

Appendix Six

WHY WE DO WHAT WE DO

An Essay on our Misguided MSE and GeoMonolith Concepts –Why and How

The Opinions Solely of Robert Barrett and Al Ruckman and written by Robert Barrett

I had the privilege of speaking to the top officials at the headquarters of the China Department of Transportation in Beijing a while back. Before that presentation, we were taken on a tour of the major beltway constructions ongoing around the city and to the Great Wall. Of note was that major concrete retaining walls used to support both sides of the new, elevated freeways were cast on site in beds and involving large numbers of laborers. These panels were elevated from horizontal to vertical with a crane. At the Great Wall and at walls around several old cities throughout the country we could see the product of hundreds of thousands of laborers who used bricks and local soil.

Along our way to these sites, there were numerous small brick yards with stockpiles of bricks of various dimensions. At that time, China had a fledgling geosynthetics industry capable of providing both woven and nonwoven polypropylene fabrics.

So, I came up with the brilliant theme for my keynote that there was an opportunity to bring back the “Great Wall” around Beijing given the ample supply of laborers and the commodity pricing for bricks and fabric. Instead of the expensive concrete panels, those folks could save time and money by building walls that would look just like the walls of their history. I was excited.

I opened with slides from our many years of research and constructions with Geosynthetically Confined Soil technology. I biased the slides with Taiwan and Japan sites and selected from our work those that had Asian participants. I had some of the Great Wall and used those to lead into my main point.

As the talk progressed, I could see an ever frowning audience. I was thinking this was a hard crowd to sell. What I had failed to take into account was that the translators were students from a local university and were liberal arts majors. They had no clue of what I said or what I wanted to say. (Later I ran into this problem in Chile, but I could understand a little Spanish in the headsets, and could rephrase and work through the points of those presentations. Here, no one spoke English, so there was no secondary understanding as there typically is at most out of country venues.)

Bottom line was as Dr. Nelson Chou later recounted, the translator told the top brass that **I said that everything they were doing today was wrong**. Indeed that is hard to sell to any crowd.

Everything We Do Is Wrong

It is hard to sell anything, in fact. My points are not that everything we are doing today is wrong....even if it is....what I want to achieve is for the reader to look in the rearview mirror and see that what was common practice for us 20 years ago has changed, improved, modified and sometimes for the better. This has been and will be the case. Yet, it is our tendency each day to value status quo, to seek peer approval and to use guidelines as rule sets. All the while, history shows that these rule sets often fail the test of time. Process over Product is an alluring addiction.

Look at everything critically...could it be wrong? Is there another explanation? For example, remember how long it took plastics to gain their rightful places in our transportation constructions? So many of our engineers laughed at the thought of using a “plastic” culvert. Reinforced Earth was almost defeated when it first hit the shores of America.

A Perfect Disaster

Within these healthy challenges to the status quo, you will find that major tenants guiding our practice are the result of committee decisions. You should remember above all else that the findings of a committee are reduced to what the least capable at the table can comprehend. ASTM and AASHTO committee selection processes typically brings practicing and directly interested professionals together and with results that can stand the tests of logic and time. Thus the danger of ringers at the table is minimal. These committees are maintained over generations, thus allowing newer members to make incremental change – perhaps a little delayed – but generally appropriate.

The one exception I found was in the committee processes at AASHTO and HiTech for developing design protocols for Mechanically Stabilized Earth. The National Concrete Masonry Association guidelines are also in error, but for different reasons, mostly involving proprietary interests. As per Appendix Two, I chaired the TRB Committee on Geosynthetics during the time period that the basic tenants of MSE were developed.

We knew those first attempts at defining reinforced soil behavior were not perfect. We hoped the errors were conservative, but the overriding mission was to get this powerful new technology in practice.

Unlike today, in the 1990's there was tremendous interest and energy in MSE technologies. Champions emerged to lead implementation. Geosynthetics companies emerged and failed, pinning their hopes on potential markets that did not materialize, much as we see in other boom/bust cycles. When we endorsed what remains the basic guidelines for MSE design, I had every expectation that there would be continual incremental improvements. Much as everything else in our geotechnical sciences.

What happened was a collective "perfect" disaster. I am fascinated with the term "perfect", as in Perfect Storm. That is when everything untoward that can happen does happen and to the maximum of the capability of each element.

Before I blame everything on AASHTO and HiTech, you the reader must go back over the other bits of historical information in these essays. It has only been very recently that I finally am able to quantify the misgivings that Al and I held for decades with MSE. Imagine you have a bucket of asphalt and a sack of gravel. How would you ever provide equations that predicted the behaviors of the possible combinations of those two components? Let's say concrete was our only paving option. Can you imagine the difficulty in introducing asphalt paving? Yet we have used these paving and cover systems to the extent we think we can "design" for it. Asphaltic concrete and cement based concretes are indeed Unique Composites that we test after combining the elements.

Had we, and I include me and Al, understood that GCS was a Unique Composite from day one, the world would be a different place. Seriously. Had we tested our Unique Composite after construction, we would have immediately discerned the critical effect of spacing and would have never thrown the lightweight confining fabrics under the bus in favor of real tiebacks like stiff grids. Grids may not have even stood the test of time. They could have disappeared along with a host of other hopefuls in that emerging market.

If only we could go back in time.

Now to blame everything on AASHTO and HiTech and FHWA would be a stretch, but it is easier to explain the problem if I do. What happened in our zeal to get MSE systems out of the labs and onto the road was that we called them "walls". And where are the rules for walls promulgated? Within the structural committees of AASHTO. And those committees were a table full of ringers. Good people, smart people, but not an ounce of direct experience in the complex soil mechanics world of MSE. So they would "vote" on design protocols. The only real faults I find here is their arrogance to assume they were "qualified" to even discuss MSE

regulation, and the spineless geotech community who raised no protest. You can take me and Al out of that camp. I have ridiculed the AASHTO process in this one case for decades. I don't think that they don't know that they don't know.

To their credit, what I supported through my TRB committee was this absolute misconception on what MSE should be. And to their discredit, these rule making groups have few members within their ranks who could have seen what we just discovered and there is no one there now to react.

Implementation Barriers Lifted

One of more exciting aspects of our new found ability to explain the heretofore counterintuitive behavior of GeoMonoliths is that our academic, private and public sector engineering communities now can develop stochastic and empirical design models with confidence based on tests on full scale models. GeoMonolith behavior was counterintuitive only because we were using simple composite, tieback analogies for visualization and as bases for attempts to develop mechanistic design protocols. Unique Composites can and do exhibit behaviors very different than their components suggest, thus in understanding this, there is nothing counter to our intuitions. We simply test the Unique Composite and accept the results.....with appropriate factors of safety, of course. And then go to the field and build.



DEFIANCE COUNTY, OHIO BRIDGE ON GRS/GCS® ABUTMENTS

Less cost, longer lasting, faster to construct and no bump – The Bridge of the Future

Conclusion

Let me attempt to deepen my points with more inflammatory statements. It is a queer aspect to me is how some of our best engineers and teachers in both public and private practice continue to defend MSE and demonize GCS/GCS® with uninformed statements like “too expensive”. Hardly anyone has even seen a GCS®/GeoMonolith construction, let alone understands the time/cost efficiency of that system. I am a design/build/warranty contractor – lower total cost and risk are why we use the generic GRS/GCS®GeoMonolith systems. This brings to question the motivation for clinging to one single mode of “reinforced earth” for a lifetime when tons of research and field demonstrations validate that our founding precepts of MSE are faulty. Our designs lead to multiple field errors..... which result in a failure rate.

In this age of enlightenment, why would our engineers and professors value status quo? My explanation is paradigm fixity, compounded by progressively devaluing responsible engineering with reliance on “standards”, “guidelines”, “peer review”, “accepted practice”, and “risk aversity” to the extent we have produced a generation of “Supertechs”. And so MSE, even with a failure rate, can somehow be condoned as long as we follow AASHTO or NCMA or the FHWA Demo 1982. Proven misconceptions are brushed aside since everyone else is doing it. We can’t change the guidelines. Those regulatory groups do not lead change, they follow practice. Practice can’t change because the guidelines don’t allow.

Go back to day one with me. It is finally obvious that the first “fabric walls” with close spacing performed beyond expectations because of Unique Composite behavior, something that we now know is like concrete, not a sum of its parts. Unique Composites must be measured and modeled after combining the elements. But what we said was the observed performance was due to the added tensile strength of the inclusion and could be modeled as a sum of the constituents with Rankine theory and element contribution. That approach says one strong sheet on wide spacing is equal to several weak sheets on close spacing. Hence the origin of MSE. We have been chasing our tails since. The search for a mechanistic modeling protocol to unify both paradigms continues, its futility blinded by paradigm fixity. Indeed, I was a party to this.

What I hope now is that you, the reader, will use your newfound recognition and understanding of Unique Composites vs simple composites to better utilize both disciplines, MSE and GeoMonoliths. My expectation is that this will generate renewed interest in research. Good times are ahead for those of us who can adapt to a new paradigm where you can do some real, generic engineering. Then no one could say that *everything* we do is wrong.

Robert K. Barrett, July, 2010

