WELDED CONNECTION

welded connection -advantages

(a) Joint efficiency is 100%.

(b) Fabrication in difficult structure is easy.

(c) Pure silence prevails during process (even though small sound is heard during oxy-acetelene welding) when compared to rivetting.

(d) No safety precautions are needed.

(e) Welding process is much faster.

(f) Welding process is much economical.

(g) This method always provide rigid joints.

(h) Minimum self weight for structure

welded connection -disadvantages

(a) Since welding is a hot process involving in non-uniform heating and cooling, structural members will be subjected to distortion resulting in more unwanted stress.

(b) Welded structures are subjected to cracks due to non-provision of expansion and contraction.

(c) Very high labour cost since skilled labour is required.

(d) Checking and verification of welding work is very difficult.

(e) Structure may be subjected to fatigue and susceptible to failure by cracking under repeated cyclic loads.

(f) Tearing of base metal plate may occur beneath the weld- known as Lamellar tearing.

WELDED CONNECTION

- Welding is the procedure of joining two metal portions in the molten state with or without pressure.
- Electric-arc-welding is commonly used.
- Part of metal to be welded is melted by using electric arc or oxyacetylene flame along with a weld rod.
- Arc heat will melt both the metal part and rod at the same time.
- Fusion happens as welding rod material flows across the arc.
- Welding rod used may be shielded or unshielded.
- In the shielded type, electrode will be coated with mineral compounds (flux) producing a gaseous shield which helps to avoid oxygen and thus stabilizing the arc.
- Shielded type improves the quality of work.

TYPES OF WELDS

- Two commonly used types are

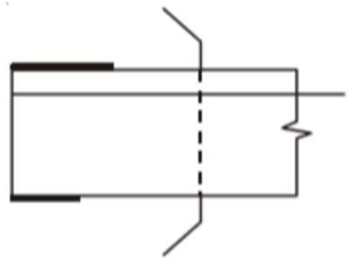
1. Fillet weld
2. Butt (groove) weld

FILLET WELD

- Used for lap joints

1. When two plates overlap each other.

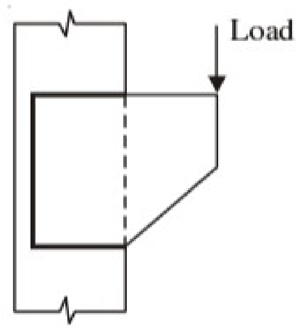
2. When a truss member is required to be connected to a gusset plate.



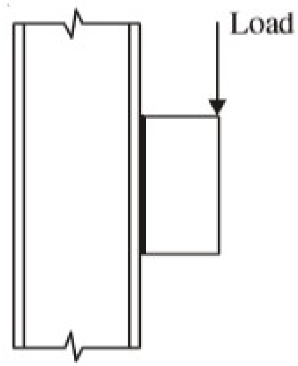
FILLET WELD

3. When there is eccentric bracket connection

Case (a) in-plane moment



Case (b) out-of plane moment

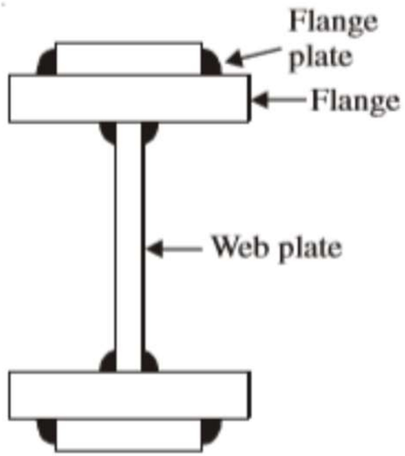


FILLET WELD

4. When plates are joined to form beams

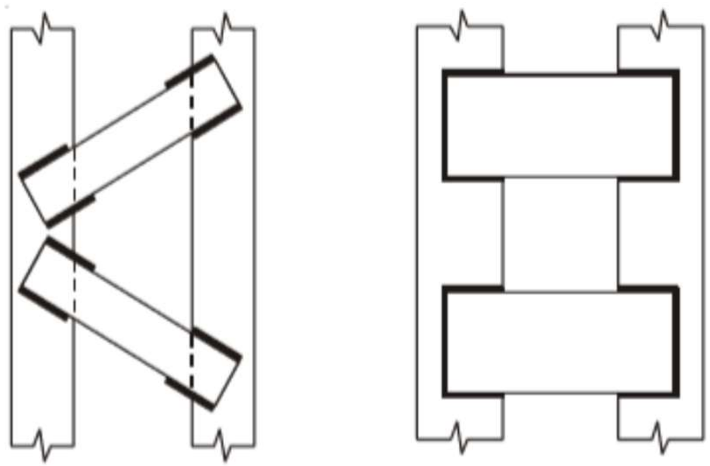
e.g., plate girder.

Welds are used to connect web plate with flange plate and also to connect flange to flange plates.



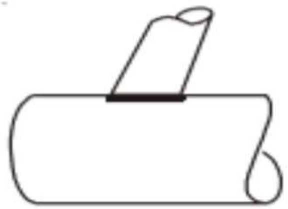
FILLET WELD

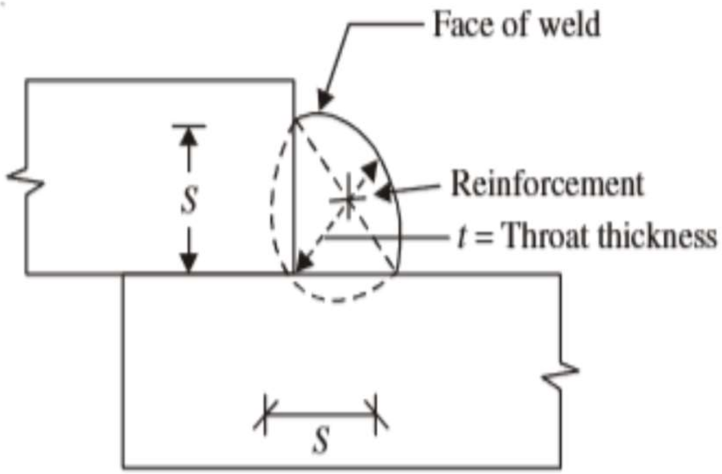
5. Lacing and battering connection in columns



FILLET WELD

6. Welded connection in tubular trusses.





SIZE OF WELD

- p78 Cl. 10.5.2.3
- The size of fillet welds shall not be less than 3 mm. The minimum size of the first run or of a single run fillet weld shall be as given in Table 21, to avoid the risk of cracking in the absence of preheating.

Table 21 Minimum Size of First Run or of a Single Run Fillet Weld

(*Clause* 10.5.2.3)

Sl No.	Thickness of Thicker Part mm		Minimum Size mm
	Over	Up to and Including	
(1)	(2)	(3)	(4)
i)	–	10	3
ii)	10	20	5
iii)	20	32	6
iv)	32	50	8 of first run 10 for minimum size of weld

NOTES

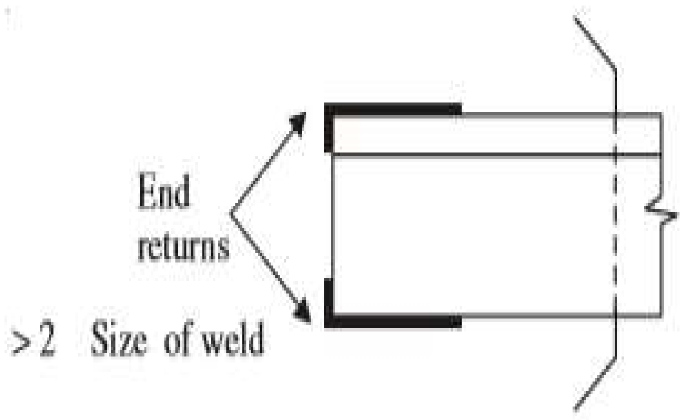
1 When the minimum size of the fillet weld given in the table is greater than the thickness of the thinner part, the minimum size of the weld should be equal to the thickness of the thinner part. The thicker part shall be adequately preheated to prevent cracking of the weld.

2 Where the thicker part is more than 50 mm thick, special precautions like pre-heating should be taken.

END RETURNS

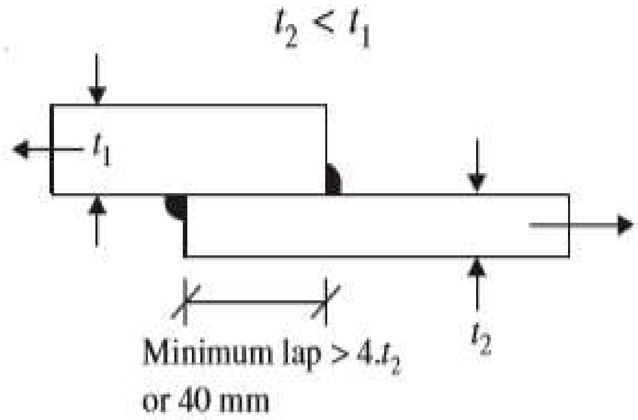
- Cl. 10.5.1.1

Fillet welds terminating at the ends or sides of parts should be returned continuously around the corners for a distance of not less than twice the size of the weld, unless it is impractical to do so. This is particularly important on the tension end of parts carrying bending loads.



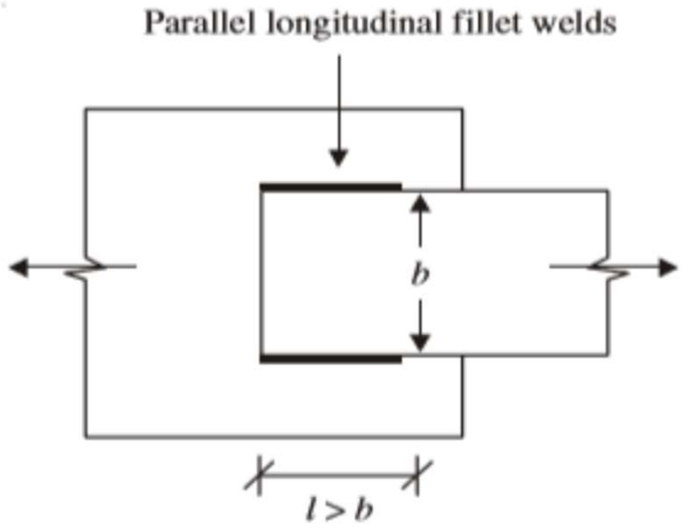
LAP JOINT

- Cl. 10.5.1.2
- In the case of lap joints, the minimum lap should not be less than four times the thickness of the thinner part joined or 40 mm, whichever is more. Single end fillet should be used only when lapped parts are restrained from openings. When end of an element is connected only by parallel longitudinal fillet welds, the length of the weld along either edge should not be less than the transverse spacing between longitudinal welds.



- Minimum lap > $4t_2$ or 40 mm whichever is more.

LAP JOINT

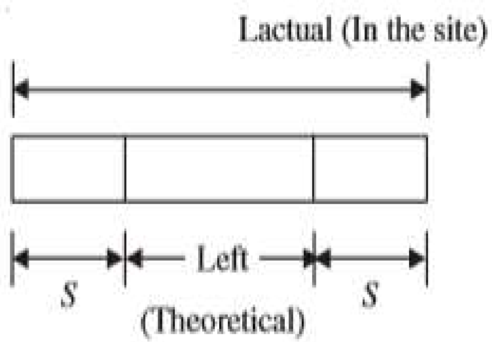


- where, b = Transverse spacing between longitudinal welds

LAP JOINT

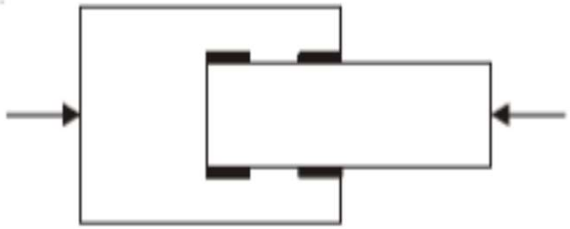
- Cl. 10.5.4.1
- The effective length of fillet weld shall be taken as only that length which is of the specified size and required throat thickness, In practice the actual length of weld is made of the effective length shown in drawing plus two times the weld size, but not less than four times the size of the weld.

- In the site, $l_{actual} = l_{effect} + 2 \times S$
- Where, S = Size of weld
- But $l_{actual} > 4S$

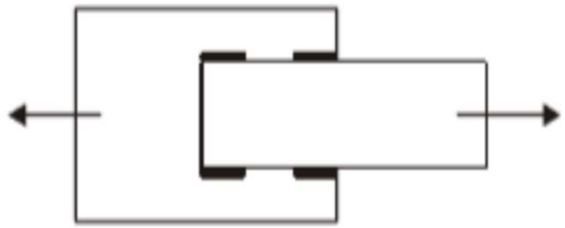


LAP JOINT

- Cl. 10.5.5.2
- The clear spacing between the effective lengths of intermittent fillet weld shall not exceed 12 and 16 times the thickness of thinner plate joined, for compression and tension joint respectively, and in no case be more than 200 mm.



Clear spacing < 12 thickness of thinner plate



Clear spacing < 16t

- In no case be more than 200 mm
- i.e., clear spacing should be < 200 mm.

FILLET WELD

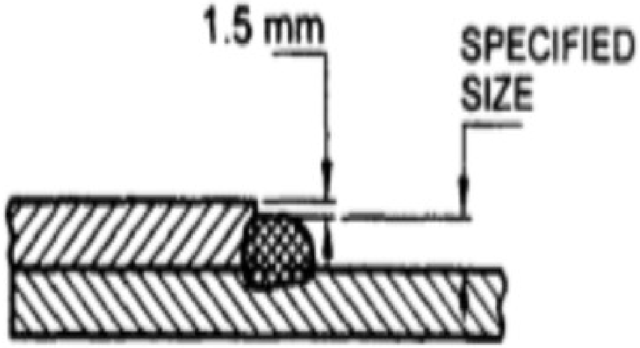
Cl. 10.5.7.1.1

- Design strength of a fillet weld based on its throat area
- Design strength of fillet weld, f_{wd} = $\frac{f_{wn}}{\gamma_{mw}}$
- f_{wn} = $\frac{f_u}{\sqrt{3}}$
- f_4 = smaller of ultimate stress of weld or of parent metal
- P30 γ_{mw} = 1.25 (Shop fabrication)

  = 1.5 (Field fabrication) [Site weld]

FILLET WELD

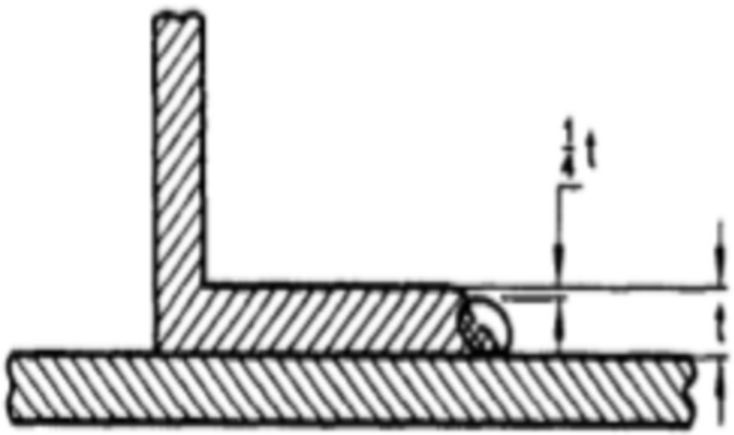
- Cl. 10.5.8.1
- Where a fillet weld is applied to the square edge of a part, the specified size of the weld should generally beat least 1.5 mm less than the edge thickness in order to avoid washing down of the exposed arris (see Fig. 17A).



17A

FILLET WELD

- Cl. 10.5.8.2
- Where the fillet weld is applied to the rounded toe of a rolled section, the specified size of the weld should generally not exceed 3/4 of the thickness of the section at the toe (see Fig. 17B).

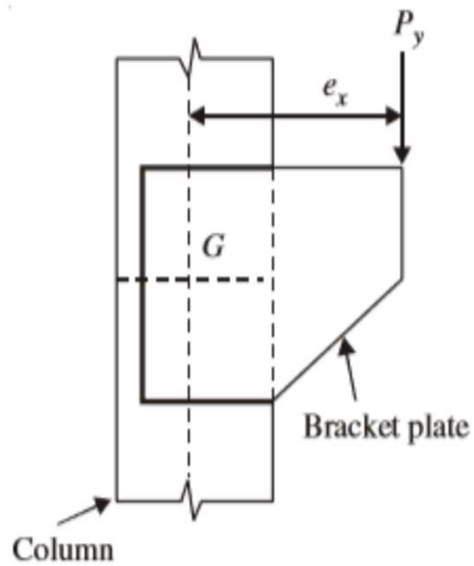


17B

ECCENTRIC WELDED BRACKET CONNECTION

Case 1: **In-plane loading**

- Consider a joint in which bracket plate is welded to a flange of a column using fillet weld. Let shape of weld line be "C". Let eccentric load be p_y and eccentricity be e_x .
- Consider unit length of weld (say 1 mm).



IN-PLANE LOADING…..

- Let L = Total length of weld
- Let R_T = Resistance offered by weld against translation
- R_T = $\frac{P_y}{L}$
- Consider a position 'i' at a distance r_i from G.
- This portion of weld will be subjected to a resistance against rotation, R_R which will be proportional to r_i
- $R_R \propto r_i$
- R_R = kr_i
- where, k is a constant of proportionality.

IN-PLANE LOADING…..

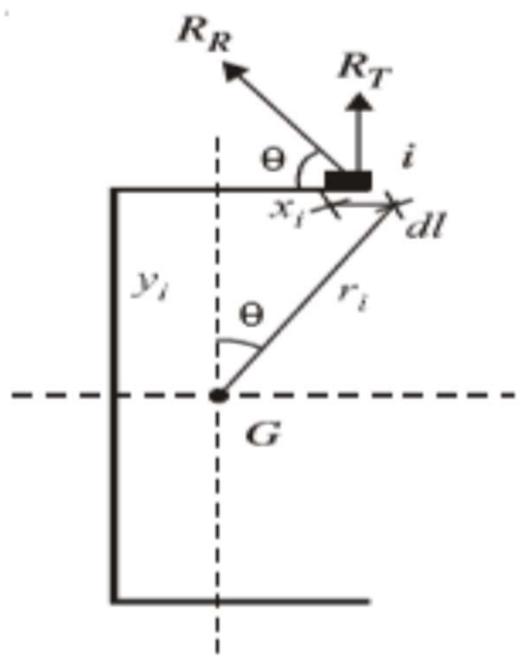
- If we consider an infinitesimal length dl of the weld,
- Then R_R = $kr_i dl$
- Moment of resistance offered by weld is
- M_R= $R_R\ r_i$ =$k\ dl\ r_i{}^2$
- If we consider entire weld length,
- Total moment of resistance, is $\sum M_R = k \sum dl\ \ r_i{}^2 = kI_p$
- Where, I_p= I_x+ I_y
- I_p is the polar moment of inertia. This should be equal to $p_y\ e_x$.

IN-PLANE LOADING…..

- $kI_p = p_y e_x$
- $k = \frac{p_y e_x}{I_p}$
- $R_R = kr_i = (\frac{p_y e_x}{I_p})\, r_i$

For unit length of weld

- Considering $\sum V$,
- $V = R_T + R_R \sin\theta$
- $V = \frac{p_y}{L} + \frac{p_y e_x}{I_p} r_i \times \frac{x_i}{r_i}$
- $V = \frac{p_y}{L} + \frac{p_y e_x}{I_p} x_i$



IN-PLANE LOADING…..

- Similarly, $\mathrm{H} = R_R \cos\theta$
- $\mathrm{H} = \frac{p_y e_x}{I_p}\, r_i \times \frac{y_i}{r_i}$
- $\mathrm{H} = \frac{p_y e_x}{I_p}\, y_i$
- Resultant force, $R = \sqrt{V^2 + H^2}$
- If this is less than strength of weld then OK.