION LOAD OF 30 kN DERIVED FROM THE CALCULATION OF ROADWAY TOPSIDE ; ADDENDUM I_2. (CONSERVATIVE APPROACH).

$F_{v;s;d} = 30 \times 1{,}5 = 45$ kN.

* CHECK ANCHOR FAILURE. (acc. CUR 25).

$V_{R;k;s} = (\alpha_m \times M_{Rk;s}) / l = (1{,}0 \times 1{,}04 \cdot 10^6) / 37 = 28{,}1$ kN.

$V_{Rd;s} = V_{Rk;s} / \gamma_{Ms} = 28{,}1 / 1{,}25 = 22{,}5$ kN.

with:

$\alpha_m = 1{,}0$

$l = a_3 + e_1 = 12 + 25 = 37$ mm.

$a_3 = 0{,}5 \times d = 0{,}5 \times 24 = 12$ mm.

e_1 = RUBBER SPACE + HALF PLATE THICKNESS $= 20 + 1/2 \times 10 = 25$ mm

$M_{Rk;s} = M^0_{Rk;s} \times (1 - \frac{N_{s;d}}{N_{Rd;s}}) = 1{,}04 \cdot 10^6 \times 1{,}0 = 1{,}04$ kNm

$M^0_{Rk;s} = 1{,}2 \times W_{el;anchor} \times f_y = 1{,}2 \times (1/32 \times \pi \times 24^3) \times 640 = 1{,}04$ kNm.

$(1 - \frac{N_{s;d}}{N_{Rd;s}}) = 1{,}0$ (NO TENSION ON ANCHOR).

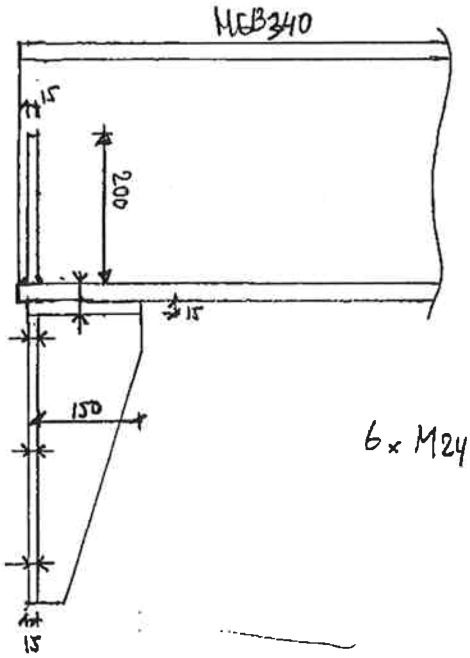
$u.c. = \frac{F_{v;s;d}}{V_{Rd;s}} = \frac{45/4}{22{,}5} = 0{,}50 \leq 1.0$ O.K

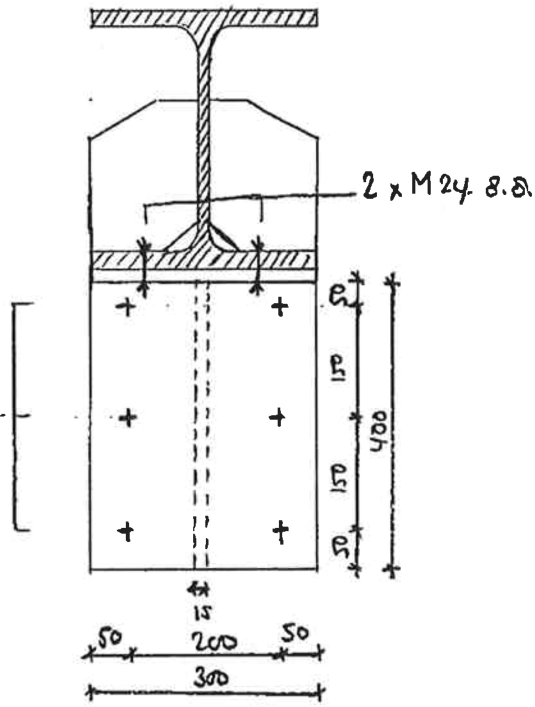
Opgesteld : MPI | Datum : 14-5-'04 | Bladnummer : I1-11 | Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

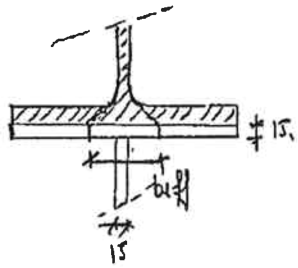
Onderdeel : SECONDARY STEEL

DETAIL CONNECTION C; SUPPORTING CONSOLE HEB 340





$V_{s;d} = 111$ kN. (SEE PAGE)



$b_{eff} = 3 \times 15 + 2 \times 27 = 99$ mm

$A_p = b_{eff} \times t = 99 \times 15 = 1485 \text{ mm}^2$

$\sigma = \frac{F}{A_p} = \frac{111 \cdot 10^3}{1485} = 75 \text{ N/mm}^2$

Opgesteld : MPI

Datum : 14-5-'04

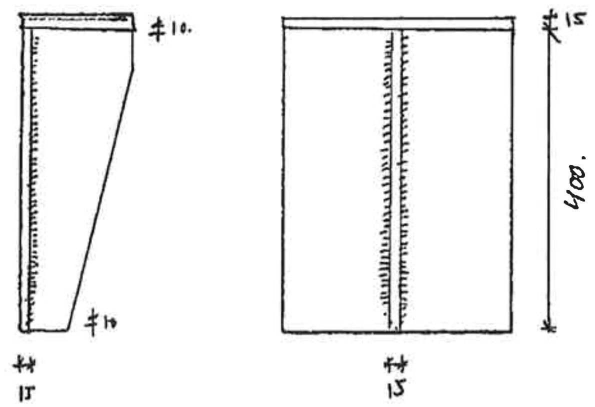
Bladnummer : I1-12

Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

CHECK WELD



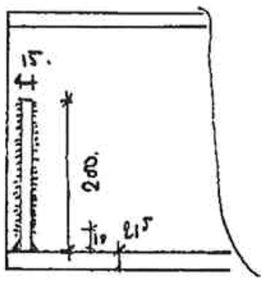
$F_{v;s;d} = 100$ kN.

$$\tau_2 = \frac{F_{v;s;d}}{2 \times a \times l_{eff}} = \frac{100 \cdot 10^3}{2 \times 5 \times 380} = 27\ N/mm^2$$

a = THROAT WELD = 5 mm

l_{eff} = EFFECTIVE LENGTH = 380 mm. (400 - 20).

$\tau_2 = 27\ N/mm^2 < 262\ N/mm^2$ **O.K**



$F_{v;s;d} = 100$ kN,

$$\tau_2 = \frac{1/2 \times F_{v;s;d}}{2 \times a \times l_{eff}} = \frac{1/2 \times 100 \cdot 10^3}{2 \times 5 \times 168,5} = 30\ N/mm^2 < 262\ N/mm^2$$ **O.K**

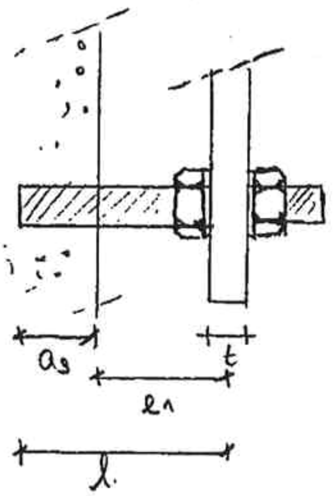
a = 5 mm.

$l_{eff} = 200 - 21,5 - 10 = 168,5$ mm

(PLATES ARE NEEDED FOR LATERAL TORSIONAL BUCKLING).

Opgesteld : MPI Datum : 14-5-'04 Bladnummer : I1-13 Rev. : 0

CHECK ANCHOR FAILURE (acc. CUR 25).



$V_{Rk,sm} = (\alpha_m \times M_{Rk,s}) / l = (2{,}0 \times 0{,}95 \cdot 10^6)/44{,}5 = 42{,}7$ kN.

$V_{R;d;s} = V_{Rk;s} / \gamma_{Ms} = 42{,}7/1{,}25 = 34{,}2$ kN.

with:

$\alpha_m = 2{,}0$

$l = a_3 + e_1 = 12\,mm + 32{,}5\,mm = 44{,}5\,mm$

$a_3 = 0{,}5\,d = 0{,}5 \times 24 = 12\,mm$

e_1 = GROUTING SPACE + HALF PLATE THICKNESS

$= 25 + \frac{1}{2} \times 15 = 32{,}5$ mm

$M_{Rk;s} = M^0_{Rk;s} \times (1 - N_{s;d}/N_{Rd;s}) = 1{,}04 \times (1 - \frac{17{,}2}{201{,}7}) = 0{,}951$ kNm

$N_{s;d} = (30\,kN \times 0{,}4) \times 0{,}35 = 34{,}3$ kN $\Rightarrow$ PER ANCHOR = 17,2 kN

$M^0_{Rk;s} = 1{,}2 \times W_{el;anchor} \times f_y = 1{,}2 \times \left(\frac{\frac{1}{64} \cdot \pi \cdot 24^4}{12}\right) \times 640 = 1{,}043$ kNm.

$N_{Rd;s} = A_s \times f_{uk} / \gamma_{Ms} = (353 \times 800)/1{,}4 = 201{,}7$ kN.

CHECK

$$u.c. = \frac{V_{s;d\ per\ anchor}}{V_{Rd;s}} = \frac{110{,}6}{34{,}2} = 0{,}54 < 1{,}0.$$

BEARING

$$F_{b;Rd} = \frac{2{,}5 \cdot \alpha \cdot f_u \cdot d \cdot t}{\gamma_{mb}} = \frac{2{,}5 \times 0{,}64 \times 510 \times 24 \times 15 \cdot 10^{-3}}{1{,}25} = 235 \text{ kN.}$$

with:

$\gamma_{mb} = 1{,}25$

$\alpha = \frac{e_1}{3 d_0} = \frac{50}{3 \times 26} = 0{,}64$ OR $\frac{p_1}{3 d_0} - \frac{1}{4} = \frac{150}{3 \times 26} - \frac{1}{4} = 1{,}67$. OR $\frac{f_{ub}}{f_u} = \frac{800}{360} = 2{,}22$

$d = 30\,mm$

$b = 15\,mm$

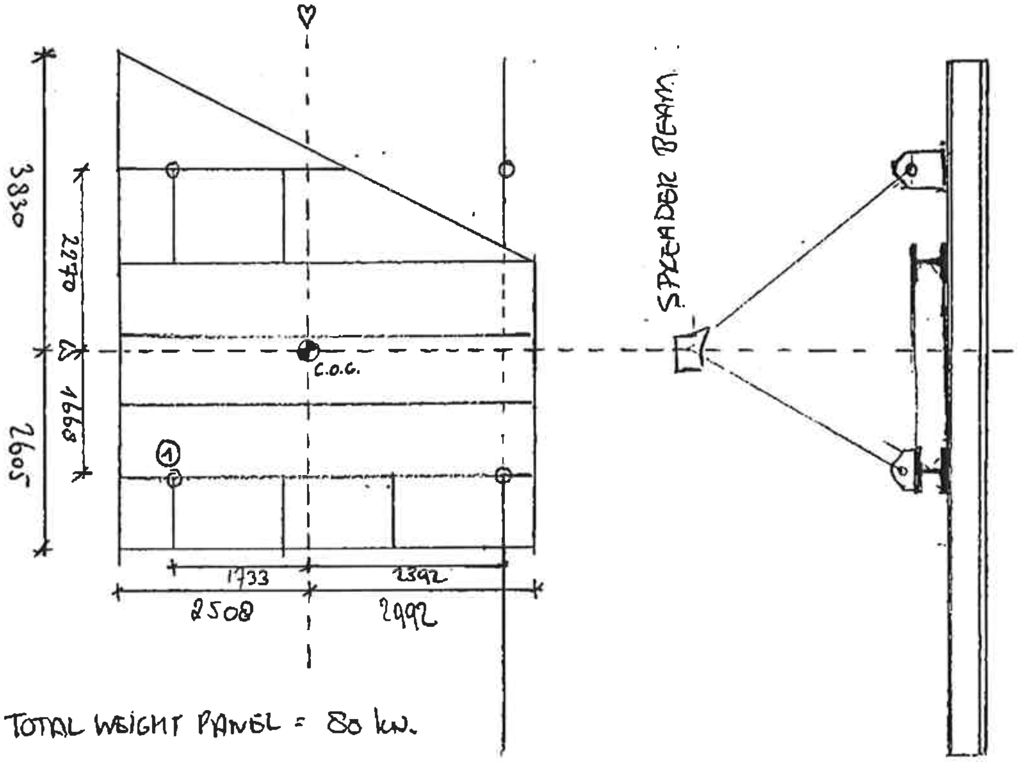
$$u.c. = \frac{F_{s;d}}{F_{b;Rd}} = \frac{111{,}6}{235} = 0{,}08 < 1{,}0.$$

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

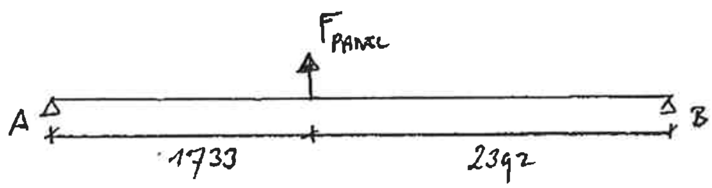
LOCATION PAD-EYES

TO REMOVE THE ROADWAY, SOME PAD-EYES WILL BE NEEDED.



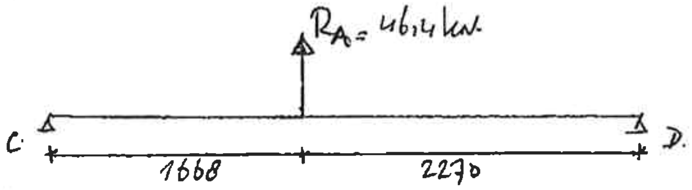
TOTAL WEIGHT PANEL = 80 kN.

DETERMINATION ON PAD-EYE LOAD:



R_A = 46,4 kN.

R_B = 33,6 kN



R_C = 26,8 kN. ⇒ POSITION 1. ⇒ F = 30 kN.

R_D = 19,6 kN.

Opgesteld : MPI

Datum : 14-5-'64.

Bladnummer : I1-15

Rev. : 0

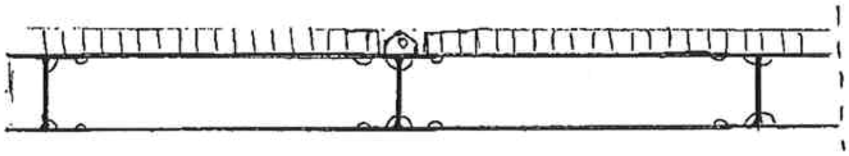
Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

CALCULATION PAD-EYE. (acc. ENV 1993-1-1).

* LOCATION 1.

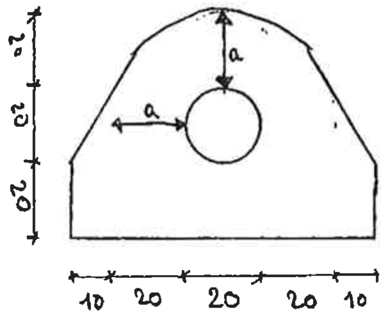
USE GREEN PIN 4,75 TON.



LOAD ON PAD-EYE AT LOCATION 1 IS DETERMINATED ON THE PREVIOUS PAGE.

$F = 30$ kN.

LIFTFACTOR; $\gamma = 1{,}3$.



$$a \geq \frac{F_{sd} \times \gamma_{Mp}}{2 \times b \times f_y} + \frac{2 \times d_0}{3} = \frac{39 \cdot 10^3 \times 1{,}25}{2 \times 25 \times 355} + \frac{2 \times 20}{3} = 16\,mm$$

$= 20\,mm$

with:

$F_{s;d} = 30 \times 1{,}3 = 39$ kN.

t = PLATE THICKNESS = 25 mm.

d_0 = HOLE DIAMETER = 20 mm

γ_{Mp} = MODEL FACTOR = 1,25

SHEAR:

$V_{s;d} = F_{s;d} = 39$ kN.

$A = 80 \times 25 = 2000\,mm^2$

$\tau = \frac{39 \cdot 10^3}{2000} = 19{,}5\,N/mm^2$

$u.c. = \frac{19{,}5}{\frac{(355/1{,}1)}{\sqrt{3}}} = 0{,}11 < 1{,}0.$

MOMENT:

$M_d = V_{s;d} \times e = 39 \cdot 10^3 \times 30 = 1{,}17$ kNm

$W_{y;el} = 1/6 \times b \times h^2 = 1/6 \times 25 \times 80^2 = 26{,}67 \cdot 10^3\,mm^3$

$\sigma = \frac{1{,}17 \cdot 10^6}{26{,}67 \cdot 10^3} = 44\,N/mm^2$

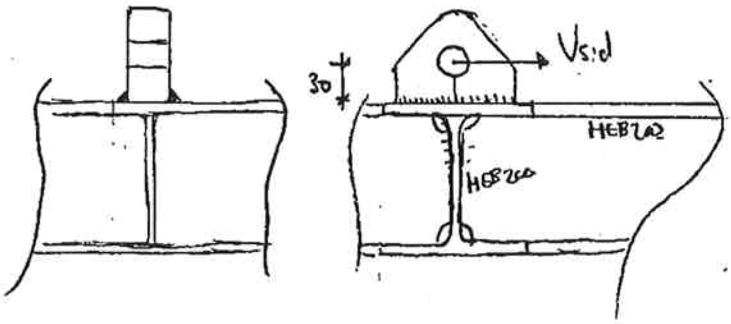
$u.c. = \frac{44}{355/1{,}1} = 0{,}14 < 1{,}0.$

Opgesteld: MPI | Datum: 14-5-'04 | Bladnummer: I1-16 | Rev.: 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

CHECK WELD



* WELD CHECK DUE TO MOMENT.

a = 5 mm.

$M_{y;s;d} = V_{s;d} \times e = 39 \cdot 10^3 \times 30 = 1{,}17\ \text{kNm}$

$W_{y;weld} = 1/6 \times (2 \times 5) \times 80^2 = 10667\ \text{mm}^3$

$\sigma = \frac{1{,}17 \cdot 10^6}{10667} = 110\ \text{N/mm}^2 < 262\ \text{N/mm}^2$

* WELD CHECK DUE TO SHEAR

$\tau_2 = \frac{V_{s;d}}{2 \cdot a \cdot l_{eff}} = \frac{39 \cdot 10^3}{2 \times 5 \times 80} = 49\ \text{N/mm}^2 < 262\ \text{N/mm}^2$

a = mm

$l_{eff} = 80\ \text{mm}$

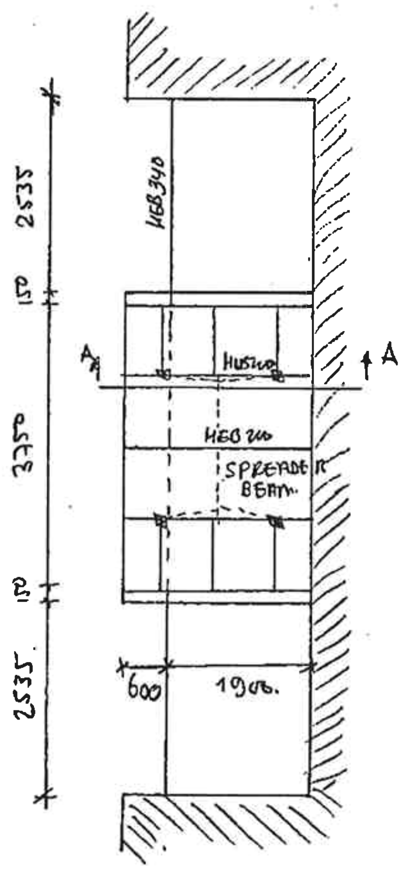
COMBINED.: $\sigma_{w;s;d} = 1/\sqrt{3} \times \sqrt{4 \times 110^2 + 3 \times 49^2} = 136\ \text{N/mm}^2 < 262\ \text{N/mm}^2$ O.K.

Opgesteld : MPI | Datum : 14-5-'04 | Bladnummer : I1-17 | Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL.

REMOVABLE ROAD ACCES FRAME AT REBATE

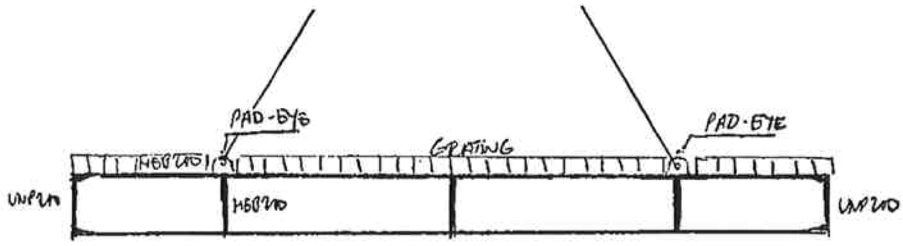


PRINCIPLE OF ROAD STRUCTURE EQUAL TO ROAD TOPSIDE.

FOR CALCULATION REFFERED TO ROAD TOPSIDE; I_2

THIS STRUCTURE IS NOT GOVERNING.

FOR LIFTING THE PANEL USE SPREADER BEAM



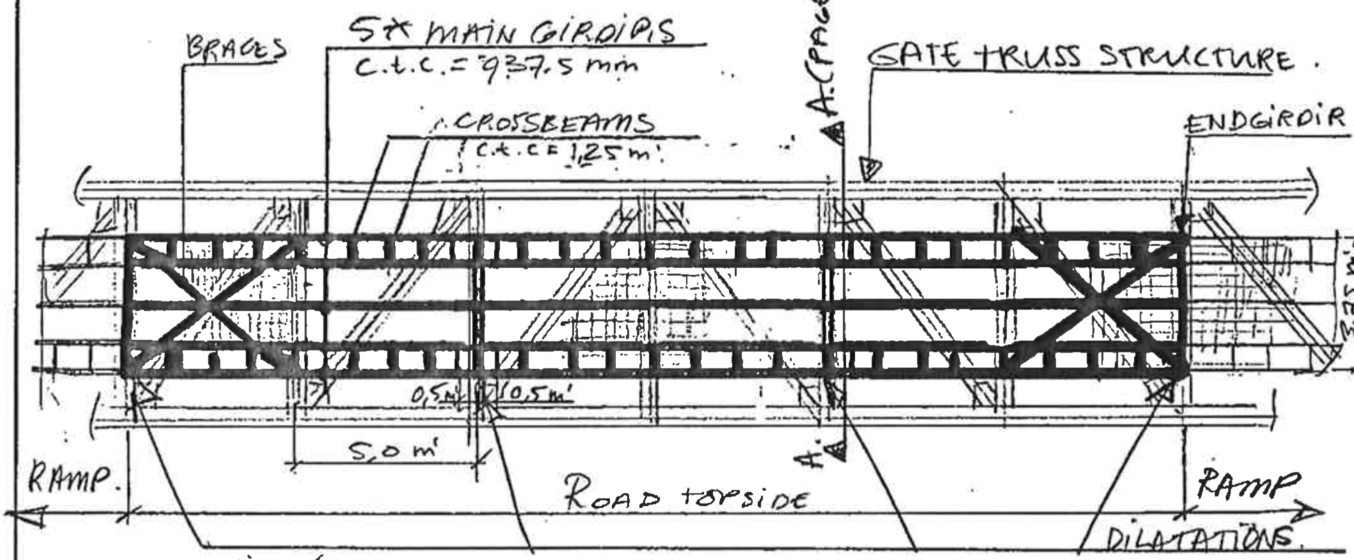
SECTION A-A

FOR DIMENSION OF PAD-EYE SEE PAGE I_1-16.

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD TOPSIDE.

(I2) ROAD TOPSIDE.



TOPVIEW.

- STEELGRADE : S355 JR
- MAINGIRDIRS : HEB200 (CALCULATED HEA200 2))
- CROSS BEAMS : HEB200 (CALCULATED HEA200 2))
- END GIRDIR : UNP200.
- GRATING : "THIELCO; SLINGERSTRAFROOSTER" (TYPE A 60/5. acc. PAGE I2-19.
- WELDS : • FRAME a=t
  • ALL OTHERS U.N.O. a5.
  • BARRIER CONNECTION

NOTES:

1) CALCULATION ROAD RAMP TOPSIDE; SEE CALC. I3.
CONNECTION DETAIL ROADTOPSIDE - RAMP; " " I3.

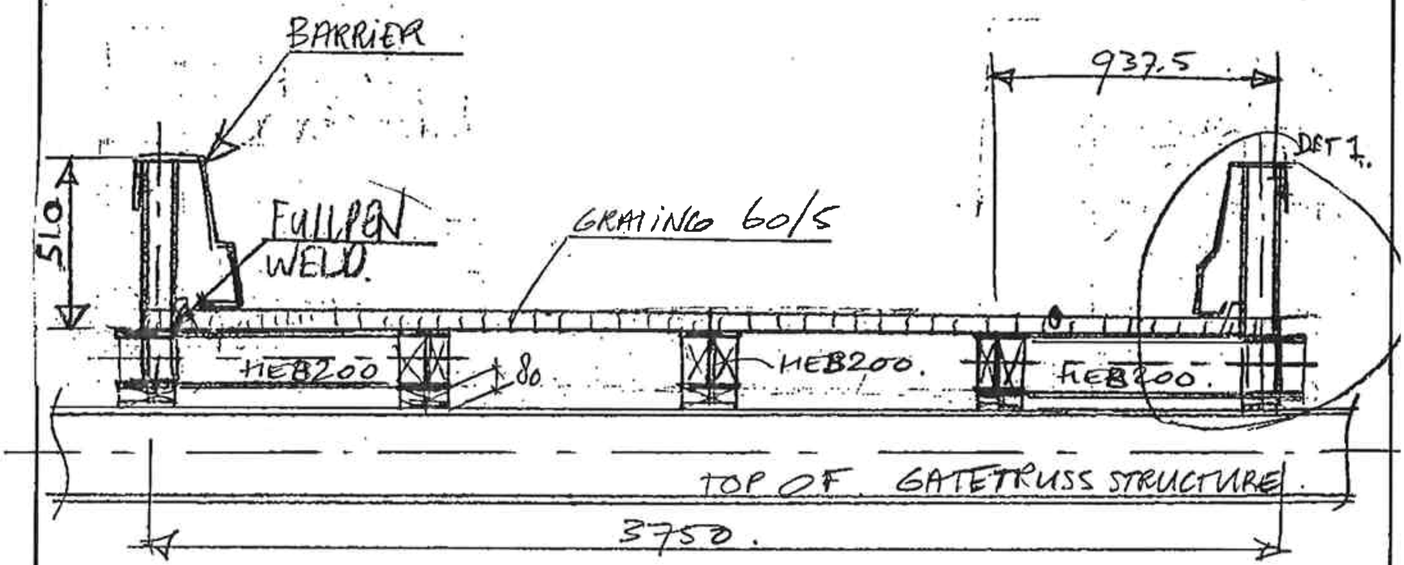
2) TAKING INTO ACCOUNT CORROSION-ALLOWANCE.

Opgesteld : Alsemgeest | Datum : 15 DEC '03 | Bladnummer : I2-1 | Rev. : 0

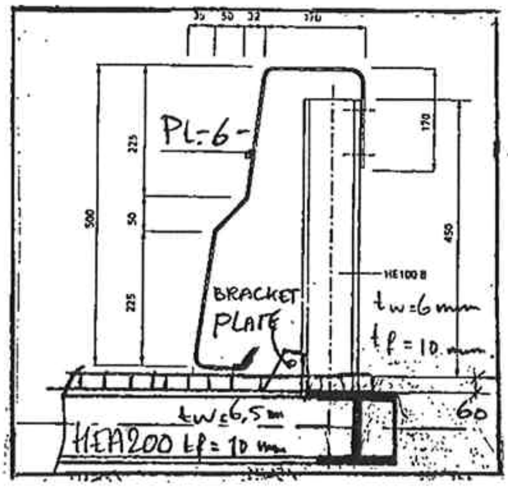
Project : Malamocco Nav. Lock Gate.

Onderdeel : Road topside.

SECTION A-A : TYPICAL FIELD SECTION.



DETAIL 1: BARRIER (EQUAL TO MINI-STEP BARRIER; INFO: I2-14 TO-16

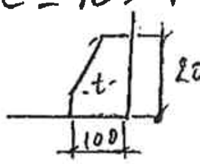


BARRIER CLASS: N1 ACC. NEN-EN 1317-1(MAY

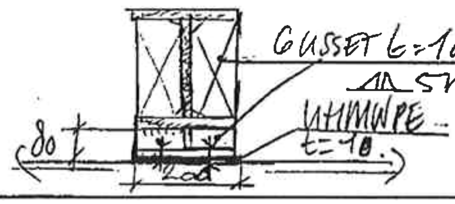
SEE PAGE I2-16

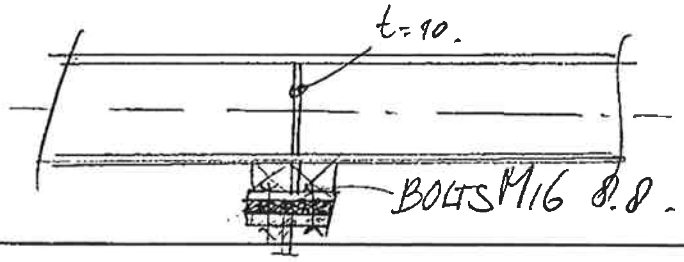
WELD: HEB100 TO HEB200 FULL PEN.

BRACKET PLATE: t = 10 ~~4~~ 5



DETAIL 2: FIELDCONNECTION TO GATE TRUSS STRUCTURE.





Opgesteld : Alsemgeest | Datum : 15 DEC. 03 | Bladnummer : I2-2. | Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD TOPSIDE

LOADS

PERSITANT

Ⓐ INNERBEAM: P.BEAM (× 0,938)

G GRATING 60/5. = 87 kG/m² = 0,87 kN/m² => 0,82 kN/m'

G HEA200 = 42 kG/m' => 0,42 kN/m'

G PER BEAM = 1,24 kN/m'.

Ⓑ OUTER BEAM:

G GRATING 60/5 ~ ½ Ⓐ = 0,41 kN/m'.

G HEA200 = 0,42 kN/m'

G BARRIER* = 0,72 kN/m'.

G PER BEAM = 1,55 kN/m'

* G BARRIER/m': HEB100: 0,51 · 20,4 / 1,25 [kG/m] = 0,08 kN/m'

PLATE (t=8mm) : ca [1000·8·1000]·78,5·10⁻⁹ = 0,63 kN/m'.

0,72 kN/m'.

LIFE LOAD

* UNIFORM LOAD = 4.0 kN/m². q Ⓐ = 3,75 kN/m'

q Ⓑ = 1,88 kN/m'.

* VEHICLE:

CONCENTRATED LOAD: 50 kN

ASSUMED: ↳ 4 WHEELS: 4 × [0,2 × 0,2] $F_{v/p. BEAM}$ = 25 kN.

↳ c.t.c. WHEELS ≅ 1,2 m'.

→ dynamic FACTOR = 1,4

Opgesteld: DA. Datum: 15 DEC '03. Bladnummer: T2-3 Rev.: 0

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD TOPSIDE.

* BRACKING / ACCELERATION LOAD. (ACC. ENV1991-3 art. 5.3.2.2)

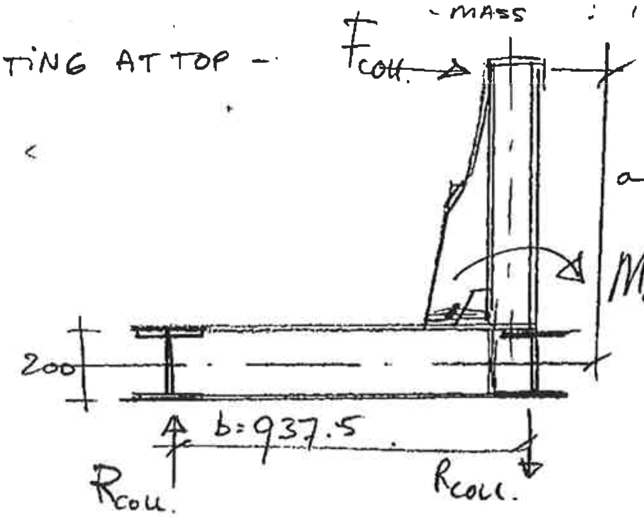
60% OF G VEHICLE = 0,6 · 50 = 30 kN.

* COLLISIONFORCE: ACC. NEN-EN 1317-1 (MAY 1998).

VALUE COLLISION FORCE WILL BE DERIVED FROM;
"HANDBOEK BERMBEVEILIGINGSVOORZIENINGEN" OF C.R.O.W. TABLE 2.3.

CHOSEN BARRIER SIMULAR TO FIG. 12.18 (PAGE I2-15); MINI STEP BARRIER;
- PRESTATION CLASS N1 ACC. I2-16; CONSISTING OF VEHICLE TB3.1.
- PERPENDICALAR COLLISSION FORCE ACC. I2-17; 59,2 kN.
- REPRESENTS: PERS. VEHICLE: - VELOCITY: 80 km/h; - ANGLE: 20 DEGREES; - MASS: 1500 kG } FAR HIGHER THEN ACTING IN THIS SITUATION (CONSERVATIVE)

ASSUME: ACTING AT TOP -



$a = 510 + \frac{190}{2} = 605.$

$F_{coll.} = 59,2 = 60$ kN.

$M_{coll} = F_{coll} \cdot a = 36,3$ kNm.

$R_{coll} = M_{coll}/b = 39$ kN.

ASSUME ACTING AT MID OF SPAN OF 5m.

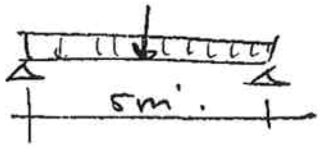
Opgesteld: DA | Datum: 15 DEC. 03 | Bladnummer: I2-4 | Rev.: 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ROAD TOPSIDE

CHECKS ACC. ENV 1993-1-1.

CHECK INNER BEAM Ⓐ HEA200



		REPR.		DESIGN.
$M_G = \frac{1}{8} \cdot q l^2 = \frac{1}{8} \cdot 1{,}24 \cdot 5{,}0^2 =$		3,9	$\times$ 1,35 =	5,23 kNm.
$M_q =$ "	$= \cdot 3{,}75 \cdot 5{,}0^2 =$	11,7	$\times$ 1,5 =	17,59 kNm.
$M_F = \frac{1}{4} F l = \frac{1}{4} \cdot 25 \cdot 5 =$		31,25	$\times$ 1,5 $\times$ 1,4 =	65,63 kNm.
$M_Ⓐ =$			=	**88,5 kNm'**
$V_G = \frac{1}{2} q l = \frac{1}{2} \cdot 1{,}24 \cdot 5{,}0 =$		3,1	$\times$ 1,35 =	4,2. kN
$V_q = \frac{1}{2} q l = \frac{1}{2} \cdot 3{,}75 \cdot 5{,}0 =$		9,4	$\times$ 1,5 =	14,0 "
$V_F = \frac{1}{2} F = \frac{1}{2} \cdot 25$		12,5	$\times$ 2,1 =	26,3 "
$V_Ⓐ = R_Ⓐ$.			=	**44,5 kN**

CLASS 3 PROFILE !

SHEAR: $V_{el;Rd} = A_v \cdot [f_y / \sqrt{3}] / \gamma_{m0}$.

$= 1808 \cdot [355/\sqrt{3}] / 1{,}1 = 337$ kN ; ✓

u.c. = $V_{Ⓐ;0} / V_{el;Rd} = 0{,}13 < 1{,}0$ ✓

BENDING: $M_{V;Rd} = W_{el} \cdot f_y / \gamma_{m0}$.

$= 388{,}6 \cdot 10^3 \cdot 355 / 1{,}1 = 125{,}4$ kNm.

u.c. = $\frac{M_Ⓐ}{M_{V;Rd}} = 0{,}7 < 1{,}0$; ✓

Opgesteld : DA. Datum : 15 DEC. 03 Bladnummer : I2-5 Rev. : 0.

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : ROAD TOPSIDE.

LATERAL-TORSIONAL BUCKLING OF BEAMS

acc. 5.5.2 + ANNEX F.

$M_{b;Rd} = \chi_{LT} \cdot \beta_w \cdot W_{pl;y} \cdot f_y / \gamma_{m0}$

$W_{el;y} = 388{,}6 \cdot 10^3 \; mm^3$

$W_{pl;y} = 429{,}5 \cdot 10^3 \; mm^3$

$\beta_w = 0{,}9$

$\alpha_{LT} = 0{,}21$

$L = 5000 \; mm$

$i_z = 49{,}8 \; mm$

$h = 190 \; mm$

$t_f = 10 \; mm$

$C_1 = 1{,}132$

ACC. F.2.4

$$\lambda_{LT} = \frac{5000/49.8}{\sqrt{1{,}132} \cdot \left[1 + \frac{1}{20}\left[\frac{5000/49.8}{190/10}\right]^2\right]^{0{,}25}} = 75{,}85$$

$$\varepsilon = \left[\frac{235}{355}\right]^{0{,}5} = 0{,}81$$

$$\lambda_1 = 0{,}81 \cdot 93{,}9 = 76{,}4$$

$$\bar{\lambda}_{LT} = \left[\frac{\lambda_{LT}}{\lambda}\right] \cdot \beta_w^{0{,}5} = \frac{75{,}85}{76{,}4} \cdot [0{,}91]^{0{,}5} = 0{,}95$$

$$\phi_{LT} = 0{,}5[1 + 0{,}21(0{,}95 - 0{,}2) + 0{,}95^2] = 1{,}031$$

$$\chi_{LT} = \frac{1}{1{,}027 + [1{,}027^2 - 0{,}95^2]^{0{,}5}} = 0{,}77$$

Opgesteld : DA

Datum : 15 dec 03

Bladnummer : Ic-6

Rev. : 0.

Project : MALAMOCCO NAV. LOCKGATE.

Onderdeel : ROAD TOPSIDE

$$M_{B;RD} = 0{,}765 \cdot 0{,}9 \cdot 429{,}5 \cdot 10^3 \cdot 355 / 1{,}1.$$

$$= 95 \text{ kNm}.$$

$$u.c. = \frac{M_{Ⓐ}}{M_{B;RD}} = 88{,}5/95 = 0{,}93 < 1{,}0 ;$$

DEFLECTION:

* DUE TO VARIABLE LOAD:

$$u_{q_{Ⓐ}} = \frac{5 q_{Ⓐ} l^4}{384 EI} = \frac{5 \cdot 3{,}75 \cdot (5000)^4}{384 \cdot 2{,}1 \cdot 10^5 \cdot 3692 \cdot 10^4} = 4{,}0 \text{ mm}$$

$$u_{Fv.} = \frac{F l^3}{48 EI} = \frac{25 \cdot 10^3 \cdot 1{,}4 \cdot (5000)^3}{48 \cdot 2{,}1 \cdot 10^5 \cdot 3692 \cdot 10^4} = \boxed{12{,}0} \text{ mm}$$

MAX. DEFLECTION = 12 mm / 5,0 m = $\frac{1}{416} * L$ } o.k.

ALLOWABLE : $\frac{1}{250} * L$

* DUE TO PERSISTANT LOADS.

$$u_{GⒶ} = u_{q_{Ⓐ}} \cdot \frac{1{,}24}{3{,}75} = 1{,}3 \text{ mm}.$$

→ CLEARENCE BETWEEN ROAD BRIDGE AND GATE TRUSS STRUCTURE,
TAKE 80 mm.

Opgesteld : DA Datum : 15 DEC 03 Bladnummer : I2-7 Rev. : 0

Project : Malamocco Nav. Lock Gate.

Onderdeel : Road topside.

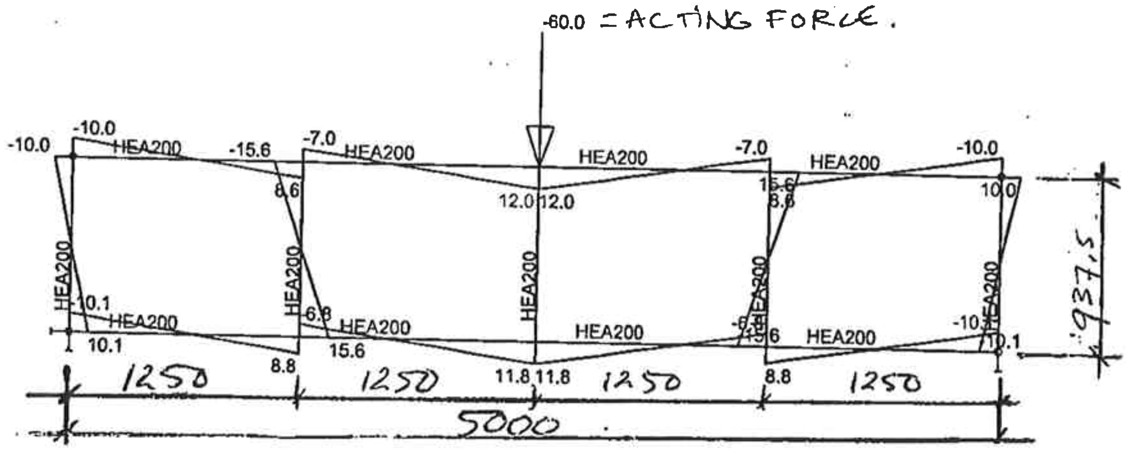
CHECK OUTER BEAM. (B) HEA 200.

			DESIGN LOAD	$*\psi/\gamma$ =	ACCIDENTAL	
BENDING IN PLANE: $M_{G;D}$ =	$5{,}23 \cdot \frac{1{,}55}{1{,}24}$	=	6,54	$*1{,}0/1{,}85$ =	4,85	kNm
$M_{q;D}$ =	$17{,}59 \cdot \frac{1{,}88}{3{,}75}$	=	8,82	$*0{,}7/1{,}5$ =	4,12	"
$M_{F;D}$ =	65,63	=	65,63	$*0{,}7/1{,}5$ =	30,63	"
$M_{F coll;D}$ =	$\frac{1}{4} \cdot R_{coll} \cdot l = \frac{1}{4} \cdot 39.5$ =			=	48,8	kNm
$M_{y;tot;s;D}$.		=	81 kNm.	⇒	89	kN/m

BENDING OUT PLANE

DUE TO COLLISION FORCE F_{coll} PERPENDICULAR TO BARRIE THE TWO OUTER BEAMS ACT AS "VIERENDEEL" BEAM.

MOMENT DISTRIBUTION



$M_{z;s;D}$ = 12,0 kNm (ACCIDENTAL γ=1,0).

Opgesteld : DA

Datum : 15 DEC. 03

Bladnummer : I2-8

Rev. : 0

Project : Malamocco Nav. Lock Gate

Onderdeel : Road: topside.

DESIGN SITUATION.

$$u.c. = \frac{M_{y:s:d:tot}}{M_{R:d}} = 81/125,4 = 0,65 < 1,0 \; ok$$

ACCIDENTAL SITUATION.

$$\frac{M_{y:s:d:tot}}{M_{y:Rd}} + \frac{M_{z:s:d:tot}}{M_{z:Rd}} \leq 1,0$$

$$M_{Nz:Rd} = W_{el:z} \cdot f_y / \gamma_{M0}$$
$$= 133,6 \cdot 10^{3} \cdot 355 / 1,1 = 43 \text{ kNm}$$

$$\frac{89,2}{125,4} + \frac{12,0}{43} = 0,71 + 0,28 = 0,99 < 1,0 \; \underline{o.k}$$

NOTE: CONSERVATIVE COLLISION FORCE
+ CALCULATED WITH HEA 200 INSTEAD OF HEB200

Opgesteld : DA.

Datum : 15 DEC 03

Bladnummer : I2-9

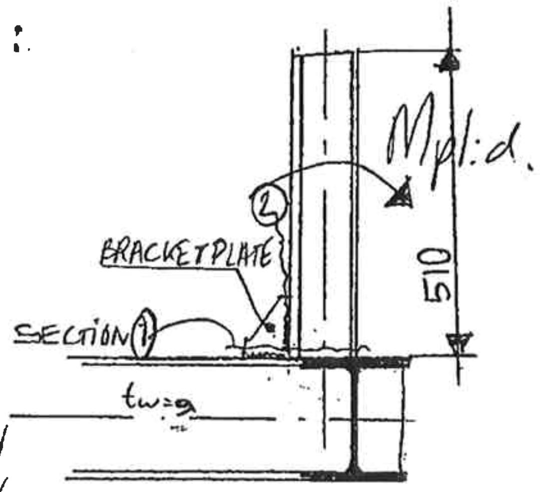
Rev. : 0

Project	:	MALAMOCCO NAV. LOCK GATE
Onderdeel	:	DETAILS LAGOON SIDE

DETAIL ①: CONNECTION BARRIER TO HEB200.

(HEB100 ONTO HEB200 WITH FULL PEN WELD)

CAPACITY HEB100 - COLUMN:



$M_{pl:d}$ HEB100 = $W_{pl:d} \cdot f_y / \gamma_m$

$= 89910 \cdot 355 / 1{,}1$

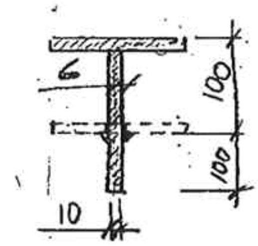
$= 29$ kNm'.

MAX. ACTING LOADING:

SEE I2-4: coll. FORCE = 59,2 kN

$M_d = 59{,}2 * 510 \cdot 10^{-3} = 30{,}2$ kNm

① FORCE IN INNERFLANGE TAKEN OVER BY BRACKETPLATE.



NEW LOWER CROSSSECTION: SEE PAGE I2-20.

$W_{el:d} = 9{,}42 \cdot 10^4$ mm^3

$M_{el:u:d} = W_{el:d} \cdot 355 / 1{,}1 = 30{,}4$ kNm' > 30,2 kNm.

u.c. = 1,0;

ALL WELDS a 5

NOTE: NO CORROSION-ALLOWANCE TAKEN INTO ACCOUNT;
∴ CONNECTION CALCULATED ON CAPACITY HEB100 AND MAX. LOADING (WHICH IN THIS SITUATION OF THE ROADBRIDGE IS HIGHLY CONSERVATIVE).

Opgesteld:	Datum:	Bladnummer:	Rev.:
DA	29-01-04	I2-10.	A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD TOPSIDE

CHECK GRATING 60/5.

c.t.c.-distance HEA200 = $\frac{3750}{4}$ = 937.5 mm' < 1000mm

CHOSEN GRATING "FOR EXAMPLE" "THIELCO" SLINGERSTAAFROOSTER (TYPE A).

acc. TABLE PROD (PAGE I2-19):

q: CAPACITY

$q_{REP;1000mm'}$ = 9855 kG/m²

= 98 kN/m²

q_{ACTING} = 4 kN/m² < 98 ✓.

F CAPACITY

$F_{REP;1000mm'}$ = 21 kN   A=200x200

$F_{ACTING;P.WHEEL}$ = $\frac{50}{4}$ = 12,5 × 1,4 = 17.5 kN < 21 ✓.

(*) CHECK IS ON REPRESENTIVE LOADING (UNFACTORED) DUE TO THE FACT THAT THE SAVETY FACTORS ARE INCLUDED IN TABLE.

γ_{YIELD} = 1,7.

γ_{BREAK} = 2,4.

✓

Opgesteld : D/A.   Datum : 15 DEC. '03   Bladnummer : I2-11   Rev. : 2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD TOPSIDE.

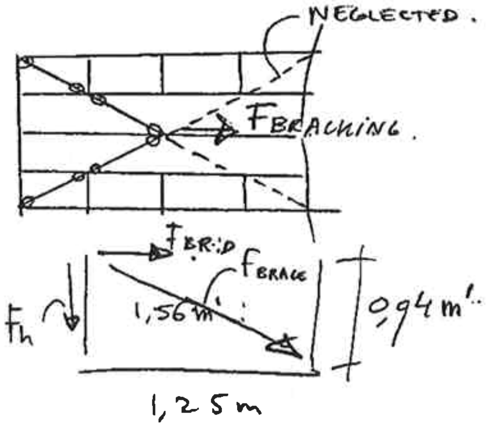
BRACES L50/50/5 * (WELD : a = 5)

$F_{BRACKING}$ = 30 kN (REPR).

$F_{BR;D}$ = 1,5 · 30 = 45 kN

(ASUME ONE BRACE FULL FORCE.)

$F_{BRACE;D} = \frac{1,56}{1,25} \cdot 45 = 56,3$ kN.



L 50/50/5 : $F_{CAP} = A f_y / \gamma_m$

= 480,3 · 355/1,1

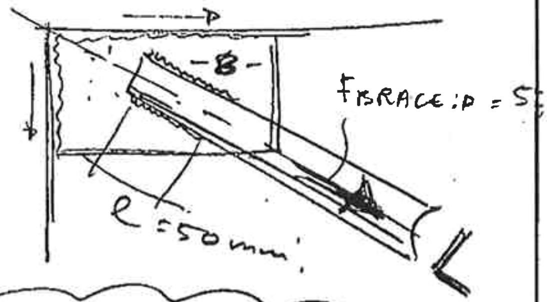
= 155 kN

u.c = 56/155 = 0,36 ; OK

weld length : L50/50/5.

$l = \frac{57 \cdot 10^3}{5 \cdot 262 \cdot 2} = 22$ mm.

TAKE : 50 mm. min.



*

- PLATE THICKNESS : t = 8 mm ; CONSERVATIVE.
- BRACE : L50/50/5. ; U.C. LOW → STILL SUFFICIENT WITH COROSSION -1mm-

Opgesteld : D. Alsemgeest. Datum : 15 DEC. 03 Bladnummer : I2-12 Rev. : 0

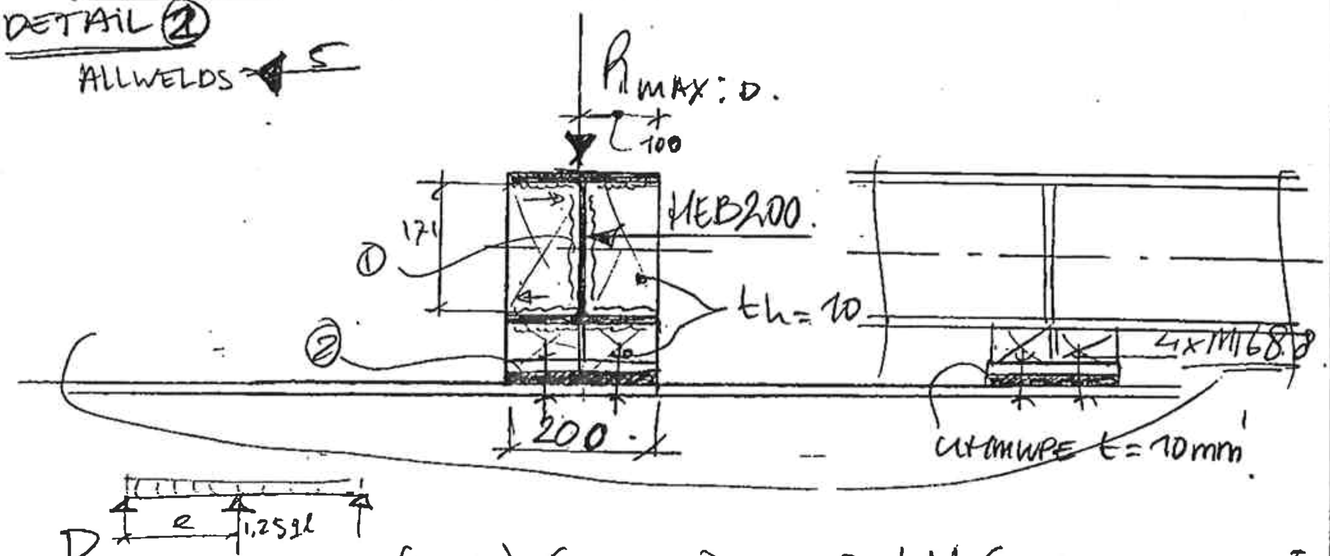
Project : Malamocco Nav. Lock Gate

Onderdeel : Road topside.

CONNECTION TO LOCK GATE.

DETAIL ①

ALLWELDS 5



$R_{D;max} = 1{,}25 \cdot 2 \cdot (4{,}2+14{,}0) + (2{,}6 \cdot 3 \cdot 2) = 98\ kN$ (DERIVED FROM PAGE I2-…)

$\approx 100\ kN$.

① PLATE GOVERNING th=10 (CALC. t=8)

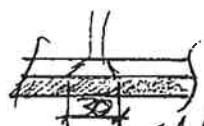
$$\tau = 100 \cdot 10^3 / 2 \cdot 8 \cdot 171 = 38\ N/mm^2$$
$$\tau_{u;d} = 355 / 1{,}1 \cdot \sqrt{3} = 187\ N/mm^2$$
u.c. = 0,2. ok

② PLATE th=10: (CALC t=8)

$\sigma_{pl} = 100 \cdot 10^3 / 8 \cdot 180 = 63\ N/mm^2 < 355/1{,}1$; u.c. = 0,2 ✓

weld: $\sigma_{w;s;d} = 2 \cdot \left[\frac{63 \cdot 8}{2 \cdot 4 \sqrt{2}}\right] \sqrt{3} = 52\ N/mm^2 < 262$; u.c. = 0,2 ✓.

UHMWPE:



$$\sigma_{c;d} = 100 \cdot 10^3 / 200 \cdot 30 = 17\ N/mm^2$$
$$\sigma_{c;u;d} = 22/1{,}1 = 20\ N/mm^2$$
u.c. = 0,85.

Opgesteld : DA. Datum : 15 DEC '03 Bladnummer : I2-13 Rev. : 0.

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD TOPSIDE.

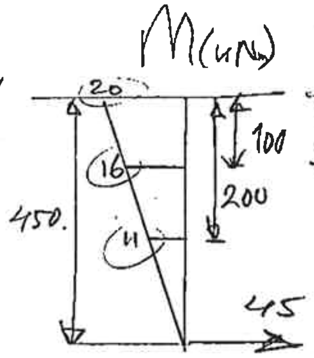
BOLTED CONNECTION M16 8.8.

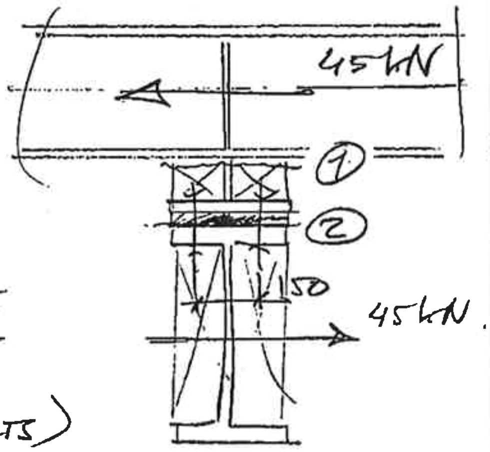
*LOAD: BRAKING 45 kN

- COLLISION: $\frac{60}{2} = 30$ kN

BRAKING GOVERNING.

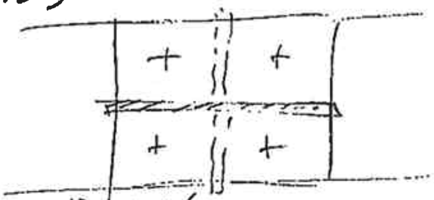
$M_d = 45 \cdot 450 = 20$ kNm.





M_d SECTION ② $= 20 \cdot \frac{250}{450} =$ 11 (CHECK BOLTS)

M_d SECTION ① $= 20 \cdot \frac{350}{450} =$ 16. (CHECK PLATE).



SECTION ①: pl. 300 × 10 (8)

$\sigma = \frac{6 \cdot 16 \cdot 10^3}{8 \cdot 300^2} = 134$ N/mm²; u.c. $= 134 \cdot 1,1/355 = 0,42$ ok

$\tau = \frac{45 \cdot 10^3}{8 \cdot 300} = 19$ N/mm². u.c. $= 19 \cdot 1,1\sqrt{3}/355 = 0,1$ ok

SECTION ②: UHMWPE:

$\sigma = \sigma_{pl} \cdot (t_{pl}/b) = 23$ N/mm² ; $b = 8 \cdot (2 \cdot 8 \sqrt{\frac{355/1,1}{3 \cdot 20}}) = 45$ mm.

$f_{c;u;d} =$ 20 N/mm² } u.c. = 1,18 → conservatief.

BOLTS M16 8.8.

$F_{t;s;d} = M/(h \cdot 2) = 11 \cdot 10^6/(150 \cdot 2) = 37$ kN.

$F_{v;s;d} = 45/4 = 11$ kN.

CAPACITY M16 8.8 ⇒ $F_{tud} = 90.4$ kN, $F_{vud} = 60.3$ kN } ok.

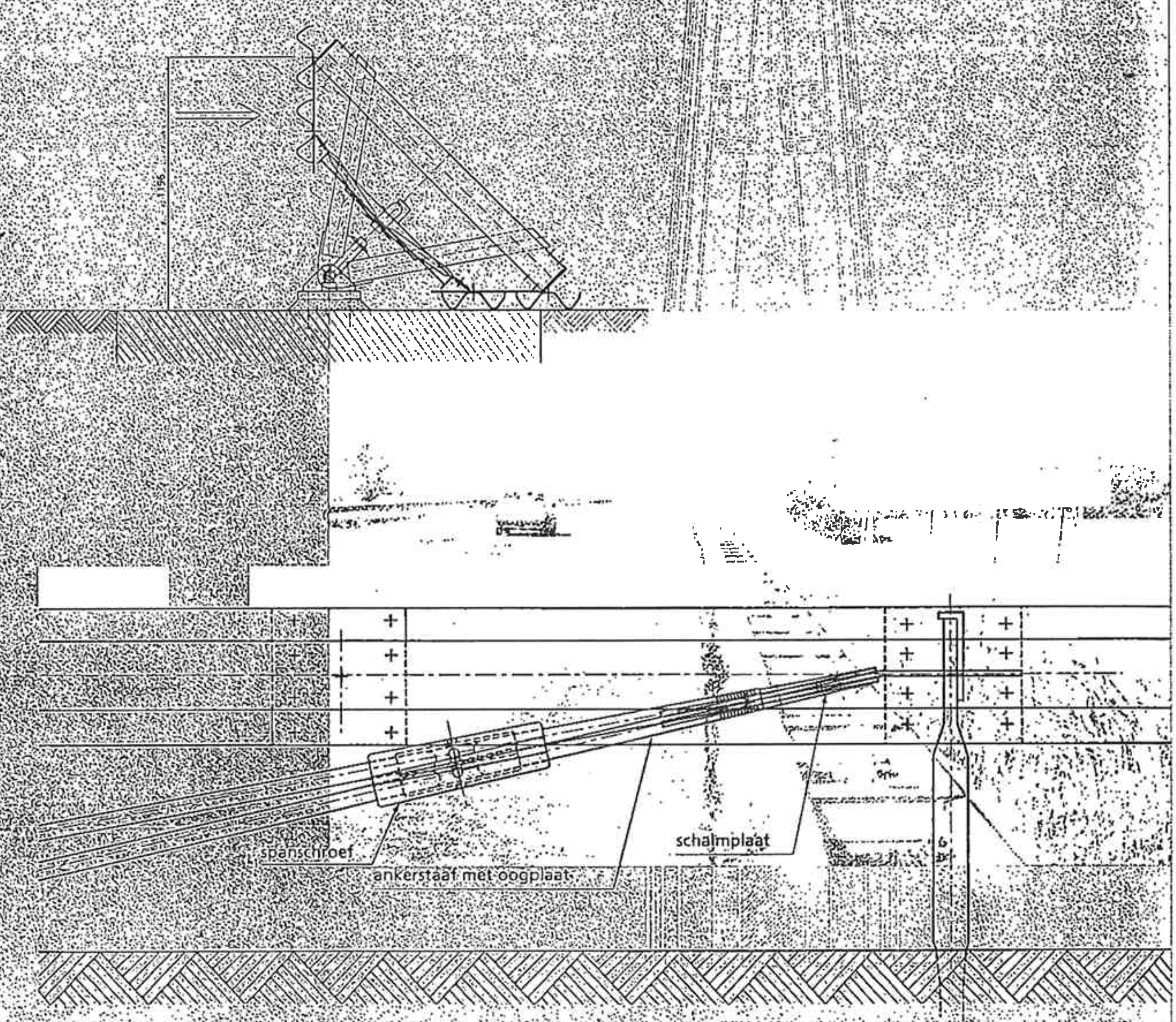
Opgesteld: ALSEMGEEST. Datum: 17 mei 04 Bladnummer: I2-13a. Rev.: A2.

kenniscentrum voor verkeer, vervoer en infrastructuur

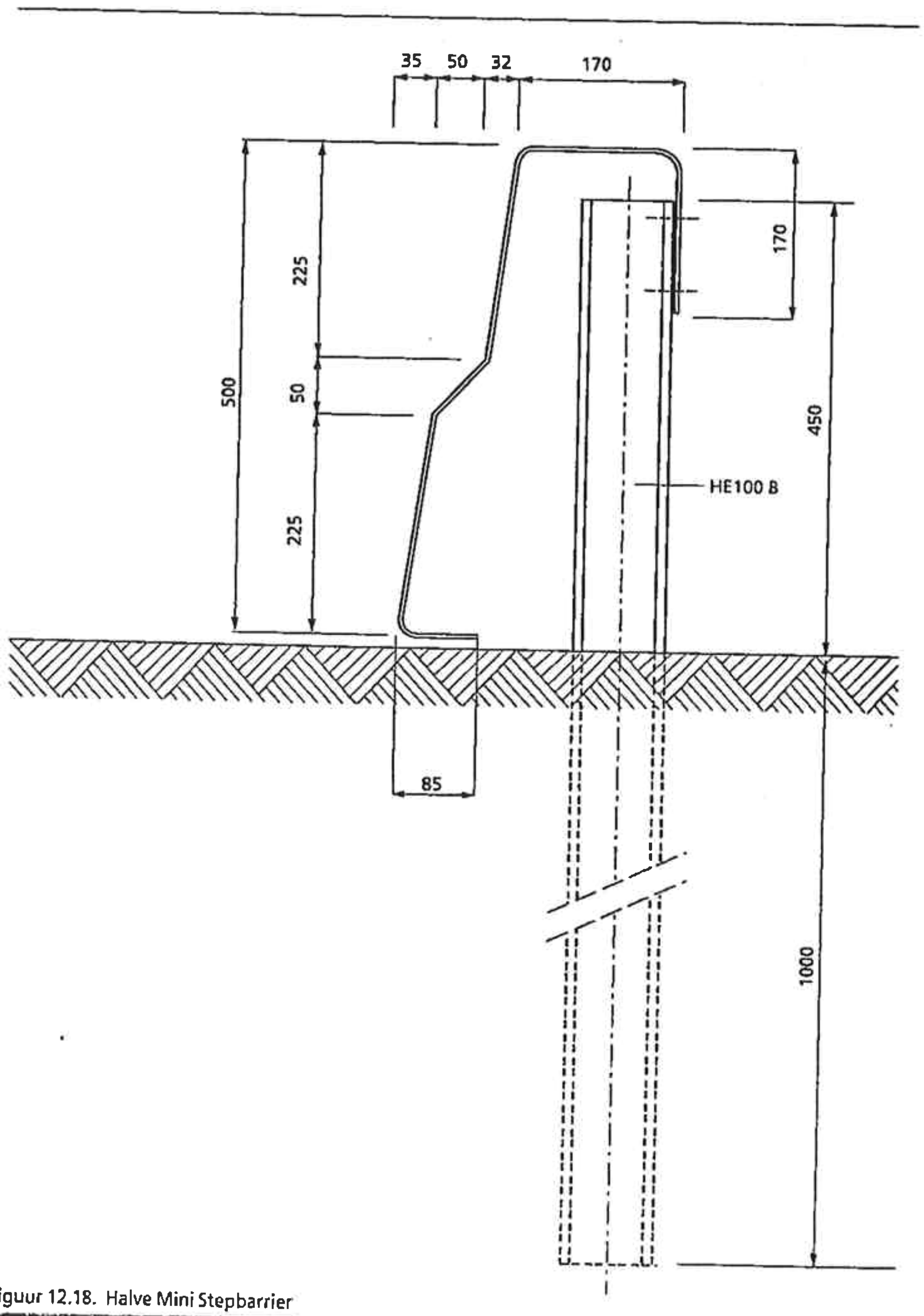
BARRIER INFORMATION.

CROW

Handboek Bermbeveiligingsvoorzieningen



I2-



Figuur 12.18. Halve Mini Stepbarrier

Maten in mm

2,00 m nagenoeg aan de eisen van prestatieklasse H2. Uit de simulaties met de personenauto (TB11) als met de bus (TB51) blijkt, dat de verschillen tussen de stijlafstanden van 2,00 m en 1,33 m klein zijn. De halve stalen (RWS)Stepbarrier moet als een starre geleidebarrier worden aangemerkt. De (statische) uitbuiging bedraagt slechts enkele tientallen millimeters.

12.4 Overige geleidebarriers

In binnen en buitenland zijn verschillende betonnen en stalen geleidebarriers op de markt beschikbaar, die voldoen aan de in NEN-EN 1317 gestelde eisen. Een voorbeeld van een stalen geleidebarrier is de Safe-Guard (Prins Dokkum, figuur 12.13). De geometrie van het aanrijdingsvlak wijkt echter enigszins af van het Stepprofiel.
De Safe-Guard is conform NEN-EN 1317 onderworpen aan botsproeven in de prestatieklasse H2. Bij de proef TB11 was de barrier om de 12,00 m verankerd, terwijl dit bij de TB51-proef om de 4,00 m het geval was.
De resultaten zijn:

- TB11 (personenauto):
  - ASI-waarde 0,9 (A-niveau);
  - werkende breedte W3;
- TB51: werkende breedte W4.

12.5 Ontwikkelingen

12.5.1 Prestatieklasse H4

In bijzondere situaties langs autosnelwegen is het kerend vermogen in de prestatieklasse H2 te gering. Dit kan bijvoorbeeld het geval zijn als maatschappelijke belangrijke voorzieningen moeten worden afgeschermd. De ontwikkeling van een Stepbarrier op H4-niveau is door de Bouwdienst Rijkswaterstaat in samenwerking met het bedrijfsleven ter hand genomen. Simulaties hebben aangetoond dat de volgende prototypen perspectieven bieden:

- figuur 12.14: de stalen (RWS)Stepbarrier;
- figuur 12.15: de betonnen prefab Stepbarrier;
- figuur 12.16: de triangel.

12.5.2 Lage prestatieklassen

Mini (halve) Stepbarrier

Ook op niet-autosnelwegen is het aandeel (ernstige) enkelvoudige ongevallen hoog. In het algemeen zijn wegbeheerders zeer terughoudend met het plaatsen van geleiderailconstructie of geleidebarriers langs deze wegen ter afscherming van gevarenzones zoals bomen en sloten. Deze voorzieningen worden sterk geassocieerd met autosnelwegen, waarmee de herkenbaarheid van de niet-autosnelwegen en het daarmee samenhangende verkeersgedrag in gevaar komt.

Een mogelijke afschermingsvoorziening voor niet-autosnelwegen is de stalen Mini-Stepbarrier en de halve stalen Mini-Stepbarrier (Laura Metaal, figuur 12.17 en figuur 12.18). De barrier conform figuur 12.17 bestaat uit elementen met een lengte van 6,00 m en is om de 12,00 m uitgevoerd met een snelkoppeling. Uit de botsproef op T3-niveau, waarbij de barrier los op de ondergrond was geplaatst, komt naar voren dat de Mini Stepbarrier met snelkoppeling aan de gestelde eisen in de prestatieklasse T3 voldoet:

- TB21:
  - ASI-waarde 0,30 (A-niveau);
  - werkende breedte W2;
- TB41: werkende breedte W5.

In figuur 12.18 is een prototype van een stalen halve Mini-Stepbarrier afgebeeld. Deze uitvoeringsvorm is met behulp van INP-palen in de ondergrond verankerd. Uit computersimulaties met paalafstanden van 1,33 m en 2,00 m en verschillende paalweerstanden met het testvoertuig TB31 (prestatieklasse N1) blijkt, dat

- de ASI-waarde 0,7 à 0,85 is;
- de statische uitbuiging circa 180 mm bedraagt;
- de paalafstand van weinig invloed is.

Wicon

Met name op enkelbaans wegen is het belangrijk dat een afschermingsvoorziening het voertuig niet terugkaatst in de (tegemoetkomende) verkeersstroom. Vanuit deze gedachte is de Wicon (WIelklem geleideCONstructie) ontwikkeld (Prins Dokkum, figuur 12.19). Bij een zwaardere aanrijding breekt een pen af en wordt de rail in een verticale stand gedrukt. De wielen van de auto komen dan in de geleidingsgoot terecht. De gootconstructie houdt het voertuig vast zodat het niet kan terugkeren naar de rijbaan. Een proef op ware schaal met een personenauto (80 km/h, 10° en 900 kg) leerde het volgende:

I2-16

PRESTATION CLASS :

Tabel 2.2. Prestatieklassen geleiderail-constructies

Prestatieklasse		Ontwerpvoertuig(en) (zie tabel 2.1)
Omschrijving	*klasse*	
Laag kerend vermogen, tijdelijke situaties	T1	TB 21
	T2	TB 22
	T3	TB41 + TB21
Normaal kerend vermogen	N1	TB31
	N2	TB32 + TB11
Hoog kerend vermogen	H1	TB42 + TB11
	H2	TB51 + TB11
	H3	TB61 + TB11
Zeer hoog kerend vermogen	H4a	TB71 + TB11
	H4b	TB81 + TB11

Bron: NEN-EN 1317-2 (mei 1998, vrije vertaling)

In het verleden zijn de huidige geleiderailconstructies in Nederland aan diverse botsproeven op werkelijke schaal onderworpen. Die proeven zijn onder bepaalde condities uitgevoerd met personenauto's en autobussen. De huidige Nederlandse geleiderailconstructies zijn (nog) niet getest conform de NEN-EN normen in de klasse H2. Mede op basis van botsproeven op vergelijkbare constructies in het buitenland wordt aangenomen, dat deze voldoen aan de H2-eisen met een ASI-waarde (letselkans) die kleiner is dan 1,0 (tabel 2.4).

Botskrachten

De optredende botskrachten bij aanrijding van gelei constructies zijn afhankelijk van:

- de massa van het voertuig;
- de botssnelheid van het voertuig;
- de hoek waaronder het voertuig de constructie raa (inrijhoek);
- de vervorming van het voertuig;
- de zijdelingse verplaatsing en/of vervorming van constructie.

Omdat het voertuig de constructie onder een hoek a rijdt, ontstaan er zowel krachten evenwijdig aan, als dwars op de constructie. De te stellen eisen ten aanz van stabiliteit, kerend vermogen en mate van deforr worden geheel bepaald door de botskracht loodrech de geleideconstructie.

Door het CEN is de gemiddelde botskracht afhanke van de zijdelingse verplaatsing van de constructie re kundig bepaald (tabel 2.3). Deze waarden zijn indic tief. Benadrukt wordt dat de in de tabel weergegeve botskrachten loodrecht op de constructie gemiddeld zijn. De maximale botskracht (piekwaarde), die ged rende een zeer korte tijd optreedt, is waarschijnlijk 2 à 3 maal zo groot.

Tabel 2.3. Gemiddelde botskrachten loodrecht op constructie per prestatieklasse

Prestatieklasse	Kinetische energie (kJ)	Zijdelingse verplaatsing (m)					
		≤0,10	0,40	0,80	1,20	1,60	2,00
		Gemiddelde loodrechte botsbelasting (kN) AVERAGE PERPEDICULAR COLLISIONFORCE					
T1	6,2	16,8	9,3	5,8	4,2	3,3	2,7
T2	21,5	36,5	24,2	16,7	12,7	10,3	8,6
T3	36,6	46,7	33,8	24,7	19,4	16,0	13,6
N1	43,3	59,2	42,0	30,3	23,7	19,4	16,5
N2	81,9	112,0	79,4	57,2	44,7	36,7	31,1
H1	126,6	93,6	76,6	61,7	51,6	44,4	38,9
H2	287,5	133,0	116,8	100,4	88,1	78,5	70,8
H3	462,1	266,4	227,1	189,8	163,0	142,9	127,1
H4a	572,0	311,3	267,6	225,4	194,7	171,4	153,1
H4b	724,6	269,1	242,1	213,6	191,1	172,8	157,8

Bron: NEN-EN 1317-1 (mei 1998, vrije vertaling)

2 Richtlijnen en normen

2.1 Europese normen

Het Comité Européen de Normalisation (CEN) heeft concrete uitgangspunten en ontwerpnormen vastgesteld, waaraan geleideconstructies moeten voldoen. Deze Europese normen zijn door het Nederlands Normalisatie-instituut gepubliceerd onder NEN-EN 1317-1 en NEN-EN 1317-2. In voorliggend handboek zijn om redenen van leesbaarheid/begrijpbaarheid enkele essentiële gegevens uit deze normen overgenomen. Een geautoriseerde versie in de Nederlandse taal is niet beschikbaar, waardoor met een 'vrije vertaling' is volstaan.

2.1.1 Botsproefcondities

Ontwerpvoertuigen

Het Nederlandse voertuigenpark is wat betreft afmetingen en massa zeer divers samengesteld. De ontwerper zal voor de keuze en de dimensionering van een afschermingsvoorziening in een bepaalde situatie het maatgevende ontwerpvoertuig of de maatgevende combinatie van ontwerpvoertuigen en inrijcondities moeten vaststellen. In tabel 2.1 zijn de genormaliseerde ontwerpvoertuigen met bijbehorende botsproefcondities gegeven.

Prestatieklassen

De norm onderscheidt verschillende prestatieklassen. Een constructie in een bepaalde klasse moet de in tabel 2.2 genoemde voertuigen onder bepaalde voorwaarden keren (het kerend vermogen). Bij de keuze van een permanente geleideconstructie op autosnelwegen moeten conform NEN-EN 1317-1 en 1317-2 de volgende uitgangspunten worden gehanteerd [1]:

- prestatieklasse H2, een hogere klasse moet met redenen zijn omkleed;
- op basis van botsproeven op werkelijke schaal moet zijn aangetoond, dat de te plaatsen constructie voldoet aan de eisen van de gekozen prestatieklasse.

Bij tabel 2.2 dient het volgende te worden opgemerkt:

- De prestatieklasse 'laag' is bedoeld voor tijdelijke situaties (zie afdeling V), maar in tijdelijke situaties mogen ook geleideconstructies in een hogere klasse worden gebruikt.
- Een succesvolle test in de klassen 'hoog' en 'zeer hoog' betekent, dat de constructie ook voldoet aan de eisen van een lagere klasse. Tests in de klassen N1 en N2 zijn echter niet representatief voor tijdelijke situaties (in klasse T enkele zwaardere botsproefcondities).
- Voor tests in de klasse 'zeer hoog' zijn twee verschillende typen zware voertuigen gedefinieerd (de klassen H4a en H4b).

Tabel 2.1. Botsproefcondities geleideconstructies

Test	Type voertuig	Botssnelheid (km/h)	Inrijhoek (°)	Massa voertuig (kg)
TB 11	personenauto	100	20	900
TB 21	personenauto	80	8	1.300
TB 22	personenauto	80	15	1.300
TB 31	personenauto	80	20	1.500
TB 32	personenauto	110	20	1.500
TB 41	vrachtauto	70	8	10.000
TB 42	vrachtauto	70	15	10.000
TB 51	autobus	70	20	13.000
TB 61	vrachtauto	80	20	16.000
TB 71	vrachtauto	65	20	30.000
TB 81	gelede vrachtauto	65	20	38.000

Bron: NEN-EN 1317-2 (mei 1998, vrije vertaling)

UNFACTORED REPRESENTIVE ALLOWABLE LOADING ON GRATING.

BELASTINGSTABELLEN A TYPE

draagstaaf	25/3	30/3	40/3	25/5	30/5	40/5	50/5	60/5
vrijdragende overspanning				verdeelde belasting kg/m²				
500	4750	6475	11325	7090	10305	17895	28350	39410
600	3300	4495	7865	4920	7155	12425	19685	27370
700	2425	3300	5780	3615	5255	9130	14465	20105
800	1865	2530	4425	2770	4025	6990	11075	15395
900	1465	2000	3495	2190	3180	5525	8750	12165
1000	1190	1620	2830	1770	2575	4475	7085	9855
1100	980	1335	2340	1465	2130	3695	5855	8145
1200	825	1125	1965	1230	1790	3105	4920	6840
1300	705	960	1675	1050	1525	2645	4195	5830
1400	605	825	1445	905	1315	2285	3615	5025
1500	530	720	1260	790	1145	1990	3150	4380
1600	465	630	1105	690	1005	1750	2770	3850
1700		560	980		890	1550	2450	3410
1800		500	875		795	1380	2185	3040
1900			785			1240	1965	2730
2000			710			1120	1770	2465
2100								2235
				puntbelasting vlak 200 x 200 mm in kg				
500	550	750	1310	850	1240	2150	3410	4735
600	440	600	1050	680	990	1720	2725	3790
700	365	500	875	570	825	1435	2270	3160
800	315	430	750	485	710	1230	1945	2705
900	275	375	655	425	620	1075	1705	2370
1000	245	336	585	380	550	955	1515	2105
1100	220	300	525	340	495	860	1365	1895
1200	200	270	475	310	450	780	1240	1720
1300	185	250	435	285	415	715	1135	1580
1400	170	230	405	260	380	660	1050	1460
1500	155	215	375	245	355	615	975	1355
1600	145	200	350	225	330	575	910	1265
1700		185	330		310	540	850	1185
1800			310			505	800	1115
1900			290			480	760	1055
2000			275			455	720	1000
2100							680	950
Gewicht (kg/m²)	27	31	37	38	44	55	72	87

Over roosters die extreem zwaar worden belast (bijv. zware heftrucks, vrachtverkeer etc) verstrekken wij u graag informatie.

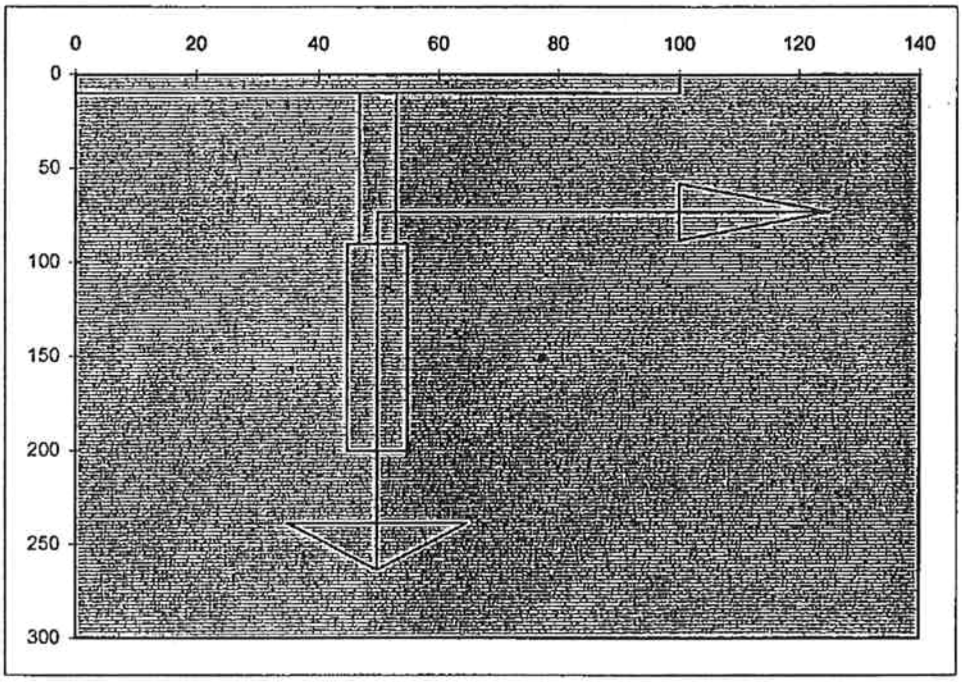
Type A zwaarverkeer rooster

Toelaatbare buigspanning =140 N/mm²
Veiligheidsfactor tot strekgrens =1,7
Veiligheidsfactor tot breukgrens =2,4
SAFETY FACTOR
Doorbuiging $f \leq 4$ mm (wit)
Doorbuiging 1/200 x overspanning (donkerblauw)
grensgevallen $f \leq 10$ mm (lichtblauw)

uitvoer

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : HEB100 + bracketpl. 100*10
referentie : Mal. Nav. Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	200	mm
breedte (y)	=	100	mm

Zwaartepuntsafstanden

$-e_y$	=	-50	mm
$+e_y$	=	50	mm
$-e_z$	=	-73	mm
$+e_z$	=	127	mm

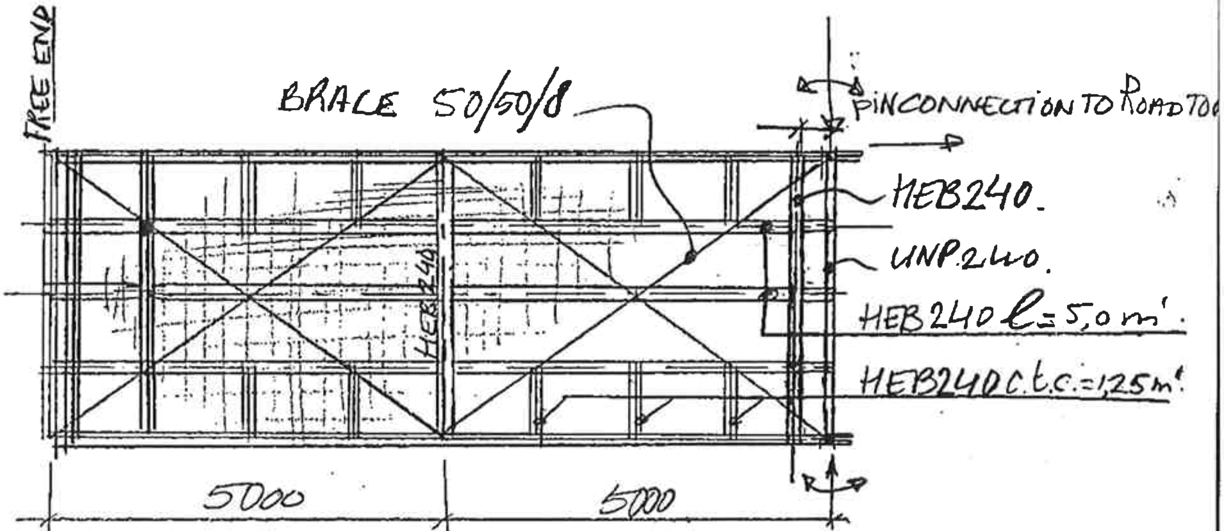
Statische waarden

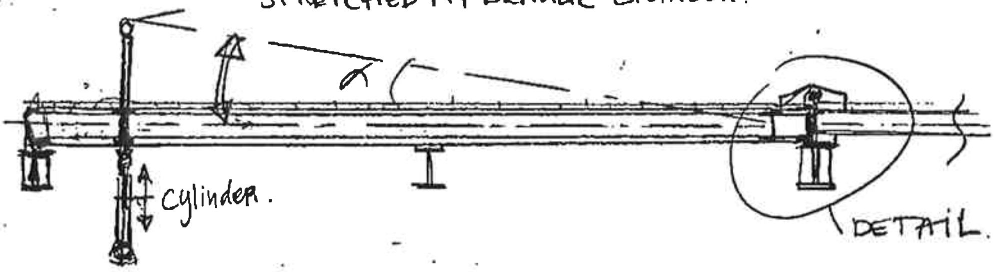
oppervlak A	2580	mm^2
traagheidsmoment I_{yy}	1,195E+07	mm^4
weerstandsmoment $W_{y;el;b}$	-1,64E+05	mm^3
weerstandsmoment $W_{y;el;o}$	9,42E+04	mm^3
weerstandsmoment $W_{y;pl}$	1,60E+05	mm^3
traagheidsstraal i_y	68	mm
traagheidsmoment I_{zz}	8,439E+05	mm^4
weerstandsmoment $W_{z;el;l}$	-1,69E+04	mm^3
weerstandsmoment $W_{z;el;r}$	1,69E+04	mm^3
weerstandsmoment $W_{z;pl}$	2,85E+04	mm^3
traagheidsstraal i_z	18	mm

Project : MALAMACCO NAV. LOCK GATE.

Onderdeel : ROAD RAMP TOPSIDE (MOVEABLE)

I3. ROAD RAMP TOPSIDE. (MOVEABLE).



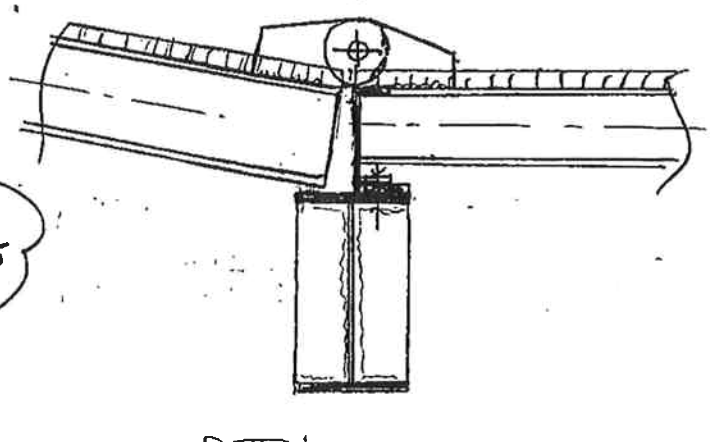


* BUILT-UP EQUAL TO ROAD TOPSIDE (PAGE I2.-1)

- BARRIER LEFT OUT FROM SKETCH.
- STEELGRADE: S355

$\tan\alpha = 1600/10000 \Rightarrow \alpha = 9°$

NOTE: THIS CALC. PART CONSISTS OF THE DEVIATING CHECKS FROM THE ROADTOPSIDE CALCULATIONS (I2)



DETAIL:

Opgesteld : D.A Datum : 15 DEC. 53 Bladnummer : I3-1 Rev.: 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ROAD RAMP TOPSIDE. (MOVEABLE)

CHECKS REFERRED TO CALC. "ROAD TOPSIDE"

* CHECKS RECALCULATED; WITH DIFFRENT STARTING POINTS (ACC. I2)
* INNER BEAM GOVERNING (A) HEB240

LOADS

$G_{HEB240} = 83,2$ kg

$G_{per\ beam} = 0,82 + 0,832 = 1,65$ kN/m'. (INCL. GRATING)

$M_G = \frac{1}{8} \cdot 1,65 \cdot 10^2 = 20,7 \times 1,35 = 27,9$ kNm

$M_q = \frac{1}{8} \cdot 3,75 \cdot 10^2 = - \times 1,5 = 70,4$ "

$M_F = \frac{1}{4} \cdot 25 \cdot 10 = - \times 1,5 \times 1,4 = 131,3$ " +

$M_{(A)} = 230$ kNm'

$V_G = \frac{1}{2} \cdot 1,65 \cdot 10 = 8,25 \times 1,35 = 11,1$ kN

$V_q = \frac{1}{2} \cdot 3,75 \cdot 10 = 18,75 \times 1,5 = 28,1$ kN

$V_F = \frac{1}{2} F = 25/2 \times 2,1 = 26,3$ kN +

$V_{(A)} = 65,5$ kN.

R_{max} (A) $= 11,1 + 28,1 + 2 \times 26,3 = 92$ kN.

CHECK:

SHEAR: $V_{el;R;d} = \frac{3323}{1808} \times 337 = 6,8$ kN

$u.c = 65,5 / 6,8 = 0,11$;-)

BENDING: $M_{V;R;d} = \frac{938,3}{388,6} \times 125,4 = 303$ kNm

$u.c = 230/303 = 0,76$.

Opgesteld : P.A. | Datum : 15 DEC. 03 | Bladnummer : I3-2 | Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD RAMP TOPSIDE (MOVEABLE).

LATERAL-TORSIONAL BUCKLING OF BEAMS. HEB240.

$M_{b;Rd} = X_{LT} \cdot \beta_w \cdot W_{pl;y} \cdot f_y / \gamma_{m0}$.

$W_{el;y} = 938{,}3 \cdot 10^3\ mm^3$.

$W_{pl;y} = 1053 \cdot 10^3\ mm^3$.

$\beta_w = 0{,}9$.

$L = 5000\ mm$.

$i_z = 60{,}8\ mm$.

$h = 240\ mm$.

$t_f = 17\ mm$.

$$\lambda_{LT} = \frac{5000/60{,}8}{\sqrt{1{,}132} \cdot \left[1 + \frac{1}{20}\left[\frac{5000/60{,}8}{240/17}\right]^2\right]^{0{,}25}} = 60{,}3.$$

$$\bar{\lambda}_{LT} = \frac{60{,}3}{76{,}4} \cdot [0{,}9]^{0{,}5} = 0{,}75$$

$$\phi_{LT} = 0{,}5\left[1 + 0{,}21\,[0{,}75 - 0{,}2] + 0{,}75^2\right] = 0{,}84$$

$$X_{LT} = \frac{1}{0{,}84 + [0{,}84^2 - 0{,}75^2]^{0{,}5}} = 0{,}821.$$

$$M_{B;Rd} = 0{,}821 \cdot 0{,}9 \cdot 1053 \cdot 10^3 \cdot 355/1{,}1.$$

$$= \underline{251}\ kNm.$$

$$u.c. = \frac{M_{(A)}}{M_{B;Rd}} = 230/251 = 0{,}92 < 1{,}0;\ OK$$

Opgesteld : DA.

Datum : 16 DEC. 03

Bladnummer : I3-3

Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD RAMP TOPSIDE (MOVEABLE).

DEFLECTION HEB240. DUE TO VAKLOAD:

$$u_{qA} = \frac{5 \cdot 3{,}75 \cdot (10000)^4}{384 \cdot 2{,}1 \cdot 10^5 \cdot 11259 \cdot 10^4} = 21 \text{ mm}$$

$$u_{Fv} = \frac{25 \cdot 10^3 \cdot 1{,}4 \, (10000)^3}{48 \cdot 2{,}1 \cdot 10^5 \cdot 11259 \cdot 10^4} = \boxed{31} \text{ "} +$$

MAX. DEFLECTION = 31 mm' / 10 m' = $\frac{1}{323} * L$ } ✓.

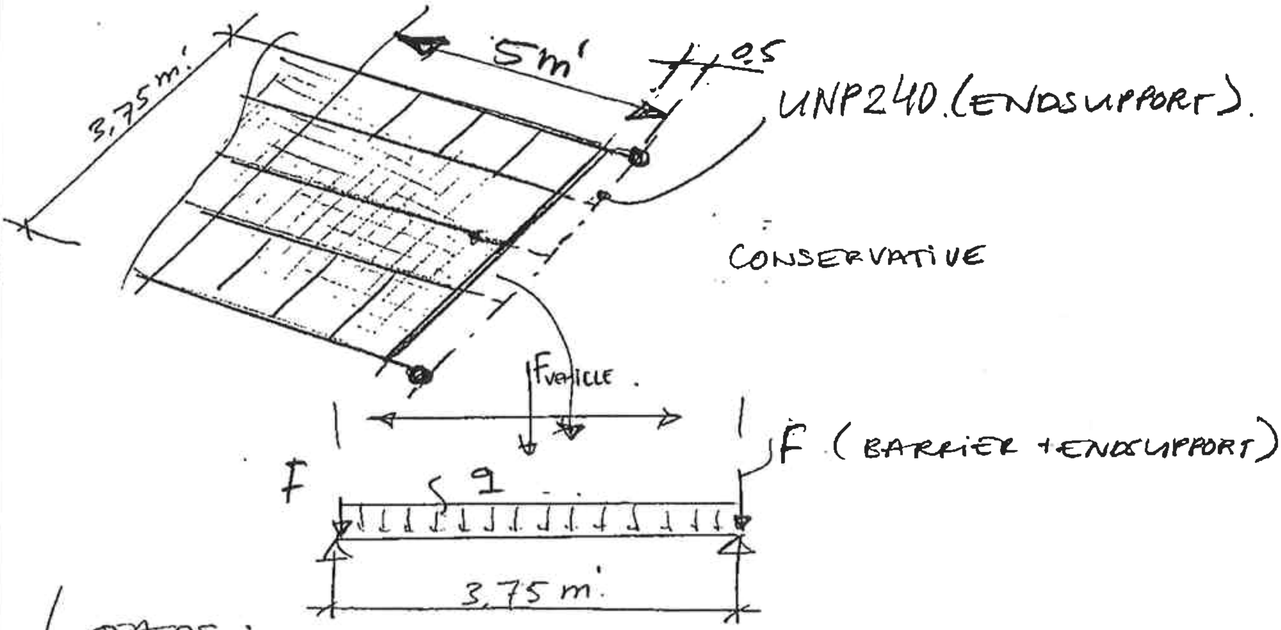
ALLOWABLE. $\frac{1}{250} * L$

Opgesteld : I.A. | Datum : | Bladnummer : I3-4 | Rev. : 0

Project : MALLAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD RAMP TOPSIDE (MOVEABLE).

END BEAMS HEB240 :



LOADS :

PERSISTANT

q : $G_{GRATING} = \frac{1}{2} \cdot 0,87 \cdot 10$ = 4,35 kN/m'

$G_{STEEL\ HEB240} = (5 \cdot 10\,m + 3 \cdot 3,75) \cdot 0,832 / (2 \cdot 3,75)$ = 6,81 "

$G_{STEEL\ HEB200}^{*} = (12 \cdot 0,9375\,m) \cdot 0,612 / (2 \cdot 3,75)$ = 0,92 " +

$q_{AVERAGE}$ = 12,0 kN/m'

$F_{ENDSUPPORT}: \frac{1}{2}(33,2 \cdot 3,75 + 2 \cdot 0,5 \cdot 83,2)/100$ = 1,25 kN

$F_{BARRIER}: G_{BARRIER} = \frac{1}{2} \cdot 0,72 \cdot 10$ = 3,6 kN.

LIVE LOAD

F : VEHICLE - = 50 kN.

q : UNIFORM = $\frac{1}{2} \cdot 4,0 \cdot 10$ = 20 kN/m'

(* WORKED OUT IN HEB240 : EXTRA MASS NEGLECTABLE)

Opgesteld : D.A. Datum : 16 DEC. 03 Bladnummer : I 3.5 Rev. : 0

Project	: MALAMOCCO NAV. LOCK GATE.
Onderdeel	: ROAD RAMP TOPSIDE (MOVEABLE).

DESIGN

$\hat{M}_{PERSISTANT} := \frac{1}{8} \cdot 12{,}0 \cdot 3{,}75^2 = 21{,}0 \times 1{,}35 = 28{,}5$ kNm

$M_{VAR;q\,UNIFORM} = \frac{1}{8} \cdot 20 \cdot 3{,}75^2 = 35{,}2 \times 1{,}5 = 52{,}7$ kNm.

$M_{VAR;F\,VEHICLE} = \frac{1}{4} \cdot 50 \cdot 3{,}75 = 46{,}9 \times 1{,}4 \times 1{,}5 = 98{,}4$ kNm. +

$M_{D;tot}$: $= 180$ kNm'

$R_{PERSISTANT} = \frac{1}{2} \cdot 12 \cdot 3{,}75 = 22{,}5 \times 1{,}35 = 30{,}4$ kN.

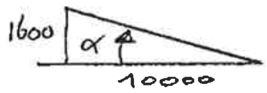
$R_{BARRIER+ENDSUPP.} = 1{,}25 + 3{,}6 = 4{,}85 \times 1{,}35 = 6{,}6$

$R_{VAR;q\,UNIF.} = \frac{1}{2} \cdot 20 \cdot 3{,}75 = 37{,}5 \times 1{,}5 = 56{,}3$ kN

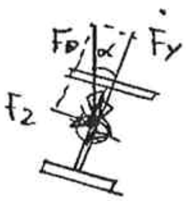
$R_{VEHICLE;MAX} = (25 + \frac{3}{4} \cdot 25)$ (1, 3) $\times 1{,}4 \times 1{,}5 = 91{,}9$ kN. +

$R_{D;MAX}$: $= 186$ kN.

OPERATING SITUATION:



$\alpha \cong 9^0$



$F_y \cong F_D$ $\Rightarrow M_{y;s;d} = 180$ kNm;

$F_z = \frac{1600}{10000} F_D = 0{,}16\, F_D \Rightarrow M_{z;s;d} = 29$ kNm;

CHECKS: SHEAR IN WEAK AXIS NEGLECTABLE.

CAPACITY: $V_{EL;R;D} = 618$ kN (PAGE I3-2)

: $M_{N;y;RD} = 303$ kN.

$M_{N;z;RD} = M_{N;y;R;d} \cdot \frac{W_{z;el}}{W_{y;el}} = 303 \cdot \frac{326{,}9 \cdot 10^3}{938{,}3 \cdot 10^3} = 106$ kN.

SHEAR: u.c. $= 186/618 = 0{,}3$; ✓.

BENDING: u.c $= \left[\frac{180}{303}\right]^2 + \left[29/106\right] = 0{,}63 < 1{,}0$; ✓

Opgesteld :	Datum :	Bladnummer :	Rev. :
D.A.	17 DEC 03	I3-6.	0.

Project : Malamocco Nav. Lock Gate

Onderdeel : Road ramp topside

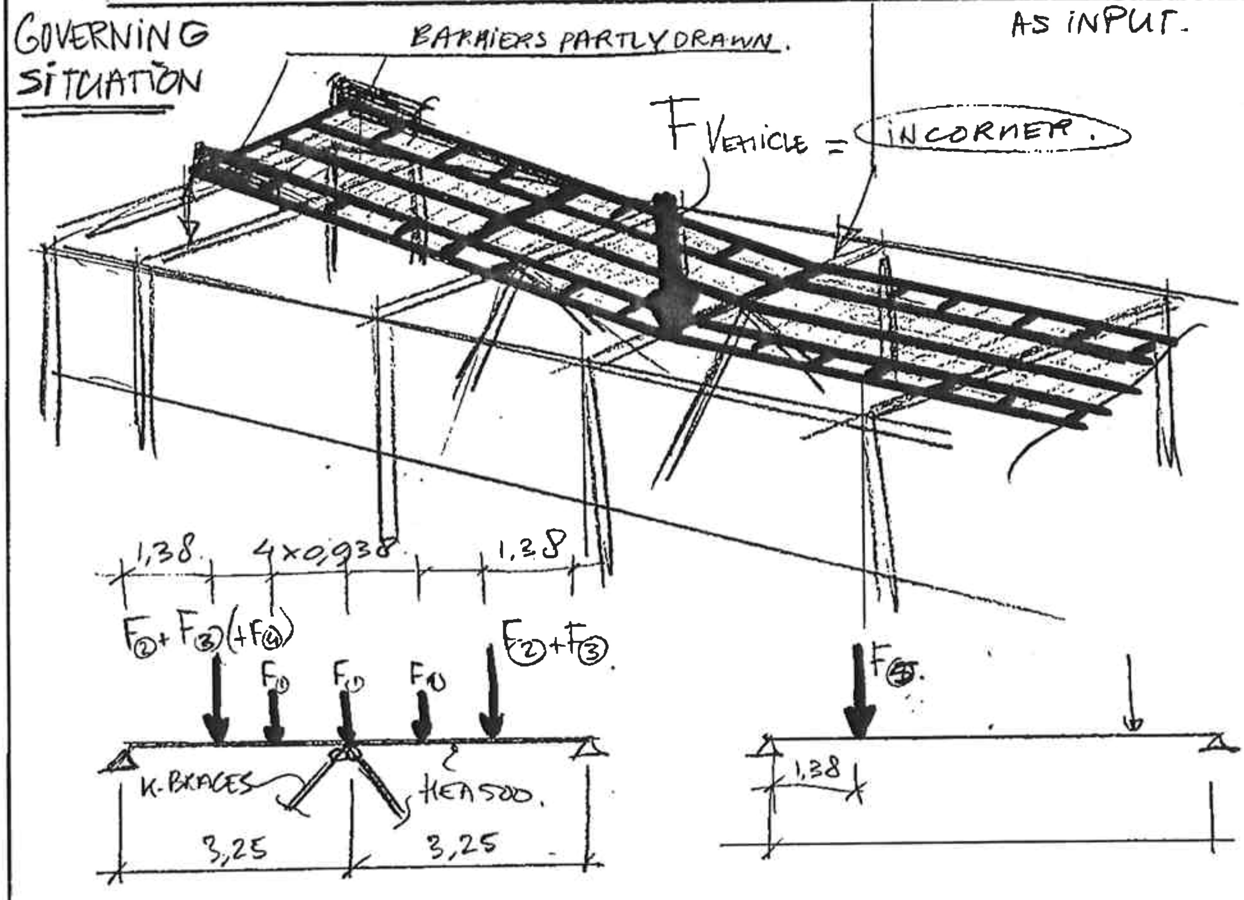
CHECK ROAD TOPSIDE SUPPORT ; HEA 500.

· CHECK WILL BE MADE IN MAIN STRUCTURAL CALCULATION: MV03P-PE-M-A-R-4..

DETERMINATION OF REACTIONS OUT OF ROAD TOPSIDE:

GOVERNING SITUATION

AS INPUT.



FRONT SIDE. (VERT. F)

TOP VIEW. (hor. F).

F① = VERT. LOADS FROM INNER BEAMS ROAD TOPSIDE.

F② = " " " OUTER " ROAD TOPSIDE.

F③ = " " FROM ROAD RAMP TOPSIDE.

F④ = " " FROM VEHICLE (VEHICLE AT ONE SIDE).

F⑤ = HORIZONTAL LOAD (BRAKING LOAD).

K-BRACE = VERTICAL SUPPORT + TORSION BUCKLING SUPPORT + NO HORIZONTAL SUPPORT.

Opgesteld : D.A.

Datum : 17 DEC. 03

Bladnummer : I 3-10

Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD RAMP TOPSIDE SUPPORT HEA300.

LOADS FROM ROAD TOPSIDE:

ROAD TOPSIDE:

$G_{GRATING} = \frac{1}{2} \cdot 0{,}87 \cdot 5 \quad = 2{,}2\ kN/m'$

$G_{HEB200} = \left[5 \cdot 5m + 3 \cdot 0{,}9375m'\right] + 3{,}75m\,/\,(2 \cdot 3{,}75) = 4{,}2 \quad ''$

- $q_{G\,AVERAGE} \quad = 6{,}4\ kN/m'$

- $q_{UNIFORM} = \frac{1}{2} \cdot 4 \cdot 5 \quad = 20\ kN/m'$
- $G_{BARRIER} = \frac{1}{2} \cdot 0{,}72 \cdot 5{,}0 \quad = 1{,}8\ kN.$

LOADS FROM ROAD RAMP TOPSIDE: (I3-6)

SUM: REPRESENTATIVE.

		REPR.	DESIGN	
$F_{①}$ PERSISTANT	$= 0{,}9375 \cdot 6{,}4$	$= 6.0 \cdot 1{,}35$	$= 8{,}1$	kN
$F_{①}$ LIVELOAD	$=$ " $\cdot 20$	$= 19{,}0 \cdot 1{,}5$	$= 28{,}5$	kN
$F_{②}$ PERSISTANT	$= \frac{0{,}9772}{2} \cdot 6{,}4 + 1{,}8$	$= 4{,}8 \cdot 1{,}35$	$= 6{,}5$	kN.
$F_{②}$ LIVELOAD	$= F_{①}/2$	$= 9{,}5 \cdot 1{,}5$	$= 14{,}3$	kN.
$F_{③}$ PERSISTANT	$= 22{,}51 + 4{,}85$	$= 27{,}4 \cdot 1{,}35$	$= 37{,}0$	kN
$F_{③}$ LIVELOAD	$=$	$= 37{,}5 \cdot 1{,}5$	$= 56{,}3$	kN
$F_{④}$ MAX.	$= (25 + 3/4 \cdot 25) \cdot 1{,}4$	$= 61{,}3 \cdot 1{,}5$	$= 92{,}0$	kN.
$F_{⑤}$	$=$	$= 30 \cdot 1{,}5$	$= 45{,}0$	kN.

Opgesteld : DA. Datum : 17 DEC. 03 Bladnummer : I3-11 Rev. : 0.

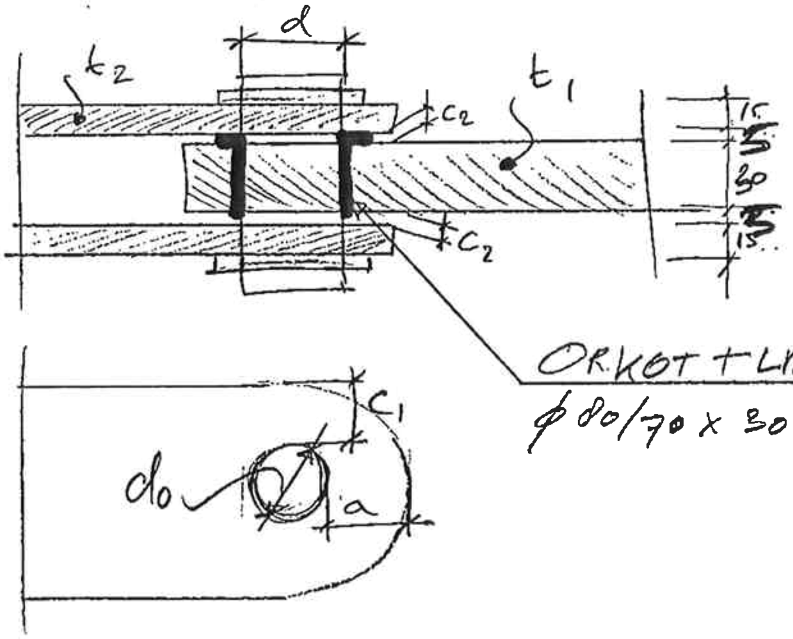
Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD RAMP TOPSIDE (MOVEABLE).

PIN CONNECTION acc. ENV1993-1-1;6.5.13.

- DOUBLE PLATE : $t_2 = 15$ (x2) mm
- SINGLE PLATE : $t_1 = 30$ mm.

- PIN ϕ 70 mm. $= d_0$
- HOLE ϕ 80/70 mm $= d$.
- $\gamma_{mp} = 1.25$.
- PLATES : S355.
- PIN : STAINLESS STEEL GRADE 431 S29 (No. 1.4057) : $\sigma_t = 800\ N/mm^2$, $\sigma_{0,2} = 600\ N/mm^2$



ORKOT TLM MARINE : $\sigma_t = 60\ N/mm^2$
ϕ 80/70 x 30 mm. $\sigma_c = 346\ N/mm^2$
$\tau_c = 120\ N/mm^2$

Opgesteld : D.A.   Datum : 17 DEC. '03   Bladnummer : I3-7   Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD.

ACTING LOADS

- $R_{MAX;VERT;D} = 186$ kN (PAGE I3-6)
- $R_{MAX;HOR;D} = 45$ kN (BRACKING: I2-12)

$R_{MAX} = \sqrt{186^2 + 45^2} = 190$ kN

- $M_{S;D} = \frac{190 \cdot 10^3}{8}(30 + 4.5 + 2.15) = 1{,}95$ kNm.

CAPACITY:

$F_{BR;D} = 1{,}5 (2.15) \cdot 70 \cdot 355 / 1{,}25 = 895$ kN

$F_{VR;D} = 0{,}6 \cdot [\frac{\pi}{4} \cdot 70^2] \cdot 800 / 1{,}25 = 1478$ kN

$M_{RD} = 0{,}8 [\frac{\pi}{64} \cdot 70^3] \cdot 600 / 1{,}25 = 6{,}46$ kNm.

CHECKS:

- BEARING PLATE + PIN: $u.c = 190/895 = 0{,}21 < 1{,}0$; ✓
- BENDING PIN; $u.c = 1{,}9/6{,}46 = 0{,}30 < 1{,}0$; ✓
- COMB. SHEAR + BENDING: $0{,}30^2 + \left[\frac{190}{1478}\right]^2 = 0{,}10 < 1{,}0$; ✓

BEARING CHECK ORKOT

$\sigma_{S;D} = 190 \cdot 10^3 / 30 \cdot 70 = 90\ N/mm^2$.

$u.c = 90/120 \approx 0{,}75$; ✓.

Opgesteld : D. Alsemgeest. Datum : 17. DEC. 03 Bladnummer : I3-8 Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : ROAD

DIMENSIONS PLATE

Ⓐ VERT.; $a \geq \frac{184 \cdot 10^3 \cdot 1{,}25}{2 \cdot 20 \cdot 355} + \frac{2 \cdot 80}{3} = 16 + 54 = \underline{70}$ mm'.

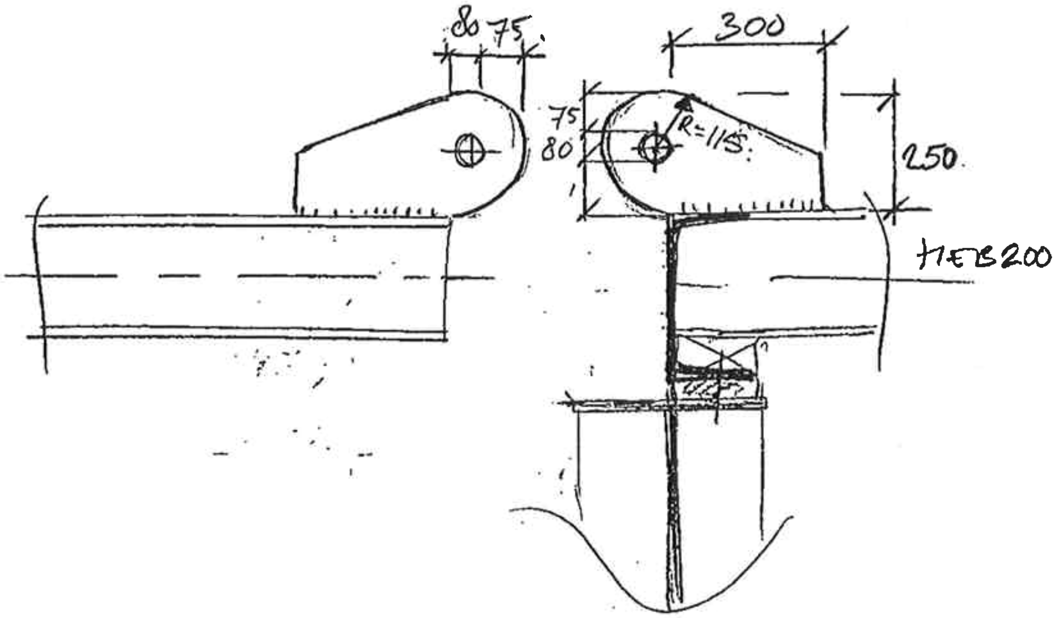
$c_1 \geq 16 + \frac{54}{2} = 43$ mm'

Ⓑ HOR; $a \geq 16 \cdot \frac{30}{180} + 54 = 57$ mm'

$c_1 \geq 3 + 54/2 = 30$. mm'.

CHOSEN DIMENSIONS:

(DIRECTION OF FORCES GIVEN IN SKETCH)



Opgesteld : D.A.

Datum : 17 DEC. 03

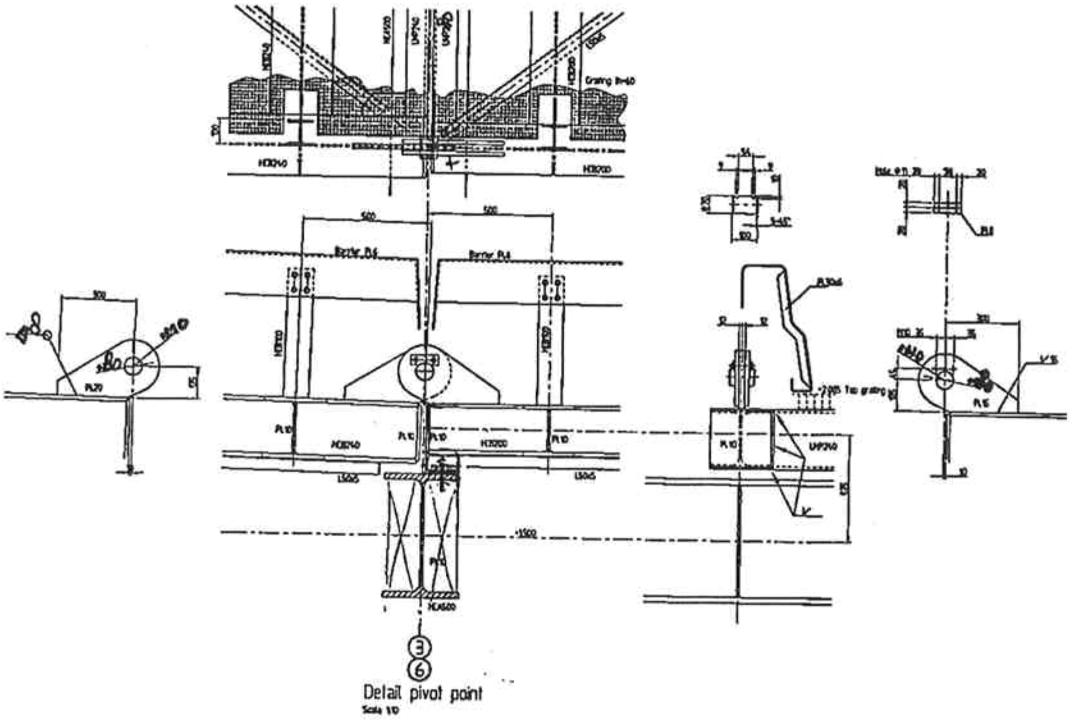
Bladnummer : I3-07

Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : I . CONNECTION ROAD RAMP TO TOPSIDE .

CONNECTION ROADRAMP TO TOPSIDE .



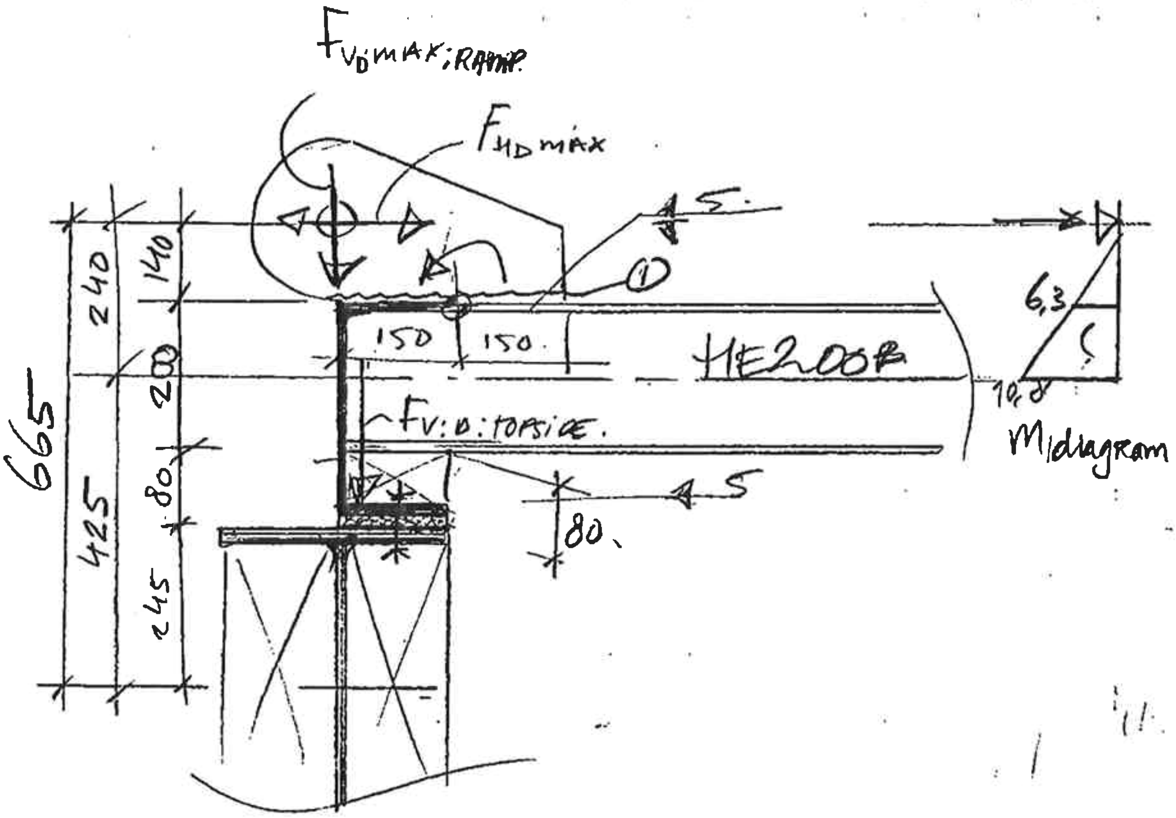
Opgesteld : DA

Datum : 290104

Bladnummer : I3-12

Rev. : A

Project :	MALAMOCCO NAV. LOCK GATE.
Onderdeel :	CONNECTION ROAD RAMP TO TOPSIDE.



SITUATION: VEHICLE BRAKES ON RAMP JUST AT CONNECTION.

$F_{V;D;RAMP}$ = 37,0+56,3+92 = 186 kN (I2-11)

$F_{V;D;TOPSIDE}$ = 6,5+14,3 = 21 kN +

$F_{V;D;TOT}$ = 207 kN.

NOTE: MOMENT TAKEN BY HEB200.

Opgesteld: DA	Datum: 290104	Bladnummer: I2-12	Rev.: A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : CONNECTION ROADRAMP TO TOPSIDE.

SECTION ①. PLATE 300×20 + ∠45

$N_D = F_{V;D;tot} = 207$ kN.

$V_D = F_{H;D;max} = 45$ kN.

$M_D = 207 \cdot 0{,}15 + 45 \cdot 0{,}14 = 37{,}4$ kN.

DIMENSIONS: -1mm'-OFF: (CORROSION ALLOWANCE)

$A = 298 \cdot 18 = 5364$ mm^2.

$W = \frac{1}{6} \cdot 298^2 \cdot 18 = 266412$ mm^3.

PLATE STRESS:

$\sigma_N = N_D/A = 39$ N/mm^2.

$\sigma_m = M_D/W = 140$ N/mm^2 +

$\sigma_{TOT} = 179$ N/mm^2.

$\tau = V_D/A = 8$ N/mm^2.

WELD STRESS:

$\sigma_{v.m.} = \frac{2}{\sqrt{3}}\left(179 \cdot \frac{18}{2 \cdot 5 \cdot \sqrt{2}}\right) = 263$ N/mm^2.

CHECKS:

PLATE : u.c. = $179/(355/1{,}1) = 0{,}56$ o.k.

WELD : u.c. = $263/262 = 1{,}0$ - o.k.

NOTE: DOUBLE PLATE t=15 → ~~k~~ 15. o.k.

SINGLE PLATE t=20 → ~~a~~ 8 o.k.

Opgesteld : DA

Datum : 290104

Bladnummer : F3-14.

Rev. : A2

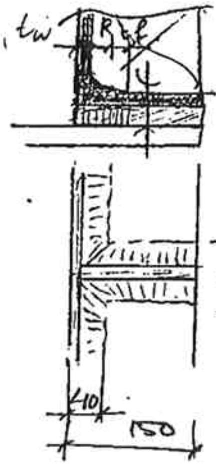
Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : CONNECTION ROADRAMP TO TOPSIDE.

SECTION ② : T-PIECE t=10 WELDS ~~12~~ 5.

DIMENSIONS: -1 mm - OFF (CORROSION - ALLOWANCE).

$A = 200 \cdot 40 + (150 - 40) \cdot 30$
$= 11300 \text{ mm}^2$



LOADS:

$N_0 = 207$ kN

UHMWPE-STRESSES:

$\sigma_{c;d} = N_0 / A = 18,3 \text{ N/mm}^2$
$\tau_{u;d} = 22 / 1,1 = 20 \text{ N/mm}^2$
} u.c. = 0,92; ok.

Opgesteld: DA. Datum: 290104. Bladnummer: I 3-14. Rev.: A2

Project : Malamocco Nav. Lock Gate.

Onderdeel : Sezondary steel.

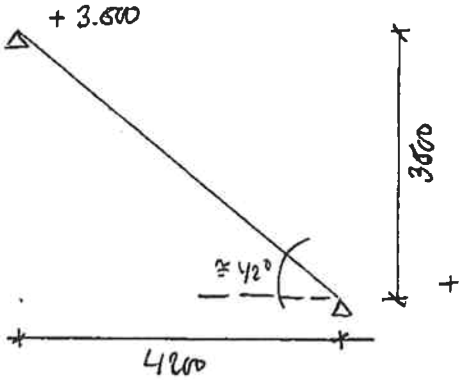
I.4 Miscellaneous secundary structures.

Opgesteld :	Datum :	Bladnummer :	Rev. :
Alsemgeest	280604	I4-1.	A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

(A.) STAIRS / LADDERS.



TO ACCESS THE GEAR ROOM A STAIR WILL BE NEEDED. TOP FLOOR AT + 0.000 AND TOP ROOF AT + 3.600.

THE STAIR HAS A WIDTH OF 1,3 m.

THE LIVE LOAD ON THE STAIR IS A UNIFORM LOAD OF 4,0 kN/m^2

THE LENGTH OF THE STAIR IS 5,53 m.

LOADS

* DEAD LOAD.

- STRINGER : UNP 200 : 0,253 kN/m'

TOTAL DEAD LOAD. = 1,0 kN/m' (ASSUMED : PROFILE + STAIRS + RAILING).

* LIFE LOAD.

UNIFORM LOAD : 4,0 kN/m^2 : $\frac{1}{2} \times 1{,}3 \times 4{,}0 = 2{,}60$ kN/m'

CHECK STRINGER : UNP 200.

$M_{y;s;d} = \frac{1}{8} \times ((1{,}35 \times 1{,}0) + (1{,}5 \times 2{,}6)) \times 5{,}53^2 = 20$ kNm

$M_{y;u;d} = W_{y;el} \times f_y = 191{,}4 \cdot 10^3 \times 355/1{,}1 = 61{,}8$ kNm

$u.c. = 20{,}1/61{,}8 = 0{,}33 < 1{,}0$ O.K.

DEFLECTION

$$u = \frac{5}{384} \times \frac{q \times l^4}{EI} = \frac{5}{384} \times \frac{(1{,}0 + 2{,}6) \times 5530^4}{2{,}1 \cdot 10^5 \times 1914 \cdot 10^4} = 11 \text{ mm} < 1/250\, L = 1/250 \times 5530 = 22 \text{ mm}$$

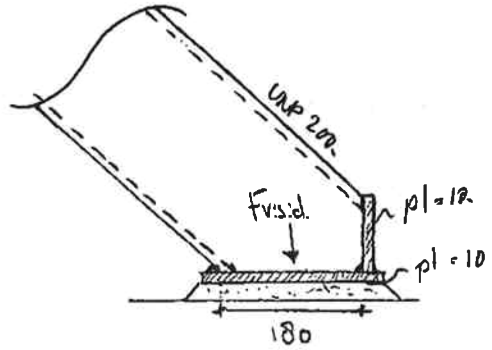
Opgesteld : MPI | Datum : 14-5-'01 | Bladnummer : I4-2 | Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : SECONDARY STEEL.

CONNECTION STAIR.

AT EL. +0.000



COMPRESSION:

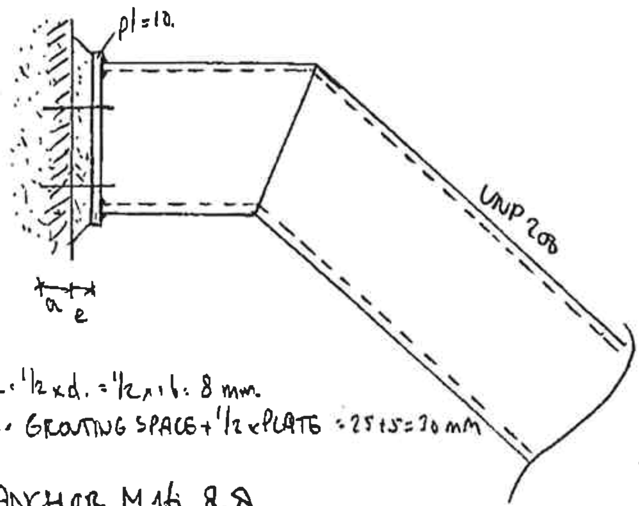
$A = 180 \times 8{,}5 = 1530\ mm^2$

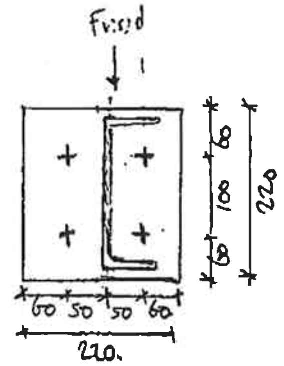
$F_{v;s;d} = 16\ kN.$

$\sigma = \frac{16 \cdot 10^3}{1530} = 10{,}5\ N/mm^2 < 355/1{,}1$

CONCRETE : $f_{j;u;d} = 13{,}3\ N/mm^2 > 10{,}5\ N/mm^2$.

AT EL. +3.500





$a = 1/2 \times d. = 1/2 \times 16 = 8\ mm.$

$e = $ GROUTING SPACE $+ 1/2 \times$ PLATE $= 25 + 5 = 30\ mm$

ANCHOR M16. 8.8.

$V_{R;h;s} = (\alpha_m \times M_{R;h;s}) \times l =$

$= (2{,}0 \times 0{,}156 \cdot 10^6) / 33 = 8{,}2\ kN.$

$\alpha_m = 2{,}0.$

$M_{R;h;s} = 1{,}2 \times (1/32 \cdot \pi \cdot 16^3) \times 355/1{,}1 = 0{,}156\ kNm.$

$l = a + e = 8 + 30 = 38\ mm.$

$F_{v;s;d} = 16\ kN.$

SHEAR DUE TO MOMENT :

$M = 8 \times 0{,}05 = 0{,}4\ kNm.$

$F_{shear} = \frac{0{,}4}{0{,}1} = 4\ kN.$

TOTAL SHEAR ON ANCHOR $= \frac{16}{4} + 4 = 8\ kN.$

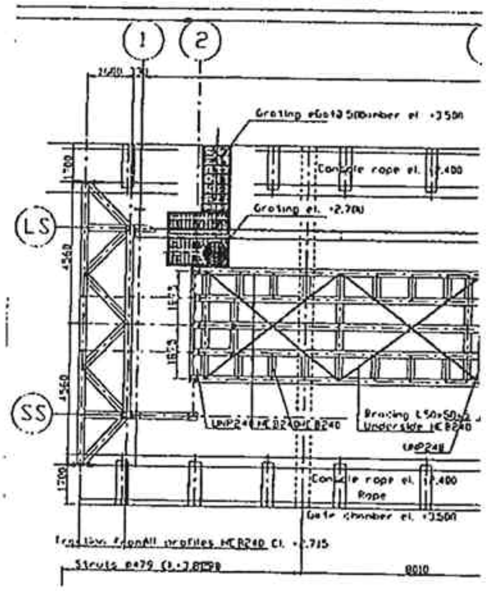
$U.C. = \frac{8{,}0}{8{,}2} = 0{,}98 < 1{,}0$ **O.K.**

Opgesteld : MPJ | Datum : 14-5-'04 | Bladnummer : I4-3 | Rev. : A2

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: SECONDARY STEEL.

(B): WALKWAYS

1. PLATFORM WALKWAY AT +3.500.



LOADS

DEAD LOAD = 1,0 kN/m²

LIFE LOAD = 4,0 kN/m² (ACC TO BASIS OF STRUCTURAL DESIGN)

COMBINATIONS

- SLS = 1,0 x D.L. + 1,0 x L.L.
- ULS = 1,35 x D.L + 1,5 x L.L.

MATERIAL / FACTORS.

STEEL GRADE : S235 ; 235 N/mm²

γ_m = 1,1. (ACC. TO BASIS OF STRUCTURAL DESIGN).

Opgesteld :	Datum :	Bladnummer :	Rev. :
MP1	14-5-'04	I 4-4	A2

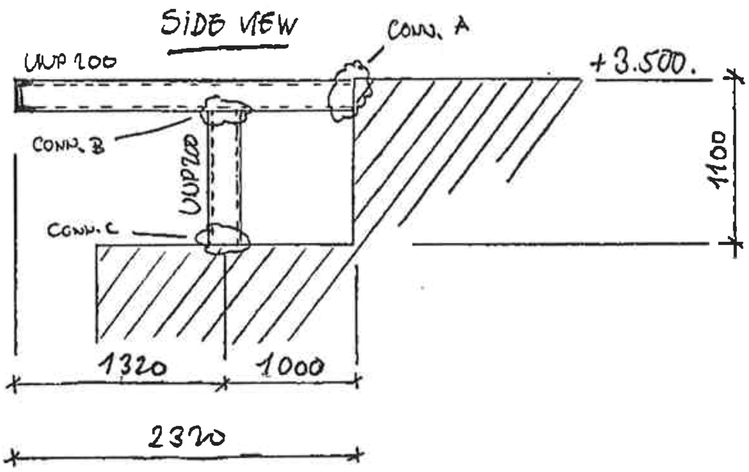
DEFLECTION

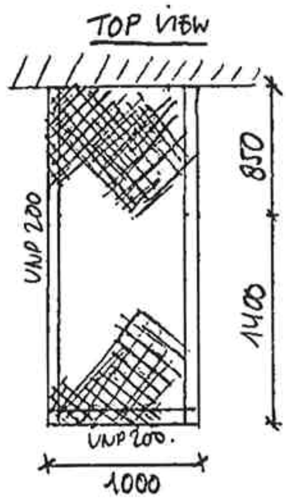
MAXIMUM ALLOWABLE VERTICAL DEFLECTION : $\delta_{max} = 1/250\ L$.

CORROSION

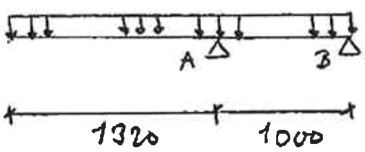
CORROSION ALLOWANCE OF 1 mm AROUND THE STRUCTURE.

FOOTPATH AT EL. +3.500





SYSTEM



$q_{rep} = 1{,}0 \times 0{,}5 + 4{,}0 \times 0{,}5 = 2{,}5\ kN/m'$

$q_d = 1{,}35 \times 1{,}0 \times 0{,}5 + 1{,}5 \times 4{,}0 \times 0{,}5 = 3{,}7\ kN/m'$

SUPPORT REACTIONS

$R_A = (1000 + 1320)^2 \times \frac{3{,}7}{2 \times 1000} = 10\ kN.$ (COMPRESSION).

$R_B = (1000^2 - 1320^2) \times \frac{3{,}7}{2 \times 1000} = -1{,}4\ kN.$ (TENSION).

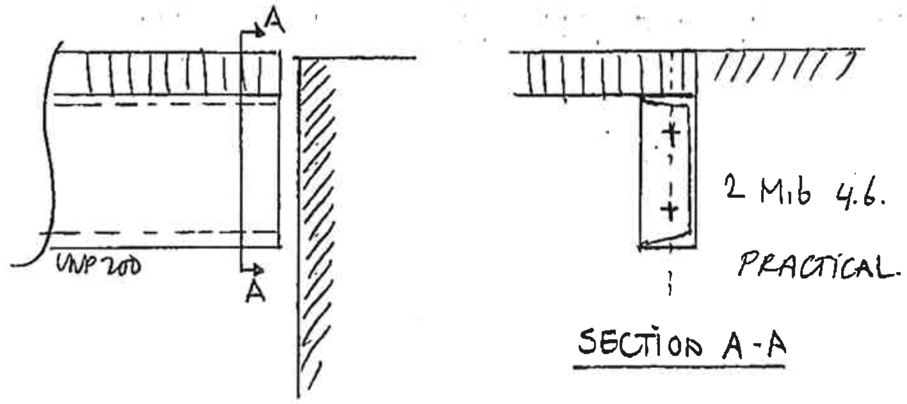
$M_{max} = 1/2 \times 3{,}7 \times 1{,}32^2 = 3{,}3\ kNm' < M_{Rd} = 191{,}4 \cdot 10^3 \times 235/1{,}1 = 40{,}9\ kNm.$

$\delta_{max} = \frac{2{,}5 \times 1320}{24 \times 2{,}1 \cdot 10^5 \times 1914 \cdot 10^4} \times \left(4 \times 1320^2 \times 1000 - 1000^3 + 6 \times 1320^2 \times 1320 - 4 \times 1320 \times 1320^2 + 1320^3\right)$

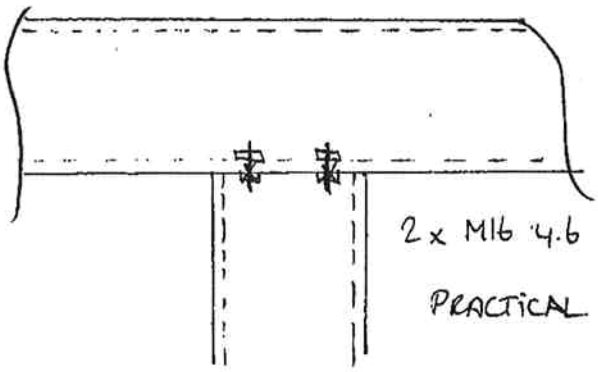
$= 0{,}44\ mm < 1/250\ L\ (= 1/250 \times 1400 = 5{,}6\ mm) \Rightarrow$ DEFLECTION AT OVERHANG

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: SECONDARY STEEL.

CONNECTION A



CONNECTION B



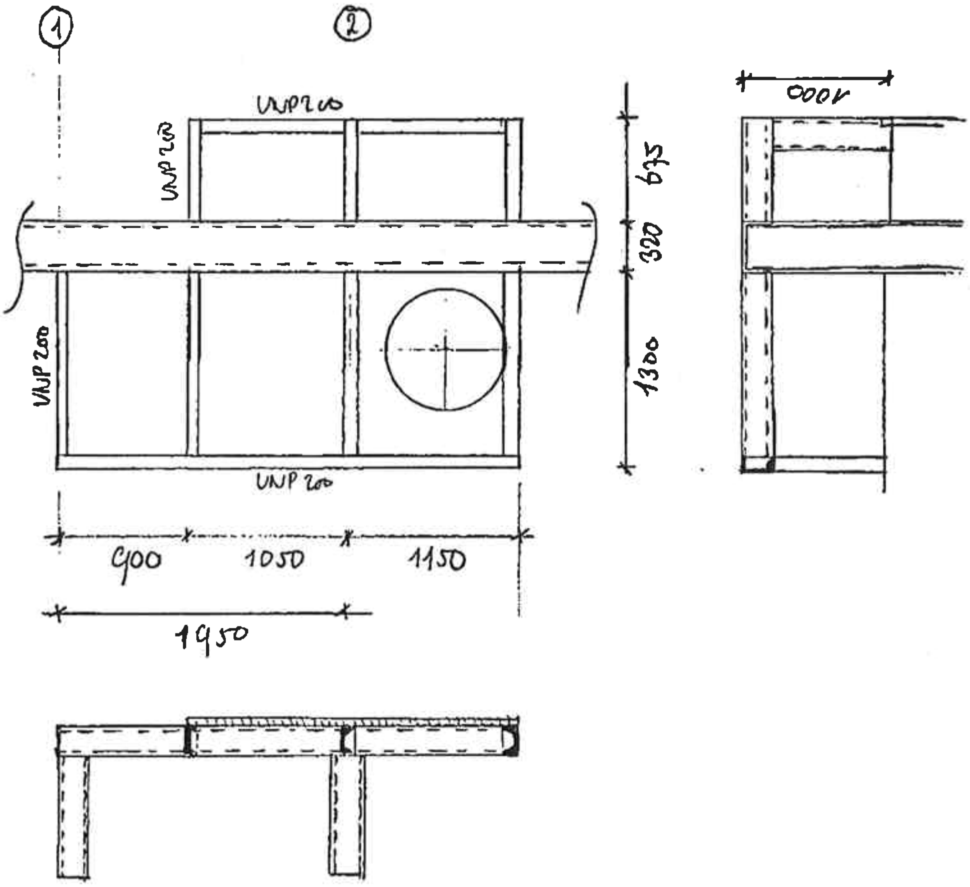
CONNECTION C

EQUAL TO CONNECTION A

Opgesteld :	Datum :	Bladnummer :	Rev. :
MP1	14-5-'04	I4-6	A2

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: SECONDARY STEEL

2. PLATFORM WALKWAY AT + 2.700.



LOADS

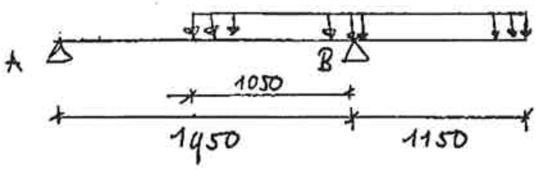
$q_{rep} = (1{,}0 \times 1{,}3) + (4{,}0 \times 1{,}3) = 6{,}5$ kN/m'

$q_{d} = (1{,}35 \times 1{,}0 \times 1{,}3) + (1{,}5 \times 4{,}0 \times 1{,}3) = 9{,}6$ kN/m'

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

SYSTEM.



(GETS THE WHOLE AREA OF GRATING AS LOAD).

SUPPORT REACTIONS

$$R_A = \frac{9,6 \times 1,05^2}{2 \times 1.95} - \frac{9,6 \times 1.15^2}{2 \times 1.95} = -0,6 \text{ kN.}$$

$$R_B = \frac{9,6 \times 1,15}{2 \times 1,95} \times (2 \times 1,95 + 1,15) + \frac{9,6 \times 1,05}{2 \times 1,95} \times (2 \times 1,95 - 1,05) = 22 \text{ kN.}$$

$$M_{max} = \tfrac{1}{2} \times 9,6 \times 1,15^2 = 6,4 \text{ kNm} < M_{Rd} = 40,9 \text{ kNm.}$$

$$\delta_{max} = 0,8 \text{ mm} < \tfrac{1}{250} L \; (= \tfrac{1}{250} \times 1150 = 4,6 \text{ mm}).$$

Opgesteld : MPI

Datum : 14-5-'04

Bladnummer : I4-8

Rev. : A2

Project	:	MALAMOCCO NAV. LOCK. GATE
Onderdeel	:	SECONDARY STEEL

C. PIPERACK

THE PIPERACK IS CALCULATED FOR SELF WEIGHT AND FOR WAVE SLAMMING LOADS.

→ FOR THE SELF WEIGHT, WE CALCULATED ~~THE STEEL~~ SELFWEIGHT OF THE PIPES INCL. LIQUED

→ FOR THE WAVE SLAMMING AN EXPLANATION IS GIVEN IN THE CALCULATION [REF. I4-14]

RESULT FROM CALCULATION.

→ STRESSES AND DEFORMATION PIPERACK ALONG ROADWAY DUE TO SELFWEIGHT NEGLECTABLE.

→ WAVE SLAM GOVERNING FOR PIPERACK + PIPES.

PIPES AND PIPERACK MEMBERS CHECKED ON PAGE I4-24/26

PIPES: $U.C_{MAX} = 178 \cdot 1,1 / 235 = 0,84 < 1,0$; ✓

PIPERACK: $U.C._{MAX} = 46 \cdot 1,1 / 235 = 0,21 < 1,0$; ✓

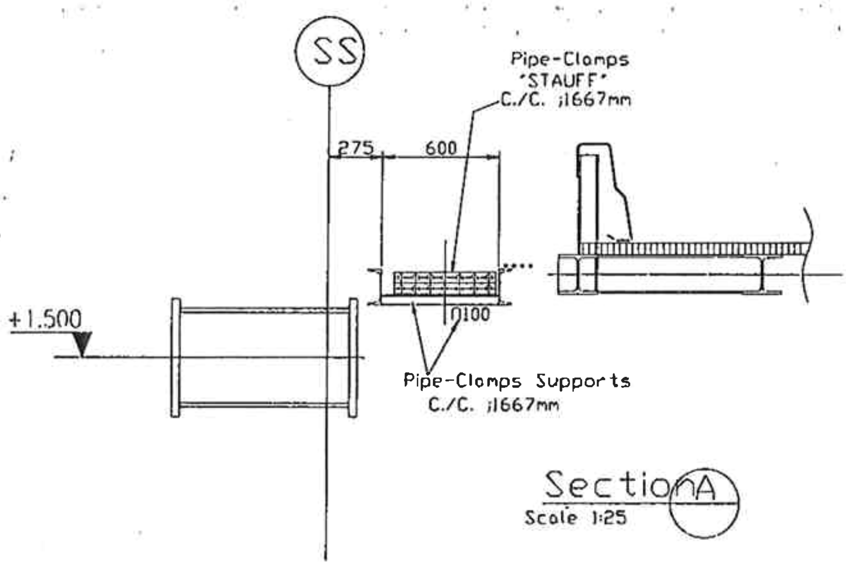
ROADSTRUCTURE: $U.C_{WAVESLAM} = 40 \cdot 1,1 / 235 = 0,19 < 1,0$; ✓

Opgesteld:	Datum:	Bladnummer:	Rev.:
MPI	26-5-'04.	I4-9	A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

PIPERACK AT + 1.950



LOADS

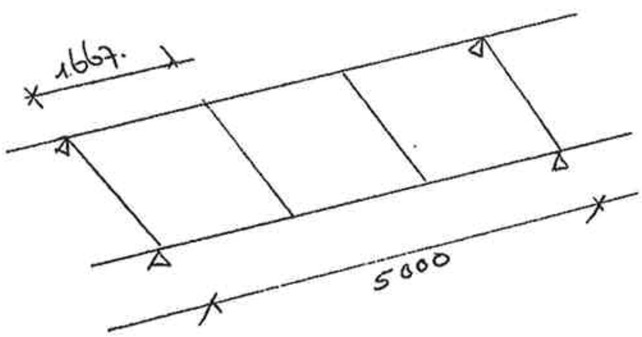
- PIPING : Ø 32⁷ x 8 ⇒ A = 621 mm^2 ⇒ q = 0,05 kN/m'

  NUMBER OF PIPES = 14 ⇒ q_{total} = 14 x 0,05 = 0,70 kN/m'

- LIQUID IN THE PIPING : WATER ⇒ 1000 kg/m^3

  A = 219 mm^2 ⇒ q = 0,0022 kN/m' x 14 = 0,031 kN/m'

SCHEME



Opgesteld : MPI

Datum : 26-5-'04

Bladnummer : I4-10

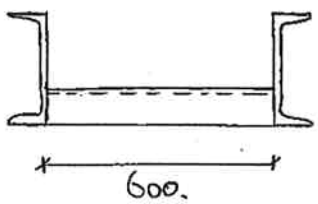
Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

DETERMINATION OF PIPERACK PROFILES

TRANSVERSE BEAM:

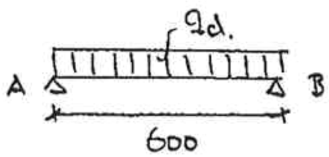


PIPING ⇒ $q_{rep.} = 0,70$ kN/m'

$l_{c.t.c.} = 1667$ mm.

$F_{rep.} = 0,70 \times 1,667 = 1,17$ kN.

SCHEME:



$$q_d = \frac{F_{rep.}}{l} \times 1,5 = \frac{1,17}{0,6} \times 1,5 = 2,93 \text{ kN/m'}$$

REACTION

$R_A = 1/2 \times q \times l = 1/2 \times 2,93 \times 0,6 = 0,9$ kN.

$R_B = R_A$

MOMENT

$M_d = 1/8 \times q \times l^2 = 1/8 \times 2,93 \times 0,6^2 = 0,13$ kNm

$$W_{needed} = \frac{M_d}{\sigma} = \frac{0,13 \cdot 10^6 \times 1,1}{235} = 609 \text{ mm}^3$$

DEFLECTION

$$u = \frac{5}{384} \times \frac{2,93 \times 600^4}{2,1 \cdot 10^5 \times I.} \Rightarrow I_{needed} = \frac{5}{384} \times \frac{2,93 \times 600^4}{2,1 \cdot 10^5 \times 2,4} = 9810 \text{ mm}^4.$$

$u = 1/250 \times l = 1/250 \times 600 = 2,4$ mm.

UNP 100:

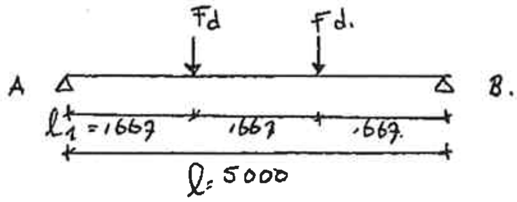
$I_z = 291500$ mm^4

$W_z = 8450$ mm^3

Opgesteld : MPI | Datum : 26-5-'04 | Bladnummer : I4-11 | Rev. : A2

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: SECONDARY STEEL

LONGITUDINAL BEAM



F_d = 0,9 kN. (SEE PREVIOUS CALCULATION).

REACTION

$R_A = F_d = 0{,}9$ kN.

$R_B = R_A$

MOMENT

$M_d = F_d \times l_1 = 0{,}9 \times 1{,}667 = 1{,}5$ kNm.

$W_{needed} = \frac{M_d}{\sigma} = \frac{1{,}5 \cdot 10^6}{235} = 6383$ mm^3.

DEFLECTION

$u = \frac{F \times l_1}{24 \cdot E \cdot I} \times (3l^2 - 4l_1^2) \Rightarrow I_{needed} = \frac{0{,}9 \cdot 10^3 \times 1667}{24 \times 2{,}1 \cdot 10^5 \times 20} \times (3 \times 5000^2 - 4 \times 1667^2)$

$u = 1/250 \times 5000 = 20$ mm. $\quad I_{needed} = 0{,}95 \cdot 10^6$ mm^4.

PROFILE : UNP 180. $\quad W_y = 150{,}7 \cdot 10^3$ mm^3 $\quad$ U.C = 0,05.

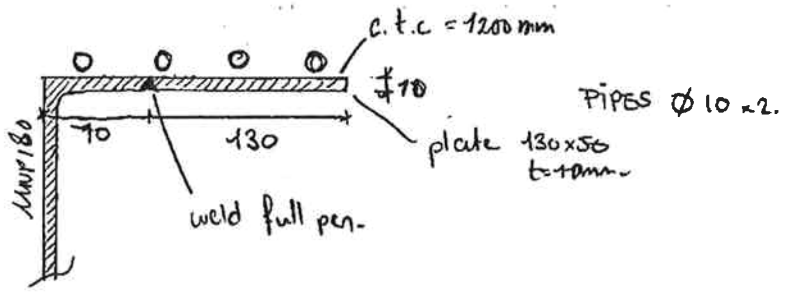
$I_y = 1350 \cdot 10^4$ mm^4

Opgesteld : MPI	Datum : 26-9-'04	Bladnummer : I4-12	Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SECONDARY STEEL

CHECK SUPPORTING PLATE.



LOADS

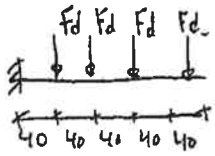
- PIPING : Ø 10 x 2 ⇒ A = 50,3 mm² ⇒ G = 0,40 kg/m' ⇒ F_{rep} = 0,40 x 1,2 = 0,48 kg.
= 0,0048 kN.

- LIQUID IN PIPE : WATER ⇒ 1000 kg/m³

A = 28,3 mm² ⇒ G = 0,028 kg/m' ⇒ F_{rep} = 0,028 x 1,2 = 0,034 kg. = 0,00034 kN.

$F_{rep;total;per\ pipe}$ = 0,0048 + 0,00034 = 0.0051 kN.
Fd = 0,0051 x 1,5 = 0,0077 kN.

SCHEME



CHECK PLATE

MOMENT : Md = 0,0077 x 0,04 + 0,0077 x 0,08 + 0,0077 x 0,12 + 0,0077 x 0,16 = $3,08 \cdot 10^{-3}$ kNm

$$\sigma = \frac{Md}{W} = \frac{3,08 \cdot 10^{-3} \cdot 10^{6}}{1/6 \times 50 \times 10^{2}} = 4\ N/mm^2.$$

SHEAR : V_z = 4 x Fd = 0,031 kN.

DEFLECTION : $u_{allowable}$ = 1/250 x 200 = 0,8 mm.

CONSERVATIVE: ALL LOAD AT END OF PLATE ⇒ u = 0,094 mm.

Opgesteld : MPI | Datum : 26-5-'04 | Bladnummer : I4-13 | Rev. : A2

Wave slamming loads.

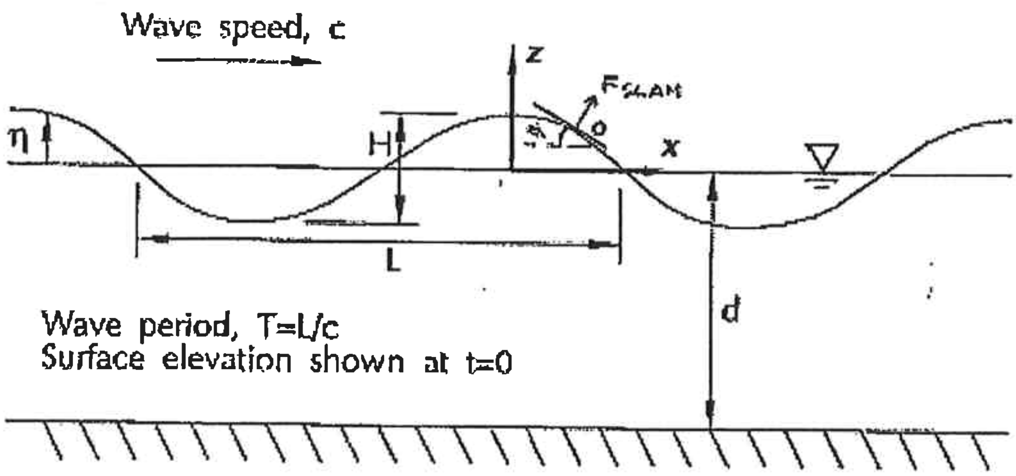
The slamming forces are calculated in a similar way as the drag force component in the Morison equitation where the drag coefficient is replaced by the slamming coefficient. Only members perpendicular (+/-10degrees) to the wave direction are subject to slamming loads. The velocity to be used for calculating the slamming force is the maximum velocity perpendicular to the water surface.

$$F_s = C_s \cdot (w/_{2g}) \cdot D \cdot U^2$$

Where
F_s = Uniform load caused by wave slamming [N/m]
C_s = Slamming Coefficient (incl. DAF) [-]
$^w/_{2g}$ =1/2 * r = density water/2 =$^1/_2$1025 [kg/m^3]
D = Diameter member [m]
U = Velocity perpendicular to water surface[m/s]
U = V_{hor} * sin α + V_{vert} * cos α
V_{hor} = Horizontal water particle velocity [m/s]
V_{vert} = Vertical water particle velocity [m/s]
α = angle of water surface [deg]

The horizontal and vertical particle velocities are taken from the SACS seastate module. The angle of the water surface is determined using the surface elevation at point of slamming and the surface elevation at a point with a phase angle 10 degrees higher than at the point of slamming, together with the wave length α was determined.

The slamming coefficient is based on DNV RP 30.5 and is thus 3.0 for tubular members, in these calculation the coefficient for rolled shaped is taken as 6.0. The DAF used is 2.0 for the midspan moment based on DNV RP 30.5.



Wave Parameters

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The slamming loads are calculated for the following waves and waterdepths:

- 2.79 m wave – 5.6 sec at 15.6 m waterdepth
- 2.79 m wave – 5.6 sec at 16.6 m waterdepth
- 2.79 m wave – 5.6 sec at 17.6 m waterdepth

The output of the wave velocities is given below. All input values used in the spreadsheet are underlined and bold.

```
SACS Release 5.1                              409                                        ID=12780409
            *********** EDI/SACS IV SEASTATE PROGRAM ***********          DATE 26-MAY-2004  TIME 08:34:48   SEA PAGE
1

                                                                                          SEA VERSION 5.1.04

                                   ******* SEASTATE OPTIONS *******

                ANALYSIS OPTIONS          UNITS (ENGLISH OR METRIC)  ............   METRIC-KN

                                          VERTICAL COORDINATE  .................   +Z

                                          ALL MEMBERS  .........................   NON-FLOODED

                                          DENSITY OF SEAWATER  .................     1.03  TONNE/M**3

                                          DENSITY OF CONSTRUCTION MATERIAL  .....    7.85  TONNE/M**3

                                          MUDLINE ELEVATION  ...................   -15.60  M.

                                          WATER DEPTH  .........................    15.60  M.

                LOAD OPTIONS              GENERATE LOADS IN STRUCTURAL COORD.  ..   YES

                                          GENERATE LOADS IN MEMBER COORD.  ......    NO

                                          GENERATE LOAD COMBINATIONS  ...........    NO

                                          OUTPUT SELECTED LOAD CASES ONLY  ......    NO

                                          GENERATE TIME HISTORY LOADS  ..........    NO

                                          GENERATE BASE TRANSFER FUNCTION .......    NO

                                          GENERATE WIND GUST LOADS .............    NO

                HYDROSTATIC COLLAPSE      PERFORM HYDROSTATIC COLLAPSE CHECK ...    NO
                OPTIONS                   HYDROSTATIC COLLAPSE FOR FLOODED GROUPS   NO

                PRINT OPTIONS             INPUT ECHO ...........................   NO PRINT

                                          OUTPUT ECHO ..........................   NO PRINT

                                          SACS IV INPUT REPORTS ................   PRINT

                                          SEASTATE INPUT REPORTS ...............   PRINT

                                          MEMBER SUMMARY FOR SEASTATE LOADS .....  NO PRINT
```


I4-15 AE

**** WAVE DESCRIPTION FOR LOAD CASE 1 ****

```
WAVE THEORY ************ STREAM FUNCTION
WAVE HEIGHT ************   2.790 M
WATER DEPTH ************  15.600 M
WAVE PERIOD ************   5.600 SECS
WAVE LENGTH ************  48.878 M
ANGLE FROM X TOWARD Y **   0.000 DEGREES
MUDLINE ELEVATION ****** -15.600 M
WAVE CELERITY **********   8.728 M /SEC
MAX. NO. SEG/MEMBER ****      10
MIN. NO. SEG/MEMBER ****       1
STREAM FUNCTION ORDER **       3
BREAKING WAVE HEIGHT       7.505 M
CREST POSITION DETERMINED BY MAXIMUM MOMENT
STARTING CREST POSITION    0.000 M
NO. STEPS **************      71
STEP SIZE **************   0.679 M
CREST WATER DEPTH ******   17.15 M
TROUGH WATER DEPTH *****   14.36 M
```


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HORIZONTAL VELOCITY

THETA	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000
SURFACE	17.146	17.112	17.013	16.858	16.661	16.433	16.189	15.939	15.693	15.458	15.238	15.038
HEIGHT												
17.15	1.949	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.84	1.874	1.842	1.750	1.603	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.47	1.786	1.757	1.669	1.528	1.339	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.03	1.689	1.661	1.579	1.446	1.267	1.049	0.799	0.000	0.000	0.000	0.000	0.000
15.53	1.584	1.558	1.481	1.357	1.190	0.986	0.752	0.497	0.230	0.000	0.000	0.000
14.96	1.473	1.449	1.378	1.263	1.109	0.919	0.702	0.465	0.217	-0.036	-0.284	-0.520
14.32	1.360	1.338	1.273	1.167	1.025	0.851	0.651	0.433	0.203	-0.030	-0.260	-0.479
13.62	1.246	1.226	1.167	1.070	0.940	0.781	0.599	0.399	0.189	-0.025	-0.236	-0.438
12.85	1.134	1.116	1.062	0.975	0.857	0.713	0.547	0.365	0.174	-0.021	-0.213	-0.397
12.01	1.025	1.009	0.961	0.882	0.776	0.646	0.496	0.332	0.160	-0.017	-0.191	-0.358
11.11	0.921	0.907	0.864	0.794	0.699	0.582	0.448	0.301	0.145	-0.013	-0.170	-0.321
10.14	0.824	0.812	0.773	0.711	0.626	0.522	0.402	0.271	0.132	-0.010	-0.151	-0.287
9.11	0.736	0.724	0.690	0.635	0.560	0.467	0.360	0.243	0.119	-0.008	-0.134	-0.255
8.00	0.656	0.646	0.615	0.566	0.499	0.417	0.322	0.218	0.107	-0.006	-0.119	-0.227
6.84	0.586	0.577	0.550	0.506	0.447	0.374	0.289	0.196	0.097	-0.005	-0.105	-0.202
5.60	0.527	0.519	0.495	0.455	0.402	0.336	0.260	0.177	0.088	-0.003	-0.094	-0.182
4.30	0.479	0.472	0.450	0.414	0.366	0.306	0.237	0.161	0.081	-0.003	-0.085	-0.165
2.93	0.443	0.437	0.416	0.384	0.339	0.284	0.220	0.150	0.075	-0.002	-0.079	-0.153
1.50	0.421	0.415	0.396	0.364	0.322	0.270	0.209	0.142	0.071	-0.002	-0.075	-0.145
0.00	0.413	0.407	0.388	0.357	0.316	0.264	0.205	0.140	0.070	-0.002	-0.073	-0.142

HORIZONTAL VELOCITY

THETA	120.000	130.000	140.000	150.000	160.000	170.000	180.000
SURFACE	14.861	14.709	14.583	14.484	14.413	14.371	14.356
HEIGHT							
17.15	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.84	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.47	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.03	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.53	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.96	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.32	-0.681	-0.861	-1.014	-1.136	-1.226	-1.281	-1.299
13.62	-0.624	-0.790	-0.931	-1.045	-1.128	-1.178	-1.195
12.85	-0.568	-0.720	-0.849	-0.954	-1.030	-1.077	-1.092
12.01	-0.513	-0.651	-0.770	-0.865	-0.935	-0.977	-0.991
11.11	-0.461	-0.586	-0.694	-0.780	-0.843	-0.882	-0.895
10.14	-0.413	-0.525	-0.622	-0.700	-0.757	-0.792	-0.804
9.11	-0.368	-0.470	-0.556	-0.626	-0.678	-0.709	-0.720
8.00	-0.328	-0.419	-0.497	-0.560	-0.606	-0.635	-0.644
6.84	-0.293	-0.375	-0.445	-0.502	-0.543	-0.569	-0.577
5.60	-0.264	-0.337	-0.400	-0.452	-0.489	-0.512	-0.520
4.30	-0.240	-0.307	-0.365	-0.412	-0.446	-0.467	-0.474
2.93	-0.222	-0.285	-0.339	-0.382	-0.414	-0.434	-0.440
1.50	-0.211	-0.270	-0.322	-0.363	-0.394	-0.412	-0.419
0.00	-0.207	-0.265	-0.315	-0.356	-0.386	-0.404	-0.410

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VERTICAL VELOCITY

THETA	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000
SURFACE	17.146	17.112	17.013	16.858	16.661	16.433	16.189	15.939	15.693	15.458	15.238	15.038
HEIGHT *												
17.15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.84	0.000	0.326	0.640	0.933	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.47	0.000	0.310	0.608	0.886	1.133	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.03	0.000	0.291	0.573	0.834	1.067	1.263	1.417	0.000	0.000	0.000	0.000	0.000
15.53	0.000	0.272	0.534	0.778	0.996	1.179	1.324	1.424	1.479	0.000	0.000	0.000
14.96	0.000	0.251	0.493	0.719	0.920	1.090	1.224	1.318	1.370	1.379	1.346	1.272
14.32	0.000	0.230	0.451	0.658	0.842	0.998	1.121	1.209	1.256	1.266	1.236	1.170
13.62	0.000	0.208	0.409	0.596	0.763	0.905	1.017	1.097	1.141	1.150	1.124	1.064
12.85	0.000	0.186	0.367	0.535	0.685	0.813	0.914	0.986	1.026	1.035	1.012	0.959
12.01	0.000	0.165	0.325	0.475	0.608	0.722	0.812	0.876	0.913	0.921	0.901	0.854
11.11	0.000	0.145	0.285	0.416	0.533	0.633	0.713	0.769	0.802	0.810	0.793	0.752
10.14	0.000	0.125	0.247	0.360	0.462	0.548	0.618	0.667	0.696	0.703	0.689	0.654
9.11	0.000	0.107	0.210	0.307	0.394	0.468	0.527	0.569	0.594	0.600	0.588	0.559
8.00	0.000	0.089	0.176	0.256	0.329	0.391	0.441	0.476	0.497	0.503	0.493	0.469
6.84	0.000	0.073	0.143	0.209	0.268	0.319	0.359	0.389	0.406	0.411	0.403	0.383
5.60	0.000	0.057	0.112	0.164	0.211	0.251	0.283	0.306	0.319	0.323	0.317	0.302
4.30	0.000	0.042	0.083	0.122	0.156	0.186	0.209	0.227	0.237	0.240	0.235	0.224
2.93	0.000	0.028	0.055	0.081	0.103	0.123	0.139	0.150	0.157	0.159	0.156	0.149
1.50	0.000	0.014	0.028	0.040	0.052	0.062	0.070	0.075	0.079	0.080	0.078	0.075
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

VERTICAL VELOCITY

THETA	120.000	130.000	140.000	150.000	160.000	170.000	180.000
SURFACE	14.861	14.709	14.583	14.484	14.413	14.371	14.356
HEIGHT *							
17.15	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.84	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.47	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.03	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.53	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.96	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.32	1.069	0.939	0.783	0.605	0.412	0.209	0.000
13.62	0.974	0.856	0.714	0.552	0.376	0.191	0.000
12.85	0.878	0.772	0.644	0.499	0.340	0.172	0.000
12.01	0.783	0.689	0.575	0.445	0.304	0.154	0.000
11.11	0.690	0.607	0.507	0.393	0.268	0.136	0.000
10.14	0.599	0.528	0.441	0.342	0.234	0.118	0.000
9.11	0.513	0.452	0.378	0.293	0.200	0.101	0.000
8.00	0.430	0.379	0.317	0.246	0.168	0.085	0.000
6.84	0.352	0.310	0.260	0.202	0.138	0.070	0.000
5.60	0.277	0.244	0.205	0.159	0.108	0.055	0.000
4.30	0.206	0.182	0.152	0.118	0.081	0.041	0.000
2.93	0.137	0.121	0.101	0.078	0.054	0.027	0.000
1.50	0.069	0.061	0.051	0.039	0.027	0.014	0.000
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000

**** WAVE DESCRIPTION FOR LOAD CASE 2 ****

WAVE THEORY ***********	STREAM FUNCTION
WAVE HEIGHT ************	2.790 M
WATER DEPTH ************	16.600 M
WAVE PERIOD ************	5.600 SECS
WAVE LENGTH ************	49.192 M
ANGLE FROM X TOWARD Y **	0.000 DEGREES
MUDLINE ELEVATION ******	-15.600 M
WAVE CELERITY **********	8.784 M /SEC
MAX. NO. SEG/MEMBER ****	10
MIN. NO. SEG/MEMBER ****	1
STREAM FUNCTION ORDER **	3
BREAKING WAVE HEIGHT	7.645 M
CREST POSITION DETERMINED BY MAXIMUN MOMENT	
STARTING CREST POSITION	0.000 M
NO. STEPS **************	71
STEP SIZE **************	0.683 M
CREST WATER DEPTH ******	18.14 M
TROUGH WATER DEPTH *****	15.35 M

I4-19 A2.

HORIZONTAL VELOCITY

THETA	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000
SURFACE	18.140	18.107	18.010	17.857	17.662	17.436	17.194	16.944	16.698	16.462	16.241	16.040
HEIGHT												
18.14	1.927	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.84	1.853	1.822	1.732	1.588	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.46	1.765	1.736	1.651	1.513	1.328	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.01	1.667	1.640	1.560	1.430	1.256	1.041	0.796	0.000	0.000	0.000	0.000	0.000
16.49	1.560	1.535	1.460	1.339	1.176	0.976	0.748	0.497	0.234	0.000	0.000	0.000
15.89	1.448	1.424	1.355	1.243	1.093	0.908	0.696	0.464	0.220	-0.029	-0.274	-0.508
15.23	1.332	1.310	1.247	1.145	1.006	0.837	0.642	0.429	0.204	-0.024	-0.250	-0.466
14.49	1.215	1.196	1.138	1.045	0.919	0.765	0.588	0.394	0.189	-0.020	-0.227	-0.425
13.68	1.100	1.082	1.031	0.947	0.833	0.694	0.534	0.358	0.173	-0.016	-0.204	-0.383
12.80	0.988	0.973	0.927	0.852	0.750	0.625	0.481	0.324	0.157	-0.013	-0.182	-0.344
11.84	0.882	0.868	0.828	0.761	0.670	0.559	0.431	0.291	0.142	-0.010	-0.161	-0.306
10.82	0.783	0.771	0.735	0.676	0.596	0.498	0.384	0.259	0.127	-0.008	-0.142	-0.272
9.72	0.693	0.682	0.650	0.598	0.528	0.441	0.341	0.231	0.114	-0.006	-0.125	-0.240
8.54	0.612	0.602	0.574	0.529	0.467	0.390	0.302	0.205	0.101	-0.004	-0.110	-0.211
7.30	0.541	0.533	0.508	0.468	0.413	0.346	0.268	0.182	0.090	-0.003	-0.097	-0.187
5.99	0.481	0.474	0.452	0.416	0.368	0.308	0.239	0.162	0.081	-0.002	-0.086	-0.166
4.60	0.433	0.427	0.407	0.375	0.331	0.278	0.215	0.147	0.073	-0.002	-0.077	-0.149
3.14	0.398	0.392	0.374	0.344	0.304	0.255	0.198	0.135	0.068	-0.001	-0.070	-0.137
1.60	0.375	0.370	0.353	0.325	0.287	0.241	0.187	0.127	0.064	-0.001	-0.066	-0.129
0.00	0.367	0.362	0.345	0.318	0.281	0.235	0.183	0.125	0.063	-0.001	-0.065	-0.126

HORIZONTAL VELOCITY

THETA	120.000	130.000	140.000	150.000	160.000	170.000	180.000
SURFACE	15.862	15.708	15.581	15.481	15.409	15.365	15.351
HEIGHT							
18.14	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.84	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.46	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.01	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.49	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.89	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.23	-0.667	-0.845	-0.998	-1.120	-1.209	-1.264	-1.282
14.49	-0.608	-0.772	-0.912	-1.025	-1.107	-1.157	-1.174
13.68	-0.550	-0.700	-0.827	-0.930	-1.005	-1.051	-1.067
12.80	-0.494	-0.629	-0.745	-0.838	-0.906	-0.948	-0.962
11.84	-0.441	-0.563	-0.666	-0.750	-0.812	-0.849	-0.862
10.82	-0.392	-0.500	-0.593	-0.668	-0.723	-0.756	-0.768
9.72	-0.347	-0.443	-0.526	-0.592	-0.641	-0.671	-0.681
8.54	-0.306	-0.392	-0.465	-0.524	-0.568	-0.594	-0.603
7.30	-0.271	-0.346	-0.412	-0.464	-0.503	-0.527	-0.535
5.99	-0.241	-0.309	-0.367	-0.414	-0.448	-0.469	-0.477
4.60	-0.217	-0.278	-0.331	-0.374	-0.405	-0.424	-0.430
3.14	-0.199	-0.256	-0.304	-0.343	-0.372	-0.390	-0.396
1.60	-0.188	-0.241	-0.287	-0.324	-0.352	-0.368	-0.374
0.00	-0.184	-0.236	-0.281	-0.317	-0.344	-0.360	-0.366

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VERTICAL VELOCITY

THETA	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000
SURFACE	18.140	18.107	18.010	17.857	17.662	17.436	17.194	16.944	16.698	16.462	16.241	16.040
HEIGHT												
18.14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.84	0.000	0.323	0.634	0.924	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.46	0.000	0.306	0.602	0.877	1.123	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.01	0.000	0.288	0.567	0.826	1.057	1.253	1.407	0.000	0.000	0.000	0.000	0.000
16.49	0.000	0.269	0.528	0.769	0.985	1.168	1.313	1.415	1.472	0.000	0.000	0.000
15.89	0.000	0.248	0.487	0.710	0.909	1.078	1.212	1.307	1.360	1.371	1.341	1.270
15.23	0.000	0.226	0.444	0.648	0.830	0.985	1.108	1.195	1.245	1.256	1.228	1.164
14.49	0.000	0.204	0.402	0.586	0.751	0.891	1.002	1.082	1.127	1.138	1.113	1.056
13.68	0.000	0.183	0.359	0.524	0.671	0.797	0.897	0.969	1.010	1.020	0.999	0.948
12.80	0.000	0.161	0.317	0.463	0.594	0.705	0.794	0.858	0.895	0.904	0.886	0.841
11.84	0.000	0.141	0.277	0.405	0.519	0.617	0.694	0.750	0.783	0.792	0.776	0.737
10.82	0.000	0.121	0.239	0.349	0.447	0.532	0.599	0.648	0.676	0.684	0.671	0.637
9.72	0.000	0.103	0.203	0.296	0.380	0.451	0.509	0.550	0.574	0.581	0.570	0.542
8.54	0.000	0.086	0.168	0.246	0.316	0.376	0.424	0.458	0.479	0.485	0.476	0.452
7.30	0.000	0.069	0.137	0.200	0.256	0.305	0.344	0.372	0.389	0.394	0.387	0.368
5.99	0.000	0.054	0.107	0.156	0.201	0.239	0.269	0.292	0.305	0.309	0.303	0.289
4.60	0.000	0.040	0.079	0.115	0.148	0.176	0.199	0.215	0.225	0.228	0.224	0.213
3.14	0.000	0.026	0.052	0.076	0.098	0.116	0.131	0.142	0.149	0.151	0.148	0.141
1.60	0.000	0.013	0.026	0.038	0.049	0.058	0.066	0.071	0.075	0.076	0.074	0.071
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

VERTICAL VELOCITY

THETA	120.000	130.000	140.000	150.000	160.000	170.000	180.000
SURFACE	15.862	15.708	15.581	15.481	15.409	15.365	15.351
HEIGHT							
18.14	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.84	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.46	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.01	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.49	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.89	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.23	1.066	0.937	0.782	0.606	0.413	0.209	0.000
14.49	0.967	0.851	0.711	0.551	0.376	0.190	0.000
13.68	0.869	0.765	0.639	0.495	0.338	0.171	0.000
12.80	0.771	0.679	0.568	0.440	0.301	0.152	0.000
11.84	0.676	0.596	0.498	0.387	0.264	0.134	0.000
10.82	0.585	0.516	0.431	0.335	0.229	0.116	0.000
9.72	0.498	0.439	0.368	0.285	0.195	0.099	0.000
8.54	0.416	0.367	0.307	0.238	0.163	0.083	0.000
7.30	0.338	0.298	0.250	0.194	0.133	0.067	0.000
5.99	0.265	0.234	0.196	0.152	0.104	0.053	0.000
4.60	0.196	0.173	0.145	0.113	0.077	0.039	0.000
3.14	0.130	0.115	0.096	0.075	0.051	0.026	0.000
1.60	0.065	0.058	0.048	0.037	0.026	0.013	0.000
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000

I4-21 A2

**** WAVE DESCRIPTION FOR LOAD CASE 3 ****

WAVE THEORY ************ STREAM FUNCTION

WAVE HEIGHT ************ 2.790 M

WATER DEPTH ************ 17.600 M

WAVE PERIOD ************ 5.600 SECS

WAVE LENGTH ************ 49.447 M

ANGLE FROM X TOWARD Y ** 0.000 DEGREES

MUDLINE ELEVATION ****** -15.600 M

WAVE CELERITY ********** 8.830 M /SEC

MAX. NO. SEG/MEMBER **** 10

MIN. NO. SEG/MEMBER **** 1

STREAM FUNCTION ORDER ** 3

BREAKING WAVE HEIGHT 7.763 M

CREST POSITION DETERMINED BY MAXIMUM MOMENT

STARTING CREST POSITION 0.000 M

NO. STEPS ************** 71

STEP SIZE ************** 0.687 M

CREST WATER DEPTH ****** 19.14 M

TROUGH WATER DEPTH ***** 16.35 M

I4-22 A2

HORIZONTAL VELOCITY

THETA	0.000	10.000	20.000	30.000	40.000	50.000	60.000	70.000	80.000	90.000	100.000	110.000
SURFACE	19.136	19.103	19.007	18.856	18.663	18.439	18.197	17.949	17.702	17.466	17.244	17.042
HEIGHT												
19.14	1.909	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.83	1.836	1.806	1.718	1.576	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.45	1.749	1.720	1.636	1.501	1.319	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.99	1.649	1.623	1.544	1.416	1.246	1.035	0.794	0.000	0.000	0.000	0.000	0.000
17.45	1.541	1.516	1.443	1.324	1.164	0.968	0.743	0.497	0.237	-0.028	0.000	0.000
16.83	1.425	1.403	1.335	1.226	1.078	0.898	0.689	0.462	0.221	-0.024	-0.266	-0.498
16.14	1.307	1.286	1.224	1.124	0.989	0.824	0.634	0.425	0.205	-0.020	-0.242	-0.455
15.36	1.187	1.168	1.113	1.022	0.900	0.750	0.578	0.388	0.188	-0.016	-0.219	-0.413
14.51	1.069	1.052	1.002	0.921	0.811	0.677	0.522	0.351	0.171	-0.013	-0.196	-0.371
13.58	0.955	0.940	0.895	0.823	0.726	0.606	0.467	0.315	0.154	-0.010	-0.174	-0.331
12.58	0.846	0.833	0.794	0.730	0.644	0.538	0.416	0.281	0.138	-0.008	-0.153	-0.293
11.49	0.746	0.734	0.700	0.644	0.568	0.475	0.367	0.248	0.123	-0.006	-0.134	-0.258
10.33	0.654	0.644	0.614	0.565	0.499	0.417	0.323	0.219	0.109	-0.005	-0.117	-0.226
9.09	0.572	0.563	0.537	0.494	0.437	0.365	0.283	0.192	0.096	-0.003	-0.102	-0.197
7.77	0.500	0.493	0.470	0.433	0.382	0.320	0.248	0.169	0.084	-0.002	-0.089	-0.172
6.37	0.440	0.434	0.414	0.381	0.337	0.282	0.219	0.149	0.075	-0.002	-0.078	-0.152
4.89	0.392	0.386	0.368	0.339	0.300	0.251	0.195	0.133	0.067	-0.001	-0.069	-0.135
3.34	0.357	0.351	0.335	0.309	0.273	0.229	0.178	0.121	0.061	-0.001	-0.063	-0.123
1.71	0.334	0.329	0.314	0.289	0.256	0.214	0.167	0.114	0.057	-0.001	-0.059	-0.115
0.00	0.326	0.322	0.307	0.283	0.250	0.209	0.163	0.111	0.056	-0.001	-0.057	-0.112

HORIZONTAL VELOCITY

THETA	120.000	130.000	140.000	150.000	160.000	170.000	180.000
SURFACE	16.863	16.708	16.579	16.478	16.405	16.361	16.347
HEIGHT							
19.14	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.83	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18.45	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.99	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17.45	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16.83	-0.713	0.000	0.000	0.000	0.000	0.000	0.000
16.14	-0.654	-0.831	-0.982	-1.104	-1.194	-1.248	-1.266
15.36	-0.594	-0.755	-0.894	-1.006	-1.087	-1.137	-1.154
14.51	-0.535	-0.681	-0.807	-0.908	-0.982	-1.027	-1.042
13.58	-0.478	-0.609	-0.722	-0.813	-0.879	-0.920	-0.934
12.58	-0.423	-0.540	-0.641	-0.722	-0.782	-0.818	-0.830
11.49	-0.373	-0.477	-0.566	-0.637	-0.690	-0.723	-0.733
10.33	-0.327	-0.418	-0.497	-0.560	-0.607	-0.635	-0.645
9.09	-0.286	-0.366	-0.435	-0.491	-0.532	-0.557	-0.566
7.77	-0.250	-0.320	-0.381	-0.430	-0.466	-0.488	-0.496
6.37	-0.221	-0.283	-0.336	-0.379	-0.411	-0.431	-0.437
4.89	-0.197	-0.252	-0.300	-0.339	-0.367	-0.385	-0.391
3.34	-0.179	-0.229	-0.273	-0.308	-0.334	-0.350	-0.356
1.71	-0.167	-0.215	-0.256	-0.289	-0.314	-0.329	-0.334
0.00	-0.163	-0.210	-0.249	-0.282	-0.306	-0.320	-0.325

I4-23 A2

DNV WAVESLAM
code check API WSD

Steel density	7850	[kg/m³]	C_s	3	
Water density	1035	[kg/m³]	DAF_{mid}	2	
Fy	345	[N/mm²]	DAF_{end}	1,5	
		[-]	L_{wave}	48,878	[m]

Surface elevation at slam	17,146	[m]
Surface elevation at slam + 10 deg	17,112	[m]

Angle of wave surface at slam	1,4345	[DEG]

	OD	wt	OD_{eff} for wave load	Unbraced length horizontal attack	Fixity hor span	V_{Hor} Waves	V_{Vert} Waves	V_{slam}	C_{shape}	I	Z	F_{slam} excl. DAF	F_{slam} incl. DAF and shape factor	M_{end} incl. DAF	M_{mid} incl. DAF	f_{bmax}
	[mm]	[mm]	[mm]	[m]	[F or P]	[m/s]	[m/s]	[m/s]		[cm⁴]	[cm³]	[kN/m]	[N/m]	[kNm]	[kNm]	[N/mm²]
	EL +6,000															
PIPES	29	2	31	1,7	P	1,95	0	0,05	1	2	1	0,0001	0,2	0,0	0,0	0,1
	12	1	14	1,2	P	1,95	0	0,05	1	0	0	0,0001	0,1	0,0	0,0	0,2
PERACK	UNP180		180	5,0	P	1,95	0	0,05	2	1350	150	0,0007	2,7	0,0	0,0	0,1
SPAD	HE200B		200	5,0	P	1,95	0	0,05	2	5696	569	0,0007	3,0	0,0	0,0	0,0
RUCTURE	HE240B		240	10,0	P	1,95	0	0,05	2	11259	938	0,0009	3,5	0,0	0,0	0,0

Ia-24 A2

DNV WAVESLAM
code check API WSD

Steel density	7850	[kg/m³]	C_s	3	
Water density	1035	[kg/m³]	DAF_{mid}	2	
Fy	345	[N/mm²]	DAF_{end}	1,5	
		[-]	L_{wave}	49,192	[m]

Surface elevation at slam	17,436	[m]
Surface elevation at slam + 10 deg	17,194	[m]

Angle of wave surface at slam	10,04	[DEG]

	OD	wt	OD_{eff} for wave load	Unbraced length horizontal attack	Fixity hor span	V_{Hor} Waves	V_{Vert} Waves	V_{slam}	C_{shape}	I	Z	F_{slam} excl. DAF	F_{slam} incl. DAF and shape factor	M_{end} incl. DAF	M_{mid} incl. DAF	f_{bmax}
	[mm]	[mm]	[mm]	[m]	[F or P]	[m/s]	[m/s]	[m/s]		[cm⁴]	[cm³]	[kN/m]	[N/m]	[kNm]	[kNm]	[N/mm²]
	EL +6,000															
PIPES	29	2	31	1,7	P	1,04	1,25	1,41	1	2	1	0,0960	192	0,0	0,1	62
	12	1	14	1,2	P	1,04	1,25	1,41	1	0	0	0,0433	87	0,0	0,0	178
PERACK	UNP180		180	5,0	P	1,04	1,25	1,41	2	1350	150	0,5573	2229	0,0	7,0	46
JADSTRUCTURE	HE200B		200	5,0	P	1,04	1,25	1,41	2	5696	569	0,6192	2477	0,0	7,7	14
	HE240B		240	10,0	P	1,04	1,25	1,41	2	11259	938	0,7431	2972	0,0	37,2	40

I4-25 A2

DNV WAVESLAM
code check API WSD

Steel density	7850	[kg/m³]	C_s	3	
Water density	1035	[kg/m³]	DAF_{mid}	2	
Fy	345	[N/mm²]	DAF_{end}	1,5	
		[-]	L_{wave}	49,447	[m]

Surface elevation at slam	17,244	[m]
Surface elevation at slam + 10 deg	17,042	[m]

Angle of wave surface at slam	8,37	[DEG]

OD [mm]	wt [mm]	OD_{eff} for wave load [mm]	Unbraced length horizontal attack [m]	Fixity hor span [F or P]		V_{Hor} Waves [m/s]	V_{Vert} Waves [m/s]	V_{slam} [m/s]	C_{shape}	I [cm⁴]	Z [cm³]	F_{slam} excl. DAF [kN/m]	F_{slam} incl. DAF and shape factor [N/m]	M_{end} incl. DAF [kNm]	M_{mid} incl. DAF [kNm]	f_{bmax} [N/mm²]
EL +6,000																
29	2	31	1,7	P		-0,27	1,34	1,28	1	2	1	0,0791	158	0,0	0,1	51
12	1	14	1,2	P		-0,27	1,34	1,28	1	0	0	0,0357	71	0,0	0,0	146
UNP180		180	5,0	P		-0,27	1,34	1,28	2	1350	150	0,4593	1837	0,0	5,7	38
HE200B		200	5,0	P		-0,27	1,34	1,28	2	5696	569	0,5104	2042	0,0	6,4	11
HE240B		240	10,0	P		-0,27	1,34	1,28	2	11259	938	0,6125	2450	0,0	30,6	33

I4-26 A2

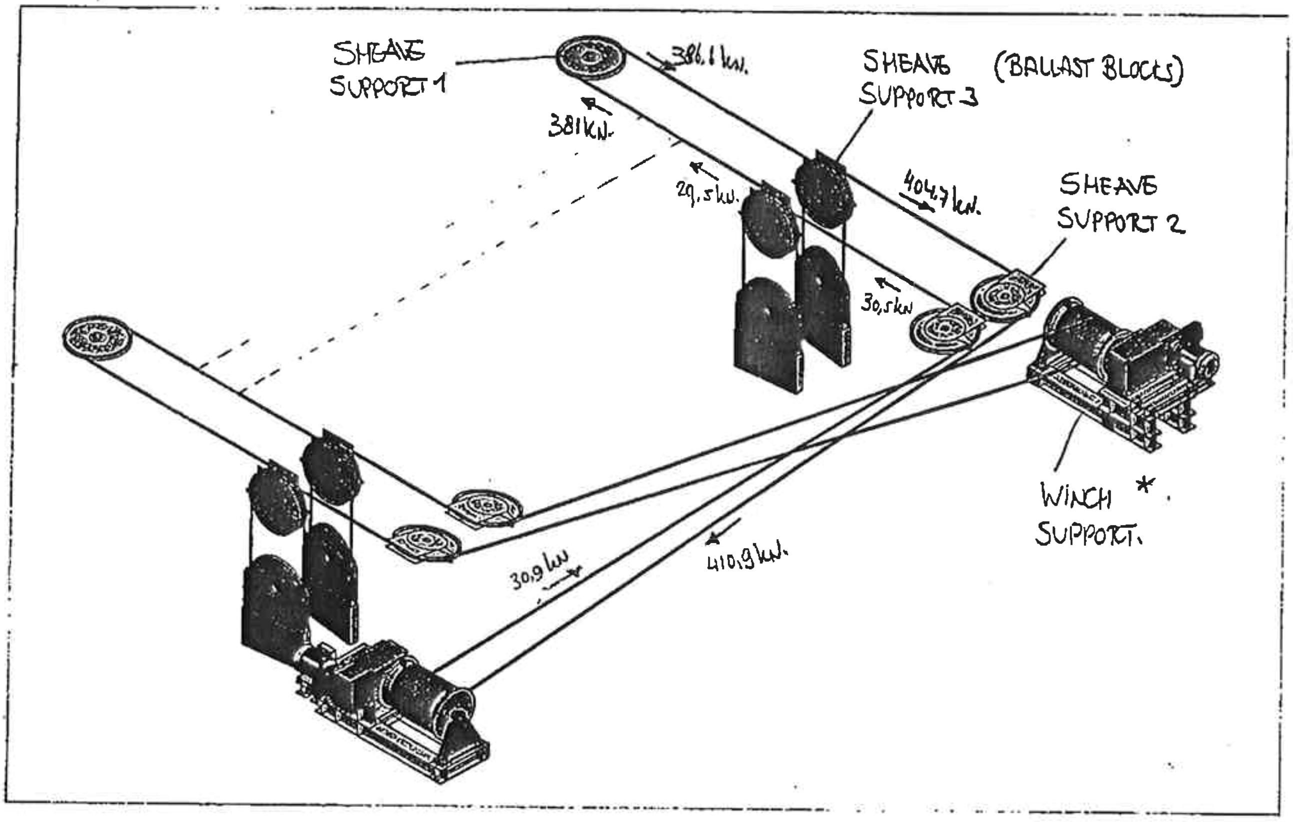
Addendum J Rope reeving / Traction system

Contents

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

J1: ROPE REEVING LOADING

THE ROPE REEVING CONFIGURATION OF THE TRACTION SYSTEM IS PRESENTED IN THE NEXT FIGURE.



THIS DOCUMENT CONTAINS THE CALCULATION OF THE ROPE REEVING SUPPORTS; SHEAVE; WINCH AND BALLAST BLOCK.

IN THE FIGURE ABOVE THE GOVERNING ROPE LOADSITUATION IS DRAWN AND THE CONSIDERED SUPPORTS ARE PRESENTED.

*FIGURE INDICATIVE; NOT MOST RECENT REVISION SHOWN.

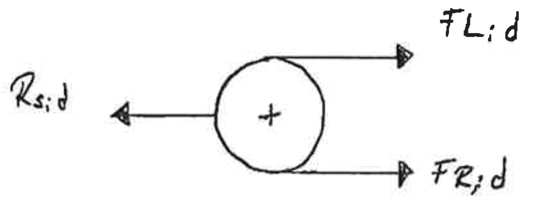
Opgesteld :	Datum :	Bladnummer :	Rev. :
MPI	26-4-'04	J1-1	0

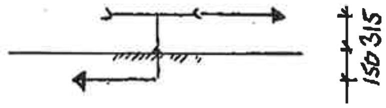
Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM

LOADING ANALYSIS

SUPPORT 1





Rope-forces: (SITUATION 2 IS GOVERNING.) ⇨ FTR 1 = 216 kN × 1,5 = 324 kN.
FTR 2 = 351 kN × 1,2 = 421,2 kN. GOVERNING

FRope = 351 kN ACCIDENTAL

30 kN SPAN.

381 kN.

FRope = FL;rep.

FR;rep = FL;rep / SHEAVE EFFICIENTCY = 381/0,985 = 368,8 kN.

SAFETY FACTOR: 1,2 ; ACCIDENTAL.

FL;d = 1,2 × 381 = 459 kN

FR;d = 1,2 × 368,8 = 464 kN

Rs;d = FL;d + FR;d = 457 + 464 = 921 kN.

My;s;d = Rs;d × a = 921 × (0,315 + 0,15) = 428,3 kNm.

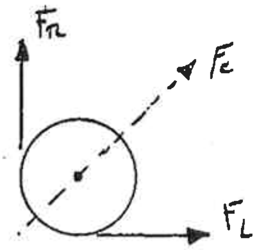
SELFWEIGHT NEGLECTED

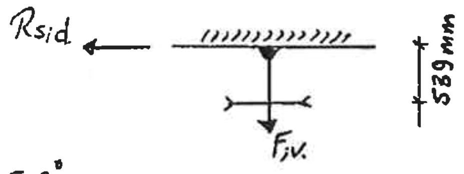
Opgesteld : mpi Datum : 26-4-'04 Bladnummer : J1 ; 2 Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM

SUPPORT 2





Slope 5,13°

$R_{s;d} = 1{,}2 \times 381 = 647$ kN

$M_{y;s;d} = 0{,}539 \times 647 = 349$ kNm

$F_{v;s;d} = 1{,}2 \times 381 \times \sin 5{,}13° = 41$ kN

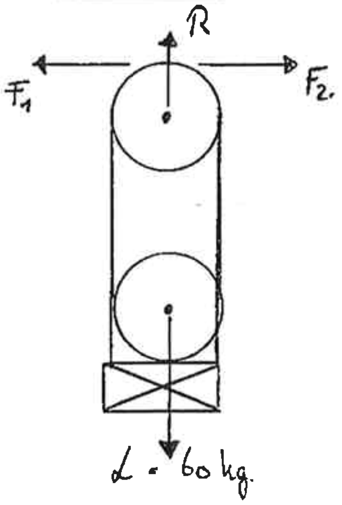
SELF WEIGHT

SHEAVE → 200 kg
SHAFT → 50 kg
SUPPORT → 600 kg
850 kg

$F_{w;s;d} = 1{,}2 \times 8{,}5\ (850\text{kg}) = 10$ kN

SUMMARY : $F_{v;s;d} = 41 + 10 = 51$ kN.

SUPPORT 3



$F_{1;max} = 386{,}8$ kN
$F_{2;max} = 404{,}7$ kN

COUNTERWEIGHT → L = 60 kN.

SELFWEIGHT:

SHEAVE (3x) → 3 × 200 = 600 kg.

SUPPORT:

BASEPLATE : $1000 \times 750 \times 40 \times 7{,}85 \cdot 10^{-6} = 236$ kg.
$2 \times 900 \times 1364 \times 20 \times 7{,}85 \cdot 10^{-6} = 385$ kg.
STIFFENER : $4 \times 200 \times 1649 \times 20 \times 7{,}85 \cdot 10^{-6} = 207$ kg
PLATE $2 \times 560 \times 200 \times 30 \times 7{,}85 \cdot 10^{-6} = 53$ kg.
881 kg.

TOTAL = 1481 kg

$F_{sw;s;d} = 1{,}2 \times 14{,}81 = 17{,}8$ kN.

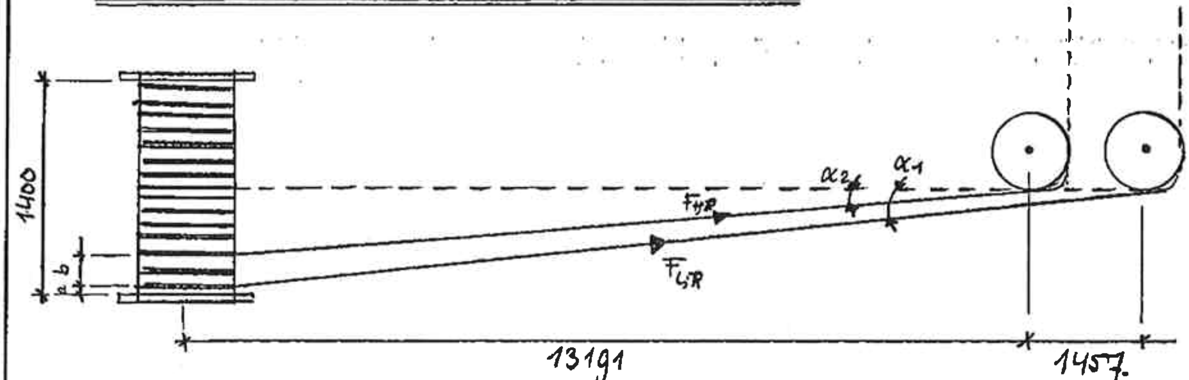
* SHEAR ON ANCHORS DUE TO DIFFERENT TENSION : 386,8 − 404,7 = 18,5 kN.
- TORSION

Opgesteld : MPI | Datum : 26-4-'04 | Bladnummer : J1;3 | Rev. : 0

Project : MALAMOCCO NAV. LOCK GATO

Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM

* DETERMINATION OF LOADS ON WINCH SUPPORT



with : (SEE MV036-P.P-E-M-M-D-5251 FOR DISTANCES)

$a = 226$ mm.

$b = 105$ mm.

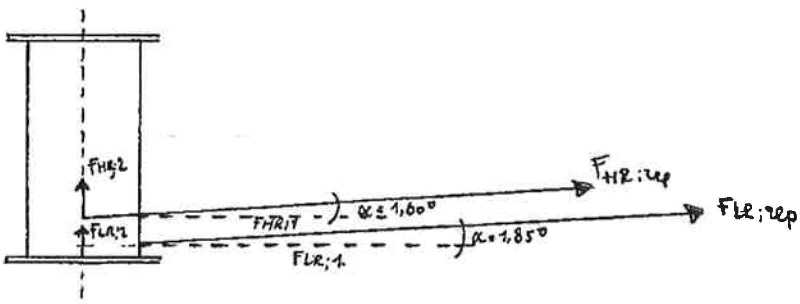
$\alpha_1 = \dfrac{(700-226)}{(13191+1457)} = 0.0324 \Rightarrow 1,85^\circ$

$\alpha_2 = \dfrac{(700-226-105)}{(13191)} = 0,028 \Rightarrow 1,60^\circ$

$F_{HR;rep} = 30,9$ kN

$F_{LR;rep} = 410,9$ kN.

RESOLVING ROPE-LOADS



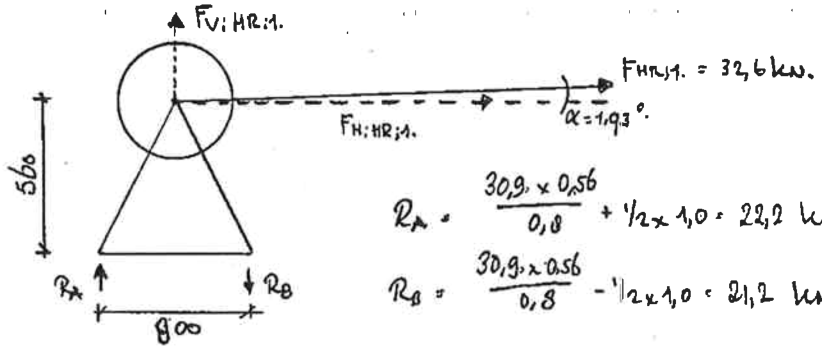
RESOLVED LOADS:

$F_{HR;1} = F_{HR;rep} \times \cos\alpha_2 = 30,9 \times \cos 1,60^\circ = 31$ kN.
$F_{HR;2} = F_{HR;rep} \times \sin\alpha_2 = 30,9 \times \sin 1,60^\circ = 1,0$ kN.

$F_{LR;1} = F_{LR;rep} \times \cos\alpha_1 = 410,9 \times \cos 1,85^\circ = 411$ kN
$F_{LR;2} = F_{LR;rep} \times \sin\alpha_1 = 410,9 \times \sin 1,85^\circ = 13$ kN

Opgesteld : MPI Datum : 26-4-'04 Bladnummer : J 1;4 Rev. : 0

RESOLVING FHR;1.



$F_{H;HR;1} = 30,9 \times \cos 1,93° = 31$ kN.

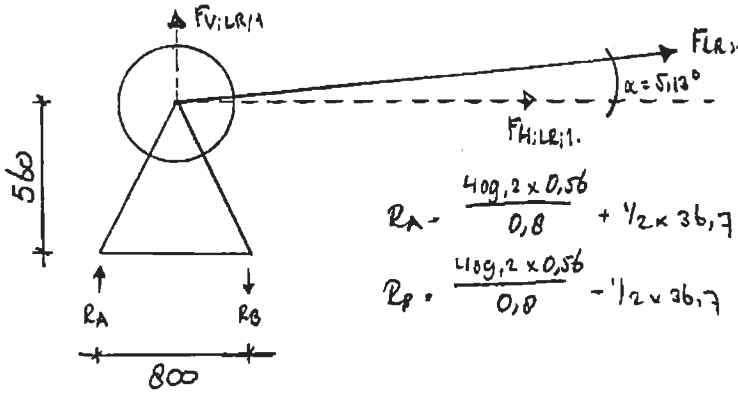
$F_{V;HR;1} = 30,9 \times \sin 1,93° = 1,0$ kN.

$$R_A = \frac{30,9 \times 0,56}{0,8} + \tfrac{1}{2} \times 1,0 = 22,2 \text{ kN.}$$

$$R_B = \frac{30,9 \times 0,56}{0,8} - \tfrac{1}{2} \times 1,0 = 21,2 \text{ kN.}$$

NOTE : CONSERVATIVE

RESOLVING FLR;1



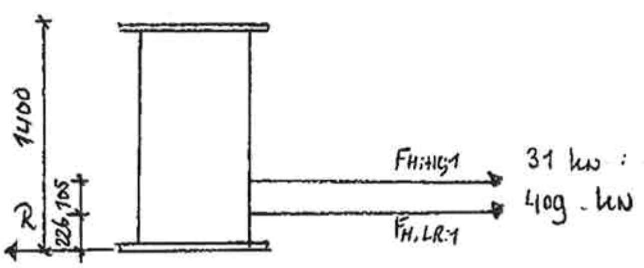
$F_{H;LR;1} = 410,9 \times \cos 5,13° = 409,2$ kN

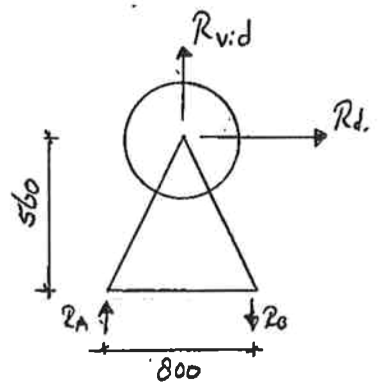
$F_{V;LR;1} = 410,9 \times \sin 5,13° = 36,7$ kN

$$R_A = \frac{409,2 \times 0,56}{0,8} + \tfrac{1}{2} \times 36,7 = 305 \text{ kN}$$

$$R_B = \frac{409,2 \times 0,56}{0,8} - \tfrac{1}{2} \times 36,7 = 268 \text{ kN.}$$

LOADS ON SUPPORT





$$R_{up} = \frac{409 \times (1400-226)}{1400} + \frac{31 \times (1400-(226+105))}{1400}$$

$$= 343 + 24 = 367 \text{ kN.}$$

$$R_d = 1,2 \times 367 = 441 \text{ kN.}$$

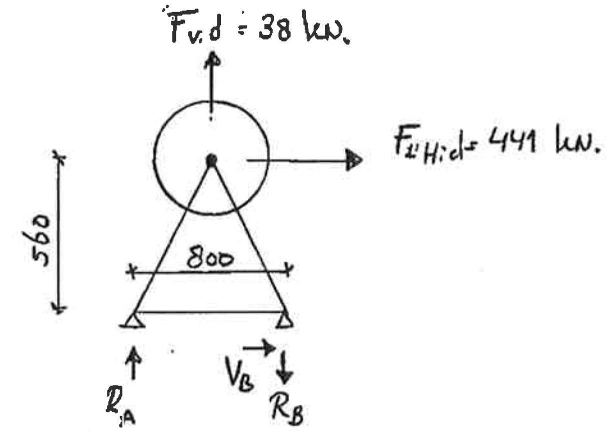
$$R_{v;d} = 1,2 \times \left(\frac{36,7 \times (1400-226)}{1400} + \frac{1,0 \times (1400-(226+105))}{1400} \right)$$

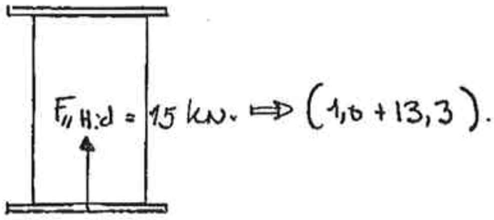
$$= 1,2 \times (30,8 + 0,84) = 38 \text{ kN.}$$

$$R_A = \frac{441 \times 0,56}{0,8} + \tfrac{1}{2} \times 38 = 328 \text{ kN. (TENSION)}$$

$$R_B = \frac{441 \times 0,56}{0,8} - \tfrac{1}{2} \times 38 = 290 \text{ kN. (COMPRESSION).}$$

SUMMARY LOADS





IN THE CALCULATION IS A CONTINGENCY FACTOR INCLUDED OF $\gamma = 1,1$.

SUPPORTS:

$$R_A = \tfrac{1}{2} \times F_{V;d} + \frac{F_{\perp H;d} \times 560}{800} + \tfrac{1}{2} \times \frac{F_{/\!/ H;d} \times 560}{1400}$$

$$= \tfrac{1}{2} \times (1,1 \times 38) + \frac{(441 \times 1,1) \times 560}{800} + \tfrac{1}{2} \times \frac{(15 \times 1,1) \times 560}{1400}$$

$$= +21 + 340 + 4 = 365 \text{ kN.}$$

$$R_B = -21 + 340 - 4 = 315 \text{ kN.}$$

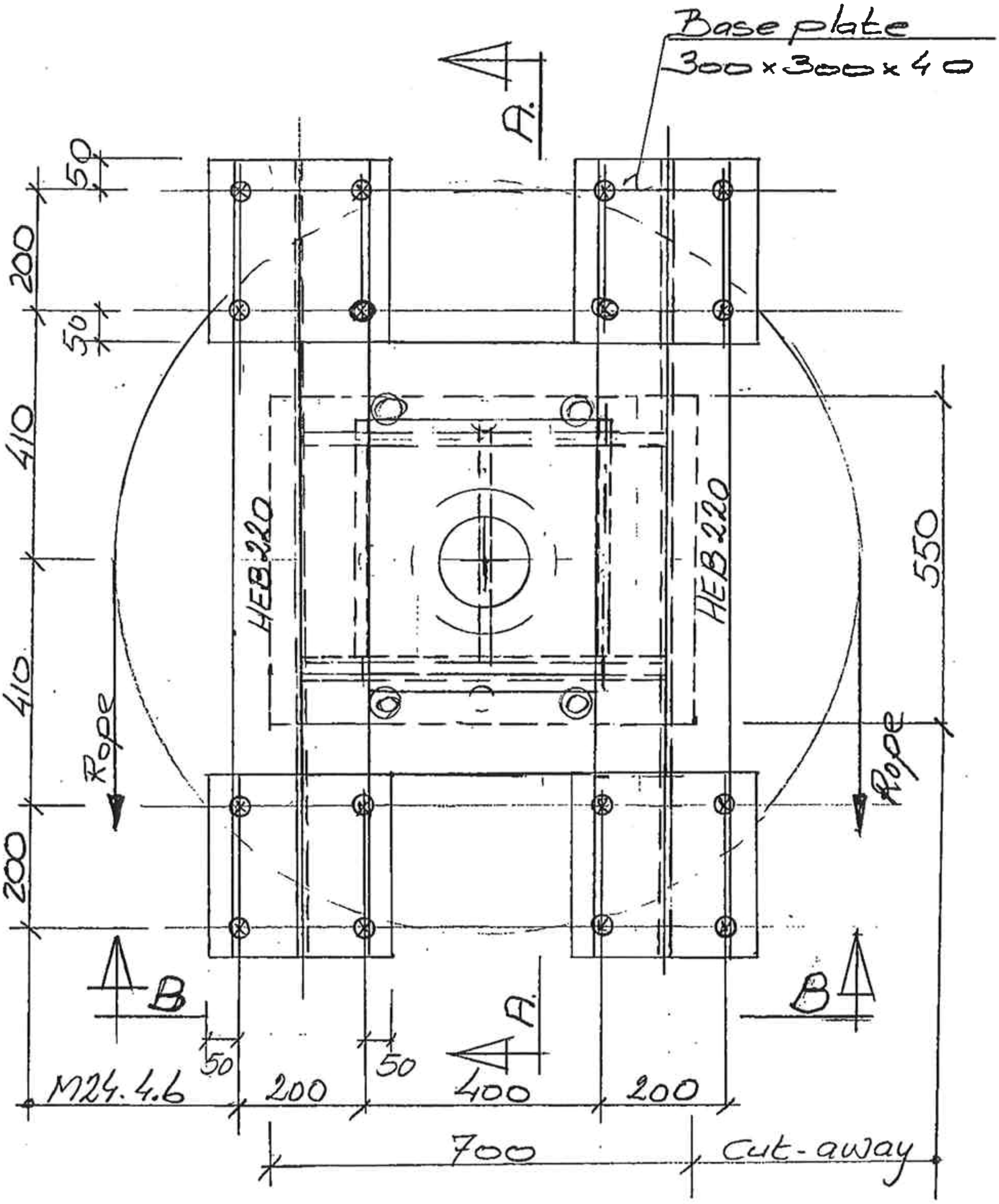
$$V_B = 485 \text{ kN.}$$

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM

J2: SHEAVE SUPPORTS

SHEAVE SUPPORT 1.



Opgesteld : MPI

Datum : 26-4-'04

Bladnummer : J2 - 1

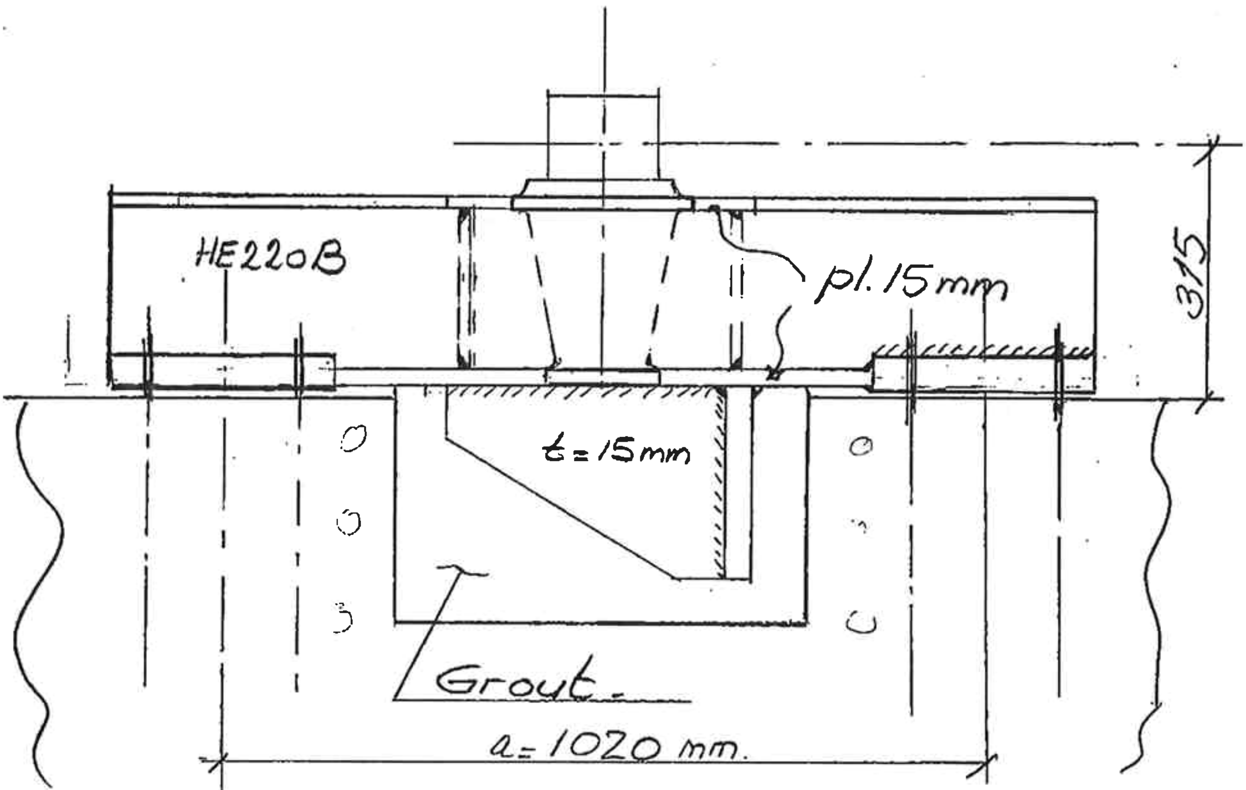
Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

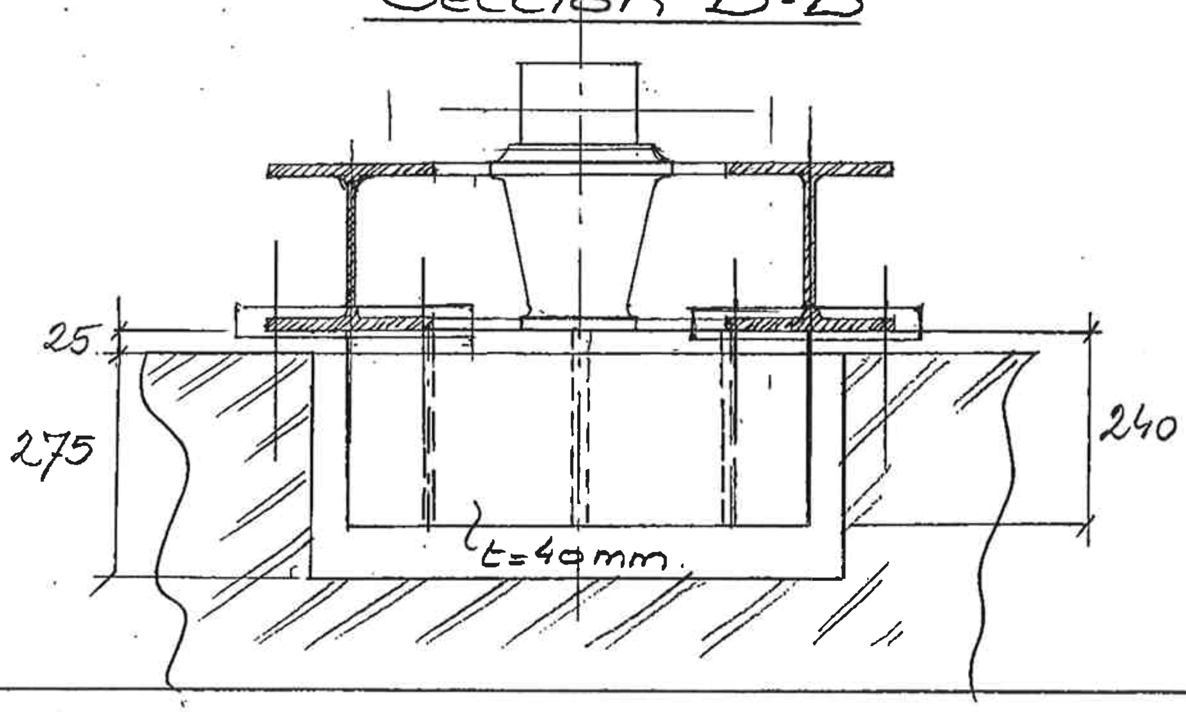
Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM

Concrete (B35) No reinforcingbar in recess

Section A-A.



Section B-B



Opgesteld : MPI

Datum : 26-4-'04

Bladnummer : J2;2

Rev. : 0

Anchor bolt: M24. 8.8.

$F_{t;u;d} = \dfrac{0.9\, a_{red}\, f_{t;b;d}\, A_{b;s}}{\gamma_m} \rightarrow \dfrac{0.9 \times 0.6 \times 800 \times 353 \times 10^{-3}}{1.25}$

$F_{t;u;d} = 122$ kN

$F_{t;s;d} = \dfrac{M_{y;s;d}}{a} \rightarrow 428 / 1.02 = 420$ kN.

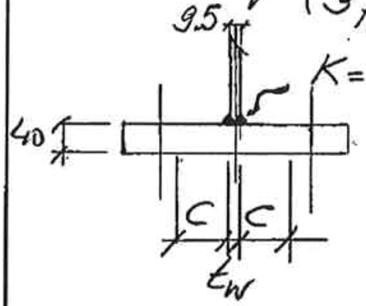
8 Bolts → 420 kN

$F_{t;s;d} \Rightarrow 420 / 8 = 52.5$ kN

$UC = 52.5 / 122 = \underline{0.43} < 1$ oké

Concrete bearing

$c = t \sqrt{\left(\dfrac{f_y}{3 f_j \gamma_{m}}\right)} \rightarrow c = 40 \sqrt{\dfrac{345}{3 \times 21 \times 1.1}} = 89$ mm.



Bearing area

$B \Rightarrow 2 \times 89 + 10 = 188$ mm.

$L = 300$ mm

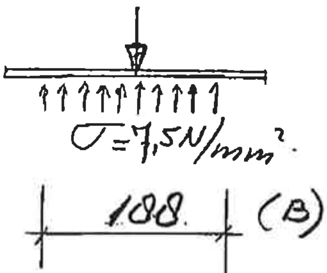
$A \Rightarrow 188 \times 300 = 56.400$ mm^2

$\sigma_c = \dfrac{F_{d;s;d}}{A} \rightarrow \dfrac{420 \times 10^3}{56400} = 7.5$ N/mm^2 < 13 N/mm^2

$UC \Rightarrow 7.5/13 = 0.58 < 1$ oké

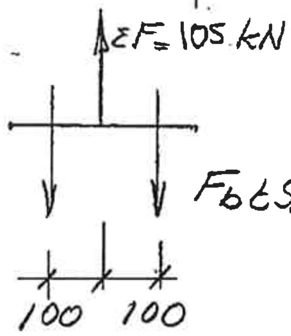
Bending base plate. $t = 40mm$.

$$M_{Rd} = \frac{t^2 f_y}{6\gamma_{mo}} \rightarrow \frac{40^2 \times 345}{6 \times 1.1} = 83636 \text{ Nmm}$$



$$M_{sd} = \tfrac{1}{2} q l^2 \rightarrow \tfrac{1}{2} \times 7.5 \times \left(\frac{188}{2}\right)^2 = 33135 \text{ Nmm}$$

$$UC = 33135 / 83636 = 0.40 < 1 \text{ oké}$$



$$M_{sd} \Rightarrow 52,5 \times 10^3 \times 100 = 5250000 \text{ Nmm}$$

5,25 kNm

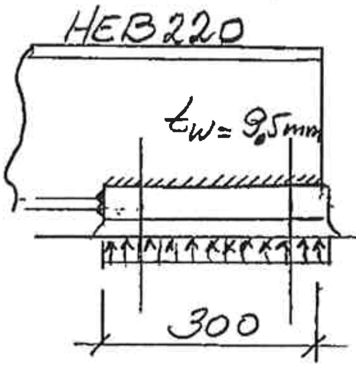
$F_{btSd} = 52,5 kN$ $B_{ef} = 150$ mm

$$M_{Rd} = 83636 \times 150 = 12545400 \text{ Nmm}$$

12.5 kNm.

$$UC \Rightarrow 5,25 / 12.5 = 0.42 < 1 \text{ oké}$$

Check web profile HE220B



$F_{dSd} = 420/2 = 210$ kN

Compressive stress

$$\sigma_d \Rightarrow \frac{210 \times 10^3}{9.5 \times 300} = 74 \text{ N/mm}^2 < \frac{355 \text{ N/mm}^2}{1.1}$$

Shear

$V_{zSd} = 210$ kN

$V_{zRd} = 335$ kN

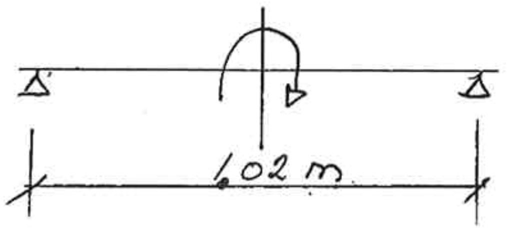
Welded K10+.
Pratical.

$$UC \Rightarrow 210 / 335 = 0,63 < 1 \text{ oké}$$

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

Check profile HEB 220 bending.



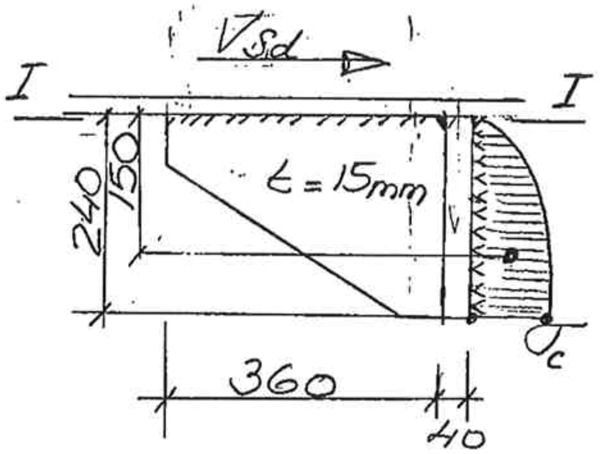
$M_{y;Sd} = 428\ kNm$

2 x profile HEB 220.

$M_{yRd} = \frac{2 \times 261}{1.1} = 475\ kNm$

$UC \Rightarrow 428/475 = 0.90 < 1$ oké

Shear plate.



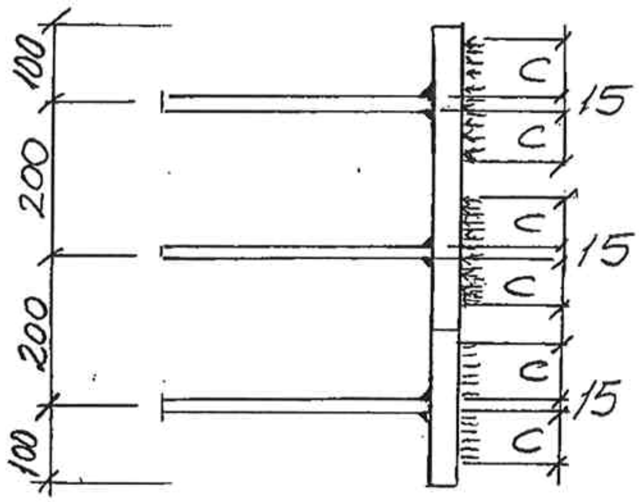
$V_{Sd} = 921\ kN.$

Shear area

$V_{Rd} = \frac{355}{\sqrt{3} \times 1.1} \times 360 \times 3 \times 15 \times 10^{-3}$

$V_{Rd} = 3018\ kN$

$UC \Rightarrow 921/3018 = 0.31 < 1$ oké



Concrete C 25-30

$c = 89\ mm$

$B_{eff} \Rightarrow 6 \times 89 + 3 \times 15 = 579\ mm$

$f_j \Rightarrow \frac{0.85 \times 25}{1.5} = 14.2\ N/mm^2$

Bearing area

$A_p = 2/3 \times 579 \times 240 = 92640\ mm^2$

$\sigma_c \Rightarrow 921 \times 10^3 / 92640 = 9.9\ N/mm^2$

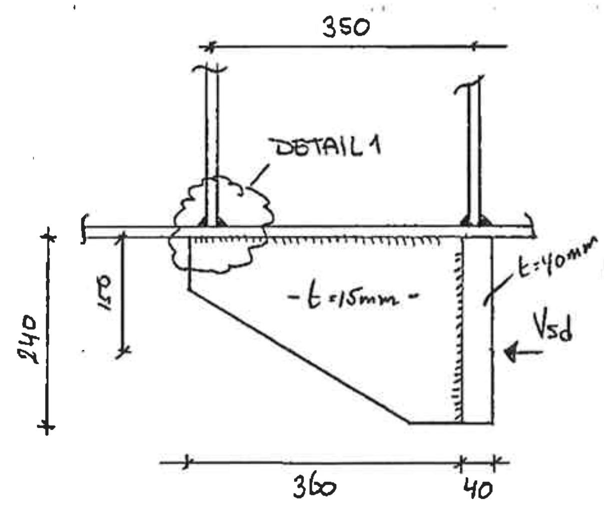
$UC \Rightarrow 9.9/14.2 = 0.70 < 1$ oké

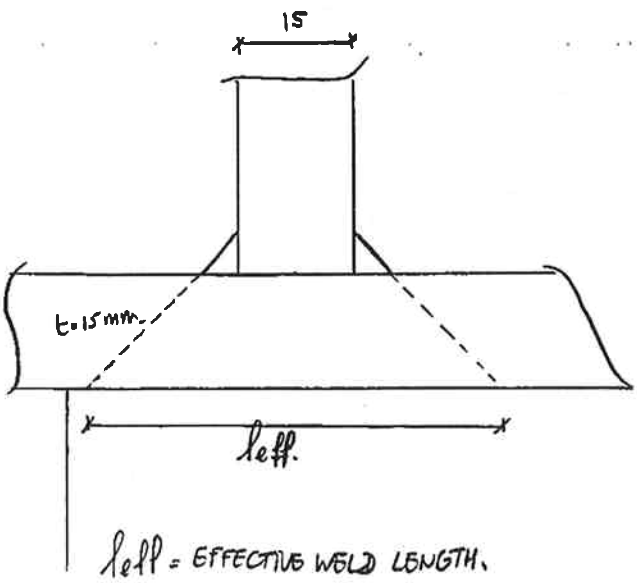
Opgesteld : MPI | Datum : 26-4-'04. | Bladnummer : J2.5 | Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM.

CHECK WELD.





leff = EFFECTIVE WELD LENGTH.

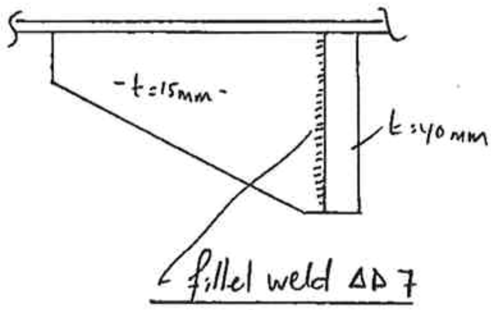
DETAIL 1

$V_{s;d} = 921$ kN.

SHEAR

$$\tau = \frac{921 \cdot 10^3}{3 \times 300 \times 2} = 512 \ N/mm^2$$

leff = 300 mm



NORMAL FORCE

$M_{y;s;d} = 921 \times 0{,}15 = 138{,}2$ kNm.

$N_{s;d} = 138{,}2 / 0{,}35 = 395$ kN.

$$\sigma = \frac{395 \cdot 10^3}{3 \times 2 \times 45} = 1463. \ N/mm^2$$

leff = 3 x 15 = 45 mm.

$$a = \frac{\sqrt{1463^2 + 512^2}}{262} = 5{,}9 \ mm \implies \text{TAKE } 7 \ mm.$$

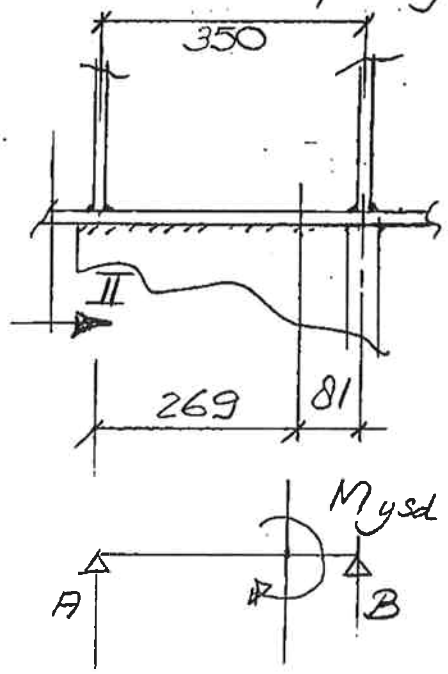
CHECK PLATE t = 15mm. O.K.

Opgesteld : MPI | Datum : 26-4-'04 | Bladnummer : J2:6 | Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM

Check coupling :

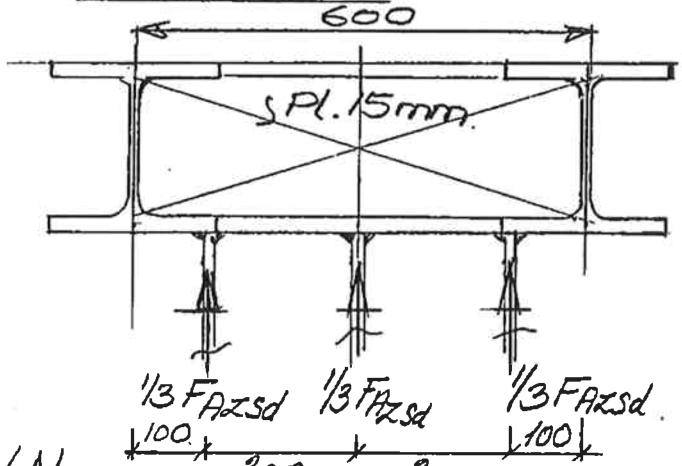


$M_{ysd} \Rightarrow 921 \times 0.150 = 138{,}2$ kNm

$F_{Azsd} \Rightarrow 138{,}2 / 0.35 = 395$ kN

$F_{Bzsd} = -395$ kN

Section II



Shear

$F_{zsd} = 395 / 2 = 197{,}5$ kN.

$F_{zRd} \Rightarrow 220 \times 15 \times \dfrac{355 \times 10^{-3}}{\sqrt{3} \times 1{,}1} = 615$ kN

$UC \Rightarrow 197{,}5 / 615 = 0.32 < 1$ oke

Bending $\rightarrow M_{ysd} \rightarrow 197{,}5 \times 0{,}1 + (197{,}5 - 1/3 \times 395) \times 0.2 = 32.9$ kNm

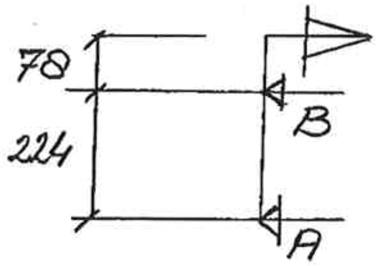
$\sigma_b \Rightarrow \dfrac{32.9 \times 10^6}{1/6 \times 15 \times 220^2} = 272\ N/mm^2 < \dfrac{355}{1.1} = 323\ N/mm^2$

Simple considered $UC = 0.84 < 1$ oké

Opgesteld : MP1 Datum : 26-4-'04 Bladnummer : J2:7 Rev. : 0

Check plate 15 mm.

Axle $F_{sd} = 921$ kN (→)



$R_{Asd} \Rightarrow 921 \times 78/224 = 321$ kN

$R_{Bsd} \Rightarrow 921 \times 302/224 = 1242$ kN

Swage action → $F_{c;sd} = 1242$ kN

diam. = $\phi 240$ mm.

Bearing resistance

$F_{bRd} \Rightarrow 2.5\, \alpha\, f_u\, d\, t \rightarrow 2.5 \times 1 \times \frac{510}{1.1} \times 240 \times 15 \times 10^{-3}$

$F_{bRd} = 4173$ kN

uc ⇒ $1242/4173 = 0.30 < 1$ oké

Swage action → $F_{c;sd} = 321$ kN

diam. = $\phi 150$ mm

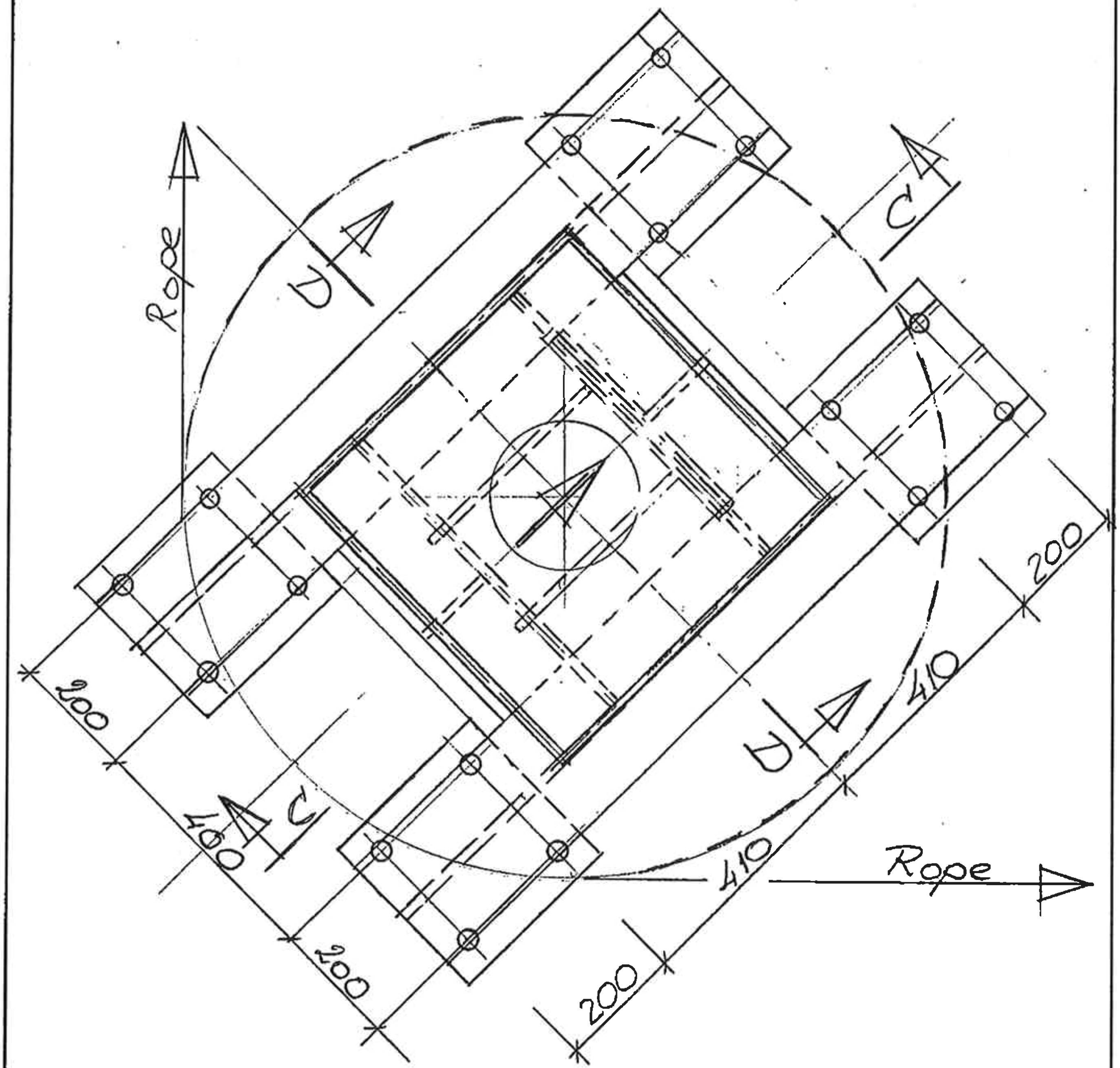
Bearing resistance

$F_{bRd} \Rightarrow 2.5 \times 1 \times \frac{510}{1.1} \times 150 \times 15 \times 10^{-3} = 2608$ kN

uc ⇒ $321/2608 = 0.13 < 1$ oké

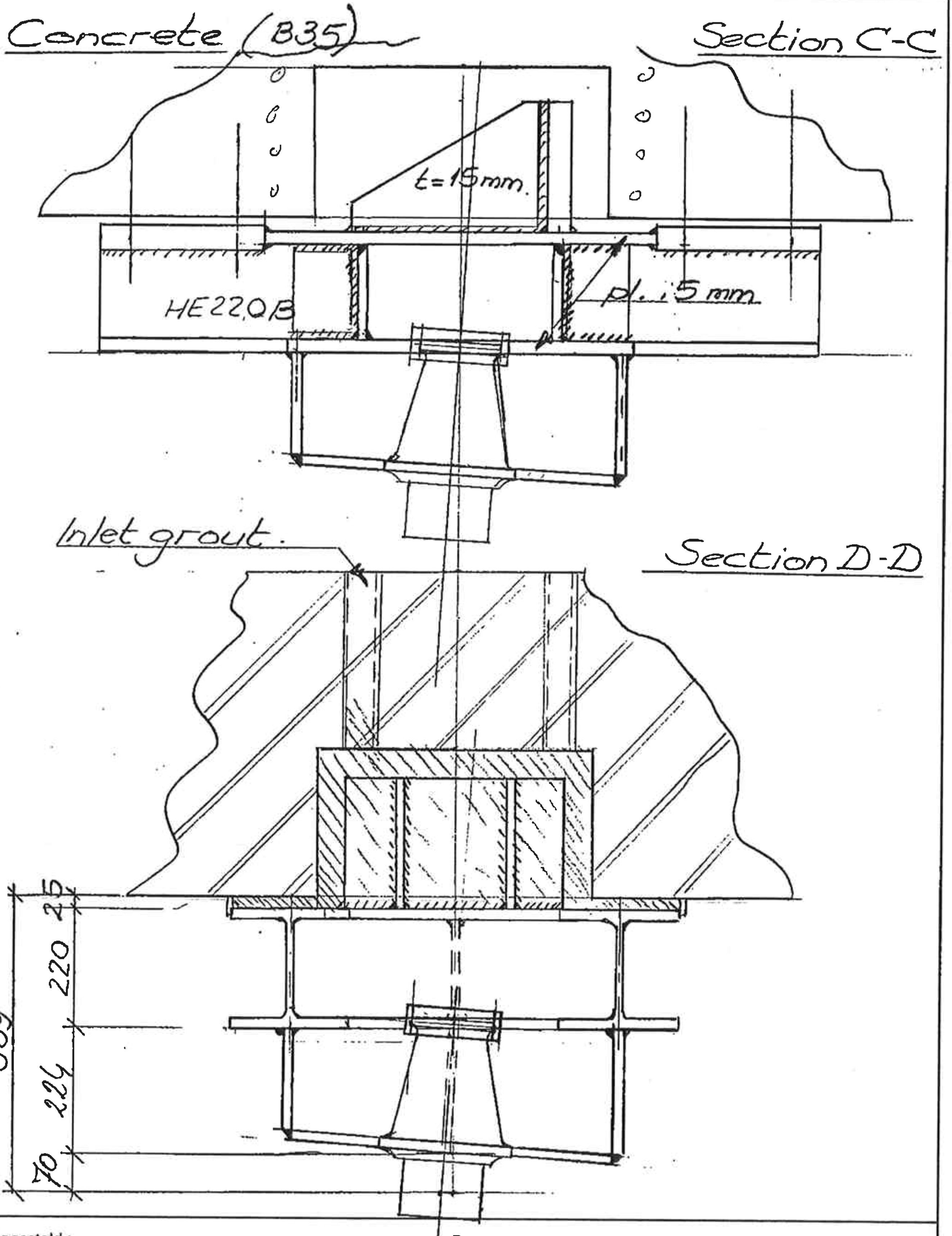
Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM 7 : ROPE REEVING / TRACTION SYSTEM

Bolts configuration
Support 2.



Opgesteld : MPI	Datum : 26-4-'04	Bladnummer : 7.2.9	Rev. : 0

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM J : ROPE REEVING / TRACTION SYSTEM



Opgesteld : MPI	Datum : 26-4-'04	Bladnummer : J2,10	Rev. : 0

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

Anchor bolt M24. 8.8

$$F_{t;u;d} = \frac{0.9\, \alpha_{red;2}\, f_{t;b;d}\, A_{b;s}}{\gamma_m} \rightarrow \frac{0.9 \times 0.6 \times 800 \times 353 \times 10^{-3}}{1.25}$$

$$F_{t;u;d} = 122 \text{ kN}$$

$$F_{t;s;d} = \frac{M_{y;s;d}}{a} \rightarrow 349 / 1.02 = 342 \text{ kN}$$

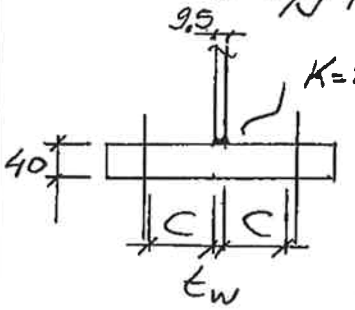
8 Bolts → 342 kN $\quad F_{v;sd} = 51$ kN

$$F_{t;s;d} \Rightarrow 342/8 + 51/16 = 46 \text{ kN}$$

$$UC = 46/122 = 0.38 < 1 \quad \text{oké}$$

Concrete press.

$$C = t\sqrt{\frac{f_u}{3 f_j \gamma_m}} \rightarrow C = 40\sqrt{\frac{345}{3 \times 21 \times 1.1}} = 89 \text{ mm}$$



Bearing area.

$B \Rightarrow 2 \times 89 + 10 = 188$ mm

$L = 300$ mm

$A \Rightarrow 188 \times 300 = 56.400 \text{ mm}^2$

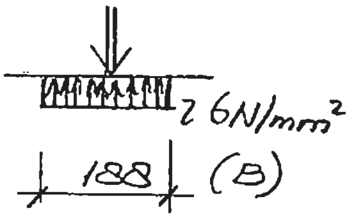
$$\sigma_c = \frac{F_{d;s;d}}{A} \rightarrow \frac{342 \times 10^3}{56400} = 6 \text{ N/mm}^2 < 13 \text{ N/mm}^2$$

$$UC \Rightarrow 6/13 = 0.47 < 1 \quad \text{oké}$$

Opgesteld : MPI	Datum : 26-4-04	Bladnummer : J2:11	Rev. : 0

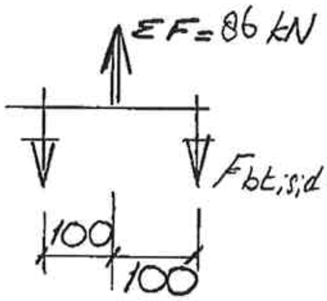
Bending baseplate $t = 40\ mm$.

$M_{Rd} = \frac{t^2 f_y}{6 \gamma_{mo}} \rightarrow \frac{40^2 \times 345}{6 \times 1.1} = 83636\ Nmm$



$M_{s;d} = \frac{1}{2} q l^2 \rightarrow \frac{1}{2} \times 6 \times \left(\frac{188}{2}\right)^2 = 26508\ Nmm$

$UC \Rightarrow 26508 / 83636 = 0.32 < 1$ oké



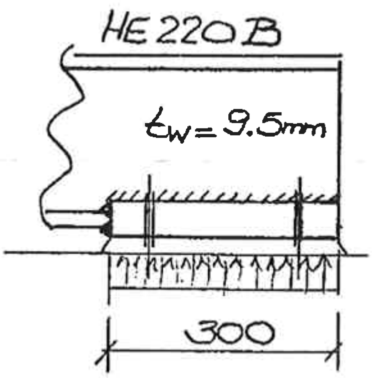
$M_{s;d} = 43 \times 0.1 = 4{,}3\ kNm$.

$B_{ef} = 150\ mm$.

$M_{Rd} \Rightarrow 83636 \times 10^{-6} \times 150 = 12.5\ kNm$

$UC \Rightarrow 4.3 / 12.5 = 0.35 < 1$ oké

Check web profile HE 220 B



$F_{d\,s;d} \Rightarrow 342/2 = 171\ kN$

Compressive stress

$\sigma_d \Rightarrow \frac{171 \times 10^3}{9.5 \times 300} = 60\ N/mm^2 < \frac{355}{1.1}\ N/mm^2$

Shear

$V_{z\,s;d} = 171\ kN \qquad V_{zRd} = 335\ kN$

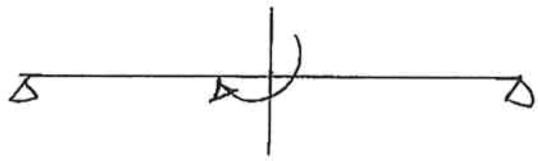
$UC \Rightarrow 171/335 = 0.51 < 1$ oké

Welded K10

Pratical

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

Check profile HEB220 bending.



$M_{zy.s;d} = 349$ kNm

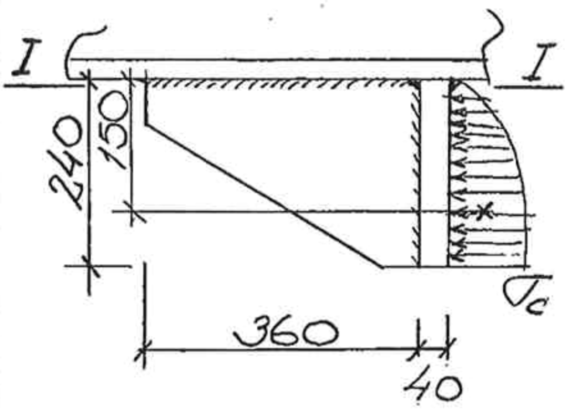
2 × profile HEB220

$M_y R_d \Rightarrow \frac{2 \times 261}{1.1} = 474.5$ kNm

$UC \Rightarrow 349 / 474.5 = 0.74 < 1$

oké

Shear plate



$V_{s;d} = 647$ kN

Shear area.

$V_{Rd} = \frac{355}{\sqrt{3} \times 1.1} \times 360 \times 2 \times 20 \times 10^{-3}$

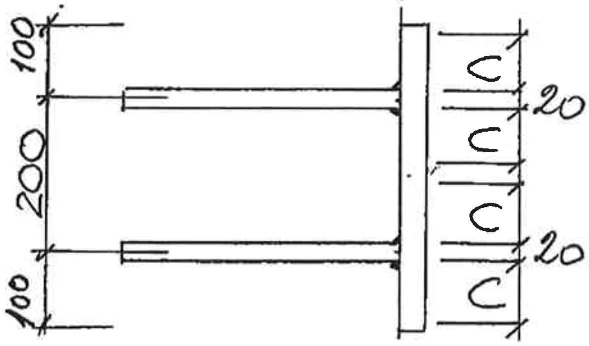
$V_{Rd} = 2683$ kN

$UC \Rightarrow 647 / 2683 = 0.25 < 1$

oké

Concrete C25-30

$c = 89$ mm



$B_{eff} = 4 \times 89 + 2 \times 20 = 396$ mm

$f_j \Rightarrow \frac{0.85 \times 25}{1.5} = 14.2$ N/mm²

Press area

$A_p = 2/3 \times 396 \times 240 = 63360$ mm²

$\sigma_c \Rightarrow 647 \times 10^3 / 63360 = 10.2$ N/mm²

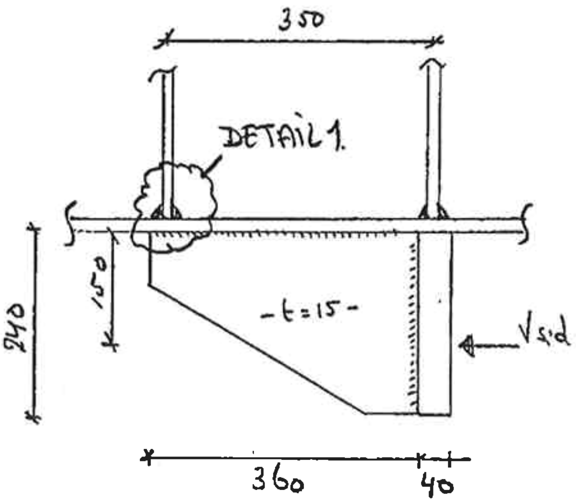
$UC \Rightarrow 10.2 / 14.2 = 0.72 < 1$ oké

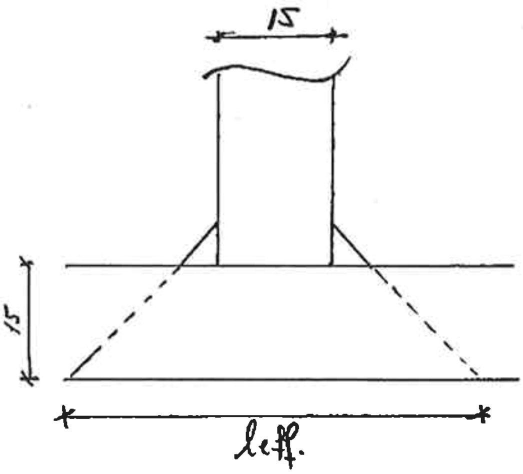
Opgesteld :	Datum :	Bladnummer :	Rev. :
MPI	26-4-'04	J2.13	0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

CHECK WELD.





leff = EFFECTIVE WELD LENGTH.

DETAIL 1

$V_{s;d} = 647$ kN.

SHEAR

$$\tau = \frac{647 \cdot 10^3}{2 \times 300 \times 2} = 539 \text{ N/mm}^2$$

leff = 300 mm

NORMAL FORCE

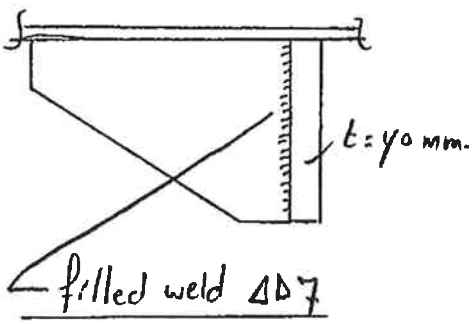
$M_{y;s;d} = 647 \times 0{,}15 = 97{,}05$ kNm.

$N_{s;d} = 97{,}05 / 0{,}35 = 277$ kN.

$$\sigma = \frac{277 \cdot 10^3}{2 \times 2 \times 45} = 1539 \text{ N/mm}^2$$

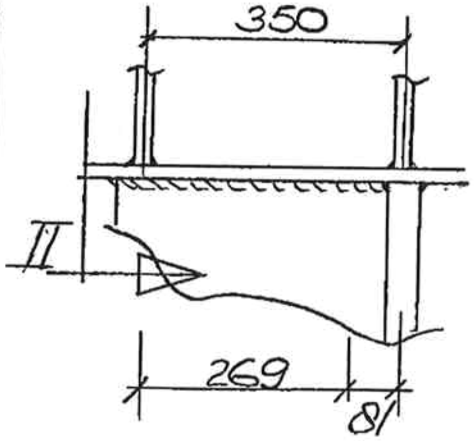
leff = 3 x 15 = 45 mm.

$$a = \frac{\sqrt{1539^2 + 539^2}}{262} = 6{,}2 \text{ mm} \Rightarrow \text{TAKE } a = 7 \text{ mm}$$



Opgesteld : MPI | Datum : 26-4-'04 | Bladnummer : J2;14 | Rev. : 0

Check coupling

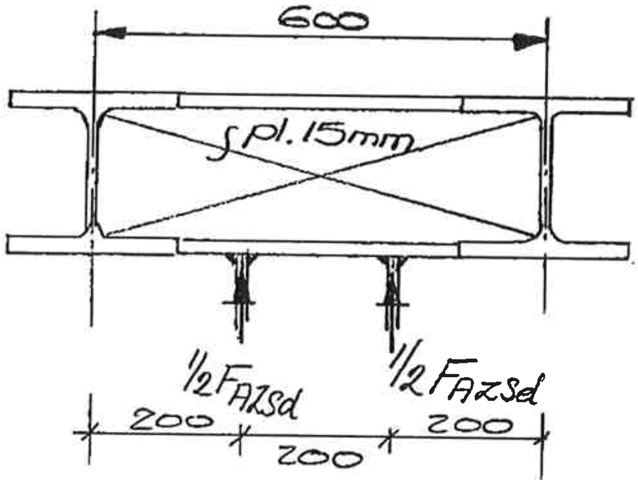


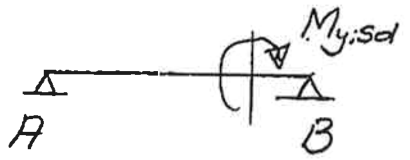
$M_{ysd} \Rightarrow 647 \times 0.15 = 97.1\ kNm$

$F_{AZsd} \Rightarrow 97.1 / 0.35 = 277\ kN$

$F_{BZsd} = -277\ kN$

Section II





Shear

$F_{Zsd} \Rightarrow 277/2 = 138.5\ kN$

$F_{ZRd} \Rightarrow 220 \times 15 \times \frac{355}{\sqrt{3} \times 1.1} \times 10^{-3} = 615\ kN$

$UC \Rightarrow 138.5/615 = 0.23 < 1$ oké

Bending

$M_{y;sd} \Rightarrow 138.5 \times 0.2 = 27.7\ kNm$

$M_{yRd} \Rightarrow 1/6 \times 15 \times 220^2 \times \frac{355}{1.1} \times 10^{-6} = 39\ kNm$

$UC \Rightarrow 27.7/39 = 0.71.. < 1$ oké

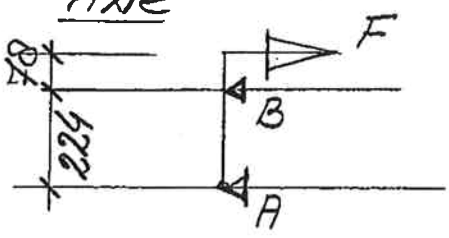
Simple considered

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

Check box. plate 15 mm.

Axle



$F_{Sd} = 647$ kN. (→)

$R_{ASd} = 647 \times 78 / 224 = 225$ kN (→)

$R_{BSd} = 647 \times 302 / 224 = 872$ kN (←)

Swage action → $F_{c;s;d} = 872$ kN

diam. = ∅240 mm.

Bearing resistance

$F_{bRd} \Rightarrow 2.5\, \alpha\, f_u\, d\, t \rightarrow 2.5 \times 1 \times \frac{510}{1.1} \times 240 \times 15 \times 10^{-3}$

$F_{bRd} = 4173$ kN

$uc \Rightarrow 872 / 4173 = 0.21 < 1$ oké

Swage action → $F_{c;s;d} = 225$ kN

diam. = ∅150 mm.

Bearing resistance

$F_{bRd} \Rightarrow 2.5 \times 1 \times \frac{510}{1.1} \times 150 \times 15 \times 10^{-3} = 2608$ kN

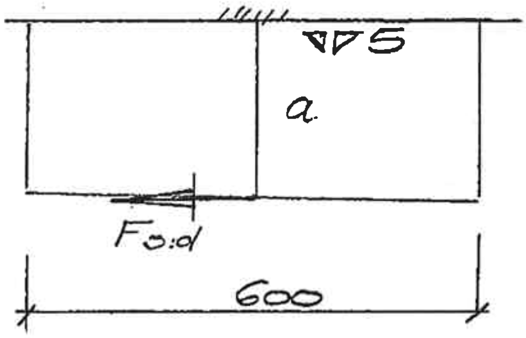
$uc \Rightarrow 225 / 2608 = 0.09 < 1$ oké

Opgesteld : MPI Datum : 26-4-'04. Bladnummer : J2:16 Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

Check box. plate 15 mm cont'd. S355J..



$F_{s;d} \Rightarrow 872/2 = 436$ kN

$a = 224$

$M_{ysd} = 436 \times 0.224 = 97.7$ kNm

Plate 15×600.

$M_{yRd} \Rightarrow 1/6 \times 15 \times 600^2 \times \frac{355}{1.1} \times 10^{-6} = 290.5$ kNm.

$UC \Rightarrow 97.7/290.5 = 0.34 < 1$ oké

Welds fillet ΔΔ5.

Shear $\tau_2 = \frac{F_{sd}}{2\,a\,l_{ref}} \Rightarrow \frac{436 \times 10^3}{2 \times 5 \times 600} = 73\ N/mm^2$

Moment $\sigma_1 = \tau_1 = \frac{3}{\sqrt{2}} \times \frac{M_{sd}}{a\,l_{ref}^2} \Rightarrow \frac{3}{\sqrt{2}} \times \frac{97.7 \times 10^6}{5 \times 600^2} = 115\ N/mm^2$.

Combination

$\sigma_{wsd} = \frac{1}{\sqrt{3}} \times \sqrt{115^2 + 3 \times 115^2 + 73^2} = 152\ N/mm^2$

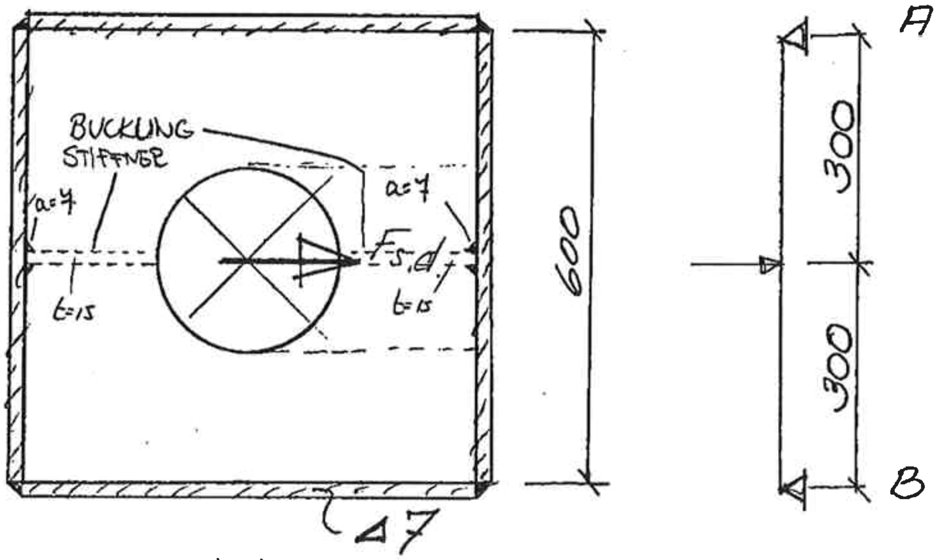
$f_{vwd} = 262\ N/mm^2$.

$UC = 152/262 = 0.58 < 1$ oké

Opgesteld : MP1 Datum : 26-4-'04 Bladnummer : J2:17 Rev. : 0

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM J: ROPE REEVING / TRACTION SYSTEM.

Check box. plate 15 mm cont'd.



$F_{sd} = 872$ kN.

$R_{Asd} = 436$ kN $\rightarrow$ $R_{BRd} = 436$ kN.

Shear.

$V_{zRd} = 600 \times 15 \times \frac{355}{\sqrt{3} \times 1.1} \times 10^{-3} = 1677$ kN

$UC = 436/1677 = 0.26 < 1$ oké

Moment

$M_{ysd} = 1/4 \times 872 \times 600 = 130800$ Nmm

$M_{yRd} = 1/6 \times 15 \times 600^2 \times \frac{355}{1.1} = 290454545$ Nmm

$UC = 130800/290454545 = 0{,}00045 << 1$ oké

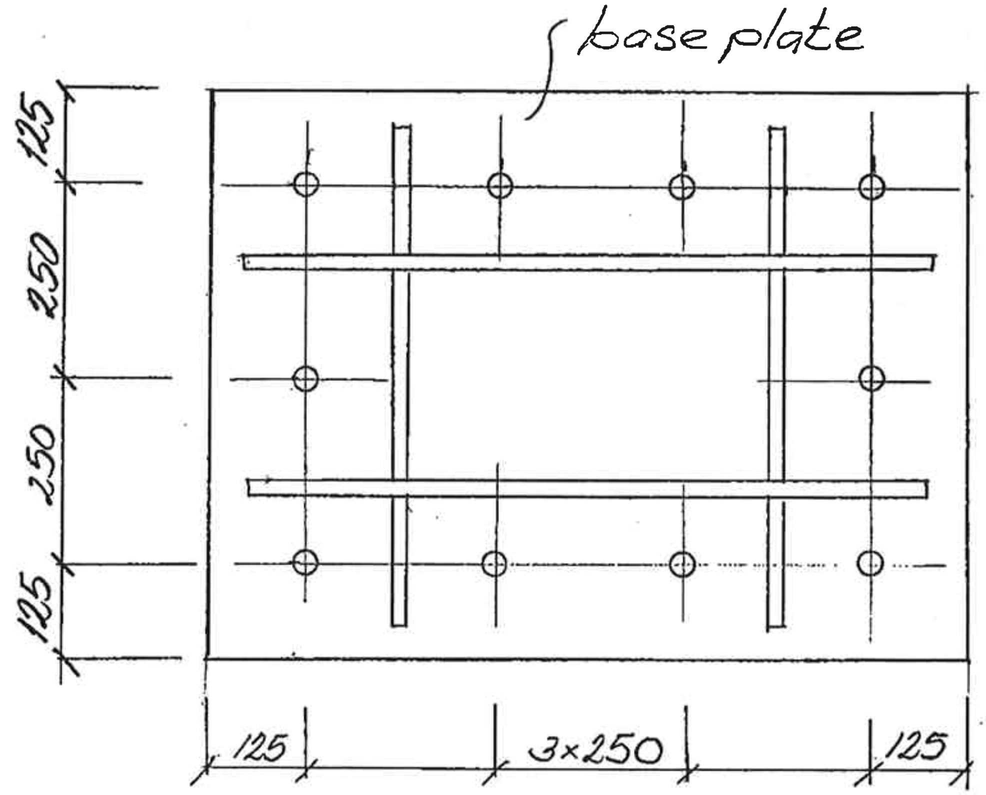
Welds Δ7

Opgesteld:	Datum:	Bladnummer:	Rev.:
MPI	26-4-'04	J2;18	0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

SHEAVE SUPPORT 3 : BALLAST BLOCK



Anchor bolt M30. 8.8 $F_{t;u;d} = 194$ kN.

$F_{t;sd} = 18 + 1{,}2 \times 60 = 90$ kN.

10 bolts → 90 kN (tensile force)

$F_{t;s;d} \Rightarrow 90/10 = 9$ kN

$UC \Rightarrow 9/194 = 0{,}05 < 1$ oké

Profile. Pratical.

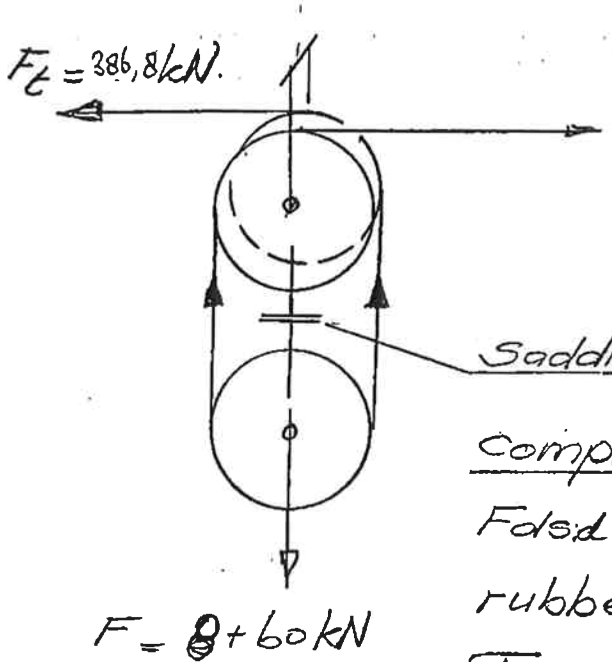
Welds Pratical

Opgesteld : MPI

Datum : 26-4-'04

Bladnummer : J2;19

Rev. : 0



Saddle support

compressive stress of rubber

$F_{d\,s;d} \Rightarrow 1.2 \times (368,8 + 404,7) = 950$ kN.

rubber blok (400 x 500 x 40)

$$\sigma_{s;d} = \frac{950 \times 10^6}{400 \times 500} = 5\ N/mm^2$$

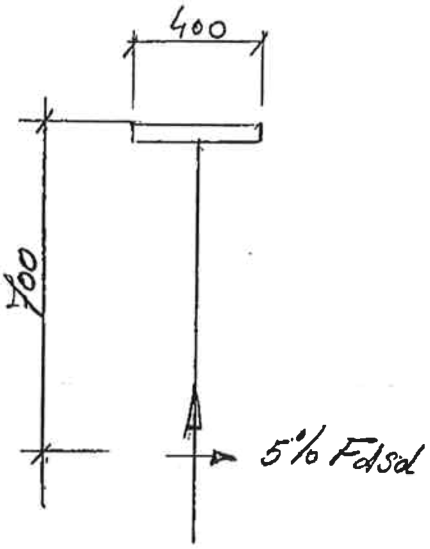
$\sigma_{Rd} = 20\ N/mm^2$

$UC = 5/20 = 0,25 < 1$ oke

Moment

$M_{s;d} \Rightarrow 0.05 \times 950 \times 0,7 = 33,2$ kNm

$$\sigma \Rightarrow \frac{33,2 \times 10^6}{1/6 \times 500 \times 400^2} = 3\ N/mm^2.$$



combination.

$\sigma_{sd} \Rightarrow 5 + 3 = 8\ N/mm^2 < 20$

oke

Project : MALAMOCCO NAV. LOCK GATE

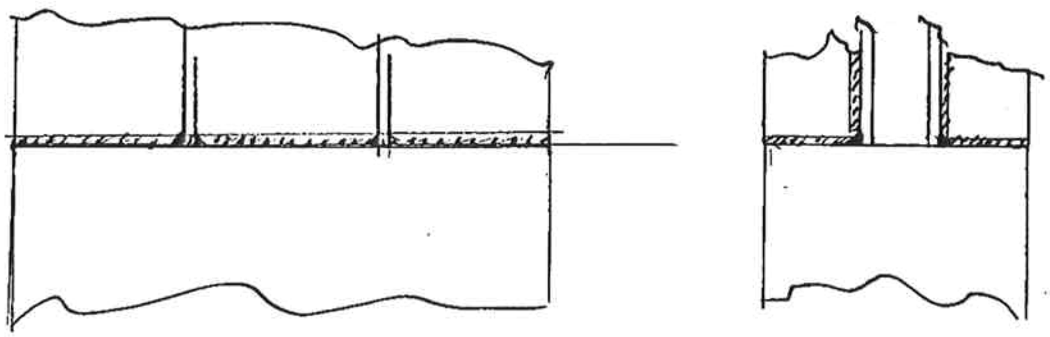
Onderdeel : ADDENDUM J: ROPE REEVING / TRACTION SYSTEM.

Check welds of counter weight.

$l_{eff} \Rightarrow 150 \times 5 + 4 \times 280 = 1870$

$\sigma_{\perp} = \tau_{\perp} = \frac{F_{sd}\sqrt{2}}{4a\, l_{eff}} \rightarrow \frac{60 \times 1.2 \times 10^3 \times \sqrt{2}}{4 \times 5 \times 1870} = 3\ N/mm^2$

$UC = 3/262 = 0{,}01 \qquad f_{rwd} = 262\ N/mm^2$



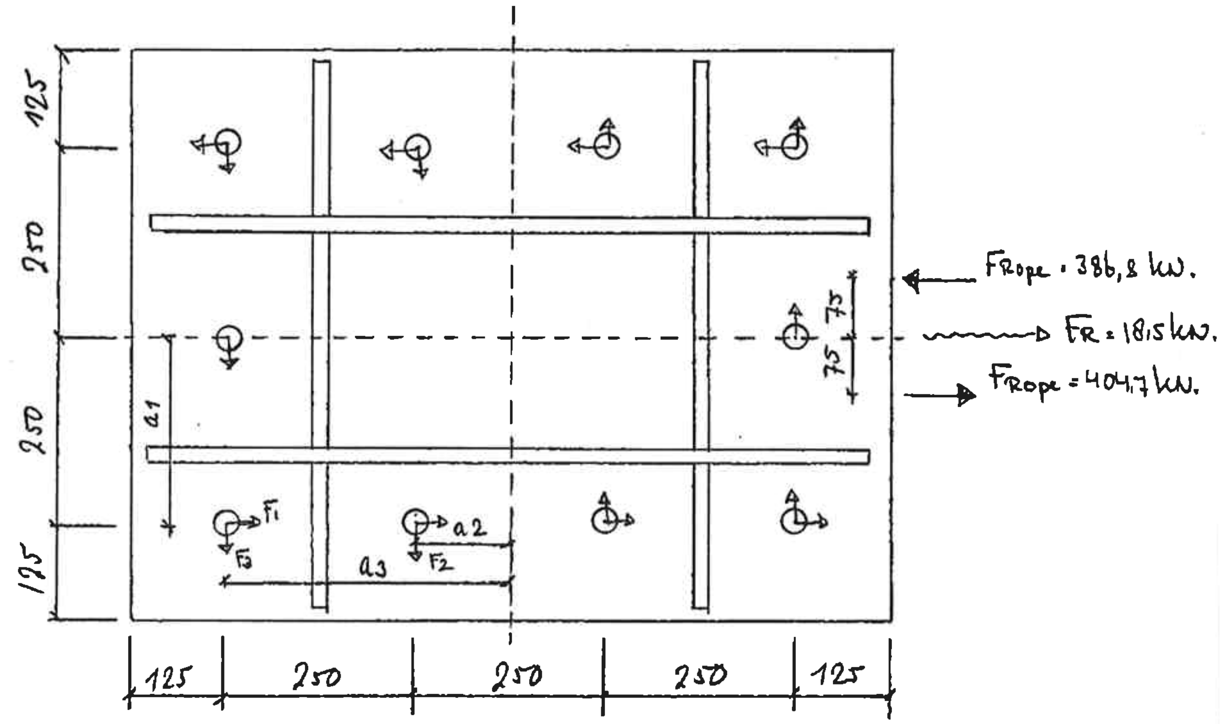
Welded pratical !

Opgesteld : MPI | Datum : 26-4-'04 | Bladnummer : J2;21 | Rev. : 0

Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

SHEAR

ANCHOR BOLT M30. 8.8.



SHEAR ON ANCHORS DUE TO TORSION.

$8 \times F_1 \times a_1 + 4 \times F_2 \times a_2 + 6 \times F_3 \times a_3 = M_T$

$M_T = (1{,}2 \times 404{,}7\ kN) \times 0{,}075 + (1{,}2 \times 386{,}8\ kN) \times 0{,}075 = 71{,}2\ kNm$

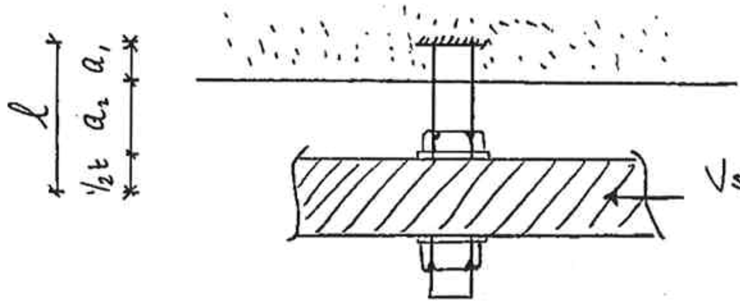
$a_1 = 250\ mm \Rightarrow a_1 = 2 \times a_2 \Rightarrow F_1 = 2 \times F_2$
$a_2 = 125\ mm$
$a_3 = 375\ mm \Rightarrow a_3 = 3 \times a_2 \Rightarrow F_3 = 3 \times F_2$

$4000\ F_2 + 500\ F_2 + 6750\ F_2 = 71{,}2\ kNm \Rightarrow F_2 = 6{,}3\ kN.$

$F_1 = 2 \times 6{,}3 = 12{,}6\ kN$
$F_3 = 3 \times 6{,}3 = 18{,}9\ kN.$

$F_{shear} = 404{,}7 - 368{,}8 = 18{,}5\ kN. \Rightarrow F_d = 18{,}5 \times 1{,}2 = 22{,}2\ kN.$
per anchor $= 22{,}2 / 10 = 2{,}22\ kN.$

ANCHOR FAILURE CHECK ACC. CUR 25



$V_{s;d} = \sqrt{12{,}6^2 + 18{,}9^2} + 2{,}2 = 25$ kN.

DIFFERENCE IN LOAD:

404,7 − 386,2 = 18,5 kN. (EXTRA SHEAR)

$18{,}5 \times 1{,}2 = 22{,}2$ kN. ⇒ $\frac{22{,}2}{10} = 2{,}22$ kN.

$a_1 = \frac{1}{2} d = \frac{1}{2} \times 24 = 12$ mm.

a_2 = GROUTING SPACE = 25 mm.

t = THICKNESS PLATE = 50 mm ⇒ $\frac{1}{2}t$ = 25 mm

$l = 12$ mm + 25 mm + 25 mm = 62 mm

$$V_{Rd} = \frac{\alpha \times M/\gamma_m}{l} = \frac{2{,}0 \times (1484063 / 1{,}25)}{62} = 36{,}5 \text{ kN.}$$

with:

α = 2,0.

$M = 1{,}2 \times W_{el} \times f_y \Rightarrow 1{,}2 \times (\frac{1}{32} \times \pi \times 27^3) \times 640 = 1484063$ Nmm.

l = 62 mm.

$V_{s;d} \leq V_{Rd} \Rightarrow$ u.c. $= \frac{25}{36{,}5} = 0{,}69 < 1{,}0$

COMBINATION OF TENSION AND SHEAR:

TENSION : u.c. = 0,05

SHEAR : u.c. = 0,69.

0,74 < 1,0

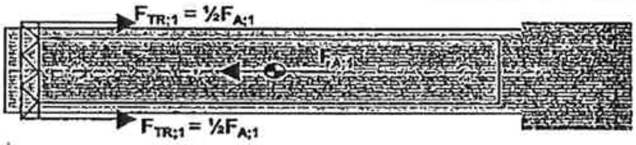
F_{TR}: Tractionforces on winchwork

Situation 1: fully operational lock gate at start movement

$F_{A;1} = \Sigma$

F_{WFE}:	103 kN
F_{HFFR}:	70 kN
$F_{IMP;H}$:	220 kN
F_{IN}:	39 kN
F_{MIS}:	1 kN +
$F_{A;1}$:	432 kN

$F_{TR;1} = ½ F_{A;1}$ **$F_{TR;1}$ = 216 kN**



Situation 2: operational lock gate at start movement; 1 malfunctioning winch

$F_{A;2} = \Sigma$

F_{WFE}:	3 kN
F_{HFFR}:	70 kN
$F_{IMP;H}$:	220 kN
F_{IN}:	7 kN
F_{MIS}:	1 kN
F_{MAL}:	51 kN +
$F_{A;2}$:	351 kN

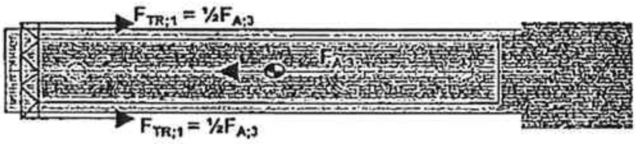
$F_{TR;2} = F_{A;2}$ **$F_{TR;2}$ = 351 kN**

Situation 3: malfunctioning of hydrofoot

$F_{A;3} = \Sigma$

F_{WFE}:	3 kN
F_{HFFR}:	220 kN
$F_{IMP;H}$:	220 kN
F_{IN}:	7 kN
F_{MIS}:	1 kN +
$F_{A;3}$:	450 kN

$F_{TR;3} = ½ F_{A;3}$ **$F_{TR;3}$ = 225 kN**



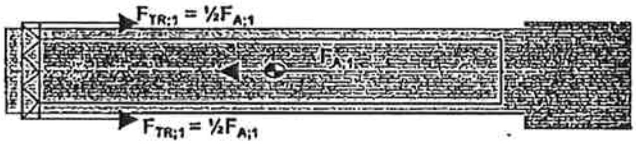
F_{TR}: Tractionforces on winchwork

Situation 1: fully operational lock gate at start movement

$F_{A;1} = \Sigma$

F_{WFE}:	86 kN
F_{HFFR}:	168 kN
$F_{IMP;H}$:	84 kN
F_{IN}:	39 kN
F_{MIS}:	2 kN +
$F_{A;1}$:	379 kN

$F_{TR;1} = ½ F_{A;1}$ — $F_{TR;1}$ 189 kN

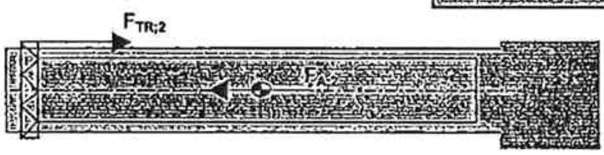


Situation 2: operational lock gate at start movement; 1 malfunctioning winch

$F_{A;2} = \Sigma$

F_{WFE}:	3 kN
F_{HFFR}:	168 kN
$F_{IMP;H}$:	84 kN
F_{IN}:	7 kN
F_{MIS}:	2 kN
F_{MAL}:	45 kN +
$F_{A;2}$:	308 kN

$F_{TR;2} = F_{A;2}$ — $F_{TR;2}$ 308 kN

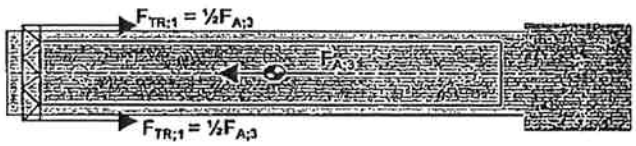


Situation 3: malfunctioning of hydrofoot

$F_{A;3} = \Sigma$

F_{WFE}:	3 kN
F_{HFFR}:	528 kN
$F_{IMP;H}$:	84 kN
F_{IN}:	7 kN
F_{MIS}:	2 kN +
$F_{A;3}$:	623 kN

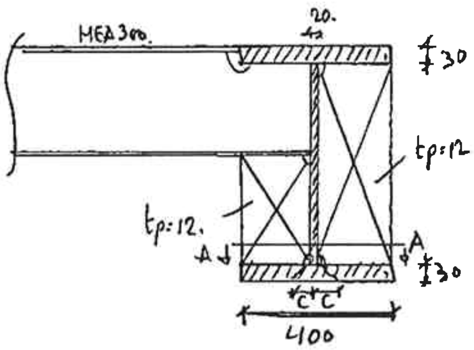
$F_{TR;3} = ½ F_{A;3}$ — $F_{TR;3}$ 312 kN

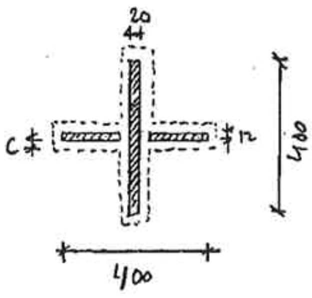


Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM J ; ROPE REEVING / TRACTION SYSTEM.

COMPRESSION SIDE

CONCRETE BEARING





SECTION A-A

CONCRETE C 30/37

$$f_{j;u;d} = \frac{2/3 \times 1{,}0 \times 30}{1{,}5} = 13{,}3 \ N/mm^2$$

$$c = t_p \times \sqrt{\frac{f_y/\gamma_m}{3 \times f_{j;u;d}}} = 40 \times \sqrt{\frac{355/1{,}1}{3 \times 13{,}3}} = 114 \ mm$$

BEARING AREA:

$$A = 400 \times (2 \times 114 + 20) + (400 - (2 \times 114 + 20)) \times (2 \times 114 + 12).$$

$$= 99200 + 34960 = 134160 \ mm^2$$

COMPRESSION FORCE ; $F_d;S_d$ = 315 kN. (REF. J1-6).

$$\sigma_c = \frac{F_d;S_d}{A} = \frac{315 \cdot 10^3}{134160} = 2{,}4 \ N/mm^2 < 13{,}3 \ N/mm^2$$

$$U.C. = \frac{2{,}4}{13{,}3} = 0{,}18 < 1{,}0$$

Opgesteld :	Datum :	Bladnummer :	Rev. :
MPJ	14-5-'04	J3-1	0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM

CHECK COMPOUND PROFILE

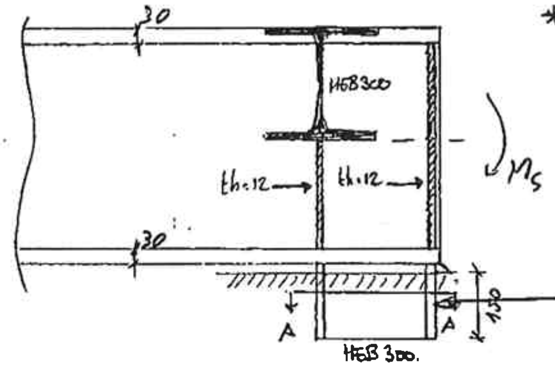
(SEE SECTION A-A, CALC. CONCRETE BEARING FOR AREA).

$A = 400 \times 20 + (400 - 20 - 2 \times 10) \times 12 = 12320 \text{ mm}^2$

$F_{d;Sd} = 315$ kN.

$\sigma_d = \frac{F_{d;Sd}}{A} = \frac{315 \cdot 10^3}{12320} = 26 \text{ N/mm}^2 < 355/1{,}1$

SHEAR KEY



* CHECK HEB300

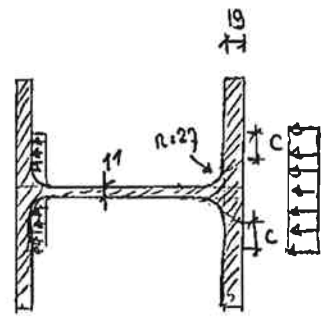
$V_{Sd} = 485$ kN.

SHEAR AREA ⇒ $A = (300 - 2 \times 19) \times 11$.

$A = 2882 \text{ mm}^2$

$V_{Rd} = 2882 \times \frac{355}{1{,}1 \times \sqrt{3}} = 537$ kN.

$u.c. = 485/537 = 0{,}91 < 1{,}0$ **O.K**



SECTION A-A

CONCRETE C30/37.

$c = t_p \times \sqrt{\frac{f_{y;d}}{3 \times f_{j;d}}} = 19 \times \sqrt{\frac{355/1{,}1}{3 \times 13{,}3}} = 54 \text{ mm}$

$B_{eff} = 2 \times 54 + 11 + 2 \times 27 = 173 \text{ mm}$

BEARING AREA ⇒ $A = 150 \times (2 \times 173) = 51900 \text{ mm}^2$

↳ ASSUMED min 150 mm.

$\sigma_c = \frac{485 \cdot 10^3}{51900} = 9{,}4 \text{ N/mm}^2 < 13{,}3 \text{ N/mm}^2$

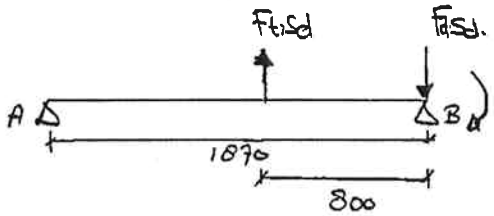
$u.c. = 9{,}4/13{,}3 = 0{,}71 < 1{,}0$ **O.K**

Opgesteld : MPI   Datum : 14-5-'04   Bladnummer : J 3-2   Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : ADDENDUM J : ROPE REEVING / TRACTION SYSTEM

CHECK COMPOUND PROFILE ON BENDING



$F_{t;Sd}$ = 365 kN. (ref. J1-6).

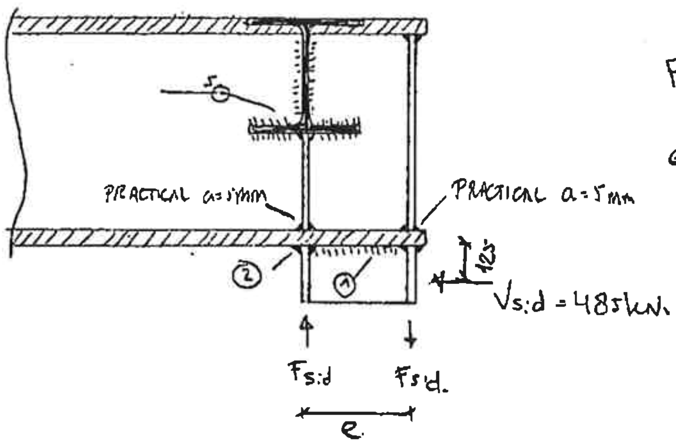
MOMENT DUE TO TENSION:

$$M = \frac{365 \times 0{,}8 \times 1{,}07}{1{,}87} = 167 \text{ kNm}$$

$$W_{y;el} = 7.30 \cdot 10^6 \text{ mm}^3$$

$$\sigma = \frac{167 \cdot 10^6}{7.30 \cdot 10^6} = 23 \text{ N/mm}^2 \quad \underline{\text{O.K.}}$$

CHECK WELD.



$$F_{s;d} = \frac{485 \times 0{,}125}{0{,}281} = 216 \text{ kN.}$$

$$e = 300 - 2 \times \tfrac{1}{2} \times 19 = 281 \text{ mm}$$

① DUE TO SHEAR. (a = 5mm)

$$\tau_2 = \frac{V_{s;d}}{2 \times a \times l_{eff}} = \frac{485 \cdot 10^3}{2 \times 5 \times 208} = 233 \text{ N/mm}^2 < 262 \text{ N/mm}^2 \quad u.c. = 233/262 = 0{,}89 < 1.0.$$

$$l_{eff} = 300 - 2 \times 19 - 2 \times 27 = 208 \text{ mm}$$

②
$$\sigma_1 = \tau_1 = \frac{F_{s;d} \times \sqrt{2}}{4 \times a \times l_{eff}} = \frac{216 \cdot 10^3 \times \sqrt{2}}{4 \times 5 \times 300} = 51 \text{ N/mm}^2$$

$$l_{eff} = 300 \text{ mm}$$

$$\sigma_{w;s;d} = 1/\sqrt{3} \times \sqrt{4 \times 51^2} = 59 \text{ N/mm}^2 < 262 \text{ N/mm}^2$$

Opgesteld : MPI Datum : 14-5-'04 Bladnummer : J3-3 Rev. : 0

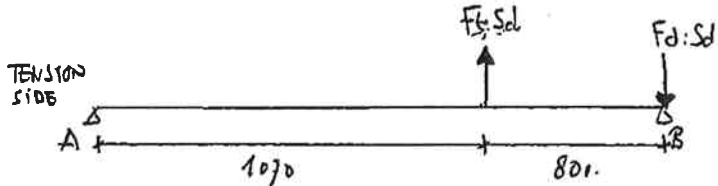
Project	: MALAMOCCO NAV. LOCK GATE
Onderdeel	: ADDENDUM J: ROPE REEVING / TRACTION SYSTEM.

TENSION SIDE

ANCHOR BOLT M 24. 8.8. (SIDE WITH 4 BOLTS).

$$F_{t;u;d} = \frac{0{,}9 \times \alpha_{ud_2} \times f_{t;b;d} \times A_{b;s}}{\gamma_m} = \frac{0{,}9 \times 0{,}6 \times 800 \times 353 \cdot 10^{-3}}{1{,}25} = 122 \text{ kN.}$$

. DETERMINATION OF TENSION FORCE:



$F_{t;Sd} = 365$ kN.

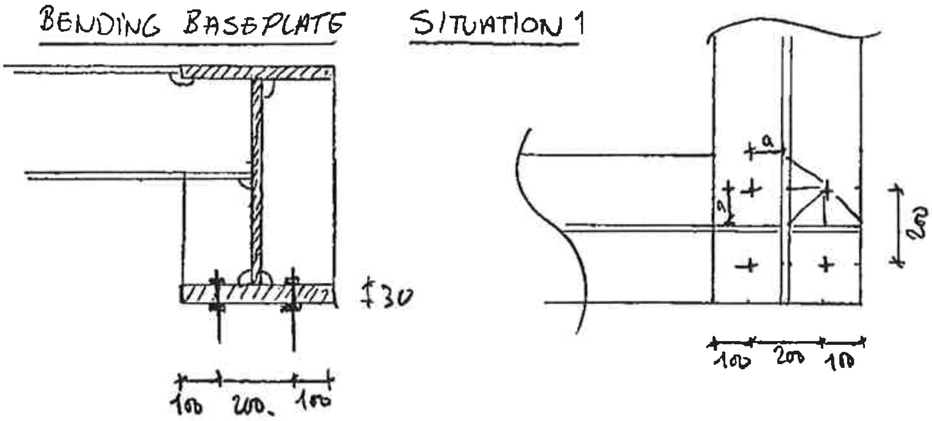
$$R_A = \frac{365 \times 0{,}8}{1{,}87} = 157 \text{ kN.} = F_{t;s;d}.$$

4 BOLTS ⇒ 157 kN.

$F_{t;s;d}$ PER BOLT = $^{157}/_{4}$ = 39,25 kN.

u.c. = $^{39{,}25}/_{122}$ = 0,32 < 1,0 **O.K**

BENDING BASEPLATE SITUATION 1



$F_{t;s;d}$ = 157 kN.

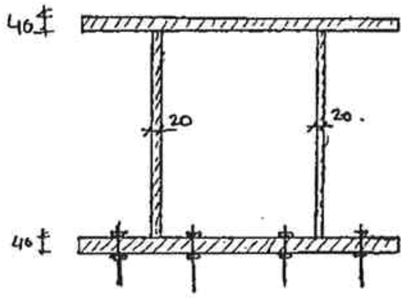
$$t_p = \sqrt{\frac{F_{t;s;d} \times 6}{n \times 4 \times f_{y;d}}} = \sqrt{\frac{157 \cdot 10^3 \times 6}{4 \times 4 \times {}^{355}/_{1{,}1}}} = 13{,}5 \text{ mm} \Rightarrow \text{PLATE : th} = 30 \text{ mm} \quad \textbf{O.k}$$

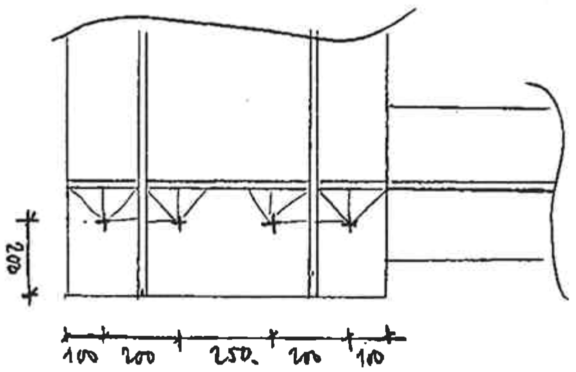
n = NUMBER OF BOLTS

Opgesteld :	Datum :	Bladnummer :	Rev. :
MPI	14-5-'04	J 3-4	0

Project	:	MALAMOCCO NAV LOCK GATE
Onderdeel	:	ADDENDUM J: ROPE REEVING / TRACTION SYSTEM

SITUATION 2





FOR CALCULATION SEE SITUATION 1.

TUBE SECTION

LOAD ON THE TUBE SECTION FROM MOTOR IS NEGLIGIBLE.

Opgesteld : MPI	Datum : 14-5-'04	Bladnummer : J3-5
Rev. : 0		

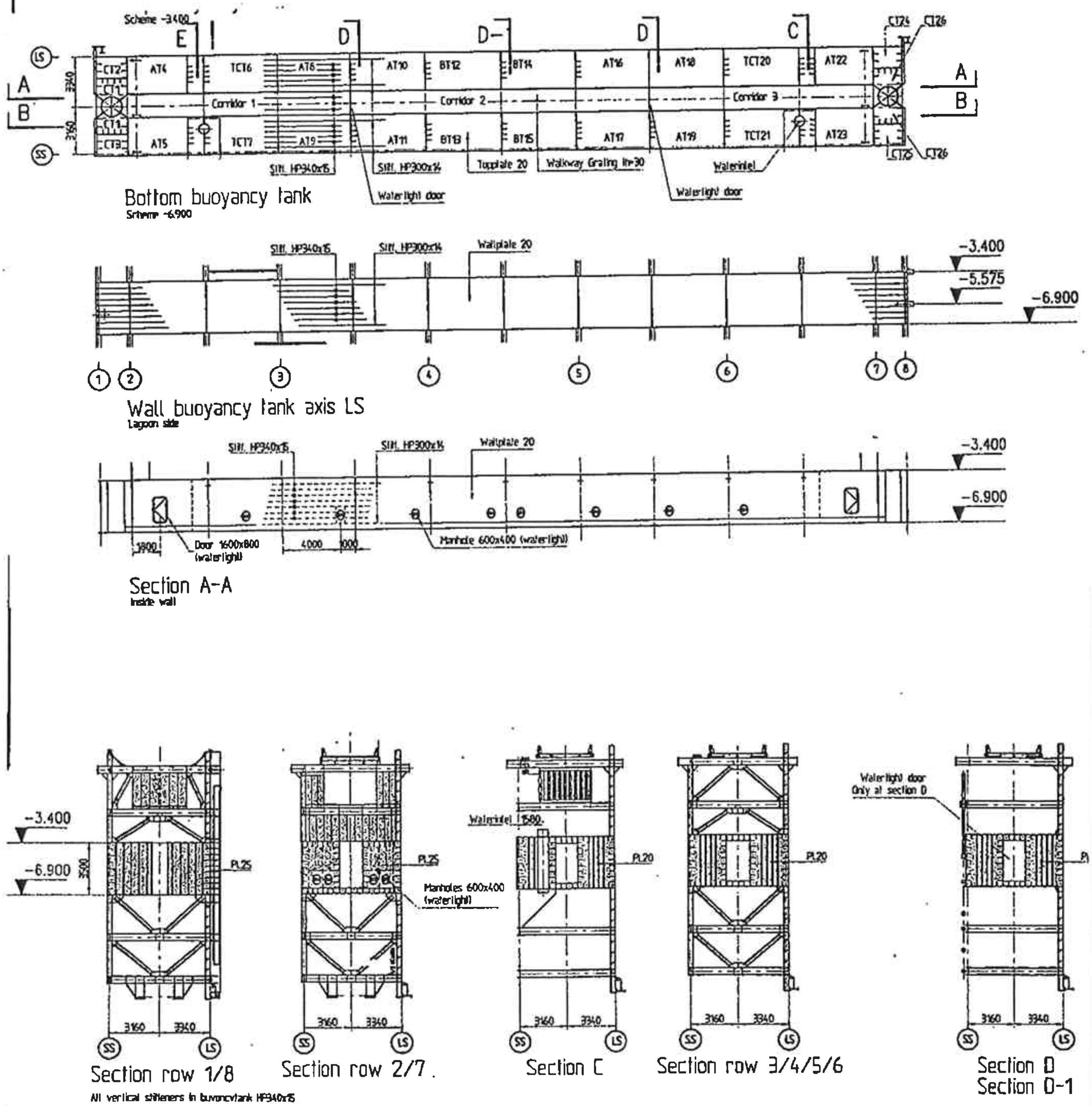
Addendum K Buoyancy chamber

Contents

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

1. OVERVIEW BUOYANCY TANKS.



Opgesteld : Alsemgeest

Datum : 220604

Bladnummer : K1-1

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

2. CHECK. BUOYANCY TANK WALLS.

LOADS

(A) LOCAL LOADING

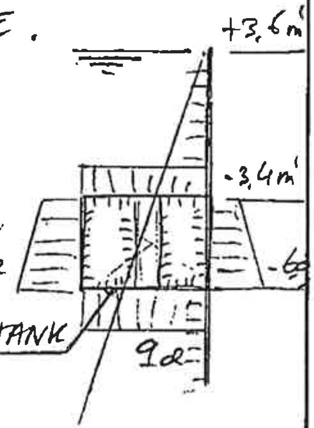
→ EXTERNAL WALLS: EXTERNAL WATERPRESSURE.

CALC. WITH WATERPRESSURELOAD

AT BOTTOM OF TANK.

$q_{DE} = \gamma \cdot P \cdot h = 1{,}5 \cdot 10{,}3 \cdot 10{,}5 = 162{,}2\ kN/m^2$

(UNIFORM OVER HEIGHT TANK; CONSERV.) BOTTOM TANK



→ INTERNAL WALLS: INTERNAL PRESSURE:

1 DUE TO WATERBALLAST INSIDE TANK.

$q_{d1} = 1{,}5 \cdot 10{,}3 \cdot 3{,}5 = 54\ kN/m^2.\ (\leq q_{DE})$

2 q_{d2} = EQUAL TO OUTSIDE WATERPRESSURE AT TIME OF INSTALLATION/FLOATING;
INTERNAL PRESSURE ≥ EXTERNALPRESSURE = q_{dE}.

∴ GOVERNING LOAD INTERNALWALLS EQUALTO EXTERNAL WALLS q_{dE} CONSERVATIVE.

(B) GLOBAL LOADING

LOADING OF BUOYANCY TANK DERIVED FROM THE MAIN CALCULATION; 3D - MEMBER MODEL.

THE GLOBAL LOADING CAN BE CALCULATED FROM THE RESULTING DUMMY FORCES OUT OF THE MAIN CALC. MODEL.

1 → HORIZONTAL DUMMIES +

2. → DIAGONAL DUMMIES.

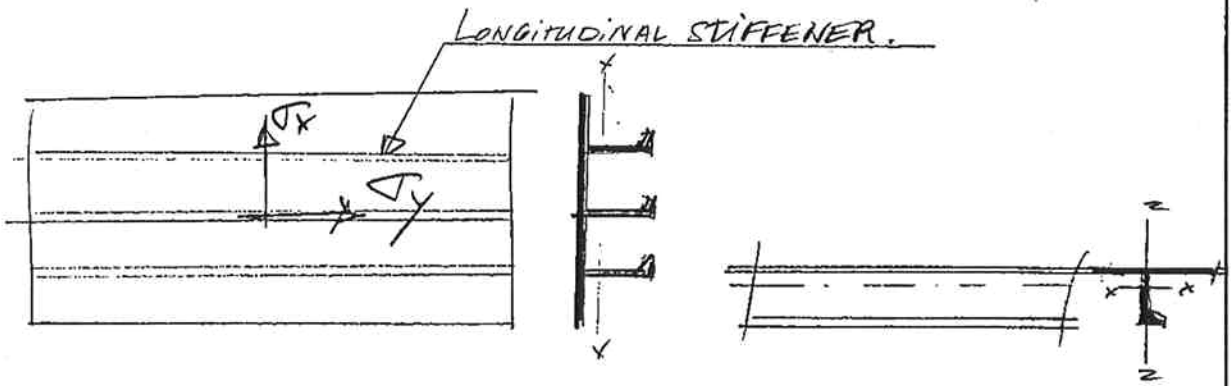
Opgesteld : AlSEMGEEST | Datum : 220604 | Bladnummer : K2-1 | Rev.: A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS

CALCULATION OF STRESSES.

→ DEFENITION OF STRESSES.

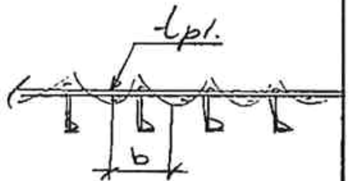


∴ σy IS AlWAYS IN THE DIRECTION OF THE STIFFENERS REGARDLESS OF THE ORIENTATION OF THE PLATE.

→ CALC. STRESSES.

(A) DUE TO LOCAL LOADING :

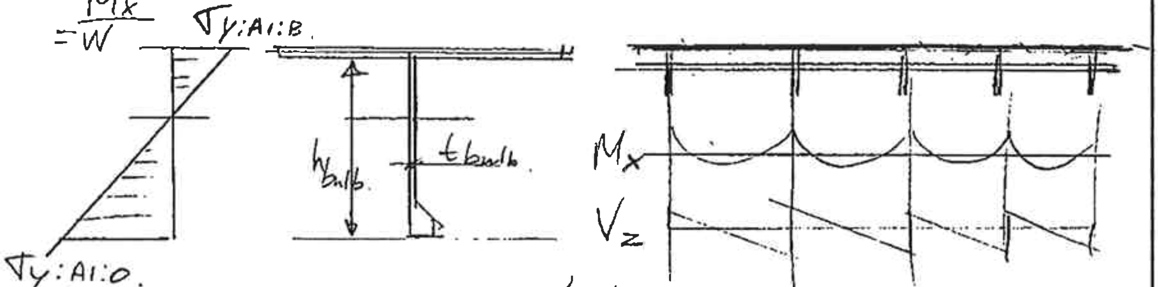
σx:A1* = LOCAL PLATE BENDING BETWEEN STIFFENERS. $= \frac{M_y}{W_{pl.}} = \frac{\frac{1}{10} q b^2}{\frac{1}{6} t_{pl.}^3}$



σx;A2 = LOCAL NORMAL STRESS; DUE TO WATER PRESSURE REACTIONS. AS DETERMINED IN CALC. PART K3-2.

σy: A1* = LOCAL PLATE BENDING BETWEEN BULKHEADS.

$= \frac{M_x}{W}$



τyz:A1* = LOCAL SHEARSTRESS $= V_z / h_{bulb} \cdot b_{bulb}$

*NOTE: σx:A1, σy:A1 AND τyz:A1; CALC. IN STRESSCOMB. SHEET [K2-]

Opgesteld : A. ASEMGEEST Datum : 220604 Bladnummer : K2-2 Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

(B) DUE TO GLOBAL LOADING (MAIN CALC.).

1. HORIZONTAL DUMMIES;

GLOBAL BENDING RESULTING ONLY IN; $\sigma_{y;B1}$.

AS DETERMINED IN CALC. PART [K3-4.].

2. DIAGONAL DUMMIES;

GLOBAL LOADING OF MAINCALC. MODEL RESULTING IN $\sigma_{y;B2}$, $\sigma_{x;B2}$ AND $\tau_{xy;B2}$ AS DETERMINED IN CALC. PART. [K3-13].

NOTE: LOAD COMBINATION 10 OF THE MAINCALC. IS GOVERNING FOR BOTH STRESSES RESULTING FROM HORIZONTAL AND DIAGONAL DUMMY MEMBERS.

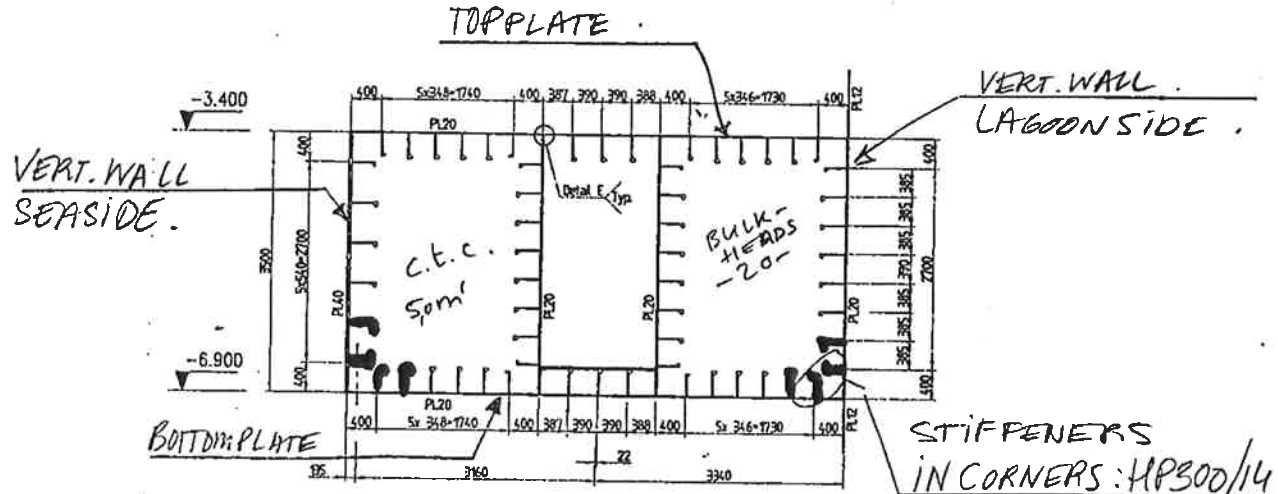
Opgesteld : Alsemgeest | Datum : 22-6-04 | Bladnummer : K2-3 | Rev. : A

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

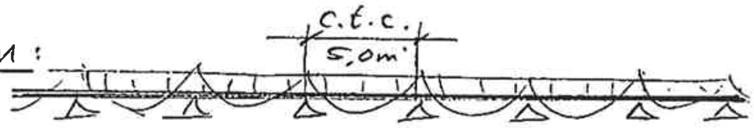
GOVERNING SECTIONS

→ LONGITUDAL STIFFENERS; MULTIPAL FIELD SYSTEM.

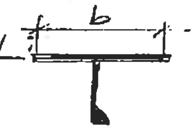


Typical cross section Buyoncy tank
Scale 1:50

SYSTEM:



SECTION



$b_{eff} = 32 t_{pl.}$ → FOR $t_{min} = 20mm'$.

$b_{eff} = 640 >> b_{max} = 540$

CONCLUSION b_{eff} = c.t.c. STIFFENERS.

- RESULTING FROM: CALC. σ_y: B1 - DIAGRAM [k3 - 12],
  - c.t.c. DISTANCE STIFFENERS,
  - SECTION PROPERTIES;

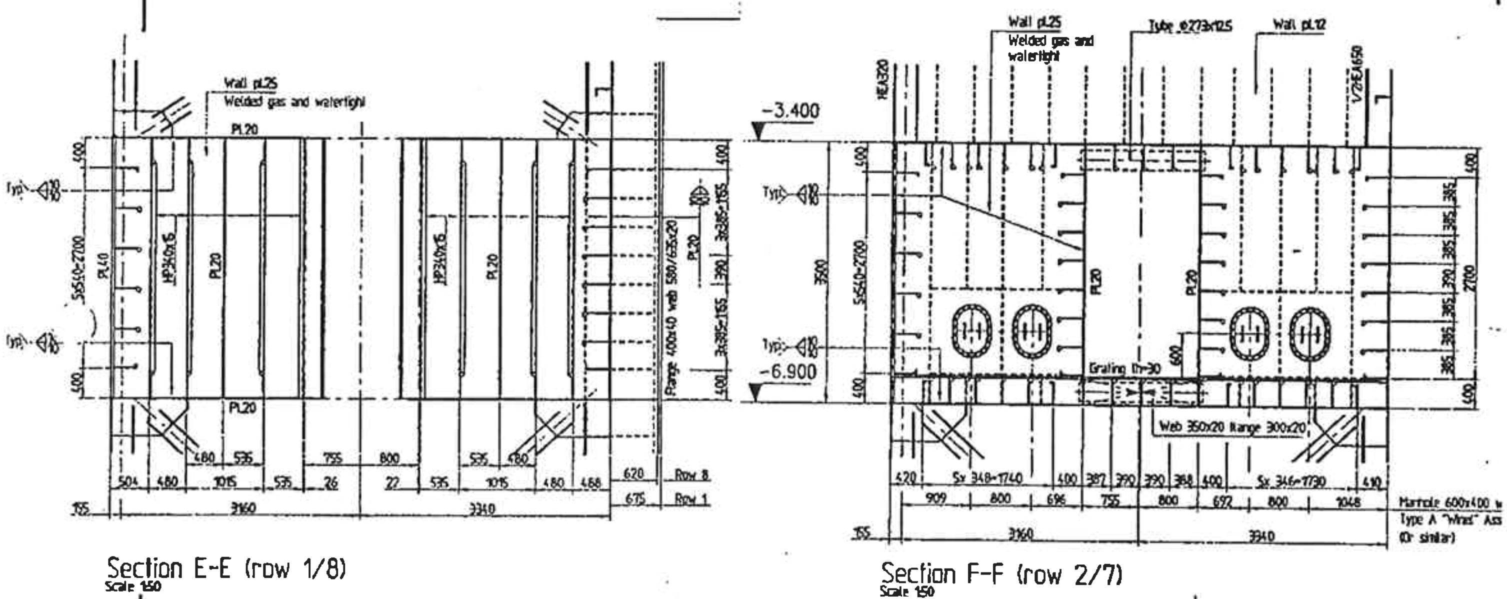
THE FIRST TWO SECTIONS IN THE CORNER (BOLT; IN FIGURE) OF THE VERT. WALLS AND THE BOTTOMPLATE ARE GOVERNING FOR THE CHECK OF THE COMPLETE MIDDLE SECTION OF THE BUOYANCY TANKS

Opgesteld: A. Semgeest | Datum: 220406 | Bladnummer: K2-4. | Rev.: A2

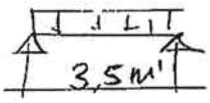
Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS

→ VERTICAL STIFFENERS; SINGULAR FIELD SYSTEM.



SYSTEM :



- ALL STIFFENERS : HP 340/15.

GOVERNING SECTIONS FOR CHECK OF BUOYANCY TANK WALL AT SUPPORTS → STIFFENED PLATE: . 535 x 25 FOR ROW 1/8
. 535 x 25 FOR ROW 2/7.

NOTE : - MAN HOLES ARE CALC. SEPERATELY.
REF. [K6] - ; (THUS NEGLECTED IN THIS SECTION)
- INNERWALLS NOT GOVERNING.

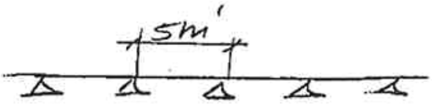
Opgesteld : Alsemgeest | Datum : 220406 | Bladnummer : K2-5 | Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

RESUME GOVERNING SECTIONS:

MULTIPLE FIELDS



1. VERT. WALL . SS : PL. $\frac{535+400}{2}$ · 40(39) + HP300/14
2. " : PL. 535 · 40(39) + HP340/15
3. VERT. WALL LS : PL. $\frac{385+400}{2}$ · 20(19) + HP300/14
4. VERT. WALL LS : PL. 385 · 20(19) + HP340/15.
5. BOTTOM PL. : PL. $\frac{420+385}{2}$ · 20(19) + HP300/14
6. " : PL. 348 · 20(19) + HP340/15

→ AFTER CORROSION OUTSIDE.

SINGULAR FIELD.

7. VERT. WALL ROW 1/8 + 2/7; pl. 535 · 25(24) + HP340/15

CHECKED CROSSSECTIONS ON MEMBERS.

* FOR MULTIPAL FIELD ⇒ SECTION AT SUPPORTS FOR BOTH NORMAL + SHEAR STRESS.

* SINGLE FIELD ⇒ - SECTION AT SUPPORT FOR SHEAR.
- SECTION AT CENTER - FOR NORMAL STRESS

NOTE: SECTION PROPERTIES CALCULATED ON SHEET K2 - 9/.. (CORROSION ALLOWANCE TAKEN INTO ACCOUNT FOR OUTSIDE WALLS) - 1mm".

Opgesteld : ALSEMGEEST. Datum : 220604 Bladnummer : K2-6. Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

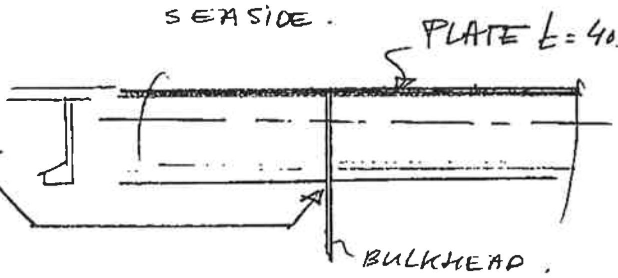
CHECK GOVERNING SECTIONS.

ON PAGE K2-8; ALL STRESSES ARE CALC. AND/OR SUMMED (DERIVED FROM CALC. PART K3), COMBINED AND CHECKED FOR THE GOVERNING LOADCOMBINATION L.C.10.

STEELCHECK;

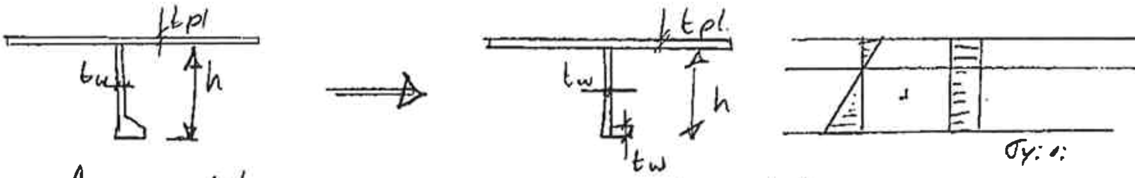
U.C. MAX = 0,94; OK

COMB. STRESS AT TIP OF BULB



WELDCHECK:

THE WELD STRESS IS CALC. DIRECTLY FROM THE PLATESTRESS. FOR THIS PURPOSE $W'_{x;o}$ IS DETERMINED FOR A CROSSECTION WITH AN EQUAL WIDTH FOR WEB AND FLANGE OF THE BULB, GIVING $\sigma_{y:A1:EQU}$.



$A_{tot.}$; W_x $\qquad$ A_{tot}' ; $W'_{x;o}$

$$\sigma_{y:o:EQU} = \frac{M_x}{W_x'} + (\sigma_{y:B1} + \sigma_{y:B2}) \cdot \frac{A'_{tot}}{A_{tot}}$$

(= INTERMEDIATE CALC. VALUE)

(circled term: $\sigma_{y:A1:EQU}$)

WELDSTRESS: $\sigma_1 = \tau_1 = \dfrac{\sigma_{y:o:EQU} \cdot t_w \cdot \sqrt{2}}{4 \cdot a_{WELD}}$; $\tau_2 = V_z / 2 \cdot a \cdot h$ $\Big\}$ $\sigma_{wsd} = \dfrac{\sqrt{4 \cdot \sigma_1^2 + 3\tau_2^2}}{\sqrt{3}}$.

(SEE NEXT PAGE).

U.C. MAX = 1,03; CONSERVATIVE AND SUFFICIENT.

Opgesteld : Alsemgeest

Datum : 220604

Bladnummer : K2 - 7.

Rev. : A2

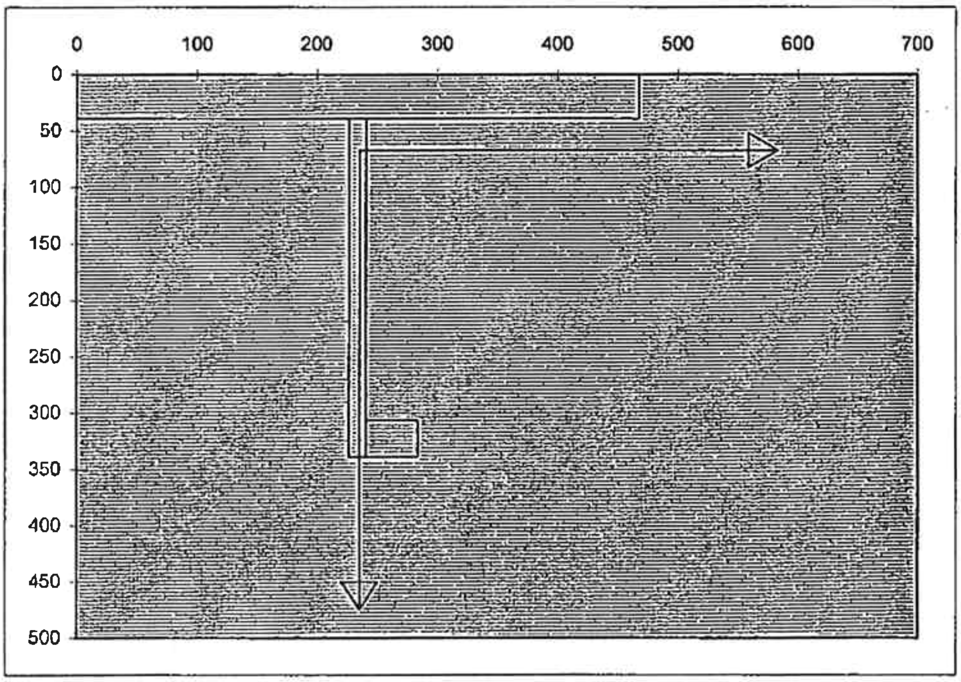
		geometry					properties					local load			
		b_{e}	t_{pl}	h_{stiff}	t_{stiff}	L	A_{tot}	A_{web}	$W_{x,b}$	$W_{x,e}$	$W_{y,plate}$	$q_{s;d}$	$M_{x;d}$	$V_{z;d}$	$M_{y;d}$
		[m]	[mm]	[mm]	[mm]	[m]	[mm²]	[mm²]	[mm³]	[mm³]	[mm³]	[kN/m²]	[kNm]	[kN]	[kNm]
multiple fields													1/10qbl²	1/2qbl	1/10qb²
1	vert.wall SeaSide 1st bulb	0,467	39	300	14	5,0	23830	4200	3,41E+06	8,42E+05	253500	162,2	189,4	189,4	3,5
2	vert.wall Seaside 2nd bulb	0,535	39	340	15	5,0	27802	5100	4,55E+06	1,18E+06	253500	162,2	216,9	216,9	4,6
3	vert.wall LagoonSide 1st bulb	0,392	19	300	14	5,0	13055	4200	1,84E+06	7,48E+05	60167	162,2	159,0	159,0	2,5
4	vert.wall LagoonSide 2nd bulb	0,385	19	340	15	5,0	14252	5100	2,17E+06	1,04E+06	60167	162,2	156,1	156,1	2,4
5	bottompl. 1st bulb	0,403	19	300	14	5,0	13245	4200	1,88E+06	7,49E+05	60167	162,2	163,4	163,4	2,6
6	bottompl. 2nd bulb	0,348	19	340	15	5,0	13550	5100	2,00E+06	1,03E+06	60167	162,2	141,1	141,1	2,0
singular fields													1/8qbl²	1/2ql	1/10qb²
7	vert.wall row 1/8	0,535	19	340	15	3,5	17102	5100	2,83E+06	1,07E+06	60167	162,2	132,9	151,9	4,6
8	vert.wall row 2/7	0,535	24	340	15	3,5	19777	5100	3,37E+06	1,11E+06	96000	162,2	132,9	151,9	4,6

Governing section check		local stress					global stress							Σ stress			comb. stress		Check normal stress		Check shear stress	
		$\sigma_{xA1;d}$	$\sigma_{xA2;d}$	$\sigma_{yA1z;d}$	$\sigma_{yA1x;d}$	$\tau_{yzA1;d}$	$\sigma_{yB1+;d}$	$\sigma_{yB1-;d}$	$\sigma_{xB2+;d}$	$\sigma_{xB2-;d}$	$\sigma_{yB2+;d}$	$\sigma_{yB2-;d}$	$\tau_{yzB2;d}$	$\Sigma\sigma_{x;d}$	$\Sigma\sigma_{y;b;d}$	$\Sigma\sigma_{y;e;d}$	$\sigma_{E;b;d}$	$\sigma_{E;e;d}$	$\sigma_{r;d}$	u.c.	$\tau_{r;d}$	u.c.
		[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]		[N/mm²]	
multiple fields		-/+																				
1	vert.wall SeaSide 1st bulb	14	-5	56	-225	45	0	-64	0	-7	0	-14	1	-19	56	-303	68	303	323	0,94	186	0,36
2	vert.wall Seaside 2nd bulb	18	-5	47	-184	43	0	-64	0	-7	0	-14	1	-23	47	-262	62	262	323	0,81	186	0,35
3	vert.wall LagoonSide 1st bulb	41	-9	86	-213	36	91	0	5	-2	10	-2	1	-45	187	-215	213	215	323	0,67	186	0,31
4	vert.wall LagoonSide 2nd bulb	40	-9	72	-150	31	91	0	5	-3	10	-3	1	-44	173	-153	199	153	323	0,62	186	0,25
5	bottompl. 1st bulb	44	-14	87	-218	39	91	-64	7	-8	28	-32	2	-51	206	-314	236	314	323	0,97	186	0,31
6	bottompl. 2nd bulb	33	-14	71	-137	28	91	-64	7	-8	28	-32	2	-40	190	-233	213	233	323	0,72	186	0,23
singular fields		-/+																				
7	vert.wall row 1/8	77	-9	-47	124	30	0	0	0	-10	0	-5	1	-86	-47	119	75	119	323	0,37	186	0,24
8	vert.wall row 2/7	48	-8	-39	120	30	0	0	0	-14	0	-7	9	-56	-39	113	52	113	323	0,35	186	0,24

Governing weld check		geometry			properties		weldstress			comb.	Check	
		h_{web}	t_{web}	a	A^{*}_{tot}	W^{*}_{xo}	$\sigma_{y;e;equ}$	$\sigma_{1;d} = \tau_{1;d}$	τ_{2}	$\sigma_{w;s;d}$	$f_{w;u;d}$	u.c.
		[mm]	[mm]	[mm]	[mm²]	[mm³]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	[N/mm²]	
multiple fields												
1	vert.wall SeaSide 1st bulb	300	14	8	23034	6,35E+05	-374	231	39	270	262	1,03
2	vert.wall Seaside 2nd bulb	340	15	8	26700	8,60E+05	-327	217	40	254	262	0,97
3	vert.wall LagoonSide 1st bulb	300	14	8	12260	5,60E+05	-286	177	33	207	263	0,79
4	vert.wall LagoonSide 2nd bulb	340	15	8	13150	7,52E+05	-210	139	29	163	264	0,62
5	bottompl. 1st bulb	300	14	8	12449	5,62E+05	-381	236	34	275	265	1,04
6	bottompl. 2nd bulb	340	15	8	12447	7,44E+05	-278	184	26	214	266	0,8
singular fields												
7	vert.wall row 1/8	340	15	8	16000	7,76E+05	-5	3	28	28	262	0,11
8	vert.wall row 2/7	340	15	8	18675	8,01E+05	-7	4	28	28	263	0,11

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 39 bulb 300*14 nr 1
referentie : Mal. Nav. Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	339	mm
breedte (y)	=	467,5	mm

Zwaartepuntsafstanden

$-e_y$	=	-235	mm
$+e_y$	=	232	mm
$-e_z$	=	-67	mm
$+e_z$	=	272	mm

Statische waarden

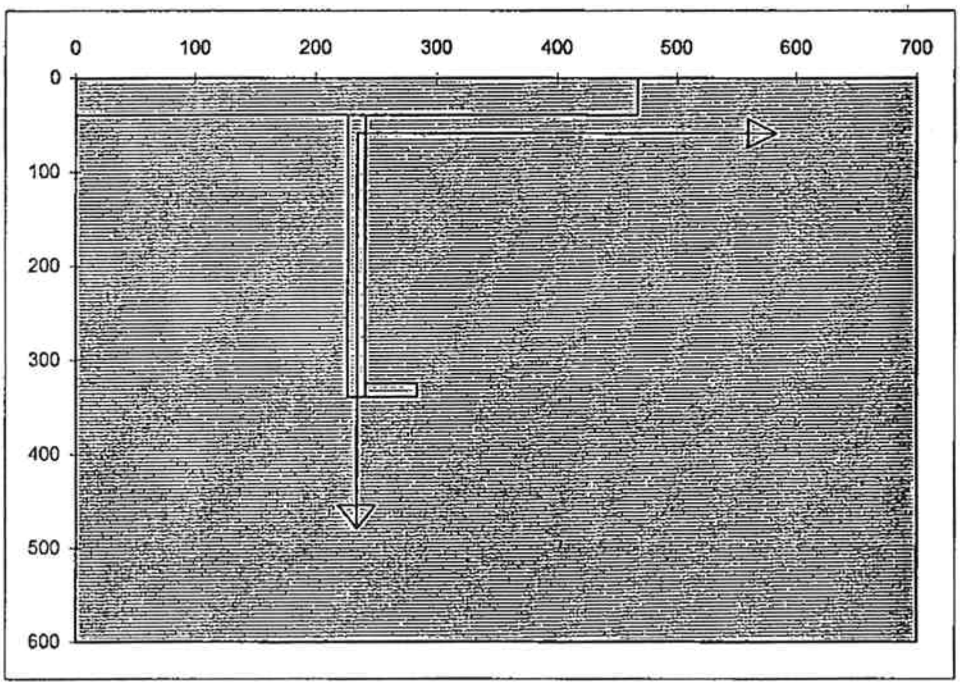
oppervlak A	23830	mm^2
traagheidsmoment I_{yy}	2,290E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-3,41E+06	mm^3
weerstandsmoment $W_{y;el;o}$	8,42E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,75E+06	mm^3
traagheidsstraal i_y	98	mm
traagheidsmoment I_{zz}	3,334E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-1,42E+06	mm^3
weerstandsmoment $W_{z;el;r}$	1,44E+06	mm^3
weerstandsmoment $W_{z;pl}$	2,18E+06	mm^3
traagheidsstraal i_z	118	mm

K2-9 A2

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 39 bulb 300 14 nr 1
referentie : Mal Nav Lock Gate barrier

FOR WELDCALC : t_{bulb} = 14 mm



Uitwendige afmetingen

hoogte (z)	=	339	mm
breedte (y)	=	467,5	mm

Zwaartepuntsafstanden

$-e_y$	=	-234	mm
$+e_y$	=	233	mm
$-e_z$	=	-59	mm
$+e_z$	=	280	mm

Statische waarden

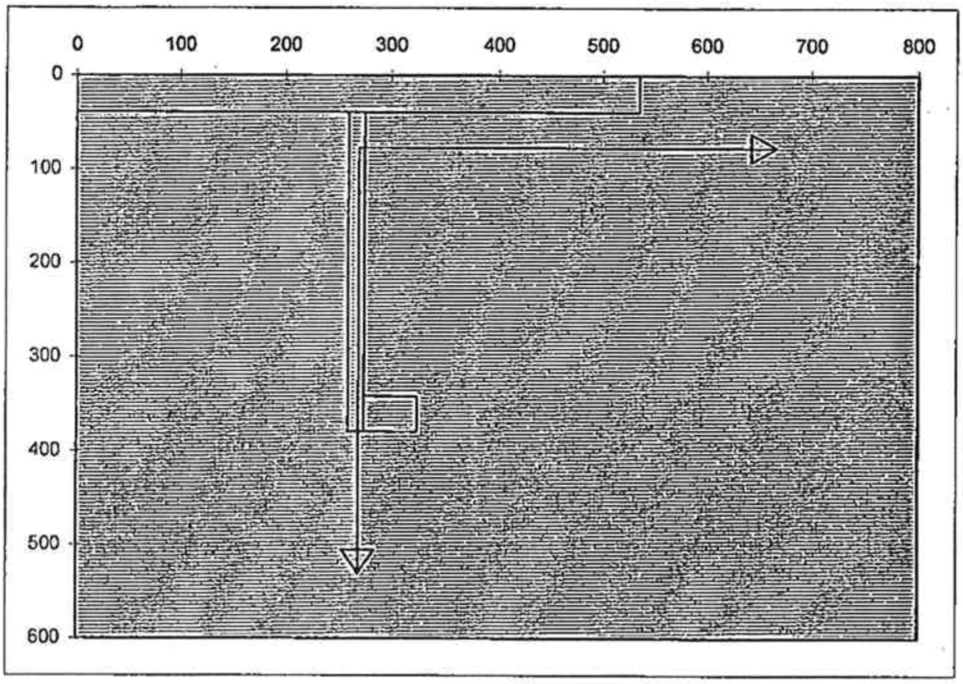
oppervlak A	23034,5	mm^2
traagheidsmoment I_{yy}	1,781E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-3,04E+06	mm^3
weerstandsmoment $W_{y;el;o}$	6,35E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,43E+06	mm^3
traagheidsstraal i_y	88	mm
traagheidsmoment I_{zz}	3,327E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-1,42E+06	mm^3
weerstandsmoment $W_{z;el;r}$	1,43E+06	mm^3
weerstandsmoment $W_{z;pl}$	2,16E+06	mm^3
traagheidsstraal i_z	120	mm

DA

K2-10 A

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 39 bulb 340*15 nr 2
referentie : Mal. Nav. Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	379	mm
breedte (y)	=	535	mm

Zwaartepuntsafstanden

$-e_y$	=	-270	mm
$+e_y$	=	265	mm
$-e_z$	=	-77	mm
$+e_z$	=	302	mm

Statische waarden

oppervlak A	27802,5	mm^2
traagheidsmoment I_{yy}	3,573E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-4,65E+06	mm^3
weerstandsmoment $W_{y;el;o}$	1,18E+06	mm^3
weerstandsmoment $W_{y;pl}$	2,41E+06	mm^3
traagheidsstraal i_y	113	mm
traagheidsmoment I_{zz}	4,999E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-1,85E+06	mm^3
weerstandsmoment $W_{z;el;r}$	1,88E+06	mm^3
weerstandsmoment $W_{z;pl}$	2,87E+06	mm^3
traagheidsstraal i_z	134	mm

DA

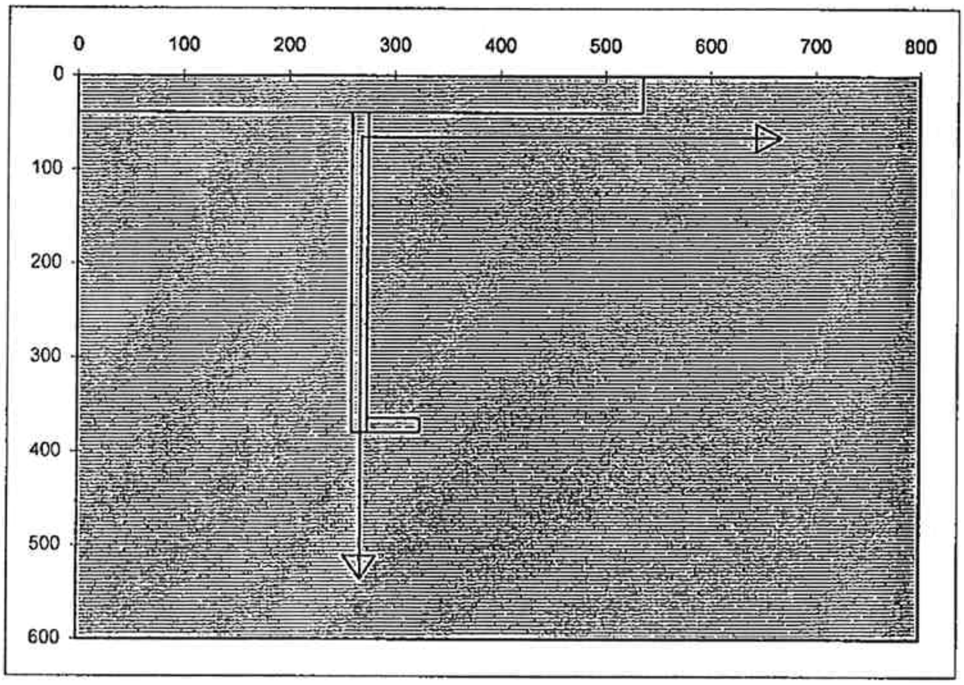
K2-11 A

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl-39 bulb-340-15 nr. 2

referentie : Mal. Nav. Lock Gate barrier

FOR WELD CALC, tbulb = 15mm



Uitwendige afmetingen

hoogte (z)	=	379	mm
breedte (y)	=	535	mm

Zwaartepuntsafstanden

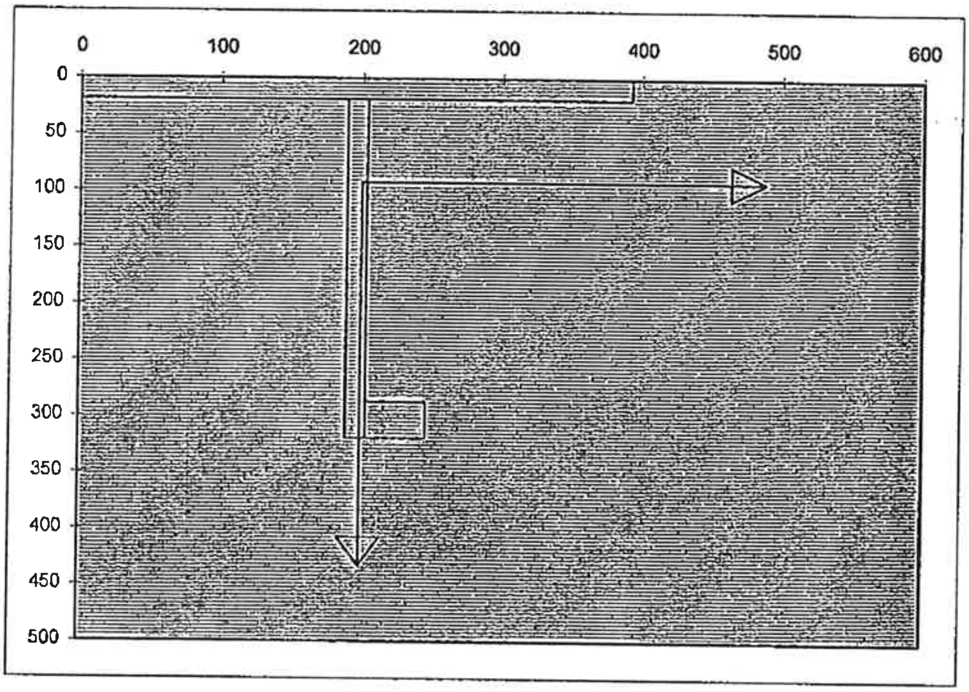
$-e_y$	=	-268	mm
$+e_y$	=	267	mm
$-e_z$	=	-65	mm
$+e_z$	=	314	mm

Statische waarden

oppervlak A	26700	mm^2
traagheidsmoment I_{yy}	2,698E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-4,13E+06	mm^3
weerstandsmoment $W_{y;el;o}$	8,60E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,93E+06	mm^3
traagheidsstraal i_y	101	mm
traagheidsmoment I_{zz}	4,986E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-1,86E+06	mm^3
weerstandsmoment $W_{z;el;r}$	1,87E+06	mm^3
weerstandsmoment $W_{z;pl}$	2,83E+06	mm^3
traagheidsstraal i_z	137	mm

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 300*14 nr 3
referentie : Mal Nav Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	319	mm
breedte (y)	=	392,5	mm

Zwaartepuntsafstanden

$-e_y$	=	-199	mm
$+e_y$	=	193	mm
$-e_z$	=	-92	mm
$+e_z$	=	227	mm

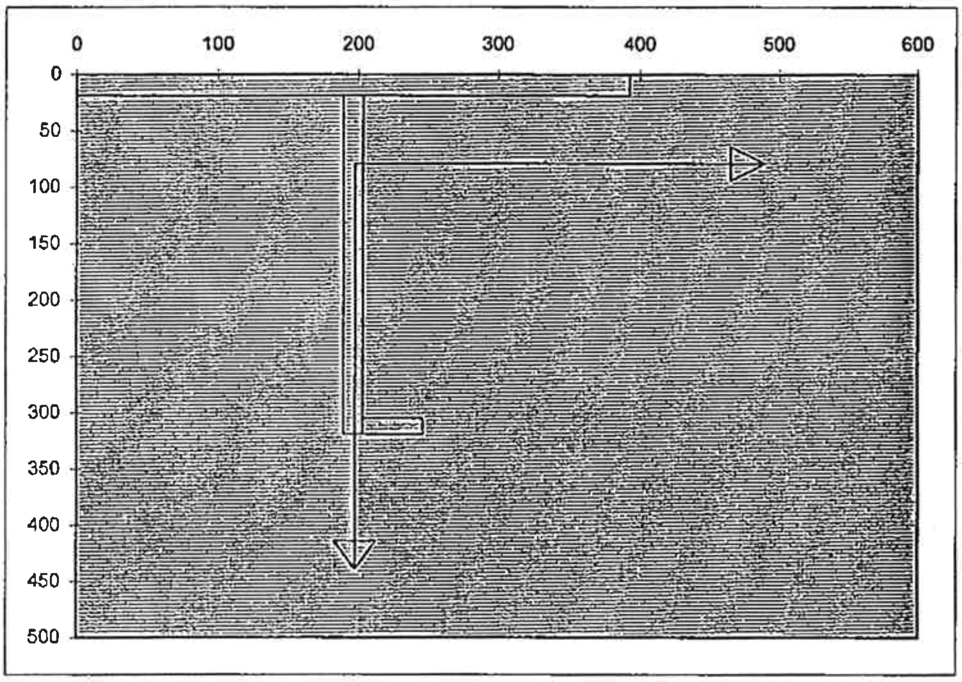
Statische waarden

oppervlak A	13055	mm^2
traagheidsmoment I_{yy}	1,696E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-1,84E+06	mm^3
weerstandsmoment $W_{y;el;o}$	7,48E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,31E+06	mm^3
traagheidsstraal i_y	114	mm
traagheidsmoment I_{zz}	9,704E+07	mm^4
weerstandsmoment $W_{z;el;l}$	-4,87E+05	mm^3
weerstandsmoment $W_{z;el;r}$	5,02E+05	mm^3
weerstandsmoment $W_{z;pl}$	7,85E+05	mm^3
traagheidsstraal i_z	86	mm

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 300 14 nr 3
referentie : Mal Nav Lock Gate barrier

FOR WELD CALC.
t bulb = 14 mm.



Uitwendige afmetingen

hoogte (z)	=	319	mm
breedte (y)	=	392,5	mm

Zwaartepuntsafstanden

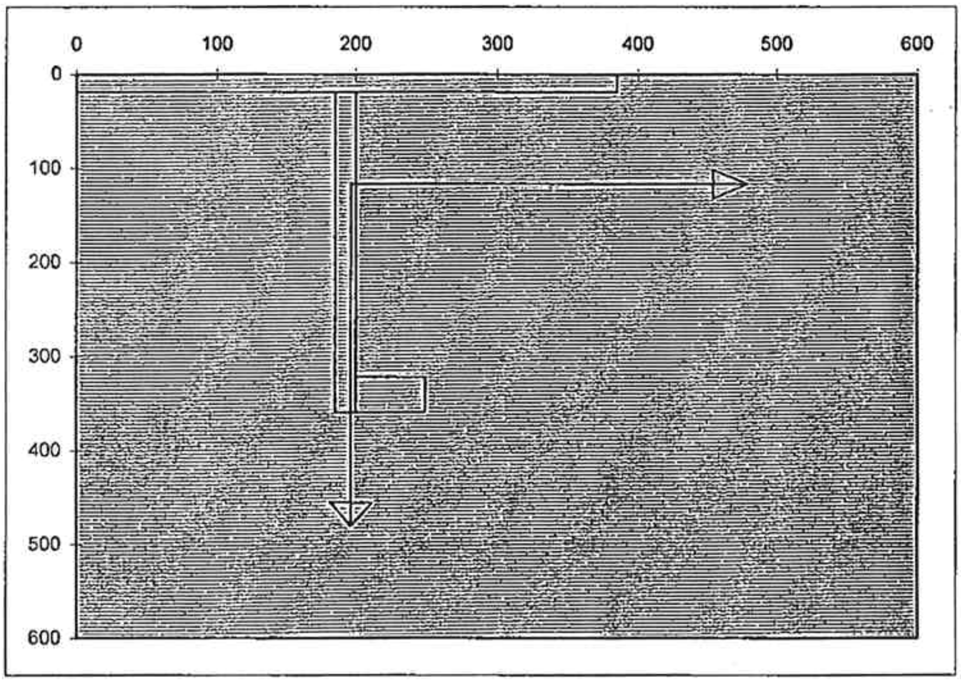
$-e_y$	=	-198	mm
$+e_y$	=	195	mm
$-e_z$	=	-79	mm
$+e_z$	=	240	mm

Statische waarden

oppervlak A	12259,5	mm^2
traagheidsmoment I_{yy}	1,345E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-1,70E+06	mm^3
weerstandsmoment $W_{y;el;o}$	5,60E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,09E+06	mm^3
traagheidsstraal i_y	105	mm
traagheidsmoment I_{zz}	9,637E+07	mm^4
weerstandsmoment $W_{z;el;l}$	-4,88E+05	mm^3
weerstandsmoment $W_{z;el;r}$	4,95E+05	mm^3
weerstandsmoment $W_{z;pl}$	7,63E+05	mm^3
traagheidsstraal i_z	89	mm

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 340 15 nr 4
referentie : Mal Nav Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	359	mm
breedte (y)	=	385	mm

Zwaartepuntsafstanden

$-e_y$	=	-197	mm
$+e_y$	=	188	mm
$-e_z$	=	-116	mm
$+e_z$	=	243	mm

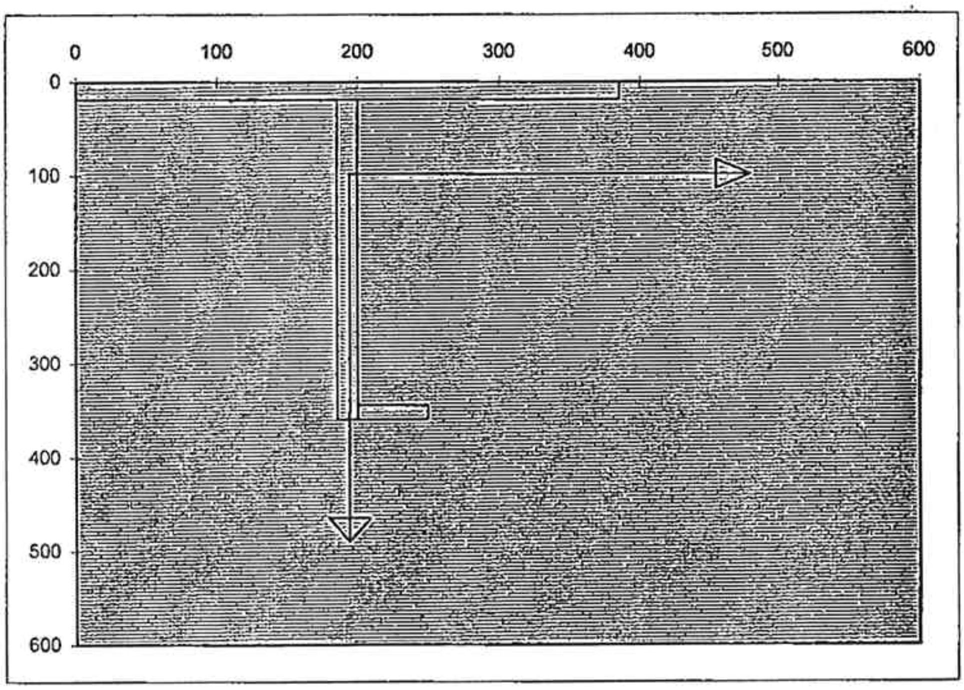
Statische waarden

oppervlak A	14252,5	mm^2
traagheidsmoment I_{yy}	2,521E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-2,17E+06	mm^3
weerstandsmoment $W_{y;el;o}$	1,04E+06	mm^3
weerstandsmoment $W_{y;pl}$	1,71E+06	mm^3
traagheidsstraal i_y	133	mm
traagheidsmoment I_{zz}	9,246E+07	mm^4
weerstandsmoment $W_{z;el;l}$	-4,70E+05	mm^3
weerstandsmoment $W_{z;el;r}$	4,91E+05	mm^3
weerstandsmoment $W_{z;pl}$	7,81E+05	mm^3
traagheidsstraal i_z	81	mm

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 340*15 nr. 4
referentie : Mal Nav. Lock Gate barrier

FOR WELDCALC.
tbulb = 15 mm'.



Uitwendige afmetingen

hoogte (z)	=	359	mm
breedte (y)	=	385	mm

Zwaartepuntsafstanden

$-e_y$	=	-194	mm
$+e_y$	=	191	mm
$-e_z$	=	-98	mm
$+e_z$	=	261	mm

Statische waarden

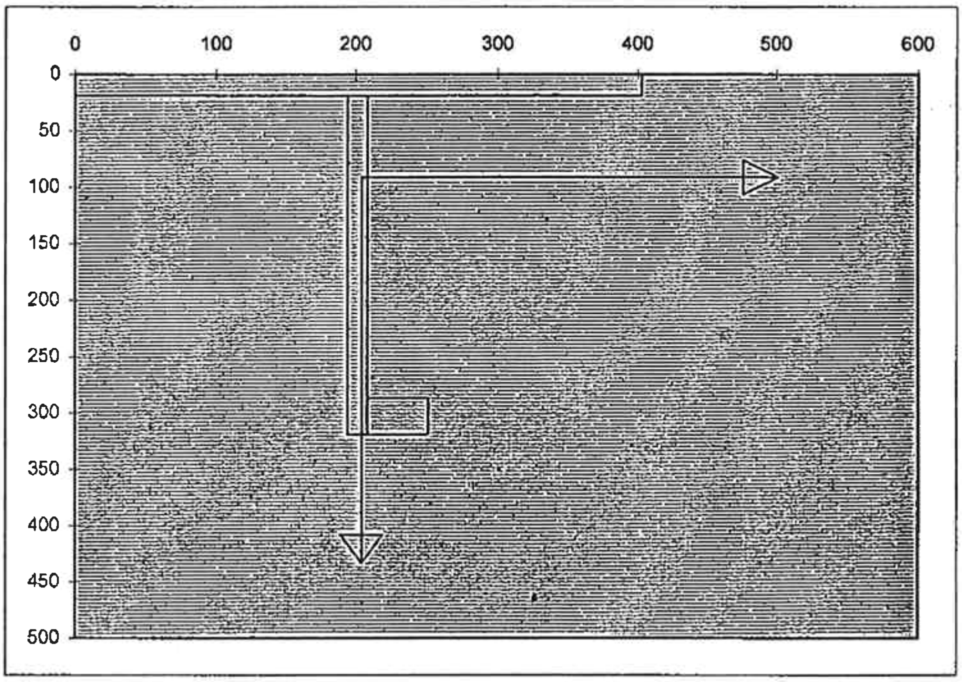
oppervlak A	13150	mm^2
traagheidsmoment I_{yy}	1,961E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-2,00E+06	mm^3
weerstandsmoment $W_{y;el;o}$	7,52E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,39E+06	mm^3
traagheidsstraal i_y	122	mm
traagheidsmoment I_{zz}	9,131E+07	mm^4
weerstandsmoment $W_{z;el;l}$	-4,70E+05	mm^3
weerstandsmoment $W_{z;el;r}$	4,79E+05	mm^3
weerstandsmoment $W_{z;pl}$	7,47E+05	mm^3
traagheidsstraal i_z	83	mm

DA

k2-16

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 300*14 nr 5
referentie : Mal. Nav. Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	319	mm
breedte (y)	=	402,5	mm

Zwaartepuntsafstanden

$-e_y$	=	-204	mm
$+e_y$	=	198	mm
$-e_z$	=	-91	mm
$+e_z$	=	228	mm

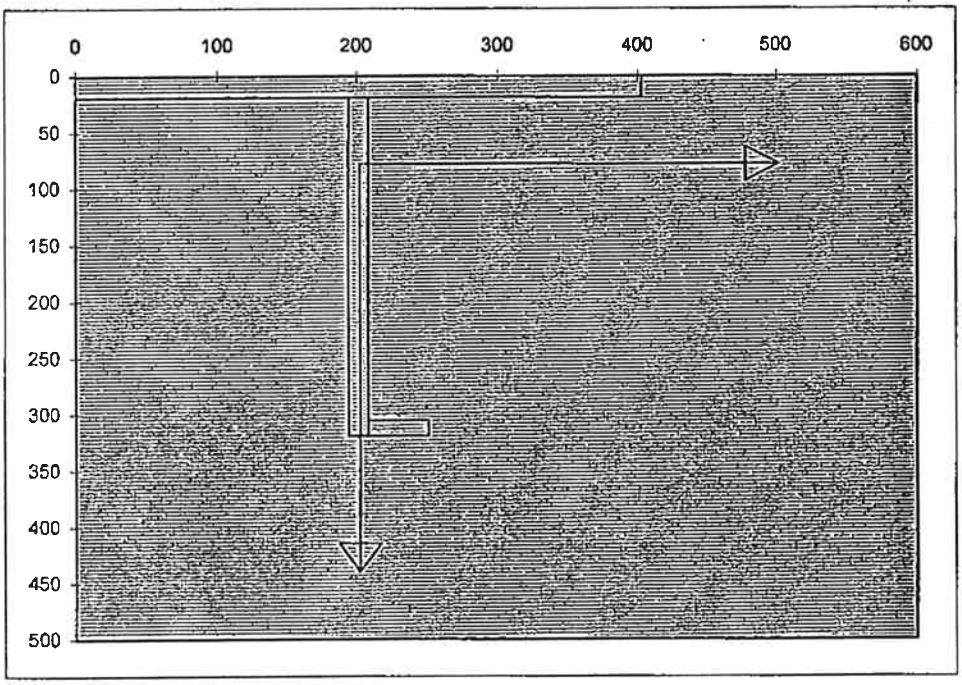
Statische waarden

oppervlak A	13245	mm^2
traagheidsmoment I_{yy}	1,709E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-1,88E+06	mm^3
weerstandsmoment $W_{y;el;o}$	7,49E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,32E+06	mm^3
traagheidsstraal i_y	114	mm
traagheidsmoment I_{zz}	1,045E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-5,12E+05	mm^3
weerstandsmoment $W_{z;el;r}$	5,27E+05	mm^3
weerstandsmoment $W_{z;pl}$	8,23E+05	mm^3
traagheidsstraal i_z	89	mm

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 300 14 nr 5
referentie : Mal Nav Lock Gate barrier

FOR WELDCALC; tbulb = 14 mm.



Uitwendige afmetingen

hoogte (z)	=	319	mm
breedte (y)	=	402,5	mm

Zwaartepuntsafstanden

$-e_y$	=	-203	mm
$+e_y$	=	200	mm
$-e_z$	=	-78	mm
$+e_z$	=	241	mm

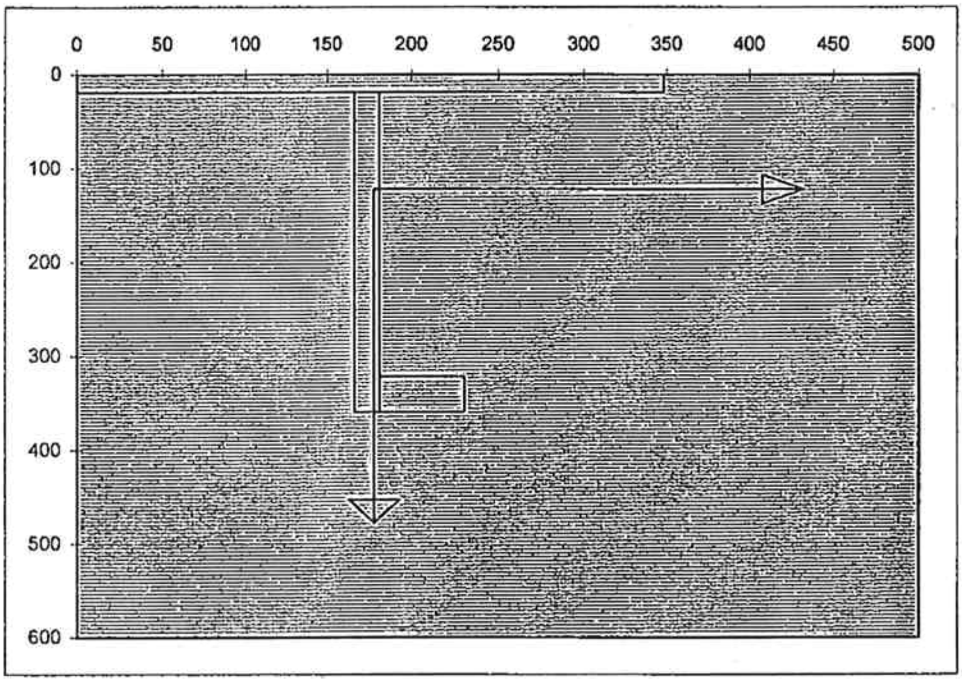
Statische waarden

oppervlak A	12449,5	mm^2
traagheidsmoment I_{yy}	1,354E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-1,74E+06	mm^3
weerstandsmoment $W_{y;el;o}$	5,62E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,10E+06	mm^3
traagheidsstraal i_y	104	mm
traagheidsmoment I_{zz}	1,039E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-5,13E+05	mm^3
weerstandsmoment $W_{z;el;r}$	5,20E+05	mm^3
weerstandsmoment $W_{z;pl}$	8,01E+05	mm^3
traagheidsstraal i_z	91	mm

K2-18-A

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 340*15 nr 6
referentie : Mal. Nav. Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	359	mm
breedte (y)	=	348	mm

Zwaartepuntsafstanden

$-e_y$	=	-178	mm
$+e_y$	=	170	mm
$-e_z$	=	-122	mm
$+e_z$	=	237	mm

Statische waarden

oppervlak A	13549,5	mm^2
traagheidsmoment I_{yy}	2,436E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-2,00E+06	mm^3
weerstandsmoment $W_{y;el;o}$	1,03E+06	mm^3
weerstandsmoment $W_{y;pl}$	1,65E+06	mm^3
traagheidsstraal i_y	134	mm
traagheidsmoment I_{zz}	6,882E+07	mm^4
weerstandsmoment $W_{z;el;l}$	-3,86E+05	mm^3
weerstandsmoment $W_{z;el;r}$	4,06E+05	mm^3
weerstandsmoment $W_{z;pl}$	6,52E+05	mm^3
traagheidsstraal i_z	71	mm

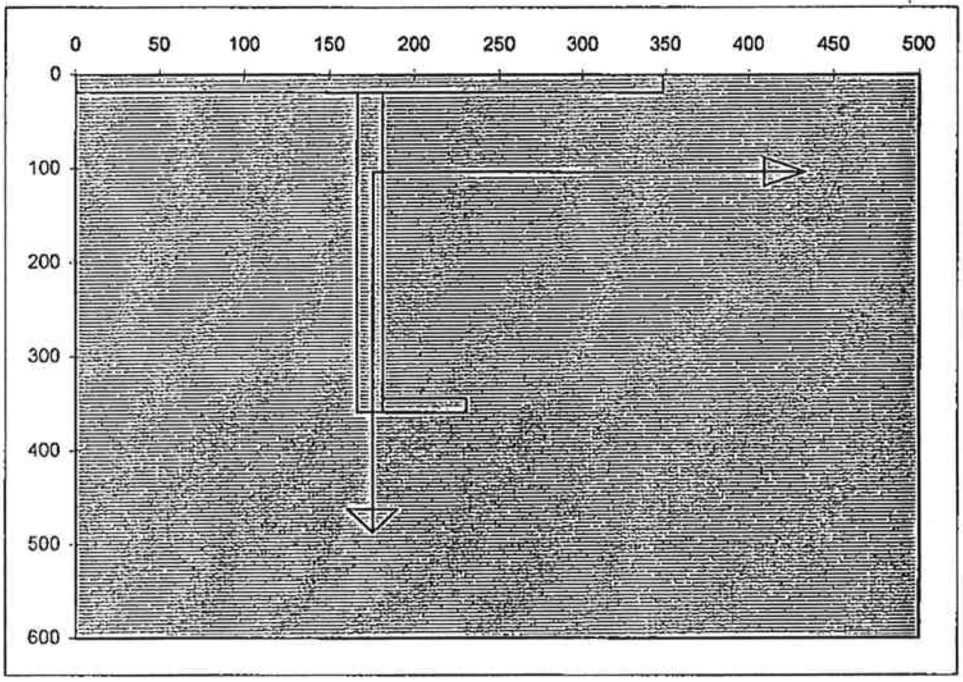
DA

K2 - 19. A

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 340*15 nr 6
referentie : Mal Nav Lock Gate barrier

FOR WELDCALC.
t lab = 15mm.



Uitwendige afmetingen

hoogte (z)	=	359	mm
breedte (y)	=	348	mm

Zwaartepuntsafstanden

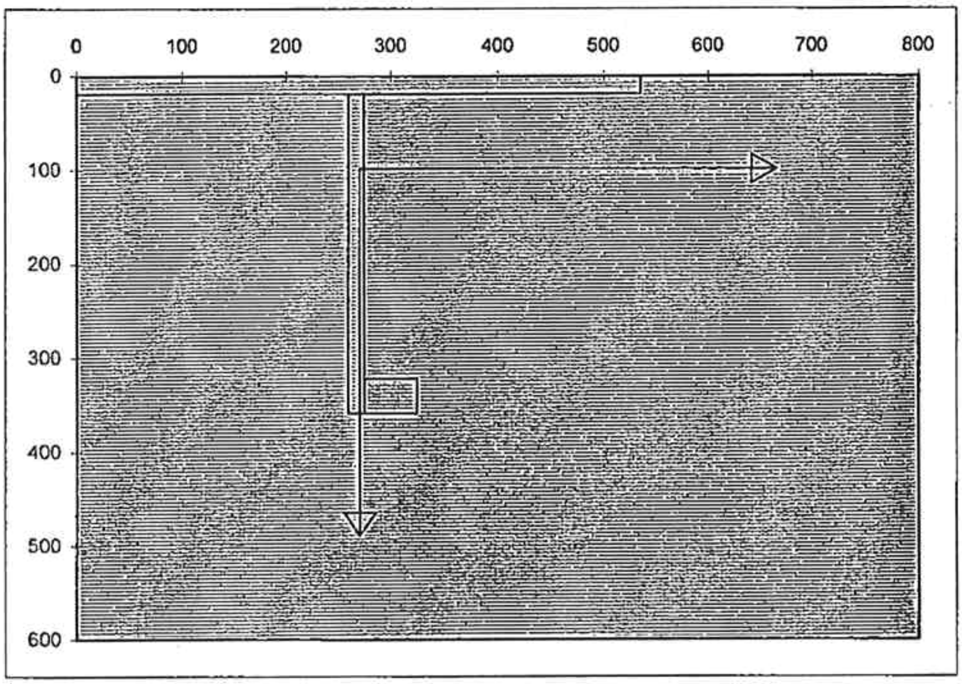
$-e_y$	=	-176	mm
$+e_y$	=	172	mm
$-e_z$	=	-103	mm
$+e_z$	=	256	mm

Statische waarden

oppervlak A	12447	mm^2
traagheidsmoment I_{yy}	1,903E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-1,84E+06	mm^3
weerstandsmoment $W_{y;el;o}$	7,44E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,35E+06	mm^3
traagheidsstraal i_y	124	mm
traagheidsmoment I_{zz}	6,768E+07	mm^4
weerstandsmoment $W_{z;el;l}$	-3,85E+05	mm^3
weerstandsmoment $W_{z;el;r}$	3,93E+05	mm^3
weerstandsmoment $W_{z;pl}$	6,18E+05	mm^3
traagheidsstraal i_z	74	mm

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 340*15 nr 7
referentie : Mal. Nav. Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	359	mm
breedte (y)	=	535	mm

Zwaartepuntsafstanden

$-e_y$	=	-271	mm
$+e_y$	=	264	mm
$-e_z$	=	-99	mm
$+e_z$	=	260	mm

Statische waarden

oppervlak A	17102,5	mm^2
traagheidsmoment I_{yy}	2,793E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-2,83E+06	mm^3
weerstandsmoment $W_{y;el;o}$	1,07E+06	mm^3
weerstandsmoment $W_{y;pl}$	1,91E+06	mm^3
traagheidsstraal i_y	128	mm
traagheidsmoment I_{zz}	2,446E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-9,03E+05	mm^3
weerstandsmoment $W_{z;el;r}$	9,26E+05	mm^3
weerstandsmoment $W_{z;pl}$	1,44E+06	mm^3
traagheidsstraal i_z	120	mm

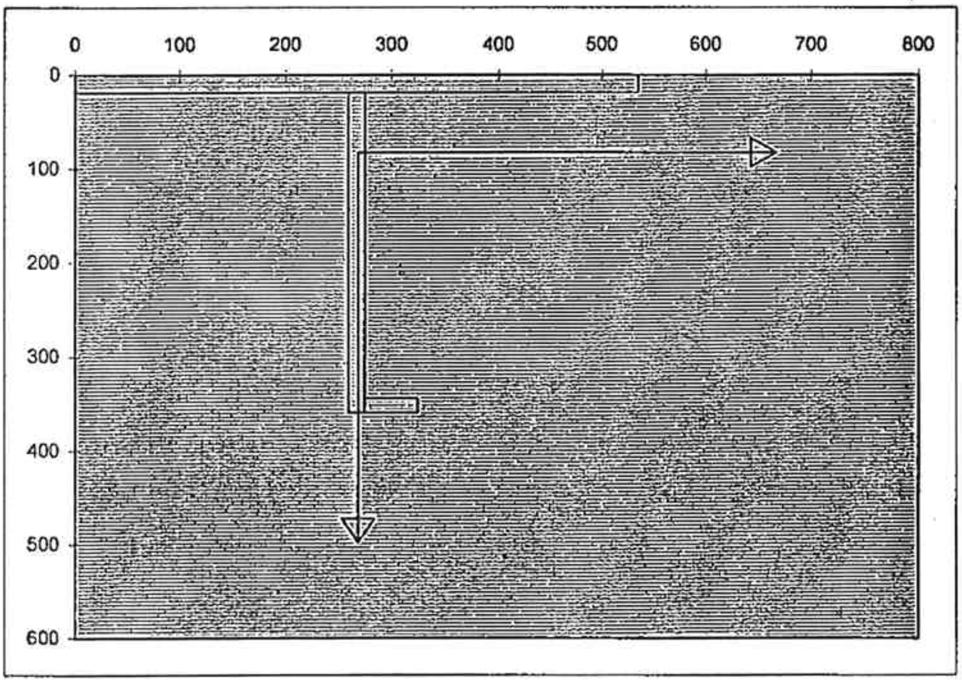
D, A

K2 - 21. A

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 19 bulb 340 15 nr 7
referentie : Mal. Nav. Lock Gate barrier

FOR WELD CALC,
tbulb = 15 mm.



Uitwendige afmetingen

hoogte (z)	=	359	mm
breedte (y)	=	535	mm

Zwaartepuntsafstanden

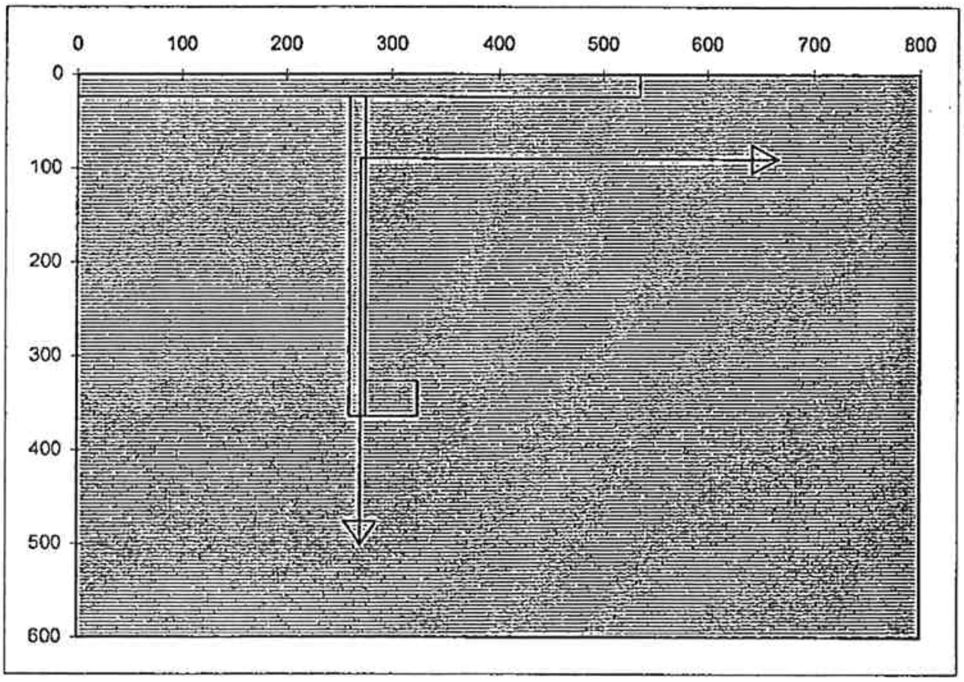
$-e_y$	=	-269	mm
$+e_y$	=	266	mm
$-e_z$	=	-82	mm
$+e_z$	=	277	mm

Statische waarden

oppervlak A	16000	mm^2
traagheidsmoment I_{yy}	2,146E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-2,60E+06	mm^3
weerstandsmoment $W_{y;el;o}$	7,76E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,54E+06	mm^3
traagheidsstraal i_y	116	mm
traagheidsmoment I_{zz}	2,434E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-9,05E+05	mm^3
weerstandsmoment $W_{z;el;r}$	9,15E+05	mm^3
weerstandsmoment $W_{z;pl}$	1,40E+06	mm^3
traagheidsstraal i_z	123	mm

Berekening statische waarden van een profiel samengesteld uit plaatvormige doorsneden.

profielnaam : pl 24 bulb 340*15 nr. 8
referentie : Mal. Nav. Lock Gate barrier



Uitwendige afmetingen

hoogte (z)	=	364	mm
breedte (y)	=	535	mm

Zwaartepuntsafstanden

$-e_y$	=	-270	mm
$+e_y$	=	265	mm
$-e_z$	=	-90	mm
$+e_z$	=	274	mm

Statische waarden

oppervlak A	19777,5	mm^2
traagheidsmoment I_{yy}	3,030E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-3,37E+06	mm^3
weerstandsmoment $W_{y;el;o}$	1,11E+06	mm^3
weerstandsmoment $W_{y;pl}$	2,07E+06	mm^3
traagheidsstraal i_y	124	mm
traagheidsmoment I_{zz}	3,084E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-1,14E+06	mm^3
weerstandsmoment $W_{z;el;r}$	1,17E+06	mm^3
weerstandsmoment $W_{z;pl}$	1,79E+06	mm^3
traagheidsstraal i_z	125	mm

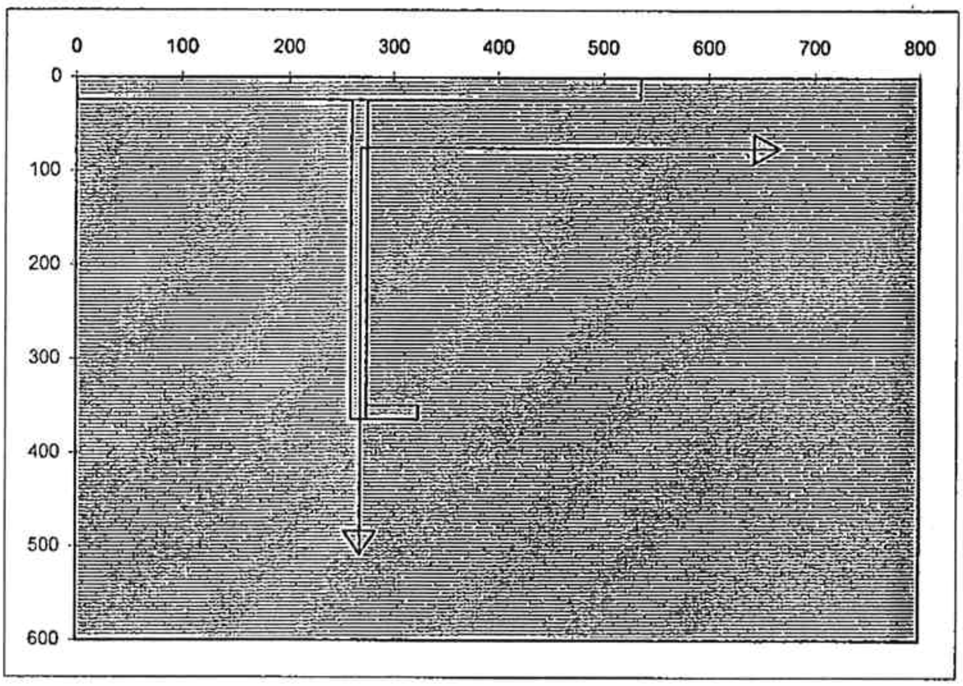
P.A

K2 - 23 A.

Berekening statische waarden van een profiel
samengesteld uit plaatvormige doorsneden.

profielnaam : pl-24 bulb 340-15 nr. 8
referentie : Mal. Nav. Lock Gate barrier

FOR WELDCALC !
tbulb = 15 mm.



Uitwendige afmetingen

hoogte (z)	=	364	mm
breedte (y)	=	535	mm

Zwaartepuntsafstanden

$-e_y$	=	-269	mm
$+e_y$	=	266	mm
$-e_z$	=	-75	mm
$+e_z$	=	289	mm

Statische waarden

oppervlak A	18675	mm^2
traagheidsmoment I_{yy}	2,312E+08	mm^4
weerstandsmoment $W_{y;el;b}$	-3,07E+06	mm^3
weerstandsmoment $W_{y;el;o}$	8,01E+05	mm^3
weerstandsmoment $W_{y;pl}$	1,66E+06	mm^3
traagheidsstraal i_y	111	mm
traagheidsmoment I_{zz}	3,072E+08	mm^4
weerstandsmoment $W_{z;el;l}$	-1,14E+06	mm^3
weerstandsmoment $W_{z;el;r}$	1,15E+06	mm^3
weerstandsmoment $W_{z;pl}$	1,76E+06	mm^3
traagheidsstraal i_z	128	mm

Project : MALAMOCCO NAV. LOCK GATE -

Onderdeel : BUOYANCY TANKS.

K3. DETERMINATION STRESSES BUOYANCY TANK WALLS.

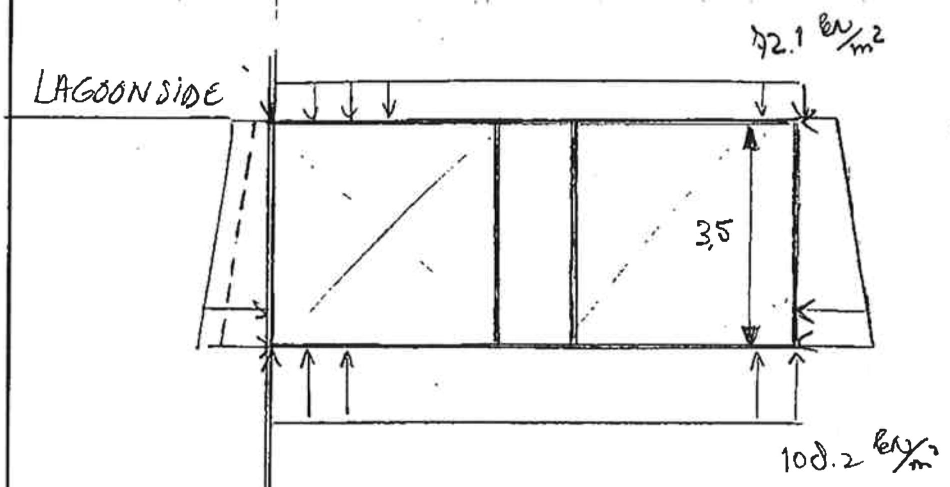
TOTAL STRESS BUILT UP OF THE FOLLOWING PARTS:

- LOCAL STRESS σ_x; A2.
- GLOBAL STRESS σ_y; B1. (HOR. DUMMY MEMBERS)
- " " σ_y; B2, σ_x; B2; τ_{xy}; B2. (DIAGONAL DUMMY MEMBERS)

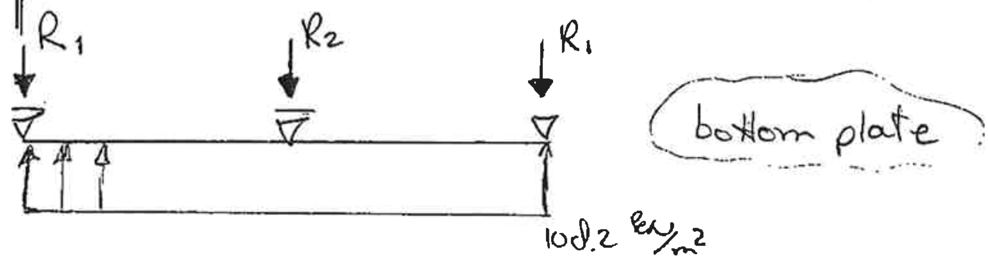
Opgesteld : A ISEMGEEST | Datum : 220604 | Bladnummer : K3-1. | Rev. : A2

Project	:	MALAMOCCO NAV. LOCK GATE.
Onderdeel	:	BUOYANCY TANKS.

1) DETERMINATION: LOCAL STRESSES σ_x; A2; DUE TO WATERPRESSURE



model:



$R_1 = 0.375 \times q l = 0.375 \cdot 108.2 \text{ kN/m}^2 \cdot \frac{6.5\text{ m}}{2} = 132 \text{ kN/m}$

$R_2 = 1,25 \cdot q l = 1,25 \cdot 108.2 \cdot \frac{6.5}{2} = 440 \text{ kN/m}$

NORMAL FORCES IN VERTICAL WALLS: NORMALSTRESS.

OUTERWALLS:

① : $\sigma_{N,d} = -1.5 \times 132 \text{ kN/m} \times 1 \text{ m} \cdot \frac{1 \cdot 10^3}{1000 \times 20 \text{ mm}^2} = -10 \text{ N/mm}^2$

→ TRANSLATED TO σ_x; A2 VIA THE WALL THICKNESS [K2-8].

② INNER WALLS: (sea inside, lagoon inside)

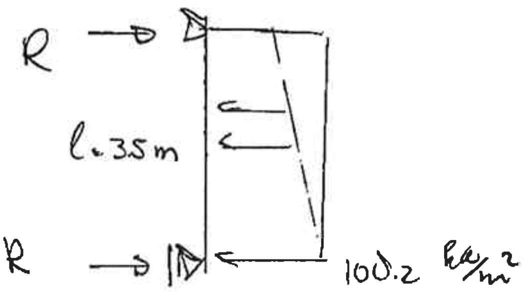
$\sigma_{N,d} = -1.5 \times 440 \text{ kN/m} \times 1 \text{ m} \frac{1 \cdot 10^3}{1000 \times 2 \times 20 \text{ mm}^2} = -17 \text{ N/mm}^2$

Opgesteld :	Datum :	Bladnummer :	Rev. :
WLA	220604	K3-2	A2

Project : MALAMOCCO NAV. LOCK GATE.

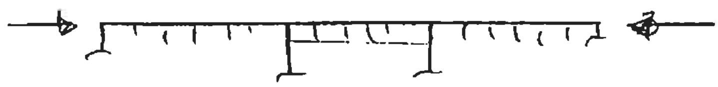
Onderdeel : BUOYANCY TANKS.

Horizontal water pressure



$R = \frac{1}{2} \times 100.2\ kN/m^2 \times 3.5\,m = 190\ kN/m$

NORMAL FORCES IN HORIZONTAL PLATES : NORMAL STRESSES.



top and bottom plate

$\sigma_x = 1.5 \times 190\ kN/m \times 1\,m\ \frac{1 \cdot 10^3}{1000 \times 20\ mm^2} = -15\ N/mm^2$

⇒ "TRANSLATED" TO σ_x; A2 VIA THE WALL THICKNESS [k2-8

Opgesteld : WLA

Datum : 220604

Bladnummer : k3-3

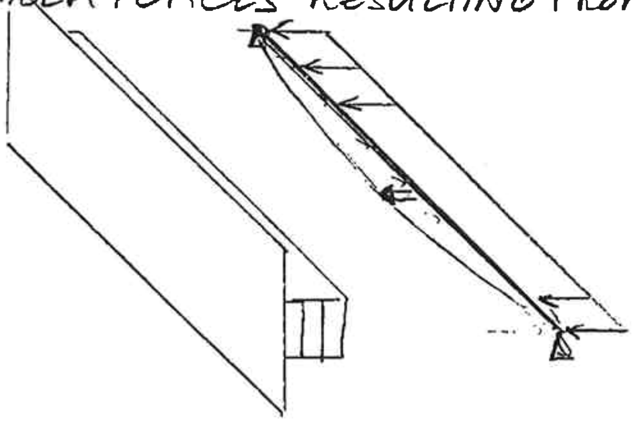
Rev. : A2

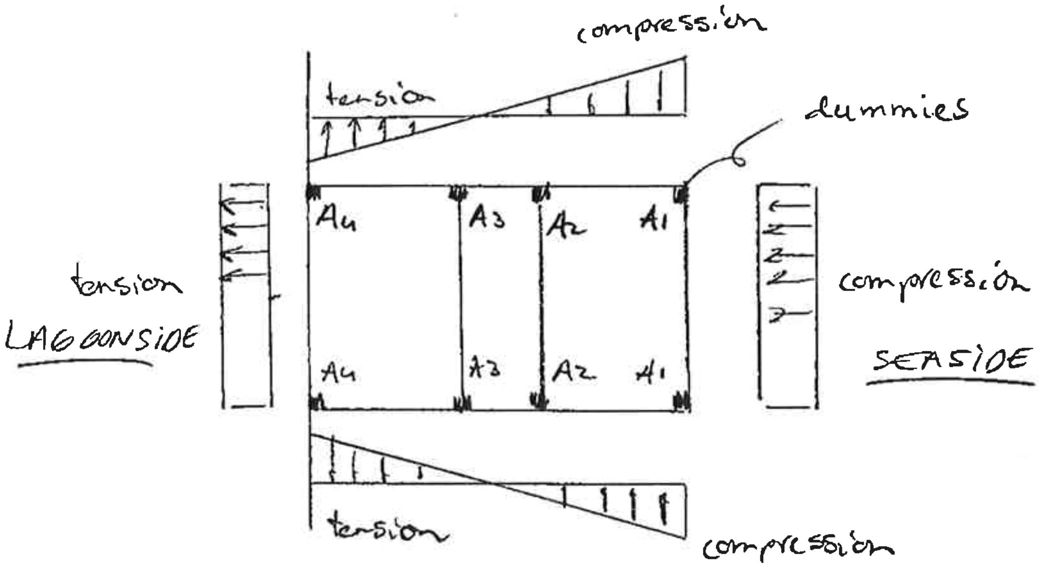
Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS

DETERMINATION GLOBAL STRESSES $\sigma_{y;B1}$; DUE TO GLOBAL BENDING.

PLATE STRESSES CALCULATED FROM HORIZONTAL DUMMY MEMBER FORCES RESULTING FROM MAIN CALCULATION





doc. R-4002 - Rev. A - p. 10-12

calculated with reduction corrosion.

Opgesteld : WLA

Datum : 220604

Bladnummer : k3-4

Rev. : A2

MALAMOCCO NAV. LOCK GATE.

BUOYANCY TANKS.

including corrosion

1

ID	qty	description	A	Σ A	Y	Σ A * Y	Iz	ΣIz	A*x²
		External wall lagoon side							
140a	1	18x3500	63000	63000	10	6.30E+05	1.7E+6	1.7E+6	7.84E+11
141	2	HP300x12	4970	9940	203	2.02E+06		000.0E+0	1.11E+11
143	6	HP340x13	6220	37320	229	8.55E+06		000.0E+0	4.09E+11
		External wall sea side							
140b	1	38x3500	133000	133000	6630	8.82E+08	16.0E+6	16.0E+6	1.27E+12
142	2	HP300x12	4970	9940	6427	6.39E+07		000.0E+0	8.30E+10
144	4	HP340x13	6220	24880	6401	1.59E+08		000.0E+0	2.04E+11
		Internal wall lagoon side							
145	1	18x3460	62280	62280	2530	1.58E+08	1.7E+6	1.7E+6	6.33E+10
147	2	HP300x12	4970	9940	2337	2.32E+07		000.0E+0	1.43E+10
149	6	HP340x13	6220	37320	2311	8.62E+07		000.0E+0	5.62E+10
		Internal wall sea side							
146	1	18x3460	62280	62280	4150	2.58E+08	1.7E+6	1.7E+6	2.33E+10
148	2	HP300x12	4970	9940	4343	4.32E+07		000.0E+0	6.45E+09
150	6	HP340x13	6220	37320	4369	1.63E+08		000.0E+0	2.58E+10
		Bottom plate -6900 (+ 6910)							
151	1	18x6590	118620	118620	3315	3.93E+08	429.3E+9	429.3E+9	5.89E+09
153	4	HP340x13	6220	24880	1270	3.16E+07		000.0E+0	1.28E+11
156	3	HP340x13	6220	18660	3340	6.23E+07		000.0E+0	7.30E+08
159	4	HP340x13	6220	24880	5385	1.34E+08		000.0E+0	8.49E+10
	1	HP300x12	4970	4970	430	2.14E+06		000.0E+0	4.80E+10
	1	HP300x12	4970	4970	2160	1.07E+07		000.0E+0	9.43E+09
	1	HP300x12	4970	4970	4515	2.24E+07		000.0E+0	4.75E+09
	1	HP300x12	4970	4970	6255	3.11E+07		000.0E+0	3.67E+10
		Topplate -3400 (+ 10390)							
161	1	18x6590	118620	118620	3315	3.93E+08	429.3E+9	429.3E+9	5.89E+09
163	4	HP340x13	6220	24880	1270	3.16E+07		000.0E+0	1.28E+11
166	3	HP340x13	6220	18660	3340	6.23E+07		000.0E+0	7.30E+08
169	4	HP340x13	6220	24880	5385	1.34E+08		000.0E+0	8.49E+10
	1	HP300x12	4970	4970	430	2.14E+06		000.0E+0	4.80E+10
	1	HP300x12	4970	4970	2160	1.07E+07		000.0E+0	9.43E+09
	1	HP300x12	4970	4970	4515	2.24E+07		000.0E+0	4.75E+09
	1	HP300x12	4970	4970	6255	3.11E+07		000.0E+0	3.67E+10
				911000		3.22E+09		858.6E+9	3.69E+12

e_R = 3538

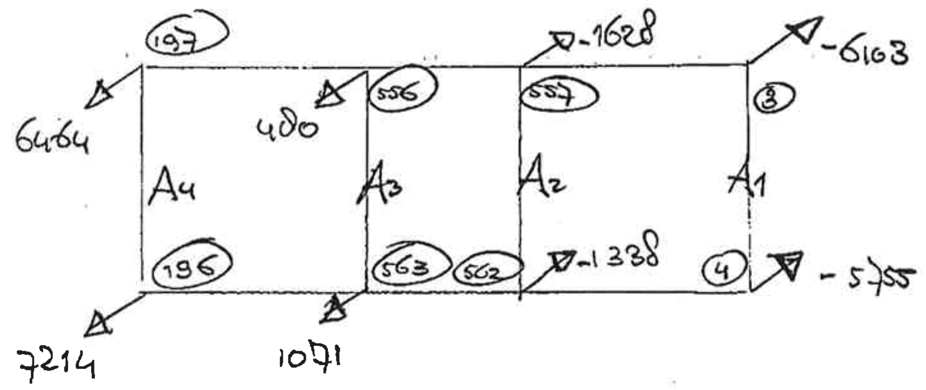
eb = 3112

Izz = 4.546E+12 mm^4

WLA 220609 K3-5 A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.



Normal fores dummies

.. resulting from Esa Prima Win GOVERNING LOADCOMBI 10.

(see next page)

Opgesteld : WLA.

Datum : 220604

Bladnummer : K3-6.

Rev. : A2

Malamocco Nav. Lock Gate.

ESA-Prima Win release 3.50.298

Buoyancy tanks.

Internal forces on macro(s). Member extreme

Linear static - extreme or all combinations
Group of macro(s) :3/4,196/197,556/557,562/563
Group of ultimate combi :10

macro	memb	combi	dx [mm]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
3	31	10	0.0	-6102.43	-1.82	89.03	77.52	-73.32	17.28
4	45			-5754.75	-2.04	173.39	-77.85	-141.93	17.73
196	546			7213.73	-3.71	166.36	3.64	-138.77	40.22
197	560			6463.08	-3.10	76.89	-5.42	-59.64	39.07
556	1086			479.12	0.23	0.06	0.76	1.67	22.72
	1080			-117.74	132.51	4.75	-28.57	0.37	-159.62
557	1100			-1627.83	0.45	-0.13	-1.72	0.78	5.73
562	1171			-1337.76	-0.22	0.05	-1.39	0.29	-7.42
563	1184			1070.31	-0.29	-0.02	-1.66	1.87	23.92
	1190			-124.99	-139.28	13.35	-41.00	-25.32	101.12

FROM MAIN CALC. MODEL.

WLA 220604. K3-7 A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

Vertical plate inside sea   Axis A2

$A_{nett} = 60850\ mm^2$ (half) ; $A_{corrosion} = 54770\ mm^2$

$F_{d\,topside} = -1628\ kN$

$$\sigma_{d\,topside} = \frac{-1628000}{54770} = -30\ N/mm^2$$

$F_{d\,bottomside} = -1338\ kN$

$$\sigma_{d.\,bottomside} = \frac{-1338000}{54770} = -25\ N/mm^2$$

Vertical plate inside lagoon   Axis A3

$F_{d\,topside} = 480\ kN$

$$\sigma_{d,topside} = \frac{480 \cdot 10^3}{54770} = 9\ N/mm^2$$

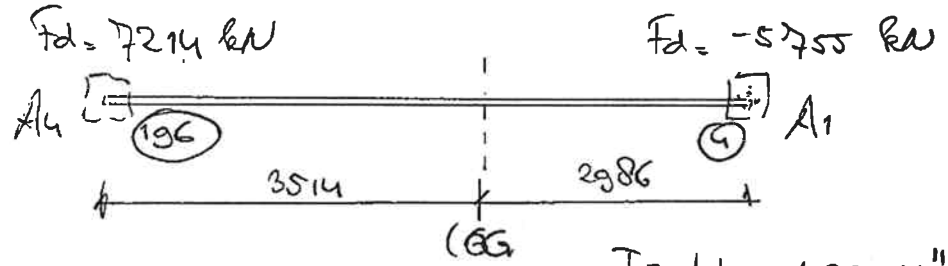
$F_{d\,bottomside} = 1071\ kN$

$$\sigma_{d.\,bottomside} = \frac{1071 \cdot 10^3}{54770} = 20\ N/mm^2$$

Opgesteld : WLA   Datum : 220601   Bladnummer : K3-8   Rev.: A2

Project	:	MALAMOCCO NAV. LOCK GATE.
Onderdeel	:	BUOYANCY TANKS.

Stress in bottom buoyancy chamber



$I_{z,plate} = 4{,}29 \cdot 10^{11}\ mm^4$

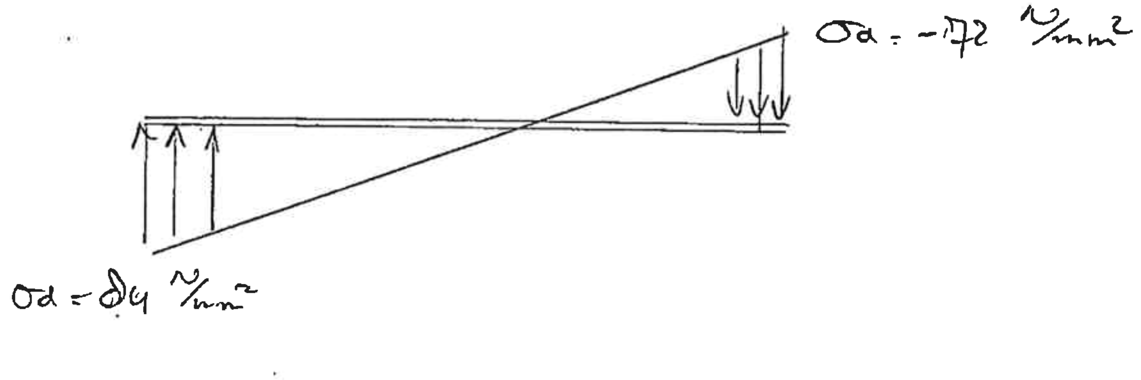
$A4: \quad Fd(\%) = \frac{20892}{78655} \times 7214 = 1917\ kN$

$A1: \quad Fd(\%) = \frac{24585}{118921} \times -5755 = -1190\ kN$

$* \quad Md = 3.514 \times 1917 + 2.986 \times 1190 = 10{,}290\ kNm$

$A4: \quad \sigma d = \frac{Md \cdot e}{Izz} = \frac{10290 \cdot 10^6 \times 3514}{4.29 \times 10^{11}} = 84\ N/mm^2$

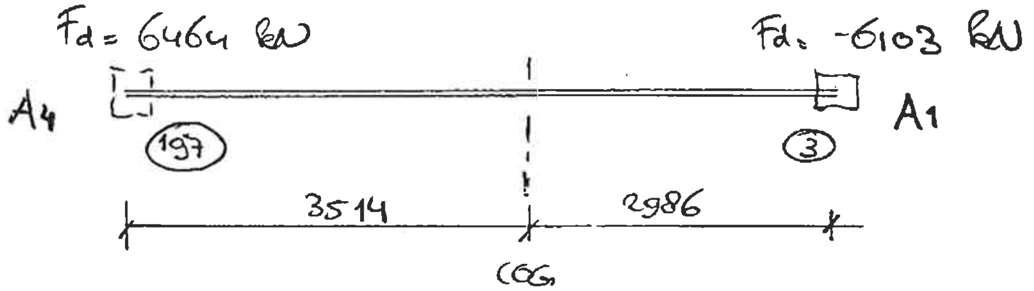
$A1: \quad \sigma d = \frac{10290 \cdot 10^6 \times 2986}{4.29 \times 10^{11}} = -72\ N/mm^2$



Opgesteld : WLA	Datum : 220604	Bladnummer : k3-9	Rev. : A2		

Project :	Malamocco Nav. Lock Gate.
Onderdeel :	Buoyancy tanks.

Stress in top buoyancy chamber



A4: area % dummy = $\frac{20892}{78655}$ = 26.56 %

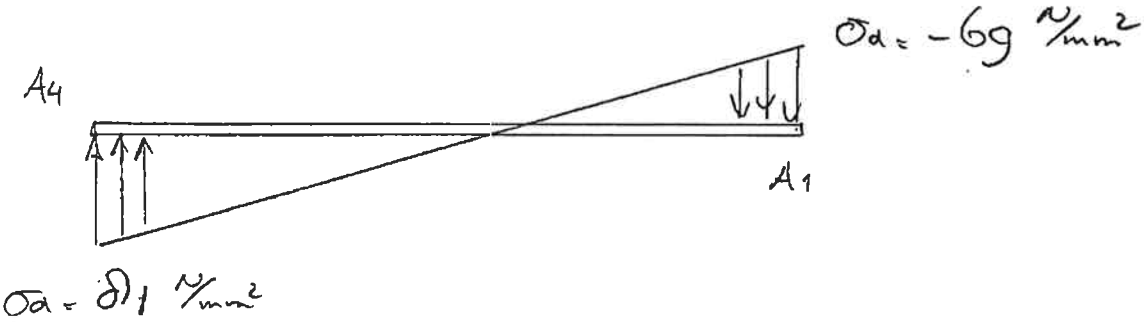
Fd(%) = 1717 kN

A1 : Fd(%) = $\frac{24585}{118921}$ × -6103 = -1262 kN

* Md = 3.514 m × 1717 kN + 2.986 m × 1262 kN = 9802 kNm

A4 : $\sigma_d = \frac{M_d \times e}{I_{zz}} = \frac{9802 \cdot 10^6 \times 3514}{4{,}29 \times 10^{11}}$ = **81 N/mm²**

A1 : $\sigma_d = \frac{9802 \cdot 10^6 \times 2986}{4.29 \times 10^{11}}$ = **-69 N/mm²**



Opgesteld :	Datum :	Bladnummer :	Rev. :
WLA	220604.	K3-10	A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

Vertical plate outside sea axis A1

$A_{nett} = 89360 \text{ mm}^2$ (half) ; $A_{corrosion} = 83910 \text{ mm}^2$

$F_{d\,topside} = -6103 \text{ kN} + 1262 \text{ kN} = -4841 \text{ kN}$

$\sigma_{d\,topside} = \frac{-4841\,000}{83910} = \underline{\underline{-58 \text{ N/mm}^2}}$

$F_{d\,bottomside} = -5755 + 1190 = -4565 \text{ kN}$

$\sigma_{d\,bottomside} = \frac{-4565 \times 10^3}{83910} = \underline{\underline{-55 \text{ N/mm}^2}}$

Vertical plate outside lagoon axis A4

$A_{nett} = 61250 \text{ mm}^2$ (half) ; $A_{corrosion} = 55130 \text{ mm}^2$

$F_{d\,topside} = 6464 - 1717 = 4747 \text{ kN}$

$\sigma_{d,topside} = \frac{4747 \cdot 10^3}{55130} = \underline{\underline{87 \text{ N/mm}^2}}$

$F_{d,bottomside} = 7214 - 1917 = 5297 \text{ kN}$

$\sigma_{d,bottomside} = \frac{5297 \cdot 10^3}{55130} = \underline{\underline{97 \text{ N/mm}^2}}$

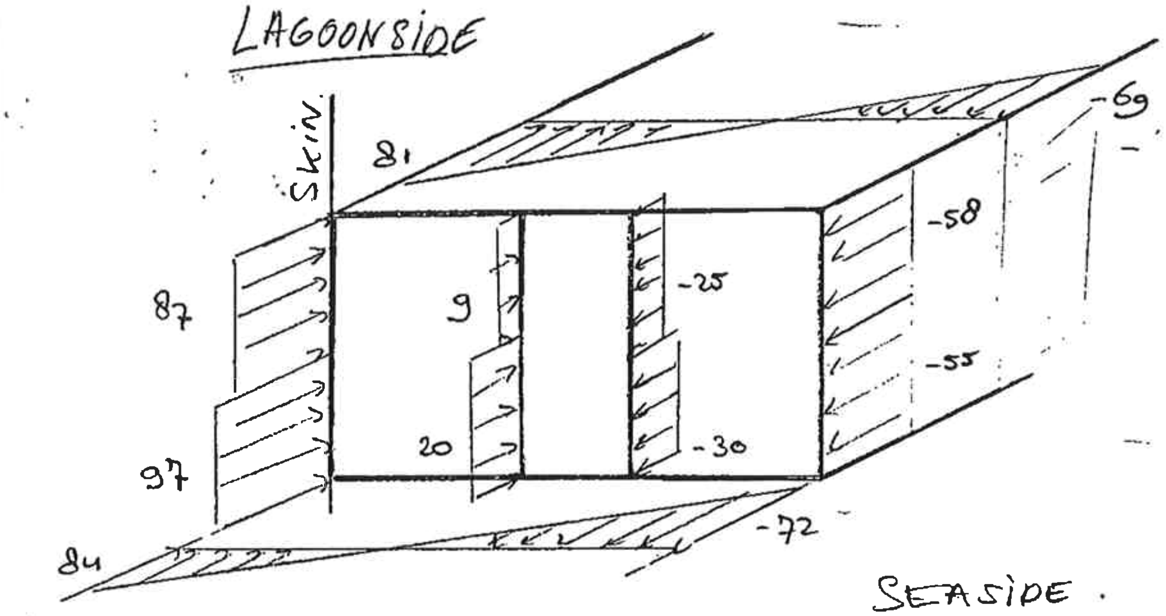
Opgesteld : WLA Datum : 220604 Bladnummer : K3-11 Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUOYANCY TANKS.

Overview stresses due to global bending gate

in [N/mm²]



σ AVERAGE IN CORNERS.

- LAGOONSIDE TOPPLATE : $(87+81)/2 = 84$ N/mm²
- LAGOONSIDE BOTTOMPLATE : $(84+97)/2 = 91$ N/mm²
- SEASIDE TOPPLATE : $(-58-69)/2 = -64$ N/mm²
- SEASIDE BOTTOMPLATE : $(-55-72)/2 = -64$ N/mm²

GOVERNING STRESSES FOR COMBINATION CHECK:

LAGOONSIDE (TENSION) : $\sigma_{y;B1+} = 0$ to 91 (N/mm²)

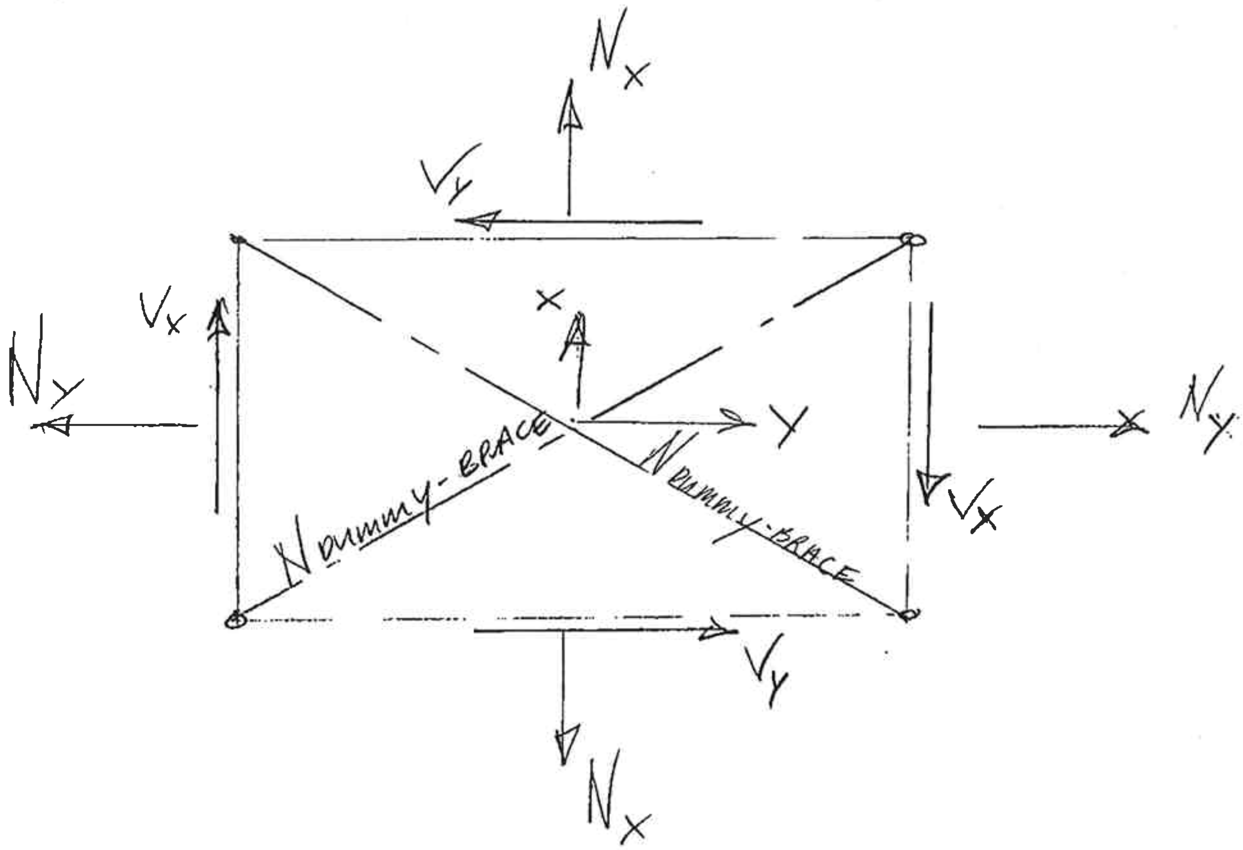
SEASIDE (COMPRESSION) : $\sigma_{y;B1-} = -64$ to 0 (N/mm²)

Opgesteld : WLA | Datum : 220604 | Bladnummer : K3-12 | Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

DETERMINATION GLOBAL PLATE STRESSES $\sigma_{y;B2}$, $\sigma_{x;B2}$ AND $\tau_{xy;B2}$ FROM DIAGONAL DUMMIES IN MAINCALC. MODEL.



NOTE: • STRESSES ON NEXT PAGE ONLY PRESENTED FOR GOVERNING LOADCOMBINATION 10.

• CALC. PLATE THICKNESS CONSERVATIVE IN DETERMINATION STRESSES

→ STIFFENERS NEGLECTED: $t_{h;CALC;\sigma_y/\sigma_x;SEASIDE} = 38mm$

$t_{h;CALC;ALL\ OTHER\ PLATES} = 10mm$

• FOR A COMPLETE EXAMPLE OF THE APPROACH FOR CALCULATION OF STRESSES, FROM DIAGONAL FORCES, SEE ADD. A1-33.

Opgesteld : WLA | Datum : 220604 | Bladnummer : K3-13. | Rev. : A2

Combi 10		Brace forces		height	widht	length	Vy	Vx	Ny	Nx	σ_y	σ_x	τ_{xy}
Buoyancy tank Members		N (kN)	N (kN)	mm	mm	mm	kN	kN	kN	kN	N/mm²	N/mm²	N/mm²
Topplate seaside													
1330	1329	-1200	750	2440	1950	3123.5	1184	1482					34
822	812	1400	-2450	2440	5000	5563.6	3426	1672					38
823	813	-2700	700	2440	5000	5563.6	3039	1483					34
824	814	-350	-2350	2440	5000	5563.6	1804	880	-315	-153	-7	-2	20
825	815	-2350	-750	2440	5000	5563.6	1438	702	-674	-329	-15	-4	16
826	816	-1600	-1800	2440	5000	5563.6	179	88	-1438	-702	-33	-8	2
827	817	-1600	-1800	2440	5000	5563.6	179	87	-1438	-702	-33	-8	2
828	818	-2350	-750	2440	5000	5563.6	1438	702	-674	-329	-15	-4	16
829	819	-350	-2350	2440	5000	5563.6	1804	880	-315	-153	-7	-2	20
830	820	-2700	700	2440	5000	5563.6	3039	1483					34
831	821	1400	-2450	2440	5000	5563.6	3426	1672					38
1326	1325	-1200	750	2440	1950	3123.5	1184	1482					34
Topplate middle													
1130	1112	2200	-2650	1620	5000	5255.9	4557	1476					51
1131	1113	-2200	1900	1620	5000	5255.9	3857	1250					43
1132	1114	1150	-1550	1620	5000	5255.9	2534	821					28
1133	1115	-1150	750	1620	5000	5255.9	1764	572					20
1134	1116	-50	-450	1620	5000	5255.9	393	127	-48	-15	-2	0	4
1135	1117	-50	-450	1620	5000	5255.9	393	127	-48	-15	-2	0	4
1136	1118	-1150	750	1620	5000	5255.9	1764	572					20
1137	1119	1150	-1550	1620	5000	5255.9	2535	821					28
1138	1120	-2200	1900	1620	5000	5255.9	3856	1249					43
1139	1121	2200	-2650	1620	5000	5255.9	4556	1476					51
Topplate lagoonside													
1327	1328	1050	-2150	2440	1950	3123.5	1955	2447					56
1144	1154	2250	-1550	2440	5000	5563.6	3386	1652					38
1145	1155	-1000	2500	2440	5000	5563.6	3132	1529					35
1146	1156	2200	-100	2440	5000	5563.6	2028	990					23
1147	1157	400	2050	2440	5000	5563.6	1499	731	359	175	8	2	17
1148	1158	1450	1150	2440	5000	5563.6	271	132	1034	504	24	6	3
1149	1159	1450	1150	2440	5000	5563.6	271	132	1034	504	24	6	3
1150	1160	400	2050	2440	5000	5563.6	1499	731	359	175	8	2	17
1151	1161	2200	-100	2440	5000	5563.6	2028	990					23
1152	1162	2200	-100	2440	5000	5563.6	2028	990					23
1153	1163	2250	-1550	2440	5000	5563.6	3385	1652					38
1323	1324	-2150	1050	2440	1950	3123.5	1955	2447					56
Bottomplate seaside													
1333	1334	750	-1250	2440	1950	3123.5	1212	1517					35
782	772	1400	-2500	2440	5000	5563.6	3459	1688					38
783	773	-2700	700	2440	5000	5563.6	2986	1457					33
784	774	-400	-2250	2440	5000	5563.6	1656	808	-359	-175	-8	-2	18
785	775	-2250	-750	2440	5000	5563.6	1380	674	-674	-329	-15	-4	15
786	776	-1550	-1650	2440	5000	5563.6	119	58	-1393	-680	-32	-8	1
787	777	-1550	-1650	2440	5000	5563.6	120	58	-1393	-680	-32	-8	1
788	778	-2250	-750	2440	5000	5563.6	1381	674	-674	-329	-15	-4	15
789	779	-400	-2250	2440	5000	5563.6	1656	808	-359	-175	-8	-2	18
790	780	-2700	700	2440	5000	5563.6	2985	1457					33
791	781	1400	-2500	2440	5000	5563.6	3459	1688					38
1337	1338	-1250	750	2440	1950	3123.5	1212	1517					35
Bottomplate middle													
1196	1214	2000	-2500	1620	5000	5255.9	4236	1372					47
1197	1215	-2000	1750	1620	5000	5255.9	3503	1135					39
1198	1216	1100	-1250	1620	5000	5255.9	2188	709					24
1199	1217	-900	800	1620	5000	5255.9	1583	513					18
1200	1218	150	-200	1620	5000	5255.9	295	95					3
1201	1219	150	-200	1620	5000	5255.9	295	96					3
1202	1220	-900	800	1620	5000	5255.9	1583	513					18
1203	1221	1100	-1250	1620	5000	5255.9	2188	709					24
1204	1222	-2000	1750	1620	5000	5255.9	3503	1135					39
1205	1223	2000	-2500	1620	5000	5255.9	4236	1372					47
Bottomplate lagoonside													
1331	1332	900	-2050	2440	1950	3123.5	1814	2270					52
1238	1228	2050	-1350	2440	5000	5563.6	3000	1464					33
1239	1229	-800	2400	2440	5000	5563.6	2831	1381					31
1240	1230	2100	150	2440	5000	5563.6	1748	853	135	66	3	1	19
1241	1231	600	2100	2440	5000	5563.6	1379	673	539	263	12	3	15
1242	1232	1550	1350	2440	5000	5563.6	185	90	1213	592	28	7	2
1243	1233	1550	1350	2440	5000	5563.6	185	90	1213	592	28	7	2
1244	1234	600	2100	2440	5000	5563.6	1379	673	539	263	12	3	15
1245	1235	2100	150	2440	5000	5563.6	1749	853	135	66	3	1	19
1246	1236	-800	2400	2440	5000	5563.6	2831	1382					31
1247	1237	2050	-1350	2440	5000	5563.6	3001	1464					33
1335	1336	-2050	900	2440	1950	3123.5	1813	2269					52

WLA 210604 page: K3-14; rev A2

Malamocco Nav. Lock Gate   Buoyancy tanks.

Combi 10 Buoyancy tank Members		Brace forces N (kN)	N (kN)	height mm	widht mm	length mm	Vy kN	Vx kN	Ny kN	Nx kN	σ_y N/mm²	σ_x N/mm²	τ_{xy} N/mm²
Vertical plate seaside													
1344	1343	200	50	3500	1950	4006.6	81	146	24	44	0	1	1
732	742	-700	-700	3500	5000	6103.3	17	12	-573	-401	-4	-2	0
733	743	-1500	-1200	3500	5000	6103.3	222	156	-983	-688	-7	-4	1
734	744	-1950	-1750	3500	5000	6103.3	184	129	-1434	-1004	-11	-5	1
735	745	-2300	-2100	3500	5000	6103.3	190	133	-1720	-1204	-13	-6	1
736	746	-2450	-2250	3500	5000	6103.3	183	128	-1843	-1290	-14	-7	1
737	747	-2450	-2250	3500	5000	6103.3	182	128	-1843	-1290	-14	-7	1
738	748	-2300	-2100	3500	5000	6103.3	190	133	-1720	-1204	-13	-6	1
739	749	-1950	-1750	3500	5000	6103.3	183	128	-1434	-1004	-11	-5	1
740	750	-1500	-1200	3500	5000	6103.3	222	156	-983	-688	-7	-4	1
741	751	-700	-700	3500	5000	6103.3	17	12	-573	-401	-4	-2	0
1346	1345	50	200	3500	1950	4006.6	82	147	24	44	0	1	1
Vertical plate inside seaside													
1297	1287	-650	-450	3500	5000	6103.3	133	93	-369	-258	-6	-3	1
1298	1288	-800	-750	3500	5000	6103.3	25	18	-614	-430	-10	-5	0
1299	1289	-900	-850	3500	5000	6103.3	9	6	-696	-487	-11	-5	0
1300	1290	-950	-950	3500	5000	6103.3	38	27	-778	-545	-12	-6	0
1301	1291	-1000	-950	3500	5000	6103.3	21	14	-778	-545	-12	-6	0
1302	1292	-1000	-950	3500	5000	6103.3	21	14	-778	-545	-12	-6	0
1303	1293	-950	-950	3500	5000	6103.3	38	27	-778	-545	-12	-6	0
1304	1294	-900	-850	3500	5000	6103.3	9	6	-696	-487	-11	-5	0
1305	1295	-800	-750	3500	5000	6103.3	25	17	-614	-430	-10	-5	0
1306	1296	-650	-450	3500	5000	6103.3	133	93	-369	-258	-6	-3	1
Vertical plate inside lagoonside													
1277	1267	-250	-300	3500	5000	6103.3	51	36	-205	-143	-3	-2	1
1278	1268	-200	50	3500	5000	6103.3	161	113					2
1279	1269	150	-50	3500	5000	6103.3	147	103					2
1280	1270	100	200	3500	5000	6103.3	93	65	82	57	1	1	1
1281	1271	200	150	3500	5000	6103.3	29	21	123	86	2	1	0
1282	1272	200	150	3500	5000	6103.3	29	21	123	86	2	1	0
1283	1273	100	200	3500	5000	6103.3	93	65	82	57	1	1	1
1284	1274	150	-50	3500	5000	6103.3	148	103					2
1285	1275	-200	50	3500	5000	6103.3	161	113					2
1286	1276	-250	-300	3500	5000	6103.3	51	36	-205	-143	-3	-2	1
Vertical plate lagoonside													
1339	1340	150	-50	3500	1950	4006.6	69	124					2
686	616	150	-150	3500	5000	6103.3	210	147					2
687	617	50	300	3500	5000	6103.3	193	135	41	29	1	0	2
688	618	600	400	3500	5000	6103.3	172	120	328	229	5	3	2
689	619	650	700	3500	5000	6103.3	62	44	533	373	8	4	1
690	620	850	750	3500	5000	6103.3	47	33	614	430	10	5	1
691	621	850	750	3500	5000	6103.3	47	33	614	430	10	5	1
692	622	650	700	3500	5000	6103.3	62	43	533	373	8	4	1
693	623	600	400	3500	5000	6103.3	172	121	328	229	5	3	2
694	624	50	300	3500	5000	6103.3	194	135	41	29	1	0	2
695	625	150	-150	3500	5000	6103.3	210	147					2
1341	1342	-50	150	3500	1950	4006.6	68	123					2
Vertical plates transverse direction													
1248	1249	-600	-550	3500	2440	4266.6	27	39	-315	-451	-5	-10	1
840	437	-200	-300	3500	2440	4266.6	53	77	-114	-164	-2	-4	1
1253	1254	-750	-400	3500	2440	4266.6	190	273	-229	-328	-4	-7	4
843	844	-50	-400	3500	2440	4266.6	183	262	-29	-41	0	-1	4
846	848	-1400	-750	3500	2440	4266.6	381	546	-429	-615	-7	-14	9
847	849	150	-450	3500	2440	4266.6	313	449					7
851	853	-1650	-850	3500	2440	4266.6	461	661	-486	-697	-8	-16	10
852	854	450	-300	3500	2440	4266.6	412	591					9
858	856	-1800	-950	3500	2440	4266.6	490	703	-543	-779	-9	-18	11
857	859	550	-150	3500	2440	4266.6	361	518					8
863	861	-1900	-1000	3500	2440	4266.6	499	716	-572	-820	-9	-19	11
862	864	700	-100	3500	2440	4266.6	410	588					9
866	868	-1900	-1050	3500	2440	4266.6	499	716	-600	-861	-10	-20	11
869	867	650	50	3500	2440	4266.6	357	512	29	41	0	1	8
873	871	-1900	-1000	3500	2440	4266.6	499	716	-572	-820	-9	-19	11
872	874	700	-100	3500	2440	4266.6	410	588					9
878	876	-1800	-950	3500	2440	4266.6	490	703	-543	-779	-9	-18	11
877	879	550	-150	3500	2440	4266.6	361	518					8
883	881	-1650	-850	3500	2440	4266.6	460	661	-486	-697	-8	-16	10
882	884	450	-300	3500	2440	4266.6	412	591					9
888	886	-1400	-750	3500	2440	4266.6	380	546	-429	-615	-7	-14	9
887	889	150	-450	3500	2440	4266.6	313	449					7
893	891	-750	-400	3500	2440	4266.6	191	274	-229	-328	-4	-7	4
892	894	-50	-400	3500	2440	4266.6	183	262	-29	-41	0	-1	4
841	842	-600	-550	3500	2440	4266.6	28	40	-315	-451	-5	-10	1
490	495	-200	-300	3500	2440	4266.6	54	77	-114	-164	-2	-4	1

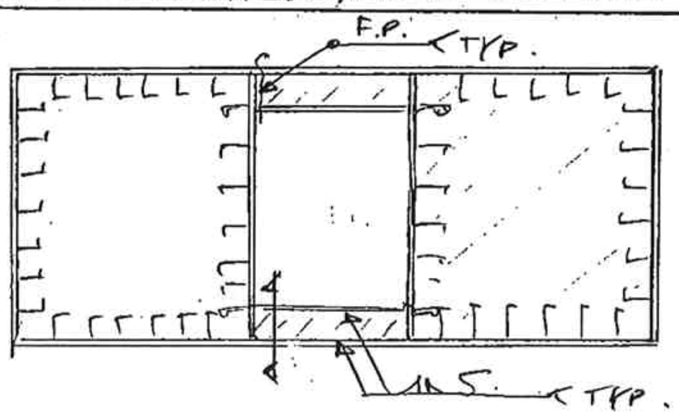
WLA

 210604 page: k3-15, rev. AE

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

K4. CALCULATION BEAMSECTION BUOYANCY TANK CORRIDOR.



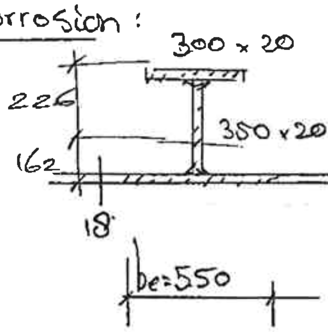
GOVERNING FORCES (EPW-MODEL) → Nd, Vd and Md
DERIVED FROM MAINCALC. DOC; See next pages. COMBI 10
load condition 1&2)

$N_d = 1392$ kN

$V_d = 700$ kN

$M_{y,d} = 470$ kNm (with a hand calculation this bending moment is also found.)

incl. corrosion:



$b_e = 32 \cdot t = 32 \cdot 18 \rightarrow 550$ mm

$I = 5,9 \cdot 10^8\ mm^3$	
$A = 22900\ mm^2$	
$W_b = 2.61\ 10^6\ mm^3$	$S_b =$
$W_o = 3.64 \cdot 10^6\ mm^3$	S_o

$S_b = 300 \cdot 20 \cdot (226-10) = 1296000\ mm^3$

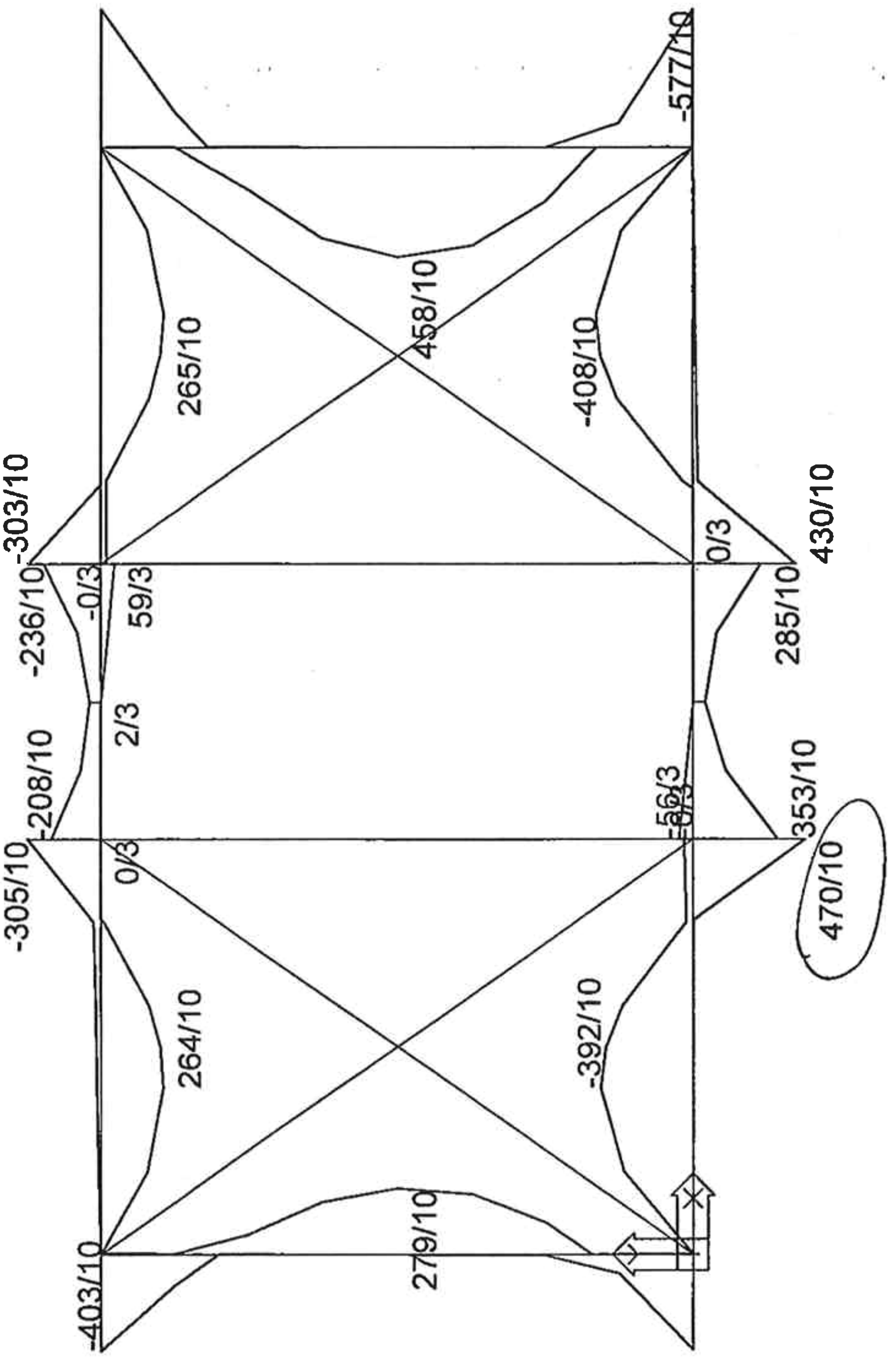
$S_o = 550 \cdot 18 (162-9) = 1377000\ mm^3$

(no corrosion inside buoyancy tank)

WELDS: - BUTTWELD → F.P.
- SHEARWELD → $\tau_{ud} = 226\ N/mm^2$, $a_{min} = \frac{V \cdot S_o}{\tau_{ud} \cdot I \cdot 2} = \frac{700 \cdot 10^3 \cdot 1377000}{226 \cdot 5,9 \cdot 10^8 \cdot 2} = 3,6$ mm

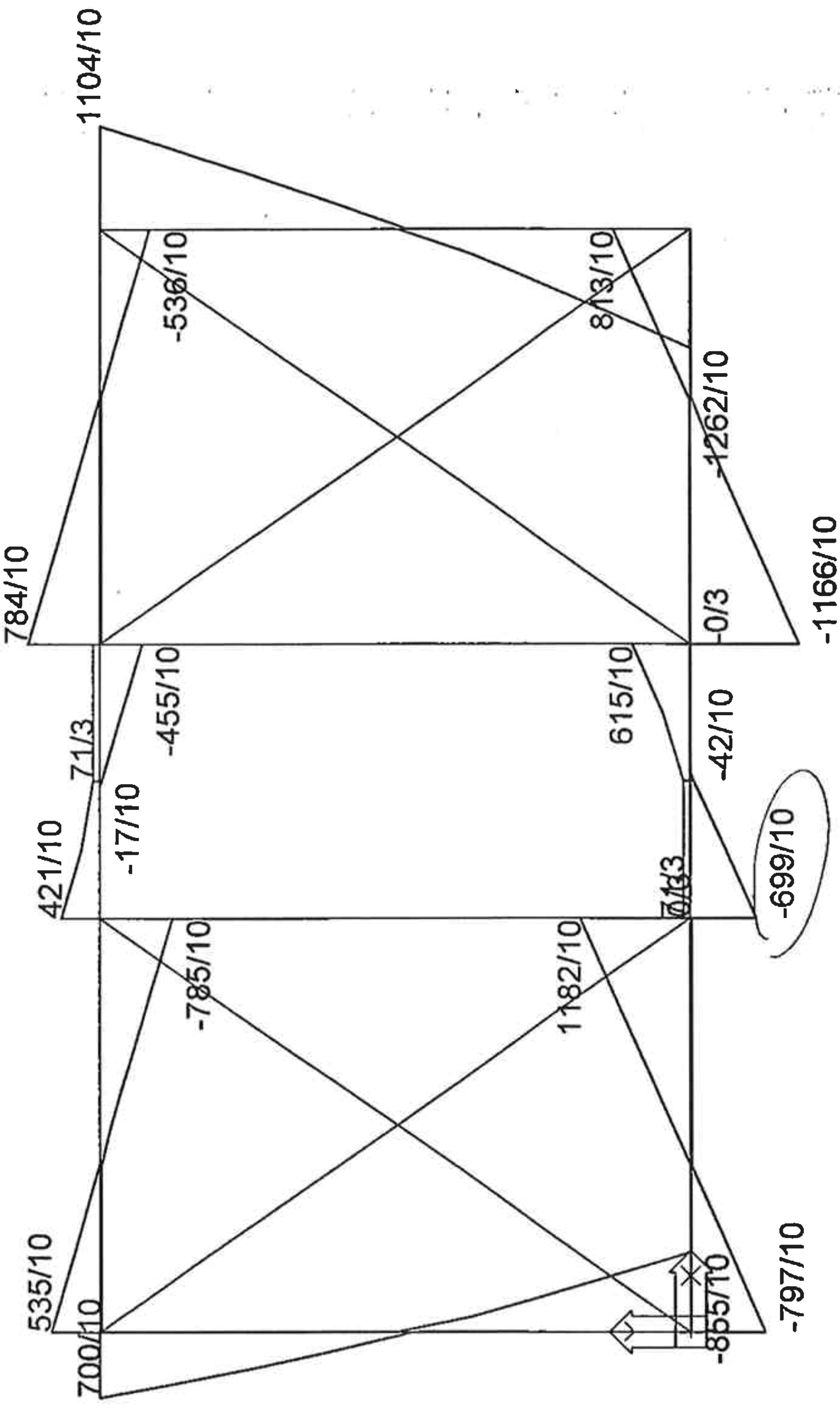
→ USE: 2*5; SUFFICIENT.

Opgesteld : WLA. Datum : 220604 Bladnummer : K4-1 Rev. : A2



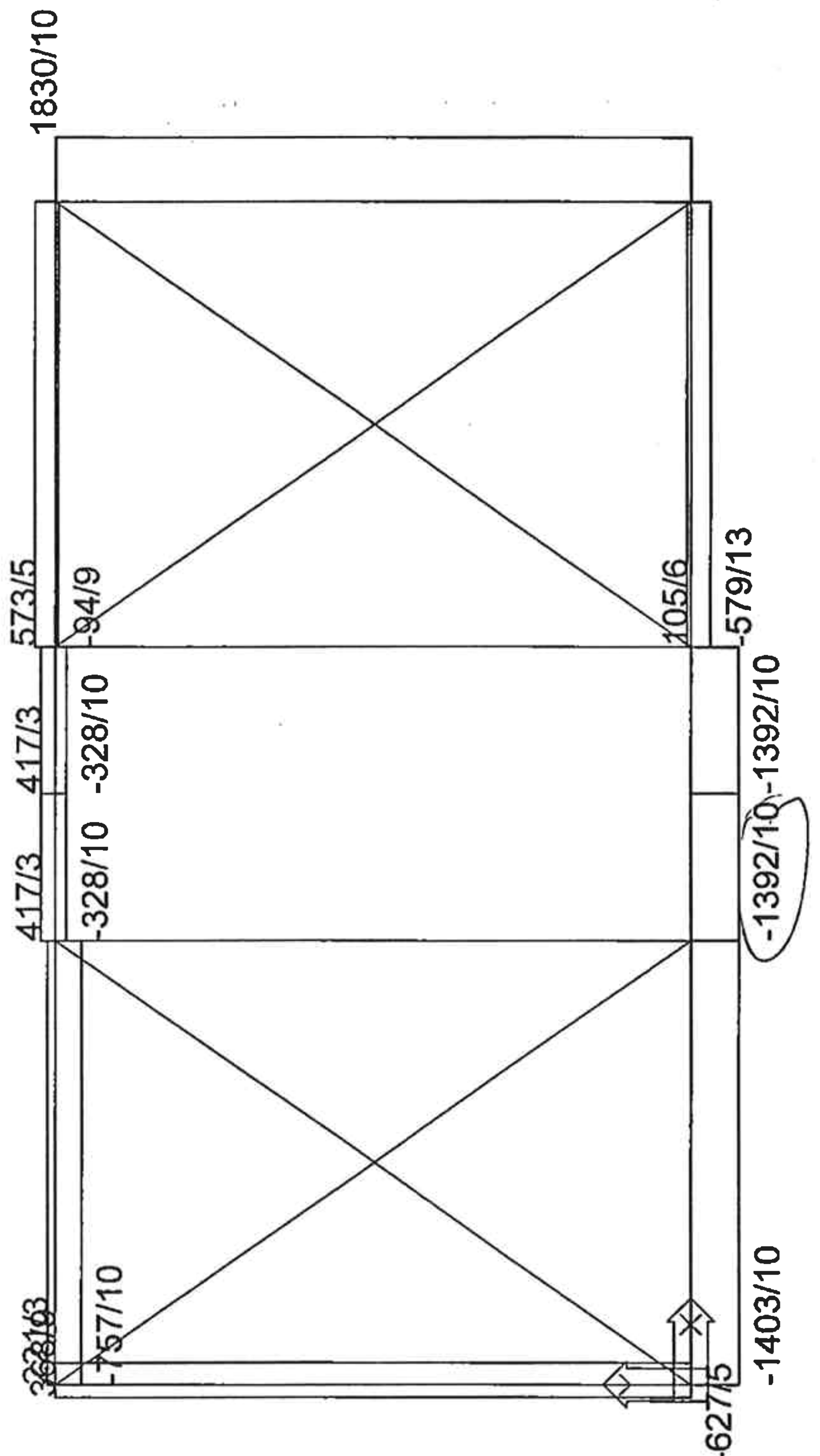
Internal forces - My on member(s). Ult. combi : 3,5/6,9/10,13/14

K4-2 A2



Internal forces - Vz on member(s). Ult. combi : 3,5/6,9/10,13/14

K4-3 A2



Internal forces - N on member(s). Ult. combi : 3,5/6,9/10,13/14

K4-4 A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

$$\sigma_d = \frac{N_d}{A} + \frac{M_d}{W}$$

max. stress → flange

$$\sigma_d = \frac{1392 \cdot 10^3}{22900} + \frac{470 \cdot 10^6}{2.61 \cdot 10^6} = 61 + 181 = 242 \text{ N/mm}^2$$

$$\tau_d = \frac{V_d}{A_{web}} = \frac{700 \cdot 10^3}{350 \times 20} = 100 \text{ N/mm}^2$$

$$\sigma_{eq,d} = \sqrt{242^2 + 3 \times 100^2} = 298 \text{ N/mm}^2$$

$$UC \quad \frac{298}{355/1.1} = 0.93 < 1.0 \quad \text{O.K.}$$

(CONSERVATIVE)

Opgesteld : WLA. Datum : 220604. Bladnummer : K4-5 Rev. : A2

Project :

Onderdeel :

Fatigue

combi 9 UGT : low water

$N_d = 963$ kN

$V_d = 370$ kN

$M_{y,d} = 248$ kNm

$$\sigma_d = \frac{963 \cdot 10^3}{22900} + \frac{248 \cdot 10^6}{2.61 \cdot 10^6} = 43 + 96 = 139 \text{ N/mm}^2$$

$$\tau_d = \frac{370 \cdot 10^3}{350 \cdot 20} = 53 \text{ N/mm}^2$$

UGT :

$\Delta\sigma_d = 242 - 139 = 103$ N/mm²

$\Delta\tau_d = 100 - 53 = 47$ N/mm²

fatigue : $\gamma = 1.35$ →

$$\Delta\sigma_d = \frac{1.35}{1.5} \times 103 = 93 \text{ N/mm}^2$$

$$\Delta\tau_d = \frac{1.35}{1.5} \cdot 47 = 42 \text{ N/mm}^2$$

Opgesteld : WLA.

Datum : 220604

Bladnummer : 44-6

Rev. : A2

memb	cr.nr	dx [mm]	combi	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
			5	-886.02	0.00	363.99	0.00	-10.65	0.00
			6	-926.29	0.00	367.02	0.00	-4.72	0.00
			9	-571.37	-0.00	429.71	-0.00	-14.81	-0.00
			10	-1403.23	0.00	786.18	0.00	-10.69	0.00
			13	-557.79	-0.00	294.27	-0.00	-23.11	-0.00
			14	-1136.13	-0.00	543.95	-0.00	-19.92	-0.00
		2440.0	3	-386.41	-0.04	-14.57	-0.11	-35.56	-0.10
			5	-886.02	0.00	548.71	0.00	212.05	0.00
			6	-926.29	0.00	551.74	0.00	219.46	0.00
			9	-571.37	-0.00	648.36	-0.00	248.24	-0.00
			10	-1403.23	0.00	1182.01	0.00	469.55	0.00
			13	-557.79	-0.00	447.32	-0.00	157.84	-0.00
			14	-1136.13	-0.00	821.03	-0.00	313.13	-0.00
761		0.0	3	-482.11	-0.66	70.98	-0.20	-56.29	0.51
			5	-744.40	0.00	-311.80	-0.00	152.96	-0.00
			6	-732.72	0.00	-327.27	-0.00	165.42	-0.00
			9	-963.65	-0.00	-370.54	-0.00	181.44	0.00
			10	-1391.51	0.00	-698.77	-0.00	352.92	-0.00
			13	-887.18	-0.00	-227.66	-0.00	101.93	0.00
			14	-1180.42	-0.01	-458.15	-0.00	222.55	0.00
		405.0	3	-482.11	-0.66	70.98	-0.20	-27.54	0.24
			5	-744.40	0.00	-158.50	-0.00	57.73	-0.00
			6	-732.72	0.00	-173.98	-0.00	63.92	-0.00
			9	-963.65	-0.00	-189.09	-0.00	68.11	0.00
			10	-1391.51	0.00	-370.28	-0.00	136.45	-0.00
			13	-887.18	-0.00	-100.65	-0.00	35.45	0.00
			14	-1180.42	-0.01	-228.20	-0.00	83.57	0.00
			3	-482.11	-0.66	70.98	-0.20	-27.54	0.24
			5	-744.40	0.00	-158.49	-0.00	57.72	-0.00
			6	-732.72	0.00	-173.97	-0.00	63.92	-0.00
			9	-963.65	-0.00	-189.08	-0.00	68.11	0.00
			10	-1391.51	0.00	-370.26	-0.00	136.44	-0.00
			13	-887.18	-0.00	-100.64	-0.00	35.45	0.00
			14	-1180.42	-0.01	-228.19	-0.00	83.56	0.00
		810.0	3	-482.11	-0.66	70.98	-0.20	1.21	-0.02
			5	-744.40	0.00	-5.20	-0.00	24.58	0.00
			6	-732.72	0.00	-20.67	-0.00	24.50	0.00
			9	-963.65	-0.00	-7.62	-0.00	28.28	-0.00
			10	-1391.51	0.00	-41.76	-0.00	53.01	0.00
			13	-887.18	-0.00	26.38	-0.00	20.41	-0.00
			14	-1180.42	-0.01	1.76	-0.00	37.71	-0.00

Internal forces on member(s).

Linear static - extreme or all combinations
Group of member(s) :760/761
Group of ultimate combi :3,5/6,9/10,13/14

memb	cr.nr	dx [mm]	combi	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
760	20	0.0	3	-386.41	-0.04	-14.57	-0.11	-0.00	0.00
			5	-886.02	0.00	-374.89	0.00	0.00	-0.00
			6	-926.29	0.00	-371.86	0.00	0.00	-0.00
			9	-571.37	-0.00	-444.88	-0.00	0.00	0.00
			10	-1403.23	0.00	-797.13	0.00	0.00	-0.00
			13	-557.79	-0.00	-317.95	-0.00	0.00	0.00
			14	-1136.13	-0.00	-564.37	-0.00	0.00	0.00
		488.0	3	-386.41	-0.04	-14.57	-0.11	-7.11	-0.02
			5	-886.02	0.00	-190.17	0.00	-137.88	0.00
			6	-926.29	0.00	-187.14	0.00	-136.39	0.00
			9	-571.37	-0.00	-226.24	-0.00	-163.75	-0.00
			10	-1403.23	0.00	-401.30	0.00	-292.42	0.00
			13	-557.79	-0.00	-164.89	-0.00	-117.81	-0.00
			14	-1136.13	-0.00	-287.29	-0.00	-207.80	-0.00
		976.0	3	-386.41	-0.04	-14.57	-0.11	-14.22	-0.04
			5	-886.02	0.00	-5.45	0.00	-185.61	0.00
			6	-926.29	0.00	-2.42	0.00	-182.65	0.00
			9	-571.37	-0.00	-7.59	-0.00	-220.81	-0.00
			10	-1403.23	0.00	-5.47	0.00	-391.67	0.00
			13	-557.79	-0.00	-11.84	-0.00	-160.94	-0.00
			14	-1136.13	-0.00	-10.21	-0.00	-280.39	-0.00
		1220.0	3	-386.41	-0.04	-14.57	-0.11	-17.78	-0.05
			5	-886.02	0.00	86.90	0.00	-175.67	0.00
			6	-926.29	0.00	89.94	0.00	-171.97	0.00
			9	-571.37	-0.00	101.73	-0.00	-209.32	-0.00
			10	-1403.23	0.00	192.43	0.00	-368.86	0.00
			13	-557.79	-0.00	64.68	-0.00	-154.49	-0.00
			14	-1136.13	-0.00	128.33	-0.00	-265.98	-0.00
			3	-386.41	-0.04	-14.57	-0.11	-17.78	-0.05
			5	-886.02	0.00	86.91	0.00	-175.67	0.00
			6	-926.29	0.00	89.95	0.00	-171.97	0.00
			9	-571.37	-0.00	101.74	-0.00	-209.32	-0.00
			10	-1403.23	0.00	192.45	0.00	-368.86	0.00
			13	-557.79	-0.00	64.69	-0.00	-154.49	-0.00
			14	-1136.13	-0.00	128.34	-0.00	-265.98	-0.00
		1464.0	3	-386.41	-0.04	-14.57	-0.11	-21.33	-0.06
			5	-886.02	0.00	179.27	0.00	-143.20	0.00
			6	-926.29	0.00	182.30	0.00	-138.75	0.00
			9	-571.37	-0.00	211.06	-0.00	-171.16	-0.00
			10	-1403.23	0.00	390.35	0.00	-297.76	0.00
			13	-557.79	-0.00	141.21	-0.00	-129.37	-0.00
			14	-1136.13	-0.00	266.87	-0.00	-217.76	-0.00
		1952.0	3	-386.41	-0.04	-14.57	-0.11	-28.44	-0.08

WLA. 220604. K4-8 A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : BUOYANCY TANKS.

K5. VERIFICATION MAINCALC. FRAMEMODEL WITH PLATEMODEL.

∴ IN ORDER TO VALIDATE THE CALCULATION BASIS OF THE MAINCALC. CONSISTING IN A 3D-FRAME MODEL WITH DUMMY-MEMBERS REPRESENTING THE PLATES, A PLATE MODEL IS BUILD AS VERIFICATION.

POINTS OF CONSIDERATION:

1. REACTIONS.
2. GLOBAL DEFORMATION
3. GLOBAL PLATESTRESS. BUOYANCY TANK + SKIN ETC.
4. (+ LOCAL EFFECTS THAT CAN NOT BE FOUND FROM MAINMO

NOTE: DIFFERENCES BETWEEN THE STRESSES DERIVED FROM ANY MODEL ARE UNFAVOURABLE. IN GENERAL THESE DIFFERENCES WILL BE SMALL AS THE STRESS LEVEL AND DIVISION OF STRESS OVER THE MODEL ARE ALIKE. NORMALLY THE LOAD FACTOR γ 1,5 WILL COVER THE DIFFERENCES BETWEEN THE DIFFERENT CALC. MODELS.

Opgesteld : Alsemgeest | Datum : 220604 | Bladnummer : K5-1 | Rev. : A1

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel :

PLATEMODEL (SHORT DESCRIPTION).

THE PLATEMODEL IS BUILT UP FROM THE EXISTING MAIN 3D-FRAME MODEL

- THE DIAGONAL DUMMIES ARE DELETED FROM THE MODEL.
- THE HORIZONTAL DUMMIES ARE GIVEN NO STIFFENES.
- PLATE ELEMENT ARE TIED BETWEEN THE DUMMIES AND OTHER PROFILES.
- THE PLATE HAVE ORTHOTROPIC PROPERTIES; IN THE DIRECTION OF THE STIFFENERS THE PLATE IS GIVEN THE PROPERTIES OF PLATE INCL. STIFFENERS. (BY. CALC. AN EQUIVALANT PLATETHICKN IN OTHER DIRECTION ONLY THE PLATE THICKNESS.
- GENERAL LOADING IS STILL AS IN THE MAIN CALC FRAME MODEL; MEMBERLOADS (INCL. ON HORIZONTAL DUMMIES). THE DUMMIES FUNCTION AS LOADINTRODUCER ONLY
- THE SUM OF THE DEADLOAD IS SLIGHTLY DIFFERENT AS FOR THE MAIN CALC. FRAME MODEL, DUE TO THE OTHER WAY OF MODELLING THE PLATES, STILL THE TOTAL VERT LOADING DUE TO DEADLOAD IS EQUAL FOR BOTH MODELS.
- AS APPLIED IN THE MAIN CALC. THE DIFFERENT CONSIDERED CONDITIONS ARE FOUND BY ADJUSTING THE SUPPORTING OF THE CONSTRUCTION.

Opgesteld : ALSEMGEEST | Datum : 300604 | Bladnummer : K5 - 2 | Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel :

IN ORDER TO MINIMIZE THIS DOCUMENT, NO MORE IN- AND OUTPUT OF THE PLATEMODEL IS GIVEN THEN REQUIRED FOR THE VERIFICATION.

NOTE ; ESA LOGIC.

→ FOR NODE AND MEMBER OUTPUT; THE RESULTS FOLLOW FROM THE "SHUFFLED" COMBI-LIST AFTER CALCULATION. REF. ADDENDUM A OF CALC. DOC. PEMAR-4002.

→ FOR PLATE-OUTPUT; THE RESULTS FOLLOW FROM THE INPUT COMBI-LIST BEFORE CALCULATION.

FOR NODE NUMBER AND COMBINATION NUMBER IS REFERRED TO THE MAIN CALC. DOC. 4001 REV. B.

Opgesteld : ALSEMGEEST. Datum : 300604. Bladnummer : K5-3. Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : VERIFICATION.

VERIFICATION (OF OUTPUT NEXT PAGES)

1 REACTIONS

* REACTIONS. DEADLOAD ONLY (SLS COMBI 1.)

- MAIN MODEL : $R_z = 12452$ kN.
- PLATE MODELS : $R_z = 12991$ kN.

RATIO : 0.96 ; ACCEPTABLE FOR VERIFICATION

∴ 4% DEVIATION CAN BE ASSIGNED TO ANOTHER LOAD DEVIATION OVER THE DIFFERENT LOADCASES AND THE ELIMINATION OF THE DUMMY MEMBERS IN THE PLATEMODEL AND REPLACEMENT WITH PLATES WITH MORE ACCURATE BUT SLIGHTLY DIFFERENT WEIGHT.

* THE GIVEN CENTERPOINT FOR THE MAIN MODEL AND PLATEMODEL IN THE SAME CONDITION CORRESPONT WITH EACH OTHE

COND. 1: - MAIN MODEL : (x, y, z) : 25951, 375, 4865

- PLATE MODEL : (x, y, z) : 25989, 375, 4865.

* HOR. REACTION DIVISION FOR GOVERNING LOADCOMBINATION (10) IN CONDITION 1. DIFFERS;

→ THE PLATEMODEL HAS A BETTER LOADDIVISION OVER THE SUPPORTS

→ THE MAINMODEL HAS HIGHER CONCENTRATED SUPPORT LOADS AT THE BUOYANCY TANK.

THE VERTICAL BEARING CHECK (ADDENDUM E) IS VERIFIED FOR THE GOVERNING SITUATION FROM THE PLATE MODEL AND WAS STIL SUFFICIËNT. (NOT RECORDED IN THIS DOCUMENT).

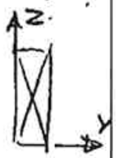
Opgesteld :	Datum :	Bladnummer :	Rev. :
Alsemgeest	06-07-04	K5-4	A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : VERIFICATION.

2. DEFORMATIONS

* DEFORMATION DEADLOAD ONLY (SLS COMBI 1).



- MAIN MODEL : $u_x = -10$ mm'. $u_y = 3$ mm'
- PLATE MODEL : $u_x = -13$ mm'. $u_y = 3$ mm'.

∴ THE DIFFERENCE CAN BE ASSIGNED TO THE DIFFERENT LOCAL LOADINTRODUCTION OF BOTH MODELS CONCERNING DEADLOAD.

* DEFORMATION NODE AT EL. +1500 mm' IN THE MIDDLE OF THE GATE FOR CONDITION ①. (NODE 160). COMBI ③.

- MAIN MODEL : $u_y = -27$ mm' / 52 m' = 0,0005 L.
- PLATE MODEL : $u_y = -33$ mm' / " = 0,0006 L.

∴ THE DISPLACEMENTS ARE NOT SIGNIFICANT, THEREFOR THE DIFFERENCE IS ACCEPTABLE.

* DEFORMATION NODE AT LEVEL +1,500 mm' AT ROW 8 OF THE GATE FOR CONDITION ④ (NODE 137). COMBI ⑥.

- MAIN MODEL : $u_y = -92$ mm'
- PLATE MODEL : $u_y = -70$ mm'.

∴ PLATE MODEL MORE FAVOURABLE RESULTS.

‖ APPERENTLY THE BENDING PROPERTIES OF THE MODEL ARE LESS FAVOURABLE AND THE SHEAR PROPERTIES ARE MORE FAVOURABLE.

* ROTATION OF HYDROFOOT SECTION ROW 7/8. COND. 4. COMBI ⑥

- MAIN MODEL : $\varphi = (92-33)/11200 = 5,3$ mRad
- PLATE MODEL : $\varphi = (57,4-14,3)/11200 = 4,0$ mRad

∴ PLATE MODEL MORE FAVOURABLE RESULTS.

Opgesteld : Alsemgeest | Datum : 06-07-04 | Bladnummer : K5-5. | Rev. : A3

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : VERIFICATION.

3. GLOBAL STRESSES BUOYANCYTANK + SKIN. ETC.

MAX-STRESSES N/mm² FROM ALL CONDITIONS	PLATE MODEL COND 1+2	PLATE MODEL COND. 4	MAIN MODEL
3.1. BOTTOM+TOPPLATE BUOYANCYTANK			
σx : D (= σy:D in mainmodel)	100/+118	NOT GOVERNING	91+28=119 / -61-8-24=-96
σy : D (= σx:D " ")	– *	–	7+28=35 / -40
τxy : D	44/-42	31/-25	
3.2. VERTICAL WALLS BUOYANCYTANK			
σx : D	51 / -84 2)	NOT GOVERNING	91+10=101 / -64-14=-78
σxy : D	17	16	1
3.3. BULKHEADS			
σx;y : D	32 1)	6 1)	11 [K5-15
3.4. CORRIDOR BEAM			
σE : D	159		–
3.5.1. SKIN (ROW 1/2 - 7/8)			
σx : D	32/-5 1)	NOT GOVERNING	NOT RELEVANT
σy : D	33/-20 1)		
τxy : D	30/-30 1)	–	–
3.5.2. SKIN (ROW 2-7)			
σx : D (=σy:D in MAIN CALC)	82/-26	NOT GOVERNING	+15/-17
σy : D (=σx:D in MAIN CALC)	22/-23 1)		+84/-57
τxy : D		–	+30
3.5.3. SKIN AT SLUICE TUBE HOLES			
σE : D	126	NOT GOVERNING	–
3.6. LOADINTRODUCTION AT ROW 1/2			
σE : D	236 2)	NOT GOVERNING	–

NOTES: → CONDITION 3 ⇒ PLATEMODEL OUTPUT NOT GOVERNING
→ 1) ARE LOCAL PEAK STRESSES; AVERAGE STRESSES ARE NOT RELEVANT.
2) TOPPED OF PEAK
→ FOR CONCLUSION; SEE NEXT PAGE.

Opgesteld : ABSEMGEEST Datum : 06-07-04 Bladnummer : K5-6 Rev. : A3

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : VERIFICATION.

CONCLUSIONS VERIFICATION GLOBAL STRESSES.

CONCERNING.

3.1 - THE PLATEMODEL GIVE SLIGHTLY HIGHER NORMAL COMPRESSIONSTRESSES.

IN THE BOTTOMPLATE, BUT VALUES ARE STILL COMPARABLE.

RECONSIDERATION OF CHECK BOTTOMPL. [K2-8].

$\Sigma \sigma_{y:D} = -218-118 = 336\ N/mm^2$.

$u.c = 336 \cdot 1,1 / 355 = 1,04$; o.k.

3.2. - RECONSIDERATION. VERT. WALLS (PLATE MODEL)

$\Sigma \sigma_{y:D} = -225-84 = 309\ N/mm^2$.

$u.c = 309 \cdot 1,1 / 345 = 0,99$; ok. ($t=40$)

3.3. HIGHER STRESSES FOR PLATEMODEL, BUT GLOBAL EFFECT STILL DOES NOT GOVERN

3.4. STRESSES FROM MAIN CALC., HIGHLY CONSERVATIVE; DUE TO CRUDE MODELLELING OF THE BULKHEAD-BOTTOMPL CONNECTION.

3.5.2. THE STRESSES FOUND IN THE PLATE-MODEL SHOW THE SAME VARIATION, BUT IN GENERAL THE STRESSES ARE SOMEWHAT HIGHER THAN FROM THE MAIN MODEL. SINCE GLOBAL STRESSES ARE LOW COMPARED TO THE LOCAL EFFECTS, THE EFFECT ON THE COMBINED U.C. IS NEGLIGIBLE

3.5.3. THE STRESS CONCENTRATION AROUND THE SLUICE TUBE HOLES. THESE CAN ONLY BE SHOWN WITH A PLATEMODEL. THUS NO COMPARISON CAN BE MADE. THE SLUICETUBE STIFFEN THE PLATE AROUND THE HOLES; IS NOT MODELLED IN THE PLATEMODEL. THE STRESSES WILL BE SIGNIFICANTLY LOWER THAN FOUND IN THE PLATEMODEL.

HOWEVER: COMBINATION OF STRESS WITH LOCAL STRESSES WILL NOT LEAD TO U.C > 1,0.

Opgesteld : ALSEMGEEST | Datum : 06-07-04 | Bladnummer : K5-7. | Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : VERIFICATION.

CONCLUSION.

- STRESSES ARE COMPARABLE
- NO SIGNIFICANT LOCAL EFFECT RESULT FROM THE PLATEMODEL CONSIDERATION. THE ONLY FOUND PEAKS CAN BE ASCRIBED TO THE MODELSIMPLIFICATIONS.

Opgesteld : ALSEMGEEST

Datum : 06-07-04.

Bladnummer : K5-8.

Rev. : A3.

Contents

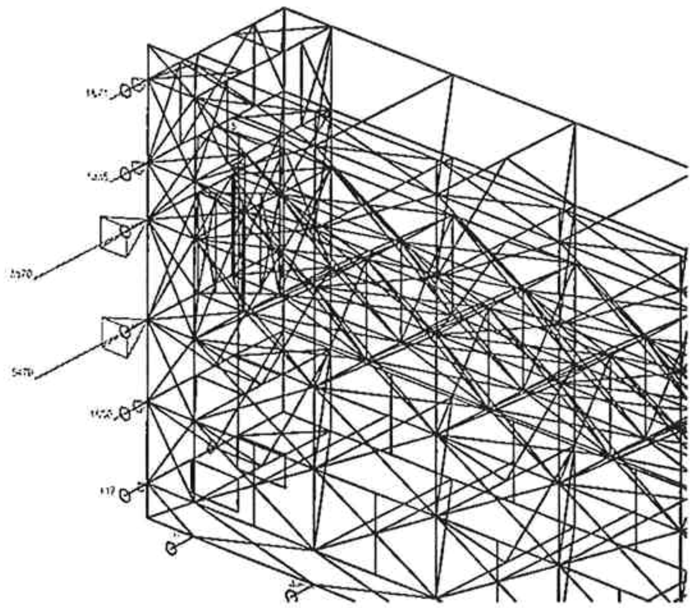
1. Reactions

Resultant (selection).

Linear static - extreme or all combinations
comb. deadload only
Group of node(s) :1/471
Group of serviceability combi :1

combi	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	0	-0	12452	36387	-12555	-0

Central point: 25950.962 375.000 4865.385 mm



Reactions. Ult. combi : 10; deviation along height

Resultant (selection).

Linear static - extreme or all combinations
Group of node(s) :1/471
Group of ultimate combi :3,5/6,9/10,13/14

combi	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
3	0	5000	13316	-13302	-13418	-120005
5	0	26834	4475	-67857	-4586	26808
6	0	23468	4475	-94037	-4586	23445
9	-0	2112	649	-290	-804	2110
10	0	39574	-284	-118557	128	39536
13	0	1478	6542	-17539	-6691	1477
14	0	27702	5890	-65314	-4018	27675

Central point: 25950.962 375.000 4865.385 mm

Resultant (selection).; per loadcase

Group of node(s) :1/471
Group of load case(s) :1/29

case	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	0	-0	4232	12319	-4228	-0
2	0	0	4657	15070	-4652	0
3	0	-0	491	1413	-491	-0
4	0	-0	975	-292	-974	-0
5	0	0	326	937	-326	-0
6	0	0	81	232	-81	0
7	0	-0	60	367	-60	0
8	0	-0	500	1459	-500	-0
9	0	0	300	890	-300	0
10	0	0	772	3781	-887	-0
11	0	0	58	210	-58	-0
12	-0	26383	-12630	-115335	12618	26357
13	0	0	2576	7407	-2574	-0
14	-0	0	-894	-2570	893	0
15	-0	-0	-448	-1288	448	-0
16	-0	1408	-12630	-38278	12618	1407
17	0	-0	1930	5548	-1928	-0
18	-0	0	-73	-211	73	0
19	0	-0	647	1860	-646	0
20	-0	0	50	100	1298	-0
21	0	0	50	144	-50	0
22	0	8366	0	-25993	0	8358
23	0	5000	0	-52173	-0	4995
24	0	5000	0	-52173	0	-120005
25	-398	0	0	-0	-4153	1144
26	-310	-0	0	0	-3235	-337
27	-0	7375	-12632	-64429	12620	7368
28	0	800	0	-8348	-0	14359
29	0	4027	0	-17647	0	4023

Central point: 25950.962 375.000 4865.385 mm

2. Deformations

Deformations in node(s). Global extreme

Linear static - extreme or all combinations
Combination deadload only
Group of node(s) :160
Group of serviceability combi :1

node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
160	1	2	3	-10	-1	0	0

Deformations in node(s). Global extreme

Linear static - extreme or all combinations
Group of node(s) :160
Group of serviceability combi :2/5

node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
160	5	1	1	-5	-1	0	0
	3	-0	-27	-4	0	0	0

Contents

1. Reactions

Resultant (selection).

Linear static - extreme or all combinations
Group of node(s) :1/471
Group of serviceability combi :1

combi	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	-0	0	12452	6369	-44585	-0

Central point: 23378.571 2785.714 5754.286 mm

Resultant (selection).

Linear static - extreme or all combinations
Group of node(s) :1/471
Group of ultimate combi :7/8,11/12

combi	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
7	-372	2819	13316	-3077	-51223	8765
8	-478	6040	13316	-14332	-52231	21793
11	-597	4228	18106	-5571	-70518	15377
12	-465	4228	18106	-5571	-69258	13473

Central point: 23378.571 2785.714 5754.286 mm

Resultant (selection).

Linear static - extreme or all combinations
Group of node(s) :1/471
Group of load case(s) :1/29

case	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	0	-0	4232	2118	-15113	0
2	-0	0	4657	3844	-16632	-0
3	-0	0	491	228	-1755	-0
4	-0	0	975	-2641	-3480	-0
5	0	0	326	151	-1164	0
6	0	0	81	38	-289	-0
7	-0	-0	60	223	-214	0
8	0	0	500	253	-1786	-0
9	0	-0	300	166	-1071	0
10	-0	-0	772	1919	-2873	0
11	-0	-0	58	70	-207	0
12	0	26383	-12630	-61436	45107	94224
13	-0	0	2576	1196	-9201	0
14	0	-0	-894	-415	3192	-0
15	0	-0	-448	-208	1600	-0
16	0	1408	-12630	-6578	45108	5028
17	-0	0	1930	896	-6891	-0
18	0	0	-73	-34	262	0
19	-0	0	647	300	-2310	-0
20	0	-0	50	-21	1169	0
21	0	0	50	23	-179	0
22	-0	8366	0	-18557	0	29878
23	-0	5000	0	-47729	0	17857
24	-0	5000	0	-47729	0	-107143
25	-398	0	0	-0	-3799	185
26	-310	0	0	-0	-2959	-1085
27	0	7375	-12632	-27422	45115	26338
28	0	800	0	-7637	-0	16417
29	-0	4027	0	-14068	0	14381

Central point: 23378.571 2785.714 5754.286 mm

2. Deformations

Deformations in node(s). Global extreme

Linear static - extreme or all combinations
Group of node(s) :137
Group of serviceability combi :6/7

node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
137	6	3	-92	-20	5	-0	-2
	7	-1	-53	-13	3	-0	-1

Deformations in node(s).

Linear static - extreme or all combinations
Group of node(s) :165,169
Group of serviceability combi :6/7

node	combi	Uy [mm]
165	6	-92
	7	-53
169	6	-33
	7	-19

Contents

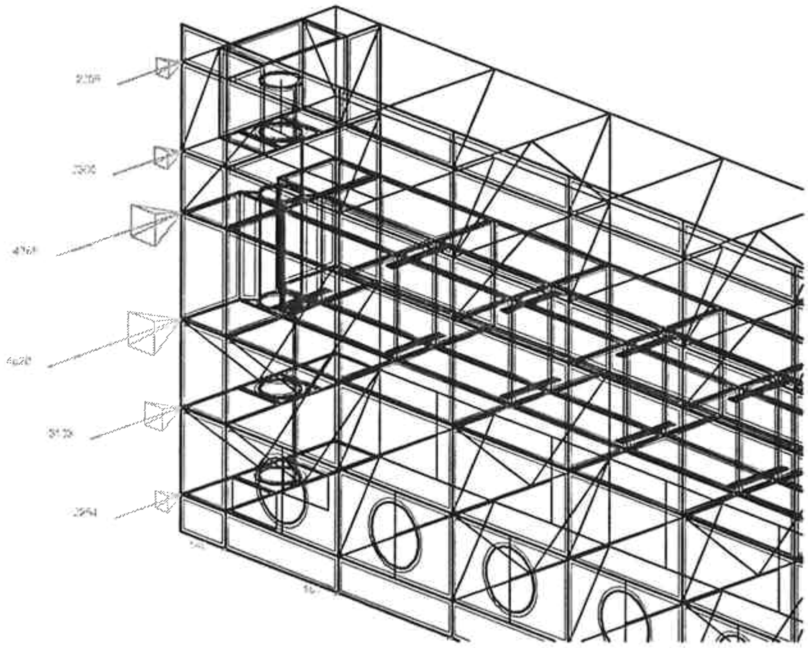
1. Reactions

Resultant (selection).

Linear static - extreme or all combinations
comb. deadload only
Group of node(s) :1/793
Group of serviceability combi :1

combi	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	0	-0	12991	36979	-12561	-0

Central point: 25988.462 375.000 4865.385 mm



Reactions. Ult. combi : 10; deviation along height

Resultant (selection).

Linear static - extreme or all combinations
Group of node(s) :1/793
Group of ultimate combi :3,5/6,9/10,13/14

combi	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
3	0	5000	13855	-12710	-13392	-120192
5	0	26834	5015	-67263	-4892	25802
6	0	23468	5015	-93443	-4892	22565
9	0	2112	1378	513	-1419	2031
10	0	39574	445	-117754	-523	38052
13	0	1478	7271	18340	-7086	1421
14	0	27702	6618	-64512	-4437	26636

Central point: 25988.462 375.000 4865.385 mm

Resultant (selection).; per loadcase'
Group of node(s) :1/793
Group of load case(s) :1/29

case	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	0	-0	8396	21933	-8143	-0
2	0	-0	2127	6115	-2045	0
3	0	-0	491	1413	-473	0
4	0	-0	1	-0	-1	-0
5	0	-0	326	937	-313	-0
6	0	-0	81	232	-78	0
7	-0	-0	60	367	-58	-0
8	0	-0	500	1459	-481	0
9	-0	-0	300	890	-288	-0
10	0	0	652	3424	-627	0
11	0	-0	58	210	-56	-0
12	-0	26383	-12629	-115333	12144	25368
13	0	0	2576	7407	-2477	0
14	0	0	-894	-2570	859	0
15	0	-0	-448	-1288	431	0
16	-0	1408	-12629	-38276	12144	1354
17	0	0	1930	5548	-1855	-0
18	0	-0	-73	-211	71	-0
19	0	-0	647	1860	-622	-0
20	-0	-0	50	100	1299	0
21	0	-0	50	144	-48	0
22	-0	8366	-0	-25993	-0	8044
23	0	5000	0	-52173	0	4808
24	0	5000	0	-52173	0	-120192
25	-398	-0	0	-0	-4153	1144
26	-310	0	0	-0	-3235	-337
27	-0	1879	-12327	-41313	11853	1807
28	-0	1879	-12327	-41313	11853	1807
29	-0	4027	-0	-17647	-0	3872

Central point: 25988.462 375.000 4865.385 mm

2. Deformation

Deformations in node(s). Global extreme

Linear static - extreme or all combinations
Combination deadload only
Group of node(s) :160
Group of serviceability combi :1

node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
160	1	2	3	-13	-1	-0	-0

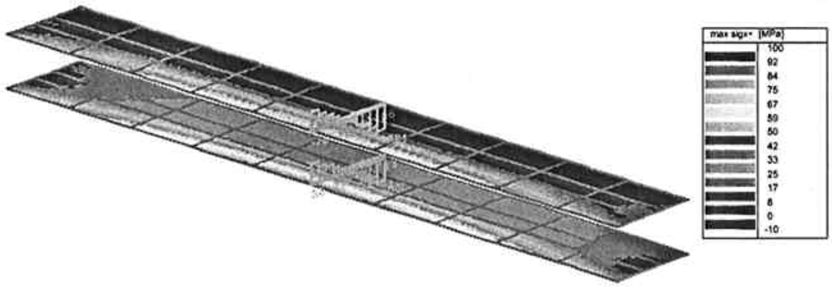
Deformations in node(s). Global extreme

Linear static - extreme or all combinations
deformation at el +1500 center of gate; between row 4/5
Group of node(s) :160
Group of serviceability combi :2/5

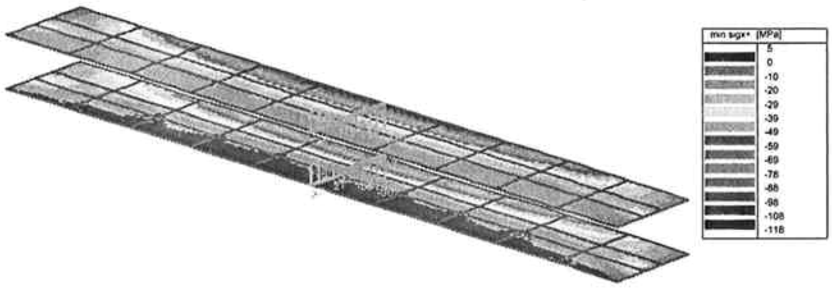
node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
160	5	1	1	-7	-1	-0	-0
	3	-0	-33	-4	-1	-0	0
	4	1	1	-7	-1	-0	-0

3. Global plate stress

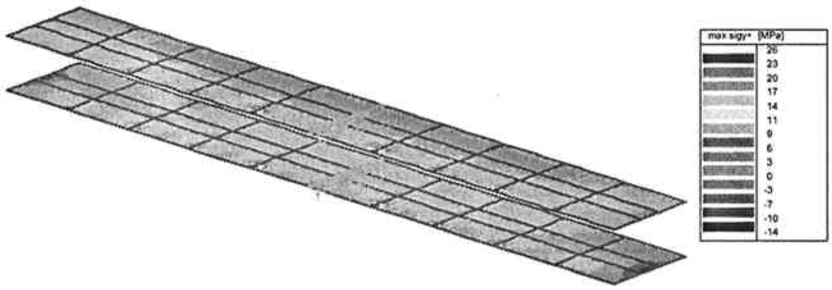
3.1. bottom+topplate buoyancy tank



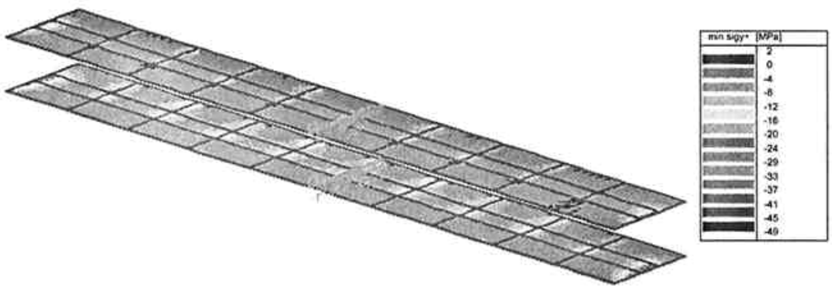
Stress - max sigx+ - FEM Combi : 1/7



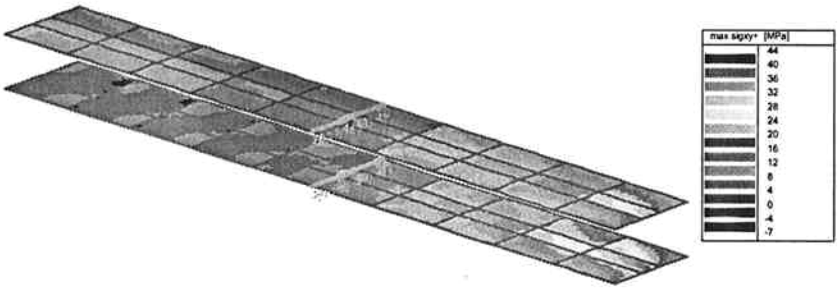
Stress - min sigx+ - FEM Combi : 1/7



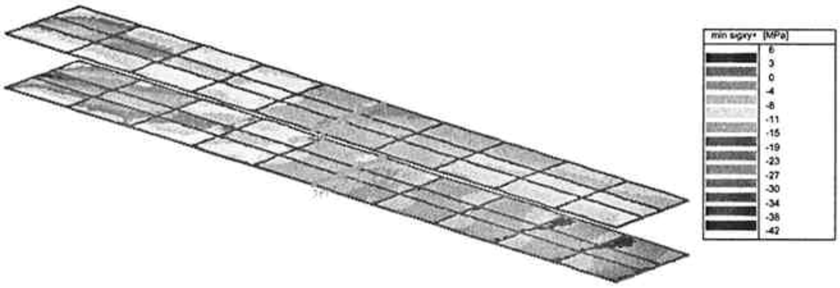
Stress - max sigy+ - FEM Combi : 1/7



Stress - min sigy+ - FEM Combi : 1/7

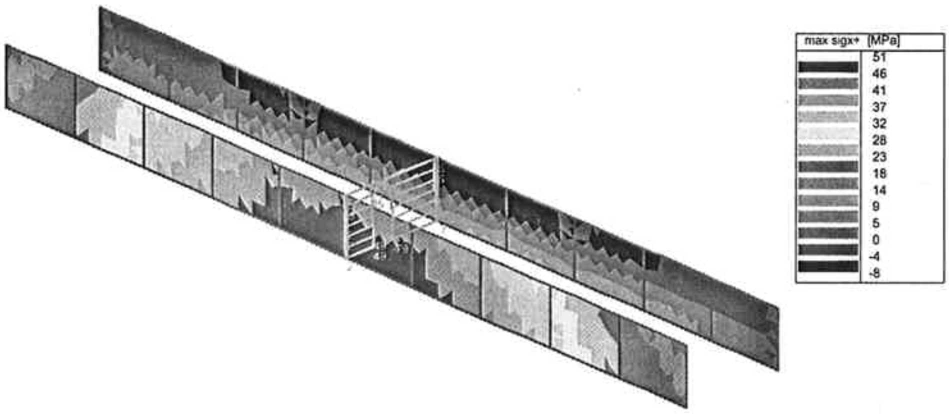


Stress - max sigxy+ - FEM Combi : 1/7

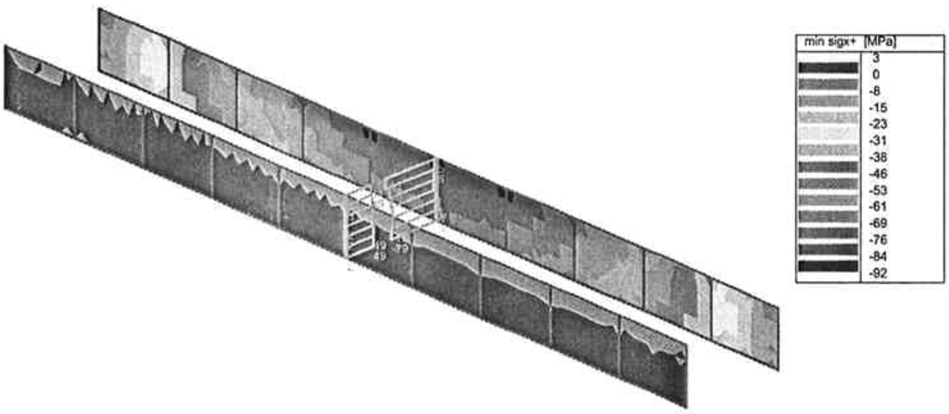


Stress - min sigxy+ - FEM Combi : 1/7

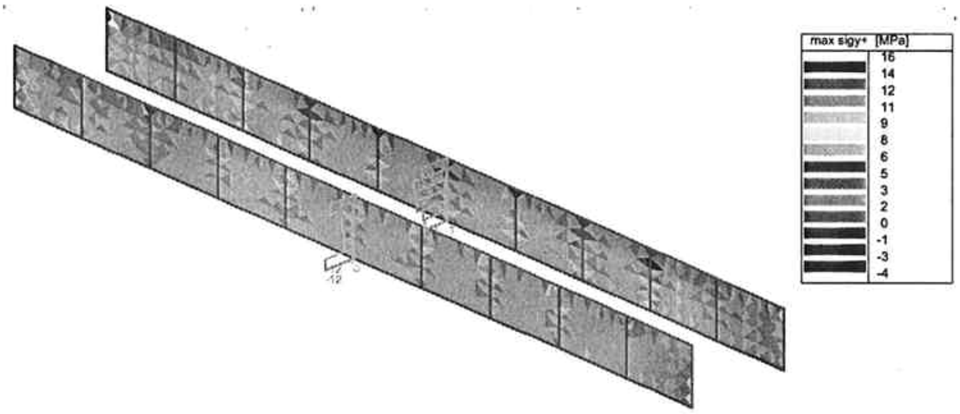
3.2. vertical walls buoyancy tank (left = lagoonside)



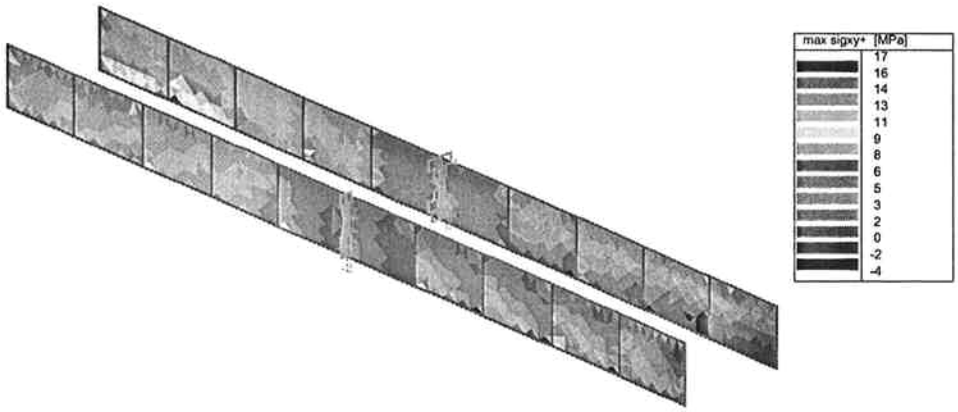
Stress - max sigx+ - FEM Combi : 1/7



Stress - min sigx+ - FEM Combi : 1/7

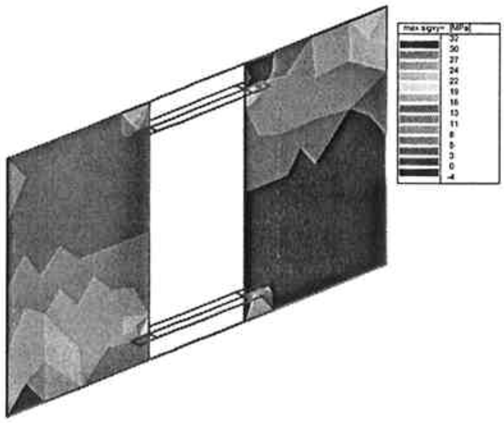


Stress - max sigy+ - FEM Combi : 1/7



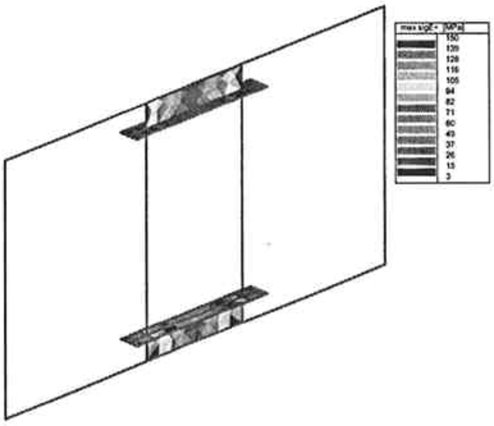
Stress - max sigxy+ - FEM Combi : 1/7

3.3. bulkheads

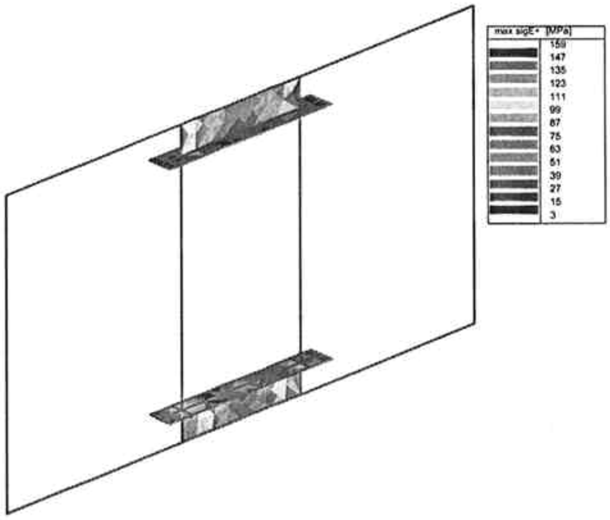


Stress - max sigxy+ - FEM Combi : 1/7

3.4. corridor beam in bulkhead



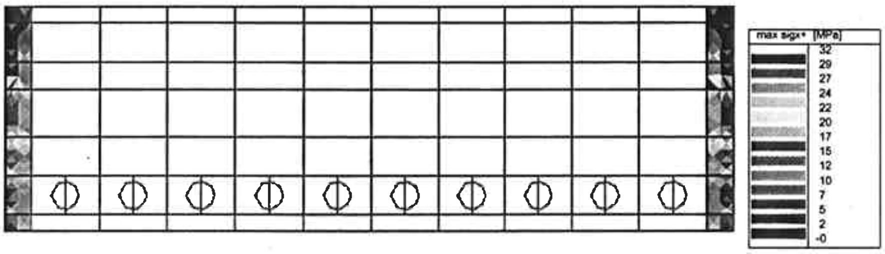
between row 2/3; Stress - max sigE+ - FEM Combi : 1/7



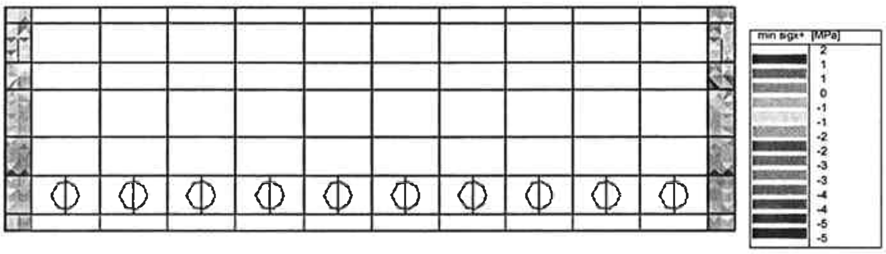
center between row 4/5; Stress - max sigE+ - FEM Combi : 1/7

3.5. skin

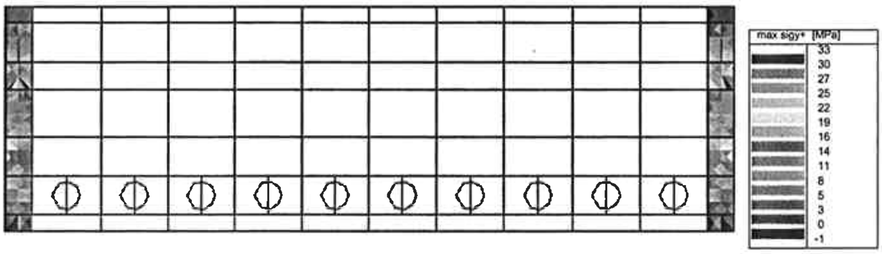
3.5.1. between row 1/2 + 7/8



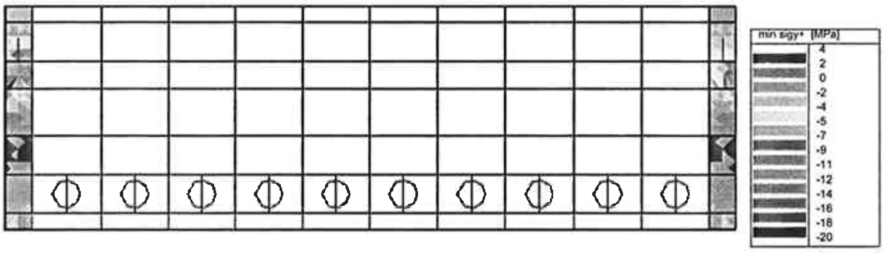
Stress - max sigx+ - FEM Combi : 1/7



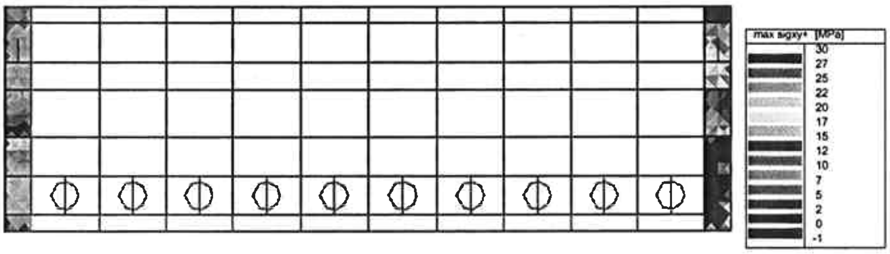
Stress - min sigx+ - FEM Combi : 1/7



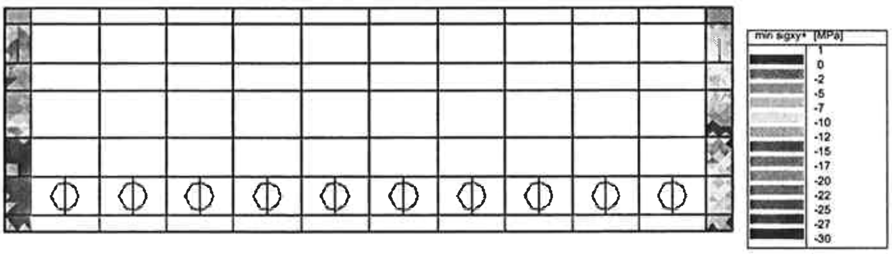
Stress - max sigy+ - FEM Combi : 1/7



Stress - min sigy+ - FEM Combi : 1/7

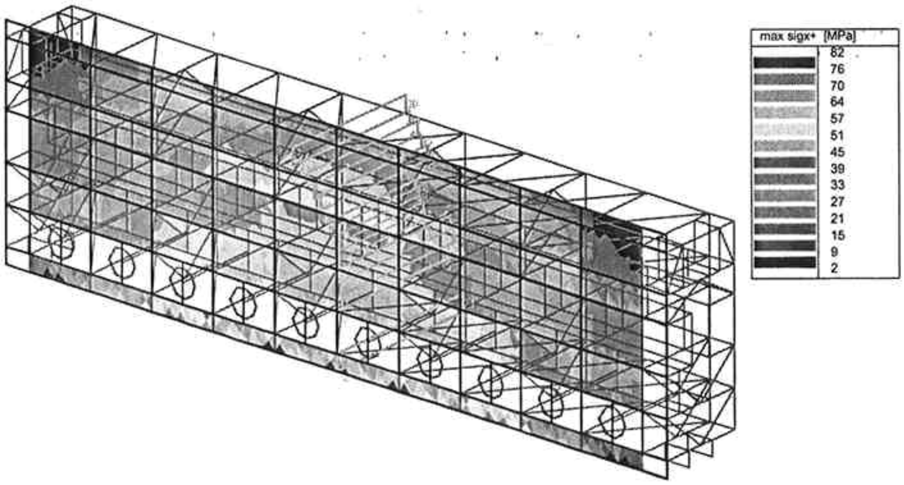


Stress - max sigxy+ - FEM Combi : 1/7

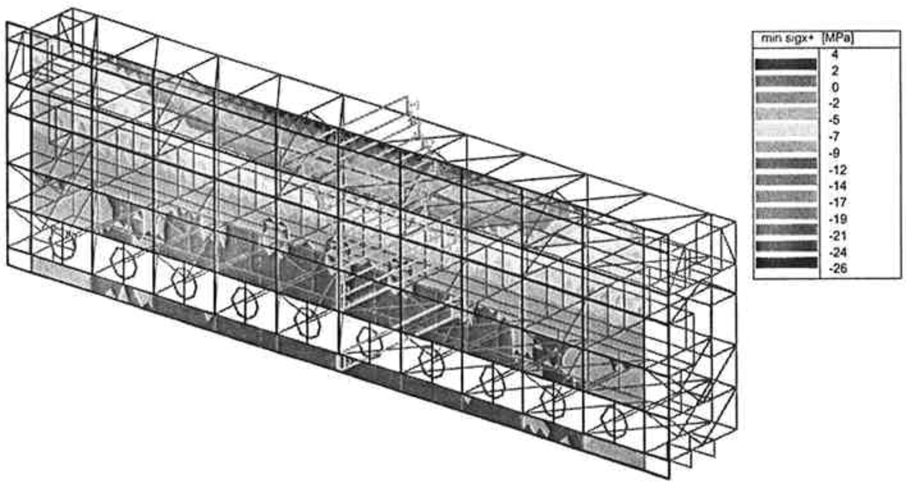


Stress - min sigxy+ - FEM Combi : 1/7

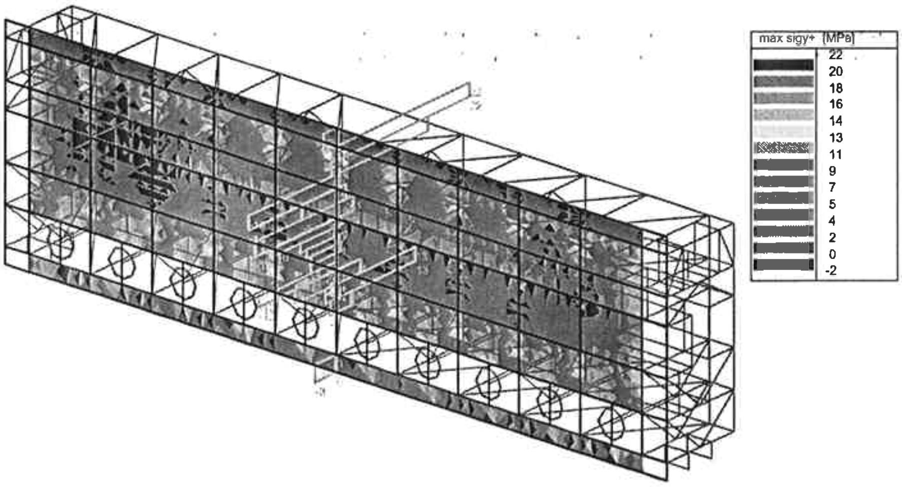
3.5.2. between row 2/7 excl. sluicetube holes



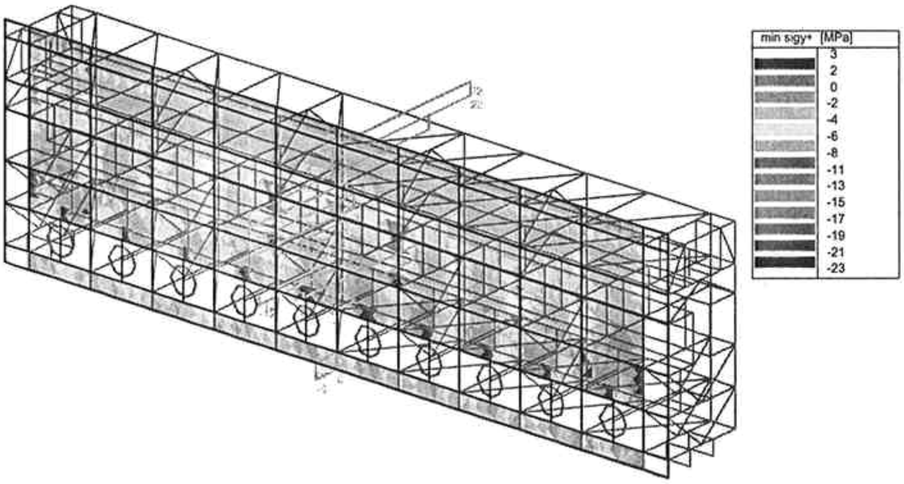
Stress - max sigx+ - FEM Combi : 1/7



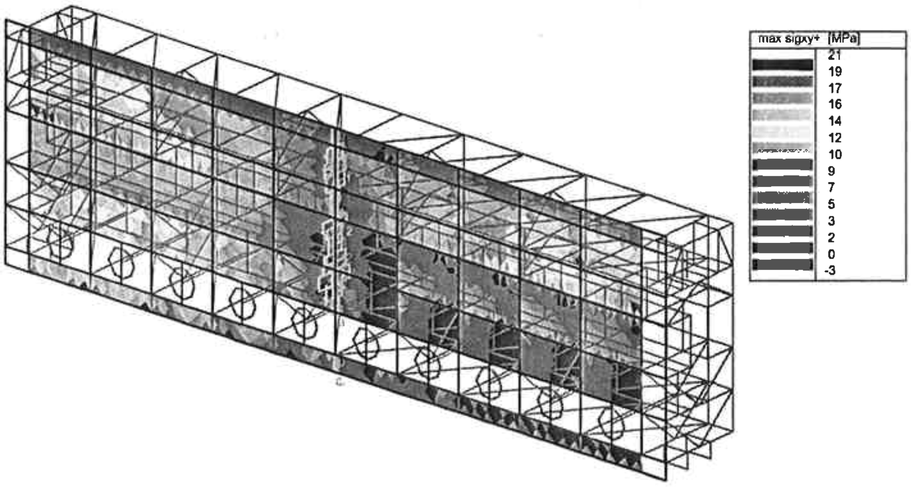
Stress - min sigx+ - FEM Combi : 1/7



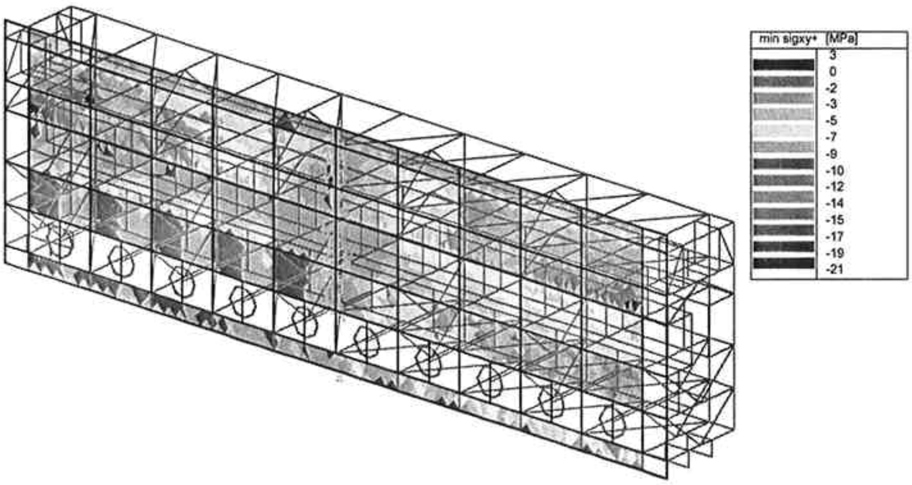
Stress - max sigy+ - FEM Combi : 1/7



Stress - min sigy+ - FEM Combi : 1/7

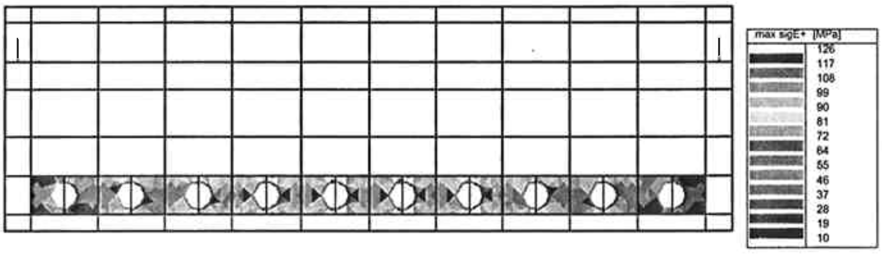


Stress - max sigxy+ - FEM Combi : 1/7

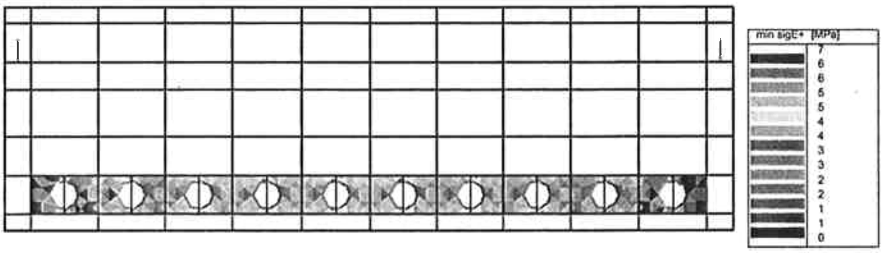


Stress - min sigxy+ - FEM Combi : 1/7

3.5.3. between row 2/7 sluicetube holes

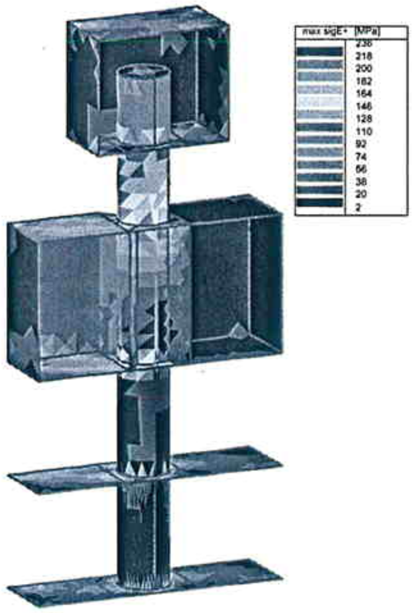


Stress - max sigE+ - FEM Combi : 1/7

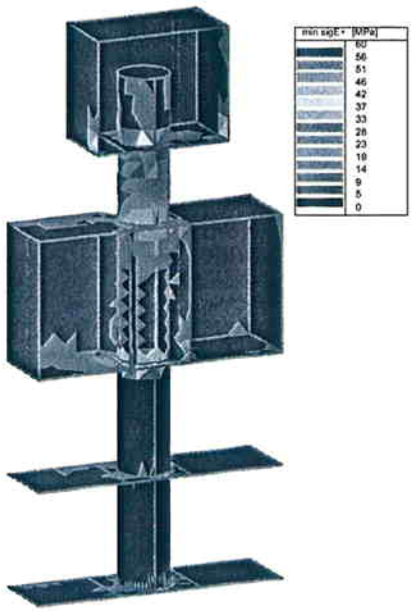


Stress - min sigE+ - FEM Combi : 1/7

3.6. loadintroduction at row 1/2



Stress - max sigE+ - FEM Combi : 1/7



Stress - min sigE+ - FEM Combi : 1/7

Contents

1. Reactions

Resultant (selection).

Linear static - extreme or all combinations
SLS combi; deadload only
Group of node(s) :1/793
Group of serviceability combi :1

combi	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	0	0	12991	5661	-46466	-0

Central point: 23378.571 2785.714 5754.286 mm

Resultant (selection).; per loadcase'

Group of node(s) :1/793
Group of load case(s) :1/29

case	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
1	0	0	8396	1693	-30054	-0
2	0	-0	2127	987	-7596	-0
3	0	-0	491	228	-1755	-0
4	0	0	1	-1	-2	-0
5	-0	-0	326	151	-1164	-0
6	0	-0	81	38	-289	-0
7	-0	-0	60	223	-214	0
8	0	0	500	253	-1786	-0
9	0	-0	300	166	-1071	0
10	0	0	652	1853	-2327	-0
11	-0	0	58	70	-207	-0
12	0	26383	-12629	-61436	45105	94224
13	0	-0	2576	1196	-9202	-0
14	0	0	-894	-415	3192	0
15	0	0	-448	-208	1600	0
16	0	1408	-12629	-6578	45105	5028
17	0	-0	1930	896	-6892	-0
18	0	0	-73	-34	262	0
19	-0	-0	647	300	-2310	-0
20	0	0	50	-21	1169	-0
21	0	-0	50	23	-179	-0
22	-0	8366	0	-18557	-0	29878
23	0	5000	0	-47729	-0	17857
24	0	5000	0	-47729	-0	-107143
25	-398	0	0	-0	-3799	185
26	-310	0	0	-0	-2959	-1085
27	0	1879	-12327	-9926	44025	6712
28	0	1879	-12327	-9926	44025	6712
29	0	4027	0	-14068	-0	14381

Central point: 23378.571 2785.714 5754.286 mm

2. Deformation

Deformations in node(s). Global extreme

Linear static - extreme or all combinations
Combination Deadload only
Group of node(s) :160
Group of serviceability combi :1

node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
160	1	-0	2	-13	-1	-0	-0

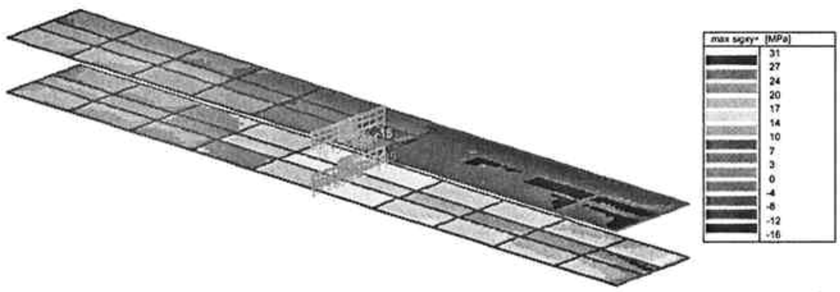
Deformations in node(s).

Linear static - extreme or all combinations
node 165; elev. -1400
node 169; elev. -12600
height between the two nodes = 11200 mm
Group of node(s) :165,169
Group of serviceability combi :6/7

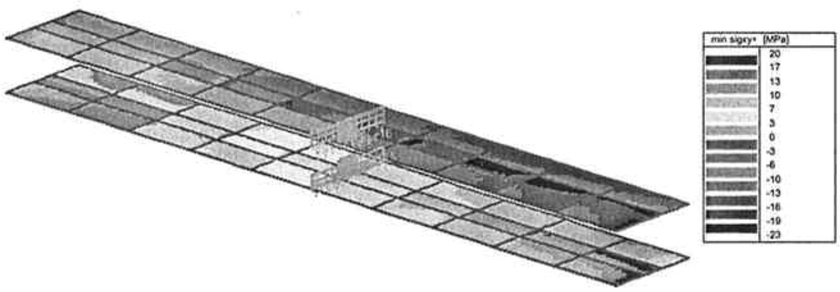
node	combi	Uy [mm]
165	6	-59.4
	7	-35.1
169	6	-14.3
	7	-8.2

3. Global plate stress buoyancy tank + skin

3.1. bottom+topplate buoyancy tank

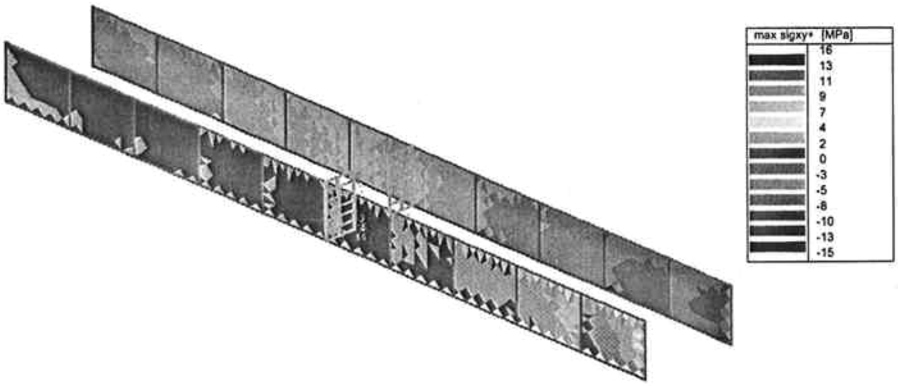


Stress - max sigxy+ - FEM Combi : 11/14



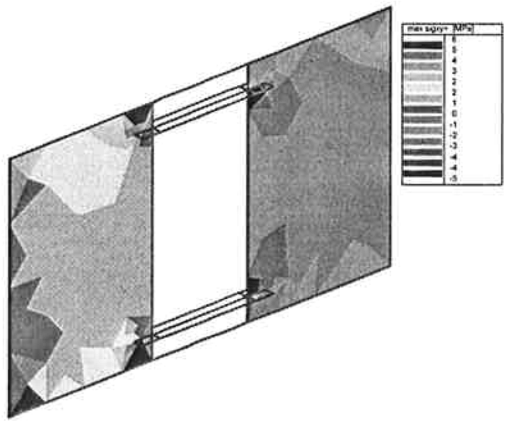
Stress - min sigxy+ - FEM Combi : 11/14

3.2. vertical walls bouvancv tank (left = laqoonside)



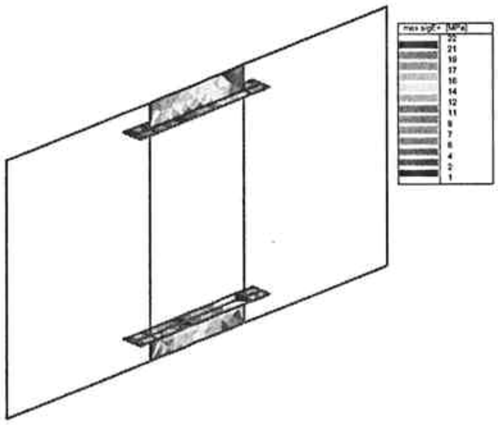
Stress - max sigxy+ - FEM Combi : 11/14

3.3. bulkheads

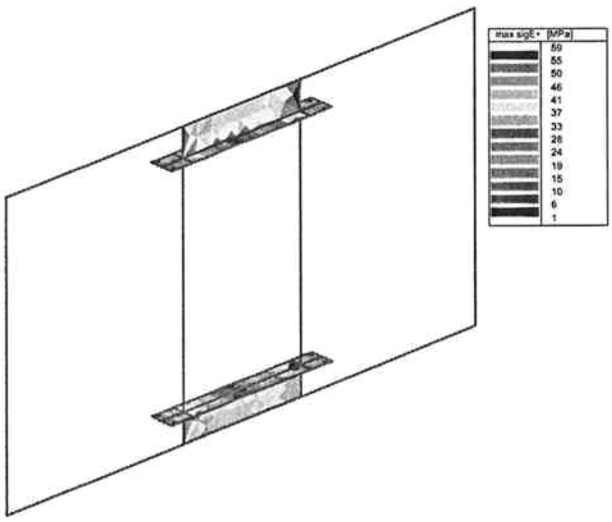


Stress - max sigxy+ - FEM Combi : 11/14

3.4. corridor beam in bulkhead



between row 2/3; Stress - max sigE+ - FEM Combi : 11/14



center between row 4/5; Stress - max sigE+ - FEM Combi : 11/14

Project	: MALAMOCCO NAV. LOCK GATE.
Onderdeel	: MANHOLES.

K6. MANHOLES IN BUOYANCYTANKS.

1. DOOR IN GANGWAY.
2. MANHOLE IN GANGWAY.
3. MANHOLE IN WALL ROW 2/7.

Opgesteld : F/IJSENGEEST	Datum : 170604	Bladnummer : K6 - 1	Rev. : A

Project : MALAMOCCO NAV. LOCK GATE.

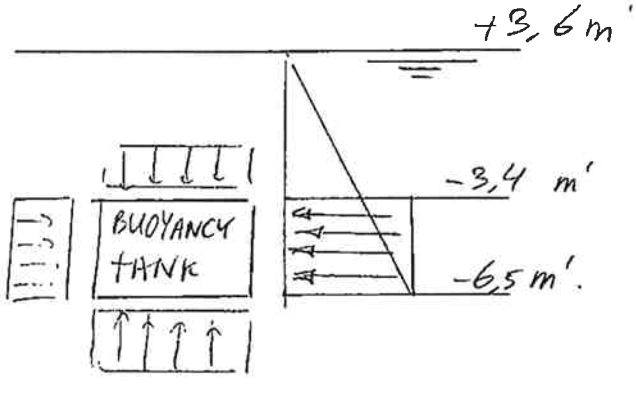
Onderdeel : MANHOLES.

LOADS.

TANKS EMPTIED BY MEANS OF INTERNAL PRESSURE.
INTERNAL PRESSURE OF TANKS > EXTERNAL WATERPRESSURE.

$$q_D = \gamma \cdot \rho \cdot h$$

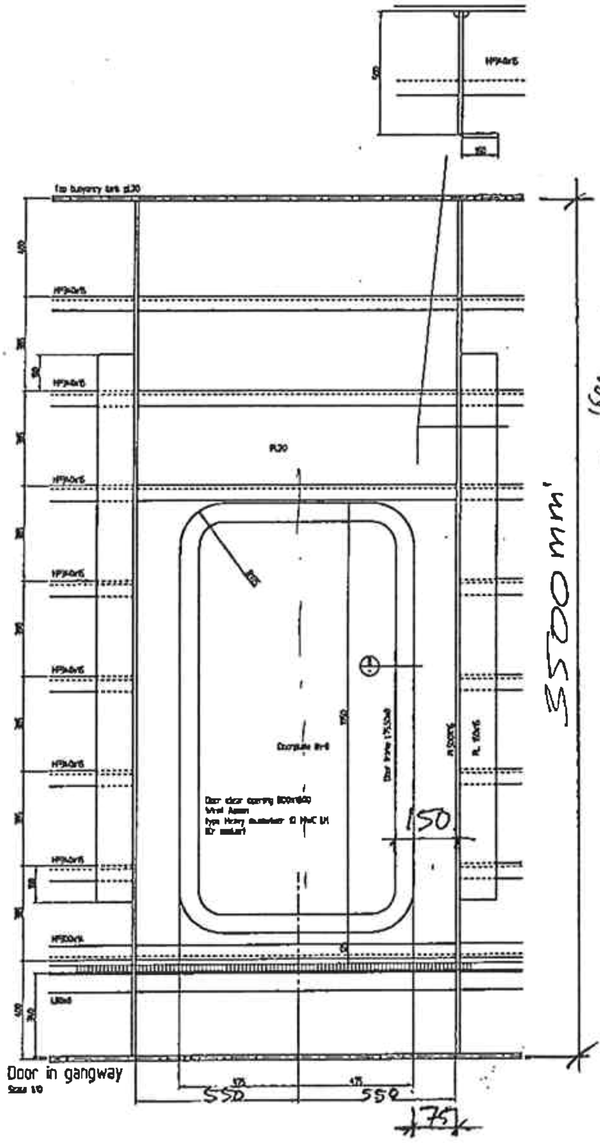
$$= 1{,}5 \cdot 10{,}3 \cdot (3{,}6 + 6{,}9) = 162{,}2\ kN/m^2$$



Opgesteld : AlSEMGEEST Datum : 170604 Bladnummer : K6-2 Rev. : A2

Project	:	MALAMOCCO NAV. LOCK GATE
Onderdeel	:	MANHOLES

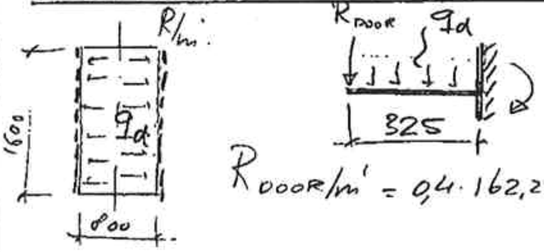
1. DOOR IN GANGWAY.



DOOR ACC. SPECIFICATIONS PAGE...
- WORKING LOAD = 12 m' WATERCOLUMN.
- ACTING LOAD = 10,5 m' " "

SUFFICIENT ✓

WALL PLATE t = 20 (18)



$R_{DOOR}/m' = 0{,}4 \cdot 162{,}2 = 65\ kN/m$

$M = \frac{1}{2} \cdot q_d l^2 + R \cdot l$

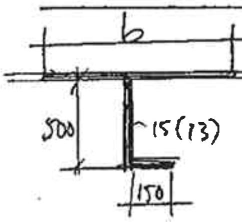
$= \frac{1}{2} \cdot 162{,}2\,(0{,}15)^2 + 65 \cdot 0{,}15 = 11{,}6\ kNm.$

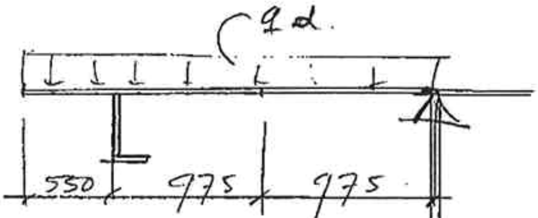
$W = \frac{1}{6} \cdot 1000 \cdot 18^2 = 54000\ mm^3$

$\sigma_E = M/W \doteq 214\ N/mm^2$

$u.c. = 214 \cdot 1{,}1 / 355 = \underline{0{,}67} < 1{,}0$ ✓

STIFFENER : ⌐ 500 x 150 x 15





$b = 25t = 25 \cdot 18 = 450\ mm'$

$b_{CALC} = 300\ mm'$

$W_{min} = 1{,}73 \cdot 10^6\ mm^3.$

$M = \frac{1}{8} \cdot (0{,}55 + 0{,}975) \cdot 162{,}2 \cdot 3{,}5^2 = 379\ kNm$

$\sigma = \frac{M}{W} = 220\ N/mm^2$

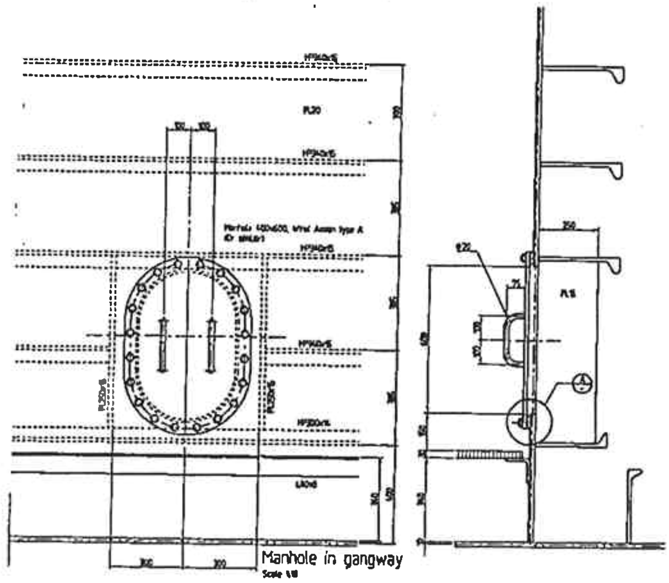
$u.c. = 0{,}68$ ✓.

Opgesteld :	Datum :	Bladnummer :	Rev. :
AlSEMGEEST	140601.	K6-3	A2

Project : MALLAMOCCO NAV. LOCK GATE.

Onderdeel : MANHOLES..

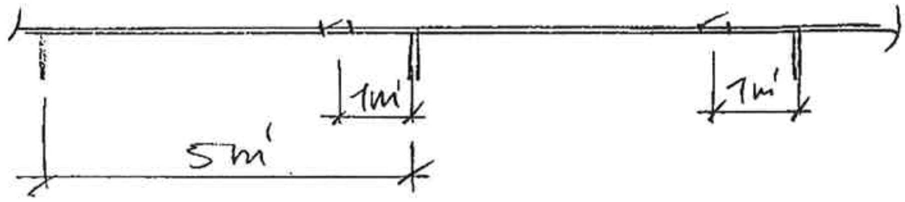
2. MANHOLE IN GANGWAY

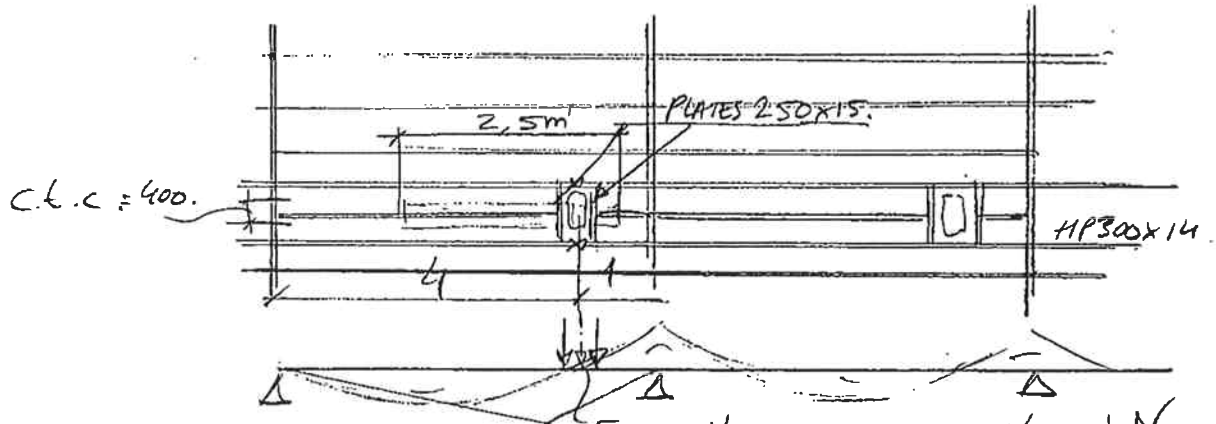


Manhole in gangway

- POSITION 1m' FROM BULKHEADS.

= $\frac{1}{5}l$; ZERO MOMENT POINTS FOR GLOBAL LOAD.





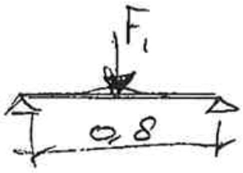
$F_{tot} = 162{,}2 \cdot 2{,}5 \cdot 0{,}4 = 162{,}2$ kN.

Opgesteld : A Isemgeest | Datum : 170604 | Bladnummer : K6-4 | Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : MAN HOLES

Pl: 250 x 15 (13)



$F_1 = \frac{2,0}{2,5} \cdot F_{tot} = 130$ kN.

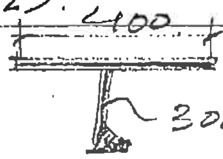
$M_d = \frac{1}{4} \cdot 0,8 \cdot 130 = 26$ kNm.

$W_{el} = \frac{1}{6} \cdot 13 \cdot 250^2 = 135417\ mm^3$ (WALLPLATE NEGLECTED).

$\sigma = M/W = 192\ N/mm^2$

HP 300 x 14. (12).

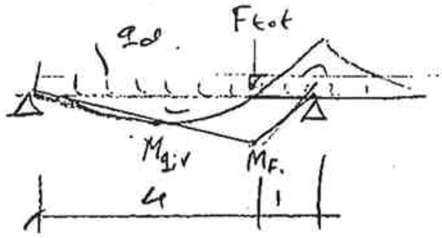
- CONSERVATIVE :



$W = 69,7 \cdot 10^4\ mm^3$.

$M_F = \frac{(4 \cdot 1)}{5} \cdot 162/2 = 65$ kNm

$M_{q:v} = 0,094 \cdot (162 \cdot 0,4) \cdot 5^2 = 153$ kNm



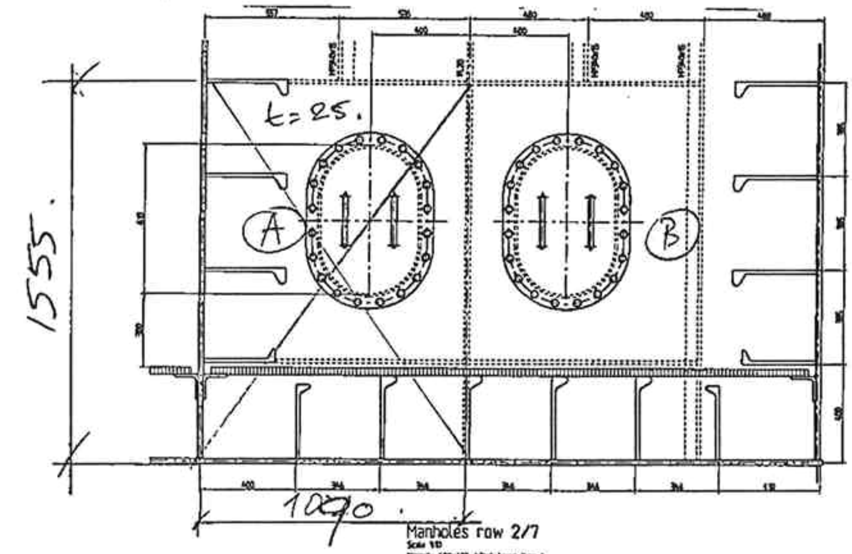
$\sigma_F = M_F/W = 94\ N/mm^2$.

$\sigma_{q:v} = M_{q:v}/W = 220\ N/mm^2$.

$\sigma_{tot} \cong 220 + 94/2 = 267\ N/mm^2$.

U.C = 267 · 1,1/355 = **0,83** ; OK.

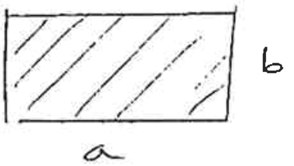
3. MANHOLES IN WALL ROW 2/7



Manholes row 2/7

WALLPLATE t = 25 (23)

- GOVERNING PLATE (A).
- STIFFENERS NEGLECTED.
- $q_0 = 162{,}2\ kN/m^2$.
- ACC. FORMULAS STRESS AND STRAIN TIMOSHENKO.



$$\frac{a}{b} = \frac{1555}{1090} = 1{,}43.$$

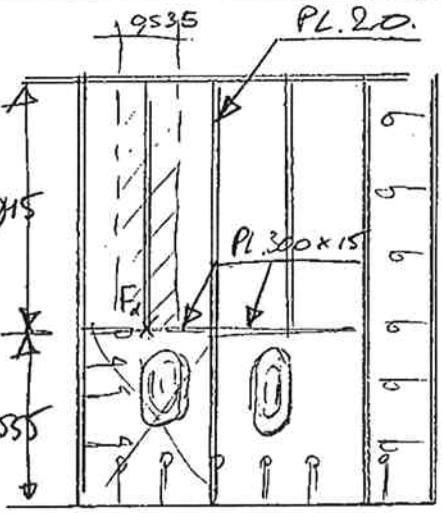
$$\beta = 0{,}47.$$

$$\sigma_{max} = \frac{\beta q \cdot b}{t^2} = \frac{0{,}47 \cdot 162{,}2 \cdot 1090}{(23)^2} = 157\ N/mm^2$$

$$u.c. = 157 \cdot 1{,}1 / 355 = \underline{0{,}49}; \checkmark$$

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : MANHOLES.



PL. 300 · 15. (12)

$F_d = \frac{1}{2} \cdot 162{,}2 \cdot 0{,}535 \cdot 1945 = 85 \text{ kN}.$

R/mm' FROM PLATE. $= \gamma\, g\, b$

$= 0{,}0804 \cdot 162{,}2 \cdot 1070$

$= 14 \text{ N/mm}'.$

$M = \frac{1}{8} \cdot 14 \cdot 1{,}07^2 + \frac{1}{4} \cdot 85 \cdot 1{,}07 = 25 \text{ kNm}.$

$W = \frac{1}{6} \cdot 12 \cdot 300^2 = 180000 \text{ mm}^3.$

$\sigma = M/W = 138 \text{ N/mm}^2.$ ✓

$V = \frac{85}{2} + \frac{1}{2} \cdot 1{,}07 \cdot 14 = 50 \text{ kN}.$

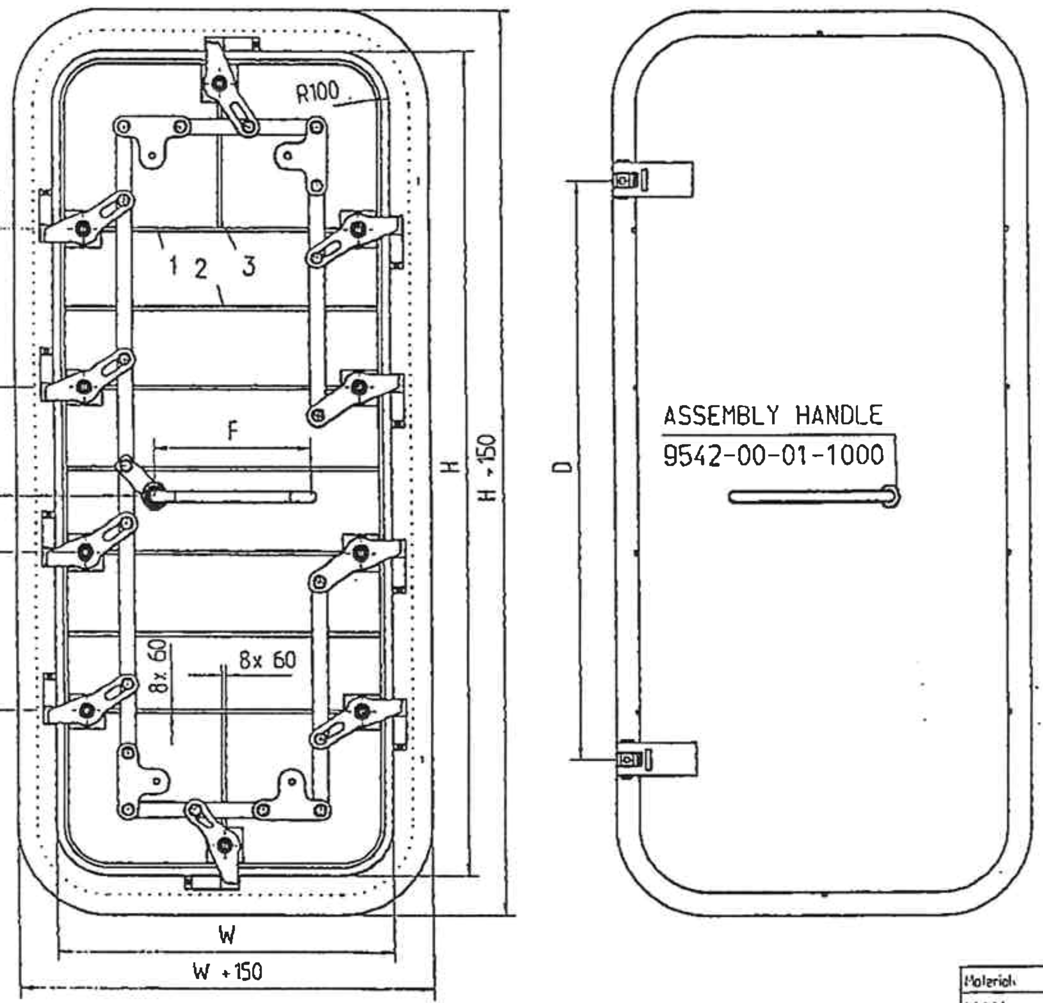
$\tau = V/A = 50 \cdot 10^3 / 12 \cdot 300 = 14 \text{ N/mm}^2.$ ✓

Opgesteld : AlSEMGEEST | Datum : 17-6-04 | Bladnummer : K6-7 | Rev. : A2

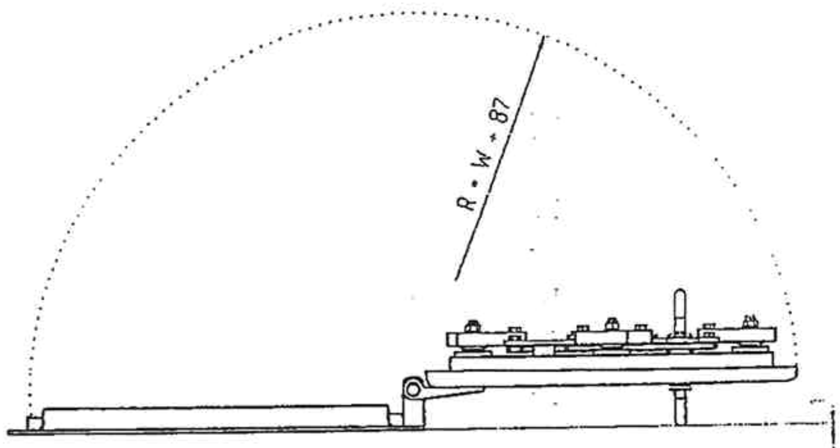
Malamocco Nav. Lock Gate; Manholes.

INSIDE VIEW

OUTSIDE VIEW



CLEAR OPENING	:	H x W		
CUT IN PLATE	:	H + 75 x W + 75		
OUTSIDE DIMENSIONS	:	H + 150 x W + 150		
HINGE DISTANCE	:	D = H x 0.7		
CLEATS DISTANCE	:	E = H x 0.51		
STIFFENER 1	:	W - 190		
STIFFENER 2	:	W - 40		
STIFFENER 3	:	H x 0.15		
HANDLE LENGTH	:	W < 750	F = 300	
	:	W >= 750	F = 400	



TOP VIEW

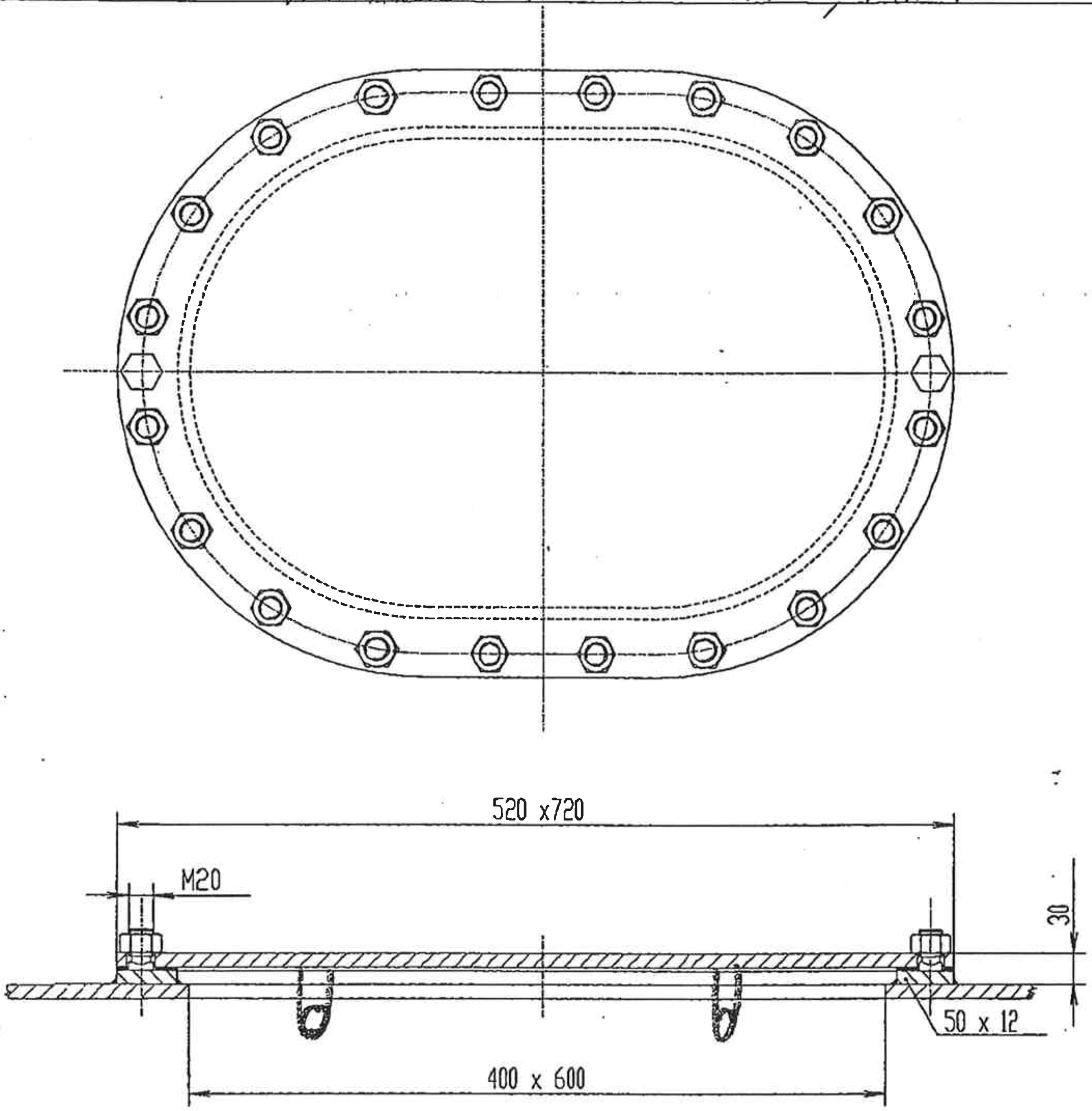
DOORPLATE	:	8 MM
COAMING	:	75 x 50 x 8
CLEATS	:	M16 / 25 mm ST52-3 ZINC, according drawing 9542-00-02-1000 / 9542-00-02-2000 cleat bush AISI 431
MECHANISM	:	Stainless steel
SEAL	:	45 x 20 EPDM
WEDGE	:	BRASS, according drawing 9542-00-03-0000
HINGE	:	according drawing 9542-00-04-1000

Material: Steel grade A				
Weight: kg				
Break all sharp edges.				
Tolerance system of limits and fits according to ISO-286				
Geometrical tolerancing according to ISO-1101	Description:	Name:	Date:	Rev.:
General tolerances according to ISO-2768	Scale: 1:10	Drawn: HRH	20.06.2003	
Fundamental tolerancing principle according to ISO-8015	Dimensions in mm	Checked:	20.06.2003	
Drawing status: For approval	Description: HEAVY MUSK. DOOR 12 MWC LH			
American projection				
WINEL Assen The Netherlands	Reference: DOOR	MUSKETEER	HEAVY	
	Size / Clear opening: hxw	Drawing number: 9542-20-17-0020		Page:
	File name: C:00018364.SZH			

The drawing and design shown is our property and may not be used or disclosed to any third person without our specific written approval

17.06.04

Malamocco Nav. lock Gate; Manholes.



Rev.	Date	Description
B	8/90	NEW DRAWING
A	8/90	NEW DRAWING

Scale:	1 : 5	Date:	Manufacture unless otherwise specified	American projection Size in mm.
Drawn:	H.R.H.	24-09-90	CAD DRAWING by PCDRAFT	
Checked:				

Description:

MANHOLE type A

—9.

WINEL
Assen - Holland

Drawing No: 87189-03

Tolerance untoleranced sizes machined surfaces DIN 7168/ISO 2768M.

Alsembeest 170604 K6-9 A2

Addendum L Tolerances

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : TOLERANCES.

L1. TOLERANCES VERTICAL BEARING.

INTRODUCTION.

CURVES AND MISALIGNMENTS IN THE STEEL GATE STRUCTURE AND THE CONCRETE STRUCTURE MUST BE LIMITED.

THE DEVIATIONS MUST BE KEPT WITHIN THE TOLERANCES. THE BEARING AREA BETWEEN STEEL AND CONCRETE STRUCTURE IS OF GREAT IMPORTANCE. CURVES AND MISALIGNMENTS AT THE VERTICAL SUPPORTS RESULT IN HIGHER MEMBERLOADS AND REACTIONS ON THE BEARINGS.

IN THIS SECTION IS DETERMINED WHAT TOLERANCES ARE TO BE KEPT FOR BOTH STEEL AND CONCRETE STRUCTURE BY EXAMINATION OF THE EFFECT DUE TO GLOBAL AND LOCAL DEFORMATIONS ALONG THE VERTICAL LINES. (INTERFACE STEEL-CONCRETE ALONG HEIGHT)

CONCLUSION.

IRREGULARITIES (LOCAL DEFORMATIONS) OF 1mm IN THE STEEL-CONCRETE INTERFACE ARE GOVERNING.
THE STEEL GATESTRUCTURE MUST COMPLY WITH THE ENV 1090 - "EXECUTION OF STEEL STRUCTURES" REGARDING TOLERANCES.

→ REQUIREMENTS FOR THE BEARING INTERFACE CONCRETE - STEEL:
- MAX. TOLERANCE STEEL STRUCTURE: ± 0,5 mm.
- MAX. TOLERANCE UHMWPE ON CONCRETE: ± 0,5 mm.

Opgesteld :	Datum :	Bladnummer :	Rev. :
ALSEMGEEST	07-07-04	L1-1.	A3.

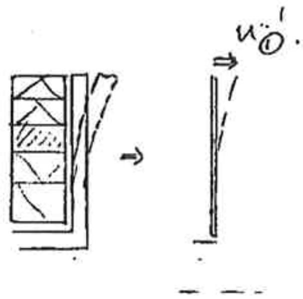
Project	:	MALAMOCCO NAV. LOCK GATE.
Onderdeel	:	TOLERANCES.

EFFECTS OF CURVES AND MISALIGNMENTS.

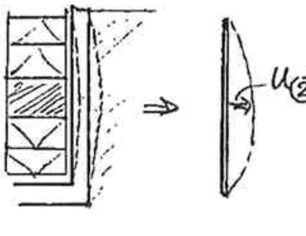
EXAMINATION EFFECTS OF POSSIBLE MISALIGNMENT AND CURVES IN VERTICAL BEARING OF GATE ALONG HEIGHT.

GLOBAL DEFORMATIONS:

(1) A LINEAR DEFLECTION OF VERT. LINE DUE TO DIFFERENCE BETWEEN BUILDING-SITUATION AND OPERATING SITUATION.

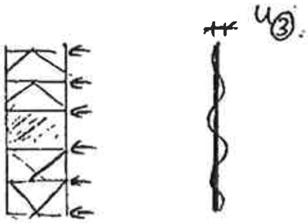


(2) A PARABOLIC DEFLECTION OF VERT. LINE DUE TO NEARBY DREDGING ACTIVITIES. BEHIND CHAMBER WALL. (SEE NOTE)



LOCAL DEFORMATIONS:

(3) RELATIVE DEFORMATION BETWEEN POINTS:



NOTE: DUE TO PRESENTS OF PERPENDICULAR SHEET PILLING WALL AT EDGES BEHIND THE VERTICAL BEARING, LARGE DEFLECTIONS FOR THIS SITUATION ARE IMPROBABLE.

Opgesteld :	Datum :	Bladnummer :	Rev. :
A1SEMGEEST	07-07-04	L1-	A3

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : TOLERANCES.

CALCULATION :

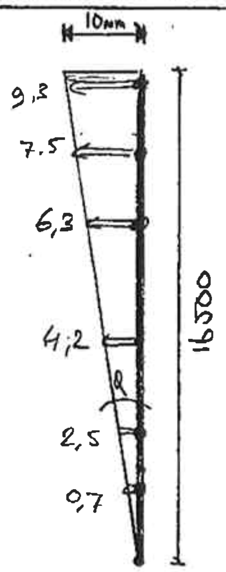
∴ DETERMINATION OF EFFECT BY MEANS OF LOADCASES WITH SUPPORT SETTLEMENTS IN THE MAIN CALC. MODEL

⇒ EFFECTS EXAMINAD FOR GLOBAL DEFLECTIONS OF: 10 mm'

⇒ " " " LOCAL " OF: 1 mm'.

① LINEAR DEFLECTION OF VERT. LINE.

- MANUAL CALC. :



$\varphi = \frac{10}{16500} = 0{,}606$ mrad.

$M_t = \frac{G_d \times I_t \times \varphi}{l} = \frac{81000 \times 2{,}04 \cdot 10^{12} \times 6{,}06 \cdot 10^{-4}}{16500} = 6068{,}8$ kNm

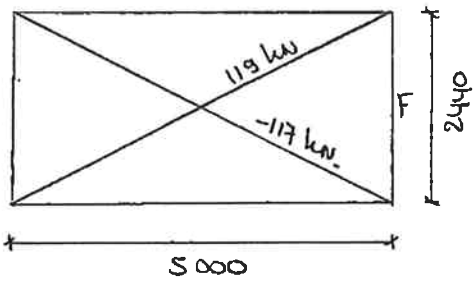
$G_d = 81000$ N/mm²

$I_t = 2{,}04 \cdot 10^{12}$ mm⁴

$\tau = \frac{M_t}{2 \times b \times H \times t} = \frac{6068{,}8 \cdot 10^{6}}{2 \times 8500 \times 3500 \times 20} = 7$ N/mm²

- COMPUTER CALCULATION :

FORCES IN DIAGONALS.



$F = \sin 26 \times 117 = 51$ kN.

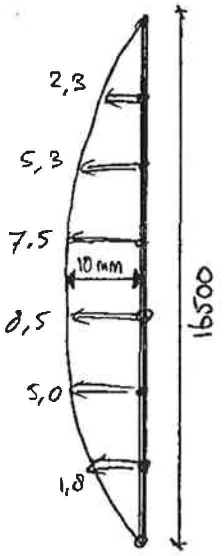
$\tau = \frac{F}{A} = \frac{51 \cdot 10^{3}}{2440 \times 20} = 1$ N/mm².

∴ STRUCTURE IS (RELATIVELY) INSENSITIVE FOR LINEAR DEFLECTIONS.

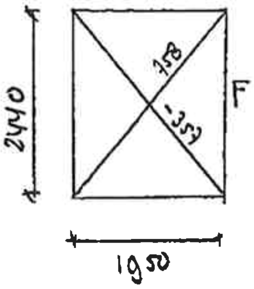
Opgesteld : MP | Datum : 24-05-04 | Bladnummer : L1-3 | Rev. : A3

Project :	MALAMOCCO NAV. LOCK GATE.
Onderdeel :	Tolerances

② PARABOLIC DEFLECTION :



FORCES IN DIAGONAL



$F = \sin 51{,}4^\circ \times -357 = -279 \text{ kN}.$

$\tau = \dfrac{279 \cdot 10^3}{2440 \times 20} = 6 \text{ N/mm}^2$

- CHECK T-PROFILE. (BEARING PROFILE).

FORCES (COMPUTER CALCULATION)

M_y	: 643,4 kNm
M_z	= 4,60 kNm
V_y	= -1,30 kN
V_z	= 101,8 kN
N	= 647,7 kN.

STRESSES.

σ	= 45 N/mm²
σ	= 3 N/mm²
τ	= 0 N/mm²
τ	= 7 N/mm²
σ	= 16 N/mm²

STRESS INCREASE ARE ACCEPTABLE, THOUGH INCREASE OF SUPPORT REACTIONS ARE SIGNIFICANT. BUT AS MENTIONED IN NOTE ON PAGE L1-2. THIS EXAMINED SITUATION IS IMPROBABLE.

Opgesteld : MP	Datum : 24-05-04	Bladnummer : L1-4	Rev. : A3

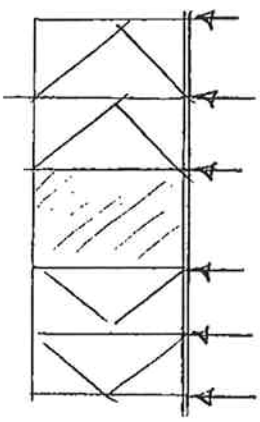
Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : TOLERANCES.

(3). RELATIVE DEFORMATION BETWEEN POINTS.

LOADCASES MADE IN 30-FRAME MAINMODEL FOR RELATIVE DEFORMATION OF 1mm' OF EACH POINT

RESULTSING MAX. REACTIONS FROM ALL LOADCASES PRESENTED IN THIS FIGURE, DERIVED FROM OUTPUT NEXT PAGE



NODENR.	REACTION MAX.
157	600 kN
151	1000 kN.
33	1200 kN
25	1200 kN.
17	700 kN
9.	500 kN.

∴ THESE RESULTS ARE SIGNIFICANT. THE ASSUMED LOCAL DEFORMATION OF 1mm' IS TAKEN AS MAX.

ALLOWABLE TOTAL TOLERANCE FOR THE STEEL-CONCRÈTE INTERFACE.

→ MAX. TOLERANCE STEELGATE = 0,5 mm'.

→ MAX. TOLERANCE CONCRETE = 0,5 mm'.

NOTES NEXT PAGE:

Opgesteld : Al SEMGEEST   Datum : 07-07-04   Bladnummer : L1-5.   Rev. : A3

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : TOLERANCES.

AD (3) NOTES :

- IRREGULARITIES WILL REDUCE DURING LIVETIME; BECAUSE OF OVERLOAD OF THE UHMWPE WILL CAUSE CREEP DURING REDEVIDING OF THE LOAD.

- THE INCREASE OF THE SUPPORTREACTIONS DUE TO TOLERANCES IS COVERED IN THE SUPPORT CALCULATION:
  - → LOADINTRODUCTION (LOCAL)
  - → UHMWPE - BEARING.
  - → STEELSTRUCTURE GATE HAS SUFFICIENT RESERVE CAPACIT[Y] FOR REDISTRIBUTION OF THE LOAD.

Opgesteld : Alsemgeest | Datum : 08-07-04 | Bladnummer : L1-6 | Rev. : A3

Reacties in steunpunten - waardes in knopen.

Lineair statisch - extreme van alle combinaties
Groep van knopen:9,17,25,33,151,157
Groep van belastinggevallen:28/33

Steunpunt	knoop	BG	Rx [kN]	Ry [kN]	Rz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
7	9	28	0.00	84.24	0.00	0.00	0.00	0.00
		29	0.00	18.99	0.00	0.00	0.00	0.00
		30	0.00	44.74	0.00	0.00	0.00	0.00
		31	0.00	-105.54	0.00	0.00	0.00	0.00
		32	0.00	-472.17	0.00	0.00	0.00	0.00
		33	0.00	* 456.98	0.00	0.00	0.00	0.00
9	17	28	0.00	28.47	0.00	0.00	0.00	0.00
		29	0.00	-17.19	0.00	0.00	0.00	0.00
		30	0.00	43.81	0.00	0.00	0.00	0.00
		31	0.00	-649.66	0.00	0.00	0.00	0.00
		32	0.00	* 1068.56	0.00	0.00	0.00	0.00
		33	0.00	-472.17	0.00	0.00	0.00	0.00
11	25	28	0.00	93.70	0.00	0.00	0.00	0.00
		29	0.00	26.93	0.00	0.00	0.00	0.00
		30	0.00	-1118.56	0.00	0.00	0.00	0.00
		31	0.00	* 1775.44	0.00	0.00	0.00	0.00
		32	0.00	-649.66	0.00	0.00	0.00	0.00
		33	0.00	-105.54	0.00	0.00	0.00	0.00
13	33	28	0.00	-173.83	0.00	0.00	0.00	0.00
		29	0.00	-1003.96	0.00	0.00	0.00	0.00
		30	0.00	* 2202.85	0.00	0.00	0.00	0.00
		31	0.00	-1118.56	0.00	0.00	0.00	0.00
		32	0.00	43.81	0.00	0.00	0.00	0.00
		33	0.00	44.74	0.00	0.00	0.00	0.00
22	151	28	0.00	-586.47	0.00	0.00	0.00	0.00
		29	0.00	* 1559.77	0.00	0.00	0.00	0.00
		30	0.00	-1003.96	0.00	0.00	0.00	0.00
		31	0.00	26.93	0.00	0.00	0.00	0.00
		32	0.00	-17.19	0.00	0.00	0.00	0.00
		33	0.00	18.99	0.00	0.00	0.00	0.00
23	157	28	0.00	* 546.31	0.00	0.00	0.00	0.00
		29	0.00	-586.47	0.00	0.00	0.00	0.00
		30	0.00	-173.83	0.00	0.00	0.00	0.00
		31	0.00	93.70	0.00	0.00	0.00	0.00
		32	0.00	28.47	0.00	0.00	0.00	0.00
		33	0.00	84.24	0.00	0.00	0.00	0.00

* declination of the actual reaction force.

Project	:	MALAMOCCO NAV. LOCK GATE.
Onderdeel	:	TOLERANCES.

RECOMMENDATIONS.

- THE STEELSTRUCTURE MUST COMPLY WITH THE ENV1090 - "EXECUTION OF STEEL STRUCTURES".
- MAX. TOLERANCE STEEL STRUCTURE : ± 0.5 mm'.
  → ALIGN STAINLESS STEEL PLATES WITH FITTING BOLTS TO BEARING T AND FILL WITH EPOXY.
- MAX. TOLERANCE CONCRETE FACE : ± 0.5 mm'.
  → ALIGN UHMWPE ON CONCRETE FACE BY GROUTING.
- PRECISION OF TOLERANCES CAN BE MEASURED BY LASER.

Opgesteld :	Datum :	Bladnummer :	Rev. :
Alsemgeest	07-07-'04	L1-8	A3

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : TOLERANCES.

L2 : TOLERANCES HORIZONTAL BEARING.

TOLERANCE OF THRESHOLD = ±5mm'.

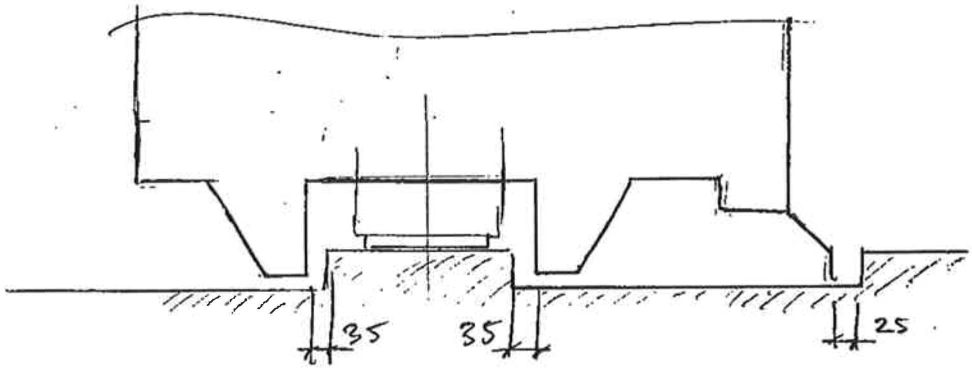
CHECK 1 : • GATE CLOSED ⇒ IMPOUNDAGE BUILDING UP.

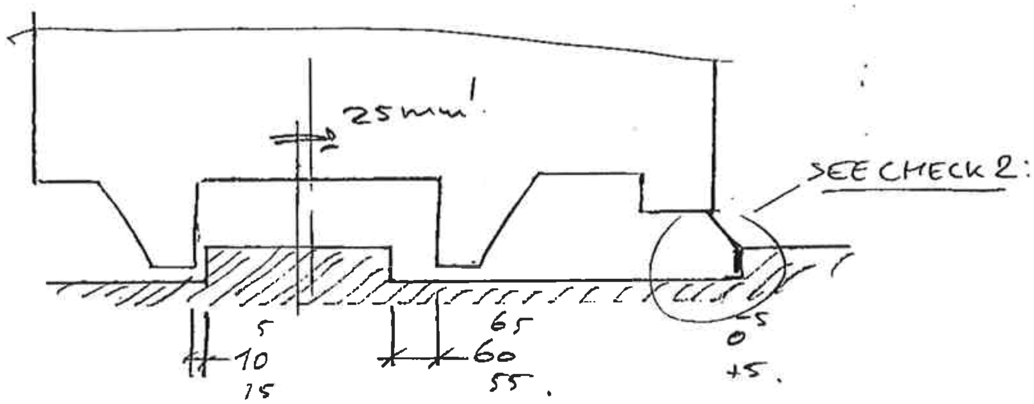
⇒ AT IMPOUNDAGE OF h = 0,2m' ; GATE IS PUSHED TO LAGOONSIDE AND MEETS THE BEARING AFTER MOVEMENT OF 25 mm'.

• NORMAL CLEARANCE = 35 mm'.

35 - 5mm' TOLERANCE = 30mm' < 35 ;

CONCLUSION : TOLERANCE SUFFICIENT





Opgesteld : Alsemgeest | Datum : 08-07-04 | Bladnummer : L2-1. | Rev. : A3.

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : TOLERANCES.

CHECK 2 AT FLEXIBLE SLAB.

- PHASE ①:

GATE CLOSED ⇒ BUILDING UP IMPOUNDAGE.

⇒ FIRST FLEXURE OF SLAB ; - UNDER NORMAL CONDITION = 25 mm'.
- WITH MIN. TOLERANCE -5mm = 20 mm'
- WITH MAX. TOLERANCE +5mm = 30 mm'

∴ FLEXIBLE PLATE IS CALCULATED FOR A DEFORMATION OF 30 mm' ; THUS SUFFICIENT.

- PHASE ②:

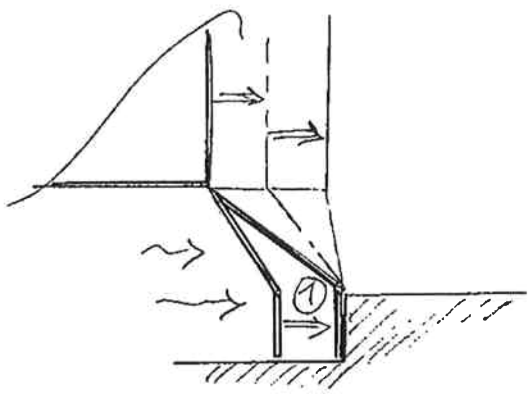
⇒ BUILDING UP IMPOUNDAGE FURTHER ⇒ GATE MOVING 25 mm' AT 0.2 m' IMPOUNDAGE

⇒ + GATE IS DEFORMING ; [FROM MAIN CALC] ⇒ 25 mm'.

⇒ DEFORMATION FLEXIBLE PLATE = WITH TOL. +5 ⇒ 30-25-25 = -2

WITH TOL. -5 ⇒ 20-25-25 = -3

∴ MAX. DEFLECTION = 30 mm' ; THUS SUFFICIENT.



Opgesteld : AlsemGeest

Datum : 080704

Bladnummer : L2-2

Rev. : A3