186 m footbridge in Kalmar, Sweden

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Hansabron, Kalmar

Location
• 400 km south of Stockholm
• 330 km east of Copenhagen
Hansabron, Kalmar

The bridge connects Kalmar’s pedestrian and bicycle network with the Hansa City shopping area as well as the city’s new football arena.

The bridge crosses the E22 motorway.
Hansabron, Kalmar

- In 2011 the municipality of Kalmar developed a bridge design proposal and held a competition to build the Hansabron bridge. This is a cable-stayed bridge with steel pylons and a 186 m long and 4.5 m wide glulam deck.
- The Swedish construction company NCC won this competition
- The proposal showed a bridge with only 4.7 m clearance above the motorway and crossbeams through the prestressed timber deck
Sweco’s assignment:

• NCC hired Sweco and Finnmap Consulting to do the bridge design
• Finnmap designed all foundations and concrete structures, as well as the T-beam timber deck between axes 1-7
• Sweco designed the steel and timber structures between axes 7-11, which is the part of the bridge over the motorway. Sweco also led the design management
Prestressing of the timber deck:

• According to Eurocode the bridge must be designed for a vehicular impact load of 500 kN. This horizontal load must be transferred to the abutments/pylons via the deck.

• The impact load leads to a large shear force in the deck, and subsequently a very high prestressing level.

• Swedish authorities allowed the use of friction values based on the Nordic Timber Bridge project, which are somewhat higher than the values in the Eurocode.

• The initial prestress level on the 600 mm thick deck is 1.4 N/mm².

• Dywidag WR 26 bars spaced 500 mm with 419 kN load were used.
Cross-section of the deck showing the prestressing system

**PRE-STRESSING BARS, DYWIDAG 26.5 WR C500 BAR FORCE 419 kN**

**TIMBER 70x140**

**27 GLULAM 165XH**
Hansabron, Kalmar

- Large channel sections to handle the prestressing force
- Rectangular crossbeams through the deck. Reinforcement screws
Hansabron, Kalmar
An orthotropic finite element program was used to optimize the stiffness of the crossbeam in relation to the timber deck in the transverse direction.

The forces are concentrated around the deck edges.

We chose a crossbeam with adequate stiffness so that we achieved acceptable shear forces in the deck.
The crossbeam through the deck is similar to a notch in a beam.

To increase the shear capacity we used SFS WB-16 threaded rods.
Assembly procedure

- The 94 m long timber deck between axes 7-11 was split in three large prefabricated elements.
- The elements were produced in Finland and transported to Kalmar by truck.
Large cranes lifted the 35 m long elements into position
Hansabron, Kalmar

The prefabricated elements were joined in a 3,0 m long connection zone. This installation was not super smooth, but it worked out fine in the end.
After installation the bridge deck's sides were covered with thin steel plates.
Conclusions:

• A lot of steel was needed to prestress the deck to handle impact load from vehicles

• Considerable amounts of timber and steel can be saved by ensuring sufficient clearance above the underlying road

• Future timber bridge projects in Sweden should be allowed to use Nordic/Norwegian values and experiences for bar loss and friction values. The Eurocode is too conservative in this respect

• Letting the crossbeams run through the deck complicates design and installation significantly as well as increases the costs

• On the positive side crossbeams through the deck give the bridge a somewhat smoother look, and improve the aesthetics.
Thank you for your attention