Sustainable Housing Environment: Form and Territory

Wojciech Januszewski[(✉)]

Faculty of Architecture, Wroclaw University of Science and Technology,
Boleslawa Prusa s 53/55, 50-317 Wrocław, Poland
`wojciech.januszewski@pwr.edu.pl`

Abstract. The problem of sustainability in housing cannot be limited only to issues like energy saving and environmental impact but should address the primary purpose of the organization of habitable environment. The goal is to harmonize the opposing needs of people: privacy and collective life, isolation and integration, locality and openness to the world, the quality of the home and the quality of the city. The expression of these aspirations is a territorial structure shaped by an architectural form. The ecological form of housing architecture balances the individual and community needs. The living space should be legibly defined by buildings. The configuration of space in a residential environment should provide a hierarchy of privacy. The formation of transition zones should ensure establishing social contacts at various levels.

Keywords: Housing · Residential architecture · Sustainability
Urban form · Territory · Habitat

1 Introduction

Housing architecture is the basic matter of the city and the city is the basic form of the ecosystem shaped by the man. In the debate on sustainability, the housing problem is one of the key issues. The effectiveness of that environment directly determines the stability of the social structure and the dynamics of spatial transformations. Housing architecture arises in diverse cultural, economic, social, and political contexts. Is it possible to create a recipe for the sustainable housing architecture? This question cannot be limited only to issues like energy saving and environmental impact but should address the primary purpose of the organization of habitable environment. The goal is to harmonize the opposing needs of people: privacy and collective life, isolation and integration, locality and openness to the world, the quality of the home and the quality of the city. The expression of these aspirations is a territorial structure shaped by an architectural form. One can distinguish three basic aspects of this issue: defining the space – how the living space is shaped by physical elements; configuration – how the living space is related to other spaces in a greater spatial structure; *transition zones* – how the physical relation among the spaces is shaped. The right solution to these aspects is the basis for the economic management of the city space.

2   Defining the Space

The visual perception of spatial systems in urban complexes shapes the territorial relations of the housing environment. Let us consider how diverse formations and spatial configurations affect the creation of territories.

The concept of space can be understood as an abstract and unlimited mathematical space or as a place – concrete and empirical space. The latter category includes the housing space. A habitat is a place on earth that is a reference point to the man's existence. The organization of the living space is, in the most general sense, the creation of here categories, in opposition to the shapeless somewhere. The creation of existential space is, in the first place, its separation from the continuum by defining the boundaries, which is the function of the architectural form [1].

Two models of perceiving the relation between space and architectural form can be distinguished:

– a free-standing form in a negative space
– a form that limits a positive space (Fig. 1).

Fig. 1. Two types of space-form relation: a free-standing form in a negative space (left), a form that limits a positive space (right). Author's drawing.

In the first model, the architectural form creates a distinctive object, while outer space (void) is the background (negative). In the second system, it is the opposite – space is the proper object, while the form remains the background [2, pp. 176–179].

The positive space model builds an urban interior and clearly defines the boundaries of a territorial zone. It seems to be the most appropriate one for the housing environment as a response to the needs of locality and security. However, one must remember that this is only one side of human needs in relation to space. The abuse of the space closing strategy results in a claustrophobic environment, an example of which was the nineteenth-century city with corridor-like streets and extremely narrow backyards [3, pp. 11–15].

The reaction to that type of environment was the extreme scattering of building development in modernist urbanism and the dominance of the negative space model.

Let us consider the system of free-standing buildings located at relatively large distances from one another (Fig. 2). The reception of such space is dominated by architectural forms. The outer space is negative: it is shapeless and homogeneous. Within that space, it is difficult to visually identify smaller spatial units that may have
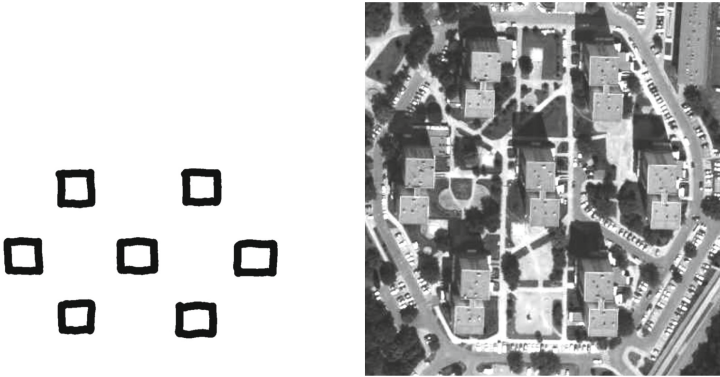
Fig. 2. Free-standing urban form: diagram (left); example: residential development Kozanow in Wroclaw, Poland (right). Image Courtesy of Google Maps.

territorial significance. The only spatially defined territory is the interior of the building which is an island of privacy in the surrounding public space [4, pp. 90–122].

The traditional urban tissue is based primarily on positive spaces. Two basic types of such space can be distinguished: a courtyard (static space) and a street (directional space). Both models shape diverse territorial relations (Fig. 3).
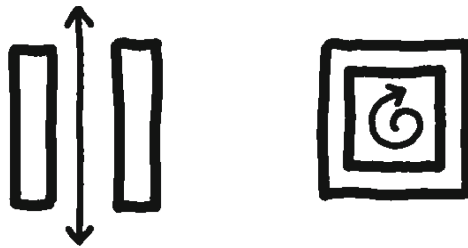

Fig. 3. Two types enclosed space: "a street" (left), "a courtyard" (right). Author's drawing.

The interior of the courtyard is the space separated from the background of the surrounding area. It can naturally create an enclave, controlled by inhabitants, with a limited access to outsiders in a physical or psychological sense. Territorial relations in the case of the street are different. The street space combines static and dynamic aspects. The street is open to traffic and flow – it is, therefore, a public space, but at the same time it is a partially defined space and enables control by its users, including the inhabitants. The degree of street privacy depends on many details in its shape, such as the dimensions of space, the formation of threshold spaces, the type and intensity of traffic, etc. The free-standing form, the street, and the courtyard are the basic types of spatial organization occurring in various variants and connections.

A common form of a middle-way solution is the so-called open block composed of the perimeter arrangement of free-standing structures (Fig. 4). Despite the occurrence of openings, this system is perceived as closed, in accordance with the general tendency of human perception to complete the shapes. The model was widely used in garden city type of development such as neighborhoods designed by Raymond Unwin and Clarence Stein. It was a way to improve the conditions of ventilation and insulation of building blocks [5, pp. 319–359]. In the post-modern urbanism, the model was promoted by Christian de Portzamparc as a contemporary compromise between the model of the nineteenth century and the functionalism [6, pp. 222–223].

Fig. 4. An open block: diagram (left); example: the urban block designed by Christian de Portzamparc in Nantes, France (right). Image Courtesy of Google Maps.

Another possible solution is the system of free-standing buildings in a greater enclosed block space, realized e.g. in Funenpark in Amsterdam. This system separates the territorial zone and at the same time creates the possibility of a free architectural composition (Fig. 5).
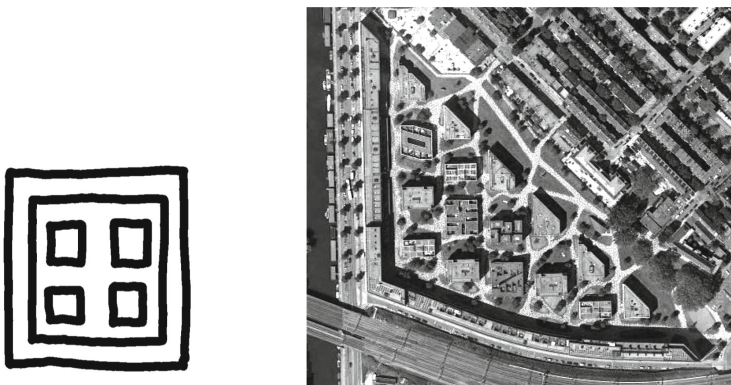

Fig. 5. Free-standing form enclosed in a perimeter block: diagram (left); example: Funenpark, Amsterdam (right). Image Courtesy of Google Maps.

The housing environment requires the balance of enclosure and openings. The postmodern criticism of the modern idea of open space seems to be exaggerated when one takes into account that modernism turned against the claustrophobia of the nineteenth-century city. The mandatory return to closed quarters is by no means the postulate of common sense. It seems rather that one should postulate for a maximum opening while maintaining the legibility of the territorial structure and the composition of the urban space.

3 Configuration

The character of architectural space is defined both by its individual features and its location in a larger spatial configuration. Among others, Bill Hillier drew attention to that problem in his research on the "syntax" of space. [7, pp. 26–51] Housing environment is a holistic problem – it will be difficult to reduce it only to the issue of individual buildings or housing estates. The difficulty in defining the limits of the habitual zone is specific for housing issues. It is expressed in the ambiguity of colloquial statements we use when talking about these matters. The sentence "Here is my home" or "I live here" may refer to the building but also to the street, district, city, country, etc.

The authors of the Charter of Athens, studying the structure of an urban organism, adopted the method of functional analysis by making a basic division of the city into the zones of living, working, and recreation. In the newly designed urban plans, a principle was established for the division of these purposes and the separation of mono-functional housing estates [8, pp. 73–91]. The housing function itself was treated rather utilitarian – as a creation of an adequate number of apartments providing proper hygienic conditions (insulation, ventilation, etc.). The doctrine of functionalism was criticized by the younger generation of architects from the later Team 10. With regard to housing problems, the term habitat – derived from biological sciences – was understood as the holistic environment of human life. The basic structure, described by habitat, is the "hierarchy of human associations" [9]. This idea was further developed by subsequent concepts based on the criticism of functionalism – the concept of
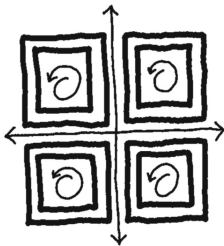

Fig. 6. Perimeter urban block: diagram (left); example: residential development for mineworkers Nikiszowiec, Katowice, Poland 1908–1918. Image Courtesy of Google Maps.

defensible space by Oscar Newman [10, pp. 1–21], degrees of publicness by Christopher Alexander [11, pp. 192–196], and the territorial structure by John Habraken [12, pp. 143–160].

These models describe the housing environment as a hierarchical arrangement of spaces sorted according to the degree of privacy and accessibility (territorial depth) – e.g. personal, private, semi-private, semi-public (or social) spaces, and finally – public space. It is also a postulate for the designed settlements to have hierarchy organized in a clear way, ensuring the implementation of diverse needs: for privacy and participation in social life.

The most widespread example illustrating the territorial hierarchy is the perimeter urban development (Fig. 6). It is a combination of street and courtyard rules. In that type of an urban system, there is a clear hierarchy of privacy and the division of different ways of utilization. The courtyard is a more private space, dedicated to the residents of a building block. The street is a public space. The legible street space is the element that brings individual quarters together into a larger urban entirety [13, pp. 81–100].

In modernist urbanism, implemented in accordance with the CIAM doctrine, the model of a street along a continuous frontage of buildings was rejected. The structure was shaped independently of the driveways, as free-standing elements – usually repetitive and standardized residential buildings. The method used to overcome the monotony was often a creative approach to urban composition, which resulted in a large variety of housing forms.

Fig. 7. Ambivalent interiors in modern urban planning: diagram (left); example: residential superblock in Brasilia. Image Courtesy of Google Maps.

It would be a mistake to state that modernist urbanism operated only in negative space. The formal repertoire contained various types of urban interiors ensuring a relative visual intimacy of the residential domain. At the same time, these interiors did not create a legible territorial hierarchy. The so-called adjacent interiors, where the buildings functioned as walls separating identical spaces; or ambivalent closing-opening systems were used as frequent solutions [14, pp. 74–81]. It is difficult to identify public, semi-public, and semi-private spaces in such arrangements. It is also difficult to assign specific exclusive spaces to specific groups of buildings, and therefore to specific user groups. Despite the clear spatial articulation, the environment remains undivided in the terms of territory (Fig. 7).
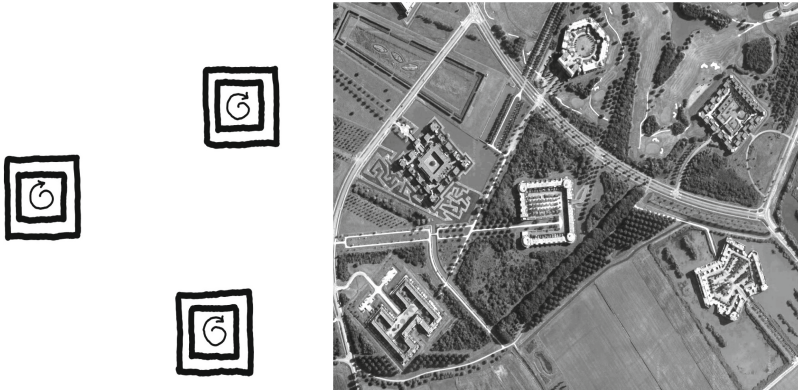
Fig. 8. Isolated residential courtyards: diagram (left); example: housing development Haverleij, Den Bosch, The Netherlands. Image Courtesy of Google Maps.

The lack of hierarchy may occur in spatially closed systems, for example in the system of courtyards that as such are free-standing objects in the landscape. The surroundings do not have the character of a built area. It is not strictly the public space, it is rather the natural or semi-natural background for the housing development. Neighbourhood spaces are not connected to the public space but are isolated enclaves (Fig. 8). Such an arrangement is rarely the result of conscious design (the example on the picture is an exception). Island systems are usually the manifestation of chaotic, unplanned urbanization. The isolation of housing enclaves has a number of negative consequences for the quality of a living place, the cohesion of urban space, and ecology.

Fig. 9. Connected courtyards: diagram (left); example: Rabenhof housing development in Vienna, 1928. Image Courtesy of Google Maps.

Another example of a non-hierarchical system is a layout of connected residential courtyards. It is in a sense the opposite to the modernist open composition (Fig. 9). These solutions are characteristic for some of the interwar "workers' yards" (Arbeit-erhof) and for theoretical projects from the circle of neo-rationalism as a reaction to the modernist open form [15, pp. 71–81]. The external space in this system is completely

closed. Similarly to the open system, space is devoid of hierarchical diversity. Subsequent urban interiors do not differ in territorial depth. This certainly applies to an ideal situation in which the structure has no beginning or end. In reality, with a limited development size, the spaces located closer to the periphery are less private than those located inside.
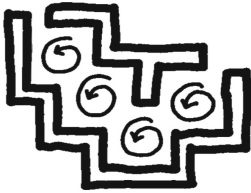

Fig. 10. Residential street: diagram (left); example: Het Dorp, housing development for disabled people designed by Jaap Bakema, 1963, Arnhem, The Netherlands. Image Courtesy of Google Maps.

An interesting example is the so-called residential alley composed of intimate static and directional spaces (Fig. 10). This system was often used in late-modernist residential architecture [16, pp. 266–268]. The feature of these developments was an intimate character of the interior and an informal shape of the building line. It was an expression of a return to the idea of the street as a social space. Theoretically, the space of the street is accessible to the public but its scale and shape give it a semi-public character.

4   Transition Zones

As it has been stated, the architectural space is defined by the relation to the neighboring spaces. This applies to the spatial configuration discussed above, as well as the physical shape of the perimeter of a given space and its contact with the surrounding. The proper design of intermediate zones is of particular importance for creating harmonious connections among different zones in the habitual environment. It is important to ensure a proper balance between the separation and the connectivity of space through the view and the physical access.

The boundaries, territorial gates, and threshold spaces are important for this matter. Territorial boundaries are spatial elements that articulate the change of control zones. These can be various types of fences, surface changes, or building walls. The territorial gate is a break in the continuity of the territorial border, allowing the transition to a different territorial level. The concept of the threshold space (or doorstep) connects to the idea of the boundary and the gate. It has been researched in architecture since the
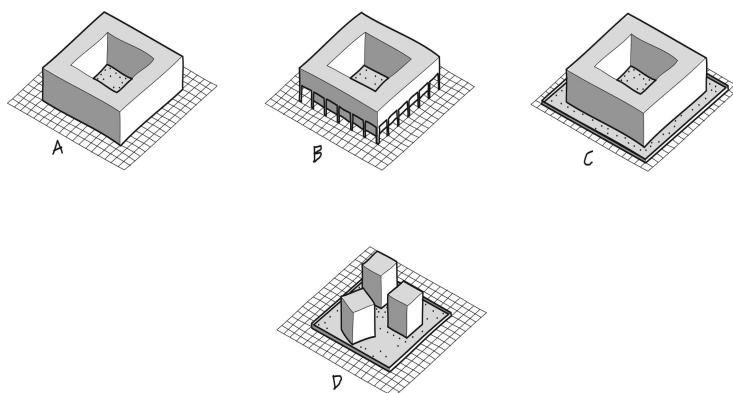
Fig. 11. A territorial border in relation and the wall of a residential building. Author's drawing from: Januszewski, W.: Wybrane aspekty organizacji przestrzeni habitatu: forma i terytorium. In: Bac, Z. (ed.) Moj piekny Habitat, pp. 74–89. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław (2016)

post-war times and Team 10 group, mainly by Aldo van Eyck [17]. The interest in the problem was born with the undermining of the doctrine of functionalism, characterized by strict separation of functions. The threshold space occurs in the joint of spaces with different levels of privacy. Its task is to mitigate the rapid transition between different territorial zones, e.g. public space of the street and private interiors of the house (e.g., entrance zone). The created threshold space signals the change of the territorial zone – it warns an unauthorized person and welcomes the guest. The threshold space – as a neutral zone – is also a convenient space for establishing social relations.

The layout of gates, boundaries, and threshold spaces defines to a large extent the character of adjacent spaces. Let us consider the relation between the territorial border and the wall of a residential building:

– the border in the building line (Fig. 11A) - the outer line of a building is at the same time the boundary of the private territory or the territory assigned to a neighbourhood community;
– withdrawn border (Fig. 11B) – public space is introduced into a block, e.g. in the form of arcades or generally accessible service premises; In this variant, the street becomes more public.
– extended border (Fig. 11C) - foreground with the greater degree of privacy than the street is created in front of the building line; The street gets more of a neighborly character.
– secondary border (Fig. 11D) - the boundary is unconnected with the buildings and clearly moved away from them; The street loses its relation to the buildings and loses its importance as a social space.

Different forms of boundaries significantly influence the relations between private and public spaces. This problem affects the threshold spaces, i.e. the transition zones between various territorial levels. Developing this issue, let us look at the examples below, illustrating different solutions.
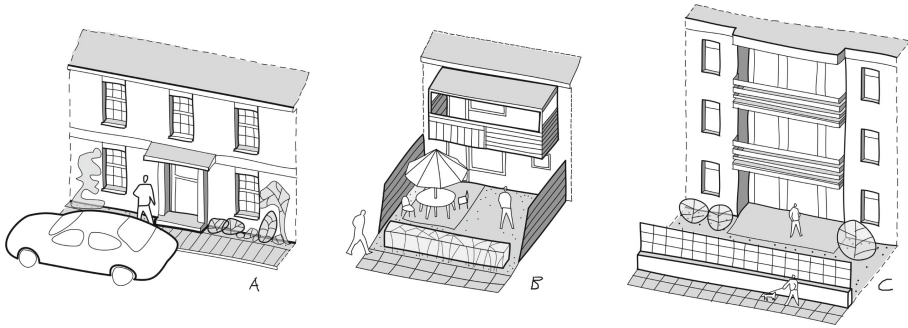
Fig. 12. Transition spaces in a residential environment. Author's drawing from: Januszewski, W.: Wybrane aspekty organizacji przestrzeni habitatu: forma i terytorium. In: Bac, Z. (ed.) Moj piekny Habitat, pp. 74–89. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław (2016)

In the first example, a residential house is shifted to the street, practically without any foreground. Only a narrow strip of green covering the width of the entrance threshold is under the control of residents who, according to their own preferences, decorate it with flowering shrubs and vines. The facade of the house is representative, the entrance zone is clearly accentuated. This solution emphasizes the public character of the street (Fig. 12A).

In the next example, the street meets the garden, which is separated by a high fence from the neighbors and a low hedge from the pavement. The building is "opened" with large windows, a terrace, and a balcony, which is its informal backside. There is the view from the public space to the private space, which makes the character of the latter more intimate, focused on neighborly relations, and therefore semi-public (Fig. 12B).

The third example shows a building separated from the street by a high, non-transparent enclosure. In this case, it is difficult to refer to any relationship between the street and the apartment building. The street functions here neither as a real public space nor as a neighbourhood. It is a "no man's land", where nobody exercises natural control, and its meaning is limited to the function of communication (Fig. 12C).

The proper shape of the transition zone should, therefore, take into account the nature of the external space, towards which the residential building is oriented. It should be possible to easily view and to access directly from the side of the private space, which makes the public space naturally controlled [18, pp. 97–99].

5   Conclusions

The analysis of different aspects of form and territory allows formulating the general characteristics of the sustainable housing architecture.

The living space should be legibly defined by the architectural form. This enables to develop the territorial structure. At the same time, there should be a balance between closures and openings to avoid the impression of being trapped or lost in the space. Defining the space should not take place at the expense of ventilation, insulation, and

contact with nature. The configuration of space in a residential environment should provide a hierarchy of privacy: public space, semi-public space for a limited neighborhood group, and private space. The formation of transition zones should ensure the possibility of maintaining privacy and establishing social contacts at various levels.

The ecological form of housing architecture balances the individual and community needs. It provides the right balance of the private domain, creates home comfort, and the quality of the public zone, ensuring the cohesion of urban organism. It is characterized by the economic use of space, through which the idea of a compact city is realized. In times when urban planning often loses to urbanization, this seems to be the right interpretation of the problem of sustainability in housing architecture.

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