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IMPROVING THE TYPOLOGICAL AND SPATIAL ORGANIZATION MODEL OF MODULAR LOW-RISE RESIDENTIAL BUILDINGS IN UZBEKISTAN

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ABSTRACT: This article examines ways to improve the typological and spatial organization of modular low-rise residential buildings under the conditions of Uzbekistan. The study aims to develop a conceptual model for organizing the functional composition of a dwelling through individual modules and their combinations, and to systematize the relationships between modules, the floor plan, and the courtyard space. The research is based on architectural presentation materials provided by the author and scholarly literature on modular construction and prefabricated housing. The methodology employs typological classification, functional-zoning analysis, compositional analysis, and a comparison of modular configurations. Since some module dimensions shown in the presentation are approximate and certain planning parameters have not yet been verified by working drawings, they are treated in this article as conceptual design data rather than final technical specifications. Based on the preliminary analysis, a typological approach is proposed in which modules dedicated to living, sleeping, and household functions are arranged around a central courtyard. The findings remain at the level of a conceptual model; further verification using working drawings, structural calculations, and user scenarios is required to establish constructional, technical, and operational performance.

Keywords: modular housing; low-rise residential building; typological model; spatial organization; functional zoning; modular configuration; central courtyard; flexible planning.

INTRODUCTION

Modular construction makes it possible to organize residential buildings on the basis of repetitive spatial or structural units. In this context, a module may be considered not only a structural component but also a spatial unit performing a specific functional role. In residential architecture, this approach creates opportunities to arrange living, sleeping, service, and household activities in an orderly manner, develop the building composition in stages, and modify the floor-plan configuration in response to changing needs.

Recent studies on modular and prefabricated housing identify off-site manufactured components, assembly processes, standardization, design flexibility, and construction management as important areas of research [1, 2]. At the same time, the architectural value of a modular system is expressed not merely through the module itself, but through the spatial relationships between modules, their functional connections, circulation routes, and links with outdoor spaces.

In Uzbekistan’s residential traditions, internal courtyards, ayvans, and open and semi-open spaces play an important role in everyday domestic life and seasonal use. Therefore, contemporary

modular housing should be designed not simply as an aggregation of enclosed rooms, but as a spatial system in which indoor and outdoor environments are interconnected. Research on courtyard typologies indicates the need to examine the relationships between courtyard geometry, microclimate, and functional use [3].

The research problem addressed in this article is how to integrate the standardized units of modular housing with family-related functional needs and courtyard-based spatial organization within a unified typological model. The aim is to conceptually improve the typological and spatial organization model of modular low-rise residential buildings for the conditions of Uzbekistan.

The objectives of the study are to identify the functional modules of modular housing; determine the relationships between modules; analyze options for creating spatial compositions around a courtyard; develop a conceptual typological model; and establish criteria for its subsequent technical verification.

MAIN BODY

2.1. Research Materials

The design materials analyzed in this study comprise the modular housing concept, module combinations, courtyard-based floor plan, façade solutions, and three-dimensional visualizations presented in the author's presentation. Modules A, B, and C are respectively defined as serving living, sleeping, and household functions. Some module dimensions are indicated approximately as 3.6 × 6.0 m, 3.6 × 4.8 m, and 3.6 × 3.6 m. These values are treated as preliminary design parameters until they are verified by final working drawings.

The plan drawings in the presentation contain dimension labels of 18.0 × 14.4 m and 14.4 × 12.0 m. It has not yet been confirmed which of these corresponds to the final building footprint. Therefore, the dimensions have not been treated as equivalent or used to calculate the general conclusions of the typological model. They are mentioned only as measurements recorded in the conceptual drawings provided by the author.

2.2. Research Methods

The study combines the following methods: (1) typological analysis, involving the grouping of modules according to their functional purpose; (2) functional-zoning analysis, identifying relationships between living, sleeping, household, and semi-open spaces; (3) compositional analysis, examining the spatial principles for arranging modules around a central courtyard; (4) comparative analysis, comparing the possibilities of arranging modules in individual, paired, and grouped configurations; and (5) visual analysis of design materials, examining the consistency between the plans, façades, and three-dimensional representations in the presentation.

2.3. Evaluation Criteria

Module configurations were examined according to the following criteria: functional autonomy, direct connections between modules, access to shared spaces, opportunities for natural lighting, degree of privacy, potential for future expansion, and connection to the courtyard. These criteria are

not quantitative performance indicators; rather, they are architectural and typological evaluation criteria.

2.4. Scope and Limitations of the Study

The study is based on an analysis of a conceptual design. It does not claim to have calculated the load-bearing capacity of the modular structures, seismic resistance, thermal performance, construction cost, or energy consumption. Substantiating these indicators would require a structural scheme, specifications of materials and layer assemblies, building services systems, working drawings, and the relevant calculations.

RESEARCH RESULTS

3.1. Typology of Functional Modules

Based on the concept presented, the functional composition of the dwelling can be divided into three main module groups: A — living module; B — sleeping module; and C — household module. This grouping differentiates residential activities according to their functions and makes it possible to incorporate modules into an overall floor plan in various combinations. However, the designation of a module does not mean that its internal composition has been fully defined. The room composition, sanitary and hygienic requirements, building services, and area standards for each module must be specified at a separate design stage.

Module	Primary Function	Typological Role	Aspects Requiring Further Specification
A	Living	Family's everyday activities and shared use	Living-room area, connection to the kitchen, access to the courtyard
B	Sleeping	Organization of personal and private zones	Number of bedrooms, sanitary facilities, acoustic privacy
C	Household	Storage, auxiliary, and service functions	Storage room, laundry, technical room, and building services

3.2. Spatial Relationships Between Modules

Three types of relationships can be distinguished in the organization of modules. In the first arrangement, modules are placed sequentially to form a linear plan. In the second, modules are joined in an L- or U-shaped configuration, creating an open internal space or a sheltered courtyard. In the third, modules are grouped around a central courtyard, forming a more enclosed perimeter

and a shared internal space. The conceptual design presented is closest to the third approach, in which the central courtyard is interpreted as a spatial element connecting rooms and semi-open spaces.

3.3. A Typological Model Organized Around a Courtyard

In the proposed model, the living module is positioned as the center of shared family activities, the sleeping module as a relatively private zone, and the household module as an auxiliary service zone. The courtyard functions as an open space that connects these functional components. An ayvan or shaded transitional zone is considered an intermediate space between the interior and exterior. This organizational approach is intended not merely to connect modular blocks structurally, but to arrange them in accordance with everyday patterns of use.

3.4. Status of Module Dimensions and Planning Indicators in the Article

The preliminary design materials include module dimensions based on a width of 3.6 m, as well as plan-footprint labels of 18.0 × 14.4 m and 14.4 × 12.0 m. The author notes that some of these values are approximate. Accordingly, this article does not generalize these figures as standard module dimensions or as confirmed building dimensions. Before final publication, each dimension should be checked against the relevant plan, section, or module drawing, and any unverified values should be identified as “approximate” in the figure captions.

DISCUSSION

The key feature of the proposed typological approach is that modules are interpreted not as isolated structural units, but as spatial blocks with specific functional purposes. In scholarly literature on modular and prefabricated housing, flexibility, module integration, manufacturing, and assembly processes are considered important research topics alongside standardization [1, 2]. This article, however, focuses on the architectural relationships between modules and the spatial organization formed around a courtyard. A systematic review published in 2026 also analyzes modular housing systems in terms of typologies such as volumetric modules, panel systems, open building systems, expandable systems, and component-based systems. It notes that the degree of prefabrication does not necessarily correspond to long-term flexibility in a uniform manner [5].

The courtyard typology creates a central shared space and connects the internal functional areas of the dwelling. Studies of courtyard microclimates show that the performance of such spaces depends on geometry, orientation, solar exposure, and ventilation conditions [3]. However, the microclimatic performance of the courtyard has not been calculated in this article; it has been analyzed as a typological and spatial element.

The main limitation of the study is the conceptual nature of the design materials and the fact that some dimensions have not been verified. At the next stage, module dimensions should be clarified on the basis of working drawings; the room composition of each module should be defined; furniture layouts and circulation routes should be checked; and structural connections and building services should be coordinated. Comparing plan alternatives for different household compositions and usage scenarios would also help assess the model’s practical applicability.

CONCLUSION

Based on the design concept presented, a preliminary typological model has been developed for organizing modular low-rise housing through modules dedicated to living, sleeping, and household functions. Grouping the modules around a central courtyard makes it possible to establish a spatial connection between the internal functional zones and the shared outdoor space.

The study identifies linear, angular, and courtyard-based grouped configurations as alternative forms of inter-module relationships. The conceptual solution presented corresponds to the courtyard-based arrangement. In this configuration, the living module is interpreted as a space for shared activities, the sleeping module as a private living area, and the household module as a space for auxiliary and service functions.

Since some module and plan dimensions shown in the presentation are approximate, they have not been accepted as final technical parameters. To strengthen the practical validity of the model, further studies should verify it on the basis of working drawings, structural solutions, room areas, building services provision, and different family-use scenarios.

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