Balance of the built environment in structural terms

PhD. Eng. Arch.
WOJCIECH JANUSZEWSKI
Wrocław University of Science and Technology
Faculty of Architecture
ORCID: 0000-0002-7385-7430

The reorganisation of a habitat is a change in the internal relationships of the polar categories in a specific region and spatial scale. A healthy environment can be defined as one that balances these categories at each level of the analysis. Reforms and re-evaluations in the built environment can be interpreted as attempts to restore balance, as illustrated with examples from the history of architecture and urban planning. The results of the work contribute to the general theory of the built environment, essential for the proper design process in a wide spectrum of spatial scale.

The aim of the work is to present the principle of the environmental organisation based on balance of opposites. The first assumption is the notion of unchanging and universal structure, which is the ground for the variety of particular cases of the habitat [1]. In the work, the method structural analysis has been used[1]. In structural terms, understanding the reality should embrace not only individual phenomena, but also the entire structure of the relationship within which they occur. Relations function as binary oppositions i.e. pairs of mutually defining and opposing concepts (e.g. the concept of cold makes sense with respect to warm, etc.)[2].

The built environment is the space of human life, i.e. a human habitat, the essence of which lies in the fusion of physical objects and the way they are experienced and understood (individually or collectively). These meanings arise in the perceptual process based on categories that are natural for the human psyche and further developed in culture. The habitat is therefore a part of the 'living world' (Lebenswelt).

The experience of the built environment takes the form of the human's relationship with things and with other people.

Primarily, the environment determines:
- what is the relation of the human to things (spatial aspect),
- what is the relationship of the human to other people (social aspect),
- how can the human influence the arrangement of things in space (aspect of organisational dynamics).

According to the structural method, basic binary oppositions can be assigned to individual aspects. And so:
- for the spatial aspect: **interior – exterior**,
- for the social aspect: **individual – collective**,
- for the dynamic aspect: **variable – permanent**.

At this point, we will look at how the proposed method can be applied in describing the environment as a whole. Let us consider it on the example of the interior– exterior opposition in the A, B, C1, C2 space system.

Space B is separated from the general space A. The relation of A and B is asymmetric (A contains B, B does not contain A). Space A is differentiated into the inner space (B) and the outer space–the difference between A and B. Space B is then differentiated again by introducing C1 and C2, which are the interiors in B, and the outer space is the difference

A
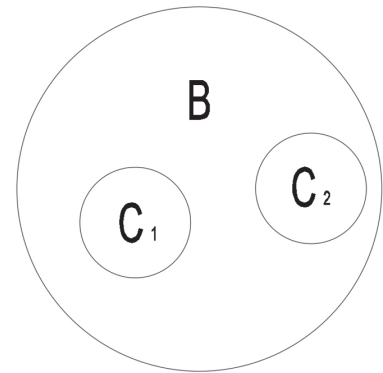
II. 1.

B\(C1 ∪ C2). The spaces C1 and C2 are in a neighbourly (symmetrical) relation and are not affected by the interior/exterior opposition. The spaces A, B, C1, C2 form a typical containment hierarchy (or nested hierarchy):

$$(C1, C2) \subset B \subset A$$

and, at the same time, the hierarchy of levels of organisation laid out according to the interior-exterior relation (Table 1.).

Table. 1. An example of enclosure hierarchy

level of organisation	interior	exterior
'A'	B	A\B
'B'	C1, C2	B\(C1 ∪ C2)

Table. 2. Exemplary enclosure hierarchy for a specific habitat

level of organisation	interior	exterior
plots	townhouses	courtyards / gardens
city	plots grouped into blocks	urban space - streets/squares
landscape	city	natural areas and agricultural lands

II. 2. Levels of organization: a) plot, b) city, c) landscape (fragments of the city plan of Delft, 1675, the so-called Kaart Figuratief)
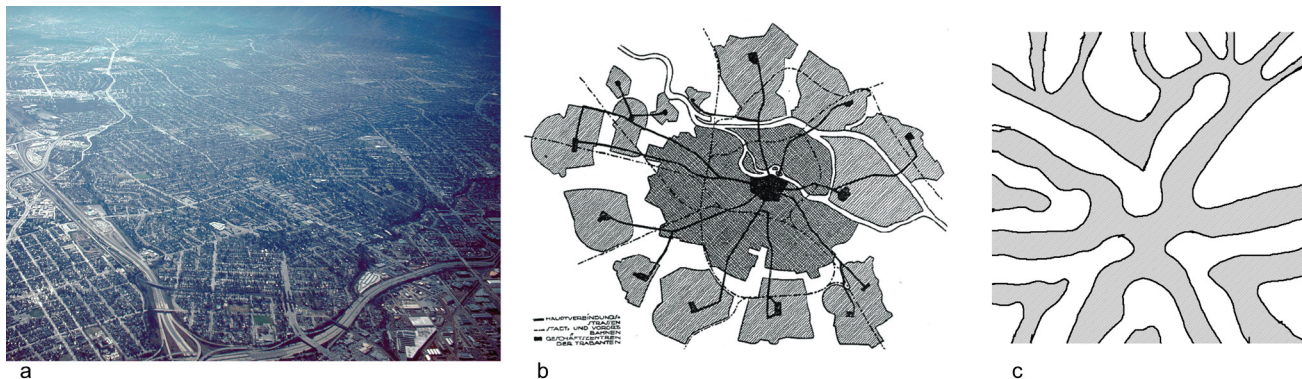
II. 3. Enclosure and opening at the urban level: a) the 'endless' city - San José (Wikimedia Commons, photo by Robert Campbell); b) an attempt to break the concentric development – 'garden suburbs' - Ernst May's plan for Wrocław, 1922. c) 'city-country fingers' according to the 'pattern' by Ch. Alexander.
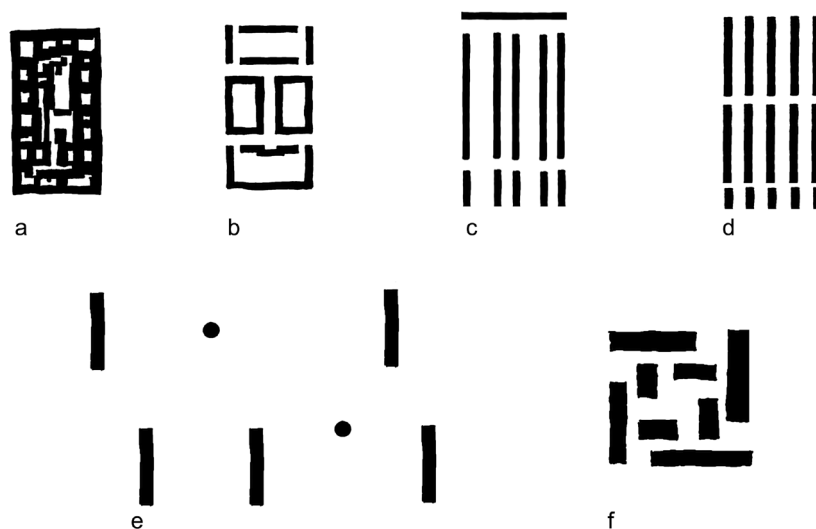
Let us illustrate this model with an example taken from a real built environment by analysing the structure of the medieval city shown in il. 2.

The given environment can be described as follows: (Table 2.)

At each scale, closed elements (townhouse – building block – fortified city) can be opposed to certain open spaces (courtyard – streets – natural areas). Every form has its counter-form. This illustrates the dialectical nature of the habitat and the balance of opposing categories, as well as the self-similar or fractal structure. In the following part, individual aspects of the environment and the oppositions assigned to them will be discussed in more detail.

II. 4. The evolution of urban forms in the 20th century: a) Mietskaserne; b) Wohnhof; c) Zeilenbau – early form; d) Zeilenbau – final form (a-d based on a drawing by Ernst May from 1930); e) free-standing buildings (based on Le Corbusier's Plan for Meaux from 1955 r.); f) closing-opening systems – 'square that breathes' (based on the design by A. van Eyck from 1958)

Interior and exterior

According to Jaap Bakema, the goal of architecture is 'to clarify the relation of man to the cosmic space'[3]. Christian Norberg-Schulz, on the other hand, writes: *'The basic property of man-made places is therefore concentration and enclosure. They are 'insides' in a full sense, which means that they gather what is known'*[4] . The built environment is a form of domesticating the space by defining micro worlds, which are the reference points for experiencing the world as a whole. These spaces are the places, or the existential spaces in the strict sense: being is possible in the defined here. As Heiddeger said: 'The boundary is that, from which something begins its *presencing*"[5]. Individual spaces (interiors) are being extracted from the external or open space by means of physical objects. At the same time the categories of interior and exterior exist as the cognitive structure (so called visual schemata [6]) 'we think with' at different spatial scales. The experience of being inside may refer both to spaces comparable to the size of the human body (e.g. a room) and – by further metaphorical projection[6] – to much larger forms (city, region, etc.)

The distribution of the enclosure in particular spatial scales is variable, as evidenced by historical transformations of urban models. For example, the congestion of European cities in the modern era resulted in the disappearance of open spaces at the level of the plot[7]. In turn, the territorial expansion of the city, after removing the corset of fortifications, led to the disappearance of dialectical relationship between the city and the landscape. Cultural representations of an industrial city such as Dickens's 'Oliver Twist' or 'The Promised Land' by W. Reymont [8] emanate an at-

[3] as reported by Strauven: [4] p. 217.
[4] [5] p.10.
[5] [5] p. 13.
[6] [6] pp. 29–30.
[7] i.e. burgage cycle described by. M.Conzen [7].

mosphere of confinement and trap – an infinite interior that, like Piranesi's multi-level dungeons or Dante's circles of Hell, is not balanced by any exterior (il. 3a).

One of the main themes of the urban reform in the first decades of the 20th century was the 're-opening' of the dense and continuous fabric of cities on a macro scale, e.g. the concept of garden cities and suburbs (il. 3b), large housing estates[8] and later ideas (il. 3b). The level of an urban block was also transformed ('cleaning' the interior of a block, 'tearing up' the perimeter and, finally, the complete disappearance of the block form) [10] (il. 4 a-e).

From the point of view of the dialectics of interior and exterior, the new model can be interpreted as follows: the category of interiority at the urban level is disappearing. The building is now situated directly in the new kind of open 'city-landscape'. In the '50s–'60s of the 20th century, it became clear that the lack of the defined (i.e. enclosed) space resulted in the disappearance of urbanity as such. Balanced solutions were sought – e.g. in the circle of Team 10. One of the most interesting proposals was the idea of Aldo van Eyck's 'space that breathes' – open and closed at the same time[9]. Further waves of criticism of Modernism led in the 1970s and 1980s to the return of defined urban block and the corridor street.

Individual – collective

The built environment in the social aspect, can be defined as a system of human relationships established in a spatial form. This system reflects the complex status of the human in society, expressed in the duality of needs i.e. for isolation and integration. The man strives to maintain his own autonomy, and at the same time, as Aristotle's politikon zoon, he functions in a wider context and strives to maintain social contacts. Therefore, he demands both separate individual space and collective space that gives an opportunity to meet others. Similarly to the form, we can describe the territorial structure of the environment as a hierarchical system (Table 3.)

A traditional European city consisted of an open and accessible public space and individual spaces directly related to it (plots and townhouses)[10]. The exceptions in that structure were various forms of collective housing – monasteries, beguinages, and the early forms of social housing (such as Fuggerei in Augsburg, Hofjes in Amsterdam, etc.). These forms were distinguished by their own internal collective space. The city itself – due to its limited size, the enclosure by defensive walls, and special laws binding solely on its territory – constituted a territorial form and defined the urban community[11].

That territorial function of cities declined in the industrial age with the rapid urbanisation. At the same time, the territorial structure was transformed at the building and block levels.

Table. 3. Exemplary territorial hierarchy for a specific habitat

level of organisation	individual	collective
flat	individual rooms	common parts of the apartment
residential segment	flats	staircase, corridor, common areas
city block	residential buildings	city block's interior/courtyard
neighbourhood	urban blocks	streets/public spaces/urban infrastructure

Table. 4. Hierarchy of transformation levels for a sample habitat

level of organisation	variable (undetermined)	permanent (determined)
room	furniture	room boundary
building	internal divisions	structure
plot	building	plot boundaries
town	parcels/ buildings	streets / squares

As a result of the expansion and internal divisions, an individual townhouse evolved into a tenement house, consisting of many individual flats accessible from a common staircase, with shared courtyards. At the beginning of the 20th century, these courts were transformed into spacious internal courtyards in the new kind of social housing [13]. The dichotomy (public street – private house) has been replaced with a more complex hierarchy (public street – semi-public courtyard – building – flat).

Along with Modernism and the collapse of the perimeter urban block, urban space lost any territorial features. Free–standing and freely composed buildings no longer defined legible zones that could be assigned to specific groups of residents. Thus, since the 1970s, it has been postulated to return to legible territorial hierarchies [14].

The territorial transformations affected the city also at a macro scale. The urban reformers of the early 20th century struggled against anonymity and the disappearance of social ties in cities. The tool for it was supposed to be the 're-structuring' of urban spaces, i.e. dividing them into identifiable cells. For example, C. Perry postulated a division of the city into autonomous fragments defined by transit communication, and integrated through a common services[12]. The concept found a wide response among post–war modernist architects[13] and contributed to the development of the final form of a large housing estate (grand ensemble).

The actual success of post-war housing estate planning as the generator of neighbourly bonds is being questioned today. It seems that the separation of these areas from traditional city centres, combined with dispersed urban tissue, contributed to the further decline of a traditional urban life rather than to its reactivation. According to Hillier, the generator of contacts is a well–defined, permeable network of public space rather than the isolated enclaves [17].

The contemporary fragmentation of the city structure no longer results from ideological assumptions, but rather from the inertia of planning systems that are unable to counteract the

dispersion of urban fabric. Today we are also dealing with the phenomenon of 'privatization' of urban space. It is manifested, among others, by 'gated communities', separated from the system of public space for the sake of comfort and supposed safety of their residents [18].

Variable – permanent

The built environment can be viewed dynamically, i.e. as a process of transformation performed by individuals, groups, and institutions. The dynamics of changes differs in individual spatial scales - some arrangements change quickly, others are relatively persistent [19]. As before, it is possible to describe the transformation process in a hierarchical way (Table 4.).

The dynamics of environment is related to the control over transformations, which at different levels is exercised by different entities. The history of city building can be interpreted as a sequence of shifts of control over space. The emergence of control over the public space, executed by the political power, has marked the beginning of urban planning[14]. The modernity in urban design – from Vendome Square, through the activity of G. Haussmann or 'garden city' designs by R. Unwin, and the functional city – can be understood as a process of the centralization of control over urban form at the expense of individuals. The turning point of this tendency was manifested in the failure of large social housing estates in the second half of the 20th century.

In response to the monotony and inflexibility of these developments, the movement for the 'user participation' has been born. In the 1960s, John Habraken introduced the support-infill concept [22]. The 'support' was to be a permanent element of the building (e.g.

8 [9] pp. 33–42.
9 [4] pp. 325–327.
10 This distinguishes the European model from, for example, a city in the Middle East, composed of relatively isolated family, tribal, and religious enclaves. [11] pp. 287–288.
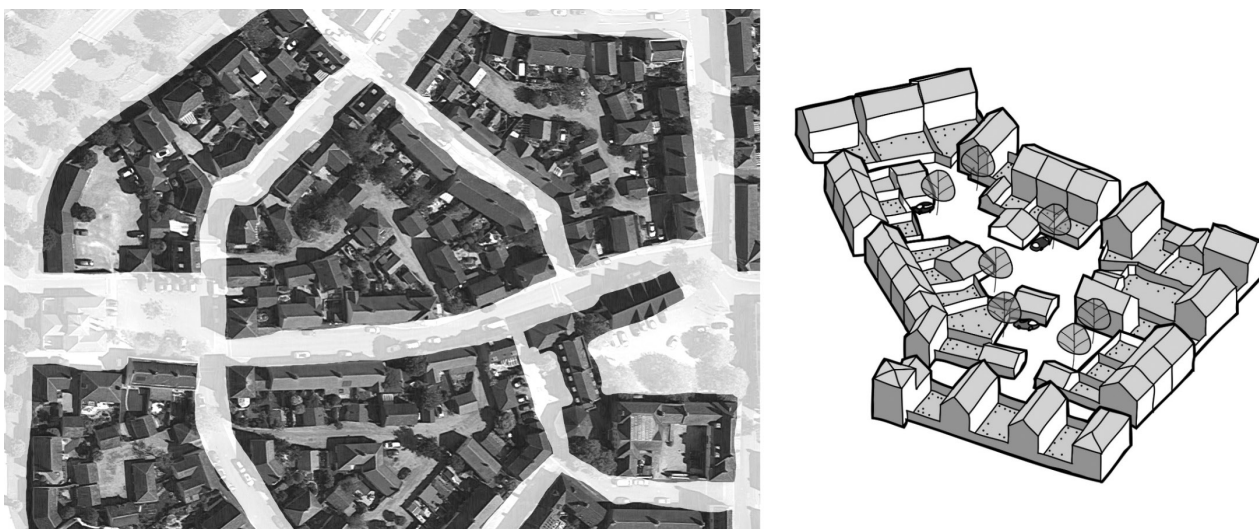11 [12] pp.13–72.
12 [15] pp. 27–28.
13 [16] p. 170.
14 [20] pp. 150-154 and also [21] pp. 37–39.

Il. 5. Nordwestbahnhof project in Vienna – master plan and perspective view (www.enf.ch)

Il. 6. Poundbury, England – fragments. On the left: the arrangement of residential blocks and public space; on the right: the organization of a single block (left: based on Google, right: author's drawing)

structural frame, mechanical and electrical systems etc), provided by the public entity. The control over variable 'infill' (e.g. internal partitions) would be given to the residents. The concept explains the correct principle of environmental organisation on any scale. For example: a street controlled by the community allows for a private construction, tenants in an office building are allowed to make individual internal arrangements, etc. The gradual distribution of control seems natural to the habitat. Both excessive centralization, as well as excessive dispersion of control (present e.g. in spontaneous settlements, like favelas) should be avoided. We need both permanent configurations that will stabilize our environment and regulate basic relationships on a large scale, as well as the possibility of individual expression and quick response to changing needs - order and freedom.

Designing
a balanced environment

Is it possible to create a completely 'binary' environment that fully icludes all 3 aspects and their opposing values? Such an ideal would require a perfect harmony of form and process, and a balance of bottom-up factors and institutional control. In the theories from the beginning of the 20th century (e.g. in Louis Mumford or R. Unwin), such an ideal was an early, not yet over-densified medieval city. In the complex conditions of the today's metropolis, we can rather consider specific design interventions that may have a positive or negative impact on the global balance of the habitat.

The given analysis leads to the conclusion that the key of design is to identify tensions and prioritize them in the process of shaping the idea. The measure of success is the spatial and functional articulation of binary values.

There are numerous contemporary projects on various scales, in which highlighting opposites and linking them into a coherent whole is the is a design priority.

For example, the deliberate shaping of the open-closed relationship may be observed Nordwestbahnhof project in Vienna by ENF Architekten Zürich (the original competition entry from 2009). The design of the new urban district in the disused railway area contrasts a compact urban blocks and a vast, open park space. As a result, well-defined urban spaces as well as wide open vistas and direct contact with the green landscape for inhabitants were obtained (il. 5.).

An example of a consciously shaped individual-collective relationship is the urban project of the English town of Poundbury by Leon Krier, carried out continuously since 1993. The design maintains the traditional division

Il. 7. Borneo, Amsterdam (Google, Wikimedia Commons)

of space into public streets and residential blocks. In turn, within the blocks, private plots can be distinguished around the perimeter and a semi-public courtyard inside. The urban tissue is based on a clear territorial hierarchy: public-semi-public-private (il. 6.).

The variable-permanent relationship is brilliantly highlighted in the renowned Borneo harbour district in Amsterdam (completed in 2000). The innovation here was the introduction of user participation in a single large development. The complex includes 60 terraced houses individually designed by various architects for individual clients [24, pp.136-137]. Each of the houses had to meet the constraints of the master plan (by WEST 8). The development combines order and unification at the urban level with freedom and variability at the architectural level (il. 7.).

Conclusions

The presented considerations reveal the image of the environment as a multi-level and multi-faceted structure. The primary purpose of this structure is to harmonize opposing human needs. Conscious action in the environment consists in establishing the boundary between opposites and regulating their mutual tension[15]. This does not mean, however, that the environment is always balanced. Individual activities may conflict with each other or lead to imbalances on a different scale of the organization. This is evidenced by the constant attempts to repair the habitat, which are present in the history of architecture and town planning. A perfectly healthy environment, that is, perfectly balanced at all levels, is an ideal rather than a description of reality. However, this ideal is needed if we want to construct criteria for assessing specific solutions. The important role of architectural theory and education is marked here, which, apart from partial research and specialized teaching, should also deepen and convey the overall picture of the environment as a system of organized relations.

Bibliography

[1] Piaget J., Strukturalizm, Wiedza Powszechna, Warszawa 1972.
[2] Hertzberger H., Architecture and Structuralism. The Ordering of Space, Nai Publishers, Rotterdam 2015.
[3] Krokiewicz A., Zarys filozofii greckiej. Od Talesa do Platona, PAX, Warszawa 1971.
[4] Strauven F., Aldo van Eyck. The Shape of Relativity, Architectura & Natura, Amsterdam 1998.
[5] Norberg-Schulz Ch., Genius Loci, Towards a Phenomenology of Architecture, Rizzoli, New York 1980.
[6] Lakoff G., Johnson M., Metaphors We Live By, The University of Chicago Press, Chicago 1980.
[7] Feliciotti, Alessandra & Romice, Ombretta & Porta, Sergio. (2018). From system ecology to urban morphology: towards a theory of urban form resilience. 5993. 10.3390/IFOU2018-05993.
[8] Różańska G., Obraz miasta w „Ziemi obiecanej" Władysława Stanisława Reymonta. „Słupskie Prace Filologiczne. Seria Filologia Polska" 2002 no 1 pp. 141-147.
[9] Wojtkun G., Osiedle mieszkaniowe w strukturze miasta XX wieku, Politechnika Szczecińska, Szczecin 2004.
[10] Panerei P., Castex J., Depaule J., Urban forms. The death and life of the urban block, Architectural Press, Oxford 2004.
[11] Habraken N.J., The Structure of the Ordinary: Form and Control in the Built Environment, The MIT Press, Cambridge, Mass. 2000.
[12] Mumford L., The Culture of Cities, Secker & Warburg, London 1945.
[13] Kononowicz W., Między tradycją a nowoczesnością. Przyczynek do rozwoju racjonalnych form budownictwa mieszkaniowego we Wrocławiu w latach 1874-1930, „Architectus" Nr 1(19) 2006, pp.19–30.
[14] Newman O., Defensible Space – Crime Preventiom Through Urban Design. Collier Books, New York 1973.
[15] Chwalibog K., Ewolucja struktury zespołów mieszkaniowych, Panstwowe Wydawnictwo Naukowe, Warszawa 1976.
[16] Mumford E., The CIAM Discourse on Urbanism 1928–1960, The MIT Press, Cambridge, Mass. 2002.
[17] Hanson J., Hillier B., The architecture of community: some new proposals on the social consequences of architectural and planning decisions, "Architecture et Comportement/Architecture and Behaviour" , vol. 3, nr 3/1987, pp. 251–273.
[18] Januszewski W., Habitat as a process: The concept of the built environment from a dynamic perspective, "Housing Environment" 31/2020, DOI: 10.4467/25438700SM.20.011.12685.
[19] Jałowiecki B., Łukowski W., Gettoizacja polskiej przestrzeni miejskiej, Scholar, Warszawa 2007.
[20] Tobolczyk M., Narodziny architektury, Wydawnictwo Naukowe PWN, Warszawa 2000.
[21] Pawłowski K., Urbanistyka a'la Française, vol.1, Universitas, Kraków 2016.
[22] Habraken N.J., Aap Noot Mies Huis. Three r's for housing, "Forum" no. 1/1966, pp. 1–38.
[23] Levi-Strauss C., Antropologia strukturalna, Aletheia, Warszawa 2009.
[24] Abrahamse J., Buurman M., Hulsman B., Ibelings H., Jolles A., Eastern Harbour District Amsterdam: Urbanism and Architecture, NAi Publishers, Rotterdam 2006.

Abstract: The subject of this work is an in-depth analysis of the structure of the built environment as a system of organised relations. Three elementary aspects expressed in binary oppositions were distinguished: interior – exterior (formal aspect), individual – collective (social aspect), variable – permanent (dynamic aspect). These aspects reflect the diverse psychophysical needs and existential states of a human being. The reorganisation of a habitat is a change in the internal relationships of these categories in a specific region and spatial scale. A healthy environment can be defined as one that balances polar categories at each level of the analysis. Reforms and re-evaluations in the built environment can be interpreted as attempts to restore balance, as illustrated with examples from the history of architecture and urban planning. The results of the work contribute to the general theory of the built environment, essential for the proper design process in a wide spectrum of spatial scale.

Keywords: built environment theory, structuralism, habitat, healthy environment

Streszczenie: ZDROWE ŚRODOWISKO ZBUDOWANE W UJĘCIU STRUKTURALISTYCZNYM. Przedmiotem pracy jest pogłębiona analiza struktury środowiska zbudowanego jako system zorganizowanych relacji. Wyodrębniono trzy elementarne aspekty wyrażone w opozycjach binarnych: wnętrze – zewnętrze (aspekt formalny), indywidualne – kolektywne (aspekt społeczny), trwałość – zmienność (aspekt dynamiczny). Aspekty te odzwierciedlają zróżnicowane potrzeby psychofizyczne oraz stany egzystencjalne człowieka. Reorganizacja habitatu jest zmianą wewnętrznych relacji ww. kategorii w określonym regionie i skali przestrzennej. Zdrowe środowisko można określić jako takie, które równoważy biegunowe kategorie na każdym poziomie analizy. Reformy, a także przewartościowania w środowisku zbudowanym są próbami przywrócenia jego równowagi, co zilustrowano przykładami z historii architektury oraz urbanistyki. Wyniki pracy stanowią przyczynek do ogólnej teorii habitatu i prawidłowego procesu projektowego w szerokim spektrum skali przestrzennej.

Słowa kluczowe: teoria środowiska zbudowanego, strukturalizm, habitat, zdrowe środowisko

[15] Therefore, the slogan of Van Eyck seems to be right, to whom architecture is 'form of 'in-between'.