Tensile Stress (Ch 25)

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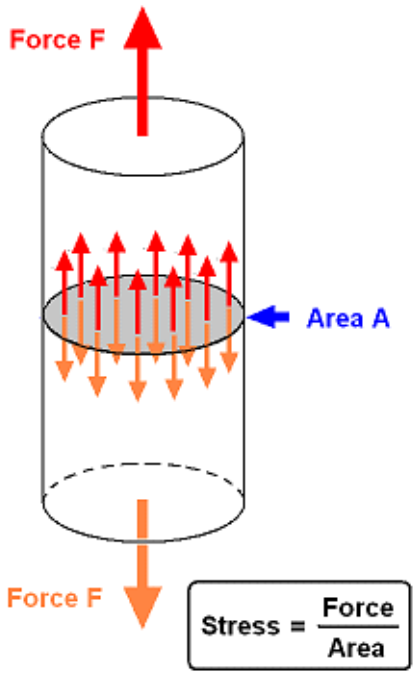


Stress = Force / Area
(MPa) (N) (mm^2)

$f = F / A$ (Ivanoff, p320)

$\sigma = F / A$ (rest of the world)

Engineers like to use mm when working with stress so they automatically get answer in MPa.

Imagine the part breaks - this is the area you should use to calculate stress.

Tension or Compression (Axial Stresses)

Ivanoff: f_t or f_c

World: σ (Sigma)

Shear Stress:

Ivanoff: f_s

World: τ (Tau)

Problem Q25.2 (p322) Diam = 12mm, F = 14.7 kN. Find stress.

Stress = F/A

(Mpa) = (N) / (mm^2)

= 14.7*1000 / (pi*6^2)

= 130 MPa

Q25.4 Find diameter of copper wire that broke at 264N

Stress = F/A

(Mpa) = (N) / (mm^2)

A = Stress / F

From p319, UTS copper = 415 Mpa

A = F / Stress

A = 264 / 415 = 0.6361 mm^2

Pi * r^2 = 0.6361 mm^2
r^2 = (0.6361/Pi) = 0.202477
So r = 0.202477^0.5 = 0.449974 mm
Diameter = 0.449974*2 = 0.9000 mm

Q25.5 10mm diameter, load = 32.6kN. What force to break 1.5mm diam?
Stress = F / A = 32.6*1000/(pi*5^2) = 415.076 Mpa
Stress = F / A
F = Stress * A = 415.076 * (pi*0.75^2) = 733.5 N

Factor of Safety (p321)

How many times you could multiply the *working stress* before it breaks.
FS = ultimate strength / working strength

Q 25.9: A MS bar 20x30mm, under 141 kN. What is FS?
UTS MS = 470MPa (Table 25.1, p319)
Find working stress;
Stress = F/A = 141000 / (20 * 30) = 235 Mpa
FS = ultimate strength / working strength
FS = 470 / 235 = 2

Compressive Stress (Ch 26)

Questions 26:1 to 26:5 (Read Chapter 26.1-2: Compressive Stress)

Exactly the same as tensile stress. Compressive stress is higher.

Q25.2 Concrete Diam = 150mm, F = 433kN. Find stress.

Stress = F/A

(Mpa) = (N) / (mm^2)

= 433000/(pi*75^2)

= 24.5 MPa

Factor of Safety (p321)

How many times you could multiply the *working stress* before it breaks.

FS = ultimate strength / working strength

Q 25.9: A MS bar 20x30mm, under 141 kN. What is FS?
UTS MS = 470MPa (Table 25.1, p319)

Find working stress;
Stress = F/A = 141000 / (20 * 30) = 235 Mpa
FS = ultimate strength / working strength
FS = 470 / 235 = 2

Shear Stress (Ch 27)

Questions 27:1 to 27:16 (Read Chapter 27.1-2: Shear Stress)

SHEAR = sliding apart.
Same equation, different way of applying force. Watch out for area!
For metals, this is usually the lowest of the 3 types of stress.

Stress = Force / Area
(MPa) (N) (mm^2)

$f_s = F / A$ (Ivanoff, p344)

$\tau = F / A$ (rest of the world)

Example 27.1 p343
Punch out 12mm diameter in MS plate 6mm. What force required?

From p342, ultimate shear stress (USS) = 360MPa
f = F/A
(Mpa) = (N) / (mm^2)
F = f *A
= 360 * (pi*12*6)
= 81430 N
= 81.43 kN

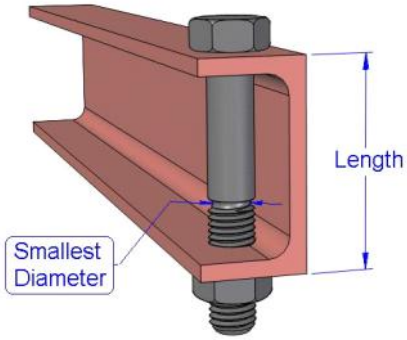
A lap joint is held by a 34 mm diameter bolt. If the force across the joint is 13 kN, what is the shear stress in the bolt? (Ignore the friction effect of tightening the bolt)

Area in shear? CSA of bolt. (Cross-sectional area)
Area = pi*17^2 = 907.92 mm^2
Stress = F/A
= 13000/ 907.92
= 14.3184 Mpa

Test Examples

Tuesday, 7 February 2012
6:10 PM

Q9: A grade 8.8 bolt has a minimum diameter of 13mm. If if must withstand 16kN, what is the Factor of Safety over breakage?



UTS = 800MPa

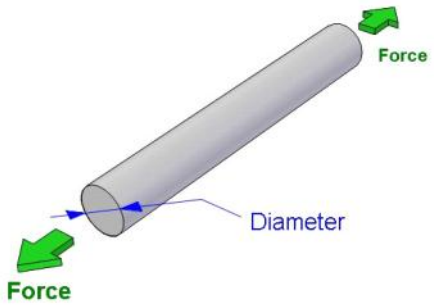
Working Stress: $\sigma = F / A$

Area = Pi * (13/2)^2 = 132.73mm^2

Stress = 16000 / 132.73 = 120.55 MPa

F of S = 800/120.55 = 6.6363

Q11: The tensile working stress of a brass bar is 90Mpa. What diameter is needed to withstand 5.4kN?



WS = 90MPa

Working Stress: $\sigma = F / A$

$A = F / \sigma$

Area = 5400 / 90 = 60 mm^2

Find diam?

A = Pi*R^2

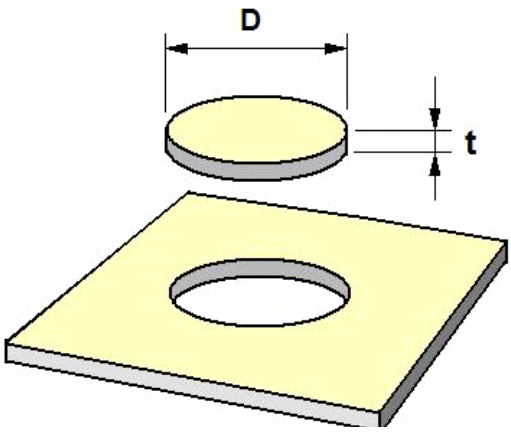
R = (A/Pi)^0.5

= (60 /Pi)^0.5 = 4.3702 mm

Diam = 4.3702*2 = 8.7404 mm

(BTW: 5400N = 5400/9.81 = 550.4587 kg)

Q14: It took a force of 25kN to punch a 19mm diameter hole in a 3.7mm steel plate. What was the shear stress?



Find shear stress

Shear Stress: $\tau = F / A$

A = Circum * thickness

= Pi * 19 * 3.7 = 220.854 mm^2

Stress = 25 * 1000 / 220.854 = 113.197 MPa

A = Circum * thickness

= Pi * 19 * 3.7 = 220.854 mm^2

Stress = 25 * 1000 / 220.854 = 113.197 MPa