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Lighting requirements of dwellings: a comparison between Russian federation and Italy

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Abstract

Good lighting is a key factor for indoor health and wellness. Hygienic regulations regarding illumination requirements have been elaborated much time ago and in different countries. The authors describe these requirements in Italy and in the Russian Federation, analysing their contents and issues and comparing them. The results show that the Russian ones are updated, more precise and complete. In conclusion, the authors stress the strong need for a revision and update of the specific Italian hygienic and sanitary regulations.

Introduction

The natural light is the visible part of the electromagnetic radiations emitted by the sun and is characterized by a continual spectral band with wavelength (λ) between 380 and 780 nm. Thanks to the contribution of the infrared and ultraviolet components, sunlight represents the main source of light and heat on earth (1).

It is well established that natural lighting and insulation have important effects on human health and wellbeing (1, 2). These effects are not limited to the visual ones, but involve a number of others, such as psychological and metabolic, but also the regulation of sleep-wake rhythm, the drying of internal surfaces and the germicidal effect of ultraviolet radiation (3-5).

A wide variety of illnesses and disorders are linked directly to the absence or the excess of sunlight exposure, among them rickets, myopia, skin precancerous and malignant lesions, dazzle, depression and other mood disorders (4, 6-11). For the above mentioned reasons health regulations and building codes have taken into account natural lighting in indoor environment, and in particular in dwellings, for a long time (12).

To evaluate the effects and quality of lighting in an indoor environment a number of parameters should be considered, such as windows' area (in relation to floor area), room length, light angle, windows position (6, 13-15), but also urban factors such as street width, building highness and presence of green areas (6, 16). Law enforcement being a key part of Public Health protection

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of indoor environments (17, 18), we decided to make a comparison of two different systems of illumination prescription in indoor environment, the one in force in the Russian Federation and the one in force in Italy. Of course we are talking of two very different countries if we consider extension, location and climate, but also of two highly developed and historically advanced countries in the field of hygienic standards.

Italy

In Italy the main regulatory act that deals with lighting is the Ministerial Decree 07/05/1975 (19), whose article 5 in fact states: "*All housing rooms, except those used as toilets, lobbies, corridors, stairs and closets, must enjoy direct natural lighting, appropriate to the intended use. For each room, the width of the window must be proportioned to ensure an average daylight factor value of not less than 2% and in any case the openable surface of windows must be not less than 1/8 of the floor surface. For public housing it is recommended, on the basis of the above provisions and of the results of experimental trials, to adopt standardized dimensions of windows and their fixtures*" (19).

The regulation states an important hygienic goal for health protection in indoor environment, but the requirements are quite generic and do not take into account the complexity of illumination. It is necessary to underline how the Local Hygiene Codes and Municipal Building Codes might act on this matter, of course being more restrictive than national regulation, although previous studies have demonstrated how these regulatory instruments are mostly out-dated, inhomogeneous and often inadequate (20, 21). It has to be underlined that Italian regulations take into account illumination requirements specifically regarding children in a Ministerial Decree related to schools (22). This document states that illumination should not be less than 100 lux in service areas, not less than 200 in study rooms and libraries, and not less of 300 lux on working surfaces (desks, blackboards, worktops).

The European legislation widely takes into account lighting of many different spaces (working places, sport facilities, streets, tunnels, etc), but it does not focus on dwellings (23-25).

Russian Federation

Sanitary Regulations and Norms (SanPiN) 2.2.1/2.1.1.1278-03 provide hygienic natural, artificial and combined lighting requirements for residential and public buildings in the Russian Federation (26). This document regulates design, construction and restoration of residential and public buildings in populated areas.

Hygienic requirements for natural lighting of residential and public buildings. Natural lighting is considered to be the light produced by the sun and penetrating the room through the windows (openings in the supporting constructions). Its intensity is conditioned by time parameters, location data and weather conditions.

Buildings intended for continuous human occupancy must have natural lighting, i.e. even the most perfect artificial lighting system cannot replace natural lighting. Natural lighting may be of the following types: side lighting, valance lighting and combined lighting.

"Light climate" of a given region should be taken into consideration when making light calculations for buildings located in different regions of the Russian Federation. "Light climate" is a set of natural lighting conditions typical of a given area (lighting and light exposure on horizontal surface and vertical surfaces differently oriented on horizon sides produced by scattered sky light and direct solar radiation, sunshine

duration and underlying surface albedo) during a period longer than 10 years (27). Natural lighting of the building should be calculated excluding furniture, equipment and shade gardening.

Combined natural lighting is reported to be a combination of natural side and valance lighting (28). In case of combined natural lighting the room is divided into side and valance lighting zones. Natural lighting calculation should be performed for each zone.

Several values should be calculated while assessing natural lighting: (1) light factor; (2) laying depth; and (3) laying ratio (29).

(1) **Light factor** is a ratio of window area to floor area. Its standard value for residential buildings is 1:5.

Light angle on the work surface (α) shows the angle of light beams on the given horizontal surface. Standard α value must be no less than 27°.

Opening angle (γ) demonstrates the sky profile amount that directly lightens the given area. Standard γ value must be no less than 5°.

Natural lighting ratio (KEO) is a percentage ratio of in-door lighting ($E_{вн}$) to out-door lighting ($E_{нар}$) estimated with a luxmeter at the same time of the day or night: $KEO = (E_{вн} / E_{нар}) \cdot 100$

(2) **Laying depth** is defined as a distance from the outer wall to the furthest point of the room.

(3) **Laying ratio** is defined as a ratio of laying depth to the floor-to-window-upper-edge height.

Residential and public buildings in the central and historical city areas with one-sided lateral lighting must have a KEO value in the center of the room equal to 0.5%. For children's rooms its value must rise to 0.7%. KEO at a given point of the room is defined as a lighting ratio at this point to simultaneous outside lighting of the open horizontal surface lightened by the entire sky profile diffuse light. KEO is measured in relative units and shows the percentage of lighting at the given point of the room comparing to simultaneous horizontal lighting under the open sky (28).

KEO under valance or combined lighting in living rooms, bedrooms, kitchens must be 2.0%; in children's room 2.5%.

Natural lighting requirements for residential buildings depending on the destination of rooms are given in Table 1.

Hygienic requirements for artificial lighting of residential and public buildings. Artificial lighting is divided into primary (working) and emergency, general and combined. All rooms in the building must be provided with working artificial lighting. All rooms in public buildings must be provided with general lighting. Rooms of the public buildings, where people work under severe eye strain, such as study rooms and libraries,

Table 1 - Standard natural lighting requirements for residential buildings

Rooms	Natural lighting	
	KEO (%)	
	Under valance or combined lighting	Under side lighting
Living rooms, bedrooms	2.0	0.5
Kitchens	2.0	0.5
Children's rooms	2.5	0.7
Study rooms, libraries	3.0	1.0

Table 2 - Standard artificial lighting requirements for residential buildings

Rooms	Lighting of the working surfaces (lux)
Living rooms, bedrooms	150
Kitchens	150
Children's room	200
Study rooms and libraries	300
Connecting corridors	50
Bathrooms	50

should be supplied with combined lighting system.

Artificial lighting requirements for residential buildings depending on the destination of rooms are given in Table 2.

Hygienic requirements for combined lighting of residential and public buildings. Combined lighting is defined as lighting when natural and artificial lighting is used during the full-time working day. (28) Combined lighting is provided when it is required according to space planning and architectural decisions, apart from rooms in the residential buildings, hotels and hospital wards.

Combined lighting requirements for residential buildings depending on the destination of the rooms are given in Table 3.

Table 3- **Standard artificial lighting requirements for residential buildings**

Rooms	Combined lighting KEO (%)	
	Under valance or combined lighting	Under side lighting
Kitchens	1.2	0.3
Studies, libraries	1.8	0.6
Communal stairs	0.1	0.1

Conclusions

The occurrence and re-occurrence of pathologies related to the quality of dwellings upholds once more the ultimate importance of domestic environment as principal living space (4, 30-32) and highlights the need to provide rigorous requirements with regard to human-built environment, mainly residences (17, 33, 34). The present study underlines how Italian legislation is by far less specific and detailed when compared with the Russian one. Russian standards are more easily applicable and by far more updated.

In fact, Italian laws do not take into account many fundamental aspects such as room length, angle of light (Forster Angle, Weber Angle), windows position, floor, building highness and orientation. The strictly prescriptive approach of Italian requirements should be updated, in order to simplify the controls and to implement lighting in indoor environment. It was already underlined in different studies (14, 20, 34) that switching to a performance-based approach would be more helpful. That could be much useful if applied to lighting, fixing the requirements on measures taken in different rooms, as it happens in the Russian Federation.

The authors once again highlight the need to develop new and updated regulatory instruments for building hygiene, relying on the most recent acquisitions of international scientific literature and guaranteeing the highest standards in Public Health safeguard.

Riassunto

Requisiti di illuminazione delle abitazioni: un confronto fra Federazione Russa ed Italia

L'illuminazione rappresenta uno dei principali fattori di benessere in ambiente confinato. Le normative igienico-sanitarie trattano da tempo, ed a livello inter-

nazionale, i requisiti dell'illuminazione delle abitazioni. Gli autori descrivono il sistema di detti requisiti in Italia e nella Federazione Russa, analizzandone i contenuti e le criticità e mettendoli a confronto. Il quadro che ne consegue vede una maggiore modernità, precisione e complessità dei requisiti russi rispetto a quelli italiani. In conclusione, gli autori richiamano alla stringente necessità di una revisione e di un aggiornamento della specifica regolamentazione igienico-sanitaria in Italia.

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