LESSON OBJECTIVES
1. **Distinguish** between N, X, and SC bolts and describe where each would be specified.
2. **Compute** the nominal bolt-shear strength of an N or X bolt, \( r_n \), and use this to compute the nominal strength of the entire connection, \( R_n \).
3. **Compute** the bolt-slip allowable strength of an SC bolt, \( r_n \), and use this to compute the capacity of the entire connection, \( R_n \).
4. **Determine** bolt nominal strengths via Part 7 tables.
5. **Select** the number of bolts needed for a connection (not covered in class, but pretty darned self-evident after 5 other examples)

TERMS
- \( A_b \) = the nominal cross-sectional area (in\(^2\)) of the bolt or threaded rod.
- “faying surface” = the contact surfaces for a slip critical connection. A class A surface is a standard surface with a coefficient of friction of 0.30, while a class B surface has been blast-cleaned for a coefficient of friction of 0.50.
- \( F_{nv} \) = the max shear stress (ksi) of a bolt
- \( F_{nt} \) = the max tensile stress (ksi) of a bolt
- \( r_{all} \) = the allowable capacity of a bolt (kips)
- \( R_{all} \) = the allowable capacity of all the bolts in a connection (kips)
- \( r_n \) = the nominal strength of a bolt (kips)
- \( R_n \) = the nominal strength of all the bolts in a connection (kips)

REMEMBER: The shear strength of a ductile metal is generally equal to 0.60 times the metal’s tensile strength.

REFERENCE
- **Required Reading:**
  - Segui Textbook: pp. 377 to 397 (but “bolt bearing” will be covered in Lesson 22)
  - AISC Chapter J (found in part 16): sections J.3.1 to J.3.8
- **Key reference:** Part 7 Bolt tables (Tables 7-1, 7-2, and 7-3 will be used on the homework).
- **Course Website:** See the powerpoint on bolts for today.
**Lesson 21: Bolted Connections - Bolts**

**NAME:** __________________________________________

**HOMEWORK** - due Friday. Presentation does not count. Simply hand this sheet in, showing the answers in the units specified, only (please don’t cover the page in random scribbling. Do your work elsewhere)

1. A 3/8" diameter bolt was tested in tension, failing at a load of 6.63 kips. A single ½" diameter bolt from the same manufacturer, manufactured from the same steel (assume the failure stress is identical) will be used in a double shear application, as shown. Determine: \( P_n \), \( P_n/\Omega \), and \( \phi P_n \) for the bolted connection, assuming that bolt shear controls.

\[
\text{P_n, P_n/\Omega, and } \phi P_n
\]

\[
\text{Side View}
\]

\[
\text{Top View}
\]

Answers: \( P_n = \) _________ kips \( P_n/\Omega = \) _________ kips \( \phi P_n = \) _________ kips

2. Reading (Chapter J in AISC): TRUE or FALSE. An ASTM A490 bolt is considered to be a “Group B” bolt.

3. What is the minimum bolt pretension that is required for a 7/8” Group B bolt, per AISC specifications?

Answer: Minimum bolt pretension = ______________ kips

4. Would it be safe per ASD standards for an A325 bolt to be subjected to a tensile stress of 50 ksi?

Circle the Answer: SAFE UNSAFE

5. The beam-to-column connection shown is called a double-angle all-bolted framed beam connection. Because it is a non-moment-resisting connection, it must only be designed for resisting vertical shear forces. It uses two angles (L shapes) that “sandwich the web of the beam, as shown. If the connection uses 1” Group A N bolts (threads not excluded from the shear planes), determine the ASD allowable shear force \( R_n/\Omega \) for the connection.

Answer: \( R_n/\Omega = \) ______________ kips

6. Determine the number of Group A ¾” N bolts that are needed for the following problem, using ASD. The tension member is subjected to 80 kips tension due to wind load and 5 kips tension due to live load. Note: be sure to use the ASD load combinations, properly (the 80 kips wind is, indeed, an “ultimate wind” that will be reduced per ASD combinations).

Answer: ____________ bolts
7. For all of the same given information as the previous problem, determine the number of $\frac{3}{4}''$ Group A slip-critical (SC) bolts that are needed, assuming that a Class A faying surface exists and that the holes are standard (STD). There are no filler plates.

Answer: ____________ bolts

8. For all of the same given information as the previous two problems, determine the number of $\frac{3}{4}''$ Group A slip-critical (SC) bolts that are needed, assuming that a Class B faying surface exists and that the holes are long-slotted (LSLT). There are no filler plates.

Answer: ____________ bolts

9. Reading question (Chapter J). Report the dimensions for a Standard (STD), Oversize (OVS), Short-Slot (SSLT), and Long-Slot (LSLT) hole for a $\frac{3}{4}''$ diameter bolt:

Answers:

<table>
<thead>
<tr>
<th>Type</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD</td>
<td>__________</td>
</tr>
<tr>
<td>OVS</td>
<td>__________</td>
</tr>
<tr>
<td>SSLT</td>
<td>__________</td>
</tr>
<tr>
<td>LSLT</td>
<td>__________</td>
</tr>
</tbody>
</table>

10. What is the $\Omega$ factor for a slip-critical bolt in a long-slotted hole?
Answer:

11. Bolts are usually subjected to shear, but here is a case in which a connection subjects bolts to tension. In this case, a “Tee” shape is bolted as shown and subjected to a force that puts tension on the bolts. If the bolts are $\frac{3}{4}''$ diameter Group A bolts, determine the ASD allowable tensile force for the connection (note: if you take an advanced steel course, you will learn that this type of connection is also prone to a phenomenon known as “prying action.” However this is beyond the scope of CE311).

Answer:

$$R_n/\Omega = \text{______________ kips}$$