MICROSEISMS OF THE NOHBI PLAIN IN JAPAN

BY

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ABSTRACT

The comparatively longer period of micro-vibration on the surface of soil layers has been considered to be mainly due to some sources or characteristic properties of deposits to deeper depth. Recently the high rize building and large scale structures are built, so the lower frequency range in a soil layer is also a matter of concerns in earthquake engineering.

Here, the microseisms of the plain are observed and the correspondence of the thickness of layers to the predominant period of it is investigated.

OBSERVATION

The observation fields of microseisms for four years (1976-1979) is the Nohbi plain in the middle of Japan, as shown Fig.1(a) and Fig.1(b). This plain has experienced the severe earthquake damages in the Nohbi strong earthquake. The geological profiles of the plain are almost horizontally layered in North-South section, but are dipped slowly in the East-West, as shown Fig.2. The deposits in the western part of it is the deepest to about 1500 meters. The seismometer used in observation has five or ten seconds in period. The microseisms are observed separately three times during four years, over the plain and are measured for three components, i.e., North to South, East to West and up to down direction in each site.

DATA PROCESSING

Informations of microseisms recorded on a data recorder by the seismometer, are exchanged to the numerical data through the A/D converter.

Numerical data processing by the Fast Fourier Transform technique is performed by a electronic computer and obtained results are graphically displayed by a X-Y plotter. The numerical parameters used in the analysis are chosen from the frequency considered. A number of Fourier spectra by FFT computed in a constant lag time are averaged over the number of running times for about 450 seconds.

RESULTS

Three series of observations of microseisms in the Nohbi plain are carried out in order to use them for earthquake engineering.

(1) The microseismic observation along the two lines (EW-5 and NS-3) orthogonally located and geologically different from each other, is executed.

According to the results which is shown in Fig.3 by spectral analysis of measured data, the predominant frequency of horizontal components (EW and NS) on NS-3 line is in the narrow range near 0.25 Hz, but that on EW-5 line changes from 0.22 Hz to 0.3 Hz depending on the depth of deposits on the hard soil layers. The underground structure and soil formation in the Nohbi plain is known directly about to the depth of 200 meters by the various

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ground detection. The depth of bedrock is generally considered to be more than 1000 meters deep from the relation the soil deposits and Bouger anomaly[1].

So, the deeper the soil layer is, the longer the predominant period of the observed site is. It is concluded that the microseisms give the inherent property of the deep soil layer on the hard rock[2].

(2) The observation in site E on the diluvium terrace is executed through one year. The seasonal change of microseismic properties upon the frequency and amplitude is investigated. The variation on spectral properties through four seasons falls into the small as shown in Fig.4. Especially, the variance of frequency is comparatively large in summer and that of amplitude is remarkably large in winter. The overall averaged spectra over the observation through one year show that 4m/sec wind velocity bisects the amplitude behavior, but the frequency in each direction did not change as shown in Fig.5.

(3) "Every two hour for a week" observation in site E is carried out. The influence of the weather condition (i.e., wind velocity and atmospheric pressure) upon the microseismic behavior is investigated on frequency and amplitude of spectra as shown in Fig.6. The decrease of atmospheric pressure and the increase of wind velocity by the typhoon passing through the Nohbi plain during the observation did not give any remarkable change to the frequency, but give several times of Fourier amplitude in spectra than the ordinary time.

CONCLUDING REMARKS

The observation of microseisms by the seismometer with 5 or 10 seconds is carried out for the purpose of investigating the dynamic properties of the deeper soil deposits of the plain.

The results obtained are, as follows.

(1) The predominant longer period is 3.3 to 4.5 seconds which corresponds to the properties of the thickness of the deeper soil layer. Especially, the deeper the deposits on the comparatively rigid base is, the longer the predominant period is. The period in this range seems to be the inherent characteristics of deposits of several hundred meters to one thousand meters.

(2) The predominant frequency and Fourier amplitude of microseisms is most changeable and scatter in spring to summer, it looks to be due to the weather condition.

(3) From the continuing observation of microseisms in a specific site, the predominant period is not so sensible to the change of seasons and weather condition such as wind velocity and atmospheric pressure. But, Fourier amplitude of microseisms observed is very changeable to exterior and surrounding conditions.

(4) The variation of microseismic properties in a specific site during a year, is considerably remarkable in spring to summer. This seasonal change is due to various interaction of weather condition and sea wave properties.

(5) Judging from the above observation on microseisms along the geologically different site with various depth and during the continuing observation in a specific site for a long time, the predominant period looks like the inherent dynamic properties with the comparatively deeper soil deposits of the plain. This properties are slightly effected by the weather condition and seasonal variations.

REFERENCES

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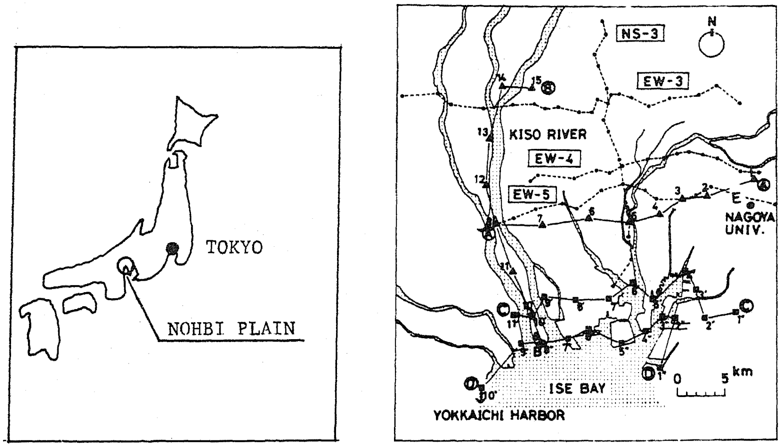
(2) Taga,N. & Miyazaki,T., Proc.V th Japan Earth.Enging Symp.,1978,pp.313-320.



(a) (b)

Fig.1 Situation of The Plain and Observed Sites

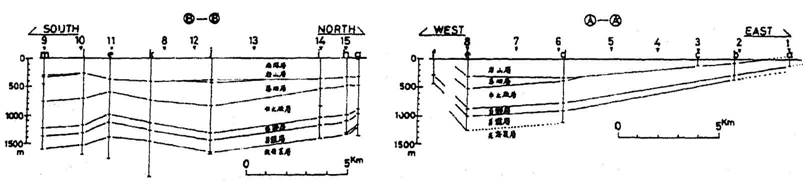
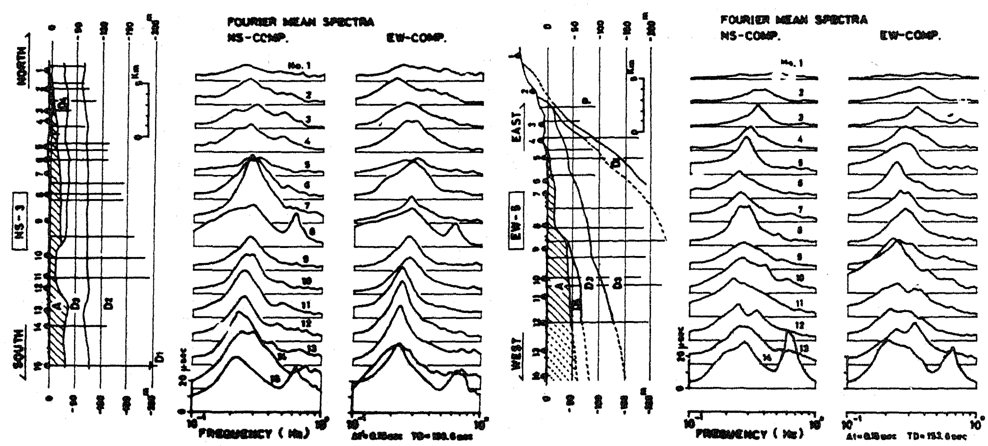


Fig.2 Geological Profile of The Plain



(a) NS-3 (b) EW-5

Fig.3 Spectral Properties

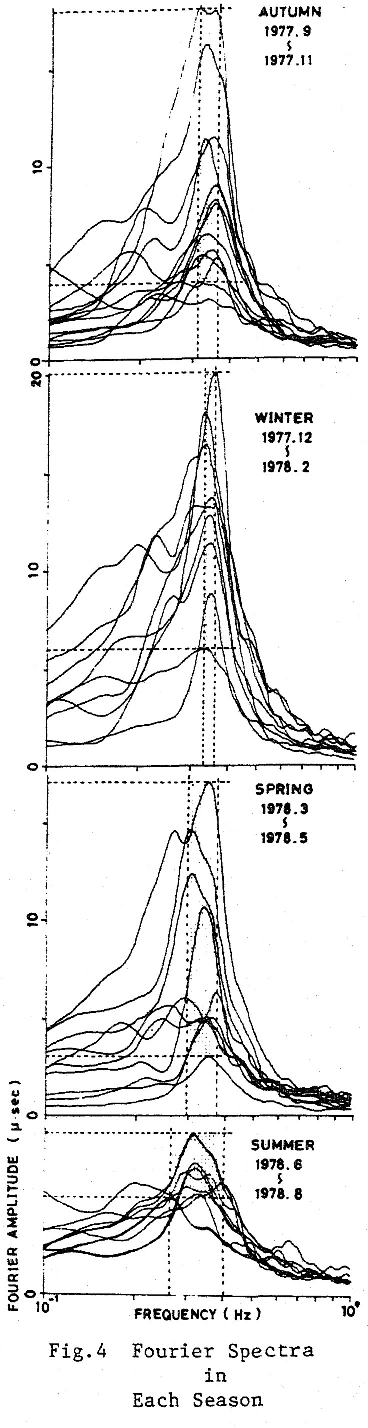


Fig.4 Fourier Spectra
in
Each Season

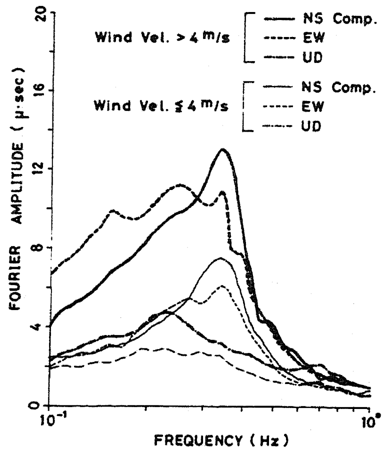


Fig.5 Fourier Spectra
and
Wind Velocity

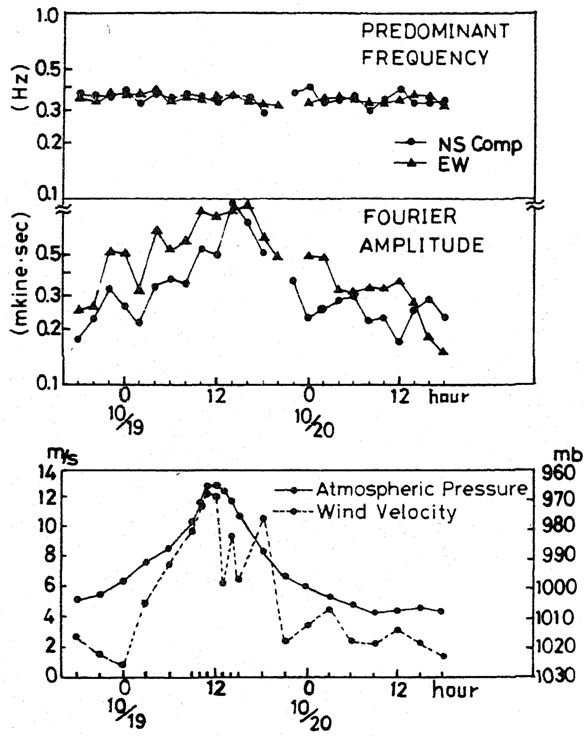


Fig.6 Predominant Frequency,
Fourier Amplitude
and The Weather Condition