Announcements

- In-class Written Quiz 4 (No CBTF) – Friday, October 26
  - 50 minutes: arrive early – we will start on time!
  - Must attend registered lecture section.
  - Bring student ID card.
  - Extra office hour by Dr. Richard Keane: Thu. (10/25), 7-10pm
  - DRES accommodations must be made with DRES office before Wednesday (10/24), schedule the quiz for Friday (10/26) afternoon.
  - Conflict quiz must be scheduled before Wednesday (10/24) upon excused absence request approval.

- Upcoming deadlines:
  - Tuesday (10/23)
  - PL HW
Recap: Internal Forces and Moment

- Normal Force (N)
- Shear Force (V)
- Bending Moment (M)
Determine the normal force, shear force, and bending moment at C of the beam.

2. FBD (no distributed loads)

\[ F_E = (600 \text{N/m})(1.5 \text{m}) \frac{1}{2} \]

\[ \Sigma F_x = -N = 0 \]
\[ \Sigma F_y = V - F_R = 0 \]
\[ \Sigma M_c = -M - F_R (0.5 \text{m}) = 0 \]
Determine the normal force, shear force, and bending moment at C.

1) \[ F_{EoE} \]
   \[ \Sigma F_x = \sum A_x = 0 \]
   \[ \Sigma F_y = A_y - F_x + B \]
   \[ \Sigma M_A = -F_x(6 \cos 45^\circ + 3) + B(6 \cos 45^\circ + 6) = 0 \]

2) \[ F_{EoE} \]
   \[ \Sigma F_x' = A_x \cos 45^\circ - A_y \sin 45^\circ + N = 0 \]
   \[ \Sigma F_y' = A_x \sin 45^\circ + A_y \cos 45^\circ - V = 0 \]
   \[ \Sigma M_A' = -V(2m) + M = 0 \]
Shear and Moment Diagram

Beams: structural members designed to support loadings applied perpendicular to their axes.

Simply supported beam

Cantilever beam
Shear and Moment Diagram

**Goal:** provide detailed knowledge of the variations of internal loadings (V and M) throughout the beam

**Procedure**
1. Find support reactions (free-body diagram of entire structure)
2. Specify coordinates $x$
3. Divide the beam into regions
4. Draw FBD of a segment
5. Apply equations of equilibrium to derive $V$ and $M$ as functions of $x$

$\Rightarrow$ Repeat steps 4 & 5 for each "region" from step 3.
Shear and Moment Diagram

Draw the shear and moment diagrams for the beam.

1) Find reaction support:

\[ \Sigma F_y = A_y - 7\text{kN} + B = 0 \]
\[ \Sigma M_A = (-7\text{kN})(2\text{m}) - 12\text{kN}\cdot\text{m} + B(8\text{m}) = 0 \]

\[ B = \frac{26\text{kN}}{8} = \frac{13}{4}\text{kN} \]
\[ A_y = (7 - \frac{26}{8})\text{kN} = \frac{15}{4}\text{kN} \]

EoE
\[ \Sigma F_y = Ay = V(\text{x}) \]
\[ \Sigma M_A = -V_x + M_i = 0 \]
\[ M_1 = V_i \cdot x = \left[ A_y \cdot x = M_1(x) \right] \]

- Find the value of \( M_1 \) at \( x = 2m \):
  \[ M(2m) = \frac{15}{4} (2) \text{ kN} \cdot \text{m} \]

\[ \Sigma F_y = A_y - 7 \text{ kN} - V_2 = 0 \]

\[ V_2 = A_y - 7 \text{ kN} = \frac{-13}{4} \text{ kN} \]

\[ \Sigma M_A = -(7 \text{ kN})(2m) - V_2 x + M_2 = 0 \]

\[ M_2 = 14 \text{ kN} \cdot \text{m} + \left(\frac{-13}{4}\right)x \]

- Find \( M_2 \) at \( x = 2m \) and \( x = 4m \):
  \[ M_2(2m) = 14 - \frac{13}{4} (2) = \frac{15}{2} \text{ kN} \cdot \text{m} \]
  \[ M_2(4m) = 14 - \frac{13}{4} (4) = 1 \text{ kN} \cdot \text{m} \]