

Politecnico di Milano

PhD in ARCHITECTURE, BUILT ENVIRONMENT AND CONSTRUCTION ENGINEERING - 30th cycle

**Research Title: METHODS OF ANALYSIS AND INNOVATIVE STRATEGIES
FOR SEISMIC ASSESSMENT AND RETROFITTING OF EXISTING STRUCTURES**

Scholarships and Financial support	
Monthly net income of PhD scholarship (max 36 months)	€ €1020.16 (In case of a change of the welfare rates during the three-year period, the amount could be slightly modified)
Number of scholarships	1
Beginning of PhD	01/05/2015
Deadline for application	03/03/2015
Context of the research activity	
Motivations and objectives of the research in this field	<p>The assessment of the seismic vulnerability of existing structures, designed without specific earthquake-resistant provisions, and the definition of techniques and strategies for seismic retrofitting represent interesting and current topics for structural engineering.</p> <p>The assessment of the seismic vulnerability of existing structures can be carried out by using displacement-based methodologies within performance-based approaches. Nonlinear static analysis procedures can provide an efficient alternative to both standard linear analyses and more complex nonlinear dynamic analyses. In literature simplified methods, based on displacement approaches, for the analysis of the nonlinear behavior of structures are present.</p> <p>Standard procedures, based on a single invariant force distribution, and more advanced procedures, such as multi-modal and adaptive, have been proposed, but further studies are required. The issue of the extension of analysis procedures to three-dimensional analyses, above all concerning plan-wise irregular structures, should be investigated. The recent Italian Code NTC (2008) and the subsequent Explicative Notes (2009) deal with the local analysis of existing masonry structures by using the kinematic theorem of limit analysis, assuming masonry as no tension material.</p> <p>Special investigations should be performed for existing masonry churches, for which Italian Guidelines on Architectural Heritage (2011) deal with the vulnerability analysis through the identification of 28 preassigned collapse mechanisms. The use of innovative technologies for seismic protection of existing structures, above all in case of strategic buildings, can represent a promising solution both for the mitigation of the seismic effects of new buildings and for the retrofit of existing ones. The use and the effectiveness of innovative materials (FRP and SMA materials) and the insertion of supplementary dissipative devices or seismic isolation systems are currently under investigation along with design and analysis procedures, modeling</p>

	<p>criteria and rational strategies for structural retrofitting.</p> <p>The main aims of this research project are:-the development of a displacement-based methodology within a performance based approach in order to accurately evaluate the seismic behavior of existing structures, with particular attention to complex buildings with plan and elevation irregularities. - the development of design procedures and criteria for seismic retrofitting of structures by using innovative techniques based on new materials and supplementary dissipative systems.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Most of the research activity will be carried out by means of analytical and numerical models and tools.</p> <p>Experimental activity and treatment of data coming from laboratory and in-situ tests are also required. The results expected concern the development of simplified methods of analysis for the seismic structural assessment and the formulation of design procedures for innovative retrofitting techniques. The main phases of the research project can be summarized as:</p> <ul style="list-style-type: none"> • Proposal and development of methodologies for seismic assessment of existing buildings, based on a) simplified numerical models, b) finite element limit analysis and c) application of nonlinear static analysis procedures for fast and accurate assessment of the seismic response of structures according to displacement-based approaches. • Extension of simplified methods of analysis to irregular and complex structures and determination of the correction factors taking into account the effects of structural irregularities in plan and elevation. • Proposal and choice of rational strategies for seismic structural retrofitting. • Definition of design criteria and assessment of the effectiveness of different retrofitting innovative technologies. <p>Research activities will be performed by the research group in cooperation with other national and international research institutions and companies. Training doctoral courses. The attendance to the following courses offered within the PhD program is strongly suggested to the PhD student:</p> <ul style="list-style-type: none"> • Earthquake Engineering • Structural Rehabilitation • Mechanics of Masonry • Nonlinear Analysis of Reinforced Concrete Structures • Nonlinear Finite Elements
<p>Educational objectives</p>	<p>The proposed research is multi-disciplinary, since many and different topics are involved (materials, structures, technological aspects, earthquake engineering, structural analysis and design, preservation of architectural heritage...). The PhD student engaged in this multidisciplinary project is expected to acquire specialized knowledge on the field of seismic analysis, assessment and retrofitting of existing structures.</p>
<p>Job opportunities</p>	<p>The most direct career opportunities offered by this research project are within research institutions (universities, research centers public or private), large engineering firms, consulting companies, design offices and public authorities involved in preservation of architectural heritage.</p>
<p>Composition of the research group</p>	<p>1 Full Professors 1 Associated Professors 2 Assistant Professors</p>

	1 PhD Students
Name of the principal investigator	Gabriele Milani
E-mail address, phone number and web-page	Gabriele Milani – ABC Department, Politecnico di Milano - gabriele.milani@polimi.it
List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research.	1. Arcidiocesi di Ferrara Comacchio

Additional support	
<u>Housing:</u> financial aid per PhD student per year (gross amount)	=
<u>Funding for educational activities</u> (purchase of study books and material, funding for participation in courses, summer schools, workshops and conferences): funding per PhD student per year	2 nd year: € 1370 per student 3 rd year: € 1370 per student
<u>Teaching assistantship:</u> availability of funding in recognition of support to teaching activities by the PhD student	There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.
<u>Computer availability:</u>	1 st year: <i>shared use</i> 2 nd year: <i>shared use</i> 3 rd year: <i>shared use</i>
<u>Desk availability:</u>	1 st year: <i>shared use</i> 2 nd year: <i>shared use</i> 3 rd year: <i>shared use</i>