

Notes: 1. Any missing data is to be reasonably assumed. 2. Design Aids can be used.

Question 1: (10%)

Calculate M_u for a doubly reinforced rectangular cross-section of breadth 300 mm and total height of 650 mm using the equations of first principles of ultimate limit state method. The tension reinforcement of the section consists of 9 bars of diameter 20 mm and the compression reinforcement consists of 4 bars of diameter 18 mm. Assume $f_{cu} = 25 \text{ N/mm}^2$ and steel 400/600.

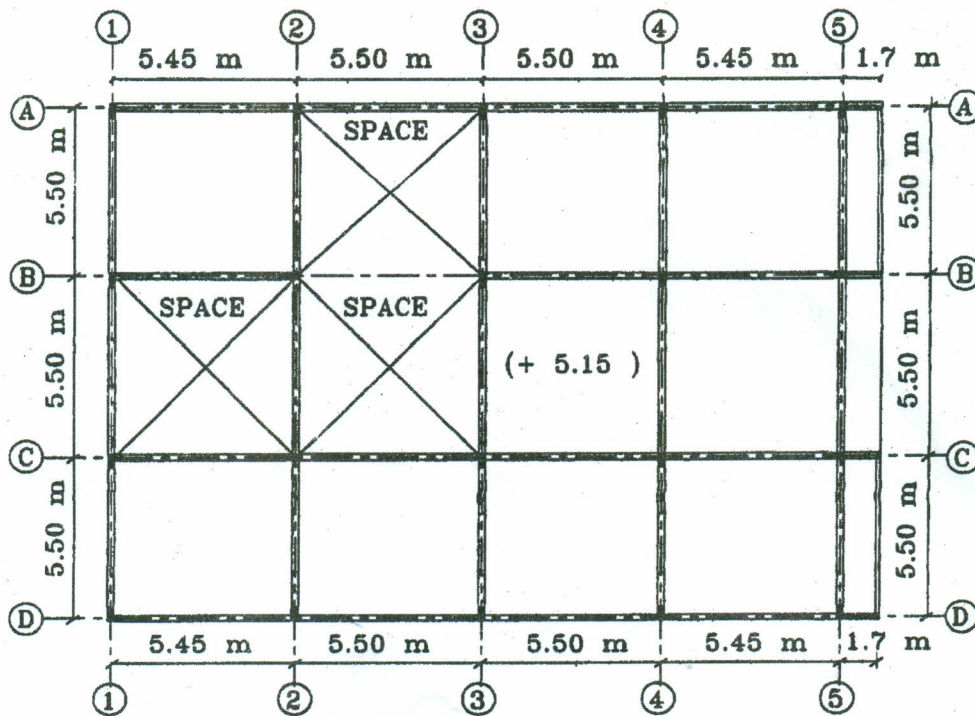
Question 2: (20%)

A cantilever beam of span 2.85 m with variable depth having concentrated ultimate load P_u at the free end equal to 395 kN. The breadth of the cantilever is equal to 450 mm and the total height at the free end and at the support is equal to 600 mm and 1100 mm, respectively. The beam is reinforced with 12D22 as a tensile steel and 4D22 as a compression steel. Draw to suitable scale the diagonal tension diagram for the beam and design the beam for shear using stirrups and bent-up bars. Use concrete with $f_{cu} = 30 \text{ N/mm}^2$.

Question 3: (25%)

The figure shows the structural plan of the first story of R/C building. The level of the first story is 5.25 m. Assume that the slab live load is equal to 6.50 kN/m^2 and the covering materials is equal to 1.5 kN/m^2 . Using steel 240/350 and concrete with $f_{cu} = 30 \text{ MPa}$, it is required to:

- 1) Design the solid slabs of the first story between axia 3-3 and axis 5-5 (including the external parts). (15%)
- 2) Draw the reinforcement of the designed slabs to scale 1:50. (10%)

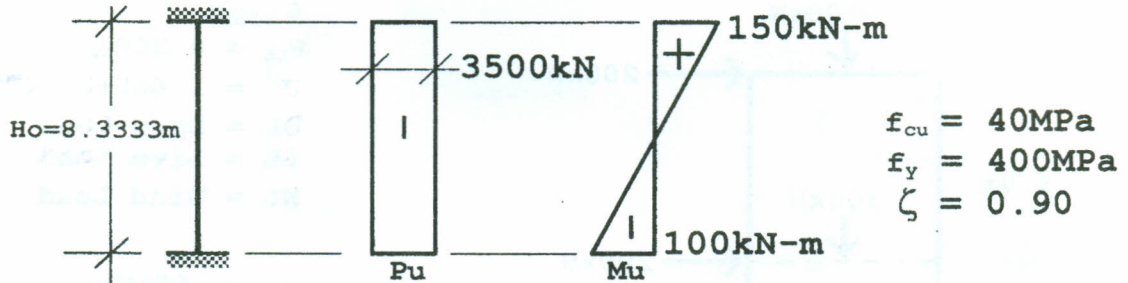


My best wishes, Prof. Dr. Ahmed Yousef

Problem No. 4 (18%):

For the shown unbraced square column, It is required to:

1. Estimate the column size (assume $\mu = 1.0\%$).
2. Check if the column is slender?
3. Compute the design moment, M_D .
4. Select the column reinforcement (bars in 4-faces).
5. Draw the reinforcement detailings to scale 1:10.



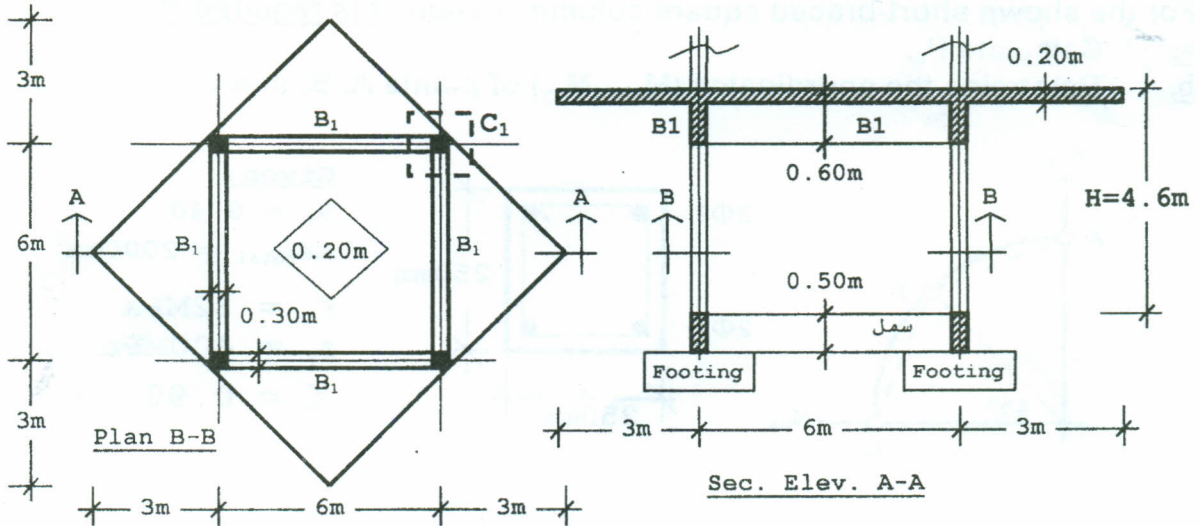
Problem No. 5 (20%):

A cross-section elevation and a structural plan of a building are shown below.

Input Data:	Beam B ₁	Slab	Loads	Materials
	$b = 0.30\text{m}$	$t_s = 0.20\text{m}$	LL = 3.50kN/m^2	$f_{cu} = 30\text{MPa}$
	$t = 0.60\text{m}$		flooring = 2.0kN/m^2	$f_y = 360\text{MPa}$

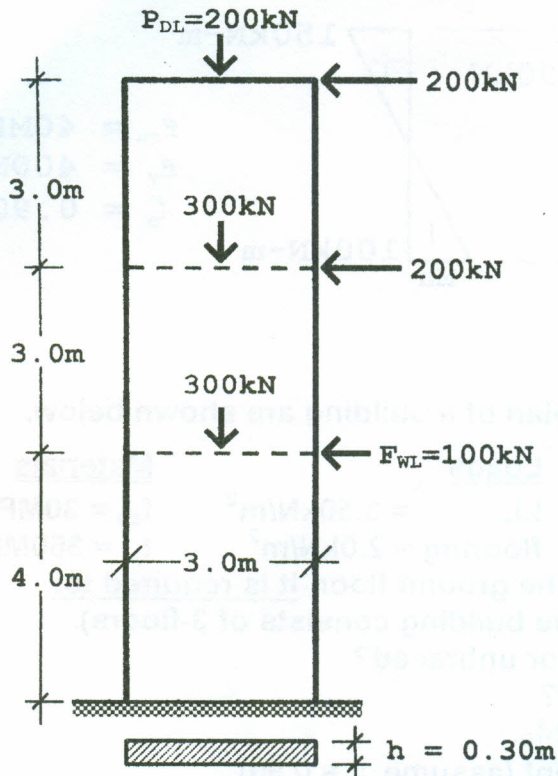
For the square column C₁ (300×300mm) at the ground floor, it is required to:

1. Compute the ultimate loads (the building consists of 3-floors).
2. Check if the column is braced or unbraced?
3. Check if the column is slender?
4. Compute the design moment, M_D .
5. Select the column reinforcement (assume $\zeta = 0.90$).
6. Draw the reinforcement detailings to scale 1:10.



Problem No. 6 (17%):

1. For the shown structural wall (a planar shear wall), it is required to:
 - a. Are lateral loads resisted mainly by flexural- or shear-action? and Why?
 - b. Show that the given horizontal and vertical reinforcement satisfies all of the Egyptian Code requirements regarding minimum reinforcement percentage and maximum spacing.
 - c. Check the adequacy of the wall at its base.



Given:

$$P_{LL} = 0.50P_{DL}$$

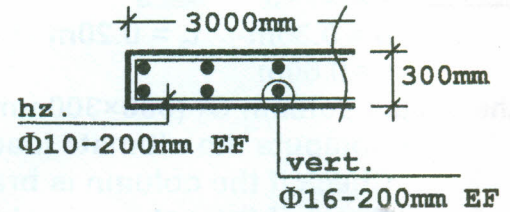
$$U = 1.6WL + 0.90DL$$

DL = Dead Load
LL = Live Load
WL = Wind Load

$$f_{cu} = 40\text{MPa}$$

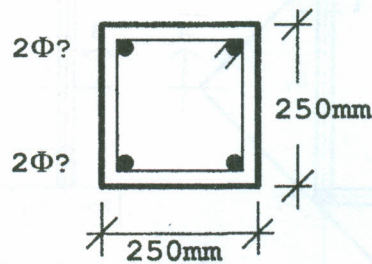
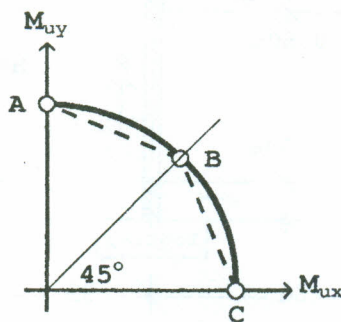
$$f_y = 400\text{MPa}$$

$$\zeta = 0.90$$



2. For the shown short-braced square column section, it is required to:

- a. Calculate P_u .
- b. Determine the coordinates (M_{ux}, M_{uy}) of points A, B, and C.



Given:

$$R_b = 0.40$$

$$A_{s_{total}} = 2000\text{mm}^2$$

$$f_{cu} = 32\text{MPa}$$

$$f_y = 400\text{MPa}$$

$$\zeta = 0.90$$

Best Wishes
Dr. Mohamed El-Zoughiby