CE 311 Exam 4
October 25, 2013
50 minute time limit

You are allowed to use the AISC manual, pencils, and a calculator.

2. (0.1 points). World Series trivia question: Who made the catch shown to the right in the 1954 World Series?
   
   **Willie Mays**

3. (0.1 points). Who hit the ball that was caught by the player shown in the picture on the right?
   
   **Vic Wertz**

4. What NHL hockey player played from the 1946/1947 season until retiring at the end of the 1970/1971 season, then came back and played the 1979/1980 season at the age of 52?
   
   **Gordie Howe**

5. What NHL hockey player has the record for most career goals in the regular season?
   
   **"The Great One" - Wayne Gretzky**

6. What institution of higher learning has won the greatest number of Division I Ice Hockey National Championships?
   
   **Michigan Wolverines**

7. Spell the last name of the Head Men’s Basketball Coach from Duke University.
   
   It is impossible, only he knows how to spell it.

Exam Version A
(20 points) Draw the line diagram for Column B1, due to a wind pressure of 20psf (ultimate wind pressure is 33.3psf, but the ASD factor is 0.6 for wind, giving a pressure of 20psf, for this analysis), acting from East-to-West (putting positive pressure on the East wall), and determine the maximum moment on B1, due to wind, only.

**Given:** The roof acts as a diaphragm. All connections are simple (non-moment-resisting). The girts are evenly-spaced at 4'.

\[
F_{\text{G}} = (24')(4')(20\text{psf}) = 1.92K
\]

\[
\frac{1.92}{z} + 1.92 = \frac{1.92}{z}
\]

\[
F_{\text{G}} = 1.92K
\]

\[
\text{Area} = \frac{M_{\text{max}}}{K} = 1.92(4) = 7.68 \text{K-ft}
\]
1. (5 points). Explain what an X bolt is and why it is not commonly used.

**X bolts demand the assurance that bolts will be installed w/ threads excluded from the shear planes. This is unrealistic, as it depends on ironworkers always installing the correct bolt length in each hole.**

3. (3 points) **TRUE** or FALSE. A ½" Group A Slip Critical bolt has the same actual resistance to shear failure as a ¾" Group A N bolt.

**Identical Bolt, Identical Shear Strength.**

4. (3 points) **TRUE** or FALSE. Given the same loads, a bolted connection that uses Group A (A325) SC bolts requires a greater number than a connection that uses the same sized Group A (A325) N bolts.

5. (3 points) The two connections shown use the same angles, bolts, hole-sizes, and hole-spacing. The only difference is the orientation of the angles: A has long-legs-back-to-back, while B has short-legs-back-to-back. Circle the connection that is stronger with respect to fracture.

6. (3 points) The two connections shown have angles of the same gross area. The connections use the same-sized bolt holes. Circle the design that will be stronger with respect to fracture.

7. (3 points) The two connections shown have angles of the same gross area. The connections use the same-sized bolt holes. Circle the design that will be stronger with respect to bearing failure of the holes.

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Exam Version A
Problems on this page refer to the building, below. The roof acts as a diaphragm. All connections are simple (non-moment-resisting). The story height is 15’. The column spacing is 30’ in both directions.

3D View, Omitting Diaphragm and Wall Framing, for clarity

3D View, Showing Diaphragm and Wall Framing

8. (3 points) TRUE or FALSE. The building shown above would be unstable if the roof diaphragm did not exist.

 COLUMN LINE A WOULD BE UNBRACED.

9. (25 points). Determine the force on the brace along Column Line 1, between A and B, due to wind pressure of 20psf, directed from East to West and state whether the brace is in tension or compression.

\[ P_w = 30' (7.5') (20 \text{psf}) = 4.5 \text{k} \]

\[ P_w = 4.5 \text{k} \]

\[ 0 = \Sigma F_x \implies F_B = 4.5 \text{k} \]

\[ 0 = \Sigma M_B = -15 (4.5) + 30 F_2 \implies F_2 = 2.25 \text{k} \]

\[ 0 = \Sigma F_y \implies F_1 = 2.25 \text{k} \]

\[ F = \sqrt{2.25^2 + 1.125^2} = 2.52 \text{k} \]

Exam Version A
(32 points). Use the ASD method to determine the allowable tensile load $P_u$/Ω with respect to the fracture mode and the holes (bearing/tearout) for the A36 Double Channel section (each channel is a C10×20) if it is connected to the gusset using $3/4''$ bolts in standard holes. Do not analyze the gusset.

**Fracture:**

\[ A_g = 11.74 \text{ in}^2 \]
\[ t_w = 0.379'' \]
\[ A_n = 11.74 - 4 \left( \frac{2}{3} \right) (0.379) = 10.41 \text{ in}^2 \]
\[ U = 1 - \frac{0.606''}{12''} = 0.950 \]
\[ \frac{P_n}{Ω} = \frac{(58 \text{ksi})(10.41 \text{ in}^2)(0.950)}{2} = 287 \text{k} \]

**Holes**

- **Edge @ 2''**: 52.2 k/'' w/ $3/4$ bolts, Table 7-5
- **Interior @ 3''**: 52.2 k/'' w/ $3/4$ bolts, Table 7-4

\[ \Rightarrow \frac{P_n}{Ω} = (52.2)(0.379'')(2 \text{ sides}) = 39.6 \text{k/ hole (both sides)} \]
\[ \Rightarrow \frac{P_n}{Ω} = (10 \text{ holes})(39.6 \text{k/ hole}) = 396 \text{k} \text{ hole bearings} \]