Book Review

Modeling of vibroacoustic processes in pipe systems

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Samara State Aerospace University named after Academician S. P. Korolyov (National Research University) Publishing House, Samara
2008, 168 p., ISBN 978-5-9900760-5-1
In the Russian language

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The research book generalizes results of scientific investigations in the field of modeling of vibroacoustic processes in pipe systems. The main attention is devoted to pipes in which bending vibrations take place. Deformations of the cross sections of the pipe are considered to be small with respect to the amplitudes of transverse vibrations. Those conditions are satisfied in a number of pipes in rocket and space devices, aviation engines, agricultural devices, hydraulic pressing devices and in many other engineering systems. It is assumed that the analyzed frequencies are to be lower than the frequency at which the distributed parameters of the fluid in the cross section of the pipe become important and those frequencies are to be lower than one third of the lowest eigenfrequency of the cross section of the shell of the pipe.

Methods of modeling of vibroacoustic characteristics of elements of hydro-mechanical systems are described. The developed method of design of pipe systems under the simultaneous action of static pressure loading, dynamic loading by pulsating fluid, kinematic excitation of the supports and connected devices, under thermal and external forced loads acting to the pipe is presented. The proposed methods enable to ensure the required vibroacoustic and strength characteristics of the pipe.

The generalized mathematical model of vibroacoustic processes in pipe systems is proposed. This model takes into account not only pulsations of pressure which excite the vibrations of the pipe, but also it takes into account the effect of vibrations of mechanical subsystem to the wave processes in the fluid. It is shown that from this generalized model of vibroacoustic processes in the pipe system the model of small amplitude vibrations, the model of free vibrations and other simplified models can be obtained. Two basic methods of modeling are presented in detail in the book:

1) modeling of a pipe as a rigid deformable body by taking the fluid structure interaction into account by using the finite element method and the ANSYS software;
2) modeling of a pipe on the basis of the theory of curvilinear beams by taking the interaction with the fluid into account and by using the method of finite differences.

In both models the authors did take the action of wave processes in the fluid to the dynamics of the pipe system into account. A number of test problems of modeling of vibroacoustic characteristics of pipes are solved and the results of analysis are presented.

Methods of calculation of internal stresses in pipes and of evaluation of their strength properties are described. The use of results of analysis of vibroacoustic characteristics of the pipes for determination of stresses in them is important in engineering applications and it is presented in the research book.

This book is based on the investigations performed at the Institute of Machine Acoustics of Samara State Aerospace University named after Academician S. P. Korolyov (National Research University) by the leading scientists of the Institute.

The book is recommended for scientists, researchers and engineers, which are involved in design and use of pipe systems.