

Internal Loads

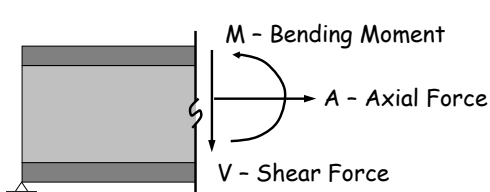
- Internal Loadings Developed in Structural Members
- Before a structural member can be sized or designed, the forces and moments that act on the member must be determined.
- In this section, we will develop methods to calculate the forces and moment at any point along the member's axis.

Internal Loads

- **Internal Loadings at a Specified Point**
- In general, the internal load at a specified point can be determined by the *method of sections*
- Typically, coplanar structures are subject to internal loadings that may consist of an axial force A , a shear force V , and the bending moment M

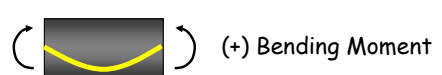
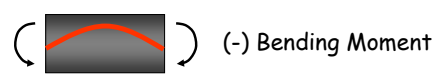
Internal Loads

- **Internal Loadings at a Specified Point**



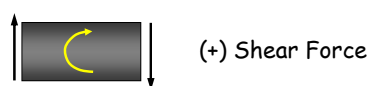
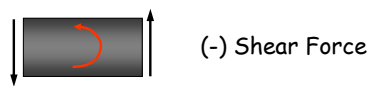
Internal Loads

- **Internal Loadings at a Specified Point**

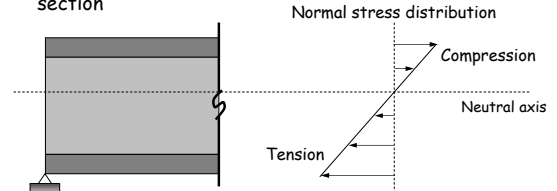
Internal Loads

- **Internal Loadings at a Specified Point**

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- **Internal Loadings at a Specified Point**
- These three types of loadings are used to represent the *stress distribution* acting over the member cross-section



Internal Loads

▪ **Procedure for analysis** - the following is a procedure for determining the internal forces in a member using the method of sections:

1. Before the member is "cut" or sectioned, determine the support reactions for the structure.
2. Keeping all external loadings in their exact locations, make an imaginary "cut" through the member at the point where the internal loading is desired.

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

Internal Loads

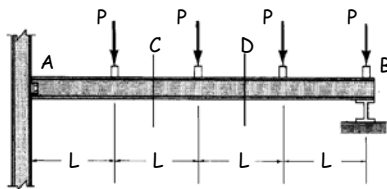
▪ **Procedure for analysis** - the following is a procedure for determining the internal forces in a member using the method of sections:

3. Apply the three equations of equilibrium.

In most cases, the moment equation should be summed at the cut section about the *centroid* of the member cross-section to eliminate the unknowns A and V .

Internal Loads

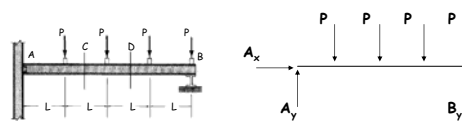
▪ **Example:** Consider the following beam



Determine the shear and moment in the floor girder at points C and D (both points are at the center of each span L (see page 19 in notes).

Internal Loads

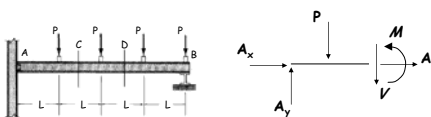
▪ **Example:** Consider the following beam



$$\begin{aligned} \sum M_A = 0 &= -P(L + 2L + 3L + 4L) + B_y(4L) & B_y &= 2.5P \\ \sum F_y = 0 &= A_y + B_y - 4P & A_y &= 1.5P \\ \sum F_x = 0 &= A_x \end{aligned}$$

Internal Loads

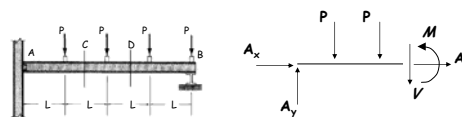
▪ **Cut the beam at point C**



$$\begin{aligned} \sum M_{cut} &= M + P\frac{L}{2} - A_y\frac{3L}{2} & M &= 1.75PL \\ \sum F_y = 0 &= A_y - V - P & V &= 0.5P \\ \sum F_x = 0 &= A \end{aligned}$$

Internal Loads

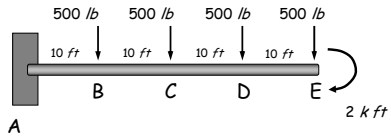
▪ **Cut the beam at point D**



$$\begin{aligned} \sum M_{cut} &= M + P\frac{L}{2} + P\frac{3L}{2} - A_y\frac{5L}{2} & M &= 1.75PL \\ \sum F_y = 0 &= A_y - V - P - P & V &= -0.5P \\ \sum F_x = 0 &= A \end{aligned}$$

Internal Loads

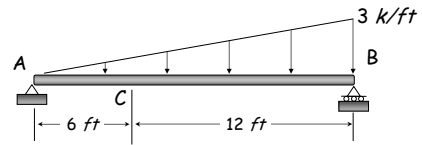
- Example: Consider the following beam



Determine the internal shear and moment in the cantilever beam shown above at a section passing through point C (see p. 20 in notes).

Internal Loads

- Example: Consider the following beam



Determine the internal shear and moment in the at a section passing through point C (see p. 21 in notes).

End of Internal Loads - Part 1

Any questions?

