

C1	21/03/08	EMMISSIONE PER APPROVAZIONE E A SEGUITO COMMENTI CVN	JRA	LB	YE
C0	01/10/04	EMMISSIONE 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 2 di 3

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

CONSORZIO "VENEZIA NUOVA"

COORDINAMENTO PROGETTAZIONE

VERIFICATO

S. Dalla Villa

CONTROLLATO

M. Brotto

CONSORZIO VENEZIA NUOVA

PROGETTAZIONE

ING. ALBERTO SCOTTI

IL RESPONSABILE: ING. ALBERTO SCOTTI

CONSULENZA SPECIALISTICA



Addendum E Supports and Guidance Gate structure

Contents:

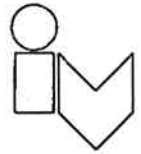
- E1 Loads derived from main calculations**
- E2 Horizontal supports bottom**
- E3 Horizontal supporting along height**
- E4 Horizontal supports at top**
- E5 Guidance sealing**

Note:

This section covers only the calculation of the horizontal supporting. For vertical supporting, see the mechanical calculation of the hydrofeet: document MV036P-PE-M-M-R-5003. For calculation of the vertical temporary supports, see chapter 3.3; detail calculation Truss connections / nodes.

Project : MALAMOCO NAV. LOCK GATE.

Onderdeel : SUPPORTING.



E. SUPPORTING.

NOTE : THIS SECTION COVERS THE CALCULATION OF THE
HORIZONTAL SUPPORTING.

FOR CALC. VERTICAL SUPPORTING; SEE DETAIL CALC. SECTION 2.2.2.

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E1. LOADING DERIVED FROM MAIN CALC	E1-1/11
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E3. HORIZONTAL SUPPORT ALONG HEIGHT	E3 - 1/15.
E4. HORIZONTAL SUPPORT AT TOP :	E4 - 1/11.
E5. GUIDANCE WATERPROOFING	E5 - 1/45.

Opgesteld : ALSEMGEEST

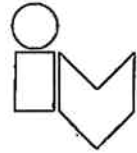
Datum : 03-04

Bladnummer : E-INDEX

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : SUPPORTING.



E1. LOADING DERIVED FROM MAIN CALCULATION.

... LOADING ON HORIZONTAL SUPPORTS DERIVED FROM
MAIN CALC. MV036P-PE-MAR-4002

SUMMARY OF GOVERNING LOADING PER SUPPORT.:

GENERAL NOTE

- DURING MOVEMENT (OPENING/CLOSING)
THE HORIZONTAL LOAD DUE TO FRICTION UNDER VERTICAL
LOAD = $0,2 \cdot V$. (FOR ALL STEEL-UTMMPFE-CONTACTS)
- FURTHER NOTES ARE GATHERED ON PAGE E1-9.

Opgesteld : ASEMGEEST

Datum : 03-04

Bladnummer : E1-1

Rev. : A2

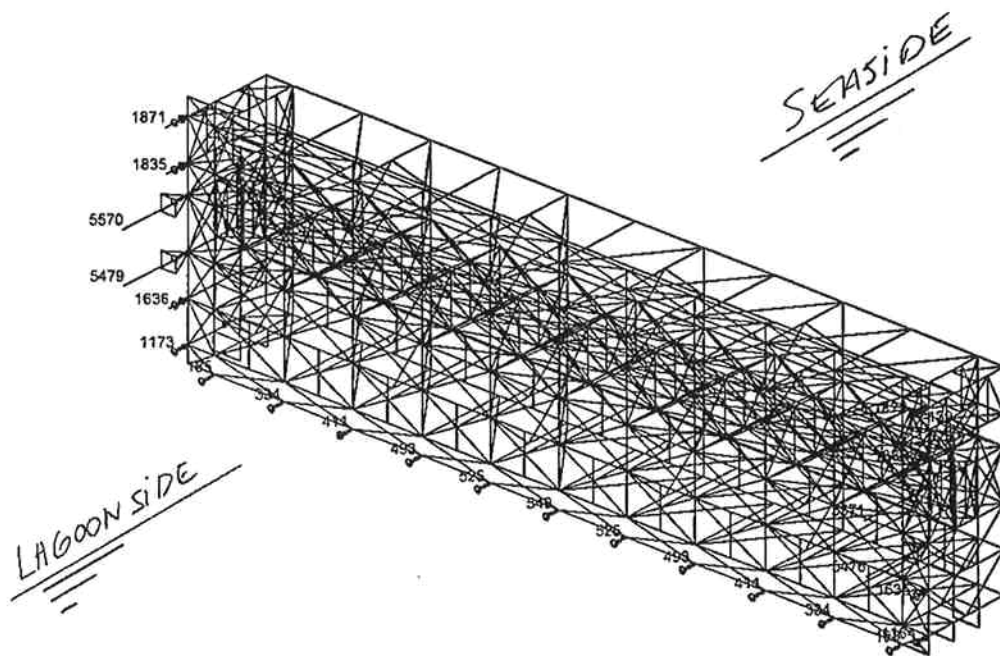
ESA-Prima Win release 3.50.357

Project : Malamocco Nav. Lock Gate

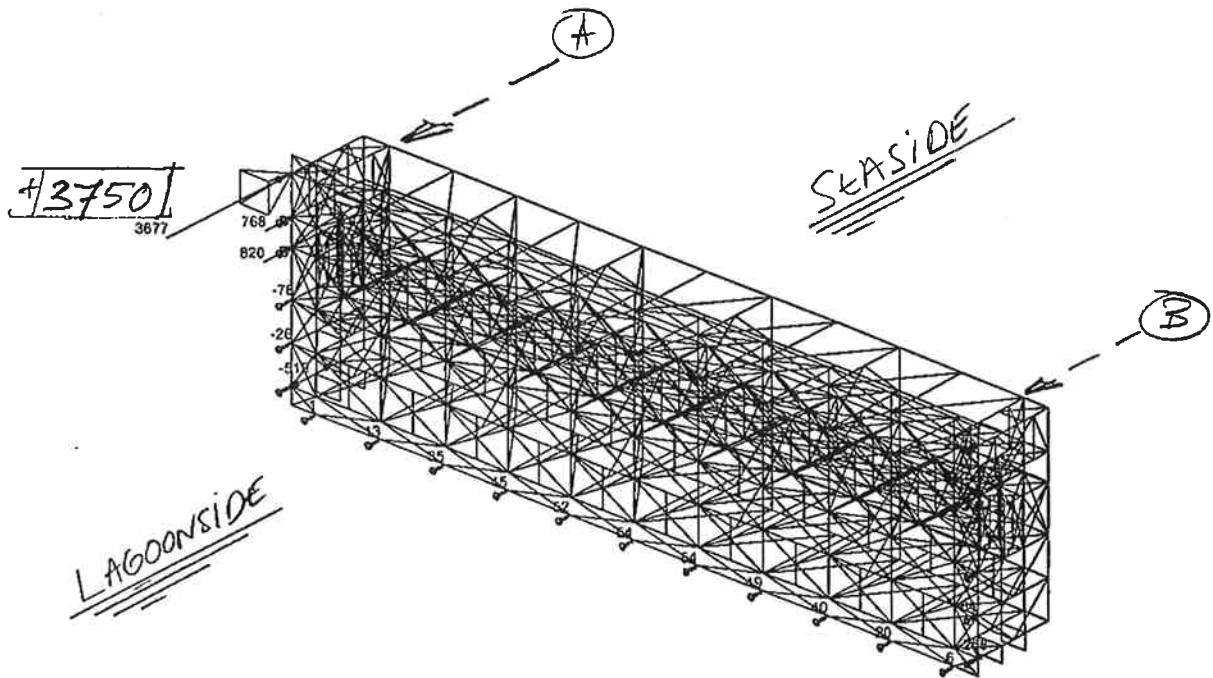
Description: Main Model rev A2 (closed; condition 1+2)

Page : 2

Date : vrijdag 25 juni 2004



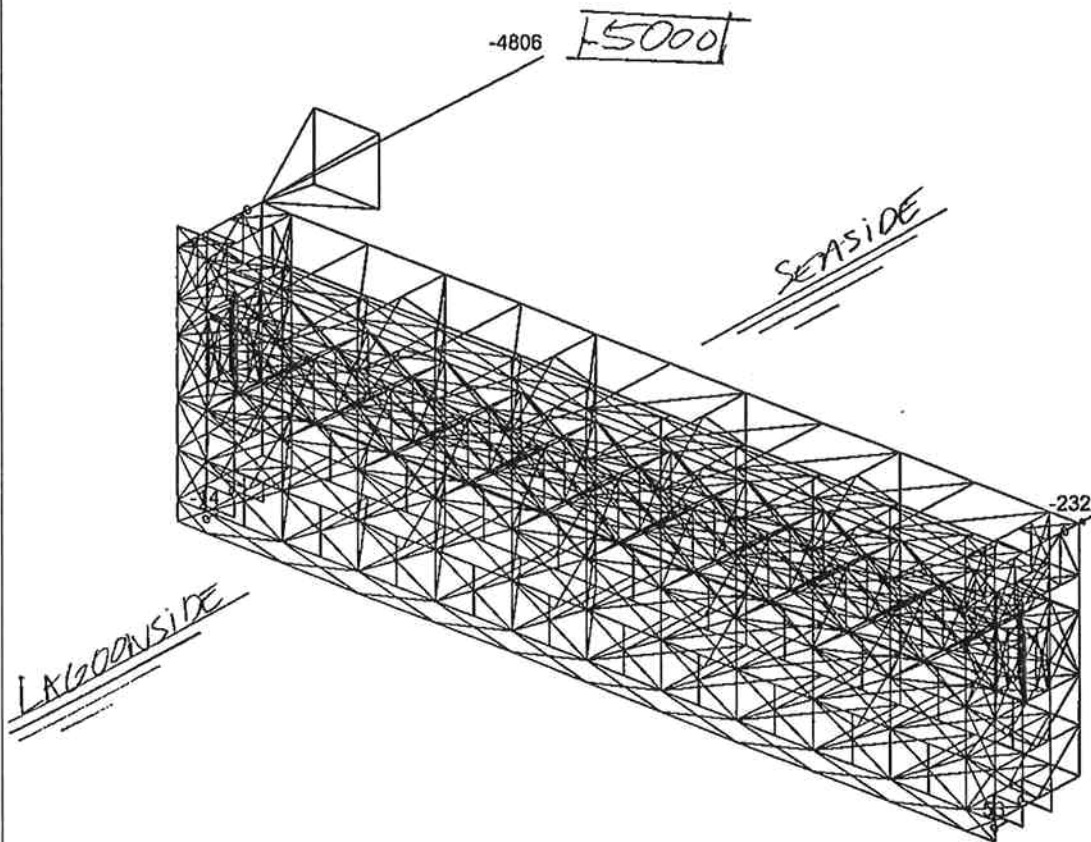
Reactions. Ult. combi : 10 (condition 1; closed; high water)



NOTE : CANACT AT BOTH SIDES (A + B)

Reactions. Ult. combi : 3 (condition 2; closed; boatimpact to lagoonside)

E1-3.

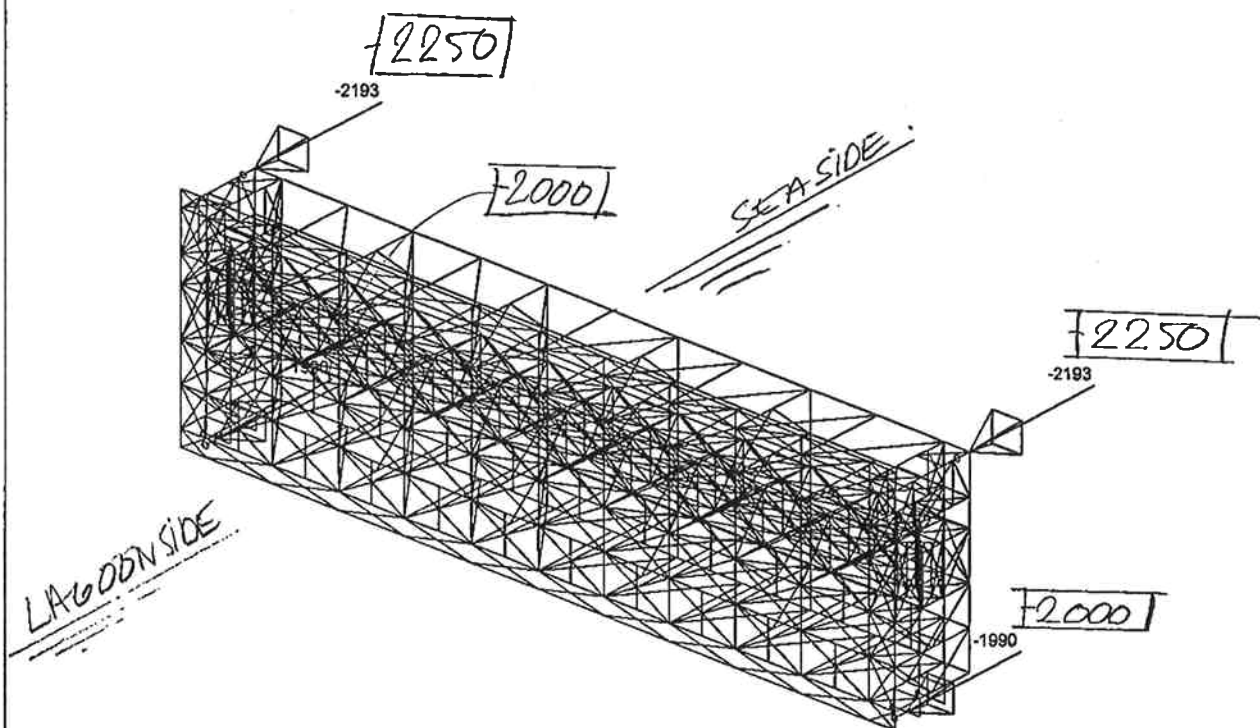


Reactions. Ult. combi : 4 (condition 3; boatimpact to seaside)

ESA-Prima Win release 3.50.357

Project : Malamocco Nav. Lock Gate
Description: Main model rev A2 (closed; condition 3)

Page : 2
Date : vrijdag 25 juni 2004



Reactions. Ult. combi : 1 (condition 3; closed; earthquake to seaside)

#1-5.

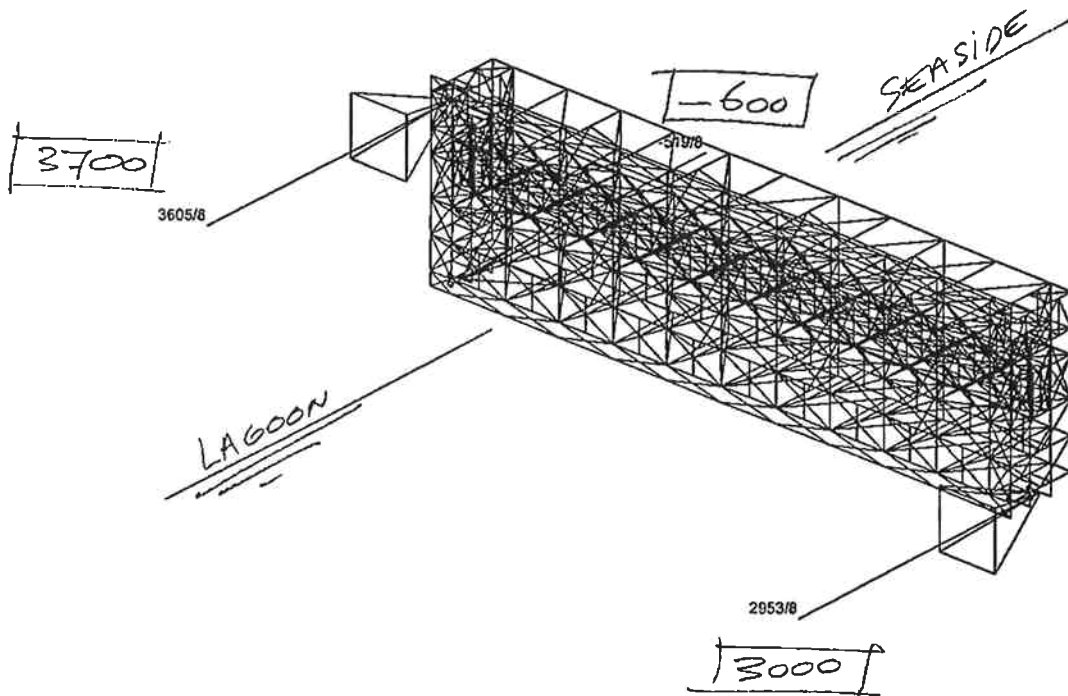
ESA-Prima Win release 3.50.357

Project : Malamocco Nav.Lock Gate

Description: Main Model Rev A2 (opening/closing condtion)

Page : 2

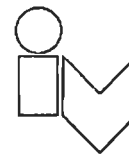
Date : vrijdag 25 juni 2004



Reactions. Ult. combi : 7/8,11/12 (condition 4; opening/closing; wave slam combi's)

EP-6.

Project : MALAMACCO NAV. LOCK GATE



Onderdeel : FLOX-SUPPORTS LOADING

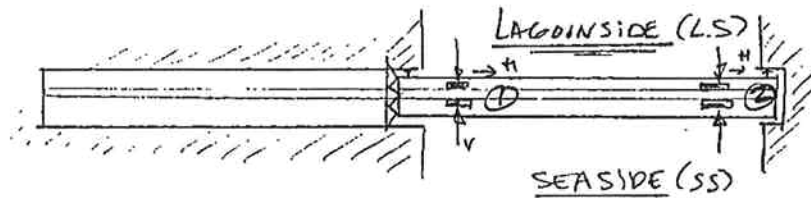
A) LOADING HORIZONTAL SUPPORT ALONG HEIGHT :

(DESIGN VALUES)

MAX. LOADING FOR ALL COMBINATIONS ; SEE PAGE E1-2.

B) LOADING HORIZONTAL SUPPORTS BOTTOM :

(DESIGN VALUES)



SUPPORT	LOC.	SIT. LOAD COMBINATION	
		MOVEMENT (NEARLY CLOSED)	EARTHQUAKE
①	L.S.	-	-
	S.S.	-	V = 2000 kN
②	L.S.	V = 3000 kN. H = 600 kN.	-
	S.S.	V = 600 kN.	V = 2000 kN.

NOTES: SEE PAGE E1-70.

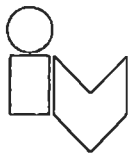
Opgesteld : ALSMGERST

Datum : 03-04

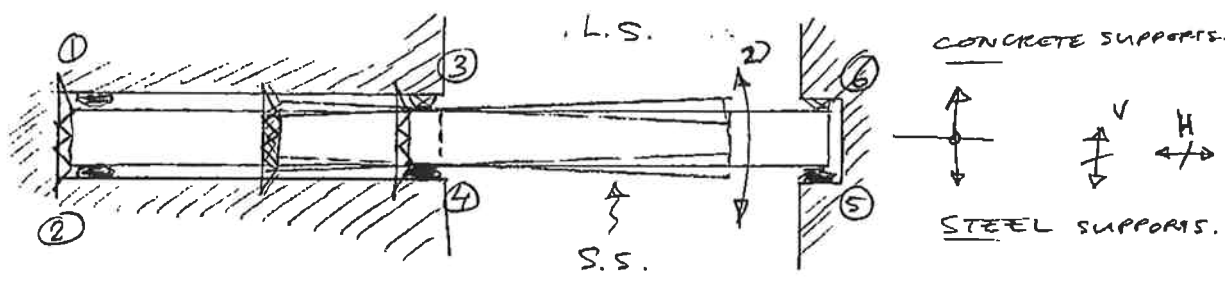
Bladnummer : E1-7

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE .
 Onderdeel : HOR. SUPPORTS LOADING .



C) LOADING GUIDANCE AT TOP. (DESIGN VALUES)



(LOADS IN KN)

SIT. LOAD COMBINATION

SUPPORT	TYPE	EARTHQUAKE	BOAT IMPACT	CLOSED	MOVEMENT NEAR ③/⑥	CLOSING AT ③/⑥	OPENING AT ⑤/⑥
①	CONCRETE	V = 2250	-	-	-	-	-
②	STEEL	V = 2250	-	-	-	-	-
③	CONCRETE	- 1)	V = 3750 ⁶⁾	V = 1900 ⁶⁾	V = 3700 H = 740	V = 1200 ²⁾ H = 240	-
④	STEEL	V = 2250	V = 5000	-	V = 1200 ³⁾ H = 240	V = 1200 ³⁾ H = 240	-
⑤	STEEL	V = 2250	V = 5000	-	-	FALLIGN ²⁾ V = 467 H = 177	-
⑥	CONCRETE	- 1)	V = 3750 ⁶⁾	V = 1900 ⁶⁾	-	FALLIGN ²⁾ V = 467 H = 177	-

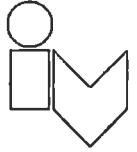
* FOR NOTES SEE PAGE E1-9.

6) ACTING WHEN GATE IS CLOSED OVER SLAB ALONG HEIGHT.
 BEARING IS CHECKED IN SUPPORT ALONG HEIGHT.

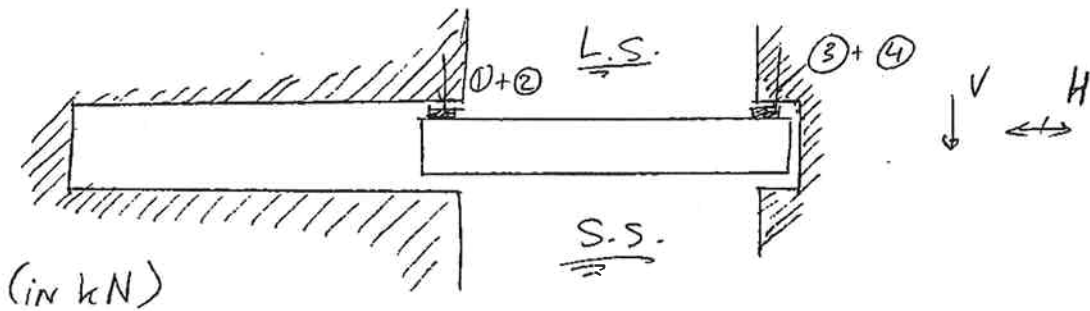
Opgesteld : ALSEMGEEST Datum : 08-04 Bladnummer : E1-8 Rev. : A2

Project : MALAMOLCO NAV. LOCK GATE

Onderdeel : HOK. SUPPORTS



⑤ LOADING GUIDANCE WATERPROOFING (DESIGN VALUES)



SUPPORT	LOC.	SIT. LOADCOMB. 3)	
		CLOSING 4)	OPENING.
①	TOP	-	V = 338 H = 67,5
②	BOTTOM	-	V = 338 H = 67,5
③	TOP	V = 219 H = 67,5	V = 338 H = 67,5
④	BOTTOM	V = 219 H = 67,5	V = 338 H = 67,5

NOTES : SEE PAGE E1-9..

Opgesteld : H. Sangerat

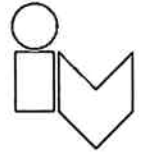
Datum : 03-04

Bladnummer : E1-9

Rev. : AL

Project : MALAMOCO NAV. LOCK GATE .

Onderdeel : HOR. SUPPORTING LOADING.



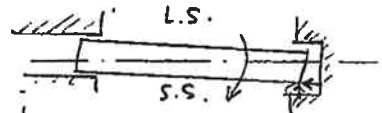
NOTES ON PREVIOUS PAGES :

1) EARTHQUAKE LOAD L.S IS BEARED BY SUPPORTS ALONG HEIGHT @ IN CLOSED SITUATION. (NOT GOVERNING)

2) THE ALIGN FORCE DUE TO HYDROFOOT FRICTION (FFR) + MASS INERTIA FORCE (F_m) TO BE OVERWON WHEN GATE DOOR IS NOT ARRIVING STRAIGHT AT REBATE ON S.S. (S)

$$F_{align: v: D} = 311 \cdot 1,5 = 467 \text{ kN}$$

$$F_{align: H: D} = 118 \cdot 1,5 = 177 \text{ kN}$$



CALCULATED ON PAGE: E1-10/11

3) PUSH OFF FORCE OF GUIDANCE WATERPROOFING BEAM :

$$\text{LOAD} = 0,1 \text{ m}^3 \text{ IMPOUNDAGE} = 1,5 \cdot 225 = 338 \text{ kN}$$

4.) EQUAL TO 2) , BUT TO L.S. :

$$F_{align: v: D} = 146 \cdot 1,5 = 219 \text{ kN} \quad \left| \text{CALC ON PAGE E1-10/11} \right.$$

$$F_{align: H: D} = 45 \cdot 1,5 = 67,5 \text{ kN}$$

5) ASSUME ACTING NOT ONLY TO LAGOON SIDE, BUT ALSO TO SEASIDE.

Opgesteld : ALSEMGEEST

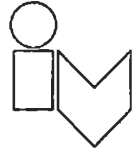
Datum : 03-04

Bladnummer : E1-10

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : HOR. SUPPORTS LOADING.



APPENDIX:

CALCULATION ALIGNMENT FORCE.

ALIGN FORCE = FORCE DUE TO FRICTION HYDROFOOT (F_{FR})
+ MASS INERTIA FORCE (F_m).

DEPARTING FACTOR = ANGLE OF GUIDE SLOPE :

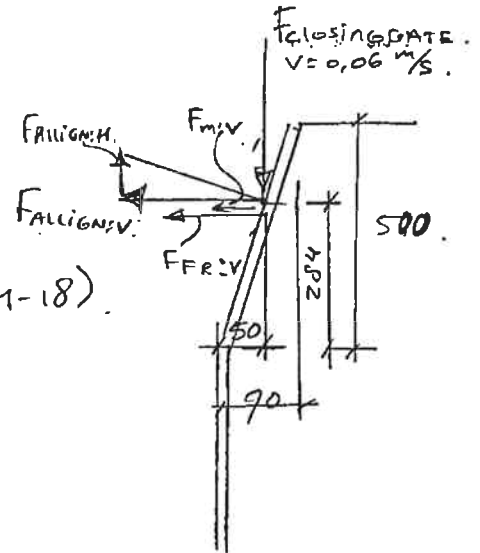
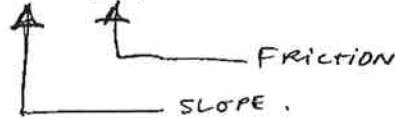
FORCE ON GUIDANCE AT TOP(S)

SLOPE = $90/500 = 0,18$

DUE TO FRICTION HYDROFOOT

F_{FR:V} = $\frac{528}{2} = 264 \text{ kN}$ (DERIVED FROM D1-18).

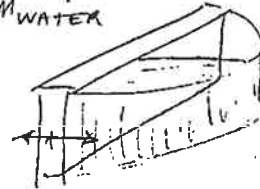
F_{FR:H} = $(0,18 + 0,2) \cdot F_{FR:V} = 100 \text{ kN}$



DUE TO MASS INERTIA

$$M_{DRAGGING} = \frac{1250 \cdot 10^3 + 500 \cdot 10^3}{\gamma_{GATE}} + \frac{1030 \cdot 16,5 \cdot \frac{\pi}{4} \cdot 0,53,9^2}{\gamma_{WATER}}$$

$$= 21140 \cdot 10^3 \text{ Kg.}$$



V_{CLOSING} = 0,06 m/s.

MAX. MISALIGNMENT = 50 mm (CLEARANCE SUPPORT AT BOTTOM)

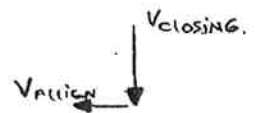
ALIGN DISTANCE = 284 mm.

ALIGN TIME = $\frac{x}{v} = \frac{0,284}{0,06} = 4,7 \text{ SEC.}$

V_{ALIGN} = $0,18 \cdot V_{CLOSING} = 0,01 \text{ m/s.}$

ACCELERATION a = $V_{ALIGN} / t_{ALIGN} = 0,01 / 4,7 = 0,0022 \text{ m/s}^2$

F_{m,V} = m · a = $21140 \cdot 10^3 \cdot 0,0022 = 46,5 \text{ kN.}$



Opgesteld : ALSEMGEEST

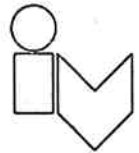
Datum : 03-04

Bladnummer : E7-11

Rev. : A2

Project : MALAMOCO NAV. LOCK GATE.

Onderdeel : HOR. SUPPORT LOADING.



$$F_{m:v} = 46,5 \text{ kN}$$

$$F_{m:h} = (0,18 + 0,2) \cdot F_{m:v} = 17,5 \text{ kN}$$

ALIGN FORCE ON GUIDE AT TOP (5) + (6)

$$F_{\text{ALIGN:VERT}} = 264 + 46,5 = \underline{311} \text{ kN}$$

$$F_{\text{ALIGN:HOR}} = 100 + 17,5 = 118 \text{ kN}$$

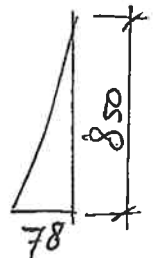
FORCE ON WATERPROOFING GUIDE SUPPORT (3) + (4)

$$\text{SLOPE} = 78 / 850 = 0,1$$

DUE TO FRICTION HYDROFOOT.

$$F_{\text{FR:V}} = 264 / 2 = 132 \text{ kN (top + bottom)}$$

$$F_{\text{FR:H}} = (0,1 + 0,2) \cdot 132 = 40 \text{ kN}$$



DUE TO MASS INERTIA.

$$\text{ALIGN DISTANCE} = \frac{50}{75} \cdot 810 = 540 \text{ mm}$$

$$\text{ALIGN TIME } (t_a) = x/v = \frac{0,54}{0,06} = 9,0 \text{ SEC}$$

$$v_{\text{ALIGN}} = 0,1 \cdot 0,06 = 0,006 \text{ m/s}$$

$$a = v_a / t_a = \frac{0,006}{9,0} = 0,0007 \text{ m/s}^2$$

$$F_{m:v} = m \cdot a = 14,1 \text{ kN}$$

$$F_{m:h} = (0,1 + 0,2) \cdot F_{m:v} = 4,2 \text{ kN}$$

ALIGN FORCE ON WATERPROOFING GUIDANCE SUPPORT (3) + (4)

$$F_{\text{ALIGN:VERT.}} = 132 + 14,1 = \underline{146} \text{ kN}$$

$$F_{\text{ALIGN:HOR.}} = 40 + 4,2 = 45 \text{ kN}$$

Opgesteld : ALSEMGEEST

Datum : -03-04

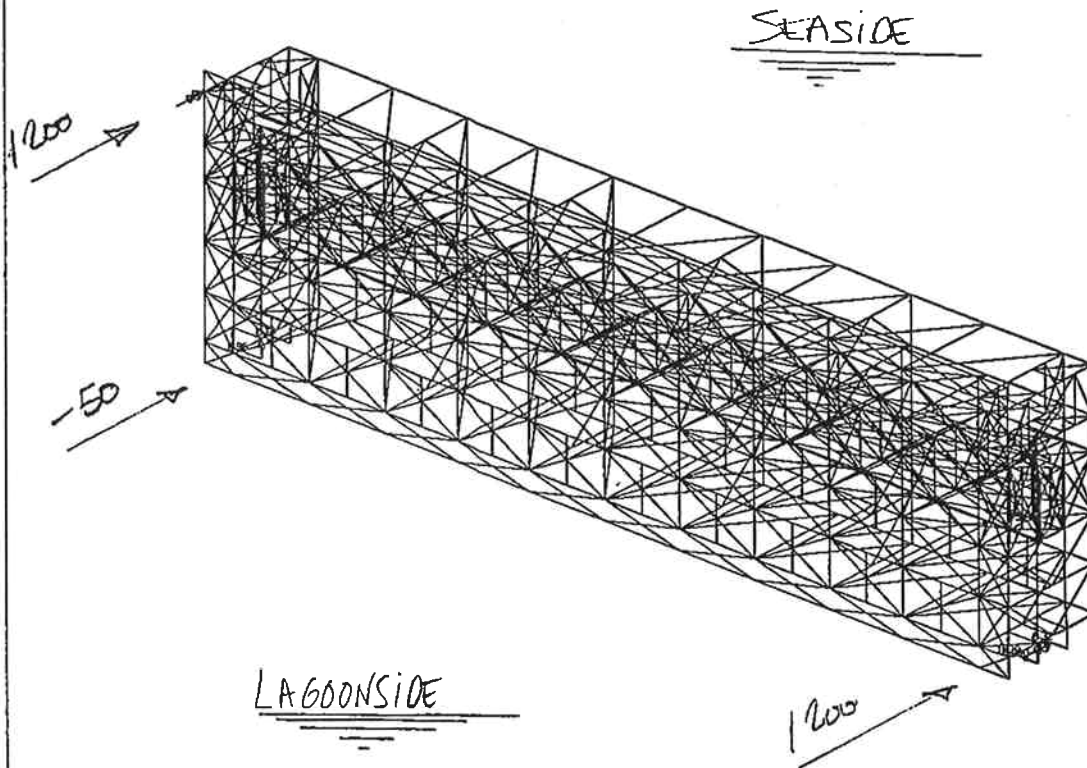
Bladnummer : E7-12

Rev. : A2

OPENING / CLOSING

DESIGN FORCE

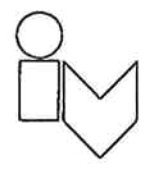
4 MAR 2004



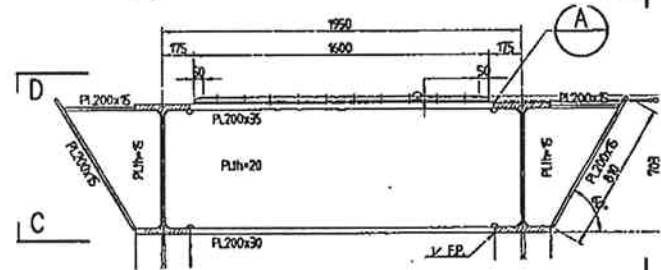
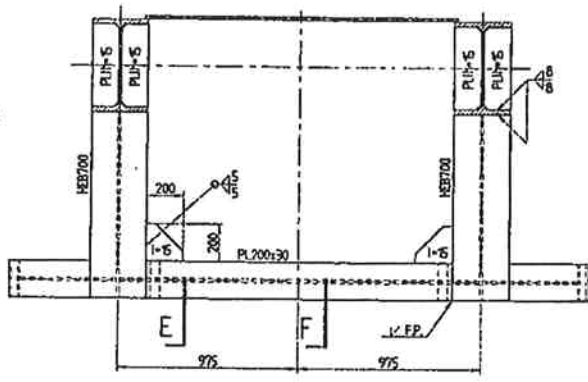
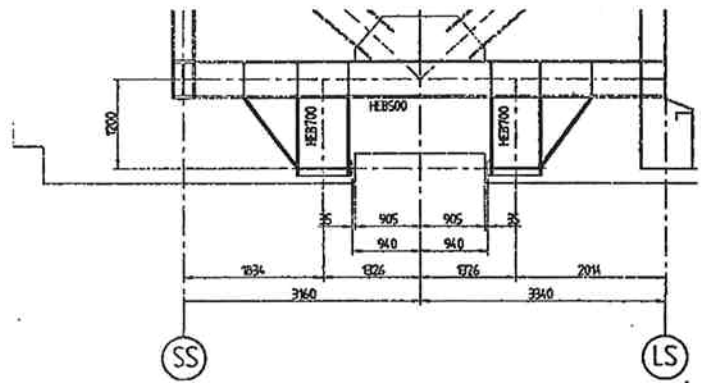
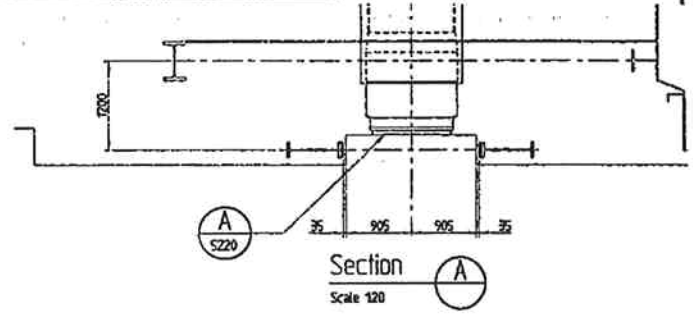
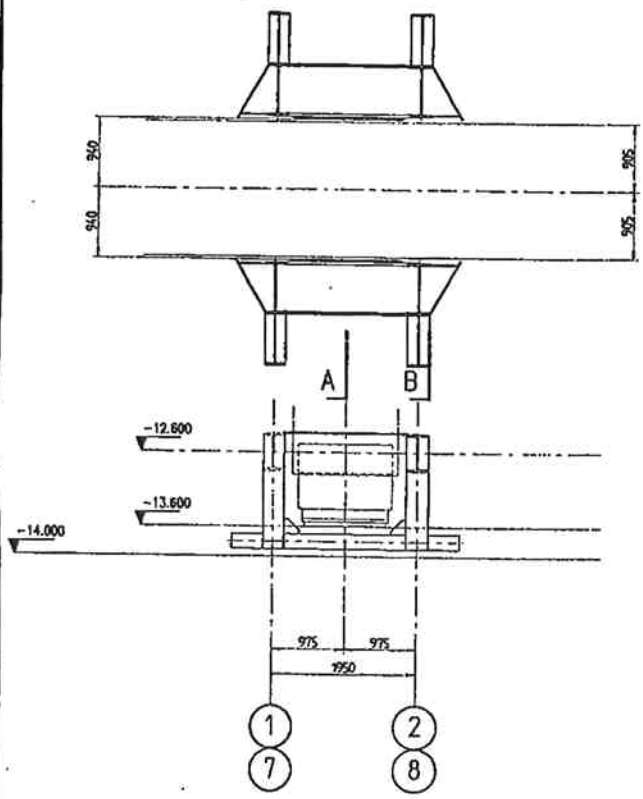
Reactions. Ult. combi : 11

Project : MALANOCCO NAV. LOCK GATE .

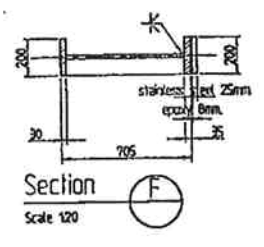
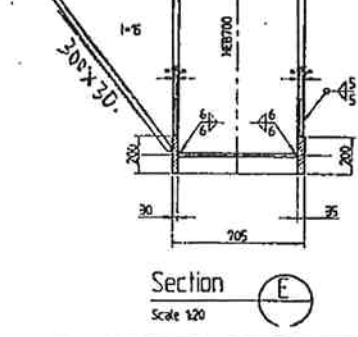
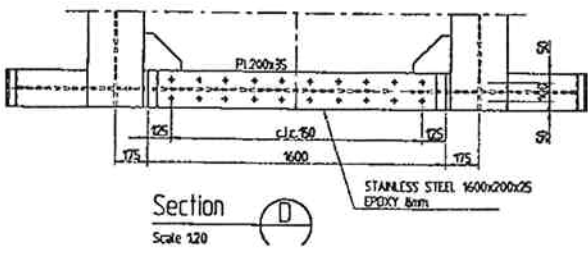
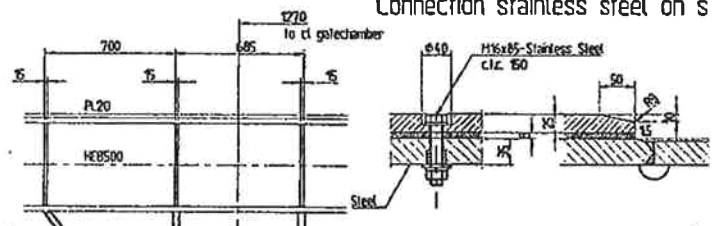
Onderdeel : HORIZONTAL SUPPORTS BOTTOM



E2 HORIZONTAL SUPPORTS BOTTOM



Connection stainless steel on s



Opgesteld : ALSEMGEEST

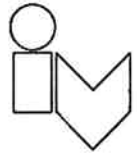
Datum : 28-04-04

Bladnummer : E2-1

Rev. : A2

Project : MALAMOLCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORT BOTTOM .



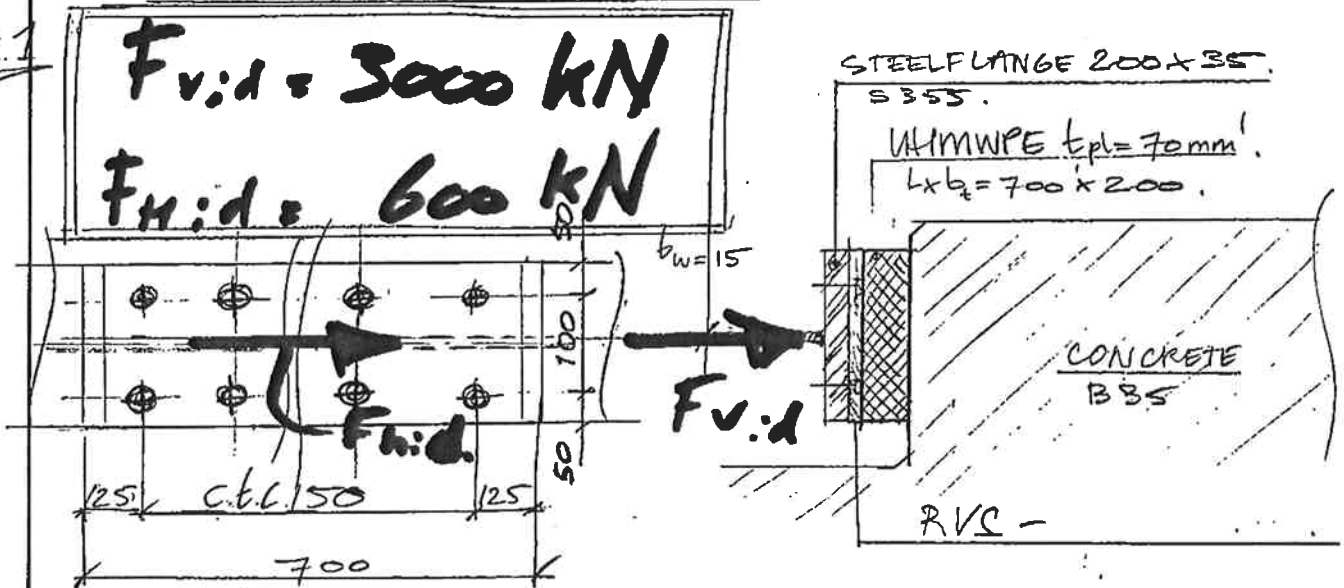
NOTE : CHECKS WITH -1mm- CORROSION ALLOWANCE .

LOCAL BEARING CHECK :

LC.1

$$F_{v;d} = 3000 \text{ kN}$$

$$F_{H;d} = 600 \text{ kN}$$



UHMMWPE GOVERNING :

$$f_{c,u;d:UHMMWPE} = 8 \text{ N/mm}^2$$

BEARING AREA :

$$b = t_w + 2 \cdot c ; t_w = 15 - 2 = 13 \text{ mm}'$$

$$c = t_{pl} \cdot \sqrt{\frac{f_{y;d \text{ steel}}}{3 \cdot f_{c,u;d:UHMMWPE}}}$$
$$= 33 \cdot \sqrt{\frac{345/1.1}{3 \cdot 8}} = 120 \text{ mm}'$$

$$b = 13 + 2 \cdot 120 = 253 \text{ mm}' \Rightarrow 200$$

$$A_c = b \times L = 200 \cdot 1500 = 300.000 \text{ mm}^2$$

Opgesteld : ALSEMGEEST

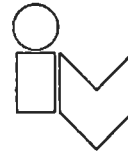
Datum : 28-04-04

Bladnummer : E2-2

Rev. : A2

Project : MALAM OCCO NAV. LOCK GATE.

Onderdeel : HORIZONTAL SUPPORT BOTTOM.



L.C. ①: ULTIMATE COMPRESSION LOAD.

$$f_{c:s;d} = \frac{F_{c;d}}{A_c} = \frac{3000 \cdot 10^3}{300.000} = 10 \text{ N/mm}^2$$

This is higher than fluid, but since no creep will occur (short load only during wave / earth-quake) acceptable

L.C. ②: MAX. COMB. COMPRESSION + SHEAR.

compression $f_{c:s;d} = \frac{F_{c;d}}{A_c} = \frac{1200 \cdot 10^3}{375000} = 3,2 \text{ N/mm}^2$

SHEAR $f_{s:s;d} = \frac{F_{s;d}}{A_{tot}} = \frac{240 \cdot 10^3}{400000} = 0,7 \text{ N/mm}^2$

$$f_{E:s;d} = \sqrt{3,2^2 + 3 \cdot 0,7^2} = 3,5 \text{ N/mm}^2$$

$$u.c. = \frac{f_{E:s;d}}{f_{cud}} = \frac{3,5}{8,0} = 0,43 \text{ OK}$$

L.C. ③: BEARING HORIZONTAL LOAD.

MUMWPE CONNECTED BY 2x10 BOLTS.

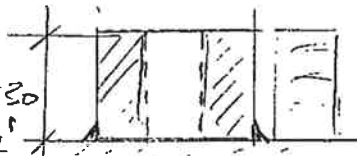
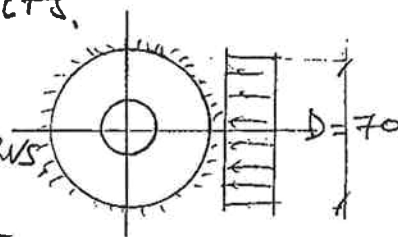
MUMWPE - CONCRETE > MUMWPE - RVS.

FRICION WITH CONCRETE BIGGER THAN RVS.

SO THEORETICALLY THE HORIZONTAL

LOAD IS BEARED BY FRICTION.

CAPACITY BOLTED CONNECTION AS BACKUP.



$F_{B;u;d}$; PER BOLT (DERIVED FROM E-14) = 12 kN.

$F_{B;u;d}$; TOT. = $2 \cdot 10 \cdot 12 = 240 \text{ kN} \Rightarrow F_{B;u;d} = F_{B;s;d}$; OK.

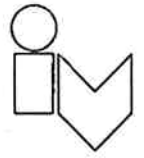
Opgesteld : ASEMGEEST

Datum : 28-04-04

Bladnummer : E2-3

Rev. : A2

Project : MALAMOLLO NAV. LOCK GATE



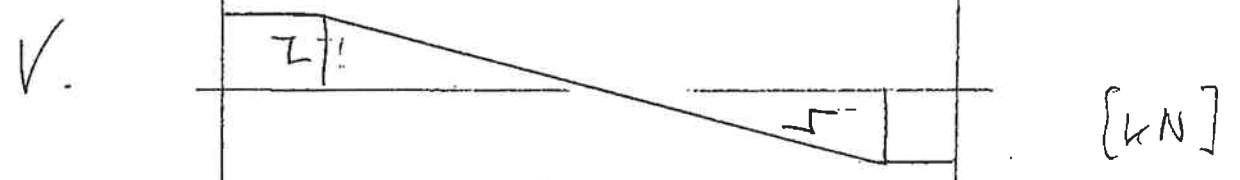
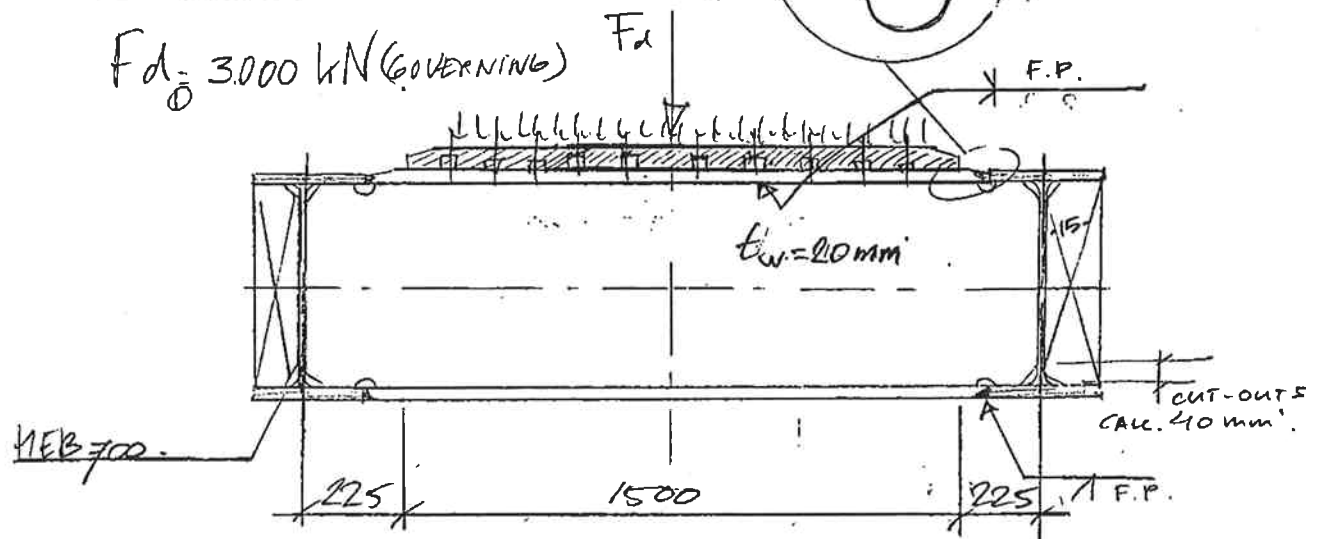
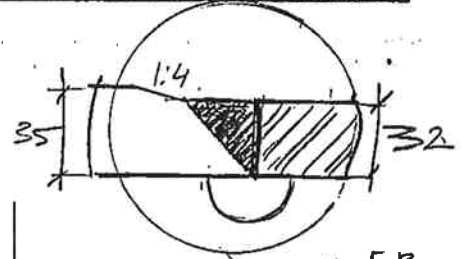
Onderdeel : HORIZONTAL SUPPORT BOTTOM

LOADCASE (1) : ULTIMATE COMPRESSION

SPREADER BEAM:

GLOBAL

$F_d = 3000 \text{ kN (GOVERNING)}$



$$R_d = V_{d \max} = \frac{F_{d0}}{2} = 1500 \text{ kN}$$

$$M_{d; \max} = 0,225 \cdot 1500 + \frac{1}{2} \cdot 0,750 \cdot 1500 = 900 \text{ kNm}$$

Opgesteld : ALSEMGEEST

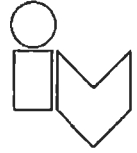
Datum : 28-04-04

Bladnummer : 2-4

Rev. : AL

Project : MALAMOLLO NAV. LOCK GATE.

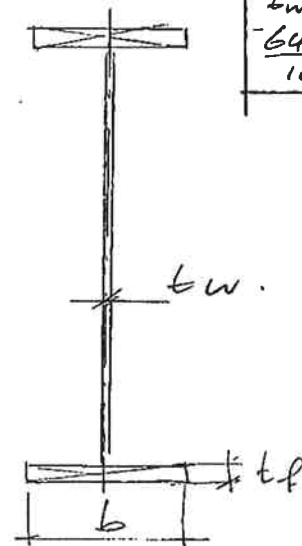
Onderdeel : HORIZONTAL SUPPORT BOTTOM.



REDUCED CROSS-SECTION PROPERTIES (OUTLINE - 1mm-)

SPREADER BEAM:

$b = 198 \text{ mm}$
 $h = 698 \text{ mm}$
 $t_w = 11 \text{ mm}$
 $t_f = 28 \text{ mm}$
 $A = 22644 \text{ mm}^2$
 $I_y = 1,642 \cdot 10^9 \text{ mm}^4$
 $W_{y;d} = 4,7 \cdot 10^6 \text{ mm}^3$



CLASS 3
$\frac{b}{t_w} \leq 124 \cdot 0,81 = 100$
$\frac{642}{18} = 36 ; \text{OK}$

PLB 700:

$b = 298 \text{ mm}$
 $h = 698 \text{ mm}$
 $t_w = 15 \text{ mm}$
 $t_f = 30 \text{ mm}$
 $A = 27450 \text{ mm}^2$
 $I_y = 2,321 \cdot 10^9 \text{ mm}^4$
 $W_{y;d} = 665 \cdot 10^6 \text{ mm}^3$

CAPACITY:

STEEL PL. < 16 : $f_y = 355 \text{ N/mm}^2$
16 < STEEL PL. < 40 : " = 345 "
STEEL PL. > 40 : " = 335 "

$$f_{w;d} : \text{weld} = \frac{f_u / \sqrt{3}}{\beta_w \cdot \gamma_m}$$
$$= \frac{570 / \sqrt{3}}{0,9 \cdot 1,25} = 262 \text{ N/mm}^2$$

Opgesteld : ALSEMGER ST

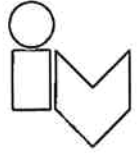
Datum : 28-04-04

Bladnummer : E2.5

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : HORIZONTAL SUPPORT BOTTOM.



SPREADER BEAM

GLOBAL CHECK:

BENDING: $\sigma_D = M_D / W_{ely} = 900 \cdot 10^6 / 4,7 \cdot 10^6 = 192 \text{ N/mm}^2$

u.c. = $\sigma_D / f_{yD} = 192 \cdot 1,1 / 345 = 0,61$; OK.

BENDING + SHEAR: $\tau_D = F_{QD} / A_{WEB} = 1500 \cdot 10^3 / 18(698 - 2 \cdot 28) = 130 \text{ N/mm}^2$

$\sigma_B = 130 \cdot \frac{337,5}{900} = 72 \text{ N/mm}^2$

$\sigma_E = \sqrt{\sigma_B^2 + 3 \cdot \tau_D^2} = 237 \text{ N/mm}^2$

u.c. = $\sigma_E / f_{yD} = 237 \cdot 1,1 / 345 = 0,76$; OK.

Corrosion-reduction factor 1,1 $\Rightarrow 0,84$; OK.
FLANGE - WEB CONNECTION (GLOBAL)

PL20(18) $t_{s,d} = \frac{V \cdot S}{b \cdot I_y} = \frac{1500 \cdot 10^3 \cdot [298 \cdot 28 \cdot 322]}{18 \cdot 1,642 \cdot 10^9} = 743 \text{ N/mm}^2$

$\tau_{u;0;pl} = \frac{355}{1,1} / \sqrt{3} = 186 \text{ N/mm}^2$

u.c. = $743 / 186 = 0,77$ OK.

WELD: $\Delta 6$ (CALC 5) $\tau_{w;s;d} = 743 / 2,5 = 257 \text{ N/mm}^2$
u.c. = $\tau_{w;s;d} / f_{w;w;d} = 0,98$ OK.

FLANGE - WEB AT BEARING (LOCAL)

PL20(18) $\sigma_{L,D} = F_d / A_{NECK} = 2000 \cdot 10^3 / 18 \cdot 1500 = 74 \text{ N/mm}^2$

u.c. = $74 \cdot 1,1 / 355 = 0,23$ OK.

WELD: $\left[\frac{18}{2,5} \cdot 74 \right] 2 / \sqrt{3} = 153 \text{ N/mm}^2$; typical weld AN 6: OK.

Opgesteld : A. SENGELST

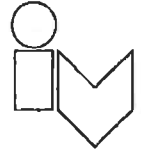
Datum : 28-04-04

Bladnummer : E2-6

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORT BOTTOM .



CONNECTION SPREADER BEAM - HEB.700

$$PL: \tau_b = \frac{F_{b0}}{A_{WEB}} = \frac{1500 \cdot 10^3}{15 \cdot (698 - 2 \cdot [28 + 40])} = 178 \text{ N/mm}^2$$

$$u.c. = \frac{178 \cdot 1,1 \cdot \sqrt{3}}{355} = 0,95; \underline{O.K.}$$

WEBS: #6 (CALC. 5).

$$\tau_b = 178 \cdot 1,5 / 2 \cdot 5 = 267 \text{ N/mm}^2$$

$$u.c. = \tau_b / f_{wvd} = 267 / 262 = 1,0. \underline{O.K.}$$

SUFFICIENT DUE TO CONSERVATIVE ASSUMPTION OF 40 mm.

Opgesteld : ALSEMGEEST

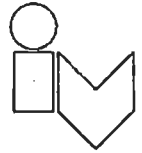
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Bladnummer : #2-7

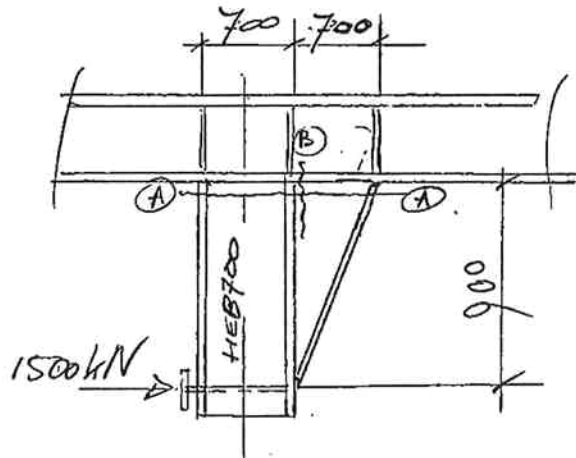
Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORT BOTTOM .



CONSOLE HEB700 INCL. BRACKET



LOADS

$$F_{V:SID @-@} = 1500 \text{ kN} .$$

$$M_{S:ID @-@} = 0,9 \cdot F_{V:SID @-@} = 1350 \text{ kNm} .$$

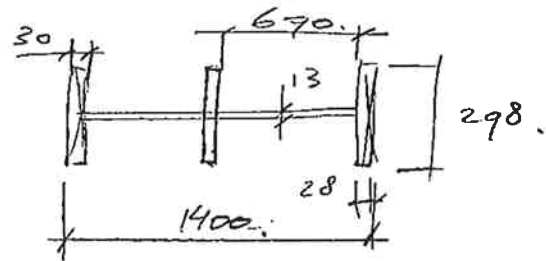
PROPERTIES : SECTION (A-A)

$$A = 45100 \text{ mm}^2$$

$$I_y = 1,116 \cdot 10^{10} \text{ mm}^4$$

$$W_{y:el} = 1,6 \cdot 10^7 \text{ mm}^3$$

$$A_v = (1400 - 2 \cdot 30) \cdot 13 = 17420 \text{ mm}^2 .$$



Opgesteld : Alsemgeest .

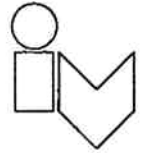
Datum : 28-04-04

Bladnummer : E2-8

Rev. : A2

Project : MALAMOCO NAV. Lock GATE .

Onderdeel : HORIZONTAL SUPPORT BOTTOM .



SECTION (A) - (A)

STRESSES PL.

$$\sigma_B = \frac{M_{d1}}{W_{y,d1}} = \frac{1350 \cdot 10^6}{1,6 \cdot 10^7} = 84 \text{ N/mm}^2$$

$$\tau_D = \frac{F_{v,s,d}}{A_{vz}} = \frac{1500 \cdot 10^3}{17420} = 86 \text{ N/mm}^2$$

WELD STRESSES : ~~A-8~~ (calc. 7)

FLANGE : $\sigma_1 = \tau_1 = \frac{84 \cdot 30}{14} = 181 \text{ N/mm}^2$

$$\tau_{w,s,d} = \frac{2 \cdot 181}{\sqrt{2}} = 209 \text{ N/mm}^2$$

$$u.c. = \frac{\tau_{w,s,d}}{f_{w,u,d}} = \frac{209}{262} = 0,8 \text{ O.K.}$$

WEB : $\tau_2 = \frac{67 \cdot 13}{10} = 87 \text{ N/mm}^2$ (NOT GOVERNING)

SECTION (B) - (B) AT HEIGHT (A) - (A)

$$\tau_{@PI} = \frac{V \cdot S}{b \cdot I}$$

$$= \frac{1500 \cdot 10^3 \cdot [(670 \cdot 13) \cdot [\frac{670}{2} + 12] + [298 \cdot 30] \cdot (670 + 12 + 15)]}{13 \cdot 1,16 \cdot 10^{10}}$$

$$= 95 \text{ N/mm}^2 ; \text{ NOT GOVERNING. } \rightarrow \text{ WELD TYPICAL.}$$

~~A-6~~

SECTION (B) - (B) AT HEIGHT SPREADER BEAM

CONSERVATIVE :

$$\tau_{PI} = \frac{V \cdot S}{b \cdot I_{Y_{HEB700}}} = \frac{1500 \cdot 10^3 \cdot [298 \cdot 30 \cdot [348 \cdot 30]]}{13 \cdot 2,321 \cdot 10^9} = 148 \text{ N/mm}^2$$



$$u.c. = \frac{148}{262} = 0,57 \rightarrow \text{ WELD } \text{A-6} \text{ O.K.}$$

Opgesteld : ALBEMGEEST

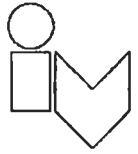
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Bladnummer :

Rev. : E2-9 AL

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : HORIZONTAL SUPPORT BOTTOM.



WEB STIFFENERS $t_{pl} = 15 \text{ a} \rightarrow 8$.

$$h_i = 498 - 2 \cdot [28 + 40] = 362 \text{ mm}'$$

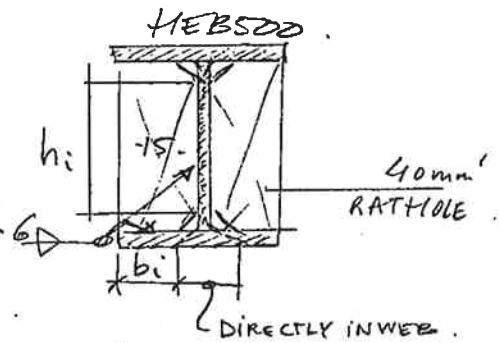
$$b_i = [298 - (2 \cdot 40) - 15.5] / 2 = 101 \text{ mm}'$$

$$\tau_{\text{FLANGE CONSOLE}} [E2-9] = 84 \text{ N/mm}^2$$

$$\tau_{\text{STIFFENER}} = 84 \cdot \frac{30}{1} = 194 \text{ N/mm}^2$$

$$\tau_{\text{STIFFENER}} = \tau_{\text{STIFFENER}} \cdot \frac{b_i}{h_i}$$

$$= 194 \cdot 101 / 362 = 54 \text{ N/mm}^2$$



CHECK WELDS : A 6 (5)

STIFF. - FLANGE :

$$\tau_{\text{WELD}} = \tau_{\text{STIFF}} \cdot \frac{1}{\sqrt{3}} = 224 \text{ N/mm}^2 \quad \left. \begin{array}{l} \text{u.c.} = 0.86 \text{ ok} \\ 262 \text{ N/mm}^2 \end{array} \right\}$$

$\tau_{\text{WELD}} =$

STIFF. - WEB HEB700 :

$$\tau_{\text{STIFF}} = 54 \text{ N/mm}^2 \quad \left. \begin{array}{l} \text{u.c.} = 0.21 \text{ ok} \\ 262 \text{ N/mm}^2 \end{array} \right\}$$

$\tau_{\text{WELD}} =$

Opgesteld : AISEMGEEST

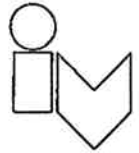
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Bladnummer : E2-10

Rev. : AR

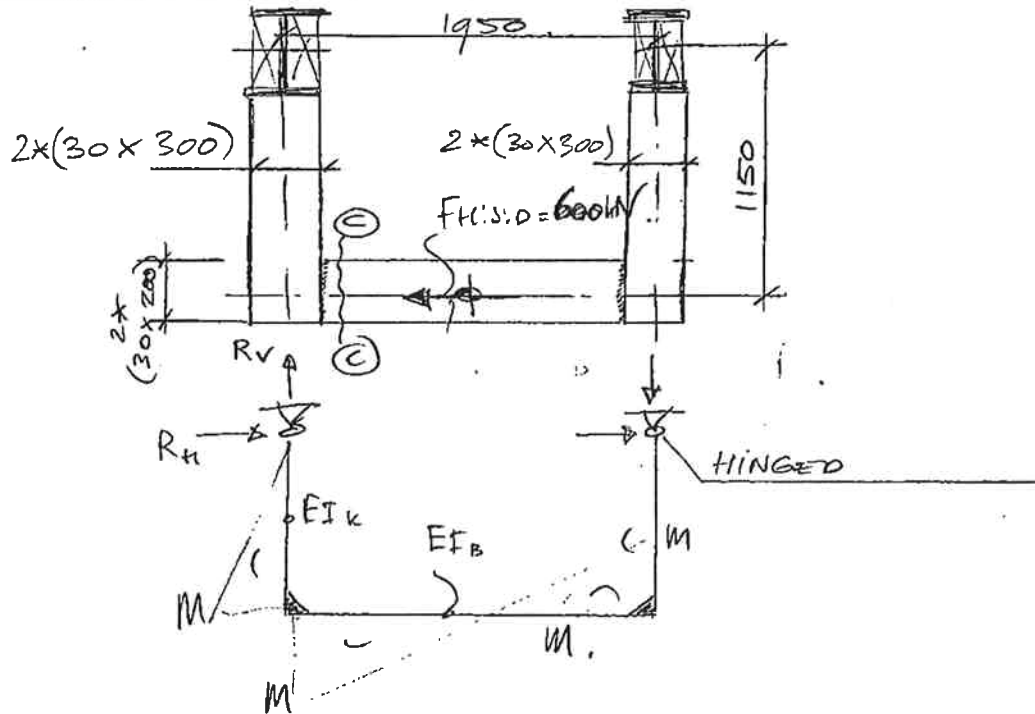
Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORT BOTTOM .



LOADCASE ② : MAX COMB. OF COMPRESSION + SHEAR.

CHECK ON BENDING STRESS DUE TO SHEAR.



GOVERNING SECTION ① - ①

CONSERVATIVE : $EI_k = EI_B$

LOADING : $R_H = 600/2 = 300 \text{ kN}$. (CONSERVATIVE; MAX $F_H = 240 \text{ kN}$ LOADCASE ②)

$$R_v = 300 \cdot 115/195 = 177 \text{ kN}$$

$$M = 300 \cdot 115 = 345 \text{ kNm}$$

$$W_{el} \text{ ① - ①} = \frac{2}{6} \cdot 28 \cdot 198^2 = 365904 \text{ mm}^3$$

$$A \text{ ① - ①} = 2 \cdot 198 \cdot 28 = 11088 \text{ mm}^2$$

$$\sigma \text{ ① - ①} = R_H/A + M/W_{el} = 27 + 943 = 970 \text{ N/mm}^2$$

$$u.c = 970 \cdot 11/345 = 3,1 \neq 1,0 ; \text{AD GUSSET PLATES.}$$

Opgesteld : *A. SEMGEEST*

Datum : 28-04-04

Bladnummer : E2-11

Rev. : A2

Project : MALAMOLLO NAV. LOCK GATE

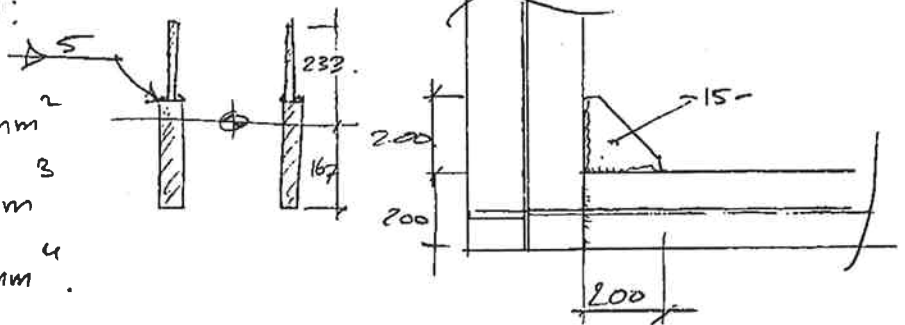
Onderdeel : HORIZONTAL SUPPORT BOTTOM



STIFFENING CORNER BY GUSSET PL. AT EACH SIDE

SECTION C-C:

$$A' = 16800 \text{ mm}^2$$
$$W_{el}' = 1,23 \cdot 10^6 \text{ mm}^3$$
$$I' = 2,053 \cdot 10^8 \text{ mm}^4$$



$$\sigma_{C-C} = \frac{R_H}{A'} + \frac{M}{W'}$$
$$= 18 + 280 = 298 \text{ N/mm}^2$$

$$u.c. = 298 \cdot 1/355 = 0,92 \text{ OK}$$

t_{WELD} → 5

$$\tau_{WELD} = \frac{V \cdot S}{b \cdot T} = \frac{300 \cdot 10^3 (200 \cdot 28) \cdot 133}{2 \cdot 4 \cdot 2,053 \cdot 10^8} = 135 \text{ N/mm}^2$$

$$u.c. = 135 / 262 = 0,52 \text{ OK}$$

Opgesteld : ALSEMGEEST

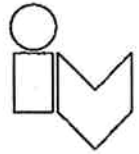
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Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : HORIZONTAL SUPPORT BOTTOM



DEFLECTION (UNDER MAX. REPR. LOAD. $F_0/1,5$)

DEFLECTION SPREADER BEAM

$$u_1 = \frac{F_{\text{ref}} l^3}{48EI} \Rightarrow F_{\text{R}} = 3000/1,5 = 2000 \text{ kN}$$
$$= \frac{2000 \cdot 10^3 \cdot 1950^3}{48 \cdot 2,1 \cdot 10^5 \cdot 1,642 \cdot 10^9}$$
$$= 0,9 \text{ mm}$$

DEFLECTION CONSOLE HEB 700 + STIFF.

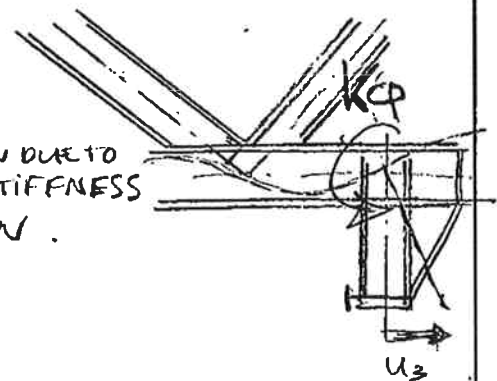
$$u_2 = \frac{R \cdot l^3}{3EI}$$
$$= \frac{7000 \cdot 10^3 \cdot 1150^3}{3 \cdot 2,1 \cdot 10^5 \cdot 7,776 \cdot 10^{10}}$$
$$= 0,22 \text{ mm}$$

TOTAL DEFLECTION

$$u_{\text{tot}} = u_1 + u_2 + u_3$$

$u_3 = 0$ (ASSUMED) → DEFLECTION DUE TO ROTATION STIFFNESS CONNECTION.

$$u_{\text{tot}} = 0,9 + 0,22 = 1,12 \text{ mm}$$



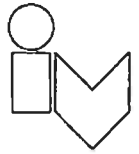
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Datum : 9 DEC. 03

Bladnummer : E2-13

Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE



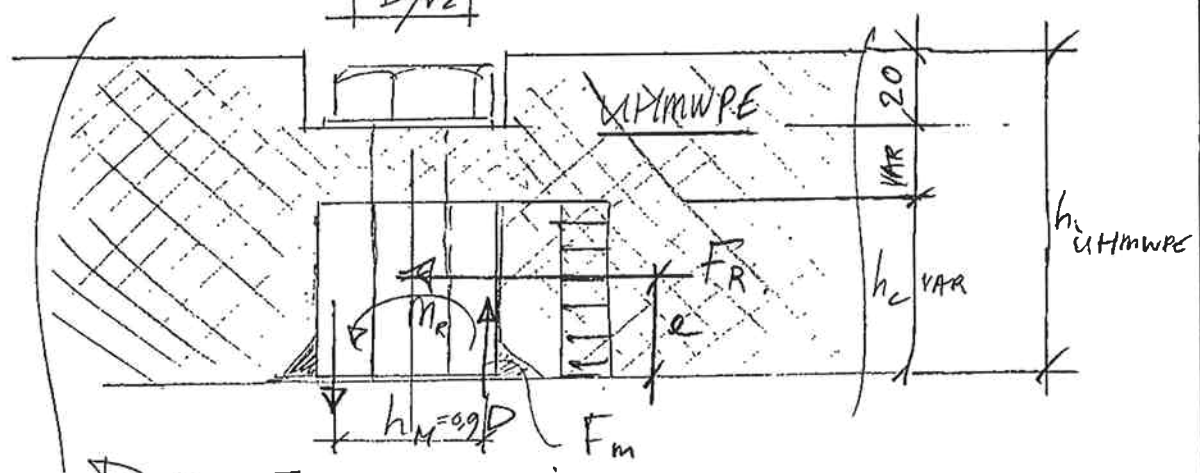
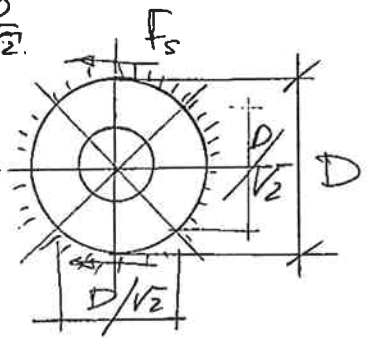
Onderdeel : CAPACITY BOLT CONNECTOR AT UHMWPE

APPENDIX

BOLT CONNECTOR FOR FASTENING OF UHMWPE-PADS

SHEAR : $F_s = \frac{1}{4}$ OF WELD : $\frac{P}{\sqrt{2}}$

NORMAL FORCE DUE TO MOMENT : $F_m = \frac{1}{4}$ OF WELD $\frac{P}{\sqrt{2}}$



$D = 70 \text{ mm}$
 $h_{\text{UHMWPE}} = 70 - 120 \text{ mm}$
 $h_c = 30 - 50 \text{ mm}$
 $e = 15 - 25 \text{ mm}$
 $f_{c.u.d} = 8 \text{ N/mm}^2 \text{ (UHMWPE)}$
 $A = h_c \cdot D/\sqrt{2}$
 $= 1485 - 2475 \text{ mm}^2$

LOAD:
 $F_R = f_{c.u.d} \cdot A$
 $= 12 - 20 \text{ kN}$
 $M_R = F_R \cdot e$
 $= 0,45 - 1,25 \text{ kNm}$

DESIGNED ON BEARING CAPACITY UHMWPE

Opgesteld : ALSEMGEEST

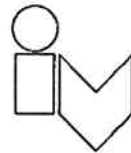
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Bladnummer : E2-14

Rev. : A2

Project : MALAMOCLO NAV. LOCK GATE .

Onderdeel : CAPACITY BOLT CONNECTOR
AT UYIMWPE .



CHECK WELD CONNECTION X.S. (Calc. 4).

MAX. SHEAR.

$$F_s = F_{Rd} / 2 = 50 / 2 = 25 \text{ kN} .$$

$$\tau_2 = \frac{F_s}{a \cdot D / \sqrt{2}} = \frac{25 \cdot 10^3}{4 \cdot 70 / \sqrt{2}} = 126 \text{ N/mm}^2 .$$

$$u.c. = \frac{126}{262} = 0,48 \text{ OK} .$$

MAX. NORMAL FORCE DUE TO MOMENT.

$$F_m = M_R / h_m = \frac{1,25 \cdot 10^6}{0,9 \cdot D} = 20 \text{ kN}$$

$$\sigma_1 = \tau_1 = \frac{F_m \cdot \sqrt{2}}{2 \cdot a \cdot D / \sqrt{2}} = \frac{20 \cdot 10^3}{4 \cdot 70} = 71 \text{ N/mm}^2 .$$

$$\sigma_{\text{twissid}} = 2 \cdot 71 / \sqrt{3} = 80 \text{ N/mm}^2 .$$

$$u.c. = \frac{80}{262} = 0,3 \text{ OK} .$$

Opgesteld : D. Alsemgeest

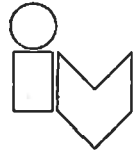
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Bladnummer : E2-15

Rev. : AR

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORT ALONG HEIGHT



E3. HORIZONTAL SUPPORT ALONG HEIGHT

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NOTE:

THIS CALCULATION CONSISTS OF CHECKING:

- LOCAL LOAD INTRODUCTION STEEL AT SIDE OF DOOR
- BEARING STRESS UHMWPE AND CONCRETE AT SIDE OF GATE CHAMBER.
(UHMWPE GOVERNING OVER CONCRETE REF. E3-5)
- ALLOWED; 1mm OFF OUTLINE PROFILES IN CALCULATION AS CORROSION TOLERANCE.

Opgesteld : ALSEMEST

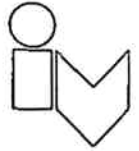
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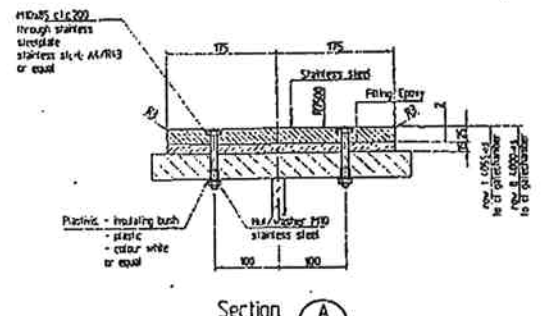
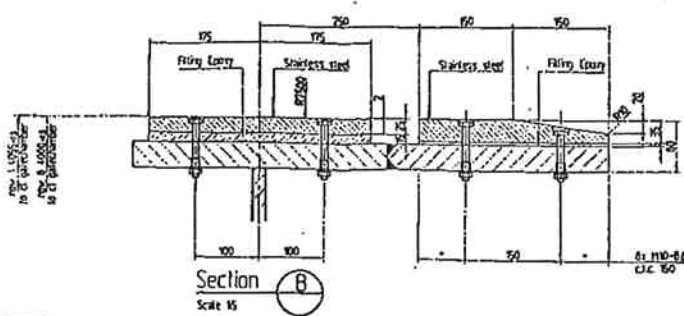
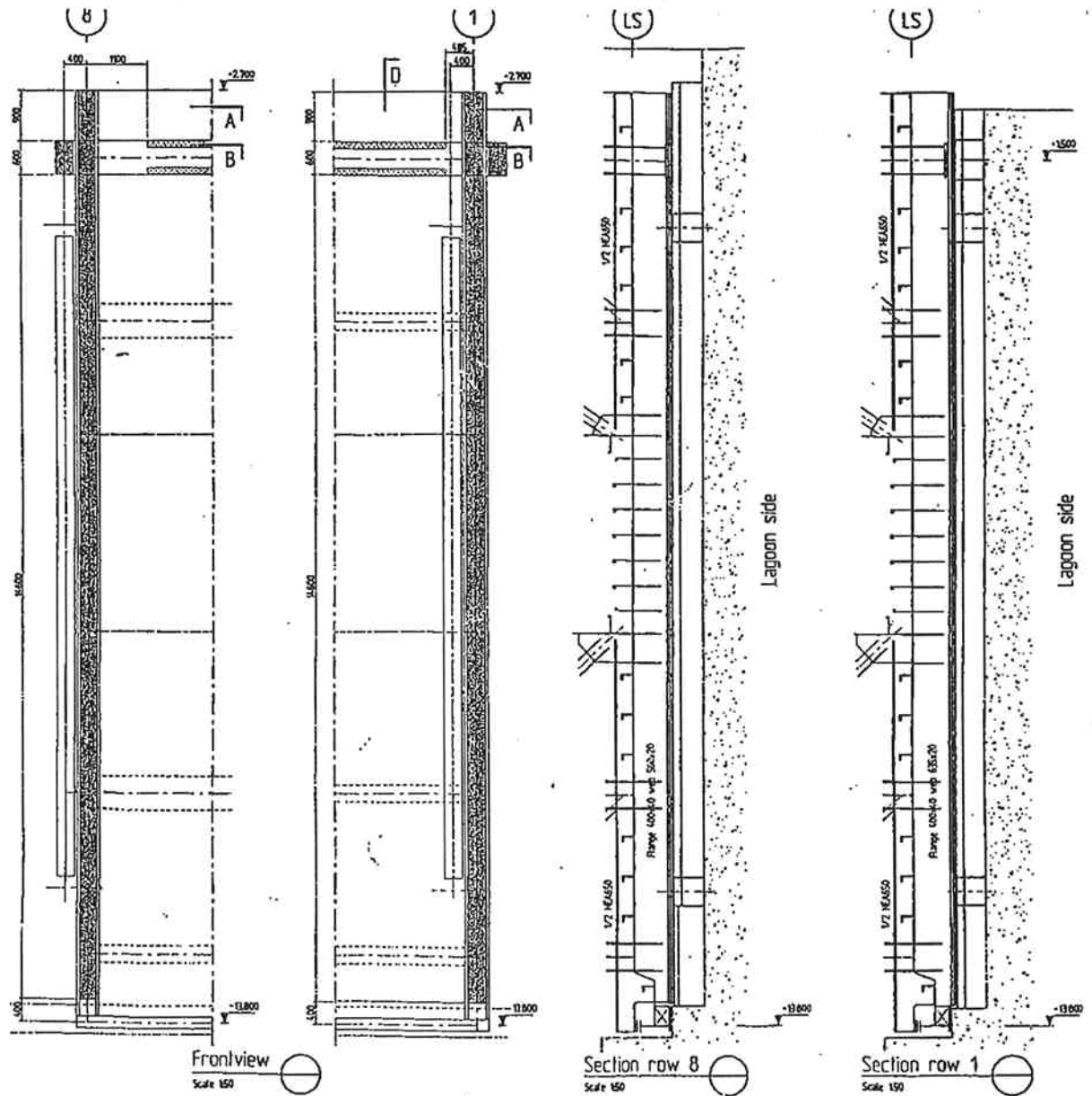
Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : FLOR. SUPPORTS ALONG HEIGHT



1. OVERVIEW. (GATE SIDE)



Opgesteld : **ALSEMGEEST**

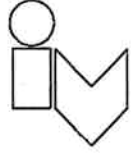
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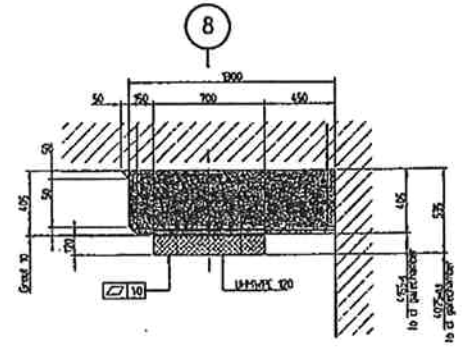
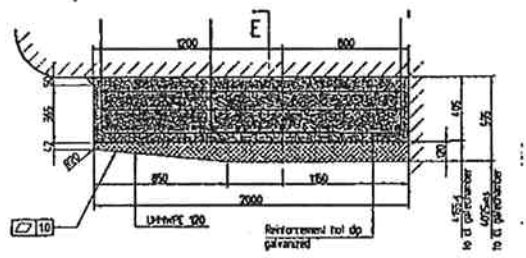
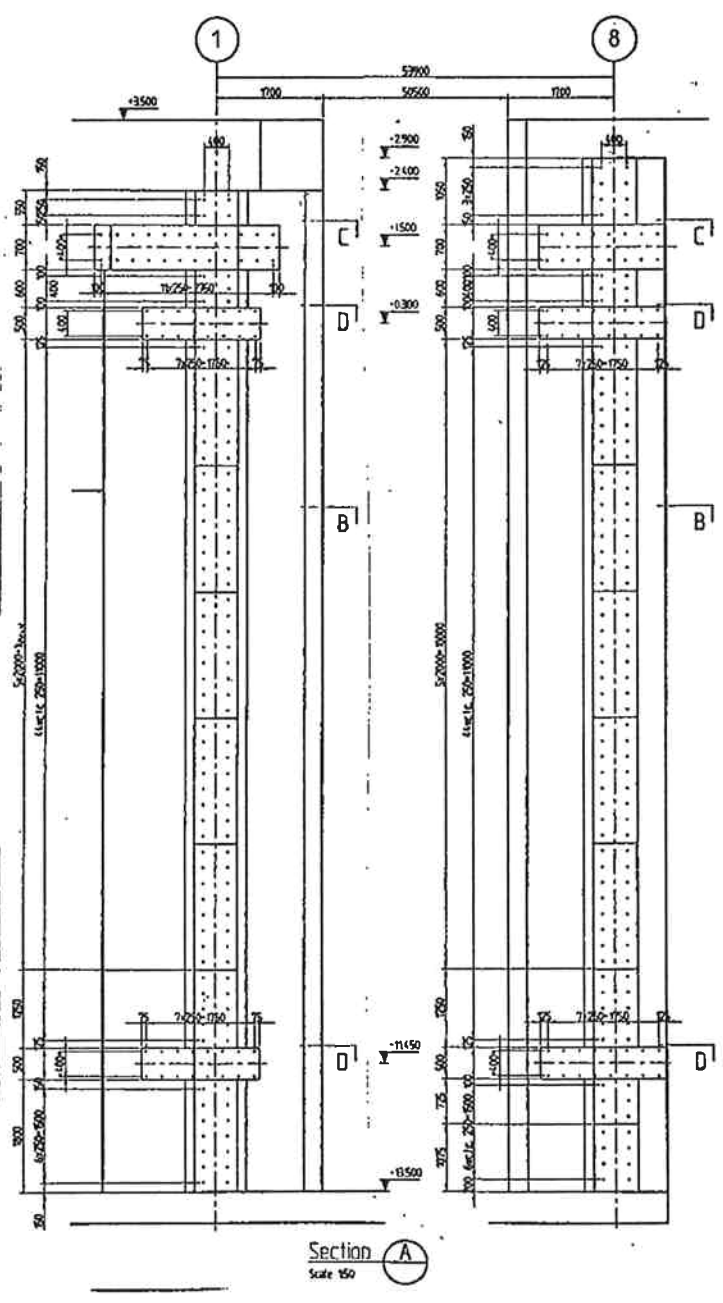
Rev. : **A2**

Project : MALAMOLCO NAV. Lock GATE

Onderdeel : HOR. SUPPORTS ALONG HEIGHT



1. OVERVIEW (CONCRETE SIDE)



UHMWPE
 $E_{CALC} = 800 \text{ N/mm}^2$
 $f_{c,u;d} = 8 \text{ N/mm}^2$ (AVERAGE)
 $= 12 \text{ N/mm}^2$ (PEAK*)

* NOTE: ALLOWABLE AT SHORT TERM LOADING.

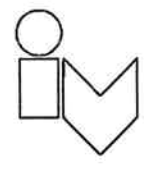
Opgesteld : ALSEMGEEST

Datum : 28-06-04

Bladnummer : E3-3

Rev. : A2

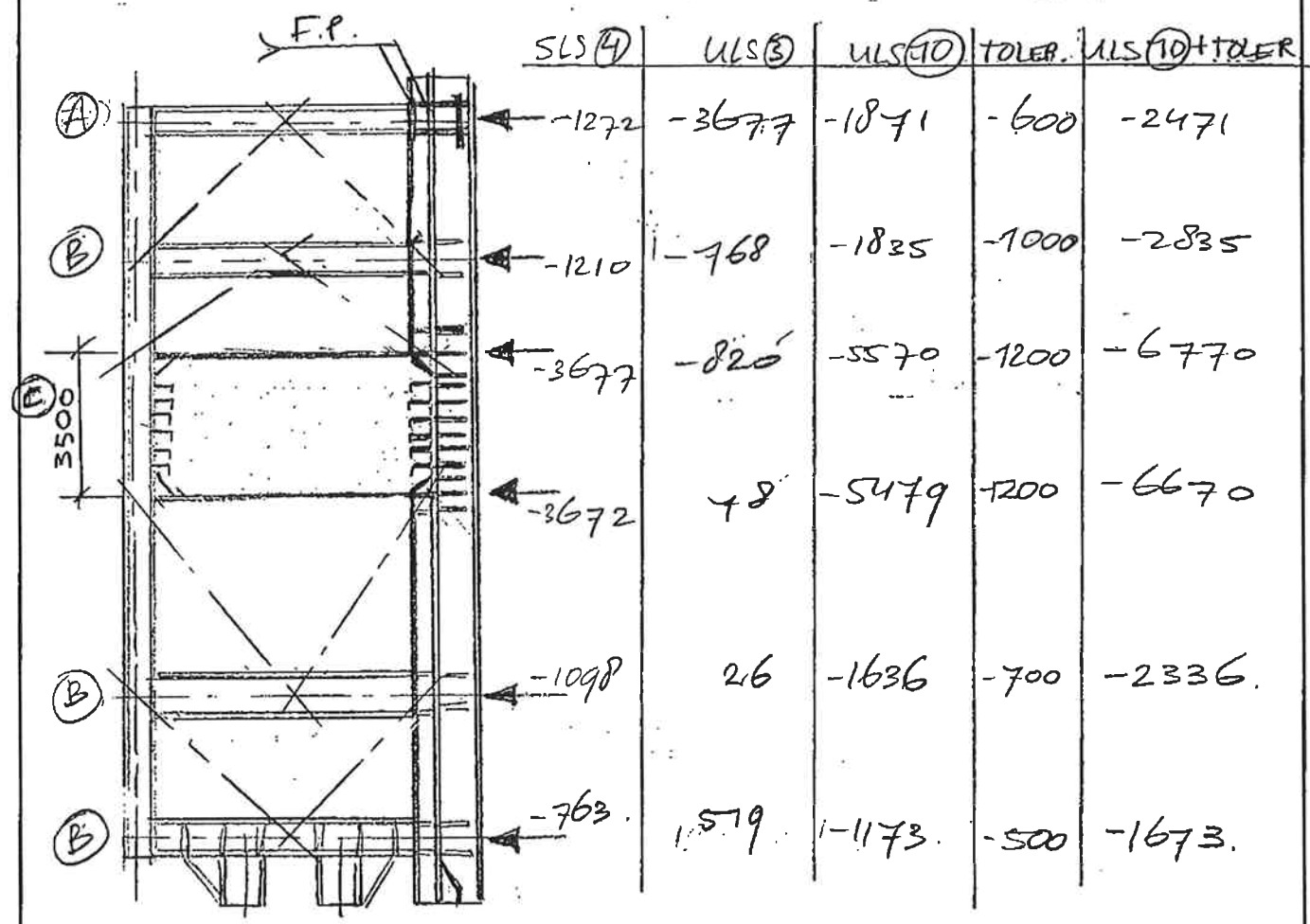
Project : MALAMOCCO NAV. LOCKGATE
 Onderdeel : HORIZONTAL SUPPORT ALONG HEIGHT.



2. LOADS .

LOADS DERIVED FROM SECTION E1. [IN kN]

GOVERNING SITUATIONS ULS : HIGHWATER COMBI (10) (cond. 1)
 ACCIDENTAL BOAT IMPACT COMBI (3) (cond. 2)
 SLS : HIGHWATER COMBI (4) (cond. 1)



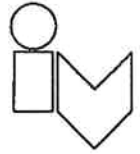
NOTE : DERIVED FROM ADDENDUM L; REACTION DUE TO TOLERANCES.
 IN THE NORMAL ULS COMBI (10) THE VERY UNLIKELY SITUATION
 WILL BE EXAMINED OF HIGHERING THE REACTIONS WITH
 THE MAX. TOLERANCE REACTIONS FOR EACH POINT!

NOTE: GLOBAL STRESSES FROM MAIN CALCULATION NEGLECTABLE.

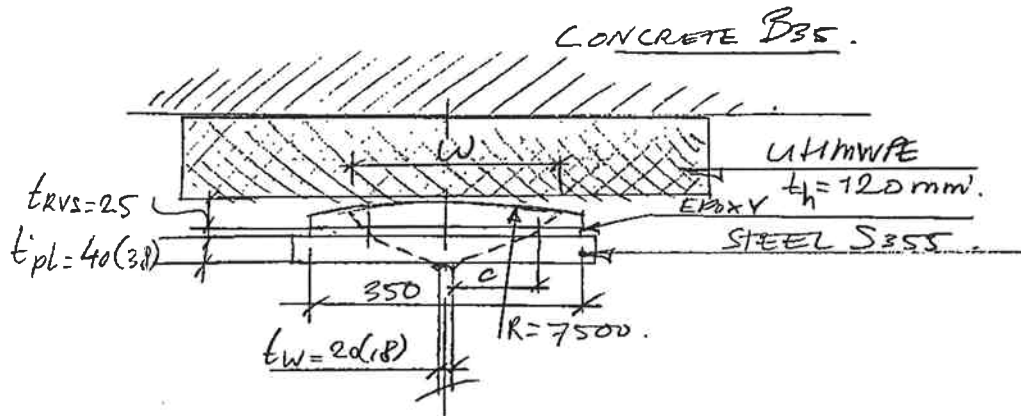
Opgesteld : ALSENGEEST Datum : 03-04 Bladnummer : E3-4 Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : HORIZONTAL SUPPORTS ALONG HEIGHT



3. UHMWPE - BEARING CHECK



ALLOWABLE DESIGN STRESS :

$$f_{c;u;d}: \text{STEEL} = \frac{345}{1,1} = 314 \text{ N/mm}^2$$

$$f_{c;u;d}: \text{UHMWPE} = \boxed{8 \text{ N/mm}^2} \text{ (AVERAGE)}$$

$$f_{c;u;d}: \text{CONCRETE} = 0,67 \cdot \frac{30}{1,5} = 13,3 \text{ N/mm}^2 \text{ (NOT GOVERNING)}$$

W : SPREAD WIDTH DETERMINED ON WEAKEST ELEMENT (UHMWPE).

$$c = t_{pl} \cdot \sqrt{\frac{f_{yd}: \text{steel}}{3 \cdot f_{c;u;d}: \text{UHMWPE}}}$$

$$= 38 \cdot \sqrt{\frac{314}{3 \cdot 8}} = 138 \text{ mm}$$

$$W = 2 \cdot c + t_w + 2 \cdot t_{rvs} =$$

$$= 2 \cdot 138 + 18 + 2 \cdot 25 = \underline{344 \text{ mm}} \geq 350 \text{ mm}$$

PL. 40 IS SUFFICIENT FOR ACTIVATING THE FULL WIDTH
AT AN AVERAGE STRESS OF 8 N/mm^2 ; 8

Opgesteld : D. AISENGEEST

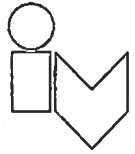
Datum : 200604

Bladnummer : E3-5

Rev. : A2

Project : MALAMOCO NAV. LOCK, GATE

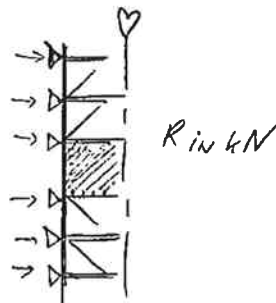
Onderdeel : HORIZONTAL SUPPORTS ALONG HEIGHT.



REACTION DEVIATION ALONG HEIGHT OF UHMWPE - BEARING,

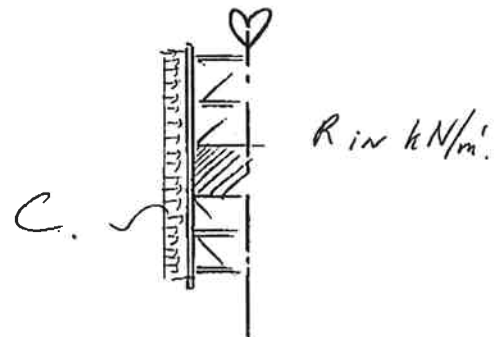
SUPPORTS ALONG HEIGHT AT ROW. ① AND ⑧ ; ...

IN MAINCALL. MODEL



POINT SUPPORTS

REALITY



SUBSOIL C

THE ACTUAL REACTION DEVIATION ALONG THE HEIGHT IS DETERMINED BY MODELLING SEPERATELY.

THE VERT. BEARING-T SPRING SUPPORTED: ALONG THE ENTIRE LENGTH (SUBSOIL C) LOADED WITH THE GOVERNING REACTIONS FROM THE MAIN CALC. DOC. [EB-4].

$$C_{\text{SUBSOIL}} = \frac{E \cdot A_{\text{BEARING}}}{t_{\text{UHMWPE}}} \text{ / m}^2$$
$$= \frac{800 \cdot [344 \cdot 1000]}{120} = \underline{\underline{2293,3 \text{ MN/m}^2}}$$

RESULT OF CALC. (NEXT PAGES)

$$R_{\text{MAX}; D} = 2281 \text{ N/mm}^2 \quad (2791 \text{ N/mm}^2; \text{incl. tolerances})$$

ACCOMPANYING DEFORMATION: 1,0 mm (0,7 in, SLS) ..

Opgesteld : ALSEMGEEST

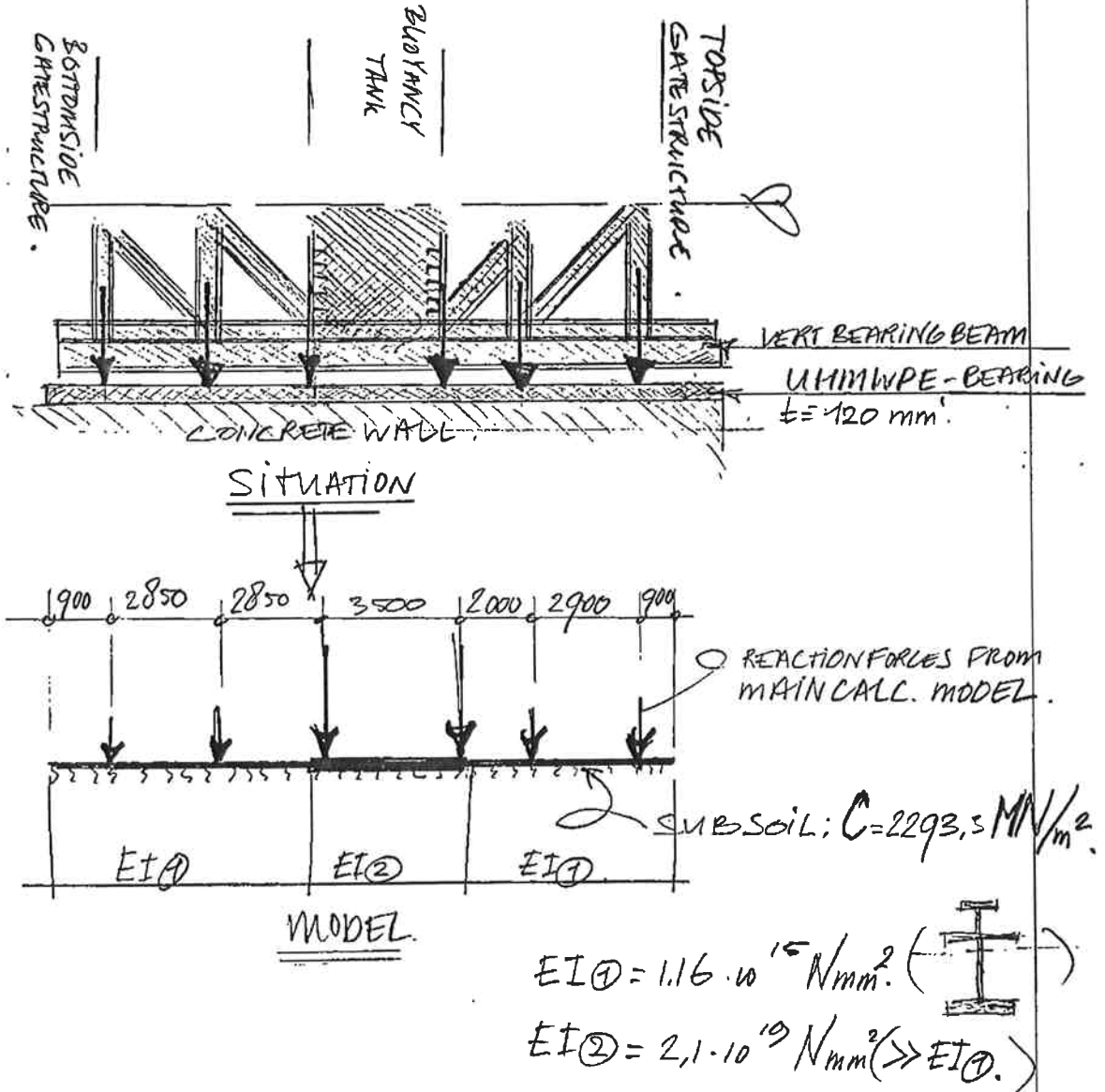
Datum : 280604

Bladnummer : EB-6

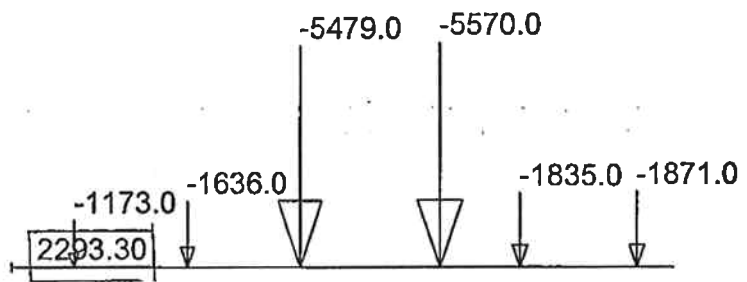
Rev. : A2

Contents

Overview: Governing situations	
Reactions: Load case(s) : 1	
Deformation on macro(s): Load case(s) : 1	
Reactions: Load case(s) : 1	

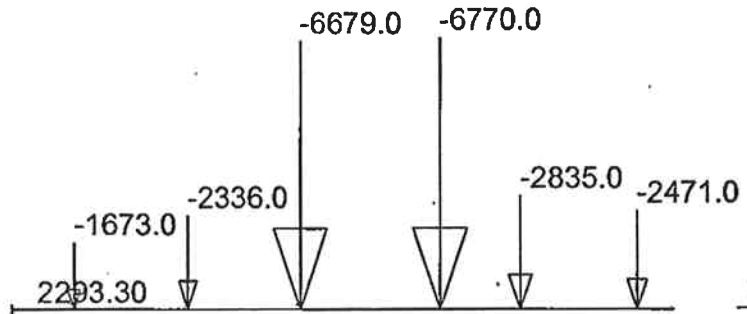


RESULTING IN
MAX. ULS REACTION ON ULTIMATE BEARING WITHOUT TOLERANCES



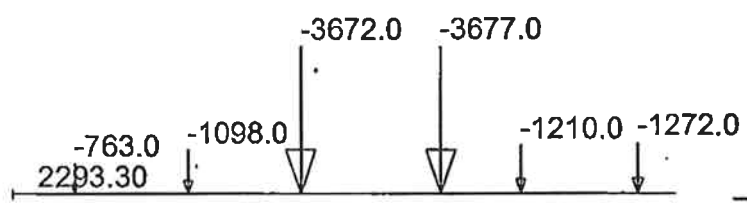
ULS COMBI (10)
1.35 DL + 1.5 LL HIGHWATER.

MAX. ULS REACTION WITH UNLIKELY TOLERANCES.



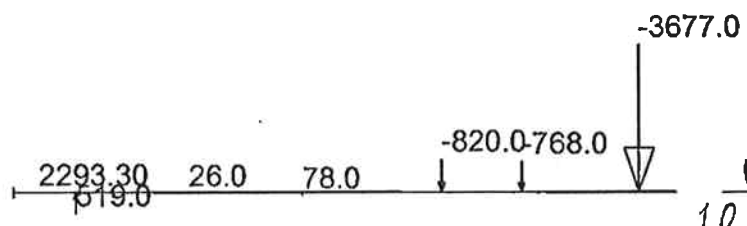
ULS COMBI (10)
INCL. LOAD INCREASE DUE TO TOLERANCES. (HIGHLY CONSERVATIVE)

MAX. SLS DEFORMATION OF ULTIMATE BEARING.



SLS COMBI (4)
1.0 DL + 1.0 LL HIGHWATER.

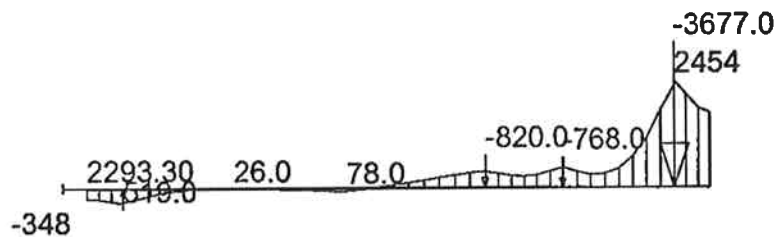
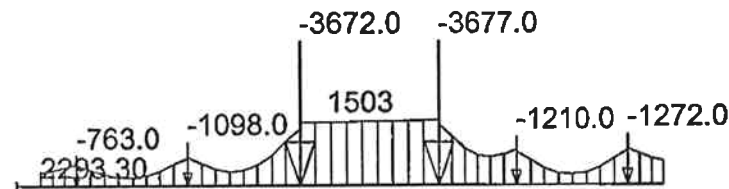
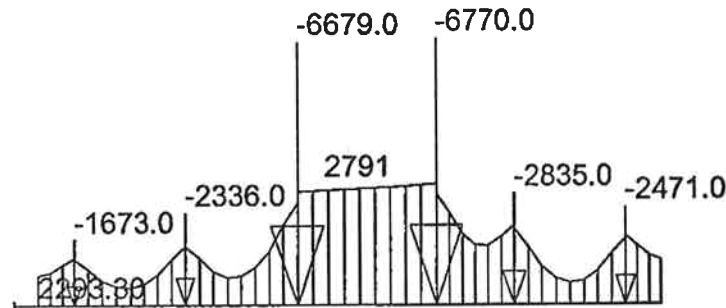
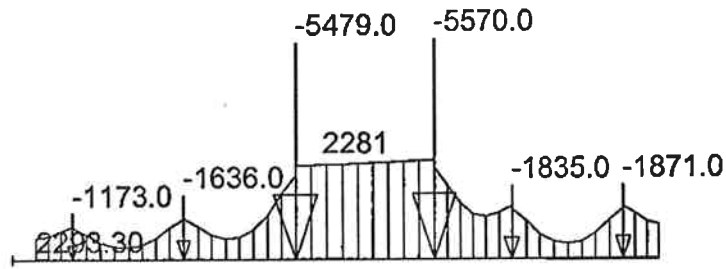
MAX. REACTION AND DEFORMATION OF ULTIMATE BEARINGS.



ULS COMBI (3) (ACCIDENTAL)
1.0 DL + 0.7 LL HIGHWATER + BOAT IM

Overview Governing situations

ES-8.

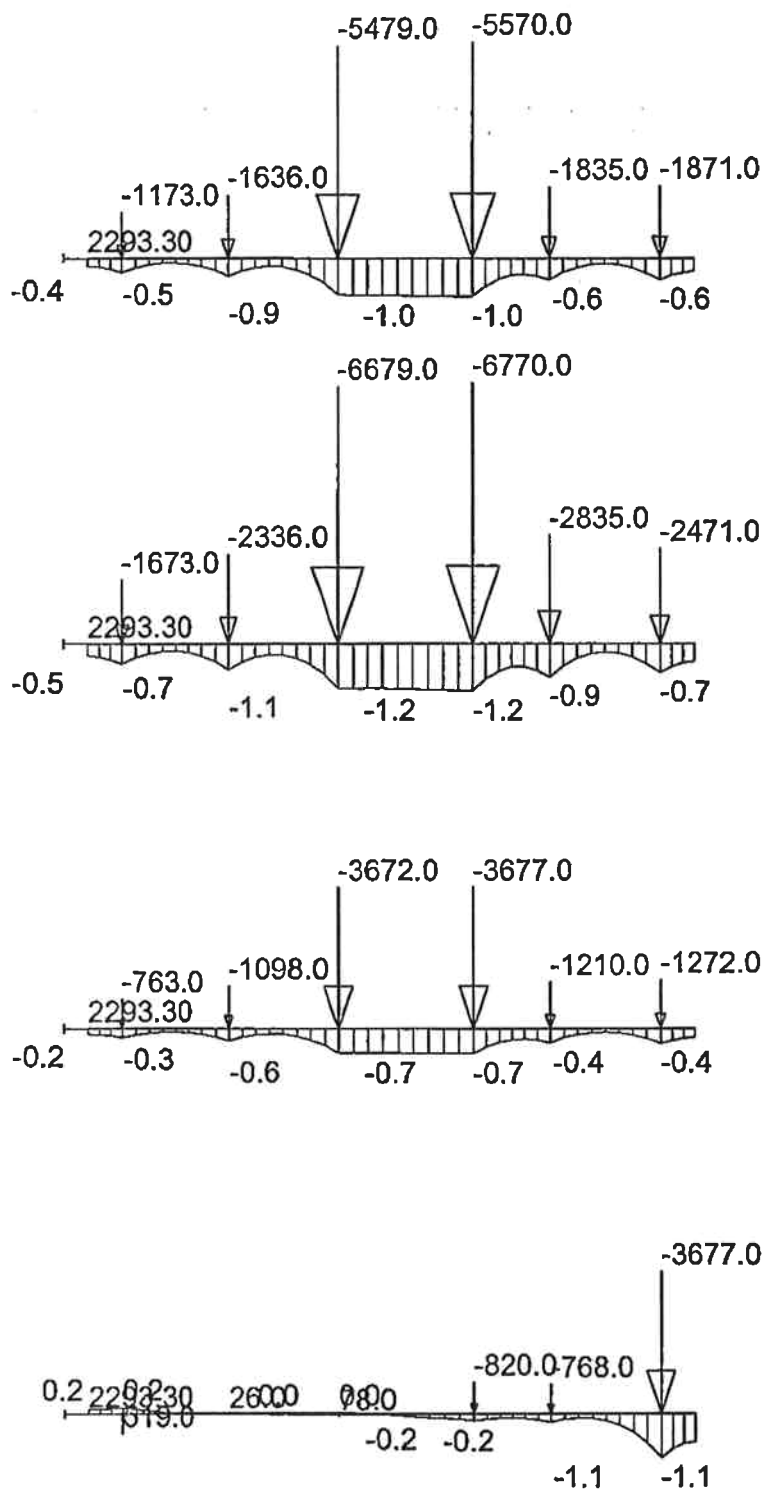


Reactions. Load case(s) : 1

MAX. REACTION ON BEARING

$$R_{MAX ID} = 2791 \text{ kN/m'}$$

E3-g



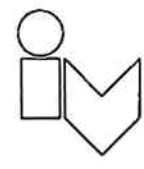
Deformation on macro(s). Load case(s) : 1

MAX. DEFORMATION ON BEARING.

$$u_z = -1,2 \text{ mm.}$$

Project : MALAMOCO NAV. LOCK GATE

Onderdeel : HORIZONTAL SUPPORT ALONG HEIGHT

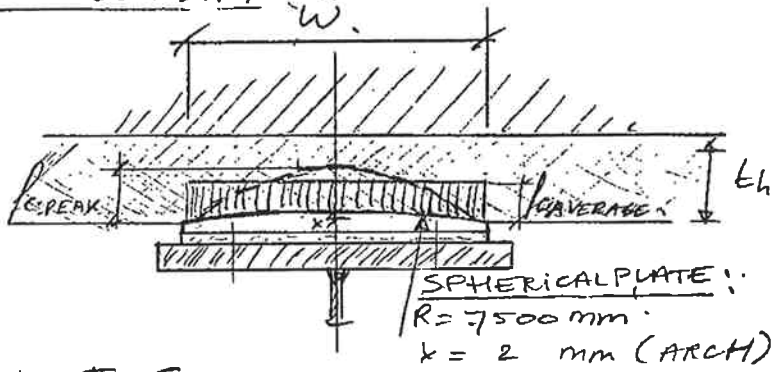


ALLOWABLE REACTION ON UHMWPE BEARING

ACCORDING MAX. ALLOWABLE STRESS + GEOMETRY RIS-PLATE:

$\therefore f_{c;uid; UHMWPE} = 12 \text{ N/mm}^2$ PEAK STRESS (SHORT TERM)
 $= 8 \text{ N/mm}^2$ AVERAGE STRESS.

PLATE GEOMETRY



$\sigma = E \cdot \epsilon$

$f_{c;uid; UHMWPE} = E \cdot \frac{\Delta t_h}{t_h} = 800 \cdot \frac{\Delta t_h}{120}$

Δt_h VARIES FROM EDGE TO MIDDLE OF SPHERICAL PLATE, SO DO THE STRESSES:

WHEN: $f_{c;uid; mid \text{ OF PL. } (x=2 \text{ mm})} = 12 \text{ N/mm}^2 \Rightarrow \Delta t_h = 1,8 \text{ mm}$
 $\Rightarrow \frac{F}{\text{mm}^2} = \frac{E \cdot \Delta t_h}{t_h} = 12 \text{ N/mm}^2$

$\rightarrow \Delta t_h = 1,8 \text{ mm}$

$\rightarrow \frac{F}{\text{mm}^2} = \frac{E \cdot \Delta t_h}{t_h} = 12 \text{ N/mm}^2$

$\rightarrow R_{ALLOWABLE} = \Sigma F \text{ OVER } W = 2629 \text{ N/mm}^2$

$\rightarrow W' = \text{EFFECTIVE BEARING WIDTH} = 320 \text{ mm}$

$\rightarrow f_{c; AVERAGE} = R_{ALLOWABLE} / W' = 8,0 \text{ N/mm}^2 \text{ .OK.}$

RESULTING FROM DIAGRAM ON PAGE E3-13.
2629 N/mm^2
320 mm
$8,0 \text{ N/mm}^2 \text{ .OK.}$

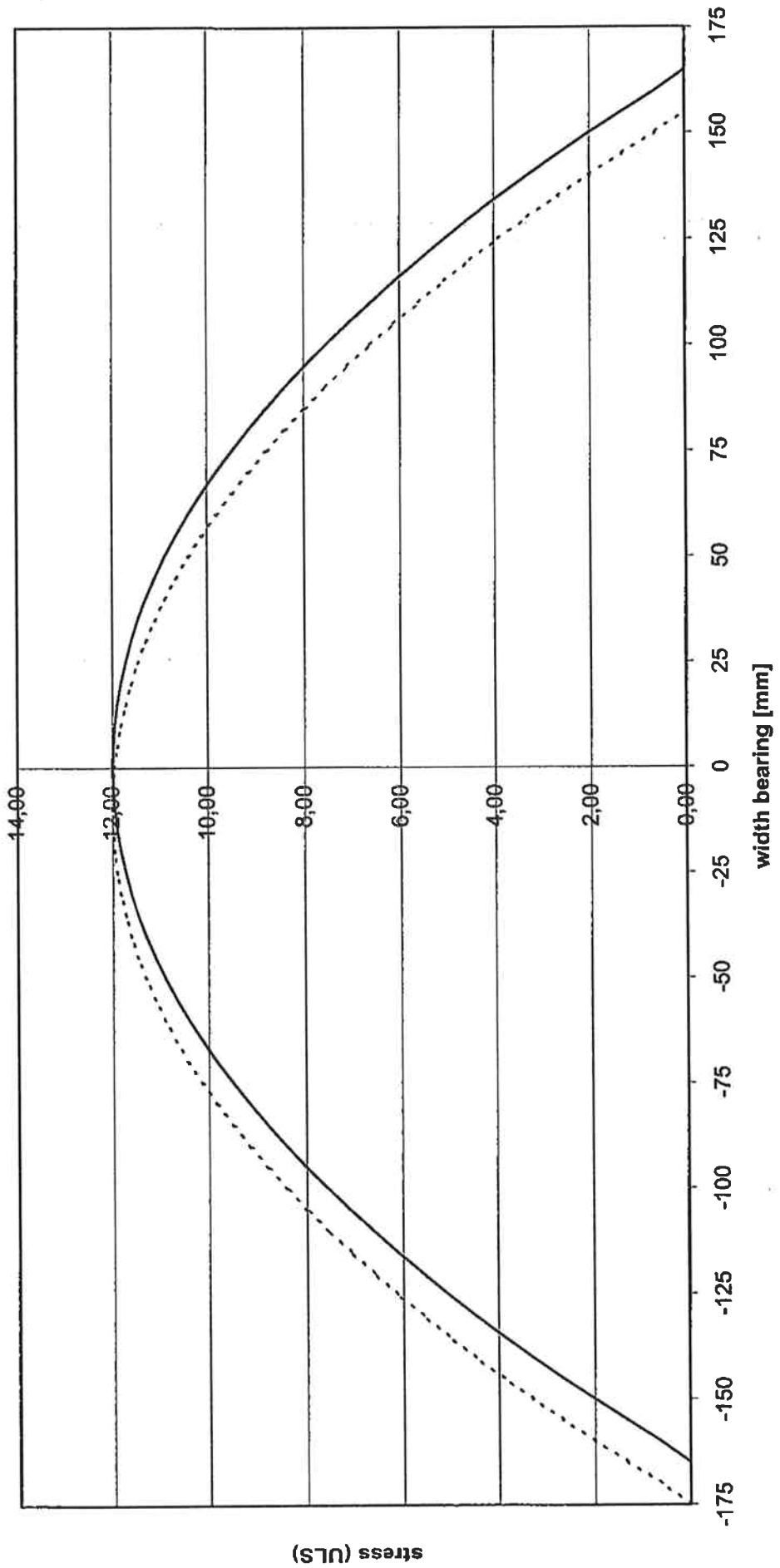
Opgesteld : ALSEMGEEST.

Datum : 28-06-04

Bladnummer : E3-12

Rev. : A2

**Stress development ULS with max. 12 N/mm² peak stress on UHMWPE; max impression 1.8 mm;
bearing 350 mm wide and rounded off R=7500 mm**



— stress - centric; total value 2629 kN/m - - - - stress after 2 mrad rotation; same total value

Project : MALAMOCO NAV. LOCK GATE.

Onderdeel : HORIZONTAL SUPPORT ALONG HEIGHT.



RESUME FOR CHECK UHMWPE.

$$\left. \begin{aligned} R_{ACTING} &= 2281 \text{ N/mm}^2 \\ R_{ALLOWABLE} &= 2629 \text{ N/mm}^2 \end{aligned} \right\} \text{u.c.} = 0,87. \text{ O.K.}$$

TAKENING INTO ACCOUNT (THE WORST COMBINATION OF TOLERANCES (VERY UNLIKELY):

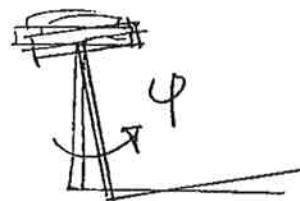
$$R_{ACTING, \text{max}} = 2791 \text{ N/mm}^2 \rightarrow \text{u.c.} = 1,06$$

∴ THE OVERLOAD DUE TO TOLERANCES WILL BE COMPENSATED BY THE CREEP CHARACTERISTIC OF THE UHMWPE-MATERIAL IN THE TIME.

CHECK BEARING WIDTH UNDER ROTATION.

DERIVED FROM MAIN CALC. MODEL:

$$\varphi_{\text{max}} = 2,0 \text{ mrad. [REF. E3-23]}$$



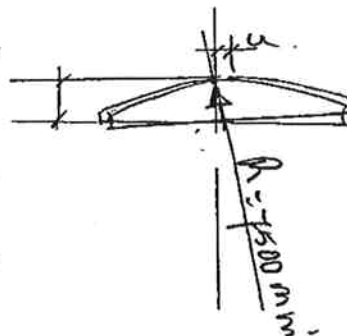
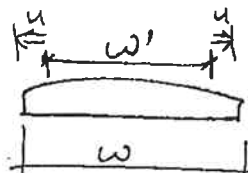
DUE TO THIS ROTATION THE BEARING AREA WILL DISPLACE OVER THE DISTANCE U

$$u = \varphi \cdot R = 2 \cdot 10^{-3} \cdot 7500 = 15 \text{ mm}$$

$$W = 350 \text{ mm}$$

$$W' + 2 \cdot u \leq W$$

$$320 + 30 = 350; \text{ O.K.}$$



WIDTH OF SPHERICAL PLATE SUFFICIENT.

Opgesteld : A. SEMBEE ST.

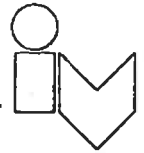
Datum : 28-06-06

Bladnummer : E3-14.

Rev. : A2

Project : MALAMOLLO NAV. LOCK GATE

Onderdeel : HORIZONTAL SUPPORT ALONG HEIGHT



④. CAPACITY BEARING-T (UNSTIFFENED).

⊗ CAPACITY UNSTIFFENED WEB: F_k .

CONSIDER 1mm PLATE

$$i_y = \sqrt{I_y / A} = \sqrt{\frac{12 \cdot 120^3}{1 \cdot 120}} = 5,77 \text{ mm}$$

$$\lambda = \frac{l_{\text{eff}}}{i_y} = \frac{635}{5,77} = 110$$

$$\lambda_1 = 93,7 \cdot 0,81 = 76,1$$

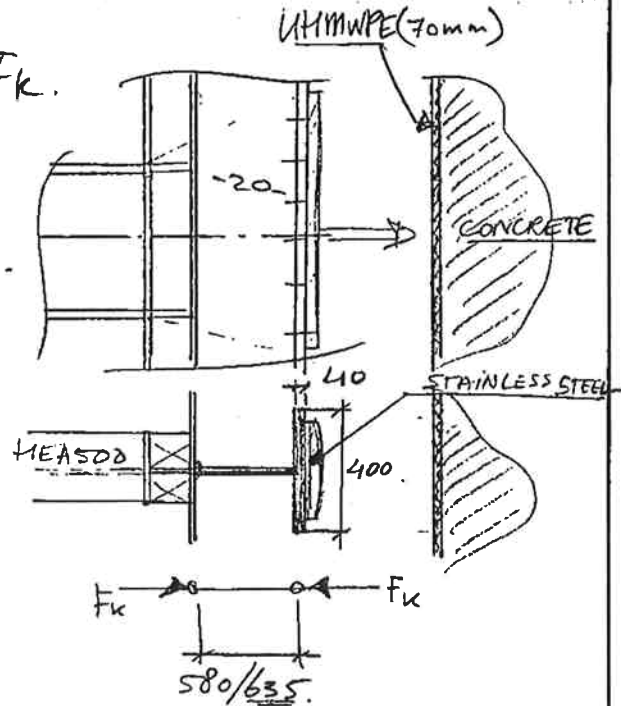
$$\bar{\lambda} = \frac{\lambda}{\lambda_1} = 1,45$$

CURVE C $\Rightarrow \phi_c = 0,2219$

$$F_k = \phi_c \cdot A \cdot f_y \cdot \alpha$$

$$= 0,2219 \cdot (1118) \cdot \frac{845}{1,1} = 1,87 \text{ kN/mm}$$

$$f_k = F_k / t = \frac{1,87 \cdot 10^3}{18} = 104 \text{ N/mm}^2 ; \text{critical buckling stress.}$$



THE ACTING STRESS IN THE MIDDLE SECTION OF THE WEB

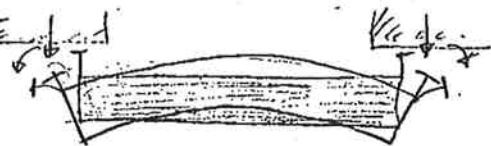
CALCULATED ON NEXT PAGES; SHOULD NOT EXCEED f_k ;

IF SO THE WEB SHOULD BE STIFFENED.

NOTE: THE WEB WILL STILL BE STIFFENED AT THE BEARINGS IN ORDER TO REDUCE THE OUT OF PLANE BENDING OF THE BEARING T CAUSED BY EXCENTRIC LOADING.

DUE TO DEFLECTION OF THE GATE

SEE PAGE E2



Opgesteld: AISENGEEST

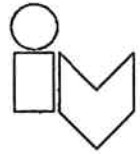
Datum: 03-04

Bladnummer: E3-15

Rev: A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : HOR. SUPPORT ALONG HEIGHT.



⑤ LOAD INTRODUCTION + BEARING CHECK .

3 DETAILS TO BE CHECKED, (REF. E3-4).

	MAX. LOADING	FOR CALC. *
Ⓐ AT BUMPER BEAM	$-3677 - 600 = -4277$	-4500 kN
Ⓑ GENERAL HEADS	$-1835 - 1000 = -2835$	-3500 kN
Ⓒ AT TANK WALL	$-6770 - 6670 = -13440$	-14000 kN

*

NOTE : ROUNDED UP FOR CONTINGENCY .

Opgesteld : ALSEMGEEST

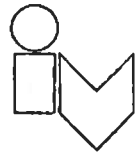
Datum : 26-06-04

Bladnummer : E3-16.

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : HOR. SUPPORT ALONG HEIGHT.



GENERAL

WELD NECK OF BEARING T 118(7)

$R_{max;d}$ DERIVED FROM PAGE E3-9 :

$$R_{max;d} = 2791 \text{ N/mm}$$

$$\sigma_i = \tau_i = R/2a = \frac{2791}{2 \cdot 7} = 200 \text{ N/mm}^2$$

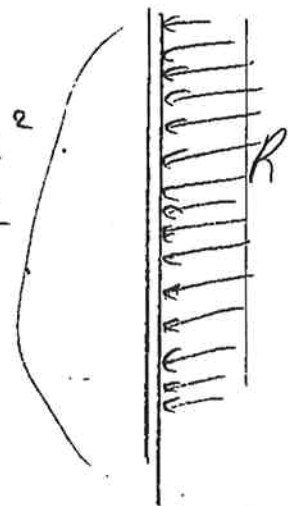
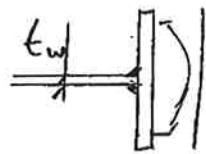
$$\tau_{w:s;d} = 2 \cdot 200 / \sqrt{3} = 230 \text{ N/mm}^2$$

$$f_{wud} = 262 \text{ N/mm}^2$$

$$u.c. = \underline{0,88} < 1,0 \quad \checkmark$$

15 mm eccentricity gives a moment of

$$M_d = 2791 \times 15 \cdot 10^{-3} = 0,04 \text{ kNm/m} \rightarrow \text{neglect.}$$



Opgesteld : ALSEMGEEST

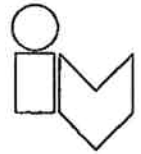
Datum : 280604

Bladnummer : E3-17

Rev. : A2

Project : MALANOCLO NAV. LOCK GATE .

Onderdeel : HOK. SUPPORT ALONG HEIGHT .



Ⓐ BEARING AT BUMPER BEAM

SECTION ① : SIDE OF STIFFENERS .

$$F_N; \text{CALC} = 4500 \text{ kN} .$$

$$A = 15834 \text{ mm}^2 .$$

$$\sigma_N = \frac{F}{A} = 284 \text{ N/mm}^2 .$$

$$u.c = 284 \cdot 1,1 / 355 = 0,88 ; \text{OK}$$

SECTION ② : AT BEARING

(REF. E3-17 : $\sigma_{\text{NECK}}; \text{MAX}$)

∴ CALC. σ_{AVERAGE} IN NECK .

$$\begin{aligned} \sigma_{\text{AV}; \text{NECK}} &= \frac{F_N}{A_{\text{NECK}}} \\ &= 4500 \cdot 10^3 / (900 + 1450) \cdot 18 = 106 \text{ N/mm}^2 . \end{aligned}$$

O.K.

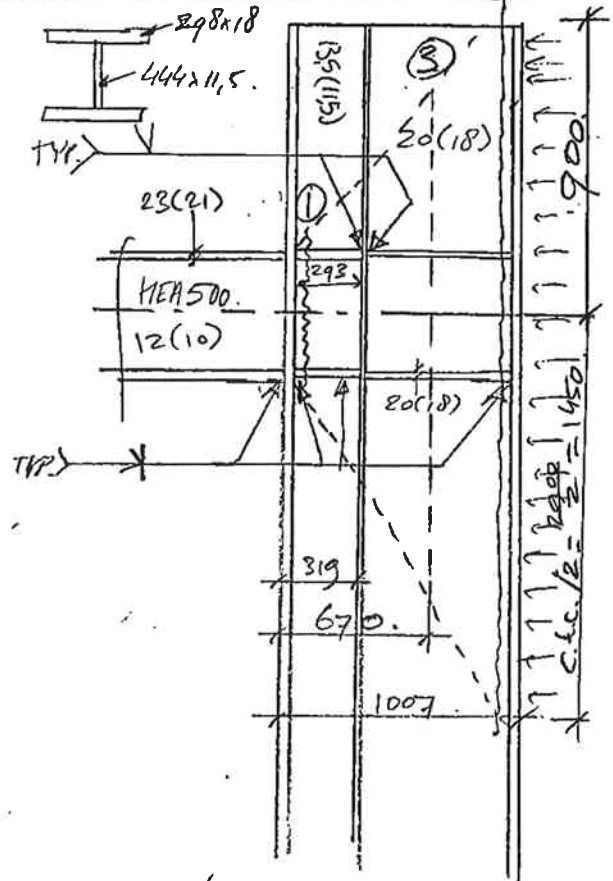
SECTION ③ : MID OF FREE PLATE :

REF. ④ E3-15; NO EXTRA STIFFENERS IF $\sigma_{\text{MID}} < \sigma_K$.

$$\sigma_K = 104 \text{ N/mm}^2 .$$

$$\sigma_{\text{MID}} = \frac{l_1}{l_2} \cdot \sigma_{\text{AV}; \text{NECK}} = \frac{500 \cdot \left(\frac{670}{1007 \cdot 2350}\right)}{2350} \cdot 106 = 93 \text{ N/mm}^2 .$$

$93 < 104$; O.K. NO EXTRA STIFFENERS NEEDED; THE PRESENT STIFFENERS COVER THE LOCAL PEAK STRESS.



Opgesteld : ASEM GEEST

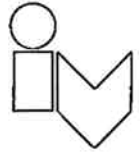
Datum : 28-06-04

Bladnummer : E3-18.

Rev. : A2

Project : MALAMOLLO NAV. LOCK GATE .

Onderdeel : HOR. SUPPORTS ALONG HEIGHT.



Ⓑ GENERAL HEA500 CONNECTION.

CALC. EQUAL TO Ⓐ (REF. E3-18.)

SECTION ①; SIDE OF STIFFENED $\frac{1}{2}$ HEA650.

$$F_N: \text{CALC} = -3500 \text{ kN}$$

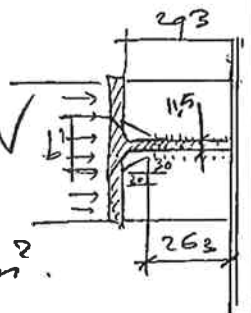
$$\sigma_N = 284 \cdot \frac{3500}{4500} = 221 \text{ N/mm}^2$$

$$\text{u.c.} = 221 \cdot 61 / 355 = \underline{0,69}; \underline{\text{OK}}$$

CONNECTION STIFF. TO $\frac{1}{2}$ HEA650 WEB.

$$F_{\text{FLANGE}} = \sigma_N \cdot A_{\text{FL}} = 221 \cdot 300 \cdot 23 = 1525 \text{ kN}$$

∴ WELD F.P.; PLATE GOVERNING → $t_{\text{pl}}: \text{u.d.} = 355 / 1,1 \cdot \sqrt{3}$
 $= 186 \text{ N/mm}^2$



$$F_{\text{CAP}} = 186 \cdot 263 \cdot 11,5 \cdot 2 = 1125 \text{ kN}$$

$$F_{\text{THROUGH NECK}} = 1525 - 1125 = 400 \text{ kN}$$

$$F_{\text{CAP THROUGH NECK}} = \sigma_N \cdot b' \cdot t_{\text{pl}}$$

$$= 221 \cdot (11,5 + 2 \cdot 27 + 2 \cdot 30) \cdot 23$$

$$= 638 \text{ kN} > 400; \text{SUFFICIENT}$$

SECTION ②: AT BEARING

$$l_{\text{②}} = \frac{2900 + 2000}{2} = 2450 \text{ mm}$$

$$\sigma_{\text{AV; NECK}} = 3500 \cdot 10^3 / 2450 \cdot 18 = 80 \text{ N/mm}^2 \cdot \underline{\text{OK}}$$

SECTION ③: AT MID OF PLATE FIELD.

$$\sigma_{\text{mid}} = 80 \cdot \frac{500 + (\frac{67 \cdot 2450}{1007})}{2450} = 70 \text{ N/mm}^2 < 104 \text{ N/mm}^2 \cdot \underline{\text{OK}}$$

NO EXTRA STIFFENERS

Opgesteld : ALSEMGEEST

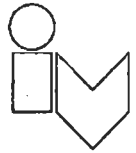
Datum : 28-06-04

Bladnummer : E3-19

Rev. : A2

Project : Malamocco Nav. Lock Gate.

Onderdeel : Flor. SUPPORT ALONG HEIGHT.



③ BEARING CONNECTION AT TANK WALL

LOADS FROM MODEL WILL ACT AS DISTRIBUTED LOAD OVER HEIGHT OF TANK WALL (REF. E3-16).

$$F_d = -14000 \text{ kN} \quad h_0 = 3,5 \text{ m} \quad \int q_d = \frac{F_d}{h_0} = 4000 \text{ N/mm} \Rightarrow \sigma_{s:pl.} = \frac{4000}{18} = 222 \text{ N/mm}^2$$

$222 > 104$; ADD STIFFENERS : $t_{pl} = 15 \text{ mm}$

C.C. - DISTANCE EQUAL TO STIFFENERS IN TANK
GUSSET PLATES ONLY ON WEB, NOT CONNECTED TO FLANGE

NO BUCKLING PROBLEMS (SEE PAGE E-)

LAST STIFFENERS MIN 355 OUT OF TANK WALL.

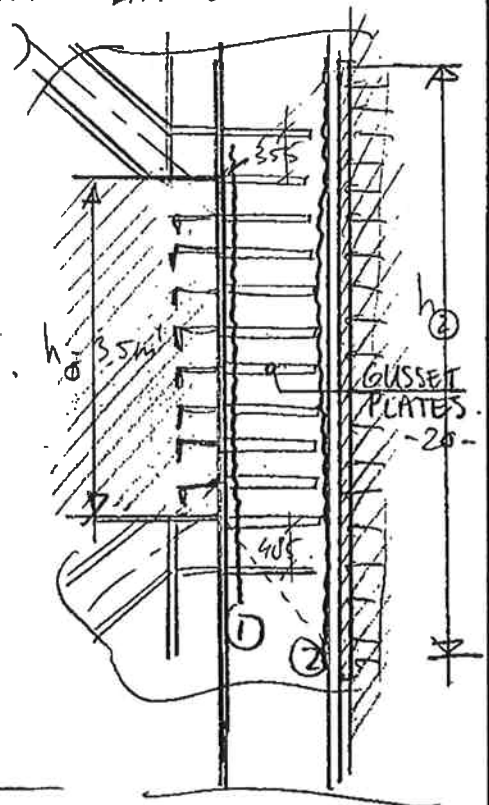
REF. E3-11:

F_A OUTSIDE LAST STIFFENERS = 544 kN

$$\sigma_A = \frac{544 \cdot 10^3}{333 \cdot 18} = 91 \text{ N/mm}^2$$

$\sigma_A < \sigma_k$; $91 < 104$.

WEB SUFFICIENTLY SUPPORTED. OK



① LOAD INTRODUCTION STEEL

$$\sigma_{s:pl.} = 222 \text{ N/mm}^2$$

$$u.c. = \frac{222}{(345 \cdot 1.1)} = 0,71 \text{ OK}$$

Opgesteld : Alsembeest

Datum : 03-04

Bladnummer : E3-20.

Rev. A2

Project : MALAMOCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORT ALONG HEIGHT.



STIFFENERS BEARING - T

- (NOTE PAGE E3-6')

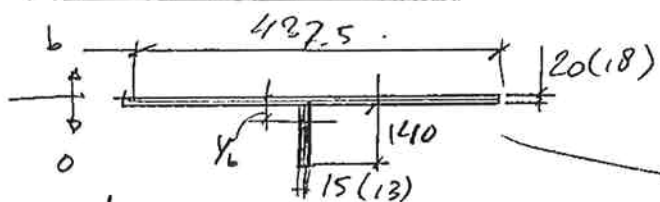
GOVERNING STIFFENER :

DETAIL.	LOAD	number	LOAD/STIFFENER
⊕	3500	2	1750 kN = F_D ; MAX.
⊙	14000	11	<u>1275 kN</u>

ADDITIONAL STRESS IN WEB :

- c.t.c. STIFFENERS = 427.5 mm^{-1} .
- PARTICIPATING WIDTH OF WEB $\leq 25t = 25 \cdot 18 = 450$ } OK

SECTION - 1mm - OF.



$$\begin{aligned}
 A &= 9695 \text{ mm}^2 \\
 W_b &= 5,21 \cdot 10^5 \text{ mm}^3 \\
 W_o &= 9,25 \cdot 10^4 \text{ mm}^3
 \end{aligned}$$

$$y_b = 24 \text{ mm}^{-1}$$

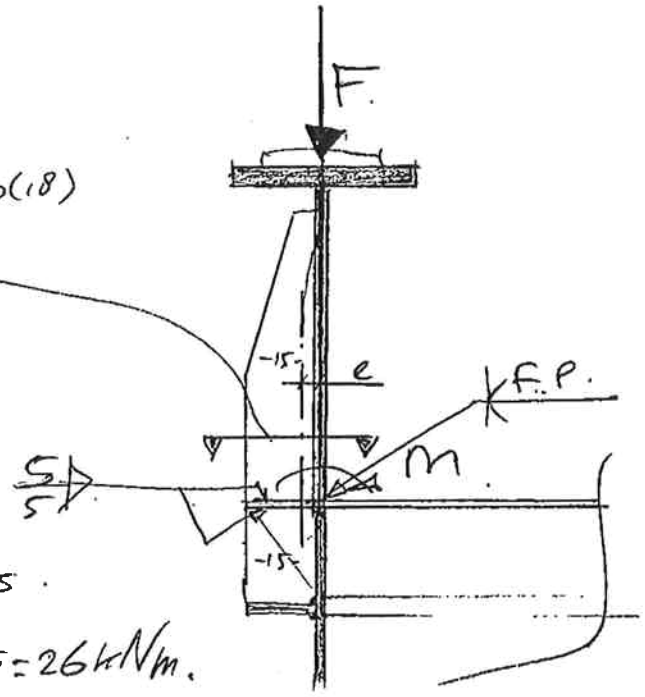
$$e = y_b - t_p/2 = 24 - \frac{18}{2} = 15$$

$$M = F \cdot e = 1750 \cdot 10^3 \cdot 15 = 26 \text{ kNm}$$

$$\sigma_b = \frac{M}{W_b} + \frac{F}{A} = 51 + 232 = 283 \text{ N/mm}^2 \Rightarrow \text{WELD FULLY OK}$$

$$\sigma_o = \frac{M}{W_o} - \frac{F}{A} = 284 - 232 = 52 \text{ N/mm}^2 \Rightarrow \text{MIN WELD SUFFICIENT}$$

2 * 5 AA OK



Opgesteld : ALSEMGEEST

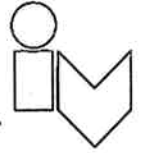
Datum : 03-04

Bladnummer : E3-21

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORT ALONG HEIGHT.



E X C E N T R I C M O M E N T D U E T O D E F L E C T I O N O F G A T E

MAX. ROTATION DERIVED
FROM MAIN CALL. SEE
NEXT PAGES ;

$$\varphi_{i2 \max} = 2,0 \text{ mrad.}$$

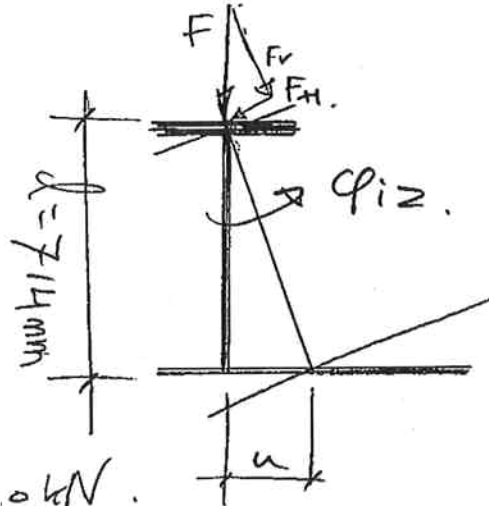
$$u = \varphi_{i2} \cdot l$$

$$= 2 \cdot 10^{-3} \cdot 714 = 1,43 \text{ mm.}$$

$$F_h = \varphi_{i2} \cdot F = 20 \cdot 10^{-3} \cdot 1055 = 2,0 \text{ kN.}$$

$$M = F \cdot u = 1055 \cdot 1,43 \cdot 10^{-3} = 1,5 \text{ kNm. (FIRST ORDER).}$$

THE FIRST ORDER MOMENT IS \ll MOMENT IN OTHER DIRECTION,
STIFFNER SUFFICIENT.



Opgesteld : **ALSEMGEEST**

Datum : /
03-04

Bladnummer :
EB-12

Rev. :
A2

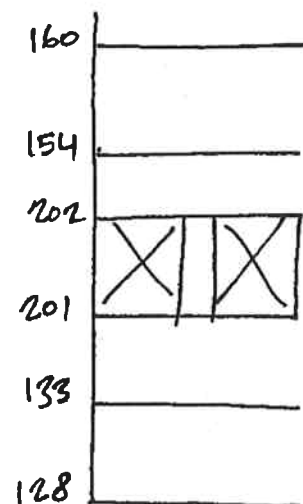
Deformations in node(s). Local extreme

Linear static - extreme or all combinations

Group of node(s) : 128,133,154,160,201/202

Group of serviceability combi : 2,4/6

node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
128	6	1	-3	-5	-0	0	-0
128	4	0	-27	-2	1	0	0
133	6	1	-2	-5	-0	0	-0
133	4	0	-27	-2	-0	0	0
154	6	1	-0	-5	-0	0	0
154	4	0	-27	-3	1	0	0
154	5	1	-0	-5	-0	-0	0
160	6	1	1	-5	-1	0	0
160	4	0	-28	-4	0	0	0
201	6	1	-1	-5	-1	0	-0
201	4	0	-25	-2	-3	0	0
202	6	1	-1	-6	0	0	0
202	4	0	-25	-3	2	0	0



CENTRE

Deformations in node(s). Local extreme

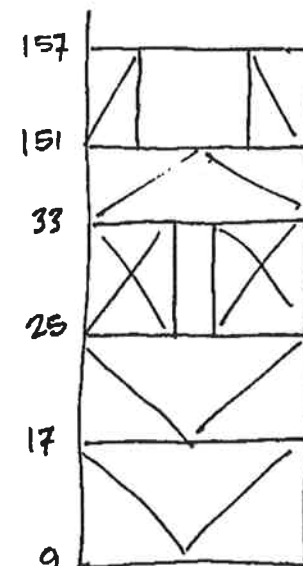
Linear static - extreme or all combinations

Group of node(s) : 9,17,25,33,151,157

Group of serviceability combi : 2,4/6

node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
9	4	-3.6	-0.0	-0.3	0.0	-0.1	-1.8
9	5	-0.4	0.0	-1.7	0.0	0.2	-0.2
9	6	-0.4	0.0	-1.7	0.0	0.2	-0.2
17	6	0.1	-0.0	-1.7	0.0	0.2	-0.1
17	4	-3.4	-0.0	-0.3	-0.0	0.1	-1.9
17	5	0.1	-0.0	-1.7	0.0	0.2	-0.1
25	6	0.5	-0.0	-1.7	-0.0	0.2	-0.1
25	4	-3.4	-0.0	-0.3	-0.1	-0.0	-1.8
25	5	0.5	-0.0	-1.7	-0.0	0.2	-0.1
25	2	0.0	-0.0	-0.4	-0.1	-0.0	-0.1
33	6	1.1	0.0	-1.7	0.0	0.2	-0.0
33	4	-3.0	-0.0	-0.0	0.1	0.3	-1.8
33	5	1.0	0.0	-1.7	0.0	0.2	-0.0
151	6	1.3	0.0	-1.8	0.0	0.1	-0.1
151	4	-2.4	-0.0	-0.0	0.0	0.3	-2.0
151	5	1.3	0.0	-1.8	-0.0	0.1	-0.1

MAX. ROTATION: 2,0 MRAD.



END

ESA-Prima Win release 3.50.63

Project : Sluis Venezia

Author : A.Boogers

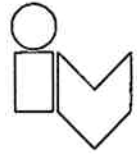
Page : 2

Date : 15.12.03

node	combi	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
151	2	0.2	-0.0	-0.4	-0.0	0.0	-0.1
157	6	1.6	-0.0	-1.8	-0.0	0.2	0.1
157	4	-1.5	-0.0	0.0	-0.0	0.2	-1.9
157	5	1.6	-0.0	-1.8	-0.0	0.2	0.1

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORT AT TOP .



E4. HORIZONTAL SUPPORT AT TOP.

CALCULATION CONSIST OF:

- CALC. STEEL GUIDES (SEASIDE) .
- CHECK BEARING CONCRETE GUIDE (LAGOON SIDE) ,
INCL. CHECK BUMPER BEAM NOSE (LAGOON SIDE) .

Opgesteld : ALSEMEST.

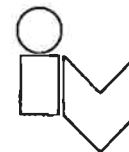
Datum : 14-05-'04

Bladnummer : E4-1,

Rev. : A2

Project : MALAMOCO NAV. LOCK GATE

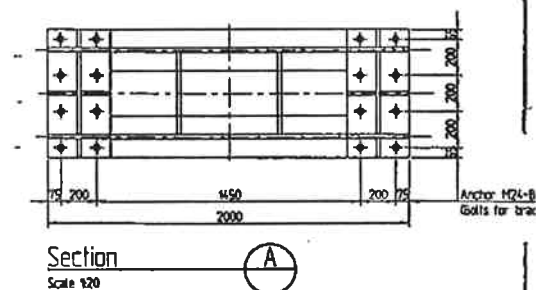
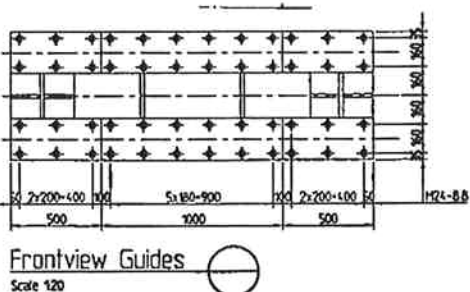
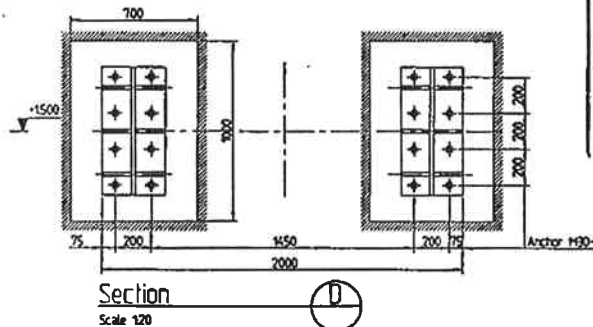
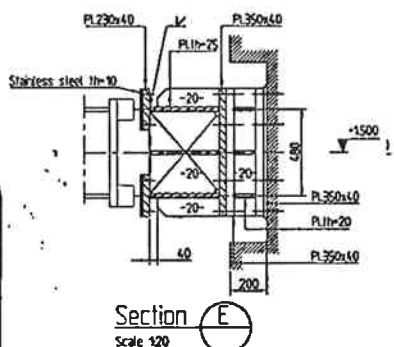
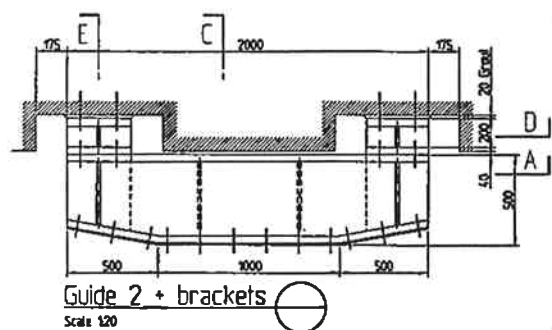
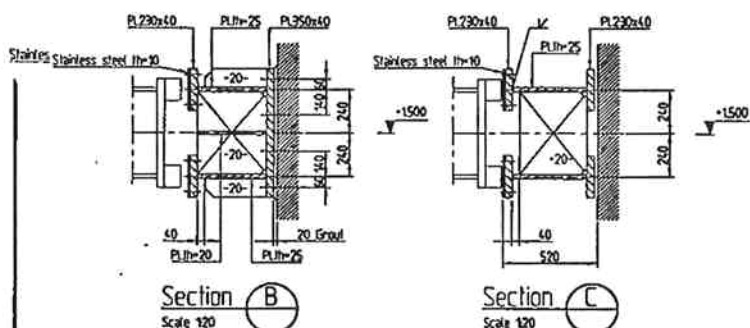
Onderdeel : HORIZONTAL SUPPORTS AT TOP



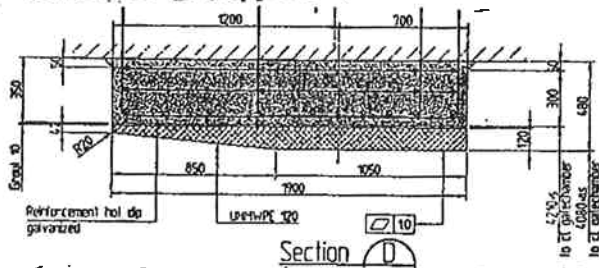
OVERVIEW

DERIVED FROM : DRAWINGS : MV036P-PEMAD-4322 : STEEL

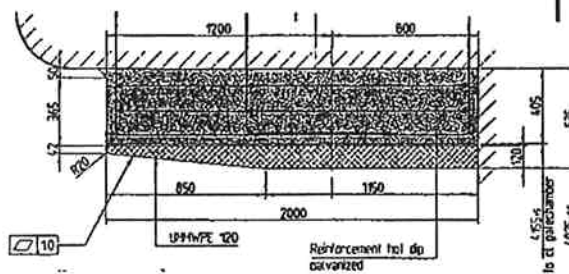
CONCRETE



STEEL GUIDES : SEASIDE



CONCRETE GUIDES : LAGOON SIDE



Opgesteld : *ALSENGEST*

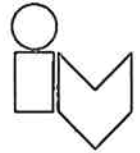
Datum : *05-04*

Bladnummer : *ELP-2*

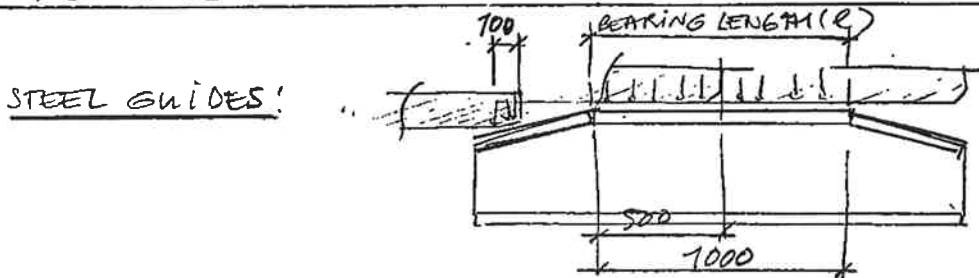
Rev. : *A2*

Project : MALANUCCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORTS AT TOP.



LOADS : (DERIVED FROM E1-8)



① ACCIDENTAL LOAD : BOAT IMPACT : 5000 kN .

ℓ : BEARING LENGTH (MIN.) = 500 mm' .

IN THIS ACCIDENTAL CASE DEMOLITION UTMWPE ALLOWABLE .

② EARTHQUAKE : 2250 kN .

ℓ : BEARING LENGTH (MIN.) = 500 mm' .

③ ULTIMATE COMB. LOAD (STRAIGHT) COMPRESSION = 1200 kN .
SHEAR = 240 kN .

ℓ : BEARING LENGTH = 1000 mm' .

④ ULTIMATE COMB. LOAD ON SLOPE : COMP. = 467 kN .

SHEAR = 167 kN .

ℓ : BEARING LENGTH = 100 mm' .

CONCRETE GUIDES :

ALL LOADS EQUAL TO LOAD ON STEEL GUIDES.

AD ③ ; ULT. COMBI : COMPRESSION = 3700 kN .
SHEAR = 740 kN .

} CHECKED IN
CALC. PART E3 ;
SUPPORTS ALONG HEIGHT

GLOBAL CHECK ALREADY CALC. IN PART E3 "SUPPORTS ALONG HEIGHT"

LOCAL CHECK GUIDANCE ; E4-11 .

Opgesteld : ALSEMGEEST

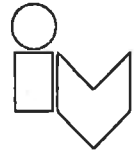
Datum : 05-04

Bladnummer : E4-3

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : HORIZONTAL SUPPORTS AT TOP .



CHECK STEEL GUIDES:

BEARING AREA: GATE - GUIDE .

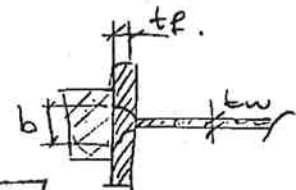
L.C.① : $F_D = 5000 \text{ kN}$
 $l = 500 \text{ mm}$

• ULTIMATE : $f_{c:s:d} = \frac{22}{1,1} = 20 \text{ N/mm}^2$ ALLOWABLE .

$t_w = 20 \text{ mm} = 18 \text{ mm}$ CALC .

$t_f = 40 \text{ mm} = 38 \text{ mm}$ CALC .

$c = t_f \cdot \sqrt{\frac{f_y d}{3 \cdot f_{c:s:d}}} = 38 \cdot \sqrt{\frac{345/1,1}{3 \cdot 20}} = 137 \text{ mm}$



$b = 2c + t_w = 2 \cdot 137 + 18 = 290 \text{ mm}$

$f_{c:s:d} = \frac{F_d}{2(b \cdot l)} = \frac{5000 \cdot 10^3}{2 \cdot 290 \cdot 500} = 17 \text{ N/mm}^2$

u.c. : $\frac{17}{20} = 0,85 < 1,0$; PERMILITATION ULTIMATE ALLOWABLE IN THIS SITUATION .

• NECK (STEEL) : $\sigma_{s:d} = F_D/A = \frac{5000 \cdot 10^3}{2(500 \cdot 18)} = 278 \text{ N/mm}^2$

u.c. = $\frac{278 \cdot 1,1}{345} = 0,89 < 1,0$ OK .

• WELD FULL PEN : OK

L.C.② : $F_D = 2250 \text{ kN}$
 $l = 500 \text{ mm}$

ULTIMATE : $f_{c:s:d} = 17 \cdot \frac{2250}{5000} = 7,7 \text{ N/mm}^2$

u.c. = $\frac{7,7}{20} = 0,385 < 1,0$; OK .

(UNDER EARTHQUAKE ULTIMATE CONDITIONS ULTIMATE INTACT .)

Opgesteld : ALSEMGEEST

Datum : 05-04

Bladnummer : EL-4

Rev. : A2

Project : MALAMACCO NAV. LOCK GATE

Onderdeel : HORIZONTAL SUPPORTS AT TOP



CHECK ON SLOPE

L.C. (4): $F_D = 467 \text{ kN}$

$l = 100 \text{ mm}$

UTMMPPE: $f_c : s : d = \frac{467 \cdot 10^3}{2 \cdot 100 \cdot 290} = 8 \text{ N/mm}^2$

u.c. = $8/8 = 1,0$; OK

GLOBAL BEAM CHECK

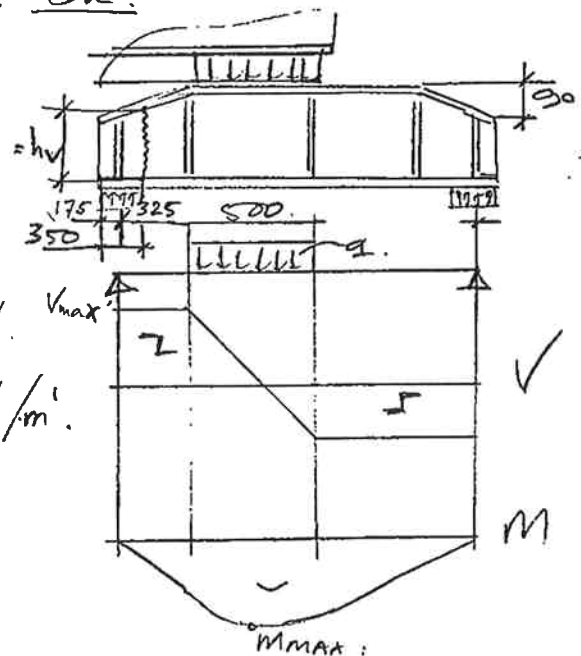
L.C. 1. GOVERNING.

$F_{\text{PER BEAM}} = \frac{5000}{2} = 2500 \text{ kN}$

$q_{\text{PER BEAM}} = \frac{2500}{0,5} = 5000 \text{ kN/m}$

$M_{\text{max}} = 798 \text{ kNm}$

$V_{\text{max}} = R_{\text{max}} = 1621 \text{ kN}$



SECTION PROPERTIES:

$W_{pl} = 4,27 \cdot 10^6 \text{ mm}^3$

$A_v = 23.393 = 9089 \text{ mm}^2$ (h_w AT EDGE OF SUPPORT = $510 - 10 - 80 - \frac{150}{500} \cdot 90 = 393$)

$I_y = 1,06 \cdot 10^9 \text{ mm}^4$

STRESS:

$\sigma = M/W = 187 \text{ N/mm}^2$. u.c. = $187 \cdot 1,1/345 = 0,60$; OK

$\tau = V/A_v = 180 \text{ N/mm}^2$, u.c. = $180 \cdot 1,1 \cdot \sqrt{3}/1345 = 0,99$; OK

Opgesteld : ALSEMGEEST

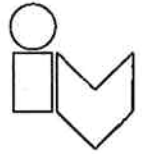
Datum : 05-04

Bladnummer : E4-5

Rev. : A2

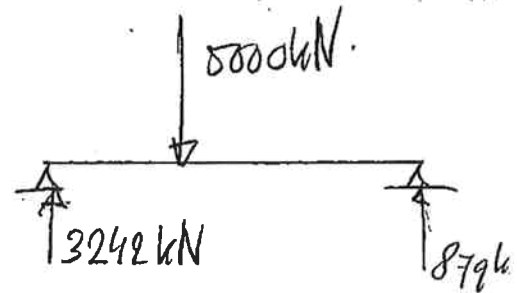
Project : MALAMOCCO NAV. Lock GATE

Onderdeel : HORIZONTAL SUPPORTS AT TOP



LOCAL INTRODUCTION CHECK.

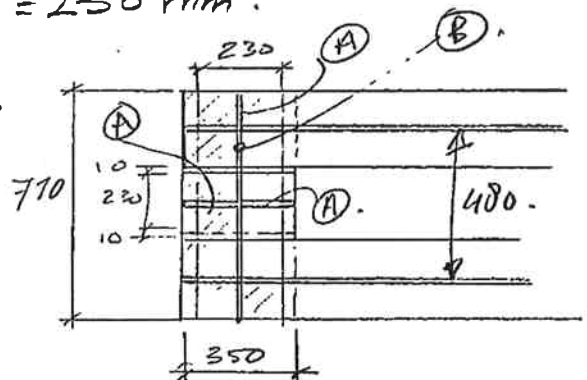
$$R_{max; total} = 2 \cdot R_{max; BEAM}$$
$$= 2 \cdot 1621 = 3242 \text{ kN}$$



BEARING AREA :

$$b = t_w + t_f \cdot \sqrt{\frac{R_{max}}{3 \cdot f_{c;sid}}}$$
$$= 18 + 38 \cdot \sqrt{\frac{345 / 1.1}{3 \cdot 13.3}} = 230 \text{ mm}$$

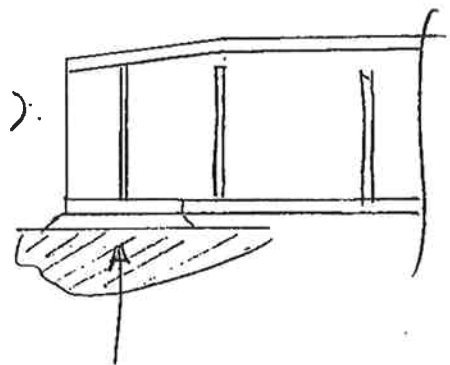
$$A = 710 \cdot 350 = 248500 \text{ mm}^2$$



$$f_{c;sid} = \frac{R_{max}}{A} = 13.0 \text{ N/mm}^2$$

$f_{c;sid} = 13.3 \text{ N/mm}^2$ (B35 CONCRETE).

u.c = 0,98; OK



Opgesteld : ALSEMGEEST

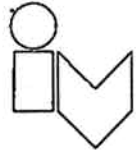
Datum : 05-04

Bladnummer : E4-b. AL

Rev :

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : HORIZONTAL SUPPORTS AT TOP.



GUSSET PLATES: $t = 20 \text{ mm}$ (calc. 18).

$b_{\text{SPREAD}} = 230 \text{ mm}$.

CALC. FROM CAPACITY CONCRETE.

$$f_c: \text{c.i.d} = 13,3 \text{ N/mm}^2.$$

PLATES (A):

$$\sigma_{\text{PL}} = 13,3 \cdot 230 / 18 = 170 \text{ N/mm}^2. \quad \text{u.c.} = \frac{170 \cdot 111}{345} = 0,54, \text{OK}$$

WELD $\Delta \Delta$ a + 8 (calc. 7).

$$\tau_1 = \sigma_1 = 170 \cdot 18 \cdot \sqrt{2} / 4 \cdot 7 = 155 \text{ N/mm}^2.$$

$$\tau_{\text{WISSD}} = \frac{2}{\sqrt{3}} \cdot 155 = 179 \text{ N/mm}^2.$$

$$\text{u.c.} = \frac{179}{262} = 0,68; \text{OK}$$

PLATE (B):

$$V_{\text{MAX}} = \frac{1}{2} \cdot 4180 \cdot 250 \cdot 13,3 = 1117 \text{ kN}.$$

$$\tau_{\text{PL}} = \frac{V_{\text{MAX}}}{h_{\text{PL}} \cdot b_{\text{PL}}} = \frac{1117 \cdot 10^3}{360 \cdot 18} = 172 \text{ N/mm}^2. \quad h_{\text{PL}} = 570 - 10 - 80 - \frac{325}{2} \cdot 90 \approx 360$$

$$\text{u.c.} = 172 / 186 = 0,93 < 1,0; \text{OK}$$

WELD $\Delta \Delta$ 8 (calc. 7).

$$\tau_2 = 172 \cdot \frac{18}{2 \cdot 7} = 221 \text{ N/mm}^2.$$

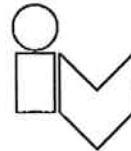
$$\text{u.c.} = \frac{221}{262} = 0,85 < 1,0 \text{OK}$$

Opgesteld : AISEMGEEST.

Datum : 05-04

Bladnummer : E4-7. A2.

Project : MALAMOCCO NAV. LOCK GATE.

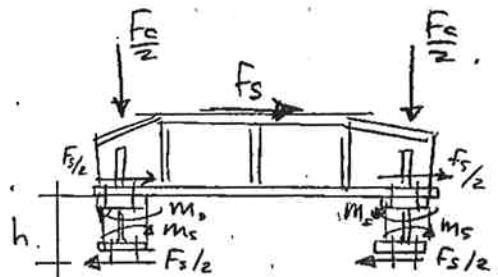


Onderdeel : HORIZONTAL SUPPORTS AT TOP.

CONNECTIONS:

L.C. ③: - COMPRESSION: $F_c = 1200 \text{ kN}$.

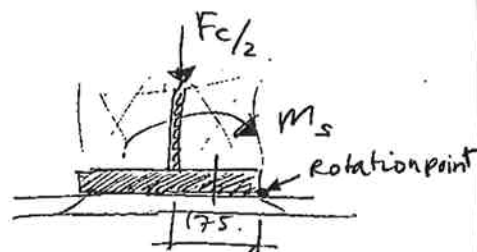
- SHEAR: $F_s = 240 \text{ kN}$.



$h = 260 \text{ mm}$

$M_s = \frac{1}{2}(F_s \cdot h) = 16 \text{ kNm}$ PER SIDE.

$M_{F_c} = \frac{1}{2} \cdot 1200 \cdot 175 = 105 \text{ kNm}$ PER SIDE



* NO TENSION ON CONNECTIONS. $M_{F_c} > M_s$ IN L.C. ③.

* SHEAR PER BOLT = $F_s / 16 = 15 \text{ kN}$.

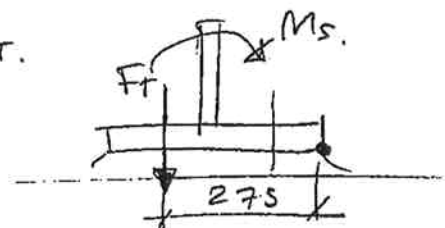
L.C. ④ COMPRESSION = 465 kN (CONTACT AT ONE SIDE, SO OTHER SIDE SHEAR + MOMENT)

SHEAR = 167 kN.

$M_{\text{BOLT CONNECTION}} = M_s - M_{F_c} = M_s = \frac{1}{2} \left(\frac{167}{2} \right) \cdot 0,26 = 11 \text{ kNm}$.

* FTENSION BOLTS = $\frac{M_s}{4 \cdot 275} = 10 \text{ kN}$; PER BOLT.

* FSHEAR BOLTS = $\frac{167}{16} = 11 \text{ kN}$ "



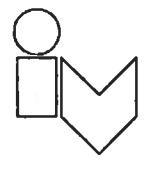
Opgesteld: AL SEINGEEST

Datum: 05-09

Bladnummer: E4-8 Rev: A2

Project : MALAMOCO NAV. LOCK GATE.

Onderdeel : HORIZONTAL SUPPORTS AT TOP.

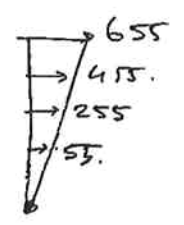


NOTE : LOAD FROM SELF WEIGHT.

$$\begin{aligned} \text{WEIGHT PLATES CA. : } & 2 [2,0 \cdot 0,5 \cdot 25 \cdot 10^{-3}] \cdot 78,5 = 4 \text{ kN} \\ & 4 [2,0 \cdot 40 \cdot 230 \cdot 10^{-6}] \cdot 78,5 = 6 \text{ kN} \\ & 5 [70 \cdot 0,5 \cdot 20 \cdot 10^{-6}] \cdot 78,5 = 3 \text{ kN} \\ & \hline & 13 \text{ kN} \cdot 1,35 = 20 \text{ kN.} \end{aligned}$$

PER BOLT $F_{\text{SHEAR}} = 20/10 = 2 \text{ kN}$.

$$F_{\text{TENSION}} = \frac{[20 \cdot 10^3 \cdot 250] \cdot 655}{4 [655^2 + 455^2 + 255^2 + 55^2]} = 1,2 \text{ kN}$$



TOTAL ACTING LOAD:

SHEAR: $F_{V:s;d} = 11 + 2 = 13 \text{ kN}$

TENSION: $F_{T:s;d} = 10 + 1,2 = 11,2 \text{ kN}$

CHECK ANCHORAGE M24 8.8. GOVERNING.

(ACC. CUR 25)

$$V_{Rk:s} = (\alpha_m \cdot M_{Rk:s}) / l$$

$$\alpha_m = 2,0$$

$$l = 0,5 \cdot 24 + 20 + \frac{40}{2} = 52 \text{ mm}$$

$$M'_{Rk:s} = 1,2 \cdot W_{el} \cdot f_{yk} = 1,2 \left(\frac{64 \cdot \pi \cdot 24^4}{12} \right) \cdot \frac{640}{1,25} = 0,835 \text{ kNm}$$

$$M_{Rk:s} = M'_{Rk:s} \cdot \left(1 - \frac{F_{T:s;d}}{F_{Tud}} \right)$$

$$F_{Tud} = A_s \cdot f_{uk} / \gamma_{ms} = (353 \cdot 800) / 1,24 = 200 \text{ kN}$$

$$M_{Rk:s} = 0,835 \cdot \left(1 - \frac{11,2}{200} \right) = 0,78 \text{ kNm}$$

$$V_{Rk:s} = 2 \cdot 0,78 / 52 \cdot 10^{-3} = 30,3 \text{ kN}$$

$$u.c = F_{V:s;d} / V_{Rk:s} = 13 / 30,3 = 0,43 < 1,0 ; \text{ OK}$$

Opgesteld : ALSEMGEEST.

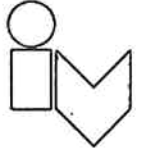
Datum : 05-04

Bladnummer :

Rev : E4-9-A2.

Project : MALAMOCCONAV. Lock Gate.

Onderdeel : HORIZONTAL SUPPORTS AT TOP.



CONNECTION STAINLESS STEEL.

M10. 8.8.

$$F_{v:uid} = 0,6 \cdot f_{ub} \cdot A_s / \gamma_m = 0,6 \cdot 800 \cdot 58 / 1,25 = \underline{22} \text{ kN}$$

$$F_{r:uid} = 2,5 \cdot \alpha \cdot f_u \cdot d \cdot t / \gamma_m = 2,5 \cdot 510 \cdot 10 \cdot 5 / 1,25 = 51 \text{ kN}.$$

PLANE SURFACE :

$$F_{\text{SHEAR MAX. (LOADCASE 3)}} = 240 \text{ kN}.$$

$$\begin{aligned} \text{min. AMOUNT OF BOLTS} &= 240 / 22 = 11 \text{ bolts.} \\ \text{PRESENT} &= 4 \times 6 = 24 \text{ bolts} \end{aligned} \quad \left. \vphantom{\begin{aligned} \text{min. AMOUNT OF BOLTS} \\ \text{PRESENT} \end{aligned}} \right\} \underline{\text{O.K.}}$$

SLOPE :

$$F_{\text{SHEAR MAX (L.C. 4)}} = 167 \text{ kN}.$$

$$\begin{aligned} \text{min. AMOUNT OF BOLTS} &= 167 / 22 = 8 \text{ bolts.} \\ \text{PRESENT} &= 4 \times 3 = 12 \text{ bolts} \end{aligned} \quad \left. \vphantom{\begin{aligned} \text{min. AMOUNT OF BOLTS} \\ \text{PRESENT} \end{aligned}} \right\} \underline{\text{O.K.}}$$

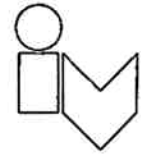
Opgesteld : A. SEMBES

Datum : 05-04

Bladnummer : E4-10 A2 Rev. :

Project : MALAMOCCO NAV. Lock Gate.

Onderdeel : HORIZONTAL SUPPORTS AT TOP



CHECK CONCRETE GUIDES:

LOCAL CHECK BEARING:

CAPACITY:

$$f_{c,u;d} \text{ CONCRETE} = 13,2 \text{ N/mm}^2 \Rightarrow f_{c,u;d} \text{ UHMWPE} = 8 \text{ N/mm}^2 \text{ GOVERNING.}$$

$$F_{c,u;d} = f_{c,u;d} \cdot b \cdot h_{eff}$$

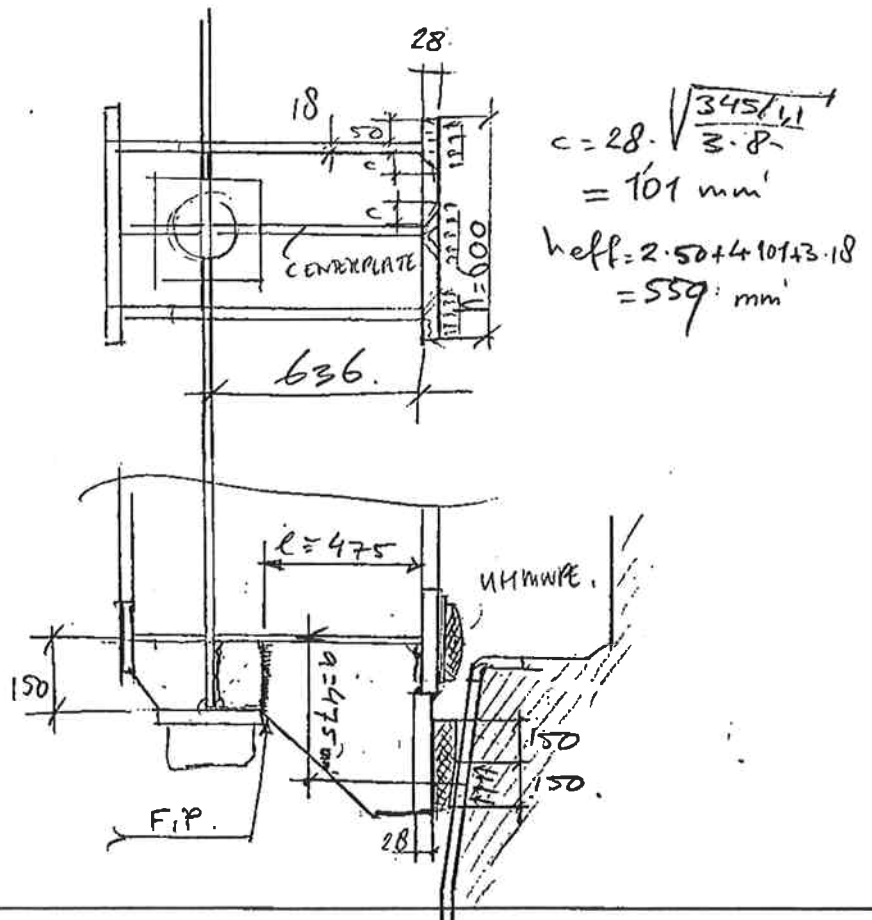
$$= 8 \cdot 150 \cdot 559 = 671 \text{ kN}$$

$$F_{c,s;d} = 467 \text{ kN}$$

} u.c. = 0,7 OK.

• CHECK SUPPORTIVE PLATES: NEXT PAGE.

• OTHER CHECKS: SEE CHECK STEEL GUIDES.



Opgesteld : **ALSEMGEEST**

Datum : **05-04**

Bladnummer : **E4-11** Rev. : **A2**

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : HORIZONTAL SUPPORTS AT TOP.



CHECK SUPPORTIVE PLATES

CENTER PLATE GOVERNING.

SECTION AT BEARING: PL. 20(18) + WELD ~~AN~~ S (4).

$$F_{c.p} = 671 \cdot \frac{(2 \cdot 107 + 18)}{559} = 264 \text{ kN (CAPACITY)}$$

$$f_N = \frac{F_{c.p}}{A} = \frac{264 \cdot 10^3}{18 \cdot (150 + 28) \cdot 20} = 83 \text{ N/mm}^2$$

└ SPREAD PL + ULTIMATE.

WELD GOVERNING.

$$f_{w,i.s.d} = 2 \cdot (83 / \sqrt{2}) \cdot (10/8) = 264 \text{ N/mm}^2$$
$$f_{w,u.s.d} = 262 \text{ N/mm}^2$$

} u.c. = 0,82 ; OK

CHECK MINI SECTION CENTER PLATE ! CONSERVATIVE

$$l = 475 \text{ mm}$$

$$f = M/W = \frac{F_{c.p} \cdot a}{\frac{1}{6} \cdot t_p \cdot l^2} = \frac{264 \cdot 10^3 \cdot 475}{\frac{1}{6} \cdot 18 \cdot 475^2} = 186 \text{ N/mm}^2$$

$$u.c. = 186 \cdot \frac{1,1}{345} = 0,60 ; \underline{OK}$$

CHECK WELDS TO SKIN AND FLANGE ; ~~AN~~ S (4).

$$f_{u.s.d} = 262 \text{ N/mm}^2$$

$$l_{min} = \frac{264 \cdot 10^3 \cdot 475}{636 / 262 \cdot 2 \cdot 4} = 94 \text{ mm}$$
$$l_{PRESENT} = (400 - 10) / 2 - 40 = 151 \neq 150$$

} u.c. = 0,63 ; OK

Opgesteld :

A. SEMGEEST

Datum :

05-04

Bladnummer :

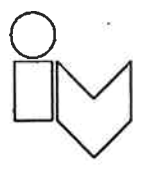
E4-12

Rev. :

A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : GUIDANCE WATERPROOFING.



ES. GUIDANCE WATERPROOFING.

<u>INDEX</u>	<u>PAGE</u>
1. BASICS	ES-2
2. CAMBER	ES-4.
3. CALCULATION	ES-4.
4. RESULTS	ES-13.
5. LOADSITUATION FOR CHECKS	ES-15.
6. CHECK GUIDANCE WATERPROOFING BEAM	ES-16.
7. CHECK DETAIL CONNECTIONS TO GATEDOOR.	ES-21/43.

Opgesteld: *A. SEMGEEST*

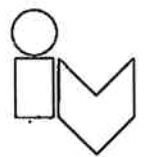
Datum: 03-04

Bladnummer: ES-1

Rev.: A2

Project : MALAMOLCO NAV. LOCK GATE

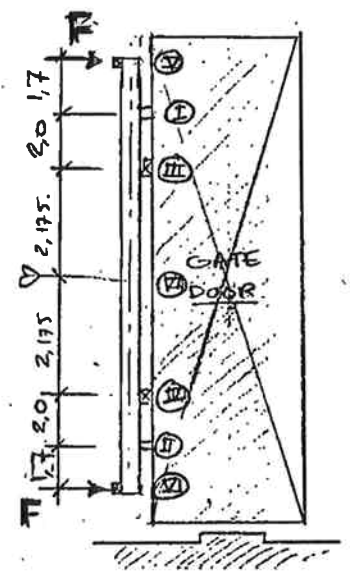
Onderdeel : GUIDANCE WATERPROOFING



1. BASICS

THE GUIDANCE WATERPROOFING CONSIST OF TWO VERTICAL BEAM EACH AT ONE SIDE OF THE GATE DOOR NEXT TO THE BEARING-FACE

- Ⓐ + Ⓑ ARE CONNECTION POINTS TO GATE DOOR.
- Ⓒ + Ⓓ ARE FILLINGS WHICH PRESTRESS THE BEAM.
- Ⓔ + Ⓕ ARE CONTACT AREAS TO GATE CHAMBER WALL IN CASE OF IMPOUNDAGE.

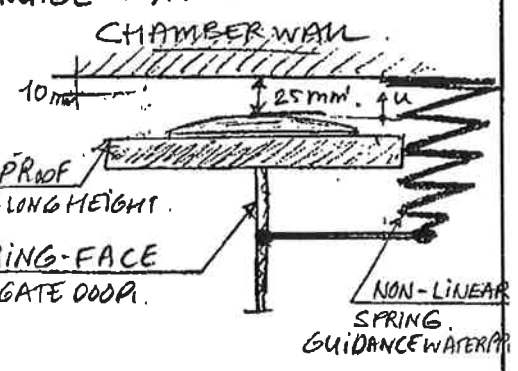


THE SYSTEM WILL ACT AS A NON-LINEAR SPRING:

- DUE TO THE PRESTRESS, BY MEANS OF FILLINGS AT THE BEAM ACTS AS A FOURFOLD SUPPORTED BEAM. (Ⓐ, Ⓑ, Ⓒ, Ⓓ) FOR LOADING $\leq 0,1 m'$ IMPOUNDAGE.
- FOR IMPOUNDAGE $> 0,1 m'$, DUE TO DEFLECTION OF THE BEAM, PRESTRESS IS LOST AT Ⓒ + Ⓓ. THE BEAM BECOMES SIMPLY SUPPORTED AT Ⓐ + Ⓑ AND ACT LESS STIFFER COMPARED TO IMPOUNDAGE $< 0,1 m'$.

FUNCTION

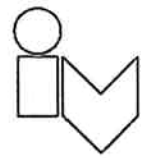
SECURE CLEARANCE BETWEEN GATE DOOR AND CHAMBER WALL AT LITTLE COINCIDENTAL IMPOUNDAGE ($h_{imp} < 0,2 m'$)



* FOR INSTALLING THE FILLINGS, THE BEAM IS JACKET UP AT Ⓔ

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : GUIDANCE WATERPROOFING



SPRING CONDITIONS :

① impoundage $h \leq 0,1 \text{ m}$; SEAL STILL CLEAR FROM WALL.

LOAD AT ④ + ⑤ = 225 kN

DEFLECTION AT ⑤ + ⑥ < 10 mm

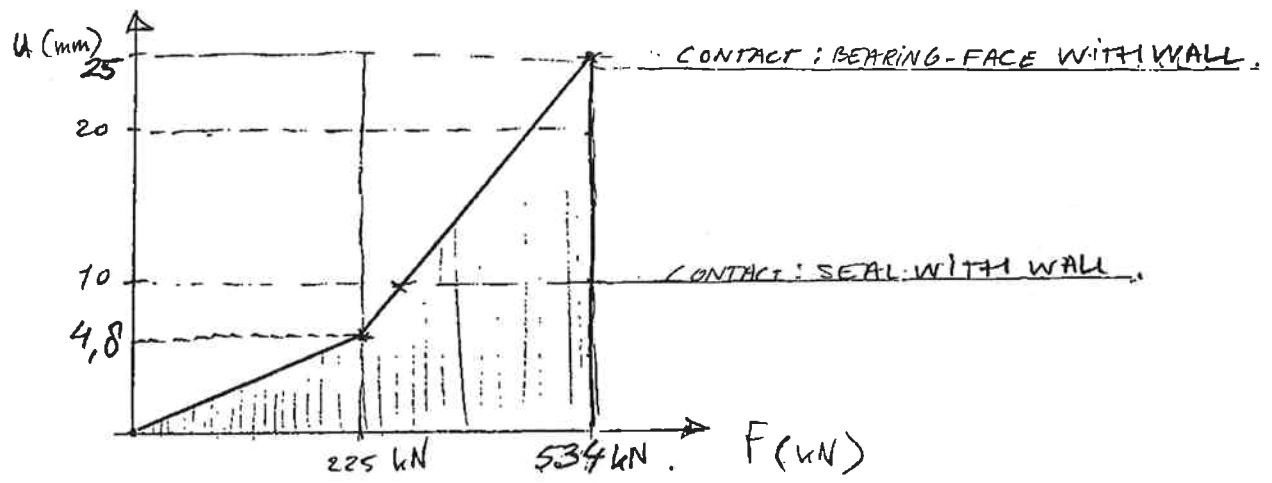
② impoundage $h = 0,2 \text{ m}$; - SEAL TIGHTEND TO WALL.
- BEARING-FACE GATE DOOR PRESSED TO WALL.

LOAD AT ② + ③ = 534 kN (RESULTING FROM CALCULATION)

DEFLECTION AT ⑤ + ⑥ = 25 mm (NO CLEARANCE)

LOAD-DEFORMATION DIAGRAM (F-u) *

ACCORDING CALCULATION ON NEXT PAGES :



* NOTE: BEAM HEM400 (WITHOUT CORROSION)

Opgesteld : ALSEMGEEST

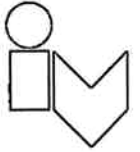
Datum : 16-03-04

Bladnummer : ES-3,

Rev. : A2

Project : MALAMOCO NAV. LOCK GATE .

Onderdeel : GUIDANCE WATERPROOFING .



2. CAMBER.

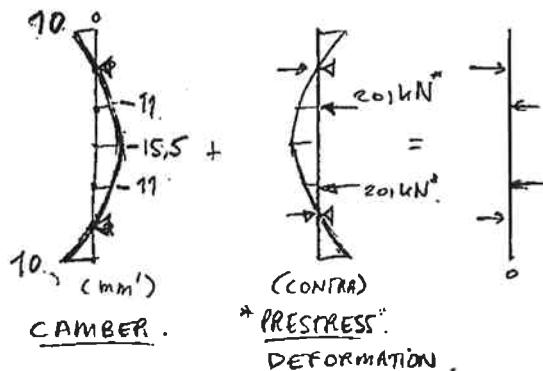
THE GUIDANCE WATERPROOFING - BEAMS ARE CAMBERED.

THE CAMBER IS EQUAL TO DEFORMATION - LINE OF SIMPLY SUPPORTED

BEAM LOADED AT (III) + (IV) WITH THE REACTIONS IN THESE POINTS. FOR

THE FOURFOLD - SUPPORTED SYSTEM, LOADED WITH 0,1 m' IMPOUNDAGE.

RESULTING IN A NON - DEFLECTED BEAM IN PRESTRESSED SITUATION
ACCORDING NEXT FIGURE :



3. CALCULATION .

WITH ESA PRIMA WIN. ON NEXT PAGES, RESULTING IN !

→ DEFORMATION IF LOADED BY 0,1 m' IMPOUNDAGE. - (DUE TO PRESTRESS, NEXT TO

THE BEAM IS SUPPORTED AT (III) + (IV))

→ HIGHERING THE LOAD TO 0,2 m' IMPOUNDAGE. - RESULTING IN LOAD
INCREASE AT (V) AND (VI), AT THE MAX. DISPLACEMENT OF 25 mm'.

→ ALSO EXAMINED FOR: MEM400 TAKEN INTO ACCOUNT: CORROSION
ALLOWANCE - 1 mm' - OFF.

→ MEMBER FORCES, REACTIONS AND STRESSES CALC. MANUALLY.

ESA PRIMA IS MANIPULATED, GIVING NOT THE RIGHT MOMENT LINES ETC.

Opgesteld: A. SEMBEEST

Datum: 16-03-'04

Bladnummer: ES-4.

Rev.: A2

Contents

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List of material	1
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Supports & Subsoil	3
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2: OUTPUT	6
Deformation on macro(s). Load case(s) : 1	6
Reactions. Load case(s) : 1/2	7
Deformation - uz on member(s). Load case(s) : 1	8

1. INPUT

Basic data

Type of structure : Frame XZ

Number of nodes:	49
Number of members:	42
Number of 1D macros:	30
Number of bound. lines:	0
Number of 2D macros:	0
Number of profiles :	2
Number of cases:	2
Number of materials:	1

Material

Name:		
S 355		
Ultimate strength	510.000 MPa	
Yield design	355.000 MPa	
E modulus	210000.00 MPa	
Poisson coeff.	0.30	
Density	0.000 kg/mm ³	
Extensibility	1.2e-005 mm/mm.K	

List of material

Group of members :
 1/42

no	Name:	quality	unit weight kg/mm	length mm	weight kg
1	HEM400	S 355	0.26	47000.00	12020.39
2	lw (430,19,305,38)	S 355	0.23	35250.00	8275.36

ES-5

ESA-Prima Win release 3.50.298

Project : Guidance waterproofing
 Author : Alsemgeest

Page : 3
 Date : vrijdag 19 maart 2004

Profile no. 2 - lw (430,19,305,38)
 Material : 3 - S 355

1	P19/354 - S 355
2	P38/305 - S 355
3	P38/305 - S 355

A:	2.990600e+004 mm ²		
Ay/A:	0.637	Az/A:	0.231
Iy:	9.635118e+008 mm ⁴	Iz:	1.798956e+008 mm ⁴
Iyz:	0.000000e+000 mm ⁴	It:	1.205355e+007 mm ⁴
Iw:	6.937613e+012 mm ⁶		
Wely:	4.481450e+006 mm ³	Welz:	1.179644e+006 mm ³
Wply:	5.138531e+006 mm ³	Wplz:	1.799423e+006 mm ³
cy:	-9.50 mm	cz:	177.00 mm
iy:	179.49 mm	iz:	77.56 mm
dy:	0.00 mm	dz:	-0.00 mm
Outline :		2042.00 mm	

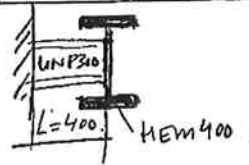
Type for check: I section

Height	430.00 mm	Width	305.00 mm
Thickness of flange	38.00 mm	Thickness of web	19.00 mm
Radius	19.00 mm		

Supports

support	node	type	flexibility MN/m-MNm/rad	Size mm
1	2	XZRy	kry = 0.08	200.00
2	4	XZRy	kry = 0.08	200.00
3	7	XZRy	kry = 0.08	200.00
4	9	XZRy	kry = 0.08	200.00
5	11	X		200.00
6	12	X		200.00
7	13	X		200.00
8	14	X		200.00
9	16	XZRy	kry = 0.08	200.00
10	20	XZRy	kry = 0.08	200.00
11	23	XZRy	kry = 0.08	200.00
12	27	XZRy	kry = 0.08	200.00
13	30	XZRy	kry = 0.08	200.00
14	34	XZRy	kry = 0.08	200.00
15	37	XZRy	kry = 0.08	200.00
16	41	XZRy	kry = 0.08	200.00
17	44	XZRy	kry = 0.08	200.00

ROTATION STIFFENESS TAKEN INTO ACCOUNT OF SUPPORTS (I) + (II)



$$\frac{M}{\varphi} = \frac{G \cdot I_t}{L}$$

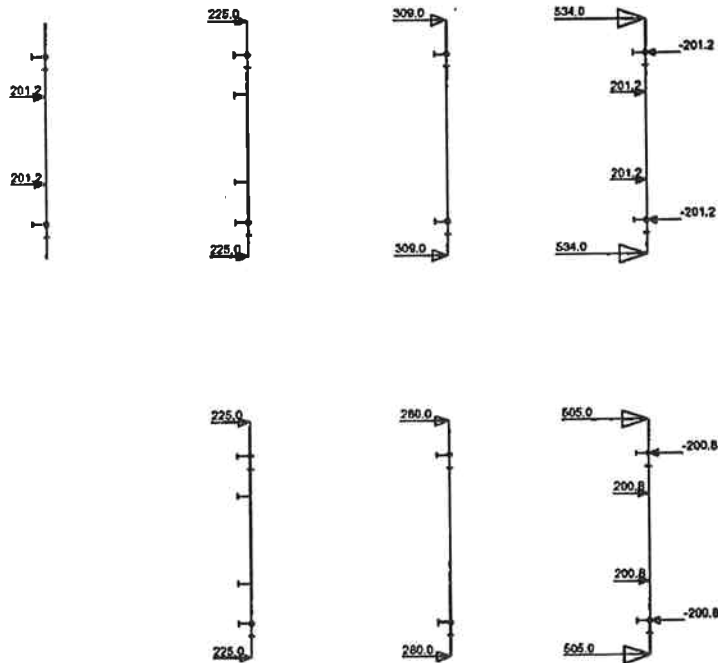
$$= \frac{81000 \cdot 38,07 \cdot 10^4}{400} = 77,1 \text{ kNm/rad}$$

$K_{Ry} = 0,08 \text{ MNm/rad}$

support	node	type	flexibility MN/m-MNm/rad	Size mm
18	48	XZRy	kry =0.08	200.00

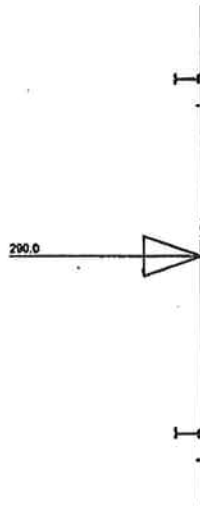
Loadcases

Case	Name	Description
1	impoundage sequence	Permanent - Loads
2	jacking	Permanent - Loads



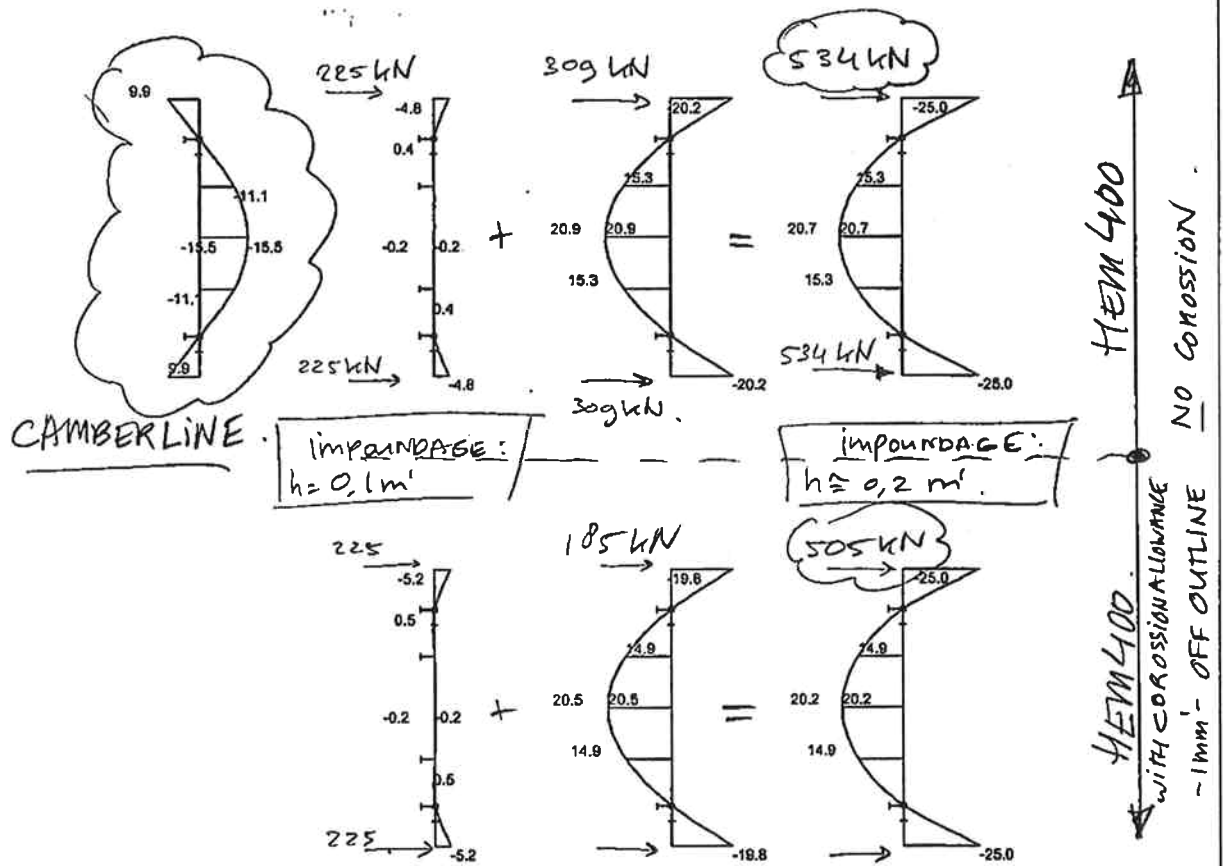
Nodal loads.Loadcases - 1

ES-8

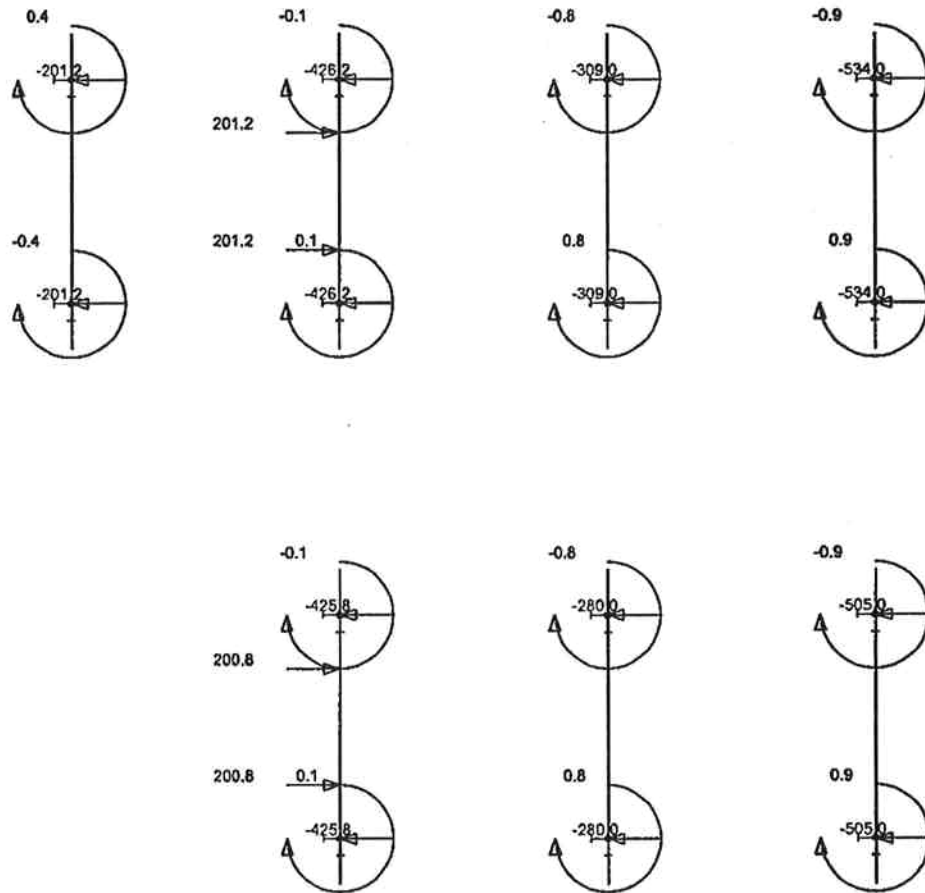


Nodal loads.Loadcases - 2: jacking force

2. OUTPUT

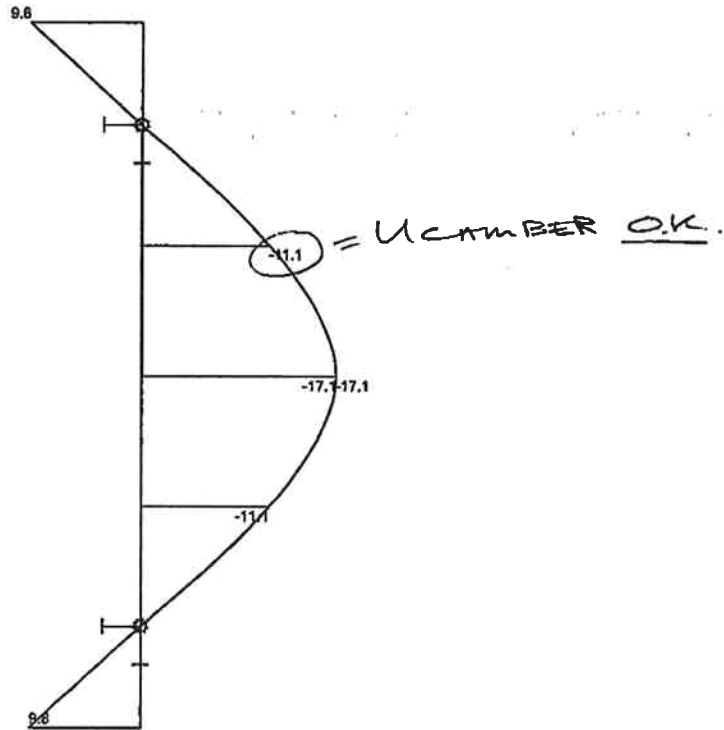


Deformation on macro(s). Load case(s) : 1



Reactions. Load case(s) : 1/2

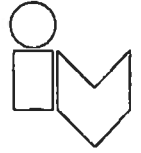
ES-11



Deformation - uz on member(s). Load case(s) : 2

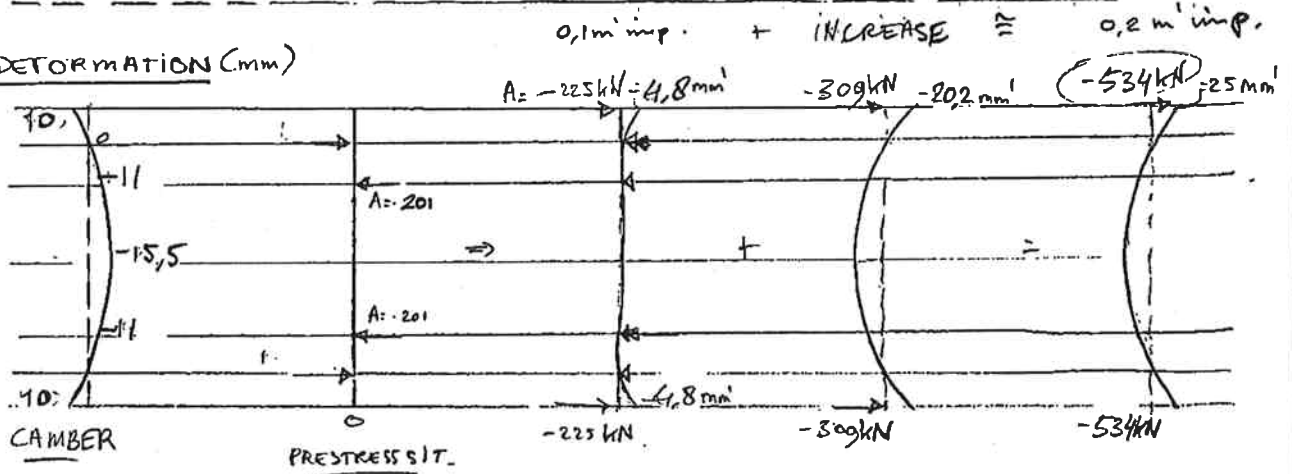
Project : MALAMOCO NAV. LOCK GATE .

Onderdeel : GUIDANCE WATERPROOFING

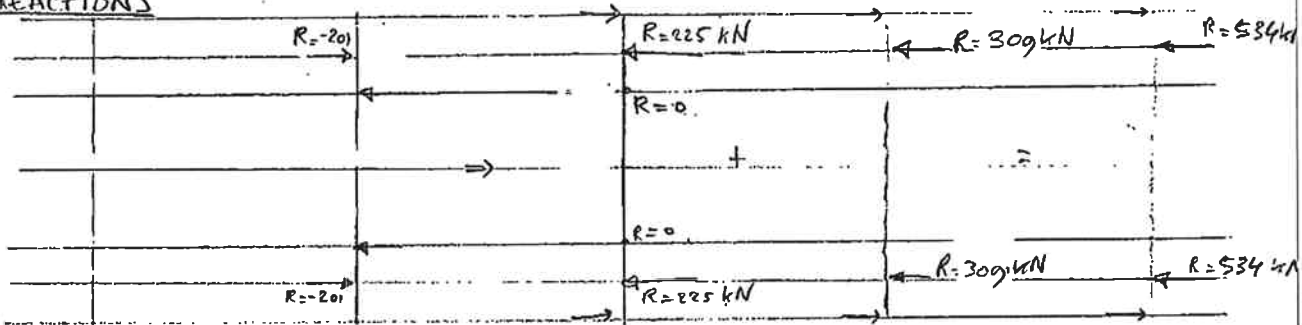


4. RESULTS (WITHOUT CORROSION)

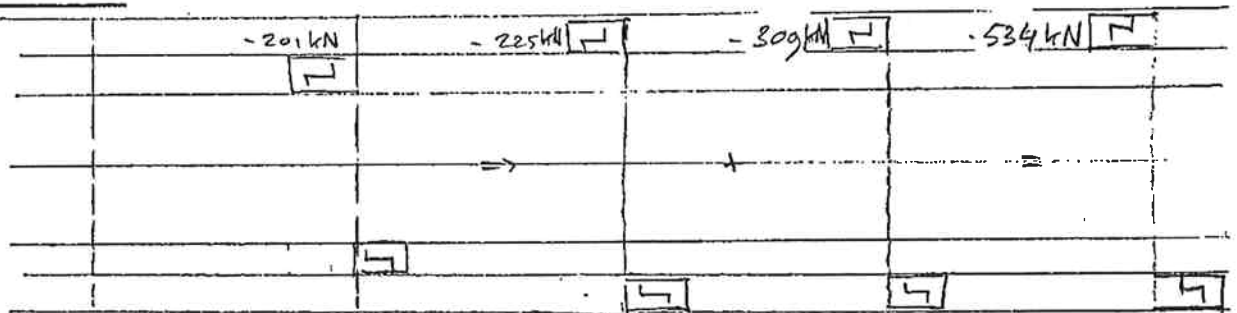
DEFORMATION (mm)



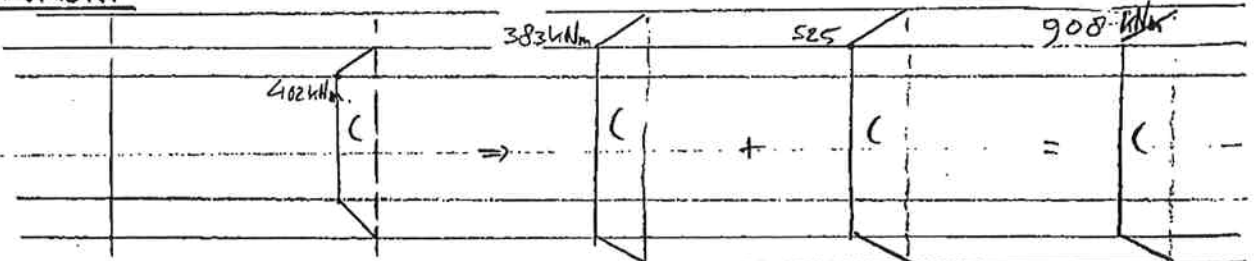
REACTIONS



SHEAR



MOMENT



Opgesteld : A. SEIN GEEST

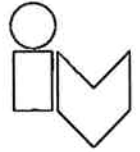
Datum : 16.03.64

Bladnummer : ES-13

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : GUIDANCE WATERPROOFING.



RESULTS (GOVERNING)

* GOVERNING DEFORMATION AT LOAD 0,1 m' impoundage :

$$u = 4,8 \text{ mm} < 10 \text{ mm} \text{ CLEARANCE: } \underline{\text{O.K.}}$$

* MAX. LOAD ON CONNECTION TO GATE DOOR : (I) + (II)

$$R_{\text{max}} = 534 \text{ kN.}$$

* MAX. LOAD ON FILLINGS : (III) + (IV)

$$R_{\text{max}} = 201 \text{ kN.}$$

* MAX. MEMBER FORCES; GOVERNING SECTION (REPR.)

$$M_{y:S:R} = 908 \text{ kNm.}$$

$$V_{z:S:R} = 534 \text{ kN.}$$

#HEM400.

$$M_{y:S:R} = 858 \text{ kNm.}$$

$$V_{z:S:R} = 505 \text{ kN.}$$

#HEM400 WITH CORROSION TOLERANCE.

NOTE: ALL NAMED LOADS; REPRESENTATIVE VALUES WITHOUT FACTOR

Opgesteld : A. SEMGEEST.

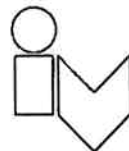
Datum : 16-03-04

Bladnummer : ES-14

Rev. : A2.

Project : MALAMOLCO NAV. LOCK GATE

Onderdeel : GUIDANCE WATERPROOFING



LOAD SITUATIONS FOR CHECKS (CONSERVATIVE; SEE NOTE)

① JACK-UP SITUATION (NOT GOVERNING)

$$M_{y:sid} = 1,5 \cdot \frac{1}{4} \cdot 290 \cdot 8,35 = 815 \text{ kNm}$$

$$V_{y:sid} = 1,5 \cdot 290/2 = 218 \text{ kN}$$

② MOVEMENT DOOR; OPENING GOVERNING (PAGE E7-8)

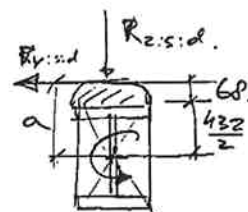
$$V_{z:sid} = (0,1 \text{ m impoundage}) = 338 \text{ kN}$$

$$V_{y:sid} = 0,2 \cdot 338 = 68 \text{ kN}$$

$$M_{y:sid} = 1,7 \cdot 338 = 575 \text{ kNm}$$

$$M_{z:sid} = 1,7 \cdot 68 = 116 \text{ kNm}$$

$$M_{T:sid} = 0,284 \cdot 68 = 20 \text{ kNm}$$



③ ULTIMATE LOAD SITUATION ACC. PREVIOUS CALC.

HEM 400 WITHOUT CORROSION

$$M_{y:sid} = 1,5 \cdot 908 = 1362 \text{ kNm}$$

$$V_{z:sid} = 1,5 \cdot 534 = 801 \text{ kN}$$

HEM 400 WITH CORROSION

$$M_{y:sid} = 1,5 \cdot 858 = 1287 \text{ kNm}$$

$$V_{z:sid} = 1,5 \cdot 505 = 758 \text{ kN}$$

Max. load is limited by max possible deflection 25m

NOTE: ALL LOADS ARE FACTORED *1,5; HIGHLY CONSERVATIVE

Opgesteld: ALSEMGEEST

Datum: 03-04

Bladnummer: ES-15

Rev.: AL

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : GUIDANCE WATERPROOFING



CHECK WATERPROOFING GUIDANCE BEAM

CHECK STRENGTH (LOAD SITUATION 3)

HEM 400 WITHOUT CORROSION TOLERANCE :

ACTING : $M_D = 1362 \text{ kNm}$

$V_D = 1801 \text{ kN}$

CAPACITY :

$A_v = t_w \cdot h_w = 21 \cdot 352 = 7392 \text{ mm}^2$

$V_{el:u:d} = A_v \cdot f_y / \sqrt{3} \gamma_{mo} =$

$= 7392 \cdot 355 / (\sqrt{3} \cdot 1,1) = 1377 \text{ kN}$

$\rho = (2 V_D / V_{el:u:d} - 1)^2$

$= 0,027$

$M_{v:rd} = [W_{el} - \frac{\rho A_v^2}{4 t_w}] f_y / \gamma_{mo}$

$= [4820 \cdot 10^3 - (0,027 \cdot 7392^2 / 4 \cdot 21)] \cdot 345 / 1,1$

$= 1506 \text{ kNm}$

$u.c. = M_D / M_{v:rd} = 1362 / 1506 = 0,9 \quad \underline{\text{O.K.}}$

HEM 400 WITH CORROSION TOLERANCE :

ACTING : $M_D = 1287 \text{ kNm}$

$V_D = 758 \text{ kN}$

CAPACITY : $A_v = 19 \cdot 350 = 6650 \text{ mm}^2$

$V_{el:u:d} = 1239 \text{ kN}$

$\rho = 0,05$

$M_{v:rd} = [4390 \cdot 10^3 - 0,05 \cdot 6650^2 / 4 \cdot 19] \cdot 345 / 1,1 = 1368 \text{ kNm}$

$u.c. = M_D / M_{v:rd} = 1287 / 1368 = 0,94 \quad \underline{\text{O.K.}}$

Opgesteld : ALSEMGEEST

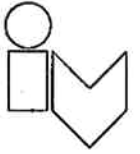
Datum : 16-03-04

Bladnummer : ES-16

Rev. A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : GUIDANCE WATERPROOFING.



CHECK LATERAL TORSIONAL BUCKLING (LOADSITUATION ③)

HEM400:

$$\lambda_{LT} = \frac{L/c_2}{(C_1)^{0.5} \left[1 + \frac{1}{20} \left[\frac{L/c_2}{h/t_f} \right]^2 \right]^{0.25}} \quad (\text{ENV 1993-1-1; F2.2. (F.21)})$$
$$= \frac{2175/77}{(1)^{0.5} \left[1 + \frac{1}{20} \left[\frac{2175/77}{432/40} \right]^2 \right]^{0.25}} = 26,3..$$

$$\bar{\lambda}_{LT} = [\lambda_{LT} \lambda_1] \cdot [\beta_w]^{0.5} = \frac{26,3}{\sqrt{93,9 \cdot 0,81}} \left[\frac{4820}{5571} \right]^{0.5} = 0,323$$

$$\phi_{LT} = 0,5 \left[1 + 0,49 (0,323 - 0,2) + 0,323^2 \right] = 0,582$$

$$\chi_{LT} = \frac{1}{0,582 + [0,582^2 - 0,323^2]^{0.5}} = 0,937$$

$$M_{b;rd} = \chi_{LT} \cdot \beta_w \cdot W_{ply} \cdot f_y / \gamma_m$$

$$= 0,937 \cdot \left(\frac{4820}{5571} \right) \cdot 10^3 \cdot 345 / 1,1 = 1417 \text{ kNm}$$

$$u.c. = M_{s;d} / M_{b;rd} = 7362 / 1417 = 0,96 < 1,0 \text{ O.K.}$$

RESTRAINED BEAM AT: (I) + (II) + (III) + (IV) + (VII)

HEM400 WITH CORROSION TOLERANCE:

$$M_{b;rd} = \frac{W_{el; HEM400; CORROSION}}{W_{el; HEM400; NO CORROSION}} M_{b;rd; HEM400}$$
$$= \frac{4,39 \cdot 10^6}{4,82 \cdot 10^6} \cdot 1417 = 1291 \text{ kNm}$$

$$u.c. = 1362 / 1291 = 1,05; \text{ still sufficient: because}$$

- EXTREME LOAD CANNOT OCCUR.
- BEAM IS REPLACEABLE.

Opgesteld: A. SEMGEEST

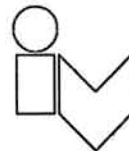
Datum: 17-03-04

Bladnummer: E5-17

Rev.: A2

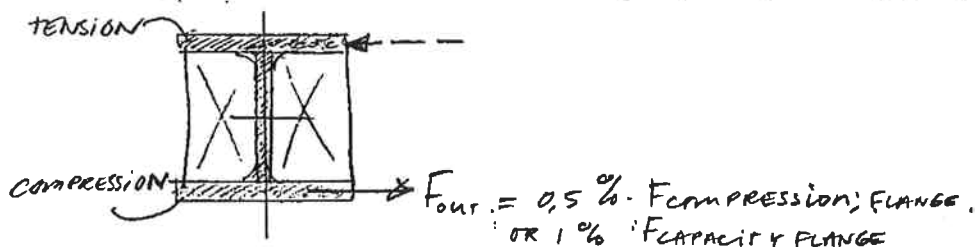
Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : GUIDANCE WATERPROOFING SUPPORTS.



NOTE: RESTRAINTMENT OF BEAM AT (III) + (IV) + (VII).

* FLANGE IN COMPRESSION IS CONNECTED TO THE FLANGE IN TENSION BY MEANS OF STIFFNERS.



→ F_{OUT} SHOULD BE COUNTERACTED AT THE FLANGE IN TENSION TO MAKE A GOOD RESTRAIN FOR TORSIONAL BUCKLING.

THIS CAN NOT BE BEARED DIRECTLY AT (III) + (IV) OR (VII) FOR THE BEAM IS NOT HELD DIRECTLY AT THESE POINTS.

→ F_{OUT} IS TRANSFERED TO THE CONNECTIONS (I) + (II) BY MEANS OF WEAK AXIS BENDING, PRODUCING EXTRA STRESSES:

$$\text{ACTING STRESS: } \sigma_{FL} = \frac{M_d}{W_{HEM400}} = \frac{1,5 \cdot 908 \cdot 10^6}{48 \cdot 20 \cdot 10^3} = 283 \text{ N/mm}^2$$

$$F_{OUT} : \begin{matrix} 0,005 \cdot A_{FLANGE} \cdot \sigma_{FL} = 0,005 \cdot (307 \cdot 40) \cdot 283 = 17,4 \text{ N/mm}^2 \\ 0,01 \cdot A_{FLANGE} \cdot \sigma_{FL} = 0,01 \cdot (307 \cdot 40) \cdot \frac{283}{1,1} = 19,0 \text{ N/mm}^2 \end{matrix}$$

$$\text{WEAK AXIS BENDING STRESS FLANGE TIP: } \sigma_T = \frac{\frac{1}{4} \cdot F_{OUT} \cdot l}{W_{FLANGE}} = \frac{\frac{1}{4} \cdot 19 \cdot 10^3 \cdot 0,350}{\frac{1}{8} \cdot 40 \cdot 307} = 63 \text{ N/mm}^2$$

$$\sigma_{TOT: FLANGE TIP} = \sigma_{FL} + \sigma_T = 283 + 63 = 346 \text{ N/mm}^2$$

$$u.c. = \frac{346 \cdot 1,1}{345} = 1,1$$

DUE TO CONSERVATIVE APPROACH OF LOAD (SAFETY FACTOR=1,5) THIS IS STILL SUFFICIENT.

Opgesteld : AISEMGEEST

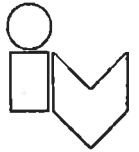
Datum : 04-04

Bladnummer : E5-18

Rev. : A2

Project : MALAMO CO NAV. LOCK GATE

Onderdeel : GUIDANCE, WATERPROOFING.



CHECK STRENGTH: MEM 400 WITH CORROSION-ALLOWANCE.

LOADSITUATION (2):

VON MISES STRESS IN FLANGE GOVERNING.

$$\begin{aligned}\sigma &= \frac{M_{y:s:d}}{W_{ely:d}} + \frac{M_{z:s:d}}{W_{elz:d}} \\ &= \frac{575 \cdot 10^6}{4,39 \cdot 10^6} + \frac{116 \cdot 10^6}{1,13 \cdot 10^6} \\ &= 131 + 103 = 234 \text{ N/mm}^2.\end{aligned}$$

$$\tau = \frac{V_{y:s:d}}{2 \cdot A_F} + \frac{M_T \cdot t_f}{I_t}$$

$$A_F = 38 \cdot 298 = 11324 \text{ mm}^2$$

$$I_t = 2 \cdot \left[\frac{1}{3} \cdot 298 \cdot 38^3 \right] + \frac{1}{3} \cdot 352 \cdot 19^3 = 11,706 \cdot 10^6 \text{ mm}^4$$

$$\begin{aligned}\tau &= \frac{68 \cdot 10^3}{2 \cdot 11324} + \frac{20 \cdot 10^6 \cdot 38}{11,706 \cdot 10^6} \\ &= 3 + 65 = 68 \text{ N/mm}^2.\end{aligned}$$

$$\sigma_{v.m} = \sqrt{\sigma^2 + 3\tau^2} = 262 \text{ N/mm}^2$$

$$u.c. = \frac{262 \cdot 1,1}{345} = 0,84 < 1,0 \text{ o.k.}$$

Opgesteld : AISEMGEEST

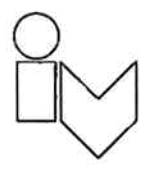
Datum : 03-04

Bladnummer : ES-19.

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : GUIDANCE WATERPROOFING.



DEFORMATION END OF BEAM. (OUT OF PLANE)

$$\varphi_{i:z} = \frac{M_{T:R} \cdot L}{G \cdot I_t}$$

$$M_{T:R} = 20 / 1,5 = 13,3 \text{ kNm.}$$

$$L = 1700 \text{ mm'}$$

$$G = 81000 \text{ N/mm}^2$$

$$I_t = 1524 \cdot 10^4 \text{ mm}^4$$

$$\varphi_{i:z} = 0,0184 \text{ RAD.}$$

$$u_y(\varphi_{i:z}) = 0,0184 \cdot \frac{(432+63)}{\text{BOTTOM FIXED}} = 9,2 \text{ mm'}$$

$$u_y(F_{y:R}) = u_2 \text{ PER kN} \cdot F_{y:R} \cdot \frac{I_z}{I_y}$$

$$u_2 \text{ PER kN} = \frac{20,2 \text{ mm}}{309 \text{ kN}} = 0,0654 \text{ mm/kN (acc. ES-20)}$$

$$F_{y:R} = 68 / 1,5 = 45,3 \text{ kN.}$$

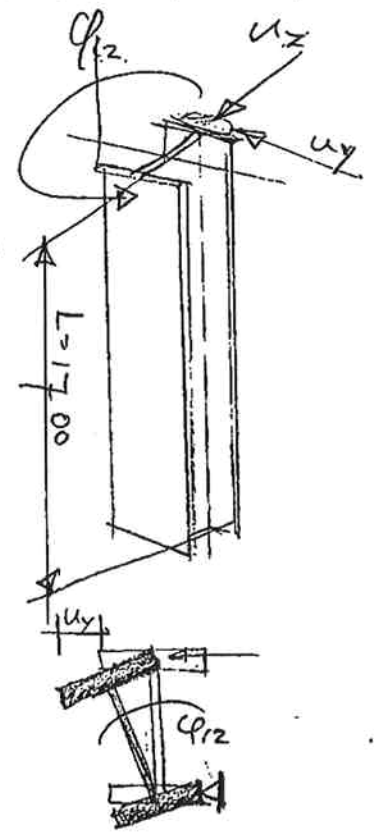
$$I_y = 104119 \cdot 10^4 \text{ mm}^4$$

$$I_z = 19335 \cdot 10^4 \text{ mm}^4$$

$$u_y(F_{y:R}) = 0,6 \text{ mm'}$$

$$u_{y:606} = u_y(\varphi_{i:z}) + u_y(F_{y:R}) = 9,8 \text{ mm'}$$

DEFORMATION WILL NOT OCCUR.



Opgesteld : **ALSEM GEEST**

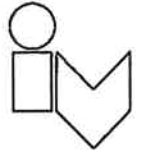
Datum : 03-04

Bladnummer : ES-20

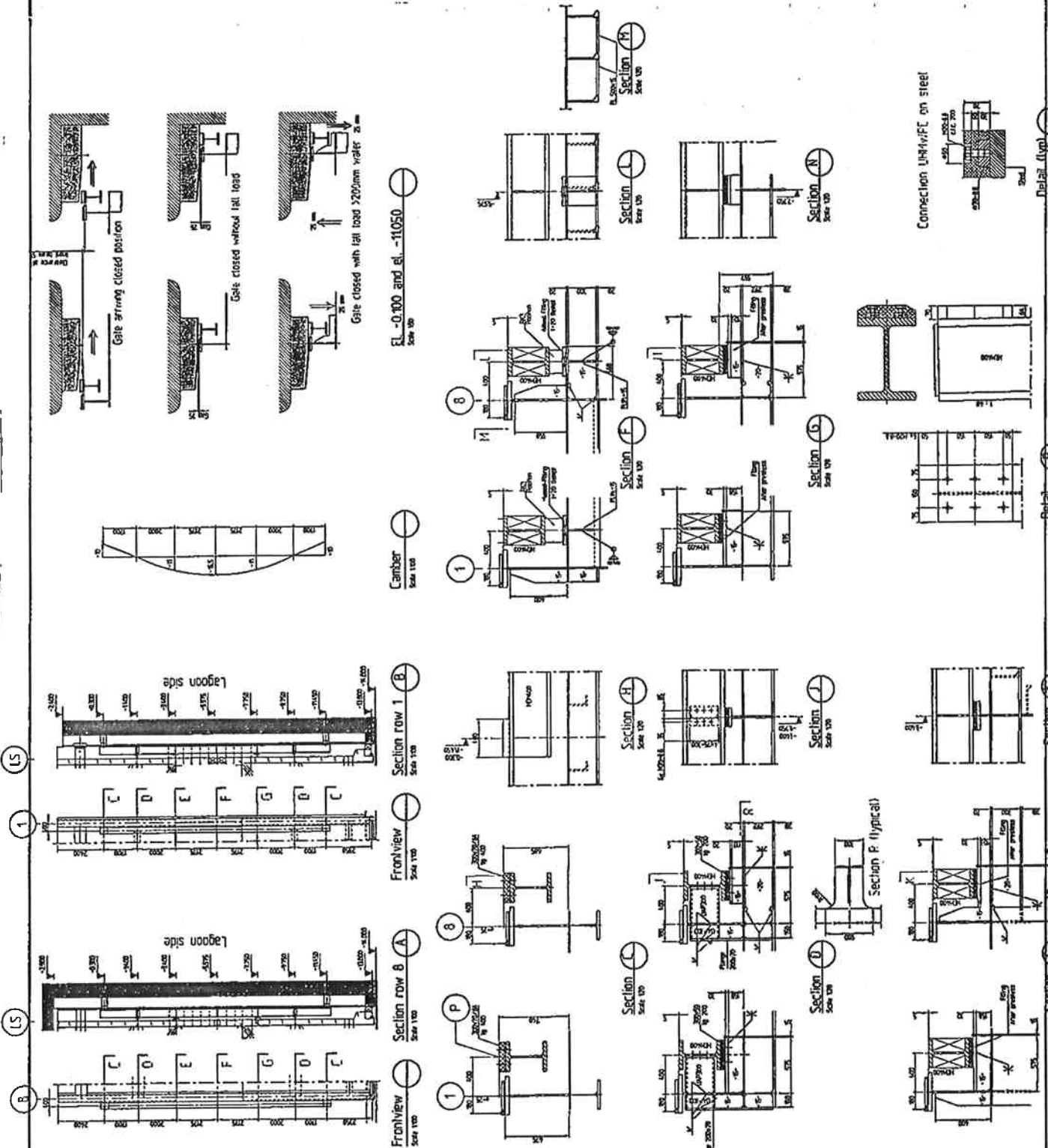
Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE -

Onderdeel : GUIDANCE WATERPROOFING SUPPORTS.



ES. 7 CHECK DETAIL CONNECTIONS TO GATE DOOR.



Opgesteld : *A. SEMEREST*

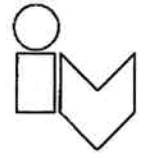
Datum : *04-04*

Bladnummer : *ES-21*

Rev. : *A2*

Project : MALAMOLCO NAV. LOCK GATE.

Onderdeel : WATERPROOFING GUIDANCE SUPPORTS.



LOADS (REF: TO ES-13)			REPRESENTATIVE :
I/II	SUSPENSION :	• DOWNWARD.	534 kN
		• UPWARD.	202 kN
III/IV	FILLINGS		202 kN
VII	JACK POINT		290 kN.
V/VI	CANTILEVERING PART.	MAX. VERT. LOAD .	V = 534 kN .
		COMBI. VERT. & HOR. LOAD DURING MOVEMENT *	V = 338 kN H = 67.5 kN } DESIGN LOAD.

NOTE : ONLY GOVERNING TYPICALS ARE CHECKED.

* LOAD DURING MOVEMENT DERIVED FROM PAGE E7-8.

Opgesteld : AL SEMGEEST

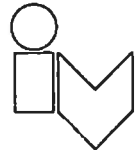
Datum : 03-04

Bladnummer : ES-26

Rev. : A2

Project : MALAMOCCHO NAV. LOCK GATE

Onderdeel : WATERPROOFING GUIDANCE SUPPORTS

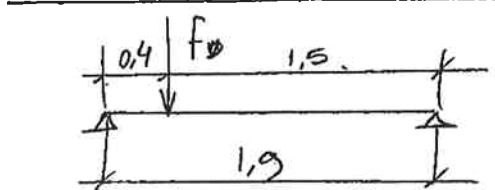


GOVERNING SECTION AT (I)/(II) (TYPICAL)

* GLOBAL CHECK UNDER MAX. DOWNWARD LOAD:

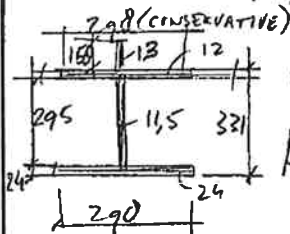
$F_D = 1,5 \cdot 534 = 801 \text{ kN}$

Row (I)



$M_d = \frac{0,4 \cdot 1,5}{1,9} \cdot F_D = 253 \text{ kNm}$

$V_d = \frac{1,5}{1,9} \cdot F_D = 653 \text{ kN}$



$W_{ely} = 1,27 \cdot 10^6 \text{ mm}^3$

$A_v = \frac{16 \cdot 13}{295 \cdot 11,5} = 5446 \text{ mm}^2$

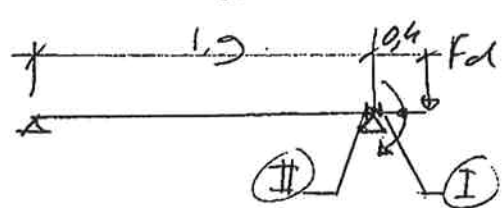
$\sigma_b = M_d / W_{ely} = 200 \text{ N/mm}^2$

$\tau = V_d / A_v = 120 \text{ N/mm}^2$

$\sigma_{um} = \sqrt{\sigma_b^2 + 3\tau^2} = 288 \text{ N/mm}^2$

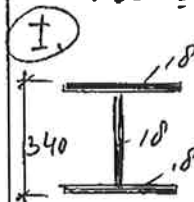
$u.c. = 288 \cdot \frac{1,1}{355} = 0,89; \text{OK}$

Row (B)



$M_d = 0,4 \cdot F_D = 320 \text{ kNm}$

$V_d = F_D = 801 \text{ kN}$



$W_{ely} = 1,89 \cdot 10^6 \text{ mm}^3$

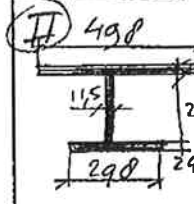
$A_v = 18 \cdot 298 = 5364 \text{ mm}^2$

$\sigma_b = M_d / W_{ely} = 169 \text{ N/mm}^2$

$\tau = V_d / A_v = 150 \text{ N/mm}^2$

$\sigma_{um} = 309 \text{ N/mm}^2$

$u.c._{max} = 309 \cdot \frac{1,1}{355} = 0,96 < 1,0 \text{ OK}$



$W_{ely} = 1,94 \cdot 10^6 \text{ mm}^3$

$A_v = 11,5 \cdot 298 = 3427 \text{ mm}^2$

$V_d = \frac{0,4}{1,9} \cdot F_D = 170 \text{ kN}$

$\sigma_b = M_d / W_{ely} = 165 \text{ N/mm}^2$

$\tau = V_d / A_v = 50 \text{ N/mm}^2$

$\sigma_{um} = 187 \text{ N/mm}^2 \text{ u.c.} = 0,58 \text{ OK}$

Opgesteld : f. s. m. g. e. s. t.

Datum : 03-04

Bladnummer : E5-27

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE

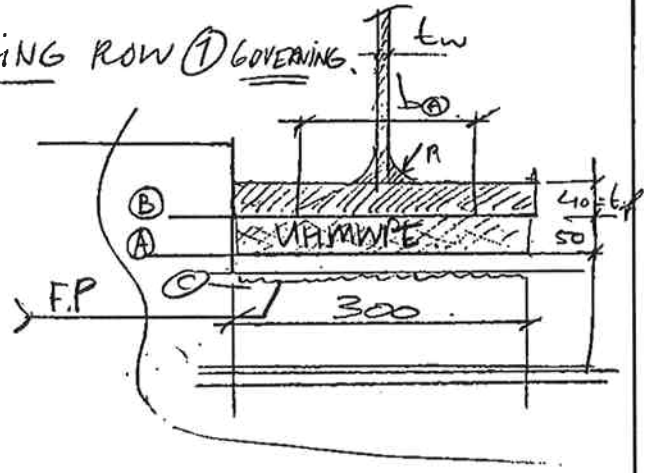
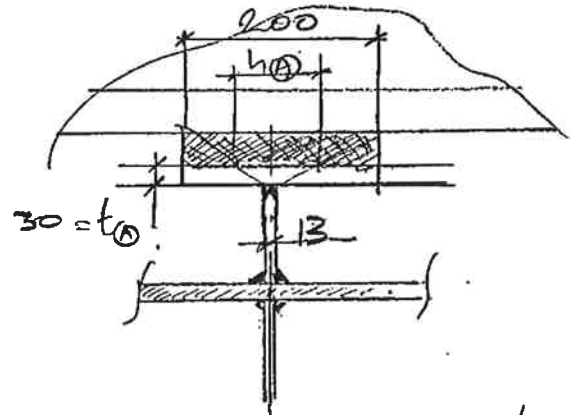
Onderdeel : GUIDANCE WATERPROOFING SUPPORTS



* LOCAL CHECK UNDER MAX. DOWNWARD LOAD:

- 1mm - CORROSION OFF -

LOAD INTRODUCTION AT BEARING ROW ① GOVERNING.



$f_{s;d, UHMWPE} = 8 \text{ N/mm}^2$

$b_{SPREAD} : b_{\textcircled{B}} = t_w + 2R + 2 \cdot (t_f \cdot \sqrt{\frac{355}{3 \cdot 8 \cdot 1.1}}) = 19 + 2 \cdot 27 + 2 \cdot (38 \cdot 3,67) = 352 \text{ } \underline{\underline{300 \text{ mm}}}$

$b_{\textcircled{A}} = b_{\textcircled{B}} + 2 \cdot 50 = 349 \text{ } \underline{\underline{300 \text{ mm}}}$

$h_{SPREAD} = h_{\textcircled{A}} = 13 + 2 \cdot (28 \cdot 3,67) = 218 \text{ mm}$

$h_{\textcircled{B}} = h_{\textcircled{A}} + 2 \cdot 50 = 318 \text{ } \underline{\underline{200 \text{ mm}}}$

$A_{\textcircled{A}} = 300 \cdot 218 = 65506 \text{ mm}^2$

$A_{\textcircled{B}} = 300 \cdot 200 = 60000 \text{ mm}^2$

LOAD DUE TO DEFORMATION.
REPRESENTATIVE $\delta = 1,9 \text{ UHMWPE}$
FOR STEEL CHECK $\delta = 1,5$ TAKEN

$f_{s;d, UHMWPE} \textcircled{A} = \frac{F_R}{A} = \frac{534 \cdot 10^3}{65506} = 8,2 \text{ N/mm}^2 ; \text{ u.c. } = 1,0$

$\textcircled{B} = \frac{534 \cdot 10^3}{60000} = 8,9 \text{ N/mm}^2 ; \text{ O.K.}$

SECTION $\textcircled{C} : f_N = \frac{801 \cdot 10^3}{300 \cdot 13} = 205 \text{ N/mm}^2 \Rightarrow \text{u.c.} = \frac{205 \cdot 1,1}{355} = 0,63 \text{ O.K.}$

Opgesteld : A. Semjeste

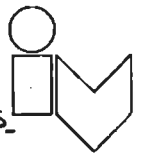
Datum : 03-04

Bladnummer : 5-28

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : GUIDANCE WATERPROOFING SUPPORTS.



* Buckling CHECK CAPACITY WEBS.

	MAIN WEB ROW ⑦	MAIN WEB ROW ⑧	T-WEB GENERAL ①/③
l	300	300	158 mm
l_{pl}	14	20	15 "
l_{calc}	12	18	13 "
$i_y = \sqrt{I/A}$	3,47	5,77	3,75 "
$\lambda = l/i_y$	86,6	52,0	42,1
$\lambda_1 = 93,9 \cdot \epsilon$	76,1	76,1	76,1
$\bar{\lambda} = \lambda/\lambda_1$	1,14	0,68	0,55
curve ①: X	0,464	0,737	0,814
$f_{y,d} = \frac{323}{1,1}$	323	323	323 N/mm ²
$F_{buckling}$	<u>150</u>	<u>238</u>	<u>263</u> N/mm ²

CHECK: $\sigma = F_D / b \cdot t$

main web row ⑦ : $\sigma = \frac{801 \cdot a^3}{(300 \cdot 2 \cdot 158) \cdot 12} = 109 \text{ N/mm}^2$; u.c. = $\frac{109}{150} = 0,73$
OK

main web row ⑧ : $\sigma = \frac{801 \cdot a^3}{300 \cdot 18} = 148 \text{ N/mm}^2$; u.c. = $\frac{148}{238} = 0,62$
OK

general t-web : $\sigma = \frac{801 \cdot a^3}{300 \cdot 12} = 205 \text{ N/mm}^2$; u.c. = $\frac{205}{263} = 0,78$
OK

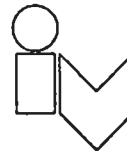
Opgesteld : PLS-EMGEEST

Datum : 04-04

Bladnummer : ES-29

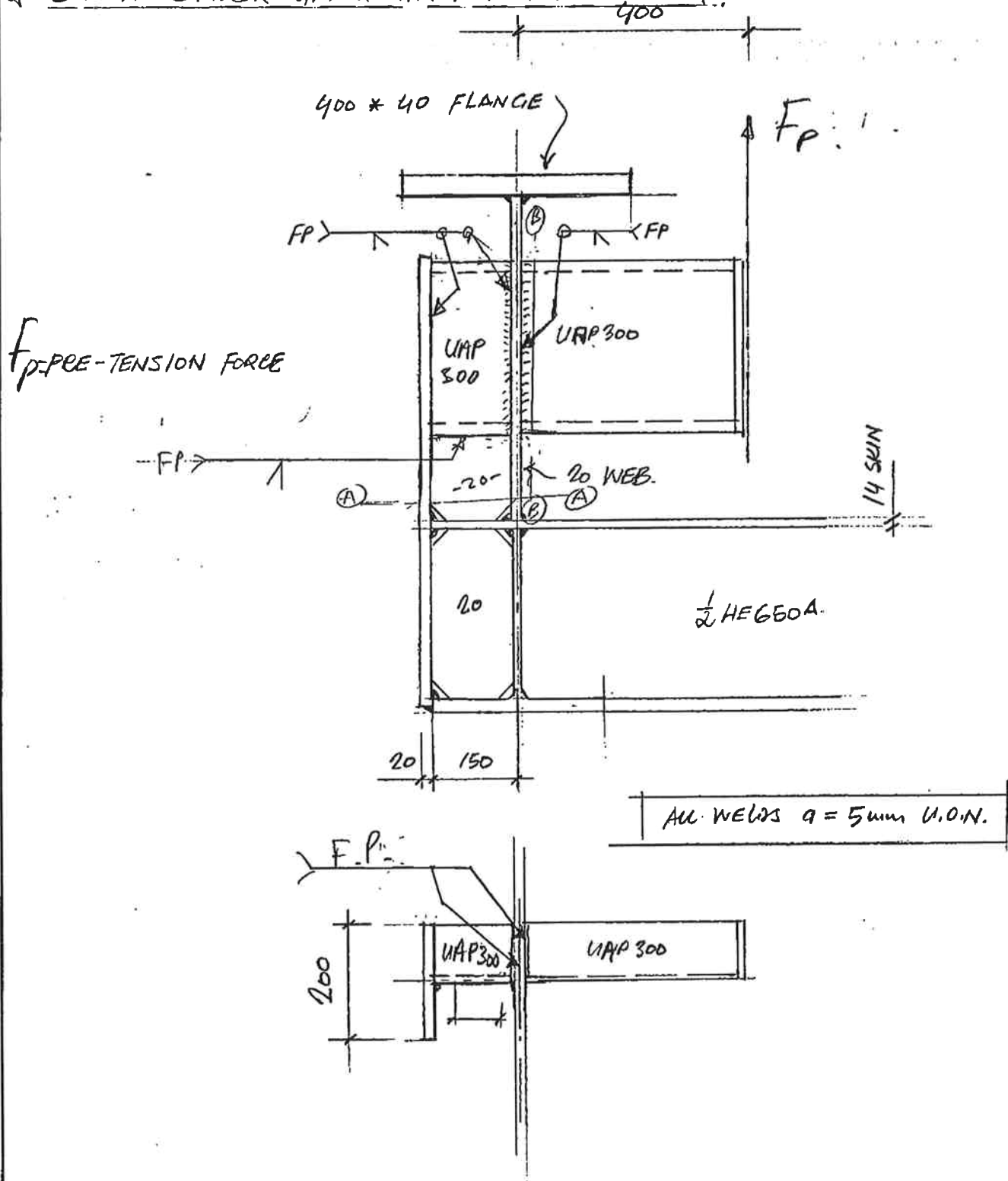
Rev. : A2

Project : MALAMOCLO LOCK VENICE



Onderdeel : GUIDANCE WATERPROOFING SUPPORTS.

* GLOBAL CHECK UNDER MAX. UPWARD LOADING...



Opgesteld : GWJ

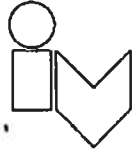
Datum : 03-04

Bladnummer : ES-30

Rev. : A2

Project : MALAMOCO NAV. LOCK GATE.

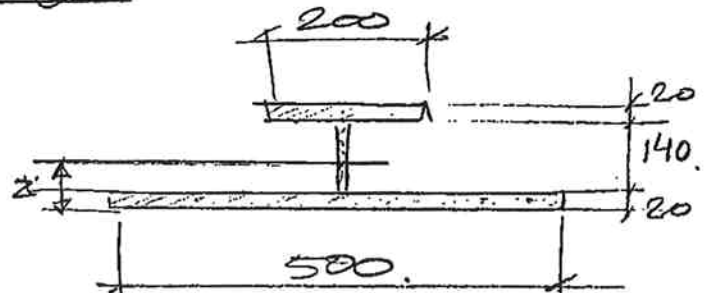
Onderdeel : GUIDANCE WATERPROOFING SUPPORTS



CHECK SECTION ①-①

PROPERTIES : (1mm' OFF)

$$A = 15120 \text{ mm}^2$$
$$W_{ely} = 6,11 \cdot 10^5 \text{ mm}^3$$
$$z = 60 \text{ mm}$$



LOADS:

$$F_{t, sid} = 202 \cdot 1,5 = 303 \text{ kN}$$

$$M_d = 303 \cdot 10^3 \cdot (60 + 400) = 140 \text{ kNm}$$

STRESS:

$$\sigma_N = F_{t, sid} / A = 20 \text{ N/mm}^2$$

$$\sigma_B = M_d / W_{ely} = 230 \text{ N/mm}^2 +$$

$$\sigma_{TOT} = 250 \text{ N/mm}^2$$

$$u.c. = 250 \cdot 1,1 / 355 = 0,77 ; \underline{OK}$$

① NOTE: CHECKED CONSERVATIVE WITH CORROSION-ALLOWANCE
+ $\gamma = 1,5$

Opgesteld : ALSEMGEEST

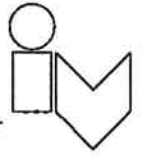
Datum : 03-04

Bladnummer : ES-31

Rev. : A2

Project : Malamocco Nav. Lock Gate.

Onderdeel : GUIDANCE WATERPROOFING SUPPORTS



CHECK UAP 300 :

PROPERTIES - 7mm - CORROSION ALLOWANCE :

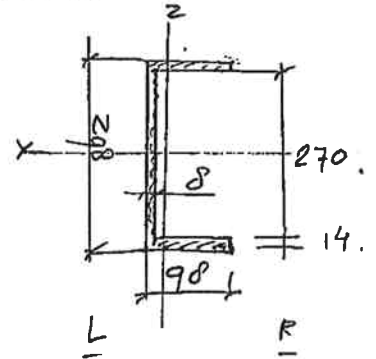
$$A_{vz} = 270 \cdot 8 = 2160 \text{ mm}^2$$

$$A_{vy} = 2 \cdot 98 \cdot 14 = 2744 \text{ mm}^2$$

$$W_{el:y} = 4,60 \cdot 10^5 \text{ mm}^3$$

$$W_{el:z} = \frac{L}{12} = 1,60 \cdot 10^5 \text{ mm}^3$$

$$I_t = \frac{1}{3} \cdot 284 \cdot 8^3 + \frac{2}{3} \cdot 94 \cdot 14^3 = 220427 \text{ mm}^4$$



PROPERTIES WITHOUT CORROSION ALLOWANCE :

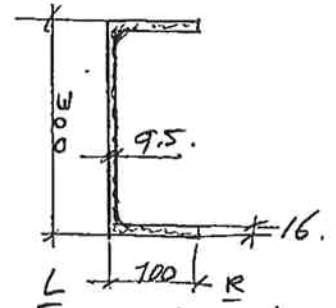
$$A_{vz} = 268 \cdot 9,5 = 2546 \text{ mm}^2$$

$$A_{vy} = 2 \cdot 100 \cdot 16 = 3200 \text{ mm}^2$$

$$W_{el:y} = 544,7 \cdot 10^3 \text{ mm}^3$$

$$W_{el:z} = \frac{L}{12} = 79,88 \cdot 10^3 \text{ mm}^3$$

$$I_t = 19,18 \cdot 10^3 \text{ mm}^3$$



Opgesteld : **ALSEMEST**

Datum : 03-04

Bladnummer : E5-32

Rev. : A2

Project : MALAMECCO NAV. LOCK GATE

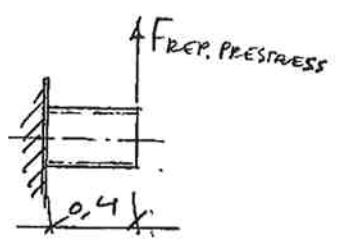
Onderdeel : WATERPROOFING GUIDANCE SUPPORTS 

LOADS ON UAP 300 :

- IN Z-DIRECTION :
- UPWARD LOAD DUE TO PRESTRESS : $F_{PREP}; PRESTRESS = 202 \text{ kN}$
- IN Y-DIRECTION :
- DUE TO SELFWEIGHT HEM400 ; PER UAP = $6 \cdot \frac{1}{2} L \cdot g$
 $= 256 \cdot \frac{11,75}{2} \cdot 10 = 15 \text{ kN}$
- TORSION DUE TO PRESTRESS :
- $M_T = 0,9 \text{ kNm}$ (DERIVED FROM PAGE ES-11.)

LOADFACTORS

LOAD	CORROSION ALLOWANCE	γ	
		YES	NO
SELFWEIGHT (HEM400)		1,2	1,2
PRESTRESS		1,1*	1,5



RESULTING IN :

LOAD	CORROSION ALLOW.	YES	NO	
$V_Z : 0$		222	303	kN
$V_Y : 0$		18	18	kN
$M_Y : 0$		89	121	kNm
$M_Z : 0$		7,2	7,2	kNm
$M_T : 0$		1,0	1,35	kNm

⊗ NOTE : PRESTRESS IS A GOOD MEASURABLE LOAD, THEREFOR.
 A FACTOR 1,1 IS SUFFICIENT FOR THE SITUATION WITH CORROSION ALLOWANCE

Opgesteld : 

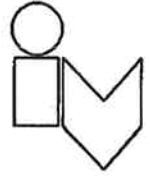
Datum : 03-04

Bladnummer : ES-33

Rev. : A2

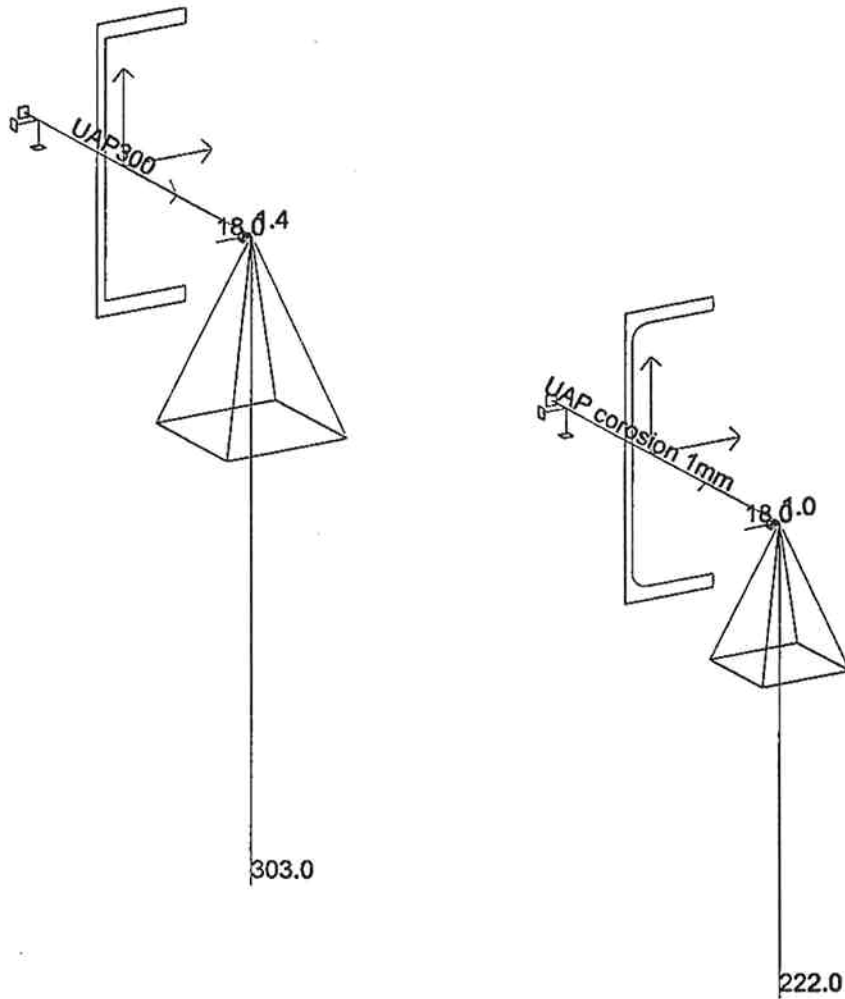
Project : Malamocco Nav. Lock Gate

Onderdeel : Guidance waterproofing supports



Guidance Waterproofing Support UAP300 Check acc. E.C.

Checked with ESA Prima Win:



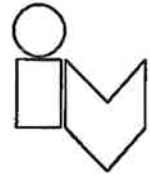
overview

Opgesteld : D. Aisemgeest

Datum: 02-04-04

Bladnummer: E5-34 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Guidance waterproofing supports

EC3. Member all. LC all.

EC3 Code Check

Macro 1	Member 1	UAP corosion 1mm	S 355	Loadcase 1	0.91
---------	----------	------------------	-------	------------	------

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

The critical check is on position 0.00 m

Internal forces		
NSd	0.00	kN
Vy.Sd	-18.00	kN
Vz.Sd	-222.00	kN
Mt.Sd	-1.00	kNm
My.Sd	88.80	kNm
Mz.Sd	7.20	kNm

Only elastic check

Shear check (Vy)

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

Table of values		
Vpl.Rd	478.14	kN
unity check	0.04	

Shear check (Vz)

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

Table of values		
Vpl.Rd	401.16	kN
unity check	0.55	

Opgesteld : D. Aisemgeest

Datum: 02-04-04

Bladnummer: E5-35 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Guidance waterproofing supports

Combined bending, axial force and shear force check

according to article ENV 1993-1-3 : 5.7 and formula ENV 1993-1-3: (5.11a,b,c)
Section classification is 3.

Table of values		
sigma N	0.00	MPa
sigma Myy	187.84	MPa
sigma Mzz	106.26	MPa
Tau z	0.00	MPa
Tau z	0.00	MPa
Tau t	-0.00	MPa

ro 0.01 place 3
unity check 0.91
Element satisfies the section check !

STABILITY CHECK

Buckling parameters	yy	zz	
type	sway	sway	
Slenderness	6.83	26.48	
Reduced slenderness	0.09	0.35	
Buckling curve	c	c	
Imperfection	0.49	0.49	
Reduction factor	1.00	0.93	
Length	0.40	0.40	m
Buckling factor	2.02	2.02	
Buckling length	0.81	0.81	m
Critical Euler load	222638.81	14823.93	kN

LTB check

according to article 5.5.2. and formula (5.48)

Table of values		
Mb.Rd	152.57	kNm
Beta W	0.86	
reduction	1.00	
imperfection	0.49	
Mcr	1068.40	kNm

LTB		
LTB length	0.40	m
k	1.00	
kw	1.00	
C1	1.88	
C2	0.00	
C3	0.94	

load in center of gravity
unity check =0.58

Opgesteld : D. Alsemgeest

Datum: 02-04-04

Bladnummer: E5-36 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Guidance waterproofing supports

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

Table of values	
ky	1.00
kz	1.00
muy	-0.04
muz	-0.14
BetaMy	1.80
BetaMz	1.80

unity check $= 0.00 + 0.58 + 0.33 = 0.91$

Compression, bending and LTB check
according to article ENV 1993-1-3 : 6.5.2 and formula (6.12)

Table of values	
klt	1.00
kz	1.00
mult	0.21
muz	-0.14
BetaMit	1.80
BetaMz	1.80

unity check $= 0.00 + 0.58 + 0.33 = 0.91$

Element satisfies the stability check !

Project : Malamocco Nav. Lock Gate

Onderdeel : Guidance waterproofing supports



Macro 2	Member 2	UAP300	S 355	Loadcase 1	0.97
---------	----------	--------	-------	------------	------

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 f_y	355.00	MPa
tension strength f_u	510.00	MPa
fabrication	rolled	

SECTION CHECK

Width-to-thickness ratio for outstand flanges (Tab.5.3.1. c).
ratio 6.25 on position 0.00 m

ratio		
maximum ratio	1	8.14
maximum ratio	2	8.95
maximum ratio	3	13.66

==> Class cross-section 1

The critical check is on position 0.00 m

Internal forces		
NSd	0.00	kN
Vy.Sd	-18.00	kN
Vz.Sd	-303.00	kN
Mt.Sd	-1.35	kNm
My.Sd	121.20	kNm
Mz.Sd	7.20	kNm

Only elastic check

Shear check (Vy)

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

Table of values		
Vpl.Rd	616.74	kN
unity check	0.03	

Shear check (Vz)

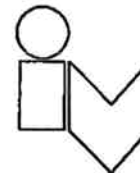
according to article 5.4.6. and formula (5.20)
Section classification is 3.

Opgesteld : D. Alsemgeest

Datum: 02-04-04

Bladnummer: E5- 28 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Guidance waterproofing supports

Table of values	
Vpl.Rd	552.27 kN
unity check	0.55

Combined bending, axial force and shear force check

according to article ENV 1993-1-3 : 5.7 and formula ENV 1993-1-3: (5.11a,b,c)
Section classification is 3.

Table of values	
sigma N	0.00 MPa
sigma Myy	222.25 MPa
sigma Mzz	90.15 MPa
Tau z	-0.00 MPa
Tau z	-0.00 MPa
Tau t	-59.50 MPa

ro 0.01 place 11
unity check 0.97
Element satisfies the section check !

STABILITY CHECK

Buckling parameters	yy	zz	
type	sway	sway	
Slenderness	6.85	26.14	
Reduced slenderness	0.09	0.34	
Buckling curve	c	c	
Imperfection	0.49	0.49	
Reduction factor	1.00	0.93	
Length	0.40	0.40	m
Buckling factor	2.02	2.02	
Buckling length	0.81	0.81	m
Critical Euler load	258548.66	17763.37	kN

LTB check

according to article 5.5.2. and formula (5.48)

Table of values	
Mb.Rd	175.79 kNm
Beta W	0.85
reduction	1.00
imperfection	0.21
Mcr	8778.08 kNm

LTB	
LTB length	0.40 m
k	1.00
kw	1.00
C1	1.88

Opgesteld : D. Alsemgeest

Datum: 02-04-04

Bladnummer: E5-39 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Guidance waterproofing supports

LTB	
C2	0.00
C3	0.94

load in center of gravity
unity check = 0.69

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

Table of values	
ky	1.00
kz	1.00
muy	-0.04
muz	-0.14
BetaMy	1.80
BetaMz	1.80

unity check = 0.00 + 0.69 + 0.28 = 0.97

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

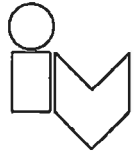
Table of values	
klt	1.00
kz	1.00
mult	-0.06
muz	-0.14
BetaMlt	1.80
BetaMz	1.80

unity check = 0.00 + 0.69 + 0.28 = 0.97

Element satisfies the stability check !

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : GUIDANCE WATERPROOFING SUPPORTS.



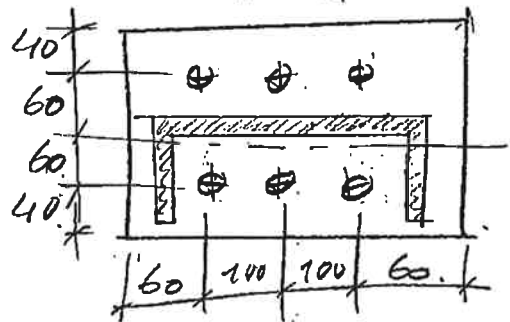
* LOCAL CHECK UNDER MAX. UPWARD LOADING.

LOADS :

$$V_{z;D} = 303 \text{ kN}$$

$$V_{y;D} = 18 \text{ kN}$$

$$M_{T;D} = 1,35 \text{ kNm}$$



$$F_{v;S;D} \text{ PER BOLT} = \sqrt{\left(\frac{303}{6}\right)^2 + \left(\frac{18}{6}\right) + \left(\frac{1,35}{0,2 \cdot 2}\right)^2}$$
$$= 57 \text{ kN}$$

M20 d.8.

$$\text{SHEAR } F_{v;Rd} = 0,6 f_{ub} \cdot A_s / \gamma_{mb}$$

$$= 0,6 \cdot 800 \cdot 245 / 1,25 = 94 \text{ kN}$$

$$\text{BEARING } F_{b;Rd} = 2,5 \alpha \cdot f_u \cdot d \cdot t_{min} / \gamma_{mb}$$

$$= \frac{2}{3} \cdot 2,5 \cdot 0,83 \cdot 490 \cdot 20 \cdot 13 / 1,25 = 141 \text{ kN}$$

$\rightarrow P_2 = 2,4 d_0 = 50 \text{ mm}$

$$\frac{2}{3} d_0 = \frac{50}{3} = 16,67 \text{ mm}$$
$$\frac{2}{3} d_0 = 3 \cdot 20 = 60 \text{ mm}$$
$$\rightarrow 16,67 \text{ mm}$$
$$\rightarrow 0,83$$

$$\text{SHEAR GOVERNING: u.c.} = 57 / 94 = 0,54 \text{ O.K.}$$

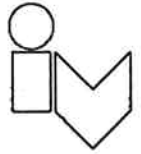
Opgesteld : ALSEMGEEST

Datum : 03-04

Bladnummer : ES-91 Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : GUIDANCE WATERPROOFING SUPPORTS.



DETAIL. VII : LOAD INTRODUCTION AT JACK

$F_D; \text{JACK} = 290 \times \overset{\text{CONSERVATIVE.}}{1.5} = 435 \text{ kN.}$

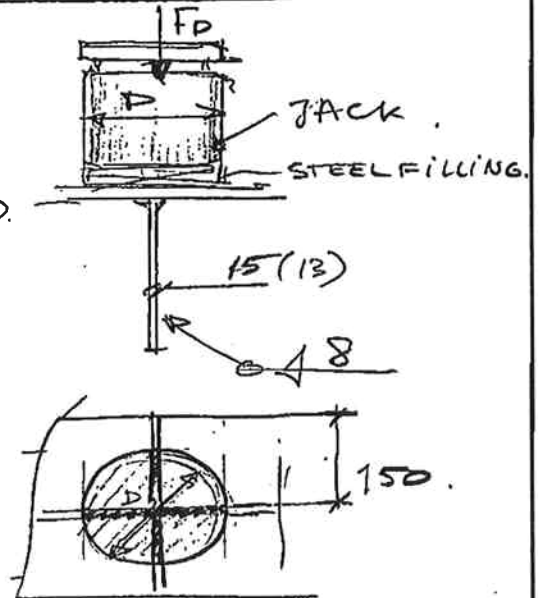
ASSUME $D_{\text{JACK}} = 150 \text{ mm}^1$ (min.)

CHECK PLATE GOVERNING?

$A \approx 2 \cdot 150 \cdot 13 = 3900 \text{ mm}^2$

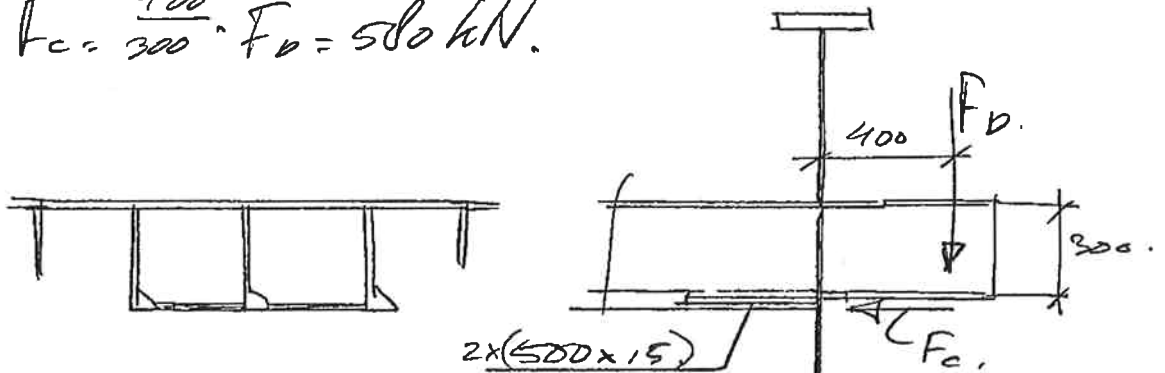
$\sigma_D = F_D/A = 111 \text{ N/mm}^2$

$u.c. = \frac{111 \cdot 1.1}{355} = 935 \text{ O.K.}$



BACKING AT ROW 8; PL 500 x 15 BETWEEN SKIN STIFFENERS :

$F_c = \frac{400}{300} \cdot F_D = 580 \text{ kN.}$



ACTIVATES 3 STIFFENERS WITH PARTICIPATING SKIN.

SUFFICIENT. O.K.

Opgesteld : ALSEMGEES

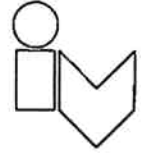
Datum : 03-04

Bladnummer : ES-42

Rev. : A2

Project : MALAMOLLO NAV. LOCK GATE

Onderdeel : GUIDANCE WATERPROOFING SUPPORTS



VI BEARING CHECK GUIDANCE WATERPROOFING BEAM TO CHAMBER

$A_{BEARING} = b \times h = \frac{280}{4} \times 400$ NETTO EXCL SLOPES.
SPREAD WIDTH ACC. PAGE E5-28 = 300 mm, $\times 280$

$A_{STEEL} \rightarrow UTMWPE = 280 \times 400 = 112000 \text{ mm}^2$

* MAX. VERT. LOAD = 534 * 1.5 = 801 kN (E5-26)

$\sigma = F/A = 801 \cdot 10^3 / 112000 = 7,2 \text{ N/mm}^2$
 $f_{c;d} = 8,0 \text{ N/mm}^2$ (capacity UTMWPE) } u.c. = 0,9 OK.

* MAX. HOR. LOAD = 67,5 kN (E5-26)

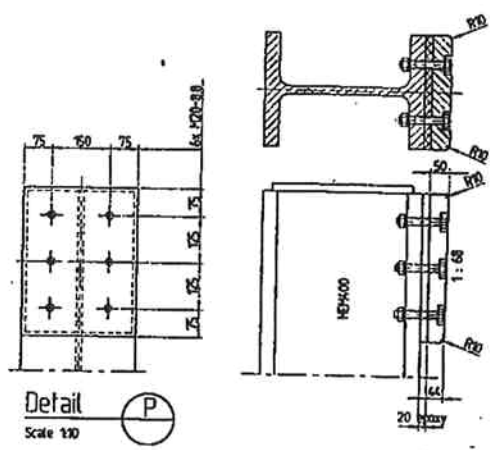
CONNECTION WITH 6 BOLTS:

SHEAR CAPACITY acc. E2-14 = 30 kN PER BOLT

$u.c. = \frac{67,5 \cdot 10^3}{6 \cdot 30} = 0,38$ OK.

* NEXT PAGE:

CHECK UNDER LOAD < MAX. LOAD.



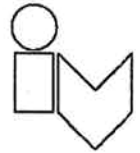
Opgesteld : A. SEMGEEST

Datum : 03-04

Bladnummer : E5-43

Rev. : A2

Project : Malamocco Navigation Lock Gate



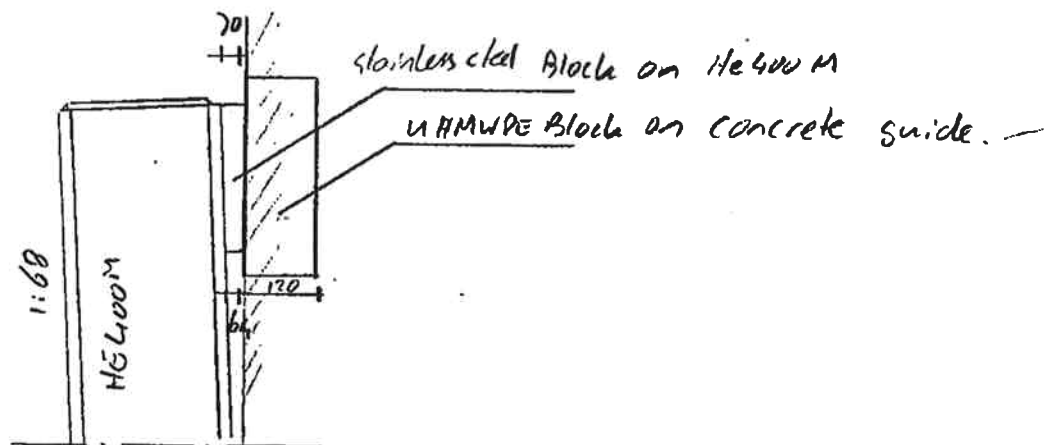
Onderdeel :

UHMWPE - bearings at guidance waterproofing
(see dwg. MV036P-PE-M-AD-4323)

Bearings will be shaped such that the surface
of UHMWPE on HELIUM is parallel to UHMWPE on concrete at
the maximum load (angle : $1:68 = 0.0147$ rad)

$$F_{\max; rep} = 534 \text{ kN}$$

$$A = 280 \times 400 = 112000 \text{ mm}^2$$



$$\sigma_d = \frac{534 \cdot 10^3 \cdot 1.5}{112000} = 72 \text{ N/mm}^2 < 8 ; \text{OK.}$$

For loads lower than the maximum load
the UHMWPE needs to deform in order to
build up the reaction force:

$$50\% \text{ of } F_{\max; rep} = 262 \text{ kN}$$

$$\text{required netto rotation : } \frac{1}{2} \times 0.0147 = 0.00735 \text{ rad}$$

$$E_{\text{UHMWPE}} = 800 \text{ N/mm}^2$$

Opgesteld :

JA

Datum :

9-4-04

Bladnummer :

ES-44

Rev. :

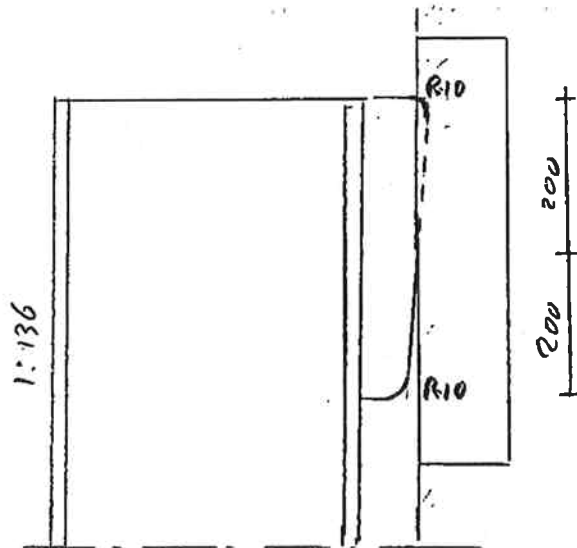
A2

Project : Malamocco Navigation Lock Gate



Onderdeel :

sum of thickness UHMWPE : $h_{tot} = 120$



$$\Delta l = 200 \times 0.00735 = 1.5 \text{ mm}$$
$$\epsilon = \frac{\Delta l}{l} = \frac{1.5}{120} = 0.0125$$

$$\sigma_{max} = E \epsilon = 800 \times 0.0125 = 10 \text{ N/mm}^2$$

$$F_{tot} = \int \sigma dA = 10 \times \frac{1}{2} \times 280 \times 200 = 280 \text{ kN}$$

Due to creep the slide will gradually change so that more bearing will be found at smaller deformation. For higher loads the angle will increase, thus the max. contact force will reduce while the contact-length increases.

Strength & flexibility of UHMWPE is sufficient -

Max. force on bearing

$$F_{max} = \frac{1}{1.5} \times 8 \times 280 \times 400 = 59.7 \text{ kN} > 53.4 \text{ kN, ok.}$$

Opgesteld :

J.A

Datum :

9-4-04

Bladnummer :

ES-45

Rev. :

AL

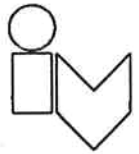
Addendum F Hydrojet tubes

Contents:

- F1 Loads**
- F2 Tubes**
- F3 Connections**
- F4. Hydrofoot sliding pad**

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : WATERJET TUBES.



F. WATERJET TUBES.

INDEX.

PAGES

F1. LOADS -----

F2. TUBE -----

F3. CONNECTIONS. -----

F4. HYDROFOOT. -----

NOTE: CORROSION-ALLOWANCE TAKEN INTO ACCOUNT;
ALL PROFILE AREAS REDUCED WITH 1 - 1mm - AROUND OUTLINE

Opgesteld : ALSEMGEEST

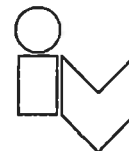
Datum : FEBR. 04

Bladnummer : F-INDEX

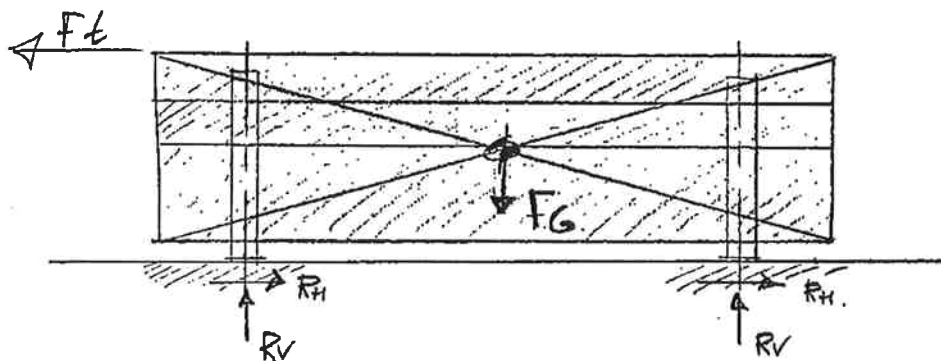
Rev. : AR

Project : MALAMOCCHO NAV. LOCK GATE .

Onderdeel : WATERJET TUBES .



F1. LOADS.



$$R_V = F_G / 2 + F_{AIR}$$

$$R_H = F_{HHR} / 2$$

WITH: F_G = NETTO WEIGHT OF DOOR

F_{AIR} = ADDED AND REDUCED FORCE ON HYDROFEET
DUE TO TRACTION FORCE.

F_{HHR} = FRICTION OF HYDROFEET.

DERIVED FROM
SECTION D1 OF:
TRACTION FRAME CALC

3 SITUATIONS:

- (A) TRACTION OF DOOR AT WATERLEVEL $MLS + 2600 \text{ mm}'$
- (B) TRACTION OF DOOR AT " $LLWS - 1300 \text{ mm}'$
- (C) ACCIDENTAL; NON-TRACTION SITUATION; BUOYANCY CHAMBERS

FAILED AND FULL OF WATER \Rightarrow MAX. VERT. LOAD, NO HOR. LOAD.

NOTE: ANOTHER LOAD ON WATERJET TUBES IS: WATER PRESSURE.

THIS LOAD PRODUCES STRESSES IN OTHER DIRECTION AND
ARE EXAMINED SEPERATLY IN SECTION F2-5.

Opgesteld: ALDENGEEST

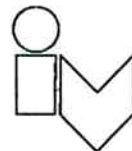
Datum: FEBR. '04

Bladnummer: F1-1

Rev.: AC

Project : MALAMOLCO NAV. LOCK GATE

Onderdeel : WATERJET TUBES.



LOADS PER SITUATION: (in kN)

NOTE: VALUES DERIVED FROM SECTION D1. OF TRACTION FRAME CALC

A. TRACTION MLS +2600	FG ^D	FA/R	REPR. DESIGN*		FH/R	REPR. DESIGN*	
			Rv:R	Rv:D		Rh:R	Rh:D
1 FULLY OPERATING	1000	81	581	797	70	35	47
2 MALFUNCTIONING WINCH	1000	74	574	764	70	35	47
3 MALFUNCT. HYDROFOOT	1000	105	605	801	220	110	149

B. TRACTION UWS -1300	FG ^D	FA/R	REPR. DESIGN*		FH/R	REPR. DESIGN*	
			Rv:R	Rv:D		Rh:R	Rh:D
1. "	2400	93	1293	1760	168	84	114
2. "	2400	85	1285	1722	168	84	114
3. "	2400	183	1383	1840	528	264	356

C ACCIDENTAL: RV = 5250 kN (SEE NOTE 2.)

* LOAD FACTORS FOR DESIGN VALUES:

A/B	YG	YFA/R	YFR.
1. "	1,35	1,5	1,35
2. "	1,35	1,2	1,35
3. "	1,35	1,2	1,35

C $\gamma_A = 1,0$

NOTES!

1) FG: NET TO WEIGHT OF DOOR WITH BUOYANCY.

2) C IN THIS SITUATION NO BUOYANCY IS PRESENT. THE LOAD ON THE HYDROFEET IS THE TOTAL MASS OF THE STEEL CONSTRUCTION (UNDER WATER).

$$R_v = \frac{1}{2} G_{DOOR} \cdot \frac{\rho_{STEEL UNDER WATER}}{\rho_{STEEL}} = \frac{12000 \cdot 68,5}{2 \cdot 78,5} = 5250 \text{ kN.}$$

Opgesteld: P. SEINBERG

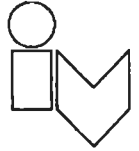
Datum: FEBR. 04

Bladnummer: F1-2

Rev.: A2

Project : MALAMOCO NAV. LOCK GATE

Onderdeel : WATERJET TUBES.



GOVERNING LOADS FOR CALCULATION

TAKEN INTO ACCOUNT A CONTINGENCY ON PREVIOUS LOADS
OF CA. 1,1 ;

I. GOVERNING SITUATION: $R_{V;D} + R_{H;D;MAX}$

ⓑ₃. $R_{V;D} = 2000 \text{ kN}$.

$R_{H;D} = 400 \text{ kN}$.

II. GOVERNING SITUATION: $R_{V;D;MAX}$

ⓒ $R_{V;D} = 6000 \text{ kN}$.

NOTE: LOADS IN TRIM CALCULATION MV036P-PE-MAR-4010
DO NOT EXCEED THESE DESIGN VALUES.

Opgesteld : PLSEMGEEST

Datum : FEBR. '04

Bladnummer : F1-3

Rev. : 12

Project : MALAMOCCO NAV. LOCK GATE

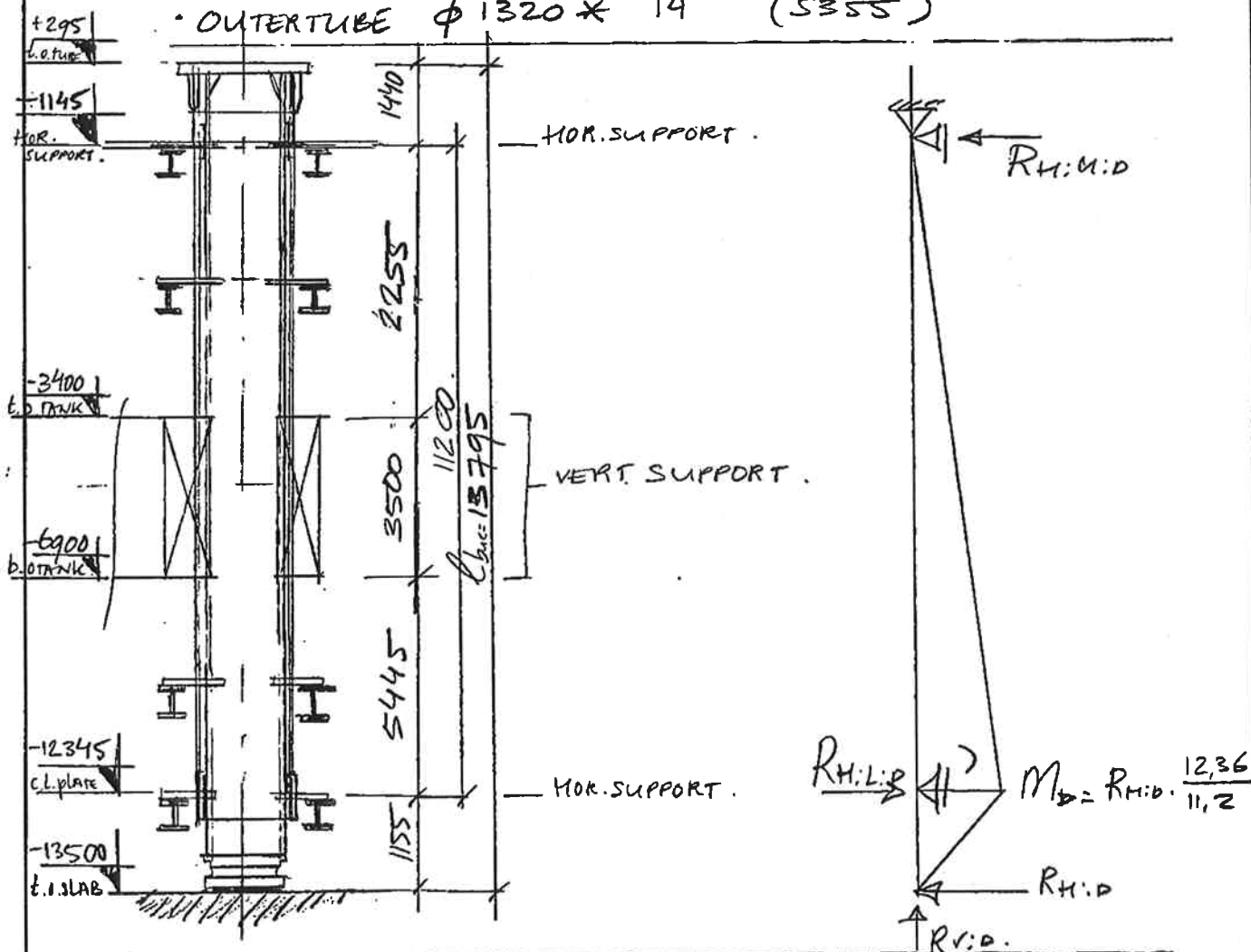
Onderdeel : WATERJET TUBES.



F2. TUBE

GENERAL CROSSSECTION FOR GLOBAL CALCULATION:

- INNERTUBE $\phi 1220 \times 14$ (S355)
- OUTERTUBE $\phi 1320 \times 14$ (S355)



DERIVED FROM F1:

$$\begin{aligned}
 \text{I: } & R_{V:D} = 2000 \text{ kN} \\
 & R_{H:D} = 400 \text{ kN} \\
 \text{II: } & R_{V:D} = 6000 \text{ kN} \\
 & R_{H:D} = - \text{ kN}
 \end{aligned}
 \quad \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} \begin{aligned}
 M_D &= 1,155 \cdot R_{H:D} = 462 \text{ kNm} \\
 R_{H:L:D} &= \frac{12,36}{11,2} \cdot R_{H:D} = 441 \text{ kN} \\
 R_{H:U:D} &= R_{H:L:D} - R_{H:D} = 41 \text{ kN}
 \end{aligned}$$

Opgesteld : TTISEMGEEST

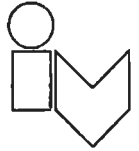
Datum : FEBR.04

Bladnummer : F2-1.

Rev. : A2

Project : MALAMOCCO NAV. Lock GATE

Onderdeel : WATERJET TUBES.



PROFILE CHARACTERISTICS :

IN CALCULATION - 1 mm - OF DUE TO CORROSION TOLERANCE .

INNERTUBE : $\phi 1220 \times 14$ ($t_c = 12^5$)

(S355) $I_y = 977765 \cdot 10^4 \text{ mm}^4$

$$W_y = 16029 \cdot 10^3 \text{ mm}^3$$

$$A = 53800 \text{ mm}^2$$

$$i_y = 426,3 \text{ mm}$$

OUTERTUBE : $\phi 1320 \times 14$ ($t_c = 12^5$)

(S355) $I_y = 1097323 \cdot 10^4 \text{ mm}^4$

$$W_y = 16626 \cdot 10^3 \text{ mm}^3$$

$$A = 51300 \text{ mm}^2$$

$$i_y = 462,3 \text{ mm}$$

CLASSIFICATION : ACC. ENV. 1993-1-1.

GENERAL CONDITIONS FOR CLASS 3: $d/t \leq 90 \cdot E^2$

$$E = 0,81$$

INNERTUBE : $\frac{1220}{14 \cdot 0,81^2} = 133 \not\leq 90$

CLASS 4;
→ COMPRESSIVE MEMBER
CAPACITY = BUCKLING STRESS σ_{cr}

OUTERTUBE : $\frac{1320}{14 \cdot 0,81^2} = 144 \not\leq 90$

CLASS 4;
NO COMPRESSIVE MEMBER
CAPACITY = YIELD STRESS $f_y \cdot D$

Opgesteld : PISENBERG EST.

Datum : FEBR. 04

Bladnummer : F 2-2

Rev. : AR

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : WATERJETTUBES.



ULTIMATE STRESS FOR CALCULATION.

INNERTUBE : CAPACITY = $f_{CR;D}$ acc. DIN 4114 / NEN 2016

CRITICAL BUCKLING STRESS: $\sigma_{CR} \neq f_y$.

$$\sigma_{CR} = 0,2 \cdot \frac{E \cdot t}{R} \neq 355 \text{ N/mm}^2.$$

$$\sigma_{CR} = 0,2 \cdot \frac{2,1 \cdot 10^5 \cdot 12}{1220/2} = 826 \text{ N/mm}^2 \neq f_y \\ = 355 \text{ N/mm}^2.$$

$$f_{CR;D} = \frac{* 355}{1,1} / \gamma_{CR} = 239 \text{ N/mm}^2 \\ (\gamma_{CR} = 1,35)$$

* ACCORDING: DIN 4114 / NEN 2016.

OUTERTUBE : ALWAYS IN TENSION.

$$\text{CAPACITY: YIELD STRESS} = f_{y;D} = \frac{355}{1,1} = 322 \text{ N/mm}^2$$

Opgesteld : ALSEMGEEST.

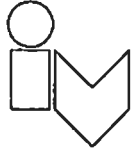
Datum : FEBR. 04

Bladnummer : F2-3

Rev. : A2

Project : MALAMOLCO NAV. LOCK GATE

Onderdeel : WATERJET TUBES.



GLOBAL STRENGTH (INCL. LOCAL BUCKLING)

INNER TUBE GOVERNING:

SITUATION I:

$$\sigma_{SID} = \frac{R_{v:pt}}{A} + \frac{M_D}{W_y} = \frac{2000 \cdot 10^3}{53800} + \frac{462 \cdot 10^6}{16029 \cdot 10^3}$$
$$= 37 + 29 = 66 \text{ N/mm}^2$$

$$u.c. = \sigma_{SID} / f_{cr:ID} = 66 / 239 = 0,28 : \underline{O.K.}$$

SITUATION II:

$$f_{c:ID} = \frac{R_{v:ID}}{A} = \frac{6000 \cdot 10^3}{53800} = 111 \text{ N/mm}^2$$

$$u.c. = \frac{111}{239} = 0,47 \underline{O.K.}$$

GLOBAL BUCKLING: (ENV 1993-1-1)

SIT. II GOVERNING:

$$l_{buc} = 13795 \text{ mm}$$

$$\lambda = l / i_y = 13795 / 426,3 = 32,4$$
$$\lambda_1 = 93,9 \cdot 0,81 = 76,4$$
$$\left. \begin{array}{l} \lambda \\ \lambda_1 \end{array} \right\} \bar{\lambda} = 0,42$$

$$\beta = 0,88 \text{ (CURVE C)}$$

$$\text{SITUATION II: } \frac{R_{v:ID}}{\beta \cdot A \cdot f_{y:ID}} = \frac{6000 \cdot 10^3}{0,88 \cdot 53800 \cdot \frac{355}{1,1}} = 0,4; \underline{O.K.}$$

$$\text{SITUATION I: } \frac{R_{v:pt}}{\beta \cdot A \cdot f_{y:pt}} + \frac{1,5 \cdot M_D}{W_y \cdot f_{y:ID}} = 0,4 \cdot 6000 + \frac{1,5 \cdot 462 \cdot 10^6}{16029 \cdot 10^3 \cdot \frac{355}{1,1}} = 0,26; \underline{O.K.}$$

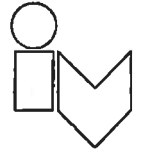
Opgesteld: ABEMGEEST.

Datum: FEBR. 04

Bladnummer: F2-4.

Rev.: A2

Project : MALAMOCCO NAV. LOCK GATE



Onderdeel : WATERJETTUBES

PIPE STRESS DUE TO WATER PRESSURE

$$q_{\text{WATER}} = 10,3 \cdot h \text{ kN/m}^2$$

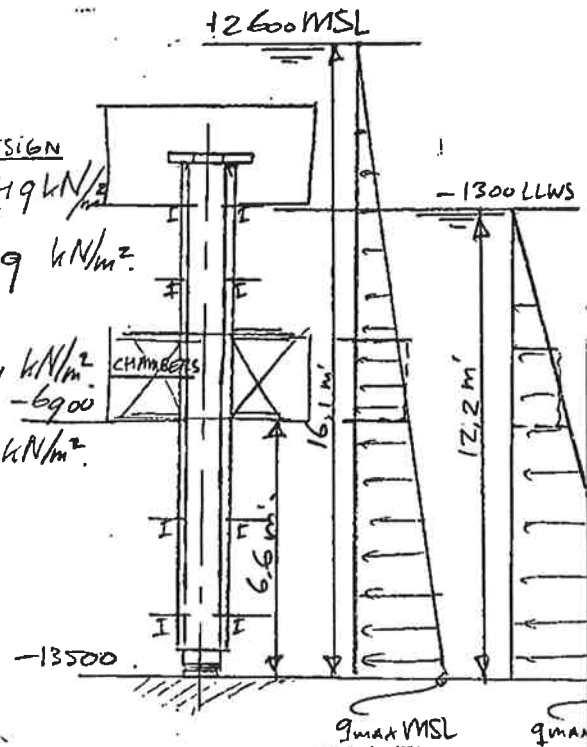
q_{MAX}: PIPE AT BOTTOM

$$q_{\text{MAX}; \text{MSL}} = \frac{\text{REFF.}}{1} \times 8 = \text{DESIGN} \\ 165,8 \times 1,5 = 249 \text{ kN/m}^2$$

$$q_{\text{MAX}; \text{LLWS}} = 125,7 \times 1,5 = 189 \text{ kN/m}^2$$

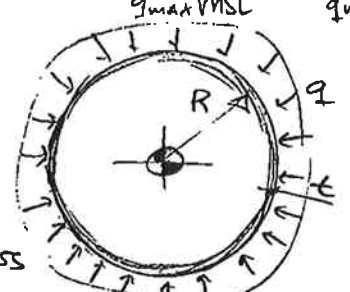
$$q_{\text{B.O. PIPE}; \text{MSL}} = 97,9 \times 1,5 = 146,9 \text{ kN/m}^2$$

$$q_{\text{B.O. PIPE}; \text{LLWS}} = 57,7 \times 1,5 = 87 \text{ kN/m}^2$$



INNER TUBE : UNIFORM LOADING OF PIPE

$$\sigma_{\text{HOOP}; D} = \frac{q \cdot R}{t} = \frac{249 \cdot 10^{-3} \cdot 670}{12,5} = 12 \text{ N/mm}^2$$



WATER PRESSURE PRODUCES NO SIGNIFICANT INCREASE OF STRESS

OUTER TUBE : LOADING ON PART OF PIPE WALL AS CHAMBER WALL

GOVERNING SITUATION: MSL WATER LEVEL + EMPTY CHAMBERS.

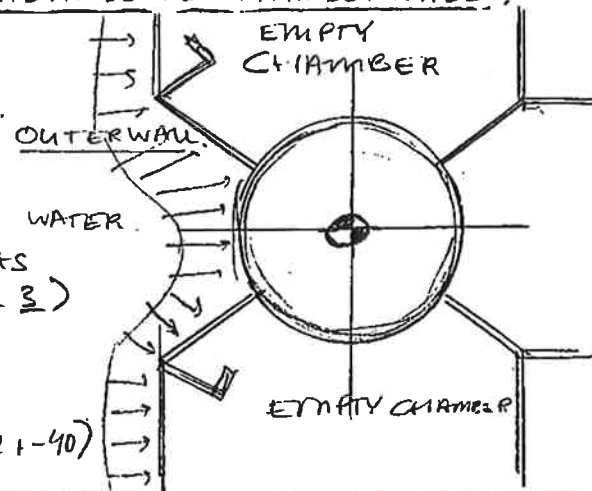
CONSERVATIVE $\Rightarrow q = 146,9 \text{ kN/m}^2$

OVER FULL CHAMBER HEIGHT.

EXAMINATION BY FEM-CALCULATION AS LOADCASE 2 IN SECTION F3 (DETAIL 3)

$$\sigma_{\text{MAX}; D} = 118 \text{ N/mm}^2 \text{ (VON MISES)}$$

$$U.C = 0,37 \text{ O.K. (REF. F3-371-40)}$$



Opgesteld: H. BEMGEEST

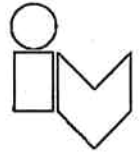
Datum: FEBR. '04

Bladnummer: F2-5

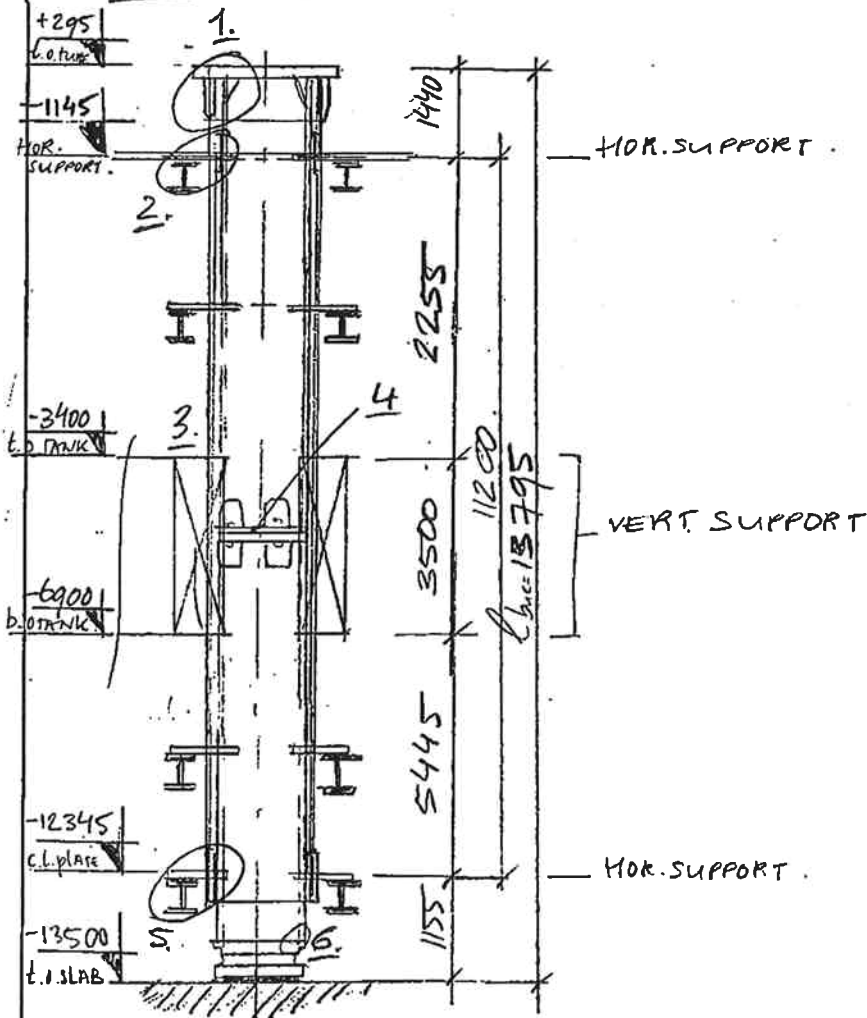
Rev: A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : WATERJET TUBES .



F3. CONNECTIONS.



1. CONNECTION INNERTUBE - OUTERTUBE .
2. UPPER HORIZONTAL SUPPORT .
3. VERTICAL SUPPORT OUTERTUBE - CHAMBER WALL .
4. PARTITION IN INNER TUBE .
5. LOWER HORIZONTAL SUPPORT .
6. HYDRO FOOT CONNECTION .
7. PAD EYES .

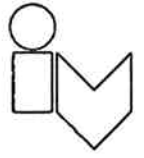
Opgesteld : ALSEMGEEST

Datum : FEBR. '04

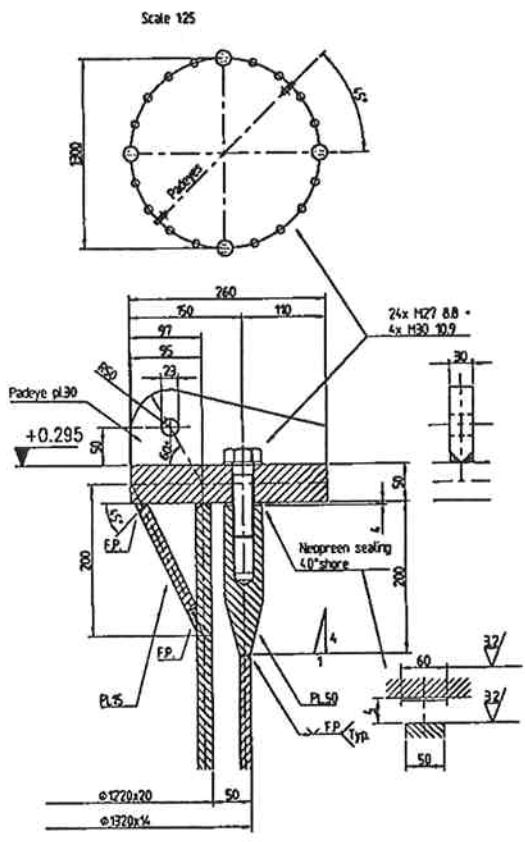
Bladnummer : F3-7 Rev. : AL

Project : MALAMOCCO NAV. LOCK GATE.

Onderdeel : WATERJETTURES.



DET. I. CONNECTION INNERTUBE - OUTFERTURE



Detail 1
Scale 1:5

Opgesteld : *ALSEMGEEST*

Datum : *FEBR. 64*

Bladnummer : *F3-2*

Rev. : *A2*

Project : MALAMOCCO NAVI LOCK GATE.

Onderdeel : WATERJET TUBES.



LOADS

THERE ARE 2 GOVERNING SITUATIONS:

① WORKING SITUATION

THE INNERTUBE IS CONNECTED TO THE OUTERTUBES BY 28 BOLTS.

MAX. LOAD SITUATION IS ACCIDENTAL. $F = \underline{\underline{6000 \text{ kN}}}$ (F1-3 ©)

② INSTALLATION SITUATION / INSPECTION SITUATION

FOR INSPECTION OF THE HYDROFOOT OR GAINING THE INNER TUBE, THE LOAD OF THE BOLTS WILL BE TAKEN OVER BY 4 HOLLOW CYLINDER JACKS.

THE SEQUENCE OF THE INSPECTION PROCEDURE IS GIVEN ON PAGE F3-61.

THE LOAD OF THE DOOR IS REDUCED IN THIS SITUATION TO: $\underline{\underline{750 \text{ kN}}}$ PER TUBE. (DERIVED FROM: DOC. -4010, ^{Regular / normal water level} (measured))

FOR THE CALC. INCL. CONTINGENCY: $\underline{\underline{825 \text{ kN}}}$

CALCULATION

→ CALCULATION OF STRESSES AND BOLT FORCES IN BOTH SITUATIONS

BY MEANS OF FEM-CALCULATION ON NEXT PAGES.

LOADS AS UNIFORM LOAD IN CENTERLINE OF INNERTUBE PLATE.

$$q_① = \frac{6000}{\pi \cdot 1,2} = 1591,5 \text{ kN/m'}$$

$$q_② = \frac{825}{\pi \cdot 1,2} = 218,8 \text{ kN/m'}$$

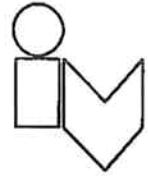
Opgesteld : ALSEMGEEST

Datum : FEBR 04

Bladnummer : F3-3

Rev. : A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

F3. 1. Waterjet connection inner-outertube : Calc. Working situation

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ring stiffener Stress - sigE- - LC : 1	
4.3. Reactions	
Reactions in node(s). Load case(s) : 1	

Opgesteld : D. Alsemgeest

Datum: 17-02-04

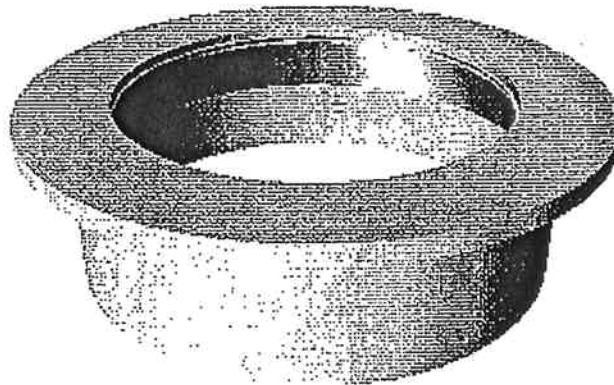
Bladnummer: F3-4 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

1. Overview model



overview model

2. Input (numerical)

Basic data

Type of structure : General XYZ

Number of nodes:	
Number of members:	
Number of 1D macros:	
Number of bound. lines:	
Number of 2D macros:	
Number of profiles :	
Number of cases:	
Number of materials:	

Material

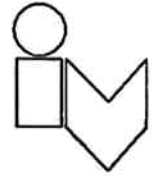
Name		
:		
S 355		
Ultimate strength		510.000 MPa
Yield design		355.000 MPa
E modulus		210000.00 MPa
Poisson coeff.		0.30
Density		0.000 kg/mm ³
Extensibility		1.2e-005 mm/mm.K

Opgesteld : D. Alsemgeest

Datum: 17-02-04

Bladnummer: F3-5 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

Nodes

node	X mm	Y mm	Z mm
1	730	0	0
2	0	730	0
3	-	0	0
	730		
4	0	-	0
		730	
5	600	0	0
6	-	520	0
	300		
7	-	-	0
	300	520	
8	600	0	-
			200
9	0	600	-
			200
10	-	0	-
	600		200
11	0	600	0
12	-	0	0
	600		
13	650	0	0
14	634	145	0
15	586	282	0
16	508	405	0
17	405	508	0
18	282	586	0
19	145	634	0
20	-0	650	0
21	-	634	0
	145		
22	-	586	0
	282		
23	-	508	0
	405		
24	-	405	0
	508		
25	-	282	0
	586		
26	-	145	0
	634		
27	-	-0	0
	650		
28	-	-	0
	634	145	
29	-	-	0
	586	282	
30	-	-	0
	508	405	
31	-	-	0
	405	508	
32	-	-	0
	282	586	
33	-	-	0
	145	634	
34	-0	-	0
		650	
35	145	-	0

Opgesteld : D. Alsemgeest

Datum: 17-02-04

Bladnummer: F3-6 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

node	X mm	Y mm	Z mm
		634	
36	282	-	0
		586	
37	405	-	0
		508	
38	508	-	0
		405	
39	586	-	0
		282	
40	634	-	0
		145	
41	600	0	-
			400
42	0	600	-
			400
43	-	0	-
	600		400
44	500	0	0
45	0	500	0
46	-	0	0
	500		
47	-	433	0
	250		
48	-	-	0
	250	433	

Boundaries

bound. line	type	node
1	Circle	1,2,3
2	Circle	5,6,7
3	Circle	8,9,10
4	Line	8,5
5	Circle	5,11,12
6	Circle	41,42,43
7	Line	41,8
8	Line	8,44
9	Circle	44,45,46
10	Circle	44,47,48

2D Macros

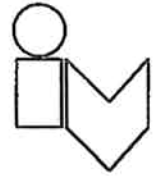
num	type	
1		
	S 355	Thickness 49.00 mm
	Boundary:	1
	Nodes :	4,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40
	1 Inner line:	2
	1 Hole:	10
2		
	S 355	Thickness 19.00 mm
	Boundary:	3,4,5,4
3		
	S 355	Thickness 19.00 mm
	Boundary:	6,7,3,7
4		
	S 355	Thickness 14.00 mm
	Boundary:	3,8,9,8

Opgesteld : D. Alsemgeest

Datum: 17-02-04

Bladnummer: F3-7 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

Supports

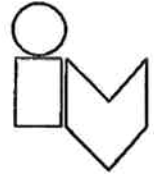
support	boundary	node	type	Size mm
1	6		XY	200.00
2		13	Z	200.00
3		14	Z	200.00
4		15	Z	200.00
5		16	Z	200.00
6		17	Z	200.00
7		18	Z	200.00
8		19	Z	200.00
9		20	Z	200.00
10		21	Z	200.00
11		22	Z	200.00
12		23	Z	200.00
13		24	Z	200.00
14		25	Z	200.00
15		26	Z	200.00
16		27	Z	200.00
17		28	Z	200.00
18		29	Z	200.00
19		30	Z	200.00
20		31	Z	200.00
21		32	Z	200.00
22		33	Z	200.00
23		34	Z	200.00
24		35	Z	200.00
25		36	Z	200.00
26		37	Z	200.00
27		38	Z	200.00
28		39	Z	200.00
29		40	Z	200.00

Opgesteld : D. Alsemgeest

Datum: 17-02-04

Bladnummer: F3-8 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

Loadcases

Case	Name:	coeff	Description
1	accidental max. load (6000 kN)	1.00	Permanent - Loads

Loadcase no. 1 - distributed loads

bound	type	dx mm	exY mm	exZ mm		X beg end	Y beg end	Z beg end
6	force kN/m	0.00 rel 1.00	0.0 0	0.0 0	glo len	0.00 0.00	0.00 0.00	1591 .55 1591 .55

Opgesteld : D. Alsemgeest

Datum: 17-02-04

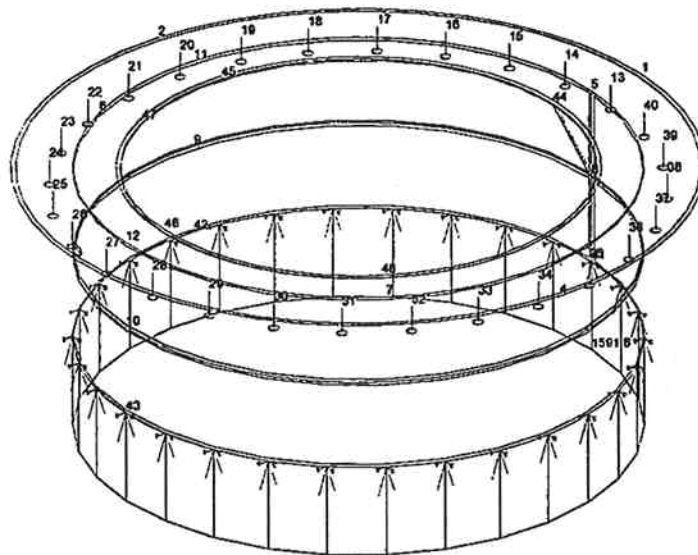
Bladnummer: F3-9 Rev. A2

Project : Malamocco Nav. Lock Gate

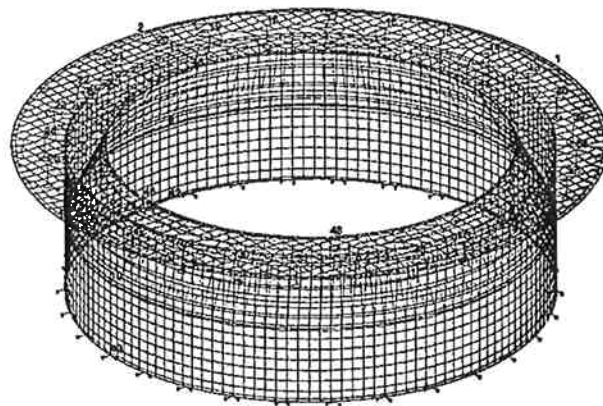
Onderdeel : Waterjet connection inner-outertube: Calc.



3. Input (graphical)



Input model



element-net

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

4. Output

Calculation protocol.

Linear calculation

Number of 2D elements	4306
Number of 1D elements	0
Number of mesh nodes	4040
Number of equations	24240
Loadcases	LC 1 accidental max. load (6000 kN)
Bending theory	Mindlin
Start of calculation	17.02.2004 11:32
End of calculation	17.02.2004 11:32

Sum of loads and reactions.

		X	Y	Z
loadcase 1	loads	0.0	0.0	5999.5
	reactions	-0.0	-0.0	-5999.5
	contact	0.0	0.0	0.0

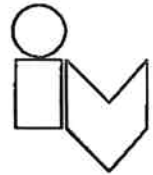
Opgesteld : D. Alsemgeest

Datum: 17-02-04

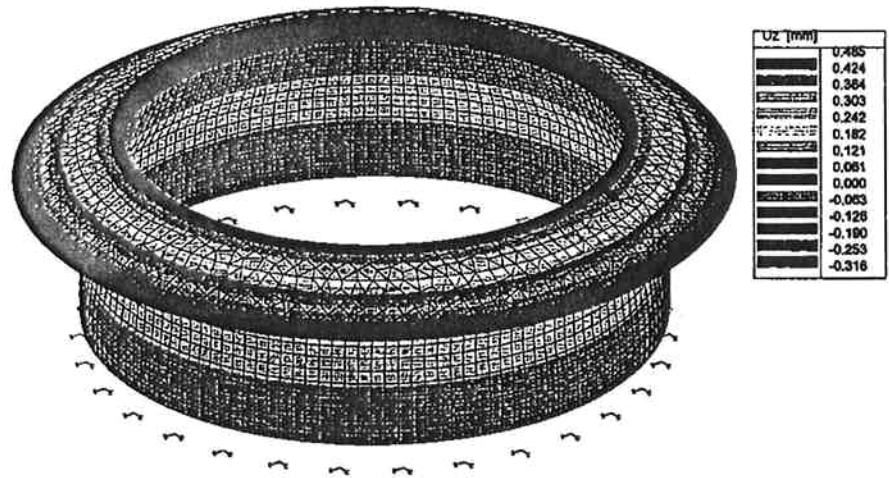
Bladnummer: F3-11 Rev. A2

Project : Malamocco Nav. Lock Gate

Onderdeel : Waterjet connection inner-outertube: Calc.

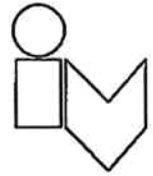


4.1. Deformation



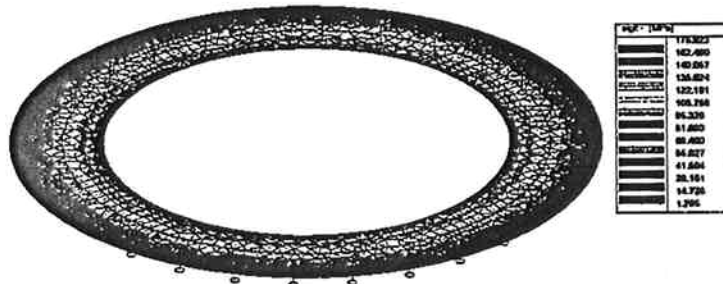
Deformation - Uz - LC : 1

Project : Malamocco Nav. Lock Gate

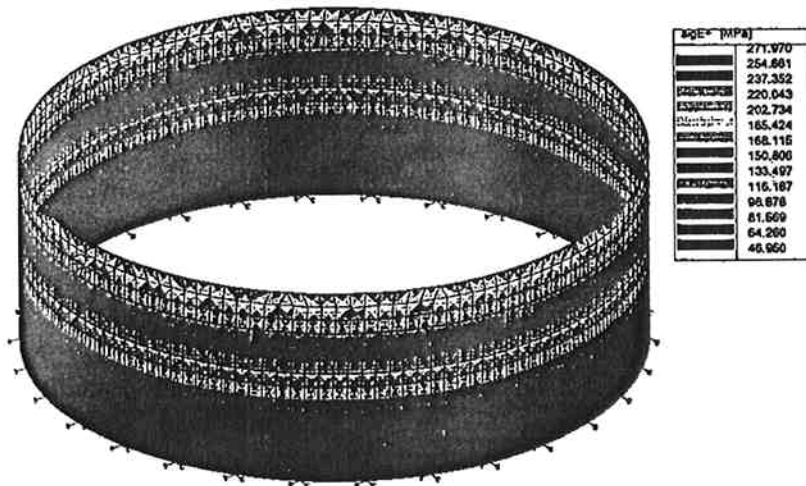


Onderdeel : Waterjet connection inner-outertube: Calc.

4.2. Stresses



upper ring; Stress - sigE- - LC : 1



Innertube Stress - sigE+ - LC : 1

Opgesteld : D. Aisemgeest

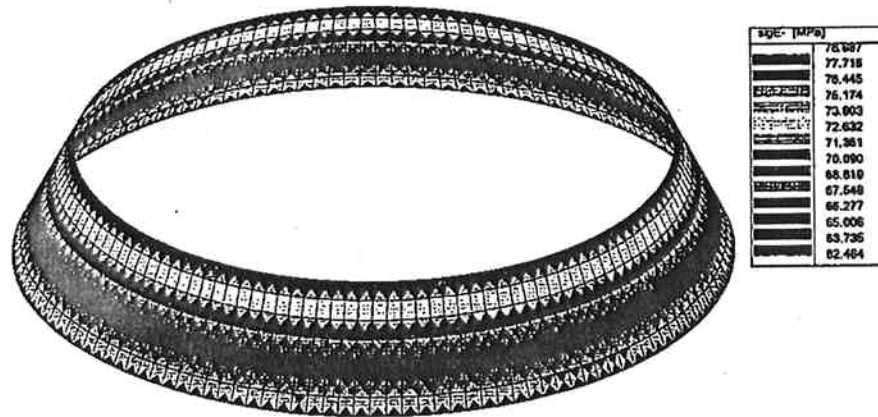
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Bladnummer: F3-13 Rev. A2

Project : Malamocco Nav. Lock Gate

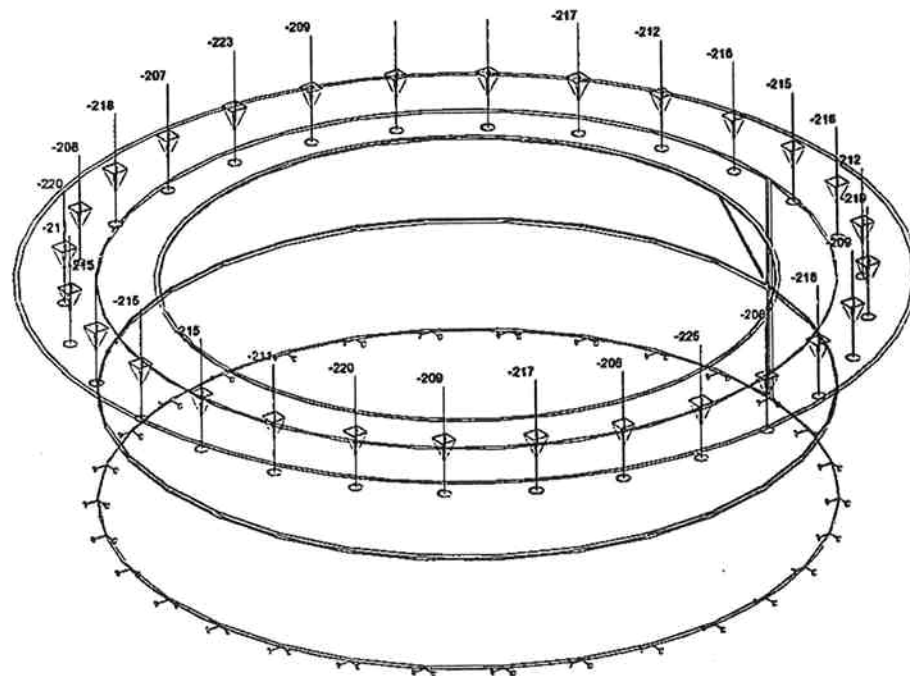


Onderdeel : Waterjet connection inner-outertube: Calc.



ring stiffener Stress - sigE- - LC : 1

4.3. Reactions



Reactions in node(s). Load case(s) : 1

Project : Malamocco Nav. Lock Gate



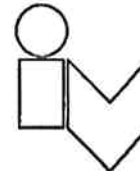
Onderdeel : Waterjet connection inner-outertube: Calc.

F3. 2. Waterjet connection inner-outertube : Calc. Inspection situation

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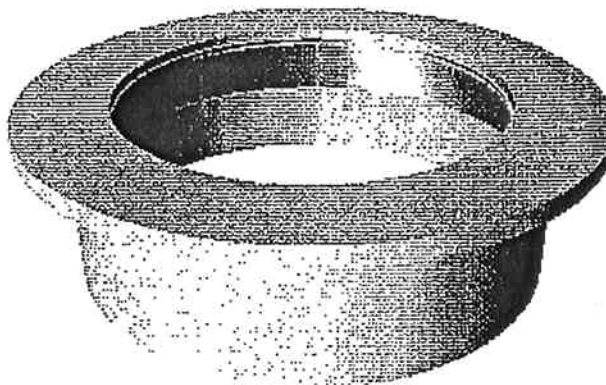
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ring stiffener Stress - sigE- - LC : 1	
4.3. Reactions	
Reactions in node(s). Load case(s) : 1	

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

1. Overview model



overview model

2. Input (numerical)

Basic data

Type of structure : General XYZ

Number of nodes:	
Number of members:	
Number of 1D macros:	
Number of bound. lines:	
Number of 2D macros:	
Number of profiles :	
Number of cases:	
Number of materials:	

Material

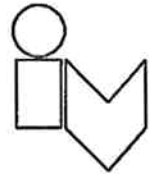
Name:		
S 355		
Ultimate strength		510.000 MPa
Yield design		355.000 MPa
E modulus		210000.00 MPa
Poisson coeff.		0.30
Density		0.000 kg/mm ³
Extensibility		1.2e-005 mm/mm.K

Opgesteld : D. Alsemgeest

Datum: 17-02-04

Bladnummer: F3-16 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

Supports

supp ort	bounda ry	n o d e	ty p e	Siz e mm
1	6		X Y	200 .00
2		1 3	Z	200 .00
3		2 0	Z	200 .00
4		2 7	Z	200 .00
5		3 4	Z	200 .00

Loadcases

C a s e	Name:	coef f	Description
1	load at inspection sit. (825 kN)	1.00	Permanent - Loads

Loadcase no. 1 - distributed loads

bou nd	type	dx mm	e x Y m m	e x Z m m	X beg end	Y beg end	Z beg end
6	forc e kN/ m	0.00 rel 1.00	0. 0 0	0. 0 0	g 0.00 0.00	0.00 0.00	218 .84 218 .84

Opgesteld : D. Alsemgeest

Datum: 17-02-04

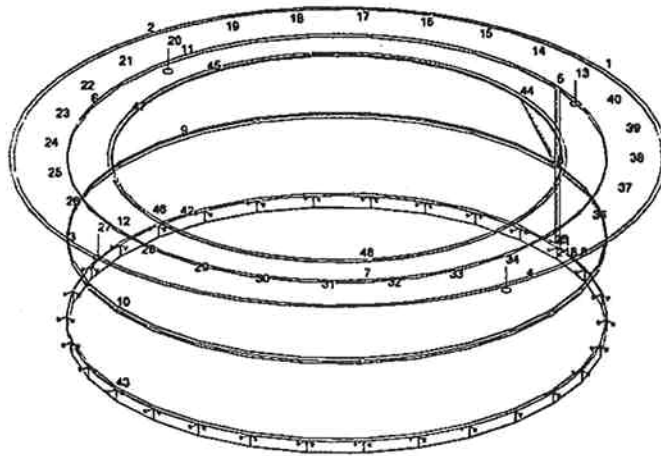
Bladnummer: F3-17 Rev. A2

Project : Malamocco Nav. Lock Gate

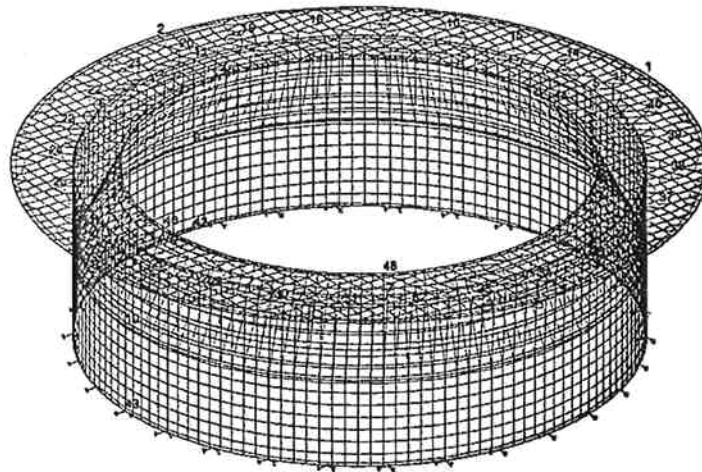


Onderdeel : Waterjet connection inner-outertube: Calc.

3. Input (graphical)



input model



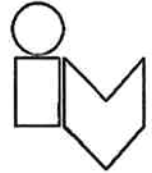
element-net

Opgesteld : D. Alsemgeest

Datum: 17-02-04

Bladnummer: F3-18 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection inner-outertube: Calc.

4. Output

Calculation protocol.

Linear calculation

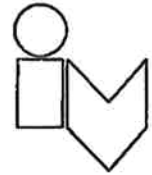
Number of 2D elements	4306
Number of 1D elements	0
Number of mesh nodes	4040
Number of equations	24240
Loadcases	LC 1 load at inspection sit. (825 kN)
Bending theory	Mindlin
Start of calculation	17.02.2004 12:06
End of calculation	17.02.2004 12:07

Sum of loads and reactions.

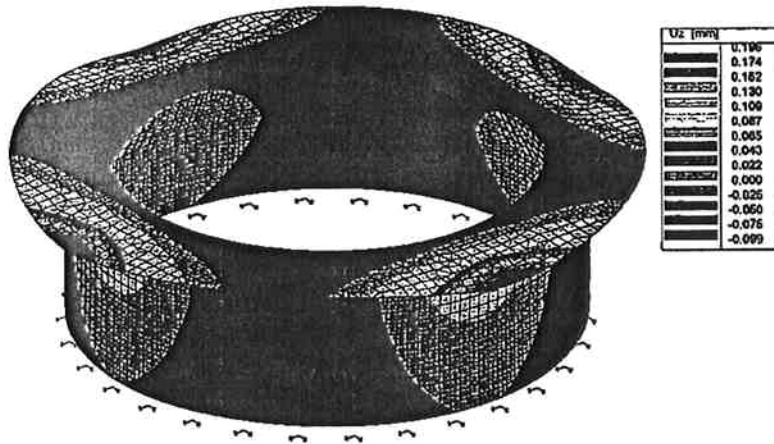
		K	Y	Z
loadcase 1	loads	0	0.	824
		0	0	.9
	reactions	0	-	-
		0	0.	824
		0	0	.9
	contact	0	0.	0.0
		0	0	

Project : Malamocco Nav. Lock Gate

Onderdeel : Waterjet connection inner-outertube: Calc.



4.1. Deformation



Deformation - Uz - LC : 1

Opgesteld : D. Alsemgeest

Datum: 17-02-04

Bladnummer: F3-20 Rev. A2

Project : Malamocco Nav. Lock Gate



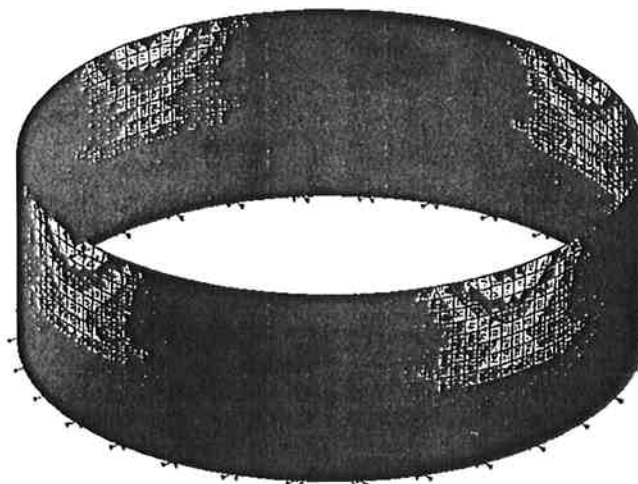
Onderdeel : Waterjet connection inner-outertube: Calc.

4.2. Stresses



Stress (MPa)
112.838
103.494
94.150
84.806
75.462
66.117
56.773
47.429
38.085
28.741
19.396
10.052
0.708

upper ring; Stress - sigE - LC : 1



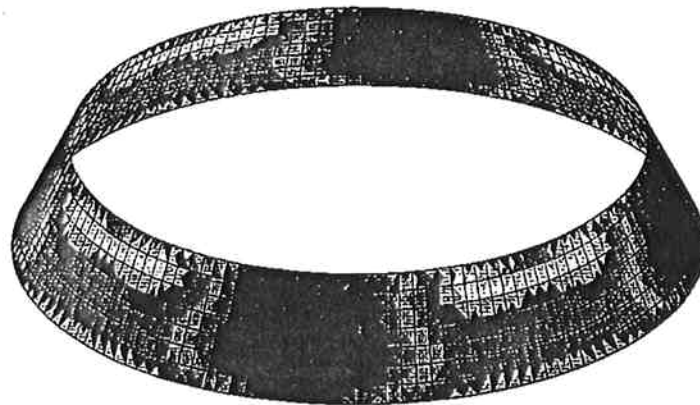
sigE+ (MPa)
122.183
112.838
103.494
94.150
84.806
75.462
66.117
56.773
47.429
38.085
28.741
19.396
10.052
0.708

Innertube Stress - sigE+ - LC : 1

Project : Malamocco Nav. Lock Gate



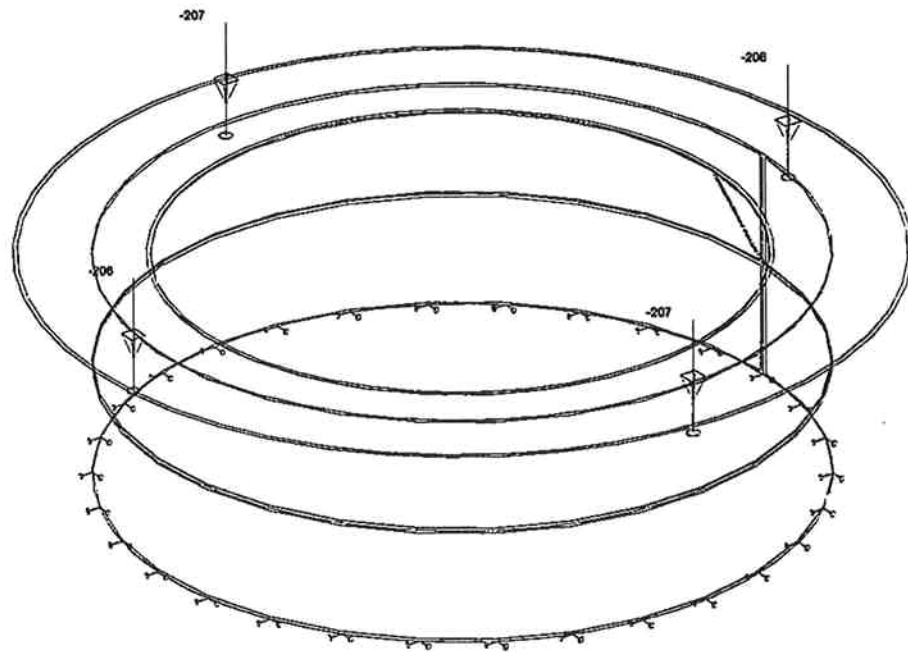
Onderdeel : Waterjet connection inner-outertube: Calc.



sigE- (MPa)	
21.489	
20.186	
18.903	
17.610	
16.317	
15.024	
13.731	
12.438	
11.145	
9.852	
8.559	
7.265	
5.972	
4.679	

ring stiffener Stress - sigE- - LC : 1

4.3. Reactions



Reactions in node(s). Load case(s) : 1

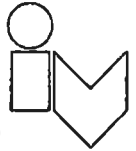
Opgesteld : D. Alsemgeest

Datum: 17-02-04

Bladnummer: F3-22 Rev. A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : WATERJET TUBES .



CHECKS WATERJET TUBE CONNECTION INNER-OUTERTUBE:

IN GENERAL: WORKING SITUATION WITH ACCIDENTAL LOAD IS GOVERNING (SEE FEM-CALC.).

STRESSES: PLATE:

PIPE WALL INNER TUBE: $t = 20$ ($t_{calc.} = 19 \text{ mm}$).

$$u.c. = \frac{\sigma_{s:0}:E}{f_{y:0}} = \frac{272}{\frac{345}{1,1}} = 0,87 \quad \underline{\text{O.K.}}$$

RING $t = 50$ ($t_{calc.} = 49 \text{ mm}$)

$$u.c. = \frac{\sigma_{s:0}:E}{f_{y:0}} = \frac{176}{\frac{335}{1,1}} = 0,58 \quad \underline{\text{O.K.}}$$

RING STIFFENER $t = 15$ ($t_{calc.} = 14 \text{ mm}$)

$$u.c. = \frac{\sigma_{s:0}:E}{f_{y:0}} = \frac{79}{\frac{355}{1,1}} = 0,25 \quad \underline{\text{O.K.}}$$

DEFORMATION: NO SIGNIFICANT DISPLACEMENT/ROTATION AT BOLT: O.K.

BOLTS:

	<u>WORKING</u>	<u>INSTALLATION</u>	<u>IN</u>
$F_t: s:0; \text{MAX} =$	$\textcircled{218} \text{ kN}$	207 kN	FEM-CALC.
$= 6000/28 = 215 \text{ kN}$	$\frac{215}{1,1} = 207 \text{ kN}$	$\frac{207}{1,1} = 207 \text{ kN}$	THEORETICAL
$F_t: u:0$ ($0,9 \text{ tub. } A_s / \gamma_m$)	$\frac{M_{27} 3,8}{264 \text{ kN}}$	$\frac{M_{30} 10,9}{404 \text{ kN}}$	
u.c. =	0,82	0,52	<u>O.K.</u>

Opgesteld: A. SEMGEEST

Datum: FEBR. 04

Bladnummer: F3-23. A2

Rev.:

Project : Malamocco Nav. Lock Gate

Onderdeel : Waterjet connection vertical support



F3. 3. Waterjet connection: vertical support

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element-net	
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Stress - sigE- - LC : 1	
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4.3.2. Stresses cheekplates	
Stress - sigE- - LC : 2	
4.3.3. Reactions	
Reactions. Load case(s) : 2	
Reactions. Load case(s) : 2 horizontal plate connection Ry	
Reactions. Load case(s) : 2 horizontal plate connection Rx	
4.3.4. Deformation	
Deformation - Uy - LC : 2	

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-24 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

1. overview model



overview model

2. Input (numerical)

Basic data

Type of structure : General XYZ

Number of nodes:	
Number of members:	
Number of 1D macros:	
Number of bound. lines:	
Number of 2D macros:	
Number of profiles :	
Number of cases:	
Number of materials:	

Material

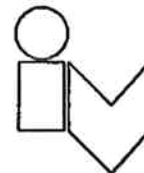
Na me:		
S 355		
	Ultimate strength	510.000 MPa
	Yield design	355.000 MPa
	E modulus	210000.00 MPa
	Poisson coeff.	0.30
	Density	0.000 kg/mm ³
	Extensibility	1.2e-005 mm/mm.K
S 355		
	Ultimate strength	510.000 MPa
	Yield design	355.000 MPa
	E modulus	210000.00 MPa
	Poisson coeff.	0.30
	Density	0.000 kg/mm ³
	Extensibility	1.2e-005 mm/mm.K

Opgesteld : D. Alsemgeest

Datum: 19-02-04

Bladnummer: F3-25 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

Nodes

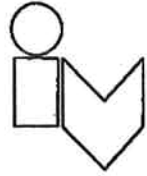
node	X mm	Y mm	Z mm
1	650	0	0
2	460	460	0
3	0	650	0
4	0	650	3500
5	460	460	3500
6	650	0	3500
7	- 460	460	0
8	- 650	0	0
9	- 650	0	3500
10	- 460	460	3500
11	- 460	-460	0
12	-0	-650	0
13	-0	-650	3500
14	- 460	-460	3500
15	460	-460	0
16	460	-460	3500
17	0	650	4500
18	460	460	4500
19	650	0	4500
20	- 650	0	4500
21	- 460	460	4500
22	-0	-650	4500
23	- 460	-460	4500
24	460	-460	4500
25	650	0	-1000
26	460	460	-1000
27	0	650	-1000
28	- 460	460	-1000
29	- 650	0	-1000
30	- 460	-460	-1000
31	-0	-650	-1000
32	460	-460	-1000
33	137 9	0	3500
34	137 9	0	0
35	0	1379	3500
36	0	1379	0
37	- 137 9	0	3500
38	-	0	0

Opgesteld : D. Alsemgeest

Datum: 19-02-04

Bladnummer: F3-26 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

node	X mm	Y mm	Z mm
	137 9		
39	-0	-1379	3500
40	-0	-1379	0

Boundaries

bound. line	type	node
1	Arc	1,2,3
2	Line	3,4
3	Arc	4,5,6
4	Line	6,1
5	Arc	3,7,8
6	Line	8,9
7	Arc	9,10,4
8	Arc	8,11,12
9	Line	12,13
10	Arc	13,14,9
11	Arc	12,15,1
12	Arc	6,16,13
13	Line	4,17
14	Arc	17,18,19
15	Line	19,6
16	Line	9,20
17	Arc	20,21,17
18	Line	13,22
19	Arc	22,23,20
20	Arc	19,24,22
21	Arc	25,26,27
22	Line	27,3
23	Line	1,25
24	Arc	27,28,29
25	Line	29,8
26	Arc	29,30,31
27	Line	31,12
28	Arc	31,32,25
29	Line	6,33
30	Line	33,34
31	Line	34,1
32	Line	4,35
33	Line	35,36
34	Line	36,3
35	Line	9,37
36	Line	37,38
37	Line	38,8
38	Line	13,39
39	Line	39,40
40	Line	40,12

Opgesteld : D. Alsemgeest

Datum: 19-02-04

Bladnummer: F3-27 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

2D Macros

	type	
1	S 355	Thickness 12.00 mm
	Boundary:	1,2,3,4
2	S 355	Thickness 12.00 mm
	Boundary:	5,6,7,2
3	S 355	Thickness 12.00 mm
	Boundary:	8,9,10,6
4	S 355	Thickness 12.00 mm
	Boundary:	11,4,12,9
5	S 355	Thickness 12.00 mm
	Boundary:	3,13,14,15
6	S 355	Thickness 12.00 mm
	Boundary:	7,16,17,13
7	S 355	Thickness 12.00 mm
	Boundary:	10,18,19,16
8	S 355	Thickness 12.00 mm
	Boundary:	12,15,20,18
9	S 355	Thickness 12.00 mm
	Boundary:	21,22,1,23
10	S 355	Thickness 12.00 mm
	Boundary:	24,25,5,22
11	S 355	Thickness 12.00 mm
	Boundary:	26,27,8,25
12	S 355	Thickness 12.00 mm
	Boundary:	28,23,11,27
13	S 355	Thickness 18.00 mm
	Boundary:	29,30,31,4
14	S 355	Thickness 18.00 mm
	Boundary:	32,33,34,2
15	S 355	Thickness 18.00 mm
	Boundary:	35,36,37,6
16	S 355	Thickness 18.00 mm
	Boundary:	38,39,40,9

Opgesteld : D. Alsemgeest

Datum: 19-02-04

Bladnummer: F3-28 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

Supports

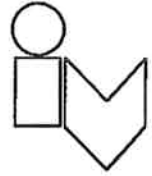
support	boundary	type	Size mm
1	1	XY	200.00
2	3	XY	200.00
3	5	XY	200.00
4	7	XY	200.00
5	8	XY	200.00
6	10	XY	200.00
7	11	XY	200.00
8	12	XY	200.00
9	14	XY	200.00
10	17	XY	200.00
11	19	XY	200.00
12	20	XY	200.00
13	21	XY	200.00
14	24	XY	200.00
15	26	XY	200.00
16	28	XY	200.00
17	29	XY	200.00
18	30	XYZ	200.00
19	31	XY	200.00
20	32	XY	200.00
21	33	XYZ	200.00
22	34	XY	200.00
23	35	XY	200.00
24	36	XYZ	200.00
25	37	XY	200.00
26	38	XY	200.00
27	39	XYZ	200.00
28	40	XY	200.00

Opgesteld : D. Alsemgeest

Datum: 19-02-04

Bladnummer: F3-29 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

Loadcases

Case	Name:	coeff	Description
	max. accidental load (6000 kN)		Permanent - Loads
	waterpressure		Permanent - Loads

Loadcase no. 1 - distributed loads

bound	type	dx mm	exY mm	exZ mm		X beg end	Y beg end	Z beg end
14	force kN/m	0.00 rel 1.00	0.00	0.00	glo len	0.00 0.00	0.00 0.00	1469.12 1469.12
17	force kN/m	0.00 rel 1.00	0.00	0.00	glo len	0.00 0.00	0.00 0.00	1469.12 1469.12
19	force kN/m	0.00 rel 1.00	0.00	0.00	glo len	0.00 0.00	0.00 0.00	1469.12 1469.12
20	force kN/m	0.00 rel 1.00	0.00	0.00	glo len	0.00 0.00	0.00 0.00	1469.12 1469.12

Loadcase no. 2 - Distributed loads 2D

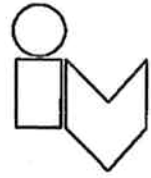
macro	qx kN/m ²	qy kN/m ²	qz kN/m ²
3	0.00	0.00	146.80
15	0.00	0.00	146.80
16	0.00	0.00	146.80

Opgesteld : D. Alsemgeest

Datum: 19-02-04

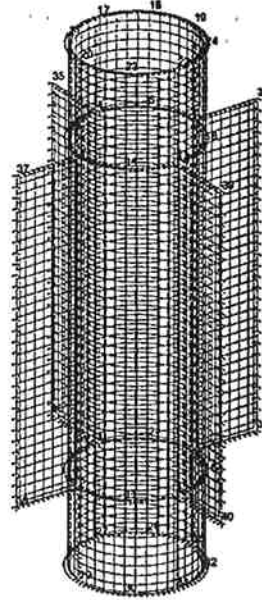
Bladnummer: F3-30 Rev. A2

Project : Malamocco Nav. Lock Gate

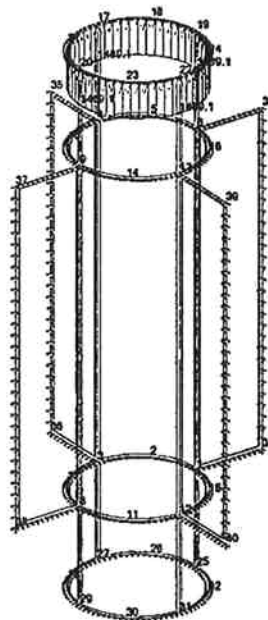


Onderdeel : Waterjet connection vertical support

3. Input (graphical)



element-net



Distributed loads.Loadcases - 1

Opgesteld : D. Aisemgeest

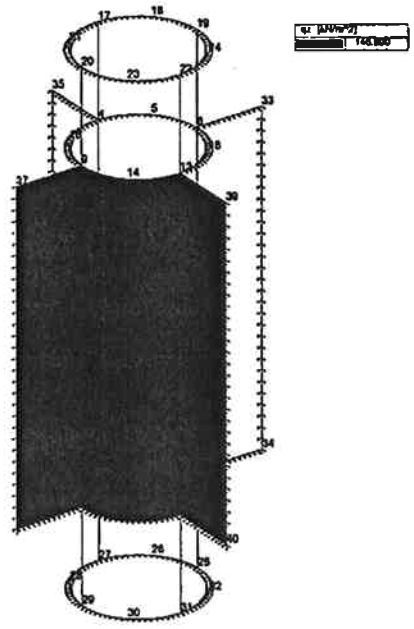
Datum: 19-02-04

Bladnummer: F3-31 Rev. A2

Project : Malamocco Nav. Lock Gate

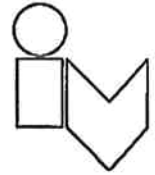


Onderdeel : Waterjet connection vertical support



Surface load - qz local - LC : 2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

4. Output

4.1.

Calculation protocol.

Linear calculation

Number of 2D elements	3180
Number of 1D elements	0
Number of mesh nodes	3248
Number of equations	19488
Loadcases	LC 1 max. accidental load (6000 kN)
	LC 2 waterpressure
Bending theory	Mindlin
Start of calculation	19.02.2004 13:55
End of calculation	19.02.2004 13:56

Sum of loads and reactions.

		X	Y	Z
loadcase 1	loads	0.0	0.0	5993.8
	reactions	-0.0	0.0	-5993.8
	contact	0.0	0.0	0.0
loadcase 2	loads	708.5	708.5	-0.0
	reactions	-708.5	-708.5	-0.0
	contact	0.0	0.0	0.0

Opgesteld : D. Alsemgeest

Datum: 19-02-04

Bladnummer: F3-33 Rev. A2

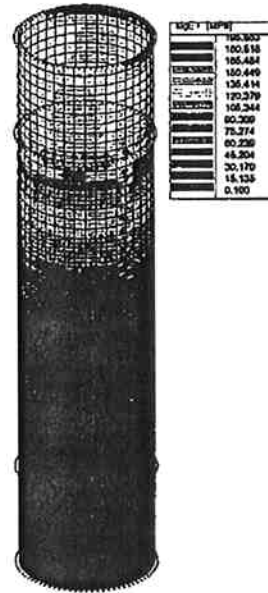
Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

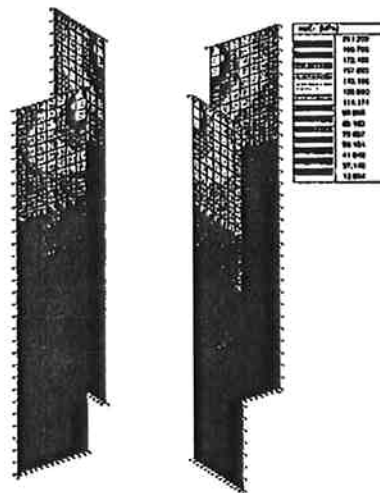
4.2. loadcase 1: vertical support accidental vertical load

4.2.1. Stresses Tube wall



Stress - sigE+ - LC : 1

4.2.2. Stresses cheekplates



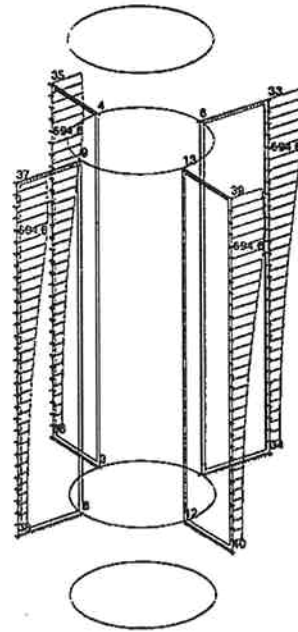
Stress - sigE- - LC : 1

Project : Malamocco Nav. Lock Gate

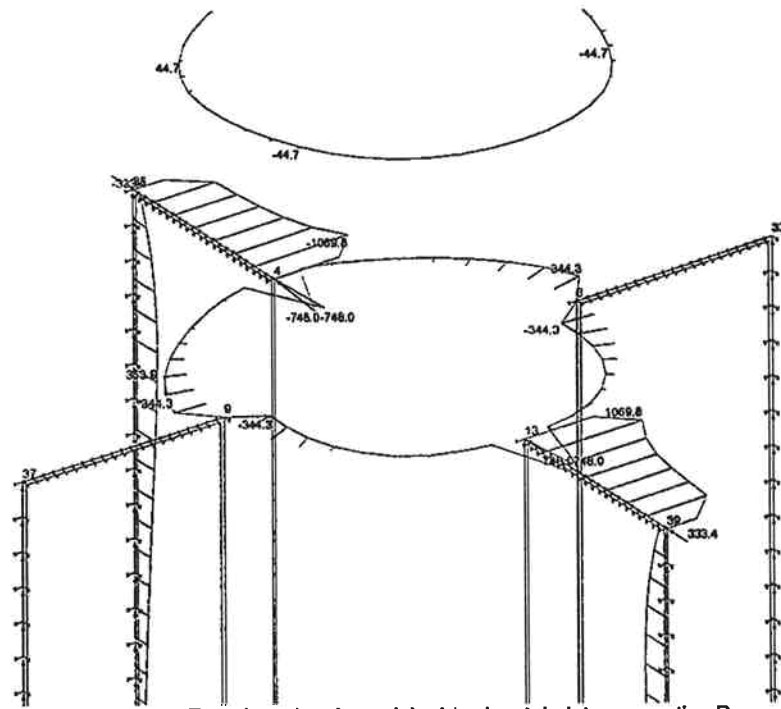


Onderdeel : Waterjet connection vertical support

4.2.3. Reaction deviation allong height



Reactions. Load case(s) : 1



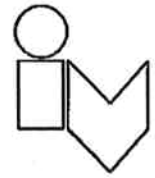
Reactions. Load case(s) : 1 horizontal plate connection Ry

Opgesteld : D. Alsemgeest

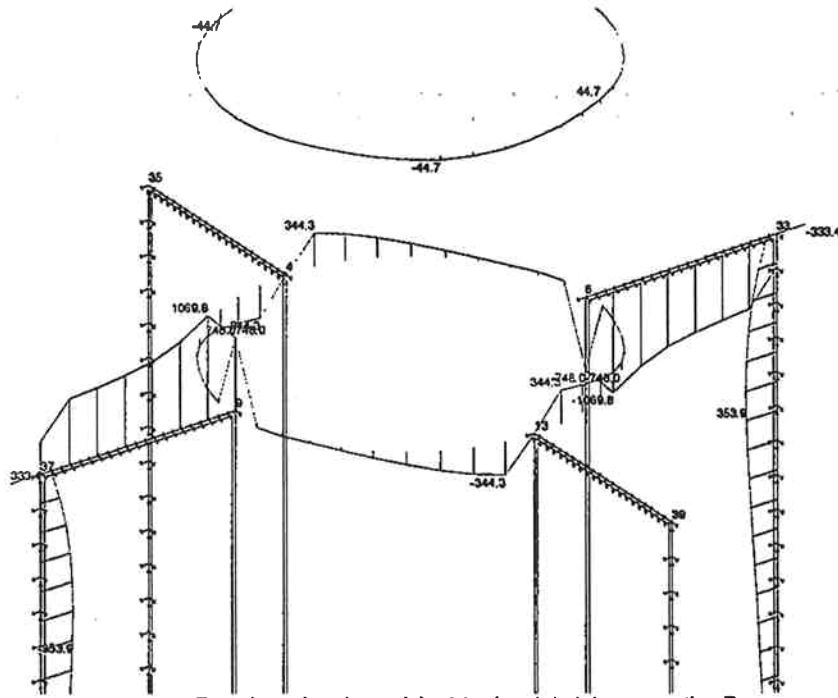
Datum: 19-02-04

Bladnummer: F3-35 Rev. A2

Project : Malamocco Nav. Lock Gate

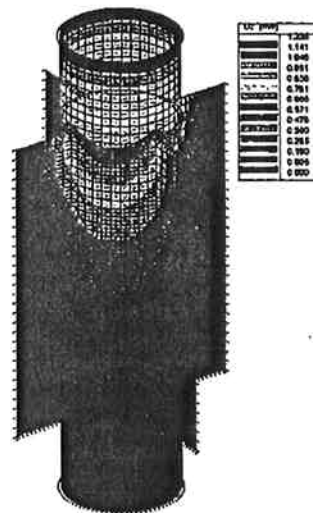


Onderdeel : Waterjet connection vertical support



Reactions. Load case(s) : 1 horizontal plate connection Rx

4.2.4. Deformation



Deformation - Uz - LC : 1

Opgesteld : D. Aisemgeest

Datum: 01-03-04

Bladnummer: F3-36 Rev. A2

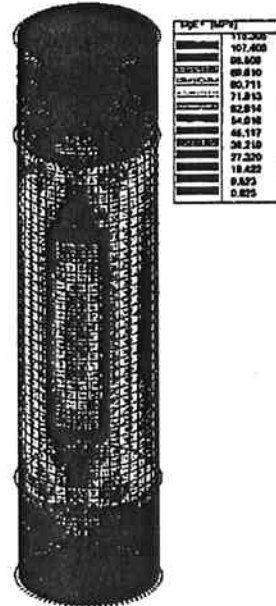
Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support

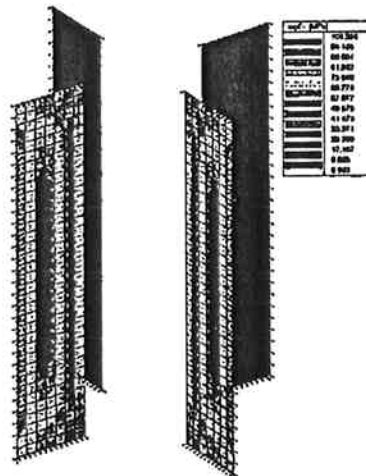
4.3. loadcase 2: waterpressure against outside wall

4.3.1. Stresses Tube wall



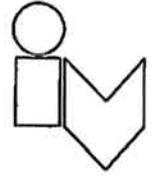
Stress - sigE+ - LC : 2

4.3.2. Stresses cheekplates



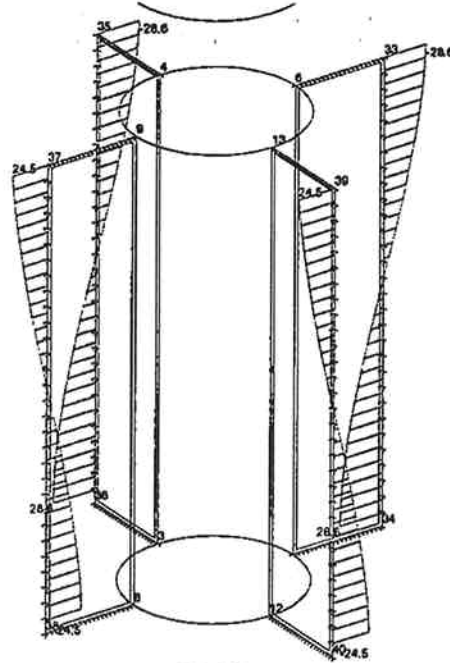
Stress - sigE- - LC : 2

Project : Malamocco Nav. Lock Gate

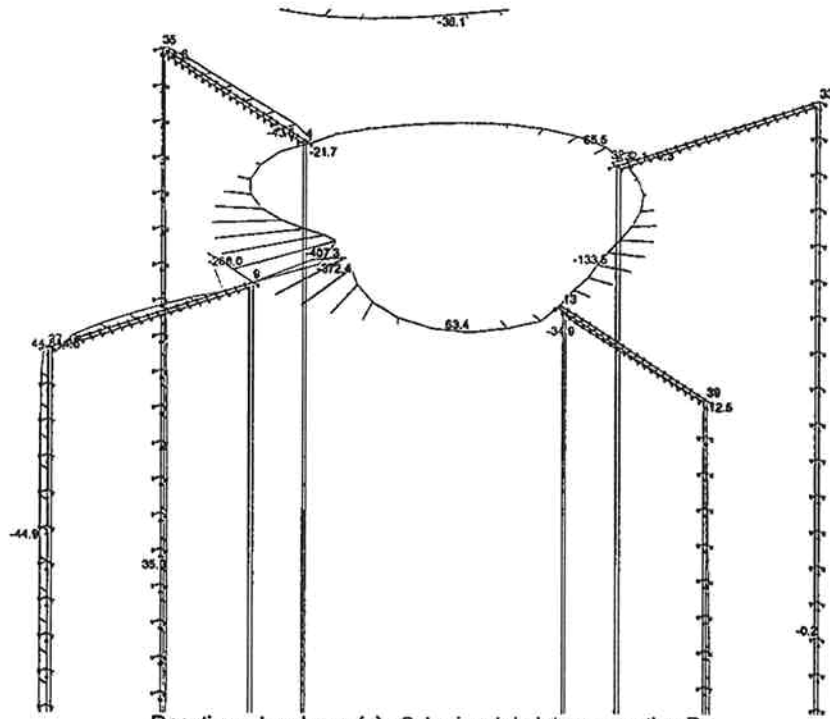


Onderdeel : Waterjet connection vertical support

4.3.3. Reactions



Reactions. Load case(s) : 2



Reactions. Load case(s) : 2 horizontal plate connection Ry

Opgesteld : D. Aisemgeest

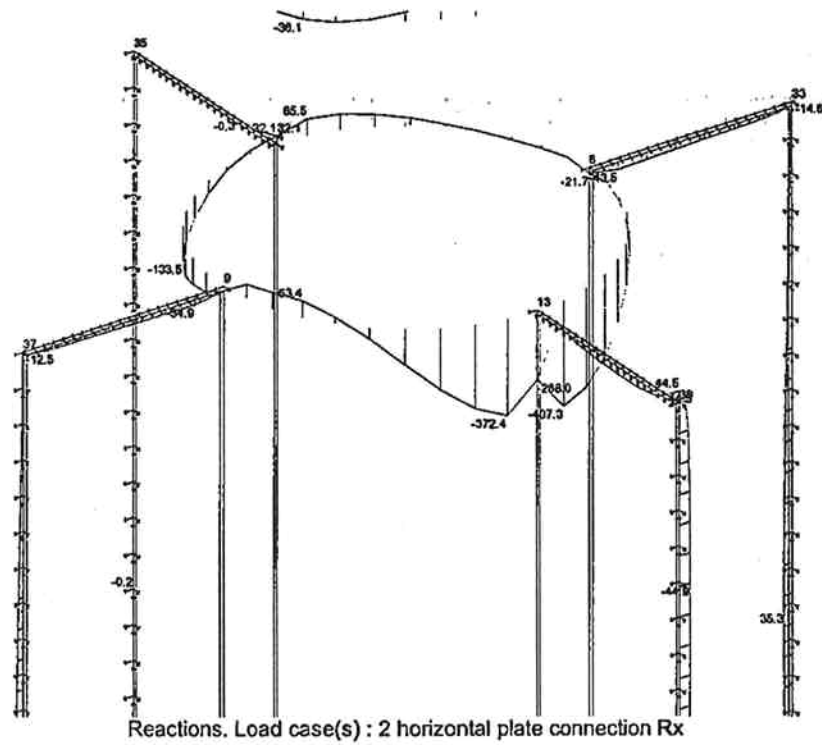
Datum: 19-02-04

Bladnummer: F3-38 Rev. A2

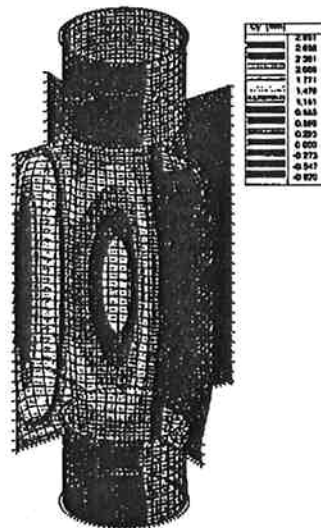
Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection vertical support



4.3.4. Deformation



Deformation - Uy - LC : 2

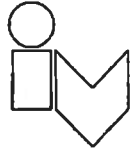
Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-39 Rev. A2

Project : MALAMOLCO NAV. LOCK GATE .

Onderdeel : WATERJETTUBES



CHECKS WATERJETTUBE VERTICAL-SUPPORT.

RESULTING FROM FEM-CALCULATION.

STRESSES PLATE :

OUTERTUBE t = 14 (CALC. 12)

L.C. 1. ACCIDENTAL VERT. LOAD : U.C. = $\frac{196}{(355/1,1)} = 0,6$ ($\times 1,2 = 0,74$)

L.C. 2. WATERPRESSURE : U.C. = $\frac{118}{(355/1,1)} = 0,37$.

NEXT PAGE .

CHEECK PLATES t = 20 (CALC. 18)

L.C. 1. " U.C. = $\frac{201}{(345/1,1)} = 0,64$ ($\times 1,2 = 0,77$)

L.C. 2. " U.C. = $\frac{106}{(345/1,1)} = 0,34$.

WELD CONNECTIONS: L.C. 1. GOVERNING

ALL WELDS : S. (CALC. 4)

R_{tot} ; VERTICAL WELD = 695 N/mm^2

R_{tot} ; HOR. CHEECKPLATE WELD = 1070 N/mm^2 .

R_{tot} ; HOR. PLATE-TUBE WELD = $\sqrt{748^2 + 345^2} = 824 \text{ N/mm}^2$.

$f_w : s : d = 1070 / 2 \cdot 4 = 134 \text{ N/mm}^2$.

$f_w : d = \frac{510/\sqrt{E}}{0,9 \cdot 1,25} = 262 \text{ N/mm}^2$.

U.C. = $\frac{134}{262} = 0,51$ ($\times 1,2 = 0,62$).

DEFORMATION

L.C. 2. DEFORMATION CHEECKPLATE = 3 mm L = 729 mm $\rightarrow \delta = 0,004 \cdot L$.

Opgesteld : ALSEMGEEST

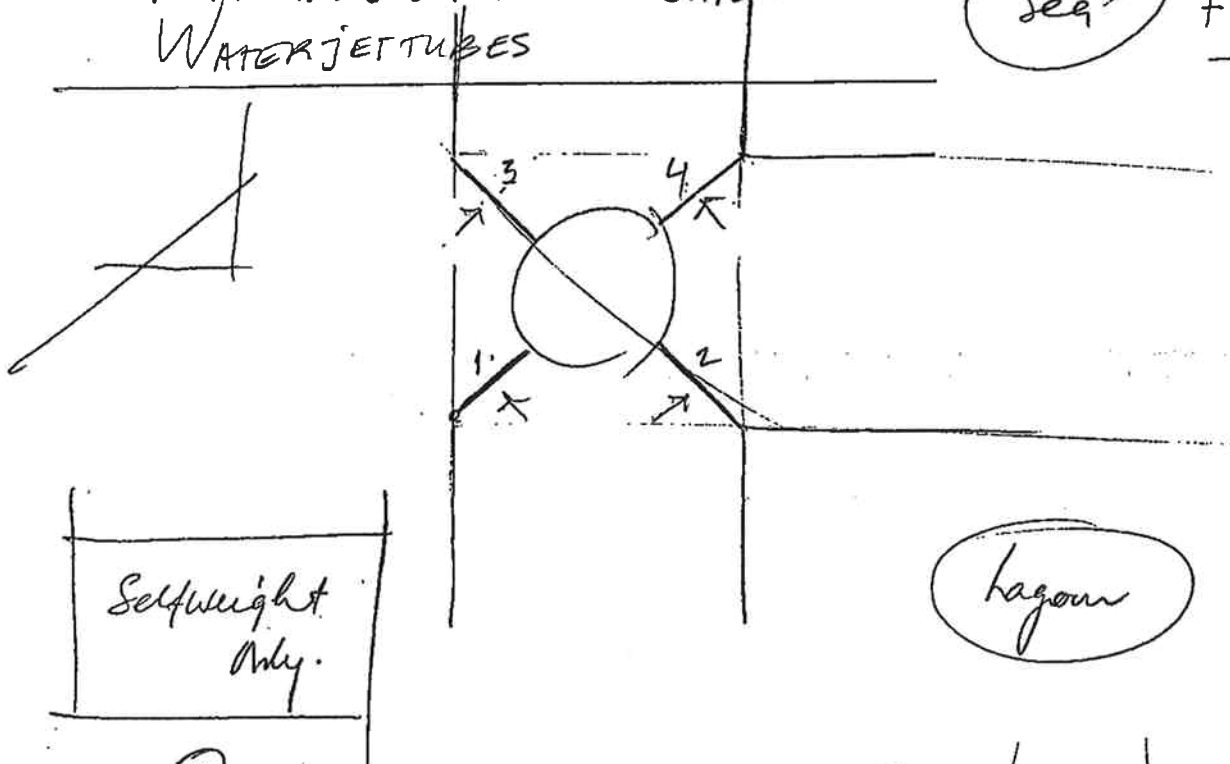
Datum : 01-03-04

Bladnummer : F3-40

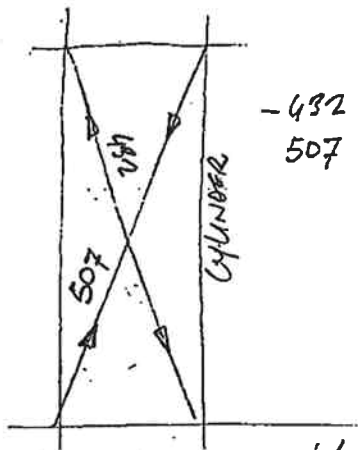
Rev. : A2

VIACAMOCCO NAV. LOCK GATE
WATER JETTUBES

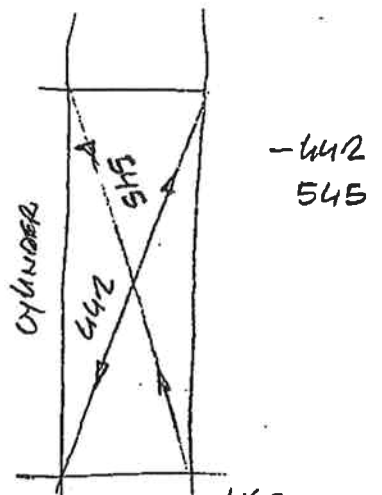
Seq. F₃ - 40° RE



①



②



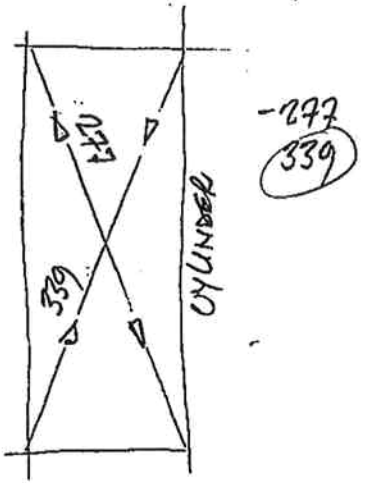
AVERAGE: $\frac{277 + 432 + 442 + 410}{4} = 390 \rightarrow \delta_{max} = \frac{442}{390} = 1,13$

$\frac{339 + 507 + 545 + 516}{4} = 477 \rightarrow \delta_{max} = \frac{545}{477} = 1,14$

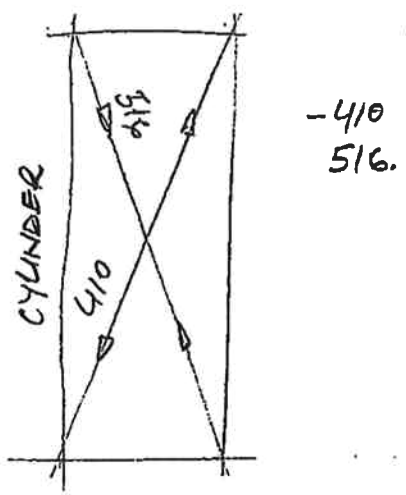
CONSERVATIVE TAKE

$\delta = 1.2$

③



④



NOTE: LOAD DIVISION FROM CYLINDER OVER THE 4 PLATES.
ACC. MAIN CALCULATION (DOC. 4002)

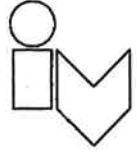
THE DIVISION IS NOT EQUAL OVER ALL PLATES.

THIS WAS ASSUMED IN PREVIOUS CALC.

THEREFOR THE RESULTS WILL BE INCREASED WITH A FACTOR $\delta = 1.2$

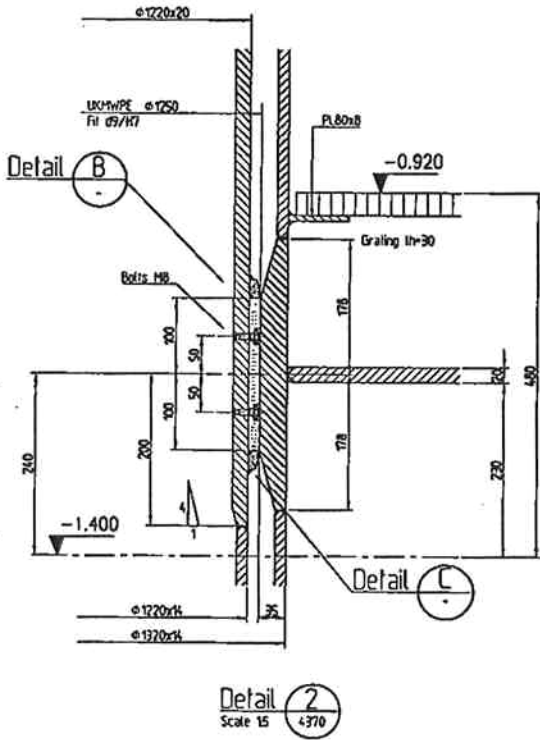
Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : WATER JET TUBES .

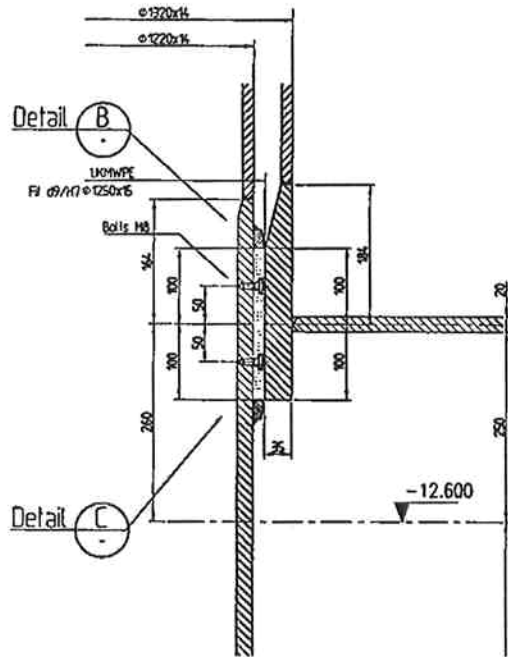


DET. 2 : UPPER HORIZONTAL SUPPORT .

+ DET. 5 : LOWER HORIZONTAL SUPPORT .



UPPER HORIZONTAL SUPPORT .



LOWER HORIZONTAL SUPPORT

Opgesteld : ALSEMGEEST .

Datum : FEBR. 04

Bladnummer : F3 41 .

Rev. : A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

F3. 5. Waterjet connection: horizontal support

Contents

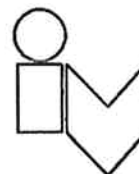
1. Overview model	
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2. Input (numerical)	
Basic data , used materials	
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Boundaries	
2D Macros	
Supports & Subsoil	
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Deformation - Ux - Nonl. Combi : 1	
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Stress - sigE - Nonl. Combi : 1	
4.3. Reaction Lower connection	
Reactions. Non. combi : 1	
Calculation protocol.	

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-42 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

1. Overview model



overview model

2. Input (numerical)

Basic data

Type of structure : General XYZ

Number of nodes:	129
Number of members:	0
Number of 1D macros:	0
Number of bound. lines:	29
Number of 2D macros:	13
Number of profiles :	1
Number of cases:	1
Number of materials:	1

Material

Name:		
S 355		
Ultimate strength		510.000 MPa
Yield design		355.000 MPa
E modulus		210000.00 MPa
Poisson coeff.		0.30
Density		0.000 kg/mm ³
Extensibility		1.2e-005 mm/mm.K

Nodes

node	X mm	Y mm	Z mm
1	600	0	0
2	424	424	0
3	0	600	0
4	0	600	1155
5	424	424	1155
6	600	0	1155
7	-424	424	0
8	-600	0	0
9	-600	0	1155

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-43 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

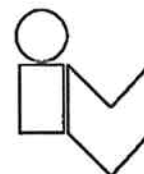
node	X mm	Y mm	Z mm
10	-424	424	1155
11	-424	-424	0
12	-0	-600	0
13	-0	-600	1155
14	-424	-424	1155
15	424	-424	0
16	424	-424	1155
17	0	600	1355
18	424	424	1355
19	600	0	1355
20	-600	0	1355
21	-424	424	1355
22	-0	-600	1355
23	-424	-424	1355
24	424	-424	1355
25	94	593	1155
26	185	571	1155
27	272	535	1155
28	353	485	1155
29	485	353	1155
30	535	272	1155
31	571	185	1155
32	593	94	1155
33	-593	94	1155
34	-571	185	1155
35	-535	272	1155
36	-485	353	1155
37	-353	485	1155
38	-272	535	1155
39	-185	571	1155
40	-94	593	1155
41	-94	-593	1155
42	-185	-571	1155
43	-272	-535	1155
44	-353	-485	1155
45	-485	-353	1155
46	-535	-272	1155
47	-571	-185	1155
48	-593	-94	1155
49	593	-94	1155
50	571	-185	1155
51	535	-272	1155
52	485	-353	1155
53	353	-485	1155
54	272	-535	1155
55	185	-571	1155
56	94	-593	1155
57	94	593	1355
58	185	571	1355
59	272	535	1355
60	353	485	1355
61	485	353	1355
62	535	272	1355
63	571	185	1355
64	593	94	1355
65	-593	94	1355
66	-571	185	1355

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-44 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

node	X mm	Y mm	Z mm
67	-535	272	1355
68	-485	353	1355
69	-353	485	1355
70	-272	535	1355
71	-185	571	1355
72	-94	593	1355
73	-94	-593	1355
74	-185	-571	1355
75	-272	-535	1355
76	-353	-485	1355
77	-485	-353	1355
78	-535	-272	1355
79	-571	-185	1355
80	-593	-94	1355
81	593	-94	1355
82	571	-185	1355
83	535	-272	1355
84	485	-353	1355
85	353	-485	1355
86	272	-535	1355
87	185	-571	1355
88	94	-593	1355
89	0	0	0
90	0	600	12555
91	424	424	12555
92	600	0	12555
93	94	593	12555
94	185	571	12555
95	272	535	12555
96	353	485	12555
97	485	353	12555
98	535	272	12555
99	571	185	12555
100	593	94	12555
101	-600	0	12555
102	-424	424	12555
103	-593	94	12555
104	-571	185	12555
105	-535	272	12555
106	-485	353	12555
107	-353	485	12555
108	-272	535	12555
109	-185	571	12555
110	-94	593	12555
111	-0	-600	12555
112	-424	-424	12555
113	-94	-593	12555
114	-185	-571	12555
115	-272	-535	12555
116	-353	-485	12555
117	-485	-353	12555
118	-535	-272	12555
119	-571	-185	12555
120	-593	-94	12555
121	424	-424	12555
122	593	-94	12555
123	571	-185	12555

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-45 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

node	X mm	Y mm	Z mm
124	535	-272	12555
125	485	-353	12555
126	353	-485	12555
127	272	-535	12555
128	185	-571	12555
129	94	-593	12555

Boundaries

bound. line	type	node
1	Arc	1,2,3
2	Line	3,4
3	Arc	4,5,6
4	Line	6,1
5	Arc	3,7,8
6	Line	8,9
7	Arc	9,10,4
8	Arc	8,11,12
9	Line	12,13
10	Arc	13,14,9
11	Arc	12,15,1
12	Arc	6,16,13
13	Line	4,17
14	Arc	17,18,19
15	Line	19,6
16	Line	9,20
17	Arc	20,21,17
18	Line	13,22
19	Arc	22,23,20
20	Arc	19,24,22
21	Circle	1,3,8
22	Line	17,90
23	Arc	90,91,92
24	Line	92,19
25	Line	20,101
26	Arc	101,102,90
27	Line	22,111
28	Arc	111,112,101
29	Arc	92,121,111

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-46 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

2D Macros

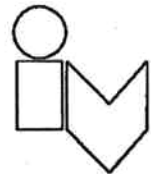
num	type	
1		
	S 355	Thickness 19.00 mm
	Boundary:	1,2,3,4
	Nodes :	25,26,27,28,5,29,30,31,32
2		
	S 355	Thickness 19.00 mm
	Boundary:	5,6,7,2
	Nodes :	33,34,35,36,10,37,38,39,40
3		
	S 355	Thickness 19.00 mm
	Boundary:	8,9,10,6
	Nodes :	41,42,43,44,14,45,46,47,48
4		
	S 355	Thickness 19.00 mm
	Boundary:	11,4,12,9
	Nodes :	49,50,51,52,16,53,54,55,56
5		
	S 355	Thickness 19.00 mm
	Boundary:	3,13,14,15
	Nodes :	57,58,59,60,18,61,62,63,64
6		
	S 355	Thickness 19.00 mm
	Boundary:	7,16,17,13
	Nodes :	65,66,67,68,21,69,70,71,72
7		
	S 355	Thickness 19.00 mm
	Boundary:	10,18,19,16
	Nodes :	73,74,75,76,23,77,78,79,80
8		
	S 355	Thickness 19.00 mm
	Boundary:	12,15,20,18
	Nodes :	81,82,83,84,24,85,86,87,88
9		
	S 355	Thickness 300.00 mm
	Boundary:	21
	Nodes :	12,89
10		
	S 355	Thickness 13.00 mm
	Boundary:	14,22,23,24
	Nodes :	93,94,95,96,91,97,98,99,100
11		
	S 355	Thickness 13.00 mm
	Boundary:	17,25,26,22
	Nodes :	103,104,105,106,102,107,108,109,110
12		
	S 355	Thickness 13.00 mm
	Boundary:	19,27,28,25
	Nodes :	113,114,115,116,112,117,118,119,120
13		
	S 355	Thickness 13.00 mm
	Boundary:	20,24,29,27
	Nodes :	122,123,124,125,121,126,127,128,129

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-47 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

Supports

support	node	type	rot deg	flexibility MN/m-MNm/rad	Size mm
1	4	X	Rz =90.00	X - press only	20.00
2	5	X	Rz =-145.00	X - press only	20.00
3	6	X	Rz =180.00	X - press only	20.00
4	9	X		X - press only	20.00
5	10	X	Rz =-45.00	X - press only	20.00
6	13	X	Rz =90.00	X - press only	20.00
7	14	X	Rz =45.00	X - press only	20.00
8	16	X	Rz =145.00	X - press only	20.00
9	25	X	Rz =-99.00	X - press only	20.00
10	26	X	Rz =118.00	X - press only	20.00
11	27	X	Rz =-127.00	X - press only	20.00
12	28	X	Rz =-136.00	X - press only	20.00
13	29	X	Rz =-154.00	X - press only	20.00
14	30	X	Rz =-163.00	X - press only	20.00
15	31	X	Rz =-172.00	X - press only	20.00
16	32	X	Rz =-181.00	X - press only	20.00
17	33	X	Rz =9.00	X - press only	20.00
18	34	X	Rz =18.00	X - press only	20.00
19	35	X	Rz =-27.00	X - press only	20.00
20	36	X	Rz =36.00	X - press only	20.00
21	37	X	Rz =54.00	X - press only	20.00
22	38	X	Rz =63.00	X - press only	20.00
23	39	X	Rz =-72.00	X - press only	20.00
24	40	X	Rz =-81.00	X - press only	20.00
25	41	X	Rz =81.00	X - press only	20.00
26	42	X	Rz =72.00	X - press only	20.00
27	43	X	Rz =63.00	X - press only	20.00
28	44	X	Rz =54.00	X - press only	20.00
29	45	X	Rz =36.00	X - press only	20.00
30	46	X	Rz =27.00	X - press only	20.00
31	47	X	Rz =18.00	X - press only	20.00
32	48	X	Rz =9.00	X - press only	20.00
33	49	X	Rz =181.00	X - press only	20.00
34	50	X	Rz =172.00	X - press only	20.00
35	51	X	Rz =163.00	X - press only	20.00
36	52	X	Rz =154.00	X - press only	20.00
37	53	X	Rz =136.00	X - press only	20.00
38	54	X	Rz =127.00	X - press only	20.00
39	55	X	Rz =118.00	X - press only	20.00
40	56	X	Rz =99.00	X - press only	20.00
41	90	XYZ			20.00
42	91	XYZ			20.00
43	92	XYZ			20.00
44	93	XYZ			20.00
45	94	XYZ			20.00
46	95	XYZ			20.00
47	96	XYZ			20.00
48	97	XYZ			20.00
49	98	XYZ			20.00
50	99	XYZ			20.00
51	100	XYZ			20.00
52	101	XYZ			20.00
53	102	XYZ			20.00
54	103	XYZ			20.00

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-48 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

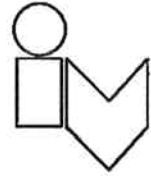
support	node	type	rot deg	flexibility MN/m-MNm/rad	Size mm
55	104	XYZ			20.00
56	105	XYZ			20.00
57	106	XYZ			20.00
58	107	XYZ			20.00
59	108	XYZ			20.00
60	109	XYZ			20.00
61	110	XYZ			20.00
62	111	XYZ			20.00
63	112	XYZ			20.00
64	113	XYZ			20.00
65	114	XYZ			20.00
66	115	XYZ			20.00
67	116	XYZ			20.00
68	117	XYZ			20.00
69	118	XYZ			20.00
70	119	XYZ			20.00
71	120	XYZ			20.00
72	121	XYZ			20.00
73	122	XYZ			20.00
74	123	XYZ			20.00
75	124	XYZ			20.00
76	125	XYZ			20.00
77	126	XYZ			20.00
78	127	XYZ			20.00
79	128	XYZ			20.00
80	129	XYZ			20.00

Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-49 Rev. A2

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

Loadcases

Case	Name:	coeff	Description
1	combi hor 400kN + vert 2000kN *	1.00	Permanent - Loads

(* Design Value)

Loadcase no. 1 - nodal loads

node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
89	-400.00	0.00	0.00	0.00	0.00	0.00

Loadcase no. 1 - distributed loads

bound	type	dx mm	exY mm	exZ mm		X beg end	Y beg end	Z beg end
1	force kN/m	0.00 1.00	rel	0.00	0.00	glo len	0.00 0.00	0.00 530.51
5	force kN/m	0.00 1.00	rel	0.00	0.00	glo len	0.00 0.00	0.00 530.51
8	force kN/m	0.00 1.00	rel	0.00	0.00	glo len	0.00 0.00	0.00 530.51
11	force kN/m	0.00 1.00	rel	0.00	0.00	glo len	0.00 0.00	0.00 530.51

Nonlinear combination

Combi	Group of init. deformations	dx mm/m	dy mm/m	Group of init. curvatures	Case	coeff
C 1		0	0.00	0	1 combi hor 400kN + vert 2000kN	1.00

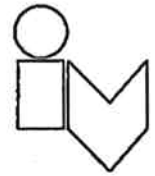
Opgesteld : D. Alsemgeest

Datum: 01-03-04

Bladnummer: F3-50 Rev. A2

Project : Malamocco Nav. Lock Gate

Onderdeel : Waterjet connection horizontal support

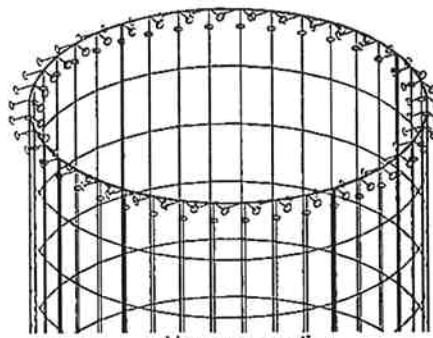


3. Input (graphical)

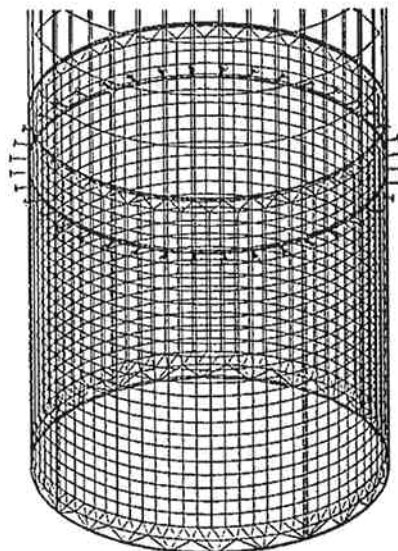
Geometry



input model



Upper connection



Lower connection

Opgesteld : D. Aisemgeest

Datum: 01-03-04

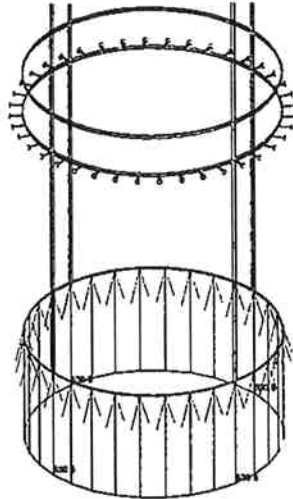
Bladnummer: F3-51 Rev. A2

Project : Malamocco Nav. Lock Gate

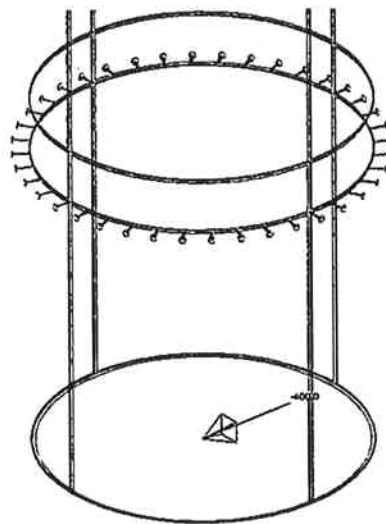


Onderdeel : Waterjet connection horizontal support

Loads



Distributed loads.Loadcases - 1



Nodal loads.Loadcases - 1

Project : Malamocco Nav. Lock Gate



Onderdeel : Waterjet connection horizontal support

4. Output

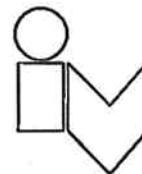
Calculation protocol.

Nonlinear calculation

Number of 2D elements	4576
Number of 1D elements	0
Number of mesh nodes	4401
Number of equations	26406
Maximum iterations	50
Bending theory	Mindlin

Number Combi	Start	End	NoOfIteration
NC 1	01.03.2004 14:59	01.03.2004 15:02	4

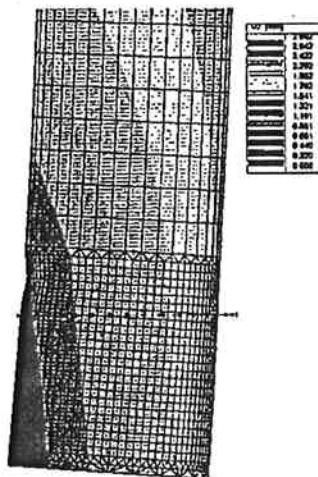
Project : Malamocco Nav. Lock Gate



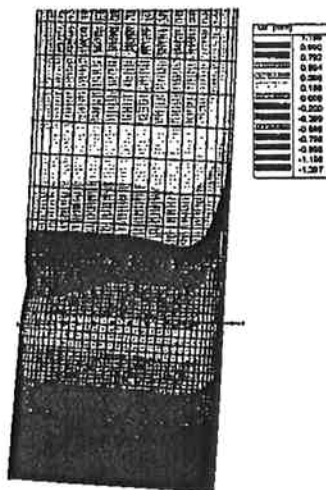
Onderdeel : Waterjet connection horizontal support

Lower connection governing

4.1. Deformation



Deformation - Uz - Nonl. Combi : 1



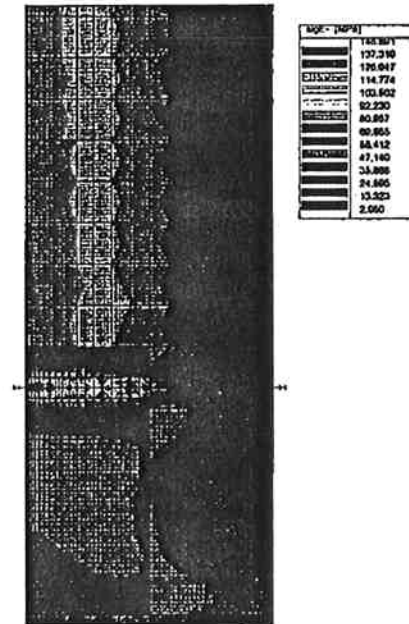
Deformation - Ux - Nonl. Combi : 1

Project : Malamocco Nav. Lock Gate



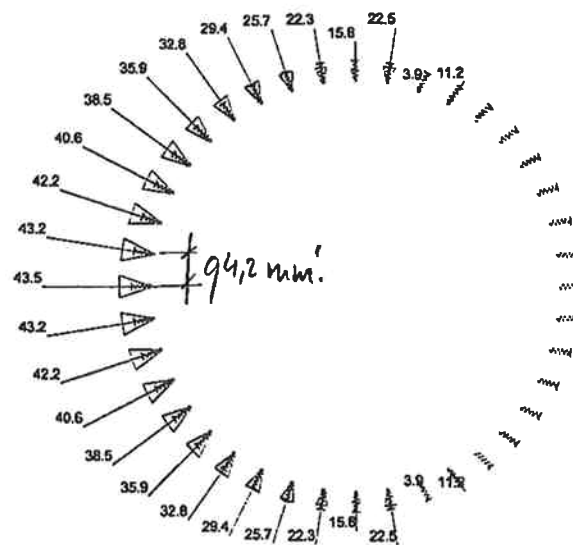
Onderdeel : Waterjet connection horizontal support

4.2. Stresses



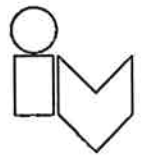
Stress - sigE - - Nonl. Combi : 1

4.3. Reaction Lower connection



Reactions. Non. combi : 1

Project : MALAMOCO NAV. LOCK GATE



Onderdeel : WATERJETTUBES

CHECKS WATERTUBES HORIZONTAL SUPPORTS.

RESULTING FROM FEM-CALCULATION.

GOVERNING: DETAIL 5; LOWER + HORIZONTAL SUPPORT.

LOCAL PIPESTRESS: CALC. t. = 18 mm'

$\sigma_{E:D} = 149 \text{ N/mm}^2$

u.c. = $149 / (345 / 1.1) = 0.48$ O.K.

LOAD INTRODUCTION: PLATE t = 20

(acc. F3-55) $q_d = \frac{43.5 \text{ kN}}{94.2 \text{ mm}} = 462 \text{ kN/m'}$

$D = 1320 \text{ mm'}$

$h = 975 - (1320 / 2) = 315 \text{ mm'}$

$t = 20 \text{ mm'}$ (calc. = 18 mm')

$l = \frac{D}{4} = 1037 \text{ mm'}$

$W = \frac{1}{2} \cdot t \cdot h^2 = 297675 \text{ mm}^3$

$A = h \cdot t = 5670 \text{ mm}^2$

$V_{s:d} = \frac{R_{t,d}}{2} = 441 / 2 = 221 \text{ kN. (F2-1)}$

$M_0 = \frac{1}{12} \cdot q \cdot l^2 = 41.4 \text{ kNm}$

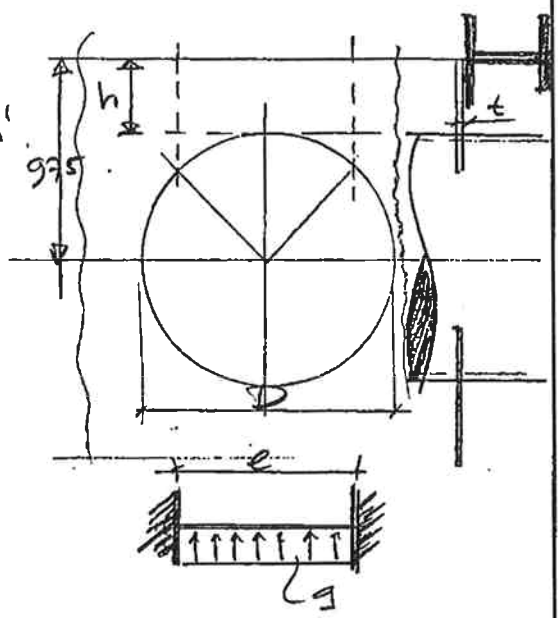
$\sigma_e = M_0 / W = 139 \text{ N/mm}^2$

$\tau_v = V_{s:d} / A = 39 \text{ N/mm}^2$

$\tau_N = q / t = 26 \text{ N/mm}^2$

$\sigma_{E,D} = \sqrt{139^2 + 39^2 - (139 \cdot 39) + 5 \cdot 26^2} = 132 \text{ N/mm}^2$

u.c. max = $139 / (355 / 1.1) = 0.43$ O.K.



Opgesteld : ALSEMGEEST

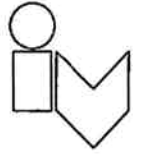
Datum : 02-03-04

Bladnummer : F3-56

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : WATERJETTUBES.



LOAD INTRODUCTION UHMWPE:

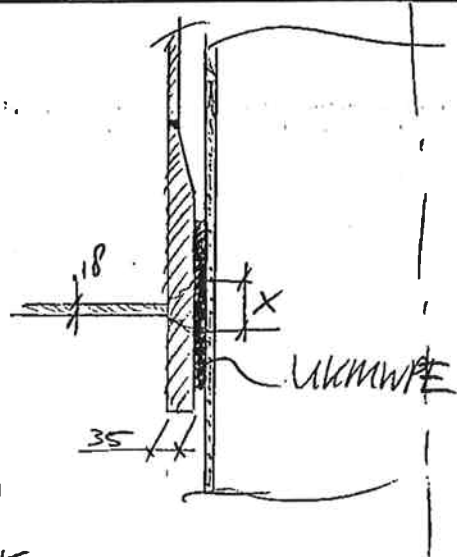
$$q_a = 462 \text{ kN/m}.$$

$$x = 18 + 2 \cdot 35 = 88 \text{ mm}.$$

$$f_{s:d} = q/x = 5,3 \text{ N/mm}^2.$$

$$f_{u:d} = 22 \text{ N/mm}^2 \text{ (ALLOWABLE)}$$

$$u.c. = f_{s:d} / f_{u:d} = 0,24 \text{ OK.}$$



Opgesteld : *ALSEMGEEST*

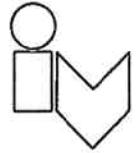
Datum : *02-03-04*

Bladnummer : *F3-57.*

Rev. : *A2.*

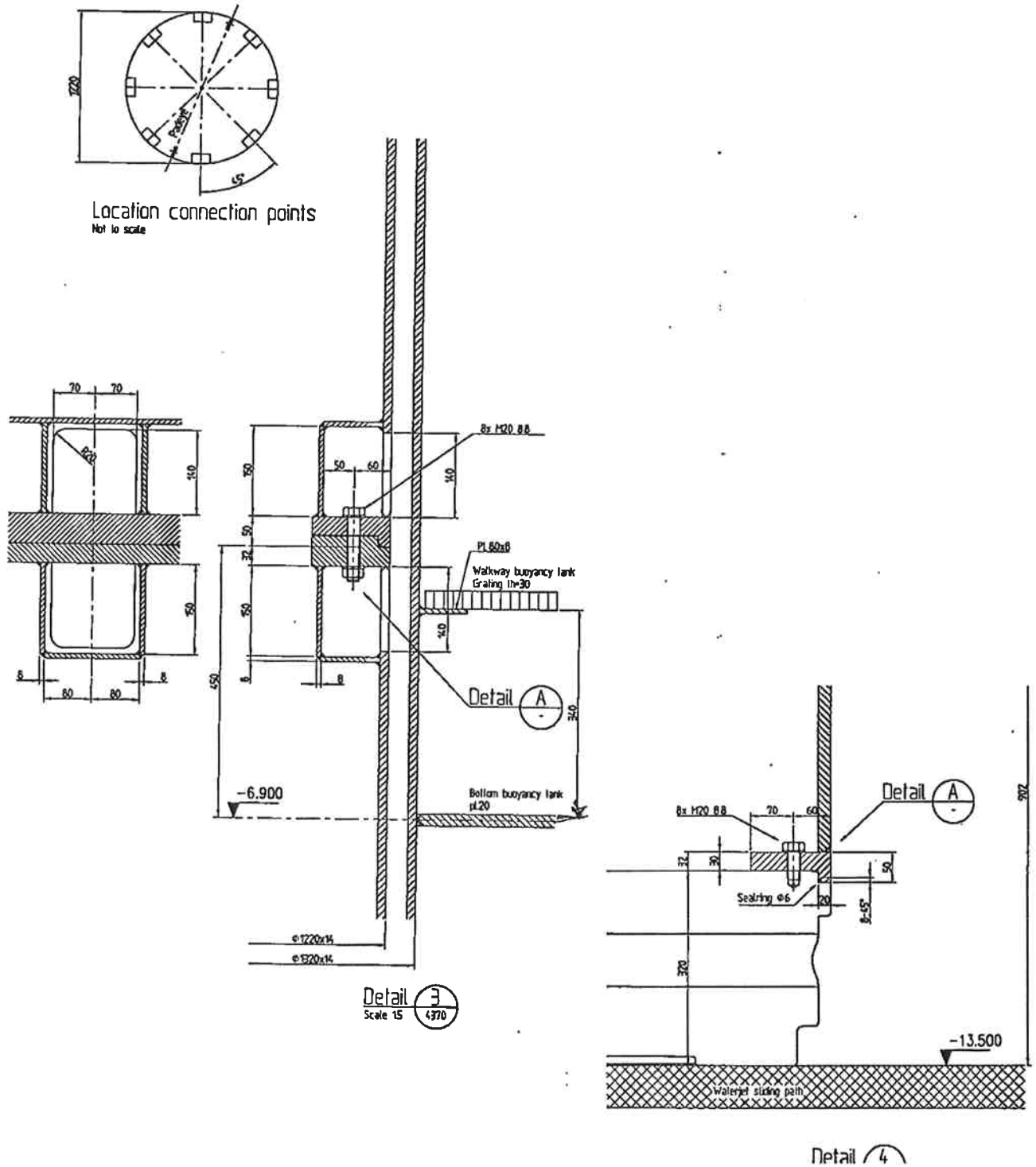
Project : MALAMOCO NAV. LOCK GATE

Onderdeel : WATERJET TUBES



DET. 4. PARTITION IN INNER TUBE.

DET. 6. CONNECTION HYDROFOOT.



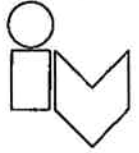
Opgesteld : A. SEMGEEST

Datum : FEBR. 04

Bladnummer : F3-58. Rev. A2

Project : MALAMOCCO NAV. LOCK GATE -

Onderdeel : WATER JETTUBES.



SELF WEIGHT WATERJET (INNER) TUBE.

① TOPRING:

$$\pi(730^2 - 520^2) \cdot 50 \cdot 10^{-9} \cdot 7850 = 349 \text{ KG}$$

PIPE $\phi 1220 \cdot 20$ (1,6m):

$$591 \cdot 1,6 = 946 \text{ KG.}$$

CONUSSTIFFENER:

$$\pi \cdot (224 \cdot 15)(2 \cdot 550) \cdot 10^{-9} \cdot 7850 = 91 \text{ KG}$$

$$G_{\text{① tot.}} = 1386 \text{ KG.}$$

② PIPE $\phi 1220 \cdot 14$ (4,8m)

$$423 \cdot 4,8 = 2031 \text{ KG.}$$

③ PIPE $\phi 1220 \cdot 14$ (0,5)

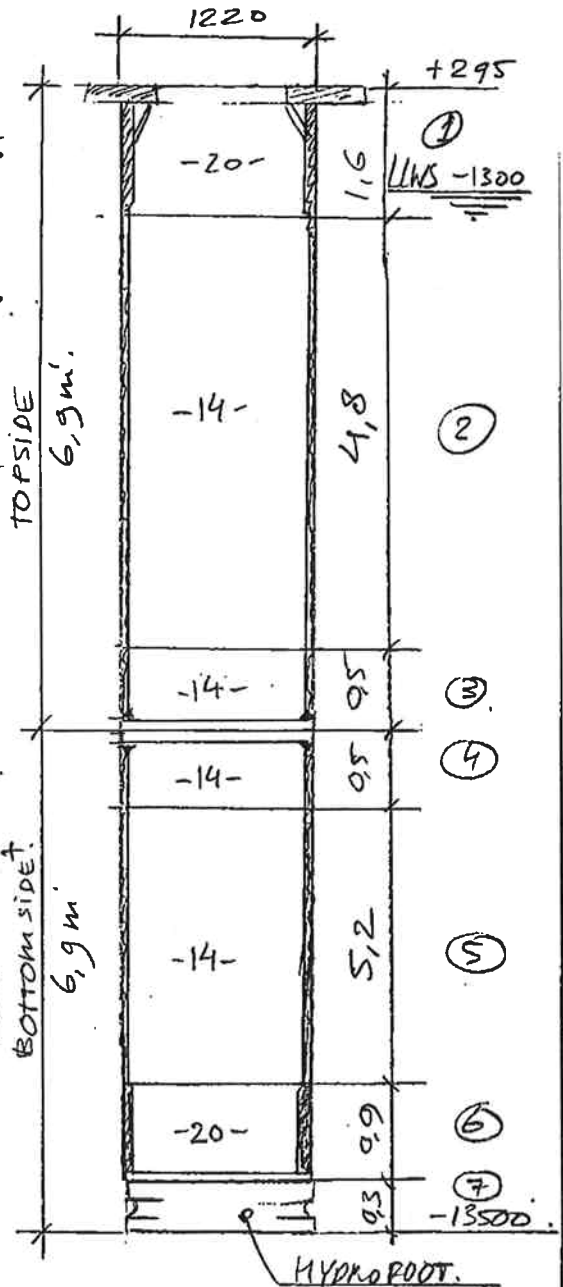
$$423 \cdot 0,5 = 212 \text{ KG.}$$

BOTTOMRING

$$\pi(610^2 - 510^2) \cdot 34 \cdot 10^{-9} \cdot 7850 = 94 \text{ KG}$$

$$G_{\text{③ tot}} = 306 \text{ KG}$$

$$G_{\text{TOPSIDE}} = 3723 \text{ KG.}$$



Opgesteld: FRSENGEEST.

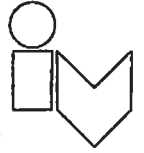
Datum: FEBR. 04

Bladnummer: F3-59

Rev.: A2

Project : MALAMULLO NAT. LOCK GATE.

Onderdeel : WATERJET TUBES.



④ TOPRING

$$94 \cdot \frac{46}{34} = 127 \text{ KG.}$$

$$\frac{\text{PIPE } \phi 1220 \cdot 14 (0,5 \text{ m}^2)}{423 \cdot 0,5} = 212 \text{ KG.} +$$

$$\text{G④} = \underline{339} \text{ KG.}$$

⑤ PIPE $\phi 1220 \cdot 14 (5,2)$

$$423 \cdot 5,2 = \underline{2200} \text{ KG.}$$

⑥ PIPE $\phi 1220 \cdot 20 (0,9)$

$$591 \cdot 0,9 = 532 \text{ KG.}$$

BOTTOMRING

$$\text{IDEN TOPSIDE} = 94 \text{ KG}$$

HYDROFOOT

$$\frac{\pi \cdot 1170^2}{4} \cdot 220 \cdot 10^{-9} \cdot 7850 = 1900 \text{ KG} +$$

$$\text{G⑥} = \underline{2526} \text{ KG}$$

$$\text{G BOTTOMSIDE} = 5065 \text{ KG.}$$

$$\text{G WATERJET (INNER) TUBE} = 8788 \text{ KG.}$$

Opgesteld : ALSENGEEST.

Datum : FEBR. 04

Bladnummer : F3-60

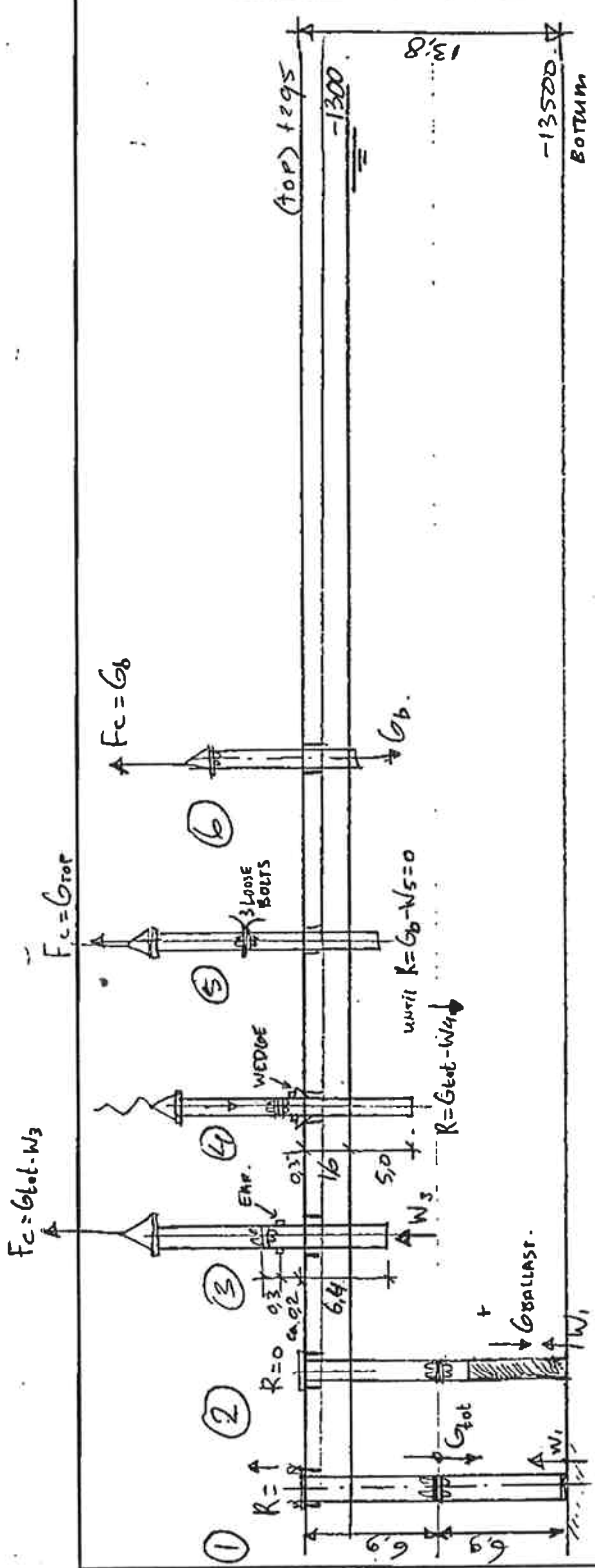
Rev. : A2

Project : MALAMOCO NAV. LOCK GATE .

Onderdeel : WATERJET TUBES .



INSTALLATION SEQUENCE .



- ① START: TRIM DOOR BALLAST UNTIL, PRESSURE ON HYDROFOOT MEASURES 750 kN.
REPLACE AT 4 POINTS BOLTS M30 WITH HOLLOW CYLINDER JACKS.
PRESTRESS WITH JACKS, UNTIL TOTAL MEASURED LOAD ON JACKS ≥ 750 kN.
RELEASE ALL OTHER BOLTS. \rightarrow BOLTED CONNECTION NOW REPAIRED BY JACKS.
 - ② LOWERING DOOR WITH JACKS UNTIL REST ON SLAB WITH TEMPORARILY SUPPORTS.
TENSION ON JACKS IS THE BUOYANCY OF THE WATERJET TUBES ($R = W - G$)
FILL TUBE WITH WATER UNTIL MEASURED LOAD ON JACKS $R = 0$. AND REMOVE JACKS.
③ CONTROLLED EMPTYING OF TUBE.
 - ④ CONNECT TUBE TO CRANE AND LIFT TUBE UNTIL. PARTITION AND SUPPORTIVE 'EARS' IS ABOVE OUTER TUBE.
WEDGE THE INNER TUBE BETWEEN OUTER TUBE WALL. INNER TUBE REST ON SUPPORTIVE 'EARS'.
 - ⑤ WHEN TENSION IS OF PARTITION \rightarrow REMOVE BOLTS, BUT KEEP 3 LOOSE TIGHTENED.
LIFT TUBE WITH CRANE. BOTTOM PART OF TUBE FOLLOWS DUE TO BUOYANCY FORCE.
WHEN HEIGHT REACHED SO $R = G_0 - W_5$. LOAD ON BOLT $= 0$ AND RELEASE LAST BOLTS.
 - ⑥ TOPSIDE IS CRANED ASIDE.
CONNECT BOTTOMSIDE OF TUBE TO CRANE AND LIFT OUT.
- G_{tot} = TOTAL WEIGHT OF INNER TUBE =
 G_0 = WEIGHT INNER TUBE BOTTOMSIDE
 G_{TOT} = WEIGHT INNER TUBE TOPSIDE.
 W = BUOYANCY FORCE DEPENDING OF HEIGHT.
 R = EQUILIBRIUM OF G AND W .

Opgesteld : F. SEMGEEST

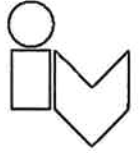
Datum : FEBR. '04

Bladnummer : FW-61

Rev. : A2

Project : MALAMOLLO NAV. LOCK GATE.

Onderdeel : WATERJET TUBES.



LOADS IN DIFFERENT STAGES (AT WATERLEVEL LLWS-1300).

$$W: \text{BUOYANCY FORCE / m' TUBE} = \rho \cdot A \\ = 10,3 \left[\pi \cdot \frac{1200^2}{4} \right] 10^{-6} = 11,65 \text{ kN/m' } \\ = 1165 \text{ kg/m'}$$

STAGE (1) $G_{\text{tot}} = 8788 \text{ kg.}$

$$W_1 = 1165 \cdot (13,8 - 1,3) = 14563 \text{ kg.}$$

$$R_1 = W_1 - G_{\text{tot}} = 5775 \text{ kg.}$$

STAGE (2) : $h_{\text{BALLAST}} = R_1 / W_m = 5775 / 1165 = \boxed{4,96 \text{ m' WATERFILL}}$

$$R_2 = W_1 - G_{\text{tot}} - G_{\text{BALLAST}} = 0.$$

STAGE (3/4) : STAGE 3 GOVERNING.

$$W_3 = (6,4 - 1,6) \cdot 1165 = 5592 \text{ kg.}$$

$$F_c = G_{\text{tot}} - W_3 = 3196 \text{ kg.}$$

STAGE (5) $W > G_0.$

$$F_c \dots = G_{\text{top}} = 3723 \text{ kg WHEN } R = G_0 - W_5 = 0.$$

STAGE (6) : $F_c = G_0 = \underline{5065 \text{ kg.}} = F_{c; \text{max}}$.

MAX. CRANELOAD = WEIGHT OF TUBES PARTITION.

NOTE: CONNECTION: HYDROFOOT - INNER TUBE } ALWAYS UNDER COMPRESSION.
" " PARTITION - " }

Opgesteld : ATSEMGEEST

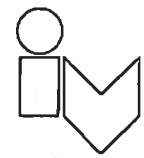
Datum : FEBR. 04

Bladnummer : F3-62.

Rev. : A2

Project : MALLAMOCCHIO NAV. LOCK GATE .

Onderdeel : WATERJET TUBES.



BOLTED CONNECTIONS → INNER TUBE - HYDROFOOT PARTITION

SEE NOTE PREVIOUS PAGE: TENSION = 0 .

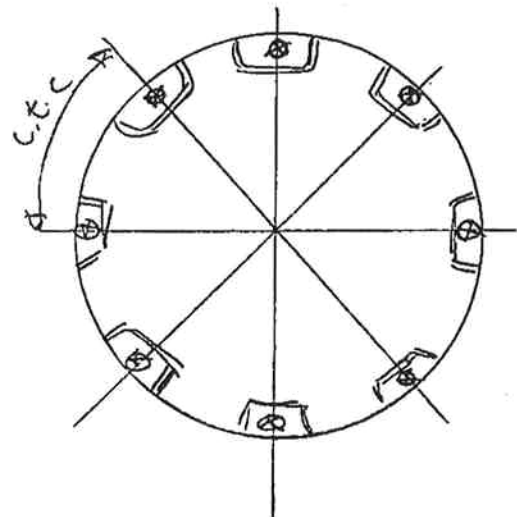
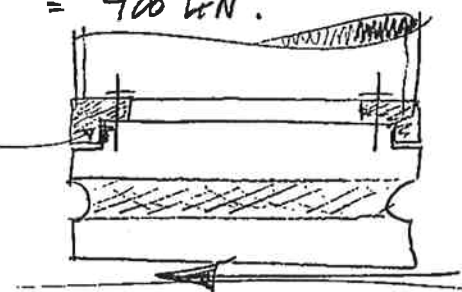
SEE PAGE F2-1 : SHEAR = 400 kN .

SHEAR FORCE THROUGH BEARING AT RING

BOLTS : PRACTICAL .

8 * M20 .

$$c.t.t. \approx \frac{\pi \cdot 1220}{8} \approx 480 \text{ mm}^2$$

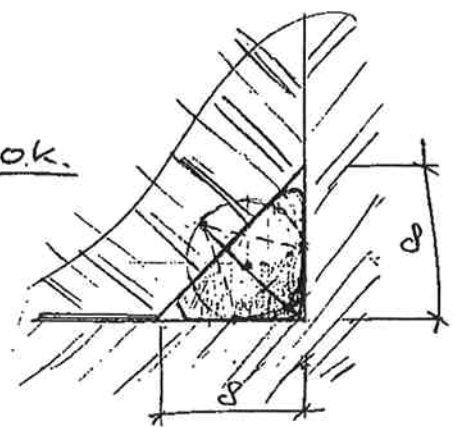


WATERTIGHTENING RING φ6

$$d_{MAX} \Rightarrow A_{\Delta} = A_{\phi}$$

$$\frac{1}{2} \cdot d^2 = \frac{\pi}{4} \cdot d^2$$

$$d = 6,38 \text{ mm} \Rightarrow 6 < 6,38 \text{ ok.}$$



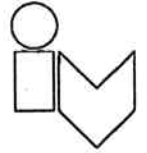
d = 6 mm
R = 3 mm

Opgesteld : **ALSEMGEEST**

Datum : **FEBR. 04**

Bladnummer : **F2.63** Rev. : **A2**

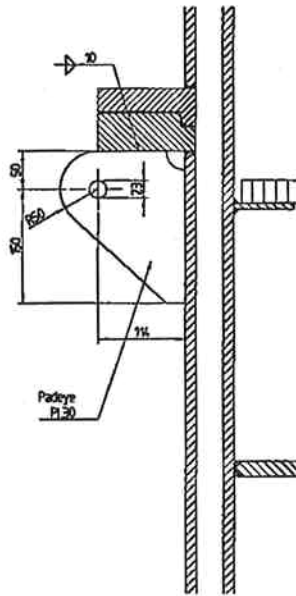
Project : MALAMOCCO NAV. LOCK GATE .



Onderdeel : WATERJETTUBES.

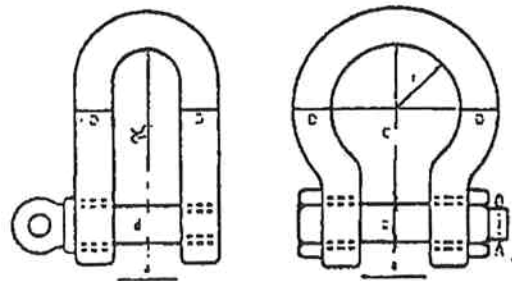
F3.7 PADEYE CONNECTIONS.

PADEYE AT PARTITION.



PADEYE AT UPPER CONNECTION

REF. PAGE F3-2



Werk- last in ton	Beugel diam. mm	Bout diam. mm	Wijde mm	Inw. lengte		Beugel wijde type H mm	Gewicht	
				Type D	Type H		Type D	Type H
				c	c		kg	kg
3.25	16	19	26	51	64	43	0.63	0.70
4.75	19	22	31	59	76	51	0.95	1
6.5	22	25	36	73	83	58	1.55	1.70

SHACKLE!

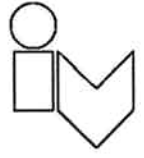
Opgesteld : *ALSEMCEEST*

Datum : 02-03-'04

Bladnummer : F3-64

Rev. : AZ

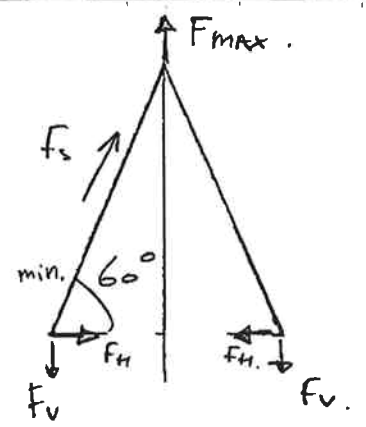
Project : MALAMOCCO NAV. Lock GATE



Onderdeel : WATERJET TUBES.

CHECK BOTTOMSIDE - PADEYE . GOVERNING

MAX. LOAD = $G_{BOTTOMSIDE} = 5065 \text{ KG.}$
 MAX. LOAD PER SHACKLE = $\frac{G}{2 / \sin 60^\circ}$
 + $= 2924 \text{ kg} \approx 3 \text{ ton.}$
 CAPACITY SHACKLE : 4,75 ton. OK.



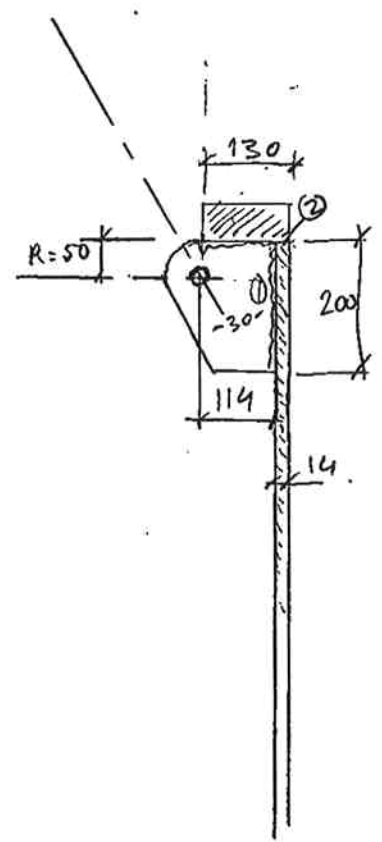
$F_{V:D} = 1,3 \cdot 1,2 \cdot 5065 / 2 = 40 \text{ kN}$
 $F_{H:D} = \frac{F_{V:D}}{\tan 60^\circ} = 23 \text{ kN}$
 $F_{S:D} = 1,3 \cdot 1,2 \cdot 30 = 47 \text{ kN}$ } INCL. DYNAMIC FACTOR ; 1,3.

EYE PLATE

$d_{SHACKLE} = 22 \text{ mm'}$
 $d_{HOLE} = 23 \text{ mm' } = d_0$
 $t_{PLATE} = 30 \text{ mm' (calc. 28)}$
 $f_y = 345 \text{ N/mm}^2$

$a \geq \frac{F_{S:D} \cdot \gamma_{mp}}{2t \cdot f_y} + \frac{2 \cdot d_0}{3} = 3 + 16 = 19 \text{ mm'}$
 $c \geq \frac{F_{S:D} \cdot \gamma_{mp}}{2t \cdot f_y} + \frac{d_0}{3} = 3 + 8 = 11 \text{ mm'}$

Acting : $a = c = 50 - \frac{23}{2} = 38,5 \text{ mm' OK.}$



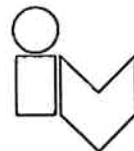
Opgesteld : *ALSEMGEEST*

Datum : 02.03.04

Bladnummer : F3-65

Rev. :

Project : MALAMOCCO NAV. LOCK GATE



Onderdeel : WATERTUBES.

CONNECTION PLATE - RING! PLATE $t = 20$.
WELDS ~~A~~ 10. (calc. 8)

① WELD VERTICAL.

$$F_{V,D} = 40 \text{ kN.}$$

$$\tau_2 = \frac{40 \cdot 10^3}{2 \cdot 8 \cdot 200} = 13 \text{ N/mm}^2 < 0.4.$$

② WELD HORIZONTAL.

$$\text{BENDING: } M_D = F_{V,D} \cdot \left(114 + \frac{20}{2}\right) + F_{H,D} \cdot 50 \cdot 10^{-3} = 4.96 + 1.15 = 6.11 \text{ kNm}$$

$$\sigma_1 = \tau_1 = \frac{3 \cdot M_D}{\sqrt{2} \cdot a \cdot l^2} = \frac{3 \cdot 6.11 \cdot 10^6}{\sqrt{2} \cdot 8 \cdot (150 - 20)^2} = 134 \text{ N/mm}^2.$$

$$\text{SHEAR: } F_{H,D} = 23 \text{ kN}$$

$$\tau_2 = \frac{23 \cdot 10^3}{2 \cdot 8 \cdot 110} = 13 \text{ N/mm}^2.$$

$$\sigma_{\text{w:sd}} = \sqrt{4 \cdot 134^2 + 3 \cdot 13^2} / \sqrt{3} = 155 \text{ N/mm}^2.$$

$$f_{\text{w:sd}} = 262 \text{ N/mm}^2.$$

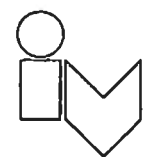
$$u.c. = 155 / 262 = 0.6 \text{ o.k.}$$

Opgesteld : P. SEMGEEST

Datum : 02-03-04

Bladnummer : F3-66 Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE



Onderdeel : WATERJET TUBES

CHECK RING

BENDING :

M_{RING} DUE TO R_{HID} ACCORDING

ROARK FORMULAS TABLE 17.

$$M_{max} = \frac{R_{hid} \cdot R \cdot k_2}{\pi}$$

$$R = 545 \text{ mm}$$

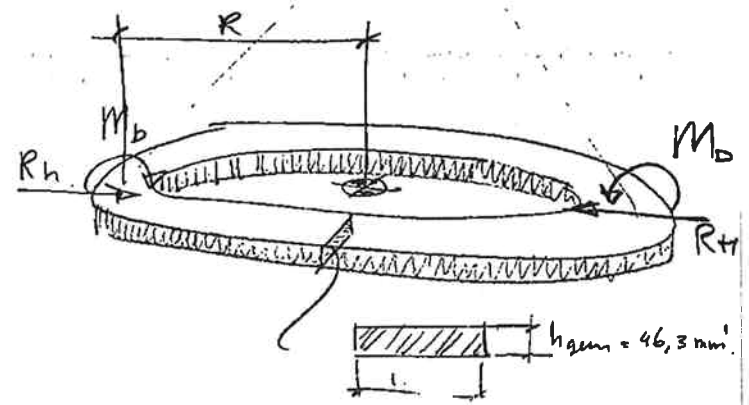
$$k_2: \alpha = \frac{I}{AR^2} = 0,0047$$

$$k_2 = 1 - \alpha = 0,9953$$

$$M_{max} = \frac{23 \cdot 0,545 \cdot 0,9953}{\pi} = \text{kNm}$$

$$W = \frac{I}{c} = \frac{8476760}{(130/2)} = 130411 \text{ mm}^3$$

$$f_B = M/W = 31 \text{ N/mm}^2$$



$$A = 130 \cdot 46,3 = 6019 \text{ mm}^2$$

$$I = \frac{1}{12} \cdot 46,3 \cdot 130^3 = 8476760 \text{ mm}^4$$

TORSION SHEAR

$$T = M_{D, WELD} \text{ @ PREVIOUS PAGE} = \text{kNm}$$

$$\tau = \frac{T}{0,25 \cdot 130 \cdot 46,3^2} = 95 \text{ N/mm}^2$$

COMBINED

$$f_{EID} = \sqrt{31^2 + 3 \cdot 95^2} = 160 \text{ N/mm}^2$$

$$\text{CHECK: U.C.} = \frac{f_{EID}}{f_{yid}} = \frac{160}{(335/1,1)} = 0,56 \text{ O.K.}$$

Opgesteld: ALSEMGEEST

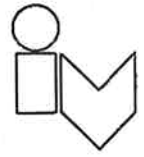
Datum: 02-03-04

Bladnummer: F3-67

Rev. A2

Project : MAAVAMOLCO NAV. LOCK GATE .

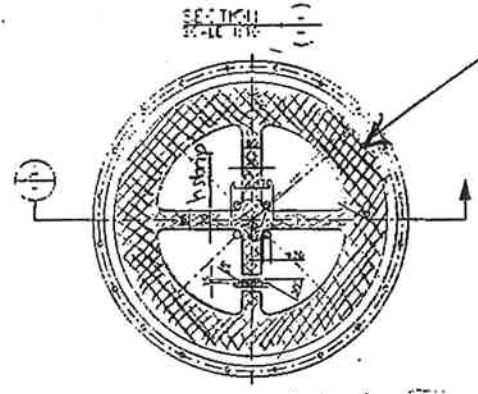
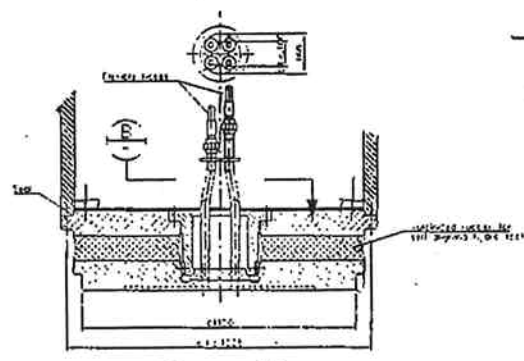
Onderdeel : WATERJETTUBES.



F4. SLIDING PAD

CALCULATED :

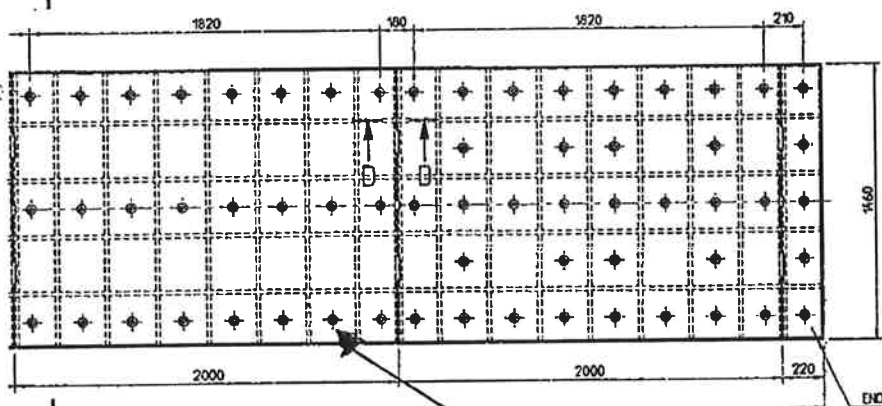
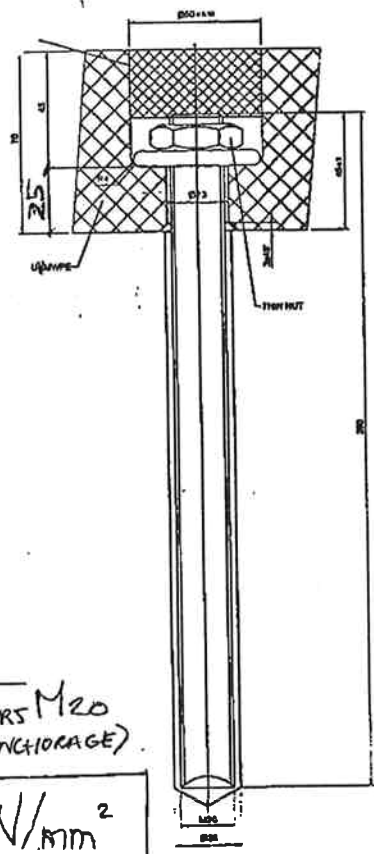
- 1 CONTACT STRESS UHMWPE UNDER ULTIMED LOAD
- 2 DEFORMATION UHMWPE UNDER WORKING LOAD.
- 3 HORIZONTAL RESISTANCE SLIDING PAD.
- 4 CAPACITY SLIDING PAD CONNECTION.



PRESSURE AREA.

$R_{out} = 570 \text{ mm}$
 $R_{in} = 410 \text{ mm}$
 $h_{strip} = 70 \text{ mm}$

HYDROFOOT



SLIDE - PADS (UHMWPE)

GOVERNING PAD
FIXED WITH 24 ANCHORS M20 FASTENERS (CHEMICAL ANCHORAGE)

UHMWPE : ALLOWABLE CONTACT STRESS $f_{c,ul} = 20 \text{ N/mm}^2$
 $E = 700 \text{ N/mm}^2$

Opgesteld : ALSEMGEEST

Datum : FEBR. 04

Bladnummer : F4-1

Rev. : A2

Project : MALAMOCCO NAV. LOCK GATE .

Onderdeel : WATERJET TUBES .



1. CONTACT STRESS UHMWPE

UNDER ULTIMATE LOAD :

$$F_{v;d} = 6000 \text{ kN} ; \text{Acc. F1 } \textcircled{C}$$

$$A_{HF} = \pi \cdot (570^2 - 410^2) + 2 \cdot 410 \cdot 70 + 2 \cdot (410 - \frac{70}{2}) \cdot 70 = 576250 \text{ mm}^2$$

$$f_{c;s;d} = F_{v;d} / A_{HF} = 11 \text{ N/mm}^2$$

$$f_{c;u;d} = 20 \text{ N/mm}^2 \Rightarrow \text{short load; no creep.}$$

$$u.c = 0,55 < 1,0 ; \text{O.K.}$$

Long load $f_{c;c;d} = 135 \text{ N/mm}^2$; $u.c = \frac{3,5}{8} = 0,44$

2. DEFORMATION UHMWPE ;

UNDER WORKING LOAD WITH REPRESENTATIVE VALUES.

$$F_{v;r} = \frac{1380 \text{ kN}}{1,1} ; \text{Acc. F1. } \textcircled{B}_3$$

= 1500 kN .

(CONTINGENCY).

$$f_{c;s;r} = \frac{1500}{6000} \cdot 11 = 2,8 \text{ N/mm}^2$$

$$\sigma = E \cdot \epsilon$$

$$\Delta l = \frac{\sigma}{E} \cdot l ; l = h_{\text{UHMWPE}} = 70 \text{ mm}$$

$$\Delta l = \frac{2,8}{700} \cdot 70 = 0,28 \text{ mm}$$

Opgesteld : P. SEMGEEST .

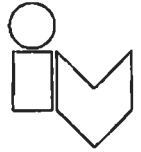
Datum : FEBR. 04

Bladnummer : F4-2

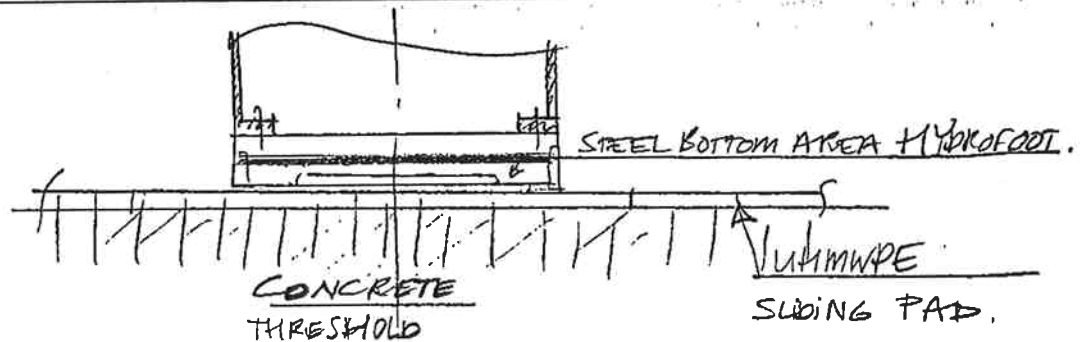
Rev. : A2

Project : MALAMOCCA NAV. LOCK GATE.

Onderdeel : WATERJET TUBES.



2. HORIZONTAL RESISTANCE SLIDING PADS:



- | | STATIC | DYNAMIC |
|--|--------|---------|
| • FRICTION COEFFICIENT STEEL - UHMWPE. $\mu_{STEEL-UHMWPE} = 0,27$ | 0,27 | 0,23. |
| • UHMWPE - CONCRETE $\mu_{UHMWPE-CONCRETE} = 0,21$ | 0,21 | 0,20. |

FRICTION WITH CONCRETE HIGHER.

THEORETICALLY SLIDING PAD IS HELD HORIZONTALLY BY FRICTION UNDER VERTICAL LOAD.

IF FRICTION DISAPPOINTING HORIZONTAL LOAD HAS TO BE BEARED BY THE CONNECTION OF THE SLIDING PAD. BOLT CONNECTION IS ADDITIONAL TO THE ABOVE.

Opgesteld : ALSEMGEEST

Datum : 05-04

Bladnummer : F4-3. Rev. : A2

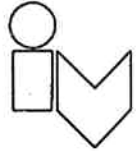


Addendum G

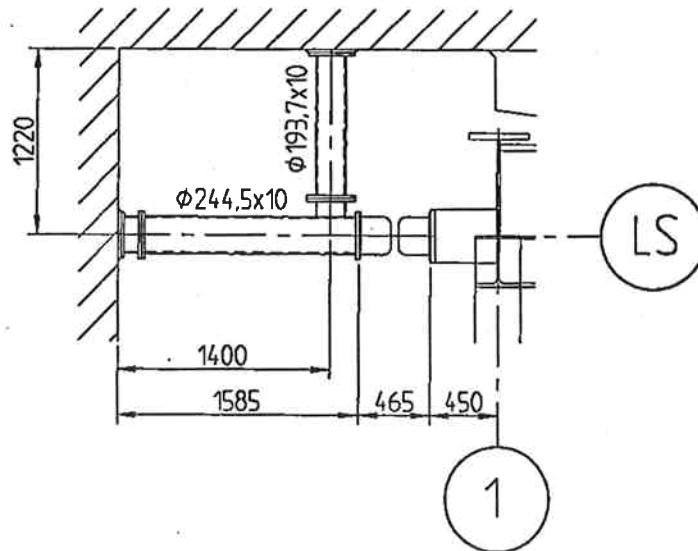
Buffers

Project : MALAMOCCO NAV. LOCK GATE

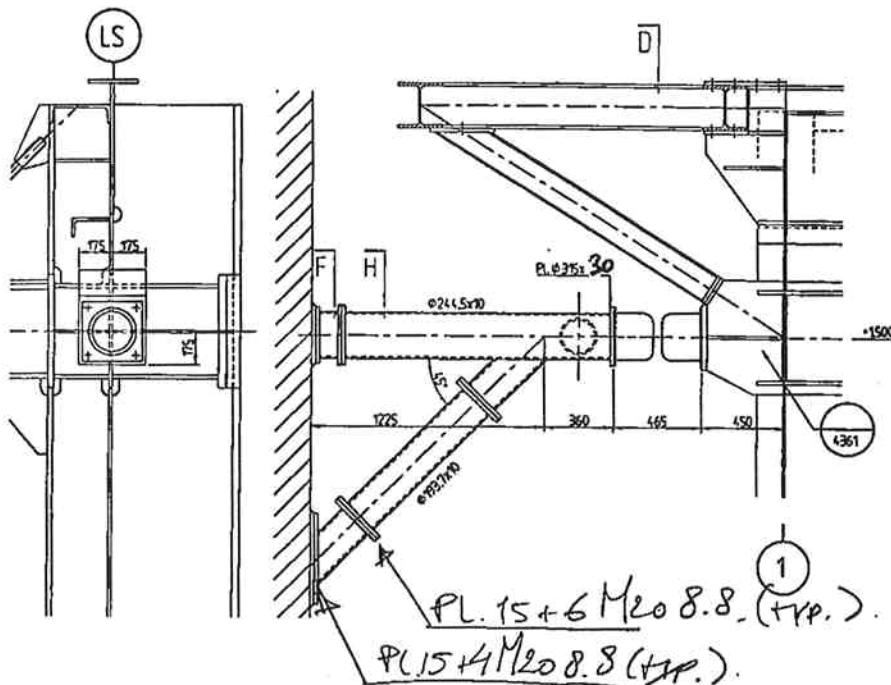
Onderdeel : BUFFERS



THERE ARE SEVERAL BUFFERS ALONG THE WALLS OF THE LOCK CHAMBER
IN THE CALCULATION BELOW, WE CHECK THE GOVERNING BUFFER.



el.+1500



ALL WELDS : AWS.
STEEL : S355.

Opgesteld : MPI

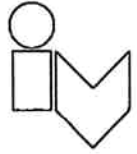
Datum : 15-4-'04

Bladnummer : G-1

Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS



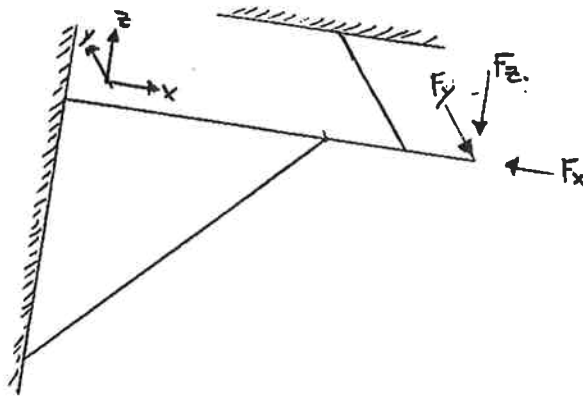
LOADS

THE FORCE ON THE BUFFER IS 440 kN ($F_{H;1}$). FOR THE HORIZONTAL FORCE PERPENDICULAR TO THE BUFFER AND VERTICAL FORCE WE TAKE 5% OF THE LONGITUDINAL FORCE.

- $F_x = 440$ kN (LONGITUDINAL). \Rightarrow MV036-PE-M-M-R-5003; CALC. MECH. MEMBERS.

- $F_y = 0,05 \times 400 = 22$ kN (PERPENDICULAR, HOR).

- $F_z = 0,05 \times 400 = 22$ kN (LONGITUDINAL).



COMBINATION

SLS : $1,0 \times \text{SELF WEIGHT} + 1,0 \times F_{H;1} + 1,0 \times F_{H;2} + 1,0 \times F_z$.

ULS : $1,0 \times \text{SELF WEIGHT} + 1,0 \times F_{H;1} + 1,0 \times F_{H;2} + 1,0 \times F_z$.

(SAFETY FACTOR IS 1,0, BECAUSE IT'S AN ACCIDENTAL LOAD)

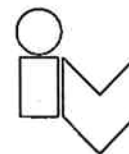
Opgesteld : MPI

Datum : 15-4-'04

Bladnummer : G-2

Rev. : 0

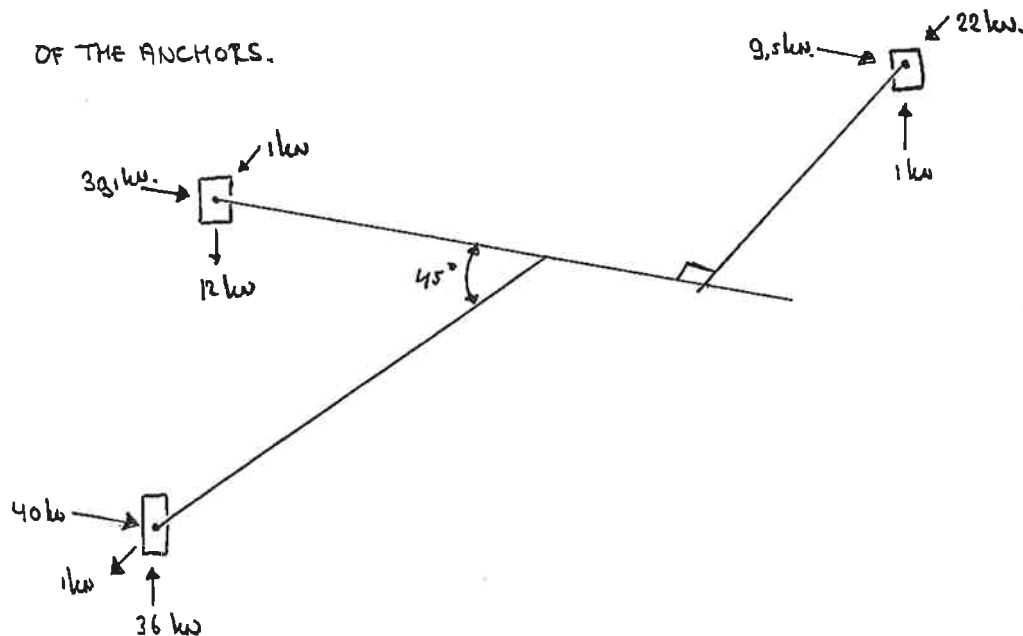
Project : MALAMOCCO NAV. LOCK GATE



Onderdeel : BUFFERS

REACTIONS

THE SKETCH BELOW SHOWS THE GOVERNING REACTIONS FOR THE CALCULATION OF THE ANCHORS.



THE REACTIONS, GIVEN ABOVE, AS RESULT OF A COMPUTER CALCULATION.

COMPUTER CALCULATION ESA-PRIMA-WIN:

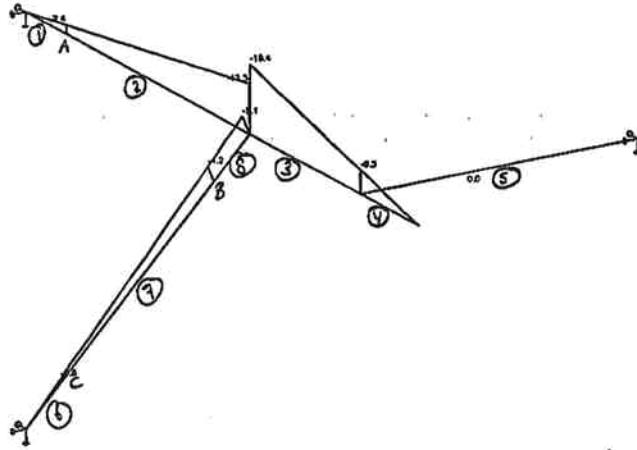
MEMBER	SECTION	N _c :s:d	M _y :s:d	M _z :s:d
1	A	39,1 kN	2,4 kNm	0,2 kNm
2		39,1 kN	18,4 kNm	1,0 kNm
3		43,1 kN	18,4 kNm	1,0 kNm
4		44,0 kN	6,3 kNm	6,3 kNm
5		21 kN	0 kNm	7,8 kNm
6	C	53 kN	0,8 kNm	0 kNm
7		53 kN	4,2 kNm	0 kNm
8		53 kN	4,2 kNm	0 kNm

Opgesteld : MPI

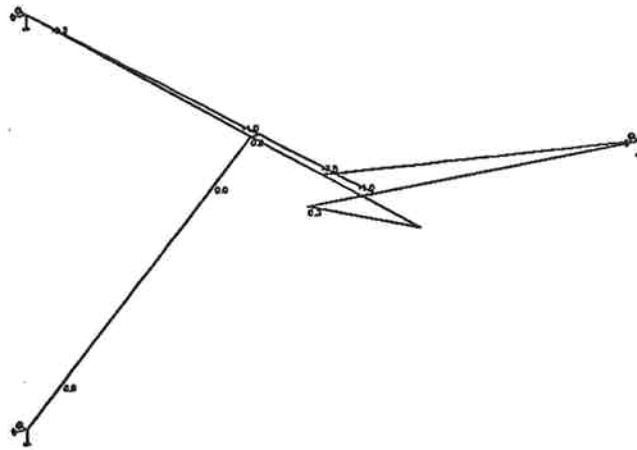
Datum : 15-4-'04

Bladnummer : G-3a

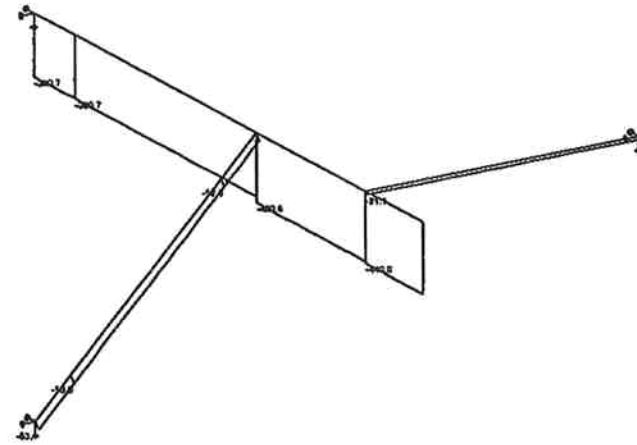
Rev. : 0



Moment in y-axis



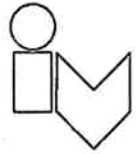
Moment in z-axis



Normal forces

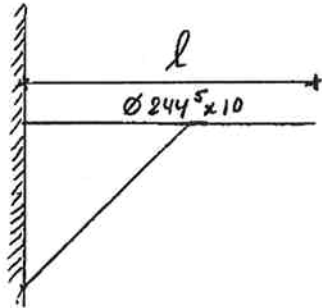
Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS



CHECK PROFILE BUFFER

BUCKLING; AXIAL COMPRESSION. (acc. 5.5.1.)



FOR THE BUCKLING LENGTH, WE TAKE THE WHOLE LENGTH OF THE BEAM

$$l = 1925 \text{ mm}$$

$$N_{c:s:d} = 440 \text{ kN}$$

PROFILE : $\varnothing 244^5 \times 10$; STEEL : S355.

CORROSION ALLOWANCE : 2 mm OF THE THICKNESS.

PROFILE AFTER CORROSION REDUCTION : $\varnothing 240^5 \times 8$

$$\lambda = \frac{l}{i} = \frac{1925}{82,20} = 23,42$$

$$\lambda_1 = 93,9 \times \epsilon = 93,9 \times 0,81 = 76,1$$

$$\epsilon = \left(\frac{235}{355}\right)^{0,5} = 0,81$$

$$\bar{\lambda} = \frac{\lambda}{\lambda_1} = \frac{23,42}{76,1} = 0,31$$

$$X = 0,9439 \text{ (CURVE C)}$$

$$N_{b,Rd} = \frac{X \times \beta_A \times A \times f_y}{\gamma_{M1}} = \frac{0,9439 \times 1,0 \times 5839 \times 355}{1,1} = 1779 \text{ kN}$$

$$\text{unity check} = \frac{N_{c:s:d}}{N_{b,Rd}} = \frac{440}{1779} = 0,25 < 1,0$$

Opgesteld :
MP1

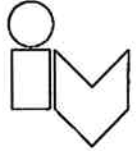
Datum :
15-4-'04

Bladnummer :
6-4

Rev. :
0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS



BENDING AND AXIAL COMPRESSION. acc. S.5.4. (3), FORMULA (S.53).

$$u.c. = \frac{N_{c:s:d}}{X_{min} \times A \times f_y / \gamma_{M1}} + \frac{k_y \times M_{y:s:d}}{W_{el,y} \times f_y / \gamma_{M1}} + \frac{k_z \times M_{z:s:d}}{W_{el,z} \times f_y / \gamma_{M1}} \leq 1,0.$$

FACTOR DETERMINATION:

$$k_y = 1 - \frac{M_y \times N_{s:d}}{X_y \times A \times f_y} = 1 - \frac{-0,372 \times 440000}{0,9439 \times 5839 \times 355} = 1,084 > 0,9.$$

$$\mu_y = \bar{\lambda}_y \times (2 \times \beta_{My} - 4) = 0,31 \times (2 \times 1,4 - 4) = -0,372$$

$$k_z = 1 - \frac{M_z \times N_{s:d}}{X_z \times A \times f_y} = 1 - \frac{-0,372 \times 440000}{0,9439 \times 5839 \times 355} = -1,084 < 0,9.$$

$$\mu_z = \bar{\lambda}_z \times (2 \times \beta_{Mz} - 4) = 0,31 \times (2 \times 1,4 - 4) = -0,372$$

$$u.c. = \frac{440 \cdot 10^3}{0,9439 \times 5839 \times 355 / 1,1} + \frac{1,084 \times 18,4 \cdot 10^6}{328055 \times 355 / 1,1} + \frac{1,084 \times 6,3 \cdot 10^6}{328055 \times 355 / 1,1} = 0,25 + 0,19 + 0,07 = 0,51 < 1,0.$$

Opgesteld :
MPI

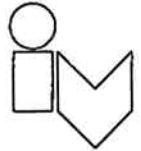
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Bladnummer :
6-5

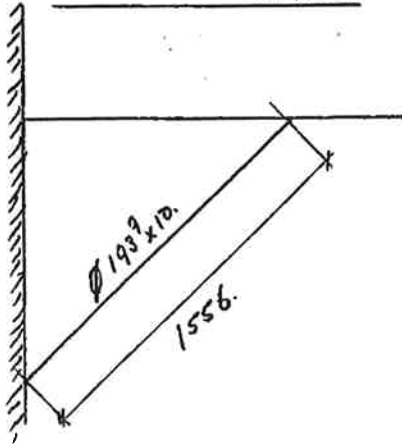
Rev. :
0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS



GOVERNING SUPPORT



$$N_{c:s;d} = 56,25 \text{ kN.}$$

PROFILE : $193^2 \times 10$.

CORROSION ALLOWANCE : 2 mm OF THE THICKNESS

PROFILE AFTER CORROSION DEDUCTION : $\phi 189^2 \times 8$

$$\lambda = \frac{1556}{64,26} = 24,21$$

$$\lambda_1 = 93,9 \times \epsilon = 93,9 \times 0,81 = 76,1$$

$$\epsilon = \left(\frac{235}{355}\right)^{0,5} = 0,81$$

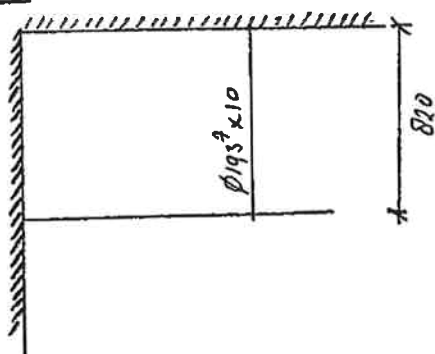
$$\bar{\lambda} = \frac{\lambda}{\lambda_1} = \frac{24,21}{76,1} = 0,32$$

$$X = 0,93$$

$$N_{b;Rd} = \frac{X \times B_n \times A \times f_y}{\gamma_{M1}} = \frac{0,93 \times 1,0 \times 4563 \times 355}{1,1} = 1428 \text{ kN.}$$

$$u.c. = \frac{56,25}{1428} = 0,04 < 1,0.$$

NOTE:



$$l = 820 \text{ mm} < 1556 \text{ mm.}$$

$$N_{c:s;d} = 25,82 \text{ kN.} < 56,25 \text{ kN.}$$

NOT GOVERNING.

Opgesteld :
mp1

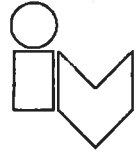
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15-4-'14

Bladnummer :
G-6

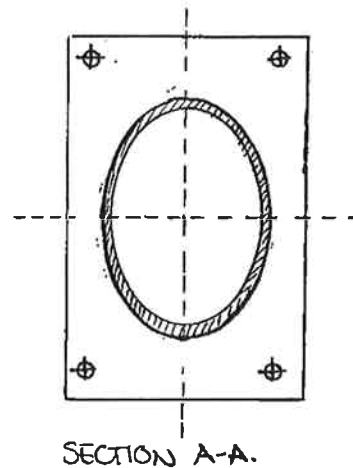
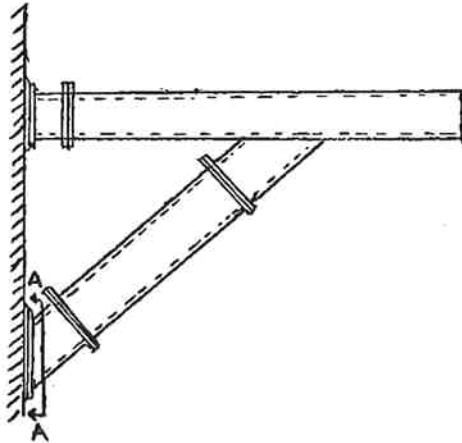
Rev. :
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Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS



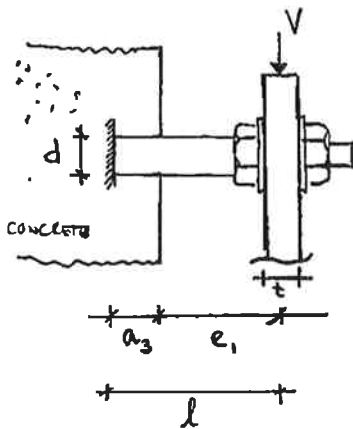
ANCHOR CALCULATION



4 x M20 8.8.

FOR THE CHECK OF THE CONNECTION IS THE SHEAR FORCE GOVERNING.

ANCHOR FAILURE CHECK acc. CUR 25.



$$V_{Rk,sm} = (\alpha_m \times M_{Rk,s}) / l = (2,0 \times 0,33 \cdot 10^6) / 35 = 18,86 \text{ kN}$$

with:
 $\alpha_m = 2,0$

$$l = a_3 + e_1 = 10 + 25 = 35 \text{ mm}$$

$$a_3 = 0,5 \times d = 0,5 \times 20 = 10 \text{ mm}$$

$e_1 = \text{GROUTING SPACE} + \text{HAULT PLATE THICKNESS}$

$$= 20 + 1/2 \times 10 = 25 \text{ mm}$$

CHECK:

$$u.c. = \frac{V_s \cdot d \text{ per anchor}}{18,86}$$

$$= \frac{36 \text{ kN} / 4}{18,86} = 0,48 \leq 1,0$$

$$M_{Rk,s} = M_{Rk,s}^0 (1 - N_s \cdot d / N_{Rd,s}) = 0,33 \cdot 10^6 (1 - 0) = 0,33 \text{ kNm}$$

$$M_{Rk,s}^0 = 1,2 \times W_{el,anchor} \times f_y = 1,2 \times \left(\frac{1}{64} \times \pi \times 20^4 \right) \times 355 = 0,33 \text{ kNm}$$

$N_{Rd,s} \Rightarrow \text{NORMAL FORCES, NEGLECTABLE, DUE TO MOMENT.}$

Opgesteld :
mpi

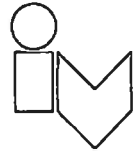
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Bladnummer :
G-7

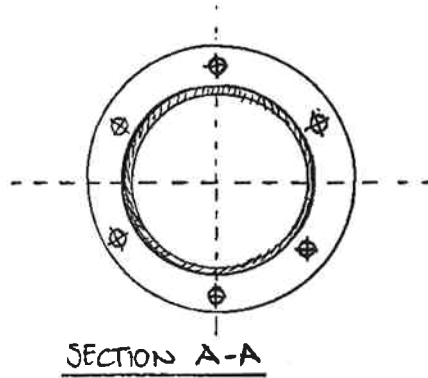
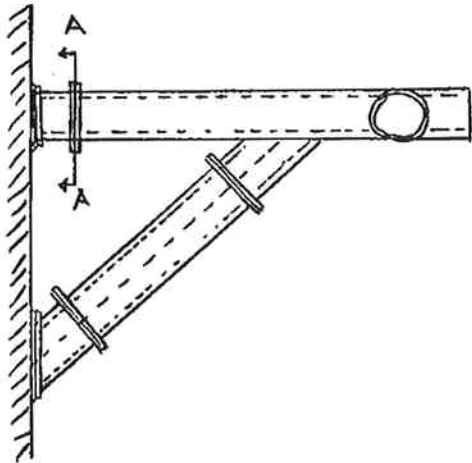
Rev. :
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Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS

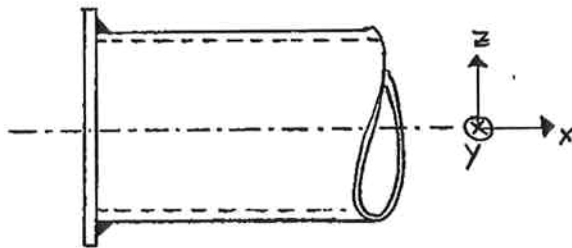


COUPLING :



NO TENSION,
BOLTS: PRACTICAL M20 8.8.
(APPLY ON EVERY COUPLING).

WELD PIPE-ENDPATE.



GOVERNING FORCES :

$V_z; \max = 12 \text{ kN}$ $M_z; s;d = 0,2 \text{ kNm}$

$V_y; \max = 1 \text{ kN}$ $M_y; s;d = 4,2 \text{ kNm}$

WELD

PRACTICAL : $a = 5 \text{ mm}$.

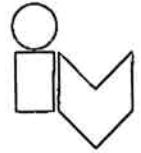
Opgesteld :
MPI

Datum :
15-4-'04

Bladnummer :
G-8

Rev. :
0

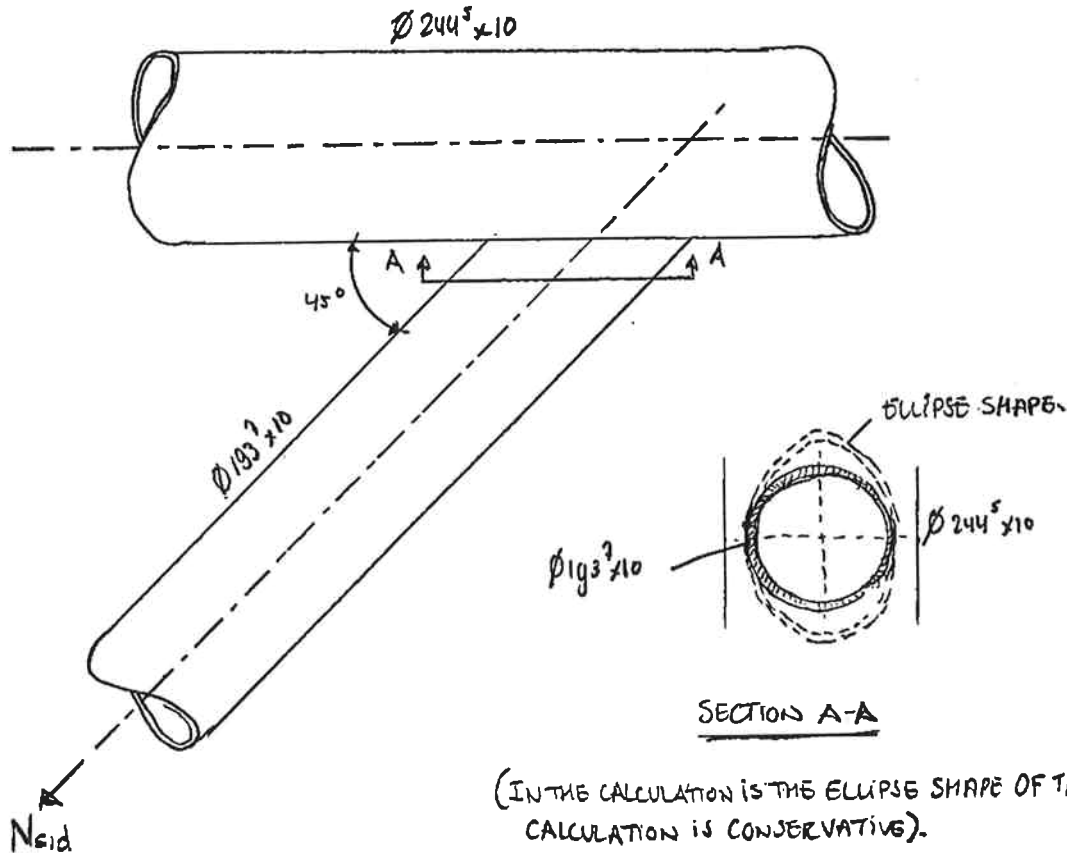
Project : MALAMOCCO NAV. LOCK GATE



Onderdeel : BUFFERS

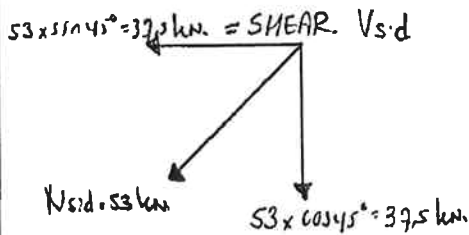
CHECK PIPE CONNECTION (PIPEWALL CHECK IS NOT GOVERNING).

WELD : $a = 5\text{mm}$ (IN CALCULATION $a = 4\text{mm}$; CORROSION ALLOWANCES).

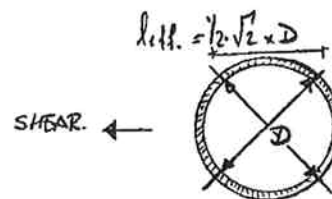


(IN THE CALCULATION IS THE ELLIPSE SHAPE OF THE PIPE NEGLECTED. CALCULATION IS CONSERVATIVE).

RESOLUTION OF FORCES:



SHEAR



$$l_{eff} = 2 \times \frac{1}{2} \sqrt{2} \cdot D$$

$$\tau = \frac{V_{s;d}}{\sqrt{2} \times D \times a}$$

$$= \frac{37,5 \cdot 10^3}{\sqrt{2} \times 193,7 \times 5} = 28 \text{ N/mm}^2$$

TENSION

$$\sigma = \tau = \frac{N_{t;s;d}}{A_{pipe}} \times \frac{t_{pipe}}{a \sqrt{2}} = \frac{37,5 \cdot 10^3}{165} \times \frac{8}{4 \sqrt{2}}$$

$$= 10 \text{ N/mm}^2$$

STRESS IN THE WELD

$$\sigma_{w;s;d} = \frac{1}{\sqrt{2}} \times \sqrt{10^2 + 3 \times 10^2 + 3 \times 28^2} = 30 \text{ N/mm}^2 < 262 \text{ N/mm}^2$$

$$M.C. = \frac{30}{262} = 0,12 < 1,0$$

Opgesteld : mpi

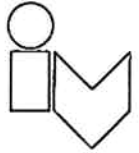
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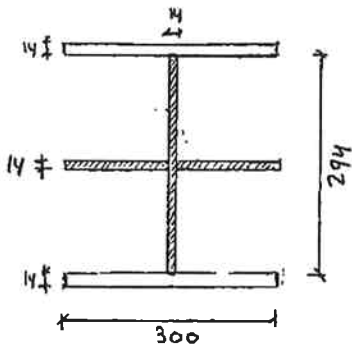
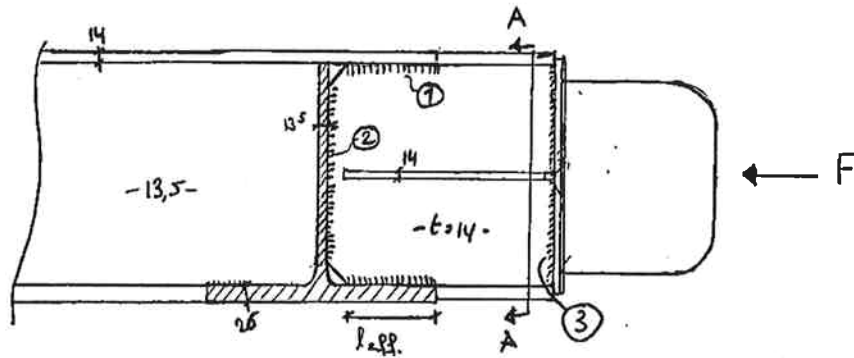
Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS



INTRODUCTION OF FORCES AT 1/2 HEA 650 AXIS SS



- WELD CHECK GOVERNING.

WELD SECTION ①

WE ASSUMED 75% OF 1/2 F OVER THE WELD. (BECAUSE OF CORROSION REDUCE THE WELD WITH 1mm).

$$F_d = 440 \text{ kN}$$

$$a = 5 \text{ mm}$$

$$\tau_z = \frac{0,75 F_s \cdot d / 2}{2 \times a \times l_{eff}} = \frac{0,75 \times (0,5 \times 440) \cdot 10^3}{2 \times (5-1) \times 116} = 178 \text{ N/mm}^2 < 262 \text{ N/mm}^2$$

$$l_{eff} = 116 \text{ mm}$$

WELD SECTION ②

WE ASSUMED 25% OF F OVER THE WELD.

$$F_d = 440 \text{ kN}$$

$$a = 5 \text{ mm}$$

$$\tau_{1,2} = \tau_s = \frac{0,25 F_s \cdot d \times \sqrt{2}}{4 \times a \times l_{eff}} = \frac{0,25 \times 440 \cdot 10^3 \sqrt{2}}{4 \times (5-1) \times 294} = 30 \text{ N/mm}^2$$

$$\sigma_{w:s:cl} = \frac{1}{\sqrt{3}} \times \sqrt{4 \times 30^2} = 85 \text{ N/mm}^2 < 262 \text{ N/mm}^2$$

Opgesteld : MP1

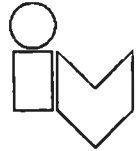
Datum : 15-4-'04

Bladnummer : G-10

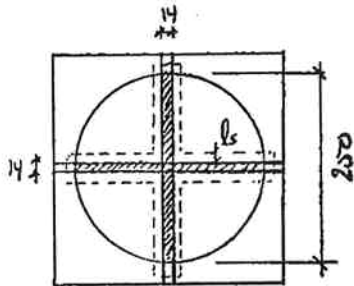
Rev. : 0

Project : MALAMOCLO NAV. LOCK. GATE

Onderdeel : BUFFERS



SECTION ③



DETERMINATION OF SPREADING ZONE:

$$l_s = t_p \times \sqrt{\frac{3 \times \sigma_p}{f_{jR}}} = (14-2) \times \sqrt{\frac{355/1,1}{3 \times 20}} = 27,5 \text{ mm}$$

$$f_{jR} = 20 \text{ N/mm}^2 ; \text{ ALLOWABLE RUBBER STRESS. } \left(\frac{22 \text{ N/mm}^2}{1,1} \right)$$

COMPRESSION ZONE:

$$A_c = (2 \times 250 \times (2 \times 27,8 + 12)) - (2 \times 27,8 + 12)^2 = 29230 \text{ mm}^2$$

$$\sigma_{rubber} = \frac{F_j}{A_c} = \frac{440 \cdot 10^3}{29230} = 15 \text{ N/mm}^2 < 20 \text{ N/mm}^2$$

WELD

$$F_j = 440 \text{ kN}$$

$$\sigma_1 = \tau_1 = \frac{\sigma_{rubber} \times B}{2 \times a} = \frac{15 \times (27,8 \times 2 + 12)}{2 \times 4} = 127 \text{ N/mm}^2$$

$$a = 5 \text{ mm (USE } a = 4 \text{ mm)}$$

$$\text{SHEAR} = 22 \text{ kN}$$

$$\tau_2 = \frac{F_s \cdot d}{2 \times a \times l_{eff}} \Rightarrow \frac{22 \cdot 10^3}{2 \times 4 \times 250} = 11 \text{ N/mm}^2$$

$$\sigma_{weld} = \frac{1}{\sqrt{3}} \times \sqrt{4 \times 127^2 + 3 \times 11^2} = 147 \text{ N/mm}^2 < 262 \text{ N/mm}^2$$

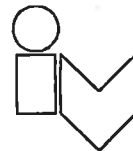
Opgesteld : MPI

Datum : 15-4-2014

Bladnummer : G-11

Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE



Onderdeel : BUFFERS

CHECK PLATE

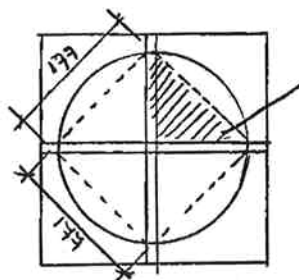
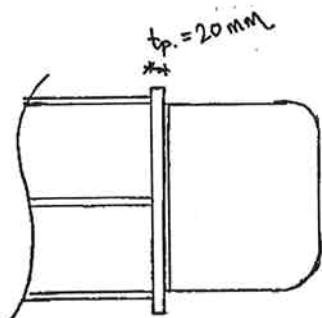
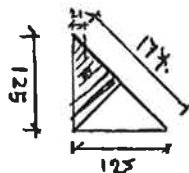


PLATE WITH TWO EDGES SIMPLY SUPPORTED AND TWO EDGES FREE.

PLATE CHECK WITH AN UNIFORM DISTRIBUTED PRESSURE (q).



$$q = \frac{F}{A} = \frac{440 \cdot 10^2}{31329} = 14 \text{ N/mm}^2$$

$$A = 177 \times 177 = 31329 \text{ mm}^2$$

$$M = 21 \times 14 \times \left(\frac{1}{2} \times 125 \times \frac{125}{2} \right) = 1,15 \text{ kNm}$$

$$W = \frac{1}{6} \times 125 \times 125^2 = 6750 \text{ mm}^3$$

$$\sigma = \frac{M}{W} = \frac{1,15 \cdot 10^6}{6750} = 170 \text{ N/mm}^2 < 323 \text{ N/mm}^2$$

$$m.c. = \frac{170}{323} = 0,53 < 1,0$$

Opgesteld :
MPI

Datum :
15-4-'04

Bladnummer :
G-12

Rev. :
0

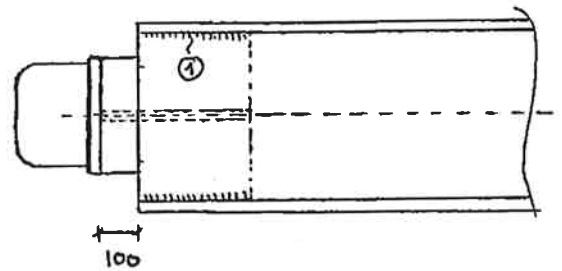
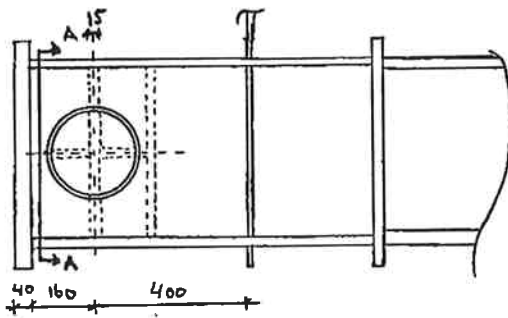
Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS



LOCAL INTRODUCTION OF FORCES. AT BUMPER BEAM.

FOR THE CHECK OF THE ENDPLATE AND RUBBER SEE INTRODUCTION OF FORCES AT 'L' HEA 650.



SECTION A-A

WELD 1

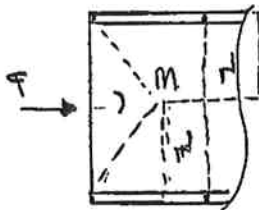
$$F = \frac{1}{2} \times 440 = 220 \text{ kN}$$

$$\tau_2 = \frac{F \cdot d}{2 \cdot a \cdot l_{\text{eff}}} \Rightarrow 262 = \frac{220 \cdot 10^3}{2 \cdot (5-1) \cdot l_{\text{eff}}}$$

$$l_{\text{eff}} = 105 \text{ mm} \Rightarrow \text{TAKE } l_{\text{eff}} = 150 \text{ mm}$$

$$\tau = \frac{220 \cdot 10^3}{2 \cdot (5-1) \cdot 150} = 183 \text{ N/mm}^2 \Rightarrow \tau_{\text{plate} \cdot 15} = \frac{2 \cdot (5-1)}{15-2} = 113 \text{ N/mm}^2 < \frac{355/\sqrt{5}}{1.1} = 186 \text{ N/mm}^2$$

CHECK PLATE



$$M = 'l_{\text{ux}} F \times d = '14 \times 440 \times 0,25 = 27,5 \text{ kNm}$$

$$W_{\text{plate}} = '16 \times 15 \times h^2 = 2,5 h^2$$

$$\sigma = \frac{M}{W} \Rightarrow \frac{27,5 \cdot 10^6}{2,5 h^2} \leq 355/1,1$$

$$h = \sqrt{\frac{27,5 \cdot 10^6}{2,5 \cdot 355/1,1}} = 185 \text{ mm}$$

$$\tau = \frac{F}{A} = \frac{440 \cdot 10^3}{h \times 15} \leq 186 \text{ N/mm}^2 \Rightarrow h = 158 \text{ mm}^2$$

TAKE $h = 250 \text{ mm}$. (ADAPT WELD CALCULATION WITH 250 mm)

Opgesteld : MPI

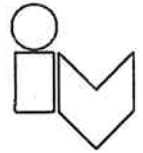
Datum : 15-4-'04

Bladnummer : G-13

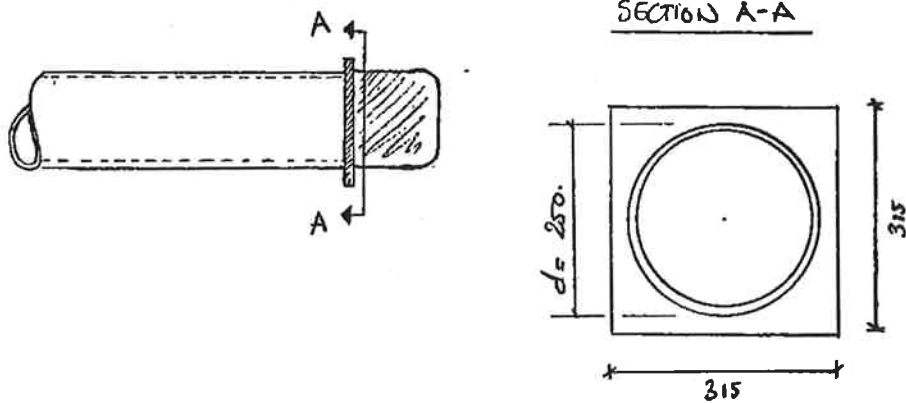
Rev. : 0

Project : MALAMOCCO NAV. LOCK GATE

Onderdeel : BUFFERS



CHECK ENDPLATE AT BUFFER PIPE



ENDPLATE IS SUPPORTED ALONG THE EDGE AND LOADED WITH A UNIFORMLY DISTRIBUTED PRESSURE. THE PLATE HAS TO BE CHECKED ON MAXIMUM STRESS AND DEFLECTION. THE CHECK IS MADE WITH FORMULA OF ROARK.

$$t = 25 \text{ mm} = 0,984 \text{ inch.} \Rightarrow \text{USE } t = 23 \text{ mm} = 0,906 \text{ inch.}$$

$$d = 250 \text{ mm} = 9,842 \text{ inch.} \Rightarrow a = 4,921 \text{ inch}$$

$$q = 1305 \text{ lb/inch}^2$$

$$D = \frac{30 \cdot 10^6 \times 0,906^3}{12 \times (1 - 0,3^2)} = 2043070$$

$$M_{\max} = \frac{q \times a^2}{16} \times (3 + \nu) = \frac{1305 \times 4,921^2}{16} \times (3 + 0,3) = 6518 \text{ in-lb/inch}$$

$$\sigma_{\max} = \frac{6 \times M_{\max}}{t^2} = \frac{6 \times 6518}{0,906^2} = 471644 \text{ lb/inch}^2 = 329 \text{ N/mm}^2 > \frac{345}{1,1} \text{ N/mm}^2 = 314 \text{ N/mm}^2$$

$$\text{TAKI } t = 30 \text{ mm.} \Rightarrow \sigma = 222 \text{ N/mm}^2 \text{ (} t = 30 - 2 = 28 \text{ mm)}$$

$$\text{DEFLECTION: } \frac{-q \times a^4}{64D} \times \frac{5 + \nu}{1 + \nu} = \frac{-1305 \times 4,921^4}{64 \times 2043070} \times \frac{5 + 0,3}{1 + 0,3} = 0,013 \text{ inch} = 0,33 \text{ mm.}$$

Opgesteld : MPI

Datum : 15-4-'04

Bladnummer : 6-14

Rev. : 0

Addendum H Control spaces

Contents

- H1 Control space**
- H2 Hydrojet working space**

Project : MALAMUCO LOCK VENICE

Onderdeel : CONTROL SPACES.



H1. CONTROL SPACES.

1. FLOOR PLATE & BEAMS _____ H1-1.
2. TOP PLATE _____ H1-5.
3. SIDE PLATES _____ H1-9.
4. ACCESS CONTROL SPACE _____ H1-17.

NOTE : REVISIONS ON THIS SECTION : [REF. H1-20]

- TRANSPORT LOADING CONDITION ADDED;
- PLATEWORK REDUCED TO 12mm'.
- CONNECTION DETAILS.

Opgesteld : G.W.J

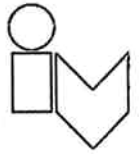
Datum : 12/03

Bladnummer : H1-INDEX A2

Rev. :

Project : MALAMOCO LOCK VENICE

Onderdeel : H1: CONTROL SPACES.



CONTROL ROOM.

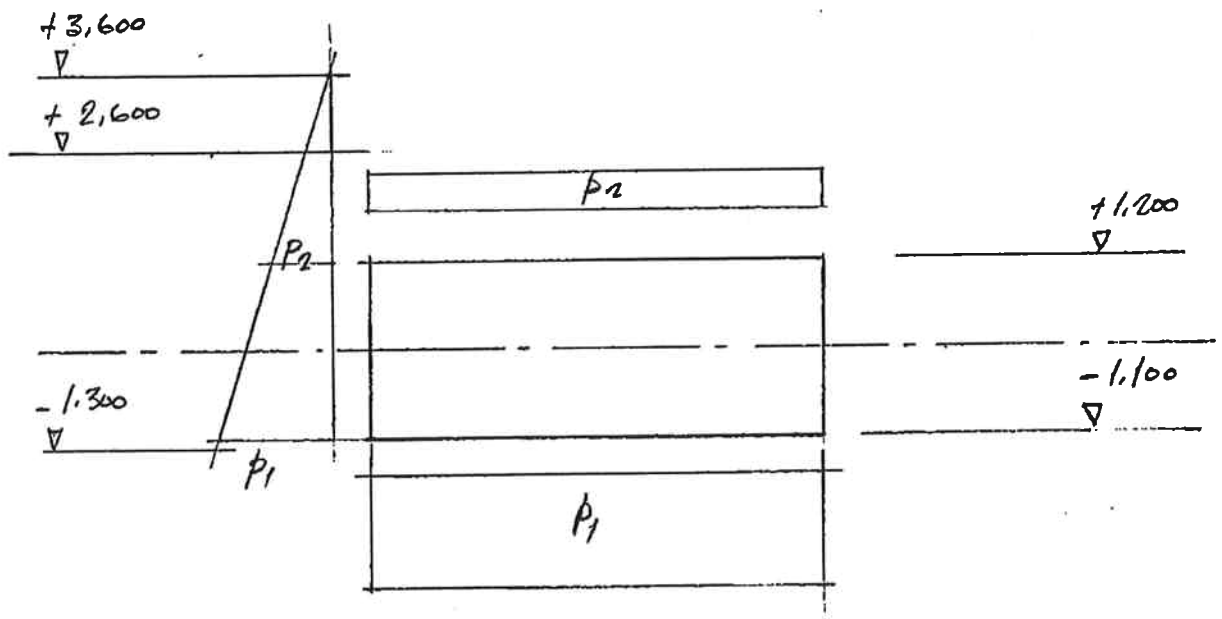
HYDROSTATIC LOADS.

WATER $\gamma = 10,3 \text{ kN/m}^3$.

MAX SWL = +2,60 m

MIN SWL = -1,30 m

MAX WAVE HEIGHT = 1,00 m



$p_1 = 4,7 * 10,3 = 48,4 \text{ kN/m}^2$

$p_2 = 2,4 * 10,3 = 24,7 \text{ kN/m}^2$

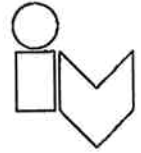
Opgesteld : GWJ

Datum : 12/03

Bladnummer : H1-1

Rev. : A2

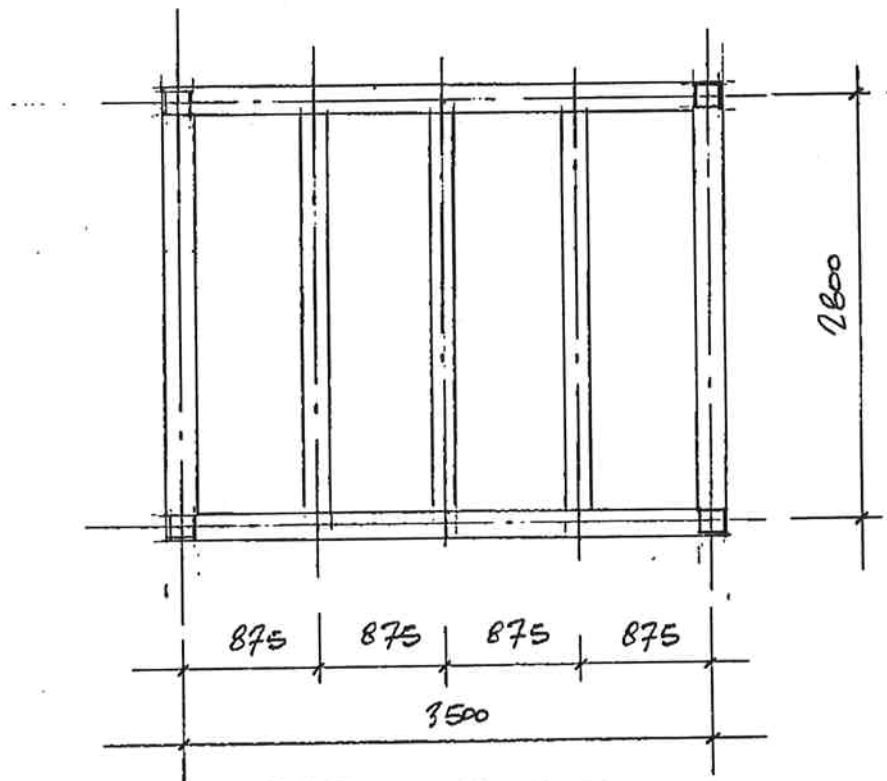
Project : MALAMOCCO LOCK VENICE



Onderdeel :

FLOOR LAYOUT.

WATER PRESSURE = 48.4 KN/m².



LOADING. KN/m²

FLOOR STEELWORK & GRATING

EQUIPMENT LOADS

SERVICES (MISC).

FLOOR LIVE.

DL	LL.
1.0	
~ 15.0	
0.5	
	4.0
16.5	4.0

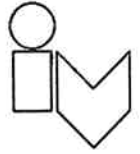
Opgesteld : GWJ

Datum : 01/04

Bladnummer : H1-2

Rev. : A2

Project : MALAMOCO LOCK VENICE



Onderdeel :

FLOOR PLATE.

USE 14mm PLATE ~ ALLOW 2mm CORROSION → 12mm PLATE.

WATER PRESSURE = 48,4 kN/m²

MAX FLOOR BEAM SPACING -

$$S = 100 t \sqrt{\frac{f_t}{\gamma_m \cdot 6 \cdot 8 \cdot 9}}$$

$$\text{FOR } t = 12\text{mm} \quad S = 100 \times 12 \sqrt{\frac{355}{1.1 \times 6 \times 1.5 \times 48.4}} = 1033\text{mm}$$

MAXIMUM ALLOWABLE $\delta = t/2 = 12/2 = 6\text{mm}$ $I = 14.4 \times 10^4 \text{mm}^4$

$$L = \sqrt[4]{\frac{768 \times \delta \times E \times I}{5 \times q}}$$

$$L = \sqrt[4]{\frac{768 \times 0,006 \times 2.1 \times 14.4}{5 \times 48.4}} = 0,87\text{m}$$

USE L = 875mm $\delta = 6.1\text{mm}$

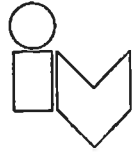
Opgesteld : GWJ

Datum : 01/04.

Bladnummer : H1-3

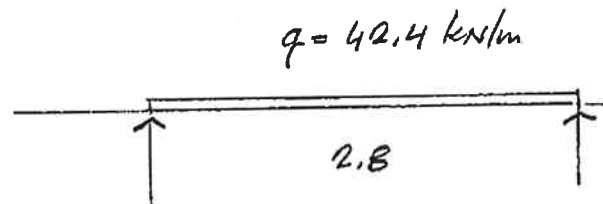
Rev. : A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

FLOOR BEAM.



$$q = 0.875 * 48.4 = 42.4 \text{ kN/m}$$

$$M = 42.4 * 2.8^2 / 8 = 41.6 \text{ kNm}$$

$$I_{REF} (L/300) = 1734 * 10^4 \text{ mm}^4$$

$$M_{SD} = 1.5 * 41.6 = 62.4 \text{ kNm}$$

$$W_{REF} = \frac{1.1 * 62.4 * 10^6}{355} = 194 * 10^3 \text{ mm}^3$$

USE HE180 B $I_y = 3831 * 10^4 \text{ mm}^4$ $W_y = 481.4 * 10^3 \text{ mm}^3$

$$\delta = \frac{5}{384} * \frac{42.4 * 2.8^4}{2.1 * 3831} * 10^3 = 4.2 \text{ mm}$$

GLOBAL DEFLECTION OF PLATE = $6.1 + 4.2 = \underline{10.3 \text{ mm}}$ L/270

NO ALLOWANCE MADE FOR CORROSION - HOWEVER, THE BEAM DEFLECTION IS CALCULATED CONSERVATIVELY SINCE THE POSITIVE EFFECT OF THE FLOOR GRAVITY LOADING HAS NOT BEEN UTILISED. \rightarrow HE180^B OK.

Opgesteld :

GWJ

Datum :

01/04

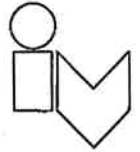
Bladnummer :

H1-4

Rev. :

12

Project : MALAMOCLO LOCK VENICE.



Onderdeel :

TOP PLATE Platework: made of 12 mm see Add. H1-24

USE 14 mm PLATE ~ ALLOW 2 mm CORROSION → 12 mm PLATE.

WATER PRESSURE 24.7 kN/m²

MAX STIFFENER SPACING -

$$L = 100 t \sqrt{\frac{f_y}{\gamma_M \phi \sigma}}$$

$$L = 100 \times 12 \sqrt{\frac{355}{1.1 \times 0.6 \times 1.5 \times 24.7}} = 1446 \text{ mm}$$

MAX ALLOWABLE $\delta = t/2 = 12/2 = 6 \text{ mm}$ $I = 14.4 \times 10^4 \text{ mm}^4$

$$L = \sqrt[4]{\frac{768 \times \delta \times E \times I}{5 \times q}}$$

$$L = \sqrt[4]{\frac{768 \times 0.006 \times 2.1 \times 14.4}{5 \times 24.7}} = 1.03 \text{ m}$$

USE L = 875 mm $\delta = 3.1 \text{ mm}$

Opgesteld :

GWJ

Datum :

01/04

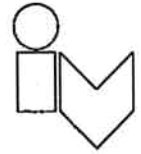
Bladnummer :

H1-5

Rev. :

A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

TOP PLATE STIFFENER

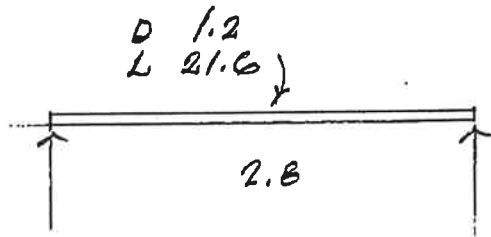
LOADING KN/m

SELFWEIGHT.

14mm PLATE. $0,875 \times 1,10 =$

HYDROSTATIC $0,875 \times 24,7 =$

DL	LL
0,2	
1,0	
	21,6
1,2	21,6



$$M = 22,8 \times 2,8^2 / 8 = 22,3 \text{ kNm}$$

$$I_{REQ} (L/300) = 990 \times 10^4 \text{ mm}^4$$

$$M_{SD} = 1,5 \times 22,3 = 33,5 \text{ kNm}$$

$$W_{REQ} = \frac{1,1 \times 33,5 \times 10^6}{355} = 103,8 \times 10^3 \text{ mm}^3$$

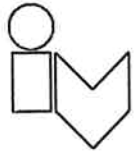
Opgesteld : GWJ

Datum : 01/04

Bladnummer : H1-6.

Rev. : A2

Project : MALAMOCO LOCK VENICE



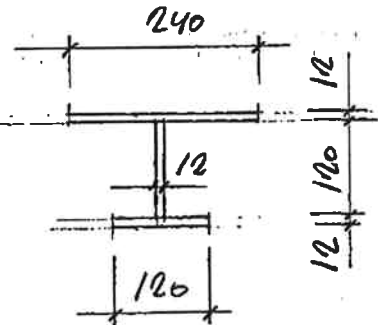
Onderdeel :

PROPERTIES IN CORRODED CONDITION.

AREA = 5760 mm² (REV. NEXT PAGE)

$$W_y = 215$$

$$I_y = 1903 \times 10^4 \text{ mm}^4$$



$$\delta = \frac{5}{384} \times \frac{22.8 \times 2.8^4}{2.1 \times 1903} \times 10^3 = 4.6 \text{ mm}$$

GLOBAL DEFLECTION OF PLATE $\Delta = 3.1 + 4.6 = 7.7 \text{ mm}$ L/360

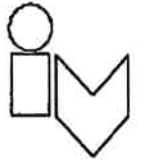
Opgesteld : GWJ

Datum : 01/04

Bladnummer : H1-7

Rev. : A2

Project : Malamocco Lock Venice



Part : Control Space
Top Plate Stiffener

Tee Stiffener

14 x 120mm (corroded condition)

Plate

Plate thickness	d	12.0 mm
Effective Flange width	B	240.0 mm

Tee

Web height	H	120 mm
Web thickness	t_w	12 mm
Flange width	W	120 mm
Flange thickness	t_f	12 mm

Section Properties

Section Area	A	5760 mm ²
Y Axis		
Moment of Inertia Y-Y	I_y	1903 E+4 mm ⁴
Section Modulus Y-Y	W_y	215 E+3 mm ³
Radius of Gyration Y-Y	i_y	57.5 mm
Extreme fibre Top	e_{y1}	55.5 mm
Extreme fibre Bottom	e_{y2}	88.5 mm

Prepared :
G W Jardine

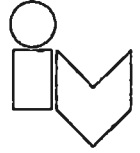
Date :
january 2004

Page number :
H1-B

Rev :

A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

TRY PROFILED PLATE. 750 PITCH 120 TROUGH * 14 THK

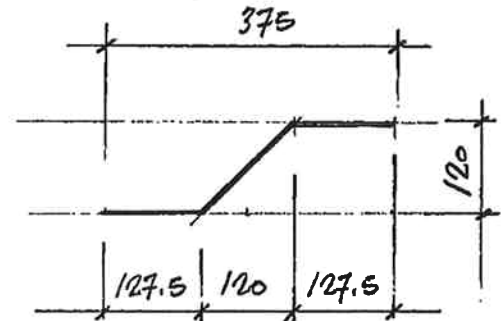
ALLOW 2mm CORROSION \rightarrow 12mm

$$A = 19809 \text{ mm}^2$$

$$W = 485,8 \times 10^3 \text{ mm}^3$$

$$I = 2915 \times 10^4 \text{ mm}^4$$

$$i = 86,39 \text{ mm}$$



$$f_y = 355 \text{ N/mm}^2$$

COMPRESSION

$$N = 67,8 \text{ kN}$$

$$N_{sd} = 1,5 \times 67,8 = 102 \text{ kN}$$

$$\lambda = \frac{2300}{86,39} = 26,6$$

$$\lambda_e = 76,4$$

$$\bar{\lambda} = \frac{26,6}{76,4} = 0,35$$

$$\chi = 0,923 (c)$$

$$N_{Rd} = 19,8 \times 355 = 7029 \text{ kN} \rightarrow \text{ok} \quad (\text{u.c. } 0,02)$$

FLEXURAL.

$$M_{sd} = 1,5 \times 21,2 = 31,8 \text{ kNm}$$

$$M_{Rd} = 0,4858 \times 355 = 172 \text{ kNm}$$

$$\sigma_a = \frac{1,1 \times 31,8 \times 10^3}{485,8} = 72 \text{ N/mm}^2$$

Opgesteld :

G.W.J

Datum :

01/04.

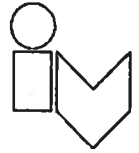
Bladnummer :

H1-10

Rev. :

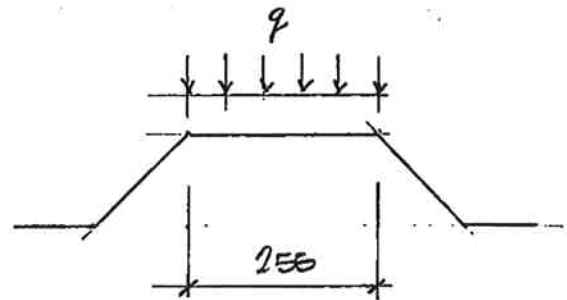
A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

LOCAL BENDING.



$$q = 37.2 \text{ kN/m}$$

$$M = 37.2 \times 0.255^2 / 10 = 0.24 \text{ kNm}$$

$$W = 1000 \times 12^2 / 6 = 24 \times 10^3 \text{ mm}^3$$

$$M_{sd} = 1.5 \times 0.24 = 0.36 \text{ kNm}$$

$$\sigma_d = \frac{1.1 \times 0.36 \times 10^3}{24} = 16.5 \text{ N/mm}^2$$

$$\text{COMBINED FLEXURAL } \sigma = 72 + 16.5 = 88.5 \text{ N/mm}^2$$

$$\text{u.c. } \frac{88.5}{355} = 0.25 < 1.0 \rightarrow \text{ok}$$

DEFLECTION

$$q_{AVE} = \frac{8 \times 21.2}{2.3^2} = 32.1 \text{ kN/m}$$

$$\delta = \frac{5}{384} \times \frac{32.1 \times 2.3^4}{2.1 \times 2915} \times 10^3 = 1.9 \text{ mm} \quad H/1200.$$

Opgesteld :

GWJ

Datum :

01/04.

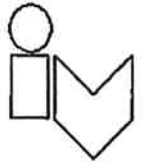
Bladnummer :

H1-11

Rev. :

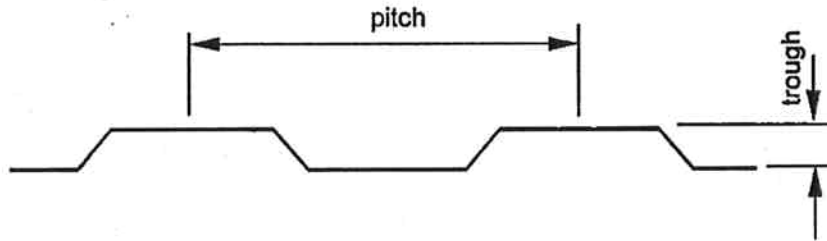
A2

Project : Malamocco Lock Venice



Part : Control Space
Profiled Plating

Profiled Plating - Dimensions & Properties



TYPE

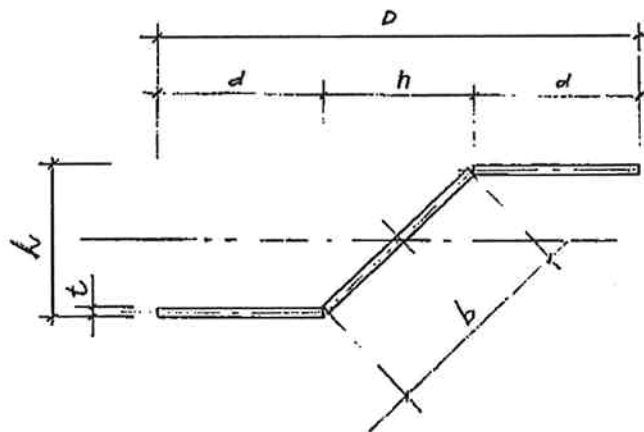
Pitch	mm	:	500	625	750	1000
Trough	mm	:	80	100	120	160
t	mm	:	12	12	12	12

DIMENSIONS

D	mm	:	250	312,5	375	500
h	mm	:	80	100	120	160
t	mm	:	10	10	10	10
d	mm	:	85	106,25	127,5	170
b	mm	:	103,1	131,4	159,7	216,2

PROPERTIES (per metre width)

A_g	mm^2	:	13110	13206	13286	13350
A_{net}	mm^2	:	10925	11005	11072	11125
G	kg/m^2	:	102,91	103,67	104,30	104,80
I	$x 10^4 mm^4$:	1023,1	1686,9	2516,8	4675,1
W	$x 10^3 mm^3$:	255,8	337,4	419,5	584,4
i	mm	:	56,27	71,99	87,73	119,24



Compiled :

G W Jardine

Date :

april 2003

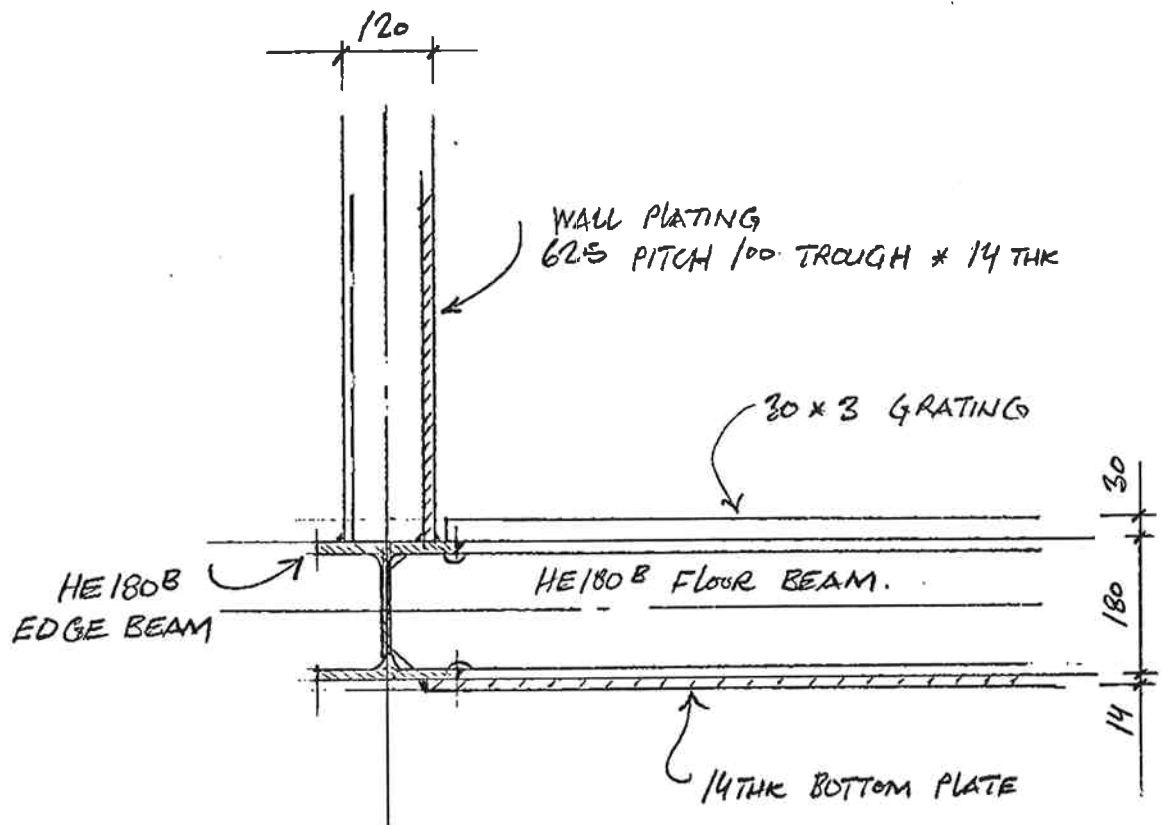
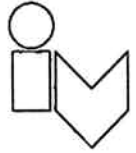
Page number :

Rev :

H1-12 A2

Project : MALAMOCCO. LOCK VENICE.

Onderdeel : CONTROL SPACE



EDGE DETAIL.

Opgesteld :
GWJ

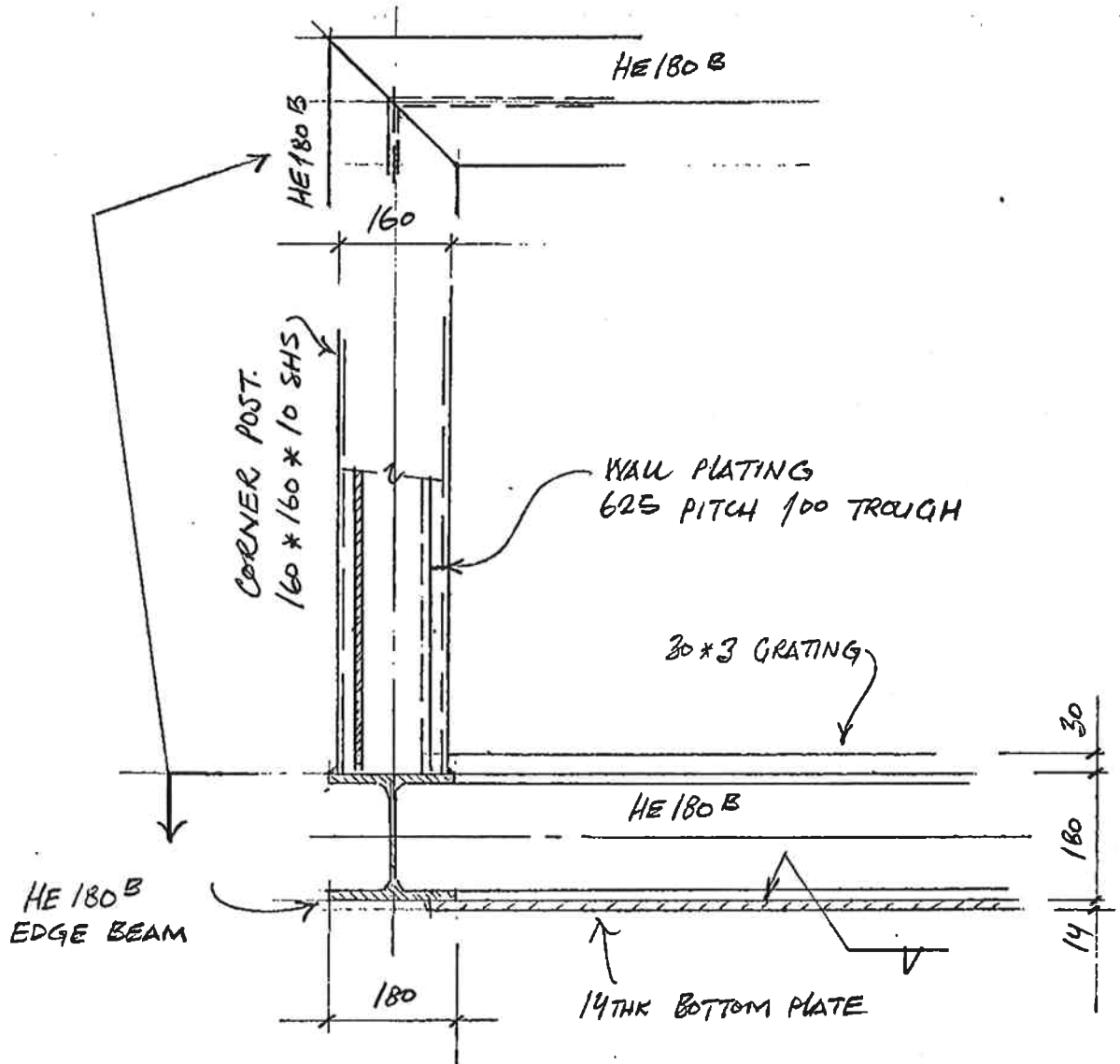
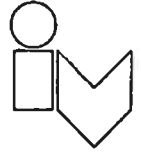
Datum :
12/03

Bladnummer :
H1-13

Rev. :
A2

Project : MALAMOCCO. LOCK VENICE

Onderdeel : CONTROL SPACE



CORNER EDGE DETAIL.

Opgesteld : *GW*

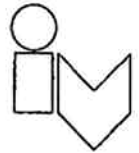
Datum : *12/03*

Bladnummer : *H1-14*

Rev. : *A2*

Project : MALAMOCCO LOCK VENICE

Onderdeel : CONTROL SPACE



BUOYANCY FORCES

ESTIMATED MASS OF CONTAINER -

LENGTH 3500 mm

WIDTH 2800 mm

HEIGHT 2300 mm

ROOF

HE 180 B $2 \times 3,68 \times 51,2 = 377$
 $2 \times 2,98 \times 51,2 = 306$

HE 140 B $3 \times 2,80 \times 33,7 = 283$

14 THK PLATE $3,5 \times 2,8 \times 110 = 1078$

2044 kg

FLOOR

HE 180 B $2 \times 3,68 \times 51,2 = 377$
 $2 \times 2,98 \times 51,2 = 306$
 $2 \times 2,80 \times 51,2 = 287$

14 THK PLT $3,5 \times 2,8 \times 110 = 1078$

GRATING $3,5 \times 2,8 \times 30 = 294$

2342 kg

CORNER POSTS

100 x 10.0 ∇ $4 \times 2,14 \times 46,3 = 397$

397 kg

Opgesteld :

GWJ

Datum :

12/03

Bladnummer :

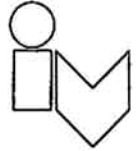
H1-15

Rev. :

A2

Project : MALAMOCCO LOCK VENICE

Onderdeel : CONTROL SPACE



WALL PLATING

625 PITCH 100 TROUGH * 14 THK (150 kg/m²)

$$2 * 3,34 * 1,96 * 150 = 1964$$

$$2 * 2,64 * 1,96 * 150 = 1553$$

3517 kg

CONTAINER MASS = 8300 kg.

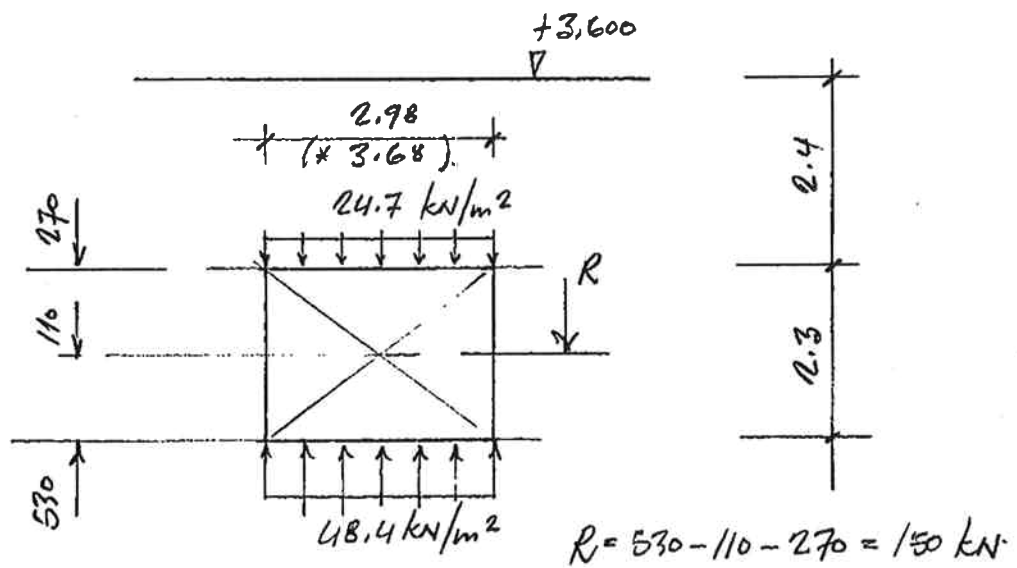
EQUIPMENT ~ = 3000 kg.

11300 kg

DRY LOADING → USE 12000 kg.

WET LOADING → USE 11000 kg.

BUOYANCY.



Opgesteld : GWJ

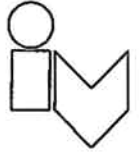
Datum : 12/03

Bladnummer : H1-16

Rev. : A2

Project : MAR. NAV. LOCK GATE

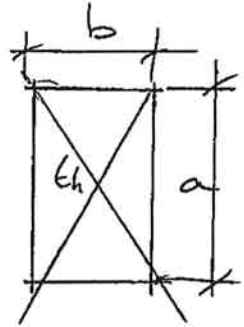
Onderdeel : CONTROL SPACES.



CHECK PLATE THICKNESS.

$$t_h \text{ PLATE} = 12 \text{ mm}^1 \text{ (10 calc.)}$$

$$\text{FREE PLATE AREA} = a \times b = 1600 \times 600.$$



LOAD

$$\text{WATER PRESSURE} : q_{\text{wid.}} = \gamma \cdot \Delta h \cdot \rho_w.$$

$$\Delta h = 3,6 + 1,0 = 4,6 \text{ m}^1.$$

$$q_{\text{wid.}} = 1,5 \cdot 4,6 \cdot 10,3 = 7,11 \text{ kN/m}^2.$$

CHECK ACC.; ROARK; FORMULAS FOR STRESS AND STRAIN TABLE

$$\text{PLATE STRESS: } \sigma_b = \frac{\beta q_{\text{wid.}} \cdot b^2}{t_h^2} = \frac{0,6493 \cdot 7,11 \cdot 0,6^2}{0,012^2} = 174 \text{ N/mm}^2$$

$$\text{(} a/b = 2,67 \Rightarrow \beta = 0,6493 \text{)}$$

$$\text{u.c.} = 174 \cdot 1,1 / 355 = 0,54 < 1,0 \text{ OK}$$

$$\text{WELD CONNECTION: } R_{\text{weld}} = \gamma \cdot q_b.$$

$$= 0,504 \cdot 7,11 \cdot 0,6 = 2,2 \text{ N/mm}^1$$

weld: 12,5 sufficient, OK.

Opgesteld : AL SAMGEEST

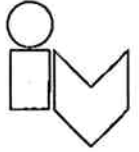
Datum : 02-07-04

Bladnummer : 47-18.

Rev. : A2.

Project : MAL. NAV. LOCK GATE.

Onderdeel : CONTROL SPACES.



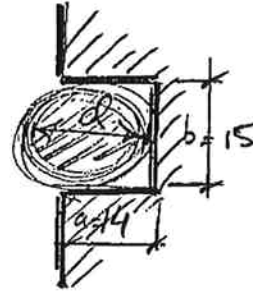
CHECK CONNECTION:

$$d_{ring} = 16 \text{ mm}.$$

$$A_{ring} = \frac{1}{4} \pi d^2 \\ = 201 \text{ mm}^2.$$

$$SPACING = 14 \times 15 \text{ mm}^2.$$

$$A_s = 210 \text{ mm}^2.$$



CHECKS $d_{ring} > a ; 16 > 14 \text{ OK.}$

$$d_{ring} > b ; 16 > 15 \text{ OK.}$$

$$A_{ring} \approx A_{spacing} ; 201 \approx 210 ; \text{OK.}$$

* BOLTED CONNECTION PRACTICAL; C. E. C. 200 mm'

FOR WATERTIGHTENING. OK.

* WELDS: ALL WELDS AS OK PRACTICAL.

Opgesteld : ALSEMGEEST

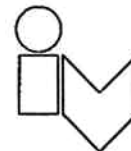
Datum : 02-07-84.

Bladnummer : 117-19.

Rev. : AR

Project : MALAMOCLO LOCK VENICE.

Onderdeel : CONTROL SPACE.



REVISION

1. TRANSPORT LOADING CONDITION ADDED.
2. PLATEWORK REDUCED TO 12mm

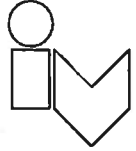
Opgesteld :
GWJ

Datum :

Bladnummer :
11 20. A2

Rev. :

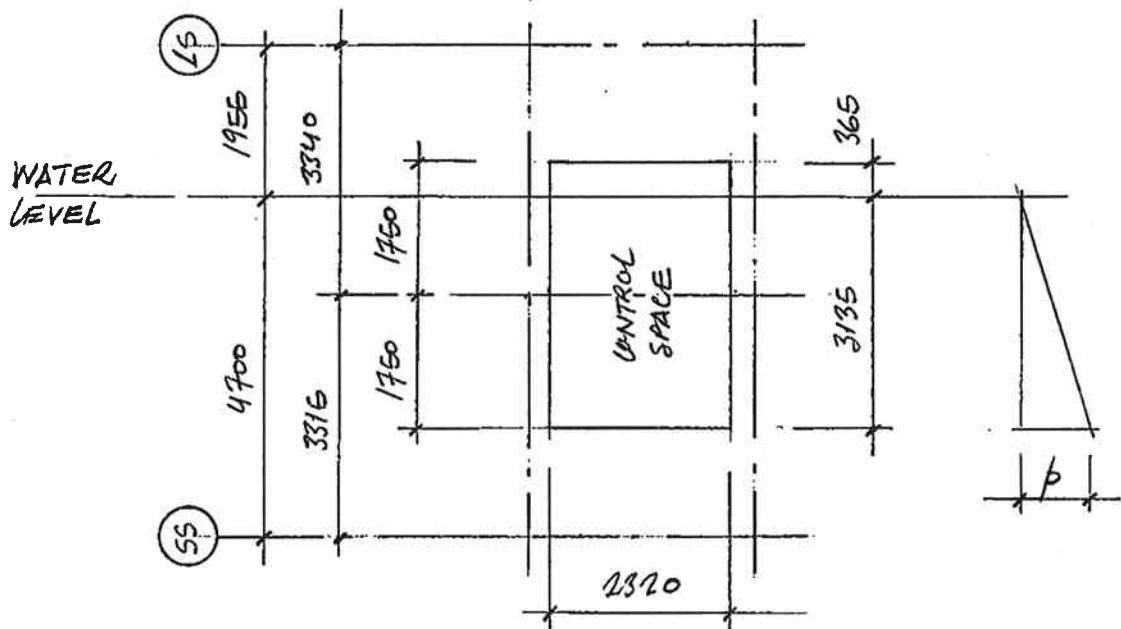
Project : MALAMOCLO LOCK VENICE.



Onderdeel :

CONTROL SPACE

TRANSPORT LOADING



$$\rho = 10.3 \text{ kN/m}^3$$

$$p = 10.3 \times 3.135 = 32.3 \text{ kN/m}^2$$

$$\text{VOLUME SUBMERGED} = 2.3 \times 2.8 \times 3.2 = 20.6 \text{ m}^3$$

$$\text{BUOYANCY FORCE} = 20.6 \times 10.3 = 212 \text{ kN}$$

$$\text{MASS CONTAINER (EMPTY)} = 8000 \text{ kg} = 80 \text{ kN}$$

$$\text{RESULTANT UPWARD FORCE} = 212 - 80 = 132 \text{ kN}$$

Opgesteld : GWJ

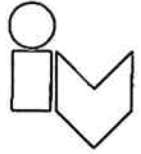
Datum :

Bladnummer : H1-21

Rev. : 2

Project :

Onderdeel :



HEAVE FORCES

BASED ON NOBLE DENTON CRITERIA :

HEAVE 5 m CONTAINER WEIGHT = 120 kN.
CYCLE 10 sec
ACCELERATION 0.2g

$$F_{\text{HEAVE}} = \frac{W}{9.81} \left\{ A * \left(\frac{2\pi}{T} \right)^2 \right\}$$
$$= \frac{120}{9.81} \left\{ 5 * \left(\frac{2\pi}{10} \right)^2 \right\} = 25 \text{ kN}$$

THIS FORCE WILL ACT ON THE CONTAINER SIDE WALLS
AS WATER PRESSURE AND WILL BE TRANSFERRED TO
THE MOUNTINGS VIA THE STIFF FRAMEWORK.

Opgesteld :

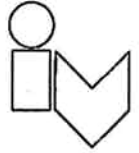
Datum :

Bladnummer :

Rev. :

H1-22, A2

Project : MALAMOUO LOCK VENICE



Onderdeel :

CONTROL SPACES

1. 12mm PLATE REDUCTION
2. TRANSPORT LOADING CONNECTION FORCES
3. CONNECTION DETAIL

Opgesteld :

GWJ

Datum :

4/04

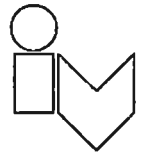
Bladnummer :

H1-23

Rev. :

A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

CHECK CONTAINER DESIGN FOR 12mm PLATING

1. BOTTOM PLATE.

ALLOW 1. mm SACRIFICIAL LAYER \rightarrow 11. mm

FLOOR BEAM SPACING 875 mm

$$q = 48.4 \text{ kN/m} \quad (\text{IGNORE SELFWEIGHT})$$

$$M = 1.5 \times 48.4 \times 0.875^2 / 10 = 5.6 \text{ kNm}$$

$$W = 1000 \times 11^2 / 6 = 20.2 \times 10^3 \text{ mm}^3$$

$$\sigma = \frac{5.6 \times 10^3}{20.2} = 278 \text{ N/mm}^2 \quad (0.86)$$

$$\delta = \frac{5 \times 48.4 \times 0.875^4 \times 10^3}{768 \times 2.1 \times 6.3} = 10.6 \text{ mm} \quad (L/83)$$

2. TOP PLATE.

$$\text{WATER } p = 24.7 \text{ kN/m}^2$$

$$\text{SELF WEIGHT} = 1.3 \text{ kN/m}^2$$

$$q = 26 \text{ kN/m} \quad \text{OPERATING}$$

$$q = 33 \text{ kN/m} \quad \text{TRANS PART.}$$

$$M = 1.5 \times 33 \times 0.875^2 / 10 = 3.8 \text{ kNm}$$

$$\sigma = \frac{3.8 \times 10^3}{20.2} = 188 \text{ N/mm}^2 \quad (0.58)$$

$$\delta = \frac{5 \times 26 \times 0.875^4 \times 10^3}{768 \times 2.1 \times 11.09} = 4.3 \text{ mm} \quad (L/203)$$

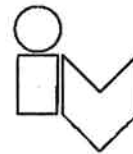
Opgesteld : GWJ

Datum : 4/04

Bladnummer : H1-24

Rev. : A2

Project : MALAMOCLO LOCK VENICE.



Onderdeel :

SIDE PLATE.

TRY PROFILED PLATE 750 PITCH 120 TROUGH 12mm THICK

PLATE PROPERTIES (CORRODED TO 10mm)

PER 1m WIDTH

$$A_{net} = 16587 \text{ mm}^2$$

$$W = 419,5 \times 10^3 \text{ mm}^3$$

$$i = 87,73 \text{ mm}$$

$$I = 2516,8 \times 10^4 \text{ mm}^4$$

$$q = 48,4 \text{ kN/m} \quad \text{OPERATING.} \quad M_{max} = 21,2 \text{ kNm}$$

$$q = 24,4 \text{ kN/m} \quad \text{TRANSPORT.} \quad M_{max} = 16,1 \text{ kNm}$$

$$\sigma_{sd} = \frac{1,5 \times 21,2 \times 10^3}{419,5} = 76 \text{ N/mm}^2 \quad (0,24)$$

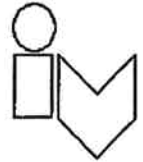
$$\delta = \frac{5 \times 32,1 \times 2,34 \times 10^3}{384 \times 2,1 \times 2516,8} = 2,2 \text{ mm} \quad (L/1039)$$

Opgesteld : GWJ

Datum : 4/04

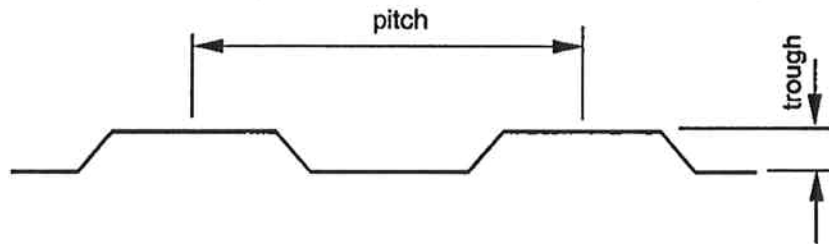
Bladnummer : 41-25 Rev. : A2

Project : Malamocco Lock Venice



Part : Control Space
 Profiled Plating

Profiled Plating - Dimensions & Properties



TYPE

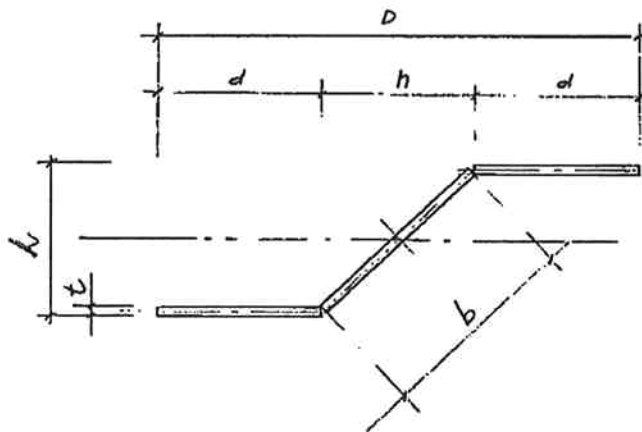
Pitch	mm	:	500	625	750	1000
Trough	mm	:	80	100	120	160
t	mm	:	12	12	12	12

DIMENSIONS

D	mm	:	250	312,5	375	500
h	mm	:	80	100	120	160
t	mm	:	10	10	10	10
d	mm	:	85	106,25	127,5	170
b	mm	:	103,1	131,4	159,7	216,2

PROPERTIES (per metre width)

A_g	mm ²	:	13110	16507	19905	26700
A_{net}	mm ²	:	10925	13756	16587	22250
G	kg/m ²	:	102,91	129,58	156,25	209,59
$I \times 10^4$	mm ⁴	:	1023,1	1686,9	2516,8	4675,1
$W \times 10^3$	mm ³	:	255,8	337,4	419,5	584,4
i	mm	:	56,27	71,99	87,73	119,24



Compiled :

G W Jardine

Date :

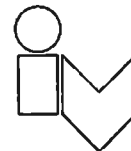
april 2003

Page number :

H1-26 A2

Rev :

Project : MALMOCCO LOCK VENICE

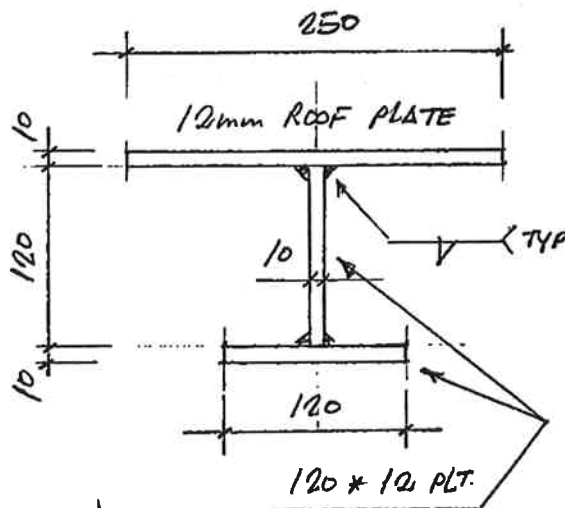


Onderdeel :

TOP PLATE STIFFENERS.

PROPERTIES (CORRODED)

AREA 4900 mm²
 Wy 179 * 10³ mm³
 Iy 1565 * 10⁴ mm⁴



$$q = 0.875 * 33 = 29 \text{ kN/m (TRANSPORT)}$$

$$M_{sd} = 1.5 * 29 * 2.8^2 / 8 = 42.63 \text{ kNm}$$

$$\sigma_{sd} = \frac{42.63 * 10^3}{179} = 238 \text{ N/mm}^2 \quad (0.74)$$

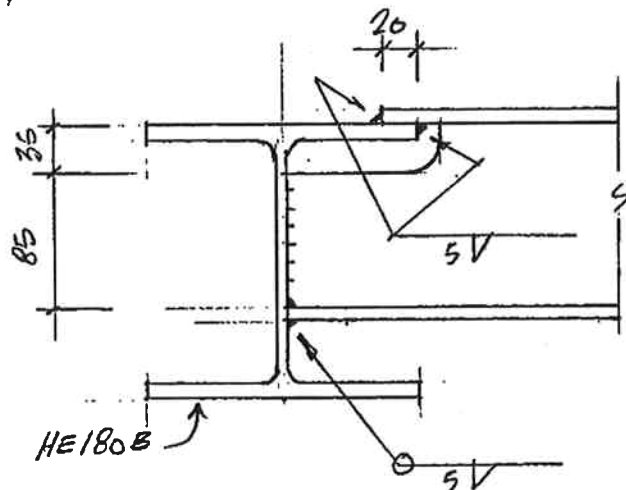
$$V_{sd} = \frac{1.5 * 29 * 2.8}{2} = 61 \text{ kN}$$

$$\tau_{sd} = \frac{61 * 10^3}{10 * 85} = 72 \text{ N/mm}^2 \quad (0.39)$$

DEFLECTION

$$q = 0.875 * 26 = 23 \text{ kN/m}$$

$$\delta = \frac{5 * 23 * 2.8^4 * 10^3}{384 * 2.1 * 1565} = 5.6 \text{ mm (L/500)}$$



Opgesteld : GWJ

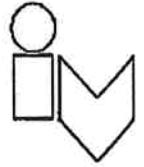
Datum : 6/04

Bladnummer :

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Rev. :

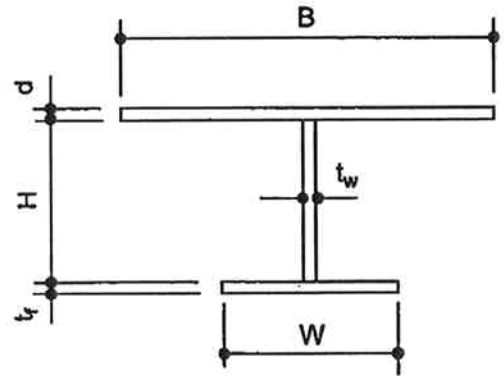
Project : Malamocco Lock Venice



Part : Control Space
Top Plate Stiffener

Tee Stiffener

12 x 120 mm
corroded condition



Plate

Plate thickness	d	10 mm
Effective Flange width	B	250 mm

Tee

Web height	H	120 mm
Web thickness	t_w	10 mm
Flange width	W	120 mm
Flange thickness	t_f	10 mm

Section Properties

Section Area	A	4900 mm ²
Y Axis		
Moment of Inertia Y-Y	I_y	1565 E+4 mm ⁴
Section Modulus Y-Y	W_{y1}	297 E+3 mm ³
	W_{y2}	179 E+3 mm ³
Extreme fibre Top	e_{y1}	52,8 mm
Extreme fibre Bottom	e_{y2}	87,2 mm
Radius of Gyration Y-Y	i_y	56,5 mm

Prepared :
G W Jardine

Date :
april 2004

Page number :

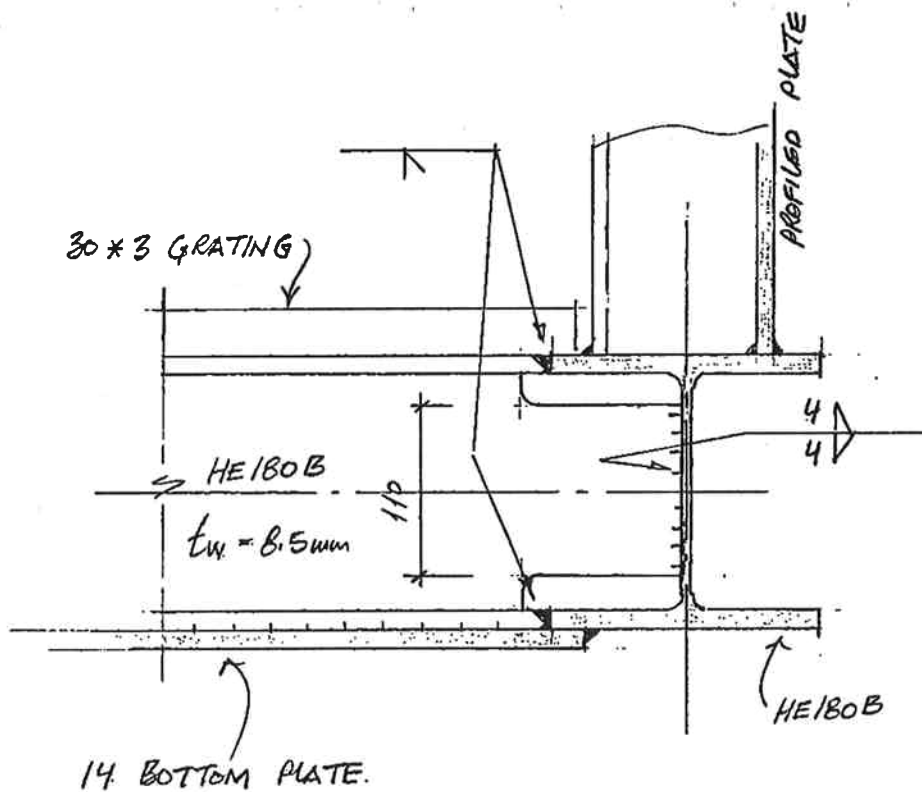
Rev :

11-28 A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :



WEB SHEAR

$$V = 42.4 \times 2.8 / 2 = 60 \text{ kN}$$

$$T_{\text{sol}} = \frac{1.5 \times 60 \times 10^3}{6.5 \times 110} = 126 \text{ N/mm}^2 \quad (0.68)$$

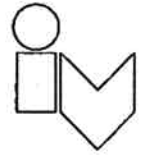
Opgesteld : GWJ

Datum : 4/04

Bladnummer : H1-29. A2

Rev. :

Project : MALAMOCCO LOCK VENICE



Onderdeel :

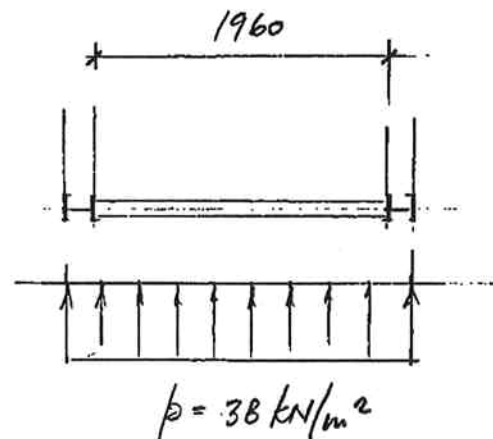
TORSION RESISTANCE OF HE180B WELDED FRAME.

$$p = 38 \text{ kN/m}^2 \text{ (TRANSPORT)}$$

FORCE ON PROFILED PLATE =

$$38 * 1.96 = 74.5 \text{ kN/m}$$

$$R = 74.5 / 2 = 38 \text{ kN/m}$$

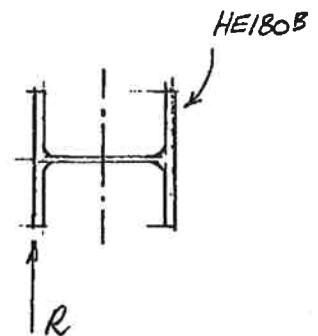


BEAM TORSION

$$T_w = 38 * 0.875 / 2 = 16.63 \text{ kNm}$$

$$W_{wl} = 278.9 * 10^3 \text{ mm}^3$$

$$T_{sd} = \frac{1.5 * 16.63 * 10^3}{278.9} = 90 \text{ N/mm}^2 \text{ (0.48)}$$

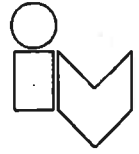


Opgesteld : GWJ

Datum : 4/04

Bladnummer : 1130, A2 Rev. :

Project : MALAMOUO LOCK VENICE



Onderdeel :

CONNECTION FORCES

TRANSPORT LOADING.

BUOYANCY 132 kN

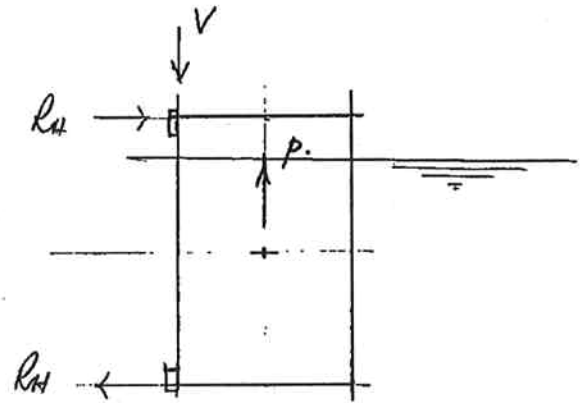
HEAVE 15 kN

$$P = 157 \text{ kN}$$

$$V = 157 \text{ kN}$$

$$M = 157 \times 2.3/2 = 181 \text{ kNm}$$

$$R_H = \pm 181/3.5 = \pm 52 \text{ kN}$$



BOLTS ~ M24 GR 8.8

3 * BOLTS PER FOOTING

$$V / \text{BOLT} = 157 / 6 = 26 \text{ kN}$$

$$T / \text{BOLT} = 52 / 6 = 9 \text{ kN} \rightarrow \boxed{\text{BOLTS OK}}$$

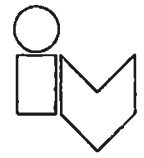
Opgesteld : GWJ

Datum : 4/04

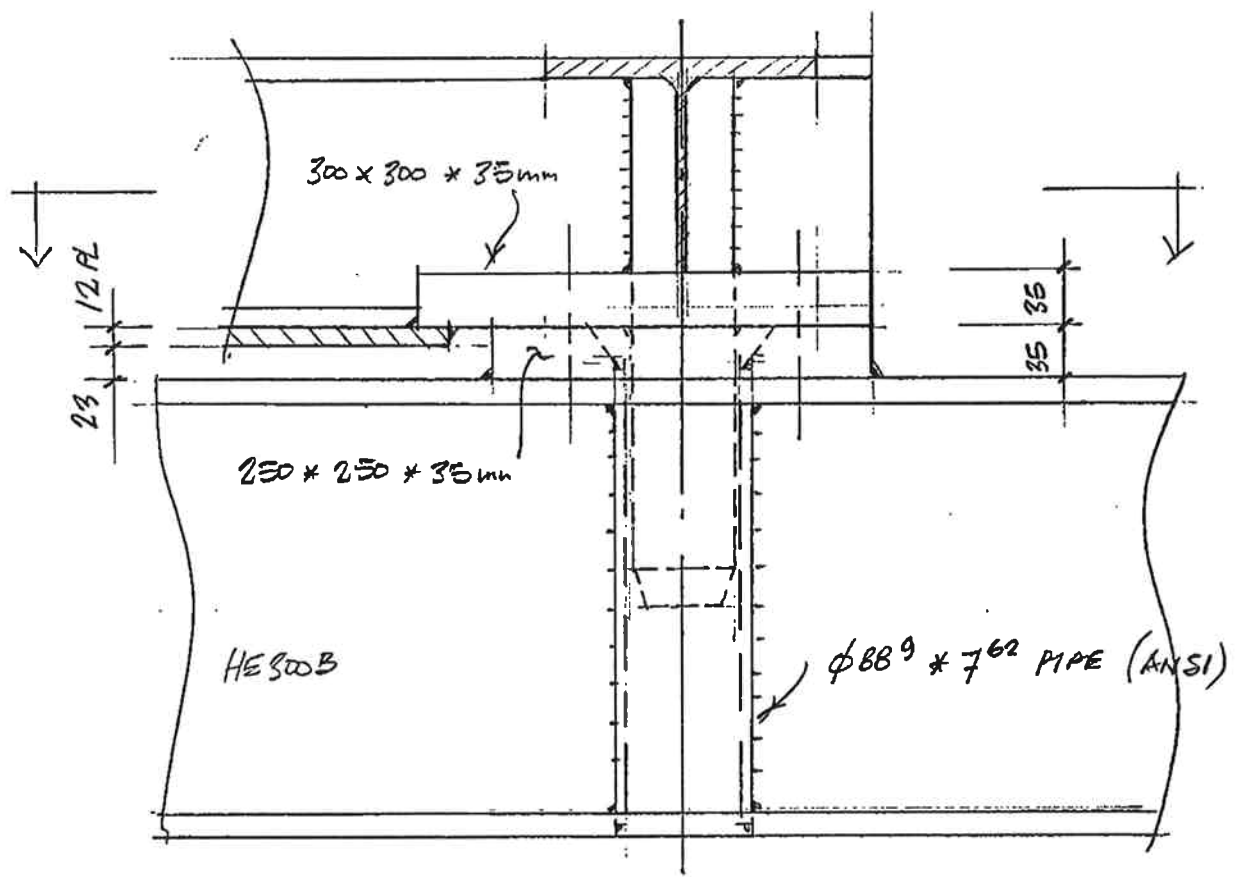
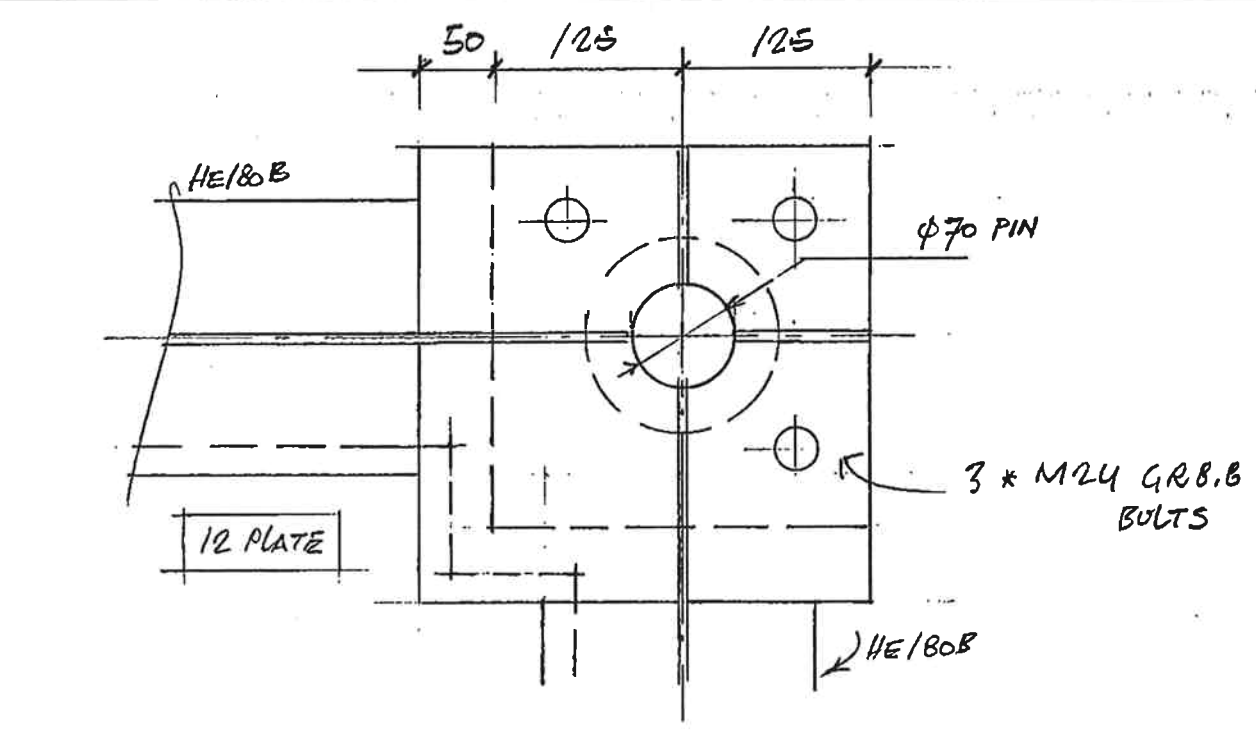
Bladnummer : 117-81

Rev. : A-2

Project : MALAMOCLO LOCK VENICE.



Onderdeel :



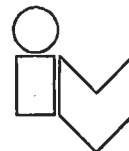
Opgesteld : *GWJ*

Datum : 4/04

Bladnummer : H1-31

Rev. : A2

Project : MALAMOCO LOCK VENICE



Onderdeel :

H2. WORKING AREA

1. ROOF PLATE + ACCESS HATCH _____ H2-1
2. FLOOR PLATE + FLOOR BEAMS _____ H2-10.
3. WALL PLATES _____ H2-13.
4. ROOF & FLOOR PLATES N IN-PLANE LOADING _____ H2-20.
5. WALL PLATE LINE 1+13 N IN-PLANE LOADING. _____ H2-28

NOTE : REVISION TO THIS SECTION : [REF. H2-32].

→ REVISION MEMBER FORCES FROM EPW.

→ TRANSPORT LOADING CONDITION ADDED.

→ PLATE THICKNESS WALLS + STIFF. REDUCED TO 12mm

→ ROAD RAMP SUPPORT DETAILS ADDED [H2-62]

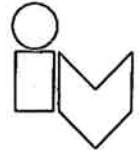
Opgesteld : GWJ

Datum : 01/04

Bladnummer : H2-INDEX A2

Rev. :

Project : MALAMOCCO LOCK VENICE.



Onderdeel : H2: HYDROJET WORKING SPACE

WORKING AREA.

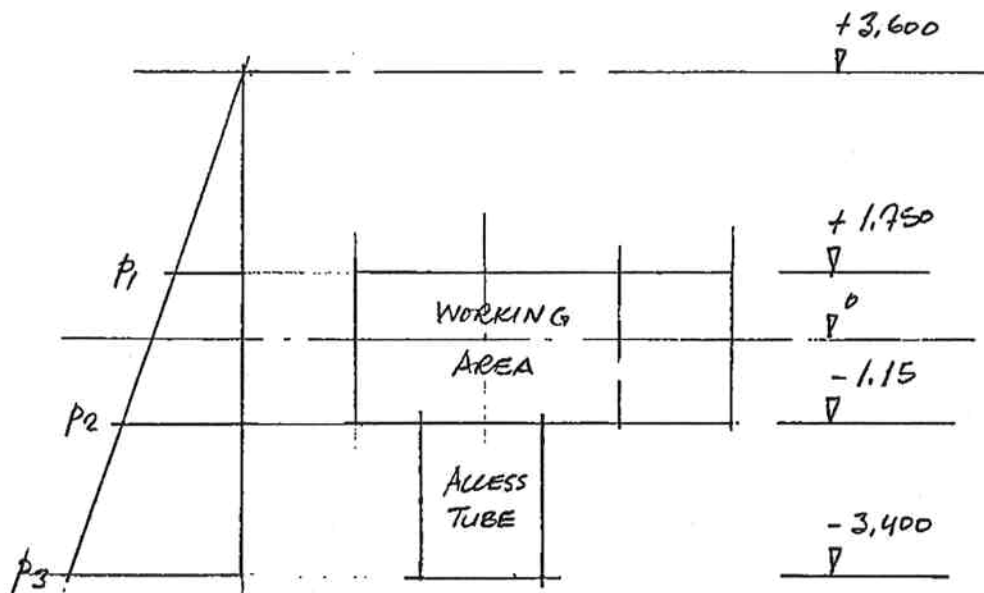
HYDROSTATIC LOADS

$$\text{WATER } \gamma = 10.3 \text{ kN/m}^3.$$

$$\text{MAX SWL} = +2.600 \text{ m}$$

$$\text{MIN SWL} = -1.300 \text{ m}$$

$$\text{MAX WAVE HEIGHT} = 1.00 \text{ m}$$



$$p_1 = 1.85 * 10.3 = 19.1 \text{ kN/m}^2$$

$$p_2 = 4.95 * 10.3 = 48.9 \text{ kN/m}^2$$

$$p_3 = 7.00 * 10.3 = 72.1 \text{ kN/m}^2$$

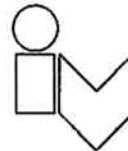
Opgesteld : GWJ

Datum : 01/04

Bladnummer : H2-1

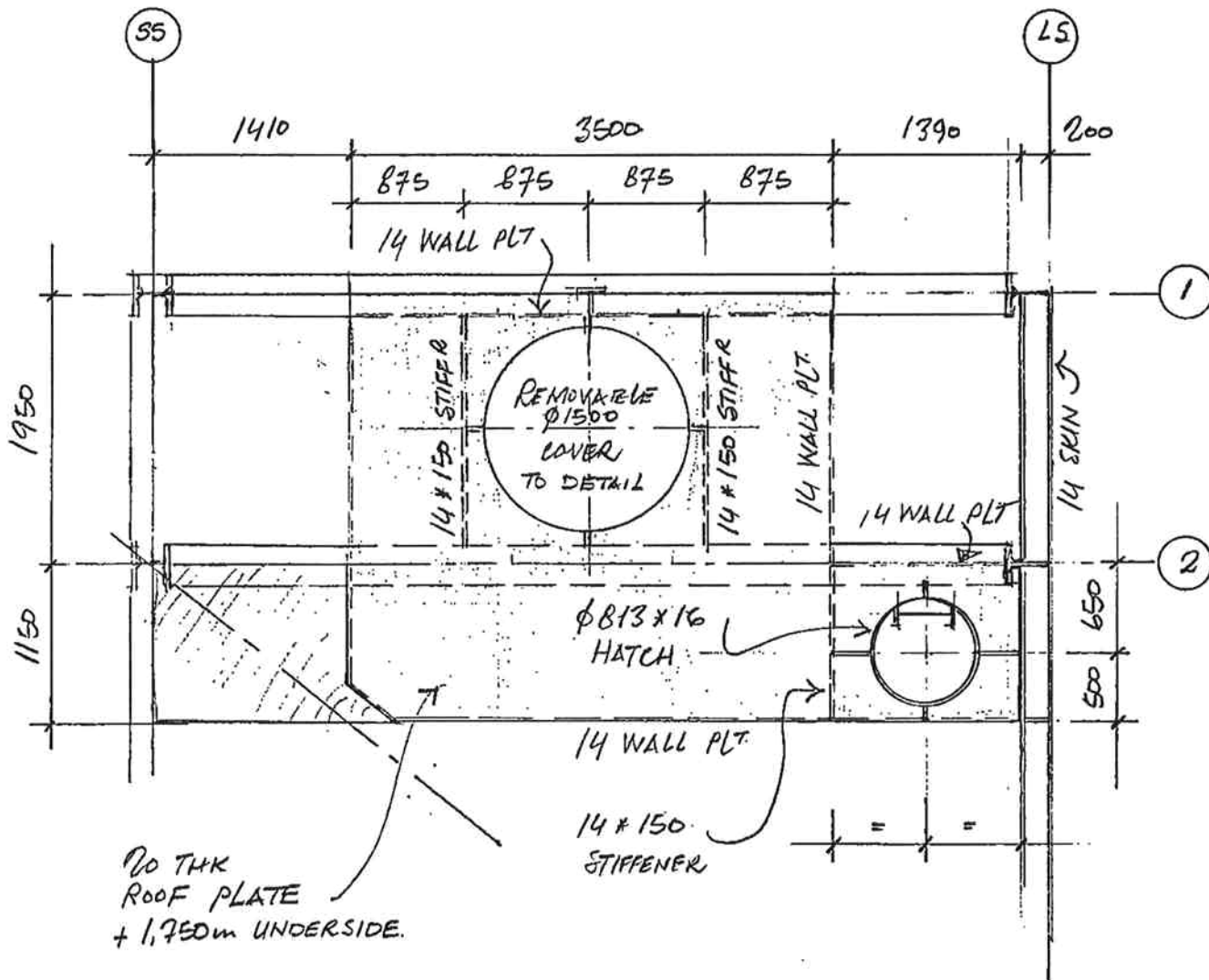
Rev.: A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

ROOF PLAN



(IN REVISION ALL PL. 14 \Rightarrow PL. 12)

Opgesteld : GWJ

Datum : 12/03

Bladnummer : H2-2

Rev. : A2

Project : MALAMOCO LOCK VENICE.



Onderdeel :

WORKING AREA

ROOF PLATE. (20mm)

LOADING. (KN/m²).

SELFWEIGHT.

HYDROSTATIC

DL.	LL.
1.6	
	19.1

USE 20mm PLATE N ALLOW 2mm CORROSION → 18mm PLATE

$$q = 1.6 + 19.1 = 20.7 \text{ KN/m}$$

MAX SPAN 18mm PLATE —

$$L = 100t \sqrt{\frac{fy}{\gamma_m \gamma q}}$$

$$L = 100 * 18 \sqrt{\frac{355}{1.1 * 1.5 * 20.7}} = 2369 \text{ mm}$$

MAX ALLOWABLE DEFLECTION = $t/2$

DEFLECTION LIMIT. = $18/2 = 9 \text{ mm}$

$$I = 1000 * 18^3 / 12 = 0.486 * 10^{-6} \text{ m}^4$$

Opgesteld :

GWJ

Datum :

12/03

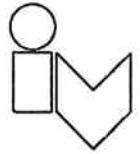
Bladnummer :

H2-3

Rev. :

A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :

$$L = \sqrt[4]{\frac{768 * \delta * E * I}{5 * q}}$$

$$L = \sqrt[4]{\frac{768 * 0,009 * 2.1 * 48.6}{5 * 20.7}} = 1.6 \text{ m} \Rightarrow 1600 \text{ mm}$$

MAX PLATE SPAN = 1200 mm (< 1600 → ok)

$$\text{PLATE } \delta = \frac{5}{768} * \frac{20.7 * 1.2^4}{2.1 * 48.6} * 10^3 = 2.7 \text{ mm} (< 9 \text{ mm } L/400)$$

STIFFENERS

SPAN 1950 mm

SPACING 1300 mm (MAX)

LOADING (KN/m)

SELFWEIGHT

20 mm PLATE $1.3 * 1.6 =$

HYDROSTATIC $1.3 * 19.1 =$

DL	LL
0.5	
2.1	
	24.8
2.6	25

Opgesteld : GWJ

Datum : 12/03

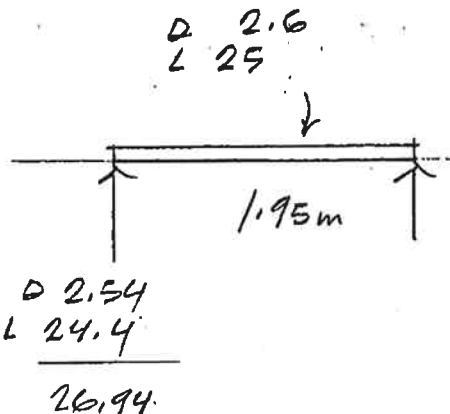
Bladnummer : H2-4

Rev. : A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :



$$M = 27.6 \times 1.95^2 / 8 = 13.1 \text{ kNm}$$

$$I_{REQ} (L/300) = 380 \times 10^4 \text{ mm}^4$$

$$M_{SD} = 1.5 \times 13.1 = 19.7 \text{ kNm}$$

$$W_{REQ} = \frac{1.1 \times 19.7 \times 10^6}{355} = 61.0 \times 10^3 \text{ mm}^3$$

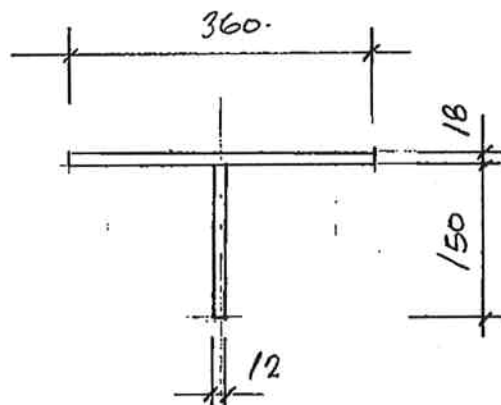
USE 14 * 150 mm FLAT.

CORRODED PROPERTIES

$$W = 96 \times 10^3 \text{ mm}^3$$

$$I = 1349 \times 10^4 \text{ mm}^4$$

DEFLECTION ok



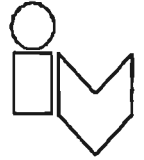
Opgesteld : GWJ

Datum : 12/03

Bladnummer : H2-5

Rev. : A2

Project : Malamocco Lock Venice



Part : Working Space
Roof Plate

Flat Stiffener

14 x 150mm (corroded condition)

Plate

Plate thickness	d	18.0 mm
Effective Flange width	B	360.0 mm

Flat

Height	H	150 mm
Thickness	t	12 mm

Section Properties

Section Area	A	8280 mm ²
Y Axis		
Moment of Inertia Y-Y	I_y	1349 E+4 mm ⁴
Section Modulus Y-Y	W_y	96 E+3 mm ³
Radius of Gyration Y-Y	i_y	40.4 mm
Extreme fibre Top	e_{y1}	27.3 mm
Extreme fibre Bottom	e_{y2}	140.7 mm

Prepared :

G W Jardine

Date :

january 2004

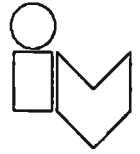
Page number :

H2-6

Rev :

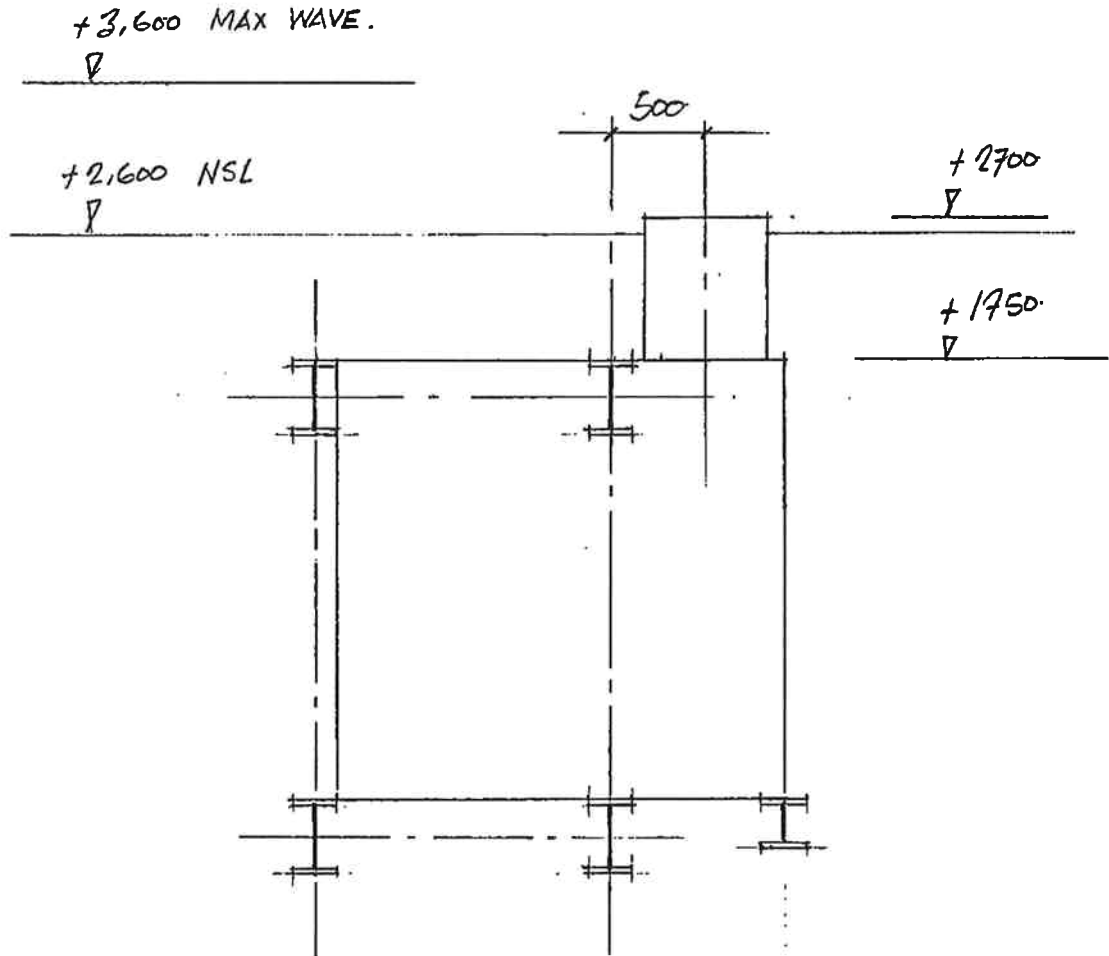
#2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

ACCESS HATCH.



Opgesteld : GWJ

Datum : 12/03.

Bladnummer : H2-7

Rev. : A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

MAX WATER PRESSURE ON CYLINDER -

$$p = 10.3 \times 1.85 = 19.1 \text{ kN/m}^2$$

WAVE BREAKING FORCE. -

DNV

$$F_s = 0.5 \gamma C_s A_e V^2 \text{ kN}$$

$$\gamma = 10.3 \text{ kN/m}^3$$

$$C_s = 10$$

$$D = 0.9 \text{ m (INCL. 50mm MARINE GROWTH)}$$

$$V = 1.2 \text{ m/s}$$

$$H = 1.0 \text{ m}$$

$$A_e = \frac{\pi D}{8} \times \frac{H}{4} = \frac{\pi 0.9}{8} \times \frac{1.0}{4} = 0.1 \text{ m}^2$$

$$F_s = 0.5 \times 10.3 \times 10 \times 0.1 \times 1.2^2 = 7.4 \text{ kN}$$

$$\text{MAX WAVE HEIGHT} = 1.0 \text{ m}$$

$$\text{RESULTANT HORIZONTAL PRESSURE} = 1.0 \times 10.3 = 10.3 \text{ kN/m}^2$$

Opgesteld :

GKJ

Datum :

12/03.

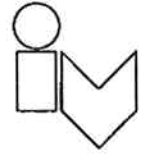
Bladnummer :

H2-8

Rev. :

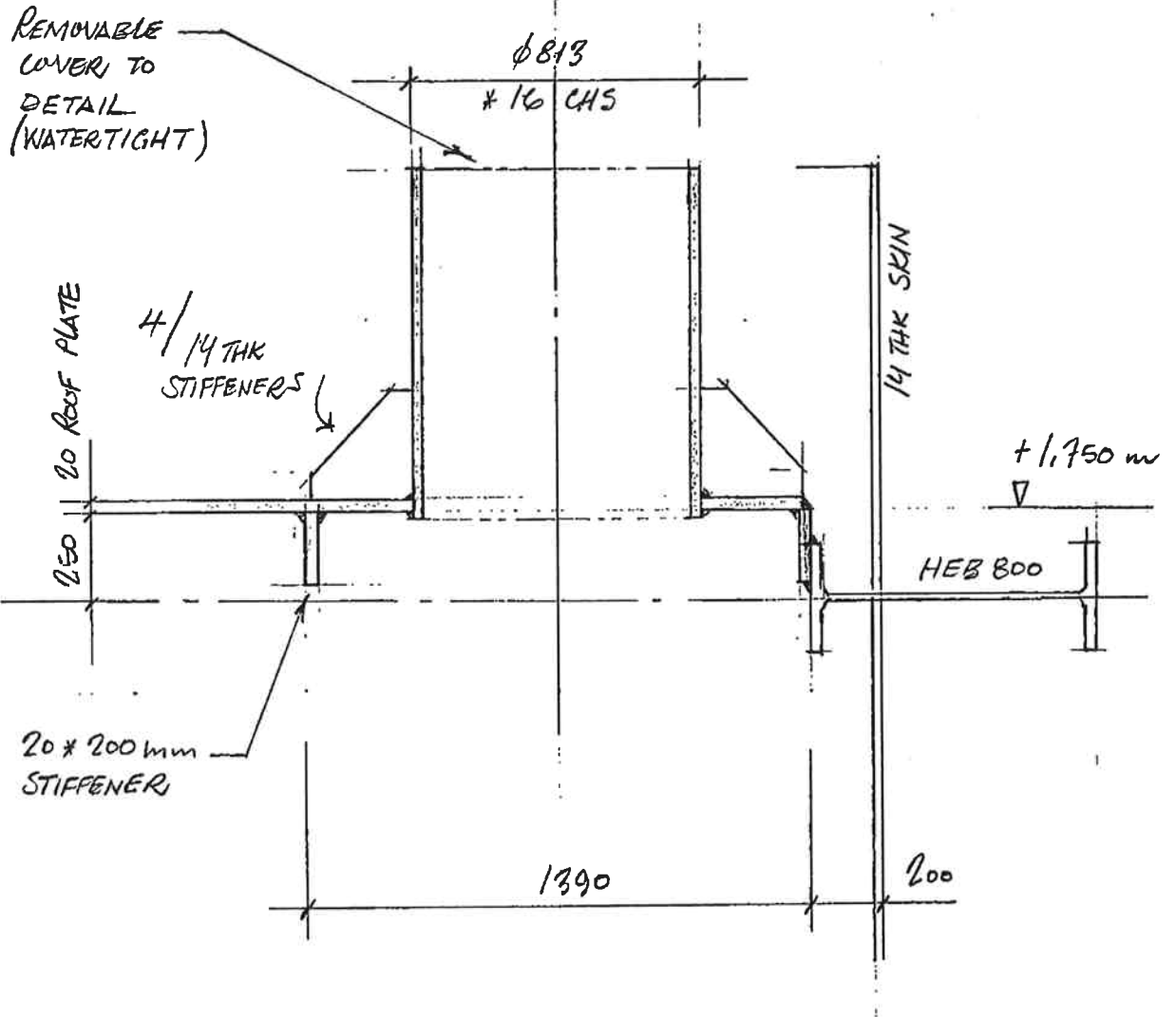
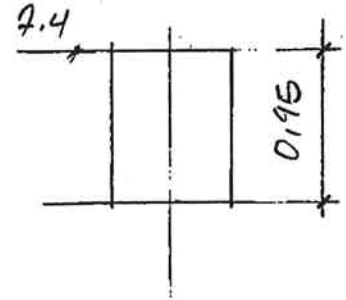
A2

Project : M&L&MOCCO LOCK VENICE.



Onderdeel :

$$\text{MAX } M = 7.4 \times 0.95 = 7 \text{ kNm}$$



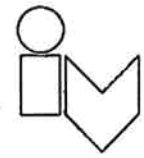
Opgesteld : *GWJ*

Datum : 12/03

Bladnummer : H2-9

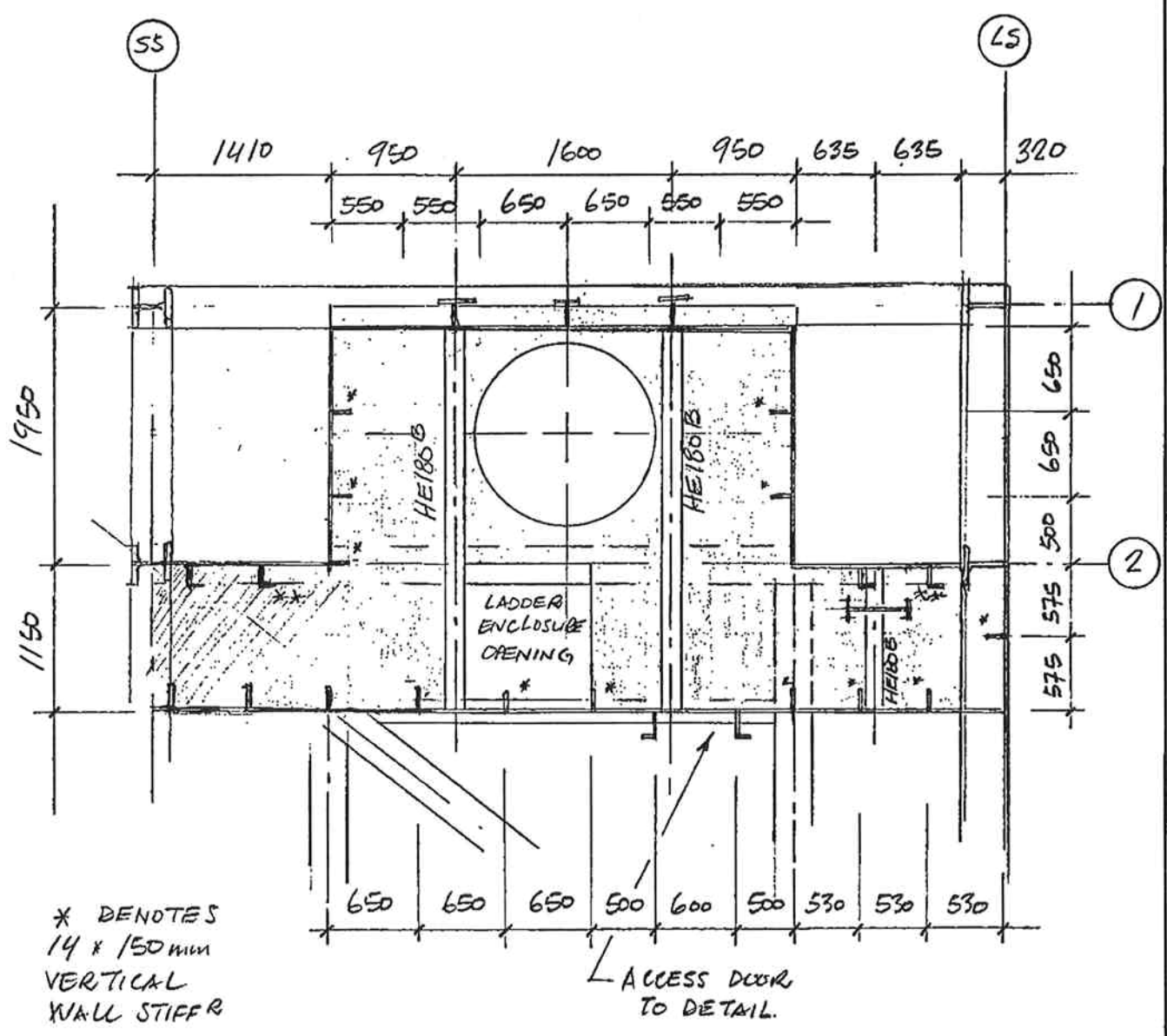
Rev. : A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :

FLOOR PLAN



SECONDARY FLOOR BEAMS TO SUPPORT GRATING ~ UNP 180.

** SEE REVISION -

NOTE: ALL PL. 14 ⇒ PL. 12.

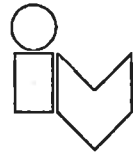
Opgesteld : GWJ

Datum : 12/03.

Bladnummer : H2-10

Rev. : 12

Project : MALAMOCCO. LOCK VENICE.



Onderdeel :

WORKING AREA.

FLOOR PLATE 20mm

LOADING.

HYDROSTATIC 48.9 kN/m²

USE 20mm PLATE ~ ALLOW 2mm CORROSION → 18mm PLATE.

MAX SPAN 18mm PLATE -

$$L = 100 \times 18 \sqrt{\frac{355}{1.1 \times 6 \times 1.5 \times 48.9}} = 1541 \text{ mm}$$

DEFLECTION LIMIT = 18/2 = 9 mm

$$I = 1000 \times 18^3 / 12 = 0.486 \times 10^6 \text{ mm}^4$$

$$L = \sqrt[4]{\frac{768 \times \delta \times EI}{5q}}$$

$$L = \sqrt[4]{\frac{768 \times 0.009 \times 2.1 \times 48.6}{5 \times 48.9}} = 1.31 \text{ m} \Rightarrow 1310 \text{ mm}$$

MAX PLATE SPAN = ~ 950 mm

$$\delta = \frac{5}{768} \times \frac{48.9 \times 0.95^4}{2.1 \times 48.6} \times 10^3 = 2.5 \text{ mm} \quad L/380$$

Opgesteld :

GWJ

Datum :

12/03

Bladnummer :

H2-11

Rev. :

A2

Project : MALAMOCLO LOCK VENICE.



Onderdeel :

FLOOR BEAMS.

SPAN 1950 mm $q_f = 1.2 * 48.9 = 58.7 \text{ kN/m}$

SPACING 1200 mm (CONSERVATIVE)

USE HE 180 B $I_y = 3831 * 10^4 \text{ mm}^4$

$$\delta = \frac{5}{384} * \frac{58.7 * 1.95^4}{2.1 * 3831} * 10^3 = 1.4 \text{ mm}$$

MAX GLOBAL PLATE DEFLECTION $\Delta = 2.5 + 1.4 = \underline{3.9 \text{ mm}}$ $L/500.$

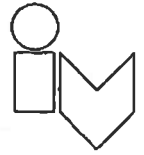
Opgesteld : GWJ

Datum : 12/03

Bladnummer : H2-12

Rev. : A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :

WALL PLATE N GRID LINE 1.

$$\text{MAX HYDROSTATIC PRESSURE} = 48.9 \text{ kN/m}^2$$

MAX PLATE SPAN FOR 14mm PLATE ($t_{\text{eff}} = 12\text{mm}$)

$$L = 100 \times 12 \sqrt{\frac{355}{1.1 \times 6 \times 1.5 \times 48.9}} = 1028 \text{ mm}$$

δ ALLOWABLE $\approx 5\text{mm}$ ($< t/2$).

$$I = 1000 \times 12^3 / 12 = 0.144 \times 10^{-6} \text{ mm}^4$$

$$L = \sqrt[4]{\frac{768}{5} \times \frac{\delta EI}{q}}$$

$$L = \sqrt[4]{\frac{768}{5} \times \frac{0.005 \times 2.1 \times 14.4}{48.9}} = 0.83 \text{ m}$$

USE MAX PLATE SPAN = 650 mm.

$$\text{PLATE DEFLECTION } \delta = \frac{5}{768} \times \frac{48.9 \times 0.65^4}{2.1 \times 14.4} = 0.0019 \text{ m} \\ \Rightarrow 1.9 \text{ mm.}$$

Opgesteld :

GWJ

Datum :

12/03

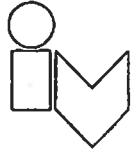
Bladnummer :

H2-13

Rev. :

A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

VERTICAL STIFFENER (EXTERNAL).

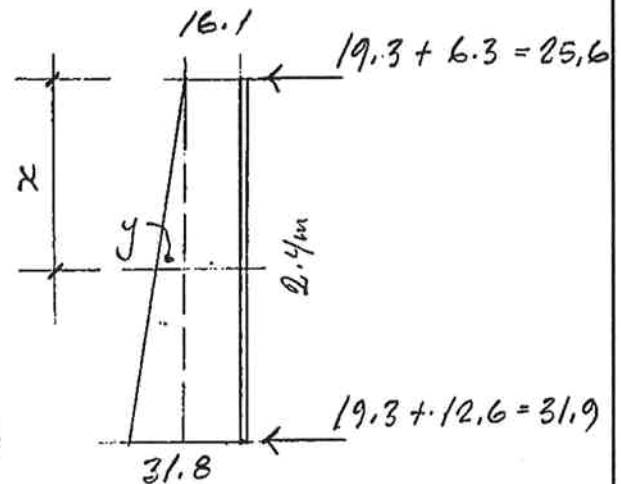
$$H = 2400 \text{ mm} \quad S = 650 \text{ mm}$$

$$q_1 = 24.7 * 0.65 = 16.1 \text{ kN/m}$$

$$q_2 = 48.9 * 0.65 = 31.8 \text{ kN/m}$$

TOTAL STIFFENER LOAD --

$$F = 2.4 \left(\frac{16.1 + 31.8}{2} \right) \\ = 57.5 \text{ kN}$$



CALCULATE x POSITION OF ZERO SHEAR.

$$A = 16.1x + \frac{xy}{2} = 25.6$$

$$\frac{x}{y} = \frac{2.4}{15.7}$$

$$y = \frac{15.7x}{2.4}$$

SUBSTITUTING --

$$3.3x^2 + 16.1x - 25.6 = 0$$

$$x = \frac{-16.1 \pm \sqrt{16.1^2 + 4(3.3)(25.6)}}{2(3.3)}$$

$$x = \frac{-16.1 \pm 24.4}{6.6}$$

$$x = 1.26 \text{ m} \quad y = 8.2 \text{ kN/m}$$

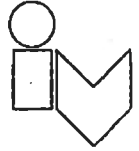
Opgesteld : GYJ

Datum : 12/03

Bladnummer : H2-14

Rev. : A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

$$\begin{aligned} M &= 25.6 \times 1.26 &= 32.26 + \\ &16.1 \times 1.26^2 / 2 &= 12.78 - \\ &8.2 \times 1.26^2 / 3 &= 4.34 - \\ M_{\max} &= 15.1 \text{ kNm} \end{aligned}$$

δ ALLOWABLE $\approx 5 \text{ mm}$

$$\delta = 2400 / 5 = L / 480$$

$$I_{\text{REQ}} (L / 480) = 804 \times 10^4 \text{ mm}^4$$

$$M_{\text{SD}} = 1.5 \times 15.1 = 22.7 \text{ kNm}$$

$$W_{\text{REQ}} = \frac{1.1 \times 22.7 \times 10^6}{355} = 70.3 \times 10^3 \text{ mm}^3$$

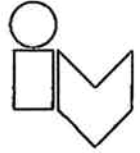
Opgesteld :
GW

Datum :
12/03

Bladnummer :
H2-15

Rev. :
A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

WALL PLATE - INTERNAL STIFFENERIS

14 x 150 mm STIFFENER

UNRODED PROPERTIES

$$I_y = 1068 \times 10^4 \text{ mm}^4$$

$$W_y = 86 \times 10^3 \text{ mm}^3$$

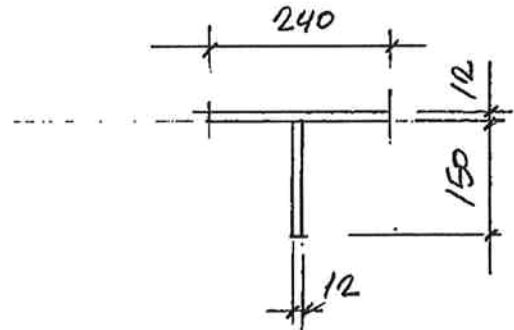
$$l_e = 2400 \text{ mm}$$

$$i_y = 40.4 \text{ mm}$$

$$q_{AVE} = \frac{8 \times 15.1}{2.4^2} = 21 \text{ kN/m}$$

$$\delta = \frac{5}{384} \times \frac{21 \times 2.4^4}{2.1 \times 1068} \times 10^3 = 4.1 \text{ mm}$$

GLOBAL DEFLECTION $\Delta = 1.9 + 4.1 = 6.0 \text{ mm}$ L/400



Opgesteld : GWJ

Datum : 01/04.

Bladnummer : H2-10

Rev. : A2

Project : Malamocco Lock Venice



Part : Working Space
Wall Plate

Flat Stiffener

14 x 150mm (corroded condition)

Plate

Plate thickness	d	12.0 mm
Effective Flange width	B	240.0 mm

Flat

Height	H	150 mm
Thickness	t	12 mm

Section Properties

Section Area	A	4680 mm ²
Y Axis		
Moment of Inertia Y-Y	I_y	1068 E+4 mm ⁴
Section Modulus Y-Y	W_y	86 E+3 mm ³
Radius of Gyration Y-Y	i_y	47.8 mm
Extreme fibre Top	e_{y1}	37.2 mm
Extreme fibre Bottom	e_{y2}	124.8 mm

Prepared :
G W Jardine

Date :
january 2004

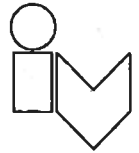
Page number :

H2-17

Rev :

A2

Project : MALAMOCLO LOCK VENICE



Onderdeel :

WALL PLATE - EXTERNAL STIFFENER

$$A = 6480 \text{ mm}^2$$

$$W_y = 328 \times 10^3 \text{ mm}^3$$

$$I_y = 3296 \times 10^4 \text{ mm}^4$$

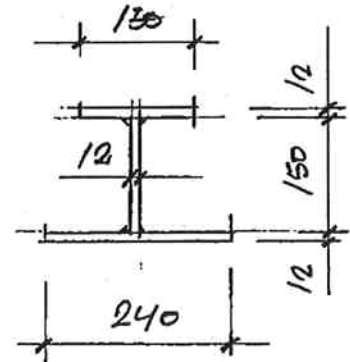
$$l_e = 2400 \text{ mm} \quad i_y = 71.3 \text{ mm}$$

$$\varepsilon = \sqrt{\frac{235}{355}} = 0.81$$

$$c = \frac{150 - 12 - 2(6)}{2} = 63$$

$$\frac{c}{t_f} = \frac{63}{12} = 5.3$$

$$\frac{5.3}{0.81} = 6.5 < 9 \rightarrow \text{FLANGE IS CLASS 1} \rightarrow \text{ok}$$



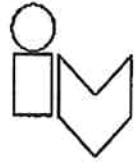
Opgesteld : GWJ

Datum : 01/04.

Bladnummer : H2-18

Rev. : A2

Project : Malamocco Lock Venice



Part : Working Space
Wall Stiffener - external

Tee Stiffener

14 x 150mm (corroded condition)

Plate

Plate thickness	d	12.0 mm
Effective Flange width	B	240.0 mm

Tee

Web height	H	150 mm
Web thickness	t_w	12 mm
Flange width	W	150 mm
Flange thickness	t_f	12.0 mm

Section Properties

Section Area	A	6480 mm ²
Y Axis		
Moment of Inertia Y-Y	I_y	3296 E+4 mm ⁴
Section Modulus Y-Y	W_y	328 E+3 mm ³
Radius of Gyration Y-Y	i_y	71.3 mm
Extreme fibre Top	e_{Y1}	73.5 mm
Extreme fibre Bottom	e_{Y2}	100.5 mm

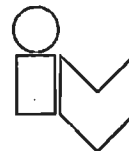
Prepared :
G W Jardine

Date :
january 2004

Page number :
H2-19

Rev :
A2

Project : MALAMOCLO LOCK VENICE.



Onderdeel :

REVISION

1. REVISED MEMBER FORCES EPW
2. TRANSPORT LOADING CONDITION ADDED
3. PLATE THICKNESS WAHS + STIFFENERS REDUCED TO 12mm.
4. Total check platerwork including global forces EPW

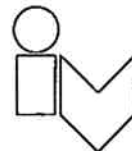
Opgesteld : (JW)

Datum : 5/04

Bladnummer : 12-20

Rev. : A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

WORKING AREA ~ REVISED CALCULATIONS

1. WALL PLATES 12mm ~ GENERAL
2. WALL PLATES LINE 1 + 13 ~ IN-PLANE LOADING
3. WALL PLATES LINE 2 + 12 ~ IN-PLANE LOADING.
4. ROOF & FLOOR PLATES ~ IN-PLANE LOADING
5. ROAD RAMP SUPPORT DETAILS

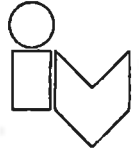
Opgesteld :
GWJ

Datum :
5/04

Bladnummer :
H2-21

Rev. :
A2.

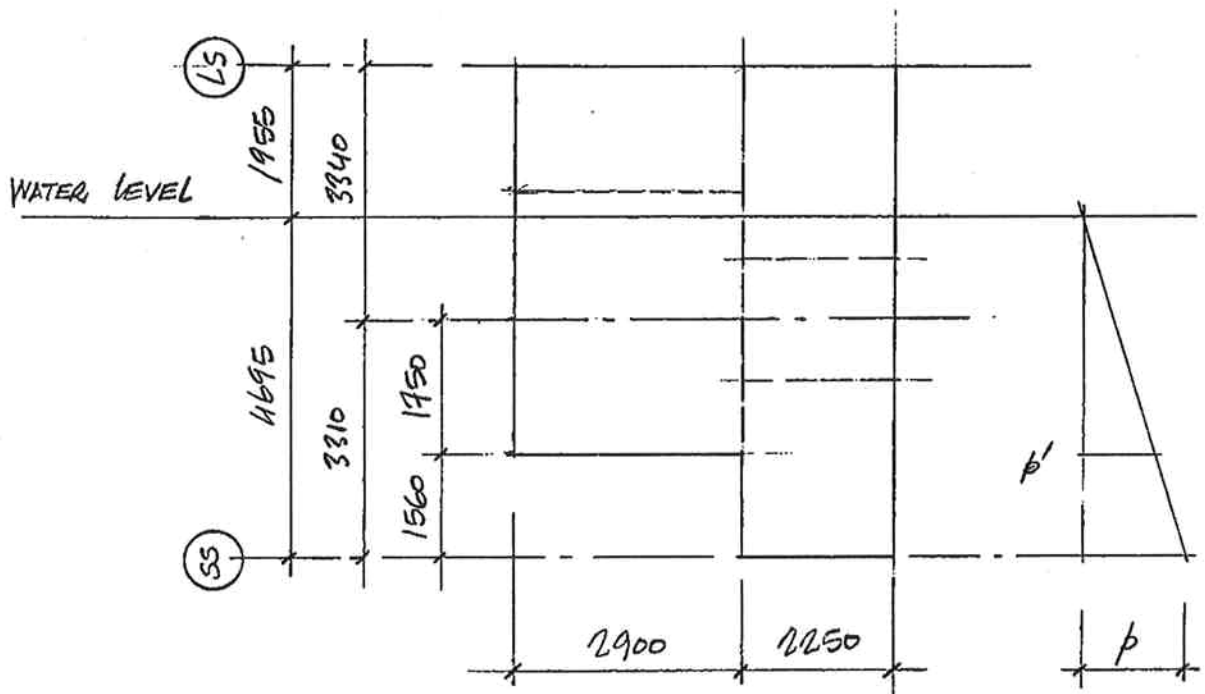
Project : MALAMOCCO LOCK VENICE



Onderdeel :

WORKING AREA

TRANSPORT LOADING.



$$\rho = 10.3 \text{ kN/m}^3$$

$$p = 10.3 \times 4.695 = 48.4 \text{ kN/m}^2$$

$$p' = 10.3 \times 3.135 = 32.3 \text{ kN/m}^2$$

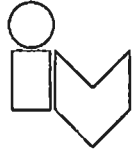
Opgesteld : G.W.J

Datum :

Bladnummer : H2-22

Rev. : A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :

CHECK 'WORKING AREA' DESIGN FOR 12mm PLATE

WALLS.

ALLOW 2mm SACRIFICIAL LAYER → 10mm PLATE.

STIFFENER SPACING (MAX) = 650 mm

$$q_{MAX} = 32.3 \text{ kN/m}^2 \text{ (TRANSPORT)}$$

$$q_{MAX} = 48.9 \text{ kN/m}^2 \text{ (OPERATING)}$$

$$M = 48.9 \times 0.65^2 / 10 = 2.1 \text{ kNm}$$

$$W = 1000 \times 10^2 / 6 = 16.7 \times 10^3 \text{ mm}^3$$

$$\sigma_{Ed} = \frac{1.5 \times 2.1 \times 10^3}{16.7} = 189 \text{ N/mm}^2 \text{ (0.59)}$$

$$I = 1000 \times 10^3 / 12 = 8.3 \times 10^4 \text{ mm}^4$$

$$\delta = \frac{5 \times 48.9 \times 0.65^4 \times 10^3}{768 \times 2.1 \times 8.3} = 3.7 \text{ mm}$$

$$\text{GLOBAL DEFLECTION } \Delta = 3.7 + 4.9 = 8.6 \text{ mm (H/279)}$$

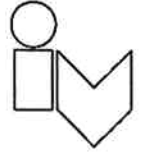
Opgesteld : GWJ

Datum :

Bladnummer : H2-23

Rev. : A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :

PLATE STIFFENERS

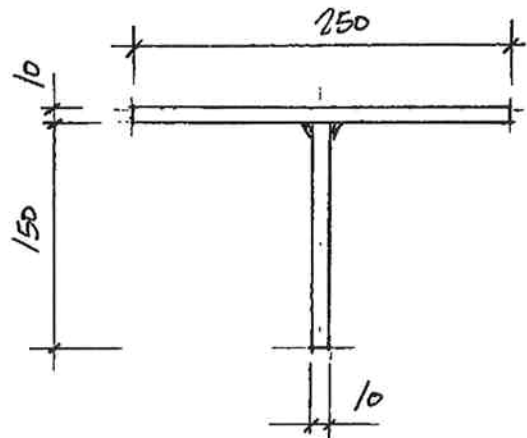
INTERNAL STIFFENERS

STIFFENER PROPERTIES. (CORRODED)

$$AREA = 4000 \text{ mm}^2$$

$$W_y = 71 \times 10^3 \text{ mm}^3$$

$$I_y = 883 \times 10^4 \text{ mm}^4$$



$$q = 0.65 \times 32.3 = 21 \text{ kN/m}^2 \text{ (TRANSPORT)}$$

$$M = 21 \times 2.4^2 / 8 = 15.1 \text{ kNm}$$

$$M = 15.1 \text{ kNm (OPERATING)}$$

$$M_{sd} = 1.5 \times 15.1 = 22.7 \text{ kNm}$$

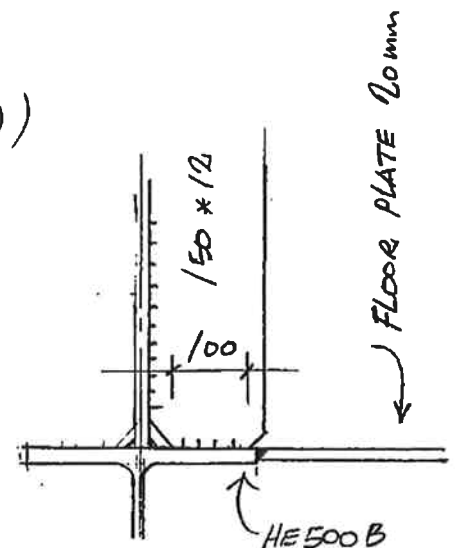
$$\sigma_{sd} = \frac{22.7 \times 10^3}{71} = 320 \text{ N/mm}^2 \text{ (0.99)}$$

$$V = 31.9 \text{ kN (OPERATING)}$$

$$V_{sd} = 1.5 \times 31.9 = 48 \text{ kN}$$

$$\tau_{sd} = \frac{48 \times 10^3}{10 \times 100} = 48 \text{ N/mm}^2 \text{ (0.26)}$$

$$\delta = \frac{5 \times 21 \times 2.4^4 \times 10^3}{384 \times 2.1 \times 883} = 4.9 \text{ mm}$$



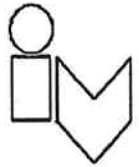
Opgesteld : GWJ

Datum :

Bladnummer : H12-24

Rev. : A2

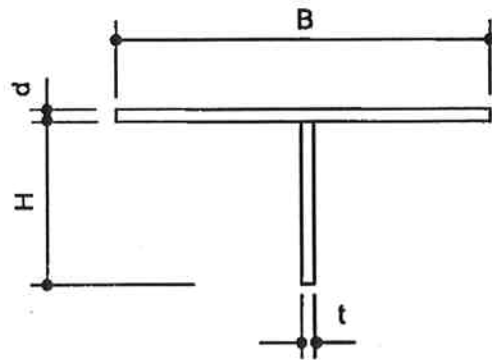
Project : *Malamocco Lock Venice*



Part : *Working Area*
wall stiffener - internal

Flat Stiffener

12 x 150 mm
corroded condition



Plate

Plate thickness	<i>d</i>	10 mm
Effective Flange width	<i>B</i>	250 mm

Flat

Height	<i>H</i>	150 mm
Thickness	<i>t</i>	10 mm

Section Properties

Section Area	<i>A</i>	4000 mm ²
Y Axis		
Moment of Inertia Y-Y	<i>I_y</i>	883 E+4 mm ⁴
Section Modulus Y-Y	<i>W_{y1}</i>	252 E+3 mm ³
	<i>W_{y2}</i>	71 E+3 mm ³
Extreme fibre Top	<i>e_{y1}</i>	35,0 mm
Extreme fibre Bottom	<i>e_{y2}</i>	125,0 mm
Radius of Gyration Y-Y	<i>i_y</i>	47,0 mm

Prepared :

G W Jardine

Date :

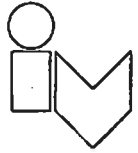
april 2004

Page number :

Rev :

H12-25 AL

Project :



Onderdeel :

EXTERNAL STIFFENER

STIFFENER PROPERTIES (CORRODED)

$$AREA = 4900 \text{ mm}^2$$

$$W_y = 179 \times 10^3 \text{ mm}^3$$

$$I_y = 1565 \times 10^4 \text{ mm}^4$$

$$p = 48.9 \text{ kN/m}^2$$

$$q = 0.65 \times 48.9 = 32 \text{ kN/m}$$

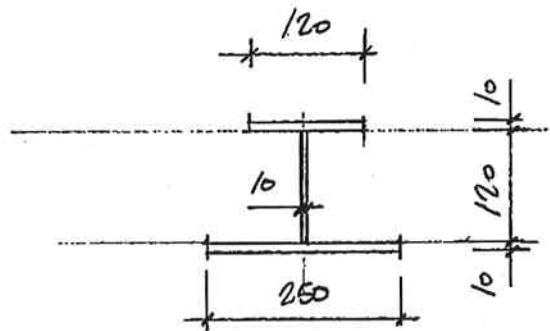
$$M_{sd} = 1.5 \times 32 \times 2.4^2 / 8 = 35 \text{ kNm}$$

$$\sigma_{sd} = \frac{35 \times 10^3}{179} = 196 \text{ N/mm}^2 \quad (0.6)$$

$$V = 32 \times 2.4 / 2 = 38.4 \text{ kN}$$

$$V_{sd} = 1.5 \times 38.4 = 57.6 \text{ kN}$$

$$\tau_{sd} = \frac{57.6 \times 10^3}{10 \times 100} = 57.6 \text{ N/mm}^2 \quad (0.31)$$



DEFLECTION

$$\delta = \frac{5 \times 32 \times 2.4^4 \times 10^3}{384 \times 2.1 \times 1565} = 4.2 \text{ mm}$$

Opgesteld :

Datum :

Bladnummer :

Rev. :

H12-26

A2

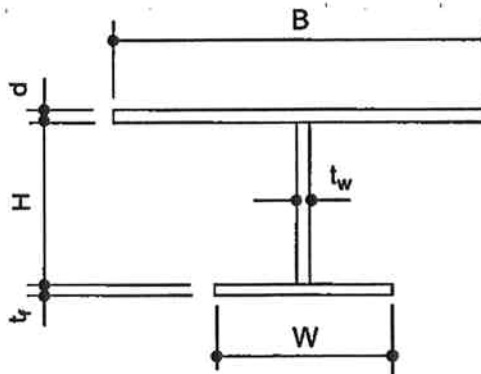
Project : *Malamocco Lock Venice*



Part : *Working Area*
wall stiffener - external

Tee Stiffener

12 x 120 mm
corroded condition



Plate

Plate thickness	<i>d</i>	10 mm
Effective Flange width	<i>B</i>	250 mm

Tee

Web height	<i>H</i>	120 mm
Web thickness	<i>t_w</i>	10 mm
Flange width	<i>W</i>	120 mm
Flange thickness	<i>t_f</i>	10 mm

Section Properties

Section Area	<i>A</i>	4900 mm ²
Y Axis		
Moment of Inertia Y-Y	<i>I_y</i>	1565 E+4 mm ⁴
Section Modulus Y-Y	<i>W_{y1}</i>	297 E+3 mm ³
	<i>W_{y2}</i>	179 E+3 mm ³
Extreme fibre Top	<i>e_{y1}</i>	52,8 mm
Extreme fibre Bottom	<i>e_{y2}</i>	87,2 mm
Radius of Gyration Y-Y	<i>i_y</i>	56,5 mm

Prepared :
G W Jardine

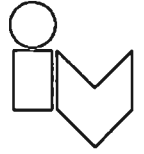
Date :
april 2004

Page number :

Rev :

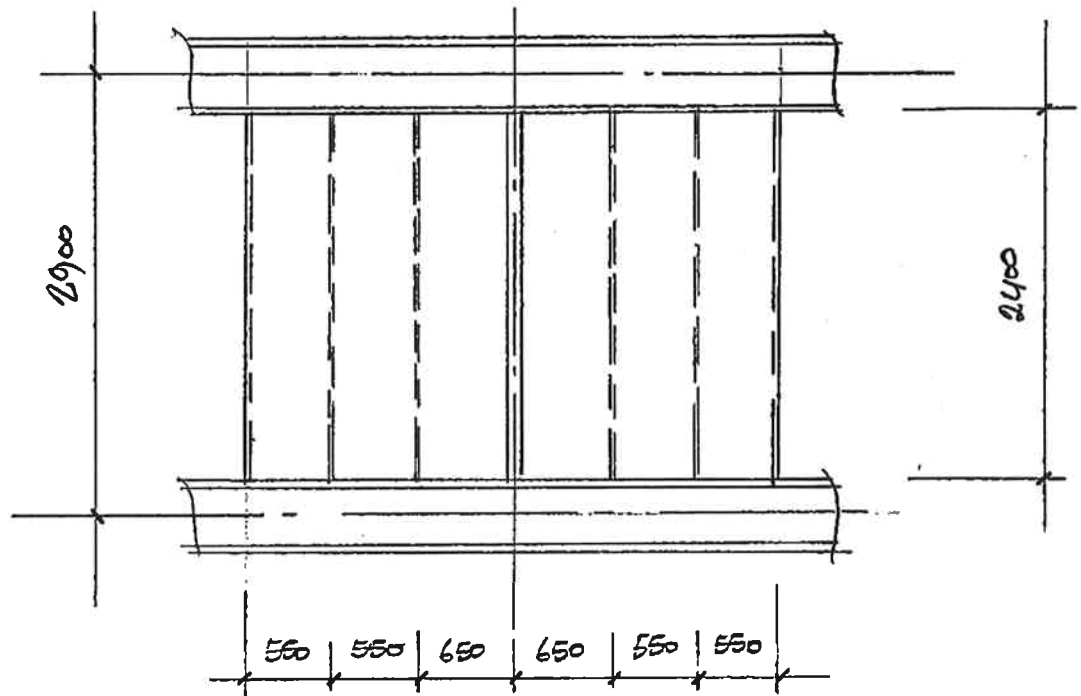
H12-21 A2

Project : MALAMOCLO LOCK VENICE



Onderdeel :

PLATE ON GRID LINE 1/13



Opgesteld : GWJ

Datum :

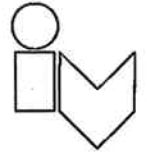
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Rev. :

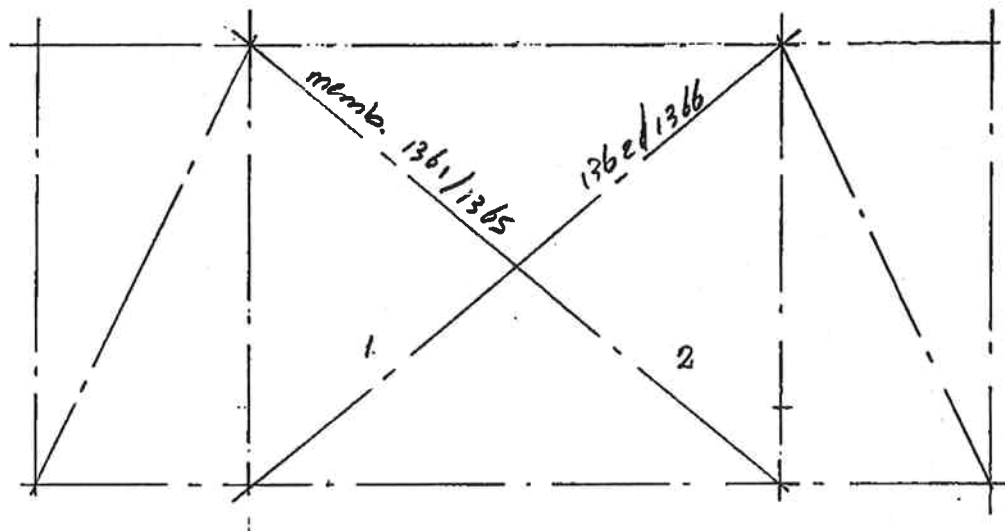
H12-28

A2.

Project : MALAMOCCO LOCK VENICE



Onderdeel :



LOADING (in kN)

loads updated model : only very small difference / NO changes structure

<u>LOADING CONDITION</u>	<u>LOAD COMBI</u>	<u>BRACE 1</u>	<u>BRACE 2</u>
1	10	-317	-180
2	3	-428	-423
3	2	-849	295

Opgesteld : GWJ

Datum :

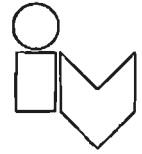
Bladnummer :

Rev. :

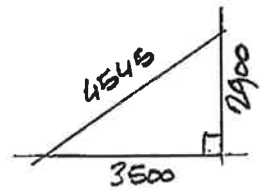
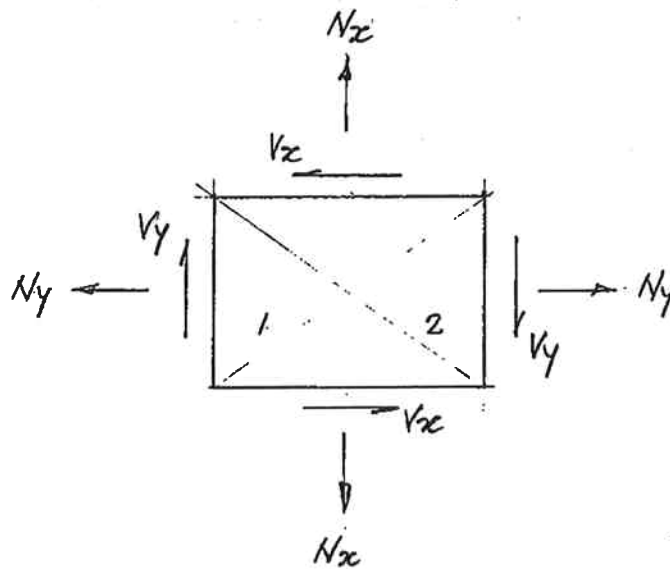
H2-20

A2.

Project : MALAMOCLO LOCK VENICE



Onderdeel :



LOADING CONDITION	LOAD COMBI	N_{xz}	N_y	V_{xz}	V_y
1	10	-115	-138	106	89
2	3	-270	-326	4	3
3	2	~	~	881	730

$$q = 2400 \text{ mm}$$

$$b = 650 \text{ mm}$$

$$\alpha = \frac{2400}{650} = 3.7$$

Opgesteld : GWJ

Datum :

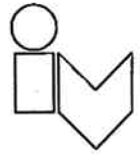
Bladnummer :

Rev. :

12-30

AL

Project : MALAMOCLO LOCK VENICE.



Onderdeel :

1. SHEAR BUCKLING. (EC3 5.6.3)

$$d = 2400 \text{ mm}$$

$$d = 650 \text{ mm (MAX STIFFER SPAACING)}$$

$$t = \frac{2400}{650} = 3.7$$

$$V_{\text{MAX}} = 881 \text{ kN}$$

$$T_d = \frac{881 \times 10^3}{10 \times 3500} = 25.2 \text{ N/mm}^2$$

$$k_T = 5.35 + \frac{4.0}{3.7^2} = 5.64$$

$$T_{cr} = \frac{5.64 \times \pi^2 \times 2.1 \text{E}5}{12(1-0.3^2)} \times \left(\frac{10}{650}\right)^2 = 254 \text{ N/mm}^2$$

$$\bar{\lambda} = \sqrt{\frac{355}{\sqrt{3} \times 254}} = 0.9. (< 1.2)$$

$$T_{bc} = \left\{ 1 - 0.625(0.9 - 0.8) \right\} \frac{355}{\sqrt{3}} = 192 \text{ N/mm}^2$$

$$\text{U.C. } \frac{25.2}{192} = 0.13$$

2. COMPRESSION BUCKLING.

CHECK NOT REQUIRED!

Opgesteld : GWJ

Datum :

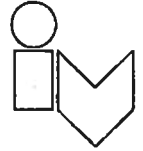
Bladnummer :

Rev. :

H2-31

A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

3. PLATE STRENGTH

NORMAL STRESSES

$$\sigma_{x,d} = \frac{270 \times 10^3}{10 \times 3500} = 8 \text{ N/mm}^2$$

$$\sigma_{y,d} = \frac{326 \times 10^3}{10 \times 2400} = 14 \text{ N/mm}^2$$

BENDING STRESSES (From manual calc.)

STIFFENED PLATE.

$$\sigma_{x,d} = 78 \text{ N/mm}^2 \text{ (COMPRESSION)}$$

BETWEEN STIFFENERS

$$\sigma_{y,d} = 189 \text{ N/mm}^2$$

EQUIVALENT STRESS

$$\sigma_{x,d} = 8 + 78 = 86 \text{ N/mm}^2$$

$$\sigma_{y,d} = 14 + 189 = 203 \text{ N/mm}^2$$

$$\sigma_{v,s,d} = \sqrt{86^2 + 203^2 - (86)(203)} = 177 \text{ N/mm}^2$$

$$\text{U.C. } \frac{177}{355/1.1} = 0.55$$

Opgesteld : GWJ

Datum :

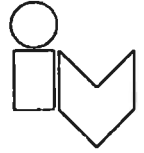
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Rev. :

H2.32

A2

Project :



Onderdeel :

VERTICAL STIFFENERS

INTERNAL STIFFENERS.

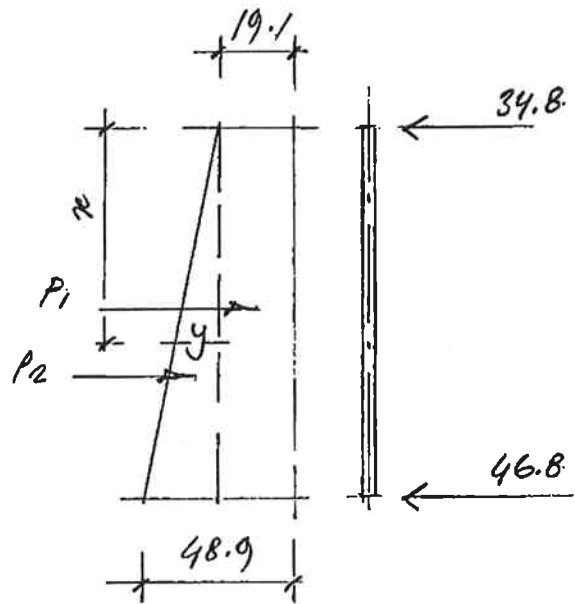
$$p_1 = 19.1 \text{ kN/m}^2$$

$$p_2 = 48.9 \text{ kN/m}^2$$

$$P_1 = 45.8 \text{ kN}$$

$$P_2 = 35.8 \text{ kN}$$

$$\underline{81.6 \text{ kN}}$$



CALCULATE x POSITION OF ZERO SHEAR

$$A = 19.1x + \frac{\pi y}{2} = 34.8$$

$$\frac{y}{x} = \frac{29.8}{2.4}$$

$$y = \frac{29.8x}{2.4}$$

SUBSTITUTING :

$$19.1x + \frac{29.8x^2}{4.8} = 34.8$$

$$6.2x^2 + 19.1x - 34.8 = 0$$

$$x = \frac{-19.1 \pm \sqrt{19.1^2 + 4(6.2)(34.8)}}{2(6.2)}$$

$$x = \frac{-19.1 \pm 35.0}{12.4}$$

$$x = 1.28 \text{ m}$$

$$y = 15.9 \text{ kN/m}$$

Opgesteld : GWJ

Datum :

Bladnummer :

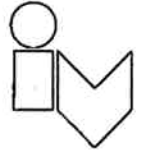
Rev. :

12-33

A2

Project :

Onderdeel :



BENDING

$$\begin{aligned} M &= 34,8 \times 1,28 = 44,6 \\ & (19,1 \times 1,28^2/2) = -15,7 \\ & (15,9 \times 1,28^2/3) = -8,7 \\ & \hline & 20,2 \text{ kNm/m} \end{aligned}$$

STIFFENER MOMENT

$$M = 0,65 \times 20,2 = 13,1 \text{ kNm}$$

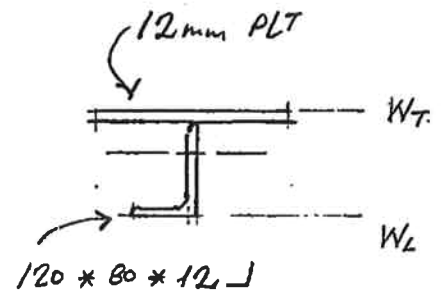
$$M_{sd} = 1,5 \times 13,1 = 19,7 \text{ kNm}$$

$$W_L = 122 \times 10^3 \text{ mm}^3$$

$$W_T = 255 \times 10^3 \text{ mm}^3$$

$$\sigma_{t,d} = \frac{19,7 \times 10^3}{122} = 162 \text{ N/mm}^2 \text{ (ANGLE LEG)}$$

$$\sigma_{c,d} = \frac{19,7 \times 10^3}{255} = 78 \text{ N/mm}^2 \text{ (PLATE)}$$



COMPRESSION

$$A = 4410 \text{ mm}^2 \quad i = 49,4 \text{ mm} \quad l = 2400 \text{ mm}$$

$$\sigma_{x,d} = 8 \text{ N/mm}^2$$

$$F_{ST,d} = 4410 \times 8 \times 10^{-3} = 36 \text{ kN}$$

$$\lambda = \frac{2400}{47} = 51 \quad \lambda_e = \pi \sqrt{\frac{E}{f_y}} = 76,4$$

$$\bar{\lambda} = \frac{51}{76,4} = 0,67 \quad \omega = 0,74 \text{ (c)}$$

Opgesteld :

Datum :

Bladnummer :

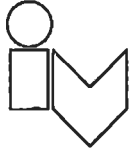
Rev. :

H12-34

A2.

Project :

Onderdeel :



COMBINED BENDING AND COMPRESSION.

$$\frac{8 * 1.1}{0.74 * 355} + \frac{162 * 1.1}{355} = 0.03 + 0.50 = 0.53$$

Opgesteld : GWJ

Datum :

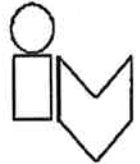
Bladnummer :

Rev. :

H12-35

A2

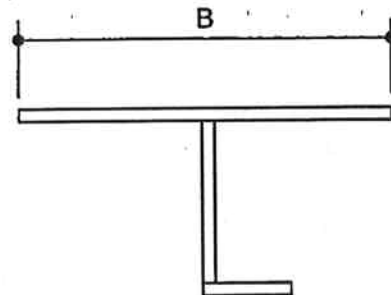
Project : Malamocco Lock Venice



Part : Buoyancy Tank
vertical stiffener internal

Angle Stiffener

120x80x12L
corroded condition



Plate

Plate thickness	t	10,0 mm
Effective Flange width	B	250,0 mm

Angle

Angle Area	A	1910,0 mm ²
Angle Vertical Leg	L	120,0 mm
Angle Inertia Y-Y	I_y	276,0 E+4 mm ⁴
Angle Neutral Axis Y-Y	e_y	39,2 mm
Angle Inertia Z-Z	I_z	98,1 E+4 mm ⁴
Angle Neutral Axis Z-Z	e_z	19,5 mm

Section Properties

Section Area	A	4410 mm ²
Y Axis		
Moment of Inertia Y-Y	I_y	1075 E+4 mm ⁴
Section Modulus Y-Y	W_y	122 E+3 mm ³ 255
Radius of Gyration Y-Y	i_y	49,4 mm
Extreme fibre Top	y_1	42,2 mm
Extreme fibre Bottom	y_2	87,8 mm
Z Axis		
Moment of Inertia Z-Z	I_z	1400 E+4 mm ⁴
Section Modulus Z-Z	W_z	112 E+3 mm ³
Radius of Gyration Z-Z	i_z	56,3 mm

Prepared :

G W Jardine

Date :

may 2004

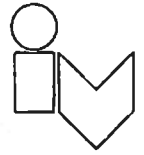
Page number :

112-36

Rev :

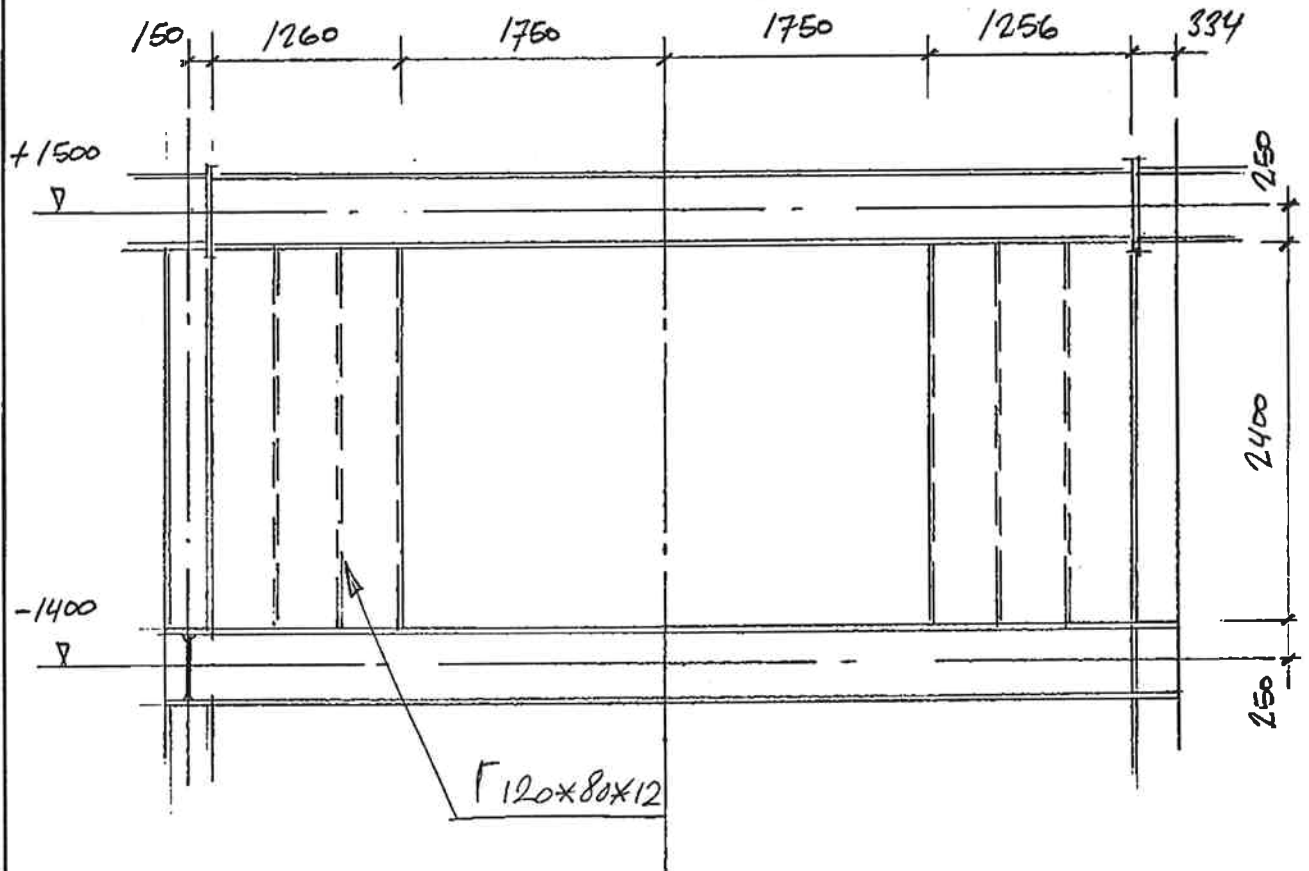
A2

Project : MALAMOCLO LOCK VENICE.



Onderdeel :

PLATES ON GRID LINE 2/12



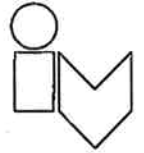
Opgesteld : GWJ

Datum :

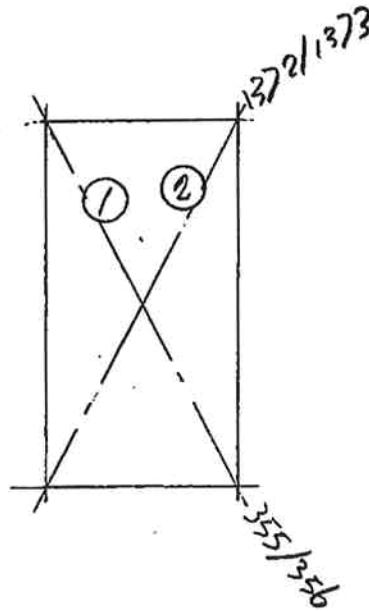
Bladnummer : H2-32

Rev. : AR

Project : MALAMOCCO LOCK VENICE



Onderdeel :



LOADING

<u>LOADING CONDITION</u>	<u>LOAD COMBI</u>	<u>BRACE 1</u>	<u>BRACE 2</u>
1.	10	-47	-212
2.	3	360	-572
3.	4	-232	383
4.	11	-159	93

Small changes in forces / neglect.

Opgesteld : GWJ

Datum :

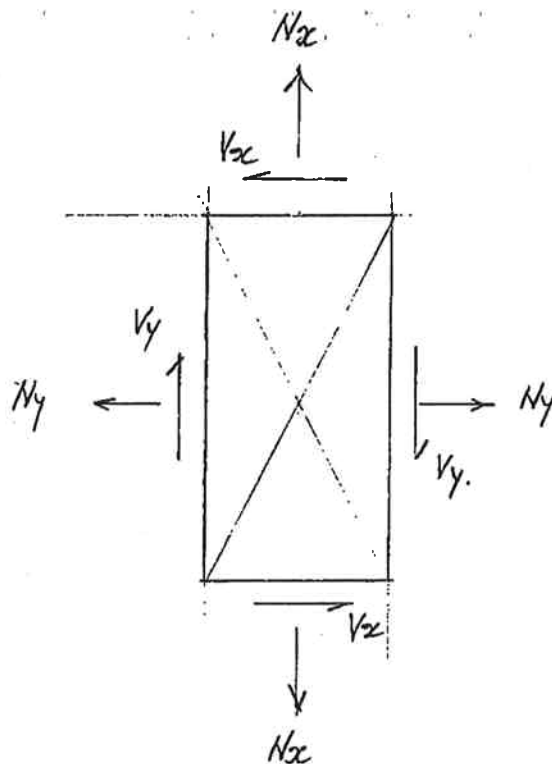
Bladnummer : 712-38

Rev. : A2

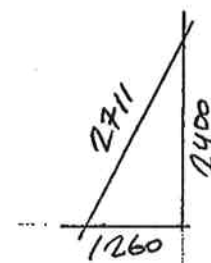
Project : MALAMOCCO LOCK VENICE



Onderdeel :



$a = 2400 \text{ mm}$
 $d = 450 \text{ mm}$



LOADING CONDITION	LOAD COMBI	N_x	N_y	V_z	V_y
1	10	-146	-77	22	42
2	3	~	~	433	825
3	4	~	~	286	545
4	11	~	~	118	223

Opgesteld : *GWJ*

Datum :

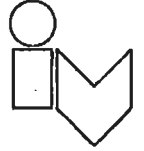
Bladnummer :

Rev. :

H2-39

A2

Project : MALAMOCCHO LOCK VENICE



Onderdeel :

$$e = \frac{2400}{450} = 5.3$$

$$\text{MAX SHEAR} = 825 \text{ kN}$$

SHEAR BUCKLING (EC3 5.6.3)

$$T_d = \frac{825 \times 10^2}{10 \times 2400} = 35 \text{ N/mm}^2$$

$$k_T = 5.34 + \frac{4.0}{5.3^2} = 5.48$$

$$T_{cr} = \frac{5.48 \times \pi^2 \times 2.1 \text{ ES}}{12(1-0.3^2)} \times \left(\frac{10}{450}\right)^2 = 514 \text{ N/mm}^2$$

$$\bar{\lambda} = \sqrt{\frac{355}{\sqrt{3} \times 514}} = 0.63 (< 0.8)$$

$$T_{bc} = \frac{355}{\sqrt{3}} = 205 \text{ N/mm}^2$$

$$\text{u.c.} \quad \frac{35}{205/1.1} = 0.19$$

COMPRESSION BUCKLING

NO CHECK REQUIRED!

Opgesteld : G.W.J.

Datum :

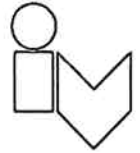
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12-40

A2.

Project : MALAMOCLO LOCK VENICE



Onderdeel :

PLATE STRENGTH

1. BENDING STRESSES. (from manual calc.)

STIFFENED PLATE.

$$\sigma_{x,d} = 78 \text{ N/mm}^2$$

PLATE BETWEEN STIFFENERS.

$$\sigma_{y,d} = 189 \text{ N/mm}^2$$

2. SHEAR STRESS (from EPW-model)

$$\tau = 35 \text{ N/mm}^2$$

EQUIVALENT STRESS

$$\sigma_{v,s,d} = \sqrt{78^2 + 189^2 - (78)(189) + 3(35^2 + 35^2)} = 186 \text{ N/mm}^2$$

$$\text{U.I.C. } \frac{186}{355/1.1} = 0.58.$$

Opgesteld : GWJ

Datum :

Bladnummer :

Rev. :

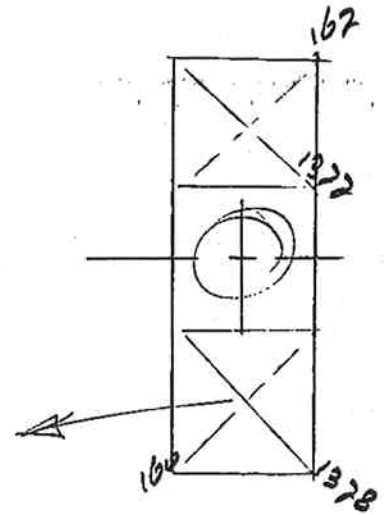
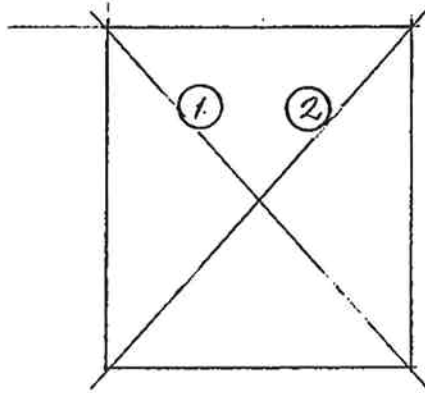
H2-41

AL

Project : MALAMOCCO LOCK VENICE



Onderdeel :



force changes are small / neglect because of low u.c.

LOADING

LOADING CONDITION	LOAD COMBI	ROOF PLATE		FLOOR PLATE	
		BRACE 1	BRACE 2	BRACE 1	BRACE 2
1.	10	119	-776	336	-659
2.	3	-220	-1335	214	-339
	6	34	-666	286	-627
3.	4	-571	592	-270	280
	2	-284	115	-338	487
4.	12	-91	-152	-280	245

Opgesteld : GWJ

Datum :

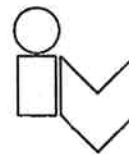
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Rev. :

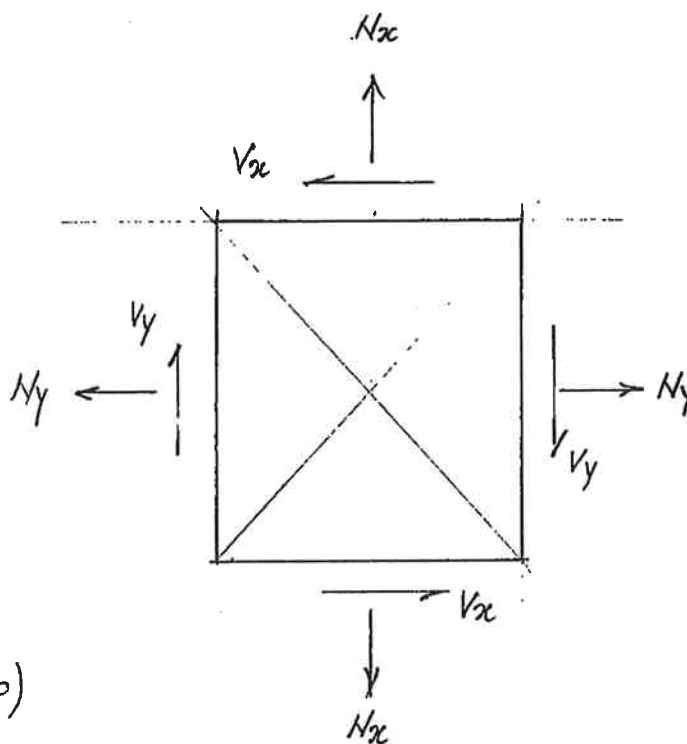
12-12

12

Project : MALAMOCCO LOCK VENICE



Onderdeel :



$a = 1950 \text{ mm}$
 $d = 1410 \text{ mm}$
 $t = 18 \text{ mm (20)}$

LOADING CONDITION	LOAD COMBI	N_x	N_y	V_x	V_y
1	10	~	~	646	757
2	3.	-849	-724	143	168
	6	~	~	593	695
3	4	~	~	755	885

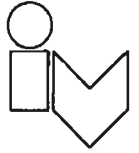
Opgesteld : **GWJ**

Datum :

Bladnummer : **12-63**

Rev. : **A2.**

Project : MALAMOCO LOCK VENICE.



Onderdeel :

$$e = \frac{1950}{1410} = 1,38$$

SHEAR BUCKLING (EC3 5.6.3)

$$V_{max} = 885 \text{ kN}$$

$$K_T = 5,34 + \frac{4}{1,38^2} = 7,44$$

$$T_{cr} = \frac{7,44 * \pi^2 * 2,1 \text{ E5} * \left(\frac{18}{1410}\right)^2}{12(1-0,3^2)} = 230 \text{ N/mm}^2$$

$$\bar{\lambda} = \sqrt{\frac{355}{\sqrt{3} * 230}} = 0,94$$

$$T_{be} = \left\{1 - 0,625(0,94 - 0,8)\right\} \left(\frac{355}{\sqrt{3}}\right) = 187 \text{ N/mm}^2$$

$$T_d = \frac{885 * 10^3}{18 * 2265} = 22 \text{ N/mm}^2$$

$$\text{u.c. } \frac{22}{187/1,1} = 0,13$$

COMPRESSION BUCKLING

NO CHECK REQUIRED!

Opgesteld : GWJ

Datum :

Bladnummer :

Rev. :

H2-64

A2

Project :

Onderdeel :

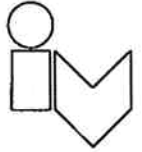


PLATE STRENGTH

1. BENDING STRESSES.

PLATE BETWEEN STIFFENERS

$$M_{sd} = 1.5 \times 48.9 \times 0.95^2 / 10 = 6.62 \text{ kNm}$$

$$W = 1000 \times 18^2 / 6 = 54 \times 10^3 \text{ mm}^3$$

$$\sigma_{x,d} = \frac{6.62 \times 10^3}{54} = 123 \text{ N/mm}^2$$

2. NORMAL STRESSES

$$\sigma_{x,d} = \frac{849 \times 10^3}{18 \times 1950} = 24 \text{ N/mm}^2$$

$$\sigma_{y,d} = \frac{724 \times 10^3}{18 \times 2265} = 18 \text{ N/mm}^2$$

3. SHEAR STRESS

$$\tau = \frac{168 \times 10^3}{18 \times 2265} = 4 \text{ N/mm}^2 \text{ OR } 22 \text{ N/mm}^2$$

EQUIVALENT STRESS

$$\sigma_{vis,d} = \sqrt{147^2 + 18^2 - (147)(18) + 3(22^2 + 22^2)} = 149 \text{ N/mm}^2$$

$$\text{u.c. } \frac{149}{355/1.1} = 0.46$$

Opgesteld : GWJ

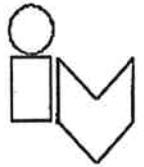
Datum :

Bladnummer : 12-45

Rev. :

A2

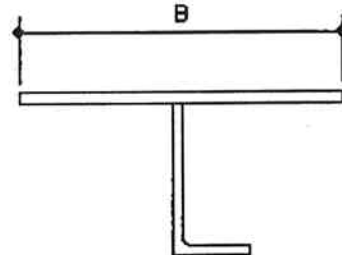
Project : *Malamocco Lock Venice*



Part : *Buoyancy Tank*
vertical stiffener internal

Angle Stiffener

120x80x12L
corroded condition



Plate

Plate thickness	<i>t</i>	10,0 mm
Effective Flange width	<i>B</i>	250,0 mm

Angle

Angle Area	<i>A</i>	1910,0 mm ²
Angle Vertical Leg	<i>L</i>	120,0 mm
Angle Inertia Y-Y	<i>I_y</i>	276,0 E+4 mm ⁴
Angle Neutral Axis Y-Y	<i>e_y</i>	39,2 mm
Angle Inertia Z-Z	<i>I_z</i>	98,1 E+4 mm ⁴
Angle Neutral Axis Z-Z	<i>e_z</i>	19,5 mm

Section Properties

Section Area	<i>A</i>	4410 mm ²
Y Axis		
Moment of Inertia Y-Y	<i>I_y</i>	1075 E+4 mm ⁴
Section Modulus Y-Y	<i>W_y</i>	122 E+3 mm ³
Radius of Gyration Y-Y	<i>i_y</i>	49,4 mm
Extreme fibre Top	<i>y₁</i>	42,2 mm
Extreme fibre Bottom	<i>y₂</i>	87,8 mm
Z Axis		
Moment of Inertia Z-Z	<i>I_z</i>	1400 E+4 mm ⁴
Section Modulus Z-Z	<i>W_z</i>	112 E+3 mm ³
Radius of Gyration Z-Z	<i>i_z</i>	56,3 mm

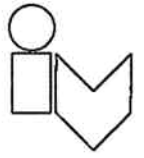
Prepared :
G W Jardine

Date :
may 2004

Page number :
H2-46

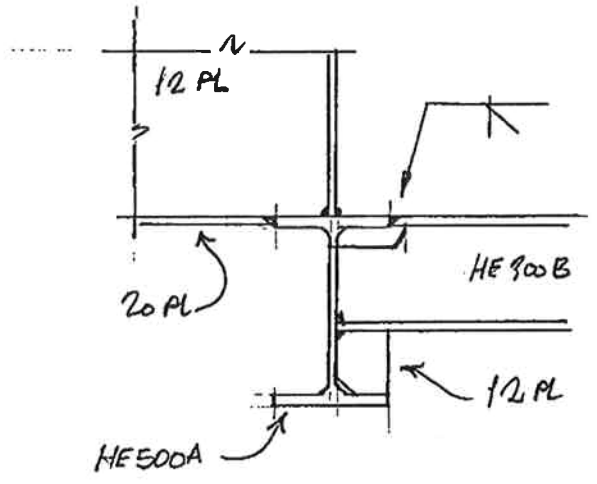
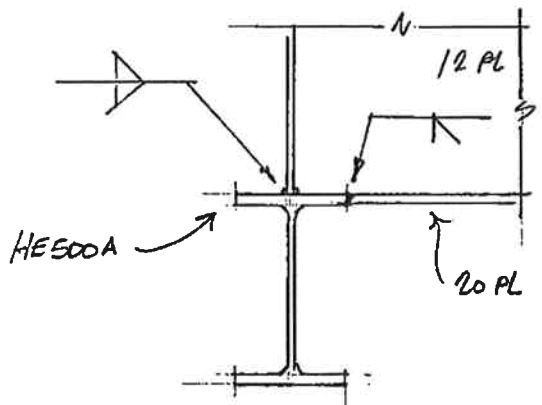
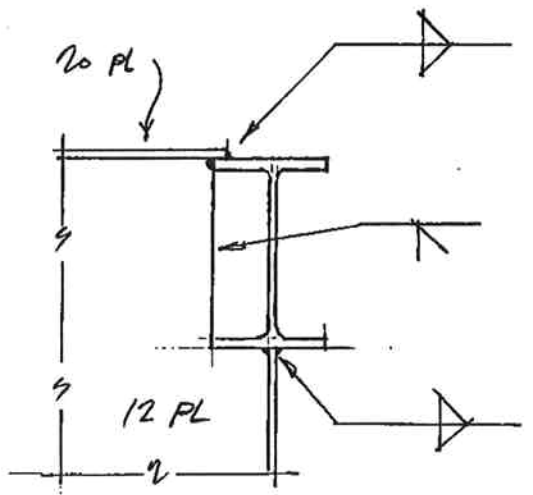
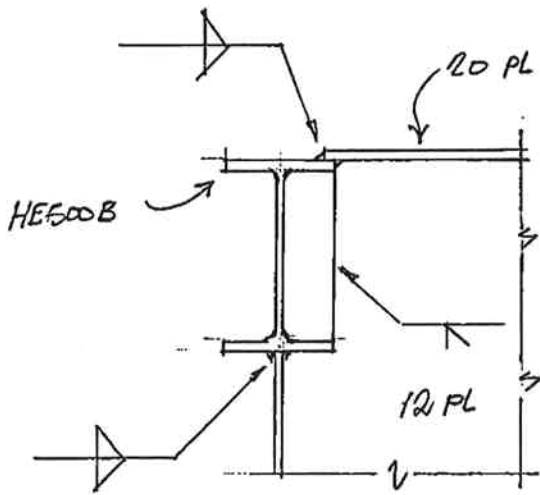
Rev :
A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :

WORKING AREA ~ WELD DETAILS



Opgesteld : GWJ

Datum :

Bladnummer :

Rev. :

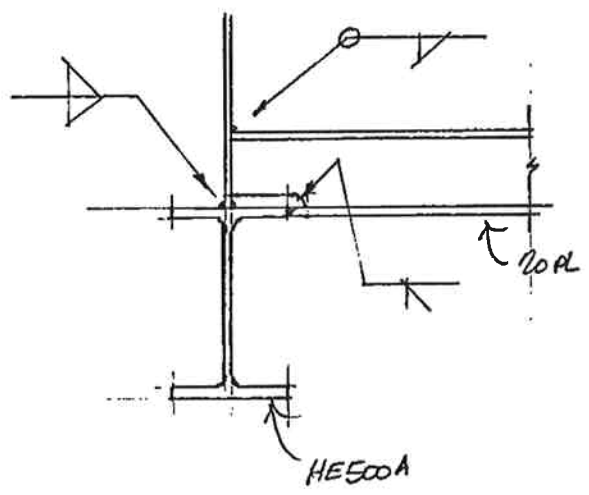
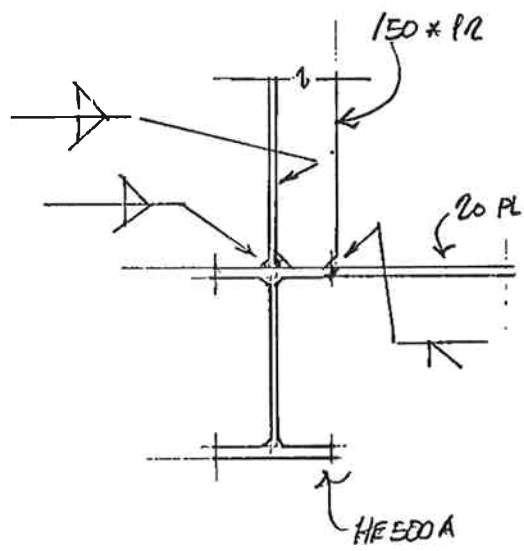
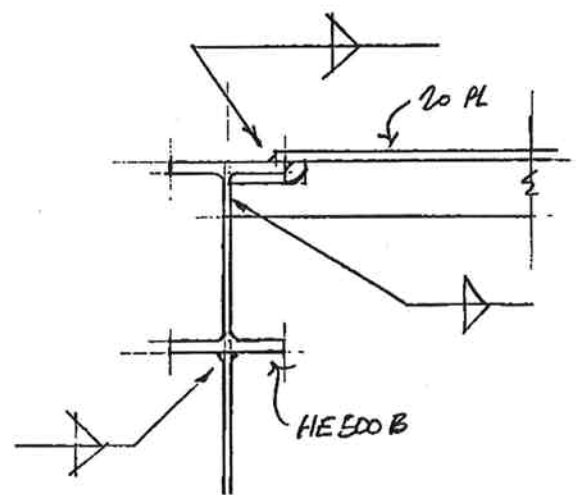
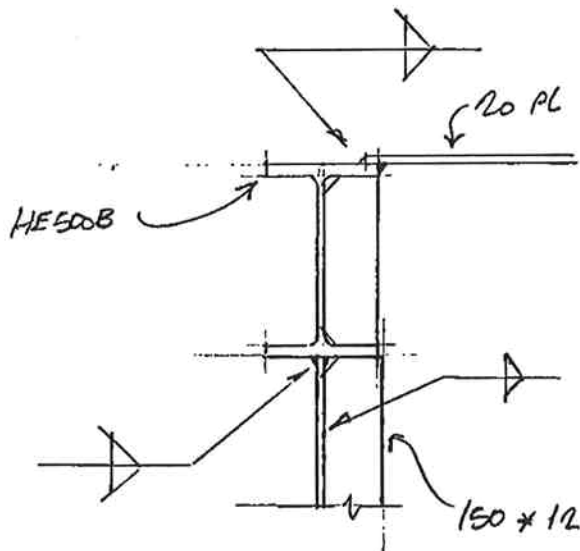
112-42

A2,

Project : MALAMOCLO LOUK VENICE



Onderdeel :



Opgesteld : GWJ

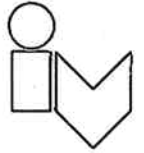
Datum :

Bladnummer : 112-48

Rev. : A2

Project :

Onderdeel :



WORKING AREA ~ ROOF OPENING.

$$p = 19,1 \text{ kN/m}^2$$

$$\phi \text{ UD} = 1420 \text{ mm}$$

$$q = 0,019 \text{ N/mm}$$

$$M = 0,019 \times 1420^2 / 8 = 4789 \text{ Nmm}$$

$$M_{sd} = 1,5 \times M = 7184 \text{ Nmm}$$

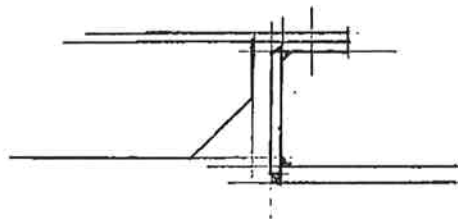
$$W = 1 \times 10^2 / 6 = 16,67 \text{ mm}^3$$

$$I = 1 \times 10^3 / 12 = 83,3 \text{ mm}^4$$

$$\sigma_d = \frac{0,5 \times 7184}{16,67} = 216 \text{ N/mm}^2 \quad (0,67)$$

$$\delta = \frac{5}{384} \times \frac{0,5 \times 0,019 \times 1420^4}{2,1 \times 10^5 \times 83,3} = 29 \text{ mm} \rightarrow \text{TOO HIGH}$$

↓
PROVIDE STIFFENERS!



Opgesteld :

Datum :

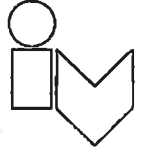
Bladnummer :

Rev. :

A2-49

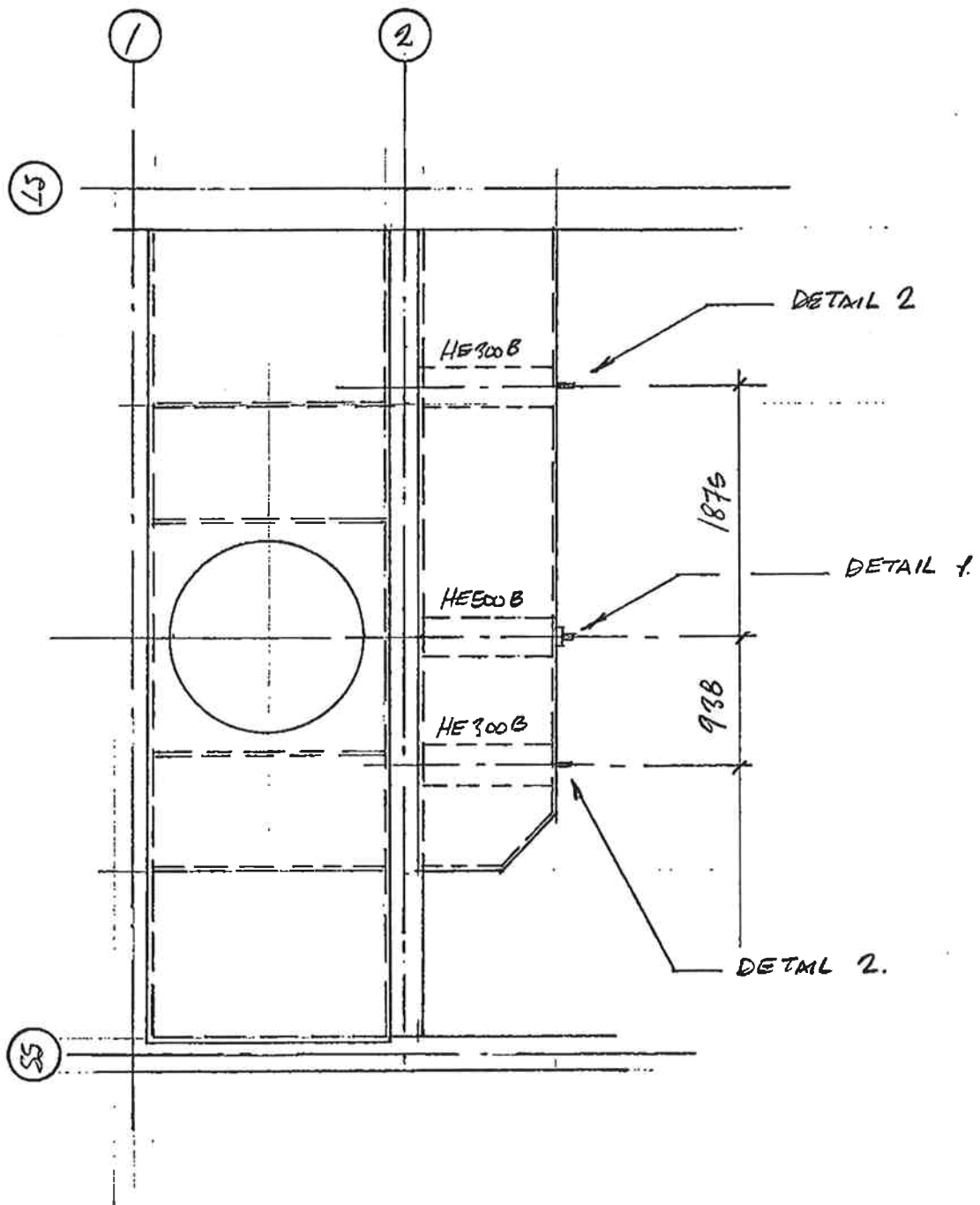
A2

Project : MALAMOCCO LOCK VENICE



Onderdeel :

ROAD RAMP SUPPORT DETAILS ~ WORKING AREA



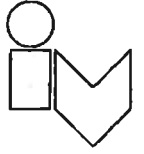
Opgesteld : GWJ

Datum :

Bladnummer : H2-50

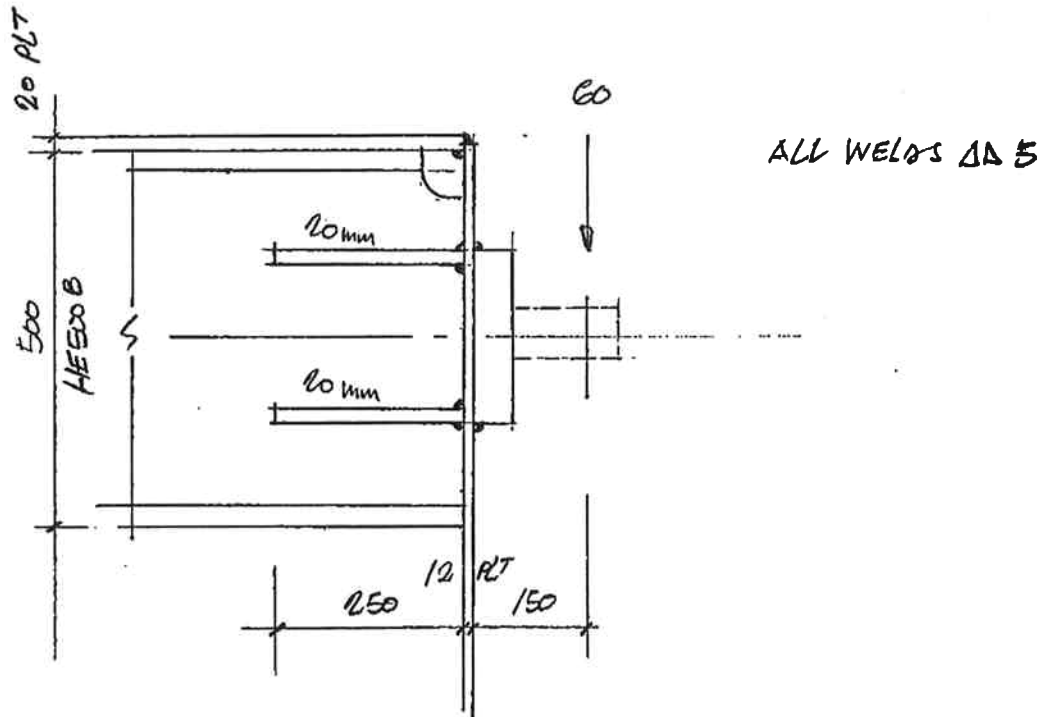
Rev. : A2

Project : MALAMOCIO LOCK VENICE



Onderdeel :

ROAD RAMP CYLINDER SUPPORT.



DETAIL 1.

Opgesteld :

GWJ

Datum :

Bladnummer :

H12-51

Rev. :

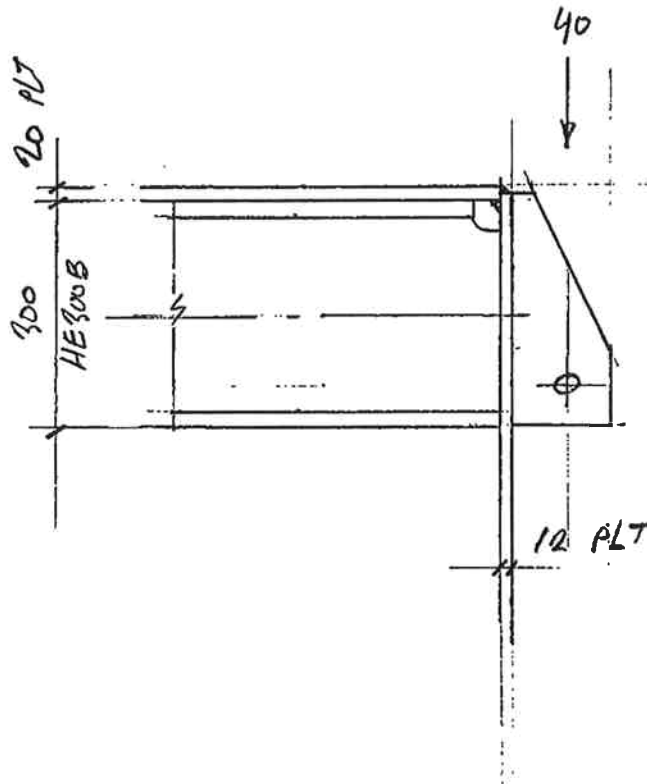
A2.

Project : MALAMOCCO LOCK VENICE



Onderdeel :

ROAD RAMP STAY SUPPORT.



ALL WELDS 105

DETAIL 2.

Opgesteld : GWJ

Datum :

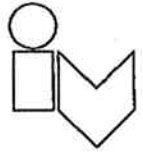
Bladnummer :

Rev. :

H2-52

A2

Project :

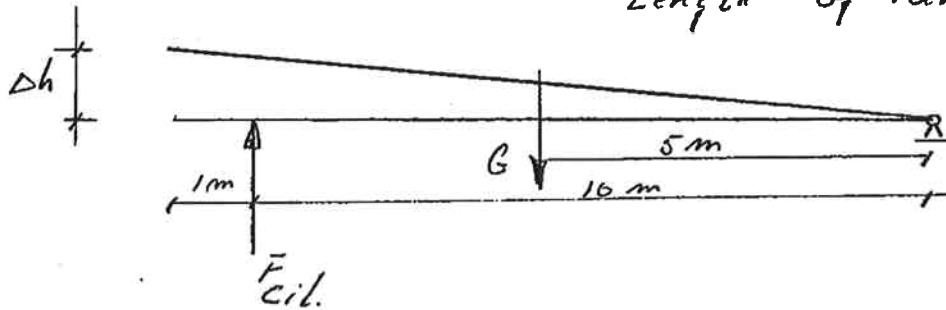


Onderdeel :

Roadramp.

Lifting force

Weight of ramp 108 kN
Length of ramp 10 m



$$F_{cil} = \frac{5 \times 108}{9} = 60 \text{ kN}$$

Cylinder 100/56

$$A_1 = 78,5 \text{ cm}^2$$

with $p = 100 \text{ bar} \rightarrow F_1 = 78,5 \text{ kN}$

Locking pins

Shear force on locking pins

1) weight of ramp ... 108 kN

2) Load due to traffic 400 kN

total 508 kN

$$F_{ping} = \frac{5 \times 508}{9} = 282,2 \text{ kN} \rightarrow 150 \text{ kN / side}$$

Opgesteld :

Datum :

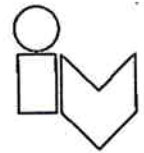
Bladnummer :

Rev. :

H12-53

A2

Project :

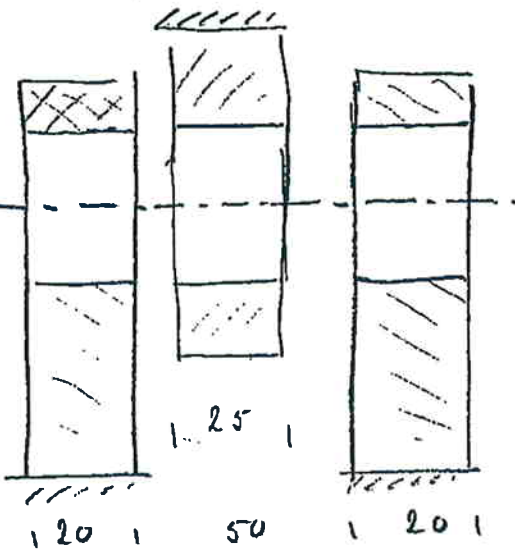


Onderdeel :

Pin ϕ 70 mm

$F = 150 \text{ kN}$

with $\sigma = 100 \text{ N/mm}^2 \rightarrow b = \frac{150.000}{100 \times 70} = 22 \text{ mm}$



$$BM = \frac{1}{4} PL = \frac{1}{4} \times 150 \times 10^3 \times 70$$

$$BM = 2,625 \times 10^6 \text{ Nmm}$$

$$W_b = 0,1 d^3 = 0,1 \times 70^3 = 34,3 \times 10^3 \text{ mm}^3$$

$$\sigma_b = \frac{2625 \times 10^3}{34,3 \times 10^3} = 76,53 \text{ N/mm}^2$$

$$\tau = \frac{4}{3} \times \frac{150000}{2 \times \frac{70}{4} \times 70^2} = 26 \text{ N/mm}^2$$

$$\sigma_{id} = \sqrt{\sigma^2 + 3\tau^2} = 88,0 \text{ N/mm}^2$$

Opgesteld :

Datum :

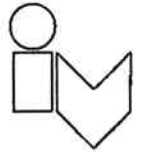
Bladnummer :

Rev. :

H2.59

A2

Project : MALAMOCCO LOCK VENICE.



Onderdeel :

PLATE STIFFENERS ~ BUCKLING CHECK

$$L = 5000 \text{ mm}$$

$$A = 13292 \text{ mm}^2$$

$$I = 22812 \times 10^4 \text{ mm}^4$$

$$i = \sqrt{\frac{22812 \times 10^4}{13292}} = 131 \text{ mm}$$

$$\sigma_{x,d} = 63,3 \text{ N/mm}^2$$

$$N_{sd} = 63,3 \times 13,292 = 842 \text{ kN}$$

$$\lambda = \frac{5000}{131} = 38,2 \quad \lambda_e = \pi \sqrt{\frac{E}{f_{y,d}}} = 80,1$$

$$\bar{\lambda} = \frac{38,2}{80,1} = 0,48 \quad \chi = 0,854$$

$$N_{Rd} = 0,854 \times 13,292 \times 355/1,1 = 3663 \text{ kN. } (> 842).$$

NO FURTHER CHECKS REQUIRED.

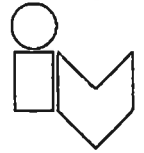
Opgesteld : GWJ

Datum : 01/04

Bladnummer : 112-55

Rev. : A2

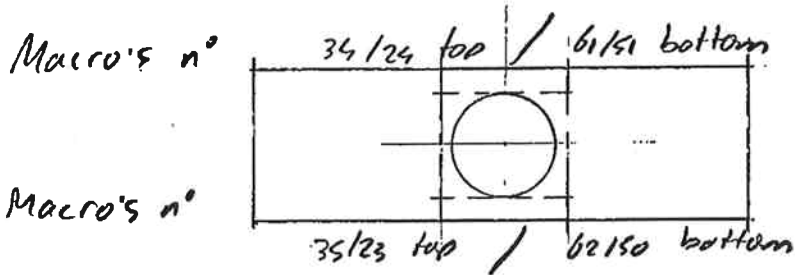
Project : MALAMOCLO LOCK VENICE



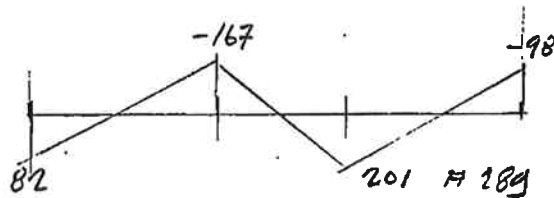
Onderdeel :

WORKING AREAS.

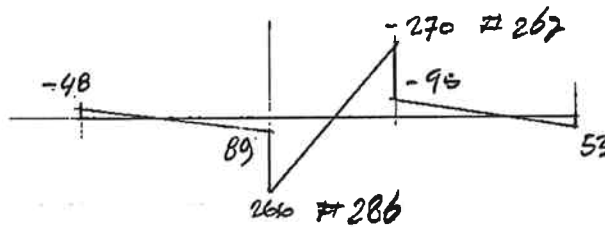
HEEDOB TRANSVERSALS WORKING SPACE



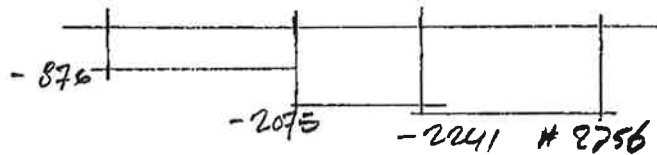
M_y



M_z



N



Opgesteld : GWJ

Datum :

Bladnummer :

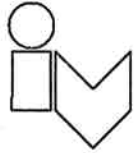
Rev. :

M2-56

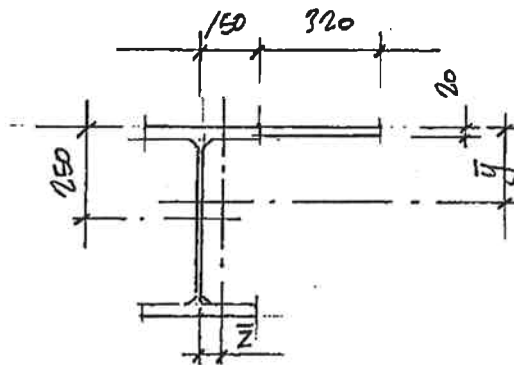
A2

Project :

Onderdeel :



SECTION PROPERTIES



$$\begin{aligned} \text{AREA HEED B} &= 23864 \\ 320 \times 20 &= 6400 \\ \hline &30264 \text{ mm}^2 \end{aligned}$$

NEUTRAL AXIS. Y-Y.

$$\begin{aligned} 23864 \times 250 &= 5966000 \\ 6400 \times 10 &= 64000 \\ \hline &6030000 \end{aligned}$$

$$\bar{y} = \frac{6030000}{30264} = 199 \text{ mm}$$

$$\begin{aligned} I_{yy} &= \frac{1071760 \times 10^4}{6400 (199 - 10)^2} \\ &130037 \times 10^4 \text{ mm}^4 \end{aligned}$$

$$\begin{aligned} W_{yy} &= \frac{130037 \times 10^4}{500 - 199} \\ &= 4320 \times 10^3 \text{ mm}^3 \end{aligned}$$

NEUTRAL AXIS Z-Z.

$$6400 \times 310 = 1984000$$

$$\bar{z} = \frac{1984000}{30264} = 65,6 \text{ mm}$$

$$\begin{aligned} I_{zz} &= \frac{12624 \times 10^4}{23864 (65,6)^2} \\ &20 \times 320^3 / 12 \\ &6400 (310 - 65,6)^2 \\ \hline &66583 \times 10^4 \text{ mm}^4 \end{aligned}$$

$$\begin{aligned} W_{zz} &= \frac{66583 \times 10^4}{470 - 65,6} \\ &= 1646 \times 10^3 \text{ mm}^3 \end{aligned}$$

Opgesteld :

GWJ

Datum :

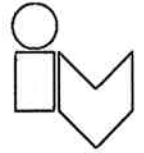
Bladnummer :

H2-57

Rev. :

A2

Project :



Onderdeel :

Forces modified EPW model

(see MV036P-PEMAR-4002)

$$N_{sd} = -2075 \text{ kN} \quad \# 2750$$

$$M_{y_{sd}} = 201 \text{ kNm} \quad \# 284$$

$$M_{z_{sd}} = 270 \text{ kNm} \quad \# 262$$

$$\sigma_x = \frac{2075 \times 10^3}{30264} = 69 \text{ N/mm}^2 \quad \# 91$$

$$\sigma_y = \frac{201 \times 10^3}{4320} = 47 \text{ N/mm}^2 \quad \# 62$$

$$\sigma_z = \frac{270 \times 10^3}{1646} = 164 \text{ N/mm}^2 \quad \# 162$$

$$\sigma_a = 69 + 47 + 164 = 280 \text{ N/mm}^2 \quad (0,87)$$

301

(# 0,94) ; O.K.

Note : combined max. forces at different locations.

Opgesteld :

Datum :

Bladnummer :

Rev. :

H12-58

A2