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Preserving our collection - the new building of the Shanghai Library

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Abstract: This paper examines the regulations of the Chinese National Standard for Library Building Design where collection preservation and disaster prevention are concerned. It describes how the design of the Shanghai Library new building abides by these regulations, and discusses what special plans are established in the library for disaster preparedness and management.

The new building of the Shanghai Library was opened to the public in 1996, covering a space of 83,000 m^2, providing more than 3,000 reading seats, and housing over 40 million items, some of which are the most treasured in China. The design of the building is in strict accordance with the Chinese National Library Building Standard, and it takes such matters as the southern climate, disaster prevention, energy saving, etc, into consideration. The design is representative of modern library buildings in the country.

The latest "Chinese National Standard JGJ38-99, Regulations for Library Building Design" was established in 1999, which is largely based on the previous standard established in 1987, JGJ38-87, but with higher requirements in many aspects. Matters concerning collection preservation and disaster prevention, including earthquake protection, humidity and temperature control, ventilation, air-conditioning, water damage and fire prevention, etc. are given careful considerations.

I. The National Standards

1. Collection preservation

1) Temperature and humidity control

There are different temperature requirements for the general collection and the special collection storages. The temperature should be controlled between 5°C and 30° C, and relative humidity between 40% and 65% for the general collection storage. For the special collection storage, the temperature is between 12~24° C, and relative humidity between 45% ~ 60%, within 10% of the daily change. There should be an intermediate room between the special collection storage and the reading room next to it, to avoid the sudden change of temperature and humidity.

2) Water damage and moisture prevention

The ground outside of the storage should have good drainage design, and drainage pipelines should not cross the storage. The rooftop should have effective external rainwater drainage devices.

For the underground storage, the water prevention design should follow the national standard GBJ108 "Water Prevention Technical Rules for Underground Project".

3) Sunlight and ultraviolet light protection

The storage and reading rooms should use ultraviolet protective glass and sunshade to avoid direct sunlight. When florescent light is used, there should be ultraviolet filtering and fire prevention measures.

4) Security

The special collection storage should have separate locks and an automatic alarm system. Open-shelf reading rooms should install theft protection devices. The main entrance, special collection storage, important facilities room, computer center should install closed circuit TV monitoring system.

5) Heating, ventilation and air-conditioning

The heating and air-conditioning equipment should be placed in a special engine room, and be located far away from the reading and storage areas. The engine room should have fireproof doors.

The reading rooms should have good natural ventilation, which should be met with the building design or mechanical ventilation devices.

The air entering the special collection storage should go through the purification process first.

2. Disaster prevention

1) Fire Prevention

The fire prevention design for the library building should also follow the current national standard GBJ16, Fire Prevention Regulations for the Building Design and GB50045, Fire Prevention Design of the High Building for Civil Use.

Careful compartmentation and structure layout are required for fire and smoke prevention. The storage should be completely separated from the building next to it with a fireproof wall that has a fire-resistive minimum of 3.00h.

When the building height exceeds 24 meters, each fire compartment of the storage or reading room should not exceed 700 m^2, and the underground storage should not exceed 300 m^2. But when an automatic fire suppression system is installed, this space

can be doubled.

In a library with a collection of over one million items, the storage should install an automatic fire alarm system. The special collection storage and the computer room should have gas fire suppression devices.

2) Emergency evacuation

The library should have more than two emergency exits for the building, and they should be located apart. In the storage and reading rooms, each fire compartment should have at least two emergency exits.

The emergency evacuation stair of the storage should be designed as an enclosed or smoke-preventing stairway, and it should be located outside the storage.

The library should have an emergency broadcasting system.

2) Water damage prevention

The library should have both interior and exterior water provision and drainage systems, as well as adequate water provision for fire fighting.

Water supply points should not be located in the storage. Water provision pipes should not cross the storage.

3) Lighting

The library should have emergency and security lightings. The storage lighting should have a separate switch, and the general switch of each floor should be located outside the storage.

II. The Design of the Shanghai Library New Building

The design of the Shanghai Library new building complies with the national library building standard in all aspects. The building is so constructed and equipped with necessary devices that it can sustain heavy earthquake, and provide protection from the harmful effects of the southern climate and possible water damage. It is completely equipped with fire detection and suppression systems to provide a high level of protection for the collection.

The designer realized that building security can be promoted by the physical structure and layout of the building itself, and its design considered the following major issues: the level of people occupancy in different parts of the library, the need to allow for extended opening in particular areas, the vulnerability of the collection to fire and water damages, and the changes in temperature or humidity, the arrangements for regular people passage and their evacuation in emergency, and the various facilities required for library services and disaster management.

1. Building structure and interior layout

The building mainly consists of two towers of 107m (23 floors above the ground) on the right and 59m (11 floors) on the left. There are reading rooms from the 1st to the 4th floor on the right and from the 1st to the 3rd floor on the left. The computer center in located on the 5th floor on the right, and the rest of the floors are used as book storages.

1) Providing protection against earth-quake and other natural disasters

The building has a monolithic in-situ concrete structure that can resist an earthquake measuring 7 on the Richter scale.

The Storage has a load of 600kg and a height of 2.5m. In the reading rooms, the load is 500 kg and the heights are 2.8m and 4.2m separately. The column grid of the

storage is 7.2m x 7.2m, and the floor is of in-situ concrete. The other rooms are with frame structure and in-situ concrete floor.

The building rooftop is equipped with lightening protection devices, too.

2) Resisting the spread of fire, and providing convenience for personal evacuation and fire fighting operation

On the right wing of the building, which houses collections mostly published after 1949 and is more heavily used by the public, there is an atrium structure connecting reading rooms from the 1st to the 4th floor. There is an open stair linking these floors inside the reading rooms. There are also an elevator carrying readers from the ground floor to the 4th floor reading room, an escalator from the 1st to the 3rd floor reading room, and a spiral stair from the 1st to the 4th floor.

The atrium gives a sense of spaciousness, but removes the horizontal fire divisions provided by floors. Considering this aspect, the floors are separated from the open interior by fire proof rolling doors, providing vertical compartmentation. The fire-proof doors are interlocking steel slats, which can close automatically in a fire, and can also be closed manually.

There are two separate elevators for the staff and the storage, linking the ground floor to the top of the storage tower (23 floors). There is also an enclosed stair for the storage, which is located outside the reading rooms and can be used by readers in emergency, too. The stair is more than 1.2 m^2 in width, and declivity is less than 1: 1.5.

There are general book storage, ancient book storage and rare book storages in the building. The general storage is located in the higher tower on the right, and the ancient book storage is in the lower tower on the left. In these book storages, every 1,000m^2 is a fire compartment. There are two rare book storages, one above the ground and the other underground. Each is of 600 m^2, with 300m^2 as a fire compartment. The fire compartments are separated by coordinated rolling fire-proof doors, which are open in ordinary time, but will close automatically when the automatic fire alarm is on.

There are also book lifts in both general and ancient book storages, and automatic book carrier conveying books through the 23 floors of the general book storage tower.

The design also gives enough space for the parking of fire-fighting trucks outside the building, providing convenience for dealing with fire in the high-level storage.

3) Preventing water damage

The walls are of solid concrete, with water prevention layers both outside and inside. There is a waterproof layer on the roof, too. There are rainwater pipes on the rooftop collecting rainwater into the half circular water buckets and then into stainless rainwater pipes installed on the surface of the wall.

The library basement takes up a space of 6,103m^2, about 7.6% of the total floor area. The bottom board of its exterior wall is of reinforced concrete protecting against water penetration. There is pedestal supported panel flooring for the underground rare book storage, preventing moisture and convenient for drainage.

2. Security devices

The library has installed various facilities to provide protection from fire, water damage, theft, insects, mould and mildew, etc.

1) Ventilation

The library has a flexible ventilation system. It combines natural ventilation,

mechanical air handling and a full air-conditioning system that has central provision of heat and cold air, but with localized controls. All the windows in the building can be opened.

The rare book storage, audio-visual collection storage, microfilm collection storage and computer center have separated air-conditioning systems, which provide these areas with a constant temperature and humidity. The temperature is kept at 24-25° C in summer and 12-15° C in winter, and the relative humidity is about 60%. In addition, the microfilm collection storage is installed with air purification devises, so that hazardous gas and dust cannot enter the storage.

The other storages and reading rooms are provided with low level air-conditioning according to seasons, but mostly rely on mechanical ventilation and dehumidification.

There is a transmission room between the rare book storage, staff work room and reading room, to reduce the sudden change of temperature and humidity.

2) Fire prevention

The library has a very well coordinated fire prevention system, which integrates process control and information management.

In addition to fire hydrants, portable fire extinguishers using carbon dioxide, 1211, or dry powder are placed in various locations throughout the library.

There is a manual alarm bell on the surface of the fire hydrant chest, and also a phone plug directly connected with the Disaster Prevention Center. When the manual alarm bell is pressed, the floors below and above the area will sound alarm, and the R-21 central emergency panel in the Disaster Prevention Center will indicate the location of the emergency.

A fire zone panel is also located outside the storage on every floor. When a fire occurs that automatically activates the fire alarm system, an indicator light on the panel will show the area in which the fire is located

Smoke detectors and automatic water sprinklers are installed all over the building. When in fire and the temperature reaches 68° C, water will sprinkle automatically. The alarming system is connected with the Disaster Prevention Center, which also has direct phone connection with the local fire fighting department.

Halon 1301 devices are installed in the rare book storage, microfilm collection storage, audiovisual materials storage, electricity control room and computer center. When in fire, the alarm will sound automatically and will start the halon 1301 device, sending signal to the Fire Prevention Center at the same time. The halon 1301 device can be started manually in the emergency area, too.

The Fire Prevention Center has two R-21 fire alarm control panels. When fire or gas leaking happens, the panel will show the location of the accident, and will start the linkage system for automatic control.

The linkage system works in the following way: When the smoke detector sounds alarm, it will send signals to the Disaster Prevention Center, and the fire-proof rolling door will fall to its half. When the temperature alarm is on, the door will fall to its full length. The elevator will start pressure ventilation and mechanical smoke discharge, and will quickly stop on the lowest floor, opening doors automatically. Other emergency doors will open automatically. When the ventilator is stopped, the none-emergency electricity will cut off, replaced by emergency electricity supply.

In the Disaster Prevention Center, there is also a manual operation station for controlling fire prevention devices, and a CRT automatic fire alarm display equipped with a computer screen that indicates the location of various fire prevention devices.

By clicking a mouse on the screen, the operator can start or shut down the fire hydrant, sprinklers, ventilators and fireproof doors, etc.

The library has installed closed a circuit television system for the surveillance of all areas, and an emergency public announcement system. Loud speakers are installed on the passages, lobby and storages. It has separate electrical supply, and is controlled by the Fire Prevention Center.

There are two electricity supply lines for the whole building. If both lines fail, there are also interior batteries in the generator, which will automatically shift the supply.

The central air-conditioning system is powered by the pipeline gas supply, with 4 sets of heat and refrigeration machines. It has various fire prevention devices, including gas leaking detector, temperature detector, automatic water sprinklers and fire hydrants. The security alarm system, information and control are all connected with the Disaster Prevention Center.

The automatic carrier system serving the general book circulation service has its own independent fire prevention and alarming system. At the entrance of the carrier on every floor, there is a fireproof door, which can lock automatically in emergency. When smoke is detected, the ordinary electricity supply will cut off, and replaced by emergency supply. At the same time, the detector will transmit the emergency information to the alarm panel of the Carrier Control Center, which will indicate the location of the fire and stop the carrier automatically.

Noncombustible draperies are used for all windows. There is no carpeting in the library. All floors are either of wood or marble.

3) Fire-fighting water supply

The fire fighting water supply consists of internal and external fire hydrants, outside water pump stations and high pressure pumps. There is a circular network of water pipes with water entrance on both ends and higher and lower level water supply. There are water tanks on the rooftop of both towers, and outside water pump stations on several locations. When the water tanks are exhausted, fire-fighters can start the water supply from the outside pump stations by turning on the switch inside any fire hydrant closet.

4) Other protection methods

There is an electromagnetic door system controlling all exits of the reading rooms. The library has a closed-circuit TV monitoring system, with video cameras installed in various locations, which can provide a psychological deterrent to potential misbehavior. In rare book storage and computer room, there are also infrared lamps to ensure clear video images in darkness.

Since book drop fires are common, the 24-hour book return is placed in the security office, where security guards are on duty 24 hours a day.

The library has installed emergency lighting for stairways and central areas at all hours.

The library preservation staff has inserted papers containing a certain chemical between the pages of rare books to prevent moth and insects. This chemical is not harmful to human beings but can kill insects. It vaporizes at room temperature, thus keeping the storage free of moth and insects. To prevent mildew from growing on books, the book preservation staff regularly distribute sanitizing tissues (containing a chemical concocted by the preservation staff), protecting people’s hands, thus library documents.

III. Disaster management plans

To ensure the reliability of the facilities and the compliance with disaster prevention codes, the library has established very strict disaster management plans, which are enforced at various levels.

1. Administration

It is required by law that Director of the library be the legal representative of the library responsible for the disaster management, with professional certification. Director of each library department is responsible for disaster management in his or her department.

The library provides its staff with regular training so that they have constant disaster prevention awareness. The training workshop is conducted at least once a year.

2. Practical measures

The building construction is compatible to the national building standards, and further renovation should strictly observe the current standards.

The library provides very good signs and labels for public orientation, and a floor plan is posted at each level. A good evacuation plan is established.

There are routine security cruises of the building a few times a day and 24-hour security guards. The special technical staff conducts regular maintenance and inspection of the facilities: The alarming system is checked every day, water supply and fire hydrants every month, halon 1300 devices twice a month and other facilities (smoke detector, fire rolling doors, etc.) once every 3 months. Fire pumps are run once a month.

The whole library is a non-smoking area, and no fire is allowed in the building.

Most of the first- and second-rate rare books are digitized and made into CD-ROMs. These CD-ROMs are placed in a juke-box located apart from the ancient book collection department.

3. After-disaster management

1) Document transfer

It is very important to transfer the collection to other library storage buildings when a disaster occurs. The Shanghai Library has 3 additional storage buildings in different locations, which can also be used as post-disaster process centers.

2) Water damage

Since mold and mildew will grow quickly due to the growth of temperature, it is essential to take measures to lower temperature and dry the building environment. The library will use air-conditioner and moisture removing devices to achieve this purpose, and if electricity is out, lime or charcoal will be used to absorb moisture.

For treating water damaged books, the following steps will be taken: a) Freeze the books in a refrigerating house. b) Dry the books at a temperature lower than 8° C. c) Conduct further technical processing, including chemical treatment and rebinding, etc. The whole process takes about 60 days.

3) Pest prevention

The library makes sure to provide general and local environment controls to prevent the spread of pest.

Pest never occurred to the library's own collection since routine control measures

are conducted. But in 1997, 45,000 volumes of donated books and genealogical materials containing silverfish entered the new library building and the pest quickly spread to other books and storages. The library conducted the following measures to curb the spread of the pest: a) Control the local environment by sealing the doors and windows of the storage and closing air-conditioning pipes for 4-5days. b) Killing the silverfish by using a self-made pesticide (in the pyrethrins series). Papers containing such a chemical were inserted between book pages. The chemical evaporated in room temperature and achieved the purpose of controlling the environment as well. There is no return of the pest after the disaster control.

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