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^2. 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^2

Since square footing , B= √5.5 =2.345 m^2

Provide a square footing = 2.4mx 2.4m

Net upward pressure , p_0= 600/(2.4x2.4) = 104.17 KN/m^2

Design of section

The maximum BM acts at the face of column

M=p_0 B/8 (B-b)^2 =112.8kNm

Mu = 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 x2.4{0.5 (2.4 -0.5) 0.001d}

Vu = 1.5V

Tc = Vu/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 pt = 0.3% for M20 concrete, τc==0.384 N/mm^2

Hence design shear stress = kτc =0.445 N/mm^2

From which we get d= 246.7 =250 mm

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 = 750mm

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

Fu=1.5F

$Tv = Fu/4b_od = 812.13x\ 10^6/(4x\ 750x\ 250) = 1.083N/mm^2$

Permissible shear stress = ks τc

where ks =(0.5+βc) = (0.5+1) with a maximum value 1. ks=1

$\tau c = 0.25\sqrt{fck} = 1.118\ N/mm^2$

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

Hence safe.

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

Calculation of reinforcement

Ast= $1944\ mm^2$

Using 12 mm bars, spacing required = 138.27 mm

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

Development length

L_d=564 mm

Provide 60 mm side cover, length of bars available =0.5[B-b]-60=890 mm >Ld

So safe.

Transfer of load at column base

A_2= 500x500 = $250000\ mm^2$

A_1=[500+2(2x330)]= $3312400\ mm^2$

$\sqrt{(A_1/A_2)} = 3.64$

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

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

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

Hence safe.

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