

## **Urban Heritage Conservation by GIS under Urban Renewal:**

### **A Case study of Hankou Historical District in Wuhan, China**

#### **1. Introduction**

Rapid urbanization has made the inner city change quickly with the urban sprawl of the whole city. In China, a mass of urban renewal projects have been carried out for meeting the new need of people's life. However, the traditional means of total renewal has destroyed the urban heritage seriously, which especially led to the diminishing of historical district space. It is urgent to protect and reutilize the urban heritage effectively under the background of rapid urban renewal.

With regard to urban heritage conservation, several values should be concerned on and be realized: First is for the common good. As the testimony of historical civilization, urban heritage reflects the uniqueness and context of a zone, a city or a region. Urban heritage conservation means the protection of public wealth and common good, which is helpful to improve people's life quality, to enhance people's sense of belonging, and to evoke people's emotion.

Second is for the economic development. According to the experience of some developed countries, such as England and America, it is not workable only to depend on government funds to conserve so many urban heritages. The social forces and market function play important roles as well (Zhang, 2007) (Ren, 2007). Although the government funds still is the main source for urban heritage conservation in China and not as ample as in the developed countries, some achievements have been made yet. The conservation and development of Shanghai Xintiandi, Ping Yao and Zhou Zhuang brought huge economic and social benefits. As for a planner, a main object is striving to realize the double win of urban heritage conservation and economic development.

Third is for the sustainable development. In modern times, sustainable development is a significant goal in urban planning, and it is considered that urban heritage conservation is an important content in sustainable development. Facts show that taking diversified methods for conservation, renewing selectively with the banishing of total renewal, and endowing urban heritage with new use are effective means for realizing sustainable development.

From the proclamation of Venice Charter in 1964 and Washington Charter in 1987, the meaning of "urban heritage conservation" has developed a lot: Protected objects changed from respective cultural relics to historical districts and historical cities; and involved fields tended from pure physical field to economic, social and environment multi-field. All these determine the coordination of several municipal bodies and the sharing of much information.

Traditional research methods cannot meet the need of collecting, manipulating and analyzing mass data, which is just the superiority of GIS technique.

In China, two disadvantages exist in urban heritage conservation: One is the less application of GIS in this field, compared with the developed countries. The other is the lack of constructive methods for urban heritage conservation, except for the determination of protection range in which the destruction and construction are limited.

A GIS-based conceptual model will be designed for urban heritage conservation in this paper, which integrates three parts: one is for Urban Heritage Inventory; another is for Urban Visual Management, and the other is for Evaluation of Historical District Renewal. Following the designation of conceptual model, a case of Hankou Historical District in Wuhan, China is applied to show the application result of the GIS conceptual model.

## **2. Theoretical Background about Urban Heritage Conservation**

### ***Meaning of Heritage Conservation and its development***

In a long period, historical buildings were usually destroyed as symbol of the past. For example, in Ancient China and Ancient Rome, buildings and cities of pervious dynasty were damaged ruinously, which means to discard the old ways of life in favor of the new. Heritage conservation and restoration began to be paid attention to from 18<sup>th</sup> century end, and is becoming more scientific and modern (Huang, 2008).

In Europe, original heritage conservation was confined to conservation and restoration of monuments (Wang, 2000). After the appearance of Venice Charter in 1964 and Washington Charter in 1987, the meaning of heritage conservation has developed a lot: Protected objects changed from respective monuments to historical districts, historical cities, and culture routes involved in several cities or countries; from architecture wonder to folk heritage; from ancient heritage to modern heritage and so on (Wang, 2007).

In China, heritage conservation started relatively later, which can be traced back to 1920s when the foundation of Chinese Construction Society was used to study Chinese ancient architecture by scientific method systematically. Subsequently, "IMPLEMENTATION RULES" for "MONUMENTS CONVERSATION LAW" was proclaimed in 1931. In 1961, State Council promulgated "MANAGEMENT REGULATIONS OF CULTURAL RELIC PROTECTION" and annunciated the first batch of Key Cultural Relic Units under State Protection, which means the establishment of the cultural relic unit protection system. Then, State Council annunciated the first batch of Historical Cities in 1982, which means the establishment of the historical city protection system as well. In 1986, State Council regulated that the blocks, building complexes, towns, and villages, where cultural relics are abound or where traditional style and local characteristics are preserved, can be defined as Conservancy District Of History And Culture, according to their historical, scientific and artistic values (Wang, 2004).

As a historical city, Wuhan was engaged in the development and protection planning of historical city from 1984 and completed the first planning formulation in 1990. Then, the second and the third planning formulations are completed in 1996 and 2006 respectively. The protection plan in 1990 made the level division for spatial protection, which was not limited in cultural relics protection but extended to the protection of blocks and urban areas with intact historical features. The protection plan in 1996 mainly improved the previous protection system. A special point of plan in 2006 is the protection of “historical urban landscape” that means an area gathered and clustered with historic buildings where the buildings style and form, spatial structure and street landscape could integrally represent the typical local cultural characteristics of one certain history period in Wuhan city. The other special point is the proposition of environment element protection (Hu, 2008).

### ***Means and Methods about Urban Heritage Conservation and Renewal***

The concept of discarding the old ways of life in favor of the new and the traditional means of total renewal led to the diminishing of historical district space. With the enhancement of people’s consciousness of urban heritage conservation, the means of conservation and renewal have been studied.

For example, Buissink (1985) had defined six activities about urban heritage conservation and renewal that are maintenance, improvement, restoration, rehabilitation (upgrading), reconstruction, and redevelopment (Table 1). Some of the means have been used in Chinese historical districts, such as the Jing An District, the Lu Wan District, and the Nan Shi District in Shanghai where the older houses were protected and renewed with a combination of reconstruction, renovation, upgrading and a small part of redevelopment during the period from 1992 to 1993 (McCallum, 1993).

Application of GIS is considered as another effective means for urban heritage conservation now. Because of the advantage of GIS on data management, data analysis and visualization, it is helpful in the filed of urban heritage conservation, with the aims of investigation on cultural relics or historical environment, foundation of database, evaluation of historical or cultural values, monitor management for influence factors, and planning formulation for urban heritage conservation. The famous foreign cases are the protection projects of Angkor Wat in Cambodia, Wanrong in Laos, Vietnam Hue, and some protection projects in Europe, Australia and North America. The use of GIS in Chinese urban heritage is relatively later, which started from 1980s for information construction of cultural relics and museums. In recent years, GIS has been used in historical district protection research and the development of archaeological information system (Mao, 2006).

Moreover, the method of Multi-criteria Analysis has been applied in urban heritage conservation at present, which includes economic, social, environmental factors and so on. From the viewpoint of economic factor, replacement of land or areas from residential to commercial use was proved to be a feasible way for the reuse of historical districts, by selling and renting some residential land or areas (McCallum, 1993). Some social and cultural factors

such as people's attitude are considered to be related to the difficult degree of urban heritage conservation and renewal.

**Table 1 Urban Heritage Conservation and Renewal Matrix**

<b>Project Designation</b>	<b>Range of activities</b>	<b>Purpose</b>	<b>Physical environment</b>	<b>Included in the concept</b>
Maintenance	Painting, Repairs; Replacement of decay parts	Up-keep, Safeguarding the function value	Not affected	No
Improvement	Adding new elements: balcony, attic, central heating, shower; Bring existing elements up-to-date	Modernization, Adjusting the building in accordance with a new set of values	Not affected	No
Restoration	Abolishing the shortcomings; Replacing old and adding new elements	Modernization, Adjusting the buildings to meet modern standards	Not affected	Yes
Rehabilitation (upgrading)	Largely as under "restoration"	As under "restoration"	Not affected	Yes
Reconstruction	Improving and Adjusting the internal structure while retaining the external appearance	Making the building suitable for new uses	Minor adjustments following from the changes in use	Yes
Total renewal (Redevelopment)	Partial or total demolition of the buildings in an (limited) area followed by new construction	Making run-down and decayed areas again suitable for use	Reconstructed according to plan	Yes

**Source: (Buissink, 1985)**

***Needed data for Urban Heritage Conservation and Renewal***

In this paper, A GIS-based conceptual model will be designed for urban heritage conservation, which integrates three parts: one is for Urban Heritage Inventory; another is for Urban Visual Management, and the other is for Evaluation of Historical District Renewal. In case study of Hankou in Wuhan city, Lifen<sup>1</sup> represents a special inhabited form built from 19<sup>th</sup> century end to 1949 before Liberation, syncretizing the western style into Chinese traditional residential buildings. Therefore, the conservation model mainly includes historical building and Lifen two levels.

<sup>1</sup> Lifen was called in the early Tang Dynasty but not only appeared in the modern history. In the ancient time residents inhabited a region as a group of families, it was called as a "Li". Different from Shanghai being called as "Li Nong", in Wuhan it is called as "Lifen". "Fen" is from local dialect of Wuhan, meaning as a little region of habitat. However, in this paper "Lifen" refers to the "new" style of dwelling houses appeared in the modern history, syncretizing the western style into Chinese traditional residential buildings.

### ***Needed Data for Urban Heritage Inventory***

According to the administrative division, Wuhan city is made of 13 zones including Jiang'an Zone, Jianghan Zone, Qiaokou Zone and so on, with a zone made of several districts and a district made of several neighborhoods. Thus, district name and neighborhood name will be used to describe where the heritage is located.

About the data for historical building protection, Zhou Jian and Zhang Kai (2001) listed some items that contain building type (including architecture style and level for protection), protective status, architecture constituent factors (including garden, courtyard, enclosing wall, orientation and entrance), and environment constituent factors (including tree, water well, public aisle and characteristic paving).

Referring from the Project of Beijing's Old and Dilapidated Housing Renewal (Lu, 1993) (Lu, 1994), building function, building layer, building floor area, number of households and population in building and district, facilities, number of buildings in district, and lane arrangement are selected in historical building protection and Lifan protection in this study.

### ***Needed Data for Urban Visual Management***

Referring from the theory of urban imago of Kevin Lynch, three visual factors are defined for Urban Visual Management that are visual area, visual line and visual point, which can be in turn used to generate height control zone for urban heritage conservation and renewal.

At visual area level, Lifan and some characteristic public space, such as green area, square, and small plot for activity are included. At visual line level, street and corridor sight line are included. At visual point level, mark building (including its garden or courtyard), mark structure and important tree are all involved.

### ***Needed Data for Evaluation of Historical District Renewal***

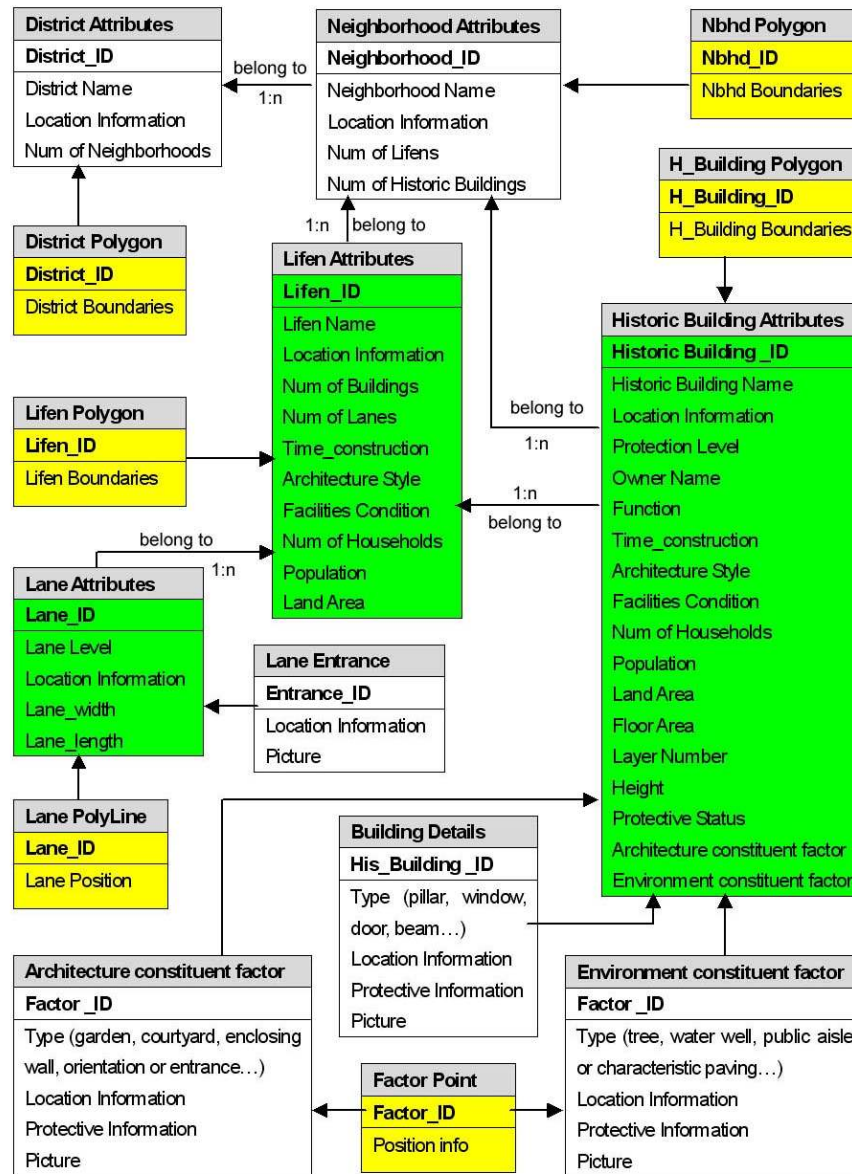
As Buissink (1985) had defined six activities about urban heritage conservation and renewal that are maintenance, improvement, restoration, rehabilitation (upgrading), reconstruction, and redevelopment, the main object of GIS-based conceptual model for evaluation of historical district renewal is to analyze which buildings can be maintained or improved, which need be restored or reconstructed, and which buildings should be redeveloped.

The cultural relics protection unit listed in Wuhan Protection Plan should be maintained and improved surely. In view of some other old buildings, those with high artistic value but without nice protection status, without sufficient facilities or in crowding condition need be restored or reconstructed, while those without high artistic value, and in bad physical status, with insufficient facilities or in crowding condition should be redeveloped. In view of new buildings in historical district, those exceeding limited height that means inconsistent with traditional

style on certain degree should be redeveloped. According to above description, data about building artistic value, protective status, facilities and people's living condition are needed.

### 3. GIS-based Conceptual Model for Urban Heritage Conservation and Renewal

#### *Model for Urban Heritage Inventory*

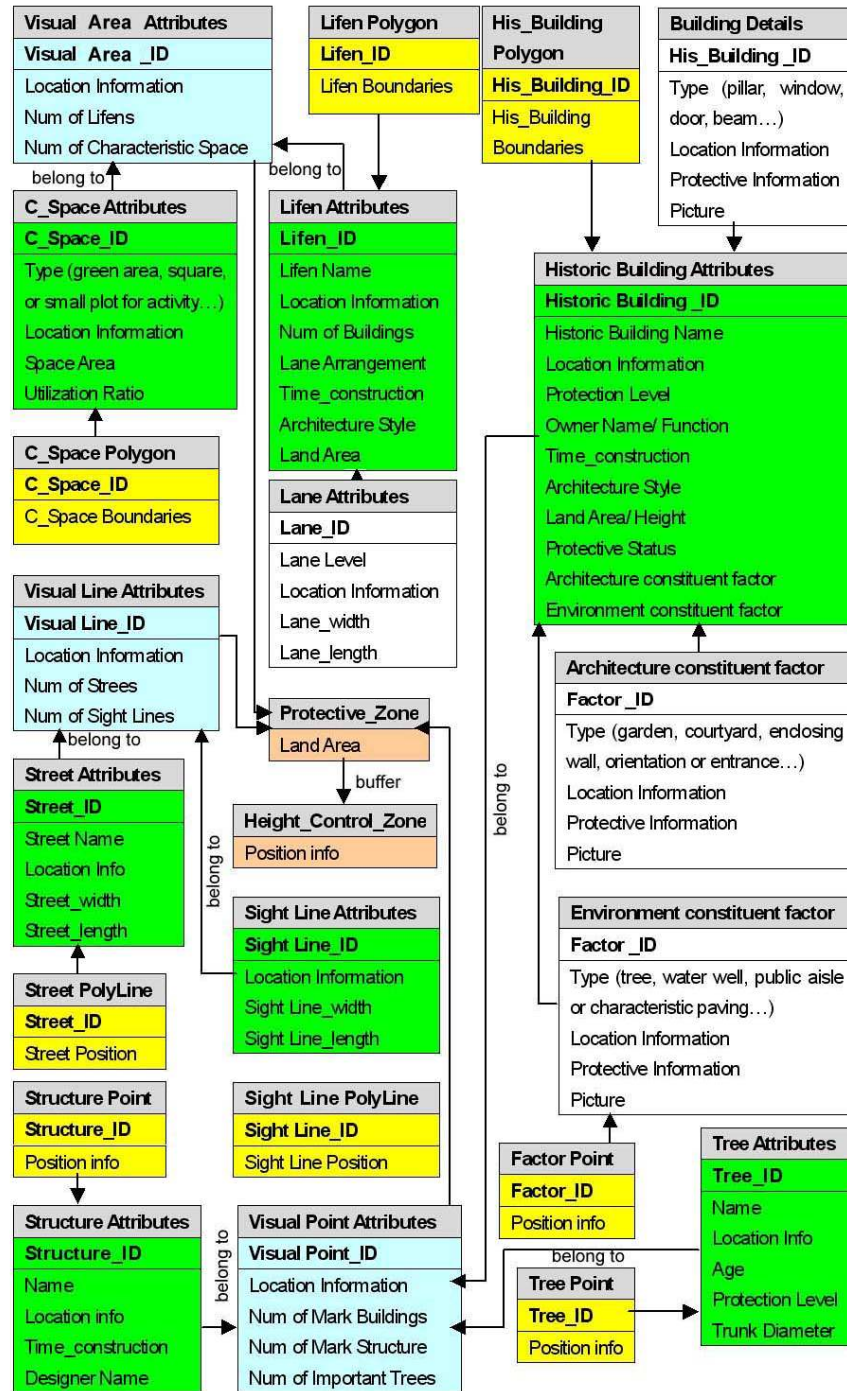


**Figure 1 GIS-based Conceptual Model for Urban Heritage Inventory**

The model for urban heritage inventory reflects the general information about urban heritage that involves district, neighborhood, Lifen, historic building, lane, constituent factor and details of building from big to small. In Figure 1, yellow means entity part of model, while white and green represent attribute part of model, in which green part is the core of model including

Lifen, historic building and lane. Generally, entity part can be used to reflect the spatial distribution directly and attribute part is useful for management, analysis and decision-making.

**Model for Urban Visual Management**



**Figure 2 GIS-based Conceptual Model for Urban Visual Management**

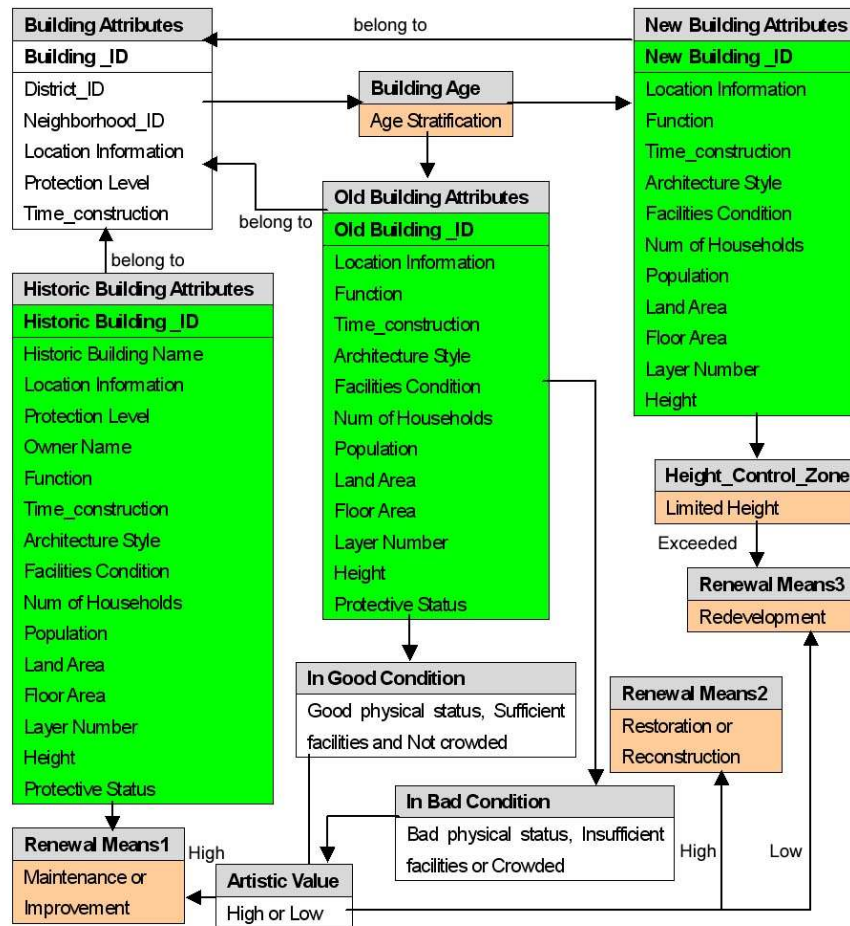
The model for urban visual management focuses on visual elements, concluded as visual



area, visual line and visual point, which includes Lifan, characteristic public space, street, corridor sight line, mark building, mark structure and important tree. In Figure 2, yellow means entity part of model, while blue, green and white represent attribute part of model, in which blue and green part is the core of model at different level, and red part means protective zone and height control zone generated at final for urban heritage conservation and renewal.

The height control zone can be generated by the “buffer” function in GIS, according to different planning intention. For example, in Project of Beijing’s Old and Dilapidated Housing Renewal (Lu, 1994), there are four kinds of height control zones that are 6-meter control zone, 9-to-12-meter control zone, 18-meter control zone, and 35-to-45-meter control zone respectively dispersing from inner to outer city approximately. Unfortunately, no such height control zones have been defined yet in Wuhan, except for the purple line around protective building and district. The application of height control and its result will be shown in next chapter.

### 3.3. Model for Evaluation of Historical District Renewal



**Figure 3 GIS-based Conceptual Model for Evaluation of Historical District Renewal**  
As mentioned above, the main object of this model is to analyze the suitable renewal means



to different buildings in historical district. Figure 3 is more like a flow chart of analyzing process, in which historic building and old building in good condition and with high artistic value can be renewed by means 1, old building in bad condition but with high artistic value can be renewed by means 2, while old building in bad condition and with low artistic and the new building exceeding limited height should be renewed by means 3. Because the historical district renewal is a giant project and needs massive funds and time, some buildings are considered not to be so urgent to renew, which are old buildings in good condition but with low artistic value and new buildings under limited height. These buildings are defined to be maintained temporarily and renewed in future in this study. The application result of model as an evaluation map will be shown in next chapter.

#### **4. Application of GIS-based Conceptual Model**

##### ***Brief History of Case Study Area***

As one of the three towns in Wuhan with Wuchang and Hanyang, Hankou is located at north of the junction of Yangtze River and Hanjiang River. After the Second Opium War (1856-1860), Hankou became the Concession District of British, German, France, Russia, and Japan as an open trading port. With the import of West Architecture Form, a “new” style of dwelling houses called as “Lifen” appeared in the Hankou Concession District at the end of 19<sup>th</sup> century, syncretizing the western style into Chinese traditional residential buildings.

At beginning, Lifen was built imitating the Lane of Shanghai, but for more interest, this part Lifen was done in worse living condition without independent kitchen and toilet in each unit, such as Sande Li, ChangQin Li and so on. From 1911 to 1937, a large number of Lifens boomed out with complete functions and in better environment, such as Kunhou Li, Xian’an Fang and so on. After then, the construction of Lifen came into recession period and stopped completely after Liberation in 1949 (Li, 2000).

It is noteworthy that many of the Lifen’s buildings have been destroyed in the past and began to be paid attention to in recent years. With the processing of protection and renewal projects simultaneously, the visage in the Concession District is a mixture of old and new buildings now.

##### ***Case study***

According to the model for urban visual management, visual area includes Lifen and characteristic public space; visual line includes characteristic street and corridor sight line; and visual point includes mark building, mark structure and important tree. Figure 5 shows the distribution of the protective visual elements. In order to protect the traditional style of historical district, height control zones are defined in this study, according to the distance from protective elements.

First is the definition of strict protective zone, in which buildings cannot be constructed and demolished randomly. In this study, the strict protective boundary of Lifan and characteristic public space is the original boundary of them; the strict protective boundary of historical building is 20-meter outer extended boundary; the strict protective boundary of characteristic street is the boundary of street and its nearest bilateral buildings; and the strict protective area of corridor sight line is a 60° sector in front of the mark building that is the circle center of the sector. Considering that the average side length of blocks in historical district is about 150 to 200 meters, the radius of sight line sector is defined as 500 meters in this paper, in order that the corridor sight line can cross two or three blocks.

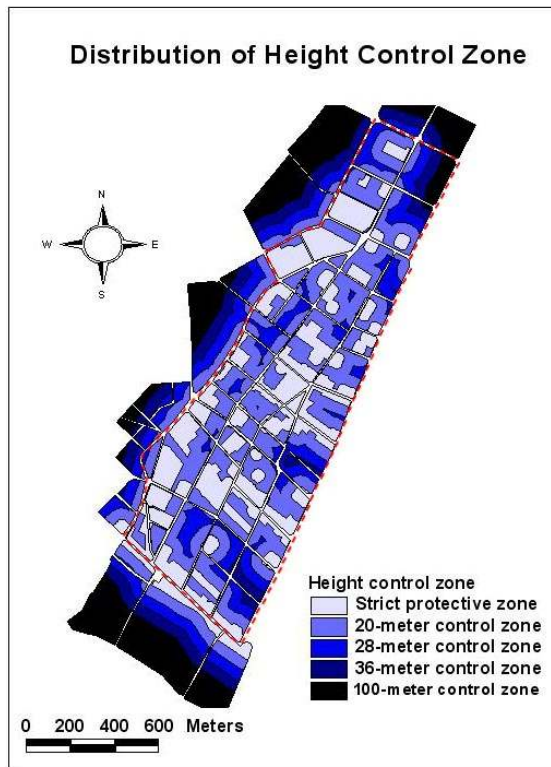


Figure 4 Distribution of Height Control Zone

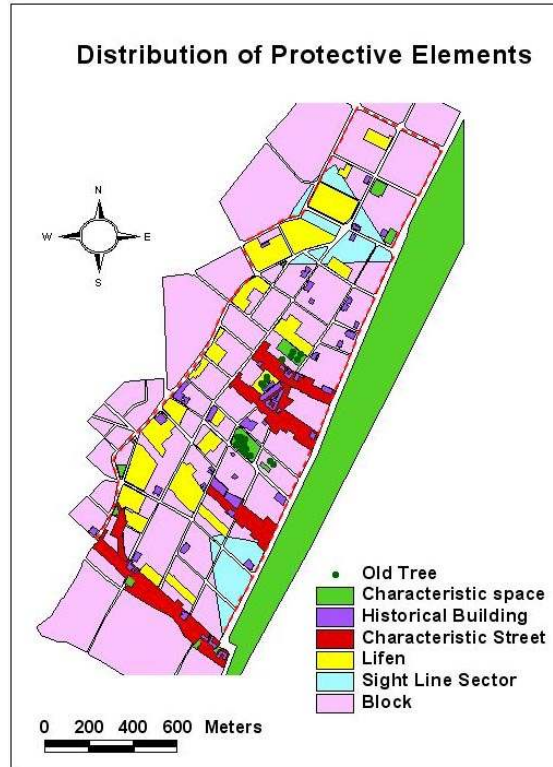
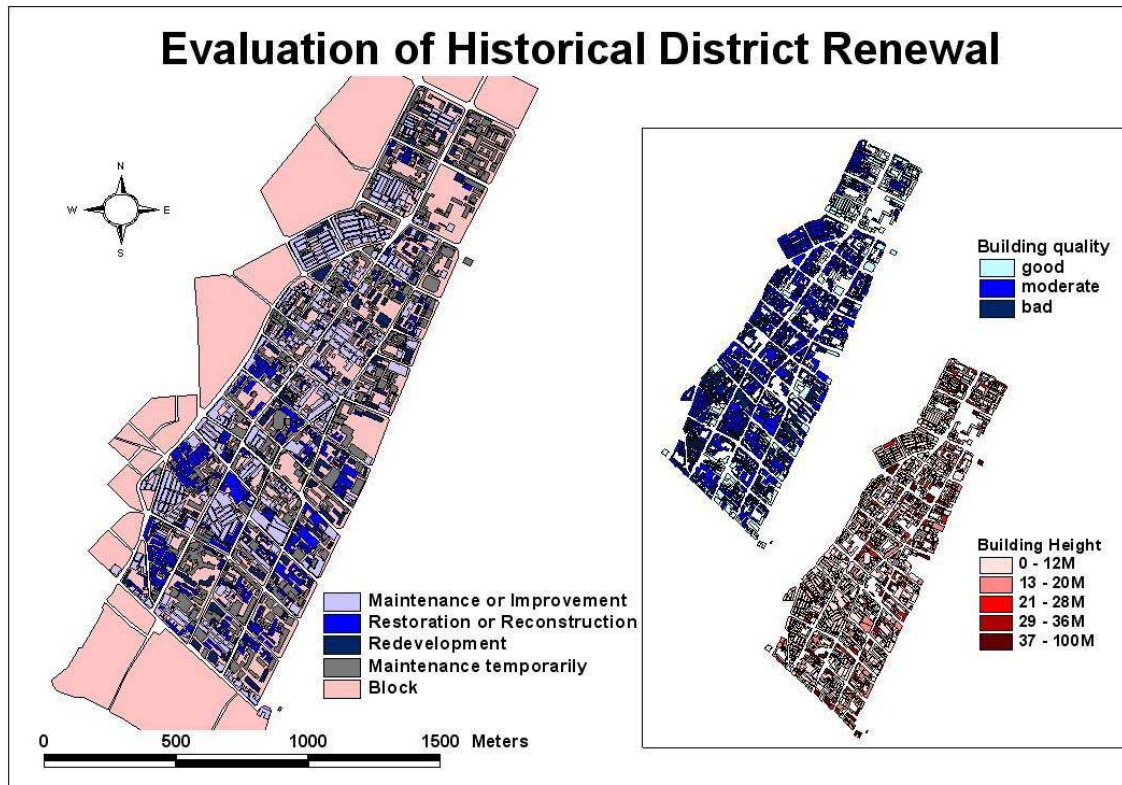


Figure 5 Distribution of Protective Elements

Second is the definition of height control zone. Figure 4 shows the distribution of height control zone in historical district. On the basis that the average side length of blocks in historical district is about 150 meters, three height control zones are defined with the buffer distance of 50 meters for each. Through the statistics of historical buildings in the strict protective zone, 79.7% is under 12-meter height and the highest one is about 20 meters. For coordination, the limited height in the 50-meter buffer zone is considered as 20 meters. Since the gap between highest building and general building in the strict protective zone is about 8 meters, it can be used as module for height control zones. To infer from this, the limited height in 100-meter buffer zone and 150-meter buffer zone are 28 meters and 36 meters respectively.

Generally speaking, the buildings beyond 150-meter buffer zone have relatively less influence

on traditional style of historical district. In order that the height of these buildings do not affect the visage in strict protective zone, the limited height beyond 150-meter buffer zone but still in historical district is extended to 100 meters. Moreover, the limited height of sight line sector is the height of mark building, so as not to block the view of mark building.



**Figure 6 Evaluation of Historical District Renewal**

According to the model for evaluation of historical district renewal, by using the variables of building's protection level, age, protective condition, artistic value and height, the evaluation of historical district renewal has been made. Figure 6 shows the result of evaluation. After statistics, 482 buildings are involved in protective means of maintenance or improvement, 391 buildings are involved in protective means of restoration or reconstruction, 338 buildings are involved in means of redevelopment, and the rest 475 buildings can be maintained temporarily and renewed in future.

## 5. Conclusion

This paper focuses on designation of a GIS-based conceptual model for urban heritage conservation. The theoretical background is framed by literature review, including meaning of urban heritage conservation, means and method about urban heritage conservation and renewal, and needed data for conceptual model. A case study of Hankou historical district in Wuhan, China is used to show the application results of visual management, height control and renewal evaluation. Using the GIS-based conceptual model in Chapter 3, many other researches can be made, such as research on lane arrangement, protection of mark structure and building details etc. At the same time, some items about conceptual model should be

discussed furtherly, such as the division of old and new buildings, the division of high and low artistic value, and the definition of characteristic street. As limited by the length of this paper, above items are omitted from discussion.

Author: Li Rui, School of Urban Design, Wuhan University, China

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