COST Action TU1205 (BISTS)

Building Integration of Solar Thermal Systems

OVERVIEW OF BISTS STATE OF THE ART, MODELS AND APPLICATIONS

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Cost Action TU1205 – Basic Info

Chair of the Action: Soteris Kalogirou, Cyprus

Vice-Chair of the Action: Mervyn Smyth, UK

Rapporteur: Luis Braganca, Portugal

Working Group 1 Leader: Werner Platzer, Germany

Working Group 1 Deputy Leader: Aleksandra Krstic-Furundzic, Serbia

Working Group 2 Leader: Daniel Chemisana, Spain

Working Group 2 Deputy Leader: Alberto Coronas, Spain

Working Group 3 Leader: Aggelos Zacharopoulos, UK

Working Group 3 Deputy Leader: Manolis Souliotis, Greece

Working Group 4 Leader: Brian Norton, Ireland

Working Group 4 Deputy Leader: David Kennedy, Ireland

Management Committee

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Manuela Almeida, Portugal

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Muhsin Kilic, Turkey

Andy Ford, UK

Working Group Participants

Rumen Popov, Burgaria

Rafaela Agathokleous, Cyprus

Constantinos Christofi, Cyprus

Georgios Florides, Cyprus

Charalambos Tsioutis, Cyprus

Andreas Savvides, Cyprus

Constantinos Vasiliades, Cyprus

Christoph Cappel, Germany

Christoph Maurer, Germany

Christophis Koroneos, Greece

Aritra Ghosh, Ireland

Donal Keys, Ireland

Tim Oleary, Ireland

Sarah McCormack, Ireland

Mick Mckeever, Ireland

Lacour Ayompe, Ireland

Carlos Ochoa, Israel

Annamaria Buonomano, Italy

Tamasauskas Rokas, Lithuania

Artur Rusowicz, Poland

Laura Aelenei, Portugal

Ricardo Mateus, Portugal

Sandra Montaro da Silva, Portugal

Eliseu Ribeiro, Portugal

Ivan Miletic, Serbia

Danijela Nikolic, Serbia

Jasna Radulovic, Serbia

Blagojebic Mirko, Serbia

Kosic Tatjana, Serbia

Luisa F. Cabeza, Spain

Iñigo Iparraguirre, Spain

Chrysovalantou Lamnatou, Spain

Stefan Remke, Spain

Lopez Lorenzo Jose, Spain

Jayanta Deb Mondol, UK

Trevor Hyde, UK

Non-COST countries participation

Andreas Athienitis, Canada

James Russell, USA

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Wall, M.; Munari Probst, M. C.; Roecker, Ch.; Dubois, M.-C.; Horvat, M.; Jørgensen, O. B.; Kappel, K. (2012): Achieving Solar Energy in Architecture-IEA SHC Task 41. In *Energy Procedia* 30, pp. 1250–1260. DOI: 10.1016/j.egypro.2012.11.138.

Yang, H. X.; Marshall, R. H.; Brinkworth, B. J. (1996): Validated simulation for thermal regulation of photovoltaic structures. In IEEE Electron Devices Society (Ed.): Proceedings of IEEE 25th Photovoltaic Specialists Conference: Institute of Electrical & Electronics Engineers (IEEE).

Zakaria, M. A.; Hawlader, M.N.A. (2013): A review on solar assisted heat pump systems in Singapore. In *Renewable and Sustainable Energy Reviews 26 286–293*.

PART II:

Review on modelling and simulation of building-integrated solar thermal systems

Contributors:

Chr. Lamnatou, Spain

J. Mondol, UK

A. Ghosh,

D. Nikolic, Serbia

M. Bojic, Serbia

S. Kalogirou, Cyprus

D. Chemisana, Spain

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Abstract

In the present study, a literature review focusing on Building-Integrated (BI) solar systems is conducted. The review refers to systems which produce thermal, electrical or both thermal/ electrical energy. Emphasis is given on the BI solar thermal systems while the solar electrical and solar thermal/electrical systems are also included in order to have a more complete picture of the current literature. The results of the review show that in the literature the greatest part of the models are thermal and/or energetic simulations of BI Photovoltaic-Thermal (PVT) (or BI PV) and skin façades. Thus, there is a need for thermal and/or energetic modelling works about BI solar thermal systems, especially for models which give emphasis to the building (since the greatest part of the investigations give emphasis to the system itself). On the other hand, the optical-models are very few and certainly, more optical-modelling studies are needed since they could provide useful information for the behaviour of the BI solar thermal systems from the optical point of view.

1 Introduction

The building sector is an energy-demand sector and the use of renewable energy technologies could provide considerable benefits. Among renewable energy systems, solar energy technologies are promising especially for countries with high solar radiation. In the frame of this concept, several solar systems have been already tested and applied in buildings. Nevertheless, there is a potential for further development and this could be achieved by adopting solar systems which are integrated into the building envelope. This specific type of systems in the literature is known as Building Integrated (BI) solar systems. BI configurations are a new tendency in the building sector and they provide several advantages given the fact that they replace a part of the building (façade, roof, etc.). Among the BI systems, solar thermal are a recent development; thereby, there is a potential for further development and this could be achieved by investigating this type of installations e.g. by means of modelling.

The present work provides an overview in terms of modelling works about BI solar thermal systems. References from the literature about BI solar thermal configurations along with other systems (which produce electrical and thermal or only electrical energy) are cited, separated into groups, based on the type of the model (thermal, energetic simulation, etc.) and based on the specific characteristics of each system (skin façade, solar thermal collector, Photovoltaic-Thermal (PVT), etc.). In this way, a complete picture of the studies available in literature is provided while the gaps in literature are identified. It should be noted that few works about systems which are Building-Added (BA) (and not real BI) are also cited for certain cases when the system/or the model is of great interest. Moreover, in some categories, some general studies (e.g. about modelling of building components) are also cited.

In the literature there are no review works about the modelling studies in the field of BI solar thermal systems and thus, the present work is an innovative study. The results of the present investigation reveal which types of models/systems are available in the current literature and which types need further development. In this way, the present work provides useful information for example for academic/research purposes while models/systems which would be interesting for future investigation are also proposed.

2 Studies of Energetic Simulation (emphasis: building)

2.1 BI, Skin Façade

1. Ciampi M., Leccese F. and Tuoni G., Ventilated facades energy performance in summer cooling of buildings, 2003: Solar Energy 75(6), 491–502.

http://dx.doi.org/10.1016/j.solener.2003.09.010

Contexts	Outcomes
An analytical, simple method for design applications → evaluation of electrical energy savings in buildings	In all cases, the energy saving increases as the air duct width increases, The positioning of the insulating