

● Filter Drains to Prevent Piping Failure of Sediment Retention Ponds and Earth Bunds – Seepage Collars are no longer accepted best practice

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Below are guidelines for constructing filter collars around pipe in decanting earth bunds and temporary sediment ponds for earthworks. More technical guidance is provided for other purposes.

The guideline is based upon the results of a recent review carried out by DamWatch Services Ltd, a Wellington based engineering consultancy that specialises in dam safety. It is intended that references to seepage collars in existing Bay of Plenty Regional Council (council) guidelines will be replaced with filter collars and filter drains.

Background

During a recent legal case, arising from the blow out (piping failure) of an earth embankment, the use of seepage collars was put into question. As a result, council reviewed the use of seepage collars and found that current international best practice for small dams such as sediment retention ponds, is to use filter drains instead of seepage collars. This information sheet has therefore been released to update council's earthworks guidelines. This is intended to provide an outline of the scope and detail of filter drains to be used in sediment retention ponds and bunds.

Introduction

Blow Out/Piping Failure

The three main causes of failure associated with pipes are:

- Water tracking (piping) along the pipe – whereby defects along external surfaces of the pipe result in preferential pathways developing along which external water sources can track. The pipe itself is not affected.
- Flow out of the pipe – whereby a rupture causes water to escape the pipe and saturate the external fill
- Piping into the pipe – whereby the pipe collapses and external water sources enter the pipe

Defects along external pipe surfaces can be introduced between the pipe and backfill due to poor construction practice. Insufficient compaction results in low density zones prone to hydraulic fracture beneath pipe haunches. Defects can also be introduced within the backfill along the line of the pipe, specifically where differential settlement occurs above pipes constructed within trenches.

Anti Seep Collars/ Seepage Collars

Anti seep collars make it harder for water to track along the pipe by increasing the flow path. However, our studies have recently shown that adding anti seep collars do not guarantee against failure, because they can:

- Hinder soil compaction around pipes
- Cause cracks which enables seepage paths to develop and result in failure
- Cause uneven settlement around the collar which leads to pipe damage

Filter Drain Guidelines

Filter drains give far greater assurance against failure and are now recognised as the best technical practice against piping failures.

Drainage filters along the pipe allow some water seepage and prevent fines being eroded along the pipe. As time goes by the filtering process leads to an increasingly effective seal against water flow. However, for this process to work it is important that the filter drain (sand) continues from the collar to the point that the pipe emerges downstream.

Whilst drainage filters represent best technical practice it must be recognised that a poorly designed and/or badly constructed drainage filter to a pipe may also be susceptible to failure.

¹ DamWatch Services Ltd (2006) Review of the use of Seepage Collars in Small Dams, September 2006, Wellington

Key Guidelines

These guidelines have been prepared for pipes used in sediment retention ponds and bunds and must relate to small dams – see definition at bottom of page.

1. Do not use earth fill materials susceptible to piping. Earth materials susceptible to piping include, but are not limited to, non-cohesive silts and fine sands. Seek professional advice if any doubt exists as to the suitability of the proposed earth fill material selected to construct the embankment
2. To reduce the risk of seepage paths developing along the pipe ensure backfill is adequately compacted along the entire length of the pipe especially beneath the haunches of the pipe and in/outlets.

3. Filter collars are to be constructed around any pipes embedded within the dam or in the embankment foundation (refer to Figure 1). The purpose of the filter collar is to control seepage. With reference to Figure 1 filter collar requirements are as follows:
 - a) The filter collar must be positioned along the pipe ensuring they start just after half way through the dam / pond bund i.e. $h = 2/3 H$, where H is the height of the embankment.
 - b) The filter collar should be 1 m x 1 m x 1 m and allow for sufficient compaction around the pipe. Specific design is required if the pipe diameter is greater than 200 mm.
 - c) The filter material must be medium to coarse sand e.g. a $D_{15} = 0.7$ mm is anticipated to provide a good filter. If there is any doubt as

to the compatibility of filter materials with the local ground conditions or embankment fill, then professional advice must be sought.

- d) The filter sands must be compacted sufficiently wet to optimize compaction and avoid saturation collapse.
- e) The filter drain must continue to the outlet to allow for drainage from the filter collar to the downstream toe.
- f) The outlet must allow for seepage from the filter drain and be stabilised against erosion and dissipate energy e.g. Rock fill / rip rap at the outlet with a heavy duty geotextile filter fabric.
- g) Small dams as defined by the Building Act 2004 are water retaining structures that are less than 3 m high and retain less than 20,000 cubic metres of fluid.

