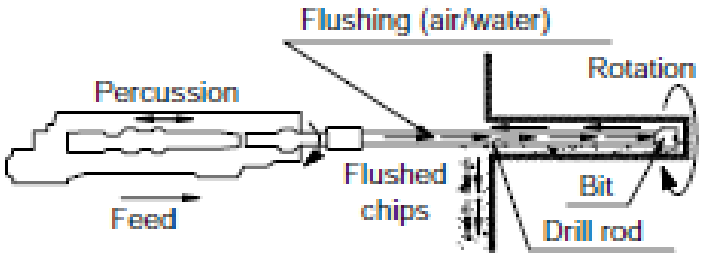
# Drilling

Drilling or boring is a prime operation in the excavation technology without which exploration, development, exploitation and liquidation of mineral deposits could not succeed.

The purpose of drilling (rock penetration) in mining operations is to create small or large diameter holes in the rock massive for the placement of explosives in order to loosen and fragment the material for subsequent operations.

**Operating components of the drilling system**

There are four main functional components of a drilling system, working in the following manner to attack the rock as illustrated in figure below.




(d) Principle of percussive drilling

1. ***The drill***: it acts as prime mover converting the original form of energy that could be fluid, pneumatic or electric into the mechanical energy to actuate the system.

2. ***The rod (or drill steel, stem or pipe)*****:** it transmits the energy from prime mover to the bit or applicator.

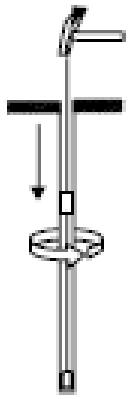
3. ***The bit***: it is the applicator of energy attacking the rock mechanically to achieve penetration.

**4.** ***The circulation fluid*****:** it cleans the hole, cools the bit, and at times stabilizes the hole. It supports the penetration through removal of cuttings. Air, water or sometimes mud can be used for this purpose.

**Mechanics of rock penetration**

**Top-hammer drilling**

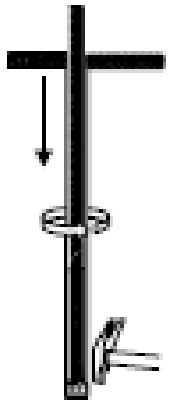
In this system the top-hammer's piston hits the shank adapter and creates a shock wave, which is transmitted through the drill string to the bit.



Top hammer drilling

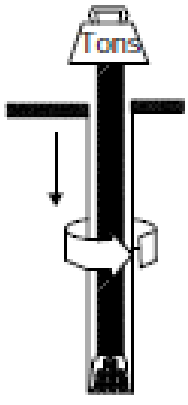
**Down-the-hole (DTH) drilling**

In this system the down-the-hole hammer and its impact mechanism operate down the hole. The piston strikes directly on the bit, and no energy is lost through joints in the drill string .



**Rotary drilling**

Rotary crushing is a drilling method, which was originally used for drilling oil wells, but it is now days also employed for the blast hole drilling in large open pits and hard species of rocks. In rotary drilling energy is transmitted via drill rod, which rotates at the same time as the drill bit is forced down by high feed force.

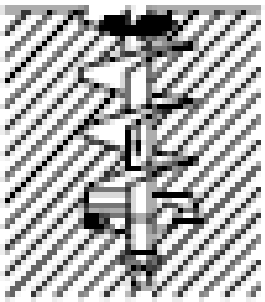



Rotary drilling

All rotary drilling requires high feed pressure and slow rotation. The relationship between these two parameters varies with the type of rock. In soft formations low pressure and higher rotation rate and vice versa, are the logics usually followed.

**Augur drill**

The augur drill (fig. 4.2(c)) is the simplest type of rotary drill in which a hallow-stem augur is rotated into the ground without mud or flushing. The continuous-flight augurs convey the cuttings continuously to the surface. This also works on the rotary cutting principle.



Augur drilling

**Motive power of rock drills**

In addition to the above-mentioned basis, there are several other ways to classify the rock drills. Depending upon the motive power they can be classified as pneumatic, electrical and hydraulic rock drills, as illustrated in figure.

*Figure Rock drills' classification based on their motive power.*

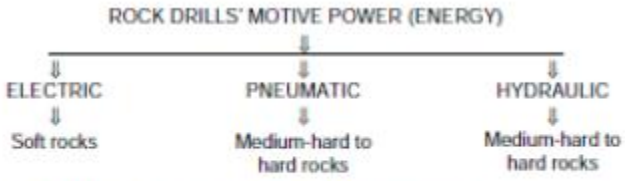



Figure Rock drills' classification based on their motive power.

**Selection of drill**

*Drill selection*:

Drill selection for a particular application should be based on the technological and cost factors.

It is considered that the lower cost is obtainable in soft rock with rotary drag-bit drilling, in medium and hard rock with rotary roller-bit and rotary-percussion drilling, and in very hard rock with percussion drilling.

Use of percussive drills is very common in underground metalliferous mines and tunnels.

The rotary drills are common in underground coal mines. In surface mines both types of drills have applications depending upon the rock types.

***Drilling efficiency*:**

Drilling efficiency can be measured by taking into consideration the following parameters:

- By the manner in which the drilling tool i.e. the drill acts upon the hole bottom (percussive, rotary or percussive rotary)
- The forces and the rate with which the drilling tools act upon the hole bottom
- Hole diameter and its depth
- The method and speed with which the drilling cuttings are removed from the hole.

These factors determine a type of drill required to suit a particular type of rock, as drillabilty of rocks differs widely.

## Using of Drilling

The drilling used in mining for various purposes:

- For underground mining;
    - vertical development (Shaft, raises, slopes)
    - Horizontal development: (tunnels, rumps,drives)
    - Stop preparation
    - Stopping (Ring, holes, fans)
- For surface mining:
    - Quarries
    - Open pit
    - Open cast
- Also it used for controlled blasting holes to reduce over break.