\textbf{Mohr's Circle - Multiply all \#s x 10^6}

\[I_{x1} = 68.96 \times 10^6 \text{ mm}^4 \quad I_{y1} = 132.48 \times 10^6 \text{ mm}^4 \quad I_{x1y1} = -21.6 \times 10^6 \text{ mm}^4\]

\[I_{av} = \frac{I_x + I_y}{2} = \frac{68.96 + 132.48}{2} = 100.72\]

\[\tan \gamma = \frac{21.6}{100.72 - 68.96} = 0.6801 \quad \gamma = \frac{34.2196^\circ}{\text{or} 34.22^\circ}\]

\[R = \sqrt{(100.72 - 68.96)^2 + 21.6^2} = 38.41\]

\[I_{max} = I_{av} + R = 100.72 + 38.41 = 139.13\]
\[I_{min} = I_{av} - R = 100.72 - 38.41 = 62.31\]

\[\begin{cases} I_{max} = 139.13 \times 10^6 \text{ mm}^4 \\ I_{min} = 62.31 \times 10^6 \text{ mm}^4 \end{cases}\]
\[ I_{xx0} = 38.41 \cos 4^\circ 22' = 38.30 \]
\[ b = 38.41 \cos 4^\circ 22' = 38.30 \]

\[ I_{x30} = I_{xx0} + a = 100.72 + 2.83 = 103.55 \]
\[ I_{y30} = b = -38.30 \]

**Orientation of Principal Axes from Circle**

\[ \tan \beta = \frac{I_{max} - I_y}{I_{xy}} = \frac{139.13 - 132.48}{21.6} = \frac{6.65}{21.6} = 0.3079 \]

\[ \beta = 17.11^\circ \]

\[ \tan \beta = \frac{I_{xy}}{I_{ymin}} = \frac{21.6}{132.48 - 62.31} = \frac{21.6}{70.17} = 0.3078 \]

\[ \beta = 17.11^\circ \]

Note that these are the same answers we got for problem 10.86.

Final step is to go back to cross section sketch and draw orientation of Principal Axes.