ARCHITECTURAL INTEGRATION OF LOW-CARBON TECHNOLOGY AND BUILDING-INTEGRATED PHOTOVOLTAICS (BIPV): INTO THE DESIGN PROCESS OF ADVANCED ACTIVE FÄÇADES (AAF)

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OVERVIEW

Building Integrated Photovoltaics (BIPV) performance is improving rapidly. However, its potential is diminished because of several barriers. Due to its limited expressive quality, architects tend to avoid integrating BIPV in building design, more particularly, in façades. In order to bridge the gap between technology and design, this research aims at developing design strategies to integrate BIPV’s expressive issues into today’s façade construction, focusing on new collective residential dwellings.

In this context, the poster presents the Advanced Active Façade (AAF) concept, which results from the analysis of façade’s evolution, in terms of requirements and constructive solutions. The AAF benefits from passive low-carbon design strategies and active BIPV technology.

This system permits to meet low energy consumption targets and, by integrating BIPV expressive issues, it enables architects to play with a range of expressive parameters such as transparency, color and modulation.

RESEARCH METHODOLOGY

ANALYSIS

Analysis and classification of the existing façade design strategies of collective residential buildings in the current Swiss context. This classification depends on the dimensional composition of façade materials, elements and building general structure.

The results provided by this research present a façade classification in four groups:

Group 1: “Solid wall” includes those façades where the horizontal slab dimension is apparent and highlighted on the façade.

Group 2: “Variable wall”, includes those façades where the horizontal slab dimension is apparent and highlighted on the façade.

Group 3: “Balkoner”, refers to those façades where the structural system is also visible but the floor slabs are no longer highlighted.

Group 4: “Total volume”, includes those façades where the horizontal slab and the interior distribution is not apparent.

ANALYSIS OF THE FAÇADE REQUIREMENTS AND SYSTEMS TRAJECTORY

This chapter explores the design principles of façade construction systems that meet the most demanding insulating targets and is compatible with constant improvement.

The results of this analysis have highlighted the latest façade requirements, which are:

(a) To increase the building’s energy consumption.
(b) To account with little embodied carbon.
(c) To generate energy as part of the envelope solution.

The whole trajectory analysis is represented in the following chart:

INTEGRATED DESIGN

AFA construction system.

It is a façade-based, self-supporting and demonstrable façade system which meets the most demanding insulating targets and is compatible with a wide range of existing BIPV systems and emerging technologies.

The AAF construction system enables architects to play with a range of expressive parameters such as transparency and color. This prefabricated system meets active collective residential building design trends studied in phase A (2011) and developed in phase B. Therefore, suitable for a rapid and solid construction in the Swiss context.

The main features are:

- Low embodied carbon
- Natural insulation: cellulose
- Reinforced metal elements: Chosen recycled Aluminium
- Lightweight materials
- High thermal stability
- Low maintenance design
- Exposed component replacement
-北方 constructions
- Recyclable system

Designed to be disassembled

Active Façade

Building Integrated Photovoltaics
- Ventilated façade
- Punctual fixation
- Weight design
- Dimension study
- Energy production targets

As it is an on-going process, the preliminary conclusions of this research permit to affirm that it is possible to integrate a BIPV system in a prefabricated construction system, based on current façade construction requirements and applicable to residential buildings.

The developed work also demonstrates that BIPV can be part of the dimensional composition of a collective residential housing façade. This is to say, with the AAF Design strategies provided, architects can control BIPV expressive issues and produce façades which fit in the current composition trends in the Swiss context.

The next steps involve the assessment phase, where the environmental impact, cost, architectural quality and social acceptance will be evaluated, a prototype construction and a student competition, where the theoretical knowledge could be applied to the professional practice.

The output of the research will provide architects with a system and assessed design strategies to optimize the design process of BIPV façades. Our objective is that architects, and society in general, find PV technology as a familiar construction material.