RESEARCH PAYS OFF

Lightweight Wood Fiber Material Used for Embankment

Washington State Department of Transportation

State highway agencies often face the challenge of constructing transportation facilities over highly compressible soft foundation materials. Not only are there engineering problems to overcome, but these foundation materials are inevitably found in wetland areas that are highly sensitive environmentally. Therefore, construction over this soft material is undertaken only when it is unavoidable and even then with appropriate mitigation measures to protect or enhance the surrounding environment.

Problem

In 1986 the Washington State Department of Transportation (WSDOT) planned to construct a portion of a new highway (spur of SR-109) partially across a wetland in a coastal area of western Washington. The new 2.86-kilometer portion of the two-lane highway begins near Hoquiam and extends northeasterly to SR-101 (Figure 1).

The surficial layer of the foundation soils in the project area was of very soft and compressible organic sandy silt. This soft material raised concerns about the settlement and stability of any fills. A creek, whose water level is controlled by the tidal action in Gray Harbor and winter rainfall, flows through the project site and causes frequent flooding--creating the potential for fill-effluent to pollute the water near the project.

After WSDOT examined several possibilities with respect to settlement, stability, and environmental problems, it studied three options in detail, including a provision requiring the replacement of wetlands when damage could not be avoided. The first option was construction of a bridge supported by a deep foundation system costing $1,700,000. The second option was ground improvement using "stone columns" at an estimated cost of $1,500,000. The third option, which was based on previous research and study of other applications, was to use wood fiber as lightweight fill material over soft ground and to reinforce it with geotextile because of the large required height for the fill. The last option was ultimately chosen, and the actual cost was $972,221.

Solution

Wood fiber fill was initially used on SR-101 to repair a landslide that had destroyed a section of the roadway in 1972; and WSDOT constructed 20 more fills between 1973 and 1986. The performance of the existing fills was evaluated on the basis of quality of the wood fiber fill, quality of the effluent, and condition of the pavement. More than half of the material samples obtained from fills of various ages were found to be fresh or nearly fresh, and none was completely decomposed. This proved that adequate soil cover--0.6 meter in the projects studied--would properly protect and ensure the longevity of the fill material. In all but one case the quality of pavement over the wood fiber fills was better than that in the surrounding area. Finally, samples of surface water obtained near the fills did not show any harmful effects from effluents.

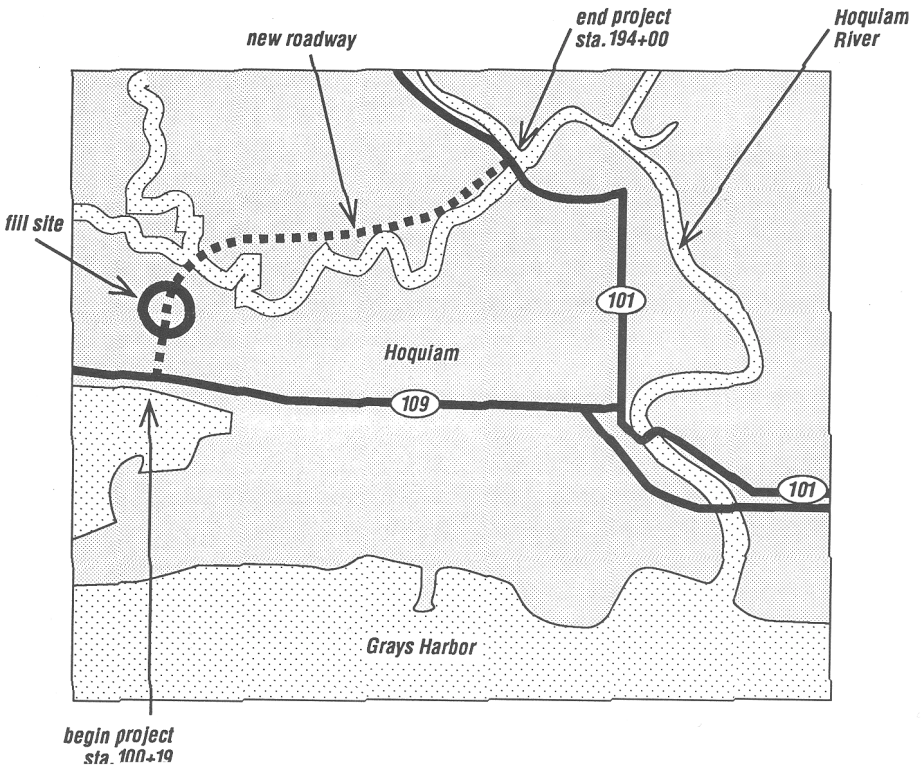


Figure 1 Project vicinity map.

Application

For the SR-109 spur project, design and construction of a wood fiber fill was planned, taking into account evaluations of rotational slope stability and bearing capacity failure, expected fill settlement, and the area of affected wetland. From an initial analysis, a combination of lightweight wood fiber fill, controlled rates of construction, and geotextile reinforcement was selected. Furthermore, environmental concerns dictated that the wood fiber had to be above the mean high water level to prevent alternate wetting and drying that could result in decay of the wood fiber and short-term leachate concentrations. Hence, the bottom 1.5 meters of the 13-meter-high, 180-meter-long fill would be constructed with silty gravel sand (Figure 2). Construction of the fill to the subgrade level was completed in September 1987. Paving began in November 1988.

In 1992, samples from the 5-year-old wood fiber fill exhumed from beneath the 0.6-meter topsoil cover were found to be nearly fresh. Despite the traffic of predominately logging trucks, the pavement showed no distress. Water samples taken near the fill showed no negative impacts from any leachates.

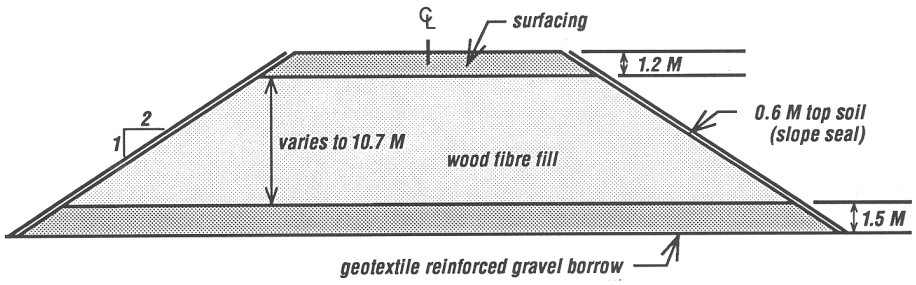


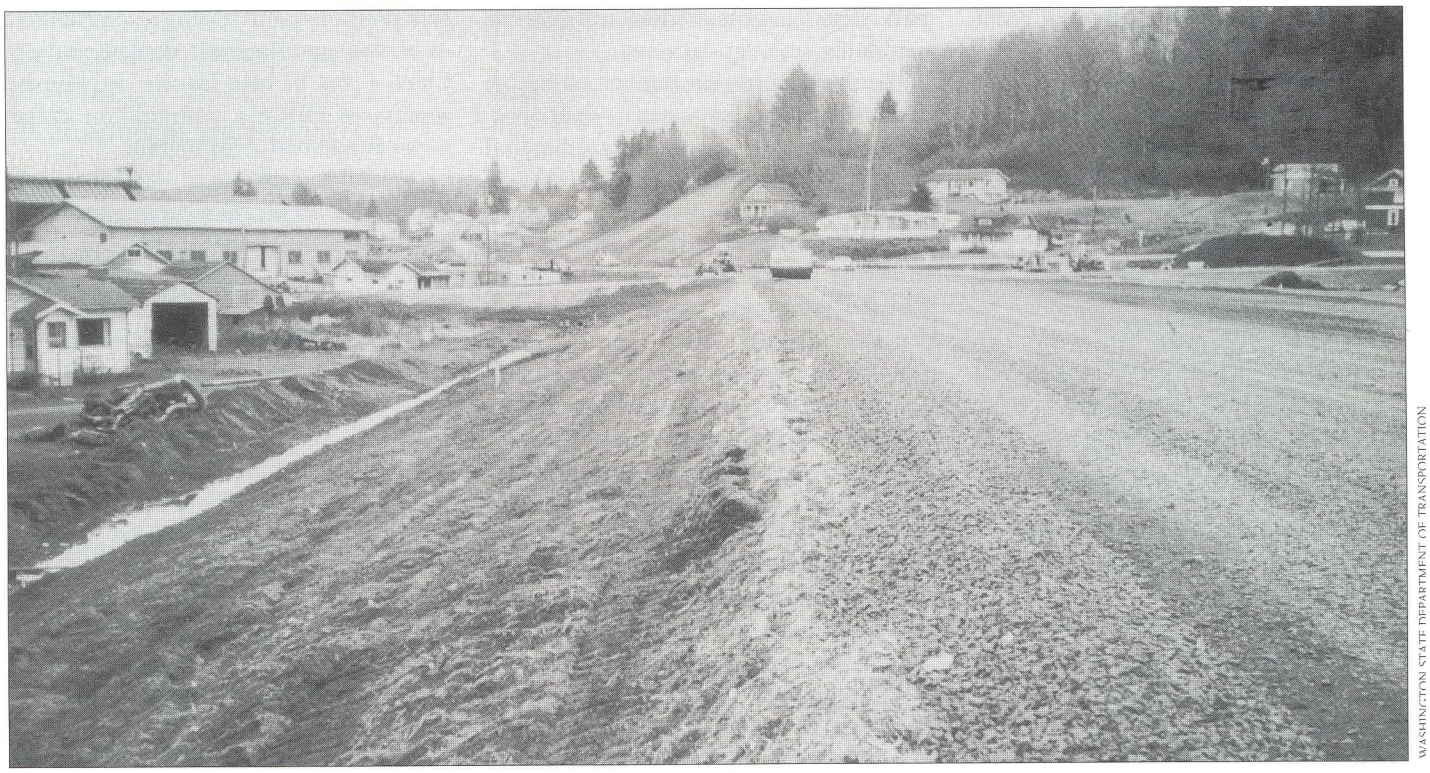
Figure 2 Design cross section for reinforced wood fiber fill.

Benefits

WSDOT demonstrated a new application for a readily available local material. Agency personnel and others involved in the project gained invaluable experience and knowledge in designing and constructing cost-effective lightweight fill. In addition, a conservative estimate of savings for the Hoquiam project ranges from $500,000 to $700,000 over the other two alternatives studied. The previous 20 wood fiber fill projects have provided additional savings. WSDOT plans to use wood fiber as fill material on appropriate future projects that have potential for more savings.

For further information, contact Alan P. Kilian (206-753-7111) or Tony M. Allen (206-753-7099) of WSDOT, P.O. Box 47365, Olympia, Washington 98504.

Suggestions for "Research Pays Off" topics are welcome. Contact Crawford F. Jencks, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 (telephone 202-334-2379).



Wood fiber fill construction in Raymond, Washington.