

The Oslo Airport Express Train

Ove Narvesen

Gardermobanen is Norway's first high-speed railway. There have been no equivalent railway construction projects in Norway since the start of the railways at the end of the last century. Gardermobanen is a gigantic project that has placed stringent requirements upon the best resources within Norway as well as on international building and construction companies. From the planning and project phases, quality, functionality, and the visual overall picture have been the focal points. This is now reflected in the completed construction work and buildings.

On 8 October 1992, the Norwegian Parliament approved the building of a new main airport for eastern Norway at Gardermoen, about 50 km north of Oslo and situated away from the most populated areas of the region. The decision to build the airport at Gardermoen was controversial and came after some 30 years of discussion over where the airport should be sited. At the same time, it was decided to build a high-speed railway link from Oslo to Gardermoen in order to establish a modern transport system to the airport.

Why Train?

The main reasons for choosing a high-speed rail service to link the airport to its main market were the environmental benefits to the community in general, the time- and cost-savings to airline passengers, and higher efficiency for the railways. On routes to and from airports with severe congestion peaks, high-speed rail links designed to meet the airline passengers' quality and service requirements will have competitive advantages and attain a high market share. The only other alternative considered was bus transport but it was concluded that a railway would obtain a much higher market share than buses. However, a major bus operation was calculated as being more cost effective. The Gardermobanen Line runs parallel to

the Oslo-Eidsvoll main line along the entire route and construction of a new line next to an operating line created many challenges and increased the project costs considerably. The aim was to construct a completely new infrastructure closely linked to the existing system without disturbing existing and ongoing traffic. Linking the Gardermobanen Line to the main line has been a major project in its own right.

The construction of the new line has had a synergetic effect on the local and regional train traffic. Although the *Airport Express* trains only travel to Gardermoen and then return to Oslo and Asker, the tracks continue to Eidsvoll where they connect to the main line. As a result, trains from Lillehammer and Trondheim can also stop at Gardermoen. In other words, most trains run by Norwegian State Railways (NSB BA) can use the Gardermobanen, greatly strengthening train connections in eastern Norway.

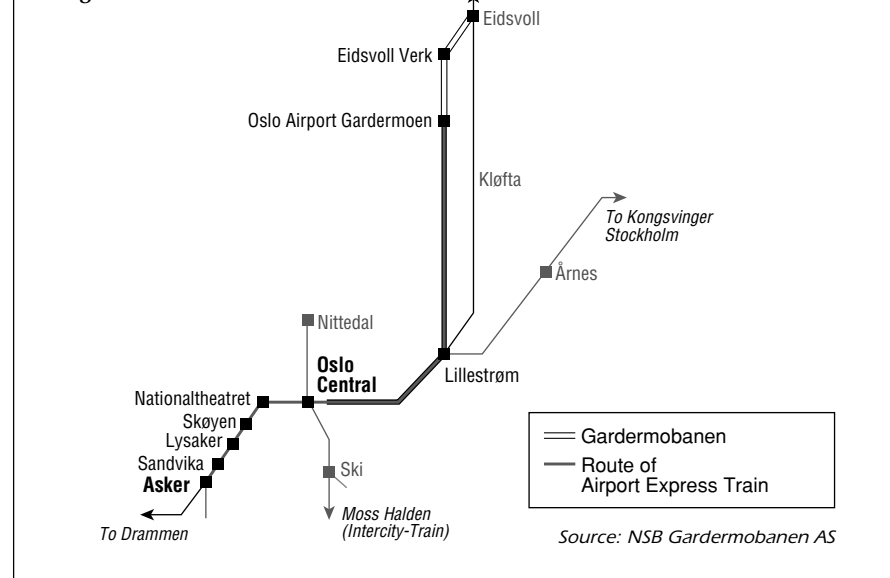
The Construction

It is over 30 years since the last major rail link was built in Norway as the final part of the northern railway between Trondheim and Bodø.

Gardermobanen and the *Airport Express* trains introduce a whole new era of train transport in Norway. Gardermobanen is the first high-speed railway built in Norway. It is designed for an operating speed of 210 km/h. This places stringent requirements on all line components, such as the overhead catenary, tracks, points, and signalling systems. Gardermobanen uses the latest railway technologies, even from an international perspective.

The line includes about 66 km of new line with 18 km of tunnels, 12 large bridges, and a number of larger and smaller culverts. Eight stations have been rebuilt. The Lillestrøm and Oslo Airport Gardermoen stations are completely new as is the station at Eidsvoll Verk. The *Airport Express* trains will be fast, comfortable, safe and the most environment-

Figure 1 Gardermobanen Route



friendly transport for passengers travelling to and from the new Oslo Airport at Gardermoen.

The electronic installations include signalling, power, communications, and IT. The Gardermobanen signal installations are the first in Norway to ensure safe train operations at up to 210 km/h. The systems use hardware and software instead of conventional relay-based technology and are divided into three areas: fuse installations, CTC (Centralized Traffic Control), and ATC (Automatic Train Control).

The power supplies feed electrical power to the *Airport Express* trains and to installations along the line. Two new modern converter stations, supplying power to the overhead catenary have been built. The catenary supports are new and specially designed for the Gardermobanen, winning a 1996 Good Design Award. The auxiliary power system consists of a standard high-voltage power cable network feeding installations such as point heaters, signalling equipment, communications equipment, tunnel and platform lighting, and tunnel ventilation.

The communication equipment consists of a network for *Airport Express* train operational services, passenger information services and business administration operations. It includes the following sub-systems: exchanges, transmitters, radio systems, public information systems and network supervision.

The Gardermobanen IT-systems include planning, traffic supervision, and ticketing, and support for decision-making, economics and office administration.

The Oslo Central Gardermobanen Terminal

The *Airport Express* terminal has been integrated into Oslo Central Station with a new parking garage for 650 cars on the sea side. The taxi ranks, bus station and short-term parking are all close by. A direct underground walkway links the terminal with Oslo Central Station. The



Airport Express train arriving at Oslo Airport

(NSB Gardermobanen AS)

terminal has information and ticket counters, information displays and ticket machines. Scandinavian Airline Systems (SAS) and Braathens Airlines both have check-in, information and ticket counters. There are also banking, kiosk, and food services in the terminal. Tracks 13 and 14 are reserved for the *Airport Express*.

The Oslo Lufthavn Gardermoen Terminal

This terminal is integrated into the airport buildings and is just a short distance via escalators and lifts to the check-in counters, and arrival and departure zones. The terminal has four tracks: two for the *Airport Express* trains and two for other through traffic. All *Airport Express* passengers must pass through electronic ticket controls on the platform. The station hall has services, information displays, ticket and information counters, and ticket machines for the *Airport Express* trains. There are also ticket machines and train information displays in the baggage hall.

The trains

NSB Gardermobanen AS purchased 16 *Airport Express* EMU trains, each consisting of three carriages. EMUs were chosen because they are less vulnerable to faults and the trains can keep on schedule even if 1/3 of the motive power is lost. Each carriage has two doors, one can accommodate wheelchairs. The luggage racks are located near the doors and the

seats face the nearest door, so passengers can keep an eye on their luggage. To ensure the best comfort, the carriages are airtight and air-conditioned. Both Global System for Mobile Communication (GSM) and Nordic Mobile Telephone (NMT) cellular telephones can be used onboard. The trains have a driver's cab at both ends and the safety requirements and ergonomic design are specially adapted to high-speed operations.

Tunnel problems

The line has three tunnels; the 13.8-km Romeriksporten Tunnel (the longest), the 1.6-km Bekkedalshøgda Tunnel, and the 550-m Eidsvoll Tunnel through soft uncompacted material. The tunnel construction involved dynamiting 2.2 million m³ of rock (1.65 million m³ in the Romeriksporten).

Driving the tunnels presented many special challenges especially water seepage in the Romeriksporten. Sealing by pre-injection was insufficient to hold the groundwater in balance, so it was supplemented by large-scale post-injection of cement and chemical sealants. Driving the Eidsvoll Tunnel through uncompacted material required technologies that have seldom been used previously in Norway. Some parts caved in during construction but the section was dug out again and completed within the scheduled construction period.

Bridges and culverts

The Gardermobanen has a total of 12 larger railway bridges and a number of smaller culverts; 130,000 m³ of concrete have gone into the bridges, and culverts, as well as into a number of road bridges and culverts, and large crossings for wild animals. There are 20 bridges, culverts and tunnels allowing small and large animals to cross the tracks safely, which is important in maintaining the biological diversity of the region.

Safety

One of the primary goals of NSB Gardermobanen AS is to be the safest transport carrier to and from Oslo Airport and the Gardermobanen has been planned and built according to the latest rules and regulations. The *Airport Express* trains are type approved and the signal and safety equipment are approved separately. Time has been reserved for testing the various systems and installations to ensure that all systems function as they should.

All possible risk areas will be identified before starting Gardermobanen operations. There are separately documented requirements for installations and equipment, and for operational procedures and personnel competence. All incidents will be reported and a special database will ensure that incidents are analyzed and corrective action taken.

A separate emergency plan has been prepared for use in co-operation with the emergency services. The necessary state-of-readiness resources have been specified. In addition, special emergency carriages have been developed to ensure that the fire brigade can reach the scene of an accident as quickly as possible. A special rescue train has been developed to ensure swift rescue and effective evacuation from tunnels. This train will be on permanent standby at Oslo Central Station. All personnel have been trained

in emergency systems so that they can help with effective evacuation and first aid for passengers. Rescue parties are included in training schedules to ensure that efficient external assistance will be provided.

Airport Express Trains and the Environment

The Gardermobanen is constructed according to the environmental requirements of Parliament set forth in the control plans, as well as according to the company's own requirements. Before construction started, NSB Gardermobanen AS designed its own Environmental Programme and Guidelines for the Visual Environment. An Environmental Programme for Operations has also been designed.

The Gardermobanen and the *Airport Express* trains make a great effort to protect the environment. The train is pollution-free. Attention to the environment has been of central importance during all construction stages. For example, a new type of 3-m high noise baffle was constructed for the Gardermobanen. The lower 2 m is aluminium and the top 1 m is hardened glass. The interior of the lower aluminium section is filled with sound absorbent material. When appropriate, these noise baffles are replaced by earth banks.

Noise insulation initiatives have also been undertaken on individual homes near the line by replacing windows and doors, and insulating walls and roofs. Outside areas that have been used by Gardermobanen during construction, have been improved, for

example, by landscaping and by building garages and parking areas. New parks have been established, especially in the areas along the railway line through Lillestrøm.

Interim studies have also confirmed that all the essential environmental goals have been reached, except for the unforeseen water leakage problems in the Romeriksporten Tunnel and some problems with pollution from chemical sealants. The greatest environmental benefits will come from persuading 50% of air passengers to use the trains to and from the new airport.

Heading for Success!

Exactly 6 years after the build decision, both the new airport and high-speed rail link opened on 8 October 1998. Thanks to the new airport rail link, most of the disadvantages of building the airport 50 km from Oslo city centre seem to have been eliminated. The airport rail link will ensure that access times from Oslo to the airport are the same as the 19-minute journey time to the old airport at Fornebu by car or bus. However, because of some remaining water seepage problems, the *Airport Express* trains presently detour around the tunnel, requiring 33 minutes to get to the airport. This situation will probably be rectified by August 1999. But fortunately, it does not seem to stop air passengers using the train. After the first few months of operation, the *Airport Express* already holds a market share of 38%, which is very close to the most optimistic estimates. The experiences so far all point in the direction of success. ■



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Dr Narvesen is former Director of Corporate Communications with NSB Gardermobanen AS. Prior to this, he was editor in chief for two major publishing companies. He has also worked as Director of Information for humanitarian organizations, and as a researcher at the Norwegian Institute of International Affairs. He obtained his doctorate in 1979 from the University of Oslo.