INFLUENCE OF THE UNDERGROUND WATEROSCILLATION UPON THE AMPLITUDES AND PERIODS OF THE GROUND MICROSEISMIC NOISE

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ABSTRACT

Ground microseismic noise characteristics provide very useful information for determination of the initial parametres which are neccessary for analysis of the influence of the local soil conditions on the earthquake effect.

The characteristics of the ground microseismic noise, which are of interest, depend upon the physical and mechanical properties of the soil layers bellow the ground surface. Underground water directly affects the changing of the physical and mechanical soil properties, thus underground water lever oscillations induce changing of the ground microseismic noise properties.

Presented in this paper are the results obtained by investigation of the influence of the underground water level oscillations upon changing of the periods of amplitudes of the ground microseismic noise, as obtained by investigation of the July 26, 1963 Skopje earthquake effect investigations for the purpose of seismic microzoning of the town area.

INTRODUCTION

Investigations were carried out for two characteristic sites consisting of alluvium sand and gravel materials deposited over neogene sediments in layers of different thickness. The sand and gravel materials had the same physical and mechanical properties for both sites, thus they differed only in the thickness of the alluvium deposits and the depth of the underground water level. The geotechnical profiles of both sites are shown in Fig. 1a and Fig. 1b.

Measurements of the ground microseismic noise and the parametres of the underground water level were carried out every fifth day during a period of 3 to 4 months. During the measurement period the underground water level made a cycle ranging from minimum to maximum depth as considered with respect to the ground surface level. The oscillation of the underground water level for the both sites is presented in Fig. 2a and Fig. 2b.

Ground microseismic noise measurements were carried out applying three-componental devise with uniform amplification of amplitude within the range of 0.02 - 0.8 sec. They were always performed during the night period and lasted for 3 to 5 minutes. In order to eliminate the influence of seismic noise of various kind the measurements were carried out on concrete blocks (with proportions 70x70x50 cm) placed near piesometric boreholes.

Ground microseismic noise records have been analysed applying the Fourier analysis. In this way the periods and the amplitudes of oscillation of some sand and gravel layer deposits, as well as the ground surface

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layer of the deposit which is directly influenced by the underground water level oscillations have been determined.

REVIEW OF THE OBTAINED RESULTS

In order to determine the influence of the underground water level oscillations upon the changing of the physical and mechanical properties of the soil materials, detailed analysis of the periods and amplitudes of the recorded microseismic noise oscillations have been carried out. Applying the known expression for the period of propagation of the transversal harmonic wave vertically along the soil medium as $To = 4H/Vs$, (where To, H and Vs are the period of oscillation, thickness of the layer and velocity of transversal seismic wave propagation along the layer, respectively), the drilled lithological structures, the determined Vs velocities and the obtained periods the structures under the ground surface conditioning the obtained periods and the corresponding amplitude of noise oscillation have been defined. Then the influence of the underground water oscillation upon the changing of the obtained periods and amplitudes conditioned by the determined underground structures have been analysed.

The obtained results are presented in Figures 3a and 3b for the influence of the change of the periods and in Figures 4a and 4b for change of the amplitudes.

It can be seen from Figures 3a and 3b that by increase in underground water level there is a tendency for increase in the periods. The change of the periods depends on the ratio between (d), the underground water level change and the total thickness of the layer (h), i.e. the ratio d/h. Increase in this ratio results in increase in the change of the periods. It is obvious from Fig. 3a that the maximum change in the underground water level (d = 0.8 m) is about 2% of the total thickness of the thickest water bearing layer, thus having a neglectable influence of 0.02% change in the amplitude. In the case of the water bearing layer with the smallest thickness, h = 7.6 m, the maximum d/h ratio is about 10.5%, while the magnitude variation is for about 5%. By analysis of the obtained results from Figures 3a and 3b it is seen that in the case of full water saturation of a soil layer its periods of oscillation can be increased for about 15%.

The influence of the underground water level on the amplitudes of the microseismic noise oscillations have been analysed using the average amplitudes (A_{sr}) of the corresponding determined periods. It can be generally seen from the obtained results shown in Figures 4a and 4b that the amplitudes of the microseismic oscillations increase with increase in the the underground water level. Analysing the obtained ratios between the amplitudes of oscillations (A_{sr}) and the mentioned ratio d/h it may be concluded that the influence of the underground water level variations upon the change of the oscillation amplitudes is more expressed and higher when these changes occur in layers of smaller thickness. In the case of soil layers of larger thickness these influences are small and negligeable. The largest change in amplitude is in the case of oscillations induced by the underground water level and the upper ground layer. Based on obtained results, it is obvious from Fig. 4a that for the ground layer thickness h = 4.6 m a 10% increase in the underground water level, with respect to the total thickness of the layer, the amplitude of the microseismic noise increases 50 - 60%, while in the case of ground layer of larger thickness, with an adequate increase in underground water level of several percent, the amplitudes increase for

about 20 - 30%.

It is obvious from the presented results on the periods (T) and the amplitudes (A_{sr}) of the microseismic noise upon the underground water oscillations that underground water affect the physical and mechanical, as well as the elastic-dynamic parametres of the soil materials which means that they will also affect the ground motion characteristics during strong earthquakes. This influence is particularly expressed in the case of water bearing layers of smaller thickness, and the obtained results point ot the need for bigger attention during investigation of the problem.

RERERENCES

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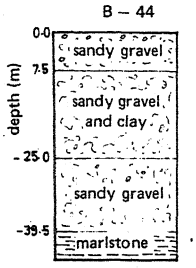

Fig. 1a Lithological structure of B-44

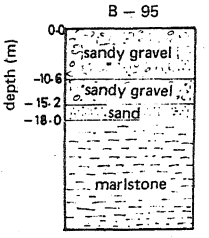

Fig. 1b Lithological structure of B-95

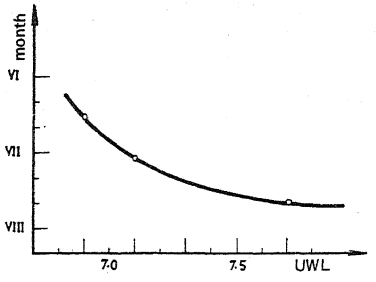

Fig. 2a Underground water level oscillation at B-44

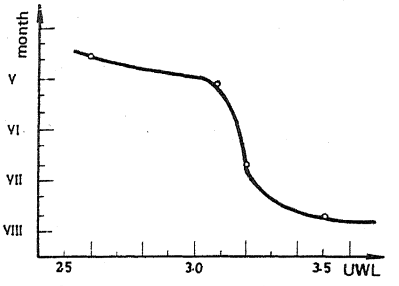

Fig. 2b Underground water level oscillation at B-95

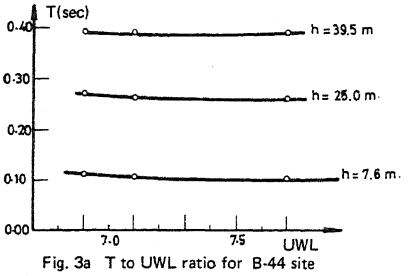

Fig. 3a T to UWL ratio for B-44 site

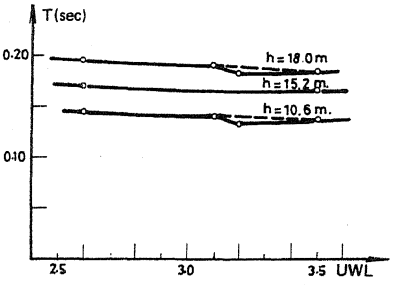

Fig. 3b T to UWL ratio for B-95 site

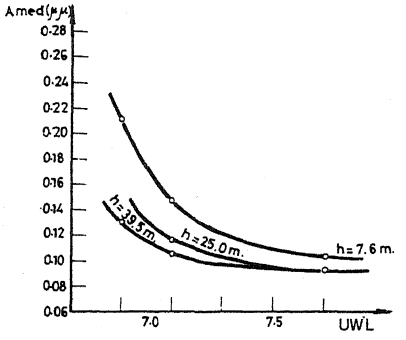

Fig. 4a Dependence of amplitude A of the microseismic noise on underground water level for B-44 site

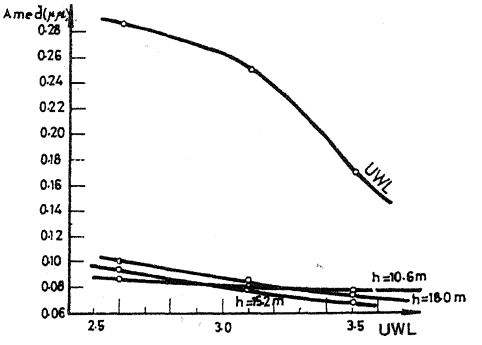

Fig. 4b Dependence of amplitude A on underground water level for B-95 site