

# *Discussion on Sustainable Concept in the Teaching of Hospital Building Design*

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**Abstract**—Hospital building is a large energy consumption and its sustainable development is imminent. In the process of popularizing the concept of sustainable hospital to the public, it is necessary to promote the sustainable hospital concept among the architectural practitioners, especially for college students who will be engaged in building industry related work in the future. Starting from the importance of the concept of sustainable building design in hospital, this paper intends to analyze the existing problems of hospital design and education, clarify the sustainable hospital building design shall be new development trend. Therefore, it is essential to apply the sustainable concept throughout the teaching of hospital design. This paper then discusses the suggestion of incorporating sustainable theory into the teaching system of hospital building design course, and provides support for the relevant new teaching methods. This paper intends to provide reference for training design talents who shall be adapt to the sustainable development of hospital buildings.

**Keywords**—sustainable; hospital building design; teaching

## I. INTRODUCTION

In recent years, the continuous deterioration of the natural environment, diminishing resources and other problems have caused people to pay increasing attention to the natural ecological environment. Some traditional architectural design methods, especially based on design aesthetics, can not satisfy the needs of today's social development.

The sustainable concept of green architecture theory thoughts quickly spread in architecture design professional in colleges and universities, be integrated into the traditional architectural design of classroom teaching. Many colleges and universities adopt sustainable concept into architectural design theory is the new reform of design professional. Amount schools already have promoted the concept of sustainable development in teaching and established related courses.

## II. THE IMPORTANCE OF SUSTAINABLE CONCEPT IN HOSPITAL ARCHITECTURAL DESIGN

Hospital is the place to maintain human health and continue human life, while hospital building also is one of the biggest energy consumers in public building types. Under the influence of "sustainable development" and "green building", people have realized the importance of green hospital construction to the whole human society sustainable development. Based on

the concept theory of "sustainable building", green hospital building has become an important direction for the development of modern medical building facilities in the world now.

In the Chinese national standard-"Green Hospital Building Evaluation Standard" (GB/T 51153-2015), the definitions of green hospital building given: In the whole life cycle of the hospital building and on the premise of ensuring the medical process, the green hospital building should maximize the resource saving (land saving, energy saving, water saving and material saving), protect the environment and reduce pollution, provide healthy, applicable and efficient use space for patients and medical workers, and live in harmony with nature. In this case, the design of sustainable hospital should not only meet the requirements of green building but also needs to achieve the unique goals for hospital design. A sustainable hospital building shall make good balance among nature, society and people. In the meantime, it also needs to reduce the negative influence from building itself to natural environment, and make the building into the natural and harmonious coexistence.

According to the particularity of healthcare services group, hospital buildings also need to pay attention to establish pleasurable, healthy and safe space for patients and medical practitioners, especially for the recuperate space environment which beneficial to patients' physiological, psychological rehabilitation. Therefore, the construction of green hospitals should not only meet the requirements of green building and the functions of hospital building, but also strengthen the harmonious relationship between hospital buildings and people on the basis of providing high-quality and efficient services for medical procedures.

•Necessity of sustainable design in Chinese hospital construction

First of all, in today's society with rapid development of architectural technology, hospital design has fallen into an unprecedented bottleneck. Because break through and innovation is hard from traditional architectural design perspective, it is necessary to combine new ideas, methods and technologies for architectural creation. The concept of sustainable can broaden the thinking of hospital architecture design in China and point out a new development direction for hospital planning and construction. Secondly, the sustainability of architecture has been widely applied in many practical

projects in China. As an important type of architecture, hospital building is not only closely related to people's life, but also more widely existing in social life. Therefore, the sustainability of hospital design is an important part of China's sustainable development in the new era, and also is one important way for Chinese hospital to integrate with international medical construction. Thirdly, as an important type of public building, hospital buildings need to be self-renewing with the continuous development of the society. Traditional architectural design methods can only meet the needs of the society for hospital buildings in a short period of time, while, most of them will produce problems such as energy waste and unreasonable layout through long-term use. The practice of sustainability ensures the long-term self-renewal of hospital buildings, which saves significant resources for society and the environment.

### III. EXISTING PROBLEMS IN HOSPITAL ARCHITECTURAL DESIGN

On the basis of medical science and technology, hospital is particular space to prevent and cure of patients or specific people, as well as providing health care services. Besides the general public building characteristics, hospitals are the especial space due to the collection of pathogens and vulnerable groups. In certain extent, hospitals are often given a social responsibility to heal the wounded and rescue the dying. This also distinguishes hospital buildings from normal public buildings.

Development of modern hospital building tends to be large in scale, complex in function and high level of environmental comfort and safety. The energy requirements and equipment running time requirements of outpatient and emergency, medical technology, ward, operation department and logistics are different. Electromechanical equipment is numerous, energy consumption is dispersive and multifarious. The heating, ventilation and air conditioning system consumes huge energy, and the hospital buildings have high requirements on the continuity of electricity supply and quality. For health considerations, Medical technology, medical and other departments, there are a large number of steam and hot water requirements for medical and medical technology departments. In order to provide patients and medical staff with good medical treatment and working environment, as well as the special requirements of temperature and humidity in the treatment process, the load of refrigeration, heating, humidification and ventilation is increasing recently.

The annual heating quantity of the hospital is large, and the requirements of the users are also different. There are two distinguishing types of indoor environment control in hospitals. One is the general departments with large quantity and wide area, such as the general ward and consulting room, which only need seasonal comfortable air conditioning. The other is space with the relatively small number of aseptic and humidity control requirements, such as operating room, aseptic ward and other key departments. These spaces need year-round air conditioning and humidity control is also the key factor to ensure aseptic environment. The construction of hospitals in China has been accelerated in recent years, with the characteristics of large building volume, high floor height, increased built area for ward bed, and more new functional

departments. Therefore, the requirements of humanized design and energy saving are improved. Due to the energy consumption status in hospital: the internal area of the building is expanded, the temperature and humidity control departments are increased, the consumption of hot water is increased, the contradiction between seasonal air conditioning and annual air conditioning is intensified, the energy consumption is sharp raising and expenditure reaches more than 10% of the total operating expenses of the hospital. Therefore, the energy saving of the hospital building is urgent.

### IV. EXISTING PROBLEMS IN HOSPITAL ARCHITECTURAL EDUCATION

Due to the complex function, strict requirements and low creative design freedom, the hospital building design process has often been described as "dancing with shackles". It is different from traditional design courses, a lot of medical technology theoretical knowledge should be taught in the class for architectural students, as well as the learning methods also shall be changed more technical and logical. The expression of architectural modeling and design drawings used by students in the past will be greatly limited and challenged in the architectural design of hospitals. In the teaching process, because some students only have a partial understanding of the sustainable building theory and technology, they cannot reasonably apply and innovate on the ecological technology level for hospital design. Some students just directly refer to the design works of well-known hospital buildings for imitation, the final design results show that they are not combined with the local ecology and ideas own, but more like blindly following the trend of the popular. In this case, the concept of sustainable is not being integrated into the teaching system of hospital architectural design. The knowledge and skills learned in class are only limited to the surface of hospital architectural design, not real implanted in students' concept of hospital design and planning, and even form the habit of imitating when drawing architectural drawings.

In the current architectural design teaching system, the professional theory knowledge for architecture including building structure, building materials, built environment, local cultural customs, local history and other aspects of the content. However, courses on combining modern medical techniques with sustainable technologies are rare. The theoretical course of hospital building is not closely related to the design course, so it is easy to form a separation between the design course and medical technology in practical design process. A lot of students still pay more attentions to appearance and drawings of construction in hospital design, thus ignoring the special design requirements and technical characteristics of medical technology in architecture. If students do not have a solid grasp of the knowledge of sustainable architecture, it will be difficult to truly reflect the design goals of energy saving, environmental protection and people-oriented in the practice of hospital design.

### V. SUGGESTIONS

The sustainability of hospital will be the new development direction of hospital architecture. Although "sustainable" has

become a trend in the development of architectural design, there are still many challenges when it is applied in the architectural classroom teaching of hospital design. In the process of architectural development, the relationship between human and environment has always been an important issue for architects to consider. The concept of sustainability throughout hospital construction is an essential and important measure in the new concept of modern hospital development. The teaching of sustainable hospital architecture does not only focus on energy saving, but also requires students to combine the design of hospital architecture with the environment from medical technology, society, psychology, architecture and other aspects. In teaching process, teachers need to guide students from the basic professional perspective of architecture, and let the concept of sustainability run through hospital building planning, individual design, energy utilization, energy consumption and operation mode of the whole life cycle.

The teaching reform of hospital building design should base on the traditional teaching mode, innovate teaching concept and reform teaching method. The traditional teaching of architectural design in universities is generally divided into two parts. The first part is the study of design theory, which teaches students the basic conceptual theoretical knowledge and relevant design skills, thus students can establish their own systematic knowledge network structure. The second part is the course architectural design training for students, which teaches students to complete the design scheme of independent innovation according to different design specific requirements and improves their practical design ability. This paper suggests that modular teaching research should be added in hospital design teaching. The purpose is to expand students' professional knowledge about hospital design through the complete project module, and can add the sustainable concept and knowledge into project research. It can improve the design ability of sustainable hospital, as well as help students make the most rational choices when faced with multiple sustainable technologies during design process.

This paper suggests that innovation in hospital design teaching can be carried out from the following aspects:

#### *A. Enrich the Curriculum Content*

The knowledge that students learn in class usually comes from teachers' lectures and textbooks. Therefore, the content related to sustainable concept and green hospital needs to be added into the textbook compilation or lecture content as the main knowledge of course teaching. In addition, first of all, the explanation of sustainable knowledge needs to be arranged in order according to the effective teaching sequence, and teachers also need to update and modify the content of the textbook frequently. Secondly, taking green building education as an extension of hospital architectural design study can promote students to establish scientific sustainable development concept.

#### *B. Adjust the Appropriate Curriculum Sequence*

At present, the curriculum system and teaching content of many colleges and universities are only arranged by teachers, while students have no choice. The innovation of hospital design should not only be reflected in the arrangement of

curriculum sequence, but also in the reform of curriculum content. Each chapter should be divided into stages according to key points of hospital design. In addition, letting students choose their own class time and the arrangement of course content can be conducive to efficient learning according to student's own conditions. The education module of hospital design is divided into three sections: theoretical knowledge explanation section, architectural design training section and thematic research section. For students with solid foundation, they can also choose cross-stage education. In a word, the concept of sustainability should be integrated among the three sections in order to realize the education of sustainable hospital design.

#### *C. Innovative Teaching Methods*

##### *1) Internet MOOC*

Internet MOOC teaching is an innovative teaching method popular in various universities. MOOC is an integrated teaching method through Internet technology, which breaks the constraints of traditional teaching time and place. In the course system construction, experts from different backgrounds can be invited to teach the knowledge points. Especially for the hospital design, MOOC can involve a lot of stakeholders with different professional backgrounds (such as doctors, architects and engineers) share their knowledge through MOOC platform. Students can also choose to study independently. For example, in the stage of theoretical knowledge education, students can choose the modules they want through MOOC platform, and learn more independently and flexibly. In the training stage, MOOC information-based teaching allows students to communicate with teachers about design concepts and program modifications in a timely manner. In the project research stage, the open advantage of MOOC is more conducive to students' access to scientific research and practice opportunities, so as to improve their comprehensive application ability.

##### *2) Research-based Learning*

The value of research-based learning lies in improving students' innovative thinking and practical ability. Green hospital building which based on sustainable concept is the current development trend. Therefore, carrying out exploratory learning effectively is mainly to enable students to make innovations, realize new ideas through their own research and exploration, and then apply their advantages of innovative thinking to architectural design practice.

##### *3) Encourage participation in related discipline competitions*

Taking part in the architectural competition is one of the best ways to comprehensively test and quickly improve students' knowledge ability. Competition is easy to stimulate the motivation and enthusiasm of students to study independently. All kinds of innovation competitions, often closely combined with the forefront and latest direction of the major and discipline, have an important role in leading the direction of professional development. Through competitions and other practical links, students' ability to acquire sustainable hospital building knowledge can be improved and tested. It can also accumulate valuable experience for improving the innovative design ability of hospital buildings.

## VI. SUMMARY

Nowadays, green ecology and sustainable development have become the common topic of hospital architectural practice and hospital building design teaching. Sustainable theory is applied in hospital a, which can improve the medical environment, reduce energy consumption, save energy, and promote the harmonious development of buildings, cities, human beings and nature. In terms of teaching, sustainable theory is still a hot academic issue for architectural educators and experts to deeply study and explore. The theory of sustainable architecture plays an important role in the course of hospital building design, which enables students to have a detailed understanding of the knowledge chain of sustainable philosophy through learning process, so as to improve their understanding and innovation of hospital design.

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