Theory of Elastic Space
-A case study on traditional dwellings in China-

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Keywords

Chinese traditional dwellings, Spontaneous behaviour, Overflow , Profile, Elastic space.

1. INTRODUCTION

1.1 Background

As J. Jacobs[1] said, when we discuss a city, the first thing that comes to our mind is the street. If the street is lively, so is the city;if the street is depressed, so is the city. The importance of streets to a city can be seen. However, in the context of China's rapid urbanization, on the one hand, many historical and cultural cities have been tragically destroyed, historical streets have disappeared, traditional streets have been toppled and flattened, and replaced by so-called modern; on the other hand, despite the great efforts to protect the traditional dwellings, the method is too crude and extreme, or it is completely isolated and sealed like a site Visitors can only look at it from a distance, either by rebuilding or refurbishing it into a "fake antique" according to the architectural style, and turning it into a uniform commercial tourism area.

The reason for this is actually a lack of awareness of street space. In the buildings and streets of traditional dwellings, if there is no human being, the architectural style will remain intact, and it will only be a dead body. In other words, the behavior of residents in architecture and streets is equivalent to the role of software in hardware, and the two are a unified and indivisible whole. Compared with the self-proclaimed protection and regeneration of traditional architectural styles, can the study of spatiality including physical entities and residents' behaviors suggest another solution different from the traditional protection and regeneration of traditional dwellings? This is also one of the important purposes of this article as a basic theoretical research.

The behavior phenomena appearing in it are difficult to discuss with the space theory of classic architecture, so the concept of "overflow" needs to be introduced. Overflow refers to the accumulation of private goods and some public goods in outdoor spaces. The phenomenon of stacking and placing is called overflow. Then, the self-issued items in the above life scene are the tables, chairs, tea sets, flower pots, bird cages, rocking chairs, laundry tubs, clothes poles, checkerboards and so on. Spillover is actually a physical visualization of residents' self-promotion. This article is also an attempt to start from the investigation and analysis of spillovers and discuss the differences from previous spatial studies.

1.2 Previous studies

Aoki and Yuasa[2] studied the concept of "overflow", and the research object was extended to the street. They pointed out that, it is necessary to establish a relatively neutral scientific method to consolidate the architectural planning system. The research of Aoki et al. Examined the relationship between open space and closed space. Among them, the “envelope” survey method also adopted in this paper was used to quantify the very important actual factor of “overflow”. At the same time, the concept of "Self-Expression" (expressed) proposed by was expanded to "extension of commodity" (overflow), not only including the original indoor goods, but also covering outdoor goods with more common properties. This is the same as the perception of "overflow" in this article.

Profile theory was proposed by Y.Ashihara[3]. According to Ashihara's definition, what determines the original appearance of a building is called the "primary profile "; protrusions

outside the building's exterior wall, temporary additions, and other objects are called "secondary profile ". According to Ashihara, the streets of European cities are determined by the primary profile. In contrast, the streets of East Asia are mostly determined by secondary profile. However, Ashihara also pointed out that, like the streets in the West, because primary profile can reflect the sense of history, beauty, and attractive urban landscape, it is necessary to reduce the clutter and interference of secondary profile as much as possible. This view is not shared by this article.

2.METHODS

2.1 Definition

The most fundamental meaning of the concept of "overflow" is that the lack of space for placing items in the room prevents daily items such as life and business from being placed indoors, and can only be temporarily stacked outdoors. This article basically agrees with the point in Aoki's thesis, that in outdoor spaces (including atrium space and street space), the stacked private goods and some public goods are called "overflow" . The phenomenon of stacking and placing is called overflow.(Fig.1)

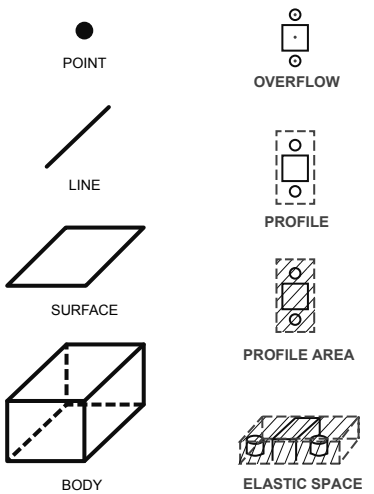

Fig.1 Definition of elastic space

This article believes that the concept of Y.Ashihara's secondary profile needs to be subdivided and expanded: the direct extension of the profile (the building protrusion, the appendage) is the secondary profile, such as an additional eave Canopies, awnings, hanging store signs and signboards, etc., are all closely related to the primary profile and can be considered as extensions and extensions of the building. On the other hand, they have a very important property is to provide a sense of residential place. Although their original purpose is to resist external forces such as sun and rain, the actual effect is that residents' daily semi-outdoor or outdoor activities occur in these places; and overflows, such as tables and chairs, benches, bird cages, Potted plants, stalls sold by stores, and sundries, etc. In order to distinguish them from the second redefined profile, the boundary of the area they surround is called the "tertiary profile".

It is defined here that in the interface space between the building and the street or between the building and the atrium, the spontaneous daily life behaviour of the residents has caused the overflow phenomenon. The boundary of the area surrounded by the building's protrusions and additions is called the secondary profile, and the boundary of the area

surrounded by the overflow is called the tertiary profile The space formed by the secondary profile and tertiary profile is called "elastic space".

2.2 Research location

F.Maki[4] started research on the characteristics of Tokyo's cities, and finally came down to the concept of Japan's unique "Oku" space. That is, the root of the many distinctive characteristics of the Tokyo city stems from the mysterious space with rich layers and blurred borders. At the same time, the mysterious space is actually related to Japanese concepts such as “Wabisabi” and “Sugima”. Contemporaneous K. Kurokawa[5] proposed the concept of "middle domain". K. Kurokawa believes that, one of the characteristics of East Asian street space is that many parts are both public and private, and can be called semi-public or semi-private. This ambiguous and vague space is called the middle domain. The profile theory of Y.Ashihara was mentioned above, which will not be repeated here. In fact, it can be used as a simple coordinate for street space research. Later, the semi-transparent space theory proposed by N. Furuya[6] originated from the study of windows in buildings. If openings such as windows are treated as filters, people inside the building can filter external elements by slightly adjusting the transparency of the filter, then the space that is established in this way is called translucent space. From the perspective of street space, it is actually discussing the boundary between the interior and exterior of the building.

This article is a continuation of the research system of the Japanese scholars mentioned above, and attempts to further clarify the interface space in the study of street space by discussing the concepts of the third profile theory and elastic space feature. The tertiary profile, in this article, specifically refers to the boundary formed by the overflow, and can describe the daily life of the residents in the space domain. In fact, the boundaries and limits of the elastic space proposed in this paper are determined, and the secondary profile and the primary profile are redefined as the coordinates of street space research. The concept of elastic space proposed in this article is more focused on describing similar thin-layer properties than the grasp of the entire street space. (Fig.2)

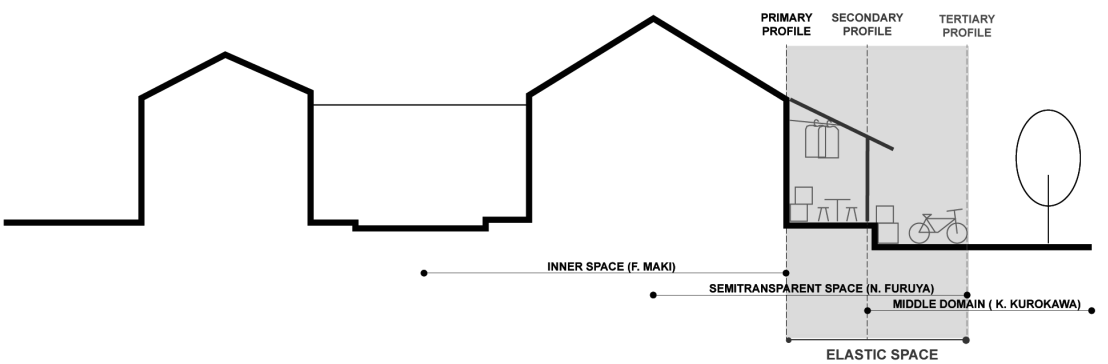

Fig.2 Research location of elastic space

2.3 Characteristics of elastic space

(1) Diversity. The elastic space is diverse and variable. Unlike buildings designed by architects or unified planning, residents spontaneously add and modify their houses and shops according to the most practical use needs, making the flexible space more variable.
(2) Dependency. The dependency of elastic space is closely related to the concept of profile mentioned above. The secondary profile line is an extension of the primary profile, and the tertiary profile is extension of the secondary profile.
(3) Transparency. Unlike Europe, China is similar to Japan. In particular, traditional dwellings are mostly made of wood, which is more flexible and lighter than stone in terms of its material properties or replacement and renovation.

(4) Openness. The openness in the elastic space is expressed not only by the physical openness and closedness, but also by the openness of human visual perception.
(5) Regularity. The regularity of elastic space is reflected in the feedback of time factor. According to human-based behavior patterns, with the residents' regular daily work and rest activities every day.
(6) Inclusiveness.
The space environment is a coordinated and restrictive relationship to human behavior. People make appropriate behavior activities according to external environmental factors.

2.4 Research model

Among the constituent elements, the primary profile, secondary, tertiary profile are used to describe the overflow. The primary profile is represented by black, the secondary profile is represented by red, and tertiary profile is represented by blue. It can be seen that the so-called profile actually appear as solid bodies, so further analysis methods are needed.
On the interface where the concept of interface space was discussed above, that is, the elastic space is reflected on the top interface, side interface, and bottom interface, the analysis method is: on a plane, the projection of each profile on the top interface is calculated And the area occupied by each profile on the bottom interface; on the elevation, the projection of each profile on the side interface is counted; on the three-dimensional, the proportion of each contour is calculated by fisheye photos.
Through the transformation from concept to specific operation method, when discussing the elastic space of an object, it is through actual survey and measurement to count the area or proportion occupied by each profile on the plane, elevation, and volume. Further discuss and analyze the relationship between them or with other factors.(Fig.3)

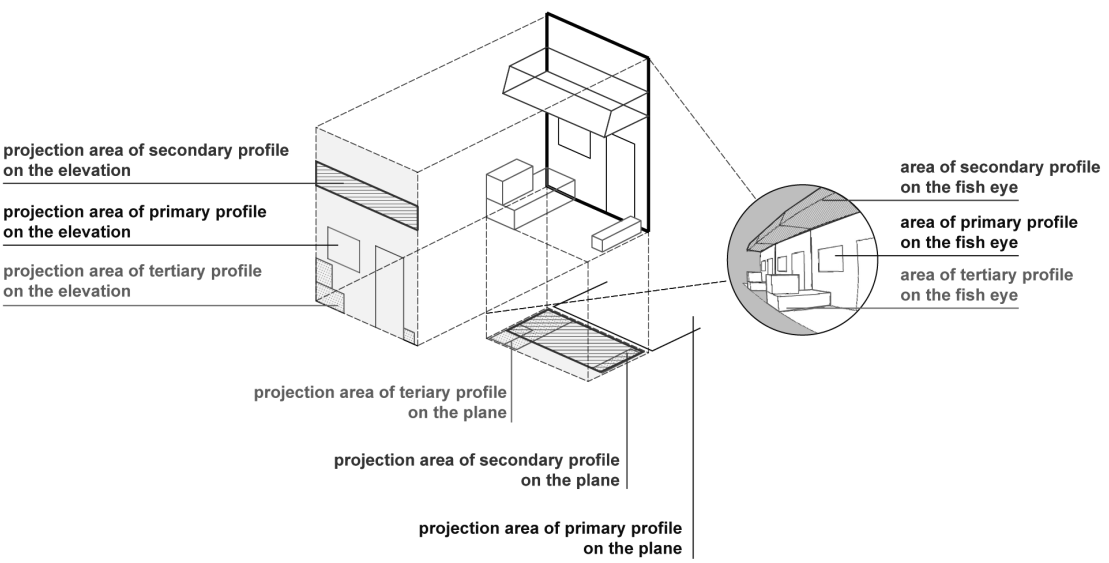

Fig.3. Research model of elastic space

3.RESULTS

3.1 Investigation objects

As mentioned above, at the level of the profile concept, the interface space is different from that in Europe, China, Japan and other regions, although each has its own characteristics, but the root causes are similar. Therefore, the Fujian-Taiwan-Ryukyu Islands-Kyushu area as the interchange of East Asia is a relatively suitable research area. Among them, the

continental nature of China's Fujian region can provide a richer and more diverse research sample. At the same time, the preservation of traditional dwellings and neighborhoods in Fujian, including folk customs, is one of the few in China. Therefore, in this study, the Fujian region, especially the two major port cities, Quanzhou and Zhangzhou(Fig.4), were used as the survey targets.

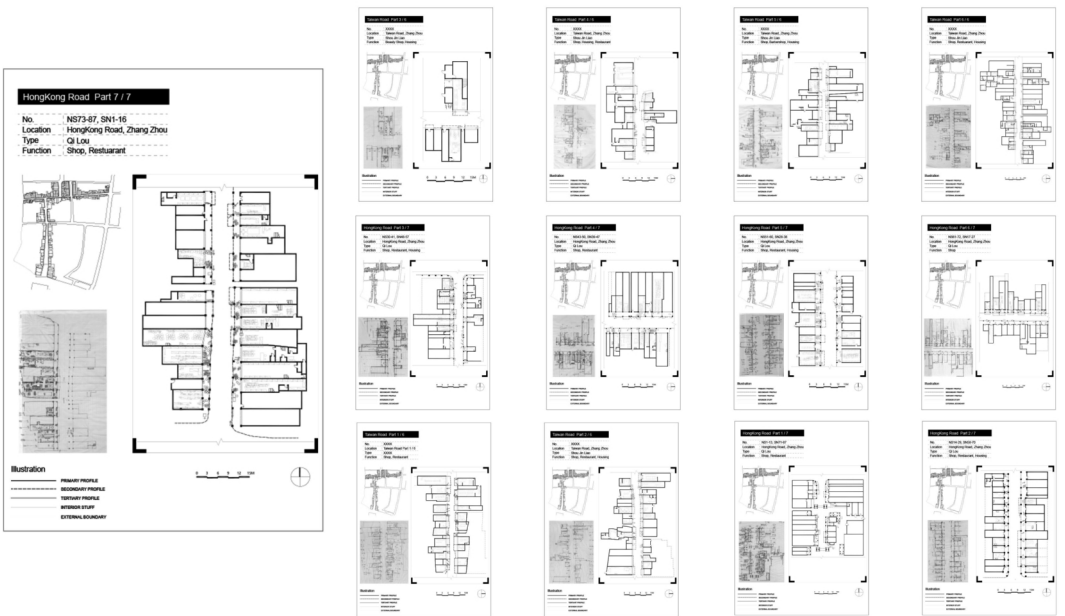

Fig.4.Example of measurement result of Zhangzhou case

3.2 The analysis of street-outward elastic space (Zhangzhou)

The most obvious manifestations are:

(1) Diversity
The combination and transformation of various profile in a variety of ways can represent the daily life behavior of residents to a certain extent, that is, the diversity that occurs in elastic spaces.

(2) Dependency
The secondary profile is attached to the primary profile to a certain extent, and the tertiary profile is attached to the secondary profile to the extent of this layer-by-layer, parasitic relationship.

(3) Regularity
By examining the changes of different canopies in the time period, it can be clearly seen that the regularity exists in the street-outward elastic space.

3.3 The analysis of the atrium-inward elastic space (Quanzhou)

The most obvious manifestations are:

(1) Diversity
Although the typical plane of the atrium space is fixed, due to the difference in scale, style, and number of households, it also reflects diversity;

(2) Dependency
The performance of the tertiary contour attached to the secondary profile to a certain extent is particularly obvious, reflecting the parasitic relationship;

(3) Openness

The fisheye survey found that the openness of the atrium was also related to spillover.

4. CONCLUSION

As shown in the figure, combining the case studies of Zhangzhou and Quanzhou above, both of them start from the basic model of elastic space and sort out improved models that can represent local architectural elements.
Then, by classifying the primary, secondary, tertiary profile, the main influence factors are extracted. Then, the data on the plane, elevation, and stereo are obtained through statistical actual mapping to verify the elastic space characteristics. The analysis of the two types of elastic spaces can in fact show that the street-outward elastic space and the atrium-inward elastic space jointly show that: (Fig.5)

(1) Dependency, Diversity
the dependency is the most prominent characteristic of the elastic space, followed by the diversity is relatively significant;
(2) Regularity
The reason is that in the street-outward-oriented elastic space, the regularity is summarized through the analysis of the timeline;
(3) Openness
in the atrium-inward-oriented elastic space, the openness is summarized through the fisheye photo analysis of the openness.
(4) Transparency, Inclusiveness
Transparency and inclusiveness cannot be quantitatively analyzed in the existing research models, and can only be discussed qualitatively at this stage.

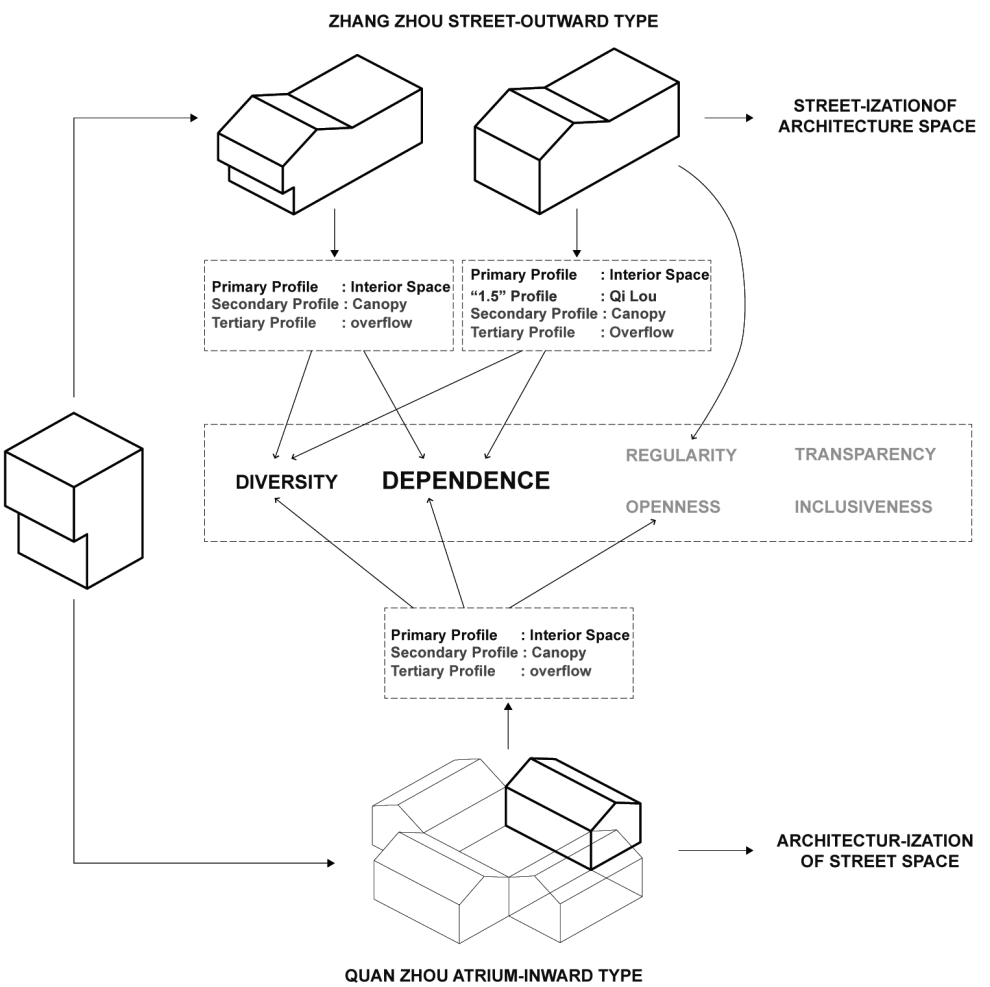

Fig.5. Summary of analysis results of 2 types elastic space

"Architecturalization of street space " and "street-ization of architectural space " summed up the core connotations of street-outward type and atrium-inward type of elastic space. This research is also based on this concept, and comprehensively compares the street space and atrium space of seemingly unrelated traditional dwellings. The two are completely different in physical form, but due to the self-issued overflow phenomenon of the user, private goods appear on the street where public goods should be placed, which creates an attribute of an atrium; the atrium, which should have only private items, due to the sharing of multi-family items, the atrium has the attributes of a street. In fact, the area or space between this critical and public street and private atrium can be called "common space". The nature of the discussion space essentially becomes a question of discussing all attributes, or domain awareness.

REFERENCES

[1] Jacbos, J. (1961). *The Death and Life of Great American Cites.* London: Jonathan Cape, 1961.

[2] Aoki, Y., et al.(1993). *Private use and territory in alley space, Hypotheses and tests of planning concepts through the field surveys on alley-space Part 1.* Architectural Institute of Japan Journal of Architecture and Planning. No.449.

[3] Ashihara, Y. (1983). *The Aesthetic Townscape.* Cambridge: MIT Press.

[4] Fumihiko, M. (2018).*City With A Hidden Past.* Tokyo: Kajima Institute.

[5] Kurokawa, K. (1994). *The philosophy of symbiosis.* Cambridge: Academy Press.

[6] Furuya, N. (2002). *Shuffled.* Tokyo: Toto Publishing.