ENAC – School of Architecture, Civil and Environmental Engineering
SGC – Civil Engineering Section
LMS – Soil Mechanics Laboratory
lms.epfl.ch

Master thesis/Semester project
Fall Semester 2023
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Soil-structure interaction for retaining walls: a new loading application principle

EPFL Supervisor: Professor Lyesse Laloui
GRUNER Supervisors: Dr. Angelica Tuttolomondo, Dr. John Eichenberger

Motivation of the project

Retaining structures are geotechnical constructions that can be either temporary or permanent, designed to provide support to materials that would otherwise be unstable or prone to collapse. The design of retaining structures typically employs numerical methods that consider the interaction between the soil and the structure. One such method is the subgrade reaction approach, which treats the wall as a beam supported by elastoplastic springs. The accurate calculation of external loads acting on the retaining structure and their transfer to the soil and retaining wall is a critical aspect of the design process. Currently, both elastic solutions and limit state solutions are available for this purpose.

This project aims to conduct a thorough analysis of the existing solutions for applying external loads on retaining walls and to propose a new methodology that accounts for soil elasto-plasticity.

Keywords

Retaining wall, design, programming (Matlab or Phyton), numerical simulations

References

- Lambe, T.W., and Whitman. R.V. 1969. Soil mechanics. Wiley.
- SIA 267: Geotechnical design.
- Eurocode 7. Geotechnical design.

Goal of the project

The expected outcomes of this project are as follows:

- Development of a novel theoretical methodology for the application of charges on retaining walls that considers soil elasto-plasticity.
- Development of a calculation tool that incorporates the newly developed theoretical methodology for the application of charges, enabling more accurate and efficient analysis of retaining walls under external loads.

These outcomes are expected to contribute significantly to the field of geotechnical engineering by providing engineers and designers with a more robust and reliable approach to the design and analysis of retaining structures.

Tasks and work to carry out

The student is expected to perform the following tasks:

- Studying different loading application scenarios
- Developing suitable script for each loading scenario
- Developing a new elasto-plastic methodology
- Developing useful calculation tools

Deliverables

- Report

The student will have to prepare a technical report containing the introduction and motivation for the project, the description of the accomplished work and related results as well as conclusions. The technical report will have to be prepared in an electronic format and send to the supervisors by the end of the semester.

- Final Presentation

The student will have to present his work during a presentation at the end of the semester. The day and the place of the presentation will be communicated to the student.

Planning

- Meetings and presentations

A weekly meeting (on Friday pm) with one of the supervisors is suggested to discuss the progress of the project. One meeting per month will be organised with Prof. Laloui (dates will be communicated to the student).
During the meetings, the student will have to present (i) the progress of the work, (ii) possible questions and remarks and (iii) a summary of the next steps for the project. During these meetings, the supervisors may vary the foreseen goals of the project, if necessary. The student will have to prepare all the possible questions before the meeting in written form and a summary of each meeting for the next fixed meeting.

- Report

The report will be written in English. Graphs will be built with the Grapher software, Matlab, or with the aid of Microsoft Excel. Particular attention will be given to the writing up of the report. In the document, the student will have to clearly introduce the topic, to highlight the hypotheses made, to present the considered methodology, to discuss the obtained results and to draw the related conclusions.

- **Electronic files**

At the end of the project, the student will have to send to the supervisors a folder containing a clear classification of all the electronic files developed during the project, including those related to the reports, obtained data, presentations, poster and graphs.

Grading

The final grade will be assigned considering the following proportions of contribution:

- Implication and initiative during the semester 30%
- Technical report 50%
- Oral presentation 20%

The evaluation will also consider the work methodology, discipline, and resourcefulness of the student.

General rules of the project

The schedule of the project is defined by the EPFL Academic Calendar:
https://memento.epfl.ch/academic-calendar/?period=180

The student signature on the submitted report certifies that the work is original and developed by him/herself. This work is property of the EPFL and cannot be disseminated without the approval of the considered Institution.

Contacts

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