

Second Semester Final Exam

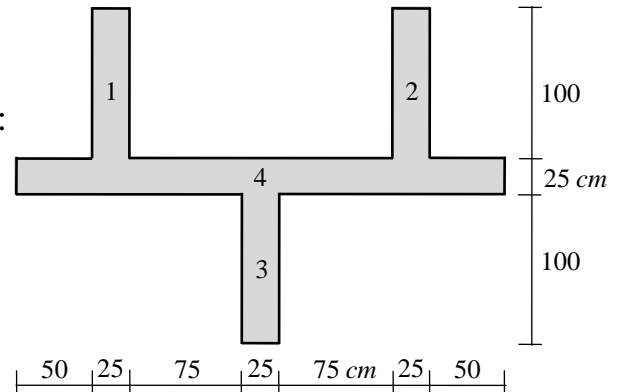
- Attempt all questions.
- The Exam consists of **5** questions in **2** pages.
- Maximum grade is **60 Marks**.

Question (1): (12 Marks)

For the shown cross-section, determine the following:

- (a) The location of the centroid.
- (b) The moments of inertia about the centroidal axes (I_{x_c} & I_{y_c}).

Note: Divide the cross-section to 4 elements as shown on the figure.



Question (2): (12 Marks)

A column of variable circular cross-section is subjected to axial loads as shown.

Check if the column is safe or not.

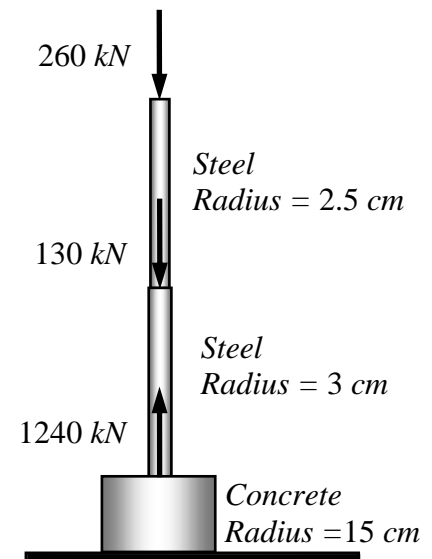
Given Data:

Allowable compressive stress for concrete = 80 MPa

Allowable tensile stress for concrete = 10 MPa

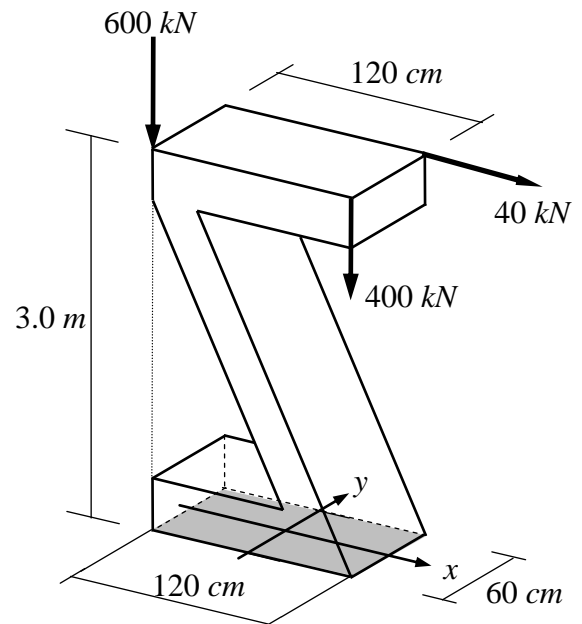
Allowable compressive stress for steel = 140 MPa

Allowable tensile stress for steel = 140 MPa



Question (3): (12 Marks)

At the base section ($120 \text{ cm} \times 60 \text{ cm}$) of the shown column, draw the normal stress distribution and calculate the maximum normal stresses. Neglect the column weight.



Please turn over

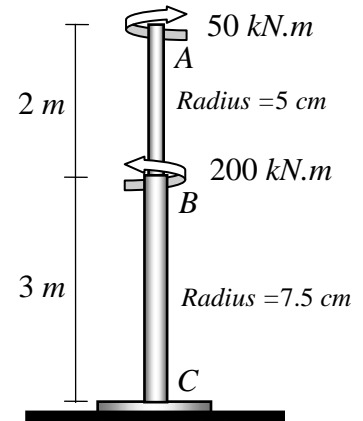
Question (4): (12 Marks)

For the shown column of variable circular cross-section,

- Draw the twisting moment diagram.
- Determine the maximum shear stress in each part (**AB** and **BC**).
- Determine the angle of twist ϕ of section A with respect to the fixed support at C.

$$G = 8000 \text{ kN/cm}^2$$

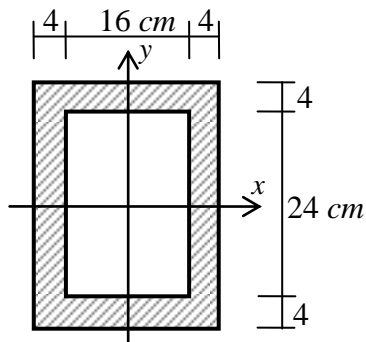
$$\tau = \frac{Tr}{J} \quad \text{and} \quad \phi = \frac{TL}{JG}$$



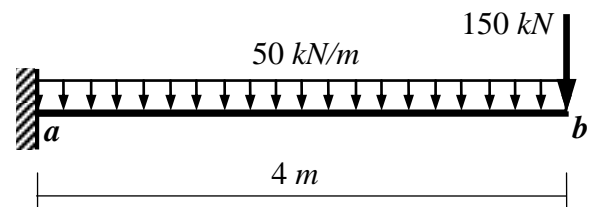
Question (5): (12 Marks)

For the shown beam, calculate and draw:

- The **normal** stress distribution over the cross-section at *a*.
- The **shear** stress distribution over the cross-section at *a*.



Cross-section of the beam



With my best wishes

Dr. M. Abdel-Kader