Modeling the structural performance of existing reinforced concrete structures

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Mission of the course
 	
Main topics
	The assessment of the effective structural performance as well as the prediction and the evaluation of future structural performance of existing concrete structures with or without damage is a very actual issue. Existing structures are different entities to contemporary new structures and are often characterized by sub-optimal details, as too short anchorage length, lack of splitting reinforcement, inappropriately reinforced shear, too large stirrups distances, insufficient reinforcement, plain steel and so on. Moreover, damage caused by deterioration of concrete and/or steel affects the structural capacity in terms of strength and ductility.
	Current codes are typically written for the design of new structures, then the structural safety of an existing structure may be affected by a higher level of approximation and anyway cannot be assessed with the current methods. The proposed course illustrates appropriate and reliable procedures to analyze existing structures in order to:
	  ✓ Assess their actual structural performance;
	  ✓ Evaluate their residual safety, robustness, vulnerability, serviceability;
	  ✓ Predict the evolution of their actual structural performance in the time;
	  ✓ Identify interventions to get a certain safety level and/or to extend the service life.
	Special attention will be given to structures that have experienced structural deterioration/damage and circumstances where the operational requirements have been modified, potentially requiring enhanced structural capacity in the optic of a safe operability in the working life.

Teaching staff

Dr. Stefania Imperatore achieved her PhD in Structural Engineering at the University of Rome Tor Vergata and is specialized in the analysis and modeling of structures deteriorated by corrosion. Stefania is actually assistant professor in Structural Engineering at the University of Rome "Niccolò Cusano", where teaches Structural Engineering and Seismic Reliability of Masonry Structures. The principal research topics are:

- Structural behavior of R.C and P.C structures damaged by corrosion and definition of their residual life.
- Analysis of bridge slabs under punching loads
- Structural and Seismic behavior of old concrete dams
- Analysis of masonry element under seismic actions
- Seismic behavior of historical masonry churches
- Retrofitting of R.C. and Masonry structures with Innovative Materials

Course organization	The course has an expected duration of 20h equally splitted into theoretical lessons and practical exercises (it is suggested a laptop every two students).
Course outline	*Lesson 1 – 2018/03/01-15:00-17:00.* Characterization of deterioration mechanisms and prognosis methods. Tools and techniques for surveys and monitoring. *Definition of deterioration mechanism and prediction of damage/deteriorations levels considered in the assessment approach. Definition of models and methods for the characterization of the deterioration level and the rate of chance of the material properties and/or structural performance based on the results of the inspections surveys and/or monitoring by using appropriate models for the mechanisms of deterioration. Benchmarks and approaches based on inspection, testing and monitoring activities, design and construction records, information upon previous interventions and environmental conditions.* *Lesson 2 – 2018/03/02-10:30-13:30; 15:00-18:00.* Determination of the actual condition of deteriorated components: steel and concrete. *Concrete strength evaluation by mean destructive and non-destructive techniques. Deteriorating effect of alkali aggregate reaction, carbonation, frost thaw cycle, chloride attack and so on. Determination of the corrosion degree of the steel (reinforcing and prestressing reinforcement) including the probability of cross section reduction in critical regions. Numerical applications (in Italian).* *Lesson 3 – 2018/03/09-10:30-13:30; 15:00-18:00.* Determination of the bearing capacity of structures with sub-optimal detailing and/or damaged components. Determination of the remaining service life of the structure. *Careful determination of the bearing capacity, by mean appropriate analysis of the structure by non linear finite element programs. Determination of the residual service life of the structure, also accounting for the spatial variability uncertainties (of the deterioration, of the materials, of the detailing). Numerical applications (in Italian).* *Lesson 4 – 2018/03/16-10:30-13:30; 15:00-18:00.* Conservation and repair measures for damaged existing structures; selection and implementation of the interventions. *Definition of intervention, type of intervention, selection method of intervention, information needed for design/execution of intervention and method for collecting information; materials for intervention; design and execution method for intervention; assessment and performance after intervention. Numerical applications (in Italian).*
Learning evaluation	Students are required to prepare a final report on a subject agreed upon with the teacher and to present the numerical application developed during the course.

Location: *Niccolò Cusano University- Department of Engineering. Via Don Carlo Gnocchi, 3 Rome.*
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