ENGR 350-01

Name: 

Prof.: Filler, Fall 2008

Score: ______ of ______ = ______ %

FIRST EXAM
(Open Book, Open Notes)

Fill in the blank(s) using the words below. Each word is used once, and only once, except for one word, which is used three times. (1 point each blank)

creep uncertainties Yielding uniform resist
legitimate strain flex FOS
centric centroid deflection not

1. Factors of Safety deal with legitimate uncertainties.

2. 'yielding' means subsequent permanent deformation.

3. To be able to use the equation \( \sigma = \frac{P}{A} \), the applied force must be centric. And, indeed, if that is the case, then the stress distribution will be uniform. For the applied force to be centric, the line of action of the force must pass through the centroid of the section in question.

4. Some beams, say, made from wood or reinforced concrete, will sag immediately under load, and then if the load is sustained, will sag even more. We call this time dependent sag (or deflection) 'creep'.

5. Strain is relative deformation.

6. If a load normal to a section is not centric - yikes, the load distribution will not be uniform, and if the section is that of a beam, it will also tend to flex the beam.

7. Regarding beams (flexural members), dealing with 'serviceability' means we want to make sure the beam doesn't have too much deflection (sag).

8. One design approach is to calculate the reasonably possible 'bad' event that could happen, divide it into the member or system's ability to resist this ('bad') event, and make sure that the ratio is greater than or equal to some prescribed Factor of Safety (FOS).

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1 I can't remember if I covered this or not - so if you get this one - I'll give you extra credit.
2. Consider a 5/8 in. diameter structural bolt to be used in a tension condition in a steel connection. The 'height' \( h \) of the bolt head is 7/16 in. If the allowable shear stress for the shank shearing out of the head is 30,000 psi, and the design load on the bolt is 10,500 lb, determine the amount, \( y \), of the head that can be 'ground off'. (10 points).

\[ T = 10,500 \text{ lb} \]

\[ 10,500 \text{ lb} \]

So \( V = T = 10,500 \text{ lb} \)

The stress, \( \sigma_v = \frac{V}{A} \), where \( A = \text{shearing area} = \text{circumf} \times \left( \frac{7}{16} - y \right) \)

and to get \( y \) ... we set \( \sigma_v = \text{the allowable value of} \ 30,000 \text{ psi} \).

\[ \frac{30,000 \text{ psi}}{1 \text{ in}^2} = \frac{10,500 \text{ lb}}{\pi \left( \frac{5}{8} \text{ in} \right) \left( \frac{7}{16} - y \right)} \]

... \( y = \frac{0.25}{\text{ in.}} \)

Answer: \( \frac{1}{4}'' \)...

... leaving less than 3/16...
3. A '2 x 12' joist set on edge delivers a reaction of 750 lb to a wood sill plate. If the allowable bearing stress perpendicular to the grain of the wood (in both joist and wood plate) is 500 psi, determine the minimum bearing length for the joist (but not less than 1-1/2 in. (10 points; show your work.)

\[
\sigma_b = \frac{750}{1.5 \times \ell_b} \quad \text{let} = 500 \text{ psi}
\]

So \[\ell_b = \frac{750}{1.5 \text{ in} \times 500 \text{ psi}} = 1.0 \text{ in.} \]

but, not less than 1.5 " \[= 1.5 \text{ in.} \]

min. bearing length = \[1.50\] in.