Cable-Stayed Bridge Elements Lifetime Optimization Model

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Summary

Authors of this paper are working on the analytically obtained mathematical model of interaction between elements of cable-stayed bridges. The influence of systems geometry, mechanical and physical parameters of cables, pylons and stiffening girder on the behaviour of all structure is observed. Some results and useful recommendations about optimal solution from economical and technical point of view are presented.

A way to improve the fatigue conditions of the cable-stayed bridge is installation of active devices, which in an exact moment can decrease deformations and stresses from elements with poor load bearing capacity by giving them away to the others with higher capacity. Properties of such a system can be examined by the proposed method.

Keywords: *cable-stayed bridge; post-tensioning; optimization; active devices*.

1. Introduction

Previous publications [1] have demonstrated the relationships how parameters of cables and stiffening girder effect the systems deformations and strains in the girder. A possibility was found to reduce the girders bending stiffness and the cross-section of cables simultaneously, without changes in the defined optimal bending moment diagram. In this case the critical factor remains the value of allowable deflection, which may not be exceeded. As a result of proposed optimization material consumption can be reduced and the most economical solution for choice of system parameters can be found. Figure 1 shows the linear relationship between the required cross-sections for three pairs of cables, depending on assumed stiffness of girder. Figures 2 and 3 show how positive and negative bending moment peak values in beam are affected by cross-section of cables and stiffness of girder.

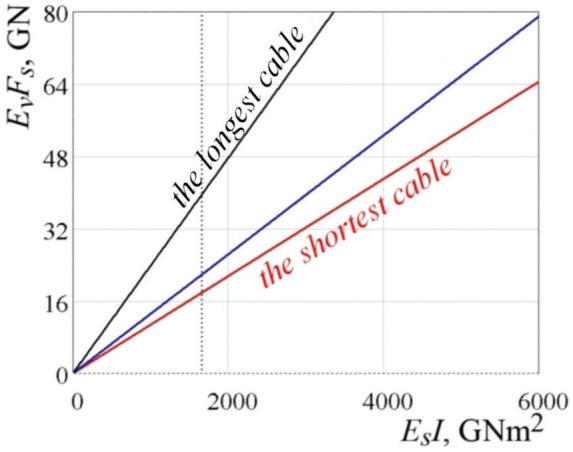

Fig.1: The required values of stiffness of cables E_vF_s (GN) depending on E_sI (GNm^2) of the stiffening girder

These regularities allow making effective preliminary assumption of the parameters of cable-stayed bridge. Graphical correlations are obtained by analytically solving the system of differential equations representing the deformed shape of a statically undetermined and geometrically nonlinear cable system. In fact, the presented analytical method allows detailed analysis on the following systems characteristics:

- distribution of stresses in girder depending on location of cables anchors;

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