

Influence of slope cutting on failures induced by the July heavy rain, and the Iburi-tobu earthquake, 2018.

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Many cases of failure induced by slope cutting have been also reported in the past. Some examples are added here by the July heavy rain from June 28 to July 8 and the Hokkaido Iburi-tobu earthquake on September 6, 2018. In the July heavy rain, many slope failures occurred widely main in western part of Japan including Hiroshima, Ehime and Gifu Prefectures. The Iburi-tobu earthquake caused collapses in high density in the hilly area around at Atsuma Town, Hokkaido.

Case A (Hokkaido): a failure that 20 m in width and 50 m in length caused by the Iburi-tobu earthquake. It is smaller scale one in the many failures by the earthquake. Similar to many other cases, sliding surface is the base of Tarumai-d tephra (9ka) lying under 2.5 m from the earth surface. The slope toe has been cut about 3 m in height for a hut. As a result, inclined weak layer became to daylight in the cutting slope.

Case B (Ehime Prefecture): a 30 m wide failure occurred on an orange grove slope by the July heavy rain. It is initially surface failure 0.5 m in depth, although the secondary 2 m deep failure continued on the left side. A trail for working passes at the top of the failure, and a pipe for sprinkling was buried along the trail. Leaked water from the pipe might cause the initial failure, so many small gullies run from the top. Otherwise, groove into strongly weathered Cretaceous sandstone is possible factor of the failure.

Case C (Gifu Prefecture): a forest road shoulder composed of highly weathered Jurassic Hida Granite was collapsed 25 m in width. The failure occurred on a shallow valley slope and the road passes through the upper part of the slope in up-hill grade. Although this valley has only small catchment area originally, rain water was drained from upper neighboring valley through the road and flowed out to the road shoulder along small undulations on the road. This large quantity of water caused the failure. Involving catchment area was enlarged at least 8.5 times than before the road opened.

There are many sites needed slope cutting for architecture and civil structure and dense network of forest road is required for proper management of forestry and agriculture. However, any slope cutting causes hydrological and geomorphological changes despite of its scale. When large impacts like heavy rain or earthquake occur, modified landforms can be a factor of landslide. Slope failures are induced by daylighting of weak layer in the case A, and by flowing water in the upper part of slope in the cases B and C. Moreover, construction of the forest road made drainage area increase by capture of the upper neighboring valley in the case C. On the planning of slope cutting, appropriate design, construction and maintenance should be taken considering microlandforms, subsurface geological properties and structures.

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