

Wind analysis of an air-inflated membrane structure

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Abstract

Air-inflated structures are portable, very light structures with small folded/uninflated volume and with extremely short set-up and dismantling time. Air-inflated structures were built with larger and larger spans in the previous years. Since the building codes do not provide the pressure coefficients of membrane structures, normally they are determined by the help of wind tunnel tests or CFD (Computational Fluid Dynamics) calculations. The current research deals with the wind analysis of a structure composed of six air-inflated arches. The 3 main steps of the research are: a) The determination of the pressure coefficients of the surface of the inflated structure by the help of wind tunnel tests. The pressure coefficients were determined for different wind directions in the case of a closed and an open set-up (structures with and without end walls). b) The nonlinear static analysis of the structure on the basis of the determined pressure coefficients. c) Wind tunnel tests of the model of a deformed shape of the structure (the deformed shape is determined numerically on the basis of the pressure coefficients of the inflated structure). Comparison of the pressure coefficients of the inflated structure (without external loads) and the pressure coefficients of the deformed shape. The aim of the last step of the research is to analyze the efficiency of the wind tunnel tests of a rigid model in the case of a structure with large deformations. Similar analysis was completed previously for a conical tensile membrane structure [1].



Figure 1: The model of the open structure for the wind tunnel tests (on the left) and the pressure coefficient field when the wind blows from the right (on the right)

References

- [1] K. Hincz and M. Gamboa-Marrufo, “Deformed shape wind analysis of tensile membrane structures”, *Journal of Structural Engineering (ASCE)*, vol. 142(3), Paper: 04015153, 5 p., 2016.