CZ.1.05/1.1.00/02.0060: The investigation of fatigue oscillations induced wind loads on cables with ice of cable supported bridges

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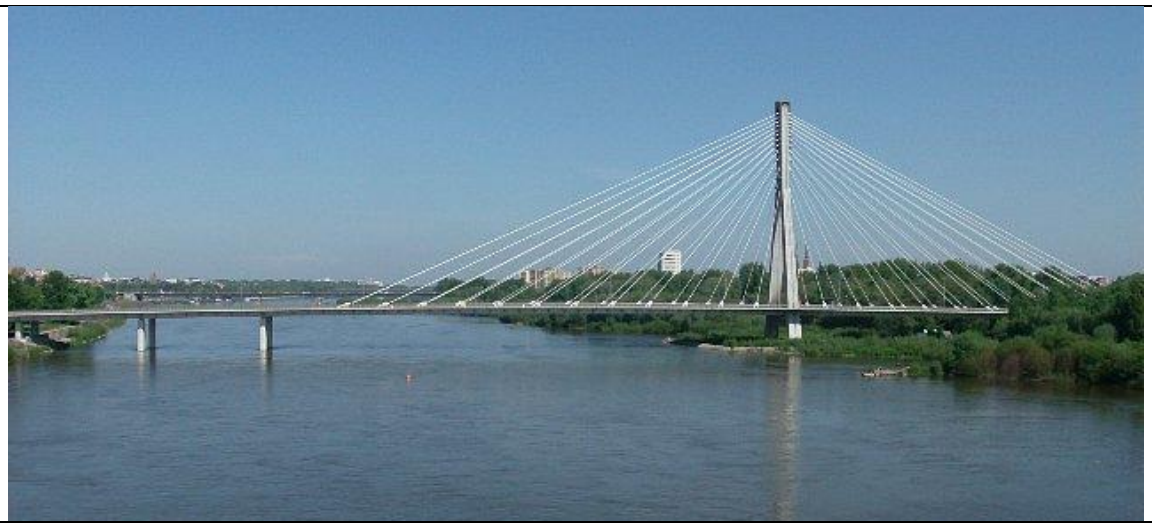
The investigations were carried out on the model of the cables of the Świętokrzyski Bridge located over the Vistula River in Warsaw. It is fifth of the largest cable-stayed bridge in Poland. The bridge has one 87.5 m tall pylon. Main girders of the bridge deck are a steel plate continuous beam composite with reinforced concrete bridge decks, which are 30.00 m, 40.00 m, 180.00 m and 140.00 m long. The hanger span constructions of spans 180.00 m and 140.00 m to the pylon, with the shape resembling the letter A is realized by 48 cables in two planes. The total length of the bridge including access viaducts at both ends of the bridge is 510.00 m. The objective of the project is an implementation of model tests in order to investigate of fatigue oscillations induced wind loads on cables with ice of cable-supported bridges.



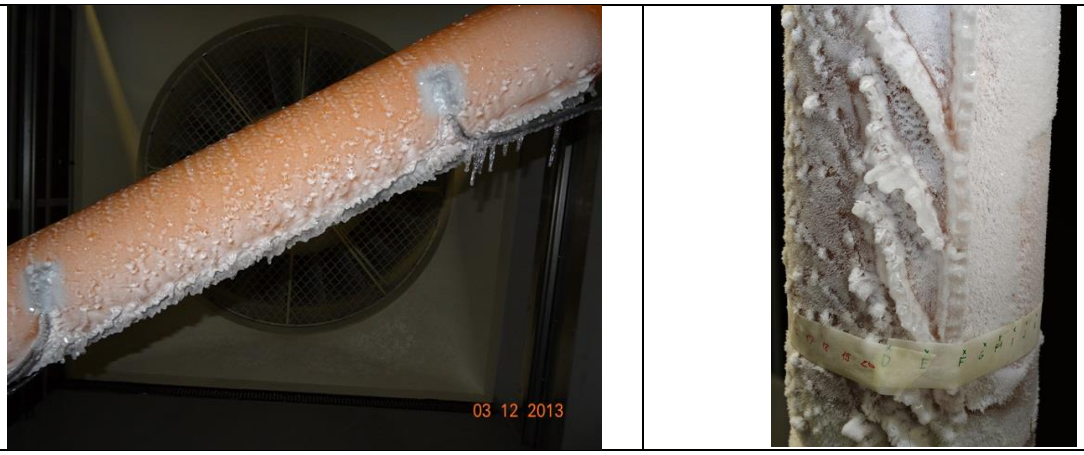
View of Świętokrzyski Bridge in Warsaw

The investigations involve the following stages: stage i: experimental icing of the sectional cable model supported bridge in full scale (the scale 1:1) in the climatic section of the Wind Tunnel CET. The stage ii: making of the sectional model of the ice cable supported bridge in less scale (the scale 1:2). The stage iii: aerodynamic investigations of the icing sectional cable model supported bridge in less scale in the aerodynamic section of the Wind Tunnel CET.

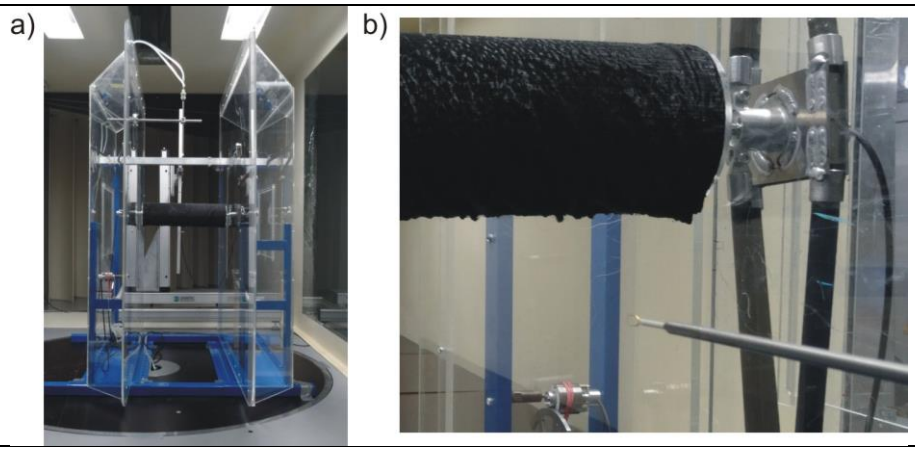
The numerical model of iced cable was prepared and made with using a 3D printer in a appropriate scale. The following investigations concerns of the influence of icing on the aerodynamics effects of bridge cables are: the investigation of the aerodynamic coefficients of the iced cable for different wind direction, the prediction of the critical wind speed and the visualization of the inflow around the iced cable in the critical vortex excitation region, the prediction of the possibility of the galloping instabilities of the iced cable.

The Strouhal number is one of the most important parameter, which is necessary for an analysis of the vortex excitation response of slender structures. The method and results of

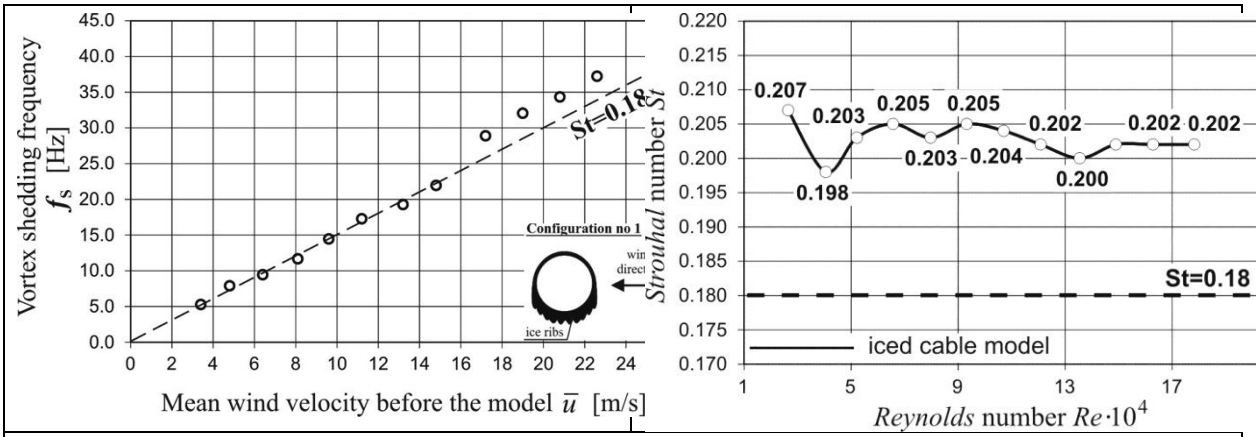
wind tunnel investigations of Strouhal number of iced cable model of cable-supported bridges are presented. The methodology leading to the experimental icing of the inclined cable model in the climatic section of the laboratory was prepared. The Strouhal number was determined within the range of the Reynolds number between 28e3 and 122e3, based on the dominant vortex shedding frequency measured in the flow behind the model.



Test result of the ice accretion



a) View of the special frame with the iced cable model in aerodynamic section; b) view of the fixation of the model and the hot-wire anemometer CTA behind the model



Left-Frequency of the vortex shedding as a function of wind speed. Right- Strouhal number as a function of the Reynolds number.