

The good, the bad, and the profitable

Cut and fill mining is a favored choice for irregular orebodies and good to poor quality rock, and today, modern technology is keeping profits high.

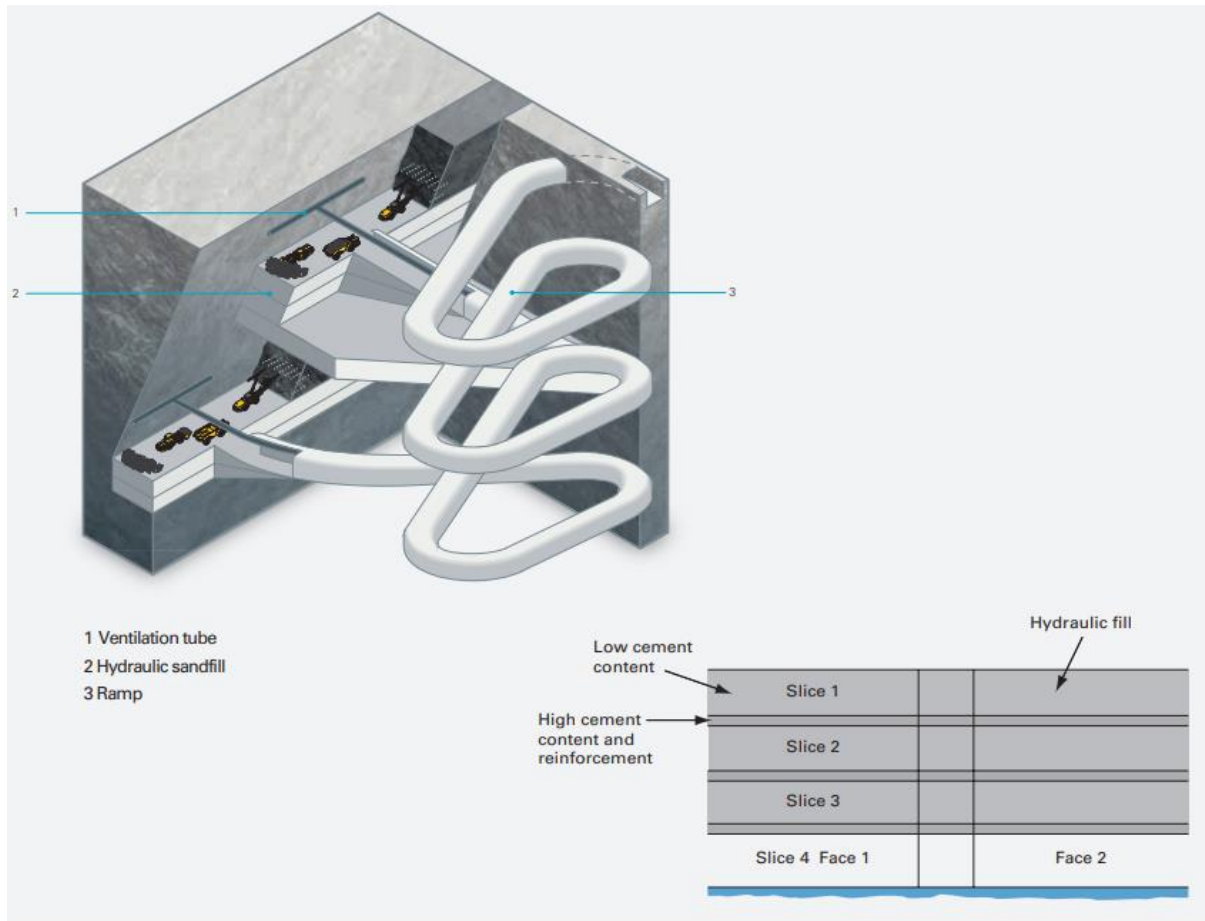


Figure 1 and 2: The methodology of cut and fill mining, suitable for steep and narrow orebodies, where each level is backfilled.

Cut and fill mining (C&F) is generally referred to as a small-scale mining method, but that does not mean that it is low yield. With the right technology, cut and fill can result in rich rewards.

Typical for C&F mining is backfill. The drifts are developed in the orebody and then backfilled, and mining is carried out from the bottom upwards in horizontal slices of, for example, 5–6 meters, where each level is also backfilled. After backfilling, the mining equipment moves back in to stand on top of the fill, using it as a working platform from which to excavate the next slice. This technique is particularly useful for orebodies that are steep and narrow (usually 4–12 m) with uneven boundaries that would be difficult to follow with large-scale mining techniques. Furthermore, C&F is a good solution in poor rock conditions, where it would be hard to open larger voids with satisfactory stability, and for areas where surface disturbance is not permitted. The ore is drilled, blasted, loaded and removed from the stope, which is then backfilled using either a cement and sand mixture, cement mixed with tailings from the dressing plant or waste rock from development drifts (see Figure 1&2). Before filling, stope entries are barricaded, and drainage tubes are installed. The stope is then filled with sand to almost its full height, and the cement is mixed into the final pours to provide a solid floor for mining equipment.



The same fleet of equipment can be used for both development of the cut and fill mine and for production.

Minimum waste

As no rib pillars are left and the crown pillar is usually taken out in a single large blast, most of the ore can be recovered with a minimum of waste dilution.

The development parameters for C&F mining include:

- A footwall haulage drive along the orebody at the main level
- An undercut of the stope area with drains for water
- A spiral ramp in the footwall, with an access drive to the undercut and to the production areas
- A raise connection to the level above for ventilation and filling material

The stope face appears as a wall. Breasting holes are drilled, charged, and blasted with an open slot at the bottom providing swell space for the blasted rock. The mineralization shows in the stope face, where it can be conveniently inspected by geologists. The drill pattern is often modified to follow variations in ore boundaries, and in fact, mining is frequently diverted from the planned stope boundaries to recover ore from mineral enclosures in the host rock. Sections with low grade ore can be left in place or deposited in adjacent, mined out stope sections.

If the rock in the orebody is exceptionally poor, C&F miners often create an undercut at the foot of the slice where the back wall is stabilized with backfill. Mining is started from the upper level by driving a normal drift round where the opening is supported by rock bolts and mesh.

When the first cut is completed, a wire fabric mesh and/or bolts are installed on the floor of the cut, and the opening is backfilled with cemented, stabilized fill with a higher cement content at the bottom as this will become the roof in the next level (see Figure 2). It is important to clean the surface to obtain good adhesion between the fill and the stope wall. Access to the mining area on the next cut is achieved by ramps going downward, where mining is resumed below the fill.

The smooth fill surface and controlled fragmentation created by C&F operations are ideal for the LHD loaders, which are the standard vehicles for mucking and transport in C&F mines. It is important, however, that tramming distances from the stopes to the ore passes are within convenient range. Alternatively, the ore can be trucked directly to the surface.

Pros and cons

While it is true that the C&F method is simple and effective, it does require more time in terms of man hours than large-scale methods, and the cost for rock support and drilling and blasting is higher. In addition, C&F requires people and machines to work inside the stope, exposed to the rock face, which is sometimes highly stressed and is, therefore, not the most ideal situation from a safety perspective. On the other hand, the same equipment fleet that is used for the development work can be used for mining the ore, which is a big advantage, and modern technology contributes to the extraction process.

Another clear advantage is selectivity. Even in orebodies with comparatively scattered mineralization, the high-grade sections can be mined separately, while the low-grade rock can be left in the stopes.

In an effort to increase productivity and safety, there is a growing trend towards replacing cut and fill mining with bench stoping and fill.