Annotation on PhD Thesis

Title: Mathematical modelling of loading and deformation of buried structures

Author: Gutuleac Elena

Institute: Institute of Mathematics and Computer Science of the A.S.M.

Date of defense: February 14, 2014

Keywords: mathematical modelling, numerical methods, software package, dynamic loading, elastoplastic media, saturated ground.

Structure of the thesis: The PhD thesis is written in Russian and consists of an introduction, 4 chapters, conclusion, bibliography of 133 titles, 39 figures, 4 tables, and 2 annexes. The main text of the thesis comprises 121 pages. The basic results of the thesis are published in 14 scientific papers.

The study in the thesis: is to develop mathematical modelling, numerical methods, software package, deformable solid body mechanics.

The aim of research: consists in developing refined mathematical model and numerical method for solving the problems of dynamic loading and deformation underground structures by a shock or seismic waves.

Scientific novelty: there was developed a mathematical model, an algorithm and an original software package for monitoring the state of structures, which represent the environmental risks.

The solved important scientific problem: the behaviour of buried structures under shock or seismic loading and the effect of the surrounding ground on the deformation processes of structures was studied.

Applicative value of the thesis: the application of this method will bring a new level of technical solutions to important applications

such as identifying areas of critical stress, assessment of the strength characteristics of structures under shock or seismic loading.

Implementation of the scientific results: the results can be used to determine the strength characteristics of buried structures, that represent environmental risks (fuel tanks, oil storage tanks, ammunition depots). The specialized software system may be used for computer monitoring of storages filled in with toxic, petroleum and explosive substances. It is an effective tool for studying the strength of structures filled with aggressive substances in terms of dynamic loading taking into account detonation, the influence of elasticity and plasticity, and other real physical effects. However not only assessing the condition of operating equipment, but also reliability-focused design of new highly effective machines and structures requires defining the strength characteristics of their elements. These data allow evaluating the ultimate strength of a structure under shock or seismic action, identify at the design stage the most hazardous zones from the viewpoint of stress concentration.

Main scientific results: 1) Some basic mathematical models and numerical methods for computer simulation of the dynamic loading of buried structures (filled with various substances) have been identified, justified and studied. 2) The algorithm within the framework of the chosen model was developed. It allows calculating the stress-strain state of the buried structures taking into account properties of structural materials, ground and fill material. 3) The software package for monitoring the state of structures, which represent the environmental risks was developed. It contains the dynamic library of material parameters for different types of equations of state. It allows flexible definition of geometry of the computational domain, initial and boundary conditions for solving the problem. It allows visualising the results of calculations. 4) Computational experiments were carried out for the specific problems in order to investigate the state of buried structures under conditions of intense short-term loading. The complex software provides a detailed pattern of dynamic processes taking place in particular problems.