UYANWA PETER VICTOR
17/ENG03/036
CVE308

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

1b) Limit state design considers the disadvantages 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 when the design of a structural member is based on a liner stress – strain relationship, assuming that the working stress are only a fraction of the elastic 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 = $h \times 24\ kN/m^2$

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

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

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

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

D.G.K = $((A + B) \times sf) + C$

$= (4.8 \times 1.14) + 3.3$

$= 8.77\ kN/m$

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 = $T + 0 + 0.1 + 0.5(10 + 6) = (275 \times 12) + 0.5$
$(225 + 225) = 3.525\ m$

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

$= 150 - 25 - 6 = 114\ mm$

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

$\frac{M}{bd^2 f_{cu}} = \frac{18.24 \times 10^6}{1000 \times 114^2 \times 25} = 0.052$

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

$z = J_a c = 0.938 \times 1.9 = 111.622 mm$

$f_s = \frac{m}{0.75 f_y z} = \frac{8.24 \times 10^6}{0.95 \times 416 \times 111.622} = 419.53$

As per = 452 mm

provide Y12 @ 254 c/c (As Pur = 452 mm)

Deflection check

$f_s = 2/3 \times 1/s \times \frac{A_{req}}{A_{prov}} \times f_y$

$f_s = 2/3 \times 1 \times \frac{41953}{452} \times 250$

$= 154.69 N/mm^2$

$M.f = 0.55 + \frac{477 - 154.69}{170(0.9 + \frac{18.24 \times 10^6}{1000 \times 1192})} = 1.78$

$d_{req} = \frac{span}{af \times ecr} = \frac{3525}{1.73 \times 26} = 76.17 mm$

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

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

$P_2 = P_5 = P_9 = \frac{4500}{4000} = 1.125 < 2 =$ 2 way slab

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

$P_{10} = P_{11} = P_{12} = \frac{4000}{1500} = 2.66772 =$ 1 way slab

Design for P_2

$\frac{l_y}{l_x} = \frac{4300}{4000} = 1.070 = \simeq 1:1$

Short span coefficient = –

0.054

long span coefficient = 0.038

0.044

Assuming specification

Slab thickness = 175 mm

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

$f_y = 410 N/mm^2$

DL = 1.4 Gk + 1.6 Qk

G/C = weight slab = 0.175 × 24
Partition = 1.0
Finishes = 1.2

6.4 kN/m²

Assuming for factors

$n = (1.4 \times 6.4) + (1.6 \times 5)$
= 16.96 ≃ 17 kN/m²

Short span coefficient = 0.044
0.033

Long span coefficient = 0.037
0.028

Short span mid = n
$M = \beta sx \, wl^2 x$ = 0.0044 × 17 × 4^2
= 11.968

d = h - cover - $\phi/2$ = 144

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

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

= 0.95

z = $z_a \cdot d$ = 0.95 × 144 = 136.8
$A_s = M/0.95 f_y z$ = $\frac{11.968 \times 10^6}{0.95 \times 410 \times 136.8}$ = 224.61

Provide Y12 @ 377 mm

Continuous
$m = \beta sx \, wl^2 x$ = 0.033 × 17 × 4^2 = 8.976
d = 144
$k = \frac{m}{}$ = $\frac{8.976 \times 10^6}{1000 \times 144^2 \times 25}$ = 0.0173

$2a = 0.5 + \sqrt{0.25 - k/0.4} = 0.5 + \sqrt{0.25 - \frac{0.0173}{0.9}} = 0.83$

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

$As = \frac{m}{0.95 fyd} = \frac{8.976 \times 10^6}{0.95 \times 410 \times 119.52} = 172.81mm$

Provide Y^{12} @ 377mm

Long span m/c

$d = d$ (short span) - steel thickness $= 144 - 12 = 131mm$

$m = \beta x\, ad^2 x = 0.037 \times 17 \times 4^2 = 10.064$

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

$2a = 0.5 + \sqrt{0.25 - k/0.4} = 0.97 > 0.95 = 0.95$

$z = la\, c = 0.95 \times 132 = 125.4$

$As = \frac{M}{0.95 fyz} = \frac{10.064 \times 10^6}{0.95 \times 125.4 \times 40} = 206.64$

Provide Y12 at 377 mm

Long span continuous

$d = 132mm$

$m = \beta x\, wl^2 x = 0.028 \times 17 \times 4^2 = 7.616$

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

$La = 0.5 + \sqrt{0.25 + -k/0.9} = 0.98 > 0.95 = 0.95$

$z = la\, d = 125.4$

$As = \frac{M}{0.95 fyz} = \frac{7.616 \times 10}{0.95 \times 410 \times 125.4} = 155.93$

Provide Y^{12} @ 377mm

Deflection check

$f_s = 2/3\, fy\, B$

As/e

$q = 8$ pcure

$f_s = 2/3 \times 250 \times 1 \frac{\times 224.61}{37}$

$= 97.3$

$m\, ix = 0.55 + \frac{477 - 99.3}{120(0.9 + \frac{11.465 \times 10^6}{1000 \times 144^2})}$

$= 2.68 > 2$

$d\, req = \frac{4 \times 1000}{2 \times 26} = 76.92$

$=$ OK