

Gar 656.713 NSB Gar



GARDERMOBANEN

Norway's first high-speed railway



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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 and the beginning of this one. Gardermobanen is a gigantic project that has placed stringent requirements upon the best resources within Norwegian as well as international building and construction capabilities. From the planning and project design phase of the Gardermobanen, quality, functionality, environmental protection, safety and comprehensive design have been the focal points. This is now reflected in the completed construction work and buildings.

The project includes approx. 66 kilometres of new stretches of railway, which includes 18 kilometres of tunnels, 12 large bridges and a number of larger and smaller culverts. Eight stations have been rebuilt. The Lillestrøm and Oslo Lufthavn Gardermoen stations are completely new. A completely new station has also been built at Eidsvoll Verk. All preparations have been made so that the Airport Express Trains will be projected as fast, comfortable, safe and the most environmentally friendly transportation alternative for passengers travelling to or from Oslo Lufthavn Gardermoen.



The Airport Express Train station is in close range to taxis, buses and the underground.

THE STATIONS

• The Airport Express Train Terminal

The Airport Express Train Terminal has been integrated into the Oslo Central Station. The Express Train Terminal is on the sea side of Oslo Central Station, where a new parking garage has been built. There is parking space for 650 cars in connection with the approach to the new arrival area. The taxi stand, bus station and parking are all in the near vicinity. There is a direct connection below street level, between the Jernbanetorget Underground station and Oslo Central Station. Inside the terminal there are information and ticket counters, information display panels and ticket dispensers for the Airport Express Train. SAS and Braathens airlines are established with check-in, information and ticket counters. Bank, kiosk and food services are also located within the terminal. Tracks 13 and 14 are reserved for the Airport Express Train.

Artistic Decoration

A wave, crafted in steel, hangs diagonally across the ceiling in the Airport Express Train Terminal. The ornamentation is illuminated and enriched with colours to complete the overall effect of the artwork. Complementary to the steel ornamentation, there is a parallel diagonal pattern with depressed natural stone squares fitted into the the floor.





• Lillestrøm

The Lillestrøm Station has been completely rebuilt with a new continuous station hall under the track area. The station hall connects the city side and the south side of Lillestrøm together. The Airport Express Train uses tracks 1,2,3 and 4. The new station building has been constructed in connection with the old station building. A public transport bus terminal has also been built and preparations have been made for taxi stands on both sides of the terminal. Business establishments and services are located inside the station hall. When completed, there will be a total of 800 parking spaces divided between the north and south sides of the station. An area for bicycles has also been prepared. A new highway, route 159, is under construction and will have direct access to the station. There is also extensive redesign of the streets around the station.

Artistic Decoration

Outside the station building a sculptural work has been erected, based on a granite block that has been divided and reunited as two figures – a positive and a negative form – constituting a dancing pair. The work has been named "Stationary Tango".





Artistic decoration named "Stationary Tango".

• Other stations

NSB Gardermobanen AS has also had the responsibility for building several other stations along the tracks which will not service the Airport Express Train, but handle NSB's other train services. These stations function as regional public transport terminals.

Leirsund Station

A new station with platform and waiting room has been built at Leirsund. New access roads have been constructed with appurtenant transit parking and new loading areas for buses and taxis.

Lindeberg Station

Two new platforms and roofs have been built. Transit parking and access roads have been improved.

Kløfta Station

A new station building, new platforms, parking areas, public transit terminal and underground walkways, primarily for pedestrians and cyclists, have been built. Transit parking, buses and taxis are available at the station. Highway no. 2 has been rerouted and improves the traffic flow in the area and access to the parking areas and the public transit terminal.

Eidsvoll Verk Station

Eidsvoll Verk station is a completely new station with two new platforms and roofs. Transit parking, buses and taxis are avail-

able at the station. Adjustments to the local roadways and the building of pedestrian and bicycle paths have resulted in good accessibility.

Eidsvoll Station

A new railway station has been built at Eidsvoll with two new platforms and a station hall with a waiting room. The main railway and Gardermobanen are joined at Eidsvoll. A new public transit terminal with bus, taxi and transit parking provide good accessibility.

Leirsund station



Lindeberg station



Kløfta station



Eidsvoll Verk station



Eidsvoll station





The Airport Express Train tickets are checked at the turnstiles at Oslo Airport at Gardermoen.

Upon arrival at the airport, you take the escalator or lift straight up to the check-in counter.

• Oslo Lufthavn Gardermoen

The terminal is integrated in the terminal building at the airport. With the aid of lifts or escalators, the check-in counters, arrival and departure zones are within easy and quick reach. Four tracks have been built to the station. Two tracks are for the Airport Express Trains and two are for the other through train traffic. All Airport Express Train passengers must pass through an electronic ticket control on the platform. Services, information display panels, ticket and information counters, as well as ticket dispensers for the Airport Express Train are available in the station hall. Ticket dispensers and information about the trains are also available in the baggage hall.

Artistic Decoration

There are sculptures of steel, some hanging from the ceiling, some standing on the floor. There are also lighted boxes made of glass with motifs from the mountains, flush mounted in the floor. A sound shower is automatically triggered by motion detectors on the Airport Express Train platforms. In the sound shower, one experiences whispering voices and sounds. You will also discover poetry in both Norwegian and English embedded in the floor. Colourful vases, some standing and some lying, are also to be found in the station hall.







Key Data for the Airport Express Trains

Number of trains:

6

Number of seats per train:

175

Maximum speed:

210 km/h

Weight:

approx. 150 tons

Length:

approx. 82 metres

Height:

3.7 metres

Width:

approx. 3 metres

Construction material:

Stainless steel

Maximum power:

2645 kW

Maximum weight per axel:

16.5 tons

Acceleration from start with load:

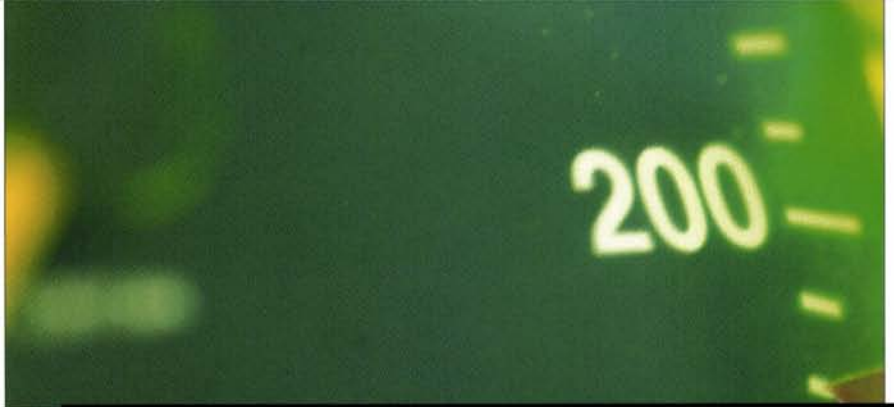
0.65 m/s²

Nominell voltage, frequency:

15 kV, 16 2/3 Hz



THE AIRPORT EXPRESS TRAIN



Airconditioning and pressurized cabins make travelling with the Airport Express Train a pleasant experience.

NSB Gardermobanen AS has purchased 16 Airport Express Trains. Each train consists of three carriages with shared traction. This means that each carriage is driven by motors and is therefore less vulnerable to faults and can maintain the schedule even with a loss of 1/3 of the power. Each carriage has two entrance doors. One of the entrance doors in each of the carriages is adapted to accommodate wheelchairs. Luggage space is located in the entrance areas. The seats in the Airport Express Trains are mounted facing the nearest entrance, so that the passengers at any time can keep their eyes on their luggage. In order to ensure the best possible comfort, the carriages are airtight and are equipped with airconditioning units. It is possible to use both GSM and NMT cellular telephones onboard the Airport Express Trains. There is a driver's compartment at both ends of the trains. Safety requirements and ergonomic design are specially adapted to high-speed operation.

The Airport Express Train stops at the following stations:

- Asker
- Sandvika
- Lysaker
- Skøyen
- Nationaltheatret
- Oslo S
- Lillestrøm
- Oslo Lufthavn Gardermoen

The Airport Express Trains will travel at speeds up to 210 km/h on Norway's first high-speed railway.



THE ROUTE



Technology and Development

Gardermobanen is the first high-speed railway that has been built in Norway. The railway is designed for an operating speed of 210 km/h. This places stringent requirements on all of the components that are important for the high-speed standard, such as the railway's alignment, tracks, points, contact wiring installations and signaling systems. Gardermobanen is built based on the most modern technical principles of railway construction, even in an international perspective. 13 R&D projects have been carried out in order to increase the quality of the total solution of the railway.

The Route

Gardermobanen has been built from Etterstad in Oslo via Lillestrøm to Oslo Lufthavn Gardermoen and Eidsvoll. The total stretch is 66 km. The distance from Oslo Central Station to Oslo Lufthavn Gardermoen is 48 km. The railway is a double track system except for the last 3.5 km before Eidsvoll station.

Work on the Tracks

Work on the tracks includes building a total of 130 km tracks and 73 points. 300,000 tons of crushed rock have been used as ballast and 205,000 concrete sleepers. The tracks are type UIC60, and are supplied in lengths of 108 and 400 metres. The tracks are all-welded. Pandrol FastClip is used as the medium for fastening the tracks. This is the first time ever that the method of fastening has also been applied to points. Lubrication-free slideplates have also been developed in the project that require less maintenance and release no pollutants. Newly developed box sleepers for drive machines and point heaters have been introduced through the project.

CONSTRUCTION



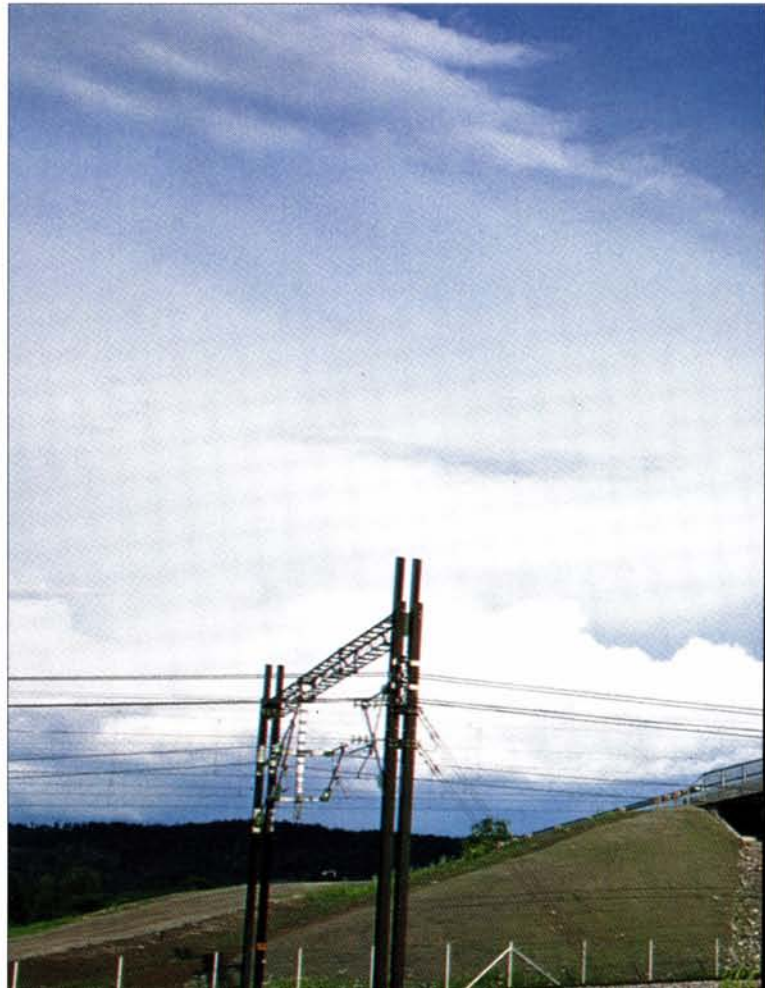
Difficulties building tunnels

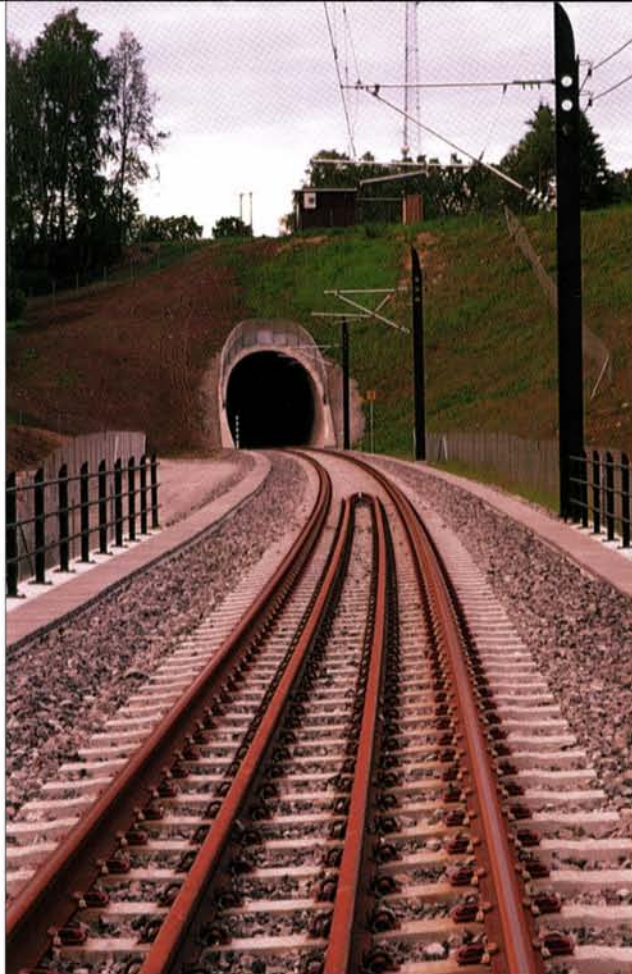
Three tunnels have been built to accommodate Gardermobanen, of which Romeriksporten is the longest: 13.8 km. Bekkedalshøgda rock tunnel is 1.6 km and the Eidsvoll tunnel with uncompacted material is 550 metres long. 2.2 million m³ of rock have been blasted (of which 1.65 million m³ in the Romeriksporten).

There are special challenges involved when building tunnels. The water leakage in the Romeriksporten has been the largest problem. The method of sealing has been pre-injection which has shown to be insufficient to hold the ground water in balance. This has been supplemented with post-injection of cement and chemical sealants on a larger scale than at any previous time. Tunnel operation in uncompacted material requires technologies which previously have seldom been applied in Norway. Parts of the uncompacted material used in the Eidsvoll tunnel caved in during construction. This section was dug out again and completed within the scheduled construction period.

Bridges and Culverts

A total of 12 larger railway bridges and a number of smaller culverts along the Gardermobanen have been built. 130,000 m³ concrete have gone into the building of bridges, railway culverts, as well as a number of crossing bridges and culverts for road connections and wild game crossings. There are a total of 20 bridges, culverts and tunnels which are important for the biological diversity in that small and large animals can safely cross the tracks.





*Left: Culvert south of Gardermoen.
Right: Uncompacted material at Eidsvoll tunnel.
Below: Bridge at Åråsen.*





The entire Gardermobanen is controlled from the remote control centre at Oslo Central Station.

ELECTRICAL



Signal gantry (bridge) on the Gardermobanen.

The signal installations for the Gardermobanen are the first in Norway to ensure safe train operation up to 210 km/h. The systems are based on modern technologies, with the use of hardware and software instead of the conventional relay based technology. The signal installations are divided into three branches of trade: fuse installations, remote control (CTC, Centralized Traffic Control) and ATC (Automatic Train Control).

Power Supplies

The power supplies transport electrical power to the Airport Express Trains and to the railway technical installations along the railway. Two new modern converter stations, i.e. supply stations to the contact wiring installations have been built. The contact wiring masts are new and specially designed for the Gardermobanen. They were awarded the "Emblem for Good Design" in 1996. The auxiliary power system consists of a standard high-voltage power cable network for supply with high availability for railway technical installations such as point heaters, signal equipment, telematic equipment, tunnel and platform lighting, as well as tunnel ventilation.

Telephony

The telephony equipment consists of a communications network for operational services of the Airport Express Trains, information and service for the passengers and rational administration of business operations. The communication systems include the following subsystems: exchanges, transmission, radio systems, public information systems and network supervision.

IT

The Information Technology systems for Gardermobanen include planning, traffic supervision, ticketing, decision support, economics and office support.



SAFETY

NSB Gardermobanen AS has as its primary safety goal to be the safest transportation service to and from Oslo Lufthavn Gardermoen.

Gardermobanen has been planned and projected according to the latest rules and regulations. The Airport Express Trains are type approved and the railway's signal and safety equipment are approved separately.

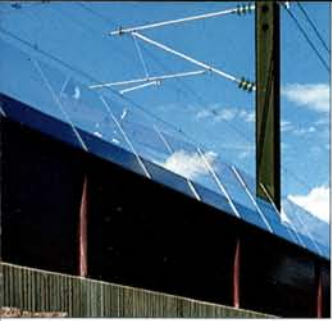
All possible risk areas were identified before commencing operations on the Gardermobanen. These are separately documented requirements for installations and equipment and requirements for operational procedures and competence of the personnel. All undesirable incidents will be reported and a special database will ensure that this type of incident will be analysed and that corrective action will be executed.

A separate emergency plan has been prepared for Gardermobanen. In addition, special emergency carriages have been developed for the Gardermobanen that will ensure that the fire department will be promptly in place at the scene of an accident. A special rescue train has been developed that will ensure swift rescue and effective evacuation from tunnels. This train is located at Oslo Central Station.

*Gardermobanen and the Airport Express Train:
the safest transport alternative to Oslo Lufthavn Gardermoen.*







The Gardermobanen baffle is a newly developed noise deflector.

ENVIRONMENT

Gardermobanen is constructed according to the environmental requirements the Parliament set forth in the control plans and according to the company's own requirements.

Noise baffles

NSB Gardermobanen AS has developed a new type of noise baffle – the Gardermobanen baffle – that is mounted along sections of the railway. The noise baffle is three metres high. The lower two metres are constructed of aluminium. Sound absorbing material has been installed between the baffles outer walls and perforated plates on the side closest to the noise source. The upper meter of the wall is made of hardened glass and is mounted at an angle towards the noise source so that it acts as a noise reflector. In some instances, installation of noise baffles for the individual housing unit, gives the best effect. In these cases local noise baffles have been installed instead of or as a supplement to the Gardermobanen baffle. Banks of earth replace noise baffles where these are more appropriate.

Environmental initiatives for housing

There are some points along the Gardermobanen that are not sufficiently protected by noise-deflection walls in order to comply with the guidelines set forth for indoor noise levels. This is especially true for Lillestrøm. In these instances, noise insulation initiatives have been executed on individual homes, totally 1,000 homes, divided into apartment buildings and individual homes. The work which has been carried out in

some of these instances are replacing windows and doors, re-insulation of walls and roofs, building new balconies and enclosing these in glass. Most of the homes have received larger or smaller ventilation systems.

Outside areas, which Gardermobanen used during construction, have been improved with landscaping, installation of new garages, parking areas, new garbage stalls, bicycle parking etc. In addition, new parks have been established in the areas along the railway through Lillestrøm.

Wild game crossing north of Gardermoen.



DESIGN



Comprehensive design – from stations and facilities to trains and uniforms – is one of the fundamental principles of the Gardermobane project.

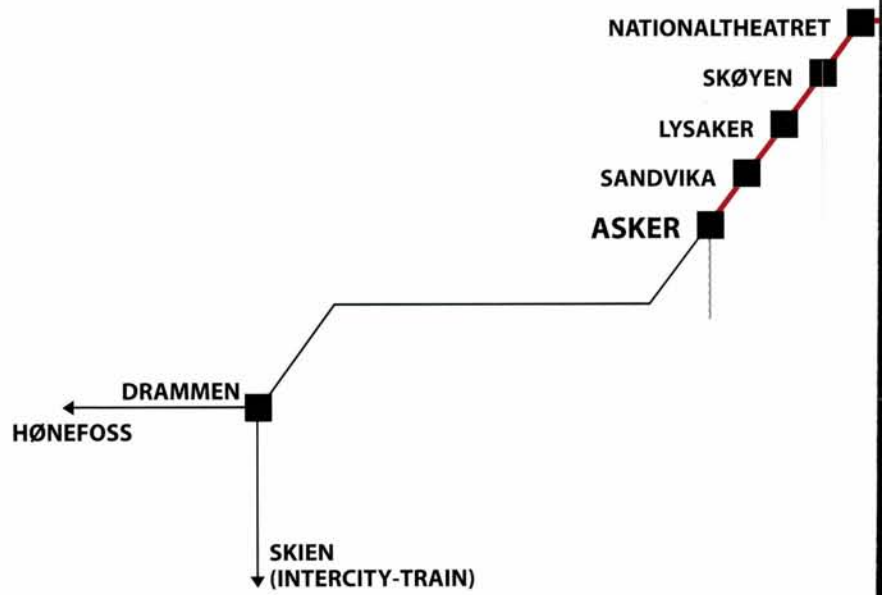
In order to project Norwegian culture and technological standards, the visual environment has had a high priority from the planning stages of the construction of the Gardermoen project. This has been done in order to achieve a comprehensive design for the railway line, the Airport Express Train, airport and highways.

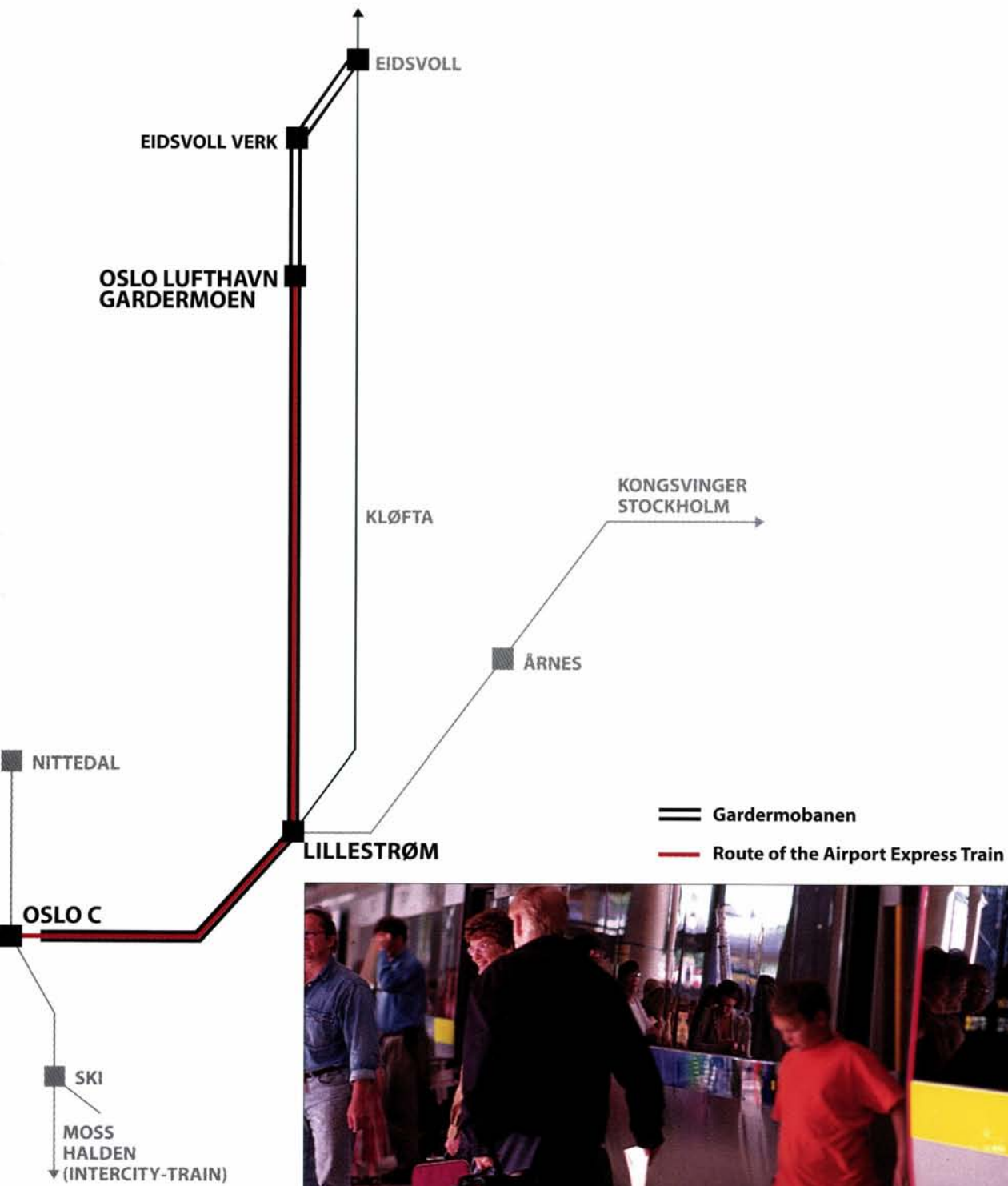
The Gardermobanen's visual profile is reflected in the technical installations, cutaways, land fills, tunnels, bridges, stations and in elements such as noise baffles, trolley wire masts, etc. Materials that have a distinctive Norwegian character have been chosen for the station buildings, similar to those used at Oslo Airport. Glass, wood and stone have been used to a large extent. There is a substantial element of natural materials that are timeless and robust. At the same time, they should be modern and future oriented. The Airport Express Train represents the future of Norwegian railway operations and projects our present day design, high technology, architecture, speed and comfort, but at the same time refers to the train's distinctive character and history.

The most important design goal has been to project the qualities of the travel adventures the public has yet to experience. Not just the Airport Express Trains, but everything from the railway lines and station environments to signs and time tables will, by their appearance, create expectations – of comfort, dependability, speed and precision.

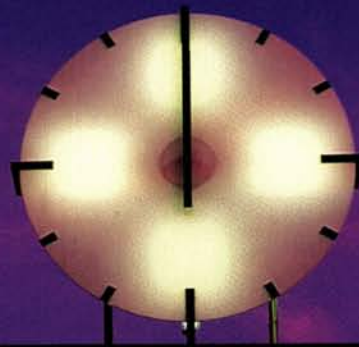


M A P





CHRONOLOGY



1992

October 8: The Parliament approves the building of Gardermobanen over the Oslo–Gardermoen–Eidsvoll stretch as a feeder system to the new main airport, Oslo Lufthavn Gardermoen.

NSB Gardermobanen AS established as development corporation owned entirely by the state and NSB.

1994

February: Construction of the Gardermobanen starts.

1996:

December: NSB Gardermobanen AS was assigned the added responsibility of future operation of Gardermobanen and the Airport Express Trains that will travel Asker–Oslo Lufthavn Gardermoen.

1998

June: The board of directors at NSB passes a resolution to postpone the opening of Romeriksporten.

October 8: Opening of the new major airport at Gardermoen, Oslo Lufthavn. Gardermobanen opens from Lillestrøm to Eidsvoll. The Airport Express Train will have 2–4 departures per hour, until the completion of Romeriksporten.



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NSB Gardermobanen AS
0048 Oslo

Telephone: +47 23 15 90 00
Fax: +47 23 15 90 01
Internet: www.flytoget.no



Jernbaneverket
Biblioteket

JBV



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