





# Elastic Twisting of Solid Noncircular Sections

The assumptions stated above for circular cross sections no longer apply for noncircular sections. Mainly, transverse cross sections warp during twisting of shafts with solid noncircular sections.

The theory of elasticity can be used to derive the formulas for  $\gamma$  and  $\phi$ . This is beyond the scope of this course.

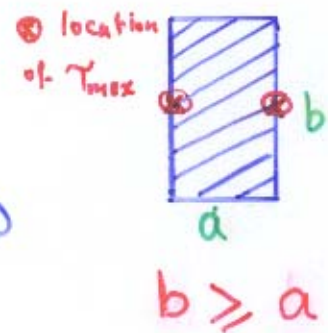
↓ for different noncircular shapes such as:

rectangle  ; triangle   
ellipse  ; thick-walled closed   
etc.

The formulas for rectangular cross sections will be stated below without proofs. For other shapes, one can see other references.

$$\tau_{max} = \frac{T}{\alpha b a^3}$$

←  $\tau_{max}$  only!  
at middle of long leg



$$\frac{d\phi}{dz} = \frac{T}{\beta b a^3 G}$$

$$\phi = \frac{TL}{\beta b a^3 G}$$

$\alpha$  and  $\beta$  are obtained from the table given, by knowing  $\frac{b}{a}$  ratio.

⊗ Very important:  $b \geq a \Rightarrow \frac{b}{a} \geq 1$