

2011 International Conference on Green Buildings and Sustainable Cities

Sustainable development of high-rise building

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Abstract

The purpose of this thesis is to discuss the sustainable development of high-rise building in Chinese cities. As the construction climax of high-rise building has arrived in China, many constructed or constructing high-rise buildings are still in the state of environment-unfriendly, low standard and efficiency, high consumption and pollution, and featureless. This kind of development is not sustainable. The method used in this study is analysis of environment protection, safety, and efficiency of the high-rise building, which tend to solve these above problems and make a sustainable development. The paper suggests that it is necessary to establish the green high-rise building system, which to be composed of external environment, internal floorplan and Architectural Form.

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Selection and/or peer-review under responsibility of APAAS

Keywords: high-rise building; sustainable development; green system;

1. Creation in external environment

1.1. Climate considerations

Climate is the first considerations in constructing. Under the condition of meeting the general distance requirement of sunshine, we can reduce buildings density and increase external space of high-rise building, so that to improve the external natural illumination, landscaping and microclimatic of external environment, then creating a more fresh and pleasant space to habitat. As far as the wind environment, it is necessary to make a model and test in wind tunnel for the high-rise building which has the special demand for environment. Discovering the best figure and size, and adjusting the design. At the same time,

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it is very effective that virescence, making holes on shell and gradient height backing, which can improve the external wind environment obviously.

1.2. Optimal utilization of land

Because of the high land prices in modern city, the density of buildings is high in many regions. It has caused the city "Canyon" and the congestion public space. The controlling of plot ratio and building density is an effective way. On the one hand, plot ratio controlling can restrict the target of land area utilization of high-rise buildings. On the other hand, the height of high-rise buildings can be controlled through the interaction of plot ratio and building density. So, the optimal utilization of land is very helpful to achieve a good relationship between buildings and surrounding environment, then an enough public space could be saved to improve the quality of external environment[1], see Fig 1(a); (b). Therefore, architects should attach great importance to the intrinsic link of architecture and natural environment.

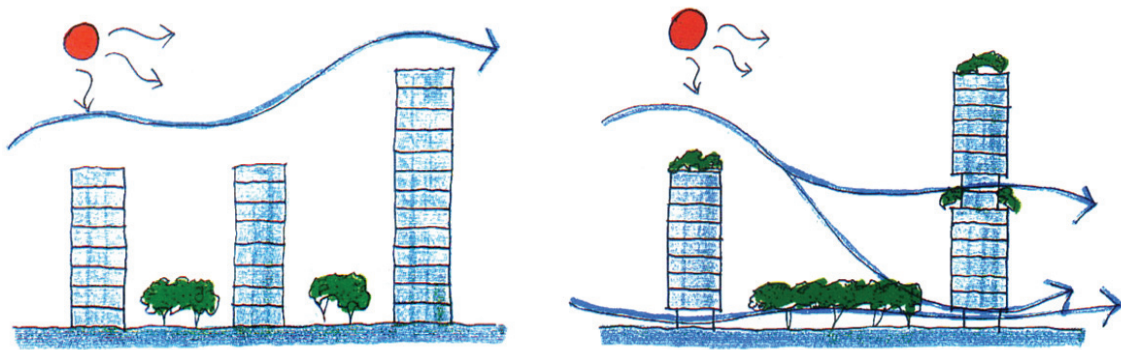


Fig. 1. (a) traditional land utilization; (b) ideal land utilization

1.3. Organizing the efficiency transport network

The reasonable entrance, fire passageway and parking place which set by information technology, is guarantee for an unobstructed, safety and efficiency traffic network. In the concrete jungle city, more emphasis has been placed on intelligent transport network which use the system of interchange, vertical conversion and real time supervision.

2. Floorplan and spatial constitution

2.1. Floorplan and Efficiency

The direction toward of high-rise building is significance to the rational using of natural resources. Studies have shown that the same building which towards to east or west will have more energy load than to north and south. So the cores of building should be arranged at the east-west direction to keep the main body from direct sunlight, thus saving air conditioning energy consumption and minimize the heat loss. Rational direction will help the building to receive sufficient natural light and ventilation. The more layers mean the more staff and greater requirements of energy consumption. So, the efficiency of standard

floor and the cores parts should be kept in the proper ratio and the ratio is helpful to evaluate the design of height, layers, floorplan and standard floor size of high-rise building.

2.2. Efficient space arrangement

Affected by upper flow, the enclosed air condition system is generally adopted in high-rise building. Hence bring the problems of heavy energy consumption and air condition syndrome. This is contrary to sustainable development idea, but aroused the exploring for a green high-rise building design, with nature, reduce energy consumption and improve the space environment. Among them, the improved atrium structure is one of the effective ways to ameliorate the quality of internal space. Atrium can be used as buffer space, or solve such problems in high-rise building as lighting and ventilation, also can purify the indoor air.

2.3. Convenient and safe transportation

Transportation in high-rise building should be organic and efficient. Otherwise it will impair the building's entire function and safety. In the horizontal direction, the length and width of aisle should be standardized control, circular aisle is very beneficial for traffic and evacuation, and the pouched aisle should be forbidden or set the evacuation facilities at the end of it. Because people get used to escape toward the familiar direction in an emergency, with blind obedience and multi-directional, the staircase should be arranged in the ends of aisles to form a complete two-way evacuation. At the sides of elevator well, the stairs should be arranged for emergency evacuation.

In the vertical direction, the appropriate number and layout of the passenger elevator should be considered. We can adopt the partitioning method to improve efficiency. Fire elevator must be configured according to the technical specifications. The Mixing usage of stairs is unsuited in Main building and annex. The super high-rise building should be set up the refuge floors. For two towers or complex type of high-rise buildings, the "air corridor" can be set to link the lift conversion layer and the refuge floors, improving transport efficiency and help evacuating each other. Diverse and efficient transportation forms can also make the architectural style vivid and unique.

3. The forming of high-rise building

3.1. terrain, environment and forming

Sustainable development of high-rise building depends on the symbiosis with its environment. When handling the relationship between architecture and terrain, whether the single or groups building, they all should be achieve the harmony with the surrounding environment on its form and function. Ignoring local terrain and arbitrary construction, that is the short-sighted practices. Felling trees or cutting mountains in construction will eventually bring the result of wasting and damaging to the ecology and environment. When Kenneth Frampton anglicizing the example of Chapel at Ronchamp, he said "The beetle forming of latter' - shell roof and a huge dripping mouth, sided chapel and altar - have been carefully diapason, which matching the "visual and acoustic" and the undulating terrain of its surrounding landscape so harmony." [2] So, the resonance between the buildings and its sculpture style should be established with terrain environment.

3.2. Forming and climate construction

The development of modern high-rise building tends to large size and multi-functional, although the technology of air-conditioning can provide a variety of artificial climate, but it also consumed large amounts of energy, so the utilization of natural energy is very important in its sustainable development. Thus, we can shape the architectural forms to adapt to the local climate, and empower the building with the ability to improve its interior microclimate. For example, when designing Al Sharq office (the winner of Future Architecture Award, MIPIM), Atkins has attached great importance to the local climate of Middle-east. Sheet structure with green plants was utilized in the main body to reduce the load of sandy base, and keep interior space from direct sunlight. On the top level, the huge open hole which link to atrium also can accelerate the indoors' air ventilation and introduce in lighting, and providing a beautiful viewing platform for users at the same time, see Fig 2(a); (b); (c).



Fig. 2. (a) Atkins, office of Al Sharq; (b) day scene; (b) top-level structure

3.3. traditional culture and style

The environment of building is influenced by social, economic and cultural. Among them, the cultural factors has a particularly means for high-rise building. City is the product of history, different periods and continuous evolution have made the city unity in diversity. So the form of high-rise buildings should be considered as a product of the continuous evolution traditional forms, it is the bridge to link the history and future. the Jin Mao mansion in Shanghai which designed by SOM is a good example, the design is base on the environmental and contextual which can raise the awareness of Chinese traditional architecture, the form of pagoda is the basic prototype, which contains the Chinese traditional thought, “Unanimity of Heaven and Men”. With an enhanced perspective and gradient structure, the forming of the building seems vigorous and gracefulness, see Fig 3(a); (b); (c).

Nowadays, there are many factor should be taken into account in high-rise building, such as information, intelligence technology, energy, resource crisis, environmental degradation, population growth and other factors. All of these require the architects to have the broaden views and grasp the overall situation, creating the sustainable high-rise building on the base of holistic, comprehensive and integrated. Therefore, the establishment of green high-rise building system is necessary. It is a system of high performance and good taste which refers to a less natural resources and energy consumption, and with local characteristics. Many valuable thought have been raised in this field, such as architects Brenda Vale promoted six architecture principles in “Green architecture: design for a sustainable future”: energy conservation, climate design, minimal use of new energy, respects user, respects the site[3]. They have the important reference value for green high-rise building design.



Fig. 3. (a) Jin Mao mansion, Shanghai; (b) interior; (c) Qianxun pagoda of the Chongsheng Temple, Dali, Yunnan

Information technology is another important factor to promote the modern high-rise building. It brings us the intelligent building, which combines computer and communication technology to high-rise buildings. It can automatically adjust the internal environment, though monitoring the external situation of the weather, temperature, humidity and wind, etc. Offering us the space environment with efficient, comfortable, energy saving and safety. Intelligent development can enhance the investment value and protect the environment, and maximum utilizing the resources. It will positively stimulate the development of high-rise buildings to achieve the goal of green and sustainable

4. Summary

The changing and development is eternal, but the question is how to action? The thinking of sustainable development has provided us a whole new concept, which with more value of culture, economy and ecology. Just as one comment said in “The Architectural Review”, “Change is the driving force to cultural and society, everything will be gone, but it is not means something upheaval or destructive”. We should be kind to the earth and environment, regarding the sustainable development of high-rise building as an opportunity rather than a constraint for our feature.

Acknowledgements

The author is indebted to the Institute of Landscape Art Research of Wuhan University of Technology for its information support for this paper.

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