CE 415
DESIGN OF STEEL STRUCTURES

LECTURE 9
WELDING

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OUTLINE

- Welding Specification
- Welding Symbol
- Types of welded joints
- Fillet weld design

What is welding?

Welding is the process of joining materials (usually metals) by heating them to suitable temperatures such that the materials coalesce into one material. There may or may not be pressure, and there may or may not be filler material applied.

Arc welding is the general term for the many processes that use electrical energy in the form of an electric arc to generate the heat necessary for welding.

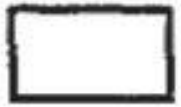
Shielded Metal Arc Welding (SMAW)

- The electrode material is specified under various American Welding Society specifications.
- The designations such as E60XX or E70XX indicate 60 ksi and 70 ksi, respectively, for tensile strength.
- For welding high-carbon or low-alloy steels, low-hydrogen electrodes are required to be used with SMAW for all steels having yield stresses higher than 36 ksi (248 MPa). The low-hydrogen electrode is a rod with a carbonate of soda, or 'lime' coating.

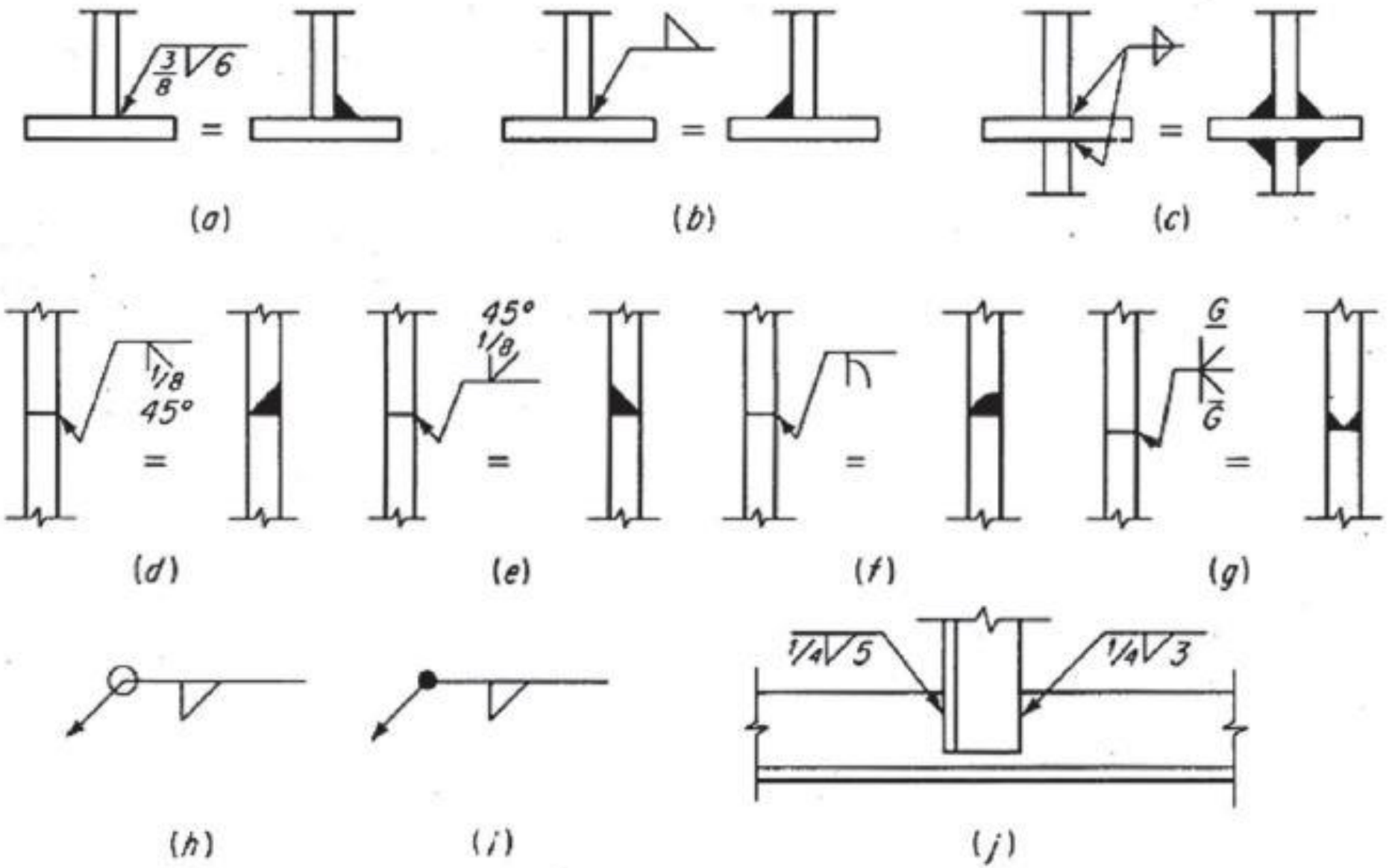
Welding Specifications

AWS: American Welding Society
ASTM: American Society for Testing & Materials

Welding Symbol

Basic Weld Symbols									
			Groove or Butt						
Back	Fillet	Plug or Slot	Square	V	Bevel	U	J	Flare V	Flare Bevel
									
Supplementary Weld Symbols									
Backing	Spacer	Weld All Around	Field Weld	Contour		For other basic and supplementary weld symbols, see AWS A2.4			
				Flush	Convex				
									

Welding Symbol

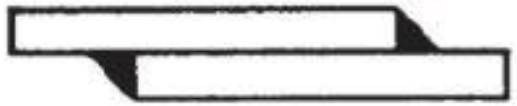


TYPES OF WELDED JOINTS

There are five basic types of welded joints, although many variations and combinations are found in practice. The five basic types are the

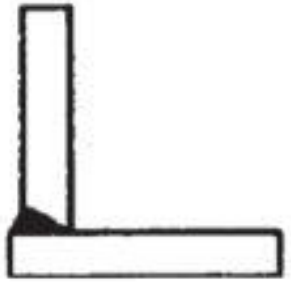
a) **Butt joint**
b) **Lap joint**
c) **Tee joint**
d) **Corner joint**
e) **Edge joints**

(a) Butt joint



(b) Lap joint

(c) Tee joint



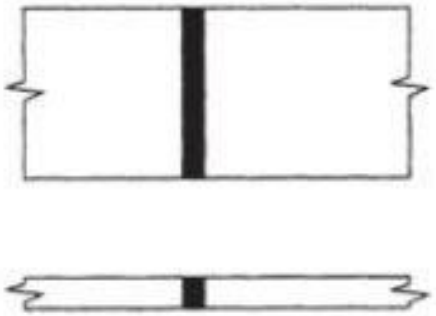
(d) Corner joint

(e) Edge joint

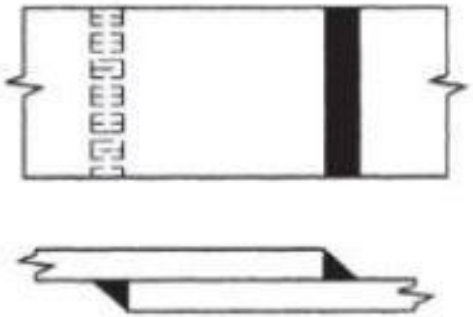
TYPES OF WELDS

There are four basic types of welds:

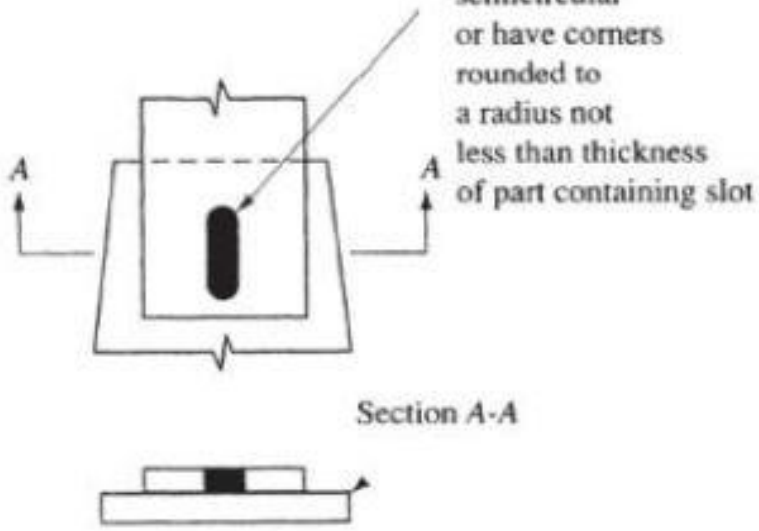
a) Groove weld
b) Fillet weld
c) Slot weld
d) Plug weld



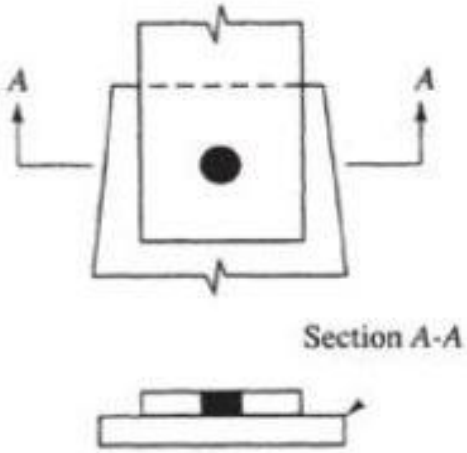
(a) Groove weld



(b) Fillet welds



(c) Slot weld



(d) Plug weld

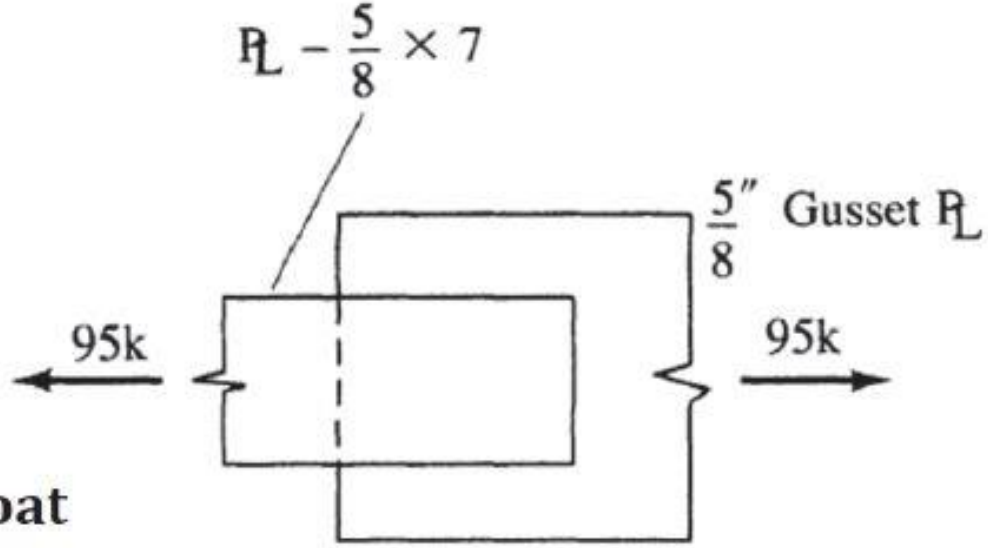
Examples

Determine the size and length of the fillet weld for the lap joint shown in Fig. Follow ASD. All plates are A36 steel (F_y = 36 ksi, F_u = 58 ksi)

Referring to Sec. 5.11, AISC-J2.2b gives the following limits of weld size,

$$\text{Maximum size} = \frac{5}{8} - \frac{1}{16} = \frac{9}{16} \text{ in.}$$

$$\text{Minimum size} = \frac{1}{4} \text{ in.}$$



(a) Problem

Use ½-in. fillet weld, the effective throat dimension, t_e, is taken as

$$t_e = 0.707a = 0.707(0.50) = 0.354 \text{ in.}$$

Choose E60XX weld, F_{EXX} = 60 ksi. The nominal strength of ½-in. fillet weld per inch of length, according to Eq. 5.13.1,

$R_{nw} = 0.6t_eF_{EXX} = 0.6(0.354)(60) = 12.74$ kip/in

Example contd....

Allowable strength of weld , R_{nw}/Ω = 12.74/2.0 = 6.37 kip/in

Check 7" wide plate shear $\frac{R_n}{\Omega} = \frac{0.6tF_y}{1.50}$ **= [0.6(5/8)36]/1.5=9.0 k/in**

plate rupture $\frac{R_n}{\Omega} = \frac{0.6tF_u}{2.00}$ **= [0.6(5/8)58]/2=10.88 k/in**

∴ Weld strength controls,

Weld length = 95/6.37=14.9 in. Use 7½-in on each side.