Ice-shedding and aerodynamic investigations of bridge cables with steel wire meshes

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Abstract

Numerous cable-supported bridges in cold climate regions are prone to seasonal ice or snow shedding, primarily from the bridge cables. Specific atmospheric conditions are required to trigger this phenomenon, which often results in dangerously sized pieces of ice or snow falling off the cables on the bridge deck below. Ice or snow shedding events that have led to bridge closures and insurance claims have been increasingly reported throughout the world in the past two decades. In this paper, a recently developed passive solution in the form of a steel wire mesh, which can be effectively used on new as well as on existing bridges, is introduced. Despite having a higher drag coefficient than the conventional helically filleted cable surface, the wire mesh is capable of retaining the ice on the surface of the cable for an extended time. This leads to prolonged ice melting and fragmentation of the ice before or during shedding, thus achieving a substantial risk reduction.

Keywords: cable surface, force coefficients, ice accretion, ice retention, risk reduction.

1 Introduction

Ice or snow shedding events on cable-supported bridges in cold climate regions have become more and more common with the increased construction of these bridges in the last few decades. During specific weather conditions, precipitation in the form of freezing rain or snow and sleet causes accumulation of ice or wet snow on the surface of the cables. The resulting adhesive bond at the cable-ice interface is very strong at this stage. Once the atmospheric conditions change and the temperatures are above 0 °C, the ice starts to melt [1]. Aided by the solar radiation penetrating the ice, the adhesion between the cable surface and the ice weakens as a thin layer of water forms under the ice. Consequently, ice shedding occurs as the wind and gravity forces acting on the ice overcome any residual adhesion and friction. The chunks of ice falling on the bridge deck might be of considerable size and mass, which poses a risk for the traversing traffic and pedestrians. Numerous insurance claims and bridge closures put a strain on the bridge owners as well as the regional economy. To improve traffic safety and reduce the associated economic losses various countermeasures have

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