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1a purpose of structural design
1) every structure to be design must be safe,
2) the structure must be economical
3) the deformation of a structure must not impere with the integrity of the structure

1.b) limit state design consider all the disadvantage of modular ration / elastic design and load ~~factor~~ of design and any other failure that can cause the structures to be structural unfit for use.

WHILE

Elastic design is a method of analysis which the design ~~sign of~~ of a structural member is based on a linear stress - strain relationship, assuming that the working stress are only a fraction of the elastic limit of the material.

1c straight flight (STAIR CASE) design.

$f_y = 410\ N/mm^2$, $f_{cu} = 25\ N/mm^2$

rise = 150mm, tread = 275 m

slab thickness = 150mm.

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

load analysis:

A - WAIST = $R + 24\ kN/m^2$

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

B - FINISHERS = $1.2\ kN/m^2$

C - STEPS = $T + \frac{1}{2} + 24\ kN/m^2$

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

D. G. K = $((A+B) + S_f) + C$

$$= (4.8 + 1.14) + 3.3 = 8.77\ kN/m$$

D. L. F = $1.4\ G_K + 1.6\ Q_K$

$$= 1.4(8.77) + 1.6(1.5) = 14.68\ kN/m^2.$$

Span = Fhotal + $0.5\ (l_a + l_b)$ = $(275 + 12) + 0.5\ (225 + 225)$

$$= 3.525\ m$$

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

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

$$M = \frac{Fl^2}{10} = \frac{14.68 + 3.525^2}{10} = 18.24\ kNm$$

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

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

$Z = Jad = 0.938 \times 119 = 111.622 mm$

$As = \frac{M}{0.95 f_y Z} = \frac{18.24 \times 10^6}{0.95 \times 410 \times 111.622} = 419.58 mm^2$

$As_{prov} = 452mm$

provid Y12 @ 250 c/c ($As_{prov} = 452mm^2$)

Deflection check.

$fs = \frac{2}{3} \times \frac{1}{\beta} \times \frac{A_{req}}{A_{prov}} \times fyv$

$fs = \frac{2}{3} \times 1 \times \frac{419.53}{452} \times 250 = 154.69 N/mm^2$

$M.f = 0.55 + \frac{477 - 154.69}{120\left(0.9 + \frac{13.24 \times 10^6}{1000 \times 119^2}\right)} = 1.78$

$d_{req} = \frac{span}{Mf \times edv} = \frac{3525}{1.78 \times 26} = 76.17 mm$

since $d_{req} < d$, Deflection is ok

Q9

A				
B	P_1	P_7	P_7	P_4
C	P_2	P_8	P_8	P_5
D	P_3	P_9	P_9	P_6

$P1 = P2 = P3 = \frac{4300}{4000} = 1.075 < 2$ = 2 way slab

$P7 = P8 = P9 = \frac{4500}{4000} = 1.125 < 2$ = 2 way slab

$P4 = P5 = P6 = \frac{4300}{4000} = 1.075 < 2$ = 2 way slab

$P10 = P11 = P12 = \frac{4000}{1500} = 2.60 > 2$ 1 way slab

Designing for P2

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

Shortspan Co-efficient = —
0.054

long span Co-efficient = 0.058
0.044

Assuming spe of slab thickness = 175mm

$f_{cu} = 25 N/mm^2$

$f_y = 410 N/mm^2$

$DL = 1.4 G_K + 1.6 Q_K$

G_K = weight of slab = 0.175 × 24

portition = 1.0

finishes = 1.2

6.4 kN/m².

Asssumming for factory

D.L $(1.4 \times 6.4) + (1.6 \times 5) = 16.96 \simeq 17 kN/m^2$

Short span co-efficient $= 0.044$

0.033

long span Co-efficient $= \frac{0.037}{0.028}$

$M = \beta x \, wl^2 x = 0.044 \times 17 \times 4^2 = 11.968$

$d = h - cover = \frac{1}{2}\phi = 144 mm$

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

$Ia = 0.5 + \sqrt{0.25 - \frac{K}{0.9}} = 0.97 > 0.95 = 0.9$

$z = Iad \quad 0.95 \times 144 = 136.8$

$As = \frac{M}{0.95 f_y z} = \frac{11.968 \times 10^6}{0.95 \times 410 \times 136.8} = 224.61 mm^2.$

provide y12 @ 377 mm

Continous

$M = \beta x \, wl^2 x = 0.033 \times 17 \times 4^2 = 8.976$

Scanned with CamScanner

$d = 144$

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

$I_a = 0.5 + \sqrt{0.25 - \frac{K}{0.9}} = 0.5 + \sqrt{0.25 - \frac{0.0173}{0.9}} = 0.83$

$Z = I_a d = 0.83 \times 144 = 119.52$

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

provide y12 @ 397m

long span

mid

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

$M = \beta_x w l^2 x = 0.037 \times 17 \times 4^2 = 10.064$

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

$I_a = 0.5 + \sqrt{0.25 - \frac{K}{0.9}} = 0.97 > 0.95 = 0.95$

$Z = I_a d = 0.95 \times 132 = 125.4$

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

Scanned with CamScanner

Provide y12 @ 377mm

long span continous.

d = 132mm

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

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

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

$z = Iad = 125.4$

$AS = \frac{M}{0.95 f_y z} = \frac{7.616 \times 10^6}{0.95 \times 410 \times 125.4} = 155.93 mm^2$

provide y12 @ 377mm

Deflection check.

$f_s = \frac{2}{3} P_{yr} \beta \frac{A_{req}}{A_s \text{ approved}}$

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

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

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