SEAHA CENTRE FOR DOCTORAL TRAINING IN SCIENCE AND ENGINEERING IN ARTS HERITAGE AND ARCHAEOLOGY

Micro-environmental control for the mitigation of mould growth in indoor heritage

The National Trust maintains nearly 300 historic properties housing varied collections which are affected by a number of environmental agents of deterioration. Mould growth is one of the main risks for organic materials in historic house collections, damaging textiles, paintings and books. Currently, conservation heating is the main strategy used by the Trust to control environmental conditions. It is well known that the development of mould is more likely under certain conditions of temperature and humidity. However, there is strong evidence suggesting that average room conditions are not a sufficient indicator of the risk of mould, as methods based solely on these criteria often fail to predict mould growth in situations where it is observed.

Two factors have been traditionally ignored in mould growth studies in heritage environments (or elsewhere): the inhomogeneity of T/RH conditions and the effects of air movement. It has been observed repeatedly that the formation of micro-climates in semi-enclosed areas (e.g. the back of bookshelves, spaces between books, and constrained spaces between furniture) can cause localised mould growth independently of the average conditions of a room. It is suspected that air movement contributes to the desiccation of mould, and can therefore be used to limit and control its growth.

Currently, however, the role of air motion in the formation of these micro-climates is poorly understood. Furthermore, the mechanisms relating air motion with spore germination are unknown, and as yet there are no technical solutions that allow the thermal control of micro-climates smaller than a single room. To address this issue this project aims to answer the following research questions:

(i) What is the relationship between air motion and mould growth?
(ii) How can the localized risk of mould growth be quantified, monitored and assessed?
(iii) How can air velocity, temperature and humidity be locally controlled with minimum energy consumption?

The successful candidate will have the opportunity to work on experimental research, environmental design and preventive conservation. Experiments will be carried out in environmental chambers with controlled T, RH and air velocity conditions, as well as monitoring in actual historical properties in order to explore the conditions for mould growth. The environmental research will focus on the development of a science-based solution to the micro-management of environmental conditions. Computational fluid dynamics (CFD) will be used to test and develop passive or low energy methods to control air motion using free convection or localized heating. Finally, this research will aim at informing preventive conservation by developing criteria to assess mould growth in indoor heritage, and identify a suitable test-material that can be used to develop a standard and low-cost test for the quantification of mould risk in indoor environments.

This research can bring a radical change in the way indoor environments are managed, by focusing on localised micro-environments instead of whole room volumes. The project aims at developing a new engineering solution, informed by experiments and focused on improving preventive conservation.

The student will benefit from the knowledge of environmental monitoring and simulation of the UCL Institute for Sustainable Heritage (Dr. Josep Grau-Bové) and UCL Chemical Engineering (Dr. Luca Mazzei), the expertise of Tobit Curteis Associates in the environmental deterioration of historic buildings and of the National Trust (Dr. Nigel Blades), which will provide supervision, extensive experience in mould in historic buildings, as well as case study sites such as Blickling Hall (Norfolk), for which environmental data and records of mould growth are already available.

UCL UNIVERSITY OF OXFORD University of Brighton EPSRC

The student will also have the opportunity to work and study with the Trust's central preventive conservation team as part of the project.

Academic entry criteria:

This exciting project will provide the successful candidate a valuable set of interdisciplinary skills in environmental simulation and monitoring, experimental design and heritage management, as well as professional skills to develop their future career in a wide variety of multidisciplinary environments ranging from academia and conservation to engineering consultancy. The successful candidate will have a good first degree in a relevant discipline such as engineering, science, physics, material science, conservation, heritage science or architecture. Previous knowledge of CFD and/or environmental modelling is a plus.Previous knowledge of CFD and/or environmental modelling is a plus.

This project is part of the EPSRC Centre for Doctoral Training in Science and Engineering in Arts, Heritage and Archaeology at University College London, University of Oxford and University of Brighton (www.seaha-cdt.ac.uk), in collaboration with the National Trust and Tobit Curteis and Associates. Funded by the Engineering and Physical Sciences Research Council (EPSRC) through the Centre for Doctoral Training, the four year doctoral research programme will be supervised jointly by the UCL Institute for Sustainable Heritage (http://www.bartlett.ucl.ac.uk/heritage), UCL Chemical Engineering and the National Trust. For further details contact Dr. Josep Grau-Bové (josep.grau.bove@ucl.ac.uk).

As a SEAHA student, you will have unparalleled access to research infrastructure and expertise across three universities and almost 50 heritage, research and industrial partners. In addition to the university doctoral training requirements, SEAHA students take part in an exciting range of cohort activities, ranging from residential events and group projects, to conferences and careers events. Please visit the SEAHA website (www.seaha-cdt.ac.uk) for details.

The SEAHA Studentship will cover home fees and a stipend of up to a maximum of £17,208 per year (current rate) for eligible applicants (http://www.seaha-cdt.ac.uk/opportunities/eligibility-criteria/), and a substantial budget for research, travel, and cohort activities.

The application should include:

- A covering letter clearly stating:
  - Your motivation and how the course will contribute to your career development
  - Your residency status and eligibility for funding according to the information provided http://www.seaha-cdt.ac.uk/opportunities/eligibility-criteria/, or how you intend to sponsor your studies if not eligible for funding
  - Your academic eligibility
- Names of two academic referees (or one academic and one professional if applicable)
- Proof of meeting the UCL English language proficiency requirements where necessary. For SEAHA candidates, an advanced level certificate is normally required (details of English language proficiency requirements can be found at http://www.ucl.ac.uk/prospective-students/graduate/apply/english-language/index)

The applications should be sent by email directly to the Centre Manager: manager@seaha-cdt.ac.uk

Application deadline: open until filled.
UCL Taking Action for Equality.