TECHNICAL NOTE

Minimum and Maximum Cover Heights for Alternate HP Storm Pipe Trench

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Introduction

The information in this document is designed to provide answers regarding general cover heights questions regarding the alternative trench installation of ADS HP Storm pipe; the data provided is based on Culvert Analysis and Design (CANDE) with information presented in the *Structures* section (Section 2) of the Drainage Handbook and is not intended to be used for project design. Project specific properties should be included in analysis for specific project design.

Minimum Cover

Minimum cover for non-traffic rated applications (grass or landscape areas) is 12" (300mm) from top of pipe to ground surface, for all pipe diameters. Additional cover may be required to prevent flotation.

Maximum Cover

The maximum burial depth is highly influenced by the type of backfill and level of compaction around the pipe. General maximum cover limits for ADS HP Storm utilized in non-traffic rated storm drainage applications; using different backfill materials (split backfill) in the backfill zone, as depicted in Figure 1, are shown in Table 2.

Table 2 was developed using CANDE modeling software. CANDE is a finite element analysis tool developed by Dr. Mike Katona under the sponsorship of the FHWA and AASHTO and is available for download. The AASHTO LRFD design method is not able to evaluate complex scenarios, such as changing backfill material. AASHTO LRFD load and resistance factors, shown in the *Structures* section of the Drainage Handbook, are utilized in the CANDE analysis. Additionally, the CANDE analysis assumes no hydrostatic load around the pipe, uses material properties consistent with the expected performance characteristics for HP Storm materials, as shown in Table 1 below, and assumes the native (in-situ) soil is of adequate strength and suitable for installation. For applications requiring fill heights greater than those shown in Table 2, contact an ADS Engineer.

It should be noted that while an installation condition as depicted in Figure 1 can be modeled in CANDE and other structural evaluation software, there are constructability and practical installation considerations that should be taken into account when a designer is determining the best backfill plan for a project.

1. Changing material types at the springline of the pipe requires accounting for the different soil confining strengths of the two materials. This variation in soil strengths can result in a reduced cover height when compared to an installation where a single material type is used for the entire pipe embedment. Where materials of differing strengths are used in the pipe embedment, susceptibility to pipe deflection can increase if the materials are not properly placed and compacted.
2. The fill heights shown in Table 2 are based upon a minimum compaction density of 85% being achieved for the native material above the pipe springline. When considering moisture content and compaction effort, adequate compaction of Class 3 and 4 materials can be more difficult to achieve compared to the effort of a Class 1 material used in the haunch zone of the pipe.
3. When materials of different gradation are placed adjacent to each other, filter fabric separation or properly graded material, under the guidance of a geotechnical engineer, is recommended in order to prevent the migration of fines into the open-graded material.

These considerations are not intended to explicitly allow or discourage the use of native materials above the pipe springline, but simply to state that such embedment can be successful when implemented correctly. While ADS supports that the product can perform well within these installation parameters, overall successful execution is dependent not only on the product, but on coordination, input and agreement between the owner, engineer and contractor, based on each party's needs.

Table 1
ADS HP Storm Mechanical Properties

Resin	ASTM Specification	Allowable Long Term Strain %	Initial		100-Year	
			Fu (psi)	E (psi)	Fu (psi)	E (psi)
Polypropylene, Impact-modified copolymer	ASTM F2881	3.7	3,500	175,000	1,000	27,000

Figure 1
ADS HP Storm Pipe Split Backfill Trench Detail
(Non-Traffic Applications)

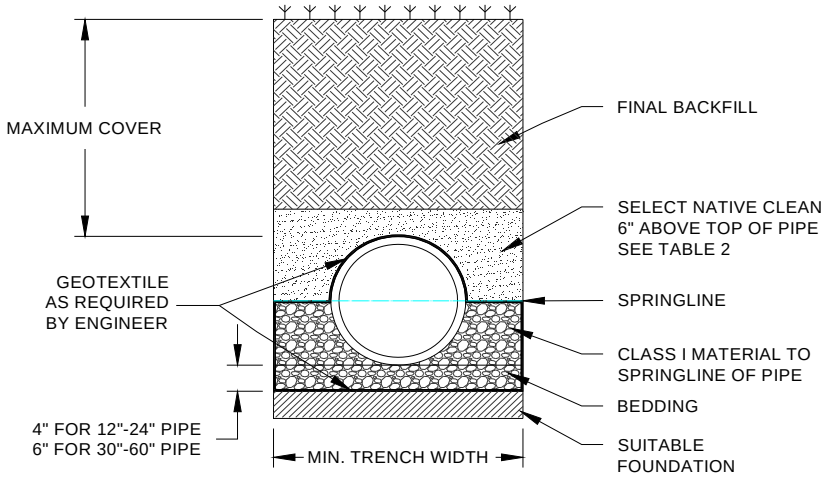

Table 2
Maximum Cover for ADS HP Storm Pipe with Split Backfill, ft (m)

Diameter in (mm)	Class 2	Class 3	Class 4
12 (300)	17 (5.2)	14 (4.3)	11 (3.4)
15 (375)	17 (5.2)	14 (4.3)	10 (3.0)
18 (450)	16 (4.9)	13 (4.0)	10 (3.0)
24 (600)	14 (4.3)	12 (3.7)	9 (2.7)
30 (750)	13 (4.0)	12 (3.7)	8 (2.4)
36 (900)	11 (3.4)	11 (3.4)	7 (2.1)
42 (1050)	11 (3.4)	11 (3.4)	7 (2.1)
48 (1200)	11 (3.4)	10 (3.0)	6 (1.8)
60 (1500)	11 (3.4)	10 (3.0)	6 (1.8)

Notes:

1. *Results based CANDE analysis. Calculations assume no hydrostatic pressure and a soil density of 120 pcf (1926 kg/m^3) for overburden material.*
2. *Backfill materials and compaction levels not shown in the table may also be acceptable. Contact ADS for further detail.*
3. *Class 1 material used below springline must be adequately "knifed" into haunch and in between corrugations. Unless otherwise noted by the engineer class I material must be compacted in 6-inch (200mm) lifts.*
4. *Select native clean backfill shall be well placed, moderately compacted (85% SPD) Class IV or better per ASTM D2321 with no foreign debris including rocks, large clumps of organic or frozen material.*
5. *For projects where cover exceeds the maximum values listed above, contact ADS for specific design considerations.*