Research on wind field characteristics measured in U-shaped valley at bridge site by Lidar

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Abstract

Currently, research on wind fields of U-shaped valleys is rarely reported. In order to study the wind characteristics in a mountainous U-shaped valley, a lidar was placed at a bridge site located in a U-shaped valley. Then, nearly 6 months of original data ranging from 0 m to 810 m were analyzed statistically. It was found that the wind parameters are correlated among different virtual wind towers (VWTs). The wind speed profile is divided into three categories: disordered, linear and nonlinear. The wind direction is consistent with the main wind direction at the bridge site and the average wind direction of different VWTs has a high consistency. The concept of wind-direction deflection rate is put forward to describe the variation of wind direction with height. These measured wind parameters could be used as a reference for bridge wind-resistant design.

Keywords: bridge engineering; wind characteristics; field measurement; U-shaped valley; lidar; bridge site

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1 Introduction

Many long-span bridges have been built in mountainous valley areas, for example, Royal Gorge Bridge, (1929, 384 m), Cañon City, Colorado, USA; and Yachihe Bridge (2016, 800 m), Guizhou Province, China; and more will be built in the future. The requirement for long-span bridges in mountainous valley areas also enhances the performance standard of long-span bridges. Among them, the influence of wind on the long-span bridges cannot be ignored, and is even one of the critical factors. At the same time, the distribution of wind parameters in mountainous valley terrain is complex and different from that in flat terrain. Although much research has been conducted in this field, due to the impact of topographic relief and elevation changes, the spatio-temporal distribution of wind speed in mountainous valley areas has its own unique patterns, which are generally analyzed on a case-by-case basis and are difficult to be described by a unified mathematical model. At present, the study of wind parameters in mountainous valley areas is one of the hot topics in wind engineering research.

Wind tunnel terrain model test, numerical simulation, and field measurement are the mainly method to study the wind parameters. Wind tunnel terrain model test is widely used, but there is room for improvement in accuracy because of characteristic flow simulation and scaling model making [1]. With the development of computer technology and computational fluid dynamic (CFD), numerical simulation methods have been applied more and more widely, and their reliability has also been verified [2]. However, further research is needed in calculating domain size and setting boundary conditions. In spite of the time consuming, huge investment and limited measured

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