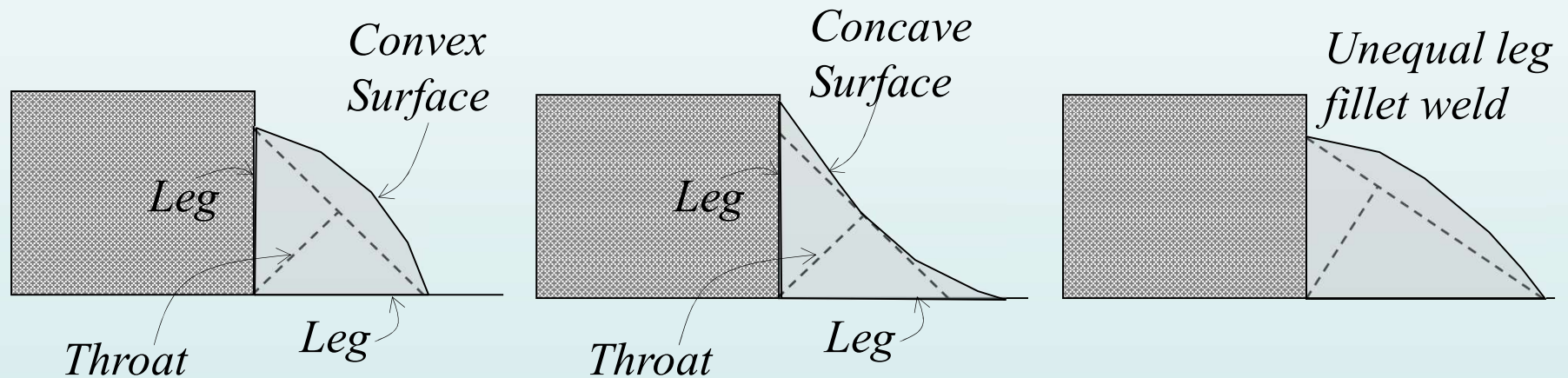


# Fillet Weld

- Stronger in tension and compression than in shear



- Fillet weld designations:

**12 mm SMAW E70XX:** fillet weld with equal leg size of 12 mm, formed using *Shielded Metal Arc Welding* Process, with filler metal electrodes having a minimum weld tensile strength of 70 ksi.

**9 mm-by-12 mm SAW E110XX:** fillet weld with unequal leg sizes, formed by using *Submerged Arc Metal* process, with filler metal electrodes having a minimum weld tensile strength of 758 MPa.

# Fillet Weld Strength

*Stress in fillet weld = factored load/eff. throat area*

Limit state of **Fillet Weld** is shear fracture through the throat, regardless of how it is loaded

$$\phi = 0.75$$

$$f_w = 0.6 F_{EXX}$$

Design Strength:

$$\phi V_n = \phi f_w t_e L_w$$

For equal leg fillet weld:

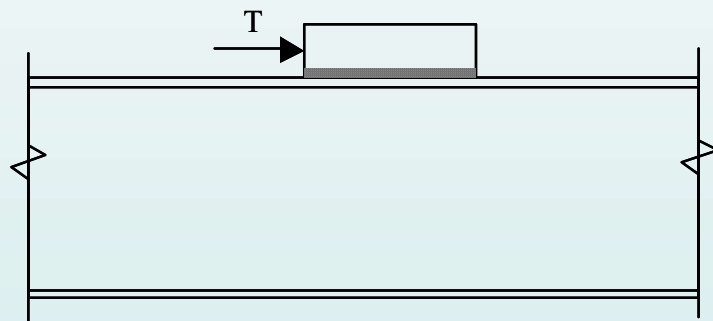
$$\phi V_n = \phi f_w (0.707 a) L_w$$

# Design of Welded Connections

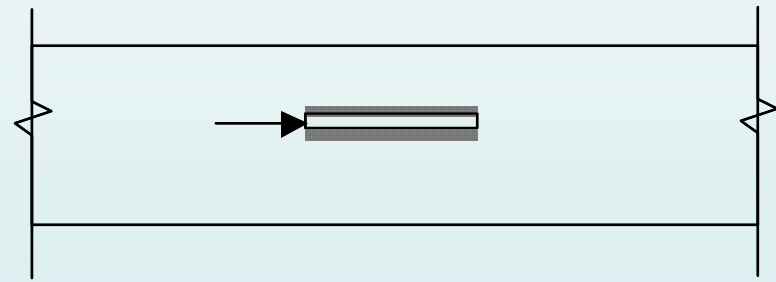
- **Table J2.5** in the AISC Specifications gives the weld design strength
  - $f_w = 0.60 F_{EXX}$
  - For E70XX,  $\phi f_w = 0.75 \times 0.60 \times 482 = 217 \text{ MPa}$
- Additionally, the shear strength of the base metal must also be considered:
  - $\phi R_n = 0.9 \times 0.6 F_y \times \text{area of base metal subjected to shear}$
  - where,  $F_y$  is the yield strength of the base metal.

# Design of Welded Connections

- For example



Elevation



Plan

Strength of weld in shear =  $0.75 \times 0.707 \times a \times L_w \times f_w$

- In weld design problems it is advantageous to work with strength per unit length of the weld or base metal.

# Limitations on Weld Dimensions

- Minimum size ( $a_{\min}$ )
  - Function of the thickness of the thinnest connected plate
  - Given in Table J2.4 in the AISC specifications
- Maximum size ( $a_{\max}$ )
  - function of the thickness of the thinnest connected plate:
  - for plates with thickness  $\leq 6$  mm,  $a_{\max} = 6$  mm.
  - for plates with thickness  $\geq 6$  mm,  $a_{\max} = t - 2$  mm.  $>6$ mm
- Minimum length ( $L_w$ )
  - Length ( $L_w$ )  $\geq 4 a$  otherwise,  $a_{\text{eff}} = L_w / 4$   $a =$  weld size
  - Read J2.2 b page 16.1-95
  - Intermittent fillet welds:  $L_{w-\min} = 4 a$  and 38 mm.

# Limitations on Weld Dimensions

**TABLE J2.4**  
**Minimum Size of Fillet Welds**

<b>Material Thickness of Thinner Part Joined, in. (mm)</b>	<b>Minimum Size of Fillet Weld, <sup>[a]</sup> in. (mm)</b>
To 1/4 (6) inclusive	1/8 (3)
Over 1/4 (6) to 1/2 (13)	3/16 (5)
Over 1/2 (13) to 3/4 (19)	1/4 (6)
Over 3/4 (19)	5/16 (8)

<sup>[a]</sup> Leg dimension of fillet welds. Single pass welds must be used.

Note: See Section J2.2b for maximum size of fillet welds.

## Limitations on Weld Size – AISC Specifications J2.2b Page 16.1-95

- The *minimum length* of fillet weld may not be less than 4 x the weld leg size. If it is, the effective weld size must be reduced to  $\frac{1}{4}$  of the weld length
- The *maximum size* of a fillet weld along edges of material less than 6 mm thick equals the material thickness. For material thicker than 6 mm, the *maximum size* may not exceed the material thickness less 2 mm. (to prevent melting of base material)
- The *minimum weld size* of fillet welds and *minimum effective throat thickness* for partial-penetration groove welds are given in LRFD Tables J2.4 and J2.3 based on the thickness of the base materials (to ensure fusion and minimize distortion)
- *Minimum end return* of fillet weld  $\geq 2$  x weld size

# Limitations on Weld Dimensions

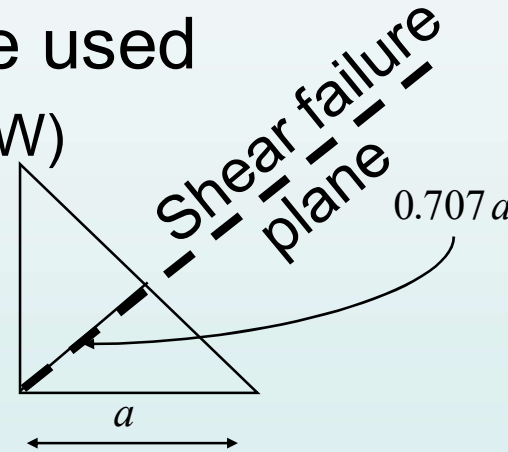
- **Maximum effective length - read AISC J2.2b**
  - If weld length  $L_w < 100 a$ , then effective weld length  $(L_{w\text{-eff}}) = L_w$
  - If  $L_w < 300 a$ , then effective weld length  $(L_{w\text{-eff}}) = L_w (1.2 - 0.002 L_w/a)$
  - If  $L_w > 300 a$ , the effective weld length  $(L_{w\text{-eff}}) = 0.6 L_w$
- **Weld Terminations - read AISC J2.2b**
  - Lap joint – fillet welds terminate at a distance  $> a$  from edge.
  - Weld returns around corners must be  $> 2 a$



# Guidelines for Fillet Weld design

- Two types of fillet welds can be used
  - Shielded Metal Arc Welding (SMAW)

$$t_{eff} = 0.707 a$$



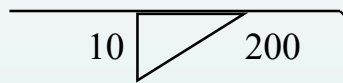
- Automatic Submerged Arc Welding (SAW)

$$t_{eff} = a$$

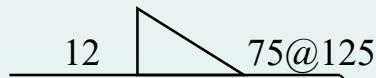
AISC – Section J2.2

# Weld Symbols

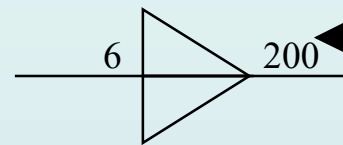
## (American Welding Society AWS)



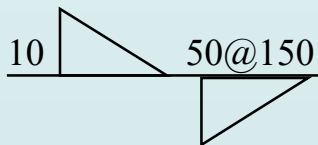
Fillet weld on arrow side. Weld's leg size is 10 mm. Weld size is given to the left of the weld symbol. Weld length (200 mm) is given to the right of the symbol



Fillet weld, 12 mm size and 75 mm long intermittent welds 125 on center, on the far side



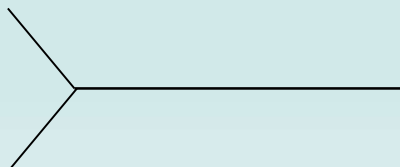
Field fillet welds, 6 mm in size and 200 mm long, both sides.



Fillet welds on both sides, staggered intermittent 10 mm in size, 50 mm long and 150 mm on center



Weld all around joint



Tail used to reference certain specification or process