### Load Combinations for LRFD: (AISC Manual, p. 2-8)

<table>
<thead>
<tr>
<th>Expression</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4D</td>
<td></td>
</tr>
<tr>
<td>1.2D + 1.6L + 0.5(Lr or S or R)</td>
<td>(1)</td>
</tr>
<tr>
<td>1.2D + 1.6(Lr or S or R) + (0.5L + 0.8W)*</td>
<td>(2)</td>
</tr>
<tr>
<td>1.2D + 1.6W + 0.5L + 0.5(Lr or S or R)*</td>
<td>(3)</td>
</tr>
<tr>
<td>1.2D ± 1.0E + 0.5L + 0.25S*</td>
<td>(4)</td>
</tr>
<tr>
<td>0.9D ± (1.6W or 1.0E)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

*Factor for L is 1.0 for garages or public areas in which live load is greater than 100 psf.

**Study example 2.1, pp. 23-24**

Note: Most structural analysis software packages (Visual Analysis, RISA, etc.) incorporate these load combinations.
2.4) **Probabilistic Basis for Load and Resistance Factors**

- \( R = \text{resistance} \)
- \( Q = \text{load effects} \)
- \( \frac{R}{Q} < 1 \) \( \Rightarrow \) "FA(UL)R"

\[
P_f = P \left[ \ln \left( \frac{R}{Q} \right) < 0 \right]
\]
\[ U = \ln \left( \frac{R}{Q} \right) - \left[ \ln \left( \frac{R}{Q} \right) \right]_m \]

\[ \sigma_{\ln \left( \frac{R}{Q} \right)} \]

\[ P_F = P \left\{ \left( U \sigma_{\ln \left( \frac{R}{Q} \right)} + \left[ \ln \left( \frac{R}{Q} \right) \right]_m \right) < 0 \right\} \]

**Ultimately:** \[ \beta = \frac{\left[ \ln \left( \frac{R}{Q} \right) \right]_m}{\sigma_{\ln \left( \frac{R}{Q} \right)}} \]

and \[ \phi = \frac{R_m}{R_n} e^{0.55 \beta V_R} \]

(see textbook for more details)
2.5) Manual of Steel Construction, AISC 3rd Edition

For the next 14 weeks in CVEN 446 - studying and familiarizing with many parts of this manual, in particular the specifications (Part 16) and the design aids.

2.6 Design Computations and Precision

Use as many figures as your calculator will handle when computing. When reporting answers use no more than 3 or 4 (max.) significant figures. Using more than this is not justified because of uncertainty in loads, material properties, member properties, etc.
3.1) Introduction: Chapter B, D, J of AISC Manual

- "Simpliest" of all members to design.
- Tension members: members in a truss or brace in a frame

- Shapes typically used: Channel, W-shape, Angle, Double Angle, HSS (also rods and cables not studied in 446)

| Stress: \( f = \frac{P}{A} \) | Axial Stress
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( f ) = axial stress</td>
<td>( P ) = axial load</td>
</tr>
<tr>
<td>( A ) = cross-section area</td>
<td></td>
</tr>
</tbody>
</table>

Applicable Limit States:

1) Gross-section yielding (G-SY) \( \) Chapter D
2) Net-section fracture (NSF) \( \) Chapter J
3) Block shear rupture fracture (BSR, BSF) \( \) Chapter J
3.2-3.4) Analysis' Design of Members

**Gross Area and Net Area:** Chapter B, p.16.1-14

\[ A_g = \text{gross area} = \text{total cross-sectional area} \]

\[ A_n = \text{net area} \]

\[ A_n = A_g - A_{\text{holes}} \]

\[ A_{\text{holes}} = \sum_i d_i \cdot t_i \]

- **Where:**
  - \( n = \# \) of holes through the cross-section of interest
  - \( t_i = \text{thickness of the element} \)
  - \( d_i = d_{\text{hole}} + \frac{1}{16} '' \) for damage
  - \( d_i = d_{\text{bolt}} + \frac{1}{16} '' + \frac{1}{6} '' \) for damage
  - Standard overdrill

Note: \( d_{\text{hole}} = d_{\text{bolt}} + \frac{1}{16} '' \) for a standard hole.
Effective Net Area

\[ A_e = \text{effective net area} \]

\[ A_e = U A_n \]

(for bolted connections)

\[ A_e = U A_n \]

(for welded connections)

\[ U = \text{shear lag factor, see Table D3.1, p.16.1-29 of AISC Manual.} \]

When all "elements" of a cross section are connected by a fastener or weld to transmit load, \[ U = 1.0 \]

**W-section:**

\[ U = 1.0 \]
Not all elements connected, \( U \leq 1.0 \) due to effects of "shear lag."

Consider:

"Ineffective material" \( \frac{3}{3} \) critical section

Case #1

\[ (Ae)_{\text{case}} 1 < (Ae)_{\text{case}} 2 \]