



CURRENT STATUS OF STRONG-MOTION EARTHQUAKE OBSERVATION IN JAPANESE PORTS

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ABSTRACT: Strong ground motions and the response of structures have been observed in the major ports in Japan for more than 40 years. The network now covers the entire coastline of Japan with 110 accelerographs in 60 ports. This article describes the current status of the network, some findings from recent observations and data availability.

Key Words: port, strong ground motion, observation, acceleration, annual reports, CD-ROM, ASCII data, website

INTRODUCTION

The Strong-Motion Earthquake Observation in Japanese Ports started in 1962 with eleven SMAC-B2 accelerographs installed at ports in Japan, including Yokohama, Shimizu, Nagoya, Kobe and Kagoshima. The first record was obtained on March 27, 1963 in the Port of Nagoya. Since then, the observation has been conducted based on the collaboration between the Port and Harbour Research Institute (PHRI), the Ministry of Transport, and relevant regional port offices of the central or local governments. The regional offices have been in charge of the maintenance of the accelerographs, while the research institute has been in charge of data collection, correction, analysis and storage. The network expanded gradually and 110 accelerographs had been installed in 60 ports as of March 2004. In April 2001, PHRI was succeeded by two institutes, namely, the Independent Administrative Institution Port and Airport Research Institute (PARI) and the National Institute for Land and Infrastructure Management (NILIM). Both institutes are involved in the Strong-Motion Earthquake Observation in Japanese Ports. PARI is in charge of data collection, correction, analysis and storage. PARI also publishes annual reports on the observations, recent versions of which include a CD-ROM including digital data from the network. NILIM developed a website for domestic users (www.eq.yok.nilim.go.jp) from which all the digital data from the network since 1963 can be downloaded. This article briefly describes the current status of the network.

CURRENT NETWORK

The Strong-Motion Earthquake Observation in Japanese Ports covers the entire coastline of Japan with 110 accelerographs in 60 ports, as shown in Fig.1, as of March 2004. The network consists of 85 ERS-F/G/GV accelerographs and 25 SMAC-MDU accelerographs, all of which are digital instruments. The network consists of three kinds of stations; the first to record accelerations on the ground surface, the second to record accelerations in the ground by using bore-holes and the third to record the

earthquake response of structures such as quay walls or gantry cranes. A station that records the earthquake response of a structure is always accompanied by another station which records ground accelerations in its vicinity. Currently 67 accelerographs out of 110 are installed on the ground, 33 in the ground using bore-holes and the remaining 10 on structures such as quay walls or gantry cranes. Most of the accelerographs are connected to a telephone line (NTT-ISDN digital data transfer line) and an on-line data transfer system between the stations and the Port and Airport Research Institute in Yokosuka is available. This on-line system contributes not only to rapid acquisition of data but also to reduction of maintenance cost at regional offices because the staffs at PARI can monitor the conditions of accelerographs. For more information including the types of accelerographs and installation conditions, refer to the CD-ROM attached to the annual reports (e.g., Nozu *et al.* 2003). Soil profiles at the stations are also available on the CD.

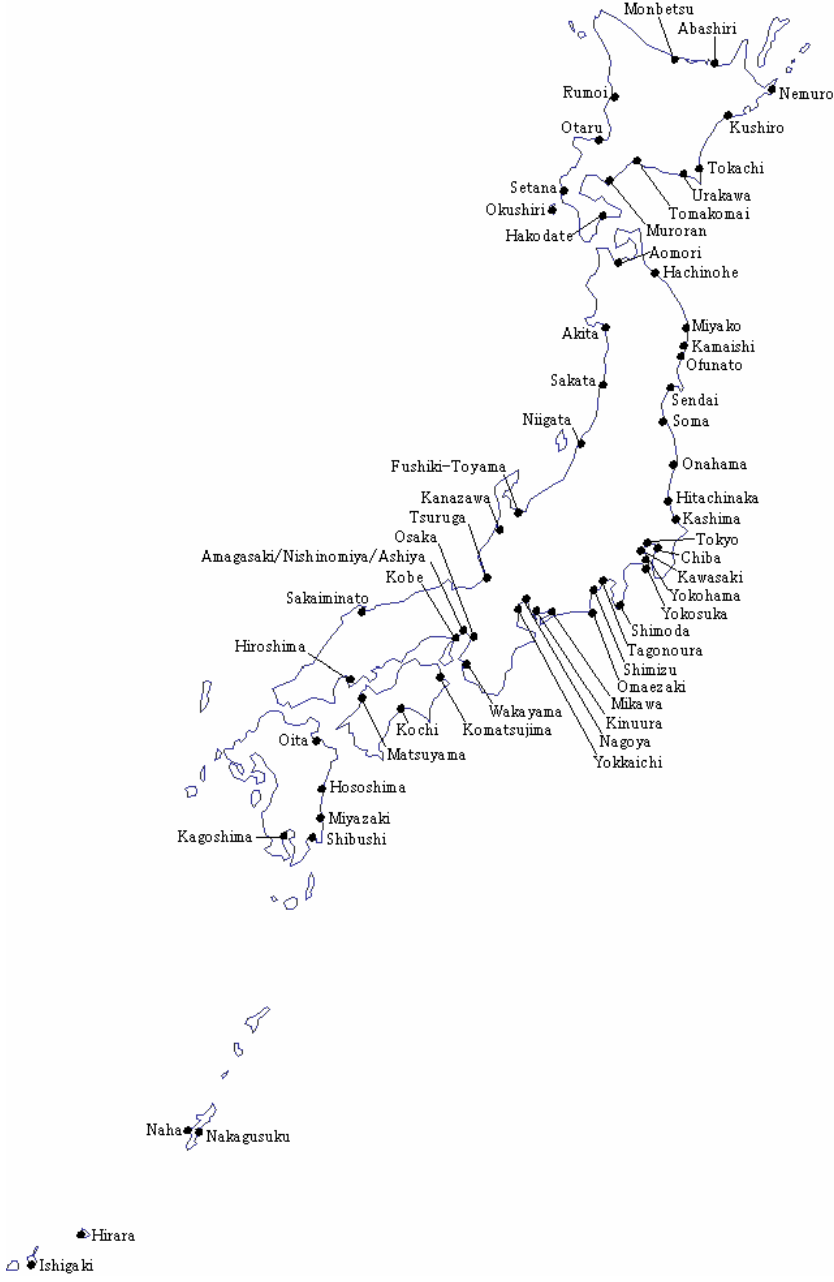


Fig. 1 Current network of the Strong-Motion Earthquake Observation in Japanese Ports

SOME FINDINGS FROM RECENT OBSERVATIONS

Reproduction of predominant periods

The predominant period of earthquake ground motion is site-dependent. Examples from recent observations in Japanese ports are shown in Fig.2. In the Port of Hachinohe, Fourier spectra from both the 1968 Tokachi-oki earthquake ($M_J=7.9$) and the 1994 Sanriku Haruka-oki earthquake ($M_J=7.5$) are characterized by a peak at 2.5 seconds. In the Port of Kushiro, Fourier spectra from both the 1993 Kushiro-oki earthquake ($M_J=7.9$) and the 2003 Tokachi-oki earthquake ($M_J=8.0$) are characterized by peaks at 1.0-2.0 seconds. These observations emphasize how important it is to adopt a design ground motion that appropriately reflects site characteristics.

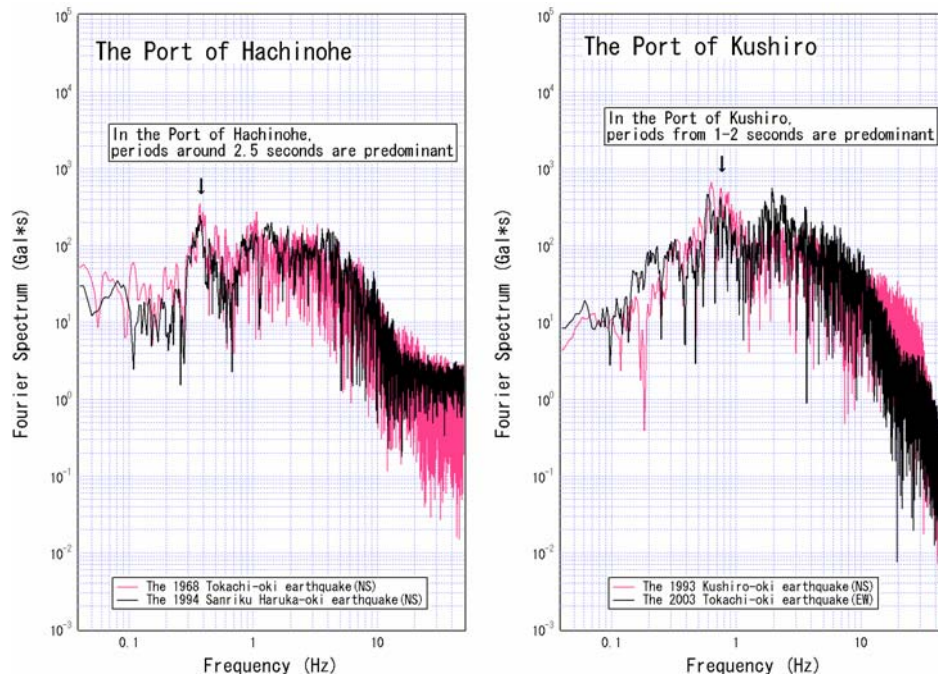


Fig. 2 Reproduction of predominant periods in the records from Japanese ports

Amplification at longer periods

Due to rapid developments of various strong-motion networks including K-NET in Japan, it is now easy to compare the records from different networks. Because ports are positioned along the coastline, they are often located on thick sediments. There is a tendency, therefore, for stations in ports to have larger amplifications at periods longer than 1 second relative to stations from other networks. As an example, Fig.3 shows site amplification factors at stations from various networks in the former Shimizu City, Japan, relative to ERI on sandstone. It can be clearly seen that stations at the port (KJO and MHO) show the largest amplifications at periods longer than 1 second. Thus it is clear that even the most recent networks including K-NET are not dense enough to resolve site characteristics. For the purpose of evaluating site amplifications appropriately, circulation of records from different organizations is essential.

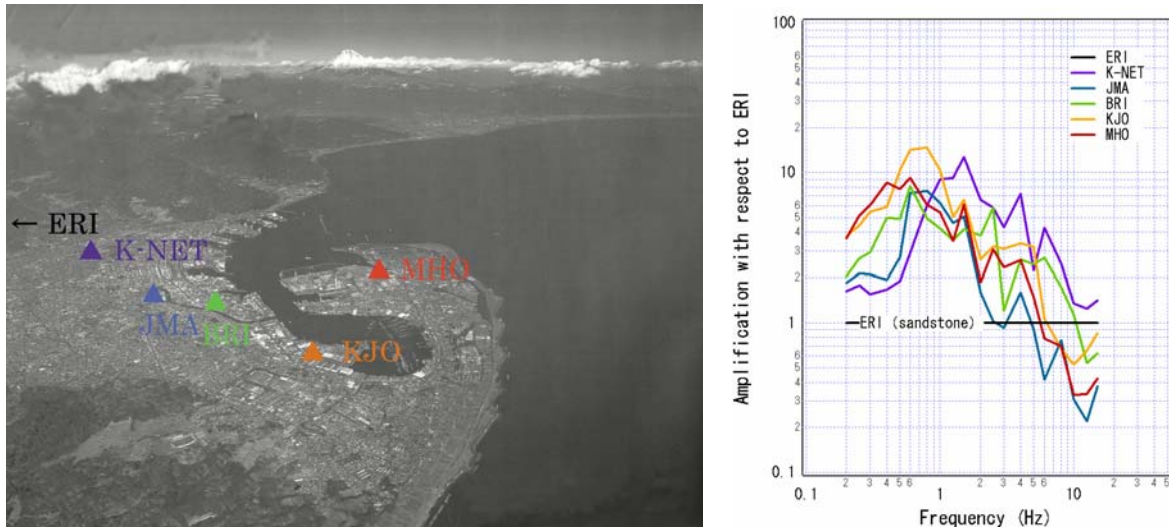


Fig. 3 Locations of stations in former Shimizu City, Japan (left) and site amplification factors (right)

DATA AVAILABILITY

Records from the Strong-Motion Earthquake Observation in Japanese Ports have been published as annual reports from PHRI (1962-1998) (e.g., Tsuchida *et al.* 1968) and PARI (1999-). Annual reports since 1976 contain computer plots of original and corrected accelograms, integrated velocities, displacements, Fourier spectra and response spectra (e.g., Kurata *et al.* 1978). These time histories and spectra were obtained based on the procedure described in Iai *et al.* (1978). Special reports were also published when disastrous earthquakes occurred (e.g., Tsuchida *et al.*, 1969).

Recent annual reports from PARI (e.g., Nozu *et al.* 2003) have been published with a CD-ROM, which contains all the ASCII data of the original and corrected accelerograms obtained in the previous year. Although the printed portion of these reports is in Japanese, the contents of the CD-ROM are in both Japanese and English. Accelerograms are available on the CD in user-friendly CSV format.

In April, 2002, NILIM developed a website (www.eq.ysk.nilim.go.jp) from which all the digital data from the network since 1963 can be downloaded. As the website was developed for domestic users, contents are only in Japanese. The development of a website for international users is under consideration.

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