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CENTRIFUGE MODELING OF FAULT RUPTURE PROPAGATION THROUGH DRY AND WET SAND BY USING A NEW SPLIT BOX

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Fault rupture propagation through the soil layers can have extremely influenced by soil type and its characteristics. The effects of intergranular water on fault rupture propagation can be investigated by physical models using 1g tests or centrifuge modeling. Existing of intergranular water in sandy soil can produce apparent cohesion. This virtual cohesion can be used in 1g physical models to investigate the effect of cohesion on fault rupture propagation through cohesive soil (Ahmadi et al., 2018). This effect cannot be negligible in 1g models due to its significant value in comparison with stress level of small scale models. In such a situation less amount of cohesion can also have large influences on fault rupture propagation so centrifuge modeling is the best method to study the fault rupture propagation through cohesive or wet soils. The stress level of soil layer in centrifuge model is equal to the prototype so there is no need to reduce cohesion in small scale model. As a result, cohesion of soil in small scale model is equal to its value in prototype. In real condition, it should be investigated that fault rupture can be influenced by intergranular water effects in granular soil or not.

In this study, geotechnical centrifuge of soil laboratory of International Institute of Earthquake Engineering and Seismology (IIEES) was employed to investigate faulting phenomena. This is the first study after assembling this centrifuge apparatus. A new split box was produced that can exert relative displacement to the soil layer. Dip angle of this split box is 90 degrees that can simulate a vertical faulting. The faulting was exerted to the model by using a steel shaft, connected to an electro motor. Centrifuge acceleration was chosen to be 40g that can model a 6 m soil layer (height layer of soil is 15 cm in model). 1.6 m vertical displacement (4 cm in model) was applied to the model. Split box has a dimension of 55 cm in length, 40 cm in width and 28 cm in height (Ahmadi, 2017). Figure 1 shows the centrifuge apparatus and split box that were used in current study.

Figure 1. Centrifuge apparatus and split box that was used in current study.

Two centrifuge tests were conducted. In one of them dry pure sand layer was examined. In the other one, 5% water was added to the soil to make a wet soil layer. Firoozkooh #161 sand was used for this study. Dry and wet tests were produced by using sand raining and wet tamping methods, respectively. Fault rupture propagation was captured during faulting and shear band formation was observed by using a PIV software that was developed at IIEES (Fadaee et al., 2012). Besides, required bedrock displacement that fault can outcrop (h_0) was measured and normalized by soil layer height (H). h_0/H parameter can be used for distinguishing between two tests.

Results show that the pattern of fault rupture was changed as it depicted in Figure 2. In dry sand different fault paths create during faulting that was captured by using PIV software. Different fault paths are widen the zone of distortion at the ground that was shown by W/H parameter (W is the width of distortion at the ground and H is the height of soil layer). Tension cracks are appeared in wet test due to apparent cohesion that was induced by intergranular water. However, h_0/H parameter are approximately equal for both of these tests. This shows that in this parameter, there is no difference between wet and dry sand in real condition; however; in other studies in 1g field (Ahmadi et al., 2018), intergranular water had a significant effect on h_0/H in comparison with dry test. Table 1 shows h_0/H and W/H parameter for wet and dry sand.

In conclusion, some differences between dry and wet tests were observed during faulting in centrifuge modeling such as the pattern of fault propagation, creation of tension cracks and width of distortion. However, in comparison with other studies (Ahmadi et al., 2018), the effect of intergranular water is less in real condition (that was investigated by centrifuge modeling) than 1g small scale models (that was investigated by 1g physical modeling) on fault rupture propagation.

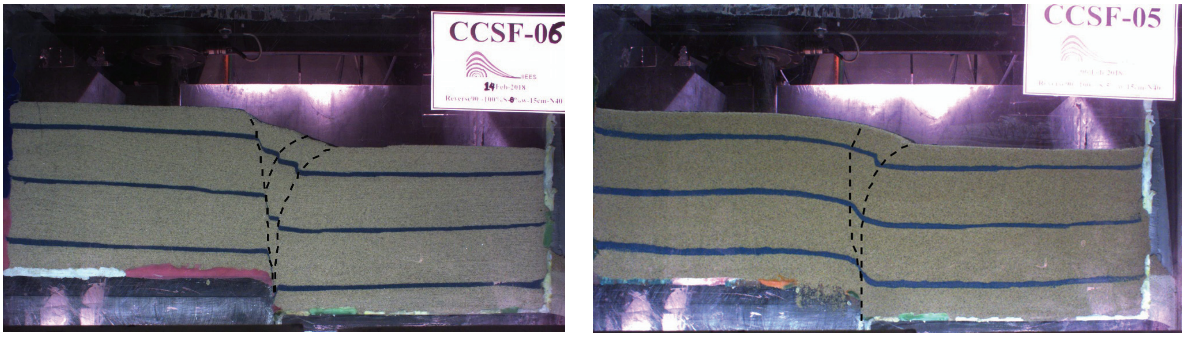

Figure 2. Shear band zone that was created by fault rupture through: Left) Dry sand; Right) Wet sand.

Table 1. h_0/H and W/H parameter for dry and wet sand

Parameter	Dry Sand	Wet Sand
h_0/H (%)	4.9 %	4.7 %
W/H (%)	67%	60%

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