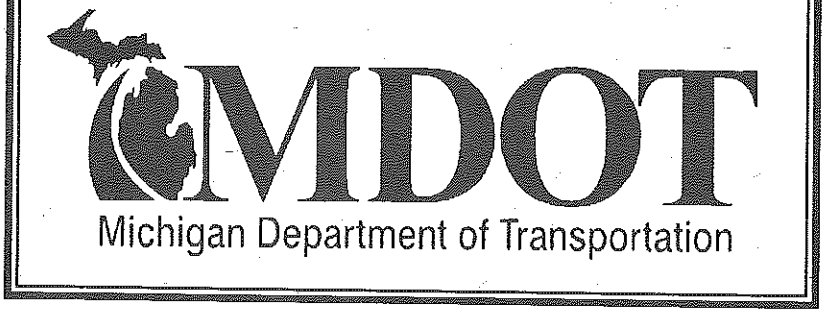
INSPECTION AND PERFORMANCE EVALUATION OF PREFABRICATED DRAINAGE SYSTEM (PDS)



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
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16. 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.

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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]

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

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

[4]The 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.

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

[6]This 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/endsection 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/endsection 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/endsection 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/endsection.

The area around the headwall/endsection should have stone riprap placed on a geotextile blanket to keep the grass away from the headwall/endsection 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]

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[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. Site specific testing for the soil retention, permeability, and clogging resistance of filter fabrics used for underdrains. (Districts & C&T)[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.

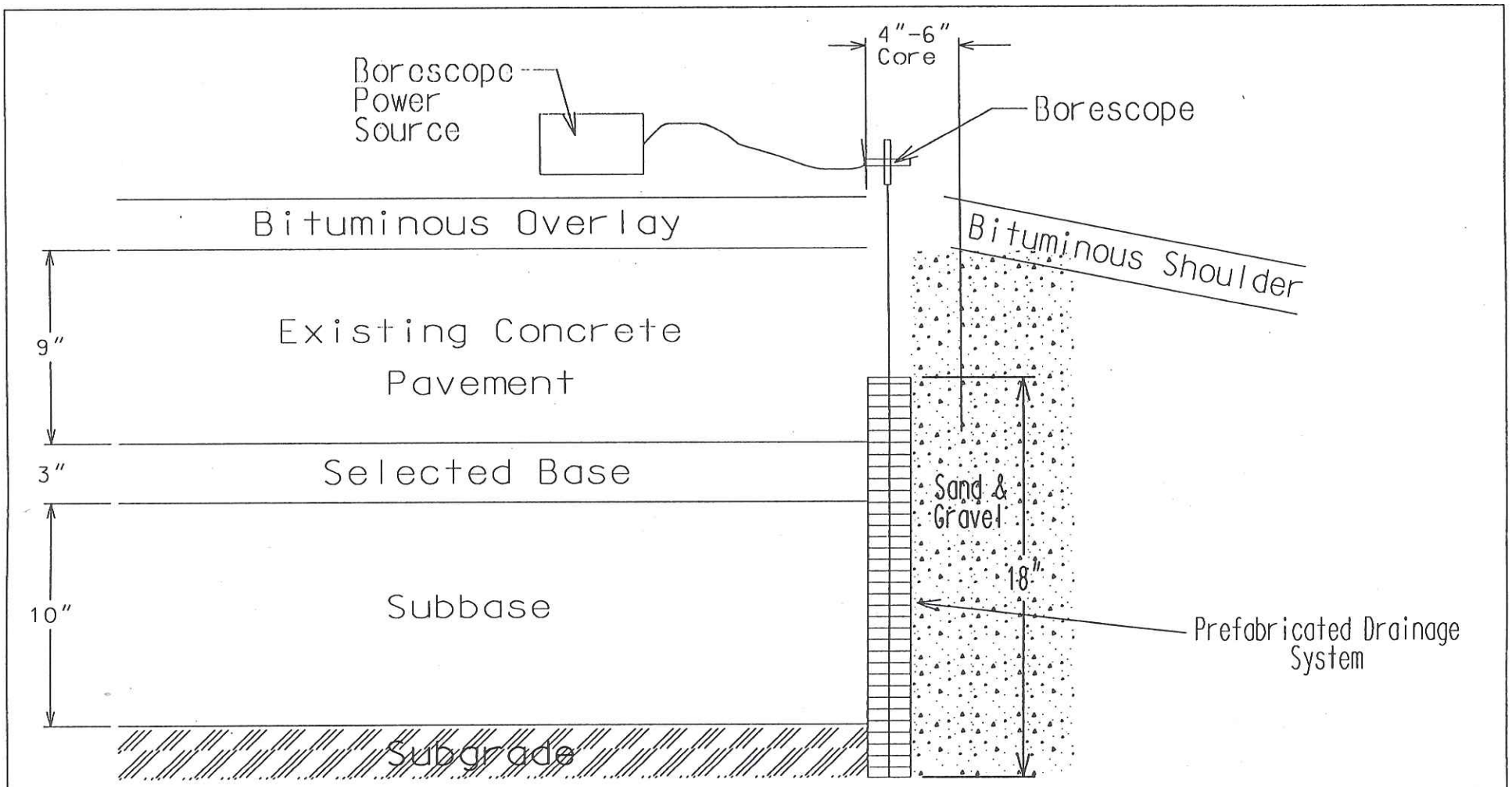
By the end of the 1991 construction season, the department had placed over 1,066,800 m (3,500,000 lft) of PDS at a cost of over $9.7 million, along with many millions of meters (feet) of trench type underdrain that were placed prior 1992.

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

Endsection of the outlet pipe for the PDS has become separated from outlet pipe.

Close-up of the endsection of the outlet pipe for the PDS separated from the outlet pipe.

FIGURE 4

TABLES

TABLE # 1

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

PROJECT NUMBER	CONTROL SECTION	JOB NUMBER	BEGINNING CONTROL SECTION MILE POST	BEGINNING CONTROL SECTION MILE POST	SECOND CONTROL SECTION	SECOND JOB NUMBER	BEGINNING CONTROL SECTION MILE POST	BEGINNING CONTROL SECTION MILE POST	DESCRIPTION	PROJECT COMPLETED	TYPE OF PREFABRICATED DRAINAGE SYSTEM (PDS)	QUANITY OF PDS
1	67051	22835A	17.783	18.294	18011		0.000	11.887	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).	1985	Enkadrain Type 9222 - 18" and MDM Hydraway Edge Drain - 18"	61,887
2	16021	28111A	0.000	6.470	16024		0.000	2.780	M-68 from US-31 to South Intersection of M-68 and Old US-27	1990	MDM Monsanto - 18"	53,013
3	16092	25559A	13.090	15.218	24071				I-75 from US-31 Interchange then Norhterly to the South approach of the Mackinaw Bridge	1988	Monsanto Hydraway	
4	09101	28167A	0.887	11.638	09042		0.000	1.300	Westbound US-10 from west of Flajole Road then easterly to east of the I-75 Interchange.	1990	MDM Hydraway Drain 2000 - 18" from Monsanto	59,226
5	09101	28163A	0.887	11.638	09042		0.000	1.300	Eastbound US-10 from west of Flajole Road then easterly to the I-75 Interchange	1990	Contech Strip Drain	106,000
6	73112	24182A	8.300	9.330	73111		0.000	1.760	I-75 from X04 of 73111 to I-675 Interchange	1990	Pro-Drain	44,518
7	50015	05668A							M-53 from 27 Mile Road easterly to 34 Mile Road in Macomb County	1990 & 1991	Pro Drain 30, Advanced Drainage System & Hydraway Drain 2000	87,000
8	63101	24020A							I-696 from I-275 to Franklin Road	1990	Unknown	
9	58151	25556A	0.000	6.520					Northbound I-75 from Ohio State Line northerly to north of Luna Pier Road, Monroe County	1987	18" Hydraway Drain by Monsanto	67,865
10	58151	26762A	0.000	12.340					I-75 Southbound commencing at the Ohio State Line, Thence Northerly to South of Dunbar Road, Monroe County	1988	Monsanto Hydraway	129,750
11	58152	28352A	4.870	11.510					I-75 from north of Post Road, northerly to the north county line Monroe County.	1990	Pro-Drain 20 and Pro-Drain 30	325,838
11A	58151	27927A	11.960	15.256	58152		0.000	4.870	I-75 from south of Dunbar Road northerly to the I-275 Interchange, City of Monroe, Monroe County.	1989	12" Monsanto Hydraway and 12" & 18" Advanced Drainage System	251,692
12	13081	24112A							I-94 from west of Helmer Road easterly to the 6 1/2 mile road bridge in Cahoun County	1988	Hitek 20 (18")	92,783
13	39024	25077A							I-94 from east of US-131 easterly to west of Westnedge Ave.	1988	Monsanto Hydraway (18")	22,231
14	13082	28211A							I-94 from east of M-66 easterly to west of 11 mile road, Calhoun Co.	1990	Pro Drain 30 - 18" and Pro Drain 20 - 18"	98,100
15	41025	26573A	7.300	11.492	41024	25547A	0.000	3.160	I-96 from M-21 Easterly to the Thornapple River	1987	Ameriadrain	158,971
16	34031	28115A	7.038	7.512	34032		0.000	0.394	M-66 from Portland Rd. North to Grand River Ave.	1989	Not known	11,320

TABLE 2
The Prefabricated Drainage Systems (P.D.S.) Inspected

11/27/95 12:57:29 PM

Manufacturer	Product Name	Type of Core(1)	Filter Fabric Over Core
Monsanto	Hydraway	SHCC	Needle Punched Nonwoven Polypropylene
Contech	Strip Drain	MSCC	Needle Punched Nonwoven Polyester
Pro-Drain(3)	PDS 20	MDCC	Needle Punched Nonwoven Polypropylene
Pro-Drain(4)	PDS 30	MSCC	Needle Punched Nonwoven Polypropylene
Advanced Drainage Systems	AdvanEDGE	CTSC	Needle Punched Nonwoven Polypropylene
Burcan Industries Ltd.	Hitek 20	MDCC	Needle Punched Nonwoven Polypropylene
American Wick Drain(2)	Akwadrain	MDCC	Needle Punched Nonwoven Polypropylene

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

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

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

(4) Through 1989 used a molded single cuspated core with a heat bonded nonwoven polyproplene filter fabric and in 1990 stated using a molded single cuspated core with a needle punched nonwoven filter fabric.

TABLE # 3

SUMMARY OF INSPECTION OF PREFABRICATED DRAINAGE SYSTEMS (P.D.S.)

11/20/98 08:25 AM

Project No./ Description	Site No.	Type of PDS	Size of PDS (in.)	Depth of Cover over PDS (in.)	Height of Staining on Core and Fabric (in.)	Depth of Sediment in PDS (inches)	Water Flow Present	Condition of Fabric	Type of Outlet	Conditon of Outlet: Percent Covered	Conditon of Outlet: Percent Plugged	Conditon of Outlet: Flow Present	Conditon of Outlet: Previous Flow	Viewport Installed	Remarks
	1														No PDS installed at this location
	2			14	6	0	NO	Both Sides Good		33	0	NO	YES	NO	
1 / M-115	3	MDM Hydraway	18	10	8	3	NO	Both Sides Good	Corrugated	20	100	NO	NO	NO	Cleaned Outlet then some flow
	4			13	8	0	NO	Both Sides Good	Pipe	10	10	YES	YES	NO	
	5			12	10	4	NO	Both Sides Good		20	20	NO	YES	NO	
	6			14	8	1	NO	Both Sides Good		20	20	NO	YES	YES	
	1			11	7	1/2	YES	Both Sides Good		20	10	YES	YES	NO	
2 / M-68	2	Hydraway 2000	18	11	4	1/4	NO	Both Sides Good	Conc. Culv.	100	100	NO	NO	NO	Outlet buried under 2' of embankment no
									Endsection						flow after digging out.
	3			12	6	1/4	NO	Both Sides Good		0	0	NO	YES	NO	
3 / I-75 north of US-31		MDM Hydraway	18												Deleted due to insufficient time
	1			10	4	0	YES	Both Sides Good		10	10	YES	YES	NO	
4 / WB US-10	2	Hydraway 2000	18	10	4	1/8	NO	Both Sides Good	Conc. Culv.	30	20	NO	YES	YES	
	3			11	2	0	NO	Both Sides Good	Endsection	20	30	NO	NO	YES	
	1	Strip Drain		13	4	1/4	NO	Both Sides Good		20	95	NO	NO	YES	Cleaned outlet no flow occured
5 / EB US-10	2	Hydraway 2000	18	12	4	1/4	NO	Both Sides Good	Conc. Culv.	30	50	NO	NO		
	3	Strip Drain		12	4	1/4	YES	Both Sides Good	Endsection	20	10	YES	YES	YES	
	1			12	---	Filled	---	Soil caked on outside, soil also on inside		95	80	NO	NO	NO	At both sites: Slight flow after cleaning outlets, Filter Fabric is a heat bonded nonwolven which had become weak and could
6 / I-75 Zilwaukee		PDS 20	18						Metal Culv.						
	2			12	---	Filled	---	Soil caked on outside, soil also on inside	Endsection	95	80	NO	NO	NO	be torn by hand. Could not complete the inspection due to thin double cuspated core. The filter fabric was full of fines.
	1	AdvanEDGE		11	4	1/4	NO	Both Sides Good		20	0	NO	YES	YES	Trace of fines between fabric and core
7 / M-53	2	PDS 30	18	12	4	1/4	NO	Both Sides Good	Conc. Culv.	0	0	NO	NO	YES	1/2" of water standing at end of outlet
	3	Hydraway 2000		13	4	1/4	YES	Both Sides Good	Endsection	0	0	NO	YES	YES	
8 / I-696	8	Unknown													Deleted due to inclement weather
	1			13	---	---	---	---		0	100	NO	NO	NO	Could not inspect as the ground water and water from coring would not drain out of the core hole.
9 / NB I-75 North of State Line		MDM Hydraway	18						Round Conc.						
	2			14	---	---	---	---	Endsection	0	0	YES	YES	NO	Could not finish inspecion due to rain, thunder and fighting.
	1			14	11	0	YES	Both Sides Good		100	5	YES	YES	NO	Endsection over grown with grass
10 / SB I-75 North of State Line	2	MDM Hydraway	18	14	11	0	YES	Both Sides Good	Conc. Culv.	100	5	YES	YES	NO	Endsection over grown with grass
	3			13	6	1/2	YES	Both Sides Good	Endsection	100	10	YES	YES	NO	Endsection over grown with grass
	1	PDS 30		13	9	1/4	YES	Both Sides Good		10	0	YES	YES	YES	
	2	PDS 30		13	---	---	---	Both Sides Good		10	0	NO	YES	NO	Aggregate got into borescope hole and could not complete the investigation
11 / I-75 North of I-275	3	PDS 30	18	15	8	1/2	NO	Both Sides Good	Conc. Culv.	20	0	NO	YES	NO	
	4	PDS 20		14	---	---	---	Both Sides Good at top	Endsection	0	0	NO	YES	NO	Could not borescope because of thin double cuspated core. Top 1"-2" of core crushed
	5	PDS 20		15	---	---	---	Both Sides Good		0	0	NO	YES	NO	Could not borescope because of thin double

Manufactured by:

1.) Monsanto
2.) Contech
3.) Pro-Drain
4.) Advance Drainage System
5.) Burcan Industries Ltd.
6.) American Wick Drain

TABLE # 3 (Continued)

SUMMARY OF INSPECTION OF PREFABRICATED DRAINAGE SYSTEMS (P.D.S.)

11/20/98 08:31 AM

11A / I-75 South of I-275	1	MDM Hydraway	12	14	6	0	NO	Both Sides Good	Conc. Culv. Endsection	20	95	NO	NO	NO	PDS installed backwards with column side toward the shoulder
12 / I-94 Battle Creek	1	Hitek 20	18	11	---	---	---	Heavy clay/silt on outside, silt on inside down 6"	Conc. Culv. Endsection	10	60	NO	YES	NO	Core double cuspated and severly bowed could only could only go down 6". Filter Fabric is a heat bonded nonwolven which had become weak and could be torn easily by hand.
	2			13	1	0	NO	Heavy silt on outside		10	75	NO	NO	NO	
13 / I-94 Kalamazoo	1			13	2	0	NO	Both Sides Good	Conc. Culv. Endsection	0	100	NO	NO	NO	Cleaned out endsection no flow occured.
	2	MDM Hydraway	18	13	18	0	NO	Both Sides Good		0	100	NO	NO	NO	Cleaned out endsection no flow occured. Staining on inside of PDS on shoulder side down 16" and on both sides bottom 2".
14 / I-94 East of M-66	1	PDS 30	18	14	0	0	NO	Both Sides Good	Conc. Culv. Endsection	5	0	NO	NO	NO	Soil in this area is a well draining sand and gravel which proides good veritcal drainage.
15 / I-96	1			11	0	9	NO	Heavy clay/silt both sides		10	50	NO	NO	NO	
	2	Akwadrain	18	11	6	1 1/2	NO	Both Sides Good	Conc. Culv.	10	10	NO	YES	NO	
	3			14	0	0	NO	Both Sides Good 8" down	Endsection	10	20	NO	YES	NO	Could only go down 8" with borescope due to double cuspated core and severe curving of the PDS toward the pavement
16 / M-66		Unknown													Cancelled 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.

PREFABRICATED DRAINAGE SYSTEMS (PDS)
USE OF GEOCOMPOSITE UNDERDRAINS IN REGION 5
CURRENT STATUS
OCTOBER 1997

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 Andrewski, 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

MDOT
Michigan Department of Transportation

OFFICE MEMORANDUM

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