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Field measurements of boundary layer wind characteristics and wind loads of a parabolic trough solar collector

Bo Gong [a], Zhifeng Wang [a,*], Zhengnong Li [b], Jianhan Zhang [a], Xiangdong Fu [a]

[a] The Key Laboratory of Solar Thermal Energy and Photovoltaic System, Institute of Electrical Engineering, 100190 Beijing, China
[b] Key Laboratory of Building Safety and Energy Efficiency (Hunan University), Ministry of Education, 410082 Changsha, China

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Abstract

The focus of the current study is the wind loads on a 11.92 m section of parabolic trough collector with an aperture of 5.76 m, located in Beijing, PR China. This paper presents selected results of full-scale field measurements of wind loads and wind pressure on the solar collector. The field data such as wind speed, wind direction and wind pressures are simultaneously measured from the solar collector. The measured data are analyzed to obtain the information on boundary layer wind characteristics, wind pressures and wind loads on the solar collector. The results presented in this paper are expected to be of considerable interest and of use to researchers and engineers involved in analysis and design of parabolic trough solar collectors.

Keywords: Parabolic trough solar collector; Field measurement; Wind characteristics; Wind pressure; Wind load

1. Introduction

Parabolic trough solar collector is a kind of reflector tracking the sun on support of steel structure by regulating its pitch in real time. The array field of solar collectors, with high accuracy requirements during performance, is located at open terrain or suburban terrain and it is sensitive to gust. Therefore, the stationary and dynamic effects of wind will be the major design parameter for the structure and also the drive systems. It is important to state that the incident static and dynamic forces will affect the dynamic behavior/dynamic response of the collector. It is not only a matter of wind but also of the design, collector weight and inertia. This has resulted in a greater emphasis on understanding the structural behavior of solar collectors under wind action. Wind load estimates for parabolic trough solar collectors have relied largely on wind tunnel tests sponsored by Sandia National Laboratories in the late 1970s and early 1980s, specially Peter and Derickson (1992), Peter et al. (1980), Randall and Mcbride (1980) and Randall and Tate (1982). These reports provided mean wind loads coefficients for an isolated parabolic trough solar collector and for a collector within an array field. From March 2001 to August 2003, Hosoya and Peterka (2008) have conducted a series of wind tunnel tests. His tests included peak load and the distribution of local pressures across the face of the solar collector, which are of significance for designer of solar collectors. His study also includes examination of wind loads on collectors located deep inside an array field for the purpose of extending design load data as a function of position. From June 2008 to August 2010, about 8000 different collector test configurations have been conducted by Holzs et al. (2010) in some wind tunnels. Two main focus points were reflected: minimization of individual collector loads and

* Corresponding author. Tel.: +86 010 62520684; fax: +86 010 62587946.
E-mail address: zhifeng@vip.sina.com (Z. Wang).

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