

# Research on Teaching Reform Strategy of Civil Engineering Specialty under the Background of Double Carbon Strategy

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**Abstract:** The dual-carbon strategy is a new strategic direction put forward by China to deal with climate change, which emphasizes the goal of carbon capping and carbon neutrality. Under this background, the teaching of civil engineering is facing great pressure of reform, which requires cultivating compound talents with professional knowledge and adapting to the development of low-carbon economy. Based on the significance of the teaching reform of civil engineering specialty under the background of "double carbon" strategy, this paper deeply explores the challenges faced in the teaching reform, and puts forward specific teaching strategies and suggestions from the perspectives of curriculum content integration, practice strengthening and evaluation mechanism renewal, hoping to provide reference for the teaching of civil engineering specialty.

**Keywords:** dual-carbon strategy; Major in civil engineering; Teaching reform strategy

## 1. Introduction

With the aggravation of global climate change and increasing concern for environmental protection, China puts forward the dual-carbon strategy, that is, the long-term goal of "carbon peaking and carbon neutralization", aiming at building a green and low-carbon circular development economic system. Under this macro background, all walks of life are facing the pressure and opportunity of transformation and upgrading. Civil engineering as a basic industry closely related to the national economy and people's lives, its education and training has played a vital role in this transformation process. How to integrate the concept of green and low carbon into teaching and cultivate talents who master core technologies and have sustainable thinking has become an important issue in the field of civil engineering education.

## 2. The significance of teaching reform of civil engineering specialty under the background of double carbon strategy

### 2.1 Respond to national goals and train pioneers of the times

Under the background of dual-carbon strategy, the significance of teaching reform of civil engineering specialty is particularly important. The teaching reform is to respond to the country's long-term goal of carbon peaking and carbon neutralization, and make civil engineering education more in line with the national development strategy [1]. With China's increasingly prominent leading role in global climate governance, civil engineering majors need to train more professionals with green construction and sustainable development concepts. The purpose of teaching reform is to cultivate advanced talents who are true pioneers of the times and can provide technical and strategic support for green buildings and low-carbon city construction on a global scale. Future urban construction is not only a pile of bricks and concrete, but also a complex system closely linked with environment, society and economy. Therefore, what the society needs is engineers who not only know traditional civil engineering technology, but also have innovative thinking, interdisciplinary knowledge and global vision. They will become the key force to push forward the civil engineering field in China in a greener, more intelligent and humanized direction.

### 2.2 Strengthen the concept of green and promote sustainable construction

In order to respond to the national goals of carbon peaking and carbon neutralization, civil

engineering education needs to keep pace with the times and deepen the integration of green concepts. Strengthening the concept of green is not only to meet the current environmental challenges, but also to promote sustainable construction and ensure that future buildings and urban designs are both environmentally friendly and efficient. In order to achieve this goal, civil engineering majors must cultivate a new generation of engineers with the concept of green construction and sustainable development. These engineers will provide key technical and strategic support for the construction of green buildings and low-carbon cities on a global scale. With the increasing impact of the construction industry on the environment and resources, engineers with innovative thinking, interdisciplinary knowledge and global vision will become the key to promote the green, intelligent and humanized direction of civil engineering.

### ***2.3 Broaden the horizon of knowledge and promote interdisciplinary integration***

In order to meet the increasingly complex architectural and urban challenges, it is far from enough to rely solely on traditional civil engineering knowledge. Broadening knowledge horizon means introducing more scientific, technical, social and humanistic knowledge, so that students can understand and solve problems from multiple dimensions and levels [2]. In addition, interdisciplinary integration has brought a broader development space for civil engineering. For example, urban planning combining ecological principles and architectural design integrating new materials and technologies all require engineers to have interdisciplinary knowledge and skills. This not only helps to improve the innovation and sustainability of engineering, but also helps to cultivate civil engineers with more leadership, creativity and global competitiveness. Therefore, civil engineering teaching should encourage students to participate in interdisciplinary research and projects, and cultivate their comprehensive analysis and innovative problem solving ability.

### ***2.4 Stimulate students' interest and innovate practice and research***

For students, interest is the best teacher. If students can have a strong interest in a certain subject from the heart, they will naturally take the initiative to explore, study and delve into it. In order to cultivate students' practical ability and research spirit, a large number of real engineering cases and challenges will be introduced into teaching to encourage students to participate in various practical activities. For example, students can be organized to conduct field visits and personally participate in the actual work of construction sites, or students can be encouraged to design small building structures independently, so as to experience the charm of engineering. Encouraging students to participate in research work is also an important way to stimulate their interest. By guiding students to participate in teachers' research projects or supporting students to carry out their own small-scale research, they can feel the power of knowledge and exercise their research ability in the actual research process.

## **3. The challenges faced by the teaching reform of civil engineering specialty under the background of dual-carbon strategy**

### ***3.1 The balance between traditional and emerging technologies***

Civil engineering, as a subject with a long history, contains a lot of traditional knowledge and technology in its teaching content, which has been verified in long-term practice and is the cornerstone of engineering construction. However, driven by the dual-carbon strategy, new technologies and concepts are constantly emerging, such as green buildings, carbon-neutral technologies, smart buildings, etc. These new technologies are of great significance for achieving the dual-carbon goal. In teaching, how to balance traditional and emerging technologies has become a difficult problem. On the one hand, it is unrealistic to completely abandon traditional technologies, because these technologies still play a key role in many projects. Moreover, for civil engineers, mastering traditional technology is their basic skill. On the other hand, ignoring new technologies means losing the opportunity to keep pace with the times, which may put students at a disadvantage in their future careers. In addition, emerging technologies often involve multidisciplinary knowledge, such as environmental science, materials science, information technology, etc., which puts forward higher requirements for teachers' comprehensive quality and ability. Therefore, how to ensure that students can master the basic traditional technology and understand and apply the new technology in the limited teaching time has become an urgent problem to be solved in the teaching reform of civil engineering specialty.

### ***3.2 The resource constraints of the green training base***

Under the background of double carbon strategy, the teaching reform of civil engineering specialty emphasizes more and more practical teaching and green construction. However, at present, some schools and educational institutions are faced with the limitation of green training base resources. As a practical platform integrating advanced green building technology, renewable energy utilization and environmental protection materials application, the construction and operation and maintenance of green training base need large capital investment. At the same time, geographical location, site area and related supporting facilities are all factors that restrict the construction of green training base. In addition, even with material resources, a group of teachers with green building knowledge and practical experience are needed to guide students. At present, there are relatively few teachers with this experience, which also brings challenges to the development of green training. Compared with traditional building training, green training updates equipment, materials and technology faster, which means that educational institutions need continuous investment to ensure that the technology of training base always remains at the forefront of the industry. Therefore, although the green training base has irreplaceable value for civil engineering education, its popularization and promotion still faces a series of challenges due to the limitation of resources.

### ***3.3 The construction dilemma of green innovation evaluation standard***

Green construction has become an important direction of civil engineering education, and the establishment and improvement of green innovation evaluation standards play a vital role in guiding practice. However, at present, the construction of green innovation evaluation standards still faces some difficulties. First of all, the green technology and concept in the field of civil engineering are updated rapidly, which makes the evaluation criteria need to be updated constantly to adapt to the new technology and market demand. However, the update and formulation of evaluation standards usually need to go through strict procedures, which makes it difficult to keep up with the development speed of the industry. Secondly, green construction involves a wide range of fields, from material selection, design concept to construction technology, operation and maintenance management, etc., all need clear evaluation indicators. However, how to balance each index and ensure the fairness and scientificity of the evaluation is a very challenging problem. Thirdly, regional differences, cultural background, climatic conditions and other factors will have an impact on the green construction of civil engineering, and a single evaluation standard is difficult to meet the needs of different regions and projects. Therefore, the balance between universality and pertinence of evaluation criteria is also a problem that needs attention. Finally, compared with the traditional construction evaluation, Green Innovation evaluation pays more attention to sustainability and long-term benefits. This requires that the evaluation criteria should not only consider the short-term benefits of the project, but also fully consider its long-term environmental, social and economic effects.

### ***3.4 Barriers to deep interdisciplinary integration***

There are a series of barriers in the practice of interdisciplinary deep integration, which pose challenges to educational reform. The traditional education system is often subject-centered, and the boundaries between courses are clear, which leads to the restriction of inter-disciplinary communication and cooperation. At the same time, the solidification of the curriculum also makes it difficult to introduce new and interdisciplinary content into teaching. Most civil engineering teachers have deep background in their own disciplines, but they may lack knowledge and experience in other disciplines. This means increasing interdisciplinary training and cooperation to promote the interdisciplinary ability of teachers' teams. The current evaluation system is mainly based on the performance of a single discipline, so it is difficult to fully encourage and evaluate interdisciplinary teaching and research. Therefore, it is necessary to establish new evaluation and incentive mechanisms to support interdisciplinary cooperation and research. The problem of resource allocation and support. Interdisciplinary research and teaching often need specific resources and support, such as laboratories, research funds and cooperation platforms. However, the existing resource allocation mechanism may not meet these special needs, which leads to the limitation of interdisciplinary cooperation. Although the deep integration of interdisciplines is the inevitable trend of civil engineering education reform, it still faces a series of challenges and barriers in practice, which require educators and decision makers to work together to find effective strategies and means to overcome.

#### **4. The teaching reform strategy of civil engineering specialty under the background of double carbon strategy**

##### ***4.1 Integrate the curriculum content and pay attention to the integration of low-carbon technologies***

Under the background of dual-carbon strategy, the teaching reform strategy of civil engineering should first strengthen the integration of curriculum content, and organically integrate the content of carbon emission and low-carbon technology into basic and professional courses [3]. Curriculum redesign: Traditional civil engineering courses should be restructured to include topics related to low-carbon architecture and sustainability. For example, structural design courses can add units using recycled materials, so that students can understand and apply the role of low-carbon materials in buildings. Fusion of actual cases: Introduce real and successful low-carbon building cases into the classroom, so that students can analyze and understand the low-carbon technologies and strategies behind them. Through case studies, students can more intuitively understand the application of low-carbon technology in practical engineering. Adoption of modular teaching: Special modules can be set up to focus on a specific low-carbon technology or strategy, such as passive building design, green roof and so on. In this way, students can choose the modules they are interested in to study deeply. In addition, strengthen links with the industry: invite industry leaders in low-carbon technologies to the classroom to share their experiences and knowledge. This can not only increase students' understanding of practical application, but also enhance students' awareness of career planning. It is the core of the teaching reform strategy of civil engineering to integrate the curriculum content and ensure the full attention and application of low-carbon technology.

##### ***4.2 Strengthen practical links and promote green engineering training***

We will set up a green training base: This initiative will involve establishing practice bases related to green buildings and renewable energy, enabling students to gain hands-on experience with the application and implementation of green technology. For example, we plan to build a small solar-powered building prototype where students can conduct field operations and maintenance tasks. Regarding the green sourcing of experimental materials: During the practical training sessions, we will make a concerted effort to select environmentally friendly and renewable building materials and technologies. Such as using recycled concrete, green insulation materials, etc., so that students can realize the advantages of green building materials in practice. Our institution aims to deepen cooperation with enterprises: We will cooperate with enterprises that are engaged in green building to allow students to go beyond the campus and practice on real construction sites. This collaboration will enable students to understand and master the application of green technology in practical projects. Additionally, we plan to hold green training competitions: We will establish competitions in green building design, green material use, and other related areas to encourage students to innovate and practice, thereby showcasing their talents in the field of green engineering. Strengthening practice links to ensure that students can deeply understand and master the concept and technology of green engineering in practice is the key to train civil engineering students to respond to the dual-carbon strategy and contribute to the future development of green buildings.

##### ***4.3 Update the evaluation mechanism and encourage green innovative thinking***

Traditional evaluation mechanism tends to be biased towards the memory and application of knowledge, but nowadays, it is more necessary to highlight the cultivation and encouragement of students' green innovative thinking. Reshaping evaluation criteria: In the performance evaluation, besides examining students' basic knowledge and skills, we should increase the assessment proportion of their green design, green material application and green technology innovation [4]. For example, for a civil engineering project, it depends not only on whether its structural design is reasonable, but also on whether it considers factors such as energy saving, environmental protection and sustainability. Our educational program will implement dynamic evaluation: We encourage students to carry out green practice and innovation continuously throughout the learning process, instead of relying solely on a one-time evaluation at the end of the term. In this way, students can get timely feedback in every link of the project implementation process, and further stimulate their green innovative thinking. Educational institutions should set up a green innovation reward mechanism: They can offer material or honorary rewards to students or teams who make significant breakthroughs in green technologies and methods, including providing research funds and opportunities for publishing academic papers. Through the above measures, we can effectively update the evaluation mechanism, really encourage and stimulate students' green

innovative thinking, and lay a solid foundation for cultivating civil engineering talents who meet the requirements of the dual-carbon strategy.

#### ***4.4 Interdisciplinary cooperation to learn the wisdom of dual-carbon strategy***

Under the background of dual-carbon strategy, civil engineering majors must jump out of the traditional framework, cooperate deeply with other disciplines, draw wisdom from them, and jointly contribute to building a low-carbon and sustainable future [5]. The department should cooperate with environmental science and engineering majors to research the life cycle carbon emissions of building materials and to seek more sustainable and eco-friendly alternatives, such as high-performance concrete and green composite materials. Additionally, it should examine the influence of urban microclimates on building energy consumption and foster the integration of green building design with urban ecology. In collaboration with energy science majors, the department should also investigate building energy efficiency optimization strategies, incorporating the use of clean energies such as solar photovoltaic, geothermal, and wind energy, to ensure the minimization of energy consumption throughout the design, construction, and use phases of civil engineering projects. Cooperation in the field of information technology can not be ignored. With the help of big data, Internet of Things, artificial intelligence and other technologies, the performance of civil engineering structures can be monitored and adjusted in real time to ensure that their carbon emissions are always in the optimal state during long-term use. Cooperation with economics and management majors is also very important. Through the research on carbon emission trading, economic benefits of green buildings and cost-effectiveness of low-carbon technologies, it provides a solid economic basis for the decision-making of civil engineering projects. Interdisciplinary cooperation can not only bring more extensive and in-depth knowledge system to civil engineering majors, but also provide them with more perfect and detailed solutions, help them better respond to the national dual-carbon strategy and make greater contributions to building a green and sustainable future.

## **5. Conclusion**

In a word, the continuous reform of civil engineering teaching under the background of dual-carbon strategy plays an irreplaceable role in training engineering talents to meet future challenges. Therefore, if educators and scholars want to carry out teaching reform better in this period, they must keep up with the development trend of the industry, actively explore the combination of low-carbon technology and civil engineering, and flexibly use innovative methods. Educational institutions should actively combine with industry practice to ensure the coherence and depth of civil engineering education. Only in this way can students feel the charm of green buildings in the academic environment, cultivate their interest and love for green buildings, and promote the development of civil engineering education to a higher level.

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