

Shear and Moment Functions

- **Beams** are structural members that carry lateral loading (perpendicular to the bending axis).
- To design a beam, detailed knowledge of the variation of the axial force, A , shear force, V , and the bending moment, M , throughout the member is required.

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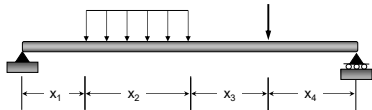
Shear and Moment Functions

- Typically, axial force is not considered since:
 1. in most cases, the loading is perpendicular to the beam and
 2. the beam's resistance to shear and bending moment is more critical.
- The variation of the shear force and bending moment along the beam may be written as a function of the position, x .

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Shear and Moment Functions

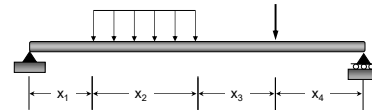
In general, the shear force and bending moment functions are discontinuous at points where the type and magnitude of the loading change.



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Shear and Moment Functions

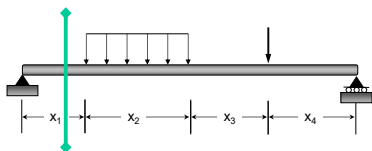
Therefore, the variation of the internal shear force and bending moment should be determined for each region between any two **discontinuities of loading**.



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Shear and Moment Functions

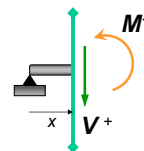
Consider the x_1



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Shear and Moment Functions

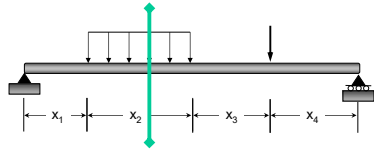
Consider the x_1



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Shear and Moment Functions

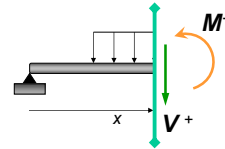
Consider the x_2



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Shear and Moment Functions

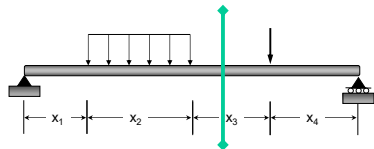
Consider the x_2



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Shear and Moment Functions

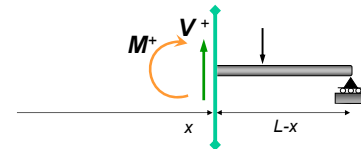
Consider the x_3



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Shear and Moment Functions

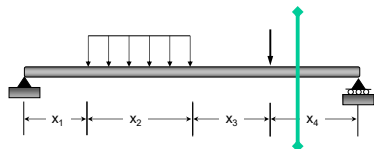
Consider the x_3



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Shear and Moment Functions

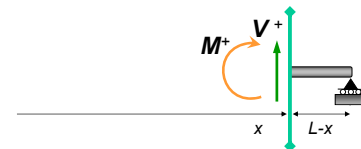
Consider the x_4



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Shear and Moment Functions

Consider the x_4



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Shear and Moment Functions

Procedure for analysis - the variation of shear force and bending moment in a member is determined using the **method of sections**:

1. Determine the support reactions for the structure.

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Shear and Moment Functions

Procedure for analysis - the variation of shear force and bending moment in a member is determined using the **method of sections**:

2. Keeping all external loadings in their exact locations, make an imaginary "cut" through the member at a point within the region where the shear and moment functions are desired.

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Shear and Moment Functions

Procedure for analysis - the variation of shear force and bending moment in a member is determined using the **method of sections**:

3. Draw the corresponding free-body diagram of one of the "cut" segments indicating the unknown reactions V and M acting in their positive (+) directions

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Shear and Moment Functions

Procedure for analysis - the variation of shear force and bending moment in a member is determined using the **method of sections**:

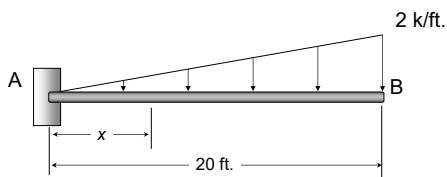
4. Apply the equations of equilibrium.

The moment equation should be summed at the cut section.

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Shear and Moment Functions

Example: Consider the following beam

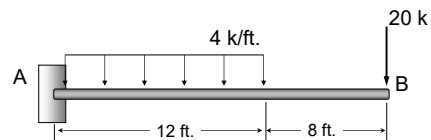


Determine the internal shear force and bending moment as a function of x

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Shear and Moment Functions

Example: Consider the following beam

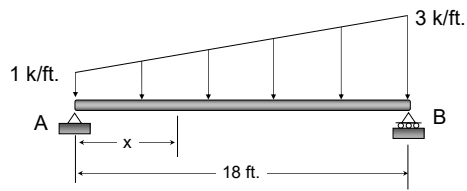


Determine the internal shear force and bending moment as a function of x

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Shear and Moment Functions

Example: Consider the following beam

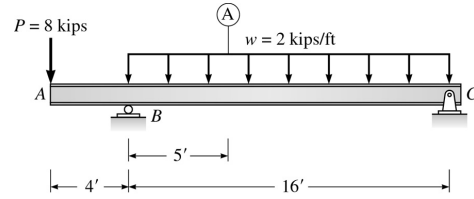


Determine the internal shear force and bending moment as a function of x

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Shear and Moment Functions

Example: Consider the following beam

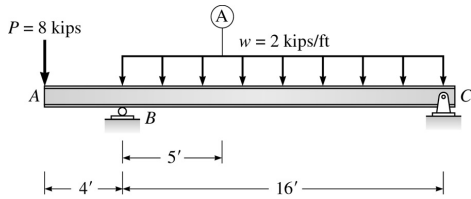


1. Determine the internal shear and moment as a function of x using an origin at end A and evaluate the moment at section A.

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Shear and Moment Functions

Example: Consider the following beam

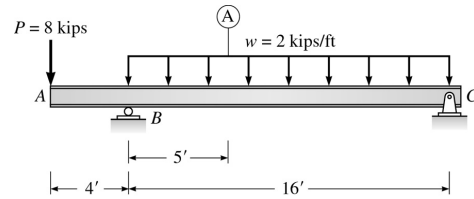


2. Locate the point of zero shear between B and C.

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Shear and Moment Functions

Example: Consider the following beam



3. Evaluate the maximum moment between B and C.

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End of Internal Loads – Part 2

Any questions?



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