12th INTERNATIONAL MARDIN ARTUKLU SCIENTIFIC RESEARCHES CONFERENCE

August 17-19, 2024 / Mardin, Turkiye

Abstracts Book

Editors

Assoc. Prof. Dr. Naseem AKHTER

Gulnaz GAFUROVA

ISBN: 978-625-367-821-0

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ABSTRACTS BOOK

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by
IKSAD PUBLISHING HOUSE®

https://iksadyayinevi.com/

Issued: 05.09.2024

ISBN: 978-625-367-821-0

CONFERENCE ID

12th INTERNATIONAL MARDIN ARTUKLU SCIENTIFIC RESEARCHES CONFERENCE

DATE and PLACE

August 17-19, 2024 / Mardin, Turkiye

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EVALUATION PROCESS

All applications have undergone a double-blind peer review process

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LIQUID SLOSHING IN FUEL TANKS UNDER PERIODIC LOADS WITH DAMPING

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Abstract
Objective. This research focuses on analysing the stability of fluid movement within tanks subjected to coupled external periodic loads, incorporating the effects of damping. An efficient computational method has been developed, utilizing the method of given modes and the one-dimensional boundary element method. Upon solving the spectral problem and determining the natural frequencies and modes of liquid oscillations in a rigid tank, a system of differential equations is derived to describe the free surface's movement over time. These equations are obtained using the dynamic condition on the free surface. The stability of liquid movement under vertical harmonic loads is examined using the Ince-Strutt diagram for each fundamental frequency.
Relevance. New conditions of using equipment and introduction of new materials have significantly altered the stress-strain states and vibration characteristics of elements in modern structures. This necessitates enhanced research into the strength and dynamic characteristics of equipment operating under increased force and temperature conditions, especially when interacting with various aggregates. The issue of liquid sloshing in tanks first emerged in the 1960s with the advent of space vehicle flights. Poor design choices led to significant liquid fluctuations in fuel tanks, resulting in stability loss, deviations from calculated trajectories, and even complete destruction of launch vehicles. Designing powerful new launch vehicles demands innovative tank designs, which can now take on quite exotic forms [1]. Consequently, interest in studying the motion stability of reservoirs and fuel tanks has persisted for several decades [2]-[4].
Conclusion. A method has been developed to determine the time-varying level of the free surface of a liquid in rigid shells of rotation. The spectral problem of identifying the frequencies and modes of liquid oscillations in a truncated conical tank is addressed by reducing it to a system of one-dimensional integral equations. Using the Ains-Strett diagram, zones of instability in fluid movement under harmonic vertical loads have been identified. The influence

of Rayleigh damping on the growth of the free surface level has been clarified. Future work will focus on studying the oscillations of elastic shells of rotation containing liquid, using various composite materials [7].

Keywords: free surface, liquid sloshing in tanks, singular integral equations, boundary element method, damping, Ince-Strutt diagram