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Reliability-based code-calibration for the design of long-span bridges

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This paper presents robust approaches for the reliability-based code calibration of three types of structural members in cable-supported, long-span bridges. The three types of structural members include girders, cables and pylons. Since the members are designed for different types of external loads and load-carrying mechanism, a distinct approach should be adopted for each type of the members in the code-calibration process. The girders and cables mainly carry the gravitational loads induced by the permanent and live loads by the bending moment and tension, respectively, while pylons should resist the bending moment and compression caused by lateral wind load and self-weight of a bridge. Dissimilar to short- to medium-span bridges, the bending moment induced by the vehicular live load becomes larger than 50% of the total bending moment carried by the girder of a long-span bridge. An optimization scheme is formulated to obtain load factors for the girder in the aforementioned range of the load composition satisfying the current target reliability index of 3.5 or 3.75. As no target reliability index for the cables is available, the target reliability indices and load factors for cable members are determined by investigating the two cable-stayed bridges and three suspension bridges in Korea. The pylons of a long-span bridge are usually designed for the load combination under strong wind, which induces the bending moment as well as the compressive force in pylon sections. The axial force-bending moment interaction diagram is utilized to define the strength of a pylon and to calculate the reliability index. A general approach is proposed for evaluating wind load factors based on measured wind data for RC columns. The advanced first-order second-moment reliability method is employed throughout the calibration process. The target reliability index and load factors obtained by the proposed approaches are presented for three types of the structural members and compared with those in the current design specifications for small- to medium-span bridges. Detailed discussions on the LRFD concepts for long-span bridges are made.