

Underground Mining of Metalliferous Deposits
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Lecture 34
Stope and Pillar – II

STOPE AND PILLAR METHOD- Recapitulation

- **Stope and pillar** is a mining system in which a series of open stopes are made from a series of raises connecting two levels.
 - Ore from a series of short-span stopes are extracted across a horizontal plane, creating horizontal arrays of **Stopes** and **pillars**.
 - To do this, "rooms" of ore are dug out (expanding the raises) while "**pillars**" of untouched material are left to support the roof overburden.
 - ❖ **Applicability:** This method is used where the ore body **width is between 1.5 to 4.0m**
 - ❖ **Host rock/Hangwall:** moderate to strong
 - ❖ **Orebody:** weakly moderate to strong
 - ❖ **Dip:** 30-40 degree
 - ❖ **Temporary support:** Timbers for temporary support should be available
 - ❖ **Backfill materials:** should be available specially for deeper levels
- I. A raise is put along the H/W contact from lower level to upper level.
 - II. A sill pillar of 5m above the lower level and a crown pillar of 3m below the upper level are left as support.
 - III. A chute is installed at the lower level, together with an electric scraper engine to load the broken ore into mine cars.

Sill Pillars - A **sill pillar** is the horizontal part of the orebody left between the level drive and stope drive.

Crown Pillars – A **crown pillar** is the horizontal part of orebody left between stope roof and level drive

- The dimensions of these pillars are completely dependent on the geotechnical characteristics of host rock, span of stopes and depth of working
- Usually a sill pillar of 5m above the lower level and a crown pillar of 3 m below the upper level are left as support.

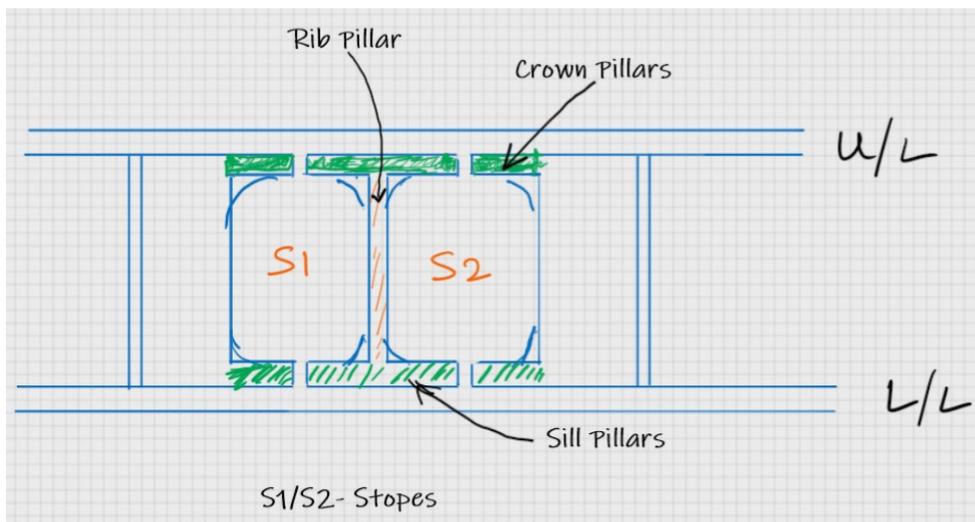


Figure 1. Representation of Rib, Sill and Crown pillar

- These **horizontal pillars** are the main support structures for stopes during excavation.
- Although a thick sill and crown pillar provides support for the hanging wall and add to the overall stability of the stopes, it may be uneconomic from mineral conservation point of view.
- Very thick crown pillars cause the loss of reserves whilst undersized pillars may cause failure and instability in the mine.
- Thus the optimization of sill and crown pillar dimension is very important for metalliferous mines.

Rib Pillars: a **rib pillar** separates one stope from the other and is aligned transverse of the stope, perpendicular to the strike. It is used in mines to increase the strata stability of the stope [and support the raises, winzes or shaft of the mine.]

Method of working: Two different approaches

1. Top down (Funnel Method)

2. Bottom up (Inverted V)

1. Top down (Funnel Method)

- Start with installing services (compressed air, water, manway ladders etc.) from top of centre raise
- Installation of Scraper engine at bottom Level
- Installation of Chute (or use existing one)
- Drill and blast stope drive (underhand)
- Better free face creation
- Jackhammers
- Stripping both sides alternately till the sill level is reached

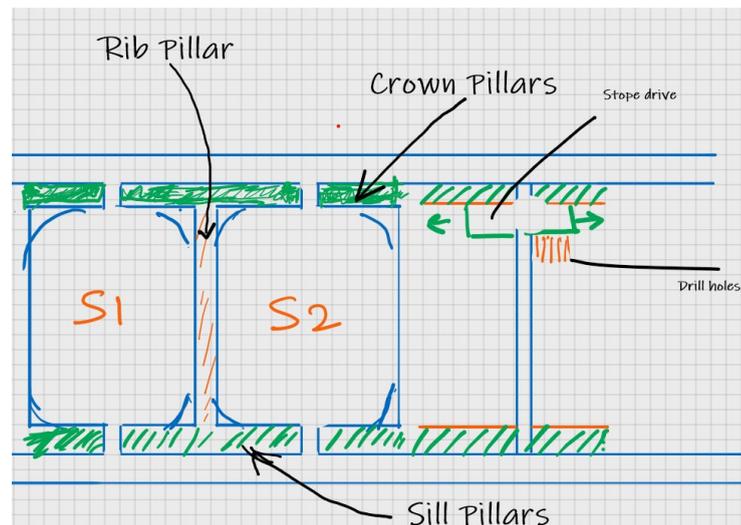


Figure 2. Top down (Funnel Method)

2. Bottom Up Method (inverted V)

- Start with installing services (compressed air, water, manway ladders etc.) from **top to bottom** of centre raise
- Installation of Scraper engine at bottom Level
- Installation of Chute (or use existing one)
- Drill and blast stope drive (overhand drilling) above Sill Pillar
- Better free face creation
- Jackhammers
- Stripping both sides alternately till the crown level is reached

Comparison between two approaches:

Top down:

1. Operation from top provides more safety in the beginning, but a later stage, the workers always travel through excavated/widened stope which is a safety concern
2. Mucking is easier since the blasted ore tends to get collected at the bottom of the funnel. Less scattered hence much easier to scrap by the hoe/scrapper shovel
3. We need to maintain the entire stope till the stoping is complete

Bottom up:

1. Operation from bottom gives easy access in the beginning and chances of rolling/falling material from top are always there
2. As we go up, mucking becomes increasingly difficult, since blasted ore gets scattered.
3. It is a retreating method means workers seldom travel in the widened area of the stope.

Drilling and blasting:

- Jackhammers are used for stope development drives, side stripping, Rock bolting)
- Hole length :~1.8 m 32mm dia. (during side stripping fanning round is preferred to create free face)
- Blasting: AN based slurry explosive sticks with Gelatin as bottom primer
- Stope must be well ventilated for comfort of working and quick clearing of smokes & fumes after blasting

Mucking

- A double hoist at the loading and transfer point moves both the cable with scrapper bucket and empty cable through a pulley fixed at the face of heading.
- The scrapper bucket, which is open at the end facing conveying direction is automatically loaded by scrapping through the material like a prow, and is pulled by the haulage cable up to the loading platform to be emptied into a mining car.
- A scraper loader is used for haulage in horizontal gently steep and trackless roadways with stable ground (not consolidated back fill, abandoned workings, etc.) as, e.g., in drifting, transport to chute, cutting of sills etc..

- A double hoist at the loading and transfer point moves both the cable with scraper bucket and empty cable through a pulley fixed at the face of heading.
- The scraper bucket, which is open at the end facing conveying direction is automatically loaded by scrapping through the material like a prow, and is pulled by the haulage cable up to the loading platform to be emptied into a mining car.
- Battery operated locomotives are used for transportation of ore to Grizzly.

STOPE AND PILLAR METHOD (Support)

- In this method, both faces of a central raise are advanced to a span of 10m, with systematic bolting of the roof at a grid pattern of 1.2m x 1.2 m, 1.5m long, 20m dia **tor-steel grouted rock bolts** are used as conventional support in place of timbers.
- **Timbers** are often used for temporary support in working faces.
- A **rib pillar** of 3 m wide is left between two consecutive stopes. (For shallow depth mines, faces are advanced up to a span of 15 m and a rib pillar of 4 m wide is left between two consecutive stopes).
- **Crown and Sill Pillars** for protection of levels
- Once the mining is completed to the extremities of the stope, **back filling** of the excavated area is done in deeper mines. This is to provide stability to the levels and better working at other levels.

Advantages:

1. Comparatively simple method with minor mechanization
2. Flexible in operation (no. of stopes can be easily increased)
3. 1200 – 1500 TPM can be easily achieved with less manpower.
4. Percentage of recovery is very high (only rib pillars etc. are left)

Disadvantages:

1. Low production
2. Mucking difficult specially in bottom up option
3. Filling may be necessary at higher depth (cost)
4. Extreme caution required while moving along the slope in the stope