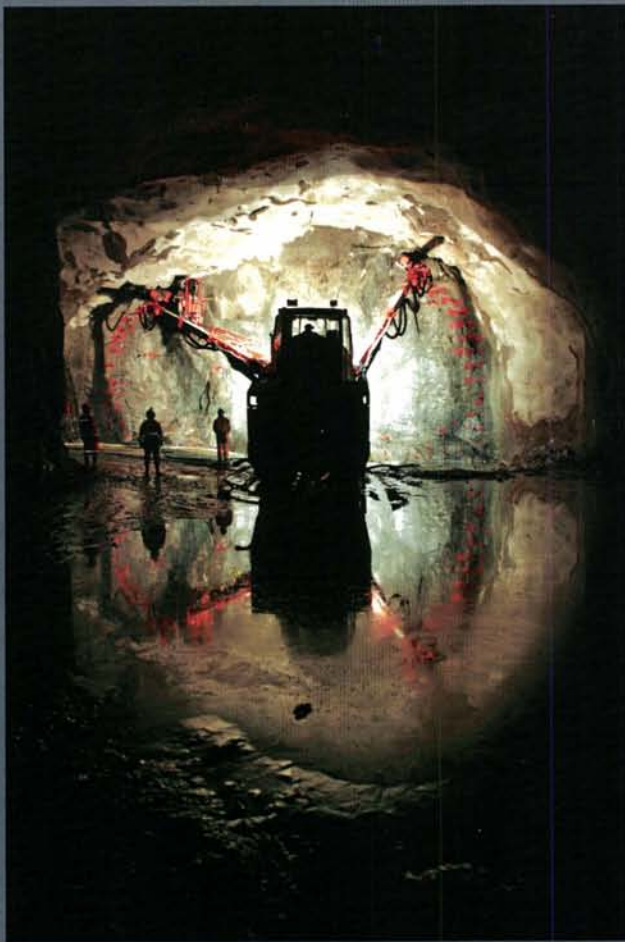


Stortrykk 492

Oslo - Ski: New double track

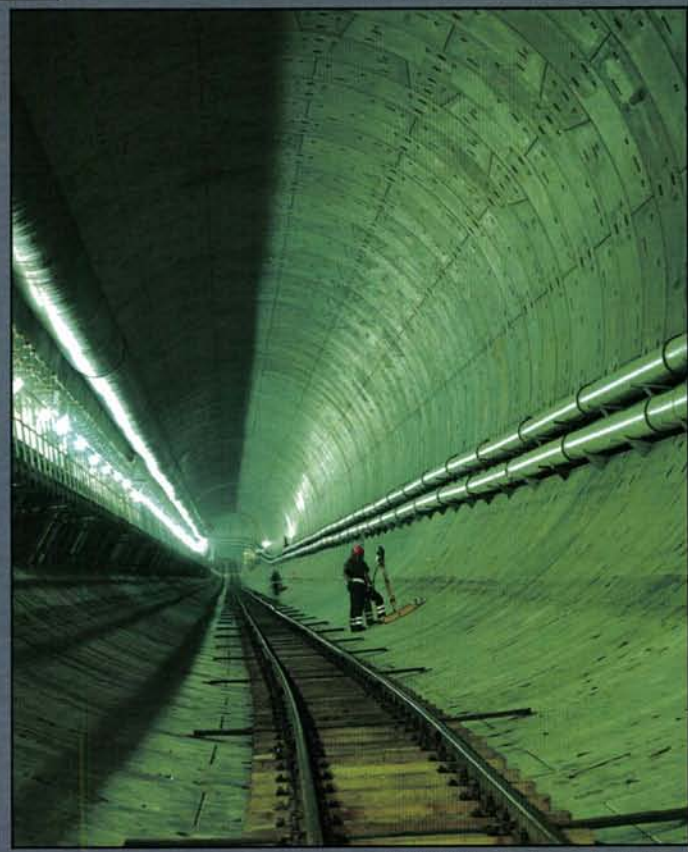
- the biggest upcoming railway project in Norway



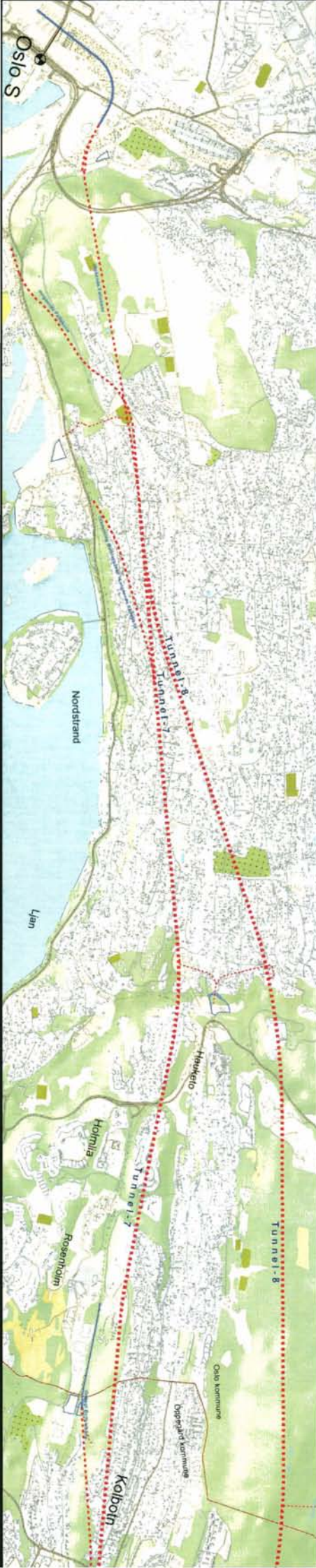
Drill and blast

Drill
and
blast?

Or
TBM?



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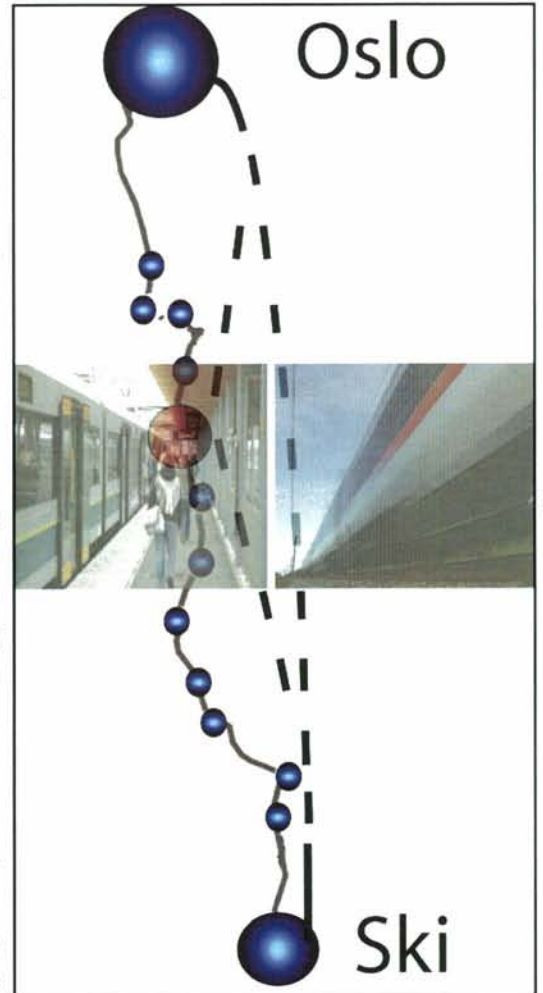
The project and the area

The Norwegian National Rail Administration is planning a 24 km expansion from two to four tracks between Oslo and Ski on the Østfold Line.

Rock tunnels will constitute as much as 18 km of the projected line, and both TBM and drill and blast are considered as excavation methods.

Today capacity on the Østfold Line is stretched to the limit. Improving capacity south of Oslo is vital in order to increase rail transport locally and nationally – for both freight and passenger traffic.

By separating express trains from the slower, local trains, the new double track (the Follo Line) will shorten travel time, improve punctuality and more than double capacity.



The Follo line to the right, shown with the two alternative lines. The existing Østfold line to the left.

Apart from the rock tunnel, the project includes shorter cut-and-cover tunnels, a new station at Ski and an open terrain section of a few kilometers.

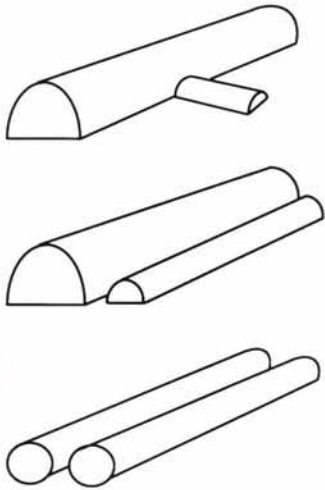
Two alternative lines are projected, as shown on the maps. Alternative A includes a new, two level station at the town of Kolbotn, while the line in alternative B goes directly from Oslo to Ski.

The Norwegian National Rail Administration has not yet chosen one of the alternatives, but the decision is due later in 2008. The line is planned for speeds up to 200 km/h. Construction will start in 2013 depending on public funding.

The map to the left shows the alternative lines from Oslo to Kolbotn. The stretch from Kolbotn to Ski is on the opposite page.

Tunnel concepts and excavation methods

Planning has reached a stage where initial reports on tunnel concepts, safety and tunneling methods have been completed. Further planning will be based on one of the following concepts:



1. A double-track tunnel with a cross section of 118 m², with five main access tunnels and 13 smaller escape tunnels to the surface.
2. A double-track tunnel with a cross section of 118 m² and a parallel service tunnel with a cross section of 25 m². There will be escape connections between the tunnels every 1000 meters, as well as five main access tunnels to the surface.
3. Two single track tunnels with a cross section of 70 m² each, with escape connections every 500 meters.

Drill and blast or TBM?

Concepts number 1 and 2 are considered suitable only for drill and blast, while the concept with two single-track tunnels is a good candidate for both drill and blast and TBM tunneling.

The area in question is heavily populated, entailing restrictions on blasting, transport, noise, dust and maintaining groundwater levels. Leakage control will be important to avoid ground subsidence, and a comprehensive ground investigation programme will precede construction. The concept reports state that for the single track tunnels, both methods are likely to be competitive.

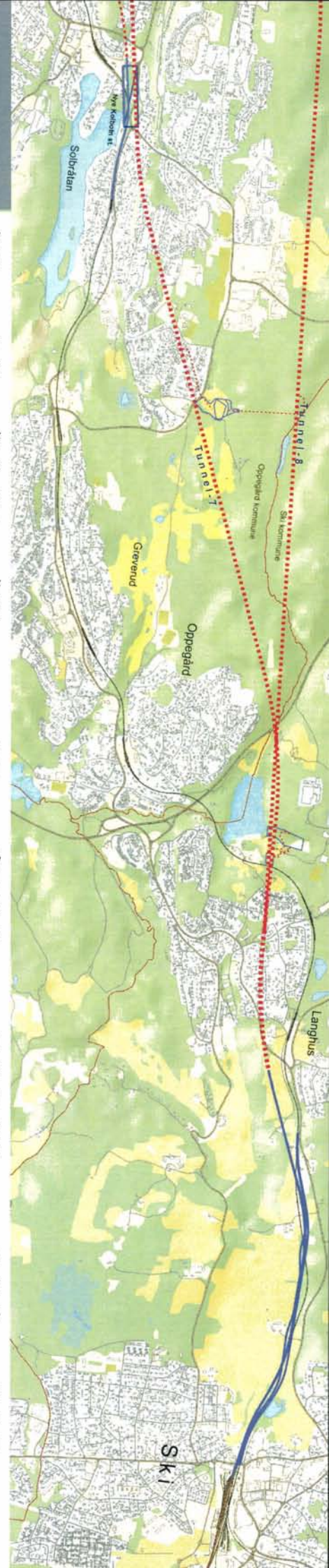
Drill and blast

With five access tunnels, no section of tunnel blasted from a single front will exceed 2000 meters. The total length of access tunnels will be 1480 meters with alternative A, and 2810 meters with alternative B. Drill and blast is widely used in Norway, because the method offers flexibility regarding tunnelling through varied rock conditions. Water and frost protection will be necessary throughout the tunnel.

TBM

The initial concept reports point towards using four double-shield TBMs with full lining. The TBMs are suggested to work in pairs in each direction from a single point of attack. Length of the access tunnel will be 240 or 1020 meters, depending on the line alternative chosen.

According to the National Rail Administration's regulations, single track tunnels must have a diameter of 9,1 meters. Using a TBM, this means a circular cross section of 10,23 meters before lining. Leakage control and environmental concerns speak in favour of the TBM alternative.



Geology and contact information

The bedrock of the project area consists of Precambrian gneisses and dikes or layers of amphibolite/metadolerite.

The bedrock is mainly of good rock quality for rock excavation. The gneisses often have large joint spacing, but fracture and fault zones are expected along the tunnel alignment.

Laboratory testing of rock samples have shown that the gneisses and amphibolites have high uniaxial compressive strength.

Oslo - Ski

- 24 km
- Rock tunnels up to 18 km of the distance
- Further planning starts in 2009
- Building can start in 2013



Drilled rock cores of good rock quality in upper part of the picture, and weathered rock with quartz cemented fractures below.

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