Description of Funded Research Projects
1st Call for H.F.R.I. Research Projects to support Post-Doctoral Researchers

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Research Project Title:

Numerical and experimental assessment of solar air heater systems performance towards zero energy buildings

Principal Investigator:
Dimitrios Fidaros

Popular Title:

Computational simulation and experiments for the use of passive solar applications for buildings with reduced energy consumption

Scientific Field:
Engineering and Technological Sciences

Host Institution:
University of Thessaly - Greece

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The main objective of the project is the development of a user-friendly software tool for the design and energy performance assessment of three types of Solar Air Heater (SAH) systems for heating buildings in Mediterranean climatic conditions. SAH systems represent a cost-effective technology used either to heat a space attached to it or to heat air for industrial applications and processes.

Initially a simplified software tool based on ISO 13790 will be developed. A test cell of 12 m2 will be constructed with modular south wall where three SAH systems and a modification of the last one will be adapted and measured. Measurements will concern both the indoor microclimatic conditions and the energy performance during winter and summer. Those measurements will be used for the validation of full Computational Fluid Dynamics (CFD) models and of CFD-BES (Building Energy Simulation) models. In parallel the operation of the passive systems will be studied with the state of art BES tools too. The validated numerical models will be used for the estimation of heat transfer coefficients and dynamic parameters for various configurations, geometric characteristics and external climatic conditions. These parameters will be used for the optimization of the simplified software tool developed in the first phase. Finally, a good practice guide will be produced for the SAHs' design and operation.

The proposed scientific approach will offer innovative aspects on: i) the development of CFD models capable to simulate the operation of SAH systems, ii) the coupling between the CFD with BES tool in order to create boundary conditions and perform conflated simulation, and iii) the dimensional analysis of the main flow and heat transfer mechanisms in terms of dimensionless numbers based on the theory of Fluid Mechanics and Heat Transfer (like Re, Nu, Gr, Ra etc) that will give the results a wider validity and generality.

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Project Impact on Society

The impact of the project results in the Greek society is focus on two levels: a) job growth and b) buildings environmental footprint reduction.

a) It is expected job and economy growth for (i) engineers since designers who will be provided with a friendly user tool for the design of SAH systems and the estimation of their energy performance advancing their skills and promoting their possibilities to offer their expertise beyond frontiers (ii) buildings constructors and special technicians (iii) labors in industrial sector which will produced prefabricated elements of SAH systems. In EU it is forecasted that the budget for the greening and the renovation – refurbishment will reach the amount of 25b€ up to 2030.

b) The reduction of buildings environmental footprint is related with the energy saving from the application of the solar air heater systems on buildings, the related reduced natural sources consumption and greenhouse gases emissions.

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To me, H.F.R.I. funding would mean...

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H.F.R.I. funding for the academic research described in this proposal, strengthens and assists in the creation of a small research team by young scientists, able to work within the country and promote research in a field of strong interest inside and outside of country. Research activity for buildings with reduced or near zero energy consumption, has beneficial effects on society as a whole in combating energy poverty, in the national economy by reducing energy costs and, most importantly, in the environment by reducing the use of natural resources and greenhouse gas emissions.

Producing research results that potentially will be used in the design of modern constructions by present research team, will enhance its ability to further implement new and innovative methods in the integration of passive solutions and RES systems into buildings, by expanding its capabilities to claim funding from European and national resources, to study and produce prototype product designs with international orientation.

The Principal Investigator,

Dimitrios Fidaros

Funding

Amount: **180,000 €**

Duration: **36 months**

Foundation: **H.F.R.I.**

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