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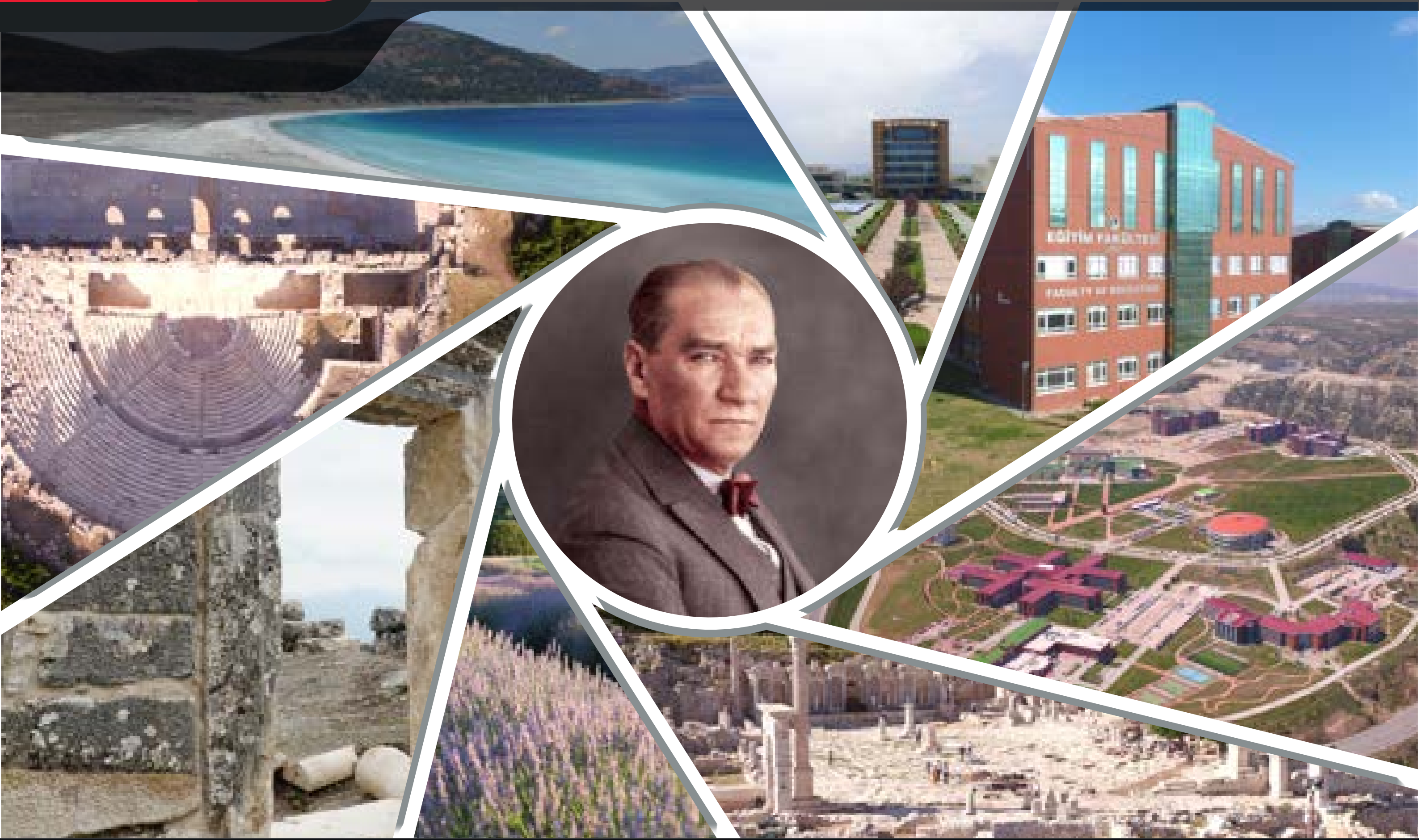
6th INTERNATIONAL EDUCATION & INNOVATIVE SCIENCES CONGRESS

November 24-25, 2022, Burdur
Burdur Mehmet Akif Ersoy University



ABSTRACT BOOK

EDITORS:
Dr. Firdevs SAVİ ÇAKAR
Dr. Mustafa KILINÇ
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CONTENT

STUDY OF OSCILLATIONS NATURAL FREQUENCIES FOR EMPTY AND FILLED WITH ENVIRONMENTALLY HAZARDOUS LIQUID CYLINDRICAL ELASTIC TANKS

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Abstract

Tanks for storing oil, drinking water and chemicals usually have the cylindrical shells form. The strength determination of such tanks is the actual issue, especially under the suddenly applied loads action in order to prevent ecologically dangerous effects on the environment and prevent emergency situations. These could be seismic impacts, or shock loads due to explosions, aircraft crashes, etc. Most often, these tanks are modeled as rigid shells. But in practice, these tanks based on the elastic foundation, which helps to reduce vibrations under external influences [1-4].

In these tanks, intense liquid sloshing occurs under the sudden loads action. Some of scientific publications [2-6] and others have devoted to the study of this phenomenon. Different devices have been used to extinguish sloshes. Thus, in [5] it has been suggested to install horizontal or vertical partitions. In [6] it has been established that with certain geometric parameters, the frequencies of elastic walls oscillations could approach the frequencies of oscillations of the free surface, which poses the threat to the tanks safe operation. In [7-8], the use of nanocomposite materials in tanks has been proposed to increase their strength characteristics under seismic loads. Therefore, it is important to study the issues of tanks oscillations in the coupled formulation, taking into account the elasticity of the walls and the aggregate sloshing. It should be noted that the oscillations frequencies of elastic cylindrical walls are usually higher than the bottom oscillations frequencies. Therefore, the issue of choosing the tank elastic bottom characteristics in order to reduce vibrations is relevant. For this, elastic bases various models have been used.

Solving problems of the shell structures dynamics in interaction with the environment requires the creation of new effective computer modeling methods. Among them, it has been noted the methods of integral equations in combination with Fourier series expansions, the method of boundary elements, the method of finite volumes, and the method of finite elements.

The paper has been investigated the cylindrical shell oscillations on the elastic Winkler base. The reservoir has been assumed to be partially filled with the ideal incompressible fluid. The task has been to determine the frequencies and shapes of such shell, taking into account the flapping of the free surface and the elastic bottom vibrations. The presence of the elastic base makes it possible to take into account the interaction with the soil.

In the table 1 shows the numerical values of the oscillations natural frequencies for empty and liquid-filled cylindrical elastic tanks, without taking into account the influence of the elastic base. Here, the coefficients n_S, n_L indicate the number of shell forms and liquid including in the coupled oscillations, J is the number of the oscillations coupled form. Four forms of shell oscillations and five forms of clapping have been used for numerical simulation.

Table 1. Frequencies of empty and liquid-filled elastic tanks, n = 0.1, Hz

n = 0					*n* = 1			
J	n_S	n_L	Shell without liquid	Shell with liquid	n_S	n_L	Shell without liquid	Shell with liquid
1		1		0.9739		1		0.6418
2		2		1.3208		2		1.1509
3		3		1.5909		3		1.4564
4		4		1.8209		4		1.7054
5		5		2.0249		5		1.9212
6	1	1,2	23.233	7.6591	1,2		48.520	21.902
7	2,1		91.101	43.308	2,1		139.70	79.712
8	3,2		205.25	117.03	3,2,1		232.44	178.42
9	4,3,2		365.79	230.31	4,3		277.30	210.00

These data show the difference between the frequencies of filled and empty shells. As the frequency number increases, this difference gradually decreases. The frequencies of oscillations related to elastic walls significantly exceed the frequencies associated with sloshing.

Keywords: Study, Environment, Elastic

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