8th International Conference on Seismology & Earthquake Engineering
11-13 Nov. 2019, Tehran, Iran

NUMERICAL INVESTIGATION OF SURFACE FAULT RUPTURE HAZARD MITIGATION FOR SPREAD FOOTING

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Keywords: Fault rupture, Mitigation, V barrier

During earthquakes, both transient ground shaking and permanent ground deformation are produced. The fault rupture could arrive at the ground surface and threaten the safety of the potentially existing structures. This could have destructive effects on engineered structures and facilities. Recent earthquakes, such as the 1999 earthquake in Turkey and Taiwan, and the 2008 earthquake in China, have shown that faulting can cause extensive damage to different structures. Although surface fault rupture is not a new problem, there are only a few potential mitigation schemes in the world containing some type of provisions for reducing the risks. Fault setbacks or avoidance of construction in the proximity of seismically active faults are usually supposed as the first priority but with increasing demands on land use, avoidance is becoming more difficult and so it would be prudent to have a reliable strategy available for protecting building over fault zone.

This paper explores mitigation for protecting structures against potential surface fault rupture hazard. Although V-Shaped polymer layer has been previously used to reduce the seismic risk, in this research we use this mitigation for protecting existing or new buildings with spread foundations against potential reverse fault rupture hazards.

In this numerical modeling we adopted elastoplastic Mohr-Coulomb constitutive model with isotropic strain softening. In this numerical modeling placing a V-shaped polymer layer beneath the spread footing to reduce rotation and differential displacement of reverse fault rupture. Figure 1 shows the model geometry and position of the polymer layer, in which case the layer is considered below the structure and when the spread footing is located in the corner. It should be noted that in these analyses, the vertical displacement rates (Fault) of 1, 1.5, 2 and 2.5 m were applied to the model in a quasi-static manner in small steps, so that the effects of inertia will not affect the results. Besides, the angle of application of the fault in these analyzes is 60 degrees.

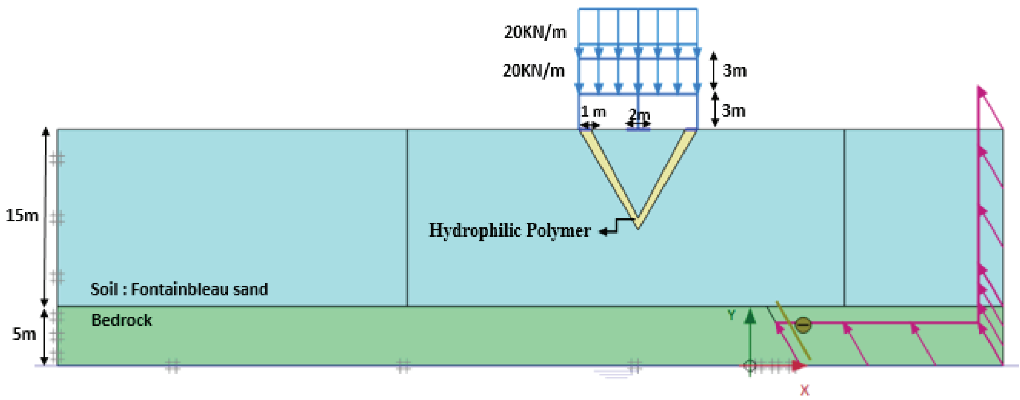

Figure 1. The model geometry and position of the polymer layer.

The results presented in Table 1 indicate that the polymer layer in this situation was able to significantly reduce rotation of structure compared to the state without the polymer layer, thus this mitigation performing well.

Table 1. Rotate of spread foundation with and without the polymer layer.

Fault Displacement (m)	Rotation of Footing without Polymer Layer	Rotation of Footing with Polymer Layer
1	2.35	1.39
1.5	6.07	4.25
2	9.19	7.13
2.5	10.16	8.13

If the conditions of a free zone of about 3 m are not possible on either side of the structure, then a polymeric layer can be used in this situation due to the numerical modeling results for spread footing on corner of structures. It should also be noted that this approach has also been successful in reducing the risk of surface faulting and has been able to reduce rotation of foundation.

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