CE 311 Exam 4
October 24, 2014
50 minute time limit

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

Bonus Questions:
1. (8 points) It is known that the wooden beam shown will fail by elastic lateral-torsional buckling when subjected to the equal end-moments, shown. If $E=1000\text{ksi}$ and $G=400\text{ksi}$, determine the maximum moment that the beam can sustain.

\[
M_{cr} = \frac{\pi^2EI}{(200)^2} = \frac{13.2 \text{ kip$\cdot$in}}{}
\]

2. 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

3. What NHL hockey player has the record for most career goals in the regular season?

THE GREAT ONE - WAYNE GRETZKY

4. What institution of higher learning has won the greatest number of Division I Ice Hockey National Championships?

U. OF MICHIGAN

5. Spell the last name of the Head Men’s Basketball Coach from Duke University.

KRZCYNSCH
KRYZE4#CHT
KREYSCHEWIZZLE
KRZYzewski

Exam Version A
1. (50 points) Member A of the truss shown is a double angle 2L2½ x 2x 3/16" LLBB A36 member, connected with (3) 5/8" Group A N bolts, in standard holes. Determine if it is adequate per ASD, considering Yield, Fracture, and Bolts, only. You may use either method for the shear lag factor, U, but clearly indicate which was used.

**Diagram of Truss and Cross-Sections**

**Yield:** 
\[ \frac{P_n}{A_n} = \left(1.64 \text{ kips} \right) \left(36 \text{ ksi} \right) \left(\frac{8}{4} \right) = 35.4 \text{ kips} \]

**Fracture:** 
\[ A_e = 1.64 - \left(2 \text{ in} \right) \left(2.154 \right) \left(\frac{8}{4} \right) = 1.359 \text{ in}^2 \]

\[ A_e = 0.6 \left(1.359 \right) = 0.8154 \text{ in}^2 \]

\[ A_e = \frac{U A_n}{A} = 1.244 \text{ in}^2 \]

\[ \frac{P_n}{A_e} = \frac{\left(0.8154 \right) \left(35.4 \right)}{2} = 23.6 \text{ kips} \]

\[ \frac{P_n}{A_e} = \frac{\left(1.244 \right) \left(35.4 \right)}{2} = 36.1 \text{ kips} \]

**Bolts:** (3) (16.6 kips) = 49.8 kips

2 Alternates Shown:

- \[ U = 0.6 \left( \text{ Table D3.1} \right) \text{ or } U = 1 - \frac{0.508}{6} = 0.9153 \]

- \[ A_e = 0.6 \left(1.359 \right) = 0.8154 \text{ in}^2 \]

**Final Answers:**

- Applied Force in Member A, \( P = 30 \text{ kips} \)
- Yield, \( P_e \Omega = 35.4 \text{ kips} \)
- Fracture, \( P_f \Omega = 23.6 \text{ kips} \)
- Bolt Shear, \( P_s \Omega = 49.8 \text{ kips} \)
- Controlling Allowable Load, \( P_s \Omega = 23.6 \text{ kips} \)
- Is it Safe? (circle): YES or NO

\[ \text{Depends on } U \]

- \[ U = 0.6 \rightarrow \text{ NO} \]
- \[ U = 0.9153 \rightarrow \text{ YES} \]
1. (5 points). Double-angle bolted tension connections, (1) and (2) are shown. (1) and (2) have the same gross areas and bolt sizes. Circle the correct answer.

- (1) has higher fracture strength, (2) has higher hole bearing strength.
- (2) has higher fracture strength, (1) has higher hole bearing strength.
- (1) has higher fracture strength, (1) has higher hole bearing strength.
- (2) has higher fracture strength, (2) has higher hole bearing strength.

2. (5 points). Which connection has the lowest fracture strength? All connections have the same gross areas, the same 3/4" bolts, and the same spacings. Connection A has standard 13/16" holes. Connections B and C have short-slotted holes (13/16" x 1"), but with different orientations, as shown.

Cross-Section (same for all)

Connection A: Standard Holes

Connection B: Short-Slotted Holes

Connection C: Short-Slotted Holes

The lowest fracture strength is (circle the correct answer):

- A
- B
- C

3. (5 points). TRUE or FALSE. AISC dimensional specifications permit 2 lines of bolts to be used in an L5x3x 3/4" shape, if the long legs are back-to-back.

Are Two Lines of Bolts Permitted?
4. (35 points). The building shown has story heights of 30' and all column lines are 40' apart. The building is subjected to 20 psf wind pressure, directed from South to North. All connections are simple, non-moment-resisting. The roof acts as a diaphragm. The exterior wall consists of the stud-framing, spanning from a foundation wall to the roof diaphragm, as shown along column line C, between lines 2 and 3 (but not shown elsewhere, for clarity). Answer the following:

A. Magnitude of force in Brace A.
B. Magnitude of force in Brace B.
C. TRUE or FALSE. Column C is considered braced by the roof diaphragm and would, therefore be designed for KL=50' 

FINAL ANSWERS:
A. Force in Brace A: 15 kips
B. Force in Brace B: 0 kips
C. Circle TRUE or FALSE