

Screw Fastenings

1. SCREW THREADS

2. BOLTS

3. STRESSES IN FASTNERS

BOLTS

A bolt comprises of two parts - a shank and a head.

The shank is cylindrical and is threaded at the tail end for a sufficient length so as to effectively engage with a nut.

The shape of the head depends upon the purpose for which the bolt is required.

While considering the length of the bolt, the thickness of the head is not taken into account.

Hexagonal-headed bolt:

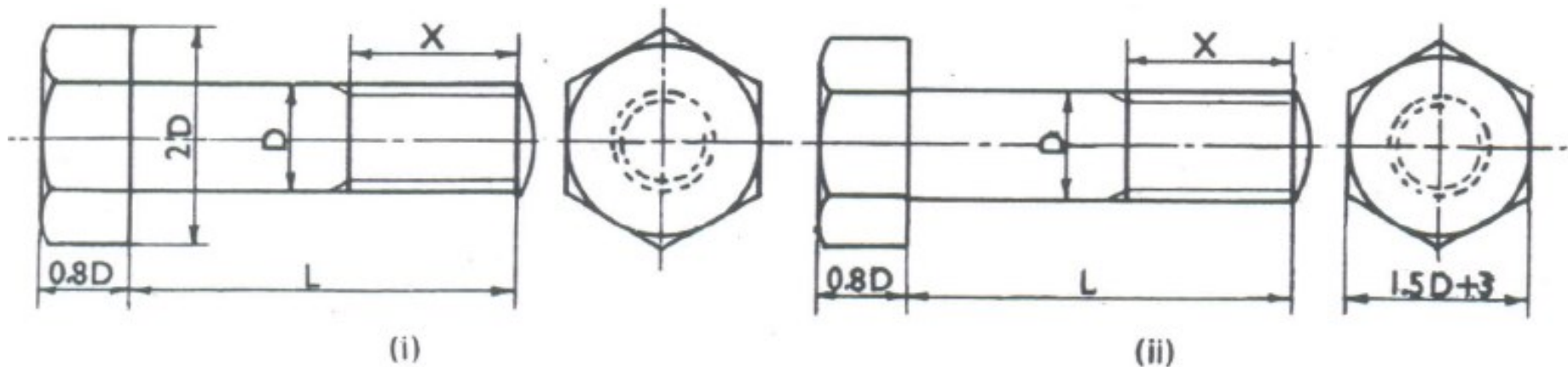
This is the most common form of a bolt.

The hexagonal head is chamfered at its upper end.

To prevent rotation of the bolt while screwing the nut on or off it, the bolt-head is held by another spanner.

The dimensions of the bolt-head are the same as those of the hexagonal nut, except for the thickness.

For elementary work, the thickness is taken as $0.8D$ to D .



Hexagonal-headed bolt

Methods of preventing rotation of a bolt while screwing a nut on or off it

When it is not possible to hold a bolt-head by means of a spanner, the bolt is prevented from rotating by the provision of one of the following, below the bolt-head:

- (i) a square neck
- (ii) a pin
- (iii) a snug.

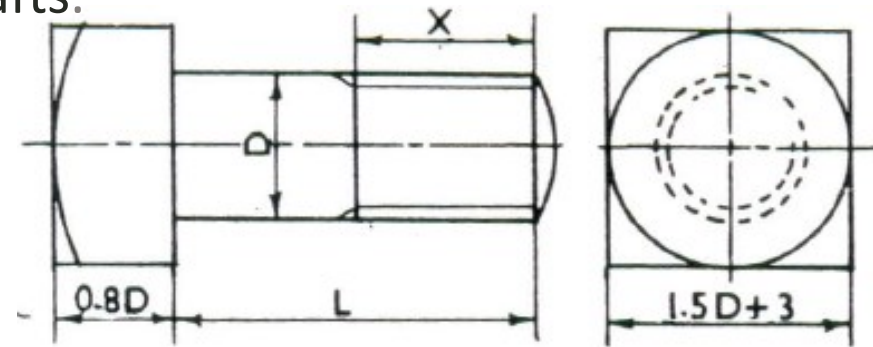
Square-headed bolt

This bolt is generally used when the head is to be accommodated in a recess. This recess also is made of square shape so that the bolt is prevented from turning when the nut is screwed on or off it. This bolt is commonly used in bearings for shafts.

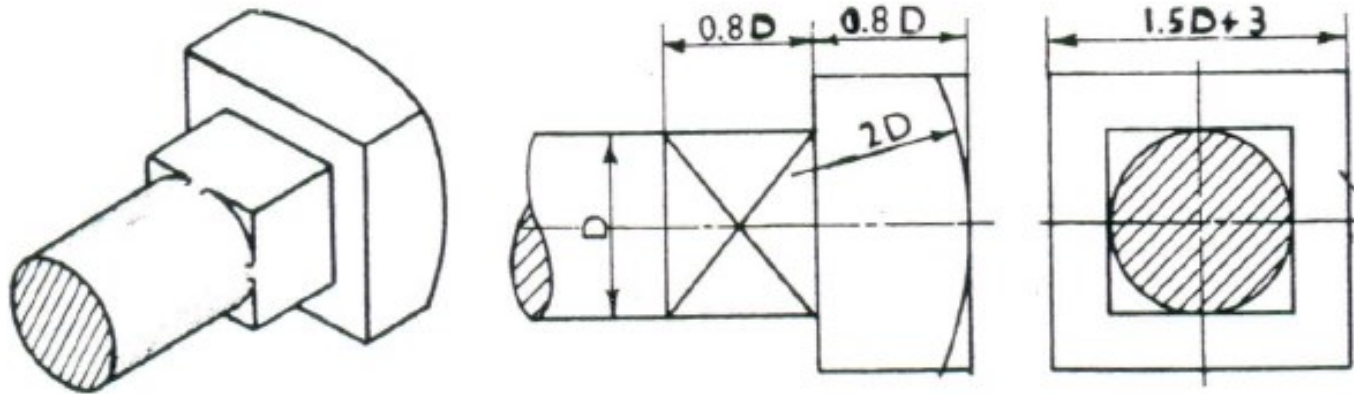
The bolt-head is chamfered at its upper end.

Thickness of bolt-head = $0.80D$ to D

Width across flats = $1.5D+3$ mm



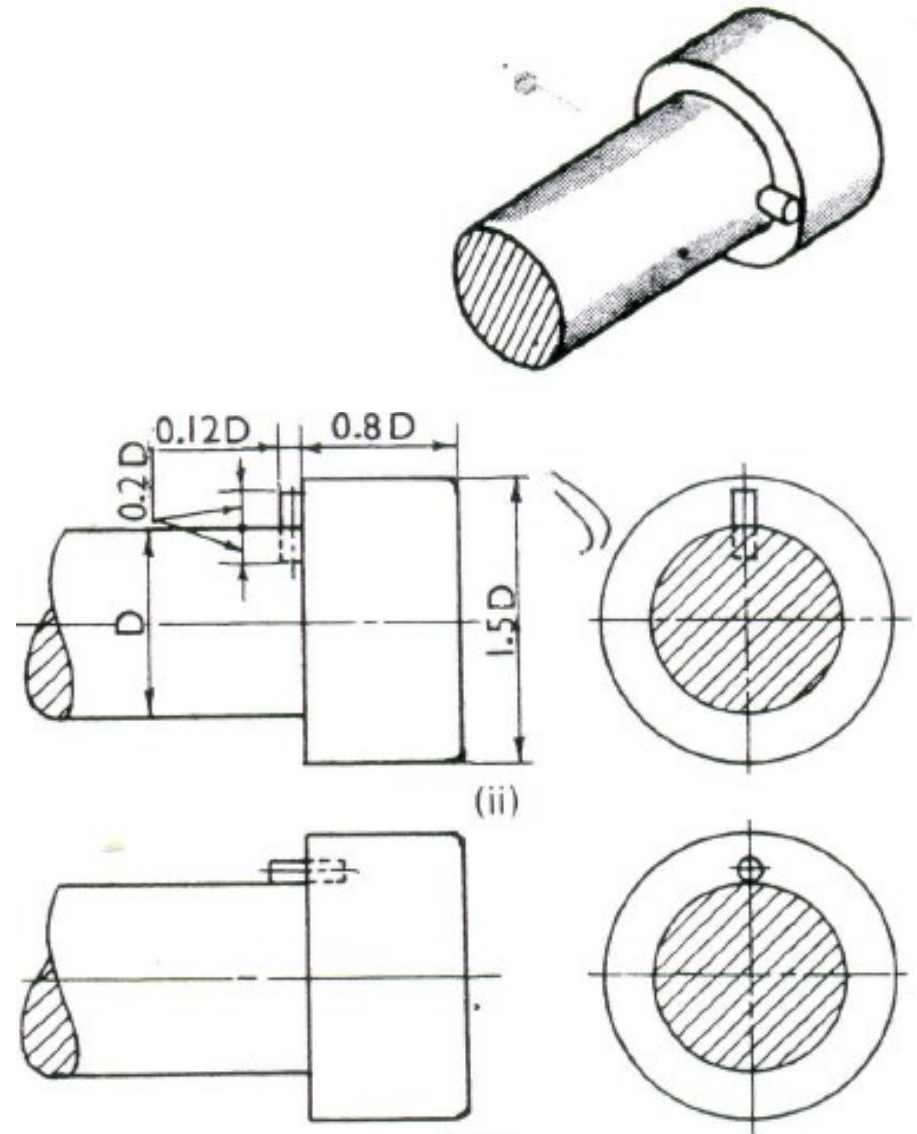
Square-headed bolt



Square-headed bolt (with sq. neck)

Cylindrical or cheese-headed bolt

This bolt is used when the space for accommodating the bolt-head is comparatively limited or where the use of a **spanner** for holding it is to be avoided. It is commonly used in big ends of connecting rods, eccentrics etc.

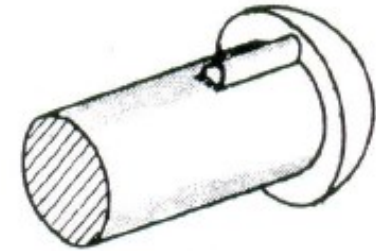


Cup-headed or round-headed bolt

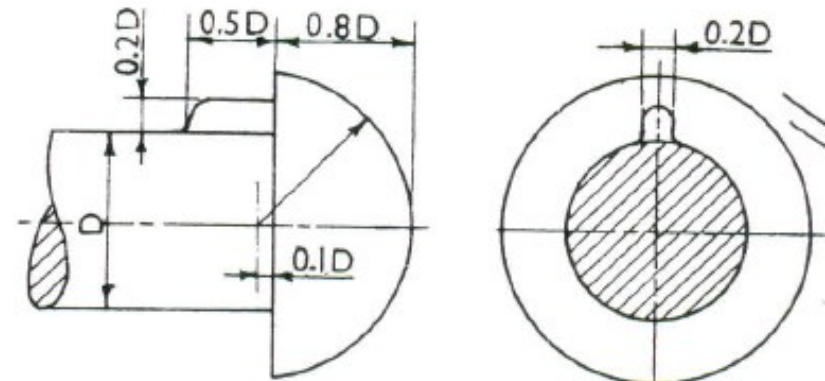
It is provided with a snug forged on the shank just below the head.

It fits into a corresponding recess in the adjacent piece to prevent rotation of the bolt.

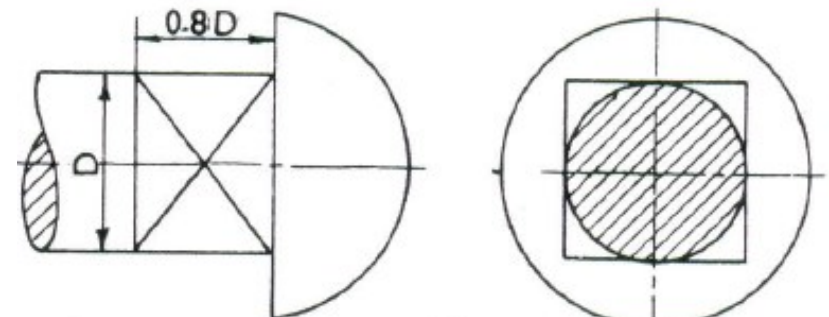
This bolt is often provided with a square neck.



(i)



(ii)



(iii)

Cup-headed bolt

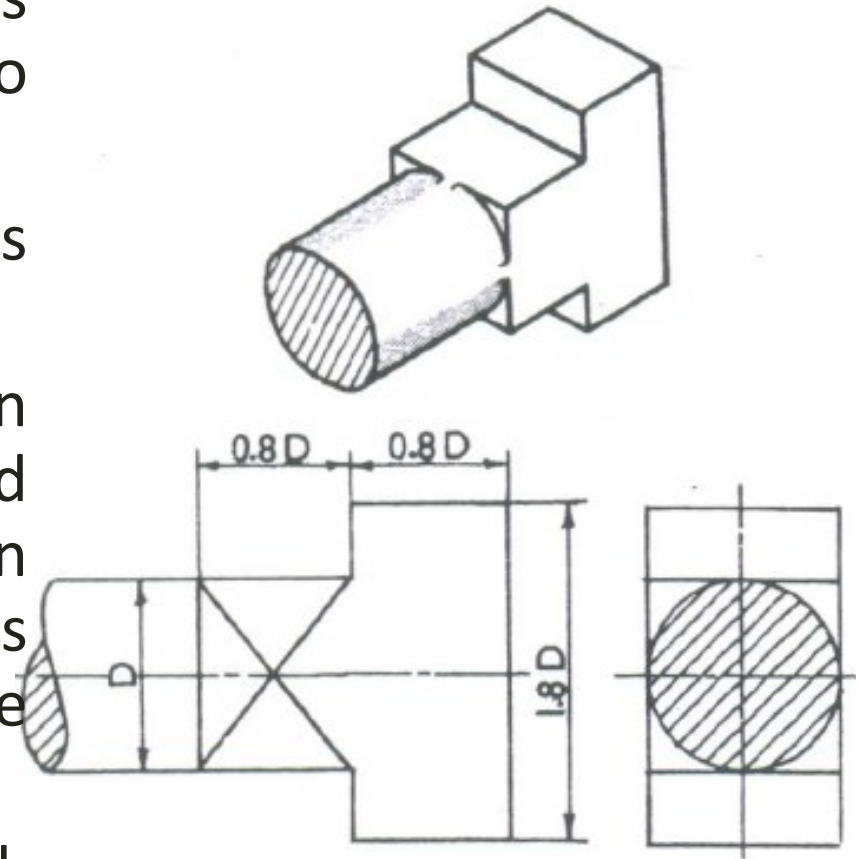
T-headed bolt

It is used in machine-tool tables in which T-slots are cut to accommodate the T-heads.

The neck of this bolt also is usually square in section.

The T-headed bolt is often made use of in gland and stuffing box arrangement in boiler mountings such as stop valve, feed-check valve etc.

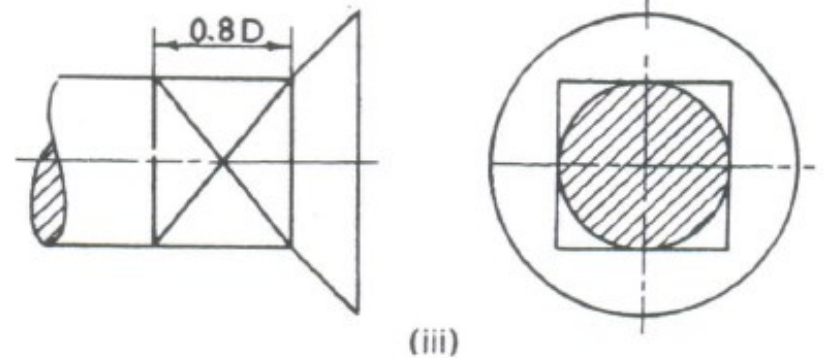
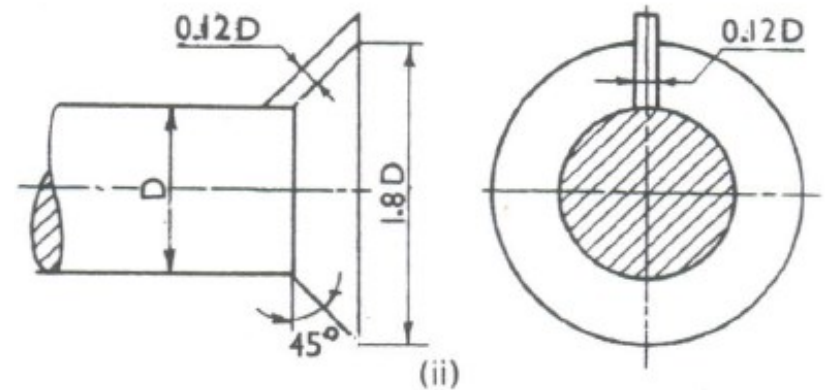
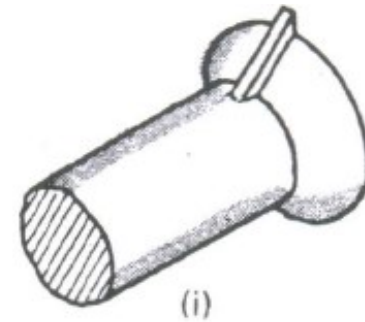
In that case the square neck becomes unnecessary and hence, it is not provided.



T-headed bolt

Countersunk-headed bolt

Where the head of a bolt must not project above the surface of the connected piece, this form of bolt is used. It may be provided with a snug or a neck of square cross-section.



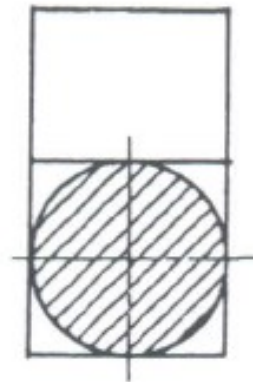
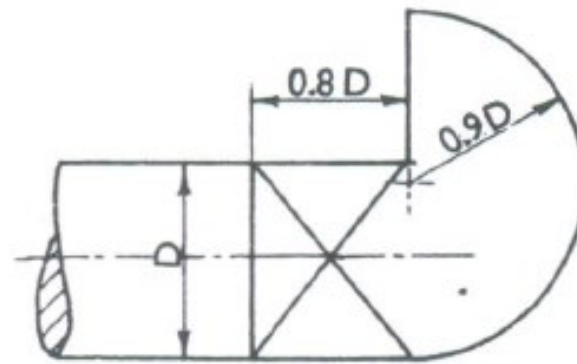
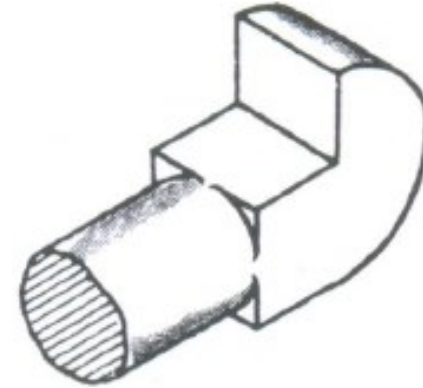
Countersunk-headed bolt

Hook bolt

This bolt passes through a hole in one piece only, while the other piece is gripped by the hook-shaped bolt-head.

It is used when it is not possible to drill a hole in the piece adjoining the bolt-head.

The square neck prevents rotation of the bolt.

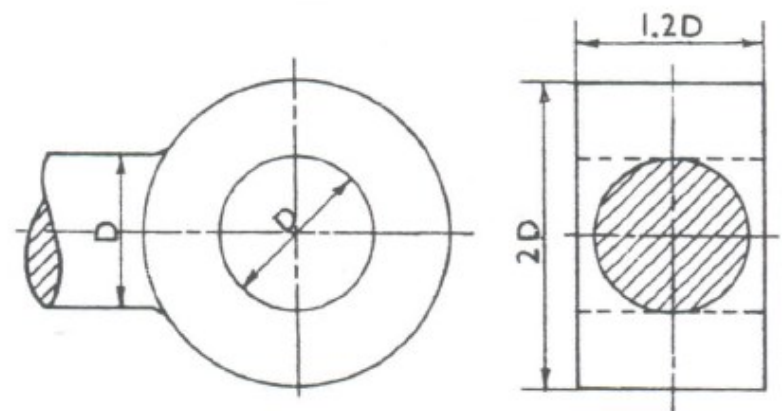
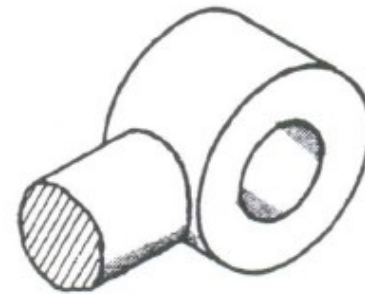
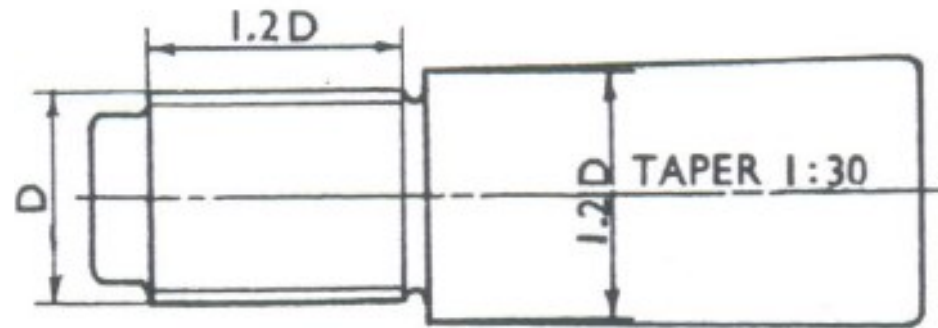


Hook bolt

Headless tapered bolt and Eye-bolt

Its shank is tapering and it has no head. It is used mainly in marine shaft couplings.

This bolt has a circular ring of rectangular cross-section as its head which can be conveniently held to prevent its rotation.

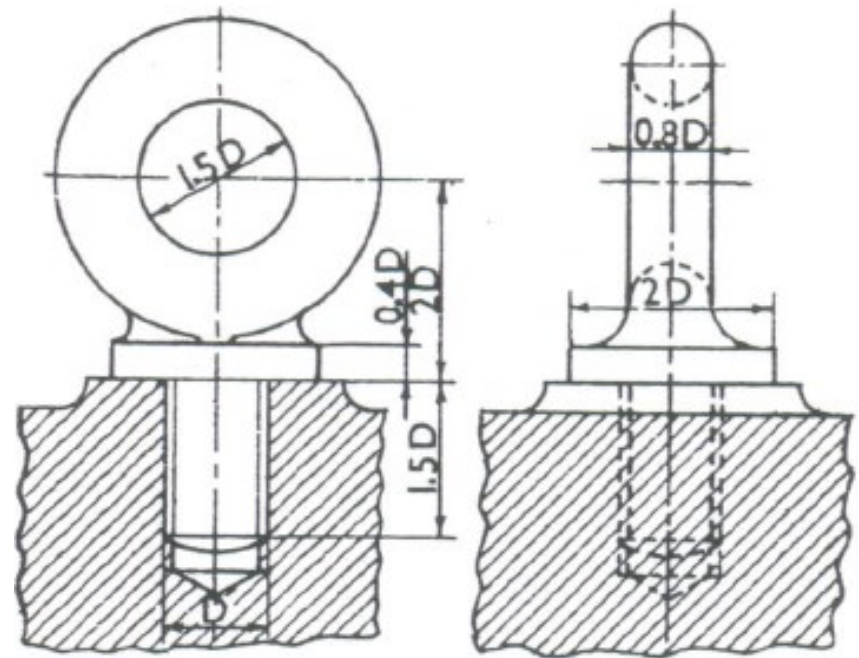


Eye-bolt

Lifting eye-bolt

It is used as an appliance for lifting heavy machines.

It is screwed inside a threaded hole on the top of the machine directly above its center of gravity.



Lifting eye-bolt

Tap-bolt or cap-screw

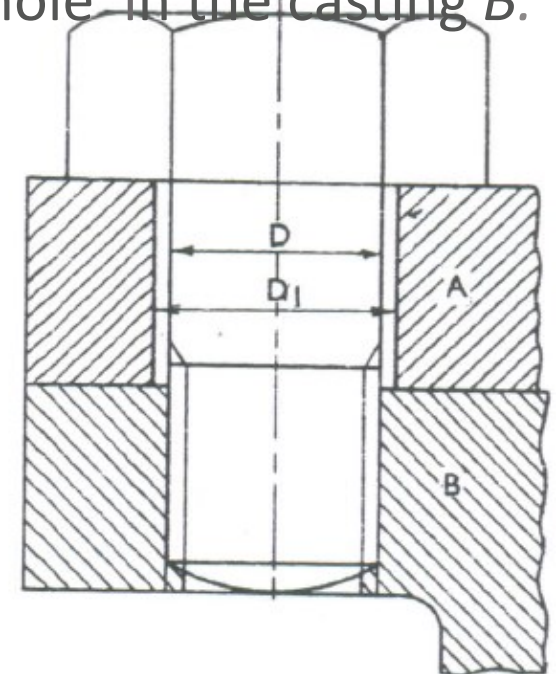
It is a bolt used as a screw. i.e. screwed into a threaded hole in a casting instead of a nut.

It is used when it is not possible to accommodate the nut.

It passes loosely through a clear hole in the piece *A* adjoining the bolt-head and is screwed into a threaded hole in the casting *B*.

Frequent insertion or removal of the tap-bolt is likely to damage the threads in the casting.

Owing to this disadvantage. This method of fastening is employed only when parts are not to be disconnected very often. Tap-bolts have various forms of heads similar to those of set-screws as shown in fig. They are used for connecting a cylinder-head with a cylinder of an internal combustion engine.

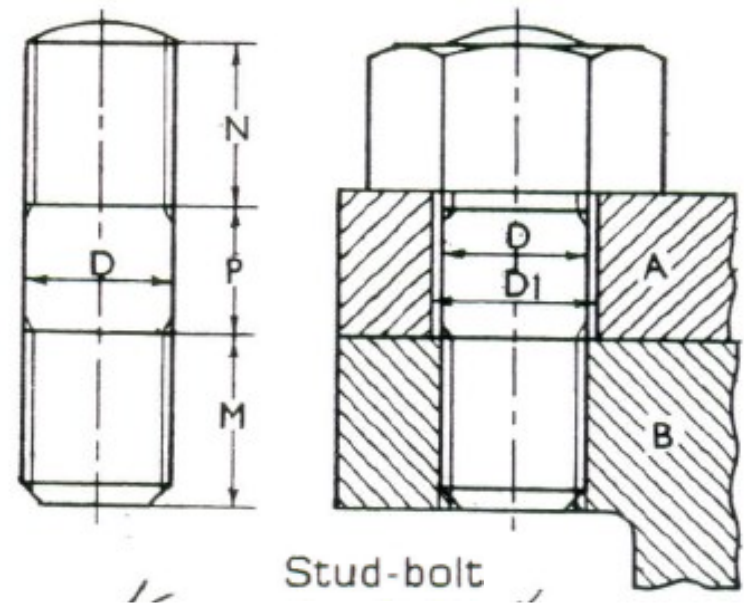


Tap-bolt or cap-screw

Stud-bolt or stud

It consists of only a cylindrical shank threaded at both ends. The nut-end N is threaded for a length slightly more than the thickness of a nut or nuts to be used. The other end M , called the metal-end is threaded for a length at least equal to the diameter of the stud. The length of the plain part P , between the two ends, depends upon the thickness of the piece adjoining the nut.

The stud is used in place of a bolt, when there is insufficient space to accommodate the bolt-head or to avoid use of an unnecessarily long bolt. Studs are commonly used to connect cylinder-covers to engine cylinders.

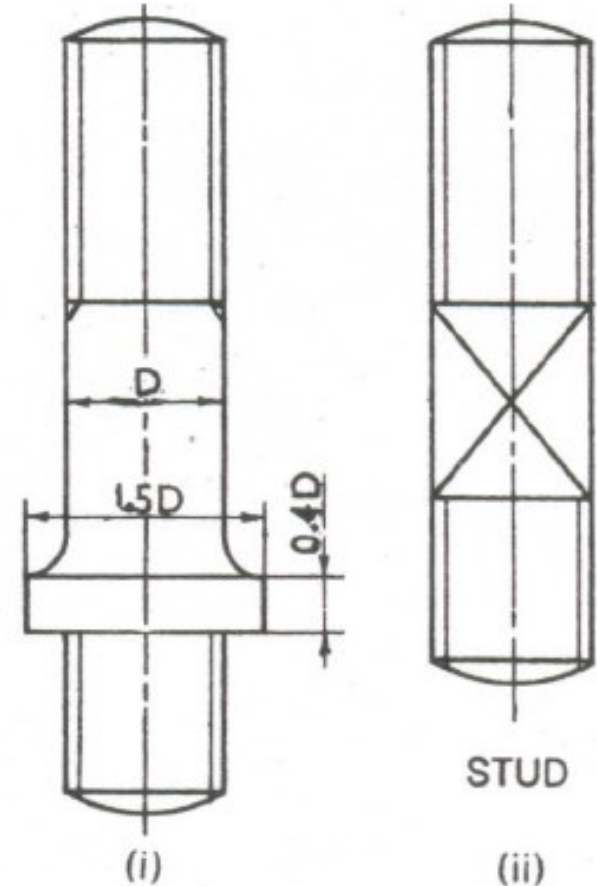


When a stud is used for connecting a piece to a very thick block, the hole is drilled in that block and then tapped.

The diameter d of the drill is equal to the core diameter of the stud.

The end of the hole is conical on account of the pointed end of the drill.

The depth of the hole is kept at least equal to $1.25D$ (where D is the diameter of the stud).

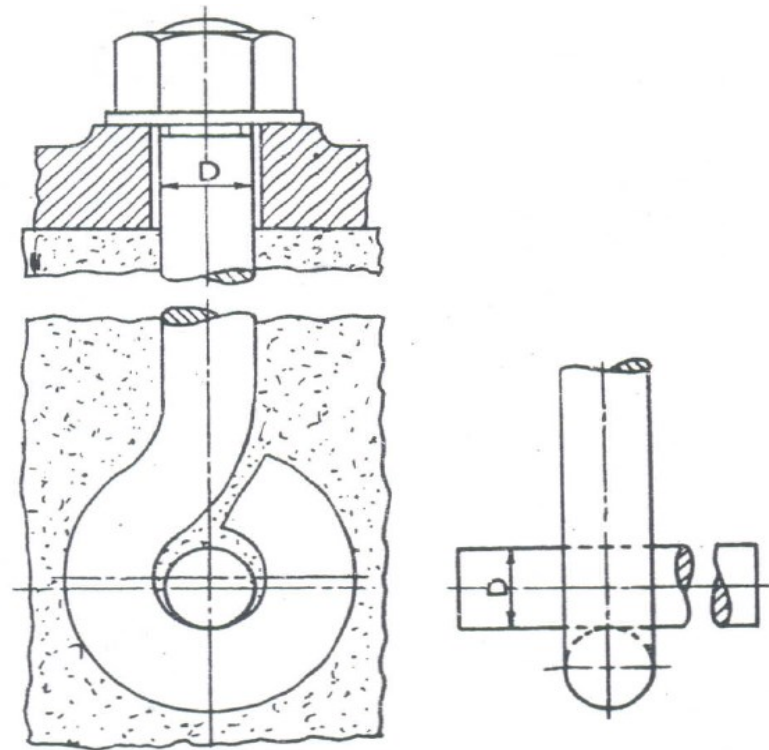


Foundation bolts

These bolts are used for fixing machines to their foundations.

(i) Eye foundation bolt:

Simple forms of these bolts can be quickly forged from a mild-steel or wrought-iron bar. These bolts are suspended in the hole and cement grout is then poured to fill up the space around them. Fig. shows two views of an eye-bolt forged from a bar. It has a piece of mild- steel bar passing through the eye and at right angles to it. The stationary engines and lathe machines are fixed on the foundation by these bolts.

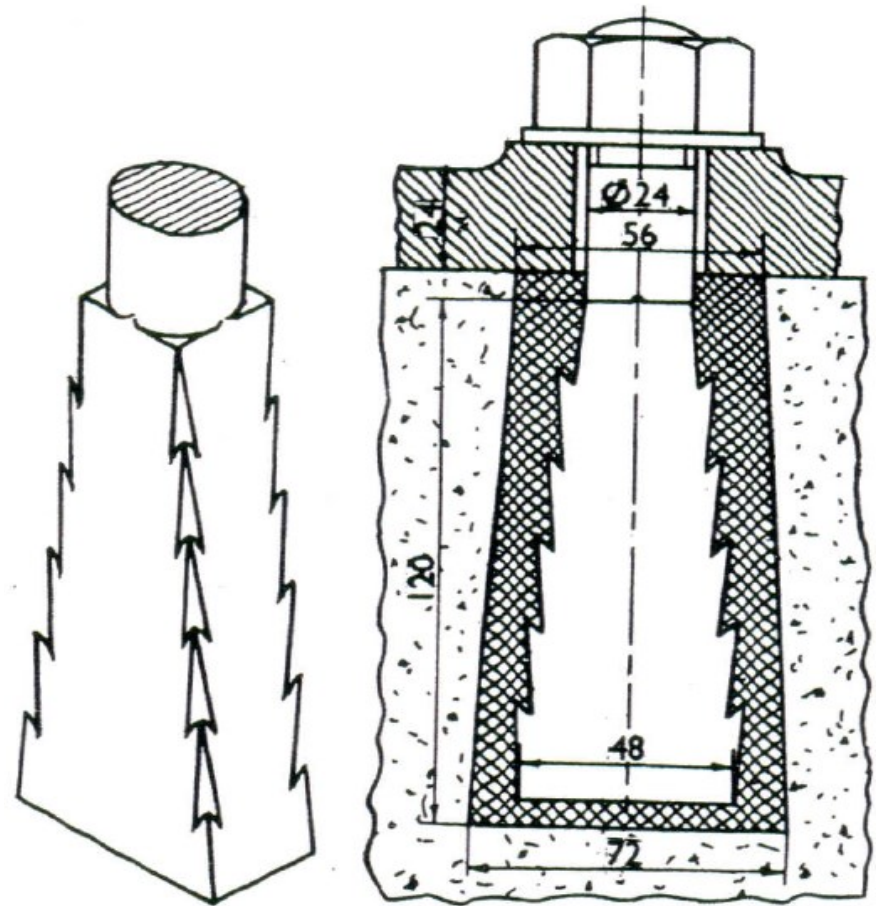


Eye foundation bolt

Foundation bolts

(ii) Rag bolt:

It has its lower part rectangular in cross-section and increasing in width only. Its edges are indented or grooved. The bolt is freely suspended in its position in concrete or stone foundation and the annular space around it is filled with molten lead or sulphur. This bolt cannot be easily dislodged after it has been grouted.

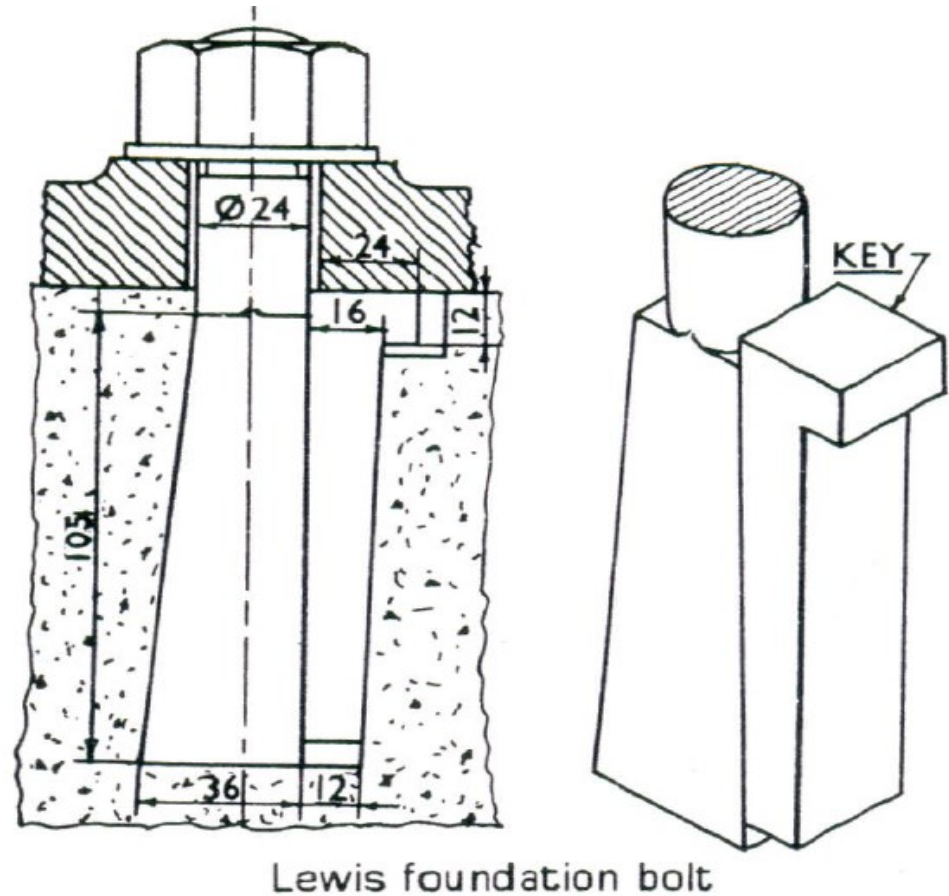


Rag foundation bolt

Foundation bolts

(iii) Lewis bolt:

This bolt is fixed in position by inserting a key on the face opposite the tapering face. It can be removed without difficulty by withdrawing the key, which is also tapering.

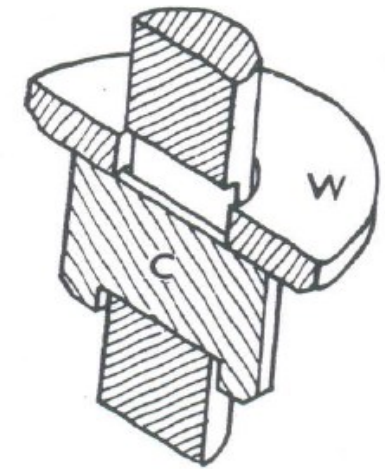
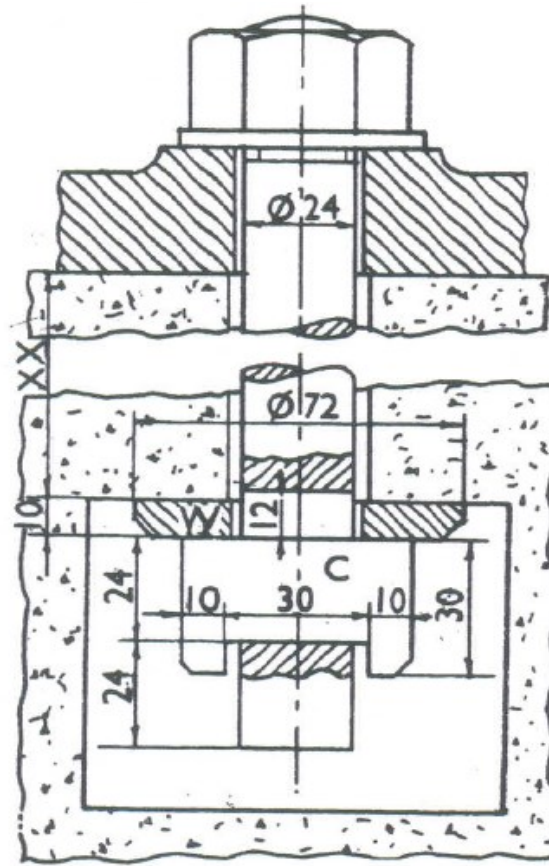


Lewis foundation bolt

Foundation bolts

(iv) Cotter bolt:

It is used for fixing heavy machines. It has a rectangular slot to receive a cotter C, which is inserted through a hand-hole, previously kept in the foundation for this purpose. A cast-iron washer -W provides bearing surface for the cotter. Heavy machine-tools are fixed on the foundation by these bolts.



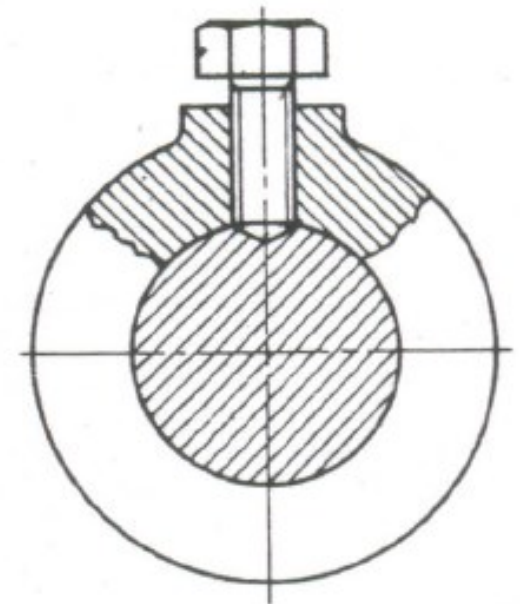
Cotter foundation bolt

Set-screws

A set-screw is similar to a tap-bolt, but is threaded practically throughout its length.

It is used to prevent relative movement between two pieces.

It is screwed into a tapped hole in the piece adjoining the screw-head while its end presses on the other piece thus preventing relative rotation or sliding. Heads of set-screws except those which can be operated by spanners or wrenches are provided with screw-driver slots.

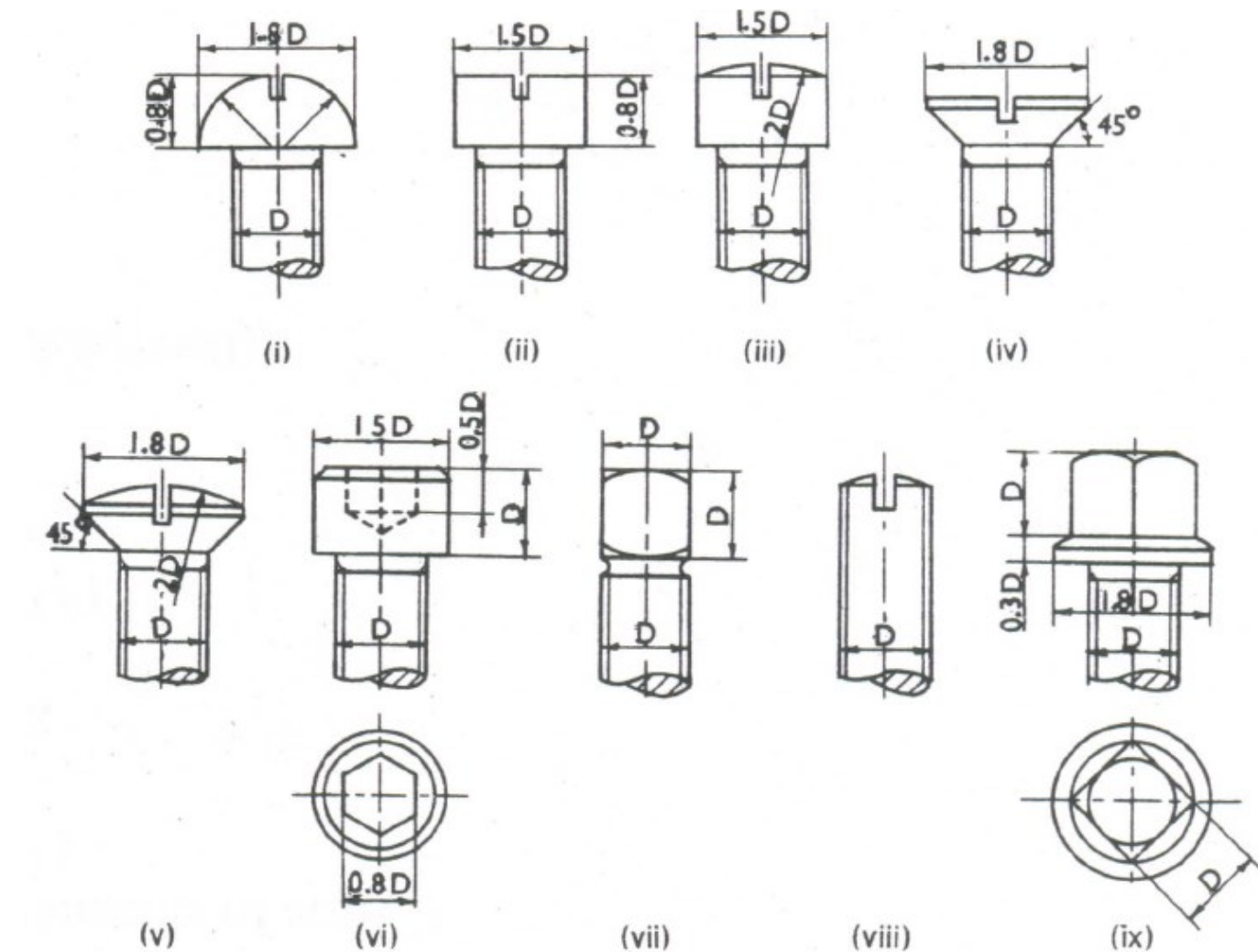


Set-screw

Set-screws have heads of various forms. Hexagonal and square heads are similar to bolt-heads.

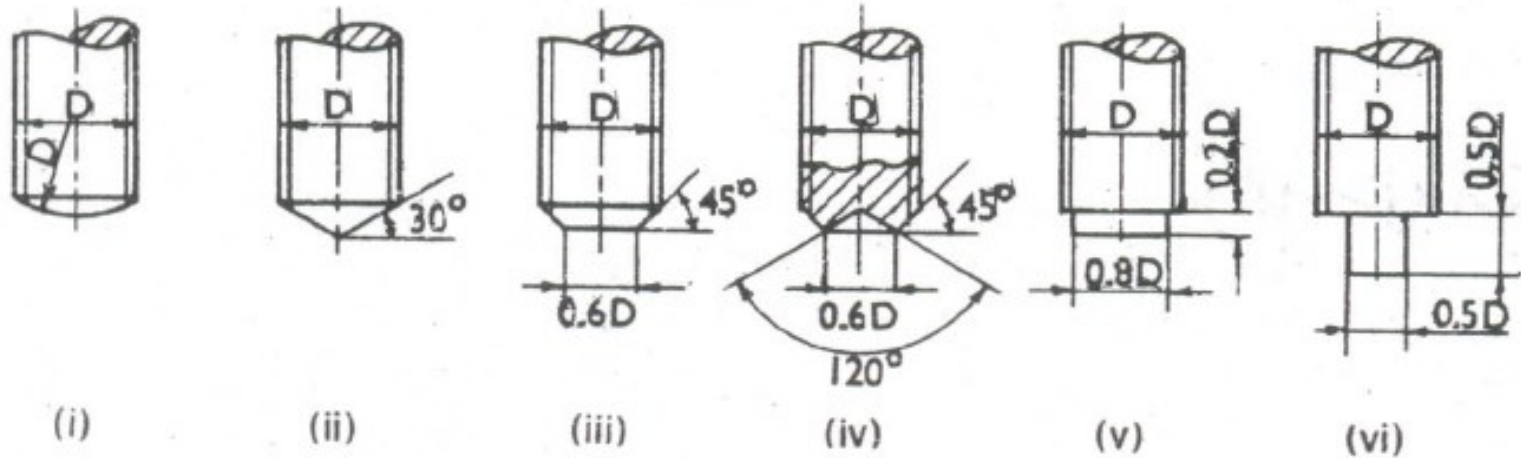
The other forms of heads as shown in fig. are

- (i) round or cup,
- (ii) cylindrical or cheese,
- (iii) fillister,
- (iv) countersunk,
- (v) rounded countersunk (called instrument screw) and
- (vi) socket.
- (vii) The square head is sometimes made of smaller size.
- (viii) The grub screw has no head.



(ix) shows a collar screw with a square head. Width of the slot for the screw driver, in each case, is equal to $0.2D + 0.1$ mm, while its depth is equal to $0.25D$ and $0.4D$ in case of flat top and rounded top respectively.

Ends of set-screws, the grub screws are made in one of the following shapes shown in fig. below (i) oval, (ii) conical, (iii) flat, (iv) cup, (v) half dog and (vi) full dog.



Difference Between Screw & Bolt

A screw is similar to a bolt - the names are often loosely interchanged - though strictly a bolt is equipped with a nut which is rotated to tighten the assembly, whereas a screw is itself rotated and engages with a threaded (or 'tapped') hole in a stationary component such as an engine block casting.