ARCHES

a gaze on Central European highway structures

Project presentation

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IBDiM
The main goal of NMS’s administration is constructing a new roads - mainly motorways.

Insufficient resources for the conservation of existing infrastructure.
Road transport

the primary means of mobility for European people and goods
Pan-European corridors
May 1st 2004

1st European Union Enlargement

10 new road networks in system

December 31st 2007

2nd European Union Enlargement

2 new road networks in system
Road system distribution between EU15 and NMS [km]

- EU 15: 3,725,196 km
- NMS: 1,167,268 km

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Road network in new Members States [km]

- Poland: 364,697 km
- Hungary: 159,568 km
- Czech Republic: 127,204 km
- Lithuania: 77,148 km
- Latvia: 60,472 km
- Estonia: 55,944 km
- Slovakia: 42,970 km
- Slovenia: 44,033 km
- Cyprus: 20,250 km
- Malta: 13,943 km
- Bulgaria: 2,222 km
- Romania: 198,817 km

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Conclusion:

$\frac{1}{4}$ of European roads located in CEEC

Critical for E/W and N/S corridors
SIXTH FRAMEWORK PROGRAMME

PRI ORITY 1.6.2

Sustainable Surface Transport

Call 3B
FEHRL
Forum of European National Highway Research Laboratories
the initiative body of the proposal
The Arches Genesis
1st of September 2006

Official start of the ARCHES Project
The ARCHES fact file
The ARCHES partners

Road and Bridge Research Institute
Slovenian National Building and Civil Engineering Institute
Transport Research Centre
Technical University of Catalonia
Ecole Polytechnique Fédérale de Lausanne
University College Dublin
Forum of European National Highway Research Laboratories
Leggedoor Concrete Repair
Autostrade per l’Italia
University of Zagreb
Salonit Anhovo
Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (TNO)

Poland
Slovenia
Czech Republic
Spain
Switzerland
Ireland
Belgium
Holland
Italy
Croatia
Slovenia
Holland
56 researchers and technicians involved
The Project main goal

to reduce the gap
in the standard of highway infrastructure between
Central and Eastern European Countries (CEEC)
and the rest of the EU
The project structure and its main aims

WP2 Avoid intervention
WP3 Prevent corrosion
WP4 Strengthen the structure
WP5 Harden to last

Maximise Use of Existing Infrastructure
Minimise Cost & Societal and Environmental Impact
Bridge the Gap
Workpackage 2

Structural Assessment

The main objective is to develop CEEC-appropriate techniques for optimal bridge assessment
Structural Assessment objectives

- Assess real traffic loads and bridge performance in most efficient way, in CEEC
- Validate soft load testing (normal traffic) = more efficient, no road closures
- Propose a methodology of proof load testing for assessment
- Validate values of reduced dynamic amplification factor (DAF) from SAMARIS
- Validate algorithms for decision making processes associated with Bridge Management Systems (BMS) adapted to CEEC
Workpackage 3

Prevention of Corrosion

The objective - to provide techniques that will arrest corrosion in existing concrete structures and to develop new cheap reinforcing materials that are highly resistant to corrosion.
Prevention of Corrosion objectives

- Study applicability and interest of low-alloyed (and stainless) steels for CEEC road bridges

- Develop and apply new smart Cathodic Protection systems applied in targeted locations

- Develop and validate small electrical resistance (ER) corrosion probes and apply with black and low-alloyed steels to structures
Workpackage 4

Strengthening of Highway Structures

The objective – to develop techniques for bridge strengthening with *Fibre Reinforced Polymer*
Workpackage 5

Hardening of Highway Structures

The objective – to develop techniques for hardening structures in zones of severe environmental and mechanical loading with the use of *Ultra High Performance Fibre Reinforced Concretes*
Goal 1: Development of UHPFRC recipes from local materials in Slovenia and Poland.

Goal 2: Full scale applications of UHPFRC for rehabilitation in Slovenia and Poland.
The ARCHES achievements
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<tr>
<td>1</td>
<td>D 06</td>
<td>Recommendations for the tailoring of UHPFRC recipes</td>
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<td>2</td>
<td>D 07</td>
<td>Internet database of load test results and analytical calculations</td>
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<td>3</td>
<td>D 08</td>
<td>Recommendations on the use of results of monitoring on bridge safety assessment and maintenance</td>
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<td>4</td>
<td>D 09</td>
<td>Recommendations on systematic decision making processes associated with maintenance and reconstruction of bridges</td>
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<td>D 10</td>
<td>Recommendations on dynamic amplification allowance in assessment of bridges</td>
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<td>6</td>
<td>D 11</td>
<td>Recommendations for the use of low-alloy steel</td>
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<td>Recommendations for the use of Cathodic Protection systems</td>
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<td>Recommendations for prestressed externally glued FRP strips</td>
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<td>9</td>
<td>D 14</td>
<td>Recommendations for the use of UHPFRC for composite structural members</td>
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<td>10</td>
<td>D 16</td>
<td>Recommendations on the use of soft, diagnostic or proof load testing</td>
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Barcza viaduct load testing
Barcza viaduct load testing

Preliminary diagnostic (January 2008)

Diagnostic (November 2008)

Proof (November 2008)
Proof load testing
Test load
Diagnostic and proof load testing
Proof load testing - Test results - Deflections/Time
Gamela bridge proof-load test
Gameljne bridge girder lab test
Load test
Internet data base
Low-alloyed steel

Testing program

...in simulated pore water with different Cl concentrations
- polarization resistance,
- potentiodynamic measurements,
- electrochemical impedance spectroscopy,

...concrete specimens
- chosen low-alloy steels embedded in them.
- Corrosion induced by wetting and drying with chloride solution.
- Specimens tested with electrochemical measurements

...an exposure site will be established in the real marine environment

ER (electrochemical resistance) probes for corrosion monitoring developed in the third task of WP 3 will be embedded in concrete specimens.
Cathodic Protection pilot test – Slovenia

Cathodic Protection pilot test – Poland
Prestressed externally glued CFRP strips in Seroczyn Bridge
Prestressed externally glued CFRP strips in Seroczyn Bridge
SALONIT field trial – October 2008
300 litres batches
Total 900 litres
Loss = 50 litres

Slopes of 5+ % can be cast without difficulties
Application time:
10 m² = 10 minutes
Log Cezsoski bridge – Soca river,
-rehabilitation of the sidewalk and deck with UHPFRC,
-replacement of the expansion joint
Log Cezsoski bridge – Soca river
Log Cezsoski bridge – Soca river
Log Cezsoski bridge – Soca river
Log Cezsoski bridge – Soca river
Królowy Most bridge
Królowy Most bridge
Królowy Most bridge
Conclusions

- Project ARCHES targeted to CEEC/NMS
- From the laboratory to the site, strong emphasis on in-situ applications
- Validation of several new methods of optimised assessment, tailored to CEEC
- Implementation of new, easier methods to monitor and prevent/arrest corrosion
- Implementation in CEEC of newest methods of structural rehabilitations to decrease costs and duration of sites
The end in four days

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The ARCHES website

http://arches.fehrl.org/