Prepared by
All Questions are Weighted Equally.
Closed Book and Notes

August 2007
Ph.D. Qualifying Examination
Solid and Structural Mechanics
Michigan State University
Department of Mechanical Engineering

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Exam Number: 2007

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Solid and Structural Mechanics
1. Shown in the figure is a pendulum of a clock which has a 3-lb weight suspended by three rods of 30-in. length. Two of the rods are made of brass \( (E_b = 30 \times 10^6 \text{ psi}) \) and the third is steel \( (E_s = 15 \times 10^6 \text{ psi}) \). Determine the following:
(a) How much of the 3-lb suspended weight is carried by each rod.
(b) The deflection of each rod.
Determine the ratio of maximum bending stress ($\sigma_{max}$) to the maximum shear stress.

2. A rectangular beam is carried on simple supports and subjected to a central load.
The following strains have been determined by the strain rosette shown below. Use

$$\gamma_1 = 80 \times 10^{-6}$$

$$\gamma_2 = 120 \times 10^{-6}$$

$$\gamma_3 = 480 \times 10^{-6}$$

Mori's circle to find the principal strains and the maximum in-plane shear strain, and

their associated directions.
For the beam and loading shown in the following diagram, determine the reaction at the roller support. No formula is provided. You must derive all the necessary formulae yourself and show them on your answer sheet.