Michigan Department of Transportation - M•DOT

Mates

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PREFABRICATED DRAINAGE SYSTEMS (PDS)

Our pavement design specifies highway edge drains used by the Michigan Department of Transportation in most regions of the State. Their purpose is to prolong pavement life by removing water from under it. In the past, we have generally used trench drains where a 4 or 6-in. diameter perforated pipe is placed in a trench and backfilled with drainable sand or pea-stone. In the mid 1980s, we began to use some geocomposite drains (prefabricated drainage systems or PDS) which are normally composed of a plastic drainage pipe or flat section with a geotextile wrap. Use of PDS has greatly increased since 1988.

During that period, the projects have included simple overlays, rehabilitation of pavements, and complete replacement of pavements. These include crack and seat, break and seat, rubblizing of concrete pavement, recycling of concrete pavement, and reconstruction. It was not known whether the PDS would function successfully in all of these situations.

In February 1992, the Monsanto Co. offered to inspect various installations of PDS covering a period that began in 1985. This offer provided an opportunity to specifically investigate and address the issue of how these systems were functioning in a variety of locations around the State.

Based on information from the Districts describing 41 construction projects on which PDS had been used, 16 projects were selected for inspection and evaluation. The number of sites inspected on each project ranged from three to six. The projects chosen provided a good representation of construction projects using different rehabilitation techniques that had used PDS. The types of PDS (all with geotextile covering) are described as:

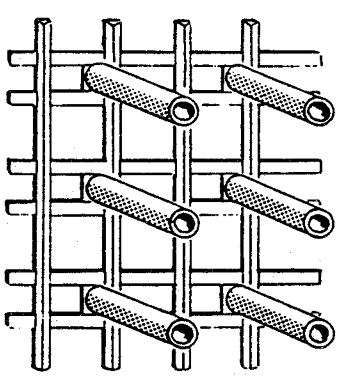
1) single hollow column core (columns on one side of core only),

2) molded single cuspated core (cuspids on one side of core only),

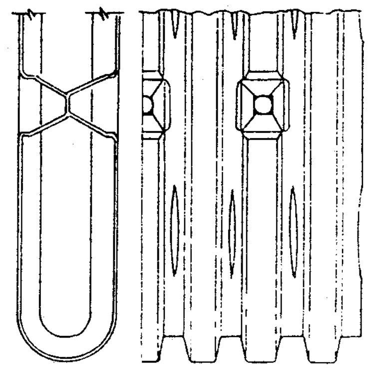
3) molded double cuspated core (cuspids on both sides of core),

4) continuous tubular support core.

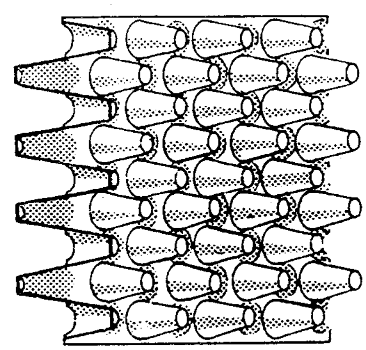
Figure 1 illustrates these four types.



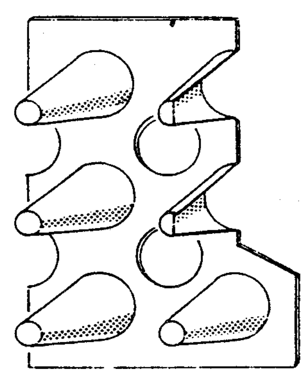
SINGLE HOLLOW COLUMN CORE.



CONTINUOUS TUBLAR SUPPORT CORE.



MOLDED DOUBLE CUSPATED CORE.



MOLDED SINGLE CUSPATED CORE.

The projects ranged from the oldest installation of PDS (1985) to some of the newest installations. The inspection and evaluation were conducted July 13 through 24, 1992.

The prefabricated drainage systems that were inspected were:

1) Monsanto 'Hydraway' (single hollow column core with a needle-punched non-woven polypropylene geotextile (filter fabric) over the core),

2) Contech Strip Drain (a molded single cuspated core with a needle-punched non-woven polyester geotextile over the core),

3) Pro-Drain 'PDS 20 and 30' (double and single molded cuspated cores, respectively, and both use a needle-punched

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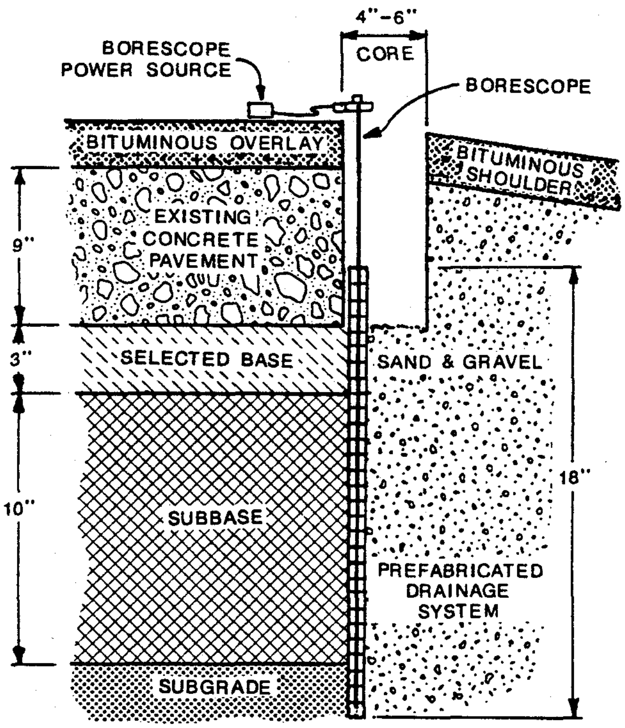
non-woven geotextile over the core),

4) Advanced Drainage Systems 'AdvanEDGE' (a continuous tubular core with a heat-bonded non-woven polypropylene geotextile over the core),

5) Hitek 20 (a molded double cuspated core with a heat-bonded non-woven polypropylene geotextile, which has been discontinued), and

6) American Wick Drain "Akwadrain' (a molded double cuspated core with a needle-punched non-woven polypropylene geotextile over the core (in 1987), which now uses a single cuspated core with the same fabric).

The inspection of the PDS was performed using a borescope. It consisted of coring a 4 to 6-in. hole above the PDS and inserting a fiber-optics probe inside the drain (Fig. 2). The probe permits viewing of the interior of the core. If the borescoping is done in the rain or shortly after a rainfall, one should see water droplets passing from the geotextile into the core and flowing at the bottom of the PDS. If it is not raining, soil staining can be observed on the fabric and also on the core showing varying concentrations of previous water flow. Visual observations are also done at the outlet. Typically, there may be evidence of erosion at the end of the outlet, which would not be present if the outflow is stable or not concentrated. At some of the locations where the borescoping was done, permanent view ports were installed for future inspection.



TYPICAL CROSS SECTION SHOWING INSERTED BORESCOPE
FIGURE 2.

The personnel and equipment to do the borescoping were provided by the Monsanto Co. and the District Offices provided personnel and equipment for traffic control and coring.

In general, the inspection revealed that the PDS systems are working well. The expected staining of the core was observed indicating previous water flow and the height of the water flow levels in the core. The soil stains on both the fabric and the core indicated that the heaviest concentration of water flow was 3 to 4 in. from the bottom of the PDS (the PDS was either 12 or 18 in. high). Minimal infiltration of fines into the core was observed. Inspection of projects where the existing pavement had been rubblized, or where asphalt stabilized crushed concrete had been used as open graded drainage course, revealed no evidence in the core of calcium carbonate precipitate from the rubblized pavement or the crushed concrete as reported by some other DOTs. Without stabilizing crushed concrete used in an open graded drainage course with asphalt or asphalt emulsion, calcium carbonate leachate occasionally has been observed. This is serious as it can plug the PDS fabric and severely impede its draining ability. Further, there was no evidence that the geotextile had been clogged by the precipitate (i.e., the filter fabric becoming completely covered and/or saturated with precipitate, soil fines, etc., allowing little or no flow through the fabric). However, the filter fabric was heavy with soil fines at some of the locations and at two or three of the locations the filter fabric appeared to be completely clogged by soil fines. There was some bending over of the top 1 to 2 in. and there was some 'J-ing' (the curving up of the bottom of the PDS) both caused by construction installation methods (Fig. 3).

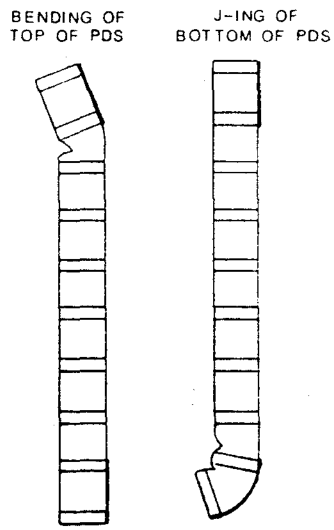


FIGURE 3.

Some problems observed were:

1) the PDS had not been placed to proper grade and to proper position in the trench during construction to ensure that the water would flow through the PDS to the outlet pipe,

2) the outlet pipes for the PDS were not placed to proper alignment and grade to provide a positive outlet for the water into roadside ditches,

3) the outlet pipes were not kept clean during and after construction to provide an unobstructed outlet for the water collected by the PDS,

4) there was a lack of marking of the location of the outlets so that they could be easily found and the outlet maintained, and

5) the ditches had not been kept clean to provide an unobstructed outlet for the discharge water.

Monitoring the performance of the PDS will continue at the locations where the permanent view ports were installed. Special effort will be taken to observe if, over time, there is any formation of the calcium carbonate precipitate on the fabric or a build-up of the precipitate in the bottom of the PDS. For the moment, these particular prefabricated drainage systems are functioning when properly installed and maintained.

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