THE EFFECTS OF SOIL THICKNESS ON REVERSE FAULT RUPTURE PROPAGATION

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During strong earthquakes fault rupture often propagate to the ground surface threatening the safety of existing structures. This could have devastating effects on structures overlying the faults such as what was observed in the Turkey and Taiwan earthquakes in 1999. These observations reminded the profession and researchers to devote more efforts on surface fault rupture hazard mitigation approaches and investigations.

Most building codes suggest using setbacks for mitigating damages caused by the effects of surface fault rupture, assuming that when rupture occurs, buildings are far enough away to avoid any damages. The aim of this paper is to investigate how thickness of soil layers can affect surface fault rupturing and to define the relationship between the position of the fault rupture on the surface (as shown in Figure1) and the thickness of soil layer. The conclusions reached in this research are based on physical modeling tests which were performed just under the normal gravity conditions.

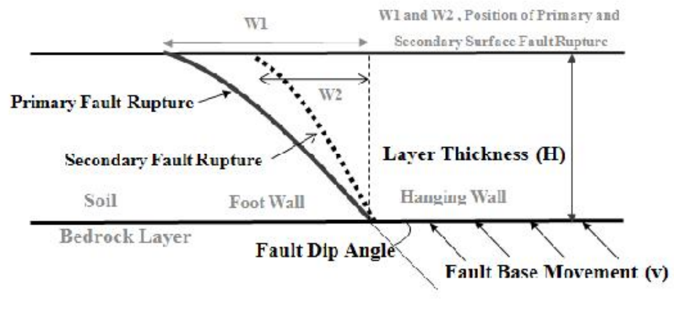

Figure 1. The geometry of model on 1-g physical modeling tests to determine the location of the surface fault rupture -the width of the affected zone- in soil layer over reverse faults

The 1-g physical modeling approach was adopted in this study particularly since the 1-g model tests were much more economic and accessible and also 1-g model tests could be reliable for the investigation of surface fault rupture propagation based on Moosavi et al. 2010. The device used for testing was designed in such a way that the reverse fault rupture events could be modeled along different dip angles. Two Plexiglas plates with a thickness of 5 centimeters were installed at each side of the box, perpendicular to the fault strike. to enable digital photography of the vertical section throughout the soil

(Figure 2). The testing investigated reverse fault rupture propagation with a dip angle of 45 degree through the bedrock in a quasi- static mode using a hydraulic piston beneath the moving floor.


Figure 2. The 1-g model tests apparatus (left) and the pluviation technique with an electric sand rainer (right)

After performing the four soil model experiments, both the effect of model height on the propagation procedure and the position of the fault rupture at the surface were scrutinized.

After measuring the position of the primary fault rupture on the surface (shown with W1 in figure 1), it was observed that by thickening the soil in the model, an increase in base movement is required for surface rupture to occur, in a normalized situation the two factors, position of the fault rupture on the surface and the base movement required for surface fault rupture occurring has a different process and as it can be seen in figure 3, it decreases similar to Tani et al. 1996.

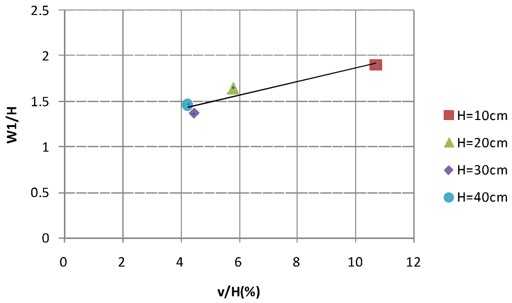

Figure 3. The relation between the position of the primary fault rupture on the surface (W1) and the required base movement (v)

When using setbacks and avoidance of construction near fault areas in order to stay safe against surface fault rupture we have to put in mind that thickness of soil may affect the position of the rupture on the surface, making the ground crack in areas that may cause devastation. When thickening the soil layer, the base movement required for surface fault rupture to occurring has an increasing process but in a normalized situation, the position of the fault rupture on the surface and the base movement required for surface fault rupture occurring has a reverse relation. It is observed that without consideration of the effects of soil thickness on surface fault rupture propagation, the setback provision does not give generally enough assurance for reverse faults.

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