



# TU1406

COST ACTION

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QUALITY SPECIFICATIONS FOR ROADWAY BRIDGES,  
STANDARDIZATION AT A EUROPEAN LEVEL

## Scientific Report on Short Term Scientific Mission

Researcher  
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Start Date  
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## 1. AIMS AND OBJECTIVES

For the obtaining bridge performance indicators Non-Destructive Techniques and methods can be used. These techniques can on reliable manner inspect these components that are not accessible during the detailed visual inspection. This kind of bridge inspection often are not typically scheduled but may be needed if any considerations about bridge safety exist.

For decision making in maintenance and quality control plans it is very important that there is continuous monitoring over bridge condition exists and that deterioration processes are spotted and followed during the time. Establishing benchmark for monitoring deterioration processes in bridge structures is also one of the reasons why and when Non-Destructive Techniques (NDT) should be applied. It is very important that adequate standards and procedures for NDT exists in order of their appropriate use and interpretation of results. Existence of such guidelines would have positive contribution to management of bridge structure.

Aim of this STSM is to investigate the usage of NDT for obtaining bridge performance indicators in practice on host institution and region or existing guidelines in this area. Focus of this mission is on listing of an adequate NDT, planning activities and test preparation, also on reporting and final results of usage non-destructive techniques in testing.

## 2. WORK CARRIED OUT

During this STSM various activities have been done and following work has been carried out:

- Investigation of codes for bridge and road inspection that is on force in region of Napoli. Gathering knowledge about inspection system, time schedule of planed inspection, bridge component that are evaluated in inspection and bridge indicators obtained from the inspection.
- Visiting laboratory for structure on the Department for structure
- Gathering information about on ongoing projects and available equipment in laboratory. Special attention was payed on equipment for NDT and past project related to NDT investigation of bridge structure, since ongoing projects were not related to the topic of this STSM
- Discussing usage of NDT for obtaining bridge performance indicators, exchanging experience and knowledge in required equipment and gathering and interpreting results
- Discussing possible future collaboration

## 3. MAIN RESULTS

### 3.1. BRIDGE MAINTENANCE AND NON-DESTRUCTIVE TECHNIQUES FOR OBTAINING BRIDGE PERFORMANCE INDICATORS – PRACTISE IN ITALY

As it has been presented in discussion in Italy and region of Napoli bridge maintenance, maintenance planning and quality plans for bridges are under the auspices of kind of public-private partnership. Maintenance planning may vary from company to company but it is under the state provision .It was found that many of document related to bridge maintenance are not available and it is owned by the company that is under the contract for maintenance of roads (bridges and viaducts) in particular area. It was presented that common practice is that more severe rules are applied by the sub-contractors than it is prescribed on state level.

In most of the cases tree levels of inspection exist. Level 1 is common examination done by staff employed often done without any written report, except in case of new problem noticed. Level 2 and Level 3 are done in two and four years' time with written report that is submitted to higher instance.

In Italy it is practice to discuss maintenance of bridge, and bridge indicator parameters depending on construction material. As it is well known, depending on material for construction bridges can be separated in tree big groups: masonry, concrete, steel bridges. Various NDT can be used because each type of bridge has its own weaknesses and maintenance related problems. In this report NDT for obtaining bridge performance indicators will be discussed separately for concrete, steel and masonry bridges, as it was noticed as practice in regulations and practice investigated in this STSM.

### **3.2. OBJECTIVES OF USAGE OF NON-DESTRUCTIVE TESTING OF BRIDGES**

It is noted that non-destructive methods in practice are used in higher level of bridge inspection (level 3). It is highly justified because practice of detail visual inspection on lower levels of bridge inspection has been proved as satisfying for examine bridge condition. Main objective of higher level of bridge inspection and usage of NDT, that are noticed, are:

1. Establishing bridge current condition both physical and functional
2. To determine possible future problems and likely time frame
3. To determine need for maintenance and type of maintenance measures
4. To provide feedback to designers and construction engineers

This type of inspection should be followed by adequate reporting. Reports in practice most of the times have prescribed content by the guidelines of the company. It is noted that reports are consisting of:

- Description of test plans and test methods;
- Photo documentation of testing location;
- Test results and interpretation, recommended maintenance and maintenance materials.

Sometimes Report also has a part of preliminary quantification of works on maintenance and interventions in terms of recommended work value.

### **3.3. TYPES OF BRIDGE INSPECTION**

Visual inspection, in situ inspection and laboratory investigation are tree types of non-destructive techniques that are broadly in use.

Visual inspection must be used before NDT, with aim to determine visible defects like concrete cracking and spalling, reinforcement exposure, corrosion by which testing plan is validate and it is ensured that all critical location are covered by testing.

In situ testing includes: surface testing, material sampling and exposure of interior parts of structure that were not possible to investigate in visual inspection.

Samples of material taken in in situ testing are investigated in laboratory. Laboratory testing is used to examine strength, petrographic content and chemical examination of taken samples.

### **3.4. REPORTING**

Report after non-destructive testing should have:

- Introduction;
- investigation results;
- discussion of obtained results; and most important
- detailed explanation of current bridge condition and recommendations for further testing and maintenance work.

In description of current condition it should be noted (but not always in practice) for every component examined (abutment, pier, deck slab, deck beam etc.) approximately remaining service life and prediction if maintenance work is required in next 10 years for example. These information should be conclusion of report and right feedback to whom required testing.

### 3.5. LIST OF NON-DESTRUCTIVE TECHNIQUES

Type of structure	Available Test Methods	When to use
Steel bridge	Visual Inspection Dye Penetrant Testing Magnetic Particle Testing Ultrasonic Testing Radiographic Testing Eddy Current Tensile Testing Hardness/Rebound Testing Microstructure Testing	<ul style="list-style-type: none"> <li>– When corrosion is identified on welds</li> <li>– When thickness or properties of steel needs to be determined.</li> <li>– When general corrosion or environment-assisted cracking is suspected</li> </ul>
Concrete bridges – Concrete Durability and Deterioration	Cement content and type Chloride and Sulfate Contents Ultrasonic Transmission Velocity (Ultrasonic Pulse Velocity) Petrographic examination Apparent Volume of Permeable Voids (AVPV)	<ul style="list-style-type: none"> <li>– To assist in determining concrete strength and durability</li> <li>– To identify and assess extent of chemical deterioration mechanisms such as sulphate, acid sulphate or soft water effecting.</li> </ul>
Concrete bridges – Strength Examination	Pullout Pull off test Combined use of Ultrasonic Pulse Velocity tester and rebound hammer test Tensile Strength Rebound Hammer Core Drilling Method	To determine concrete strength
Concrete bridges – For assessment of corrosion condition of reinforcement and to determine reinforcement diameter and cover	Half-cell potentiometer Resistivity meter test Test for carbonation of concrete Test for chloride content of concrete Endoscopy Technique Profometer Micro covermeter Ground Penetrating Radar	<ul style="list-style-type: none"> <li>– When condition of steel reinforcement needs to be known.</li> <li>– When visual inspections may have identified significant cracking, rust staining</li> <li>– When knowledge of cover is required</li> </ul>
Masonry bridges	Flat Jack Testing Impact Echo Testing Impulse radar testing Infrared thermography Boroscope	<ul style="list-style-type: none"> <li>– When the condition of joints or the material on the outer surface is required</li> <li>– inspecting mortar and outer layer of brick or stone</li> </ul>

## 4. FUTURE COLLABORATION

Future collaboration was discussed and it was found that two institutions regard this cost action, but also in other topics can cooperate. Object for further collaboration can be topics in bridge sustainability indicators and cooperation in researching and testing of cold formed steel structures.

## 5. FORESEEN PUBLICATIONS/ARTICLES

The results of STSM will be expanded and published in relevant scientific conferences in future.

## 6. ADDITIONAL COMMENTS

Many thanks for host institution Federico II, Professor R. Landolfo and Ms. Lucrezia Cascini for making possible this STSM. Also thanks to COST office for giving me this opportunity.

## 7. REFERENCES

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<http://www.mit.gov.it>
3. link to current maintenace works inthe italian network  
[http://www.mit.gov.it/mit/site.php?o=vh&id\\_cat=256](http://www.mit.gov.it/mit/site.php?o=vh&id_cat=256)
4. Link to a governmental society for engineering works:  
<http://www.spea-engineering.it/services-expertise/asset-management-monitoring-and-maintenance/>
5. CNR: NORME TECNICHE 165 ISTRUZIONI SULLA PIANIFICAZIONE DELLA MANUTENZIONE STRADALE. PONTI E VIADOTTI

## 8. ANNEXES

### 8.1.CONFIRMATION BY THE HOST INSTITUTION ON THE SUCCESSFUL EXECUTION OF THE STSM



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TO WHOM IT MAY CONCERN

This is to confirm that Eng. Nina Serdar successfully completed her STSM in Naples that was held from 22 March 2016 to 29 March 2016 at the Department of Structures for Engineering and Architecture of the University of Naples Federico II

Naples, 30/03/2016

The Host  
Prof. R. Landolfo

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