UNIT V DESIGN OF FOOTINGS

Design of wall footing

Problem

Design a footing for 250mm thick has masonry wall with supports to carry a design load of 200kn/m at service state. Consider unit weight of soil 20KN/m^3. Angle of repose = 30°. Allowable bearing capacity 150KN/m^2, M_{20}, Fe_{415} .

Given Data:

q_0 = $150 KN/m^2$

γ = $20\ KN/m^3$

B = 250mm

p_u = 200 KNm

Ø = 30°

f_{ck} = $20\ N/mm^2$

f_y = $415\ N/mm^2$

Step 2:

Determination of depth of foundation

$$h = \frac{q_0}{\gamma} \times [\,1 - sin\emptyset / 1 + sin\emptyset\,]^2$$

$$= \frac{150}{20} \times [\,1 - sin30/1 + sin30\,]^2$$

$$= 0.83 \cong 1\text{m}$$

Step 3:

Find width of footing

$$B = \frac{Load}{S.B.C}$$

$$= \frac{200}{150} = 1.35 \text{ m}$$

Step 4:

Find total load

Self weight of footing = $(L \times B \times D)\,\gamma$

= $(1 \times 1.35 \times 1)\ 25$

= 33.75 ≅ 34

Total Load = p_u + self weight

= 200 + 34

= 234 KN/m^2

Step 5:

Actual width of footing

Actual width = $\frac{234}{150}$ = 1.56≅ 1.6 m

Step 6:

Net upward pressure

P_o = $\frac{Load(given)}{Width \times 1(m\ given)}$

= $\frac{200}{1.6}$ = $125 KN/m^2\ /m\ length$

Step 7:

a) Depth of Basis of Bending Compression

M = $\frac{P_O}{8}$ x (B – b) x (B - $\frac{b}{4}$)

= $\frac{125}{8}$ x (1.6 – 250 x 10^{-3}) x (1.6 – $\frac{250 \times 10^{-3}}{4}$)

M = 32.43 KNm

Factored Moment = 1.5 x M

= 1.5 x 32.43

M_u = 48.645 KNm

M_u lim = $\frac{0.36\ x_{u\,max}}{d}$ f_{ck} [1- $\frac{0,42 x_{u\,max}}{d}$] bd^2

= 0.36 x 0.48 x 20 [1- 0.42 x 0.48]bd^2

= 2.759 bd^2

M_u lim = M_u

2.759 bd^2 = 48.645 x 10^3

2.759 x 10^{-3}x 10^3xd^2 = 48.645 x 10^3

d = 132.78 mm

D = d + cover

= 132.78 + 60

= 192.78 mm

D = 200 mm

b) Depth on basis of one way shear

Assume, p_t = 0.3%

τ_v = τ_c x K

τ_c ref IS456 Pg No: 73

0.25 → 0.36

0.50 → 0.48

τ_c = 0.38

Permissible shear stress, τ_v = 0.38 K

K ref IS 456 Pg No : 73

K = 1.20

τ_v = 0.38 x 1.20

τ_v = 0.456

c)Critical section lies 'd' distances from face of wall

V_u = 1.5 P_o a

a = $\frac{B}{2} - \frac{b}{2}$

= $\frac{1.35}{2} - \frac{250}{2}$

a = 675 mm

a = 0.675 m

V_u = 1.5 x P_o x a

= 1.5 x 125 x 0.675 = 126.56 N/m^2

τ_v = $\frac{V_u}{bd}$

0.456 = $\frac{126.56 \times 10^3}{1000 \times d}$

d = 277.54 mm ≅ 280 mm.

D = d + d_c

= 280 + 60 = 340 mm

Design Reinforcement

M_u = 0.87 f_y Ast d [1- $\frac{\text{fyAst}}{bd\, f_{ck}}$]

$$48.65 \times 10^6 = 0.87 \times 415 \times Ast \times 270 \left[1 - \frac{415\ Ast}{1000 \times 270 \times 20}\right]$$

$$Ast = 519.83$$

Provide 12mm Ø at 200mm C/C.

Distribution Reinforcement

$$= \frac{0.12}{100} \times 1000 \times 250$$

$$= 300\text{mm}$$