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Simulation of Building Damage Distribution in Downtown Mashiki during the Mainshock of the 2016 Kumamoto Earthquake based on the Numerical Modeling of Building Responses

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During the mainshock of the 2016 Kumamto earthquake, it appeared an area that many wooden buildings were severely damaged in the Downtown Mashiki, Kumamoto, Japan (NILIM and BRI 2016). To estimate the distribution of the building damage in that area, we have identified the velocity structure from ground surface to seismic bedrock of Downtown Mashiki in Kumamoto, Japan. Next, we made a suffixed grid model with 30*30 grids (about 47m * 47m) in our target area at Mashiki by the linear interpolate method. After that, we estimated the horizontal ground motions of every grid point using the linear analysis and equivalent linear analysis method. Then, we inputted the estimated horizontal ground motions into the numerical model of the standard 2-floor wooden house with different construction period (Nagato and Kawase 2004; Yoshida et al., 2004). We did two scenarios of building damage ratio estimation at Mashiki. In the first scenario, we used the statistical analysis results of wooden house ages in Mashiki (Yamazaki et al. 2018) : before 1950, 1951-1970, 1971-1981 and after 1982. We estimated the building damage ratio at each grid point and made the building damage distribution map. In the second scenario, we estimated the building damage ratio by associating with the location and construction period of each building in the target area. We got the building locations in Mashiki by referencing to the Open Street Map (OSM). Next, we calibrated the building construction period in Mashiki by comprehensively considering the aerial photos which were taken in 1947, 1956, 1967 and 1975 from the Geospatial Information Authority of Japan (GSI) and the research results of Yamada et al. (2017) and Moya et al. (2018). We calculated damage ratio of each building by considering the influence coefficient of four surrounding grid points. Finally, we made the averaged damage ratio distribution map of Mashiki in accordance with the similar grid size of the field survey result. We found most of the building damage ratios were concentrated on the area between the local Road 28 and the Akizu River and the estimated distribution map using the estimated ground motions of equivalent linear analysis was similar to the field survey result.

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