Thermal Effects in the Long-Term Monitoring of Bridges

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Summary

Daily and seasonal temperature variations induce deflections of bridges. The amplitude of these moments is significant in comparison with the yearly increment caused by irreversible long-term deflections. To improve the quality of the interpretation of monitoring measurements, thermal movements thus need to be taken into account in the long-term monitoring of bridge deflections.

The paper presents the results of the long-term monitoring of deflections of several bridges in Switzerland over the past 20 years, with a particular attention given to thermal effects. The daily and seasonal movements of bridges under thermal effects are shown. The correlation between the measured temperatures and gradients and the position of bridge is shown, and methods to compensate for thermal effects are outlined. This allows to filter out the largest part of the thermal effects and to make more accurate assessments of the actual irreversible deformations.

The significant influence of temperature on the measurement results is illustrated on the basis of a large number of manual measurements by hydrostatic leveling and automatic measurements by electronic inclinometers. The simultaneous measurement of the ambient temperature and of the temperature of the concrete of the bridge itself gives useful information to take thermal effects into account.

Keywords: thermal effects, monitoring, bridge, deflection

1. Introduction

Monitoring of bridges has become an important component of the safety and maintenance setup of transportation lines. While the monitoring systems themselves can be compensated so that they are not sensitive to temperature changes, the monitored structure cannot. During the measurements, it is continuously exposed to thermal effects, mostly from the ambient temperature and direct sunlight, but also from wind or water-induced thermal fluxes. While these effects have long been known of specialists of the monitoring of structures, who, for example, often tend to perform their measurements during the night or at dawn to avoid the effects of direct sunlight, this type of approach may not always be sufficient to avoid all thermal effects. Additionally, some measurement methods, as for example surveying techniques or accurate GPS localization, need some time for the measurement to be performed [1]. This means that the measurement starts while the structure has a given shape, and ends when the structure has another shape, possible intermediate measurements being taken as the structure is in other, intermediate shapes.

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