The SUREBridge project – Sustainable Refurbishment of Existing Bridges

Reza Haghani
CTH
SUREBridge Workshop
2017-09-01
What is Sustainability?

The Common definition of Sustainability

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

(Our Common Future, The Brundtland Commission)
Sustainability is a process

- Vision
- Goals and objectives
- Indicators of progress
- Evaluation
- Repetition
Sustainability is a process

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term thinking</td>
<td>Long-term thinking</td>
</tr>
<tr>
<td>An economy outside environment and society</td>
<td>An integrated economy</td>
</tr>
<tr>
<td>Fossil fuel resources</td>
<td>Renewable energy resources</td>
</tr>
<tr>
<td>Seeing society, environment and economic challenges as separate and competing</td>
<td>Seeing society, environment and economic challenges as having connection</td>
</tr>
</tbody>
</table>
Sustainability pillars

- **Environment**
  - Less impact

- **Society**
  - Meet client demands

- **Economy**
  - Lower cost
Impact of construction industry on the environment

- Energy and water consumption
- CO₂ production
- Impacts on soil, ground water, wild life

- Mineral consumption (>50% of extracted minerals)
- Waste production (180 mT/year)
- Site related nuisance (traffic-noise-dust, etc.)
Participation of activities

- 26% - Housing
- 31% - Non-residential
- 20% - Civil engineering
  - Roads, railways, bridges, tunnels, hydraulic structures, etc.
- 23% - Rehabilitation and maintenance
  - Repair, life extension and maintenance of dwellings, non-residential buildings, etc.
Situation in Sweden - Some facts

- Ca. 20,200 bridges (16,000 road and 4,200 railway bridges)
- 10% of road bridges and 23% of railway bridges are in class 3
- During 1999-2009
  - 13 B€ investment (Road)
  - 49 M€ investment (Railway)
- Trend of increasing axle loads accelerates deterioration
Situation in Sweden - Some facts

- Cost of maintenance is considerable (ca. 37% of the total budget)

Strategic sustainable intervention programs are needed!!
FRP materials

- Very high specific strength and stiffness
- Very good durability - corrosion resistance
- Tailor-made
- Light-weight - Low installation cost - safer construction site
- Aesthetics
- Low thermal conductivity

- Stiffness governed design
- Lack of standards
- High cost
Common problems in concrete bridges

- Investigations show that 70% of problems are related to concrete edge beams and decks → loss of capacity, damage to girders and sub-structure
- Axel load increase → necessity for external reinforcement
- Synergy of overloading and deterioration and lack of proper maintenance → demolition
- According to the model code (2010), a good deal of residual capacity exists in most cases
SUREBRIDGE

SUREBridge intends to provide a sustainable technical solution and a design tool for refurbishment of old concrete bridges using FRP composites.

Possible necessary transverse reinforcement and protection in form of FRP laminates or reinforced polymer mortar.

Possible necessary longitudinal reinforcement in form of pre-stressed or passive CFRP laminates.
Innovative features

- A novel method to use pre-stressed CFRP laminates for strengthening in tension
- No need for mechanical anchorage
- Compensation for pre-stress loss in pre-stressed elements
- Improved serviceability (deformation)
- Better use of CFRP material (x2 utilization compared to passive strengthening)
- Improved durability (crack pattern and width control)
Innovative features
Innovative features

- Tailor-made GFRP deck system
  - Light weight
  - Good durability characteristics
  - Flexibility in design
  - Robustness
Innovative features

- Tool for design
- Interactive interface
Final product..
About Infravation

The ERA-NET Plus Infravation program was initiated as a pooled research fund to develop transport infrastructure innovations addressing the challenges identified in the European Commission's White paper on transport.

Transnational collaboration of 11 countries and the EC on road infrastructure innovation
Infravation partners

Dutch Ministry if Infrastructure and the Environment - Netherlands

Federal Ministry of Transport and Digital Infrastructure - Germany

Danish Road Directorate

Norwegian Public Road Administration

Federal Highway Administration - USA

Swedish Transport Administration

Icelandic Road Administration

French Ministry of Ecology, Sustainable development and Energy

Center for Development of Industrial Technology - Spain

National Transport Infrastructure Company - Israel

Italian National Roads and Highways Authority

TUV Rheinland Consulting

CEDR

European Commission

FEHRL
The aim of the program

Aims at cost-effective advanced systems, materials and techniques in road infrastructure construction and maintenance, including repair, retrofitting and revamping.
Challenges

A. Advanced predictive infrastructure performance processes
B. Enhanced durability and life-time extension
C. Rapid and non-destructive methods for routine quality and performance checks of materials and construction
D. Keeping freight routes open through zero-intrusive maintenance
E. Ensuring infrastructure performance under all weather conditions
F. Resource and energy efficiency in road construction and maintenance (eco-design)
G. Virgin material reduction by substitution or recycling
Projects
Partners

CHALMERS

FiberCore europe

AICE Consulting

SURE BRIDGE
Sustainable Rehabilitation of Existing Bridges
Official kick in 2016

public kick-off 27 May 2016, Rotterdam
This project has received funding from the European Union’s Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 31109806.0009.
SUREBRIDGE is co-funded by Funding Partners of The ERA-NET Plus Infravation and the European Commission. The Funding Partners of the Infravation 2014 Call are:
MINISTERIE VAN INFRASTRUCTUUR EN MILIEU, RIJKSWATERSTAAT
BUNDESMINISTERIUM FÜR VERKEHR, BAU UND STADTENTWICKLUNG,
DANISH ROAD DIRECTORATE,
STATENS VEGVESEN VEGDIREKTORATET,
TRAFIKVERKET – TRV,
VEGAGERDIN,
MINISTERE DE L’ECOLOGIE, DU DEVELOPPEMENT DURABLE ET DE L’ENERGIE,
CENTRO PARA EL DESARROLLO TECNOLOGICO INDUSTRIAL,
ANAS S.p.A.,
NETIVEI, ISRAEL - NATIONAL TRANSPORT INFRASTRUCTURE COMPANY LTD,
FEDERAL HIGHWAY ADMINISTRATION USDOT