Simulation of the Aratozawa Landslide using Ring Shear Tests and LS-RAPID model

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The deep large-scale landslide near Aratozawa Dam of Miyagi Prefecture in Japan was occurred due to
main shock of the Iwate-Miyagi inland earthquake on 14 June 2008. The earthquake magnitude reached
7.2 which results a huge mass movement close to the Aratozawa reservoir. Study on the Aratozawa
landslide is necessary in order to understand and clarify the initiation mechanism and motion
behavior particularly when the seismic loading plays as a main triggering factor. This paper shows
the newest version of the undrained dynamic ring shear apparatus which then integrated with the
LS-RAPID as a landslide simulation model. In further, results of this research could be a
significant step forward for the landslide hazard assessment efforts to reduce human casualties and
public infrastructure damage.
The laboratory experiment for the Aratozawa samples was carried out by means of ring shear
apparatus ICL-2 version. This version is the newest apparatus that has been built so far by Sassa
and other colleagues started in 2012 for practical use. Still, the main purposes of this apparatus
for landslides are to observe the pore water pressure generation in undrained condition, shear
strength reduction and failure motion behavior of samples within a large shear displacement. The
development of this ring shear apparatus also emphasizing the change of normal stress platform from
pillar-beam based, to the single central axis-based. Several parameters resulted from experiment by
ring shear tests then occupied for the LS-RAPID geotechnical simulation. Landslide simulation model
using LS-RAPID aims to observe the overall process of landslide phenomena started from the
initiation process by pore pressure increase and seismic loading up to the moving process which
involving the volume enlargement and traveling process of the landslide mass.
The critical pore pressure ratio was obtained from ring shear tests. In addition, the friction
coefficient, shear displacement at the start of shear strength reduction and steady state shear
resistance of the Aratozawa samples were also produced from the tests. We brought the results from
ring shear tests as an input parameter in the LS-RAPID. The results of LS-RAPID so far could
explain the initiation mechanism and motion of Aratozawa landslide. However, further detailed study
is still needed, particularly for the factors from reservoir catchment and relation of reservoir
and groundwater condition before and when the earthquake takes place.

Keywords: Aratozawa landslide, Ring shear tests, Shear strength reduction, LS-RAPID