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March 29, 2015

To Whom It May Concern:

The Stormwater Management Academy at the University of Central Florida has completed laboratory and field tests to evaluate the structural capacity of PTI PIPE-R™ used for subsurface drainage. The definition of the PTI PIPE-R™ for this study is a bundle of corrugated HDPE pipes bound and wrapped in specially built geotextile. Strength evaluation testing was conducted on a single pipe and pipe bundles (BPUs) in the laboratory, and the complete system (PTI PIPE-R™) underneath a flexible pavement section in the field.

The laboratory testing was limited to the determination of the vertical deformation resistance of the PIPE-R™ and was conducted in accordance with the specifications of AASHTO M294 – Load and Resistance Factor Bridge Design (LRFD) Specifications (following ASTM Standard Test Method D2412: Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading). The results from the laboratory testing showed that the single pipe had a pipe stiffness of approximately **57 psi** (**396 kPa**), which was greater than the AASHTO specified minimum pipe stiffness of **35 psi** (**240 kPa**). The equivalent BPU stiffness values, depending on the depth and the number of BPUs, varied from **38** to **232 psi** (**262 – 1600 kPa**) with increasing bundle depth (or equivalent pipe diameter). Table 1 presents the summary of the test results and the corresponding AASHTO minimum pipe stiffness.

Table 1 Pipe stiffness for the five PIPE-R system BPUs

PIPE-R system	Load lb. (kN)	5-% Deflection inches (mm)	Actual Pipe Stiffness lb./in/in (kPa)	Minimum Pipe Stiffness lb./in/in (kPa)
One layer Single BPU	218 (0.97)	0.44 (11.15)	61 (421)	35 (240)
One layer of three BPUs	5195 (23.11)	0.47 (11.85)	232 (1600)	50 (260)
Two layer of three BPUs	2717 (12.09)	0.89 (27.25)	86 (593)	38 (260)
Three layer of three BPUs	2237 (9.95)	1.30 (33.10)	58 (400)	30 (205)
Four layer of three BPUs	1715 (7.63)	1.74 (44.10)	38 (262)	22 (150)

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The subsurface field-testing on the PTI PIPE-R™ was conducted at the PTI field site in Groveland, Florida. AASHTO LRFD Bridge Design Specifications was used to determine the combined live load and dead load pressure due to AASHTO HS-20 and HS-25 truck loadings on the BPU at varying depths below the pavement system. A four layer 10-bundle section of the PTI PIPE-R™ was installed underneath three different pavement sections (labeled #1, #2, and #3) and subjected to H-20 tandem-axle truck loading (22 kips maximum axle load). The vertical deformation of the PTI PIPE-R™ was measured using state-of-the-art instrumentation to read and record real-time values during the loading. Figure 1 shows the typical transverse cross-sectional depth of each layer for the three pavement sections.

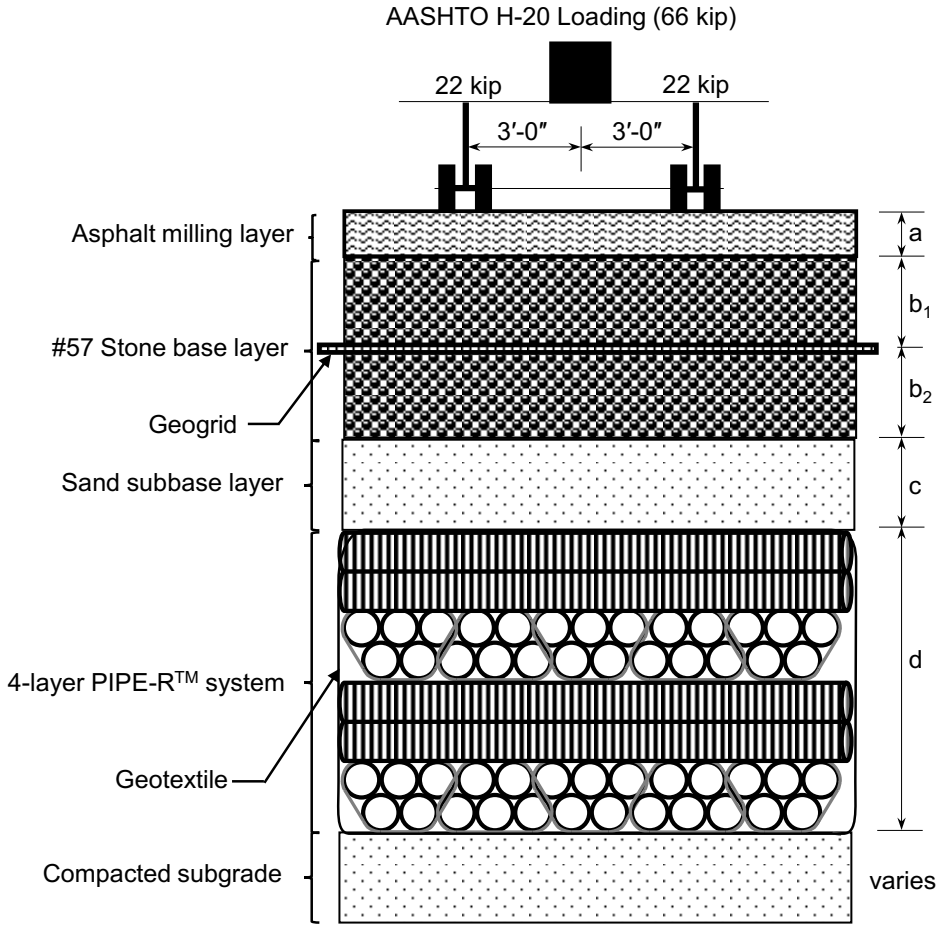

Figure 1 Typical pavement transverse sections

Table 2 presents the depth of each layer for the three pavement sections and the corresponding measured vertical deflection values. The percentage of deflection relative

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to the PIPE-R™ depth was less than the 5-percent minimum required in AASHTO M292. The range of deflections was between **0.2- to 2.0-percent** of the PIPE-R™ system depth. However, the Stormwater Management Academy **does not recommend** the use of cover depth used for section #3 because it is less than the AASHTO allowable minimum cover depth paved areas subjected to traffic loading. The deflection results presented in the study are applicable only to the four-layer 10-bundle PIPE-R™ system and not for the entire pavement section.

Table 2 Field pavement sections and corresponding PIPE-R™ system vertical deflections

Pavement Section	Depth of layer (in.)					Field Deflection (in.)	Percent Deflection (%)
	a	b_1	b_2	c	d		
#1	6	12	12	13	35	0.067	0.19
#2	6	12	12	-	35	0.315	0.90
#3	6	6	6	-	35	0.638	1.82

The results from the study are limited to the specific field-testing performed and serve only as a guide, and not a recommendation, for design engineers. Any PIPE-R™ system design and installation for subsurface drainage must be performed in accordance with the AASHTO LRFD Design Specification and any relevant local regulatory design guidelines. The Stormwater Management Academy shall not be responsible for any failure due to the incorrect application of the results presented in this brief.

Sincerely

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