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FACULTY OF ENGINEERING AND TECHNOLOGY

Department of Mechanical Engineering

MEPS102:Strength of Material

Lecture 20

Topic: Shear force and bending moment diagram

Instructor:

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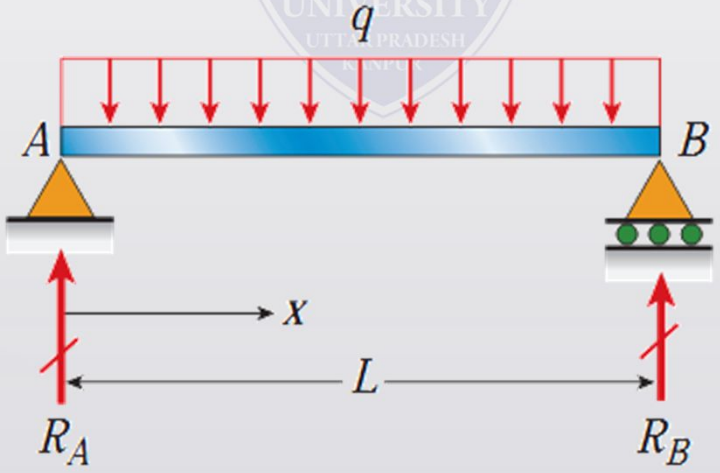
Procedure for Uniform Load

- ✓A simple beam with a uniformly distributed load of constant intensity q is shown
- ✓Because the beam and its loading are symmetric, we see immediately that each of the reactions (R_A and R_B) is equal to qL / 2. The same can be found out from equilibrium equation of entire beam

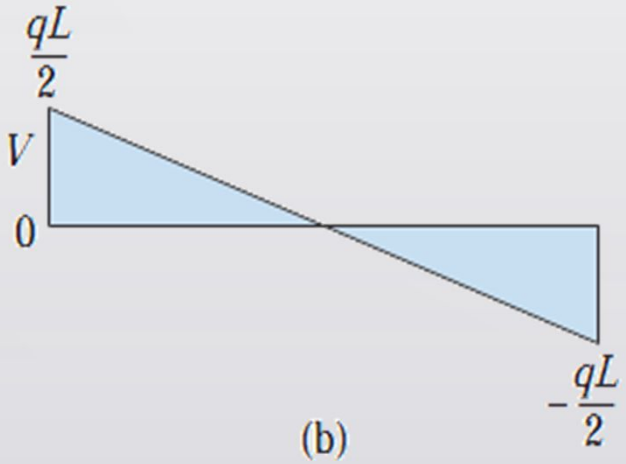


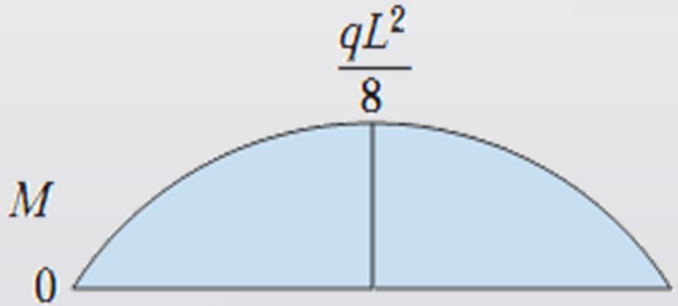
Procedure for Uniform Load

- ✓Therefore, the shear force and bending moment at distance x from the left-hand end are

$$V = R_A - qx = \frac{qL}{2} - qx$$

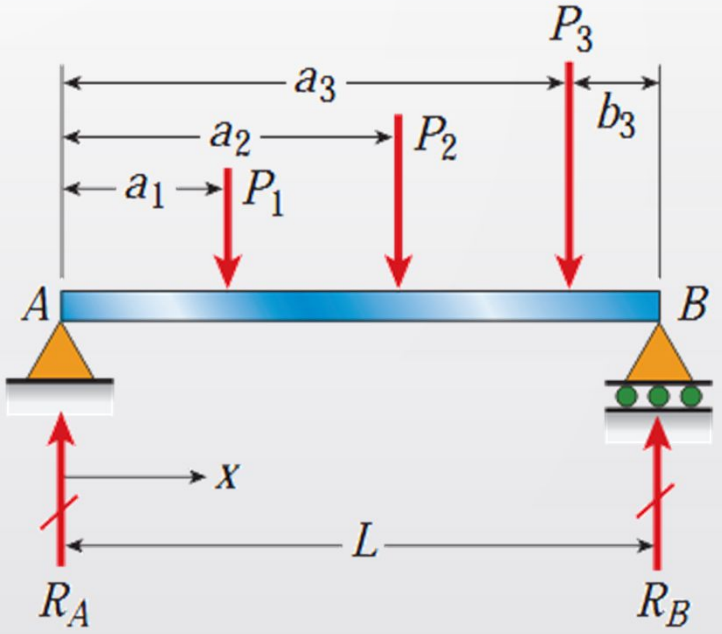
$$M = R_A x - qx\left(\frac{x}{2}\right) = \frac{qLx}{2} - \frac{qx^2}{2}$$





Several Concentrated Loads

- If several concentrated loads act on a simple beam, expressions for the shear forces and bending moments may be determined for each segment of the beam between the points of load application.
- Again using free-body diagrams of the left-hand part of the beam and measuring the distance x from end A, we obtain the following equations for the first segment of the beam:



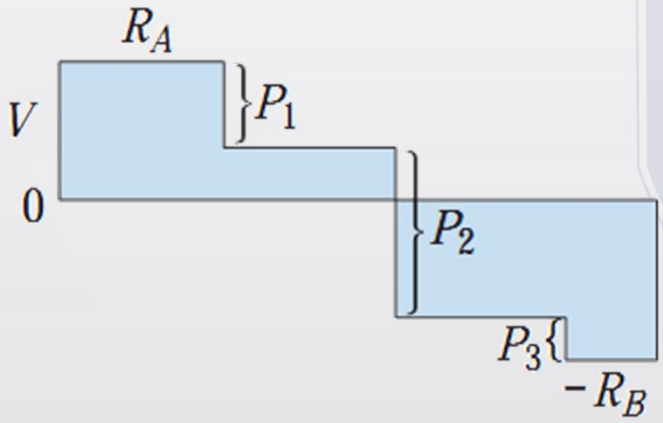
$$V = R_A \qquad M = R_A x \qquad (0 < x < a_1)$$

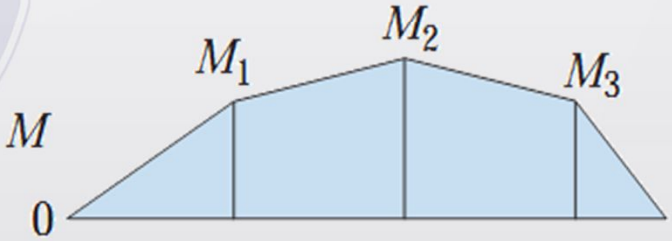
For the second segment, we get

$$V = R_A - P_1 \qquad M = R_A x - P_1(x - a_1) \qquad (a_1 < x < a_2)$$

And so on

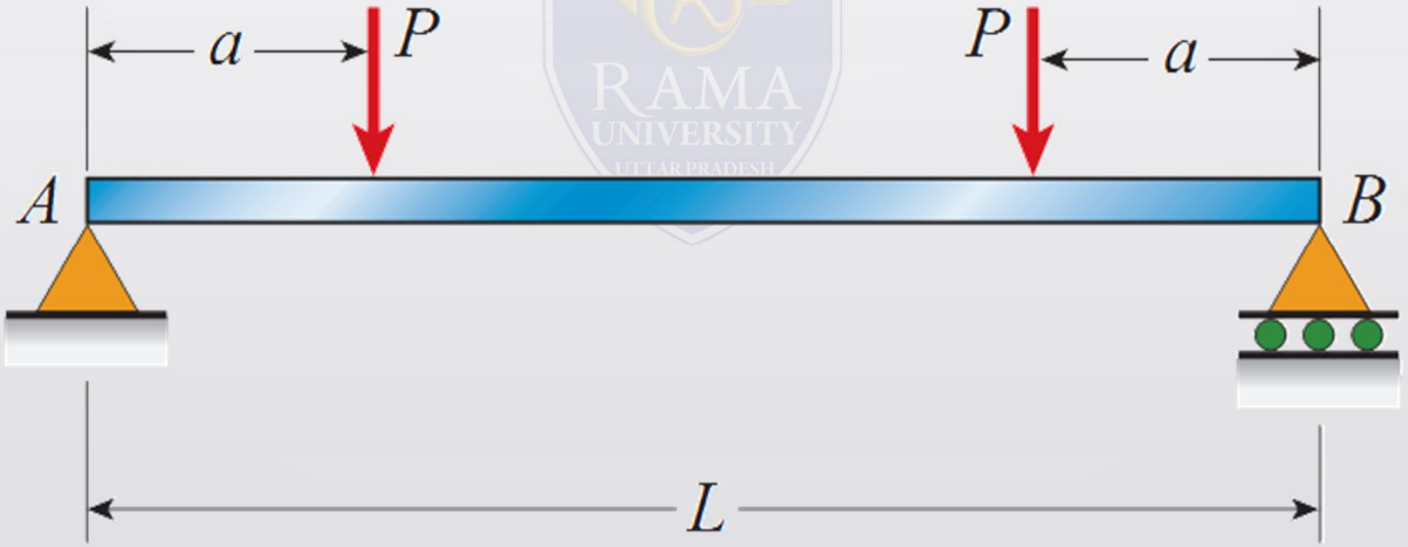
Several Concentrated Loads





Questions

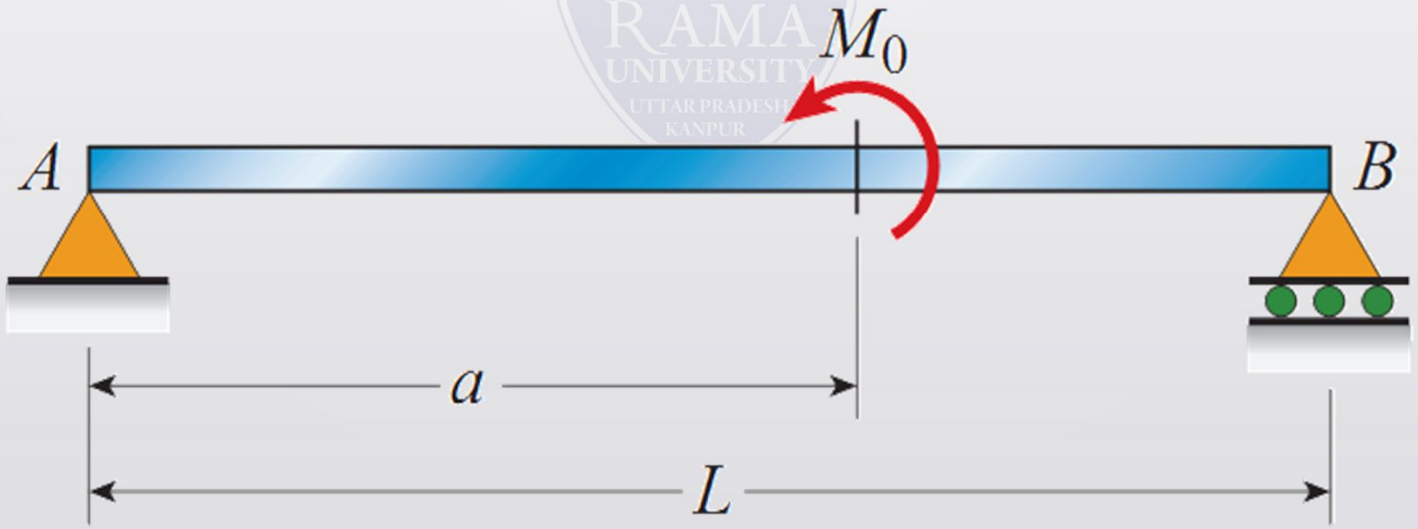
4.5-1 Draw the shear-force and bending-moment diagrams for a simple beam AB supporting two equal concentrated loads P (see figure).



Questions

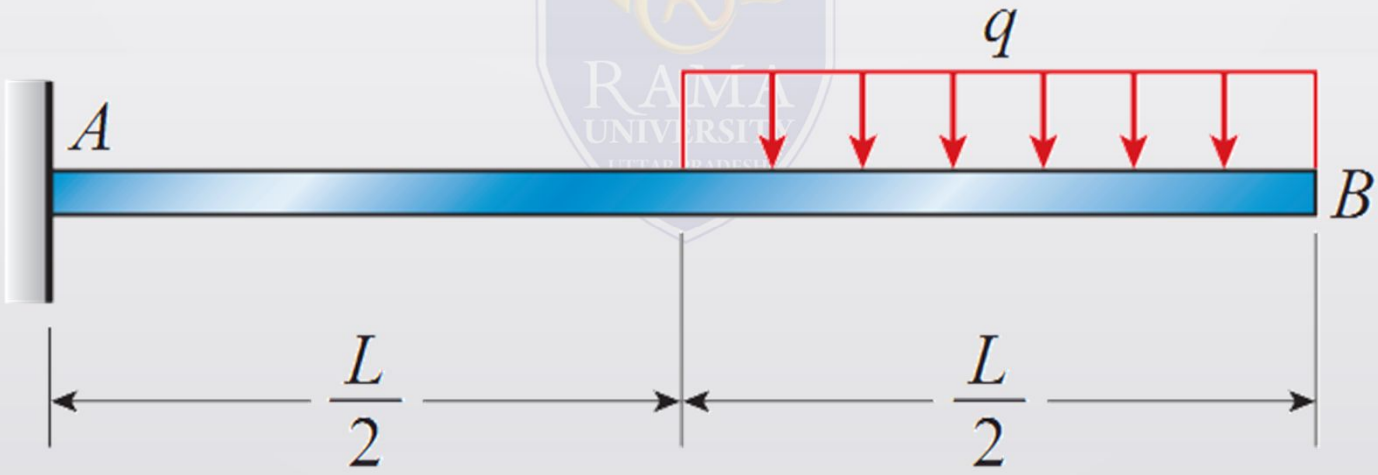
4.5-2 A simple beam AB is subjected to a counterclockwise couple of moment M_0 acting at distance a from the left-hand support (see figure).

Draw the shear-force and bending-moment diagrams for this beam.



Questions

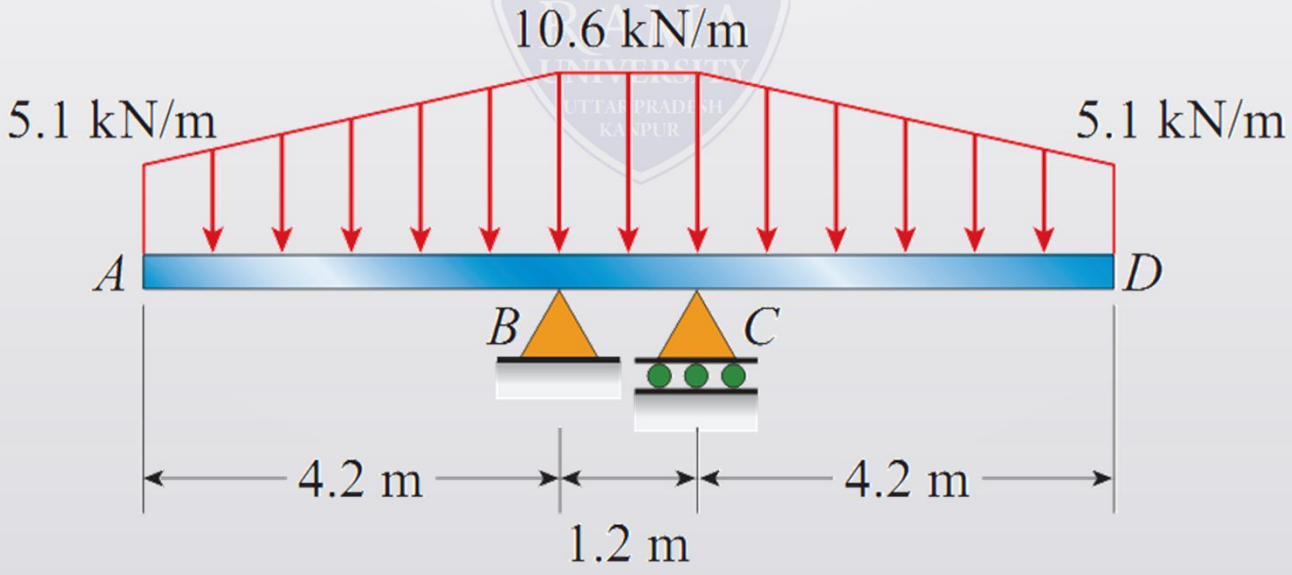
4.5-3 Draw the shear-force and bending-moment diagrams for a cantilever beam AB carrying a uniform load of intensity q over one-half of its length (see figure).



Questions

4.5-22 The beam *ABCD* shown in the figure has overhangs that extend in both directions for a distance of 4.2 m from the supports at *B* and *C*, which are 1.2 m apart.

Draw the shear-force and bending-moment diagrams for this overhanging beam.



Questions

4.5-31 The beam shown below has a sliding support at A and an elastic support with spring constant k at B. A distributed load $q(x)$ is applied over the entire beam. Find all support reactions, then plot shear (V) and moment (M) diagrams for beam AB; *label* all critical V and M values and also the *distance* to points where any critical ordinates are zero.