

# Teaching Model Reform for Graduation Design of Civil Engineering Based on Integration of Industry and Education

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**Abstract:** This paper explores the reform of the teaching model for graduation design of civil engineering based on the integration of industry and education. The integration of industry and education is of great significance to the civil engineering major. However, currently, there are some problems in graduation design, such as a narrow and outdated scope of topic selection, a mismatch between talent cultivation and market demands, insufficient construction of internship bases, and a lack of "double-qualified" teachers. In response to these problems, it reforms measures such as scientific topic selection, modification of the talent cultivation program, strengthening the construction of internship bases, and organizing a team of "double-qualified" teachers have been put forward. In the future, attention should be paid to combining the national strategic needs and the cutting-edge technologies in the industry, optimizing the cultivation program, and strengthening the construction of internship bases and the team of "dual-qualified" teachers, so as to promote the development of the teaching mode and cultivate more high-quality applied talents.

**Keywords:** civil engineering; graduation design; integration of industry and education; reform of teaching model; talent cultivation

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## I. The concept and significance of the integration of industry and education

With the development of social economy and the adjustment of industrial structure, the demand for civil engineering professionals in the job market is becoming increasingly diverse. As a new education model, the integration of industry and education provides new ideas and methods for the teaching of graduation design in civil engineering major. The Report of the 20th National Congress of the Communist Party of China proposed, "Adhere to cultivating talents for the Party and the country, comprehensively improve the quality of independent talent cultivation, focus on fostering top-notch innovative talents, and gather outstanding talents from all over the world to put them to good use."

The integration of industry and education refers to the in-depth cooperation between production and education, closely combined the actual needs of the industry with the talent cultivation of education<sup>[1]</sup>. Under this model, a long-term and stable cooperative relationship is established between schools and enterprises, and both parties participate jointly in the talent cultivation process to achieve the sharing and optimal allocation of educational and industrial resources.

Industry-education integration holds significant importance in civil engineering major. Firstly, it helps to improve the quality of talent cultivation by enabling students to master professional knowledge and skills in practice, thereby improving their comprehensive quality. Secondly, it promotes industrial upgrading and economic development, providing high-quality professionals for the industry and driving industrial technological innovation and upgrading. Thirdly, it realizes the coordinated development of education and industry, promotes the optimal allocation of educational and industrial resources, and achieves mutual benefit and win-win results. Last but not least, it is conducive to improving the economic capacity of the "campus life circle" of universities<sup>[2]</sup>.

## II. Problems in the graduation design of civil engineering

At present, the graduation design of civil engineering major in the School of Civil Engineering of Henan Polytechnic University starts in the second semester of the senior year, and all the content of the graduation design is completed in the 3rd to 14th weeks, and the defense is carried out in the 15th week, with a total of 13 weeks<sup>[1]</sup>.

### (1) Narrow topic selection range and outdated topics

Taking a personal graduation design as an example, the design of multi-story and high-rise reinforced concrete frame structures is often chosen. The design content mainly includes two aspects: architectural design and structural design. In the architectural design part, according to the different use functions of the office building, offices, rest rooms, and elevator shafts are set up respectively. There is one staircase and one elevator shaft inside the building, and the toilets are located close to the stairs to maximize space utilization within the

limited space as much as possible. The building layout is simple and regular, and the internal space layout is reasonable, meeting the requirements of use functions. In the structural design process, a transverse frame is selected for calculation and design. When arranging the structural layout and counting the loads, all the walls in the building are directly placed on the beams. The D-value method is used to calculate the horizontal seismic internal forces, and the moment redistribution method is used to calculate the internal forces of the frame under vertical loads. Then, the internal force combination and adjustment are carried out for the control sections of the transverse frame beams and columns, and the most unfavorable internal forces of the beam and column sections are selected from the adjusted data for the reinforcement design of the sections. The floor slabs and roof slabs include one-way and two-way slabs, which are designed respectively. The staircase adopts a slab-type staircase, and the design of the flight slab, platform slab, and platform beam is required. Finally, the structural construction drawings are drawn.

At present, there are many limitations in the topic selection of graduation design for civil engineering major in Henan Polytechnic University. On the one hand, the common topic types at present mainly focus on the design of multi-story and high-rise reinforced concrete frame structures, steel frame structures, monolithic precast concrete frame structures, spatial model analysis (PKPM), and so on. And most students tend to choose the design of multi-story and high-rise reinforced concrete frame structures. The narrowness of this topic selection range leads to serious homogenization of students' graduation design content. At the same time, in the process of completing the graduation design, some students cannot comprehensively apply the knowledge they have learned, thus breaking the relationship between various disciplines. In fact, most civil buildings nowadays adopt frame-shear wall structures. The topic selection of graduation design has not kept up with the development trend of building structures in a timely manner. In addition, recently, with the wide application of computer-aided design, software drawing has become indispensable in civil engineering design, but the existing topic selection does not reflect this aspect enough, resulting in a certain disconnection between students' graduation design and actual engineering applications. This fails to fully meet the demand for diversified design capabilities in the modern civil engineering industry.

## **(2) Talent cultivation does not meet the needs of the job market**

There is a problem of mismatch between talent cultivation in civil engineering major and the needs of the job market. On the one hand, there is a general tendency to emphasize theory over practice in the teaching process. Although students have a certain accumulation of theoretical knowledge, they are relatively weak in practical operation and engineering practice ability<sup>[3]</sup>. There are not many practical courses for civil engineering students, and the investment in teaching in practical links such as construction technology and project management is insufficient, resulting in students' lack of ability to deal with actual projects. On the other hand, the student cultivation plan has not kept up with the rapid development of the industry in a timely manner, and the curriculum setting and teaching content update are lagging behind. Knowledge in emerging building technologies, environmental protection materials, intelligent construction management, and other aspects has not been fully reflected in the teaching, making students less competitive in the job market and difficult to meet the demand for applied talents in the development of the industry.

## **(3) Insufficient construction of internship bases**

The internship base is an important place for civil engineering students to combine theoretical knowledge with practice. However, currently, the construction of internship bases faces many difficulties. Existing internship bases, such as the Henan Polytechnic University Science and Technology Park, Xiaolangdi Water Conservancy Project Company, and Pingmei Construction Engineering Group Co., Ltd., have the following three problems. Firstly, the degree of school-enterprise joint scientific research is not deep enough. There is a lack of an effective cooperation mechanism and common interests between enterprises and the universities, resulting in low enthusiasm of enterprises to participate in the construction of internship bases. Secondly, the construction of internship bases requires a large amount of capital investment, which is used for site construction, equipment purchase, teacher training, and other aspects. However, it is difficult for universities and enterprises to reach a consensus on the source and proportion of capital investment, and the lack of funds has become an important factor restricting the construction of internship bases. Finally, the internship bases are far away from the university, and arranging students for internships requires a lot of manpower, material resources, and financial resources. The insufficient quantity and low quality of internship bases cannot provide students with enough practical opportunities and good practical conditions, which affects the cultivation of students' practical ability and the improvement of their comprehensive quality.

#### **(4) Lack of a team of "dual-qualified" teachers**

The lack of a team of "dual-qualified" teachers is a prominent problem in the teaching of civil engineering major. Most teachers directly enter universities to teach after completing their studies. Although they have a solid theoretical knowledge, they lack practical engineering experience. In the process of guiding graduation design, these teachers can often only provide students with guidance from a theoretical level, and it is difficult to impart the problems and solutions in actual projects to students. And they cannot effectively guide students to carry out engineering practice and innovative design. Due to the lack of engineering practice experience, teachers are also prone to be disconnected from actual projects in teaching content and methods, resulting in poor teaching effects. Students' understanding and comprehension of actual engineering problems are not deep enough, which is not conducive to the cultivation of students' practical ability and professional quality. If students choose technical positions, they will need more time to adapt to the actual construction site environment after starting work.

### **III. Reform Measurement**

#### **(1) Scientific Topic Selection**

In order to solve the problems of a narrow topic selection range and outdated topics, the scope of graduation design topic selection should be broadened. On the one hand, it can increase the types of topics, such as introducing the construction organization design of various actual engineering projects, engineering quality inspection and evaluation, engineering application based on BIM technology, etc. At the same time, experimental topics can also be incorporated, such as research on the mechanical properties of new concrete materials<sup>[4]</sup>, which can enhance students' practical skills. Relying on actual projects, it makes students have an in-depth understanding of the whole process of engineering projects from planning to implementation and master the technical key points and management methods at different stages. On the other hand, the university should pay attention to the comprehensiveness of topic selection, and encourage students to choose topics that combine practice and theory. For example, it can carry out structural design optimization in combination with the performance research of new building materials, or carry out renovation design of existing buildings based on the concept of green buildings<sup>[1]</sup>. Such topics can not only stimulate students' innovative thinking but also prompt students to integrate the knowledge they have learned, improve their ability to comprehensively apply knowledge to solve practical problems and better adapt to the diversified development needs of the civil engineering industry.

#### **(2) Modify the cultivation plan to meet the market demand for talents**

The market's demand for civil engineering professionals has gradually shifted towards application-oriented talents. Therefore, it is necessary to optimize and adjust the cultivation plan. Firstly, it promotes the construction of high-quality courses, eliminates some outdated course contents and adds new courses closely related to the development of the industry. For example, it can offer cutting-edge courses such as green building technology, intelligent construction, and Building Information Model (BIM) application, so that students can master the latest industry trends and technologies in a timely manner. Secondly, it is necessary to strengthen the practical teaching links and increase the proportion of practical teaching in the total curriculum system. It is important to establish a comprehensive practical teaching system, including multiple links such as course experiments, course design, internship training, and graduation design, ensuring that students have enough time and opportunities for practical operation. Moreover, it is also crucial to pay attention to the cultivation of students' comprehensive quality. In addition to professional skills, the university should strengthen the cultivation of students' abilities in communication and collaboration, innovative thinking, project management, and other aspects. Through organizing team projects, subject competitions, and other activities, students' team spirit and innovative ability can be developed, laying a solid foundation for students' future development in the workplace<sup>[5]</sup>.

#### **(3) Strengthen the construction of internship bases for the integration of industry and education**

The construction of internship bases is a crucial link in the integration of industry and education. In order to strengthen the construction of internship bases, universities should actively carry out in-depth cooperation with enterprises. On the one hand, it can increase the frequency and duration of on-site teaching, allowing students to learn and practice in real engineering environments. For example, universities can arrange students to intern at the construction sites of construction enterprises, allowing them to experience every aspect of engineering construction, and understand the actual operation processes such as construction technology and construction organization management, so as to cultivate students' practical operation ability and the ability to solve on-site problems. On the other hand, it also can strengthen scientific research cooperation with enterprises, and jointly carry out engineering project research and technological innovation. Universities use their own

scientific research advantages to provide technical support and solutions for enterprises; enterprises provide universities with practical platforms and engineering data to achieve the coordinated development of production, education, research, and application. In addition, through university-enterprise cooperation, it can establish a stable operation mechanism for internship bases, clarify the rights and obligations of both parties, jointly invest funds and resources, ensure the normal operation and sustainable development of internship bases, provide students with more high-quality internship opportunities and practical conditions, and comprehensively improve students' innovative ability<sup>[6]</sup>.

#### **(4) Establish a team of "dual-qualified" teachers**

In response to the lack of a team of "double-qualified" teachers, universities should formulate corresponding teacher training plans. Universities can select teachers to take temporary posts in enterprises for training, allowing teachers to deeply participate in the design, construction, and management of actual engineering projects at the enterprise front line, and accumulate engineering practice experience. At the same time, it is also important to encourage teachers to carry out exchanges and visits with enterprise technicians, and jointly participate in academic seminars, technical training, and other activities to keep abreast of the latest technologies and development trends in the industry. In addition, universities can also hire senior technicians and managers with rich engineering experience from enterprises as part-time teachers to enrich the teaching staff. These part-time teachers can bring actual engineering cases and practical experience into the classroom, providing students with more practical and targeted teaching content. Through the combination of internal and external efforts, it will gradually build a team of "dual-qualified" teachers who not only have a solid theoretical knowledge but also rich engineering experience, providing strong support for improving the teaching quality of graduation design and the level of talent cultivation<sup>[2,6]</sup>.

### **IV. Conclusion**

The integration of industry and education is an inevitable trend in the teaching model reform of graduation design for civil engineering major. In the future, the degree of integration of industry and education should be further deepened, and the cooperation fields should be expanded. In terms of topic selection, more attention should be paid to combining national major strategic needs and cutting-edge technologies in the industry, such as in the fields of smart city construction, green buildings and sustainable development, and new infrastructure construction, to cultivate students' forward-looking thinking and the ability to solve complex engineering problems. In terms of the cultivation plan, it will continuously optimize the curriculum system, strengthen the integration of interdisciplinary knowledge and cultivate innovative talents with comprehensive qualities. Meanwhile, it's necessary to strengthen the informatization construction of internship bases and use technologies such as the Internet, big data, and virtual reality to provide students with more abundant and efficient practical teaching resources. At the same time, it should further improve the long-term mechanism for the construction of a team of "dual-qualified" teachers, encourage teachers to actively participate in enterprise practice and scientific research projects and continuously improve teachers' engineering practice ability and teaching standard. Through continuous reform and innovation, it promotes the continuous development of the teaching model of graduation design for civil engineering major and cultivates more high-quality, applied professionals for the industry.

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### **References**

- [1]. Meng Yangjun, Li Can. Exploration on the Reform of Graduation Design for Civil Engineering Major under the Background of "Integration of Industry and Education" [J]. The Science Education Article Collects (First Half Month), 2017(1): 65-66+82.
- [2]. Wang Duoliang, Li Jianguang, Li Yan. Innovative Exploration of the Talent Cultivation Mode of Local Applied Undergraduate Colleges and Universities under the Background of the Integration of Industry and Education [J]. Intelligence, 2024(28): 161-164.

- [3]. Zhang Junyan. Research on the Talent Cultivation Mechanism of Civil Engineering Major in Local Universities under the Background of the Integration of Industry and Education [J]. *Development Guide to Building Materials*, 2024, 22(4): 1-3.
- [4]. Fan Yuhui, Wang Ning. Experimental Study on the Mechanical Properties of MMA-Reinforced Recycled Coarse Aggregate Concrete [J]. *Journal of Henan Polytechnic University (Natural Science Edition)*, 2024, 43(1): 189-195.
- [5]. Lou Youxin, Zhang Xian, Zhao Ping, et al. Teaching Reform and Practical Exploration of the Graduation Internship Course Based on the Talent Cultivation Mode of the Integration of Industry and Education [J]. *Polymer Bulletin*: 1-7.
- [6]. Li Zhiping, Li Kun, Zhu Junhua. Optimization Strategies for the Talent Cultivation Quality of Civil Engineering Major in Local Colleges and Universities under the Background of the Integration of Industry and Education [J]. *Anhui Architecture*, 2024, 31(6): 105-106.