

# Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website [www-csc.utt.fr](http://www-csc.utt.fr))

Supervisor's name : MEFTAH Given names : Fekri

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

Laboratory : Laboratoire de Génie Civil et Génie Mécanique  
Equipe GEOSAX Website address : <http://geosax-lcgcm.insa-rennes.fr/>

Institution : INSA Rennes Website address : [www.insa-rennes.fr](http://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](mailto:Fekri.Meftah@insa-rennes.fr)

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

Title : A probabilistic thermo-hygro-mechanical approach for concrete modeled as a random heterogeneous porous medium

Subject :

The behavior of cementitious materials still remains under investigation, especially in some particular engineering applications: tightness of dams and storage structures, safety evaluations during fire in tall buildings and in tunnels, particular scenarios of thermo-hydraulic loading in pipes and other containment structures. In such situations, a complexity in assessing concrete behavior comes from its microstructure, which needs to be sketched as a deformable heterogeneous chemically reactive porous matrix, partially saturated with water and/or other fluids. The heterogeneous microstructure is mainly related to aggregates, cement paste porosity partially filled by fluids, micro-cracks provoked by internal stresses and cracks due to external loadings. Their inevitable presence weakens the porous matrix resistance and constitutes a preferential flow path for fluids, gas and pollutants: material durability and long-term behavior are therefore seriously affected.

From the modelling point of view, heterogeneity can be described either by representing explicitly the microstructure morphology at the mesoscale or by an implicit probabilistic representation of this morphology at the macroscale. This latter allows for significantly reducing computational cost of numerical simulation and therefore for analyzing large-scale problems.

Keywords :

Civil Engineering – Finite Element Modeling - Homogenization / Upscale Modeling – Cementitious Materials – Concrete – Durability Mechanics – Thermo-Hygro-Mechanical couplings – Heterogeneous Random Porous Medium –

Expected collaborations :

Actual collaboration with Research Institute 3S-R, Grenoble, France

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:

- Construction materials / Probabilistic methods in engineering / Matlab programming

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

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