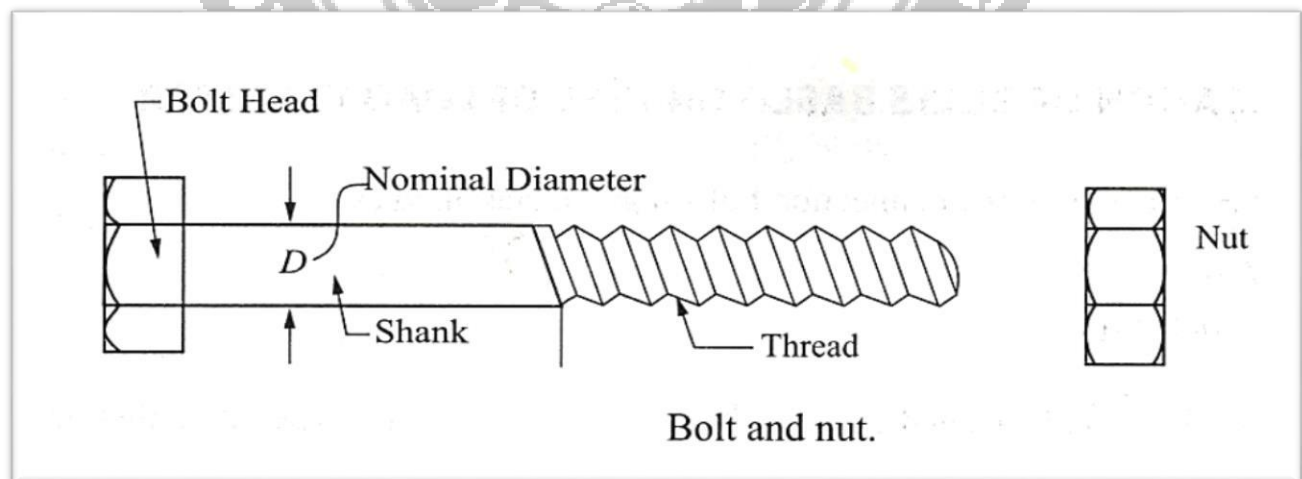


UNIT II CONNECTIONS IN STEEL STRUCTURES

Type of Fasteners- Bolts Pins and welds- Types of simple bolted and welded connections Relative advantages and Limitations-Modes of failure-the concept of Shear lag-efficiency of joints- Axially loaded bolted connections for Plates and Angle Members using bearing type bolts -Prying forces and Hanger connection- Design of Slip critical connections with High strength Friction Grip bolts.- Design of joints for combined shear and Tension- Eccentrically Loaded Bolted Bracket Connections- Welds-symbols and specifications- Effective area of welds-Fillet and but Welded connections-Axially Loaded connections for Plate and angle truss members and Eccentrically Loaded bracket connections.

Bolted Connections



- Bolt is a metal pin with a head at one end and a shank threaded at other end to receive a nut,. Steel washers are usually provided under the bolt head and nuts to prevent the treaded portion of the bolt from bearing on the connecting pieces and to distribute the clamping pressure on the bolted member.

- A bolt connection can be used for end connections in tension and compression members. They can also hold down column bases in position and as separator for purlins and beams in foundations.
- Bolts are having the following advantages over rivets and pins:
 - The erection of the structures can be speeded up.
 - Less skilled labour can be employed.
 - Overall cost of bolted connection is lesser than the other alternatives.

However the following shortcomings are also associated with the bolted connections:

- Cost of material is high, about double than that of rivets.
- The tensile strength of bolt is reduced due to the reduced area at the root of the thread and stress concentration.
- Normally strength reduction will be there for loose fit bolts.
- Bolts may get loose when subjected to vibrations

Types of bolts:

Block Bolts:- [Unfinished Bolts]

- These bolts are made from mild steel with square or hexagonal heads.
- The nominal dia(d) available are 12,16,20,22,24,27,30 & 36 mm designated as M16 M20 etc.,
- As the shank is unfinished, there is no contact with the members at the entire shown of contact surface.
- Joints remain quite loose result into large deflections & loosening of nuts in course of time.
- Generally the diameter of bolt hole is 1.5mm to 2m larger than the nominal diameter of shank.

Fitted Bolts:- [Turned Bolts]

- These bolts are made from M.S. steel formed from hexagonal rods which are finished by turning to a circular shape within the bolts hole.

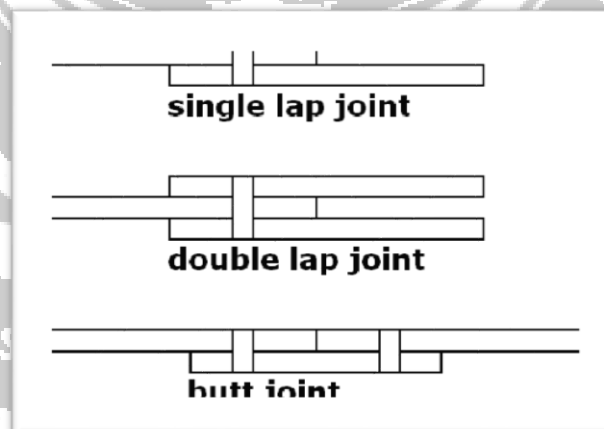
- The actual dimension of the bolt holes are kept 1.2 to 1.3mm larger than the nominal dia. Where the slot hole is kept 1.5mm larger than 'd'
- Aligning the bolt holes needs special care.

Friction Type Bolts: - [HSFG – High Strength Friction Grib bolts]

- These are made from high strength steel rod, where the surface of a shank is kept unfinished and are tightened to a proof load using calculated wrenches.
- Nuts are prevented by using clamping devices.
- The shearing load is first resisted by the frictional force b/w the member and the head.
- It can be used for dynamic moving loads and HSFG Bolts replaces rivets.
- The nominal dia available are 16,20,24,30 & 36mm.

Classification of Bolt Joints:

- ❖ Butt joint
- ❖ Cover joint
- ❖ Tee-Joint
- ❖ Lap- joint



Failure of bolted connections

Failure of bolted connection can be classified broadly in to two:

- Failure of the bolt

- Failure of connecting parts.

Bolted joints may fail in any of the following six ways

- Shear failure of bolts.
- Bearing failure of bolts.
- Bearing failure of plates
- Tension failure of bolts.
- Tension or tearing failure of plates.
- Block shear failure.

Welded connection

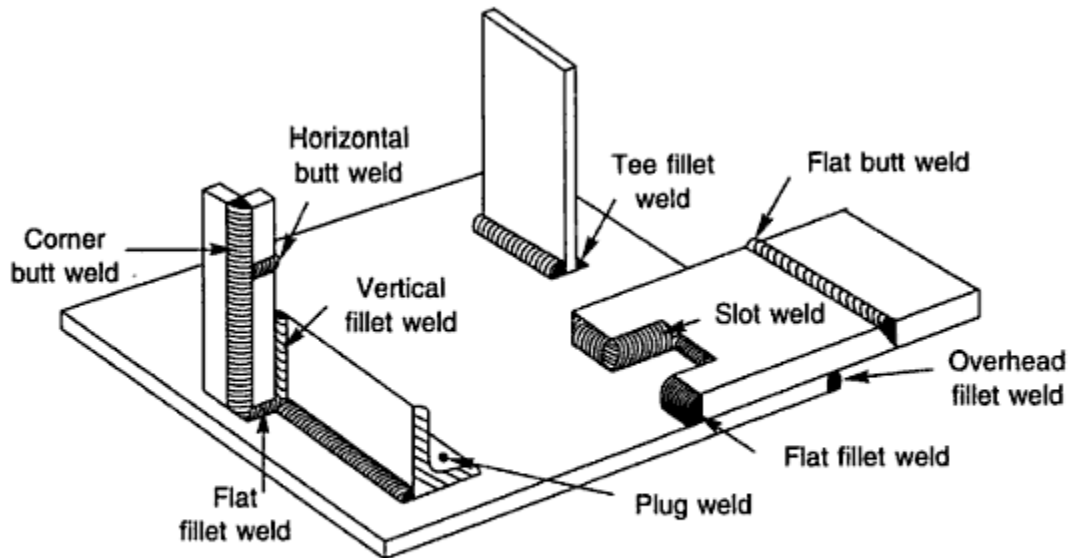
When two members are connected by means of welds, such a connection is known as welded connection. Welding offers an opportunity to the designer to achieve a more efficient use of the materials.

Types of welded connections

The basic types of welded joints can be classified depending on the types of welds, position of welds and type of joint.

Based on type of weld, welds can be classified in to

- ❖ fillet weld,
- ❖ groove weld (or butt weld),
- ❖ plug weld,
- ❖ slot weld,
- ❖ spot weld



Types and Positions of Welds

Advantages and disadvantages of welded joints

The following are the advantages of welded joints.

- Due to the absence of gusset plates and other connectors, the welds are usually lighter.
- Welding process is quicker as it requires no drilling of holes.
- Welding is more adaptable than other types of connections and can even be used in circular pipes.
- 100% efficiency can be achieved in welding whereas the connection such as bolts can have a maximum efficiency of 70 - 80%.
- Noise produced during the welding process is relatively less.
- Welds usually have good aesthetic appearance.
- Welded joints are air tight and water tight and can be used for water tanks and gas tanks.
- Welded joints are rigid.
- Mismatch of holes will never happen in welded connection.
- Alternation of joints can easily be made in the case of welded connections.

However the welded connection is having the following disadvantages.

- Due to the uneven heating and cooling, members are likely to distort in the process of Welding.
- Possibility of brittle fracture is more in the case of welded connections.
- Welded connections are more prone to failure due to fatigue stresses.
- The inspection of welded joints is difficult and expensive. It can only be done by Employing NDT.
- Highly skilled persons are required for welding.
- Proper welding in field conditions is difficult.
- Welded joints are over rigid.

TERMINOLOGY:

Pitch (p) is the distance between the centers of two consecutive bolts measured along a row of bolts. When the bolts are placed staggered, then the pitch is known as staggered pitch.

Gauge (g) is the distance between the centers of two consecutive bolts measured adjacent row of bolts.

Edge distance (e) is the distance of a bolt hole from the adjacent edge of the plate

End Distance(e') is the distance of the nearest bolt hole from the end of the plate.

OBSERVE OPTIMIZE OUTSPREAD

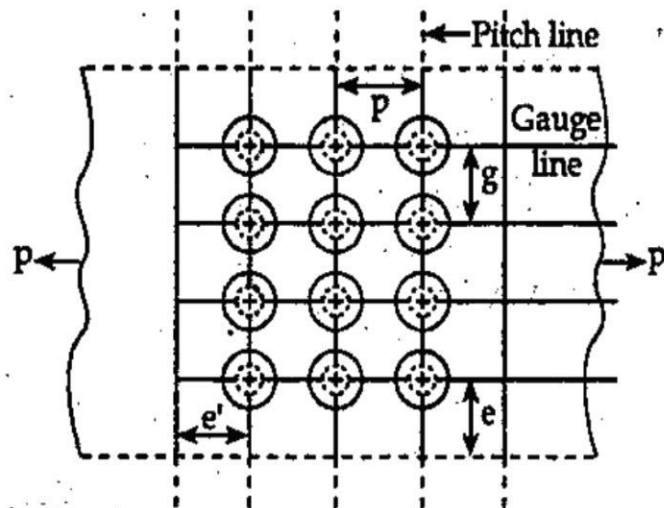
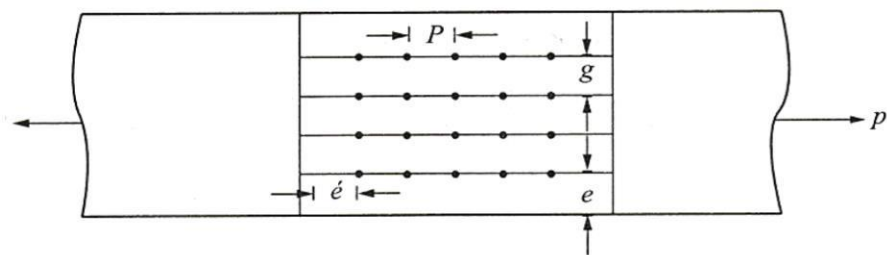
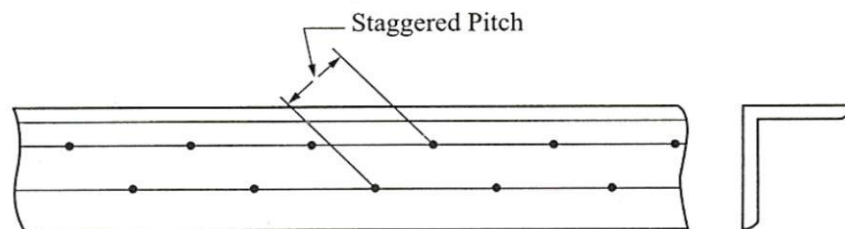


Figure: Pitch, gauge, end and edge distance



Pitch, gauge distance and edge distance.



Bolt distance in staggered bolts.