15th World Congress on Computational Mechanics (WCCM-XV)
8th Asian Pacific Congress on Computational Mechanics (APCOM-VIII)
31 July – 5 August 2022, Yokohama, Japan

Multiscale Modelling of Normal Fault Rupture-Soil-Foundation Interaction

Lifan Chen[1], Ning Guo[2*] and Zhongxuan Yang[3]

[1] College of Civil Engineering and Architecture, Zhejiang University, 866 Yuhangtang Road, Hangzhou, Zhejiang, 310058, China.
lifanchen@zju.eddu.cn
[2] College of Civil Engineering and Architecture, Zhejiang University, 866 Yuhangtang Road, Hangzhou, Zhejiang, 310058, China.
nguo@zju.edu.cn
https://person.zju.edu.cn/nguo
[3] College of Civil Engineering and Architecture, Zhejiang University, 866 Yuhangtang Road, Hangzhou, Zhejiang, 310058, China.
zxyang@zju.edu.cn
https://person.zju.edu.cn/zxyang

Key Words: *Multiscale modelling, finite element method, discrete element method, normal fault rupture, soil-foundation interaction*

A multiscale approach [1] that couples the finite-element method (FEM) and the discrete-element method (DEM) is employed to model and analyse the earthquake fault rupture-soil-foundation interaction (FR-SFI) problem. In the approach, the soil constitutive responses are obtained from DEM solutions of representative volume elements (RVEs) embedded at the FEM integration points so as to effectively bypass the phenomenological hypotheses in conventional FEM simulations. The fault rupture surfaces and shear localization patterns under normal faults with or without foundation atop have been well captured by the multiscale approach and verified with available centrifuge experimental [2] and numerical results [3]. By examining the responses and microstructural evolutions of local RVE packings, it is found that the RVEs located in- or outside the shear bands behave distinctly, and may change their stress states from initial at-rest to active in the normal fault case. The micromechanics study also sheds lights on the capability of heavy foundations in protecting the superstructure as a result of rupture surface diversion.

REFERENCES

[1] Guo, N. and Zhao, J.D. A coupled FEM/DEM approach for hierarchical multiscale modelling of granular media. *Int. J. Numer. Meth. Eng.* (2014) **99**(11) : 789-818

[2] Bransby, M.F., Davies, M.C. and Nahas, A.EI. Centrifuge modelling of normal fault–foundation interaction. *Bull. Earthquake. Eng.* (2008) **6**: 585-605

[3] Garcia, F.E. and Bray, J.D. Discrete element analysis of earthquake fault rupture-soil-foundation interaction. *J. Geotech. Geoenviron. Eng.* (2019) **145**(9): 04019046.