A.) Locate and calculate the maximum bending stress

B.) Calculate maximum deflection at point P

A.) Assume load P is centered along the longitudinal axis of the beam (i.e., no torsion), and the body and load are static.

**Free Body Diagram**

\[ \sum F_x = 0 \]
\[ \sum F_y = 0 = V - P \quad \therefore V = P = 50.0 \text{ lbs} \]
\[ \sum M_A = 0 = M - (Q)P \quad \therefore M = (Q)P = 7,000'' \times 50.0 \text{ lbs} = 350 \text{ in-lbs} \]

**Shear and Bending Moment Diagrams**

Shear:

\[ V = 50.0 \text{ lbs} \]

Bending Moment:

\[ M = -350 \text{ in-lbs} \]

Moment @ B is zero.
**Maximum Bending Stress:**

\[ \sigma = \frac{Mc}{I} \quad c = 0.15'' = \text{max distance to neutral axis} \]

\[ I = \frac{bh^3}{12} - \frac{bh_1 h_1}{12} = \frac{1}{12} - \frac{0.5bh_1}{12} \]

\[ I = 0.0345 \text{in}^4 \]

Since bending stress is directly proportional to the magnitude of the bending moment \( M \), the maximum bending stress will be at point \( A \) on the top (tensile) and bottom (compressive) edges of the beam.

\[ \sigma_{\text{max}} = \frac{Mc}{I} = \frac{(350 \text{ in} \cdot \text{lb}) (0.5'')} {0.0345 \text{in}^4} = 5070 \text{ psi} \]

**B. From beam tables, we have the equation for deflection of a cantilevered beam:**

\[ S_{\text{max}} = \frac{PL^3}{3EI} \]

\[ P = 50,0 \text{ lb} \]
\[ L = 7.000'' \]
\[ E = 29 \text{ Mpsi} \leftarrow \text{from table in Norton, 2nd Ed.} \]
\[ I = 0.0354 \text{in}^4 \]

\[ S_{\text{max}} = \frac{(50.0 \text{ lb}) (7.000)^3} {3 (29 \times 10^6 \text{psi}) (0.0354 \text{in}^4)} = 0.00557 \text{in} \]