The Importance of Seismic Death Risk Assessment Each Household Unit

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1.Introduction
The Kumamoto earthquake started with a foreshock at 21:26 in April 14, 2016. It had an Mj of 6.5 and a Japan Meteorological Agency (JMA) seismic intensity of 7 in Mashiki town (JMA 2016). The subsequent mainshock of which Mj was 7.3 occurred at 01:25 JST in April 16, 2016. Accordingly, the people staying in Mashiki town have experienced tremendous strong motions of a JMA seismic intensity of 7 twice a couple of days (JMA 2016). The 2016 Kumamoto earthquake resulted in the death of 50 people in the Kumamoto Prefecture (2016).
The highest death count was recorded in Mashiki town, where 19 people totally killed by collapsed buildings. The death count breakdown showed that 7 and 12 people killed during the foreshock and the mainshock, respectively. During a series of disasters, many people in Mashiki town evacuated to designated evacuation sites or rushed to their own cars immediately after the foreshock. It resulted that the foreshock activates residents to evacuate into safer sites and decreases killed people by the subsequent mainshock. We estimated that the total number of deaths caused by building damage from a series of shocks would reach to 45, if nobody could evacuate after the foreshock. Result, the death toll decreased by 26 people (Nakashima and Okada, 2016). Generally, most of people evacuated are prone to return home as time goes by. As a result, many people die at the time of a subsequent mainshock. It is important to provide death risk information to each household for the purpose of supporting their decision making of appropriate evacuation.

2.Method
We estimate the death risk of the household where the dead occurred due to collapse building. The death ratio of household was obtained by applying the equations of Nakashima and Okada (2008, 2016).

3.Risk Estimation for Household Unit
Using the proposed method, we estimate the death rate of each household for the main shock and the foreshock. Consider as an example that a house is built in the 1970s and three people stay there at the earthquake occurs. Assuming that the seismic intensity of the foreshock is 6.49 and the main shock is 6.77, the occurrence probability of wooden building damage in the foreshock is estimated to 12% at the damage degree of D4 and 6% at D 5 and 1% at D 6, and it increases to 16% at D4 and 18% at D5 and 12% at D6 in the mainshock. In addition, the probability of death increases to 3% in the foreshock and 15% in the main shock. Similar results were obtained for other households.

4.Conclusion
Such information about death risk each household unit will be useful for decision-making of the evacuation start immediately after the disaster.

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