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Numerical analysis of the mechanical proprieties of an active creeping fault: example of the Chihshang fault, Eastern Taiwan

J.C. Lee (1), **K.J. Chang** (1), J.J. Huang (2) and M.L. Lin (2)

(1) Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan, ROC, (2) Department of Civil Engineering, National Taiwan University, Taipei, Taiwan, ROC (kjchang@earth.sinica.edu.tw)

The Chihshang fault is one of the most active segments of the Longitudinal Valley Fault, the plate suture between the converging Philippine and Eurasian plates in eastern Taiwan. During the last 25 years with instrumental observation, the Chihshang fault reveals a seasonal creeping behavior at a rapid rate of about 20-30 mm/yr. This fault exhibits a distinct seasonal variation with creeping steadily in rainy season and remaining locked during dry season of the years. By means of numerical modeling, using elastic and visco-elastic models, the fault geometry and the mechanical behaviors of the fault and its surround rocks, in the uppermost 140 m surface level are analyzed. By searching best-fits for the least residual mean values, we obtained an optimal model with the following parameters: 1) 15 m of unconsolidated covered deposits for the surfacial locked zone, 2) 45cX of the fault dip angle, 3) cohesion of about 40 KPa and friction angle of 9cX for the mechanical strength of the fault plane, 4) Young's modulus of about 24 MPa for the surrounding rocks, 5) Lateral earth pressure coefficient (k) is about 2.0. These results show that the Chihshang fault at the Chinyuan site has a relatively week mechanical strength, which is consistent with the fact of continuously surface creep. However, creep occurred only in wet seasons indicates the mechanical strength of the fault might become significantly stronger during the dry season when no surface slip occurred. The optimal model also indicates that a gentle anticlinal fold developed in the hanging wall of the fault and that the slip on the fault plane decreases gradually from depth toward the surface with near-zero slip in the upper 15-20 m. A back thrust associated with principal thrust is also suggested by leveling data. It is worth to note that the fault surface fractures on human construction distributed in a rather wide fault zone, that we interpreted as being due to a predominant anticlinal

fold structure in the hanging wall. It should be taken into consideration for mitigation against seismic hazards.