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Comparison of two earthquake induced landslides in Northern Iran

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The paper presents a study of two problematic failed slopes in the Alborz mountain range of Iran triggered by a magnitude 7.4 earthquake that struck on June 20, 1990. This earthquake killed an estimated 40000 people, injured more than 60000 and left more than 400000 homeless. There was extensive damage and landslides in three Northern provinces of Iran and nearly all buildings in the Rudbar-Manjil area were destroyed. More than 100 landslides were triggered by the earthquake some of them catastrophic. Among them two landslides are well known because of their damages, sizes and behavior. The study looks at the morphology of reactivation of a pre-existing landslide (Rudbar landslide). In addition the paper investigates differences between two landslides (Rudbar and Fatalak landslides) such as their geology, geotechnical aspects, velocity, seismic response and morphology by making a Digital Elevation Model. The Fatalak landslide, with 800m length that killed more than 170 people occurred in weakly cemented, badly sorted and well rounded recent gravely sediments, whereas Rudbar landslide with the length of more than 2km happened in remolded silty and sandy sediments of Jurassic era. The average terrain steepness of the Fatalak landslide before the event was about 20o. Based on present study the Fatalak landslide is a retrogressive, sudden debris slide-debris flow. The slide simulation done during the present study shows the moving material had speed of more than 120km/h in its final stage. It is determined by photogrammetric methods and field investigation that the slide is contain of one stage and four segments. Conversely most of the terrain before the Rudbar landslide had about 12o slope angle. In contrast with the other landslide, the slide movement took place at about two weeks. However the highest part of the body with steepness of 20o and another escarpment in the middle of the body slid at the same time with the earthquake. Based on present study the slide contains of two

stages, three parts and nine segments. This retrogressive, reactivated landslide took place in mostly remolded silty and sandy Jurassic materials. Several evidences such as remoulded material in the intact part of the present Rudbar landslide, old bulges, bending of the Sefidrud River and big escarpments along gully drainages confirm that the area had been exposed to another landslide. The old landslide which is much bigger than the present one could have happened in crushed glacial sediments due to gully erosional features with the possibility of earthquake triggering. More cohesion, less steepness, and more influence of existing water in the landslide of Rudbar is the main reason for its slower movement compare to the Fatalak landslide. More field research is already suggested to distinguish gully erosional features in the area of the Rudbar landslide in order to prevent future mass movements. In addition there is a need to reinvestigate the Fatalak landslide in terms of possible previous landslide and finding similar failure potentials in neighboring terrains.