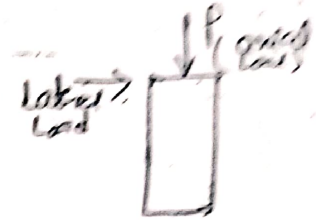
Introduction of Design of Steel Structure

The structural Engineering is the branch of Engineering which deals with 'Structural Analysis' and structural Design'.

In structural Analysis we need to determine the structural parameters like slope, deflection, Bending Moment, shear force and soil Reaction etc which can be expressed in differential equation which are as follows



- $y \longrightarrow$ Deflection

$\frac{dy}{dx} \longrightarrow$ slope

$$EI \frac{d^2y}{dx^2} = M \text{ (moment)}$$

$$EI \frac{d^3y}{dx^3} = V \text{ (shear)}$$

$$EI \frac{d^4y}{dx^4} = p \text{ (soil Reaction)}$$

The structural Analysis deals with suitable arrangement of 'structural elements' for the structures to support the external Loads (e.g. slab, which are likely to act on the structure

Structural Design deals with selection of proper material, proper sizes & shape of each member. The selection must be economical &

several combination of Loads. Finally the structural design deals with preparation of chart with fine drawings. Here structural steel is used as the material as the structure as well as structural design. These structural Design is known as Design of steel structures

⇒ Advantages of steel :-

1. The steel members have high strength, Therefore the steel members can resists heavy loads.
2. The steel members have long service of life, because of high density properties of steel
3. The steel members can be easily replaced and disambeled
4. The steel structures can be Inspected (checked) quickly and convieniently
5. The steel members can be easily handled and Transported

⇒ Disadvantages :-

1. The steel members are effected with corrosion. The corrosion can be prevented by applying

Paints and Varnishes

2. Steel members are very costly

⇒ Note :-

* The Young's Modulus for steel $E = 200\ kN/mm^2$ (or $E = 2 \times 10^5\ N/mm^2$)

* Unit weight (density) of steel ranges from 78 to 79 kN/m

coefficient of Thermal expansion $\alpha = 12 \times 10^{-6}$

WELDING

fatigue = Bending

⇒ Introduction to welding :-

Definition :-

Welding is defined as the process of joining two steel pieces by the process of heating (or) applying pressure

In other words welding is defined as the union (U) between two pieces of metal faces by applying heat (or) pressure.

⇒ Advantages of Welding :-

1. The cost of labour and materials are less expensive
2. Welding can be done very quickly
3. By the process of welding the welded joints give better appearance.
4. During the process of welding there will be no noise pollution.
5. Very small size members may be used in welding
6. More safer and easy process.

⇒ Disadvantages of Welding :-

1. By the process of welding it is difficult inspect the welded joints
2. For welding a highly skillful person is req

there is ... (residual)
due to continuous application of pressure
4. Due to uneven heating and cooling buckling (could lead
may takes place. This may lines for the
development of additional stresses

⇒ Types Of Welding :-

A Welding may be classified into 4 categories

1. Metal Arc Welding
2. Gas Welding → Oxyacetelene welding
   → Oxyhydrocarbon welding
3. Pressure Welding
4. Thermit & union Melt Welding

1. Metal Arc Welding :-

In Metal Arc welding the electrodes are used. While taking electrodes it is necessary to remember that the heated metal combines chemically with oxygen & Nitrogen forming oxides and Nitrites. For good quality of welding use bare electrodes (cyllindrical shaped) are used
(cylindrical)

2 Gas Welding :-

Gas Welding is the process of welding which is used to join two steel pieces by applying Oxyacetylene (oxyacetylene) gas (or oxy-hydro carbon gases. If we use oxy-acetelene gas for the welding it is called oxy-acetelene welding. If we use oxy-hydro carbon then it is called oxy-hydrocarbon

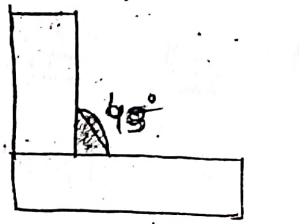
5. Pressure welding

In welding process the weld is made by sustained pressure while the surfaces are to be united to be plastic is known as pressure welding.

⟹ Types of Welding Joints :-

Welded joint may be classified into the following categories

1. Butt weld joint
2. Fillet weld joint
3. lap weld joint
4. edge weld joint
5. T - weld joint (or) Tee-weld joint
6. corner weld joint



1. Butt - Weld Joint :-

Butt weld joint is the welding which obtained when the edge of the plates are welded

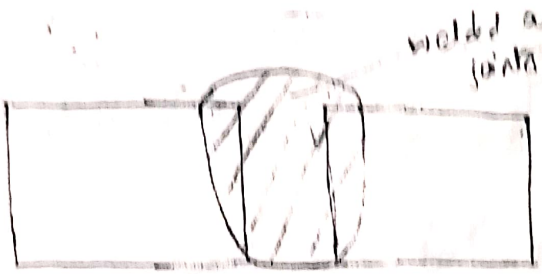
Butt weld is also term as groove weld. The Butt weld is used to joint structural members carrying direct compression (or) Tension.

→ Types of Butt Weld :-

When the edge of the plate thickness is 5 mm we don't require any bevelling if the plate thickness is greater than 5 mm then there must be bevelling

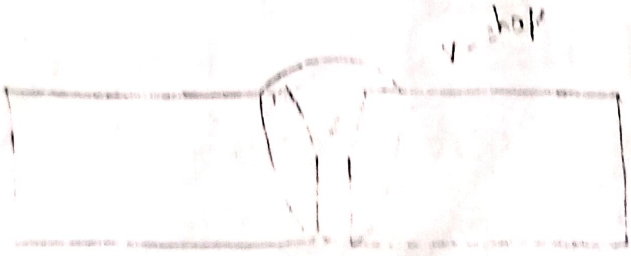
(a) Square Butt welding :-

A square Butt weld is a weld which are joined parallel to one another but approximate the surfaces of weld lie at right angles (90°). A square butt weld is shown in following fig. diagrametrically



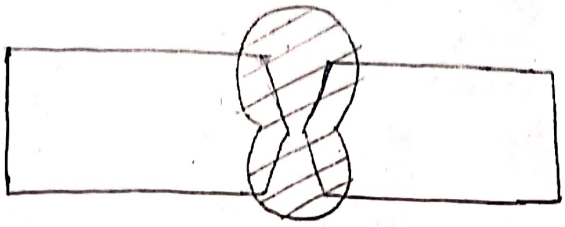
(b) single-V Butt weld :-

A single-V Butt weld is a weld at which the edges of both surfaces are welde so that c/s looks like a V-shape which is shown in following fig. diagrametrically



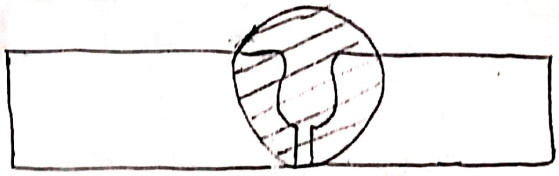
Double - V- Butt weld.

A Double V-butt weld is a weld at which the edge of both surfaces are double V-weld, so that c/s looks like two opposing V's which is shown in following figure diagramatically



(d) Single U- Butt weld :-

A single U-Butt weld is a weld at which the edges of surfaces are Vebelled so that c/s looks like U-shape



e) Double U- Butt weld :-

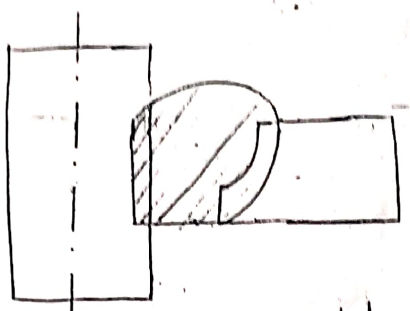
A Double U- Butt weld is a weld at which the edge of the surfaca are bevelled so that c/s looks like two opposing U's which is shown in following figure diagramatically

(f) Single J - Butt Weld :-

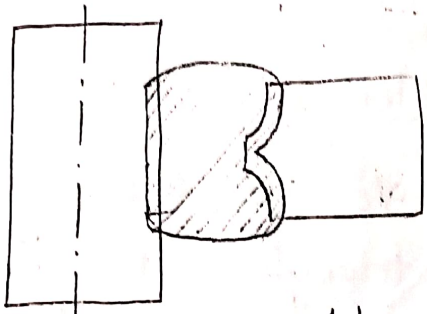
A single J - Butt weld is a weld at which the edges of surfaces are bevelled so that the c/s looks like J - shape.

(g) Double - J - Butt Weld :-

is a weld at which the edges of surfaces are bevelled so that the c/s looks like two opposing J's which is shown following figure diagramatically



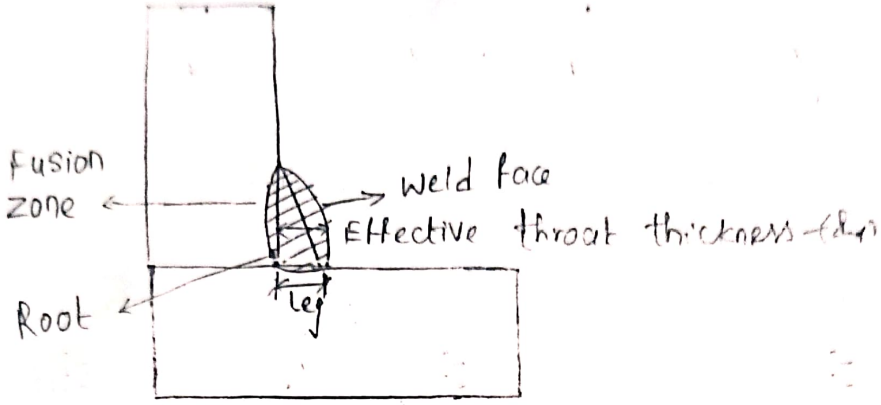
Single J- Butt Weld



Double J- Butt Weld

⇒ Fillet Weld :-

A fillet weld is a weld of approximately triangular c/s joining two surfaces approximately at right angles to each other in Lap joint (or) Tee-joint. A fillet weld is shown diagramatically as follows



⇒ Types of Fillet Weld :-

Fillet weld may be classified into 4 categories

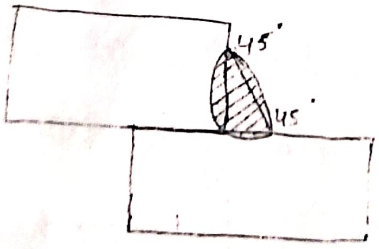
(a) Based on the angle formed at the c/s :-

Based on the angle formed at the c/s fillet weld may be classified into 2 types

(i) standard Fillet weld
(ii) special Fillet weld

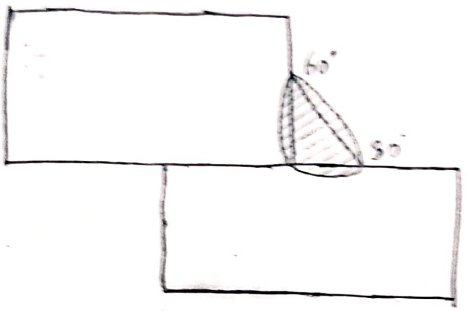
(i) standard Fillet Weld :-

If the c/s of the fillet weld is 45° making an isosceles triangle is known as standard Fillet weld which is shown in following figure.



→(ii) Special fillet weld :-

If the c/s of fillet weld is making an angle of 30° & 60° triangle then it is said to be known as special fillet weld, which is diagramatically shown as follows



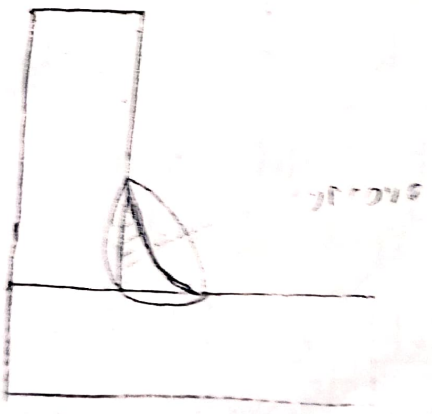
(b) Based on the shape of the weld :-

It may be classified into 3 types which is base on shape of the fillet

(i) concave fillet weld
(ii) convex fillet weld
(iii) Mitre fillet weld (flat shape)

(i) Concave fillet weld :-

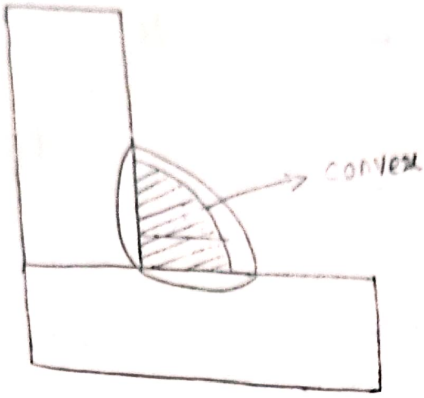
If the weld face of the fillet weld is concave in shape then the weld is known as concave fillet weld. which is shown in following figure



(ii) Fillet weld :-

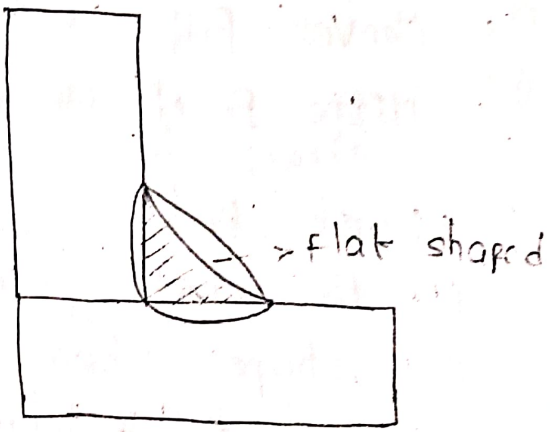
If the weld face of the fillet weld is

fillet weld. which is shown in following figure



(iii) Mitre Fillet Weld (Flat shape) :-

A fillet weld whose weld face is approximately flat & Levelled then the weld is said to be known as Mitre Fillet weld, which is shown in following figure



(c) Based on Depth of penetration :-

It may be of 2 types

(i) Normal fillet weld
(ii) Deep Fillet weld

(i) Normal Fillet Weld :-

A Fillet weld whose depth of penentration is less than 2.4 mm beyond the Root then it is said to be known as Normal fillet weld

(ii) Deep Fillet Weld :-

A fillet weld whose depth of penetration is greater than 2.4 mm then it is known as Deep fillet weld.

(d) Based on Direction of stress :-

It may be of 3 types

(i) Side Fillet weld
(ii) End Fillet weld
(iii) Diagonal Fillet weld

(i) Side Fillet Weld :-

Side Fillet weld is a weld stressed in Longitudinal shear i.e a Fillet weld in which the axis is parallel to the direction of applied load

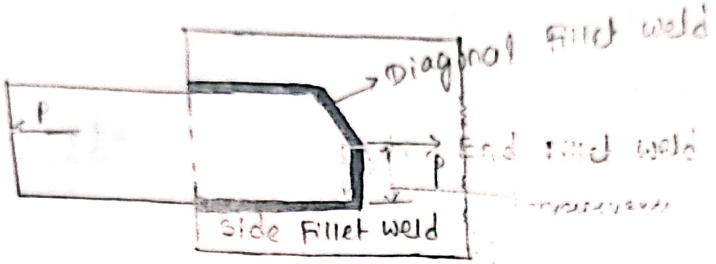
(ii) End Fillet Weld :-

End Fillet weld is a weld stressed in transverse shear i.e a fillet weld whose axis is at the right angles to the direction of applied load. It is also known as Transverse Fillet weld

(iii) Diagonal Fillet weld :-

It is the Fillet weld at which the axis is inclined to the direction of applied load.

The three set of Fillet weld is diagramatically shown as follows



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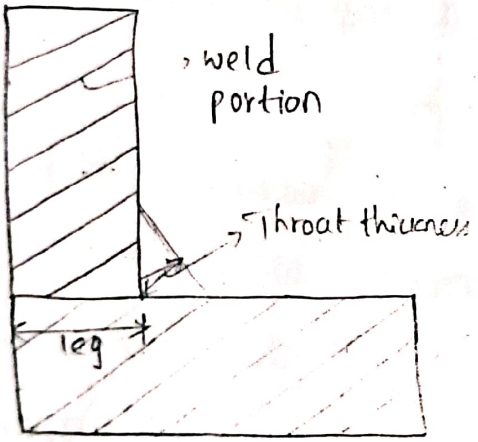
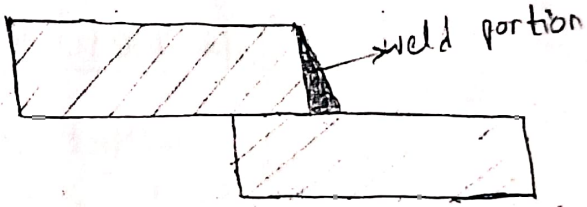
3. Lap Joint :-

It is obtained by welding the edges of plates placed in a position to overlap each other. It comes under fillet weld joint which is diagramatically shown as follows



(i)



(ii)

weld

6. Corner Joint :-

Corner Joint is obtained by welding the edges of plates at the corner placed at right angles to each other

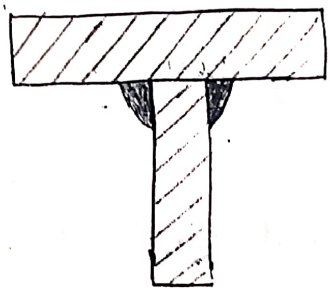
4. Ed

4. Edge - Weld Joint :-

It is obtained by welding the edges of plates placed in touch with each other which is diagramatically shown as follows

5. T-Weld Joint (or) Tee - Weld Joint :-

It is obtained by welding the edges of plat placed perpendicular to each other which is show diagramatically as follows.



⟹ Types of Stresses :-

The following are the various types of stresse which depends upon 'loading'

1. Tensile stress
2. Compressive stress
3. Bending stress
4. Bearing stress
5. Shear stress

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1. Tensile stress :-

When a structural member is subjected to direct axial tensile load then it is called "tensile stress"

Permissible Tensile stress = 150 N/mm² (0.6 fy)

take fy = 250

2. Compressive Stress :- (σ_c)

When a structural member is subjected to direct axial compressive load, then the stress developed is known as "compressive stress".

4. Bearing stress :-

When the load is transfered through one surface to another surface in contact then the stress is known as "Bearing stress". It is indicated by σ_p

Permissible Bearing stress = 0.75 fy ∵ fy = 250

σ_p = 187.5 N/mm²

* permissible shear stress = 0.4 fy

(σ_z)

σ = 0.4 × 250

σ_{shear} = 100 N/mm²

* permissible Bending stress σ_b = 0.66 fy

σ_b = 165 N/mm²

Allowable stress in the weld = 110 N/mm²