

THE USE OF EXPANDED POLYSTYRENE AS A LIGHTWEIGHT FILL ON INDIANA S.R. 109

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BACKGROUND:

The design and construction of a highway embankment over deposits of peat and muck is difficult due to low shear strengths, high compressibilities and excessive amounts of creep associated with these soil types. Large deposits of peat and muck are located within the northern part of the State of Indiana. The two major problems associated with these soil types are shear failure and compressibility. Total settlements, differential settlements and shear failure all occur over a long time which compounds the problems. Due to low shear strengths, shear failures occur very easily either during or after construction. The corrections to these problems are both expensive and time consuming.

For the Indiana Department of Transportation, maintaining state routes on peat bogs and other soft soils has always been a problem due to the persistent settlement, horizontal movement, and shearing (cracking) of the roadway. In late 1994, this same situation was faced on S.R. 109 in Noble county. The existing ditch line was realigned, flattening the side slopes, but this did not alleviate the problem. Soon after construction, shear cracks in the pavement and movement of the side slope began to reoccur. Eventually, a large crack developed in the pavement, and settlement was noticed which forced INDOT to close the roadway to vehicular traffic.

GEOTECHNICAL INVESTIGATION:

INDOT's Geotechnical section was given the task to search for a more viable solution to this recurring problem. A subsurface investigation was performed, and a profile of the subsurface soils was drawn. It was determined that the peat bog was a maximum of 38 feet deep. The most obvious solution was to reduce the load if possible. However, other considerations made it necessary to raise the profile grade up to 32 inches. Other methods like total removal and replacement of peat, load transfer to firm ground, and soil modification or remediation, etc., were also considered, but were believed to be too expensive.

DESIGN:

INDOT's Geotechnical section after evaluating all possible solutions, took the initiative, recommending the use of "EPS" as a lightweight geosynthetic embankment material to be placed underneath the

pavement in order to raise the grade, and reduce the load on the unstable soils. INDOT's Design section and Geotechnical section incorporated the design of the "EPS" roadway embankment, with information collected from the manufacturer of this material and other sources. FHWA is acknowledged for supporting and sponsoring this experimental project.

An 1100 foot section of S.R. 109 was designed to include Expanded Polystyrene as embankment fill over soft silty clay, silty loam, peat, and marl. To design this roadway using "EPS" foam blocks, it was necessary to predict the highest ground water level likely to occur in order to balance the buoyancy forces, and insure that the "EPS" fill would not float the pavement. INDOT's Hydraulic section provided a Q100 flood elevation, and this was taken as the high water level for this particular area. INDOT's Geotechnical section prepared the specifications for the use of EPS foam on this project and provided technical support during construction of the embankment.

CONSTRUCTION:

"EPS" foam was placed in 4 foot wide blocks with a maximum thickness of 40 inches and a maximum length of 16 feet. The density of the "EPS" foam used on this project is 1.5 pounds per cubic feet. Some of the blocks were placed on a leveling layer of B-borrow. Mostly it was placed in two layers with staggered joints. A 4" thick reinforced concrete slab was poured in-situ on top of the "EPS" blocks, and this was overlaid with 16 inches of #8 stone, then 13 inches of bituminous pavement. The construction of this project was done by Geiger Developing, Inc. under the supervision of INDOT's Fort Wayne District.

CONCLUSION:

Placing "EPS" foam blocks is much faster than placing other fill materials, because no compaction is necessary. An 8.3 cubic yard block of "EPS" may be placed manually with a small dolly, because the block weighs 300 pounds. Heavy hauling equipment is not necessary. It took a small crew only eleven working days to place 6156 cubic yards of "EPS" blocks without heavy equipment.

In the United States, the use of Expanded Polystyrene Foam (EPS) as a lightweight roadway fill material is very recent, and is limited to a few particular applications. It is a big leap for the State of Indiana to use this state of the art material and technology on a state road. This is the largest project in the United States to use "EPS" in this way, and Indiana is the third state in the United States to use "EPS" as a roadway fill.

Post construction monitoring is being done by INDOT's Geotechnical Section to evaluate the performance of Expanded Polystyrene (EPS) as a lightweight roadway fill.