Experience on the Effects of Scouring and Hydrodynamic Forces on the Evaluation of Tsunami Felling Resistance Using Coastal Forest Model

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Coastal forests mitigate tsunami damage, but the 2011 Tohoku Pacific Offshore Earthquake tsunami inflicted severe damage on coastal forests in the affected areas. Efforts are now underway to establish healthy coastal forest zones with disaster prevention capabilities. Currently, the evaluation of tree resistance to windthrow—used as a growth target—primarily relies on results from tree falling tests similar to those for windthrow. However, during actual tsunamis, concerns exist regarding the effects of scouring of the forest floor and the impact of inundation on ground bearing capacity, in addition to hydrodynamic forces. These factors are not sufficiently reflected in current tsunami-induced tree resistance to falling tests.
To clarify the effects of scouring and hydraulic forces on tree fall, this study conducted uprooting tests in a sand-bed soil tank using 1/10-scale tree models with varying root system conditions. The parameters of the tree models were rooting depth (5 types) and diameter at breast height (3 types). The ultimate load causing tree fall was measured under both dry conditions and semi-submerged conditions induced by water flow. The results confirmed that the ultimate load under conditions where the trees were subjected to hydraulic forces and scouring within the channel was significantly lower than the ultimate load in the dry soil tank. This suggests that, in addition to the reduction in soil bearing capacity due to immersion, scouring is a significant factor severely compromising root system stability. These findings indicate the necessity of establishing a new evaluation method for wind resistance that accounts for the unique hydraulic phenomena associated with tsunamis.

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