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

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The authors, in the past study\textsuperscript{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, \textit{GEOASIA}\textsuperscript{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\textsuperscript{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\textsuperscript{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 released 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.


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