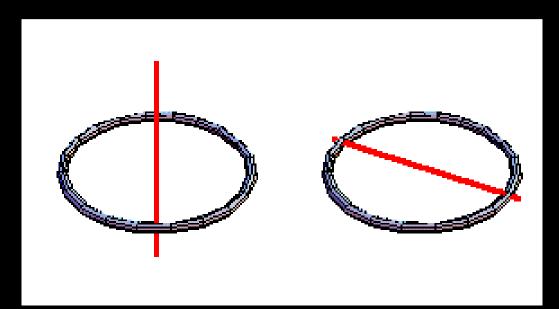
Architectural Structures I: Statics and Strength of Materials ENDS 231

DR. ANNE NICHOLS Spring 2008

lecture twelve



moment of inertia of an area

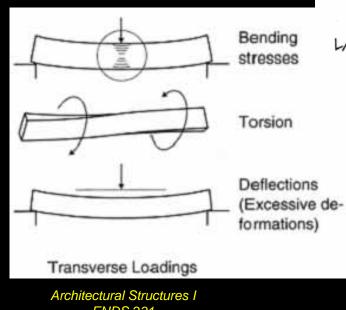
Moment of Inertia 1 Lecture 12

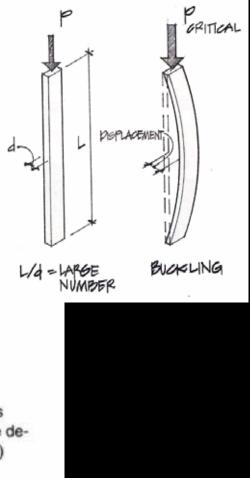
Architectural Structures I ENDS 231

Moments of Inertia

• 2nd moment area -math concept – area x (distance)² • need for behavior of – beams

- columns





Moment of Inertia 2 Lecture 12

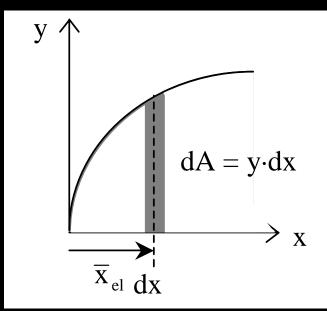
ENDS 231

Moment of Inertia

- about any reference <u>axis</u>
- can be <u>negative</u>

$$I_{y} = \int x^{2} dA$$

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



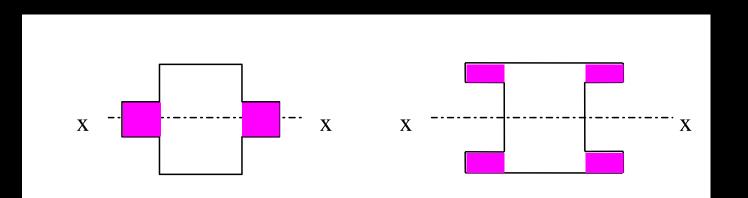
resistance to bending and buckling

Moment of Inertia 3 Lecture 12 Architectural Structures I ENDS 231

Moment of Inertia

same area moved away a distance

-larger I

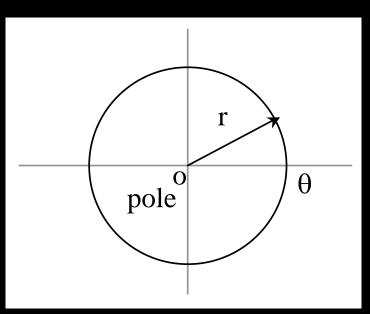


Moment of Inertia 4 Lecture 12 Architectural Structures I ENDS 231

Polar Moment of Inertia

- for round-ish shapes
- uses polar coordinates (r and θ)
- resistance to twisting

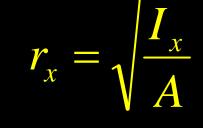
 $J_o = \int r^2 dA$

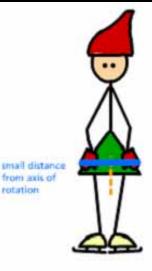


Architectural Structures I ENDS 231

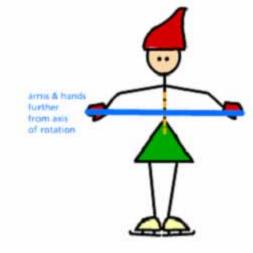
Radius of Gyration

• measure of inertia with respect to area





When a figure skater changes position, he or she is redistributing his or her mass. Thus, every position has it's own unique rotational inertia.



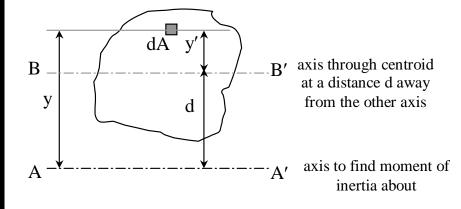
The rotational inertia of the figure skater increases when her arms are raised because more of her mass is redistributed further from her axis of rotation.

Moment of Inertia 6 Lecture 12 Architectural Structures I ENDS 231

Parallel Axis Theorem

 can find composite I once composite centroid is known (basic shapes)

$$I_{x} = I_{cx} + Ad_{y}^{2}$$
$$= \overline{I}_{x} + Ad_{y}^{2}$$



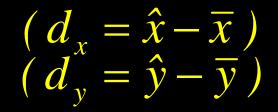
$$I = \sum \bar{I} + \sum Ad^2$$

$$\overline{I} = I - Ad^2$$

Moment of Inertia 7 Lecture 12 Architectural Structures I ENDS 231

Basic Procedure

- 1. Draw reference origin (if not given)
- 2. Divide into basic shapes (+/-)
- 3. Label shapes
- 4. Draw table with $A, \overline{x}, \overline{x}A, \overline{y}, \overline{y}A, \overline{I}s, ds,$ and Ad^2s
- 5. Fill in table and get \hat{x} and \hat{y} for composite
- 6. Sum necessary columns
- 7. Sum \overline{I} 's and Ad^2 's

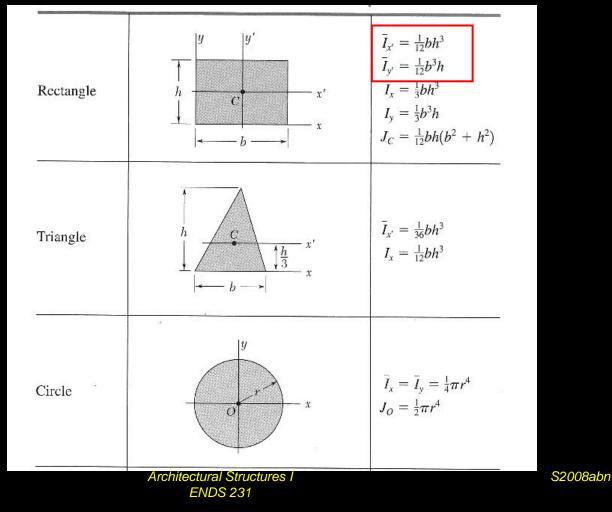


Moment of Inertia 8 Lecture 12 Architectural Structures I ENDS 231

Area Moments of Inertia

• Table 7.2 – pg. 252: (bars refer to centroid)

- x, y - x', y' - C



Moment of Inertia 9 Lecture 12