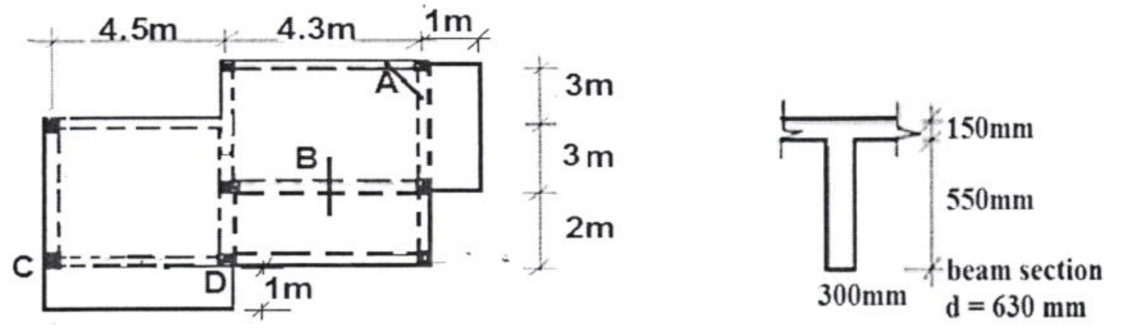
University Of Technology
Building and Construction Eng. Dept.
Final Exam – First Attempt – 2014/2015

Subject :Concrete structures — Class: Fourth
Branch :Building and Construction Management Engineering — Time : 3 Hours
Examiner :Dr. Iqbal N. Gorgis — Date : 7 / 6 / 2015

Note: Use **f 'c = 25 MPa and fy = 420 MPa** for solving all the questions.
Solve only **four** questions.

Q.1: A concrete slab with 150 mm thickness supports service dead load of 6 kN/m^2 including its own weight and service live loads of 3 kN/m^2, find:

1- Area of steel reinforcement required for the slab at point A, and B using Φ12mm.
2- Total loads on beam CD? (the spans are c/c)

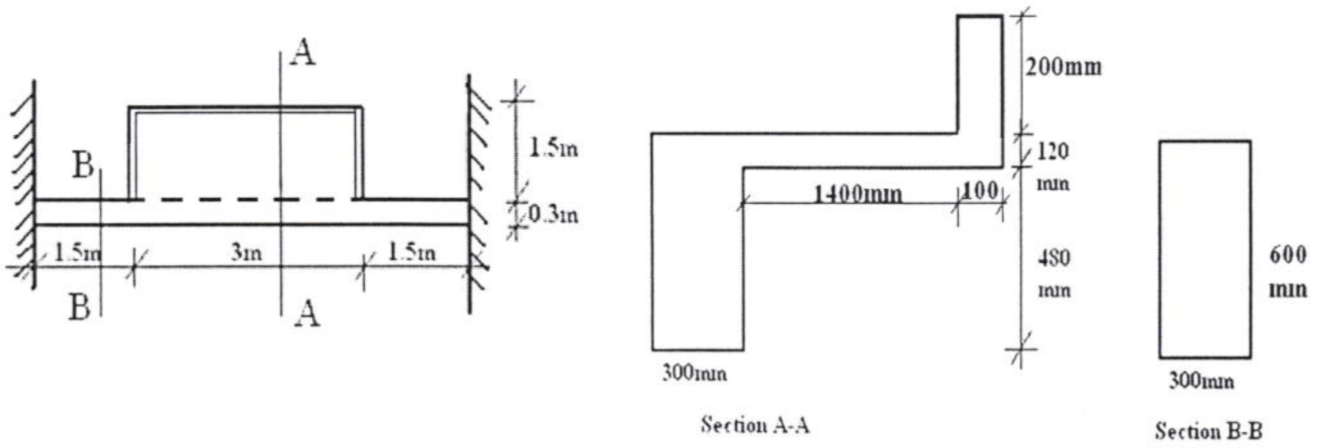


All beams are 300mm in width and all columns are 300*300mm

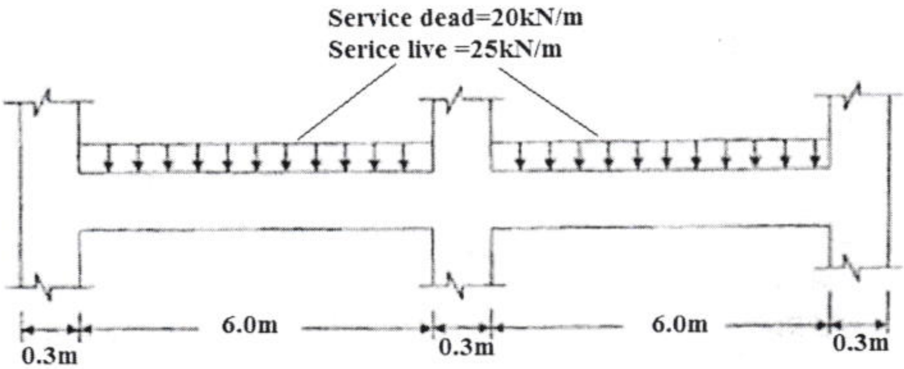
Q.2: Answer **either A or B** :

A) A circular short spirally reinforced column with 400mm diameter supports a factored load of 800kN. The load is applied with eccentricities of $\mathbf{e_y}$ = 130 mm and $\mathbf{e_x}$ = 152mm, find the steel area required using bars with 30 mm diameter for longitudinal and 10mm for spiral (use d' = 60mm)?

B) A concrete beam with cantilever slabs as shown, check only if the critical section of the beam can with stand the torsion and shear loading. The dead load including slab dead weight is 4 kN/m^2 and live load of 3 kN/m^2 use bars with 10mm diameter (d= 530mm).



Q.3: Design the critical section of the beam for bending and shear using bars with 25mm in diameter and 10 mm stirrups, if b=250mm , $\rho = 0.5\rho_{max}$ (assume weight of beam 5kN/m) .

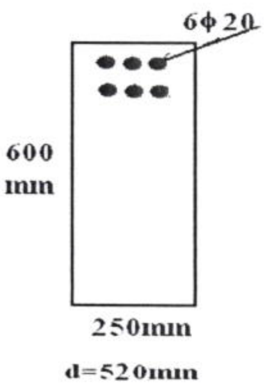


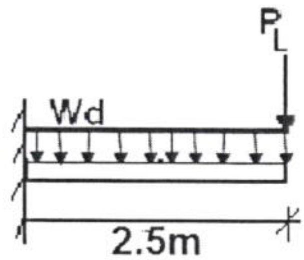
Q.4: Design a wall footing for a masonry wall with 250mm thickness, the wall supports a service live load of 60 and service dead loads of 50 kN/m. The bearing capacity of the soil is 120kN/m^2 at depth of 0.75m for γ soil = 16 kN/m^3 (try thickness of footing of 250 mm using bars with diameter of 12mm and cover of 70mm).

Q.5: Check the deflection of the free end of the beam shown if the beam is part of roof supporting or attached to nonstructural elements likely to be damaged by large deflections and 50% of live load is continued for 24 months. The distributed dead load including its own weight is 15kN/m and concentrated live load of 50kN.

$\Delta_{free\ end} = \frac{W_d L^4}{8EI}$, and $\Delta_{free\ end} = \frac{P_L L^3}{3EI}$?

$\frac{b * y^2}{2} = nAs * (d - y)$ and $I_{crack} = \frac{b * y^3}{3} + nAs * (d - y)^2$





Concrete structures 2015

Set -1 $f_c' = 25$ MPa $f_y = 420$ MPa.

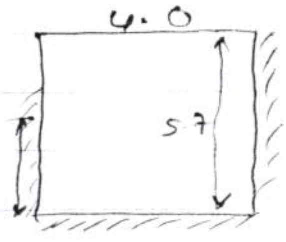
Solutions:

Q.1

① $W_u = 1.2 * 6 + 1.6 * 3 = \underset{D.L.}{7.2} + \underset{L.L.}{4.8} = 12$ kN/m

For point B,

case 9 $m = \frac{4}{5.7} = 0.7$



from one way $= \frac{wL^2}{12} = \frac{12(2)^2}{12} = 4$ kN.m/m
< 3m

$M_b^- = 0.011 * 12 * (5.7)^2 = 4.288$ kN.m (governs) الأكبر

For point A,

$M^+_a = (0.033 * 7.2 + 0.05 * 4.8)(4)^2 = 7.64$ kN.m/m.

$d_{av} = 150 - 20 - 12 = 118$ mm.

$A_{s\,min} = 0.0018 * 1000 * 150 = 270$ mm²/m

$\mu = \frac{f_y}{0.85 f_c'} = 19.764$

Noted: $R_u = \frac{M_u \times 10^6}{0.9 \times 1000 (118)^2}$

M_u	R_u	ρ	A_s	Spacing
7.64	0.6096	0.00147 < 0.0018	270	$\frac{113 \times 1000}{270} = 418$
4.288	0.342			2h = 300

both directions.

use Ø12 @ 300 mm c/c.

② Load on beam CD:

from cantilever $= 12 * 1 = 12$ kN/m.

$m = \frac{4.2}{4.7}$ from slab (case 4) (m = 0.9)

$= \frac{0.4 * 12 * 4.2 * 4.7}{2 * 4.2} = 11.28$ kN/m.

wt. of beam $= 1.2 * 24 * 0.3 * 0.55 = 4.752$ kN/m.

$\Sigma = 28.032$ kN/m.

Q.2 either A or B:

(A) $P_u = 800$ kN.

$e_{new} = \sqrt{(130)^2 + (152)^2} = 200$ mm.

$\frac{e}{D} = \frac{200}{400} = 0.5$ } $\gamma = \frac{400 - 120}{400} = 0.7$

$k = \frac{800 * 1000}{0.75 * 25 * \frac{\pi (400)^2}{4}} = 0.3395$

$\rho_g = 0.03 = \frac{A_{st}}{A_g}$

$\therefore A_{st} = 0.03 * \pi (400)^2 / 4 = 3769.91$ mm^2

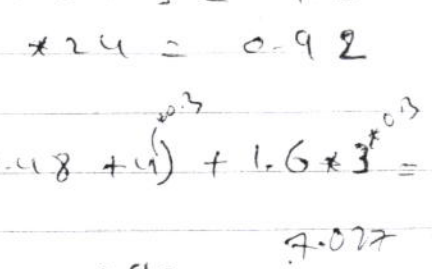
no. $\phi 30 = \frac{3769.91}{\pi (30)^2 / 4} = 5.3 \approx \underline{6}$ bars $\phi 30$ mm

$\phi 10$ mm

$\rho_{sp} = 0.45 \left[\left(\frac{400}{400 - 80} \right)^2 - 1 \right] \frac{25}{420} = 0.01507$

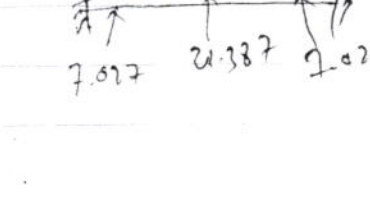
$S_p = \frac{4 * 79 (320 - 10)}{0.01507 (320)^2} = 63.5 \approx 60$ > 25 mm, < 75 mm

use $\phi 10$ @ 60 mm c/c.



B/ $W_u = 1.2(4) + 1.6 * 3 = 9.6$ kN/m^2

$P = 1.2 * 0.32 * 0.1 * 24 = 0.92$ kN/m



wt of rectangular =

$1.2 [24 * 0.3 * 0.48 + 4) + 1.6 * 3 * 0.3 =$ 7.027 kN/m

7.027

Σ load for = $9.6 * 1.4 + 0.92 +$

Shear = 21.387 kN/m.

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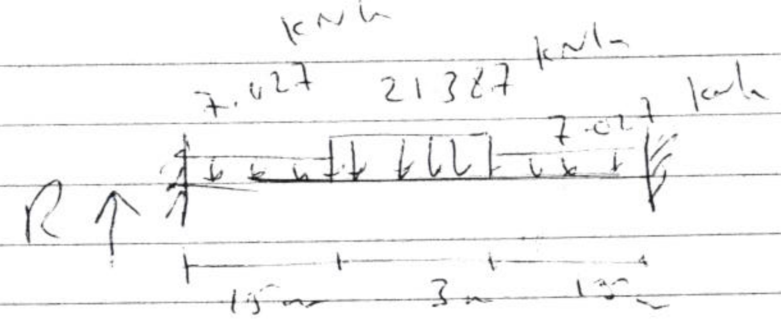


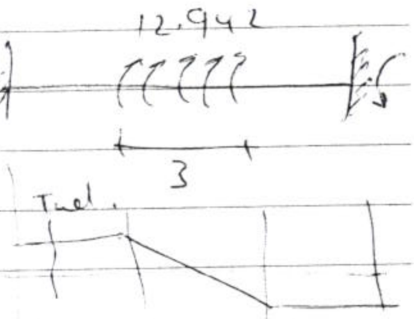
$R = (7.027 * 3 + 21.387 * 3)/2 = 42.621$ kN

$V_{ud} = 42.621 - 0.53 * 7.027 = 38.897$ kN

For Torsion =

$0.92\,(0.1 + 1.4 + 0.15) + 9.6 * 1.4\,(0.7 + 0.15)$

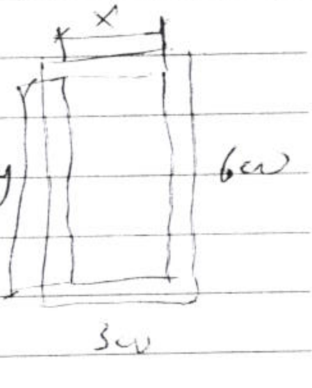
$= 12.942$ kNm



$T_{ud} = 12.943 * \frac{3}{2} = 19.443$

$x = 300 - 2(40) - 10 = 210$ mm

$y = 600 - 2(40) - 10 = 510$ mm



$P_{ch} = 2(210 + 510) = 1440$ mm

$A_{ch} = 210 * 510 = 107100$ mm²

$T_{cr} = 0.75 \frac{\sqrt{25}}{12} \frac{(300 * 600)^2}{2\,(300 + 600)\,10^6} = 5.625$ kNm < 19.442 kNm.

we need Torsion design

$\sqrt{\left(\frac{38.397 \times 10^3}{300 * 510}\right)^2 + \left(\frac{19.413 \times 10^6 * 1440}{1.7\,(107100)^2}\right)^2} < \frac{5}{6} * 0.75\sqrt{25}$

$1.454 < 3.125$

ok.

The section is adequate.