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Development of an Interface between BIM-model and an AI-based Control System for Building Facades with Integrated PV Technology

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Abstract : Urban structures will be used more intensively in the future through redensification or new planned districts with high building densities. Especially, to achieve positive energy balances like requested for Positive Energy Districts (PED) the single use of roofs is not sufficient for dense urban areas. However, the increasing share of window significantly reduces the facade area available for use in PV generation. Through the use of PV technology at other building components, such as external venetian blinds, onsite generation can be maximized and standard functionalities of this product can be positively extended. While offering advantages in terms of infrastructure, sustainability in the use of resources and efficiency, these systems require an increased optimization in planning and control strategies of buildings. External venetian blinds with PV technology require an intelligent control concept to meet the required demands such as maximum power generation, glare prevention, high daylight autonomy, avoidance of summer overheating but also use of passive solar gains in wintertime. Today, geometric representation of outdoor spaces and at the building level, three-dimensional geometric information is available for planning with Building Information Modeling (BIM). In a research project, a web application which is called HELLA DECART was developed to provide this data structure to extract the data required for the simulation from the BIM models and to make it usable for the calculations and coupled simulations. The investigated object is uploaded as an IFC file to this web application and includes the object as well as the neighboring buildings and possible remote shading. This tool uses a ray tracing method to determine possible glare from solar reflections of a neighboring building as well as near and far shadows per window on the object. Subsequently, an annual estimate of the sunlight per window is calculated by taking weather data into account. This optimized daylight assessment per window provides the ability to calculate an estimation of the potential power generation at the integrated PV on the venetian blind but also for the daylight and solar entry. As a next step, these results of the calculations as well as all necessary parameters for the thermal simulation can be provided. The overall aim of this workflow is to advance the coordination between the BIM model and coupled building simulation with the resulting shading and daylighting system with the artificial lighting system and maximum power generation in a control system. In the research project Powershade, an AI based control concept for PV integrated façade elements with coupled simulation results is investigated. The developed automated workflow concept in this paper is tested by using an office living lab at the HELLA company.

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