Analysis of the most determining factors from Romanian urban regulation, at the state level, in relation to sanitation, hygiene and health throughout recent history

Ch Cazacu*, C Chitonu and R Muntean

1 Faculty of Civil Engineering, Transilvania University of Brasov, Romania

* cazacu.christiana@unitbv.ro

Abstract. Construction represents an important branch of the Romanian economy. The construction branch must be characterized by flexibility and diversity, attributes that favor change, through generation, continuous development and rapid transposition into practice of new ideas. The demands of society are becoming more and more severe throughout the all countries of the world. Expectations and needs are becoming increasingly explicit for issues such as: health and safety of the place where we live or work environmental protection, operational safety.

1. Introduction

This article looks into the past construction sector and at challenges in the modern building mass related to indoor climate, hygiene and occupant wellbeing. As the statistics show, the indoor quality for buildings is directly influenced by the different building materials used in the process of construction and in further maintenance. The indoor environment may vary due to the level or types of human activities, which are carried out inside the buildings. The health of occupants is most related to the air quality, internal atmosphere [1, 2].

The ventilation systems have advantages and also disadvantages. The differences between the architectural programs are mainly determined if ventilation needs to be considered, due to the size of buildings, activities or functionality. Spreading the contaminated air, or impurities and microparticles, brings the high risk of short or long term infections and air borne diseases.

Studies show that this environmental comfort that occupants need is determined by physiological, esthetical and physical factors (microclimate) but also by spatial ones (the shape and dimensions of the interiors, the arrangement of objects) [3]. A building’s interior microclimate is influenced by some factors, as it can be seen in figure 1.

- temperature: should be 20 - 21°C, in rooms with low energy consumption activities, and 15 - 18°C, where energy consumption is high;
- the air humidity must be 40 - 50%, because when it grows above these values, microbes and mold appear, and the hot and dry air causes respiratory difficulties;
- a bad relative humidity, temperature or humidification will affect the skin and can give upper airway symptoms, and also the perceptions in the office environment [4]; the optimum composition of the air must be ensured by a good ventilation of the rooms;
- natural light penetrates as much as possible inside the room and has a good distribution if the windows are high and evenly placed;
• in artificial lighting, the position and direction of the light source must have the effect of optimum light intensity and avoid blinding its users;
• the noise produced inside, but also outside the buildings are important for those in the interior spaces; in order not to become annoying, the sound insulation of the building is necessary.

Figure 1. Factors that can influence the microclimate of homes.

1.1. The purpose of this study
The purpose of this paper is a research based on studies and analyses of the most determining factors in relation to sanitation, hygiene and health throughout recent history within Romanian State regulations.

The research is part of BIMHealthy project - Housing as a strategy for health promotion from an intersectoral and multi-disciplinary approach–co-funded by the Erasmus+ Programme of the European Union, [5]. The project started in October 2019 and it will end in September 2021. Six organizations, universities, research and development centers and private companies from three countries, Spain, Poland and Romania, are involved into this project.

The project aims to develop an interoperability between buildings and the health of their users to promote the realization of healthy housing as a global model, both in terms of the built environment and public health, by integrating new BIM technologies (Building Information Modelling) as tools for design and control of buildings [6, 7].

This section analyses the urban regulations, parameter values for Romanian cities, which, sometimes, are freely established in each City Council, but also the most representative parameters that regulate the interior of the homes built in Romania over time.

Through this study answers to the following questions, were sought:
• when did the constructions in Romania start to be build taking into account, apart from the structural strength and appearance, the health and safety of the building’s users?
• are there technical and legal rules that regulate the construction of residential buildings from this point of view?
• if so, which are they and when did they appear throughout history?
• which are the main regulations, contained in these norms?
• and how have they changed over time, depending on the users’ needs?
• which are their recommendations regarding hygiene, health and safety for a construction?

2. Historical data
In time, in Romanian construction sector, there where important changes, especially in the construction technology, determined by: the introduction in execution of new materials, use of high-performance machinery, machines and equipment on construction sites, introduction of automation in the secondary industrial production of construction, wide range of prefabrication used on a larger scale, the introduction of new structural solutions [8].
The research started in 1935, because it is the first period in which some data on aspects related to the health and safety of constructions were found. In the interwar period and the first years after the Second World War, there is a continuous development of construction activity, in the form of built areas and the number of permits issued nationwide, over 10,000 permits being issued only in 1937, as it can be seen in table 1:

| Year | No. authorization | sqm per unit |
|------|-------------------|--------------|
| 1935 | 10728             | 165          |
| 1936 | 10018             | 147          |
| 1937 | 10370             | 131          |
| 1938 | 7776              | 127          |

Between 1950 - 1968, the development of constructions was characterized by a rapid dynamic, the production of this branch has been developed in 1968 nine times compared to 1950. The contribution of the construction sector to the creation of total social product and national income increased continuously, occupying in 1968 the third place after industry and agriculture in terms of material production. If in 1938, the construction sector achieved 5.4% of the social product, and 4.4% of the national income, being on the last place within the material production branches, in 1968 its share increased to 10.1% and respectively 9.2%.

In 1958 appeared the Decree no 144 regarding the regulation of the issuance of authorizations for construction, repair and demolition of constructions, as well as those related to the alienation and division of lands with or without constructions. Within this norm are presented details regarding:
- number of rooms in a house, provisions between them and minimum dimensions;
- minimum dimensions of rooms;
- insulation and waterproofing conditions;
- quality of the materials used for a building.

Decision no. 1650/1968 on the construction of housing in the urban environment from centralized state funds presents the realization of housing from centralized state funds, differentiated by number of rooms, comfort, endowment and price, apartment areas, facilities and price limits for different categories of housing and apartment sizes like:
- the apartments could have 1 to 4 rooms;
- a normal apartment could contain the following rooms: kitchen with sleeping area (10 - 11 sqm), room with cooking space (10 - 11 sqm), sleeping room (12sqm), bathroom or shared bathroom on the landing;
- for a 1 to 4 room apartment, the kitchen must be at least 3 to 4 sqm;
- common areas like: technical basement, laundry, drier;
- the sanitary objects: W.C. with water, washstand, shower, bath shower;
- the apartments could be centrally heated, or with one or two terracotta stoves.

Decision no. 585/1971 on the construction of urban housing from centralized state funds present data about urban dwellings that are from centralized state funds and put into use since 1972 were differentiated by the number of rooms, comfort, endowment and price, as follows in table 2.

In the past, those who lived in block apartments, had their homes connected to a national gas network and very few used personal apartment heating systems. The rooms were equipped with standardized and pre-dimensioned ceramic radiators, depending on the size of the rooms. For those who lived in private homes, the options were more varied because they could opt for heating with gas or wood stoves, and their size was not limited or special required.
Table 2. Number of rooms, comfort and price of different category of apartment.

| Category of apartment | Number of rooms | Room area (sqm) | Kitchen area (sqm) |
|-----------------------|-----------------|-----------------|-------------------|
| I                     | 1               | 14              | 3                 |
|                       | 2               | 24              | 3 - 4             |
| II                    | 3               | 33              | 4 - 5             |
|                       | 4               | 42              | 4 - 5             |
|                       | 1               | 13              | 3                 |
| III                   | 2               | 23              | 3                 |
|                       | 3               | 32              | 4 - 5             |
|                       | 4               | 41              | 4 - 5             |
| studio                | 1               | 8.5             | -                 |

The change in political regime in 1989 had a significant impact on the field of housing: rules on control of residence and restricted access in major cities were discontinued, ownership of more than one dwelling was allowed, the law on systematization was abolished, access to real estate was liberalized, the number of actors (construction, rental) in housing multiplied and housing in collective blocks was privatized. These measures have determined a fundamental change in the housing sector and the mechanisms of housing construction and administration [10].

In 1996 appeared the Regulation regarding the design of dwelling buildings NP 016 [11]. This normative establishes the location and compliance conditions corresponding to the housing constructions in Romania, as well as the technical conditions, criteria and performance levels corresponding to the quality requirements, to which the housing constructions must meet, in accordance with the provisions of Law 10/1995 regarding the quality in construction. It aims to ensure the necessary protection and comfort, for the users (regardless of age or health) in accordance with specific requirements, by improving the performance of residential buildings. The provisions of this norm apply to the design of new residential buildings, located in urban or rural areas, as well as to the modernization, redevelopment, transformation, repair and consolidation of existing housing constructions.

2.1. Height regime of buildings
The establishment of the height regime of buildings, must be done in accordance with the provisions of PUG (general urban plan), PUZ (zonal urban plan) and PUD (detailed urban plan), as well as indicators of POT (percentage of land occupation) and CUT (land use coefficient) provided in the Urban Certificate, taking into account, at the same time, the influence of the wind and the air currents in the area.

2.2. Choosing the location of residential buildings
The objective of this standard (NP016) is also to establish the minimum acoustic conditions required for buildings, suitable for the use and activity of its occupants. The norm recommends to avoid locations in the vicinity of sources producing noxious substances, loud noises and vibrations (airport, industrial areas, heavy traffic arteries):
- maximum allowed noxious concentrations according to the provisions of STAS 12574/1987;
- permissible noise value: max. 50 dB (A) 2.00 m from the building façade (in case it is not possible to comply with this condition, appropriate insulation measures will be taken) [12].

For an increased thermal comfort inside the houses, it is recommended to orient the houses towards the cardinal points, so as to avoid the north location of the bedrooms.
2.3. Sunshine
The technical condition for sunshine, presented in NP 016, refers to the criteria of direct penetration of sunlight into the building. A home must be located and oriented in such a way that at least one of the living rooms (bedroom or living room) receives direct solar radiation, a certain number of hours per day, at certain minimum angles, throughout the year.

- the duration of sunshine for at least one of the living rooms, on a reference day (February 21, or October 21) must be at least 2 hours;
- the vertical angle of incidence of direct sunlight, on the reference day (February 21 or October 21), must be min. 6°;
- the angle of incidence in the horizontal plane of the direct sunlight, on the reference day (February 21 or October 21), must be min. 20°;
- the avoidance of the blinding phenomenon will be ensured by the correct orientation of the rooms, by the shielding of the glazed surfaces (in the case of buildings located in geographical areas with a high degree of sunshine, or of buildings with improperly oriented rooms).

2.4. Lighting of residential buildings
The technical condition for the lighting of residential buildings involves ensuring the quantity and quality of light (natural and artificial) so that users can carry out their household activities properly, both during the day and at night, in conditions of hygiene and health.

The value of natural lighting (for the winter solstice, overcast sky), should be for:
- living rooms (min. 30 lx),
- kitchens (min. 60 lx),
- bathrooms, hallways, corridors (min. 16 lx).

The ratio between the area of the windows and the area of the floors will be for:
- living rooms 1/6 ... 1/8;
- the other rooms 1/8 ... 1/10;
- stairs 1/10 ... 1/14.

If the natural light does not comply with the conditions specified above, it is necessary that the natural lighting be partially or totally compensated, depending on the destination of the room, with artificial lighting according to the provisions of ongoing standards.

The average lighting level, for normal room lighting at \( h = 0.85 - 1.0 \text{ m from the floor} \), should be as presented in table 3:

| Room Type                  | General lighting | Local lighting                      |
|---------------------------|------------------|-------------------------------------|
| Bedroom                   | 50 lx            | 50 lx                               |
| Living rooms              | 50 + 100 lx      | read 300 lx (on the table surface)   |
|                           |                  | sewing 500 lx (on the work surface)  |
| Bathroom                  | 75 lx            | 100 + 200 lx (on the surface of the mirror) |
| Kitchens                  | 100 lx           | 300 lx (on the work surface)        |
| Hallway, corridors        | 50 + 100 lx      | 50-75 lx (on the surface of the steps) |
| Garage                    | 50 lx            | 50 lx                               |
| Basements, cellar, garbage | 50 lx           | 50-75 lx                            |
2.5. Hygrothermal hygiene of the indoor environment in homes

Creating a minimum allowable hygrothermal environment involves ensuring a proper thermal environment, both in winter and in summer. It is allowed that these conditions are not met 1 day/year in winter and 5 days/year in summer. Ensuring the hygrothermal environment must be correlated with ensuring air quality and optimizing energy consumption.

The normal global thermal environment comfort index (PMV) (the predictable average option calculated according to SR ISO-7730/2006), should be: PMV = -0.5 ... + 0.5, and the temperature of the indoor environment (Ti,) (according to SR 1907/2-2014):

A. in winter (minimum values):
- in living rooms, halls (20°C), vestibule (18°C), bathroom, showers (22°C), toilets in the apartment (18°C), toilets outside the apartment (15°C), garages under dwellings (10°C), kitchen (18°C), stairs, corridors outside the apartment (10°C);
B. in summer max. 25° C in all rooms.

The relative humidity of the indoor air (Φi) (according to SR ISO-7730/2006), will be between 35% and 60%.

The speed of the air currents (vi) (according to SR ISO 7730/2006), will be:
- in winter: vi = max. 0.15 m/s;
- in summer: vi = max.0.275 m/s.

Ensuring the normal local thermal environment:
- the asymmetry of the radiation temperature of windows or other cold surfaces (calculated according to SR ISO-7730/00), will be: max. 10°C;
- asymmetry of the radiation temperature of a heated ceiling (calculated according to SR ISO-7730/2006), will be: min. 5°C;
- the vertical air temperature difference, between the head and ankle level (according to SR ISO 7730-2006), will be: max. 3°C;
- the amount of heat given off by the foot of the floor, related to the cold-hot sensation (according to STAS 6472/10-85), will be:
  - in living rooms (warm floors): 
    \[ Q_1 = 50 \times 10^3 \text{ J/m}^2, \quad Q_{10} = 300 \times 10^3 \text{ J/m}^2 \]
  - in the other rooms:
    \[ Q_1 = 60 \times 10^3 \text{ J/m}^2, \quad Q_{10} = 400 \times 10^3 \text{ J/m}^2 \]

2.6. Acoustic hygiene of the indoor environment

The technical condition regarding the acoustic hygiene of the indoor environment, supposes the design and realization of the interior spaces of the residential buildings so that the disturbing noise perceived by the users, to be maintained at a level that cannot affect their health.

Acoustic hygiene refers to the indoor conditions regarding noise, respectively to the indoor acoustic environment. The acoustic ambience in the living rooms coming from sources outside the room it is recommended at the level of max. 35dB.

2.7. Water hygiene

The technical condition, regarding the hygiene of the water, presupposes that the distribution of the water should be done in a sufficient flow, in the conditions of satisfying the purity criteria corresponding to the drinking water.

The water necessary to supply the installations in the residential buildings must have a certain quality, expressed by all its physical, chemical, bacteriological, etc. according to the STAS 1342/1991. The values for the water flow at the point of consumption should be: \( Q = \text{min. } 0.15 \text{ l/s (at the kitchen washer), } Q = \text{min. } 0.05 \text{ l/s (at the bathroom sink and bathtub) with an optimal water speed = 1 m/s and the required quantities of drinking water min. 110 l/pers./day.} \)
2.8. Air hygiene
The technical condition related to air hygiene involves ensuring the quality of the air inside residential buildings, respectively ensuring a proper atmospheric environment, so that there are no releases of harmful substances, toxic gases or dangerous radiation emissions, which could endanger the health of occupants. In Romania the required oxygen concentration will be min. 16.3% (of the volume of the room) and the maximum allowed concentrations of carbon monoxide will be: max. 6 mg m$^{-3}$.[11]

The maximum permitted concentrations of water vapor will be: max. 15.400 mg/m$^3$ ($T_{med} = 25 \pm 3^\circ$) in summer regime and max. 9.450 mg/m$^3$ ($T_{med} = 20 \pm 2^\circ$) in winter regime [11].

Natural ventilation of rooms: air exchange (on the whole house) 0.5 … 1 vol/h.

Organized natural ventilation or mechanical suction ventilation is mandatory for outbuildings without windows to the outside (bathrooms, rooms with shower, closet and washbasin, rooms with closet and pantries), for outbuildings with windows to the outside, but with equipment for cooking food or hot water with open flame (bathrooms, kitchens) and for garbage collection rooms as well as for basements. All living rooms must be provided with the possibility of natural ventilation.

Mechanical ventilation (individual exhaust ventilation): for kitchens (without windows): min. 120 m$^3$/h, for bathrooms: min. 60 m$^3$/h, for shower rooms with toilet and washbasin: min. 60 m$^3$/h, for rooms with toilet and washbasin: min. 30 m$^3$/h [11].

2.9. Ensuring the quality of finishes in rooms, in terms of protection against poisoning with toxic substances
- materials that do not contain toxic substances and that do not emit harmful gases, dangerous to health, will be used;
- materials resistant to cleaning and sanitation actions will be used, depending on the destination of the rooms;
- measures will be taken to avoid the formation of fungi, by correcting the external closures correctly and by ensuring adequate ventilation.

2.10. Hygiene of sewage and manure
The technical condition regarding the hygiene of the waste liquids, supposes the assurance of an adequate system of elimination of the used (impure) domestic or meteoric waters, as well as of the manures:
- avoidance of pollution of the natural environment, respectively of groundwater, or of the soil, with wastewater coming from the sewerage system of construction objects;
- avoiding the risk of emitting unpleasant odors - odor level = 0;
- avoiding the interconnection between wastewater and drinking water;
- it is ensured by the correct solution of the sewerage and water supply systems, according to the provisions of regulations 1 9/2013, STAS 1795/1987, STAS 3051/1991, NTPA 001/2002, NTPA 002/2002, NP 118/2006.

The regulations also present data about indoor traffic safety, doors, stairs, hallways, floors. These provisions purposes are the realization of buildings that are as safe as possible for the occupants, in order to avoid home accidents.

NP 057-02 [12], the normative regarding the design of residential buildings replaces the old normative NP 016-96, and is valid until today and aims to ensure the necessary protection and comfort for users (regardless of age or health) in accordance with specific requirements, by improving the performance of residential buildings.

The norm mostly includes the provisions of the norm, which it replaces with small modifications brought to some values related to the ventilation of the rooms, humidity or brightness.
3. Conclusion
In the past and also now, financial resources, physical condition and socio-economic circumstances can affect the technical design choices for buildings. However, buildings can present a great number of possible risks both in construction and operation. There are many duties placed on those designing, constructing and operating buildings to control health risks. For a new construction, the hygiene and the health of the occupants must become a priority strategy, and needs to be considered early on in the project because it is the key to securing a safe construction [13 - 15]. The client’s role is fundamental to this, to establish and maintain a health and safety approach. The health and safety strategy should set clear health and safety objectives. In the current situation of COVID-19 pandemic, the further urban planning should include some key factors in building design, which can either increase or reduce the spread of diseases in public or private buildings. The size of buildings, height versus smaller buildings, or less densely situated buildings will impact the wellbeing of the occupants and also will benefit their health if the indoor air quality and hygiene factors are considered part of the planning strategy [16, 17].

Recommendations for a hygiene and health construction:
• provide designs that eliminate or reduce hazards in the work or living place;
• prevent occupational injuries and illnesses;
• prevent slips, trips and falls;
• eliminate exposure to hazardous materials;
• provide good indoor air quality and adequate ventilation;
• provide ergonomic workplaces and furniture to prevent work-related musculoskeletal disorders;
• perform proper buildings operations and maintenance.

In a sustainable urban development, it is imperative that the building mass is built for increased hygiene and considering infection control purposes in the future. Making improvements in the use of building materials, shapes, functionality, ability to clean, purposeful ventilation and ensuring smarter and more targeted spatial connections are key factors for improving the wellbeing of occupants. The balance between architectural, urban planning and building services in regards of the energy required for heating and cooling, domestic hot water, controlled ventilation, lighting and other technical facilities in buildings should be designed to optimize the levels of health, indoor air quality and well-being defined by the Member States at national level or regional.

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