Problem:

A rectangular box beam has the dimensions shown and is subjected to a vertical shear force \( V = 60 \) kN. Determine the web shear stresses \( \tau_A \) and \( \tau_B \) at the locations A and B indicated in the figure.

Solution:

The centroidal principal moment of inertia of the beam section is

\[
I_{zz} = \frac{150 \times 250^3}{12} - \frac{126 \times 226^3}{12} = 74109152 \text{ in}^4
\]

The first moment areas of the locations A and B are

\[
(Q_z)_A = (75 \times 12) \times (125 - 6) = 107100 \text{ mm}^3
\]
\[
(Q_z)_B = 107100 + (125 - 12) \times 12 \times \left( \frac{125 - 12}{2} \right) = 183714 \text{ mm}^3
\]

The shear stresses at the locations A and B are

\[
\tau_A = \left( \frac{V_y \times Q_z}{t \times I_{zz}} \right)_A = \frac{60 \times 10^3 \times 107100}{12 \times 74109152} = 7.225 \text{ MPa}
\]
\[
\tau_B = \left( \frac{V_y \times Q_z}{t \times I_{zz}} \right)_B = \frac{60 \times 10^3 \times 183714}{12 \times 74109152} = 12.395 \text{ MPa}
\]