

Construction of Teaching Case Base of *Anti-Seismic Design of Building Structure*

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Abstract: *Anti-Seismic Design of Building Structures* is an important course in civil engineering majors, and it is also a course that pays equal attention to theory and practice. Therefore, by establishing a case base for *Anti-Seismic Design of Building Structures*, the obscure theoretical knowledge can be taught to students in the form of examples, and the knowledge becomes intuitive. In this way, the students' understanding of anti-seismic design theory and the efficiency of teaching can be improved, and the students' interest in learning can be stimulated.

Keywords: Building structure; Anti-seismic design; Case base

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1. Introduction

According to statistics, there are about 5 million earthquakes every year around the world, and some earthquakes can only be detected by seismographs because they are too far away or that their shock waves are too small. Earthquakes that caused serious harm to people occurred only a dozen to twenty times in history, but once an earthquake occurs, it will cause serious damage to people's lives and property safety. Therefore, it is important to do a good job in the anti-seismic design of a building. Therefore, the construction of a case base for *Anti-Seismic Design of Building Structure* can provide more educational resources for students majoring in civil engineering. This online and offline (hybrid) teaching method can not only make classes more interesting and allow students to have a better understanding of the subject, but also enhance students' ability to discover and solve problems.

2. Overview of case base construction

Different from the traditional teaching method, case-based teaching pays more attention to the understanding of cases. It is a new interactive and open teaching method. Case teaching requires careful planning and preparation. It is important to make sure that the case matches the actual teaching content and plays a role in guiding students.

Case-based teaching has been welcomed by most teachers and students and has been popularized in colleges and universities in many countries. Students are able to think from different perspectives through case studies in combination with theories, and they can discuss about the cases and analyze them. In this way, students can gain a better understanding of the subject and explain it to others. Besides, the traditional educational concept that only focuses on imparting knowledge can be transformed, and theoretical teaching can be integrated with practical lessons, so that students can be more interested in learning while grasping the cases, and improve their comprehensive quality. The construction of a case base is necessary for case-

based teaching. Large and small cases at home and abroad are collected in a case base, so that students can have a deeper and more thorough understanding of the theories learned. Case-based teaching can make up for the shortcomings of traditional teaching, in which students can understand the theories and improve their practical skills while studying the case.

3. Significance of case base construction

The construction of a case base is helpful for students to understand theoretical knowledge. *Anti-Seismic Design of Building Structure* is course in civil engineering major that involves many theories, which focuses on the development of thinking skills. Therefore, it is impossible to achieve this goal through traditional teaching methods alone. Therefore, with the help of the case base, the teacher can turn obscure theoretical knowledge in the textbook into vivid, intuitive, and figurative examples through case studies, so that students can master theoretical knowledge and improve their comprehensive quality in the discussion of cases. The case base contains pictures, videos, building information modeling (BIM) models, animations, etc., which are visually intuitive ^[1]. Teachers can use the cases in the case base to make the lessons immersive, so that students can understand the case more intuitively and the theories behind it.

Secondly, the case base can enhance students' ability in designing anti-seismic buildings. The purpose of *Anti-seismic Design of Building Structures* is not only to master theoretical knowledge, but more importantly, to put the theoretical knowledge into practice. *Anti-Seismic Design of Building Structures* is a complex course. From model selection to construction measures, every part of it cannot be taught using traditional teaching methods alone. However, the construction of a case base of *Anti-Seismic Design of Building Structures* can integrate real engineering with the design plan, where the teacher leads the students in analyzing the design drawings of the real case, reproduce the whole process of design drawing. Teachers can even let the students analyze the design draft and propose optimization measures to improve students' designing skills, so that students can applied the theoretical knowledge they have learned.

Finally, the construction of the case base can better allow students to be the main body of the classroom. In traditional teaching, the role of the teacher is emphasized, in which the teacher is the main body of teaching, and students passively accept knowledge. This one-way process of imparting knowledge is not ideal and cannot grab the attention of students. When constructing the case base and adopting the method of case-based teaching, students can have a preview of the core content of the lessons before class, thereby making it easier for teachers to explain theoretical knowledge in class, thus leaving more time for students to discuss, communicate, and analyze the cases. In this way, autonomous learning can be encouraged, and students will gain self-confidence and a sense of accomplishment in the process of discussing, researching, and solving problems.

4. The overall concept case base construction of *Anti-Seismic Design of Building Structures*

Firstly, a professional team should be created to build a case base according to the syllabus, learning objectives, and course requirements. Teachers can then collect and write cases according to the content of the course, edit materials, sort out cases, and discuss the use of cases together. For example, when the topic is about earthquake and earthquake resistance, the core content of the lesson will be the causes and hazards of earthquakes, the transmission and characteristics of anti-seismic waves, the terminology of earthquakes, and the classification standards for anti-seismic fortification. Materials like domestic and foreign news reports on earthquakes, cause analysis, and the direction of anti-seismic waves in the form of animation and video can then be collected. Teachers can then select and play videos from the case base during their lessons, and extract terms related to earthquakes, causes and hazards of earthquakes, transmission and characteristics of anti-seismic waves, etc. from the videos or materials, so as to cultivate their students' sensitivity to information.

Secondly, the case base can be diversified. In addition to videos, animations, pictures, etc., the case base can also include BIM models, virtual simulation technology, and other technologies, so that the form and content of case-based teaching is more vivid. For example, when teaching anti-seismic design of concrete structures, the core content of the course will be the anti-seismic level, frame structure damage due to earthquakes, frame structure design, anti-seismic shear wall structure damage, and shear wall anti-seismic performance evaluation. In this case, teachers can use pictures to show students the damage of strong columns and weak beams and columns and strong beams of multi-storey frame structures caused by earthquakes. At the same time, they can also use BIM models to show students the damage of concrete frame structures and deformation and construction of reinforcement. Teachers can teach their students how to evaluate the anti-seismic performance of shear walls through virtual simulation experiments.

Finally, teachers should fully utilize the case base. The ultimate purpose of building a case base is to improve classroom teaching. Therefore, teachers should think about how to make good use of the case base. For example, when the chapter is about conceptual design of structures, its core content would be irregular planes, vertical irregular surfaces, the setting of anti-seismic joints, and multiple lines of anti-seismic defense. Teachers can choose different types of irregular schemes from the cases for students to understand them. However, in the teaching of the setting of anti-seismic joints and multiple anti-seismic defense lines, teachers should not just show pictures, but also analyze the cases, from the layout to the setting of multiple anti-seismic defense lines. In other words, teachers should select the cases according to the teaching objectives, guide students to discover the pros and cons of the cases, and strengthen the teacher-student interactions. Teachers should guide students to think in a directional way, so that they can grasp the course content in the process of participating in case analysis.

5. Teaching with the *Anti-Seismic Design of Building Structures* case base

The purpose of constructing the teaching case base of *Anti-Seismic Design of Building Structures* is to maximize the advantages of case-based teaching, stimulate students' interest in learning, deepen the mastery of theoretical knowledge of *Anti-Seismic Design of Building Structures*, improve anti-seismic designing skills, and stimulate students' potential in anti-seismic building design. The main contents of *Anti-Seismic Design of Building Structure* case base include three aspects: The first one is classic earthquake disasters in ancient and modern China and foreign countries, the second one is anti-seismic design, and the third one is simulation experiments.

In the teaching of this course, teachers can use earthquake disasters that have occurred in the history of ancient and modern China and foreign countries as examples to let students understand the hazards of earthquakes and the consequences of inadequate earthquake prevention, so that students can learn from past experiences. Students will then be more aware of the importance of earthquake prevention. After students have learned anti-seismic design from the case studies, they can then evaluate the design plan, and teachers can guide students in designing an anti-seismic plan. Students can then improve their designing skills while perfecting the plan. The simulation experiment involves using simulation software to simulate reality, conduct experiments on the anti-seismic design, which can stimulate students' innovation skills, and cultivate students' logical thinking.

The construction of *Anti-Seismic Design of Building Structures* case base can not only realize the sharing of online and offline teaching resources, but also promote teaching reform and innovation, improves students' practical skills, and encourage active learning.

6. Problems in the case-based teaching of *Anti-seismic Design of Building Structures*

The construction of *Anti-seismic Design of Building Structures* case base in China still falls behind its demands. Although it has progressed from borrowing foreign cases to independent collection and

compilation of local cases, it is undeniable that the construction of *Anti-Seismic Design of Building Structures* case bases started relatively late, and there are still some problems.

First of all, the quality of the case bases for *Anti-seismic Design of Building Structures* is low, which is firstly reflected in the quantity. Although many cases from ancient and modern China and foreign countries have been compiled in the case base, most of the cases are similar, and there are not many classic cases. There is a lack original design schemes in the case base. Secondly, most of the earthquake case studies are shallow, and there is not much for students to explore and study. In addition, because there is no unified standard when selecting cases, the quality of cases in the case base is uneven. For example, some cases are completely reproduced from newspapers or the Internet, and some cases have incomplete information, so it is difficult to apply them in teaching.

Secondly, the sources of cases are limited. There are two main sources of cases in the current case base, one is real cases collected and edited from the Internet, newspapers, and other channels; and the other type consist of new cases modified by relevant personnel based on information such as the syllabus, teaching objectives, and theoretical knowledge combined with relevant materials. Therefore, it is difficult to collect comprehensive and systematic cases for teachers to use in their lessons. At the same time, because the construction of the case base lacks the necessary incentives, the staff do not realize the significance of case bases when collecting the cases. Besides, not enough attention is given to the construction of case bases, so the staff lack enthusiasm, which in turn makes the construction of the case base difficult.

Furthermore, the case base is not well-utilized. One of the reasons for the construction of the case base is to enable teachers to find cases that meet the course content and improve the teaching quality through case studies. However, although teachers are aware of the importance of case-based teaching, and are also willing to use some cases in their lessons, the cases used are often directly obtained from newspapers or the Internet, which are in the form of pictures and texts, making it difficult to achieve the purpose of case-based teaching. In addition, under the background of big data, the sources of cases are very confusing. Teachers often get slightly biased information based on the sources of cases, which leads to inefficient use of case bases.

Finally, the use of case base is not promoted enough. Most colleges and universities build case bases only to meet the needs of their own schools, so the scope of coverage is small, and there is no unified editing and management mechanism. Therefore, teachers often have no idea where to start when organizing case resources. With the rapid development of informatization, the staff can quickly edit the related cases. However, the use of the case base is only limited to the scope of the colleges and universities, and the lack of promotion cannot reflect the significance of case bases.

In short, the problem in case base construction is the lack of motivation and foundation for development, and the construction of the case base is a huge and systematic process, so there is still a long way to go.

7. Solutions for the problems in the construction of *Anti-Seismic Design of Building Structure* case base

Based on the problems in the construction of case bases described earlier, the problem of insufficient development motivation and poor foundation of case bases can be solved from several aspects.

First of all, a sound system and mechanism should be established to improve the the utilization of case bases and insufficient promotion of the case base. In the process of building the case base, there must be a certain procedure and specification for the selection standards, selection process, review of cases, and the incentive mechanism for the case editors. In his way, the operation of the case base can be more organized, the rights and responsibilities of relevant departments can be clarified, and the construction of case bases can be well-managed. Considering the syllabus of the subject, the important and difficult points of teaching,

as well as the teaching objectives and content, it is necessary to build a case base that not only covers one college or university, but also major primary and secondary colleges of the whole country as a collaborative platform for case bases that is open to all users can promote the development of case bases.

Secondly, the capital for case bases should be increased. The construction case bases is a systematic and huge project. Therefore, it requires a large amount of financial support. The operation of the case base cannot be supported only by the investment of the college or university. Therefore, the country and other social organizations should also provide some financial support for the construction of case bases. The sources of funds for the construction of case bases should be continuously expanded to ensure the smooth operation of the case base.

Thirdly, the sources of cases should be broadened. The construction of a case base requires the formation of a professional team and regular training to improve the comprehensive quality of case collection and editing staff, so that they can be more sensitive to the cases they collect and edit. Secondly, in addition to using pictures and videos about earthquakes published in newspapers and the Internet, the students' design plans can also be included in it, and for some excellent designs, teachers can have them modified by professionals who compile original cases for students. Colleges and universities can also give academic recognition to excellent case designs and provide opportunities to publish periodicals as an encouragement to motivate teachers and students to continue to innovate and forge ahead.

Finally, in the process of constructing case bases, it is necessary to obtain the support of all parties. Not only in terms of financial and cognitive support, but also to instill the concept of earthquake resistance into people, so that more people know that the construction of the case base is not only to improve the efficiency of teaching and promote innovation and reform of teaching, but also to put it into practice ultimately. The earthquakes that occurred in the history of our country not only caused serious damage to people's lives and property, but also left serious psychological trauma to the people. Therefore, the construction of the case base can potentially improve the earthquake resistance of our country's buildings and reduce the safety risks of people's lives and property.

8. Conclusion

The key to the construction of case bases is to integrate the resources of all parties. The theoretical knowledge of the course can be displayed to students intuitively and visually through the construction of the case base, thereby enhancing the students' understanding of the knowledge and improving students' practical skills. Although there are still some problems in the construction of case bases in our country, as long as colleges and universities and related organizations strengthen the construction of related systems and mechanisms and ensure the quality of case base construction, the courses on *Anti-Seismic Design of Building Structures* in civil engineering can then develop smoothly.

Disclosure statement

The authors declare no conflict of interest.

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