

Testing and Evaluation on the Air Quality in “Green Building”

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Abstract: There is a building with an area of 6800 m². The goal is to explain the principal of “Green Building”. The advantages of this research are energy-efficiency and environmental protection on the building. We hope to establish an agreeable and a healthy working environment for employees who work in those offices. Therefore, a design strategy using several considerations was applied in architectural and equipment, including amortizing layer strategy, utilization of natural resources and so on. This paper introduces the technological measures and methods that we used in air quality testing process for this architecture and shows the concept of “Green building”. Especially, this paper also suggests new perspective of designing and constructing for intelligent building after experiencing the outbreak of SARA epidemic.

Keywords: Automatic Test, Green Architecture, Intelligent Building, Environmental Protection, Energy-Saving, Air Quality

1. CONCEPT OF GREEN BUILDING

Many scholars predict that human kind will gradually say farewell to the “false” prosperity of which establishing on the basis of environmental destruction and find a green road featuring high efficiency, harmony as well as ecology balance. From 1970s, the wave of “ecological awareness” spread every corner of the world, it promotes every person involved in this evolution rushing for his or her destined objective. Consequently, defence natural, attention environment and constructing a healthy living as well as consuming style are becoming increasingly vital as a strong voice for people in today’s society.

From 1960s, the pollution problems of industrialized countries are becoming more and more critical. Facing the deteriorated living condition of our world, campaigns claiming for greenness activity in the word. In early 60s, American architect Paul combined the words “ecology” and “architecture” as “arcology” compared with the concept of “simple ecology philosophy” proposed by those masters in the early period, the concept of ecology has been introduced into architecture theories and practices.

1990s, the conference of United Nations for environment and development hold in Geneva passed “21 century agenda”, explicitly expounding the theory of sustainable development. As a response to this theory, all kinds of thoughts as well as theory structures which maintain different names but contain similar principals in architecture field such as “Green Architecture”, “Ecology architecture” and “sustainable Architecture” gradually becoming one of the most popular topics in last 10 years of the twentieth century.

2. INTELLIGENT BUILDING AND GREEN ARCHITECTURE

2.1 Re-consideration on Intelligent Building

There are four features of Intelligent Building as follows: Office Automation; Advanced communication facility; Building Automation; Accommodation for future development;

1992, a research group conducted by Voiker Hankopf raised a theory in its book of “Designing of The Office of the Future” showing that when addressing Intellectual Building, traditionally it means applying high technology equipments in buildings. On the contrary, practice proved that traditional knowledge for this issue is not comprehensive enough, apart from bringing advanced products into architecture, we also have to place our attention on providing favorable material, psychal atmosphere, organization style in order to enhance employees’ working speed, comprehensive ability, communication capability as well as creativity.

The current Intelligent Building development trend means that provide mankind with comfortable, secure living environment as well as highly efficient working environment by maintaining a sustainable development policy, adopting energy-saving and environmental protection as its principal aim, using modern computer technology as its method, depending advanced information products as its indemnification. It is obvious that with the development of our society, Intelligent building no longer presents as simply putting a high-tech bag into one kind of architecture design in a traditional method, instead, it adopts high technology as its assurance to achieve the goal of persistent development.

It is easy to realize that with the improvement of modern technology, a great number of modern office environment have been built on the basis of a luxury consumption pattern—Central air-conditioner with

constant temperature and humidity as well as huge artificial lighting are consuming considerable nature resources: those white collars seems already accustomed with lighting. FCU and all year round outfits, ties and also a sense of content without any vitality. While consuming a huge number of energy, office buildings also isolate people from the access into nature.

All these aspects discussed above require us to propose a new consumption theory which different from the former "greenery consumption method" and an integrate planning principal for a deeply thorough consideration as well as a successful solution. It is far less enough to draw a complete determination in accomplishing a healthy as well as high efficiency working environment by simply emphasizing the advancement of technology and applying high-tech system. Especially for China, a developing country, it is particular important for us to consider questions such as high efficiency, economy and rationality.

2.2. The building from intellectuality to greenery

With the development of intellectuality and information, unimaginable changes have taken place in individuals' working pattern, as a result, people begin to raise distinctive realization and requirement concerning "time" and "space" when compared with former ideas. By using personal computer as well as Internet communication technology, distance between individuals has been increasingly reduced. Nevertheless, while confronted with considerable information records, those office employees also facing with a great amount of pressure imposed by the process of decision-making. Compared with foretime what more welcomed in office are those creative works, when people relief themselves from heavy physical occupations they recognize that their brains become more easy to feel tired than any single period of the past time. Consequently, with the advent of the knowledge economy age, building design will symbolize more on the emphasize of working environment and the concentration on using environmental factors to stimulate employees' working passion as well as creativity. Accordingly, for an enterprise, the most advantageous method in lowering its cost is to shape the environment which can allow workers to fully develop their enthusiasm and creativity.

On the other hand, people gradually realize that there exists a critical linkage between criteria such as high standards, high quality, high efficiency pursued with the interior environment of buildings and intensive energy, resources consumption as well as negative impacts of those activities violating the rule of sustainable development. Digital designing and application of intellectual appliances could be the only one of many solutions in relieving. Especially, as for developing countries, due to limitations imposed by their science, economical and social condition, it seems unlikely that an intellectual method based on high technology situation could be a superior direction for their building development.

The real technological level of those so called "intellectual" or "digital building" deserves a serious assessment. According to a result from a investigator by construction administration about 60 intellectual

buildings around country, merely 5% can be acknowledged as advance, 50% among intellectual disability, while 30% almost in the stage of paralysis. At the mean time, in nowadays' American Intelligent building field, modern computer technology, the application of advanced information products which been praised so intensively by us, are merely been treated as an assurance measurement. Its real goal is now being transformed from "architecture automation and intellectual control of interior environment" to "providing mankind with comfortable, secure living environment as well as highly efficient working atmosphere by maintaining a sustainable development policy, adopting energy-conserving and environmental protection as its central principal, using modern computer technology as its method, depending advanced information field products as its indemnification." For that matter, like what we mentioned above, although architectural design cannot be separated from the support of high technology, the high-tech system represented by intellectuality and information technology may not be used as the golden key. In line with today's prospective, it is unnecessary and impossible by depending solely on the emphasis of the advancement of technology and relying merely on high technology system to attain the achievement of pursuing the healthy, high efficient working environment. As the concept of sustainable development as a choice become largely accepted by people all over the world, the intellectual as well as sustainable feature about modern architecture become gradually combined with each other to a great degree; the belief of greenery, health and Sustainable development bring intelligent building and its design with entirely novel objectives, concepts and methods.

Another point paying attention to is that the exploration of green architecture is not the complete denial of the theory of intellectual building, but a positive extension as well as a revision of the latter. At this critical point, it is advisable for us to extend our scope and adopt a totally original method to evaluate the orientation of future development of architecture.

3. SICKNESS BUILDING SYNDROME (SBS)

In international community, there exists a event which could be regarded as a milestone for Green Building research: according to a investigation of a variety of SBS cases, SCBR has summarized several reasons in leading SBS as follows:

- (1) Outside pollution which conveyed into the house, such as exhaust gas of vehicles from the garage, burning plants, pollutant transmitted into the building from building site and gas pipelines.
- (2) pollutant brought about by construction materials, such as mineral fabrics, ceiling cement, isolated material which contained formaldehyde.
- (3) microorganism which come from humid air, appliance, air conditioner, air-supply and exhaust.
- (4) chemical substances used in construction process.
- (5) pollutant produced by room appliances such as printer.

After investigate several buildings with the area over 4,000,000 m² which contain the problem of SBS, one American company classifies architecture reasons

which may led to SBS into the following categories: 64% with low efficiency of the process of ventilation system; 63% problems maintained by polluted air disposal appliances; 5% problems concerning working efficiency of filtration procedure in ventilation system; 38% polluted ventilation pipelines; 35% no fresh air from outside to the building.

It is clear that air quality within an architecture plays an essential role when determining whether this building deserves the title as "green". It is also very critical for us to develop a series of methods testing and evaluation of room air quality.

4. SUMMARY OF OUR WORK

From the end of 2001, we have had a project concerning real investigation and theory researching about a building named building of Tsinghua architecture and designing institute which hold the honor of being one of the first office buildings designed, constructed and putted into practical utilization according to "green building" theory. Until now, we have conducted works of date testing and information recording, achieving numerous precious date in the testing locale and therefore, establishing stability experimental basis for the evaluation of the original design and use as well as application and improvement of devices within architecture.

Testing works mainly locates in Tsinghua Designing Institute, there have been three modes in this testing process:

4.1 Automatic Date Recording Device

Before being used in the experiment, automatic date recording device should be conducted with necessary design by PC computer through port in series. The necessary setting: the origination point of date recording time, interval time, the devices' serial number and so forth. Secondly, placing the automatic date recording device at the expected location, then it will operate in its normal function. Any time during the operation of the automatic date recording device, date can be collected through port in series using PC computer or notebook computer.

In order to let the date collected meet the requirement of the rule of proper space allocation, we have placed 40 this kind of automatic recording devices in the building.

4.2 Testing device for temperature, humidity and air flow volume

This device is a kind of fully automatic multi-functional device which can be operated and adjusted in testing location. It was produced by HP company and should be connected with 220VAC power supply. This device has six probe used for measuring volume of air flow and speed of wind or it can be connected with 2 groups, each of them contains 24 temperature(humid) probe. Such as heat resistance, it can work independently. When using the additional probe, we ought to use PC computers or notebook computers and through parallel port to read and collect data.

4.3 Multi-channels computer collecting data system

The main propose for industry control computer in the data collecting process is to provide a software

platform used to control data collection card and a fictional instruments interface, in order to supervise the operation of data collection card timely and store data gained by data collection card for future analysis.

The pattern of data collection card: Lab-PC-1200, it is one of a series of data collection cards produced by NI company, it can accomplish data input (A/D), data output (D/A) and data recording within given time period. It has 8 analog signals input channels, 2 analog signals output channels.

The main task for data collection card is conveyed data collection analog signals (voltage) by foregoing adjustment broad into digital signals which can be stored by PC computers.

Instrument Simulation Technique has been adopted in the multi-channels automatic data processing by computer.

4.4 Others

Besides the above three testing devices, we have also used particular equipment to test CO₂, niton, formaldehyde, benzene family cpd.

We test and record data of air flow volume, temperature and electricity consumption level of the relative part of air conditioners in air conditioner compartments. We also launched three surveys concerning the comfort level of working places.

From energy conservation aspect, we proposed theoretical questions and original proposals considering design, application of equipments and renovation in this architecture.

5. SOME CONSIDERATIONS

The above work is the fulfillment according to the plan which based on the foundation of traditional architecture design regulations. However, in areas which are closely connected with green architecture such as air quality, production, installation and application of air conditioner even with architecture itself, new problems have appeared after the outbreak of SARS epidemic. For that reason, based on relevant materials and reports, we shall discuss it next paper.

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