

Andreas Zilian
Professor of Mechanics and Structural Analysis

Université du Luxembourg
Faculty of Science, Technology and Communication
Institute of Computational Engineering

Campus Belval
6, Avenue de la Fonte
L-4362 Esch-sur-Alzette, Luxembourg

T. +352 / 46 66 44 5220
F. +352 / 46 66 44 5200
andreas.zilian@uni.lu



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Ref.: ECON4SD-2017-07-10-PhD4

Doctoral Candidate in Civil Engineering / Computational Engineering

Project: Eco-Construction for Sustainable Development (ECON4SD)

Sub-project: **Predictive modelling and integrated simulation of 3D concrete degradation**

- Ref: R-AGR-3265-10-C
- Fixed-term 14 months initial contract, extendable up to 45 months in total
- Full-time (40 hours/week)
- Starting 1st October 2017, student and employee status

The successful applicant will work on the EU funded project *Eco-Construction for Sustainable Development (ECON4SD)* as part of a research group consisting of six doctoral students and one PostDoc that are all involved in this project. A group of professors will supervise the advancement of the doctoral studies. The doctoral student will be a member of the *Doctoral School in Science and Engineering (DSSE)* offering a *Doctoral Programme in Civil Engineering Sciences* providing interdisciplinary and internationally competitive research training.

PhD project: Evaluation and estimation of the structural health over the lifetime of a building can be performed based on a combination of continuous monitoring and powerful predictive models using numerical simulation techniques. Prediction of the properties of (reinforced) concrete structures, e.g. porosity, density, permeability and strength, is a challenging task as it requires the simultaneous consideration of coupled multi-physics and multi-scale processes associated with mechanical behaviour (shrinkage, creep), hydration, and heat and mass transport involving phase changes and chemical reactions. Long-term exposition of concrete constructions to the environment can lead to harmful microstructural degradation due to carbonation (reducing alkalinity) and chemical attack (sulfate-driven growth of ettringite, calcium leaching) starting from the surface and progressing to the interior of cementitious material.

The PhD research project aims at (a) developing a unified deterministic 3D continuum model for concrete ageing due to environmental exposition, (b) deriving an integral *level of degradation* to be integrated into BIM-guided structural monitoring, and (c) making available an open-source simulation tool for concrete degradation using the FEniCS finite element platform (<https://fenicsproject.org>).

Your Mission

- Research on predictive modelling and integrated simulation of 3D concrete degradation
- Disseminate results through scientific publications and talks at international conferences
- Obtain a PhD in Engineering Science within the framework of the Doctoral Programme in Civil Engineering Sciences of the faculty Doctoral School
- Contribute to undergraduate-level teaching activities (about 3h of assistance per week)

Your Profile

- Master's degree in Civil Engineering, Computational Engineering or similar;
- Profound knowledge of Structural and Continuum Mechanics, Applied Mathematics and Finite Element Analysis;
- Knowledge of Python/C++ programming and development environments;
- Experience in Material Modelling or Multiscale/Multiphysics Analysis is an asset;
- Full working proficiency in the English language. A certified level B2 is the minimum required, while level C1 is a plus;

Further Information

Applications (Cover letter including motivation of research interest, CV, electronic copy of MSc graduation project, copies of MSc diploma including full transcript of records, language certificate) must be sent by e-mail to andreas.zilian@uni.lu.

Applications are to be received no later than 31 August 2017. Only complete applications will be considered. The University of Luxembourg is an equal opportunity employer. All applications will be treated in the strictest confidence.

For more information please contact Professor Dr.-Ing. Andreas Zilian (andreas.zilian@uni.lu).