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ORGANIZATION OF COMFORTABLE STUDENT DWELLING UNITS

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Abstract

The authors propose promising architectural and space-planning design for dwelling units and particular functional zones based on the analysis of ergonomic features of student youth. It is concluded that in Russia, moving the most functions from remote premises directly to the dwelling unit will require increasing room area by 7-8 meters. The research object is buildings and accommodation complexes for the dwelling of university students. The subject of the study is the creation of comfortable dwelling units appropriate to present-day requirements of living conditions, as well as particular functional zones. The area standards for living rooms of various functions and capacity are determined based on the study of filling the room with necessary furniture, observing comfortable working areas, as well as hygienic requirements. It is proposed to allow designing single occupancy rooms with a living space of 9 m².

Keywords

Campus – Student quarter – Academy – Higher education – Youth – Student

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Introduction

The construction of the students' physical living environment is largely determined by the set and functional dimensions of furniture and equipment items, the order of their arrangement in the premises, and the connection of these premises with each other. Organizing comfortable dwelling units includes the provision of functional processes taking into account the anthropometric features of youth, as well as selecting comfortable furniture and equipment which would meet the ergonomic requirements, determining on this basis the area standards, furniture and equipment items¹.

Functional and anthropometric features of student youth

Anthropometric parameters of young people and the nature of their functional activity differ somewhat from the average parameters of a mature adult, and thus the design of residential environment for them has a number of features that require detailed consideration². The most important indicators to determine the architectural and planning solution parameters when designing the dwelling units and their interiors³ are given in Table 1 and illustrated in Fig. 1.

| No. | Attribute | Limiting dimensions, mm | | | | | |
|-----|--|-------------------------|-------|--------------|--------------|-------|--------------|
| | | Males | | | Females | | |
| | | M-2 σ | M | M+2 σ | M-2 σ | M | M+2 σ |
| 1 | Height | 1,591 | 1,723 | 1,855 | 1,491 | 1,595 | 1,697 |
| 2 | Vertical arm reach zone | 1,910 | 2,080 | 2,260 | 1,710 | 1,850 | 2,000 |
| 3 | Shoulder radius | 220 | 230 | 240 | 160 | 170 | 190 |
| 4 | Lateral arm reach zone (from the body axis) | 740 | 800 | 860 | 660 | 760 | 860 |
| 5 | Shoulder breadth | 420 | 450 | 480 | 330 | 400 | 470 |
| 6 | Largest diameter of the hips | 326 | 364 | 402 | 339 | 392 | 445 |
| 7 | Elbow width | 375 | 437 | 499 | 341 | 397 | 453 |
| 8 | Diameter of the thigh | 106 | 138 | 170 | 113 | 145 | 177 |
| 9 | Height from foot to seat | 390 | 430 | 480 | 360 | 380 | 400 |
| 10 | Height when seated | 840 | 900 | 960 | 770 | 820 | 870 |
| 11 | Elbow height above the floor | 610 | 680 | 740 | 550 | 620 | 690 |
| 12 | Maximum vertical reach of the hand (when seated) | 1,142 | 1,240 | 1,338 | 984 | 1,102 | 1,220 |

Table 1
Basic anthropometric parameters of student youth

¹ A. L. Gelfond, "Public building and public space. The duality relations Academia", Architecture and Construction num 2 (2015): 18-31.

² M. V. Puchko, "Universitetskij gorodok. Principy sozdaniya prostranstva sovremennyh universitetskikh kompleksov", Bulletin of Tomsk State University of Architecture and Construction num 3 (2011): 79-88 y N. B. Ulyanova, "Formirovanie etnohudozhestvennoj kul'tury u budushchego dizajnera v vuze", Ethnic Social Medium and Interethnic Culture num 4 Vol: 46 (2012): 125-127.

³ V. F. Runge y Yu.P. Manusevich, Ergonomika v dizajne sredy (Moscow, Architecture-S, 2005): 328.

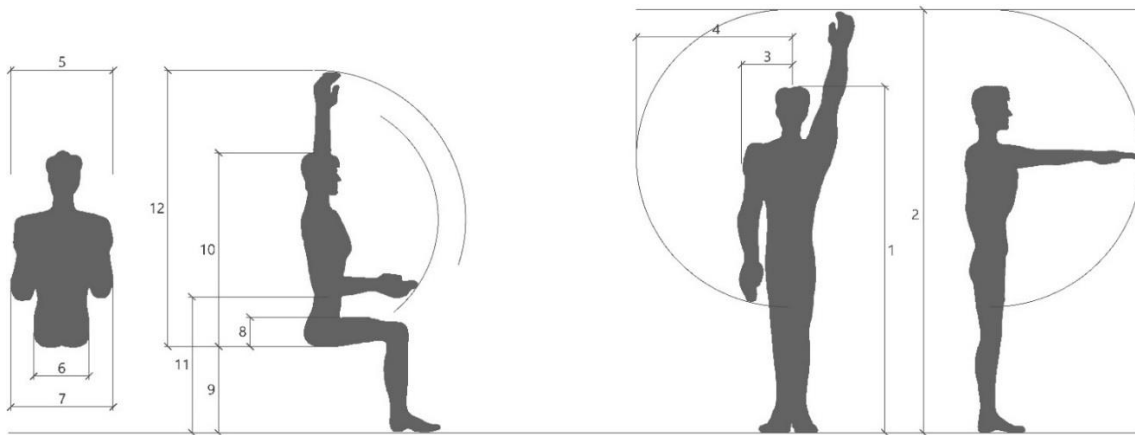


Figure 1

An illustration of the main anthropometric parameters (Table 1)

An important feature of building a residential environment for students is the dynamic nature of their life-sustaining activity that should be taken into account when organizing the space of the dwelling unit. Functional areas and interior elements must be multifunctional and meet dynamically changing requirements. Furniture should have improved performance characteristics in terms of strength and wear resistance. It is also necessary to provide for the possibility of furniture transformation and expanded functional use of its elements⁴.

It is necessary to take into account the important characteristics inherent to age of student youth (from 18 to 25 years), such as dexterity, mobility, strength, allowing the use of transforming, built-in, and folding furniture in residential units that also significantly expands the possible height of the shelves, cabinets, and storage containers. There are no problems with their accessibility when placed at a height from 0 to 1,700 mm, and even higher if using appropriate fitments (such as for example a folding stool).

When designing dwelling units, it is necessary to take into account their location in the building structure, as well as the location of the building itself to determine the optimal composition of functional zones and reduce the unproductive time spent on forced transitions⁵.

⁴ I. B. Melnikova y K. I. Beloborodova, "Predlozheniya planirovochnoj organizacii obshchezhitij dlya trudovyh migrantov v moskovskom megapolise", *Scientific Review* num 6 (2015): 52-57 y N. B. Ulyanova y A. V. Gudkova, "Estetika sociokul'turnogo prostranstva Scientific Research and Development", *Social and Humanitarian Research and Technology* Vol: 4 num 4 (2015): 83-86.

⁵ N. Danilina, *Intermodal system for mobility demand in the realities of the Russian Federation: Reality and forecast. Proceedings of the International Conference on Sustainable Cities, ICSC E3S, Web of Conferences. 2016*; S. V. Privezentseva, *Issues of the organization of the universal environment of public buildings. (Proceedings of the 20th International interuniversity science-to-practice conference of students, undergraduates, postgraduates and young scientists "Construction: formation of the living environment". 2017. 164-166* y A. Slavin; S. Sinenko y N. Yoshin, *The evolutionary development of the methodology of operational planning of construction production. Proceedings of the 21st International Scientific Conference on Advances in Civil Engineering "Construction: The formation of the living environment. IOP Conference Series: Materials Science and Engineering. 2018.*

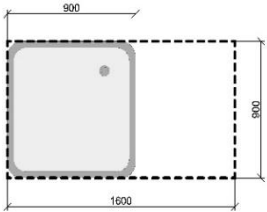
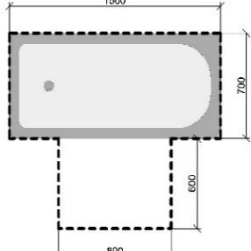
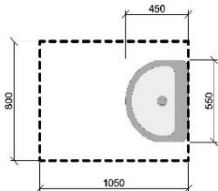
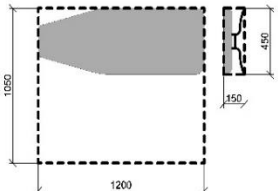
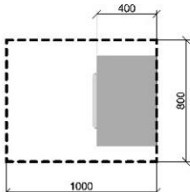
Functional areas, optimized list of furniture and equipment for dwelling units

When itemizing the list and location of furniture and equipment, it is necessary to be guided not only by their own dimensions but also by the space required by the function inherent in this item, i.e. the working zone (area). Thus, the useful area of each piece of furniture and equipment is composed of its own area and its working area, i.e. the area necessary for using this item (drawers, open doors, operator's area, etc.). In addition, the area and linear dimensions of the room should provide free placement of furniture items for various purposes as well as a convenient approach to them. Working areas should be divided preferably into acceptable and unacceptable areas. Acceptable areas include, first of all, working areas of furniture and equipment items in rooms designed for a single user, for example, when placing a sink next to the flush toilet in a bathroom. In this case, it is obvious that even the maximum overlap of their working areas will not create significant discomfort to a single user in the room. Another example is the overlapping working space of a cabinet and a bed, which belong to the same user. It is also obvious that the user of these items will be able to only work with one of them at a time. One more example of an acceptable overlap of working space is the case of a short combination time, where the probability of simultaneous use of both items is quite low and cannot create serious unhandiness in their exploitation (for example, the location of the washing machine under the sink).

Working areas that are not allowed to be combined include those of all kinds of furniture and equipment that are likely to be used by different users in the same long period of time. Especially it is not allowed to combine working spaces for home independent study with any other items of furniture and equipment. Zones for homework should be located maximally isolated from other functional areas because any distraction of attention significantly reduces the productivity of scientific and academic work⁶.

Based on the consideration of anthropometric parameters, as well as the nomenclature of manufactured furniture, the characteristic parameters of the main pieces of furniture used in the dwelling units of the student dormitory are considered below. The given dimensions of the main pieces of furniture can be used to determine the standard areas of the premises. It is necessary to consider particularly and determine the feasibility of arranging equipment which is promising for placing directly in the living rooms of the student dwelling. To solve this problem, the following parameters were defined for each piece of equipment: the maximum area occupied by the equipment (calculated geometrically); the estimated reduction in area of public facilities associated with the transfer of equipment and functional areas into the dwelling units (determined under applicable regulations); a total increase of usable area of the building; calculated time-saving effect (shown in accordance with the data in the previous sections) (Table 2). Although these data are valid only for specific (given) dimensions of the equipment, and the reduction in the area of public premises will vary slightly from project to project, one can argue that these estimates are sufficiently reliable and, despite the assumptions made, it is possible to rely on these results for an overall assessment.

⁶ L. A. Kurochkin, *Osnovnye principy proektirovaniya zhiloy yachejki studencheskogo obshchezhitiya*: Ph.D. thesis in architecture (Moscow, 1971) y I. B. Melnikova y K. I. Beloborodova, *Predlozheniya planirovochnoj organizacii obshchezhitij dlya trudovyh migrantov v moskovskom megapolise*. Proceedings of the 1st International science-to-practice conference on sustainable territories (Moscow, National Research Moscow State University of Civil Engineering (NIU MGSU), 2018).

| No | Equipment or household appliance item | The characteristic overall dimensions (of own and working area), conventionally taken for calculation | Maximum space occupied by the equipment | The designed average decrease in the area of public premises when transferring equipment to an individual living room | The designed total increase in usable area per student, caused by the transfer of equipment to the living room |
|----|---------------------------------------|---|---|---|--|
| 1 | Shower unit |  | 1.44 m ² | 0.24 m ² | 1.20 m ² |
| 2 | Bath |  | 1.53 m ² | 0.24 m ² | 1.29 m ² |
| 3 | Bathroom sink |  | 0.84 m ² | 0.14 m ² | 0.70 m ² |
| 4 | Ironing-table |  | 1.26 m ² (0.068 m ² when folded) | 0.1 m ² | -0.032 m ² (the area occupied by the folded ironing-table is used for the calculation) |
| 5 | Washing-machine |  | 0.8 m ² | 0.1 m ² | 0.7 m ² |

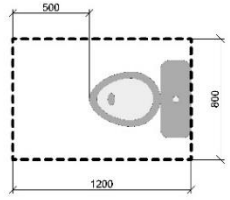
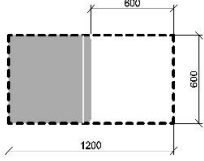
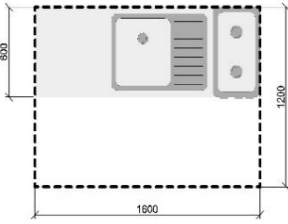
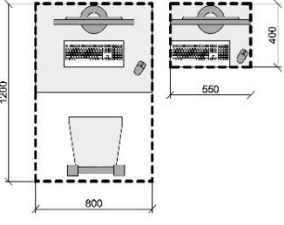
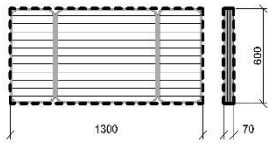
| | | | | | |
|----|------------------------|---|--|---------------------|---|
| 6 | Flush toilet |  | 0.96 m ² | 0.16 m ² | 0.80 m ² |
| 7 | Fridge |  | 0.72 m ² | 0.1 m ² | 0.62 m ² |
| 8 | Breakfast bar |  | 1.92 m ² | 1 m ² | 0.92 m ² |
| 9 | Computerized workplace |  | 0.96 m ² | 0.7 m ² | 0.26 m ² |
| 10 | Clothes-airer |  | 0.78 m ² (0.04 m ² when folded) | 0.1 m ² | -0.06 m ² (the area occupied by the folded clothes-airer is used for the calculation) |

Table 2
The feasibility of arranging equipment in the living rooms of the student dwelling

Thus, despite the above-described conditional assumptions made in the design calculations, these parameters can be used to determine the general parameters of student dwelling units, the optimal list of furniture and equipment of a residential unit, as well as to assess the effectiveness of the decisions made.

Summarizing the above data, it can be also concluded that the transfer of the proposed functions from remote premises to a living room or unit will require increasing room area by 7-8 meters, but at the same time will save residents on average up to nine hours a week, which is now spent on unproductive transitions in the building.

Definition of area standards for premises, as well as the list of furniture and equipment of the dwelling unit

Based on the previously conducted research, single and double units (for certain categories of residents) with a different set of furniture, equipment, and amenities, placed directly in the dwelling unit or in a block of several rooms, should be considered the most promising dwelling for students.

Furniture placing techniques in living rooms can be one-, two-, and three-sided or in-line. The analysis of planning solution methods for rooms of different capacities, provided that the necessary dimensions of the aisles are met, shows the following⁷.

- One-sided arrangement of furniture allows increasing the room width to 1.8 m that can contribute to the more rational use of space with a small number of furniture items and equipment, but entails some operational disadvantages, and does not meet the planning and living requirements in case of a large number of furniture and equipment. This arrangement of furniture can be used for organizing rooms for bachelors, where most of the functional areas are moved to the residential block, as well as when solving special design and planning tasks.

- The two-sided arrangement is advantageous in terms of planning and living conditions for most rooms having the width ranging from 2.5 to 3.0 m and allows placing conveniently a sufficient number of furniture items and equipment, as well as using area efficiently.

- Three- and four-sided arrangement of furniture is satisfactory in terms of layout and household qualities in rooms with a width of 2.7-3.2 m. Such an arrangement is rational in high-comfort rooms for graduate students, doctoral students, or student families. Also, such an arrangement of furniture can be used in common spaces of residential blocks for bachelor students.

The room area is determined based on two factors:

- filling the room with necessary furniture in compliance with comfortable working zones taking into account the functional specifics of students' life;

- in compliance with hygienic requirements based on the required volume of air mass and taking into account the air exchange rate.

The minimum area of a dwelling unit that takes into account the capacity of each room based on the necessary set of furniture and equipment is given below⁸.

⁷ I. B. Melnikova y K. I. Beloborodova, "Predlozheniya planirovochnoj organizacii obshchezhitij dlya trudovyh migrantov v moskovskom megapolise", Scientific Review num 6 (2015): 52-57.

⁸ I. S. Samylova, "Modernization of University Libraries for Example NRU MGSU", International Journal of Applied Science and Technology – Integral num 2 (2019): 1-7; T. V. Kireeva, "New approaches in the formation of the architectural and landscape environment of the university", International Research Journal num 2-4 Vol: 44 (2016): 101-102 y L. A. Kurochkin, Osnovnye principy proektirovaniya zhiloy yachejki studencheskogo obshchezhitiya: Ph.D. thesis in architecture (Moscow, 1971).

- The area of a single room with a minimum set of functions implemented in the room (sleep, rest, storage of personal belongings, home independent work) must be 7-7.5 m². The total area of a single room with an extended set of functions (sleep, rest, storage of personal belongings, home independent work, cooking and eating, personal hygiene, common hygiene, washing of personal clothing, drying and ironing of personal clothing) must be at least 15 m².

- The minimum area of a double room (for example, for families) with a minimum set of implemented functions (sleep, rest, storage of personal belongings, home independent work) should be 6-6.5 m² per person (or 12-13 m² – total room area). The total area of a double room with an extended set of functions (sleep, rest, storage of personal belongings, home independent work, cooking and eating, personal hygiene, common hygiene, washing of personal clothes, drying and ironing of clothes) must be at least 20-22 m².

When making calculations based on the hygienically necessary volume of the air mass, it is necessary to take into account the air exchange rate. According to recent studies of hygienists, the air inflow for residential premises should be at least 3 m³/h per 1 m² of the premises but not less than 30 m³/h per person^{9,10,11}. Thus, at a natural and easily achievable air exchange rate of 1.2-1.5, the living space standard meeting hygienic requirements will be 9 m² for a single room, and 16 m² for a double room, i.e. 8 m² per person. Thus, it is quite possible to allow designing single rooms for students with an area of 9 m², and in the future set this standard in the regulatory documents of the Russian Federation.

Planning techniques for the arrangement of service spaces in residential rooms depend on the number and type of household appliances, equipment, and furniture. Therefore, it is advisable to provide in a residential block an isolated arrangement of equipment components, combined with the entryway or living room.

It should be particularly noted that it is advisable to use niche kitchens, studio kitchens, and small kitchens (breakfast bars) since the comfort of living conditions largely depends on the solution of this issue. Some residents, due to their material considerations and taste preferences, would like to have at their individual disposal a small heating device for short cooking or heating ready meals. This can be carried out by arranging small kitchen-niche directly in the living room or in the entryway. Such solutions are widely used in modern foreign practice. The need to use kitchens in dwelling units requires specifying their parameters in the regulatory requirements. The lower limit of the area is determined according to fire protection regulations. Based on the room volume of 8 m³, at a height of 2.5 m, the room area will be equal to 3.2 m² (when using electric stoves, the kitchen area may be smaller). Analysis of foreign design and construction practices has shown the possibility of reducing this area to 1.5-2 m².

⁹ A.V. Tsygankov, A.S. Beloglazova (Fonyakova). "Kompleksnaya ocenka effektivnosti sistem kondicionirovaniya vozduha v pomeshcheniyah zhilyh zdaniy". Bulletin of the International Academy of Cold 4 (2011): 33-36.

¹⁰ A.M. Sajfutdinova, V.N. Kupriyanov. Osobennosti estestvennogo vozduhoobmena zhilyh pomeshchenij. Architecture and Construction 5 (2009): 319-325.

¹¹ K.S. Shaginyan, A.Yu. Okunev. "Sistemy ventilyacii grazhdanskih zdaniy. problemy i novye sposoby ih resheniya". Architecture and Construction 3 (2010): 530-537.

In the current context, with a small number of users (1-2 people), the shower unit (bath) in dormitories is preferable if it is combined with a toilet, washbasin, and washing machine within a single bathroom space, while at a larger number of users, for example, 3-6 people living in a unit, a shower unit should be arranged separately.

Conclusion

Thus, based on the analysis of ergonomic features of student youth, it is concluded that moving all the proposed functions from remote premises directly to the dwelling unit will require increasing room area by 7-8 meters.

Determining the area standards for living rooms of different functionality and capacity based on the consideration of filling the room with the necessary furniture, in compliance with comfortable working areas, as well as hygienic requirements, allows proposing the design of single rooms with the living space of 9 m², and make appropriate changes to the current regulatory documents of the Russian Federation.

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