

Video number 11: Costs

Remember this picture? It illustrates the phases of constructing an underground facility using pillars. This might be the most cost-efficient underground structure possible to construct due to the minimal amount of material to be excavated.

According to this picture, we need to drill ten 100-meter-long horizontal boreholes and widen them to a diameter of 3 meters. The final stage requires removing walls at certain places, leaving pillars in between to ensure stability.

The result is an underground structure that is between 2.5 to 3 meters high, 40 meters wide, and 100 meters long, providing an approximate floor area of 3,500 square meters, also taking into account the floor space taken by pillars.

To construct this, we need to:

- a) Drill 10 boreholes of 100-meter length.
- b) Excavate 10 tunnels of 100 m length and transport about 7,000 cubic meters of material.
- c) Excavate and transport an additional 1,000 cubic meters of material between pillars.

Short boreholes are not extremely expensive; they cost about 100 EUR per meter. Therefore, 10 boreholes of 100 meters will cost 100,000 EUR.

Excavation and removal of 1 cubic meter of material in tunnels constructed conventionally cost around 50 EUR. If we use this price for further calculations, the excavation and removal of 7,000 cubic meters would cost about 350,000 EUR. Excavation between pillars will cost an additional 100,000 EUR.

In summary, the construction of such an underground structure would cost 550,000 EUR for the construction of about 3,500 square meters of floor area. This means that one square meter of floor would cost a little less than 160 EUR per square meter.

You can't construct anything for that price on the surface. A surface industrial or office facility would cost more than 1,000 EUR per square meter in developed countries and no less than 200 EUR per square meter anywhere in the world.

It's clear that the most important value is the price for excavation, estimated to be 50 EUR per cubic meter. In conventional tunneling, this price covers:

- Drilling boreholes for explosives
- Explosives
- Loading material and transport to the surface
- Drilling machines, excavators, trucks, other mechanization
- Salaries, amortization, research, taxes, profit

For underground construction according to the Deep Underground concept, the construction price is a bit different. It includes:

- Drilling boreholes
- Excavation according to the Deep Underground concept
- Transport with pumps or ventilators to the surface
- Power costs, drilling machines, excavators, transport mechanization

- Salaries, amortization, research, taxes, profit

We already know the price for drilling is 100,000 EUR, about 20% of the 550,000 EUR price for the entire facility. Since 550,000 EUR is the price for the entire facility's excavation at the rate of 50 EUR per cubic meter, and an estimated 20% of that would be drilling costs, we can deduce that drilling would account for about 110,000 EUR of the budget for the entire facility or about 10 EUR per cubic meter. Therefore, 40 EUR per cubic meter should cover all tasks besides drilling.

Now, we can compare both methods. If we take into account a 10-meter daily advance for conventional tunneling, those 10 tunnels can be excavated in 100 days with one set of mechanization. The Deep Underground concept requires 10 sets of equipment to do the same in 100 days.

Take another look at the list on the left. It required explosives, a driller, an excavator, a truck, machines (costing hundreds of thousands of dollars), fuel to run all that, and, of course, people to operate. All that for 50 EUR per cubic meter. On the other hand, we need 10 pumps or ventilators, each able to remove from 0.54 to 14.1 cubic meters a day from the borehole. The cost for this equipment and power supply should be relatively low, and the number of operators to run everything should be small. That means the majority of the 40 EUR per cubic meter could be spent on excavator equipment.

We already mentioned that there are about 10 methods — or even more — with the potential to remove material according to the Deep Underground concept. Some of the proposed methods are relatively well-known, but some require long and expensive development for such use, and therefore, aren't cheap.

At the moment, we don't know what production or the price of excavation equipment according to the Deep Underground concept would be, but this video shows that there is a place for even expensive excavators.

If we can keep the costs for excavating at around 40 EUR per cubic meter, then we can theoretically construct a usable underground facility for 160 EUR per square meter. In some parts of the world, this type of underground facility might cost 250 EUR per cubic meter to construct but should still be cheaper than anything constructed on the surface.

Speaking of the surface, let's see in the following video how to use the excavated material.