**Quarterly Progress Report:**
**Project Number and Title:** 3.12—Lateral Loading of Unreinforced Rigid Elements and Basal Stability of Columns Supported Systems
**Research Area:** Geotechnical Infrastructure Engineering
**PI:** *Aaron Gallant, University of Maine*
**Co-PI(s):**
**Reporting Period:** *01/2021-30/2021*
**Submission Date:** *03/2021*

**Overview:**

This project goal is to assess the basal stability of column supported systems. The systems are divided on two types: embankments and Mechanically Stabilized Earth (MSE wall). In this quarterly report, a big step was made regarding column supported embankments. Some of the achievements were:

- A new variable called rupture height --- that indicate the fill height where the first crack in the unreinforced columns occurs. A parametric study was carried out to determine the consequences of fracturing for several subsoil conditions and column arrangements.
- A displacements-based approach to analyze the basal instability (factor of safety) of the system has been linked to the degree of lateral spreading that occurs.
- The geosynthetic was found to provide ductility to the system. However, the rupture height did not change varying the geosynthetic stiffness in the undrained case.

**Table 1: Task Progress**

| Task Number | Start Date | End Date | % Complete |
|---|---|---|---|
| Task 1: Assess stresses in subsoil. | 06/2018 | 06/2019 | 100% |
| Task 2: Establish a numerical approach to account for fracture in basal stability. | 06/2019 | 09/2019 | 100% |
| Task 3: Calibrate models with field measurements that include lateral and vertical deformations. | 06/2019 | 12/2020 | 95% |
| Task 4: Perform parametric study for fill embankments. | 01/2020 | 04/2020 | 100% |
| Task 5: Perform parametric study for MSE walls. | 06/2020 | 06/2021 | 30% |
| Task 6: Recommended design guidance for industry. | 03/2020 | 06/2021 | 70% |
| Overall Project: | *06/2018* | *06/2021* | 90% |

**Table 2: Budget Progress**

| Project Budget | Spend – Project to Date | % Project to Date* |
|---|---|---|
| $33,380 | $00,000 | 00.0% (3/2021) |

***Include the date the budget is current to.***

**Table 3: Presentations at Conferences, Workshops, Seminars, and Other Events**

| Title | Event | Type | Location | Date(s) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 2020 TIDC annual Conference | Conference | Annual conference | University of Maine | August 12,2020 |
| 45th Annual Conference on Deep Foundations | Online conference | Annual conference | Online | October 27, 2020 |

**Table 4: Publications and Submitted Papers and Reports**

| Type | Title | Citation | Date | Status |
|---|---|---|---|---|
| Journal | Field Observations and Analysis of the Subgrade Response beneath GRCS Embankments at the Council Bluffs Interchange System | Gallant, Aaron, Ehab Shatnawi, and Danilo Botero-Lopez. 2019. "Field Observations and Analysis of the Subgrade Response beneath GRCS Embankments at the Council Bluffs Interchange System." Journal of Geotechnical and Geoenviromental Engineering. | 2020 | Accepted |
| Journal | Lateral Spreading of Embankments supported on Fractured Unreinforced high-modulus columns over Soft Soil | Gallant, Aaron, and Danilo Botero-Lopez. 2019. "Lateral Spreading and stability of Embankments supported on Fractured Unreinforced high-modulus columns." DFI Journal. | 2020 | 2nd revision |

**Participants and Collaborators:**

*Use the table below to list all individuals who have worked on the project.*

**Table 5: Active Principal Investigators, faculty, administrators, and Management Team Members**

| Individual Name | Email Address | Department | Role in Research |
|---|---|---|---|
| Aaron Gallant | aaron.gallant@maine.edu | Civil | PI |

*Use the table below to list all students who have participated in the project during the reporting. (This includes all paid, unpaid, intern, independent study, or any other student that participated in this project.)*

**Table 6: Student Participants during the reporting period**

| Student Name | Email Address | Class | Major | Role in research |
|---|---|---|---|---|
| Danilo Botero-Lopez | | Ph.D | Civil Engineering | Research Assistant |

*Use the table below to list any students who worked on this project and graduated during this reporting period.*

**Table 7: Student Graduates**

| Student Name | Role in Research | Degree | Graduation Date |
|---|---|---|---|
| N/A | | | |
| | | | |

*Use the table below to list organizations have been involved as partners on this project and their contribution to the project.*

| Table 8: Research Project Collaborators during the reporting period | | | | | | |
|---|---|---|---|---|---|---|
| **Organization** | **Location** | **Contribution to the Project** | | | | |
| | | **Financial Support** | **In-Kind Support** | **Facilities** | **Collaborative Research** | **Personnel Exchanges** |
| Deep Foundations Institute (DFI) | Hawthorne, NJ | X | | | | |
| Jacobs Engineering | Herndon, VA | | X | | | |

*List all other outputs, outcomes, and impacts here (i.e. patent applications, technologies, techniques, licenses issued, and/or website addresses used to disseminate research findings). Please be sure to provide detailed information about each item as with the tables above.*

*Have other collaborators or contacts been involved? If so, who and how? (This would include collaborations with others within the lead or partner universities; especially interdepartmental or interdisciplinary collaborations.)*

| Table 9: Other Collaborators | | | |
|---|---|---|---|
| **Collaborator Name and Title** | **Contact Information** | **Organization and Department** | **Contribution to Research** |
| N/A | | | |
| | | | |

*Who is the Technical Champion for this project?*
Name: Tanner Balckburn
Title: Chief Geotechnical Engineering
Organization: Hayward Baker
Location (City & State):
Email Address: jtblackburn@keller-na.com

**Changes:**

N/A

**Planned Activities:**

Future work will be focused on the analysis of the fracturing based on the calibrated models and parameters. A parametric study for column supported on MSE walls is going to be performed to analyze another subsoil conditions and column geometry.