Education Reform and Development

Research Article

Application of BIM in the Teaching of Smart Harbor Channel and Coastal Engineering

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Abstract: It is very important to change the traditional instructional model of port channel and coastal engineering, in order to promote the interdisciplinary integration of engineering, ecology, environment and information. This paper discussed how to integrate successfully BIM (Building information modeling) and new teaching concept of intelligent port and waterway engineering into the process of teaching, and then gave the teaching plan and introduced the phased results achieved. The results show that BIM technology can be widely and deeply integrated into the teaching process of port channel and coastal engineering, and make the teaching process more stereoscopic and intuitive. So, it can provide reference for the teaching of higher education courses of port channel and coastal engineering.

Key words: BIM technology; Smart port; Harbor Channel and Coastal Engineering; Industrial model

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1 Introduction

With the international rise of our country's hydraulic construction engineering, the development of computer application technology and the popularization of general knowledge, the use of computers to draw water conservancy engineering drawings and processing graphics technology has become the main means of modern engineering project design and drawing. Learning and mastering advanced graphics technology and graphic information modeling technology have become an inevitable requirement and important standard for the teaching of engineering graphics. In order to meet the requirements of the internationalization of our country's hydraulic building engineering construction, the construction of "new engineering" in colleges and universities, the Engineering Education Certification Standards and the National Standards for Undergraduate Professional Teaching Quality in General Colleges and Universities, the teaching reform of port, waterway and coastal engineering has been the general trend. This article introduces BIM (Building information modeling) into the teaching of port, waterway and coastal engineering. Based on the development of smart port, waterway and coastal engineering, combined with engineering examples, it allows students to clearly understand the structure of ports, waterways, and coastal engineering to provide experience in the teaching process.

Domestic scholars have conducted teaching research on BIM software in the fields of water conservancy, civil engineering, construction, etc. Wang Jianchao[1] took Shenyang Jianzhu University as an example, introduced BIM technology in concrete teaching, and summarized his own experience and methods. It has a good teaching effect. Jiang Ningshan[2] introduced BIM technology in the teaching process of house architecture, which made the teaching system of house architecture more comprehensive. Xie Xinyong[3] conducted a research on BIM teaching practice in colleges and universities according to the actual situation, and found that the BIM teaching link needs to be improved during

the practical teaching process. Zhang Shaozhi[4] combined BIM technology and VR technology in HVAC teaching. Aiming at the shortcomings of traditional teaching problems, he proposed teaching reform measures to adapt to the new situation and improved the overall professional quality of students. Wang Ying[5] applied BIM technology in the modeling process of water conservancy projects to achieve high efficiency, integration and three-dimensionality. Wang Yongsheng[6] established a set of technical processes for rough and fine models of reservoir based on BIM technology, and his research results are widely used in the management of the entire life cycle of water conservancy projects. Miao Qian[7] applied BIM modeling technology in the visual simulation of water conservancy and hydropower projects according to the data organization form of Navisworks software, and realized the dynamic demonstration of the construction process of water conservancy and hydropower projects and the visual query of simulation information. In the teaching project of port, waterway and coastal engineering, the BIM model teaching is applied. Through learning, students can master the basic operation of BIM and establish the BIM structure model of each profession. This article addresses the shortcomings of traditional teaching problems and proposes adapting to the new situation. Teaching reform measures to cultivate students' ability to apply BIM technology to solve complex problems in the field of port and coastal engineering.

2 Traditional teaching issues of port, waterway and coastal engineering

According to the author's actual teaching process, this article expounds a series of problems in the current teaching process of port, waterway and coastal engineering. The teaching of them in undergraduate colleges and universities mostly adopts blackboard combined with multimedia. In the teaching process of each course, teachers work hard to instill knowledge to the students who passively absorb it during the course, and the effect is not satisfactory, especially for courses with complex overall structure and many assembly components. It is difficult for students to form three-dimensional models in their minds. They lacks a perceptual understanding of the structure, which leads to poor learning initiative of students. It in turn leads to a decline in teachers' interest in the teaching process and poor teaching effects.

The major of port and waterway and coastal engineering belongs to the discipline of water conservancy engineering. The curriculum needs to be combined with practice and requires high hands-on ability. Most of the newly introduced teachers from undergraduate colleges and universities have strong scientific research capabilities but lack experiences of live construction, design, and management of port, waterway and coastal engineering. In the actual teaching process, they particularly outweigh theory over practice. In terms of the training program for engineering undergraduates, the practice link is relatively large. Practical teaching is divided into cognitive internship and graduation internship process. Internship time is relatively small, and internship is often in a certain stage of a certain project. During the internship process of port, waterway and coastal engineering, students can clearly understand a certain period of engineering construction, but lack the overall understanding and control of engineering construction. Therefore, it becomes increasingly important on how to make students understand the whole picture of engineering construction.

The graduation design and thesis is a testing process of the undergraduate of higher education. In the process of writing the graduation design and thesis, the knowledge learned at the undergraduate level can be changed from passive to active, reflecting the knowledge framework of the undergraduate stage. However, there are generally common problems: the update of specifications and textbooks is slow; the update of student graduation design and thesis citation specifications is generally stagnant. Especially for solid structure engineering, the application of CAD modeling is quick and convenient, but the overall engineering assembly process is not directly accessible.

In view of the above-mentioned problems in the teaching process, this research injects the idea of BIM 3D modeling technology into the undergraduate teaching process of port and waterway and

coastal engineering to provide reference for future undergraduate teaching.

3 Course reform of port, waterway and coastal engineering based on BIM technology

3.1 The reform goals of BIM technology in the teaching of port, waterway and coastal engineering courses

The course system of Port, Waterway and Coastal Engineering can be divided into three levels: basic courses, professional basic courses and professional courses. The goal of the teaching reform of port, waterway and coastal engineering based on BIM modeling technology is to build a comprehensive teaching platform for port and shipping engineering. This platform integrates consulting, design, construction and management to enhance students' understanding of the entire project and improve the visualization effect. It is to realize the transformation of the teaching curriculum from a mainly 2D CAD curriculum to a 3D solid model-oriented BIM teaching model. That said, it can promote students' understanding of port and hydraulic structures, waterway engineering and coastal engineering, and create an innovative teaching platform.

3.2 Comprehensive reform measures of BIM technology teaching in port, waterway and coastal engineering

3.2.1 Introducing the basic knowledge of BIM technology into the teaching of basic theory courses

During the first semester of freshmen's admission, the BIM lectures were conducted by engineers from the industry-university-research cooperative enterprise, CCCC the First Navigation Engineering Survey and Design Institute Co., Ltd., CIMC Raffles, and Yantai Port Company, so that the freshmen could generally understand in BIM technology and its application in port, waterway and coastal engineering. It will stimulate students' interest and enthusiasm in learning.

In the follow-up professional basic courses, we will undertake CAD courses and set up BIM professional software modeling courses. This course mainly includes two parts: basic modeling course of port, waterway and coastal engineering, structural component modeling course of port waterway and coastal engineering. The basic modeling course of port and waterway and coastal engineering is mainly based on the introduction of water conservancy engineering, and the basic component model is constructed without involving the type and size of internal structure; the basic modeling course of port and waterway and coastal engineering is mainly based on hydraulic reinforced concrete, steel structure, and foundation Based on engineering, Revit is used for structural component modeling and analysis. This part involves the internal structure of structural components and calculation of engineering quantities.

3.2.2 BIM modeling application in practical teaching

In accordance with the development needs of the port and coastal industry, we have successively negotiated with CCCC First Shipping Engineering Survey and Design Institute Co., Ltd., CIMC Raffles, Yantai Port and other units to jointly build a production-education integration and collaborative education training model. Internship training bases have been established for BIM port terminal 3D design, BIM coastal protection construction progress analysis, etc. And a dual tutor system for academic and engineering is implemented. Schools and enterprises are mutually recruited, and internal and external resources are shared. By introducing enterprise BIM technology into the classroom, putting engineering projects into design, and practical graduation internships, it has realized the close connection between professional and industrial chain, teaching process and production process.

3.2.3 Encouraging students to learn BIM motivation with innovation and enterpreneurship

We should focus on the improvement of students' knowledge, ability, and quality, based on BIM technology. We should actively promote college students' innovation and enterpreneurship. The BIM foundation of port and waterway and coastal engineering will be popularized to cultivate students' basic abilities. The competitions will drive the teaching reform, practice, and learning of students. That is how we can stimulate students' interest in scientific and technological innovation and learning motivation, enhance college students' innovation and

entrepreneurial ability, and provide students with a good and broad practice platform.

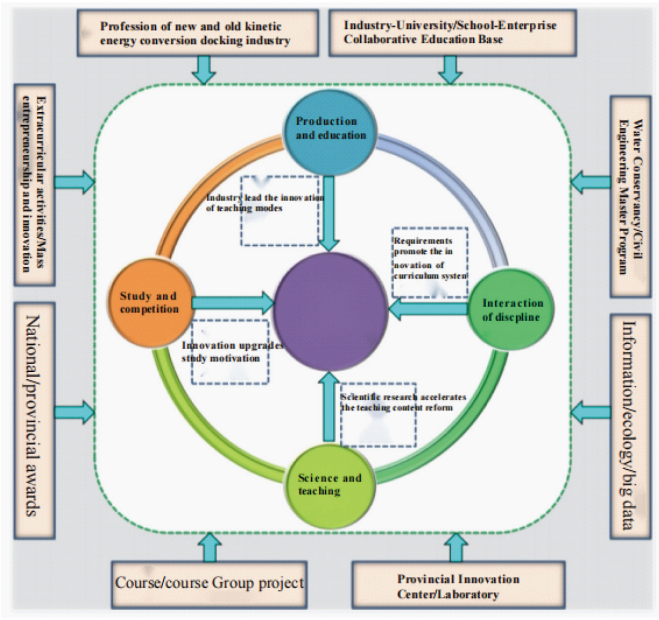

Figure 1. New ideas for comprehensive teaching reform

4 Application of BIM in the teaching of port, waterway and coastal engineering

BIM technology belongs to the field of construction. There is currently no specialized commercial software in the field of port, waterway and coastal engineering. However, the engineering disciplines are all similar, especially basic mechanics, basic structural forms, etc., and I transform my thinking mode in the teaching process to applicate the BIM in construction project on port, waterway and coastal engineering. It can enable students to form a more visualized understanding of port, waterway and coastal engineering. In the teaching process of "Hydraulic Reinforced Concrete", taking the corbel reinforced concrete column as an example, I let the students remember the internal reinforcement structure of the steel bar, and use BIM for three-dimensional modeling as shown in Figure 2. In order to familiarize students with the manufacturing process of fabricated components, the H-shaped steel column and concrete connection model was established using BIM, as shown in Figure 3. In the teaching process, students are allowed to operate in groups and build different models by themselves. They can not only be familiar with three-dimensional models, but also exercise three-dimensional thinking skills, which will greatly improve the students' teamwork ability. This is meaningful for college students to enter the society or for further study in graduate school.

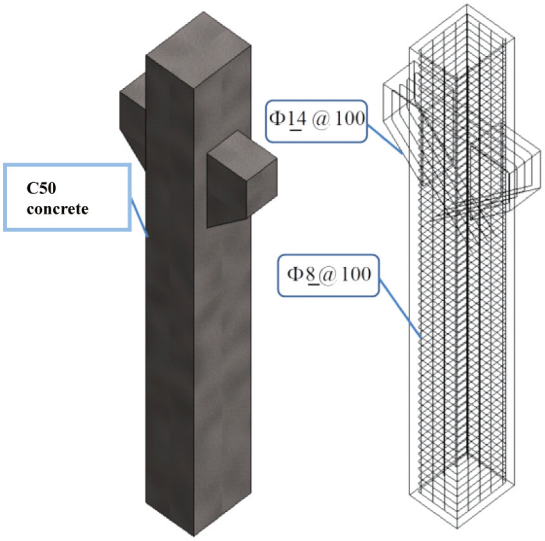

Figure 2. Corbel reinforced concrete column model

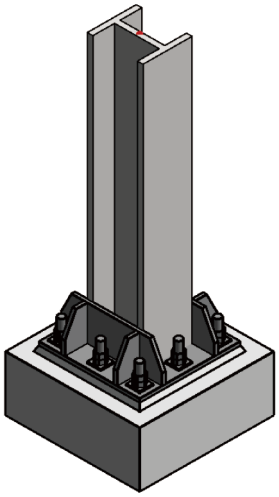

Figure 3. H-shaped steel column and concrete connection model

In the teaching process of "Water Transport Engineering Construction", we take the construction process of sluice as an example. The sluice structure is composed of the lock chamber, the upstream approach channel, the downstream approach channel, the upstream connecting section, the downstream connecting section and the downstream stilling pool. The overall structure is complex, and students have fewer opportunities to contact, and it is difficult to understand the whole construction cycle of the overall sluice structure process. In the classroom teaching process, BIM modeling software is used to model the overall structure of the sluice and its reinforcement. The internal structure is clearly visible. The three-dimensional effect is obvious, and the statistical

engineering data is convenient and quick. The overall structure of the sluice is shown in Figure 4. In some projects with poor geological conditions, the concrete retaining wall of the approach channel needs to adopt the pile foundation type. In order to enable students to have a deeper understanding and memory of this kind of processing plan, two classes with a total of 60 students are divided into 12 groups with 5 people in each group, and basic model modeling is carried out, as shown in Figure 5. It can exercise the teamwork ability of each group member, cultivate students' practical engineering ability, and use BIM modeling software to apply the knowledge learned in class to engineering practice.

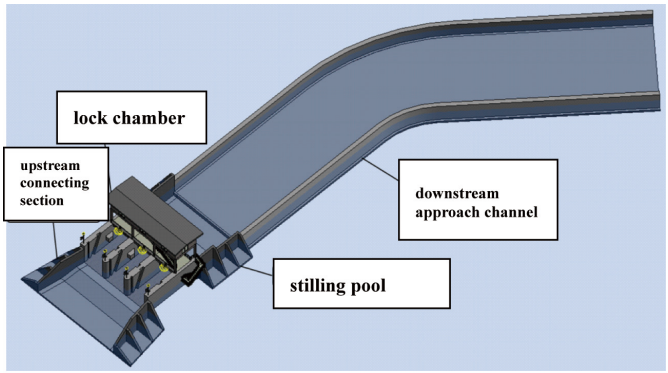

Figure 4. BIM overall structure modeling of sluice

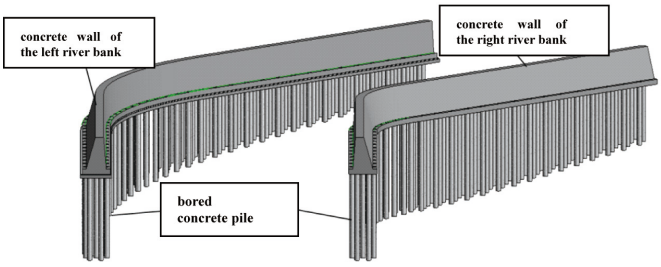

Figure 5. Structure type of pile foundation

5 Conclusion

In the teaching process of the smart port, the application of BIM model not only allows students to familiarize themselves with the current information of the changing frontier content in this field, but also allows the theoretical knowledge learned in the classroom to be better applied to information technology, which will help undergraduates in the future. They will continue to study this field and lay a good foundation for working in this field. Through the teaching reform of this major, the following teaching effects can be achieved: (1) Students can solve practical engineering problems with the basic professional knowledge they have learned, and apply theories to practice; (2) Students are trained to have strong computer application ability and be able to choose and use appropriate technology, resources, modern engineering tools and information technology tools to simulate complex engineering problems; (3) Each group of students can assume the roles of individuals, team members and leaders in the context of a multidisciplinary team. They give full play to the ability of cooperation and communication; (4) Students can exercise the awareness of autonomous learning and lifelong learning of undergraduate students, and have the ability to continuously learn and adapt to development.

As the teaching reform is a dynamic adjustment process, the current teaching feedback content still needs to be further improved. In the future teaching reform, I will vigorously apply the engineering practical software Lizheng Geotechnical Software, ABAQUS, ANSYS, FLUENT and other finite element software for teaching, allowing students to learn more practical work experience in planning, design, construction and other practical work.

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