A timber bridge across Lake Mjøsa in Norway

ICTB 2013 Las Vegas
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Content:

- History
- Conceptual design
- Technical challenges
- Future development
Location
Location
Existing bridge:

- Opened 1985
- Total length 1421m
- Concrete box girder
- Span width 69m
- Pile foundations
- 2 lanes + walkway/pavement
History:

• Existing bridge opened 1985
• Feasibility study for 2nd crossing 2006
• Feasibility seminar for timber bridge crossing 2010
• Conceptual design 2nd crossing 2012-13
• Launching of R&D timber bridge project 2013
Feasibility study 2006:

- Building a 2nd bridge is feasible
- One possible placing of the bridge in vicinity of the existing bridge
- One possible placing of the bridge somewhat 1km south of the existing bridge involving deep sea foundations
Feasibility seminar for timber bridge crossing 2010:

- 2 day seminar with a large number of bridge experts, architects and officials.
- Conclusion is that to build a timber bridge across Mjøsa is feasible
- 3 alternative solutions outlined.
Conceptual design 2nd crossing 2012-13:

- Southern line preferrable
- Wide range of alternatives examined wrt. technical solution, construction, esthetics, environmental impact and costs
- Elimination method has revealed two alternatives:
  - Concrete bridge with extradized main spans
  - Timber bridge
Timber bridge development for 2nd Mjøsa bridge:

- Visibility
- Durability
- Constructionability

- Esthetics
- Costs
- State of the art elements
Vital figures:

- Total bridge length: 1650m
- Span widths: 56.0m + 9 x 69.0m + 4 x 120.75m + 4 x 69.0m + 3 x 56.0m + 46.0m
- Timber area: 8.05 m³/m
Why composite structure timber-concrete?

- Big number of expansion joints is not recommended due to maintenance costs
  - At each support: 23 joints
  - At every other support: 12 joints
  - As existing bridge: 6 joints
  - At abutments: 2 joints

- A floating concrete deck with only 2 joints will require a lot of sliding bearings
  - Vertical supports every 10 m give 300 bearings
  - Horizontal supports at each column give 42 additional bearings
Technical challenges

- Termal expansion difference between timber and concrete
  - Timber termal expansion coefficient is about half of concrete
  - Maximum contraction about 50 degrees celcius
  - This give an unconstrained movement difference if 190mm at each end of the bridge

- Shrinkage of concrete
  - Free shrinkage of app. 0,36 ‰.

- Expansion/contraction due to variation in humidity
  - 0,01 % per percent humidity content (fibre direction)
  - Variations up to 12-16% RH
  - Same direction as concrete shrinkage
Finite element analysis of composite action

- Model of 3 spans
- Loading
  - Dead weight
  - Traffic
  - Temperature
- Dowel requirement
  - $13\varnothing 19$ pr m
Alternative shear connection between timber and concrete

• Continous

• Nodal
R&D Project:

- Not yet launched, but financial part fixed
- Duration 2 years
- Content not fixed, but could contain:
  - Large scale effects on timber bridges
  - Cable stay solutions on timber bridges
  - Large spans on timber bridges
  - Temperature effects on timber bridges
  - Material specifications on timber
  - Preservation of timber
  - Composite behaviour between timber and concrete
Thank you for your attention