RECLAMATION
Managing Water in the West

U.S. Department of the Interior
Bureau of Reclamation

Synthetic Sheet Piles to Improve Canal Safety

Synthetic sheet piles are an effective method to cutoff embankment flaws such animal burrows and decaying tree root systems

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Results of this study provide Reclamation's designers and operating water districts information regarding where synthetic sheet piles are a viable canal safety improvement method and where they can be used to reduce seepage losses.

Mission Issue

Synthetic sheet piles are cost effective cutoff wall technology to address canal safety issues and reduce seepage losses.

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Problem

Reclamation experiences a number of seepage related failures and incidents each year at its canals. These failures are often attributed to animal burrows and/or decaying tree root systems within the embankment or shallow foundation soils. Canals often provide excellent habitat for burrowing animals with an ample supply of water and vegetation. Some of the larger burrowing animals can have large diameter burrows and multiple dens, but they may only extend a few feet below the ground surface; whereas some smaller burrowing animals can have an extensive burrow network that may extend tens of feet downwards and laterally.

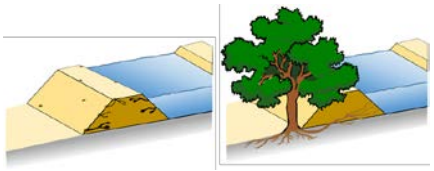
Woody vegetation within the canal's prism and along the outer banks can produce root systems that pass through the embankment and shallow foundation soils. As the roots grow and expand, they are in close contact with the surrounding soils. When the trees and brush die, however, the root systems wither and begin to decay. The decaying root systems can then provide a concentrated seepage pathway through the embankment and/or shallow foundation soils.

Inundated animal burrows, root systems, or other flaws provide a shortened seepage pathway through the affected embankment and/or shallow foundation soils. Concentrated seepage along these pathways can lead to erosion of the surrounding soils. Once erosion initiates, the seepage pathways enlarge, and the seepage flow and erosion rates accelerate. In loose silty soils, enlargement and breach development may take just a few hours.

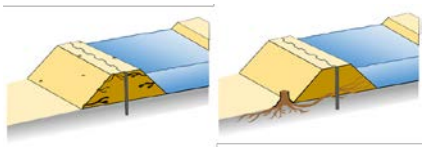
Solution

A field trial project was conducted to evaluate the use of synthetic sheet piles to reduce the potential for seepage and internal erosion related failures at Reclamation's canals. The field trial was constructed at the Truckee Canal in Fernley, Nevada. The Truckee Canal was selected for the field trial because a large amount of existing subsurface information was available to select a range of site conditions commonly encountered at other Reclamation canals.

Three test sites were selected: (1) Site 1 had favorable site conditions with loose, fine grained soils; (2) Site 2 had dense, cobbly soils; and (3) Site 3 had medium dense, sandy to gravelly soils with a less permeable foundation layer at depth. The field trial included about 1,000 linear feet of sheet piling with installed depths ranging from 15 to 25 feet. An experienced pile driving contractor was hired to install most of the field trial synthetic sheet piling. A portion of field trial was constructed by Reclamation's Provo, Utah, construction office using an excavator mounted vibratory hammer.



Canal embankment compromised by animal burrows (left) and tree root system.



Synthetic sheet piles used to cut off animal burrows (left) and tree root system (right)

"Synthetic sheet piles are a cost-effective alternative to improve canal safety as compared to embankment reconstruction or the addition of concrete canal lining systems. Sheet piling can be installed with minimal impacts to canal operations. Designers should work with geotechnical engineers and geologists to identify sites suitable for synthetic sheet piles."

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More Information

https://www.usbr.gov/research/projects/detail.cfm?id=1700

https://www.usbr.gov/research/projects/researcher.cfm?id=2910

Application and Results

Synthetic sheet piles were shown to be an effective cutoff wall alternative to reduce the impacts of animal burrows and tree root systems at Reclamation's canals. The synthetic sheet piles provide a barrier between flaws on the wet and dry sides of the canal embankment. In addition, synthetic sheet piles can be installed without any interruptions to canal operations.

Synthetic sheet piles appear to best suited for wet/saturated, fine-grained, loose to medium dense soils. Installation attempts at sites with dense to very dense, gravelly and cobbly soils resulted in severe damage to the synthetic sheet piles, even when the steel mandrel was used. Unreinforced PVC/vinyl sheet piles are not appropriate in gravelly and cobbly soils. Alternative installation methods, such as pre-trenching with a slurry stabilized trench, is required to avoid installation damage in these difficult soil conditions.

Synthetic sheet piles driven into a less permeable foundation layer are a viable method to limit lateral seepage losses. Additional research in this area would be needed to quantify these theories, but in most cases, canal lining is likely a more effective measure to reduce seepage losses.

Future Plans

Findings from this study can be used by Reclamation's designers, as well as in local water districts, and can provide a cost-effective alternative to improve canal safety. The TSC looks forward to supporting the regional and area offices in implementing the findings from this study.

Installed synthetic sheet pile cutoff wall.