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Estimation of the bed rock fault angle of the earthquake fault which appeared in the 1999 Taiwan ChiChi earthquake using

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An active fault which develops in a plain is often covered with a weak surface stratum. A large-scale fault slip in the bed rock may propagate to a surface stratum, and will often generate the fault rupture on the surface, which is indicated by the generation of a shear belt in the stratum. Depending on the case, a fault slip will sometimes appear on the ground surface not as a shear belt but as a fault flexure. The stratum keeps its continuity without being disrupted by the underground shear belt.

It is impossible to evaluate the fault angle of the bedrock in the fault produced by the fault flexure because no shear belt was generated in the stratum. Nevertheless, it is essential to determine the fault angle of the bed rock in order to predict the character of future earthquakes. For example, the displacement of a fault is H/sin (S), where H is the height of the fault for one event scarp, and S is the fault angle of the bed-rock. The magnitude of an earthquake is proportional to the amount of displacement for one event (Matsuda 1975); therefore, the smaller the S, the larger the earthquake. Moreover, the determination of the fault angle of the bed rock is important for the estimation of the earthquake occurrence probability of active faults using Delta CFF (Coulomb Failure Function).

The September 21, 1999 Chichi earthquake in central Taiwan produced a 95 km long surface rupture (Chen et al. 2007).

Chen et al. (2007) excavated a trench in the earthquake surface rupture area (the Shijia site), and confirmed that the stratum forms a flexure. They also drilled boreholes near the earthquake surface rupture and found shear zones at two places. The shear zones assumed to be on the fault plane of the bed rock. Accordingly, two fault angles of the bed rock 25 and 49 degree estimated from the depth of the shear zones.

In the Shijia site, the stratum was silty sand. When simulating the deformation of sandy soil, it is necessary to take dilatancy into consideration (Johansson and Konagai 2007). Because, it is known that the material that forms the stratum sand or silt changes the appearance configuration of the fault scarp (Kawai and Tani 2003). Therefore, in this research, a simulation using the CIP (Constrained Interpolation Profile) method was performed considering the dilatancy of the stratum, and the fault angle of the bed rock was estimated by calculating the shape of the flexure.

The simulation program used in this research is SDSSC (The Stratum Deformation Simulation System using the CIP method). SDSSC is a program for calculating a deformation of the stratum (Ando 2012).

The fault angle of the bed rock and the maximum slip rate obtained for the Shijia trench were 49 degree and 1.25-1.5 m/s, respectively.

Keywords: stratum deformation simulation, ChiChi earthquake, surface rupture, fault flexure, CIP method, dilatancy