FAQs

1. **The service stair of an office building is to be located in a staircase hall measuring 3000mm x 5000mm. The vertical height of floor is 3500mm and thickness of slab is 125mm. The stair is supported on 230mm thick walls. Use M20 and Fe415 as materials. Live load on slab is 3 kN/m^2. Draw the cross section of staircase showing reinforcement details.**

Size of room = 3000mm x 5000mm clear

Components of Staircase:

Assume thickness of riser as 150mm

Total height of roof including thickness of slab = 3500 + 125mm

= 3625mm

Height of each flight = 3625 / 2 = 1812.5mm

No. of riser for each flight = 1812.5 / 150 = 12.08

Provide 12 Nos of steps for each flight.

Exact height of riser (R) = 1812.5 / 12 = 151.04mm

Assume tread be (T) = 275mm

Horizontal length of waist slab = 12 x 275 = 3300mm

Remaining length = 5000 – 3300 = 1700mm

Provide width of mid landing = 900mm

Width of passage at GF = 800mm

a. Load calculations:

on waist slab

i. Dead loads

Assume thickness of slab from l/d = 20;

d = l/20

= 5230 / 20

d = 261.5mm

D = 261.5 + 20 + 16/2

= 289.5mm

Keep D=230mm; d=202mm

Self-weight of slab in slope = 0.23 x 25 = 5.75 kN/m^2

Self-weight of slab in horizontal = 5.75 $\sqrt{R^2+T^2}$ / T

= 6.56 kN/m^2

Dead weight of steps = 0.151 x 20/2 = 1.51 kN/m^2

Weight of floor finish = 0.025 x 24 = 0.60 kN/m^2

Weight of hanrails (as per IS875) = 0.60 kN/m^2

Total dead loads $\mathbf{w_d}$ = **9.27 k N/m^2**

Live load on slab $\mathbf{w_l}$ = **3.00 kN/m^2**

Total load on slab $\mathbf{w}$ = **12.27 kN/m^2**

on landing slab

i. Dead loads

Self-weight of slab = 0.23 x 25 = 5.75 kN/m^2

Weight of floor finish = 0.025 x 24 = 0.60 kN/m^2

Total dead loads $\mathbf{w_d}$ = **6.35 kN/m^2**

ii. Live load on slab $\mathbf{w_l}$ = **3.00 kN/m^2**

iii. Total load on slab $\mathbf{w}$ = **9.35 kN/m^2**

b. Bending moment calculations

To find reactions at supports

Taking moment about A

R_B = 29.18 kN

R_A = 29.36 kN

Distance of point of zero shear from left support A = 2.60m

Maximum bending moment = 40.12 kNm

M_u = 60.18 kNm

c. Effective depth of slab

Consider 1m width of the slab and by equating M_u to M_{ulim}

M_{ulim} = $0.138f_{ck}bd^2$ = M_u

d = 147.66 mm < 202mm; hence safe against flexure.

Keep D = 230mm; d = 202mm

d. Area of reinforcement

a. Main Steel:

$\mathbf{M_u}$ = $\mathbf{0.87f_yA_{st}(d\text{-}o.416x_u)}$

$A_{st,\,reg}$ = 910.10mm^2

Provide 16mm diameter bar

No. of bars = 4.35 = 5 Nos.

Hence provide 6 Nos of 16mm diameter bars.

$A_{st\,pro}$ = 1206.36 mm^2

b. Distribution Steel

A_{st} = 0.12% cross sectional area

= 242.40 mm^2

Use 8mm dia MS bar

Spacing = 207.37mm

Provide 8mm dia bar at 175 mm c/c

e. Check for deflection

As per cl.23.2.1 of IS 456:2000

l/d = 20 x M.F

p_t = 0.60%

f_s = 0.58 f_y $A_{st\ reg}$ / $A_{st\ pro}$ = 181.60 N/mm^2

As per Fig.4; M.F = 1.8

Hence d = 145.28mm < 202mm; Hence safe against deflection.