VIBRATION OF PLATES PARTIALLY AND TOTALLY IMMERSED IN FLUID BY THE BOUNDARY ELEMENT METHOD

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Natural vibrations of Kirchhoff plates immersed in fluid (water) are considered using the Boundary Element Method. The influence of the surrounding fluid considering a liquid free surface on the plate vibrations is analysed. This is problem of the fluid-structure interaction in which the boundary-domain integral equations considering the simplified boundary conditions are used for describing the plate deformation and motion [1], [2]. Surrounding liquid is a source of the additional inertia forces resulting from its mass. Additionally, compressible liquid can play the role of radiation damping forces [2], [3]. In present analysis it is assumed that the fluid is inviscid and incompressible.

The set of boundary elements for the plate and rectangular boundary elements (sub-domains) for the fluid are introduced [2], [3]. All rectangular sub-domains for the fluid are associated with the set of internal collocation points located at the plate domain. It allows to create fully populated fluid mass matrix, which is adjoined to lumped plate mass matrix.

One of several analyzed examples is the clamped sqare steel plate of dimensions 10.0m×10.0m and thickness 0.238m [4], which is perpendicularly immersed in water to half its length, from the side of middle free edge. The water free surface effect is considered too. The number of boundary elements of the same length is 120, the number of lumped masses is 400. The part of the plate domain immersed in water is divided into 200 sub-domains. Natural frequencies [rad/s] from the first to fifth are respectively: 8.16 (8.22), 21.83 (21.85), 64.36 (65.40), 75.40 (76.68), 96.47 (98.15). Results in round brackets are given by Fu and Price [4].

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