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CALCULATION SHEET

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Rectangular Tank on Ground

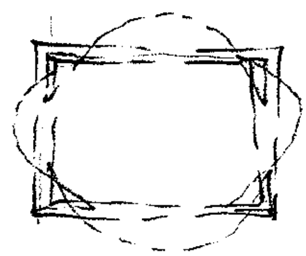
Subjected to bending in 2 directions

1) Horizontal Strip
2) Vertical Cantilevers.

$L/S < 2.00$ ⇒ Design as continuous horizontal slab & subjected to water pressure of wh / unit area at depth h from the water surface

$$M_{centre} = \frac{wh.L^2}{16}$$

$$M_{corner} = \frac{wh.L^2}{12}$$

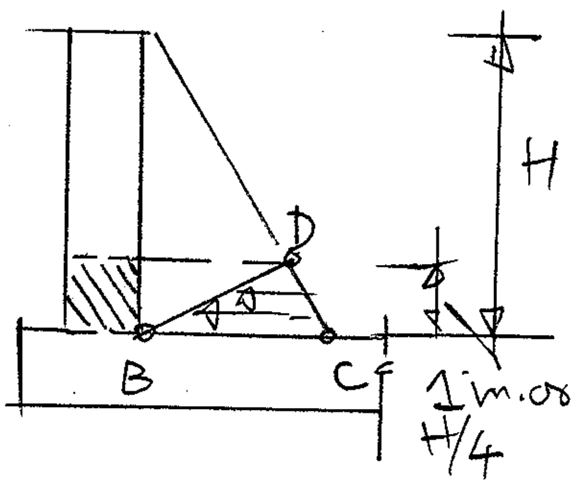


$L/S \geq 2.00$ ⇒ a) long wall are consider as Vertical Cantilevers.

Short wall consider as spanning between the long wall and taken as fixed

b) Cantilever effect of Short wall

- Though the Short wall in principle spans horizontally between long wall
- It possible that short wall may have a cantilevering effect.
- Usual to consider that for the bottom 1 meter or H/4
- The water pressure taken for design on Cantilevering part is given by BDC



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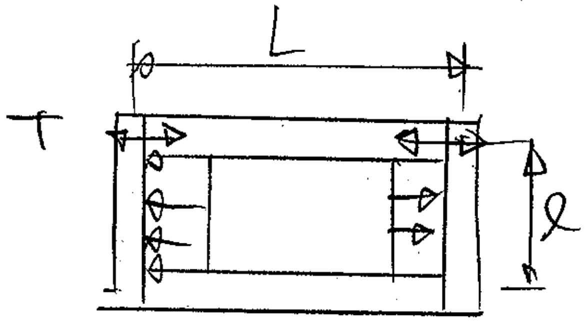
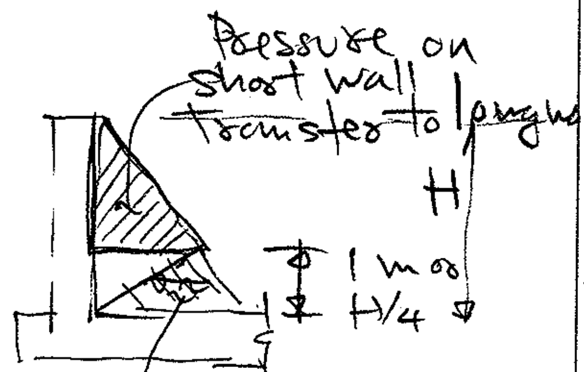
c) Pull on the long wall – Short walls

C.1) Pull on the long Wall

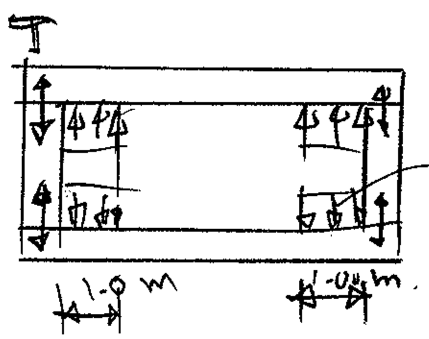




Consider that the bottom will act as a cantilever.

$$T = \frac{W(H-1)l}{2}$$

C.2) Pull on the short wall



long wall will behave actually as Cantilever from Base Slab

Part of the water Pressure act on the long wall for a Certain distance from Corner will produce a tension in the short wall

$T = \omega(H \times 1) \times 1$ per metre

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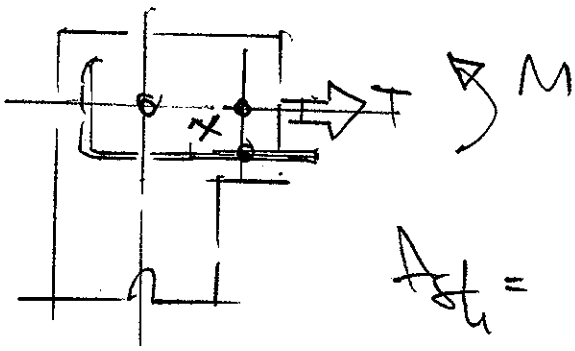
Analysis of tank wall section subjected to bending & Pull



$$A_{st_1} = \frac{M - T.x}{f_s . j d}$$

$$A_{st_2} = \frac{T}{f_s}$$

* Total requirement = $A_{st_1} + A_{st_2}$

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Water Tank 5.00 × 5.00 × 3.00 m deep.

Thickness of Wall

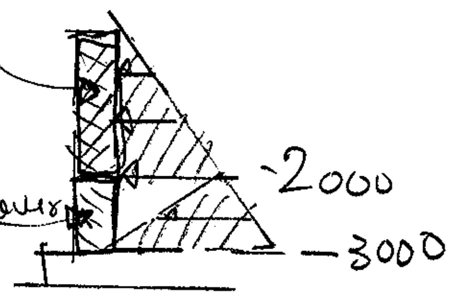
i 15 cm
ii 3 cm/metre depth + 5 = 9 + 5 = 14 cm
iii 6 cm/metre length = 6 × 5 = 30 cm.

Provide Wall Thickness 30 cm.

Effective span = 5 + 0.30 = 5.30 m

design as Continuous horizontal slab

Consider a level 1 m above the Floor



$P = 1000 \times 2 = 2000$ kg/m²

$M_{corner} = \dfrac{2000 \times 5.3^2}{12} = 4681$ kg.m

$M_{mid} = \dfrac{2000 \times 5.3^2}{16} = 3511$ kg.m

Pull on the wall per metre height at this level

$P = W(H-1)l/2 = 1000(3-1)5/2 = 5000$ kg.

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Design of Corner Section

$d = 30 - 3.4 = 26.6$ cm

Effective BM $= M - T.x$

$= 4681 - 5000\,(0.266 - 0.15)$

$= 4010$ kg-m

$A_{t1} = \frac{4010}{f_s . jd} = 18.35\ cm^2$

$A_{t2} = \frac{5000}{f_s} = 5.00\ cm^2$

$A_t = 18.35 + 5.00 = 23.35\ cm^2$: $\phi 19 @ 100$ (A) (Horizontal)

Design of Mid-span Section

Effective BM $= 3511 - 5000\,(0.266 - 0.15)$

$= 2931$ kg.m

$A_{t1} = \frac{2931}{f_s\, jd} = 10.25\ cm^2$

$A_{t2} = \frac{5000}{f_s} = 4.00\ cm^2$

$A_t = 10.25 + 4.00 = 14.25\ cm^2$ - $\phi 19 @ 170$ (B)

<Horizontal>

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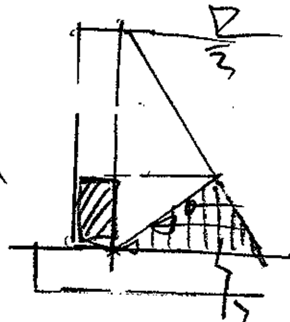
Design of the bottom 1 metre height of wall

$P = \frac{1}{2} \times 3000 = 1500$ kg/m

$M = \frac{1}{3} \times 1500 = 500$ kg·m/m

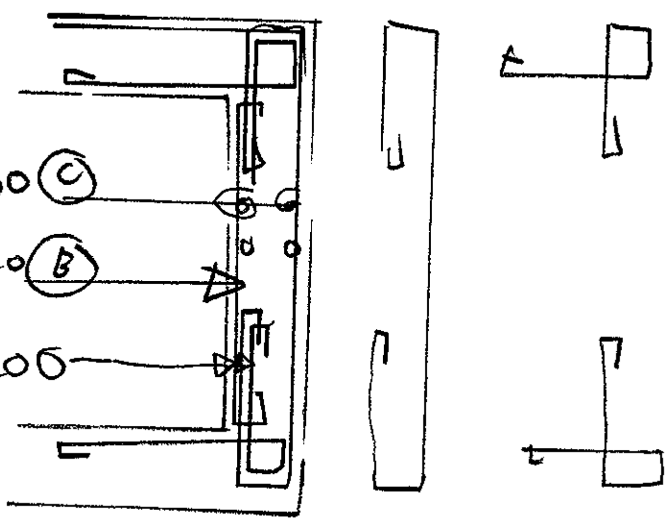


$A_{st} = \frac{500}{f_s j d} = 2.24$ cm²/m

$A_{st\,min} = 0.0025 \times 100 \times 30 = 7.50$ cm²/m } φ10@80 (C) <Vertical>

Base slab

Provided 24 cm thick : φ10@80# (T&B)



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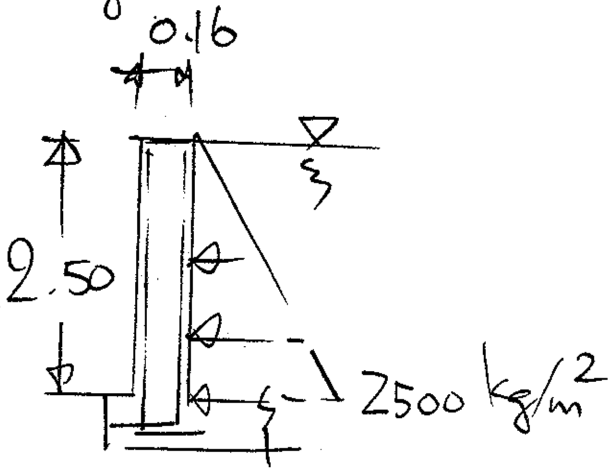
Water Tank 6.00 x 3.00 x 2.50 m deep.

$L/l = \frac{6}{3} = 2.00$ - long wall designed as vertical cantilever
- Short wall as spanning horizontal between long wall

Design of long wall



$M = \frac{1}{2} \times 2500 \times 2.5 \times 2.5/3$
$= 2605$ kg.m/m

$A_s = \frac{2605}{f_s jd} = 20.28$ cm²/m

$= \phi 16 @ 90$ mm (Vert.)

Pull on the long wall

$P = \frac{w(2.50-1) \times 3}{2} = 2250$ kg

$A_s = \frac{2250}{f_s} = 2.02$ cm²/m

$A_{s\,min} = 0.25\% = 4.00$ cm²/m

$\phi 10 @ 160$ mm. (Hoz.)

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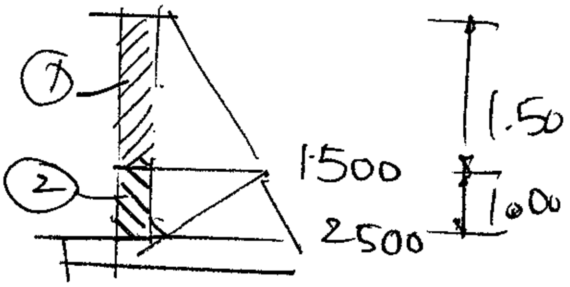
Design of Short Wall



Considers a level one metre above the top of Bottom.

$= 1000(2.50-1)$

$= 1500 \ kg/m^2$

Effective span of horizontal spanning slab.

$= 3.00 + 0.16 = 3.16 \ m$

Corner Section

$M_{cor} = 1500 \times 3.16^2/12$

$= 1249 \ kgm/m$

Water pressure at the level on 1-metre length of long wall will be transferred to the short wall

$= 1500 \times 1.00 = 1500 \ kg.$

$M = M_{cor} - T.x$

$= 1249 - 1500(0.127 - 0.08)$

$= 1060 \ kgm$

$A_{t1} = \frac{1060}{f_s j d} = 9.94 \ cm^2/m$

$A_{t2} = \frac{1500}{f_s} = 1.35 \ cm^2/m$

$A_t = 11.29 \ cm^2$: $\phi 16$ @ 170 mm (Horiz.)

Mid-Span-Section

$M_{mid} = \frac{1500 \times 3.16^2}{24} = 600$ kg-m/m

$M = M - T.x$

$= 600 - 1500(0.127 - 0.08)$

$= 498$ kg-m/m

$A_{t1} = \frac{498}{f_s j d} = 3.65$ cm²/m

$A_{t2} = \frac{1500}{f_s} = 1.08$ "

$A_t = 4.73$ cm²/m : $\phi 16 @ 340$ mm (Horz)

Design for the bottom one metre cantilevering effect of the Short Wall

$M = \frac{1}{2} \times 2500 \times 1 \times \frac{1}{3}$

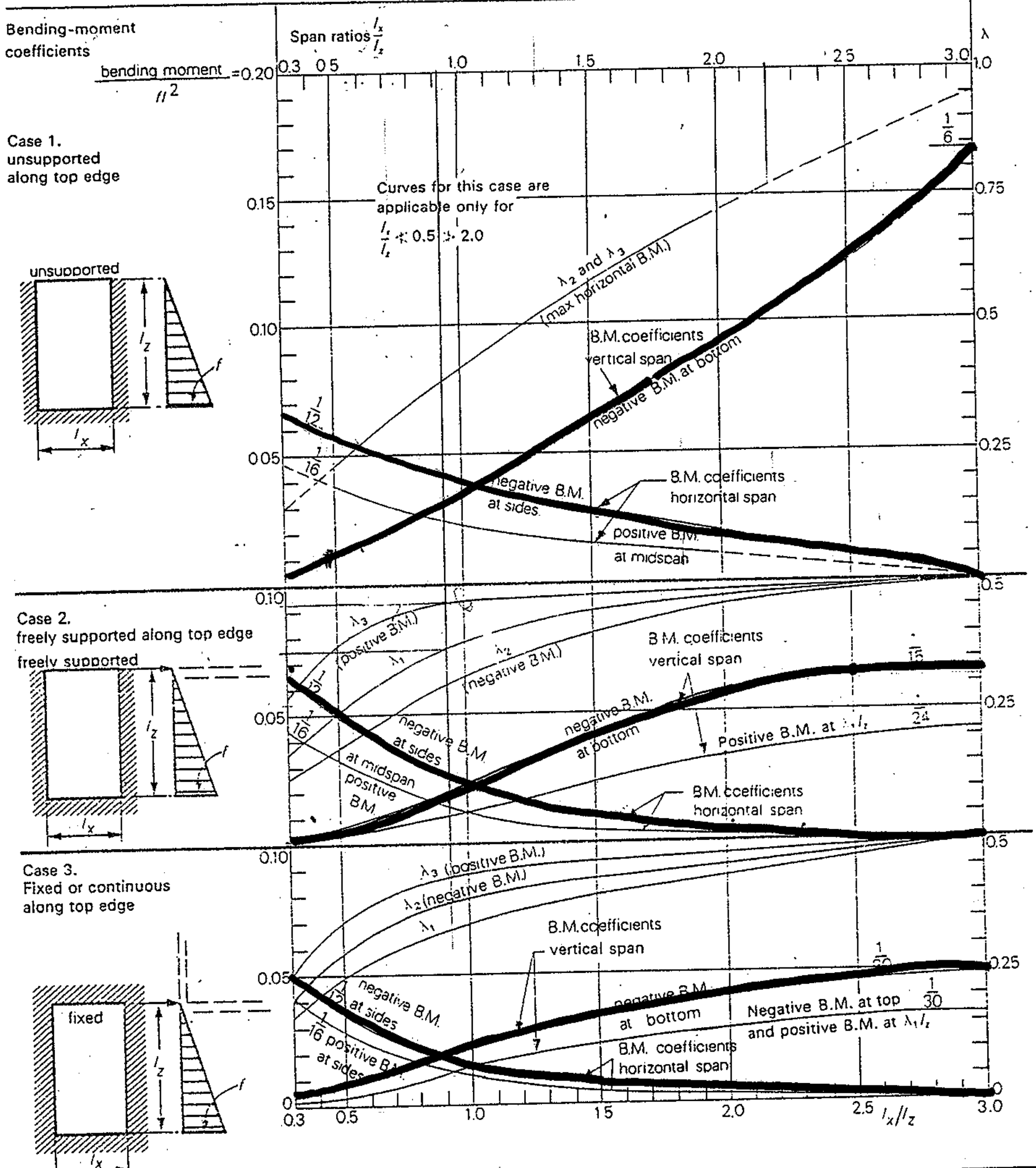
$= 416$ kgm/m

$A_s = \frac{416}{f_s j d} = 4.09$ cm²/m

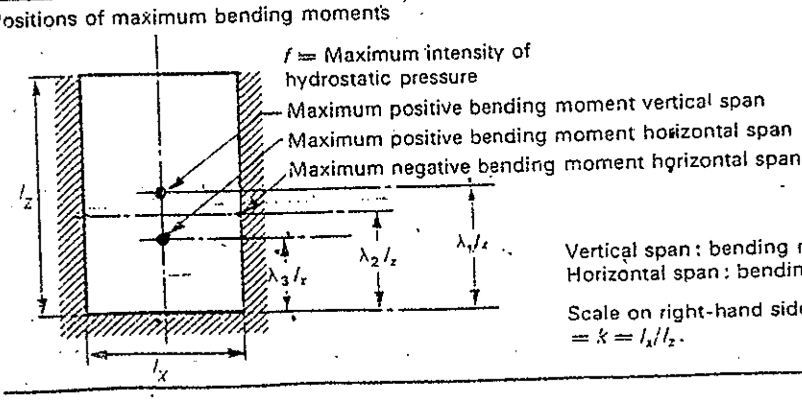
$A_{s,min} = 0.25\% = 4.00$ cm²/m

} $\phi 10 @ 160$ mm (Vert)

Two-way slabs: Rectangular panels: Triangularly-distributed loads



Positions of maximum bending moments



Notes

Panels fixed or continuous along bottom edge and both vertical sides; condition along top edge as indicated.

Fractions thus '$\frac{1}{12}$' indicate coefficients to which curves are asymptotic or to which coefficients approach as span ratio l_x/l_z approaches zero or infinity.

Vertical span: bending moment = (coefficient) fl_z^2
Horizontal span: bending moment = (coefficient) fl_x^2

Scale on right-hand side is for values of λ_1, λ_2 and λ_3. Ratio of spans $= k = l_x/l_z$.