
depositphotos

Riveted JOINTS

sambungan paku keling

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Riveted JOINTS

- Sambungan rivet/keling digunakan untuk membuat sambungan permanen antara plat seperti pada tanki, boiler, dsb.
- Fungsi rivet pada sebuah joint adalah untuk membuat sambungan yang memiliki kekuatan *(strength)* dan kerapatan *(tightness)*.
- Kekuatan diperlukan untuk mencegah kegagalan sambungan. Kerapatan diperlukan agar sambungan makin kuat dan mencegah kebocoran.

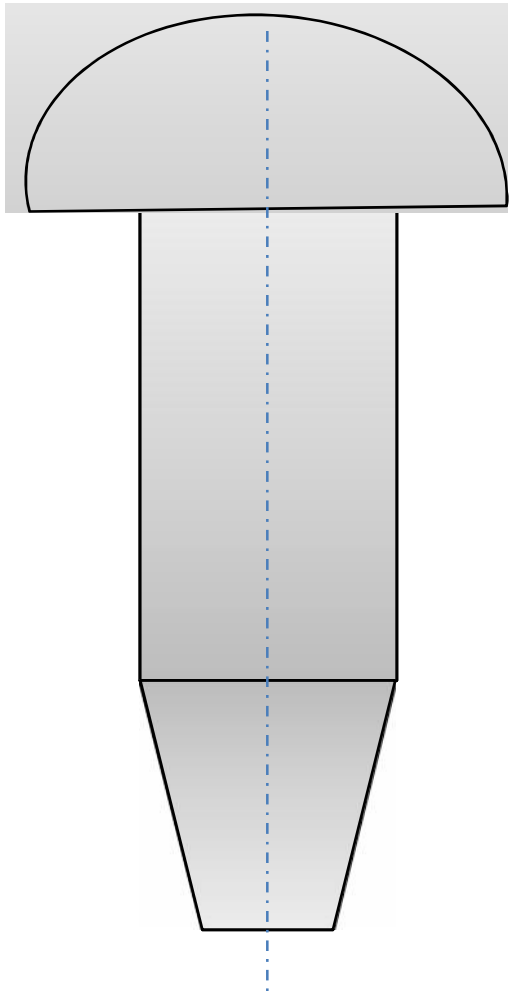
Advantages of riveted joints:

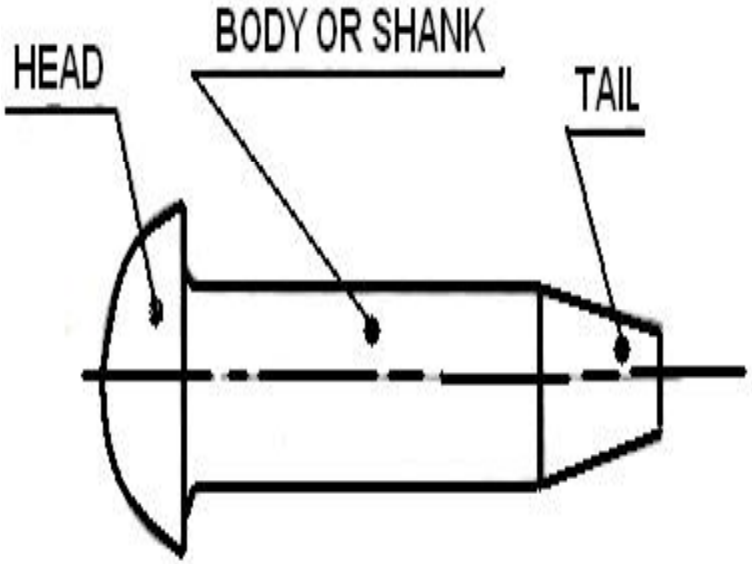
- Cheaper fabrication cost
- Low maintenance cost
- Dissimilar metals can also be joined, even non-metallic joints are possible with riveted joints.
- Ease of riveting process.

http://www.indiastudychannel.com/resources/146267-Rivet-types-riveted-joints.aspx

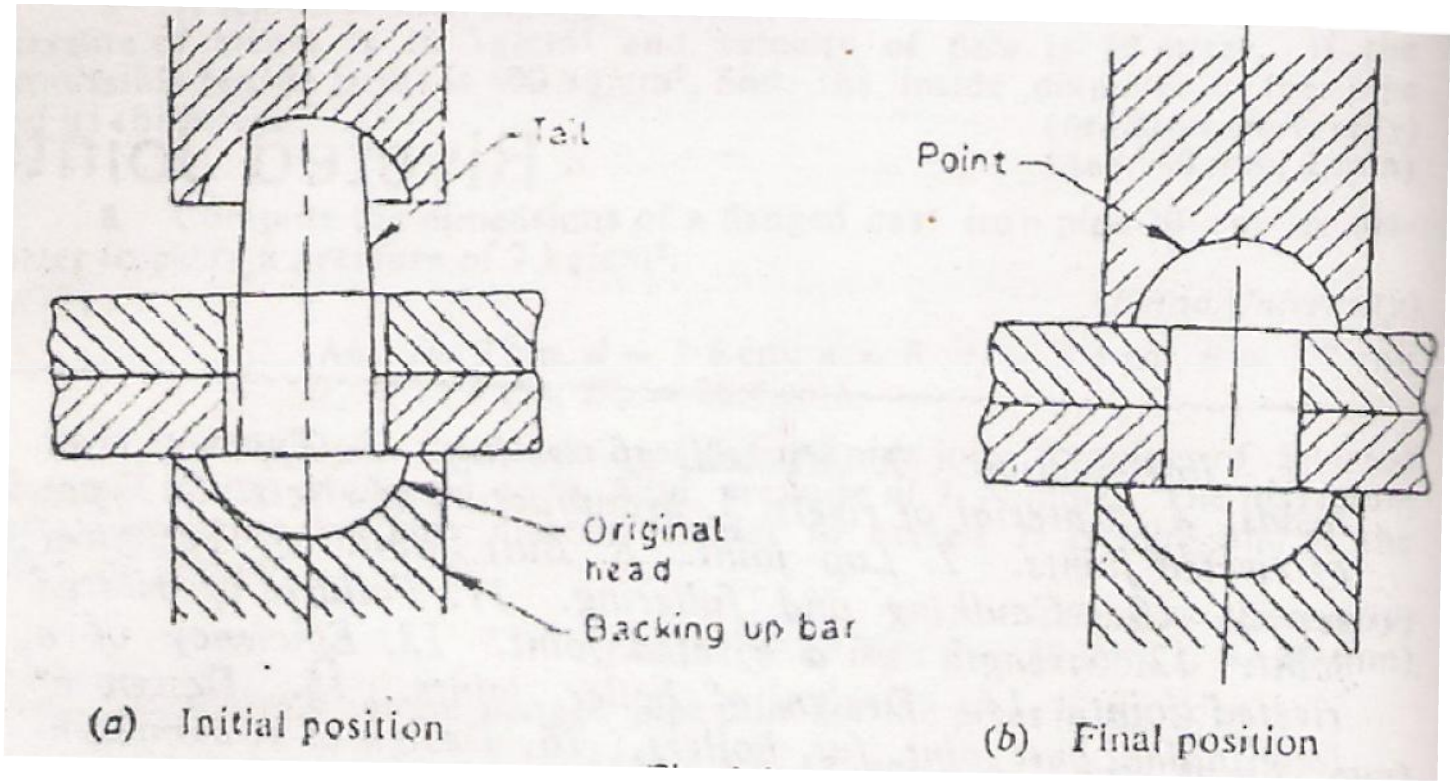
Disadvantages of riveted joints:

- Skilled workers required
- Leakage may be a problem for this type of joints, but this is overcome by special techniques.




HEAD
BODY OR SHANK
TAIL

Proses riveting / HEAD FORMING **:**



You know that the riveted joint is created by passing the stem of a rivet through holes in two plates as is shown in Figure 3.1(a). The creation of head by process of upsetting is shown in Figure 3.1(b). The upsetting of the cylindrical portion of the rivet can be done cold or hot. **When diameter of rivet is 12 mm or less, cold upsetting can be done**. For larger diameters the rivet is first heated to light red and inserted. The head forming immediately follows. The rivet completely fills the hole in hot process. Yet it must be understood that due to subsequent cooling the length reduces and diameter decreases. The reduction of length pulls the heads of rivet against plates and makes the joint slightly stronger. The reduction of diameter creates clearance between the inside of the hole and the rivet. Such decrease in length and diameter does not occur in cold worked rivet.

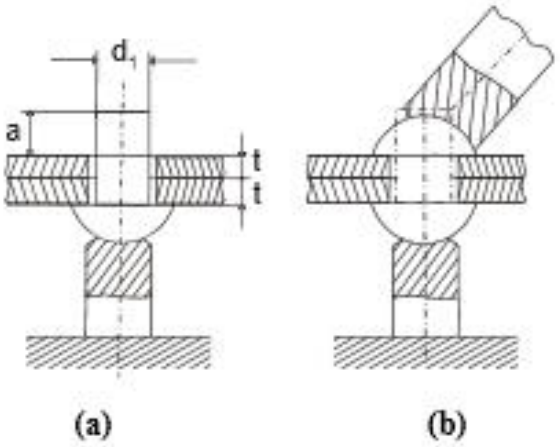


Figure 3.1 : Typical Head Forming of Rivet

Rivet Heading Process(Riveting):

Usually clearance is considered as per following:

If diameter of rivet, d = 12 to 24 mm,

Clearance, C = 1.5 mm

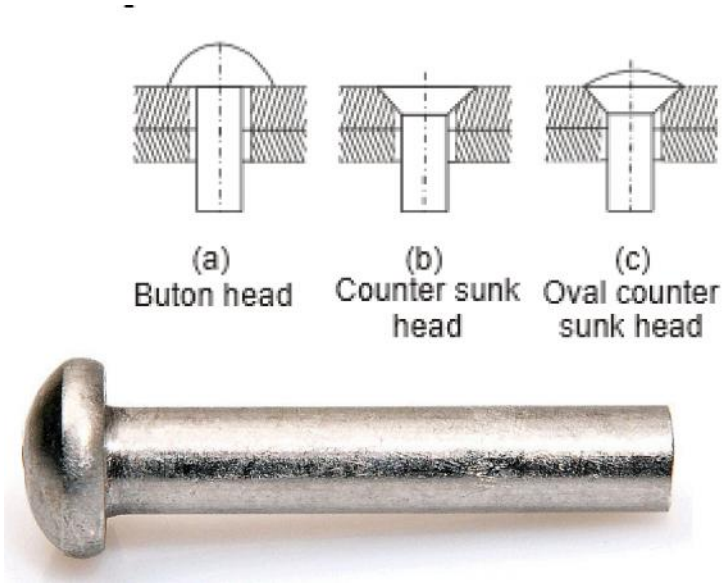
If diameter of rivet, d = 24 to 48 mm,

Clearance, C = 2 mm

http://www.indiastudychannel.com/resources/146267-Rivet-types-riveted-joints.aspx

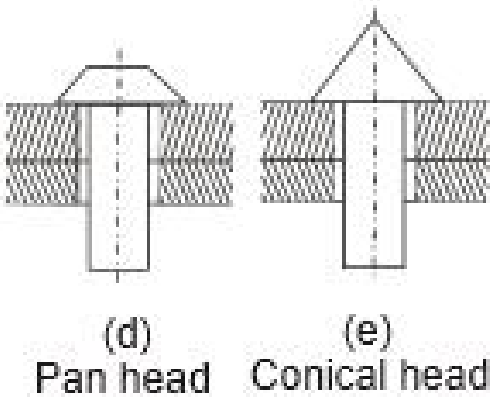
TYPES OF RIVET

- Rivets with counter sunk head as in Figure 3.2(b) and oval counter sunk rivets shown in Figure 3.2(c) are not as strong as button head rivets. They are used only when protruding rivet heads are objectionable. **Rivet jenis ini banyak dipakai pada pembuatan kapal**.



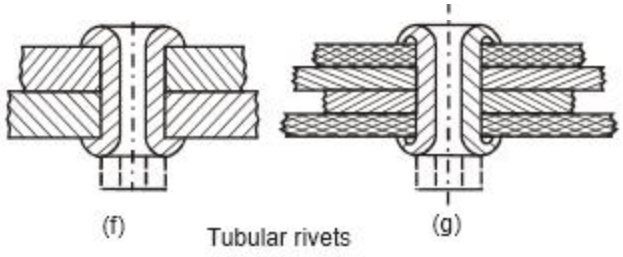
TYPES OF RIVETS

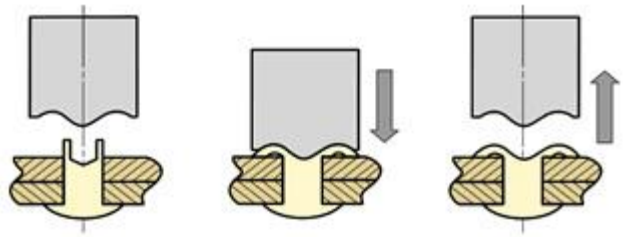
- Pan heads and conical heads, Figures 3.2(d) and (e) are less frequently used and are difficult to form.

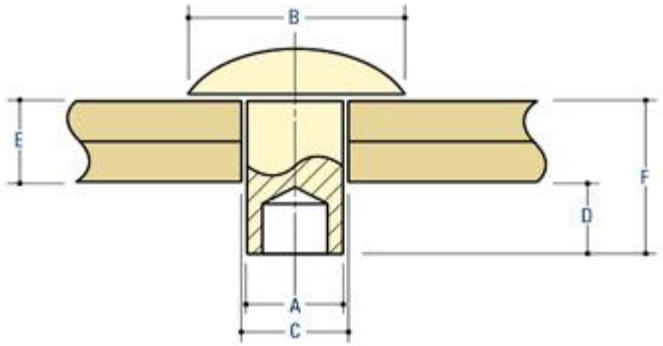


TYPES OF RIVETS

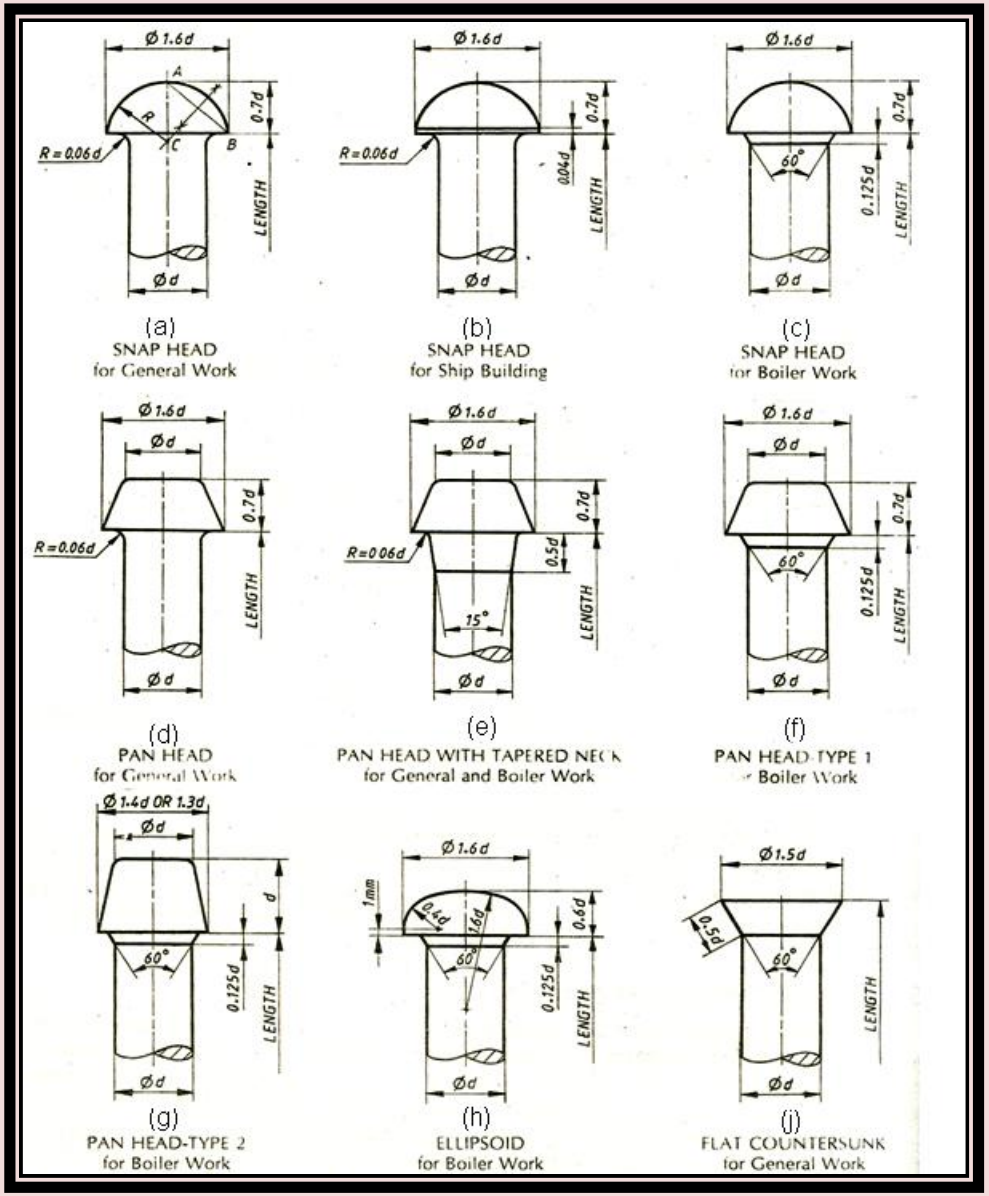
- Tubular rivets, Figures 3.2(f) and (g) are special deviation from solid rivet shank. These rivets are used in aircrafts.







Tipe-tipe **HEAD**



Kepala rivet untuk penggunaan umum (diameter dibawah 12 mm). IS : 2155 – 1962

Tipe-tipe HEAD

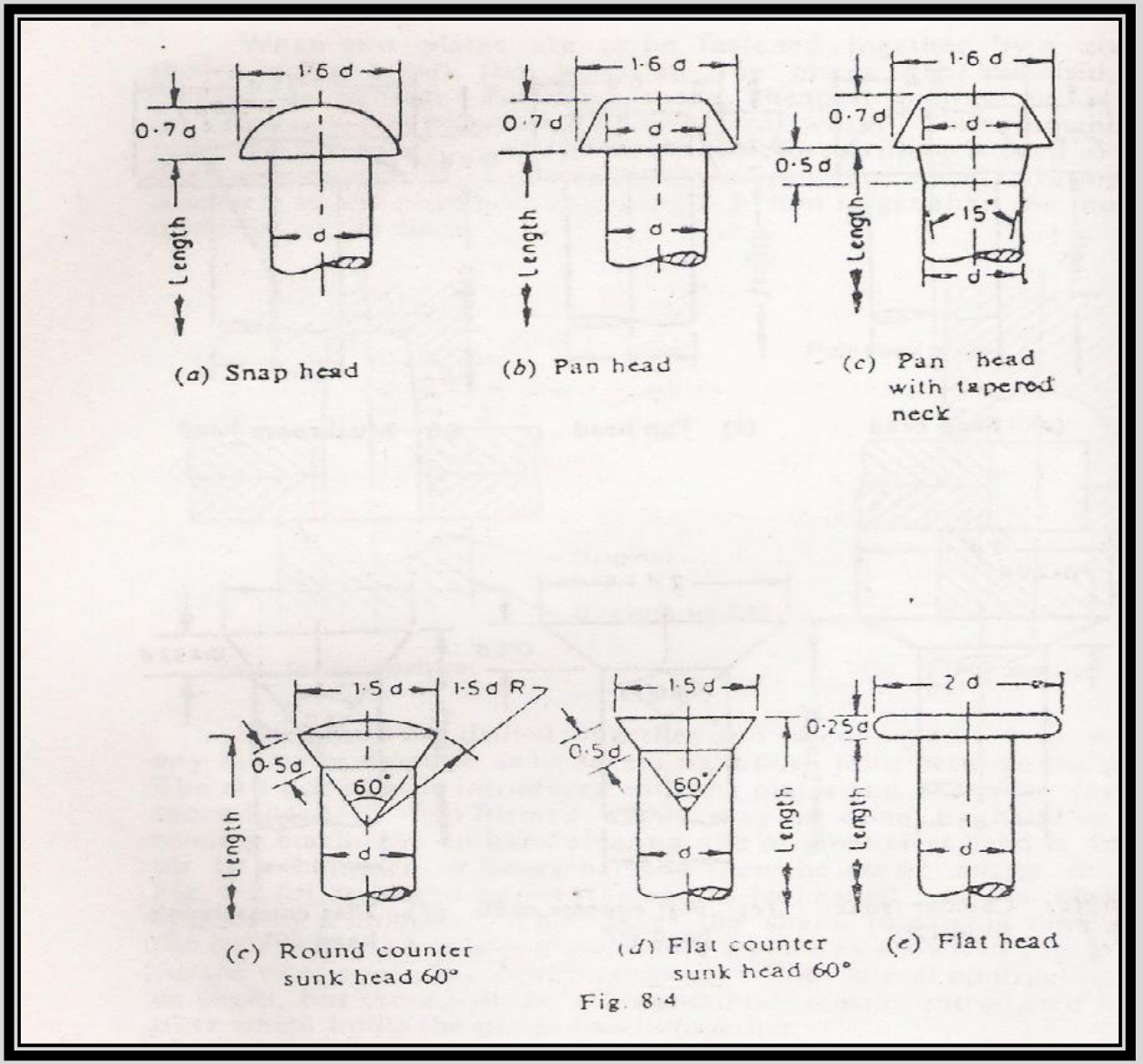
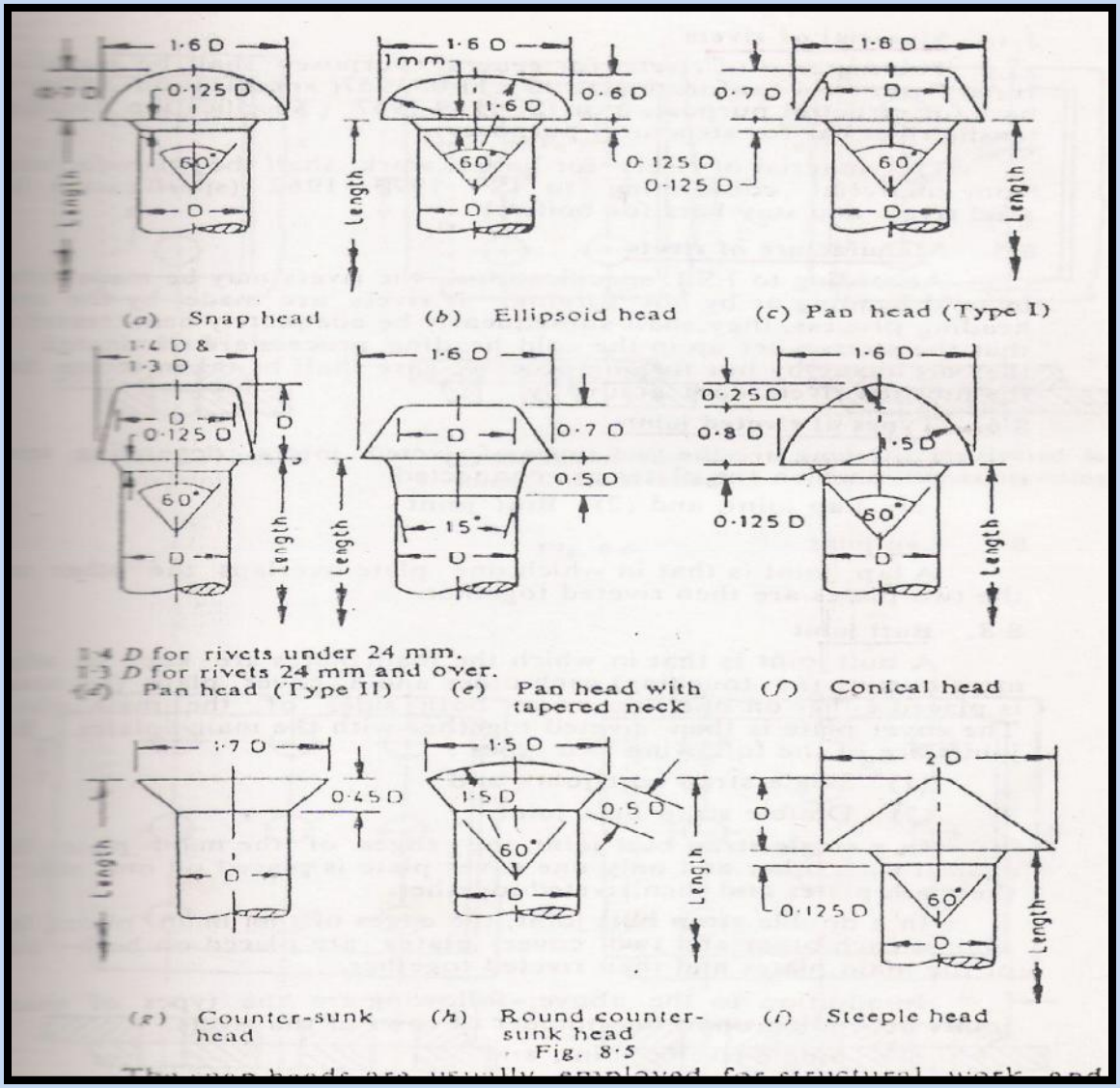


Fig. 8·4

Kepala rivet untuk penggunaan umum (diameter mulai 12 mm - 48 mm). IS : 1929 – 1961

Tipe-tipe HEAD



Kepala rivet untuk boiler (diameter mulai 12 mm - 48 mm). IS : 1928 – 1961

Bahan **RIVET**

Bahan rivet umumnya adalah dari baja (low carbon steel). Untuk keperluan lain biasanya terbuat dari kuningan, aluminum atau tembaga.

IS-2100-1962 gives the steel rivet specifications which are used in boilers.

TYPES OF RIVETED JOINTS

The classification of riveted joints is based on following :

(a)According to purpose,

(b)According to position of plates connected, and

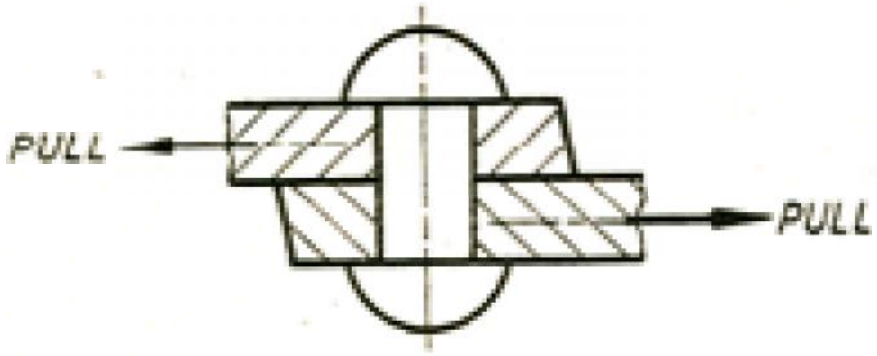
(c)According to arrangement of rivets.

Jenis sambungan RIVET

Ada dua jenis sambungan rivet (berdasar pada bagaimana cara plat dihubungkan) :

1. Lap Joint
2. Butt Joint

Lap Joint : kedua plat ditumpuk dan kemudian di rivet



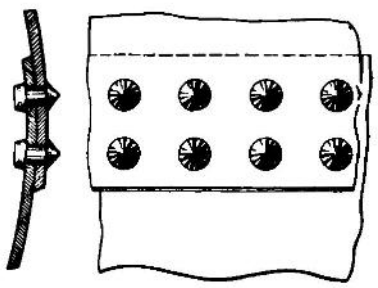


Fig. 6.

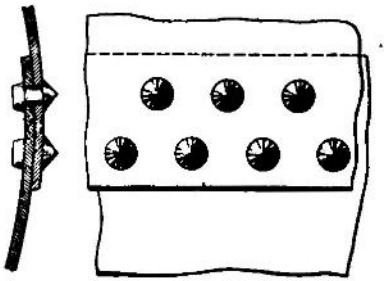
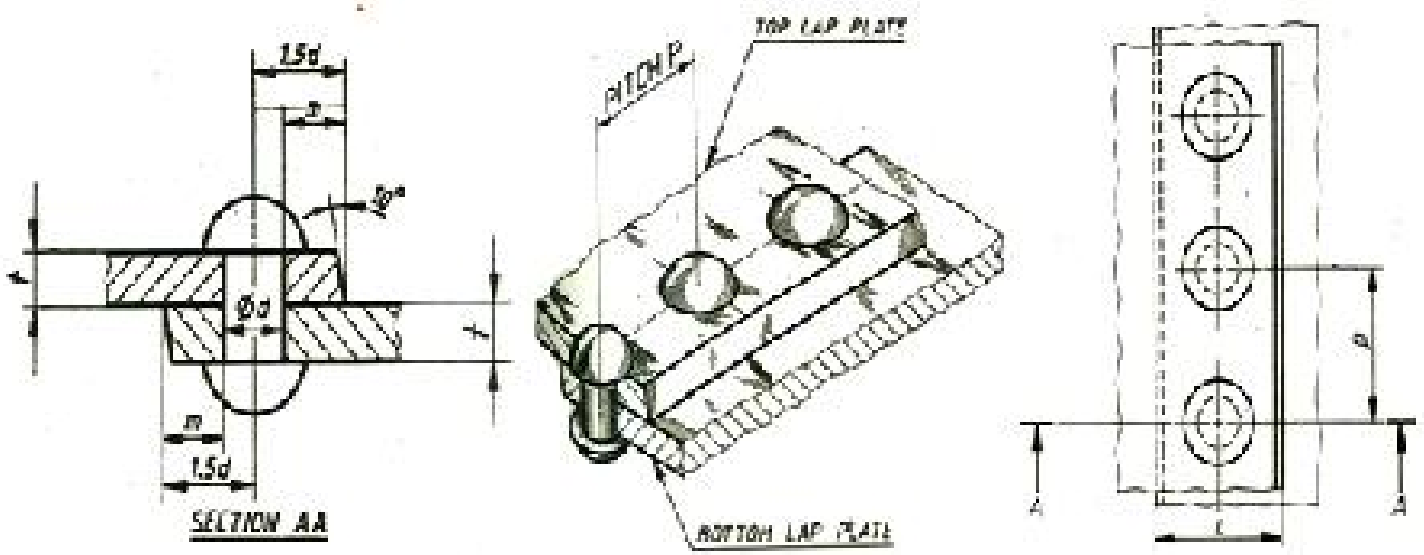
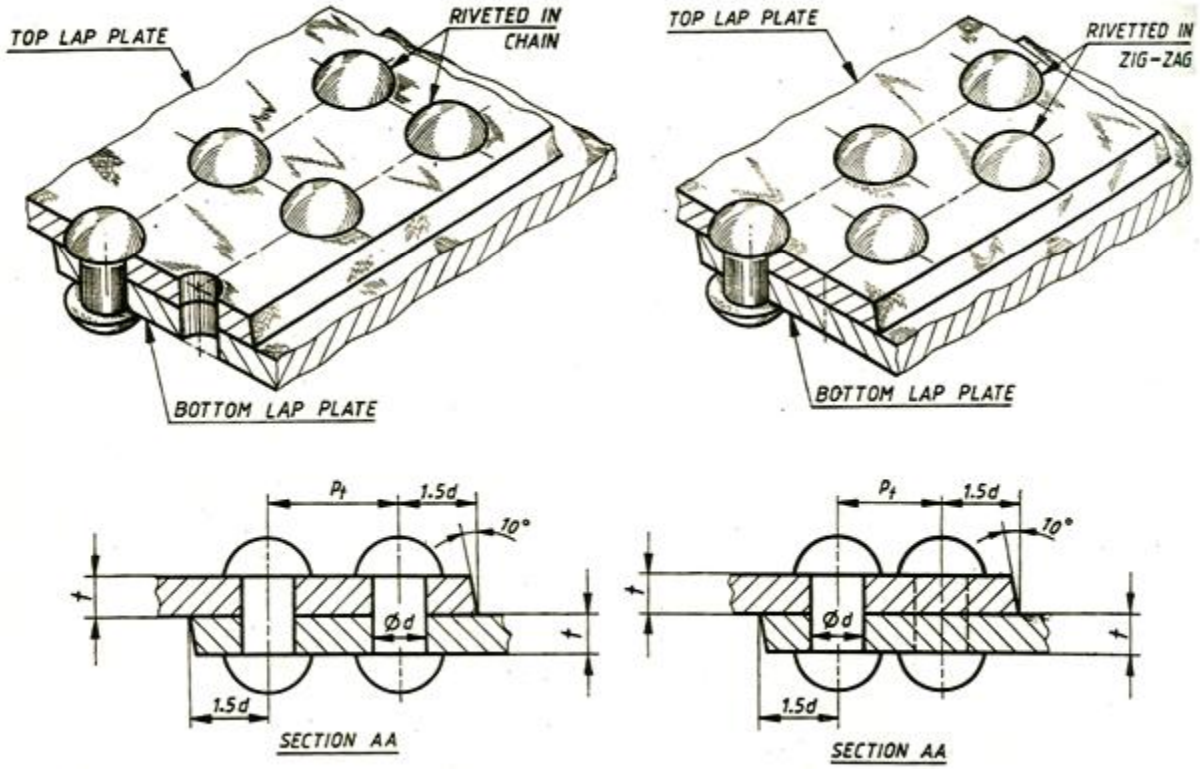


Fig. 7.

Single Riveted Lap joint

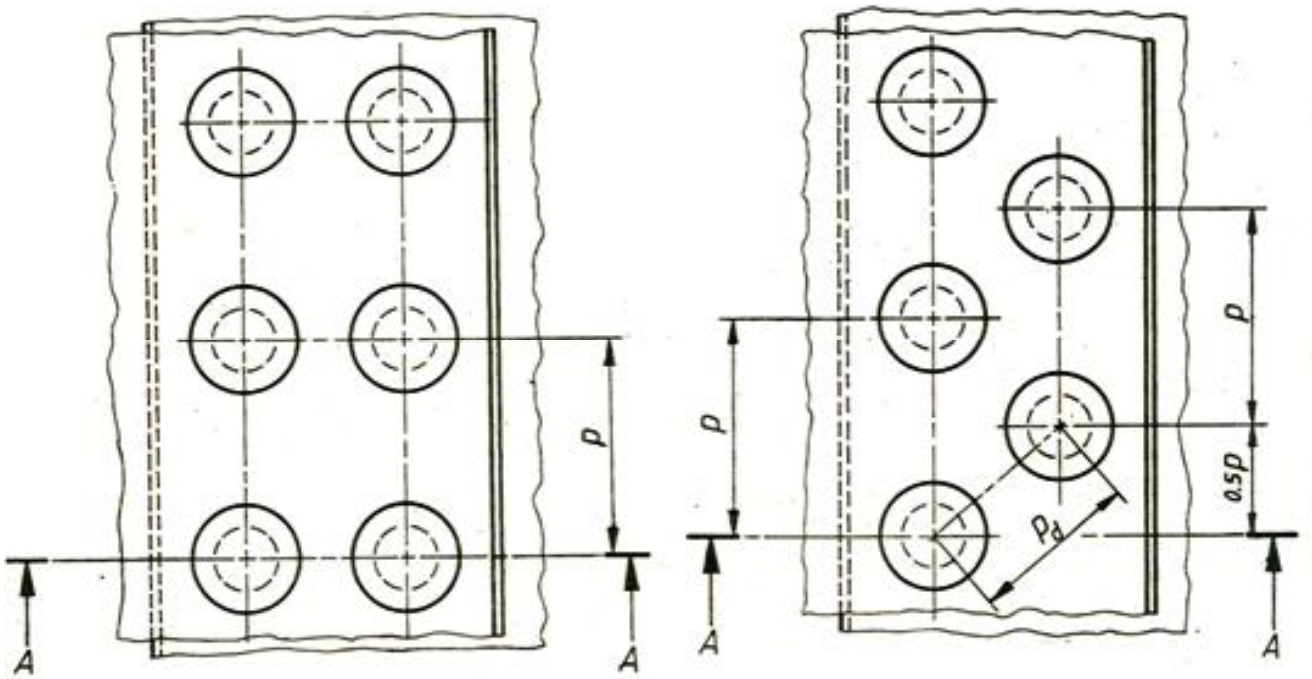


Ex. Double riveted lap joint



http://onlineeducations.net/rivets-and-riveted-joints/

Double Riveted Lap Joint with Chain and Zig-Zag Riveting



Butt Joint : plat utama *(main plate)* diletakkan saling bersentuhan dan plat cover *(strap)* diletakkan pada salah satu sisi atau kedua sisi dari plat utama, baru kemudian di rivet bersama

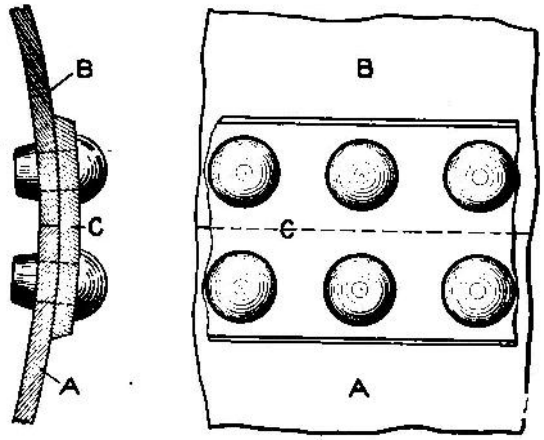
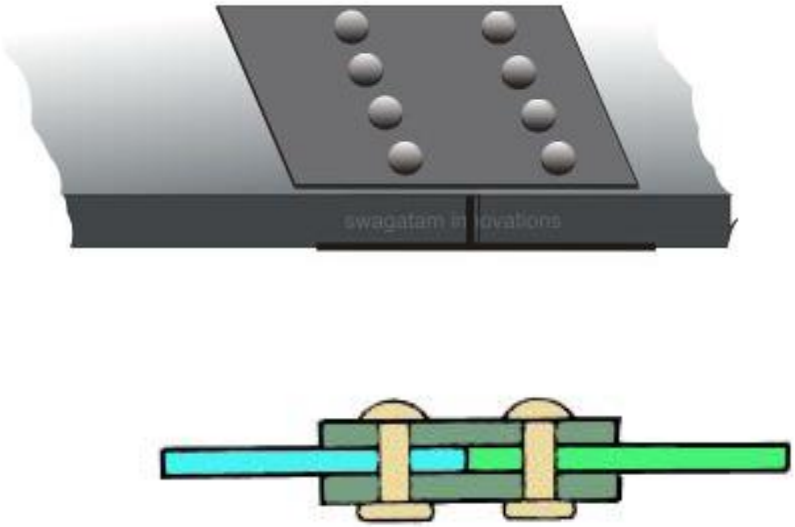
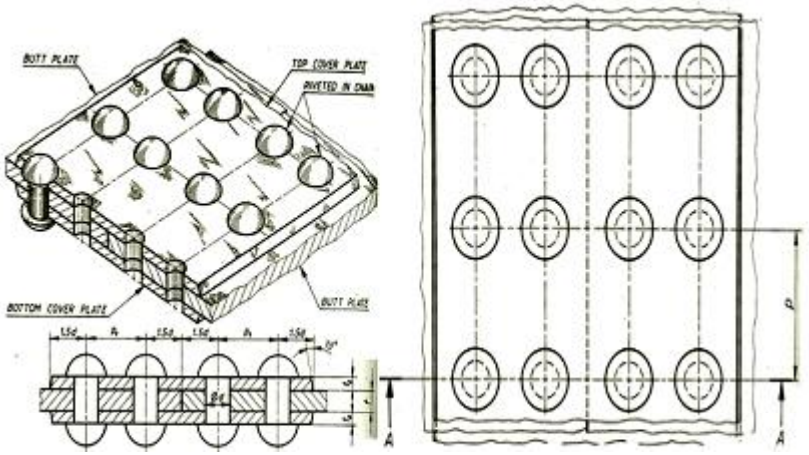
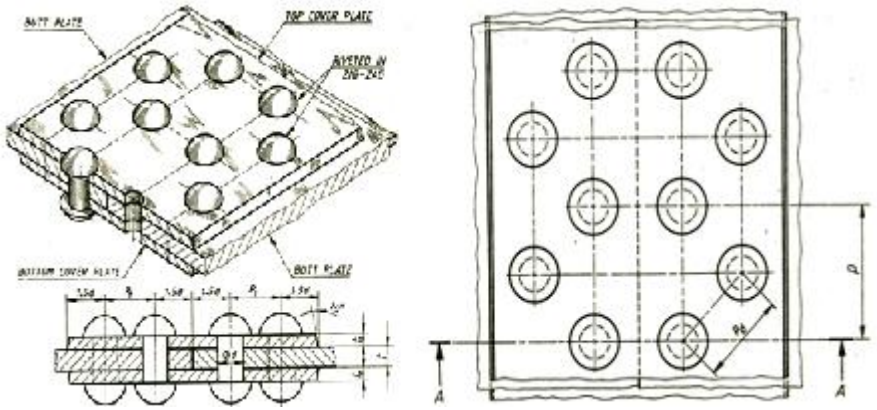


Fig. 8.



Double Riveting With Double Cover and Chain Riveting



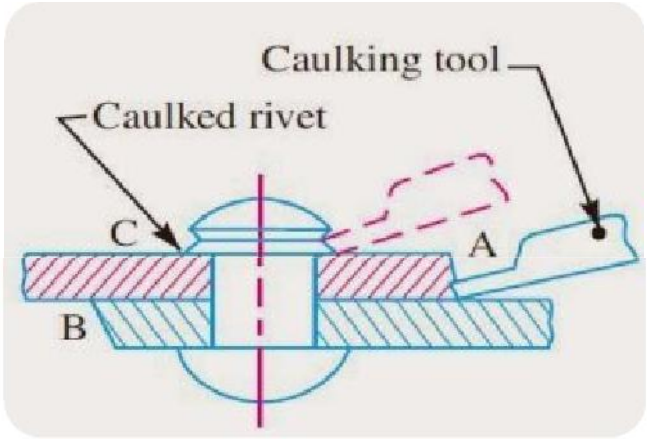


Double Riveted With Double Cover Plates and Zig-Zag Joint

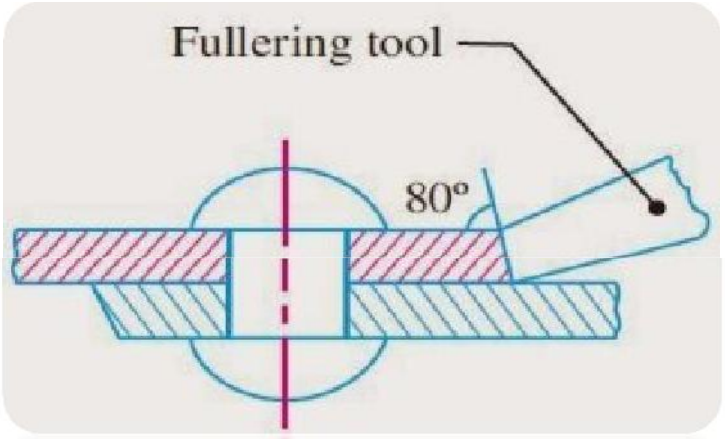
Lap joints are used for circumferential seams, and the stronger joint (butt joint) for longitudinal joints.

For high pressures in marine boilers, triple riveting is frequently used.

Caulking & Fullering

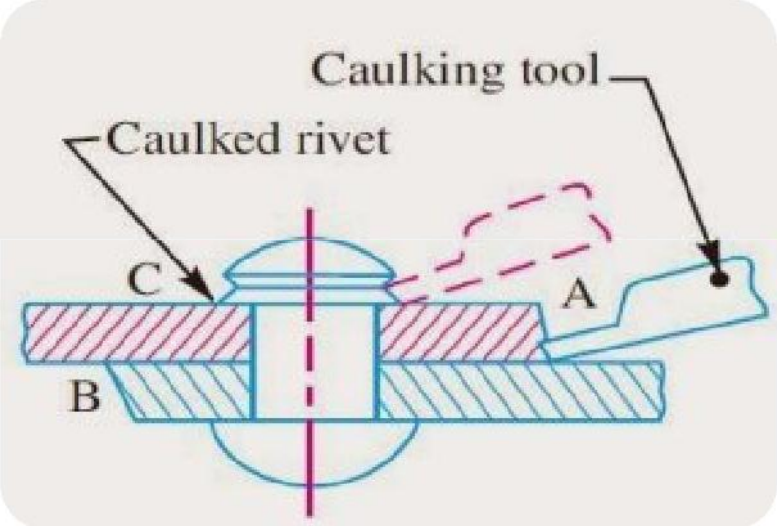


Caulking Tool



Fullering Tool

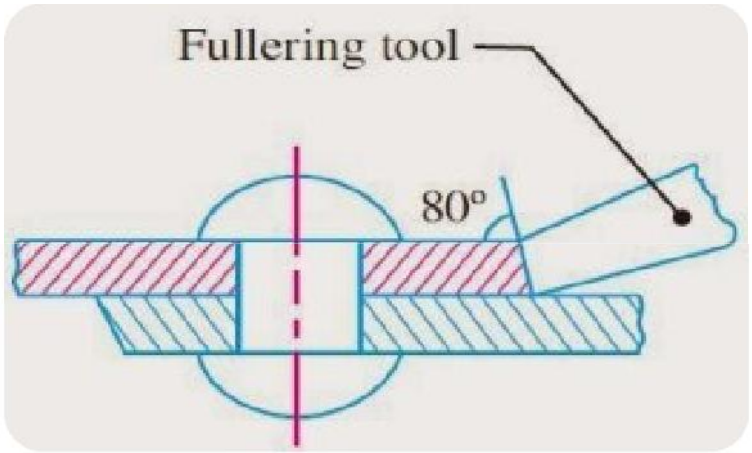
Difference Between Caulking and Fullering



Caulking Tool

- **<u>Caulking:</u>**
  - It is used to obtain leak proof joints.
  - This operation is carried out by using narrow blunt tool called caulking tool.
  - The thickness of tool is about 5mm.
  - Surface finish obtained is less compared to fullering.
  - More risk of damaging the plates.

Difference Between Caulking and Fullering



Fullering Tool

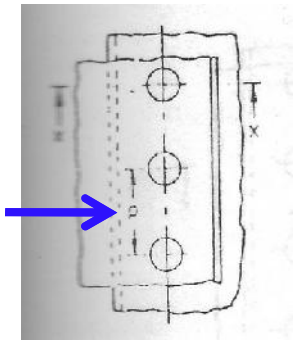
- **<u>Fullering:</u>**
  - It is used to obtain leak proof joints.
  - It is carried out by using fullering tools.
  - The thickness of tool is equal to the thickness of the plate.
  - It is gives clean surface finish.
  - Less risk of damaging the plates.

http://mechanizer.info/blog/2014/03/13/difference-between-caulking-and-fullering/

Istilah **teknis**

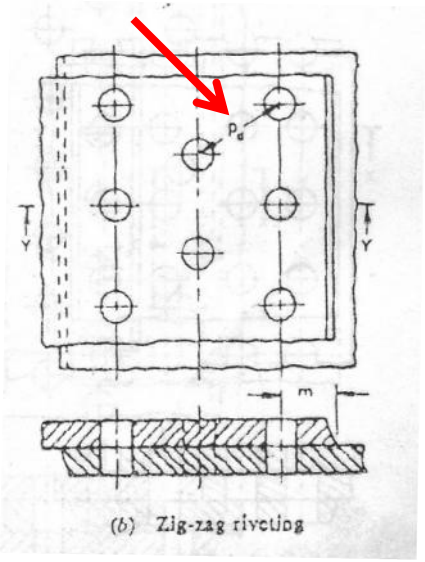
- **Pitch :** jarak antara pusat satu rivet ke pusat rivet lain yang terdekat.

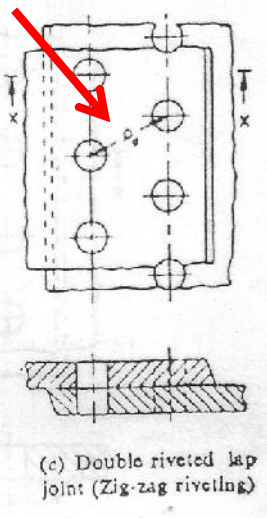
- Biasanya dinotasikan dengan : p



Istilah **teknis**

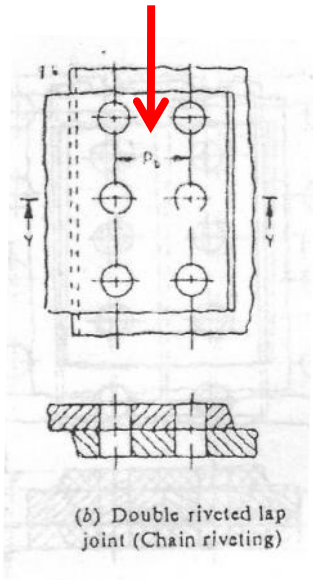
- **Diagonal pitch :** jarak antara pusat-pusat rivet yang saling berdekatan secara zig-zag.
- Biasanya dinotasikan dengan p_d





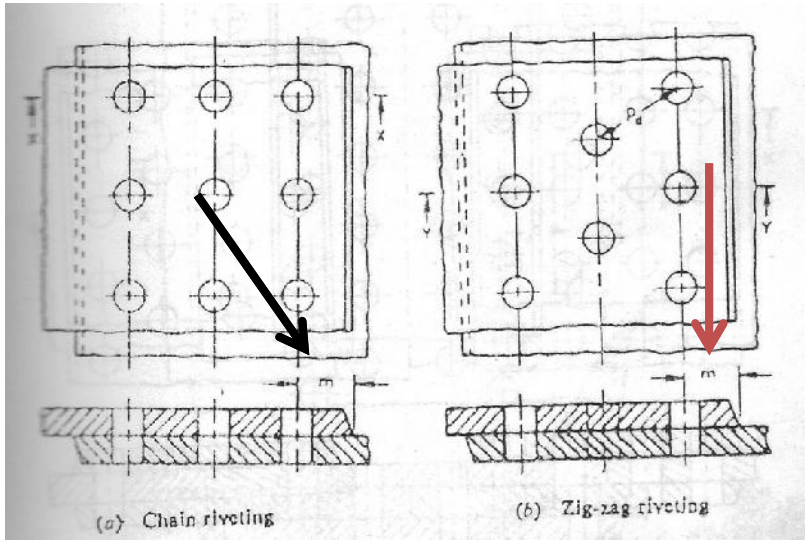
Istilah **teknis**

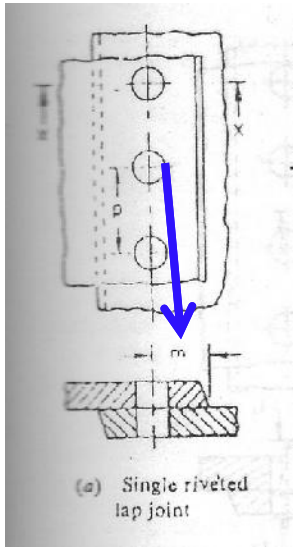
- **Back pitch :** jarak antar kolom pada sambungan rivet.
- Biasanya dinotasikan dengan p_b



Istilah **teknis**

- **Margin :** jarak antara pusat lubang rivet ke sisi terdekat dari plat.
- Biasanya dinotasikan dengan *m*






TITANIC

Remember

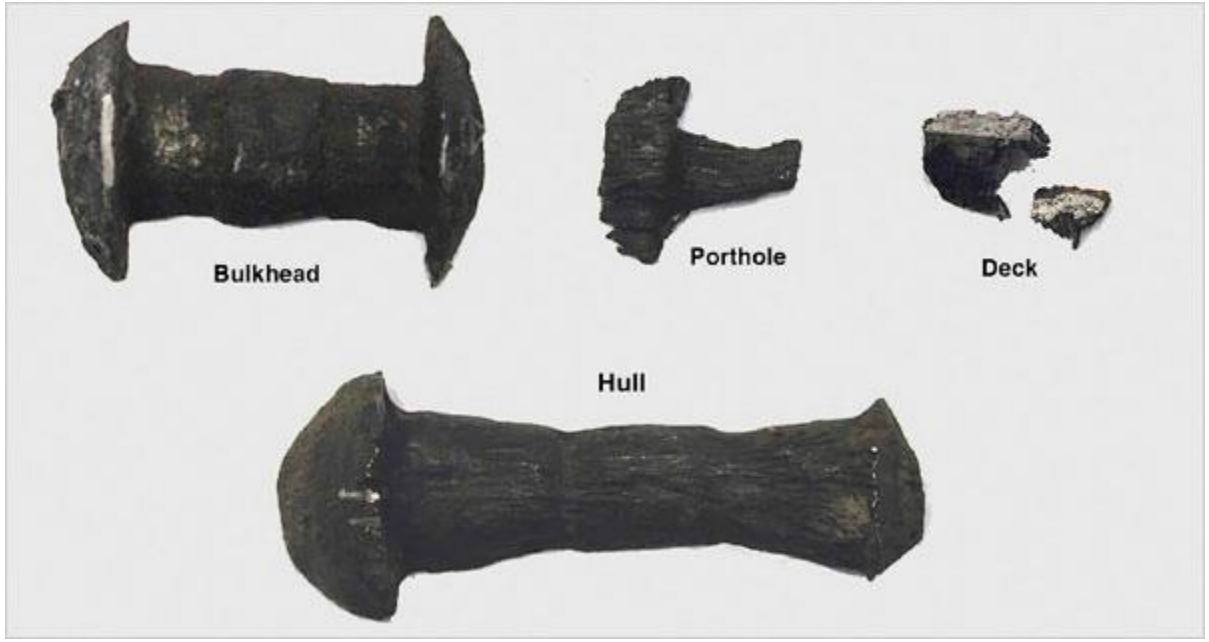
Tenggelamnya Kapal Titanic ?

Apa penyebabnya ?

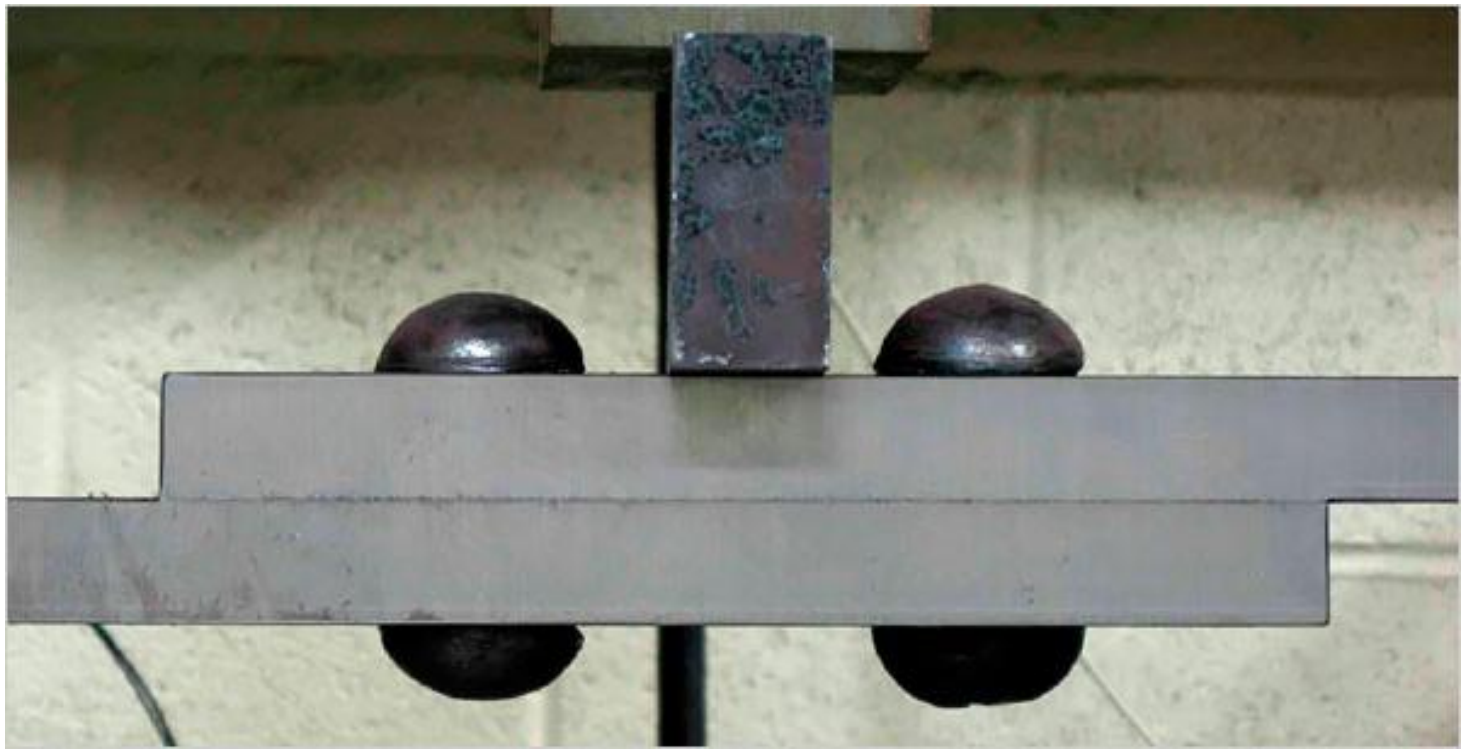
Iron vs Steel Rivets — Why the Titanic Sank

- The article In Weak Rivets, a Possible Key to Tianic's Doom, lays out the accumulating evidence that it was the use of cheaper, weaker, iron rivets, over stronger steel rivets that allowed the ice burg to to rip such gigantic gashes in the hull of the great ship.

Samples of four different types of rivets recovered from the Titanic. While some ships of the time were built entirely with steel rivets, the Titanic used a mix of steel and iron rivets. In the bow, where the Titanic hit the iceberg, weaker iron rivets were used.



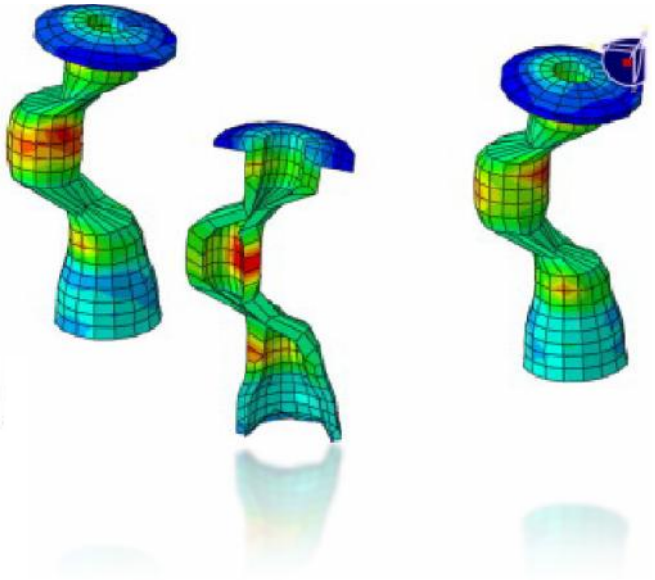
To test the theory of weak rivets on the Titanic, Chris Topp, a blacksmith in Yorkshire, England, recreated one of the Titanic's double-riveted hull joints.

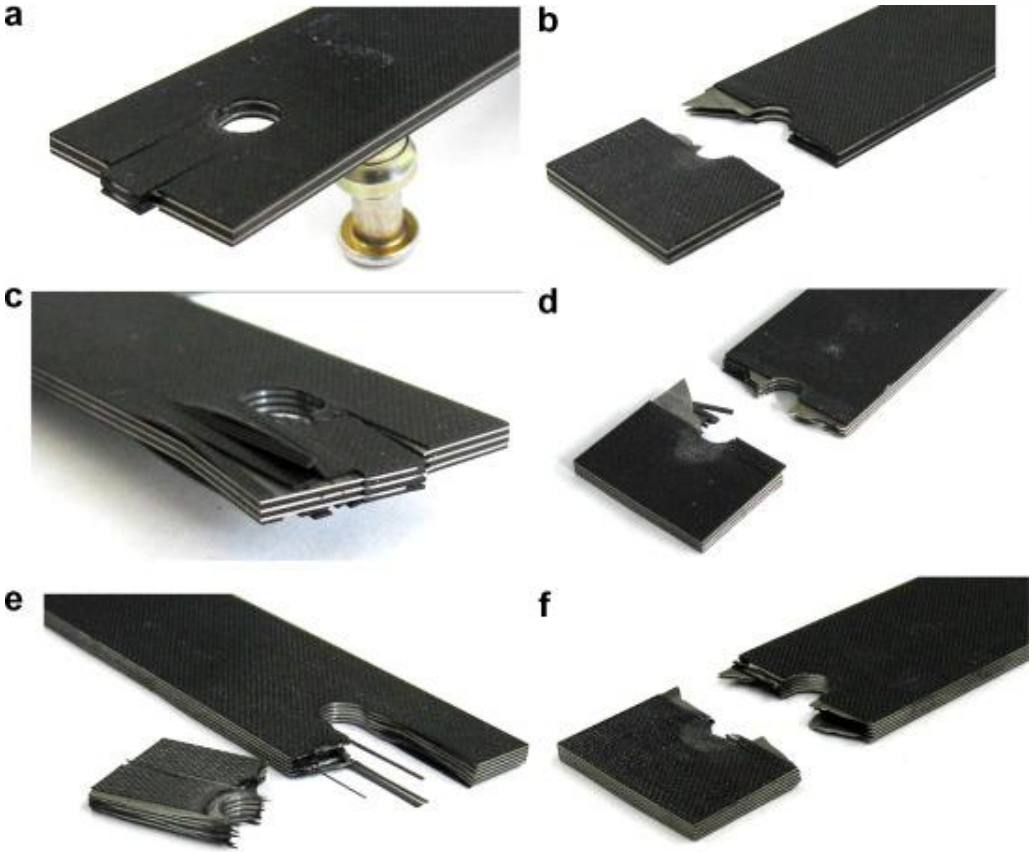


Stresses similar to what the Titanic experienced in its collision with the iceberg were applied to the joint, and the top of one of the rivets popped off, at a load only 60 percent of what a good quality rivet should have withstood.

The small “button” on the inside of the rivet head was similar in shape to broken rivets recovered from the Titanic wreckage.

Riveted Failure



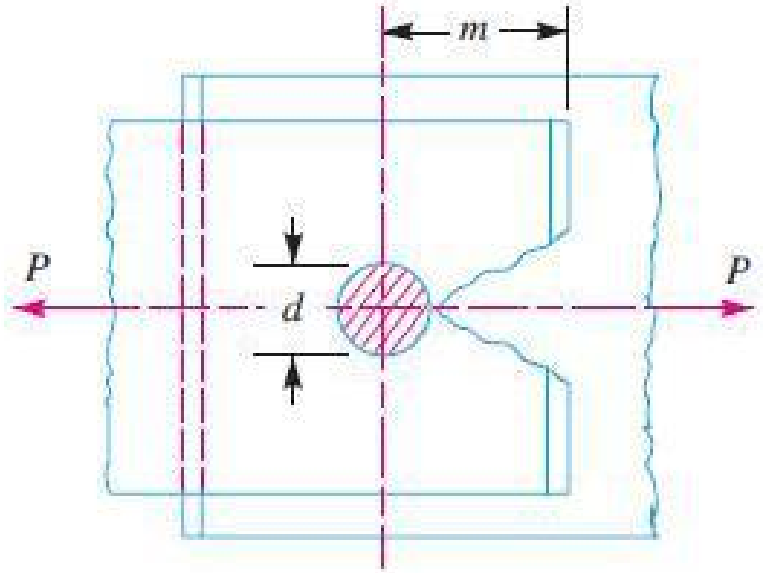


Kegagalan sambungan RIVET

- Robek pada salah satu sisi plat *(tearing of the plate at an edge)*
- Robek pada plat melintasi baris rivet *(tearing of the plate across a row of rivets)*
- Bergesernya rivet *(shearing of the rivets)*
- Hancurnya/rusak rivet *(crushing of the rivets)*

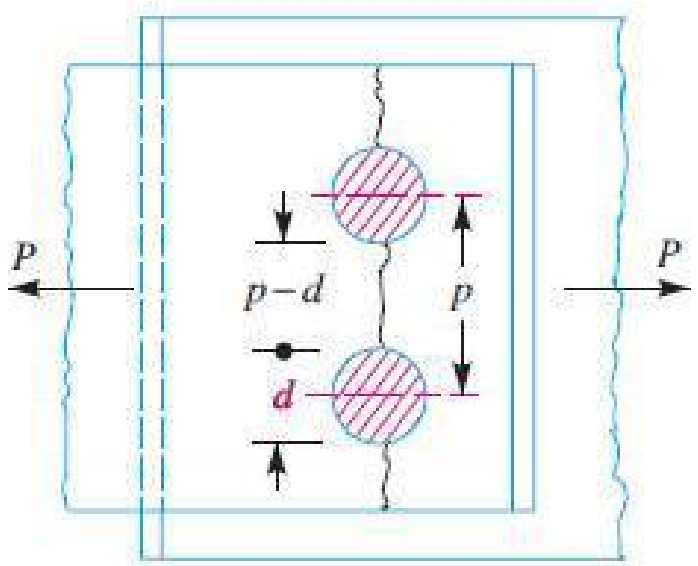
Tearing of the plate at an edge

- Dapat dihindari dengan cara membuat margin, m = 1,5 d.
- d = diameter rivet



Tearing of the plate across a row of rivets

- Akibat gaya tarik yang bekerja pada main plate, maka cover plate atau main plate dapat mengalami robekan.



Tearing Resistance of the plate

Luas area robekan per panjang pitch :

$A_t = (p - d)t$

Tearing Resistance Plat: $P_t = \sigma_{ijin}.A_t = \sigma_{ijin}\,(p - d)t$

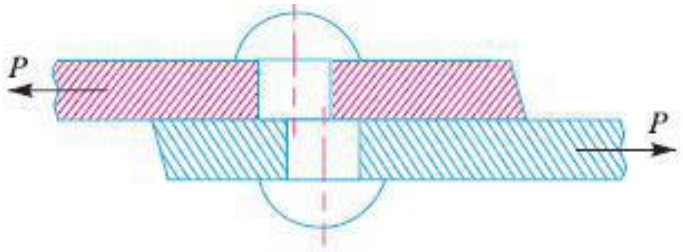
p : pitch rivet

d : diameter rivet

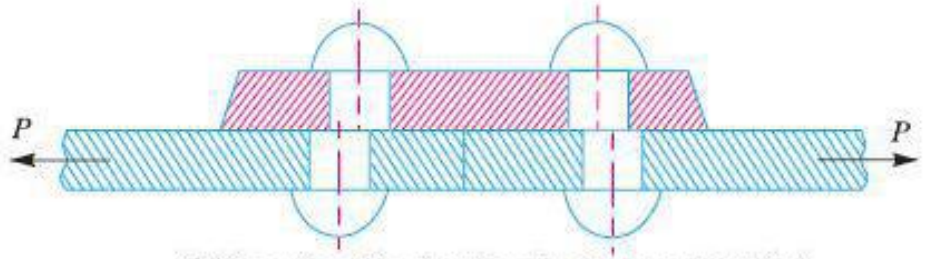
t : tebal plat

σ_{ijin} : tegangan tarik ijin bahan plat

Shearing of the rivets



(*a*) Shearing off a rivet in a lap joint.



(*b*) Shearing off a rivet in a single cover butt joint.

Fig. 9.15. Shearing of rivets.

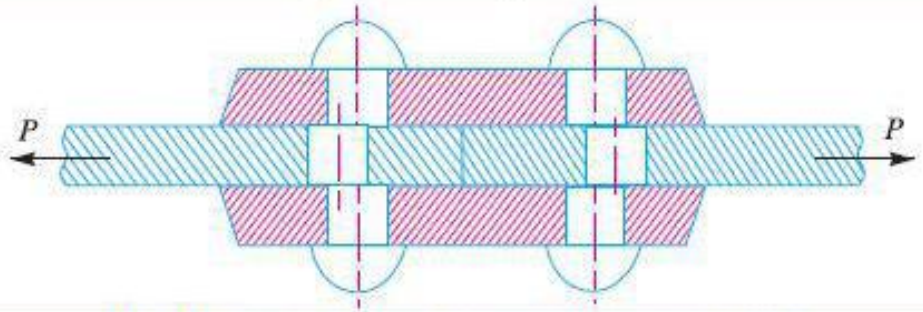
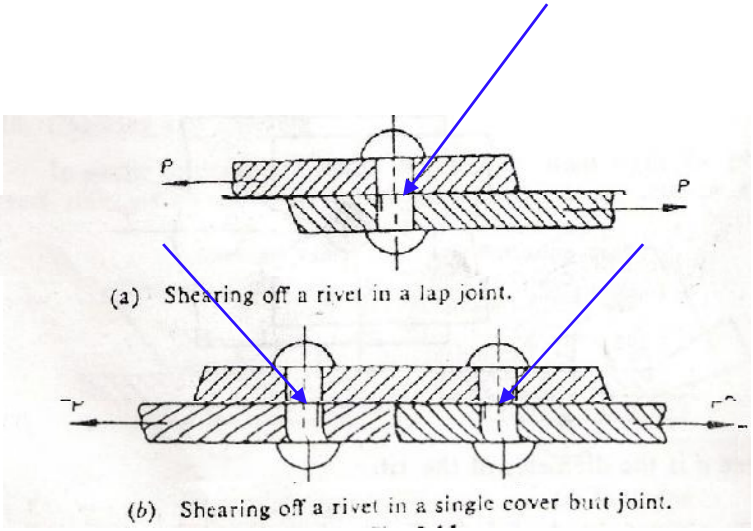


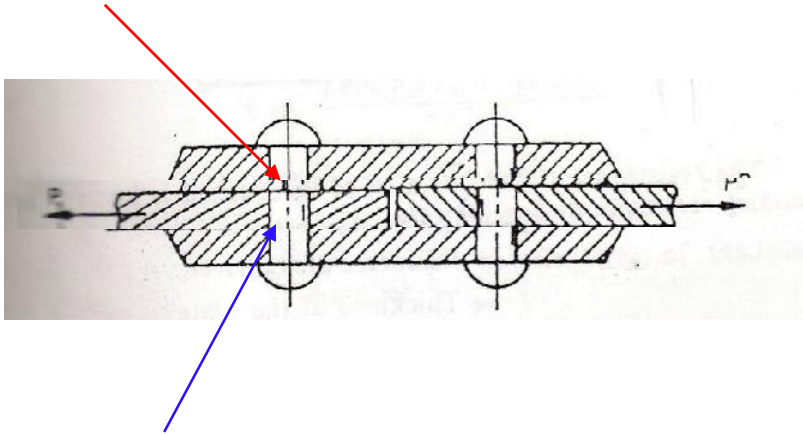
Fig. 9.16. Shearing off a rivet in double cover butt joint.

Shearing of the rivets

Single shear



Double shear



Jika **d = diameter rivet**, **τ_{ijin} = tegangan geser ijin bahan rivet**, **n = jumlah rivet per panjang pitch,** maka

Luas area geseran :

$$A_s = \frac{®}{4} d^2 \quad (untuk\ geseran\ \ tunggal)$$

$$A_s = 2\,x\,\frac{®}{4} d^2 \quad (teoritis\ \ untuk\ geseran\ ganda)$$

$$A_s = 1{,}875\,x\,\frac{®}{4} d^2 \quad (\ geseran\ \ ganda\ \ sesuai\ \ IBR)$$

Shearing Resistance Rivet

Shearing Resistance Rivet:

$$P_s = \frac{®}{4} d^{2} {}_{ijin} \; x \; n$$

Single shear

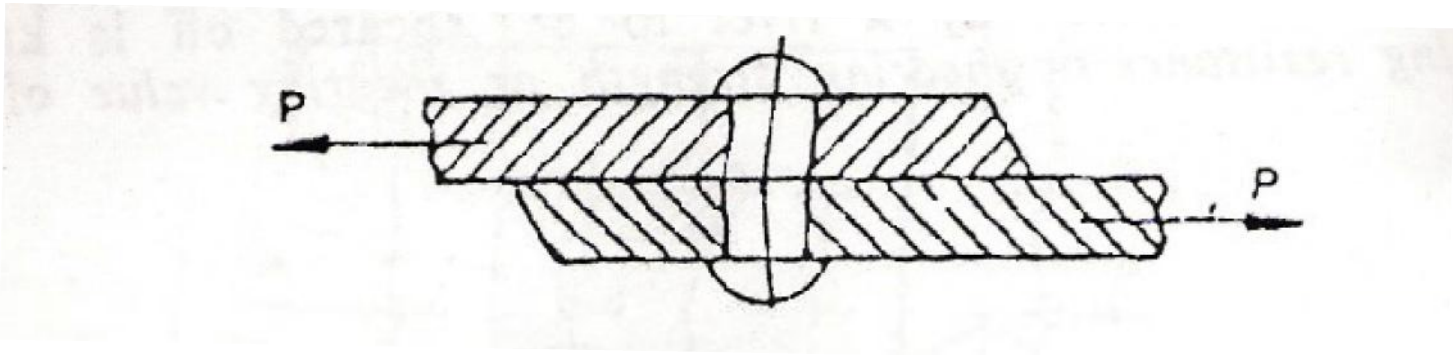
$$P_s = 2\,x \frac{®}{4} d^{2} {}_{ijin} \; x \; n$$

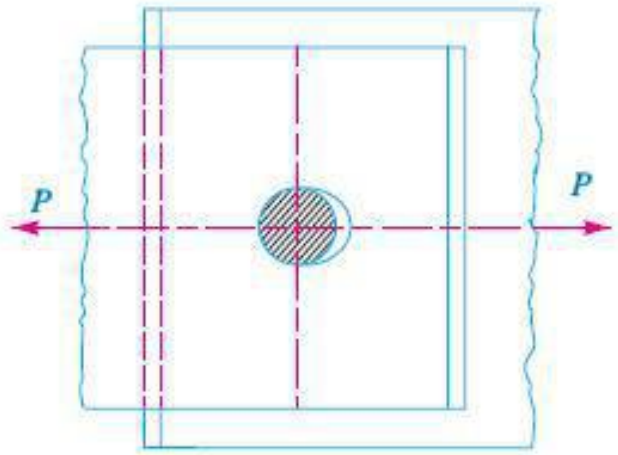
Double shear teoritis

$$P_s = 1{,}875\,x \frac{®}{4} d^{2} {}_{ijin} \; x \; n$$

Double shear IBR

Crushing of the rivets





Jika **d** = diameter rivet, **t** = tebal plat, $\mathbf{f_c}$ = tegangan crush ijin bahan rivet, **n** = jumlah rivet per panjang pitch, maka

Luas area crushing per rivet :

$A_c = d.t$

Sehingga total crushing area = n.d.t

Crushing Resistance :

$P_c = n.d.t.f_c$

Kekuatan Sambungan RIVET

Kekuatan suatu sambungan dapat didefinisikan sebagai gaya maksimum yang dapat ditransmisikan tanpa terjadi kegagalan sambungan.

P_t, P_s dan P_c adalah tarikan yang dibutuhkan untuk merobek plat, menggeser rivet dan menekuk rivet.

Efisiensi Sambungan RIVET

Efisiensi Sambungan RIVET adalah rasio kekuatan sambungan terhadap kekuatan plat tanpa rivet (plat utuh).

Kekuatan sambuangan rivet diambil nilai terkecil dari P_t, P_s dan P_c.

Kekuatan plat tanpa rivet : $P = p \times t \times f_t$

$$efisiensi = \frac{least\ \ of\ \ P_t, P_s, P_c}{p.t.f_t}$$

Tabel efisiensi sambungan rivet untuk boiler menurut Indian Boiler Regulations

Lap joint	Efisiensi (%)	Butt joint (double strap)	Efisiensi (%)
Single riveted	45 - 60	Single riveted	55 – 60
Double riveted	63 - 70	Double riveted	70 – 83
Triple riveted	72 - 80	Triple riveted (5 rivets per pitch)	80 – 90
		Quadruple riveted	85 – 94