



# Exploring the Talent Cultivation mode of Intelligent Construction Majors Integrating Green and Low-Carbon Concepts

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**Abstract.** With the implementation of China's "dual-carbon" goal, the construction industry has begun to develop in the direction of energy saving, emission reduction and greening, and at the same time, it has put forward a new demand for the training of talents in the construction industry. The article analyzes the deficiencies in the green and low-carbon education of intelligent construction majors in our university, and explores three aspects of the construction of low-carbon ideology and politics case base in general education courses, engineering case through teaching in specialized courses and the application of green and low-carbon technology in practice links to serve the implementation of the "dual-carbon" strategy and provide references for the cultivation of qualified intelligent construction talents. Provide reference for the cultivation of qualified intelligent construction talents.

**Keywords:** green and low carbon concept; building low carbon; intelligent construction; talent training.

## 1 Introduction

Intelligent construction, green building, green operation and maintenance, and low carbon building are the main directions of the current development and transformation and upgrading of the construction industry <sup>[1]</sup>. With the implementation of the "double carbon" goal, the concept of green and low carbon should be further strengthened in teaching, and the integration of green and low carbon education is one of the contents of the multidisciplinary crossover of the intelligent construction program. How to enable students to effectively master the new knowledge and skills in green and low carbon, and enhance their independent innovation ability and comprehensive practical ability while keeping the total credit hours unchanged <sup>[2]</sup>, is an important research topic.

## 2 The Current Situation and Trend of Education on Green and Low-Carbon Concepts at Home and Abroad

The European Union (EU) is one of the first economies in the world to put forward a carbon-neutral plan, and its green and low-carbon education has made an early start and remarkable progress, and has built a more comprehensive policy framework. In recent years, for green low-carbon education, the EU has successively issued policy documents such as "University Vision on the European Green Deal", "Council Proposal on Green Transition and Sustainable Development Learning" and "European Green Sustainability Competency Framework" to promote the reshaping of the concept of green sustainable education, build a platform for green transition, and construct a green low-carbon education system. Most developed countries in Europe and the United States have integrated the concepts of "green", "sustainability" and "carbon emission" into every major and every course, and through this measure, they are able to stock up the "dual carbon" education system. "Dual-carbon" talents, covering various industries, can help enterprises in different fields to carry out development and strategic transformation effectively [3].

For China, green and low-carbon education is in the early stage of development, and it is necessary to improve policies and measures as soon as possible. Realizing the dual-carbon goal requires corresponding dual-carbon talents. In April 2022, the Ministry of Education issued the "Work Plan for Strengthening Carbon Peak and Carbon-Neutral Higher Education Talent Cultivation System Construction", which explicitly pointed out that it is necessary to "incorporate green and low-carbon concepts into the education teaching system" [4]. Intelligent construction is an innovative mode of engineering construction formed by the fusion of new-generation information technology and engineering construction, which requires that students of this specialty be able to provide society with human-centered, green and sustainable intelligent engineering products and services [5]. Therefore, it is of great significance to explore the talent cultivation mode of intelligent construction integrating green and low-carbon concepts in the context of dual-carbon, so as to provide qualified talents for realizing the goal of "dual-carbon".

## 3 Deficiencies in Green and Low-Carbon Education

China's time to realize the "double carbon" goal is tight, and various industries are in urgent need of high-quality green talents to provide strong support. The development mode of high energy consumption and high carbon emission in the construction industry is in urgent need of transformation, and the goal of training talents for intelligent construction majors is to provide talents for the high-quality green development of the construction industry. Therefore, the teaching of intelligent construction should be closely centered on the goal of "dual-carbon", break through the bottleneck of green and low-carbon education, and realize the sustainable development and construction of undergraduate professional education. The

(1) Insufficient green and low-carbon ideological and political content in the general studies course is not in line with the policies and measures of green and low-carbon education put forward by the state, and it is also inconsistent with the requirements of the professional certification of engineering and sustainable development. On the one hand, the current teaching resources of the general education course lack case resources that are integrated with undergraduates' study majors. For the intelligent construction major, the knowledge related to "dual-carbon" has not yet been integrated into the general education course, which makes it difficult to link the teaching contents with the knowledge of different fields, and restricts the cultivation of students' inter-disciplinary cross-thinking and comprehensive ability. On the other hand, there are shortcomings in the coverage, level and participation channels of the concept of green and low-carbon education, which are not sufficient to support the graduation requirements of sustainable development<sup>[6]</sup>.

(2) Green concept education in the teaching process of professional courses has not formed a knowledge system, most of the courses emphasize the teaching of theoretical basic knowledge, and do not pay enough attention to green and low-carbon education, and students' knowledge of green and low-carbon is in a fragmented and fragmented state, and their ability to innovate is insufficient, which makes it difficult to meet the requirements of the "dual-carbon" strategy for intelligent construction graduates of the new era. requirements for Construction Graduates<sup>[7]</sup>. It is difficult for students to form an overall understanding of the green and low-carbon economy and to master related knowledge and skills. The theoretical teaching is out of line with the latest development requirements of "dual-carbon", and there is insufficient coverage of new energy, resource recycling, carbon sinks, carbon emission reduction, carbon finance and other related contents, and there is a lack of in-depth case studies.

(3) The green and low-carbon content of practical teaching is not comprehensive, the number of participants in competitions and entrepreneurship and innovation is small, and the depth of internship courses in green and low-carbon is not enough, so it is difficult for graduates to meet the requirements of the society for green and low-carbon talents. The syllabus of "dual-carbon" education has little content on "dual-carbon" education. The reasons for this are: firstly, the lack of awareness of green and low carbon education, that the practice link is mainly to train students' professional knowledge and ability, and little consideration for things not related to the profession; secondly, the lack of the concept of sustainable development of professional practice, professional ability training is limited to the short-term needs of the moment, and there is a lack of long-term layout and planning. However, the "double carbon" goal has become the core layout of economic and social development of all mankind, therefore, the development and planning of all intelligent construction majors should be centered on the achievement of the "double carbon" goal.

## 4 Incorporating the Idea of Building a Green and Low-Carbon Intelligent Construction Training System

In view of the deficiencies in green and low-carbon education of intelligent construction under the perspective of "dual-carbon" goal, this paper puts forward the ideas of teaching reform in three aspects, namely, the construction of ideological and political case library in general education courses, the integrated teaching of engineering cases in specialized courses, and the strengthening of application and innovation of green and low-carbon technology in practice. Innovate the undergraduate education mode based on the goal of "dual carbon", and cultivate diversified and complex talents with professional ability, green and low-carbon innovation consciousness and cross-border ability. In terms of teaching content, low carbon and energy saving in building design, construction, operation and maintenance, dismantling and recycling are comprehensively considered for the whole life cycle of green and low-carbon buildings [8]. the construction of intelligent construction professional training system is carried out from the three aspects of green ideological and political education in the general education course, low-carbon construction engineering case teaching in the specialized course, and the reinforcement of green and low-carbon education in the practical teaching, and the concept of green and low-carbon is carried out throughout the stages of eight semesters in four years in the university.

(1) Establish a green and low-carbon material ideological and political library in general education, and innovate the talent cultivation mode. In order to build a green and low-carbon demand-oriented case library for intelligent construction majors, it is necessary to firstly clarify the professional fields involved in the general education courses and understand the actual demand of the field. Take higher mathematics as an example, as a basic subject, it is widely used in all stages of the construction field, and its application in green and low carbon is also very common. Therefore, it is very important for math teachers to cooperate with teachers of intelligent construction majors, industry experts and enterprises. Through exchanges and cooperation, math teachers can deeply understand the application scenarios of mathematics in engineering field, discuss the application of mathematics in practical work and engineering problem solving methods, so as to clarify the direction and focus of the construction of the case library. For example, predicting building life cycle carbon emissions through mathematical models, applying mathematical knowledge to solve multi-objective optimization of building operation and maintenance schemes. This case study will enable students to gain deeper understanding and experience in mathematics learning, apply mathematical knowledge to social practice, and contribute to solving the problems of the times. Secondly, in the process of collecting and screening green and low-carbon cases, it is necessary to collect a wide range of actual cases related to green and low-carbon buildings and pay attention to the quality and representativeness of the cases [9]. These cases can not only show the application of mathematics in practical problems, but also have the potential of ideological education. Similarly, other general education courses such as university physics, university English and other courses should also build green and low-carbon Civics materials for construction majors, which can be used in the classroom teaching of intelligent construction and other disciplines.

(2) Combined with the interactive teaching of engineering cases in the specialized courses, it runs through the teaching process of the specialized courses from the lower grade to the upper grade, forming a systematic and complete green and low-carbon teaching system. The main goal of the interactive teaching mode of engineering cases is to combine the green and low-carbon contents of engineering cases with theoretical knowledge, fully mobilize students' enthusiasm, and thus realize the synergistic enhancement of theory, green and low-carbon, and innovation. In order to realize the interactive teaching mode of green low-carbon education engineering cases, it is necessary to adjust and improve in two aspects. The following are some examples of the modes of teaching

Firstly, the teaching content should be adjusted appropriately and teaching resources should be enriched. The opening time of the courses with green and low-carbon contents and the corresponding green and low-carbon contents are shown in Table 1. In each of the eight semesters of the four years of university, the theoretical courses are equipped with green and low-carbon education contents, so that the concept of green and low-carbon education can be carried out throughout the whole stage of university. By updating and enriching the teaching content, on the one hand, students can master more green and low-carbon related policies and knowledge, and on the other hand, it can stimulate students' learning enthusiasm and realize the effect of active learning. For example, the steel structure course takes the construction of Thor Mountain and Vulcan Mountain square cabin hospitals as a case study, introduces the application of professional knowledge, and at the same time, teaches the concept of low-carbon and green design and construction, and the construction cycle section only took more than ten days to build the two hospitals, which is not only the embodiment of the high efficiency of the manufacturing level and the low-carbon and energy-saving, but also demonstrates China's speed and the construction level to the whole world.

The second innovative teaching mode, comprehensive assistance to the teaching of intelligent construction professional courses with less class time, more content, knowledge, boring features, the use of traditional teacher-led teaching mode is ineffective in education to try a new model to a certain extent can solve the above problems. There are many new tools that can be effectively applied to teaching, changing the traditional teaching mode at the same time to bring better teaching results, such as "rain classroom", virtual simulation technology. At the same time, for the teaching content that students' participation is not high, the form of flipped classroom can also strengthen the main role of students, effectively mobilize students' learning enthusiasm, and achieve better teaching results. Case-oriented, through the design of driving teaching method based on typical work tasks, let students independently access relevant information, do secondary school, realize the unity of theory and practice and the fragmented knowledge to form an engineering application system, truly cultivate students to learn and solve problems independently.

For example, in the BIM engineering application course, typical cases of BIM software application can be introduced, such as the National Convention and Exhibition Center, which realizes the effect of "column-free" for the first time in large exhibition halls, the Laogang Renewable Energy Utilization Center, which is a model of green energy-saving value, the 117 Building in Tianjin, and the Suzhou Zhongnan

Center. BIM Building Performance Simulation teaches students how to realize sustainable and green building design and management in BIM modeling. BIM building performance simulation teaches students how to realize sustainable and green building design and management in BIM model, including energy-saving design, energy consumption simulation, renewable energy use, environmental analysis, etc. Students will learn how to use BIM technology to promote the transformation and development of green and low-carbon buildings. The students will learn how to utilize BIM technology to promote the transformation and development of green and low-carbon buildings.

**Table 1.** Specialized courses incorporate green and low-carbon education

Semester	course title	Green and low-carbon pedagogical content
1	Introduction to Civil Engineering	Dual Carbon Targets, Green Buildings and Evaluation Standards
2	BIM Technology Fundamentals	Learning BIM functions and its application in low carbon with engineering cases
3	Fundamentals of Building Thermal Engineering intelligent control of indoor artificial environments	carbon emission factors of building materials, the relationship of building materials to the thermal performance and carbon emissions of buildings
4	BIM engineering applications Smart energy systems for buildings Intelligent Sensing Networks	BIM model with professional software to analyze the carbon emission of building life cycle, and optimize the design of the model
5	Artificial intelligence data analysis	Simulation and analysis of building energy consumption and carbon emission calculation
6	Intelligent construction Intelligent control	Comparison of energy consumption and carbon emissions of different construction schemes;
7	Structure selection	Analysis of Green and Low Carbon Factors in Structural Selection
8	Graduation design	Optimization analysis of the design or research topic in terms of green and low carbon

(3) Practical links to strengthen green low-carbon education. By combining theoretical knowledge with practical training, students can apply the green and low-carbon knowledge they have learned to actual projects. The semesters in which the independent practical courses are held and the contents of green and low-carbon education are shown in Table 2. The arrangement of the practical contents embodies the characteristics from the basic to the application and then to the improvement and innovation. Take the steel structure course design as an example, in the course design, attention is paid to introducing the new technology, new system and new materials of steel structure engineering to students<sup>[10]</sup>, which can broaden students' horizons, and at the same time, let students understand the status quo of new green environmental

protection materials, which can stimulate students' interest in learning steel structure courses and cultivate their innovative thinking ability.

**Table 2.** Practical teaching green low-carbon education

Semester	course title	Green low-carbon content
Summer 1	BIM technology-based course design	Optimize the design of building orientation, shape, floor-to-floor distance, wall-to-window ratio, etc.
Summer 2	Smart Mapping Internship	Green mapping technology applications
Summer 2	Awareness internships	Visiting star-rated green buildings and summarizing the application of green and low-carbon technologies
5	course design for concrete stacked building covers	Comparing the carbon emissions of different building materials
Summer 3	BIM5D construction organization design course design	Analysis of green construction technology application.
7	Practical training in digital production of prefabricated components	Comparison of energy consumption and carbon emissions of prefabricated component production and on-site manufacturing
8	Graduation design	Integrated application of green and low-carbon technologies

## 5 Conclusions

Low-carbon development of the construction industry requires a large number of low-carbon talents, the research and development and application of green and low-carbon technology is the key to carbon emission reduction in the construction industry, and it is the only way to realize "carbon peak" and "carbon neutral". The cultivation of green and low-carbon talents in intelligent construction needs to be strengthened and implemented in all aspects from general education to professional education, with the integration of green and low-carbon contents into the curriculum teaching, constant improvement and innovation in the teaching mode, and the organization of practical teaching to carry out diversified green and low-carbon technological practice activities in intelligent construction, so as to deepen the implementation of the concept of green and low-carbon in practice. At the same time, green low-carbon education should also continue to contact with the business community, according to the feedback of social demand, timely adjustments to improve the training program, increase the intensity of intelligent construction of green low-carbon composite talent training, the development of a special talent training program for the community to cultivate a high level of green building technology personnel.

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## References

1. W. L. Wu, X. Liu, R. Roland, et al. Analysis of hot spots and development trend of technology research in construction industry[J]. *Journal of Civil Engineering and Management*, 2021, 38(04):58-62. DOI:10.13579/j.cnki.2095-0985.2021.04.009.
2. Jiang Yangfei, Xu Yuting. Exploring the path of integrating the green low-carbon concept into the evaluation system of ideological work in colleges and universities[J]. *Contemporary Education Forum*, 2023(03):11-18. DOI:10.13694/j.cnki.ddjylt.20230518.002.
3. Li Jian. Construction of international talent cultivation system in the field of "dual carbon" under the background of new engineering[J]. *Journal of Higher Education*, 2023, 9(26):11-14. DOI:10.19980/j.CN23-1593/G4.2023.26.003
4. Duan Jiaowen, Yu Haixiang. Demand and Cultivation of Green and Low Carbon Transportation Talents[J]. *Shanxi Finance and Economics Journal*, 2023, 45(S2):324-326.
5. Ding Lieyun. Reflections on the cultivation of innovative engineering and technology talents for intelligent construction [J]. *Higher Engineering Education Research*, 2019 (05):1-4+29.
6. Nie Yuzheng, Du Huanzheng. Theoretical Exploration and Practical Path of Strengthening Ecological Civilization Education in Colleges and Universities under the Goal of "Double Carbon"[J]. *Contemporary Education Forum*, 2023(06):1-9.
7. Wu Luyang. Development status and outlook of green low-carbon buildings in China[J]. *Architecture*, 2023, (07):42-44.
8. ZHANG Kai, LU Yumei, LU Haisu. Research on countermeasures for high-quality development of green building in China under the background of dual-carbon target[J]. *Architecture Je*, 2022, 43(03):14-20. DOI:10.14181/j.cnki.1002-851x.202203014
9. Xu Mei. Research on the path of higher mathematics course civics construction based on case base[J]. *University*, 2024 (12):91-94.
10. Zhou Dantong. Teaching reform of "new energy materials" course by integrating green low-carbon concept[J]. *Yunnan Chemical Industry*, 2024, 51(04):213-216.

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