



# PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 38th cycle

**Research Area n. 1 - Advanced Materials and Smart Structures**

**PNRR\_352 Research Field: STRUCTURAL HEALTH MONITORING AND PREDICTIVE  
MAINTENANCE OF RAILWAYS BRIDGE**

<b>Monthly net income of PhDscholarship (max 36 months)</b>
<b>€ 1400.0</b>
In case of a change of the welfare rates during the three-year period, the amount could be modified.

<b>Context of the research activity</b>	
<b>Motivation and objectives of the research in this field</b>	<p>The performance of bridges and infrastructural networks evolve over time because of damage caused by natural events (earthquakes, landslides, floods), anthropogenic actions (shocks, explosions, fires) and aging and progressive degradation phenomena (fatigue and corrosion). The difficulty of catching the triggering of some forms of degradation and progressive collapse phenomena requires an assessment of the life cycle of infrastructural works not only in terms of safety and reliability, but also with regard to other performance indicators. Safety, reliability and robustness are key parameters to control the design of individual components and structures, but in the case of bridges, an even broader vision is needed that takes into account the maintenance strategies and how its interaction with the structural health monitoring techniques. The objective of the research is therefore the development of methodologies and technological solutions for bridge monitoring in terms of safety, and interaction with the maintenance procedures; AI, big data and machine learning process will be used to support the management of critical infrastructure to develop sustainable and intelligent mobility of goods and people (Smart Infrastructure).</p>



<p><b>Methods and techniques that will be developed and used to carry out the research</b></p>	<p>The design of effective monitoring systems for infrastructures requires a multidisciplinary approach, which combines the dynamics of the mechanical system with data analysis, to design algorithms that optimally combine signal processing and Machine-Learning skills with the knowledge of the process. A true integration of the skills will lead to new results of high scientific value, with strong repercussions on the industrial sectors of reference, thus allowing a precious technology transfer. The research topics will be developed through numerical and analytical modelling approaches, supported by experimental activities to allow a robust development of the identified technical solutions. The PhD student will use data coming from experimental tests on real bridges, so to put in practice developed algorithms on real datasets coming from infrastructure system.</p>
<p><b>Educational objectives</b></p>	<p>The PhD graduate will be able to: have a in depth mechanical knowledge of infrastructures systems, with reference to railway bridges; develop complex algorithms by mixing model-based approach and deep-learning strategies; critically analyze results coming from AI-based algorithms. We provide doctoral candidates with high-level scientific training, fostering and refining research and problem-solving abilities by focusing on both theoretical and experimental skills. A PhD in Mechanical Engineering will be able to layout, draft and carry-on original research, by leading a research group or working in a team.</p>
<p><b>Job opportunities</b></p>	<p>Job opportunities may be found in infrastructure companies, engineering societies, builders. Among the companies that are cooperating in the research Italferr, RFI, Regione Lombardia, ASPI, Milano Serravalle and RaiWay can be listed.</p>
<p><b>Composition of the research group</b></p>	<p>10 Full Professors 10 Associated Professors 15 Assistant Professors 20 PhD Students</p>
<p><b>Name of the research directors</b></p>	<p>Prof. Marco Belloli</p>

<p style="text-align: center;"><b>Contacts</b></p>	
<p><i>Phone:</i> 02 23998451    <i>Email:</i> marco.belloli@polimi.it</p>	



phd-dmec@polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Amount monthly	700.0 €
By number of months	6

National Operational Program for Research and Innovation	
Company where the candidate will attend the stage (name and brief description)	ITALFERR S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	ETH Zürich
By number of months abroad	6

Company where the candidate will attend the stage (name and brief description)	ITALFERR S.p.A.
By number of months at the company	6
Institution or company where the candidate will spend the period abroad (name and brief description)	ETH Zürich
By number of months abroad	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
<p>Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 5.707, 13.</p> <p>Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. 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.</p>

Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 5.707, 13.

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. 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.