Topic 2.3: Building Integrated PV systems

Numerical modelling of combined Building Integrated PV / Thermal systems

J.J. Bloem[1], A. Gandini[2], L. Mazzarella[2]
[1]Joint Research Centre, Environment Institute, Renewable Energies Unit
I - 21020 Ispra, Italy
Tel +39.0332.789842, Fax +39.0332.789992, E-mail hans.bloem@jrc.it
[2]Politecnico di Milano, Italy

ABSTRACT

Objectives
The main objective of the presented work was the development of a calculation model for ventilated PV applications integrated in the building envelope (BIPV). A further objective was the validation of the model using data from a well-controlled outdoor experiment.

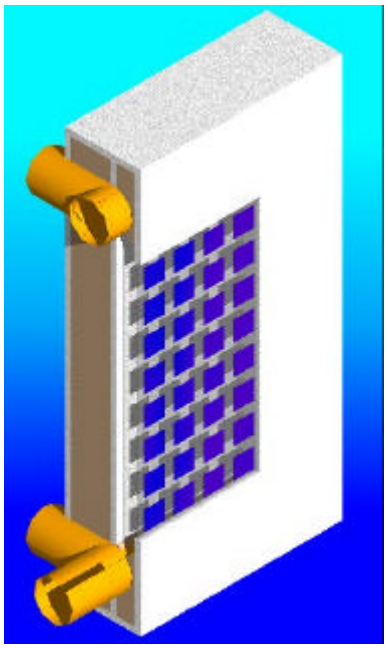
Approach
A literature study provided the theoretical basis for the description of the thermal and electrical processes in BIPV applications. Based on this experience the experimental set-up was designed and different models were created for elaborations of the obtained data.

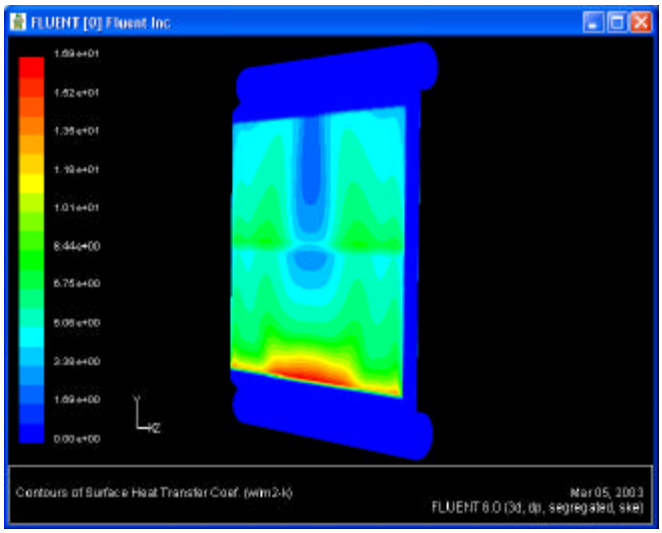
Experimental work
At the JRC in Ispra, four different composed PV modules were tested under Standard Test Conditions in the ESTI laboratory before they each were installed on the Test Reference Environment at the outdoor BIPV test facility [2]. For model validation purposes the PV modules differ in composition of the layers. The boundary conditions in the TRE, such as air-velocity and air-flow path in the air gap, have been different as well for the same purposes. Thermo graphical images were made throughout the experiment for validation.

The JRC outdoor Test Reference Environment (TRE)

Modelling
Three type of models based on energy flows [1], different for their complexity have been studied. Accordingly the model parameters have been determined using the

collected data. The model has been written in Fortran to be added to the TRNSYS simulation environment. Additional modelling for the air flow path was carried out with the Fluent software tool.





Above: Contour of the surface heat transfer coefficient

Left: Cross view of the Test Reference Environment

Results and Conclusion

Data have been collected over a period of eight months using four PV modules, each under ten different but comparable conditions. Validation of the model has been carried out successfully using these data. The result of this work is a software model that could be used by engineers and architects for the prediction of total energy performance of BIPV applications.

References

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3. "Numerical analysis of double skin façades " – E. Avanzi, L. Mazzarella – Politecnico di Milano - 2001