



Indian Institute of Technology Bhubaneswar  
School of Infrastructure

Subject Name : Solid Mechanics

Subject Code: CE2L001

Tutorial No. 8

Date: November 13, 2025

Instructions:

- (1) Provide neatly labelled diagrams whenever necessary.
- (2) You may find the given expressions of centroids for different geometric shapes useful.

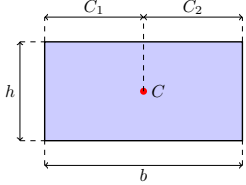
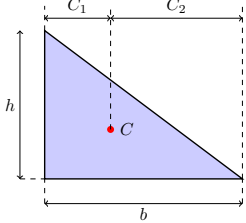
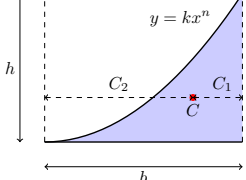
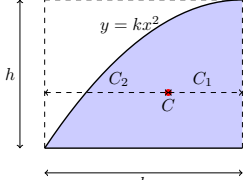
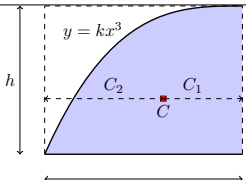
| Name               | Geometric shape   | Area             | $C_1$           | $C_2$                |
|--------------------|---|------------------|-----------------|----------------------|
| Rectangle          |    | $bh$             | $\frac{b}{2}$   | $\frac{b}{2}$        |
| Triangle           |  | $\frac{bh}{2}$   | $\frac{b}{3}$   | $\frac{2b}{3}$       |
| General spandrel   |  | $\frac{bh}{n+1}$ | $\frac{b}{n+2}$ | $\frac{b(n+1)}{n+2}$ |
| Parabolic Spandrel |  | $\frac{2bh}{3}$  | $\frac{3b}{8}$  | $\frac{5b}{8}$       |
| Cubic spandrel     |  | $\frac{3bh}{4}$  | $\frac{2b}{5}$  | $\frac{3b}{5}$       |

Figure 1: Geometric shape, area and centroids

1. (a) What are the assumptions made in the double integration method for calculating beam deflections?  
 (b) What are the limitations of the double integration method, and when is it not applicable?  
 (c) How do you handle discontinuous loading conditions, such as point loads or sudden changes in distributed loads, when using the double integration method?  
 (d) How does the double integration method account for the effects of shear deformation on beam deflections?
2. Consider a simply supported beam of length  $L$  subjected to a point load  $P$  applied at the center.

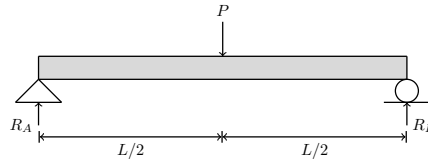


Figure 2: Simply Supported Beam with Center Load.

Using the double integration method, determine the deflection at the center of the beam.

3. Find the slope at point A, the deflection at point C and E of the beam shown in Fig. 3. Comment on the results.

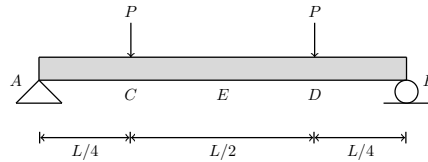


Figure 3: Simply supported beam with four-point loads

4. A cantilever beam of length  $L$  is subjected to a uniformly distributed load  $w_0$  per unit length. Using the double integration method, determine the deflection at the free end of the beam.
5. A beam of length  $L$  is fixed at both ends and carries a point load  $P$  at its center. Using the double integration method, determine the deflection at the center of the beam.
6. Find the slope at point A and deflection at point C of the beam shown in Fig. 4. Comment on the results.

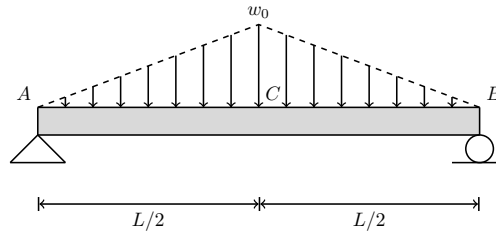


Figure 4

7. Find the slope at point A and deflection at point C of the beam shown in Fig. 5.

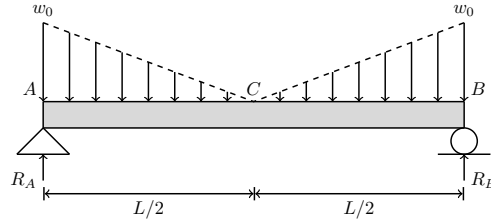


Figure 5

8. A cantilever beam of length  $L$  is subjected to a moment  $M$  at the free end. Using the double integration method, determine the deflection at the free end of the beam.
9. Find the slope at point A, the deflection at point C, and the deflection at point D of the beam shown in Fig. 6.

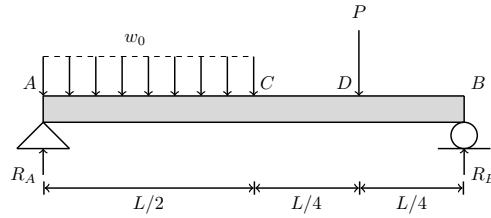


Figure 6

10. Find the slope at point A, the deflection at point C, and the deflection at point D of the beam shown in Fig. 7.

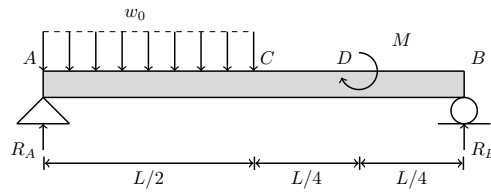


Figure 7