ABCPhD CALL4SCHOLARSHIP 34
RESEARCH TOPIC: Dynamic Modeling of Building Occupant Behavior and Interaction with Energy Efficiency Devices
34th Cycle
**ABC PhD Programme – CALL 4 SCHOLARSHIPS 34**


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**Funding and management of the thematic scholarships**

- **Number of scholarships:** 1 (one)
- **Monthly net income:** € 1,400,00 (max 36 months)
  [In case of a change of the welfare rates during the three-year period, the amount could be slightly modified]
- **Additional support:** Funding for educational activities(*) : € 1,534,33 per student
  [for the 2nd and 3rd year]
- **Starting of PhD activity:** 1/2/2019
- **Research Directors:** Graziano Salvalai (polimi), Roberto Lollini (eurac)
- **Research Group:** G. Salvalai, M. Imperadori; U. Filippi Oberegger, Roberto Lollini.
- **Funding and cooperating Institutions:** the scholarship is funded by Politecnico di Milano, Department ABC and EURAC Research.

(*) (purchase of study books and material, funding for participation in courses, summer schools, workshops, conferences)
Context of the research activity

Occupant behaviour is widely recognized as a major contributing factor to uncertainty of building performance, as demonstrated by the recently started EBC Annex 79 on Occupant Behaviour-Centric Building Design and Operation to which EURAC Research will contribute. Worldwide research in this field ranges from behavioural data collection and simulation of occupant behaviour in buildings to driving behavioural change towards increased energy efficiency and indoor environmental quality. However, there are still many gaps in knowledge and limitations to current methodologies. Advancements require leveraging the expertise and resources of researchers and practitioners around the world to develop robust modelling of occupant behaviour in buildings. A standard framework to describe and model occupant behaviour in buildings needs to be developed to enable model exchange or reuse. This framework must consider the adaptive and non-adaptive triggers as well as the contextual factors influencing occupant behaviour. Behavioural data acquired through monitoring and surveys must be transformed into load profiles and actions on building systems that can be used in building energy simulation software for the estimation of the energy performance and indoor environmental quality of buildings. This in turn enables designing robust energy flexible buildings and sustainable energy conservation measures.
Motivation and objectives of the research in this field

This research is concerned with the development of tailored occupant behaviour models to be deployed in dynamic building energy simulation programs. The PhD student will also study, model, and simulate the interaction of occupants with passive (e.g., windows, shading devices) and active (e.g., HVAC equipment) energy and comfort related systems. Expected results are realistic occupant behaviours as well as related thermal and electrical load profiles at high time resolution and different scales for a variety of occupant, building, device, and climate typologies.

The final objective of the PhD’s work is to develop support instruments for research and advanced consultancy of stakeholders (designers, building owners, facility managers, technology providers, energy consultants, occupants) working on increasing energy efficiency and indoor environmental quality in buildings.
Methods and techniques that will be developed and used to carry out the research

Firstly, the Candidate will analyse the state-of-the-art in characterising occupant behaviour with a focus on building energy simulation programs, from the collection of tailored, reliable input data through monitoring and surveys to the evaluation of simulation results. The next step is to develop statistical and physics-based modelling methods, algorithms, and tools for generating realistic hourly and sub-hourly occupant behaviours and thermal and electrical load profiles. These behaviour and load generation tools are then to be coupled with dynamic building energy modelling software, such as EnergyPlus and TRNSYS. With a complete workflow ready, from behavioural data acquisition to exploitation of simulation results, the Candidate will need to work on the validation of the developed models, identifying suitable metrics for quantifying accuracy and realism of the sub-models involved. An appropriate test matrix will be used to quantify the impacts of occupant behaviours on energy use and indoor environmental quality in different occupant, building, building device, and climate settings. The work will be developed in close contact with R&D projects followed by EURAC Research and will be tuned with the most advanced international research groups. Upon availability, the Candidate will take part in national and international conferences about the topic.
Educational objectives

The learning objectives of the PhD Candidate are the following:

• To acquire the fundamental research skills, a deep understanding of quantitative and deductive methods and qualitative and inductive ones, a critical thinking attitude and experience working in an interdisciplinary research group
• To obtain a deep understanding about occupant behavior and its drivers, building energy systems, energy efficiency, and indoor environmental quality
• To gain a deep knowledge of data acquisition methods and statistical analysis
• To master occupant behavior, load profile generation, and dynamic building energy simulation models in an integrated design approach, with the most advanced digital technologies
• A scientific writing attitude, demonstrated by a good publication record in recognized international journals and conferences
• Collaborative, communication, and management skills, demonstrated in international multi-disciplinary R&D projects
Job opportunities

The PhD has the direct likelihood of leading to a staff member position within EURAC Research with the intent to help the institution target new buildings as well as retrofits. Moreover, this specific doctoral program will provide the candidate with good theoretical and practical background to collaborate in interdisciplinary teams and energy flexible building projects. Job opportunities are available with profit and non-profit companies, NGOs, public institutions as well as international institutions involved in cooperation projects and university teaching, in the following sectors:

- Energy efficiency;
- Indoor environmental quality;
- Energy management;
- Sustainable heating and cooling;
- Construction sector;
- Information and communication technology;
- Policy-maker sector;
- R&D sector.