POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

THEMATIC Research Field: WIND ENGINEERING

Monthly net income of PhDscholarship (max 36 months)
€ 1500.0 In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity	
Motivation and objectives of the research in this field	The increasing demand for long-span bridges, often featuring complex deck geometries such as multi-box sections, necessitates a deeper understanding of the aeroelastic forces that influence their performance under dynamic wind loading. With the non-linear and non-stationary behavior of turbulent winds becoming more evident, especially in the context of climate change and the construction of taller, more flexible structures, traditional wind engineering approaches are no longer sufficient to capture the full spectrum of aerodynamic phenomena. This research is motivated by the need to develop more accurate predictive models that incorporate advanced Computational Fluid Dynamics (CFD) techniques, capable of simulating both steady and unsteady flow conditions. The objective is to refine the analysis of aeroelastic forces on bridge decks, particularly multi-box configurations, through the integration of numerical, experimental, and computational methods. By doing so, this research aims to provide more reliable tools for engineers, enhance the safety and efficiency of bridge designs, and push the boundaries of fluid-structure interaction modeling, ultimately contributing to the development of more resilient infrastructure in challenging environmental conditions.
Methods and techniques that will be developed and used to carry out the research	The PhD candidate will be responsible for developing advanced experimental, numerical, and computational models to accurately capture the aeroelastic forces acting on bridge decks, with a particular focus on multi-box deck

	sections (such as twin-box and three-box configurations). These models will account for non-linear aerodynamic behaviors and the non-stationary characteristics of incoming turbulent wind. In addition to traditional modeling approaches, the candidate will leverage Computational Fluid Dynamics (CFD) simulations, in both 2D and 3D, to study steady and unsteady flow conditions around various deck geometries and bridge configurations. The candidate will validate these models and investigate the non-linear aeroelastic characteristics of bridge deck sections with diverse geometries through a combination of wind tunnel tests and numerical simulations. These tests will include both sectional and aeroelastic full bridge models, conducted in the state-of-the-art wind tunnel at Politecnico di Milano, equipped with a 3-degree-of-freedom dynamometric test rig. CFD simulations, particularly under unsteady conditions, will complement these experimental efforts, providing detailed insights into flow structures and vortex shedding phenomena that are often difficult to capture through physical tests alone. Additionally, the candidate's research will integrate the developed CFD models into existing in-house fluid-structure interaction programs, utilizing tools such as Matlab and Fortran, along with CFD software packages like ANSYS Fluent or OpenFOAM. The research will focus on coupling CFD models with numerical simulations to improve accuracy, while also exploring novel computational approaches, such as Large Eddy Simulations (LES), which have shown great promise but have not yet been widely employed in wind engineering. Overall, the candidate's research will combine cutting-edge CFD techniques with advanced numerical modeling and experimental validation to push the boundaries of current wind engineering practices. By utilizing both steady and unsteady CFD simulations, alongside traditional wind tunnel testing, this work will significantly contribute to a deeper understanding of non-linear, non-stationary wind effects on long-span bridges, establishing a robust framework for future applications.
Educational objectives	The PhD program offers a remarkable opportunity for candidates who are motivated and ambitious, possess

	proficiency in goal-oriented work, demonstrate good cooperation abilities, and excel in scientific writing and oral presentation skills.The main objective for the candidate is to contribute original research and advancements in the development and validation of numerical and experimental tools for simulating the aeroelastic response of bridges. This research will involve collaborating with renowned international experts, fostering valuable relationships, and working effectively within a high-level international research team.By engaging in this challenging research environment, the PhD candidate will acquire valuable skills, knowledge, and expertise, establishing themselves as an expert in the field of wind engineering and bridge design. They will be equipped to tackle complex problems and make significant contributions in their chosen area of specialization.
Job opportunities	The competence and expertise acquired through this research will open up various job opportunities primarily in the wind engineering field. These opportunities include positions in engineering companies, engineering and project management firms, as well as with operators and infrastructure managers who deal with wind-related aspects. Additionally, the acquired skills will be valuable for R&D departments of companies involved in road and railway infrastructure design. The knowledge and expertise in bridge aeroelastic response gained during the PhD program will be applicable to addressing the challenges faced in these industries. Furthermore, job prospects extend to national and international academic and non-academic institutions and organizations that are actively engaged in innovation, research, and technical development. These institutions and organizations often seek professionals with expertise in wind engineering and bridge design to contribute to their projects and initiatives. Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared Master of Science holders in the same field.
Composition of the research group	3 Full Professors 3 Associated Professors

	2 Assistant Professors 3 PhD Students
Name of the research directors	Prof. Tommaso Argentini

Contacts
Email tommaso.argentini@polimi.it ; 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)	--

Scholarship Increase for a period abroad	
Amount monthly	750.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
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 6.114,50. Our candidates are strongly encouraged to spend a research period abroad, joining high-level research groups in the specific PhD research topic, selected in agreement with the Supervisor. An increase in the scholarship will be applied for periods up to 6 months (approx. 750 euro/month- net amount). Teaching assistantship: availability of funding in recognition of supporting teaching activitiesby 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.