



TU1406

COST ACTION

QUALITY SPECIFICATIONS FOR ROADWAY BRIDGES,
STANDARDIZATION AT A EUROPEAN LEVEL



ESF provides the
COST Office through a
European Commission contract



COST is supported by
the EU Framework
Programme



Training School - Stockholm

Performance-based assessment of Existing Road Bridges

12th – 16th September, 2016
KTH Royal Institute of Technology
Stockholm, Sweden

ACTION CONTACTS

Chair of the Action
Vice Chair of the Action
School Co-Organizer
Local organizers

Action websites
School webpage

Prof. José C. Matos
Prof. Joan R. Casas
Dr. Niels Peter Høj
Prof. Raid Karoumi
Dr. Mohammed Safi
<http://www.tu1406.eu>
<http://www.tu1406.eu/stockholm>

chair@tu1406.eu
vicechair@tu1406.eu
niels.hoj@hoj.ch
raid.karoumi@byv.kth.se
mohammed.safi@folkbro.com
<http://www.cost.eu>

CONTENTS

1.	Introduction	4
1.1.	About COST	4
1.2.	COST Action TU1406.....	5
1.2.1.	Abstract.....	5
1.2.2.	Action TU1406 Working Groups.....	5
2.	Training School - Stockholm.....	7
2.1.	Objectives.....	7
2.2.	Scope	7
2.3.	Programme.....	8
2.4.	Location, Dates and Travelling	9
2.4.1.	Location and Date	9
2.4.2.	How to get to KTH Royal Institute of Technology.....	10
2.5.	Accommodation.....	11
2.6.	Committees	11
2.6.1.	Scientific Committee	11
2.6.2.	Organizing Committee	11
2.6.3.	Secretariat.....	12
2.6.4.	Local Organizers.....	12
3.	How to participate	13
3.1.	Registration	13
3.2.	Funding and Reimbursement	13
3.3.	Instructions and Templates for Presentations	13
3.4.	Copyright Agreement, ISBN E-Book.....	13
4.	Social Event.....	13
5.	Technical Visit.....	14

1. INTRODUCTION

1.1. ABOUT COST

Founded in 1971, COST – European Cooperation in Science and Technology – is the first and widest European framework for the transnational coordination of nationally funded research activities. It is based on an inter-governmental agreement and comprises currently 35 European Member Countries plus one Cooperating State.

COST's mission is to strengthen Europe's scientific and technical research capacity by supporting cooperation and interaction between European researchers, covering from basic to applied or technological research and including research addressing issues of pre-normative nature or of particular societal importance.

As a precursor of advanced multidisciplinary research, COST plays an important role in the construction of the European Research Area (ERA), by anticipating and complementing the activities of the Framework Programmes, acting as a "bridge" spanning the scientific communities of Europe as a whole, increasing the mobility of researchers across the continent, and fostering the establishment of large Framework Programme projects in many key scientific domains.

The funds provided by COST support the coordination costs of the pan-European research networks (COST Actions), ultimately multiplying the potential of nationally funded research work. In this way, COST has leveraged during the last seven years approximately EUR 5 billion of research funding through its support and reaches out to over 30.000 researchers across Europe. COST is funded from of the EU RTD Framework Programmes budget.

During the last eight years, COST scientific organisation was based on 9 scientific domains embracing all fields of research:

- Biomedicine and Molecular Biosciences (BMBS);
- Chemistry and Molecular Sciences and Technologies (CMST);
- Earth System Science and Environmental Management (ESSEM);
- Food and Agriculture (FA);
- Forests, their Products and Services (FPS);
- Individuals, Societies, Cultures and Health (ISCH);
- Information and Communication Technologies (ICT);
- Materials, Physics and Nanosciences (MPNS);
- Transport and Urban Development (TUD).

COST also supports research networks spanning over several scientific domains (Trans-Domain) with broad, interdisciplinary dimension.

The scientific organisation of COST is currently being scrutinised in order to best fit the needs of the European research communities in the new context of Horizon 2020.

The key features of COST are:

- Open to all fields in Science and Technology through a "bottom up" approach - the idea and subject of a COST Action comes from the European scientists themselves;
- Fosters inclusiveness and equality of access;
- Commits to build capacity by connecting high-quality scientific communities throughout Europe and worldwide;
- Focuses strongly on providing networking opportunities for early stage researchers;
- Aims at increasing the impact of research on policy makers, regulatory bodies and national decision makers as well as the private sector.
- Offers a flexible structure, easy implementation and lean management of the networking activities.

1.2. COST ACTION TU1406

1.2.1. ABSTRACT

During the implementation of asset management strategies, maintenance actions are required in order to retain assets at a desired performance level. In case of roadway bridges, specific performance indicators are established for their components. These indicators can be qualitative or quantitative-based, and they can be obtained during principal inspections, through a visual examination, a non-destructive testing or a temporary or permanent monitoring system. Then, obtained indicators are compared with performance goals, in order to evaluate if the quality control plan is accomplished. It is verified that there is a large disparity in Europe regarding the way these indicators are quantified and how such goals are specified. Therefore, this Action aims to bring together, for the first time, both the research and practicing communities in order to accelerate the establishment of a European guideline in this subject. An important aim is to define formal indicators related to sustainable performance of roadway bridges.

1.2.2. ACTION TU1406 WORKING GROUPS

In order to adequately achieve the objectives of the Action, six Working Groups (WG-s) have been established:

WG1: PERFORMANCE INDICATORS

Leader: Alfred Strauss

E-mail: alfred.strauss@boku.ac.at

Vice-Leader: Ana Mandić-Ivanković

E-mail: mandicka@grad.hr

Working Group 1 focuses on the characterization of bridge performance indicators, which can address: (a) the safety: the load factor, the reliability index to ULS; (b) the serviceability: the condition index, the reliability index to SLS; (c) the availability, robustness; (d) the costs: the total LCC, values related to durability aspects; and (e) aspects of environmental efficiency: CO2 footprint. A technical report on performance indicators will be developed at the end.

WG2: PERFORMANCE GOALS

Leader: Irina Stipanovic

E-mail: i.stipanovic@utwente.nl

Vice-Leader: Lojze Bevc

E-mail: lojze.bevc@zag.si

The main objective of Working Group 2 is to identify existing performance goals (where the term goal pertains to quantifiable requirement and/or threshold value) for the indicators previously indicated in WG1. The performance goals will vary according to technical, environmental, economic and social factors. A technical report on performance goals will be developed at the end.

WG3: ESTABLISHMENT OF A QUALITY CONTROL PLAN

Leader: Rade Hajdin

E-mail: rade.hajdin@grf.bg.ac.rs

Vice-Leader: Matej Kušar

E-mail: matej.kusar@fgg.uni-lj.si

Based on results from WG1 and WG2, as well as on a survey of existing approaches in practice, the objective of Working Group 3 is to provide a report with detailed step-by-step explanations for the establishment of QC plans for different types of bridges. The QC plans will address the dynamics and uncertainty of the processes that may significantly compromise bridge performance.

WG4: IMPLEMENTATION IN A CASE STUDY

Leader: Amir Kedar
Vice-Leader: Sander Sein

E-mail: akedar@kedmor.co.il
E-mail: sander.sein@mnt.ee

A series of benchmarks will be developed during Working Group 4. To this end, some of the performance indicators identified in WG1 will be computed for a set of roadway bridges over EU. These indicators will be then compared with specific goals, as identified in WG2. At the end of the process, a QC plan will be applied to those bridges utilising recommendations from WG3. A data basis will be then established for benchmarking.

WG5: DRAFTING OF GUIDELINE/RECOMMENDATIONS

Leader: Vikram Pakrashi
Vice-Leader: Helmut Wenzel

E-mail: v.pakrashi@ucc.ie
E-mail: wenzel@vce.at

Working Group 5 focuses on the development of guidelines, drawing support from all the other WG-s. These guidelines for a systematic maintenance and management of highway bridge assets will acknowledge the variation of philosophical, technical and implementation methodologies throughout the EU, with the expectation that the delivered framework will be scalable and portable for standardised implementation in existing or new infrastructure networks.

WG6: DISSEMINATION

Leader: Guðmundur Guðmundsson

E-mail:
gudmundur.v.gudmundsson@vegagerdin.is

Vice-Leader:
Stavroula Pantazopoulou

E-mail: pantaz@ucy.ac.cy

The aim of this WG is to disseminate all results which were obtained in all the other WG-s. Dissemination consists in establishing liaisons with existing national and international associations, conferences, working groups and journals. Also, this group will be responsible to continuously update the website as well as all the other dissemination frameworks.

2. TRAINING SCHOOL - STOCKHOLM

2.1. OBJECTIVES

The objective of the COST TU1406 Training School-Stockholm is to spread the latest knowledge and development acquired by the action in the topic of performance-based assessment of existing road bridges. Besides, the school aims at teaching the most recent knowledge on performance assessment procedures with the adoption of specific goals. In particular the COST TU1406 Training School-Stockholm focuses on the findings of WG1: Performance indicators and on WG2: Performance goals.

The WG1 goal was to explore those performance indicators of bridge structures, in the course of international research cooperation, which capture the mechanical and technical properties and its degradation behavior, already partly covered by code specifications. Considerations also include: natural aging, quality of the material; service life design methods; sustainable indicators; environmental, economic and social based indicators, performance profiles. The WG2 goal was to identify existing performance goals (where the term goal pertains to quantifiable requirement and/or threshold value) for the indicators previously indicated in WG1. The performance goals vary according to technical, environmental, economic and social factors.

2.2. SCOPE

The training school is co-organised with IABSE in Sweden and will take place preceding the 19th Congress of IABSE in Stockholm 2016.

Venue: KTH Royal Institute of Technology, Stockholm.

Time: 12 – 16 September 2016

Local Organizer	Co-Organizer
Prof. Raid Karoumi <i>KTH – Royal Institute of Technology, Division of Structural Design and Bridges, Sweden.</i>	Prof. José C. Matos <i>Minho University, School of Engineering, Civil Engineering Department, Guimarães, Portugal.</i>
Dr. Mohammed Safi <i>FOLKBRO, Sweden.</i>	Dr. Niels Peter Høj <i>HOJ Consulting GmbH, Switzerland.</i>

The training school will cover the WG1 and WG2 topics of COST Action TU 1406, which are "the assessment of road bridges through Key Performance Indicators (KPIs)" and "the establishment of Performance Thresholds / Goals".

Organisers: TUD COST Action TU1406 "Quality specifications for roadway bridges, standardization at a European level (BridgeSpec)" (http://www.cost.eu/COST_Actions/tud/TU1406) in collaboration with IABSE.

Trainers list of experts:

- Prof. José C. Matos, Civil Engineering Department, School of Engineering, University of Minho (UMinho), Portugal.
- Dr. Niels Peter Høj, HOJ Consulting GmbH, Brunnen, Switzerland.
- Prof. Alfred Strauss, University of Natural Resources and Life Sciences (BOKU), Institute of Structural Engineering, Austria.
- Prof. Irina Stipanovic, University of Twente (UTwente), Faculty of Engineering Technology Construction Management and Engineering Department, The Netherlands.
- Ing. Radomír Pukl CSc. Červenka Consulting, Czech Republic.
- Prof. Drahomir Novak, Brno University, Czech Republic.
- Prof. Raid Karoumi, KTH - Royal Institute of Technology, Division of Structural Design and Bridges, Sweden.
- Dr. John Leander, KTH - Royal Institute of Technology, Division of Structural Design and Bridges, Sweden.
- Prof. Costin Pacoste, ELU Konsult and KTH - Royal Institute of Technology, Division of Structural Design and Bridges, Sweden.

- Prof. Lennart Elfgren, Department of Civil, Environmental and Natural Resources Engineering, Luleå University of Technology, Sweden.
- Dr. Mohammed Safi, LCC Analyses, Folkbro, Sweden.

2.3. PROGRAMME

	When	What	Lecturer
12/9	Monday		
	9:00 – 12:00	Key performance indicators KPIs (e.g. condition indicators; reliability and robustness; sustainability indicators - environmental, social).	Prof. Alfred Strauss; Prof. Irina Stipanovic; Niels Peter Høj.
	12:00 – 13:00	Lunch	
	13:00 – 16:00 (*)	Case studies, KPIs – inspection, monitoring, goals, thresholds, criteria.	Prof. Alfred Strauss; Prof. Irina Stipanovic; Niels Peter Høj.
13/9	Tuesday		
	9:00 – 12:00	Deterministic modelling-techniques and software associated with structural performance and KPI's.	Prof. D. Novak; Prof. Radomir Pukl; Prof. Alfred Strauss.
	12:00 – 13:00	Lunch	
	13:00 – 16:00 (*)	Case studies – Deterministic modelling of the structural performance.	Prof. D. Novak; Prof. Radomir Pukl; Prof. Alfred Strauss.
14/9	Wednesday		
	9:00 – 12:00	Probabilistic modelling-techniques and software associated with structural performance and KPI's.	Prof. D. Novak; Prof. Radomir Pukl; Prof. Alfred Strauss.
	12:00 – 13:00	Lunch	
	13:00 – 16:00 (*)	Case studies – Probabilistic modelling of the structural performance.	Prof. D. Novak; Prof. Radomir Pukl; Prof. Alfred Strauss.
15/9	Thursday		
	9:00 – 12:00	Dynamic, Monitoring and Fatigue modelling-techniques and software associated with structural performance and KPI's.	Prof. Costin Pacoste; Dr. John Leander; Prof. Raid Karoumi.
	12:00 – 13:00	Lunch	
	13:00 – 16:00 (*)	Case studies - Dynamic and Fatigue modelling of the structural performance.	Prof. Costin Pacoste; Dr. John Leander; Prof. Raid Karoumi.
16/9	Friday		
	9:00 – 10:00	KPIs Associated with global performance: load capacity and loading tests.	Prof. Lennart Elfgren.
	10:00 – 12:00	KPIs associated with sustainability: Life-Cycle Cost analysis (LCC), Life-Cycle assessment (LCA) and Bridge Management Systems.	Dr. Mohammed Safi; Prof. Irina Stipanovic; Prof. Jose Matos.
	12:00 – 13:00	Lunch	
	13:00 – 15:00 (*)	Case studies: KPIs & Economics. LCC and LCA-analysis in bridge investment and management.	Dr. Mohammed Safi; Prof. Irina Stipanovic; Prof. Jose Matos.
	15:00 – 17:00 (**)	Technical visit to Slussen project, Stockholm.	Dr. Mohammed Safi.

(*) Independent students work in a lab room, monitored by the trainers. The assignments, by groups of two, should be delivered to Prof. Alfred Strauss and Dr. Niels Peter Høj by 30 September 2016.

(**) The technical visit is a free post-training school option to participants.

2.4. LOCATION, DATES AND TRAVELLING

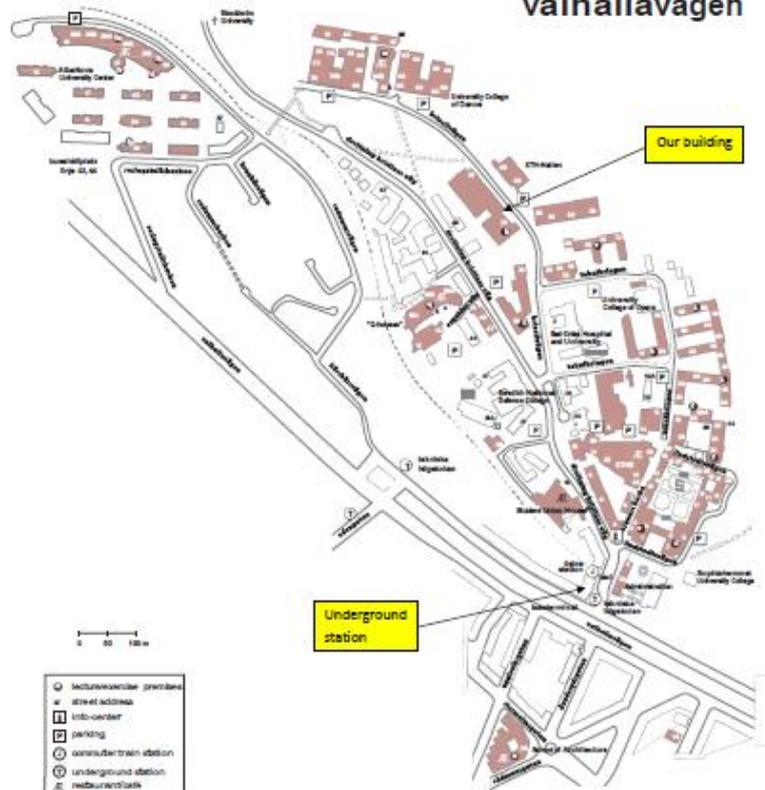
2.4.1. LOCATION AND DATE

The training school is hosted by KTH Royal Institute of Technology, Stockholm, Sweden. It will be held between the 12th and 16th September 2016 in room M110 (ground level) at the division of structural engineering and bridges, department of civil & architectural engineering, at the school of architectural and build environment. The venue is located near to the *Tekniska Högskolan* underground station, only 8 minutes of walk.

KTH Royal Institute of Technology
 Brinellvägen 23
 114 28 Stockholm
 Phone: +46 8 790 7960
 Web: <https://www.kth.se/en/abe/inst/byv>



KTH main campus valhallavägen



See this link for better resolution map: **Building number B**
https://www.kth.se/polopoly_fs/1.566475/KTH_Campus_map.pdf

2.4.2. HOW TO GET TO KTH ROYAL INSTITUTE OF TECHNOLOGY

The venue is located 14 minutes from Stockholm's central train station **T-Centralen**, which is most conveniently reachable via the high speed train **Arlanda Express** within 19 minutes from Stockholm **Arlanda Airport**. A taxi ride from the **Arlanda Airport** to the venue takes approx. 37 minutes and costs around 400 Swedish Krona SEK, 1 EUR is approx. = 9.48 SEK. Many car rental companies operate at the airport. Highway is connecting airport with the city. Payment by credit cards in taxis is possible.

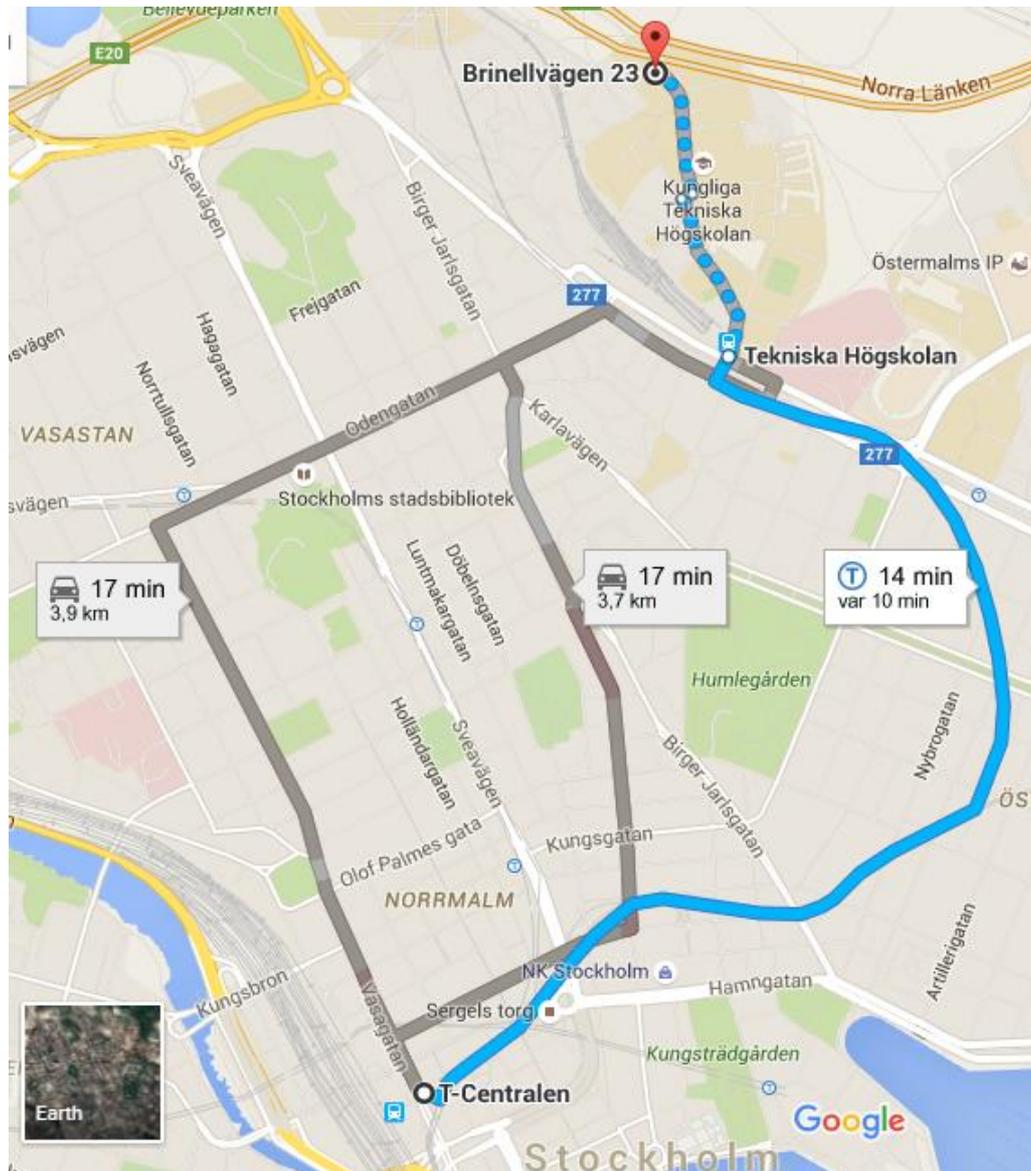


Figure 1. Travelling from Stockholm's central train station (T-Centralen) to the venue

Useful websites:

General info about Stockholm: <http://www.visitstockholm.com/en/>

Public transport information inside Stockholm: <http://sl.se/en/>

Airport taxi information: https://www.swedavia.com/arlanda/?_ga=1.197546219.579209710.1468236743

2.5. ACCOMMODATION

Local organizers suggest using the following listed hotels for accommodation, conveniently located nearby the venue.

Elite Hotel Arcadia

web: www.elite.se/eng/node/1403
 e-mail: reservations.arcadia@elite.se

Closest to KTH

Ask for discounted rate for KTH visitors!

Elite Hotel Stockholm Plaza

Birger Jarlsgatan 29
 Tel.: + 46 8 566 220 00
 web: www.elite.se/eng/hotell/stockholm/plaza/

Ask for discounted rate for KTH visitors!

Scandic Park

Karlavägen 43
 tel. +46 (0)8 517 348 00
 web: www.scandic-hotels.se/park

Hotel Riddargatan

Riddargatan 14
 Tel: +46 (0)8 555 730 00
 web: www.profilhotels.se/hotelriddargatan/
 e-mail: hotelriddargatan@profilhotels.se

Kom Hotel

Döbelnsgatan 17
 tel. + 46 8 412 23 00

Hotel Birger Jarl

Tulegatan 8
 Tel. + 46 8 674 18 00
 web: www.birgerjarl.se

2.6. COMMITTEES

An executive scientific committee as well an organizing committee were defined.

2.6.1. SCIENTIFIC COMMITTEE

<i>Name</i>	<i>TU1406 Position</i>	<i>E-mail</i>
José C. Matos	Chair	chair@tu1406.eu
Niels Peter Høj	MC member	niels.hoj@hoj.ch
Raid Karoumi	WG member	raid.karoumi@byv.kth.se
Alfred Strauss	WG1 Leader	wg1@tu1406.eu
Irina Stipanovic	WG2 Leader	wg2@tu1406.eu
Mohammed Safi	MC member	mohammed.safi@folkbro.com
Radomir Pukl	–	radomir.pukl@cervenka.cz
Drahomir Novak	–	novak.d@fce.vutbr.cz
Lennart Elfgren	–	lennart.elfgren@ltu.se
Costin Pacoste	–	costin.pacoste@elu.se
John Leander	–	john.leander@byv.kth.se

2.6.2. ORGANIZING COMMITTEE

<i>Name</i>	<i>TU1406 Position</i>	<i>E-mail</i>
José C. Matos	Chair	chair@tu1406.eu
Niels Peter Høj	MC member	niels.hoj@hoj.ch
Alfred Strauss	WG1 Leader	wg1@tu1406.eu
Irina Stipanovic	WG2 Leader	wg2@tu1406.eu

2.6.3. SECRETARIAT

<i>Name</i>	<i>TU1406 Position</i>	<i>E-mail</i>
Eleni Chatzi	Technical Secretariat	tecsec@tu1406.eu
Lara Leite	Administrative Secretariat	adminsec@tu1406.eu
Ana Neves	Local Secretariat	acneves@kth.se

2.6.4. LOCAL ORGANIZERS

<i>Name</i>	<i>TU1406 Position</i>	<i>E-mail</i>
Raid Karoumi	WG member	raid.karoumi@byv.kth.se
Mohammed Safi	MC member	mohammed.safi@folkbro.com

3. HOW TO PARTICIPATE

3.1. REGISTRATION

There is no need for registration, except for the Technical Visit and Networking Dinner.

A google form was created to determine the ability/willingness of the participants to:

1. Participate in the planned technical visit on Friday 16/09 between 15:00 – 17:00
2. Participate in the planned network dinner on Wednesday 14/9 at 18:30
3. Use their own laptops during the school days

Please answer these questions through using the link <http://goo.gl/forms/X5xejwlaEh4ZuezV2>.

3.2. FUNDING AND REIMBURSEMENT

COST supports the participation of Trainees and Trainers for their attendance at approved Training Schools. The Trainers will receive their travel, accommodation and meal expenses in line with the eligibility rules. 15 Trainees approved by Organization/Management Committee, based on technical curriculum and on the COST policies on ESR (early stage researcher), gender and inclusiveness country, are entitled to receive a fixed Grant of 700€ and free registration.

3.3. INSTRUCTIONS AND TEMPLATES FOR PRESENTATIONS

Trainees are kindly asked to use the word templates for their assignments, available at <http://www.tu1406.eu/stockholm>, in order to achieve a degree of coherency. Trainers are kindly asked to use the power point templates for their lectures, available at <http://www.tu1406.eu/stockholm>, in order to achieve a degree of coherency. Both templates will be sent in attachment to the invitation email.

3.4. COPYRIGHT AGREEMENT, ISBN E-BOOK

The participants are kindly asked to accept copyright and publishing rules in order to allow organizers to publish and disseminate their assignments and presentations. This is determined by filling a specific form provided at <http://www.tu1406.eu/stockholm>. In order to disseminate some assignments and presentations, an ISBN indexed E-Book will be published after the training school.

4. SOCIAL EVENT

A network dinner is planned on Wednesday 14/9 at 18:30 in the famous Cypem Restaurant. The dinner costs around 40 Euros.

See the following link for more information about the restaurant: <http://restaurangcypem.se/>

5. TECHNICAL VISIT



Slussen has served the Stockholmers for over 70 years and has become one of the most historically important junctures in the City. It now needs reconstruction to become a vibrant meeting place with modern traffic solutions.

Slussen will be rebuilt to become an effective and safe juncture for both pedestrians, cyclists and public transport. The aim is to turn it into one of Stockholm's most attractive meeting spots with cultural events, entertainment venues, parks, restaurants and cafes.

Main points of the reconstruction project:

- **A new park:** tomorrow's Slussen will have a new park to the east of Katarinahissen with panoramic views of Saltsjön and Skeppsholmen. The park will have terraces towards Stadsgårdskajen where boats and ferries can moore.
- **The plaza by the lock:** this will be Slussen's focal point by the actual lock. Pedestrian and cycling lanes will surround the two water basis which make up a plaza of water. This will be a place to enjoy the sun, either on one of the terraces or at a café.
- **Södermalmstorg:** the new buildings will have facades made of glass in order to facilitate an interaction between the indoors environment and the vibrant square outside.
- **Ryssgården:** the square will keep most of its current form but will become a part of passage between Katarinaparken and the water. Important views will be kept.
- **The bus terminal:** will be placed inside the Katarina bedrock. A safe and modern hub will be created for commuters from Nacka and Värmdö. The bus terminal will be connected with Saltsjöbanan and the underground, facilitating indoor movement between buses, trains and the underground.
- **New buildings:** next to Södermalmstorg two low rising buildings will be built to accommodate restaurants or cultural activities. In front of the KF House and the glass houses which currently exist, new office buildings will be built. The design of these buildings has not yet been decided, only the size. The ground floors will facilitate public areas such as cafés and boutiques.
- **More space for:** public transport, pedestrians and cyclists as well as boat traffic and personal transportation.

- **Important links about project:**

<https://www.youtube.com/watch?v=oqXHIG5Ffuk>

<https://www.youtube.com/watch?v=IW17Ps1EKWg>

More information available at:

- [The New Slussen brochure](#)
- [Read more on the future Slussen](#)



TU1406
COST ACTION

WWW.TU1406.EU