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Effects of Slope Tree Planting for Green Geo-technology

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1. Introduction
The nature and effect of trees should be more positively evaluated as an engineering-works structural element, and it is considered to be necessary to utilize trees for stabilization of slopes. Here the effect of the slope reinforcement of tree roots, the slope collapse control of canopy by interception of rainfall, and the absorption effect of CO2 by the slope tree planting were studied.
2. The slope reinforcement effect of a tree roots
The slope reinforcement effect of trees which were planted during more than 12years, was examined on the slope of Miyagse-Dam located in Sagamihara-city, Kanagawa pref. This investigation was carried out by digging up the root system, and invasion situations of the root system into a base rock crack were visually investigated, and drawing-out resistance strength of root was measured on the site.
It was investigated that root systems grew within soils and reached the base rock-mass of the slope. The reached roots invaded into cracks of rock-mass.
The drawing-out test of 40 roots was carried out. The diameters of roots, the resistance strength were measured. The diameter of roots, resistance strength were from 1mm to 24mm from 20N to 1650N, respectively. The measured strengths suggested that the roots stabilize the plantation soils and that trees settled on the slope safely.
3. Slope collapse control effect of canopy by rain interception
In order to confirm the rain interception effect by the tree canopy, three rain gauges (R1, R2, R3) were installed around one trees, these rainfalls were compared with the rainfall without the influence of a tree canopy. The three rain gauges were installed from a trunk to R3 through R1, R 2, As a result, the rate of rain interception close to the trunk was large. The average rate of rain interception was about 40%. In the windy day, the decrease of the rate of rain interception was also checked. Consequently, the rate of slope safety was increased about 20% by the tree planting.
4. Growth of trees, and carbon dioxide fixation
About 70,000 nursery trees were planted on a large and steep rock slope (total planted area of 48, 000m2) in 1995. Sample investigations of the trees were performed in 2001 and 2007 in order to estimate such as growth rate and the rate of carbon dioxide fixation. As a result, the growth rate of the trees is much higher at the bottom part of the slope than at the upper part of the slope because the retention volume of the percolation water from precipitation is much larger at the former than at the latter.
The growth rate of deciduous trees is higher than that of evergreen trees, and the rate of carbon fixation per deciduous tree is higher than that per evergreen tree. The carbon dioxide fixation per unit area of the slope during twelve years from 1995 to 2007 is 0.43kgCO2/m2/year.
5. Conclusion
From a viewpoint on utilization of trees in engineering, the slope reinforcement effect of tree roots, the slope collapse control effect of canopy by rain interception, and the absorption effect of CO2 by the slope tree planting were evaluated quantitatively.
Although it was the result of being based on the limited investigation and limited data, the contribution to the slope stability by trees and the absorption effect of CO2 against global

warming were checked. From now on, for the improvement in reliability of this hypothesis data under various environment or conditions should be needed.

Keywords: slope stability, slope tree planting, canopy effect, root effect, carbon dioxide fixation