PhD in Civil and Environmental Engineering

Research Title: Civil structures under damage: large scale testing and numerical modeling for residual safety assessment

SESSION: SUMMER 2019

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Context of the research activity

The Italian civil engineering society is called to answer the urgent need to manage existing civil infrastructures and constructions. The obsolescence of existing infrastructural networks with their bridges, tunnels and roads other than constructions such as buildings or dams is a huge legacy that the society faces today and that will employ large resources in the near future. As an example, it is estimated that more than 11,000 bridges in Italy fail the safety verifications for different reasons other than damage due to aging but they are still in service. For them it is mandatory to evaluate a priority of intervention and reliable testing techniques for their analysis. The resources must be addressed to the most vulnerable structures in the territory to avoid other collapses as happened for Morandi bridge, Annone Brianza bridge and viaduct in Fossano just to mention the last episodes. Italian territory is full of mountains and coasts that required an extraordinary capability to build infrastructures in the late sixties and seventies that are still today the only way of access to some areas. The competitiveness of a country is strictly related to the efficiency and the safety of its infrastructural network.

The actual request is for specific tools aimed to evaluate through integrated protocol the residual safety of civil structure. A key element of this approach...
### Objectives

The aim of the present research will be to develop effective expertise within the structural and infrastructural field with particular attention to existing strategic structures such as bridges to improve the awareness that is fundamental for the new generation of leaders in civil engineering society. This work will be done designing and performing with Taylor made testing devices at large (real) scale, analyzing elements coming from structures in service of Italian structural heritage. Damaging phenomena will be evaluated and mapped using advanced diagnostic experimental techniques with a multidisciplinary approach to detect the damage entity, update the damage conditions and to estimate the evolution of residual safety through numerical simulation. Large scale structural field tests will be designed to extract the largest amount of data and results will be used for structural evaluation, choice of structural retrofitting methods with innovative materials and techniques. These controlled test setups will be also the testing site for innovative emerging technology for monitoring structural safety in civil structures. Numerical modelling will be used to simulate the structural condition according to the experimental test outcomes and to evaluate the residual service life. A recent Agreement among Public Authorities (supervisors are in charge for this project for Politecnico di Torino), give possibilities to test more than 30 elements (beams with 20 meters length and top of the piers) coming from the dismantling of the viaduct of Corso Grosseto in Torino with 50 years of service life and with evident damage using the testing equipment of the Interdepartmental center SISCON (Safety of Infrastructures and Construction). This research project will be a unique opportunity into the structural testing field and will be the benchmark for further researches in this area.

### Skills and competencies for the development of the activity

A candidate profile with a good ability to set up experimental tests and testing systems, the use of tools for numerical analysis and modeling other than a knowledge of damaging mechanism is required. The candidate should demonstrate his potential to develop an innovative research in this field in order to effectively contribute to advancements and develop expertise on large scale testing and numerical modelling of damaged structures.