Korean Guideline for Performance-based Assessment of Existing Bridges

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Summary

A series of researches for the assessment of existing infrastructures have been intensively carried out for more than 10 years in Korea. The products will be eventually related to a new guideline or code. Some of them are the results obtained from a joint work between Korean Concrete Institute (KCI) and Japan Concrete Institute (JCI). The results have been contributed to ISO standard of ISO/FDIS 16311-2. KCI implemented the concept into a revised '*Design code for concrete structures*' published in 2012 and JCI also developed a new *'Guideline for performance-based evaluation of existing concrete structures*' in 2012. In addition, Korea Expressway Co. develops a performance-based guideline for the safety assessment of bridges. The paper summarizes such activities and research outcomes with the fundamental approach to the assessment of bridges in Korea. The proposed approach is examined through a field application to an existing highway bridge.

Keywords: performance-based; safety assessment; codes; guidelines; highway bridges.

1. A Proposed Approach

The resistance for the assessment R_A should be larger than the load effects for the assessment U_A.

$$R_A \geq U_A \tag{1}$$

Each part of resistance and load effects for the assessment, R_A and U_A, are defined by multiplying an additional modification factor to the design values as expressed in Eq.(2).

$$R_A = \phi_A(\phi R_n) \qquad U_A = \gamma_A\left(\sum \gamma_i Q_i\right) \tag{2}$$

where ϕ_A = resistance modification factor for the assessment and γ_A = load modification factor for the assessment. A single modification factor is considered for the load effects regardless of the dead load and live load effects but different factors may be applied to the dead loads and live loads later on because statistical distribution of those loads are not the same.

Then, the rate factor and its corresponding load carrying capacity are defined by Eq.(3).

$$RF = \frac{\phi_A(\phi R_n) - \gamma_A(\gamma_D D)}{\gamma_A(\gamma_L L)(1+I)} \tag{3}$$

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2. Examination of the Proposed Approach through a Field Test

To examine the proposed method of assessing the safety performance, a diagnostic load test was carried out on a simply supported concrete girder bridge of the span length 15m as shown in Fig. 1. The condition of the bridge was determined as rate *C* by a regular inspection.

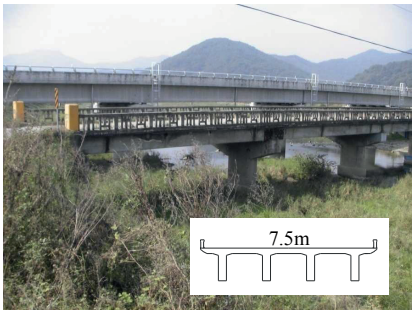

Fig. 1: A bridge for testing

An analytical model for the bridge was updated using the measured data. The updated model was verified by comparing the measured and computed deflections at the girders as demonstrated by Fig. 2. The measured and computed natural frequencies also showed almost the same values.

The rate factor of the bridge was evaluated by some available methods and the results are compared in Fig. 3. The 'current' Korean guideline provided the most conservative result. The proposed Eq.(3) with or without considering the reduced target reliability index in the assessment resulted in a little higher rate factor RF but still less than those from other countries.

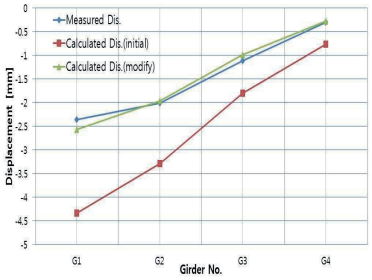

Fig. 2: Comparison of girder deflections

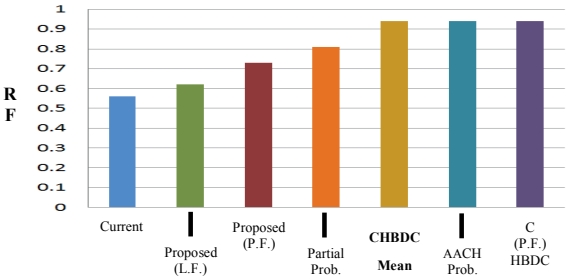

Fig. 3: Computed RFs by various assessment methods

3. Conclusions

An advanced method to assess the safety performance of a bridge structure is studied in Korea to develop a new guideline or code. The proposed method is based on a statistical approach rather than a deterministic way as the current Korean guideline. The current Korean guideline gives too conservative result on the evaluation of the load carrying capacity of a bridge compared with those results from some available international codes and guidelines. However, the available methods in other countries also seem to reflect the economical aspect too seriously. Therefore, it is necessary to select a proper target reliability index for the assessment and to determine the partial factors reflecting on the opinions from the society.