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Article

Promoting Human Well-being and Environmental Health: A Framework for a Sustainable Building Typology, Case of Dilmunia, Bahrain

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Abstract

The rising environmental challenges of climate change substantially impact human health. Subsequently, global architectural landscapes are evolving towards greener, healthier, and more innovative buildings that promote human and environmental health. As green buildings are still in their initial stages in Bahrain, this paper aims to adopt a qualitative approach to investigate the potential of proposing a new sustainable building typology in Dilmunia with a focus on healing and wellness. This is achieved through participatory research involving focus group discussions with experts and stakeholders in Bahrain's architecture, engineering, and construction industry. The discussions highlight the positive implications of the new building typology and emphasize the significance of implementing green building rating systems at the early stages of the design process, incorporating passive design strategies, designing communal activity zones, occupant behaviour, and managing operational expenditure efficiently. A framework is proposed to guide the design of a new sustainable building typology in Dilmunia that focuses on enhancing the well-being of the community and reducing the environmental impacts, whilst ensuring economic viability. The framework's applicability extends to other areas that share a similar socio-cultural background to enhance the quality of life through architectural design.

Keywords: well-being; health; quality of life; sustainability; focus group

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1. Introduction

It is widely accepted that the existential climate crisis already affects various aspects of human and environmental health (Engineer et al., 2021). The rapid increase in greenhouse gas emissions worldwide has increased the global mean surface temperature of approximately 0.94°C in the last fifty years. Additionally, the frequency and intensity of natural disasters have increased, along with a substantial rise in sea levels and negative impacts on biodiversity (Schipper et al., 2024; Zhao et al., 2022). It is also evident that the climate crisis is affecting human health and well-being on many levels, in terms of the molecular level and physiological level to the psychological and intellectual level, and social and behavioral levels (Assem et al., 2023; Engineer et al., 2021). The increase in GHG emissions has adverse direct and indirect effects, not only on the environment but also on

human health and well-being (Kiehbadroudinezhad et al., 2024). Figure 1 depicts Barton & Grant's concept of a welfare city, emphasizing the impact of the surrounding natural and built environment on human health and well-being (Barton et al., 2015). Due to climate change, the World Health Organization (WHO) has estimated that between 2030 and 2050, there will be 250,000 additional deaths per year. This is due to various climate-related diseases such as undernutrition, infections, overheating, and climate anxiety (Mahmood & Guinto, 2022). Researchers and practitioners around the globe are increasingly studying pathways and solutions for climate change mitigation and adaptation (Zhao et al., 2022). This is particularly evident in the architecture, engineering, and construction industry, as buildings account for approximately 37% of global emissions (Henry, 2021).

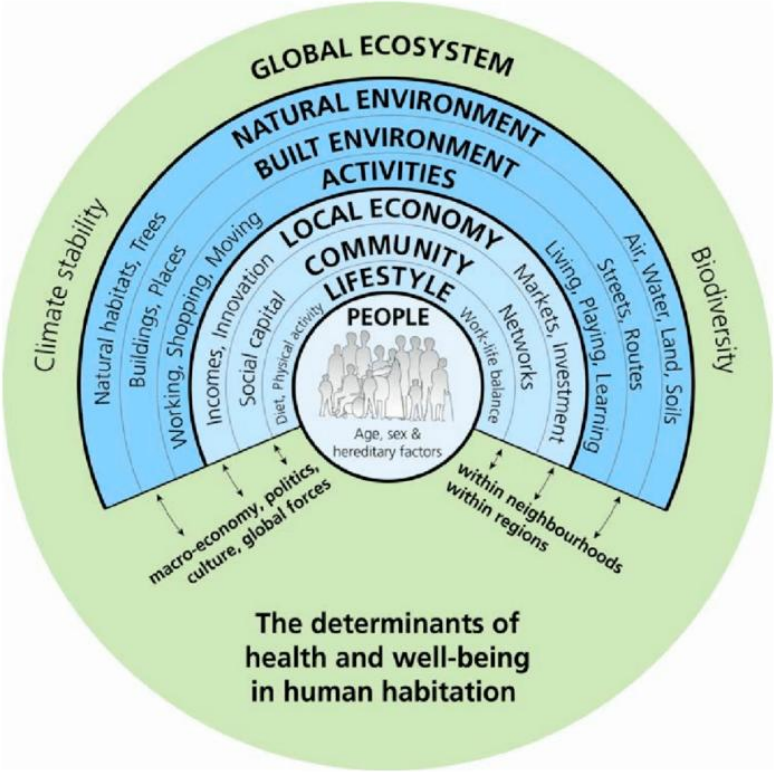

Figure 1: The relationship between the determinants of health and well-being and the natural and built environment (Barton et al., 2015).

The built environment and its many layers have the potential to significantly impact different aspects of human well-being and environmental health (Engineer et al., 2021). Many sustainability advocates and scholars have examined this relationship to emphasize its importance for sustainable development (Ebbini, 2024). Cloutier studied the connection between sustainability and well-being in existing literature (Cloutier, 2022). Assem et al. explored the link between smart, sustainable buildings and occupant behavior and proposed a neuro-architecture model to enhance well-being (Assem et al., 2023). O'Mahony's work emphasizes the importance of carefully integrating sustainability and well-being to develop a new concept of 'sustainable well-being' (O'Mahony, 2022). In efforts to reduce environmental impacts and the consumption of natural resources and enhance the well-being of building occupants, a plethora of countries have adopted the concepts of green and sustainable buildings (ALshabanat & Omer, 2023). Many green building rating systems and standards also advocate for human health within sustainable building design. The WELL Building Standard embeds health and well-being in sustainable building design, construction, and operation (Ebbini, 2024). Many papers highlight the significance of participatory research in enhancing sustainable development and

occupants' well-being and quality of life (Keahey, 2020; Sollis et al., 2022). This type of research is beneficial due to integrating different sources of knowledge to co-create solutions (Torralba et al., 2022).

Despite the growing body of knowledge on human and environmental health in the pursuit of sustainability, there are still limited studies when reviewing the case of Bahrain. Bahrain is a hot climatic region that has witnessed a rapid surge in population growth and resource consumption, resulting in an exacerbated energy demand (ALshabanat & Omer, 2023). The population density, car-dependent lifestyle, and the location of the oil-producing country along the Arabian Gulf increase its risk of experiencing heat waves, floods, and air pollution, negatively impacting human health (Hieronymus & Kalén, 2020). Despite the strong emphasis at the policy and strategy levels from the high authority on implementing sustainability (SDs) and green buildings in Bahrain, which appear as the main objectives in its strategic master plan, research on green buildings in Bahrain is still premature due to the lack of a national green building rating system, insufficient awareness and training, and lack of incentives for their implementation (Abdulrahim et al., 2024). The quality of life in Bahrain is ranked second to last among the Gulf Cooperation Council (GCC) countries. Although the share of GHG emissions (0.1%) is considered negligible on a global scale, its GHG emissions per capita (19.9 metric tons), are amongst the highest in the world (Alsabbagh & Alnaser, 2023; Mercer, 2024). In 2021, the concept of medical tourism, also known as wellness tourism, was introduced as one of the seven pillars of the 2022-2026 Tourism Strategy in Bahrain, acknowledging the importance of health and well-being not only through the national sustainability initiatives but also economically within the tourism. In addition to increasing tourism's contribution to the country's GDP to reach 11.4% in 2026, the strategy aims to highlight Bahrain as a global tourist hub whilst diversifying tourism (BNA, 2024). Wellness tourism offers many health benefits, including improved QoL (Liao, 2023). Marketing the concept of wellness tourism is also included as an initiative to encourage the private health sector to invest in the country's health sector, outlined in Bahrain's National Health Plan 2016-2025 (SCH, 2016). This underscores its significance on the path to sustainability, economic growth, and well-being nationally in Bahrain. Dilmunia, an artificial island in Bahrain, was designed as a health island to promote wellness tourism in the country. The development is still in its initial stages, with only a few buildings built, highlighting the potential for designing a sustainable wellness facility to enhance the community's well-being. This underscores the significance and relevance of the study.

In this context, this research aims to address the knowledge gap of limited studies on human and environmental health to investigate the potential of proposing a new building typology in Dilmunia to promote human and environmental health. The findings guide the proposal of a framework that focuses on enhancing the community's well-being and reducing the environmental impacts, whilst ensuring economic viability. The research objectives include 1) To conduct participatory research through focus group discussions with experts and stakeholders in the architecture, engineering, and construction industry in Bahrain to explore their perceptions and co-generate knowledge, and 2) To propose a framework to guide the design of a sustainable building typology focused on human well-being and environmental health. The paper is divided into five sections. The first presents an in-depth literature review on sustainable design theories, human-centric design, participatory research, and a background about Bahrain's sustainability and well-being strategies, and background about Dilmunia. The second outlines the materials and methods adopted in the study. Subsequently, the results are highlighted, followed by a discussion of the main themes emerging from the findings. The final section concludes the study, highlighting the main findings, their implications and significance, limitations, and opportunities for future research.

2. Literature Review

2.1 Sustainable Design Theories

As the building sector significantly contributes to climate change and the energy crisis, an urgent shift to more sustainable practices is required (Chen et al., 2023). The increased awareness of sustainability has called for an increased interest in sustainable design concepts and theories, also known as green design, which have expanded during the last ten years. It is generally accepted that sustainable design refers to product design that minimizes environmental impact by addressing the three pillars of sustainability. In other words, it is a design that is environmentally sound, socially responsible, and economically feasible (Horani, 2023). The main established principles of green buildings include sustainable sites, water conservation, energy and environment, indoor environmental quality, and the conservation of materials and resources (Ragheb et al., 2016). Existing literature also highlights the importance of incorporating passive design strategies to enhance the sustainability of buildings and increase the health and well-being of occupants (Kujundzic et al., 2023).

The LEED certification program, originally coined in 1993, provides a comprehensive framework and critical insights into sustainable building standards (Di Gaetano et al., 2023). The program has undergone multiple developments, and its latest version, known as LEED v5, encompasses eight categories designed to enhance the sustainability of buildings, as illustrated in Figure 2. The categories focus on the three main themes of decarbonization, quality of life, and the conservation and restoration of the ecosystem. The categories urge design teams to explicitly focus on the integrative process, planning and assessments, location and transport, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and project priorities and innovation (USGBC, 2024).

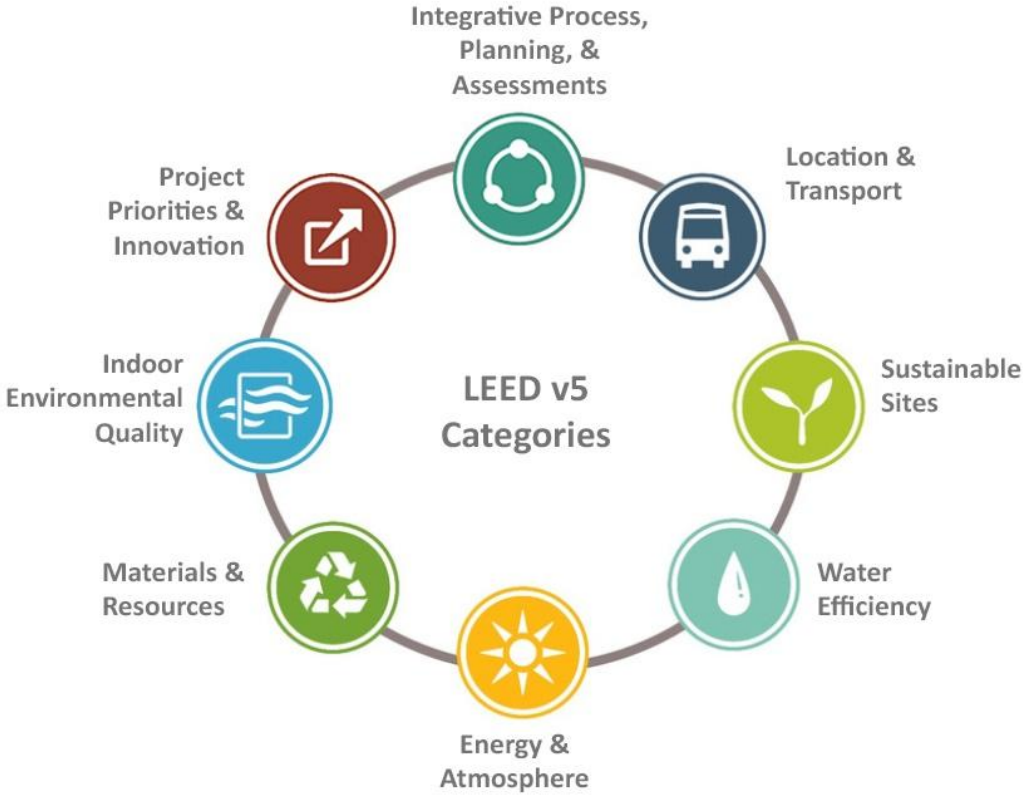

Figure 2: LEED v5 Categories for sustainable design (Adapted from USGBC, 2024).

The integrative process is a key requirement for green buildings to ensure the integration of sustainability strategies early in the design process. Energy efficiency is considered one of the most important if not key, aspects of green and sustainable buildings and has its own category within the LEED standard (Hafez et al., 2023). Existing research on energy efficiency emphasizes the importance of considering occupant behavior to help in the long-term sustainability of buildings (Far et al., 2022). Literature on renewable energy, or energy derived from natural sources, underlines its integral role in mitigating climate change by reducing greenhouse gas emissions and addressing sustainable development goals (Yang et al., 2022). Governments play a crucial role in implementing renewables and developing standards for their application, whilst advanced technologies such as artificial intelligence and machine learning (Chen et al., 2023). Conserving materials, resources, and water are also instrumental in ensuring a low carbon footprint. The location and transport category encourages selecting sites close to public transport and cycling facilities to promote walkability, as transportation accounts for a quarter of the global energy emissions (Ritchie, 2023). Sustainable sites focus on the impact of buildings on the surrounding environment, and indoor air quality ensures adequate indoor environments to enhance the well-being and comfort of occupants. Project priorities and innovation are more tailored toward innovative strategies beyond the basic requirements and specific to the geographic location of projects. Having discussed the main categories often referred to in sustainable design theories and particularly in green buildings, the following section delves into human centric design approaches that focus on the health and well-being of occupants.

2.2 Participatory Research and Human-Centered Design for Health and Well-being

A substantial amount of research highlights the growing synergies between sustainability and human-centered design. Human-centered design is a participatory design approach that helps guide designers in developing sustainable design that focuses on well-being and the quality of life of occupants (Bødker et al., 2022; Rossi & Attaianese, 2023). The concept of well-being is heavily debated in literature, as some scholars are divided on whether it is an objective or subjective notion (Helne, 2021). Despite this, experts agree that human-centered design prioritizes the needs of occupants and the participatory and cyclical nature of the design process (Göttgens & Oertelt-Prigione, 2021). Biophilic design is also considered a vital human-centric approach in environmentally sustainable design (Wijesooriya & Brambilla, 2020). For sustainable design to be truly sustainable, participatory research involving stakeholders and users through engagement frameworks is instrumental in bringing about transformative change (Keahey, 2020). Participatory and human-centered design has been present in the works of various scholars throughout the years.

Maslow's motivational theory, through his hierarchy of needs, is considered one of the most cited works in psychology textbooks. He categorizes human needs from basic physiological needs to security, social, esteem, and more complex self-actualization needs (Desmet & Fokkinga, 2020). Desmet and Fokkinga argue that a striking limitation of Maslow's needs is the narrowed focus on the individual, and they suggest that subjective well-being is not only determined by individual needs but also by the needs of their community. Based on Maslow's hierarchy of needs, they propose a framework of thirteen fundamental needs to enhance well-being through human-centered design. Their typology of fundamental needs includes autonomy, beauty, comfort, community, competence, fitness, impact, morality, purpose, recognition, relatedness, security, and stimulation. To emphasize health and well-being in sustainable development, the WELL building standard was launched in 2014 to promote the design of healthy built environments. The latest version of the standard, v2, encompasses ten core design concepts which include air, water, nourishment, light, movement, thermal comfort, sound, materials, mind, and

community (Ebbini, 2024). The WELL standard supports human-centered design, in addition to Maslow's hierarchy of needs, and its core concepts are illustrated in Figure 3. The concepts are used as a benchmark in this research, along with the LEED categories outlined in the previous section. The following and final part of this literature review presents an overview of Bahrain's sustainability and well-being strategies, in addition to background about Dilmunia island, to set the scene for the research.

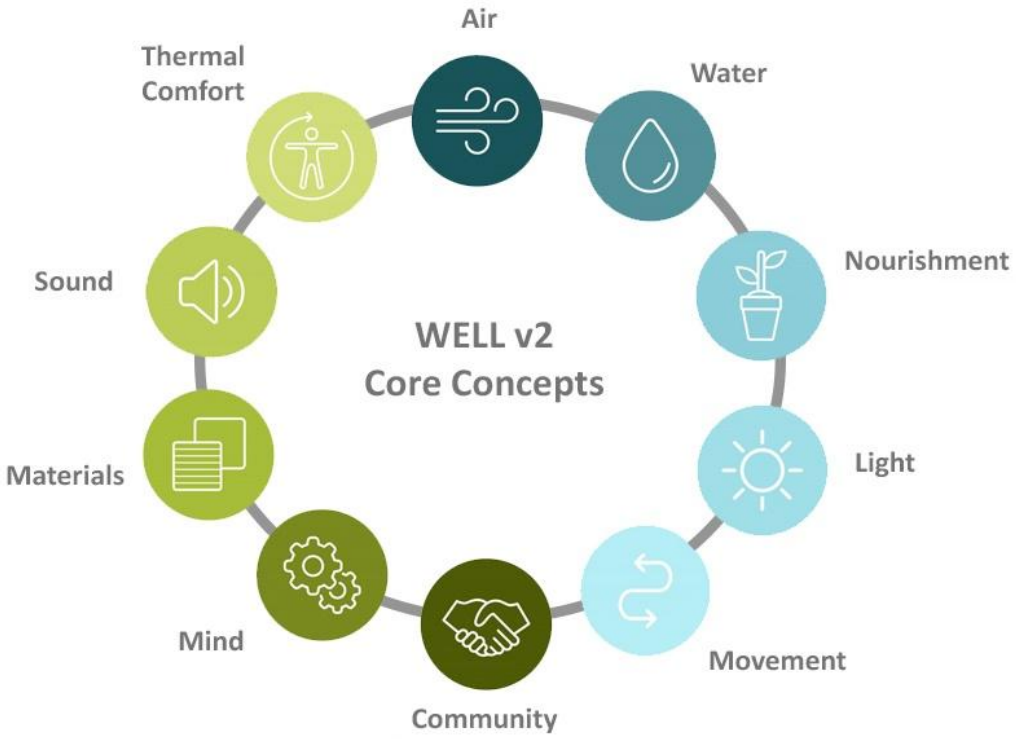

Figure 3: WELL Standard v5 Core Concepts for Healthy Buildings that Enhance Well-being (Adapted by Authors from Ebbini, 2024)

2.3. Contextual Background

Bahrain set forth many sustainability initiatives, including the 2030 Economic Vision, the Government Plan, the Green Building Code, and various environmental laws, in line with the UN's SDGs (Alsabbagh & Alnaser, 2022). Additionally, the National Energy Efficiency Action Plan (NEEAP), and the National Renewable Energy Action Plan (NREAP) have been implemented to reduce GHG emissions and mitigate climate change (UN, 2023). Recently, at the 28th United Nations Climate Change Conference (COP28) held in Dubai, Bahrain announced its new National Action Plan, "Blueprint Bahrain". The plan aims to achieve carbon neutrality through three pathways: a low-carbon economy, adaptation to climate change, and the creation of sustainable opportunities in the new green economy (UN, 2023). These initiatives emphasize Bahrain's goals to achieve greener, healthier, and more innovative buildings for a more sustainable built environment.

In addition to the well-defined sustainability goals in the built environment, Bahrain is focused on enhancing the quality of life of citizens and residents. The new National Health Plan targets improved wellness, quality of health, and quality of life (SCH, 2016). In efforts to increase and diversify the healthcare options in Bahrain, the country has many ongoing projects to develop the sector, including King Abdullah Bin Abdulaziz Medical City, which is a sustainable healthcare complex that will get LEED certified, the newly constructed Mohamad Bin Khalifa Cardiac Centre (MKCC) in Awali, and establishing Dilmunia as a health island (Dilmunia, 2017, HAJ, 2025).

Specifically, the National Health Plan also includes an initiative to promote medical tourism, which has been the concept of Dilmunia. This initiative, along with its location and accessibility, makes the island of Dilmunia an ideal platform for constructing an experimental, sustainable, and healthy building typology.

Dilmunia Health Island is located on the Northeastern coast of Bahrain, as illustrated in Figure 4. The artificial island is positioned within a 15-minute drive from Bahrain International Airport, a 25-minute drive to the Capital, Manama, and a 40-minute drive to the King Fahad Causeway. The island has a total reclaimed area of 125 hectares and a total gross floor area of approximately 1,800,000 sqm (Google Earth, 2025).

Figure 4: The location of Dilmunia Health Island on the map of Bahrain (Google Earth, 2025).

Dilmunia's strategic framework is built upon understanding contemporary societal aspirations for integrated development. Society is shifting from a focus on monetary wealth to a focus on holistic prosperity, meaning money is not the sole driver of individual happiness. Today, the trend has moved towards people who want lifestyles that provide genuine well-being. Dilmunia provides a foundation for such a lifestyle. The name Dilmunia is inspired by the ancient civilization of Dilmun, which is believed to be the original Garden of Eden. Dilmunia seeks to create a modern Garden of Eden where a progressive society can prosper while balancing the need for growth with the need for a healthy, sustainable ecology.

The master plan for the development is designed to include residential and mixed-use buildings (60%), offices (4%), retail (10%), hotels (9%), and wellness (17%). The Dilmunia Health District is spread across 12,232.7 square meters of land, forming the central core of the island, as highlighted in Figures 5, 6, and 7. Dilmunia Health District aims to provide different healthcare services, including rehabilitation, alternative treatments, and wellness, amongst others, whilst ultimately promoting medical tourism, sustainability, and QoL. The first phase of the development commenced in 2013, and it is currently in its third phase. Although several projects have been completed, such as Canal View, Mall of Dilmunia, Seavillas, and Nadeen International School, work has not yet started on the central Dilmunia Health District.

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Figure 5: The potential plot is located within Dilmunia Health District.

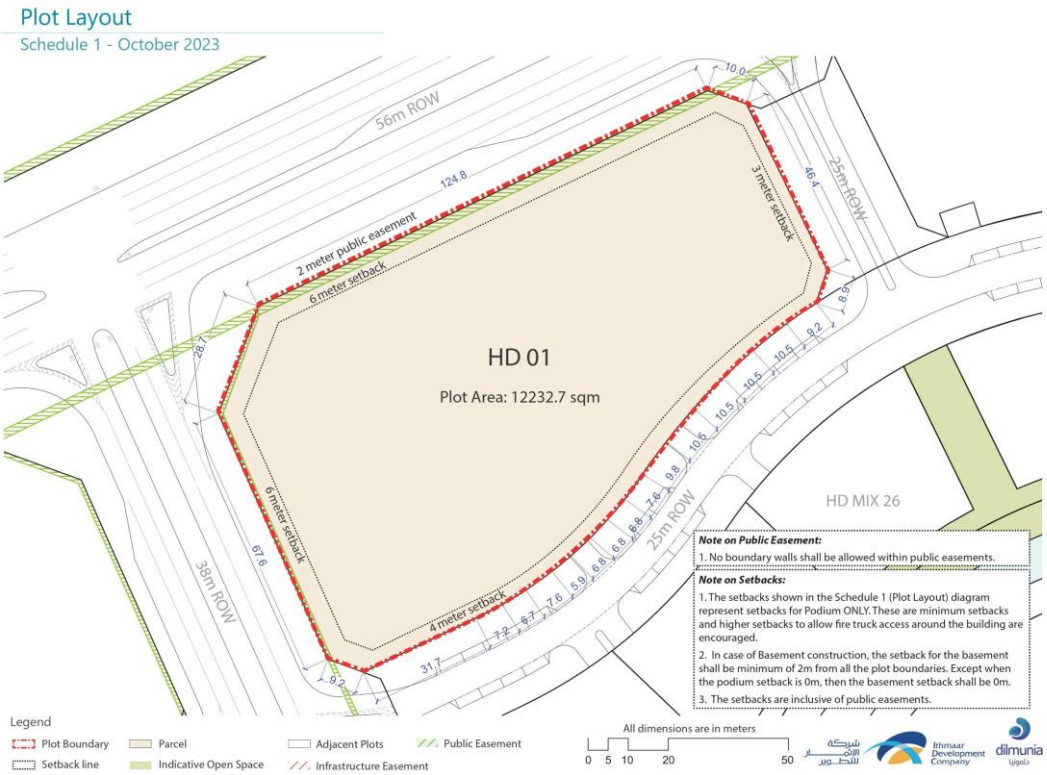

Figure 6: The detailed dimensions of the plot.

Following rigorous research on sustainable healthcare buildings in Bahrain, it is evident that there are many ongoing public and private projects with the potential to expand existing primary healthcare centers and hospitals in line with improving the quality of health. This presents an opportunity to construct a multifunctional sustainable building that promotes health and well-being whilst raising awareness about sustainability and contributing to the sustainable development vision in Bahrain. The new building typology would address all three pillars of sustainability and have a tremendous impact on residents' quality of life and well-being, contribute to the economy from a financially sustainable standpoint, and address the national and global issues of global warming.

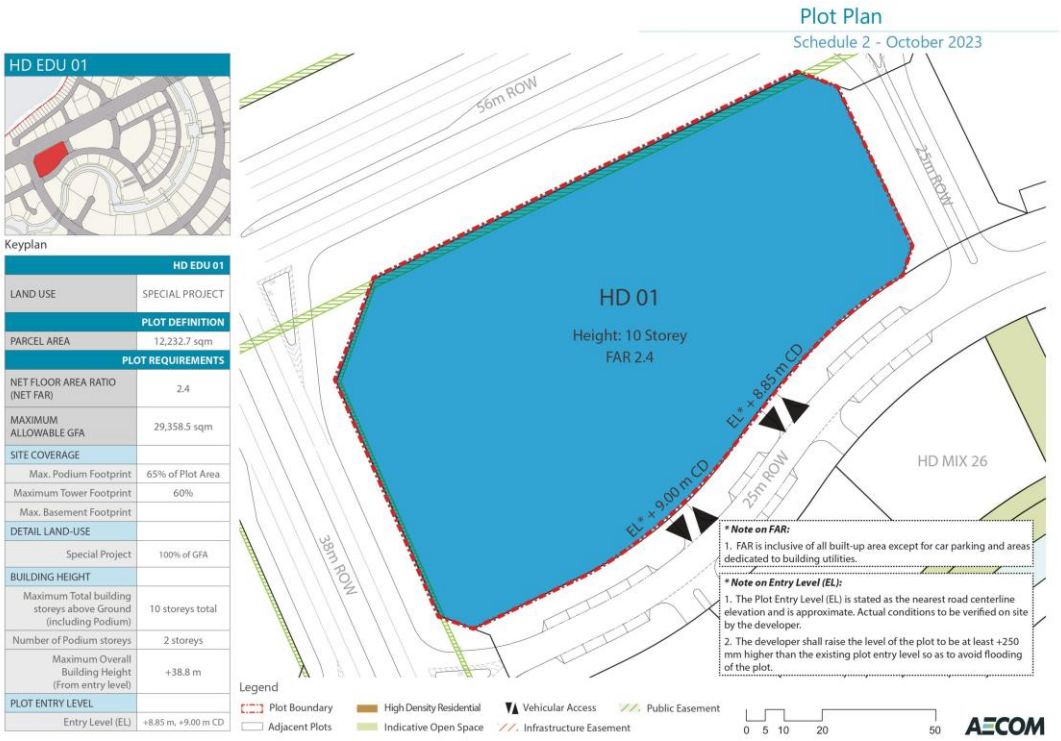

Figure 7. The regulation that manages the design of the plot.

The building will be designed to implement sustainable, passive, innovative, and green practices. Table 1 outlines the project objectives derived from the national sustainability initiatives. Having set the contextual scene for this research, the following section discusses the research methodology in detail to map it to the study's aim and objectives.

Table 1: Derivation of potential project objectives based on the national sustainability initiatives.

Project objectives derived from National Sustainability Initiatives	**Environmental**	**Economical**	**Social**
Government Plan 2023-2026	Sustainable development, infrastructure, and environment	Economic recovery and financial sustainability	Raising the standard of living
Economic Vision 2030	Protect the environment	Cutting-edge infrastructure and an appealing living environment	Fairness in society with equal access to education and healthcare
National Health Plan 2016-2025	Sustainable use of available resources	Free-of-charge health service to Bahrainis	Quality, safety, fairness, transparency
Architectural vision for a potential project	Sustainable, passive, smart, green practices	Shared facilities considering OpEx	Promote well-being and enhanced QoL

3. Materials and Methods

3.1 Study Design

This study adopts a qualitative methodological approach to conduct participatory research through focus group discussions with experts and stakeholders in the architecture, engineering, and construction industry in Bahrain. The focus group was adopted as a qualitative research tool, as it is usually an effective method of gathering opinions and data around a pre-determined topic (Basnet, 2018). In this research, it is used to explore the perceptions of experts and co-generate knowledge, to investigate the potential of

proposing a new sustainable building typology in Dilmunia with a focus on healing and well-being. The methodology's structure is outlined in Figure 8.

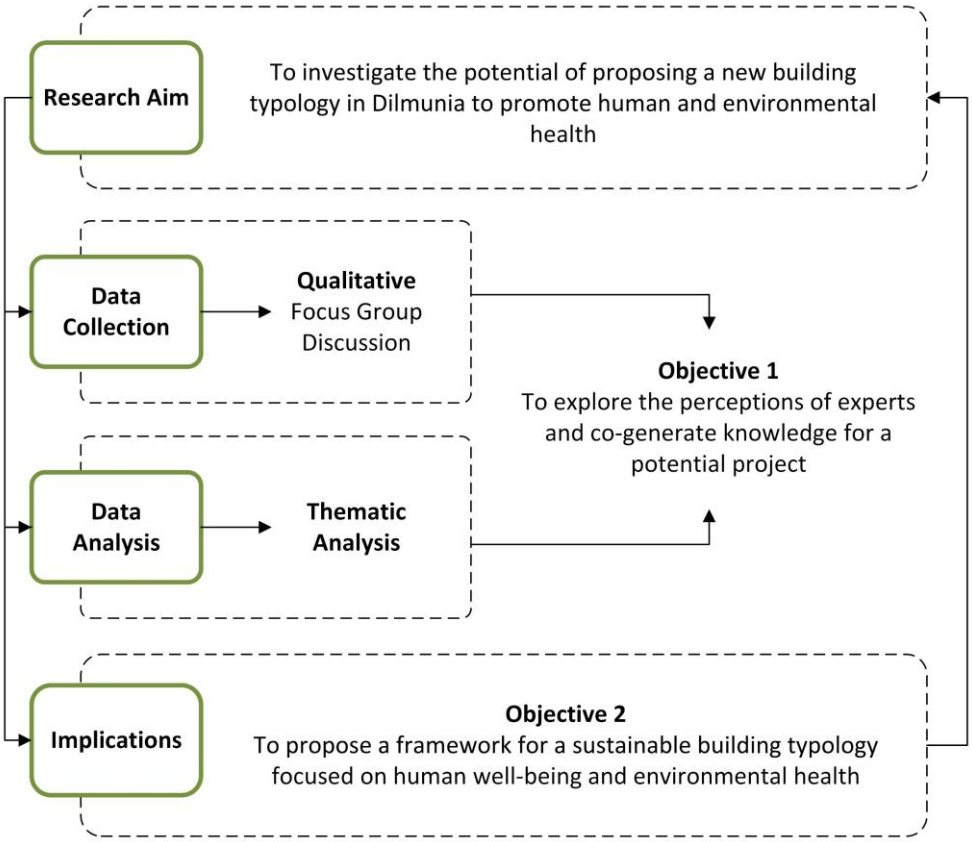

Figure 8: Structure of Research Methodology.

3.2 Participants

A strategic sample of ten experts was invited to the focus group discussion, and a total of eight participated in the focus group discussion. The details of the participants are depicted in Table 2.

Table 2. Focus Group Discussion Participants.

No.	Background
1	Architect, Sustainability Expert
2	Superintendent Project Controls
3	Architect, Academic
4	Interior Designer, Academic
5	Professor of Sustainable Architecture
6	Architect, Urban Planner
7	Lawyer
8	Landscape Architect

The recommended size for focus groups is usually between six and twelve participants (Fusch et al., 2022). The participants were selected based on their common expertise and experience in the AEC industry, yet they covered a range of specialties and perspectives. The group included architects, sustainability experts, academics, a superintendent

of project controls, an interior designer, an urban planner, a landscape architect, and a lawyer. Figure 9 illustrates the focus group discussion.

Figure 9: Participants of the focus group discussion.

3.3 Data Collection and Analysis

The focus group discussion took place during the month of November 2024. The session was held at a public meeting space and lasted approximately 60 minutes. The discussion was semi-structured and included a set of preliminary questions (see Table 3) shared with the participants before the discussion. The session started with a short introduction by the research team, followed by the preliminary questions. The research team took Notes during the session, in addition to a recording, which was later transcribed for the analysis. Thematic analysis was conducted on the data, including familiarization with the findings and identifying and organizing recurring themes. The findings guided the proposal of a framework for a sustainable building typology in Dilmunia, which focuses on human and environmental health.

Table 3: Focus Group Preliminary Questions.

No.	Question
1	What do you see as the biggest opportunities or challenges for creating a sustainable, multi-functional building in Dilmunia?
2	What types of wellness programs or educational facilities do you think would be most impactful within this setting?
3	What strategies can be employed to seamlessly integrate coffee shops, wellness, healthcare, and educational facilities?
4	Are there ways the building itself can serve as a teaching tool for sustainable design practices?
5	What approaches would you suggest for monitoring and managing operational costs, especially in terms of energy and resource use?
6	How could technology support the multi-functionality of the building while maintaining a low environmental impact?

3.4 Validation and Ethical Considerations

The participants were invited to the focus group discussion through a formal e-mail and phone call. They were informed about the purpose and details of the session and invited to participate voluntarily. To enhance the accuracy and validity of the data, Guba and Lincoln's criteria were adopted, which include credibility, transferability, confirmability, and dependability.

The findings were shared with the participants for verification purposes to ensure credibility. Transferability and confirmability were ensured through note-taking and session documentation. To ensure dependability, exact quotes were used in the analysis to eliminate bias. The anonymity and confidentiality of the findings were ensured by using numeric identifiers instead of participants' names.

4. Results

The focus group discussion results include valuable insights from all eight participating experts. The points discussed included a range of perspectives and perceptions on the proposal of a new sustainable building typology in Dilmunia, as listed in Table 4. The participants addressed the three dimensions of sustainability: some focused on the social aspects of design, others on economic considerations, and still others on environmental concerns.

The first participant (P1), an architect and expert in sustainability, had a very technical perspective of design and focused on cooling technologies and thermal comfort devices to enable the utilization of outdoor spaces during most months of the year. The Qatar World Cup stadiums were suggested as a point of reference to further study the environmental technologies used, as Qatar hosted the latest World Cup during the summer months of a very similar climate to Bahrain. Evaporative cooling, seawater chillers, solar devices on the roofs and façades, wind turbines, and shaded cycling routes were also points of discussion. P1 also mentioned new solar technologies that utilize the power of both solar and heat energy. The Abu Dhabi Rehabilitation Clinic was suggested as a potential case study, particularly regarding the outdoor rehabilitation garden integrated into the landscape design to enhance visitors' well-being.

The second participant (P2) discussed the significance of capital and operational costs and the return on investment from his experience in project controls in the engineering industry. He also suggested the integration of shaded parking spaces that use the power of solar energy as an environmental solution in the potential building. The third participant (P3) was also fixated on green and sustainable building technologies. He suggested using green walls, green roofs, and various passive architectural technologies. Additionally, he emphasized the importance of nanomaterials, transparent solar cells, and glass fiber-reinforced concrete on the building façade. He mentioned the limitations of solar cells, particularly in polluted areas. His background as an architect allowed him to discuss different challenges of the site, such as pollution and energy usage data, to search for opportunities that require architectural solutions. Moreover, he introduced the concept of the 15-minute city to enhance the walkability and well-being of the community in Dilmunia.

Participant Four (P4) comes from a background in interior design and mostly shifted the discussion towards using the spaces. She stressed the significance of user-centered design and the importance of considering the types of users, age groups, classes, and surrounding buildings. Considering that Dilmunia is a newly established city with mostly residential buildings and existing schools in the area, it is vital to consider all age groups, including children and families, and design for equality for all citizens and visitors to promote inclusivity. She also briefly touched upon courtyards and traditional Bahraini sustainable passive design strategies as potential elements that can be incorporated in the design of the new building, by learning from the past.

Table 4: Main points discussed and issues raised by the eight experts.

No.	Main Points Discussed
P1	– External cooling units based on traditional cooling towers 2m buffer and cooling playgrounds and Qatar stadiums as an outdoor thermal comfort cooling device. – Evaporative cooling, seawater chillers, solar farm in roof and façade, vertical wind turbines, shaded cycling routes – Solar devices that take advantage of both solar and heat energy – Outdoor rehabilitation gardens in the Abu Dhabi rehab clinic
P2	– Shaded parking and integration of solar – Operational cost and return on investment
P3	– Pollution data or energy usage data in Dilmunia is a potential issue requiring sustainable architectural solutions – Green walls and roofs, passive architectural technologies, and nanomaterials – Limitations of solar cells in polluted areas – 15-minute city concept to enhance walkability – Transparent solar cell on the façade – Glass fiber reinforced concrete
P4	– Significance of considering users, age groups, and surrounding building typologies – Designing for all classes – Courtyards and traditional Bahraini passive design
P5	– Utilize Estidama and LEED checklists as benchmarks – Use of smart sensors – The integration of water and landscaping features to enhance well-being – Passive design and extending wall thicknesses – Incorporating interactive small dancing fountains
P6	– Souq Al Baraha, Masdar City, Msheireb Downtown Doha as potential case studies – Studies on traffic in the area
P7	– Multi-functional spaces and shared-purpose spaces
P8	– Taking advantage of onshore and offshore wind directions on-site

The Estidama and LEED standards were mentioned by the fifth participant (P5), which will be further investigated and used as benchmarks in the design of the new sustainable building. Additionally, the use of smart sensors, water features, landscaping elements, and extending wall thicknesses as a passive design strategy, and the inclusion of interactive dancing fountains can engage the community and aid in enhancing the overall well-being of the visitors. The sixth participant (P6) listed three local case studies that can provide valuable insights into social and environmental sustainability design principles: Souq Al Baraha, Masdar City, and Msheireb Downtown Doha. He also suggested analyzing traffic leading to the entrance of Dilmunia to identify solutions to reduce its intensity. The seventh and eighth participants (P7) and (P8) emphasized the importance of having shared-purpose facilities and common areas within the building to activate the ground

floor. Furthermore, considering the onshore and offshore wind directions can guide the orientation of the new project.

5. Discussion

The discussion points in the form of documented notes and transcriptions were analyzed and can be categorized into five primary themes. These are contextual site challenges, layout and functionality, green and innovative technologies, passive design strategies, benchmarks, and case studies. Figure 10 maps the derived themes with the LEED categories for green buildings and the WELL core concepts discussed in the literature review section. The mapping clearly emphasizes the importance of benchmarking and certification and the use of case studies in the design of a new sustainable building typology in Dilmunia with regard to environmental sustainability and human well-being (Madson et al., 2022). Contextual site challenges mostly address the environmental aspects of sustainability, however, there are still some social-human aspects, which include ensuring adequate air quality and water sources, using light, promoting movement, reducing unwanted sounds, and enhancing thermal comfort. As for the layout and functionality of the spaces, it focuses more on the building occupants and user experience. Integrating green and smart technologies and passive design can also benefit human and environmental health. The mapping also indicates that environmental and human health are closely linked, with many categories overlapping between the LEED and WELL standards. This is repeatedly emphasized in the literature on green buildings that link sustainability with improving occupant health and well-being (Meena et al., 2022).

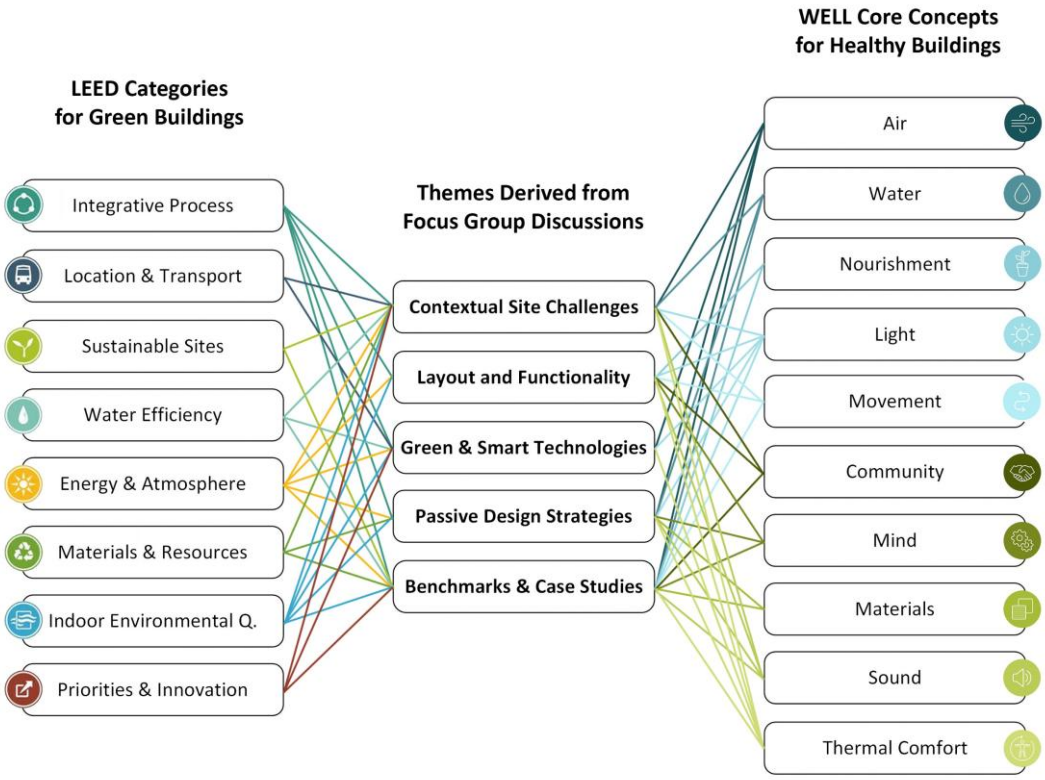

Figure 10: Mapping of the focus group discussion themes with the LEED categories and WELL core concepts.

Based on the focus group and literature review findings, a framework (see Table 5) is proposed to guide the design of a sustainable building typology in Dilmunia focused on human well-being and environmental health. The framework is organized from the macro to the micro-scale design. It focuses on five main variables intimately linked with sustainability and human-centered design, which are the design process, site context, building envelope, layout and circulation, and building elements.

Table 5: Framework for the design of a sustainable building typology focused on human well-being and environmental health.

Variable	Design Recommendation
Design Process	– Integrative process – Prioritizing passive design strategies – Inclusion of flexible and adaptive spaces – Utilization of participatory research – Provision for rainwater harvesting – Use of LEED and WELL standards for benchmarking – In-depth site and climatic analysis
Site Context	– Close proximity to alternative transportation – Optimized building orientation – Encourage walkability (15-minute city) – Native landscaping – Incorporate renewable energy – Outdoor social and green spaces – Clear accessibility
Building Envelope	– Design for energy efficiency – Incorporate passive design strategies – Low-carbon materials – Nano-cell and solar technologies – Green walls and green/cool roofs – High performance windows and glazing – Thicker walls for energy efficiency
Layout & Circulation	– Prioritize natural light and views – Availability of healthy food options – Improve ventilation and airflow – Spaces that encourage physical activity – Spaces that promote social connection
Building Elements	– Dual flush toilets for water efficiency – Install water efficient appliances – Smart irrigation systems – Include biophilic elements – Non-toxic paints – Elements that encourage pro-environmental behaviour – Smart lighting and sensors – Acoustic insulation and soundproofing – Shading devices and solar control

5.1 The Design Process

The design process usually starts with defining the main design objectives, goals, and priorities (Vite & Morbiducci, 2021). The proposed new building typology in Dilmunia aims to enhance human and environmental health. This can be addressed prior to starting the project and within the design process itself. Existing literature highlights the importance of an integrative design process involving participatory research that looks at user needs, and the collaboration of multi-disciplinary teams to enhance the sustainability of buildings early on in the design (Li et al., 2022). Prioritizing passive design strategies and learning from traditional Bahraini houses can improve energy efficiency and the well-being of occupants. The design process should also include providing flexible, adaptable spaces to accommodate the multi-functionality of the new building

typology. Provisions for specific sustainability site-related strategies, such as rainwater harvesting, can add value and resilience to the project. Adopting the LEED standard for green buildings and the WELL standard for healthy buildings can help the project achieve its main objectives. Finally, in-depth site and climatic analysis is required to understand the site's contextual challenges, to address them effectively, and to prioritize architectural solutions.

5.2 Site Context

To ensure a healthy lifestyle that encourages well-being, the building should be located within proximity to alternative transportation, such as bus stops or cycling routes. This can also encourage walkability, which aligns with the concept of a 15-minute walkable city to build safer, more sustainable, and resilient cities (Moreno et al., 2021). The orientation of the building should be optimized for solar control. Additionally, incorporating native landscaping can reduce water usage, whilst renewable energy sources can reduce the energy usage of the entire building. Apparent accessibility and outdoor social and green spaces within the site can improve connectivity with the surrounding landscape and facilitate interaction and community well-being.

5.3 Building Envelope

The building envelope is a barrier between the indoor and outdoor environment, and it plays a significant role in enhancing the sustainability of buildings and improving thermal comfort for occupants (Al-Shatnawi et al., 2024). It also provides opportunities to increase the energy efficiency of buildings. Thicker walls for insulation, shading, high-performance glazing, low carbon materials, and incorporating nano-cell and solar technologies in the façade and building envelope can advance the performance of buildings and promote the well-being of occupants. Passive design strategies such as natural ventilation, daylighting, and the presence of natural elements can also reduce the energy demand and create healthier and more comfortable spaces. To regulate the temperature in the building, enhance the air quality, and provide acoustic barriers, green walls and cool roofs can be integrated in the envelope as an additional strategy.

5.4 Layout and Circulation

The architectural layout of spaces significantly contributes to the overall experience of occupants, including satisfaction levels, safety, and comfort (Li et al., 2024). Visual access to natural light and outdoor views can especially increase comfort and promote well-being. The layout design should also ensure the availability of healthy food options within close proximity to the main spaces in the building. A focus on ventilation is also important to ensure adequate airflow throughout the building. The different zones within the building should be arranged to encourage physical activity and movement and promote social connection between the users.

5.5. Building Elements

The building elements and technologies in a building can also benefit both the environment and occupants. Installing dual flush toilets, water-efficient appliances, and innovative irrigation systems can improve water efficiency. Placing biophilic elements can create healthier indoor environments, foster a connection with nature, and improve overall satisfaction by reducing stress. Non-toxic paints with low VOC can create safer and more sustainable environments with enhanced air quality. Integrating smart lighting and sensors can increase energy efficiency, security, and safety, and cost savings while improving

the indoor environment and well-being. Managing sound and noise through the use of acoustic insulation and soundproofing can enhance comfort and privacy, increase productivity, and improve health. Additionally, controlling solar energy and utilizing shading devices, especially in Bahrain's hot climate, can save energy, reduce glare, and contribute to the building's sustainability. Finally, considering occupant behavior and designing spaces and elements that encourage pro-environmental behavior can positively contribute to the sustainability of the building.

6. Conclusions

This paper investigates the potential of proposing a new building typology in Dilmunia, Bahrain, which promotes human and environmental health. The study contributes to the limited knowledge gap on the relationship between environmental impacts and well-being in Bahrain. Based on the findings from participatory research, including a focus group discussion with experts, a framework is proposed with design guidelines that focus on enhancing the community's well-being and reducing the environmental impact whilst ensuring economic viability. The guidelines refer to the whole design process and focus on sustainable human-centered design principles through the site context, building envelope, layout, circulation, and building elements. The applicability of the proposed framework extends to other areas with a similar socio-cultural background to enhance the quality of life and sustainability through architectural design. The discussion highlighted the new building typology's positive implications. It emphasized the significance of implementing green building rating systems at the early stages of the design process, incorporating passive design strategies, designing communal activity zones, considering occupant behaviour, and managing operational expenditure efficiently.

Whilst the focus group discussions yielded various insights and perspectives from experts, the research team is aware of potential bias due to the self-selection of participants and diversified the sample to include different professions within the AEC industry. Future research could integrate the qualitative findings with quantitative data related to climatic and energy aspects of the site. In addition, another focus group can be conducted with residents of Dilmunia to understand their needs, which can be incorporated in the design of the new building. In conclusion, as human and environmental health are deeply intertwined, effective design should seamlessly integrate both principles to create spaces supporting the health of occupants and the environment.

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