How to Prepare for Active Faults - Lessons learned from the Hanshin-Awaji Earthquake -

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Introduction

The Hanshin-Awaji Earthquake of 17 January caused massive damages to the Hanshin region where is the socioeconomic center of the western Japan. One of the characteristics of this earthquake is that the earthquake accompanied pre-existing active faults. After the occurrence of the earthquake much attention has been paid to active faults in elsewhere in Japan as well as in the Hanshin region. There are more than 1,500 active faults have been mapped on land Japan. Elsewhere in Japan is always at risk of earthquake occurring along such a fault.

The Hanshin-Awaji Earthquake

In the early morning of 17 January, 1995, an earthquake which magnitude was 7.2(JMA) hit the western Japan including the Hanshin region. The epicenter is located at the northern tip of the Awaji island. From the epicenter to the south, ground dislocation has been observed clearly along the Nojima Fault, one of the pre-existing active faults in the island of Awaji.

Although, from the epicenter to the north, there is no clear surface faulting has been observed, a narrow zone of severe damage runs almost parallel to the active faults in the region. There is a controversy on the cause of this severe damage zone and the controversy attracts more attention among the general public to active faults.

An extreme argument requires a law which restricts any construction along an active fault, such as the Alquist-Priolo Special Studies Zone Act in California, USA. There is no doubt that such a law can reduce earthquake disaster. However, at

the same time, such a law restricts socioeconomic activities along the designated fault and hence causes economic loss of other type than the economic loss due to an earthquake. A trade-off between the damage reduced by the law and economic loss due to the law should be considered.

Recurrence Interval of Earthquake Faulting

Recurrence interval of an active faulting at plate boundary, such as the San Andreas Fault on the west coast of the United States, is on the order of hundred years. This means that earthquakes tend to occur once in every hundred years at the same place along an active fault at plate boundary. In this case a building of 50 years life has 50% chance to encounter an earthquake during its life.

On the other hand, recurrence interval of intra-plate fault is on the order of thousands years. For example, the recurrence interval of the Atera Fault which is known as the one of the most active fault in Japan is 1,700 years. Less active faults have much longer recurrence interval. In this case a building of 50 years life has only few percent chance to encounter an earthquake during its life.

Countermeasure for Earthquake

Since the most of the active faults in Japan are intra-plate type, each buildings nearby an active fault has negligible chance to suffer an earthquake by the fault during its life. However, once an earthquake occurs along an active fault nearby it causes serious damage to the buildings such as we have learned from the Hanshin-Awaji earthquake.

Any earthquake can not be stopped occurring and earthquake-resisting design is not effective to any building on an active fault. We should realize that there is a limit for engineering countermeasure.

We have experienced frequent occurring disasters such as floods, typhoons, tornadoes. However, we have not obtained a perfect countermeasure to prevent even such frequent occurring disasters. For less frequent disasters, such as earthquake disaster, the most effective and feasible countermeasure is being ready for such disasters. Emergency management will play the most important role to minimize the losses.

Map of Active Faults in Japan

Map of Maximum Expected Earthquake Magnitude
based on active faults data (after Kakimi et al., 1994)