A Brief Discussion on Teaching and Scientific Research Innovation of Assembly Building Technology

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Abstract. Construction industrialization and assembly building are the trend of development in the future, but the current related assembly technology and level is still relatively lagging behind, and lack of scientific research. The talents in the field of assembly building is very scarce, far from meeting the needs of production and society. In view of the existing problems in the development of assembly buildings, combined with the experience of the author's workplace, the author puts forward the specific plans and measures for personnel training and teaching reform by using the methods of investigation and summary analysis, and probes into the key technologies for scientific research and innovation of assembly buildings and the plans for carrying out the research. The reform research has a good effect in our practical application, and provides a reference for further research.

1. Introduction

Assembly building conforms to the development direction of green, environmental protection, high quality and high efficiency, which can improve the labor productivity and the overall quality of the building, reduce the cost, material consumption and energy consumption. The main characteristics of assembly building can be summarized as: design standardization, production factory, construction assembly, decoration integration, management information and application intelligence. Therefore, assembly building is also called construction industrialization (industrialization) in the industry. Under the current economic, technological and social background, it has profound practical significance to vigorously promote the construction industrialization[1]. However, the development of assembly buildings in China has experienced many ups and downs. The overall level of development is relatively backward, the level of related scientific research and technology and the assembly rate are relatively low, especially in the aspect of personnel training of prefabricated buildings, which is far from meeting the needs of the construction industry for such professional talents or skilled workers. At present, some vocational colleges have carried out the training of assembly building talents, but there is little research on the training of this aspect of talents in the civil engineering major of undergraduate colleges and universities, and the corresponding programs and curriculum system are almost not formulated. This paper discusses the experience of Xinyu College in the training of talents in the direction of assembly building, puts forward a set of scientific and reasonable training mode and teaching method for talents of assembly building suitable for undergraduate colleges, and discusses the key issues affecting the development of prefabricated building and the key points of scientific research and innovation.
2. Research on teaching reform of assembly building

2.1. The current teaching situation of assembly building
With the inclination and increasing support of the national policy for the prefabricated construction industry, the construction industry and colleges and universities have gradually attached importance to the cultivation of prefabricated talents, and set up relevant courses to carry out teaching work. However, at present, no specialized assembly building specialty has been set up in each undergraduate college, while only some vocational colleges have set up the specialty direction of assembly building in the corresponding building engineering technology specialty and set up several corresponding courses. On the whole, there is a lack of assembly building talents, which is far from meeting the needs of the society, including very few researchers, engineers, technicians and skilled workers in this field. Therefore, it is urgent to speed up and improve the training and teaching of assembly talents.

2.2. Teaching reform plan and measures of assembly building

2.2.1. Personnel training program reform
The formulation of talent training plan is very important for the training of any professional talents. It can be designed and considered systematically from the aspects of talent positioning, training objectives, direction division, training system, knowledge module, curriculum, theoretical and practical class hour distribution, practical approach and graduation requirements in a macro perspective. Therefore, in order to really cultivate the professionals who are competent for the assembly construction industry, we must reform and design the talent training program.

The author's department has carried out many investigations and discussions in the revision of the training program of the new version of civil engineering major, fully considered the above problems, listed the prefabricated building as a training direction of civil engineering major, and set up a series of courses, including the arrangement of compulsory and elective courses and practical links (these courses are divided into different platform modules according to their nature: major basic courses, professional core courses, professional elective courses and practical courses, totaling more than 20 credits). The graduation design topics of the students in this field should also be related to prefabricated buildings. In this way, the quality of talent training in the direction of prefabricated building is guaranteed under the framework of talent training program.

2.2.2. Innovation of teaching methods
Due to the characteristics of the industrialization of prefabricated buildings, BIM technology can show its advantages in this field. It can realize the efficient and convenient application of the whole industrial chain integration and the whole professional collaborative integration in the aspects of the design, production, construction, decoration and management of prefabricated buildings. Therefore, we should strengthen the study of BIM technology related courses, especially related software (such as CAD, Revit software).

It is necessary to attach importance to the application of teaching methods and means. Through theoretical teaching, case teaching, independent learning, practical research, exchange and discussion and other teaching activities, students can understand and master the main technologies of prefabricated buildings in the classroom[2]. There are many high-performance computer rooms, virtual simulation laboratory, multimedia smart classroom, and professional training room in my unit. Teachers are encouraged to implement innovative teaching methods such as situational teaching, case teaching, flipped classroom and rain classroom in combination with the characteristics of each course, making full use of the advantages of online and offline hybrid teaching to improve the teaching effect.

In addition, in order to make students better understand and master and increase their perceptual knowledge, it is suitable to adopt the "on-site teaching method" teaching, including the real on-site teaching by moving classroom teaching to the construction site or training site and the virtual on-site
teaching combined with VR machine room. For example, after the class has taught the prefabricated components and their types, students can be arranged to visit the prefabricated component production factories for study to understand the factory manufacturing process and characteristics of prefabricated components[3].

2.2.3. Compilation of series of teaching books
Due to the slow and lagging development of assembly buildings in China, there are very few existing teaching books related to prefabricated buildings, especially for undergraduates. Most of the undergraduate civil engineering colleges and universities have not yet set up assembly building courses, and the steering committee of civil engineering specialty has not included such courses in the recommendation of core and compulsory courses. For this reason, we held a seminar on the development of series teaching materials and the construction of curriculum resources in Jiangxi higher education institutions, and decided to organize an expert team to set up an assembly type series teaching books preparation committee to start the preparation of relevant teaching books (8 in total). At present, the first draft (partially revised draft) has been basically completed and will be published soon. The development and construction of a series of teaching materials will surely improve the quality of teaching and personnel training.

2.2.4. Attach importance to practical teaching
According to the characteristics of relevant courses with strong practicality, it is very necessary to arrange practical teaching as much as possible; at the same time, it is also necessary to strengthen cooperation with enterprises to provide conditions for teachers and students to improve their practical ability, and to participate in the solution of enterprise problems, to transport or train qualified talents for enterprises, to achieve complementary advantages and integration of production and teaching. In the role exchange of students and employees in the school and enterprise environment, students of prefabricated building talents combine theoretical knowledge with practice to continuously improve their professional level[4]. Similar to the teaching of traditional architectural engineering courses, we also arrange the following practical courses (links) in the practical link of assembly architecture: cognition practice, production practice, curriculum design, graduation practice and design. In addition to signing cooperation agreements with many enterprises and establishing practice bases, we have also built prefabricated building (including frame, shear wall, wet and dry connection and other forms) and component construction and hoisting exhibition area in the school, which is convenient for students to visit and operate. In addition, we attach great importance to leading and guiding students to participate in various disciplines competitions, and have won many awards of BIM assembly competitions at national, provincial and municipal levels or industry associations. These competitions are very useful for students to quickly grasp relevant knowledge and have solid design, construction and management capabilities.

2.2.5. Application of virtual simulation technology
Because of the need to carry out experimental teaching in the whole process of the structure, structure, construction, management and safety education of the prefabricated building, but the real field experiment has the characteristics of large consumption of resources and materials, high risk of some experiments, and can not achieve the real combination of theoretical teaching and practical teaching. Therefore, we have cooperated with the enterprise to successfully build the prefabricated building technology experiment center and talent training base, including the core assembly BIM + simulation training room and assembly building VR experience center, which can carry out the virtual simulation experiment teaching project of assembly concrete structure component hoisting. This teaching project uses three-dimensional simulation technology to simulate the whole life cycle of assembly construction, with zero risk and zero cost to realize repeated teaching and training. The teaching project (platform) can realize the reading images of PC components of assembly concrete buildings, the key points of production quality control of components of prefabricated concrete structures, the
construction simulation of hoisting components of prefabricated concrete structures and the practical training of safety education. As shown in Fig. 1, it is a screenshot of roaming experience in PC production workshop; Fig. 2 is a simulation animation of component hoisting construction.

Through the virtual simulation experiment platform, the reliable, safe and economical experiment teaching effect is achieved, and the students get better training. The virtual simulation experiment project will further explore the new mode of co-construction, co-management and sharing among universities, scientific research institutes and enterprises, so as to realize all-round opening and sharing.

3. Research on key technology innovation of assembly building

There is still a lot of work to be done in the research of assembly buildings. At present, the research results of relevant theories and technologies are far from meeting the needs of the growing industry and practical engineering. Therefore, we should vigorously strengthen the innovation research in this field, guide and promote the rapid development of this industry with new theories, methods, equipment and technologies, especially in the research of key technologies. Many new technical problems caused by cast-in-place changing into assembly have not been solved, especially the technical problems of connection nodes. The key to improving the integrity and seismic performance of assembly buildings is the quality and reliability of joint connection. At present, there are many problems in the common use of sleeve grouting and mortar anchor lap in engineering practice, which become the pain point and soft rib in construction. The inadequacy of overall performance and seismic performance is also the most important factor that seriously restricts the development and promotion of assembly buildings.

Therefore, this paper considers that the key work or the most critical issue that affects the development and promotion of assembly technology is the connection mode of assembly components and the research and development of new technology, which should be carried out in this area.

Based on the experience gained from the research work we are carrying out, it is suggested to conduct in-depth research on the new technology (method and process) and performance of the connection of the structural components (parts) of prefabricated concrete buildings by the method of
experimental research, theoretical analysis and numerical simulation, and analyze the main mechanical performance improvement indexes of such new structural system and joints. On this basis, the shear bearing capacity calculation method and the bending bearing capacity calculation method of beam column in the core area of the new type of assembly connection are analyzed and studied, and compared with the traditional sleeve connection method in technology and economy.

First of all, we should develop and design several new connection methods (technologies) for prefabricated concrete structure components, including linear component node (mainly beam-column connection, beam-beam connection of frame structure) and plane component connection (mainly beam-plate connection of frame structure, wall-wall connection and wall-plate connection of shear wall structure). According to the above-mentioned specific connection nodes, the scientific and applicable specific connection methods and processes should be studied respectively.

In addition, at present, the research work in the field of durability of assembly building structure (especially underground prefabricated structure) is very few at home and abroad. I think the durability of prefabricated structure should also be listed as a key issue for research. Obviously, there are some differences between the assembly building structure and the non-assembly building in the factors, ways and effects that affect the durability of the structure, which need to be differentiated and specialized research. It is necessary to study the influencing factors, failure risks and calculation methods of durability failure of assembly building structures, so as to establish a complete set of method system for durability risk assessment of assembly building structures[5].

4. Conclusion
It is necessary to make a reasonable plan and do a good job in the top-level design for the cultivation of assembly building talents. In the process of teaching design and specific teaching, we should have the courage to reform and apply modern teaching methods, especially virtual simulation technology to carry out teaching work. We should attach importance to the practical teaching work of joint enterprises, follow the law of talent training, and practice proves that students' learning effect and training quality are ideal. The teaching of prefabricated building should be combined with the scientific research work in this field to promote each other. The research work of prefabricated buildings should find out the key technologies and research directions, and quickly solve the key problems affecting the development of buildings.

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References
[1] Pan, H.K. (2020) Introduction to prefabricated building. Science Press, Beijing.
[2] Wu, D.Y. (2019) Teaching Model of Precast Building Technology in Colleges and Universities under the Background of Construction Industrialization. Education Modernization, 6:179-180.
[3] Li, S.J., Wang, J.F., Wan, H.Y. (2018) Teaching of precast concrete structure. construction technology, 27:99-103.
[4] Zhang, C. (2019) The reform of the teaching course of prefabricated building in the major of Construction Engineering in Higher Vocational Education. Residence, 10:195.
[5] Pan, H.K., Yang, L.D. (2019) The study on risk of durability failure for large assembled building structures. Journal of Xinyu University, 24:19-23.