

A new Design and Construction Guideline for Geosynthetically Confined Soil

Recommended procedures for designing Mechanically Stabilized Earth (MSE) structures are provided in documents maintained by government agencies and national trade associations (American Association of State Highway and Transportation Officials, United States Forest Service, National Concrete Masonry Association, Federal Highway Administration, and more). The design approach adopted by these agencies attributes the stabilizing effects of the soil reinforcement as a type of unprestressed “tieback” where the soil reinforcement’s tensile resistance opposes the horizontal earth pressure. The magnitude of the force generated by the horizontal earth pressure assigned to each layer of soil reinforcement or tensile inclusion is in proportion to the individual reinforcement’s elevation in the retaining wall and its vertical spacing between neighboring layers. No credit is given to spacing/confining effects of the inclusions.

This design approach is a translation from externally supported wall systems and fails to reflect observed behaviors. With wider spacing, failure rates of 5 to 10% are reported, and it follows that many more MSE walls exist at factors of safety well below design expectations. With closer spacing and granular backfill, performance exceeds design expectations by factors of 10 to 20. This phenomenon was again demonstrated in NCHRP Report 556.

Members of the Soil Nail Launcher, Inc. team have been involved in reinforced/confined soil research for more than 40 years. The search for an analytical model that reflects measured behavior in MSE has been something akin to the quest for the Holy Grail, and including some of the Pythonian deviations from the original story. However, after years of seemingly futile dead ends, there is light at the end of the tunnel.

We have finally developed a significantly more accurate model for design of earth/geosynthetic composites that may be applied to a specific subset of MSE walls. For these walls the soil reinforcement has an additional stabilizing influence on the soil

mass. In addition to providing a horizontal tensile force opposing the earth pressure (as described above), the soil reinforcement also affects the state of stress within the soil mass effectively providing an "improved" soil shear strength. Because the tension in closely spaced confining elements imparts a confining stress on the soil mass the phrase "Geosynthetically Confined Soil" or GCS is used to differentiate these wall systems from other MSE wall types.

First costs for design and construction are practically the same for the new SNL, Inc. GCS constructions and traditional MSE. Factoring in the cost of current and incipient failures in the prevailing MSE systems, the SNL, Inc. GCS versions are markedly more reliable and therefore less expensive.

SNL, Inc. and their engineers have used this approach empirically in design/construction for decades. Our team has been responsible for spending millions of dollars in MSE research and we have hundreds of millions of dollars worth of structures and related features supported on our GCS constructions. Our designs were based on observed behavior in laboratory and field demonstrations. Now we have a modeling tool that reflects what we learned. We can even design with negative batter.

SNL, Inc. offers the GCS Design Guideline for sale. Please contact us for terms, conditions and costs via email at bob@soilnaillauncher.com