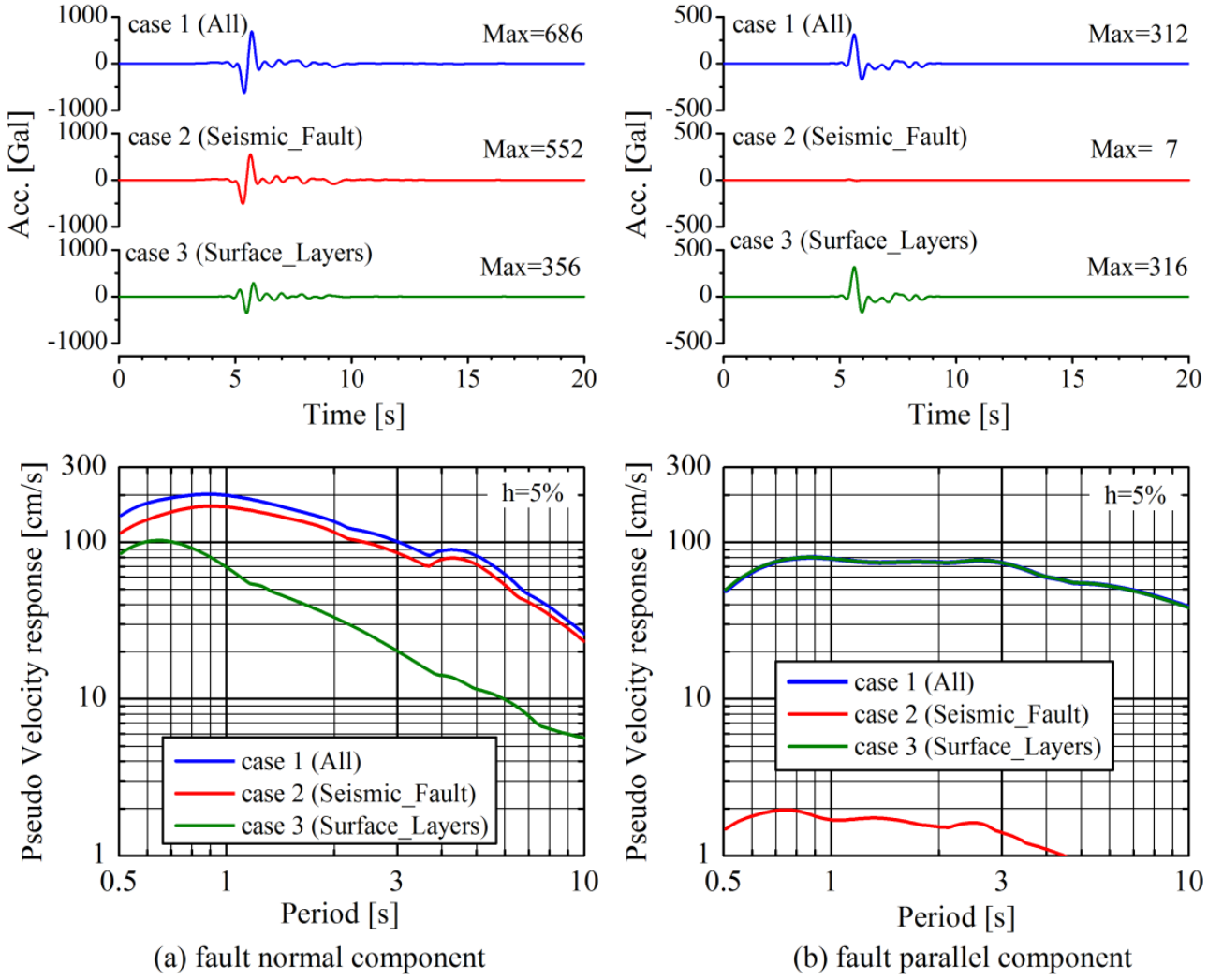
Proposal of Evaluation Method of Strong Ground Motions in Area Close to the Fault Trace

*Dan Kazuo[1], Kiyoshi Irie[1], Saruul Dorjpalam[1], Torita Haruhiko[1]

1. Ohsaki Research Institute, Inc.

In Japan, only the seismic waves radiated from the fault in the seismogenic layer under the surface layers are considered in the usual strong motion prediction (e.g., Headquarters for Earthquake Research Promotion, 2016). However, in the inland crustal earthquakes, the seismic waves radiated from the fault in the surface layers above the seismogenic layer could influence the strong ground motions in the areas close to the fault traces. Hence, we proposed an evaluation method of the seismic waves radiated from the faults in the surface layers in vertical strike-slip and dipping reverse faults to investigate their influence on the strong motions.
In this method, we synthesized the seismic waves by the wave number integration technique, using the slip-velocity time functions obtained from the dynamic fault rupturing simulation by the three-dimensional finite difference method. And we calculated seismic waves at two points 50 m and 2 km close to the fault traces as a demonstration (in this abstract only the results at the 50 m point will be shown). The used dynamic fault rupturing model was 25 km in length, with the surface layers of 3-km thickness, the seismogenic layer of 15-km thickness, and the slip-weakening law. We decided the model parameters under the constraints by three empirical relationships among fault parameters of the surface and subsurface faults.
As the results of the vertical strike-slip fault show, 80 to 90 % of the fault normal component of the seismic waves radiated from the entire fault was attributed to the seismic waves radiated from the fault in the seismogenic layer. Almost 100 % of the fault parallel component at the point 50 m close to the fault trace was attributed to the seismic waves radiated from the fault in the surface layers. At the point 50 m close to the fault trace of the vertical strike-slip fault, the seismic waves of the fault normal component were larger than those of the fault parallel component in the period range of 0.5 to 6 seconds.
Also, we evaluated the seismic waves radiated from the dipping reverse fault by the same procedure as that for the vertical strike-slip fault. As the results of the dipping reverse fault show, 100% of the seismic waves of the fault normal component of the seismic waves radiated from the entire fault at the point 50 m close to the fault trace were attributed to those from the fault in the seismogenic layer in the period range shorter than 3 seconds. The seismic waves of the fault normal component from the fault in the seismogenic layer decreased to about 70% of those from the entire fault in the period range longer than 3 seconds. On the other hand, about the seismic waves of the fault parallel component, the seismic waves radiated from the fault in the surface layers have similar amplitudes to those from the fault in the seismogenic layer. At the point 50 m close to the fault trace of the dipping reverse fault, the seismic waves of the fault normal component were larger than those of the fault parallel component in the entire period range of 1 to 10 seconds.

Keywords: strong motions, close fault, dynamic simulation



(a) fault normal component (b) fault parallel component

Comparison of the seismic waves of case 1 (All), case 2 (Seismic_Fault), and case 3 (Surface_Layers) at point A (fault distance is 50 m) from the vertical strike-slip fault