The formation of open spaces in residential construction in view of decreasing the labour intensity of their maintenance

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Abstract. The article analyses various schemes of development and maintenance of urban environment. It reveals the characteristics which improve the condition of open architectural spaces, systematizes the leading directions in this field and presents optimization schemes of load and modular stages. They serve the base for the improved optimization schemes of structure and functional zoning of open spaces. Growing load on territories necessitates the reviewing of such concepts and working out modern optimization schemes of developing urban environment. On the basis of analytical studies in this field we defined three directions and enumerated the requirements for structural and planning organization of space in a conceptual aspect. The highlighted issue is highly relevant and the suggested directions of developing city-construction on the whole are assuming priority importance.

1. Introduction

Open urban spaces are socially and functionally significant areas of the city singled out by means of buildings, various constructions and landscape which perform specific city-forming functions, contribute to the improvement of sanitation and hygiene policies (aeration, insolation) and serve as the sources of emotional and artistic climate of urban territories. Modern tendencies of city growth demonstrate two development vectors – urban expansion towards suburban areas and increased density of construction especially in the city centre through the demolition of outdated housing [1, 2]. Modern construction activity stresses the problem of mass housing quality and aesthetics of its spatial environment. The urban problem of developing and reconstructing city territories still remains underdeveloped. The term “urban environment” includes beautification and sustainability of open spaces. The creation of harmonious habitats in the city greatly depends on grounds maintenance: winter and summer city cleaning, greening and household waste management [3].

Numerous sociological surveys carried out in million-person cities confirm that the amount of people dissatisfied with their city beautification – greening, road conditions, maintaining parks, square parks and adjacent territories was 59%. Dissatisfaction with other indicators of urban environment is much lower. According to the results of the studies only 30% of new residential areas of Chelyabinsk are maintained at the appropriate level. It is therefore necessary to sort out differences between the existing architectural and construction environment and new functional processes.

One of the directions to improve the condition of open architectural spaces is the full coverage of necessary types of territory management, the organization of this process at a high technological level.
The task to decrease the labour-intensity of cleaning services and open spaces maintenance using urban development means is of particular importance here.

2. Methodology

The studied spheres of urban environment consume a great amount of social labour and, as practice shows, according to the recruiting agencies’ data, there exists a lack of staff in such spheres. Due to the fact that our country faces a decline in the population growth, there is an urgent need in the creation of efficient architectural designs in urban development sphere, concerning the social labour for the maintenance of infrastructure. If one does not take into account these requirements, the created environment will have poor maintenance and service, i.e. the quality will not satisfy a consumer[2].

Foreign urbanism expertise, in particular, design projects experience presented by Sir Andrew Derbyshire in his report “Realization of projects” is based on several rules which can be applied in our research:

- one should take into account that while moving to more advanced technologies general economics gets reoriented from a production to a service sector;
- it is forbidden to destroy nature and historically valuable landscapes;
- planning urban development should serve as social and political activities which are “inter-professional” and “non-departmental” in their initial conditions;
- we cannot neglect the citizens’ interests in pursuit of financial success;
- the planning system should be flexible;
- all possible consequences of construction activities must be born in mind;
- ongoing communication with citizens and local community is obligatory during territorial development.

Architectural and planning of urban development are not rational from the point of their servicing effort and grounds maintenance. In order to overcome this obstacle one should discover a connection between architectural and planning organization of urban environment and optimization of labour input for territory service and maintenance [4, 5].

The study involving 7 different in architectural and planning organization subdistricts demonstrates that costs in the structure of social labour in the spheres under investigation can differ 1,5-2 times (from 8 up to 14 people per 1000 citizens). It happens due to the changes in the size of serviced territories, the route length of machinery; traffic on urban motorways; areas of increased complexity of servicing and maintenance.

Characteristics influencing these indicators are the following:

- structural and planning organization of space (the scale and character of open spaces, infrastructural organization, transport and pedestrian zones of the residential area etc.) and placing the territories in the structure of higher-level construction;
- beautification issues (shape and type of horizontal cover, equipment of a housing development territory, engineering equipment of urban territories, greening, availability of transport and pedestrian communications, arrangement of entrances and adjacent areas);
- reservation of areas for urban infrastructure constructions penetrating into the territory of housing development, temporary constructions.

These characteristics depend on complex projects, i.e. a designer can reduce the labour intensity of open spaces maintenance. One should analyze the natural influence of all these characteristics on the indicators of labour intensity. While comparing modern residential subdistricts and central part of the housing development of Chelyabinsk we can trace the following regularities:

- closed spaces without transport transit are less labour intensive in their maintenance than a spacious development of modern housing constructions with numerous badly-organized parking areas of private transport. The maintenance of such territories gets complicated while the depreciation of small machinery increases.
• mixed arrangement of infrastructure objects in urban environment and high load of transport and pedestrian communications produces a negative effect on labour intensity of maintenance;
• simultaneous construction of objects on numerous sectors with the reservation of areas for future housing development in the centre of subdistricts increase labour intensity of these areas maintenance;
• the scale of construction objects and their peculiarities form different opportunities of the residents’ activities, as well as the peculiarities of their use of open spaces. The residential territory of low-rise buildings forms predominantly private (individual) and neighbouring spaces, when the proportionality of vertical dimensions of housing development and open spaces suggests psychological comfort. The higher the opportunities for the residents’ participation in the maintenance process are, the lower are the costs of public work [6].

3. Analysis of selected aspects
The analysis of various schemes of urban environment maintenance for 1970-s housing development reveals a definite system of balanced development of the territory with insignificant loads. It presupposed periodic maintenance work. In modern districts this system is preserved, though the load has increased dramatically (densification, transport and pedestrian activities) which can lead to a more rapid obsolescence of engineering networks and as a result to the increase of labour input for their maintenance. The latter leads to increased workload of servicing companies provoking obvious reduction of quality of urban spaces maintenance.

When the loads on territory continue increasing there is a need to review these concepts and work out modern optimization schemes of urban environment development. In particular, the model with an even distribution of cleaning services can be replaced by an optimization scheme of extreme load areas. This scheme suggests designating areas different in their regularity of servicing and population’s participation in this process. The areas must be serviced differently and planning should take into account various forms and possibilities of servicing [7, 8].

Analytical studies on this topic can help single out three directions which meet different requirements in architectural and planning aspects.
1. Sections of territories aimed at mechanized maintenance (consumption of services, transit lanes, localization of important functional areas).
2. Areas aimed at occasional servicing. The designation of these areas is connected with insignificant loads on the territory. Such areas provide self-serving and waste neutralization. These areas are supposed to be located in places which are least subject to functional loads.
3. Areas including active participation of residents in their maintenance. Neighbouring (community) areas are created for people living in the same neighbourhood. In fact, they present a yard or a limited access area, which is shared and controlled by residents (Figure 1, 2).

Areas suitable for self-serving are sectors of gaps between territories of different functional purpose, near-building areas and courtyard areas [9]. Creative potential of residents concerning their residential environment can ensure a considerable reduction of costs in the sphere of open urban space maintenance[9-11].

We also should note the feasibility of using modular stages. The construction in new subdistricts is usually performed within a long period of time. If the whole territory of a subdistrict is involved in building and construction, its servicing and maintenance can be really complicated.

The territory of residential clusters attracts objects of non-residential building constructions. They also influence the maintenance process of the territory, either improving it or considerably reducing sanitary and hygienic condition of open areas [12]. This influence is usually underestimated or disregarded by a designing practice.

There exists no possibility to edit or correct the master plan and introduce some changes, which produces a negative effect on the process under study and quality of living environment [13, 14].
Designing practice should respond more flexibly to the changes which can appear during the realization of a project. It is vitally necessary to introduce changes in the initial project, respond flexibly to engineering and technical changes [15]. The revision of the created and approved project is really costly.

Figure 1. Space of limited access area. Housing development in Prague.  
Figure 2. House territory. Residential development in Moscow

The principle presented in our study is based on a programme and purpose approach to the formation of urban environment and seems rather promising. This approach is a basis of a master plan and presupposes a programme bringing together all companies and services taking part in the formation of city environment and offers designers an opportunity of continued participation in this process.

We can single out several stages in the work on the formation of residential areas.
1. Drawing up a task description for a master plan.
2. Defining the main directions and characteristics (general composition, main communications etc.)
3. Creating a control element project (residential area construction).
4. Realizing the element.
5. Studying the realization experience, introducing emerging additions and corrections (feedback).
6. On this basis developing the next element.

Based on the schemes of load optimization and modular stages we can propose the ways to create an optimal structure and functional zoning of open spaces where territories subject to servicing are considerably reduced whereas labour-intensive elements connected with territory maintenance are optimized [16, 17].

Among the optimizing factors we can mention the following: block construction of housing development using street construction of the whole cluster, which helps concentrate pedestrian streams on a small amount of directions; define zones of various forms of service; partial return to regularity and symmetry which improve the orientation in such spaces and optimization of machinery work; using enclosed and semi-enclosed yard spaces which enable address reference of territories; designation of residential groups which can help bring the construction to its ending and transfer it to the next residential group; removing social functions from yard spaces; creating zones of different functionality by means of architectural and planning communications through gaps which exclude arbitrary transit and using them as occasional service zones [18].

4. Conclusion
The proposed measures can significantly improve sanitary, hygienic and esthetic indicators of housing development and produce a social effect connected with the increase in ecological security and
strengthening open space control. They can also reduce labour-intensity of territory maintenance by 15-20%. In order to understand the value of economic effect (12 people engaged in service sphere and territory maintenance per 1000 residents), the proposed activities can save the labour of three people. Besides, the formation of socially demanded housing development based on interaction with nature can contribute to the creation of harmonious residential environment which can be characterized by individuality and high comfort of living [19, 20].

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