Teaching geotechnical engineering

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ABSTRACT: Geotechnical engineering is an essential part of the analysis and design of any civil engineering project. It is mainly an empirical discipline based on practical experience.
Students completing civil engineering program should demonstrate a sound knowledge of soils and rocks properties, why these properties are needed, how to obtain them and how to use them in practice. Furthermore, they should have a good idea about the typical values of engineering properties of various soils and rocks, and a good engineering judgement and intuition to determine if the results are of right order of magnitude. Students can develop these skills through classroom courses and self study.
This paper presents how the undergraduate engineers should be trained in geotechnical engineering in order to integrate industry firms with confidence. We emphasize the importance of the practical experience for geotechnical engineering educator; computer test simulation or video to explain the laboratory and field tests in the classroom; and summer training in industry firms to ensure a good transition from university to the real world.

1 INTRODUCTION

Unlike other fields of civil engineering; the geotechnical engineering depends chiefly on practical experience. The diversity and complexity of the natural materials make the calculation and experimentation in this discipline more complex.

Whatever the sophisticated methods used during field exploration, the difference between reality and investigation results can not be avoided in most cases. In order to remedy to the insufficient information about the real soil behavior and therefore, to reduce the risk of structure failure, the soil behavior should be observed during the period of construction and subsequently the design or method of construction may have to be adjusted in accordance with the findings.

The design of earthwork and foundation engineering is based on crude hypotheses and empirical procedures. These procedures need a large amount of experience to be used safely.

Whoever, the experience accumulated by each engineer can not cover all aspects of the geotechnical problems that may be encountered and therefore, the experience of others is needed. One way to find this experience is by doing research in technical bibliography and the engineering students should learn how to get the information needed and how to use it to solve the problem in question.

Moreover, the engineering students should learn that a geotechnical problem can not be solved by a simple formula, engineering judgment and intuition are necessary. Students can develop these skills through illustrating examples, laboratory and field tests, and simple cases of real design projects.

2 TRAINING OF UNDERGRADUATE STUDENTS

Undergraduate students are usually taught two courses of the fundamental principles of soil mechanics.

The first course (third academic year) includes index properties, compaction and hydraulics of soils, stresses in soils, consolidation and settlements, shear strength and soil explorations.

The second course (fourth academic year) deals with the stability of slopes and the general principles of the structures design such as retaining walls and foundations.

During the second course the teacher selects an example of real design project related to each topic such as retaining wall, spread foundation, mat foundation, pile foundation and slope stability analysis. The design examples are selected such that they cover a wide range of geotechnical issues.

These design examples are solved during practical lessons, where calculation methodology and presentation of the final work are explained by the teacher. The choice of soil parameters based on the results of in situ tests such as SPT or CPT or using technical bibliography is also explained.

At the end of each design example, the students are grouped in teams of two to three and assigned different little projects similar to that solved in the

class with slight modifications such as soil types, structure dimensions, etc. The teams are asked to do the work at home as well as during practical lessons, where the teacher can help them solving the encountered problems.

After completion of each little project, teams are asked to present their works in front of the students. The questions regarding the accomplishment of the work are asked by the teacher as well as by the students.

3 TEACHERS WITH PROFESSIONAL EXPERIENCE

Besides theoretical background, the geotechnical engineering educator should have sufficient professional experience to be successful in his mission of teaching. Professional experience helps educators to teach professional practice issues, to relate theory to practice, to show the engineering significance of soil properties and how to use them in practice.

In addition to above mentioned skills, teacher should be organized, so the student can understand the course quickly and effectively, and learn that the organization is the key of success. The teacher should recognize that each student has different level of understanding and he should use different ways and methods to present the course. Furthermore, teacher should show enthusiasm about the course and give some practical examples in order to motivate the students and make learning enjoyable for them.

In conclusion, a good teacher is a facilitator of learning not simply a source of information.

4 LABORATORY AND FIELD TESTS USING COMPUTER SIMULATION OR VIDEO

Laboratory and field tests are very important for students to develop a feel for soils and rocks behaviour. One way to help teach these tests in classroom is through computer test simulation or video, especially for field tests where most of the faculty members teaching geotechnical engineering do not have sufficient field experience to explain various field tests.

These tools improve the quality of learning and reduce the explanation time of geotechnical field exploration and laboratory tests compared to the traditional methods based on pictures and imaginations.

5 SUMMER TRAINING IN INDUSTRY FIRMS

Field training is an essential part in geotechnical engineering education. Students are asked to undergo trainings in industry firms for a period of two months during summer vacation at the end of the third and fourth academic years.

The main purpose of this training is to expose the students to industry environment and practices.

The training allows students to be familiarized with geotechnical field tests, to what and how to observe in the field and to understand the relation between the design and construction.

At the end of each training, students are asked to submit their training reports in order to be evaluated by the teacher.

6 CONCLUSION

The author is convinced that geotechnical engineering courses are better taught by teachers having academic and professional experience. He noticed that professional practice interest and motivates students.

On the other hand; the incorporation of new technology in classes such as computer simulation or video helps geotechnical engineering educator to improve the quality of instruction.

Simple real design projects enable students to correlate what has been learnt in basic topics with the real world and allow them to start developing their own engineering judgement and intuition, which are essential to be a successful geotechnical engineer.

Finally, students should keep in mind that analytical methods in geotechnical engineering can at best only our guide, to which good judgement and experience based on similar circumstances should be added (*Meyerhof, 2001*).

7 REFERENCES

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