ICTB 2017

3RD INTERNATIONAL CONFERENCE ON TIMBER BRIDGES

26-29 June, 2017 | Skellefteå, Sweden

Conference Programme

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Research Institutes of Sweden

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Welcome to ICTB 2017

RISE Research Institutes of Sweden in cooperation with Luleå University of Technology have the pleasure to welcome you to the Conference on Timber Bridges which will take place in Skellefteå. The conference is supported by the municipality of Skellefteå (Skellefteå kommun) and the Swedish Research Council Formas.

The successful conferences ICTB 2010 in Lillehammer, Norway, and ICTB 2013 in Las Vegas, USA, is now being followed up by a third conference in Skellefteå, Sweden. The conference will be a unique opportunity to network with an international community of experts on timber bridges, including highway, railway and pedestrian structures.

We received a lot of technical abstracts and have created a program that offers many topics concerning timber bridges. We welcome you to Skellefteå and the conference and hope you will find interesting technical sessions and meetings with speakers and attendees to learn more and maybe find new collaborations for the future.

Anders Gustafsson

Conference chair

ICTB 2017 Committes

International Scientific Committee

James Wacker, USDA Forest Service, Forest Products Lab. (USA)
Kjell Arne Malo, Norwegian University Of Science and Technology, NTNU, (Norway)
Roberto Crocetti, Lund University, (Sweden)
Robert Widmann, Empa – Structural Engineering Research Laboratory, (Switzerland)
A.J.M Jorissen, Technische Universiteit Eindhoven, (Netherlands),
Hideyuki Nasu, Nippon Institute of Technology, (Japan)
Mats Ekevad, Luleå University of Technology, (Sweden)
Anna Pousette, RISE Research Institutes of Sweden, (Sweden)

Conference Planning Committee

Anders Gustafsson, RISE Research Institutes of Sweden
Anna Pousette, RISE Research Institutes of Sweden
Per-Anders Fjällström, RISE Research Institutes of Sweden
Mats Ekevad, Luleå University of Technology
Olle Hagman, Luleå University of Technology

Keynote Speakers

 **A. J. M. Jorissen**	Professor André J. M. Jorissen at Technische Universiteit Eindhoven, the Department of the Built Environment, is expert in the research program Structural Design. Main topics are Manufacturing technology, mechanical technology, robotics; Urban and rural planning; Building technology; Architecture and building construction.
 **Kjell Arne Malo**	Professor Kjell Arne Malo got his PhD from Norwegian Institute of Technology. His professional background is from steel- aluminium and timber structures. His current research topics and fields of interests are material models for wood, strength and stiffness of connections for timber structures, vibrations and comfort issues in multi-storey timber buildings, and design of timber bridges. He has since 2002 lectured university courses on timber engineering and basic mechanics and is supervisor for MSc and PhD students in timber engineering at NTNU, Norway. He is national delegate to the European standardization committee on timber structures, convenor for committee on the new Eurocode EN 1995-2 Timber Bridges.
 **Robert Widmann**	Robert Widmann is Civil Engineer. After servicing in German Airforce for 10 years as an EOD specialist Robert studied civil engineering at the University of Biberach, Germany. Practical works in a construction company and in an engineering office followed and in 1997 Robert joined Wood Laboratory of Empa in Duebendorf Switzerland as a research engineer. His main focus was timber engineering and within this field he worked on a wide variety of topics, including timber bridges. Since 2015 Robert is working as a Test Engineer in the Structural Engineering Research Laboratory of Empa. As a group leader he is responsible for the structural test facility of this laboratory, which includes - amongs others - testing of big timber structural members.
 **James P. Wacker**	James' current position is research engineer at the Forest Products Laboratory, a national laboratory within the USDA-Forest Service. He has been involved with various aspects of timber bridge research in the field and in the laboratory. Over the past 25 years, James has led a handful of national field studies aimed at characterizing the performance or durability characteristics of highway bridges. More recently, he has been involved with the evaluation of several NDE techniques for inspection of timber bridge structures. As a member of the American Society of Civil Engineers (ASCE), Jim served as chairperson for the timber bridges technical committee, and currently serves on its technical activities executive committee. He is also a registered professional engineer in the state of Wisconsin.
 **Hideyuki Nasu**	Hideyuki Nasu is a professor at Nippon Institute of Technology, and is the head of its Architecture department. His academic degree is Doctor of Engineering and he has license of First-grade qualified Architect. His fields of expertise include wooden structural engineering. He is working with: research and development for wooden skeleton framing with high spec joints; vibration damping technology for wooden houses; middle to high-rise wooden structures with cross laminated timber (CLT), etc.

Programme overview

Pre-Tour

Monday - 26 June 2017	See separate programme

Conference programme

Place of the Conference: Forumsalen, Campus Skellefteå (Laboratorgränd 13, Skellefteå)

The duration of each presentation is scheduled 20 minutes including questions. Presentations should be about 15 minutes to allow a 5 minutes question time and discussion.

Tuesday - 27 June 2017	
7:30 – 11:00	*Attendee Registration, Presenter Check-in, Posters*
8:45 – 9:00	Opening Session
9:00 – 10:00	Keynote Presentations
10:00 – 10:30	Coffee Break
10:30 – 12:10	Technical Session 1 Design of timber bridges I
12:10 – 13:10	Lunch
13:10 – 14:50	Technical Session 2 Monitoring
14:50 – 15:50	Coffee Break / Poster session
15:50 – 17:30	Technical Session 3 Joints
17:30 – 19:00	Technical visit - Skellefteå Wooden buildings and bridges
19:00 – 21:00	Information from Timber Bridge Manufacturer including Buffet Dinner (Stiftsgården)

Wednesday - 28 June 2017		
7:30 – 11:00	*Attendee Registration, Presenter Check-in*	
7:50-8:00	Introduction to the day	
8:00 – 9:00	Keynote Presentations	
9:00 – 10:40	Technical Session 4 Durability and LCA	
10:40 – 11:10	Coffee Break	
11:10 – 12:40	Technical Session 5 Design of timber bridges II	
12:40 – 13:40	Lunch	
13:40 – 15:20	Technical Session 6 Timber concrete bridges	
15:20 – 15:50	Coffee Break	
15:50 – 17:10	Technical Session 7 Historical bridges	Technical Session 8 FEM Analyses
17:10 –	Committee Meeting, next conference	

19:00 – 21:30	Dinner Banquet Skellefteå

Thursday – 29 June 2017	
7:30 – 8:00	*Attendee Registration, Presenter Check-in*
7:50-8:00	Introduction to the day
8:00 – 8:30	Keynote Presentation
8:30 – 9:50	Technical Session 9 Testing
9:50 – 10:10	Coffee Break
10:10 – 11:300	Technical Session 10 Case studies
11:30 – 11:40	Close-out Session
11:40 – 13:00	Lunch

Poster Session

Tuesday 27 June 2017, 14:50-15:50

Folding System for Timber Truss Bridge *Hideyuki Hirasawa, Honomi Ansai, Jun Tonuma*	**Vaida footbridge – from design to demolition** *Lauri Perv, Mihkel Sinisalu, Alar Just*
Performance evaluation of the cross laminated timber for the bridge decks *Yusuke Ariyama, Takanobu Sasaki, Tomoyuki Hayashi, Atsushi Toyoda, Humihiko Gotou, Katsuhiko Takami, Shogo Araki*	**Adhesive system for acetylated wood for load bearing constructions - The GIAceWood project** *Andreas Treu, Ronny Bredesen, Ferry Bongers*
Creep behavior of oak pegs under tension in dry and wet conditions *Jiři Kunecký, Michal Kloiber, Hana Hasníková, Jaroslav Hrivnák, Václav Sebera, Jan Tippner, Jaromír Milch*	**A Covered Cross Laminated Timber Bridge - From Concept to Product** *Lars Laitila, Niclas Björngrim, Peter Bomark & Tobias Pahlberg*
Mechanical analysis of scarf joint fastened using cylindrical wooden dowel *Jan Tippner, Jaromír Milch, Jiři Kunecký, Michal Kloiber, Martin Brabec, Václav Sebera*	**Wooden CLT-Bridge** *Student Workshop 2017*

Detailed Technical Programme

Tuesday 27 June 2017

8:45-9:00	**Opening Session,** *Olle Hagman, Luleå University of Technology*
9:00-10:00	**Keynote Presentations** *André Jorissen, Design and manufacturing of timber bridges in the Netherlands* *Kjell Arne Malo, Developments of durable timber bridges*
10:30-12:10	**Technical Session 1, Design of timber bridges I** *Moderator: James P. Wacker, USDA Forest Service, Forest Products Laboratory*
	A timber bridge across Lake Mjøsa in Norway *Ole Kristian Løke, Trond Arne Stensby, Johannes Veie, Yngve Årtun, Svein Erik Jakobssen, Per Meaas*
	Comparison of network patterns suitable for timber bridges with crossbeams *Anna Weronika Ostrycharzyk, Kjell Arne Malo*
	Effect of Nordic climate on cupping of stress laminated timber decks *Stefania Fortino, Giovanni Metelli, Petr Hradil, Federico Ossodi, Anna Pousette, Tomi Toratti*
	Anchor plates for pre-stressing rods and compression orthogonal to grain of timber *Fransesco Mirko Massaro, Kjell Arne Malo*
	Mechanical properties of acetylated radiate pine *Ferry Bongers*
13:10-14:50	**Technical Session 2, Monitoring and testing** *Moderator: Olle Hagman, Luleå University of Technology*
	Advantages of moisture content monitoring in timber bridges *Andreas Müller, Bettina Franke, Marcus Schiere, Steffen Franke*
	Moisture monitoring of nine protected timber bridges in Germany *Johannes Koch, Ralf W. Arndt, Antje Simon, Markus G. Jahreis*
	Moisture Content Monitoring in Glulam by Electrical Methods *Hang Li, Marianne Perrin, Florent Eyma, Xavier Jacob, Vincent Gibiat*
	Smart Timber Bridge on Geosynthetic Reinforced Soil (GRS) Abutments *Adam Senalik, James P. Wacker, Travis K. Hosteng, John Hermanson*
	A Robust, Passive Resistance Sensor for Moisture Content Monitoring of Timber Bridges *Niclas Björngrim, Per-Anders Fjellström, Olle Hagman*
14:50-15:50	**Poster Session**
15:50-17:30	**Technical Session 3, Joints** *Moderator: Alar Just, RISE Research Institutes of Sweden*
	Effect of on-site splice joints for timber network arch bridges *Martin Cepelka, Kjell Arne Malo*
	Parallel splitting mode of failure in dowel type connections with chamfered cuts *Katarzyna Ostapska-Luczkowska, Kjell Arne Malo*
	Effects of Notching on Timber Girder Performance *Justin Dewey, Rabin Tuladhar, Lara Mullamphy, Lucy McCormack*
	Fatigue strength of axially loaded threaded rods embedded in glulam at 45° to the grain *Haris Stamatopoulos, Kjell Arne Malo*
	Reinforcement of Sundbyveien Bridge *Magne A. Bjertnæs, Trond Arne Stensby*

Detailed Technical Programme

Wednesday 28 June 2017

7:50-8:00	**Introduction to the day,** *Anders Gustafsson RISE Research Institutes of Sweden*
8:00-9:00	**Keynote Presentations** *Robert Widmann*, From then to now: A short history of Swiss timber bridge designs *James P. Wacker*, U.S. Timber Bridges: Current Activities and Future Directions
9:00-10:40	**Technical Session 4, Durability and LCA** *Moderator: Anna Pousette, RISE Research Institutes of Sweden*
	Learning Experiences from Norwegian Timber Bridge Inspections *Hauke Burkart, Otto Kleppe*
	Rational maintenance of timber bridges *Daniel Honfi, Thomas Lechner, Jochen Köhler*
	Investigation of timber bridges in Estonia *Per-Anders Fjellström, Alar Just*
	Comparative life cycle assessment of concrete and timber road bridge deck designs *Reyn O´Born, Katalin Vertes*
	Life cycle Assessment on two design alternatives of the Driva Bridge *Yishu Niu, Lauri salokangas, Gerhard Fink*
11:10-12:40	**Technical Session 5, Design of timber bridges II** *Moderator: Mats Ekevad, Luleå University of Technology*
	A parametrized process: Design and realization of timber truss bridges *John Haddal Mork, Marcin Luczkowski, Bendik Manum, Anders Rønnquist*
	Correct geometry against water damages in Design of Timber Bridges *Tönis Teppand, Renno Reitsnik*
	New design Guidelines for structural protected timber bridges *Antje Simon, Markus G. Jahreis, Johannes Koch, Ralf Arndt*
	Improved efge design for stress-laminated decks made of spruce *Anna Pousette, Peter Jacobsson, Erik Johansson, Lars-Olof Nilsson, Christine Warg*
13:40-15:20	**Technical Session 6, Timber-concrete composite bridges** *Moderator: Kjell Arne Malo, NTNU Norwegian University of Science and Technology*
	Investigation of Early Timber-Concrete Composite Bridges in the United States *James P. Wacker, Alfredo Dias, Travis K. Hosteng*
	Design of wood-concrete composite beams under deck bridge – Theoretical development and construction examples *Fabien Renaudin, Philippe Jandin*
	Short-term analysis of timber-concrete composite bridges *Joonas Jaaranen, Lauri Salokangas, Gerhard Fink*
	Long-term analysis of timber-concrete composite bridges *Joonas Jaaranen, Lauri Salokangas, Gerhard Fink*
	Laminated Steel-Timber-Concrete Beams for Bridges *Jeno Balogh, István Szücs, Rose Holtzman*

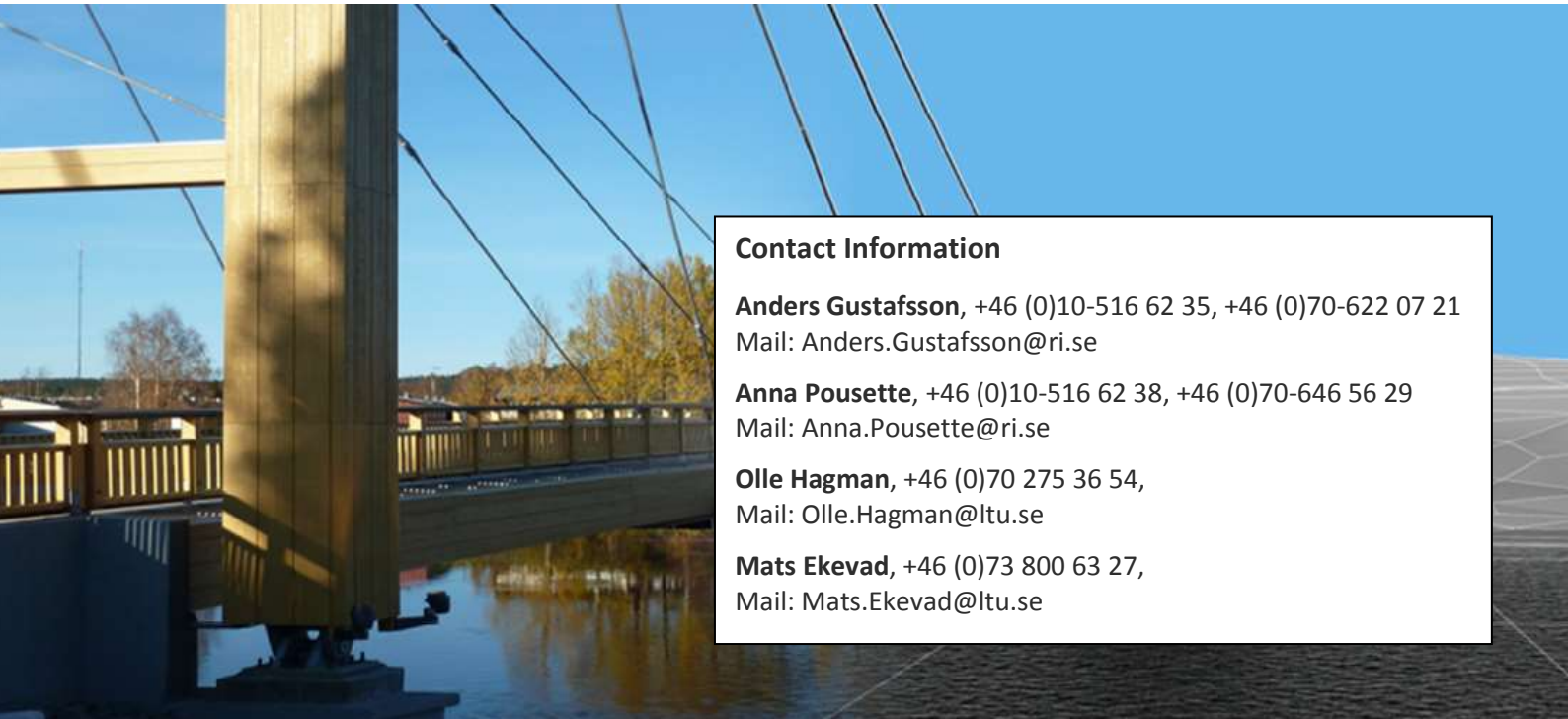
Parallell Sessions

15:50-17:10	**Technical Session 7, Historical bridges** *Moderator: Anders Gustafsson, RISE Research Institutes of Sweden*
	A Century of a Bridge of Perfection *Liu Yan*
	Historic Timber Howe Trusses of British Columbia *Murray Johnson, Gary Farnden*
	The Cloak Bridge in Česky Krumlov – construction history research *Jiri Blaha*
	Structural Evolution of Woven Arched Covered Timber Bridges in China *Yaxin Li, Sudarshan Krishnan*
15:50-17:10	**Technical Session 8, FEM Analyses** *Moderator: André J. M. Jorissen, Technische Universitet Eindhoven*
	Mechanics of Stress-Laminated Timber Bridges with Butt End Joints *Mats Ekevad, Johannes A. J. Huber, Peter Jacobsson*
	Simulation of moisture diffusion in timber bridges exposed to rain *Petr Hradil, Stefania Fortino, Giovanni Metelli, Alessandro Musci, Jakob Dohnal, Maria Fredriksson*
	Updating of numerical timber bridges models by experimental modal analysis *Julio Vivas, Soledad Rodriguez, Juan Carlos Santos*
	Comparison of Cross- and Stress-Laminated Timber Bridge Decks *Jonas Turesson, Mats Ekevad, Sven Berg*

Detailed Technical Programme

Thursday 29 June 2017

7:50-8:00	**Introduction to the day,** *Anders Gustafsson RISE Research Institutes of Sweden*
8:00-8:30	**Keynote Presentation** *Hideyuki Nasu, Examples of Japanese wooden bridges and Japanese wooden structures*
8:30-9:50	**Technical Session 9, Testing** *Moderator: Robert Widmann, Empa – Structural Engineering Research Laboratory*
	Inspection of a cable-stayed bridge by 3D-scanner *Balázs Major, Olle Hagman*
	The potential of acoustic Emission for Timber damage Assessment *Imen Yahyaoui, Marianne Perrin, Xiaojing Gong*
	Analysis of Mini-jack technique for in situ measurement of strength *Michal Kloiber, Jan Tippner, Jiři Kunecký,Václav Sebera, Jaromír Milch, Jaroslav Hrivnák*
	The Cloak Bridge in Česky Krumlov – measuring of mechanical properties *Michal Kloiber, Václav Sebera, Jaroslav Hrivnák Jan Tippner, Jiři Kunecký*
10:10-11:30	**Technical Session 10, Case studies** *Moderator: Per-Anders Fjellström, RISE Research Institutes of Sweden*
	Design flaws on Norwegian Timber Bridges *Hauke Burkart, Tormod Dyken*
	Björgum bridge, a roofed timber footbridge in Norway *Asmund Sveen, Trond Even Eggen, Yngve O. Aartun*
	Field condition assessment of the first vehicular timber bridge in Korea, Hanareum Bridge *Sang-Joon Lee, Kwang-Mo Kim, Kug-Bo Shim*
	Network arch bridge with glulam arches. Lessons learned and further development *Johannes Veie*
11:30-11:40	**Close-out Session,** *Anders Gustafsson, RISE Research Institutes of Sweden*



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Pre-Tour Programme

- 07.30 Departure from Skellefteå, pick-up at Skellefteå Stadshotell, Scandic and Hotell Aurum
- 09.15 Holmsund, Road Bridge over water. Stop for 20-30min with coffee/tea and sandwich.
- 10.00 Strömpilen, Pedestrian Bridge over Road and Railroad, stop for 15-20min.
- 10.45 I20, Pedestrian Bridge over Road and Railroad, stop for 15-20min.
- 11.30 Skeppsvik, Road Bridges over water.
- 12.00- 12-45 Lunch at Skeppsviks Mansion. www.skeppsvik.se
- 13.15 Ratuån, a small Road Bridge over Sävarån. Short stop in the picturesque and historical village of Ratan.
- 14.45 Stackgrönnan, Pedestrian Bridge over water, short stop.
- 15.00 Älvsbacka Bridge, modern Pedestrian Bridge over the river, traditional Swedish ”fika” is served, coffee/tea and Cinnamon roll.
- 17.45 We walk from city centre to Lejonströmsbron an old Road Bridge over the river, aperitif and snacks.
- 19.00 Dinner at Nordanågården. www.nordanagarden.se

1. Road Bridge, Lövsundet

A typical Swedish Road Bridge built with a stressed laminated glulam deck made of spruce.

Short facts

- Builer Martinsons Träbroar, 2009
- Owner Umeå kommun.
- Total length: 17,72m (58.1 ft.)
- Deck with: 8,98m (29.45 ft.)
- Deck height: 0,81m (- ft.)
- Stressing bars: Three rows of Dywidag GWS 20 pre-stressed to 173.3 kN.

2. Pedestrian Bridge, Strömpilen

Pedestrian bridge with one of the longest stressed laminated glulam decks in Sweden.

Short facts

- Builer SvenskaTräbroar, 2007
- Owner Umeå kommun.
- Total length: 230m (- ft.)
- Deck with: 3,91m (- ft.)
- Deck height: 0,45m (- ft.)
- Stressing bars: Two rows of Dywidag GWS 15 pre-stressed to 136 kN.

3. Pedestrian Bridge, I20

Pedestrian bridge with a box- beam deck.

Short facts

- Builer SvenskaTräbroar, 2005
- Owner Trafikverket
- Total length: 157,1m (- ft.)
- Deck with: 4,5m (- ft.)
- Deck height: 1,26m (- ft.)
- Stressing bars: Two rows, upper row Dywidag GWS 20 pre-stressed to 190 kN and lower row Dywidag GWS 15 pre-stressed to 133 kN.

4. -6. Road Bridges, Skeppsvik

Three small Road Bridges over Sävarån.

Short facts

- Builer Martinsons, 1995
- Owner Trafikverket
- Total length: bridge 1 22,4m, bridge 2 11,7m and bridge 3 16,5m(- ft.)
- Deck with: 4,2m (- ft.)
- Girders x 6: Bridge 1 720 x213 mm.
- Bridge 2 766 x 213 mm.
- Bridge 3 990 x 213 mm

7. Road Bridge, Djäkneboda

A typical Swedish Road Bridge built with a stressed laminated glulam deck made of spruce.

Short facts

- • Builer Martinsons Träbroar AB, 2011, 7415/B
- • Owner Trafikverket
- • Total length: 8m (x ft.)
- • Stressing bars: Two rows of Dywidag GWS 20 pre-stressed to x kN.
- • Estimated service life: 80 years

8. Pedestrian Bridge, Stackgrönnan

Pedestrian Bridge with box-beam deck.

Short facts

- Builer Martinsons Träbroar AB, 2010, 7206/D
- Owner Trafikverket
- Total length: 24,6m (x ft.)
- Deck with: 3,1 m (x ft.)
- Deck height: 0,81 m (- ft.)
- Stressing bars: Two rows, upper row Dywidag GWS 15 pre-stressed to 129 kN and lower row Dywidag GWS 15 pre-stressed to 97 kN.

9. Pedestrian Bridge, Älvsbacka

Pedestrian bridge over Skellefteälven. The estimated service life is 80 years.

Short facts

- Builer Martinsons Träbroar AB, 2011, 7206/D
- Owner Trafikverket
- Total length: 182m, span 130m (x ft.)
- Deck with: 4 m (x ft.)
- Towers: 24 m
- Girders: x m (- ft.)

10. Road Bridge, Lejonströmsbron

Sweden’s oldest timber bridge is a road bridge and it’s still in use after 280 years!

Short facts

- • Builer Martinsons Träbroar AB, 1735-1737
- • Owner Skellefteå Kommun
- • Total length: 218m (x ft.), originally 314m
- • Deck with: 5m (x ft.)

Through our international collaboration programmes with academia, industry, and the public sector, we ensure the competitiveness of the Swedish business community on an international level and contribute to a sustainable society. Our 2,200 employees support and promote all manner of innovative processes, and our roughly 100 testbeds and demonstration facilities are instrumental in developing the future-proofing of products, technologies, and services. RISE Research Institutes of Sweden is fully owned by the Swedish state.

I internationell samverkan med akademi, näringsliv och offentlig sektor bidrar vi till ett konkurrenskraftigt näringsliv och ett hållbart samhälle. RISE 2 200 medarbetare driver och stöder alla typer av innovationsprocesser. Vi erbjuder ett 100-tal test- och demonstrationsmiljöer för framtidssäkra produkter, tekniker och tjänster. RISE Research Institutes of Sweden ägs av svenska staten.

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