JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL WATER SUPPLY AND DRAINAGE BOARD
MINISTRY OF URBAN DEVELOPMENT, CONSTRUCTION
AND PUBLIC UTILITIES
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

THE DETAILED DESIGN STUDY ON THE PROJECT FOR REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FINAL REPORT

APPENDICES TO DESIGN REPORT ON THE CONTRACT FOR CIVIL WORKS

MARCH 2001

NIHON SUIDO CONSULTANTS CO., LTD.

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CURRENCY EQUIVALENTS

(As of August, 2000)

Currency Unit = Sri Lankan Rupee (Rs.)

US$1.00 = 79.47 Rs.

US$1.00 = 109.288 Yen (Japanese Yen)

1.0 Rs. = 1.37522 Yen (Japanese Yen)

1.0 Yen (Japanese Yen) = 0.727 Rs.

DESIGN REPORT ON CIVIL WORKS

APPENDIX - DESIGN CALCULATIONS AND OTHERS

TABLE OF CONTENTS

- Gothatuwa Ground Reservoir Site
  - Gravity Drain for Overflow / Washout

- Gothatuwa Ground Reservoir, Pump House and Gothatuwa New Water Tower
  - Time Series Analysis of Storage and Pump Cycles

PART III MISCELLANEOUS

- Maligakanda Office Building
  - Catalogue for Lighting Fixtures and Diesel Generator

- Maligakanda Office Building
  - Catalogue for Water Pumps and Fire Pumps

- Maligakanda / Ellie House Reservoirs
  - Chlorinators

- Maligakanda Reservoir Site
  - External Clamp on Ultrasonic Flowmeter

- Ellie House Reservoir
  - Penstock Gates

- Gothatuwa – Kolonnawa Pump House
  - Pumps

- Gothatuwa – Kolonnawa Pump House
  - Surge Tanks

- Gothatuwa – Kolonnawa Pump House
  - Electromagnetic Flowmeter

- Gothatuwa Pump House
  - Pumps

- Gothatuwa Pump House
  - Flow Control Valve

- Gothatuwa Pump House
  - Electromagnetic Flowmeter

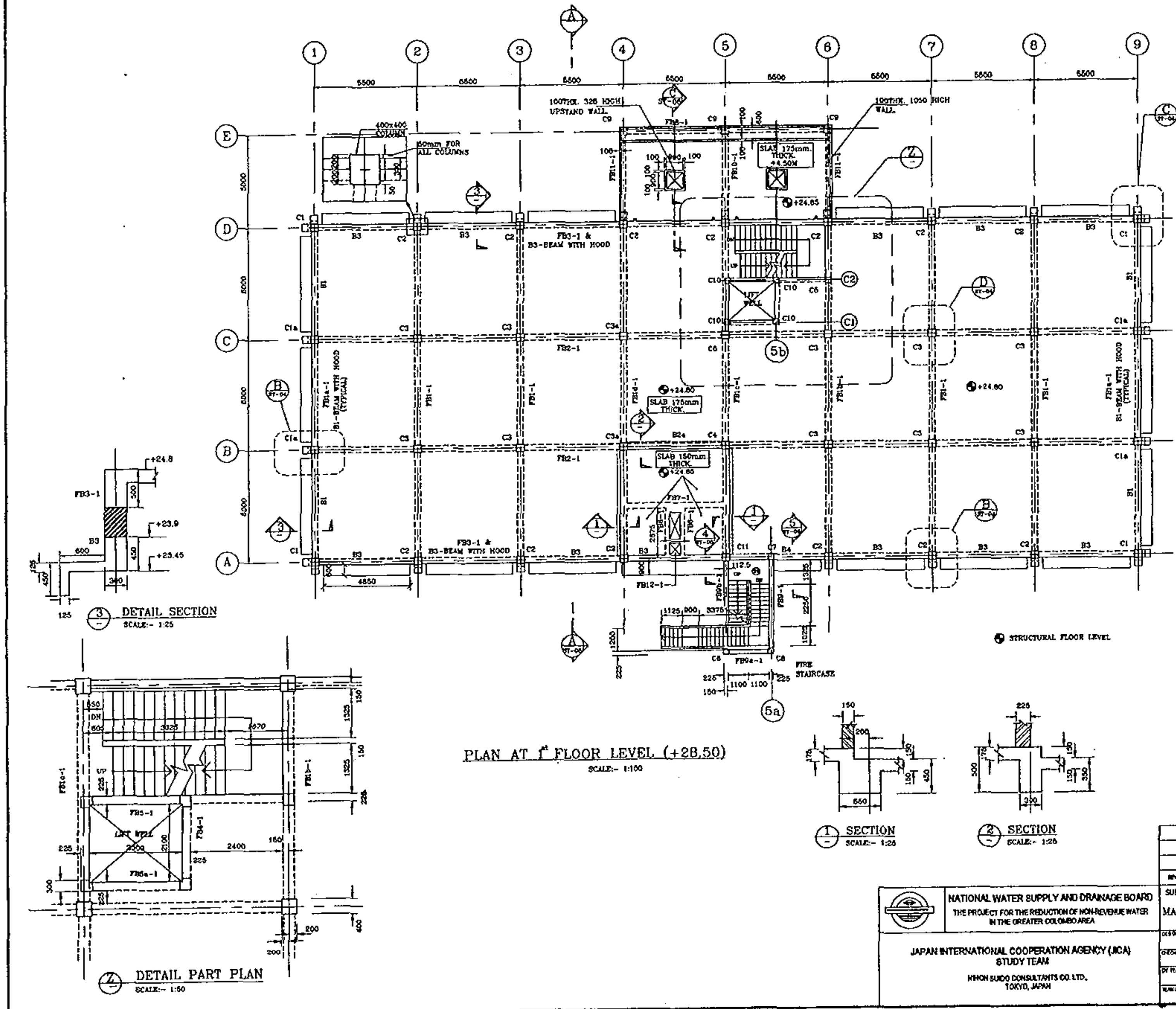
- Gothatuwa Pump House
  - Diesel Generator

- Gothatuwa Pump House
  - Penstock Gates

PART I

DESIGN CALCULATIONS – STRUCTURAL

MALIGAKANDA OFFICE BUILDING



BEAM TYPE	SIZE
FB1-1, FB1b-1, FB1c-1, FB1d-1	300x600
FB1a-1, FB3-1, FB2-1	300x500
B3, B1	300x450
FB4-1, FB5-1, FB5a-1, FB6-1	225x300
FB6-1	225x300
FB7-1	300x600
FB8-1, FB10-1, FB11-1	300x500
FB9-1, FB9a-1 FB9b-1	225x300
FB12-1	225x300

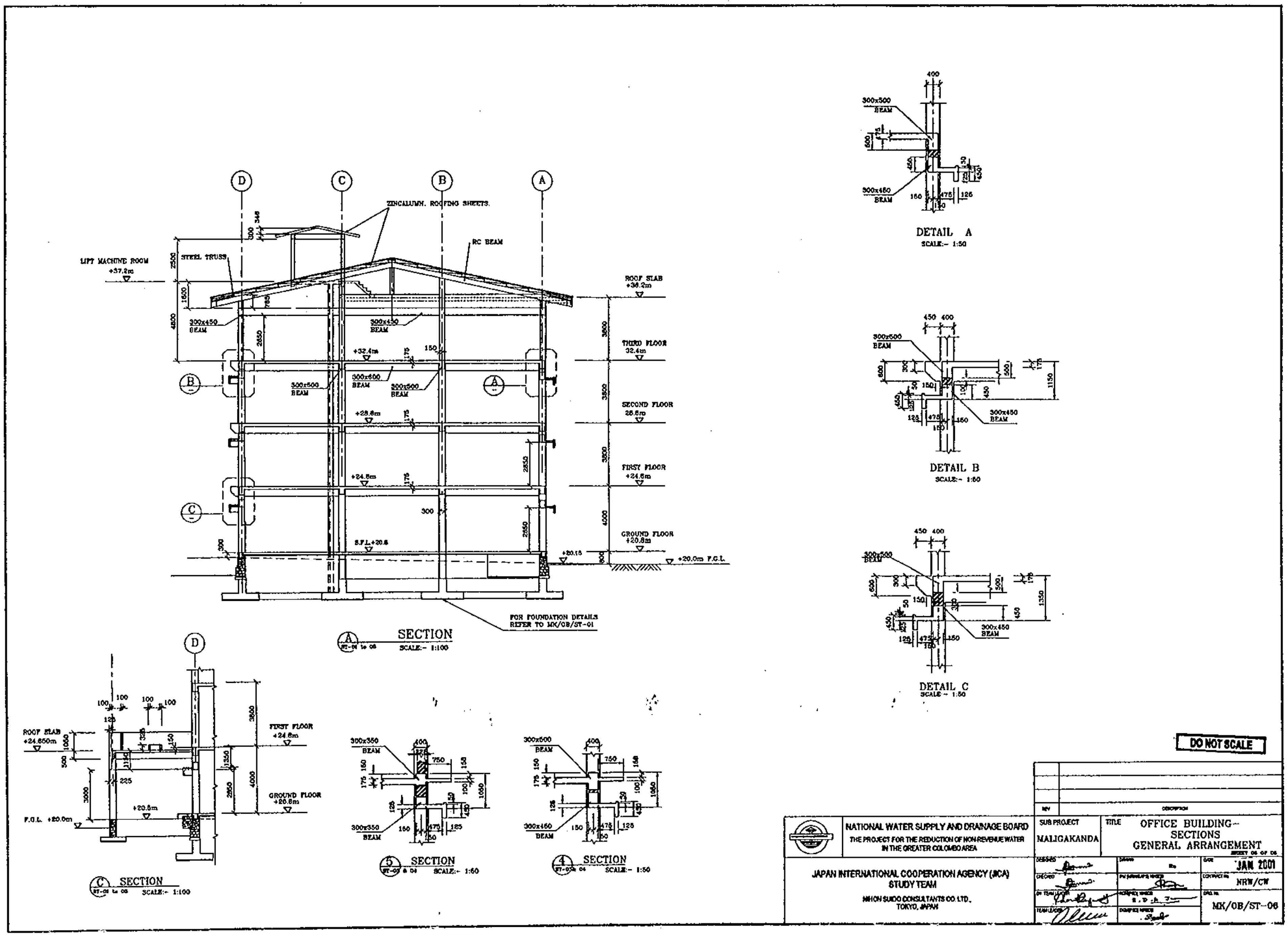
COL.TYPE	SIZE
C1, C1a	400x400
C2, C3, C3a, C4, C6, C11	400x400
C5	300x300
C7	300x300
C9	400x400
C8	300 x 300 (225, 75)
C10	300 x 300 (225, 75)

DO NOT SCALE

NATIONAL WATER SUPPLY AND DRAINAGE BOARD
THE PROJECT FOR THE REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) STUDY TEAM
NIHON SUIDO CONSULTANTS CO. LTD. TOKYO, JAPAN

SUB PROJECT: MALIGAKANDA
TITLE: OFFICE BUILDING- FIRST FLOOR PLAN · GENERAL ARRANGEMENT
SHEET 3 OF 8
DATE: JAN 2001
CONTRACT No. NRW/CW
DRG. No. MK/OB/ST-03


SECTION A
SCALE:- 1:100
LIFT MACHINE ROOM +37.2m
STEEL TRUSS
ZINCALUMN. ROOFING SHEETS.
RC BEAM
ROOF SLAB +36.2m
THIRD FLOOR 32.4m
SECOND FLOOR 28.6m
FIRST FLOOR +24.6m
GROUND FLOOR +20.8m
+20.0m F.G.L.
S.F.L.+20.8
300x450 BEAM
300x500 BEAM
FOR FOUNDATION DETAILS REFER TO MK/OB/ST-01
DETAIL A
SCALE:- 1:50
DETAIL B
SCALE:- 1:50
DETAIL C
SCALE:- 1:50
SECTION C
SCALE:- 1:100
SECTION 5
SCALE:- 1:50
SECTION 4
SCALE:- 1:50
DO NOT SCALE
NATIONAL WATER SUPPLY AND DRAINAGE BOARD
THE PROJECT FOR THE REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) STUDY TEAM
NIHON SUIDO CONSULTANTS CO. LTD., TOKYO, JAPAN
SUB PROJECT
MALIGAKANDA
TITLE
OFFICE BUILDING-- SECTIONS GENERAL ARRANGEMENT
JAN 2001
NRW/CW
MK/OB/ST--06

	PROJECT Reduction of non-Revenue water in the Greater Co. area.		JOB REF
	CALCULATIONS BY	CHECKED BY	CALC SHEET OB-R-01
	PART OF STRUCTURE Office building Roof slab.		DATE

MEMBER REF	CALCULATIONS	OUT PUT

slab.

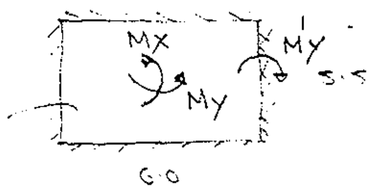
dead 0.175 × 24 = 4.2

finishes 0.065 × 22 = 1.43

5.63 kN/m²

super - 10.0 kN/m²

n = 1.4 × 5.63 + 1.6 × 10 = 23.88



204

$\frac{l_y}{l_x} = \frac{6.0}{5.5} = 1.09$

Mx = 0.044 × 24 × 5.5² = 31.9

My = 0.043 × 726 = 31.2

My' = 0.057 × " = 41.4

h = 175
d = 175 − 20 − 16
= 147

Mx = 32 kNm

$\frac{M}{f_{cu}bd^2} = \frac{32 \times 10^6}{25 \times 10^3 \times 147^2} = 0.059$

z = 0.92 × 147 = 135

$A_{st} = \frac{32 \times 10^6}{0.87 \times 450 \times 135} = 605$ - Y12 @ 150 (753)

$\frac{M}{bd^2} = \frac{32 \times 10^6}{10^3 \times 147^2} = 1.48$

$f_s = \frac{5}{8} \times 450 \times \frac{605}{753} = 226$

$\gamma_{st} = 0.55 + \frac{(477 - 226)}{120(0.9 + 1.48)} = 1.43$

$d = \frac{5.5 \times 10^3}{20 \times 1.43} = 192$

Try h = 200
d = 174

$\frac{M}{f_{cu}bd^2} = \frac{32 \times 10^6}{25 \times 10^3 \times 174^2} = 0.042$

z = 0.944 × 174 = 164

$A_{st} = \frac{32 \times 10^6}{0.87 \times 450 \times 164} = 498$ - Y10 @ 125 (628)

$\frac{M}{bd^2} = \frac{32 \times 10^6}{10^3 \times 174^2} = 1.06$

PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET OB-R-02
PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUT PUT

$$f_s = \frac{5}{8} \times 450 \times \frac{498}{628} = 223$$

$$\gamma_{st} = 0.55 + \frac{(477-223)}{120(0.9+1.06)} = 1.63$$

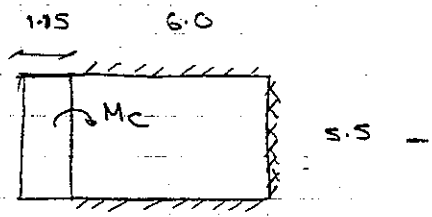
$$d = \frac{5.5\times10^3}{20\times1.63} = 169 < 174 \quad o.k.$$

$$M_y' = 42 \text{ kNm}$$

$$\frac{M}{f_{cu}bd^2} = \frac{42\times10^6}{25\times10^3\times174^2} = 0.055$$

$$z = 0.928 \times 174 = 162$$

$$A_{st} = \frac{42\times10^6}{0.87\times450\times162} = 576 \text{ - Y10 @ 100 (785)}$$



$$M_c = 24 \times \frac{(1.15)^2}{2} = 15.87$$

$$\frac{M}{f_{cu}bd^2} = \frac{16\times10^6}{25\times10^3\times174^2} = 0.021$$

$$z = 0.95 \times 174 = 165$$

$$A_{st} = \frac{16\times10^6}{0.87\times450\times165} = 248 \text{ - Y10 @ 250 (314)}$$

$$\frac{M}{bd^2} = 0.53$$

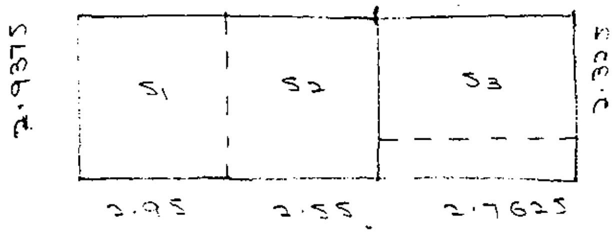
$$f_s = \frac{5}{8} \times 450 \times \frac{248}{314} = 222$$

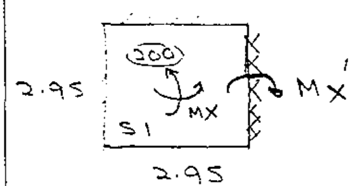
$$\gamma_{st} = 0.55 + \frac{(477-222)}{120(0.9+0.53)} = 2.04$$

$$d = \frac{1.15\times10^3}{7\times2} = 82 \quad o.k$$

	PROJECT		JOB REF
	CALCULATIONS BY	CHECKED BY	CALC SHEET 08-R-03
	PART OF STRUCTURE M/C floor slab		DATE

MEMBER REF	CALCULATIONS	OUT PUT





$Mx = 0.043 \times 24 \times 2.95^2 = 8.98$ kNm

$Mx' = 0.057 \times 24 \times 2.95^2 = 11.91$ "

$Mx = 9$

$\frac{M}{f_{cu} b d^2} = \frac{9 \times 10^6}{25 \times 10^3 \times 174^2} = 0.012$

$Z = 0.95 \times 174 = 165$

$A_{st} = \frac{9 \times 10^6}{0.87 \times 450 \times 165} = 139$ (Y10 @ 250) –

$\frac{M}{bd^2} = \frac{9 \times 10^6}{10^3 \times 174^2} = 0.3$

$f_s = \frac{5}{8} \times 450 \times \frac{139}{261} = 150$

$\gamma_{st} = 0.55 + \frac{(477 - 150)}{120(0.9 + 0.3)} = 2.82$

$d = \frac{2.95 \times 10^3}{20 \times 2} = 74 < 174$ o.k.

$Mx' = 12$

$A_{st} = 186$ –

Y10 @ 225 (349)

CONSULTING ENGINEERS

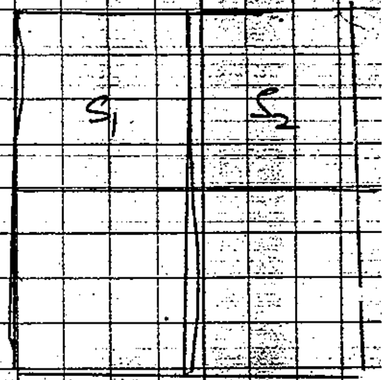
PROJECT Reduction of non-Revenue water in the Greater Co area | JOB REF

CALCULATIONS BY | CHECKED BY | CALC SHEET 08-S-

PART OF STRUCTURE Office building Floor slab | DATE

MEMBER REF | CALCULATIONS | OUTPUT

Typical Grid - 5.5 x 6.0



Loading

slab - 200 mm = 4.8 kN/m²
finishes 1.43 "
Gene part 1.00 "
7.23 "

Imposed - 3.00 "

n = 1.4 x 7.23 + 1.6 x 3.0 = 14.95 kN/m²
n = 14.95

STAIRS:-

waist 200 = 4.8 kN/m²
steps .25 x .175 / 2 x 4 x 24 = 2.1 "
finishes = 1.43
8.33

Impo = 3.00 "

n = 8.33 x 1.22 x 1.4 + 1.6 x 3.0
= 19.03 kN/m²

110 mm bk on main beams

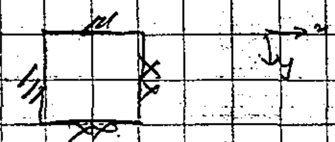
= 2.5 x 3 x 1.4 = 10.5 kN/m

	PROJECT	JOB REF
	CALCULATIONS BY / CHECKED BY	CALC SHEET OB-S-02
	PART OF STRUCTURE	DATE

MEMBER REF	CALCULATIONS	OUT PUT

Slab type S_1

$\frac{l_y}{l_x} = \frac{6.0}{5.5} = 1.09$



$M_x = .040 \times 15 \times 5.5^2 = 18.15$ kNm/m

$M_{x}' = .053 \qquad = 24.05$

$M_y = .035 \qquad = 15.88$

$M_{y}' = .047 \qquad = 21.33$

$M = 17.09$ kNm $\qquad d = 200 - 20 - 8 = 172$ mm

$\frac{M}{f_{cu} b d^2} = \frac{17.09 \times 10^6}{20 \times 10^3 \times 172^2} = .03$

$z = .95 d$

$A_s = \frac{17.09 \times 10^6}{.87 \times 460 \times .95 \times 172} = 261$ mm²/m

provide Y10 @ 200 c/c (392)

$f_s = 192$ N/mm²

$\gamma_{st} = 2.0 \qquad d =$

$d = \frac{5500}{26 \times 2} = 106 < 172$ mm

Try with

$h = 175$ mm $\qquad d = 147$ mm

$\frac{M}{f_{cu} b d^2} = \frac{18.15 \times 10^6}{20 \times 10^3 \times 147^2} = .042 \qquad z = .944 d$ | Y10@2

$A_s = 327$ mm²/m | 1.86 / 1.63

$f_s = 240$ N/mm² $\qquad \gamma_{st} = 1.65$

$d = 131$ mm < 147 mm ✓

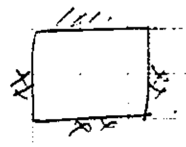
PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET 08-S-
PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUTPUT

	M	M/$f_{cu}bd^2$	z	Ast mm²/m		
	24.05	.06	.918d	445	Y10 @ 175 c/c	150
d = 137	15.88	.042	.944d	307	Y10 @ 250 c/c	
	21.33	.05	.933d	289	Y10 @ 250 c/c	

Slab Type S_2.

$\frac{l_y}{l_x} = 1.09$



$M_x = .032 \times 15 \times 5.5^2 = 14.52$ kNm/m

$M_x' = .048 \times " = 19.51$ "

$M_y = .028 \times " = 12.71$ "

$M_y' = .037 \times " = 16.79$ "

	M	M/$f_{cu}bd^2$	z	Ast mm²/m	Output
	14.52	.034	.95d	260	Y10 @ 25
	19.51	.045	.939d	353	Y10 @ 2
d = 137	12.71	.029	.095	247	Y10 @ 3
	16.79	.039	.0942	303	Y10 @ 2

M = 14.52 kNm

Ast = 260 mm²/m ; provide Y10 @ 250 c/c — 314

$f_s = 238$ N/mm²

$\gamma_1 = 1.70$

$d = \frac{5500}{26 \times 1.7} = 124$ mm < 147 — Y10 @ c/c

PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET 08 - S - 04
PART OF STRUCTURE		DATE

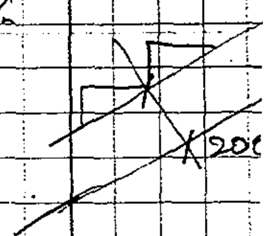
MEMBER REF	CALCULATIONS	OUTPUT

STAIRS:-

Span = 5.5 m

$wl^2/12$ = $\frac{18.23 \times 5.5^2}{12}$ = 45.95 kNm/m

d = 147 mm.



$\frac{M}{f_{cu}bd^2}$ = .11   z = .835d

A_s = $\frac{45.95 \times 10^6}{.87 \times 460 \times .835 \times d}$

= 936 mm²/m   provide Y16 @ 150 c/c (1340

fs = 201 N/mm²

γ_d = 1.31.

d = $\frac{5500}{26 \times 1.31}$ = 162 < 147.

Use 200 thick waist

~~with Same R/F~~

$\frac{M}{f_{cu}bd^2}$ = .08   z = .887d.

A_s = 753 mm²/m

fs = 215 N/mm² . γ_d = 1.34

d = 158 < 172 mm

Y16 @ 200 c/c

Beam at Intermediate landing level

U.d.l = $18.23 \times \frac{5.5}{2}$ + 22 = 72.B kN/m

400 x

Span = 3.2 m   B.M = $\frac{72 \times 3.2^2}{8}$ = 92.33 kNm

d = 360

b = 2 4 ...

9 $\frac{M}{f_{cu}bd^2}$ = .08   z = .887d.

V = $\frac{72 \times 3.2}{2}$ = 115.2 kN

4Y20 ... 2Y25

2Y20 + 2Y16. A_s = ~~722~~ V_c = 1.42 ...

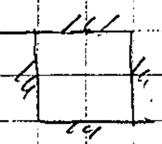
PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET 08-S-05
PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUTPUT

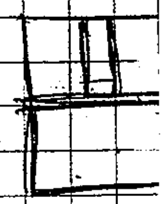
Slab - with Toilets.

150 mm drop.

Slab 200 = 4.8 kN
Finish = 2.0 "
Partition = 4.0 "



M_x = .113 × 14.15 × 3.0^2 = 14.39 kNm/m
M_y = .037 × " × " = 4.71 "



l_y / l_x = 5.5/3 = 1.83

M = 14.39 kNm

$\frac{M}{f_{cu} b d^2} = \frac{14.39 \times 10^6}{20 \times 10^3 \times 124^2}$

= .05

h = 150 mm
d = 150 − 20 − 6
= 124 mm

z = .9470

A_s = 306 mm^2/m Y10 @ 200 c/c (392)

f_s = 225 N/mm^2

M = 1.66

d = $\frac{3000}{20 \times 1.66}$ = 90 < 124 mm O.K.

Load on small beam :- (B6)

span 3.0

Slab = 150 — 3.6 kN/m
Finishes 2.0 "
Partition 4.4 "
10.6 "

n = 1.4×10 + 1.6 × 2.5
= 18.0 kN/m²

PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET 08-S-0
PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUT PUT

B6

u.d.l = $\frac{18 \times 2.5}{2}$ + 10.5 + 2.0 = 35 kN/m

$wl^2/8$ = $35 \times \frac{3.0^2}{8}$ = 39.38 kNm.

d = 300 − 25 − 8 = 267 mm.

$\frac{M}{bd^2}$ = $\frac{39.38 \times 10^6}{20 \times 200 \times 267^2}$ = .09

z = .816 d

As = 479 mm²

V = $35 \times \frac{3.0}{2}$ = 52.5 kN

v = $\frac{52.5 \times 10^3}{200 \times 267}$ = .98 N/mm

tv = 197 N/

Output: 2Y16 +2Y12; 4 10 @

Beam B7 span = 5.5 m.

u.d.l = $16.15 \times \frac{3.0}{2}$ + 10.5 + 2.5 = 34 kN/m.

$wl^2/8$ + 52.5 × 2.5 = 259.81 kNm

be = $\frac{.75}{10} \times 5500$ + 300
= 712.5 kN

d = 550 − 25 = 490

$\frac{M}{bd^2}$ = 0.11   z = .835d

As = $\frac{259.81 \times 10^6}{.87 \times 460 \times .835 \times 410}$

= 1896 mm²

Output: 4Y25; 3Y25 + 2

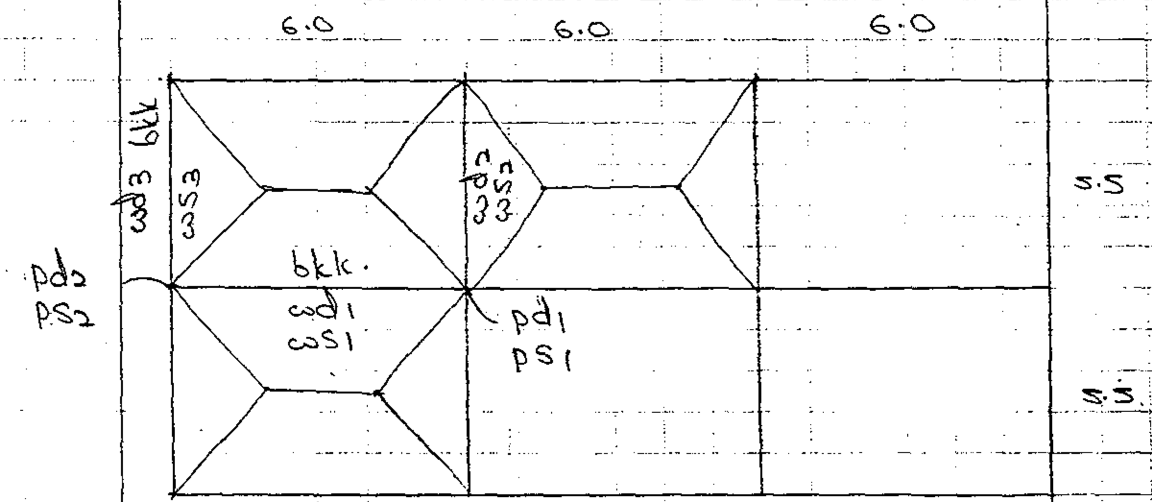
CONSULTING ENGINEERS

PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET OB-S-
PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUTPUT
	$V = 34 \times \frac{5.5}{2} + 52.5 =$	
	$= 146$ kN	
	$v = \frac{146 \times 10^3}{300 \times 410} = 1.19$ N/mm	
	with 2 Y 25 — .8%, $v_c = .53$ N/mm²	
	$b(v-v_c) = 800 (1.19 - .53)$	
	$= 198$ N/mm	Y10 @ 27

PROJECT NRW		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET 08-F-01
PART OF STRUCTURE office building Floor beams		DATE

MEMBER REF	CALCULATIONS	OUT PUT



loading
Dead
slab 0.175 × 24 = 4.2
finishes 0.05 × 22 = 1.1
partitions = 1.0
6.3 kN/m² — S.LS
super = 3.0 kN/m²

$wd_1 = 6.3 \times \frac{5.5}{6}\left(3 - \frac{5.5^2}{6.0}\right) \times 2 + \{ = 39.79$ kN/m
(blk) $0.275 \times 18 \times 3.0$
(14.85)

$ws_1 = 3.0 \times \frac{5.5}{6}\left(3 - \frac{5.5^2}{6.0}\right) \times 2 = 11.88$ kN/m

$wd_2 = 6.3 \times \frac{5.5}{3} \times 2 + 14.85 = 37.95$ kN/m

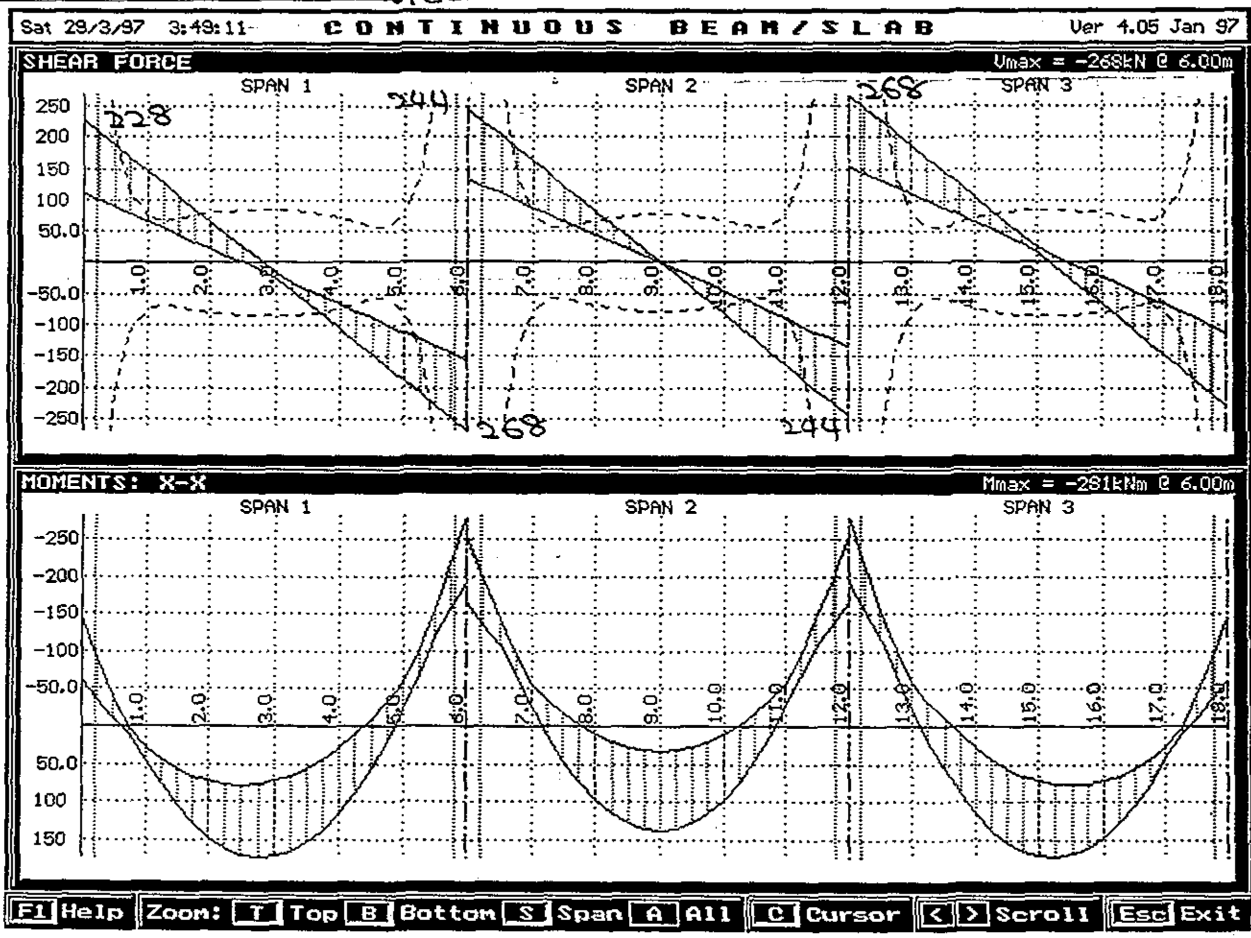
$ws_2 = 3.0 \times \frac{5.5}{3} \times 2 = 11.0$,,

$wd_3 = 6.3 \times \frac{5.5}{3} + 14.85$ (blk.) $= 26.4$ kN/m
$ws_3 = 3.0 \times 5.5/3 = 5.5$ kN/m

$pd_1 = 37.95 \times 5.5 = 208.73$ kN
$ps_1 = 11.0 \times 5.5 = 60.5$ "
$pd_2 = 26.4 \times 5.5 = 145.2$ "
$ps_2 = 5.5 \times 5.5 = 30.2$ "

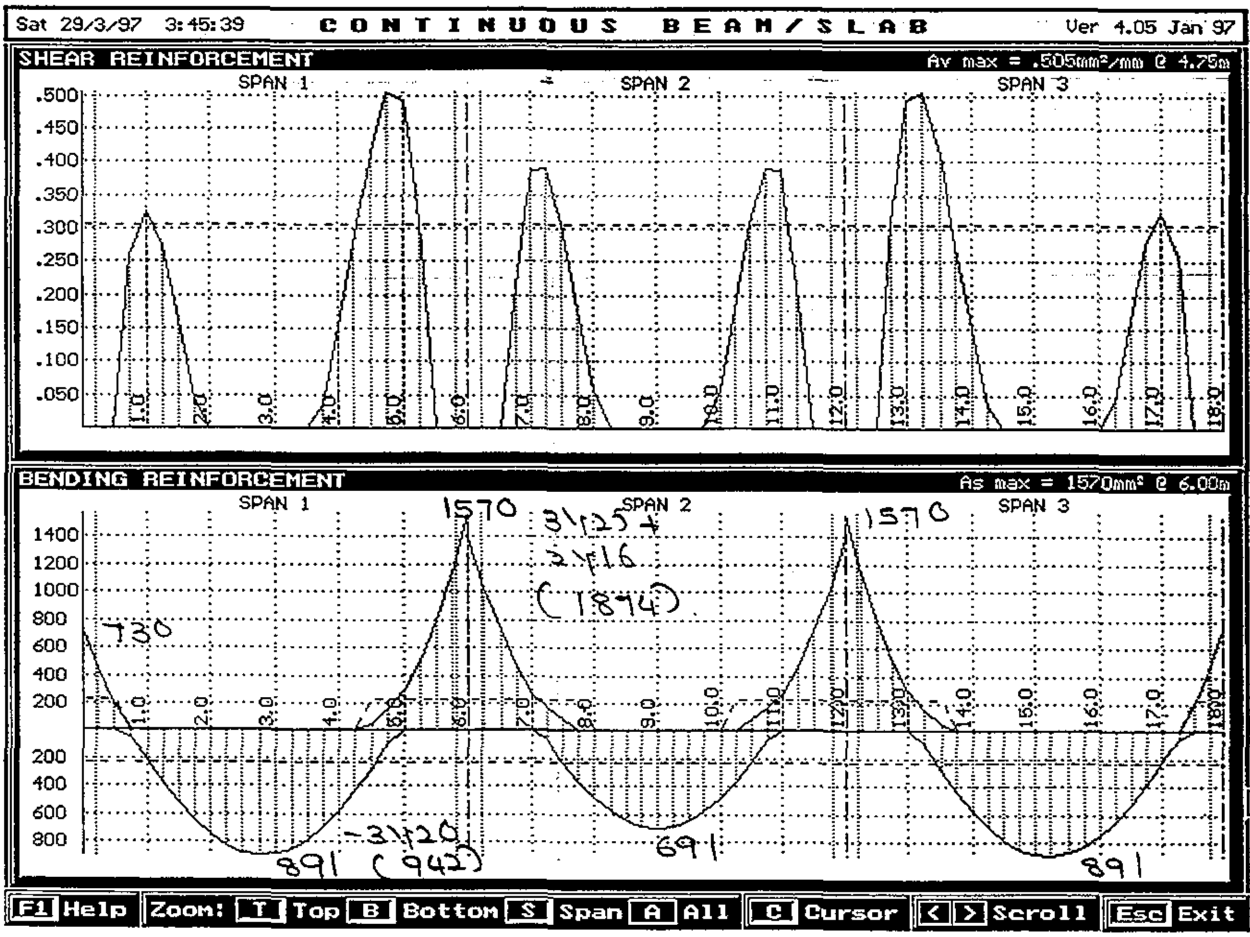
FB1 OB-F-0

ULS



Sat 29/3/97 3:49:11 CONTINUOUS BEAM/SLAB Ver 4.05 Jan 97
SHEAR FORCE
Vmax = -268kN @ 6.00m
SPAN 1
SPAN 2
SPAN 3
228
244
268
268
244
MOMENTS: X-X
Mmax = -281kNm @ 6.00m
F1 Help Zoom: T Top B Bottom S Span A All C Cursor < > Scroll Esc Exit

FB1 OB-F-03


Sat 29/3/97 3:45:39
CONTINUOUS BEAM/SLAB
Ver 4.05 Jan 97
SHEAR REINFORCEMENT
Av max = .505mm²/mm @ 4.75m
SPAN 1
SPAN 2
SPAN 3
.500
.450
.400
.350
.300
.250
.200
.150
.100
.050
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0
BENDING REINFORCEMENT
As max = 1570mm² @ 6.00m
1400
1200
1000
800
600
400
200
200
400
600
800
730
1570
3Y25 + 2Y16 (1894)
1570
-3Y20
891 (942)
691
891
F1 Help
Zoom: T Top B Bottom S Span A All
C Cursor
< > Scroll
Esc Exit

PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET 08-F-04
PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUTPUT

Beam FB1 - 300 x 600

Top r/f at support =
Ast = 1570 - 3r25 + 2r16 (1874) — ULS, Ref steel diagrams

bot r/f at span
Ast = 891 - 3r20 (942)

V = 268 kN

$V_u = \frac{268 \times 10^3}{300 \times 532} = 1.68\ N/mm^2$

d = 600 - 25 - 10 - 25 - 16/2 = 532

$\frac{100 A_s}{bd} = \frac{100 \times 1874}{300 \times 532} = 1.17$

$V_c = 0.66\ N/mm^2$

$b(v - v_c) = 300(1.68 - 0.66) = 306.$

r10 @ 150 c/c

V = 228 kN

$V_u = \frac{228 \times 10^3}{300 \times 532} = 1.43$

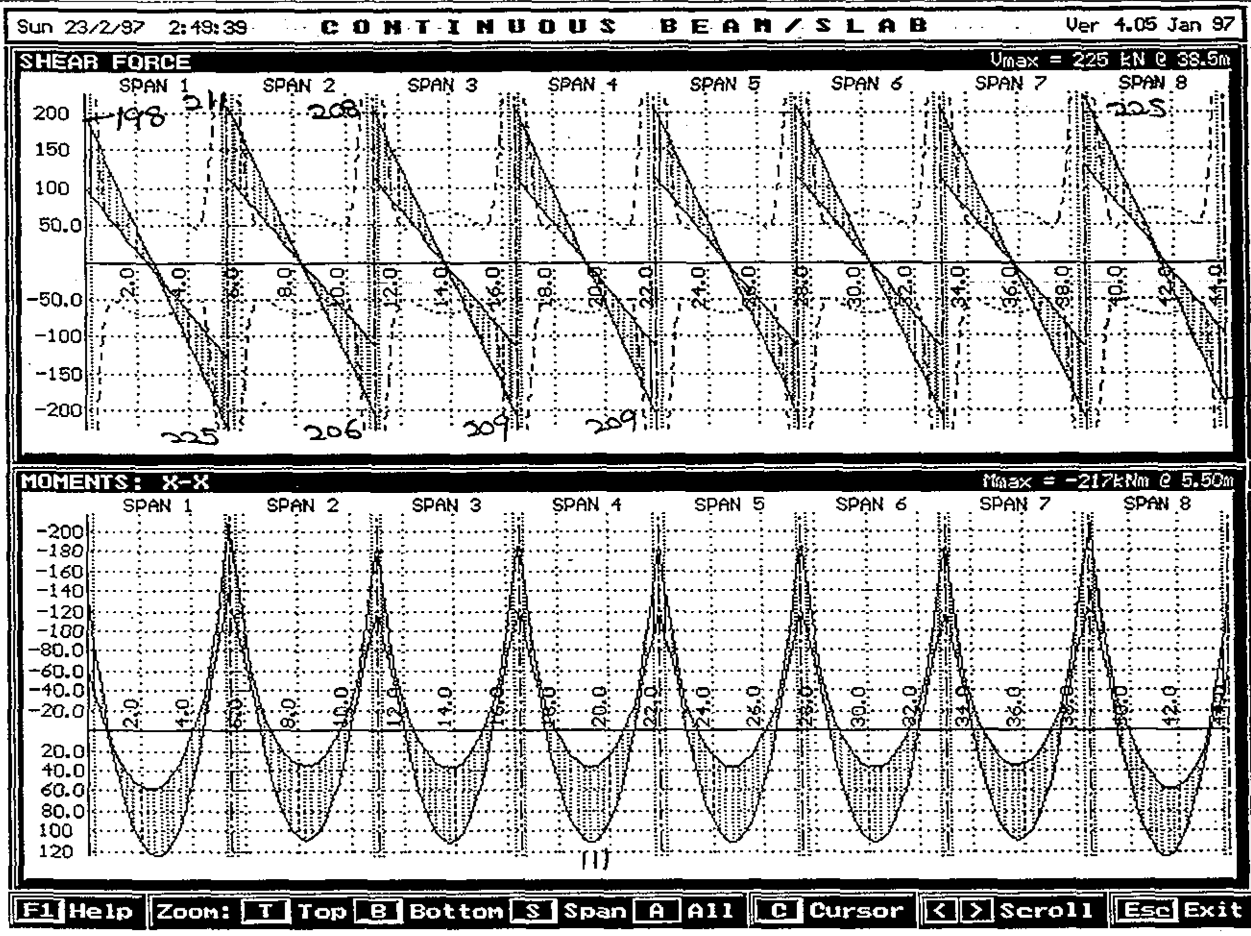
d = 600 - 25 - 10 - 25/2 = 552.5

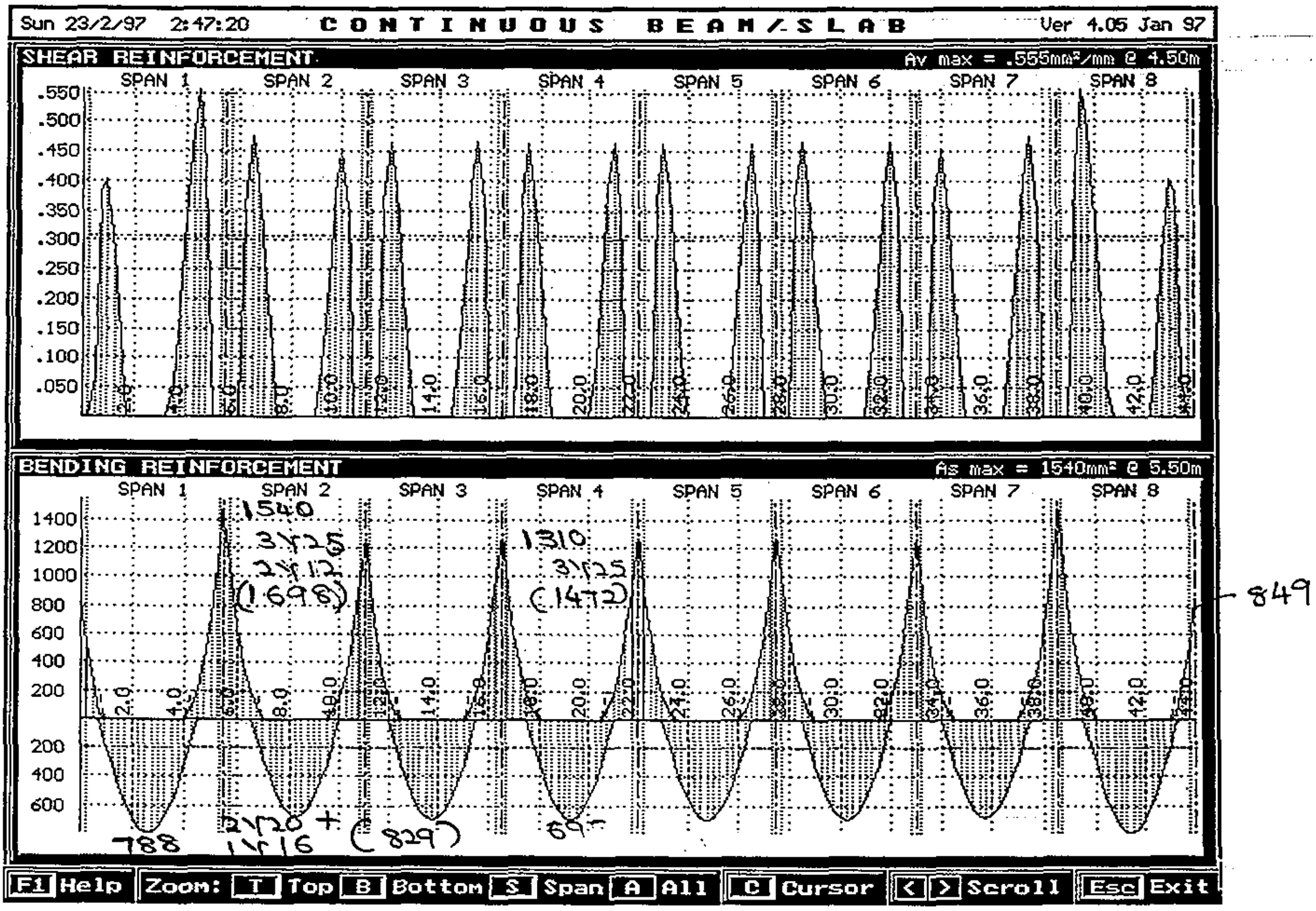
$\frac{100 A_s}{bd} = \frac{100 \times 1472}{300 \times 552} = 0.89$

$V_c = 0.6$

$b(v - v_c) = 249$ - r10 @ 200 c/c.

GB - F - 05
FB2 - 300 x 500





Sun 23/2/97 2:47:20
CONTINUOUS BEAM/SLAB
Ver 4.05 Jan 97
SHEAR REINFORCEMENT
Av max = .555mm²/mm @ 4.50m
SPAN 1 SPAN 2 SPAN 3 SPAN 4 SPAN 5 SPAN 6 SPAN 7 SPAN 8
BENDING REINFORCEMENT
As max = 1540mm² @ 5.50m
1540
3Y25
2Y12
(1698)
1310
3Y25
(1472)
849
788
2Y20 +
1Y16
(829)
F1 Help Zoom: T Top B Bottom S Span A All C Cursor < > Scroll Esc Exit

DAYANANDA ASSOCIATES	PROJECT		JOB REF
CONSULTING ENGINEERS	CALCULATIONS BY	CHECKED BY	CALC SHEET OB-F-09
	PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUT PUT
	Beam FB2 - 300×500	

Top r/f at supports

Ast = 1540 - 3Y25 + 2Y12 (1698)

bottom r/f at span

Ast = 788 - 2Y20 + 1Y16 (829)

d = 500 - 25 - 10 = 455

V = 225 kN

$V_u = \frac{225 \times 10^3}{300 \times 455} = 1.65\ N/mm^2$

$\frac{100 A_s}{bd} = \frac{100 \times 1472}{300 \times 455} = 1.08$

$V_c = 0.64$

$b(V - V_c) = 300(1.65 - 0.64) = 303$

Y10 @ 175 c/c

V = 209 kN

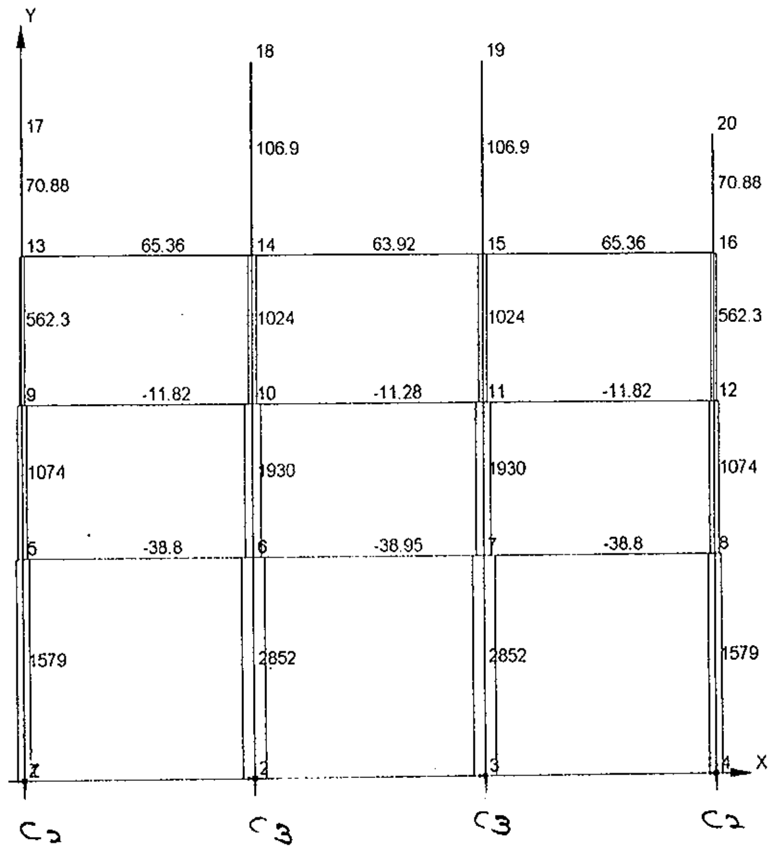
$V_u = \frac{209 \times 10^3}{300 \times 455} = 1.53\ N/mm^2$

$V_c = 0.64$

$b(V - V_c) = 300(1.53 - 0.64) = 267$

Y10 @ 200

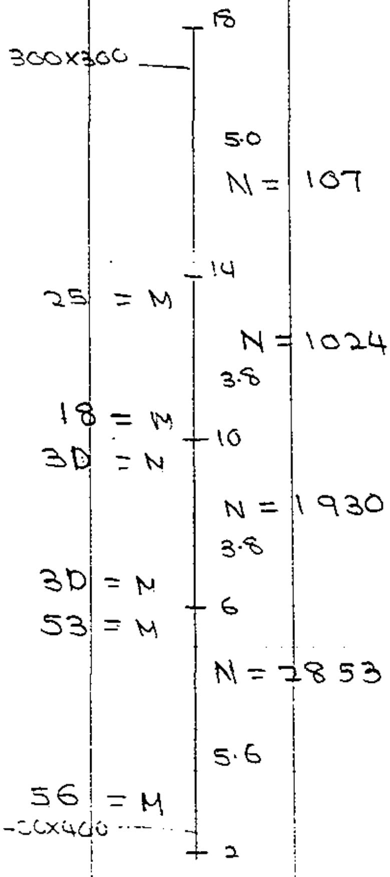
TYPICAL MAIN FRAME
(AXIAL LOADS)



PROJECT NRW		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET OB-C-02
PART OF STRUCTURE office building columns		DATE

MEMBER REF	CALCULATIONS	OUT PUT

column C3 -



2-6

N = 2853 Mx = 56

l_{ox} = 5600 - 500 = 5100

l_{ex} = 1.2 × 5100 = 6120

$\frac{l_{ex}}{h} = \frac{6120}{400} = 15.3 > 10$ unbraced slender

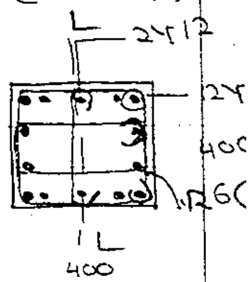
Madd = 2853 × 0.11 × 1 × 0.4 = 126

M Tot = 56 + 126 = 182 kNm.

$\frac{N}{bhf_{cu}} = \frac{2853 \times 10^3}{400^2 \times 25} = 0.71$ d = 400 - 40 ... = 337.5

$\frac{M}{bh^2 f_{cu}} = \frac{182 \times 10^6}{400 \times 400^2 \times 25} = 0.11$ $\frac{d}{h} = 0.84$

ASC = $0.62 \times \frac{25}{450} \times 400^2 = 5511$ - 12Y25 (5889)



6-10

N = 1930 kN Mx = 30 kNm

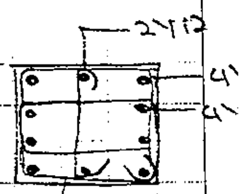
l_{ox} = 3800 - 500 = 3300

l_{ex} = 1.2 × 3300 = 3960

$\frac{l_{ex}}{h} = \frac{3960}{400} = 9.9$

$\frac{l_{ey}}{b} = \frac{1.2(3800-600)}{400} = 9.6$ - short

$\frac{N}{bhf_{cu}} = \frac{1930 \times 10^3}{400^2 \times 25} = 0.48$



$\frac{M}{bh^2 f_{cu}} = \frac{30 \times 10^6}{400 \times 400^2 \times 25} = 0.021$

ASC = 0.01 × 400² = 1600 - 4Y16. 4Y20

	PROJECT	JOB REF
	CALCULATIONS BY / CHECKED BY	CALC SHEET OB-C-03
	PART OF STRUCTURE	DATE

MEMBER REF	CALCULATIONS	OUT PUT

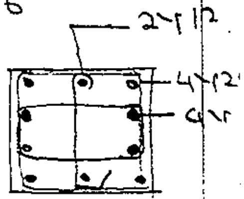
10 – 14.

$N = 1024\ kN \qquad M_x = 25\ kNm$

$\frac{N}{bhf_{cu}} = \frac{1024 \times 10^3}{400^2 \times 25} = 0.256$

$\frac{M}{bh^2 f_{cu}} = \frac{25 \times 10^6}{400 \times 400^2 \times 25} = 0.016$

provide $= 0.01 \times 400^2 = 1600$ – 4Y20, 4Y16



14 – 18.

$N = 107\ kN$

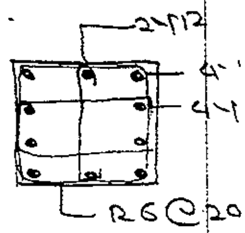
$l_{ox} = 5000 - 600 = 4400$

$l_{ex} = 1.2 \times 4400 = 5280$

$\frac{l_{ex}}{h} = \frac{5280}{300} = 17.6$ – slender.

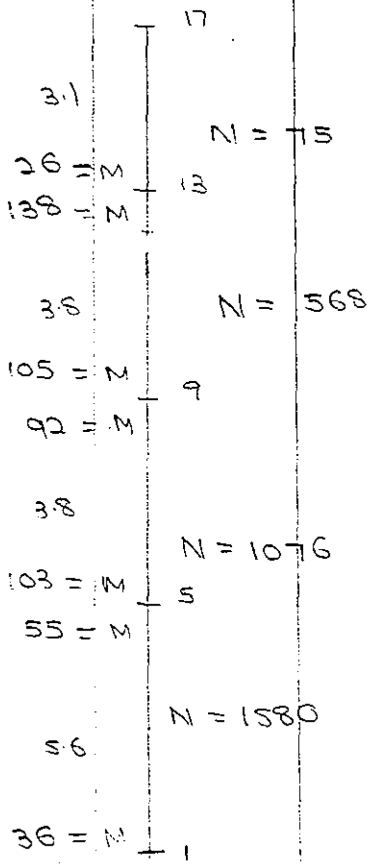
$M_{add} = 107 \times 0.16 \times 1 \times 0.3 = 5.1$

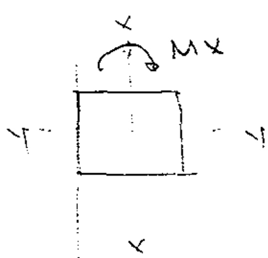
Provide $A_{sc} = 0.01 \times 300^2 = 900$ – 4Y16 (1256), 4Y12



[illegible]	PROJECT	JOB REF
	CALCULATIONS BY / CHECKED BY	CALC SHEET OB-C-04
	PART OF STRUCTURE	DATE

MEMBER REF	CALCULATIONS	OUT PUT





column C2

1 – 5

N = 1580 kN   Mi = 103 kNm.

l_o = 5600 − 500 = 5100

$\frac{l_{ex}}{h} = \frac{1.2 \times 5100}{400} = 15.3 > 10$ slender

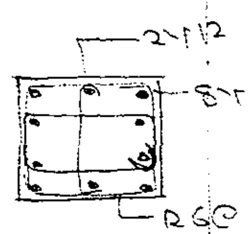
Madd = 1580 × 0.11 × 0.4 = 69.52

Mtot = 103 + 70 = 173 kNm

$\frac{N}{bhf_{cu}} = \frac{1580 \times 10^3}{400^2 \times 25} = 0.395$

$\frac{M}{bh^2 f_{cu}} = \frac{173 \times 10^6}{400 \times 400^2 \times 25} = 0.11$

$A_{sc} = 0.38 \times \frac{25}{450} \times 400^2 = 3378$ – 8Y25



5 – 9

N = 1076 kN   Mi = 105 kNm.

short column

$\frac{N}{bhf_{cu}} = \frac{1076 \times 10^3}{400^2 \times 25} = 0.27$

$\frac{M}{bh^2 f_{cu}} = \frac{105 \times 10^6}{400 \times 400^2 \times 25} = 0.07$

$A_{sc} = 0.11 \times \frac{25}{450} \times 400^2 = 977.$

provide $A_{sc} = 0.01 \times 400^2 = 1600$ – 4Y20, 4Y16

9 – 13

N = 568 kN   M = 138

provide $A_{sc} = 0.01 \times 400^2 = 1600$

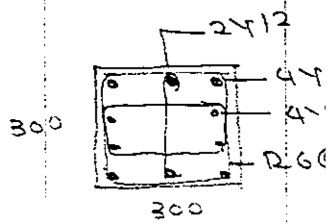
PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET 08-C-05
PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUT PUT

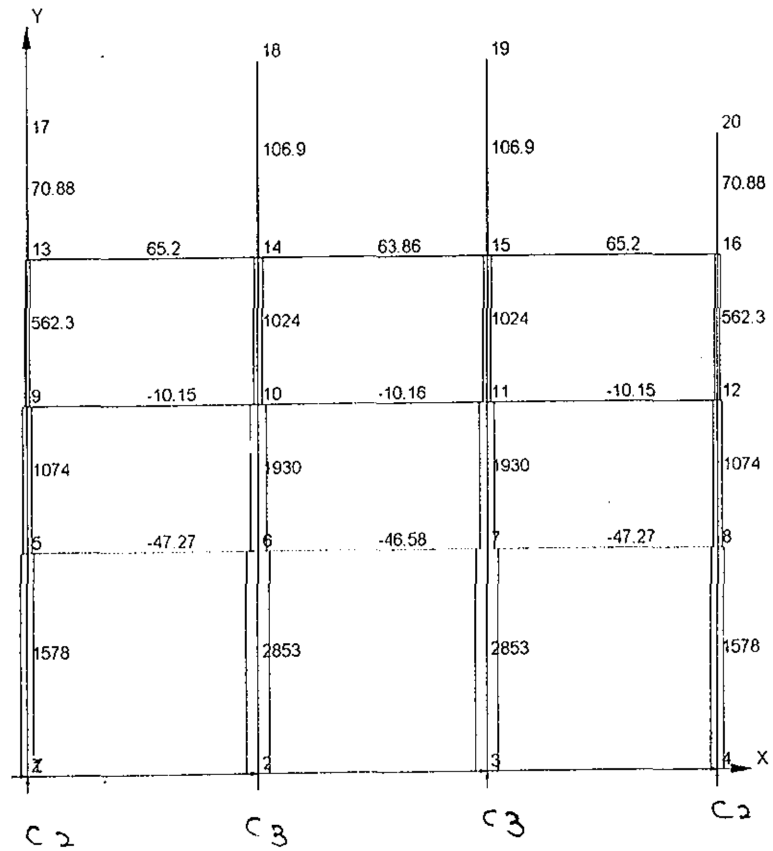
13-17.

N = 75.

provide $Asc = 0.01 \times 300^2 = 900$ – 4Y16
4Y12 (1256)



TYPICAL MAIN FRAME

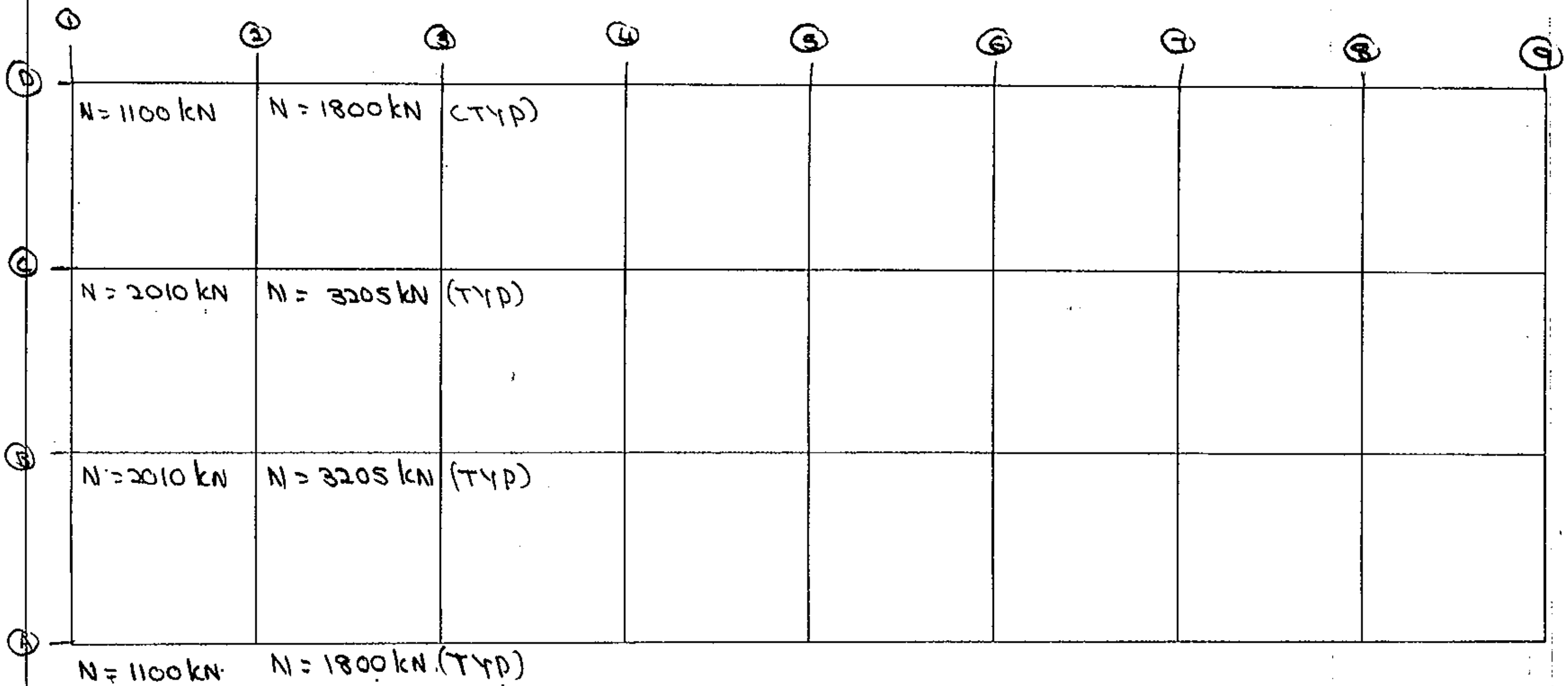


FOUNDATION PLAN

MN/ELEM

STRUCTURE DATA

TYPE = SPACE
NJ = 299
NM = 322
NE = 0
NS = 0
NRJ= 299
NL = 3
XMAX= 44.0
YMAX= .0
ZMAX= 18.0



J=299,M=322

UNIT MET KNS

S T A A D   P O S T - P L O T (REV: 22.3a)   DATE: NOV 15, 2000

TITLE: "AF-8-11A.STD" MALIGA ADMIN BUILDING FOU

User ID: Research Engineers, Inc.

08-FD-02

DAYANANDA ASSOCIATES	PROJECT NRW		JOB REF
CONSULTING ENGINEERS	CALCULATIONS BY	CHECKED BY	CALC SHEET OB-FD-03
	PART OF STRUCTURE OFFICE BUILDING. FOUNDATION		DATE

MEMBER REF	CALCULATIONS	OUT PUT

Foundation load

Mid frame

C2 - edge column

load from upper floors = 1578 kN

" " Ground floor (bkk load) = 0·275 × 18 × 4·0 × (5·5 + 0·4×6) × 1·4 = 219 kN

Total load = 1797 kN

say 1800 kN

C3 - mid column.

load from upper floors = 2853 kN

" " Ground floor (bkk load) = 0·275 × 18 × 4·0 (5·5 + 2×0·6×6) × 1·1 = 352 kN

Total = 3205 kN

Edge frame

C1a - edge column

load from upper floors = 957 kN

" " Ground " (bkk load) = 0·275 × 18 × 4·0 × (0·4×6 + 5·5/2) × 1 = 143 kN

Total load = 1100 kN

C1 - mid column.

load from upper floors = 1734 kN

" " Ground " (bkk load) = 0·275 × 18 × 4·0 × (5·5/2 + 2×0·6×6) × 1 = 276 kN

Total = 2010 kN

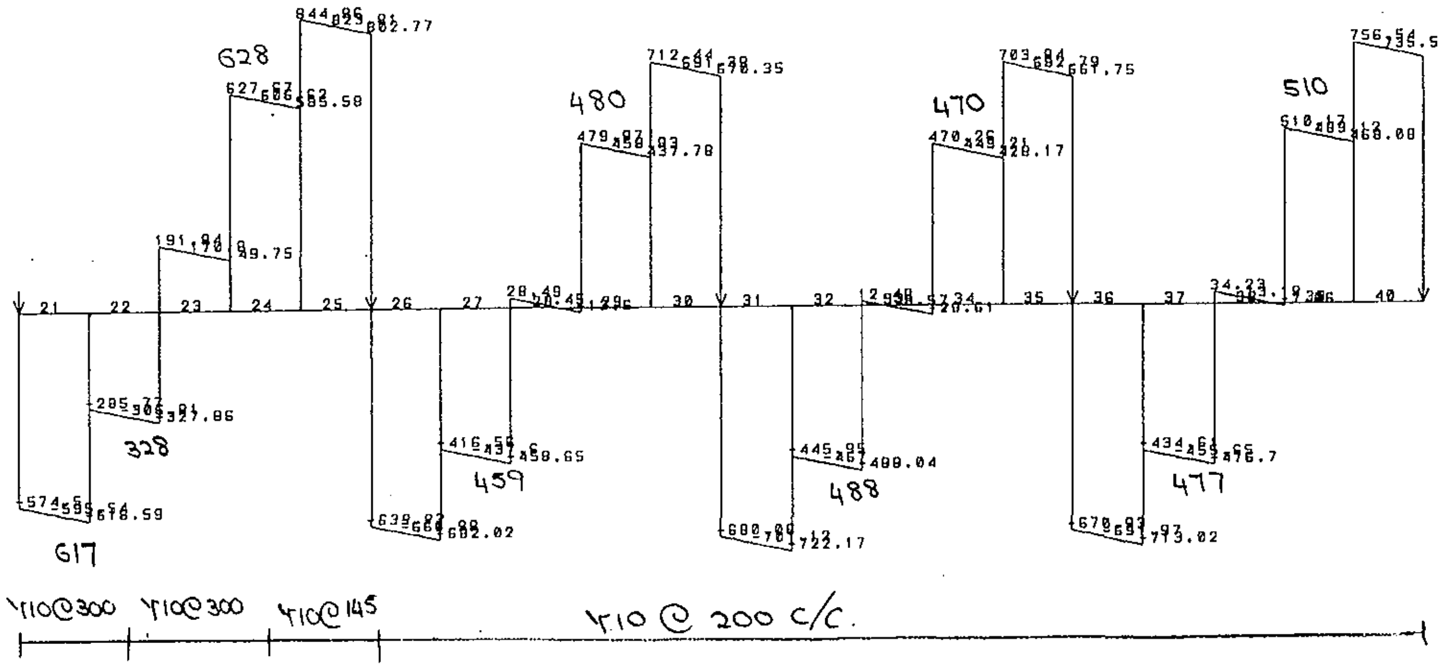
BEAM DESIGN (BS:8110)		GB-ma-second-mid			
====================					
Project	maliga				
Beam	GB BEAM ON AXIS -B				
fcu (N/mm^2) =	25	25	25	25	25
fy (N/mm^2) =	450	450	450	450	450
bw (mm) =	450				
h (mm) =	1200				
d (mm) =	1090				
d' (mm) =	97.5				
bf (mm) =	450				
hf (mm) =	400				
m (kNm) =	995	468	767	466	828
redist % =	0	0	0	0	0
DESIGN FOR BENDI					
k' =	0.156	0.156	0.156	0.156	0.156
k (M/bd^2fcu)=	0.074	0.035	0.057	0.035	0.062
z (mm)=	991	1036	1015	1036	1009
x (mm)=	220	121	166	121	180
fsc (N/mm^2)=	390	136	288	136	321
====================	====================	====================	====================	====================	====================
As (mm^2)=	2565	1154	1929	1149	2096
As'(mm^2)=	0	0	0	0	0
====================	====================	====================	====================	====================	====================
DESIGN FOR SHEAR					
V (kN) =	328	628	191	480	510
As (mm^2)=	1472	1472	1472	1472	1472
bv (mm)=	450	450	450	450	450
d (mm)=	1090	1090	1090	1090	1090
v (N/mm^2)=	0.67	1.28	0.39	0.98	1.04
100As/bd =	0.30	0.30	0.30	0.30	0.30
vc (N/mm^2)=	0.42	0.42	0.42	0.42	0.42
b(v-vc) =	111	386	-15	250	277
b*0.4 =	180	180	180	180	180
====================	====================	====================	====================	====================	====================
Links R6 2legs	68	32	68	49	44
Links Y10 2legs	311	145	311	224	202
Links, Max spaci	818	818	818	818	818
====================	====================	====================	====================	====================	====================

SHEAR FORCE DIAGRAM OF BEAM ON AXIS - B

LN= 2 MN/ELEM
SHEAR FY LN= 10

STRUCTURE DATA

TYPE =	SPACE
NJ =	299
NM =	322
NE =	0
NS =	0
NRJ=	299
NL =	3
XMAX=	44.0
YMAX=	.0
ZMAX=	18.0



Maximum= 844.86
J=299, M=322

UNIT MET KNS

S T A A D P O S T - P L O T (REV: 22.3a) DATE: NOV 15, 2000

TITLE: "AF-B-11A.STD" MALIGA ADMIN BUILDING FOU

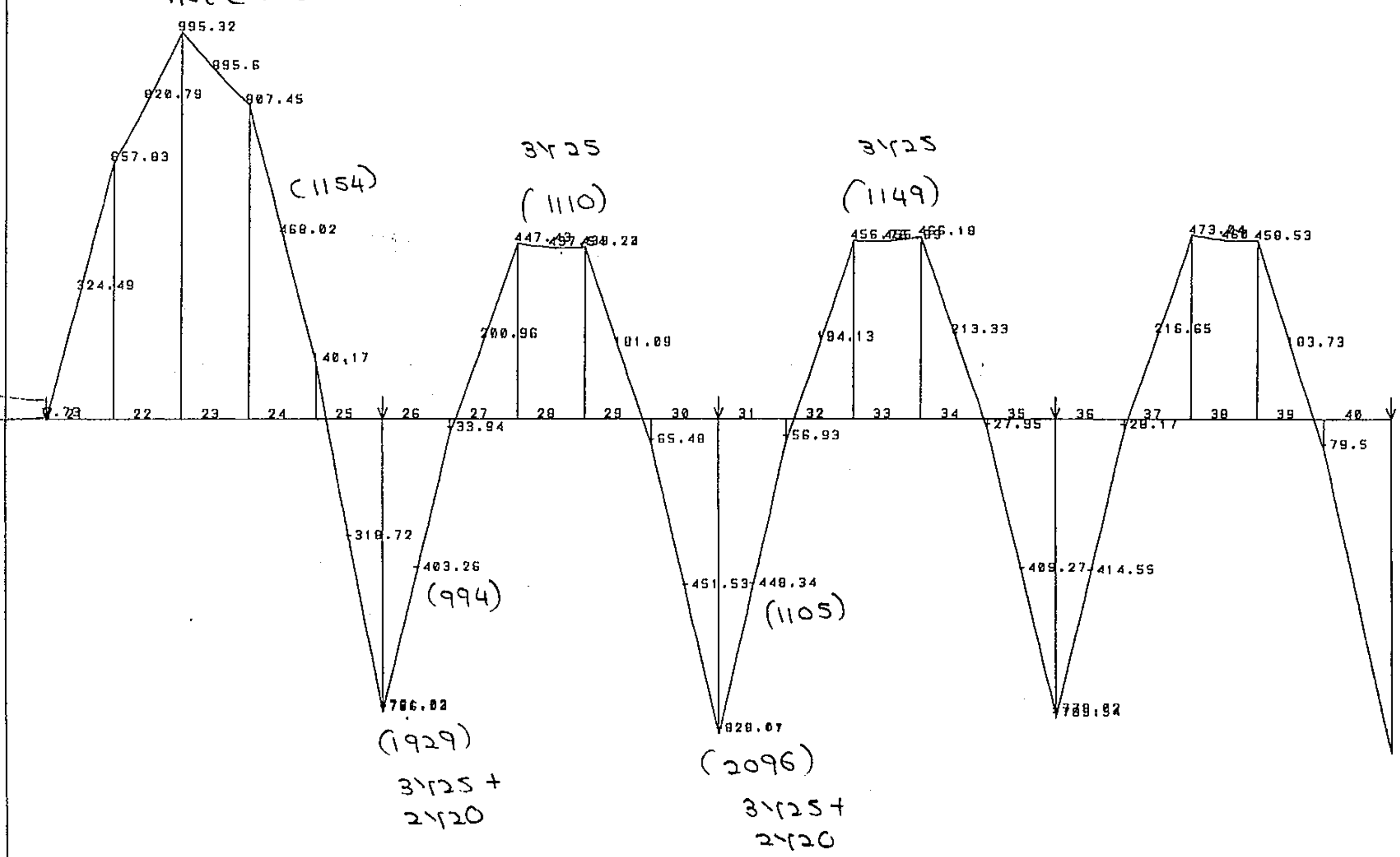
OB-FD-05

BENDING MOMENT DIAGRAM OF BEAM ON AXIS - B

LN= 2 MN/ELEM
MOMENT MZ LN= 10

STRUCTURE DATA

TYPE = SPACE
NJ = 299
NM = 322
NE = 0
NS = 0
NRJ= 299
NL = 3
XMAX= 44.0
YMAX= .0
ZMAX= 18.0



Maximum= 995.32
J=299,M=322

UNIT MET KNS

S T A A D P O S T - P L O T (REV: 22.3a)

DATE: NOV 15, 2000

TITLE: "AF-8-11A.STD" MALIGA ADMIN BUILDING FOU

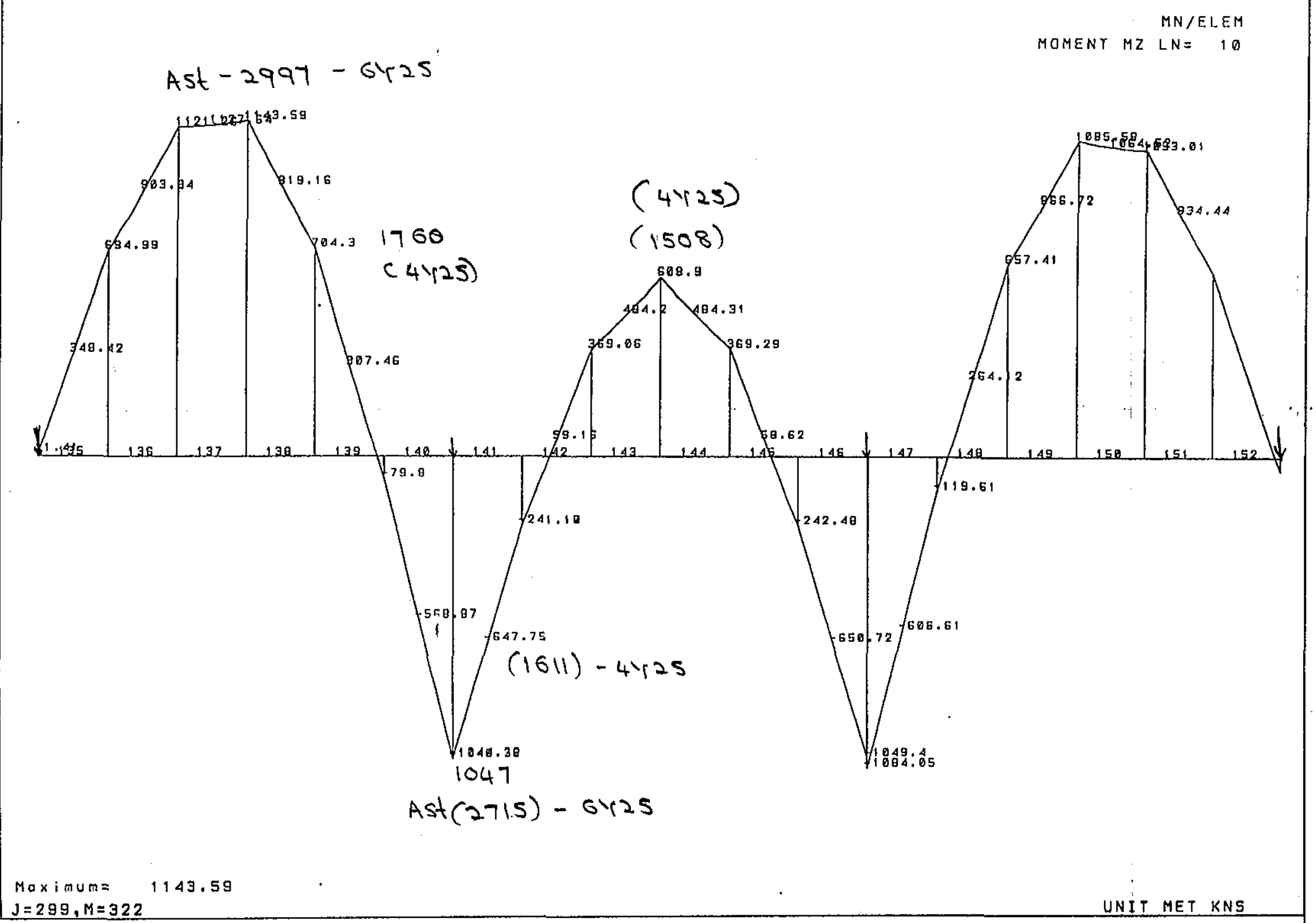
OB-F7

BEAM DESIGN (BS:8110)		GB-ma-short mid			
====================					
Project	maliga				
Beam	GB BEAM ON AXIS-4				
fcu (N/mm^2) =	25	25	25	25	25
fy (N/mm^2) =	450	450	450	450	450
bw (mm) =	450				
h (mm) =	1200				
d (mm) =	1090				
d' (mm) =	97.5				
bf (mm) =	450				
hf (mm) =	400				
m (kNm) =	1143	704	1047	648	609
redist % =	0	0	0	0	0
DESIGN FOR BENDI					
k' =	0.156	0.156	0.156	0.156	0.156
k (M/bd^2fcu) =	0.086	0.053	0.078	0.048	0.046
z (mm) =	974	1022	985	1028	1032
x (mm) =	258	151	233	138	130
fsc (N/mm^2) =	392	249	392	207	173
==========					
As (mm^2) =	2997	1760	2715	1611	1508
As' (mm^2) =	0	0	0	0	0
==========					
DESIGN FOR SHEAR					
V (kN) =	458	803	630	259	797
As (mm^2) =	1963	1963	1963	1963	1963
bv (mm) =	450	450	450	450	450
d (mm) =	1090	1090	1090	1090	1090
v (N/mm^2) =	0.93	1.64	1.28	0.53	1.62
100As/bd =	0.40	0.40	0.40	0.40	0.40
vc (N/mm^2) =	0.47	0.47	0.47	0.47	0.47
b(v-vc) =	211	527	368	28	522
b*0.4 =	180	180	180	180	180
==========					
Links R6 2legs	58	23	33	68	24
Links Y10 2legs	266	106	152	311	107
Links, Max spaci	818	818	818	818	818
==========					

BENDING MOMENT DIAGRAM OF BEAM ON AXIS-4

STRUCTURE DATA

TYPE = SPACE
NJ = 299
NM = 322
NE = 0
NS = 0
NRJ= 299
NL = 3
XMAX= 44.0
YMAX= .0
ZMAX= 18.0

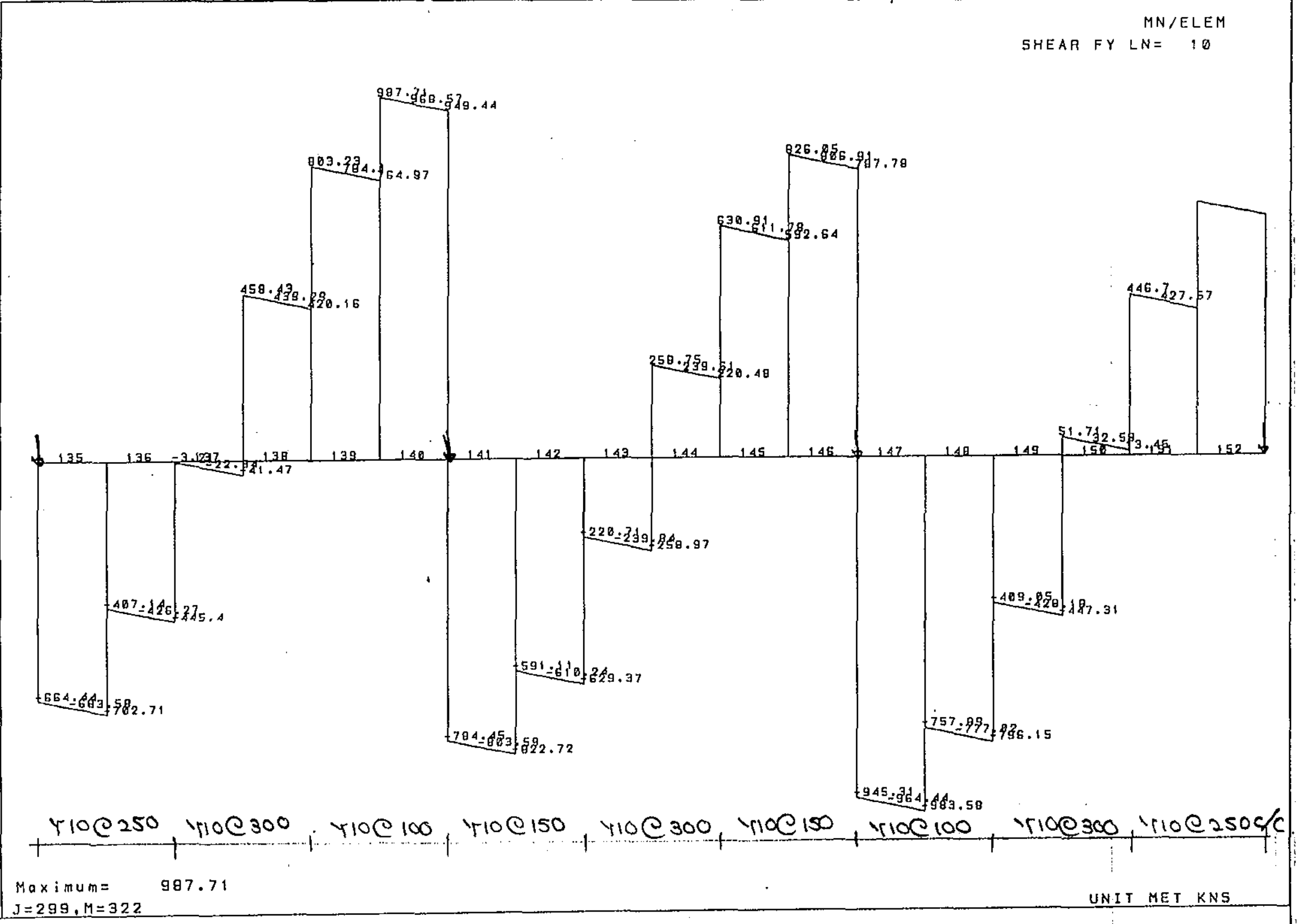


S T A A D P O S T - P L O T (REV: 22.3a)
DATE: NOV 15, 2000
TITLE: "AF-8-11A.STD" MALIGA ADMIN BUILDING FOU

SHEAR FORCE DIAGRAM OF BEAM ON AXIS-4

STRUCTURE DATA

TYPE = SPACE
NJ = 299
NM = 322
NE = 0
NS = 0
NRJ= 299
NL = 3
XMAX= 44.0
YMAX= .0
ZMAX= 18.0



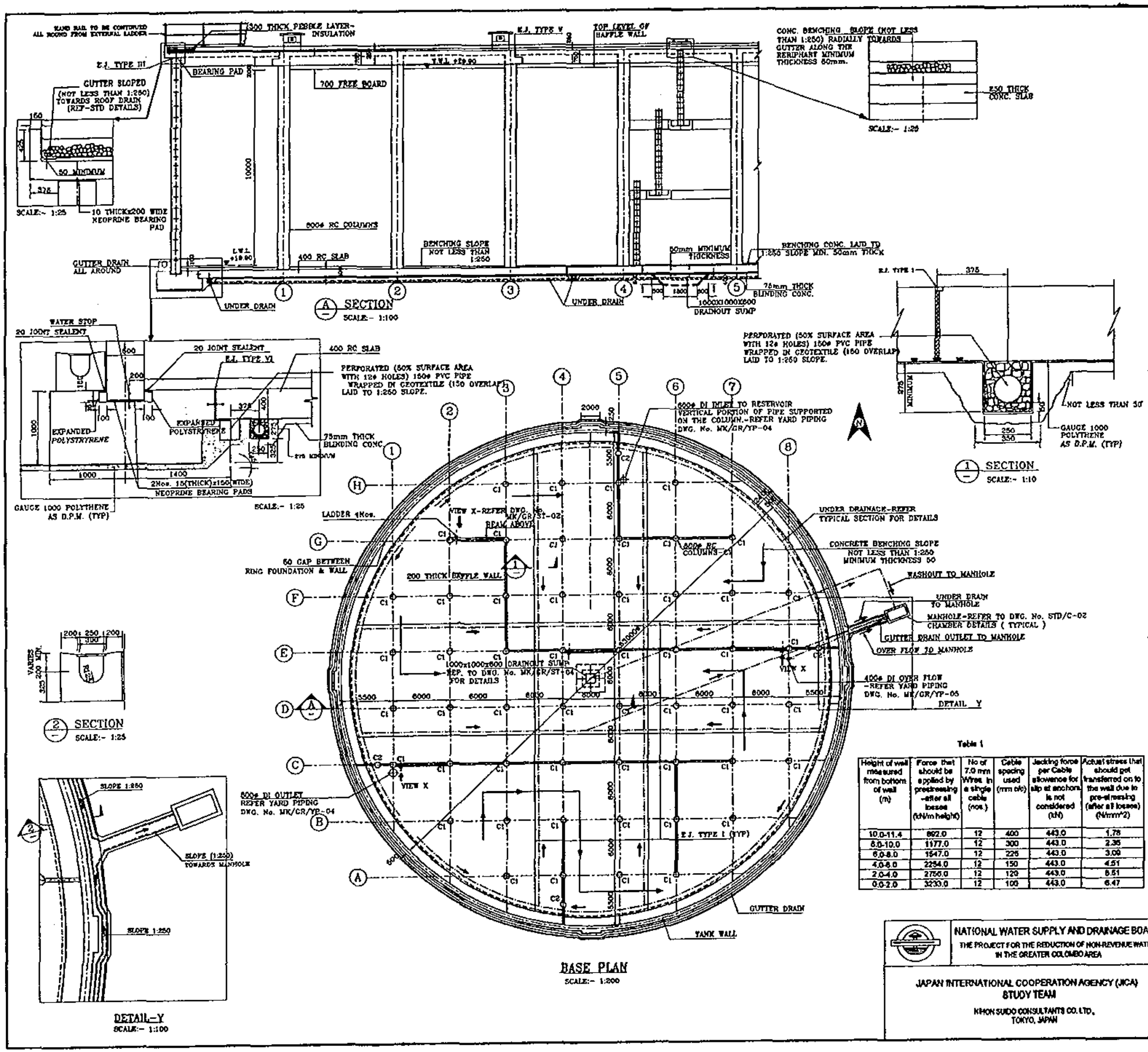
S T A A D P O S T - P L O T (REV: 22.3a) DATE: NOV 15, 2000

TITLE: "AF-B-11A.STD" MALIGA ADMIN BUILDING FOU

User ID: Research Engineers, Inc.

OB-FD-

MALIGAKANDA NEW RESERVOIR



Notes:-

1 The drawings to be read in conjunction with Standard Drawings, Structural and other relevant drawings.

2 All exposed concrete corners shall be chamfered 20 mm unless otherwise stated on the drawings.

3 The blinding concrete shall be grade 15 having Characteristic strength of 15 N/mm^2.

4 The structural concrete of the perimeter post-tensioned circular wall shall be grade 40 having a Characteristic strength of 40. N/mm^2 and for all other *structural members the concrete shall be grade 35A* having a Characteristic strength of 35. N/mm^2 unless otherwise noted on the drawings.

5 All laps in reinforcing steel (48 x bar diameter) shall be staggered.

6 All reinforcing steel in the perimeter wall shall be arranged so that there is a minimum of 40 mm between any bar and the nearest cable duct and clear cover to reinforcing steel shall be 50. mm.

7 The proprietary post-tensioning wires, ducts and anchorages shall be approved by the Engineer prior to start with construction.

8 The contractor shall provide adequate steel supports for the cable ducts and reinforcing steel *in addition to the designed reinforcement shown on drawings* and the details shall be approved by the Engineer.

9 Wires shall be placed in the ducts before concreting commences.

10 All cable ducts shall be grouted and grout vents shall be provided at all points necessary at not more than 10.m centres. The grout mix shall be approved by the Engineer and shall contain approved expanding agent.

11 The cables shall be stressed in the order shown. The wires in the cables shall not be cropped until all wires have been stressed.

12 The wires shall not be cropped closer than 25. mm from the grips and cropping of wires shall not commence until the stressing records have been approved by the Engineer.

13 Each pre-stressing wire shall be 7.0 mm dia high tensile low relaxation steel conforming to BS 5896-1980 with ultimate guaranteed tensile strength not less than 1680 N/mm^2 and shall be stressed as shown in Table 1.

14 The pre-stressing wires shall be stressed only after the complete wall is cast and the entire wall concrete attains 28 day strength and after a minimum period of 28 days.

15 Anchorage recesses shall be dimensioned by the contractor to suit type of anchor used and the details shall be approved by the Engineer. All anchor recesses shall be covered with non-shrink cement sand mortar after stressing all wires and grouting the ducts are completed and approved by the Engineer.

16 All exposed concrete surfaces shall be in accordance with the specifications.

17 The wires in the cable ducts shall be stressed in two operations, first with 50% of the force on all cables and second to complete the balance 50% of the forces and in the following order of ducts.

1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40, 43, 46, 49, 52, 55, 58, 61

2, 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, 44, 47, 50, 53, 56, 59,

3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, and 57.

18 The notation used in labeling the cable ducts (and wires) is as shown in example table 1 of dwg. No MK/GR/ST-06

19. The cement used to produce concrete for the foundation structure such as the perimeter ro ring foundation and the base slab of the reservoir shall be Portland Cement complying to BS 12 mixed with 25 % pulverized fuel ash (pfa). The cement content of the concrete shall be not less than 380 kg/m^3 and the maximum free water cement ratio shall be 0.45.

loads (unfactored)

super imposed load on roof	2.5kN/m²
250 mm pebble layer on roof	5.0 kN/m²
benching concrete (250 mm average)g on roof	5.5 kN/m²
Density of water	10.0 Kn/M³

Parameters assumed -post tensioning

Coeff. of friction	0.3
Profile Coeff.	0.0025 /m

Allowable bearing capacity of founding material = 200 kN/m²

Table 1

Height of wall measured from bottom of wall (m)	Force that should be applied by prestressing -after all losses (kN/m height)	No of 7.0 mm Wires in a single cable (nos.)	Cable spacing used (mm c/c)	Jacking force per Cable allowance for slip at anchors is not considered (kN)	Actual stress that should get transferred on to the wall due to pre-stressing (after all losses) (N/mm^2)
10.0-11.4	892.0	12	400	443.0	1.78
8.0-10.0	1177.0	12	300	443.0	2.35
6.0-8.0	1547.0	12	225	443.0	3.09
4.0-6.0	2254.0	12	150	443.0	4.51
2.0-4.0	2756.0	12	120	443.0	5.51
0.0-2.0	3230.0	12	100	443.0	6.47

DO NOT SCALE

REV	DESCRIPTION

NATIONAL WATER SUPPLY AND DRAINAGE BOARD
THE PROJECT FOR THE REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
STUDY TEAM
NIHON SUIDO CONSULTANTS CO. LTD.
TOKYO, JAPAN

SUB PROJECT: MALIGAKANDA

TITLE: NEW RESERVOIR
GENERAL ARRANGEMENT
SHEET 1 OF 3

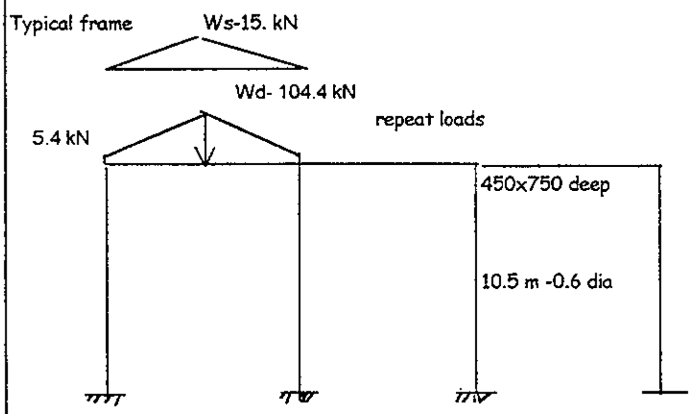
DATE: JAN 2001

CONTRACT No.: NRW/CW

DRG No.: MK/GR/ST-01

PROJECT	Reduction of non-revenue water in the Greater Colombo Area
PART OF STRUCTUR	Maligakanda -Ground Reservoir -22000 m^3

REF	CALCULATIONS	OUTPUT



w_d = 0.25*24+0.25*20+0.25*22 = 16.5 kN/m^2

w_s = 2.5 = 2.5 kN/m^2

U_{sls} = 16.5+2.5 = 19 kN/m^2

U_{uls} = 1.4*16.5+1.6*2.5 = 27.1 kN/m^2

		SLS	ULT
16.5*6/2*2 + 0.5*0.45*24	=	104.4	146.16
2.5*6*2/2	=	15	24

SLS

M_{x1} = $0.047*19*6^2$ = 32.15 → Y12-100c/c at support

M_{x2} = $0.035*19*6^2$ = 23.94 → Y10-100c/c at span

ULS

M_{x1} = 45.85

M_{x2} = 34.15

Min A_{st} = 0.13%A_c

Column reactions = $532+0.45^2*\pi*10.5*24/4$

= 572 kN

bearing A = 572/150

= 2x2 m^2

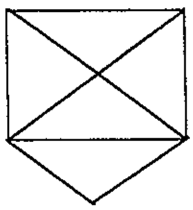
PROJECT	Reduction of non-revenue water in the Greater Colombo Area
PART OF STRUCTUR	Maligakanda -Ground Reservoir -22000 m^3

REF	CALCULATIONS	OUTPUT

Slab

Wd 16.5*6*2/2 = 99 kN/m

Ws 2.5*6*2/2 = 15 kN/m



5m span slab end spans simply supported,

M_{sls} = $19*5^2/8$ = 59.33 kNm

M_{ult} = $27.1*5^2/8$ = 84.69 kNm

h=250

d=200

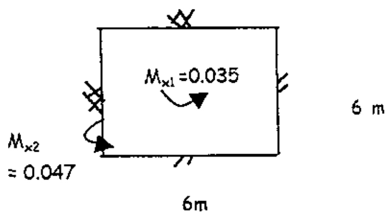
Provide Y12-150c/c

+

Y10-150c/c

o.k

Slab typical span



SLS

M_{x1} = $0.035*6^2*19$ = 23.94 kNm

M_{x2} = $0.047*6^2*19$ = 32.15 kNm

ULT

M_{x1} = $0.035*6^2*27.1$ = 34.15 kNm

M_{x2} = $0.047*6^2*27.1$ = 45.85 kNm

(A_{st})-min = $12*10^{-6}*T*\phi*bh/(3*0.2*2)$

T = 31+15

= 46

(A_{st})-min = $12*10^{-6}*46*10*200*10^3/(3*0.2*2)$

= 920 mm^2 → 460mm^2 of 10mm dia. Per side

Y10-170c/c required

Bottom r/f → Y10-100c/c

o.k

Top r/f → Y10-75c/c over supports and curtail to Y10-150c/c in spans

Maligakanda reservoir rehab- Roof slab -5.0 m avg. free span						
		1st layer	2nd layer			
Dia of Bar mm		10	12	fy N/mm^2	450	
Spacing mm		150	150	fcuN/mm^2	35	
Bredth of Sect mm		1000				
Depth of sect mm		250	space-mm			
Clear cover mm		40	0			
Service M (kNM)		59.33				
				wcr(8007)	0.170	mm
				max 0.2mm		
Ast-mm^2	1278	524	754			
Effect Depth mm			199			
fst N/mm^2		265.43				
fst All'ble		360.00			gamma St	1.28
fcb N/mm^2		9.58				
fcb alI'ble		15.75				
			M-kanda			

Maligakanda reservoir rehab- Roo						
		1st layer	2nd layer			
Dia of Bar mm		16	0	fy N/mm^2	450	
Spacing mm		75	150	fcuN/mm^2	35	
Bredth of Sect mm		1000				
Depth of sect mm		250	space-mm			
Clear cover mm		50	0			
Service M (kNM)		59.33				
				wcr(8007)	0.148	mm
				max 0.2mm		
Ast-mm^2	2682	2682	0.00			
Effective Depth			192			
fst N/mm^2		136.90				
fst All'ble		360.00			gamma St	1.68
fcb N/mm^2		8.05				
fcb alI'ble		15.75				

PROJECT	Reduction of non-revenue water in the Greater Colombo Area
PART OF STRUCTUR	Maligakanda -Ground Reservoir -22000 m^3

REF	CALCULATIONS	OUT PUT
	Column 600 mm dia. l/r = 1.3*10.5*10^3*/600 = 22.75 M_{add} = 403.46*2*0.26*0.6 = 125.88 kNm M_{sls} = 72.5 kNm M_x = 125.88+72.5 = 198.6 kNm M_x/h' = M_y/b' $N/(A_c/f_{cu})$ = 403.46*2*10^3/[(π/4)*600^2*35] = 0.08 β = 0.9 Enhanced uni-axial moment, M_{sls}-uniaxial = 198.6*1.9 = 337.3 kNm N_{sls} = 403.46*2 + (π/4)*0.6^2*24*10.5 = 876.2 kN R = 30 cm R_s = (300-50-16)/10 = 23.4 cm A_s = 11259 mm^2 → Provide 14 Y32 (4% A_c)	

Maligakanda -Reservoir -Roof slab- bottom r/f					
		1st layer	2nd layer		
Dia of Bar mm		10	0	fy N/mm^2	450
Spacing mm		100	200	fcuN/mm^2	35
Bredth of Sect mm		1000			
Depth of sect mm		200	space-mm		
Clear cover mm		40	50		
Service M (kNM)		23.94			
				wcr(8007)	0.162
				max 0.2mm	
Ast-mm^2	786	786	0		
Effect Depth mm			155		
fst N/mm^2		220.42			
fst All'ble		360.00			
fcb N/mm^2		6.89			
fcb all'ble		15.75			
roof			Reservoir		
~~base~~ slab -top r/f -over supports					
		1st layer	2nd layer		
Dia of Bar mm		10	12	fy N/mm^2	450
Spacing mm		200	200	fcuN/mm^2	35
Bredth of Sect mm		1000			
Depth of sect mm		200	space-mm		
Clear cover mm		40	0		
Service M (kNM)		32.15			
				wcr(8007)	0.159
				max 0.2mm	
Ast-mm^2	959	393	565.71		
Effective Depth			149		
fst N/mm^2		256.38			
fst All'ble		360.00			
fcb N/mm^2		9.26			
fcb all'ble		15.75			
Reservoir	Daya's				

Y10 - ~~75~~ c/c
(= 1047 mm^2/m) ok.

PROJECT	Reduction of non-revenue water in the Greater Colombo Area	
PART OF STRUCTUR	Maligakanda -Ground Reservoir -22000 m^3	
REF.	CALCULATIONS	OUTPUTS
	Vertical R/F of wall	
	Check for temperature difference	
	T = 15+10 = 25 °C	
	E_s = 200*10^3 N/mm^2	
	= 200*10^3/15	
	= 14*10^3 N/mm^2	
	M = E*I*T*α/t	
	M = E_c*I*T*e/t	
	= 14*10^3*(1/12)*10^3*500^3*12*10^-6*25*10^-6/500	
	= 87.5 kNm/m	
	Y 20-150c/c Provided	o.k
	Max^m N = 0.5*24*11 + 15*2 kN	
	= 162 kN	
	Min^m A_{st} = 0.0035*250*10^3/2	
	= 437.5 mm^2	
	500 mm thick section,	
	T_1 = 40.25 °C	
	A_{st} = 12*10^-6*40.25*250*10^3*f/(3*0.2*2)	
	= 100.63 f	
	f(mm) A_{st}(mm^2)	
	16 1610	
	20 2013 Y20-150c/c	o.k

Vertical Steel for Tempt stresses						
		1st layer	2nd layer			
Dia of Bar mm		16	0	fy N/mm^2	450	
Spacing mm		150	200	fcuN/mm^2	40	
Bredth of Sect mm		1000				
Depth of sect mm		500	space-mm			
Clear cover mm		50	0			
Service M (kNM)		136.00				
				wcr(8007)	0.201	mm
				max 0.2mm		
Ast-mm^2	1341	1341	0			
Effect Depth mm			442			
fst N/mm^2		251.45				
fst All'ble		360.00				
fcb N/mm^2		5.81				
fcb all'ble		18				
			Maligakanda			
Vertical Steel for Tempt stresses						
		1st layer	2nd layer			
Dia of Bar mm		10	0	fy N/mm^2	450	
Spacing mm		150	100	fcuN/mm^2	35	
Bredth of Sect mm		1000				
Depth of sect mm		200	space-mm			
Clear cover mm		40	50			
Service M (kNM)		20				
				wcr(8007)	0.192	mm
				max 0.2mm		
Ast-mm^2	524	524	0.00			
Effective Depth			155			
fst N/mm^2		271.16				
fst All'ble		360.00				
fcb N/mm^2		6.67				
fcb all'ble		15.75				

120 – 150 [illegible]

Serviciability Limit State -(Direct Load + Moment)							
Maligakanda Reservoir wall			File	sl-1			
Direct Load -kN	N =	165.00				Clear cover in mm	50.00
						Bar dia -mm in comp face	16.00
						Spacing in mm	150.00
Ast in tensile face	As =	1340.95				As' (mm^2/m)	1340.95
			Assumed x -mm		139.00	Bar dia -mm tens Face	16.00
						Spacing -mm	150.00
			Feed NEW x -mm		139.74	Ast (mm^2/m)	1340.95
Moment in kNM	M =	90.00				Crack width in mm	0.195
Height of section in mm	h =	500.00					
Asc in Comp face	As' =	1340.95					
			fcr(N/mm^2)	fst(N/mm^2)			
			4.70	151.33			

Serviciability Limit State -(Direct Load + Moment)							
Maligakanda Reservoir wall							
Direct Load -kN	N =	200.00				Clear cover in mm	50.00
						Bar dia -mm in comp face	20.00
						Spacing in mm	150.00
Ast tensile face	As =	2095.24				As' (mm^2/m)	2095.24
			Assumed x =		166.00	Bar dia -mm tens Face	20.00
						Spacing -mm	150.00
			Feed NEW x=		165.63	Ast (mm^2/m)	2095.24
Moment in kNM	M =	100.00				Crack width in mm	0.138
Height of section in mm	h =	500.00					
Ast Comp face	As' =	2095.24					
			fcr(N/mm^2)	fst(N/mm^2)			
			4.29	106.90			
sl-1 Daya,s							

Y20 – 150 OK

	Location	Maligakanda -reservoir -roof beams-RB-3 Free span			
Dist bet two layers	32				
Bar Dia layers 1 & 2	25	20	fy N/mm^2	450	
Number of bars	5	2	fcuN/mm^2	35	
Breadth of sect mm	450				
Depth of sect mm	750	Space bet bars		56.25	
Clear cover mm	50				
Service M (kNm)	366.30	Ult M (kNm)		518.22	
Es (kN/mm^2)	200	Depth to Asc		65	
Ec (kN/mm^2)	28			Ast- Mult	Asc-Mult
		Ast2	629		
Total Ast mm^2	3084	Ast1	2455	2145	0
Effective Depth mm	676.39				
fst N/mm^2	203.59		Defln	1.188	
fst Allowable	360.00		Coeiff:		
fcb N/mm^2	10.00				
fcb allowable	15.75				
			Wcr 8007	0.19	
			mm 0.2		
	Location	Mahara -reservoir-beam @ expansion joint			
Dist bet two layers	32				
Bar Dia layers 1 & 2	20	20	fy N/mm^2	460	
Number of bars	5	0	fcuN/mm^2	35	
Breadth of sect mm	500				
Depth of sect mm	500	Space bet bars		75.00	
Clear cover mm	50				
Service M (kNm)	114.00	Ult M (kNm)		171	
Es (kN/mm^2)	200	Depth to Asc		65	
Ec (kN/mm^2)	28			Ast- Mult	Asc-Mult
		Ast2	0		
Total Ast mm^2	1571	Ast1	1571	1033	0
Effective Depth mm	440.00				
fst N/mm^2	187.44		Defln	1.455	
fst Allowable	368.00		Coeiff:		
fcb N/mm^2	7.42				
fcb allowable	15.75				
			Wcr 8007	0.17	
			mm 0.2		

PROJECT *	Reduction of non-revenue water in the Greater Colombo Area	
PART OF STRUCTURE	Maligakanda -Ground Reservoir -22000 m^3	
REF.	CALCULATIONS	OUTPUT

Base slab

h=400mm

Applied UDL = 10*10.5+0.5*24 kN/m^2

= 117 kN/m^2

Column load = (187+235)*2 + (π/4)*0.6²*24*10.5 kN — SLS

= 915.15 kN

From computer output,

$(M_x)_{sls}$ = 109x 1.25 kNm with enhancement of 25%

$(M_x)_{ult}$ = 136.25x1.4

= 190.75 kNm

R/F to control thermal & shrinkage cracking,

A_{st} = $12*10^{-6}*(34.5+15)*200*10^3*\phi/(3*0.2*2)$

= 99 ϕ

ϕ	A_{st}
16	1584
20	1920
25	2475

Provide Y20-125c/c — $(M_x)_{sls}$ o.k.

$(M_x)_{ult}$ = 190.75 kNm

A_{st} = 1517 mm^2 → Y20-125c/c x twolayers

refer to shear chk

Provide Y20-125c/c + Y20-125c/c over support — o.k.

Average pressur = 915.15/6 x6 25.42 kN/m^2

V_u = (915.15-(25.42 x PIx1.590^2)x1.4x1.15x 10^3)/PIx1.590x330

= 0.83 N/mm^2

R/F at column points

Y20-125 c/c + Y20-125 c/c vc =0.86 N/mm^2 Ast =1920x2

Y20-125 c/c

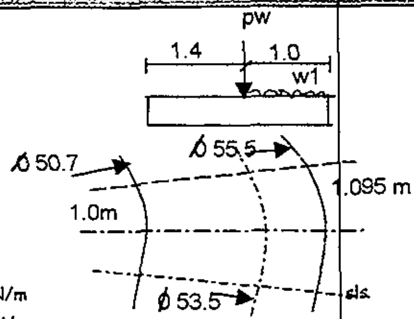
M_x = 148 kNm

w_{cr} = 0.2 mm — SLS

PROJECT	*	Reduction of non-revenue water in the Greater Colombo Area
PART OF STRUCTURE		Maligakanda -Ground Reservoir -22000 m^3

REF	CALCULATIONS	OUTPUT

Perimeter ring foundation



wall load = 0.5*24*11.4 kN/m
Roof load = 19*2.5 KN/m
Total wall load pw = 184.3 kN/m
Water load w1 = 10*10.5 kN/m^2

Applied wall load = 184*1.055 kN
= 194.12 kN
Applied water load = 105*(26.75^2-25.35^2)/2/25.3 kN

Resultant load
Axial load ps = 194.12 + 151.36 kN
= 345.48 kN
Moment Ms = (194.12*0.2) -(151.35*0.5)
= -36.85 kNm

fc = p/A +or- M/z
= 346*25.35/(27.75^2-25.35^2)*0.5 +or-37*6/1.0*2.4^2kN/m^2
= 137.65 +or-38.54 kN/m^2
= 176 Or 99 kN/m^2
Mx-sls = 176*1.15^2/2 kNm
= 116 kNm

PROJECT *	Reduction of non-revenue water in the Greater Colombo Area	
PART OF STRUCTURE	Maligakanda -Ground Reservoir -22000 m^3	
REF	CALCULATIONS	OUTPUT

Transverse steel

Mx-sls = 116 kNm
Mx-ult = 116*1.4 kNm
Ast = 688 mm^2/m
Provide y16 @ 225 c/c

Longitudinal steel

R/F to control thermal & shrinkage cracking ,
Ast = 12*10^-6*66*250*10^3*ϕ/ (3*2*0.2)
= 165 ϕ

ϕ	Ast	
16	2640	provide y20 @ 100c/c
20	3300	

Base bottom Ast = 66 ϕ provide y20 @ 225c/c

For links Ast = 0.0035*250*10^3/2
= 437.5 mm^2/m

provide y12 @ 225c/c

```
11 1.0 20 1.0
LOAD COMB 31 HALF WATER PRESSURE + PRESTRESS AFTER LOSSES
11 1.0 21 1.0
PERFORM ANALYSIS
LOAD LIST 1
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
*PRINT ELEM FORCES LIST 45 TO 1845 BY 180
*PRINT SUPPORT REACTIONS
*PRINT JOINT DISP LIST 1 TO 180
LOAD LIST 2
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
*PRINT ELEM FORCES LIST 45 TO 1845 BY 180
LOAD LIST 3
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
LOAD LIST 4
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
LOAD LIST 5
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
LOAD LIST 6
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
LOAD LIST 7
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
LOAD LIST 8
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
LOAD LIST 9
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
LOAD LIST 10
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
LOAD LIST 11
*PRINT SUPPORT REACTIONS
PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
*LOAD LIST 30
*PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
*LOAD LIST 31
*PRIINT ELEM FORCES LIST 1 TO 1801 BY 180
*PRINT SUPPORT REACTIONS
*PRINT JOINT DISP LIST 1 TO 180
*PRINT JOINT DISP 1 TO 360
*PRINT SUPPORT REACTIONS LIST 7 180 179 178 177
FINISH
```

Column load of 915 kN

GR-15

MN/ELEM

STDR LOAD= 1

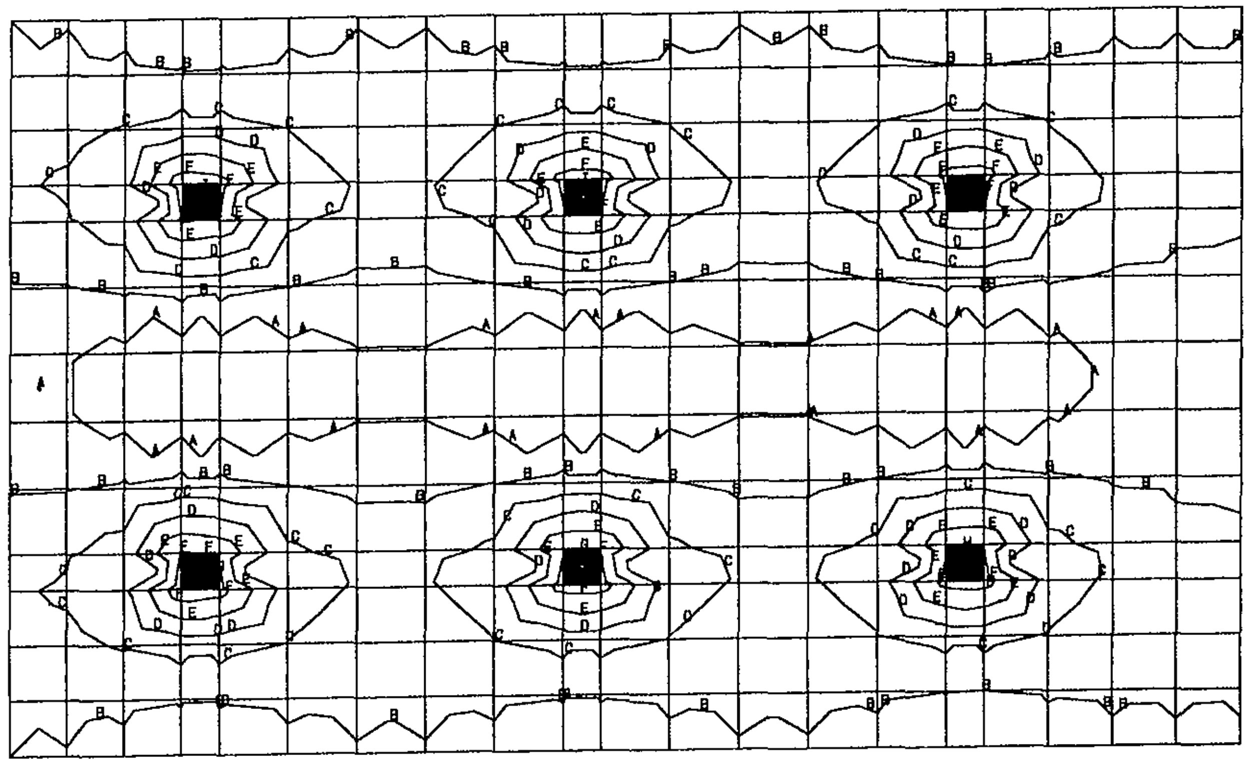
MY CONTOUR

A	-17.3
B	3
C	23.31
D	43.61
E	63.92
F	84.22
G	104.52
H	124.83
I	145.13
J	165.44
K	185.74
L	206.05
M	226.35
N	246.65
O	266.96
	287.26

Y20 - 125

STRUCTURE DATA

TYPE = SPACE
NJ = 294
NM = 0
NE = 260
NS = 0
NRJ= 294
NL = 2
XMAX= 19.3
YMAX= .0
ZMAX= 12.0



J=294,E=260

UNIT MET KNS

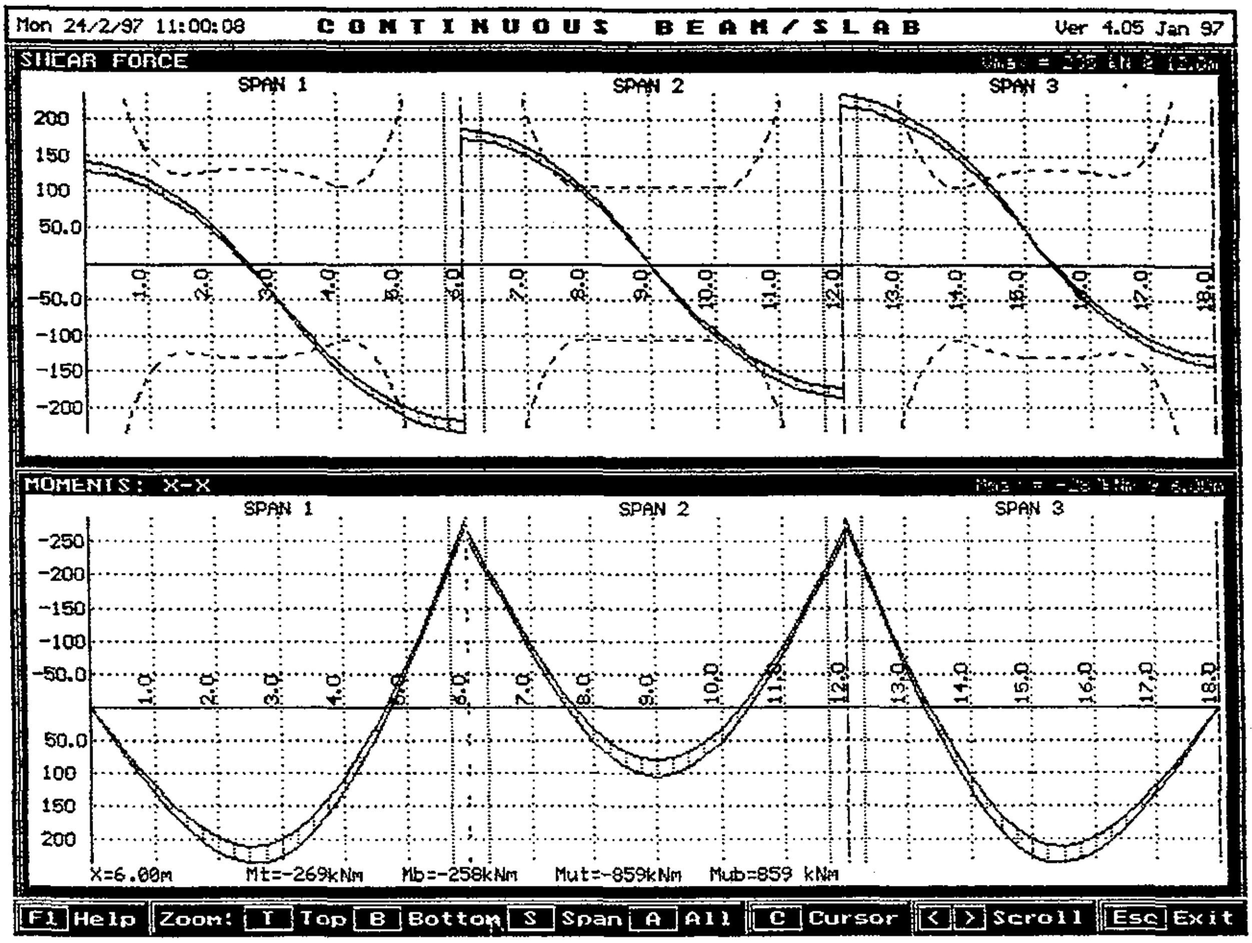
S T A A D P O S T - P L O T (REV: 22.3a)

DATE: JUL 12, 2000

TITLE: "CIRBASE2.STD" MALIGAKANGA RERSERVOIR BA

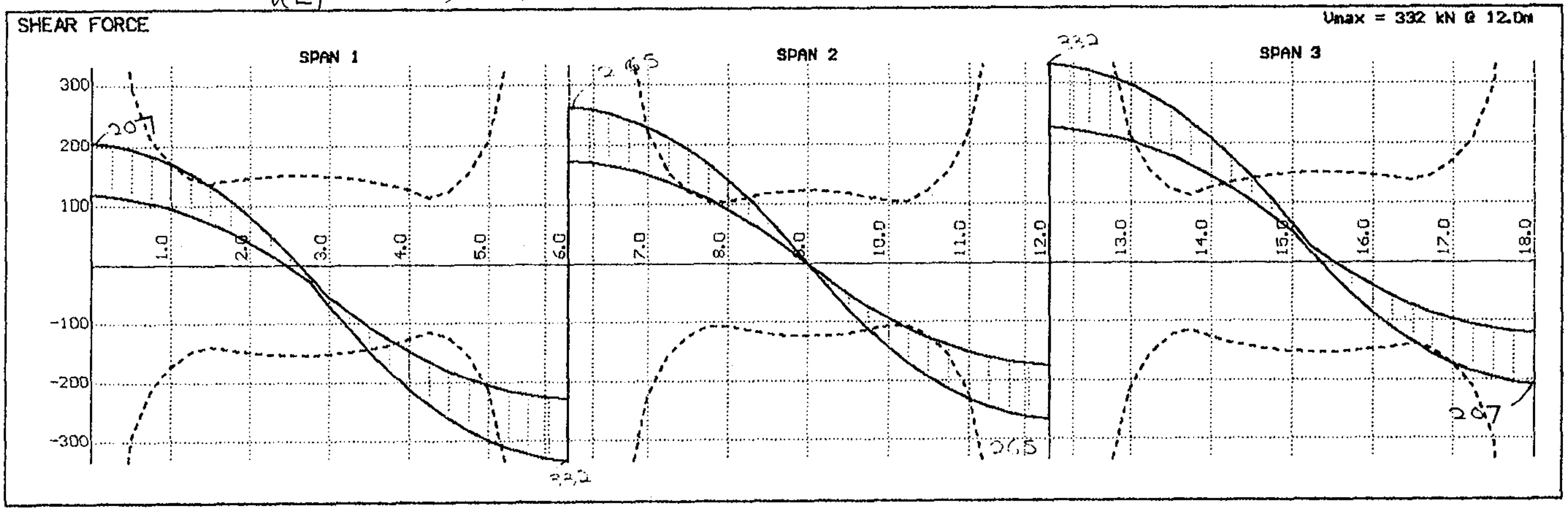
PROJECT	Reduction of non-revenue water in the Greater Colombo Area	
PART OF STRUCTURE	Maligakanda -Ground Reservoir -22000 m^3	

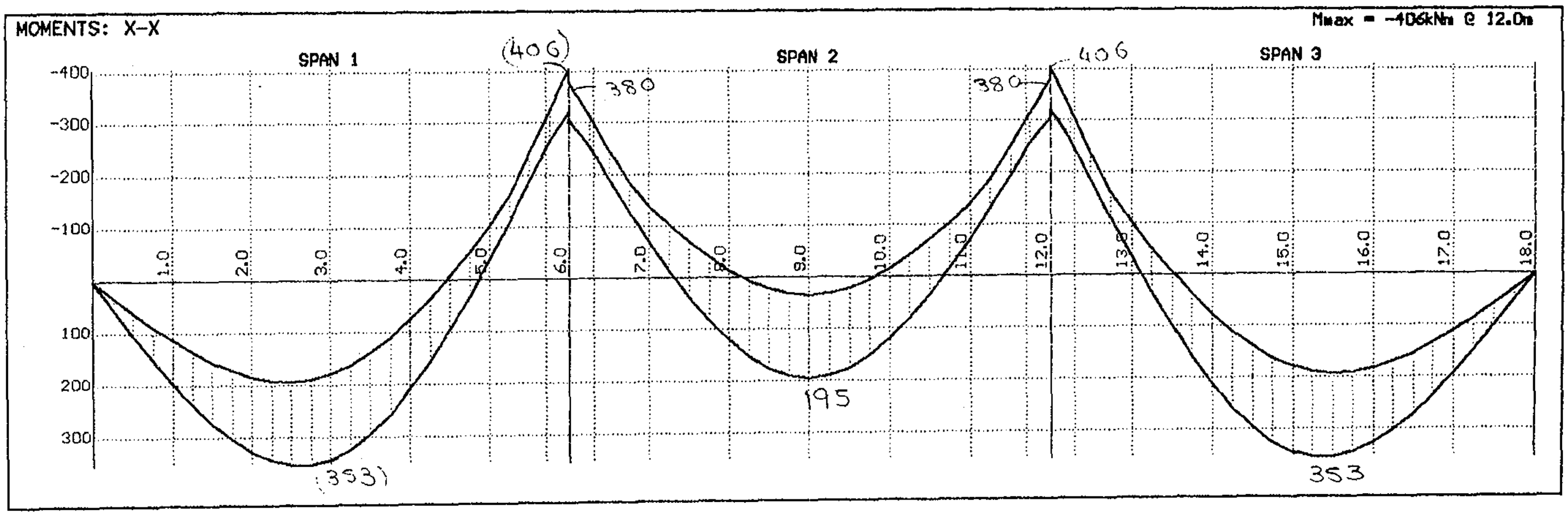
REF	CALCULATIONS					OUTPUT
	Roof Beams					
	RB$_2$					450*750
	Support moments					cover = 40mm
	M_{ult}	=	406 kNm			
	M_{sls}	=	287 kNm			5Y20
						2Y20
	V_u	=	332 kN			
	v_u	=	332*10^3*/(450*687)			
		=	1.07 N/mm^2			
	5Y20 v_c	=	0.57 N/mm^2	→	Y10-180c/c	
	7Y20 v_c	=	0.63 N/mm^2	→	Y10-225c/c	o.k
	Span moments					
	M_{ult}	=	353 kNm			5Y20
	M_{sls}	=	236 kNm			
	V_u	=	265 kN			
	5Y20 v_c	=	0.57 N/mm^2	→	Y10-225c/c	o.k
	RB$_1$					
	Support moments					
	M_{ult}	=	458 kNm			5Y20
	M_{sls}	=	323 kNm			2Y25
						A_{st}2554mm^2
	V_u	=	331 kN			
	5Y20+2Y25 v_c	=	0.66 N/mm^2	→	Y10-225c/c	o.k
	Span moments					
	M_{ult}	=	298 kNm			5Y20
	M_{sls}	=	196 kNm			
	V_u	=	211 kN			
	5Y20 v_c	=	0.56 N/mm^2	→	Y10-225c/c	o.k


Mon 24/2/97 11:00:08
CONTINUOUS BEAM/SLAB
Ver 4.05 Jan 97
SHEAR FORCE
SPAN 1
SPAN 2
SPAN 3
200
150
100
50.0
-50.0
-100
-150
-200
MOMENTS: X-X
-250
-200
-150
-100
-50.0
50.0
100
150
200
X=6.00m
Mt=-269kNm
Mb=-258kNm
Mut=-859kNm
Mub=859 kNm
F1 Help
Zoom: T Top B Bottom S Span A All
C Cursor
< > Scroll
Esc Exit

JICA-RB10

ULT RB6, RB2

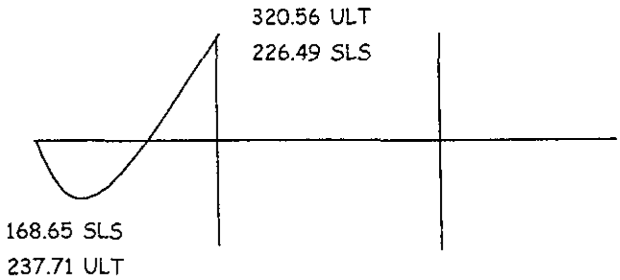




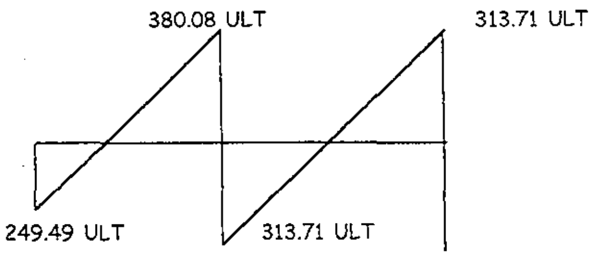
PROJECT	Reduction of non-revenue water in the Greater Colombo Area
PART OF STRUCTURE	Maligakanda -Ground Reservoir -22000 m^3

REF	CALCULATIONS	OUT PUT
	Typical beam	450 x 750 deep d =750-50-10

Moment Diagram



Shear Force Diagram



A_{st} = 1249 mm^2

PROJECT	Reduction of non-revenue water in the Greater Colombo Area	
PART OF STRUCTURE	Maligakanda -Ground Reservoir -22000 m^3	
REF	CALCULATIONS	OUT PUT

M_{sls} = 226.49 kNm

5Y20 required

v_u = $320.56*10^3/(450*690)$

= 1.03 N/mm^2

v_c = 0.56 N/mm^2 → Y10-250c/c — o.k

Main beam RB14

support moments: M_{ult} 406 kNm, M_{sls} 287 kNm } 5Y20 +2Y20 — 450*750, d=750-50-15 = 625mm

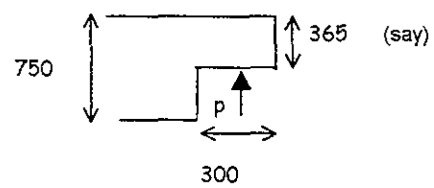
span moments

M_{ult} 353kNm, M_{sls} 236kNm } 5Y20

M_{ult} = 406 kNm

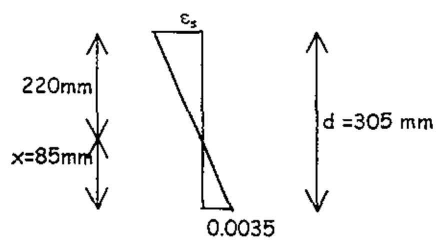
A_{st} = 1619 mm^2 → 5Y20

Beam nibs -Typical



p = 226.2 kN ult

Strain profile



d=365-50-10 = 305mm

PROJECT	Reduction of non-revenue water in the Greater Colombo Area	
PART OF STRUCTURE	Maligakanda -Ground Reservoir -22000 m^3	
REF	CALCULATIONS	OUT PUT

a_v = 150 mm

a_v/d = 150/305

= 0.49

V/f_{cu} = $226.2*10^3/(450*305*35)$

= 0.05

z/d = 0.875

z = 267 mm

β = $\tan^{-1}(z/a_v)$

= $\tan^{-1}(267/150)$

= 60.67

F_t = $V\cot\beta$

= 226.2 cot 60.67

= 127.08 kN

ε_s = 220*0.0035/85

= 0.0091 > 0.002

f_s = 450/1.15

= 391

A_{st} = $169.44*10^3/391$

= 444

Provide 3Y20 v_c = 0.67 N/mm^2

Allowable shear stress = 0.67*2

= 2.73 N/mm^2

v = $226.2*10^3/(450*305)$

= 1.65 < v_c

Main wall

- Vertical r/f to cater for secondary stresses due to stressing

- Horizontal r/f nominal -minimum = $(0.0035*250*10^3)/2$ mm^2/m per face

= 437.5 mm^2

R/f for vertical bending

Load case 2 prestressing Bottom 2.0 m

From computer analysis

M_y = 93.53 kNm/m

F_y = 189.6x0.5 kNm/m

= 90 kNm/m

(A_{st})-min = $12*10^{-6}*40.25*250*10^3\phi/(6*0.2)$

= 100.63 ϕ

PROJECT	Reduction of non-revenue water in the Greater Colombo Area	
PART OF STRUCTURE	Maligakanda -Ground Reservoir -22000 m^3	
REF	CALCULATIONS	OUTPUT

ϕ	A_{st}
12	1207
16	1610
20	2012.5

Y20-150c/c o.k for M_y = 93.53 kN/m

Horizontal r/f for full restraint,

= 10^{-5}*(40.25+15)*250*10^3 ϕ

= 138.13 ϕ

ϕ	A_{st}
16	2210
20	2763

Horizontal minimum = 0.0035*250*10^3/2

= 437.5 mm^2

Y16-200/c (1005mm^2)

Design of anchor blocks

spacing = 100 mm

$2Y_{po}$ = 100 mm

Y_{po}/Y_o = 50/150

= 0.33

T4.7 BS8110 — F_{bst}/P_o = 0.22

F_{bst} = 0.22*412 kN

A_{st} = F_{bst}/(0.87*250)

= 0.22*412*10^3/(0.87*250)

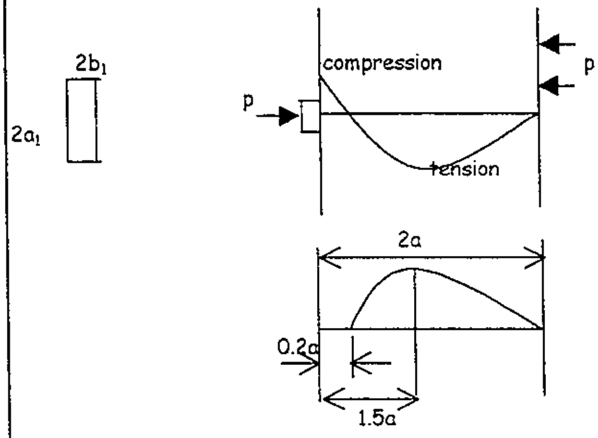
= 416 mm^2 → 10 loops of R12 Spiral

A_{st} = (π/4)*12^2*10

= 1130 mm^2

PROJECT	Reduction of non-revenue water in the Greater Colombo Area	
PART OF STRUCTURE	Maligakanda -Ground Reservoir -22000 m^3	
REF	CALCULATIONS	OUT-PUT

Distribution of bursting tension



$2a_1$	=	100
$2a$	=	300
a_1/a	=	0.33
T/P	=	0.2
T	=	0.2*294 kN

(bursting tension)

No. of Y12 bars = $0.2*294*10^3/(113*390)$ → Provide 2 Y 12

Properties of Pre-stressing -Max avg-water height 1.9 m

Tendon properties

Nominal Diameter of prestressing wire	=	7	mm
Area /wire	=	38.5	mm^2
No of wires in a cable	=	12	
Design force for 12 wires 0.7X1860N/mm^2	=	601.524	kN

Tank Dimensions

Internal Diameter	=	53	m
Wall Thickness	=	500	mm
Tank wall height	=	11.4	m
Average water height considered	=	1.9	m
Base Condition		Sliding Joint	

Calculations

P,req'd, P app'd & & Ring T due to Water P -kN = 892.00 892.00 508.25

Loss due to Friction

Initial Jacking Force	P_x	=	0.74	P_0
		=	**443**	kN

Maxium compressive stress in concrete when tank empty	=	1.78	N/mm^2
Assumed % of prestress losses		10.725%	losses
Initial Stress	=	2.00	N/mm^2
Actual % of Percentage of Losses	=	10.724%	**OK**

Additional Force to Cater maximum Temparature rise of 35C^0

Maxium Temporature Rise (Assume)	=	35	C^0
Length of Cable	=	84.82	m
Extention in Cable	=	36	mm
Stress in Cable	=	84	N/mm^2
Additional force Required	=	39	kN
Design force in Cable	=	**357**	kN

Cable Spacing & pressure intensity on shaft 400 1.78 mm & N/mm^2

Properties of Pre-stressing -Max avg-water height 2.9 m

Tendon properties

Nominal Diameter of prestressing wire	=	7	mm
Area /wire	=	38.5	mm^2
No of wires in a cable	=	12	
Design force for 12 wires 0.7X1860N/mm^2	=	601.524	kN

Tank Dimensions

Internal Diameter	=	53	m
Wall Thickness	=	500	mm
Tank wall height	=	11.4	m
Average water height considered	=	2.9	m
Base Condition		Sliding Joint	

Calculations

P,req'd, P app'd & & Ring T due to Water P -k	=	**1177.00**	**1176.81**	**775.75**
Initial Jacking Force P_x	=	0.74 P_0		
	=	**443** kN		
Maxium compressive stress in concrete when tank empty	=	2.35	N/mm^2	
Assumed % of prestress losses		11.580%	losses	
Initial Stress	=	2.66	N/mm^2	
Actual % of Percentage of Losses	=	11.573%	**OK**	

Additional Force to Cater maximum Temparature rise of 35C^0

Maxium Temparature Rise (Assume)	=	35	C^0
Length of Cable	=	84.82	m
Extention in Cable	=	36	mm
Stress in Cable	=	84	N/mm^2
Additional force Required	=	39	kN
Design force in Cable	=	**353**	kN
Cable Spacing & pressure intensity on shaft	300	2.35	mm & N/mm^2

Properties of Pre-stressing -Max avg-water height 4.9 m

Tendon properties

Nominal Diameter of prestressing wire	=	7	mm
Area /wire	=	38.5	mm^2
No of wires in a cable	=	12	
Design force for 12 wires 0.7X1860N/mm^2	=	601.524	kN

Tank Dimensions

Internal Diameter	=	53	m
Wall Thickness	=	500	mm
Tank wall height	=	11.4	m
Average water height considered	=	4.9	m
Base Condition		Sliding Joint	

Calculations

P,req'd, P app'd & & Ring T due to Water P -k	=	**1547.00**	**1546.88**	**1310.75**

Initial Jacking Force	P_x	=	0.74	P_0
		=	443	kN
Maxium compressive stress in concrete when tank empty		=	3.09	N/mm^2
Assumed % of prestress losses			12.700%	losses
Initial Stress		=	3.54	N/mm^2
Actual % of Percentage of Losses		=	12.700%	**OK**

Additional Force to Cater maximum Temparature rise of 35C^0^

Maxium Temparature Rise (Assume)	=	35	C^0
Length of Cable	=	84.82	m
Extention in Cable	=	36	mm
Stress in Cable	=	84	N/mm^2
Additional force Required	=	39	kN
Design force in Cable	=	**348**	kN

Cable Spacing & pressure intensity on shaft	225	3.09	mm & N/mm^2

Properties of Pre-stressing -Max avg-water height 6.9 m

Tendon properties

Nominal Diameter of prestressing wire	=	7	mm
Area /wire	=	38.5	mm^2
No of wires in a cable	=	12	
Design force for 12 wires 0.7X1860N/mm^2	=	601.524	kN

Tank Dimensions

Internal Diameter	=	53	m
Wall Thickness	=	500	mm
Tank wall height	=	11.4	m
Average water height considered	=	6.9	m
Base Condition	Sliding Joint		

Calculations

P,req'd, P app'd & & Ring T due to Water P -k = 2254.00 2254.02 1845.75

Initial Jacking Force	P_x	=	0.74	P_0
		=	443	kN
Maxium compressive stress in concrete when tank empty		=	4.51	N/mm^2
	Assumed % of prestress losses		14.945%	losses
Initial Stress		=	5.30	N/mm^2
Actual % of Percentage of Losses		=	14.944%	OK

Additional Force to Cater maximum Temparature rise of 35C^0^

Maxium Temparature Rise (Assume)	=	35	C^0
Length of Cable	=	84.82	m
Extention in Cable	=	36	mm
Stress in Cable	=	84	N/mm^2
Additional force Required	=	39	kN
Design force in Cable	=	**338**	kN

Cable Spacing & pressure intensity on shaft 150 4.51 mm & N/mm^2

Properties of Pre-stressing -Max avg-water height 8.9 m

Tendon properties

Nominal Diameter of prestressing wire	=	7	mm
Area /wire	=	38.5	mm^2
No of wires in a cable	=	12	
Design force for 12 wires 0.7X1860N/mm^2	=	601.524	kN

Tank Dimensions

Internal Diameter	=	53	m
Wall Thickness	=	500	mm
Tank wall height	=	11.4	m
Average water height considered	=	8.9	m
Base Condition		Sliding Joint	

Calculations

P,req'd, P app'd & & Ring T due to Water P -k	=	**2756.00**	**2755.67**	**2380.75**	
Initial Jacking Force P_x	=	0.74 P_0			
	=	**443** kN			
Maxium compressive stress in concrete when tank empty	=	5.51	N/mm^2		
Assumed % of prestress losses		16.620%	losses		
Initial Stress	=	6.61	N/mm^2		
Actual % of Percentage of Losses	=	16.619%	OK		

Additional Force to Cater maximum Temparature rise of 35C⁰

Maxium Temparature Rise (Assume)	=	35	C^0
Length of Cable	=	84.82	m
Extention in Cable	=	36	mm
Stress in Cable	=	84	N/mm^2
Additional force Required	=	**39**	kN
Design force in Cable	=	**331**	kN
Cable Spacing & pressure intensity on shaft		120	5.51 mm & N/mm^2

Properties of Pre-stressing -Max avg-water height 10.9 m

Tendon properties

Nominal Diameter of prestressing wire	=	7 mm
Area /wire	=	38.5 mm^2
No of wires in a cable	=	12
Design force for 12 wires 0.7X1860N/mm^2	=	601.524 kN

Tank Dimensions

Internal Diameter	=	53 m
Wall Thickness	=	500 mm
Tank wall height	=	11.4 m
Average water height considered	=	10.9 m
Base Condition		Sliding Joint

Calculations

P,req'd, P app'd & & Ring T due to Water P -kN	=	**3233.00**	**3233.08**	**2915.75**

Initial Jacking Force	P_x	=	0.74 P_0
		=	**443** kN

Maxium compressive stress in concrete when tank empty	=	6.47 N/mm^2
Assumed % of prestress losses		18.283% losses
Initial Stress	=	7.91 N/mm^2
Actual % of Percentage of Losses	=	18.283% **OK**

Additional Force to Cater maximum Temparature rise of 35C⁰

Maxium Temparature Rise (Assume)	=	35 C^0
Length of Cable	=	84.82 m
Extention in Cable	=	36 mm
Stress in Cable	=	84 N/mm^2
Additional force Required	=	**39** kN
Design force in Cable	=	**323** kN
Cable Spacing & pressure intensity on shaft	100	6.47 mm & N/mm^2

GR-30

1. STAAD SPACE M-CIR53A.STD-12-10-00

LOAD 1 -PRESTRESSING BOTTOM 1.0 METER

```
ELEMENT  LOAD        QX           QY            MX           MY            MXY
                   VONT         VONB          FX           FY            FXY

   1       1        -.01        56.83          2.83        18.86           .00
                 3305.12      3047.49      -3273.31      -261.60          -.03
     TOP :  SMAX=   191.12  SMIN= -3205.41  TMAX=  1698.27  ANGLE=    .0
     BOTT:  SMAX=  -714.33  SMIN= -3341.21  TMAX=  1313.44  ANGLE=    .0

 181       1        -.01        77.06          7.59        50.61           .00
                 2624.91      2062.38      -2178.48      -237.60           .01
     TOP :  SMAX=   977.00  SMIN= -1996.30  TMAX=  1486.65  ANGLE=    .0
     BOTT:  SMAX= -1452.21  SMIN= -2360.65  TMAX=   454.22  ANGLE=    .0

 361       1        -.01        14.09         10.79        71.95           .00
                 2190.33      1766.99      -1257.46      -213.60           .01
     TOP :  SMAX=  1513.20  SMIN=  -998.45  TMAX=  1255.83  ANGLE=    .0
     BOTT:  SMAX= -1516.46  SMIN= -1940.40  TMAX=   211.97  ANGLE=    .0

 541       1         .00       -19.21         10.44        69.61           .00
                 1671.43      1614.08       -581.64      -189.60           .00
     TOP :  SMAX=  1481.14  SMIN=  -331.04  TMAX=   906.09  ANGLE=    .0
     BOTT:  SMAX=  -832.23  SMIN= -1860.34  TMAX=   514.05  ANGLE=    .0

 721       1         .00       -32.02          8.42        56.13           .00
                 1154.38      1372.41       -145.57      -165.60           .00
     TOP :  SMAX=  1181.60  SMIN=    56.50  TMAX=   562.55  ANGLE=    .0
     BOTT:  SMAX=  -347.63  SMIN= -1512.80  TMAX=   582.58  ANGLE=    .0

 901       1         .00       -32.45          5.95        39.66           .00
                  721.09      1070.71         95.90      -141.60           .00
     TOP :  SMAX=   810.16  SMIN=   238.66  TMAX=   285.75  ANGLE=    .0
     BOTT:  SMAX=   -46.85  SMIN= -1093.36  TMAX=   523.26  ANGLE=    .0

1081       1         .00       -26.65          3.71        24.75           .00
                  415.50       772.41        199.11      -117.60           .00
     TOP :  SMAX=   476.29  SMIN=   288.18  TMAX=    94.05  ANGLE=    .0
     BOTT:  SMAX=   110.04  SMIN=  -711.49  TMAX=   410.76  ANGLE=    .0

1261       1         .00       -18.78          2.01        13.39           .00
                  247.69       519.23        215.49       -93.60           .00
     TOP :  SMAX=   263.69  SMIN=   227.77  TMAX=    17.96  ANGLE=    .0
     BOTT:  SMAX=   167.29  SMIN=  -414.97  TMAX=   291.13  ANGLE=    .0

1441       1         .00       -11.28           .89         5.96           .00
                  180.75       326.19        184.46       -69.60           .00
     TOP :  SMAX=   205.89  SMIN=    73.34  TMAX=    66.28  ANGLE=    .0
     BOTT:  SMAX=   163.03  SMIN=  -212.54  TMAX=   187.78  ANGLE=    .0

1621       1         .00        -5.38           .29         1.91           .00
                  138.78       188.24        131.99       -45.60           .00
     TOP :  SMAX=   138.85  SMIN=      .15  TMAX=    69.35  ANGLE=    .0
     BOTT:  SMAX=   125.14  SMIN=   -91.35  TMAX=   108.24  ANGLE=    .0

1801       1         .00        -1.59           .04          .29           .00
                   81.71        89.14         72.38       -21.60           .00
     TOP :  SMAX=    73.42  SMIN=   -14.60  TMAX=    44.01  ANGLE=    .0
     BOTT:  SMAX=    71.33  SMIN=   -28.60  TMAX=    49.97  ANGLE=    .0
```

LOAD 2 -PRESTRESSING BOTTOM 2.0 METER

```
ELEMENT  LOAD       QX          QY          MX          MY          MXY
                    VONT        VONE        FX          FY          FXY

   1       2       -.02       15.02       1.77       11.78          .00
                 5437.14     5260.24   -5468.89    -261.61         -.04
   TOP :  SMAX=    21.22   SMIN= -5426.50  TMAX=  2723.86  ANGLE=   .0
   BOTT:  SMAX=  -544.44   SMIN= -5511.28  TMAX=  2483.42  ANGLE=   .0

 181       2       -.02       82.18       5.05       33.70          .00
                 4159.55     3677.26   -3965.75    -237.60          .01
   TOP :  SMAX=   571.14   SMIN= -3844.47  TMAX=  2207.80  ANGLE=   .0
   BOTT:  SMAX= -1046.34   SMIN= -4087.03  TMAX=  1520.34  ANGLE=   .0

 361       2       -.01       82.29      10.89       72.63          .00
                 3358.95     2520.99   -2583.46    -213.60          .01
   TOP :  SMAX=  1529.47   SMIN= -2322.03  TMAX=  1925.75  ANGLE=   .0
   BOTT:  SMAX= -1956.67   SMIN= -2844.88  TMAX=   444.11  ANGLE=   .0

 541       2       -.01        8.50      14.03       93.53          .00
                 2784.11     2183.82   -1449.92    -189.60          .01
   TOP :  SMAX=  2055.24   SMIN= -1113.23  TMAX=  1584.24  ANGLE=   .0
   BOTT:  SMAX= -1786.62   SMIN= -2434.44  TMAX=   323.91  ANGLE=   .0

 721       2        .00      -29.18      13.06       87.09          .00
                 2104.25     1961.58    -635.89    -165.60          .00
   TOP :  SMAX=  1924.44   SMIN=  -322.41  TMAX=  1123.43  ANGLE=   .0
   BOTT:  SMAX=  -949.36   SMIN= -2255.64  TMAX=   653.14  ANGLE=   .0

 901       2        .00      -42.40      10.26       68.39          .00
                 1441.78     1630.35    -122.13    -141.60          .00
   TOP :  SMAX=  1499.80   SMIN=   124.05  TMAX=   687.87  ANGLE=   .0
   BOTT:  SMAX=  -368.31   SMIN= -1783.00  TMAX=   707.34  ANGLE=   .0

1081       2        .00      -41.21       7.06       47.07          .00
                  895.28     1239.93     154.31    -117.60          .00
   TOP :  SMAX=  1012.12   SMIN=   323.74  TMAX=   344.19  ANGLE=   .0
   BOTT:  SMAX=   -15.12   SMIN= -1247.32  TMAX=   616.10  ANGLE=   .0

1261       2        .00      -33.03       4.25       28.36          .00
                  513.88      868.17     266.47     -93.60          .00
   TOP :  SMAX=   587.01   SMIN=   368.54  TMAX=   109.23  ANGLE=   .0
   BOTT:  SMAX=   164.40   SMIN=  -774.22  TMAX=   469.31  ANGLE=   .0

1441       2        .00      -22.72       2.16       14.43          .00
                  307.43      564.81     278.98     -69.60          .00
   TOP :  SMAX=   330.91   SMIN=   276.75  TMAX=    27.08  ANGLE=   .0
   BOTT:  SMAX=   227.05   SMIN=  -415.95  TMAX=   321.50  ANGLE=   .0

1621       2        .00      -13.01        .84        5.59          .00
                  229.24      346.95     240.21     -45.60          .00
   TOP :  SMAX=   260.33   SMIN=    88.67  TMAX=    85.83  ANGLE=   .0
   BOTT:  SMAX=   220.08   SMIN=  -179.87  TMAX=   199.98  ANGLE=   .0

1801       2        .00       -5.17        .18        1.18          .00
                  182.02      206.31     181.03     -21.60          .00
   TOP :  SMAX=   185.25   SMIN=     6.66  TMAX=    89.30  ANGLE=   .0
   BOTT:  SMAX=   176.81   SMIN=   -49.86  TMAX=   113.34  ANGLE=   .0
```

LOAD 3 -PRESTRESSING BOTTOM 3.0 METER

```
 ELEMENT   LOAD         QX          QY           MX           MY            MXY
                       VONT        VONB          FX           FY            FXY


     1       3         -.03       -4.99        1.27         8.47            .00
                    6499.42     6369.64    -6558.87      -261.61           -.04
      TOP :  SMAX=   -59.42  SMIN= -6528.44  TMAX=  3235.01  ANGLE=    .0
      BOTT:  SMAX=  -464.80  SMIN= -6589.31  TMAX=  3062.26  ANGLE=    .0

   181       3         -.02       20.81        1.51        10.11            .00
                    5069.17     4916.89    -5103.02      -237.60            .01
      TOP :  SMAX=     4.99  SMIN= -5066.67  TMAX=  2535.83  ANGLE=    .0
      BOTT:  SMAX=  -480.20  SMIN= -5139.37  TMAX=  2329.58  ANGLE=    .0

   361       3         -.02       82.07        5.04        33.59            .00
                    3896.27     3414.20    -3686.99      -213.60            .01
      TOP :  SMAX=   592.45  SMIN= -3566.12  TMAX=  2079.28  ANGLE=    .0
      BOTT:  SMAX= -1019.65  SMIN= -3807.85  TMAX=  1394.10  ANGLE=    .0

   541       3         -.01       73.07       10.55        70.32            .00
                    3164.72     2355.94    -2390.60      -189.60            .01
      TOP :  SMAX=  1499.13  SMIN= -2137.48  TMAX=  1817.80  ANGLE=    .0
      BOTT:  SMAX= -1877.33  SMIN= -2643.71  TMAX=   383.19  ANGLE=    .0

   721       3         -.01        4.94       13.22        88.16            .00
                    2612.05     2040.89    -1334.76      -165.60            .01
      TOP :  SMAX=  1950.24  SMIN= -1017.43  TMAX=  1483.83  ANGLE=    .0
      BOTT:  SMAX= -1652.10  SMIN= -2281.44  TMAX=   314.67  ANGLE=    .0

   901       3          .00      -29.63       12.12        80.80            .00
                    1958.42     1810.02     -580.19      -141.60            .00
      TOP :  SMAX=  1797.65  SMIN=  -289.34  TMAX=  1043.50  ANGLE=    .0
      BOTT:  SMAX=  -871.04  SMIN= -2080.86  TMAX=   604.91  ANGLE=    .0

  1081       3          .00      -41.56        9.34        62.27            .00
                    1320.95     1475.47     -104.28      -117.60            .00
      TOP :  SMAX=  1376.80  SMIN=   119.85  TMAX=   628.47  ANGLE=    .0
      BOTT:  SMAX=  -328.41  SMIN= -1612.00  TMAX=   641.80  ANGLE=    .0

  1261       3          .00      -40.08        6.22        41.47            .00
                     794.36     1091.98      155.55       -93.60            .00
      TOP :  SMAX=   901.62  SMIN=   304.80  TMAX=   298.41  ANGLE=    .0
      BOTT:  SMAX=     6.29  SMIN= -1088.82  TMAX=   547.56  ANGLE=    .0

  1441       3          .00      -31.86        3.50        23.33            .00
                     438.46      740.64      270.58       -69.60            .00
      TOP :  SMAX=   490.29  SMIN=   354.53  TMAX=    67.88  ANGLE=    .0
      BOTT:  SMAX=   186.62  SMIN=  -629.49  TMAX=   408.05  ANGLE=    .0

  1621       3          .00      -21.06        1.51        10.08            .00
                     295.35      480.43      303.42       -45.60            .00
      TOP :  SMAX=   339.68  SMIN=   196.26  TMAX=    71.71  ANGLE=    .0
      BOTT:  SMAX=   267.17  SMIN=  -287.46  TMAX=   277.31  ANGLE=    .0

1801      3          .00       -9.83         .36         2.39         .00
                     292.36      337.96      300.03       -21.60            .00
      TOP :  SMAX=   308.63  SMIN=    35.84  TMAX=   136.39  ANGLE=    .0
      BOTT:  SMAX=   291.44  SMIN=   -79.04  TMAX=   185.24  ANGLE=    .0
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LOAD 4 -PRESTRESSING BOTTOM 4.0 METER

 ELEMENT   LOAD          QX          QY           MX            MY             MXY
                        VONT        VONB          FX            FY             FXY


    1       4          -.04      -13.77         1.06          7.07             .00
                    7000.42     6891.15     -7071.30       -261.61           -.03
     TOP :  SMAX=    -91.86   SMIN= -7045.89  TMAX=  3477.02  ANGLE=     .0
     BOTT:  SMAX=   -431.36   SMIN= -7096.70  TMAX=  3332.67  ANGLE=     .0

  181       4          -.03      -11.38         -.17         -1.14             .00
                    5728.56     5745.93     -5852.30       -237.60             .01
     TOP :  SMAX=   -265.06   SMIN= -5856.49  TMAX=  2795.72  ANGLE=     .0
     BOTT:  SMAX=   -210.15   SMIN= -5848.12  TMAX=  2818.98  ANGLE=     .0

  361       4          -.02       18.31         -.20         -1.35             .00
                    4518.03     4538.21     -4631.05       -213.60             .01
     TOP :  SMAX=   -245.89   SMIN= -4635.96  TMAX=  2195.03  ANGLE=     .0
     BOTT:  SMAX=   -181.31   SMIN= -4626.15  TMAX=  2222.42  ANGLE=     .0

  541       4          -.02       75.48         3.02         20.17             .00
                    3493.75     3199.12     -3409.75       -189.60             .01
     TOP :  SMAX=    294.48   SMIN= -3337.19  TMAX=  1815.84  ANGLE=     .0
     BOTT:  SMAX=   -673.69   SMIN= -3482.32  TMAX=  1404.31  ANGLE=     .0

  721       4          -.01       73.85         8.35         55.69             .00
                    2834.29     2149.36     -2261.60       -165.60             .00
     TOP :  SMAX=   1171.00   SMIN= -2061.15  TMAX=  1616.08  ANGLE=     .0
     BOTT:  SMAX=  -1502.21   SMIN= -2462.04  TMAX=   479.91  ANGLE=     .0

  901       4          -.01        8.54        11.22         74.78             .00
                    2348.02     1782.61     -1303.64       -141.60             .00
     TOP :  SMAX=   1653.16   SMIN= -1034.47  TMAX=  1343.82  ANGLE=     .0
     BOTT:  SMAX=  -1572.81   SMIN= -1936.37  TMAX=   181.78  ANGLE=     .0

 1081       4           .00      -25.96        10.40         69.32             .00
                    1748.33     1543.27      -600.55       -117.60             .00
     TOP :  SMAX=   1546.19   SMIN=  -351.02  TMAX=   948.60  ANGLE=     .0
     BOTT:  SMAX=   -850.07   SMIN= -1781.39  TMAX=   465.66  ANGLE=     .0

 1261       4           .00      -38.97         7.85         52.37             .00
                    1138.07     1221.05      -136.12        -93.60             .00
     TOP :  SMAX=   1163.36   SMIN=    52.38  TMAX=   555.49  ANGLE=     .0
     BOTT:  SMAX=   -324.63   SMIN= -1350.56  TMAX=   512.96  ANGLE=     .0

 1441       4           .00      -38.33         4.89         32.62             .00
                     624.63      867.54       146.73        -69.60             .00
     TOP :  SMAX=    713.30   SMIN=   264.13  TMAX=   224.59  ANGLE=     .0
     BOTT:  SMAX=     29.33   SMIN=  -852.50  TMAX=   440.92  ANGLE=     .0

 1621       4           .00      -29.53         2.31         15.41             .00
                     350.02      590.26       315.59        -45.60             .00
     TOP :  SMAX=    371.04   SMIN=   324.31  TMAX=    23.36  ANGLE=     .0
     BOTT:  SMAX=    260.13   SMIN=  -415.51  TMAX=   337.82  ANGLE=     .0

 1801       4           .00      -15.64          .59          3.97             .00
                     412.00      484.46       429.60        -21.60             .00
     TOP :  SMAX=    443.86   SMIN=    73.65  TMAX=   185.10  ANGLE=     .0
     BOTT:  SMAX=    415.35   SMIN=  -116.85  TMAX=   266.10  ANGLE=     .0

     LOAD 5 -PRESTRESSING BOTTOM 5.0 METER

 ELEMENT   LOAD          QX          QY           MX            MY             MXY
                        VONT        VONB          FX            FY             FXY

    1       5          -.03      -15.13         1.03          6.91             .00
                    7111.18     7004.22     -7183.36       -261.61           -.03
     TOP :  SMAX=    -95.72   SMIN= -7158.56  TMAX=  3531.42  ANGLE=     .0
     BOTT:  SMAX=   -427.49   SMIN= -7208.17  TMAX=  3390.34  ANGLE=     .0
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 181      5         -.03      -21.29         -.56        -3.74          .00
                 6057.61     6115.06     -6201.15      -237.60          .01
   TOP :  SMAX=  -327.46   SMIN= -6214.70  TMAX=  2943.62  ANGLE=       .0
   BOTT:  SMAX=  -147.75   SMIN= -6187.59  TMAX=  3019.92  ANGLE=       .0

 361      5         -.02       -8.78        -1.93       -12.83          .00
                 5012.12     5207.82     -5206.25      -213.60          .01
   TOP :  SMAX=  -521.61   SMIN= -5252.53  TMAX=  2365.46  ANGLE=       .0
   BOTT:  SMAX=    94.40   SMIN= -5159.97  TMAX=  2627.19  ANGLE=       .0

 541      5         -.02       23.47        -1.62       -10.80          .00
                 4002.56     4165.37     -4169.09      -189.60          .01
   TOP :  SMAX=  -448.80   SMIN= -4208.04  TMAX=  1879.62  ANGLE=       .0
   BOTT:  SMAX=    69.59   SMIN= -4130.13  TMAX=  2099.86  ANGLE=       .0

 721      5         -.01       76.11         1.86        12.41          .00
                 3122.48     2939.31     -3098.88      -165.60          .00
   TOP :  SMAX=   132.19   SMIN= -3054.28  TMAX=  1593.24  ANGLE=       .0
   BOTT:  SMAX=  -463.40   SMIN= -3143.48  TMAX=  1340.04  ANGLE=       .0

 901      5         -.01       64.87         6.90        46.04          .00
                 2531.50     1943.80     -2074.05      -141.60          .00
   TOP :  SMAX=   963.38   SMIN= -1908.37  TMAX=  1435.88  ANGLE=       .0
   BOTT:  SMAX= -1246.59   SMIN= -2239.74  TMAX=   496.57  ANGLE=       .0

1081      5          .00        4.73         9.31        62.08          .00
                 2048.31     1526.08     -1205.61      -117.60          .00
   TOP :  SMAX=  1372.24   SMIN=  -982.20  TMAX=  1177.22  ANGLE=       .0
   BOTT:  SMAX= -1429.03   SMIN= -1607.45  TMAX=    89.21  ANGLE=       .0

1261      5          .00      -27.13         9.31        55.45          .00
                 1443.45     1234.05      -548.25       -93.60          .00
   TOP :  SMAX=  1237.16   SMIN=  -348.70  TMAX=   792.93  ANGLE=       .0
   BOTT:  SMAX=  -747.81   SMIN= -1424.37  TMAX=   338.28  ANGLE=       .0

1441      5          .00      -38.30         5.75        38.37          .00
                  824.43      900.96       -81.52       -69.60          .00
   TOP :  SMAX=   851.25   SMIN=    56.55  TMAX=   397.35  ANGLE=       .0
   BOTT:  SMAX=  -219.60   SMIN=  -990.45  TMAX=   385.43  ANGLE=       .0

1621      5          .00      -34.84         2.93        19.57          .00
                  383.60      626.33       252.12       -45.60          .00
   TOP :  SMAX=   424.19   SMIN=   322.54  TMAX=    50.82  ANGLE=       .0
   BOTT:  SMAX=   181.70   SMIN=  -515.39  TMAX=   348.55  ANGLE=       .0

1801      5          .00      -20.49          .80         5.35          .00
                  491.32      587.00       516.71       -21.60          .00
   TOP :  SMAX=   535.91   SMIN=   106.71  TMAX=   214.60  ANGLE=       .0
   BOTT:  SMAX=   497.51   SMIN=  -149.91  TMAX=   323.71  ANGLE=       .0

   LOAD 6 -PRESTRESSING BOTTOM 6.0 METER

ELEMENT  LOAD         QX          QY           MX           MY            MXY
                     VONT        VONB          FX           FY            FXY

   1      6         -.03      -13.39         1.09         7.26          .00
                 7054.43     6942.10     -7123.73      -161.61         -.02
   TOP :  SMAX=   -87.29   SMIN= -7097.67  TMAX=  3505.19  ANGLE=       .0
   BOTT:  SMAX=  -435.92   SMIN= -7149.79  TMAX=  3356.93  ANGLE=       .0

 181      6         -.03      -21.35         -.40        -2.62          .00
                 6223.36     6263.57     -6358.63      -237.60          .01
   TOP :  SMAX=  -300.47   SMIN= -6368.15  TMAX=  3033.84  ANGLE=       .0
   BOTT:  SMAX=  -174.74   SMIN= -6349.11  TMAX=  3087.18  ANGLE=       .0

 361      6         -.02      -18.75        -2.08       -13.86          .00
                 5381.83     5594.62     -5584.13      -213.60          .01
   TOP :  SMAX=  -546.26   SMIN= -5634.12  TMAX=  2543.93  ANGLE=       .0
   BOTT:  SMAX=   119.05   SMIN= -5534.15  TMAX=  2826.60  ANGLE=       .0
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 541       6        -.02      -4.53       -3.15       -20.97          .00
              4531.35    4851.20    -4762.32     -189.60          .00
   TOP :  SMAX=  -692.92  SMIN= -4837.89  TMAX=  2072.49  ANGLE=    .0
   BOTT:  SMAX=   313.71  SMIN= -4686.74  TMAX=  2500.22  ANGLE=    .0

 721       6        -.02      22.66       -2.68       -17.84          .00
              3673.30    3943.32    -3869.74     -165.60          .01
   TOP :  SMAX=  -593.86  SMIN= -3934.05  TMAX=  1670.09  ANGLE=    .0
   BOTT:  SMAX=   262.65  SMIN= -3805.43  TMAX=  2034.04  ANGLE=    .0

 901       6        -.01      65.34         .40         2.66          .00
              2871.19    2831.19    -2918.80     -141.60          .00
   TOP :  SMAX=   -77.80  SMIN= -2909.30  TMAX=  1415.75  ANGLE=    .0
   BOTT:  SMAX=  -205.41  SMIN= -2928.30  TMAX=  1361.45  ANGLE=    .0

1081       6        -.01      59.07        4.84        32.28          .00
              2264.21    1821.14    -1979.06     -117.60          .00
   TOP :  SMAX=   657.20  SMIN= -1862.90  TMAX=  1260.05  ANGLE=    .0
   BOTT:  SMAX=  -892.41  SMIN= -2095.22  TMAX=   601.41  ANGLE=    .0

1261       6        -.01       1.59        6.92        46.14          .00
              1729.69    1261.50    -1148.24      -93.60          .00
   TOP :  SMAX=  1013.85  SMIN=  -982.19  TMAX=   998.02  ANGLE=    .0
   BOTT:  SMAX= -1201.05  SMIN= -1314.30  TMAX=    56.63  ANGLE=    .0

1441       6         .00     -27.99        5.77        38.49          .00
              1061.89     867.92     -473.34      -69.60          .00
   TOP :  SMAX=   854.12  SMIN=  -334.84  TMAX=   594.48  ANGLE=    .0
   BOTT:  SMAX=  -611.84  SMIN=  -993.32  TMAX=   190.74  ANGLE=    .0

1621       6         .00     -35.15        3.28        21.86          .00
               424.76     565.76       69.62      -45.60          .00
   TOP :  SMAX=   479.02  SMIN=   148.25  TMAX=   165.38  ANGLE=    .0
   BOTT:  SMAX=    -9.02  SMIN=  -570.22  TMAX=   280.60  ANGLE=    .0

 FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD          QX           QY          MX            MY           MXY
                      VONT         VONE         FX            FY           FXY


1801       6         .00     -23.79         .96         6.40          .00
               506.34     619.80      536.29      -21.60          .00
   TOP :  SMAX=   559.29  SMIN=   132.07  TMAX=   213.61  ANGLE=    .0
   BOTT:  SMAX=   513.29  SMIN=  -175.27  TMAX=   344.28  ANGLE=    .0

LOAD 7 -PRESTRESSING BOTTOM 7.0 METER

 FORCE OR STRESS = FORCE/WIDTH/THICK, MOMENT = FORCE-LENGTH/WIDTH

ELEMENT  LOAD          QX           QY          MX            MY           MXY
                      VONT         VONE         FX            FY           FXY

   1       7        -.03     -11.34        1.14         7.64          .00
              6965.23    6847.26    -7031.46     -261.61         -.02
   TOP :  SMAX=   -78.30  SMIN= -7004.05  TMAX=  3462.87  ANGLE=    .0
   BOTT:  SMAX=  -444.91  SMIN= -7059.86  TMAX=  3306.98  ANGLE=    .0

 181       7        -.03     -18.01        -.11         -.71          .00
              6261.78    6272.62    -6392.61     -237.61          .00
   TOP :  SMAX=  -254.73  SMIN= -6385.26  TMAX=  3065.27  ANGLE=    .0
   BOTT:  SMAX=  -220.48  SMIN= -6379.95  TMAX=  3079.74  ANGLE=    .0

 361       7        -.02     -18.56       -1.63       -10.88          .00
              5548.05    5715.54    -5730.90     -213.60          .01
   TOP :  SMAX=  -474.64  SMIN= -5770.12  TMAX=  2647.74  ANGLE=    .0
   BOTT:  SMAX=    47.43  SMIN= -5691.67  TMAX=  2869.55  ANGLE=    .0
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 541       7         -.02      -12.21       -2.95       -19.64           .00
                  4816.05     5117.64    -5041.66     -189.60            .00
   TOP :  SMAX=  -661.08   SMIN= -5112.44  TMAX=  2225.68  ANGLE=      .0
   BOTT:  SMAX=   281.88   SMIN= -4970.87  TMAX=  2626.37  ANGLE=      .0

 721       7         -.02        2.10       -3.51       -23.36           .00
                  4055.29     4411.77    -4285.17     -165.60            .00
   TOP :  SMAX=  -726.15   SMIN= -4369.31  TMAX=  1821.58  ANGLE=      .0
   BOTT:  SMAX=   394.95   SMIN= -4201.02  TMAX=  2297.98  ANGLE=      .0

 901       7         -.01       27.14       -2.61       -17.36           .00
                  3268.91     3532.50    -3449.51     -141.60            .00
   TOP :  SMAX=  -558.20   SMIN= -3512.06  TMAX=  1476.93  ANGLE=      .0
   BOTT:  SMAX=   274.99   SMIN= -3386.96  TMAX=  1830.98  ANGLE=      .0

1081       7         -.01       57.89         .37         2.50           .00
                  2519.17     2481.38    -2556.44     -117.60            .00
   TOP :  SMAX=   -57.68   SMIN= -2547.52  TMAX=  1244.92  ANGLE=      .0
   BOTT:  SMAX=  -177.52   SMIN= -2565.37  TMAX=  1193.92  ANGLE=      .0

1261       7         -.01       37.55        3.74        24.97           .00
                  1887.15     1537.90    -1672.61      -93.60            .00
   TOP :  SMAX=   505.70   SMIN= -1582.78  TMAX=  1044.24  ANGLE=      .0
   BOTT:  SMAX=  -692.90   SMIN= -1762.45  TMAX=   534.78  ANGLE=      .0

1441       7          .00       -9.26        4.62        30.79           .00
                  1239.79      908.31     -872.09      -69.60            .00
   TOP :  SMAX=   669.29   SMIN=  -761.31  TMAX=   715.30  ANGLE=      .0
   BOTT:  SMAX=  -808.48   SMIN=  -982.86  TMAX=    87.19  ANGLE=      .0

1621       7          .00      -28.38        3.04        20.28           .00
                   500.22      461.45     -175.16      -45.60            .00
   TOP :  SMAX=   441.23   SMIN=  -102.19  TMAX=   271.71  ANGLE=      .0
   BOTT:  SMAX=  -248.13   SMIN=  -532.43  TMAX=   142.15  ANGLE=      .0

1801       7          .00      -23.12         .96         6.43           .00
                   424.52      538.77      451.93      -21.60            .00
   TOP :  SMAX=   475.02   SMIN=   132.70  TMAX=   171.16  ANGLE=      .0
   BOTT:  SMAX=   428.84   SMIN=  -175.90  TMAX=   302.37  ANGLE=      .0


LOAD 8 -PRESTRESSING BOTTOM 8.0 METER
 ELEMENT  LOAD          QX          QY          MX           MY          MXY
                      VONT        VONB          FX           FY          FXY


   1       8         -.01       -9.23        1.20         8.01           .00
                  6866.78     6743.23    -6929.94     -261.60           -.02
   TOP :  SMAX=   -69.33   SMIN= -6901.19  TMAX=  3415.93  ANGLE=      .0
   BOTT:  SMAX=  -453.87   SMIN= -6958.70  TMAX=  3252.41  ANGLE=      .0

 181       8         -.02      -13.59         .21         1.42           .00
                  6255.37     6233.30    -6359.67     -237.60            .00
   TOP :  SMAX=  -203.51   SMIN= -6354.64  TMAX=  3075.56  ANGLE=      .0
   BOTT:  SMAX=  -271.70   SMIN= -6364.71  TMAX=  3046.50  ANGLE=      .0

 361       8         -.02      -14.84        -.99        -6.57           .00
                  5641.32     5742.56    -5794.05     -213.60            .00
   TOP :  SMAX=  -371.22   SMIN= -5817.76  TMAX=  2723.27  ANGLE=      .0
   BOTT:  SMAX=   -55.98   SMIN= -5770.34  TMAX=  2857.18  ANGLE=      .0

 541       8         -.02      -12.64       -2.16       -14.36           .00
                  5011.70     5233.07    -5205.63     -189.60            .00
   TOP :  SMAX=  -534.12   SMIN= -5257.37  TMAX=  2361.62  ANGLE=      .0
   BOTT:  SMAX=   154.92   SMIN= -5153.89  TMAX=  2654.40  ANGLE=      .0

 721       8         -.02       -6.56       -3.03       -20.15           .00
                  4352.18     4662.25    -4567.71     -165.60            .00
   TOP :  SMAX=  -649.21   SMIN= -4640.32  TMAX=  1996.55  ANGLE=      .0
   BOTT:  SMAX=   318.01   SMIN= -4495.10  TMAX=  2406.55  ANGLE=      .0
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 901       8        -.00       5.64       -3.23      -21.49           .00
              3654.03    3993.48    -3860.65    -141.60           .00
   TOP :  SMAX=  -657.29  SMIN= -3938.07  TMAX=  1640.39  ANGLE=    .0
   BOTT:  SMAX=   374.19  SMIN= -3783.24  TMAX=  2178.66  ANGLE=    .1

1081       8        -.01      18.96       -2.49      -18.56           .00
              1916.66    3169.71    -3190.20    -117.60           .00
   TOP :  SMAX=  -615.16  SMIN= -3139.99  TMAX=  1311.41  ANGLE=    .
   BOTT:  SMAX=   179.98  SMIN= -3111.60  TMAX=  1651.19  ANGLE=    .1

1261       8        -.01      35.90        -.63       -4.16           .00
              2168.57    2231.80    -2243.74     -93.60           .00
   TOP :  SMAX=  -193.36  SMIN= -2258.77  TMAX=  1032.71  ANGLE=    .0
   BOTT:  SMAX=     6.16  SMIN= -2228.72  TMAX=  1117.44  ANGLE=    .0

1441       8        -.01      26.41        1.51       10.08           .00
              1450.90    1301.93    -1393.22     -69.60           .00
   TOP :  SMAX=   171.43  SMIN= -1358.99  TMAX=   764.71  ANGLE=    .
   BOTT:  SMAX=  -311.63  SMIN= -1429.47  TMAX=   558.91  ANGLE=    ..

1621       8         .00      -9.91        1.94       11.92           .00
               699.74     540.37     -575.35     -45.60           .00
   TOP :  SMAX=   264.57  SMIN=  -528.88  TMAX=   396.73  ANGLE=    .0
   BOTT:  SMAX=  -355.78  SMIN=  -621.81  TMAX=   133.02  ANGLE=    .0


ELEMENT  LOAD         QX           QY            MX           MY           MXY
                    VONT         VONB           FX           FY           FXY


1801       8         .10     -16.77         .75        3.04           .00
               188.99     281.51      199.97     -21.60           .10
   TOP :  SMAX=   217.94  SMIN=    99.28  TMAX=    59.33  ANGLE=    .0
   BOTT:  SMAX=   181.79  SMIN=  -142.48  TMAX=   162.13  ANGLE=    .0


   LOAD 9 -PRESTRESSING BOTTOM 9.0 METER

ELEMENT  LOAD         QX           QY            MX           MY           MXY
                    VONT         VONE           FX           FY           FXY
   1       9        -.03      -7.89        1.23        8.14           .00
              6802.13    6675.12    -6863.38    -161.60          -.02
   TOP :  SMAX=   -63.80  SMIN= -6833.81  TMAX=  3385.00  ANGLE=    .1
   BOTT:  SMAX=  -459.40  SMIN= -6892.96  TMAX=  3216.78  ANGLE=    .1

 181       9        -.05     -10.40         .40        1.93           .00
              6232.57    6188.71    -6325.75    -237.60           .00
   TOP :  SMAX=  -169.58  SMIN= -6316.63  TMAX=  3073.52  ANGLE=    .0
   BOTT:  SMAX=  -305.82  SMIN= -6335.86  TMAX=  3015.12  ANGLE=    .0

 361       9        -.05     -11.07        -.51       -3.35           .00
              5668.67    5720.23    -5797.81    -213.60           .00
   TOP :  SMAX=  -294.01  SMIN= -5809.96  TMAX=  2757.97  ANGLE=    .0
   BOTT:  SMAX=  -133.20  SMIN= -5785.66  TMAX=  2826.23  ANGLE=    .0

 541       9        -.02      -9.56       -1.42       -9.41           .00
              5097.14    5241.57    -5258.25    -189.60           .00
   TOP :  SMAX=  -415.67  SMIN= -5292.24  TMAX=  2438.29  ANGLE=    .0
   BOTT:  SMAX=    36.46  SMIN= -5224.25  TMAX=  2630.35  ANGLE=    .0

 721       9        -.02      -6.90       -2.18      -14.50           .00
              4503.65    4727.66    -4686.13    -165.60           .00
   TOP :  SMAX=  -513.55  SMIN= -4738.41  TMAX=  2112.43  ANGLE=    .1
   BOTT:  SMAX=   182.34  SMIN= -4633.85  TMAX=  2408.10  ANGLE=    .1

 901       9        -.02       -.61       -2.61      -17.34           .00
              3977.90    4145.69    -4164.07    -141.60           .01
   TOP :  SMAX=  -557.81  SMIN= -4116.59  TMAX=  1744.39  ANGLE=    .1
   BOTT:  SMAX=   274.60  SMIN= -4002.88  TMAX=  2138.98  ANGLE=    .1
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1081      9        -.01      3.39      -1.66      -17.71          .00
                 3209.32   3482.33   -3390.23    -117.60          .00
   TOP :  SMAX=  -542.72  SMIN= -3446.06  TMAX=  1451.69  ANGLE=   .1
   BOTT:  SMAX=   317.81  SMIN= -3318.37  TMAX=  1811.98  ANGLE=   .1

1261      9        -.11      7.34      -2.43      -18.11          .11
                 1491.67   1740.19   -1639.17     -93.60          .11
   TOP :  SMAX=  -492.18  SMIN= -1697.55  TMAX=  1117.63  ANGLE=   .1
   BOTT:  SMAX=   195.19  SMIN= -2580.79  TMAX=  1437.94  ANGLE=   .1

1441      9        -.01     26.05      -1.27       -9.10          .00
                 1747.71   1886.94   -1840.98     -69.60          .00
   TOP :  SMAX=  -297.97  SMIN= -1973.91  TMAX=   791.92  ANGLE=   .1
   BOTT:  SMAX=   148.79  SMIN= -1909.15  TMAX=   979.46  ANGLE=   .1

1621      9         .00     17.18        .06         .41          .00
                  992.93    986.54   -1011.66     -45.60          .00
   TOP :  SMAX=   -35.65  SMIN= -1010.27  TMAX=   487.21  ANGLE=   .0
   BOTT:  SMAX=   -55.35  SMIN= -1013.05  TMAX=   478.85  ANGLE=   .0
ELEMENT  LOAD        QX        QY         MX          MY          MXY
                   VONT      VONB         FX          FY          FXY

1801      9         .00     -4.91        .32        2.17          .00
                  191.44    165.77    -182.10     -21.60          .00
   TOP :  SMAX=    30.50  SMIN=  -174.36  TMAX=   102.43  ANGLE=   .0
   BOTT:  SMAX=   -73.70  SMIN=  -189.84  TMAX=    58.07  ANGLE=   .0

   LOAD 10 -PRESTRESSING BOTTOM 10.0 METER

ELEMENT  LOAD        QX        QY         MX          MY          MXY
                   VONT      VONB         FX          FY          FXY


   1     10        -.03     -6.99       1.15        9.39          .00
                 6755.71   6626.42   -6818.69    -261.60         -.01
   TOP :  SMAX=   -60.11  SMIN= -6755.57  TMAX=  3362.73  ANGLE=   .0
   BOTT:  SMAX=  -463.36  SMIN= -6848.81  TMAX=  3191.37  ANGLE=   .0

 181     10        -.03     -7.88        .57        3.96          .00
                 6201.42   6141.79   -6286.44    -237.60          .00
   TOP :  SMAX=  -145.02  SMIN= -6272.65  TMAX=  3063.82  ANGLE=   .0
   BOTT:  SMAX=  -330.19  SMIN= -6300.23  TMAX=  2985.02  ANGLE=   .0

 361     10        -.02     -7.29       -.11        -.73          .00
                 5661.28   5670.40   -5770.60    -213.60          .00
   TOP :  SMAX=  -231.17  SMIN= -5773.33  TMAX=  2771.08  ANGLE=   .0
   BOTT:  SMAX=  -196.03  SMIN= -5767.96  TMAX=  2785.91  ANGLE=   .0

 541     10        -.02     -5.44       -.71       -4.72          .00
                 5124.72   5197.51   -5262.35    -189.60          .00
   TOP :  SMAX=  -302.84  SMIN= -5269.42  TMAX=  2483.29  ANGLE=   .0
   BOTT:  SMAX=   -76.36  SMIN= -5235.29  TMAX=  2579.46  ANGLE=   .0

 721     10        -.02     -2.89      -1.15       -7.63          .00
                 4581.08   4699.14   -4717.91    -165.60          .00
   TOP :  SMAX=  -348.70  SMIN= -4745.47  TMAX=  2199.38  ANGLE=   .0
   BOTT:  SMAX=    17.51  SMIN= -4690.36  TMAX=  2353.93  ANGLE=   .0

 901     10        -.02      1.17      -1.34       -8.93          .00
                 4023.37   4161.90   -4151.09    -141.60          .00
   TOP :  SMAX=  -355.93  SMIN= -4199.51  TMAX=  1916.79  ANGLE=   .0
   BOTT:  SMAX=    72.75  SMIN= -4125.05  TMAX=  2098.90  ANGLE=   .0

1081     10        -.02       .12      -1.43       -9.53          .00
                 3440.06   3588.23   -3565.75    -117.60          .00
   TOP :  SMAX=  -346.36  SMIN= -3600.14  TMAX=  1626.89  ANGLE=   .0
   BOTT:  SMAX=   111.16  SMIN= -3531.35  TMAX=  1821.26  ANGLE=   .0
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  1261    10        -.11       -4.84       -1.76       -11.69           .00
                 2914.54     2996.39    -2940.73      -93.60            .00
     TOP :  SMAX=  -374.06  SMIN= -2982.87  TMAX=  1304.40  ANGLE=     .0
     BOTT:  SMAX=   186.86  SMIN= -2898.58  TMAX=  1542.72  ANGLE=     .0

  1441    10        -.01         .25       -2.08       -13.97           .00
                 2152.22     2367.71    -2275.05      -69.60            .00
     TOP :  SMAX=  -402.63  SMIN= -2328.47  TMAX=   961.17  ANGLE=     .0
     BOTT:  SMAX=   263.33  SMIN= -2225.04  TMAX=  1244.19  ANGLE=     .0

  1621    10        -.01       17.44       -1.80       -11.66           .00
                 1473.31     1639.13    -1562.28      -45.60            .00
     TOP :  SMAX=  -301.62  SMIN= -1600.75  TMAX=   649.61  ANGLE=     .0
     BOTT:  SMAX=   210.32  SMIN= -1523.82  TMAX=   867.07  ANGLE=     .0

ELEMENT   LOAD        QX          QY          MX           MY           MXY
                     VONT        VONB        , FX          FY           FXY

  1801    10         .00       16.97        -.50        -3.33           .00
                  779.57      831.96     -913.31      -21.60            .00
     TOP :  SMAX=  -101.59  SMIN=  -925.39  TMAX=   361.90  ANGLE=     .0
     BOTT:  SMAX=    59.39  SMIN=  -900.13  TMAX=   419.81  ANGLE=     .0


 LOAD 11 -PRESTRESS BOTTOM 11.0 METRES

ELEMENT   LOAD        QX          QY          MX           MY           MXY
                     VONT        VONB         FX           FY           FXY

     1    11        -.02       -6.63        1.26         9.45           .10
                 6733.41     6603.31    -6761.94     -261.61           -.11
     TOP :  SMAX=   -55.60  SMIN= -6761.61  TMAX=  3351.91  ANGLE=     .0
     BOTT:  SMAX=  -464.40  SMIN= -6923.26  TMAX=  3179.43  ANGLE=     .0

   181    11        -.01       -6.31         .65         4.36           .00
                 6163.66     6096.27    -6244.63     -137.61            .00
     TOP :  SMAX=  -132.86  SMIN= -6229.01  TMAX=  3048.08  ANGLE=     .0
     BOTT:  SMAX=  -342.34  SMIN= -6260.23  TMAX=  2958.94  ANGLE=     .0

   361    11        -.03       -3.85         .15         1.00           .00
                 5615.72     5600.15    -5711.65     -115.60            .01
     TOP :  SMAX=  -149.69  SMIN= -5706.16  TMAX=  2759.14  ANGLE=     .0
     BOTT:  SMAX=  -137.82  SMIN= -5715.13  TMAX=  2749.91  ANGLE=     .0

   541    11        -.01         .41        -.11         -.68           .00
                 5085.17     5095.55    -5191.49     -199.61            .00
     TOP :  SMAX=  -206.00  SMIN= -5185.04  TMAX=  2489.52  ANGLE=     .0
     BOTT:  SMAX=  -173.20  SMIN= -5179.94  TMAX=  2503.37  ANGLE=     .0

   721    11        -.02        5.54        -.01         -.02           .00
                 4570.67     4570.96    -4651.47     -165.60            .00
     TOP :  SMAX=  -166.00  SMIN= -4651.61  TMAX=  2242.80  ANGLE=     .0
     BOTT:  SMAX=  -165.20  SMIN= -4651.32  TMAX=  2243.06  ANGLE=     .0

   901    11        -.01       11.61         .51         3.45           .00
                 4079.56     4025.41    -4100.08     -141.61            .00
     TOP :  SMAX=   -59.90  SMIN= -4105.60  TMAX=  2024.92  ANGLE=     .0
     BOTT:  SMAX=  -224.40  SMIN= -4133.51  TMAX=  1954.46  ANGLE=     .0

  1081    11        -.02       10.79        1.23         8.12           .00
                 3615.81     3485.49    -3612.78     -117.60            .00
     TOP :  SMAX=    70.79  SMIN= -3573.15  TMAX=  1616.52  ANGLE=     .0
     BOTT:  SMAX=  -315.00  SMIN= -3652.31  TMAX=  1658.65  ANGLE=     .0

  1261    11        -.01        2.09        1.60        10.66           .00
                 3158.68     1991.57    -3112.68      -93.60            .00
     TOP :  SMAX=   162.30  SMIN= -3074.87  TMAX=  1619.36  ANGLE=     .0
     BOTT:  SMAX=  -349.55  SMIN= -3150.99  TMAX=  1400.71  ANGLE=     .0

  1441    11        -.01       -2.88        1.48         9.77           .00
                 2710.67     2555.63    -2668.67      -69.60            .00
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     TOP :  SMAX=   164.74  SMIN= -1613.69  TMAX=  1394.36  ANGLE=    .0
     BOTT:  SMAX=  -304.13  SMIN= -1694.75  TMAX=  1195.11  ANGLE=    .0

  1621    11         -.01       -5.50        1.05         7.33          .00
                   2277.67    2164.88    -1138.64       -45.60          .00
     TOP :  SMAX=   113.12  SMIN= -2213.61  TMAX=  1169.36  ANGLE=    .0
     BOTT:  SMAX=  -214.31  SMIN= -2264.07  TMAX=  1024.88  ANGLE=    .0

 1801    11         -.11       -3.74         .62         4.13          .01
                   1868.26    1800.63    -1843.13       -11.61          .00
     TOP :  SMAX=    77.40  SMIN= -1928.38  TMAX=   951.98  ANGLE=    .0
     BOTT:  SMAX=  -120.60  SMIN= -1857.90  TMAX=   868.65  ANGLE=    .0

LOAD COMB 30 FULL WATER PRESSURE + PRESTRESS

ELEMENT  LOAD        QX          QY          MX          MY           MXY
                    VONT        VONB         FX          FY           FXY


    1     30         .00       -3.25         .04          .26          .00
                   827.99     826.70     -926.50      -161.59          .00
     TOP :  SMAX=  -255.34  SMIN=  -925.59  TMAX=   335.13  ANGLE=    .0
     BOTT:  SMAX=  -267.85  SMIN=  -927.41  TMAX=   329.78  ANGLE=    .0

  181     30         .01       -2.13        -.16        -1.03          .00
                   845.64     851.96     -941.97      -137.60          .00
     TOP :  SMAX=  -162.13  SMIN=  -945.69  TMAX=   341.73  ANGLE=    .0
     BOTT:  SMAX=  -211.97  SMIN=  -938.14  TMAX=   361.63  ANGLE=    .0

  361     30         .00       -1.39        -.28        -1.85          .00
                   861.14     875.04     -953.96      -113.60          .00
     TOP :  SMAX=  -158.09  SMIN=  -960.67  TMAX=   351.09  ANGLE=    .0
     BOTT:  SMAX=  -169.11  SMIN=  -947.06  TMAX=   389.07  ANGLE=    .0

  541     30        -.01        1.19        -.28        -1.86          .00
                   873.18     889.39     -959.69      -189.60          .00
     TOP :  SMAX=  -234.13  SMIN=  -966.41  TMAX=   366.09  ANGLE=    .0
     BOTT:  SMAX=  -144.97  SMIN=  -951.97  TMAX=   414.00  ANGLE=    .0

  721     30         .00        4.91        -.05         -.31          .00
                   886.70     889.62     -959.28      -165.60          .00
     TOP :  SMAX=  -172.64  SMIN=  -960.39  TMAX=   393.78  ANGLE=    .0
     BOTT:  SMAX=  -158.36  SMIN=  -958.17  TMAX=   399.90  ANGLE=    .0

  901     30        -.01        9.94         .52         3.44          .00
                   917.86     880.24     -958.29      -141.60          .00
     TOP :  SMAX=   -58.97  SMIN=  -945.92  TMAX=   443.47  ANGLE=    .0
     BOTT:  SMAX=  -124.13  SMIN=  -974.87  TMAX=   375.12  ANGLE=    .0

 1081     30        -.01        8.38        1.21         9.07          .00
                   991.11     884.91     -989.47      -117.60          .00
     TOP :  SMAX=    78.13  SMIN=  -940.43  TMAX=   509.24  ANGLE=    .0
     BOTT:  SMAX=  -311.33  SMIN=  -994.81  TMAX=   343.59  ANGLE=    .0

 1261     30         .00        -.49        1.52        10.14          .00
                  1054.57     923.49    -1008.17       -93.60          .00
     TOP :  SMAX=   149.75  SMIN=  -971.69  TMAX=   560.72  ANGLE=    .0
     BOTT:  SMAX=  -336.95  SMIN= -1044.65  TMAX=   353.85  ANGLE=    .0

 1441     30         .00       -6.27        1.33         9.85          .00
                  1127.81    1002.46    -1091.43       -69.61          .00
     TOP :  SMAX=   140.94  SMIN= -1149.59  TMAX=   596.11  ANGLE=    .0
     BOTT:  SMAX=  -182.74  SMIN= -1113.27  TMAX=   311.61  ANGLE=    .0

 1621     30         .00       -7.16         .69         5.96          .00
                  1215.20    1124.25    -1185.11       -45.60          .00
     TOP :  SMAX=    97.09  SMIN= -1163.74  TMAX=   630.42  ANGLE=    .0
     BOTT:  SMAX=  -188.28  SMIN= -1206.51  TMAX=   509.11  ANGLE=    .0

  1801     30         .00       -3.97         .51         3.39          .00
                  1329.33    1273.37    -1309.58       -21.60          .00
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      TOP :  SMAX=    69.67  SMIN= -1297.38  TMAX=   678.61  ANGLE=    .0
      BOTT:  SMAX=  -103.17  SMIN= -1321.78  TMAX=   609.35  ANGLE=    .0


LOAD COMB 31 HALF WATER PRESSURE - PRESTRESS

 ELEMENT  LOAD          QX            QY            NX            NY            NXY
                       VOUT          VOUB           FX            FY            FXY
     1      31          -.01         -7.63          .57          3.82           .00
                      3877.89       3823.07     -3973.75      -161.60           .00
      TOP :  SMAX=  -169.99  SMIN= -3960.08  TMAX=  1895.08  ANGLE=    .0
      BOTT:  SMAX=  -353.21  SMIN= -3987.41  TMAX=  1817.10  ANGLE=    .0

   181      31          -.01        -12.81         -.21         -1.35           .00
                      3825.09       3844.59     -3948.01      -237.60           .00
      TOP :  SMAX=  -270.03  SMIN= -3952.95  TMAX=  1841.46  ANGLE=    .0
      BOTT:  SMAX=  -208.17  SMIN= -3943.08  TMAX=  1868.95  ANGLE=    .0

   361      31          -.02        -14.65        -1.24         -9.24           .00
                      3758.22       3879.52     -3917.21      -213.60           .00
      TOP :  SMAX=  -411.24  SMIN= -3946.93  TMAX=  1767.84  ANGLE=    .0
      BOTT:  SMAX=   -15.96  SMIN= -3857.48  TMAX=  1935.76  ANGLE=    .0

   541      31          -.02        -12.74        -2.27        -15.19           .00
                      3667.21       3893.13     -3857.75      -189.60           .00
      TOP :  SMAX=  -553.11  SMIN= -3912.35  TMAX=  1679.62  ANGLE=    .0
      BOTT:  SMAX=   173.91  SMIN= -3913.16  TMAX=  1988.53  ANGLE=    .0

   721      31          -.01         -6.49        -3.02        -20.11           .00
                      3539.25       3841.81     -3746.04      -165.61           .00
      TOP :  SMAX=  -647.96  SMIN= -3916.48  TMAX=  1595.05  ANGLE=    .0
      BOTT:  SMAX=   316.76  SMIN= -3673.61  TMAX=  1995.19  ANGLE=    .0

   901      31          -.01          6.41        -3.06        -20.37           .00
                      3368.12       3678.02     -3565.43      -141.60           .00
      TOP :  SMAX=  -630.56  SMIN= -3638.84  TMAX=  1504.14  ANGLE=    .0
      BOTT:  SMAX=   347.36  SMIN= -3491.02  TMAX=  1919.69  ANGLE=    .0

  1081      31          -.02         15.87        -2.28        -15.17           .00
                      3156.63       3390.44     -3315.12      -117.60           .00
      TOP :  SMAX=  -481.75  SMIN= -3369.81  TMAX=  1444.03  ANGLE=    .0
      BOTT:  SMAX=   146.56  SMIN= -3260.43  TMAX=  1703.49  ANGLE=    .0

  1261      31          -.01         14.01        -1.12         -8.10           .00
                      2918.55       3034.91     -3011.44       -93.60           .00
      TOP :  SMAX=  -288.11  SMIN= -3041.68  TMAX=  1376.78  ANGLE=    .0
      BOTT:  SMAX=   107.91  SMIN= -2966.19  TMAX=  1541.06  ANGLE=    .0

  1441      31          -.01         10.54         -.37         -1.40           .00
                      2619.57       2666.72     -2681.27       -69.60           .00
      TOP :  SMAX=  -127.58  SMIN= -2690.04  TMAX=  1281.23  ANGLE=    .0
      BOTT:  SMAX=   -11.61  SMIN= -2672.51  TMAX=  1330.45  ANGLE=    .0

  1621      31          -.01          5.81          .18          1.79           .00
                      2317.66       2310.11     -2341.24       -45.6            .
      TOP :  SMAX=   -19.61  SMIN= -2357.4   TMAX=  1168.69  ANGLE=    .0
      BOTT:  SMAX=   -71.5   SMIN= -2341.    TMAX=  1136.78  ANGLE=    .

  1801      31          -.01          2.39          .38          2.55           .00
                      2015.51       1973.56     -2004.54       -21.60           .00
      TOP :  SMAX=    39.60  SMIN= -1995.40  TMAX=  1017.51  ANGLE=    .0
      BOTT:  SMAX=   -82.60  SMIN= -2013.66  TMAX=   965.43  ANGLE=    .0
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LOAD CASE 31 FULL TWL - PRESTRESS -SLS
ELEMENT  LOAD        QX          QY          MX          MY          MXY
                     VONT        VONE        FX          FY          FXY

   1      31          .00        -4.77        .05         .65          .[illegible]
                   1111.95     1120.09    -1119.17    -181.59         .[illegible]
  TOP :  SMAX=  -253.28  SMIN= -1227.96  TMAX=   487.34  ANGLE=    .[illegible]
  BOTT:  SMAX=  -269.90  SMIN= -1230.38  TMAX=   480.24  ANGLE=    .0

 181      31          .[illegible]        -4.34       -.28        -1.84          .[illegible]
                   1161.49     1178.33    -1269.77    -237.60         .[illegible]
  TOP :  SMAX=  -191.66  SMIN= -1276.41  TMAX=   497.38  ANGLE=    .[illegible]
  BOTT:  SMAX=  -193.54  SMIN= -1263.11  TMAX=   534.79  ANGLE=    .[illegible]

 361      32         -.01        -1.16       -.51        -1.39          .[illegible]
                   1196.51     1231.00    -1314.11    -113.60         .[illegible]
  TOP :  SMAX=  -294.60  SMIN= -1316.30  TMAX=   510.95  ANGLE=    .0
  BOTT:  SMAX=  -132.60  SMIN= -1291.93  TMAX=   579.67  ANGLE=    .0

 541      32         -.01         1.10       -.54        -3.57          .00
                   1225.66     1265.39    -1327.01    -189.60         .00
  TOP :  SMAX=  -275.29  SMIN= -1339.89  TMAX=   532.30  ANGLE=    .0
  BOTT:  SMAX=  -113.91  SMIN= -1314.13  TMAX=   605.11  ANGLE=    .0

 721      31          .00         5.00       -.30        -1.30          .[illegible]
                   1251.06     1275.99    -1327.87    -185.60         .[illegible]
  TOP :  SMAX=  -213.50  SMIN= -1345.08  TMAX=   565.79  ANGLE=    .[illegible]
  BOTT:  SMAX=  -117.70  SMIN= -1330.66  TMAX=   606.48  ANGLE=    .[illegible]

 9[illegible]1      31         -.01         9.88        .26         1.76          .00
                   1289.16     1266.68    -1340.16    -141.60         .00
  TOP :  SMAX=   -99.30  SMIN= -1335.94  TMAX=   618.32  ANGLE=    .0
  BOTT:  SMAX=  -183.90  SMIN= -1348.58  TMAX=   582.34  ANGLE=    .0

1091      31         -.01         8.09        .94         6.30          .00
                   1347.42     1361.81    -1351.94    -117.60         .[illegible]
  TOP :  SMAX=    33.66  SMIN= -1330.18  TMAX=   681.97  ANGLE=    .0
  BOTT:  SMAX=  -168.86  SMIN= -1375.60  TMAX=   553.37  ANGLE=    .0

1[illegible]81      31         -.01         -.89       1.23         8.19          .00
                   1419.81     1293.99    -1394.97     -93.60         .[illegible]
  TOP :  SMAX=   1[illegible].92  SMIN= -1355.53  TMAX=   729.22  ANGLE=    .0
  BOTT:  SMAX=  -291.11  SMIN= -1414.41  TMAX=   561.15  ANGLE=    .0

1441      32         -.01        -5.39       1.01         6.76          .00
                   1468.89     1369.03    -1444.78     -69.60         .00
  TOP :  SMAX=    92.40  SMIN= -1420.81  TMAX=   756.46  ANGLE=    .[illegible]
  BOTT:  SMAX=  -231.60  SMIN= -1469.05  TMAX=   618.73  ANGLE=    .[illegible]

16[illegible]1      31         -.01        -5.38        .63         4.22          .[illegible]
                   1641.31     1475.02    -1627.83     -45.61         .[illegible]
  TOP :  SMAX=    58.81  SMIN= -1611.66  TMAX=   794.22  ANGLE=    .
  BOTT:  SMAX=  -146.99  SMIN= -1643.[illegible]  TMAX=   [illegible].[illegible]  ANGLE=    .[illegible]

1[illegible]01      31         -.01         -.91        .43         1.84          .00
                   1639.42     1593.02    -1616.81     -11.60         .00
  TOP :  SMAX=    46.61  SMIN= -1618.61  TMAX=   831.11  ANGLE=    .0
  BOTT:  SMAX=   -89.81  SMIN= -1636.03  TMAX=   773.11  ANGLE=    .[illegible]
```
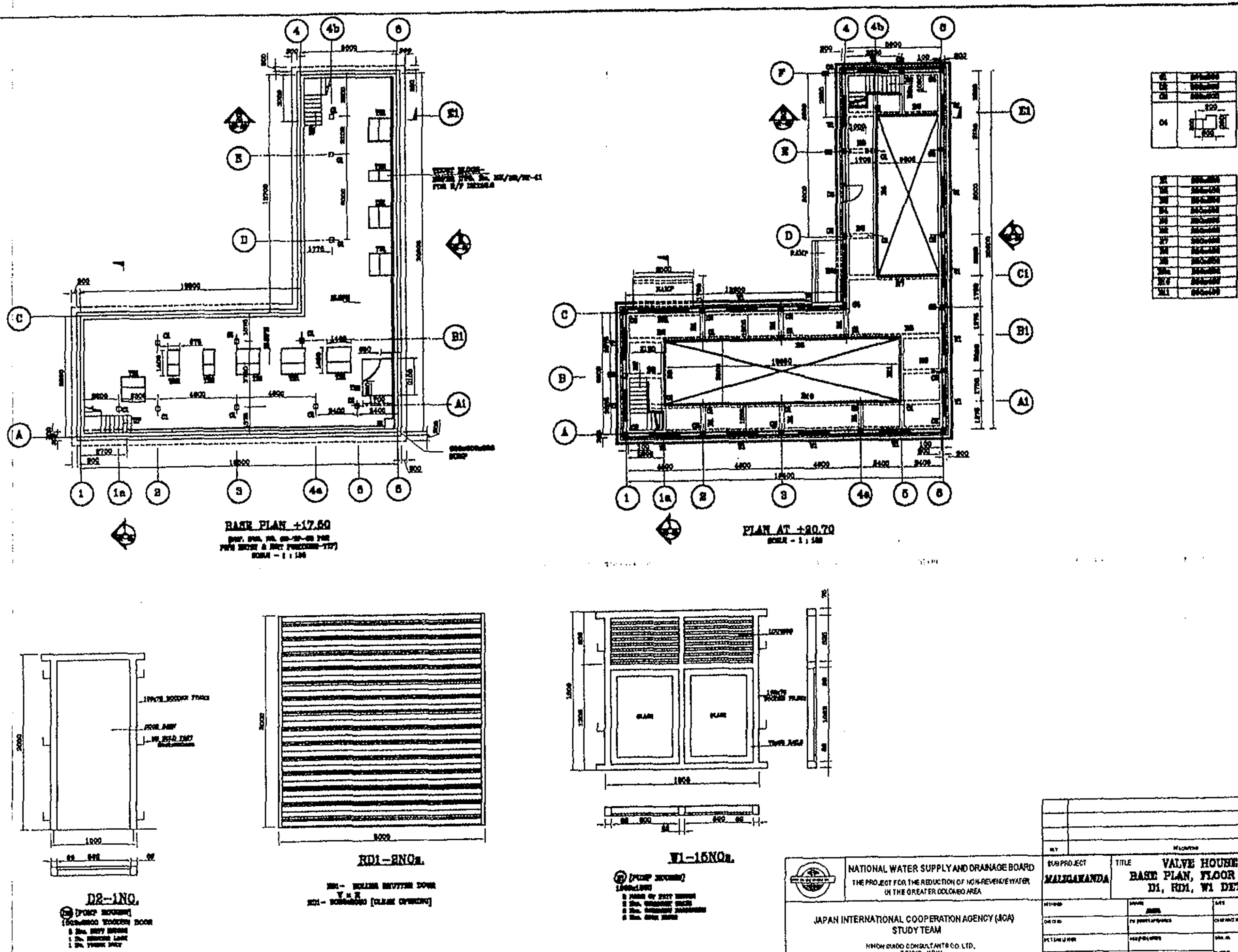
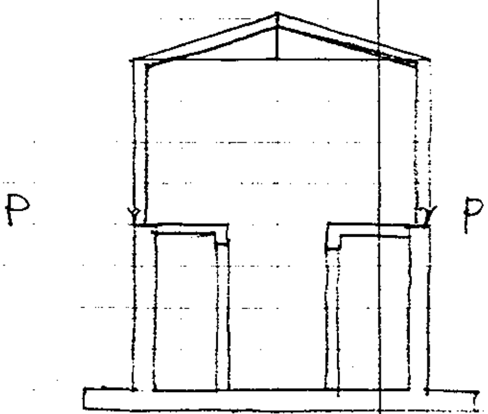



NATIONAL WATER SUPPLY AND DRAINAGE BOARD
THE PROJECT FOR THE REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
STUDY TEAM
NIHON SUIDO CONSULTANTS CO. LTD.
TOKYO, JAPAN

SUB PROJECT	MALIGAKANDA
TITLE	VALVE HOUSE BASE PLAN, FLOOR PLAN & D1, RD1, W1 DETAILS
DRAWING No.	MK-GR-ST-09

CEYWATER CONSULTANT (PVT) LTD.	PROJECT	JOB NO.
INFRASTRUCTURE & ENVIRONMENTAL ENGINEERS AND PLANNERS	CALCULATIONS BY	SHEET.........OF ....
	SCHEME MALIGA KANDA COMPONENT VALVE HOUSE	DATE

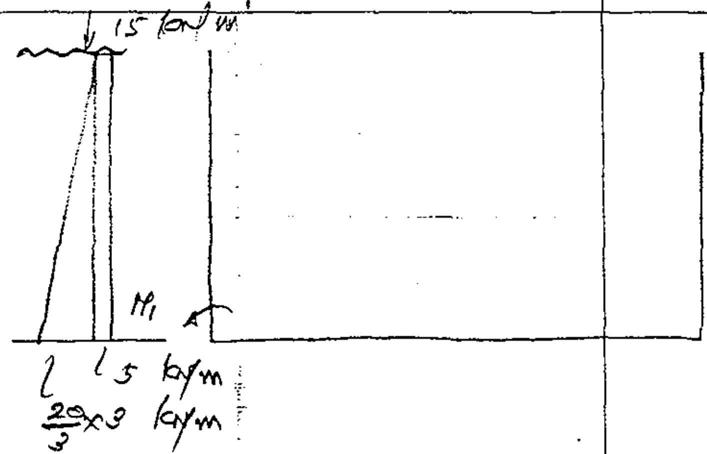
ITEM	CALCULATIONS	OUT PUT
	Typ. Bay. – 4·60 m considered.	
	Loading Roofing self = 1·34 kN/m²	
	Super = 0·75 kN/m²	
	Brick wall with plaster = 4·95 kN/m/m	
	Platform & Pipe floor = 10·0 kN/m² super load	
	Monorail = 15 kN	
	P = 104· kN – comp. output	ULT.
		
	Brick wall to 3·0 high = 4·95×4·60×3×1·4 = 95·6 kN	ULT
	R.C platform = [0·25×24×1·4×1·5 + 10×1·6×1·5] ×4·60 = 164·8 kN	
	R.C walls = 0·3×24×1·4×4·6 = 46·4	
	Pipe floor = [10×1·6×6·5× 4·60 + (0·2+0·4)×24×7·9×4·60×1·4] = 1211·0 kN	
	Avg. bearing pressure = (2×104 + 95·6×2 + 168·4×2 + 46·4×2 + 1211) / (7·9×4·60×1·5) = 37·4 kN/m² < 200 kN/m² OK	

02

DAYANANDA ASSOCIATES	PROJECT		JOB REF
CONSULTING ENGINEERS	CALCULATIONS BY	CHECKED BY	CALC SHEET
	PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUT PUT

case 1.



$M_1 = (5 \times \frac{3^2}{2} + 20 \times \frac{3^2}{6}) \times 1.4$ kNm — ULT

$= 73.5$ kNm (52.5 kNm - SLS)

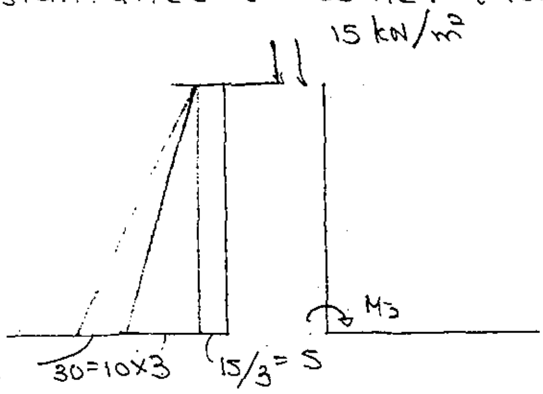
Base - M_ϕ $= (37.4 - 0.6 \times 24 \times 1.4) \times \frac{6.9^2}{8} - 73.5$ kNm

$= 32.2$ kNm/m — ULT

Base - edge V_u $= 17.54 \times \frac{6.5}{2}$ kN/m — ULT

$= 57.0$ kN/m

case 2.
with instantaneous water table rise.



$M_2 = 5 \times \frac{3^2}{2} + 30 \times \frac{3^2}{6} + 10 \times \frac{3^2}{6} = 82.5$ kN/m — SLS.

$= 115.5$ kN/m — ULT

provide Y12 - 125 c/c.
crack with < 0.2

MEMBER REF	CALCULATIONS	OUT PUT
	R/f to control thermal & shrinkage contraction	
	$\rho_{crit} = 0.0035\ bh$	
	$A_{st} = 0.0035 \times 10^3 \times 400 = 1400\ mm^2$.	
	Provide Y12 - 150 c/c (753) at each face.	

DAYANANDA ASSOCIATES	PROJECT		JOB REF
CONSULTING ENGINEERS	CALCULATIONS BY	CHECKED BY	CALC SHEET
	PART OF STRUCTURE: Maligakanda Valve House		DATE

MEMBER REF	CALCULATIONS	OUT PUT
	Floor slab at gr floor level	

loading - Self $0.25 \times 24 \times 1.4$; Super 10×1.6 $\Big] = 24.4\ kN/m^2$.

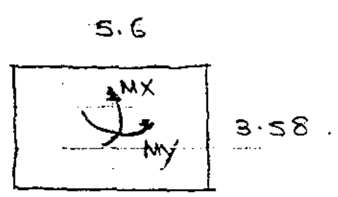
Slab 1.75 m span (typ panel)

$M_{\phi} \approx 24.4 \times \frac{1.75^2}{8} = 9.34\ kNm$.

Ast = 150 mm²/m. - Y10 @ 300 c/c (261) — $d = 200 - 25 - 8 = 167$

$\gamma st = 2.68$

$d = \frac{1.75 \times 10^3}{20 \times 2} = 44 < 167$ o.k.



$M_x = 0.108 \times 24.4 \times 3.58^2 = 33.75\ kNm$
$M_y = 0.046 \times$ " $= 12.51$ "

$M_x = 33.75\ kNm$
Ast = 553 mm²/m - Y12 @ 150 c/c
$\gamma st = 1.6$.

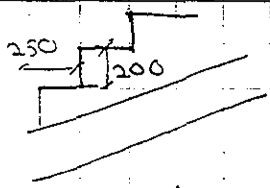
$d = \frac{3.58 \times 10^3}{1.6 \times 20} = 112 < 167$ o.k.

$M_y = 12.51\ kNm$.
Ast = 219 mm² - Y10 @ 175 c/c (448)

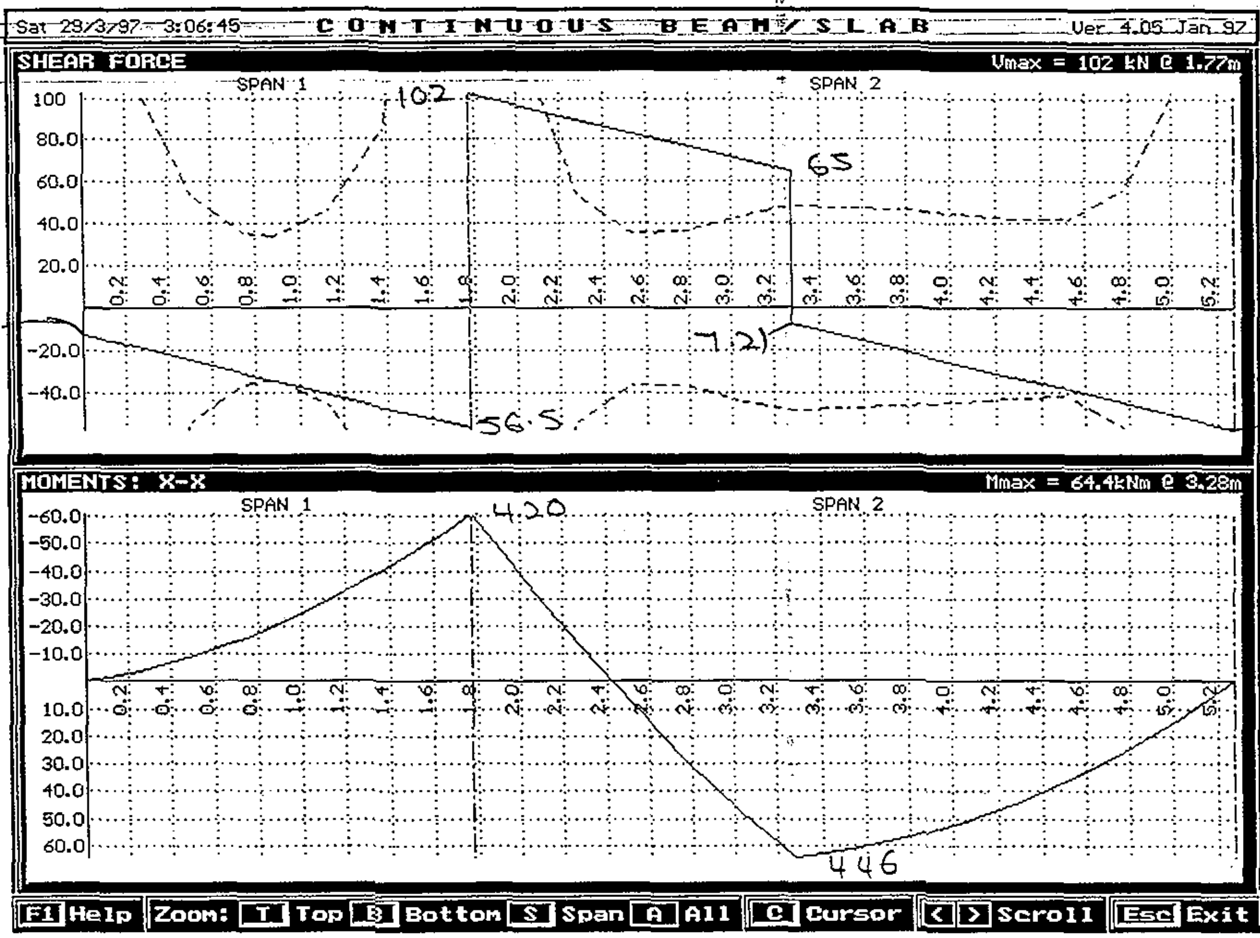
DAYANANDA ASSOCIATES

CONSULTING ENGINEERS

PROJECT		JOB REF
CALCULATIONS BY	CHECKED BY	CALC SHEET
PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUT PUT
	stairs	
		
	Dead 0.2 × 24 × 1.28 = 6.14 kN/m²	
	steps 0.2/2 × 24 = 2.4	
	finishes 0.065 × 22 × 1.28 = 1.83	
	10.37 kN/m²	
	super = 5.0 "	
	n = 1.4 × 10.37 + 1.6 × 5.0 = 22.52 kN/m².	
	$M = \frac{wl^2}{8} = 22.52 \times \frac{3.325^2}{8} = 31.12$ kNm.	$d = 200 - 20 - \frac{12}{2}$ = 174
	Ast = 483 - Y12 @ 150 (753)	
	Yst = 1.83.	
	d = 90 < 174 o.k.	

Floor Beams,
250 × 450   M-UH-B6



$$V_u = \frac{102 \times 10^3}{250 \times 415} = 0.98$$

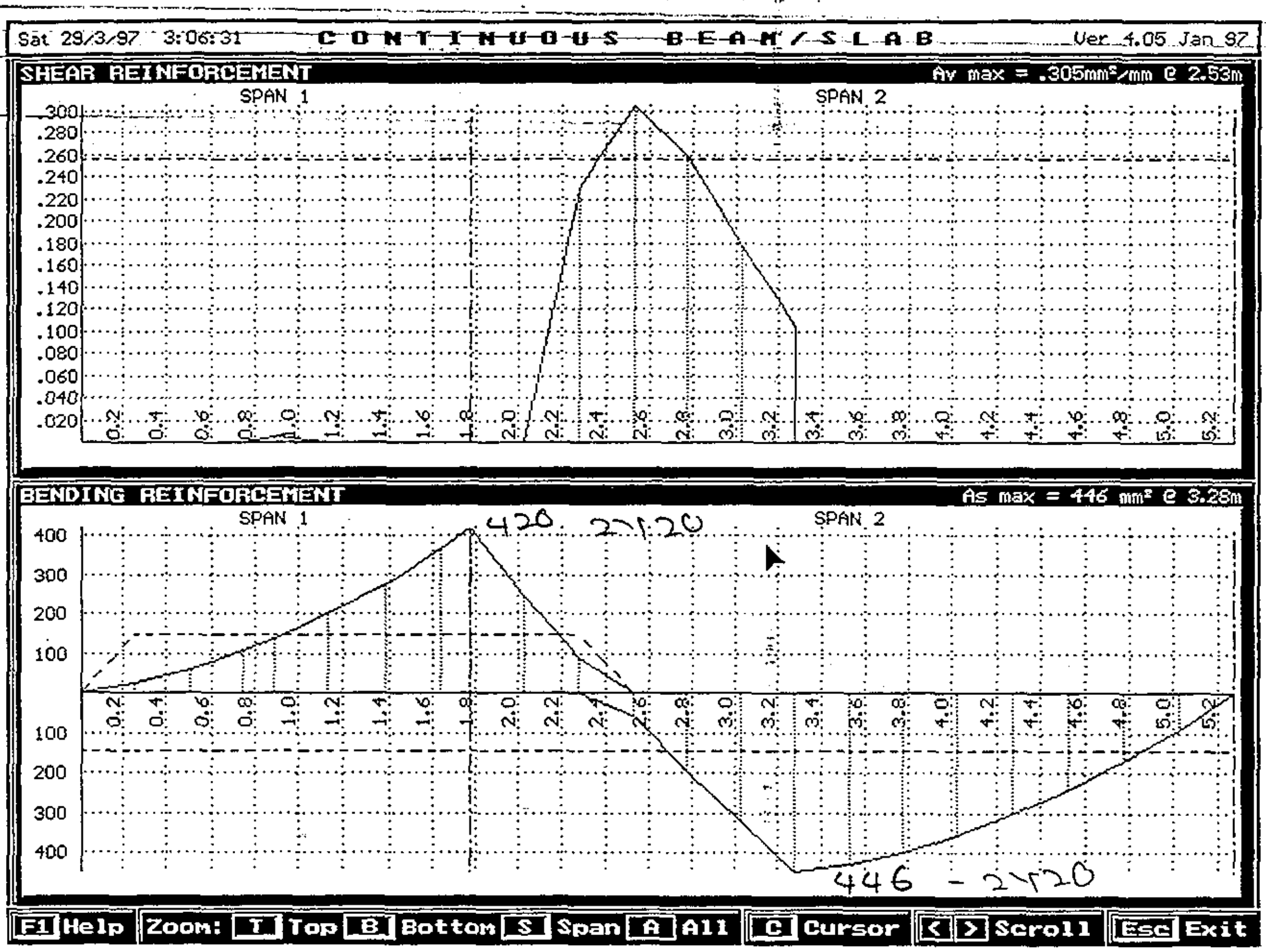
$$\frac{100 A_s}{bd} = \frac{100 \times 628}{250 \times 415} = 0.61$$

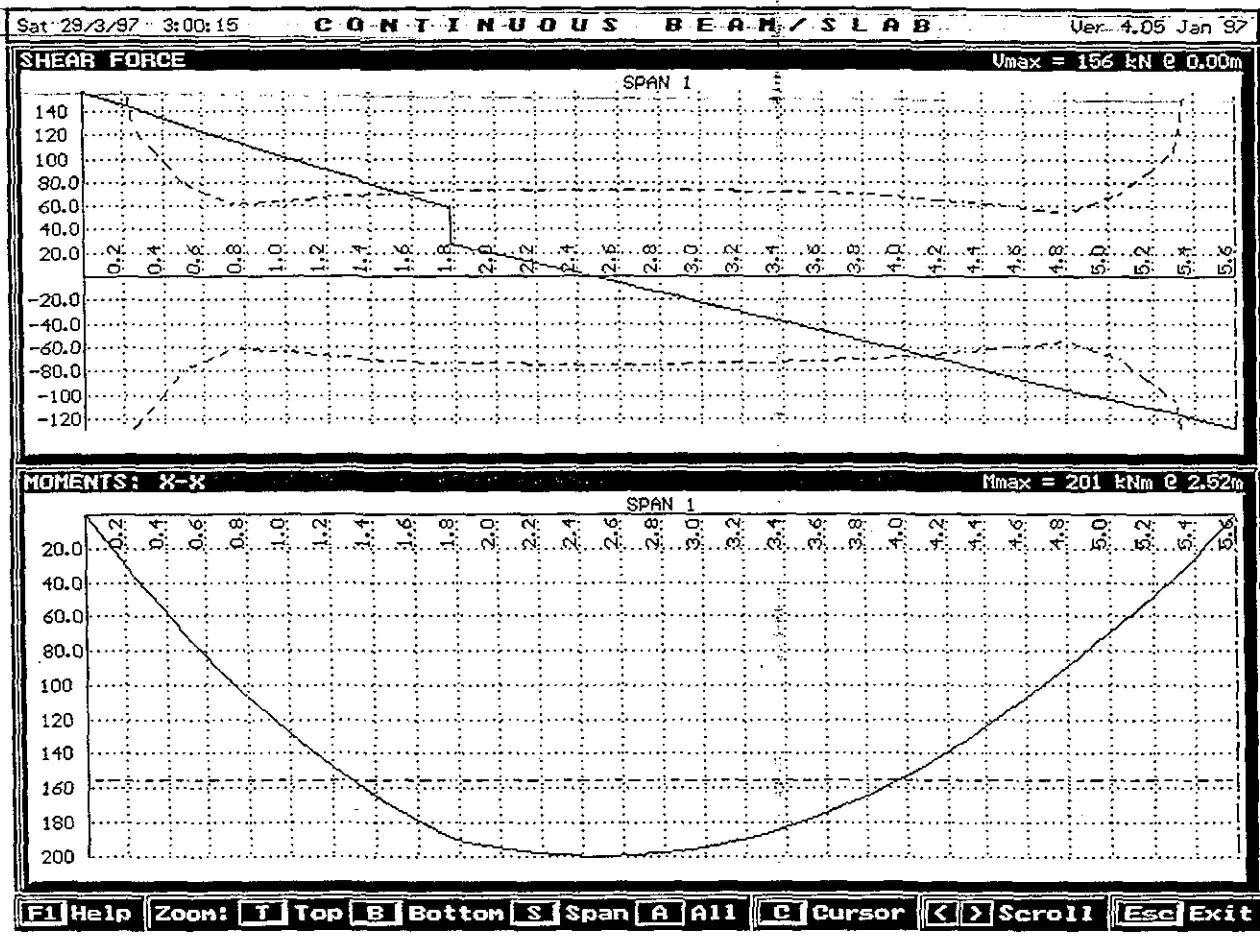
$$V_c = 0.53$$

$$b(V - V_c) = 112.5$$

Y10 @ 300

07


Sat 29/3/97 3:06:31 C O N T I N U O U S B E A M / S L A B Ver 4.05 Jan 97
SHEAR REINFORCEMENT
Av max = .305mm²/mm @ 2.53m
SPAN 1
SPAN 2
.300
.280
.260
.240
.220
.200
.180
.160
.140
.120
.100
.080
.060
.040
.020
0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2
BENDING REINFORCEMENT
As max = 446 mm² @ 3.28m
SPAN 1
SPAN 2
420
2Y20
400
300
200
100
100
200
300
400
446 - 2Y20
F1 Help
Zoom: T Top B Bottom S Span A All
C Cursor
< > Scroll
Esc Exit



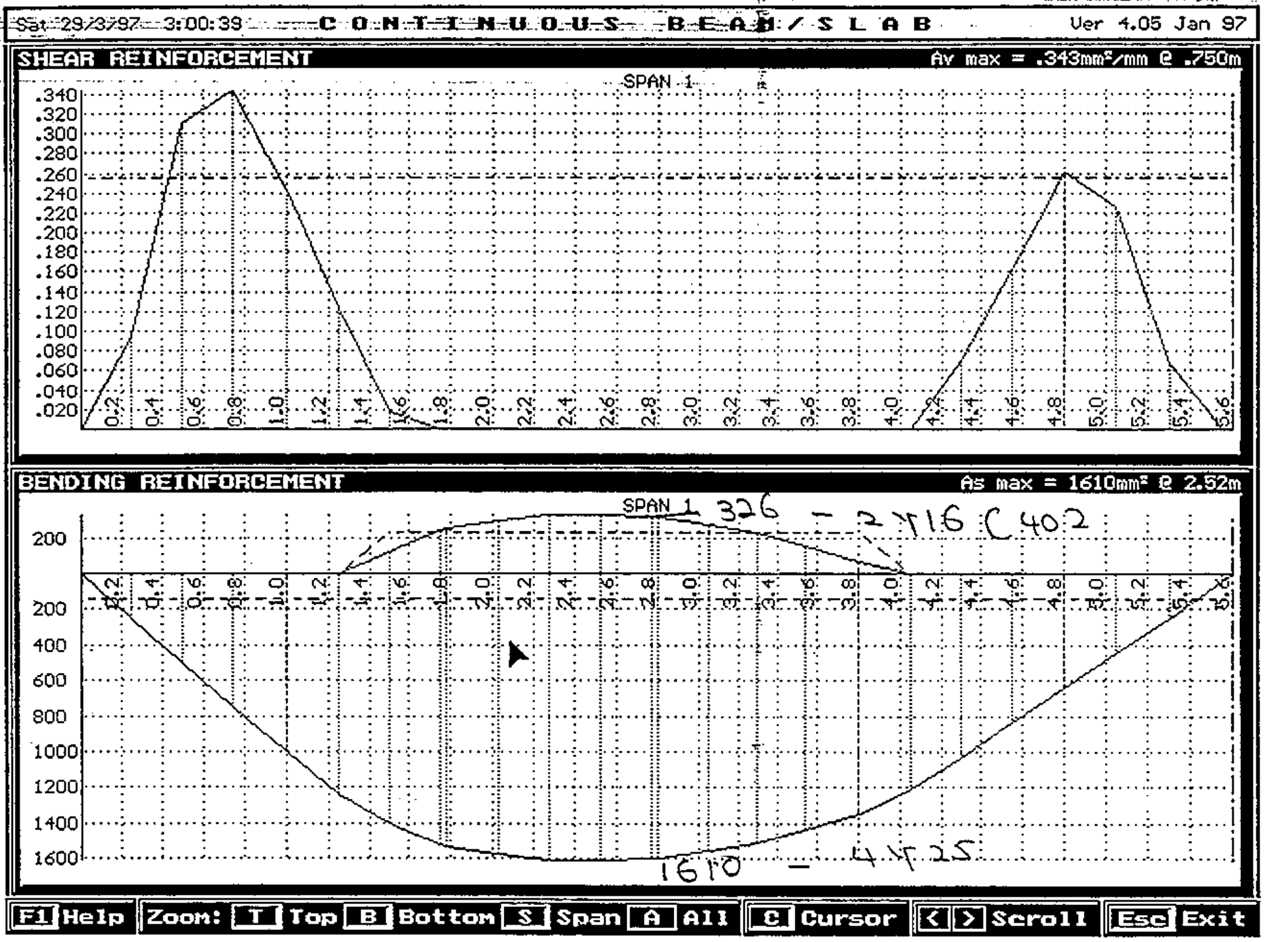
$$V_u = \frac{156 \times 10^3}{250 \times 415} = 1.5$$

$$\frac{100 AS}{bd} = \frac{100 \times 981}{250 \times 415} = 0.95$$

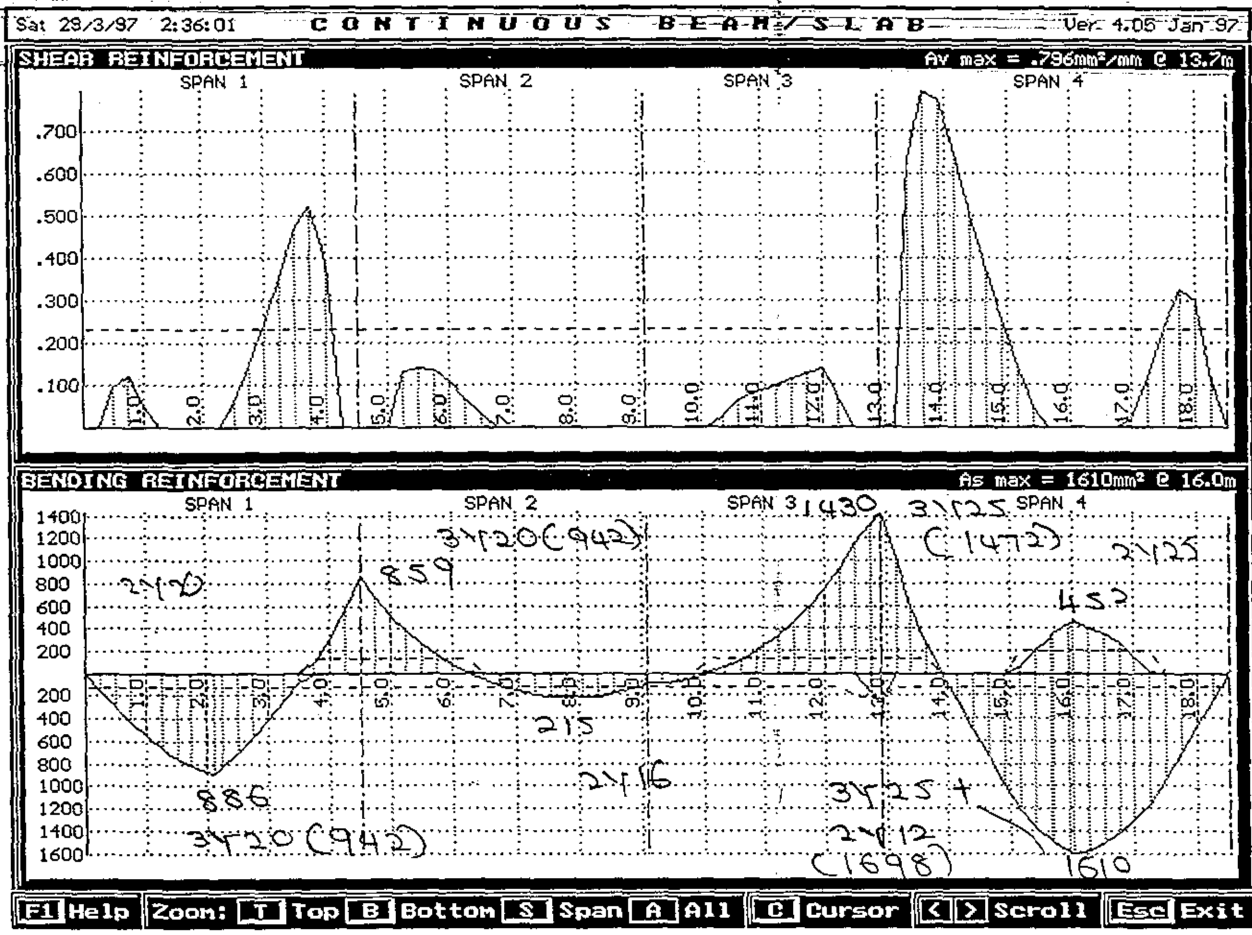
$$V_c = 0.62\ N/mm^2$$

$b(V - V_c) = 220$ — Y10@250

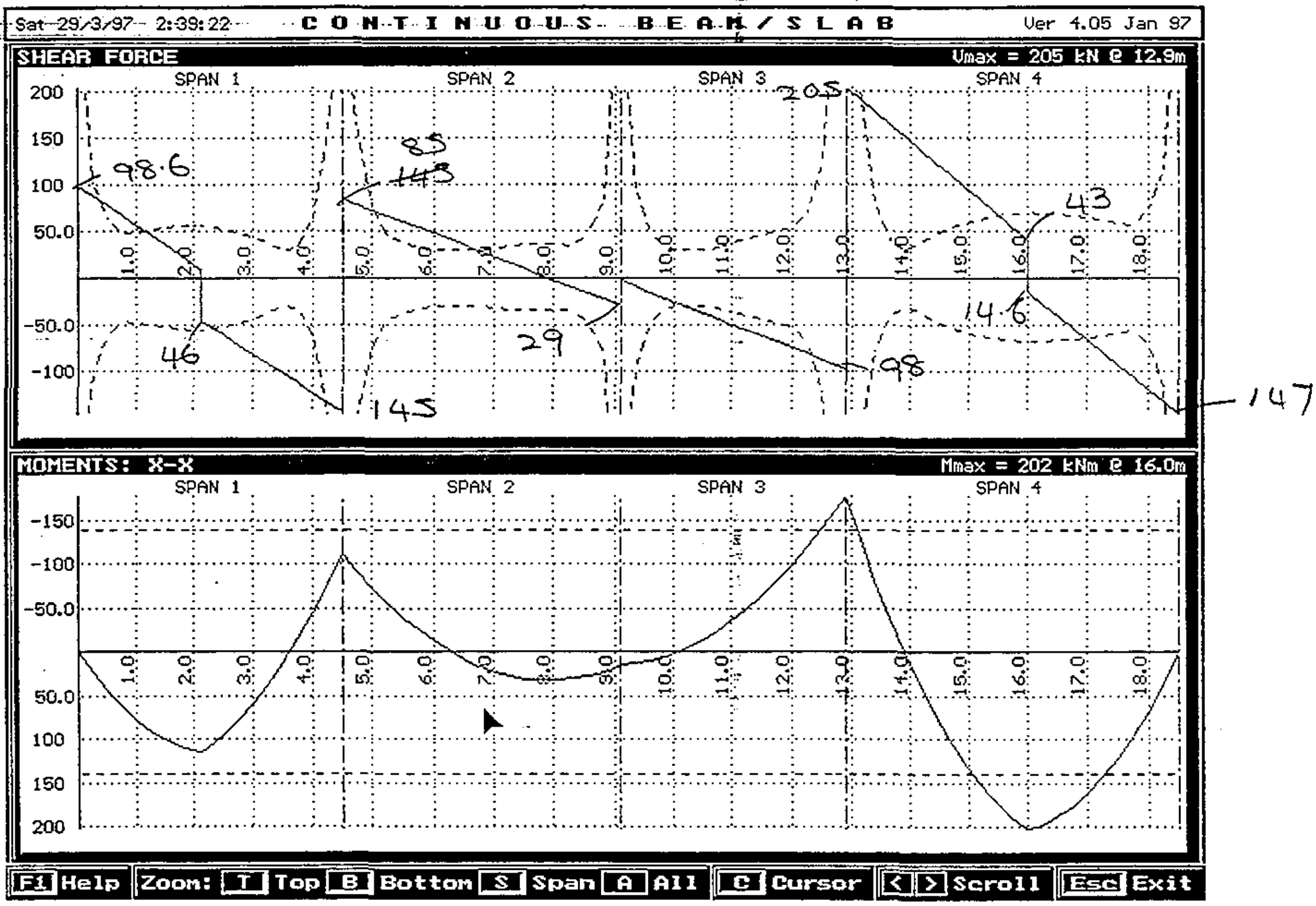
09



Sat 29/3/97 3:00:39 C O N T I N U O U S B E A M / S L A B Ver 4.05 Jan 97
SHEAR REINFORCEMENT
Av max = .343mm²/mm @ .750m
SPAN 1
.340 .320 .300 .280 .260 .240 .220 .200 .180 .160 .140 .120 .100 .080 .060 .040 .020
0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8 5.0 5.2 5.4 5.6
BENDING REINFORCEMENT
As max = 1610mm² @ 2.52m
SPAN 1
326 – 2T16 (402
200 200 400 600 800 1000 1200 1400 1600
1610 – 4T25
F1 Help
Zoom: T Top B Bottom S Span A All
C Cursor
< > Scroll
Esc Exit


Sat 29/3/97 2:36:01
CONTINUOUS BEAM/SLAB
Ver. 4.05 Jan 97
SHEAR REINFORCEMENT
Av max = .796mm²/mm @ 13.7m
SPAN 1
SPAN 2
SPAN 3
SPAN 4
.700
.600
.500
.400
.300
.200
.100
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0
BENDING REINFORCEMENT
As max = 1610mm² @ 16.0m
1400
1200
1000
800
600
400
200
1600
3Y20(942)
859
1430
3Y25
(1472)
2Y25
452
886
3Y20 (942)
215
2Y16
3Y25+
2Y12
(1698)
1610
F1 Help
Zoom: T Top B Bottom S Span A All
C Cursor
< > Scroll
Esc Exit

11 250 x 450



$d = 450 - 25 - 10 = 415$

$V_u = \dfrac{99 \times 10^3}{250 \times 415} = 0.95\ N/mm^2$

$\dfrac{100AS}{bd} = \dfrac{100 \times 628}{250 \times 415} = 0.61$

$V_c = 0.53\ N/mm^2$

$b(v - V_c) = 105$ – Y10 @ 300 c/c

$V_u = \dfrac{147 \times 10^3}{250 \times 415} = 1.42$

$\dfrac{100AS}{bd} = \dfrac{100 \times 981}{250 \times 415} = 0.96$

$V_c = 0.62$

$b(v - V_c) = 200$ – Y10 @ 250

$V_u = \dfrac{205 \times 10^3}{250 \times 415} = 1.98$

$\dfrac{100AS}{bd} = \dfrac{100 \times 1472}{250 \times 415} = 1.42$

$V_c = 0.71\ N/mm^2$

$b(v - V_c) = 317.5$

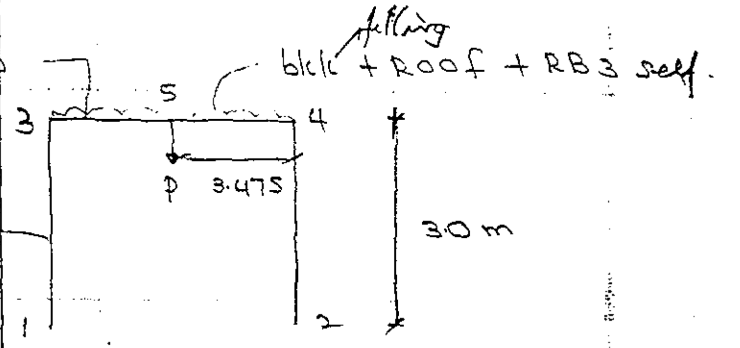
Y10 @ 150

DAYANANDA ASSOCIATES	PROJECT Maligakanda valve house		JOB REF
CONSULTING ENGINEERS	CALCULATIONS BY	CHECKED BY	CALC SHEET
	PART OF STRUCTURE		DATE

MEMBER REF	CALCULATIONS	OUT PUT

250 x 450

300x300 C_2



P = 15 x (1.5 x 1.2) ULT
(impact factor.

bkk = 0.275 x 18 x 0.929 = 4.59 SLS. at Nodes

Roof

wd = 1.34 x 4.6 = 6.16 kN/m

→ ws = 0.75 x 4.6. = 3.45 "

File 1 1 Fix 2 pin P.Y. - PF1

2 1 Fix 2 Fix -PF2

RB3 0.25 x 0.25 x 24 = 1.5 kN/m.

load case 1 - dead

2 - super

3 - 1.5 x 1.2

	wd	ws
Node 3/4 -	6.16 + 1.5 = 7.66	3.45
5 =	6.16 + 4.59 + 1.5 = 12.25	3.45

[redacted] Software Consultants (Pty) Ltd Internet http://www.prokon.com E-Mail : mail@prokon.com	Job Number		Sheet
	Job Title		
	Client		
	Calcs by	Checked by	Date

```
========================= OUTPUT: LINEAR ANALYSIS ===========================
============================= REACTIONS at ULS ==============================

Node  Lcase       X-force    Y-force     Z-moment
                    kN         kN          kNm

1     C1            0.00     103.79        0.00
2     C1            0.00     103.54        0.00

================== REACTIONS AT SLS (Combinations only) ======================

Node  Lcase       X-force    Y-force     Z-moment
                    kN         kN          kNm

1     C1            0.00      70.27        0.00
2     C1            0.00      70.13        0.00

============ BEAM ELEMENT END FORCES IN LOCAL ELEMENT AXES at ULS =============

Elem       Lcase       Axial     Y-Shear    M-xx      Axial     Y-Shear    M-xx
                        kN         kN       kNm        kN         kN       kNm

1-3        C1          99.06       0.00      0.00    -99.06       0.00      0.00
2-4        C1          98.81       0.00      0.00    -98.81       0.00      0.00
3-5        C1           0.00      94.34      0.00      0.00     -14.21    192.17
4-5        C1           0.00      94.09      0.00      0.00     -12.79    192.17

============================= STATISTICAL DATA ==============================

Own weight of structure = 32.91 kN

No. of real numbers in Stiffness matrix = 66  (396 bytes)
Time used to analyse = 0: 0:0.220 seconds
Total number of : Nodes                = 5
                  Beam Elements        = 4
                  Shell Elements       = 0
                  Supports             = 2
                  Section properties   = 2
                  Load cases           = 3
                  Load combinations    = 1

============================== END OF OUTPUT ================================
```

PF1 - support 1 Fix
2 Pin

Software Consultants (Pty) Ltd	Job Number		Sheet
Internet: http://www.prokon.com	Job Title		
E-Mail : mail@prokon.com	Client		
	Calcs by	Checked by	Date

========================= OUTPUT: LINEAR ANALYSIS =============================

============================== REACTIONS at ULS ===============================

PF2

Node	Lcase	X-force kN	Y-force kN	Z-moment kNm
1	C1	21.87	103.79	0.00
2	C1	-21.87	103.54	0.00

================= REACTIONS AT SLS (Combinations only) =====================

Node	Lcase	X-force kN	Y-force kN	Z-moment kNm
1	C1	14.59	70.27	0.00
2	C1	-14.59	70.13	0.00

============ BEAM ELEMENT END FORCES IN LOCAL ELEMENT AXES at ULS ==============

Elem	Lcase	Axial kN	Y-Shear kN	M-xx kNm	Axial kN	Y-Shear kN	M-xx kNm
1-3	C1	99.06	-21.87	0.00	-99.06	21.87	-65.62
2-4	C1	98.81	21.87	0.00	-98.81	-21.87	65.62
3-5	C1	21.87	94.34	65.62	-21.87	-14.21	126.54
4-5	C1	21.87	94.09	65.62	-21.87	-12.79	126.54

============================ STATISTICAL DATA ===============================

Own weight of structure = 32.91 kN

No. of real numbers in Stiffness matrix = 66 (396 bytes)
Time used to analyse = 0: 0:0.270 seconds
Total number of : Nodes = 5
Beam Elements = 4
Shell Elements = 0
Supports = 2
Section properties = 2
Load cases = 3
Load combinations = 1

============================== END OF OUTPUT ================================