ICTB 2013
Steien Network Arch Bridge

Johannes Veie
Norwegian Public Road Administration

Rune B Abrahamsen
Sweco

Egil Rønnekleiv
Plan architects
Existing situation

- Location: Alvdal municipality. Hedmark County, 300 km north of the capital Oslo.
- Existing bridges built in 1953 and 1983.
- The main bridge is in a bad condition.
- High maintenance costs.
- A preliminary study in 2010 concluded that both should be replaced.
Network arch bridge and a glulam truss bridge

To alternatives was considered in the end of the preliminary study.

The study was performed by: NPRA, Sweco technical consultants and PLAN architects.

The network arch was chosen as the preferred alternative.
Architectural comments

● Steien network arch bridge in one span over the river Glomma will provide an innovative and elegant design with strong identity and architectural quality.

● Double timber arches connected with diagonals in tension made of plates in stainless steel, along with a slender network, gives a very light and airy superstructure with a good side visibility and transparency. The bridge will appear as a new landmark in Alvdal.

● Walkways on the outside of the network planes provide a good contact with the river scenery.
Some general facts

- Span: 88.0 meters
- The bridge carries two traffic lanes, 8 meters wide, and two 3 meters wide pedestrian walkways. Total 19 meters wide.
- Cross section of arches: \( w \times d = 850 \times 600 \) mm
- Height from centre slab to centre lower arch: 14 meters
- Distance between the centrelines of two arches: 1.25 meter
- Spacing of hangers and diagonals along the arches: 2.5 meters
- The slab is made of in situ casted light weight aggregate concrete with prestressing.
- Hangers: \( \varnothing 48 \) mm tension bars.
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FINAL DESIGN
Definition of a network arch bridge

Characteristics of an optimal network arch bridge (Tveit 2011):

- Deck made out of concrete
- Ties imbedded in the deck in the form of prestressing cables.
- Arches made as part of a circle
- The upper node of the hangers are evenly spaced along the arch and the hangers not being merged in the nodal points.
- Most hangers crossing at least two other hangers
Structural performance compared to a typical tied arch
Distribution of moments and compressive forces due to asymmetric loading. Steien arch bridge.
Experience from other network arch bridges
Construction of the bridge

- When the interim route is established the road bridge and footbridge are demolished.
- Abutments are established prior to or simultaneously with the framework for bridge deck being established.
- Framework established on filling and / or temporary piles, optionally also using existing pillars.
- The slab is casted independent of the arches.
- Each arch can be pre-assembled on factory and mounted on site in 4 segments.
- To compensate for the deflection the slab is casted with a camber. After stressing the slab will be jacked with an additional camber in order to ease the mounting of the hangers and reduce the need of hanger adjustments.
Utilization of the arches

- Total weight of the superstructure: 2264 tons
- Total traffic loading: 495 tons
- Ratio between self-weight of the superstructure + traffic loading and self-weight alone:
  \[ \frac{2760 \text{ tonnes}}{2264 \text{ tonnes}} = 1.22 \]
- Knowing that the long term modification factor for strength is 0.6, and the same factor for combined loading of self-weight and traffic is 0.9, giving a ratio of 1.5, it is possible to explain why self-weight is governing the design.
Loadmodel 1 according to NS-EN 1991-2:2003
Equally distributed load on the pedestrian carriageways are
q=5,0 kN/m² without simultaneous traffic loading
q=2,5 kN/m² with simultaneous traffic loading
1st buckling mode

Buckling factor = 8
Selfweight alone
Thank you for your attention