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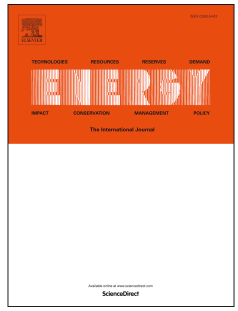

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Wind loads on heliostats of various column heights: An experimental study

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Abstract

Wind tunnel measurements were carried out to analyze the influence of column height and to estimate the steady and unsteady wind loads on heliostats. A heliostat model was tested at three different column heights for typical configurations. Wind pressure distributions across the mirror plane and fluctuating wind pressure characteristics are presented and analyzed.
The results show that an increase in the column height produces larger steady and unsteady pressure wind loads, stronger vortex shedding and higher shedding frequencies. Nevertheless, the effect of column height is limited on Gaussian and non-Gaussian characteristics.
Irregularity and weakness of vortex shedding appear at the smallest column height and can be useful to avoid the resonance of the structure. The results of this study are also valid for stand-alone ground mounted photovoltaic trackers of similar shape.

Keywords: Wind tunnel/ Heliostat model/ Column height/ Pressure coefficient/ Vortex shedding frequency/ Concentrated solar power.

1. Introduction:

Concentrating solar power (CSP) is a promising option and one of the favorable solutions for clean energy production. At solar tower plants, the heliostat field contains a large number of mirrors that track the sun and direct the sunlight toward the top of the tower [1]. A receiver absorbs the radiation there and supplies thermal energy to a power cycle to produce the electricity.
In the construction of such plants, the heliostats field represents the most important cost element which contributes about 39% to the total cost of the plants [2, 3]. Therefore, a heliostat design with low capital cost is of a major interest. One opportunity to reduce the cost is to develop a heliostat which is able to resist the different kind of wind loads, avoiding the unnecessary safety margins simultaneously [4]. To achieve this target there is a need to estimate accurately the wind effects on the different structures of heliostats.
Wind loads on the heliostats can be divided into two parts: the static wind load and the dynamic wind load. Static loads depend mainly on the mean wind speed. The dynamic loads depend mainly on the turbulent content of the incident wind and the body-induced turbulence [5-7]. Hence, wind tunnel tests are still considered as an important and reliable method for evaluating wind load on heliostats.

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