



2022 – GeoPrediction Rules



The Geo-Institute of the American Society of Civil Engineers

Presents

The Competition Rules for the 13th *Annual* National GeoPREDICTION at 2022 Geo-Congress Charlotte, NC

Important Dates

GeoPrediction Reports Due.....	January 14, 2022 5:00PM EST
Invitation to GeoPrediction Finale.....	February 4, 2022
2022 Geo-Congress.....	March 20 – 23, 2022
Geo-Congress 2022 Information.....	https://www.geocongress.org/
GeoPrediction Presentations	March 21, 2022



13th Annual National GeoPrediction Rules – 2022 Geo-Congress

- 1. Objective:** The objective of the GeoPrediction competition is to develop an accurate prediction of geotechnical behavior given information regarding subsurface, boundary, and initial conditions, as well as the geotechnical/structural/hydraulic loading. The GeoPrediction competition may involve using available geotechnical software, empirical correlations, or developing a simple, but accurate, computer code for making this prediction.
- For the 2022 GeoPrediction, the competing teams will calculate estimated movements due to the construction of an embankment.
- 2. Geotech data:** Input data for the problem, including problem description, boring logs, and test data, are found on the following sheets.
- 3. Eligibility:** A GeoPrediction team will consist of one or two students. Each team MUST include at least one undergraduate student. Graduate students can not submit a prediction without mentoring an undergraduate student. However, a team may consist of one or two undergraduate students. Students must be enrolled during the Spring 2022 Semester or Quarter. Up to two teams per school may compete.
- 4. Submittal:** Each GeoPrediction team will submit a GeoPrediction Report that will, at a minimum, contain the following information:
- The Report shall be no more than three (3) pages long (not including any references and title page). One inch margins, single spacing, and 12 point Time New Roman font are required.
 - Include the provided **Table 4** (completed) in your report.
 - The Report shall contain the methods (assumptions, correlations, analytical procedures, numerical procedures, computers software, etc.) that the team employed to develop the GeoPrediction. Methods must be referenced properly.
 - The cover page must include the name of the institution; names, email addresses, and status (i.e., graduate or undergraduate) of each team member; as well as the name and contact information of the faculty that advised the team in developing their prediction.
 - Submit your report electronically in PDF format to Dr. Matthew Sleep (matthew.sleep@uky.edu) by 5pm Eastern Standard Time on January 14, 2022 with the subject line “2022 Geo-Congress GeoPrediction Submittal – School Name”. Sender will receive confirmation of receipt by email. Late submissions are not accepted. If you do not receive a confirmation email within 24 hours of submission, please re-send the information.



5. Judging: The submitted GeoPrediction reports will be judged and ranked by an anonymous panel of geotechnical faculty and engineers. Initial judging will be based on criteria (a) through (d) below.

- | | |
|---|-----|
| a. Format, length, grammar, English usage | 15% |
| b. Clarity of technical presentation | 15% |
| c. Logical and concise use of appropriate geotechnical methods and principles | 20% |
| d. Accuracy of GeoPrediction | 20% |
| e. Presentation of results | 30% |

6. Selection: The winning team will receive the prestigious Mohr's Circle Award. Up to fifteen (15) teams may be invited to submit a GeoPrediction Presentation based on the ranking of their GeoPrediction reports. The selected teams will be notified by February 4, 2022. The top teams (based total score of items a-d listed in section #5) will receive reimbursement for student registration for up to two team members. Top teams after presentation judging will receive partial travel stipends.

7. Presentations: Teams invited to present their GeoPrediction Results will prepare a 10-minute (maximum) presentation that describes their methods and GeoPrediction for viewing by judges and the public. Teams invited to present will do so at the GeoCongress on March 21, 2022.

As noted in Item 5, the Presentation will constitute the final 30% of each invited team's final GeoPrediction score.

8. Questions: Questions should be emailed to Matthew Sleep (matthew.sleep@uky.edu). It is anticipated that these questions will be uploaded for all to review at the GeoWorld Website (TBD).



Project Description

The 2022 GeoCongress will focus on the State of the Art and Practice. Since the first presentation of Karl von Terzaghi's one dimensional theory of consolidation in the 1920's, engineers, researchers and students have utilized the theory to calculate movements in soils due to changes in stress. We understand the assumptions of Terzaghi's theory of one-dimensional consolidation. As our understanding of soil behavior improves with time, we improve our methods to predict soil movements. In the spirit of the 2022 GeoCongress' focus on the State of the Art and Practice, students will predict movements in soils due to changes in stresses.

A gravel and sand embankment was constructed in three stages on a saturated clay soil. Immediately after construction began, vertical settlements of the original ground surface were measured. In addition, lateral movements of the soil subsurface to either side of the embankment were measured using inclinometers. Your task is to predict the horizontal and vertical movements due to construction of the embankment.

Existing Conditions

Prior to construction of the gravel and sand embankment, a single hollow stem auger soil boring was completed at the center line of the new embankment. The soil details are shown in Figure 1 with lab and in situ soil data shown in Table 1 and 2.



Boring No. B1 - Surface Elevation 808.3 ft		
Depth (ft)	Graphic	Soil Information
0		
5		Grey clay, highly organic
10		Green clay, slightly organic
15		Grey clay, thinly bedded, minor layers of silt and sand increasing with depth
20		
25		
30		
35		Grey to brown clay, thinly bedded, occasional thin layers of silt and sand
40		
45		
50		Rock

Figure 1 – Soil boring information from embankment centerline prior to construction – this soil boring was taken at point V1 in Figure 6. The MSL elevation of 808.3 feet of the soil boring is ground level = 0 in Figure 6.



Table 1 – Soil properties from Boring No. B1 – depths are relative to Figure 1

Depth (ft)	Atterberg Limits		In Situ Water Content (%)	Total Unit Weight (pcf)
	PL	LL		
6	30	84	80	82
9	25	68	84	85
19	21	44	63	N/A
26	35	98	98	N/A
36	23	58	59	95
40	23	59	60	96

Table 2 – In situ vane shear strength results – depths are relative to Figure 1

Depth (ft)	Shear Strength (psf)
6	240
9	205
19	186
26	316
36	372
40	380



New Construction

A sand and gravel embankment was constructed in 3 stages. Stage 1 is shown in Figure 2, Stage 2 in Figure 3, and the final stage in Figure 4. The start of construction is designated as Day 0. The construction timeline is displayed in Table 3. The embankment is 130 feet long (perpendicular to page). Measurements of movement are taken in the center of this 130-foot-long embankment.

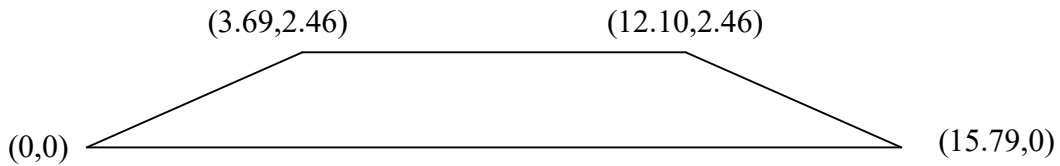


Figure 2 – Sand and gravel embankment (average 102 pcf unit weight) for the first stage of loading. Coordinates are in feet. Embankment constructed in 2 days. 130 feet long

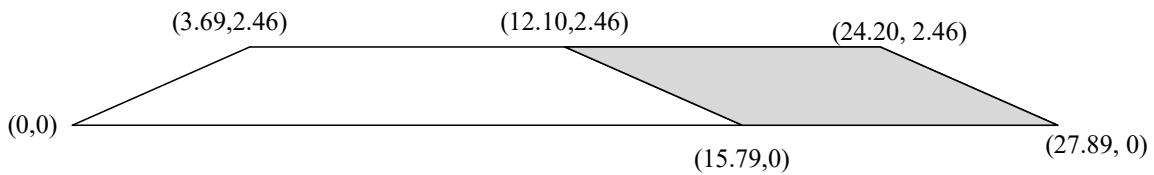


Figure 3 – Sand and gravel embankment (average 102 pcf unit weight) for the second stage of loading (grey). Coordinates are in feet. Second loading portion (shaded in grey) constructed in 2 days. Construction started on Day 9. 130 feet long

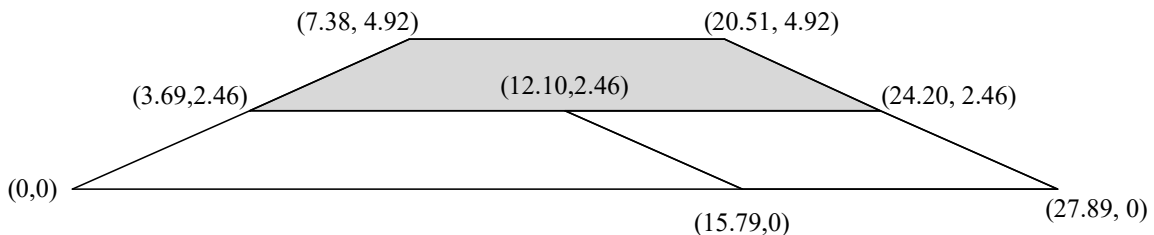


Figure 4 – Sand and gravel embankment (average 102 pcf unit weight) for the final stage of loading (grey). Coordinates are in feet. Final loading portion (shaded in grey) constructed in 2 days. Construction started on Day 21, 130 feet long

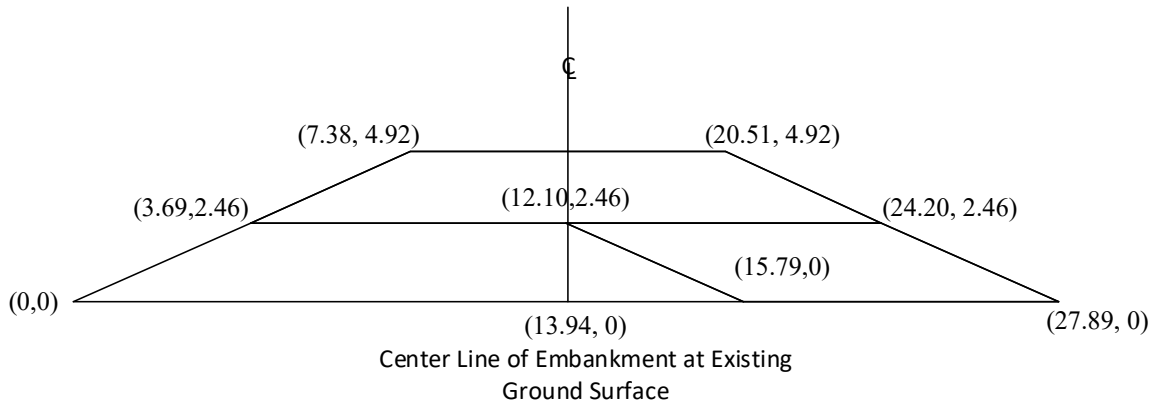


Figure 5 – Fully constructed embankment with vertices measured in feet - vertical settlements measured at point (13.94, 0) - 0 is the elevation of the ground surface at the start of construction

Table 3 – Staged construction timeline

Day	Event
0	Start of 1st loading stage construction
2	End of 1st loading stage construction
9	Start of construction of 2nd stage of loading
11	End of 2nd loading stage construction
21	Start of 3rd and final loading stage construction
23	End of 3rd and final loading stage construction

GeoPrediction

Your task is to complete Table 4 and include with your report.

Table 4 – Table to be completed and included with your report

Point of Interest	New x coordinate		Percent Score Confidence (each cell must be at least 15%)
	Day 44	Day 240	
L1			
L2			
R1			
R2			
	New y coordinate		
	Day 500		
U1			
V1			
			Sum must be 100%!



Your task is to determine the new x coordinates for points shown in Figure 6 at Day 44 and Day 240 of the project for points L1, L2, R1 and R2. These predictions are the horizontal, or lateral, movements of these points.

For example, the starting position of point L1 is (-12.96, -8). If you predict 0.5 feet of lateral movement to the left of this point at Day 44, the new x coordinate would be -13.46.

You must also predict the new y coordinate, or vertical movement, of points U1 and V1 at Day 500.

For example, the starting position of point V1 is (13.94, 0). If you predict 1.2 feet of vertical movement (down) of this point at 500 days, the new y coordinate would be -1.2.

Finally, as engineers are often tasked with understanding their level of confidence in their calculations, you must choose what percent of your overall score should be taken for each prediction point. You must have a sum equal to 100% and each prediction must be at least 15% confidence.

For example,

Point of Interest	New x coordinate		Percent Score Confidence (each cell must be at least 15%)
	Day 44	Day 240	
L1			15%
L2			20%
R1			15%
R2			15%
	New y coordinate		
	Day 500		
U1			20%
V1			15%
			Sum must be 100%!

To aid in your prediction, the following settlement measurements were taken of point V1.

Table 5 – Settlements of the original ground surface at the centerline of the fully constructed embankment (V1) shown in Figure 5. Day 0 is the same as shown in the construction timeline of Table 1.

Day	Settlement (inches)
10	0.629
50	5.406
100	7.501

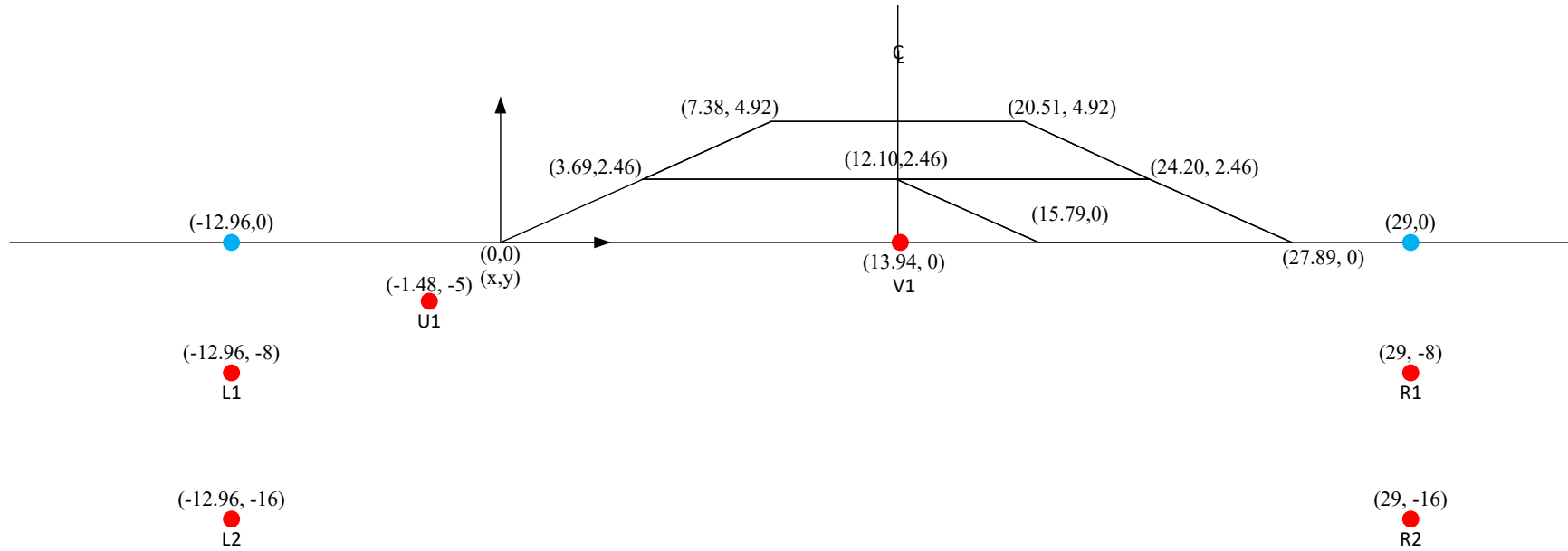


Figure 6 – Points of interest – all coordinates are in feet NOTE – the position of (0, 0)