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Exzellente Forschung für Hessens Zukunft

INNASOL – Einbindung eines innovativen Asphaltsolarkollektors in die Energiegebäudetechnik

TECHNISCHE UNIVERSITÄT DARMSTADT

ISM+D
Institute of Structural Mechanics and Design
Institut für Statik und Konstruktion

A project of energy harvesting through asphalt solar collectors for building operation

The research project INNASOL (funding code: 519/02/00.004-(0001)) is an implementation project involving energy harvesting through asphalt solar collectors integrated underneath a parking lot ground for building operation. The objective of this project is firstly to construct a prototype of an asphalt surface with heat transfer functionality (Fig. 1). This asphalt surface prototype features a water-permeable porous intermediate layer, intended to transport the heat transfer medium, allowing heat extraction of the pavement or road in summer and preventing freezing in winter. Through this active asphalt temperature management, it is anticipated that the surface will have a longer lifespan and will not require winter maintenance. Secondly, since heat will be extracted from the surface, it is aimed to realize the connection between the asphalt collector and adjacent buildings. Through simulative investigation, an optimal variant of combination of components in the energy system and operational strategy is chosen and implemented in real life. After the monitoring and operation, the actual performance of this integrated asphalt collector building energy system is evaluated. The measurement data is used to validate the simulation model and continuously optimize the system. The research results of this project can serve as a reference for future utilization of roads as solar collector, aiding in the development of distributed local renewable energy harvesting systems for the energy transition in the future.

Objectives and Approaches

To address the global climate problem, the German government has set energy policy goals for 2050. To achieve this, it is necessary to increase the share of renewable energy in the overall energy consumption. By effectively integrating asphalt collectors, heat pumps, and thermal storage devices into the older energy system, it is possible to efficiently harness solar thermal energy and reduce the primary energy consumption. Unlike traditional heat pipe systems, INNSASOL aims to use a porous medium in the intermediate layer of the innovative asphalt collector (see Fig. 1, created by VWB TU Darmstadt). The purpose is to avoid complex piping systems, save on construction and maintenance costs. Additionally, in this approach, the contact area between the heat transfer medium and the asphalt collector is larger compared to heat pipe systems, which can significantly improve the efficiency. In addition, this configuration is beneficial for asphalt recycling and reuse, acting as a more environmentally friendly design. In collaboration with Wilhelm Schütz GmbH and Ingenieurbüro Horn, this innovative asphalt collector will be constructed in the company's parking lot area, collecting solar energy to supply the company's office building (Fig. 2).

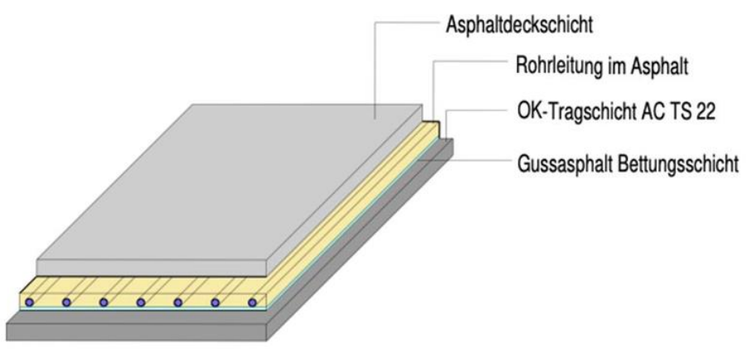

Fig. 1: A design variant of the asphalt solar collector

Fig. 2: Site plan and schematic connection concept between the building and asphalt solar collector

ISM+D Tasks:

As a research institute with experience from projects related with district energy systems and thermally activated building systems, the ISM+D is primarily tasked with the integration of asphalt collector into building energy systems (including simulation, measurement and monitoring), accompanying and coordinating the Milestones mentioned below. The focus is on the design, operation, monitoring, and optimization of the energy systems within the building, see Fig. 3.

M 1
Conceptual design of integration of the asphalt solar collector into building; Developing the simulation model.

M 2
Detail planning of the construction measure.

M 3
Simulative determination of material and operational parameters of asphalt collector; Construction of the collector.

M 4
Realization of the interlinking between the asphalt collector and the office building.

M 5
Commissioning and monitoring.

M 6
Collection and evaluation of the measurement data; Validation of the simulation model.

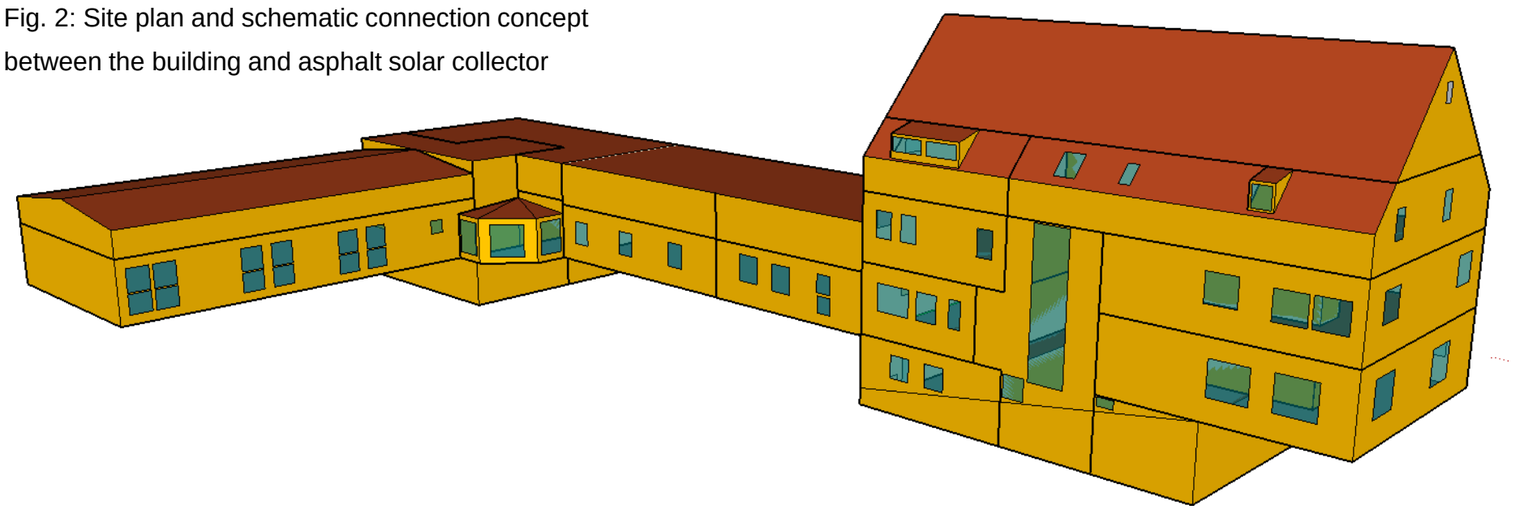

Fig. 3: Skech-up model of the building connected to the asphalt solar collector

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