Institute of Energy & Sustainable Development

De Montfort University, Leicester, UK

PHD STUDENTSHIPS - 3 POSTS

The Institute of Energy and Sustainable Development is one of the top ten UK Universities conducting research into the Built Environment (rated 4A in the 1996 Research Assessment Exercise).

The multi-disciplinary team of engineers, architects, planners, social scientists and computer scientists seeks to make a worthwhile and significant contribution to sustainable development through research, consultancy and education.

Following research grant successes, the Institute is able to offer three studentships in the following areas:

1. Application of Computational Fluid Dynamics to Natural Ventilation;
2. Predicting the impact of the wide-scale uptake of solar energy and, in particular, building-integrated photovoltaics on urban electricity supply networks; and
3. Modelling the impact of asymmetric radiation fields on the thermal comfort of human beings.

Each studentship is tenable for three years. They include tuition fees (UK and EU students) and a bursary of £6,620. Applicants will join a forward looking, vibrant research team and are expected to have a good first degree and relevant skills as described in the further particulars. For an application form and further details contact Claire Stevenson indicating the post in which you are interested:

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Closing date: Friday 15th December 2000

INSTITUTE OF ENERGY & SUSTAINABLE DEVELOPMENT

De Montfort University, Leicester

The mission statement of the Institute is "...to make a worthwhile and significant contribution to sustainable development through research, consultancy and education provision of the highest standards." These activities help improve quality of life for communities and individuals, and facilitate wealth creation. In the 1996 Research Assessment Exercise, the Institute was awarded a grade 4A.

The multi-disciplinary staff profile includes: physicists, mathematicians, social scientists, environmental psychologists, mechanical engineers, electrical engineers, software and hardware engineers, teachers and economists. The Institute's success is based on nurturing 'home-grown' academic excellence and a common commitment to the Institute's mission.

Since its founding in 1994, the Institute has grown from a strong foundation in building energy and environment modelling to embrace renewable energy technology and the wider technical, economic and social barriers to a more sustainable urban development. The Institute employs 22 research and support staff including two Professors and is directed by Professor Kevin Lomas. They are supported by the UK OST research councils and various EU programmes.

Previous research projects have included: fundamental modelling work undertaken to predict human thermal comfort in dynamic and asymmetric thermal environments; simulation of buoyancy-driven ventilation in buildings; validation of thermal simulation programs; development of dessicant cooling machines; and prediction of time-varying illuminance from artificial and natural light sources. The latter also enables the likely implications of wide scale urban deployment of solar technologies to be evaluated.

At a more practical level the Institute is planning the renewable energy strategy for the 3,000 home Ashton Green sustainable settlement in Leicester and has conducted environmental design work to underpin the design of world class buildings including: the stadium for the Sydney 2000 Olympics; the Queens Building (Green Building of the Year 1995); and Coventry University Library. The Institute offers strategic advice to local government through the East Midlands Development Agency, and runs the secretariat for the East Midlands Sustainable Development Round Table. With £1M of external funding, the Institute designed and had built the Brocks Hill Environment Centre in Leicester. This project enables research into ventilated photovoltaics, wind energy and thermal storage. The city of Leicester is a living laboratory for urban energy and environment research carried out within the Institute.

The Institute also operates an MSc course in Energy and Sustainable Development.

Three Year PhD Studentship:

Application of Computational Fluid Dynamics to Natural Ventilation

THE PROJECT

Interest in low energy building design has increased significantly in recent years in response to pressure to reduce the nation's CO_2 emissions. An important feature of 'green' buildings is natural ventilation. In a truly passive building, ventilation is achieved by harnessing the naturally occurring forces of wind and buoyancy. However, at the design stage of such buildings, it is difficult to determine how well a proposed natural ventilation strategy is likely to perform. This can be overcome using Computational Fluid Dynamics (CFD): a detailed computer simulation technique capable of predicting air speed and temperature at many locations throughout spaces.

The aim of this project is to investigate how well CFD programs can predict natural ventilation airflows and to establish guidelines for CFD practitioners on how best to use the technique for this purpose. The work builds on research already undertaken within the Institute which involved CFD modelling of buoyancy-driven flows in simple spaces. The new research will extend this by considering more complex building geometries and the combined influence of wind and buoyancy, and possible infiltration of pollutants. Once a set of robust techniques for modelling the many complexities of natural ventilation has been established, they will be used to address natural ventilation in real building designs. This will enable the influence of key building design parameters on the performance of natural ventilation strategies to be investigated.

The findings of the project will advance the practice of CFD modelling in this area and provide useful information for architects and building engineers regarding the key design features of natural ventilation strategies.

REQUIREMENTS

The ideal candidate will have a mathematics, physics or engineering background and may have some knowledge of CFD techniques.

For further technical details, please contact:

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Three Year PhD Studentship:

The Impact of the Wide-Scale Uptake of Solar Energy in particular, Building-Integrated Photovoltaics

THE PROJECT

The student will work on the EPSRC-funded "Solar City" project which aims to create a planning tool for Local Authorities (LAs) and electricity system Distribution Network Operators (DNOs). The tool will identify buildings suitable for siting building-integrated photovoltaics (BiPVs) and other solar systems (e.g. solar water heating) and will predict the technical and economic impact of these solar systems on urban electricity supply networks. The approach will link dynamic building electrical energy prediction models to a detailed model of the local energy supply network in order to predict the impact of increased solar energy usage on the electricity network (in particular, local voltages and currents).

The tool will be based on a geographical information system with underlying solar radiation, solar system and electricity supply network models and associated databases. It will help LAs to plan effectively for energy and CO2 reduction in the context of a broader use of solar energy and enable DNOs to anticipate the effects of such developments on their networks. As a common software tool, it will also help these, and other key players, to co-operate more effectively by improving communication and by providing a shared basis for planning more sustainable cities.

This is a collaborative research project involving the IESD, the Centre for Renewable Energy Systems Technology (CREST) at Loughborough University, the Midlands Electricity Board, Leicester City Council and Shropshire City Council.

The IESD's objectives are as follows: (i) To devise a classification scheme for buildings and produce estimated electricity demand profiles for each type and then develop a strategy for calibrating the profiles to match measured transformer loads. (ii) To create a 3D model of an area of Shrewsbury, conduct rapid site surveys to classify buildings and assign to each a basic demand profile under the above strategy. (iii) To refine the IESD's innovative prototype method of predicting solar irradiance on surfaces in urban settings and, using the model of Shrewsbury, to automate the process of creating 'solar maps' so that whole cities can be readily analysed. (iv)To link the above maps to a suitable BiPV model and existing models of solar water heating (and perhaps models of passive solar heating and daylighting). (v) To predict the impact on local electricity flows for two scenarios: extensive and restrained integration of BiPV and other solar systems in Shrewsbury. (vi)To consolidate the software framework and deploy the planning tool within the participating LA and DNO.

The appointed Research Student will work closely with a Research Fellow, an experienced software engineer, to create or refine models of PV, solar water heating and daylighting and to develop the strategy for generating and calibrating electrical load profiles using a building classification scheme. There will also be opportunities for on-site survey work to obtain missing information for the models.

REQUIREMENTS

Applicants should have a genuine interest in the mission of the Institute and willingness and ability to contribute to its established modular MSc course in Energy and Sustainable Development.

In view of the interdisciplinary nature of the project, qualifications in a number of academic subject areas may be acceptable, but those with a significant energy- and environment-related content together with a strong numerate basis will be preferred.

For further technical details, please contact:

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Three Year PhD Studentship:

Asymmetric Radiant Fields & Human Thermal Comfort

THE PROJECT

During their daily lives, human beings are frequently subjected to asymmetric radiant fields. Asymmetric thermal and solar radiation can cause thermal discomfort both outdoors and inside buildings, cars, aircraft cabins and other artificial climates. Modelling human responses to inhomogeneous radiation is, therefore, an important challenge for current research into thermal comfort, human performance and health.

The first part of the research project will concentrate on modelling the long- and short-wave radiative heat exchange occurring between a thermoregulated, three-dimensional human body and asymmetric radiant enclosures, and high intensity sources. In the second part, human perceptual responses to asymmetric radiation fields obtained from experimental studies will be modelled using statistical regression techniques. The third part will be concerned with linking the predictive tool with other computer models predicting environmental conditions, i.e. building simulation programs.

The aim of the project is to advance the modelling of human radiative heat transfer and to significantly upgrade our ability to predict and quantify human thermal comfort effects under the complex radiation scenarios occurring in daily life such as combinations of direct and diffuse solar radiation, hot radiators, heated floors, chilled ceilings, cold walls or windows.

REQUIREMENTS

Applicants should have a good first degree in technical engineering, physics or mathematics and have an interest in computer modelling. Some knowledge of human thermal comfort theory would be useful but is not essential.

Good computer modelling skills, experience in MS Windows programming (Delphi), and a fundamental knowledge of the physics of the long-wave and short-wave radiative heat exchange are highly desirable.

For further technical details, please contact:

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