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ORIGINAL RESEARCH PAPER

The design of intensive urban block form structure

He Jin[1*] and Balint Bachmann[2]

[1] Marcel Breuer Doctoral School, Faculty of Engineering and Information Technology, University of Pécs, Pécs, Hungary

[2] Faculty of Engineering and Information Technology, University of Pécs, Pécs, Hungary

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ABSTRACT

On the basis of elaborating the connotation of intensive city block, it is pointed out that the intensive structure organization is the key to realize intensive city block. The order complexity of the block structure is formed by the close connection, overlapping of elements, the depth difference and their compound association. This paper constructs the basic pedigree of block structure design from three levels of street configuration, plot organization and building layout, and forms the derivation and comprehensive application strategy of pedigree from the organic linkage and compound of each other.

KEYWORDS

intensive, city block, morphological structure, the connection, overlapping

1. THE CONNOTATION OF INTENSIVE CITY BLOCK AND ITS PROBLEMS

1.1. Connotation understanding of intensive city block

The concept of intensification originates from the study of agricultural operation mode. It refers to the use of advanced technology and management methods to obtain high yield and income per unit area of land by investing more non-land elements [1, pp. 838–839]. The contradiction between the limitation of land resources and the increase of space demand promotes the introduction of the concept of intensification in the evaluation of urban land use efficiency.

With the continuous exploration of urban space development time and the in-depth and interactive influence of geography, city, architecture and other related disciplines, the connotation of urban space intensive development is constantly changing. The initial concept of intensification emphasizes the economic indicators of land use intensity and land average output value represented by floor area ratio. Furthermore, represented by various location theories, the distribution principle of different types of land is judged according to the market value of land, and the efficiency of urban land use can be improved through "rational allocation of urban land and land replacement". With the proposal of Sustainable Development GoalS (SDGS), the government and professional fields generally realize that the intensive use of urban land must be based on the bearing capacity of resources and environment, and take into account the unity of economic benefits, social benefits and environmental benefits. On the whole, people's understanding of the connotation of urban space intensification development shows a clear trend of change, that is, from the single pursuit of land construction capacity to the coordination effect of multi-dimensional elements, so as to meet more diversified urban needs [2]. The core connotation of intensive urban block is to realize the value-added of functional elements, spatial scale and spatial significance through scientific compact and orderly organization of the form structure on the given block land, so as to enhance the efficiency of land use and urban vitality and promote

*Corresponding author.
E-mail: 185661698@qq.com

the sustainable development of urban space. The intensity or intensity of urban blocks is not a fixed quantity value but is presented in the coordination and matching of elements in terms of scale, organizational structure, site quality, functional attributes and environmental performance, which can be highlighted in comparison.

The retrieval of the research field shows that the existing research on urban spatial intensification is more focused on the macro-economic geography and partial exploration of urban planning. The studies on intensification at the micro level for instance urban blocks are still relatively sporadic. The practice in the field of urban architectural design focuses more on the function and space management of the interior of the building, but less on the extension exploration of the intensive space of the block. The lack of intensive research on the block scale and its basic theoretical methods greatly affects the contribution of the design and architectural creation of the surrounding city to the quality of urban space intensive development.

1.2. Reflection on the practice of intensive space in blocks

At the level of urban connection, the intensification approaches and evaluation elements are generally adopted at present, for instance high plot ratio development, accessibility of road system, mixed use of block land and compact layout of buildings (Fig. 1). However, these elements and methods can only solve one aspect of the problem, but it is difficult to drive the block space system and effectively intensive development. Wide roads cannot solve the congestion caused by intensive land development and functional concentration; At the same time of high intensity development, the architectural form is isolated in the modern grid network, the lack of connectivity of the layout pattern leads to the fragmentation of public space and loss of vitality; The planarization of land layout restricts the potential of three-dimensional space utilization. If the supporting facilities aiming at "functional mixing" lose the effective support to people's behavior activities, it will be difficult to become a sufficient condition for spatial vitality. The essence of these methods is to improve the quality or scale of a single element in the block form, or simply add elements to elements, but ignore the grasp of the structural relations between elements, so it is difficult to achieve systematic intensification effect. In what way are the morphological elements of urban blocks organized together, and how do they affect people's behavior and activity patterns, thus affecting economic and social benefits? Therefore, the organization logic must be explored among the elements of the block form, obtain the scientific cognition of the urban block form structure, and then look for the design method of the intensive block form.

1.3. Morphologic structure hidden in the neighborhood environment

In the 1960s, Jacobs [3] argued that modern urban planning had "robbed" cities, while traditional cities characterized by "ordered complexity" were more vibrant. Christopher Alexander [4] regarded the city as a system and explained that the natural city with "semi-network" structure is more attractive than the artificial city with "tree" structure. He revealed that the structural relationship is the essential cause of the great contrast between the two urban models, and proved that a structure can be recognized and described by scientific graphical methods. Since then, network system theory has gradually become an important tool to describe and study the topological relations and motion modes among urban spatial elements. Based on the theory of complex system, Michael Batty [5] proposed the concept of fractal city [6]. On this basis, N. A. Salingaros [7, 8] believes that the urban form with fractal characteristics should be complicated and connected by multiple hierarchical elements, and introduces concepts for instance small-world network and scale hierarchy to describe this feature.

Structural theory is an important school in the field of international urban morphology, which was first introduced by B. Hillier [9] to analyze network space. He believes that any specific space has its corresponding position in the overall network system, and the structural relationship between street spaces affects people's travel patterns, thus affecting the distribution of social and economic activities in

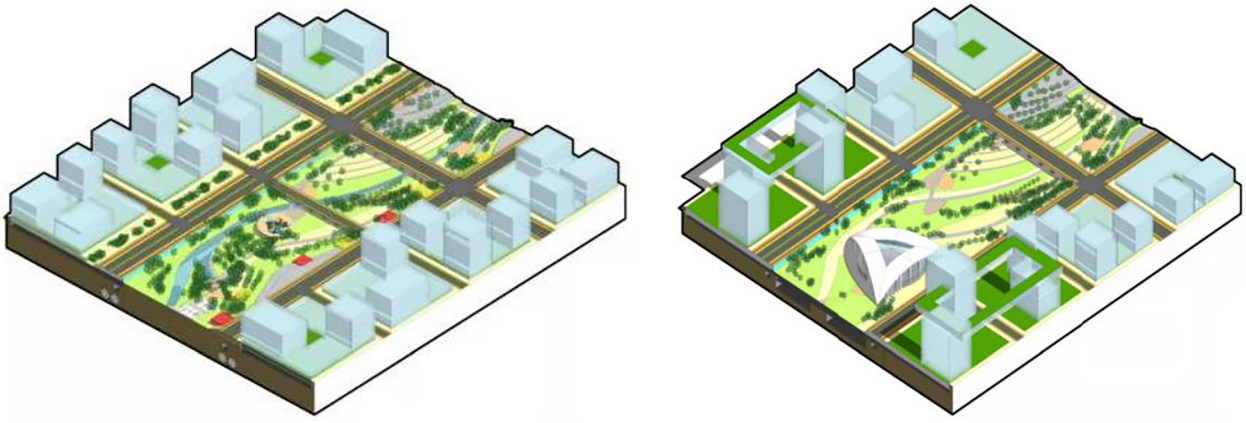

Fig. 1. Block land and compact layout of buildings (*Source:* Designed by Jin He)

space [9]. S. Marshall [10, 11] proposed that grid type and tributary type are the two prototypes of street architecture, and quantitative description and analysis were carried out on the characteristics of junction architecture through three indicators of continuity, continuity and depth. K. Kropf's [10] multi-hierarchy theory integrates the ideas of typology and fabric, and makes it clear that the connections among streets, sites (Spaces not covered by buildings within a plot) and building rooms can describe the spatial network through which people move [12].

In the 1960s, when Alexander published his book [4] "A City is Not a Tree," similar academic claims were made in the field of architecture. Japanese architect F. Maki in his book [13] "Investigations in Collective Form," proposed three basic forms of urban spatial connection: compositional, megastructure and group form. He pointed out that synthetic form is the form mode commonly adopted by modernist cities, a static structure lacking continuity [14]. However, the construction cycle of group form is longer, and it mostly appears in traditional towns. It is composed of many small and dense units connected with each other, and has strong growth.

These scholars from different academic backgrounds all regard the city as a complex spatial organizational structure formed by several elements and connections, and attempt to explore the relationship between the physical spatial form of the city and its behavior pattern, functional organization and spatial efficiency by analyzing the complex structure behind the natural urban form. Their description and cognition of urban morphological structure have consensus (Fig. 2):

- The vitality of a city comes from the connectivity between elements. The relative number of connections largely determines the operation mode of a city, and the close connection is an important basis for convenient movement and free communication;
- Overlap is the core feature of complex networks, that is, one element is shared by two or more groups of material elements that can play an independent role at the same time, and overlapping elements play a double or even more connection role, acting as a structural adhesive;
- Depth is used to describe the topological distance between the element and the high-level or more public base element, and to express the difficulty of reaching a certain element from the base element. Depth is an important concept to identify node differences, which is of great significance to create diversified urban environment.

2. THE STRUCTURAL CHARACTERISTICS OF INTENSIVE BLOCK

Through the systematic analysis of typical block samples at home and abroad, the structural characteristics of intensive city block can be further understood and revealed. This paper selects the sample blocks, which reflect different intensification tendency and degree in the different course of urban development (Table 1). These samples are partly derived from urban design and architects' engineering practice, partly from the free transformation of society or individuals, and related to the socio-economic background of the corresponding area. Streets, plots and buildings constitute the basic morphological elements of blocks (groups), and the connection, overlap and level difference among elements reveal the characteristics of block organization structure and its intensification quality and degree [15].

2.1. Close connection

Bálint Bachmann [16] created a visitor center with an active connection to the public space of Cella Septichors. From the comparison of modernist blocks, it can be seen that the modernist cities are obviously lacking in the connectivity of traditional European cities. Public streets connected with small plots on both sides, building directly into the surrounding streets, street as a public activity of active line and the shape elements of connection, form a continuous sequence (for blocks morphological structure characteristics, later will use "dot" abstract expression street, the plot and the building three kinds of shape elements, with the "line" the connection relationship between the abstract elements).

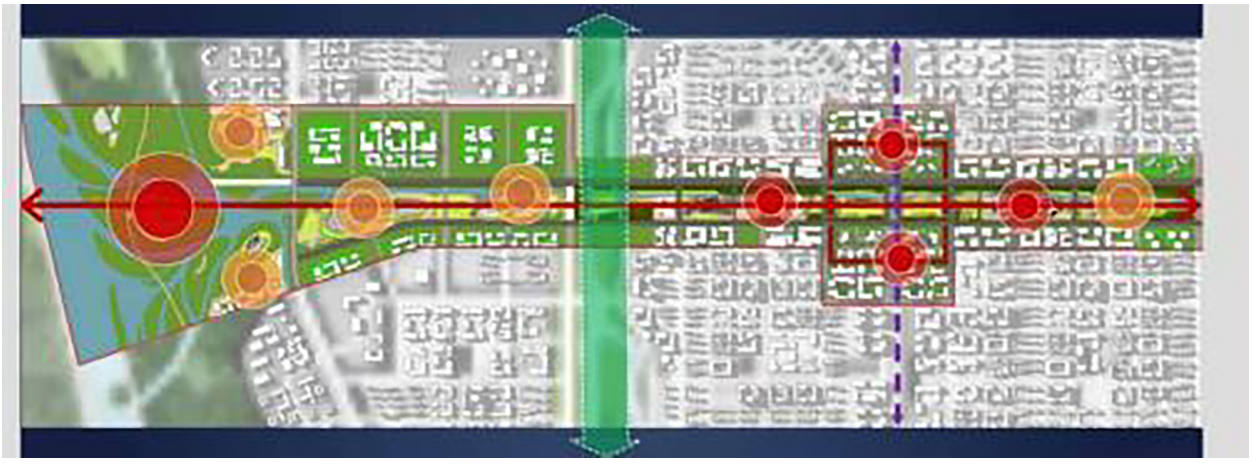

Fig. 2. Urban morphological structures (*Source:* Designed by Jin He)

Table 1. Comparison of typical block samples in different times

Era	The development demands	Sample
1850–1930s The city beautification movement in the early period of Modernism	Compact layout, enhance the quality of public environment, strengthen street space	Paris, France Haussmann converted neighborhood, Zelda's Fairy Imported neighborhood
1930–1970s Modernism, the Athenian Charter, post-war reconstruction	Clear functional zoning, rapid construction of "large scale" geometric housing The central business district module was initially formed during the period of skyscraper popularity	Residential Brasilia, Brazil Rockefeller Center, New York, USA
1980s-present Charter of Machu Picchu, TOD theory, people-oriented	Inheriting the street contours and diversity of traditional cities, bringing more sunlight and air into the streets	Open Block' in Massena District, Paris, France
	High-density central area, commercial, residential, hotel, exhibition, catering, transportation and other urban functions are highly concentrated and mixed	Roppongi New Town, Tokyo, Japan; La Defense, Paris, France; Canary Wharf, London, England; Heart Gate, Milan, Italy
	Station city integrated development mode, three-dimensional space stock into a variety of mixed functions, and integrated development with the surrounding area	Kowloon Station, Admiralty, Swire Centre, Hong Kong, China, Shiodome Station, Osaka Station, Niko Tokawa Station, Japan
	Joint development and urban renewal with the participation of citizens, and strive to further optimize and improve the environmental quality	The old Water Tower neighborhood of Barcelona, Spain
The superposition and accumulation of multiple construction periods	Continuous self-organizing transformation. After long-term running-in and accumulation, good traffic accessibility, functional mixing, building density and site diversification	Nanjing Old Town, China; Harajuku, Tokyo, Japan; Gangnam, Seoul, Korea

2.2. Elements overlapping

In order to improve the urban public space environment, the Government of Barcelona, Spain, organized the Special Internal Reform Program (SIRP) of the old city in the 1980s [13]. With the joint investment of various parties and the active participation of citizens, the inner space of the block was intensively utilized. The interior of the old Water Tower block in Barcelona was separated by multiple property rights blocks before the renovation, and it has no publicity at all. The interior space of the transformed block is integrated into a centralized semi-public space, whose access relationship is achieved by crossing the ground floor of a block. While enhancing the connection, the site elements of the plot are clearly overlapping in function, both carrying the buildings inside the plot and as part of the "semi-public" street, thus connecting the courtyard inside the block with the urban street space; The courtyard inside the transformed block is also transformed into an overlapping element. It can be seen that under the condition of constant construction intensity, the carrying capacity and use efficiency of urban space can be significantly enhanced through overlapping of elements [17].

Due to the demand for living facilities, it is a typical phenomenon that the ground floor of residential buildings facing streets in many old cities in China is transformed into small commercial stores. The original residential buildings are entered from the yard inside the plot. After the transformation, the shops on the ground floor face the street directly, while the upper residential part still keeps the original way of entering. This transformation diversifies the single connection, enhances the compact connection, and overlaps the building elements to achieve a mixed function. In fact, the pattern of "high-rise building + podium" is also a common means of overlapping elements.

2.3. The depth of the differential

East Asian cities generally have the characteristics of large block pattern. The peripheral roads emphasize the function of fast traffic, while the inner streets provide relatively quiet space adapted to community life, which is a structure that gives consideration to mobility and stability. From the perspective of street architecture, the characteristic of "outside moving and inside quiet" benefits from the difference of street depth types. In the homogeneous grid road network, the connection type between streets is single and there is no difference in depth between each other, while the tributary road network can create a variety of depth types. In large blocks in this project of Xiong An City design, the mixed pattern of grid type and tributary type road network is mostly adopted.

The Xiong An project has started the experiment of street structure transformation since 2003, which is conducted through the re-grading operation of the street system The 9 separate blocks were merged to form the superblock, with the boundary being the main road suitable for fast traffic, and the inner streets being returned to the citizens as places for walking, shopping and outdoor activities. Blocked by fast traffic, street parks, artisan workshops and retail businesses appear in different locations within the super block, forming an overall structure with significant internal and external differences and close internal connections. By

Fig. 3. Xiong an city design (*Source:* designed by Jin He)

Fig. 5. A complex network structure (*Source:* Designed by Jin He)

means of scale, section and control, enhancing the hierarchical difference of streets can also bring about the change of spatial depth, thus creating a diversified urban space that can carry more functions (Figs 3–4).

3. THE BASIC PEDIGREE OF INTENSIVE BLOCK STRUCTURAL DESIGN

The connotative characteristics of the intensive block form structure reveal the significance of carrying out the fine block structure design, and at the same time suggest the basic principles of this structural design. Based on the consensus on the basic elements of block form, we can construct the basic pedigree of block structural design from three dimensions: street, plot and building.

3.1. Basic spectrum

3.1.1. Street configuration. Dense street network and moderate paragraph length are the basic guarantee to increase the overall connectivity of the street system. The configuration of road network density and block scale are the premise of each other, and block scale is closely related to the dominant function of the block and the division or combination of internal blocks. On this basis, the organization and optimization of street structure can be divided into two ways: one is to establish road grade classification, which is generally achieved through the classification of traffic function, road surface reconstruction design and pedestrian control. The other is the fabric approach, through the combination and application of grid and tributary street patterns, forming street types with different connection characteristics and depth differences, thus creating a complex network structure that can carry mixed functions and diversified places at the block (group) scale (Fig. 5).

3.1.2. Block organization. A lot is a further division of a block. A block can be a lot, but more often a combination of lots, so lots cannot be equated with blocks. Some control detailed planning has ignored the division and organization of block scale, which has led to the rough and loose spatial texture of many new urban areas, which runs counter to the goal of land intensification. At the same time, the plot directly adjacent to the street will inevitably become overlapping elements. The integration and overlap of blocks provide an effective way to tap the potential of block land under different scales and geometric characteristics.

3.1.3. Architectural layout. Under the concept of intensification, it is necessary to advocate the establishment of multiple connection modes between the block buildings and the streets (ground, underground and air), which will help to improve the close connection between the functional and spatial elements and avoid the single closed layout mode common in large blocks.

Fig. 4. Xiong An City design (*Source:* Designed by Jin He)

4. CONCLUSION

Street configuration is associated with the formation of block groups; The street can also be connected with the plot or building; The combination of plots constitutes the whole block.

The comprehensive application of pedigrees or models should be based on the principle of adaptability of objectives and conditions. For example, in the limited land use space, the combination mode of plot superposition + courtyard (B2 + C1) not only ensures the continuity of street business, but also creates a quiet living space inside the block, which is a common strategy to achieve functional mixing in the compact old city center. This composite mode is often adopted in the development mode of "track + property" in First-tier cities of Hong Kong, China and Japan. In grid city blocks, the lack of diversity caused by single street fabric type can be effectively avoided by matching plots with different functions and scales (A1 + B1 + B2) based on the difference of street grades. + building three-dimensional grid street layout (a1 + c1) is a kind of land use development and the combination of rail transit facilities solution, by means of architectural space three-dimensional processing different dimensions of urban transportation space together, the continuity of urban space no longer riven by motor vehicle road, some urban development in Hong Kong, China and Japan found in the most obvious.

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