

Green Campus and Sponge Campus Design of the New Campus of Hebei Engineering University

Zhenwei Zhang

School of Civil Engineering and Architecture, Anhui University of Science and Technology, Huainan, China

zhangzhenwei@aust.edu.cn

Abstract: *Taking the Hebei Engineering University's new campus design as an example, which is based on the concept of sponge city, this paper analyzes its geographical location, landscape design, campus planning, building energy conservation from aspects of sponge campus and the green campus construction, and finally puts forward the strategies of ecological campus design. Finally, the rationalization proposals for the construction of green campus in northern China are put forward.*

Keywords: *Sponge campus; Green campus; Ecological energy conservation*

1. Introduction

Scholars began to study green campus from twentieth Century, and carried out practice in many aspects. China has also introduced "Notice of construction of frugal schools", "Green school evaluation criteria", "Technical guidance on campus construction and management technology (trial)" and other documents to guide the construction of green campus (Gao and Liu, 2016). In addition, the concept of "sponge city" was put forward in the "Low carbon city and regional development technology BBS" in 2012^[1,2], emphasizing the combination of urban construction and natural hydrological environment. As an important component of the city, sponge campus construction will become the trend of development (Wang and Tang, 2016). The new campus of Hebei Engineering University is a green campus based on the concept of sponge campus. This paper analyzes its geographical location, landscape design, campus planning, building energy conservation from aspects of sponge campus and the green campus construction^[3,4,5], and finally puts forward the strategies of ecological campus design. Finally, the rationalization proposals for the construction of green campus in northern China are put forward.

2. Location analysis of new campus

Handan is located in the southernmost tip of Hebei province. It is the center of the four provinces of Shanxi, Hebei, Shandong and Henan provinces. Under the background of integration of the beijing-tianjin-hebei region, Handan is focusing on the construction of the eastern development zone (Meng, 2015). In order to promote the development of the development zone, the government decided to relocate the Hebei Engineering University to the development zone. This will provide powerful talents and knowledge supply for the development zone (Wang and Wang, 2015).

The location of university campus should meets the development of the city, and the site should avoid the low-lying water area of the city and consider the influence of the topography on future use. It can increase the flood prevention ability of the university campus through artificial filling. Handan is warm temperate and semi-humid continental monsoon climate. It is hot in summer and has heavy rainfall in July and August. Therefore, it is necessary to build the new campus into a sponge campus. In addition, the overall topography of the eastern part of Handan is lower than that of the west, and the topography of the new campus is lower than the surrounding terrain. In order to prevent the surrounding rainwater pouring into the campus, before the construction started, the school decided to pad the new campus terrain. Although it has increased construction costs, it has laid a solid foundation for its long-term use (Figure 1).

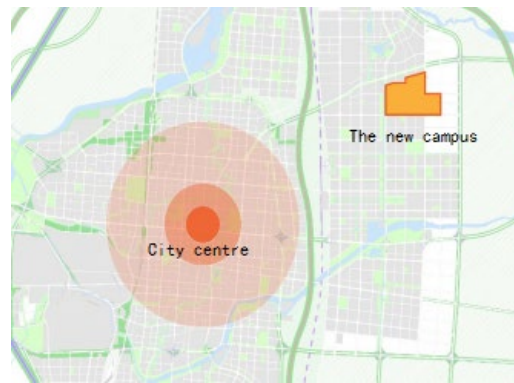


Figure 1: Location analysis of new campus.

3. Sponge campus construction and water resources utilization

Sponge city is a new concept of city stormwater management^[6,7], which demand urban construction to respect nature and adapt to nature. The ecological function of rainwater system for water absorption, water storage, seepage and water purification should be developed to promote the use of rainwater resources and ecological protection. Sponge campus is an important part of sponge City. It is of great significance for campus flood control, adapting to the environment and making full use of water resources.

3.1. Utilization of water resources

The main water system around the new campus of Hebei Engineering University can be summarized as two rivers, two canals and one lake. The two river is floodway of Zhang river and a new artificial river parallel to Zhao Wang Street. The two channel is the Hanlin gutter and Victory gutter. One lake is East Lake park. The new campus wil bring in the water of Xinkaihe into the campus. The water flow into the Hanlin ditch after cycle in the campus. The campus water system is part of the urban water system. Water recycling system is adopted on campus to collect domestic water and rainwater for landscaping and cleaning to realize the recycling of water resources. The maintenance of water resources should be considered when the waterscape is set in northern china. It is very important for the northern region to consider the maintenance cost of waterscape (Li, 2014). Considering the actual rainfall in Handan, in order to reduce the maintenance cost in the use of landscape, the lake area of the new campus has been reduced in the design phase. It promotes the eco energy conservation in the whole life cycle of green campus.

3.2. Sponge campus implementation measures

According to the original topography of the site, ribbon water is designed surround the teaching area and living area, so as to improve the campus climate. Around the campus water system, a number of rainwater gardens, ecological tree pools, artificial wetlands and waterscape are arranged on campus, which can effectively enhance the ability of campus to collect, purify and save rainwater (Sarah P Church,2015). Rainwater gardens and ecological tree pools have the function of storing water and promoting groundwater recharge. They are also used as biological retention areas or biological filters which can reduce pollutant concentration through deposition, permeation, adsorption, precipitation, biotransformation and decomposition procedures (Hanbae Yang, et al,2013). In addition, the gray area between the teaching buildings is designed as an interesting ecological garden to enhance rainwater infiltration and improve the environment of the teaching group. Permeable pavement is used on campus roads to ensure rapid infiltration of rainwater. Both sides of the road are provided with sunken green spaces, so as to avoid road seep. Through reasonable waterscape arrangement and technical practice, the campus flood disaster can be effectively prevented, and the rainwater will be optimized through the combination of "infiltration, stagnation, storage, purify, utilize, discharge" in a combination of ways to achieve the optimization of rainwater discharge and utilization(Figure 2).

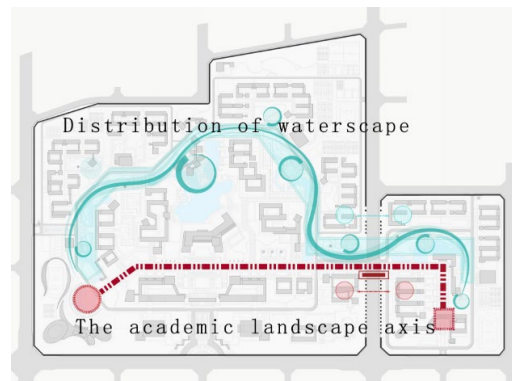


Figure 2: Sketch map of waterscape and academic landscape.

3.3. The presentation of eco-culture

A series of exhibition areas of ecological energy saving, such as green technology exhibition area, rainwater purification and utilization exhibition area, are arranged on the belt of waterscape. The campus ecological water system not only has the function of landscape, but also has the function of promoting green culture. This will integrate the green campus and ecological campus culture into campus life, and strengthen the cultivation of students' green energy saving concept.

4. Campus layout

In the early stage of campus planning, whether to consider energy conservation is important for the cost after putting into use. Therefore, it is important for builders and designers to design ecological campus by using natural conditions (Wang, 2012). The planning of new campus is based on the concept of "ecological academy". An ecological landscape belt and an academic long axis are designed. The teaching area is arranged between one axis and the landscape belt, and the student living area is arranged at the outside of the landscape belt. The functional area are divided by landscape belt, and each functional area is connected in a form streamline to form a whole (Figure 3).

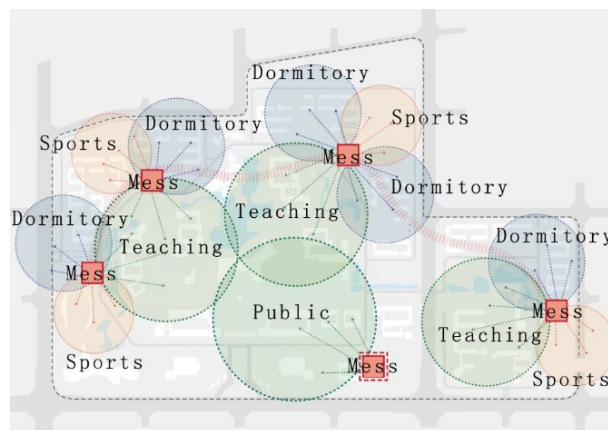


Figure 3: The analysis of functional partition and distribution.

The layout of the new campus absorbs the advantages of group and district. The college with similar subjects is designed as a teaching group. The dormitories, living quarters, restaurants and sports facilities are arranged in the periphery of each group to optimize the allocation of school resources. This will reduce students' time and consumption on the traffic and optimize the traffic environment on the campus during the rush hour. It is conform to the student's triangle mode of life activities. The layout of the building group can reasonably control the spacing and orientation of the building, and ensure the good lighting and ventilation of the dormitories and teaching buildings^[8]. It is of great importance to the comfort and energy saving in the process of use.

5. Land conservation measures

For the campus construction, land saving measures are mainly in the following aspects, such as reasonable zoning, reasonable traffic organization, the use of underground space and the construction of the interior space to make full use of space^[10,11]. The construction should follow the principles of low density, high capacity and stereoscopic operation (Lin and Kang,2008). Firstly, in the construction of the new campus of Hebei Engineering University, in order to realize the full utilization of the land, the departments with similar subjects are set up as teaching groups, and dormitory buildings are arranged outside each group. Secondly, through the formation of compact buildings, the arrangement of the landscape and waterscape with the vacant space between the groups, the overall utilization of the new campus land has been realized. In the design process, the initial plan, the larger scale entrance plaza is adjusted. The width of the square was adjusted from 360 meters and 500 meters to 200 meters and 120 meters, narrowing the scale of the entrance square. Through reasonable scheme adjustment, two reserve land will be saved. In addition, some parking lots and supermarkets are put into the underground space, which takes full advantage of the underground space of the new campus(Figure 4).

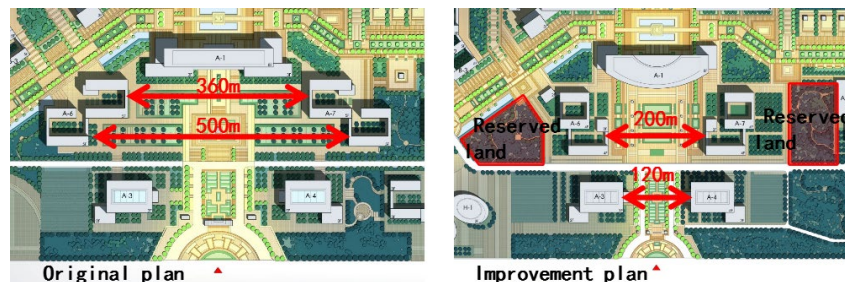


Figure 4: The analysis of land saving measurement in entrance.

6. Green building energy saving measures

Green building is the key point of green campus construction. Green building technical guidelines point out that green construction means to save resources (energy saving, land saving, water saving and festival saving) to the maximum extent, protect environment and reduce pollution in the whole life cycle^[9,11].

The new campus applies the green construction standard to the campus architectural design. Campus buildings should avoid new, strange and special architectural forms, and the overall form and scale should be reasonable, so as to avoid waste. Firstly, in order to save material and reduce the cost, the original large span gate plan was changed into a concise and saving column form. Secondly, in the design process of new campus library, the construction scheme of large cantilever and large span is eliminated. With the saving construction form, the structure cost is reduced. In addition, campus architecture is concise and unified, highlighting the cultural characteristics of Engineering colleges.

Campus building has the characteristics of frequent use and large personnel density. Indoor thermal environment has a significant impact on teachers and students. If the indoor environment is bad, it will not only reduce students' learning ability, but also reduce the effect of teaching (Mumovic D, Palmer J, 2009). In the premise of ensuring the quality of indoor environment, energy saving measures should be taken into full consideration. In the construction of the new campus, in order to reduce the influence of outdoor environment on indoor thermal environment and reduce the energy consumption of indoor air conditioning, the building facade was avoided from blindly using large glass curtain walls and large windows. Secondly, in order to reduce the influence of western exposure, a variety of sun shading methods are adopted. Furthermore, the entrance of the building is provided with a gate to form a thermal brake to enhance the stability of the internal thermal environment of the building. Finally, the layout of teaching groups adopts courtyard style, which takes full advantage of natural lighting and ventilation. The main rooms such as classrooms are arranged on the north and south sides of the good lighting and ventilate, and the secondary functions such as halls, storage rooms and staircases are arranged on the eastern and western sides. In this way, the energy consumption of buildings is reduced through reasonable functional zoning.

In addition to the improvement of hardware of green campus and the awareness of energy saving of teachers and students is also very important. In addition, it is also important for managers to formulate appropriate energy saving management programs for different functional public spaces. Only by giving full play to the subjective initiative of users can we improve the construction of green campus more comprehensively.

7. Conclusion

Green campus and sponge campus are the future directions for the development of universities. Based on the planning and design of the new campus of Hebei Engineering University, the following suggestions are put forward for the construction of the new campus in the northern China:

(1) The location of the new campus should take into consideration the development strategy and direction of the city. Give full play to the functions of the University's culture, science, technology and education to enhance the service ability of the university. At the same time, It is important to should avoid urban low-lying areas and consider whether to pad high ground before the construction and to strengthen the flood fighting capacity of the campus.

(2) Sponge campus is an integral part of sponge city. The northern university should make full use of the natural water system to supplement the campus waterscape and form a circulatory system. To make full use of natural precipitation and water circulation system to maintain the campus river system. In order to enhance the ability of flood fighting, sponge campus infrastructure is very important.

(3) With the opportunity of new campus construction, discipline should be optimized and restructured. The similar disciplines should be organized in the form of teaching groups to enhance the cooperation and development among different disciplines. Dormitory, sports ground and dining hall can be arranged by teaching group, which is convenient for teachers and students to study life.

(4) The scattered land can be integrated into reserve land by adjusting the layout. The functions of supermarkets, parking lots and other functions can be put into the underground space, so as to save land.

(5) Architectural style and form should adopt economic savings scheme, and the main financial resources should be used for the investment of subject and teaching equipment. Reasonable energy saving measures should be adopted to reduce energy consumption in buildings.

University is an important force in social development and a weathervane of scientific culture. Green campus and sponge campus construction are of great significance to green building and sponge city development. Colleges and universities in different areas should combine local natural conditions. In terms of location, landscape, planning and energy saving, it is important to make rational use of natural resources and promote the harmonious coexistence of campus and nature. The construction of green campus and sponge campus not only improves the ecological environment of the campus materially, but also promotes the construction of the green city and sponge city by carrying forward the ecological culture.

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