Podcast Introduction

Greetings

Welcome to our #35th Episode of the FGI Podcast Series.

My name is Tim Stark and I am a Professor of Civil Engineering at the University of Illinois at Urbana-Champaign.

On today's episode, we are going to focus on our October 21, 2021 webinar titled: "An Introduction to Mechanically Stabilized Earth (MSE) Walls" with the second portion of the webinar covering detailed design calculations in early 2022.

I would like to quickly re-introduce our distinguished webinar speaker:

Professor Richard Bathurst who is Professor Emeritus of Civil Engineering at the Royal Military College in Kingston, Canada where he has taught since 1980. Richard has authored or co-authored over 400 papers in referred journals, conference proceedings, and research monographs. Dr. Bathurst's primary research activities are focused on the use of geosynthetic and metallic reinforcement in earth retaining wall systems, numerical modelling, seismic performance, and design of these systems. Dr. Bathurst is Editor-in-Chief of the peer-reviewed and popular technical journal Geosynthetics International Journal and past-President of the International Geosynthetics Society (IGS). It is great honor to have Richard join us for the first of two webinars on MSE Walls.

Questions from Live Webinar Presentation That We Didn't Get To:

1. Most examples seem to show the same strap lengths throughout the wall height. Is this most common, or are differing strap lengths common?
   See my response to #1 in the next section of questions.
2. What are the pros and cons to using #10 quarry screenings in the reinforced backfill zone of metal strip MSE walls?
   Recommended practice for MSE walls in North American practice is that the reinforced fill should be well-graded in accordance with the Unified Soil Classification System (USCS) in ASTM D2487. The fines content should not be greater than 15%. There are also pH/electro-chemical property limits that should be respected and these limits can be found in FHWA and AASHTO documents. If the #10 stone is for a particular project, then project-specific fill-steel strap pullout tests should be carried out to provide the designer with project-specific interaction coefficients for pullout design.
3. How do we ensure the shear behavior between the reinforced soil and the retaining soil?
   Include good drainage practice so that water cannot migrate into this interface over the design life of the structure (a geomembrane placed at the base of a surface granular drainage layer could be used for this purpose), and ensure both the backfill and reinforced soils are well compacted.
4. Is it possible that we can provide geosynthetic reinforced soil with integrated bridge system even for railway bridges where more dynamic loads can be expected?
   This has been done in Japan.
5. Isn't a supplementary facing needed to prevent deterioration of the geotextile wrap around face due to prolonged exposure to sunlight?
   If the wrapped face is permanent and exposed, then a protective covering is required. Shotcrete and asphaltic sprays have been used for this purpose. The tall unprotected wrapped face wall that I showed in my presentation was a temporary structure used to support the sides of a pre-load embankment that was constructed to pre-consolidate the foundation soils at the project location. Regardless, cutting of the exposed face due to vandalism is a possibility for any exposed wrapped face structure.
6. What is your view on MSE technology for tailings dams in mining operations - this in light of the disastrous failures the mining industry is prone to?

Based on my understanding of the mechanisms that led to the large tailings failures that have received a lot of press lately, the presence of MSE walls would not have influenced the outcome. The properties of tailings fills vary widely and expected to influence both the internal and external stability of a MSE wall. As just one example I was once involved in pullout testing of geogrid reinforcement materials in oil sand (tailings) backfill. The bitumen content of the soil led to much lower pullout resistance than would be expected for the same soil without a bitumen content.

7. A few months ago FGI presented the webinar for the MSE wall that moved at the West Virginia Airport (?). For the next webinar on MSE berm, would it be possible to also cover that one from an MSE wall design perspective? That is: what could be done better? I recall that the remediation did not involve the MSE technique. Curious if MSE technique would work if changes in design. May want to add a discussion in presentation regarding with water building up behind the wall after construction, (drainage, etc). I have personally dealt with issues with MSE walls due to piezometric head build up behind the wall and also maintenance issues.
   I am happy to discuss the important issues that you mention in my next webinar.
8. Is there a rule of thumb of what the deformation of the MSE wall will be? (to activate active earth pressure).
   Predicting wall deformations is difficult particularly as deformations are very sensitive to type of wall and construction quality. There are publications that provide guidance on specified and expected wall deformations for well-designed and constructed walls. Typical wall deformations are in the range of 1% to 2% of the height of the wall for well-designed and constructed walls. The common belief that the earth pressures in the soil reinforced soil zone are at an active state everywhere under operational conditions is a myth. It is for this reason that the calculation of loads in the reinforcing layers in geosynthetic layers using the stiffness method (and coherent gravity method for steel MSE walls) in the most current edition of the AASHTO specifications is based on back-fitting to measured loads rather than the assumption that the reinforcement loads must resist active earth pressures. All will be revealed in my next webinar.
9. As follow up, I see designers not doing any real design of leveling pad or base for MSE but they do design soil layers and geotextiles. Shouldn't be a problem but we tend to not see the base material being evaluated like a

normal concrete wall would - focus on back material vs lower is the overall question so maybe just bad design use vs method being good.
I agree that for flexible modular block walls the levelling pad design is simple. Recall that these structures can tolerate differential settlements more than walls with concrete panels. For these structures, a concrete footing is recommended and they can be designed as a conventional footing.

10. Is a geofoam cushion placed against a wall good for multiple earthquakes, or does it have just a one-time use? Does all the compression get used up on the first earthquake?
The seismic buffer must be designed to stay within the elastic range of the material for the design earthquake. This can be done by choosing a suitable thickness for the layer. There are specially manufactured geofoam materials that are "elasticized" to increase the initial elastic strain range.

Questions Submitted AFTER live presentation (via survey):

1. Are the strap lengths typically variable with wall height, or of a consistent length? Similarly, does density of straps change with height?
The minimum strap lengths in design guidance documents and codes are prescriptive, e.g. 60% or 70% of the wall height. This can govern the internal arrangement of the straps and is the reason many walls have uniform reinforcement lengths. However, because of the low coverage ratio of the straps, it is not unusual to increase the length of the straps at the top of the wall in order to have sufficient pullout capacity. It is not unusual to have smaller spacing for the reinforcement layers with depth below the top of the wall because the loads in the reinforcement increase with depth consistent with conventional notions of lateral earth pressure theory.
2. From a failure standpoint, and our geotechnical consulting firm has been involved in evaluating 14 MSE wall failures, would you agree with the following of factors contributing to failures? #1 reason – poor construction, #2 reason - poor design, #3 reason - material defects.
Yes. However, I would like to clarify my answer regarding #2 by saying that design principles and methods in use today are safe provided project conditions apply and assumptions made at time of design apply over the life of the structure. Geosynthetic and steel reinforcement materials are highly

engineered materials and are unlikely to have material defects when they leave the plant. Of course, these materials must be handled and installed correctly on site to prevent damage.

3. Is there a study on the use of back fillers with friction angle less than 35 degrees? or what can we do when is not possible to find back filler with the desire grading.
   Designing and constructing MSE walls with lower friction angle soils is possible and indeed is done routinely in countries where only so called "marginal" cohesive-frictional soils are available. Of course, this requires a knowledgeable designer and a competent and experienced contractor.
4. What can be done to maintain MSE wall stability if an excavation is required near the wall base (ex: urban environment utility work)?
   Strategies to support the base of conventional retaining walls are also applicable to MSE walls.
5. What is the fines content limit for the reinforced backfill (fill over geogrid) where an additional aggregate drainage layer would be recommended?
   The reinforced soil should satisfy the gradation specifications published in AASHTO and FHWA guidelines regardless of the presence of an aggregate drainage layer. A maximum of 15% fines is recommend for select fills. Higher fines content can be used with caution for marginal fills.
6. Is it possible to add secondary (taps) layers of geogrids between primary layers to help the connection performance by decreasing the concentrated loads (or pressure) at this zone?
   Yes. However, it is difficult to know or compute the reduction in reinforcement loads in the primary layers using this method. One strategy if the reinforcement spacing is low enough, is to treat the facing plus the short secondary reinforcement lengths as a wider composite facing column. A wider facing column will reduce the load demand on the primary layers.
7. What is your take regarding the use of high modulus geotextiles as reinforcement?
   There is no practical reason why high modulus geotextiles cannot be used to perform the soil reinforcement function.

Thanks to Richard for joining us again and that is all the time that we have today.............

If you have any additional questions or would like additional information, send your question to Professor Bathurst at (bathurst-r@rmc.ca) or download the webinar slides because his email address is on the title and last slides.

the FGI at: fabricatedgeomembrane@gmail.com or visit the FGI website at fabricatedgeomembrane.com.