

Department	School of Engineering and the Built Environment
Supervisors	Dr Inji Kenawy – Associate Professor in Architecture Technology and Built Environment Dr Suha Jaradat – Associate Professor, Programme Leader of Architecture Technology, and Lead of Research
Project Title	Digitally twinned rating systems for low energy housing in Scotland.
<p>PROJECT DESCRIPTION</p> <p>This PhD Project aims to develop innovative ‘digitally twinned’ rating systems for low energy housing in Scotland. Energy efficiency is becoming a pressing issue that must be addressed in current and future housing developments. This is mainly resulting from the global climate and environmental challenges facing the world. Various low-energy solutions, certificates, and building standards have been developed to solve this issue. Among the well-established and known certificates and rating systems for low-energy buildings, are the Building Research Establishment Environmental Assessment Method (BREEAM), Passive House (PH), the Leadership in Energy and Environmental Design (LEEDS), and the Association for Environment Conscious Building (AECB). Passive House benefits have been well-established not only in energy consumption but also in relation to occupants’ evaluation (Pitts, 2017). Occupants’ usage is another vital determinant of energy performance for houses. The performance gap results from the difference between the actual building performance and the calculated one, which is mostly by users’ behaviours. However, the research also shows how the profits associated with low-energy buildings are underrated by the public. Therefore, linking Building Information Modelling (BIM) with low-energy design software (Cemesova, 2015), and using it to evaluate Net Zero energy buildings for existing buildings has been endorsed (Kaewunruen et al, 2019). It’s also noted that low-energy buildings have been more attractive to businesses and large houses rather than social housing developments.</p> <p>This project focuses on the suitability of the different low-energy building systems for Scotland’s new and retrofit housing developments and their possibilities to be associated with digital technologies such as BIM and/or digital twin. The outputs of the project contribute to guiding the development of the current building regulations. Case studies will be selected as part of the research journey. The main objectives of the research are to include:</p> <ol style="list-style-type: none"> 1. Reviewing and evaluating the different low energy systems, certificates, and standards for new development and retrofit projects. 2. Testing the possibility of using BIM and/or Digital twin with selected low-energy systems. 3. Developing a framework that could be used in new social housing and retrofit developments. <p>If you’re interested in energy efficiency, housing development, retrofit projects, BIM, digital twins and building regulations the supervisory team is looking forward to reading your application.</p> <p>Keywords: Low energy buildings, Passive House (Passivhaus), BIM, digital twin, Energy Efficiency, AECB, BREEAM, LEEDS, building regulations, Building rating systems.</p> <p>Academic qualifications A first degree (at least a 2.1) ideally in Architecture, Built Environment/Urban Development with a good fundamental knowledge of Urban Studies and Sustainable Cities.</p>	

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other,

equivalent qualifications will be accepted. [Full details of the University's policy](#) are available online.

Essential attributes:

- Experience of fundamental BIM and digital twins, academic writing and critical analysis
- Competent in Environmental Design, Built environment studies, BIM and digital twin tools
- Knowledge of IT, analytical skills and research methods
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Indicative Bibliography	<ol style="list-style-type: none">1. Pitts, A., 2017, Passive House and Low Energy Buildings: Barriers and Opportunities for Future Development within UK Practice, <i>Sustainability</i>, 9 (2), p. 272, https://doi.org/10.3390/su90202722. Cemesova, A.; Hopfe, C.J.; Mcleod, R.S. PassivBIM: Enhancing interoperability between BIM and low energy design software. <i>Autom. Constr.</i> 2015, 57, 17–32.3. Kaewunruen, S., Rungskunroch, P, and Welsh, J., 2019, A Digital-Twin Evaluation of Net Zero Energy Building for Existing Buildings, <i>Sustainability</i> 11(1), p. 159; https://doi.org/10.3390/su11010159
Enquiries	For informal enquiries about this PhD project, please contact Dr Inji Kenawy by email (i.kenawy@napier.ac.uk)
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process

