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Integration and architectural issues of a photovoltaic/thermal linear solar concentrator

Alessandro Cappelletti[a], Lucia Ceccherini Nelli[b], , Alberto Reatti[c]

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Highlights

- A hybrid PVT concentrator based on a semi-parabolic mirror suitable for building integration.
- Façade building integrated examples of the proposed hybrid concentrator.
- Electric and thermal estimation procedure performances for the horizontal and vertical design.
- Mutual shading results for power vertical and horizontal configuration.
- Comparable costs with the systems realized by standard flat modules.

Abstract

Modern photovoltaics and thermal technologies are widely available for the building sector at competitive prices. However, innovative approaches must be explored and implemented to find new architectural solutions at the building scale.

This paper presents an electro-thermal solar concentrator and proposals for its building integration. The proposed device has a small size and is based on a 20x semi-parabolic mirror concentrating the sunlight on a linear focus where a string of mono-crystalline PV cells is placed. A thermal receiver is placed on the back-side of the cells, a fluid circulating in the thermal receiver provides the heat recovery. The linear focus allows a monoaxial sun tracking. The proposed device has been numerically analyzed with the support of experimental data. The small size and the linear focus make feasible the integration of arrays of the proposed innovative device in roofs or façades of both new and existing buildings where they contribute to the auto-generation of a portion of the overall required energy. Several examples of the possibilities of array building integration of the described small-size solar concentrator are proposed. The device can be horizontally and/or vertically mounted to better match the architectural needs. The potential yearly power generation of a single unit three meters long, is evaluated to be as high as 120 $kWh_{elettric}$/year and 500 $kWh_{thermal}$/year. Horizontal mounting results in a power production about 30% higher than the vertical mounting.

The significance of this paper is that small size, single axis solar tracking, suitable for building integration is presented, studies of its possible integration in the building are given, the power generation capabilities of the proposed solutions are analyzed in detail. These capabilities have been derived using data achieved by experimental tests performed on a prototype constituted by four semi-parabolic mirrors. The novel contribution is that a new research direction toward further improvement of the performance, system design and installation of a prefabricated modular façade component, is presented. Moreover, the proposed PVT low concentrated solar device is integrable into buildings, easy to install and manage. Finally, the modern and attractive architectural designs are proposed.

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1. Introduction
2. Solar concentrator description
3. Shading devices integration with t…
4. Description of the analysis method
5. Solar concentrator analysis and it…
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Funding
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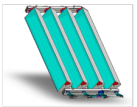
Figures and tables



panels; Thermal concentrator; Building envelope integration

Corresponding author.

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