Technical Note

TN 5.19A AdvanEdge® Drainage Layout for Synthetic Turf Fields

Introduction

The drainage layout for an athletic field is dependent on several factors; rainfall event, catchment area, field type, soil permeability as well as other site conditions. The rainfall event is typically based on historical data for the geographic area and is measured in inches per hour. The catchment area, typically measured in square feet, may not only be the area of the proposed athletic field; but depending on site topography, may also need to include surrounding areas. The type of field, natural or synthetic turf, will influence the permeability of the soils, with natural turf being less preamble than synthetic. For this reason the spacing of collector lines within a natural turf field are typically closer together than a similar synthetic field.

Natural and synthetic turf fields are designed similarly, but with some noted exceptions. Natural fields typically have less permeable bases. The designer may also assume some rainwater runoff coefficient less than 1.0 depending on the catchment area, site conditions, and how conservative one wants to be in the calculations. In natural turf athletic fields, the spacing of the collector pipes are mostly influenced by the soil permeability and the desired drainage time; this consequently leads to collector lines with narrow spacing or high drainage times. Synthetic fields on the other hand offer highly permeable stone bases and so may incorporate collector lines with wider spacing. Because the playing surface of synthetic fields drain rather quickly, it is common to assume zero rainwater runoff or a rainwater runoff coefficient of 1.0.

Example Calculations (English Units)

The example below will briefly discuss how one may determine the amount of rainwater to drain from a synthetic turf field, and present a typically drainage layout. We will assume a catchment area of 380ft x 170ft, a runoff coefficient of 1.0 (no runoff), and a rainfall intensity of 1.0 inches per hour.

Rational Equation:

$$Q = CIA$$

Where,
Q = Flow Rate, gallons per minute (gpm)
C = Rainwater Runoff Coefficient (1.0 for no runoff for synthetic turf)
I = Rainfall intensity, inches per hour (1.0 in/hr)
A = Catchment Area, square feet (380ft x 170ft = 64600SF)

$$Q = CIA \Rightarrow 1.0 \times 1.0 \frac{in}{hr} \times 64{,}600\ ft^2 \left(\frac{1\,ft}{12\,in}\right)\left(\frac{1hr}{60\min}\right)\left(\frac{7.48\,gal}{1\,ft^3}\right) = 671\,gpm$$

We will assume the field has two outlets and so will divide the field into two drainage areas or 335.5 gpm per side. We will also assume the collector pipes to be 12" AdvanEdge with a flow rate of 21 gpm which has been third party certified to ASTM D4716.

Determine the quantity of AdvanEdge:	Determine the spacing between collector lines:
$\frac{335.5gpm}{21gpm} = 15.97 \approx 16\,runs\ per\ side$	$\frac{380\ ft}{16\,runs} = 23.75 \approx 23\,to\,24\ ft\,between\,runs$

Drainage Layout

Now that we understand the minimum requirements to drain the field, we can move on to a layout. A typically layout for a synthetic turf may be to crown the field on a 0.5% slope from sideline to sideline and arrange the AdvanEdge collector pipes in a herringbone pattern. This type of layout will intercept rainwater as it infiltrates to the bottom stone and so will promote positive drainage. The proposed layout, figure 1, depicts 12" AdvanEdge on 20 foot lateral spacing; and because the herringbone design, results in 22 runs of AdvanEdge per side.

This drainage provided with this layout will be:

21 gpm per run of AdvanEdge x 22 runs per side = 462 gpm per side *or* 924 gpm for the entire field

The additional lines of AdvanEdge along with narrower spacing results in a higher flow rate and thus the rainfall removal of a larger storm event may be achieved.

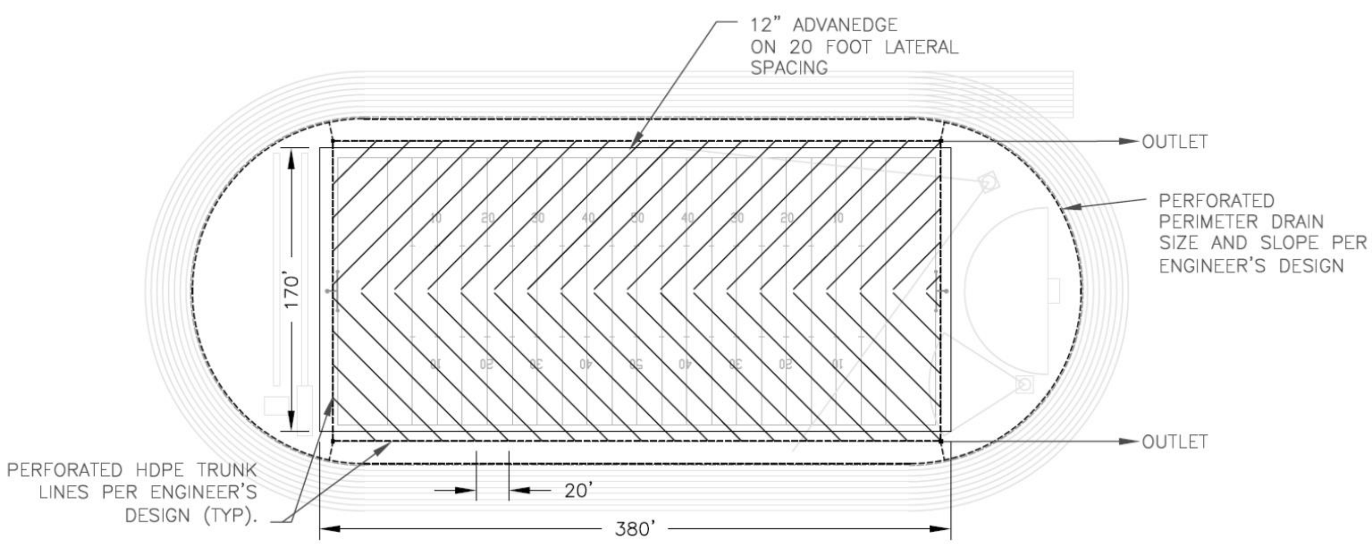
$$I = \frac{Q}{CA} \Rightarrow \left(\frac{924\,gpm}{1.0 \times 64{,}600\,sf}\right)\left(\frac{1\,ft^3}{7.48\,gal}\right)\left(\frac{60\,\text{min}}{1hr}\right)\left(\frac{12in}{1\,ft}\right) = 1.37\,\frac{in}{hr}$$

Transport Pipe

Lastly the transport pipe, or what may be commonly referred to as the perimeter drain, can be sized. With the current layout having two outlets, the collector pipes for half the field will need to drain 462 gpm. It is common to choose a perforated pipe as the transport pipe. The use of N-12 or single wall pipe may be left to the designer. At this point the designer needs to take into account the outlet elevations and soil cover so the transport pipe may be optimized and have sufficient cover. Using the Manning's equation or available pipe flow charts, an appropriate transport pipe may be chosen. In this case a 10-inch diameter N-12 pipe with a 0.5% slope will carry 750 gpm; more than enough required flow for half of the field.

Applying this polypropylene adjustment factor and using pipe stiffness values verified by third-party testing, RSC values for each diameter were calculated. In lieu of referencing specific RSC values by diameter, other flexible pipe products are classified into RSC categories based on the actual RSC being equal to or greater than the category RSC value. These categories are: RSC 40, RSC 63, RSC 100, RSC 160, RSC 250 and RSC 400. For ease of comparing products, Table 1 provides the third-party verified PS values and the corresponding RSC category that each respective diameter of SaniTite HP meets or exceeds.

Figure 1 – Typical Synthetic Turf Herringbone Drainage Layout



Example Calculations (Metric Units)

The example below will briefly discuss how one may determine the amount of rainwater to drain from a synthetic turf field, and present a typically drainage layout. We will assume a catchment area of 116m x 52m, a runoff coefficient of 1.0 (no runoff), and a rainfall intensity of 25 millimeters per hour.

Rational Equation:

$$Q = CIA$$

Where,
Q = Flow Rate, liters per minute (lpm)
C = Rainwater Runoff Coefficient (1.0 for no runoff for synthetic turf)
I = Rainfall intensity, millimeters per hour (25 mm/hr)
A = Catchment Area, square meters (116m x 52m = 6032m^2)

$$Q = CIA \Rightarrow 1.0 \times 25\frac{mm}{hr} \times 6032\,m^2\left(\frac{1m}{1000\,mm}\right)\left(\frac{1hr}{60\min}\right)\left(\frac{1000\,l}{1m^3}\right) = 2513\,lpm$$

We will assume the field has two outlets and so will divide the field into two drainage areas or 1256.5 lpm per side. We will also assume the collector pipes to be 300mm AdvanEdge with a flow rate of 79 lpm which has been third party certified to ASTM D4716.

Determine the quantity of AdvanEdge:	Determine the spacing between collector lines:
$\frac{1256.5lpm}{79lpm} = 15.91 \approx 16\,runs\,per\,side$	$\frac{116m}{16\,runs} = 7.25 \approx 7\,to\,8\,m\,between\,runs$

Drainage Layout

Now that we understand the minimum requirements to drain the field, we can move on to a layout. A typically layout for a synthetic turf may be to crown the field on a 0.5% slope from sideline to sideline and arrange the AdvanEdge collector pipes in a herringbone pattern. This type of layout will intercept rainwater as it infiltrates to the bottom stone and so will promote positive drainage. The proposed layout, figure 2, depicts 300mm AdvanEdge on 6 meter lateral spacing; and because the herringbone design, results in 22 runs of AdvanEdge per side.

This drainage provided with this layout will be:

79 lpm per run of AdvanEdge x 22 runs per side = 1738 lpm per side *or* 3476 lpm for the entire field

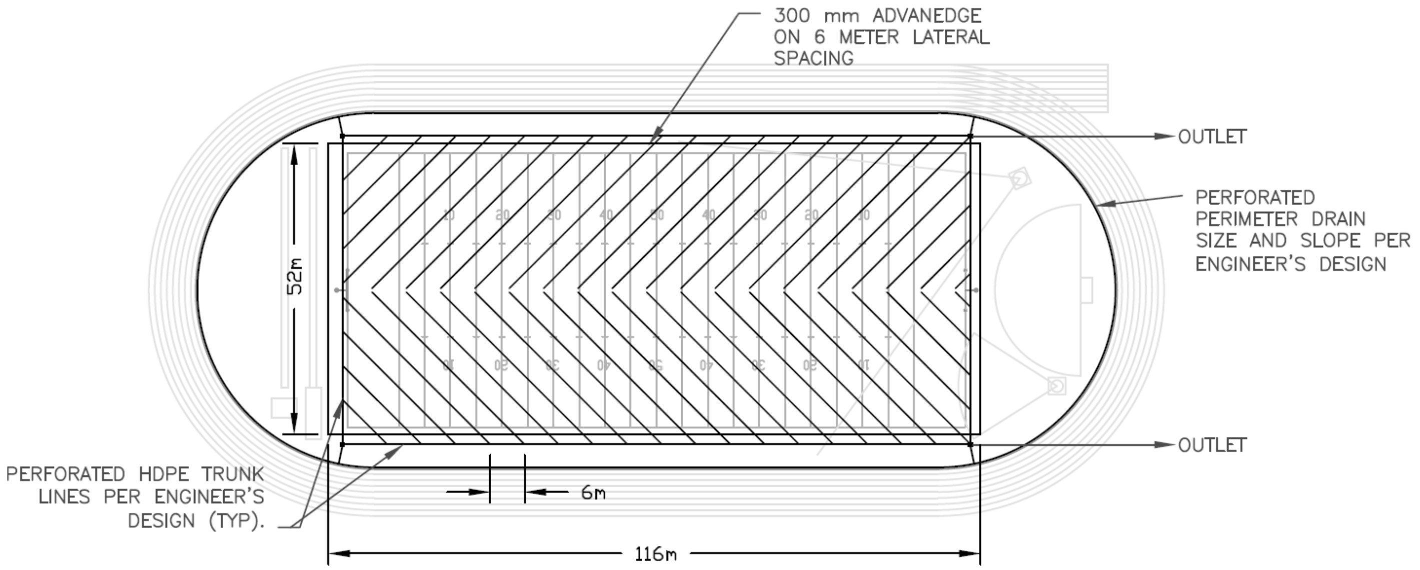
The additional lines of AdvanEdge along with narrower spacing results in a higher flow rate and thus the rainfall removal of a larger storm event may be achieved.

$$I = \frac{Q}{CA} \Rightarrow \left(\frac{3476\,lpm}{1.0 \times 6032\,m^2}\right)\left(\frac{1m^3}{1000\,l}\right)\left(\frac{60\min}{1hr}\right)\left(\frac{1000\,mm}{1m}\right) = 34.6\frac{mm}{hr}$$

Transport Pipe

Lastly the transport pipe, or what may be commonly referred to as the perimeter drain, can be sized. With the current layout having two outlets, the collector pipes for half the field will need to drain 1738 lpm. It is common to choose a perforated pipe as the transport pipe. The use of N-12 or single wall pipe may be left to the designer. At this point the designer needs to take into account the outlet elevations and soil cover so the transport pipe may be optimized and have sufficient cover. Using the Manning's equation or available pipe flow charts, an appropriate transport pipe may be chosen. In this case a 250-mm diameter N-12 pipe with a 0.5% slope will carry 2700 lpm; more than enough required flow for half of the field.

Figure 2 – Typical Synthetic Turf Herringbone Drainage Layout



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