

CEE 4534: Earth Pressures and Foundation Structures
Instructor: Prof. Joseph P. Vantassel
Homework Assignment #11
Fall 2025

Due: 7 November 2025

Problem Introduction

You are tasked with performing site characterization and retaining wall design for a bridge reconstruction project in Roanoke, VA. The following questions will walk you through this process. Note that this homework will require more engineering judgement than your other assignments as these data are from a real project. The location of the bridge reconstruction project is at coordinates (37.2161°, -79.8881°) near 3899 Jae Valley Rd, Roanoke, VA 24014.

1. Find one modern and two historical aerial photographs of the bridge construction site using Google Earth. In your memo, show the photographs side-by-side. Indicate the year each photograph was taken. Provide a north arrow and scale on each photograph. Hint: If you use the desktop version of Google Earth it can create a scale and arrow for you automatically, go to File > Save > Save Image. Underneath the images, summarize development at the site in one to three sentences.
[Course Objective #1]
2. Summarize the site's surficial and bedrock geology by developing an expected 1D geotechnical profile. Describe the expected 1D geotechnical profile in one to three sentences. Include an image and a reference to the geologic map(s) that you use to develop your expected geotechnical profile. Provide a north arrow and scale on each geologic map shown. Indicate the location of the site on the geologic map with a red rectangle. Define each layer of your 1D model by its expected material type (soil-cohesive, soil-cohesionless, or rock) and thickness (if available). Hint: The United States Geological Survey (USGS) National Geologic Map Database (NGMDB) may be helpful for finding relevant geologic maps at the site (ngmdb.usgs.gov/mapview).
[Course Objectives #1 and #2]
3. For the real bridge reconstruction project, a number of borings were advanced across the site. These data are available through Geosetta (geosetta.org), a non-profit organization that is working to archive historical geotechnical site investigation data to be a shared resource for the geotechnical profession. Use the boring logs available through Geosetta to develop a 1D geotechnical profile at the site. Define each soil layer of your 1D geotechnical profile by its expected USCS classification, thickness, unit weight, and strength parameter (i.e., effective friction angle or undrained shear strength). You should consider at least three borings across the site when developing your expected 1D geotechnical profile. Use plots of the data to illustrate how similar or different properties are between boreholes. Hint: You may need to use correlations, charts, and typical values to get all of the values that you need. Be sure to show how you reached your selected values. [Course Objectives #1 and #2]

4. Using your 1D geotechnical profile from Problem 3 to design a cantilevered concrete retaining wall for the bridge's western abutment. The retaining wall's foundation should rest on rock and extend up to the ground surface. The height of your wall will depend on the 1D geotechnical profile you determined in Problem 3. As a simplification you do not need to consider a surcharge in your retaining wall's design, although you would need to do so in practice to account for the weight of the bridge, traffic, etc. For your design, you may use the retaining wall stability design tool (i.e., retaining_wall_stability_2.05.xls) provided to you on Canvas. However, you must show some evidence that you used the tool to optimize your design by reducing your wall's volume of concrete. Do this by providing the output of the tool for your initial and final stable design. Provide a neat diagram of your final wall design in your memo. Show that your wall is safe against sliding and overturning. You may assume your wall is safe against bearing capacity failure. Clearly state any assumptions made to reach your final design. [Course Objectives #1, #3, and #4]