Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SSS25-21 Room:A04 Time:May 25 16:30-16:45

Simulation of irregular wave generation due to fault formation by an elasto-plastic finite deformation analysis

YAMADA, Shotaro[1*] ; NODA, Toshihiro[1] ; ASAOKA, Akira[2]

[1]Nagoya University, [2]Association for the Development of Earthquake Prediction

The authors, in the past study[1)], simulated shear bands formation in ground due to strike-slip fault by using a soil-water coupled finite deformation code taking into inertia force, ***GEOASIA***[2)]. In the present study, the analysis code was employed to simulate formation of normal and reverse faults and wave generation due to the formation assuming a ground composed of a highly brittle soil. The analysis code mounts the SYS Cam-clay model[3)] as an elasto-plastic constitutive model which can describe a wide variety of soils within the same theoretical framework. Also, since the rate-type equation of motion is precisely time-integrated, progressive failure will be analyzed as a nonlinear dynamic problem, and then generation and/or propagation of waves induced by shear bands formation will also naturally be developed in the analysis[4),5)]. Making use of this characteristic, wave generation induced by fault formation was focused on. When the ground was compressed from lateral faces by displacement control under plane strain condition, a reverse fault-like failure was generated as a progressive failure with strain localization (Figure 1). At that time, elastic energy accumulated on the non-destructive area at the compression stage was released at once. In the case of a horizontally stratified ground, as failure progresses rapidly, acceleration motion was reached to the max. at first motion and decayed exponentially with time in a similar way that artificial earthquake shows (Figure 2). On the other hand, in the case of a ground with initial random imperfections, as some small failure events exist in a large failure event, an irregular wave like a natural seismic wave was generated (Figure 3). On the other hand, when the ground with the initial random imperfections was extended from lateral side by strain control, a normal fault was generated and another irregular wave was generated.

1) Noda, T., Yamada, S., Asaoka, A. and Kawai, Y. (2014): Numerical simulation of shear bands formation in ground due to strike-slip fault, *Japan Geoscience Union Meeting 2014*, SSS31-08.
2) Noda, T., Asaoka, A. and Nakano, M. (2008): Soil-water coupled finite deformation analysis based on a rate-type equation of motion incorporating the SYS Cam-clay model, *Soils and Foundations*, **48(6)**, 771-790.
3) Asaoka, A., Noda, T., Yamada, E., Kaneda, K. and Nakano, M. (2002): An elasto-plastic description of two distinct volume change mechanisms of soils, *Soils and Foundations*, **42(5)**, 47-57.
4) Noda, T., Xu, B. and Asaoka, A. (2013): Acceleration generation due to strain localization of saturated clay specimen based on dynamic soil-water coupled finite deformation analysis, *Soils and Foundations*, **53(5)**, 653-670.
5) Asaoka, A., Yamada, S. and Noda, T. (2013): Numerical analysis of failure of soil ground due to surface loading and generation of vibration induced by the failure, *Japan Geoscience Union Meeting 2013*, SSS28-18.

Keywords: natural fault, reverse fault, seismic wave, strain localization, inertial force, elasto-plastic body

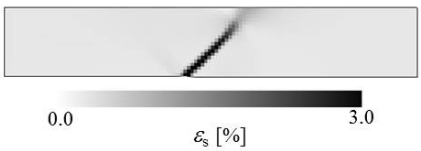

Figure 1. Reverse fault-like failure (shear strain distribution)

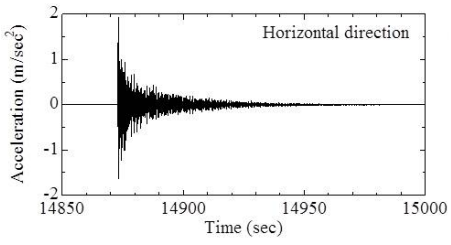

Figure 2. Wave generated in a horizontally stratified ground

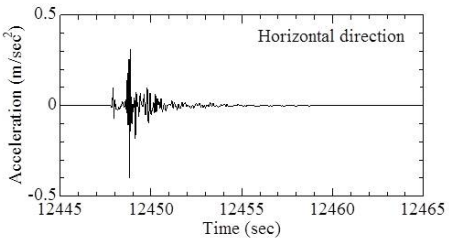

Figure 3. Wave generated in a ground with initial random imperfections