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Editorial: Design of efficient and healthy buildings

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Editorial on the Research Topic
Design of efficient and healthy buildings

People spend most of their time indoors in residential buildings; thus, maintaining good indoor air quality (IAQ) is essential. It is necessary to provide a suitable ventilation rate in these spaces (low-density occupation) taking into account that materials (finishes and furnishing) are one of the main sources ofindoor pollution (Hormigos et al., 2017). The burden of disease associated with indoor air accounts for millions of premature deaths related to exposure to Indoor Air Pollutants (IAPs). CO_2 is commonly used as a metric of IAQ. Indoor CO_2 concentrations can be significantly higher than outdoors due to human metabolism and activities. Even in presence of ventilation, controlling the CO_2 concentration below the recommended limits is challenging, and many indoor environments, such as schools, offices and transport, exceed the recommended value of 1,000 ppm. These values are often accompanied by high concentrations of other pollutants, volatile organic compunds (VOC), including bioeffluents such as viruses, and because of this, the importance of mitigating airborne disease transmission has been highlighted by the COVID-19 pandemic (López et al., 2023). Currently the total amount of volatile organic compounds (TVOC) suspended in the air are indicators of indoor pollution and their source control is necessary from the points of view of health, comfort, energy efficiency and sustainability (Mølhave et al., 1997).

The built environment has a significant impact on human health. The extent of the impact of buildings on human health and the environment depends on different environmental factors. The extent of the impact of buildings on human health and the environment depends on the design, materials and methods used for construction and operation (Awada et al., 2022). It is increasingly important to design healthy buildings in the pursuit of sustainable development, where not only the occupants play an important role in ensuring good indoor air quality through their habits, but also current developments related to interior finishes with low chemical emissions and good fungal resistance (Rupp et al., 2015; Loftness et al., 2007).

Recent research has shown that people contract COVID-19 through airborne transmission indoors, especially in poorly ventilated environments (Domínguez-Amarillo et al., 2020). It is therefore necessary to maintain optimal air quality to eradicate the virus spread. This requires innovative changes to existing indoor and outdoor infrastructure to positively influence occupants even in the most densely populated spaces (Karagulian et al., 2015). This is also a challenge to traditional residential and public building construction in the aftermath of the COVID-19 pandemic (Lopez et al., 2023).

The healthy building concept focuses primarily on the creation of a desirable environment, which is measured in terms of indoor environmental quality (IEQ) (Jain et al., 2020). A healthy IEQ is expected to positively impact the occupants of most densely populated buildings in terms of physical, mental and social wellbeing. The level of indoor environmental quality depends on several parameters, such as thermal, visual, acoustic and chemical variables (Altomonte, 2019). The parameters, which should be assessed individually and/or collectively, include indoor air quality (Agarwal et al., 2021), thermal comfort (Tartarini et al., 2020), ventilation (Dahari and Aouinet, 2020), acoustic performance (Baeza Moyano and Gonzalez, 2022; Moyano et al., 2022), lighting (Moyano et al., 2020) and spatial layout (Ribeiro et al., 2020).

Therefore, it is necessary to set up a building with a high level of IEQ to promote the health and wellbeing of its occupants (Toyinbo, 2019). Air quality is one of the factors that play a major role in providing a healthy IEQ (Hormigos et al., 2018). Indoor air quality can be compromised by both outdoor and indoor sources of pollutants related to building materials, equipment, animals and humans (Van Tran et al., 2020). Below is a summary of the main findings of the articles included in this Research Topic.

Jung et al. investigated the relationship between the concentration of indoor air pollutants according to changes in temperature and humidity in newly constructed flats before occupation. As a methodology, a field measurement was carried out in 23 dwellings in five different residential towers in Ajman (United Arab Emirates). The authors demonstrated that there is an emission deadline point at which the generation of indoor air pollutants deviates from a linear relationship at RH 40%–50% and 25°. Jung et al. also provided research where the influence of building materials was evaluated and the effect of improving the indoor air environment was analysed. The result showed that the wallpaper standard on the seventh day was 6.21%. This study will serve as a basis for the preparation of UAE standards for functional building materials with adsorption and decomposition of harmful chemicals, moisture absorption, moisture absorption and moisture resistance, as well as antibacterial and antifungal.

Sharzad and Jung provides essential data to improve indoor air quality by identifying the VOC and HCHO emission characteristics as a function of raw material characteristics and methods of finishing furniture materials. The authors show that the TVOC emission was lower when the correct? Surface finishing method, such as paint finishing, was applied. HCHO emission was increasingly lower when adhesive was used during molding. Furniture used in new houses was installed inside in the form of finished products (composite materials). It was confirmed that the amount of emission from furniture was generally higher than that from interior finishing material in general.

Cantarero et al. provided research that aims to introduce the Smart Citizen concept in architecture and landscape from a spatial understanding and perception of citizens with intellectual disabilities. A real case study developed by architects in collaboration with psychologists focused on the development of spatial intelligence for people with intellectual disabilities. The aim was to question the effectiveness of the use of technologies for such cognitive development and how even the increased use of GPS navigation systems could be a detriment to the citizen when orienting in open spaces. The main outcome of this review is whether a person with a disability is equally able to understand and navigate a space without the aid of GPS as a person without an intellectual disability.

Alonso et al. analysed the feasibility of converting to energy self-sufficiency to improve the environment, social circumstances and health of residents. In this study they evaluated possible approaches to achieve these ends. The theoretical model used was validated with detailed information collected *in situ*, based on social circumstances and energy efficiency. The authors designed improvement strategies for both individual buildings and groups of buildings, the model prioritised passive improvements to reduce demand. The results of this research will enable the residents of the neighbourhoods that collaborated in the research to actively participate in the improvement measures and to access information on their costs and benefits.

Indoor residential environments have a direct influence on human health, especially considering that in developing countries, significant levels of indoor pollution make dwellings unsafe, which has an impact on the health of the inhabitants. Housing is therefore a key factor influencing the health of people around the world, and various parameters such as air quality, ventilation, infrasound, ultrasound, acoustics, hygrothermal comfort, lighting, physical environment, building efficiency and others can contribute to healthy environment, as well as the conditions that can result from the misapplication of these parameters.

This Research Topic aims to address issues concerning Indoor Environmental Quality (IEQ), which are described more simply as the conditions inside the building. It includes air quality, but also access to daylight and views, pleasant acoustic conditions and occupant control over lighting and thermal comfort. They will also include the functional aspects of the space, such as whether the layout provides easy access to tools and people when needed and whether there is sufficient space for the occupants. Building managers and operators can increase building occupant satisfaction by considering all aspects of IEQ rather than focusing on temperature or air quality alone.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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