Use of an interactive approach and case studies in Geo-Engineering Education

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ABSTRACT: 'Group interactive learning strategies' can be very effective in the teaching of geotechnical engineering. An interactive and case studies approaches have been discussed. The importance of problem formulation in Geo-engineering education is brought out. Integration of theory and practice in the teaching of geotechnical engineering have been examined on the basis of several years of teaching of geotechnical and foundation engineering courses. Most geotechnical analyses and relationships, for use in design, are developed under idealized boundry conditions. It has been pointed out that an understanding of the departure between the idealized and the real boundry conditions is essential for the practice of geotechnical engineering and can be taught with the help of case-studies. The case studies can also be 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 can be used in teaching of case histories. Both the interactive and case studies approaches can be effectively used to improve geoengineering education.

1 INTRODUCTION

Geotechnical Engineering practice is known both as an art and a science. It has often been compared with the practice of medical profession. Judgement and experience paly vital role in Geotechnical profession. In other words, not everything about Geotechnical Engineering can be learnt in the class. There are other aspects too, which are often neglected in the teaching of Geotechnical Engineering such as "problem formulation" and "impact of the difference between 'real' and 'idealized boundry' conditions". Most Geotechnical analyses are formulated under highly idealized boundry conditions. But in reality, conditions are more complex and the degree of uncertainty, for example in the subsurface conditions, are far more widespread than in other disciplines. How then the skill to bridge the departure between the real and idealized boundry conditions be taught. All of the above are extremely important considerations and should not be left to the practicing life of in Geotechnical Engineer to learn. Efforts must be made to teach these in the classroom. The Geotechnical Engineering education should not remian confined to the development of analyses under grossly simplified assumption or the memorizing of empirical facts. There is a lot more to it. This paper presents two approaches to remedy the above mentioned situations. These approaches would help develop fresh attitude in a student towards the learning of Geotechnical Enngineering; and would make it a rewarding experience both for the teaching and learning of this discipline. These approaches are: (i) Interactive Approach and (ii) Case-History Approach.

2 THE INTERACTIVE APPROACH

According to this approach, students are challenged or forced to think as a topic is developed during a specially assigned class period called the "Interactive Period". The subject topic is announced ahead of time and a preliminary introduction is given in a traditional way to the students. During the interactive period, no formal lecturing takes place. Rather the teacher assumes the role of a coach and at times even as a student. Through a carefully structured question sequence, students are probed to think, discuss, compare and contrast their answers. For example, for a given question, all answers provided by students are written on the board. Each answer is then discusssed for its appropriateness and then revised if necessary on the basis of the discussions in the class. The teacher monitors the progress and when thinking becomes quite vigorous near the end of the period, the teacher distributes a hand out which contains the appropriate notes and answers.

The emphasis is on the process of thinking, problem formulating, and solving strategies unique to the Geotechnical Engineering. More details on the Interactive Approach are given in Singh (2003).

3 THE CASE HISTORY APPROACH

As mentioned earlier, a significant factor related to the real and idealized boundry conditions in the application of the geotechnical analysis is often neglected. 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 theories and analyses. 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 through experience; but can be learnt through a careful study of case histories. And hence the importance of teaching case studies. The following technique is recommended for study of case-histories.

4 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 be pointed out by citing real case history 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 geotechnical design class. The interactive approach mentioned above can also be used in the presentation of case studies. Problem is presented with the use of powerpoint illustrations giving as much background information as available and the tasks to be tackled. In contrast to the 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, studentas 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 Geotechncial Engineering Consulting firm, the skill for problem formulation and the development of appropriate design input parameters can be best learnt through case studies. It is further recommeneded that the presentation of case histories should be done in an interactive way. According to which, students are probed or challenged through 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 through case studies. Again, the author had the fortunate opportunity to take his course when he (Prof. Peck) presented it at Berkeley. It is at a graduate level course. Students are to act as Geotechnical Consultants and are presented with a problem from a client. Students' role as consultants requires of them to solve by asking for more information and by applying appropriate geotechnical solutions. As the discussion progress, there develops a vigorous thinking and hence a very effective education in geotechncial 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 Geotechncial Engineering profession. These aspects have changed the way we practice (ASFE). Because of the uncer-

tainty in the subsurface conditions, Geotechnical Engineering reports must always state the limitations of the methods used, and the importance of the field observations. ASFE (ASFE) has presented case studies where legal claims against geotechnical engineerng firm were filed simply because the information about limitations were 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.

5 CONCLUSIONS

1. Introduction of problem formulation and teaching of real boundry conditions versus idealized boundry conditions can greatly improve the geotechnical engineering education.
2. Interactive and case-studies approaches can be effectively used to teach 'problem formulation' and 'integration of theory and practice' of geotechnical engineering.
3. Because of the uncertainties in geoengineer ing, topics such as litigation, professional li ability and professional obligation should be covered in geo-engineering education.

6 REFERENCES

ASFE, "The Real World of Engineering – Case Histories 1 – 40" published by the Association of Engineering Firms Practicing in the Geo-Sciences (ASFE), Silver Spring, Maryland.

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