PRODUCT DESCRIPTION REPORT

Report Issued: 20 March 2018
Expanded 25 June 2018

TESTING, RESEARCH, CONSULTING AND FIELD SERVICES
Austin, TX - USA | Anaheim, CA - USA | Anderson, SC - USA | Gold Coast - Australia | Suzhou - China

This report is subject to renewal 01 April 2019

REPORT HOLDER

DriAG Systems Incorporated
4021 Justine Drive
Annandale, VA 22003

EVALUATION SUBJECT

Dri·Drain
Dri·Form

1.0 EVALUATION SCOPE

Compliance with the following codes:

2018 International Building Code® (IBC)
2018 International Residential Code® (IRC)

Property evaluated:

Foundation drainage system

2.0 USES

The Dri·Form and Dri·Drain and their different product configurations are used as alternatives to conventional sand or gravel-covered pipe drains installed around building foundations in accordance with the applicable code.

3.0 DESCRIPTION

3.1 SYSTEM COMPONENTS

The DriAG System products are manufactured to provide foundation drainage. Multiple product configurations are produced to meet specific performance needs. Each unique product configuration consists in whole or in part of the same component materials which are described below:

3.1.1 Drainage pipe: drainage core consisting of a high density polyethylene drainage pipe for water conveyance. The diameter of the pipe may be selected to assure proper evacuation of collected waters.

3.1.2 Drainage mat: drainage core consisting of a high density polyethylene dimpled or cuspated drainage mat for drainage conveyance. The height of the cusps may be selected to assure proper evacuation of collected waters.

3.1.3 Filter: thermally bonded polypropylene nonwoven geotextile. The geotextile is wrapped around and bonded to the drainage cores allowing water to enter the drainage core while preventing intrusion of backfill material into the flow pathways during backfilling. The geotextile serves as a filter allowing water to pass through to the drainage core. The maximum opening size and permeability of the geotextile filter may be designed and implemented into a specification to assure proper filtration functioning.

3.1.4 Glue: The geotextile is adhered to the cuspated drainage core via use of a thermal-set glue.

3.1.5 Mesh: A fiberglass mesh is used as a backing to the cuspated drainage core to facilitate bonding to a concrete or other substrate.

3.2 PRODUCT CONFIGURATIONS

3.2.1 The Dri·Drain is a multiple-cuspated drainage core with manufactured 0.5 in. dimples at 0.44 inch centers or 1 inc. dimples at 1.1 in. centers. The bottom of the core is fitted with a polymeric mesh to adhere to concrete, stucco or other building materials. The tops of the each cusp are flattened for gluing to the geotextile filter.

3.2.2 The Dri·Drain may provide drainage for agriculture, driveways, sidewalks, parking garages, and airports, substituting for conventional gravel based drainage systems. The Dri·Drain may be used for below-grade drainage system on the exterior wall, or above-grade with a mesh for applying stucco, stone veneer, plaster or other finishing material). The Dri·Drain may also be wrapped around drainage pipe to covey water into the pipe for drainage.

3.2.3 Dri·Form formed with Dri·Drain may provide for the construction of foundation footers complete with Dri·Drain system drainage. The Dri·Form footing form may be used for residential, commercial and Industrial footings.

4.0 DESIGN AND INSTALLATION

The Dri·Drain system must be installed in accordance with the manufacturer's published installation instructions and this report. A copy of the manufacturer's published installation instructions must be available at the job site at all times during installation.

The Dri·Drain system does not require gravel or crushed stone material and must be placed in accordance with IBC Section 1805.4 or IBC Section R401 and 405, as applicable. Discharge of the Dri·Drain system must be in accordance with IBC Section 1805.4.3 or IRC Section R405.1, as applicable.

5.0 CONDITIONS OF USE

The Dri·Form and Dri·Drain system described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Installation must comply with this report, the manufacturer's published installation instructions and the applicable codes.

5.2 All crossovers are provided via connections and do not require any penetration through foundations. Thus the Dri·Drain system does not interfere with or contribute to the structural integrity of the foundation. The calculations and drawings must be prepared and sealed by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

6.0 EVIDENCE SUBMITTED

6.1 Manufacturer's published descriptive literature and installation instructions.

6.2 Independent third party testing results addressing permeability of the filter geotextile and flow capacities of the cuspated drainage cores used in the Dri·Drain system.

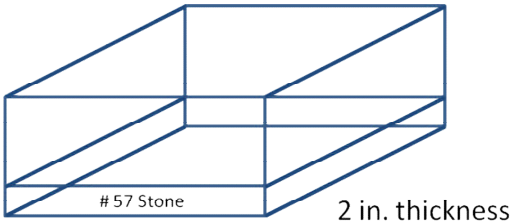
6.3 Flow comparisons of 1 inch cusp Dri·Drain with AASHTO #57 stone and structural assessment from Champion Engineering.

Example Filter Geotextile Properties			
Grab Tensile Properties (strength)	ASTM D4632	pounds force	MD: >100 TD: > 100
Grab Tensile Properties (elongation at maximum load)		%	MD: >50 TD: > 50
CBR Puncture Strength	ASTM D6241	pounds force	>200
Apparent Opening Size	ASTM D4751	mm	< 0.400
		US Standard Sieve Size	40
Permittivity	ASTM D4491	sec^{-1}	>1.8
Flow Rate		$gal/min/ft^2$	>140
Permeability		cm/sec	>0.08

Example Cuspated Core Hydraulic Properties				
Cusp Height (in)	Hydraulic Gradient (slope)	L/s	LPM	Gal/min/ft width
0.5	0.025	0.22	13.3	3.5
	0.05	0.31	18.7	4.9
	0.1	0.45	27.1	7.2
	0.25	0.71	42.9	11.3
	0.5	1.05	63	16.7
	1	1.50	90	23.8
1	0.01	0.28	16.7	4.4
	0.025	0.43	26	6.9
	0.04	0.58	35	9.2
	0.12	1.05	63.2	16.7
	0.5	2.21	132	35
	1	3.14	188	49.5

Dri·Drain Flow Capacity Comparison with AASHTO #57 Stone

Q = k * i *A
Q = Total Flow ft3/min or gallons/min
K = Permeability of #57 stone (assuming value of 0.1 cm/sec or 0.196 ft/min
I = hydraulic gradient – ft/ft – using 1 for vertical drop



16 in. width

A = 2" x 16" = 0.27 ft2

For 16 inch width of **#57 Stone**
Q = 0.52 ft3/min = **3.89 gal/min**
For 12" width of **1 in. cusp Dri·Drain**
Q = (independently measured) flow of **49.7 gal/min**

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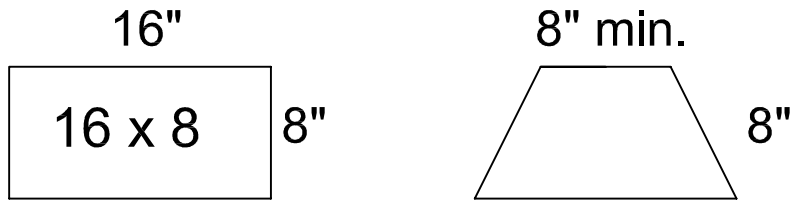
CHAMPION ENGINEERING
Design & Construction

The ACI – 318 Building Code for concrete construction clearly states, in section 15.5.2 "Shear in Footings", that the critical shear plane for concrete wall footings is at the face of the support member (wall). The wall load will be distributed over an area encompassed by a 45 ^0 line radiating from the wall face/top of footing intersection downward to the exterior sidewall face of the footing along a 45 degree angle. This constitutes the soil bearing area, not the shear strength of the footing. The shear strength is based solely on the thickness of the footing.

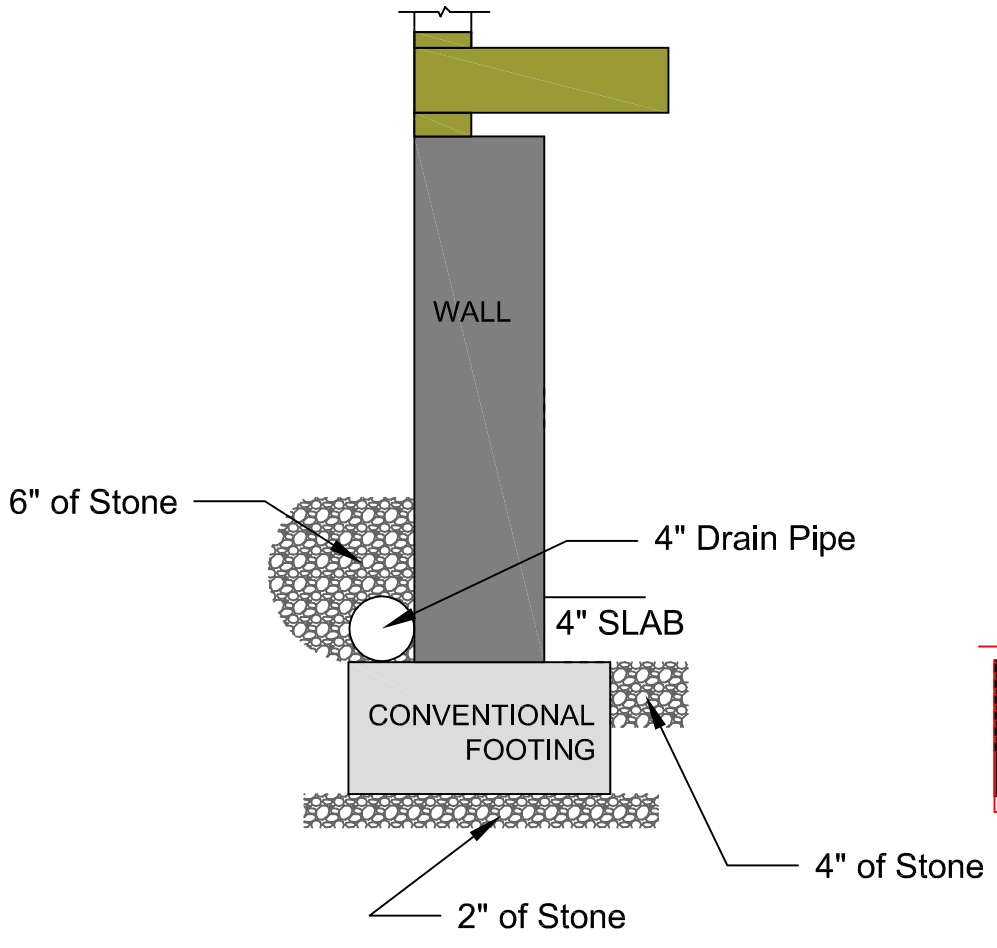
Scott Davies, P.E., SECB

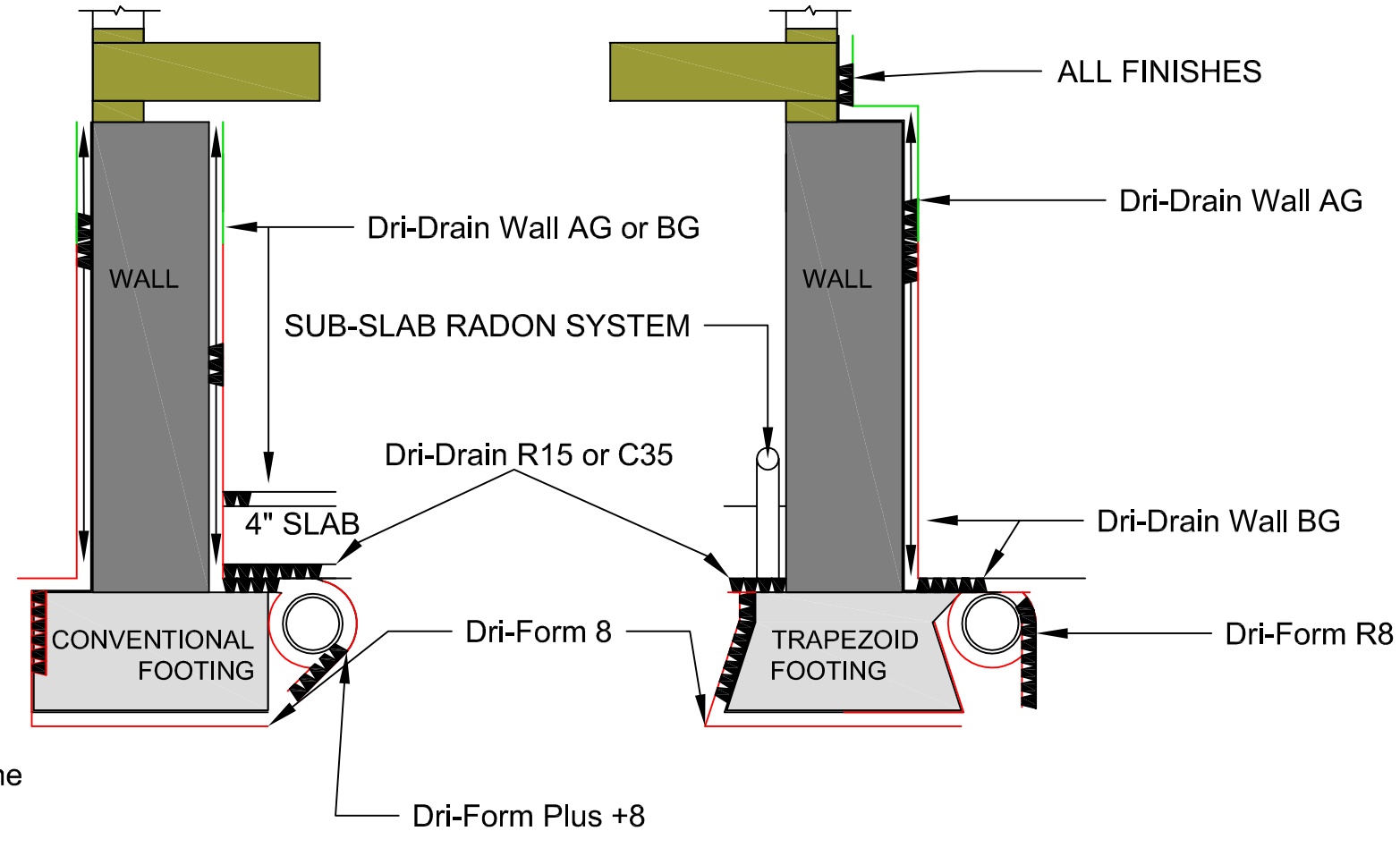
Champion Engineering

Fairfax County - Footing and Drainage Code Comparison to Dri-Form & Trapezoid



Conventional vs Trapezoid





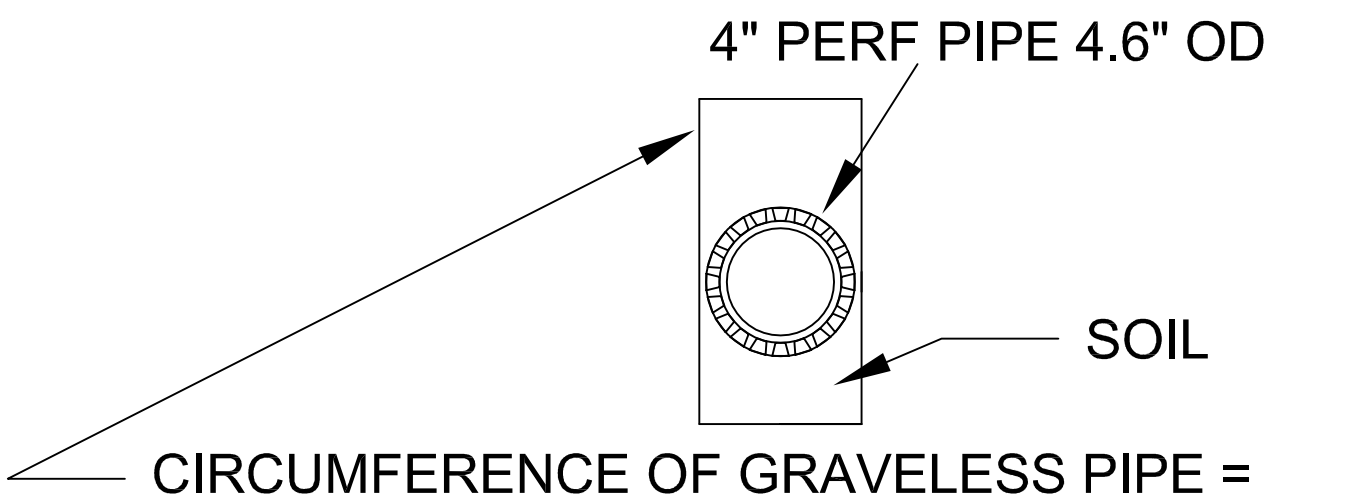
DriAG Systems Inc.	THESE DOCUMENTS CONTAIN PRIVILEGED AND CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REDISTRIBUTED WITHOUT PRIOR DriAG Systems Inc APPROVAL	DRiAG Systems Inc 4021 Justine Dr Annandale, VA 22003 (203) 767–8600	DriAG Dri-Form - Footing	DRAWN BY: DPM CHECKED BY: CSM DWG. NO. DD-AG-000003 NO. 1 DATE: June 3, 2018 OF

GRAVELESS PIPE COMPARISON TO FRENCH DRAIN

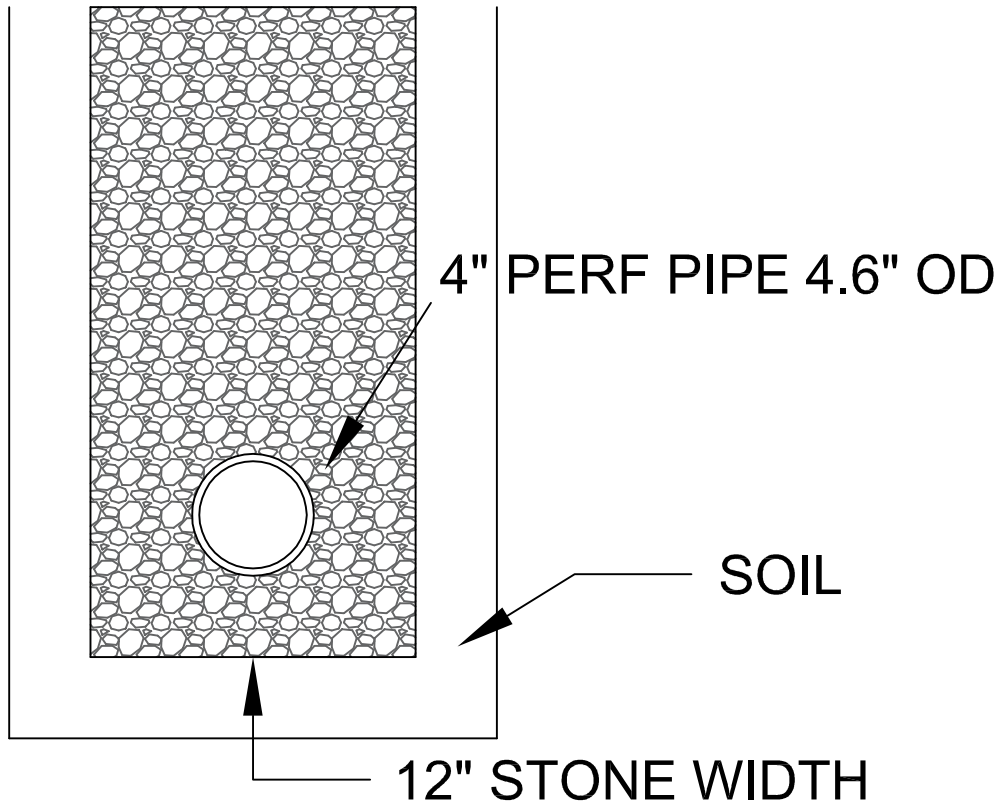
1.) FUNCTION OF A FRENCH DRAIN IS TO COLLECT WATER FROM SOIL AND TRANSPORT ALLOWING THE SURROUNDING SOIL TO DRY ASAP.

2.) THE FRENCH DRAIN WORKS BY INCREASING THE AREA OF CONTACT OF THE SURROUNDING SOIL WITH A MATERIAL THAT IS MORE POROUS THAN THE SOIL AND DELIVERS THAT COLLECTED WATER DIRECT TO THE PERFORATIONS IN THE PIPE. THEN THE PIPE TRANSPORTS THE WATER TO DAYLIGHT

6" X 6' TRENCH VS 12" X 12" X 24" TRENCH

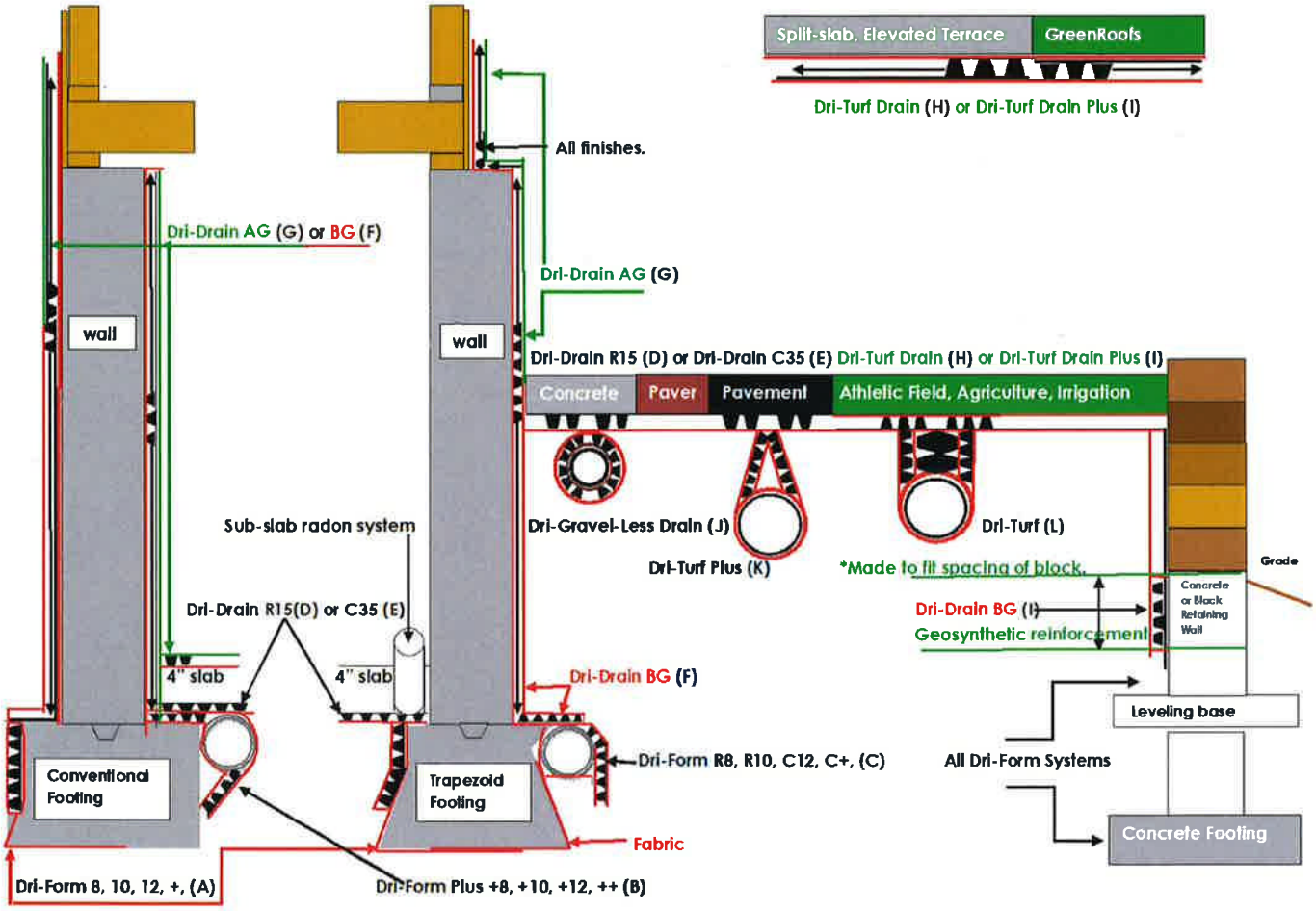


CIRCUMFERENCE OF GRAVELESS PIPE =
17.6" X 1' LENGTH = 211IN^2 OF SOIL CONTACT
@ 85% OPEN = 179" PER FOOT



DriAG Systems Inc.	THESE DOCUMENTS CONTAIN PRIVILEGED AND CONFIDENTIAL INFORMATION WHICH SHALL NOT BE REDISTRIBUTED WITHOUT PRIOR DriAG Systems Inc APPROVAL	DriAG	DRiAG Systems Inc 4021 Justine Dr Annandale, VA 22003 (203) 767-8600	DriAG Graveless Pipe	DRAWN BY: DPM CHECKED BY: CSM DWG. NO. DD-AG-000009 NO. 1 DATE: June 3, 2018 OF

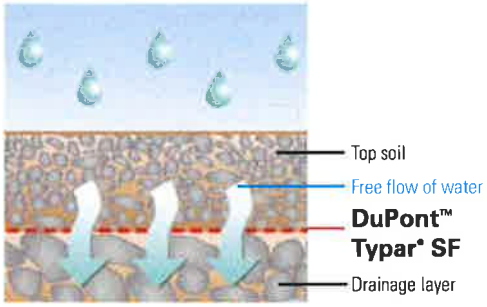
Multiple Product Applications



Filtration

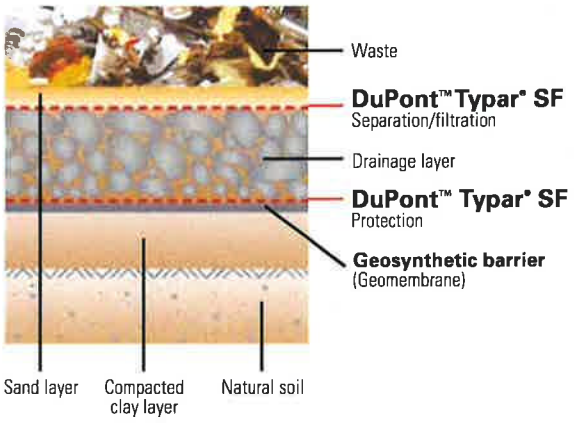
DuPont™ Typar® SF ensures:

- **Fines do not migrate into the drainage system or aggregate layers**
- **Permeability is not affected, even under soil pressure**
- **Erosion is prevented**
- **Long-term filtration**



Protection

DuPont™ Typar® SF ensures the protection of geomembranes and geosynthetic systems.

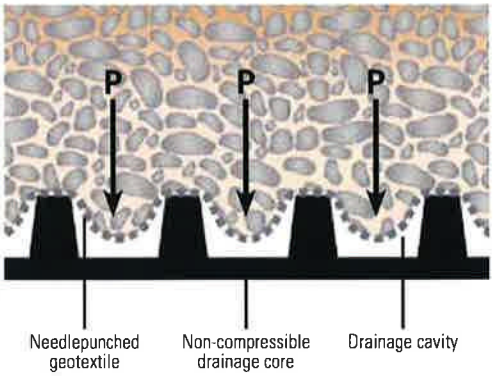


Drainage

- **Evacuation of water or leachate**

A geotextile alone cannot provide adequate drainage capacity. For efficient drainage, a combined system comprising a non-compressible core (or a drainage layer) and a stiff, robust geotextile filter, like **DuPont™ Typar® SF** is required.

With needlepunched geotextile



With DuPont™ Typar® SF

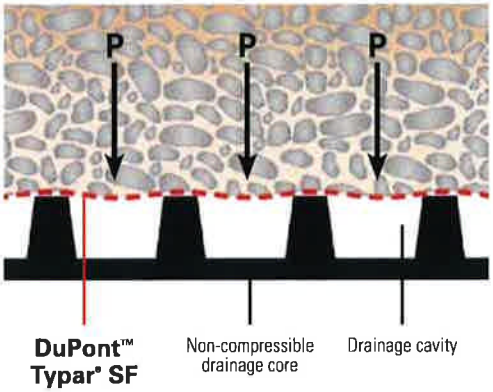
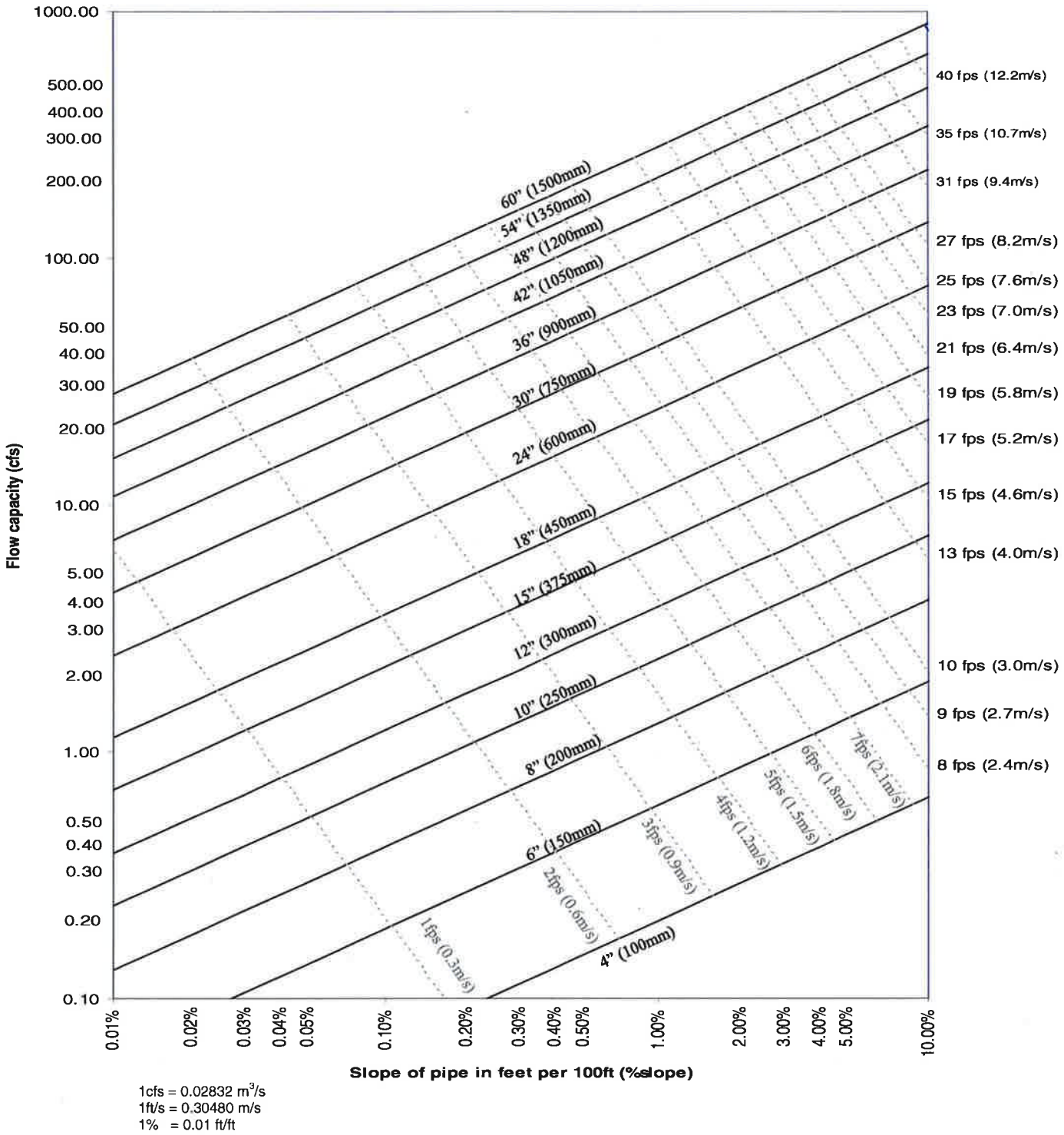


Figure 3-1
Discharge Rates for ADS Corrugated Pipe with Smooth Interior Liner[1]



1cfs = 0.02832 m^3/s
1ft/s = 0.30480 m/s
1% = 0.01 ft/ft

1. Applicable products: N-12®, MEGA GREEN®, N-12 STIB, N-12 WTIB, HP STORM, SaniTIte®, SaniTite HP, N-12 Low Head

Note: Based on a design Manning's "n" of 0.012.
Solid lines indicate pipe diameters. Dashed lines indicate approximate flow velocity.
Redeveloped from FHWA HDS 3 – Design Charts for Open-Channel Flow[2]