Dynamic response investigation of submerged prototype trash-racks in hydropower plants considering acoustic fluid-structure coupling

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Long Abstract

Abstract

The trash-racks used in hydropower plant for preventing the entry of debris are prone to have damage[1,2]. Broken bars due to fatigue problems are not uncommon. In this case large bodies can enter into the turbine causing problems in the distributor or in the runner.

The dynamic behavior of these structures has to be calculated for a safe operation of the machines. The coincidence between the hydraulic excitations (like vortex shedding) and the eigenfrequencies of the TR has to be avoided. The basic condition is that the first natural frequency of the structure is larger than the maximum frequency of the excitation.

Therefore the response of a real trash-rack when installed in the water conduits has to be known. Because the natural frequencies depend not only on the design but also on the support and on the added mass the influence of these parameters is convenient for a safe design.

This paper investigates the effects of the attachment method and of the added mass on the dynamic response of submerged trash-racks. The finite element method (FEM) has been used to calculate the dynamic response. The method has been validated with experimental results.

Real trash racks installed in hydropower plants have been selected for this study. The natural frequencies and mode-shapes of the trash-rack both in air and still water have been obtained for different attachment methods. The influence of these boundary conditions as well as the added mass effects has been analyzed in detail.

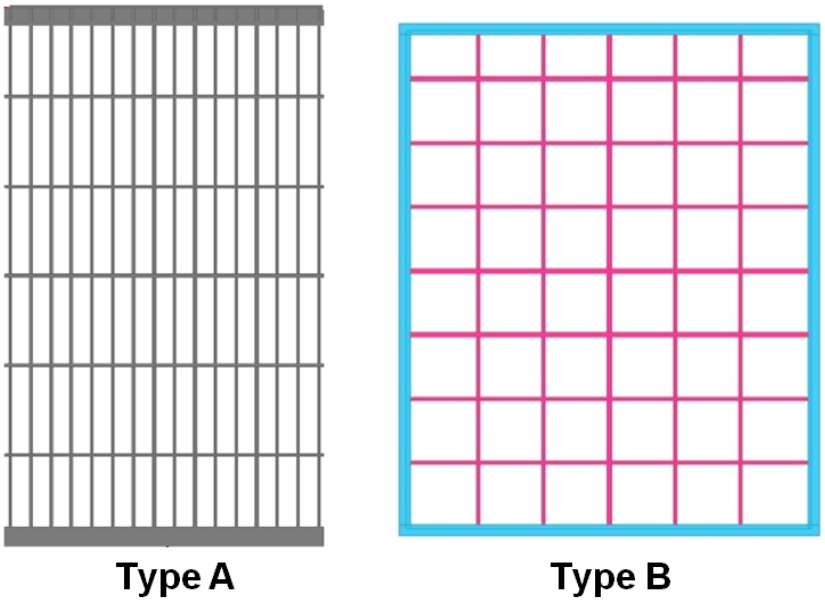

Figure 1. Typical prototype trash-racks in the existing hydropower plants.

References

[1] R. Hollenstein. Flow-induced vibrations of a trashrack. *18 IAHR-congress Graz*,1999.

[2] X. Huang, C.Valero, E. Egusquiza, Alexandre Presas, A. Guardo. Numerical and experimental analysis of the dynamic response of large submerged trash-racks. *Computers & Fluids*, 71:54–64, 2013.