Nordhordland Cable-Stayed Bridge

The Nordhordland Bridge (also called Salhus Bridge) consist of the worlds longest free floating bridge (1999), 1246 m, and a high level cable-stayed bridge across the ship channel of 32 x 50 m. The cable- stayed bridge has a main span of 172 m. This is designed in high strength light weight aggregate (LWA) concrete and cantilevered from one H-shaped pylon founded on the existing rock on land. The main span is stabilised by back spans with total length 190 m.

Contract Period
1991-1994

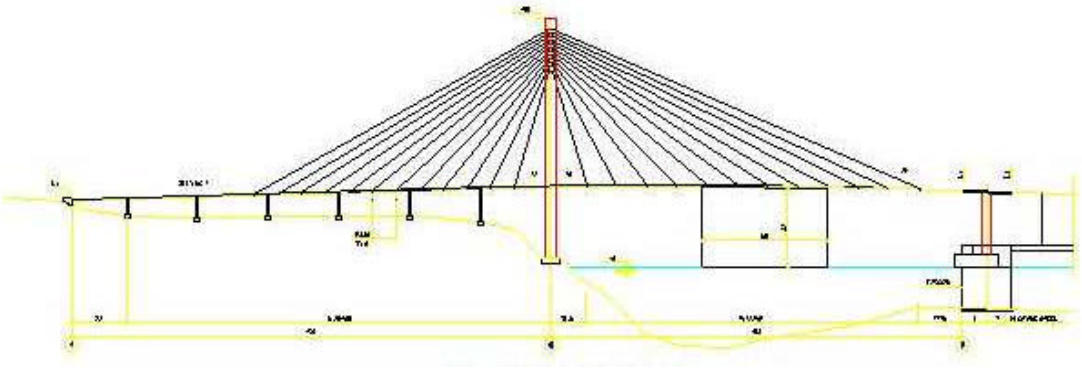
Completion
1994

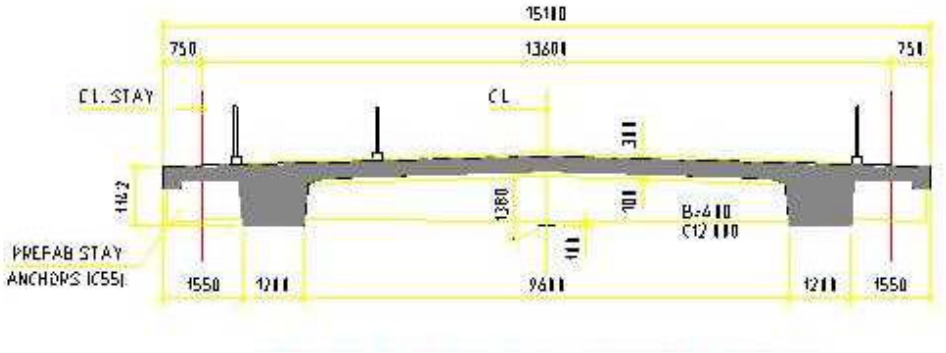
Construction cost
NOK 81 mill

Services rendered

- Preliminary Design and Cost Estimates
- Dynamic wind measurements on site and deduction of design wind climate
- Dynamic Wind and Seismic Analyses
- Tender documents
- Detailed Design and Specifications
- Construction Engineering
- Construction Drawings

Client
Norwegian Public Roads Administration





Nordhordland Bridge, cont'd

Key data

Materials:

Stays: 7 mm galvanised wires in HDPE pipe filled with grease and with HIAM-anchors.
Normal density concrete in back span and pylon: C45
High strength LWA-concrete in main span: LC55

Geometry:

Main span:	172 m
Back spans:	22 + 6 x 28 = 190 m
Width overall:	15.10 m
Top of pylon:	+98.0 m
Ship Channel:	H x B = 32 x 50 m

Climate:

Wind: 10 min. mean at elevation 10 m: V10,10 = 26.9 m/s
Turbulence intensity, horizontal: 0.2 V10,z
Turbulence intensity, vertical: 0.1 x V10,z

Mix design for LWA-concrete LC55:

High strength portland cement

HS 65:	430kg
Silica fume:	35 kg
Sand 0-5 mm:	630 kg
Leca 750, 4-8 mm:	295 kg
Leca 750, 8-12 mm:	275 kg
Water total:	195 l
Plasticizers/superpl.:	7 l

Properties of LWA concrete LC55:

Water absorption in clay aggregate:	7.5%
Theoretical mean insitu density:	1893 kg/m3
w/c+s:	0.39
Mean strength fc,mean:	70.8 MPa (100x100mm cubes)
Characteristic strength fck =	65.5 MPa
Modulus of Elasticity Ec =	21000 MPa

Design considerations

The caisson in axis 9 is the fixed point for the floating bridge and carries mainly horizontal forces in addition to small vertical loads from the bridge beam between expansion joints required by the floating bridge and the cable stayed bridge respectively.
For this bridge site two bridge types were considered – cable stayed and arch. The cable-stayed bridge was investigated for alternative designs of the main span beam in steel/concrete composite, normal weight concrete C55 and LWA-concrete LC 55. The design with LWA-concrete proved the most economical, giving more savings in stay tonnage and hold down structures in the back stay area than the cost increase due to LWA-concrete itself. Using the contract unit rates the total savings are estimated to 620.000, - NOK, or 0.83% of the total contract sum.

Nordhordland Bridge, cont'd

Construction methods

The following construction methods were used:

- pylon by slipforming
- side spans, span by span with fixed scaffold to the ground
- main span by cast-in-place segments á 12 m in free cantilevering from the pylon.

The form traveller for the main span construction was specially designed to make use of the permanent pair of stays for a new segment as load carrying members during concreting of that segment. The obtained final profile of the deck was within 35 mm of theoretical anywhere along the length of the bridge and the stay forces did not deviate by more than 5% from the theoretical. No adjustments of stay forces were thus required after the main cantilever was continuous.

Team involved

Client: Public Roads Administration (PRA), County of Hordaland
Design: PRA, Bridge Department in ass. With Dr.Ing. A. Aas-Jakobsen AS
Architect: Lund & Slaatto, Lund & Løvseth, Hindhammar – Sundt - Thomassen
Contractor: Selmer A/S
Concrete supply: Aker Betong
Light weight aggregate supply: Norsk Leca