Torsional rigidity

Torsional Rigidity

Torsional Rigidity (or) stiffness of the shaft is defined as the product of modulus of rigidity and polar moment of inertia of the shaft.

i.e., Torsional Rigidity= GJ

3.1.7 Value of section modulus for a solid circular section and Hollow circular section

Section modulus

To calculate the section modulus, the following formula applies:

$Z = I/y$.

where I = moment of inertia, y = distance from centroid to top or bottom edge of the rectangle (d/2)

For symmetrical sections the value of Z is the same above or below the centroid.

For asymmetrical sections, two values are found: Z max and Z min.

To calculate the value of Z for a simple symmetrical shape such as a rectangle:

An equation: $Z_{xx} = I_{xx}/y$. where An equation: $I_{xx} = bd^3/12$ which equals mm^4. And y = An equation: ½ depth or d divided by 2 mm.

This gives the formula for Z as: An equation: $Z = bd^2/6$ mm^3.

Note: The standard form of writing the value of Z is to write it as a number x 10^3 mm^3, e.g a value of 2,086 is written as 2.086 x 10^3.

Let us see section modulus

Section Modulus, Z = I/r

i) For a Solid circular section,

Z = $$\frac{\frac{\pi}{32}D^4}{D/2} = \frac{\pi}{16}D^3$$

ii) For a Hollow circular section

$$J = \frac{\pi}{32}(D^4 - d^4), \quad R = \frac{D}{2}$$

$$Z = \frac{\pi}{32}(D^4 - d^4) \times \frac{2}{D} = \frac{\pi}{16D}(D^4 - d^4)$$