Potential Earthquake Hazards and Geologic Feature in Kumamoto City

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SUMMARY

Microzoning research need new approaches for increasing safety of urban area. One of these approaches is to search potential earthquake hazard from viewpoint of disaster prevention technology and to transfer more steady urban structural system. The authors explain the dynamic ground classification map of Kumamoto City by Kanai's microtremors observation and report that good agreement exists between above classification and geologic units. Moreover they report the basic potential earthquake hazard maps for Kumamoto City. These maps show existing earthquake risks and give useful information in case of choosing adequate structural system and strengthening method.

INTRODUCTION

Renewal of computers made remarkable progress in earthquake resistant design of high-rise buildings. Cities are undergoing a change against modern construction techniques and are creating new urban space. Many reports about past earthquake damage show evidence of relations between damage of buildings and ground conditions of the site of construction. Fron viewpoint of design, it is desirable that optimum design of building-ground system is considered to earthquake input. In this case, it is necessary at least that dynamic properties of ground at selected site of construction are clarified in detail. If we can get these data all over regions of a city, we can make an earthquake resistant urban planning to consider surface ground conditions as Fig.1.

THE GEOLOGY OF KUMAMOTO CITY

The geology of this area is characterized roughly three categories,namely, Bed rocks, Aso volacanic rocks and river terrace deposits. From viewpoint of geological structure, Kumamoto plain has a kind of basin structure surrounded by Bed rocks. Aso volcanic rocks and Aso volcanic ash are deposited thickly in this basin. The fact that few latent faults locate in Kumamoto City and its surburbs is reported by Watanabe et al. Ref.1)

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OBSERVATION AND ANALYSES OF MICROTREMORS

The authors executed microtremors observation which is powerful tool for microzonztion at about 200 points in Kumamoto City. Kumamoto plain is classified topographically mountain, terrace and alluvial plain (Alluvial fan, Natural levee,Fluviatile depcsit , Paddy soil, Bank, Delta and Reclaimed land). The authors used seismometer (Natural Period = 1.0 sec, Damping Factor = 0.7) for microtremors observation as same conditions in Kanai's microtremors observation and measured displacement on the ground. They measured microtremors during 10-15 minutes at each point. At the time of measurement, they choose condition of low artificial disturvance and made efforts to get good record. Local wind effect was eliminated by windbreak.In laboratory, NS component of microtremors were analyzed by Fourier spectrum analyzer. The accuracy of Fourier amplitude spectra depend on the length and avaraging of the record, noise level, traffic noise and wind velocity etc.

After checking the results of analyses, the authors found the following conclusions:

1) Kinds of ground are cleary related to topographical classification in geology.
2) In Kanai method, borders of predominant period on ground I, II,III and IV are 0.15,0.35 and 0.65 sec in Kumamoto City.

SH WAVE VELOCITY AND AMPLIFICATION FACTOR

In discussing the characteristic of subsoil, another factor is SH wave velocity. In Kumamoto City, few SH wave velocity were gained by field test. The authors estimated the value of SH wave velocity from data of field test and microtremors predominant period. Estimated SH wave velocity in first and second layers shows in Fig. 8 and Fig. 9. Moreover the authors estimated the amplification factor by subsoil in case of acceleration and velocity based on Ref.3). Estimated amplification factor shows in Fig. 6. and Fig. 7.

ENGINEERING GEOLOGIC MAPS

The authers reported some basic potential earthquake hazard maps for Kumamoto City as follows: Wooden Houses collapsed by 1889 Kumamoto earthquake, Active faults,Liquefaction,Bank failure ,Risk zone for High-rise or Low-rise R/C buildings,Risk zone for Old or New Wooden Houses. The data on damage by 1889 Kumamoto earthquake is very few. The relation between point of Wooden Houses collapse and the characteristic of subsoil or the active faults is very interesting. Liquefaction and Bank failure are expected to occur on alluvial plain. Risk zones for High-rise (>5F) or Low-rise (≤ 5F) Reinforced Concrete building and for New or Old Wooden Houses were settled from viewpoint of "quasi-resonance state in their frequency domain".

ACKNOWLEDGEMENT

The authors express their sincere gratitude to the Professor of Tokyo Institute of Technology, Dr. Hiroyoshi Kobayashi.

REFERENCE

1) Kazunori Watanabe: Studies on the Aso Pyroclastic Flow Deposits in the Region to the West of Aso Caldera, Southwest Japan, I: Geology, Memoirs of the Faculty of Education, Kumamoto University, No.27, 1978

2) Kiyoshi Kanai and Teiji Tanaka: On Microtremors VIII, B.E.R.I. Vol.39,1961

3) Saburoh Midorikawa and Dr.Hiroyoshi Kobayashi: Isoseismal map in Near-Field with regard to Fault Rupture and Site Geological Conditions, Trans. of A.I.J., No.290, April, 1980

4) Ai'ichiro Tanaka: Development for Classification Method of Surface Ground Conditions by Dynamic Properties from Kanai's Microtremors Observation, Third International Earthquake Microzonation Conference,1982

5) Ai'ichiro Tanaka: Seismic Microzoning Technique using Microtremor Observation in Urban Area of Kumamoto City, Asian Regional Conference on Tall Buildings and Habitat,1982

6) Ai'ichiro Tanaka and Kenji Migita: Research on Seismic Microzoning of Kumamoto City by Microtremor Observation, BUTSURI TANKO(GEOPHYSICAL EXPORATION) Vol.35,No.6,1982

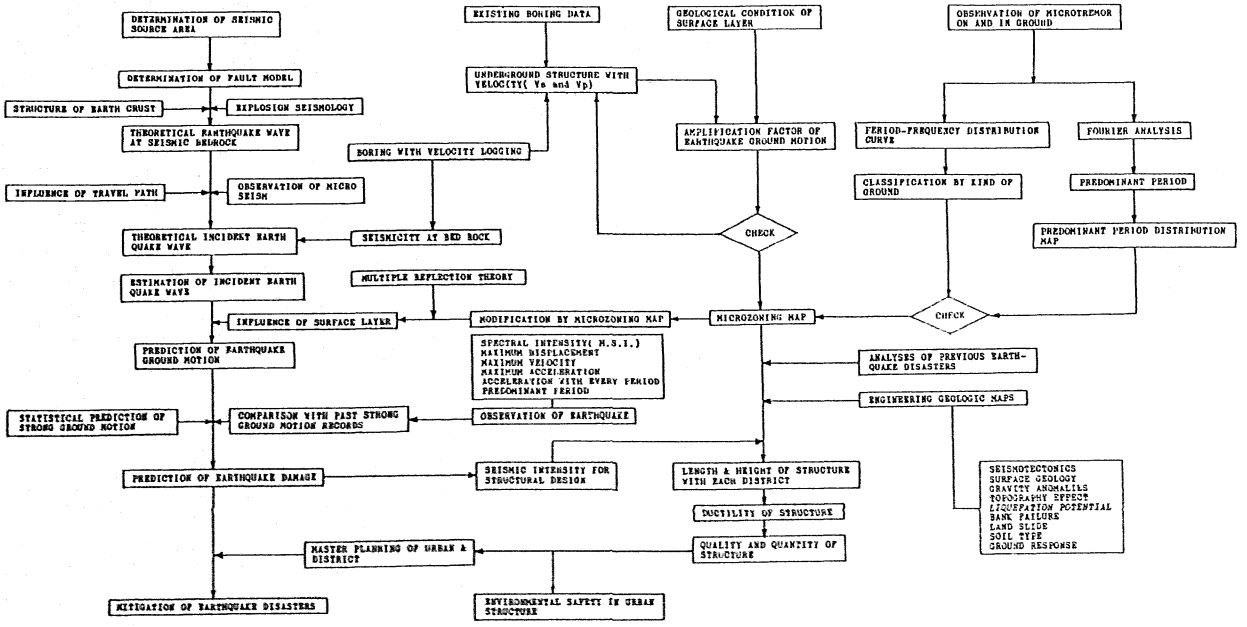

Fig.1 Flowchart for Seismic Microzoning

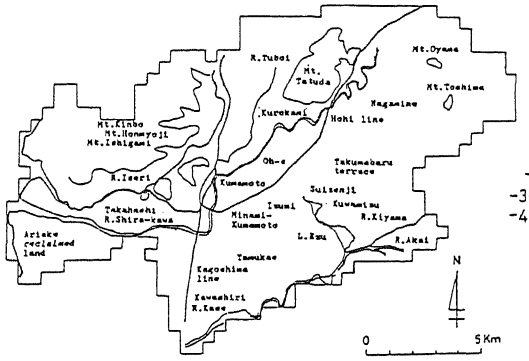

Fig.2 Sketch of Kumamoto City

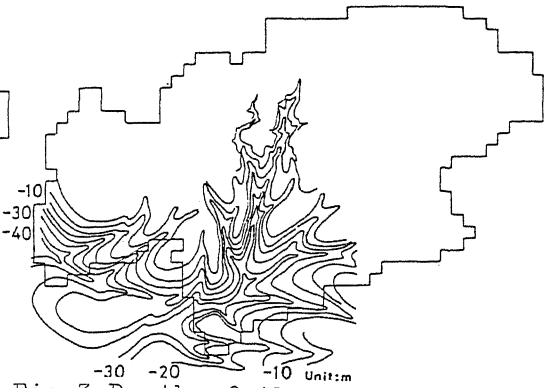

Fig.3 Depth of Alluvial Layer

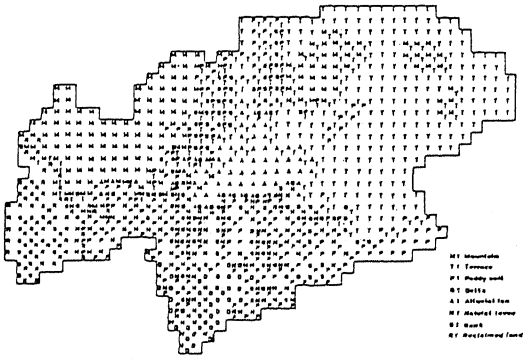

Fig.4 Distribution of Geologic Unit

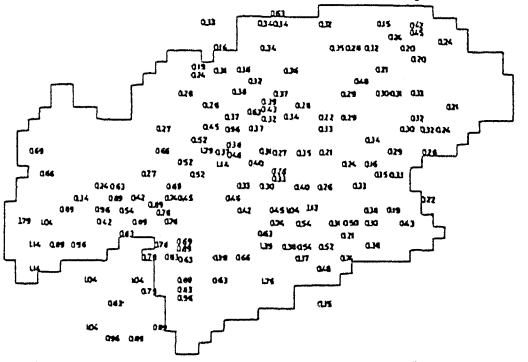

Fig.5 Predominant Period of Tremors

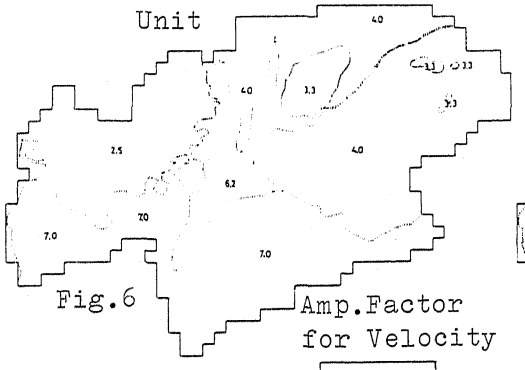

Fig.6 Amp.Factor for Velocity

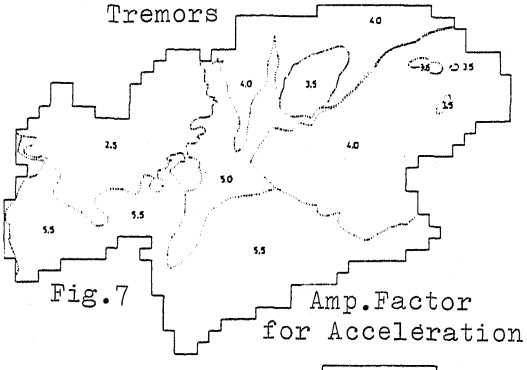

Fig.7 Amp.Factor for Acceleration

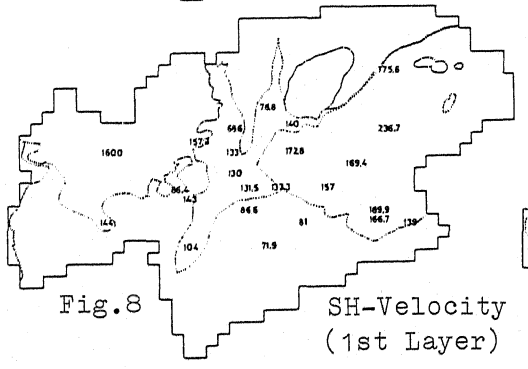

Fig.8 SH-Velocity (1st Layer)

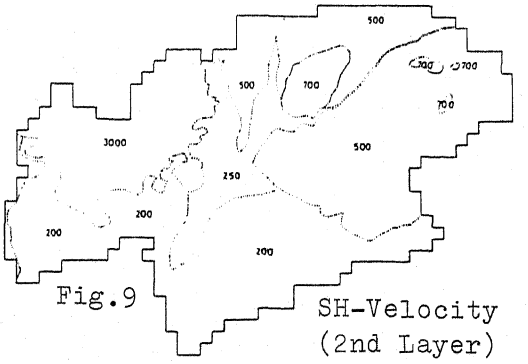

Fig.9 SH-Velocity (2nd Layer)

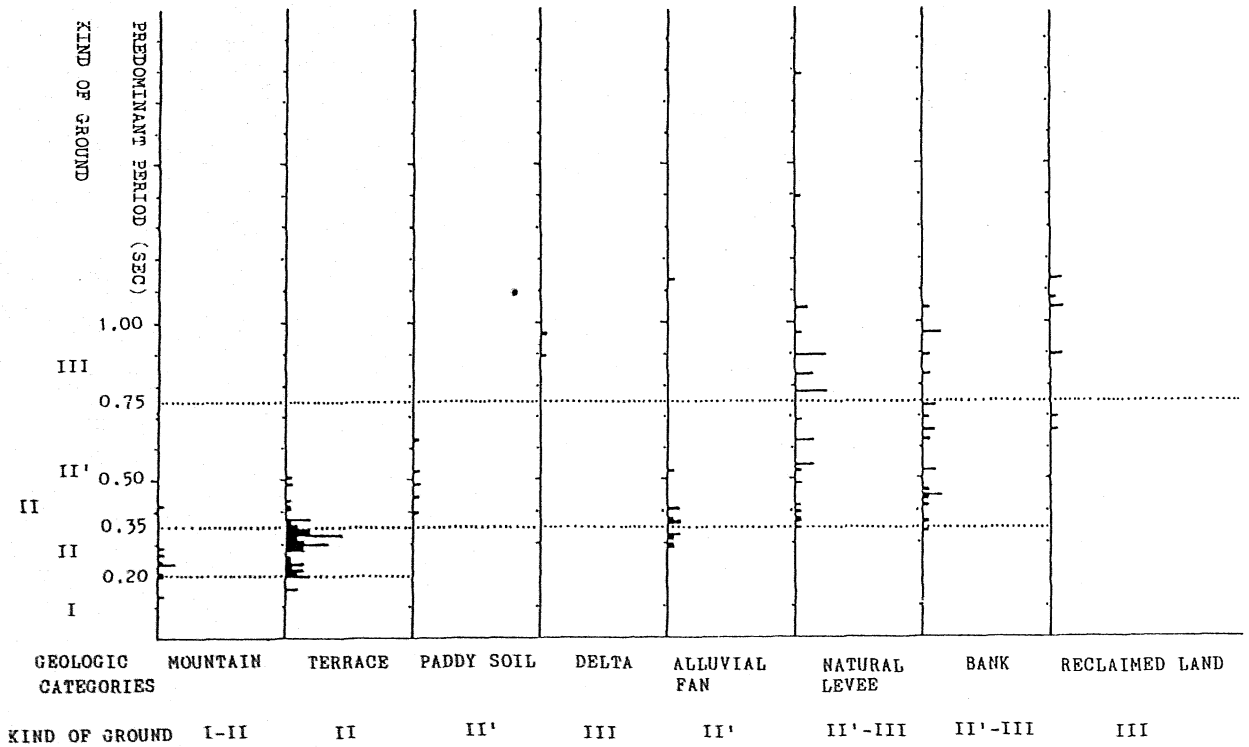

Fig.10 Predominant Period and Surface Topography

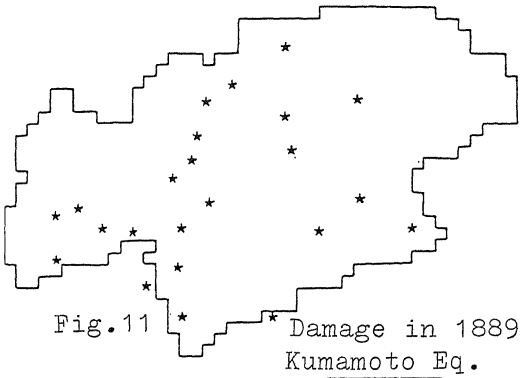

Fig.11 Damage in 1889 Kumamoto Eq.

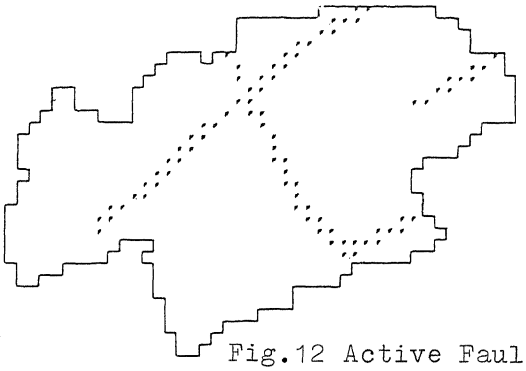

Fig.12 Active Fault

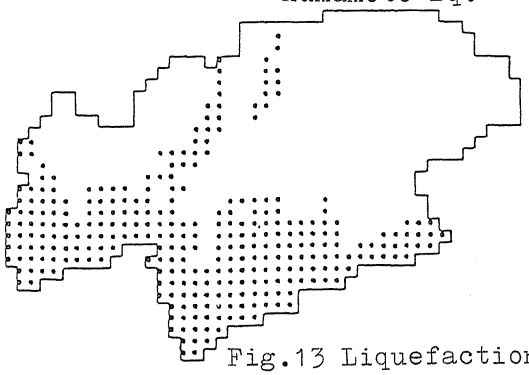

Fig.13 Liquefaction

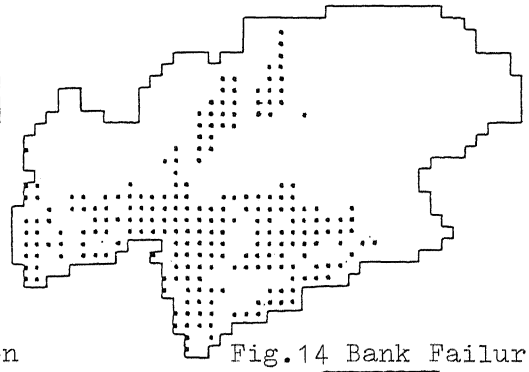

Fig.14 Bank Failure

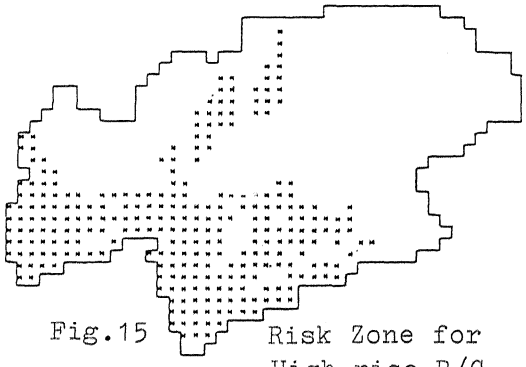

Fig.15 Risk Zone for High-rise R/C

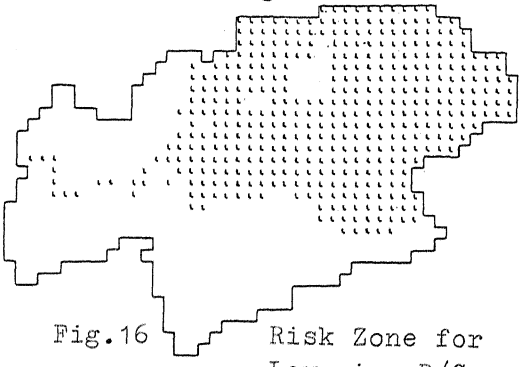

Fig.16 Risk Zone for Low-rise R/C

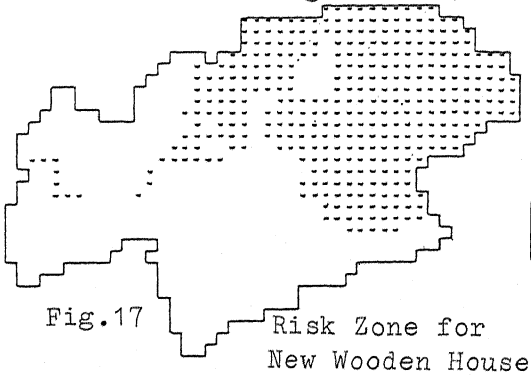

Fig.17 Risk Zone for New Wooden House

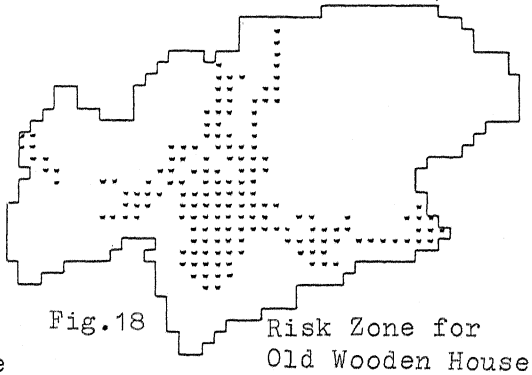

Fig.18 Risk Zone for Old Wooden House