

Construction and Practice of New Pattern of Interdisciplinary Graduation Design for BIM Applied Talents in Water Supply and Sewerage Science and Engineering—Taking Nanyang Normal University as an example

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Abstract: Graduation design is not only a key link in higher education, but also an important way to cultivate students' comprehensive ability. However, there are some problems in the traditional graduation design of water supply and sewerage science and engineering, such as emphasizing theory but ignoring practice, singleness of subject selection and insufficiency of combination with other majors. Therefore, Nanyang Normal University Water Supply and Sewerage Science and Engineering integrates the relevant knowledge of Water Supply and Sewerage Science and Engineering into the Building Information Model (BIM) technology by constructing a new model of cross-disciplinary graduation design, so as to enable students to have strong practical ability in the application of building information model, cultivate students' innovative awareness and ability, enhance students' engineering practice ability and team spirit, and provide new ideas for the application of this major in other fields.

1. Introduction

In our country, with the economic development and social progress, the urban scale is expanding, the urban population is growing rapidly, the construction of urban sewage and garbage treatment facilities is increasing, and the application of water supply and drainage is more and more extensive.

The graduates of water supply and sewerage are mainly employed in design and construction units, and graduation design is one of the important links[1]. At the same time, graduation design is also the first practical link for graduates to check whether students have the basic knowledge and skills needed for a job. Therefore, the graduation project directly affects the graduates' understanding and mastery of the knowledge and their practical operation ability in the practical work[2].

At present, the traditional graduation design mode is adopted in the teaching of water supply and drainage science and engineering in most domestic universities. The major content of graduation design is to summarize and improve the theoretical knowledge. The Building Information Model (BIM) technology is often used to assist students in graduation design. Because BIM technology can integrate complex building structure, function, equipment and facilities, construction process and project quality into 3D virtual model, BIM technology can realize information sharing and integrated management in the whole process of building design, construction, operation and maintenance, and provide digital solution for the whole life cycle of engineering construction[3-5].

Therefore, BIM technology has become an important technology in the field of construction. According to the 2017 China Construction Industry Information Development Report released by the China Construction Industry Association, the overall informatization level of China's construction industry is relatively low. Compared with developed countries, our country still has a big gap in the application of information technology. Among them, the engineering construction industry is the main bottleneck restricting the development of China's construction industry information. Therefore, it is necessary for our country to strengthen the informationization construction of engineering construction industry, and carry out comprehensive and profound reform and innovation through information technology[1, 4].

However, the students majoring in water supply and drainage are not easy to find jobs because their knowledge involves water supply engineering, drainage engineering and municipal engineering. Therefore, how to combine BIM technology with water supply and sewerage professional knowledge to solve the problems faced by the graduation design of water supply and sewerage has become an urgent problem.

Nanyang Normal University is a full-time ordinary undergraduate college which is mainly based on normal education and coordinated development of multi-subjects. The University of Water Supply and Drainage Science and Engineering has a history of 25 years, its graduates are mainly employed in municipal engineering units and design units[6-8]. In recent years, with the rapid development and popularization of computer technology and Internet technology, water supply and drainage science and engineering has been widely used and recognized[9, 10]. In order to adapt to the new requirements and challenges of the society, the school actively explores the new pattern of graduation design for water supply and drainage specialty.

2. Problems in Traditional Graduation Design of Water Supply and Sewerage Science and Engineering

Graduation design is an important part of the teaching plan of water supply and drainage science and engineering, and it is also an important means to train students to combine theoretical knowledge with engineering practice. However, there are many problems in the traditional graduation design, as follows:

(1) The traditional graduation design topics are mainly civil engineering, water supply and sewerage, building and electric, and other specialties, but the knowledge involved is relatively narrow, can not meet the needs of the society for graduates of compound talents. The major of water supply and drainage science and engineering cultivates applied talents who can be engaged in design, construction and management after graduation. At present, most of the contents of this

major are civil engineering, water supply and drainage, building and electrical engineering, etc.

(2) The traditional graduation design time is too short to connect organically with the graduation design of other majors. The major of water supply and sewerage science and engineering should combine the knowledge of civil engineering, electrical engineering and mechanical engineering. But the traditional graduation project time is short, the student often is very difficult in the short time to be familiar with the related discipline domain knowledge.

(3) The traditional graduation project is not enough to cultivate students' basic skills and lacks an effective assessment mechanism. Students majoring in water supply and sewerage science and engineering have not grasped the knowledge and applied ability well enough to solve the practical problems reasonably. At the same time, there is no specific requirement for students to master some specific skills in the training program, which leads to many students' fear of difficulties and reluctance to do relevant preparatory work.

(4) The traditional graduation design achievement evaluation system is too simple and the evaluation method is unreasonable. The graduation design result of water supply and sewerage science and engineering major is composed of three parts: the result of paper, the result of defense and the result of peacetime. Among them, the paper results include theoretical examination, experimental examination and course papers and so on. However, students majoring in water supply and sewerage science and engineering do not attach importance to the experimental examination and course papers, and their scores are relatively low.

(5) Traditional graduation design is not enough to cultivate students' innovation ability and comprehensive quality. The students of water supply and sewerage science and engineering major usually choose some simple engineering problems to study or discuss in their graduation thesis. However, due to the strong comprehensiveness and practicality of water supply and sewerage science and engineering, students often need to start from different disciplines to study or explore. However, there is no specific requirement for students to master some specific skills and comprehensive quality training in the training program of water supply and drainage science and engineering. In addition, the lack of innovative spirit and practical ability of students majoring in water supply and sewerage science and engineering is also a prominent problem.

Based on the analysis of the above problems, it is necessary to construct a new model of interdisciplinary graduation design. This model requires students majoring in water supply and drainage science and engineering to integrate the knowledge of water supply and drainage science and engineering into BIM technology.

3. New pattern construction idea

Most graduates majoring in water supply and sewerage are employed in municipal engineering, architectural design, construction and other fields, but the employment scope of graduates majoring in water supply and sewerage is relatively narrow. Based on the investigation of the employment orientation of the graduates and the requirements of the employers for the graduates' ability and quality, combined with the characteristics of the water supply and sewerage majors and the needs of the industry, a new model of graduation design is proposed. Through the mode of "1 + 2" (1 graduation design instructor + 2 students with strong application ability of BIM software), the students majoring in water supply and drainage science and engineering can give full play to their advantages and improve their practical ability.

3.1 Graduation design instructor

The instructor should not only give opinions on the students' design, but also provide ideological

education to the students. At the same time, the instructor should instruct the students to carry out the mid-term examination and defense of the graduation design, and give guidance and help to the students in time to guarantee the quality of the graduation design.

Graduation design instructor is mainly responsible for water supply and drainage science and engineering students thesis topics, opening report, mid-term inspection and defense. The instructor and the students of water supply and sewerage science and engineering are in accordance with each other in choosing the subject and choosing the right subject for graduation design. The instructor may be a teacher of the profession or an expert in the profession. Graduation design instructors need to have a solid foundation of professional knowledge and rich practical experience, in the graduation project will be the professional knowledge and BIM technology.

3.2 BIM students

According to the characteristics of the students majoring in water supply and sewerage, the graduation design instructor can encourage the students to choose 2-3 students with strong BIM ability. Because BIM is a visual modeling through computer, and the use of architectural information model for communication, coordination, decision-making and management technology. BIM technology can be used to simulate the construction progress, detect the collision of pipelines, simulate the construction scheme and optimize the pipelines. However, the students majoring in water supply and sewerage science and engineering have relatively limited knowledge and application ability to BIM, so they should be encouraged to use BIM in their graduation projects.

BIM technology can not only share the information between water supply and sewerage majors, but also improve the simulation of construction progress, pipeline collision detection and construction scheme. Combining the theory knowledge of water supply and sewerage science and engineering with BIM technology, the paper popularizes BIM knowledge and instructs the students in software operation. In addition, BIM technology can also realize the cooperation between water supply and sewerage science and engineering, municipal engineering, architectural design, construction and other industries. Therefore, the "1 + 2" model of water supply and drainage science and engineering to build a new model of cross-disciplinary graduation design is conducive to improving students' practical ability and overall quality.

3.3 Cooperation between Schools and Enterprises, Build Platform, Realize Win-Win

At present, the university in the graduation design process mainly uses the school and the enterprise cooperation pattern. However, with the rapid development of the construction industry and the wide application of BIM technology, enterprises need more and more talents with BIM ability. Through the cooperation between schools and enterprises, the combination of construction information model technology and water supply and drainage science and engineering can bring into full play the advantages of BIM technology in space information sharing, virtual construction and other aspects, and enable students to fully understand and master the methods and skills of application of BIM technology in design and improve the quality of graduation design. Through the cooperation between schools and enterprises, enterprises can understand that students majoring in water supply and drainage science and engineering have the ability to apply BIM, and can use BIM software to solve problems arising in actual projects, and at the same time, enterprises can understand that students majoring in water supply and drainage science and engineering have the ability to apply BIM in graduation design, and can use BIM software to solve problems arising in actual projects, so as to realize the win-win situation among enterprises, students and schools.

4. Graduation Design Practice under the New Mode

In the 2020-2023 graduation project of Water Supply and Sewerage Science and Engineering Department of Nanyang Normal University, each student is responsible for one project, including model construction, data processing and model demonstration.

In the whole process of system analysis, scheme design, model creation and model presentation, students use CAD software, AutoCAD and Revit to analyze and model the water supply and drainage system. From the results, students can better complete the graduation design of the various tasks, the design of clear ideas, reasonable process, good results.

By deepening and optimizing the graduation project, students not only have a deeper understanding of the water supply and drainage system, but also provide a solution to practical problems. At the same time, the implementation of the new mode of graduation design strengthens the communication and cooperation between water supply and drainage and other majors, and enhances the employment competitiveness of students.

4.1 Graduation project

Through the students' practice of 6 projects, the following results can be obtained:

(1) Deepening and optimizing the graduation design scheme. Through the cooperation among different majors, the students can get the design scheme of water supply and drainage system according to the engineering reality and solve the problems in the engineering.

(2) BIM technology and traditional technology are combined to analyze and model water supply and drainage systems. Through 3D modeling, spatial analysis, pipeline synthesis and 3D visualization, students can master the spatial layout of water supply and drainage systems and the relationship between them.

(3) The combination of BIM technology and professional knowledge of water supply and drainage, and the use of BIM technology for scheme comparison, optimization and construction drawing can effectively improve students' engineering design ability and construction organization and management ability.

(4) Through the BIM software to simulate the dangerous source and hidden trouble in the process of pipeline installation and construction, instruct students to carry out safety analysis and evaluation; Through the combination of BIM technology and traditional technology, the operation and management analysis of water supply and drainage systems shall be conducted, including operation status assessment, energy consumption analysis and emergency simulation, so as to improve the operation and management capacity of water supply and drainage systems. The results will provide valuable reference information for enterprises.

4.2 Analysis of results

In the practice of graduation design, the multi-disciplinary graduation design mode is adopted. After the students complete the graduation design, the instructor conducts a comprehensive test of the results as follows:

- (1) Having completed the tasks of graduation design;
- (2) The project model has been made and the effect is good;
- (3) Preliminary realization of multi-professional collaboration;
- (4) Exchanging results with students of other specialties and enhancing competitiveness in employment.

Practice has proved that the new mode of graduation design for water supply and drainage meets

the requirements of talent training for water supply and drainage science and engineering. Practice has proved that the model can effectively improve students' comprehensive quality, practical ability and innovation ability, and promote students' all-round development. At the same time, it also provides reference for the construction of new mode of graduation design of water supply and drainage major in other schools.

4.3 Practical effect

The implementation of the multi-disciplinary graduation project makes students have a deeper understanding of the professional knowledge they have learned, realizes the transformation from "specialized talents" to "generalist" in the knowledge structure, and broadens the employment channels for students. Students can use professional knowledge to analyze and model BIM technology, and combine BIM technology with traditional technology to solve the problems encountered in practical engineering. Students are able to propose systematic solutions from a professional perspective, compare and analyze different design options, and ultimately select the best solution. At the same time, students can learn and apply BIM technology, which promotes the cross-integration of professional courses. The application of BIM technology in graduation design makes full use of its advantages and makes up for the shortcomings of traditional graduation design. In addition, through the implementation of multi-disciplinary graduation design project, students can apply BIM technology to design and manage in the actual project. At present, the project has been implemented successfully for two years and achieved good results.

5. Conclusion

Under the background of BIM technology advocated by our country, the major of water supply and sewerage should keep pace with the times, reform the traditional graduation design mode, strengthen the cooperation with other majors, and introduce BIM technology into the graduation design of water supply and sewerage science and engineering. The practice shows that BIM technology can enrich the contents of graduation design and improve the quality of graduation design by integrating the knowledge of architecture, structure and HVAC. In addition, BIM technology can be applied not only in graduation design, but also in curriculum design and innovation and entrepreneurship training. Through this study, a new model of multidisciplinary graduation design for water supply and sewerage science and engineering majors is put forward, which can be used for reference.

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