



ROCK BLASTING

Definition of Rock Blasting

Blasting is the action of breaking and displacing rock by means of explosives

- Use of explosives to fragment the rock

Blasting operations include:

- Drilling of blast-holes
- Selecting of type of explosives and initiating devices
- Charging process (inserting of explosives into blast-holes)
- Initiation.

Rock Blasting

- Controlled use of explosives
- Purpose of fragmenting the rock
 - Loosening the in-situ rock
 - Opening up - excavation
 - Extraction of ore from the ore-body
 - Easy movement of rock
- Practiced in:
 - Mining,
 - Quarrying and
 - Civil engineering.

Rock Blasting

- Blasting is an essential part of the mining cycle
- In virtually all forms of mining, rock is broken by drilling and blasting
- Blasting technology is the process of fracturing rock
- A calculated amount of explosive is used to fragment a predetermined volume of rock.

Trend in Rock Blasting

There have been steady developments in:

- Explosives,
- Detonating,
- Delaying techniques and
- Understanding of the mechanics of rock breakage by explosives

Blasting Techniques

- Blasting is used in both open pit and underground mining operations
- Good blast design and execution are essential to successful mining operations
- Improper or poor practices in blasting can have a severely negative impact on the economics of a mine.

Rock Blasting

Blast optimisation depends on principal parameters including:

1. The rock's characteristics;
2. The properties and quantities of explosives;
3. Blast geometry;
4. Blast size;
5. The priming method; and
6. The initiation sequence.

Blasting terminology

Free face:

This is an exposed rock surface towards which the explosive charge can break out.

Blast-hole diameter (D):

The relation between blast hole diameter and face height is approximately:

$$D = 0.001 \text{ to } 0.02 H$$

Generally, the cost of drilling and blasting decreases as hole diameter increases.

Face height (H):

This is the vertical distance in metres between the top and floor of the bench.

Burden (B) :

This is the distance in metres from a blast hole to the nearest free face and has the following approximate relation:

$B = 25D$ to $30D$ for hard rock

$B = 30D$ to $35D$ for medium rock

$B = 35D$ to $40D$ for soft rock.

Spacing (S):

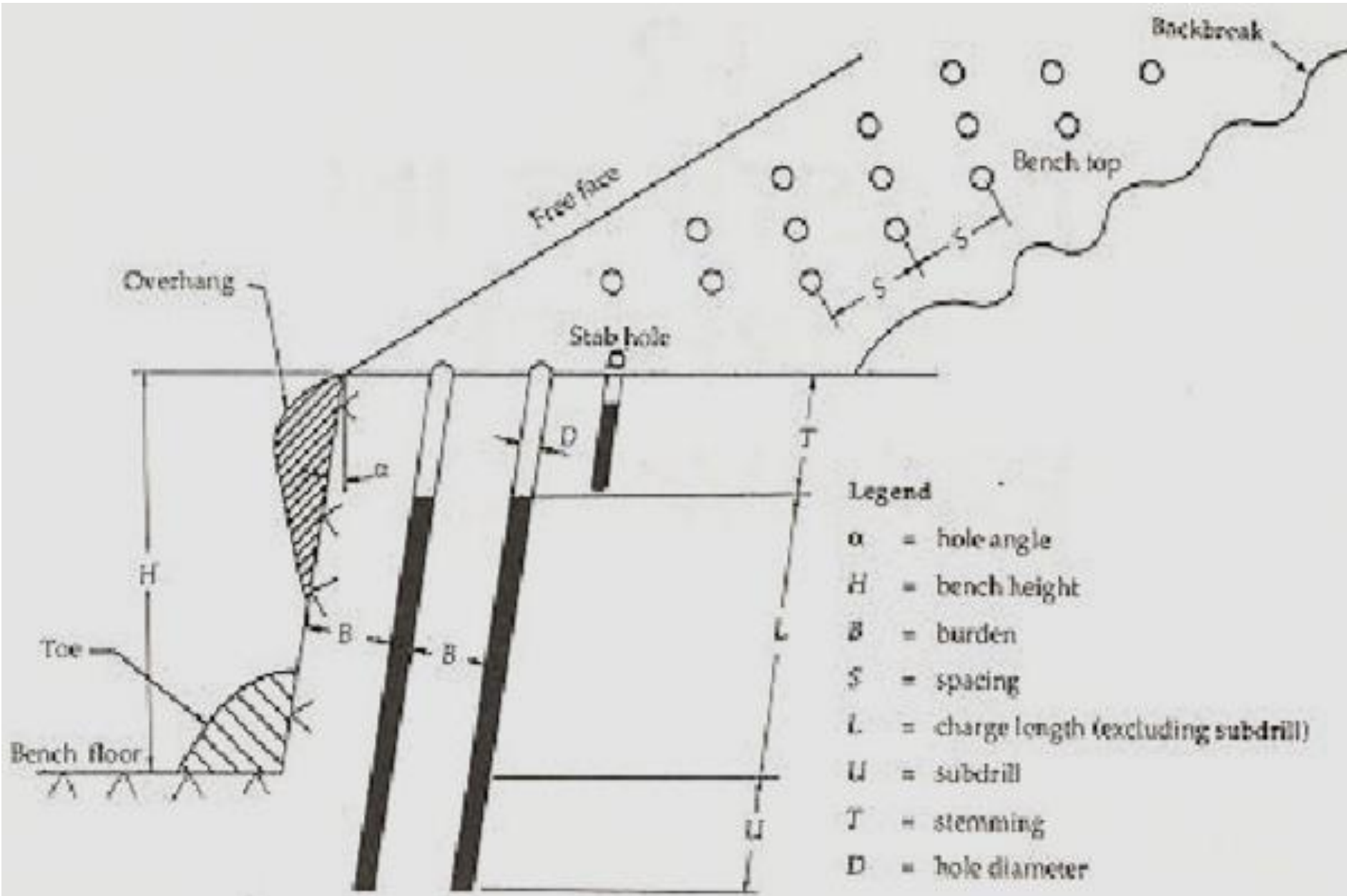
This is the distance in metres between adjacent blast-holes and is measured perpendicular to the burden. Usually the relation between drilled burden and spacing is:

$$S = 1 \text{ to } 1.8B$$

Hole angle (α):

This is a hole inclination measured in degrees. If the strata conditions permit, inclined blast-holes allow better distribution of the explosives.

Blasting Terminology



Sub-drill (sub-grade drilling or over-drilling) (U): This is the extra depth drilled below the grade level to assure that the full face of the rock can be broken to the desired excavation level.

Usually $U = 8$ to $12D$; alternatively it equals to $B/3$.

Charge length (L):

This is the explosive column in a blast hole and should be at least $20D$ in order to utilize fully the explosion-generated strain in the rock.

Stemming (T):

This is the inert material filled between the explosive charge and the collar of the blast-hole to confine the explosion gases.

The stemming material could be drill cutting, sand, mud or crushed rock.

A stemming length shorter than $20D$ usually causes fly rock, cut-offs and over break problems.

The stemming length should not be less than the effective burden B

Powder Factor or Specific Charge or Blasting Ratio

1. Defined as the quantity of explosive used per unit of rock blasted, measured in kg/m^3 per tonne of rock; or
2. As the ratio between the mass of explosives required to break a given quantity of rock and is normally expressed in kg/m^3 or kg/t^3
 - The softer (less dense) the rock that is being blasted; the smaller the powder factor.

$$\text{PF} = \frac{\text{Mass of explosives}}{\text{Tonnage of broken rock}}$$

Decoupling ratio

Can be defined as the ratio of the diameters of an explosive column and the blast-hole and is usually expressed as a percentage

Firing Patterns

In normal blasting all holes do not blast at the same time. Blasting is normally carried out as short delay blasting. The firing pattern has to be designed so that each blast-hole has free breakage

Blast Design

The best use of explosives is made when a blast:

- Produces a clean break,
- Gives good fragmentation,
- Avoids excessive fly-rock,
- Avoids vibration,
- Produces less toxic gases.

The success of achieving these goals depends significantly on good blast design.

Primary blasting

The initial action of breaking and displacing rock by means of explosives

- Primary blasting is an initial fragmentation of in-situ rock mass

Secondary Blasting

Secondary blasting is a process of blasting oversize boulders. In primary blasting, whether on surface or underground, will leave some oversize boulders, which cannot be adequately handled by the standard loading and crushing equipment.

Misfire - A blast that fails to detonate completely after an attempt at initiation; also the explosive material itself that failed to detonate as planned.

Magazine - Any building, structure, or container, other than an explosives manufacturing building, approved for the storage of explosive material

Initiation - The act of causing an explosive material to detonate or deflagrate.

Initiator - A detonator or detonating cord used to start detonation in an explosive material.

Primer - A unit, package, or cartridge of explosives used to initiate other explosives or blasting agents, and which contains: 1.) A detonator, or 2.) Detonating cord to which is attached a detonator designed to initiate the detonating cord.

Revision Questions

1. In blasting, differentiate between:
 - a) Spacing and burden
 - b) Primary and secondary blasting
2. List five reasons why stemming is important in charging blast holes with explosives?
3. List five factors which are considered in determining the powder factor
4. If an 88mm diameter hole is charged with 64mm diameter cartridges, calculate the decoupling ratio
5. Given the face height of 2.85m, estimate spacing if blasting in:
 - a) Hard rock (in MPa),
 - b) Medium rock (MPa), and
 - c) Weak formation (Mpa).