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Case Histories Oriented Teaching of Geotechnical Engineering

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ABSTRACT

Integration of theory and practice in the teaching of geotechnical engineering have been examined on the basis of several years of teaching of foundation engineering. Most geotechnical analyses and relationships for use in design are developed under idealized boundry conditions. It has been shown by the use of case studies that an understanding of the departure between the idealized and the real boundry conditions is essential for the practice of geotechnical engineering. The case studies have also been used to teach students that the success of a geotechnical engineer depends upon how well he/she bridges the gap (departure) between the idealized textbook and real world conditions by the use of judgment, experience, and parametric studies. An interactive approach was used in teaching of case histories. The paper will also present the importance of the effectiveness of interactive approach in case studies.

INTRODUCTION

Case Studies and Geotechnical Education

The geotechnical engineering practice has often been termed both, as an art and a service. It has also been compared with the practice of medical profession. Judgment and experience play vital role in the success of the Geotechnical profession. This is because of the many uncertainties in establishing accurately what is down there under the surface and how strong is it. However, what has often been neglected or treated lightly is another yet significant factor related to the real and idealized boundry conditions in the application of the geotechnical analysis. It is not easy to bring home the importance of this factor when teaching a conventional geotechnical course where most of the time must be spent in explaining concepts, and developing theory and analysis. Most of the analyses and relationships are developed under idealized boundry conditions. Because of an increasing use of computer softwares, there is at times a rush to overlook the difference between the idealized boundry conditions and real boundry conditions. Such neglects can lead to poor performance or even failures. Accordingly there is a need to learn to recognize this difference. In addition the skill to bridge the departure between the real and idealized boundry conditions is extremely important for the successful practice of geotechnical engineering. These skills are best acquired thru experience; but can be learnt thru a careful study of case histories. And hence the importance of teaching case studies.

The Techniques

First of all it is important that at the time of teaching geotechnical analysis, idealized boundry conditions and the assumptions made must be clearly stated in the development of relationship for use in design. If possible, it should also be explained as to why such assumptions have been made. Situations where these boundry conditions and assumptions are realized and where these are violated, should also be pointed out by citing real examples. And this is where the presentation of case studies can be most effective to bring out the departure in the assumptions and boundry conditions. Here an exercise of a caution must also be taught against the indiscriminate use of softwares often made with complete disregard to the above mentioned differences. Next the teaching of a skill to bridge these differences must come from careful examinations of the case studies presented in the class. Often a neglect of the difference can be the cause for the failure or poor performance of a project. It must also be remembered that experience is not so much a matter of elapsed time but of the intensity with which it is pursued and absorbed.

How then the case studies be taught and at what level of geotechnical engineering education they ought to be introduced. According to the author's experience, these should be presented at an upper division class in geotechnical design class.

Case-Study: Problem is presented with the use of power point illustrations giving as much background information as available and the tasks to be tackled. In contrast to other

disciplines in civil engineering, problem formulation is very important part of geotechnical engineering experience. In the initial stages of the presentation of a case history students are exposed to the process of problem formulation with real boundry conditions. Since input parameters for analysis are not as clearly defined in geotechnical engineering as in other disciplines, students are taught the development of design input parameters through the case studies.

On the basis of the author's eleven years of experience (7 years after M.S. and 4 years after Ph.D.) with Dames & Moore, a Geotechnical Engineering Consulting firm, the skill for problem formulation and the development of appropriate design input parameters can be best learnt thru case studies. It is further recommended that the presentation of case histories should be done in an interactive way. According to which, students are probed or challenged thru questions answers as the case studies is being presented. Students are required to assume the role of both a student and a consultant/teacher in what may be called "group-interactive learning strategies".

Prof. Ralph B. Peck's well known case studies course uses an extremely effective technique to teach the practice of Geotechnical Engineering thru case studies. Again, the author had the fortunate opportunity to take his course when he (Prof. Peck) presented it at Berkeley. It is a graduate level. Students are to act as Geotechnical Consultants and are presented with a problem from a client. Student's role as consultants requires of them to solve by asking for more information and by applying appropriate geotechnical solutions. As the discussions progress, there develops a vigorous thinking and hence a very effective education in geotechnical engineering. Application of this technique at an undergraduate level should be possible if the teacher becomes part of the team with students and acts like a coach playing/solving with them. The complexities of the problem have got to be toned down, however for undergraduate students to follow.

There is another aspect of Geotechnical Engineering practice which can only be brought home through case histories. And that is the litigation and the professional liability aspects of the Geotechnical Engineering profession. These aspects have changed the way we practice (ASFE). Because of the uncertainty in the subsurface conditions, Geotechnical Engineering reports must always state the limitations of the methods used, and the importance of field observations. ASFE has presented case studies where legal claims against geotechnical engineering firm were filed simply because the information about limitations was not made in writing. Case histories can effectively teach the difference between an adequate work and 'cheap work'; and difference between professional liability and professional obligations.

CONCLUSIONS

1. Most geotech-analyses are developed under highly simplified (or idealized) boundry conditions (or assumptions). Bridging the departure between the idealized and boundry conditions can be effectively taught by the use of case studies in geotechnical education.
2. Problem formulation-solving techniques can also be best learnt by the use of case studies.