

NEW EPS CONSTRUCTION METHOD FOR GREENING SLOPES

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1. ABSTRACT

Lately, nationwide demand for preserving and living together with the natural environment has been increasing. For the EPS construction method as well, the wall structure that can be planted has been requested. This report states development process of the new EPS construction method applied for a timber road running through natural scenic points.

At this time, EPS construction method was adopted firstly because it turned out through the initial soil tests that the site was located on the inclined ground of collapse talus. Secondly, special consideration for protecting the natural scenic surroundings was required. The substitute of the conventional "H-shape steal + concrete plate" structure, in other words, a slope structure enabling revegetation has been developed.

This wall structure uses steel net called "slope unit." The unit contains soil and is attached with planting sheet with seeds inside so that the seeds could germinate from the wall. As for the soil, "light weight soil" is employed to reduce load to the base ground.

In addition to easy installment of EPS construction method, all materials used here are designed to be compact and light-weight, so they can be carried and installed by manpower. Therefore, this method can be applied without using a large construction machines even at sites with steep geographical features.

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2. INTRODUCTION

A method of embankment that uses expanded polystyrol blocks as lightweight filling material has been increasingly promoted at construction sites recently. This "EPS" construction method, whose main purpose is to reduce earth pressure, is mainly applied to construction sites at steep slopes where no strong bearing layers are expected to exist. In most of these cases where the EPS construction method is applied, bank walls are constructed mainly by H-shape steel and concrete plates. Now there is a forest road construction site in Miyagi Prefecture in the Tohoku District where the EPS construction method was employed. The method applied to this project is modified to allow slopes to be greened with plants. This paper presents how the method is applied to the project.

3. SELECTION OF METHOD

The project is construction of a forest road meandering through the middle of Mt. Aoasayama for a distance of some 12,840 m. Road engineers had to consider the fact that the road is in a prefectural natural park and that the bank of the road is visible from communities and public roads at the foot of the mountain. The road design therefore needed to allow the road to be blended into the surrounding natural landscape.

Construction work began from both the starting point and end point of the route and was fully completed in 2000. The modified EPS construction method was applied to part of the route where the slope gradient was approximately 50° or less. If the conventional filling method had been used, road construction would have needed a higher fill and a larger road structure. In addition, the project site was found by preliminary boring to have very soft ground with an N value of 5 or less (Table 1).

Considering these factors, four essential points were identified as criteria to choose the appropriate method. These were ① adaptability to unstable ground (that is, lightness in weight), ② constructibility, ③ economic efficiency, and ④ preservation of landscape. Some methods were compared as shown in Table 2 and the EPS construction method was chosen as the most appropriate. The "slope unit" idea that allows road banks to be greened with plants was also developed to ensure harmony of the road with the environment.

4. OUTLINE OF WORK

Use of H-shape steel and concrete plates as major building blocks for wall construction has been part of the EPS construction method applied so far in Japan. What characterizes this project, however, is that special walling units and soil, engineered to allow the banks to be greened with plants, were employed.

As shown in Fig. 1, reticulated steel nets, referred to as "slope units," are used for the project. Units are attached with planting sheets with seeds embedded inside. What is unique about these units are that once the units are installed on a slope, plants will grow out of the units to settle on the slope for greening effect.

Planting base and "light weight soil," which enhances water retention capacity, are filled into the back space between the slope units and EPS blocks. "Light weight soil" is an artificial soil based on recycled soil, fine grained waste soil generated from excavation and treatment of soil for bonsai planting and specially treated to have more particulate matter so as to have an aggregate structure, and then mixed with bark compost and other micronutrients. Light weight soil features about half the weight and about double the water holding capacity of ordinary soil, which allows plants to grow with a smaller quantity of soil than ordinary soil.

The EPS construction method requires no erection of H-shape steel or other supports and may be applied to the smallest possible area. Thus, it is applicable to a steep slope and yet greatly reduces the time of construction.

The method applied to the project has all the advantages of the typical EPS construction method and yet all materials used for the method are downsized for greater reduction in size and weight, which realizes easier manual transport and installation of the method. No large construction machine is necessary even when it is applied to steep geography.

5. CONDITION OF APPLICATION

- Installation of EPS blocks (Photo 1)
- Installation of sandbags embedded with seeds (Photo 2)
- Construction of superstructure (Photo 3)
- Growth of plants on the slope (Two months after installation) (Photo 4)
- Change with time (One year after completion) (Photo 5)

6. CONCLUSION

The embankment of part of the forest road, to which the EPS construction method was applied, is covered by an even growth of plants a year after application. Despite the steepness of 1:0.3, the light weight soil is firmly settled on the bank and the planting on the bank is being integrated into the surrounding vegetation. The light weight soil proved to be effective in landscaping.

As far as the progress of invasion of local plants, creeping plants have been vigorously spreading to the slope surface from underneath. Other than creepers, local herbage, such as Japanese pampas grass and mugwort, and bush clovers stand out. No additional nourishment has been provided since completion, which lessens the workload on the part of maintenance.

Greening of slopes is not achieved upon completion of work; growth of plants on the slopes takes time, which is the very purpose of slope greening. Eight kinds of seeds are generally implanted in the slope units, but the resultant vegetation turns out monotonous. It is therefore important to take into consideration eventual invasion of local plants into the bank surface covered with slope units. In this sense, one of the future tasks is to compare the artificial vegetation of the slope units with the surrounding environment and natural soil in terms of diversity of species.

Compared with the conventional EPS construction method, the modified EPS construction method applied to the project showed improved constructibility due to downsizing of the materials used.

It is necessary to further reduce material cost and endeavor to improve and promote the modified EPS construction method.

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Table 1 Evaluation for Bearing Layers

Strata	Confirmed thickness (m)	N value (average N value)	Reason	Judgment
Viscous soil layer	0.40 ~ 3.90	2 ~ 9 (5)	It is a viscous soil layer averaging about N 5 and is not strong enough as a bearing layer.	×
Volcanic mud flow layer	3.15 ~ 8.57	7 ~ 50/0 (43)	Average N is 43, but the value locally varies and decreases. It could be necessary to remove or reinforce by soil improvement these irregular spots.	△
Andesite layer	3.20 ~ 5.40	50/0 (50)	The soil is 50 or more in N and has a stable bearing capacity enough to serve as a bearing layer.	○

○ Expected to serve as a bearing layer △ Requires review × Inappropriate as bearing layer

Table 2 Comparison of Methods

	Wall reinforcement	EPS light weight soil method (concrete plate wall)	EPS light weight soil method (slope greening possible)
Section			
Characteristics	<ul style="list-style-type: none"> Requires a large volume of fill Large loads imposed by fill Slope greening possible Requires much excavation 	<ul style="list-style-type: none"> Bank is made light in weight Requires less excavation Heavy equipment necessary to install H beams and it takes many days to drive beams Slope greening impossible 	<ul style="list-style-type: none"> Bank is made light in weight Requires less excavation Requires no H beams or heavy equipment for driving beams Shorter term for completion Slope greening possible
Adaptability	x	△	○
Constructibility	x	△	○
Economic efficiency	○	x	△
Preservation of landscape	△	x	○
Total evaluation	x	△	○

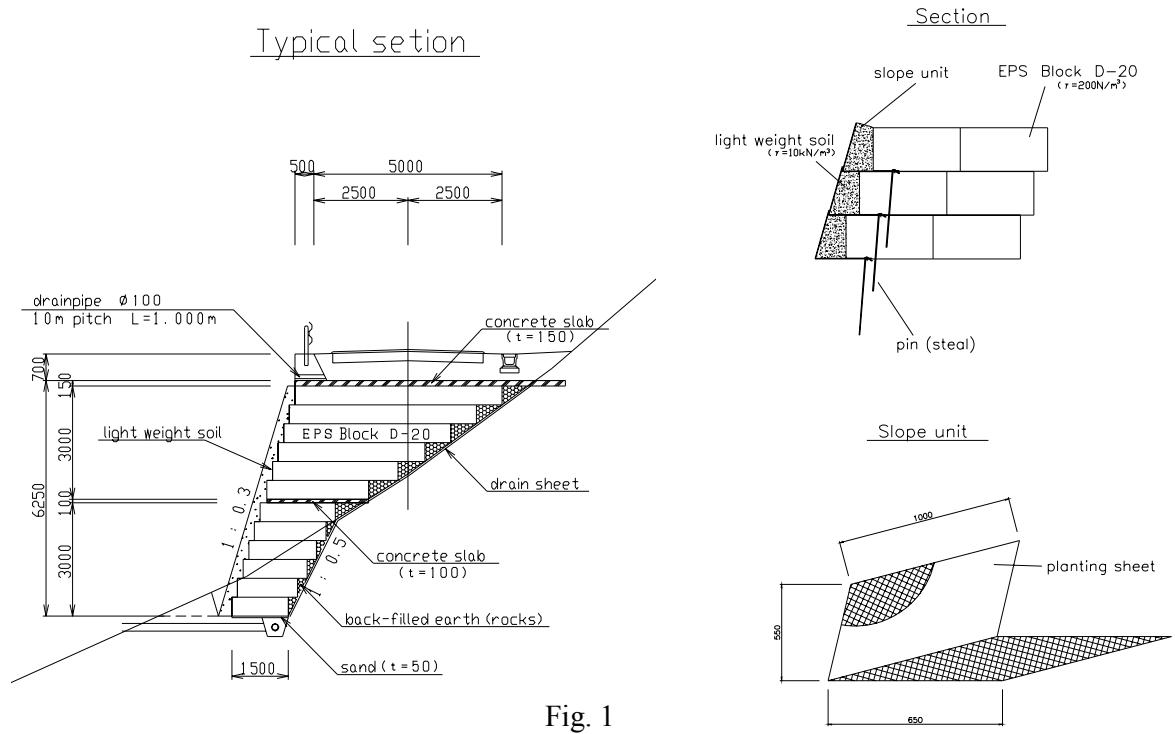


Fig. 1



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5