Analysis of the Temperature Measurement Data in Concrete Pylon

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Summary

This paper deals with monitoring and analysis of temperature measurement data in concrete pylon of long span bridges. During the construction of Geoga Bridge in Busan-Geoje Fixed Link Project, temperature sensors were installed in several sections of hollow type concrete pylon and temperatures along the depth of the four sides of the section are recorded. Ambient temperatures of concrete pylon are also recorded. Effects of temperature distribution on the construction of pylon are analyzed using actual measured data and modeling of pylon and structural system during the construction. Results are compared with several design guidelines and recommended values.

Keywords: Cable stayed bridge, Box-type pylon, Temperature sensor

1. Introduction

Bridges are subject to many loads, including gravitational, environmental and accidental effects. One of the main environmental loads is the thermal or temperature load. Temperatures in various members of bridges vary due to solar radiation, ambient temperatures and wind. Expansion and contraction due to temperature change cause stresses and deformations in the structure. In the design code of bridges, temperature effects are divided into two parts; uniform temperature changes and temperature gradient along the depth of the member. For cable bridges such as cable stayed bridge and suspension bridge, temperature differences between cables, girders and pylons are also considered. For example, Design Guideline for Steel Cable Bridges in Korea (KSCE, 2005) specifies average temperature range of -10°C~+50°C in mild region and is -30°C~+50°C in cold region. Temperature differences between deck and cable, pylon and cable are specified as 8°C and 22°C if the cable surface painted in light and dark colors respectively in cable-stayed. In suspension bridge, temperature differences ±15°C, ±10°C and ±25°C between hanger and girder, hanger and cable, girder and cable, respectively. Vertical temperature gradients are specified as shown in Fig. 1 and Fig. 2 in Korean Bridge Design Code (MLTM, 2010) and AASHTO LRFD code (AASHTO, 2007), respectively.

This paper deals with monitoring and analysis of temperature measurement data in concrete pylon of long span bridges. During the construction of Geoga Bridge pylon in Busan-Geoje Fixed Link Project, temperature sensors were installed in several sections of hollow type concrete pylon and temperatures along the depth of the four sides of the section are recorded with the ambient temperatures near concrete pylon. Measurements were continued during the construction of pylon and other structures but only one year data (Oct. 2008 ~ Oct. 2009) are collected and analyzed. Average temperature of the pylon, average temperature of each side of the pylon are calculated and compared with several design values. Also temperature gradient along the horizontal axis are also calculated and compared. However, since there is no measured temperature data at girders and cables, only temperature effects on pylons are studied in this paper. Structural analysis is performed to examine the effect of temperature distribution on pylon behavior using simplified 3-D modeling and extreme measured temperature distribution.

https://doi.org/10.2749/222137912805112923