Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name : MEFTAH Given names : Fekri

Status (prof., assistant prof., …) : Professor

Laboratory : Laboratoire de Génie Civil et Génie Mécanique Website address : https://lgcgm.fr/

Institution : INSA Rennes Website address : www.insa-rennes.fr

Scientific competence of the supervisor:

Multi-physics and Multi-scale modelling in porous construction materials
Finite element modelling and numerical programming
Mechanics and physics of materials
Probabilistic methods in engineering

Two major publications in the field proposed for the PhD :

1. F. Meftah et al. A three-dimensional staggered finite element approach for random parametric modeling of thermo-hygral coupled phenomena in porous media. Int. J. Numer. Anal. Meth. Geomech., 36, 574-596
2. F.Meftah, S.Dal Pont, Staggered Finite Volume Modeling of Transport Phenomena in Porous Materials with Convective Boundary Conditions, Transport in Porous Media, 82/2, 275-298.

Website address of the personal page :

Supervisor's email : Fekri.Meftah@insa-rennes.fr

Description of the research work proposed for a PhD ***Topic # (see list) :*** IV-6, IV-7, IV-12

Title : On modeling the effects of polypropylene fibers on preventing spalling hazard for high and ultra-high performance concretes when exposed to fast development fires

Subject :

Concrete spalling due to fire may be a vulnerability of concrete structures. The phenomenon manifests as a breakdown of concrete layers, which flake into small pebble-like pieces at the material surface exposed to fire. Spalling may lead to a reduction of the concrete resistant cross section and a direct exposure to flames of steel rebars which increases the risk of precocious failure of the structure. Adding polypropylene fibres to concrete (PPF-concrete) is an embedded solution that may reduce spalling occurrence by conferring to the material self-protection features against fire hazard. High temperature induces degradation of PPF. Then, the space initially filled by PPF progressively transforms to a network of micro-channels the connectivity of which contributes to the increase of permeability of heated PPF-concrete. This evolution of the microstructure allows reducing pore pressures, which are a major driving mechanism of fire-induced spalling. Nevertheless, adding PPF affects other required design performances of concrete (workability, durability…). Therefore, it is crucial to be able to design PPF-concretes with optimal contents of PPF fibres in order to satisfy all design requirements. The present PhD thesis aims at modelling and investigating fire induced spalling of PPF-concretes, with a focus on low permeability HPC and UHPC, in order to prevent this hazard. The approach is based on a thermo-hygro-mechanical finite element model.

Keywords :

Civil Engineering – Concrete – Fire Resistance – Fire Induced Spalling – Polypropylene Fibers – Finite Element Modeling – Thermo-Hygro-Mechanical Modeling – Mesoscale and macroscale approach.

Expected collaborations :

Rilem Technical Committee dedicated to fire-spalling of concrete:
https://www.rilem.net/groupe/256-spf-spalling-of-concrete-due-to-fire-testing-and-modelling-309

Background required from the applicant :

Skills in:
- Mechanics and Physics of Building Materials / Numerical Methods in Engineering (Finite Element Modeling…)

Knowledge of the following area will be a plus:
- Applied Statistics & Probabilistic methods in engineering / Matlab programming /

Existence of a PDF file detailing the proposal ("yes" or "no") : Yes

(see guidelines on the website www-csc.utt.fr)