ME 323: Mechanics of Materials ***Homework Set 5***

Fall 2025 ***Due: Friday, October 10***

Problem 5.1 (10 points)

A simply-supported beam with a circular cross-section is loaded as shown in **Figure 5.1(i)**. The beam cross-section at location K is shown to the right in **Figure 5.1 (ii)**. Point O on the cross-section is on the neutral axis of the beam.

a) Determine the shear force and bending moment resultants on the cross-section at K.

b) Determine distribution of normal stress on the cross-section of the beam at K as a function of y, the perpendicular distance from the neutral axis.

c) Determine the maximum (magnitude) of the normal stress on the cross-section at K.

d) Determine the shear stress on the cross-section at K on the neutral axis.

Leave your answers in terms of, at most: P, a and b.

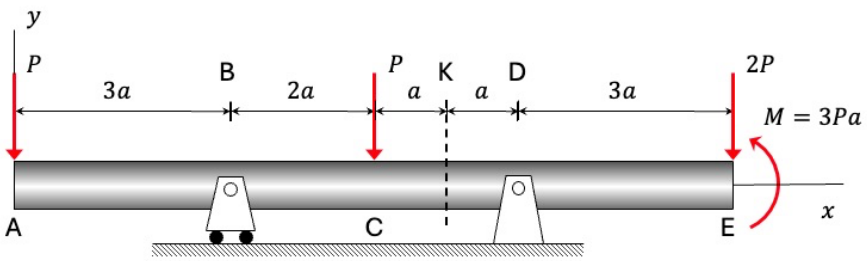


Figure 5.1 (i).

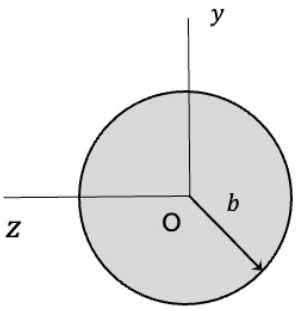


Figure 5.1 (ii).

Problem 5.2 (10 points)

Consider the T-section beam cross-section in **Figure 5.2** below.

a) Locate the neutral axis of the beam cross-section.

b) Determine the second area moment of the cross-section with respect to the neutral axis using the parallel axis theorem.

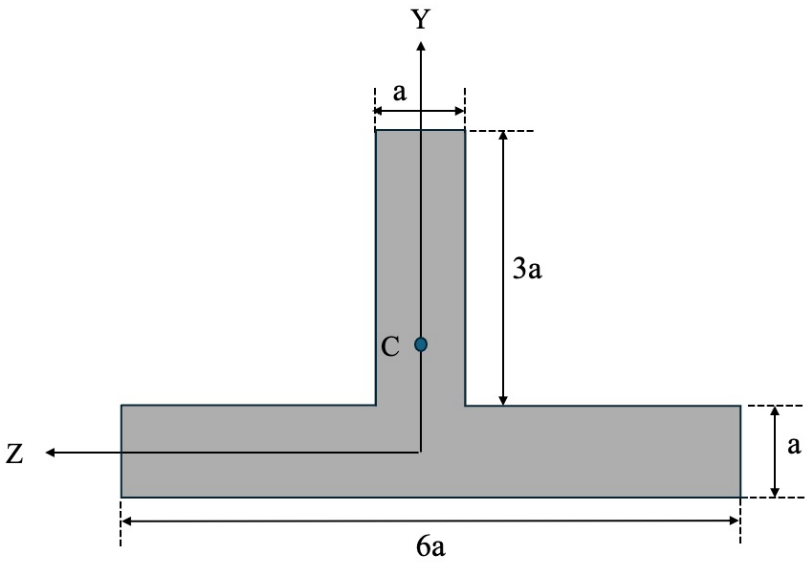


Figure 5.2

Problem 5.3 (10 points)

A rectangular, hollow cross-section beam is supported by a roller pin at point A and pinned at point C. A distributed load (force/length) acts of the beam with this load having a constant value of *w* between points A and B, and is linearly decreasing between B and C, as shown in **Figure 5.3**. The dimensions of the beam cross-section are also shown below in the figure.

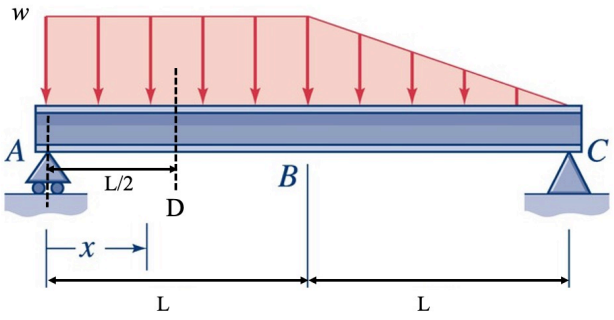
a) Determine the reactions on the beam at A and C.

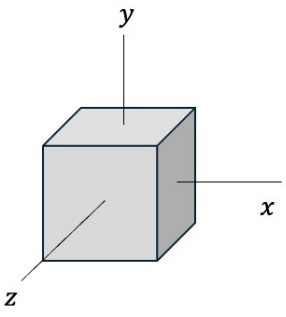
b) Determine the internal shear force and bending moment resultants at location D on the beam.

c) Determine the second area moment of the beam cross section about the neutral axis.

d) Determine the normal stress and shear stress at point K on the beam cross-section at location D on the beam.

e) Show the normal stress and shear stress acting at cross-section D on the stress element at K provided below.





Stress element at K

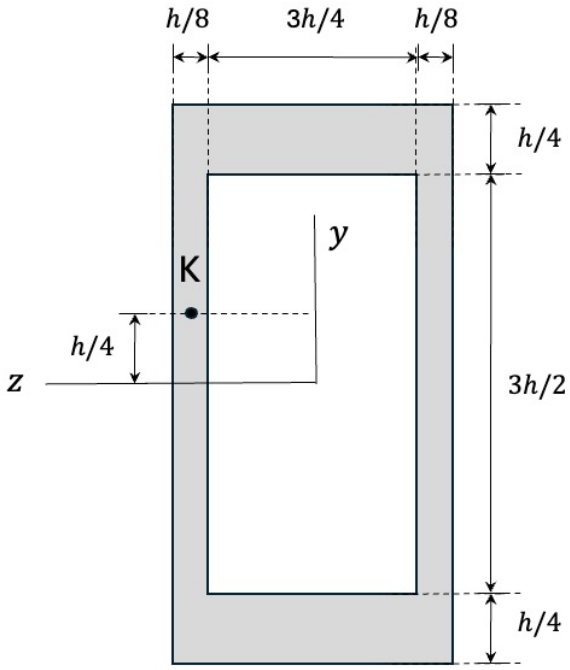


Figure 5.3

Problem 5.4 (10 points)

A shear force V and bending moment M act at a cross-section of a trapezoidal cross-sectioned beam. Consider five points (i), (ii), (iii), (iv) and (v) on the beam cross-section, as shown in **Figure 5.4**. Match up the state of stress at each of these five points with stress elements (a) through (o) shown below.

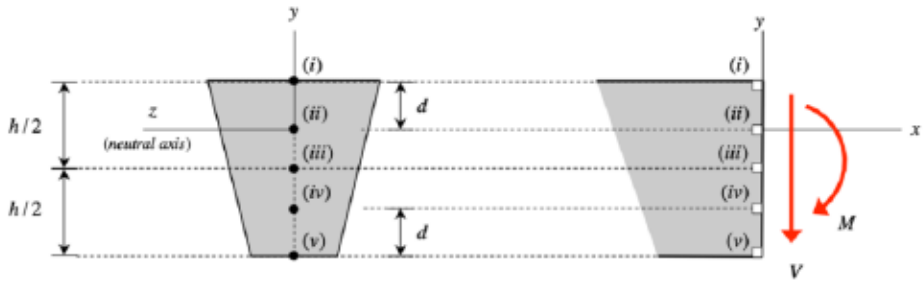
The state of stress at point (i) is:

The state of stress at point (ii) is:

The state of stress at point (iii) is:

The state of stress at point (iv) is:

The state of stress at point (v) is:



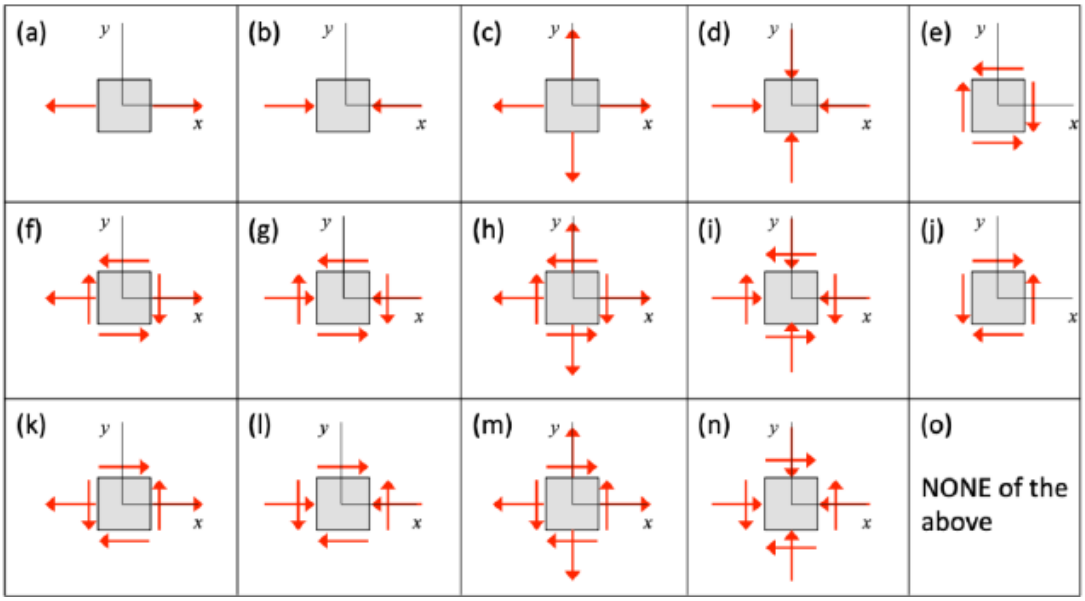


Figure 5.4