Deep underground project
March 2021

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1. Intro

Norwegians have an interesting traffic problem. Fjords generally cut the land perpendicularly to the coast, and because the water depth in fjords can be up to 2000 m, and hills around fjords can be at least several hundreds of m high, local transport is based on a combination of lorries and cars, which is time consuming.

To solve such problems, they invented several solutions. The first one, which is particularly spectacular, involves floating tunnels, which are described here.

The map on the right shows the route of a coastal road over fjords and sections with floating tunnels. Aside from the price for that road (40 billion EUR by the way), there are many technical difficulties for such constructions, and at the end of the day, there is a negative environmental impact on Norway's fjords, two of which are natural World Heritage Sites.

There are other ideas, too, including a ship tunnel to cross the hill between two fjords, as described here. The cost would be $315 million for a tunnel that is 1.7 km long, and big enough for a ship to cross.

These are big ideas, but they're expensive, technically challenging, and have a negative influence on nature.

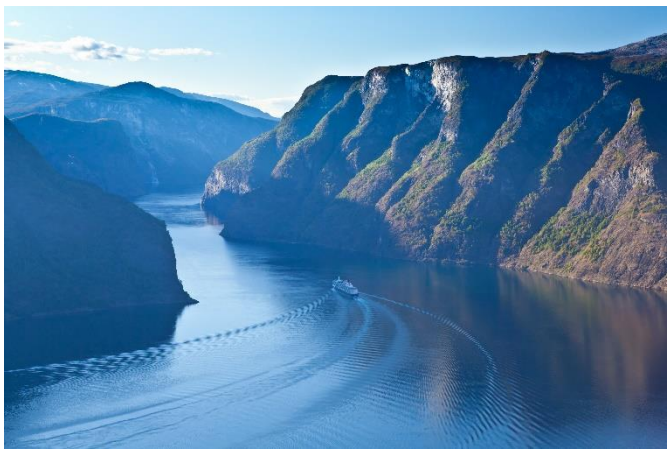
Coastal road with floating tunnel. Source: The Norwegian Public Roads Administration

2. Where the problem is

The photo on the right shows a typical fjord. There are mountains around the fjords which are often at least several hundred m high. The distance between both sides can also be several hundred m or more, and the depth of the water in a fjord is often more than 1 km.

To overcome such obstacles, interesting ideas have been conceived for projects that bring cars over the water through floating tunnels or boats through giant tunnels.

But a single water tunnel would bring a car only over a single fjord, and a ship tunnel



Typical fjord

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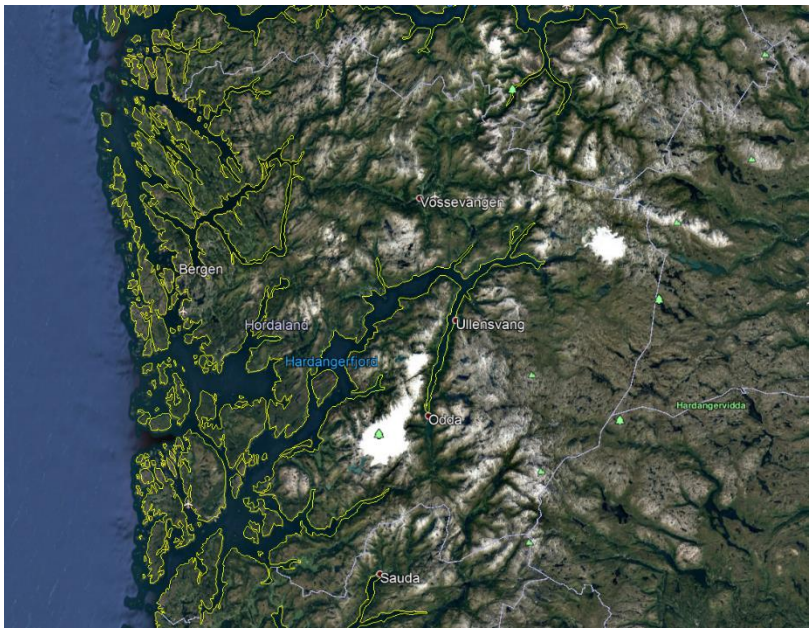
would bring a ship only to the next fjord through a single mountain, and since there are many fjords and many mountains, such projects don't make much sense. But it would be very useful if there was a more versatile vehicle that was able to transport over the mountains and under the sea, in all directions. Is there such a vehicle?



Fjord and islands around Bergen

3. Using directional elevators for transport

There is a special type of elevator called a directional or sideways elevator. Check out the link below to get a better idea of how this works.

https://www.wired.com/story/the-sideways-elevator-of-the-future-is-here

These elevators don't need ropes, so more than one elevator can be operational in a single tube, and they can move in vertical and horizontal directions. They are meant to be used in skyscrapers only, but the **deep underground project** already proposes an extension of the use of such elevators in shafts and tunnels, as described in the following link.

https://deeepunderground.com/elevators-topic.html

The idea is to create a directional elevator that moves in shafts and tunnels and is able to carry up to 30 passengers at the same time, with a speed up to 100 km/h in a horizontal direction, and a speed up to 20 km/h in a vertical direction.

4. Deep underground concept and directional elevators

The deep underground concept for traffic purposes proposes a system of shafts and tunnels which can be created at the same time by starting construction at multiple access points. Every single shaft or tunnel is started with drilling a borehole, which is later widened by using specially designed tools without requiring manpower and heavy mechanisation, as explained here:

https://deeepunderground.com/underground.html

This must be done in good geological conditions, to ensure stability without using any or at least much of the support measures, and the underground facilities must be as small as possible and of circular or elliptic shape.

So, the general idea is to construct a system of tunnels and shafts along the hills, over the hills, and under water to create a versatile transport system that can bring passengers quickly and safely from

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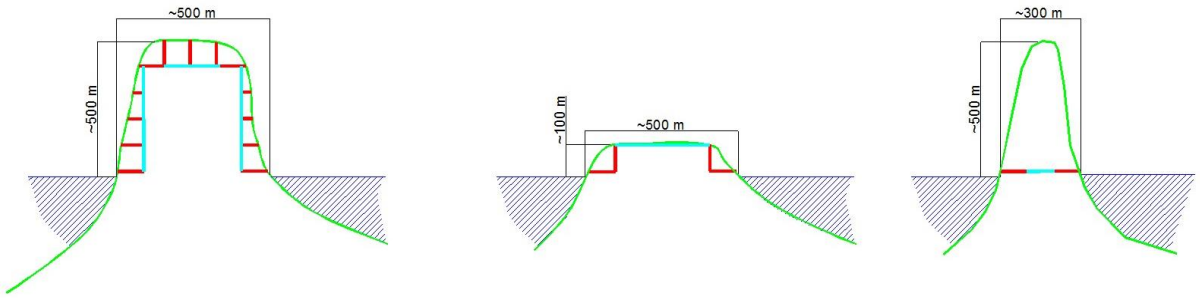
one location to another, including multiple fjords, islands, tops of mountains, and ports. Let's look at some examples.

5. Creating routes over the hills and under the sea

There are different kinds of hills between fjords. If they are high and wide, like the figure on the left below, you will need several horizontal tunnels with a length of 100 m or less and several shafts with a length of 100 m (red lines) in the first phase to create an access point. Then in the second phase, with construction of remaining tunnels and shafts (cyan lines), the whole line would be established.

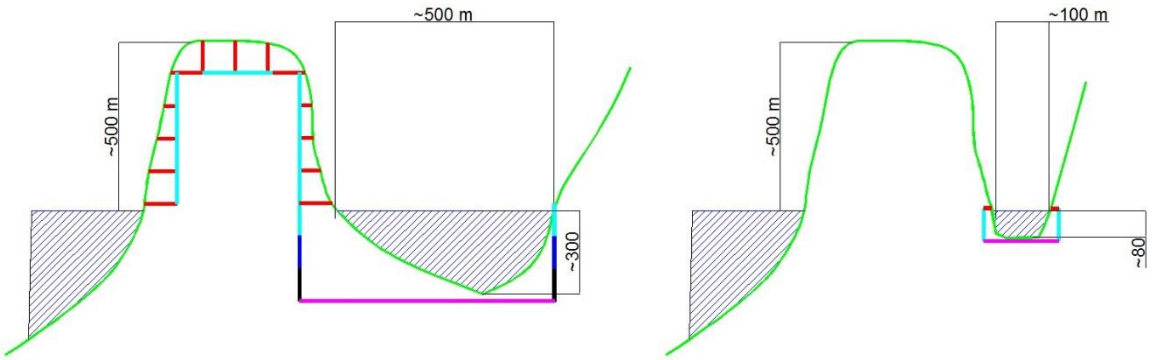
There are a lot of tunnels and shafts to construct, so it is best to find a place where configuration is optimal. The middle figure shows a flat but wide hill. In this case, only four tunnels and shafts should be constructed (red lines), and the connection between them can be established via a surface or subsurface line at the top of the hill.

The example on the right is another more favourable option, with much height but relatively short distance between two fjords. In this case, a tunnel is the best option.



Crossing different types of hills

To do the same under water can be a bit tricky, as shown in the figure at the left. The option to start excavation at several places simultaneously is not available in this case, so it would take a lot of time to excavate a tunnel under deep and wide sections. A much better option is shown on the right,



Crossing different types of fjords

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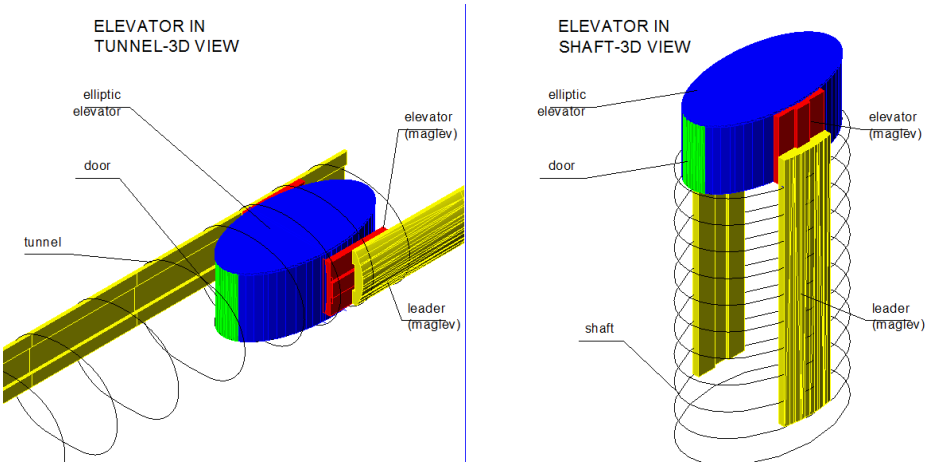
where you pick a shallow and thin part of the fjord and construct tunnels and shafts there. So, a good idea is to design your new transport line along the fjords and try to find suitable places to bridge over hills or under water.

The map below shows an idea of how the route can be designed. Note that the author has never been to Norway, so that proposal could be completely wrong. But it shows the logic of such a proposal. The land is connected with routes, generally constructed along a fjord, crossing them under the water and above the hills, using directional elevators' ability to go in every direction, including up and down.

Possible design of the routes.

6. What kinds of routes can we use?

The next figure (taken from the elevators paper) shows the principle of directional elevators moving through shafts and tunnels, but those vehicles can use existing infrastructure too, like rail routes (replacing trains) or road lanes (reserved for those vehicles). Since we are not talking about really heavy vehicles, a similar option for crossing water is not out of the question.
https://liftblog.com/gondola-royal-gorge-co/



The principle of directional elevators moving through shafts and tunnels.

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7. Conclusions

It's obvious that current solutions trying to allow lorries to float through the hills or cars to pass under the water are very expensive and technically challenging solutions with considerable negative impacts on the environment.

If there is a place for such ideas, then it is not too strange to suggest another one which is probably as crazy and expensive as those two: using directional elevators for transport. And this idea has its own advantages:

- No cars, ships, or lorries would be needed.
- It's a very versatile solution that can connect cities and points of interest underground in all directions.
- Nature will stay mostly intact, since most of the routes are underground.
- The capacity of such transport can be very high (up to 30 people), the elevators can follow each other within close distances, and they can evade each other as well.

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