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Characteristics on Response Spectra of Ground Motions Observed during the Earthquake on 15th May 1999s in Okinawa Prefecture Area

Yoshinari MATSUSHIMA*, Tetsuya YABUKI** and Yasunori ARIZUMI **

Abstract

Okinawa prefecture has lots of peculiarities for geology and topography in comparison with those of main land Japan. Namely, to make earthquake disaster minimized, it is needed to consider these different points mentioned above on seismic design of structures and to investigate the earthquake characteristics in that region. Therefore, this paper examines the ground-motion characteristics on the basis of an analysis of the observation wave records of earthquake that was observed on 15th May 1999s in the region of Okinawa prefecture.

Keywords : Subtropics small island , Earthquake, Seismic observation, Ground-motion characteristics

1. Introduction

The Hyogoken Nanbu Earthquake, of magnitude 7.2 on Richer scale shock the southern Hyogo prefecture in Japan on 17 January 1995, leading to one of the worst disaster to strike Japan. It is reported that scale of structure's damage was various on the area[1]. Some studies for the above things indicate that the earthquake characteristics differ, depending on topographic features, subsurface layers and deep irregular underground structures at that particular site[2]. It is accepted that scale of structure's damage depends on the interactive relationship between structures and earthquake at a particular site.

In the region of Okinawa prefecture, where is classified into subtropical small islands, it is well known that there are lots of peculiarities for geology and topography in comparison with those of main land Japan. Therefore, to make earthquake disaster minimized, it is needed to consider these different points as mentioned above on seismic design of structures and to investigate the earthquake characteristics in subtropical small islands.

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* Okinawa Prefecture Miyako Brunch Office

**Dept. of Civil Engineering and Architecture, Faculty of Engineering

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This paper examines ground-motion characteristics in the region of Okinawa prefecture, by comparing these Fourier spectrum features of observation wave records of earthquake that was observed on 15th May 1999s.

2. Seismic Observation Points

Okinawa prefecture government has put the seismograph in each municipality and has begun to observe seismic wave, on the purpose to make an earthquake disasters minimized. These seismic observation points are shown in Figure 1. Seismic observation waves for this paper are the data set of seismic waves on the recently most severe earthquake that was observed in Okinawa area on 15th May 1999s. The Mj was 4.6 and the depth was 20km: where Mj is the Japan Meteorological Agency earthquake magnitude. Figure 2 indicates theses points where they were observed.

By considering topographical characteristics on each observation points, theses observation points are classified into two groups. These groups are as follows.

On geology and topography, Okinawa Main Land is divided by Tengan Fault where is at the central district of it[3]. Therefore, observation points in the northern part of Okinawa Main Island are in one group; it is defined herein as the group of G1. The southern part of it is in the other one; it is defined herein as the group of G2.

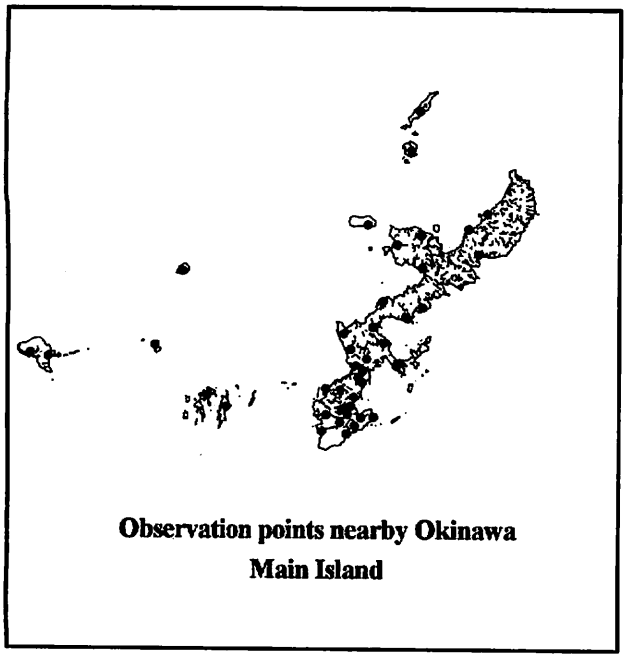
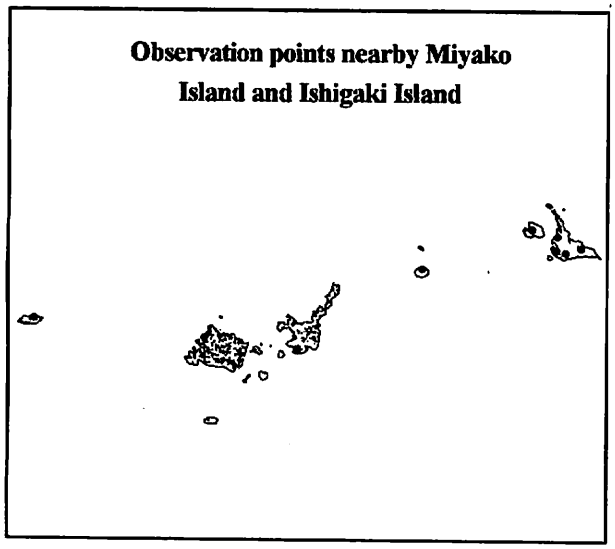


TABLE 1 Related data on the earthquake and each seismic observation point

No	maximum accelleration	epicentral distance	direction	seismic intensity scale	observation pont	classification of topography	ground Classification
1	40.2	18.97	148	3.2	Motobu	G1	III
2	8.7	34.37	170	1.9	Onna	G1	I
3	24.8	39.93	153	2.3	Ginoza	G1	I
4	9.6	42.05	176	2.3	Isikawa	G1	III
5	6.7	52.01	179	1.9	Okinawa	G2	I
6	5.4	54.42	168	1.6	Yonasiro	G2	II or III
7	3.0	55.73	180	1.5	Kitanaka	G2	I
8	7.9	60.57	162	1.6	Ginowan	G2	I
9	5.1	67.1	183	1.9	Yonabaru	G2	I
10	3.7	68.23	185	1.3	Haebaru	G2	I
11	4.1	69.67	184	1.7	Oozato	G2	I
12	5.8	70.52	189	1.7	Tomisiro	G2	I
13	4.2	70.54	180	1.6	Sashiki	G2	I
14	5.4	73.12	182	1.7	Tamagusuku	G2	I
15	4.3	75.85	190	1.4	Itoman	G2	II or III



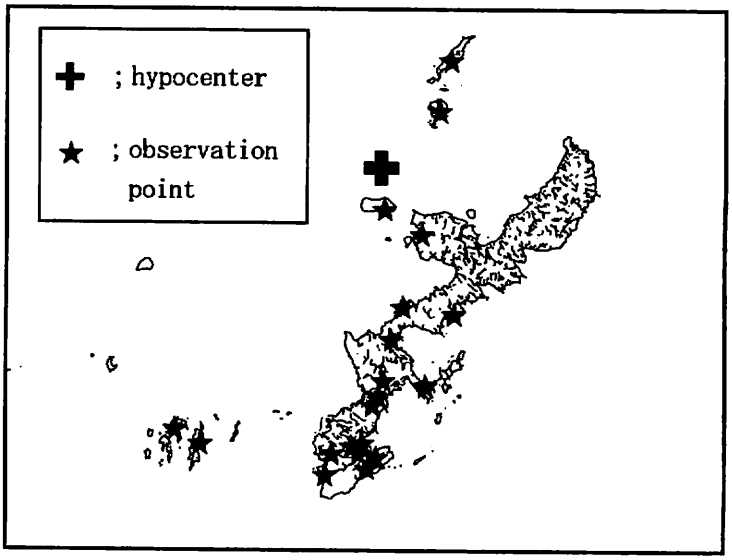


Fig. 1 Distribution map of seismic observation points on Okinawa prefecture

Fig. 2 Distribution map for observation points during the Earthquake on 1999/05/15

3. Ground Motion Characteristics

In this section, characteristic of seismic waves is examined by being classified and comparing the Fourier spectrum of these observation waves as mentioned above.

Figure 3 and 4 present the Furies spectrum of these observation waves on the group of G1 and G2 respectively.

TABLE 1 depicts related data on the earthquake and each seismic observation point. Hereupon, ground classification specified by Japan Specification of Highway-Bridge (JSHB)[4] are also shown. The ground classification has three types depending on its ground condition[4]. The ground classification in TABLE 1 is brought by reference 5). The results of the analysis are as follows.

(1) Group of G1

Observation points on Motobu and Ishikawa have the same ground classification, that is the classification of III. Observation points on Ginoza and Onna have the same ground classification of I. From Figure 4, it is seen that

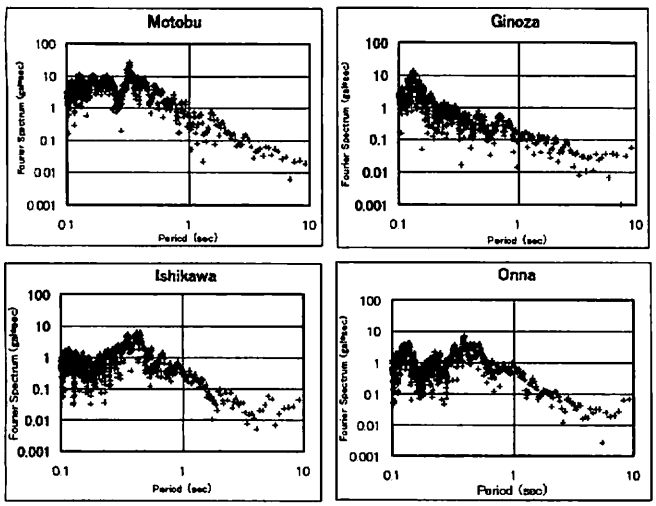


Fig. 3 The Furies spectrum of these observation waves on the group of G1

there is obvious peak in each Fourier spectrum on G2. It appears that each predominant frequency of ground motion according to the peaks varies with the observation point. Observation points on Ginoza and Ishikawa have similar degree on epicenter distance, but maximum acceleration on Ginoza is more than twice of that on Ishikawa. It is assumed that the result is brought by the influence of geographical and topographical features.

(2) Group of G2

TABLE 1 shows that observation points without Yonashiro and Itoman have same ground classification, which is the classification of Ⅰ. However, observation points on Yonashiro and Itoman are under the classification of Ⅱ or Ⅲ. From Figure 4, it can be seen that there is not obvious peak in each Fourier spectrum on G2. It also appears that the each predominant is in the range from 0.1(sec) to 1.0(sec) regardless of ground classification. Maximum accelerations on G2 are in similar degree.

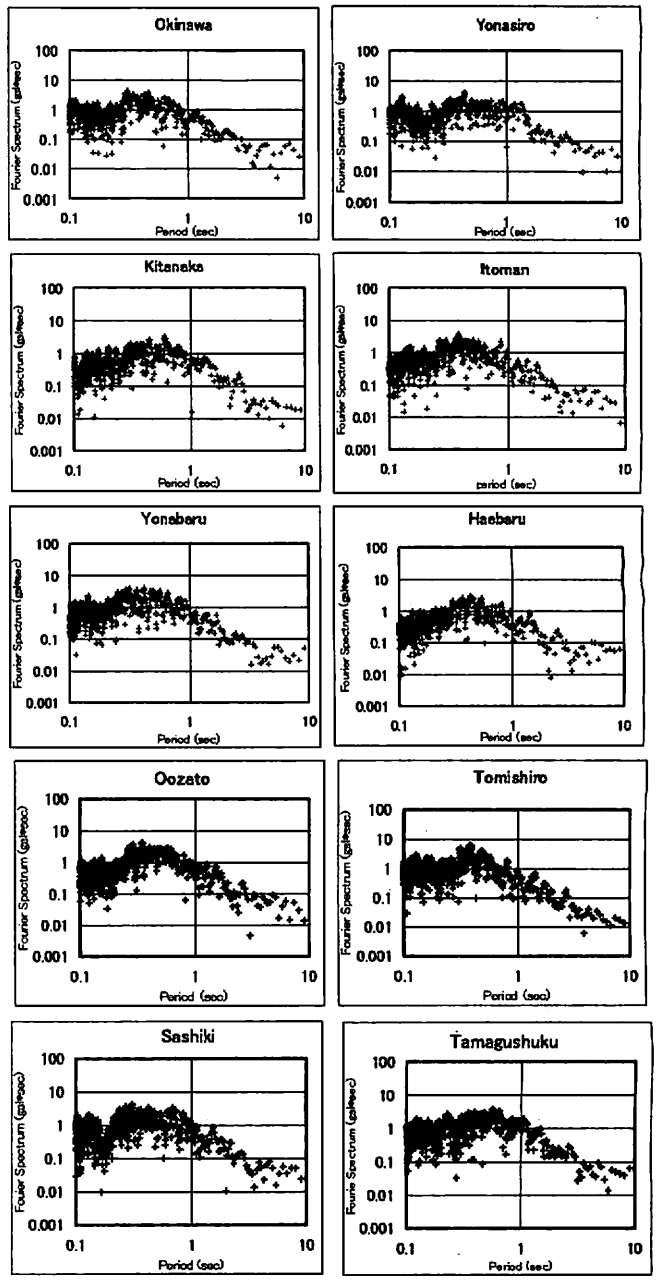


Fig. 4 The Furies spectrum of these observation waves on the group of G2

4. Conclusion

The main concluding remarks derived from this study are:

1) There is obvious peak in each Fourier spectrum on northern district of Okinawa Main Island. It appears that each predominant frequency of ground motion according to the peaks varies with the observation point.

2) There is not obvious peak in each Fourier spectrum on southern central district of Okinawa Main Island. It appears that the each predominant is in the range from 0.1(sec) to 1.0(sec) regardless of Geomorphological land classification.

3) It becomes clear that there are some qualitative differences of characteristics on seismic waves between G1 and G2.

Acknowledgment

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