Assessment of the 2016 Minami-Aso Landslide in Kumamoto Prefecture using airborne LiDAR and LS-RAPID model

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A series of earthquakes hit Kumamoto Prefecture in Kyushu Island of Japan started from the foreshock with magnitude of 6.5 that occurred on 14 April 2016 with depth of 11 km. About 140 aftershocks were occurred within two days with the magnitude varied from 3 to 6.4. The main shock with magnitude of 7.3 was hit on 16 April 2016 as the result of strike-slip faulting at shallow depth of 12 km at 32.75 of north latitude and 130.76 of east longitude. According to the Ministry of Land, Infrastructure, Transport and Tourism of Japan, at least about 97 landslides were occurred, which mainly concentrated in the Aso caldera area, northeast from the epicenter of earthquakes. The most prominent landslide was occurred on the Japan National Road 325 in Minami-Aso that destroyed a 200 m Aso large bridge (Aso-Ohashi) into the Kurokawa River.

The objective of this study is to assess the characteristic of Minami-Aso landslide and try to simulate its mechanism and motion. The soil shear parameters necessary were obtained from laboratory experiment by means of undrained ring shear apparatus ICL-2 version. Seismic loading tests was carried out in the ring shear apparatus using the 2016 Kumamoto earthquake record, East-West component, from KMM005 observation station of K-Net (NIED, Japan). The results implied that the shear strength of Minami-Aso samples was reduced significantly during earthquake together with rapid rise of the excess pore water pressure, causing rapid motion of landslide with huge energy which destroyed the bridge. To obtain more detail and accurate topography profile to be used in the LS-RAPID model, we applied the airborne LiDAR data from Asia Air Survey Co. Ltd. to generate high resolution of digital elevation model. In result, the initiation mechanism and motion of Minami-Aso landslide was clearly described in the LS-RAPID model, started from the initiation process from seismic loading up to the moving process which involving the volume enlargement and traveling process of the landslide mass. However, factor of ground wetness in the vicinity area is need to be considered in further, since we found significant amount of rainfall took place in one week before the landslide event.

Keywords: Minami-Aso landslide, Airborne LiDAR, Kumamoto earthquake, Ring shear tests, LS-RAPID