Spectrum Journal of Innovation, Reforms and Development

Volume 22, December, 2023 | **ISSN (E): 2751-1731**

Website: www.sjird.journalspark.org

INVESTIGATION OF AREAS OF NON-CONTACT IMPACT ON LAND AND BUILDINGS

I. N. Abdullaev,
Doctor of Philology, Professor,
abdullayev.ibrahim@ gmail.com

Yunusaliev E.M.,
Ph.D., Associate Professor, Fergana Polytechnic Institute
gurilish.dekan@inbox.uz

Abstract

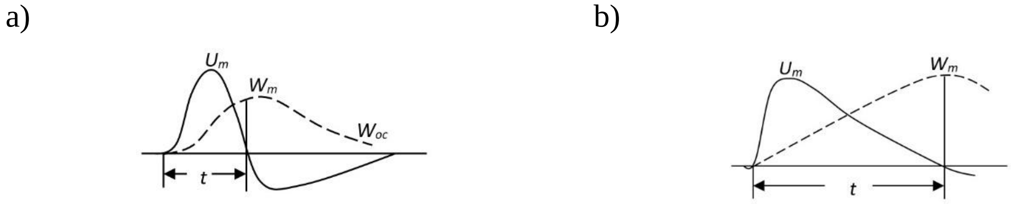
A description of the waves that occur in the ground when using the proposed non-contact shock method for testing the seismic resistance of buildings and structures during operation is presented.

Keywords: earthquake resistance of buildings and structures, impact equipment, detonation, fuel mixture, shock zones, shock waves.

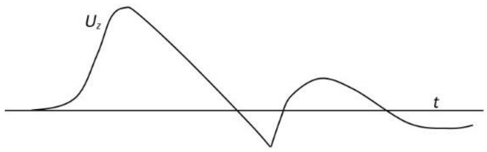
Introduction

According to the epicentral distance, the impact effect is divided into central, epicentral, near, middle and far zones (Fig. 1):

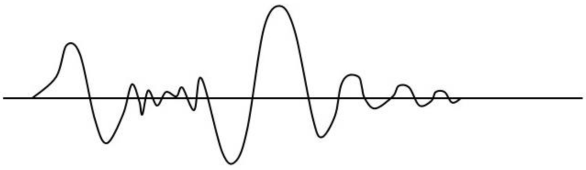
1. Central zone R0≥1 m



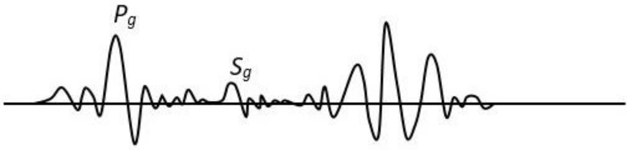
2. Epicentral zone R0.≥5 m



3. Near zone, R0≤10 m



4. Middle zone, 10≤P0≤100 m



5. Far zone, R0≥1000 m

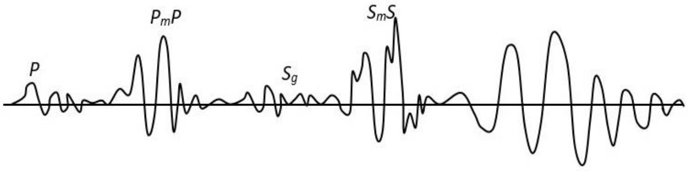


Figure 1.Dividing the seismic effect created by an impact into zones

1. Determination of impact indicators in the central impact zone.

In this zone, the formation of a seismic source occurs in waves. The main processes occurring at the impact site are compression wave, plastic deformation, fragmentation of the medium, and the formation of a cauldron. In hard rocks with low porosity, the cauldron-like cavity is mainly manifested by compression of a certain volume by a compression wave.

The size of voids rn, the zone of plastic deformation R_* the impact force is in q and depends on such properties of the medium as compressibility and strength, and is written by the following expression (1) [1].

$$r_n = \frac{0,61q^{1/3}}{\left(\rho c_p^2 \sigma_*^2\right)^{1/9}}\,; R_* = \left(\frac{\rho c_p^2}{4\sigma_*}\right)^{1/3} r_n \text{ ,(1)}$$

Here ρ, c_p is the density of the medium and the speed of sound in the ground, σ^* and the ultimate compressive strength $r_n/q^{1/3}=8\div12$ $м/кmc^{1/3}$ and $R_*=(4\div6)r_n$ and in porous alluvial weak rocks $r_n/q^{1/3}= 13\div17 м/кmc^{1/3}$ and $R_*=(5\div8)r_n$. Thus, the residual displacements correlate well with the size of the void, and plastic deformation zone - with a finite void size, which proves that the void medium is formed due to compression into an elastic region. The amplitude of the compressed wave in this region is proportional to the size of the compressed volume.

The period of oscillations propagating in the elastic zone is proportional to the radius of the plastic deformation zone $R._*/ Cp$ and is considered as a seismic source of the plastic deformation zone. A number of observations and measurements in this direction are presented in the following sources [2-3]. The measurements showed that the condition of geometric similarity is fulfilled in the central zone of the given properties of the medium. So the mass velocity Um is equal to a given distance $\bar{r} = r / q^{1/3}$ ratio from the center of impact is the following expression.

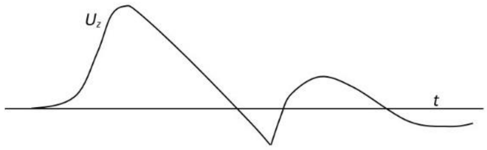
$$U_m = \frac{A}{\bar{r}_n}, \quad м / c \ (2)$$

Here, the impact energy is given in knots, and the distance is given in meters. Figure 1 shows the patterns of ground vibrations near the explosion zone.

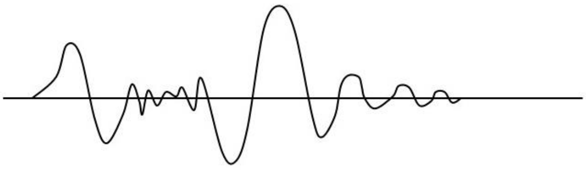
1. Central zone R0≥1 m


a) b)

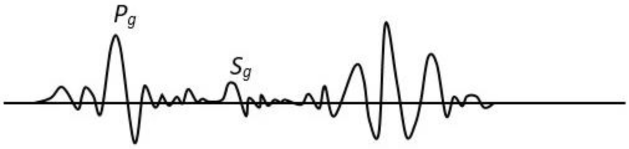
2. Epicentral zone R0.≥5 m



3. Near zone, R0≤10 m



4. Middle zone, 10≤P0≤100 m



5. Far zone, R0≥1000 m

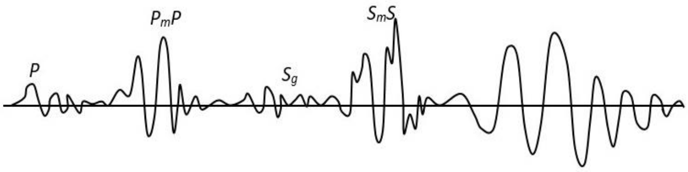


Figure 1.Dividing the seismic effect created by an impact into zones

The following equations apply between the maximum increase in the mass velocity tn and the duration of the compression phase tn in different soils:

$$\frac{t_{н}}{q^{1/3}} = 10\lg\frac{r}{q^{1/3}},\quad \text{мс}/\text{кмс}^{1/3};\quad \frac{t_{н}}{q^{1/3}} = 5lg0,05r/q^{(1/3)},\quad \text{мс}/\text{кмс}^{1/3} \quad (3)$$

and in the region of inviscid deformation:

$t_{н} / q^{1/3} = 20-40\ \text{мс}/\text{кмс}^{1/3}$ and $t_{н} / q^{1/3} = 5-15\ \text{мс}/\text{кмс}^{1/3}$ it will be

In weak or multiporous media, t+ and $t_н$ can be 2-3 times higher. From the dependencies of expressions (2) and (3), we can estimate the average acceleration of the compression wave and the maximum displacement Wm:

$$W_m = U_m t_{н} / 2;\ a_{ср} = U_m / t_{н} \quad (4)$$

The energy of the shock wave Es, determined from the results of teleseismic signal processing [3-5], mainly depends on the properties of the rock in the shock source, its relative value is given in Table 1.5.

2. Investigation of ground vibration in the epicentral zone.

In this impact zone, the main ground movement is characterized by the reflection of the compression wave from the free surface. The epicentral zone is usually measured by the radius of the rupture zone. Its dimensions are $H/q^{1/3} \leq 0{,}10 \div 0{,}2$ $м/кmс^{1/3}$ is equal , and with such a deep impact, the free mass rises sharply and separates the upper layer from the main massif. The depth of the separation layer is determined by the intensity of the impact and the compressed wave. The maximum separation depth does not exceed half the wavelength. $\delta = C_p t_н / 2$ The intense separation radius in the horizontal direction $\bar{R}$ =(0,25÷0,35) $м/кmс^{1/3}$ equal, different natural rocks are in a layered, fractured or solid state, and the separation radius $\bar{R} = (1{,}0 - 1{,}5)$ $м/кmс^{1/3}$ is equal. The vertical component of seismic impact in the epicentral zone is shown in Fig. 1.

The maximum speed of this movement is the depth of the explosion. $\bar{H} = H/q^{1/3}$ and depends on the geological structure of the area. The vertical component of the velocity in the epicenter of rocks on the immediate side surface is equal to twice the velocity of their maximum weight and can be estimated by formula (2):

$$U_z = \frac{2A}{\bar{H}^n}, \frac{см}{с}, \quad (5)$$

In soft alluvial soils, the surface velocity does not double during blasting operations. In case of surface shocks in the area of rocks covered with a layer of soft soil of very high power (on average $10 \div 10^2$ m), the rate of rise in the epicenter corresponds to the contrast.

$$U_z = \frac{25}{\bar{H}^{1{,}7}} \frac{см}{с}, (6)$$

As the epicentral distance R0 increases, the vertical component of the velocity decreases (at a typical surface jump depth of the jump $\bar{H} = 0{,}1 - 0{,}15\ м / кmс^{1/3}$):

$$U_z = 12 / \bar{R}^2, \text{cm / s}; 0{,}1 \leq \bar{R} \leq 0{,}3 \text{when m/cc1 / 3;(7)}$$

$$U_z = 20 / \bar{R}^{1{,}6}, \text{cm / s}; 0{,}3 \leq \bar{R} \leq 1 \text{when m/cc1 / 3.}$$

In such a layered medium, a distinctive feature of movement along the surface of the medium in the epicentral zone of the surface shock is a significantly smaller horizontal component compared to the vertical one. $\bar{R} < 0{,}3$ $м/кmс^{1/3}$, this difference can reach 5-10 times. As you move away from the epicenter, this difference gradually decreases and $\bar{R} \approx 1$ $м/кmс^{1/3}$ $U_x = U_z$ will be equal to the ratios (5), (7). It is easy to estimate the time and height of the free surface.

$$t = \frac{2U_z}{q}; \qquad h = \frac{U_z^2}{2q}.$$

Due to the relatively small area of the epicenter, as well as the unacceptable seismic impact on buildings and structures, this area is not of practical interest and in the future may be relevant only for aftershocks of shallow depth.

3. Ground vibration in the near zone.

Size *1км/ктс*$^{1/3}$ and 10÷15м In a zone up to, the maximum oscillation rates are usually associated with a long wave P as is the compression wave in this zone. Oscillation velocities are usually associated with the longitudinal wave R, which is directly recorded in this region as a compression wave (Figure 1). The displacement on the recordings is proportional to it, and by the end of the region, the amplitude of the surface wave R of the relief type is high, which can be observed from a reduced distance of 0,5-1 *м/ктс*$^{1/3}$ The largest amplitudes of vibrations of both the R-wave and the R-wave were recorded in the horizontal and vertical directions.

Tangential components of vibrations caused by the hydrogeological structure of the medium gradually begin to appear. The kinematic characteristics of different phases of vibrations in a seismic wave depend on the geological and structural features of the physical and mechanical properties of rocks composing the territory of a given region. The main attention is paid to the seismic effects of horizontal velocity components. Observations have shown that the main parameters of fluctuations in this area correspond to the law of energy similarity in formula (2), and the degree and rate of decrease depend on the type of ground rocks. So, for the horizontal component of the *P* wave, based on the results of processing experimental data on granites and sandstones, the following inequality was proposed.

$$U_{px} = 12/\bar{R}^{1,75}, \quad см/с; \quad R_0 \le 100-150\,м \text{ when(8)}$$

In other geological conditions, represented by regional shales and quartzite-sandstones, the ratio of the horizontal component of the wave *P* according to shock data is as follows:

$$U_{px} = 5,7/\bar{R}^{1,9}, \quad см/с; \quad R_0 \le 100-150\,м \text{ when(9)}$$

Based on the above relations (8) and (9), ground rocks are obtained by installing devices at the exit points and are shown in rows 1 and 2 according to Figure 4.1. When measuring a layer of soft rock with a thickness of about 10 m or more, we see that the vibration rate is about twice as high.

4. Ground vibration in the middle zone. In the middle zone, at altitudes of 100-150 m and approximately 800-1000 m, the amplitudes of the main longitudinal waves emanating from the granite-basalt layer predominate. The amplitudes of vibrations in the group of low-frequency surface waves (Fig. 1) are still distinct. The propagation velocities of similar seismic waves are averaged, and the duration of vibrations increases, forming several variable phases.

This is the most dangerous group of longitudinal waves in terms of seismic impact on buildings. $T_P = 0,1-0,5\ c$ with a period that includes the maximum vibration speeds in the high-frequency range. Experiments show that the intensity of vibrations in the middle zone significantly depends not only on the impact energy or the properties of the soil at the source, but also on the properties of the velocity component and the location of the reflecting layers in the earth's column. the crust. More successful for the analysis was the dependence that establishes the correlation of vibration parameters separately from the impact energy and epicentral distance:

$$U = Bq^{n}R^{k} \quad (4.11)$$

Based on the materials of foreign and domestic studies [6-9], the following relations can be recommended for the maximum values of the horizontal and vertical parts of the vibration velocity in the group of longitudinal waves of the middle zone:

$$U_{px} = 15\, q^{0,7}R^{-1.5},\ см/с;$$

$$U_{pz} = 35\, q^{0,7}R^{-1,85},\ см/с. \quad (4.12)$$

There is a significant dependence of the amplitude and time parameters of regional oscillations on the general geological structure of the region, the seismic characteristics of the direction and recording conditions in the range of specified distances. Thus, the influence of the direction and recording conditions leads to significant discrepancies in the parameters of seismic waves on different profiles up to 50-100% of the amplitude spread. However, on the other hand, the dependence of seismic vibrations on geological conditions ensures the stability of wave parameters at these distances in comparison with the nearby region, where the specific conditions and properties of rocks in the shock source have a great influence on the occurrence of seismic vibrations. vibrations. Therefore, the corresponding formula (4.13) can be successfully used to estimate the strength of aftershocks from the amplitudes of the maximum displacement of the surface wave in the calibrated direction. This experimental fact shows that it can also be successfully used in the development of a system for monitoring the energy parameters of impacts above and below the ground.

5. Ground vibration in the far zone.

It is known that waves of dominant (very large) amplitude (RmR and SmS waves) are reflected in a group of waves in a region extending over distances of more than 800-1200 m (Figure 5.1, point 5). The distance at which these waves appear and their intensity are closely related to the properties of the high-speed part of the Earth's crust, that is, its acceleration, speed difference, the presence of a transition layer, etc. Therefore, the predictive dependences of the maximum oscillation velocity in longitudinal waves have a maximum in the range of 1000-1500 m (Figure 1.3, 1 us for curve 4, 100 us for curve 41). If the thickness of the deposit is sufficient or the water table is high, the vibration rate can be doubled, which is clearly shown in Figure 1.3. In the group of longitudinal waves at distances of 1500-3000 m, the appearance of repeatedly reflected longitudinal and transverse waves of significant intensity is observed, as well as a sharp increase in the observed oscillation periods by about 1 second. For the horizontal component of the oscillation velocity, as a result of an increase in the oscillation period, approximately the same attenuation law with distance is observed as in the near region, i.e. $U_{\rho X}$ ~(1/P) $1,4^{\div\text{-}1,8}$.

In such cases, the peak of the longitudinal wave spectrum appears at a frequency of 0.8 Hz. Therefore, since the amplitude of the dominant longitudinal waves is mainly determined by the structure of the earth and the properties of the velocity along the path of wave propagation, the relationship of the main parameters of seismic waves with the shock wave energy and distance does not correspond to the similarity laws in the form of (1.2) and is organized in the form of (1.11), In particular, based on many observational data, Ur was used to determine the horizontal component of the oscillation rate per second when predicting the maximum oscillation rate at a long distance.~*q0. 8*It was considered appropriate to use the ratio.

References:

1. Lyakhov G. M. Volni v gruntax i poristiks mnogokomponentnykh sred [Waves in gruntax and poristics of multicomponent media].

2.Puchkov S. V. Zakony peremozhdeniya grunt [Laws of soil displacement]. 1974

3.Aizenberg Ya. M. Improvement of antiseismic design and construction. Review and analytical report. Stroitelstvo i arkhitektura [Construction and Architecture], Moscow: VNIINTPI Publ., 2006, p. 111.

4.Aizenberg Ya. M.ya doktor [I am a doctor]. Adaptive systems of seismic protection of buildings, Moscow: Nauka Publ., 1998, p. 248.

5.Aizenberg Ya. M. Investigation of adaptive seismic protection systems and seismic isolation methods // Earthquake-resistant construction. Link. sat. Kitai. Issue 1, Moscow: 1980, pp. 32-34.

6.Bugrov A. K. Mekhanika gruntov: ucheb [Soil mechanics]. manual /A. K. Bugrov. - SPb.: Izd5vo Politekhnik. Univ., 2007, 287 p. (in Russian)

7. Yunusaliev E. M.,Acoustic method and device for geophysical studies of the Earth's crust and the basis of detonation generators. Scientific and Technical Journal of FarPI 2016. Volume 20. No. 1. Ferghana 2016. Pages 162-164.

8.Yunusaliev E. M., Sagdiev Kh. S.Features of interaction of a submerged structure with the ground during seismic surges. Ferghana Polytechnic Institute Proceedings of the Republican scientific and technical conference "Innovative technologies in the design, construction and operation of engineering communications" March 29-30, 2019, Ferghana-2019. Pages 220-221

9.Yunusaliev E. M., Abdullaev I. N.Influence of the gas detonation shock wave on the seismic resistance of building structures.National University of Uzbekistan, International Scientific Forum, January 13-15, 2023.