January 27-29, 2023

Ankara,Türkiye

5. INTERNATIONAL ANKARA MULTIDISCIPLINARY STUDIES CONGRESS

ABSTRACT BOOK

Edited by

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CONTENT

ABSTRACT BOOK

DAMPING OF LIQUID VIBRATIONS AS IN RIGID TANKS WITH BAFFLES

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ABSTRACT

Shells of revolution are usually used as reservoirs and tanks for storage different liquids. These liquids often are inflammable or toxic. So, the intensive vibrations of these reservoirs content can lead to very dangerous consequences, such as splashing out hazardous contents, which can lead to fire, explosions, and environmental degradation [1,2].

To damp sloshing, a lot of devices were proposed by scientists and engineers [3,4] as well as advanced technological materials [5] for reservoirs manufacturing.

In this paper the fluid-filled cylindrical tanks with different baffles are considered. The conical and flat baffles are proposed [6] and quarter tanks are also investigated [7]. The liquid inside shells is supposed to be ideal and incompressible, and its flow induced by suddenly applied loadings is regarded as non-vortex.

So, liquid movement can be described by harmonical potential Φ. For the Laplace equations the boundary conditions are formulated. They are non-penetration conditions at the shell and baffle surfaces, and dynamical and kinematical conditions at the free surface. Using third Green's formula, the boundary integral equations are received, For their numerical solutions here we used boundary element method, described in [8,9]. The rigid shell is subjected to an external excitation in horizontal direction. It is assumed here that the excitation is harmonical one with given frequency and amplitude. The effect of baffle installation is studied, and its influence is estimated both on own frequencies and the free surface elevation. It has been demonstrated that the frequencies became smaller when horizontal or conical baffles are installed, but in quarter tank the inverse effect is observed, namely, the own frequencies are increased. But for both horizontal and vertical baffles, the free surface elevation is decreased via time, as it shown in Fig.1.

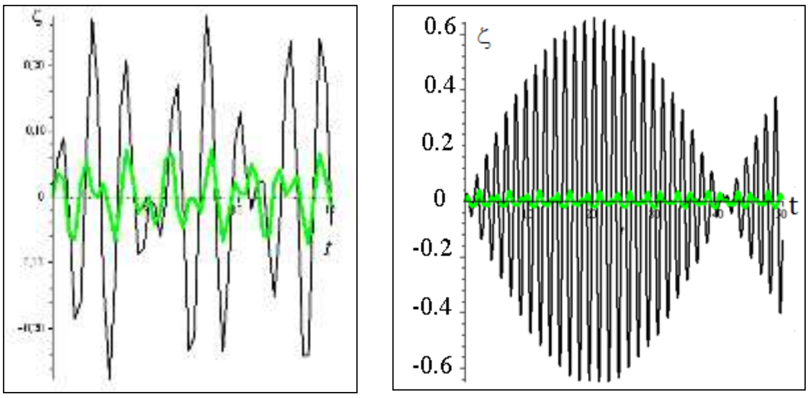

Fig.1. Free surface level at different frequencies.

Here black lines are corresponded to liquid vibrations in shells without baffles, and green lines demonstrated the essential reducing of free surface amplitudes via time.

So, the baffle installation in storage reservoirs can diminish the dangerous consequences of liquid sloshing.

Keywords: liquid sloshing, shells of revolution, baffles, forced vibrations.

NONSTATIONARY TEMPERATURE FIELDS AND THERMAL STRESSES IN A MULTILAYER AIRCRAFT GLAZING

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ABSTRACT

The majority of publications devoted to thermal stressed state of laminated structures deal with deformation of structures under steady temperature conditions or dynamic temperature fields with prescribed distribution through the thickness [1].

The hypothesis about a piecewise-linear temperature distribution through the thickness of a laminated package is often applied [2]. However, the non-stationary character of a problem requires a more exact description of the temperature field obtained directly from solution of a heat conduction equation [3-5].

A method for calculation of nonstationary thermal fields in a multilayer glazing of vehicles under the effect of impulse film heat sources is offered. The multilayer glazing is considered as a multilayer plate with complex shape made up of isotropic layers with constant thickness. The temperature on the side surface of the plate is zero. Convective heat transfer occurs on outer surfaces of the plate; on layers' interfaces film heat sources are arranged.

The heat conduction equation for an arbitrary plate layer after the Laplace transformation on time is reduced to the functional equation. In the same way initial and boundary conditions are transformed. A solution of the functional equation we search in the form of three space functions product. That enables us to get the system of ordinary differential equations. We represent the system solution as double trigonometrical series taking into account boundary conditions on the plate side surface.

Series expansion factors are determined from a system of linear algebraic equations which is formed of boundary conditions on outer surfaces and layers' interfaces. The system right member contains factors of expansion of interlayer film heat source functions. After determination of factors a transform of the required function is found by the second expansion theorem, and the problem solution has the form of double trigonometrical series.

Deformation of the plate is considered on the basis of the refined theory of the first-order accounting transverse shear strains in each layer. The thermal elastic equilibrium equations and the boundary conditions on the contour are obtained using Lagrange's variation principle. The problem solution is obtained by the embedding method [6]. According to the method, the complex-shape plate is virtually embedded within an auxiliary enveloping multilayer simply supported plate of rectangular planform shape with the same composition of layers. An auxiliary plate is one whose contour shape and boundary conditions yield a simple analytical solution. The system of general equations is integrated by expansion into Taylor series.

As an example, we investigated thermal fields and stresses in five-layer aircraft elements under heating by the film heat source. The heat source has the rectangular form. It is arranged between the first and the second layers of the glazing element. The stresses in glazing layers are determined under the action of heat fields obtained by solving the nonstationary heat conduction problem. The results were validated by comparison with test data [7].

The method offered can be used for designing a safe multilayer glazing of transport vehicles and different composite structures [8-14] under operational and emergency thermal loads.

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