World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:10, No:11, 2016

Effects of Aerodynamic on Suspended Cables Using Non-Linear Finite Element Approach

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Abstract : This work presents structural nonlinear static analysis of a horizontal taut cable using Finite Element Analysis (FEA) method. The FEA was performed analytically to determine the tensions at each nodal point and subsequently, performed based on finite element displacement method computationally using the FEA software, ANSYS 14.0 to determine their behaviour under the influence of aerodynamic forces imposed on the cable. The convergence procedure is adapted into the method to prevent excessive displacements through the computations. The work compared the two FEA cases by examining the effectiveness of the analytical model in describing the response with few degrees of freedom and the ability of the nonlinear finite element procedure adopted to capture the complex features of cable dynamics with reference to the aerodynamic external influence. Results obtained from this work explain that the analytic FEM results without aerodynamic influence show a parabolic response with an optimum deflection at nodal points 12 and 13 with the cable weight at nodes 12 and 13 having the value -1.002936N while for the cable tension shows an optimum deflection value for nodes 12 and 13 at -189396.97kg/km. The maximum displacement for the cable system was obtained from ANSYS 14.0 as 4483.83 mm for X, Y and Z components of displacements at node number 2 while the maximum displacement obtained is 4218.75mm for all the directional components. The dynamic behaviour of a taut cable investigated has application in a typical power transmission line. Aerodynamic influences on the cables were considered using FEA approach by employing ANSYS 14.0 showed a complex modal behaviour as expected.

Keywords : aerodynamics, cable tension and weight, finite element analysis, nodal, non-linear model, optimum deflection, suspended cable, transmission line
Conference Title : ICAMAME 2016 : International Conference on Aerospace, Mechanical, Automotive and Materials Engineering
Conference Location : London, United Kingdom
Conference Dates : November 24-25, 2016