

Particulate Matter Concentration Measurement in Energy Retrofit Buildings.

Rationale and Project Objectives

Retrofitting of buildings has been identified as a cost-effective means of achieving energy savings in the economy, but literature indicates a link between increased indoor particulate matter (PM) concentrations and greater building airtightness that can result from retrofit. A computational model has been developed at NUI Galway which predicts PM concentrations in retrofitted dwellings that have experienced a consequent air tightness change. The framework is flexible, and simulates multi-zone building geometries, but currently there is insufficiently detailed model validation data available. In the internship project, it is proposed that the student will fully characterise the ventilation and air tightness status of selected dwellings, through measurement, parameterise the model for the geometries and ventilation states of the those dwellings, and make comparative predictions of PM concentrations. TSI Sidepak Aerosol monitors will be used for PM measurement, and air exchange rates will be derived from tracer gas decay tests. Airtightness measurements will be made by an external agent (separate funding is available for this). The breakdown of tasks is: *Week 1: Set-up. Week 2-3 Data collection. Week 4-5 Data analysis and preliminary simulation Week 6 Project debrief.* In this six week period, the student will gain valuable experience in the use of a range of aerosol and environmental measurement equipment, and will have exposure to a computational research tool.

Supervision Plan and Facilities/Resources

The student will be supervised by Dr. Miriam Byrne who has expertise in indoor aerosol science. The necessary instruments for monitoring indoor air pollution levels, including TSI SidePak AM510 monitors and, Greywolf CO₂ analysers, are available at NUI Galway. The probabilistic modelling code, IAPPEM (<http://dx.doi.org/10.1016/j.scitotenv.2014.05.081>), which allows simulation of the passage of air pollutants into and around multi-zone buildings, was developed in Dr. Byrne's research group, and will be accessible to the student to run simulations. The computing hardware and software requirements for the project are available within the School of Physics at NUI Galway.

Dr. Byrne is a key member of NUI Galway's Centre for Climate & Air Pollution Studies, which contributes approximately 30 researchers and post-graduate students plus five academic staff to the Centre. The School of Physics component of C-CAPS typically produces 40 research publications per annum. Over the last ten years, five papers have been published in Nature or Science. During the project period, the supervisor will ensure that the student visits the Atmospheric Research Centre at Mace Head, NUI Galway, recognised by the World Meteorological Association as a Global Atmosphere Watch research site. This will expose the student to high-quality aerosol research beyond the scope of their short-term project.

Anticipated Benefits to the Student and the Research Field

The Aerosol Society Undergraduate Research Bursary would provide an excellent opportunity to develop the student's research portfolio to enhance their future submission to the prestigious Irish Research Council Government of Ireland Postgraduate Scholarship Scheme. The applicant's capability accounts for 30% of the overall project marks; two of the key assessment criteria are the "Track record and research potential of the applicant" and "the match between applicant profile and research project". A candidate with a track record in research, demonstrated through an internship, would have a substantial advantage in securing Ph.D. funding.

The project team plans to attend the Air Infiltration and Ventilation Centre Conference in Nottingham in September, to present other work, and envisage submitting an additional manuscript based on the internship data. In addition, once the data generated have been used to validate the computational model and a full range of simulations have been run, a manuscript will be submitted to the journal Building and Environment: the student will be a co-author of this manuscript.

Student Selection

Ms. Ciarraí O Toole has made an approach to Miriam Byrne's research group, seeking a summer internship. Ms O Toole is one of the highest performing students (outline CV attached) in the current 3rd year Applied Physics undergraduate class at NUI Galway, and has a clear interest in environmental physics, having secured an A-grade in her Semester 1 "Physics of the Environment" module. She has already discussed postgraduate prospects with the proposed supervisor for this proposal, and would be strong candidate for a national PhD scholarship award.