



11–12 October 2012, Riga

**Riga Technical University  
53rd International  
Scientific Conference**

Dedicated to the 150th Anniversary and  
The 1st Congress of World Engineers and  
Riga Polytechnical Institute / RTU Alumni

**DIGEST**

# **Construction Science**

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53<sup>rd</sup> INTERNATIONAL SCIENTIFIC CONFERENCE  
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# Behavior of Prestressed Suspension Bridge

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**Keywords** – Cable Truss, Kinematic Displacements, Prestression Loss, Pylon Displacements.

## I. INTRODUCTION

A suspension bridge is the most suitable type for a long-span bridge due to rational use of structural materials. Increased deformability, which is conditioned by the appearance of the kinematic displacements, is the major disadvantage of suspension bridges. This problem can be solved by application of prestressed cable truss with two concave chords and cross web. Pylon displacements can cause significant increase of structure total displacements in main span. Prestressing losing in time decrease prestressed suspension bridge total stiffness.

## II. DESCRIPTION OF INVESTIGATION OBJECT

Three span prestressed suspension bridge was assumed as an object of investigation (Fig. 1). The main span of the bridge is equal to 200 m and side spans are equal to 100 m.

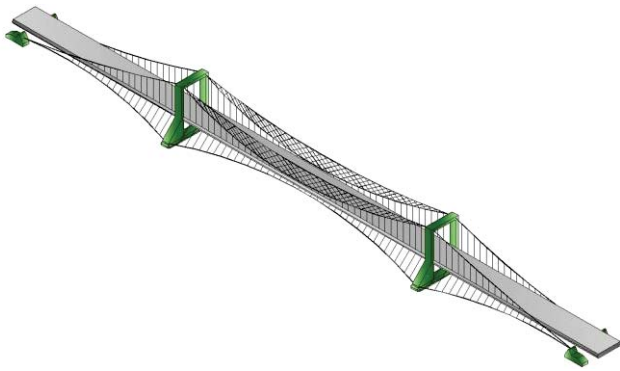


Fig. 1. Prestressed suspension bridge with cable truss

Two types of main load caring structure are analyzed – single cable and cable truss. Cable elements were made from steel ropes. Deck structure is made from light composite pultrusion profiles.

## III. INFLUENCE OF PYLON DISPLACEMENTS ON SUSPENSION BRIDGE BEHAVIOR

Structure of three span prestressed suspension bridge was modeled in FEM program ANSYS. Two types of structures were analyzed: structure with single cable and with cable truss. Maximum axial loads in pylons appeared in full three span loading case, but maximum moments appear in bridge central span loading case. Pylon horizontal displacements most influence on bridge total vertical displacements in the case of not enough pylon stiffness. Two types of pylon displacement decreasing can be used – pylon stiffness increasing or active tendons usage, which can automatically increase the level of side spans prestressing. Dependence of pylon stiffness and vertical displacements of suspension bridge is shown on Fig.2. In the case of small pylon stiffness (300 GN·m<sup>2</sup>) cable truss is by 10 % advantageous to single cable form the point of view of displacements. But total vertical displacements are not in the acceptable limit in this case. To ensure serviceability limit state stiffer pylons should

be used. Cable truss is by 35% advantageous to single cable in this case.

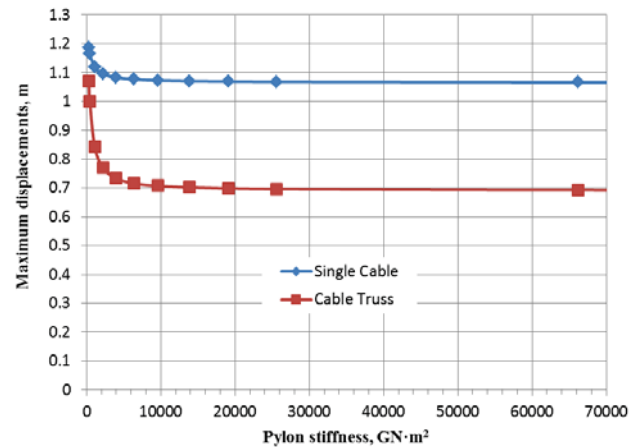


Fig. 2. Influence of pylon stiffness on displacements of prestressed suspension bridge

## IV. PRESTRESSING LOSS IN TIME

To analyze prestressing loss in time physical experiment was performed. Small scale model was initially prestressed by the level of prestressing which exceed design level by 20%. After one day level of prestressing was lowered to design level and structure was tested 88 day long (Fig. 3). The level of prestressing changed only by 0.5 %.

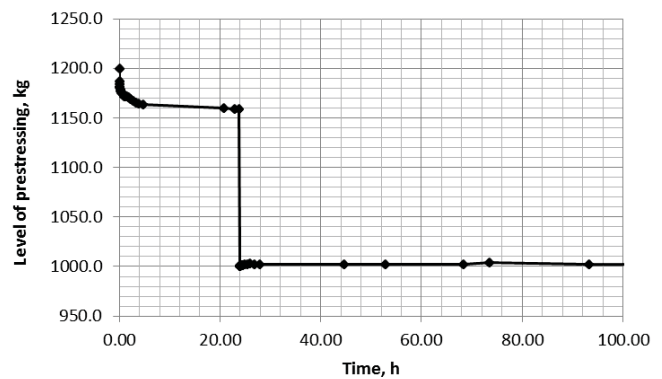


Fig. 3. Prestressing level loss in time

## V. CONCLUSIONS

Only pylons with stiffness more than 10000 GN·m<sup>2</sup> allow to ensure serviceability limit state. Cable truss is by 35% advantageous to single cable in this case.

Initial prestressing by 20% and one day sustain of prestressed suspended structure decrease prestressing loss in time to 0.5%.

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