Modular system-based urban equipment design

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Abstract. The article examines the problem of abundant squares of the administrative centers of town, typical for the Soviet period, and its solution by using the design of modular systems for creating urban equipment. The organization of a comfortable space under constantly changing conditions, the ability to quickly adapt to the needs of the consumer makes the development of modular architectural structures increasingly acute. The article considers basic principles of designing modular systems for organizing urban spaces for various public events. The main principles for optimizing the design of such modular systems have been formulated, such as multifunctionality and versatility, flexibility and adaptability, reusability, transportability and mobility. The main design features, units, parts and materials of the modular system are described. Based on the study of trends in the design of such systems, a conceptual project of modular open structures and universal pavilions for the city of Rubtsovsk, Altai Territory, is proposed. In addition to the module, a planning solution for the central square was proposed. The proposed modular system allows to improve the ergonomic and aesthetic properties of urban spaces, taking into account the climatic conditions of the region. The system has good adaptive characteristics, as it easily adapts to the needs of consumers. The cost-effective, flexible and growing structure of the modular system allows to quickly create a new image of the center of the settlement and contribute to its natural development. The offered modular objects can form a single environment complex and perfectly decorate the shopping area. The created space can be used for theatrical events and festivals, since a stage, seats for spectators and recreational areas can be built from the elements of the modules.

1. Introduction
Number of activities like fairs, festivals, open air forums continually grows in a modern city. The prosperity of public life is always associated with the emergence of new public spaces, within which people interact not only as spectators, consumers or “assets”, but also as active actors. This environment forms the modern consciousness of the townspeople. New forms of social interaction contribute to the development of collective participation and unpredictable cooperation, which are becoming increasingly important in social life today. At the same time most of former Soviet small and medium-sized towns still have unused spaces of central parts of settlements – one of the best reserved squares for citizen activity [1,2,3]. Organization of comfortable space in a continuously changing environment, ability to quickly adapt to consumer request leads to urgent development of modular architectural constructions. After studying current trends, a conceptual project of modular open construction and pavilions of universal purpose is proposed for city of Rubtsovsk, Altay region.

2. Materials and methods
Modular conception assumes that parts of an object are independent and could be used autonomously, as well as interconnect in different combinations [4, 5, 6]. This approach allows to change a way of interaction between different parts of the product, as requirements change individual parts can change as well without affecting the basic design. If individual elements are damaged, they can be easily replaced. When reused, the exterior design may be refreshed while leaving the most expensive parts...
unchanged. This allows physical changes to be minimized, but still to achieve the desired functional modifications. The presence of unified units and parts, which are used in different combinations, allows to transform the structure in different versions. The use of modular combinatorial design is considered the highest form of standardization. Standards identify and empower the most effective design methods and techniques. This contributes to the unification of the structural elements of the product, which leads to high efficiency of their production and operation.

At the initial design stage, analogues of modular sectional objects were considered. Preference was given to art objects (art installations), furniture and kiosks. The design takes into account works of such popular designers as Alik Levy, Philippe Negro, Manuel Sanz, Irene Brea and others. The analysis of world trends in the design of street modular systems has shown that modular structures are focused on the practical distribution and implementation of new technologies and materials in various areas of life, trade, information exchange, leisure centers, art objects, etc. Pre-project research of the scope of modular constructions allowed to formulate the principles for streamlining methods of functional and aesthetic development of modular systems for environmental space organization:

- System multifunctionality and universality;
- Flexibility and adaptability of system to situational changes (variability and combinatorics);
- Reusability (collapsible constructions);
- Transportability and mobility;
- Suitability of modular system for persons with disabilities;
- Taking into account the peculiarities of visual perception of environment design objects;
- Light and color spatial-layout study of design objects;
- Harmonious and integral appearance of modular system in open urban space conditions of post-soviet towns; and
- Economy and efficiency.

3. Results
Developed module is a construction based on a system of repeatable elements, easily assembled for a necessary configuration for any situation (Fig. 1).

![Figure 1. A module design.](image-url)
Laconic module space allows for reduction of price and production time, allows for easy and free assembly of several modules into a single system. The framework consists of aluminum sections with grooves that allow interconnection of elements without self-detachment concerns. For extra durability the system can be secured with bolts. Aside from interconnecting framework elements and finished constructions, grooves can be used for locking module walls, flooring and roofing. One of important components are holed wall panels that are secured to the framework. Holes are used to secure elements for holding shelves. Shelf length varies according to customer request, but width (300mm) and thickness (18mm) are fixed. Framing walls are supposed to be produced from MDF, also winter option is provided with heat insulation and a sliding window. External panel side could be used for printed advertisements. Roof allows for solar battery placement. Interior has lighting, electrical outlets, small heaters if needed. Doors — roll-ups. Aside from enumerated elements, modules are equipped with folding sunscreens, work areas for serving orders, production, packaging. Built-in furniture is placed inside module, all other elements are unified for quick production and assembly. Module dimensions are 2000x2000x2600mm. Within the available space we are able to accommodate all the necessary elements for production and sale of drinks, snacks and small souvenirs with respect to ergonomic requirements. Based on recommendations of design theoreticists [7,8,9], certain varieties of module connections are proposed (Fig. 2, Fig. 3).

![Figure 2. Module connections in clusters.](image)

![Figure 3. Module connections in rows.](image)

Besides module, there is a proposition of planning solution of central square in the city of Rubtsovsk, Altay region (Fig. 4, Fig. 5).
The center of the composition of the territory is a fountain framed by a compass pattern. Zones and pavilions are arranged in a radial way. Smooth radial movements of visitors will create a pleasant atmosphere. Based on the analysis of the potential visitors’ needs, equipment has been developed in detail for the following socially significant zones - information entrance, public catering, cinema zone, concert zone, souvenir sales, lecture hall, quiet recreation area, sanitary zone, parking. Zones of cinema, concerts, lectures and master classes are separated from each other and are located at different ends of the square. The food zone is located along the ring of the fountain and forms the boundary between the festive zone and a passage to the park. Due to the radial arrangement, trading modules can be equipped with many seating places. Each food point is isolated and equipped with trash containers and disinfectants. Recreation areas are scattered in small clusters throughout the territory. The sanitary zones are placed throughout the festival area and are represented by mobile dry closets and bins with garbage sorting function. Illuminated navigation modules are located throughout the territory. Since the modules are mobile, compact and do not require much space, the festival will take up only ½ of the space, 1/3 will be occupied by parking, which is located along the main roadway. There are four entrances to the territory, equipped with information boards, ticket offices and security frames.

4. Discussion

Today, when the significance of the central squares of former socialist cities has been lost, these real-life spaces as geographical and symbolic centers where people familiar and unfamiliar with each other meet can acquire new authentic forms of existence thanks to universal modular systems [10].

Hosting active city events with a thought-through design has a positive impact on urban growth. The symbiosis of images and products, the volume and coverage of the image market at the national or even global level and the role of the symbolic economy form the image of the city as a whole, contributing to its development [10].

Natural products at the farmers’ market, all kinds of entertainment, cultural events, holidays, festivals, fairs, etc., all these allow an area or a town to be placed on the “visual pleasures map” and to become a place of gentrification. Consumers of culture are involved in the interconnected production of symbols of
space. Modular systems are the form and vehicle for any such event, they provide redundant city squares and become places of visual attraction, desirable social “oases”.

Social culture is constructed at the micro level and is created from the variety of episodes that make up everyday life in urban spaces. As citizens are joining social life, its structure constantly changes. The process of forming the culture of public spaces will proceed organically, since the design of the equipment of the modular system has the ability to be modified according to the new desires of consumers, to adapt its form in accordance with the ever-changing content.

The proposed modular system allows improvement ergonomic and aesthetic properties of urban space. Takes into account the climate conditions for current region. This system has good adaptive properties, because it easily adapts to customer requirements. Implementation of such project with regards to the interests of the residents, tourists, state institutions and businesses could help transform spatial ensemble for city square into an area of active city life, uniting everyone. Design means became the main key elements in square areas organization. The usage of geometrically unsophisticated elements as a constructive basis is due to the necessity to fit the objects into the old Soviet urban environment and the economic capabilities of the region. Proposed modular objects can put together a uniform environment complex and exceptionally decorate the retail space. Created space could be used for on-stage holidays and festivals, because module elements could be used to construct stage, grandstand and recreational areas.

5. Conclusion

The analysis of trends in designing modular systems suited for organizing urban space allows to conclude that large empty spaces in administrative squares of Soviet period in small and medium-sized towns are best adapted for active use by residents and tourists with help of modular equipment. Such equipment could be used in any city or region depending on the territory size and configuration, weather conditions, residents’ requests’, and local infrastructure features. Worth mentioning that profitable, flexible and growing structure of modular system allows to create a new image of settlement and assist its natural development as soon as possible. The specificity of the environmental objects, for which the modular system has been developed, presupposes a large capacity and the possibility of simultaneous occupancy of the entire territory with a mass of people. Therefore, it is necessary to equip the modular structure with electronic media, digital means and communication networks. This will be the main cost for the project. Such a multifunctional urban infrastructure should include not only electronic means to improve the quality and efficiency of information, navigation, advertising, entertainment, education, training, but also identification devices, motion sensors, cameras, etc. These devices will make the modular system electronically transparent and more democratic, which will open up new perspectives for a “flexible environment” [11].

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