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Expansion of Behavioural Comfort Zone within Former Soviet Mass Housing

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Abstract. A potentially wide-used architectural approach suitable for mass housing in the form of standard-type apartment buildings erected of bricks at the end of 1960-s is posed and analyzed in the paper; namely, the capability of a renovated building's exterior space as a system of balconies and loggias to improve simultaneously the inhabitants' domestic activity scheme and the use of the dwellings' area. As a result, the dependence between the appearance of free surplus of the living area and the use of the renovated exterior space area under different weather conditions is represented. The study could add a new view at the layout and content of balconies/loggias to the (inevitable) future programs of mass housing renovation.
Keywords: sustainable architecture, mass housing, exterior space, retrofit, architectural design

1. Introduction

1.1. Current urban context as a problem

The initial phase of general industrial housing era (1950 – 70s) marked with uniformity in designing and construction processes, left a huge footprint on Soviet urban fabric. For instance, in Chelyabinsk city (population – 1.2 million) more than 40% of building stock belong to such housing (about 9.73 million of square meters [1]); but the percent is more or less the same in other similar cities. Partially imported from Western Europe as early as 1930s [2,3] and developed for the postwar decade, mass-built production technologies allowed to create rational and affordable housing, in terms of materials economy, speed of production and erection, for wide social classes. However, having been successfully used for overcoming dwelling shortage at postwar urbanization period the 'conveyer' housing had become a problem by the end of the 20th century. It has been fairly criticized both for its inadequate spatial conditions (the most spacious apartment rarely exceed 56 m2) and for uncomfortable microclimate (winter low and high summer temperatures). Nowadays these disadvantages are becoming increasingly prominent (especially being compared with conditions supplied by modern buildings). It has caused self-dependent improving activity from the direction of householders such as: construction additional balconies (especially on ground floors), extensions of existing balcony slabs, glazing, mounting of opaque screens as a visual and sun protection (figure 1).

The mentioned lacks routinely return the local professional community and authorities to an issue of mass-built housing regeneration. But the vast bulk of the building stock and extremely limited funds for reconstructive measures in Chelyabinsk (as well as in other similar cities) only induce to design local strategies which enable, on the one hand, to improve microclimatic conditions in apartments and,

on the other, – to reform image of notoriously dull appearance of the mass housing environment, that often occupies central and the most valuable areas of the city.

It is presumed in this study that the means which is able to meet the requirements and conditions mentioned above can be a retrofitting of apartments exterior space (hereafter – ES) of which transformations and influences are simulated by the example of a representative pattern of the housing stock – the sample building (hereafter – SB), seen in figure 1. This space is mostly represented in the form of small open balconies, attached to living rooms, with a modest area – from 1.5 to 2.4 m2 per a flat and the absence of any visual barriers. Although there were a number of improvements in balconies' and loggias' layout (for example, extension and glazing) in later standard-type projects (in 1980 – 90s) the ones in the earlier buildings in their majority still stay uncomfortable as a semi-private apartments' extensions unable to give habitants valuable room for wide activity at any height.

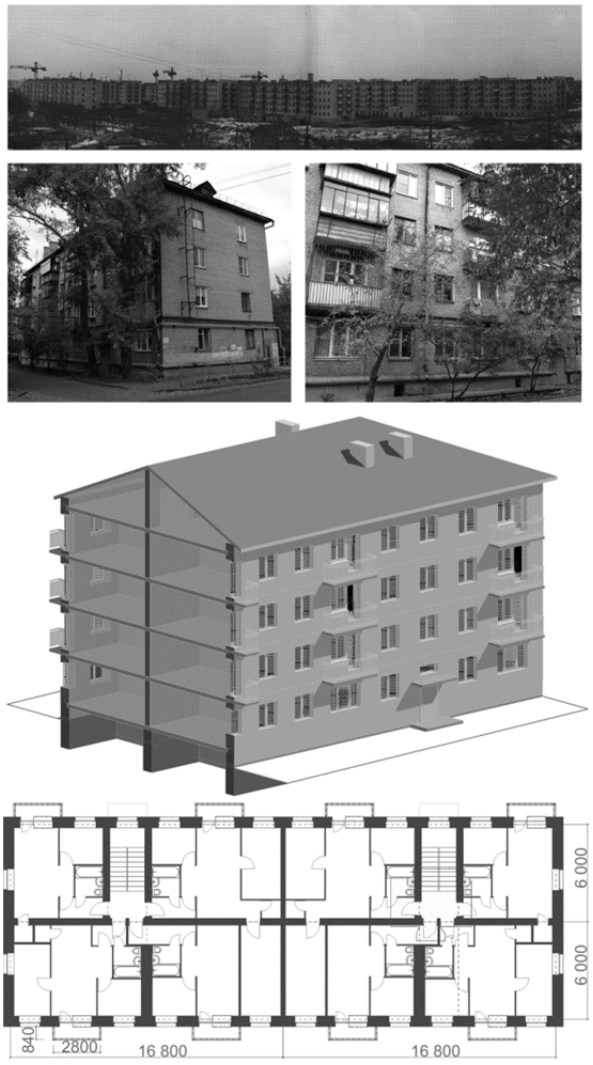

Figure 1. Standard-type apartment blocks in 1960s and today, Chelyabinsk. SB model: axonometric section, residential floors plan.

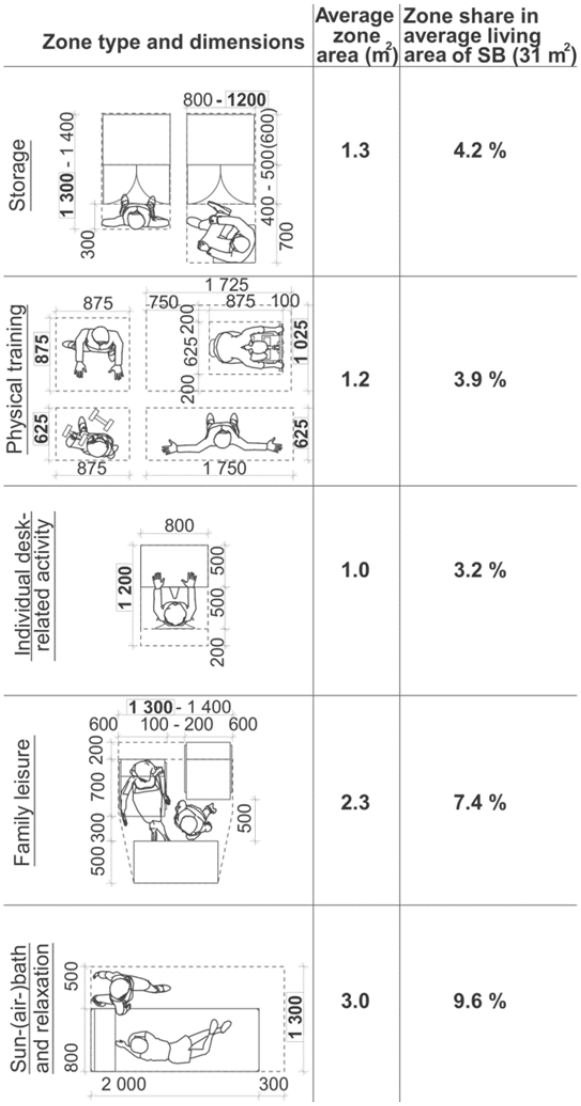

Figure 2. Characteristics of functional zones which are typical for balconies/loggias.

1.2. Aim and objectives

Pursuing the aim to survey the effect of ES retrofitting with regard to improvement in residents' routine activity, the study poses a range of objectives: 1) to determine action-based dimensions of the balconies/loggias, that can be realized as retrofitting measures; 2) to discover advantages of ES as a temporary alternative area to transfer the functional zones determined from an apartment; 3) to define periods of ES use based on combination of local climatic factors.

2. Materials and method

2.1. Building and environmental potential for the exterior space retrofitting as a material for solving the problem

One of the factors that may be considered as potential is typical urban design of the considered housing segment. Density of the standard-type residential estates is not high – for instance, mean interval between adjoining blocks of flats equals to the block's sesquialteral height (that is 22 meters in the case of SB). This allows to generate new spacious balconies and loggias with adjusted configuration based upon independent substructures on every façade. With all configurations of ES, remoteness of surrounding buildings supports favorable solar conditions in apartments and yards.

Another aspect where there is an action potential towards effective renovation by means of the ES transformation is environmental qualities. Openness or semi-openness of apartments external rooms is a property allowing inhabitants to be outdoors without leaving a building and thereby to use hygienic characteristics of open air: its coolness, influencing over mental tiredness and heat exchange of a body with environment as well as its clearness (as opposed to high level of CO_2 indoors), enabling to take exercises more effectively. Besides staying in an unglazed outer area makes it possible to gain ultra-violet rays, health-giving for an organism, which are not enough indoor because of cutting off by windowpanes. And finally – views towards natural environment inside courts. Regarding the housing type that is under consideration this is the case: the wide yards which are shaped by the rows of the buildings were planted extensively in 1970s and now allows dwellers to enjoy rich greenery being home (especially as the blocks of flats, as a rule, do not exceed the trees height).

The next relevant attribute of the buildings in favour of the renovation can be revealed through the fact that according to the National housing code such spaces as balconies, loggias, terraces etc. are non-taxable as to immovable property tax. Consequently, their assumed expansion when planning the retrofitting does not have any impact on rent. Therefore, habitants can get additional enclosed room for themselves without rising both service and tax expenditures.

One more factor relates to a widely held idea that low-rise blocks of flats psychologically and socially are much more suitable for its occupants, compared with high-rise ones, especially for multi-generational families [4]. This fully applies to the housing which has advantage of low-rising (3 – 5 stories).

The evidences listed underline considerable potential of the building stock and count in favour of ES as an affordable resource for qualitative changes in living standard and achieving massive renovating effect of this segment of housing.

2.2. Demarcating the ES

Relying upon typical functions that any dwelling everywhere is created for [5], a set of them is selected as a framework of residents' activity on adjoined exterior areas. These usual functions are as follows: storing (for example off-season clothes), physical training (with or without special accessories), individual desk-related activity (study, work or hobby), group leisure (meals in family surroundings) and relaxation (sun/air-bathing, lying etc.). In figure 2 it can be seen how sizes of human body fulfilling the functions and pieces of related domestic equipment determine dimensions of the functional zones (the method is offered in [6]). A zone's standard sizes give at least one necessary and sufficient dimension – 1.3 m (instead of current one that is 0.84 m) – that can be assumed for the width of the ES (and that is additionally sufficient to reduce vulnerability to overheating – up to 42%

with a 1.2 m or more of covering [7]). As for the length, two variants can be considered: preservation the existing size – 2.8 m or development along an apartment's perimeter up to the next one (and ultimately – around the periphery of the building). All in all four types of the balconies, each with one or two assess from every room, are shaped; the proportions are: I – 2.8x1.3 m, II – 5.6x1.3 m, III – 8.4x1.3 m, IV – 14x1.3 m (figure 3).

The four types outline possible schemes of expansion of the apartments' functional program with the use of new scope of the outer rooms and at the same time solve the problem of visual isolation of respective activity. Privacy in the apartments open areas is provided by partitions which are placed at the boundaries vertically (from a slab to another) and horizontally (above the top floor's balcony) converting some balconies into loggias.

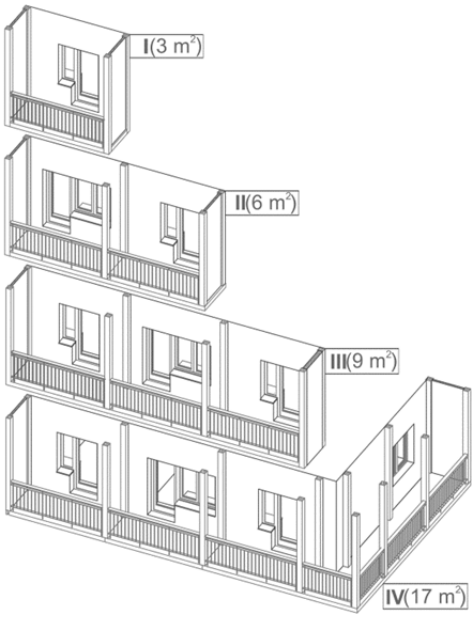

Figure 3. Balconies types with available areas.

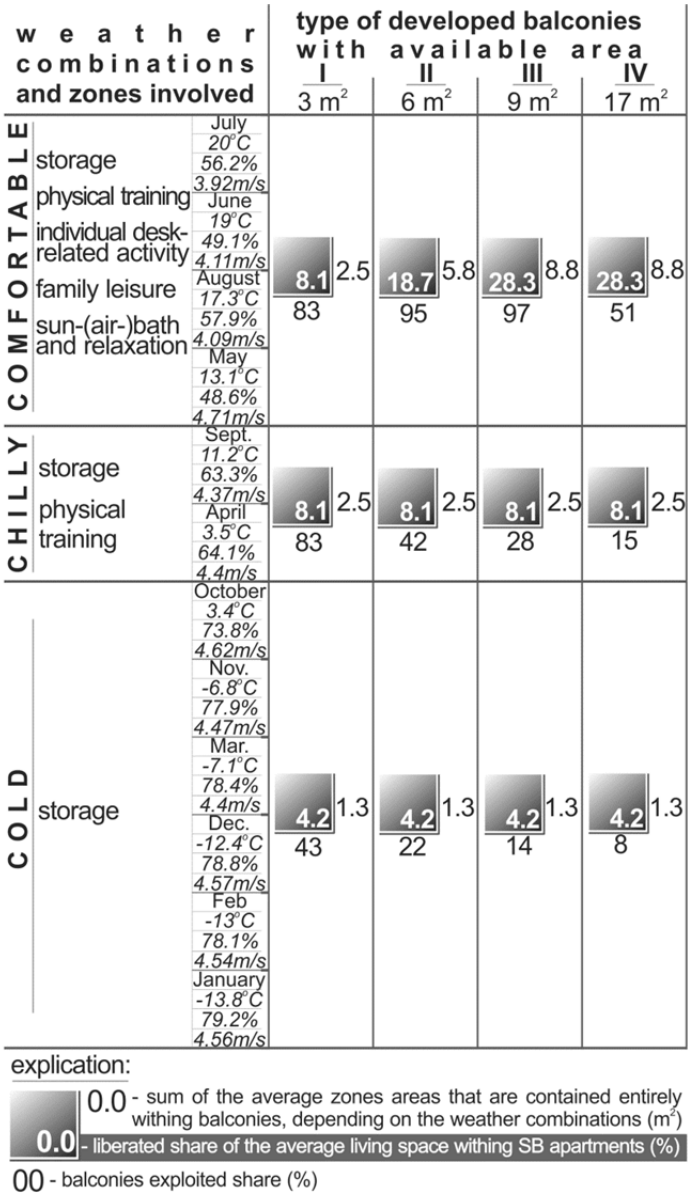

Figure 4. Weather combinations influence on the share of an apartment liberated when the functions are transferred to ES; effectiveness of the balconies types use.

3. Results

The zones standard sizes and ranked weather conditions enable to evaluate the exploited share of the external room and the area which would alternatively have been occupied indoors in the case of absence or disuse of any ES attached to the apartments at all (that often happens in the practice because of their inadequate sizes and lack of comfort). As it is shown in figure 4 the use of any balcony type as an extra area for domestic activity is directly connected with the weather conditions, which are fixed with combinations of meteorological parameters in terms of their convenience for a person (according to Climates of the USSR, 1958 – 68 [8]). The mean data, first of all, on temperature, then relative humidity or windspeed for Chelyabinsk climate are corresponded to the three weather combinations: cold (-36 – +4 ^{o}C under 2 m/s or less; -28 – +4 ^{o}C under 2 – 5 m/s; -20 – +4 ^{o}C under 5 – 10 m/s; -12 – +4 ^{o}C under 10 m/s or more), chilly (4–12 ^{o}C under around 0 m/s) and comfortable (12 – 24 ^{o}C under 25 – 74 %; 12 – 20 ^{o}C under 75 %). Since the cold period, when isolated from environment mode of activity is recommended, lasts half of a year: there is the only storage zone that normally can be included in ES functional program under such conditions. The zones implying constant presence of people can be completely realized with any of the balcony type during comfortable and partially chilly weather, where warm clothes are unnecessary for the dwellers involved. To a certain degree glazing of balconies/loggias front could prolong the period of their useful exploitation and even encourage some kinds of activity (for example, protection from adverse weather can support physical activity [9]). However, it is evident that the ES is only able to serve fully for four months in the local climate.

From the point of view of the annual exploited area, indicated in figure 4, balcony type I, the area of which is used by 63 % on average for three quarters of the year, seems the most effective. On the other hand, from the position of comfort-related aspects, this type is unable to contain the full functional program (merely sports and storage zones) during the rest tierce of the year, when the weather allows wide scope of open-air activity for the inhabitants of flats.

In this light the most rational approach gives the balcony type III. This can be used almost completely in the comfort weather (97 %) at the same time preventing appearance of unexploited area during this period in contrast to the balcony type IV nearly half of those area is surplus in the peak of the use. Although the functional zones can be placed more easily, with their not only average but maximum areas, in large balcony (type IV), but it does not add significantly to the quality of the residents' lifestyle. On the criteria of maximum use under full roominess neither simple widening without developing the length (balcony type I) nor surrounding the full apartment's perimeter (causes the appearance of type IV) seem to be optimal (though, of course, they are able to improve the current living standard). Therefore, it is an intermediate variant (embodied in type III) that both fits the criteria and is able to release 28 % of average living space (in SB) from the functions transferred to ES during the peak of its use.

4. Conclusions

Addressing apartments ES as an object for study and design this research can provide a framework for a number of future investigations on the theme and draw out applied recommendations by:

1) giving the reasons to purposefully design anew or retrofit balconies/loggias systems, in the local context, as alternative venue for storing, physical activity, individual desk-related activity, group leisure, relaxation and maybe gardening (that is not the case today), as well as determining the optimal dimensions of a balcony/loggia – 8.4x1.3 m (taking into consideration the peculiarities of the use throughout the year) – for an individual dwelling unit to realize the full functional program;

2) indicating the most suitable area to encourage physical training (views of people, activity, and nature from exercise areas potentially increase use of these spaces, according to [9] and balconies permit greater external visibility), whereby contributing to overcoming of some undesirable consequences of physical inactivity and sedentary behaviour [10];

3) promoting inclusion the outer extension of dwelling units in unobstructed, flexible and loopback space (that is possible during the retrofitting by removal existing grade changes between indoors and

outdoors of apartments and by providing additional exits to the unseparated balcony from every room), again claiming ES as a room for physical activity in the form of free 'recreational walking' around the apartments;

4) stressing the human dimension of the retrofitting process: it is worth mentioning here that the basic official standard considering socio-demographic factors for architectural design of apartment buildings [11] only concerns dependence balconies/loggias design on climatic parameters, distance from sources of noise pollution, dustiness of surrounding air and fire-prevention measures, that are not sufficient today when the focus in housing design is being shifting to greater humanization with transfer subjective attitude and emotional needs into the spotlight;

5) highlighting ES as a compensation, in a varying degree, for reluctantly used communal 'backcourts' due to often being utilitarian busy, noisy and dirty [12] in the form of private outdoor area, which, being the only apartment connection with surroundings, can neutralize indoors weak activity especially of those vulnerable residents (infants and elderly) living on upper floors that causes obstacles to their routine mobility;

6) identifying a possible basis for subsequent all energy-related building upgrades within the local housing stock [13] since for being generally accepted, besides reducing respective expenditures, any renovation on reducing energy consumption should primarily improve some basic conditions of living in a particular apartment or house [14].

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