INSPECTION AND PERFORMANCE EVALUATION OF PREFABRICATED DRAINAGE SYSTEM (PDS)

MDOT
Michigan Department of Transportation

CONSTRUCTION AND TECHNOLOGY DIVISION
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MICHIGAN DEPARTMENT OF TRANSPORTATION
MDOT

INSPECTION AND PERFORMANCE EVALUATION OF
PREFABRICATED DRAINAGE SYSTEM (PDS)
IN COOPERATION WITH MONSANTO COMPANY

Final Report

V. T. Barnhart

Testing and Research Section
Construction and Technology Division
Research Project 92 TI-1616
Research Report R-1341

Michigan Transportation Commission
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Lansing, October 1998
**Title and Subtitle**
Inspection and Performance Evaluation of Prefabricated Drainage System (PDS) in Cooperation with Monsanto Company

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**Abstract**
This study involved the investigation of geocomposite drains (Prefabricated Drainage Systems (PDS)) that were installed on construction projects that included crack and seat, break and seat, rubblizing, recycling PCC, concrete overlays and reconstruction, as underdrains, to evaluate the performance of the PDS.

The study concluded that the PDS is performing well. While there was some evidence of J-ing of the bottom and occasional bending over of the top of the PDS, these factors did not appear to obstruct the flow of water through the system. In general, the filter fabric and core were clean except for some insignificant staining of the fabric and core. There was no evidence of calcium carbonate precipitate found in the core or on the filter fabric of the PDS on the project sites where the concrete pavement had been rubblized or where untreated crushed concrete or asphalt treated crushed concrete was used as the open-graded drainage course.

Further investigative research should continue to determine the long term performance of all underdrains where the Open-Graded Drainage Course (OGDC) is used in conjunction with a dense-graded aggregate or geotextile separator.

**Key Words**
PDS, underdrains, filter, fabric
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EXECUTIVE SUMMARY

This study\(^1\) involved the investigation of geocomposite drains (Prefabricated Drainage Systems (PDS)) that were installed on construction projects as underdrains throughout the state from 1985 through 1992 to evaluate the performance of the PDS. The Monsanto Company participated with the Department in the inspection.

The types of projects where PDS was installed include pavement rehabilitation and complete pavement replacement, including crack and seat, break and seat, rubblizing, recycling PCC, concrete overlays and reconstruction.

The study concluded that the PDS is performing well. While there was some evidence of J-ing of the bottom and occasional bending over of the top of the PDS, these factors did not appear to obstruct the flow of water through the system. In general, the filter fabric and core were clean except for some insignificant staining of the fabric and core. There was no evidence of calcium carbonate precipitate found in the core or on the filter fabric of the PDS on the project sites where the concrete pavement had been rubblized or where untreated crushed concrete or asphalt treated crushed concrete was used as the open-graded drainage course.

The study recommends several actions to be carried out by Construction and Technology, Design, and Maintenance Divisions, including changes with PDS materials and construction layout.

Further investigative research should continue to determine the long term performance of all underdrains where the Open-Graded Drainage Course (OGDC) is used in conjunction with a dense-graded aggregate or geotextile separator.

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\(^1\)The publication of this report was delayed in anticipation of FHWA action to the states regarding the conclusions of NCHRP Project 15-13, entitled Long-Term Performance of Geosynthetics in Drainage Applications. The conclusions contained in NCHRP Project 15-13 were published in 1994 in NCHRP Report 367. However, no action or comment regarding the NCHRP study appears to be forthcoming from the FHWA.
ACTION PLAN

1. Construction and Technology Division - Construction Section and Regions

   A. Construction procedures for installing underdrains (PDS or Trench Type) must be followed (inspected) more closely as specified in the Standard Specifications and Special Provisions.²

2. Maintenance Division

   A. Establish and implement a yearly program of locating, remarking (if necessary), inspecting and cleaning the outlet pipe and headwall/endsection for the trench type or PDS underdrains, including the cleaning of the connecting ditch to the mainline ditch, as well as, maintenance of the mainline ditch.³

3. Construction and Technology Division - Testing and Research Section

   A. Prepare special provisions for the drainage markers to be placed in the shoulder, temporary drainage marker posts, edge of pavement underdrains and open-graded underdrains pipe.⁴
   B. Rewrite the special provision for Underdrains and Outlets Using a Prefabricated Drainage System (PDS) to include report recommendations as approved.⁵
   C. Implement site specific testing in cooperation with region staff for soil retention, permeability, and clogging resistance of filter fabrics used for underdrains (trench type and PDS).⁶
   D. Monitor the sites for 5 to 10 years where the permanent viewports were installed to determine if calcium carbonate precipitate forms on the filter fabric or builds-up in the bottom of the underdrain.⁶

²Random quality verification of construction installation being done with MDOT video camera.

³Implemented in Capital Preventive Maintenance Program-Work Category 3 Enhancement (Underdrain Cleanout and Repair) FY 97-98.

⁴The placement of a permanent marker at the outside edge of the shoulder to identify the location of all outlet pipes for underdrains was implemented by Design through a Special Provision, dated 01/03/94.

⁵The report recommendations were implemented by a Special Provision written by M&T (C&T) Division on 03-17-1993.

⁶This report was written in March 1996 and sent to PSRC for review on May 14, 1996. PSRC then sent the report to Edge Drain Committee for their March 31, 1997 meeting for specific recommendations on this item. On May 7, 1998 the Edge Drain Committee sent a letter with their recommendation to the PSRC. The PSRC reviewed the letter at their August 11, 1998 meeting and approved the recommendations of the Edge Drain Committee.
INTRODUCTION

This study involved the investigation of geocomposite drains (PDS) that were installed on construction projects as underdrains throughout the state from 1985 to the 1992. The purpose of the study was to evaluate the performance of the PDS. The investigation and evaluation was conducted from July 13 through July 24, 1992, and on September 15, 1992.

BACKGROUND

The Michigan Department of Transportation (MDOT) uses highway underdrains in most parts of the state. Their purpose is to prolong pavement service life by removing water from within the pavement structure. In the past, MDOT mostly used trench drains where a 100 mm or 150 mm (4 in or 6 in) diameter perforated pipe is placed in a trench that is backfilled with a drainable sand or peastone. In the mid-1980s, MDOT began trial uses of geocomposite drains that increased to regular usage in 1988.

The types of projects where PDS has been installed include simple overlays, rehabilitation of pavements, and complete pavement replacement. These include crack and seat, break and seat, rubblizing, recycling Portland cement concrete, concrete overlays and reconstruction. It was not known how well the PDS would function in all these situations, which helped precipitate this study.

In February of 1992, the Monsanto Company offered to work with the Department to inspect the PDS in Michigan. This offer provided an opportunity to verify how the PDS was functioning in a variety of construction projects across the state.

Information was collected from 40 construction projects where PDS had been placed. From this information, 17 projects (Table 1) were chosen for inspection and evaluation. From one to six sites were inspected on each project. The projects chosen provided a good cross-section of construction projects that used different types of PDS (Table 2). The PDS inspected at all of the sites was 460 mm (18 in) in height, except for one site (Project 11A) where it was 300 mm (12 in) in height. The projects ranged from the oldest installation of PDS (1985) to the newest installations (1992).

The inspection of the PDS was done by a method referred to as in borescoping (Figure 1), which consists of coring a 100 mm - 150 mm (4 in - 6 in) diameter hole in the pavement or shoulder above the PDS and inserting a fiber-optic probe inside the drain (Figure 2). The probe permits viewing of the interior of the core. Visual observations were also made at the headwall/endsction for the outlet pipe to see how well the outlets were working. At some of the sites where the borescoping was done, permanent viewports were installed to allow future inspections.
PROJECT FINDINGS

A detailed evaluation of all 17 sites inspected is in the research project files and available upon request.

The inspection revealed that the PDS systems are working well. There was an insignificant amount of sediment usually found in the bottom of the PDS. The depth of sediment ranged from 3 mm (1/8 in) or less to 13 mm (1/2 in) for all of the project sites except for the sites on Project Nos. 1, 6 and 15 (Table 3). The reason for a large amount of sediment on these three projects is not known. The cause cannot be determined until reconstruction or major maintenance work is be done and the PDS can be exposed.

There was the expected staining of the filter fabric and core that indicates the previous water flow levels and the maximum height of the water flow in the core. The soil stains indicated that in general the heaviest concentration of water flow for all of the sites was 50 mm - 100 mm (2 in - 4 in) from the bottom of the PDS. The highest water flow level noted in the 460 mm (18 in) PDS was 300 mm (11 in) and 150 mm (6 in) in the 300 mm (12 in) PDS.

Also, the inspection of the project sites where the existing pavement had been rubblized or where untreated crushed concrete or asphalt stabilized crushed concrete had been used as open graded drainage course, revealed that there was no evidence of calcium carbonate precipitate from the rubblized pavement or the crushed concrete in the core. Further, there was no evidence of calcium carbonate precipitate found on the filter fabric.

There was 25 mm - 50 mm (1 in - 2 in) of bending at the top and bottom (called J-ing) of the PDS at some of the sites. The bending and the J-ing were caused by construction installation methods.

The filter fabric was coated with soil fines at five of the project sites (Table 3) and at three of those sites (Project #6 sites #1 & #2 and Project #12 site #1) the filter fabric appeared to be completely blinded off - here the filter fabric had become completely covered and/or saturated with soil fines, etc. allowing little or no water flow through the fabric. The filter fabric at these three sites, was a heatbonded nonwoven material that had become weak and could be torn easily.

At most of the project sites, the headwalls/endsections for the outlet pipes for the PDS were partially covered with topsoil or overgrown with grass. The headwalls/endsections were almost impossible to find if a drainage marker post was not next to the headwall/endsection. One outlet (M-68 Project #3 Site #2) had no drainage marker post and the headwall/endsection was covered with 0.6 m (2 ft) of embankment. At another site (I-75 Project #9 Site #1), the outlet pipe and headwall/endsection was plugged with dirt, but after cleanout there was no water flow. The I-75 outlet pipe was then excavated to check on the installation of the outlet pipe and it was found that it had been improperly installed (Figure 3). Also, there was a site (I-75 Project #11 Site #1) where the headwall/endsection had been separated from the outlet pipe (Figure 4).
In summary, the most common problems observed at all of the sites were the following:

1. The PDS was placed at an improper grade and position in the trench that prevented drain water from flowing continuously through the PDS to the outlet pipe.

2. The outlet pipe and headwall/endsction were improperly aligned and not set to grade to provide a positive outlet for the water.

3. Most of the outlet pipes and/or endsections were not kept cleaned out during and after construction to provide an unobstructed outlet for the PDS water.

4. There was no marker locating the outlet pipe or the headwall to perform maintenance inspections and cleanout.

5. The outlet ditch and the mainline ditch were not maintained to provide an unobstructed outlet for the discharge water.

Conclusions and Recommendations

The inspection of the PDS at the 39 project sites revealed that in general it is performing well. While there was some evidence of J-ing of the bottom and occasional bending over of the top of the PDS, these factors did not appear to obstruct the flow of water through the system.

In general, the filter fabric and core were clean except for some staining of the fabric and core that only indicated that the PDS had water flowing through it.

There was no evidence of calcium carbonate precipitate found in the core or on the filter fabric of the PDS on the project sites where the concrete pavement had been rubblized or where untreated crushed concrete or asphalt treated crushed concrete was used as the open-graded drainage course. Monitoring at the sites where the permanent viewports were installed will continue for 5 to 10 years to determine if calcium carbonate precipitate does form on the filter fabric or build-up in the bottom of the underdrain.

On several projects there was some sediment found in the bottom of the PDS, but it caused no apparent restriction to water flow.

The outlet pipe for the underdrains (trench type or PDS) should be changed to allow only rigid PVC or corrugated steel pipe. Also, the section of pipe in the headwall/endsction must be the same type of pipe as used for the outlet pipe. This will help assure a good connection between the outlet pipe and the headwall/endsction.

The area around the headwall/endsction should have stone riprap placed on a geotextile blanket to keep the grass away from the headwall/endsction and to provide for a clear discharge path to the ditch.

The filter fabric used in the underdrains (trench type or PDS) should be limited to a needle punched, non-woven fabric.
The outlet pipe grade should be increased from a minimum of 2% to 4% to better ensure a positive discharge.

The type of underdrain backfill has a major effect on performance. If the backfill contains a high percentage of fines, there is a greater probability for clogging or blinding off of the filter fabric or the core becoming filled with sediments. The best type of backfill material to use is a well draining sand or graded pea-stone (34R series).

The PDS with a single sided core or a core that is symmetrical about the vertical axis (i.e., continuous tubular support core) has an advantage over the double-sided core because there is more area available for the drainage channel.

The PDS with a core that is symmetrical about the vertical axis has a strength advantage over either the single-sided or double-sided core in resisting the bending over of the top or J-ing of the bottom.

There needs to be consideration given to the possibility of vertical and/or eccentric (angled) load testing of the PDS due to bending over of the top and the J-ing of the bottom that was noted.

To ensure that all underdrains will function properly, project specific testing should be done on the soil retention, permeability and clogging resistance of the filter fabric used on the PDS or the trench liner.

There needs to be closer adherence to proper construction procedures to alleviate many of the major problems indicated previously.

The following items are recommended for immediate implementation:

1. The location of the outlet pipe and headwall/endsection should be temporarily marked during construction to reduce accidental damage. (Construction)\(^5\)

2. A permanent drainage marker should be placed at the outside edge of the shoulder to identify the location of all outlet pipes for the underdrains. (Design & C&T)\(^3\)

3. For reconstruction projects, the PDS should be moved from the inside of the trench (pavement side) to the outside of the trench (shoulder side). (Design & C&T)\(^7\)

4. A work item for ditch cleanout should be included in all rehabilitation projects to ensure a positive outlet for all underdrains placed on the project. (Design)\(^5\)

5. A yearly inspection program should be established for the underdrain outlets to ensure a positive outflow. Also, include any needed maintenance such as outlet cleanout and ditch cleaning. (Maintenance)\(^2\)

\(^7\)The moving of the PDS from the inside to the outside of the trench was implemented by revision of the Standard Plans dated 12/06/94

Refer to page 2 for Footnotes 2, 3, 5, and 6. 6
6. Site specific testing for the soil retention, permeability, and clogging resistance of filter fabrics used for underdrains. (Districts & C&T)\textsuperscript{6}

It is recommended that MDOT construct a project where the trench backfill for the PDS is *puddled sand* per the work that was done by Kentucky DOT.

Further research is needed to determine the long term performance of all underdrains where the following materials are used for the OGDC and where a geotextile separator is placed between the OGDC and the subbase.

1. Untreated Crushed Concrete
2. Asphalt Stabilized Crushed Concrete
3. Cement Stabilized Crushed Concrete
4. Limestone treated and untreated aggregate

Also, the performance should be monitored where a 76 mm (3 in) dense graded aggregate separator is placed between the above OGDC materials (1-4) and the existing sand subbase. Assuming that everything else is the same except for the separator, this will enable us to determine if there is a difference in the amount of sediment found in the underdrains when a geotextile separator or the 76 mm (3 in) dense graded aggregate separator is used.

By the end of the 1991 construction season, the department had placed over 1,066,800 m (3,500,000 lft) of PDS at a cost of over $9.7 million, along with many millions of meters (feet) of trench type underdrain that were placed prior 1992.

The department has invested heavily in permanent drainage systems, which in order to be effective, must routinely be inspected and maintained as drainage is a critical element in pavement performance and quality.
FIGURES
Borescope and power source used in the inspection of the Prefabricated Drainage Systems (PDS)

FIGURE 1
Typical Cross-Section showing Inserted Borescope
Figure #2
The flexible outlet pipe for PDS was improperly installed. There is a in S curve in the pipe.

FIGURE 3
End section of the outlet pipe for the PDS has become separated from outlet pipe.

Close-up of the end section of the outlet pipe for the PDS separated from the outlet pipe.
TABLES
### TABLE # 1

The Products Used in the Inspection and Evaluation of PDS (Monsanto Study)

<table>
<thead>
<tr>
<th>PROJECT NUMBER</th>
<th>CONTROL SECTION</th>
<th>JOB NUMBER</th>
<th>BEGINNING CONTROL SECTION MILE POST</th>
<th>BEGINNING CONTROL SECTION MILE POST</th>
<th>DESCRIPTION</th>
<th>PROJECT COMPLETED</th>
<th>TYPE OF PREFABRICATED DRAINAGE SYSTEM (PDS)</th>
<th>QUANTITY OF PDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67051</td>
<td>22835A</td>
<td>17.783</td>
<td>15.294</td>
<td>M-115 East of the east end of the Muskegon River Bridge easterly to Harding Ave. Just west of the US-10/M-115 Interchange.</td>
<td>1985</td>
<td>Ekanadra Type 9122 - 18&quot; and MDM Hydroway Edge Drain - 18&quot;</td>
<td>61,887</td>
</tr>
<tr>
<td>2</td>
<td>16021</td>
<td>25111A</td>
<td>0.000</td>
<td>6.470</td>
<td>M-68 from US-31 to South Intersection of M-68 and Old US-27</td>
<td>1990</td>
<td>MDM Monsanto - 18&quot;</td>
<td>53,013</td>
</tr>
<tr>
<td>3</td>
<td>16091</td>
<td>25559A</td>
<td>13.099</td>
<td>15.218</td>
<td>I-75 from US-31 Interchange then Northerly to the South approach of the Machinaw Bridge</td>
<td>1988</td>
<td>Monsanto Hydroway</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>09101</td>
<td>28167A</td>
<td>0.887</td>
<td>11.638</td>
<td>Westbound US-10 from west of Flajole Road then easterly to east of the I-75 Interchange.</td>
<td>1990</td>
<td>MDM Hydroway Drain 2000 - 18&quot; from Monsanto</td>
<td>59,226</td>
</tr>
<tr>
<td>5</td>
<td>09101</td>
<td>28163A</td>
<td>0.887</td>
<td>11.638</td>
<td>Eastbound US-10 from west of Flajole Road then easterly to the I-75 Interchange</td>
<td>1990</td>
<td>Cantech Strip Drain</td>
<td>106,000</td>
</tr>
<tr>
<td>6</td>
<td>73112</td>
<td>24181A</td>
<td>8.306</td>
<td>9.330</td>
<td>I-75 from X04 of 73111 to I-675 Interchange</td>
<td>1990</td>
<td>Pro-Drain</td>
<td>44,518</td>
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<tr>
<td>7</td>
<td>50015</td>
<td>05668A</td>
<td>0.000</td>
<td>6.520</td>
<td>M-53 from 27 Mile Road easterly to 34 Mile Road in Macomb County</td>
<td>1990 &amp; 1991</td>
<td>Pro Drain 30, Advanced Drainage System &amp; Hydroway Drain 2000</td>
<td>87,009</td>
</tr>
<tr>
<td>8</td>
<td>63101</td>
<td>24020A</td>
<td>0.000</td>
<td>12.340</td>
<td>I-696 from I-275 to Franklin Road</td>
<td>1990</td>
<td>Unknown</td>
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<tr>
<td>9</td>
<td>58151</td>
<td>25564A</td>
<td>0.000</td>
<td>6.520</td>
<td>Northbound I-75 from Ohio State Line northerly to north of Lann Pier Road, Monroe County</td>
<td>1987</td>
<td>18&quot; Hydroway Drain by Monsanto</td>
<td>67,865</td>
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<tr>
<td>10</td>
<td>58151</td>
<td>26762A</td>
<td>0.000</td>
<td>12.340</td>
<td>I-75 Southbound commencing at the Ohio State Line, Thence Northerly to South of Dunbar Road, Monroe County</td>
<td>1988</td>
<td>Monsanto Hydroway</td>
<td>129,750</td>
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<td>11</td>
<td>58152</td>
<td>28352A</td>
<td>4.870</td>
<td>11.510</td>
<td>I-75 from north of Port Road, northerly to the north county line Monroe County.</td>
<td>1990</td>
<td>Pro-Drain 20 and Pro-Drain 30</td>
<td>325,838</td>
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<td>11A</td>
<td>58151</td>
<td>27927A</td>
<td>11.960</td>
<td>15.256</td>
<td>I-75 from south of Dunbar Road northerly to the I-275 Interchange, City of Monroe, Monroe County.</td>
<td>1989</td>
<td>12&quot; Monsanto Hydroway and 12&quot; &amp; 18&quot; Advanced Drainage System</td>
<td>251,692</td>
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<td>12</td>
<td>13081</td>
<td>24112A</td>
<td>0.000</td>
<td>6.520</td>
<td>I-94 from west of Holmer Road easterly to the 6 1/2 mile road bridge in Cахоus County</td>
<td>1988</td>
<td>Hijek 20 (18&quot;)</td>
<td>92,783</td>
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<tr>
<td>13</td>
<td>30924</td>
<td>25077A</td>
<td>0.000</td>
<td>6.520</td>
<td>I-94 from east of US-131 easterly to Westside Ave.</td>
<td>1988</td>
<td>Monsanto Hydroway (18&quot;)</td>
<td>22,231</td>
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<td>14</td>
<td>13082</td>
<td>25211A</td>
<td>0.000</td>
<td>6.520</td>
<td>I-94 from east of M-66 easterly to west of 11 mile road, Cahoue Co.</td>
<td>1990</td>
<td>Pro Drain 30 - 18&quot; and Pro Drain 20 - 18&quot;</td>
<td>98,100</td>
</tr>
<tr>
<td>15</td>
<td>41025</td>
<td>26573A</td>
<td>7.300</td>
<td>11.492</td>
<td>I-96 from M-21 Easterly to the Thornapple River</td>
<td>1987</td>
<td>Ameriadrain</td>
<td>158,971</td>
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<tr>
<td>Manufacturer</td>
<td>Product Name</td>
<td>Type of Core(l)</td>
<td>Filter Fabric Over Core</td>
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<tr>
<td>Monsanto</td>
<td>Hydraway</td>
<td>SHCC</td>
<td>Needle Punched Nonwoven Polypropylene</td>
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<td>Conteck</td>
<td>Strip Drain</td>
<td>MSCC</td>
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<td>Pro-Drain(3)</td>
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<td>MDCC</td>
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<td>Pro-Drain(4)</td>
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<td>MSCC</td>
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<td>Advanced Drainage Systems</td>
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<td>Burcan Industries Ltd.</td>
<td>Hitek 20</td>
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<td>Needle Punched Nonwoven Polypropylene</td>
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</tbody>
</table>

(1) SHCC = Single Hollow Column Core (columns on only one side of core)
MSCC = Molded Single Cuspatied Core (cuspids on only one side of core)
MDCC = Molded Double Cuspatied Core (cuspids on both sides of core)
CTSC = Continuous Tubular Support Core

(2) In 1978 used a molded double cuspatied core with a needle punched nonwoven polypropylene filter fabric and now uses a single dimpled core with the same filter fabric.

(3) Through 1989 used a molded double cuspatied core with a heat bonded nonwoven polypropylene filter fabric and in 1990 stated using a molded double cuspatied core with a needle punched nonwoven filter fabric.

<table>
<thead>
<tr>
<th>Project No./ Description</th>
<th>Site No.</th>
<th>Type of PDS</th>
<th>Area of Cover of PDS (in)</th>
<th>Height of Staking (in)</th>
<th>Depth of Sediment (in)</th>
<th>Width of Flow (in)</th>
<th>Condition of Fabric</th>
<th>Condition of Outlet</th>
<th>Remarks</th>
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<td>Corrugated</td>
</tr>
<tr>
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<td></td>
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<td>Pipe</td>
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<td></td>
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<td>4</td>
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</tr>
<tr>
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<td>Conc. Culv. Endsection</td>
</tr>
<tr>
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</tr>
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<td>Conc. Culv. Endsection</td>
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<tr>
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<td></td>
<td>13</td>
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</tr>
<tr>
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<td></td>
<td></td>
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<td>Conc. Culv. Endsection</td>
</tr>
<tr>
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<td>3</td>
<td></td>
<td></td>
<td>15</td>
<td>8</td>
<td>1/2</td>
<td>NO</td>
<td>Both Sides Good</td>
<td>Conc. Culv. Endsection</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
<td>14</td>
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<td>Both Sides Good</td>
<td>Conc. Culv. Endsection</td>
</tr>
<tr>
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<td>5</td>
<td></td>
<td></td>
<td>15</td>
<td>0</td>
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<td>Both Sides Good</td>
<td>Conc. Culv. Endsection</td>
</tr>
</tbody>
</table>

Manufactured by:
1. Monostra
2. Contech
4. Advance Drainage System
5. Burnie Industries Ltd
3. Pro-Drain
6. American Wick Drain
| TABLE #3 (Continued) |
| SUMMARY OF INSPECTION OF PREFABRICATED DRAINAGE SYSTEMS (P.D.S.) |

<table>
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<th>11A/1-75 South of I-275</th>
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<table>
<thead>
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<td>2</td>
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<table>
<thead>
<tr>
<th>13/1-94 Kalamazoo</th>
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<tbody>
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</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>14/1-94 East of M-85</th>
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</thead>
<tbody>
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<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15/1-96</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

| 16/M-66 | |
|---------| |
| 1 | Unknown | | | | | | | | | | | | | | | | Canceled could not obtain Traffic Control |

Manufactured by:
1. Monsanto
2. Contech
3. Pro-Drain
4. Advance Drainage System
5. Burcan Industries Ltd.
6. American Wick Drain
APPENDIX
APPENDIX A

1. Memo from R. Hubbell of FHWA on The Use of Geocomposite Underdrains in Region 5-Current Status October 1997.

2. Office Memorandum From J. LaVoy, Chairman of the Drainage Outlet Committee to S. Bower, Chairman of the Pavement Selection Review Committee (PSRC), with recommendations on Research Report R-1341.
Illinois

Fin drains or geocomposite longitudinal underdrains have been in common use in Illinois for at least 10 years. They have been used extensively on new construction and rehabilitation projects. However, a couple of years ago, some problems were identified and a study of their performance was conducted. For a while, Illinois had a moratorium on their use. Finally, as a result of the study, some changes in the specifications were made:

1. Many of the fin drains are weak in compression and crushed in the trench. As a result, Illinois has adopted a higher compression criteria, which has basically excluded all but one manufacturer. The only make now approved for use in Illinois is ADS. The original specification was modeled after the Monsanto product, but they have changed the product to be more cost competitive and the performance suffered.

2. Many of the fabric wrapping was not doing an adequate job of filtering. Using both theoretical models and experience, the wrapping is now restricted to needle punched non woven material. The standard application also includes a sand backfill with the pipe to the outside of the trench.

If you need further information, call James DuBose at 217-782-7200. He conducted the study and has a report available if this addresses your needs.

Indiana

Indiana has eliminated PDS's for all projects. We found that through the LCCA process, PDS were costing a lot more than plastic pipe, and were not performing as promised by the distributors. We have been ripping up miles of PDS and found a lot of problems. If you need further information on the performance of PDS's, you may call Dave Andrews, INDOT Materials Engineer @ 317-232-5280.

An Indiana Research project identified PDS as a poor drainage medium.

Michigan

Michigan allowed the use of PDS as an alternate to pipe underdrains for several years but then decided to only allow their use on retrofit projects. Currently the MDOT underdrain committee is struggling with what to do on future projects. A faction of the committee would like to not allow them at all.
Minnesota

Mn/DOT uses 3" or 4" polyethylene corrugated perforated pipe drains. I do not think that MN/DOT prohibits other types but at $1.34 to 1.54 Lin FT, this is the only kind we use.

Ohio

Used only on retrofits in Ohio. Performance is going to be questionable in my mind based on observation of construction installations. ODOT, however, has done a formal performance evaluation in the form of excavation of in-service drains. Evaluation showed satisfactory performance.

Wisconsin

Wisconsin does not use them. The State experimented with a couple of installations of the fin drains then decided to go to plastic pipe exclusively.

S-21749
R. Hubbell
10-28-97
DATE: May 7, 1998

TO: Steve Bower, Chairman
Pavement Selection and Review Committee

FROM: John LaVoy, Chairman
Edge Drain Outlet Committee

SUBJECT: Research Report R-1341, *Inspection and Performance Evaluation of Prefabricated Drainage System (PDS) in Cooperation with Monsanto Company*

The Edge Drain Outlet Committee has reviewed the research report listed above. In general, the committee concurs with the recommendations and proposed actions outlined in the report. However, there is one substantial restriction the committee believes should be formalized and continued, the prohibition on the use of Prefabricated Drainage Systems (PDS) under newly constructed pavements.

Section 1.A of the report's action plan recommends better inspection during construction of both circular and PDS style underdrains. While this is a noble recommendation, given the budget and manpower constraints that MDOT is under, it is highly unlikely that additional effort will be expended to inspect underdrains during construction. However, technology is available to inspect circular underdrains after construction by using video cameras. MDOT has equipment capable of video-inspecting underdrain runs up to 150 m long and there are also private firms that can be contracted to do this inspection any time after installation. Due to the small size of the internal passageways, technology is presently not readily available to inspect the entire run of PDS-style underdrain after installation.

MDOT has had an informal policy for the past several years of only allowing PDS to be used on drainage retrofit projects or projects with relatively short design lives. Circular underdrains have been required for installations under new pavement. The Edge Drain Outlet Committee recommends that this policy be formalized and continued because of the above-mentioned capabilities of circular underdrain to be inspected after construction via video equipment. The committee believes that PDS can continue to be utilized on drainage retrofit and shorter design life projects since the potential for loss of pavement support due to drainage failure is considerably smaller for these types of projects. Adoption of this policy would coincide with an apparent national trend away from using PDS systems under new pavements. Proposed selection criterial is attached.
In summary, the Edge Drain Outlet Committee recommends approval of Research Report R-1341 if done in conjunction with the adoption of a formal policy prohibiting the use of currently available PDS under new pavement. If new PDS systems become available on the market, they could be evaluated through the New Materials Committee for their constructability, durability, and capability to be inspected after construction via a video camera.

CONSTRUCTION & TECHNOLOGY DIVISION

Attachment

JL:TH:ch
cc: P. Lynwood
    J. W. Reincke
    D. L. Smiley
    T. Hynes