Research on the Teaching Reform of Building Structure Course Integrating BIM Technology Based on the Training of Skilled Talents

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Abstract. "Building Structure" is the core course of the architectural engineering technology major in higher vocational colleges. When students learn all kinds of structural calculation, the lack of spatial imagination often makes them feel difficult in the learning process. By building models, BIM technology can help students increase their perceptual understanding of various structures and improve their learning effect. Based on the requirements of the training of skilled talents and the current situation of course teaching, with the advantage of BIM technology, this paper explores the reform of course teaching by integrating BIM technology with the training of skilled talents. While improving the teaching effect, students are more familiar with BIM technology, which gradually meets the requirements of training skilled talents and promotes the development of informatization in the construction industry.

Keywords: Building structure, Model, BIM technology, Teaching efficiency

1 Introduction

BIM technology (Building Information Modeling) is the use of modern technology and three-dimensional digital technology to build a corresponding digital model, which can integrate the information of the entire project, and use digital expression to specifically interpret the information of the project to meet the actual needs of the project itself.[1] BIM technology has the characteristics of visualization, simulation, coordination, unity and information integration,[2,5] it plays a very important role in the construction industry. BIM, as one of the most promising technologies in the construction industry in recent years,[6] has become a trend in the application of BIM technology in the field of civil engineering, and has received more and more attention in the construction industry at home and abroad. The industry also needs more and more talents who can master BIM, but the scale of talent training is far from adapting to the development trend of the industry. In order to adapt to the development of the industry, it is necessary to cultivate more skilled talents who are familiar with and master BIM.

In addition, in 2021, the Ministry of Human Resources and Social Security issued the Implementation Plan of the "Skills China Action", which mentioned that during the "14th Five-Year Plan" period (2021-2025), the proportion of skilled personnel in employment reached 30%. The "14th Five-Year Plan" and the outline of the 2035 Vision goals also propose

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that we should strengthen the training of innovative, application-oriented and skilled personnel, implement knowledge updating projects and skills upgrading actions, and expand the team of high-level engineers and highly skilled personnel. It can be seen that in the national economic construction, the status of skilled talents is also gradually improving. As the core course of architectural engineering technology major in higher vocational colleges, "Building Structure" should fully grasp the development direction and trend of education and industry, enhance students' spatial imagination of various structural components, fully integrate BIM technology to steadily promote the teaching reform of architectural structure, and promote the teaching level of "Building Structure" to a new level. It has played a guiding role for other professional courses and cultivated more BIM skilled talents to meet the needs of social development.

2 Present situation of curriculum teaching reform

The course "Architectural Structure" is rich in content, theoretical and practical, and involves the calculation of various structures. Liu Yu and Sun Zhenming proposed that under the objective requirements of the development of the construction industry, we should pay attention to the reform of teaching content, encourage the reform of innovative teaching methods and promote the evaluation of teaching reform, so as to improve students' learning experience and satisfaction.[8] Fang Zhangping, Huang Wei and Gao Hongxia, in a Discussion on the Reform of Teaching Methods of "Building Structure" Based on the Training of Technical and Skilled Talents, expounded the teaching methods of "must be sufficient", "flow chart" and "vivid example", and pointed out that the reform of teaching methods plays a key role in curriculum reform.[9] In the process of learning, many students find it difficult to understand the forces of structures in space only when they see the two-dimensional structure diagrams in books or PPT. However, traditional teaching methods are mainly lecturing, and it is difficult for students to truly understand all kinds of structural components in space, which makes it difficult to master the theoretical knowledge taught in class.Foreign universities share resources by providing rich learning and communication tools on the network teaching platform. When teachers cannot fully take into account students at different levels in classroom teaching, students can make up for the lack of knowledge through the network teaching platform. Teachers can upload curriculum-related teaching resources such as course materials, learning software, knowledge introduction, and related links for students to browse or download online for review. Students can receive learning information anytime and anywhere where the network information can be reached, and learn efficiently, realizing the real-time or non-real-time interaction between teaching and learning, breaking through the time and space restrictions of traditional face-to-face education.

Two-dimensional drawings are involved in this course, and students have poor spatial imagination and are often difficult to understand. In the reform practice of Building Structure, Sun Xiaobo and Huang Jie proposed that the introduction of building BIM technology in teaching can improve the learning effect, consolidate the ability of BIM modeling, enrich the results of professional learning and improve the quality of professional teaching.[3] Therefore, the visualization characteristics of BIM technology provide good conditions for the teaching of this kind of professional courses.

Sacks and Pikas pointed out that in order to meet the demand for BIM talents in the construction industry in the United States, a number of universities in the United States have integrated BIM technology into teaching reform, and the BIM curriculum setting modes for construction or engineering management majors are as follows: Single course mode, interactive teaching mode, multi-course joint mode and graduation design mode cover architectural design courses, structural design courses, special professional courses and engineering management courses.[7]

3 Exploration of curriculum teaching reform

3.1 BIM technology optimization teaching methods

3.1.1 Combination of case teaching and BIM technology.

The teachers of the course "Building Structure" collect relevant real BIM technology application cases, and while teaching the theoretical knowledge of building structure, they can enhance students' spatial imagination ability and improve their understanding of BIM technology, so as to become more familiar with the application of BIM technology. For example, when explaining the content of steel structure, practical engineering cases are introduced, namely, Huangshan Culture and Art Center adopts the BIM technology of construction-structure integration to solve the problem of coordinated design of complex building structures,[4] helping students to understand the knowledge of steel structure and realize the importance of BIM technology in the construction industry.

3.1.2 Multimedia teaching and BIM technology.

In teaching, teachers use BIM technology to make three-dimensional models, collect relevant videos and animations to demonstrate the real process of stress changes, make multimedia courseware and upload it in the resource library of learning platform for students to learn independently, make the teaching content more vivid and specific, and students can easily accept the knowledge, and deepen their understanding of BIM. For example, when explaining the failure characteristics of the torsional component, the geometric structure characteristics of the spatial bending and torsional component should be analyzed first, the three-dimensional modeling method should be studied, the corresponding digital computer model should be established, and the three-dimensional model of the spatial bending and torsional component should be developed. On the AutoCAD graphics platform, a 3D modeling software system for spatial bending and torsion components is developed with ObjectARX and C++ language as tools to ensure accurate lofting of bending and torsion steel components. Figure 1 is the local coordinate system at any point on the axis of specific bending and torsion components, and Figure 2 is the schematic diagram of the expansion and lofting method of bending and torsion plates. Figure 3 shows the torsional member of equal section space formed after lofting.[4] The twisted components can be clearly displayed and shown to students through GIFs, so that students can deepen their understanding of such components and help them learn relevant knowledge in the future.

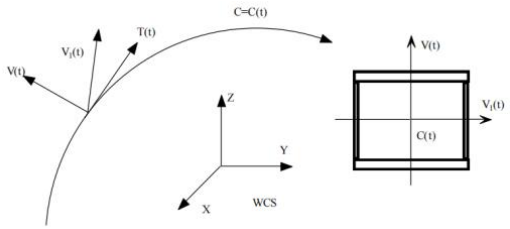

Fig. 1. Local coordinate system of any point on the axis of bending and twisting member

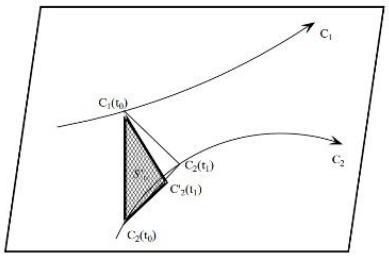

Fig. 2. Schematic diagram of the expansion lofting method of bending and twisting plates

Fig. 3. Curved and torsional members of equal section

3.2 Diversified assessment methods integrating BIM technology

This course is composed of regular grades and final grades. Regular grades are composed of online resource learning, in-class practice, regular assignments and periodic tests.

It should be pointed out that in addition to some video resources explaining theoretical knowledge, online resources also include teaching videos recorded by using BIM teaching assistance software and animations produced by using BIM technology. Students' learning details can be exported as part of their regular grades after learning. When the practical tasks in class are completed, students are often required to discuss in groups and use Revit structure to display three-dimensional reinforced concrete structures, steel structures and masonry structures, etc., and conduct structural modeling analysis. The modeling results directly affect the practical results in class, and the modeling results together with the practical results are evaluated by teachers to form normal grades. Through the integration of BIM technology in the assessment, students can promote the application of BIM technology and related software,

and cultivate BIM technical talents truly needed by enterprises, which meets the needs of enterprises for skilled talents.

3.3 Strengthen BIM technology teaching conditions

(1) Improve the BIM platform to support course construction. According to the existing BIM training room, continue to improve the hardware facilities, timely replacement, to ensure that students can successfully use BIM technology for course learning.

(2) Strengthen BIM learning and promote curriculum reform. Actively communicate with construction enterprises related to BIM technology, strive for school-enterprise cooperation units of our school, and continue to introduce experienced enterprise personnel as part-time teachers to impart more practical experience of BIM technology to students in class.

In addition, the number of teachers teaching BIM related courses is small, and the teachers are not proficient in BIM technology. By hiring BIM technology experts from outside the school to carry out special lectures and other forms of training for teachers of construction engineering courses taught in the school, the aim is to enable teachers to master the application and operation of BIM software in professional courses. Teachers of the "Building Structure" course group should actively conduct self-study on BIM technology and related software such as Revit and ArchiCAD, enter BIM school-enterprise cooperation units for practice, and constantly improve their professional abilities. To adapt to the professional development trend, cultivate BIM skilled talents who have certain modeling ability, master one or several BIM software and can skillfully use it, especially those who can use BIM modeling software to model building structures.

4 Conclusion

The recognition of BIM technology in the construction industry is gradually increasing, and it will be an indispensable basic skill in the future construction industry. In this paper, the course of "Building Structure" is reformed from three aspects: BIM technology optimization teaching method, BIM technology integration for diversified assessment and strengthening BIM technology teaching conditions. Promote teachers' ability to use BIM technology, make students more familiar with the application of BIM technology, improve their learning autonomy, improve their cooperation ability, and solve practical engineering problems related to the course, thus meeting the needs of enterprises for BIM skilled talents under the rapid social and economic development.

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