The Fjord Crossing Project

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NVF Bridge Seminar – Copenhagen 7.9.2011
Overview of the presentation

- The Coastal Route E39
- Organisation of the Fjord Crossing Project
- What has been done
- What problems do we need to solve
- How do we solve these problems
The Coastal Route E39

- Runs through six counties
- 1,75 mill. inhabitants
- 50% of total exports (not counting oil and shipping)
- 8 ferries remain

- Trondheim-Kristiansand
  21 hours today
  13 hours without ferries
The Coastal Route E39
The remaining crossings

- **Halsafjorden**
  - 2000 m crossing, 200 m deep

- **Moldefjorden**
  - 1600 m bridge in combination with 13 km sub-sea rock tunnel

- **Storfjorden**
  - 3100-3400 m crossing, 450 m deep

- **Voldafjorden**
  - 2500 m crossing, 600 m deep, possible to bypass

- **Nordfjorden**
  - 1500-1800 m crossing, 150 m deep loose soil
The Coastal Route E39
The remaining crossings

- **Sognefjorden**
  - 3700 m crossing, ca. 1300 m deep

- **Bjørnefjorden**
  - Up to 5 km crossing, 500 m deep, possible to bypass with 1.3 km crossing

- **Boknafjorden**
  - 25 km sub-sea rock tunnel, 360 m deep
The Fjord Crossing Project is led by Olav Ellevset directly under the Director of Public Roads. The Fjord Crossing Project is divided into two sub-projects:
- Socioeconomics (Region midt)
- Technology (Region vest)

Our task is to find out what is technologically possible for the fjord crossings
What has been done

«We have for a long time considered that the limit of the free span of a suspension bridge with 2 lanes of traffic is between 600 and 700 m. In 1970 the Directorate of Public Roads, in cooperation with NTH and Sintef, started a research program on the stability of long slender suspension bridges when exposed to wind considered as a stochastic variable load.

In 1980 researchers Roald Fredriksen and Erik Hjorth-Hansen presented the results of theoretical and experimental research and concluded that in most parts of the country it is possible to construct slender bridges with sufficient safety to – for spans all the way up to 1200 m.»
What has been done

Askøybrua
850 m span
Opened in 1992

Nordhordalandsbrua, 1243 m floating span,
opened in 1994

Hardangerbrua, 1310 m span, due to open in 2013

Bergsøysundbrua 931 m floating span,
opened in 1992
What has been done

- Akashi-Kaikyō
  1991 m free span
  Messina Bridge
  3 300 m free span
- The Norwegian floating bridges are still state of the art
- No submerged floating tunnels have been built, but experience from submerged tunnels can be used
What has been done
Technological advances off-shore

The Ekofisk tank: 70 m deep (1973)
The Troll platform: 303 m deep (1995)
Floating platforms (TLP) anchored at more than 1500 m deep
Sub-sea wellheads, subsea pipelines
What has been done

- Feasibility study of the crossing of the Sognefjord started with two idea seminars:
  - Floating bridges and submerged floating tunnels in December 2009
  - Suspension bridges in February 2010
- The idea phase of the feasibility study is now completed
- Cost estimates on several crossings along E39 have been done
- The next step is to attempt to document that the solutions actually will work
What problems do we need to solve
Suspension bridge

- The free span of a traditional suspension bridge with two lanes of traffic is now thought to have a limit around 1500 m. We need to come up with a new suspension bridge that fulfill our needs, longer and slender.
- Better understanding of the forces from wind
What problems do we need to solve
Floating bridge

- Find the limit of how long an end-anchored floating bridge can be.
- Anchored floating bridge.
- Stability when exposed to slow moving loads.
- Problems with passing of ships.
What problems do we need to solve
Submerged floating tunnels

- Find the limit of how long a end-anchored submerged floating tunnel can be.
- Safety issues, risk evaluation.
- Stability when exposed to slow moving loads.
- Construction methods and costs.
- Anchored submerged floating tunnels.
How do we solve these problems

- Suspension bridge
  - Directorate of Public Roads in cooperation with research institutes such as NTNU.
  - Full scale measurements on the Hardanger bridge

- Floating bridges and submerged floating tunnels
  - Private companies in cooperation with research institutes such as NTNU.
  - Challenges on how to make a good tender.
Thank you for your attention

Film: Hardangerbrua

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