The Evolving Metropolis
2019 IABSE Congress New York City

IABSE 90 YEARS

Concepts of Energy-Autonomous Building Climate Automation

Stefan REICH
Prof. Dr.
Anhalt University of Applied Sciences, building envelope research group
Dessau, Germany
stefan.reich@hs-anhalt.de

Sagar VANAPALLI
MSc
Anhalt University of Applied Sciences, building envelope research group
Dessau, Germany
sagar.vanapalli@hs-anhalt.de

Henning DUERR
Dipl.-Ing.
Anhalt University of Applied Sciences, building envelope research group
Dessau, Germany
henning.duerr@hs-anhalt.de

Contact: https://www.hs-anhalt.de/berg

1 Abstract

The controlling of the building climate requires an immense energy consumption worldwide. In modern buildings, the heating energy amount can be reduced into reasonable level by the use of building insulation and low u-value facade parts. In most countries the energy needed for building cooling is a significant amount of the total building energy consumption. At office buildings the necessary cooling energy often exceeds the consumed heating energy. Therefore modern building may use a variety of shading systems to reduce the input of solar radiation into the rooms. Beside manually operated systems especially electronically operated ones seem to be the future standard in buildings.

Despite their huge comfort and efficiency these electronically operated systems are often limited to higher standard buildings and wealthier regions. Therefore this paper describes as intermediate results of an ongoing research project several concepts of the integration of energy autonomous shading and ventilation systems. All of them base on the use of temperature sensitive shape memory alloy as actuator for the moving of mechanical components. They do not need any electrical energy or electrical components, like controllers, motors or infrastructure. The concept is demonstrated in various applications from shading blinds, shading lamellas, night cooling ventilation or forced ventilation for necessary room air exchange.

Promising main applications, as night cooling or shading lamellas are investigated and demonstrated in life-size mock-ups.

Keywords: building climate, energy autonomy, shape memory alloys, sun shading, ventilation

2 Introduction

Today in the EU, the buildings are responsible for approximately 40% of energy consumption and 36% of CO_2 emissions. Currently, about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient. [1]

Improving the energy efficiency of buildings can also generate other economic, social and environmental benefits. Better performing buildings provide higher levels of comfort and wellbeing for their occupants, and improve health by reducing illnesses caused by a poor indoor climate. The building envelope, the façade is the key for improving energy efficiency of buildings.

The current building envelopes are usually passive systems and at new built houses largely exhausted from their energetic point of view. The amount of yearly heating energy can be reduced to a reasonable level by the use of state-of-the-art façade insulation and low u-value building components. Nevertheless, today's building envelopes cannot react to changing environmental conditions related to daily or annual weather cycles nor to user needs. In a typical, highly insulated new

https://doi.org/10.2749/newyork.2019.1036
Distributed by Structurae