Untypical steel arch - wind load

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1 INTRODUCTION

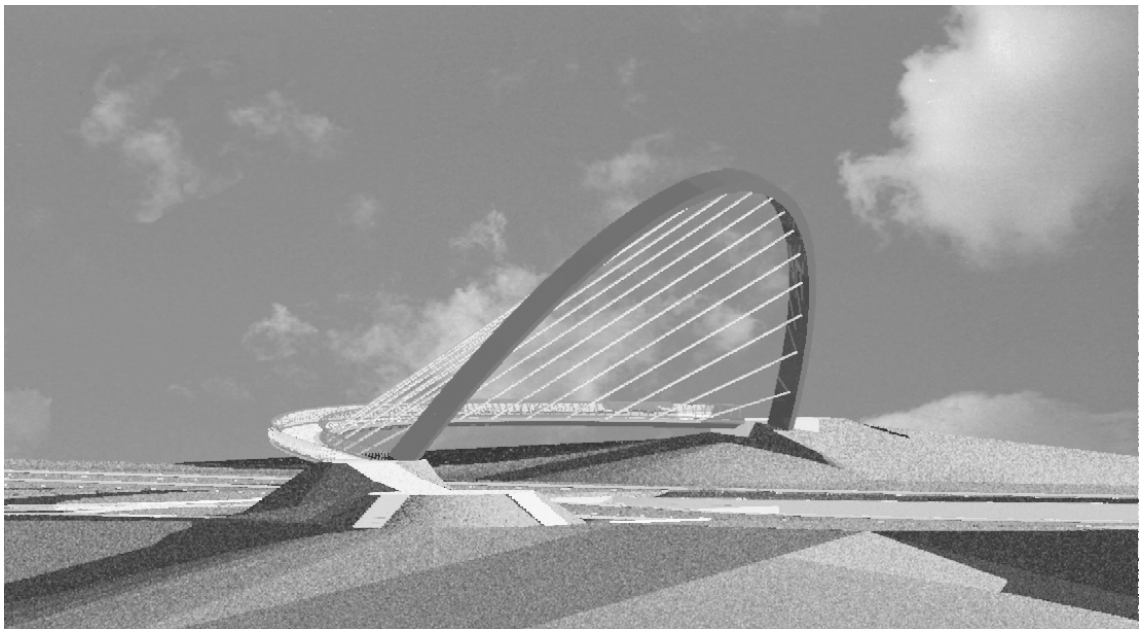

Fig 1. Visualisation of footbridge

Untypical footbridge has been projected in Katowice. Its structure imitates the Millenium Bridge in Gateshead (Great Britain). Steel arch is the most important loadbearing element of the footbridge. Concrete bridge deck is suspended to it by steel cables. In the first stage the steel arch is planned to be erected as a separate structure; afterwards it will be connected to the deck. Before the connection structure will be very flexible. Therefore, different types of aerodynamical instabilities can be taken into account.

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2 CALCULATIONS

In the article, wind action on the arch is considered in accordance with a quasi-steady theory (Flaga A., 1994). This approach enables to analyse several aerodynamic phenomena, such a galloping, special type of flutter, buffeting, and divergence. Three components of load, i.e. drag force, lift force and aerodynamic moment have been analysed. The whole arch has been treated as a slender structure which was divided into *m* elements. Each of them is represented by the inner point *k* of the cross-section. Next, formulae which are related to all points of a span are transformed to the global system of coordinates. It is assumed, that the structure works in elastic range. Their motion can be described by the following matrix equation:

$$[M]\{r^{**}\} + [C]\{r^{*}\} + [K]\{r\}=\{w\} \quad (1)$$

The Bubnow-Galerkin method is adopted. As a result, a system of many degrees of freedom is substituted by an equvivalent system with three degrees of freedom. The complex form of the set of nonlinear differential equations is resolved in a numerical way. This calculation method was presented in detail elsewhere (Flaga A., 2002), (Flaga A. & Michałowski T., 2002), (Flaga A. & Michałowski T, 2003).

Static and dynamic calculations have been made by Algor computer software. Frequencies of free vibrations, amplitudes of vibrations and static displacements have been obtained.

Furthermore, analysis according to the Polish Standard (PN-77 / B-02011) has been presented. The results, obtained according to both methods of calculations have been compared and analysed.

3 CONCLUSIONS

- Wind load, obtained from the Polish Standard method is much more greater than another one, obtained according to quasi-steady theory,
- Vortex excitation is not dangerous in this type of the structure.

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PN-77 / B-02011, Loads in static calculations, wind loads