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Unit-3

Welded Connections

* **Welded Connection :-**

Welded Joints or Connections are the Connections used for Joining of structural members by means of welding Process.

* **Welding :-**

The Process of permanently Joining two or more metal parts under the application of heat with or without pressure is known as welding.

⇒ Mild steel, Cast iron, Copper, brass and aleminium members can be welded by application of heat with or without Pressure.

* **Advantages and disadvantages of welded Joints over Riveted Joints :-**

⇒ ADVANTAGES :-

1.) The welded structures are comparatively lighter than corresponding riveted structures.
2.) The welded Joint has greater Strength as Compared to the riveted Joint.
3.) Additions and alterations can be easily made in the existing welded structure more easily than in riveted structure.

4.) A welded structure has a better finish and appearance than the corresponding riveted structure.

5.) The maintenance and painting cost for a welded structure is less than for the riveted structure.

6.) Welding takes less time than riveting.

7.) In welded connections the tension members are not weakened as in the riveted joints.

8.) Members of such shapes, which are difficult for riveting can be easily welded.

9.) It is possible to weld any part of a structure at any point But riveting requires enough clearance.

10.) No noise is produced during welding process but the riveting process is too much noisy.

11.) In welded connections the use of angles, gusset plates, splicing plates can be minimised and in many cases can be avoided.

12.) The welded joints have more efficiency than riveted joints.

Types of Welds :—

Welds may be classified depending upon the following ways :-

1.) Position of welds.

2.) Formation of welds.

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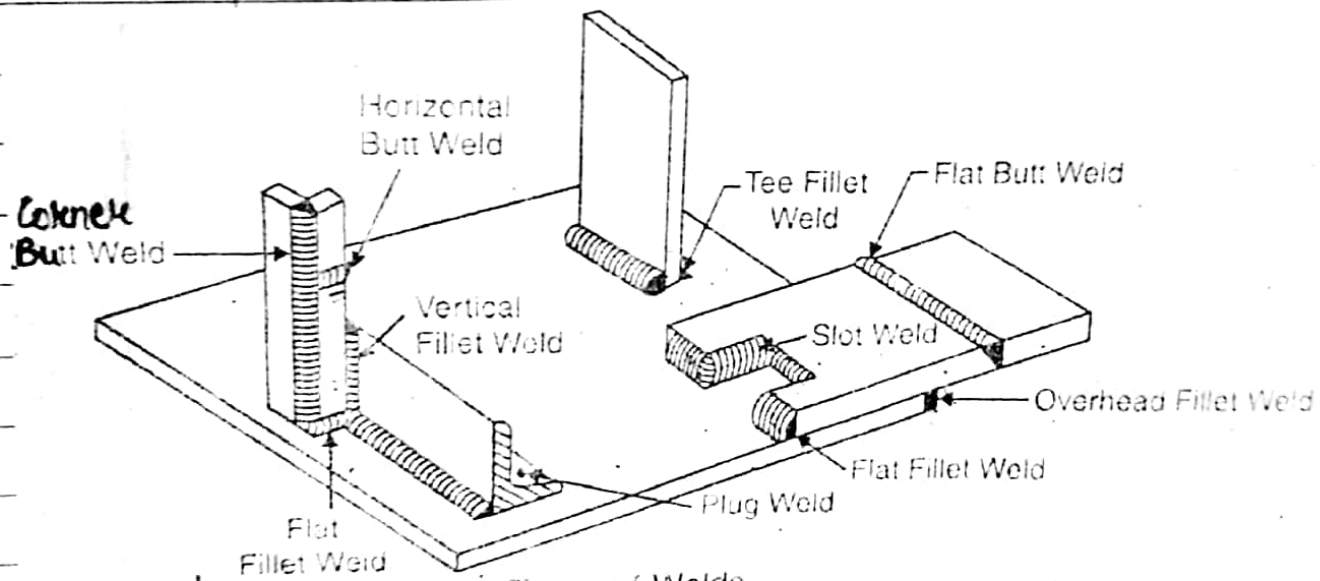
1.) Types of weld According to their Position :

1.) Horizontal Butt weld
2.) Flat Butt weld
3.) Flat fillet weld
4.) Vertical fillet weld
5.) Tee fillet weld
6.) Overhead fillet weld
7.) Corner Butt weld
8.) Plug weld
9.) Slot weld.



Types of Welds

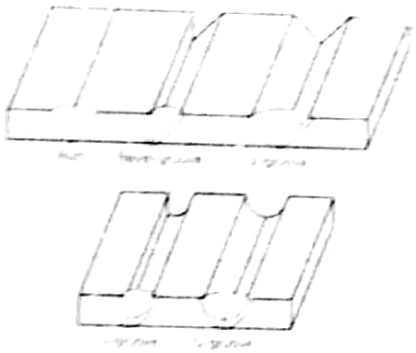
2.) Types of Welds according to their formation :

1.) Butt Weld 2.) Fillet Weld (Lap Weld)

1.) ⇒ Butt Weld :-

This type of weld is used when the members to be connected butt (i.e touch) each other.

Types of Butt welds :-



1.) Square butt weld
2.) Single V- butt weld
3.) Double V- butt Weld
4.) Single U- butt weld
5.) Double U- butt weld
6.) Single - bevel butt weld
7.) Double - bevel butt weld

1) Square Butt weld

2) Single V- butt weld

3) Double V- Butt weld

4) Single U- butt weld

5) Double V- butt weld

6.) Single - Bevel Butt weld

7.) Double Bevel Butt weld

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2.) ⇒ Fillet Weld (Lap weld) :-

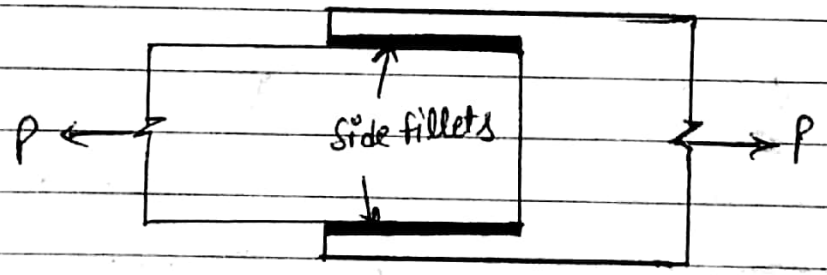
This type of weld is used when the members to be connected overlap each other. It is also called lap weld.

Types of fillet welds :-

1.) Side fillet weld
2.) End fillet weld
3.) Diagonal fillet weld.

→ Side fillet weld :-

A fillet weld the axis of which is parallel to the direction of applied is called side fillet weld or longitudinal fillet weld.

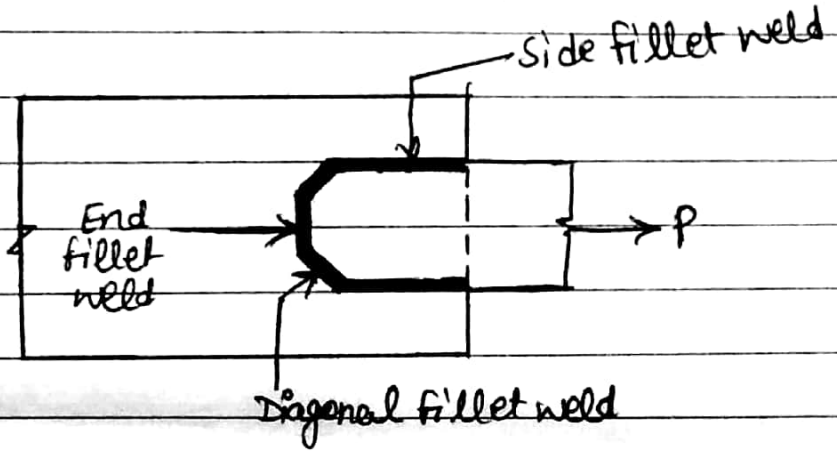


→ End fillet weld :-

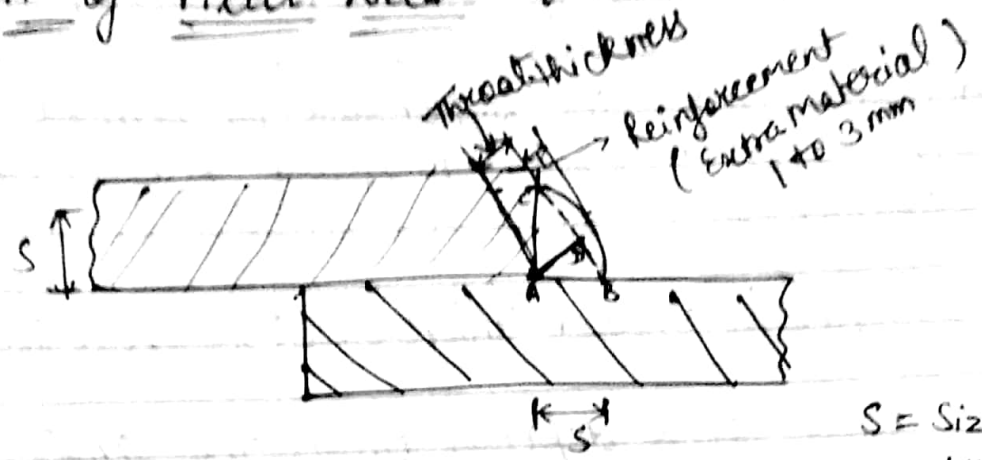
A fillet weld the axis of which is at right angles to the direction of applied load is called end fillet weld or transverse fillet weld.

→ Diagonal fillet weld :-

A fillet weld the axis of which is inclined to the direction of the applied load is called diagonal fillet weld



Design of Fillet Weld :-



1.) Size of fillet weld :- (s)

The section of the fillet weld for design purposes will be taken as an isosceles right-angled triangle.

" The length of either of the equal sides of the triangle is called the size of weld ".

Minimum Size of fillet weld → for different plate thickness

Thickness of Thicker Member	Min. Size
upto and including 10mm	3 mm
over 10mm upto & including 20mm	5 mm
" 20mm " " " 32mm	6 mm
" 32mm " " " 50 mm	8 - 10 mm

Maximum Size of fillet weld →

Max. Size of weld (for square edge) = Thickness of member - 1.5 mm

Max. size of weld for structural members (for rounded toe) = $\frac{3}{4}$ x thickness of member

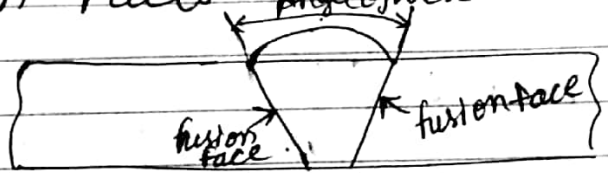
Note:- [Usually a weld size closer to the min size is selected.

2.) Throat Thickness of fillet weld (t) :-

The ⊥r distance b/w the hypotenuse of triangle and the opposite apex is called the throat thickness.

Effective throat thickness (t) = K x size of weld.

The value of K depends upon the angle b/w fusion faces.



Angle b/w fusion faces	60°–90°	91°–100	101°–106°	107–113°	114°–120°
Constant K	0.7	0.65	0.6	0.55	0.5

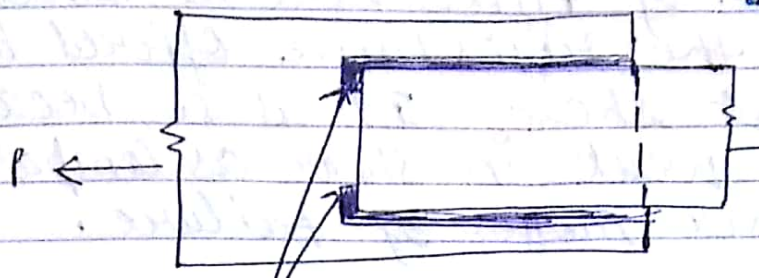
In most of the cases a right angled filled is used for which K = 0.7.

3.) Effective Length of fillet weld :-

Effective length of fillet weld = over all length − 2s.

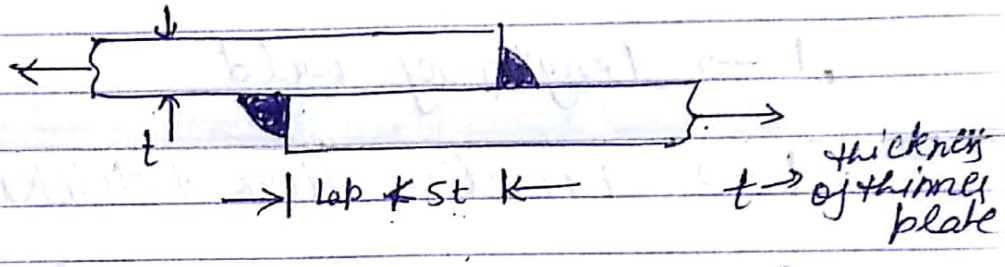
Effective length of fillet should not be less than the 4s.

4.) End Return :— The fillet weld terminating at the end or side of a member should be returned around the corner. & this end returning should not less than 2s



End Returning Not less than 2 S.

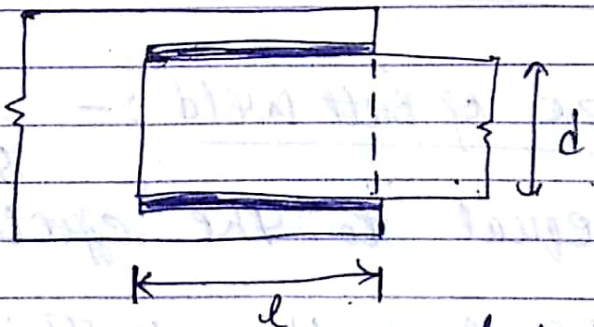
5.) Overlap :—



Overlap in a lap joint should not be less than 5 times the thickness of thinner plate

6.) Side fillet :—

In in a side fillet weld the length of each fillet weld should not be less than 1x distance b/w them (d):



l ≯ d

The 1x distance b/w the side fillets should also not exceeds 16 times the thickness of thinner plate:

d ≯ 16 x thickness of thinner plate

If d exceeds this limit then additional end fillet, Plug or slot weld is provided to prevent buckling of the parts.

Strength of fillet Weld :-

The strength of fillet weld is taken equal to the resistance offered by it against shear. It is so, because it is weak in shear as compared to other modes of failure.

Strength of fillet weld Joint = $\tau_{vf} \times l \times t$

τ_{vf} → Permissible Shear Stress in weld
(τ_{vf} = 108 N/mm² if not given)

l → length of weld.

t → Effective throat thickness = 0.7S

S → size of the weld.

Design of Butt Weld :-

1.) Size of Butt Weld :-

Size of butt weld is equal to the effective throat thickness.

2.) Effective throat Thickness :-

a) for full Penetration :-

Throat thickness(t) = Thickness of thinner member connected.

e.g. → Double-V, double U & double bevel Joint

For incomplete (Partial) Penetration :-

Throat Thickness (t) = $\frac{5}{8}$ x thickness of thinner member.

eg → Single-V, single-V Joint.

Strength of Butt Weld Joint :-

Strength of butt weld Joint = Permissible stress in weld x l x t

OR

Strength of butt weld Joint = τ_{vf} x l x t

Permissible stress in weld = 150 N/mm² (if not given)

l = length of weld = width of plate.

t = Effective throat thickness.

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★ Plug Weld :→ A plug weld is used to fastened two pices of metal when joining the pieces A hole is drilled into the top piece & it is laid over the bottom one. A weld is then made by running a bead inside of the drilled hole Thereby, holding the two pieces together

★ Slot weld :→ A weld b/w two members, one containing an elongated hole through which the other member is exposed. The hole is completely or partially filled with weld metal Thereby, joining the two members one end of the hole may be open

★ The foll specifications should be considered by designing plug & slot weld :→

i) Width or dia should be ≥ 3t & also ≥ 25 mm.

ii) Corner radius in slotted hole should be ≥ 1.5t & also ≥ 25 mm.

iii) Clear distance b/w holes should be ≥ 2t & also ≥ 25 mm

Where, t → Thickness of Plate having a hole or slot.