

May 1, 2008

TO: Mr. James Ray, FHWA Acting Administrator
FROM: Bob Barrett

cc: AASHTO Members, FHWA Officials and Others

SUBJECT: GRS/GCS - A Better Investment than MSE

Starting at the top with no expectation you will see this, I would nevertheless like to send a letter of closure to you and to many of the policy makers in our transportation systems. I will soon be winding down a 40+ year career in research and invention in the transportation fields.

My credentials for this missive are: 2 years with WVDOT; 30 years with Colorado DOT; 11 years as a design/build geotechnical contractor; 7 years as Chair of the TRB Committee on Geosynthetics; 5 years as Chair of NCHRP Panel 12-59 and publication NCHRP Report 556; membership on numerous TRB and NCHRP committees, and patents in Earthquake Resistant Abutments, Retaining Wall Facing Connections; Micropiles, Soil Nails, and Rockfall Fences.

As geotech research manager at CDOT, we spent more than 25 million dollars on reinforced soil research. We partnered with U. S. Forest Service, FHWA, the University of Colorado/Denver and many more. During and since that time, my associates and I have been responsible for over 300 million dollars worth of reinforced soil constructions. We have received numerous national and international awards.

I currently provide tech transfer workshops in the context of advancing the state of knowledge. I make about 60-70 presentations a year and have presented on all continents except Africa (and Antarctica). Much of my program is about the evolution of retaining walls in the U. S., beginning with our CDOT inventions on I-70 over Vail Pass and through Glenwood Canyon; Jerry DiMaggio's big push for a paradigm change to Reinforced Earth and my role as chair of the TRB geosynthetics committee from 90-97 where we guided the development of Mechanically Stabilized Earth (MSE) protocols.

I explain why and how that happened and in looking back, apologize for the outcome. Our haste in getting geosynthetics into the mainstream resulted in theories and assumptions that we have proven wrong. These systems have a failure rate of 2-10%.

I explain that as AASHTO, FHWA and NCMA assumed control, the clock stopped on progress. There has not been a concerted research effort to advance MSE theories or technologies in 20 years. The only attempt at progress that I see is a few folks trying to incrementally to reduce these failure rates. AASHTO's organization with bridge

engineers assuming expertise and control in these soil mechanics-based structures is the largest of the several hindrances. The second is the acquiescence of the geotechnical academic and practicing communities in allowing this to happen to their discipline.

It is a tragedy that engineers continue to support a wall system with a high failure rate. This serves to illustrate how little the AASHTO/FHWA communities know or understand MSE. If our bridges failed at a 2-10% rate, there would be quick action from all quarters.

Worse, perhaps, than a failure rate, is the unknown factor of safety of the walls that have yet to fail. When we assume a 1.3 or 1.5 factor of safety, and there is a failure rate, then certainly the majority of the walls constructed under AASHTO guidelines would not meet 1.3 or 1.5 factor of safety criteria. This will become apparent in earthquakes, floods and reduced service life.

Of course, they say contractor error is the culprit. However, after 20 years of failures, designers must accept that it is an endemic problem. Repeated failures indicate a deeper issue.

Now we have this K-stiffness initiative that claim that the quasitieback "reinforcements" in MSE can be reduced in strength. This revelation came through a review of perfectly constructed research walls and does not capture any of the several demonstrated errors in MSE constructions. The value in cost or time for reducing thickness in a geosynthetic is not measurable in the larger picture. The resultant failures from further reductions in factor of safety can be catastrophic.

Current NCHRP Project 24-22 includes construction of perfectly controlled MSE walls under AASHTO criteria and with lower quality backfill. P. I., Dr. Marr, reported at GeoAmericas 2008 that the first one of these carefully monitored research walls failed during construction! Thus, if research settings cannot guarantee a stable wall, how on earth can a contractor be held accountable?

The tough part of research with GRS/GCS composites was getting one to fail. NCHRP Report 556 describes one test where the lightest silt fence in gravel increased bearing capacity to beyond 10 tons per square foot. That is equivalent to bedrock. It is all about spacing, not strength of the inclusion. Focusing on inclusion strength is how one designs tiebacks.

As a design/build contractor, I can choose any wall - gabion, Hilfiker, bins, cribs, MSE - anything. I want to make the highest margin. I can tell you the least expensive now is GCS, and that it is 20 times more resistant to failure than an MSE wall based on AASHTO/NCMA/FHWA specifications. We spent \$300,000 on NCHRP Report 556

that explains all of this. But the nation is locked up by self-serving monopolies - few copies of 556 have been sold.

We call this more stable wall system Geosynthetically Reinforced Soil, and I call it Geosynthetically Confined Soil. "Confined" better describes the role of the inclusion. "Reinforced" is analogous to tieback systems that are within the expertise of bridge engineers.

GCS (or GRS) is an order of magnitude more resistant to earthquakes than MSE. We have \$300,000 to demonstrate this with [NCHRP Project 12-59(1)]. Dr. Sam Helwany of the University of Wisconsin is leading this demonstration.

GCS is extendable to abutments, boxes, foundations, rockfall barriers, avalanche deflection and more. It is an exciting new frontier. MSE was a necessary transitional link between externally and internally supported (true composite) GCS technologies, but it is now time to move ahead.

I am always open to emails, phone calls, meetings and presentations on this topic. I am retiring in this year and would like to see this GCS research bear fruit - sooner than later. Attached is a PowerPoint presentation that may add some clarity to this letter.

Finally, here is a link to a White Paper that illustrates the depth of misunderstanding at AASHTO with the whole concept of expecting bridge experts to be the proper shepherds of soil mechanics-based retaining systems. It would behoove all of you to have someone explain how inappropriate LRFD concepts are in soil mechanics and GCS walls.

http://www.gcswall.com/upload/AASHTO_Recommends_All_MSE_Walls_be_Larger_More_Expensive.pdf

Best Regards, Bob Barrett