



GOVERNMENT POLYTECHNIC JAJPUR

Lecture Note on
Surface Mining Technology

Prepared By :

SARATCHANDRA BISWAL

(LECT. IN MINING)

DEPARTMENT OF MINING ENGINEERING

Surface Mining Technology

Q1-

The determination of the most economic final pit layout to ascertain the mineable ore reserve which depends upon the following

- 1) the geometric outline of the orebody
- 2) the distribution of ore within the orebody
- 3) the topography
- 4) Maximum possible slope angle etc.

Dip

Dip is the angle of inclination with respect to horizontal plane.

Strike

It is the line of intersection of horizontal Plane & Bedding plane.

Factor

1. Geology or Geography (dip, strike)
2. Legal Status of land & mining rights
3. Historical, political, sociological factors
4. Mining condition
5. Ore treatment requirements.
6. Economic analysis
7. Transportation system, power supply, labour availability, manufacturing & repairs.
8. Quality / amount of reserves
9. Ground water studies
10. The depth & character of overline strata or overburden

Quarriable Limit Dt - 31/07/2019

The cost of removing overburden and its thickness goes up as the mining operation extend to the deepside of the property or deposition.

At the deepside of the property there is a point at which the cost of mining of mineral is the same as that up selling price of the mineral and the quarry work is no profit and no loss at this point.

Therefore quarriable limit is horizontal distance from outcropping point to the point at which mineral can be extracted just recovering the mining cost.

The quarriable limits depends up on the Stripping ratio and the inclination of core body.

Various parameters of a bench

Width

It is the horizontal distance betⁿ the crest point and toe of the bench.

Height

It is the vertical distance between the foot and crest of the bench.

Face

It is the surface area along the height of the bench for its full length.

Toe/foot

The lower side of a face of a bench along its length is known as toe line and the various point on this line is known as toe point of that bench.

Crest

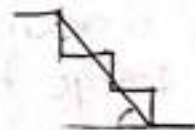
The upper side of a face of a bench ~~along~~ is known as crest line and the various point on this line is known as crest point of that bench.

bench slope angle

This is the angle which the face of Particular bench makes with horizontal is known as bench slope angle.

Pit/overall slope angle

This is the angle which an imaginary line makes with horizontal, the lower point of this line being at the foot of the lower most bench and upper point being the crest of the top most bench.



Gestation period

This is the time interval betⁿ mining start to the production start.

Stripping ratio

It can be defined as the ratio of volume of overburden remove to weight of recoverable mineral reserve.

Economy of the mining depends on that of the overburden because as the depth increases cost of extraction of overburden increases.

$$\text{Stripping ratio} = \frac{\text{weight of recoverable mineral (ton)}}{\text{volume of overburden (m}^3\text{)}}$$

$$\text{unit} = \frac{\text{ton}}{\text{m}^3}$$

Dt - 01/08/2019

Break-even stripping ratio

The point beyond which the mineral coal can't be economically extracted out is called Break-even stripping ratio.

It can also be defined as the ratio of excess cost required to produce per tonne mineral ore coal by under ground method in comparison to open cast mining method to the stripping cost per unit meter of overburden by open cast method.

Advantages & disadvantages of open cast Mining

- Large working faces coupled with the possibility of use of large and efficient equipment may very large output possible.
- Size of excavation does not limit the equipment size in open field as in under ground mines.
- Larger equipment and better organization makes the labour productivity (O.M.S) much higher.
Output (Man / Shift)
- The cost of Mining is generally lower with open field method as compared to the under ground method.
- There is greater flexibility of production with open field mining production can be varied rapidly, stop and started again when desired with greater ease.
- Percentage of extraction is higher and nearly full extraction can often be attained. The mining losses

- Stripping can be more easily done.
- Greater geological investigation of the deposit is possible in open field, thus making exploration easier and estimation of ore reserves more accurate.
- Large faces in open field lead in better specific drilling and lower specific explosive consumption.
- Support and filling are generally unnecessary in open field except for land restoration.
- Safety of work is greater.
- Except in extreme climate or environmental condition of working are far better in open field mine than in underground mine. The air is less polluted and the condition of heat & humidity are generally not so oppressive lighting is natural and much better except for night work. No artificial ventilation is necessary in open field mines.
- Supervision is more effective.

Disadvantages

- It is possible to the mine only to relatively shallow depths by open pit method economic stripping ratio determining the ultimate pit depth.
- Large capital outlay is necessary for modern mechanized open fields.
- Work suffers in extreme climate condition. Night work in open field is less efficient than day work.
- Snow and rain may disturb transport system
- A large volume of waste / overburden has to be removed which not only adds to the mining cost

dumping sight.

→ Large area of ground surface area affected by excavation which can be restore at additional cost but it is mainly possible to completely restore the original ecosystem.

→ Some times intervening weak rock in the mineral deposit makes open field vessels scattered leading to increase cost of mining.

At-05/08/2019

Box cut

opening up of open pits is done by an opening cut for the development of first working bench. The opening cut is called the box cut and slope of suitable gradient and economical point of view for transport, holding space and minimizing the cost is necessary.

(Steepest is advisable both technical and economical point of view for transports, holding space and minimizing the cost of excavation for pits.)

Boxcut is excavated initially down to the first level of the first bench from the surface. Then a level trench for opening is extended from this opening cut to form the first bench.

The opening trench is narrow keeping due regards of the turning of the machineries used for excavation and extends along or across the quarriable limit depending on the type of the deposit.

When the first bench is sufficiently advanced the box cut is oriented and extended to the next lower level.

fore opening trench fore the 2nd bench.

This way a number of working benches are developed and the width of the boxcut should be sufficient enough to diversify the approach road to all the benches.

If numbers of benches are developed from one opening cut, the cut should be started enough away from the pit limit so that bottom bench can be reached at the desired slope of the pit.

This type of opening cut may be very long and may be curved depending upon the shape and extend of the deposit.

fore opening up in hilly deposit a central trench cut is given across the top level for the first bench or from one side in the same contour level forming a length of face which will give the required production rate.

Objective of box cut

The main objective of boxcut are

- i) To reach the ore body
- ii) To provide a smooth entry to the pit
- iii) To provide space for development of working and production benches.

Types and applicability

Box cut are up two types

- i) Internal
- ii) External

Internal box cut

When the boxcut is located fully or partially on the mineralised zone, it is called an internal boxcut.

This is applicable for all types of deposit.

The cut follows a direction i.e. usually oblique to the both the strike and dip direction.

Generally the direction is so chosen that the haul road ramp formed by this cut and subsequent will not have unnecessary stop turning had any position.

External box cut

When the boxcut is totally outside the mineralised zone it is called an external boxcut.

This is applicable only for shallow and gently dipping bedded deposits.

The cut is generally located at the middle of the rise most side.

Box cut parameters

The main parameters of the boxcut are

- i) Maximum level difference
- ii) width of the floor
- iii) longitudinal inclination of the floor
- iv) front slope angle and side slope angle.

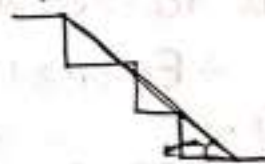
It is the slope of the excavation at which the bench excavated area will extend safely through its life till the mineral body is fully extracted. It is the factor of safety of slope angle.

Pit slope angle is the main factor of slope stability.

Pit slope

It is the inclination of the line joining the top most of ~~the~~ all the benches. This occurs in normal area of running the mine.

The angle of slope remain flattere (33°)

final pit slope angle

It is the pit slope when the mine boundary is reached. It is steeper as compared to pit slope.

It is 45° or may be more, depending upon the competence of the rock.

The slope stability depends upon following factors

- i) Geometry of the bench (height, width, no. of benches)
- ii) physico-mechanical properties of the rock.
- iii) Geological disturbance.
- iv) local climatic condition and weathering.
- v) ground water pressure.
- vi) rate of advance.
- vii) flow of water over the benches.
- viii) Presence of plane of weakness
- ix) Orientation of the bedding (dip & strike of the bed)

Different types of failure

- 1- Plane failure → failure along a plane.
- 2- Circular failure → failure along a curve.
- 3- Wedge failure → failure in the form of wedge.
- 4- toppling failure → failure in the form of toppling.

Prevention of slope ~~slide~~ failure

→ Geometry of the benches should be proper i.e height never more than width

→ For running benches width should be 3 times of the height.

→ For final slope condition width should be equal to the height.

→ Ensure the competency of the rock and ore body.

→ If there are geological disturbance, benches should not be ill to any such geological disturbance specially fault.

→ ground water level should be lower down by advance bumping through the poor holes by a Sumersible form.

→ The rate of advance should be optimum

→ There should not be any under cutting.