

(Session-2018-19)

MECHANICAL JOINTS

To connect one or more **mechanical** parts in assemblies

Joining Vs Fastening

- **Joining-** Bonding between the **base metals**.
Permanent- **Welding**, Brazing & soldering, Bonded, Pressed, Rolled, Hybrid.
- **Fastening-** No bonding between the base metals.
Temporary- **Threaded Joints (Bolted, screw, studs)**, pin joint, Cotter & Knuckle joint, Couplings, Splines.
Permanent- **Riveted joints**.

Riveted Joint

Advantages of Riveted Joints

- Low skilled worker is required.
- No thermal after effects, as in welding.
- Can be used for joining two different materials
- Can be used for non-ferrous metals
- Ability to resist vibration and impact load
- Can be used for very thin plates
- Easily inspected

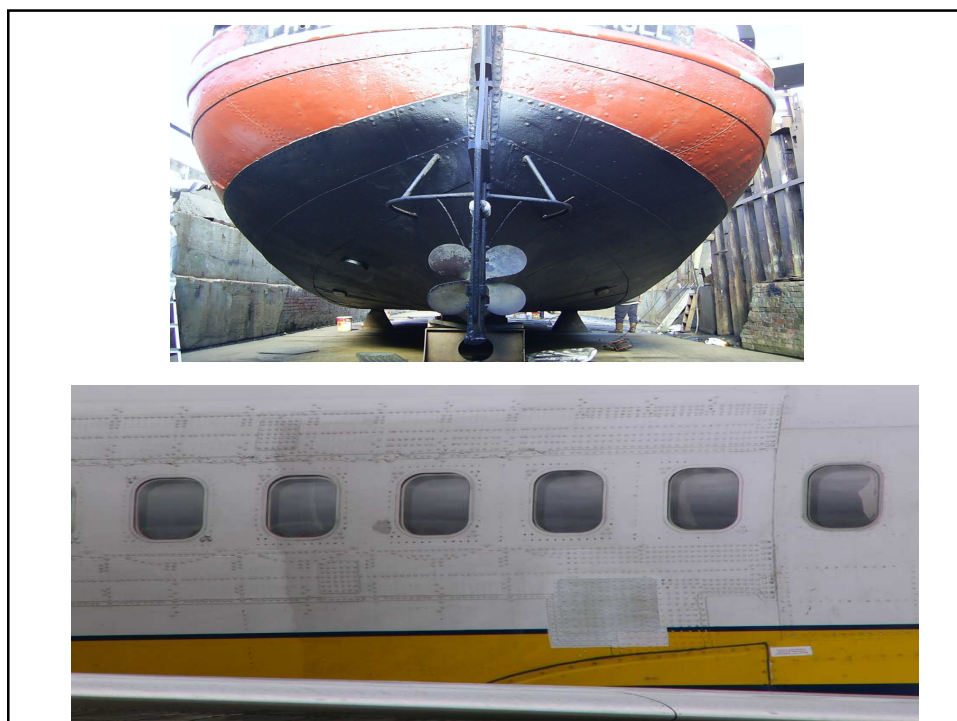
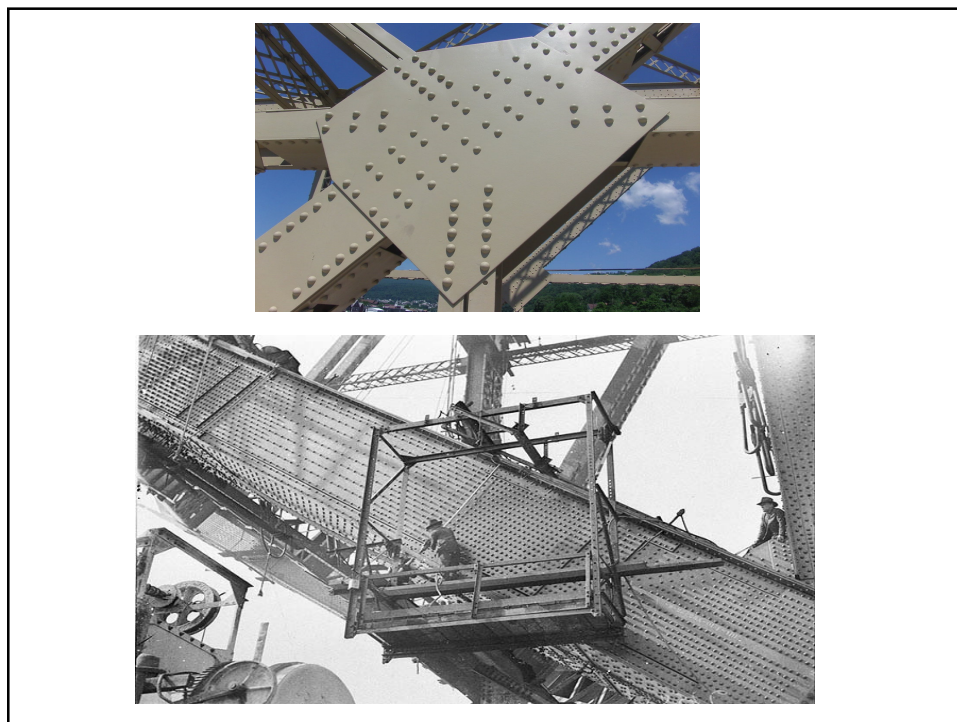
Disadvantages

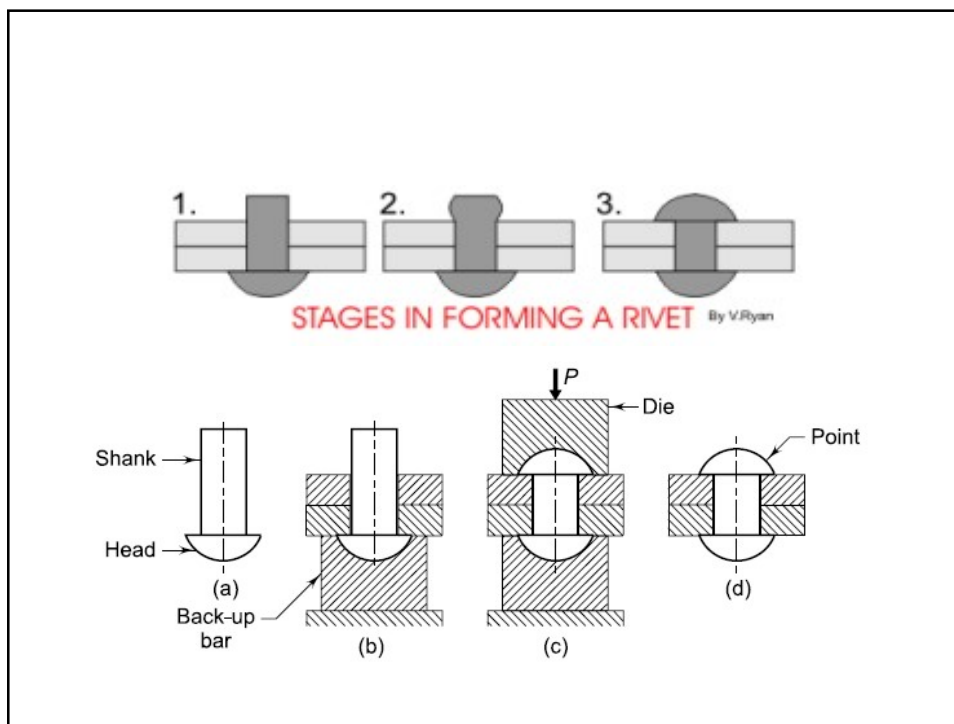
- Material cost is more
- More Weight
- Stress concentration
- Preprocessing
- Permanent fastening
- Processing to make fluid tight joint
- Low efficiency
- Feasible for only Lap and Butt Joints

Applications

Traditional mechanical structures involving riveted joints are classified into the following three groups:

- Boilers, pressure vessels and tanks
- Bridges, trusses, cranes general machinery
- Hulls of ship



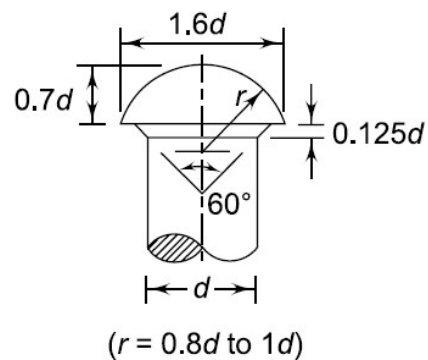


Types of Rivets (on the basis of heads)

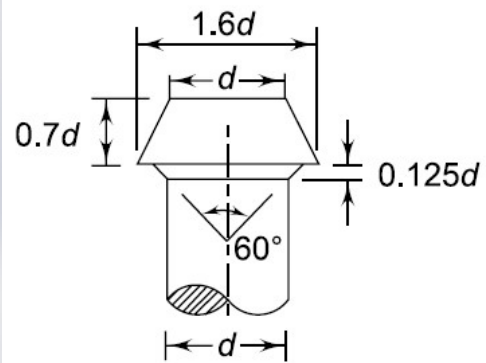
There are number of shapes for the head of the rivet.

- Snap or button head rivet
- Pan head rivet or cone head rivet
- Countersunk head rivet
- Flat head rivet

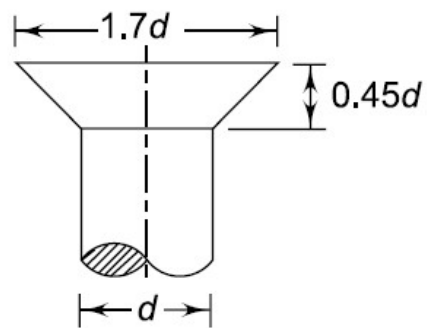
Snap Head Rivet



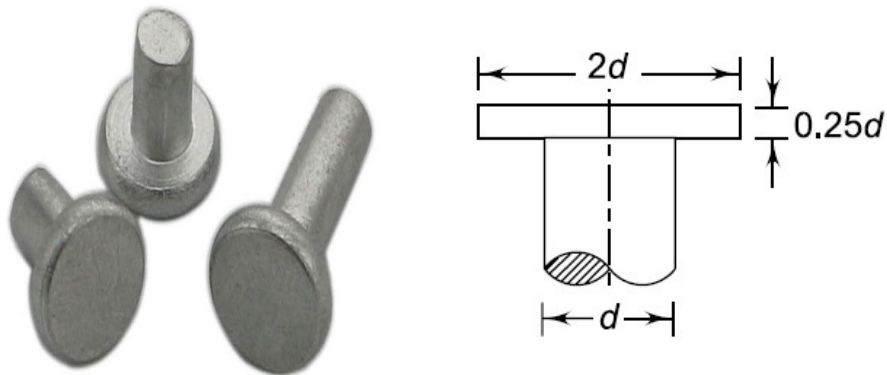
Pan Head Rivet



Countersunk Head Rivet



Flat Head Rivet



Terminology of Riveted Joints

- **Pitch (p):** the pitch of the rivet is defined as the distance between the centre of one rivet to the centre of the adjacent rivet in the same row.

Usually, $p = 3d$ (d is the shank diameter)

- **Margin (m):** The margin is the distance between the edge of the plate to the centre line of rivets in the nearest row.

Usually, $m = 1.5d$

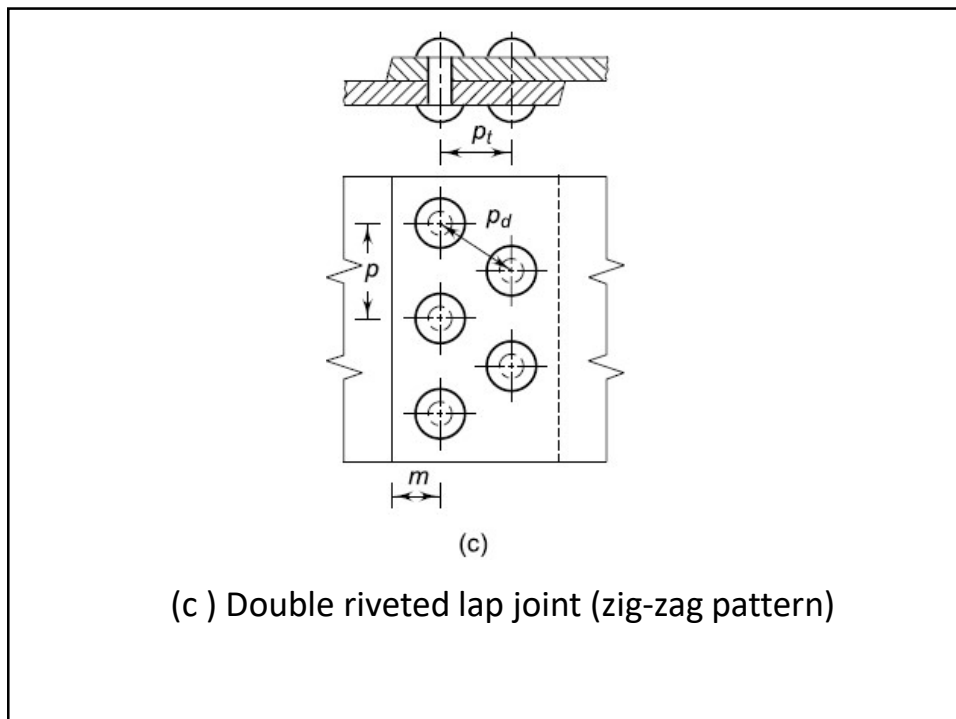
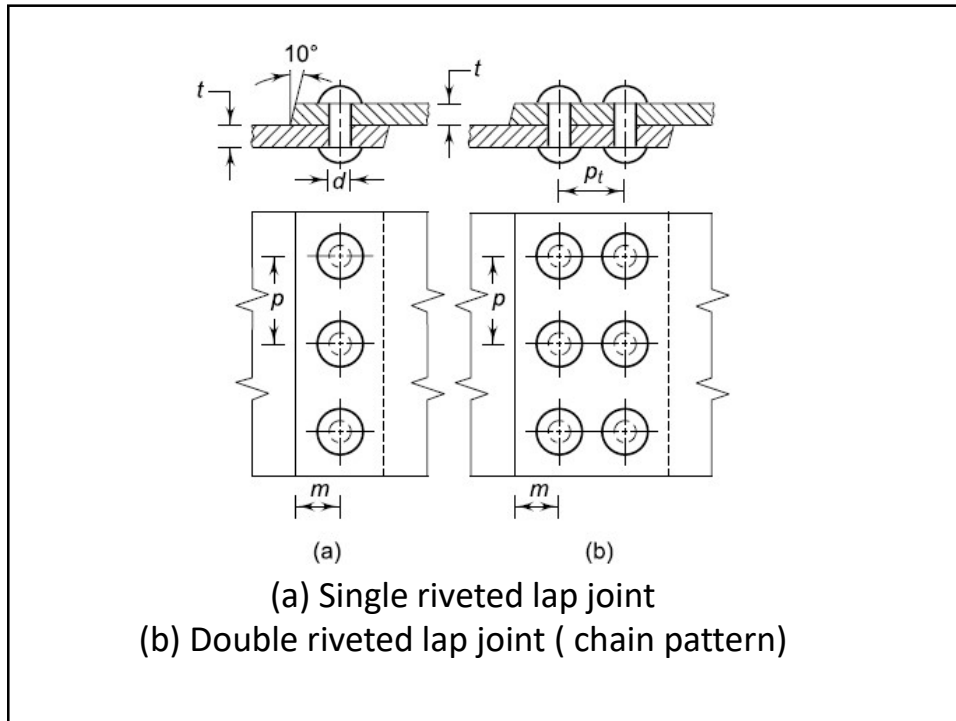
- **Tranverse Pitch (p_t):** Tranverse pitch, also called back pitch or row pitch, is the distance between two consecutive rows of rivets in the same plate.

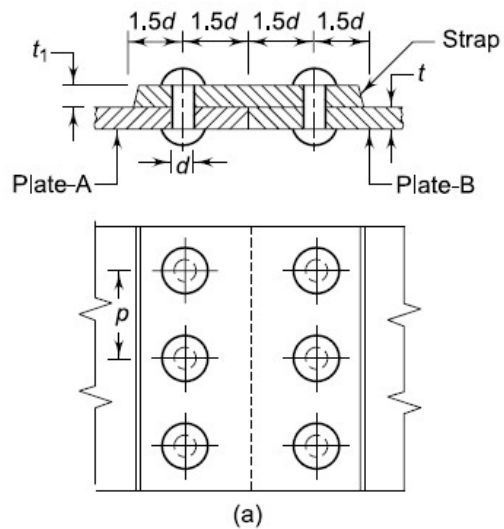
Usually, $p_t = 0.8p$ (for chain riveting)
 $p_t = 0.6p$ (for zig-zag riveting)

- **Diagonal Pitch (p_d):** Diagonal pitch is the distance between the centre of one rivet to the centre of the adjacent rivet located in the adjacent row.

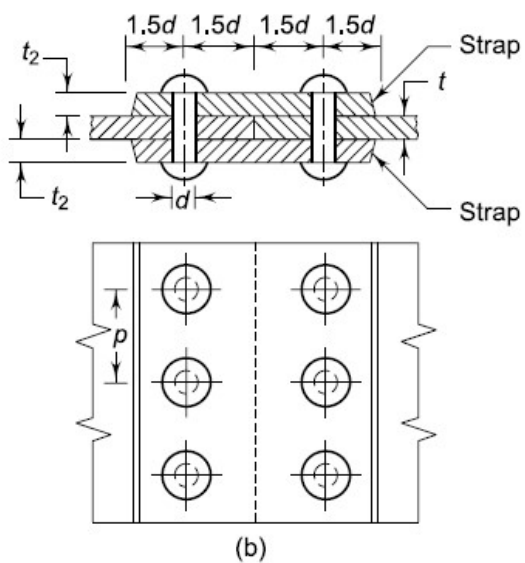
Types of Riveted Joints

- **Lap Joint**
- **Butt Joint**

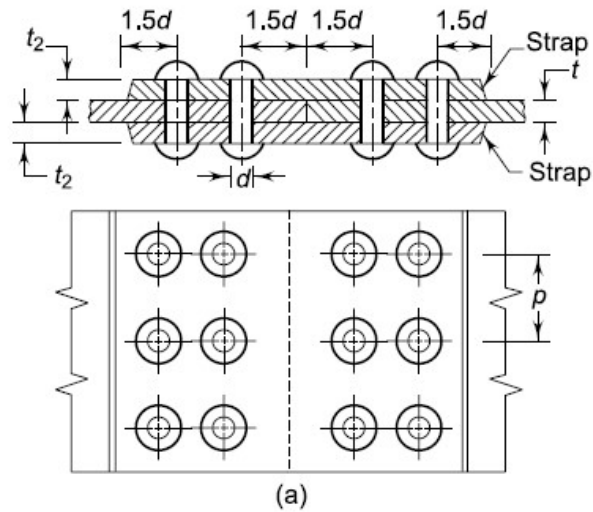




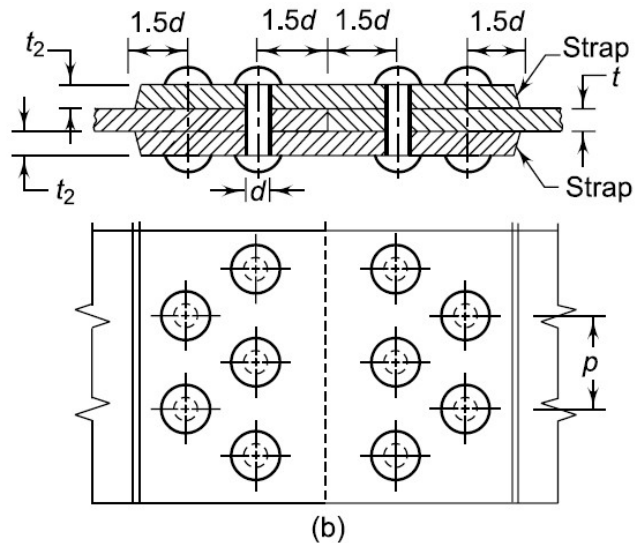
(a) Single-riveted single-strap butt joint



(b) Single-riveted double-strap butt joint

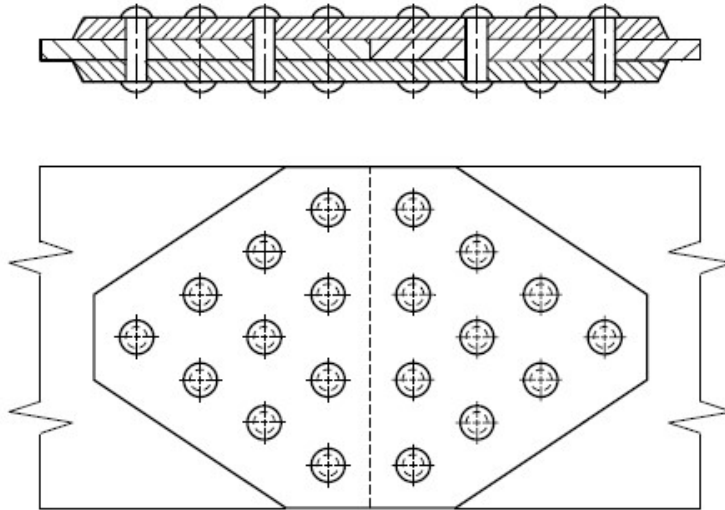


(a) Double-riveted double-strap butt joint
(chain pattern)



(b) Double-riveted double-strap butt joint
(zig-zag pattern)

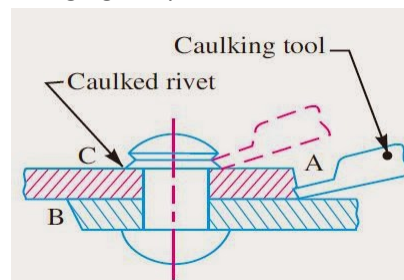
Lozenge Joint (Economical)



Caulking

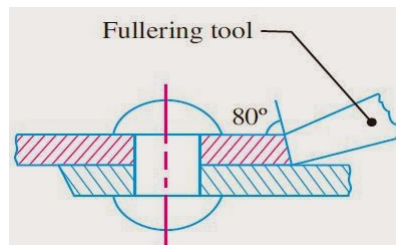
Caulking is an operation in which the outer bevel edges (about 75-80°) are hammered and driven in by a caulking tool to produce fluid tight riveted joints in the applications like Boiler, Pressure vessels, ship etc.

- The caulking tool is in the form of a blunt edge chisel.
- The thickness of tool is about 5 mm and breadth is about 38 mm.
- Surface finish obtained is less compared to fullering.
- More risk of damaging the plates.



Fullering

- It is used to obtain leak proof joints.
- It is carried out by using fullering tools.
- The thickness of tool is equal to the thickness of the plate.
- It gives clean surface finish.
- Less risk of damaging the plates.



Assumptions for the design of riveted joint

- Load is assumed to be uniformly distributed among all the rivets
- Stress in plate is assumed to be uniform
- Shear stress is assumed to be uniformly distributed over the gross area of rivets
- Bearing stress (Crushing stress) is assumed to be uniform between the contact surfaces of plate and rivet
- Bending stress in rivet is neglected
- Rivet hole is assumed to be completely filled by the rivet
- Friction between plates is neglected

Material for rivets

- The material of the rivets must be tough and ductile. They are usually made of steel (low carbon steel or nickel steel), brass, aluminium or copper, but when strength and a fluid tight joint is the main consideration, then the steel rivets are used.

The rivets for general purposes shall be manufactured from steel conforming to the following Indian Standards :

(a) IS : 1148–1982 (Reaffirmed 1992) – Specification for hot rolled rivet bars (up to 40 mm

diameter) for structural purposes; or

(b) IS : 1149–1982 (Reaffirmed 1992) – Specification for high tensile steel rivet bars for

structural purposes.

The rivets for boiler work shall be manufactured from material conforming to IS : 1990 – 1973

(Reaffirmed 1992) – Specification for steel rivets and stay bars for boilers.

Design of riveted joints

- In design equations d is diameter of rivet hole.
- If number of rivets & width is not given (n , w - nd) analysis is to be done considering number of rows (n , p - d).

TYPES OF FAILURE

- (i) shear failure of the rivet;
- (ii) tensile failure of the plate between two consecutive rivets;
- (iii) crushing failure of the plate;
- (iv) tearing of the plate in the margin area.