

= Romerike Tunnel =

The Romerike Tunnel ( Norwegian : Romeriksporten ) is a 14 @. @ 580 @- @ kilometre ( 9 @. @ 060 mi ) railway tunnel in Norway between Oslo and Lillestrøm . It is the longest railway tunnel in Norway and forms the first section of the Gardermoen Line . It is double track and electrified , permitting speeds of 210 kilometres per hour ( 130 mph ) .

Construction started in 1994 , with plans to open with the rest of the Gardermoen Line and Oslo Airport , Gardermoen on 8 October 1998 . Due to serious leakage from Lutvann and several other lakes , it did not open until 22 August 1999 . The leaks increased the cost of the tunnel from NOK 0 @. @ 5 billion to NOK 1 @. @ 8 billion . The main contractor was Scandinavian Rock Group . The tunnel was originally owned by NSB Gardermobanen but is now owned by the Norwegian National Rail Administration . The tunnel allows long @- @ distance , regional and Flytoget Airport Express Trains to bypass the old Hoved Line , reducing journey times between Oslo and Lillestrøm from 29 to 12 minutes .

= = Background = =

The tunnel was constructed as part of the high @- @ speed Gardermoen Line which runs from Oslo to Eidsvoll via Oslo Airport , Gardermoen . The tunnel makes up most of the 18 @- @ kilometre ( 11 mi ) section between Oslo Central Station and Lillestrøm Station and was built to bypass the meandering Trunk Line which dates from 1854 . Despite the older line being double track , capacity had reached its limit due to a combination of some trains making many stops and others none until Lillestrøm . The Romerike Tunnel would also be straighter and allow higher through speeds , decreasing travel time from 29 to 12 minutes . The decision to build the Gardermoen Line and Romerike Tunnel was taken by the Norwegian Parliament on 8 October 1992 , with the opening planned for six years later on 8 October 1998 .

An alternative airport site to Gardermoen was proposed at Hurum , south @- @ west of Oslo . Had Hurum been chosen , the Gardermoen Line would not have been necessary for the airport express train , but the planning documents recommended that construction still proceed to ease traffic congestion north of Oslo . The tunnel is used by all trains on the Gardermoen Line , including the Flytoget airport express , and the regional and express trains which continue via the Dovre Line . Local trains on the Hoved Line and Kongsvinger Line to the north also use the tunnel . Use of the Hoved Line is limited to freight trains and commuter trains which make stops along the route .

= = Construction = =

Construction started in August 1994 , after a tender had been won by Scandinavian Rock Group ( SRG ) , a collaboration between Målselv Anlegg , Nor Entreprenør and Peab . The original contract price was NOK 541 million . An average of 388 man @- @ years were expended during construction , and the work involved the removal of 1 @. @ 62 million tonnes of rock . There were three excavation points ( headings ) , located at Bryn , Starveien on the Oslo ? Lørenskog border , and at Stalsberg , outside Lillestrøm .

The tunnel is 14 @. @ 580 kilometres ( 9 @. @ 060 mi ) long with a 105 m<sup>2</sup> ( 1 @. @ 130 sq ft ) cross @- @ section , making it the longest tunnel in Norway when it opened , and the second longest since the opening of the Lærdal road tunnel . It allows speeds of 210 km / h ( 130 mph ) , with a slope of 0 @. @ 2 ? 0 @. @ 4 % slanting upwards towards Lillestrøm . This provides a natural updraught in the direction of Lillestrøm , but a horizontal ventilation system was needed to work in the opposite direction . This is supplemented with vertical ventilation shafts at Bryn and Starveien . The tunnel is between 6 metres ( 20 ft ) and 120 metres ( 390 ft ) below ground , being at its deepest in the vicinity of Bryn . Trains using the tunnel must be capable of a minimum speed of 160 kilometres per hour ( 99 mph ) . The tunnel has overhead wires with 15 kV AC railway electrification ( 16 2 ? 3 Hz ) .

### === Leakages ===

The tunnel needed to pass under Østmarka , a recreational area east of Oslo . The geology of this area is unstable , and was not ideal for tunnel boring . Pressure for its completion to coincide with the opening of the new airport resulted in tunnel excavation proceeding at maximum speed , without adequate measures to exclude water , which resulted in leaks . Houses above the route of the tunnel in Hellerud were damaged and the water levels of many lakes in Østmarka were reduced , including lakes Lutvann and Nordre Puttjern .

After the damage was discovered on 3 February 1997 , legal actions were initiated by the Norwegian Water Resources and Energy Directorate requiring remedial measures to halt the leakage . At its worst , the rate of leakage into the tunnel was 3 @, @ 000 litres ( 660 imp gal ; 790 US gal ) of water per minute . The Rhoca @-@ Gil proprietary sealant process was used to stop the leaks . On investigation , Rhoca @-@ Gil was revealed to contain a toxic substance called acrylamide , which caused health problems for the tunnel workers . The removal of Rhoca @-@ Gil and its replacement with concrete resulted in additional delays . In addition , an extensive permanent pumping system was installed to restore and maintain lake levels in Østmarka .

Curing the leaks and cleaning up the contamination delayed the tunnel 's completion by a year , and it was finally opened on 22 August 1999 . The entire process was further complicated by conflicts between NSB Gardermobanen and the Scandinavian Rock Group . Retrospective surveys showed a lack of control and reporting procedures during the incidents , which should have been addressed in 1995 , but were never taken seriously . Compensation was paid for approximately 60 houses which were damaged as a result of tunnel construction . An evaluation by the Ministry of Transport and Communications showed that NOK 500 million was spent fixing the leaks , but the report claimed that this was to a large extent a waste of money , resulting from inefficient engineering procedures . The same report criticized the planning and organization of the construction of the entire railway . In total the extraordinary additional costs for the tunnel totaled NOK 1 @. @ 3 billion .

### === Delay ===

When the new airport opened on 8 October 1998 the Flytoget airport express trains started operating immediately , as did the Gardermoen Line from Lillestrøm to the airport and onwards to Eidsvoll . Because the tunnel was not finished , trains were required to use the old Trunk Line from Oslo Central Station to Lillestrøm . After this diversion the express trains switched to the completed section of the new Gardermoen Line between Lillestrøm and Oslo Airport . Regular operations using the Romerike Tunnel started on 22 August 1999 .