Zukunft Bau

SUMMARY REPORT

Title

Adaptive glazing systems. Applications, energy and daylighting performance, control strategies.

Motivation

Since the 1990s research and design have been underway in the field of adaptive façade systems. In order to achieve the adaptive functionality, these systems make use of smart materials or mechanical control elements. Due to their availability to control the light and energy flux through the façade, they can contribute to the reduction of the building's energy consumption and to the improvement of the indoor comfort. They possibly have the potential to replace conventional shading systems in the near future. Though, their implementation in the building industry still suffers from a lack of comprehensive performance characteristics. In order to offer a decision-making tool for architects and stakeholders, the advantages and most promising fields of application of different adaptive systems were evaluated within the scope of the research project.

Objectives

Various commercially available adaptive technologies including passive and active adaptive glazing systems were investigated within the mentioned research project. Passive systems, such as phototropic, thermotropic or thermochromic systems, change their transmittance automatically as a reaction to changing thermal conditions or to fluctuating solar irradiation. Active systems on the contrary are controlled via electrical power supply. The active technologies are represented by electrochromic glazing systems, systems based on Polymer-Dispersed Liquid Crystals (PDLC) and Suspended-Particle-Devices (SPD). Within the mentioned project, a research on available adaptive façade technologies was conducted. Subsequently, following glazing systems were evaluated in detail:

- thermochromic glazing Suntuitive® Dynamic Glass (Pleotint LLC),
- thermotropic glazing GLASSX®crystal (GLASSX AG),
- electrochromic glazing systems: ECONTROL® smart 55/10 (EControl-Glas GmbH & Co. KG.) and SageGlass® classic (Vetrotech Saint-Gobain International AG),
- heating glass Ipatherm-Heizglas (Interpane Glas Industrie AG),
- glazing with blinds in the cavity OKAFLEX E (OKALUX GmbH),
- glazing with microlamellas encapsulated between two glazing panes MicroShade® MS-A Vertical (MicroShade A/S),
- glazing containing reflective light redirection profiles in the cavity OKASOLAR F O/U (OKALUX GmbH),
- three reference glazing units: double insulated glazing unit with thermal insulation coating (Saint-Gobain) with and without external blinds, double insulated glazing unit with sun protection coating OKATHERM Funktions-Isolierglas 69/37 (OKALUX GmbH).

The adaptive systems were characterised, studied in a façade test facility in Stuttgart and simulated numerically. The façade test facility was provided with measurement equipment for recording the outdoor and indoor conditions. The adaptive glazing systems were mounted in the south façade of different rooms of the test building and monitored during the project duration. The numerical transient energy and lighting performance simulations of the glazing systems took four different climatic conditions and three different building typologies into account (a cellular office in light timber construction, a classroom and an open plane office with solid construction, south façades fully glazed). Four different control strategies were developed for controllable glazing systems and evaluated numerically. These efforts aimed at identifying the most appropriate fields of application for the different façade technologies.

Conclusion

The in-situ tests as well as the numerical simulations performed in the project allowed for the evaluation of the most promising fields of application of the analysed adaptive glazing systems. Different climatic conditions and usage scenarios were addressed. Proposals for optimised control of the controllable systems were formulated and the potentials of adaptive glazing systems revealed.

Basic information

Short title: Adaptive glazing systems

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Project sum: 211.255,50 €

Federal funding: 153.955,50 €

Project duration: 15.10.2012 – 30.09.2016