The Importance of Drainage

Helping Water and Walls Coexist

In most of the world, where there's soil, there's water: Yet all retaining wall structures do best when kept dry. That's why proper drainage is critical. This article explores current drainage techniques that can help walls stand strong even when water comes around.

The Problem with Water

Water, when it encounters a wall, can quickly cause problems if proper wall drainage is not present. Poor drainage leads to the development of hydrostatic pressures or seepage forces on the wall system and can reduce shear strength of the soil. This combination can lead to poor wall performance, or even wall failure. In contrast, a properly designed drainage system will prevent the buildup of water forces, prevent soils from washing through the face, and provide a stiff leveling pad for support of the segmental wall units.

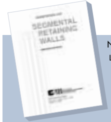
Retaining wall blocks exposed to water are particularly vulnerable to damage from subsequent freeze/thaw conditions.

Where Does the Water Come From?

Water can come from a variety of different sources. We most often think of water problems as a surface issue (rainfall). However, water sources can also be subsurface such as springs or perched water. The wall design needs to address all potential sources of water. A geotechnical engineer, experienced in the design of segmental retaining walls, can provide recommendations.

Water problems don't always happen overnight. Because water moves more slowly underground than it does above ground, a problem related to drainage can show up one to two weeks after a heavy rainfall. Poorly drained soils can also have a long-term effect on the performance of the wall, especially in fine-grained (clay or silt) soils. Poor surface and subsurface drainage can slowly saturate the soils behind a wall resulting in a wall failure years after wall construction.

The location of the groundwater table is important in the design of segmental retaining walls. A groundwater table at the base of your wall can reduce the bearing capacity of the foundation soils. Most design methodologies assume that the groundwater table is well below the base of the retaining structure. This may not be true. Be sure to check the geotechnical report for information regarding water levels encountered during the site investigation.



NCMA Offers Guidelines for Drainage

Looking for a resource to help you determine the most appropriate drainage solution for your next project? National Concrete Masonry Association (NCMA) Design Manual for Segmental Retaining Walls, Second Edition, contains the most extensive guidelines currently available. You'll find detailed criteria along with drawings to illustrate appropriate drainage solutions based on the presence and location of groundwater. For more information, or to obtain a copy of the manual from the NCMA, call (703) 713-1900.

How to Keep the Water Away

Blake Nelson, Geotechnical Engineer with the Minnesota Department of Transportation (MNDOT) presents some design strategies that can keep the water away from your walls.

The Leveling Pad

A leveling pad helps to distribute the weight of your wall over a larger area (for gravity SRWs) and provides a firm, level surface for placing the block. Typical construction uses a 6-inch thick leveling pad. At MNDOT, and at most DOTs, the base of the retaining wall is required to be below the frost level. As an alternative to deeper wall embedment, MNDOT uses a frost-free keyway that replaces the frost susceptible soils with free-draining gravel. Properly drained, the keyway allows water to flow in and out and reduces the possibility for frost heave.

Draintile

The most common drainage design strategy involves placing perforated pipes (draintile) in the backfill to collect groundwater in the reinforced soil zone. These pipes are directed to a safe location where the water can be discharged away from the wall system. A design should include as many pipes as needed based on the assessed threat of groundwater. Designers should place the drainage aggregate and draintile directly behind the facing unit or at the back of the reinforced soil zone.

Geotextile Filter

Some designs require a non-woven geotextile filter to prevent clogging of drainage aggregate in the wall system. Says Nelson, "At MNDOT, we use a perforated pipe with a geotextile filter fabric over it. You can also use other products, such as blanket, chimney, or sheet drains."

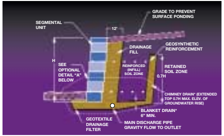
The Drainage Swale

An ideal solution for handling surface water is the use of a drainage swale, which diverts water from the wall face and reinforced soil zone.

The Correct Backfill

Using correct backfill is essential to drainage performance. Depending on the type of soil, the additional void space will make the poorly placed soil more susceptible to water penetration and the buildup of hydrostatic forces. To avoid this, Nelson often specifies free-draining sand and gravel in the reinforced soil zone (typical of DOT construction). Nelson recommends a sand or sand and gravel mix that has less than 10 percent fines passing a number 200 sieve (0.75mm). "Silt and clay can be a problem," states Nelson. "Water can't move through silt and clay very quickly.

Perforated pipes can empty out on the exterior of the wall to help remove water from soil.



This illustration from the NCMA Design Manual for Segmental Retaining Walls, Second Edition, shows a complete drainage system designed to provide maximum protection for SRWs.

Combine Drainage Options for the Best Results

The best drainage system for your structure will be project specific. Nelson, working with the DOT, likes to incorporate all available drainage strategies. "Sometimes the swale doesn't fit due to site restrictions but the keyway, as a leveling pad, and a draintile are standard. The only exception is if we're dealing with a small architectural wall that's only a few feet high."

Over time, it's inevitable that water will encroach on your retaining wall. A drainage system, including surface and subsurface methods, needs to be in place to build safe reliable structures.

Blake Nelson is a geotechnical engineer with the Minnesota Department of Transportation.