Statics - TAM 211

Lecture 36

April 18, 2018

Chap 5.5-5.6, Chap 9.5

Announcements

- Upcoming deadlines:
  - Monday (4/23)
    - Mastering Engineering Tutorial 15
  - Tuesday (4/24)
    - PL HW 14
  - Quiz 6
    - CBTF (4/25-27)
  - Written Assignment 6
    - **Wednesday May 2**

Chapter 5 Part II – 3-D Rigid Body

Chap 5.5-5.6

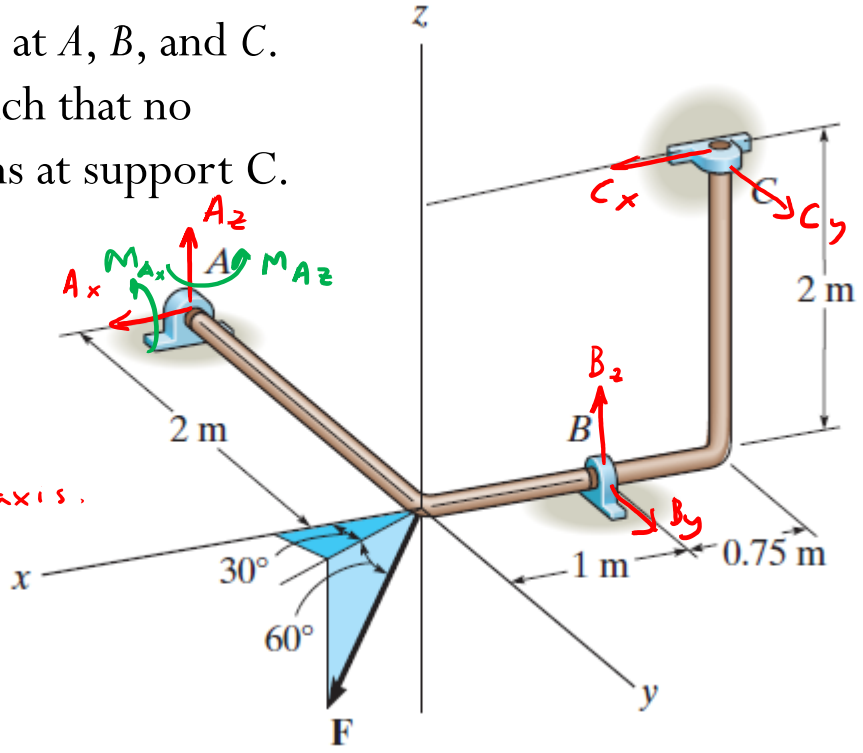
Recap: Equilibrium of a 3D rigid body

Six equations!

$$\sum F_x = 0,\ \sum F_y = 0,\ \sum F_z = 0$$
$$\sum M_x = 0\ \sum M_y = 0\ \sum M_z = 0$$

* Couple-moments are not applied to FBD if the body is supported elsewhere by additional bearings, pins or hinges that are **properly aligned** to prevent rotation in one or more axes).

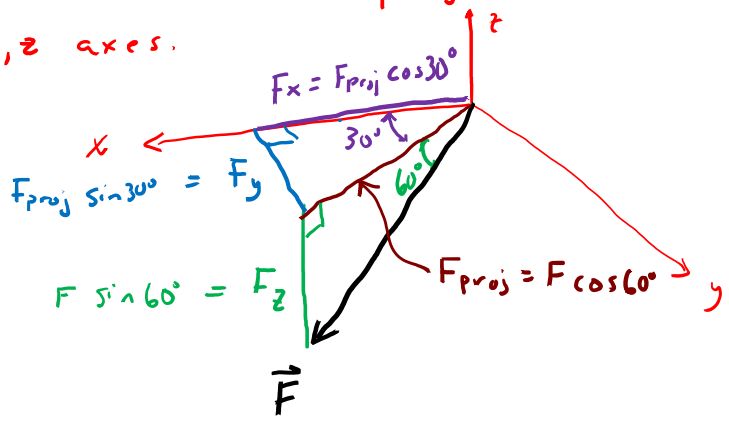
A bent rod is supported by smooth journal bearings at A, B, and C. $F = 800$ N. The supports are **properly aligned** such that no moment support is present. Determine the reactions at support C.



Pointers for this problem:

1) Bearings are properly aligned
   ⇒ No couple-moments at bearings
   Since JOURNAL bearings, only have reaction forces in axes ⊥ to shaft axis.

2) For applied force $\vec{F}$, need to consider how $\vec{F}$ will project onto x, y, z axes.



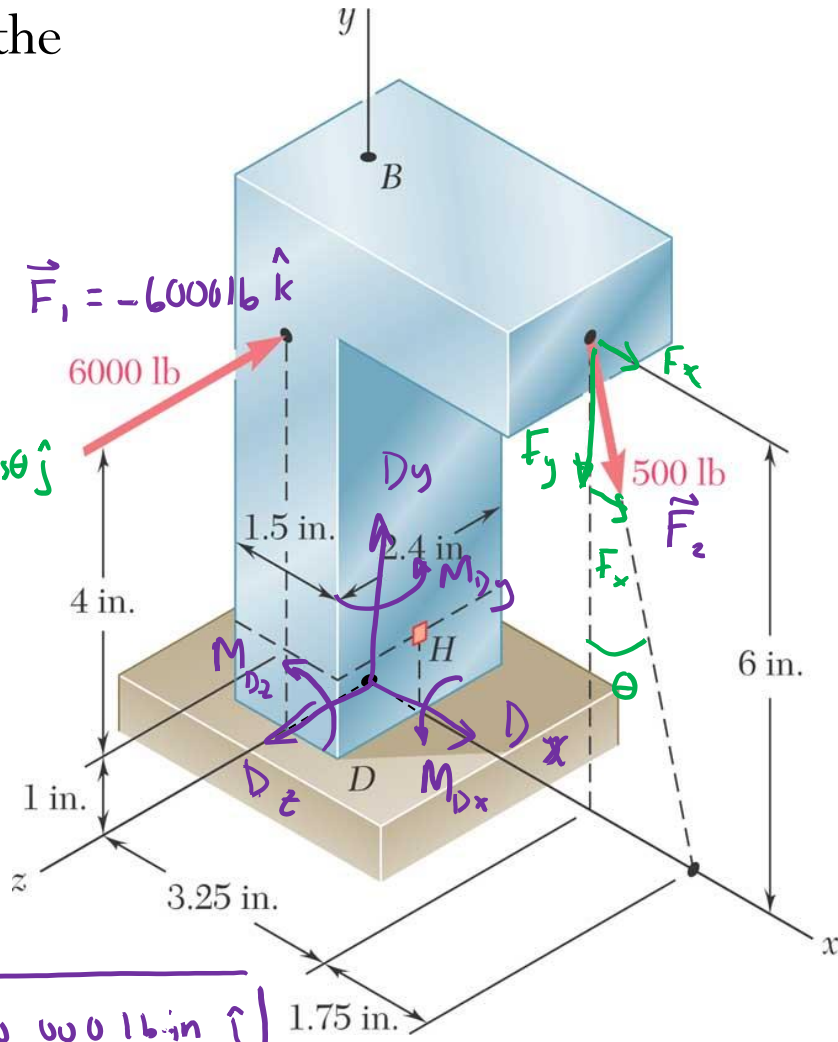
$$\vec{F} = F_x\,\hat{i} + F_y\,\hat{j} + F_z\,\hat{k}$$

$$\vec{F} = (F\cos 60°)\cos 30°\,\hat{i} + (F\cos 60°)\sin 30°\,\hat{j} - F\sin 60°\,\hat{k}$$

Calculate the reaction forces and moments at the support D at the base of the structure.

Draw FBD for blue structure.

How many unknowns? 6



$\vec{F}_1 = -600016\,\hat{k}$

$\vec{F}_2 = F_{x_2}\hat{i} - F_{y_2}\hat{j} = 500\sin\theta\,\hat{i} - 500\cos\theta\,\hat{j}$

$F_x = 500\sin\theta = 140$ $\quad \theta = \tan^{-1}\left(\frac{1.75\text{ in}}{6\text{ in}}\right)$

$F_y = 500\cos\theta = 480$ $\quad = 16.3°$

ΣF_x : $D_x + F_{x_2} = 0$ $\rightarrow$ $\boxed{D_x = -F_{x_2} = -140\text{ lb}\,\hat{i}}$

ΣF_y :

ΣF_z :

ΣM_x : $M_{Dx} - (5'')\,600016 = 0$ $\quad \boxed{M_{Dx} = 30{,}0016\text{ in}\,\hat{i}}$

ΣM_y : $\boxed{M_{Dy} = 0}$ No effect of F_1 & F_2

ΣM_z : M_{Dz} . . .

Chapter 9 Part II – Fluid Pressure

Chap 9.5

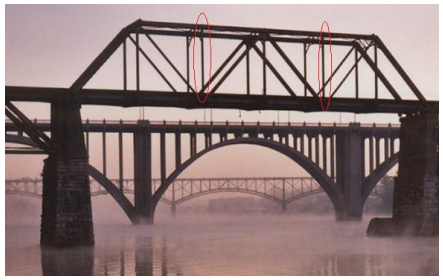
Goal and objective

- Present a method for finding the resultant force of a pressure loading caused by a fluid

Mechanics is a branch of the physical sciences that is concerned with the **state of rest or motion of bodies that are subjected to the action of forces**

SOLIDS

Rigid Bodies

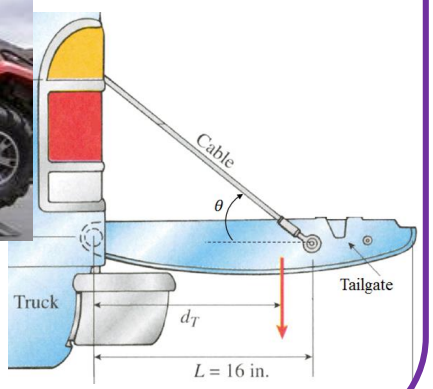


TAM 210/211: Statics

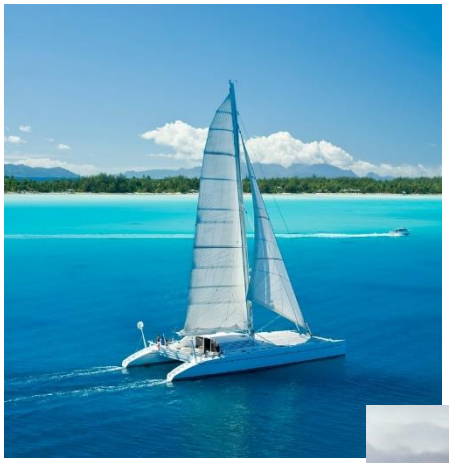
TAM212: Dynamics

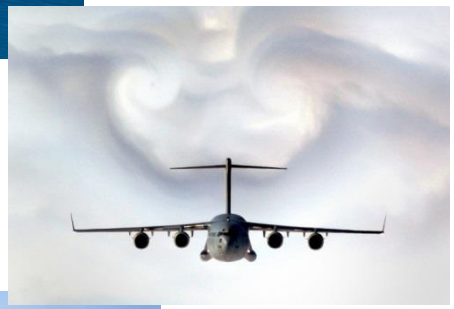
Deformable Bodies

TAM 251: Solid Mechanics



FLUIDS





What Makes a Fluid or Solid?

Honey

Rock

What is Sand?

Particles swollen with water – ‘Squishy Baff’