Analysis of fluid-structure interaction of a part of a water slide subjected to wind loads

A. Padewska*, P. Szczepaniak[†] and A. Wawrzynek[†]

[*] Department of Building Structures Theory
Faculty of Civil Engineering
Silesian University of Technology
Gliwice, Poland
e-mail: agnieszka.padewska@polsl.pl

[†] Department of Building Structures Theory
Faculty of Civil Engineering
Silesian University of Technology
Gliwice, Poland

ABSTRACT

European standard EN 1991-1-4 is dedicated to determination of aerodynamic forces acting on building structures, caused by strong winds. In case of structures made of cylindrical elements it is limited to the most popular types, like chimneys or simple trusses. At slightly more complicated situations, e.g. a pipe located close to a flat surface, the standard refers readers to the unidentified experts, suggesting that, quote: "special advice is necessary". That is why this work presents the analysis of wind loads acting on tubular structures of complex shape. The subject of the following analysis is a wind flow with hurricane velocity around a simplified part of a typical water slide, made of straight and curved cylindrical pipes. The surface roughness which is an important factor was taken into account, and also the possibility of dividing complex system into smaller, simple elements in order to the estimate of its wind load as the sum of the partial loads acting on individual basic parts was checked. What is important, an additional horizontal force perpendicular to the aerodynamic drag acting on objects in the shape of a bent pipe, which cannot be estimated by Eurocode, was taken into account.

Finite Element Method (*FEM*) and Finite Volume Method (*FVM*) were used. The analysis is performed as one-way fluid-structure interaction (*FSI*), force transfer, neglecting the possible deformations or oscillations of the structure.

Mathematical relationships proposed in earlier work of the authors, regarding objects in the shape of a bent pipe derived on the basis of an algorithm of determining impact of wind on a cylinder arranged perpendicular to the direction of air flow, as described in Eurocode 1991-1-4 were used in the current analysis. Also the relevant aerodynamic interference coefficients of flow around cylinders arranged in a row, proposed in others papers of the authors, were taken into account.

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