8.3 Shear and Bending-Moment Diagrams Constructed by Areas
8.3 Shear and Bending-Moment Diagrams Constructed by Areas Procedures and Strategies

Procedures and Strategies for Solving Problems Involving Constructing Shear and Bending-Moment Diagrams by Areas

1. You can construct the shear diagram by using the following rules:

   a) A downward concentrated load $P$ causes a downward jump of magnitude $P$ in the shear diagram.

   b) The change in shear between two "shear critical points" (points at which a concentrated load acts or a distributed load begins or ends) equals the negative of the area under the distributed load curve, $\Delta V = - \int w \, dx$.

   c) The slope of the shear curve equals the negative of the distributed load, $dV/dx = -w$. Thus if $w = \text{constant}$, the shear curve is a straight line; if $w$ is linear, the shear curve is parabolic; and if no distributed load is present ($w = 0$), the shear curve is a horizontal line.

Application of the rules to construct a shear diagram: Draw a free-body diagram of the beam, and solve for the reactions. Then starting from the left end of the beam, proceed from critical point to critical point, and apply rules a) and b) to determine the values of the shear at the critical points. Apply rule c) to determine the type of curve that connects the shear values at the critical points on the shear diagram.
2. You can construct the moment diagram by using the following rules:

a) A clockwise couple moment $M$ causes an upward jump in the moment diagram.

b) The change in moment between two "moment critical points" (shear critical points plus points at which a couple moment acts) equals the area under the shear curve, $\Delta M = \int V \, dx$.

c) The slope of the moment curve equals the shear, $dM/dx = V$. Thus if $V$ is linear, $M$ is parabolic; if $V$ is constant, $M$ is linear.

Application of the rules to construct a moment diagram: Starting from the left end of the beam, proceed from critical point to critical point, and apply rules a) and b) to determine the values of the moment at the critical points. Apply rule c) to determine the type of curve that connects the moment values at the critical points.
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Notes:

1) A point on the shear diagram at which \( V = 0 \) requires special consideration because \( \frac{dM}{dx} = V = 0 \) implies that the moment \( M \) is a local maximum or minimum there. First determine—perhaps by using similar triangles—the precise location where \( V = 0 \) on the shear diagram. Then treat this point as an additional critical point on the moment diagram and calculate the moment there by applying rule b).

2) Both diagrams must close. If either diagram does not close, check for a mistake in either your calculation of the reactions or in your calculation of \( V \) and \( M \) at successive critical points.
8.3 Shear and Bending-Moment Diagrams Constructed by Areas Problem Statement for Example 1

1. Draw the shear and moment diagrams for the beam.
8.3 Shear and Bending-Moment Diagrams Constructed by Areas Problem Statement for Example 2

2. Draw the shear and moment diagrams for the beam.
3. Draw the shear and moment diagrams for the beam.

30 lb/ft

A B

24 ft
8.3 Shear and Bending-Moment Diagrams Constructed by Areas Problem Statement for Example 4

4. Draw the shear and bending moment diagrams for the beam.
8.3 Shear and Bending-Moment Diagrams Constructed by Areas Problem Statement for Example 5

5. Draw the shear and moment diagrams for the beam.

![Diagram of a beam with 2 kN/m loading]
8.3 Shear and Bending-Moment Diagrams Constructed by Areas Problem Statement for Example 6

6. Draw the shear and moment diagrams for the beam.
7. Draw the shear and moment diagrams for the beam.
8.3 Shear and Bending-Moment Diagrams Constructed by Areas Problem Statement for Example 8

8. Draw the shear and moment diagrams for the beam.
Draw the shear and moment diagrams for the beam.