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Civil Engineering
18/Eng03/059 // Structural design (CVE 308

ASSIGNMENT 1

1a. State the Purpose of Structural design.

a, To design for Safety
b, The design can be economical
c, The deformation of the structur must not impose with the Intensity of the structure

1b Limit State :- design consider the dis advantage of load 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 liner stress - stran relationship, assuming that the working stress are only a function of the elastic limit of the material.

STAIR CASE Design

Slope Factor $= \frac{\sqrt{R^2 + T^2}}{T} = \frac{\sqrt{150^2 + 275^2}}{275} = 1.14$

* load Analysis

A WAIST $= R \times 24\,kN/m^2$

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

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

C - STEPS $= T \times 1/2 \times 24\,kN/m^2$

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

D - G.k $= ((A+B) \times S_F) + C$

$= (4.8 \times 1.14) + 3.3$

$= 8.77\,kN/m$

D - L, F $= 1.4\,Gk + 1.6\,Qk$

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

$= 14.68\,kN/m^2$

Span $= T\,total + 0.5(la + lb) = (275 \times 12) + 0.5(225 + 225) = 3.525\,m$

$d = h - cover - 1/2\,\phi$

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

$M = \frac{Fl^2}{10} = \frac{14.68 \times 3.525^2}{10} = 18.24\,kN/m$

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

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

$Z = l_a d = 0.938 \times 119 = 111.622\text{ mm}$

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

$A_{s\,prov} = 452\text{ mm}$

Provide Y12 @ 250 c/c ($A_{s\,prov} = 452$ mm)

Deflection Check

$f_s = 2/3 \times 1/\beta \times \frac{Area}{A_{prov}} \times f_y$

$f_s = 2/3 \times 1 \times \frac{419.53}{452} \times 250$

$= 154.69\ N/mm^2$

$M.F = 0.55 + \frac{477 - 154.69}{120\left(0.9 + \frac{18.24 \times 10^6}{1000 \times 114^2}\right)}$

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

Since $d_{req} < d$, deflection is ok

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

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

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

$P_{10} = P_{11} = P_{12} = \frac{4000}{1500} = 2.666 > 2 =$ 1 way Slab

2b. Desining Lx P2

$\frac{l_y}{d_x} = \frac{4300}{4000} = 1.075 = \simeq 1.1$

Shortspan Coefficant = -
0.054

Longspan Coefficent = 0.058
0.044

Starming Specifications of Slab thickness = 175mm

$F_{cy} = 25N/mm^2$

$F_Y = 410N/mm^2$

1) $L = 1.4G_k + 1.6Q_k$

Q_k = washt of Slab = 0.175 x 24

Portition = 1.0

finishes = 1.2

$6.41 kN/m^2$

Assuming for Factory

Q.L = (1.4x6.4) + (1.6x5)

= 16.96 ≃ 17kN/m²

Shatspan Coeffioent = 0.044

0.033

long span coeffient = 0.039

0.028

Short span mid = ρ

$m = B x w l^2 x = 0.044 \times 17 \times 4^2$

$= 11.968$

$d = h - \text{Cover} - 1/2 \phi = 144$

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

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

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

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

provide y12 @ 377mm

Continous

$m = B x w l^2 x = 0.033 \times 17 \times 4^2 = 8.976$

$d = 144$

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

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

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

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

Provide y12 @ 377mm

Long Span

m.d

d = d (shortspan) - steel thickness = 144 - 12 = 132 mm

$$M = B_{sx} n l^2 x = 0.037 \times 17 \times 4^2 = 10.064$$

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

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

$$z = la \cdot d = 0.95 \times 1.32 = 125.4$$

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

Provide y12 at 377mm

Long Span Continuous

$d = 132mm$

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

$k = \frac{M}{bd^2 f_{cu}} = \frac{2.616 \times 10^6}{1000 \times 132^2 \times 25} = 0.017$

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

$z = I_a - d = 125.4$

$As = \frac{M}{0.95 f_y z} = \frac{2.616 \times 10^6}{0.95 \times 410 \times 125.9}$

Provide y12 @ 377mm

Deflection Check

$f_s = \frac{2}{3} P_{yr} B \frac{Area}{As\ proved}$

$Fs = \frac{2}{3} \times 250 \times 1 \times \frac{224.61}{377} = 99.3$

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

2.

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