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17/ENG03/053
CIVIL ENGINEERING.

Assignment :

1a) The design must be economical.
(b) The deformation of the structure must not impose with the intensity of the structure
(c) To design for safety

1b) limit slab design considers the dis advantages of head factor design and any other failure that can cause the structure to be structurally unfit while Elastic design is a method of analysis which the design of a structural member is based on a linear stress - strain relationship, assuming that the working stress are only a faction of the elastic limit of the material

STAIR CASE DESIGN.

Slop factor $= \frac{\sqrt{R^2+T^2}}{T} = \frac{\sqrt{150^2+275^2}}{275} = 1.14$

Load Analysis.

A. WAIST $= h \times 24 kN/m^2$

$= 0.15 \times 24 = 3.6 kN/m^2$

B. FINISHES $= 1.2 kN/m^2$

(C.) STEPS $= T \times \frac{1}{2} = 24 kN/m^2$

$= 0.275 \times 0.5 \times 24 = 3.3 kN/m^2$

$D.G_k = ((A+B) \times S_F) + C$

$= (4.3 \cdot 1.14) + 3.3$

$= 8.77 \, kN/m$

$D.L.F = 1.4G_k + 1.6Q_k$

$= 1.4(8.77) + 1.6(1.5)$

$= 14.68 \, kN/m^2$

Span $= T_{total} + 0.5(l_2 + l_6) = (275 \times 12) + 0.5(225 + 225)$

$= 3.525 \, m$

$d = h - cover - \frac{1}{2}\phi$

$= 150 - 25 - 6 = 119 \, mm$

$M = \frac{FL^2}{10} = \frac{14.68 \times 3.525^2}{10} = 18.24 \, kNm$

$k = \frac{M}{bd^2 f_{cu}} = \frac{18.24 \times 10^6}{1000 \times 119^2 \times 25} = 0.052$

$I_a = 0.5 + \sqrt{0.25 - \frac{k}{0.9}} = 0.5 \times \sqrt{0.25 - \frac{0.052}{0.9}} = 0.938$

$Z = I_a d = 0.938 \times 119 = 111.622 \, mm$

$As = \frac{M}{0.95 f_y Z} = \frac{18.24 \times 10^6}{0.95 \times 410 \times 111.622} = 419.53$

$As_{prov} = 452 \, mm$

provide Y_{12} @ 250 c/c ($As_{prov} = 452 \, mm$)

(3)

Deflection check :

$f_s = \frac{2}{3} \times \frac{1}{\beta} \times \frac{Area}{A_{prov}} \times f_{yv}$

$f_s = \frac{2}{3} \times 1 \times \frac{414.53}{452} \times 250$

$= 154.69 \ N/mm^2$

$M.F = 0.55 + \frac{477 - 154.69}{120\left(0.9 + \frac{18.24 \times 10^6}{1000 \times 119^2}\right)} = 1.78$

$d_{req} = \frac{Span}{mf \times Bdr} = \frac{3525}{1.78 \times 26} = 76.17mm$

Since $d_{req} < d$, Deflection is OK.

2a. $P_1 = P_2 = P_3 = \frac{4300}{4000} = 1.075 < 2 =$ 2 way slab.

$P_2 = P_8 = P_9 = \frac{4500}{4000} = 1.125 < 2 =$ 2 way slab.

$P_4 = P_5 = P_6 = \frac{4300}{4000} = 1.075 < 2 =$ 2 way slab.

$P_{10} = P_{11} = P_{12} = \frac{4000}{1500} = 2.667 > 2 =$ 1 way slab

Designing for Ps

④

$\frac{ly}{lx} = \frac{4300}{4000} = 1.075 \simeq 1.1$

shortspan coefficent = ~~—~~
0.05~~2~~4

long span coefficient 0.058
0.044

Assuming specifications of slab thickness = 175mm
fcu = 25N/mm²
fy = 410N/mm²

DF = 1.4Gk ~~+~~ / 1.6Qk.

Gk = weight of slab = 0.175 x 24
Partition = 1.0
finishes = 1.2
6.4kN/m²

Assuming for factory
D.L = (1.4 x 6.4) + (1.6 x 5)

= 16.96 ≃ 17kN/m²

short span = 0.044
0.033

Long span coefficient = 0.037
0.028

Short span mid = P

$M = B_{sx}\, wL_x^2 = 0.044 \times 17 \times 4^2$
$= 11.968$

$d = h - \text{cover} - \frac{\phi}{2} = 144$

$k = \frac{M}{bd^2 f_{cu}} = \frac{11.968 \times 10^6}{1000 \times 144^2 \times 25} = 0.023$

$k = z_a = 0.5 + \sqrt{0.25 - \frac{k}{0.9}} = 0.97 > 0.95 = 0.95$

$z = z_a \cdot d = 0.95 \times 144 = 136.8$

$A_s = \frac{M}{0.95 f_y z} = \frac{11.968 \times 10^6}{0.95 \times 410 \times 136.8} = 224.61$

Provide y12 @ ~~377~~ ~~300~~ 377mm

Continous.

$M = B_{sx}\, wL_x^2 = 0.033 \times 17 \times 4^2 = 8.976$
$d = 144$

$k = \frac{M}{bd^2 f_{cu}} = \frac{8.976 \times 10^6}{1000 \times 144^2 \times 25} = 0.0173$

$z_a = 0.5 + \sqrt{0.25 - \frac{k}{0.9}} = 0.5 + \sqrt{0.25 - \frac{0.0173}{0.9}} = 0.83$

$z = z_a \cdot d = 0.83 \times 144 = 119.52$

$A_s = \frac{M}{0.95 f_y z} = \frac{8.976 \times 10^6}{0.95 \times 410 \times 119.52} = 192.81 mm$

Provide y12 @ 377mm

Long span

Mid

d = d (short span) − steel thickness = 144 − 12 = 132mm

$M = B_x a l^2 x = 0.037 \times 17 \times 4^2 = 10.064$

$k = \frac{M}{bd^2 f_{cu}} = \frac{10.064 \times 10^6}{1000 \times 132^2 \times 25} = 0.0231$

$z_a = 0.5 + \sqrt{0.25 - \frac{k}{0.9}} = 0.97 > 0.95 = 0.95$

$z = z_a \cdot d = 0.95 \times 132 = 125.4$

$A_s = \frac{M}{0.95 f_y z} = \frac{10.064 \times 10^6}{0.95 \times 125.4 \times 410} = 206.04$

Provide y12 at 377mm

Long span continous.

d = 132mm

$m = B_x w l^2 x = 0.028 \times 17 \times 4^2 = 7.616$

$k = \frac{M}{bd^2 f_{cu}} = \frac{7.616 \times 10^6}{1000 \times 132^2 \times 25} = 0.017$

$C_u = 0.5 + \sqrt{0.25 - \frac{k}{0.9}} = 0.98 > 0.95 = 0.95$

$Z = l_a \cdot d = 125.4$

$A_s = \frac{M}{0.95 f_{y_2}} = \frac{2.616 \times 10^6}{0.95 \times 410 \times 125.4} = 155.93$

provide y12 @ 377mm

Deflection check.

$f_s = \frac{2}{3} f_{yr} \; B \; \frac{Area}{As_{proved}}$

$F_s = \frac{2}{3} \times 250 \times 1 \times \frac{226.61}{377} = 99.3$

$mid_2 = \frac{0.55 + 477 - 99.3}{120(0.9 + \frac{11.968 \times 10^6}{1000 \times 144^2})} = 2.68 > 2$

2.

$d_{req} = \frac{4 \times 1000}{2 \times 26} = 76.92 = OK.$