AIR Atmospheric Innovations Research

September 25, 2020

Evaluation of Solar Technologies Combined with Insulated Wall Panel and Air Source Heat Pump

To: Potential Domestic M.A.Sc. Students

The school of engineering seeks a domestic M.A.Sc. student to join a research project starting in January 2021. The project abstract, qualifications, research activities, and compliance to the COVID-19 policies are provided below. The funding is available for 5 semesters to complete the study. The project is in partnership with an industrial client in Guelph through the Mitacs program. To be considered, the student must be a Canadian citizen or a permanent resident, and the student should apply to the University of Guelph via the link https://www.uoguelph.ca/engineering/grad/application-process. For further information, please contact principal investigator Dr. Amir A. Aliabadi at aliabadi@uoguelph.ca.

Project Abstract:

The high cost of building energy consumption, including heating and cooling applications for Canadian climates, has created a significant obstacle for affordable housing. The efficient utilization of solar energy technologies as well as the effective integration of thermal storage systems have been identified as a great step toward the net zero energy building (NZEB) scenario and affordable housing. The current research project attempts to develop an energy-efficient and economically feasible thermal energy system with building integrated components. The thermal energy system will include an air source heat pump (ASHP) assisted by building integrated solar technologies and a building integrated thermal energy storage (BITES) system. The BITES system will be designed within expanded polypropylene (EPP) panels having superior mechanical and insulation properties to commonly used insulated concrete form (ICF) blocks. The design of the building integrated components will be conducted in such a way that they could be manufactured with minimal waste toward the affordable housing target. The thermal energy system will be conceptually designed, computationally simulated, and experimentally evaluated. For experimental testing, a prototype system along with an experimental rig will be designed and constructed. The effect of several design variables such as outdoor temperature, humidity, wind, and solar radiation on the thermal performance of the system will be analyzed. The thermal performance of the system will be quantified by measuring the performance indicators including the indoor temperature, heating and cooling energy, solar panel's efficiency, thermal energy storage's efficiency, and heat pump's coefficient of performance. Based on this thermal analysis, the applicability of the prototype system for affordable housing market at full-scale for multi-unit residential buildings (MURB) will be evaluated and discussed.

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Qualifications:

The ideal candidate would have been majored in Civil, Mechanical, or Environmental Engineering programs at accredited universities. The candidate should be on the trajectory to develop strong technical skills in experimental and numerical analysis of thermo-fluid systems. Prior exposure to computer programming, sensor instrumentation, environmental sampling, data analysis, and numerical analysis of the thermo-fluid problems are desirable assets. The candidate should have strong English and technical writing skills toward writing and submitting peer-reviewed journal articles from the project results. The candidate should manage the relationship with the industrial client by performing duties toward a strongly positive research collaboration with the client.

Research Activities:

The student would help other senior research staff members who are dedicated to the project. However, the student is expected to become independent in the research after a training period. The student would help develop an experimental rig for environmental monitoring of building energy systems or a whole building mock-up. The rig will be situated at the facility of the industrial client in Guelph. This involves programming data loggers, sampling environmental data from sensors measuring temperature, humidity, air velocity, radiation fluxes, electricity, and thermal energy transfer, and post processing the collected data using the Python programming language. The student would help building and running simulation models of the building energy systems or a whole building using common open source or commercial platforms such as EnergyPlus, TRNSYS, IES <VE>, ANSYS Fluent, or OpenFOAM. Student would prepare and submit peer-reviewed journal articles from the results of the research.

Compliance to COVID-19 Policies:

Please note that research activities carried out in the context of COVID-19 need to adhere to the University of Guelph COVID-19 research principles, policies, guidelines and processes as they may be updated from time to time and communicated on the following link https://www.uoguelph.ca/research/. Additional policies may apply by the industrial client for work to be carried out in their facility.

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