CE 311 Exam 1

September 14, 2011

You are allowed to have 1 page of your own notes, the AISC manual, and a calculator.

**Given Formulae:**

**Law of Cosines:**

\[
\begin{align*}
    c^2 &= a^2 + b^2 - 2ab \cos(\gamma), \\
    b^2 &= c^2 + a^2 - 2ca \cos(\beta), \\
    a^2 &= b^2 + c^2 - 2bc \cos(\alpha), \\
    \cos(\gamma) &= \frac{a^2 + b^2 - c^2}{2ab}.
\end{align*}
\]

**Law of Sines:**

\[
\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}.
\]

**Stress**

\[
\begin{align*}
    \sigma &= E\varepsilon, \\
    \tau &= G\gamma
\end{align*}
\]

\[
G = \frac{E}{2(1 + \nu)}
\]

**Bending Flexural (normal) Stress**

\[
\begin{align*}
    M/EI &= 1/\rho, \\
    \varepsilon &= -y/\rho, \\
    \sigma &= My/I, \\
    M &= EI\kappa, \\
    I &= (\pi/4)r^4 \text{ for a solid circular cross-section}
\end{align*}
\]

**Beam Shear Stress**

\[
\begin{align*}
    \tau &= VQ/It, \\
    q &= VQ/I, \\
    q &= F/s, \\
    I &= (\pi/4)r^4 \text{ for a solid, circular shape of radius } r
\end{align*}
\]

Also:

\[
\delta = \frac{PL}{AE}
\]

**Bonus Questions (0.1 points, each)**

1. What did Republicans call the platform they hyped in the 1994 Congressional elections?

2. What political system was gradually dismantled in South Africa, starting in 1989?

3. What 20th-century conflict was dubbed the "forgotten war" despite 54,246 U.S. deaths?

4. What famous document begins: "When in the course of human events..."?

5. Who is the only person to receive the Heisman Trophy twice?
1. (50) Based on the applied load at Point D, draw the moment diagram using the standard sign convention from Strength of Materials for Column AC only (i.e., plot the diagram on the compression side). Indicate the magnitudes of all local min/max values. Where position B is located 5 feet up from position A, on the left-hand side of the column, determine the normal stress at position B due to the applied load and clearly indicate whether this stress is tensile or compressive. The column is a hollow 12"x12" square tube with a wall thickness of \( \frac{1}{2} " \), as shown.
2. (30 points) Determine the maximum dead load moment $M_D$ for Girder AB.

Given:

The floor plan below supports a 7.5" thick concrete slab (concrete unit weight = 150 lb/ft$^3$)
Fill beams are W16x26 (26 lb/ft, self-weight)
Girders are W18x35 (35 lb/ft, self-weight)
3. (4 points) Determine the normal stress at point B if the normal stress at point A is 1ksi (kip/in²)

Given: The beam is subjected to equal end-moments M, as shown. A is a position at the extreme fiber. B is a position 1” below point A. The beam has a rectangular cross-section that is 10” deep, but the width is unknown.

4. (4 points) Determine the normal strain at point B if the normal stress at point A is 1ksi (kip/in²)

Given: The beam is subjected to equal end-moments M, as shown. A is a position at the top extreme fiber. B is a position at the bottom extreme fiber. The beam has a rectangular cross-section that is 10” deep, but the width is unknown. The modulus of elasticity (AKA Elastic Modulus or Young’s Modulus) E is 1000 ksi.
5. (2 points) TRUE or FALSE. A ductile material is a material with a low elastic modulus (AKA Elastic Modulus or Young’s Modulus) E.

6. (10 points) Determine the stretched length of member AB due to the 10kip load at point B.
   