Engineering
UPDATE©
MEA MARINO ENGINEERING ASSOCIATES, INC. • Issue 52

MSE WALL FAILURES FROM USE OF NON-DURABLE BACKFILL

This project involved the lane expansion of an Interstate highway. This included lane widening and elevation of the roadway at the overpasses which was accomplished by adding fill and MSE walls on the northbound and southbound lanes. Typical cross-section of this construction is shown in Figure 1.

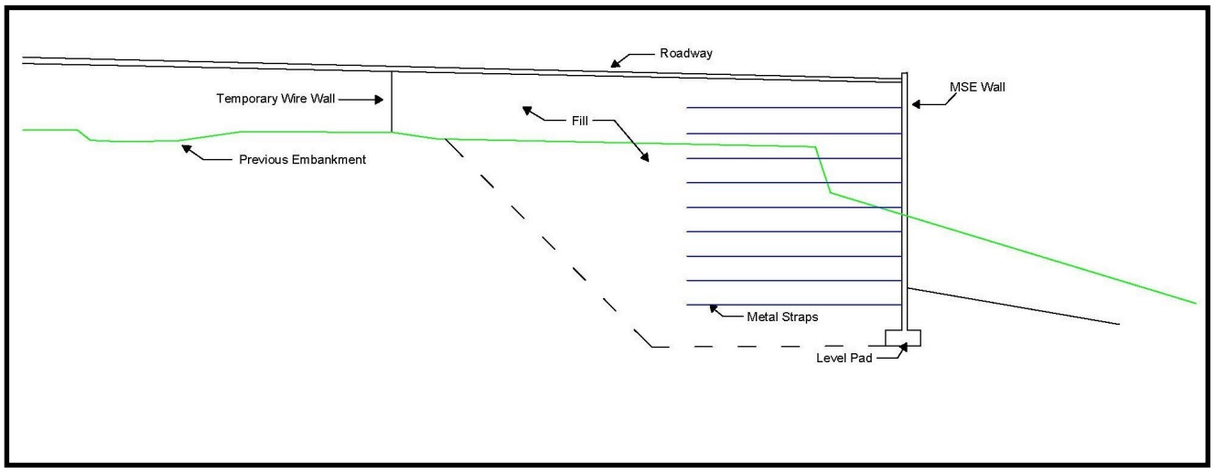

FIGURE 1 TYPICAL CROSS-SECTION OF CONSTRUCTION OF INTERSTATE WIDENING

The basic cross-section across the approaches to the interstate overpasses consisted of the pavement structure, compacted new fill, followed by the old clay embankment fill. The old fill in most places rested on virgin dark clays and then residual clays which transition into a shale bedrock. The new embankment is laterally supported with MSE walls which rested on the old clay fill. The MSE wall was designed using steel straps and a granular backfill with very little fines, thus requiring no wall drainage layer.

The new fill used consisted of tested and approved crushed caliche obtained from near surface deposit from a local quarry pit. The caliche (chalk) deposit was processed at the quarry site by ripping the rock formation and crushing the resulting rock fragments by running tracked construction equipment over them. Massive amounts of the caliche fill was then placed, compacted, and inspected on site to the specifications. The compaction specifications required that the rockfill be compacted to a minimum of 95% Standard Proctor. Also, the exposed in-place and compacted caliche showed the material was well packed with no visual open work and the larger rocks were nested into the remainder of the fill.

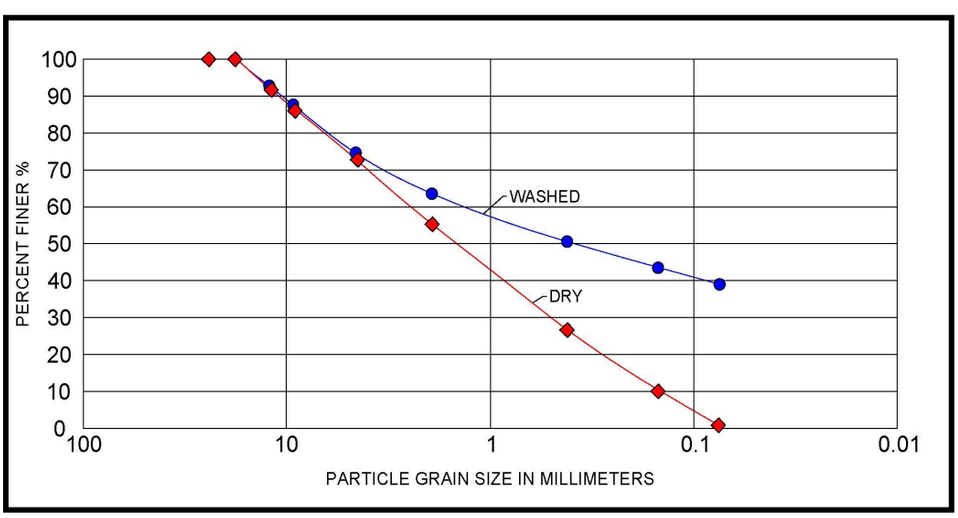

FIGURE 2 GRAIN SIZE CURVES FROM DRY AND WASH SIEVING OF PROCESSED FILL TAKEN FROM THE CHALK QUARRY (MINUS 3/4 IN. FRACTION)

Because of the soft rock-like quality of this material, however, it would undergo additional breakdown when compacted. Laboratory tests show that the caliche particles would break down when

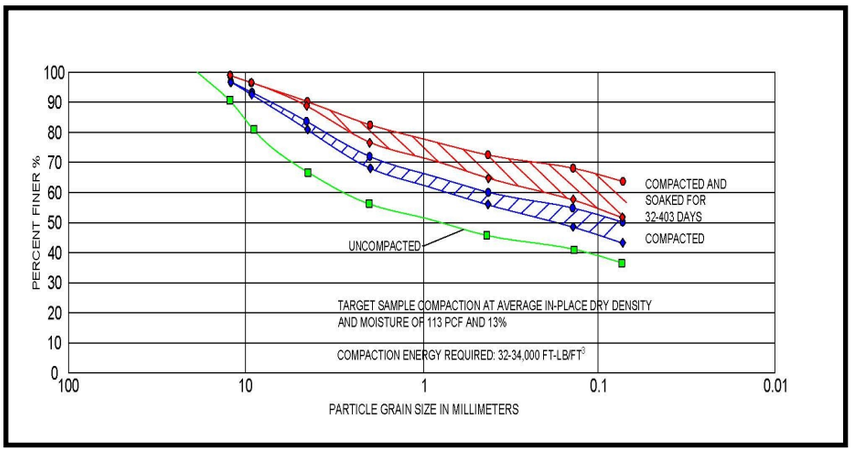

FIGURE 3 GRAIN CURVES AFTER COMPACTION AND SOAKING FOR THE SAME BULK SAMPLES (MINUS 3/4 IN. FRACTION)

soaked in addition to when compacted. This is illustrated in Figures 2 and 3. This was verified when wet mechanical sieving produced 38% more fines than dry sieving (i.e. 1.8% versus 40.0% fines). However, dry mechanical sieving was specified, and thus these submitted test results which were reviewed and approved.

Damage to the MSE walls began during construction. The first wall damage consisted of complete collapse of partially filled MSE walls a couple of panels high and 2-3 panels wide in three areas. These failures appeared to have occurred after rain. Even after several French drains were installed under the level pad footing one of these areas failed again after the wall was completed after a heavy rain. This failure was about 3 panels wide and shown in Figure 4. After noticeable distress, another MSE wall section collapsed. The event again seemed to be precipitated by heavy rains. This failure was a minimum of four panels wide and is shown in Figure 5.

FIGURE 4 COLLAPSE OF MSE WALL SECTION

FIGURE 5 COLLAPSE OF MSE WALL SECTION

These wall collapses appear to have been the result of steel strap pullout cause by the breakdown of the fill which in turn, affected the drainage behind the wall and the strength of fill. The lack of sufficient drainage along the walls resulted in excessive hydrostatic pressure against the wall panels ultimately resulting in failure. The Interstate widening project also experienced other MSE wall distress and roadway approach settlement which were at least in part related to the use of the caliche fill.

Other MEA Publications that may be of Interest:

UPDATE #39 Using Reinforced Soil For Construction Of Retaining Structures and Earth Slopes

UPDATE #42 Advantages Of Reinforced Earth Over Other Retainage Systems

UPDATE #49 Design Submittal Review Difficulties In Open/Braced Cut Construction

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 28 states in the U.S. Our projects primarily have an emphasis on Geotechnical Engineering, however, we also have significant experience in projects involving transportation, subsidence engineering, laboratory testing, training, and geophysical exploration. Gennaro G. Marino, Ph.D., P.E., D.GE is president and founder of Marino Engineering Associates, Inc., and has been a licensed professional engineer since 1984. To obtain additional information on MEA, one can also visit our website at www.meacorporation.com.

FOR MORE INFORMATION: There is a significant amount of additional information that is available on the above subject. For more information, please contact MEA at the address listed below.

MEA
MARINO ENGINEERING ASSOCIATES, INC.
1370 MCCAUSLAND AVENUE, ST. LOUIS, MISSOURI 63117
PH: 314.833.3189 FAX: 314.833.3448
http://www.meacorporation.com