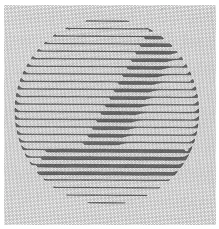
RESEARCH PAYS OFF



Laboratory tests at NYSDOT prove wick drains cheaper and easier to install

Wick Drains Gain Acceptance

One of the major concerns in geotechnical engineering is the settlement that occurs over time when a highway embankment, bridge, or building is built on compressible soil. The magnitude and rate of settlement are of concern for engineering as well as economic reasons. If 12 inches of embankment settlement occur over a period of 20 years at a pile-supported bridge abutment, it is not considered a major problem because no early, frequent asphaltic patching would be required at the bridge approach. However, the reverse would be true if settlement took place within a few years after construction.

Several methods of treatment have been commonly used to control settlement, for example, waiting periods, surcharges, and increasing the rate of foundation settlement. Traditionally sand drains—vertical columns of sand—have been used to increase the rate of foundation settlement in problem areas. With the introduction of geotextiles into geotechnical engineering, prefabricated, or wick, drains have been developed as a substitute for sand drains. Wick drains are porous geotextiles wrapped around a plastic drainage core 3 to 4 inches wide and ¼ to 3/8 inches thick. The geotextile allows water to enter the core and flow vertically through the core to a drainage blanket. The benefits of using wick drains rather than sand drains include ease and speed of installation, lower material cost, and lower overall cost, even though comparatively more of them are needed.

Problem

In the early 1980s, as more wick drains were being introduced on the market, there were no standard methods of evaluating or comparing the effectiveness of various types of drains. Because of this, it became necessary for the New York State Department of Transportation (NYSDOT) to develop such a test program. Following New York's lead, other states are conducting similar investigations.

Solution

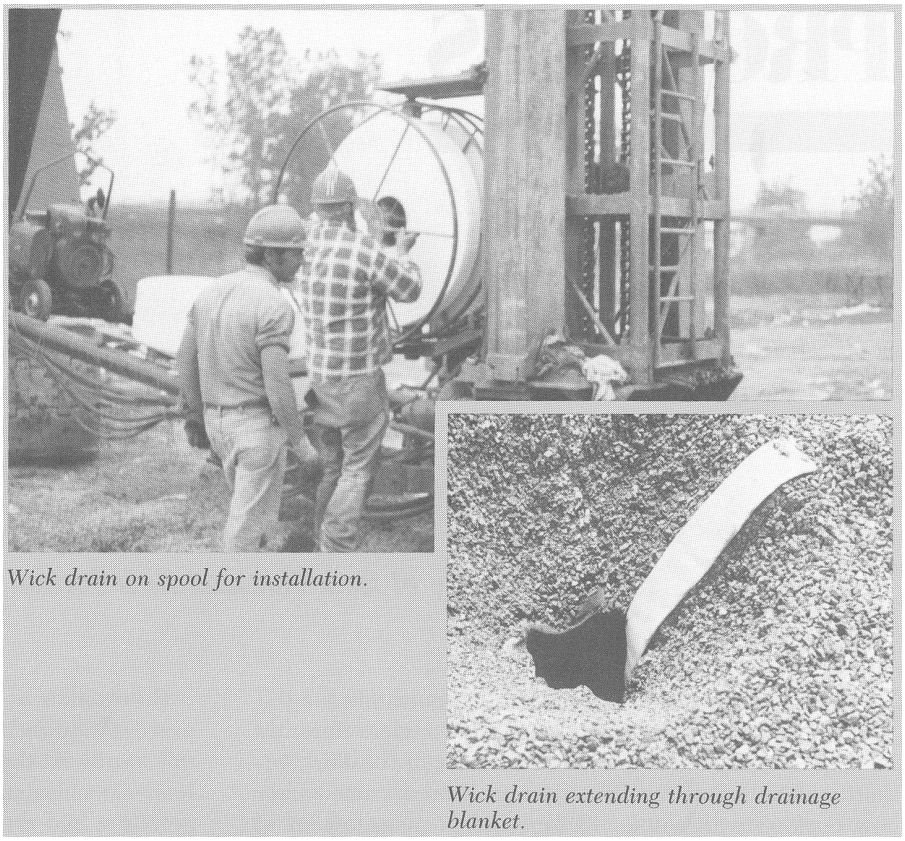
In 1983, the NYSDOT Soil Mechanics Bureau undertook an in-depth research program to determine the effectiveness of wick drains. The program consisted of three different tests—a large diameter consolidation test, a crimp test, and a lateral pressure test—developed in the Bureau's Soil Mechanics Laboratory. Following completion of the laboratory test program, the Bureau completed an evaluation of the theoretical effect of friction on the flow capacity of the wick-drain cores.

The results of this testing program were used in New York State to design wick drains on three different projects with different soil conditions. Two of the projects were built, with considerable savings over conventional alternatives. The third project was not built but would have also resulted in considerable savings.

The first phase of the testing program consisted of performing consolidation tests in the laboratory using remolded organic silty clay from the proposed Westway Project in New York City.

The results of this testing program revealed areas that needed further investigation.

1. When the consolidation testing system was dismantled, one or more crimps or bends were found in the stiffer wick drains. The crimps were caused by consolidation of the soil sample. A program was developed to investigate the effects of crimps on the performance of the wick drains under laboratory and field conditions. The investigation concluded that crimping alone did not affect the performance of the wick drains.
2. Some of the wick drains have thick geotextile core coverings and nonrigid cores. The test program showed that lateral pressure alone seriously affected the performance of the nonrigid-core wick drains.
3. The effect of different soil types on the performance of the wick drains was also investigated. The types of soil tested appeared to not significantly affect the rate at which the soil is drained.



Wick drain on spool for installation.

Wick drain extending through drainage blanket.

Application

The two projects that were constructed using wick drains were located in central New York State, one near Utica and the other near Syracuse. The soil profile studies in these two areas had indicated significant thicknesses of water-saturated compressible soils. Given the high cost of conventional foundation treatments, such as light weight fill, excavation and back fill, berms, or slope flattening, the use of wick drains was investigated.

On the basis of the results of the laboratory test program, the criteria used for accepting wick drains were that their net core flow capacity must exceed the volumetric flow rate of water from the soil and that the wick drain must drain the soil at the same rate as a 38-mm-diameter sand drain at the same spacing. The contractor chose to use a wick drain that showed an equivalent sand drain diameter of 50 mm and a net core flow capacity of 18 cm^3/s.

Benefit

An investment of about $25,000 in time and equipment in the laboratory test program resulted in a specification containing an approved list of wick drains based on properties in which the NYSDOT had confidence. One consequence of the test program was the rejection of nonrigid-core wick drains.

The savings realized in the Utica and Syracuse projects by using wick drains as the drainage medium were approximately $400,000. In contrast, conventional sand drains would effect savings of only $100,000. Besides the dollar savings, however, the use of wick drains enabled construction of these two projects within their established time schedules.

Suggestions for "Research Pays Off articles are welcome.

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