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Innovative bridge cables for the reduction of ice-shedding risk

Lubomir Matejicka

Technical University of Denmark, Kgs. Lyngby, Denmark

Christos T. Georgakis

Aarhus University, Aarhus, Denmark

Andreas Schwarz, Philipp Egger

VSL International Ltd., Bern, Switzerland

Contact: lu.matejicka@protonmail.com

Abstract

Ice and snow accretions on bridges pose a hazard for motorists and pedestrians, as shedding accretions can have a significant mass associated with them. Various technologies have been tested on numerous bridges in an attempt to prevent accretion build-up or help mitigate the effects of the falling snow or ice on the traffic below. Most have been found to have problems with durability and cost-effectiveness though. In this paper, we present preliminary test results from ice shedding tests that have been performed on innovative cable surface modifications in the DTU/Force Technology Climatic Wind Tunnel (CWT) in Lyngby, Denmark. It is shown that contrary to the ice shedding of contemporary cable surfaces, the innovative surfaces retain the ice longer during the melting process, reducing the shedding ice mass and particle size, thus reducing the risk associated with the shedding ice.

Keywords: freezing rain; ice accretion; bridge cables; ice shedding; concave fillets.

1 Introduction

Icing on suspension and cable-stayed bridges has been an issue since the first of these structures were constructed. Bridge cables are particularly prone to ice accretion due to their inclined arrangement, slenderness, and cylindrical shape. Depending on the weather conditions, the thickness of the ice layer may exceed 15 mm in case of glaze ice or even 40 mm for wet snow accretions in extreme cases, hence posing a serious threat when falling. For this reason, bridge owners are often forced to close bridges for several hours until the risk has been significantly reduced with measurable financial losses each time.

Any natural process involving accretion of water frozen either in the atmosphere or after contact with an object is classified as atmospheric icing. As described by Makkonen [1], water might be either in the form of cloud droplets, raindrops, snow or water vapour as a source for ice accretion divided into three main categories [2]: in-cloud icing, precipitation icing and hoar frost. The majority of icing events occurring on the bridges originate

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