Conservation and Renewal of Historic Buildings Based on the Principle of Extension Analysis

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Abstract — **Conservation and renewal of historic buildings is of great significance to inherit and carry forward the excellent cultural traditions. Extenics [6] provides a new method and formalized description tools for historic building protection. In this paper, we elaborate the principles of conservation of historic buildings, and then based on extension analysis principle to carry out protection analysis on conservation and renewal of historic building.**

Keywords - Historic Building Conservation; Extenics; Extension Analysis Principle

I. INTRODUCTION

Historic building is a special type of cultural relics and buildings. It is the mark of the development of human history, and is also a kind of physical witness to recognize the value of human beings and the evolution history [1-2]. The obstacles in conservation and renewal of historic buildings are not only the harsh environment and natural disasters, but also the damage caused by backward ideas, knowledge, technology and methods of human beings. Extenics was established by Professor Cai Wen, see reference [6],

Nowadays, the practice of historical building protection is developing rapidly, but theoretical research results are few and research conditions are relatively poor, lack of systematic theory and protection method based on this theory [3]. The immature Theoretical research would undoubtedly produce influence on the correct direction of historical building protection practice.

Therefore, under the current situation, here based on extension analysis principle, we carry out protection analysis on conservation and renewal of historic building.

II. PRINCIPLES OF CONSERVATION OF HISTORIC BUILDINGS

A. Authenticity Principle

No matter traditional residence houses or Historic ancient villages and towns, their value lies in the long history. The reason that we implement conservation and renewal of these buildings is to make these historical artifacts that reflect the true history to be able to deliver effective information for the future. Therefore, at the time of repair and restoration of these historic buildings, we should understand its history and truth deeply, so that our actions would not cause unintentional injuries. Firstly, we should pay attention to the changes that they experienced in history. Secondly, with respect to history as the criterion, the original architectural form and architectural structure is supposed to be reserved [4]. Thirdly, try not to abandon the original building materials, because they deserve to be repaired and reused, so as to achieve the retention of rich historical information and respect for the arts.

B. Integrity Principle

In the past, because of the limitation in terms of technology and other aspects, historic building conservation and renewal was confined only to those buildings that are listed as key cultural heritages. Fortunately, with the changes of the times, people's awareness of the conservation of historic buildings is gradually increasing, and Talents in various disciplines have joined the ranks of the protection and renewal design of historical buildings. Therefore, people gradually found that the historic building is no longer an isolated existence. What's most important, the historical buildings were in a certain historical stage, and it is integrated with the surrounding environment to form a unified integrity. Thus, the historic district is gradually formed [5]. Only by integrating the single historical building into the whole historic district and consisting on the integrity principle, could better extend the local culture and characteristics customs, to allow the whole historical space retains its own unique style and charm. Pingjiang historic district in Suzhou is a good example (shown as Figure 1). Pingjiang historic district is the epitome of the ancient city of Suzhou, with a history of over 2500 years. In the past, the residence houses in Pingjiang historic district were very old, with aging pipeline and dirty environment. Although there are many cultural relics, they suffered varying degrees of damage due to the lack of effective protection measures.

Figure 1. Pingjiang historic district.

However, through reasonable planning, Pingjiang historic district has a new look now. The government began to pay attention to the protection of historical environment, rather than just historical relics. For the old historic buildings, there are kept and repaired if possible; as for the buildings with large damage, government would demolish them and then build new ones in the traditional style.

C. Diversity Principle

In the past, people tended to put the cultural relics in display hall, so as to obtain social benefits. With the strengthening of the consciousness of protection of historic buildings, the functional requirements of historical buildings are no longer limited to the development process, but pay more attention to the lively settlement space like historic district, since such space ever constituted a complete social system.

Therefore, this requires us to consider the diversity of building function in conservation and renewal of historic buildings. Certainly, the use of historic buildings diversity function must be based on the premise of respecting the traditional architecture and traditional culture, rather than transform the original historical style and building structure in accordance with our own wishes. Hence, we must proceed from reality, according to the actual situation and the development trend of the local buildings, to make a reasonable plan for the protection and renewal of historic buildings which are suitable for the urban style of the surrounding, so as to allow the historic buildings to obtain continuity and development in the modern life.

II. BUILDING CONSERVATION DESIGN BASED ON EXTENSION ANALYSIS THEORY

For the design of the historic buildings conservation and renewal, extension analysis theory can be applied to analyze and expand the contradictions therein, respectively based on divergence analysis principle, correlation analysis principle, implication analysis principle and extensibility analysis principle.

A. Divergence Analysis Principle and Historic Buildings Conservation

In Extenics, divergence analysis principle is to conduct divergence analysis on matter element and event element, according to their divergence properties. Among them, the divergence analysis principle for matter element can be interpreted as: starting from one matter element, it can extend a plurality of matter element with the same material feature, in other words, there may be more than one value of the same matter corresponding to the same feature, as shown as Formula (1):

$$R = (N, c, v) \dashv \{(N, c, v_1), (N, c, v_2), \dots, (N, c, v_n)\} \quad (1)$$

According to this principle, in historic buildings conservation and renewal, if to use a certain matter element cannot solve the problem, then we can consider adopting the matter element that formed by other value of the same feature to solve it. The divergence analysis principle for matter element is most suitable to be used in determination of the experience theme of historical buildings. For example, for the experience theme of the Buddha Temple in Shaanxi Province can be expressed with divergence property of matter element as:

$$R = (BT, ET, v) \dashv \begin{cases} R_1 = (BT, ET, \text{representative of the Tang Dynasty architecture}) \\ R_1 = (BT, ET, \text{essence of Buddhist art}) \\ R_1 = (BT, ET, \text{beauty of the building}) \\ \dots \dots \end{cases}$$

(2)

In the formula, BT refers to Buddha Temple; ET refers to experience theme.

B. Correlation Analysis Principle and Historic Buildings Conservation

In Extenics, correlation analysis principle is to conduct analysis on the relationship between matter element and matter element, event element and event element, according to the correlation between matter and event. With formal methods, this principle can indicate the mutual relation and function mechanism between things. Wherein, the correlation analysis principle for matter element can be expressed as: for a given matter element $R(t) = (N(t), c, c(N(t)))$, there is more than one matter element with the same feature $R_c(t) = (N'(t), c, c(N'(t)))$, or the matter $\sim$ element of the same matter $R_N(t) = (N'(t), c', c'(N'(t)))$, or the matter element of the different matter $R'(t) = (N'(t), c', c'(N'(t)))$, to meet the condition $R(t) \sim R_c(t)$, or $R(t) \sim R_N(t)$, or $R(t) \sim R'(t)$.

The correlation analysis principle for matter element is most suitable to be used in the environment protection for historic building conservation. In conservation and renewal of historic building, adequately taking into account the correlation between surrounding environment and ontology,

to design building surrounding environment, may make the environment better match with the ontology.

For example, for the surrounding environment of the Puppet Palace in Changchun, correlation analysis principle could play a role. $N(t)=Puppet\ Palace\ noumenon\ configuration\ A(t)$; $N'(t)=Puppet\ Palace\ surrounding\ environment\ B(t)$; t is experience parameter; c is protection design, then $N(t)\sim(c)N'(t)$, that is, the protection design of environment scene is associated with the ontology. Pu Yi's Queen Line train railway is still kept in the surrounding environment.

C. Implication Analysis Principle and Historic Buildings Conservation

In Extenics, implication analysis principle is to take matter element and event element as formal tools to conduct analysis on matter and event, according to the implication properties of matter and event. The implication analysis principle for event element can be expressed as: assume I as the target, if I_1 and (or) I_2 is realized, I is surely realized, and then I_1 and (or) I_2 implies I, which is called And (Or) implication of the matter element; if I is realized, I_1 and (or) I_2 is surely realized, then I implies I_1 and (or) I_2, which is called And (Or) implication of the matter element. If $I_1 \rightarrow I_2$, $I_2 \rightarrow I_3$, then $I_1 \rightarrow I_3$, also be written as: $I_1 \rightarrow I_2 \rightarrow I_3$.

The implication analysis principle for event element is most suitable to be used in protection of ontology. According to this principle, the main body of historic buildings can be regarded as the upper element, while courtyard, paving, landscaping, walls are regarded as the lower elements. Under the control of the main body, to make analysis on each lower element, and carry out specific design of them, could better embody the contents of experience.

For the red army site, the implication analysis principle can be used to analyze the protection of building ontology. First of all, the overall shape protection design is set as the upper element, and it is broken down into two lower elements of building monomer and courtyard protection design; then, courtyard protection design is further broken down into pavement, green transformation and walls renovations, as shown as follow:
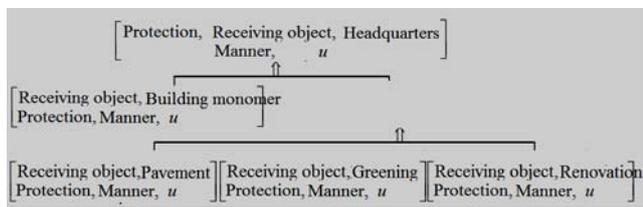

Figure 2. Elements of building.

D. Extensibility Analysis Principle and Historic Buildings Conservation

In Extenics, extensibility analysis principle is based on the extensibility properties of matter and event. Extensibility of matter includes additivity, integrability and divisibility, while extensibility of matter just includes additivity and divisibility. Extensibility analysis principle for matter element can be expressed as: for a given matter element $R_1=(N_1,\ c_1,\ c_1(N_1))$, there is more than one matter elements $R_2=(N_2,\ c_2,\ c_2(N_2))$, where N_1 and N_2 could constitute a polymer, in other words, N_1 and N_2 are additive; for a given matter element $R_1=(N_1,\ c_1,\ c_1(N_1))$, there is more than one matter element of the same dimension $R_2=(N_2,\ c_2,\ c_2(N_2))$, where N_1 and N_2 could constitute a new matter element, and form a new system, so N_1 and N_2 is integrable; if $N=N_1 \otimes N_2 \otimes ... \otimes N_n$, that is, N is available component $N//\{N_1,N_2,\ldots,N_n\}$, for any feature c, the matter magnitude value before decomposition may be greater than, less than or equal to the addition of each matter after decomposition.

The extensibility analysis principle for matter element is quite suitable to be used in design of building additional facilities and environmental implications expression. According to this principle, in historic buildings conservation and renewal, we could apply extensibility analysis principle to carry out additivity, integrability and divisibility analysis from the perspective of building noumenon and implication, to better protect the architectural form and express the implication as well.

In Chongqing Dachang houses relocation protection, the new site is around the Xibao Moutain, in the east of the main town, which is located on the north shore of the Daning River, similar to the original environmental features. Combined with the topographic features of new site, the distance between east gate and west gate of ancient town had been changed to 230m from 280m before moving; the wharf before south gate was broadened; the Palace of Imperial Lord was moved toward the direction of the street, and the Guan Yu Temple was moved into the west gate. In the process of relocation, Chongqing Dachang houses were positioned in the light of five Key buildings: east gate, south gate, west gate, Wen Family Courtyard and Ding Family cross road, to ensure that the old town could remain the original street layout and spatial perspective after relocation.

$R_0 = (Dachang$ houses, shape, Individual house$)$

$R_1 = (Dachang$ houses, shape, Gate$)$

$R_0 \otimes R_1 = (Dachang$ houses after removal, shape, Individual house $\otimes$ Gate$)$

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