

## DESIGN AND DRAWING OF WATER TANKS

### Question 2

**Design an isolated footing of uniform thickness of a RC column bearing a vertical load of 600 KN and having a base of size 500x500 mm. the safe bearing capacity of soil may be taken as 120 KN/m<sup>2</sup>. Use M20 concrete and Fe 415 steel.**

**Solution**

#### Size of footing

W=600 KN;

Self weight of footing @ 10% =60 KN

Total load =660 KN

Size of footing = 660/120 = 5.5 m<sup>2</sup>

Since square footing , B=  $\sqrt{5.5}$  =2.345 m<sup>2</sup>

Provide a square footing = 2.4mx 2.4m

Net upward pressure , p<sub>0</sub>= 600/(2.4x2.4) = 104.17 KN/m<sup>2</sup>

#### Design of section

The maximum BM acts at the face of column

M=p<sub>0</sub> B/8 (B-b)<sup>2</sup> =112.8kNm

M<sub>u</sub> = 1.5M =169.2 KN-m

Therefore d = 160 mm; D = 160+60 = 220mm

Depth on the basis of one-way shear

For a one way shear, critical section is located at a distance 'd' from the face of the column where shear force V is given by

$V = p_0 B \{0.5(B-b)-d\} = 104.17 \times 2.4 \{0.5 (2.4 -0.5) - 0.001d\}$

V<sub>u</sub> = 1.5V

$T_c = V_u/bd = 375012(0.95-0.001d)/2400d$

From table B.5.2.1.1 of IS 456:2000 k=1.16 for D = 220mm.

Also for under-reinforced section with p<sub>t</sub> = 0.3% for M20 concrete, τ<sub>c</sub>=0.384 N/mm<sup>2</sup>

Hence design shear stress = kτ<sub>c</sub> =0.445 N/mm<sup>2</sup>

From which we get d= 246.7 =250 mm

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Depth for two way shear

Take  $d$  greater one of the two i.e. 250mm. for two-way shear, the section lies at  $d/2$  from the column face all round. The width  $b_o$  of the section =  $b+d = 750\text{mm}$

Shear force around the section  $F = p_o [B^2 - b_o^2] = 541.42\text{KN}$

$F_u = 1.5F$

$T_v = F_u / 4b_o d = 812.13 \times 10^6 / (4 \times 750 \times 250) = 1.083\text{N/mm}^2$

Permissible shear stress =  $k_s \tau_c$

where  $k_s = (0.5 + \beta_c) = (0.5 + 1)$  with a maximum value 1.  $k_s = 1$

$\tau_c = 0.25 \sqrt{f_{ck}} = 1.118\text{ N/mm}^2$

Permissible shear stress =  $1.118\text{ N/mm}^2$

Hence safe.

Hence  $d = 250\text{ mm}$ , using 60 mm as effective cover and keeping  $D = 330\text{ mm}$ , effective depth =  $330 - 60 = 270\text{ mm}$  in one direction and other direction  $d = 270 - 12 = 258\text{ mm}$ .

Calculation of reinforcement

$A_{st} = 1944\text{ mm}^2$

Using 12 mm bars, spacing required = 138.27 mm

So provide 12 mm @ 125mm c/c in each direction.

Development length

$L_d = 564\text{ mm}$

Provide 60 mm side cover, length of bars available =  $0.5[B - b] - 60 = 890\text{ mm} > L_d$

So safe.

Transfer of load at column base

$A_2 = 500 \times 500 = 250000\text{ mm}^2$

$A_1 = [500 + 2(2 \times 330)] = 3312400\text{ mm}^2$

$\sqrt{A_1/A_2} = 3.64$

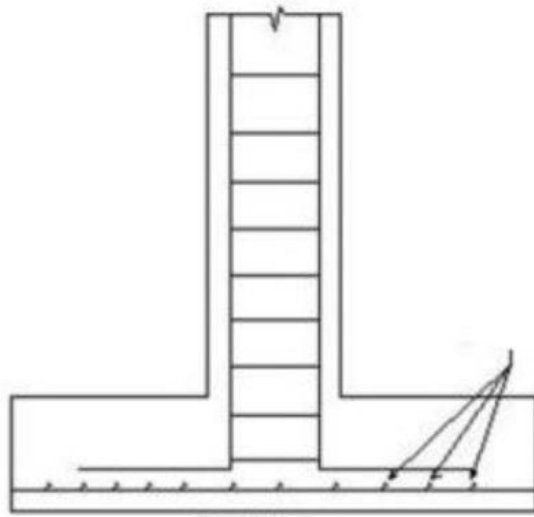
Taking  $\sqrt{A_1/A_2} = 2$

Hence permissible bearing stress =  $18\text{ KN/m}^2$

Actual bearing stress =  $3.6\text{ N/mm}^2$

Hence safe.

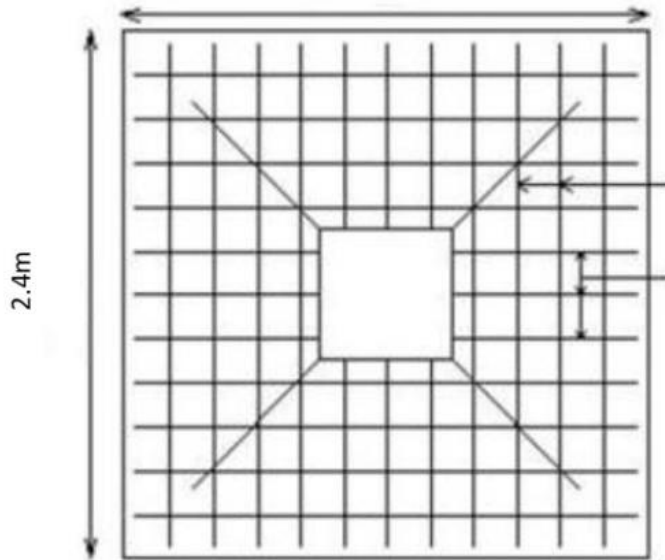
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12 mm @ 125mm c/c

Section

2.4m



12 mm @ 125mm c/c

12 mm @ 125mm c/c

Plan