

Midterm Exam 1 - Structural Analysis 1

Seoul National University

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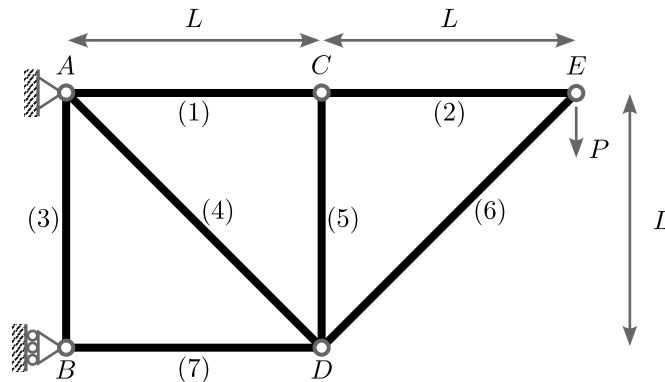
Problem 1. The heel of a high-heel shoe is typically thick where it joins the shoe and narrow where it touches the ground. Model the heel as a cantilever that is fixed at the shoe end and loaded by a transverse force at the free (ground) end. Using this idealized model, explain in words why this shape is a sensible design. Recall that the cross-sectional moment of inertia is $I = \int_A y^2 dA$.



Problem 1.

Problem 2. Consider the truss shown below, which is subjected to a downward vertical load P at node E . Support A is a pin and support B is a roller that resists only horizontal force.

- (a) Determine all reaction forces at supports A and B .
- (b) Determine the axial forces of all 7 members.
- (c) Treating the truss as an equivalent beam of span $2L$ that is supported at the wall, draw the corresponding equivalent bending moment diagram along the span.

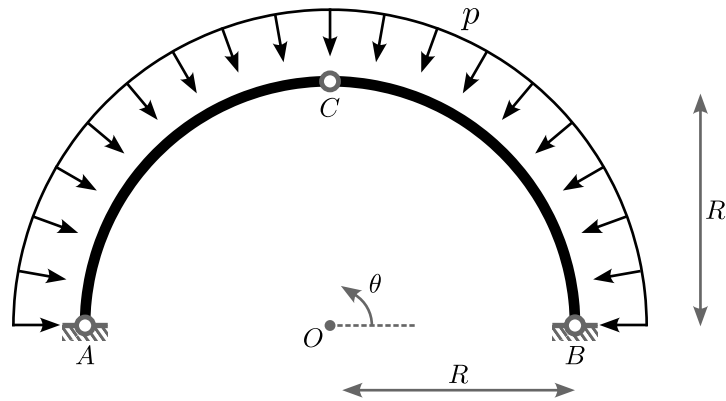


Problem 2.

Problem 3. A three-hinged arch has the shape of a semicircle of radius R with center O . The arch is supported by pins at A and B , which lie at the two ends of a horizontal diameter, and has an internal hinge at the crown C , directly above O . The arch carries a uniform radial load of intensity p (force per unit length along the arch axis). The load acts everywhere normal to the arch axis and is directed toward the center O . The angle θ is measured counterclockwise from the horizontal line through O pointing toward B , so that $0 \leq \theta \leq \pi$ along the arch.

- Determine all reaction forces at supports A and B .
- Determine the axial force $N(\theta)$, shear force $V(\theta)$, and bending moment $M(\theta)$ as functions of θ , and draw the axial force, shear force, and bending moment diagrams along the arch. State your sign conventions clearly.

Hint. An element of the arch between θ and $\theta + d\theta$ has length $ds = R d\theta$.



Problem 3.