

Plan to Flip **Shallow Foundation Design lesson**, which is one of the lessons in CE424 “Foundation and Retaining Wall Design” class:

Below is the lesson plan for flipping one of the topics of CE424 class. I am planning to flip this class eventually in a way that I can spend more time in the class focusing on solving actual design problems rather than covering the theories and equations. To do that, based on the materials that we learned during the workshop, I am planning to do the below steps to achieve these goals for each of the learning objectives of this lesson:

Learning Outcome:

- Understand the differences between shallow foundations and deep foundations.
  - Prepare a video to describe the theoretical and fundamental differences between shallow and deep footings; [Estimated time to prepare this: five hours]
  - Prepare some photos of real shallow and deep foundations [Estimated time to prepare this: two hours]
  - Prepare a short video regarding the practical applications of each of these two foundations in real life projects. [Estimated time to prepare this: five hours]
- Understand the concept of foundation design and the associated factors of safety
  - Prepare a ppt for reviewing the introduction to Civil Engineering class and summarizing the concept of factor of safety in the Civil Engineering Design. [Estimated time to prepare this: two/three hours]
- Learn various modes of soil failure regarding the bearing capacity failure
  - Prepare a ppt to review various modes of failure, general shear, local shear and punching shear. [Estimated time to prepare this: one-two hours]
  - Prepare some real-life failure projects with each of the failure modes. [Estimated time to prepare this: two hours]
- Understand various types of shallow foundations (Single footing, combined footing, strip footing, and Mat foundation) and learn the main theories for the general mode of failure (Terzaghi theory and Meyerhof theory) and the differences between them
  - Prepare a video and discussing various type of foundations, their applications, their behavior under vertical and lateral loads, and introduction to the main two bearing capacity theories, Meyerhof and Terzaghi’s methods. [Estimated time to prepare this: five-six hours]
- Be able to describe the differences between the two mentioned theories and their applications

- Prepare a new homework, probably multi-choice questions, and ask the students to complete that before coming to the class. The purpose of this homework is to assure that the students have clear understanding of the main two bearing capacity theories in regard to the shallow foundation design. [Estimated time to prepare this: two hours]
- Learn Meyerhof theory in detail, and how to calculate various sizes of the strip, shallow foundation; Expand the Meyerhof equations to other types of shallow foundation.
  - Develop a video and describe the Meyerhof theory. Describe an actual foundation design project and solve a sample example. [Estimated time to prepare this: four hours]
  - Prepare a few homework problems and ask the students to try to solve them before coming to the class. These problems will be discussed and solve in the class later. [Estimated time to prepare this: two hours]
- Learn about the design of the shallow foundations under both vertical load and the moment
  - Prepare a ppt to describe conditions that a vertical load can be coupled with a bending moment and act on a shallow foundation. [Estimated time to prepare this: two hours]
  - Describe the differences between this case and a regular vertical load case. [Estimated time to prepare this: one hours]
- Learn about the design of the shallow foundations with eccentric loads
  - Prepare a short video and describe how to design various types of shallow foundations under bending moment and vertical load (eccentricity). [Estimated time to prepare this: four hours]
  - Revise some of my homework problems accordingly so that the students can work on the problems before coming to the class. These problems will also be later discussed and solved in the class. [Estimated time to prepare this: one-two hours]
- Be able to identify various challenges of shallow foundation design; Learn how overcome the challenges regarding the shallow ground water level; Learn how overcome the challenges regarding the layered soil
  - Prepare a video (probably about 40 min, or maybe two videos, each 20 to 25 min) and discuss various challenges that the practicing engineers might encounter in real-life projects. Discuss the challenge of shallow ground water, how it can affect the design of the shallow foundation, and the possible solutions for that case. Describe the difficulties of the layered soils, its effects on the shallow foundation design, and eventually the possible solutions to handle these difficulties. [Estimated time to prepare this: seven to eight hours]