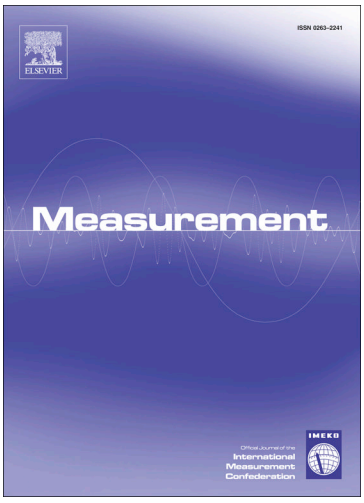


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# Monitoring and analysis of thermal effect on tower displacement in cable-stayed bridge

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## Abstract

Thermal actions greatly influence the mechanical behavior of cable-stayed bridges. The objective of this research is to investigate the characteristics of the thermal field and the variability of the quasi-static responses of the bridge towers. Based on the monitoring temperature and displacement data, the distribution of the thermal field for the bridge was studied and the time variability of the tower displacement was investigated. The correlation was analyzed to study the relationship between the temperature and the tower displacements and the tower-girder distances. The temperature-induced cable force increments were calculated and a linear regression between the cable force increments and the structural temperatures was performed. A strong linear relationship between the temperature and quasi-static responses of the tower was observed. It is concluded that thermal actions have substantial effects on the quasi-static displacement. Moreover, the temperature-induced cable forces should be fully considered in the safety design of the bridge cables.

**Keywords:** Cable-stayed bridge; Thermal field; Quasi-static response; Tower-girder distance; Cable force

## 1. Introduction

Thermal actions are continuous input loadings for bridge structures, which has substantial time-variant and spatial effects on the long span bridges especially [1]. Towers are the important load-resisting structural members in cable-stayed bridges, which are considerably influenced by temperature. Under the effect of temperature, obvious thermal-induced displacements of concrete bridge towers may occur, which can change the alignment of the bridges and cause damage to serviceability. Moreover, the thermal action can also induce secondary internal forces in concrete towers and the cables, which may endanger the structural safety. When the concrete bridge towers are subjected to environmental actions [2], such as chloride attacks, performance deteriorations may influence the thermal-induced behavior of the bridge towers. Therefore, it is necessary to study the thermal actions and the variability of the temperature-induced quasi-static displacement of bridge towers.

The thermal action has received great attentions from researchers which are considered to be an important external input loading for bridge structures. The research on the thermal effects on bridge structures can be categorized into two groups: (i) the first group researchers concentrate on the quantitative values and distribution of the thermal action itself [3-10]; (ii) the second group researchers mainly investigate the thermal-induced behavior of the bridge structures [11-16].