MN6-5 Seepage Control

6-5.1 Anti-Seep Collars (Diaphragms)

Sufficient anti-seep collars should be provided to increase the creep distance (seep line) along the conduit barrel a minimum of 15% through the potential saturated area for the following structures:

1. All water impounding structures. (Note: A water impounding structure is defined as a structure having a permanent pool adjacent to the upstream slope of the fill which is more than 2 ft deep and exists for more than 2 days.)
2. All structures with over a 250-acre watershed and having a design head (H) of 10 ft or more.

At least one standard size anti-seep collar should be used on all other structures with the exception that those listed below may be installed without a collar, consideration given to soil and construction conditions.

1. Side inlet pipe structures into ditches.
2. Grade control structures with less than 10 ft of design head (H).

Recommended sizes and spacing of anti-seep collars is provided in Table 6-5.1. The value for the maximum spacing in this table was computed based on the amount of vertical projection of the collar that is required to increase the creep distance by 15%. The collar spacing should be adjusted downward from the maximum to give an even spacing between collars.

If the collars are placed too close together, the seepage path would tend to bridge the space between the collars since this is the path of least resistance. Because of this, anti-seep collar spacing should be placed at least 10 ft apart.

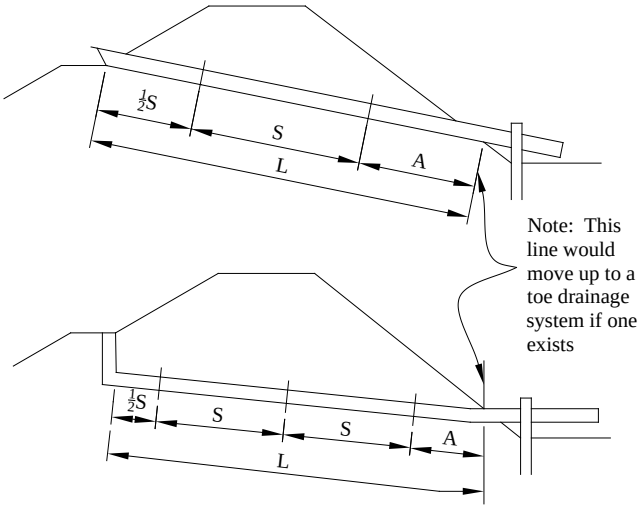
The maximum spacing for water impounding structures that are governed by Technical Release 60 is 25 feet.

Additional criteria for the design of anti-seep collars are provided in Figure E-8 in Technical Release 46, Gated Outlet Appurtenances.

The vertical projection of the collar from the conduit is used in calculating the increase in creep distance. Collars for conduits 12 inches or smaller may be square. All others should be rectangular with the horizontal dimension being about 1.5 times the vertical dimension.

Anti-seep collars shall have a watertight connection to the pipe. Anti-seep collars for metal pipe should be of the same material as the pipe. Anti-seep collars for plastic pipe may be metal or the same material as the pipe. Reinforced concrete collars should be used with rigid pipe conduits. Anti-seep collars must be structurally independent of the conduit. To insure this, knife grade asphalt sealer and preformed joint filler is used in the contact surfaces between the conduit and collar.

Figure 6-5.1 Anti-Seep Collar Diagram



Where:

L = Total length of conduit, feet
S = Spacing between collars, feet
A = Distance between last collar and downstream face of embankment, feet
= 3/4S for structures with a drainage area of less than 250 acres
= 1/2S for structures with a drainage area over 250 acres

Table 6-5.1 Anti-Seep Collar Sizes and Spacing Criteria for Water Impounding Structures

Pipe Diameter (Inches)		6 & 8	10	12		15	18	21	24	30	36	42	48	54	60
Diaphragm Size 1/	Height	4	4	4	6	6	6	7.5	7.5	7.5	7.5	7.5	9	9	9
	Width	4	4	4	10	10	10.25	12	12	12	12	12.25	14	14	14
Max. Spacing(s) 1/		21	20	19	32	31	29	37	36	32	29	26	32	29	26

1/ Dimensions and spacing in feet.

Example 6-5.1 Anti-Seep Collar Size and Spacing

Situation 1

Determine the size and maximum spacing for anti-seep collars for a water impounding structure with a drainage area of 100 acres. The conduit is a 12 inch diameter corrugated metal pipe with a total length of 72 feet.

Since the drainage area is less than 250 acres, the distance between the last collar and the downstream face of the embankment (A), from Figure 6-5.1, is 3/4S.

Try providing 2 anti-seep collars. The spacing between the two collars along the 72 foot length of conduit is:

L = 1/2S + S + 3/4S
L = 2-1/4S = 72 feet
S = 32 feet

For a conduit with a diameter of 12 inches, the maximum spacing between anti-seep collars (S) can be either 19 feet or 32 feet, according to Table 6-5.1. Since the spacing between the two anti-seep collars was calculated above to be 32 feet, the maximum spacing requirement is met.

The first collar will be placed 16 feet (1/2S) from the upstream end of the conduit. With a maximum spacing of 32 feet between the anti-seep collars, the collar height will be 6 feet and the width will be 10 feet, according to Table 6-5.1.

Situation 2

Determine the size and maximum spacing for anti-seep collars for a water impounding structure with a drainage area of 300 acres. The conduit is a 24 inch diameter corrugated metal pipe with a total length of 79 feet.

Since the drainage area is greater than 250 acres, the distance between the last collar and the downstream face of the embankment (A), from Figure 6-5.1, is 1/2S.

Start by trying to providing 2 anti-seep collars. The spacing between the two collars along the 79 foot length of conduit is:

L = 1/2S + S + 1/2S
L = 2S = 79 feet
S = 39.5 feet

For a conduit with a diameter of 24 inches, the maximum spacing between anti-seep collars (S) is 36 feet, according to Table 6-5.1. The spacing between the two anti-seep collars calculated above exceeds the maximum spacing requirement.

Next, try providing 3 anti-seep collars. The spacing between the two collars along the 79 foot length of conduit is:

L = 1/2S + S + S + 1/2S
L = 3S = 79 feet
S = 26.3 feet (use a spacing of 26 feet)

When three anti-seep collars are provided, the spacing between the collars calculated above meets the maximum spacing requirement. The first collar will be placed 13 feet (1/2S) from the upstream end of the conduit. The collar height will be 7.5 feet and the width will be 12 feet, according to Table 6-5.1.

6-5.2 Drain Diaphragms

The drain is to consist of sand, meeting fine concrete aggregate requirements (at least 15% passing the No. 40 sieve but no more than 10% passing the No. 100 sieve). If unusual soil conditions exist, a special design analysis shall be made. Additional criteria for the evaluation of the compatibility of drain materials with embankment and base soil materials is provided in National Engineering Handbook, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters.

Detailed criteria for the design of drain diaphragms, including the horizontal and vertical extents and placement, is provided in National Engineering Handbook, Part 628, Chapter 45, Filter Diaphragms.

Additional control of general seepage through an upper zone of weathered bedrock may be needed. The drain diaphragm shall be located immediately downstream of the cutoff trench, approximately parallel to the centerline of the dam, and downstream of the centerline of the dam if the cutoff is upstream of the centerline.

The drain shall be outletted at the embankment downstream toe, preferably using a drain backfill envelope continuously along the pipe to where it exits the embankment. Drain fill shall be protected from surface erosion.

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