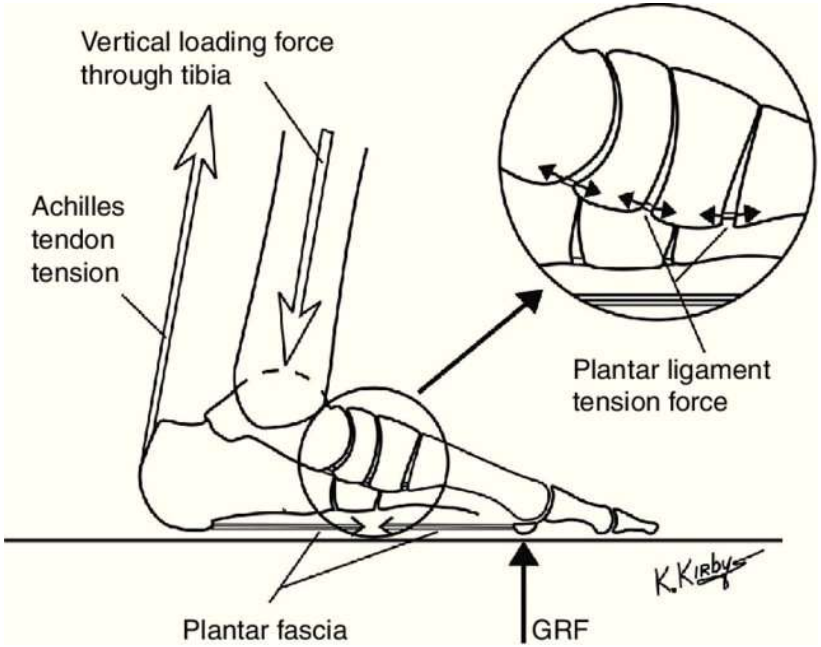
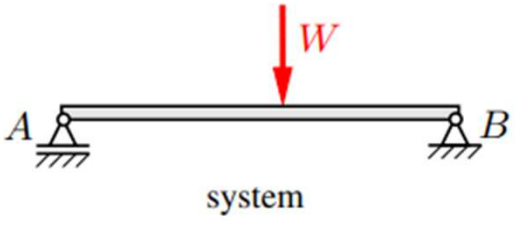
Today's Session Summary

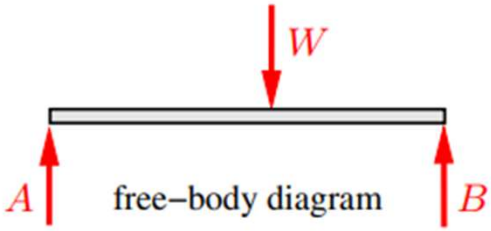
- Mechanics of materials
- Traction test
- Compression test
- Torsion test

Internal Forces vs External Forces

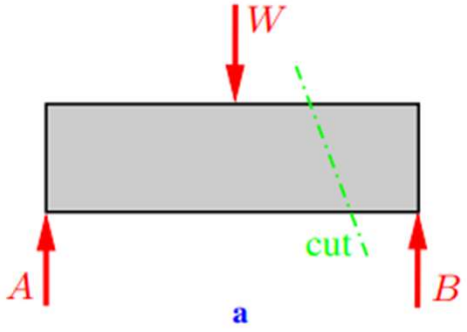


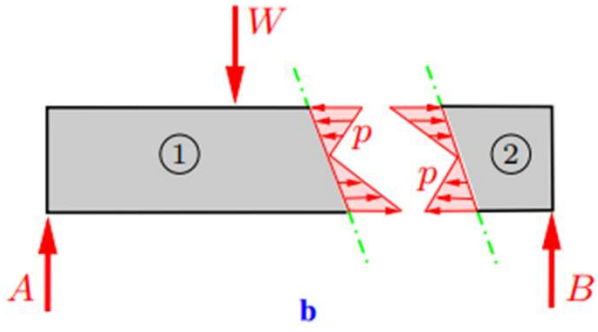
Kirby, Kevin. (2017). Longitudinal arch load-sharing system of the foot. Revista Española de Podología. 10.1016/j.repod.2017.03.003.





Bodies





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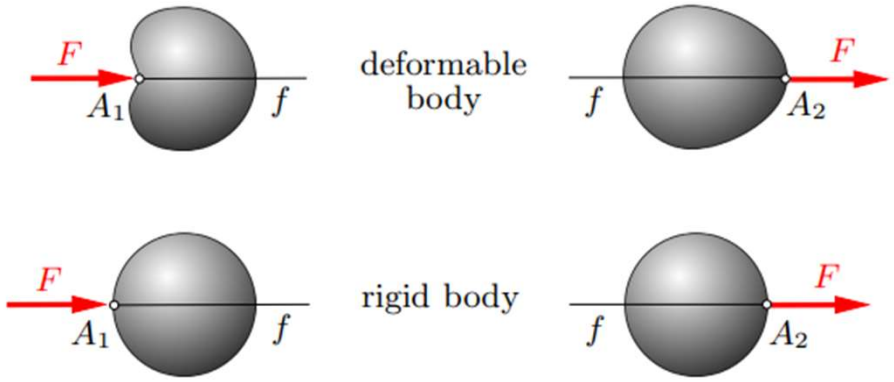
Rigid bodies vs Deformable bodies

Deformable Bodies

Rigid Bodies



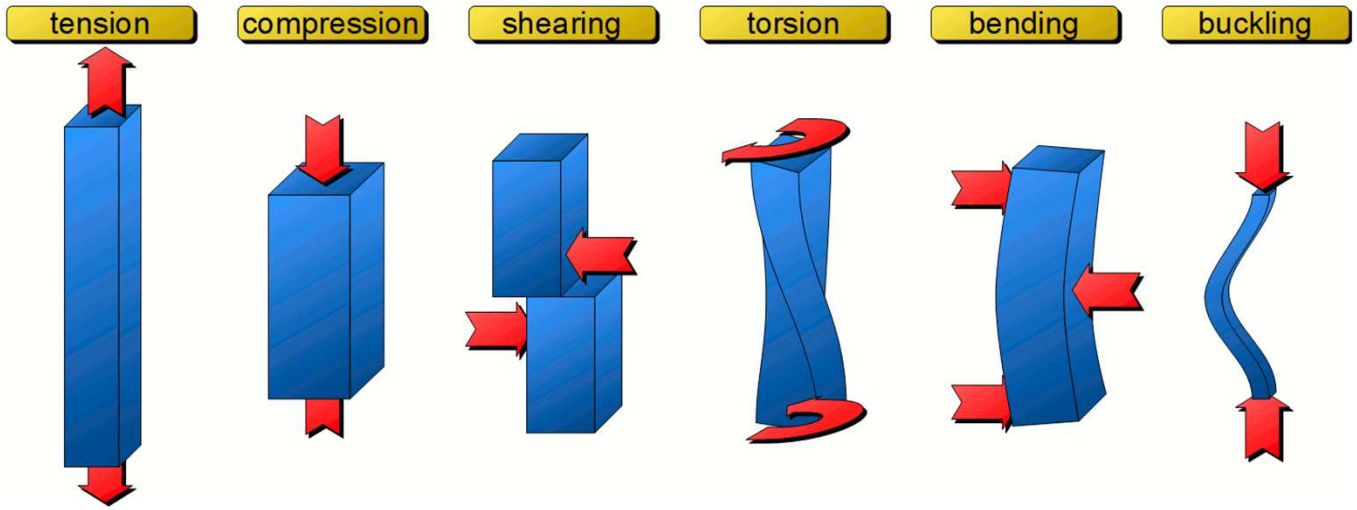
Engineering Mechanics 1: Statics 2nd ed. 2013 Edición
de Dietmar Gross, Werner Hauger, Jörg Schröder, Wolfgang A. Wall, Nimal Rajapakse.

Rigid bodies vs Deformable bodies

Internal Forces

Stresses

Strains



Engineering Mechanics 1: Statics 2nd ed. 2013 Edición
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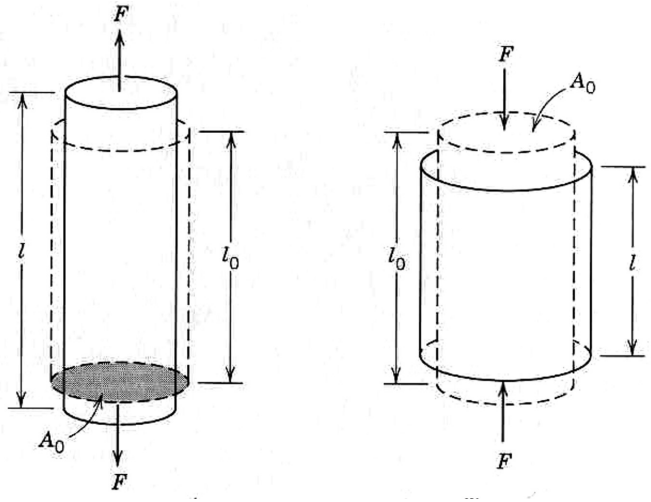
Axial Stresses

Stress - Strains – Constitutive relations

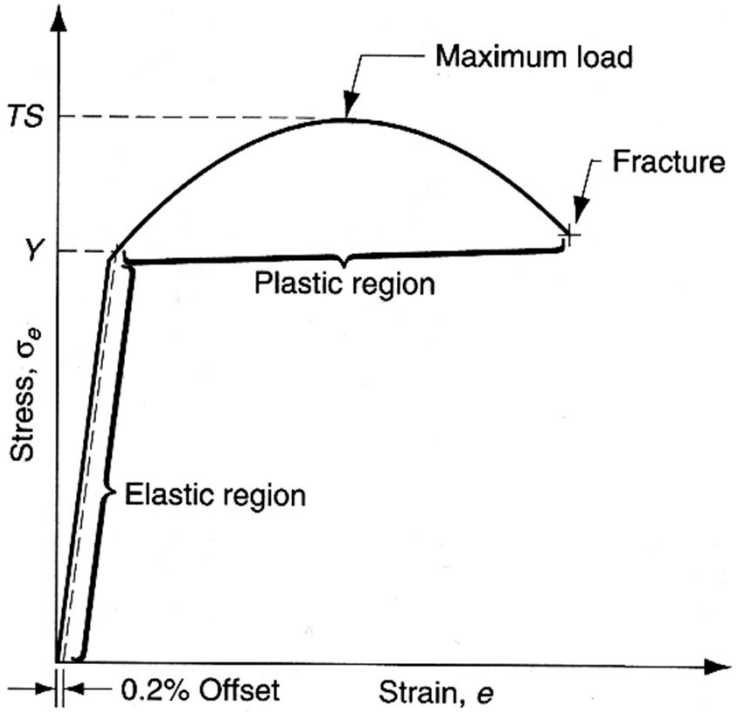
$$\varepsilon = \frac{l - l_0}{l_0}$$

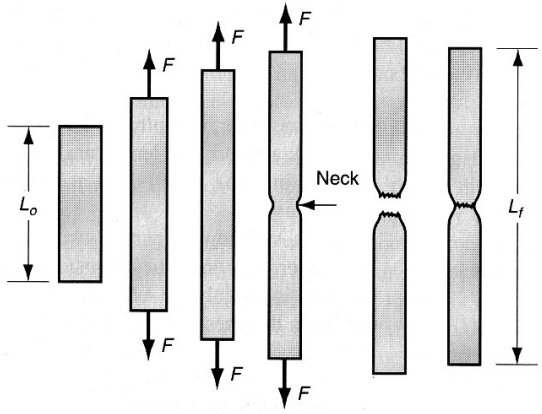
$$\sigma = \frac{F}{A_0}$$

$$\sigma = f(\varepsilon)$$



Tensile Test





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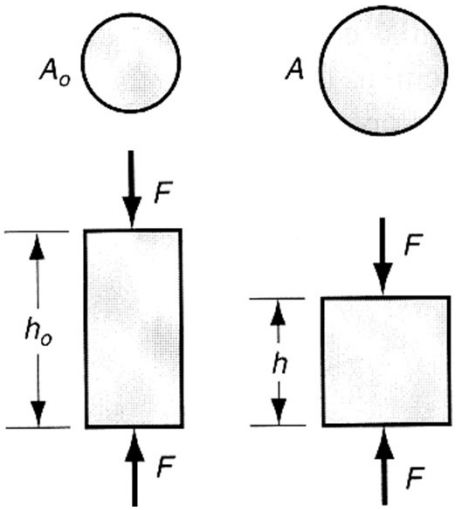
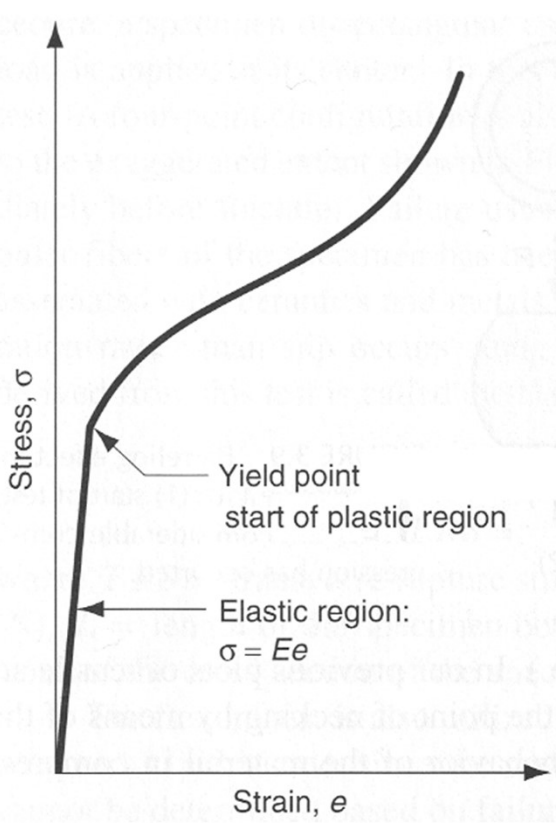
Compression Test





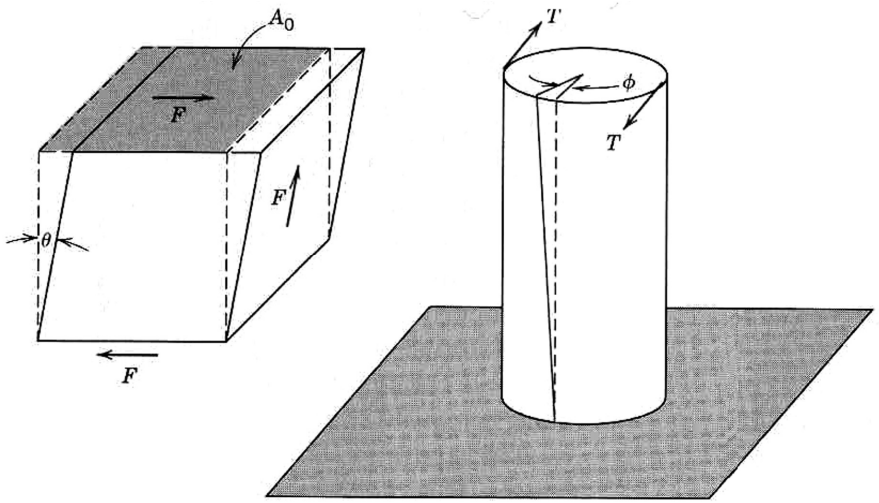
Shear Stresses

Stress - Strains – Constitutive relations

$$\gamma = 2\theta$$

$$\tau = \frac{F}{A_0}$$

$$\tau = f(\gamma)$$

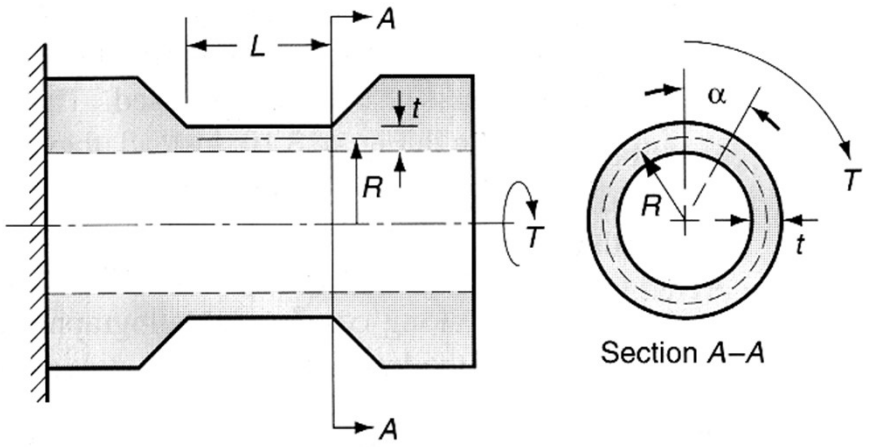


$$\gamma = \frac{r\phi}{h}$$

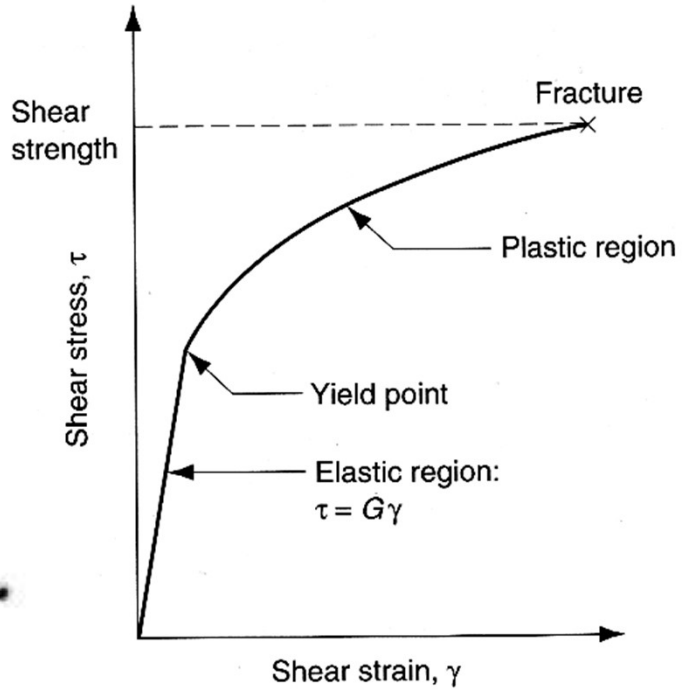
$$\tau \propto T$$

$$\tau = f(\gamma)$$

Torsion Test



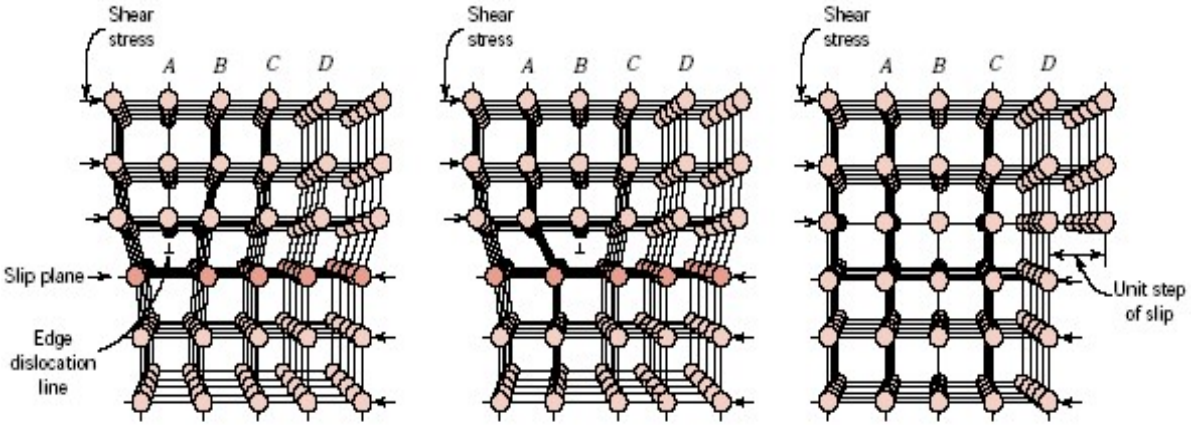
Torsion test setup.

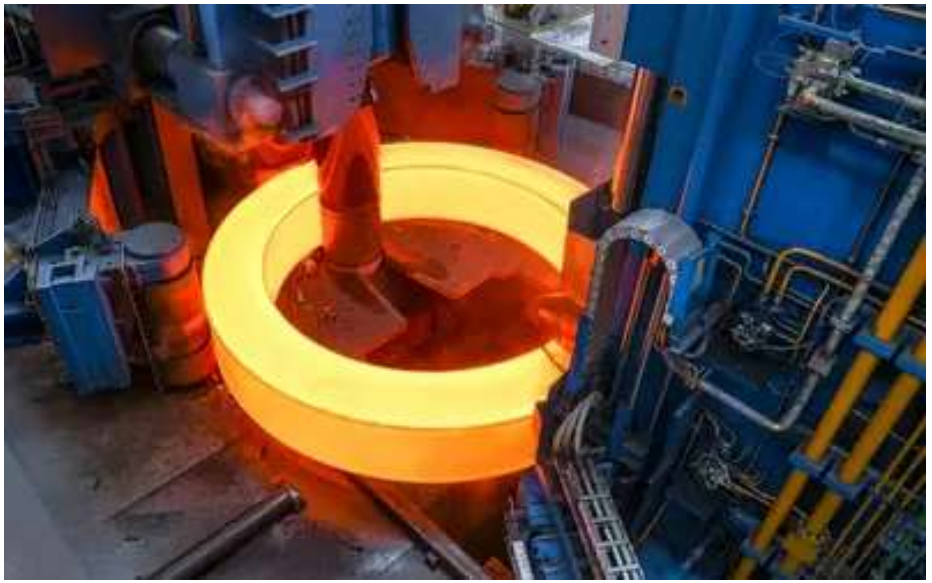


Mechanical Properties

Deformation Mechanisms

- Elastic
- Plastic





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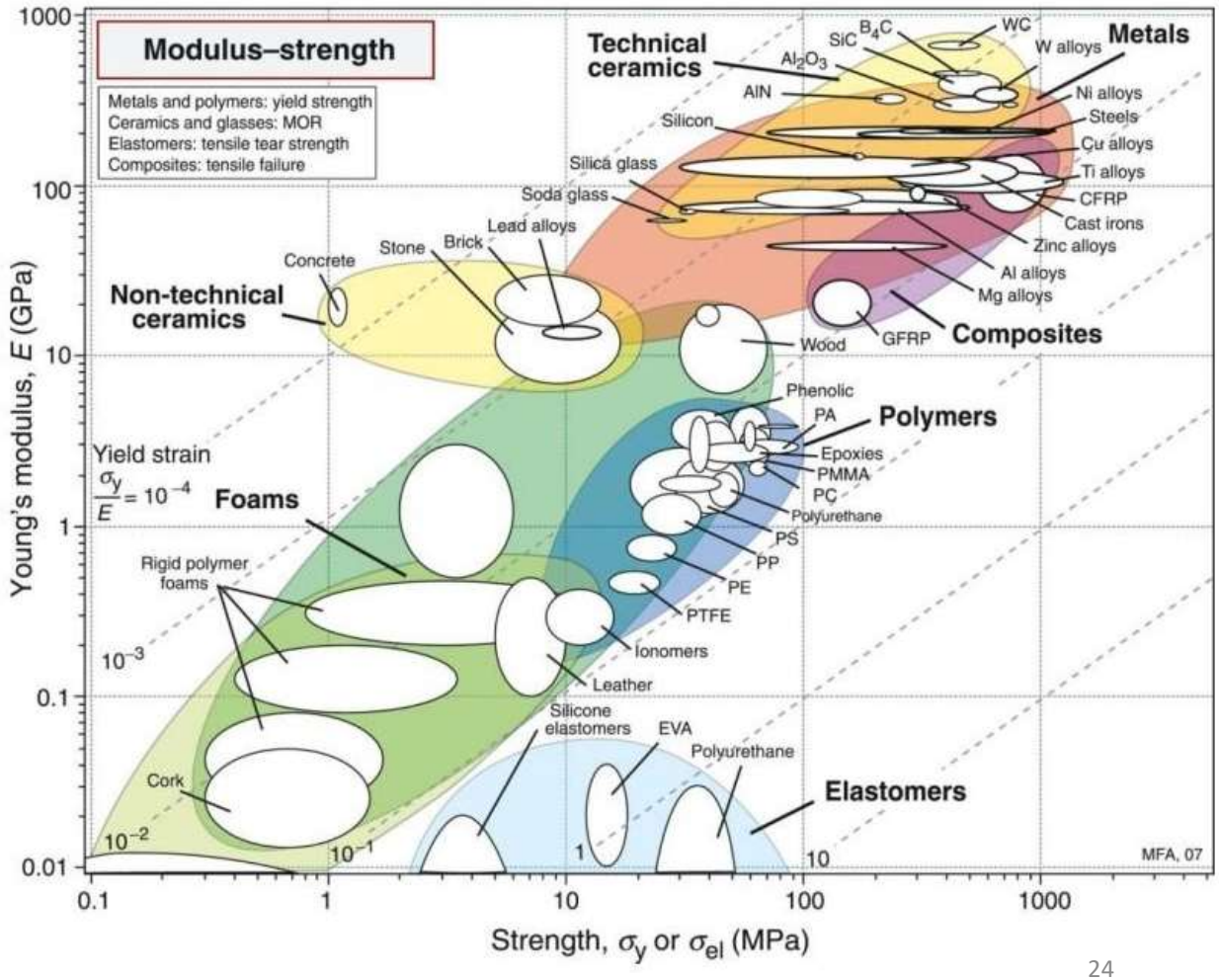
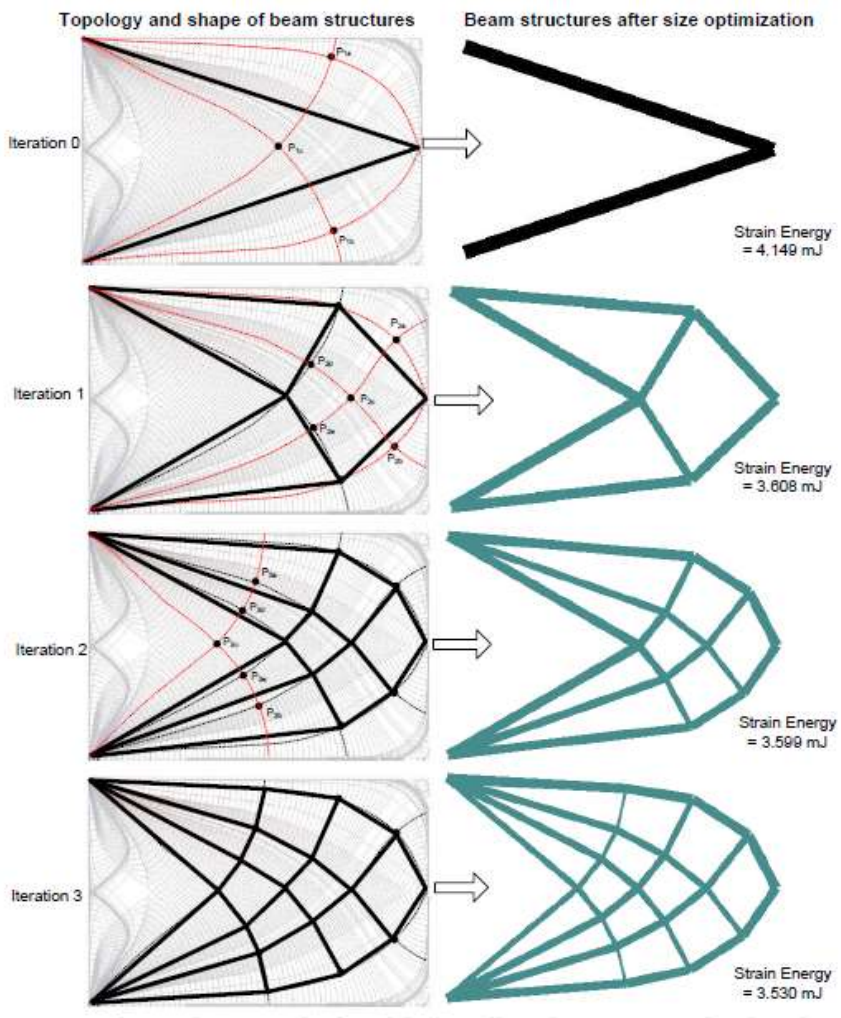
Material Properties

Material	Compression (MPa)	Tension (MPa)	Shear (MPa)	Modulus of Elasticity (GPa)
Structural Steel	--	400	--	200
Alum. Alloy	--	110	70	70
Ponderosa Pine	36	55	7.6	9
High Strength Concrete	40	low	--	30
Nylon	95	75	--	2.8
Marble	125	15	28	7.2
Cast Iron	655	170	240	12.1



Structure Design

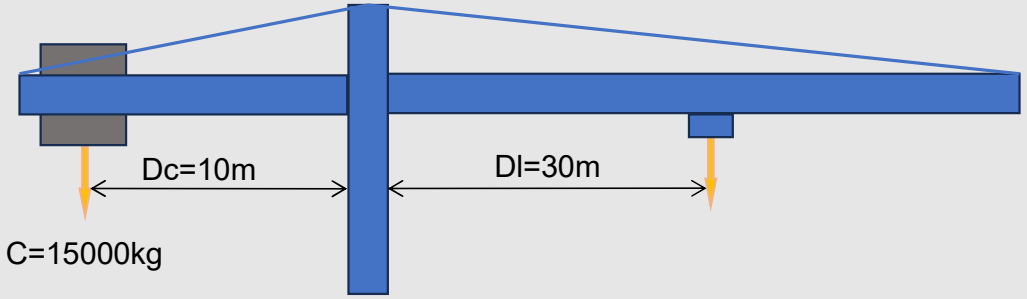


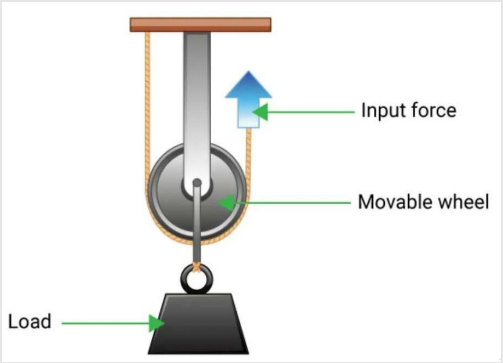
http://www.topology-opt.com/2011/05/beam-structure-optimization-for-additive-manufacturing-based-on-principal-stress-lines/

Practice

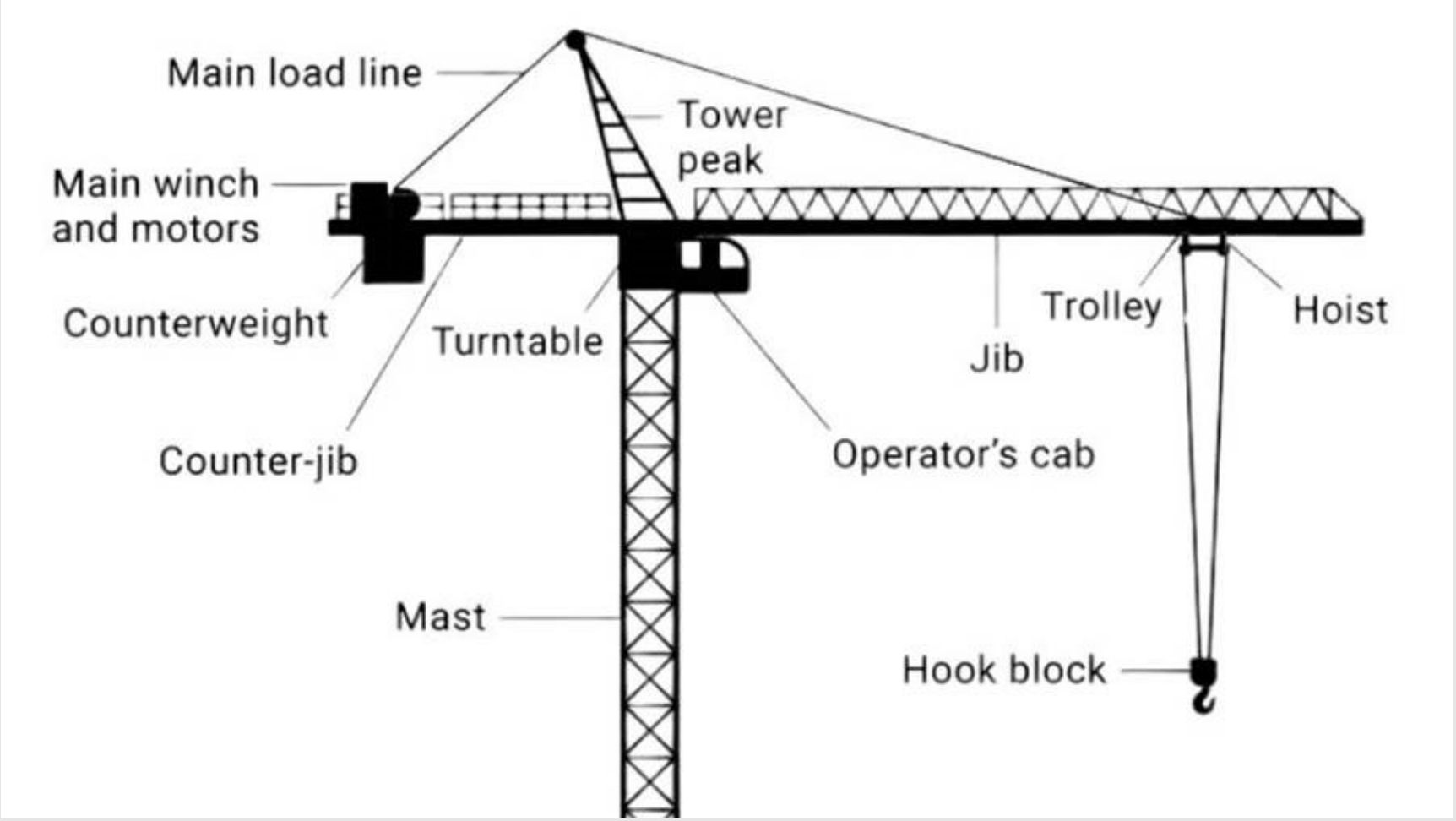
Crane design conditions

1) Equilibrated Load at maximum distance
2) Equilibrated Load at half distance
3) Wire section for a movable pulley.





Practice


Main load line
Tower peak
Main winch and motors
Counterweight
Turntable
Jib
Trolley
Hoist
Counter-jib
Operator's cab
Mast
Hook block

End Session 12