

Geotechnical Competition

Chair: Trent Ellis
e-Mail: tellis@uark.edu

Objective

The intent of this competition is to foster teamwork and sportsmanship in geotechnical engineering design. The competition rewards innovative engineering in minimizing the amount of construction materials used, while maintaining practicality in assembly and construction times.

Teams are required to design and build a miniature reinforced-soil (also called a Mechanically Stabilized Earth, or MSE) retaining wall inside of a plywood box, hereafter referred to as the Sandbox. The MSE wall must support a load of 50 lbs that is placed on an 8" x 8" wood footing whose closest edge is located 5 inches behind the wall top.

Design goals are to:

- Satisfy prescribed MSE wall construction standards in a timely fashion, and
- Sustain the specified surcharge load; while
- Minimizing overdesign in terms of amount of paper reinforcement

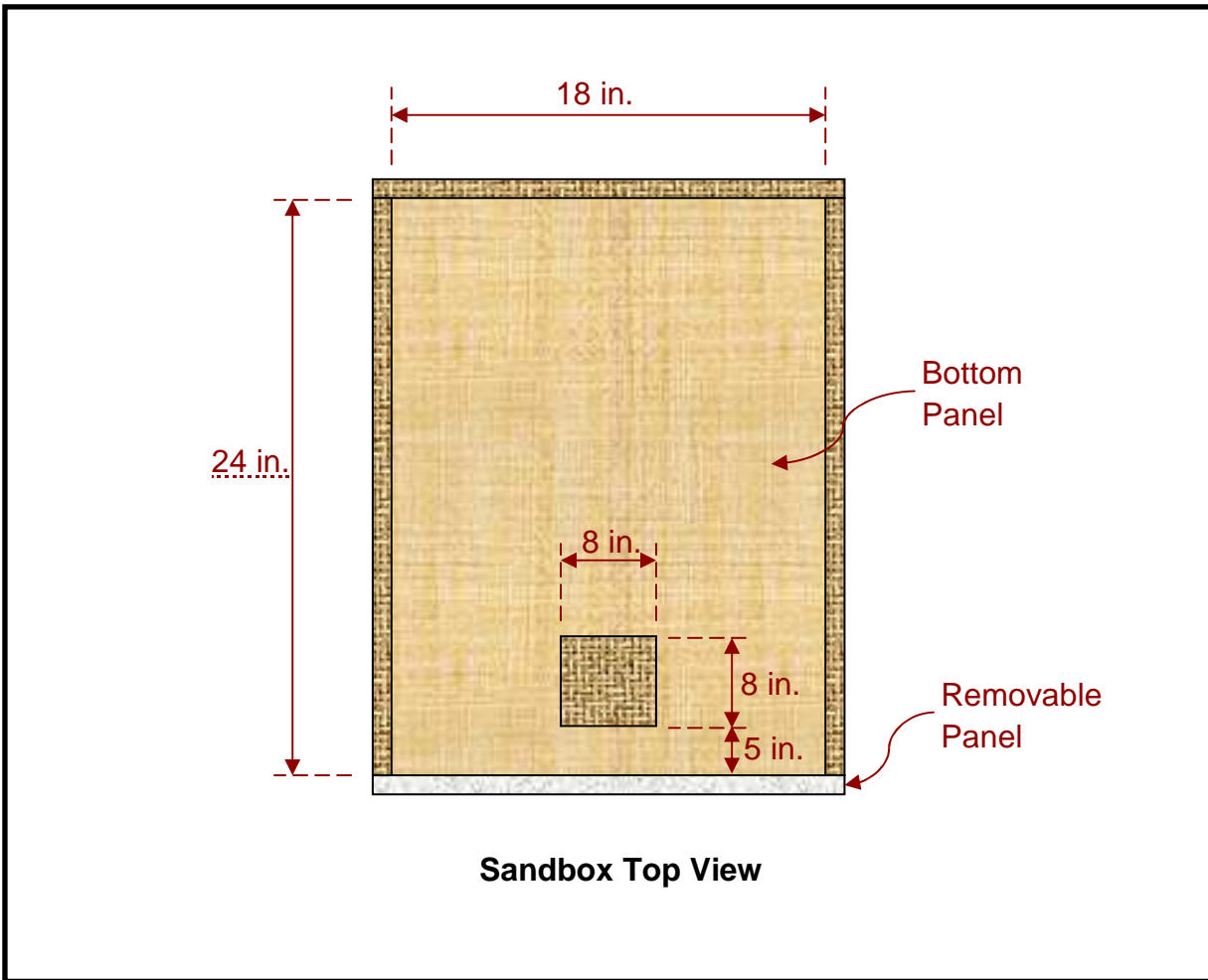
Eligibility

Only one team per school will be allowed to compete. Only student members of the school's ASCE chapter will be allowed to participate in the design of the MSE wall, and only 3 of those students will be allowed to participate in the actual construction of the wall.

Sandbox

Sandboxes will be provided for each team at the competition, but teams are encouraged to construct their own Sandboxes to test trial designs before the conference. The Sandbox has a bottom and three permanent vertical sides. The inside surfaces of the vertical walls and bottom panel will be coated with a frictionless material to prevent adhesion during loading. The fourth vertical side is where the MSE wall will be constructed, and a removable panel will be included on that side to provide lateral support during the construction of the MSE wall. See Figure 1 for Sandbox dimensions.

Figure 1. Sandbox Dimensions



Each of the 3 sides of the Sandbox, as well as the removable panel, will be braced and sealed sufficiently to prevent the removal of sand and lateral displacement of the vertical panels. That being said, no fastener, attachment or other part of the box will protrude beyond the plane of the removable panel or beyond the top of the vertical walls (18 inches tall as measured from the ground). The Sandbox will be made from standard $\frac{3}{4}$ -in. "A-C" type plywood, with the "A"-side to the inside.

Backfill

The backfill material for the Geotechnical Competition will be a clean sand provided by the University of Arkansas (moisture content to be less than 10%). The backfill material must be used as is; no water, additives, or chemical stabilizers may be placed in the backfill material. Representative samples of the sand will be sent to the participating universities at least 2 months in advance of the competition.

Reinforcing Materials

Reinforcing materials and construction tools will be provided by the University of Arkansas. Materials that will be available to teams are listed in Table 1. Teams will be provided the following tools for construction:

- Pencil
- Straight Edge
- Razor Knife
- 1-quart Scoop
- Scissors
- 5-gallon Bucket

Teams are expected to have completed their wall designs prior to arriving at the University of Arkansas for competition. Each team shall submit a design report that documents assumptions and methods that were used to design its MSE wall. Based on the analyses in the design report, each team shall specify the exact area of reinforcement paper that will be required to construct its MSE wall. No restrictions are placed on the amount of tape that is used. Teams must specify the length of 30-in. wide Kraft paper that will be required for their design no later than April 17, 2008 (during registration).

Special Note: An extra bit of area should be provided on the strip dimensions (in addition to what is required for reinforcing strength) in order to tape the reinforcement strip to the facing. This extra area must be included in the total reinforcement paper area.

Table 1. Reinforcing Materials

MSE Wall Component	Material
Facing	Posterboard, Standard Grade, 17 x 22 in.; One Sheet
Soil Reinforcement	Kraft Paper, Standard Grade, 30-in. Wide Roll; Length To Be Specified by Each Contestant
Reinforcement-Facing Attachment	Packaging Tape or Carton-Sealing Tape, Standard Grade, 1.88 or 1.89-in. Wide

Construction

Construction will proceed in two stages. Each stage must be completed in 30 minutes or less. No marking, layout or assembly of the reinforcing materials is permitted prior to the start of construction

Assembly Stage

Reinforcement and facing are marked, cut, configured and placed in the box as appropriate, preparatory to placement of sand. No sand can be placed or otherwise handled during this stage. Wing walls may be constructed to protect against spillage of sand around the edges of the MSE wall during the Assembly stage. All tape used must be laid flat against the facing, with the sticky side facing the posterboard. No anchoring of the reinforcing materials directly to the sandbox apparatus or modifying of the paper strips in any way will be permitted. The Assembly Stage of construction will be timed, and shorter construction times will earn more points.

Execution Stage

The box must be filled with sand to within 2 inches of the top. The footing is then placed on top of the sand, 5 inches back from the wall facing and centered between the side walls as previously specified. A relatively light-weight container for loading will then be placed on the wood footing.

After the container is in place, the judge(s) will direct the team to remove the front panel of the Sandbox. After a stabilization period of 1 minute, team members will apply a 50-lb surcharge load by pouring sand into the container on top of the footing. The 50 pounds of sand will have been measured and verified by a judge prior to this stage of the competition. Loading must be completed within 10 minutes after the end of the stabilization period.

Failure Criteria

Failure of the wall will be declared after any section of the wall or reinforcing materials bulges or protrudes more than 1 ½ inch horizontally from the original plane of the wall. If the judges feel that any team has deliberately tried to violate the spirit of the competition, the judges may disqualify that team, and the team will receive 0 points.

Upon completion of testing, competitors must return their test station to its starting condition.

Scoring

- Performance / Amount of Paper Used
 - If a team's MSE Wall does not fail, its score will be the inverse of the area (in^2) of paper reinforcement that it used.
 - If a team's MSE Wall does fail, its paper reinforcement area will be multiplied by a factor = $1 + [(50 \text{ lb} - \text{failure load}) / 50 \text{ lb}]$. The team's score will be the inverse of the altered area (in^2).
- Construction Time (tie-breaker)
 - If two or more teams achieve the same score, the team with the shortest construction time during the Assembly Stage will win.
- Design Report (double tie-breaker)
 - If two or more teams are still tied, or if reliable construction time data is not available, the winner shall be chosen according to which team produced the best design report.

Please notify the Chair of whether or not a team from your school will be participating in the Geotechnical Event to help us with planning!