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Research on BIM Virtual Technology based on CDIO Model in soil Mechanics of Application-oriented Universities

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Abstract: As an important and basic course of civil engineering, soil mechanics has a wide range of contents and complex basic concepts, which puts forward higher requirements for students' theoretical level besides theoretical mechanics, material mechanics, structural mechanics and other knowledge. Under the current background of new engineering, applied colleges and universities have put forward new requirements for engineering students. As a basic course of civil engineering, soil mechanics is of great significance to the training of students majoring in civil engineering. Aiming at some problems in soil mechanics education in recent years, based on CDIO mode, combined with the virtual simulation technology of BIM and the connotation of higher soil mechanics, the solutions are put forward in order to provide reference for the teaching reform of soil mechanics in colleges and universities.

1. Introduction

CDIO represents the latest achievements of educational reform in recent years, such as conceiving, designing, realizing and operating. It requires students to have a systematic theoretical level and strict practical operation level, that is, to conceive the training purpose of engineering talents with vision, to design the training plan of engineering talents with outline, and to implement the training plan of engineering talents with standards. So far, dozens of world-famous universities have participated the CDIO international organization whose mechanical departments and aerospace departments have adopted the concept and syllabus of CDIO engineering education, and achieved good results. The goal of the ability of the CDIO outline is quite consistent with the requirements of the application of innovative talents under the background of new engineering [3-4]. In China, many scholars have carried out teaching reforms on civil engineering construction [5], material mechanics [6], roadbed engineering [7] and other courses based on the concept of CDIO, which has already achieved good teaching results.

Under the background of new engineering, colleges and universities will not be able to rest on their laurels, but need to reflect on and reform the traditional higher education in order to promote students to meet national innovative talents. As a traditional engineering industry, civil engineering should continuously accept new ideas and adjust the teaching mode to approach national needs.

The Building Information Modeling(BIM) is a giant information technology revolution in the construction industry which shares and transmits the data in the whole life cycle of the building based on the real component information of the construction project. Through the three-dimensional building model, it provides and establishes coordinately and consistently calculable information for the project



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which becomes a significant tool to realize the fine management of the construction industry [8]. This technology not only effectively simplifies the construction process but also saves the time and cost of the enterprise. Additionally, when BIM technology applied into traditional teaching system, it can effectively improve students' employment competitiveness and engineering practice ability. As a basic but matter course of the major of civil engineering, soil mechanics has been facing with some problems, such as students' weak initiative of learning, inexperienced young teachers, and the discrepancy between enterprise requirements and teaching practice. Therefore, under the new background and new requirements, how to do a good job in the teaching reform of soil mechanics to protect the training of civil engineering talents is a problem worthy of deep consideration and discussion.

2. The present situation of the teaching of soil mechanics

Soil mechanics is a basic and professional course offered by building engineering, traffic engineering and other related majors in colleges and universities. The course has a strong comprehensiveness, a large amount of basic concepts as well as formulas, and also involves a variety of theories, such as seepage theory, stress calculation, consolidation theory, earth pressure theory and so on. Throughout the textbook, there are more than 200 formulas, some of which are composed of empirical parameters, which is unable to be deduced carefully and has a great impact on students' learning and understanding. In addition, the knowledge of soil mechanics involves many disciplines and covers part of the engineering practice simultaneously, which requires soil mechanics teachers to have long-term engineering experience. However, in the process of teaching and research, the author encounters some common problems, such as students and teachers do not understand each other, the actual operation ability of the project is poor, enterprises complain about the cultivation ability of colleges and universities, and so on.

2.1 Unreasonable lesson planning

With the improvement of the requirements in the current society, graduates, colleges and universities begin to broaden the professional caliber and increase different educational courses leading to the decrease of the class hours for students to study professional courses [13]. Taking Zhejiang University Ningbo Institute of Technology as an example, civil engineering students of Grade 2017 have increased their study of courses such as "C Programming Language", "Engineering structure load and its Design principle", "Water Engineering treatment" etc.. As a consequence, the opening time of the soil mechanics course has also been adjusted from the sophomore year to the first semester of the junior year. Geodynamics itself covers a lot of content, after removing part of the experimental lessons, teachers must quickly catch up with the progress in the three-hour theoretical class every week. For the students who have just come into contacting with soil mechanics, they must invest more time and energy to master the content of each lecture, and teachers need to finish the lesson preparation tirelessly in order to complete the explanation of the relevant chapters within the specified time. In this way, students are unlikely to digest the knowledge points of each lecture, and because of the coherence of soil mechanics knowledge, the ambiguity of a knowledge point leads to a blind area of knowledge points in the later stage. A good circular system may not form between students and teachers, which greatly drops students' interest in learning.

2.2 The teaching methods are outdated and the teachers are lack of practical experience in engineering

With the rapid development of information technology, there is a growing demand for innovative talents in composite applications. Colleges and universities have also made their own educational arrangements for such a situation [14]. However, in the relatively complex courses such as soil mechanics, the effect of teaching reform seems not to be obvious, and the teaching contents and methods are far from the standards of personnel training. In the classroom, teachers prefer to use 'cramming method which uses multimedia or traditional blackboard writing form to teach, but fail to

show the mysteries and principles of soil mechanics dipping into adequate height, breadth, depth and strength. Because of the systemic and vastness of soil mechanics knowledge, it is necessary to conduct on-site demonstration combined with actual engineering cases in order to make students have a deeper understanding of the relevant content. However, due to the lack of practical engineering experience and class hours of young teachers, teachers are unable to comb, analyze and use the teaching content comprehensively and systematically, which makes the new educational methods fail to be applied flexibly in the classroom.

2.3 Emphasize theory and despise practice

Many colleges and universities have a long history, and under the influence of the traditional education mode, there exists the phenomenon of emphasizing theory rather than practice. Taking the author's college as an example, when preparing for the soil mechanics course, most students only prepare for the theoretical part of the exam and abandon the experimental part as contemptuous. At the same time, the soil mechanics experiment is comprehensive, which is different from the traditional engineering experiment, the soil mechanics experiment requires students to have a higher level of theoretical knowledge, and students often cannot complete the contents well. Under the influence of the concept of 'despise practice', students used to copy the experimental purpose, experimental methods, experimental equipment and other contents, but fail to understand the knowledge points well when carrying out the experimental preview and experimental report ring section, under the influence of the concept of 'light practice'. This makes the expected results inconsistent with the purpose of engineering practice, and seriously inhibits the cultivation of compound talents.

3. New teaching mode of soil mechanics

From the above analysis, there are still many problems in the application-oriented undergraduate teaching of soil mechanics, which are multifaceted and multi-factor, including the arrangement of class hours, educational model, teachers' experience, students' cognition, social needs etc.. As an important basic subject in civil engineering, soil mechanics is of great significance to solve the problems in the teaching process.

3.1 Lengthen the class hours and set up the advanced placement course

Taking soil Mechanics published by China Construction Industry Publishing House as an example [15], the textbook has a total of 11 chapters, ranging from the physical properties of soil to the consolidation of soil. There are more than 340 symbols with physical meaning and more than 200 formulas in the book. Therefore, the arrangement of 36 class hours is difficult to explain the content of the text. Because of the lack of class hours, most teachers tend to reduce the interaction of engineering in the classroom but adopt cramming education instead, which runs counter to the cultivation of applied talents. It is also difficult for students to accept the input of a large number of physical symbol formulas in a short time, and they lose interest quickly and easily.

Therefore, there is an urgent need to optimize the teaching content and allocate the class hours reasonably to ensure the improvement of the conversion rate of education. Through the conversation with the students, the author found that except for the normal class hours, most of students have nothing to do during the winter and summer vacations. Therefore, it is possible to introduce the prerequisite course of soil mechanics and carry out the self-prerequisite course of soil mechanics by flipped classroom, cloud classroom, Mooc of Chinese universities and other online teaching platforms, which, on the one hand, makes full use of students' holiday time to ensure the state of learning. , on the another hand, helps students review and reshape the foundation of material mechanics, structural mechanics and other related contents, and enter the study of soil mechanics in a good state in the new semester. With the help of "Internet +" platform, teachers can set up enlightening classes according to the teaching contents to improve students' interest in learning.

According to the content and needs of soil mechanics, we can choose some course knowledge into the advanced placement course to form a good concept of soil mechanics engineering for students. In

the prerequisite course, most of the physical symbols of soil mechanics can be introduced to give students sufficient time to understand the meaning of the symbols and lay the foundation for the derivation of the formula. The Fig.1 showed the advanced placement course of soil mechanics, where the advanced placement course is divided into several parts to teach students, never laying the foundation for students to study soil mechanics.

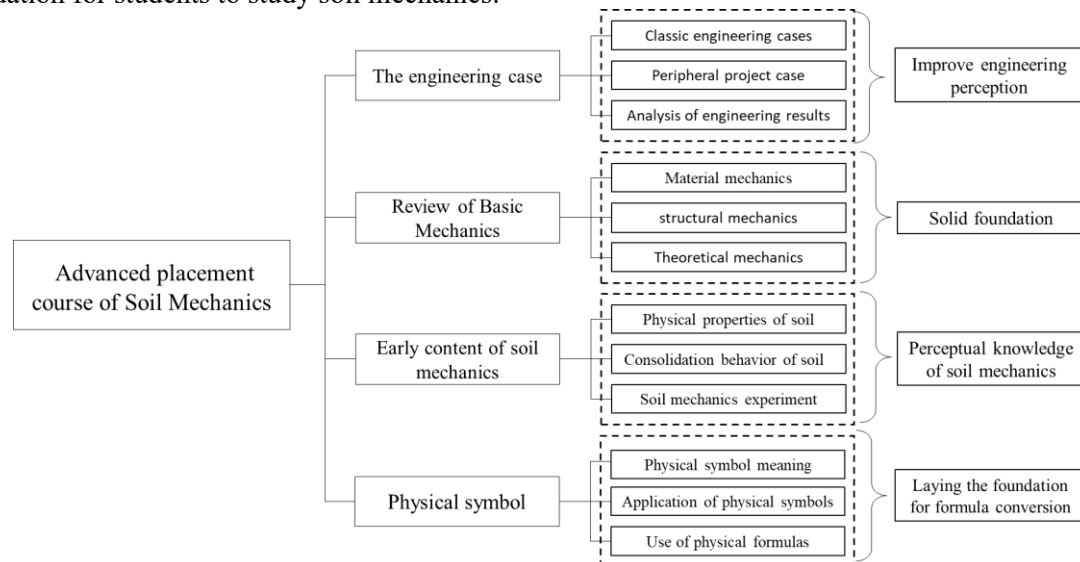


Fig.1. Advanced placement course of soil mechanics

3.2 Change traditional educational methods and integrate modern science and technology

As a new generation of applied and innovative personnel training, the traditional way of education is no longer suitable for achieving the goal of talents. Teachers should gradually change the traditional ‘cramming education’ into ‘heuristic education’ and show it to students intuitively and clearly through multimedia demonstrations and engineering examples, so as to attract students' interest and take multimedia as the focal point of teaching. In the classroom, it is recommended to adopt the student-oriented ‘heuristic classroom’ model to change the student identity into the project responsible engineer in the classroom. Combined with the actual engineering practice, the student engineer puts forward his own opinions. For example, the foundation pit design project of a certain project requires students to proceed from reality, under the leadership of the teacher, combined with the knowledge of soil mechanics, to analyze the amount of settlement, slope stability and other problems. Including the characteristics of soil permeability and consolidation, its engineering value can also be reflected into the virtual project, which greatly increases the students' comprehensive ability and improves the students' engineering application ability. This method opens the classroom and changes the education mode to CDIO mode, so that students can fully apply it to every link of conception, design, realization and operation.

It is inevitable to express engineering practice blindly by means of presentations. With the development of disciplines and information technology, the open BIM virtual simulation platform can be applied to the practical interpretation of soil mechanics engineering [16-17]. Relying on the application of BIM technology platform, students can disassemble and recognize the project from the PC side, and use the P-BIM project life-cycle galaxy management network platform to exchange and cooperate with related engineering data. The use of BIM to manage the whole life of buildings can enhance students' accurate understanding of the role of the soil mechanics knowledge in the whole life of buildings [18-20]. Relying on CA VE system, combined with BIM software project model, the whole process of project construction can be experienced in the system construction simulation module, which is beneficial to students' understanding and application of geotechnical knowledge [21].

4. Conclusion

Soil mechanics is an important basic course in civil engineering. In view of the traditionally educational problems at the present stage, it is necessary to constantly adjust the educational methods according to the social reality. In view of the problems such as less class hours, more content, light experiment, emphasis on practice and so on, CDIO education mode and BIM virtual technology can be introduced to transform the identity of students' listening subject into conception subject, participate in the actual design, operation, application and realization of the project, and further set up courses related to BIM knowledge and application skills to train modern civil engineering professionals. From this, we can enhance students' engineering application ability, combine with social needs, and promote the high-quality training of applied talents.

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