RCC WATER TANK - ON GROUND

3.1 Design a rectangular RC water tank resting on ground

Example 1

Design a rectangular RC water tank resting on ground with an open top for a capacity of 80000litres. The inside dimension of the tank may be taken as 6m x 4m. Design the side Walls of the tank using M20 grade concrete and Fe250 grade I mild steel. Draw the following views, cross sectional elevation of the tank showing reinforcement details in tank walls. Plan of the tank showing reinforcement details.

Step1 : Given data

Capacity of tank = 80000litres

size of tank = 6m x 4m

Free board = 150mm

f_{ck} =20N/mm^2

f_y = 250N/mm^2

Step2 : permissible stress

σ_{cc} = 5 N/mm^2

σ_{cbc} = 7 N/mm^2

M = 280 / 3 x σ_{cbc}

= 13.33

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σ_{st} = 115 N/mm^2 (near water face)

σ_{st} = 125 N/mm^2 (away from water face)

Q = 1.41

j = 0.84

Step3 : Dimension of tank

1m^3 = 1000litres

Free board 150mm = 0.15m

Height of water = 80000 x 10^3 / (6000 x 4000)

Height of water = 3.33 ~ 3.35m

height of side wall H = (3.35 + 0.15)

= 3.5m

L / B = 6 / 4

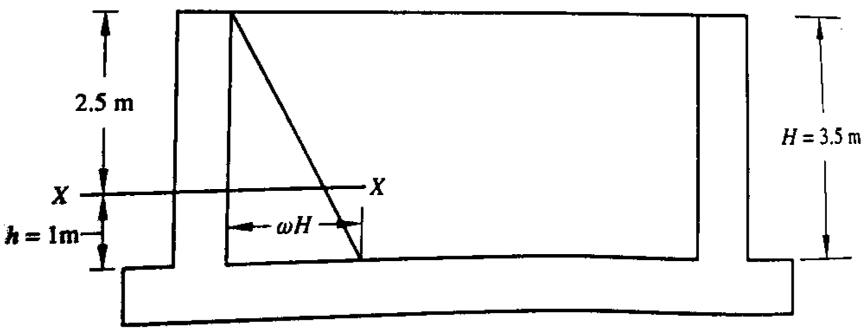
= 1.5 < 2

Intensity of pressure

P = w (H – h)

= 10 (3.5 – 1)

= 25 KN/m^2



Step4 : Moments in side walls

L =6m

B =4m

(pL^2 / 12) = (25 x 6^2 / 12)

= 75 KNm

(pL^2 / 8) = (25 x 6^2 / 8)

= 112.5 KNm

(pB^2 / 12) = (25 x 4^2 / 12)

= 34 KNm

(pB^2 / 8) = (25 x 4^2 / 8)

= 50 KNm

Moment at support =34 + (75 - 50)

= 59KNm

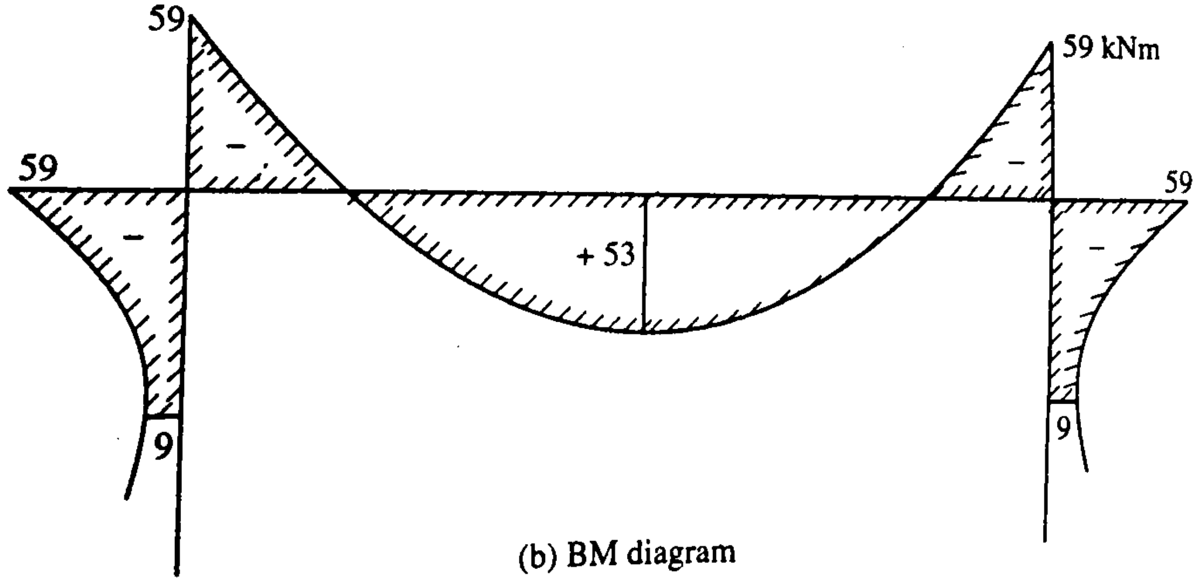
Moment at centre(long walls)

=112 - 59

= 53KNm

Moment at centre(short walls) = 50 - 59

= -9KNm



(b) BM diagram

Step5 : Design of long wall and short walls

Maximum design Moment = 59 KNm

d^2 = Max moment / (Q x b)

= 59 x 10^6 / (1.41 x 1000)

d = 204mm

Adopt effective depth d = 215mm

Overall depth D = 215 + 25

= 240mm

Direct tension in long wall

T = 0.5 x 25 x 4

= 50KN

Direct tension in short wall

T = 0.5 x 25 x 6

= 75KN

Ast (long wall corners)

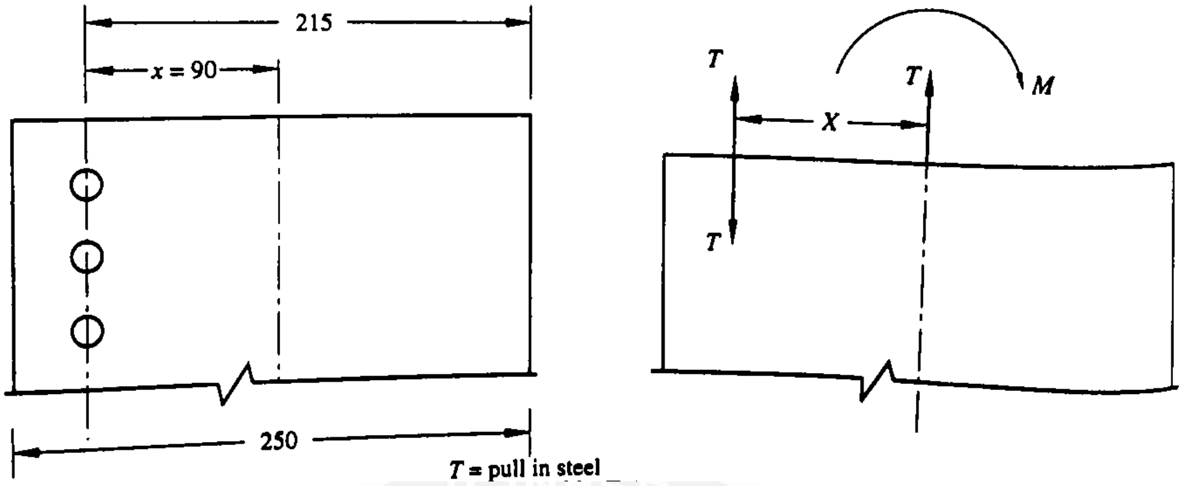
x = 215 – 125

= 90mm

=[M - Tx / σ st x j x d] + (T / σ st)

= [59 x 10^6) – (50 x 10^3 x 90)/ 115 x 0.84 x 215] + (50 x 10^3/ (115)

= 3480mm^2



spacing

Provide 20mm dia bars

Spacing = 1000 x [(πd^2 / 4) / Ast]

= 1000 x [(π x 20^2 / 4) / 3480]

= 90.27mm

Provide 20mm dia bars at 90mm c/c

Reinforcement in centre of span (long walls)

=[(M at centre – Tx) / (st x j x d)]

={[(53 x 10^6)– (50 x 10^6 x 90)]/ (125 x 0.84 x 215)}

+ [(50 x 10^6) / 125)]

= 2500mm^2

Half the bars from inner face at support

Ast = 3928 / 2

= 1964mm^2

For remaining area

Ast =2500 – 1964

= 536mm^2

Provide 16mm dia bars at 150mm c/c

Step6 : Reinforcement for cantilever moment

For 1m height from the bottom

Cantilever moment = h x w x (1/2) x (1/3)

= 3.5 x 10 x 0.5 x 0.33

= 5.83 KNm

ast = (cantilever moment / st x j x d)

= [(5.83 x 10^6) / (115 x 0.84 x 215)]

= [(5.83 x 10^6) / 20769]

= 280mm^2

Provide 20mm dia bars at 160mm c/c on both sides for height of 1m from top

Minimum reinforcement

Ast = 0.3% of cross section

= (0.3 / 100) x 1000 x 240

= 720mm^2

Reinforcement on each faces

Ast = 720 / 2

= 360mm^2

Provide 8mm dia bars

Spacing = 1000 x [(πd^2 / 4) / Ast]

= 1000 x [(π x 8^2 / 4) / 360]

= 139mm

Provide 8mm dia bars at 130mm c/c on both face

Step7 : Base slab

Provide nominal thickness of 200mm for base slab

Ast = 0.3% of cross section

= (0.3 / 100) x 1000 x 200

= 600mm^2

Provide half of reinforcement near each face

Ast = 600 / 2

= 300mm^2

Spacing

Provide 10mm dia bars on both sides

Spacing = 1000 x [(πd^2 / 4) / Ast]

= 1000 x [(π x 10^2 / 4) / 300]

= 261mm

Reinforcement details

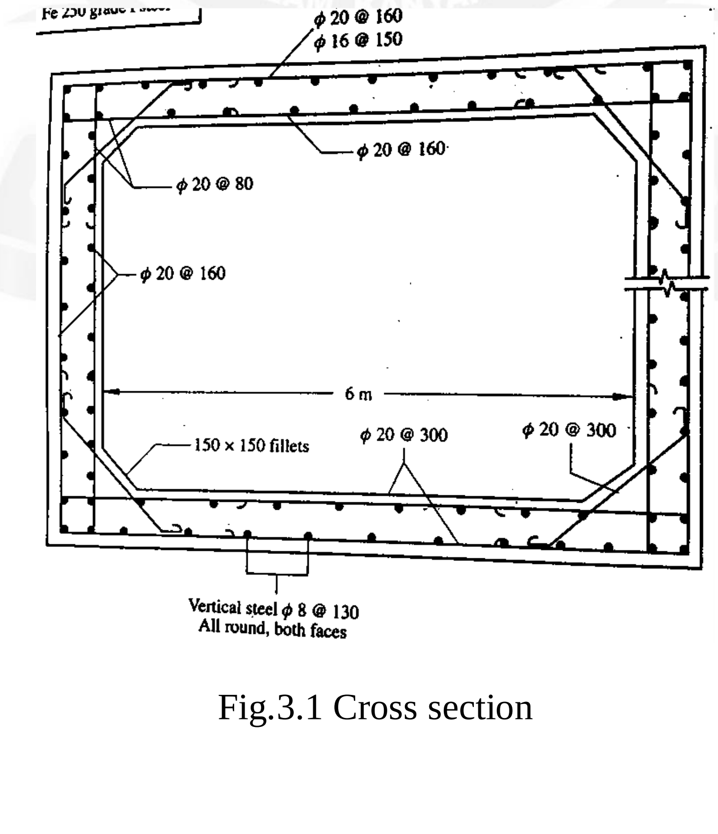


Fig.3.1 Cross section

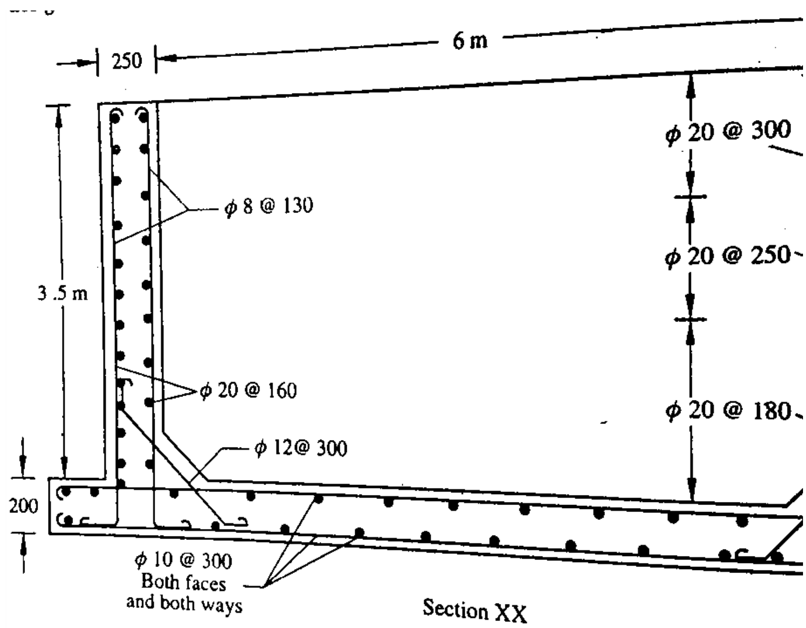


Fig.3.2 Cross section