Loss of Backfill in Mechanically Stabilized Earth Retaining Walls

Mechanically Stabilized Earth (MSE) retaining walls have been used extensively by the Texas Department of Transportation (TxDOT) since the late 1970's. These walls perform well, and tens of millions of square feet of MSE wall are currently in service. However, over time a small percentage of these retaining walls may lose select backfill from behind the walls.

The problem is caused by surface water entering the top of the wall and then transporting select material out through joints or other openings in the wall. Incidence of backfill loss is most commonly associated with very fine, uniform "sugar sands" that were allowed in past specifications, although some more recent cases have involved coarser backfills.

Mounds of select backfill appearing at the base of a wall after heavy rains are likely to signal backfill loss. As the problem becomes more advanced, voids form behind the wall face, sometimes causing precast panels to shift outward due to loss of anchorage, and causing roadways above the wall to settle due to loss of support. In extreme cases, portions of roadways and concrete riprap have ultimately collapsed into voids up to several cubic yards in size.

Surface water most often enters MSE walls through joints in flumes, coping, or approach slabs, or in the vicinity of the bridge abutments. For walls with either grass or paved slopes coming down toward the top of the wall, flumes are generally provided to collect and transport surface water off of the top of the wall. It has proven difficult to keep these flumes well sealed and flowing. Water either makes its way under the flume, or the flume may open along a joint and allow water into the wall fill. Once water begins entering the top of the wall, it flows toward the base of the wall and then out the wall face. Problems with water infiltration may exist anywhere water is concentrated along the top of a wall, such as at the end of a bridge where large amounts of water are flowing off of the bridge deck.

The joints of all MSE walls constructed since the early 1980's were required to be covered with filter fabric that allows water to pass out of the wall while maintaining the backfill behind the wall panels. If the filter fabric barrier is compromised, either through poor placement, deterioration, damage or omission, backfill material may eventually find its way out from behind the wall.

The solution to the problem is to identify all areas where water is entering a wall and then seal those locations to prevent further infiltration. The site of infiltration can often be above the area where backfill is being found at the base of the wall. Sealing these areas may require regrading of the ground behind the wall, repair of flumes, or extensive sealing of flume and coping joints. As a rule, use either silicone or hot rubber sealers to seal joints.

Fill any identified voids to restore structural integrity and stop further loss of material. TxDOT recommends Flowable Backfill (Item 401) for filling these voids, although some districts have used expandable foam (Uretek) for the same purpose. Locate voids by probing from the surface and from the face of the wall. For more detailed mapping, use Ground Penetrating Radar or coring and visual inspection.

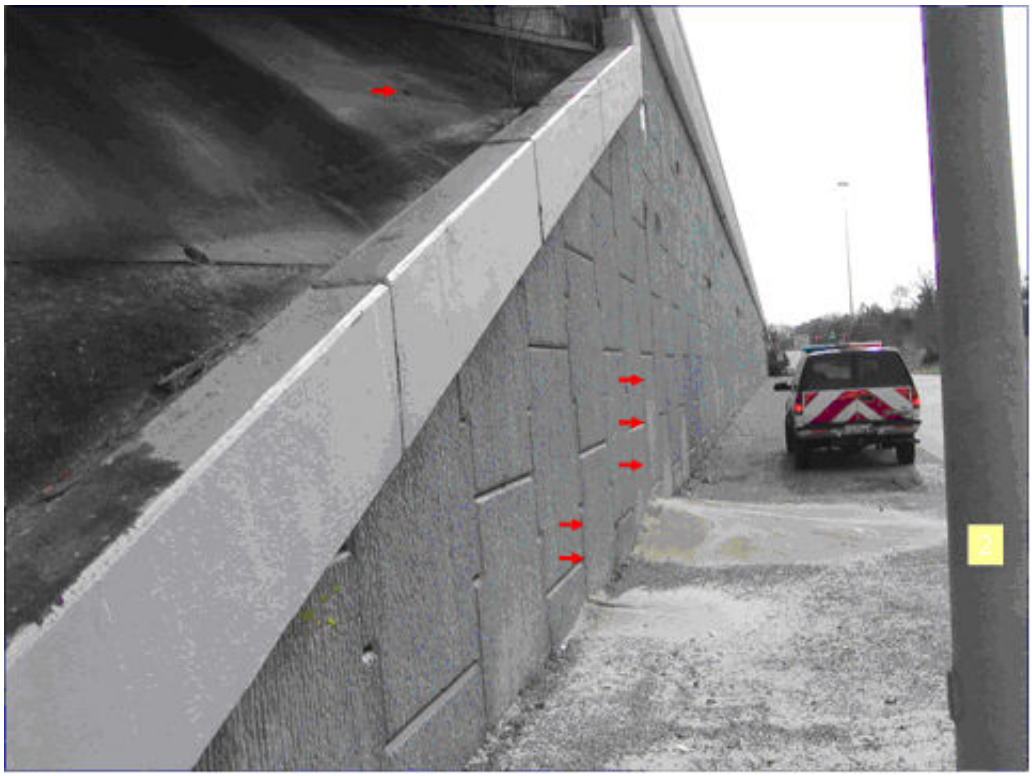
Filling voids and sealing surface joints effectively halts backfill loss. However, once identified in one spot, backfill loss often recurs in different locations along the same wall. Inspect the walls and seal joints regularly.

After filling any known voids and sealing the top of wall, evaluate the panel joint openings at the face of wall. If panels were placed with very wide joints or have shifted and left obvious wide, unprotected joints, consider sealing those joints. Seal any joint where the filter fabric is missing and backfill is exposed. While it is preferable to leave most joints open as they provide relief for water pressure that may build up inside of a wall, it is acceptable to seal a percentage of the wall joints. Joints are typically sealed by placing a backer rod and then using a non-sag silicone sealer (DMS-6310, Class 4).

Once loss of backfill begins, it gets worse as the surface area of internal voids increases. If the process is allowed to continue and voids get large enough, the wall may begin to experience panel movements and distress. For this reason evaluation of the wall and repairs should be timely.

When constructing new MSE retaining walls, several measures can prevent the problem of backfill loss during the life of the wall. Current specifications have eliminated the fine, uniform sand backfill most commonly associated with this problem; however, all backfill is subject to migration under the right combination of circumstances. Careful and complete placement of filter fabric over all open joints is the most effective deterrent. Failure to place filter fabric across even a single joint can leave an avenue for backfill to escape. Attention to drainage details at the top of wall is also important. Careful sealing of coping and barrier joints, as well as joints between flumes, riprap, and coping is critical. Anywhere that surface water can collect and flow toward or against a joint is a potential location for infiltration.

For questions on this topic, contact Mark McClelland, P.E., at 512-416-2226.



Examples of MSE retaining walls exhibiting loss of select backfill