Department	School of Engineering and the Built Environment
Supervisors	Dr. Lina Khaddour Dr. Nazmi Sellami Dr. Fadi Khwash
Project Title	Performance criteria for passive housing systems using nanostructured behaviours for energy harvesting and environmental comfort

PROJECT DESCRIPTION

In the context of wider goals towards Sustainable Development Goals SDGs through Net Zero Energy Building nZEB. A combination of sustainable design and renewable energy harvesting strategies is a promising path to sustainable development in the construction sector. 85% of UK households are connected to the gas network, which uses fossil fuels and emits significant amounts of carbon dioxide. The government target is that every home in the UK must get an Energy Performance Certificate (EPC) rating of 'C' or above. Hence, most dwellings, however, are currently in band 'D'. The emerging material systems point towards other physical phenomena for achieving transparency modulation and energy harvesting, demanding a broader range of criteria for advanced glazing controls that allow the glazed building envelope to exist as a transfer function that can address and potentially accommodate the following five principal criteria: 1. Thermal management; 2. Daylighting harvesting and modulation; 3. Maintenance of views; 4. Active power capture, transfer, storage and redistribution; 5. Information Display.

Building upon the existing set of performance requirements for high-performance nZEB, this research aims to prescribe additional system functions using nano-structured behaviors operating within Insulated Glazing Units (IGU) for energy harvesting opportunities and increased thermal comfort. Specifically, the proposed goal is to incorporate multiple functions that span energy performance with culturally valuable attributes such as variable patterning and information display. The data will be collected including measurements such as recordings of residential home indoor-air temperatures. The thermal surveys, heat flux measurements of building fabric elements, as well as concurrent on-site monitoring of the surrounding conditions and a review of household energy bills will be conducted.

The main benefits from developing this system using nano-structured behaviors are addressing the designers selection criteria at an early stage, property developers' economic objectives in adaptive façade optimization as well as the occupants' behaviour while configuring adaptive façades towards nZEB.

Academic qualifications

A first degree (at least a 2.1) ideally in Engineering background, Project Management, Built environment, Quantity surveying, Computer Science or any realeated field with a good fundamental knowledge of Thermal simulation techniques, statistical analysis.

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 Energy/Carbon footprint
- Competent in thermal simulation.
- Knowledge of nZEB
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

Selefmotivation, time management and high commitment to research.

Indicative Bibliography	M. Talaei, M. Mahdavinejad, and R. Azari, "Thermal and energy performance of algae bioreactive façades: A review," Journal of Building Engineering, vol. 28, p. 101011, Mar. 2020, doi: 10.1016/j.jobe.2019.101011. Y. Luo, L. Zhang, M. Bozlar, Z. Liu, H. Guo, and F. Meggers, "Active building envelope systems toward renewable and sustainable energy," Renewable and Sustainable Energy Reviews, vol. 104, pp. 470–491, Apr. 2019, doi: 10.1016/j.rser.2019.01.005. M. S. Buker and S. B. Riffat, "Building integrated solar thermal collectors – A review," Renewable and Sustainable Energy Reviews, vol. 51, pp. 327–346, Nov. 2015, doi: 10.1016/j.rser.2015.06.009. S. M. Hosseini, M. Mohammadi, A. Rosemann, T. Schröder, and J. Lichtenberg, "A morphological approach for kinetic façade design process to improve visual and thermal comfort: Review," Building and Environment, vol. 153, pp. 186–204, Apr. 2019, doi: 10.1016/j.buildenv.2019.02.040.
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