Week 15

ILLINOIS

TAM 210/211 Introduction of Statics

End of Semester Survey (TAM 211)

- Scan QR code to access to the survey
- Complete the survey for 5 mins (if you need more time, please let me know!)

00:05:00

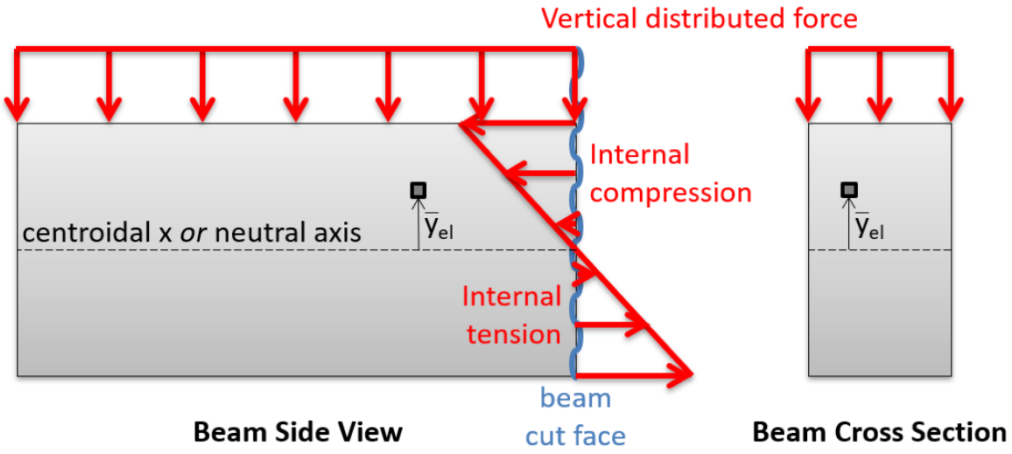
WEEK 15 – Moment of Inertia (MoI)

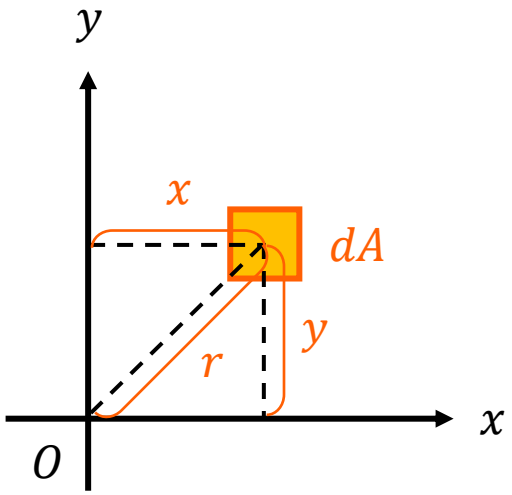
- **Moment of inertia (area moment of inertia = second moment of area)**
  - Resistance to changes in an object's rotational motion about **a given axis**
  - Determines the moment needed to produce a desired curvature about an axis

$$I_x = \int_A y^2 dA$$

$$I_y = \int_A x^2 \, dA$$

$$J_O = \int_A r^2 \, dA = \int_A (x^2 + y^2) \, dA$$





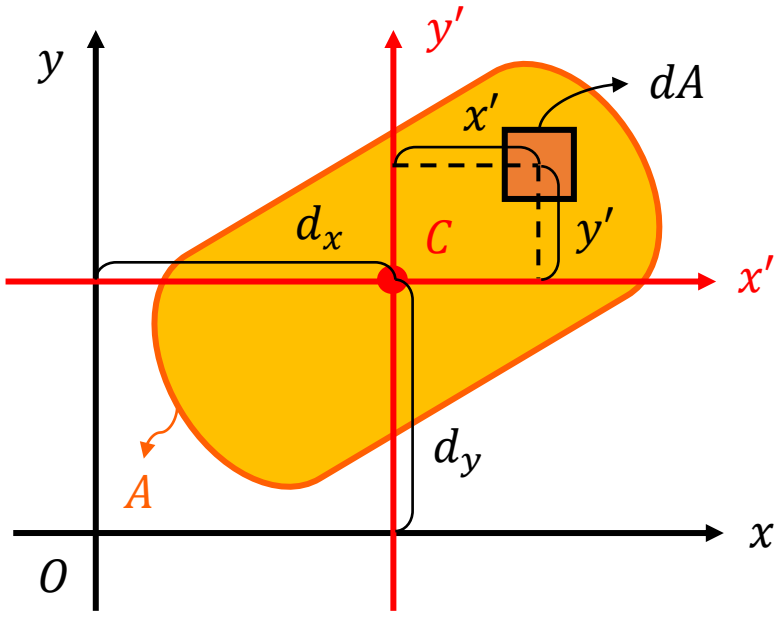
WEEK 15 – Moment of Inertia (MoI)

- **Moment of inertia for typical shapes**
  - https://www.mechref.org/sta/geometric_properties/?origin=coursemenu (reference pages)
  - https://engineeringstatics.org/parallel-axis-theorem-section.html (online textbook)

- **Parallel axis theorem**
  - The axis crossing the centroid → a given axis (O)

$$I_x = I_{x'} + A(d_y)^2, I_{x'} = \int_A (y')^2 dA$$

$$I_y = I_{y'} + A(d_x)^2, I_{y'} = \int_A (x')^2 dA$$

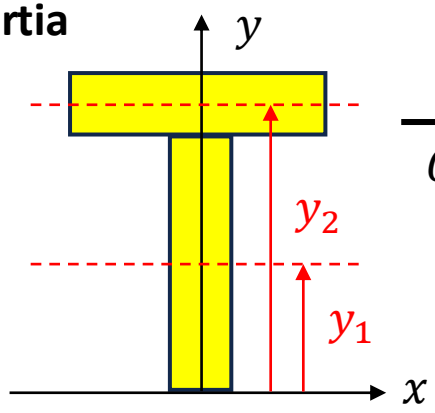


- **Combining moments of inertia**

$$I_1 = I_{y1'} + A(y_1)^2$$

$$I_2 = I_{y2'} + A(y_2)^2$$

$$I_{tot} = I_1 + I_2$$



WEEK 15 – Virtual Work

- **Virtual work (dU)**
  - Assume: displacement of a rigid body caused by forces is infinitesimally small
    - Virtual translation: $dr \to 0$
    - Virtual rotation: $d\theta \to 0$
  - In equilibrium, the sum of virtual work is zero

$$\sum dU = \sum \vec{F} \cdot d\vec{r} + \sum M \cdot d\theta \hat{k} = 0$$

  - Using virtual work, we can express equilibrium of forces and moments as a single work balance