Underground Mining of Metalliferous Deposits
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Lecture 49
Sublevel Stoping

SUBLEVEL STOPING

- In this method the orebody is vertically divided into levels, and between two levels the stopes of convenient size are formed.
- **A rib pillar** is left in between two adjacent stopes.
- Leaving a crown pillar at the top of the stope protects the level above, whereas lower level is used as haulage level to gather the ore from the stopes.

Vertically the stope is divided into a number of horizons by suitably positioned drill drives called the sublevels, and hence the name sublevel stoping. With advent of new drill machines with the ease of drilling large diameter blast holes, the conventional sub-level stoping method has gone through lot of modifications.

Applicability

Conditions suitable for Sub-level stoping:
Geotechnical parameters:

Ore strength: moderate to strong (> 40 MPa UCS)
Host rock (Footwall and hang wall rocks) are also strong

Geometry, disposition & orientation:

Deposit shape: tabular or lenticular, regular dip and defined boundaries
Deposit dip: steep (>45-50 degrees, preferably 60-90 degrees)
Deposit size: 6-30m wide, fairly large extent
(Very thin deposits : 0.7m; Thin deposits; 0.7 – 2m; Medium thick: 2m- 5m; Thick deposits: 5 – 20 m; Very thick > 20 m; e.g. HCL- Malanjkhand copper deposit is 80 m thick)

Ore grade: moderate

<u>Stope Development:</u>

1. A slot raise is made at the centre of H/W side of the stoping block.
2. X-cuts are driven from the sot raise on both side towards H/W and Foot wall.
3. After reaching the H/W & F/W, drill drives are made along the strike. Usually two drill drives are made in parallel.
4. Sub-levels are driven between raises at the ends of the stope block.

5. A single sublevel at a horizon suffices up to 15m width of ore body but beyond this two sublevels are usually driven from a cross cut extending from the slot raise.
6. For narrow veins – one sublevel in one horizon is sufficient.
7. Sublevel interval generally varies from 10 to 20 m with haulage levels placed 50 – 90 m apart.

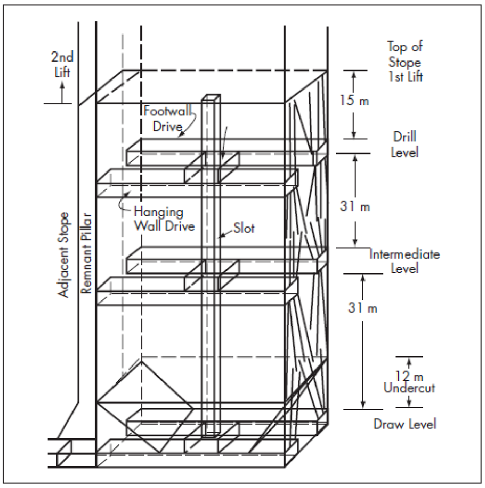

Figure 1. Stope development

The crown pillar below upper haulage level is about 10m thick. On the sides of the stoping block, a 9m side barrier or rib pillar is left. Above the bottom haulage level, sill pillars of ~8m height is left. Chute raises are driven at an interval of 15m (centre to centre) through the centre line of the block (width of orebody)

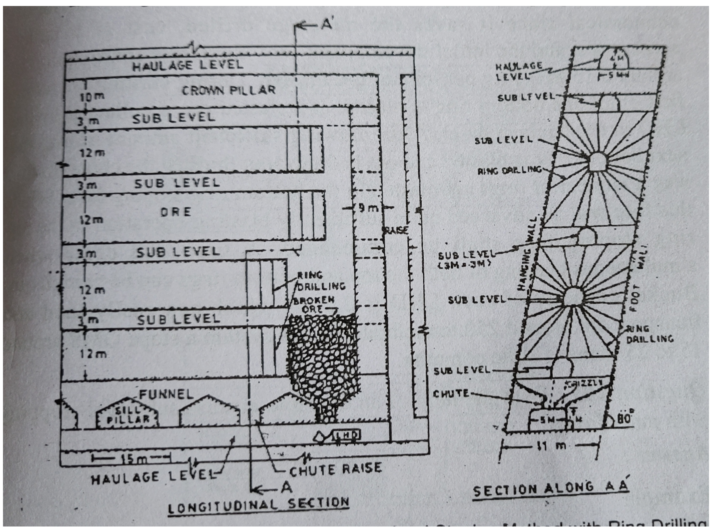

Figure 2. Sublevel stoping

Drilling: Ring drilling is a common practice from each sublevel covering both sides and up to the lower immediate sublevel. The **fan drilling** are generally directed at an angle of 75- 80 degree from the horizontal leaning towards the free face to reduce back break and increase forward throw. Simba 25 or RMT 120F are popular drill rigs with 48 - 57 mm (25 metres)/64 - 75 mm (15 metres) options.

Figure 3. Simba junior drilling machine

This is also known as “Ring Drilling Machine” and “Long Hole Drilling machine.
It is the most versatile percussion drill machine for Tunneling, Drifting, Long Hole Drilling, and Cable Bolting Holes for Roof Supports. A ring drilling machine is specially designed to drill holes in 360-degree rotation for conventional drilling. Lateral movement version is used for parallel drilling by “manual feed screw” of 54 mm to travel the feed beam in either direction up to 500 mm from the center.

Blasting: ANFO with 60% S.G. as primer initiated with short delay (25 ms) are commonly used for blasting. The delays are used between two successive holes in each row starting from the middle of the fan ring progressing towards the walls. Drilling is extensive but it is overall economical. Explosive consumption is about 0.15 to 0.30 kg per ton of ore blasted.

Mucking: During blasting operations, first of all, the front ring in the bottom most level is blasted. The blasted ore is collected by LHD from the bottom haulage drifts through the mill holes. The blasted ore is, naturally, swelled. After drawing sufficient quantity of ore, the next ring is blasted. (Retreating pattern) And the ore is again drawn from the chute or the haulage drift as the case may be. Ore from mill holes or trough passes down to draw point cross-cuts. Secondary blasting of boulders, if required is done in the draw point cross-cut. The draw point cross-cuts can directly lead to the haulage level where ore loading is done by loaders into mine cars. But with the introduction of LHDs it is a common practiced today to connect the draw point cross-cuts to a gathering drive which is in turn connected to the haulage level below through a transfer raise.Where availability of LHDs is poor, a gravity transfer system with a grizzly level is preferable because of its reduced cost of ore transfer.

Working multiple sublevels: After repeating a several rounds of blasting + mucking from the lowest sublevel, the situation permits operation of multiple sublevels in a phased retreat with the lowest one advancing (retreating faster). For wider orebodies, LHDs of 2.3 m^3

bucket capacity are commonly used for transporting 250 t/hr depending on lead distance. An OMS of 25 is quite common in Sublevel stoping method.

Backfill and Support

In sublevel stoping a backfill program is usually established in large openings created during production. Backfill allows for the recovery of support pillars, permitting up to 90% ore recovery. Apart from this, backfill provides additional ground support, reduces dilution and helps with the redistribution of stresses around openings, which reduces rock bursting events.

Typically the types of backfill used are un-cemented rock and sand fill, and cemented hydraulic/high density tailings fill made from the waste rock and tails produced from mining operations. Cemented tailings have also been known to warrant the elimination of rib pillars between stopes, which allows for a further increase in ore recovery. However, preparation and installation of cemented fill is costly and is not always economically justified, in this case recovery of the support and rib pillars is not practical. Additional support at drill level and draw levels are to be provided wherever required using Rock Bolts and Cable Bolting.