

## Referee report

on the manuscript: «Soils seismic properties research on the basis of investigation of their nonlinear properties» Journal: Nonlinear Processes in Geophysics (NPG)

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The manuscript of V.B. Zaalishvili is devoted to the analysis of existing methods and development of new methods of seismic hazard assessment of soils and, eventually, to the development of the physical bases of seismic microzonation by taking into account nonlinear elastic phenomena which are clearly observed at the intensive seismic loadings. The author uses experimental and theoretical research methods to the extent that is necessary for the reasonable development of the physical basis of the corresponding methods of instrumental method of seismic microzonation (SMZ).

Assessment validity of the soil conditions influence on the reaction of buildings and structures exposed to intense seismic impact is the most important problem SMZ. At the same time the data of engineering macroseismic survey of territories in the epicentral zone of strong and destructive earthquakes show that the earthquake effect is not often consistent with the results obtained by different SMZ methods. This is largely explained by the neglect of non-linear phenomena that occur in soils during strong earthquakes.

The author on the basis of a new approach obtained and tested the instrumental tools of seismic microzonation that allow assessing and accounting in the intensity degree calculations of nonlinearity and inelasticity levels of soils composing zonated territory. The indices of soil absorption and nonlinearity based on the use of relations of spectral characteristics of the wave field with the soil condition features of the territory are implemented. The empirical formulas relating the square of the normalized and the real spectra with the parameters of the seismic impact (magnitude, acceleration, epicentral distance, duration, weighted average frequency of ground motion) are obtained.

The developed methods have better accuracy in determining the intensity increments than the traditionally used methods, especially on loose soil. The proposed approach, being, in fact, a universal can be used in virtually any environment - in the cities, near and in the territory of critical facilities.

The results of research are well illustrated by the application results of the methodology in Georgia and Russia: cities Tbilisi, Vladikavkaz, Rustavi, Gori, Tkibuli, Kutaisi, separate sites of Big Sochi and others.

During the research the data of Racha earthquake (Georgia, 1991), the Groupm SMART-1 (isle Taiwan, 1981-1987.), the earthquake in Montenegro (former Yugoslavia, 1979), the earthquake in San Fernando (USA, 1971), etc were analyzed.

The manuscript is devoted to important scientific and practical problem and gives a systematic presentation of the methodology that is based on the account of non-linear soil properties using modern high-power non-explosive sources. This approach can be widely used in seismic microzonation of responsible structures for a wide variety of seismic and geological conditions, both in Russia and abroad.

I support the manuscript and consider it important and useful.

I recommend the manuscript for publication.