



Academic year 2024/2025

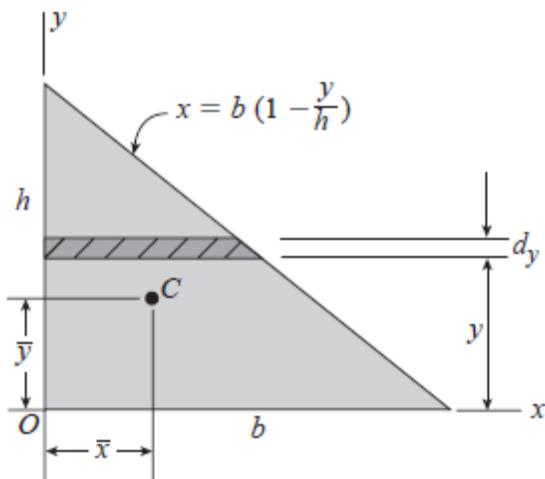
2nd Year

Mechanics of Materials (Material Strength)

T.D N° 2 (First moment and Centroids)

Problem 1 : (triangular area)

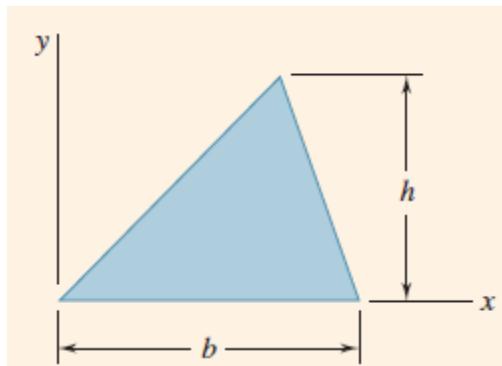
By using an horizontal rectangular differential element (strip), determine the distances (\bar{x} , \bar{y}) to the centroid C of a right triangle having base b and height h.



Problem 2 : (triangular area)

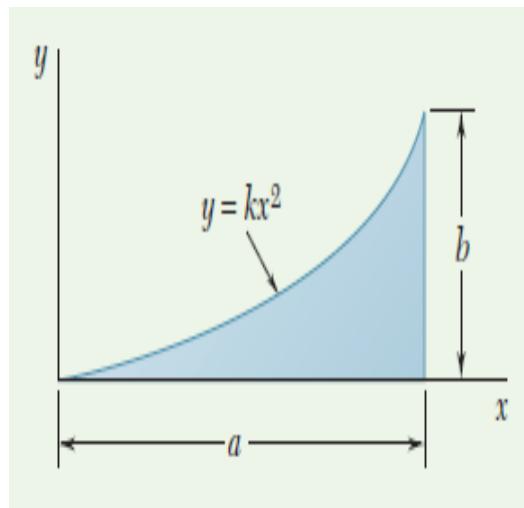
By using an horizontal rectangular differential element (strip), determine :

- 1) The triangle surface (A).
- 2) The first moment with respect to x axis.
- 3) The coordinate (\bar{y}) of the centroid C.



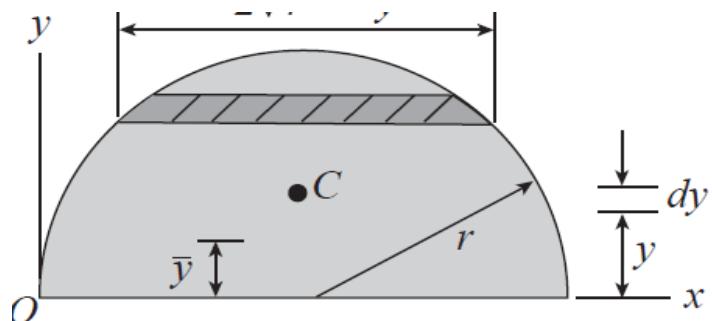
Problem 3 : (Parabolic Spandrel)

Locate the centroid of the area shown in Fig. ($k = 1$, $a = b = 1$ m). Use both horizontal and vertical strip and compare.



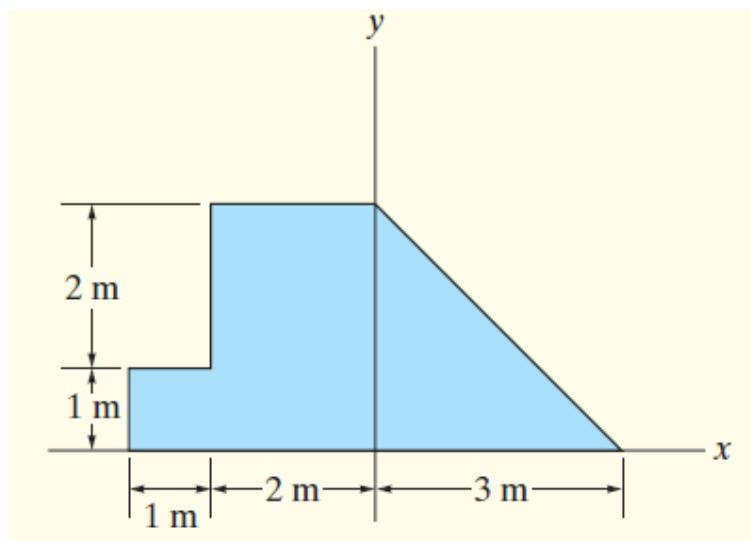
Problem 4 : (circular area)

By using an horizontal rectangular differential element (strip), determine the distance (\bar{y}) to the centroid C of a semicircle (radius r).



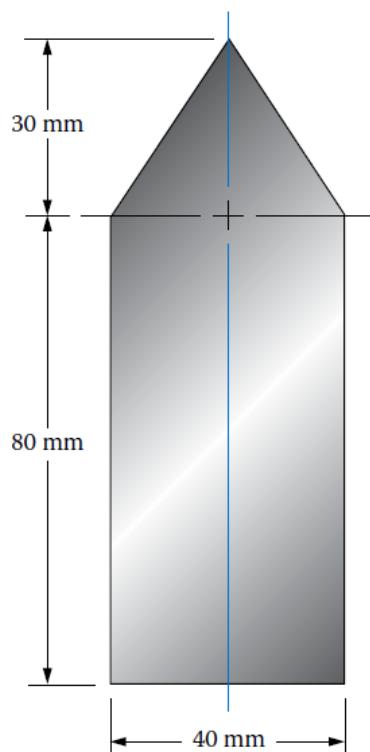
Problem 5 : (Composite Area)

Locate the centroid (\bar{x} , \bar{y}) of the plate area shown in Fig.



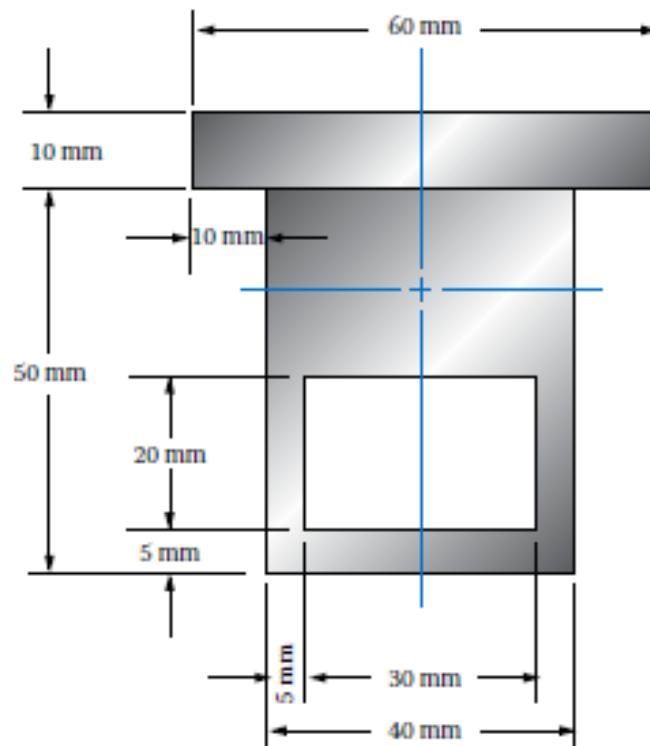
Problem 6 : (Composite Area)

Locate the centroid (\bar{x} , \bar{y}) of the plate area shown in Fig.



Problem 7 : (Composite Area)

Locate the centroid (\bar{x} , \bar{y}) of the plate area shown in Fig.



PROCEDURE FOR ANALYSIS

The center of gravity or centroid of an object or shape can be determined by single integrations using the following procedure.

Differential Element.

- Select an appropriate coordinate system, specify the coordinate axes, and then choose a differential element for integration.
- For areas the differential element is generally a *rectangle* of area dA , having a finite length and differential width.
- For volumes the differential element can be a circular *disk* of volume dV , having a finite radius and differential thickness.
- Locate the element so that it touches the arbitrary point (x, y, z) on the curve that defines the boundary of the shape.

Size and Moment Arms.

- Express the area dA or volume dV of the element in terms of the coordinates describing the curve.
- Express the moment arms \tilde{x} , \tilde{y} , \tilde{z} for the centroid or center of gravity of the element in terms of the coordinates describing the curve.

Integrations.

- Substitute the formulations for \tilde{x} , \tilde{y} , \tilde{z} and dA or dV into the appropriate equations (Eqs. 6–1 through 6–3).
- Express the function in the integrand in terms of the same variable as the differential thickness of the element.
- The limits of the integral are defined from the two extreme locations of the element's differential thickness, so that when the elements are “summed” or the integration performed, the entire region is covered.*

$$\bar{x} = \frac{\int_A \tilde{x} dA}{\int_A dA} \quad \bar{y} = \frac{\int_A \tilde{y} dA}{\int_A dA}$$