LECTURE #7 :
3.11 MECHANICS OF MATERIALS F03

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- Review of Composites
- Trusses Part 1

Review : Lecture #6 Composite Materials

- definitions : reinforcing component and “matrix”, anisotropic or isotropic
- mechanical properties (E and σ_b) depend on :

    1) mechanical properties of each component
    2) relative amount of each component, i.e. “volume fraction” $V_{component}/V_{total}$
    3) shape and size of reinforcing component
    4) loading orientation relative to anisotropic component

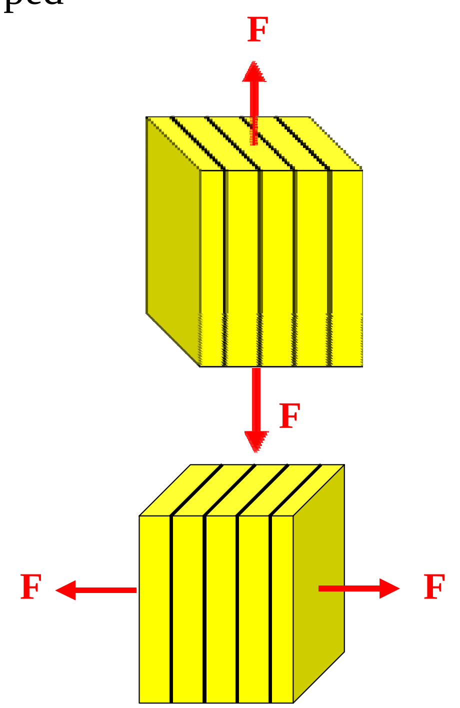
- types of composites :

    1) Fiber-reinforced *a)* continuous aligned, *b)* woven, and *c)* short fiber chopped
    2) particulate

- **rule of mixtures** for aligned continous fiber-reinforced composites :

$$E_{//} = v_f E_f + v_m E_m$$

$$\mathrm{E}_{\perp} = \frac{E_f E_m}{v_f E_m + v_m E_f}$$



$E_{//}$ = composite stiffness parallel to fiber axis

$\mathrm{E}_{\perp}$ = composite stiffness perpendicular to fiber axis

v_f = volume fraction of fibers, E_f = elastic modulus of fibers

v_m = volume fraction of matrix, E_f = elastic modulus of matrix

$1 = v_f + v_m$

Young's Modulus of a Aligned Fiber Composite

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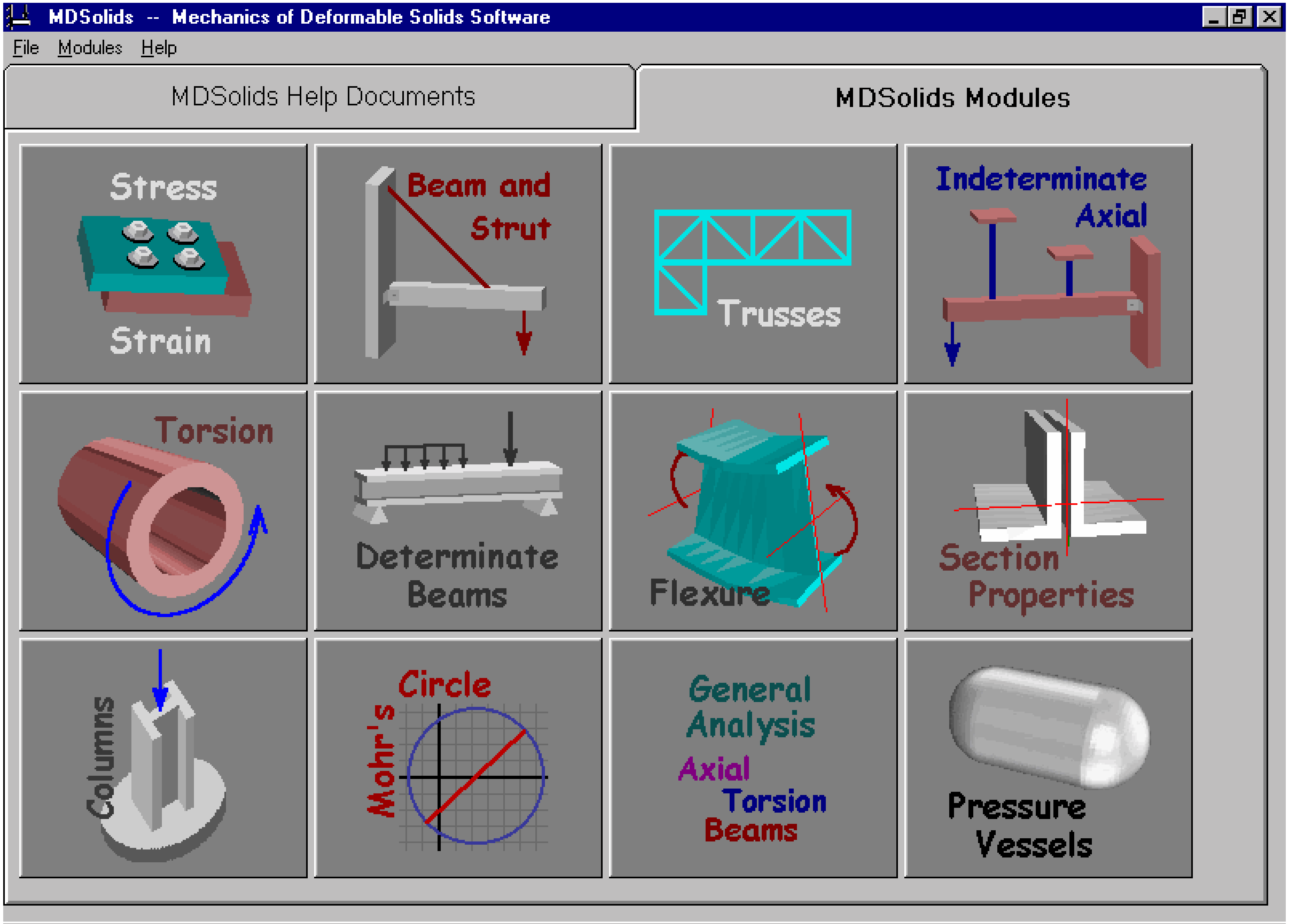
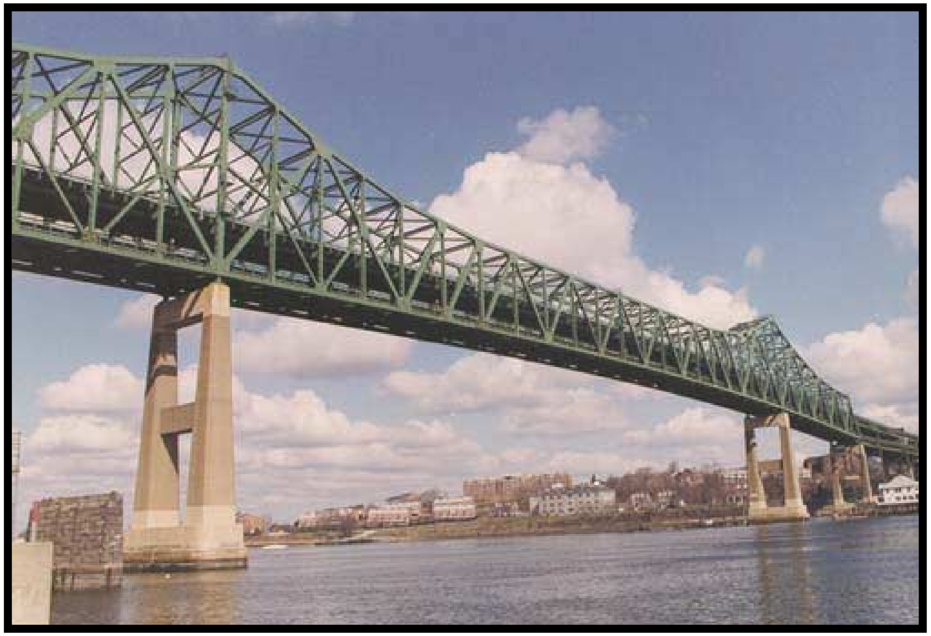
*(*http://www.mdsolids.com/)*

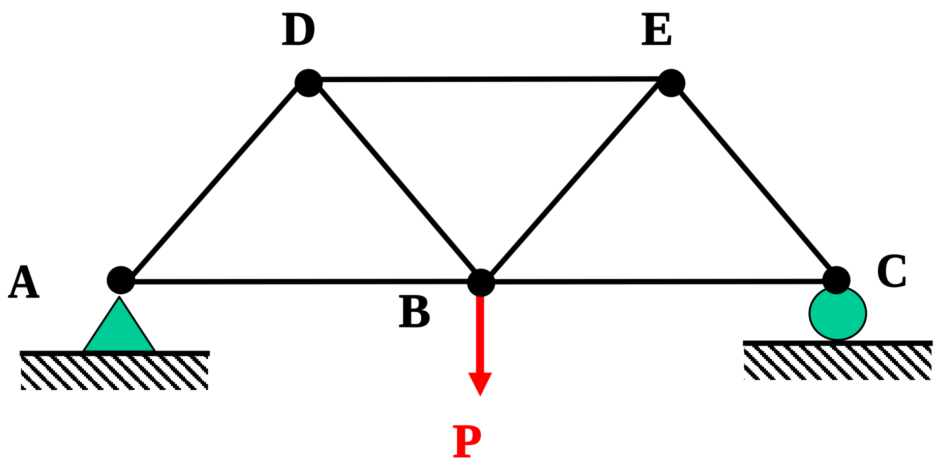


Introduction to Trusses



Tobin Memorial Bridge, Boston

Schematic of a Truss



Statically Determinate and Indeterminate

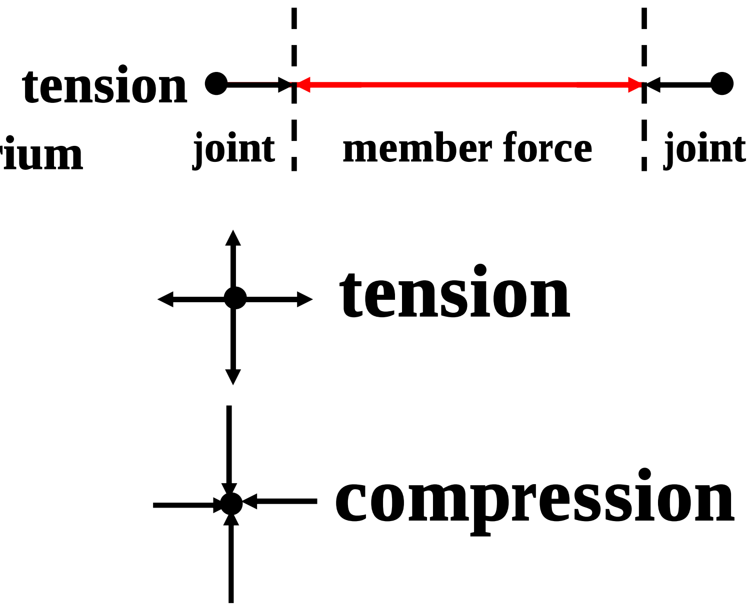
Method of Joints to Determine Member Forces

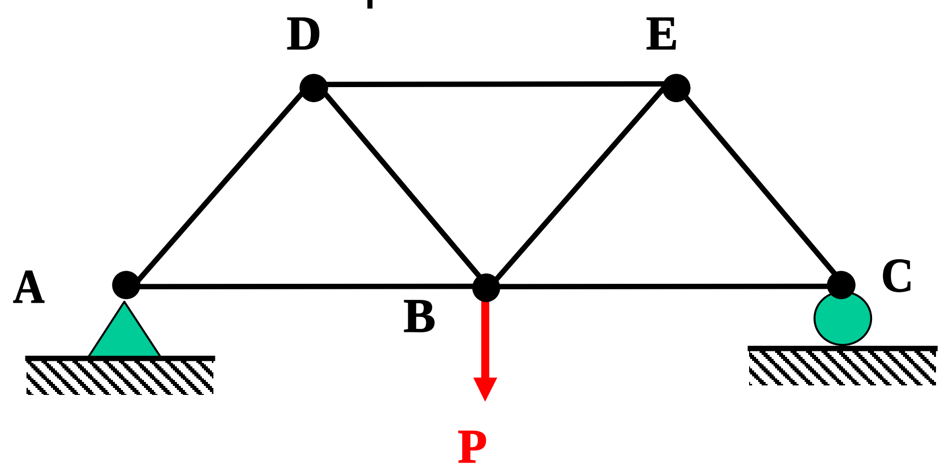
Sample Problem #1 : Find Forces in all Members

1) Draw a FBD of entire truss

2) Determine magnitude / direction of the support reactions using the eqs of static equilibrium

sign conventions



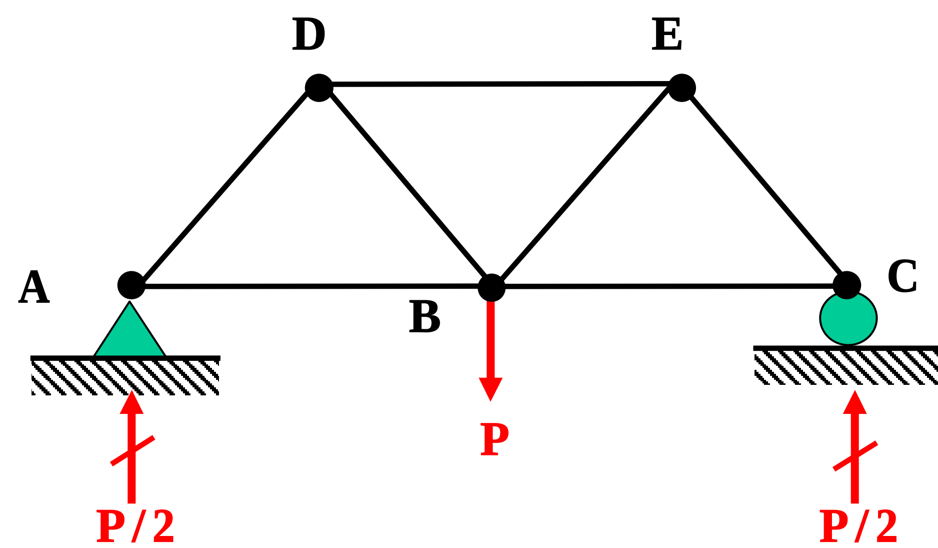


members are each of unit length

Sample Problem #1 : Find Forces in all Members

3. Identify a joint where you know the maximum amount of forces (e.g. a support with two members)

4. Draw a free-body diagram of the joint and determine whether forces are compressive or tensile



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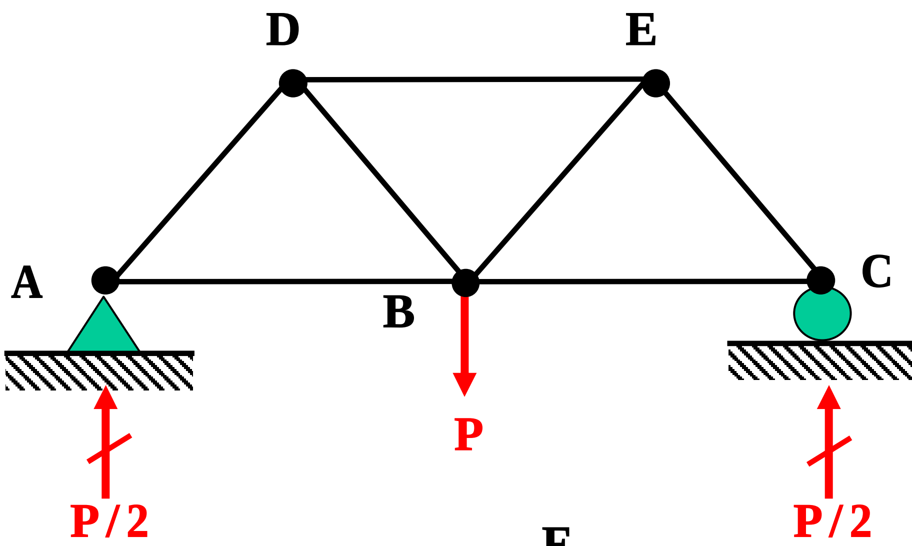
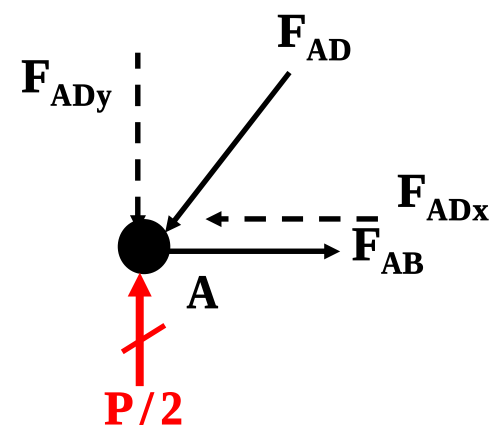
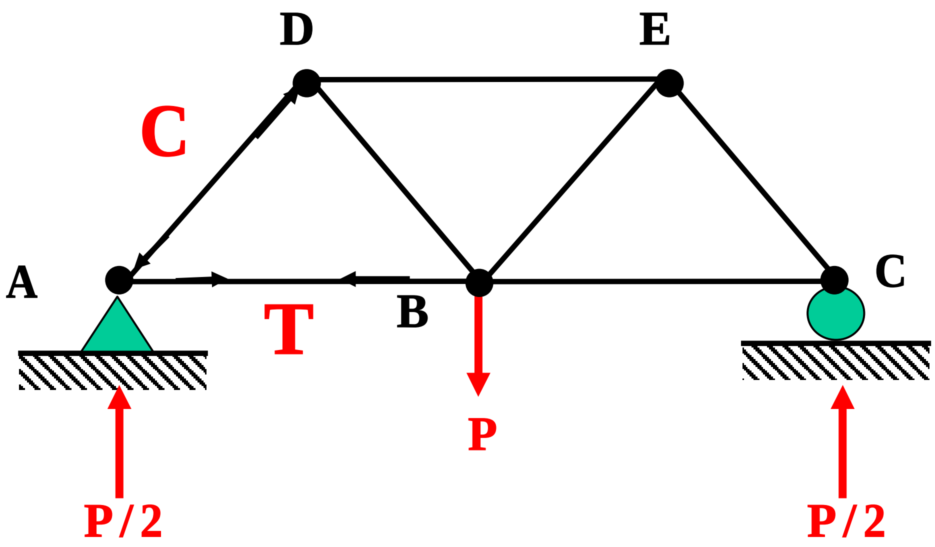




FBD of JOINT A

Sample Problem #1 : Find Forces in all Members

Move to Joint D :



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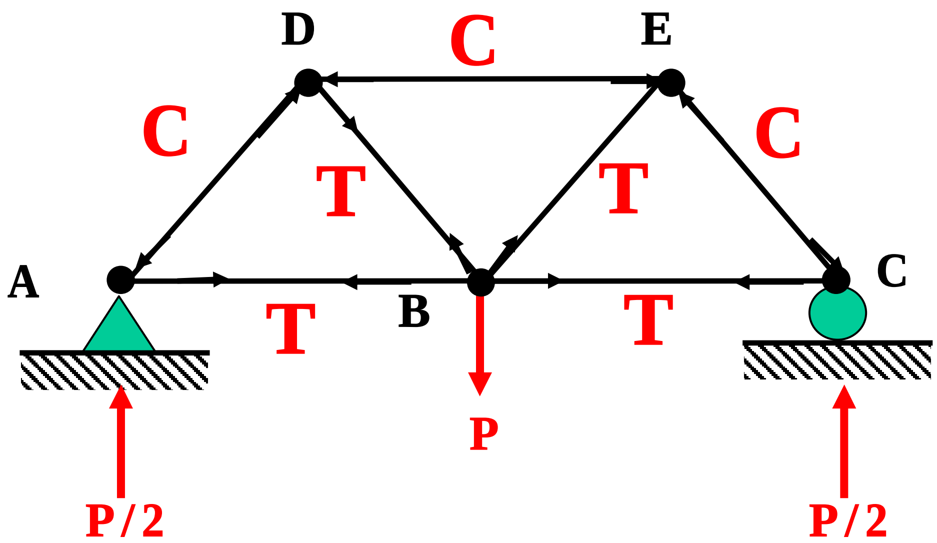

<u>Move to subsequent joints :</u>

$$F_{AD}=P/2\sin60=F_{DB}=F_{BE}=F_{EC}$$

$$F_{AB}= P\cos60/2\sin60=F_{BC}$$

$$F_{DE} =P\cos60/\sin60$$