Reconstruction of masonry windmill tower with multi-blade wind turbine, steel reservoir and water supplying system

***Piotr W. Sielicki**

Faculty of Civil and Environmental Engineering
Poznan University of Technology (PUT)
M. Skłodowskiej-Curie 5, 60-965 Poznan, Poland
e-mail: piotr.sielicki@put.edu.pl, web page: http://www.cad.put.poznan.pl/

ABSTRACT

In the early 20th century, rapid industrial growth around the world allowed to development of many advanced mechanical structures. Some of them were successfully used to improve agriculture efficiency or comfort of the life of people. Such a situation was also observed in the western part of Poland, which this time was under the partition. In 1910 in the city of Poznan polish landlord built an advanced structure to make his farming more automatic and based on the free of charge wind energy. At first glance, it was a classic windmill with a multi-blade wind turbine fixed on the top of a masonry cylindrical tower. Nevertheless, some additional elements show the uniqueness of such a structure at that time. Firstly, the water was extracted from the three independent ignition points located tens of meters from the windmill. Secondly, the water was pushed to the steel reservoir located on the top of the structure, right beneath the wind turbine. Next, this efficient water source continuously supplied the water to dozens of independent points located at the owner's field and house using only gravity force. Furthermore, extraordinary use of such structure was the supplying of electricity to the whole landlord's property.

After more than 100-year history a location of the object is the centre of a rapidly growing area of the city. In that reason, the necessity of restoration requires many retrofitting works including the reconstruction of non-existing elements but preserving the new safety regulations. In this work, the author presents the basic assumptions of a future renovation process. Moreover, the conceptual projects of missed elements are proposed based on old pictures and 3D laser scanning technique. One of the primary difficulties of the project is an existing masonry tower. Because in the future, the working wind-turbine together with the full of the water reservoir can create a complex loading state for the old unit-mortar composite a new supporting system is designed. The design process is performed using the numerical methods and employing fluid-structure interaction explicit methodology to predict the displacement and stress outcomes. This study is obtained for an existing masonry and secondly for the newly developed supporting system.