ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

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Typical Failure Modes for Stone Faced Earth Dams

Stone faced earth dams are susceptible to several forces that can ultimately lead to their deterioration and failure. The forces that may contribute to deterioration are similar to those that occur on earth embankment dams, i.e. water flowing over the dam embankment (flow erosion), leakage/seepage, and trees on the embankment. One force more closely associated with the failure of stone faced earth dams is frost heaving.

Flow Erosion
A high percentage of the stone faced earth dams have inadequately sized spillways to allow for the passage of any abnormal size storm event. As a result, these dams are frequently overtopped for short periods of time. Studies have indicated that this type of dam can sustain limited overtopping without major structural damage. However, any degree of overtopping will accelerate deterioration and should be guarded against.

Embankment Leakage/Seepage
Most dams in active use today exhibit seepage of one form or another. The location, rate of flow, and turbidity (clear or murky) are the critical factors when evaluating the seriousness of seepage from a dam. Stone faced earth dams are unique in their ability to generally resist the detrimental effects of seepage, more so than earthen embankment dams. This is due to the "free draining principle," which can be attributed to the downstream stone face of the dam acting as a crude filter. Water pressure cannot build up against this face because the voids allow seepage to drain freely. Also, a large number of these dams have been built with sufficient amounts of gravelly material, which acts to plug seepage paths over time.

Outlet Conduit Leakage
Breaks, separation of joints, or loss of conduit material within the dam structure itself could lead to leakage of water under pressure into the interior of the dam. This action could cause the washing out of material from within the dam embankment, creating the possibility for structural failure of the dam. Probably the most potentially serious situation is when a rupture occurs in the conduit on the upstream side of the gate. Because high water pressures are maintained on the upstream side of the control mechanism, a leak which develops can cause greater internal erosion and at a faster rate. The simple fact that high pressures exist in the conduit makes the development of leaks and seepage more likely. For this reason, new dams are constructed with their low level outlet controls located at the upstream side of the dam.

Tree Growth

Tree growth on stone faced earth dams can lead to failure in a number of ways. The most sudden of these is when trees growing along or near the crest of the dam are blown over. This reduces the available freeboard of the dam and can lead to overtopping, or the amount of dam embankment removed could lead to structural failure because of the reduced cross section of the dam. The root systems of these trees could extend from the upstream side all the way through the embankment at the same time providing a convenient path for seepage to develop and progress along.

Frost Heave

Frost heave occurs in silty or clayey soils and the pressures that are developed can be very large, large enough to displace concrete and stone walls. Many stone-faced earth dams display some indication of frost damage, mostly the leaning outward of the downstream stone face. Frost heaving can occur wherever soil becomes saturated and freezes. To guard against frost heave, any precipitation or seepage should be allowed to drain away from the dam.

For more information relative to the design, construction, maintenance and operation of dams, please contact the NHDES Dam Bureau at (603) 271-3406 or email damsafety@des.nh.gov. General information is available at NHDES Dam Bureau Webpage. You may also visit our office at 29 Hazen Drive, Concord, NH.

This fact sheet is accurate as of December 2019. Statutory or regulatory changes or the availability of additional information after this date may render this information inaccurate or incomplete.