

Analysis and Exploration of Ability Cultivation Mode for Passive Ultra-low Energy Building Design in Architecture Majors

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Abstract: Green buildings and passive ultra-low energy buildings are important ways to promote energy conservation, emission reduction, green development, promote the transformation and upgrading of the construction industry, and improve people's quality of life. However, the traditional architectural education system involves less content related to passive ultra-low energy buildings, making it difficult to meet the growing social needs. In response to the current shortage of talents in passive ultra-low energy building design, this article focuses on the integration of industry, academia, and research in talent cultivation, guided by the ability to design ultra-low energy buildings. It aims to consider the mode of talent cultivation that is suitable for ultra-low energy building design and carry out teaching innovation.

Keywords: Architecture Major; Passive Ultra-low Energy Building Design Capability; Personnel Training

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With the continuous promulgation of green building policies and the rapid development of the industry, new requirements have been put forward for the cultivation of passive building talents. How to effectively cultivate and enhance the innovative design ability of architectural students in passive ultra-low energy is an important direction for the research and practice of architectural education reform^[1]. This article analyzes the current situation and problems of passive ultra-low energy building industry and talents from the perspective of architecture major, and introduces the practical exploration of the integration of industry, academia, and research in the architecture major of Yanching Institute of Technology's College of Architecture to cultivate students' passive ultra-low energy building design ability.

1. Analysis of Current Situation of Passive Ultra-low Energy Construction Industry and Talent Cultivation Development

1.1 Development status of passive ultra-low energy construction industry and personnel training

Passive building began in Europe. In 1988, Professor Wolfgang proposed the concept of "passive house" in cooperation with Professor Adamson of Sweden Lund University during his stay in the Institute of Civil Architecture and Environment of Technical University of Darmstadt, and established a passive building research institute. In 2020, 27 EU (European Union) countries stipulated that all new buildings adopt the Passive House Institute Standard (PHI Standard).

According to relevant data in 2020, there were over 30000 passive housing projects worldwide, which were developing rapidly. The leading edge of technology drives the cultivation of related talents, and major architectural universities in Europe are gradually conducting passive technology training under the field of architecture related majors. Renowned European universities such as Vienna University of Technology in Austria, Technical University of Darmstadt, and Lund University in Sweden have become top universities in the world for cultivating talents in passive ultra-low energy buildings.

Japan and South Korea are also actively conducting research and construction on passive housing, but they started relatively late and lag behind China in terms of technology and talent. However, they are accelerating their pace. The South Korean government will work with its research institute to provide resources and talent development, and they believe that passive housing in various regions such as China and Japan in Asia will be better developed in 2025.

China's passive building was first completed in 2010. After 10 years of development, the total construction area of passive buildings in China has exceeded 5 million square meters, and 30 have obtained PHI certification. From 1 building 10 years ago to a 5 million square meter building, from 6 certified buildings in 2017 to 30 certified buildings, the achievements in just a few years indicate that China has become one of the countries with the fastest development of passive buildings in the world.

Problems in the development of passive ultra-low energy construction industry and personnel training in China

China introduced technology related to "nearly zero energy buildings" relatively late, around 2015. In 2010, the "Hamburg House in Germany" was the first demonstration of PHI standard passive architecture in China, and most of the corresponding talent cultivation relied on foreign exchanges and training. According to relevant data, there were over 1200 engineers engaged in passive house design in China in 2020, and 81% of passive house designers were authorized and trained by international passive house designers or consultants.

There is relatively little research on the cultivation of passive ultra-low energy talents in China, with only relevant research on the cultivation of green building talents. Zhou Qiang has explored how to integrate green building concepts into architecture professional education from five aspects: curriculum system, design courses, technical courses, theoretical courses, and practical courses in "Research on the Integration of Architectural Professional Knowledge System Framework for the Integration of Green Building Concepts"^[2]. Dong Hairong has established a curriculum system integrating technology and design with "one axis and two wings" through "Research and Practice on the Talent Training System of Architecture under the Background of Green Building", and has innovated diversified teaching methods and evaluation systems^[3].

In summary, China has become one of the countries with the fastest development of passive ultra-low energy buildings in the world, but passive ultra-low energy buildings and related industries are still in the ascendant and vigorously promoting stage. In response to the current shortage of professional and technical talents in passive ultra-low energy buildings, it is urgent to increase the training efforts for passive ultra-low energy building talents.

2. Exploration on Practice of Cultivating Design Ability of Passive Ultra-low Energy Buildings in Architecture Majors

Promoting passive ultra-low energy buildings and the rapid and large-scale development of nearly zero energy buildings is an important support to respond to the goal of "30·60 carbon neutrality and carbon peak". Passive ultra-low energy technology enables buildings to rely on the structural design of the building itself, without the need for "active" energy supply, namely air conditioning and heating, to achieve a "five constant" environment of constant temperature, constant pressure, constant oxygen, constant cleanliness, and constant stillness, creating a comfortable and healthy building space. The traditional architectural education system involves less content related to passive ultra-low energy buildings and even green buildings, making it difficult to meet the growing social needs. The Architecture major of the College of Architecture in Yanching Institute of Technology focuses on the ultra-low energy architecture research institute, with a focus on the Beijing, Tianjin and Hebei regions and an integrated training model of industry, academia, and research. It constructs a talent cultivation model of "one core, one model, and three levels" from foundation to technology, from theory to practice, and from curriculum to training, aiming to provide a talent foundation for the development of passive construction industry in the Beijing, Tianjin and Hebei regions.

2.1 Collaborating with universities and enterprises to establish an ultra-low energy building research institute

The College of Architecture began exploring the cultivation of ultra-low energy talents in 2019, and established the Ultra-low Energy Architecture Research Institute in 2021. Relying on the ultra-low energy research institute, the college actively carries out related work from academic exchanges, teacher training, course construction, internship and practical training, scientific research, student activities, and other aspects, achieving the integration of industry, academia, and research in talent cultivation, for example, inviting domestic and foreign industry experts to hold multiple forums on the development of ultra-low energy buildings, and holding energy-saving publicity weeks and lectures. Through training, teachers and students have a deep understanding of low-carbon concepts, basic knowledge of policies and norms, and initial maturity of technology and abilities.

2.2 Integrating industry and education and carrying out the construction of courses related to ultra-low energy

Through cooperation with schools and enterprises, the construction of courses related to ultra-low energy buildings can be carried out from five aspects: curriculum system, design courses, technical courses, theoretical courses, and practical courses, and a passive building modular course is set up in the talent cultivation plan. Through courses such as “Preliminary Architecture”, “Architectural Design”, “Green Building Technology”, and “Building Energy Efficiency Design”, as well as the establishment of ultra-low energy internship sessions, students are trained to understand laws and regulations, master principles, understand materials and technology, and be able to analyze knowledge and abilities. The college and enterprises jointly write a self-compiled lecture on “Ultra-low Energy Building Technology”.

2.3 Integrating development and improving talent cultivation methods

The reform of passive building ability cultivation not only stays at the level of curriculum system reform, but also requires a transformation of teaching system thinking, and runs through the integration of the entire curriculum system. The most important thing is the change of design concept. Through holding institute level discipline competitions, launching ultra-low energy building salons, establishing interest groups and other forms, the cultivation of passive ultra-low energy design ability can be enriched, achieving from passive application to active learning, from theory to consciousness.

Collaborating with enterprises, by participating in skill training, obtaining skill certificates, and attending academic conferences, the cultivation of passive ultra-low energy teachers can be strengthened. For example, by introducing experts from the field of passive ultra-low energy buildings at home and abroad, skill training and exchange in the design, production, construction, supervision, monitoring, evaluation, and acceptance of passive ultra-low energy buildings at multiple levels, forms, and channels can be conducted.

Conclusions:

Energy conservation and emission reduction in the construction field is an important way to achieve the goal of “2030 carbon peak and 2060 carbon neutrality”. The development of green buildings and passive ultra-low energy buildings is also an important way to improve people’s quality of life. The training method for the design ability of passive ultra-low energy building talents should be gradually adjusted and improved according to the development of social demand for construction talents. The international advanced concept of passive ultra-low energy should be integrated into professional education from both theoretical and practical aspects, and a complete curriculum system must be established.

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