CLEAR IDENTIFICATION OF FUNDAMENTAL IDEA OF NAKAMURA'S TECHNIQUE AND ITS APPLICATIONS

Yutaka NAKAMURA[1]

SUMMARY

A method which employs microtremor has been introduced for estimating dynamic characteristics of surface layers, in early 1950. Then usage of this method has received lots of criticism considering uncertainty about source of microtremor. After an introduction of the Nakamura's technique (H/V or QTS technique; Nakamura, 1989), many people have paid a renewed great attention for estimating dynamic characteristics of ground and structures using microtremor, since clear and reliable information was provided by very simple and inexpensive noise measurements.

In recent years, although several researchers claimed that theoretical ground of this technique is not clear and consensus based on experiment couldn't be reached, there have been many successful experimental studies based on these technique. Many theoretical studies have been performed, for explaining the amount of types of waves included in microtremor and checking the applicability of the QTS technique. And some of them are suggested that the peak on H/V ratio can be explained with the fundamental peak of Rayleigh waves. From the output of these researches, explanation of microtremor with Rayleigh waves caused some confusion between users and the author decided to clear out this problem.

The basic idea and the main goal of QTS technique are tried to be re-explained in present paper. The author's explanation about the effects of contents of Rayleigh waves in microtremor is also given. Other possible usage of products from QTS technique (predominant frequency and amplification factor) for hazard estimation is also given. As it is well known, occurrence of earthquake damage depends upon strength, period and duration of seismic motions. And these parameters are strongly influenced by seismic response characteristics of surface ground and structures. This reality makes investigation of vulnerability of ground and structures an important issue, before the earthquake occurs. For this purpose, vulnerability indices called K values were proposed by Nakamura (1996). K values are simply derived from strains of ground and structures. Formulation of K values for ground (Kg) and some application examples are also given in present paper. These new values give a chance to estimate vulnerabilities of all types of structures and ground, before the real damage occurs.

INTRODUCTION

Damages caused by the recent earthquakes are concluded as a direct result of local geological conditions affecting the ground motion. Best approach for understanding ground conditions is through direct observation of seismic ground motion, but such studies are restricted to areas with relatively high rates of seismicity. Because of these restrictions in other methods, such as high rates of seismicity and the availability of an adequate reference site, non-reference site methods have been applied to site response studies. Microtremor is a very convenient tool to estimate the effect of surface geology on seismic motion without needing other geological information.

H/V (or QTS, Quasi-Transfer Spectra) technique fits very well to this description and it has received great attention from all over the world with its simplicity together with quick information about dynamic characteristics of ground and structures. Although several researchers claimed that theoretical background of this technique is not clear, there have been many successful experimental studies performed. Method is attractive since it gives the ease of data collection and it can be applied in areas of low or even no seismicity.

[1] *System and Data Research Co. Ltd., 3-25-3 Fujimidai, Kunitachi-shi, Tokyo, Japan yutaka@sdr.co.jp*