Architectural Integration and Design of Solar Thermal Systems

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ABSTRACT

Although mature technologies at competitive prices are largely available, solar thermal is not yet playing the important role it deserves in the reduction of buildings fossil energy consumption.

The generally low architectural quality characterizing existing building integrations of solar thermal systems pinpoints the lack of design as one major reason for the low spread of the technology. As confirmed by the example of photovoltaics, the improvement of the architectural quality of building integrated systems can increase the use of a solar technology even more than price and technique.

This thesis investigates the possible ways to enhance the architectural quality of building integrated solar thermal systems, and focuses on integration into façade, where the formal constraints are major and have most impact.

The architectural integration problematic is structured into functional, constructive and formal issues, so that integration criteria are given for each architectural category.

As the functional and constructive criteria are already recognized by the scientific community, the thesis concentrates on the definition of the formal ones, yet underestimated or misunderstood.

The results of a large European survey over architects and engineers perception of building integration quality are presented, showing that for architects formal issues are not a matter of personal taste, but that they relate to professional competences, and consequently can be described.

The solar system characteristics having an impact on the formal quality of the integration are identified (formal characteristics), the related integration criteria are assessed, and finally integration guidelines to support architect integration design work are given.

The limits imposed by the collectors available in the market are pointed out, showing that the lack of appropriate products is nowadays the main barrier to BIST (Building Integrated Solar Thermal) architectural quality.

A methodology for the development of new solar thermal collectors systems responding at the same time to energy production needs and building integration requirements is defined. The importance to ensure, within the design team, the due professional competences in both these fields is stressed.

Three progressive levels of system “integrability” are defined in the path leading to the concept of "active envelope systems" and the main role of facade manufacturers is highlighted.

The methodology is applied to unglazed and glazed flat plate systems, and new façade system designs are proposed that show the relevance of the proposed approach.

Key words:
Solar thermal I Architectural integration I Active facade I Integration quality I
Facade integration I Solar architecture