Utilization Model of Underground Space to Protect Historical Relics

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ABSTRACT

Nowadays, under the condition of economic globalization, a lot of valuable historical relics all over the world are in danger because of natural environment and disasters caused by human destruction. The large-scale development and construction of cities and rebuilding of old cities also bring serious “constructive destruction” for all kinds of historical relics. Therefore, it becomes more important to strengthen historical relics protection than ever before. The article expounds the importance of historical relic protection through underground space and proposes different models of development underground space in allusion to relic classification. The use of underground space can not only alleviate contradiction of urban development and relics protection, but also provide effective it measures for protection of valuable relics which is restricted by surface condition, thereby can realize sustainable development of relics protection.

1. CONNOTATIONS OF HISTORICAL RELICS PROTECTION BY MEANS OF UNDERGROUND SPACE

Underground space can be characterized as a protected, quakeproof environment, having environmentally stability and insulation from the outside, elements favourable for the exhibition and preservation of historical relics. Compared with common architecture, underground space, completely enclosed or covered by soil, offers better protection from all kinds of natural disasters. It is part of the geosphere, differing from the above hydrosphere and aerosphere, and characterized by compactness and long-term stability of each component unit, that makes it much less vulnerable to the destructive effect of earthquakes than aboveground architecture.

A large underground space is one or two grades higher in quakeproof capability than aboveground architecture of the same kind. Insulated from the ground, underground structures have excellent fireproof performance and with their few entrances and exits, they are safer than aboveground architecture. The advantages of placing some invaluable relics underground are: most parts are not exposed to aboveground space; the limited entrances and exits make it easy to watch and inspect the relics, and therefore theft-proof; the powerful anti-disaster capability of underground space provides necessary safeguards when disasters occur [1].

The precious historical relics are much demanding in their preserving environment such as temperature and humidity. The optimal environmental conditions of preserving historical relics are shown in Table 1.

However, the perennial temperature of shallow basement as annexe is 8~25°C, and relative humidity 60%~70%. Compared with figure 1, it is obvious that underground space is environmentally stable, which serves historical relic preservation well.
Table 1. Optimal environment for preserving historical relics (Network: www.chinacov.com)

<table>
<thead>
<tr>
<th>Item on display</th>
<th>Temperature (°C)</th>
<th>Temperature variation</th>
<th>Humidity (%)</th>
<th>Humidity variation (%)</th>
<th>Luminance (lux)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books and paintings</td>
<td>18±2</td>
<td>2-5</td>
<td>50-55%</td>
<td>5%</td>
<td>50-100</td>
</tr>
<tr>
<td>Textile</td>
<td>18±2</td>
<td>2-5</td>
<td>50-55%</td>
<td>5%</td>
<td>50-100</td>
</tr>
<tr>
<td>Lacquerwork</td>
<td>18±2</td>
<td>2-5</td>
<td>60-65%</td>
<td>5%</td>
<td>150-200</td>
</tr>
<tr>
<td>Folk-custom</td>
<td>18±2</td>
<td>2-5</td>
<td>50-65%</td>
<td>5%</td>
<td>100-200</td>
</tr>
<tr>
<td>Metalwork</td>
<td>18±2</td>
<td>2-5</td>
<td>45-50%</td>
<td>5%</td>
<td>200-250</td>
</tr>
</tbody>
</table>

2. THE RESEARCH MODEL ON HISTORICAL RELICS PROTECTION BY MEANS OF UNDERGROUND SPACE

According to the Chinese historical relics protection law, unmovable relics include: ancient cultural heritage, mausoleums, architectures, grotto temples, stone inscriptions, mural paintings, important latter-day and modern historical relics and representative architectures; movable relics include: important articles of every ages, artworks, literature, manuscripts, books, representative articles and so on. Movable relics are divided into ordinary relics and valuable relics which are further classified into first, second and third grade relics. Based on the quality and features of historic sites, there are prehistoric site, urban site and architectural (constructional) sites. Prehistoric sites are places that prehistoric people consciously or unconsciously constructed and moved about, such as prehistoric villages and natural caves. Urban sites refer to such facilities organically established as roads, sewage systems, forests and fortifications. While architectural (constructional) sites are the palaces, temples, houses and dams, etc.. In terms of protection, historic sites basically fall into two categories: aboveground sites and underground sites. Some unmovable relics such as historic sites and mausoleums can be protected and exhibited by establishing museums [2].

**Model 1:** In the expansion projects of building relics at historical and cultural sites, the underground space may be the only recourse available.

The Louvre in Paris, one of the world-famous palaces, there was no more land for development around the Louvre, it was impossible to move to another place, and the regular distribution and perfect profile of the original palace permitted no additional structures on the ground. The eventually successful construction of an underground museum by using the underground space under “the Napoleon Square” retains the overall pattern of the classical architecture and at the same time meets the demand of the use of such a modern museum.

In order to highlight the image of the general way-in and way-out, and provide natural lighting for the underground central hall, pyramid-shaped glass skylights that concurrently serve as the main entrance were designed at the crossing of two major axes of the original palace at the center of the Square, and the central hall thus becomes the main entrance and exit [3]. With the glass skylights, the main entrance achieved harmony to a certain degree with the original palace (Fig.1, Fig.2).

**Model 2:** A number of are belong to the earth’s morphology or configuration under the natural ground, and its good natural condition that decided exhibit the relics of some sites, underground space must be developed. [4]

The Museum of the Yang Emperor Mausoleum of the Han Dynasty lies next to the emperor mausoleum, in the northern suburb of Xi’an. It is an entirely underground construction, with a total floor area of 6513 m². The ground, unchanged and covered with lawn, has soil 0.6 m in depth. The principal part of the architecture exists in the first underground floor with a height of 6–9.9 m. The depth of the underground museum is 13 m (Fig.3).
The main entrance to the exhibition hall is located north of Sima Road and of the same location as the Tomb. However, the best exposure of the underground constructions is southern, south-eastern or south-western, which allows sunshine and natural light to shine into the depth of the architecture. The design depth and style of the main entrance not only provide good natural lighting, but also improve to economize on energy of the architecture.

In the northern part of the sunk courtyard, Tourists, after visiting the pits, can first enter the main entrance hall and subsided yards by way of the long ramp in the north-west corner of the lobby to have a rest before arriving at the ground. Except the partial subsided openings, there are no other protrusions on the ground, thus preserving the historical state of the mausoleum (Fig. 4, Fig. 5).
Model 3: The utilization of underground space is a necessary way between protection and development for the protection of ancient architecture relics in the center district of the city. The Bell and Drum Tower Square is situated at the central of Xi’an, both the Bell Tower and the Drum Tower are historical relics at the state level. The height of architecture around the Bell Tower and the Drum Tower is limited due to the sight and cultural relics protection. The development and utilization of underground space will make it take on partial commerce, traffic, entertainment and storage functions. The connectivity of underground walking-street, sinkage square, underground commerce and underground park will form an underground synthesis which functions circulation, shopping, and sightseeing. A middle hall is located at first floor and second floor of underground department stores, and at the top of the hall which is on the ground level, there are four class towers. This design can not only bring natural light to the underground, but also format the logical make up of relationship between underground space and square space.

The utilization of underground space in the Bell and Drum Tower Square in Xi’an strengthens the protection of historical scene and relic, at the same time, it releases the pressure of traffic jam in the center district of the city. (Fig. 6, Fig. 7)

Model 4: Within the protective area of historical sites, the protection can be operated for those potential historical architecture. The development of historical relic needs new function space (such as exhibition hall, management room, storage, shopping, etc), and the architecture around historical relic may be rebuilt in the future. So the development of underground space will protect historical relic, advance soil utility rate, vacate more green area and entertainment space, fulfill the needs of modern development.
Beijing's four-courtyard make use of one or two layer of underground space to meet current requirements without alter the upground format. The first underground floor is surrounded by a sinkage court, which is used as light collection and communication between neighbours. The second underground floor is used as park and other service establishments. This model is not only enlarge the inhabitancy space but also gain the new function such as parking, storage, grief prevention, etc. (Fig. 8)

Model 5: In expansion of underground historical relics exhibition hall, the development of underground space is necessary way to the protection of underground relics. There are historical relic of underground storerooms in some of historic relic site protection districts, due to a number of precious relics, there are much demanding in their preserving environment such as temperature and humidity. The ground cannot attain to exhibit demand for the protection of historic relics. [5]

The Imperial Palace in Beijing is world cultural heritage. The chief aim of setting up such an exhibition hall was to settle the long-standing contradiction between palace protection and relic exhibition. There are at present nearly a million cultural relics in the Palace, only 1% of which are really on show, leaving the rest 99% in the underground warehouse and invisible to visitors. It is said that the plan of the underground exhibition hall has been changed from 20 thousand square meters to 30 thousand, possibly from two layers underground to partially 3 layers. If the character of underground space is drawn on to convert the underground relic warehouse to an underground exhibition hall or museum, not only the protection of cultural relics will benefit, but also the over 70 years’ Imperial Palace Museum will step into the group of the top-ranking modern museums in the world.

Model 6: the development of underground space should be prudent to some proved and unproved historical relics. The prime danger for the undiscovered relics is ignorance of its existence. Being overground or underground historic sites, before they are revealed or excavated, people’s misconduct might destroy them overnight since their value remains unknown. It is lucky if they are discovered and excavated. The view of making no use of historic sites will lead to give them up and eventually losing them. Cultural relics are not regenerative cultural resources, once destroyed, their historical value will be lost, followed by it rarity. So, in the development and exploitation of underground space, the first operation should be to prove up the position of the historical relics to protect, rescue and reasonably utilize them. Second, such operation should be avoided as indiscreet development of underground space, and overlooking relic protection to pursue economic gains. Last but not least, the consciousness of relic protection should be enhanced and the features of underground space should be made use of to deal with the relationship between relic protection and economic construction. [6]
3. CONCLUSION

In China, the restrictions of the economic and technological standards as well as people’s different views on the protection of cultural heritage lead to the slow utilization and development of underground space for relic preservation. The common understanding is to avoid such development, causes of destruction for both surface and underground relics, bring about high cost and construction intensity. Therefore, if not properly handled, trouble might occur. However, protection and development are interrelated, and development is a positive protection. We should learn from foreign experience, take our own into account, and at the same time fully understand the characteristics of the development and utilization of underground space, so that the underground space can have greater flexibility, adaptability and freedom.

REFERENCES

The historical relic protection law of the P.R.C.