

## **NTNU-CSC PhD Scholarship:**

### **3D printing concrete reinforced with 3D printed polymer lattices**

**Type of scholarship:** PhD scholarship

**Period of the scholarship:** 01 October 2021 – 30 September 2025

#### **Short description of the scholarship:**

The 3D printing of concrete is an emerging technology that is likely to exert considerable influence on new construction in the near future. The main advantages of 3DP construction are the ability to produce a more optimized/efficient form of construction and produce structures with complex geometries without expensive and time-consuming formwork.

Prototypes of 3DP systems are now in development around the globe by academics and practitioners and various realizations of 3D printed structures can already be found. However, in order to achieve real applications on the construction market on a larger scale, many research questions have to be resolved, including the structural behavior and the durability of 3D printed concrete structures.

This PhD will focus on optimizing and developing a novel sustainable construction material - 3D printable concrete reinforced with 3D printed polymer lattices to construct load bearing structure to overcome the limitations of existing 3D printable concrete materials which are normally not designed for bending and shear as these structures have to be. The aim is to bring the digital fabrication technology closer to the construction and building market.

The research will firstly start with the development of new generation of sustainable and functional compositions for 3D printing of concrete and focus on the detailed investigations of the rheological and mechanical properties of the printed concrete cured over an extended period of time. Parallel work will be undertaken on establishing methods for ensuring robust processing of 3D printing of concrete and 3D printing of polymer lattices, including essential aspects of reactor design, continuous processing, and material formulation. Full-scale prototypes will be produced at the end and tested in an attempt not only to showcase the development but also to feed into the development of assessment and design methods.

**Qualification and requirement:**

- The PhD-position's main objective is to qualify for work in research positions. The qualification requirement is completion of a master's degree or second degree (equivalent to 120 credits) with a strong academic background in, e.g. materials science, civil engineering and structural engineering or equivalent education with a grade of B or better in terms of NTNU's grading scale.
- Preferred selection criteria
  - The candidate should have a background, and practical experience, with at least two of following fields:
    - ✓ Rheology/flow properties of construction materials
    - ✓ Mechanical properties of concrete/FRC
    - ✓ 3D-printing of construction materials
    - ✓ Advanced numerical simulation (FEM/CFD)
    - ✓ Knowledge of artificial intelligence and/or machine learning
  - Comfortable working in laboratory environment

In addition, for all applicants the following applies:

- Fluent English language, both written and spoken with certificates of TOEFL minimum 95 or IELTS minimum 6.5
- Chinese citizenship documents (copy of his/her passport or national ID of P.R. China)
- CV
- A motivation letter

**Deadline for submission of application:** 15<sup>th</sup> Feb 2021

**Scholarship:** 17000 NOK/month for a period of up to 48 months

*According to the NTNU-CSC agreement*

*CSC will provide a living stipend, currently 12,500 NOK per month for a period of up to forty-eight (48) months, and a round-trip international airfare between China and Norway. NTNU will provide a monthly additional funding for a period of up to forty-eight (48) months, which combined with the CSC living stipend ensures the sufficient income (currently minimum 17,000 NOK per month) required by NTNU. No tuition fees will be charged for PhD candidates at NTNU.*

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