AEC 205 Applied Statics and Strengths of Materials

Principle of Moment

Types of Movement

- Translational
  - Straight line motion
    - Push a book across the table
- Rotational
  - Movement that is circular about some point or axis
    - Push a book but by applying force only to a corner

Moment Definition

- The tendency of a force to produce rotation of a body about some reference axis or point
  - The force must be applied some distance (d) from the point or axis under consideration
    - Revolving door: You can not open the door by pushing on the center shaft
- Discussion: can you restate the moment definition in terms that are useful or familiar to you?

Magnitude of the Moment Force

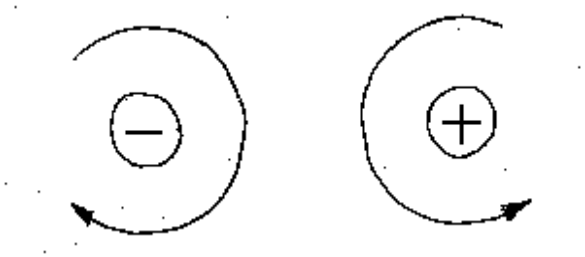
- Moment = Force x Distance
  - M= FxD
    - D is also called the moment arm
- CAUTION
  - The Distance must be the perpendicular distance from the point (or axis) to the force
  - A force acting THROUGH a point or axis cannot cause a moment about that point or axis
    - Example: pushing on a wrench along its major axis
      - Perpendicular distance example

Units for Moment

- Moment = Force x Distance so you will have one unit of force (lb, Newton) and one unit of distance (inch, foot, meter
- Common units, standard
  - In-lb, lb-ft, kip-in
- Common units, SI
  - N-m, kN-m

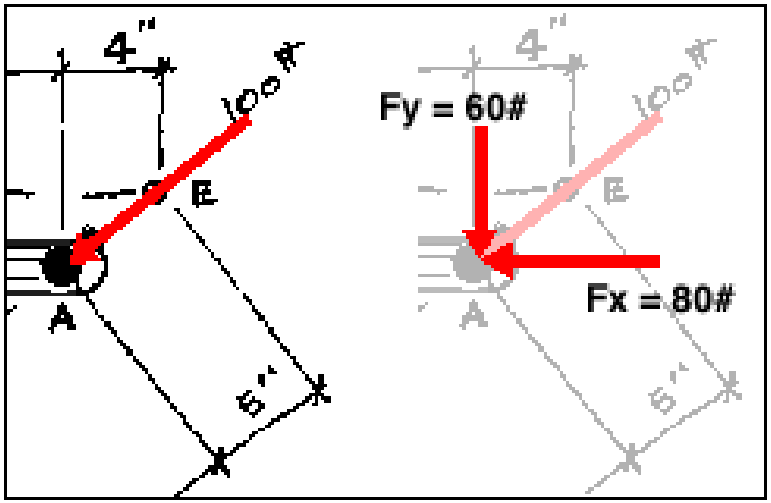
Sign Convention

- Forces producing clockwise rotation about a point or axis will be considered to result in a NEGATIVE moment
- Forces producing counterclockwise rotation about a point or axis will be considered to result in a POSTIVE moment



Varignon's Theorem

- Also called the principle of moments
  - "The moment created by a force about a point is exactly the same moment that is created by the horizontal and vertical components of that force about the point" (Burns, 2010)
  - Given M=F*d
  - $M = F_x * d_x + F_y * d_y$
  - Varignon's Theorem



Transmissibility

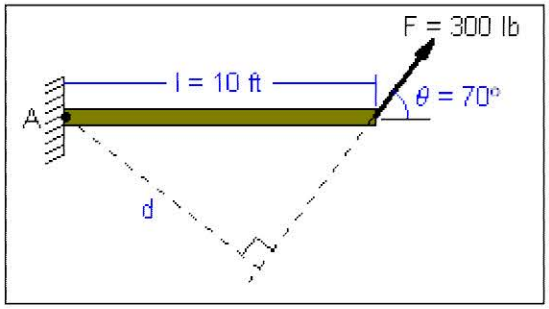
- A force can be assumed to act anywhere along its line of action with no external change to the body itself
  - Simplifies calculating the perpendicular distance

Useful Links

- What is a Moment?
- Moment and Force Video
- Force System Resultants – Moments
- Statics Online – Moments

Example Problems

A 300 lb force F acts on a beam as shown. Determine the moment of F about point A at the left end of the beam.



The moment of the force is equal to the force magnitude times the perpendicular distance, d, from point A to the line of action of the force. Thus

$$d = l \sin\theta = 10 \sin 70^\circ = 9.40 \text{ ft.}$$

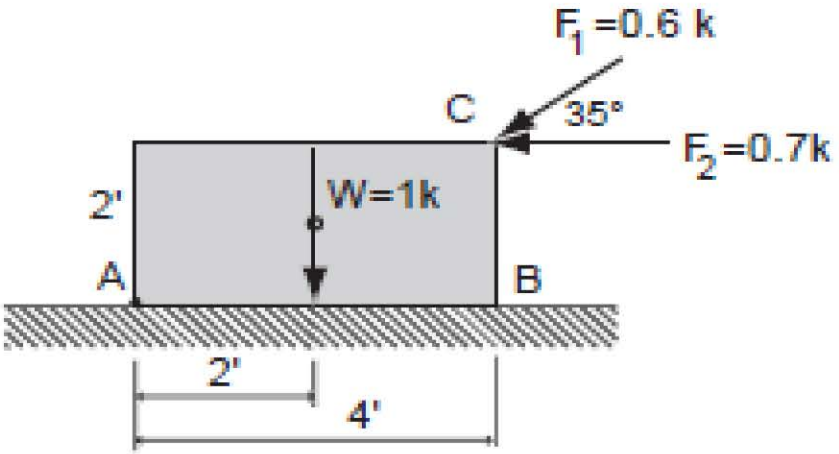
$$M_o = Fd = 300(9.40) = 2819$$

$$\boxed{M_o = 2819 \text{ lb} \cdot \text{ft} \circlearrowleft}$$

- Notice that F_x does not produce a moment about A, only F_y

Example Problems, cont.

2.3-10 A 1,000 lb. crate is subjected to two applied forces at **C**. Determine the moment about points **A** and **B** due to forces $\mathbf{F_1}$, $\mathbf{F_2}$, and the weight **W**.



- Notice that F_{1Y} does not produce a moment about B

Homework/Problems

- 2.14, 2.15, 2.16 page 59
  - Individual – 2.14 and 2.16
  - Group – 2.15
  - Be prepared to present your results for 2.15
- Write a one paragraph to one page description of how you have used the concept of the moment in an every-day situation
  - You do not need to include any calculations
  - Be prepared to discuss your application in class

Torque Wrench Calibration

- Please refer to the Torque Wrench Calibration assignment under the “Assignments” tab in WebCT

References

- Burns, T. 2010. *Applied Statics and Strengths of Materials*. Delmar. New York
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