

Redefining the Home: Sustainable Interior Design in Multifamily Housing Systematic Review

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Abstract

This study investigates the impact of sustainable interior design on family well-being in multifamily housing, focusing on its contribution to environmental sustainability and improving quality of life. Its main objective is to synthesize recent research on how ecological approaches in interior design promote energy efficiency and use sustainable materials to optimize living spaces. Using the PRISMA methodology for the systematic review, studies were analyzed that highlight practices such as the integration of renewable energies and the use of local materials, which benefit the economy and the environment. The results reveal that such practices not only reduce costs and promote local employment, but also enhance occupational well-being. The conclusions emphasize the need to reconfigure residential design to face contemporary challenges and enhance sustainability. This study proposes new directions for future research on sustainable design, highlighting its impact on quality of life and its strategic importance for global sustainability.

Keywords: Sustainable Design, Energy Efficiency, Multifamily Housing, Sustainable Material, Sustainability.

INTRODUCTION

Shelter is one of the primary requirements of human beings; therefore, it is essential to ensure overall access to affordable and appropriate housing (Gusmao et al., 2021). The idea of home has progressed over time, acquiring various forms and functions in accordance with ever-changing social needs. Thus, the most significant and pressing dilemma facing humankind in the future is how to maintain the development of resources and the environment, and how to increase public awareness regarding ecological and environmental protection (Wang, 2021). Within this scenario, green interior design in multifamily residences presents itself as a crucial strategy to improve the quality of life and family well-being while preserving the environment. Therefore, it is imperative to enhance the improvement of interior design technology and minimize the occurrence of indoor pollution (Wang, 2021). This paper shows the re-imagination of the home through green interior design in multifamily residences, with a focus on cases in Peru as well as internationally.

Accelerated urbanization and rapid population growth in Peru and Lambayeque have increased the demand for multifamily residences, simultaneously driving the need to adopt sustainable design strategies in the residential sector. According to data from the National Institute of Statistics and Informatics of Peru (INEI, 2022), the urban population in the country grew by 32.6% between 1990 and 2021, generating a growing demand for living spaces (INEI, 2022). Globally, it is estimated that 68% of the population will reside in urban areas by 2050, an increase of 55% compared to 2018 (INEI, 2017). The most relevant and urgent challenge that humanity will face in the future is how to maintain the development of resources and the environment and how to promote public awareness regarding ecological and environmental protection (Abdelmageed & Zayed, 2020).

Green interior design in multifamily residences has become a global trend in response to these challenges. Therefore, ecological design can also be referred to as green design. It needs to incorporate the concept of

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environmental protection into all stages of design, with the purpose of decreasing environmental pollution and energy waste and achieving a balance between sustainable development and economy (Zolfaghari et al., 2023). This approach seeks to merge energy efficiency, responsible use of resources, reduction of ecological footprint and promotion of family well-being in the creation of livable spaces, given that the increase in energy prices, global economic stresses and the effects of climate change are determining factors in the increase of energy poverty worldwide (Benincá et al., 2023). The literature on this topic is extensive, addressing various aspects, from the choice of materials to the implementation of innovative technologies and the promotion of sustainable lifestyles. Decoration involves the process of ornamenting a new building, while renovation is the repair, maintenance, and other activities necessary for the decoration of an old building that does not meet current aesthetic or livability needs (P. Sun et al., 2020).

This systematic literature review aims to provide a comprehensive overview of recent research and advances in the field of green interior design in multifamily residences, as well as identify best practices and opportunities for their application in local and international contexts. Through this review, we hope to contribute to the understanding of how to re-imagine housing to optimize family well-being and sustainability in an ever-evolving world. Because a home is an essential part of family life; it is more than its physical structure. It reflects the important elements of the inhabitants' lives, their ideas, behavior and other unique socio-cultural aspects. Sustainable housing (SH) and sustainable community have received significant attention globally (Sharafeddin & Arocho, 2022).

REVISION STUDIES

To carry out this literature review, extensive searches were conducted in relevant academic and scientific databases, as well as in journals specializing in interior design and sustainable architecture. Inclusion criteria focused on studies addressing sustainable interior design in multifamily housing and its relationship to family well-being. Articles published within the last sixteen years were selected to ensure up-to-date relevance of the review. Energy system-related topics and engineering-based articles were excluded.

Table 1 Comparison of the four review articles

Study	Sustainable interior design	Green design strategies	Interior design solutions	Quality of life in multifamily housing
Gusmao Brissi, S., Debs, L., & Elwakil, E. (2021).	x		x	
Sharafeddin & Arocho, 2022	x	x		x
Xiang et al., 2022			x	x
Winston, 2022	x	x		

Based on the above, the discovered items are interwoven into the interior design criteria, thus allowing for a more comprehensive investigation. According to Gusmao et al. (2021), housing stands as one of the most primordial human needs, which underlines the relevance of ensuring universal access to appropriate and affordable housing. However, it should be noted that even developed countries face difficulties in providing affordable housing for families of various economic strata (Gusmao et al., 2021).

It is emphasized that housing is an essential human need and highlights the importance of ensuring universal access to adequate and affordable housing. However, it is recognized that this need represents a challenge even for developed nations, which face challenges in providing affordable housing for families of different income levels. This also denotes that, even in economically advanced societies, there are individuals and families who struggle to find housing that is adequate and affordable. Consequently, the citation suggests that addressing this problem is of paramount importance to meet a basic need and promote a more equitable society.

According to Sharafeddin & Arocho (2022), a dwelling plays a crucial role in family life, transcending its physical structure. It reflects relevant elements of the lives of its occupants, their ideologies, behaviors and other particular socio-cultural aspects. Sustainable housing (SH) and sustainable community have attracted considerable attention globally. They are perceived as key elements in providing a high-quality built

environment (Sharafeddin & Arocho, 2022). It is highlighted that a dwelling goes beyond its physical structure, since it embodies significant elements of its residents' lives, such as their ideologies, behaviors and other socio-cultural particularities. In addition, the concept of sustainable housing and community, which have gained worldwide recognition, is mentioned. Sustainable housing implies building and maintaining dwellings in such a way that they are environmentally friendly, resource efficient and healthy for the occupants. On the other hand, a sustainable community refers to a built environment that promotes social interaction, cohesion and quality of life for its inhabitants.

These two papers address housing from different perspectives, but both emphasize the need to ensure access to adequate and affordable housing and consider factors beyond the physical construction of housing. In short, both citations emphasize the importance of providing adequate and affordable housing for all. They also recognize the challenges involved in achieving this goal and highlight the importance of considering additional factors, such as the social, cultural and environmental impact of housing and its surroundings.

On the other hand, there are studies that present analyses and solutions with respect to housing. For example, Winston indicates that a summary of emerging evidence on the impact of COVID-19 on housing suggests that the post-pandemic future could involve a mixed-use community, or a "15-minute city." This would involve higher residential density than that used in approaches favoring typical suburban development or "scattered" housing in rural areas (Winston, 2022).

Therefore, it alludes to the idea of a mixed-use community, which implies the creation of urban environments where essential services and daily activities are within walking distance of homes, thus reducing the need for long commutes and dependence on the automobile. This idea emerges as a response to the pandemic, as it recognizes the importance of having services, such as stores, green spaces, workplaces and recreational areas, close to homes, promoting a more sustainable and resilient lifestyle. Moreover, Xiang argues that a green building is a structure that minimizes or eliminates negative environmental impacts and generates benefits for the environment through its design, construction and operation. The use of green building materials improves the quality of life. However, excessive use of electronic equipment may hinder the achievement of the overall green goal, even if smart buildings are considered a beneficial stimulus to sustainability (Xiang et al., 2022).

Therefore, the importance of green buildings, which minimize environmental impacts and improve the quality of life, is highlighted. This approach involves the use of green building materials and the adoption of sustainable practices in terms of energy efficiency, waste management, use of natural resources, among others. The text also points out that excessive use of electronic equipment can be an obstacle to achieving overall green goals, even in buildings considered "smart". This suggests that, although smart buildings can offer benefits in terms of efficiency and comfort, it is crucial to take into account the energy consumption associated with electronic devices and ensure their responsible use.

In summary, both citations address issues related to housing design and its environmental impact. The former suggests a more densely populated and community-oriented urban development approach as a possible response to the pandemic, while the latter highlights the importance of green buildings that reduce environmental impacts and promote a better quality of life.

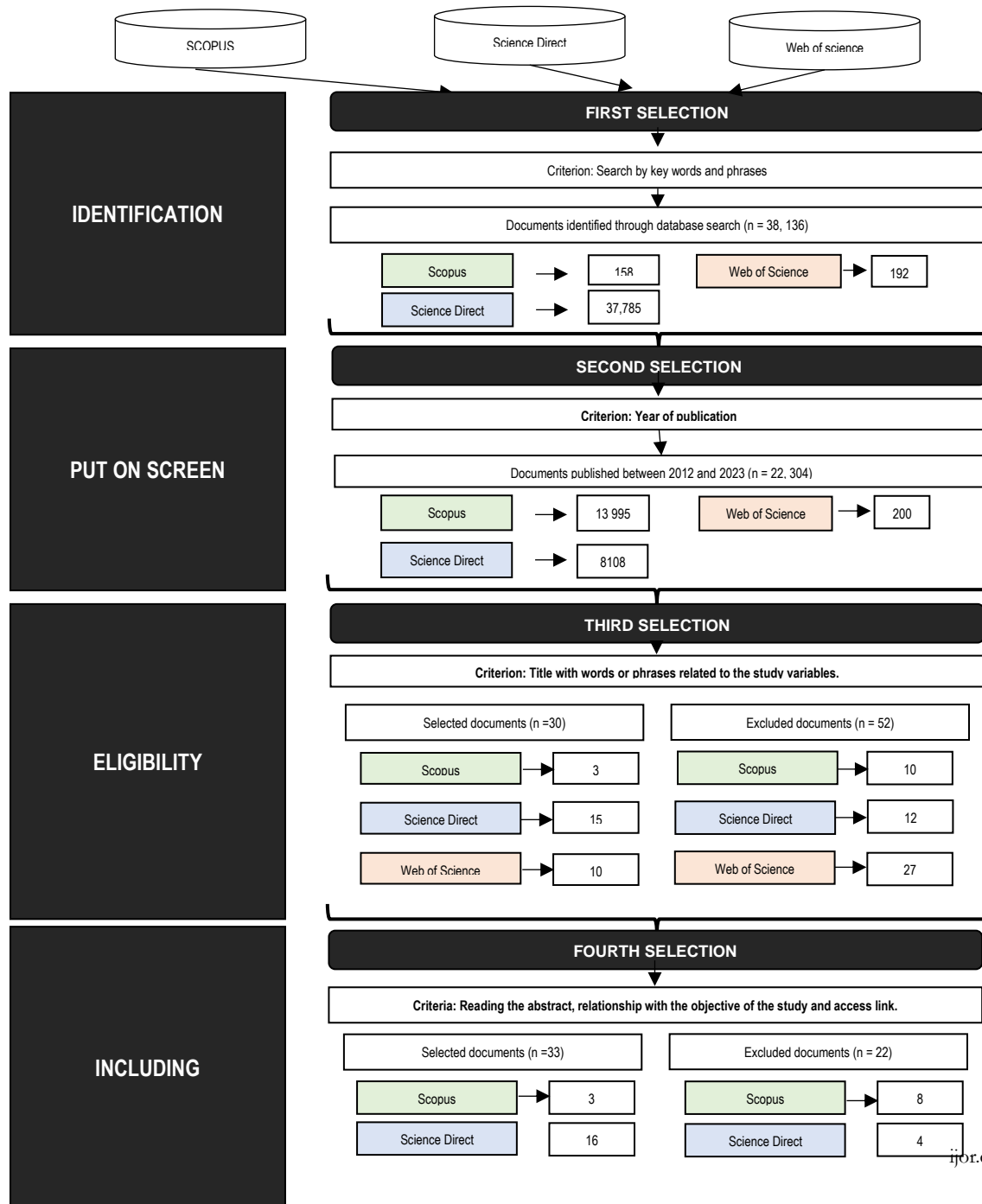
METHODOLOGY

Literature reviews or systematic reviews are distinguished by their ability to provide a comprehensive understanding of a specific topic, using secondary sources, such as scientific studies published in repositories or databases, which are found by searching automated browsers facilitated by web crawlers (Pardal-Refoyo & Pardal-Peláez, 2020). Therefore, to conduct a comprehensive literature review on the proposed topic, a structured search methodology was followed that included in the identification of concepts related to the topic of study, such as sustainable interior design, multifamily housing, family wellness, and "literature review". These terms were used to search academic databases and specialized search engines.

In addition, academic databases such as Science Direct, Scopus and Web of Science were searched for relevant scientific articles and studies. Combinations of search terms such as sustainable interior design, multifamily housing, family well-being and literature review were used in different variations to maximize the coverage of

the results. On the other hand, the titles and abstracts of the articles obtained in the initial search were examined to determine their relevance. Additionally, studies that specifically addressed sustainable interior design in multifamily housing and its impact on family well-being were prioritized. However, those that did not meet the inclusion criteria were discarded.

Likewise, a detailed reading of the selected articles was carried out to obtain relevant information on the topic to be addressed, compiling data on the methodologies used, the results obtained and the conclusions of each study. In addition, common trends and patterns were identified among the articles reviewed. Therefore, what sustainable criteria are needed to be able to make a green building? What is the relationship between interior design and sustainability? What are the methods to be able to make a sustainable interior design?



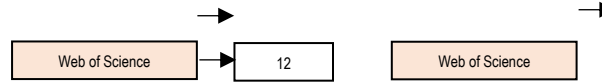


Figure 1 Selection process of studies identified in databases

Table 2 Number of documents consulted on Sustainable Interior Design in Multifamily Housing

Source	Number of files	Variable 1: Sustainable interior design in multifamily dwellings				
		Affordable housing	Resource development	Rapid population growth in Peru	Increase in urban areas worldwide	Reduce environmental pollution
Scopus	1					1
Science Direct	2	1	1			
Web of Science	2	1	1			
INEI	2			1	1	
Total	7	2	2	1	1	1

Table 3 Number of documents consulted on Family Welfare

Source	Number of files	Variable 2: Family welfare				
		Ecological interior design	Promoting public awareness	Environmental protection in the design stages	Reduction of the ecological footprint	Ornamentation and renovation process
Scopus	2		1		1	
Science Direct	3	1		1		1
Web of Science	2		1		1	
INEI						
Total	7	1	2	1	2	1

RESULTS

The term sustainable interior design also known as eco-friendly interior design or green interior design, refers to the practice of creating interior spaces that are environmentally friendly and promote sustainability at all stages, from material selection to operation and maintenance.

Sustainable interior design seeks to minimize the environmental impact of interior spaces, reduce the consumption of natural resources and energy, promote the health and well-being of occupants, and encourage responsible practices.

With respect to the first specific objective, this systematic literature review aims to provide a comprehensive overview of recent research and advances in the field of green interior design in multifamily residences, the results provide a comprehensive overview of recent research and advances in the field of green interior design in multifamily residences, specifically in relation to the topic of Redefining Home: Sustainable Interior Design in Multifamily Housing to Improve Family Well-Being - A Review of the Literature. Therefore, through this study, numerous sources of information relevant to this specific topic have been examined.

So, what sustainable criteria are needed to be able to carry out a green building?

Evidence reveals that green interior design in multifamily housing plays a crucial role in improving family well-being and promoting sustainability. Since, sustainable criteria necessary for green building have been identified, such as energy efficiency, resource management and indoor environmental quality. It has also been established that a sustainable building is characterized by its low environmental impact, resource efficiency and focus on the health and well-being of those who live in it. In addition, energy efficient buildings are sustainable buildings. As shown above, the architectural heritage of this area can be qualified as sustainable as it is high thermal performance, which provides thermal comfort and conserves energy (Alkhalidi, 2013).

Therefore, a building is sustainable when designing multifunctional and flexible spaces that adapt to the changing needs of families. This includes incorporating smart storage solutions, creating work areas in the home, and considering accessibility and mobility within the home and the materials used. For example, Table 4 represents green materials to consider in a building such as wood, gypsum, locality materials, materials with

low gas emissions since during the research at the five mills and sawmills, common lumber and cut lumber were considered to have better economic value and reuse (Yu & Fingrut, 2022).

Sustainable construction has been shown to play a key role in creating sustainable and healthy spaces for the inhabitants of multifamily dwellings. For example, proper selection of sustainable materials, optimization of energy efficiency and consideration of indoor environmental quality are key aspects of achieving sustainable interior design. Using tools such as DesignBuilder, BIM. In addition, interior design can encourage sustainable lifestyle practices and promote environmental awareness among residents. And in turn, in addition to using environmentally friendly materials, reducing energy consumption and reducing CO2 emissions are two of the most important considerations when designing green buildings (Xiang et al., 2022).

Table 4 shows a series of articles or research related to sustainable design in different countries and specific approaches. Each article has information on the author, year of publication, country of origin, as well as data related to energy efficiency, sustainable materials, bioclimatic design and recycled aggregates. These details provide an overview of the studies and approaches used in each case, showing different approaches and practices related to sustainable design in different parts of the world.

As for the author Rodger E. Edwards, Eric Lou, Anas Bataw, Syahrul Nizam Kamaruzzaman, Christopher Johnson says that BREEAM, originating in the UK and LEED originating in the U.S. both are credit-based schemes, with a project earning credits according to its compliance with set criteria (Edwards et al., 2019), where in addition the BIM tool is used for sustainable and bioclimatic designs.

Also, this table contains which systems will be used for sustainable construction as economical as they can perform well in all aspects of it. Therefore, one of the central missions of the authorities is to establish stable support policies for technology research, giving sufficient importance to the assessment of the feasibility of the technology to achieve the expected implementation effect (P. Sun et al., 2020).

However, this has to be possible to reused or added materials since workers generally said that there was little, they could do to reuse the different geometric features of the wood (Yu & Fingrut, 2022). Or as can also be glass, concrete aggregate where raw material recycling refers to a process in which the dismantled material is transformed into raw material to manufacture a construction material (Arslan, 2007). Also, the use of tiles, among other materials that are represented in Table 4.

This compilation highlights diverse global sustainable design practices, fostering awareness and knowledge sharing, promoting economical construction, improving resource management, and reducing environmental impact.

In addition, vernacular architecture has been an inspiration for innovations in environmentally and socioeconomically sustainable design and planning. Especially in traditional housing, the climatic and environmental solutions envisioned within sustainable design have already been achieved through local implementations (Kırbaş & Hızlı, 2016).

Table 4 Articles related to the question: What sustainable criteria are needed to be able to build a green building?

Code	Article	Country	Energy efficiency	Sustainable material	Bioclimatic design	Recycled aggregates
A01	Rodger E. Edwards, Eric Lou, Anas Bataw, Syahrul Nizam Kamaruzzaman, Christopher Johnson, 2019	United Kingdom	BREEAM and LEED, U.S. origin.	-	BIM tools	-
A02	Hakan Arslan, 2007	Turkey	-	Wood, plaster	-	Glass bottle, concrete aggregate
A03	Boyuan Yu, Adam Fingrut, 2022	London	-	Wood	Floor, stairs, ceiling, walls and columns.	Common wood and cut wood
A04	Sol Xiaomeng, 2021	USA	LED, halogen and compact fluorescent lamps	Wood flooring from renewable resources quickly	-	-
A05	Peiwen sol, Ning Zhang, Jian Zuob, Ruichang Mao, Xiaofeng Gao, Huabo Duan, 2020	China	Feasibility of the technology	-	-	Recycled gypsum for the production of gypsum boards

A06	Özlem Aydın, Esra Lakot Alemdağ, 2017.	Turkey	-	Local materials and construction systems	-	-	-
A07	Zachariah Bako Knows, Mahmud Mohd John, 2012	Nigeria	-	-	-	Ceramic tiles	-
A08	Marco Ortiz, Laure Itard, Philomena M. Blyssen, 2020	Netherlands	Heating and ventilation systems	-	-	-	-
A09	Mojtaba Ashour, Amir Mahdiyari, Syarmila Hany Haron, Mohd Hanizun Hanafi, 2022	Malaysia	Energy efficient lighting	-	-	-	-
A10	Abdulsamad Alkhalidi, 2022	United Arab Emirates	Thermal performance	-	-	-	-
A11	Hong Xian Li, 2023	Australia	Renewable energy production systems	-	-	DesignBuilder	-
A12	Aleya Abdel-Hadi, Iman Aboulgheit, 2012	United Kingdom	Environmental Assessment Method BRE (BREEAM), LEED, CASBEE	Low-emission materials	-	-	-
A13	Giuseppe Aruta, Fabrizio Ascione, Nicola Bianco, Teresa Iovane, Margherita Mastellone, Gerardo Maria Mauro, 2023	Italy	Heating/cooling system	-	-	-	-
A14	C. Carpino, R. Bruno, N. Arcuri, 2020	Italy	Heat pump	-	-	NET Zero Energy Building	-
A15	Ali Rajabipour, Cat Kutay, John Guenther, Milad Bazi, 2023	Australia	-	-	-	The application of BIM, AR (augmented reality) and VR (virtual reality)	Fiber-reinforced natural fibers, Adobe,

Also, what is the relationship between interior design and sustainability?

The relationship between interior design and sustainability are closely related, as interior design seeks to create spaces that are environmentally friendly, respectful of natural resources and promote a conscious lifestyle. This relationship is based on the idea that interior design can influence the efficient use of resources, the reduction of waste, the creation of healthy and comfortable spaces for their occupants, and so on. This category includes strategies to reduce costs, increase productivity, and reduce risks that are involved in the business of construction (Gusmao et al., 2021).

Interior design plays a key role in creating sustainable and healthy spaces for the occupants of multifamily dwellings. Aside from selecting sustainable materials, optimizing energy efficiency and considering indoor environmental quality are key aspects of achieving sustainable interior design. The green building movement originates from the need and desire for more energy-efficient and environmentally friendly building practices (Abdel-Hadi & Aboulgheit, 2012). It can also encourage sustainable lifestyle practices, such as the responsible use of resources and the promotion of environmental awareness.

Table 5 presents a series of articles related to sustainable construction strategies in different countries. Each article provides information on the author, the country of origin, the strategies employed, the relationship with the economy and other relevant aspects. Where, the articles address topics such as prefabricated housing construction and its impact on quality, productivity, efficiency and sustainability. Time savings and decreased operating and maintenance costs are highlighted as economic benefits where an energy and economic estimate in the case of a conversion of a single building social housing district to a community concept is highlighted (Aruta et al., 2023) (A01).

Other topics include drywall partitioning techniques, use of sustainable materials such as wood, stone and metal, adaptable skin models for visual comfort, social, environmental and economic sustainability criteria, and geometric designs (A02-A09). As well as aspects related to energy savings are also mentioned. Which in 2014, the Danish government presented a strategy for the energy renovation of the existing building stock in Denmark towards 2050, emphasizing the potential for building renovation with respect to reducing energy consumption and CO 2 emissions, without compromising environmental, social and economic quality (Nielsen et al., 2016). As well as, understanding traditional environments, energy efficiency in house design, selection of low VOC-emitting materials and use of renewable energy to achieve sustainability (A10-A18).

In general, the table presents a variety of approaches and strategies used in sustainable construction, highlighting the importance of considering economic, social and environmental aspects in decision making. These studies contribute to the development of more sustainable practices in the construction sector and seek to maximize cost-effectiveness and positive impact on the environment. For example, in the Netherlands, the energy

transition has focused mainly on the renovation and rehabilitation of the existing housing stock, particularly social housing (Ortiz et al., 2020).

Table 5 Articles related to the question: How does interior design relate to sustainability?

Code	Article	Country	Strategies	Relation	Economy
A01	Sara Gusmao Brissi, Luciana Debs and Emad Elwalkil, 2020	United States	Housing construction, prefabricated, OSC	Quality, productivity and efficiency, sustainability of your products and processes	Economic sustainability due to time savings Decrease in operating expenses
A02	Hunsang Chooa, Bogyong Le, Jinyoung Kim ,Byungjoo Choi, 2023	Singapore	Drywall partitioning techniques without destroying other finishing materials	-	-
A03	Boyuan Yu, Adam Fingrut, 2022	London	Materials database	-	Common wood and cut wood had better economic value and reuse.
A04	Sol Xiaomeng, 2021	United States	Interoperability Improves acceptability and loadability	ERP integration and green and eco-friendly interior designs	-
A05	Berrak Kırbaşa, Neslinur Hızlı, 2016.	Turkey	-	-	Stone, wood, earth, brick and metals
A06	Amir Tabadakani, Masoud Valinejad, Farzaneh Soflaci, Saeed Banihashemi, 2019.	Iran	Adaptable leather model	Optimum visual confort	-
A07	Seyyed Mohammadreza Zolfaghari, Oriol Pons, Jelena Nikolic, 2023	Iran	-	-	Applicability, suitability and validity of the proposed model
A08	Anne N. Nielsen, Rasmus L. Jensen, Tine S. Larsen, Søren B. Nissen, 2016	United Kingdom	Sustainability criteria	Social, Environmental and Economic Sustainability	Both construction and operating costs
A09	SM Amin Hosseini, Reza Yazdani, Albert de la Fuente, 2020	Iran	Geometric designs	-	-
A10	Hakan Arslan, 2007	Turkey	Economic, social and environmental effects	Minimization of existing resources, feasibility, social and physical sustainability	-
A11	JiaLu Gao, In-Sung Kim, 2023	South Korea	Intermediate space between the exterior and the interior of the house	Interior sofás	-
A12	Zachariah Bako Knows, Mahmud Mohd John, 2012	Nigeria	Climbing technique	-	-
A13	Marco Ortiz, Laure Itard, Philomena M. Bluyssen, 2020	Netherlands	-	-	Saving energy
A14	Abdulsamad Alkhalidi, 2022	United Arab Emirates	Traditional built environment	Sustainable environment due to the understanding of this traditional environment	-
A15	Rodger E. Edwards, Eric Lou, Anas Bataw, Syahrul Nizam Kamaruzzaman, Christopher Johnson, 2019.	United Kingdom	-	Sustainability during planning, design, construction, and construction	Operating costs (energy and water consumption) and environmental impacts (CO ² emissions)
A16	Hong Xian Li, 2023	Australia	Energy efficient house design	Impact of changes in heating and cooling setpoint temperatures on CO ² emissions.	-
A17	Aleya Abdel-Hadi, Iman Aboulgheit, 2012	United Kingdom	Selection of building materials and interior finishing products with zero or low VOC emissions	Building materials typically considered to be 'green'	-
A18	Giuseppe Aruta, Fabrizio Ascione, Nicola Bianco, Teresa Iovane, Margherita Mastellone, Gerardo Maria Mauro, 2023	Italy	-	-	Renewable energies achieve a degree of sustainability
A19	C. Carpino, R. Bruno, N. Arcuri, 2020	Italy	-	-	Optimum profitability

What are the methods to achieve sustainable interior design?

Table 6 presents a list of articles related to material selection and resource efficiency in sustainable design. Each article addresses specific aspects of sustainability, such as reuse, cultural adaptation, and spatial distribution. Different approaches and strategies used in different countries are mentioned, such as the use of sustainable materials, waste reduction, and energy efficiency. Sustainable design supports the well-being of residents by reducing indoor air pollution through the selection of materials with low gas emissions, providing access to daylight and views, and controlling lighting for optimal comfort (Abdel-Hadi & Aboulgheit, 2012). Specific techniques and technologies are also highlighted, such as the recycling of plaster and glass, the use of local materials, and the integration of efficient heating and ventilation systems. The articles show a variety of approaches and solutions to achieve sustainable design in different geographical and cultural contexts. On the other hand, changing lifestyles, evolving building systems, changing conceptions of materials and easy accessibility to these also changed the type of floor plan of traditional houses (Aydin & Lakot, 2017).

In addition, best practices and opportunities for application in local and international contexts can be identified. Through the comprehensive literature review, several successful strategies and approaches have been highlighted that can be implemented to promote sustainability and improve family well-being in multifamily housing design.

Among the best practices identified is the selection of sustainable materials, where environmentally friendly and low environmental impact materials should be used in the interior design of multifamily housing. This includes choosing recyclable, renewable and non-toxic materials, as well as encouraging the reuse and recycling of materials in construction. Thus, it is referred to as "recycling" when the building product is made partially or entirely from disassembled materials (Arslan, 2007).

As well as energy efficiency, since implementing measures can reduce energy consumption in multifamily housing, such as the use of efficient lighting systems, and the design of spaces that take advantage of natural light and ventilation. Therefore, efficient water use should be promoted through the installation of low-consumption devices, the implementation of rainwater harvesting and reuse systems, and awareness of responsible water use practices among residents, since, in traditional housing patterns, all buildings are compatible with the climate and geography. In addition, along with shared culture, the use of similar materials and forms creates a customary harmony and integrity among the buildings. In other words, vernacular architecture has already achieved the required ecological solutions for living comfort; moreover, current ecological discourses in sustainable housing have already been adopted in traditional housing typology (Kirbaş & Hızlı, 2016).

In terms of opportunities for the application of sustainable interior design in local and international contexts, several areas of focus have been identified such as adapting to local culture and climate by incorporating design elements that are culturally appropriate and adapted to the specific climatic and environmental conditions of each region. This involves taking into account traditional materials, construction practices and local climatic needs. Also, the design of houses in the late Joseon dynasty varies slightly according to area and family social status and lifestyle. Among them, only those in the middle and southern areas had various types of maru for climatic reasons (Gao & Kim, 2023).

In addition, sustainable criteria for green building such as energy efficiency, resource management and indoor environmental quality must be taken into account to ensure good ventilation and the use of non-toxic materials.

Therefore, the methods to achieve sustainable interior design are to select eco-friendly and low environmental impact materials, integrate efficient lighting systems and natural light utilization, design flexible and multifunctional spaces that adapt to the changing needs of the inhabitants, and consider ergonomics and thermal comfort in the distribution of furniture and layout of spaces, as an example in Korean houses even though it is also considered an enclosed space, the Korean maru is surrounded by various three-dimensional architectural elements, such as a row of columns, eaves, and edges of a raised wooden floor instead of walls and handrails (Gao & Kim, 2023). However, studies on sustainable practices within the construction industry

often identify economic barriers (i.e., upfront costs, maintenance costs, low ROI, etc.) as the most important group of barriers (Ashour et al., 2022).

Table 6 Articles related to the question: What are the methods for sustainable interior design?

Code	Article	Country	Material selection	Efficient use of resources	Reuse	Cultural adaptation	Spatial distribution
A02	Boyuan Yu, Adam Fingrut, 2022	London	Wood	-	Common wood and cut wood had better economic value and reuse.	-	-
A03	Sol Xiaomeng, 2021	USA	Wood flooring from renewable resources quickly	LED, halogen and compact fluorescent lamps	Green tiles, carpet, fabrics and even the sink and counter.	Materials from local suppliers	-
A04	Özlem Aydın, Esra Lakot Alemdağ, 2017.	Turkey	Local materials and construction systems	-	-	Lifestyle, climate, topography, sun, landscape and materials used.	Typology of the house, ranging from the traditional house to the modern house,
A05	Aleya Abdel-Hadi, Iman Aboulgheit, 2012	United Kingdom	Low-emission materials	Energy efficiency Water efficiency Materials efficiency	Bamboo and straw, dimensional stone, recycled stone, recycled metal and other non-toxic products	-	-
A06	Peiwen sol, Ning Zhang, Jian Zuob, Ruichang Mao, Xiaofeng Gao, Huabo Duan, 2020	China	Waste reduction methods	Feasibility of the technology	Recycled gypsum for the production of gypsum boards	Increased recycling rate	-
A07	Ali Rajabipour, Cat Kutay, John Guenther, Milad Bazli, 2023	Australia	-	Minimization of energy consumption	Fiber-reinforced Adobe, natural fibers	-	-
A08	Marie Panner, Caroline Lemoine, Hervé Boileau, Catalina Buhé and Roland Raymond, 2021	France	-	Rooftop solar system	-	-	-
A09	Berrak Kırbaşa, Neslinur Hızlı, 2016.	Turkey	-	-	Stone, wood, earth, brick and metals	Local climate and geography	Types of planning, orientation, spatial layout, building elements, architectural elements
A10	SM Amin Hosseini, Reza Yazdani, Albert de la Fuente, 2020	Iran	-	-	-	-	Alternative design with minimum areas
A11	JiaLu Gao, In-Sung Kim, 2023	South Korea	-	-	Wood, earth, stone, straw, shingles and paper	Construction materials	Intermediate space between the exterior and the interior of the house
A12	Marco Ortiz, Laure Itard, Philomena M. Bluysen, 2020	Netherlands	-	Heating and ventilation systems	-	-	-
A13	Mojtaba Ashour, Amir Mahdiyar, Syarmila Hany Haron, Mohd Hanizun Hanafi, 2022	Malaysia	-	Energy efficient lighting	-	-	-
A14	Abdulsamad Alkhalidi, 2022	United Arab Emirates	-	Thermal performance	-	-	Visual image and quality of urban areas
A15	Rodger E. Edwards, Eric Lou, Anas Bataw, Syahrul Nizam Kamaruzzaman,	United Kingdom	-	BREEAM and LEED, U.S. origin.	-	-	-

	Christopher Johnson, 2019.						
A16	Dirk Löhrr, 2017	Germany	-	Energy efficient housing	-	-	-
A17	Hong Xian Li, 2023	Australia	-	Renewable energy production systems	-	-	-
A18	Giuseppe Aruta, Fabrizio Ascione, Nicola Bianco, Teresa Iovane, Margherita Mastellone, Gerardo Maria Mauro, 2023	Italy	-	Heating/cooling system	Number of batteries	-	-
A19	C. Carpino, R. Bruno, N. Arcuri, 2020	Italy	-	Heat pump	-	-	-

DISCUSSION

In recent years, there has been a growing interest in sustainable interior design and its impact on family well-being within the context of multifamily housing. The objective of this study is to provide a comprehensive overview of recent research and developments in the field of green interior design in multifamily residences through a thorough review of the existing literature.

A home is not only a physical place to live, but also an environment that influences the well-being and quality of life of its inhabitants. Sustainable interior design has become a key tool for improving environmental sustainability and well-being in multifamily housing, considering aspects such as the use of eco-friendly materials and energy efficiency. Regarding energy efficiency, authors Aleya Abdel-Hadi and Iman Aboulgheit built the concept of sustainable development due to the energy crisis and environmental pollution concerns of the 1970s. Thus, the green building movement originates from the need and desire for more energy-efficient and environmentally friendly building practices (Abdel-Hadi & Aboulgheit, 2012). For this very reason, author Hong Xian Li proposed the synergy of building design, mechanical services, and renewable energy to balance capital cost with environmental benefits (Li et al., 2023).

Also, to achieve good sustainability you must consider indoor air quality and maximizing natural light. As well as remodeling and renovation are often used interchangeably in interior design and real estate practices. However, while renovation focuses on repairing and replacing obsolete building components, remodeling involves making structural changes to a building, such as spatial expansion (Choo et al., 2023). Authors Özlem Aydın and Esra Lakot Alemdağ considered the local materials of the site, taking into account the study site, which can be used for green building, since, generally, these building materials are mainly wood, and, secondly, stone. The type of building is masonry with wooden walls filled with brick or adobe, and stone as a load-bearing element is widely used in the villages of Trabzon and Giresun (Aydın & Lakot Alemdağ, 2017).

Through the literature review, we explored the most recent developments in the field of green interior design in multifamily housing and analyzed how these developments have contributed to improving family well-being and promoted a more sustainable lifestyle. Authors Aleya Abdel-Hadi and Iman Aboulgheit say that the concept of sustainable housing becomes a predominant requirement, as it consumes fewer resources, produces less harmful waste, and ensures that our actions and decisions today do not inhibit opportunities for better living for future generations (Abdel-Hadi & Aboulgheit, 2012).

On the other hand, the specific objective was to identify best practices and explore opportunities and challenges for their application in different local and international contexts. Similarly, the objective of contributing to the understanding of how to reimagine housing to optimize family well-being and sustainability in a changing world is based on the need to address current housing challenges and find solutions that promote family well-being and environmental protection. It also involved exploring the relationships between interior design, family well-being and environmental impact. By understanding these interconnections, design strategies can be developed that enhance the quality of life for families and promote sustainability in an ever-changing world (Yu & Fingrut, 2022).

Therefore, authors Ali Rajabipour, Cat Kutay, John Guenther and Milad Bazli expressed that the use of local materials in sustainable construction could improve the sense of ownership, reduce the cost of materials, labor and shipping to distant areas for materials, and create jobs in the communities themselves (Rajabipour et al., 2023). Using BIM (Building Information Modeling), and site spatiality technology and strategies, as the use of BIM for building design, can improve sustainability design decisions and minimize sustainable errors through integrated design tools (Edwards et al., 2019). In addition, there is an element such as the in-between space that can also play the role of boundary, but in a more complex way: these spaces are more than simple boundaries that separate indoor and outdoor spaces, often merging the characteristics of two overlapping areas (Gao & Kim, 2023).

Through this scientific discussion, it is hoped to foster a deeper understanding of how sustainable interior design in multifamily housing can redefine the traditional notion of home, creating livable environments that promote health, comfort, and connection to the natural environment. Since the home has suffered from problems, caused by housing deterioration can be remedied by two methods: reconstruction, which involves total demolition of existing deteriorated housing and construction of new housing, and remodeling, which involves improving the performance of an existing building by repairing or replacing obsolete components or making changes to the building's structure (Choo et al., 2023).

In addition, we sought to identify areas for future research and possible directions to further improve green interior design for the benefit of family well-being and global sustainability. For example, in Naples, Italy, there is a method that is quite articulated, based on several numerical approaches, applied through the cyclic use of many programs, namely: DesignBuilder® for building modeling, EnergyPlus as a simulation tool and MATLAB® as an optimization engine (Aruta et al., 2023). On the other hand, in the United States, smart interior design can be combined with skylights and windows to maximize sunlight and minimize artificial light. If you need artificial lighting LED, halogen, and compact fluorescent lamps can save energy and last longer (Sun, 2021).

In summary, this study will provide a comprehensive overview of recent research and advances in the field of sustainable interior design in multifamily housing, with the goal of driving positive change towards more sustainable, family-friendly homes.

CONCLUSIONS

In today's world, where concern for the environment and human well-being is constantly growing, sustainable interior design in multifamily housing has become a topic of great relevance. Throughout this literature review, recent research and developments in this field have been thoroughly examined in order to provide a comprehensive overview of best practices and opportunities for applying green interior design in multifamily residences. It has specific points for each area, such as the importance of green interior design in multifamily housing, as it highlights the relevance of incorporating sustainability and green principles into the interior design of multifamily residences. These aspects are fundamental to address today's environmental challenges and promote a more environmentally conscious and respectful lifestyle.

In addition, the identification of best practices where the main objective of the study was to recognize best practices and advances in the field of green interior design in multifamily residences. This involved the review of previous and recent research to understand how sustainable design has been addressed in this context and what strategies have proven to be effective in improving family well-being. On the other hand, opportunities for local and international application were identified that have provided information and insights applicable to both local and international contexts. This involved consideration of the particularities of different cultures and available resources to adapt and apply the best practices identified according to each specific context.

As a final point, the home as a reflection of family life goes beyond its physical structure and is a reflection of the socio-cultural aspects, ideas and behavior of its inhabitants. When considering green interior design in

multifamily housing, it is important to take these unique elements into account to ensure that proposed solutions align with the needs and values of the families who live there.

In conclusion, the article has sought to provide a comprehensive overview of green interior design in multifamily housing, identifying best practices and opportunities for application. In addition, it is recognized that a home is not only a physical structure, but also reflects socio-cultural and essential aspects of family life.

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