Potential of territory renovation of residential buildings dating from 1958 to 1975

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Abstract. By 2020, the majority of residential buildings, built in period from 1950 to 1970, will be more than 50 years old and their lifetime will be exhausted. Buildings demand modernization as well as the territory itself. The subject of building renovation of the considered period becomes more and more relevant in Russia. The housing, built in the considered period, has become outdated morally and physically. The development strategy of inhabited planning units renovation is necessary. In the article, the research of the building territory of 1958-1975 with the identification of planning schemes for the micro districts in Yekaterinburg, which aren't deformed by the pointed building, are described. Based on the comparison of modern standards with the standards of the period under review, the calculation of "the renovation potential" (the number of living space, which is possible and reasonable to integrate into the existing development) is given, in general, around the city and in particular, on the remained complete formations of micro-district scale. The assessment of micro-districts of the developed territories suitability for the transformation into modern quarters is given.

1. Introduction
The beginning of panel housing construction is considered to be the 1950th, but historically, the first experimental buildings had been built in the twenties the last century. The first house made of large reinforced concrete panels in Russia was built in Berezovsky town (20 km from Yekaterinburg) in 1945 [1]. In Berezovsky, one of the first plants that produce concrete panels for buildings and constructions was built and it still works. A bit later, during the era of Khrushchev governance (1953-1964), the era of industrial housing construction came. Due to the housing policy carried out during those years, people were settled from ramshackle housing, barracks, dug-outs and communal flats to more comfortable and private housing. In total, during the period from 1959 to 1985 about 290 million m2 total area of houses of the first mass series - "khrushchevka" were built that makes about 10% of all housing stock of the country [2]. In Sverdlovsk (the name of Yekaterinburg till 1991), from 1952 to 1961 2426 thousand m2 of living space [3], was built, of which more than 1120 thousand m2 – pre-fabricated block and panel buildings [4]. Proceeding from the standard of living space on the person in those years (9 m / persons), 124 thousand people were provided with housing successfully.

In 1950-1970 years rather high standard of living was provided in comparison with earlier years [5]. Large sites of territories, mainly in suburbs of the city, were building up with pre-fabricated panel, block and rare – brick buildings. The main unit of the housing estate during the considered period was the micro district. Micro districts were social and planning units – besides residential buildings they included the separate or attached buildings of schools, kindergartens, hospitals, shops.
As it is analysed by Meerovich M.G. [6], Kanter M.M., Karpenko M.H. [7], Zhdanova I.V. [8], Chazova O.L. [9] and others, physical deterioration and the obsolescence of buildings and territories of the period of 1958-1970 is extremely big. All scientists agree on one position – design of the development strategy for the built-up territories is necessary, because the micro districts that were built during the considered period are situated in all territory of Russia, and the residential buildings and the system of public service have ceased to satisfy to the current needs of the population [10].

Nowadays, the theory of micro district construction has become obsolete, but the question of an opportunity and expediency of transformation of micro districts in quarters, which are more comfortable for life, is little studied. In Russian urban-planning practice there are no examples of complex revitalization of territories without full demolition of buildings.

In Moscow in 2017 the large-scale project of renovation was launched, during which demolition of a large number of buildings with resettlement of inhabitants was held. This project has caused a big controversy, both among architectural community, and inhabitants of the demolished buildings. In Yekaterinburg, as well as in many other Russian cities, there is no opportunity for implementation of the project of renovation that is similar to the one launched in Moscow. The reasons are the lack of regional programs of renovation, insufficient financing from the federal budget and low interest of investors in development of the built-up territories.

2. Methodology

In this article the main attention is paid not to internal lay-out and structures of buildings, but to the established planning schemes of micro districts.

The first investigation stage was the analysis of historical evolution of urban planning design standards in the territory of modern Russia since 1930 up to now. It was revealed that standards changed 3 times in 1958, 1962 and 1975. Their careful comparison and also processing of statistical data of population and input of living spaces has allowed calculating “the renovation potential”.

During the analysis of archival and bibliographic sources [11,12] the following types of planning schemes of micro districts were revealed: group, perimeter, line, free and combined (Figure 1). Perimeter building scheme is characterized by an arrangement of buildings along red lines (street boundaries). Group scheme is a combination of several groups of buildings in the territory of the micro district. Line scheme is characterized by identical orientation of all buildings often not in parallel and not perpendicular to streets. Such types of building were recommended for town-planners and architects to implement in project design of micro districts.

![Figure 1. Types of planning scheme: group, perimeter, line, free.](image)

The retrospective analysis of maps, masterplans and references of the beginning and the end of the researched period allowed to find the territories where building was carried during the considered period. The cartographical analysis, graphic-analytical and computer modelling were used in order to detect types of building schemes of micro districts in Yekaterinburg. Identification and assignment to planning schemes of a certain type is made by method of comparing and analogies. Years of buildings construction, their structures and number of floors are revealed by using of the database of the Fund for Assistance in Reforming Housing and Communal Services website [4].

As a result, the most widespread planning schemes in building of Sverdlovsk in 1958-1975 are defined. Assessment of suitability of micro districts planning schemes for conversion to quarters is made and living space (“the renovation potential”) which is possible for entering into the established building proceeding from the changed standards of density of living space is calculated.
3. Measurement and analysis

| Evolution of standards of urban planning design |
|------------------------------------------------|
| In order to conduct the comparison, norms and standards of building developed from 1930 to 2016 [13-17] were studied. In this period, standards completely changed five times. It is important to note increase of a norm of living space per person and increase of density of living space (the ratio of the area of living space to the area of the territory of building). Besides, the optimum number of floors of the housing estate was changed (from 4 floors in norms of 1930 up to 9 floors in 1975). The most interesting change is an optimum residential planning unit – a quarter in 1930, micro district in 1958-2016, and now again a quarter in the newest norms from 2016. The comparative Table 1 is given below. |

Table 1. Comparison of the norms of urban planning.

|                  | 1930                | 1958                | 1962                | 1975                | 2016                |
|------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| residential planning unit | quarter            | micro district      | micro district      | micro district      | micro district      |
| norm of living space per person, $\eta$, [m2/person] | no standart         | 9                   | 9                   | 14,5                | 20-30               |
| population density [person/ha] | 200-300            | 330-400             | -                   | -                   | max 450             |
| optimum number of floors | 4                  | 4-5                 | 5                   | 5-9                 | no standart         |
| optimum planning scheme | tape               | free                | no standart         | no standart         | no standart         |
| density of building [%] | 25, max 40         | max 24*             | max 21*             | no standart         | -                   |
| density of living space, $\varphi$, [m2/ha] | no standart         | 2400-3000*          | 2800-3200*          | 5300-5900*          | -                   |
| coefficient of building | -                  | -                   | -                   | -                   | 0,4**               |
| coefficient of living space | -                  | -                   | -                   | -                   | 0,8**               |

* - for five-floor building
** - for building of small and average number of floors
***- for Yekaterinburg for 2017

| Population and dynamics of input of housing |
|---------------------------------------------|
| In order to conduct the assessment of scales of housing reform of Khrushchev, data of the Russian statistical yearbook were studied [18]. Data of input of living spaces in Yekaterinburg (Sverdlovsk) were found. Even excluding the living space built in villages, the number of the built housing and number of people whose living conditions have been improved, is enormously big. |
| Being based on the official data of the Fund for Assistance in Reforming Housing and Communal Services [4] website, the volume of input of living space in Sverdlovsk for the considered period is revealed. Data of input of housing and also density of living space which is most allowed by norms and standards of that time are provided in Table 2. |

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Table 2. Input of housing in Sverdlovsk.

| Year    | Number of buildings | Common living area, m² | Average number of storeys | Population  |
|---------|---------------------|------------------------|---------------------------|-------------|
| 1958    | 216                 | 416201,71              | 3,875                     | no data     |
| 1959    | 314                 | 621304,30              | 3,486                     | 778 602     |
| 1960    | 316                 | 610349,65              | 3,877                     | no data     |
| 1961    | 339                 | 663381,85              | 4,167                     | no data     |
| 1962    | 288                 | 685213,01              | 4,572                     | 853 000     |
| 1963    | 234                 | 652045,87              | 4,720                     | no data     |
| 1964    | 202                 | 576159,39              | 4,822                     | no data     |
| 1965    | 185                 | 584552,05              | 4,961                     | no data     |
| 1966    | 179                 | 600817,20              | 5,050                     | no data     |
| 1967    | 168                 | 615549,30              | 4,970                     | 961 000     |
| 1968    | 177                 | 653222,93              | 5,118                     | no data     |
| 1969    | 164                 | 602778,12              | 5,461                     | no data     |
| 1970    | 177                 | 672098,18              | 5,601                     | 1 025 045   |
| 1971    | 148                 | 627801,80              | 5,995                     | no data     |
| 1972    | 140                 | 676269,38              | 5,837                     | no data     |
| 1973    | 136                 | 724127,72              | 6,717                     | 1 099 000   |
| 1974    | 128                 | 655727,36              | 6,720                     | no data     |
| 1975    | 117                 | 694532,07              | 7,538                     | 1 163 000   |
in all  | 3628                |                        |                           | 11332132    |

"The renovation potential"
In order to assess investment attractiveness of build-up sites it is necessary to know how many living spaces can be entered in addition. The statistics given in able 2 has allowed calculating in a first approximation living space, potentially possible for consolidation in micro districts.

The integrated calculation of renovation potential is presented in Table 3.

Table 3. Calculation of renovation potential for the city in general.

| Input of housing, N, m² | Density of living space, p, m²/ha | Busy by building land plots, S=N/p, ha | Possible general living space in modern norms, Ng.=S×8000, m² | Renovation potential, Np=Ng-N, m² |
|-------------------------|----------------------------------|----------------------------------------|-----------------------------------------------------------|----------------------------------|
| 1958-1962               | 2 996 451                        | 3 000                                  | 998,8                                                     | 7 990 534,7                     | 4 994 084,2                       |
| 1963-1975               | 8 335 681                        | 3 200                                  | 2 604,9                                                   | 20 839 203,4                    | 12 503 522,1                     |
| in all                  | 11 332 132                       | 3 603,7                                | 7 829 738,1                                               | 28 829 738,1                    | 17 497 606,3                     |

Proceeding from the increased admissible density of living space it is possible to a conclude that the building of the considered period existing in the territory of Yekaterinburg can be condensed (to increase living space by construction of new buildings or by superstructure) for 154% on average. This figure is received excluding already introduced in the considered micro districts of pointed building – in micro districts with modern pointed building density of living space is higher, than it was allowed during the considered period.
Typology of building of micro districts in 1958-1975
In Sverdlovsk both pointed building, and building of integral micro districts was conducted, many of them have remained without any urban planning interventions. For more exact assessment of renovation potential the integral (without modern urban intervention) micro districts set by buildings of 1958-1975 were chosen.

Proceeding from the analyzed schemes of building [11], for each micro district the prevailing type of planning scheme was defined. The summary graphic-analytical table which contains data of urban planning indexes (Ss – area of site, ha, Sl – area of living space, m², ρ - density of living space, m²/ha) of each micro district (Table 4) was made.

Table 4. The analysis of the chosen micro districts.

| Type of planning scheme | Group | Perimeter | Line | Free |
|-------------------------|-------|-----------|------|------|
|                         | Plan  | Ss  | Sl  | p   | Plan  | Ss  | Sl  | p   | Plan  | Ss  | Sl  | p   |
|                         |       |     |     |     |       |     |     |     |       |     |     |     |
|                         | 22,0  | 105409 | 4791 | 19,5 | 82279 | 4219 | 30,6 | 133074 | 4349 | 19,3 | 107436 | 5567 |
|                         | 26,5  | 106809 | 4031 | 10,5 | 48886 | 4656 | 20,1 | 95041 | 4728 |       |       |      |
|                         | 20,9  | 105279 | 5037 | 7,5  | 43063 | 5742 | 23,6 | 141048 | 5097 |       |       |      |
|                         | 19,9  | 95620  | 4805 | 54,1 | 26539 | 4924 |       | 141048 | 5097 |       |       |      |
|                         | 24,0  | 125579 | 5232 | 57,4 | 26539 | 4924 |       | 141048 | 5097 |       |       |      |
|                         | 24,0  | 134705 | 5613 |       |       |       |       |       |       |       |       |      |
|                         | 26,3  | 148301 | 5639 |       |       |       |       |       |       |       |       |      |
|                         |       | 163,6 | 821702 | 91,6 | 440617 | 74,3 | 369163 | 19,3 | 107436 |      |      |

In all
Total area of not deformed micro districts is 348.8 hectares. Total area of living space – 1.74 million m^2. The average density of living space is 5021 m^2/ha that is above standard for the considered period. Renovation potential for these micro districts is:

\[ N_p = \frac{N}{\rho} \times 8000 - N \]  

\( N_p \) – renovation potential, \( N \) – total area of living space of the considered micro districts, \( \rho \) – average density of living space, 8000 m^2/ha – admissible density of living space according to modern standards [17].

\[ N_p = \frac{1.74}{5021} \times 8000 - 1.74 \]
\[ N_p = 1.03 \text{ million m}^2 \]

In percentage expression the renovation potential of the considered micro districts will be 59%.

The prevalence of such building planning scheme as group is obvious. The second distribution type is perimeter planning scheme. These schemes are of interest to creation of renovation strategy. From the urban planning point of view these types of building schemes are the easiest to transformation to quarters because their planning solutions have the following properties: the majority of buildings are focused by facades along streets, there is more obvious division of private and public space, there is a possibility of incorporation of buildings for locking quarters.

4. Conclusion

By results of a research of building of 1958-1970 in Yekaterinburg it is defined that the considered living space makes 27.5% of the general housing in the city. Taking into account the increased limit of density of living space, building of the considered period in general around the city can be condensed for 154%.

It is revealed that in the city the complete micro districts which aren't broken by pointed building have remained. The prevailing types of planning scheme in them are group and perimeter.

The renovation potential for these micro districts is calculated.

Considering tendencies of complex sustainable development of territories, shortage of free lands for building in the city and the renovation processes started in Moscow it is possible to assume an investors interest in development of these micro districts. Cumulative renovation potential of the studied micro districts is 59%.

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