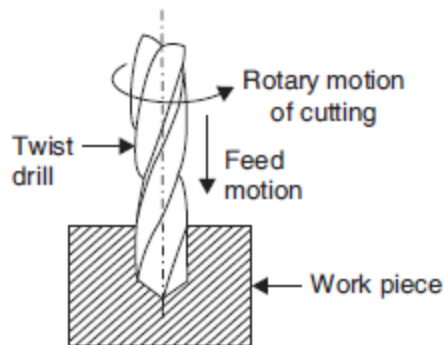


**Lecture – 4**  
**Notes : Drilling**  
**Basic Mechanical Engineering**  
**( Part – B )**

**1 Introduction:**

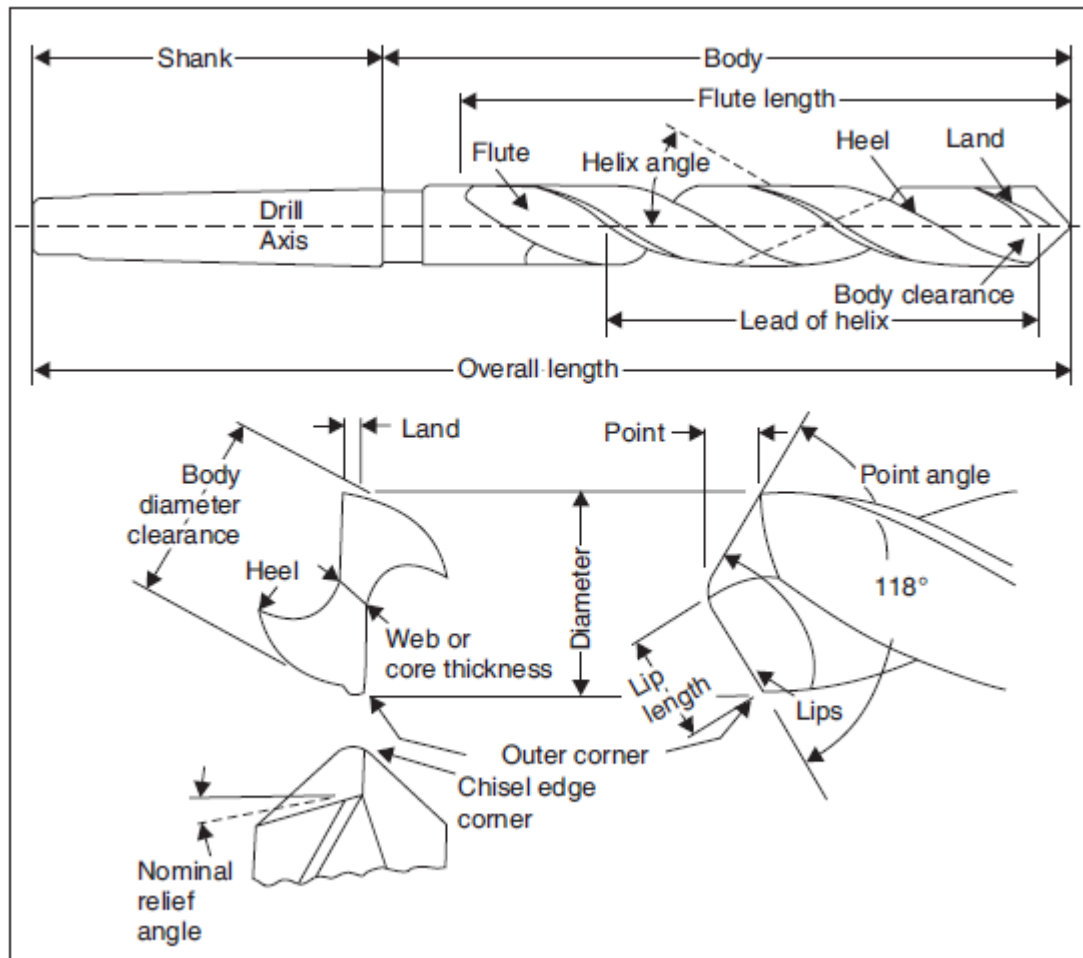
The process of drilling means making a hole in a solid metal piece by using a rotating tool called drill. In the olden days, a flat drill was used for drilling a hole, but these days, a twist drill is universally used. A twist drill is the cutting tool and it is used in conjunction with a drilling machine. A twist drill has two cutting edges, hence it is a multiple point cutting tool. The drilling operation is shown in Fig. 1.



**Fig. 1: Drilling of a Hole**

**TWIST DRILL**

A twist drill is shown duly labelled in Fig. 2. Twist drills usually have a taper shank, at the end which is fitted into the drilling machine having a tapered sleeve of matching taper. When the tapered sleeve rotates, the twist drill also rotates along with it due to the friction between two tapered surfaces. Sometimes the shank is machined parallel, then a special collet chuck is fitted in the drilling machine, in which the drill is held. The drill has two lips at the other end where the cutting takes place, when the drill rotates. The angle between the two cutting lips is usually  $118^\circ$ . The chips formed at the cutting edges are automatically guided upwards through the helical grooves cut into the body of the drill; these grooves are called flutes. This is necessary, otherwise, the chips will interfere with the metal cutting.



**Fig 2: Nomenclature of a standard general-purpose twist drill**

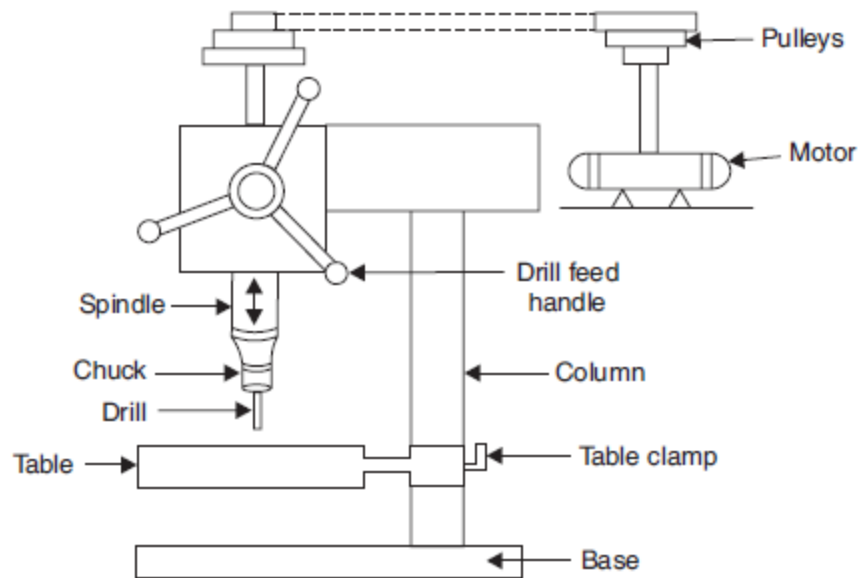
For rotating the drill and to overcome the resistance in cutting, a torque is needed to rotate the drill. An axial force is also needed which keeps pushing the drill deeper and deeper into the hole being drilled. This is provided by the machine feed. **Machine feed** is the downward axial movement of the drill per revolution of drill. The drill will not start cutting the metal, if its bottom touches the metal surface superficially. This is on account of the chisel edge which does not allow the cutting edges to come into the contact with metal and start cutting until the chisel edge penetrates the metal surface by about a mm or so. To facilitate the cutting action, a little depression is made by a punch at the centre of the hole to be drilled. Twist drills are made of solid high speed steel, hardened and ground to shape. Drills with tungsten carbide inserts are also available.

### **DRILLING MACHINES**

Drilling machines are of the following types:

1. Sensitive drilling machines,
2. Pillar type drilling machines,
3. Radial drilling machines, and
4. Multispindle drilling machines

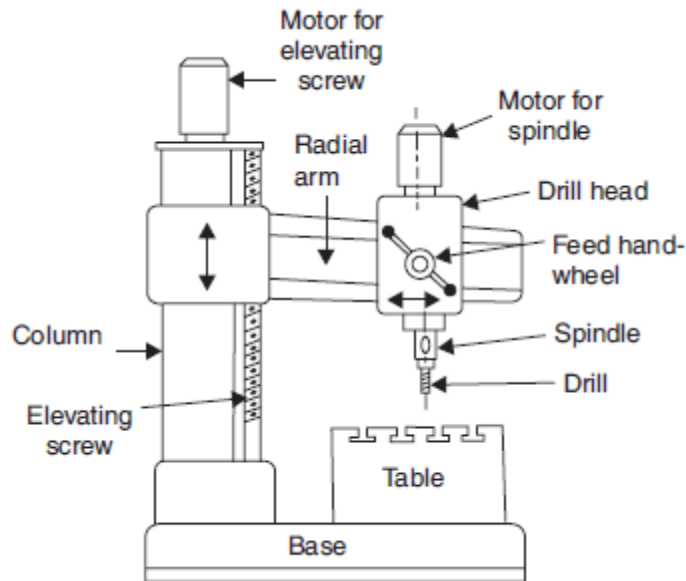
1. **Sensitive drilling machines:** A sensitive drilling machine is shown in Fig. 3.



**Fig. 3 Sensitive or bench drilling machine**

This is a light duty machine and is capable of drilling a hole of 12 mm dia maximum and its spindle speeds are correspondingly high. This machine can tackle small jobs. The work piece is kept on the table and clamped in the appropriate position and the hole is drilled by lowering the spindle of the drilling head. Feed is given by moving the hand wheel gently which lowers the spindle and the hole is drilled up to the required depth. Remember that the job has to be moved so as to align the centre of hole exactly below the spindle.

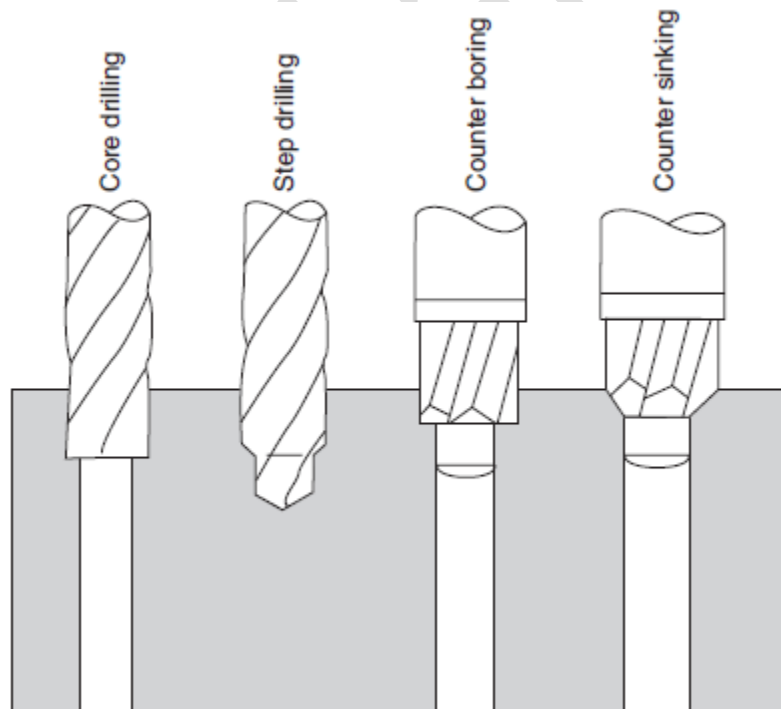
2. **Pillar type drilling machines:** These are generally similar to sensitive drilling machines but are meant for heavier work. The vertical column can be either of rectangular or round section; the latter offers the advantage that the table can be swung out and the slightly bigger jobs can be accommodated on the machine base instead of the table. The drilling head can be lowered and hole drilled in the job.
3. **Radial drilling machine:** A radial drilling machine is illustrated in Fig. 4. This is really meant to drill holes in bigger and heavier work pieces, which cannot be manipulated so that the centre of the hole may be aligned with the drilling spindle. In this case, the drilling head is mounted on a radial arm. The radial arm can be rotated around the round column and the drilling head can be moved in or out on the radial arm. The work piece is kept on the table which is really an integral part of the base and by the combined movement of the radial arm and the drilling head (think of the polar coordinates  $\theta, r$ ), any point on the work piece can be covered and a hole drilled at the required location, without shifting the heavy work piece.



**Fig. 4 Radial drilling machine**

4. **Multiple spindle drilling machines:** On these machines, more than one hole may be drilled at one time. These machines are very useful for mass production work.

**Allied operations performed on drilling machines:** Operations closely associated with drilling are shown in Fig. 5.



**Fig. 5 Common operations closely associated with drilling**

**Core drilling:** Holes made in castings by use of cores, are rough and require a special kind of drill, called core drill to clean up the holes. This operation is called core drilling.

**Step drilling:** More than one diameter can be ground on the drill body which saves an extra operation.

**Counter boring:** Often a flat surface is needed around a hole to provide a good seating area for washer and nuts/head of a bolt. The counter boring tool has a pilot, which ensures that the counter bore is concentric with the hole.

**Counter sinking:** Counter sinking provides a tapered entrance to the hole. A special counter sinking tool with a pilot is used as shown.

**Reaming:** Reaming is an operation of sizing and improving the geometry and finish of a previously drilled hole. Hand, machine and shell reamers are used for this purpose. Machine reamers are used with a drilling machine. To work efficiently, proper stock allowance is very important. Reamers cannot remove much material, but at the same time, enough material should be available all round. For holes up to 12.5 mm in diameter, about 0.38–0.4 mm of material is left as reaming allowance. A reamer follows the original hole and cannot shift its centre.

**Tapping:** Tapping is also done on a drilling machine with a special flexible adapter for holding machine taps. Tapping means cutting internal threads in a hole. A machine tap set consists of two taps rough and finish. Both taps should be used in the same order. During tapping, the spindle r.p.m. is drastically reduced and a good lubricant used.