The Fifth Symposium on Strait Crossings
June 21–24, 2009, Trondheim, Norway

The Symposium is supported by the Norwegian Public Roads Administration - NPRA
The Fifth Symposium on Strait Crossings June 21–24, 2009, Trondheim was organized by The Norwegian University of Science and Technology (NTNU) Trondheim and the research organization SINTEF, Trondheim.

**Organizing Committee**
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Ove Solheim, Norwegian Public Roads Administration

**Coordinators**
Kaare Flaate
Kåre Senneset

**Symposium Secretariat**
NTNU VIDERE
Attn: Astrid Bye
Realfagbygget (Natural Sciences Building) U 1

Secretariat is located in R3
- Lecture Halls
- Exhibition Areas

EU1: Stands no. 1 and 2
EU2: Stands no. 3 and 4
EU3: Stands no. 5 and 6
EU4: Stands no. 8, 10 and 11
**Symposium Program**

**SUNDAY 21 JUNE**

1500 – 1700  Registration
1800 – 1930  Reception at the Archbishop’s Palace
1930 – 2000  Concert in Nidaros Cathedral

**MONDAY 22 JUNE**

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<td>0800 – 0900</td>
<td>Registration</td>
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<tr>
<td>0900 – 1000</td>
<td>Opening Session – Auditorium R1</td>
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<tr>
<td>0900 – 0910</td>
<td>Welcome to Strait Crossings</td>
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<tr>
<td>0910 – 0940</td>
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<tr>
<td>0940 – 0950</td>
<td>Importance of infrastructures</td>
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<td>0950 – 1000</td>
<td>Promoting innovation</td>
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<td>1000 – 1030</td>
<td>COFFEE BREAK</td>
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<td>1030 – 1210</td>
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<td>1210 – 1300</td>
<td>LUNCH</td>
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<td>Session 6: Immersed tunnels</td>
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<td>1630 – 1800</td>
<td>Visit to the Coast and Harbour Research Laboratory</td>
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<td>1830 – 2300</td>
<td>Boat trip to Munkholmen, dinner incl.</td>
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**PROGRAM ACCOMPANYING PERSONS:**

1000 – 1300  Sightseeing in Trondheim

Bus departure from Britannia Hotel
### Tuesday 23 June

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<th>Time</th>
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| 0830 – 1000 | **Plenary Session – Invited Speakers**  
Chairman: Olav Ellevset  
“Financing of Infrastructure”,  
*Cesar Queiroz, Consultant, World Bank, USA*  
“The E39 ferry-connections in Hordaland and Rogaland” – Gas Ferries  
*Oscar Bergheim, Fjord1, Norway*  
“Prognosis and actual traffic for strait crossings projects”,  
*Leif Magne Lillebakk, Senior adviser, Public Roads Adm., Norway* |
| 1000 – 1030 | **Coffee Break** |
| 1030 – 1150 | **Session 7: General aspects of strait crossings and ferries, safety, risk**  
**Session 8: Sub-sea tunnels** |
| 1150 – 1250 | **Lunch** |
| 1250 – 1410 | **Session 9: Bridges**  
**Session 10: Field investigations** |
| 1410 – 1440 | **Coffee Break** |
| 1440 – 1600 | **Session 11: Bridges**  
**Session 12: Maintenance and operation** |
| 1250 – 1600 | **Workshop on submerged Floating Tunnels (SFT) – Auditorium R3**  
Arranged and chaired by Håvard Østlid  
**Poster Session** |
| 1930 | **Symposium Banquet**  
Britannia Hotel |

### Wednesday 24 June

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| 0900 – 1020 | **Session 13: Bridges**  
**Session 14: Submerged floating tunnels** |
| 1020 – 1050 | **Coffee Break** |
| 1050 – 1210 | **Session 15: Bridges**  
**Session 16: Submerged floating tunnels** |
| 1210 – 1310 | **Lunch** |
| 1310 – 1355 | **Summary and Closing** |
| 1400 | **Departure Post-Symposium Tour**  
Bus departure from Realfagbygget (symposium venue) via the hotels  
Participants who have not booked their hotel through the Secretariat meet at Britannia Hotel |
List of sessions

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<td>Chairman:</td>
<td>Eivind Grøv, SINTEF, TRONDHEIM</td>
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Thirty years of experience with sub-sea tunnels
Bjørn Nilsen, NTNU, NORWAY

Climate Change and Possible Impact on Coastal Structures
Arne Instanes, Instanes Polar, AS NORWAY

### SESSION 1
General Aspects of Strait Crossings 1300–1440 Auditorium R1 Chairman: Frank Myrvoll

Transportation benefits of replacing a ferry connection with a sub-sea tunnel
Ingar Hals, NPRA Region West, NORWAY

Respondents' location and stated value of headway time
Thor-Erik Sandberg Hanssen, Bodø Graduate School of Business, NORWAY

Ensuring Cross-Border Operation without compromising safety
Johnny Restrup-Sørensen, Øresundsbro Konsortiet DENMARK

Cost-benefit Analysis of Stad Shipping Tunnel
Dag Bertelsen Trude Tørset Solveig Meland SINTEF NORWAY

Designing and Tendering Strait Crossings for Life
Jakob Laigaard Jensen Niels Bitsch Morten Zinck COWI DENMARK

### SESSION 2
SubSea Tunnels 1300–1440 Auditorium R2 Chairman: Bernt Freiholtz

Fire Protection and Fire Fighting in Tunnels
Antonio Fiorentino, Ponte di archimede international, ITALY

30m Rock Pillar to the Atlantic Ocean, Sub-sea tunnelling in Faroe Islands
Eivind Grøv David Reinert Hansen, SINTEF Rock and Soil Mechanics, NORWAY

Road Tunnel Fire Protection by Water Mist Systems – Innovative Solutions for Special FOGTEC Fire Protection Tunnels
Stefan Kratzmeir, Max Lakkonen, GERMANY

From fantasy to vision: process towards planning of Helsinki-Tallinn railway tunnel
Olli Keinänen, City of Helsinki, International Relations, FINLAND

Evaluation of excavation method for the new twin-track railway line between Oslo and Ski, Norway
Thor Skjeggedal, Arnulf Hansen, The Norwegian Tunnelling Society NORWAY

### SESSION 3
Immersed Tunnels 1300–1440 Auditorium R5 Chairman: Ian Markey

The Femern Baelt Fixed Link connecting Denmark with Germany
Steen Lykke, J. Gimsing, Femern Bælt A/S, DENMARK

Offshore Access Shaft for the Bosphorus Strait Immersed Tunnel
Masaaki Toyama, Fumio Koyama, Masahiko Tsuchiya, Taisei Corporation, JAPAN

Construction of the Busan - Geoye Immersed Tunnel from the Designer’s view point
Tommy Olsen, Peter Graham Jackson, J S Lee, Cowi A/S, DENMARK

Innovative Design of Immersed tunnel - Söderströmstunneln.
Christer Johansson, Stephen Slot Odgaard, Johannes Glückert COWI A/S, DENMARK

Maintenance considerations for immersed tunnels, with particular reference to the Bjorvika Tunnel
Jonathan Baber, Lars Narvestad, Capita Symonds, UNITED KINGDOM

Construction of the Bosphorus Immersed Rail Tunnel
Walter C. Grantz, Claus Iversen, Immersed Tunnel Consultant, UNITED STATES
### SESSION 4
**General Aspects of Strait Crossings**
1510–1630
Auditorium R1
Chairman: Frank Myrvoll

Service Elements in the Ferry Industry  
*Terje A. Mathisen, Gisle Solvoll, Bodø Graduate School of Business, NORWAY*

The Stad Ship Tunnel  
*Svein Fjeld, Øystein Linnestad, Arnold Jacobsen, Dr.techn. Olav Olsen as, NORWAY*

The Influence of an Immersed Tunnel on the City Planning in Oslo  
*Svein Røed, Norwegian Public Roads Administration, NORWAY*

Environmental Impacts of Strait Crossings in Norway  
*Pål Rosland, NPRA NORWAY*

Preventing coastal erosion in arctic areas; protection by use of geosynthetics  
*Jomar Finseth, Dag T. Andreassen, Magne Wold, Even Øiseth, SINTEF Byggforsk, NORWAY*

### SESSION 5
**SubSea Tunnels**
1510–1630
Auditorium R2
Chairman: Olli Keinänen

Sub sea tunnels in Korea  
*Hee-Soon Shin, Eui-Seob Park, Korea Institute of Geoscience and Mineral Resources, KOREA SOUTH*

The Overall Design of Tsingdao Jiaozhouwan Subsea Tunnel  
*Shuming Zhou, Xianfeng Zhang, Chaoye Song, Zhiwen Tan, Peng Liu, China Railway Tunnel Survey & Design Institute CHINA*

The Marmaray Project: Connecting the Continents  
*Huseyin Belkaya, Ahmet Arslan, Haluk Ozmen, Yuksel Proje International, TURKEY*

The Bjørvika Immersed Tunnel and Land Connections  
*Ian Markey, Lars Narvestad, Norwegian Public Roads Administration, NORWAY*

### SESSION 6
**Immersed Tunnels**
1510–1630
Auditorium R5
Chairman: Frode Oset

The Tingstad tunnel - an overview of operational experiences  
*Bernt Freiholtz, Per Thunstedt, Charlotta Bjerkborn, Swedish Road Administration, SWEDEN*

The Norwegian sub-sea road tunnels: Background and experiences  
*Arne W Grønhaug, AWiGEO, NORWAY*

Design and performance of floating foundation concept for the submerged tunnel across Bjørvika in Oslo  
*Kjell Karlsrud, Kjell Narvestad, Norges Geoteknisk Institutt, (NGI), NORWAY*
Tuesday 23 June

SESSSION 7
General Aspects of Strait Crossings
1030–1150
Auditorium R1
Chairman: Kaare Flaate

The Høgsfjord SFT Project - what happened and what have been the consequences?
Lidvard Skorpa, Statens vegvesen, Region vest NORWAY

Sri Lanka - India Land Bridge Techno-Economic Feasibility Some Thoughts from England
Sydney Xavier, Retired UK Civil Servant & Civil Engineer, UNITED KINGDOM

Subsea Tunnelling: Site Investigations and Risk Management Strategies
Thomas Pennington, Don Richards, PB Americas, Inc., UNITED STATES

Stabilizing ground conditions with under-water cast concrete
Thomas Beck, Rescon Mapei AS, NORWAY

Cable ferry experiences
Egil Kvigedal, Wergeland-Halsvik as, NORWAY

SESSSION 8
SubSea Tunnels
1030–1150
Auditorium R2
Chairman: Bernt Freiholtz

Üskudar and Sirkeci Underground Stations in Istanbul, Turkey - Transfer Stations for the new Railway Line under the Bosphorus Strait
Wolfgang Georg Brunner, Wolfram Groh, BAUER Maschinen GmbH, GERMANY

Undersea Tunnels and World Perspectives
Lars Christian F. Ingerslev, Parsons Brinckerhoff, UNITED STATES

Structural and safety outline of Trans-Tokyo Bay Highway
Yoshikazu Ota, OTA Engineering, JAPAN

Simulation of long and big tunnel fire based on Smartfire
Shu-qing Hao, Tongji University, CHINA

Strait crossings by TBM, requirements and technical solutions
Tim Babendererde, Babendererde Engineers, GERMANY

Session: PLENARY SESSION – INVITED SPEAKERS
Date/Time: 23.06.2009 • 0830–1000
Room: Auditorium R1
Chair: Olav Ellevset, Norwegian Public Road Administration, NORWAY

Financing of Road Infrastructure
Cesar Queiroz, World Bank, UNITED STATES

The E39 ferry-connections in Hordaland and Rogaland – gas ferries
Oscar Bergheim, Fjord1 Fylkesbaatane, NORWAY

Prognosis and actual traffic for strait crossings projects
Leif Arne Lillebakk, Norwegian Public Roads Administration, NORWAY

1150
SESSION 9
Bridges
1250–1410
Auditorium R1
Chairman: Jørgen Holst

Development of Suspension Bridge solutions for Hålogalands Bridge
Lars Jensen Bernt Jakobsen Allan Larsen, COWI A/S, DENMARK

Efficient Utilisation of Optimal Network Arches
Per Tveit Universitet i Agder, NORWAY

The Hardanger Bridge - Creation of Norway’s longest Suspension bridge
Øivind Søvik, Public Road Organisation Western region, NORWAY

SESSION 10
Field Investigations
1250–1410
Auditorium R2
Chairman: Alf Kveen

Geophysical and geological investigations for the ROGFAST project
Jan Steinar Ronning, E. Dalsegg J. F. Dehls, Oystein Nordgulen, Odleiv Olesen, Geological Survey of Norway, NORWAY

Characterization of fracture zones in bedrock using 2D resistivity.
Jan Steinar, Ronning Einar Dalsegg, Harald Elvebakk, Guri V. Ganerod, Bjørn Heincke, Geological Survey of Norway, NORWAY

Significance of geological parameters for predicting water leakage in hard rock tunnels
Kristin Hilde Holmøy, SINTEF Building and Infrastructure, NORWAY

Uncertainty analysis for assessing rock mass quality and water inflow in hard rock subsea tunnels
Krishna Kanta Panthi, NTNU, NORWAY

Engineering geological key factors for planning and constructing hard rock subsea tunnels
Bjørn Nilsen, Arild Palmstrøm, NTNU, NORWAY

POSTER SESSION
1250–1600
Exhibition Area

The design and construction of Incheon Bridge in Korea
Jong-Ho YANG, Jai-Beom SHIM, Incheon Bridge Construction Site Office, Samsung, C&T Corporation, KOREA SOUTH

Busan-Geoje Fixed Link Immersed Tunnel
yong-il Kim, je-choon Kim, jung-sang Lee, DAEWOO E&C, KOREA SOUTH

A study on shear strength characteristic at the face of slurry shield under general stress conditions
HU Xinyu, Tongji University, Shanghai, China, CHINA

Suggested solutions for the fabrication of elements for a SFT
Alfred van der Bend, Marius Hagerup, André Myhre, Høgskolen i Ålesund, NORWAY

Durability of Highway Concrete Bridges in China
Yufang Fu, Jinquan Zhang, Wanheng Li, Research Institute of Highway, MOT CHINA

Experimental Study on Prestressed Concrete Box-Girder Bridge with Corrugated Steel Webs
Hai-bo Chen, Hong-wei Ren, Jian-yong Song, Research Institute of Highway, MOT, CHINA
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<td>Chairman: Bernt Freiholtz</td>
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Practical Management for Cable Band Bolts on Suspension Bridges during Operation
Ikuko Yamada, Akira Moriyama, Yoshiteru Yokoi, Honshu-Shikoku Bridge Expressway Company Limited, JAPAN

Long Span Suspension Bridges for Strait Crossings
Lars Jensen, COWI A/S, DENMARK

Great Belt – East Bridge Fatigue Evaluation for Orthotropic Steel Bridge Deck Structure
Ernst Laursen, Kim Agersoe Nielsen, A/S Storebælt, DENMARK

Kveøybrua: Low budget composite bridge
Ola Fjerdingstad, Norwegian Public Roads Administration, NORWAY

Optimization of Operation and Maintenance Activities and Costs for Tunnels based on experience
Jørgen Holst, Department for Tunnels and Underground Structures, COWI, DENMARK

Extended operational time for an old bridge in Sweden using instrumented integrity monitoring
Frank Myrvoll, Benny Bergstrand, Branko Glisic, Merit Enckell, Norwegian Geotechnical Institute NORWAY

Understanding the real behaviour of The New Svinesund Bridge by monitoring
Raid Karoumi, Robert Ronnebrant, Peter Harryson, Thomas Darholm, The Royal Institute of Technology (KTH), SWEDEN

Älvsborg Bridge - Replacement of suspender cables and maintenance planning
Matthew Bloomstine, Per Thunstedt, Swedish Road Administration planning SWEDEN

Altered specifications for the protection of Norwegian steel bridges and offshore structures against corrosion
Reidar Klinge, Civil Engineer Reidar Klinge, NORWAY
SESSION 13
Bridges
0900–1020
Auditorium R1
Chairman: Jørgen Holst

Hardanger Suspension Bridge - structural analyses and design
Alexander Kyte, Jon Solemsli, Kristian Berntsen, Bjørn Isaksen, Norwegian Public Roads Administration, NORWAY

Towards a vibration free deck section for cable supported supported bridges
Allan Larsen, Mike Savage, Alanna Wall, COWI A/S, DENMARK

Smaalenene cable-stayed bridge
Per Norum Larsen, Carl Hansvold, Gunnar Egset, Johs. Holt A.S, NORWAY

Specifics of long bridges monitoring
Victor Ushakov, Alexander Vasilyev, MADI Technical University, RUSSIA

SESSION 14
Submerged Floating Tunnels
0900–1020
Auditorium R2
Chairman: Lars Christian F. Ingerslev

A Conceptual Submerged Floating Tunnel
Walter C. Grantz, Bernt Jakobsen, Havard Ostlid, Immersed Tunnel Consultant UNITED STATES

Influences of Structural Damping and Buoyancy - Weight Ratio on Dynamic Responses of Submerged Floating Tunnel
Xu Long, Fei Ge, Lei Wang, Youshi Hong, Institute of Mechanics, Chinese Academy of Sciences, CHINA

Researches on Essential Mechanics Issues for Submerged Floating Tunnel
You Shi Hong, Fei Ge, Xu Long, Institute of Mechanics, Chinese Academy of Sciences, CHINA

Crossing the wide and highly exposed Sulafjord with an SFT
Bernt Jakobsen, Per Haaland, Stein Atle Haugerud, Dr.tech. Olav Olsen a.s, NORWAY

Performance evaluation of anchorage cable systems for Submerged Floating Tunnels
Giulio Martire, Matteo Esposto, Federico Mazzolani, Beatrice Faggiano, University of Naples Federico II, ITALY
### SESSION 15
**Bridges**
**1050–1210**
**Auditorium R1**
**Chairman: Børre Stensvold**

Computational issues in design and construction of a typical asymmetric cable-stayed bridges
*Tae-Yeol Lee, Hyun-Yang Shin, Jai-Beom Shim, Samsung C&T Corporation, KOREA SOUTH*

William R. Bennett Floating Bridge, Canada
*Svein Erik Jakobsen, Per Norum Larsen, Darryl Matson, Aas-Jakobsen AS, NORWAY*

The Nordhordland Bridge - A revisit and some comments
*Jan Olav Skogland, Norwegian Public Roads Administration, NORWAY*

### SUMMARY AND CLOSING
**1310–1355**
**Chairman Eivind Grøv, SINTEF, TRONDHEIM**

### SESSION 16
**Submerged Floating Tunnels**
**1050–1210**
**Auditorium R2**
**Chairman: Lars Christian F. Ingerslev**

Two-dimensional Vortex-induced Vibrations of Submerged Floating Tunnel Tethers
*Fei Ge, Xu Long, Lei Wang, Youshi Hong, Institute of Mechanics, Chinese Academy of Sciences, CHINA*

Vortex Induced Vibration in Submerged Floating Tunnels: DVL - a Distributed Vortex Layer Model
*Mariagrazia Di Pilato, Federico Perotti, Politecnico di Milano, ITALY*

The SIJLAB Joint Laboratory and the design of a prototype Archimedes Bridge
*Antonio Fiorentino, Federico Mazzolani, Federico Perotti, DIS Politecnico di Milano, ITALY*

Three-dimensional Dynamic Characteristics of Submerged Floating Cylinders Moored by Tension Legs
*Motohiro Sato, Shingo Hoshizaki, Shunji Kanie, Takashi Mikami, Graduate School of Engineering, Hokkaido University, JAPAN*

Submerged Floating Tunnels for Norwegian Fjords
*Per Tveit, Universitetet i Agder, NORWAY*
Strait Crossings 2009 would like to thank the following institutions and companies for their financial support:

- **Statens vegvesen**
  Norwegian Public Roads Administration

- Giertsen Tunnel AS
- Multiconsult

- Mesta Entreprenør as
- Norconsult AS
- Norconsult

- SINTEF
- Norwegian Tunnelling Society

- COWI AS
- Dr.techn.Olav Olsen a.s
- Dr.techn.Olav Olsen

- Leonhard Nilsen & Sønner AS (LNS)
- NGI (Norwegian Geotechnical Institute)
The exhibition area is the ideal meeting place during the symposium, and we recommend you to visit the exhibition during the coffee breaks or any time during the symposium. The following companies participate in the exhibition:

**STAND NO. 1**
COWI AS
Grenseveien 88
Postboks 6412 Etterstad, NO-0605 Oslo, Norway
Tel: +47 95 70 62 98
E-mail: info@cowi.no
http://www.cowi.no

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P.O. Box 8142 DEP., NO-0033 Oslo, Norway
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E-mail: firmapost@vegvesen.no
Web: www.vegvesen.no

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E-mail: info@bauer.de
http://www.bauer.de/en/bma/

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E-mail: tda@tda.as
http://www.tda.as

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http://www.lns.no

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57180 Terville, France
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E-mail: contact@innovativefiresystems.com
http://www.innovativefiresystems.com

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E-mail: tunnel@giertsen.no
http://www.tunnelsealing.com

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http://www.tda.as

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Norwegian Tunnelling Society
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NO-0409 Oslo, Norway
Tel: +47 22 89 11 84
E-mail: nff@nff.no
http://www.nff.no
M/S “Fjordtroll”

Nordhordaland bridge

Oslofjord sub-sea tunnel
The Fifth Symposium on Strait Crossings
June 21–24, 2009, Trondheim, Norway

The Symposium is supported by the Norwegian Public Roads Administration - NPRA