Design Life and Reliability-based Design Concept for Long-Span Cable-Supported Bridge

Inyeol PAIK
Associate Professor
Gachon University
Songnam, Korea
pinyeol@gachon.ac.kr

Seung Han LEE
Ph.D Candidate
Seoul National University
Seoul, Korea
shlee02@snu.ac.kr

Jinho LEE
Master
Seoul National University
Seoul, Korea
jhlee02@snu.ac.kr

Jae-Ung YUN
Junior Engineer
BnTech
Seoul, Korea
bbogaris@hanmail.net

Hae Sung LEE
Professor
Seoul National University
Seoul, Korea
chslee@snu.ac.kr

Summary

The basic design concepts for the limit state design code under development in Korea for the long-span cable-supported bridge are presented. Considering the importance of the structure, higher target reliability level and longer design life are defined compared to those of the ordinary bridges. In deciding the amount of safety increase, the construction cost and the consequence of structural failure are examined. Safety factors including the importance factor which is multiplied to the design strength of the structural member are calibrated through reliability analysis of the actual design examples. It is also shown that the nonlinear analysis of the cable-supported bridge yields higher reliability index of the main cable than that obtained by the linear analysis.

Keywords:long-span cable-supported bridge; design life; reliability index; construction cost; safety factor format; importance factor; nonlinear analysis.

1. Introduction

In this paper, the safety concept of the long-span cable-supported bridge (LSCSB) design is discussed. With higher target reliability and longer design life, the design load models and the load combinations for the design of the LSCSB are under proposing in Korea. The enhanced safety is taken into account by multiplying the modification factor to the load factors in the design load combination. The safety factors in the proposing code are determined after conducting probabilistic study. The statistical properties for the loads and the resistances are based on the domestic field data as well as the relevant references. The safety level of the design load combinations for the strength limit state and the extreme event limit state are under examination and a brief result is shown in this paper.

In addition, depending on the importance of the structural members such as the main cable, the pylon and the stiffened girder, the member importance factor is multiplied to the design strength of the member. For the purpose of classifying the member importance factor, the actual design works of the cable-stayed bridges and the suspension bridges are collected. The relative safety levels of the current design are calculated and the reliability indexes along the entire length of the main members are presented.

It is also presented by numerical example that the nonlinear analysis of the cable-supported bridge yields higher reliability index than that obtained by the linear analysis with the same safety factor for the design of the main cable.

https://doi.org/10.2749/222137912805111609