TITLE: Microtremor Studies on Soil Classification for the Anatolian Side of Istanbul
LANGUAGE: ENGLISH
PUBLICATION TYPE: Report
ORIGINAL PUBLICATION URL: https://8luvomezzzsk.merlincdn.net/wp-content/uploads/2020/04/iSTANBUL-ANADOLU-YAKASI-ZEMiN-SINIFLAMASINA-YONELiK-MiKROTREMOR-CALISMASI-RAPORU.pdf
REGION & COUNTRY: TÜRKİYE
HAZARD: EARTHQUAKE
THEMES: MICROZONATION

INTRODUCTION

In regions with high earthquake activity, the suitability of the region should be investigated with microzonation before structuring. In microzonation studies, it may be possible to reach accurate results by multidisciplinary collection of data and examining the results. For this purpose, drilling, geophysical, geological and geotechnical investigations must be carried out together.

To minimize earthquake damage and risk to structures, the geological features of the settlements and the mechanical behavior of the ground during earthquakes should be well known. To achieve this goal, geological and geophysical studies should be used effectively together. The application of known geophysical methods in existing settlements presents difficulties due to logistic reasons. In the face of these difficulties, the microtremor method was developed after 1990, which will not cause any problems in the environment. This method can be easily applied in large areas as it is not affected by logistic barriers. In the method, it is possible to determine the propagation speed of the seismic S wave, which is one of the most effectively used parameters in soil classification and is also known as shear wave in practice. It is also possible to determine the amplification of the ground against earthquake waves and the prevailing periods.

The Marmara region is in a tectonically active zone. The North Anatolian Fault Zone is divided into three branches and passes through and south of the Marmara Sea. There have been devastating earthquakes in this region throughout history. The existence of active fault lines and the occurrence of major earthquakes necessitated the structuring within the framework of certain rules. It has become necessary to use geophysical, geological, and geotechnical information together in the selection of new settlement areas, examining the ground conditions of existing structures and preparing development plans, and preparing maps suitable for settlement. Information about the feature of the ground is obtained by using different geophysical methods.

One of these methods is microtremor. With microtremor, the dominant period and amplification at the measurement location can be found. It is very important for the settlement to find the dominant period and the amplification rate of an incoming earthquake wave. It can give important information about how the settlement in the study area will be. Information about the number of floors of the buildings to be built can be obtained. The resonance frequency that can be caused by the vibration of the building and the ground can be found.

Knowing how the ground on the foundation rock in residential areas will affect the earthquake waves together with the topography is an important issue in determining the microzonation or soil properties. For this purpose, it is possible to reach the desired information by making use of the weak motion and strong motion sensors available in the study area. In case such instruments are not available locally or are not sufficiently sampled, it is possible to find a solution to this problem by taking microtremor recordings.

As a result of recording the microtremors in different geometries and scales, the S wave velocity profile can be found as well as the amplification and the dominant period and the ground. With long-wavelength microtremors, it is possible to detect deep structures and the variation of S wave velocity with depth (Horike, 1985; Matsushima and Okada, 1990). The measurements are taken in array form, the phase velocities are found, and the depth is converted into velocity variation by inversion. The application is easier than other geophysical methods and measurements can be taken at any place and time in the city.

Within the scope of this project, microtremor measurements were made for soil classification, and measurements were taken for the variation of S wave velocity with depth, soil amplification and determination of soil dominant period values. The study area (Figure 1) covers an area of approximately 300 km2. This area was divided into 2 km2 grids and 304 points were determined. To date, a total of 304 points have been visited, 56 in the first reporting phase, 62 in the second phase, 154 in the third report phase and 32 in the final phase of the project, and active and passive ReMi and H/V measurements were obtained at these points (Figure 1). Measurement points are also placed on the geological map of the region (Figure 2). As can be seen on the map, it was not possible to take measurements at some predetermined points due to logistical reasons. This happened for two reasons. The first reason is the points are inside the forest and transportation is not possible. The second is the points falling on the military zones and it was not possible to get permission.

RESULTS

Within the scope of the project, the gridding of the study area, the identification of the instruments to be used, the taking of a total of 644 data from 304 points from the east, the transfer of the data to the computers in the laboratory environment, the development of the existing software programs in accordance with the collected data, the learning of the use of the software program provided by the Geometrics company and the analysis of the data. At the beginning of the project, a conference was given to the Institute and Istanbul Metropolitan Municipality team and the methods to be used in the study were introduced. In addition, a Professor from Japan who is an expert on microtremor was invited during the project. Prof. Okada stayed at the institute for two months and serve 42 hours lesson. In addition to the lessons, information was exchanged on the quality and evaluation of the data obtained from the field. Some data were evaluated together with Prof. Okada and the project staff gained experience in this regard.

Measurements were completed in September 2008. The collected data was analyzed, and this final report was prepared. Apart from the site amplification and the dominant period distribution map, a velocity distribution map corresponding to an average depth of 30 m was created from the S wave velocity values found from the models produced from ReMi and Array measurements.

The analysis results show similarities when compared with the geology. In addition, there seems to be a compatibility with the topography. In most of the measured points, dispersion curves were obtained by the active (ReMi) method and depth velocity models were created. With the passive method, measurements were taken at the points where the bedrock was deeper. With this method, depth velocity information is provided for deeper depths at points that cannot be obtained with the ReMi method.