

Practical research on the teaching content and teaching method of steel structure principle

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Abstract: "Principles of Steel Structure" is a professional basic course for civil engineering undergraduates, which is of great significance to improve students' ability to analyze and solve problems and cultivate students' comprehensive quality. With the acceleration of China's industrialization process, the demand for steel structure talents is growing continuously, so it is of great significance to strengthen the training of steel structure talents. Therefore, this paper combines the teaching practice, studies the teaching content and teaching method of the steel structure principle course, and puts forward a multi-level, three-dimensional and interactive teaching mode.

Keywords: principle of steel structure; teaching content; teaching method

1. Preface

Steel structure is a new type of structure widely used in construction, bridge, transportation and other engineering fields. Steel structure principle is a professional course of civil engineering undergraduates, based on the research of the steel structure material performance, calculation theory and design method, etc., in the field of civil engineering in the role, is the follow-up courses such as reinforced concrete structure principle, bridge engineering principle, building structure of seismic design principle of the course. The course is highly theoretical, the knowledge system is relatively complex, the content is large, and the theory and practical engineering are closely combined. Therefore, in the teaching process, abstract teaching content and difficult students are prone to problems. Therefore, this paper studies the teaching content and teaching method of steel structure principle course.

2. Nature and characteristics of the course

"Principle of Steel Structure" is a professional basic course for civil engineering undergraduates, which mainly studies the composition, structure analysis and design, structure and construction technology of steel structure. In terms of engineering practice, the course introduces the composition and design of steel structure, analyzes the mechanical properties and calculation methods of steel structure, and studies the carrying capacity of steel structure under normal use conditions and its recovery ability after disaster. Therefore, the course has the following characteristics:

1) Compared with other courses of civil engineering, the course of "Principles of Steel Structure" is relatively rich in content, involving mechanics, materials, machinery, welding and other disciplines, with a wide range of contents. Therefore, the course requires the students to have a certain range of knowledge.

2) Compared with other basic courses of majors, the course content of "Steel Structure principle" is more abstract, and it is difficult for students to learn. Because the knowledge involved in this course is systematic and professional, students need to have certain professional knowledge and ability to understand and master it well^[1].

3) Closely connected with the actual steel structure engineering. Because steel structure is widely used in China, it is used in some major engineering construction. Therefore, the course involves many theoretical and typical problems in engineering practice. How to combine theoretical knowledge with engineering practice is the key and difficult problem of this course.

3. The significance of teaching content and teaching method optimization of steel structure principle

3.1 Improve students' learning efficiency and effect

In the traditional teaching mode, students' learning of steel structure principle courses is mainly taught by teachers, and students can only passively accept the knowledge. Under the innovative teaching mode, teachers can organize students to make full preview before class according to the classroom teaching content, so that students can find and ask questions independently. For some professional knowledge, teachers can also let students actively participate in the classroom learning through case teaching, engineering field teaching and other ways, so as to enhance students' understanding and understanding of the course content^[2]. In addition, teachers can also let students discuss in groups, through this way can not only promote the communication and communication between students, but also fully mobilize the students' enthusiasm for learning, stimulate their interest in learning, improve the teaching effect.

3.2 To train high-quality talents for China's construction industry

With the rapid development of China's economy, China's construction industry has also been rapid development. As a new type of building material, steel structure has been widely used in building engineering. In order to ensure the healthy development of China's construction industry, the country vigorously advocates the use of new building materials, and encourages enterprises to carry out technological innovation and development. For enterprises engaged in construction engineering, talent is the foundation of enterprise development. The innovative teaching mode can enable students to actively participate in teaching activities, actively think about problems, effectively improve students' interest and enthusiasm for learning the course content, so as to better master the course knowledge and provide high-quality talents for enterprises.

4. Teaching content and optimization of steel structure principle

4.1 Teaching content of steel structure principle

According to the requirements of the syllabus of Steel Structure Engineering, this course mainly includes three parts: first, the basic concept, basic theory and basic calculation method of steel structure, its essential characteristics and summarized; the stress performance, component and node design method, node bearing capacity, and the calculation principle and calculation process; the design and production of steel structure, and the design method and construction technology, applying the theory to practical engineering. Therefore, in the teaching of this course, the course content should be arranged reasonably.

4.1.1 Basic principles of teaching

The basic principle of steel structure is the analysis of the force mechanism of steel structure members, including the force analysis and deformation calculation of the components. The teaching mainly introduces the stress characteristics of various components, and grasps the calculation methods of their internal force and deformation. Its contents include:

Internal force analysis: including the calculation principle of internal force, calculation of section weakening and torque increase, member stability and resistance calculation, calculation of section strength and deformation of members.

Deformation calculation: including elastic and elastic-plastic deformation calculation principle and critical load determination method. In elastic deformation, the geometric condition controlling the bending deformation of the member is the section moment of inertia; in elastic-plastic deformation, the geometric condition controlling the bending and axial compressive strain is the section moment of inertia.

Stability calculation: including the basic concepts and characteristics of the stability analysis, the problems that should be paid attention to in the stability analysis, and the main influencing factors that should be considered in the stability problems.

Bearing capacity calculation: including the internal force calculation of beam, column, truss, grid

truss and other bent components. Its contents include: principle and method of section internal force calculation, internal force calculation of shaft compression member and bending compression member, internal force calculation of steel structure of rigid frame and light house^[3].

4.1.2 Teaching of basic calculation methods

In the process of learning the principle of steel structure, the most difficult part for students to understand is the teaching of the basic calculation method. The calculation methods in the steel structure course include three categories: static method, dynamic method and energy method.

The application of static method is the basic method, and the direct calculation theory.

The dynamic method is a method to calculate the dynamic reaction. It is to establish the structural mechanical model according to the dynamic characteristics of the structure to solve the reaction of the structure under the action of different dynamic loads. We solve the dynamical reaction of the structure by building the structural dynamics model.

Energy approach. It is a method to analyze the internal force and displacement of the structure according to the principle of energy balance.

According to the requirements of the teaching syllabus, teachers should carefully sort out and summarize the three categories of basic calculation methods, and choose the appropriate teaching methods according to the actual teaching situation.

4.1.3 Design method teaching

The design of the steel structure includes two stages: conceptual design and detailed design. Conceptual design is the analysis of the overall performance of the steel structure, which is to realize the mechanical properties and economic indicators of the structure through reasonable structural measures under the premise of meeting the requirements of use. Detailed design is based on the objectives and requirements determined by the conceptual design, after considering the material strength, manufacturing process, installation conditions and other factors, and then compare the calculation results with the conceptual design results, further modify and improve the design, so that it can meet the requirements of use. The contents include: basic stress member and connection of steel structure; overall analysis and member calculation of steel structure; limit state of normal use and bearing capacity of steel structure; welding process and inspection of steel structure, steel strength design principle, strength grade and steel strength conversion of steel, check calculation of component section, etc. The above teaching content is set according to the professional training objectives, aiming to enable students to fully grasp the course content.

4.2 Optimization of teaching content

According to the development status of steel structure, combined with the problems existing problems in the current project, the teaching content is optimized and some of the teaching materials are updated. It specifically includes the following aspects:

4.2.1 Combine theory with practice

The principle of steel structure course has more content, less class hours, how to let students master the principle of steel structure in a limited time, in addition to teachers carefully prepare lessons before class, should also combine engineering examples to let students learn to analyze and solve problems. Therefore, we must adhere to the principle of combining theory with practice in teaching. For example, in the course of steel structure principle, when the basic concepts and characteristics of materials, let the students analyze the properties and mechanical properties of steel to further understand the principle of steel structure; When explaining the stress characteristics of the column foot joints, explain the stress mechanism and calculation method in combination with engineering examples^[4]. So that the students can learn knowledge and master skills.

4.2.2 Combine theory with practice

The learning of theoretical knowledge is for application, while engineering practice is to apply the knowledge to specific engineering. In the course of course teaching, we should always combine theory and practice, so that students can learn to use theoretical knowledge to solve practical problems while learning theoretical knowledge. In the teaching process, we can give students some homework, such as some engineering examples, let the students complete the class discussion; can also ask students to summarize the content of the course, their own knowledge to the students. In this way, let the students

experience the fun of learning, not only can make the theory and practice combined, but also can make the students in the learning process to find problems, put forward problems, solve problems, so that the students have a better understanding and grasp of what they have learned. In addition, we can also encourage students to conduct engineering design. For example, when teaching several systems of steel structure in the principle of steel structure course, ask students to consider problems from different angles and design their own favorite forms. This can not only cultivate students' ability to solve practical problems, but also improve their interest in learning.

5. Reform of teaching methods

The principle of steel structure is a theoretical, practical and comprehensive course. In the teaching process, theoretical teaching is the main course, supplemented by a large number of practical and multimedia teaching means. The traditional classroom teaching mode is that teachers teach and students listen to lectures, which is difficult to mobilize students' initiative in learning. In the principle of "steel structure" course teaching, teachers should change role, give play to the principal role of students, the teachers by the knowledge into students' learning guide and facilitator, the traditional single teaching way into heuristic, discussion, case, interactive teaching method of the combination of multi-level, three-dimensional, interactive teaching mode.

5.1 Heuristic teaching method

Heuristic teaching method refers to teachers using the methods of inspiration, induction and discussion to guide students, fully mobilize students' enthusiasm and initiative, and cultivate students' ability to analyze and solve problems. Teachers should pay attention to grasp the key points in class, explain the concept around the key points, explain the formula thoroughly, and guide students to study independently and think independently. At the same time, teachers should use more enlightening questions to guide students in teaching, encourage students to think actively and ask questions boldly, so as to mobilize the enthusiasm of students to learn.

5.2 Discussion-type teaching method

In the teaching process of steel structure principle, the teacher can use the discussion teaching method, divide the relevant knowledge points into several questions, let the students discuss in groups, the teacher give appropriate guidance, and comment on the discussion results. In the discussion process, students can better understand the knowledge, and deepen the understanding of the knowledge points. At the same time, in the discussion, students can also play their own subjective initiative to make the classroom atmosphere more active. In addition, students can express their own opinions and opinions according to their own understanding and judgment, so as to improve their enthusiasm and initiative in learning.

5.3 Case analysis type teaching method

Case analysis teaching method refers to guiding students to learn, discuss and solve problems by choosing classic cases. The case can be a famous large-scale project at home and abroad, or it can be the latest case of steel structure engineering. Through the case analysis teaching method, students can systematically learn the principle of the steel structure, master the application of the steel structure principle, improve their interest in learning, and strengthen their practical ability^[5]. For example, when learning the steel roof structure, we can introduce the world's first steel roof structure — the "new big roof" in Hamburg, Germany. By introducing the history, design methods and successful experience of the building, students can not only deeply understand the concept and characteristics of the steel roof truss structure, but also understand the role of the building in promoting modern architectural technology.

5.4 Evaluation method of performance

Assessment is an important link in teaching, which can not only test the learning effect of students, but also urge students to take the learning process seriously and guide students to learn. Therefore, the design of the assessment method is very important. The assessment of the steel structure principle course is mainly divided into two aspects: normal score and final examination. The usual score consists

of three parts: attendance, classroom performance and homework. The final examination includes two parts: examination paper and final practice report. Regular results account for 40% of the total score, and the final practice report accounts for 30% of the total score. Through the assessment of students' learning effect, students can find the problems and deficiencies in learning, help to timely adjust the teaching content and teaching methods, and also enable teachers to effectively adjust and optimize the teaching content and methods, so as to improve the teaching quality.

5.5 Combine network courses with multimedia to enrich teaching means

Network course refers to the use of Internet or digital information technology, multimedia as the main form of expression, the teaching content is provided in the form of a variety of media to students, it is a means to realize information teaching. The principle of steel structure course has more content, fragmentary knowledge points, which requires us to teach more knowledge in the limited classroom time, and to make full use of the network course. In the teaching of steel structure principle course, various multimedia courseware such as electronic teaching plan, video, PPT should be made. These courseware can be uploaded to the teaching website before class, and students can download and learn according to their own needs. Because these courseware are carefully made, not only have a strong theoretical and knowledge, but also has a strong interest, can attract students' attention. At the same time, in order to stimulate students 'interest in learning and cultivate students' practical ability and innovation ability, the network learning platform of steel structure principle course can also be made. After learning the knowledge in the textbook in class, students can learn and consolidate it independently through the platform. In this way, students' ability to study independently, analyze and solve problems can be better cultivated.

6. Conclusion

Through the use of "heuristic, discussion and case analysis", students 'interest in learning is stimulated, and students' ability of analyzing, solving and innovative thinking is improved. Through the reform of course content and teaching methods, students 'learning of steel structure principle course has been changed from passive acceptance to active learning, which promotes the comprehensive quality of students' creative thinking ability, independent learning ability and innovative consciousness, and lays a foundation for cultivating high-quality talents of civil engineering majors.

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