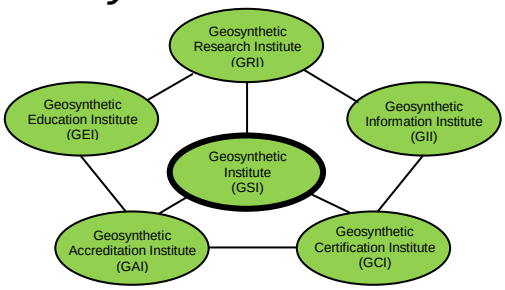
The GSI Newsletter/Report

Geosynthetic Institute



Vol. 31, No. 2 **June, 2017**

This quarterly newsletter, now in its 31st year, presents the activities of GSI and its related institutes to all who are interested. It is available on the institute's home page at www.geosynthetic-institute.org. It also serves as a quarterly report to its member organizations. Details are available by contacting George R. Koerner or Marilyn Ashley at phone (610) 522-8440; fax (610) 522-8441 or e-mail at gsigeokoerner@gmail.com or mvashley@verizon.net.

Activities of GSI's Directors and Officers

1. The Board of Directors is currently reviewing the 20-proposals submitted for GSI endowment funding. Many good topics appear to be worthy. Level of funding is $5000 and after rating them we will see how much we can afford.
2. The PVD (wick drain) specification has been approved and promulgated. It is GRI-GC16 and is one our website under "specifications".
3. A new project has been launched as to the tensile strength of PVDs in contributing to the shear strength of foundation soils. It includes both theory and laboratory testing.
4. GSI has contributed a webinar on MSE Walls and Slopes to the International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE) and it was broadcasted on June 13, 2017 followed by a 48-hour Q&A session.
5. Dr. Grace Hsuan received ASTMs 1st Dave Suits Award for test method development (see Page 7 herein).
6. Your nine person GSI Board of Directors is presently as follows:

Term Ends 2017

- Tony Eith - CEC Consultants, Inc. (Consultants and Testing Labs)
  e-mail: teith@cecinc.com
- Nathan Ivy - AGRU America Inc. (Geomembranes and GCL's)
  e-mail: nivy@agruamerica.com
- Moreno Scotto - Maccaferri (International - 2)
  e-mail: moreno.scotto@gmail.com

Term Ends 2018

- John Workman - Waste Management Inc. (Owners and Operators)
  e-mail: jworkman@wm.com
- Mark Wayne – Tensar Earth Technology (Geotextiles and Geogrids)
  e-mail: mwayne@tensarcorp.com
- Sam Allen – TRI Environmental Inc. (At-Large)
  e-mail: Sallen@tri-env.com

Term Ends 2019

- Kent von Maubeuge - NAUE GmbH & Co. KG (International-1)
  e-mail: kvmaubeuge@naue.com
- A. K. Mukhopadhyay – BTRA & GSI-India (Agencies)
  e-mail: btra@vsnl.com/btradirector@gmail.com
- Ashish Sukhadia – Chevron Phillips (Resin and Additives)
  e-mail: sukhaam@cpchem.com

IN THIS ISSUE

Overview of GRI Projects (Research)

The following projects are all funded by GSI membership dues unless specifically noted. Most are long-term projects for which we are well positioned to accomplish. *Those projects marked with an asterisk have written papers available; please ask and we will send them accordingly.* Contact George Koerner (gsigeokoerner@gmail.com), Grace Hsuan (g.hsuan@coe.drexel.edu) or Bob Koerner (robert.koerner@coe.drexel.edu) for details and/or discussions.

1. **In-Situ Temperature Monitoring of Liner and Cover Geomembranes in Dry and Wet Landfills*** - George Koerner is measuring the in-situ temperature behavior of liner and cover geomembranes and has installed multiple thermocouples for long term measurements in both wet and dry municipal solid waste landfills in Pennsylvania. The project has been extended into its 19th-year and has resulted in an extremely authoritative set of real-life data which is being used by many researchers in their geomembrane lifetime predictions.
   Note: Several landfills have reported elevated temperatures and the U.S. EPA has recently convened a workshop to assess the situation… more later.
2. **Field Exposed Lifetime of Geogrids Used at the Facing of Landfill Berms** - The facing of mechanically stabilized earth landfill berms (and other walls and slopes as well) is often using a wrap-around configuration leaving the geogrid exposed to the atmosphere. A project being conducted by George Koerner is presently investigating the behavior of two different geogrids over time. A 50-year time frame is envisioned! The long-term behavior will eventually be compared to UV laboratory predicted data as noted previously.
3. **Laboratory Exposed Lifetime of Geomembranes*** - GSI is using three UV-fluorescent devices to estimate the projected exposed lifetime of six different types of geomembranes. They are HDPE, LLDPE, fPP, EPDM, PVC (N.A.) and PVC (Euro.). They are being incubated at 60, 70, and 80°C until halflife or strength and elongation are measured. The goal is lifetime prediction. Some will take at least 90,000 light hours (~ 12.3 years). GRI Report #44 is available on results to date and a webinar is also available. The information was made available to the public in April 2016 at Orlando and will again be presented in Peru on March 30. 2017. It has now been republished in the International Geosynthetics Journal. A copy is available. (In this regard it should be noted that we have withheld the information before publication for well over a year which has been our custom.)
4. **HDPE Geomembrane Lifetime as a Function of Thickness** - This often encountered question is being evaluated by exposure at 80°C in a QUV weathering device per ASTM D7238. Formulations are exactly the same and only the sample thicknesses vary. These thicknesses are 2.76, 2.44, 1.58, 1.08, 0.77 and 0.48 mm. Parameters being evaluated in this decade long study are change in thickness and presence of crazing or cracking. Time will tell!
5. **Exposed Lifetime of Creased Geomembranes** - Stemming from a recent webinar on the effect of backfilled GM waves we have seven geomembranes which are purposely creased in double 180° bends being incubated at 80, 65, 55 and 25°C temperatures as of February 10, 2017. They are HDPE, LLDPE, LLDPE-R, fPP, fPP-R, EPDM and PVC. The project promises to take many years but should be revieling.
6. **Laboratory Exposed Lifetime of PVC (European) Geomembranes** - We have been evaluating five different European formulations for four years using three dedicated UV-fluorescent devices and the results are very impressive. The study is being conducted for CARPI Tech, a GSI member organization. The project also allows us to distinguish between PVC geomembranes manufactured in North America versus Europe. The differences are in the type of plasticizers used in the formulations as well as thicknesses.
7. **Laboratory Exposed Lifetime of Geotextiles** - A similar UV study as with geomembranes, geogrids and TRM filaments has been conducted on various geotextiles. Woven monofilaments, woven slit films, nonwoven heat bonded and needle punched types are included. In the latter are four different weights of needle punched nonwovens. All data along with laboratory and field lifetime predictions are included in GRI Report #44 and the aforementioned International Geosynthetics Journal paper in Item 4.
8. **Cable Tied Geonet Evaluations** - A study has been focused on the plastic cable ties used to connect the overlapped ends and edges of geonets and geospacers. The draft of a new GRI Test Standard is available as well as the draft of a technical paper.
9. **Retaining Wall Failure Evaluations* -** We presently have GRI Reports 38, 39, and 40 addressing mechanical stabilized earth (MSE) walls using geosynthetic reinforcement which document 82-failures. Our data base has now grown to 141, then 171, then 286 and now 307! *Readers, we have a very serious situation in this regard!* The failures are either excessive

deformation or collapses. We have presented one-day courses on this topic along with inspector training and development insofar as a field inspectors certification program; see the certification section of this Newsletter/Report. A paper was published by the Journal of Geotextiles and Geomembranes in October, 2013 and the publisher (Elsevier) reports that 1400 requests have been made to date. It was voted as being the best paper of 2013 by the journal. This was the topic of a GSI course and lecture presented at GeoAmericas in April, 2016. An up-to-date GSI webinar is available.

10. **pH Between Masonry Block Wall Units*** - George Koerner has been measuring the pH between three types of masonry blocks for over seven years to monitor the values. Concern here is over PET geogrids which are known to be sensitive to very high alkalinity environments. Indeed, the values started high, but over time are now down to eight and lower. George has a paper in this regard.
11. **Landfill Failure Analysis** - Since our originally reported paper on ten landfill failures in a 2000 publication, we have accumulated ten more. All 20-failures have been analyzed using the ReSSA Code and are now available to members and associate members as GRI Report #41. The latest two failures in this regard are both in Pennsylvania and one resulted in a worker's death!
12. **Slow Pressurization of HDPE Geomembranes in Axi-Symmetric Testing* - The** ASTM D5716 method of testing geomembranes in a 3-D axi-symmetric mode uses a pressure rate of 6.9 kPa/min (1.0 psi/min). While such a rate is appropriate for most geomembrane types, it is very fast for HDPE which is semi-crystalline and cannot readily stress relax so as to accommodate the applied pressure. To investigate slower rates we have initiated a project with rates as low as 6.9 kPa/month (1.0 psi/month)! The last test, just now begun, is at a rate of 6.9 kPa/six months (1.0 psi/six months) and it will take an estimated five years to conclude. A preliminary paper was presented at Geosynthetics '15 in Portland.
13. **Temperature Behavior Under Different Geosynthetic Layers -** Since exposed lifetime of geosynthetics is influenced by sunlight the lifetime of layers directly beneath the uppermost one (heat only, but no sunlight) is of interest. George Koerner has set up such a scenario on behalf of Watershed Inc., a GSI member.
14. **Mega Water Bags for Fresh Water Ocean Transportation** - Back in 1996 we gave the Terzaghi Lecture and suggested that massive geosynthetic bags filled with fresh water could easily be towed in the ocean thereby supplying drinking water where needed. To date it is occurring in Cypress and in several Caribbean Islands. A new GSI project is being considered. If readers have interest and ideas please advise while we are small in the experimental design phase.
15. **Generic Specifications** - A major continuing effort is ongoing with respect to the development and updating of GRI's generic geosynthetic specifications. The current status of these specifications is as follows. Incidentally, all 17 are currently being copyrighted.

<u>Completed and Available on our Website</u>
GM13 – HDPE Geomembranes
GM17 – LLDPE Geomembranes
GM18 – fPP and fPP-R Geomembranes
GM19 – Geomembrane Seams
GM21 – EPDM and EPDM-R Geomembranes
GM22 – Scrim Reinforced PE Barriers (New)
GM25 – LLDPE-R Geomembranes
GM28 – CSPE-R Geomembranes
GM30 – Coated Tape PE Barriers (New)
GCL3 – Geosynthetic Clay Liners
GS15 – Geocells using HDPE Strips
GT10 – Geotextile Tubes
GT12 (a and b) – Geotextile Cushions
GT13 (a and b) – Geotextile Separators
GCL3 – Geosynthetic Clay Liners
GC14 – Turf Reinforcement Mats
GC16 – Prefabricated Vertical Drains (New)

<u>Working; Available Upon Request</u>
GGXX – Bidirectional Geogrids (tabled)
GGXX – Unidirectional Geogrids (tabled)
GNXX – Geonet Drainage Composites (tabled)

The complete set of formalized specifications are available to everyone (members and nonmembers) on the open section of our Home Page. Please download and use them accordingly. There is a brief tutorial accompanying each specification. Also note that this is where the latest modification will always be available. They are updated/modified on an as-required basis.

16. **Other GRI Standards** - There are several GRI Standards in various forms of preparation. These include the following:
    - A practice on field seaming inspection emphasizing the electrical leak location system (ELLS).
    - Three standards on GCL joining so as to prevent/monitor panel separation.
    - A standard on GN joining with plastic cable ties… see Item 8.
    - A guide as to recommended testing of drainage geocomposites.
    - A practice explaining the use of MARV for geotextiles
    - A transverse rib bending test for homogeneous geogrids

Progress within GII (Information)

Our GSI Home Page is accessed as follows:

<<http://www.geosynthetic-institute.org>>

It has been revised and is being maintained through the fine efforts of Marilyn Ashley. Everyone (members and nonmembers) can access the open part, which has the following menu:

- **Introduction to GSI**
- **Prospectus**
- **Associate Membership (Agencies)**
- **Members by Focus Groups**
- **GSI Publications**
- **GRI Specs, Guides, White Papers**
- **Laboratory Accreditation**
- **Product Certification**
- **Newsletter/Reports**
- **Internet Courses**
- **GSI Members Links**
- **GSI Member Meetings**
- **Courses at GSI**
- **Insp. Cert. Programs**

To go further one needs a members-only password. Your contact person (see the last section of this Newsletter/Report if you do not know who it is) must get a password from Marilyn Ashley. Marilyn can be reached by e-mail at mvashley@verizon.net. When you get into this section, the following information is available. This includes:

- **GRI Test Methods**
- **GRI Reports**
- **GRI Technical Papers (Citations)**
- **Notes of GSI Meetings**
- **Links to the GSs World**
- **Keyword Search for Literature**
- **Example Problems**
- **Frequently Asked Questions (FAQs)**

The Keywords Section contains about 35,000 citations which is the majority of the geosynthetics literature published in English. It is updated as each published paper is received. Citation retrieval is quite easy provided that you have a specific topic, or area, in mind. This is the section of the website that we (and others we are told) use the most in our daily activities.

In addition to the information provided in our home page as just mentioned, Jamie Koerner (Special Projects Coordinator) performs various surveys on pertinent topics in geosynthetics. The latest is a survey on the regulatory aspects of heap leach mining. Also, if you have topics in need of the current status please advise accordingly.

Progress within GEI (Education)

GRI Reports

To date, we have 45 GRI Reports available to members and associate members. These reports vary in length from 30 to 200 pages and beginning with Report #25 they are on the password protected section of our home page. Prior to that date only the abstract is available online. All of them, however, are available in hard copy. Our most recent report is:

- #45 - A Review of 3000 Geosynthetic Q&As on the GMA Techline Since Its Inception in 2004. In it are the 100 "most difficult" questions asked and answered since the Techline's inception in 2004.

GSI Webinars (90 minutes long)

11:30 AM – 1:00 PM (Eastern Time Zone)
Registration at
www.geosynthetic-institute.org/webinar.htm
1.5 Professional Development Hours
Nonmembers Cost - $250; Members Cost - $200

Commentary on Webinars: Never in Bob K's long career has he "reached out" to so many people than when giving these GSI and ASCE webinars. For the single cost of $250 or $200 a feed is delivered over Adobe Connect to the requested site. This can be anywhere, e.g., office, conference room, auditorium or even sent to additional offices and sites. For example, NY-DEC had the feed going into their Albany auditorium and then into the 13-regions of New York State. Clearly, hundreds of participants were involved.! *Dear readers; on-line distance learning, aka, webinars, is the way to communicate information to masses of people in an inexpensive and time efficient manner. Indeed, the future of learning is here!* The remaining 2017 schedule of GSI Webinars is as follows:

Date	GSI No.	Title
June 28	W-21	Geosynthetic Applications in the Private Sector
July 12	W-15	In-Situ Stability of Soil Slopes Using Nailed GS
August 9	W-16	Sand Drains-to-Wick Drains to Sand Columns
September 13	W-17	Geosynthetics in Erosion Control
October 11	W-1	MSE Wall Failure Data Base (301 cases)
October 25	W-2	MSE Wall Back Drainage Design
November 8	W-3	MSE Wall Remediation and Monitoring
December 13	W-4	MSE Wall Field Construction Inspection Practices

Courses

We are now abandoning our in-house, one-day, courses (which have been given for the past 30-years) and delivering two of them in six segments over three consecutive days, one each morning and then afternoon. They are the following:

1. Quality Assurance/Quality Control of Geosynthetic in Waste Containment Facilities (scheduled for June 6-7-8, 2017)
2. Construction Inspection of Mechanically Stabilized Earth (MSE) Walls, Berms and Slopes (scheduled for July 25-26-27, 2017)

The third and newest of these courses is an On-Line "Designing With Geosynthetics (DwG)" course. Please go to http://www.geosynthetic-institute.org/courses.htm and scroll down to Course #3. Here you will see the requisite details. The course itself is completely coordinated with the 6th Edition of the DwG textbook. It consists of 1540 slides with ~ 18 hours of voice over; about one minute for each slide. See the special writeup in this Newsletter/Report.

Contact Jamie Koerner at jrkoerner@verizon.net if you want information and details.

GSI Fellowships

A major change over previous years has been quite successful again this year. We now offer fellowships for masters and doctoral students. The stipend is $5000 for a single year, rather than three multiple years. This change resulted in 16-proposals which were reviewed and graded by the GSI-BoD and ourselves. Nine were accepted and are listed below. If a specific proposal is of interest please contact Jamie Koerner at jrkoerner@verizon.net. Requests for RFPs for the 2017-'18 A.Y. are being reviewed currently.

GSI Fellowships for 2016-'17 A.Y.

No.	Name	University	Advisor	Topic
1	Abbaspour, Aiyoub	George Mason University	Burak Tanyu	Clogging evaluation of drainage geotextiles using recycled concrete aggregate
2	Ekici, Anil	Middle East Technical Univ.	Nejan Huvaj	Interaction of marginal fills and geogrids for walls and slopes
3	Guo, Jun	University of Kansas	Jie Han	Soil column tests to evaluate wicking geotextile to remove water
4	Haselton, Henry	Montana State University	Steve Perkins	Biaxial response of geosynthetics
5	Kermani, Behnoud	Penn State University	Ming Xiao	Geotextile separation preventing particle movement into pavements due to cyclic loading
6	Maddah, Layal	Texas A&M	Jean-Louis Briaud	MSE Walls subjected to vehicle impact on roadside barrier systems
7	Morsy, Amr	University of Texas	Jorge Zornberg	Composite behavior of geosynthetic reinforced structures
8	Yilmaz, Mehmet	University of Wisconsin	James Tinjum and Craig Benson	Co-extruded EVOH geomembrane covers to avoid Landfill gas emissions
9	Zheng, Yewei	University of California SD	Patrick Fox	GRS abutments with bridge superstructure under seismic loading

Activities within GAI (Accreditation)

The Geosynthetic Accreditation Institute's (GAI) current mission is focused on a Laboratory Accreditation Program (LAP) for geosynthetic test methods. George Koerner is in charge of the program. The GAI-LAP was developed for accrediting geosynthetic testing laboratories on a test-by-test basis. GAI-LAP suggests that laboratories use ISO 17025 as their quality system model. In addition, the program uses the GSI lab as the reference test lab and operates as an ISO 17011 enterprise. *It should be emphasized that our GSI lab does not conduct outside commercial testing.*

It should also be made clear that GAI-LAP does not profess to offer ISO certification, nor does it "certify" laboratory results. GAI-LAP provides accreditation to laboratories showing compliance with equipment and documentation for specific standard ASTM, ISO or GRI test methods. In addition, GAI-LAP verifies that an effective quality system exists at accredited laboratories by way of proficiency testing.

There have been significant additions to the number of GAI-LAP tests. Presently, there are 245 GAI-LAP test methods available for accreditation. Please consult our home page for a current listing.

As of June, 2017, the following laboratories are accredited by the GAI-LAP for the number of test methods listed in parenthesis. Contact personnel, telephone numbers and e-mails are also listed.

1^{A} - TRI/Environmental Inc. (155 tests)
Jarrett Nelson -- (512) 263-2101
jnelson@tri-env.com

3^{A} - Golder Associates (43 tests)
Henry Mock -- (770) 492-8280
Henry_Mock@golder.com

4^{C} - Geosynthetic Institute (109 tests)
George Koerner -- (610) 522-8440
gkoerner@dca.net

8^{B} - Propex Operating Co., Ringgold (11 tests)
Todd Nichols -- 438-553-3757
todd.nichols@propexglobal.com

9^{B} - Lumite (16 tests)
Rebecca Kurek -- (770) 869-1187
rkurek@lumiteco.com

13^{A} - TRI Env. Inc. (Precision Labs) (86 tests)
Cora Queja -- (714) 520-9631
cqueja@tri-env.com

14^{A} - Geotechnics (51 tests)
J. P. Kline -- (412) 823-7600
JPkline@geotechnics.net

20^{A} - GeoTesting Express, MA (60 tests)
Gary Torosian -- (978) 635-0424
gtt@geotesting.com

22^{B} - CETCO Hoffman Estates (11 tests)
Barbara Gebka – (847) 851-1500
barbara.gebka@cetco.com

24^{B} - CETCO Lovell (10 tests)
Stuart Yates -- (307) 548-6521
stuart.yates@colloid.com

25[B] - Ten Cate, Pendergrass (13 tests)
Jennifer Clark -- (706) 693-2226
j.clark@tencate.com

26[B] - Agru America Inc. (27 tests)
Maria Coffey -- (843) 325-6119
MLockliear@AgruAmerica.com

29[e] - FITI Testing and Research Institute (84 tests)
Dong Whan Kim -- 82-2-3299-8071
dwKim@fitiglobal.com

31[D] - NYS Dept. of Transportation (9 tests)
Tom Burnett -- (518) 457-4704
tburnett@dot.ny.gov

32[A] - Geo-Logic Inc. (6 tests)
Ken Criley -- (530) 272-2448
kcriley@geo-logic.com

34[B] - GSE Environmental Richey Road (29 tests)
Mauricio Ossa
mossa@gseworld.com

38[C] - Sageos/CTT Group (122 tests)
Eric Blond -- (450) 771-4608
eblond@GCTTG.com

40[B] - GSE Environmental (14 tests)
Mary Thompson -- (843) 382-4603
mthompson@gseworld.com

41[A] - SGI Testing Service, LLC (18 tests)
Zehong Yuan -- (770) 931-8222
ZYuan@interactionspecialists.com

42[C] - NPUST (GSI-Taiwan) (71 tests)
Chiwan Wayne Hsieh -- 011-886-8-7740468
CWH@mail.npust.edu.tw

43[A] - Ardaman & Associates (22 tests)
George DeStafano -- (407) 855-3860
gdestafano@ardaman.com

44[B] - Fiberweb, a Berry Global Inc. Co. (9 tests)
Mitchell Clendenin -- (615) 847-7193
mitchellclendenin@berryglobal.com

45[B] - Ten Cate Geosynthetics Malaysia SDN Bhd. (24 tests)
Boon Kean Tan -- (603) 519 28576
b.k.tan@tencate.com

46[B] - TAG Environmental Inc. (13 tests)
Colin Murphy -- (705) 725-1938
colin_murphy@tagenv.com

49[B] - Engepol Geossinteticos (15 tests)
Patricia Ferreira -- (55) 51 3303-3901
patricia@engepol.com

50[B] - ADS, Inc. Hamilton (7 tests)
Terry McElfresh -- (513) 896-2065
terry.mcelfresh@ads-pipe.com

51[B] - Solmax International Inc. (22 tests)
Simon Gilbert St. Pierre -- (450) 929-1234
simonGSP@solmax.com

53[B] - Polytex Autofagasta (19 tests)
Maria Teresa Ortiz Lopez -- 011 55-2883308
mortiz@polytex.cl

55[B] - Atarfil Geomembranes (21 tests)
Gabriel Martin Sevilla -- 34 958 439 200
gmartin@atarfil.com

56[B] - Polytex Santiago (13 tests)
Maria Teresa Ortiz Lopez -- 011 56-2-677-1000
mortiz@polytex.cl

57[B] - Ten Cate Cornelia (22 tests)
Melissa Medlin -- (706) 778-9794
m.medlin@tencate.com

58[B] - Propex Operating Co.Hazelhurst (16 tests)
Victoria Shoupe -- (912) 375-5406
Victoria.Schoupe@propexglobal.com

59[B] - Firestone (9 Tests)
Janie Simpson -- (864) 439-5641
SimpsonJanie@firestonebp.com

60[B] - Polytex Lima (14 tests)
Roberto Diaz Palacios -- 51 16169393
rdiaz@polytex.cl

61[B] - Raven Industries (18 tests)
Clint Boerhave -- (605) 335-0288
Clint.Boerhave@ravenind.com

62[B] - Solmax International Asia (14 tests)
Pei Ching Teoh – (450) 929-1234
pcteoh@solmax.com

63[A] - TRI Environmental, Inc.; DDRF (4 tests)
Jay Sprague -- (864) 346-3107
Jesprague@tri-env.com

64[B] - Agru America (NV) (14 tests)
Ryan Steele -- (775) 835-8282
RSteele@AgruAmerica.com

65[C] - Bombay Textile Research Assoc. (BTRA) (23 tests)
Riyaz Shaikh
(0) 022-25003551
btra@vsnl.com

66[B] - Rowad International Geosynthetics Co. Ltd (14 tests)
Mohammad Usman Ansari -- +966-3-812-1360
mu.ansari@tasnee.com

68[B] - Glen Raven Technical Fabrics LLC (4 tests)
Andrea Saurage -- (336) 229-5576
asaurage@glenraven.com

69[B] - GSE Environmental (13 tests)
Siriporn Chayaporenlert – 6638-636638
Siripornc@gseworld.com

70[A] - RSA Geo Lab LLC (47 tests)
Rasheed Ahmed – (908) 964-0786
geolab13@yahoo.com

71[B] - Plasticos Agricolas y Geomembranas S.A.C. (24 tests)
Manuel Constantino Olivares Espinoza –
073-511814-511829
calidad@pgaperu.com

72[B] - Tensar Corp. GA (4 tests)
Lynn Cassidy (770) 968-3255
lcassidy@tensarcorp.com

73[B] - Gai Loi JSE (10 tests)
Paul Wong 84-650-362-5825
paul905677@gmail.com

74[B] - Agru Amercica Inc. (9 tests)
Mark Lockliear - (843) 325-6119
mlocklear@AgruAmerica.com

75[B] - GeoMatrix S.A.S. (24 tests)
Javier Diaz Cipagauta (571) 424-9999
jdiaz@geomatrix.com.co

76[B] - Tehmco (Chile) (15 tests)
Patricia Rojas Perez (562) 580-2852
projas@tehmco.cl

78[B] - PQA Mexico (15 tests)
Cesar Agusto Arcila (669) 954-8202
directorcalidad@payg.mx

79[A] - TRI Geosynthetic Testing and Services (32 tests)
Ping Wang 86-512-6283-1396
Pwang@tri-env.com

80[B] - Texel Technical Materials (8 tests)
André Parent (418) 387-4801
andre.parent@texel.ca

81[B] - GSE Germany (18 tests)
Evelyn Kroeger 49-40-767420
ekroeger@gseworld.com

82[B] - CARNO ATC (1 test)
Mary Lynn Smith (770)-427-9456
marylynn.smith@cardno.com

83[B] - GSE Egypt (13 tests)
Ahmed Abdel Tawab - 202-2-828-8888
atawab@gseworld.com

84[B] - Interwrap India (14 tests)
Ashutosh Dixit - 1-778-945-2888
adixit@interwrap.com

85[B] - PAG Tacna (17 tests)
Manuel Constantino Olivares Espinoza –
073-511814-511829
calidad@pga.peru.com

86[B] - BOSTD China (29 tests)
Zheng Hong - 86-532-8780-6919
zhenghong@bostd.com

87[B] - Willacoochee Industrial (18 tests)
Jason Booth - 912-534-5757
jason@winfabusa.com

88[B] - Geosynthetic Testing Services Pvt. Ltd. (16 tests)
Deepak Manjunath - 91-02717-250019
dmanjunath@gts-pl.com

89[B] - Megaplast India Pvt. Ltd. (13 tests)
Hermendra Behera - 91-937404-4620
geo.sqc@megaplast.in

90[B] - Techfab (India) Industries Ltd. - Daman (10 tests)
Jagdish Chandra Joshi - 91-22-2287-6224
nonwoven.qualitylab@techfabindia.com
Anant Kandi - anant@techfabindia.com

91[B] - Techfab (India) Industries Ltd. - Rakholi (3 tests)
Rajendra Chavan - 91-982-593-9922
geogrid.qualitylab@techfabindia.com

92[B] - Techfab (India) Industries Ltd. - Khadoli (2 tests)
Jagdeesh B.S. - 91-22-229-76224
geotxt.works@techfabindia.com

[A]Third Party Independent [C]Institute
[B]Manufacturers QC [D]Government

If anyone desires more information on the GAI-LAP, its test methods, the associated laboratories, etc., a directory is published in December of each year. It is available on GSI's home page at http://www.geosynthetic-institute.org (Accreditation).

George R. Koerner

Commentary on ASM Specifications

On June 14, 2017 with ASTM committee D35 on Geosynthetics in Toronto Canada had a workshop on Geosynthetic Specifications. There were forty-three people in attendance for this two hour workshop which had five presentation contained within it. The agenda for the meeting was as follows;

1. Opening remarks- Jim Goddard
2. Workshop Overview- David Suits
3. Presentations
    a. International Experience on Specifying Geogrids-Chris Quirk, NAUE
    b. Overview of Geomembrane Specifications-Gary Kolbasuk, Raven Industries
    c. Waterproofing Geomembrane durability and service life for below grade structures-Rimon Salah, Sika
    d. Knitted Sock related to ASHTTO M-288, Paul Mutter, Zodiac Fabrics
    e. Geocell Strength and Stiffness, Eyal Blatmen, PRS Geo-Technologies
4. Open Discussion
5. Summary and conclusions

There was consensus at the meeting that a new committee will be started within ASTM addressing Geosynthetic Specifications (D35.06) and that L. David Suits will chair the committee. It was also decided that the first three specifications that will be attempted are as follows;

1. Geogrids,
2. Geocomposite drainage products
3. Waterproofing Geomembranes

The group wants to pursue specification creation regardless that there are multiple existing generic specifications in our industry. They believe that ASTM is the proper forum for such an effort and that it compliments their repertoire of test methods, guides and practices. It should be pointed out that ASTM D35 already has eleven specifications on its books.

Award to Professor Grace Hsuan

Congratulations are extended to Dr. Grace Hsuan, of Drexel University and the Geosynthetic Institute (GSI), who received the initial L. David Suits Award from ASTM Committee on Geosynthetics (D35). This award is given to individuals who distinguish themselves in the geosynthetics field with contributions that result in an advancement of geosynthetic knowledge in the areas of test methods, guides, practices and specifications. Grace is the first recipient of this prestigious award which was presented in person by Dave Suits in Toronto, Ontario, Canada during committee week. Dr. Hsuan was humble in her acceptance of the award and gave credit to the geosynthetic community that worked together to establish ASTM D5397 Test Method for "Evaluation of Stress Crack Resistance of Polyolefin Geomembranes using Notched Constant Tension Load Test" and other durability test methods contained in GRI specification GM13 - "Test Methods, Test Properties and Testing Frequency for "High Density Polyethylene (HDPE) Smooth and Textured Geomembranes." Grace and David are pictured below.

GAI-LAP Annual Meeting

The semi-annual GAI-LAP meeting was held in Toronto, Canada in conjunction with ASTM D35 on Thursday June 17, 2017 in the Yorkville West Room of the Sheraton Hotel. Twelve people attended this meeting which was held at 7:00 AM in the morning before Task Groups began. We should point out that a virtual repeat meeting will be held as a webinar on Wednesday July 12, 2017. We are grateful that ASTM

allowed us the venue. I also want to thank all that were in attendance for their time and effort.

Front row: Boyd Ramsey (Boyd Ramsey Consulting LLC), Melissa Medlin (TenCate), Katerina Koperna (ASTM) Maxwell Koerner (GSI), Back Row: John Paulson (Dison Construction), J.P. Kline (Geotechnics), Nigel Wrigley (NewGrid Ltd.), Nathan Ivy (AGRU America), Joel Sprague (TRI), Sam Allen (TRI) and Robert Valorio (CETCO), Not Pictured: George Koerner (GSI)

The discussion at the one hour meeting was as follows. A brief introduction and background of the GAI-LAP program was presented. Please note that we are in our 22nd year of operations. The program started in 1995. We accredit only geosynthetic labs and model the program after ISO 17025. On-site audits are conducted every five years and proficiency tests every year with a goal of the coefficient of variation less than five for each test conducted. The demographics of the current GAI-LAP labs are summarized as follows: 20 independent labs, 46 manufacturer QC labs and 5 centers (research or government) for 71 total. Thirty-eight of these labs are GSI members and 19 are international labs from 17 different countries. It appears that this program is getting traction internationally. There are 252 possible tests for accreditation (182 ASTM, 1 FTM, 8 GRI, 53 - 8 - ISO). The number of accredited tests per lab varies greatly, e.g., 4 min., 27 ave. 128 max. There has been a rapid rise of new test methods. New tests added appear to be outside the ASTM D35 arena. The international arm of testing, i.e., ISO, is very active. We particularly see this in Europe, South America and Asia.

There was a request from the GAI-LAP membership that we should look into upgrading our program to official ISO 17025 status at the last meeting in Norfolk, Virginia. I promised that I would look into this but first needed to get permission from the GSI Board of Directors. They in turn gave the OK at our Orlando, Florida meeting to proceed as long as this effort would be self-sustaining. I then contacted KOLAS in Australia and to my surprise they were very willing to grant us a memorandum of understanding (MOU) as long as we followed the steps outlined below to comply with the requirement of ISO/IEC 17011:2004 which specifies general requirements for accreditation bodies assessing and accrediting Conformity Assessment Bodies (CABs).

- A2LA will need to audit GSI annually
- Yearly on-site audits for all GAI-LAP labs
- Calibration not verification for all tests
- Strict environmental controls for temperature and relative humidity
- Proficiency tests for every test on a yearly basis
- Auditors will need to have ASQ accreditation

It was discussed at the meeting that the above six constraints would increase the current accreditation costs three to four times. Many in the audience thought that this cost was excessive and that the benefit of obtaining “official” ISO 17025 would be limited. It was decided to table this possible activity for the future.

Proficiency testing is still the hallmark of GAI-LAP. Of the 4112 proficiency test results submitted this year, only 21 first submittals were outliers representing 0.5% of the total. All outliers were resolved. Results of the proficiency tests were shared at the meeting and also distributed electronically via e-mail and CD. Congratulations to the GAI-LAP members on a job well done. Several other certification and accreditation programs around the world are now requiring proficiency test data per ISO 17025. All GAI-LAP labs easily comply with this requirement. The GAI-LAP proficiency test program would not function without samples to test. In this regard, we would like to thank the following organizations for their generous contribution of geosynthetics for this purpose.

- TenCate Inc. and Propex for geotextiles
- Brawler and AGRU America for geomembranes
- Tensar for geogrids
- AGRU America for GCLs
- ADS Inc. for plastic pipe
- SKAPS for geonets and geocomposites

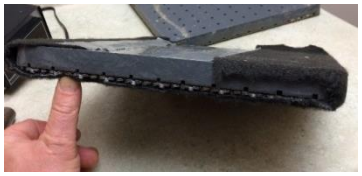
The GAI-LAP Customer Survey was again sent out to all program participants and the findings were reviewed at the meeting via a 27% return. The following are the results (5 best to 1 poorest); (a) Information exchange = 4.1; (b) Conflict resolution = 4.4; (c) Proficiency testing = 4.6; (d) Directory and internet = 3.7; Overall = 4.2. Overall results to date are as follows: 2016 (4.2), 2015 (4.3), 2014 (4.2), 2013 (4.2), 2012 (4.1), 2011 (4.1) 2010 (4.3), 2009 (4.4), 2008 (4.4), 2007 (3.9), 2006 (4.0), 2005 (4.0), 2004 (4.1), 2003 (4.1), 2002 (4.2). A total of eight on-site audits were conducted in 2017. People are embracing the audits and enjoying robust discussion during the process. We feel that the program has had a very good year and look forward to expanding our outreach going forward.

As usual at these annual meetings we had a lively discussion regarding the conflict resolution cases

addressed by the GAI-LAP this year. They are summarized below;

1. ISO 9821 Thickness; requires that all three normal pressures 2, 20 & 200 kPa be tested to comply with the method.
2. ASTM D5981 Fluid Loss; soap contamination from cleaning the apparatus and glassware invalidates results. It is also important to use distilled deionized water for this test which has a neutral pH.
3. ASTM D4716 Transmissivity; When testing the performance of a geocomposite for flow rate capacity with soil above or below the sample, it is important not to have soil loss during the testing. This is usually achieved by wrapping the GC in latex or a thin plastic film. It can also be accomplished with plumber's putty or wax to seal the edges of the specimen. These techniques are not specifically stated in the standard but are implied in the specimen preparation section of the standard. Going forward GAI-LAP will run proficiency for this method with soil.
4. ASTM D7737 Junction Strength; It has been noted, that some flexible PET coated geogrids exhibit an initial junction strength and then a secondary breaking junction strength after considerable deformation. The reported result should be the initial junction strength because the breaking junction strength is an artifact of the PET yarns knotting up behind one another in a manner not encountered in the field when soil covered.
5. ASTM D5199 Thickness; We were asked to referee a conflict between an owner and a manufacturer on the white layer thickness of a coextruded geomembrane. We defer from resolving this issue stating that there is no standard method for such a determination. The best we could do was section the GM and examine the cross section in a calibrated microscope. This technique is not covered under ASTM D5199.
6. ASTM D5321 Direct Shear; It was brought to our attention that several labs are not making area corrections when testing Geocomposites (GT-Geonet-GT) with heavily textured geomembranes. As you can see by the different clamping technique pictured below, the contact area of the specimens during testing should be maintained at one square foot throughout the test.

Bad clamping of a geocomposite



Good clamping of a geocomposite

A request from Mauricio Ossa of GSE Environmental Inc. was made to GAI-LAP to write a white paper on the topic of retesting of results. We discussed the possibly of this at the meeting along with the concepts of material rejection, reprocessing or reworking (downgrading) material, recovery of materials, returns and recalls. I was fascinated that none of these topics are covered in *ASTM D4439*-04 Standard Terminology for Geosynthetics, even though all of these concepts are key to our everyday business. The only consensus at the meeting was that we can define an "outlier" as an extreme value that differs greatly from other values in a set of values. An extreme value is considered to be an outlier if it is at least 1.5 interquartile ranges below the first quartile (Q1), or at least 1.5 interquartile ranges above the third quartile (Q3). Hence a retest might be considered if a manufacturer can prove statistically to a client that a third-party lab has generated an outlier from its internal SPC data.

A request from Beth Wilbanks of TenCate was made to GAI-LAP to write a white paper on the topic of testing geosynthetic remnants versus full roll width samples. We also discussed this issue at length at the meeting and decided to draft a white paper on the subject. We will send it out to the group for review and comment in the next month. The white paper will address sampling recommendations, avoidance of the selvage and damage and distortion of the sample due to cutting or splitting of the rolls. It was noted in jest that these handling recommendations will significantly alter how GAI-LAP ships proficiency samples each year. Duly noted, we need to improve!

The next GAI-LAP annual meeting will be held in January, 2018 in conjunction with ASTM D-35 in San Diego, California. It is a pleasure working with you. We appreciate your participation and congratulate you on your success! If you have questions, please contact me accordingly.

George Koerner (gsigeokoerner@gmail.com)

Activities within GCI (Certification)

GSI presently has three separate inspector certification programs. One (begun in 2006) is focused on QA/QC of field inspection of waste containment geosynthetics and compacted clay liners. The second (begun in 2011) is focused on MSE Wall, Berm and Slope field inspection. The third on Geosynthetic Designer Certification was begun on September 1, 2016. See our website at www.geosynthetic-institute.org under "certification" for a description and information on all three of them. They are similar in that a perspective candidate must…

- Be recommended by a professional engineer who knows, and can attest to, at least six months of

acceptable experience performing professional services within the specific application area.

- Submit a completed application and be approved by the Geosynthetic Certification Institute to take the exam.
- Must successfully pass a written examination (70% of the questions is the passing grade) proctored by GCI or a GCI designated organization and graded by the Geosynthetic Certification Institute to become a certified inspector.
- Must pay a one-time fee which covers a five-year period upon completion of the above items. The fee is $500 for five-years of certification.

Program #1 - Inspection of Liner Systems for Waste Containment Facilities

This program now in its eighth year has been recommended, and in some cases required, by solid waste owners, state regulators, and design consultants for proper QA/QC in field installation of both geosynthetic materials and compacted clay liners. The statistics to date are as follows. The examination has been greatly revised attesting to the changes occurring over the past 10-years.

Inspector Certification Test Results for
Waste Containment Inspectors
2006 – 2017

Year	Geosynthetic Materials		Compacted Clay Liners	
	No. of people taking exam	No. of people failing exam	No. of people taking exam	No. of people failing exam
2006	141	5 (3%)	128	12 (9%)
2007	82	11 (13%)	73	12 (16%)
2008	95	25 (26%)	89	20 (22%)
2009	36	7 (19%)	36	2 (5%)
2010	59	12 (20%)	54	7 (13%)
2011	54	6 (11%)	53	3 (6%)
2012	34	5 (15%)	28	3 (11%)
2013	32	4 (12%)	30	1 (3%)
2014	45	1 (3%)	42	3 (7%)
2015	56	6 (11%)	51	6 (12%)
2016	36	3 (10%)	35	5 (18%)
2017	61	1 (2%)	49	2 (4%)
TOTAL (to date)	**731**	**86 (12%)**	**668**	**75(11%)**

The 5-year renewal periods for those having taken the exam before 2010 is ongoing and about 60% have renewed accordingly. This is felt to be encouraging from our perspective.

Program #2 - Inspection of MSE Walls, Berms and Slopes

While a field inspector cannot require proper design or direct a contractor how to build a wall, flaws can be identified for possible design modification or mitigation action. Furthermore, and at minimum, construction practices can be observed and corrected if inadequate or improper.

The official launch of this inspection program was on December 1, 2011 with a course and the examination afterward. More recently a somewhat revised course on November 29, 2012 was presented. Presently, the corresponding course for this certification program has been transferred into a series of six presentations over a consecutive three-day period. Contact Jamie Koerner at jrkoerner@verizon.net for details and arrangements.

The status of the program is shown in the following table.

Inspector Certification Test Results for
MSE Walls and Berms Inspectors
(2011-2017)

Year	Course Location	MSE Wall And Berms	
		No. of People Taking the Exam	No. of People Failing the Exam
2011	GSI Course	7	0
2012	GSI Course	6	0
2013	GSI Course	2	0
2014	GSI Course	3	0
2015	GSI Course	4	0
2016	GSI On-Line Course	2	2
2017	GSI On-Line Course	0	0
TOTAL		24	0

Program #3 - Geosynthetic Designer Certification

The "Geosynthetic Designer Certification Program (GDCP)" is also now available. Please go to http://www.geosynthetic-institute.org/gdcpintro.pdf for the requisite details. Included are introduction (rationale behind the program was given in a recent GSI Column called "We're Losing the Battle"), disclaimer, requirements, application, reference material, sample questions, proctor manual and proctor application. In the *requirements section* you will see that the applicant must;

- be a graduate of an accredited engineering program,
- have six-months geosynthetic designer experience,
- complete the application form,
- pay the $500 fee for 5-years certification, and
- take a 45-question examination with ≥ 70% passing.

The *examination* itself is subdivided into 15-sections, each consisting of five questions. A candidate must answer any 3 questions in each section, making a total of 45 questions to be answered. Most of the questions are numeric, as is geosynthetic design practice in general. Unlike our other certification examination

questions, however, this examination is of an open-book, open-notes format and does require a calculator so as to "crunch the numbers".

The on-line courses for preparation of three of these certification programs is available in a series of six-90 minute webinars. Contact Jamie Koerner at jrkoerner@verizon.net for details and arrangements.

Lastly, please spread-the-word within your organization and to others as well. We sincerely hope that one, or all three, of the above programs will be beneficial in upgrading the technical base of geosynthetic design and installation so as to properly utilize all of our geosynthetic materials in all of their many applications. All three programs are on-going and if you have questions and/or comments please contact us accordingly.

Bob Koerner robert.koerner@coe.drexel.edu
Marilyn Ashley mvashley@verizon.net
Jamie Koerner jrkoerner@verizon.net

The GSI Affiliated Institutes

It has long been realized that the information generated within the GSI group should have a timely outlet to all countries, and in all languages. To this end, GSI has created affiliated institutes in three countries (Korea, Taiwan and India), and potentially others in the future. These affiliated institutes are full members of GSI and are empowered to translate and use all available information so as to create similar institutes and activities in their respective countries.

GSI-Korea was formed on February 9, 1998 as a collaborative effort between FITI Testing and Research Institute (a quasi-government organization) and INHA University (through its Geosynthetics Research Laboratory). It is presently in the transition of being held entirely within INHA University.

INHA University is located in Incheon and the geosynthetics laboratory is led by Professor Han-Yong Jeon. Dr. Jeon has 10-students working on geosynthetic-related projects and is extremely active both nationally and internationally. His active participation at conferences worldwide is very admirable. He has provided research and development in many geosynthetic subjects including geotextiles, geomembranes, geocells, additives for GCLs, recycled plastics for improved formulations, etc.

GSI-Taiwan was formed on August 18, 2000 and is wholly contained within the National Pingtung University of Science and Technology in Nei Pu, Pingtung (southern Taiwan). It completely parallels GSI in that it has specific units for research, education, information, accreditation and certification. The Director is Dr. Chiwan Wayne Hsieh who is a Professor in the Department of Civil Engineering and Dean of the R & D Office. GSI-Taiwan has an Taiwanese consortium of geogrid/geotextile manufacturers who work toward producing quality products according to the draft GRI geogrid specifications and the associated test methods. As such, GSI-Taiwan is a GAI-LAP accredited laboratory for 59 geosynthetic test methods. Dr. Hsieh has 10-students working on geosynthetic-related projects and is extremely active nationally and internationally. GSI Taiwan has hosted three very successful internal conferences to date and has also held a much broader one, namely, GSI-Asia in Taichung, Taiwan.

GSI-India under the new direction of Dr. A. K. Mukhopadhyay (who succeeds Dr. A. N. Desai) was formed in 2015. The hosting organization is the Bombay Textile Research Association (BTRA) which is world known for its excellence in textile R & D and is currently branching out into all forms of geosynthetics. We are delighted in this regard and, as a side-note, Dr. Mukhopadhyay has replaced Dr. Desai on GSI's Board of Directors to fill out his term. (See associated writeup on the "Global Geosynthetics Summit" in the December, 2014 Newsletter/Report).

Items of Interest

Please note that this section will no longer be carried in these quarterly GSI Newsletter/Reports. This is due primarily to limit the length of the reports which have grown considerably over time.

MSE Wall Failures vis-à-vis the Lack of Geotechnical Filters

Since 2001 GSI has been accumulating data on failures of geosynthetic reinforced mechanically stabilized earth (MSE) retaining walls. We presently have 301 cases, of which 191 (63%) have been caused in whole or part by water within, or adjacent to, the reinforced soil zone. We sincerely hope that our past writings and webinars are helping to correct, or at least minimize, this unfortunate situation from continuing into the future. Yet, there is one issue which has been, and continues to be, a serious omission in the design and construction of such walls. That is, the lack of a filter between fine-grained soils and gravel drainage layers in the reinforced soil zone. To place fine grained backfill soils (note that 219 of the 301 failures (73%), used silt, clayey silt, silty clay or clay soils) against gravel drainage layers with water moving from the fine-to-coarse soils is a fundamental violation of soil filtration concepts. Shown first by Terzaghi in the 1930's, followed by Bertram in the 1940's and then by the Corps of Engineers in the 1950's, soil filter design

using sand is an established practice in geotechnical engineering. There have been hundreds of researchers and practitioners since then (e.g., every geotechnical engineering professor worldwide) showing that the water will mobilize fine grained soil particles to migrate into the gravel's voids rendering its permeability greatly reduced, eventually becoming that of the fine grained soil. Thus, the gravel will no longer provide its intended purpose of drainage. This is not a hypothesis, it is a known fact and can easily by reproduced in any soils or hydraulics laboratory! Clearly needed in such cases is a filtration medium, sand or geotextile, of which the latter is easy to place, economical and readily available. Regarding geotextile filtration design, our keyword literature search shows 107 papers are available. See GSI White Paper #34 for a review of both soil and geotextile filter design. That said and with regard to MSE walls, there are three distinct locations within the standard MSE wall cross section which are deficient in this regard. Their locations are shown on Figure 1.

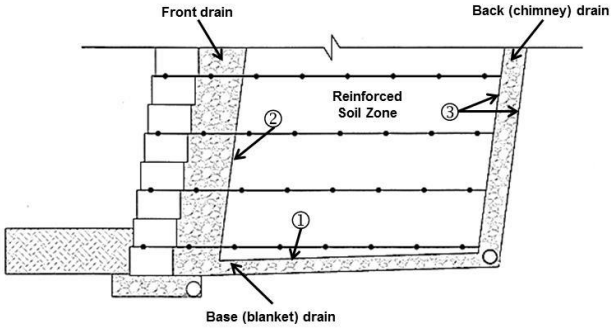
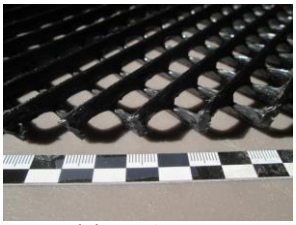
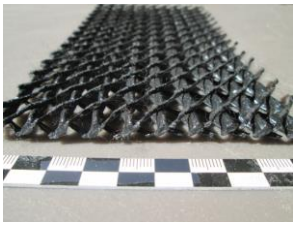
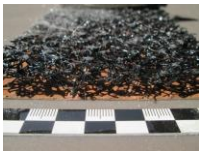


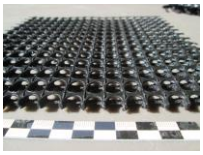
Figure 1. Base, Front and Back Drainage Locations (mod. from National Concrete Masonry Association, Herndon, VA, Pub. No. TR308, 2016)

Location "1" is easy to accommodate using a geotextile filter since it is simply laid on top of the horizontal base (also called blanket) drain. Location "2" is more difficult construction-wise since each layer of soil between adjacent reinforcement layers must be wrapped accordingly. In so doing it becomes a mini wrap-around detail. In spite of the difficulty, it simply must be accommodated accordingly. Regarding location "3", the geotextile filter must be on both sides of the back drain. This becomes a nightmare to construct using gravel as the back (also called chimney) drain. It begs the question, "why use gravel soil to begin with"? The straightforward answer to this situation is to omit the gravel and use a geocomposite drain. In this regard there are many types available under the two general categories of geonet composites and geospacer composites, see the photos of Figure 2. Let's start using them on a regular basis and forget trying to stack a thin column of gravel vertically.


Biplanar Geonets


Triplanar Geonets


3-D mat geospacers


channel geospacers

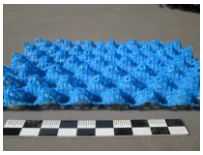

protrusion, aka nub/ column/dimple geospacers

Figure 2. Geonet and geospacer drainage cores shown without their associated geotextile filters.

At this point in time we know that there are far too many MSE wall failures and that the majority are mobilized by water within or around the reinforced soil zone. By designing and placing geotextile filters, the high permeability gravel of the front drain and base drain will be preserved. Even further, the use of drainage geocomposites for back drainage eliminates the contractors challenge of building a near vertical column of gravel and furthermore geosynthetic drainage composites automatically come with geotextile filters bonded onto both sides of the drainage core.

We feel that by not providing geotextile protected drainage to the front, base and back drainage systems of MSE wall structures it will result in long-term failures most likely in the lower regions of the wall where hydrostatic pressures are highest; see Figure 3. Incidentally, the repair of such toe failures is incredibly difficult and expensive, and certainly looks bad for all parties involved and for the industry as a whole.

Figure 3. Toe failures of MSE walls caused by hydrostatic pressures.
(compl. of Wikipedia and Google)

Robert M. Koerner

GSI's Member Organizations

We sincerely thank all of our sponsoring organizations. Without them, GSI simply could neither happen nor exist. The current GSI member organizations and their contact members are listed below. **Our newest members INOVA Geosynthetics/AERO Aggregates with Archie Filshill; Sotrafa Agrualura y Geosinteticos of Spain with Jose Miguel Munoz Gomez; Kaytech Fabrics Co. of South Africa with Garth James; Interwrap Inc. with Clive Mills/Martin Vido, Borouge Pte. Ltd. of Singapore with *Mohamed Ali Jaber/Peter Malmros/Rick Cui,* Intermas Group of Spain with Rubén Palacios and Thrace Group with Steven Lothspeich/Stella Karavasili. Thanks to all and welcome to GSI!!!**

GSE Environmental
Steve Eckhart/Jimmy Youngblood
U.S. Environmental Protection Agency
David A. Carson
Chemours Technology
Clifford Early
Federal Highway Administration
Silas Nichols/Daniel Alzamora
Golder Associates Inc.
Tim Bauters/Frank Adams/Paul Sgriccia
Tensar International Corporation
Mark H. Wayne [BoD]/Joseph Cavanaugh/Doug Brown
Low and Bonar PLC (formerly Colbond)
Richard Goodrum
Geosyntec Consultants
Ranjiv Gupta
TenCate Geosynthetics
John Henderson/Chris Lawson
CETCO
Davie Chiet/Michael Donovan/Rob Valorio
Huesker, Inc.
Sven Schröer/Andreas Elsing/Lilma Schimmel
NAUE GmbH & Co. KG
Kent von Maubeuge [BoD]
Propex Operating Company LLC
Drew Loizeaux
AVINTIV (formerly Polymer Group Inc.)
Brian H. Whitaker
TRI/Environmental Inc.
Sam R. Allen [BoD]/Joel Sprague
U. S. Army Corps of Engineers
David L. Jaros
Chevron Phillips Chemical Co.
Randy Moynihan/Jennifer Hicks/Ashish Sukhadia [BoD]
AECOM (formerly URS Corp.)
John Volk/Ron Hager/John Bove
Solmax Géosynthétiques
Jacques Cote/Simon Gilbert St-Pierre/Daniel Tan Su Ming
CARPI, Inc.
Alberto M. Scuero/John A. Wilkes
Civil & Environmental Consultants, Inc.
Tony Eith [BoD]
Agru America, Inc.
Nathan Ivy [BoD]/Markus Haager
Firestone Specialty Products
Allen Sopko/ Carol Klinker
INHA (GSI-Korea)
H.-Y. Jeon
Waste Management Inc.
Greg Cekander/John Workman [BoD]
NPUST (GSI-Taiwan)
Chiwan Wayne Hsieh
GeoComp/GeoTesting Express
W. Allen Marr/Gary T. Torosian
GEI Consultants
Michael A. Yako/Michael Ruetten
Atarfil, S. L.
Mario Garcia Girones/Emilio Carreras Torres/ Tamara Jurado Corrasco
Republic Services Inc.
Joe Benco/Tony Walker
GSE Europe
Stefan Baldauf/Catrin Tarnowski
InterGEO Services Co.
Şükrü Akçay/Archie Filshill
Raven Industries, Inc.
Gary M. Kolbasuk
CTI and Associates, Inc.
Te-Yang Soong/Kevin Foye
Advanced Earth Sciences, Inc.
Kris Khilnani/Suji Somasundaram
Carlisle Syntec, Inc.
Paul Markel/Brinda Mehta
EPI, The Liner Co.
Daniel S. Rohe/Mark Wolschon
Geo-Logic Associates
Monte Christie
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