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IMPROVEMENT OF INTERIOR LIGHT ENVIRONMENT IN APARTMENTS OF LARGE-PANEL BUILDINGS OF OLD TYPICAL SERIES

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The article considers issues connected to natural lighting in rooms. The problem of lack of natural light in an apartment of a typical building of the M111-90 series in Belarus is described and ways of its solution are presented.

Natural lighting significantly affects the physical and psycho-emotional state of people. Lack and overabundance of direct and diffuse sunlight negatively affects a person. Person's comfortable vital activity requires the optimal level and quality of natural illumination in premises. This can be achieved, among other things, due to the interior design that is competent in terms of lighting technology.

Natural lighting is the result of natural processes and depends on the geographical data of the area, season, time of day and the state of the atmosphere [2]. Lighting should be uniform, intense and not glare [1].

The penetration of natural light into the room is carried out primarily due to such light openings as windows, roof windows, balcony doors, stained glass windows and skylights, as well as reflective surfaces of the ceiling, walls, floor and other elements in the interior. Diffuse light can be created by light which is being reflected from various surfaces in the interior.

Luxmeters or photometers are used to measure the level of illumination in rooms.

According to the location of the sensor, luxmeters are divided into monoblocks and devices with remote sensors. For simple measurements, a simple monoblock luxmeter is suitable. To determine several parameters of illumination, it is necessary to use devices with advanced functionality. A specialized luxmeter with light filters is able to determine more accurately the values of the intensity of light emanating from sources with variations in its shades. Devices with remote sensors are able to determine the level of illumination more accurately than monoblocks, so this measurement reduces the influence of third-party factors. For household needs, a person can use a smartphone as a light meter. To do this, a person can install the appropriate computer program and first check the measurement results with the results of specialized devices in order to determine the error in the smartphone for correct operation with it.

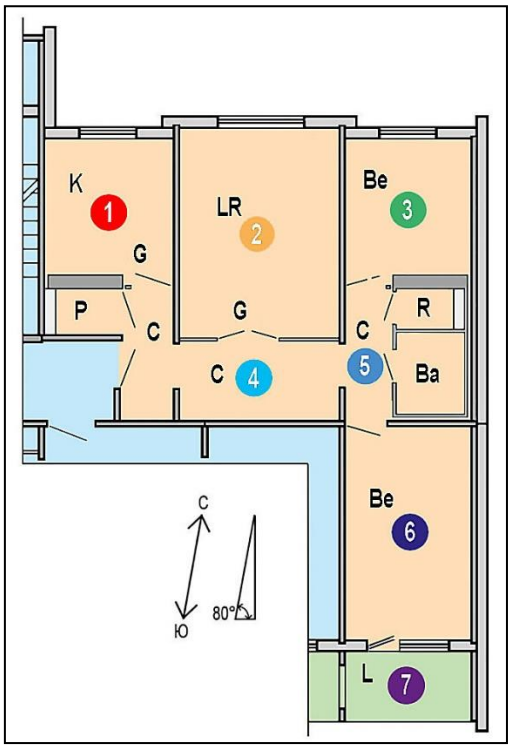
The problem of lack of natural light in rooms exists, in particular, in residential buildings of the M111-90 series, a large number of which were built in Belarus in the 1980s and 1990s. Exactly one of these buildings located in Minsk is considered in this work.

With Smart Luxmeter ver. 1.0.0 installed from the Play Store on the Xiaomi Redmi 4X smartphone, natural light was measured in the premises of the edge apartment located on the 9th floor of a 12-storey building (fig. 1). The illumination level was measured three times under different weather conditions at different times of the day (table 1).

Table 1. – Illumination measurement results

Measurement location	Room name	Illumination, lx		
		1st dimension	2nd dimension	3rd dimension
1	Kitchen	56	12	16
2	Living room	56	12	12
3	Bedroom	62	16	16
4	Corridor	4 (2)	0	0
5	Corridor	8 (0)	4	4
6	Bedroom	72	8	8
7	Loggia	1530	276	388

The corridor receives especially little daylight. If we also take into account that side lighting of rooms means a sharp decrease in illumination with distance from windows and balcony doors, we can conclude, that the apartments under consideration and similar in illumination need a significant improvement in their light environment. Moreover, such an improvement can be carried out within the framework of a general reconstruction or even a major overhaul of buildings of the type under consideration.

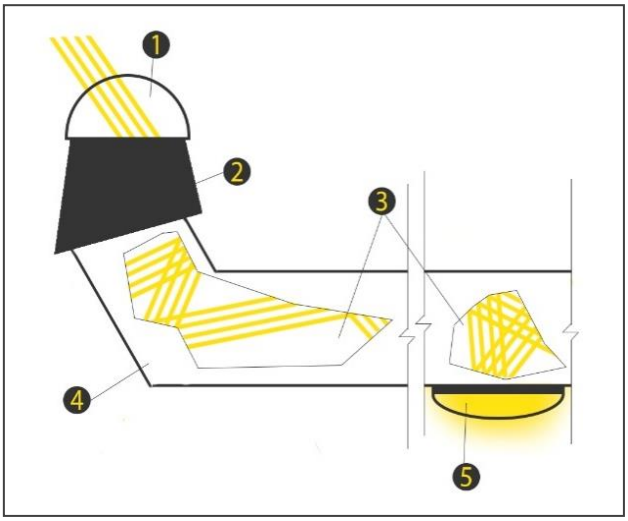


Ba – bathroom; LR – living room; P – pantry; C – corridor; K – kitchen; L – loggia;
GD – glass door; R – restroom; 1–7 – light measurement locations

Figure 1. – Scheme of the plan of a 3-room apartment of a building series M111-90

There are innovative methods of improving the light environment of premises using light guides, light wells, reflective installations. The reflective system installed on the outer wall of the building in cloudy weather redirects the reflected scattered daylight from the street through the reorientation element into the room, inside which the incoming light is reflected from the ceiling and is evenly distributed throughout the room.

Light wells are a type of light guides. The light well has a reflective inner surface [3]. The light guide lens captures sunlight with a transparent dome, after which the light enters the mirror tube, reflects from its walls and is scattered in the room with a light diffuser (fig. 2). Light wells are becoming more and more popular and technologically advanced. For example, some of them transmit up to 98% of the sunlight captured from the street into the room [4].



1 – light-collecting dome; 2 – roof connection element;
3 – reflective tube cover; 4 – light guide tube; 5 – light diffuser

Figure 2. – Light well construction

Light wells allow solving problems of insolation of premises in the absence of an architectural opportunity to raise the illumination level to optimal values. The disadvantage of this design is that the system can partially cover the window opening, thereby reducing its light-transmitting area.

To solve the problem of lack of natural light in the considered apartment of the building of the M111-90 series, the following scenario is proposed: the installation of two light guides and one reflective system. The integration of two light guides into the volume of the apartment is carried out through the eastern load-bearing wall and the loggia, which faces south. The first of these light guides has two diffusing elements and runs along the corridor, adjacent to the ceiling. The second light guide has one light outlet into the room, which is located in the central part of the ceiling of the room adjacent to the loggia. The reflective installation is fixed on the window of a large room (living room) in such a way that the main stream of light, reflected from the system, hits the ceiling and is evenly scattered throughout the room.

Thus, in order to improve the light environment, namely the level of natural light in apartments that need it, innovative methods can be used to improve the light performance. As a result of the implementation of the described scenario, the light comfort in the apartment is significantly improved in terms of the flow of sunlight into apartments premises.

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