



THE UNIVERSITY OF  
WESTERN AUSTRALIA  
*Achieve International Excellence*

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## Announcement of PhD position

The School of Civil and Resource Engineering of the University of Western Australia has a PhD position available for the following PhD project:

### MECHANICAL AND STRUCTURAL CHARACTERIZATION OF RAMMED EARTH

#### Supervisors:

Assistant Prof. Daniela Ciancio\* ([daniela@civil.uwa.edu.au](mailto:daniela@civil.uwa.edu.au))

Winthrop Prof. Andy Fourie\* ([fourie@civil.uwa.edu.au](mailto:fourie@civil.uwa.edu.au))

Dr. Charles Augarde\*\* ([charles.augarde@durham.ac.uk](mailto:charles.augarde@durham.ac.uk))

#### Affiliations:

\*The University of Western Australia, Perth, Australia

\*\*Durham University, Durham, UK.

#### Period:

Three years (full time position, 38 hours/week), starting as soon as possible after 1 February 2011.

#### Living allowance stipend:

35,000 AUD per year (tax free).

#### Summary:

The significance of this project lies in recognition of the economic, environmental and social benefits of rammed earth as a construction material in Australian remote communities, and addresses the lack of a proper Australian Standards code supporting its wide-spread use. Qualitative and quantitative characterisation of the material and structural properties of rammed earth will be done through a comprehensive program of laboratory and industry-supported on-site experimental tests. The project will result in a first ever "Proposal Form for Standards Development" for rammed earth structures, to be submitted to Standards Australia. The findings will significantly improve cost effectiveness and safety of rammed earth structures in Australia.

#### Job description:

The conceptual framework is based on 2 main areas of investigations: 1) Assessment of material properties and 2) Establishment of suitable theory for the structural use of rammed earth.

##### *Assessment of material properties of rammed earth*

Guidelines for the assessment of suitability of soil for use in rammed earth construction are relatively broad, making an accurate assessment of soil suitability difficult. These issues will be addressed using two interlinked approaches: 1) an experimental program to quantify

the *macroscale* properties of the material and 2) a *microscale* analysis using Environmental Scanning Electron Microscopy and X-Ray Computed Tomography. During the first year of the project, the PhD candidate will become familiar with standard geotechnical testing methods in order to characterise the soil prior to using it in rammed earth samples. This year, the PhD candidate will work at UWA mainly focused on cement-stabilised rammed earth. For the first part of the second year, he/she will work at Durham University under the supervision of PI Augarde, focusing on unstabilised rammed earth. Returning to UWA, the PhD candidate will spend 12 months on the analysis of this data combined with the *microscale* results described below.

During the 3 year of the project, the PhD candidate will identify cement hydrated products and water bridges within the sample. This will permit to study the relative proportion of water suction and aggregate interlocking (classical solid mechanics) responsible for the macro mechanical properties. The PhD candidate will learn to combine different disciplines (physics, mechanics and chemistry) to develop a theory that can extensively explain the observed experimental phenomena. He/She will greatly benefit from a range of new skills in a vibrant multidisciplinary research environment with academic and industry input. This will lead to excellent professional development which will foster independent leadership skills.

*Establishment of suitable theory for the structural use of rammed earth*

Rammed earth, like concrete, is a brittle material, i.e. it can resist compressive actions but it cracks under the effect of tensile forces. It is mostly employed in load bearing walls and foundations, beams, columns and roof of a house are generally made of other materials, mainly reinforced concrete, timber or steel. The lack of a suitable theory for the structural use of rammed earth means that rammed earth walls are designed using rules of thumb without any engineering fundamentals. Furthermore, the limited use of this material only in load bearing walls denies the potentialities of rammed earth application in other structural parts. This project will address these issues by proposing laboratory and on-site experiments that aim to understand the structural behaviour of rammed earth walls, lintels and foundations.

**Requirements:**

In order to register for a PhD, the applicant should have a Master degree or equivalent. The applicant should have a strong background in solid mechanics, physics and computing. English is the working language at the lab and good written and communication skills are essential.

*Qualification required:* Master in Engineering (Civil Eng., Mech.Eng., Chemical Eng.),

*International Students:* Please note that this scholarship is for a living allowance only. Any prospective student must also apply for a SIRF Scholarship to cover the cost of international student tuition fees and health care cover.

**How to apply:**

To apply for, please send a Curriculum Vitae and a motivation letter to Assistant Professor Daniela Ciancio at [daniela@civil.uwa.edu.au](mailto:daniela@civil.uwa.edu.au).