Università degli Studi di Napoli Federico II

Scuola Politecnica e delle Scienze di Base

Dipartimento di Ingegneria Industriale

Invited Lecture

Pathways to resilient solar buildings and communities

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Aula Bobbio, 1st floor, P.le Tecchio 80, 80125 - Naples

Abstract

This presentation will focus first on modeling and design of advanced solar buildings and communities that are optimized to capture solar energy through building-integrated solar systems for simultaneous production of electricity and useful heat, optimally designed windows for capturing passive solar heat gains and daylight and efficient techniques of building-integrated energy storage. Results from Canadian high-performance demonstration buildings are presented with emphasis on their design and operation. Current work by the team of the presenter on development of building-integrated solar systems and predictive control strategies is overviewed with application to the Varennes Library, a smart solar net-zero energy institutional building completed in Canada in 2016 and currently being monitored and studied. The term "Smart" is used to describe two major expected characteristics of such buildings:

1. A building that optimally controls its indoor environment and is responsive to occupant needs so as to provide good indoor comfort for work, leisure activities and rest.
2. A building that optimizes its operation so as to substantially reduce energy consumption costs while optimally interacting with energy grids – both electrical and thermal, including the possibility of electric vehicle integration and bi-directional electricity flow.

Broader design and policy issues for the built environment are discussed with focus on resilient buildings and communities interacting in an optimal way with smart energy grids so as to shift and reduce peak demand for electricity by optimizing production, storage and utilization of energy from renewable energy sources. The development of such buildings and communities poses major challenges and requires significant innovations in design, construction and operation – some of these innovations will be briefly discussed, including configurations with heat pumps connected to building-integrated solar systems and energy storage. Finally, design and operation for energy resilience is discussed and possible solutions are presented that will enable a community to generate its own electricity and heat for periods of at least one week, particularly in extreme weather conditions or emergencies.

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Dr. Andreas K. Athienitis is a Professor of Building Engineering at Concordia University and holds a Senior NSERC/Hydro Quebec Industrial Research Chair and a Concordia University Research Chair, Tier I. He obtained a B.Sc. in Mechanical Engineering (1981) from the University of New Brunswick and a Ph.D. in Mechanical Engineering from the University of Waterloo (1985). He is a Fellow of the Canadian Academy of Engineering, a Fellow of ASHRAE and a Fellow of IBPSA. He served as Scientific Director and Principal Investigator of two Natural Sciences and Engineering Research Council of Canada (NSERC) strategic networks on Smart Solar and Net-zero Energy Buildings (2005-2017) that included about 30 Canadian researchers from 15 universities and about 30 industrial and other partners. He is founder and Director of the Concordia University Centre for Zero Energy Building Studies. He is the author of more than 300 refereed papers, the Mathcad electronic book "Building Thermal Analysis" and the graduate level book "Thermal Analysis and Design of Passive Solar Buildings". He is a recipient of seven best paper awards, including ASHRAE Willis H. Carrier award. He served as subtask leader of IEA SHC Task 40 / ECBCS Annex 52 "Towards Net-zero Energy Solar Buildings" under which he co-edited and was lead author of the advanced book "Modeling, Design, and Optimization of Net-Zero Energy Buildings". He is a contributing author of the Intergovernmental Panel for Climate Change (IPCC). He played a leading role in the design of several award winning high-performance net-zero or near net-zero energy buildings. He was profiled as one of 25 top innovators in Quebec by Actualité Magazine. He has supervised over 80 graduate students with more than 10 becoming professors in universities around the world. He obtained over $30 M of research grants as principal investigator.

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