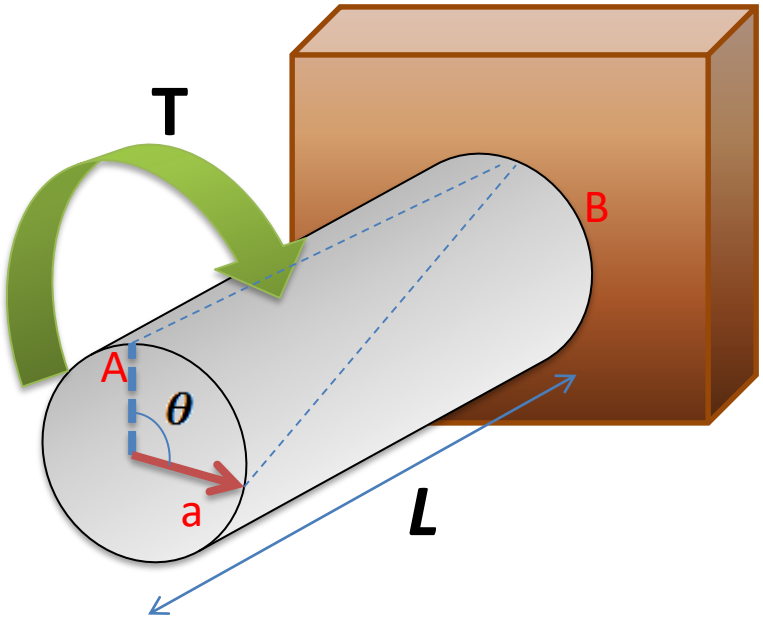
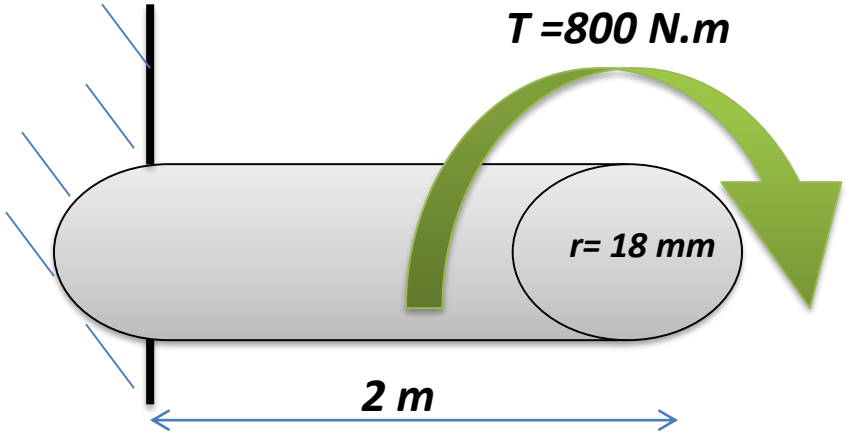
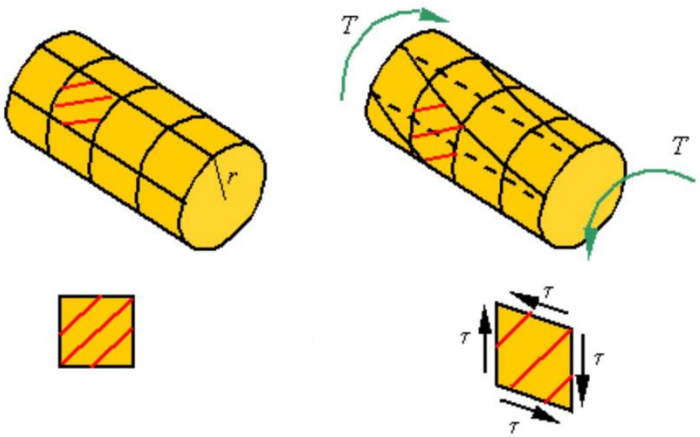

T
B
A
θ
a
L

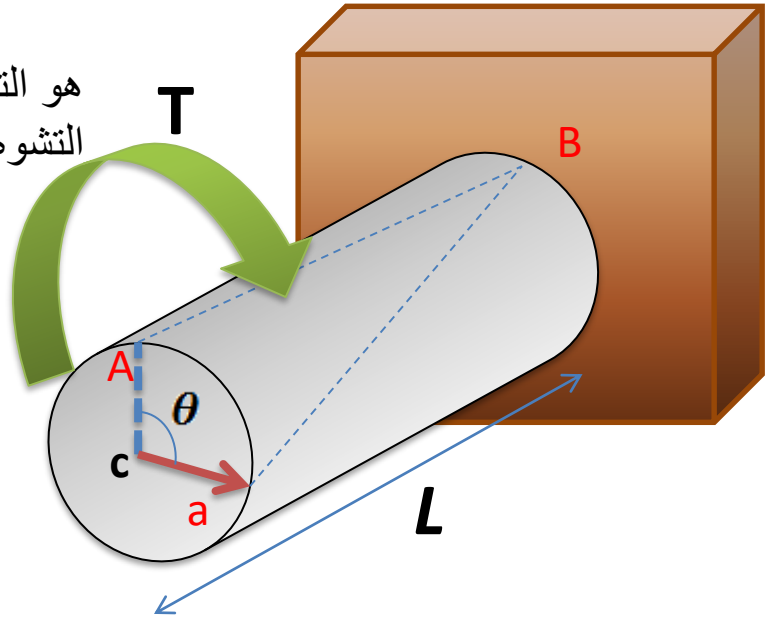

T =800 N.m
r= 18 mm
2 m

Torsion

Torsion :

هو التواء جسم ناتج عن عزم حول المحور الطولي للجسم. وإنه نوع من التشوه.

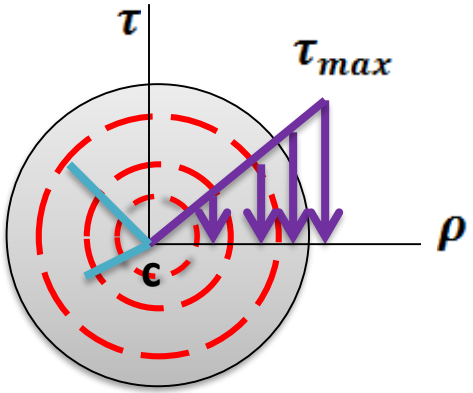




Shearing stress :

$$\tau = \frac{T\,\rho}{J}$$

$$\tau_{max} = \frac{T\,r}{J}$$



$$\tau_{max} = \frac{T\,r}{J}$$

$\tau_{max} = shearing\ stress(pa)$

$T = Torque\ (\ twisting\ moment\ )(N.m)$

$r = raduis\ of\ shaft\ (m)$

$J = polar\ moment\ of\ interia\ of\ scetion\ (m^4)$

J

Solid shaft

hollow shaft

$$J = \frac{\pi}{32} D^4$$

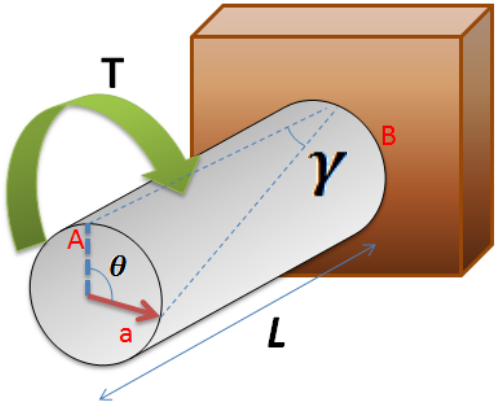
$$J = \frac{\pi}{32} (D^4 - d^4)$$

Angle of twist :

$$\theta = \frac{T\,L}{J\,G}$$

$rad.(3\pi, 5\pi, 20\pi)$

$deg.(°)(45°, 60°, 75°)$



$\theta = angle\ of\ twist(\ rad\ )$

$T = Torque\ (\ twisting\ moment\ )(N.m)$

$L = length\ of\ shaft\ (m)$

$J = polar\ moment\ of\ interia\ of\ scetion\ (m^4)$

$G = modulus\ of\ rigidity\ for\ material\ (Gpa)$

Shear strain :

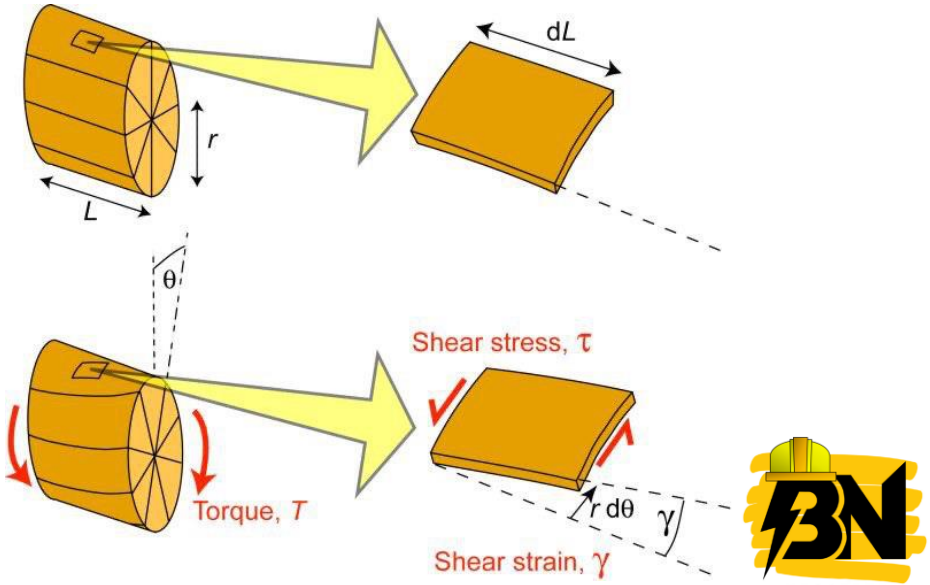
$$\gamma = \frac{r\theta}{L}$$

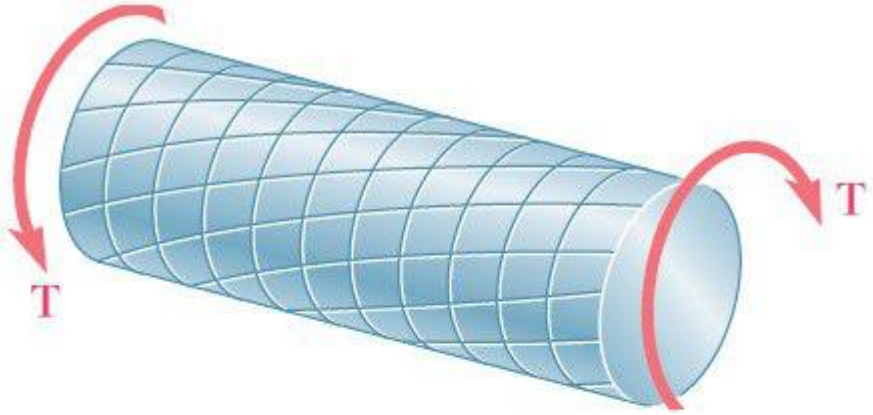
$\gamma = Shear\ strain$

$\theta = angle\ of\ twist(\ rad\ )$

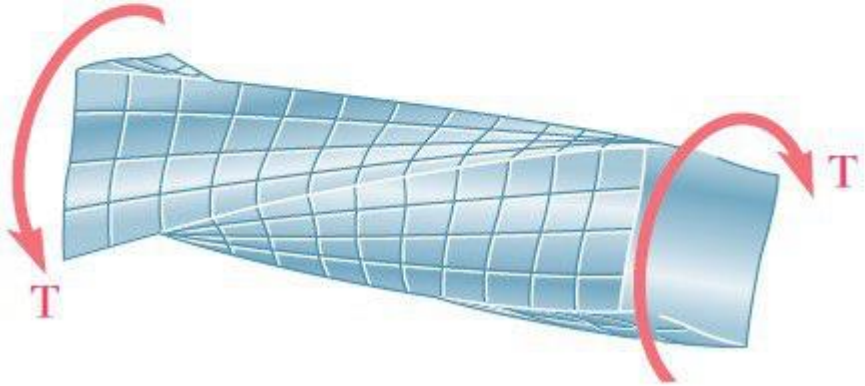
$r = raduis\ of\ shaft\ (m)$

$L = length\ of\ shaft\ (m)$





Axisymmetric



Not Axisymmetric

Power transmitted by the shaft : الطاقة المنقولة بواسطة العمود

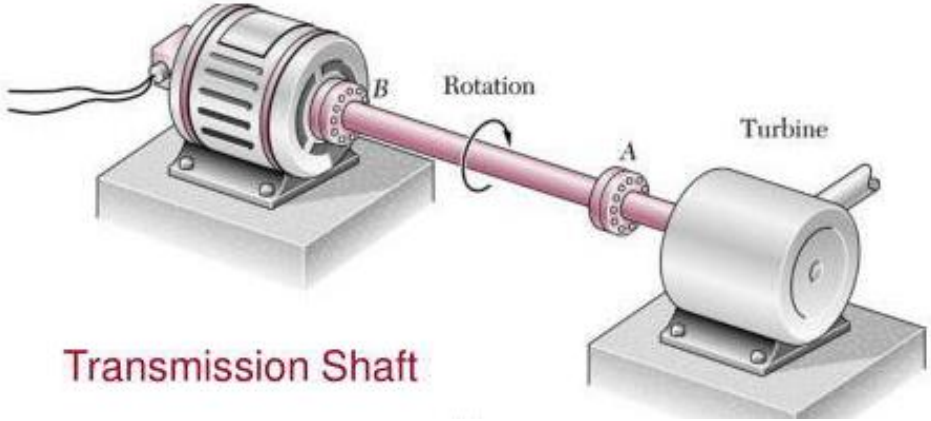
*A shaft rotating with a constant angular velocity (in radius per second) is being acted by a twisting moment (**T**) .*

عمود يدور بسرعة زاوية ثابتة (نصف قطر في الثانية) يتأثر عزم التواء (T).

$$P = W\,T$$

$$W = 2\pi f$$

$W = angular\ speed\ of\ rotation\ of\ the\ shaft$



$$P = 2\pi f\,T$$

$$HZ = \frac{1}{sec}\,(cycle\ per\ second)$$

$P = the\ power\ in\ watt\ (W)$

$f = is\ number\ of\ revloution\ per\ second\ (HZ)$

$T = Torque\ (\ twisting\ moment\ )(N.m)$

Shearing stress :

$$\tau_{max} = \frac{T\,r}{J}$$

$$J = \frac{\pi}{32} D^4$$

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

Power transmitted by the shaft :

$$P = 2\pi f\, T$$

Angle of twist :

$$\theta = \frac{T\,L}{J\,G}$$

Shear strain :

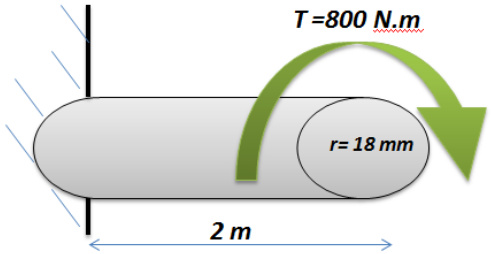
$$\gamma = \frac{r\theta}{L}$$

مثال //بالنسبة للعمود الأسطواني الموضح ، حدد الحد الأقصى. لإجهاد القص الناجم عن عزم الدوران ،اذ علمت ان معامل الصلابة هو G = 80Gpa، أوجد أيضًا زاوية الالتواء (deg.) وإجهاد القص في العمود الصلب؟

Sol:

$$\tau_{max} = \frac{T\,r}{J} = \frac{T(\frac{D}{2})}{\frac{\pi}{32}D^4}$$

$$\tau_{max} = \frac{16T}{\pi D^3}$$



$80Gpa$
$80x10^3 Mpa$
$80x10^3\ N/mm^2$

$$\tau_{max} = \frac{16(800x10^3)}{\pi(36)^3}\left(\frac{N.mm}{mm^3}\right) = 87.3\ N/mm^2$$

$$\tau_{max} = 87.3\ Mpa$$

$$\theta = \frac{T\,L}{G\,J}$$

$$\theta = \frac{(800x10^3)(2x10^3)}{(80x10^3)\left(\frac{\pi}{32}\right)(36)^4}\left(\frac{N.mm.\ mm}{\frac{N}{mm^2}.mm^4}\right)$$

$$\theta = 0.12\ rad$$

$$\theta = 0.12\left(\frac{180}{\pi}\right) = 6.87\ °$$

$$\gamma = \frac{r\theta}{L}$$

$$\gamma = \frac{18(0.12)}{2x10^3} = 108x10^{-5}$$