

Reform and Practice of Reinforcement Calculation Course based on BIM Model and Micro Model

Peng Zang

Civil Engineering Department, Wenzhou Polytechnic, Wenzhou 325035, China.

18657716677@163.com

Abstract

In the traditional teaching of engineering cost major, students' lack of ability to read drawings will seriously affect the learning of follow-up courses. The study proposes that students could use bim3D model to sort out the relationship between building structures and understand the steel structure; By making a miniature model, students could simulate the reinforcement work in the classroom, truly understand the structural construction drawings and correctly calculate the reinforcement quantities.

Keywords

BIM; Micro Model; Curriculum Reform.

1. Introduction

Based on the development trend of the construction industry, it is very important to bring BIM into the existing engineering management professional knowledge system to output high-quality management talents. With the development of Bim in China and the formation of innovation and entrepreneurship environment, many scholars in recent years focus on how to adapt to the development trend of construction industry and carry out the teaching reform of engineering cost.

In recent years, the research of BIM Technology Combined with professional teaching is gradually deepening, especially for the professional courses of map recognition and quantity calculation, the BIM teaching aids can greatly improve the teaching effect. At present, BIM software course has been set up in our college, which provides necessary knowledge and skills reserve for the research of this topic. On the other hand, architectural miniature model can also play a good auxiliary role in professional teaching. However, the practical exploration and literature research of using micro model to assist professional teaching in China is still very limited. Teaching tools such as building miniature model or steel skeleton are very scarce in Colleges and universities, and the teaching tools of steel calculation are rarely seen in the market. At present, only a few colleges and universities use the building micro model in the engineering cost major, but there are obvious differences between these models and the construction drawings of the building structure. If they are not used properly, they will mislead the students.

Based on the current situation, this paper puts forward the curriculum reform of "structural drawing recognition and reinforcement calculation" based on "BIM + micro model".

2. Content of teaching reform

2.1 Improving students' ability to read structural drawings based on BIM model

In the teaching of structural drawing recognition and reinforcement calculation, teachers usually select a typical engineering case (provide relevant design and construction drawings, plane method atlas and other data), so that students can carry out simulated reinforcement calculation with reference to theoretical knowledge points. The students are in a dynamic state. Because they see a kind of two-dimensional drawing, lack of engineering practice experience and poor spatial imagination ability, they do not establish the spatial three-dimensional model of the house shown in the drawing in their mind. As a result, they can not understand the contents of some drawings and detail nodes. BIM, a new building information technology, is introduced into the classroom, which can help students

directly see the BIM three-dimensional model, reinforcement structure, site roaming, construction simulation and other contents of the course supporting drawings, and help students sort out the structural relationship in the drawings, understand all kinds of reinforcement structures, so as to achieve the purpose of auxiliary teaching.

2.2 Improving students' ability of steel bar calculation based on the micro shrinkage model

In the past teaching of structural drawing and reinforcement calculation, it is found that many students do not understand the spatial position and function of reinforcement in structural members, but also lack of engineering practice experience. Students can only rely on the theory of dead memory and copying formula to calculate the quantity of steel bars, and they can not understand and flexibly apply the theory.

In view of the current situation of this teaching, the group proposes to improve students' interest in teaching content by making reinforcement skeleton micro shrinking model, and promote students' autonomous learning ability, and understand the characteristics and structures of various kinds of reinforcement in the production model. During the classroom teaching, students can calculate the length and number of reinforcement of the specified components according to the task groups, and prepare the concrete structure member reinforcement batching list. On this basis, students can simulate the cutting of steel bars and steel wires with wires, plastic coated wire binding materials, that is, cut the calculated results proportionally, and act as a reinforcement worker in class to make the reinforcement framework. In this process, students can understand the spatial position and shape of the reinforcement directly and clearly, better understand the drawing rules and requirements of the steel bar flat method construction drawing, and understand the construction points of the steel binding.

3. Research objectives

Based on the reform of the construction industry under the background of informatization, this paper explores the new professional teaching mode of "BIM + micro model" to improve the teaching effect of professional courses. BIM Technology + building miniature model will be loaded into the classroom to stimulate students' interest in learning, enrich teachers' teaching mode, and make students change from passive learning to active learning. Through the use of BIM three-dimensional model and the production of steel skeleton and other miniature models, students can more easily master the theory and improve their ability of engineering practice and solving practical problems. At the same time, the teaching reform research also tries to improve students' oral expression ability, cultivate realistic and pragmatic work style, establish the team spirit of division of labor and cooperation, so as to achieve the goal of comprehensive education.

4. Scheme design of teaching reform

The basic task of the research is to consolidate the theoretical foundation and improve the practical ability. BIM Technology and steel micro model are loaded into the classroom as teaching tools to carry out the overall teaching design of the course of structural drawing recognition and steel calculation; Carry out teaching reform according to the predetermined plan and plan; In the process of implementation, we should organize teaching observation and extensive discussion, evaluate teaching effect, adjust teaching design, organize students' discussion, collect feedback and reflect on the shortcomings of teaching. Finally, collect and sort out the data to form a new overall teaching design.

The specific design of teaching reform are illustrated by taking the unit teaching of "calculation of reinforcement of pile cap" as an example. The teaching content of this course is "pile cap structure drawing recognition and reinforcement calculation". The practical task is to calculate the reinforcement quantity of pile cap (Figure 1) in the drawing. However, the drawing can only reflect the plane and elevation information, which deviates greatly from the actual reinforcement cage (Fig. 2), which makes it difficult for students to understand the real structure of three-way (X / Y / Z) hoop. Through the BIM three-dimensional model (Figure3) show, let students intuitive understanding of

steel structure, and then through the production of steel skeleton model (Figure 4) to improve students' practice of steel calculation and ability to solve practical problems.

The specific teaching steps are shown in table 1:

Table 1. The specific teaching steps

Stage	Student activities	Objective
Before class: Flipped classroom	With the task of independent watching learning video, access to atlas information Complete the test questions on the information platform Set up model making team	Through flipped classroom, the students can understand the teaching task in advance, learn the theoretical knowledge independently, and have a preliminary understanding of the pile cap reinforcement structure and calculation rules
In class: BIM demonstration	Through BIM model to deepen the understanding of pile cap reinforcement structure Consolidation of calculation points of independent foundation reinforcement Group division of labor, clear team member task	Through BIM model, deepen students' understanding of steel structure. Through group division of labor, cultivate students' teamwork spirit.
In class: Group practice	Task 1: read the drawing information Read the structural construction drawings, consult the standard atlas, and find the calculation parameters of the project, such as the thickness of the steel cover, the seismic grade, the relevant dimensions of the components, the starting distance, the steel hook and so on.	To cultivate students' ability of reading plane structural construction drawing
	Task 2: manual calculation of reinforcement quantities Calculate the single length, number, total length and total mass of all kinds of reinforcement of pile cap in the task book.	Training students' ability to calculate the quantity of reinforcement by hand
	Task 3: make the steel skeleton miniature model According to the calculation results of the number and length of various kinds of steel bars, different colors and diameters of wires are used to replace the steel bars, and plastic coated iron wire is used to bind and connect the steel bars. According to the corresponding proportion of the model size and the actual size, the micro model of the steel bar skeleton is made	Improve students' interest and enthusiasm in learning; Deepen the understanding of plane method rules and reinforcement structure; Cultivate students' ability to solve practical problems and practical ability;
In class: Achievement display	Ten minutes before the end of the course, the group sent representatives on stage to show the miniature model of the steel skeleton, explaining the group's drawing recognition, calculation, model conception and model making process.	Training students' expression ability and improving comprehensive professional quality
After class: Scoring and evaluation	According to the calculation results and model display, the teacher gives the group score, and the students can also carry out inter group and intra group mutual evaluation.	Set up the spirit of students' organization, coordination and teamwork, and realize all-round education

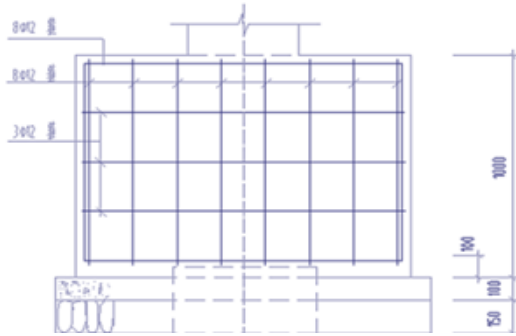


Fig. 1 Pile caps in drawings



Fig. 2 Reinforcement of pile cap

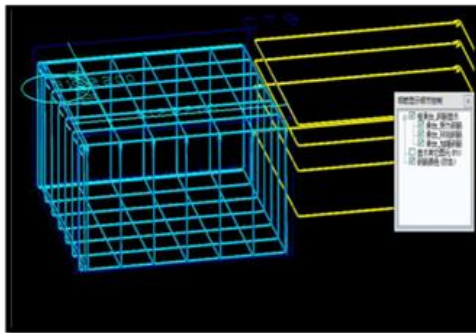


Fig. 3 BIM model of pile cap

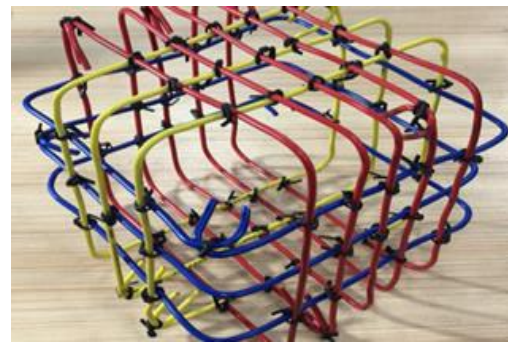


Fig. 4 Micro model of pile cap

5. Conclusion

The shape of steel bars in structural members is complex and diverse, which requires high spatial ability of students, and students are prone to be tired of learning. By using BIM model and micro model in teaching, we can make the reinforcement knowledge visible, help students understand the principle, improve their interest, grasp the key points, break through the difficulties, and improve the learning efficiency.

Acknowledgements

(1) Education and teaching reform project of Wenzhou Polytechnic in 2019/2020 academic year -- "Curriculum reform and practice of structural drawing recognition and reinforcement calculation based on BIM + micro model" (No. WZYzd202012).

References

- [1] Li Meng. Teaching reform and research based on the practical training of flat method drawing recognition and steel bar lofting [J]. Educational observation, 2021(02).
- [2] Wang Jianbin. An empirical study on the backward teaching reform based on the integration of competition and teaching [J]. Journal of Guangxi Institute of Education, 2020,(06).
- [3] Yin Suxian. Teaching reform of concrete structure course based on BIM [J]. Science and technology economy guide, 2020,28(29).
- [4] Yin Suxian. Exploration on the teaching reform of "building structure foundation and map reading" course in higher vocational engineering cost major [J]. Science and education, 2020,(09).
- [5] Bao Xianjun. Curriculum reform of "plane method drawing recognition and reinforcement calculation" under the pilot mode of 1 + X certificate [J]. Journal of Beijing printing University, 2020, (28).
- [6] Li Qian. Research on teaching reform of engineering budget course based on BIM [J]. Heilongjiang Science, 2020,11.