Ph.D. position at EPFL/Empa on:

"Compression-Dominant 3D-Printed Concrete Structural Systems for Buildings"

Empa is the research institute for materials science and technology of the ETH Domain and conducts cutting-edge research to benefit industry and society's well-being. The Empa Structural Engineering Research Laboratory developed new materials, systems, and manufacturing technics for civil infrastructure use. It is one of the biggest and most up-to-date structural laboratories in Europe, equipped with excellent testing facilities required for large-scale experiments. Some of its research endeavors to resolve open issues/questions related to 3D concrete printing. The primary goal is to develop innovative and attractive solutions for the problems hindering the wide-scale adoption of digital fabrication methods in the construction industry.

With over 350 laboratories and research groups on campus, EPFL is one of Europe's most innovative and productive scientific institutions. Ranked top 3 in Europe and top 20 worldwide in many scientific rankings, EPFL has attracted the best researchers in their fields. The School's unique structure fosters trans-disciplinary research and promotes partnerships with other institutions. It continuously combines fundamental research and engineering. PHD students at EPFL benefit from unique skills and excellent infrastructure to conduct their research.

Project description and tasks:

This PhD position is advertised within the framework of CARBCOMN project, which is a collaborative project funded by the European Innovation Council (Horizon EIC 2023), involving a consortium of 11 research and industry partners across Europe. The aim of CARBCOMN is to develop a decarbonized construction system for load-bearing concrete buildings and infrastructure.

The advertised PhD project will focus on structural form finding of compression-dominated structural systems for buildings. The structural system will be composed of discrete blocks made up of 3D printed concrete. Compression-dominant behavior will be achieved by designing an optimized structural form that directs forces primarily into compression paths, minimizing tensile stresses. This behavior will be further enhanced through mechanically induced compression using iron-based shape memory alloy (Fe-SMA) reinforcement. The PhD will comprise the following tasks:

- Topology optimization of discrete blocks to ensure material-efficient design
- Investigation of the mechanical strength characteristics of discrete blocks with small-scale experiments
- Development of innovative joining techniques for discrete blocks, with a focus on potential for deconstruction
- Large-scale experimental testing of compression dominant structural systems under quasi-static loading

Your profile and selection criteria:

The candidate should have a Masters degree in Structural Engineering with a strong background in structural form finding and topology optmization. Experience or interest in 3D concrete printing is also important. Additional skills, including experience in small and large-scale experimental testing, finite element modeling, and knowledge of shape memory alloys, would be an advantage.

A strong desire and motivation to find cutting-edge and innovative solutions in the field of structural engineering are essential. The candidate should have a clear interest in working in an application-oriented research environment in close collaboration with our industrial and academic partners. Good knowledge of English (oral and written) is mandatory. Knowledge of German would be an advantage.

We offer a multifaceted, challenging, and fully funded Ph.D. position for 48 months in a modern research environment with excellent infrastructure. The position is available as soon as possible but should be filled by no later than April 1, 2025.

For further information about the position, please contact Prof. Dr. Moslem Shahverdi (moslem.shahverdi@empa.ch).