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Structural Damages on Artificially Modified Hills around Sendai Caused by Earthquakes in 1978 and 2011

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Hills are typically modified by cutting the ridges and filling the valleys, thereby creating a flat terrain with least transport of soil. Most heavily affected houses are often located on the boundary between land cut and fill or on the land filled sites. The damages on houses on artificially modified hills were also prevalent in previous earthquake in recent Japan, after the 1978 Miyagi-ken Oki Earthquake (Murayama, 1980). The following is an early result of the preliminary fieldworks conducted in and around Sendai.

1) The contrast of damages between on the fill or on the cut/fill boundary and on the cut is very clear, as same as recent earthquakes in Japan.

2) The severest damages to houses and housing lots were caused by slide or subsidence (differential settlement) on the fill or on the cut/fill boundary. Those damages are observed more in the housing estates developed before 1970s, than in those developed after 1970s.

3) Some housing estates modified with shallower fills are damaged more than those with deeper fills. The tendency is observed in the housing estates developed before 1970s.

4) There are many cases that have damage both in 1978 and in 2011, and most of the cases have severer damage in 2011 than in 1978. Slaking of the filled material should be considered.

5) Newly built RC retaining walls (small walls around housing plots) are stronger than walls by CB or by stones.

6) Newly built houses with RC basement are tough, and they stay undamaged even against small ground failure on the housing lots.

Keywords: The 2011 off the Pacific Coast of Tohoku Earthquake, The 1978 Miyagi-ken Oki Earthquake, artificially modified land, ground damage, building damage