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A SIMPLE ESTIMATION OF STRONG GROUND MOTION DISTRIBUTION FOR DISASTER EVALUATION

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ABSTRACT

Introduction

The 1996 Hyogo-ken Nanbu Earthquake occurred in shallow crust directly beneath the city of Kobe, Japan, wreaking unprecedented natural disaster upon the area. Probably the greatest mission of researchers is to exhaustively investigate the causes of such catastrophic earthquake damage so that disaster prevention planners and others can incorporate the results in seismic disaster prevention plans and future city planning. Therefore, research and discussions are continuing at a feverish pace from various perspectives using results of detailed damage surveys and other materials.

Although these endeavors have been based on the study of the distribution of ground types and earthquake motion, there are still insufficient materials available, especially on spatial distribution, and no one can deny that damage surveys, countermeasure considerations and research have been plagued by contradictions and inconsistencies.

Therefore, using the data on earthquakes, ground and the so-called seismic-zoning method, this study will attempt to provide spatial distribution of earthquake motion, for disaster evaluation at early stage or before the event.

Ground evaluation

Among the areas suffering extensive damage from the Hyogo-ken Nanbu Earthquake was western Osaka Prefecture, for which a geotechnical engineering map is being compiled. For the southern Hyogo districts of Hanshin, Kobe, and Awaji, there are also geotechnical engineering maps, small-scale geological maps and s of boring data profiles, but there is a lack of uniform, detailed maps for the entire region.

Therefore, using existing materials, a sub surface geological map was newly compiled to show the geological distribution of ground surfaces in the region. These were classified into the following types: Rokko granites, the Kobe group, the Osaka group, terrace deposits, Holocene soils (clay, sand, gravel), and reclaimed lands. Divided into approximately 125m square meshes (see Fig.1), this map was used to analyze the damage which occurred along a narrow east-west band in Kobe and the Hanshin district, and to consider the expediency of the earthquake motion calculations.

Evaluation of earthquake motion

The fault model of the Hyogo-ken Nanbu Earthquake was set based on the aftershocks distribution which occurred within 24 hours after the main shock (after Japanese Meteorological Agency), and other information of fault. The earthquake motion at seismic bedrock (S-wave velocity is around 3km/s) was calculated by a semi-empirical method after Midorikawa et al. In addition, the amplification factor of surface layers above the seismic bedrock was obtained by establishing, through the method of Matsuoka et al, the average S-wave velocities for each of the ground types previously evaluated. Then, by multiplying the amplification factor of the surface layer by the earthquake motion of the seismic bedrock, the acceleration distribution at the ground surface was calculated (see Fig.2).

Results and discussion

The distribution of earthquake motion during the Hyogo-ken Nanbu Earthquake, as derived spatially in this study, clearly showed an acceleration level of over 500gal in the so-called "earthquake disaster belt", a narrow zone wedged between the Rokko Mountains and Osaka Bay. A somewhat lower distribution of acceleration was seen in the Rokko Mountains, terrace deposit and in reclaimed lands. Furthermore, the distribution of earthquake motion was coincident with the distribution of damage and seismic intensity, which mostly stretched from the southwest to the northeast. While damage suffered by buildings, etc., was largely the result of structural weaknesses, it was also caused by the seismic motion, ground deformation such as liquefaction, and other factors. The evaluation of all these factors should lead to the development of a more effective disaster prevention and reduction plans.

The earthquake motions used in this study were estimated from existing data and contained no newly-collected data except the fault data Overall, these simple but effective estimates provided results that were consistent with damage conditions and that could be obtained in a short time since new data had not been collected. The precision and accuracy of the seismic zoning should be improved according to the practically required level which is not consistent due to diverse factors such as socio-economic conditions and time constraints.

KEYWORDS

strong motion distribution estimation; seismic-microzoning; damage estimation; seismic risk reduction; Hyogo-ken Nanbu Earthquake.