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Extreme waves impact on the ship mooring near berth

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Ensuring safe ships berthing and loading-unloading operations at berths need reliable mooring systems. The choice of its parameters corresponds to calculating of the maximum displacements of the boat, which are caused by external impact of extreme waves, winds, and currents. Ship motions are described by system of differential equations, which contain disturbing, inertia, damping, and restoring forces, which magnitude strongly depends on the berth design and configuration of its elements. The major impact on the boat movements is caused by sea waves. In the given paper, an interaction between sea waves and ship located near the berth is studied. The cross-sectional shape of the boat is assumed to be rectangular and under-berth slope profile is approximated by finite number of steps. Different types of berth constructions are taken into account: containing impermeable or partially permeable front vertical wall, wave attenuation camera behind it with or without under-berth slope. The fluid is assumed ideal and incompressible, and its motion is potential. The stated problem is reduced to the determination of the velocity potential that satisfies the Laplace equation; the boundary condition on the free surface; the condition of non-flux through the impermeable bottom, the ship and berth elements; the condition on the surface of the permeable wall that is in proportionality between the wave flow velocity through the wall and pressure drop from its front to back faces. The problem is solved by dividing of the region into sub-domains with conditions of the hydrodynamic pressure and velocity continuity on its boundaries. In each sub-domain the solution is found using Fourier method in the form of functional series with unknown coefficients which are found from the system of linear algebraic equations. Calculated velocity potentials are used to determine different hydrodynamic characteristics of ship motions, such as horizontal and vertical components of disturbing force and moment, added masses and damping coefficients for all types of boat motions. The results of calculations are presented and they are compared with experimental data performed by authors.