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OBSERVATION NETWORK FOR STRONG MOTIONS OPERATED BY CRIEPI

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ABSTRACT: Strong motion observation has been carried out on the rock outcrops by Central Research Institute of Electric Power Industry (CRIEPI) to obtain the basic data for the evaluation of design ground motions for electric power facilities. Now we operate 40 observatories deployed mainly in the southwestern Kanto district and the Izu Peninsula, Japan. We are preparing the strong-motion database open to the public by Internet, which will be accomplished within a couple of years.

Key Words: Strong Motion Observation, Database, Rock Outcrop, Design Earthquake Ground Motion

INTRODUCTION

Strong ground motion data are important for the basis of the study in engineering seismology. Especially, the strong motions recorded on the rock outcrops are valuable for the verification of design ground motions for important structures or plants, because they are usually built on the hard bedrocks. Moreover strong motion data obtained on the rock site are useful for the study on seismic source process as the influence of the shallow subsurface structure is small. We can also use them as the reference or incident waveforms when we evaluate the strong motions on the surface of sedimentary basin. Since 1975 CRIEPI has been observing strong motions on the rock sites, mainly in the area of the Izu Peninsula and the southwestern Kanto district and thus far lots of strong motion data from the major earthquakes have been observed. In this article we introduce an outline of the CRIEPI's strong-motion observation network and several important records.

DISTRIBUTION OF OBSERVATION STATIONS AND RECORDING SYSTEM

The strong motion observation by CRIEPI started in 1975. At first we deployed the stations in the Izu Peninsula where the seismic activity is relatively high and along the Pacific coast in Fukushima Prefecture where several nuclear power plants are located. Later the number of observation stations increased and were expanded mainly to the eastern Japan. At present 38 stations for strong motion observation are under operation and 33 stations of them are located on the bedrocks. Fig.1 shows the distribution of the stations. At present all stations are integrated into the telemetric data acquisition

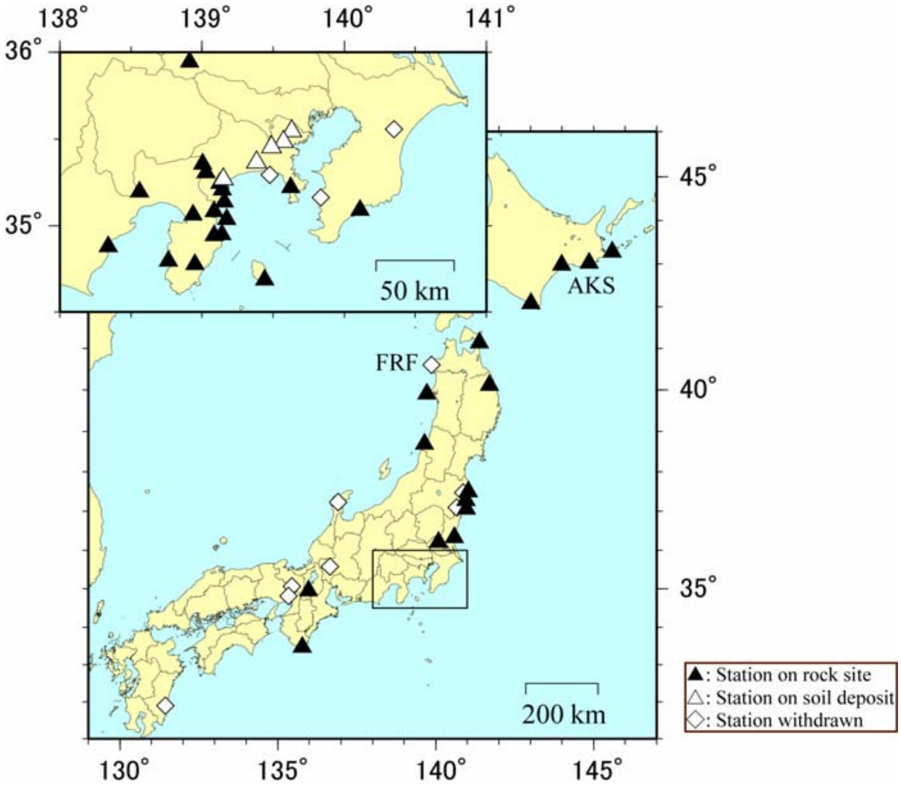

Fig.1 Distribution of strong motion stations. Solid triangles show stations on rock site and open triangles show those on soil deposit. Diamonds are stations that were already withdrawn.

Table 1 Specifications of seismograph

Resolution of accelerometer	0.06 gal
Resolution of A/D converter	16 bits
Dynamic range	> 90 dB
Sensor range	±2 G
Bandwidth	0.025 - 70 Hz
Sampling rate	100 Hz
Pre-event	20 seconds

system so that we can control each station and receive the observed data remotely from the laboratory. Time correction using GPS data is also carried out at all stations. Installed instruments are accelerometers at all stations and velocity seismographs are put together at some stations.

Specifications of strong motion accelerometer are shown in Table 1. Resolution of A/D converter is 16 bits and the maximum measurable acceleration is 2000 gals. Sampling frequency is 100 Hz and pre-trigger time is 20 seconds, respectively.

EXAMPLES OF OBSERVED ACCELEROGRAMS

Strong motion records obtained in the period of year from 1980 to 2000 are databased. 1832 records are obtained from 907 earthquakes observed. The frequency of observed events against year is shown in Fig. 2. We can see the number of observed events grows steadily since 1993. This is because the observation station network become dense and expanded. Digital recordings and telemetric system

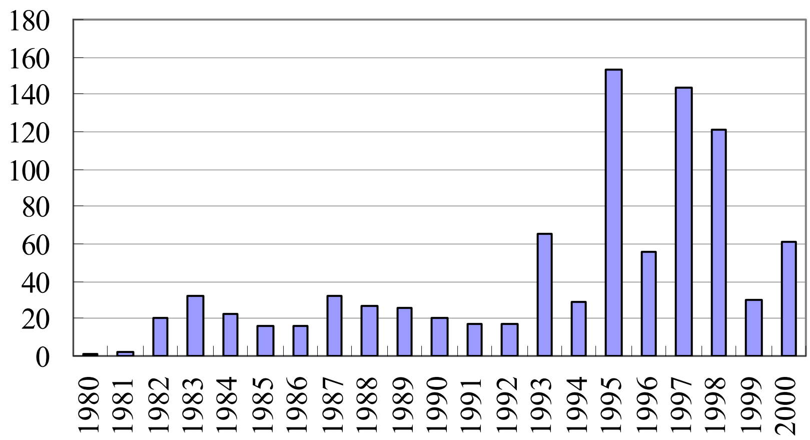

Fig. 2 Frequency of observed events against year

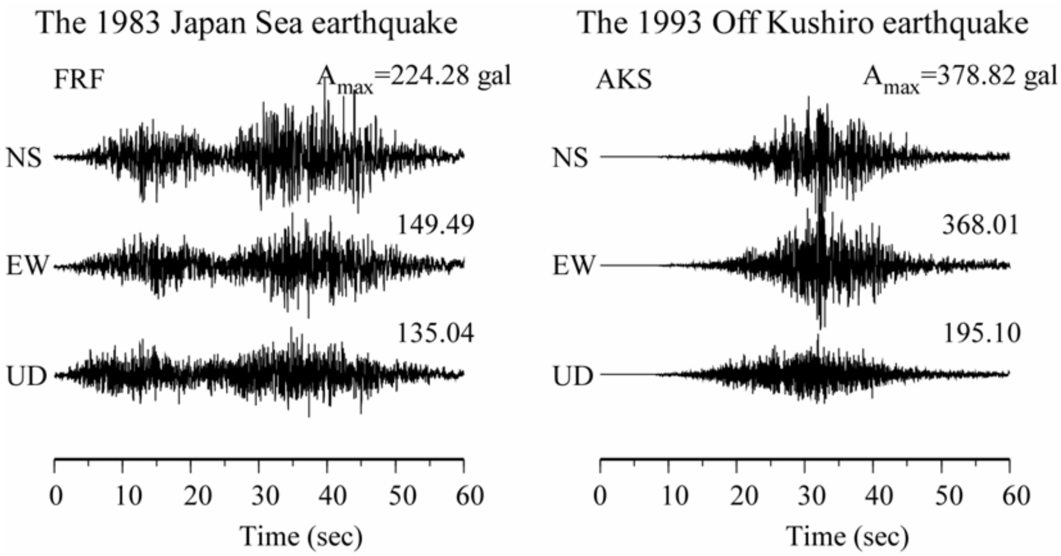

Fig.3 Observed strong motion records from the 1983 Japan Sea earthquake (left) and from the 1993 Off Kushiro earthquake (right).

also ensure stable operation of the network. In addition, the earthquake swarms east off the Izu Peninsula increase the number of observed events in 1993, 1995, 1997 and 1998. In 1995 aftershocks of the Hyogo-ken Nanbu earthquake observed at temporal stations are also included.

So far we obtained strong motion data from several major earthquakes such as the 1983 Japan Sea (Akita-oki) earthquake (M_{JMA}=7.7), the 1987 Off Fukushima earthquake swarm (M_{JMA}=6.7 for the largest event), the 1993 Off Kushiro earthquake (M_{JMA}=7.5) and the 1994 East Off Hokkaido earthquake. In Fig. 3 we show the accelerograms observed at FRF station from the 1983 Japan Sea earthquake and those observed at AKS station from the 1993 Off Kushiro earthquake (see Fig. 1 for the station code). These records were obtained at the nearest stations from the sources and they were utilized as the basic data for the study on source rupture process.

DATA PROCESSING AND PUBLICATION

We select the strong motion data with sufficiently high signal-to-noise ratio from the observed records. Selected waveform data are corrected for the baselines and band-pass filtered in the frequency range from 0.04 to 35 Hz, then added to the database with a common data format. Compiled data were published as technical reports till 2000 including the data observed from 1980 to 1999. (Yajima 1990 – 2000). Digital strong motion data are now available on the closed web site only for the limited members in Japan. We are preparing to open the database to the public on the Internet, which will be accomplished within a couple of years. Even now the digital data may be supplied by request under restricted condition such as for the purpose of research.

CONCLUSIONS

In this article we introduced the strong motion observation network operated by CRIEPI. The distinctive feature of our observation is that at many of stations seismometers are installed on the rock outcrops. At the beginning of the construction of network we aimed to obtain the records at least at one station when a large earthquake occurs since there were few strong motion observation station on the rock. Therefore the stations were distributed sparsely and extensively mainly in the Pacific coast area of eastern Japan where the large interplate earthquakes were expected to occur. And then strong motion arrays with relatively high density are deployed from the Izu Peninsula to the southwestern Kanto area.

In recent years strong motion seismometer arrays with very high density (order of 1,000 stations all over Japan) have been deployed such like K-net and KiK-net operated by the National Research Institute for Earth Science and Disaster Prevention (NIED) and the observed data are open to the public with no restriction. Even in such a situation we think the strong motion observation network on the rock site is still unique and important. In the future, rearrangement of the stations should be carried out for more efficient operation of the observation and study on the strong ground motions should be evolved by using accumulated records. Further, availability of the digital data especially to researchers also should be improved so they can get the data more quickly.

ACKNOWLEDGMENT

We used Generic Mapping Tools (Wessel and Smith 1995) to draw several figures in this paper.

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