Load distribution factors of straight and curved steel concrete composite box and I girder bridges

by

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ABSTRACT

In the present research, load distribution factors of steel-concrete composite bridges subjected to loads recommended by Australian Bridge Design Code are determined. The bridges can have straight or curved (in plan) alignments with box girder or I girder sectional configurations. The load distribution factors are quite useful in bridge design practice specifically at their preliminary design stage. These factors help a designer to quickly calculate the stress resultants (shear force or bending moment) acting on different girders of a bridge from those acting on the entire bridge section which can be estimated easily in the case of a statically determinant structure such as simply supported straight bridge treated as a beam.

Unfortunately, the horizontally curved bridges are statically indeterminate even if they are idealized as a curved beam. In order to address this issue, a closed form analytical solution without having any major simplification is developed which can be conveniently used by a designer for calculating the stress resultants acting on the entire section of a curved bridge. The unit load method, a method extracted from Castigliano's second theorem, is used to derive the analytical solution. As bridge loads consist of a number of wheel loads, the use of influence line diagrams is quite common as they help to calculate the maximum values of any parameter such as bending moment conveniently. For this purpose, the analytical solution is used to obtain the influence line diagram of shear force, bending moment and torsion of curved bridges.

A detailed finite element modelling of these bridge structures is used to calculate the load distribution factors. In order to have a reliable finite element model of these structural system, different types of element such as solid element, shell element and beam element are used in different combinations to find out the most suitable option that can accurately simulate the components of these bridge systems with reasonable computational efficiency. The

performance of these finite element models is assessed using experimental results available in literature.

These bridges can be characterized with different parameters and these parameters can vary in a wide range in real scenario. Thus there is a need for development of design formulae or charts for load distribution factors in terms of these parameters that can be readily used for designing any bridge. For this purpose, a large number of configurations of these bridges are generated by varying their different parameters and these bridges are analysed using the abovementioned finite element model. A large number of results obtained from these analyses are used to develop the design guidelines in the form of empirical expressions using multivariate regression analysis.

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LIST OF PUBLICATIONS

Journal papers

Fatemi, S.J., A.H. Sheikh, and M.S.M. Ali, *Determination of Load Distribution Factors of Steel-Concrete Composite Box and I Girder Bridges using 3D Finite Element Analysis.* submitted to International Journal of Steel Structures, 2015.

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