

Construction of Case Library for the Course of “Theory and Application of Geotechnical Engineering”

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Abstract

The course of “Theory and Application of Geotechnical Engineering” is an important course for master’s degree students majoring in civil engineering and water conservancy in universities. Learning this course is of great significance for the development of students engaged in geotechnical engineering and related majors. In view of the problems existing in the construction of case libraries for current civil engineering master’s degree courses, this paper analyzes the application prospects and practical value of the construction of a case library for “Theory and Application of Geotechnical Engineering”, and proposes ideas and strategies for the construction of a case library for “Theory and Application of Geotechnical Engineering”. Considering the great achievements in infrastructure construction since the reform and opening up, the compilation of case libraries can stimulate students’ patriotic enthusiasm and pride, achieving the effect of ideological and political education in the curriculum. Based on the typical engineering case library, the combination of theory and practice of the course “Theory and Application of Geotechnical Engineering” can be achieved. The proposed construction ideas have important reference value for the subsequent teaching reform of “Theory and Application of Geotechnical Engineering” based on case libraries.

Keywords

Theory and Application of Geotechnical Engineering, Engineering Case Library, Teaching Quality, Reform in Education

1. Introduction

Infrastructure construction is an important engine for promoting the sustainable

development of China's economy and improving the quality of people's lives. Civil engineering is an important part of the engineering category in the higher education system, and tens of thousands of talents are trained every year to engage in design, construction, management, and other related work (Liu et al., 2023a). With the development of social economy, the country has gradually entered a period of economic restructuring and industrial transformation, and the cultivation of civil engineering professionals has also shown new situations and characteristics. In 2023, the "Reform Plan for Adjusting and optimizing the Discipline and Major Settings of Ordinary Higher Education" (2023) issued by the Ministry of Education and four other departments proposed that the talent cultivation of colleges and universities in the new era should be based on the needs of national and regional economic and social development, and actively adapt to industrial development trends. Under this situation, civil engineering majors need to actively adapt to the needs of economic and social development and improve the quality of talent cultivation. In order to improve the teaching quality of civil engineering courses, many domestic scholars have conducted in-depth research on teaching methods, teaching tools, and teaching models for civil engineering courses, and have achieved gratifying research results. Many new teaching methods have been introduced into the curriculum reform, such as case-based teaching method (Fang et al., 2024; Wang et al., 2014), research-based teaching method (Zhang et al., 2023; Liu et al., 2022), numerical simulation experiment teaching method (Wang et al., 2023; Wang, 2007), modular teaching mode (Zhang et al., 2011; Zhang & Liu, 2017), innovative teaching practice mode, etc. (Liu et al., 2023b; Wang et al., 2019). These teaching methods play an important role in improving teaching quality and effectiveness, but they may not be suitable for courses with extensive content, complex theoretical systems, and strong practical applications.

The course "Theory and Application of Geotechnical Engineering" is a professional basic course for graduate students majoring in civil engineering and water conservancy, covering disciplines such as civil engineering, water conservancy engineering: transportation engineering, and geological engineering. The course is based on undergraduate courses such as soil mechanics, foundation engineering, and numerical methods for geotechnical engineering, and delves into the basic theories of seepage, deformation, and strength in geotechnical engineering. It systematically introduces analytical methods for geotechnical engineering problems, enabling students to proficiently apply geotechnical engineering theory to analyze typical geotechnical engineering problems, and cultivating their ability to independently engage in geotechnical engineering research and solve complex engineering problems. In recent years, although some domestic experts and professors have published many papers on the theoretical discussion of the construction of case libraries for civil engineering and water conservancy majors in Chinese universities, such as "Research on Case-Based Teaching Method for Master's Degree Students in Engineering Design Courses", "Research on Evaluation Indicator System for case Library construction in Universities", and "Research on the Whole

Process Construction of Case Libraries for Professional Degree Graduates”, there is little discussion on the construction of practical teaching case libraries related to civil engineering and water conservancy majors. It is not conducive to the improvement of teaching quality. therefore, it is an urgent problem to establish a scientific, objective and correct engineering case library for the course of “Geotechnical Engineering Theory and Application”.

2. Importance and Significance of the Course “Theory and Application of Geotechnical Engineering”

Since the reform and opening up 45 years ago, China has made great achievements in infrastructure construction. By the end of 2023, the total mileage of urban rail transit in Chinese Mainland will be 10165.7 km. The railway operating mileage is 159,000 km of which the total mileage of high-speed rail is 45,000 km. The total mileage of ordinary highways is 5,4368 million km, and the mileage of expressways is 183.600 km. The highway tunnels are about 30,200 km, and the railway tunnels are about 22,000 km (Ministry of Transport of the People’s Republic of China, 2023). Seven of the world’s 10 tallest buildings are located in China. Such achievements cannot be achieved without the cooperation of many industries, Among them, the profession knowledge of geotechnical engineering has laid a solid foundation for buildings (structures), and related theories are widely applied in engineering construction. The construction of a case library for “Geotechnical Engineering theory and Application” has the following three aspects of significance:

- 1) The significance of ideological and political education in the curriculum Choosing China’s reform and opening-up infrastructure as the theme of geotechnical engineering theory and application cases can play a leading role in strengthening the socialist core values of graduate students, imparting ideological and political elements such as patriotism and scientific spirit, and helping students establish a sense of confidence in Chinese culture and Chinese construction. It is also beneficial for students to establish a lofty ideal of China leading the future “intelligent manufacturing”.

- 2) The prerequisite and guarantee for the teaching of the course: The teaching resource case library is the foundation and content of the course implementation, and it is the prerequisite and guarantee for the course implementation. The smooth implementation of the curriculum depends largely on the level of development and utilization of curriculum resources. By building case resources, on the one hand, it is possible to explore the standards for the development and compilation of engineering construction cases, and improve the quality level of teaching cases: On the other hand, it can lay the foundation for the sharing of case resources, build an open application platform, and improve the efficiency of case resource utilization.

- 3) The significance of capacity building: Through cooperation with design institutes and construction companies to build case resources, we are committed to

the construction of a “community of industry, academia, and research”, striving to closely integrate the development of the school, the construction of the faculty team, the cultivation of graduate students, scientific research, industry docking, and social services, and comprehensively improve the quality of schooling. Presenting case scenarios and closely integrating theory with practice can effectively promote graduate students’ in-depth understanding of industries, professions, and technologies, enhance their theoretical application level, and implement the training requirement of “closely linking classroom knowledge with practical projects”

3. Problems in the Construction of Case Library

The construction of the case library for “Geotechnical Engineering theory and Application” is significantly lagging behind the rapid expansion of enrollment and the urgent need for case teaching reform and development. The construction of case library mainly has the following problems.

1) The cases are scattered and the level of preparation is not high. In the teaching of civil engineering and water conservancy master’s degree courses, although many teachers have begun to try to carry out case teaching, the teaching cases used are often in a fragmented state and lack systematic and standardized use. These cases are generally developed by the classroom teacher based on personal preferences or professional expertise, and the production of cases is mostly based on instructions, which provide little guidance for practice. In addition, there are few courses that form subject teams or specialized development teams to carry out case library construction, which makes the development of cases arbitrary, lacks clear evaluation criteria, and makes it difficult to ensure the quality of cases, affecting the sustainability of construction

2) The case source is single and the practicality is weak. At present, there are two main types of cases used in the case teaching of civil engineering and water conservancy master’s degree: one is adapted cases, which are mainly organized and processed by the course instructor based on publicly available materials. Combined with the course objectives and content, from collected case materials, The second is the compilation of cases, which are compiled by the course teacher participating in the production practice of the enterprise or the school-enterprise cooperation project. Combined with relevant information of the project. The drawback of adapting cases lies in the lack of integrity and authenticity of the cases obtained through the published information, resulting in unsatisfactory practical reference effects; For editing cases, the design practice information of enterprises usually involves confidentiality requirements and deadlines, which can lead to delays in design cases and reduce the completeness and timeliness of the cases to a certain extent. In addition, due to the lack of supporting case compilation incentive mechanisms and case intellectual property protection mechanisms in universities, the enthusiasm of classroom teachers to develop cases is not high, which to some extent hinders the development of cases.

3) The case privatization is obvious, the case library sharing is poor, and there source utilization rate is low. Due to the fact that existing teaching cases are mainly developed and used by classroom teachers based on their personal interests or needs, it is difficult to achieve true sharing. In addition, there are no clear regulations in relevant documents on how to implement case teaching work in the graduate department, whether it is a necessary training method for training work, and how to equip the infrastructure for case teaching. It can be seen that although the case teaching method has been widely recognized, there is still a long way to go before it can be popularized and promoted. At the same time, the lack of an open case resource library sharing platform has further exacerbated this low usage rate.

4. Application Prospect and Practical Value of the Case Library of “Theory and Application of Geotechnical Engineering”

The application prospect of this case library is mainly to support the teaching of master’s degree courses in civil engineering and water conservancy majors, Assist the practice of graduate students majoring in “Transportation” to provide them with good case experiences in participating in faculty research, or participating in graduate student innovation projects and design competitions; It can support the teaching of similar knowledge points in related courses, providing references for courses such as “Engineering Numerical Methods”, “Rock and Soil Earthquake Engineering” “New Technologies for Foundation Treatment”, and “Modern Construction Technology”

The practical value of this case library is as follows:

1) In teaching, case libraries can provide students with real-life experiences in geotechnical engineering design and construction projects, enabling them to further master geotechnical engineering theory in engineering construction and improve their ability to accurately identify, analyze. and solve engineering problems. At the same time, using projects in the case library to carry out teaching practice activities is a concrete manifestation of project-based and case-based teaching.

2) In terms of scientific research, the use of case libraries can provide reference for graduate students to participate in geotechnical engineering-related research projects, provide students with a self-learning service platform, expand the self-learning space of graduate students, and change the learning mode.

5. Strategy for Case Library Construction

Geotechnical engineering is an engineering technology that uses technical means to construct projects or parts of projects. Geotechnical engineering focuses on practice but it also contains profound scientific principles. For example, slope stability analysis is based on the principle of static equilibrium; The deformation and bearing capacity of the foundation are based on the mechanical principles of rock and soil: The movement of groundwater is based on the principles of hydraulics and groundwater dynamics: The evolution of adverse geological processes and

geological disasters is based on the principles of dynamic geology, The activity of earthquakes and faults is based on the principles of seismogeology. The instability mode of rock slope is based on the structural plane control theory of engineering geology, The relationship between the soil compaction effect of piles, the settlement of saturated soil, and time is based on the principles of pore water pressure and effective stress in soil mechanics

Geotechnical engineering is very practical, and without rich engineering experience, including successful and failed experiences, it is impossible to have strong comprehensive abilities. Theoretical literacy and practical experience complement each other, and engineering experience must be summarized at the theoretical level. The experience gained under the guidance of theory is comprehensive and systematic reaching the advanced stage of rational understanding, which can see the essence through the appearance.

The construction of knowledge points and comprehensive practice cases for the course “Geotechnical Engineering Theory and Application” organically combines the requirements of ideological and political education in the curriculum, with major national construction projects since the reform and opening up as the main body, to stimulate students’ patriotic enthusiasm and pride. Typical projects include the Qinghai-Xizang Railway, the Beijing-Shanghai High-speed Railway, the Hong Kong-Zhuhai-Macao Bridge, the Shanghai-Suzhou-Nantong Yangtze River Highway-Railway Bridge, the Central Color TV Center, the National Stadium (Bird’s Nest), the Nanjing Zifeng Tower, and the Shanghai Jinmao Tower. Teachers can build cases based on their own research projects, with the main advantage of having first-hand information that is detailed and specific.

The main steps of case analysis are to first understand the mechanism and essence of geotechnical engineering problems, simplify complex problems, establish basic concepts, build mathematical models based on concepts, and propose targeted solutions to geotechnical engineering problems based on the models. The development of the case library is guided by principles of systematicness, practicality, enlightenment authenticity, typicality, cutting-edge, and innovation for case development, and retrievability, usability, and updateability for case use. The establishment of a case library first determines the nature of the cases, and then follows a scientific construction model to develop them.

The construction of cases is carried out in a hierarchical manner according to the requirements of talent cultivation, and the nature of the cases is defined to ensure that the construction of the case library can meet the systematic and progressive requirements of curriculum teaching: 1) According to the connection between cases and teaching links, cases can be divided into classroom guidance cases, classroom discussion cases, extracurricular thinking cases, and other types of development; The connection between cases and knowledge can be achieved through description. problem-oriented guidance, and mixed content design; 2) Divide the difficulty levels of cases according to the advanced requirements of users’ positions and ability cultivation.

The construction of the case library should dynamically incorporate cutting-edge cases every year, while regularly eliminating a small number of cases that do not meet the needs. The cases in the case library will include both text and multimedia courseware. In each case, multimedia courseware integrates text, images, tables, and videos to facilitate the use and sharing of modern teaching methods.

6. Conclusion

For master's degree students in civil engineering and water conservancy, the course "Theory and Application of Geotechnical Engineering" is of great significance for future design, construction, and scientific research related to geotechnical engineering. The construction of a case library for the course: "Theory and Application of Geotechnical Engineering" can provide teaching and learning resources for relevant teachers and students, help students establish engineering thinking, provide ideas and methods for students to engage in specific engineering practices after graduation to solve practical engineering problems, and also have important practical significance and reference value for the reform of course teaching models, improvement of classroom teaching quality, and implementation of quality education. Especially, the compilation of case libraries based on the great achievements in infrastructure construction since the reform and opening up can stimulate students' patriotic enthusiasm and pride, achieving the effect of ideological and political education in the curriculum. It should be noted that the construction and maintenance of the case library for "Theory and Application of Geotechnical Engineering" is a long-term and arduous task. The case library is by no means a simple process of piecing together engineering data. It requires in-depth case analysis in conjunction with the course syllabus. With the continuous development of computer technology and the deepening of teaching reform, many new and more applicable teaching modes and methods will be explored.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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