DESIGNING AND MODELING OF A SUSPENSION BRIDGE TO EXISTING KALUTHARA BRIDGE ACROSS KALU GANGA

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ABSTRACT

The main objective of this study is to design and develop a scaled physical model of a suspension bridge for the existing Kaluthara bridge . The proposed suspension bridge is located across the Kalu Ganga and it connects the two main lands. The length of the bridge between the two main towers is 700m and it consists of six notional lanes. The suspension bridge is designed for different load combinations of permanent loads, traffic load (HA and HB loadings) as live load and wind load according to the Eurocode EN 1991-2. Altogether five load combinations are considered in the design.

In the case of in-plane analysis, the forces on and deformations of main members such as main cable, hangers, stiffener girders and main two towers under each load combinations are obtained by using finite linear finite deformation theory with a two-dimensional model. In the case of out-of-plane analysis, wind forces on and deformations of the members are calculated by using linear finite deformation. The main cables used a newly developed high-strength steel wire whose tensile strength is 1770 MPa and the allowable stress is 804 MPa with the factor of safety 2.2. Then, the resultant diameter of the main cable is 1.25 m

The width of the stiffening truss is determined to accommodate carriageway width and shoulders. The depth of the stiffening truss, which affects its flexural and torsional rigidity, is decided so as to ensure aerodynamic stability. After designing the stiffening truss configurations, wind tunnel tests are required to conduct to verify the aerodynamic stability of the girders. In judging the aerodynamic stability, in particular the flutter, of the bridge design, a bending torsional frequency ratio of 2.0 or more is recommended. The selected depth of the stiffening truss for this design is 3m. It must be noted that the three hinged stiffening warren (with verticals) type truss of 700m long is used. The design of the sectional properties of the stiffening girder is generally governed by the live load. Linear finite deformation theory is applied to determine reactions due to live loads in the longitudinal direction, in which theory the influence line of the live load is used.

The rectangular concrete towers are used in this design. For the transverse and longitudinal directions, the main towers are analysed using small deformation theory to transmit the axial force, lateral load and the bending moments that result from the axial force in the main cable, dead loads and the wind loads, into the foundation. The details of the tower base that transmits the axial force, lateral force, and bending moment into the foundation, are of grillage.

Finally, the scale physical model of the bridge (with scale of 1:200) is constructed to verify the aerodynamic stability, in particular the flutter. From the test results, it can be concluded that the bridge is stable for the aero dynamic effects specially the flutter.

***Keywords*:** Suspension Bridge, stiffening truss, concrete towers, linear elastic analysis