

# Research on the Decoration Engineering of Modern Super High Rise Buildings -- Consideration Triggered by the "Sky City" Concept Proposed by Academician Huan-cheng Jiang

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**Keywords:** high-rise building decoration; fabricated refined decoration; refuse disposal; central dust-removal system.

**Abstract:** The concept of "sky city" is proposed by Huan-cheng Jiang, Academician of the Chinese Academy of Engineering in the report Building the Dream - My pursuit of Optimization and Innovation. Through "constructing vertical city municipal buildings and multi-story high-rise buildings", the problem of population aggregation in big cities can be solved. But in super high buildings, decoration problems are particularly notable. On the basis of constructing residential space in the "sky city", and practical problems in the modern high-rise building decoration process, this paper puts forward several suggestions to deal with potential problems in residential space of high-rise buildings.

## 1. Introduction

Academician Huan-cheng Jiang has made in-depth study in the optimization and aesthetic innovation of building structure. Through exploration and practice, the economic benefits, safety, firmness and beauty of buildings can be achieved through optimized structural systems. In the report Building the Dream - My pursuit of Optimization and Innovation, Academician Jiang proposed that, "under the background of land resource scarcity, big cities are bound to develop upwardly." Judging from the development trend of Beijing, Shanghai and big cities in the Pearl River Delta, it can be found that people are gathering to metropolis and big cities. The population densities of these cities are increasing. Consequently, the sites for construction are being scarcity. Large and medium-sized cities can solve this problem by building high-rise buildings. Compared with "obtaining space from the land", "getting lands from the sky" is more feasible. That is the construction of "sky city".

"Sky City" means "constructing vertical city municipal buildings and multi-storey high rise buildings". It is applicable to the special geography conditions of Chongqing (more mountainous areas than flat grounds).

In "Sky cities", high-rise building groups, communities and cities are formed through horizontal and vertical connections between numbers of high-rise buildings. Problems like dense population and land scarcity can be solved in the future city development. Public life space, including schools, hospitals, banks, shopping malls and amusement parks are arranged in the interior space of high-rise buildings to meet residents' daily needs. In academician Huan-cheng Jiang's sky city project, super high-rise building groups should be equipped with business centers, finance departments, education facilities, and even transportation service and community centers. It is required to put forward effective decorating methods of super high rise building groups in addition to the increases of elevators, fire-fighting equipments and the green space landscape.

Currently, most constructed high-rise buildings are commercial buildings, such as Taipei 101, Shanghai World Financial Center, Nanjing Zifeng Tower and Shanghai Jin Mao Tower. These buildings have high energy consumption level and low safety performance. The needs of commercial real estate and residential projects vary significantly. Besides the requirements for decorative materials' performance on fire protection, anti-ultraviolet, corrosion resistance, acid and alkali resistance and weather fastness, following points should also be noticed in the decoration process of super high-rise buildings.

## **2. Election of new thermal insulation materials**

In hot seasons, high rise buildings are exposed to strong sunlight; the wall temperature is relatively high. New thermal insulation materials can effectively prevent the rising of indoor temperature and avoid wasting electricity caused by the widely use of air-conditioning equipment. When the temperature is low, the temperature continually decreases along with the increase of height. The indoor temperature of super high-rise buildings is lower than that of the low rise residences. The energy consumption of super high-rise buildings increases due to the usage of heating equipment. New thermal insulation materials are efficient in preserving heat in cold seasons, too. Heat produced inside the building can be effectively kept indoors, rather than being absorbed by external walls in short time.

## **3. Fabricated houses should be delivered with refined decoration**

Fabricated buildings are constructed by fabricated parts and components through on-site assembly. They are made up of structural systems, peripheral protection systems, built-in systems and equipment pipeline systems. The combination of fabricated decoration and fabricated buildings can improve the rate of assembly and save construction time. Fabricated refined decoration promotes integrated kitchens and bathrooms, prefabricated partitions, and the separation of main structure and pipeline. The decoration is composed of systems on partitions, integrated grounds, walls and ceilings, integrated equipment and pipelines, as well as ecological windows and doors. The partition walls are light-quality, fast loading partition walls filled up with heat preservation, sound insulation and fireproof materials. The surface of walls is integrated veneer of UV coating boards. The partition system can also satisfy individuals' requirements on special design of wall papers or paint through building prefabricated fireproofing boards. In the integrated ground system, pipelines are laid under the overhead layer. Cushion layer and plastering are cancelled. Carpets, wooden floors and PVC materials are chosen according to the style of design and decoration. Thus, the ground decoration can be quickly assembled, easily maintained and easily dismantled. The integrated ceiling system is suitable for the installation of various indoor materials, like high precision gypsum boards, mineral wool boards, aluminum, PVC and soft film smallpox. Lights, diffusers, air ports and other equipments are integrated into the system to improve the overall integrity of space. Quick installation and convenient maintenance can be realized. Windows and doors system is accomplished in the factory. Doors are integrated with hinges, locks and lock holes. Door pockets are integrated with door hinges. On the assembly site, the installation tools are simple and easy to operate. Equipment and pipelines are laid under the ground floors, ceilings and light partition walls. They should be easy to repair, install, dismantle and change. All assembly decoration materials should be easy-cleaning, A grade noncombustible materials, in order to effectively improve the fireproofing grade of the building. In addition, compared with the traditional decoration mode, the prefabricated decoration can also reduce garbage transportation, and avoid the using of elevator. Moreover, component parts used in the prefabricated decoration process cause less harm to elevators in handling and cleaning. Prefabricated refined decoration requires long-term cooperation between the construction unit and the property management department; later maintenance and replacement are conducive to the improvement and perfection of the prefabricated refined decoration system.

## **4. Refuse disposal system of super high-rise buildings**

Elevators serve as the main artery of super high rise buildings. As carries of people and goods, they ensure the convenience of vertical transportation. The design and use of elevators are particularly important in super high rise buildings. For communities located in super high-rise buildings, it is a waste of transportation resource to transport a large amount of living garbage through elevators. The collection of household garbage by property management department takes a long time, and the smell of garage pollutes the living environment. The package of garbage may contaminate elevators in the course of transportation; the exudation of kitchen waste can increase the chance of elevator failure.

Once elevator accident occurs, the use value of the whole building will decline. The refuse disposal system in residential space of super high-rise buildings should be designed in advance to reduce the frequency of elevator accidents caused by garbage transportation, and ensure the smooth and effective traffic of the whole building.

Therefore, when designing structures and equipment pipelines of super high-rise buildings, a garbage disposal system could be designed on priority, in order to reasonably reuse or dispose the living garbage of residents inside the super high-rise building, and reduce the frequency of transporting garbage through elevators. For example, the Pearl River Tower in Guangdong adopts the design of an intelligent vacuum garbage collection system and a standby emergency treatment system, so as to collect living garbage in the super high building quickly, and reduce the destruction and pollution of garbage to the environment. The working principle of intelligent vacuum garbage collection system goes as following. Residents drop household waste; due to gravity, garbage goes down to the bottom of collection pipelines and reaches the garbage storage tank; after accumulation to a certain amount, the valve of storage tank opens automatically, and transports garbage to the central station through the municipal main pipe network by means of airflow; the shunts of garbage divide and compress garbage, and then transport garbage to landfill or incineration sites for final processing. Gas generated during this process is purified and discharge to the atmosphere. This system effectively combines modern high-rise buildings and the municipal solid waste disposal system. The new technology and innovative solution of refuse disposal is worth promoting.

The effective way to dispose kitchen waste is to use garbage processors. In view of occupants lived in super high-rise buildings, unified garbage processors should be equipped in the kitchen; sewage pipes should be arranged properly. This system should be organically combined with the municipal sewage disposal network. Garbage disposers are usually installed at the bottom of kitchen washing basin, and are hidden inside the kitchen cabinet. They connect with sewer pipes. Extra pipelines and classification treatment measures can be designed in super high buildings. Kitchen waste processors can handle food waste and leftovers such as fishbone, eggshell, tea, fruit, vegetable leaves or stems. The residue is grinded, crushed and washed away through the sewer. It is convenient and clean. Some kitchen waste can be collected through special pipes and reused to make fertilizers. New technologies for sewage treatment and effective utilization of food residue are warmly welcomed in super high rise buildings.

## **5. Central dust removal system of super high-rise buildings**

The application of central dust removal system can not only reduce the loss of transportation resources caused by garbage transportation through elevators, but also improve the domestic environment. The central dusting system connects a main engine of dust removal with dust removal ports in each room through pipelines buried in walls and pipe wells, in order to achieve the purpose of dust removal and decontamination. When using the system, only dust removal accessories and hoses are needed; portable vacuum cleaners are unnecessary. The weight of this system is lighter; adjacent rooms can share the dusting removal ports, and making the living environment more concise and beautiful. Compared with traditional portable vacuum cleaners, central dust removal system can absorb harmful gas, moisture and slight noise, and has advantages of more thorough cleaning effects, shorter cleaning time, higher safety in powers plug and lower loss of equipment. The technology is relatively mature and widely used in foreign countries.

## **6. Introducing modular design of soft decoration to cooperate with assembly decoration**

Nowadays, the design of soft decoration is focusing on functional features of art, variability, interaction and participatory. The assembly soft decoration can realize more unified decoration styles, including material, color and size, and customize color and size of soft decoration with personality, so as to realize one-stop service. In the decoration process of high-rise buildings, the modular design of soft decoration should be introduced to cooperate with assembly decoration. Before on site decoration process, corresponding accessories should be prepared according to the structure and

assembly decoration features of the building, as well as the overall requirements of soft decoration installation. Through integrated soft decoration, hard and soft decoration can be completed in the shortest time; the simultaneous completion of basic decoration can bring forward the average occupancy date for at least three months. Confronted with the continuous improvement of fabricated decoration, modular design of soft decoration based on home integration will be the trend and development direction of software design in the future. Large scale customization and personalized demands require innovative service models and integration of all kinds of resources. Soft decoration companies should update business philosophy and enhance competitive advantages to reduce service costs and increase new profit models. Through the modular service system and visualization measures, soft decoration companies can provide consumers with integrated soft decoration solutions, and enhance their recognition degrees.

The premise of modular soft decoration design is the construction of corresponding database and modular platform. Decoration modules with same style and orientation can match with each other; modules with different styles and orientations can also be assembled to meet diversified requirements. According to apartment floor plans of high-rise buildings, designers can collect data and design professional space modules of the living room, dining room, study, bedroom, children room and balcony according to consumer demand. Soft decoration modules can rapidly response to price segments of high-end, middle-end and low-end, and enlarge choose space for consumers. The system can generate orders according to overall soft decoration products selected by consumers. During the whole process, specific information about products, such as price, size, brand, processing skills and inventory quantity are accessible. In the future, integrated design of modular soft decoration platform can be connected with applications like VR technology, so as to add experience modes and provide consumers with immersion experience through mobile devices. The modular design of integrated soft decoration is also an effective way to improve the design and execution abilities of designers.

## 7. Conclusions

When citizens are considering the advantages and disadvantages of the super high-rise buildings, the community is more concerned about construction and operation costs of these buildings. After paying high maintenance bills, various technical problems in high-rise building are solved step by step. Super high buildings lift the height of architecture, and become landmarks of cities; they also change the way people live. On the basis of breaking through the traditional decoration mode, the decoration of super high-rise buildings should focus on maximizing the benefits of residents in high-rise buildings. Taking people's living experience as the starting point, decoration engineering should provide high quality life conditions for residents in the sky city.

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