Exploring Modalities and Applications of Spatial Intervention in the Renovation of Old Buildings

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Abstract

This study aims to investigate the methodologies and applicability of new spatial interventions during the renovation of old buildings, providing a foundation for design principles. The objective is to develop guidelines and strategies that enhance the efficiency and accuracy of building renovation processes. The research methodology comprises descriptive and comparative analyses of various types of old building renovation projects, using both analog and digital (2D and 3D) drawings as reference points. The study begins with simple, easily implementable elements and aims to summarize the types of spatial intervention, with a view to developing a more advanced, sustainable system for future renovations. The findings reveal that spatial intervention methods in the renovation of old buildings can be categorized into: (1) external spatial intervention; (2) juxtaposition spatial intervention; and (3) internal spatial intervention. These categories can be further divided into nine intervention modes: (1) horizontal; (2) vertical; (3) superposition; (4) separation; (5) connection; (6) integration; (7) implicit; (8) through; and (9) device.

Keywords: spatial Intervention, design strategy, old building renovation

Introduction

With the development of the times, in the process of continuous economic and cultural development, people's behavior patterns and living needs

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will inevitably continue to change. This leads to the situation of outdated and declining old buildings. In the current environment, old buildings urgently need to be renovated in order to meet the three elements of economy, practicality, and aesthetics. Although there are many excellent and successful cases, more rough and simple large-scale demolition and construction activities directly erase the rich historical memory of this city. In the large-scale renovation of old cities, the most famous historical and cultural city has become one side of a thousand cities, and the phenomenon of homogenization is becoming increasingly serious. The globalization of technology and production methods has led to the separation of human and regional traditional spaces. The personalization and diversity of regional culture are gradually declining or even disappearing. The renovation of old buildings requires more comprehensive research. Architectural space is a product of human social and cultural activities (Hillier, 2015); Through continuous changes, the essence of architectural space is revealed, and through synchronic and diachronic analysis, people realize the true essence of architecture (Giedion, 2009). Therefore, this article explores the renovation of old buildings from the perspective of spatial intervention and proposes the concept of spatial intervention in the renovation of old buildings. Starting from simple and easy to implement elements, summarize the types of spatial interventions to establish a more advanced and sustainable system in the future.

Research Objectives

1. To explore the characteristics of new and old spaces in the process of building renovation and use them as a basis.
2. To develop more effective and correct guidelines and strategies to promote the renovation of old buildings.
3. To improve design efficiency as a basis for early design. Make contributions to the development of better integrating the renovated old buildings into the urban environment.
4. To prove the adaptability of this study through the renovation design of this project. Adapt the project to the needs of the new era, activate space, and enhance building efficiency.

Literature review

On the one hand, the topic of architectural renovation has always been very hot in academic circles, especially among the 2021 Pulitzer Prize winners

Anne Lacaton and Jean-Philippe Vassal. Now that sustainable residential design has become known, the retrofit of older buildings remains an important issue that deserves more research. Anne believes that "renovation is an opportunity to use existing resources to do more and better. Demolition is a simple but short-sighted decision. It wastes energy, materials, and history. Moreover, it will have very large negative consequences.It's an act of violence. (Harrouk & Christele, 2021)"

On the other hand, "space" is also very important in architecture. Adrian Forty's Words and Building: a vocabulary of modern architecture—a summary statement in the book. He believes that the various interpretations of space concepts in the architectural community at that time can be divided into three categories: 1. The field of architectural design, originating from Semper's The concept of "enclosure" of space; 2. The field of architectural theory, represented by Stijl, emphasizes the continuity and infinite extension of internal and external spaces. 3. A special group in the field of architecture, derived from Schmasov's "extension of the body" theory, which was further developed by Ebeling, who understood space as a "membrane" between people and the world. , a field that acts continuously with physiological sensations (Forty, 2004). Zhu Lei, an architectural scholar, believes that "in general, the understanding from the perspective of art and Neo-Confucianism is more inclined to the subject's inner spiritual experience of space, and thus the term "spatiality" was proposed. To distinguish it from the general material Space: The concept of "enclosure" widely accepted by practicing architects retains more of the material basis of space." He also believes that the spatial concept that breaks the above boundaries of "enclosure" and "continuity" is an organic space that combines the inside and outside of Frank Lloyd Wright, the master of modernist architecture... (Zhu,2007)

"History of Foreign Modern Architecture" points out that modernist architects basically believe that "architectural space is the protagonist of architecture" (Luo, 2004). In Space is the machine: a configurational theory of architecture, British architectural theorist Bill Hillier believes that architectural space is the result of human social and cultural activities (Hillier, 2015); therefore, it is necessary to use spatial intervention as an entry point to study the renovation of old buildings.

Research methods

Determines the guidelines and strategies for the renovated old building

in the design dimension by drawing lines and using software architecture using qualitative research methods. The researcher used the research method of descriptive analysis, which has the following sequence of steps:

1. Research and analyze the relevant theories and projects of old building renovation, and find the rules of space renovation.

2. Comparative analysis exists in remarkably different types of old building renovation projects as a reference.

3. Analogue and digital drawing (2D and 3D).

Results

The aim of this study is to provide an overview of the types of spatial interventions in the renovation of existing old buildings in order to summarize regular patterns and understand how sustainability can be assessed. From a multi-level architectural perspective, old buildings not only have value in material fields such as science and technology. At the same time, it is also of great significance at the spiritual level that is closely related to culture, aesthetics, values, ideology, etc. It is also the carrier of three levels of architectural technology, architectural art and architectural culture. Therefore, recycling old buildings not only preserves their material value, but also circulates their spiritual significance.

On this basis, this article tends to focus on the functional and formal design aspects of architectural space, sampling based on global literature research and more representative and widely recognized projects, and using public design methods that can better reflect the political, economic, and cultural levels of society at various historical stages. Architecture is the main focus, as Alejandro Aravena, Chairman of the Pritzker Architecture Prize Jury, said: Whether for health, political or social reasons, there is a need to build a collective consciousness. Public buildings can reflect the traditional context, cultural connotation, economic status and development level of a city or country (Harrouk & Christele, 2021).

				Housing of type		Assessment criteria			Energy-efficiency measures	
NO	Project		Country	RB	PB	ENV	ECO	SCO	Building envelope	

1	Cité du Grand Parc' (2016)		Portugal	√			√	√	√	√
2	British Museum atrium (2016)		UK		√		√	√		√
3	Havenhuis (2016)		Belgium		√	√	√	√	√	√
4	Glass Pyramid (1989)		France		√	√	√	√	√	√
5	Kolumba Museum (2007)		Germany		√	√	√	√		√
6	Bombay Sapphire Distillery (2014)		UK		√	√	√		√	√
7	Coal Drops Yard (2018)		UK		√	√	√	√	√	
8	Santa Caterina Market (2005)		Spain		√	√	√	√	√	
9	The African contemporary art museum (2017)		Africa		√	√		√		√
10	Brupes Cultural Center (2005)		Netherland		√	√		√		√
11	Changzhou "cotton warehouse city living room (2018)		China		√	√		√		√
	RB: Residence building PB:Public building ENV: Environmental ECO:Economic SCO:Social									

Table 1 Summery of selected research samples

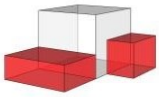
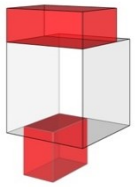
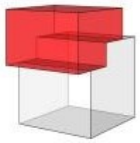
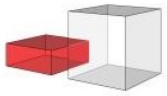
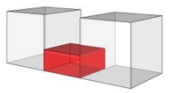
Source**:** Researcher

After selecting the research goal, according to the analysis of architectural phenomenology, the architectural phenomenology is: under the purpose of living demand, people make it appear on the spot through the deconstruction of material materials. This kind of manifestation process and manifestation itself is architectural space. Architectural space is a concrete practice space that contains interior and exterior, process and result, demand, and presentation. Its space includes four elements: purpose and demand, construction means, element materials, and form presentation. Next, when analyzing the old building reconstruction cases, we will take these four points as a reference. For example, in the case of the renovation of the British Museum building, the purpose was to build a buffer space into the museum and leisure spaces such as shops and coffee shops in order to alleviate the original flow of people and promote economic and social renewal(Foster， 2001) . Net shell steel structure construction method, using new materials such as glass and steel to contrast with the masonry materials of the old building. In the final form, in order to protect the facade of the historical building, an additional atrium is used to connect the form of the surrounding space. The author classifies this type of building renovation as a built-in atrium in a horizontal addition. Considering its impact on the original site, this type of strategy places less demand on the site and does not require more space around the building. At the same time, this type of design has a low impact on the old buildings, which is conducive to the protection of the original buildings.

Through the research, the intervention and symbiosis strategies based on the volume of architectural space are obtained, including 1 external intervention of space; 2 Spatial juxtaposition intervention; 3 Space internal intervention.

IDS/T ： Intervention design strategy / technique ISM ： Intervention specific measures
RFS ： Requirements for site RFOB ： Requirements for old buildings

	IDS/T	ISM	RFS	RFOB	Applicable building type
	Horizontal type	Interior to atrium	Lower	Low	It is applicable to historical buildings with courtyards or patios

1		Side addition	higher	moderate	It is applicable to old buildings with abundant surrounding construction sites
	vertical type 	Top layer	Lower	higher	It is generally not applicable to cultural relics buildings and historical protection buildings with high historical value, but mostly used in modern industrial, office, commercial and residential buildings.
		underground space	moderate	Low	Historic buildings and historic blocks
	Super-imposed type 	Occlusal	Lower	higher	Old buildings with good structure and declining function
2	Separate type 	Horizontal separation without mutual influence	higher	Lower	Cultural relics buildings with good status and declining functions, or historical buildings with great preservation value
	Connection type 	Embedded atrium; Connected space	moderate	Low	It is mostly used in large-scale expansion projects on one side of the base

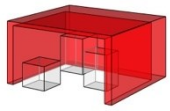
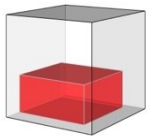
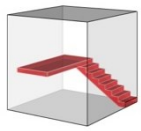
	integrated 	Second roof	Lower	Lower	General and massive reconstruction of existing buildings based on economic factors
3	Implicit 	Internal space transformation	Lower	Lower	For economic reasons, it is mostly used in the transformation of the main structure and outer envelope of historical buildings
	traversal 	The interior space extends to the outside	Low	moderate	It has great damage to the original buildings and is suitable for general old buildings that do not need protection
		Independent space inside	Lower	Lower	It is applicable to large old buildings whose internal functions often change, especially old industrial buildings.

Table 2 Adaptability analysis of spatial intervention methods

Source**:** Researcher

1 Space external intervention

The intervention strategy will build a new independent structure at the location of the old structure. The main goal is to solve the problem that the old building space cannot meet the use needs of users through the new intervention space. This strategy provides the greatest degree of freedom for the transformation, and can establish an architectural language completely different

from the old building. It should be noted that in addition to the underground addition, the direct result of the addition mode is the increase of the use area and building volume. Therefore, it will also have a certain impact on the original style of the building and the external environmental space of the building. In the historical style reserve with dense historical buildings, it must be applied carefully, and the rigid intervention in the original block structure and building group layout should be minimized in the design.

2 space juxtaposition intervention

Juxtaposition means that two or more objects are arranged in harmony with each other. The juxtaposition of old and new spaces means that on the premise of their independence and integrity, the two spaces do not interfere with each other and complement each other, so as to achieve a symbiotic relationship. In this symbiotic mode, the spaces of the new and old parts do not completely coincide with each other and remain independent of each other. It can completely retain and show the respective characteristics of the new and old parts of the space. It is a mode of showing the new and old spaces at the same time. In the creation of this model, the placement of new space does not succumb to the requirements of historical space, but it needs to consider better realizing the harmonious coexistence with historical space, and it needs to be constrained on the basis of historical environment to realize complementarity and equality in space-time relations.

The intervention of the volume of space is to juxtapose the new and old architectural spaces, so that the two spaces are independent of each other but echo each other. This intervention mode can be divided into different intervention modes according to the different intervention relationship between new space and old buildings, including separation Intervention, connection Intervention and integration Intervention.

3 space internal intervention

The internal and external walls of such old buildings that are usually reconstructed are generally protected and more or less preserved. Change and protection are not incompatible, as unreserved change is actually destruction (Schulz, N.1965). This strategy pursues the protection and restoration of old buildings, but it can still change the space of old buildings and is conducive to the use of the original structure for contemporary purposes. It can be said that

the most important architectural strategy of internal implantation is the internal space or available space of existing buildings. Internal intervention strategies are usually strongly influenced by the existing structure; In addition to paying attention to the internal space and external structure, the early planning of buildings, heritage value and urban environment may have an impact on the transformation decision-making.

The volume of the internal intervening space is to place the new building space in the old building space and intervene into the other party as a whole, so as to change the functional layout of the original building from the inside. The new space plays a role in assisting and improving the quality of the space. Space internal intervention is divided into implicit intervention, pass through intervention and device intervention.

In order to better use it in practical cases, how to select the right strategy from the 9 strategies will depend on the information of the site, the type of old buildings and the function of new buildings.

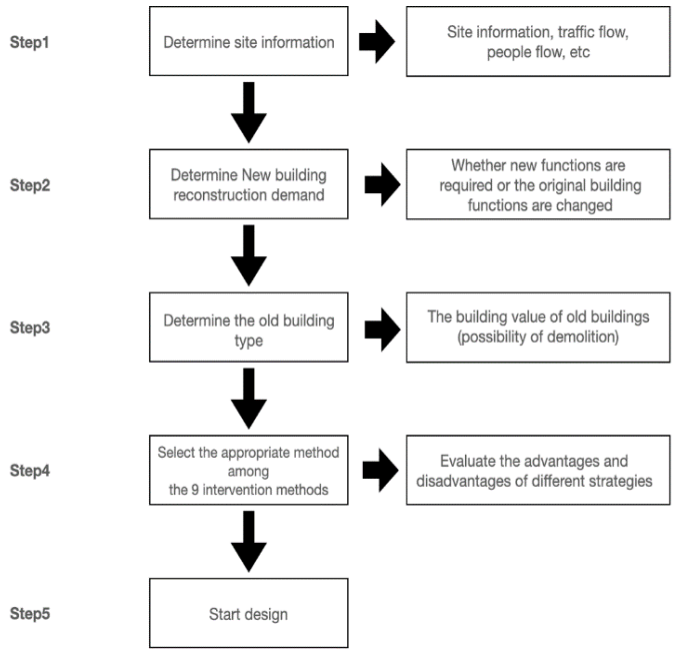


Figure 1 Flow chart of strategies selection

Source: Researcher

According to the above steps, the No. 28 building of the large workshop of Nanjing No. 2 Machine Tool Plant (No. NJ0039 of the historical building) was reconstructed. The project is located at No. 66, Lingjiao City, Laifeng Street, Qinhuai District, Nanjing City, China. It is a historical area determined by the Nanjing Industrial Heritage Protection Plan. The intervention object of this project was a factory built in the 1950s, which is an important architectural relic of Nanjing machinery manufacturing industry in the early days of the founding of the People's Republic of China. Formerly a comprehensive workshop, it is one of three single-storey large-span workshops. The old building is of brick-concrete structure, with an area of about 1749 m2. It is observed that the architectural appearance basically retains the original style and features, and the current situation is well preserved。

Figure 2 Site status
Source: NCDC

According to the environment of the above-mentioned renovation project, it can be known. On the one hand, the old building is in the historical district and cannot expand outwards, so it is less dependent on the site. On the other hand, in order not to destroy the original structure and interior of the old building, while retaining the special style of the old building as an old factory, installation-type intervention with less impact on the old building was chosen during the renovation.

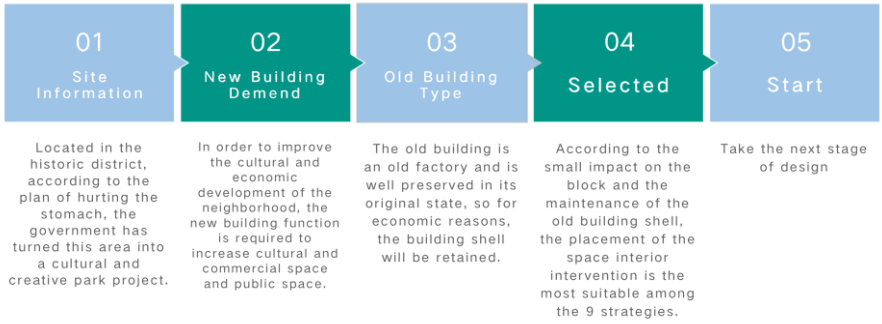


Figure 3 Design process display
Source: Researcher

Installation-type intervention mainly refers to the intervention of related stairs, ramps and other experiential devices. The requirement for superimposed intervention of experiential devices is to minimize the impact on old buildings, form reversible interventions, and protect the original state of historical buildings as much as possible. The premise. Through the placement of experiential devices, people are guided to experience the authentic historical space more realistically. Through the superimposition and placement of paths, the original static architectural historical information can be dynamically transmitted through the space, and through the addition of new spaces, enhance people's perception, thereby revitalizing the space. Through the design strategy of "inserting new installations", a complete new form of independent installation space is built inside the main factory building to accommodate two main functions.

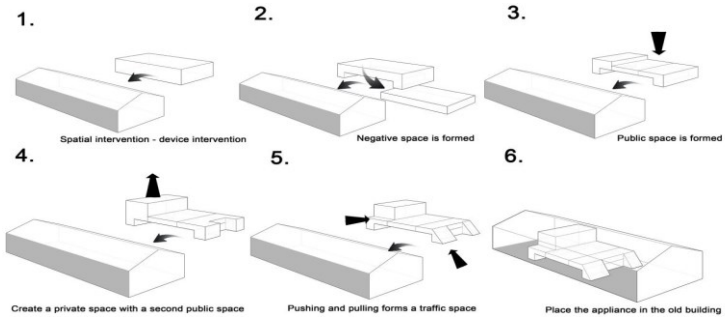


Figure 3 Internal space intervention
Source: Researcher

Due to the creation of the "interior within the interior" space of the "house within a house", everyone can experience a "gentle exterior" in the "inside" of the factory building. The public space left blank at both ends is a flexible space for users and a transitional space between indoors and outdoors .

Figure 4 section
Source: Researcher

This kind of integration of the whole device into the interior of the space. Firstly, it effectively solves the problem of differences between the large-scale interior space of the factory building and the small-scale space of shops and leisure; secondly, it controls the cost and creates an attractive new space. Finally, the original factory building was thin and energy-consuming, and this method economically and effectively achieves the environmental comfort of the new space.

Conclusion

This study has identified 9 intervention design strategies for the renovation of old buildings. And elaborate on the intervention objects, intervention elements, intervention types and methods in detail.

After the field investigation of 11 cases or the research and analysis of literature, the specific results are analyzed. The design methods for external space intervention include: (1) horizontal type (2) vertical type (3) superimposed type; For the way of spatial juxtaposition intervention, the design methods include: (1) separation type (2) connection type (3) integration type; For the way of space internal intervention, the design methods include: (1) implicit (2) traversal (3) device.

Finally, this study completes the construction of the old building design system. So that later designers can more intuitively choose appropriate strategies through the research results of the paper and improve the efficiency of building renovation. At the same time, the renovation of the building project will also give the old building a new luster, provide new functions, revitalize the surrounding neighborhoods, and meet the development interests of the public and private sectors.

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