24-261 Statics November 6, 2001
Problem Set #11 Due: November 13, 2001

Posted on the web are a list of some materials parameters that you should know by heart. There are at http://www.andrew.cmu.edu/course/24-261/miscel/materials.pdf.

You will be expected to know these parameters by the third quiz which will be held on the last day of class.

1. Problem 3.7-9 (Gere, Mechanics of Materials)

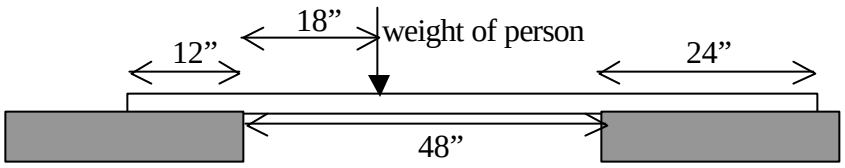
2. Problem 3.8-5 (Gere, Mechanics of Materials). In addition, at the cross-section midway between C and B, determine: (i) the rotation ? of the cross-section and (ii) the shear stress at a point which is 0.5" from the centerline of the shaft.

3. This problem deals with the Exercise machine described in http://www.andrew.cmu.edu/course/24-261/images/cybex_exercise_machine.htm. There you will find images, a description of the how the machine works, and sketches which give relevant dimensions. There is also a video which may help you to picture the motions of the parts of the machine.

Problem Statement Say that the stack of weights is 40 lb. (The main cable carries this 40 lb force.) Say that only the right leg applies a force in the middle of its leg plate.

(i) Determine the force that the right leg needs to apply in the configuration shown in the sketch giving the dimensions.
(ii) Determine the variation of the twisting moment along the main shaft (i.e., specify the value of the twisting moment along various segments of the shaft).

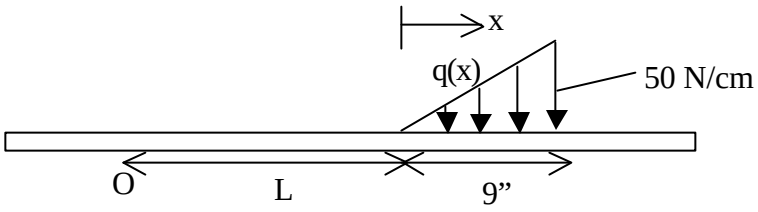
4. A board which is 12 inches wide and 0.75 inches thick spans a gap in the concrete. Besides the weight of the board (take it to be 40 lb/ft^3), there is the weight due to a person (150 lb) standing at the indicated point.



Take the force between the board and each side of the concrete to be uniformly distributed. Determine the pressure acting on each of the two sides A and B (they may be different).

5. Consider a linearly varying distribution of force acting on a beam (disregard beam in problem 5). This force varies from 0 to 50 N/cm at the right end (9 cm away from the left end). If x is defined as distance from the left end of the distribution, then the force per unit length,q(x), is written as

$$q(x) = 50(x/9) \text{ N/cm}$$



Please make sure you understand how q(x) is defined (you will have to do something similar later).

(i) Use integration to determine the net force associated with this distribution.

(ii) Use integration to derive an expression for the net moment about the point O due to the distribution of force. Point O is a distance L (in cm) from the left end.

(iii) Determine the point at which the net force found from part (i) should be applied to produce the same moment about point O as the original distribution (found in (ii)).