Space-planning decisions of sanitary facilities of residential buildings in Russia

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Abstract. Currently, in the practice of designing residential buildings in Russia, sanitary facilities are given a secondary role, which reduces the level of comfort when living in an apartment. Architects are trying to give more space to all other rooms of the apartment, reducing the area of sanitary facilities. In the work, using the examples of residential multi-apartment buildings built in recent years in Moscow and the Moscow Region, the planning decisions of modern apartments, in particular their sanitary facilities, were studied and analyzed. It was concluded that the modern space-planning decisions of the sanitary facilities do not meet the requirements for the comfort of sanitary-hygienic procedures: small areas, lack of space for furniture, irrational installation of engineering equipment, not suitable for people with disabilities, etc. New space-planning solutions have been developed for one-room, two-room and three-room apartments, which will satisfy the end users and create a comfortable living environment in apartments of residential buildings.

1. Introduction
Sanitary facilities are related to auxiliary spaces in apartments of residential buildings. The residents actively exploit lavatory and bathroom and spend a considerable amount of time there, so high comfort requirements must be imposed on them.

Today, in the practice of residential buildings design in Russia, namely when designing apartments, sanitary facilities are given a secondary role, which reduces the level of comfort when living in an apartment. As a rule, this affects the area of sanitary facilities. The architect tries to give more space to dwelling rooms in the apartment, leaving sanitary facilities in the background, or rather, practically forgetting about them.

In addition, in recent years there has been a tendency in Russia to design small-sized apartments (less than 28 m²). Apartments with a size of less than 28 m² are not recommended for design in accordance with Russian building standard SP 54.13330.2016 (Residential multi-apartment buildings. Updated edition of SNiP 31-01-2003). Undoubtedly, such an erroneous decision is caused, first of all, by the consequences of the economic crisis and a drop in income levels of people who are not able to acquire apartments of large size. A marketer works in this scenario of reducing the size and, accordingly, the architect also follows it. Now you can find apartments with a size of 13 to 20 m², which even before was not the norm.

Reducing the size of apartments leads to the fact that in a small space it is difficult to live and organize your life. This also leads to a decrease in the area of sanitary facilities, in which it becomes problematic to carry out sanitary-hygienic procedures and place the necessary devices and equipment.
Previously, there were ready-made sanitary facilities, the so-called sanitary cabins, which were assembled directly at the plants and brought to the construction site in a finished form, after which they were mounted by workers. Such a solution paid off only in one case—the speed of construction and connection to utilities. However, it did not in any way take into account the specifics of the number of people living in the apartment, and in some cases it did not lead to the convenience of carrying out sanitary-hygienic procedures, as well as to the convenience of arranging the necessary furniture.

Thus, no one was involved in the deep design of sanitary facilities, taking into account the comfort of sanitary-hygienic procedures in them, the arrangement of furniture and equipment. Only model projects were proposed that previously had certain problems, but they were not solved at all.

The decision of the space-planning premises of the sanitary facilities, which were subsequently actively introduced into large-scale construction in Russia, was carried out by such scientists and designers as V.S. Kedrov, V.N. Isaev, A.A. Otstanov, A.A. Magay et al. [1-2]. In foreign literature, one can find works devoted to this subject of such researchers as Kopeček P., Barnett F.A., Gray S.T., Tootle G.A [3-5].

In the works of V.N. Isaev, you can trace the main technical solutions associated with the placement of instruments and equipment in the sanitary and technical units of residential buildings. The basic layout solutions are given for various floor plans [6-7]. A.A. Ostavnov focused his research on the sanitary facilities located in public buildings, taking into account the comfort of conducting sanitary-hygienic procedures by people with disabilities [8-10].

This article proposes to develop space-planning solutions for sanitary facilities for a modern housing stock, taking into account the latest requirements for comfort (placement of equipment, furniture, comfortable procedures, moving in space, safety, taking into account possible accidents on engineering systems of internal cold and hot water supply).

2. Methods
Residential apartment buildings (residential complexes) built in recent years in Moscow and the Moscow Region by various construction companies (a total of about 25 objects) have been studied and analyzed. The planning decisions of modern apartments and their sanitary units were studied according to the following criteria:
- area of sanitary facilities;
- types of sanitary equipment;
- types of furniture being placed (fitted wardrobes, etc.);
- space-planning solution;
- materials from which sanitary facilities are made;
- the availability of leakage protection in the event of an accident.

Objects with both rough finish and fine finish by the developer, and ready for people to live, were examined. The following apartments were considered in all analyzed objects: studio-type studio apartments (with a kitchenette, combined with a living room), one-room, two-room and three-room apartments. In addition, the impact of utilities of cold and hot water supply, sanitation, ventilation on the formation of space-planning decisions of sanitary units was considered.

3. Results
As a result of the study, the following conclusions were made. Useful areas of sanitary facilities directly affect the comfort of sanitary-hygienic procedures. Currently, for economy-class housing and, in some cases, for business class, there is a tendency to reduce the area of auxiliary rooms in order to offer the customer apartments of a smaller size, which he can buy with his own finances. However, in this case, the comfort of the proposed housing decreases.

Significantly reduced the area of sanitary facilities in one-room studio-type apartments. Most often, you can find a spread of areas from 2.5 to 3.3 m². All sanitary facilities are combined.
The area of sanitary facilities of one-room apartments ranges from 3.3 to 3.7 m². Almost everywhere, lavatory is also designed to be combined with bathroom.

For two-bedroom apartments, the characteristic area of the sanitary facilities ranged from 4.4 to 5.5 m², however, a large number of layouts do not imply a second sanitary unit, which reduces the comfort of living. In all sanitary facilities lavatory and bathroom are designed separately.

In three-room apartments, the area of sanitary facilities is approximately similar to two-room apartments and in most cases does not exceed 5.5 m². In addition, not in all layouts of such apartments there is a second room for a sanitary unit. All sanitary facilities are also separate.

Neither in two-room, nor in three-room apartments there is no space for a laundry, which becomes simply necessary for such apartments, especially for a large families, for example, when two families live, especially of different ages.

The area of sanitary facilities directly affects the types of equipment to be placed. In the sanitary facilities of one-room studio-type apartments (with an area of 2.5-2.8 m²), in most cases it is possible to place only a compact shower cabin (shower tray), washbasin and toilet bowl. After installing the devices, the comfortable conduct of sanitary and hygienic procedures becomes difficult due to the lack of free space (Figure 1). In addition, the pipelines of water supply and sewerage systems have to be hidden in the wall in order to save the usable area of the room. With a larger area, it is possible to install a bathroom and a washing machine (narrow).

![Figure 1. Sanitary unit in a studio-type studio apartment (Gagarinsky residential complex, Schelkovo, Moscow region)](image)

The following appliances are installed in the combined plumbing assemblies of the classic one-room apartments: bathtub, washbasin, toilet bowl, washing machine (narrow).

In two-room and three-room apartments, the same devices are installed as in one-room apartments. However, the presence of separate sanitary facilities helps to greatly simplify the time spent on sanitary-hygienic procedures. Sometimes you can find a washstand located next to the toilet in the presence of free space.
Figure 2. Typical space-planning solutions for sanitary facilities:
a) for a studio type studio apartment; b) for a one-room apartment; c) the first sanitary facility (for a
two-room and three-room apartment); d) a second sanitary facility (for a two-room and three-room
apartment).

If there are two sanitary facilities in two-room and three-room apartments, the amount of
equipment may vary depending on the area. As a rule, the first sanitary facility has a bath, washbasin,
washing machine, and the second is a toilet. Due to the installation of only one toilet bowl per
apartment, the comfort of the procedures is significantly reduced.

In sanitary facilities of a small area for studio-type studio apartments and classic one-room
apartments, necessary cupboards for various items (household chemicals, personal hygiene products,
etc.) have to be hung on the wall, and the laundry basket should be taken out into the corridor.

If necessary, the sanitary units of two-room and three-room apartments also have to hang furniture
on the wall or buy it on order, as the above areas are not able to accommodate all the necessary
equipment.

Space-planning decisions of sanitary facilities in shape correspond to the installed equipment and
in most cases are similar to a rectangular or square shape (Figure 2). Everything is compact, useful and
necessary space is not always present. In addition, this form does not always allow you to install all
sanitary devices on the recommendation of design engineers, namely on one wall-block. In most cases,
all devices are distributed on different sides of the sanitary unit, which increases local pressure losses
and pressure loss along the pipe length, and also leads to unnecessary waste of pipelines, the need to
use fittings to rotate the pipeline route. In addition, very often the toilet is placed away from the sewer
riser, and due to the increased route of the pipeline in case of flushing a large amount of toilet paper,
the likelihood of blockages in the system increases significantly [11-13].

In apartments, rented out by the developer in rough finish, in most cases, walls in sanitary facilities
are not erected. Their area is indicated by tracing on the floor or using bricks or tongue-and-groove
blocks. The customer carries out the erection of walls independently. A layer of waterproofing is
applied to the floor. After the construction of the walls, the inner surface is coated with paint
waterproofing, then plaster is applied, then ceramic tile is placed on top.

Today, during the construction of sanitary facilities, very often they do not raise the floor and do
not erect sills to prevent leakage of water in the event of possible leaks during an accident on the
internal cold and hot water supply systems [14-20]. However, earlier in the industrial production of
sanitary cabs in Russia there were such sills, which is an undoubted advantage. It is not practiced to
design an emergency ladder to collect drains in the event of an accident in accordance with Russian
regulatory documents. To solve problems with possible leaks in the system of internal cold and hot
water supply systems, special leakage control systems are installed today that close the water supply from the riser in the event of a sensor that is placed on the floor of the sanitary unit.

4. Discussion

Today we can say with confidence that the space-planning decisions of sanitary units of residential buildings in Russia cannot provide the required degree of comfort, which was found out as a result of the analysis of the existing space-planning decisions that are used in modern residential buildings.

It is required, taking into account the above-mentioned shortcomings, to develop new space-planning solutions for sanitary units for apartments with different numbers of rooms, depending on existing conditions.

The area of the sanitary facilities is fully connected with the type of sanitary equipment being placed, as well as with the type of furniture being placed. All this should determine the space-planning decision of the sanitary facilities, taking into account the arrangement of devices in accordance with the recommendations of design engineers.

For studio-type studio apartments, it is advisable to refuse the design of sanitary units of a small size (less than 3.3 m$^2$) due to the fact that with such an area the comfort of using the interior space (movement, furniture arrangement) is significantly reduced. It is advisable to design all sanitary units separately. Necessary appliances: toilet bowl, bathroom, washing machine, washbasin. The minimum usable area should be at least 4.9 m$^2$ for one plumbing unit. An example of space-planning decisions of sanitary facilities is presented in Figure 3 a.

![Figure 3. Developed space-planning solutions for sanitary facilities:](image)

a) for a one-room apartment; b) the first plumbing unit (for a two-room and three-room apartment); c) a second plumbing unit (for a two-room and three-room apartment); d) a second plumbing unit (for a two-room and three-room apartment) with a living space for a toilet for pets; 1 – toilet for pets; 2 – a ladder in the floor of the sanitary unit connected to an internal sewage system

For two-room and three-room apartments, it is already necessary to design two sanitary facilities. Moreover, one sanitary facility should include appliances: bathtub, toilet bowl, washbasin (Figure 3, b). The second sanitary facility is a toilet, washbasin, washing machine, i.e. this room is also laundry, there should be a useful area for drying clothes and placing the necessary furniture. An example of space-planning solutions is shown in Figure 3, c. This solution with the installation of two toilets
greatly simplifies the comfort of using the sanitary unit, especially if two families live in the apartment together and at least two people are able-bodied and go to work at the same time in the morning.

Each designed sanitary facility should have an additional, so-called usable area for expansion, i.e. for installation, if necessary, additional sanitary appliances. For example, when a cat or small dog who is accustomed to the tray appears in the apartment, it becomes advisable to purchase and install a toilet bowl for pets – an automatic wastewater receiver that can independently flush and remove waste products into the building’s internal drainage network (Figure 3, d).

It is advisable as a fight against possible leaks (sometimes, depending on the quality of tap water, devices for dealing with leaks in the internal water supply systems are unreliable), raise the floor in the bathroom and design a floor drain connected to the internal sewage system, which will receive emergency drains and direct them to sewer riser.

In addition, all sanitary appliances should be placed in line on one wall-block and as close to each other (compactly).

Planning decisions for four and five-room apartments are not considered in this paper. In modern large-scale residential construction in Russia, apartments with so many rooms are not designed so often. However, it can be assumed that in four room apartments the number of sanitary facilities increases to three and the following devices are located directly in two bathrooms: bathtub, toilet bowl, washstand, washbasin. The third bathroom should have a space that allows you to organize the installation of not only a washing machine, toilet and washstand, but also have a usable area to accommodate several dryers for linen, as well as the allocation of areas for the ironing process. If necessary, a small pantry can be designed at the third sanitary unit.

5. Conclusions

On the basis of the literature studied, as well as the space-planning decisions of apartments constructed in recent years for multi-storey residential buildings, it was found that the rooms of the sanitary facilities do not meet modern requirements for the comfort of sanitary-hygienic procedures.

To solve this problem, new space-planning solutions were developed and proposed to improve the quality of life for a modern person in modern multi-storey residential buildings.

These developments should be implemented in accordance with the following recommendations:
- increase the usable area of sanitary facilities to accommodate the recommended equipment and necessary furniture (taking into account ease of use);
- the sanitary facility is a wet zone and, accordingly, should not, in the event of an accident on cold and hot water supply systems, pass water beyond its borders;
- mandatory availability of free space for the future to accommodate the necessary sanitary equipment at the request of residents;
- the number of sanitary facilities in the apartment should be designed depending on the expected composition of the family and the number of rooms, but not less than two starting from two-room apartments;
- when designing space-planning solutions for sanitary facilities, the interests of people with disabilities should be taken into account.

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