Engineering Principles (Statics & Strength of Materials)

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AENG 101 Introduction to Engineering

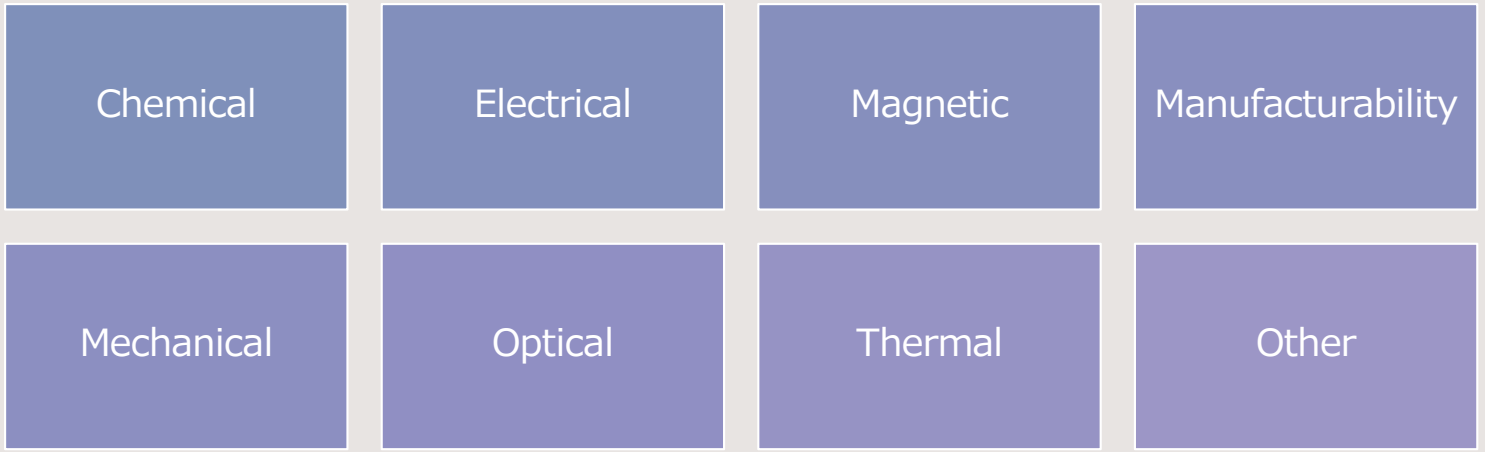
Department of Applied Engineering, Safety, & Technology (AEST)

Halperin, D. A. (1981). Statics and Strength of Materials 2nd Ed. John Wiley & Sons, Inc.

Outline

- Properties of Material
- Introduction to Statics
- Introduction to Strength of Materials

Properties of Material



An Introduction to Statics

- “Statics is the study of methods for quantifying the forces between bodies. Forces are responsible for maintaining balance and causing motion of bodies, or changes in their shape. Motion and changes in shape are critical to the functionality of artifacts in the man-made world and to phenomena in the natural world.
- Statics is an essential prerequisite for many branches of engineering, such as mechanical, civil, aeronautical, and bioengineering, which address the various consequences of forces.
- High school physics, algebra, and trigonometry are recommended prerequisites. Engineering Statics uses algebra and trigonometry and is suitable for use with either calculus- or non-calculus-based academic statics courses. Completion of a beginning physics course is helpful for success in statics, but not required..” https://oli.cmu.edu/courses/engineering-statics/

An Introduction to Statics

What is typically covered in a statics course?

- "Forces
- Free Body Diagrams
- Equilibrium of Simple Objects
- Machines and Structures Joined by Engineering Connections
- Trusses
- Friction
- Moments of Inertia"

https://oli.cmu.edu/courses/engineering-statics/

Statics: Stationary Rigid Bodies
Dynamics: Moving Rigid Bodies

Forces & Loads

- A force is that which produces or tends to produce motion or change of motion of bodies.
- Forces acting on structural members are produced by loads.
- Loads are of two major types: **Dead & Live**.
    - Dead Loads are created by gravity.
    - Live loads are variable.

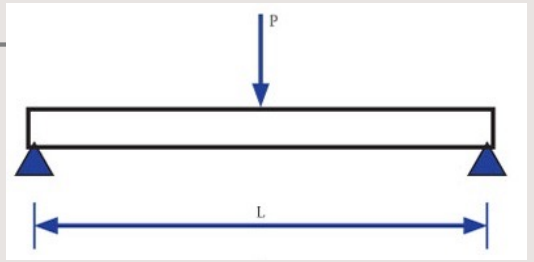
Types of Loads

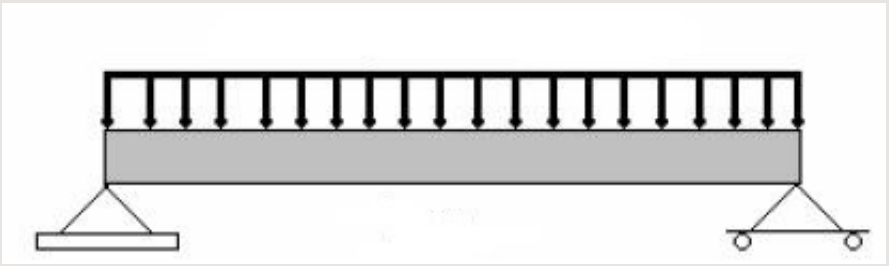
1) Concentrated – A Column supported on a beam example

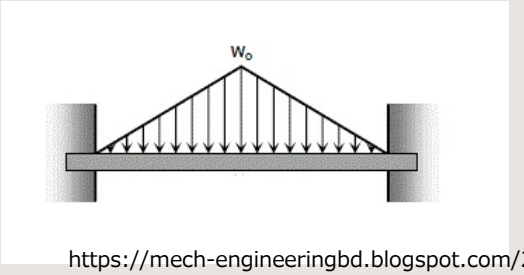
2) Distributed

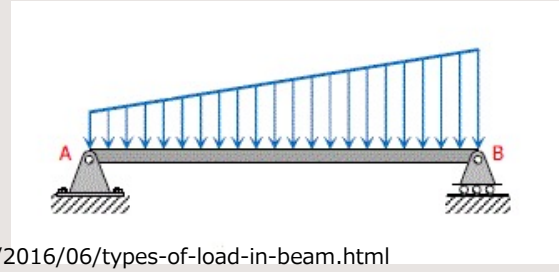
    A) Uniformly Distributed

    B) Uniformly Varying





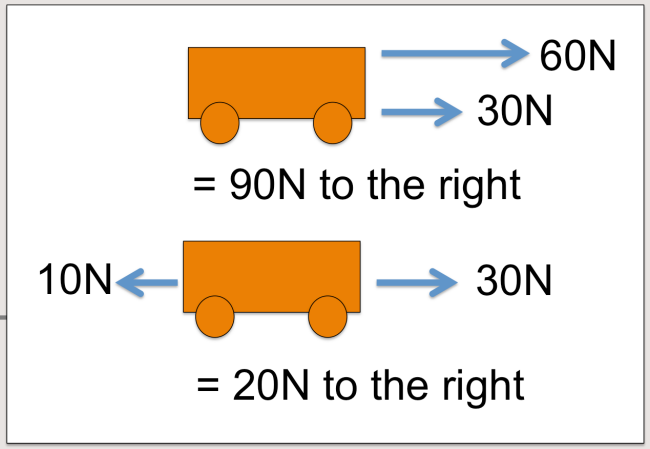




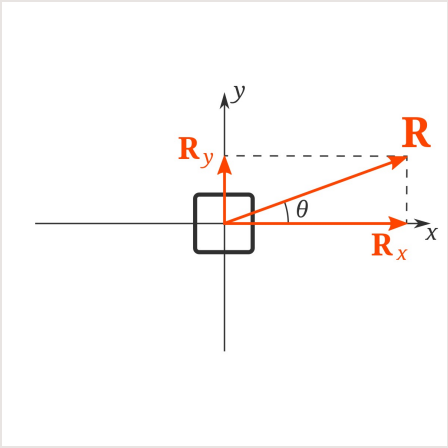
https://mech-engineeringbd.blogspot.com/2016/06/types-of-load-in-beam.html

Concurrent and Resultant Forces

- Concurrent Forces – 2 or more forces that converge on the same point.
- Colinear Concurrent Forces – 2 or more forces that appear in the same line.
- Resultant Forces – the result of the concurrent forces



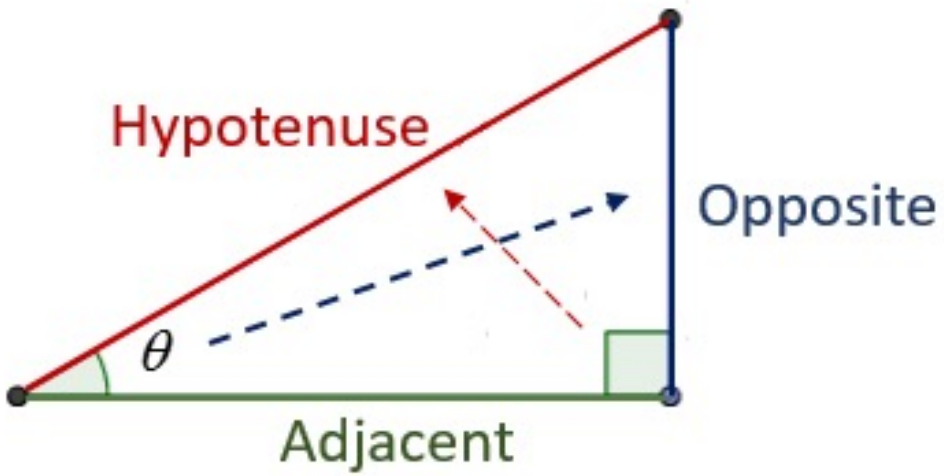
https://simple.wikipedia.org/wiki/Resultant_force



https://www.phyley.com/find-resultant-force

Trigonometry Review

SOHCAHTOA



SOH $\quad \sin\theta = \dfrac{\text{Opposite}}{\text{Hypotenuse}}$

CAH $\quad \cos\theta = \dfrac{\text{Adjacent}}{\text{Hypotenuse}}$

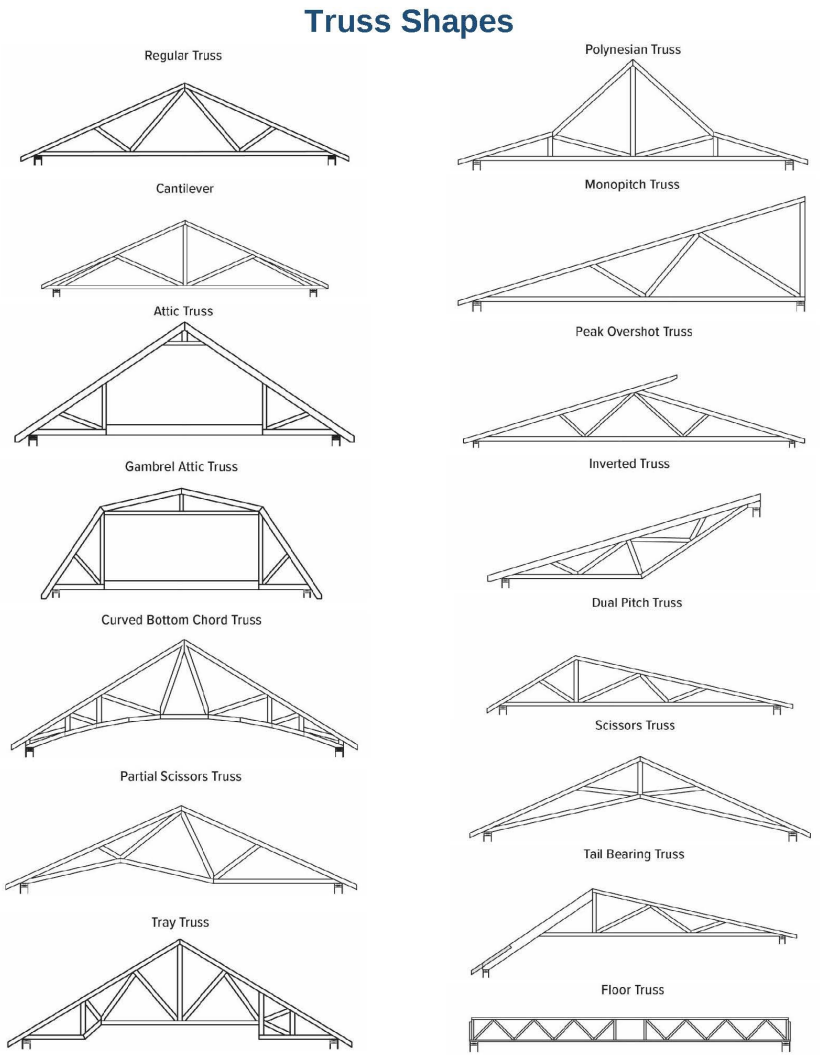
TOA $\quad \tan\theta = \dfrac{\text{Opposite}}{\text{Adjacent}}$

Are Triangles the Strongest Shape?

https://www.youtube.com/watch?v=Ofol8YG_uz8

What is a Truss?

A Truss is a structural framework that, under load conditions, reacts similarly to a beam with holes punched in it.



https://www.rigidply.com/products/roof-and-floor-trusses/truss-shapes/

Tension & Compression

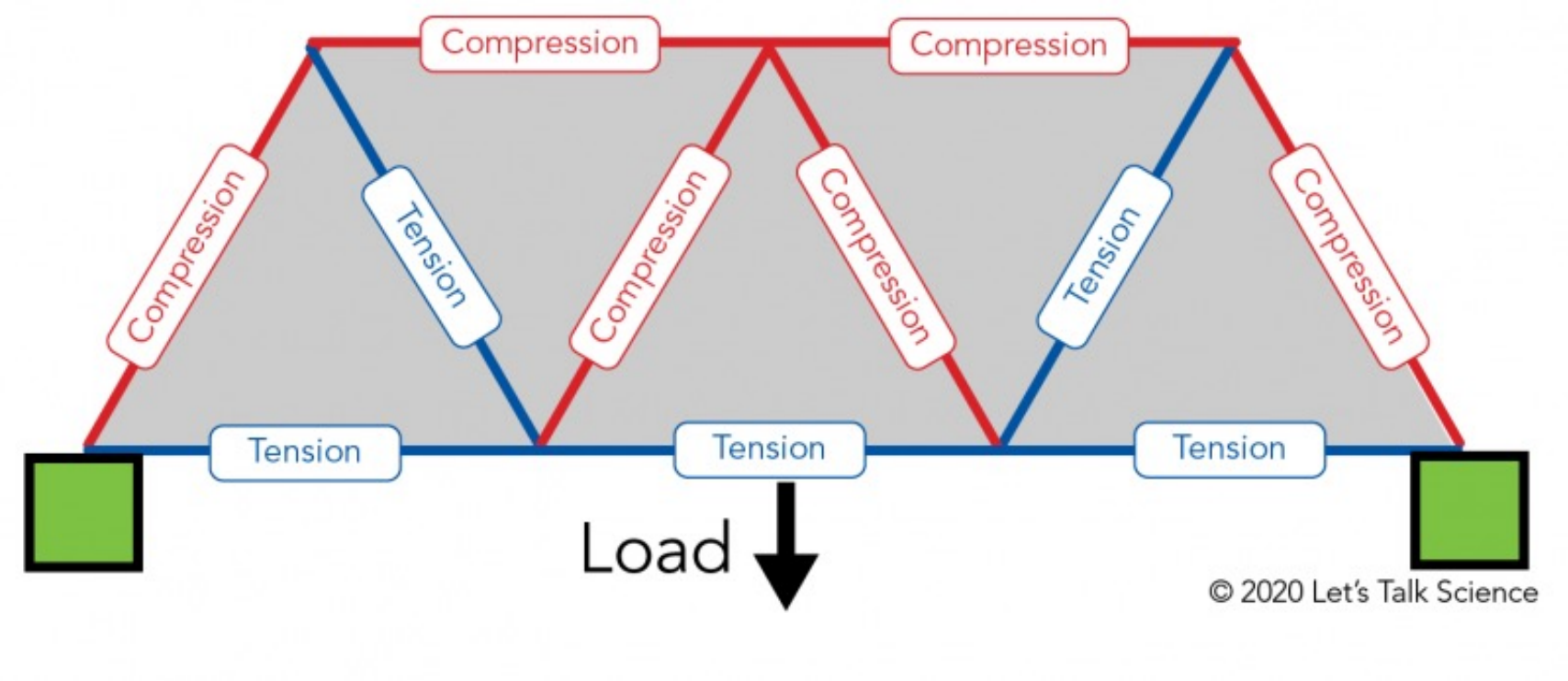
A **tension** force is one that pulls materials apart.

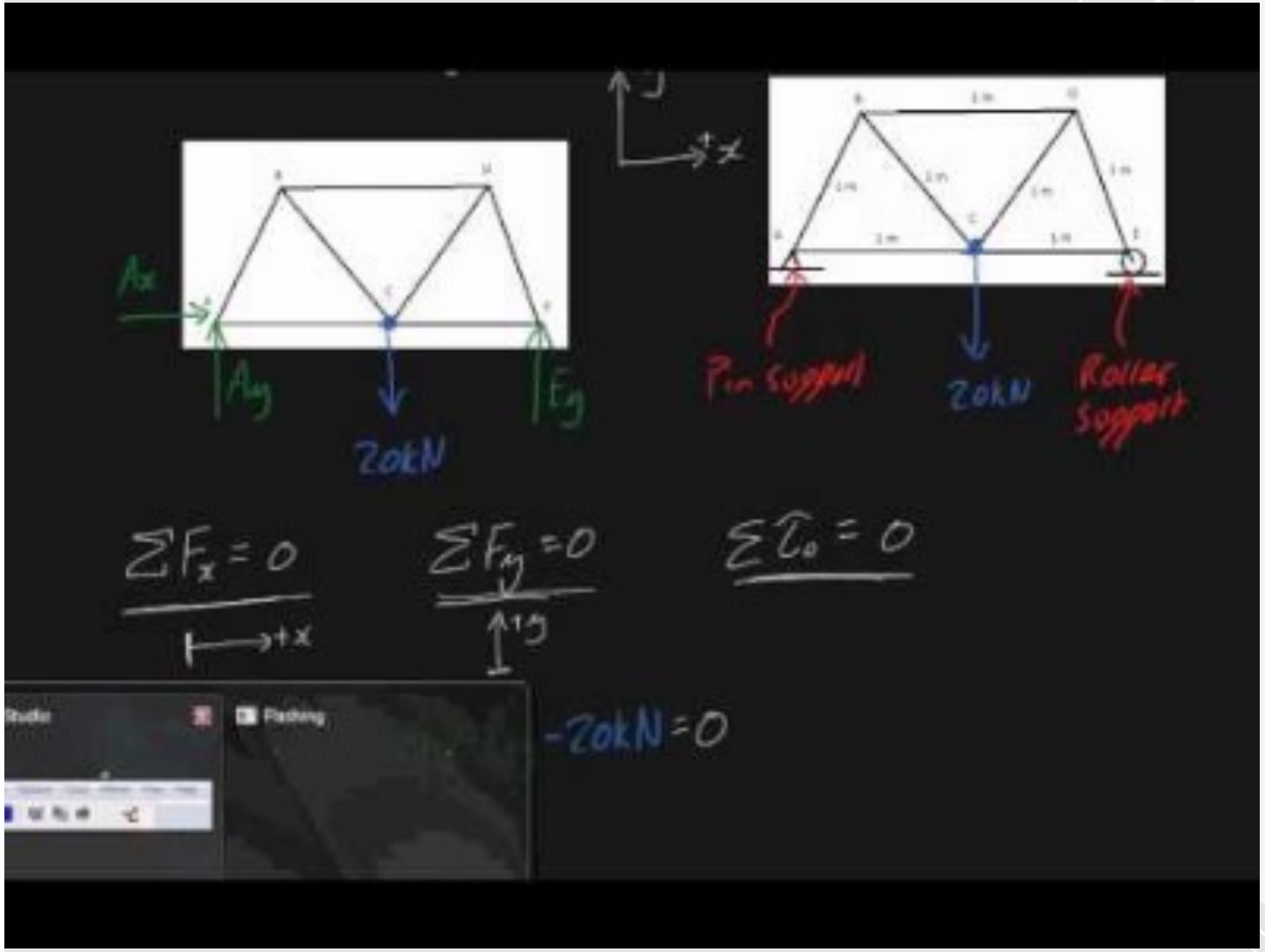
A **compression** force is one that squeezes material together. ... For example, if you pull on a strong rope, it can support a large amount of **tension**.

If you push on a rope, it cannot resist **compression** very well, and just bends.

http://www.learncivilengineering.com/wp-content/themes/thesis/images/structural-engineering/PE-reviewStructure-Mechanics-of-Materials-Tension-and-compression.pdf

Tension & Compression Forces





Calculating Forces (Simple Truss)

https://www.youtube.com/watch?v=A-ZvT_Q2LOU

Strength of Materials

(Stress & Strain)

https://www.youtube.com/watch?v=W5cviLowZ1U