University of Technology
Building and Construction Eng. Dept.
Final Exam. 2015/2016

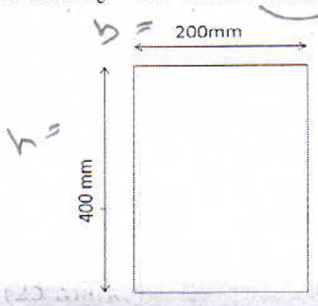
Subject: Structural Design
Branch: Enviromental Eng.
Examiners: Dr. Hussein Al-Quraishi

Fourth Class
Time : 1.5 Hrs.

Note: Open books and notes examination

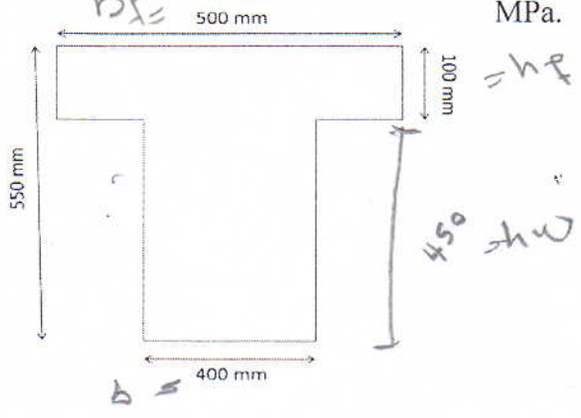
Concrete Design (Answer Two Questions)

Q.1) The normal-weight plain concrete beam shown in figure below is on a simple span of 3m. It carries a dead load (which includes the weight of the beam) of 7 kN/m. There is a concentrated load of 9 kN located at midspan use f_c= 28 MPa. Compute the maximum bending stress using flexural formula.



(25 Marks)

Q.2) A reinforced concrete floor system is to have a 100 mm thick slab supported on 400 mm wide beams as shown in figure below. At one location, the effective width of the flange be 500mm. The positive factord moment M_n at this section is 430 kN.m. Design the T-beam using concrete cover= 75mm, f_c=21 MPa and f_y=420 MPa.



(25 Marks)

Q.3) Design a simply supported one-way reinforced floor slab to span 3 m and carry a service live load of 8 kN/m^2 and a service dead load of 1kN/m^2. Use f_c=21 MPa and f_y=420 MPa. Design the slab for the ACI code minimum thickness.

(25 Marks)

حلول نموذجية / وحيد

Q.1

$$M = \frac{wl^2}{8} + \frac{Pl}{4}$$

$$= \frac{7 * 3^2}{8} + \frac{9 * 3}{4}$$

$$= 7.87 + 6.75$$

$$= 14.6 \ KN.m$$

$$\sigma_c = \sigma_t = \frac{M.c}{I} =$$

$$= \frac{14.6 * 10^6 * \frac{400}{2}}{\frac{200 * 400^3}{12}}$$

$$= 27 \ Mpa$$

Q.2

① العرض = 430

② نزول d

$d = 550 - 75 = 475$

③ $b_e = 500$

④ M_{nf}

$$M_{nf} = \phi \, 0.85 f_c' \, b \, h_f \left(d - \frac{h_f}{2}\right)$$

$$= 0.9 * 0.85 * 21 * 500 * 100 \left(475 - \frac{100}{2}\right)$$

$$= 341.4 \ KN.m$$

⑤ بما أن العزم 430 أكبر من M_{nf}

∴ المقطع شكل T

$a > h_f$

$d_f = h - 75 = 550 - 75 = 475$

$z_f = 475 - \frac{100}{2} = 425$

$A_{sf} = \frac{341.4 \times 10^6}{0.9 \times 420 \times 425} = 2125$

Asw yang

$h_w = 550 - 100 = 450$

$d_w = 450 - 75 = 375$

$a = 1$

$b = -\frac{1.7 \times 21 \times 400 \times 375}{420} = -12750$

$c = \frac{1.7 \times 21 \times 400}{0.9 \times 420^2} \times (430 - 341.4) \times 10^6 = 7969312.2$

$A_s = \frac{+12750 \mp \sqrt{12750^2 - 4 \times 1 \times 7969312.2}}{2 \times 1} = \begin{matrix} 12090.8 \\ \text{or} \\ 659.1 \end{matrix}$ (11431.7)

$A_{st} = 659.1 + 2125 = 2784.1$

$\text{no of bar} = \frac{2784.1}{\frac{\pi}{4} 25^2} = 5.6 \approx 6$

$A_{smin} = 0.25 \times \frac{\sqrt{21}}{420} \times 400 \times 475 \;//\; \frac{1.4 \times 400 \times 475}{420}$

518 633.3

$A_s > A_{smin}$ o.k

Q.3

$$h = \frac{l}{20} = \frac{3000}{20} = 150$$

$$W.D.L = 24 * 0.15 = 3.6$$

$$Wu = 1.2 * (3.6 + 1) + 1.6 * 8 = 18.32$$

$$Mu = \frac{wu l^2}{8} = \frac{18.32 * 3^2}{8} = 20.61$$

$$d = 150 - 20 - \frac{12}{2} = 124$$

$a = 1$

$b = -\frac{1.7 * 21 * 1000 * 124}{420} = -10540$

$c = 1.7 * \frac{21 * 1000}{0.9 * 420^2} * 20.6 * 10^6 = 4634523.8$

$x = A_s = \frac{-(-10540) \mp \sqrt{10540^2 - 4 * 1 * 4634523.8}}{2 * 1}$ (9620.4)

$= 10080$ or 459.8

$\therefore A_s = 459.8\ mm^2$

$S = \frac{\frac{\pi}{4} 12^2 * 1000}{459.8} = 246 \simeq 240$

$S = 240 < \begin{cases} 3 * 150 = 450 \\ 500 \end{cases}$ o.k

[illegible]

$A_s = 0.0018 * 1000 * 150 = 270$

$S = \frac{\frac{\pi}{4} 12^2 * 1000}{270} = 418$

$S = 410 < \begin{cases} S_h = 5 * 150 = 750 \\ 500 \end{cases}$