

Building Damage in the Mashiki-town for the foreshock and mainshock of the 2016 Kumamoto earthquake

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The 2016 Kumamoto earthquake caused serious building damages in the near-source regions. The Mashiki-town, about 10km northeast from the epicenter, was located less than 1km from the fault line and subjected to the two strong shakings of level 7 in the JMA seismic intensity scale. The first earthquake (foreshock, Mj6.5) occurred at 21:26, April 14 and the second one (mainshock, Mj7.3) occurred at 1:25, April 16. Since there was only 28 hours interval, it is difficult to classify the damage of two earthquakes.

We analyzed the aerial photos taken by the Geospatial Information Authority of Japan on 15th and 16th of April (<http://www.gsi.go.jp/BOUSAI/H27-kumamoto-earthquake-index.html>). The photos cover the damaged area in Mashiki-town, and two sets of photos taken before and after the mainshock help classifying the damage due to the foreshock and mainshock. We defined the following houses as collapsed building: 1) edge of the building is distorted 2) roof tiles are completely fallen down 3) center line of the roof is tilted 4) debris is observed around the building. We excluded public reinforced concrete structures.

We observed 130 totally collapsed buildings after the foreshock, but the number increased to 350 after the mainshock. The damaged buildings after the foreshock distributed between route 28 and Akitsu river, but the distribution expanded to the north of the route 28 after the mainshock. There are two strong motion stations in the surveyed area (Mashiki LGV and KiK-net KKM16). Both stations recorded seismic intensity 7 for the mainshock, but the damage distribution was very different. 21 buildings were collapsed within 200m of the Mashiki LGV, whereas only 4 building collapsed within 200m of the KiK-net KKM16.

The distribution of the damaged buildings after the mainshock has a good correlation with the distribution of the village 100 years ago. The region around the village was originally floodplain and river terrace of Akitsu river. The village was developed at the edge of the river terrace, and the floodplain was used as a rice field. In 1970s, the village was expanded to the upper river terrace and floodplain. The floodplain is in general considered to be softer soil condition, but for this particular area, damage on the floodplain was much less than that on the river terrace. We need further survey to classify the effect of the subsurface soil structure and seismic performance of the buildings for the better understanding of the damage distribution.

Figure: Damage distribution after the mainshock and aerial photo in 1964.

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