

**Geo-Institute  
of the American Society of Civil Engineers**

**Presents**

**Competition Rules  
for the National GeoChallenge**

**GeoFlorida 2010**

**Important Dates**

**Design Report due:..... 8 pm Pacific Standard Time, December 21, 2009**

**Notification of Selection and Travel Grants: .....January 15, 2010**

**GeoFlorida Conference: .....February 20 – 24, 2010**

**Pre-Competition Meeting: .....February 22, 2010**

**Competition: .....February 23, 2010**

**GeoFlorida Info: <http://www.geocongress.org>**

**GeoChallenge Info: <http://content.geoinstitute.org/student/Geo-Challenge.html>**

**October 2009**



# National GeoChallenge Competition Rules

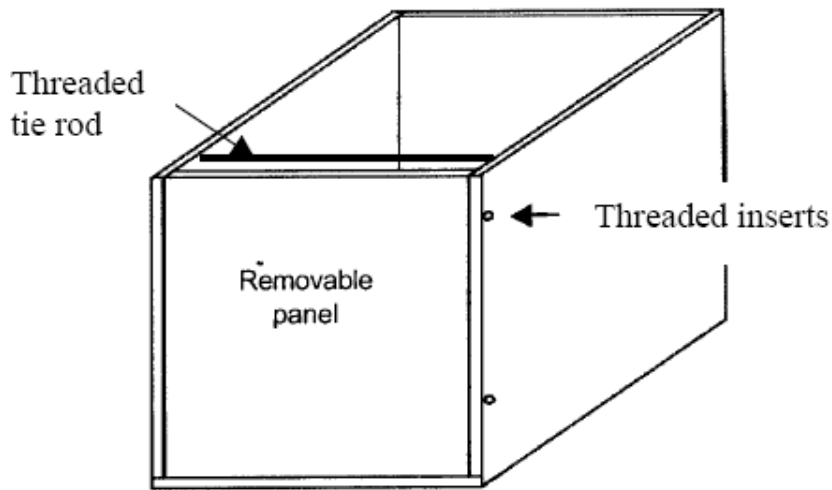
## Geo-Institute of the ASCE - GeoFlorida 2010

1. **Objective** - The objective of the GeoChallenge competition is to design and build a miniature reinforced earth (MSE) retaining wall using paper reinforcement taped to a posterboard wall facing. The design objective is to use the least area of paper strips and sustain a “footing” load of fifty (50) pounds in a 5-gallon plastic bucket placed three (3) inches behind the wall top.
2. **Eligibility** - Only one team per school will be allowed to compete. A team consists of a maximum of four (4) students consisting of not more than two (2) graduate students. Each team shall designate a captain who shall be the point of contact for the team.
3. **Submittal - The Mechanically Stabilized Earth Wall Design Report.** Invitation to the National Competition will be based upon submittal and ranking of the Design Report. Teams having previously competed at regional competitions are encouraged to update and resubmit their Design Report.
  - a. The Report shall be a maximum of three (3) pages long (not including references or title page). One inch margins, single spacing, and 12 point font are required.
  - b. Information regarding the engineered design and construction of the mechanically stabilized earth wall must be included in the Report.
  - c. Methods (lab tests, correlations, assumptions) used to obtain the engineering properties of the sand and other materials must be described in the Report. (It is possible that the type of sand to be used may be altered after the submission date due to availability. In that case see item 6.)
  - d. List design equations, material properties assumed, and factors of safety applied in your Report. Also, state dimensions (X = \_\_\_ by Y = \_\_\_) of a single rectangular paper coupon from which all reinforcement strips will be cut. The area of this coupon will be considered the total area of reinforcement. *The coupon cannot be oblong or oddly shaped to minimize reinforcement. It must be rectangular.* The maximum dimension of the paper coupon shall be no greater than 30 inches.
  - e. Judging will consider reasonableness of design equations, material properties, factors of safety, and assumptions. “Trial and error” designs will **NOT** be accepted. For example, assumed material properties of unit weight,  $\gamma = 60$  pcf, and friction angles  $\phi = 55^\circ$  would be considered unreasonable.
  - f. You must describe how this competition will impact geotechnical activities at your school and be used to promote geotechnical engineering.
  - g. Submit your Design Report electronically in PDF format to Dr. John Bowders, ([bowdersj@missouri.edu](mailto:bowdersj@missouri.edu)) by December 21, 2009, for review by an anonymous panel of geotechnical engineers. Sender will receive confirmation of receipt by e-mail. Cover page must include name of institution; names, email address and

status (graduate, undergraduate) of each team member; identification of team captain; and name and contact information for faculty advisor.

4. **National Competition Selection** – Up to twelve teams will be selected for the National GeoChallenge competition based upon their Design Reports. Design Reports will be reviewed by a geotechnical engineering panel and ranked accordingly. The National competition will be held on February 23, 2010 at the GeoFlorida GeoCongress in West Palm Beach, Florida. If the backfill and reinforcement material are specified after the submission date for the Design Report, teams selected for the competition will be allowed to revise and resubmit their Design Reports.
5. **Sandbox** – At the National competition, an apparatus hereafter referred to as a sandbox will be used. Each team shall bring their *plywood* sandbox to the competition. Painting and addition of school logos, etc., to the exterior of the box is encouraged. The sandbox shall be made up of a bottom and three fixed vertical sides. The fourth side, also vertical, must be a removable panel that serves as the temporary form against which the reinforced wall is constructed.
  1. The inside surfaces are planar.
  2. The removable panel is flush with the front of the box.
  3. The removable panel is held in place with threaded inserts and thumbscrews (See Figure 1)
  4. When the panel is removed, the two fixed parallel sides of the box are held in place by a threaded tie rod located one-half (1/2) inch below the top of the box and one (1) inch back from the inside face of the removable panel. (Figure 1).
  5. The sandbox shall be made of standard, 3/4-inch “A-C” type plywood. (Plexiglass® boxes are not allowed)
  6. The inside dimensions of the sandbox shall be 26 inches long by 18 inches wide by 18 inches high. (These dimensions will be enforced and penalties will be levied for any box not in compliance)
  7. For convenience, you may design your box so that it can be transported as flat pieces with predrilled screw holes for easy assembly at competition.
  8. Tolerance for all length measurements is 1/4 inch.
  9. There will be a 50-point deduction for out of compliance box specifications. Boxes will be checked for compliance at the “pre-competition” meeting. If a box is found to be out of compliance, it must be brought to specification by the time the competition begins to avoid the 50-point penalty.
6. **Backfill Sand-** The backfill material will be clean, dry sand provided by the host. The sand tentatively selected for use is 12/20 Filter Sand from Carmeuse Industrial Sands (formerly Oglebay Norton) in Brady, Texas (Table 1, Figure 2.) The backfill material must be used as-is; no water, additives, or chemical stabilizers may be placed in the backfill material. *If the backfill provided at the competition is different than the sand specified in the design phase due to unforeseen circumstances, i.e., delivery of sand is late or unavailable, students will not be allowed to revise their design, although every reasonable effort will be made to ensure that sand available is similar to the sand used in design. Changing of sand is often out of our control and we appreciate your*

*understanding of the logistical complications that can occur with a competition of this scale.*



**Figure 1. Schematic of plywood sandbox: front view.**

Table 1: Representative grain-size distribution for GeoChallenge competition sand.

Sieve Number	O-N 12/20		Lower Bound		Upper Bound	
	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing
10	2	100.00%	1.3	100.00%	2.3	100.00%
12	1.7	96.80%	1.2	96.90%	2.1	96.90%
16	1.18	41.80%	1.15	93.70%	2	93.70%
18	1	15.80%	0.95	38.70%	1.6	38.70%
20	0.85	3.30%	0.83	12.70%	1.3	12.70%
Pan			0.7	2.00%	1.1	2.00%

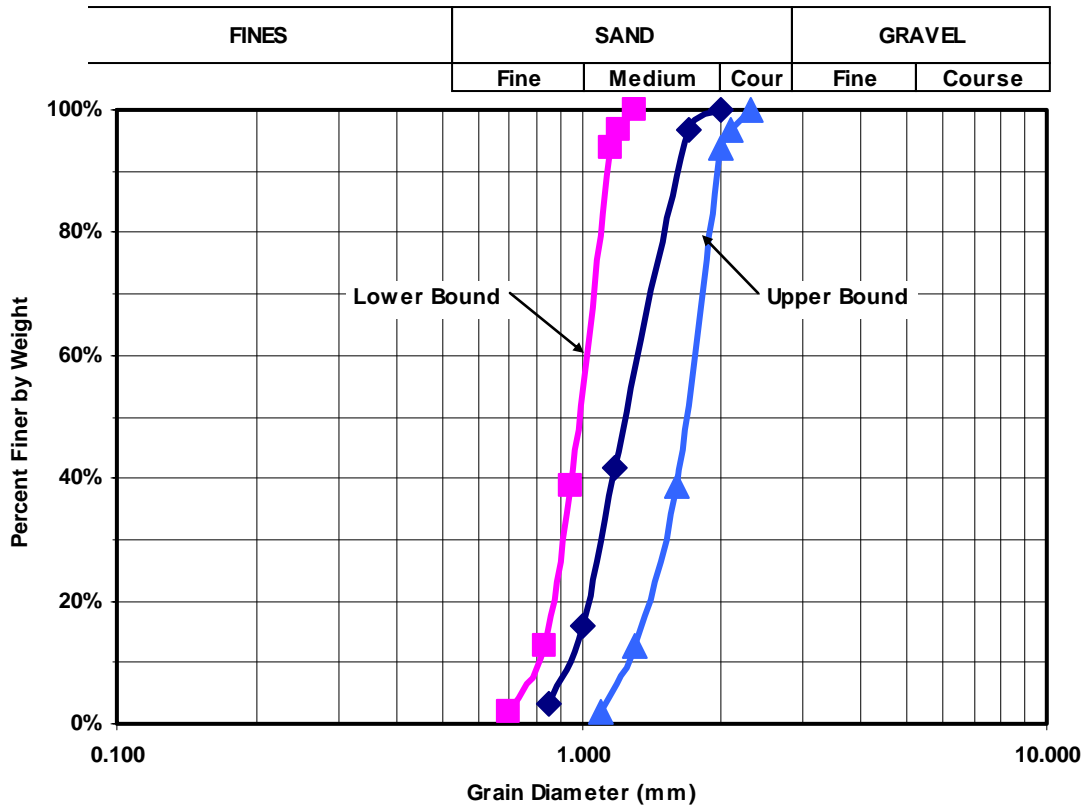


Figure 2 – Grain size distribution for sand to be supplied at the GeoChallenge competition. Upper and lower bounds show the range of potential variation in the gradation of the sand. Be sure to consider this in your design.

7. **Reinforcing Materials** - (to be furnished by host)
  - a. Facing - One sheet of poster board, standard grade, 22 x 28 inches. (Can be obtained at Wal-Mart®)
  - b. Soil Reinforcing – One “Heavy Duty 60 lb Kraft Paper” rectangular coupon of the total specified X by Y area, will be provided by the host and will be pre-cut to the rectangular size designated in each team’s design report.
  - c. Facing Attachment - Packaging tape or carton sealing tape, standard grade, 1.88 inches wide, e.g., Staples® Standard-Grade Packaging Tape, Clear, 1.89" x 54.7 yds
8. **Construction Tools**
  - a. The following construction tools may be provided by the competing team (quantities of these items shall not be restricted):
    - i. pencils, pens, and markers
    - ii. rulers and straight edges
    - iii. cardboard or poster board templates
    - iv. cutting instruments (e.g., scissors, Exacto knife, razor blades)
    - v. design notes, calculations and drawings
  - b. Scoops, buckets and shovels will be provided by the host at the competition. It may be necessary for teams to haul sand a distance not to exceed 200 feet.

- a. Buckets may be used as tampers
  - b. Rubber mallets may be used as tampers on the sides of the box.
9. **Execution** – Teams will be given (22" X 28") poster-board facing that they will have to measure and fold to size (Figure 3). Teams will have to fold the poster-board to fit their sandbox prior to assembly stage. Side wing-walls and bottom are restricted to 2" each. To assist with folding, scoring with a razor blade is recommended.

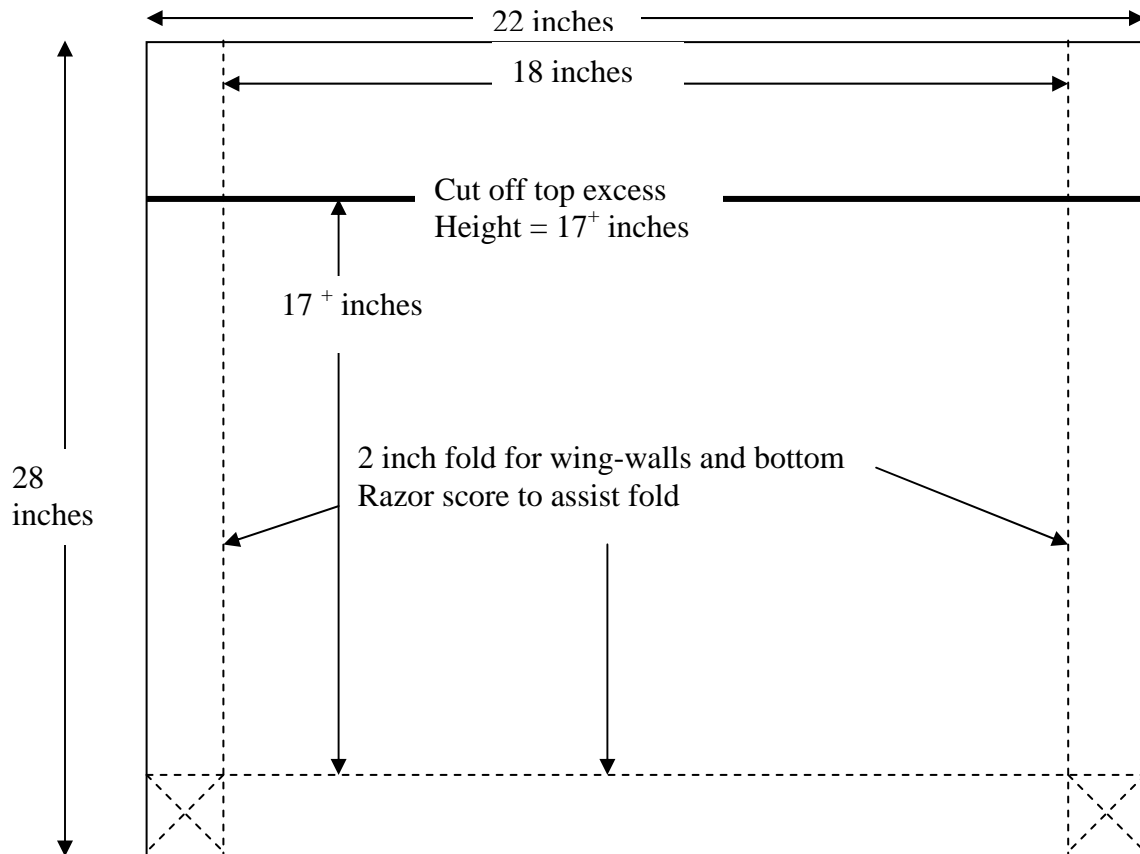


Figure 3 – Dimensions of the poster-board wall facing

- a. Assembly Stage
  - i. Assembly stage should not exceed 30 minutes.
  - ii. There are no "bonus" points for finishing early. Each team will be penalized if they take longer than 30 minutes, i.e., -1 point for each minute past the 30-minute limit. *The reason for not awarding points for finishing early is a safety concern. We do not want teams rushing to cut their reinforcement and run the risk of seriously injuring themselves with a sharp razor blade. Remember: **Safety First***
  - iii. Reinforcement and facing are marked, cut, configured, taped, and placed in the box as appropriate, preparatory to placement of sand.
  - iv. No sand shall be placed or otherwise handled during this stage.
  - v. The poster-board facing panel provided is larger than the height and width of the MSE wall so that small, two inch "wings" can be folded back to

protect against leakage of sand around the edges and bottom of the wall face. Teams will be responsible for folding and/or cutting the facing to fit their sandbox.

- vi. All tape used must be laid flat against the poster-board wall facing, with the sticky side facing the poster board. *(Tape can only be placed on the front plane of the poster board, not on the sides or bottom. Tape cannot be used to increase the strength of the paper reinforcement.)*
- vii. The box must be completely assembled before sand is added (this includes the tie rod).

b. Construction Stage

- i. Construction stage should not exceed 30 minutes.
- ii. Each team will be penalized if they take longer than 30 minutes, i.e., -1 point for each minute past the 30-minute limit.
- iii. The box must be filled with sand to within 1 inch of the top, and the sand surface shall be horizontal.
- iv. An empty, 5-gallon “loading” bucket shall then be placed on top of the sand, with the leading edge of the bucket three (3) inches back from the wall facing and centered between the side walls.
- v. The loading bucket shall be a construction standard, five-gallon bucket.
- vi. Construction shall not be considered complete until the loading bucket is in place.

c. Loading

- i. When directed by judge, the team shall remove the front panel of the sandbox.
- ii. Failure of the wall includes any measurable amount of sand running out of the wall that passes the front plane of the box. If the wall loses sand that passes the front plane of the wall, they will be disqualified and not allowed to load their wall.
- iii. If the wall does not lose any sand or deform past the front plane of the box, then after a stabilizing period of one minute, team members shall apply a 50-lb surcharge load by pouring sand into the loading bucket.
- iv. The 50 lbs of sand shall have been measured and verified by the judges prior to this stage.
- v. Loading shall be completed within 5 minutes of the stabilization period.
- vi. The wall must sustain the surcharge for at least 1 minute prior to measuring for “failure”.
- vii. Failure of the wall will be declared if any part of the wall system, including paper, tape and retained sand, reaches the front plane of the sandbox. If failure occurs before loading is complete, the judge will record the weight of sand in the loading bucket at time of failure.
- viii. In the case of a tiebreaker, teams may load their wall up to a total of three buckets (~150 lbs). The maximum amount of load is limited for safety. One minute after the first 50 pound load is applied, the process is repeated with a second 50 pound load up to 150 pounds.

## 10. Scoring

- a. The team that scores the most points shall be the winner.
- b. Points shall be awarded as follows:
  - i.  $(200-X)$  points for total area of paper requested by the team where  $X$  is the area measured in square inches.
  - ii.  $(- Y)$  points for the time taken during the assembly stage where  $Y$  is the time measured in minutes exceeding 30 minutes. For safety reasons, you will NOT get points for assembling faster than 30 minutes.
  - iii.  $(- Z)$  points for the time taken during the execution stage where  $Z$  is the time measured in minutes exceeding 30 minutes. You will NOT get points for constructing faster than 30 minutes.
  - iv. Up to 25 points shall be awarded based on the quality of the Design Report developed by the team to document their design process.
  - v. Surcharge weight will only be considered in ranking if all walls fail prior to carrying the 50 lb surcharge or if a tie occurs for the area (square inches) of paper used.
  - vi. There will be 50-point penalties for:
    - a. wrong size box
    - b. threaded rod in wrong location

Example: Team A used  $140 \text{ in}^2$  for the paper strips, supported 50-lbs surcharge, took 35 minutes in assembly, 20 minutes in execution, and Design Report = 20; their score would be:  $60$  (paper area) +  $(-5)$  assembly) -  $0$  (execution) +  $(20)$  report) = 75 points total.

- 11 **Judging** - The judges reserve the right to disqualify teams for any of the following reasons:
- a. Failure to adhere to the prescribed construction standards for the retaining wall
  - b. All Judges agree that a team has deliberately tried to violate the spirit of the competition
  - c. All Judges agree that the design calculations, safety factors, material properties, and execution techniques provide an unfair advantage.

**Appendix A: Design Report Judging Form**

**Geo-Challenge Design Report**

**Judging Form**

<b>Team School:</b>		
<b>Criterion</b>	<b>Maximum Possible Score</b>	<b>Score</b>
1) Mechanics: Satisfies specifications for length, margins, font. Punctuation, grammar, editing acceptable. Timeliness.	4	
2) Description is clear and concise. Examples: methods to obtain soil & paper properties are described. Properties are reasonable.	9	
3) Figures and tables are used in ways that clearly support the theory and equations used. Engineering calculations are reasonable.	9	
4) Strength of anticipated impact in the school and/or community	3	
<b>TOTAL</b>	25	
<p><b>Rational Design:</b> _____ Acceptable to compete _____ Unacceptable                  Design should be rational in soil and paper properties, theories used, and accuracy of calculations. Assumptions or incomplete descriptions which suggest a 'trial &amp; error' design, or provide an unfair advantage should be deemed "Unacceptable."</p>		
<p><b>Comments (to be shared with the team):</b></p>		



**Appendix C: Bio-form to be completed by each team captain and submitted to the chief judge at the pre-competition meeting**

<b>Geo-Institute of ASCE GeoFlorida, 2010</b> <b>Geo-Challenge Competition Bios</b>
Team School:
Team Mascot:
No. of Years Competing at Nationals:
Team Advisor:
<b>Team Captain:</b>
Current Year in School (junior, senior, MS, or PhD):
Hometown (City and State or Country)
Other School Activities:
Interests/Hobbies:

Future Plans, e.g., graduate school, consulting, government, other?

Geographical preferences?

**Appendix D: Bio-form to be completed by each team member and submitted to the chief judge at the pre-competition meeting**

**Geo-Institute of ASCE GeoCongress 2010**

**Geo-Challenge Competition Bios**

Team School:

Team Mascot:

Team Advisor:

**Team Member:**

Current Year in School (junior, senior, MS, or PhD):

Hometown (City and State or Country)

Other School Activities:

Interests/Hobbies:

Future Plans, e.g., graduate school, consulting, government, other?

Geographical preferences?