

CIVIL AND ENVIRONMENTAL ENGINEERING

PNRR - The effects of debris accumulation on the horseshoe vortex and local scour forming at pier foundations

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] Politecnico di TORINO [P.iva/CF:00518460019]
Supervisor	MANES COSTANTINO - costantino.manes@polito.it
Contact	POGGI DAVIDE - davide.poggi@polito.it MANES COSTANTINO - costantino.manes@polito.it
Context of the research activity	<p>The research project focuses on investigating the effects of debris accumulations on the vortex dynamics and local scour at bridge pier foundations. The problem will be addressed in laboratory experiments using advanced laser diagnostics and image analysis techniques to measure velocity fields and erosion features. The final aim is to build upon an improved understanding of the problem's physics to develop a scour prediction methods usable in hydraulic-risk assessment protocols.</p> <p>PNRR M4C2, Investimento 1.3 - Avviso n. 341 del 15/03/2022 - PE0000005 Multi risk science for resilient communities under a changing climate (RETURN) - CUP E13C22001860001</p>
Objectives	<p>The proposed research will support the development of risk assessment strategies related to debris accumulation around bridge piers during flood events and associated worsening effects on local scouring and afflux. Towards this end, the PhD candidate will carry out a series of laboratory experiments that will shed light on unresolved issues such as: (i) quantifying the effects of debris accumulations on horseshoe vortex dynamics and global momentum balance; (ii) build upon point (i) to develop a simple modelling strategy to quantify the worsening effects of debris accumulation on equilibrium local scour and flow resistance forces.</p> <p>The entire research plan will be built upon a wealth of knowledge and the experience of the tutors in terms of: (1) a novel image-based method to monitor the time evolution of the whole scour hole geometry in laboratory settings; (2) an existing theoretical (i.e. non empirical) framework developed at PoliTO that links horseshoe vortex dynamics with local scour processes and predictive formulas; 3) recent findings in terms of debris accumulation</p>

geometry as a function of flow properties and debris-elements size. At the end of his/her PhD the candidate is expected to provide a physically-based method allowing for to estimation of the scour depth of equilibrium around bridge piers, as a function of debris geometry, sediment characteristics and flow properties. It is expected and hoped that such a method will be employed in engineering practice to estimate the vulnerability of water crossing bridges against flood events.

Skills and competencies for the development of the activity

The ideal candidate should hold a Master degree in Civil or Environmental engineering as well as a strong background in hydraulics and experimental methods. The candidate should also have good writing and communication skills in english. Knowledge of italian is desired but not strictly required.