The Quantum Strategic Vision for the Concept of Energy in the Perception of Architectural Space

Batool Mowafaq Kadhim[1], Abdulla S. AL Maamory[1], Ahmed M. AL Ghaban[2]

[1]*University of Technology, Architectural Engineering, Iraq*
[2]*University of Technology President, Iraq*

Abstract: Designing spaces that promote occupant health and well-being is essential to achieve sustainable building practices. This paper considers a sustainable architecture design by investigating quantum energy and perception within architectural space. To this end, the mutual influence between the building and the user through the energy effect of space is investigated. Besides, this paper discusses the energy's role in architecture and the nature of perception in shaping spatial awareness and human engagement within environments. In addition, this paper discuss how quantum and electromagnetic energy can enhance architectural design. We aim to provide information related to the study of the magnetic field effect in architecture design, specifically the effect of the geomagnetic field on occupants. Examples of practical implementation have been presented with the aim to provide effective recommendations for future architectural design. The findings in this research highlight the potential of energy-inspired designs to create built environments that are both more sustainable and adaptive.

Keywords: architectural space, energy, quantum, perception, sustainable building.

1. Introduction

Creating spaces that promote health and comfort for occupants is fundamental to sustainable building design [1, 2, 3]. Sustainable architecture focuses on delivering high-quality indoor environments that support the well-being of residents while aiming to minimize harmful environmental impacts [4, 5, 6, 7]. A key element in achieving this is indoor lighting, which plays a substantial role in affecting human psychology and physiology [8, 9, 10]. In addition, the adverse effects of poor indoor environmental quality and pollution on occupants' health, comfort, and productivity are becoming more pronounced. Issues such as respiratory illnesses, sick building syndrome, and cardiovascular and cerebrovascular diseases are increasingly linked to substandard indoor conditions [11]. Modern green building and lighting standards increasingly advocate for maximizing natural daylight and integrating it with artificial lighting solutions, thereby ensuring spaces are sufficiently lit to enhance task performance and visual comfort [1, 12]. Although adequate lighting is essential, numerous studies suggest that light's influence on human well-being extends well beyond visibility [12].

Architectural design plays a significant role in shaping a building's energy performance, making energy-efficient design crucial [13, 14]. Besides, in architectural design, architects are responsible for determining how and where people can use spaces, especially rest areas; hence, the implications of their decisions must be understood. From an architectural viewpoint, the

building must have all its stylistic and functional features designed based on the scheduled needs and mandatory regulations to establish architectural rules. In the process of adapting to the development of history, simple and effective related solutions must be incorporated into the architectural design. The application of these standards does not impede or entail any imposition of style on the building.

Continuing construction and technological developments have developed solid foundations for energy efficiency, habitability, and sustainability in building de- sign. However, studies related to improving the quality of life in these areas still represent a challenge for architects, especially when starting to choose a project site, as it takes into account the various characteristics of the site, its orientation, topography, existing vegetation, accessibility, and local climate. Public health organizations at every level must intentionally adapt their strategies for both research and practice to address the health effects anticipated from climate change [15].

Creating adaptable built environments that promote health is essential for fostering well-being [16]. The microbiome within the built environment holds significant potential for influencing human health [17]. Central to this vision is the idea that energy is to date not thoroughly investigated in the context of architectural space. The quantum strategic vision for the concept of energy emphasizes a transformative approach to understanding and harnessing energy in a way that integrates advanced scientific principles with sustainable practices [18]. This vision advocates for a shift from traditional energy paradigms to a framework that embraces quantum mechanics and complex systems. By recognizing the interconnectedness of energy systems, this approach seeks to optimize energy efficiency and facilitate the development of innovative technologies that can address pressing global challenges, such as climate change and resource scarcity. This holistic perspective encourages stakeholders—from governments to private enterprises—to engage in forward-thinking initiatives that prioritize renewable sources and smart technologies. The impact of magnetic fields on designated comfort zones within buildings needs to be thoroughly investigated. Given the diversity of building types and usage patterns, appropriate studies are essential for each type to accurately assess these effects. It is also crucial to differentiate between ground-level magnetic influences and those generated by the building's own electrical energy systems.

Quantum architecture is a developing field that integrates architectural de- sign with the potential of quantum computing [19, 20, 21]. This forward- thinking approach aspires to boost building performance, improve energy efficiency, and support the growth of quantum technology in urban settings. As quantum computing continues to gain significance, its impact on architectural design is expected to be transformative. In particular, exploring quantum perspectives within architecture opens new avenues for understanding and designing spaces that are adaptable, responsive, and energetically attuned to human experience. Quantum physics redefines energy as a dynamic, ever-present field, introducing concepts of fluidity and transformation that can inspire architects to design spaces capable of adapting in real time to changing environmental and human needs. Integrating these quantum concepts allows for the potential creation of architectural environments that feel "alive," where spaces interact with occupants, shifting and evolving to support comfort, functionality, and sustain- ability. Such an approach not only enriches architectural perception but also establishes a forward-looking foundation for energy-sensitive design principles that align with the fluid, interconnected reality observed in quantum theory.

By fostering a culture of innovation and resilience, the quantum strategic vision aims to create a sustainable energy future that is both environmentally responsible and economically viable, ensuring that energy systems are prepared to meet the needs of generations to come. A "quantum strategic vision" in architecture reimagines space by applying principles from quantum physics to enhance both functionality and aesthetic experience [22]. This vision aims to harness quantum concepts—such as energy flux, dynamic interactions, and spatial adaptability—to create architectural spaces that feel responsive and alive [23]. By integrating

these ideas, architectural design can transcend traditional static forms, fostering environments that are perceptually fluid, energy-conscious, and more attuned to occupants' needs. This exploration seeks to redefine how architectural spaces are conceived and experienced, where each element is carefully aligned with the dynamic, interconnected nature of quantum phenomena, ultimately enriching both the practical and experiential qualities of architectural design.

The study seeks to present a conceptual and cognitive framework by linking the concept of energy and perception with architecture. This is achieved by investigating quantum energy in the perception of architectural space. This paper explores the strategic role of energy, from a quantum perspective, in shaping the perception of architectural spaces. Specifically, it examines how electro- magnetic fields, particularly those from natural geomagnetic and human-made sources, impact the well-being and sensory experience of building occupants. To this end, the research prioritizes occupant well-being in architectural design. Besides, the study contributes to understanding magnetic effects in architecture, focusing on the geomagnetic field's influence on occupants and providing design recommendations. This approach highlights the evolving relationship between human perception and architectural space, recognizing that spaces influenced by electromagnetic energy fields can affect individuals beyond direct sensory perception. The study explores how such energetic interactions can cause tension and anxiety, even if these influences are not consciously felt, and emphasizes that perception is not only a mental process but also shaped by prior experiences, attitudes, and personal lifestyles. Consequently, the research addresses a critical need to understand the strategic influence of energy on spatial perception, seeking to establish a theoretical framework that links energy, perception, and architecture to inform practical design considerations and ultimately improve architectural spaces' energetic and perceptual qualities.

1.1 Objectives of the Paper

This paper discusses linking energy and perception with architecture to offer recommendations for creating energy-conscious architectural spaces. Through a combination of fundamental exploration, this research reveals potential architectural strategies that leverage the concept of energy for a more holistic perception of space. In addition, one of the main goals of this research is to understand the effects of electromagnetic fields on the design of buildings in which these buildings are located within the field of electromagnetic lines. In addition, we aim to create awareness among design professionals (architects and urban planners) regarding the study of the electromagnetic field and its impact on the design of architectural or urban space. Most importantly, this research focus on investigating the magnetic effect in architecture, specifically the effect of the magnetic field on its occupants, in order to design a space that is comfortable for the user and has positive energy. Besides, the paper investigates the mutual influence between the building and the user through the energy effect of space. Finally, this research investigates the dimensional potential in architecture for the misrepresentation of space through illusory, subversive, and imaginative means.

The methodology of this research centers on a review and analysis of existing data, focusing on scientific literature relevant to the relationship between electromagnetic fields and architectural space design. This process involves investigating studies that explore magnetic field variations within buildings and how these influence design considerations. We discuss the concept of the magnetic field and its impact on building design. Then, we select a group of case studies that have been analyzed to illustrate variations in the magnetic fields surrounding buildings and to inform architectural guidelines that manage the interaction between energy fields and user experience. Finally, we analyze and discuss the findings to clarify key insights. Research has shown that proximity to strong electromagnetic fields can influence mental and physical comfort, and this paper aims to prioritize the health and comfort of building users by addressing these energy influences in architectural design.

1.2 Paper Organization

The structure of this paper is organized as follows. In Section 2, we provide the conceptual underpinnings that bridge quantum energy with architectural space. Each Subsection in this Section will explore a distinct yet interconnected dimension of this framework, beginning with foundational definitions to establish a common understanding. We start with the definition of the perception concept, where we clarify perception as it relates to spatial awareness and human interaction within built environments. Next, we examine the concept of quantum energy in architectural space, expanding on how quantum principles influence architectural energy dynamics. Perception of architectural space then addresses the ways individuals experience and interpret spatial forms, further enriched by the subsection perception and sensory engagement in architectural space, where we discuss how sensory stimuli activate perception and enhance user experience. Finally, energy behavior in the perception of architecture will consider how energy patterns affect human interaction with space, providing a view of architectural space as an active participant in shaping perceptual experiences. Together, these subsections provide a comprehensive framework for understanding how quantum energy and perception converge within architectural design. Section 3 provides an example of the use of ground electromagnetic energy lines in facade cladding techniques. Section 4 discusses some examples of architectural designs that have already been considered. Finally, this paper is concluded in Section 5.

2. Conceptual Framework: Quantum Energy in Architectural Space

In this section, we explore foundational ideas related to how energy interacts with architectural spaces and impacts human perception. We begin by defining key terms to set the stage for deeper discussions, starting with ”perception” to clarify the principles guiding this framework. Then, we look at how quantum energy influences spatial environments and shapes their functionality and atmosphere. We then consider how people interpret and experience architectural space, with attention to how sensory elements affect their perceptions. Finally, we examine how energy dynamics within a space contribute to the overall user experience, offering insights into the interconnected roles of energy and perception in design.

2.1 Definition of the Perception Concept

The perception word means knowledge or awareness that is one of the activities of the perceiving mind. The external senses are the main and primary source of all human knowledge [24, 25]. Perception is what we can be formed and organized as a result of dealing with the external world. The process of perception is important in learning, thinking, memory, imagination, architectural creativity, and other cognitive activities. As for the function of perception, it lies in correcting judgments and summarizing complex information. Briefing and condensing it, excluding inappropriate information, and recognizing overall patterns and shapes. Perception can also be defined as “the set of processes through which meaning is organized, compiled, and given to sensory stimuli.” The processes involved in perception include physical and natural components specific to external stimuli, as well as physiological, nervous, and sensory components [26, 27, 28]. It is the process of inferring information about and from a person’s external environment. Impressions received on the retina are organized by the brain into meaningful patterns, transforming raw visual data into recognizable forms and structures. This process allows us to interpret and understand the spatial relationships, shapes, and colors within our environment, making sense of the world through organized visual perception.[29, 30].

Sensory perception is the process through which humans interpret and respond to the physical environment using their senses—sight, sound, touch, taste, and smell [31]. This multi-dimensional experience allows individuals to construct a mental image of their

surroundings, which profoundly influences their emotions, behaviors, and well-being.

In architectural spaces, sensory perception goes beyond mere functionality; it can evoke a sense of comfort, stimulate creativity, or promote relaxation. Visual elements like color and light impact mood and spatial understanding, while auditory and olfactory cues enhance the depth of experience. In particular, sensory perception in architectural spaces can be examined through how different sensory stimuli (like light, color, shape, and texture) influence spatial experience and human response [31]. By engaging multiple senses, well-designed environments can foster immersive interactions, creating spaces that feel vibrant and alive [32]. The interplay of sensory elements contributes to a holistic environment, making sensory perception essential for crafting spaces that resonate emotionally and functionally with their users.

Minimizing negative perceptions or amplifying positive ones can allow architectural perception design to make intelligent, multi-sensory architecture both more efficient and precise [33]. Several studies have discussed the relationship between architectural space and sensory perception which would influence human behavior significance [34, 35, 36, 37, 38, 39, 40, 41].

The advancement of multi-sensory architecture is supported by innovations in algorithmic design, three-dimensional (3D) printing, interactive projection, and related technologies. These developments enable the creation of new sensory experiences and aesthetics through the integration of architectural elements with cutting-edge technology [42, 43, 44, 45, 46, 47, 48]. Involving the senses can enhance the user experience in intelligent building design, offering a broader range of sensory perceptions compared to conventional architecture [49, 50, 51].

The influence of material and spatial size on indoor environment preferences is significant, as both factors shape how individuals perceive comfort, functionality, and aesthetic appeal within a space. Materials play a key role in tactile and visual experiences; for instance, natural materials like wood or stone often evoke warmth and connection to nature, while metals or glass may communicate modernity and cleanliness [52]. The work in [31] investigated participants' sensitivity across visual, auditory, olfactory, tactile, and kinesthetic domains. The findings reveal that visual elements, especially color, are the most essential in shaping perception, while dynamic changes, such as shifts in colored lighting, significantly influence mood and preference. This insight into sensory mechanisms aims to enhance the quality of architectural design, suggesting that tailored multi-sensory stimuli can improve indoor environments, especially in intelligent or interactive architectural contexts.

2.2 Definition of the Concept of Quantum Energy in Architectural Space

The definition of the concept of energy refers to both the ability to ause an action or effect, or the positive spiritual force, or the basic entity of nature that is transmitted between parts of a system by generating physical changes within it. The concept of energy has been used to cover a wide range of different cosmic phenomena. This philosophical concept refers to the general measure of the different forms of movement of matter. These different forms of matter possess the property of being able to transform into each other. Energy is expressed in the system of physical theory in different forms: mechanical, thermal, electromagnetic, atomic, and gravity. Each form of energy determines the essential characteristics of a particular physical form of movement, in terms of the ability to transform into any other form of movement, and the amount of remaining movement that cannot be changed. The doctrine of energy (Energism) appeared as a philosophical concept at the end of the 19th century among some natural scientists, and the followers of Energism explain all natural phenomena by changes that occur in energy that is devoid of material quality.

Energy is broadly understood as a natural force capable of initiating action, defined by its inherent characteristics—whether latent or kinetic—and manifesting. Energy in our environment can be categorized into natural and artificial sources [53]. Natural energy

originates from terrestrial forces, often arising from human alterations to the land (such as mining or constructing massive foundations), Earth's rotation, geological faults, or groundwater flow. These sources may emit radiation that can be harmful to living organisms. The artificial energies are the result of the use of electrical devices within the surroundings of external or internal space. As for energy in architecture, it refers to what is related to both mass and movement. Thus, it is either latent or kinetic ac- cording to balanced force conditions and is reflected in the architectural designs and configurations of shapes and blocks. The potential energy is represented in the formation of perpendicular lines and mesh surfaces, which become an expression of structural stability and architectural formations. When kinetic energy is represented by curved and zigzag lines and surfaces used in various forms and configurations of architecture. In architecture, a building must have all its stylistic and functional attributes designed based on the scheduled needs and mandatory regulations to establish architectural rules. This can be accomplished in the process of adapting to the development of history, simple and effective related solutions must be incorporated into the design. The application of these standards does not impede or entail any imposition of style on the building. In fact, it is conceptually and visually neglectful, although its impact is tangible for long-term residents.

The effect of the magnetic field on comfort areas in buildings has been studied [54, 55, 56]. Because there are different types of buildings and different methods of use, effective research works are required for each type. Besides, ground magnetic effects must be distinguished from magnetism caused by electrical energy in the building. From the discussion above, it is evident that the broad definition of energy is fundamental across many aspects of life, including architecture. Generally, energy relates closely to nature, encompassing the capacity to generate action and exist either in latent or kinetic states. It can also appear in various forms, whether natural or artificial.

2.3 Perception of Architectural Space

The perception of architectural space is an immersive experience shaped by the interaction of sensory elements, spatial forms, and the emotional responses they evoke in individuals. In particular, it is natural for humans to have a preconceived idea of current conditions based on expectations, mental records, and past experience. This is an architecture that questions a person's perspective, perception, and position, through the manipulation between different dimensional means of representation (two-dimensional (2D) to 3D). The manipulation of the image has the ability to influence the experience of the built environment, creating a more playful interaction through the four dimensions (4D) [57, 40, 58]. Noting that the term "built environment" is used to refer to the human-made surroundings, which are separate from the natural environment [59]. Experience is an important part of the interaction that occurs between the user and the architecture [60, 40, 61]. Understanding how space and its many components such as placement, light, color, scale, perspective, and more affect our bodies is crucial to understanding the translation between space and humans [62]. The diagrams represent the different visual and sensory signals that occur with our bodies when visualizing space [63, 64].

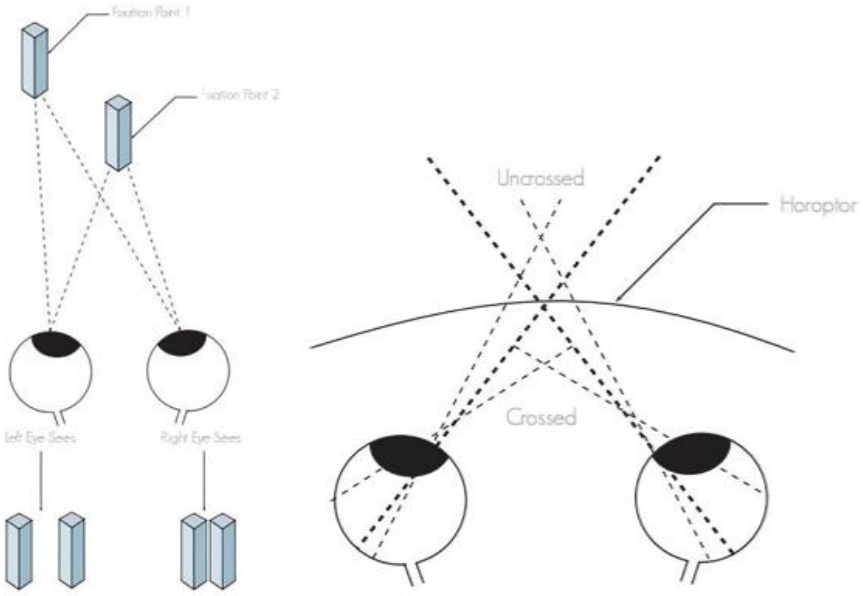

Figure 1. *Manipulating the image to influence the experience of the built environment [65, 57].*

2.4 Perception and Sensory Engagement in Architectural Space

The recipient's perception is affected by what attracts attention in the architectural space and arouses feelings through stimuli, which are characterized by the characteristics that the perceived architecture carries. are divided into three: Formal characteristics (which are considered among the most important characteristics that affect the perception process and help to assimilate and understand the surrounding environment, represented by texture, materials, color, and shadow.) Ching divides it into two aspects: the form, which is the image through which the form is classified and defined, and the relational characteristics, which include the location, direction, dominance, and balance of the form). Spatial characteristics (space relations affect perception, as the shape of the moving path of the person looking at it and the structure of the path play a major role in dividing the perspective view providing the opportunity for contemplation, and encouraging the recipient to continue the path. Ching divides it into spatial containment relations - juxtaposition relations - interference relations). Emotional sensory properties (represented by what the recipient, can feel during the process of perceiving the environment around them, through arousing interest, a feeling of surrounding, suspense, and pleasure). Everything that exists has a form, and every form requires a material to support it and a body in which it exists, matter is the means to (feeling of something), and form is the means to (perceive) the thing. If there are things in the universe that have no form, it is not possible for a person to know or perceive them.

The perception of architectural spaces is shaped by elements that draw the recipient's attention and evoke emotional responses through specific sensory stimuli [66, 67, 68]. These stimuli carry distinct qualities inherent to the architecture itself, divided into three key categories [69, 70, 68]. The first one is formal characteristics. These attributes play an essential role in the perception process, aiding in understanding and absorbing the surrounding environment. This category includes elements like texture, material, color, and shadow. Formal characteristics are split into two parts: form, which relates to the visual identity used to define and classify the object, and relational characteristics, which encompass factors such as location, direction, dominance, and balance. The second category is the spatial characteristics. The relationships between spaces significantly influence perception. The configuration of pathways and spatial structures guides visual perspectives and creates opportunities for contemplation, encouraging continuous engagement. Ching divides spatial characteristics into specific

relationships: spatial containment, juxtaposition, and interference. The third and last category is the emotional sensory properties. These relate to the feelings and reactions triggered by the surrounding environment, including interest, a sense of enclosure, suspense, and enjoyment. Sensory engagement not only enhances the perception of space but also deepens the user's connection to it. In essence, every physical form requires a material foundation and a presence to exist, where matter serves as the means to experience it, and form enables its perception. If something lacks form, it eludes recognition or perception. Thus, understanding architectural spaces involves a blend of material, form, and sensory experience that combine to shape the overall perception.

Mental perception of architectural space concerns knowledge and beliefs about the spatial properties of objects and events in the world. Cognition is about knowledge. For humans, cognitive structure and processes are part of the mind, which arises from the brain and nervous system within the human body that exists in a social and physical world. Spatial characteristics and some of the main mechanisms of architectural design affect human psychology. People spend the longest part of their day in a built environment [71], and therefore many of their thoughts and awareness about space are directly intertwined with the architectural and urban form of their surroundings [58].

Spatial structures contribute much to our language through metaphors and symbols, and they structure our experience. They include the information that makes up visual images, sound, heat, and texture, which contribute to our full sense of the world. We take in information through the senses, process it through memory, link it to interpretation, and then store it in long-term memory. Expression is almost the same in that memory and thought are processed mentally and are projected externally and the recipients' senses enter to convey the information to them, and once processed they enter the recipients' perceived space [72]. The work in [72] advances our understanding of how the built environment influences creative design in both educational and professional settings. It may serve as inspiration for designers and educators to enhance the design of their workspaces.

This succinct description of the perception of outer space and its re-perception of inner space illustrates the importance of multi-sensory information in our experience of our environment. This proves that architectural space is much more than just physical space (mass and space, corridors and rooms). It also shows that whatever real-physical– outer space looks like, our memory will store it through interpretation and relational thinking, both of which are influenced by subjective experience [72]. We perceive our context not only through its physical and sensory-visual form, but mostly through the interpenetration patterns of its components, which in turn are interwoven with our thoughts, culture, and past experiences. Many important experimental attempts have been reached in the field of design, and through the adoption of psychological analyses in attempts to understand and realize the overall relationship pattern of the parts within the basic components of the designed environment. The results reached showed contrasting formed mental maps, depending on the experience of individuals in extrapolating its components, as well as the discrepancies resulting from the concept and mechanism of the interconnection of meanings.

In general, the concept of architecture is considered physically composed of three basic elements (environment, boundaries, and man). These elements are linked together to make the idea of architecture. Humans view architectural space in the physical environment as an external space and an internal space. Volumetric space is perceived in 4D architecture space as a flexible form that constantly changes to reveal its hidden spaces and functions. In this case, the user can orient themselves to the space to suit their own purpose and needs.

The spatial properties of 4D space are defined by examining its 4D structure, allowing human participants to perceive its spatial qualities. In addition, a system has been developed to regulate movement along the 4D. This concept envisions a virtual architectural space made up of multiple 3D spaces that dynamically adjust in volume, offering a deeper

understanding of virtual spatial experiences [73]. The use of hidden line removal (a method for omitting lines that are out of view in a 2D display of a 3D object) allows the spatial representation from the 4D intersection to be defined as the exterior. Through this process, the resulting surfaces are perceived as the outer boundaries. Fig. 2 shows the elements of perception in architecture with 4D boundaries.

Degrees of human perception range from simple superficial to deep and complex according to internal and external factors and influences that affect a per- son's thoughts and perceptions. Cognition varies in nature and degrees from one entity to another, and humans are distinguished from other animals by their breadth of perception and power. However, the person himself varies in the strength of his perception from one individual to another and even differs for one individual from one age stage to another. People's awareness of things in their true, realistic form prevents them from falling into the arena of dilemmas and tribulations. Perceptions that a person perceives can be divided into several groups. These include subjective perception, innate perception, acquired perception, defective perception, and latent perception.

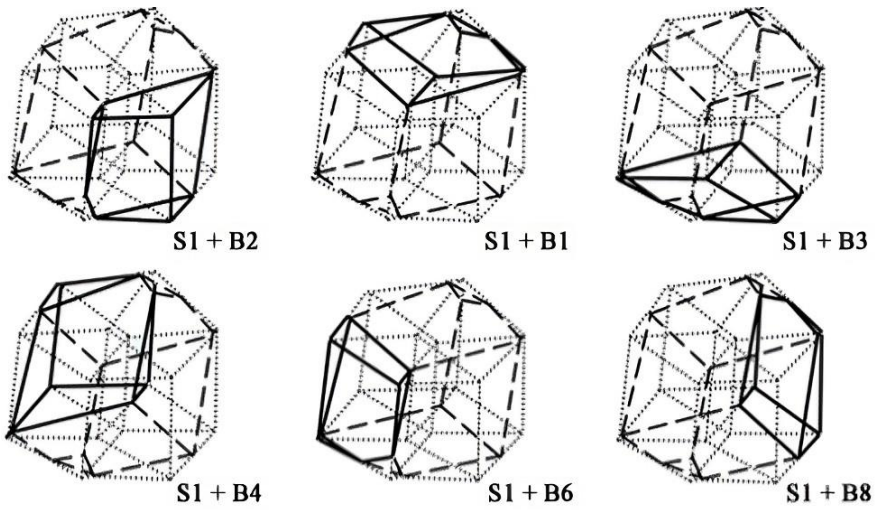

Figure 2. *Elements of perception in architecture in which (S1) represents the visible space and (B1-B6) denotes the 4D spatial boundaries [73].*

Perception is an existence that no one denies, except that it is a non-material existence as no one can describe it with color, shape, weight, chemical composition, frequencies, waves, calories, or electromagnetic fields. On this basis, the place of perception in the human self remains a matter of debate among thinkers. Some of them consider the tool of interpretation, which is the brain, to be the center of perception, and some of them assume that the soul is the center of perception and that the brain is nothing but an interpretive tool for the soul since the soul is the one that feels and is the one that perceives (Previous source). Perception is a condition in the process of completing the appearance of the product and meeting its conditions with the designer, to achieve birth linked to will and choice and its role in developing its meanings through the use of compositional relationships. Thought or perception is the transfer of reality through the senses to the brain with information through which this reality is interpreted.

It is said to convey reality, not its image because what is conveyed is the feeling of reality, not the image. The human mind was described as the substance of consciousness, which includes sensations, simple images or ideas that are copies of sensations, then complex ideas that result from the interconnection of simple ideas with each other. These correspond to the three stages in an action, which are sensation, memory, and thought. The principle in which the mind works is represented by the way in which thoughts are connected about a subject or in the perception of something. Due to the connection between time and space, and the frequency with

which these ideas were associated in the past, the idea of sensation can be replaced by the idea of form as the main value in perceiving things. Any architectural work includes a set of sensory and visual vocabulary, one dimension or another of which plays a role in achieving a type of communication between the recipient and the architecture, which affects the extent of the response to it.

Our visual perception of the place and its extension involves the process of constructing a mental image, which is built on complex cognitive processing, meaning that the visual perception of the place is not just a direct and simple narrative impression. Our eyes cannot perceive the depth of a place since they are equipped to perceive only two dimensions. Depth perception (i.e. perception of 3D space) is the result of complex cognitive processing in which the integrated sensations/perceptions (or integration of sensations/perceptions) felt by both eyes share with our various physical experiences in the relationship of the movement of our bodies in the place and our dealings with its components in addition to our experiences that it formed a kind of knowledge or interpretive memory of place and places.

2.5 Definition of the Concept of Electromagnetic field radiation

Electromagnetic radiation consists of an electric field and a magnetic field, which push charged particles in the direction of the field and at right angles to it, respectively. When buildings are located near these sources, building occupants are exposed to health risks. The work in [74] discussed the issue of the electro- magnetic field and its effects on the occupants of buildings when these buildings are located in the vicinity of the field. Electromagnetic fields are defined as electrical and magnetic fields emitted from the generation, distribution, and use of electricity, cell phones, and a variety of other sources such as radio and television broadcast towers and antennas. Two main sources of electromagnetic fields were reviewed: high-voltage power transmission lines and cell towers. Studies have shown that when buildings are constructed at an unsafe distance from fields, the occupants of these buildings become exposed to health risks, so the paper in [74] attempts to understand the risks of exposure to electromagnetic fields for building occupants.

A person's perception of the space surrounding them (the relationship of the self to the object) is characterized by being of a multi-dimensional nature, physically, mentally, and spiritually. It begins sensory (perception) and penetrates the insides of the person to mental perception (cognitive). Interest in the mind and brain is as old as recorded history, so it is considered a given. Interest in fundamental questions about perception and its physical underpinnings has been around for a long time. A lot of literature verifies the effect of electromagnetic field lines on the perception of space, which is related to the location of buildings within electromagnetic fields. With the development of laws and theories that deal with quantum physics, it has become possible to benefit from unconscious and interacting energy influences to reach conscious awareness through two types of energy. The energy is transmitted by any particle present in this universe (the particles that make up the user). In particular, exploring the energy extensions can be achieved by examining their influence on occupants the extent to which users can perceive or experience these fields, and their effect on the behavior of energy within the space, including how electromagnetic fields interact with and shape the spatial environment. This approach allows for an in-depth understanding of the role of energy fields in architecture, both in terms of human perception and the broader energy dynamics that contribute to a space's overall functionality and atmosphere.

Electromagnetic energy fields in architectural spaces emanate from the inte- rior of the Earth or the materials that make up the space itself. Electromagnetic energy fields in architectural spaces often stem from two primary sources: the natural geomagnetic field produced by the Earth and the specific materials used in construction. The Earth's magnetic field, generated by its core, interacts with architectural spaces and can influence both the human experience within the building and the structural elements themselves. This geomagnetic field

varies in intensity depending on geographic location, depth, and proximity to natural or man-made disturbances. Architects and designers, especially those focused on creating spaces with enhanced wellness or sensory experiences, may consider these factors to optimize comfort and align with natural energy flows. In addition to these natural fields, certain materials used in building construction, such as metals or mineral-rich stone, can produce or alter electro-magnetic fields within a space. Metal components can interact with external electromagnetic waves—like those from power lines or appliances—potentially amplifying or distorting the field in ways that affect both structural integrity and human well-being [75, 76]. In recent years, there has been a growing interest in understanding how these fields influence occupants, as they can subtly im- pact factors like comfort, restfulness, and productivity. Therefore, considering electromagnetic influences from both the Earth and building materials offers architects a more comprehensive approach to designing environments that are both structurally sound and attuned to human energy needs.

From the above, one of the most important goals of integrating quantum physics and architecture from an architectural perspective is to reach quantum architecture that results from design according to a system of design elements. This should take into account the unperceived energy impact of the material in order to reach an awareness of the electromagnetic waves (energy) resulting from binary behavior. Architecture significantly influences human experiences through spatial energy, as individuals interpret and respond to these spaces on a personal level. The choice of materials and color combinations used in construction plays a crucial role in shaping one's thought patterns, meaning architecture not only frames physical spaces but also enriches individual experiences. For instance, hospitals are often designed with natural lighting, soft colors, and landscaped surroundings, which collectively foster a healing environment and subtly enhance patient well-being. Noting that architecture is not always a loud way of expression but a way of living. More and more people have now understood the importance of being surrounded by good quality spaces. Our everyday spaces contribute greatly to our cognitive abilities, emotional intelligence [77], and physical well-being. Well-lit and ventilated areas that have a good balance with nature will make the residents of the place feel positive, which will affect their energy and productivity. Dark, dull spaces have been shown to have harmful effects on humans without underlying medical causes. This is because the mind is so powerful that it can translate emotions directly into our physical reality.

Sick building syndrome is one example of poorly designed spaces or buildings that negatively impact audiences [78, 79]. In particular, sick building syndrome refers to a range of symptoms that arise from exposure to harmful elements within a building environment. Common complaints linked to Sick building syndrome include headaches, fatigue, general discomfort, and nausea, all of which are influenced by factors related to the building's use and environment. Today's urban fabric [80] depicts an apocalyptic situation with crowded, unsustainable structures and poor material choices that have disturbed the emotional connection between the mind and spatial experience [81]. This has an impact on the health and well-being of the population - who tend to suffer from psycho- logical disorders along with a poor lifestyle. People travel to the suburbs, or to a natural retreat to rejuvenate and feel alive. Architecture is an ongoing experience, not a short-term stimulus. Architecture itself is a means through which humans can heal, renew, and co-exist with nature. Carefully designed structures with a perfect balance of natural elements tend to make an enormous positive impression on the mind. The beauty of architecture is perceived visually and processed emotionally. It is interesting to note that people enjoy architecture because it is the sole purpose of a space. Every place we visit has an impact on our mind which ultimately contributes to shaping us as better people. This is the power of space – to add value to human growth and development at a deeper level.

Strengthening the human Energy system - how ancient architecture can in- spire modern building design in ancient times, buildings were designed with the aim of balancing the human energy system, and creating a physically and energetically supportive space. Ancient

architects paid attention to the dimensions, proportions and materials used in the construction process to ensure that the building is compatible with the human energy system, promoting harmony and balance within the space. Our modern buildings are often constructed without regard to the human energy system, resulting in imbalances and inconsistencies. A major contributing factor to this is electromagnetic pollution caused by the electronic and mechanical components that heat and cool the interior space. Electromagnetic pollution disrupts the normal flow of energy, causing health problems such as fatigue, headaches, and insomnia [82, 83]. It can also lead to more serious conditions such as cancer and autoimmune disorders [84]. However, we can take steps to mitigate the effects of electromagnetic pollution and create buildings that support the human energy system. One effective approach to creating buildings that support the human energy system is the use of nature-based heating and cooling systems. These systems use principles of physics to maintain a comfortable indoor climate without relying on any electrical or mechanical components. Incorporating heating and cooling systems into building plans allows one to naturally heat and cool buildings and create a healthy environment that promotes well-being. In the context of natural architecture, studies have shown that being in spaces with natural shapes and vaulted ceilings can increase the level of alpha waves in our brains. Alpha waves are brain waves associated with a relaxed and meditative state of mind. When we experience an increase in alpha waves, it can help calm the mind, reduce stress and anxiety, and promote a feeling of mental clarity and focus.

2.6 Energy Behavior in the Perception of Architecture

The concept of perception in architectural design encompasses both physical stability and the dynamic transfer of energy, creating an experience that resonates with occupants on multiple levels [85]. Physical stability in architecture refers to the structural and visual qualities that evoke a sense of reliability and permanence, grounding occupants in the space. This stability is not merely structural; it also provides a foundation for the perception of spatial continuity, balance, and harmony. In contrast, the concept of energy transfer introduces a dynamic aspect, where space interacts with the occupants' sensory and emotional responses. Architectural elements—such as light, sound, and material choices—act as conduits for energy, altering perceptions and enhancing the occupants' engagement with the space.

In modern architectural design, the interplay between these two concepts is carefully calibrated. Designers often balance fixed, enduring elements with adaptable features that react to environmental changes or user presence. For example, materials that respond to natural light or shifting structural layouts can create a sense of fluidity while preserving a stable form, effectively blending physical stability with perceptual energy transfer. This approach allows spaces to evolve based on user interactions and environmental cues, making the architectural experience not only visually compelling but also energetically engaging, fostering a deep and lasting connection between the occupant and the environment.

Bio-energy, derived from organic materials such as plants, agricultural waste, and even algae, presents a compelling opportunity for sustainable architectural practices. Bio-energy can be integrated into building design through the use of biomass for heating and electricity, as well as incorporating biophilic design principles that enhance the connection between occupants and nature. This approach not only reduces reliance on fossil fuels but also promotes energy efficiency, allowing buildings to produce energy on-site. Innovative materials like bio-based composites and hempcrete can further enhance sustainability by lowering the carbon footprint of construction while improving thermal performance. Incorporating bio-energy into architectural design also involves the strategic use of green roofs, vertical gardens, and solar energy systems that harness organic processes for energy generation. These features can improve air quality and promote biodiversity while creating spaces that are visually appealing and functional. The strength of solar energy is carried by electromagnetic waves (50% in electric fields and 50% in magnetic fields). Electromagnetism, like gravity, is one of the 4D

forces of nature and it behaves in such a way that, by its presence or absence at certain wavelengths, you can feel warm in cold air or cold in warm air. It has been observed that different colors of light have different temperatures and that "invisible light" exists outside the visible spectrum. This invisible light is known today as infrared (colloquially) "radiant heat" and is the natural force by which we can effectively and efficiently heat and cool occupants of spaces. Additionally, the integration of smart technologies can optimize energy use and management within buildings, making them more adaptable to changing energy demands. By prioritizing bio-energy, architects can contribute to a more sustainable urban environment, aligning with broader goals of ecological stewardship and resilience in the face of climate change.

Several works addressed the bio-energy emanating from the human body and the extent of its relationship to architectural spaces, considering that the human's vital balance within the architectural space depends on this energy. The bio-energy can be defined as those electromagnetic waves varying in their shapes, types, lengths, and durations. Different frequencies and the effects of these waves may be tangible and intangible actions, as in the thermal energy in the human body generated as a result of anger, as well as the love that results from the feeling of joy upon seeing a person he loves, and explaining the effects of this energy emitted in the form of electromagnetic waves on humans, and studying this Influences on ancient civilizations such as the Egyptian (which considers that the human being is composed of nine bodies and that the physical component of the human being is one of them). The Chinese (which used to call chi or treatment with acupuncture in areas that facilitate the flow of energy in the body), and the Indians (which called prana the primary energy or the breathing of vital energy that appears on the human body in the form of chakras (colored auras), and the Coptic civilization (it is considered a principle On the drawing of saints, with colorful halos surrounding their heads), and Islamic, in brief, the researcher divided vital energy into five sections, some of which emanate from the universe, others emanating from within living organisms, others stored within geometric shapes, and energy within matter in all its forms, and showed the places Their emission and concentration in the human body, and the function of each of them, as an example of this is the cosmic energy, which is considered invisible energy that surrounds the planets, including the Earth, and passes through (the chakras), which are known as neural networks that receive and redirect electrons.

According to quantum physical theory, which has been widely validated and applied across various fields, particles on the Earth's surface exist in a state of dynamic interaction. Waves emanating from both individuals and surrounding spaces can influence and modulate the energy frequencies of both the user and the environment, creating a continuous, reciprocal relationship. This flow of energy—both inward and outward—seeks to achieve a balance that enhances stability, enriches energy fields, and ultimately improves the functional performance of the user and the space. This interaction reflects a conscious alignment with the core energy comprising the space, fostering a state of heightened aware- ness and harmony between the mind and the environment.

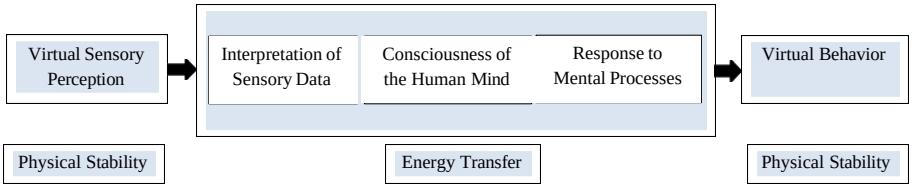

Figure 3. *The concept of perception between physical stability and energy transfer.*

In applying quantum concepts to architecture, several practical and theoretical limitations may have emerged. One significant challenge lies in translating the abstract and often complex principles of quantum mechanics into physical, tangible design elements that

can be meaningfully integrated into architectural spaces [23]. Quantum concepts, rooted in mathematical models and microscopic phenomena, are not always easily adapted to the scale and context of built environments. Furthermore, there are technological constraints that limit the feasibility of implementing quantum-inspired features in real-world architectural projects, as the necessary tools and materials are often either in developmental stages or not yet accessible at the scale required. These limitations necessitate a careful balance between theoretical exploration and practical design to avoid overextending the application of quantum ideas beyond what can be realistically achieved.

If the awareness and consciousness associated with conscious states measured at the brain level do not arise entirely from the brain, where can they arise from? One solution to this concern is to assume that a pervasive force or proto- consciousness pervades the universe that interacts with all matter and imparts some partial matter to self-consciousness [86]. The ”puzzle of perception” is represented in two distinct states: The collapse of quantum waves, leading to the physical stability of the objective world, and the emergence of conscious awareness, revealing the fundamental ambiguity of the subjective and mental world. Quantum mechanics may serve as a potential link between physical reality and consciousness [87]. Theoretical work by John von Neumann (1955) suggested that quantum theory inherently brings together the realms of physics and conscious awareness, making their interaction unavoidable. Eugene Wigner (1995) echoed this perspective, positing that consciousness may act as an intermediary between the classical and quantum domains. This implies that consciousness, potentially an emergent function of the brain, could bridge our observable world with the probabilistic quantum landscape, allowing for interactions that may define or shape our physical experience [88, 89]. According to the physical and chemical concept, each atom consists of negatively charged electrons and positively charged protons [90]. They operate according to specific relationships within the atom, and each according to its specific orbit is governed by balanced relationships that constantly bring the atom to a state of balance and stability in movement, whether through losing electrons or gaining them from another atom so that there is no attraction or repulsion within a single atom, and this indicates the existence of polarity that results in energy that is classified according to measurement methods, and that the sum of the energies emitted by the atoms or molecules of the medium that makes up space, whether it is the energy of light, the energy frequencies of matter, or the energy emitted from the interior of the Earth, has polarity between the positive and negative parts within each atom or molecule, making it in the continuous movement towards equilibrium. The same applies to the total energies within space, as they are in a constant effort to eliminate the difference in the amount of influence between two different places in the same space with the aim of creating balance and stability. This situation can be clarified by experimenting with transverse pots (which are a group of pots of different shapes and sizes connected to a conveyor channel). When the liquid is poured into one of the pots, it is distributed evenly to reach a single surface level for all the pots, meaning that no matter how much the amount of liquid differs between them, a transfer occurs in the liquid. With the aim of creating balance, in the absence of communication channels, a discrepancy is formed between one place and another. The same is true for architectural space. The polarity of energy constitutes the difference in the amount of energy present in one place rather than another and its pursuit of movement and balance of distribution if a trans- mitting medium is provided for it. Every architectural space is defined by walls and elements, which influence and are affected by electromagnetic fields and energy polarity, and are subject to the laws that govern all forms of matter and energy in the universe. The electromagnetic north is considered one of the most important forms of achieving polarity in architectural space, as it acquires electromagnetic polarity immediately if it is positioned relative to the earth’s field. Whenever the polarity of energy is achieved within the architectural space, the designer is able to benefit from the variation of energy and its self-flow towards balance and equal positioning, raising the functional efficiency of the space, and the effect is

reflected. This fundamental balance depends on the psychological state of the user.

The work in [91] highlights the critical role of “robustness” in optimizing energy efficiency and comfort within building design. The term robust design in this context means an approach that inherently minimizes the likelihood of user errors. This can be achieved by features like permanently sealed windows or integrated systems to regulate lighting, heating, cooling, or ventilation. Considering the optimization of energy efficiency is crucial in building environment control strategies [92].

Unlike air, whose buoyancy changes as its density changes, resulting in currents/convections (cold air falling/warm air rising), radiation can travel in any direction through space regardless of the temperature of the space. As demonstrated by the photons of energy emitted by the sun, radiative transfer is extremely efficient at transporting energy over very long distances at the speed of light. When photons from an incident beam within a certain range of frequencies strike atoms and molecules in an absorbing mass, they begin to vibrate. If the particles of the mass vibrate enough, the mass can change state, i.e. ”melt” or ”evaporate.” The more an object’s molecules move and vibrate, the hotter it becomes. This heat is then emitted by the object as thermal energy. Some objects, such as dark-colored objects, absorb more incident light energy than others. For example, black pavement absorbs most of the visible energy and ultraviolet light [93]. Ultraviolet light reflects very little, while light-colored concrete pavement reflects more energy than it absorbs, so the black pavement is hotter than pavement on a hot summer day. The process of absorbing and losing portions of energy to many molecules along the way is common to happen in nature. This thermal energy is then radiated in the form of longer-wavelength infrared energy.

Indoor climate engineers are interested in the ingress of short-wave solar energy and the reflection and emission of that energy as long-wave energy [94, 95, 96]. In the short waveform, this energy can be absorbed, reflected or transmitted through transparent surfaces or as conductive thermal energy in opaque surfaces [97, 98]. The absorbed electromagnetic energy excites the molecules of the absorbed surface and thus the electromagnetic energy is converted into thermal energy. This thermal energy is then re-released as long wave energy into space and can also be transmitted via conduction to the cooler side of the absorbed mass [99]. Window coatings and colors can be used to regulate the amount of shortwave energy allowed into or within a space and use radiative cooling to remove the absorbed energy.

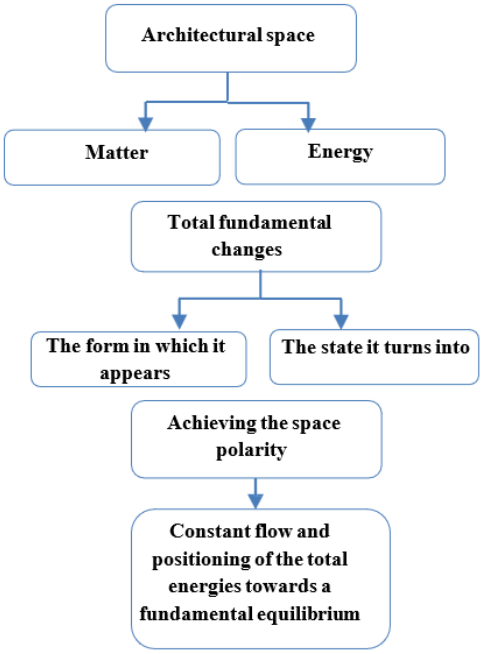

Figure 4. *Energy behavior of architectural space.*

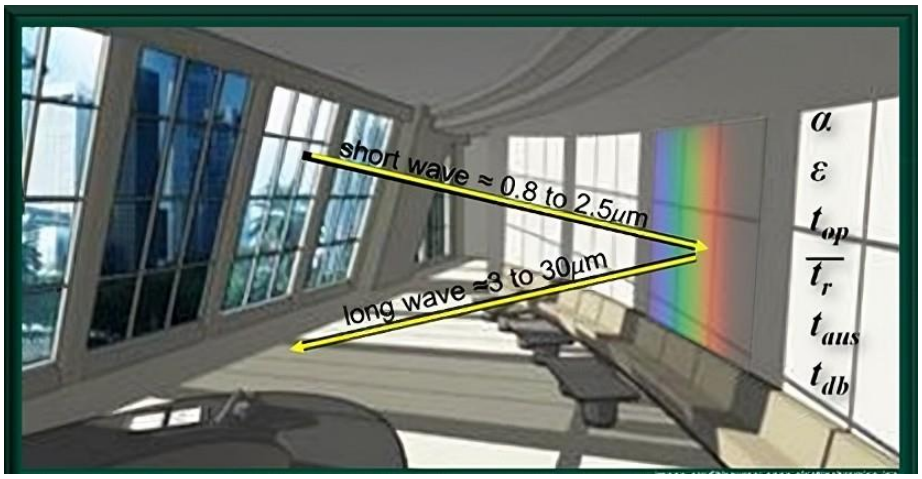

Figure 5. *An example of architectural and interior climate engineering and electromagnetic waves.*

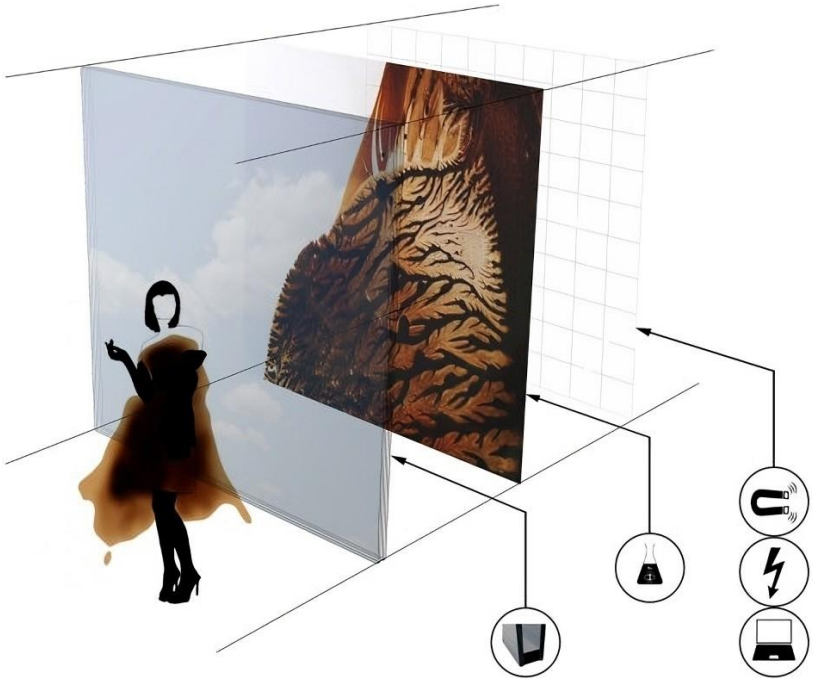

Figure 6. *Example of magnetic materials [101].*

3. Electromagnetic Structure

The concept of future architecture envisions building structural frameworks that harmonize with the Earth's natural electromagnetic energy currents. This innovative approach aims to align a building's design with the planet's inherent energy flows, utilizing spatial and material arrangements that respond to these invisible forces. By harnessing electromagnetic pathways, architects could create structures that promote greater environmental harmony and potentially improve occupants' well-being. This direction suggests a shift from traditional design principles toward energy-conscious constructions that consider not only form and function but also the subtle, dynamic interactions between built environments and the Earth's natural energy fields [100, 58].

A magnet can be defined as an object or material that generates a magnetic field, which can exert a force on other ferromagnetic materials without needing direct contact [102]. This magnetic field, while invisible, has the power to both attract and repel other magnets. Lodestone, for example, is a naturally magnetized mineral made of magnetite, which was first

used by the Greeks around 500 B.C. The term ”magnet” originates from the Greek magnetic lithos, meaning ”stone of Magnesia,” the region where these magnetic stones were discovered. In ancient China, it was observed that when pieces of lodestone were suspended from a string, they would consistently align in a particular direction. Early Chinese magnetic compasses, dating back to around 206 B.C., were initially used for divination and to help harmonize buildings according to the geomantic principles of Feng Shui. By 1040-1044, the magnetic compass be- came a crucial navigational instrument for the Chinese military. To this day, the compass remains one of the most significant applications of magnetism.

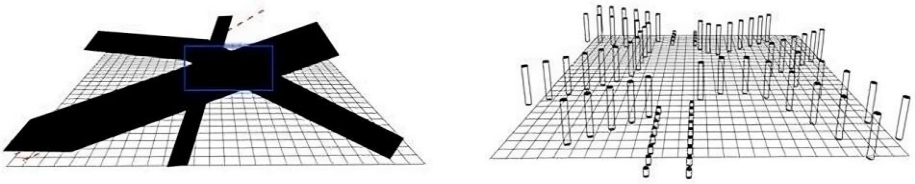

Figure 7. *Using magnetic power lines to determine the shape of the structural structure [104].*

Although lodestone is a natural magnet, magnets can also be manufactured to specific shapes, sizes, and field strengths. In 1740, Gowen Knight created the first commercially available magnet for scientific researchers and navigators. By the 1930s, researchers had developed Alnico alloy permanent magnets with enhanced power, followed by ceramic magnets in 1952, and magnets made from rare earth elements in 1966.

Fig. 7 demonstrates the use of magnetic power lines to determine the shape of the structural structure. The alignment can be achieved by analyzing the project site with geographic software that identifies the precise locations of magnetic field lines. In particular, the structural elements such as columns and beams are then positioned according to these lines, allowing movement within these spaces to align with Earth’s magnetic flow. This approach can enhance spatial energy and increase its polarity, stabilizing various energy sources—whether from the Earth’s core, the occupant, or the materials used. As a result, the energy field frequencies reach a balanced state, thereby elevating both the energy of the space and the experiences of those within it [103].

Magnetism has the potential to inspire innovation in architecture and design [105, 106, 107]. An example of the use of ground electromagnetic energy lines in facade cladding techniques is Space Group Architect in London. In particular, London-based Space Group Architects have been pioneering magnetic architecture through the development of a responsive smart material prototype [108]. Space Group Architect in London has been developing experiments based on harnessing the Earth’s energy in architecture. The objective for the construction of such a building is to create a facade cladding system. This is archived by developing a prototype of a material used to cover facades. This material can change its properties such as transparency, reflection, and color using a simulated magnetic current. Earth’s electromagnetic energy currents interact with such material. In addition, such material can be controlled through computer programs with specific algorithms linked to the Earth’s electromagnetic cur- rents network [71]. Using such computer-controlled electromagnetic currents, the material dynamically changes its transparency, reflectivity, color, and even shape. The system (cladding material) [109] consists of three glass layers or units. One of its micro-cavities contains a rheological fluid (mineral fluid) that can be changed with Earth’s magnetism and supporting magnetism. The metal- lic liquid is installed between two plates and electromagnetic sensors are behind the third part. To this end, by directing the network current into the third glass part, electromagnetic forces begin to affect the metallic liquid, leading to a change in its color and transparency, aiming to obtain interactive interfaces with the Earth’s energy [101]. By directing a current through a wired grid on the third glass layer,

electromagnetic forces alter the ferrofluid, transforming its appearance in terms of shape, color, and translucency. The computer-driven setup allows for animations, moving images, and striking visual effects, with colors that range from pale brown to deep black. If successful, this material could form a lightweight, animated external facade capable of creating vibrant visuals at night, enlivening dark spaces with colorful, moving displays.

4. Case Studies

This section provides some examples of architectural designs that have already been implemented.

4.1 University of Wollongong Molecular Horizons Building

The University of Wollongong's Molecular Horizons building is designed to serve as a state-of-the-art research facility, embodying both functionality and innovation. Architecturally, it combines advanced scientific infrastructure with a thoughtful, human-centered design that promotes collaboration and interdisciplinary research. The building's layout maximizes natural light and integrates open, flexible spaces that encourage interaction among researchers. In addition, its design emphasizes sustainability through energy-efficient systems and materials, aligning with the broader vision of fostering an environmentally responsible research environment. The Molecular Horizons building stands as an example of how architectural design can enhance both the technical and collaborative aspects of scientific discovery [110].

A 6,900 square meter collaborative research facility for the University of Wollongong, designed by Denton Corker-Marshall and Jacobs. The building is designed with highly sensitive electron microscopes located on the ground floor, which are used for molecular to improve and save lives. The University of Wollongong's Molecular Horizons Building was specifically designed to house approximately $25 million worth of advanced microscopy types of equipment. These types of equipment include high-resolution electron microscopes and other specialized tools that support molecular and cellular research, enabling scientists to visualize biological processes in unprecedented detail. This investment reflects the building's purpose as a cutting-edge research facility focused on breakthroughs in molecular science and biomedicine.

The building houses three cryogenic electron microscopy suites acoustics and electromagnetic field interference. The building includes Physical Containment.

Figure 8. *Molecular Horizons Building at the University of Wollongong [111].*

Level 2 (PC2) laboratories, research areas, workspaces, and critical resource areas with the prerequisites for acoustic and vibration design input. Laboratories are facilities

designed for work with moderate-risk biological agents and pathogens that pose a limited risk to humans, animals, or the environment. Resonate is used to determine the appropriate siting of the building, ensuring that ambient vibration levels and electromagnetic fields are low enough. The build- ing was completed in 2020, with commissioning tests for vibration, acoustics, and electromagnetic fields taking place in late 2019.

The building's design is based on precise requirements for highly sensitive equipment, these include cryogenic electron microscopes and ultra-resolution optical microscopes that are used for research at the molecular level. The de- sign consists of three elements, the services block to the south will appear as a "dark metal block" with irregularly arranged windows. The architects said the "abstract" pattern of vertically and horizontally aligned windows is a reference to the molecular systems being studied within them. The southern wing accommodates meeting rooms, common spaces, and some office/research areas Cryogenic electron microscopes in particular helped shape the design, as their extreme sensitivity to electromagnetic interference means they must be separated from services and elevators and require the use of non-ferrous materials. This resulted in a separate services and lift block covered in coal aluminum, connected to a glass research laboratory [110].

The research block to the north is visually distinct from the southern structure. This mass is supported by the crystalline volumes of the ground floor which contain specialized equipment. These crystal blocks, which can be seen from various pedestrian paths and gathering spaces on the site and the wider campus context, highlight the importance of the building. The east-west orientation of this block will result in long north and south facades. To take advantage of its passive solar design, custom U-framed glass facades on the portion of the structure housing the microscopes will eliminate the need for external solar shading devices through the use of a custom pattern. The two blocks are connected by a glass atrium containing meeting spaces.

4.2 RAM House or the Airplane Mode House Space Caviar RAM House

The RAM House or Airplane Mode House are groundbreaking architectural concepts created by Space Caviar, an Italian design research studio led by Joseph Grima and Tamar Shafrir. Space Caviar explores the intersection of architecture, technology, and culture, particularly examining how digital and network technologies transform our living spaces, cultural habits, and urban landscapes. RAM House is a model of dwelling that explores the home's response to a new definition of privacy in the age of sentient devices and signal-based communications. The home space is saturated with "smart" devices capable of monitoring its surroundings. The role of the home envelope as a shield from the outside gaze becomes irrelevant, as it is the house that watches the surroundings. RAM House proposes a space of selective electromagnetic autonomy. Within the core of the space, WiFi, mobile phone, and other radio signals are filtered by various moving shields of radar-absorbing materials (RAM) and mesh, preventing signals from entering and exiting. Just as a curtain can be drawn to visually reveal the interior of a traditional home, the panels can be opened to allow radio waves in and out, if desired. The RAM House is a proposal for coexistence with technology other than a constant virtual presence. The prototype of the RAM House allows the control of wireless signals entering or leaving the structure. The entire apartment is strictly fortified against electromagnetic fields. Architects used to be primarily concerned with issues of light, visual aesthetics, and maintaining a comfortable temperature – while also taking into account acoustic privacy. However, electromagnetics is beginning to materially impact the way we construct and manage the built environment [112].

In the case of the San Francisco apartment - the electromagnetic look of the house was achieved by applying heavy graphite-based paints to all interior surfaces. Conductive wire tape was then laid out in a large grid to connect the walls, floors, and ceilings. The windows were painted with transparent films resistant to electromagnetic fields. In general, these measures

prevent electromagnetic signals from entering the apartment. It's a living Faraday cage, an enclosure made of conductive materials, named after 19th-century inventor Michael Faraday who discovered how to block and redirect electric fields.

RAM House was an attempt to interrogate the role and function of the wall, beyond its structural purpose, in order to extend the creation of privacy. Space Caviar refers to "selective electromagnetic independence," and RAM's home made a more thoughtful compromise: some rooms would be completely sealed off from electromagnetic penetration, and other rooms would be left open like the WiFi equivalent of a covered screen. Designing to accommodate these signals suggests that another revolution in architecture is on the way, giving physical form to invisible forces and fundamentally rethinking the implications for future built environments.

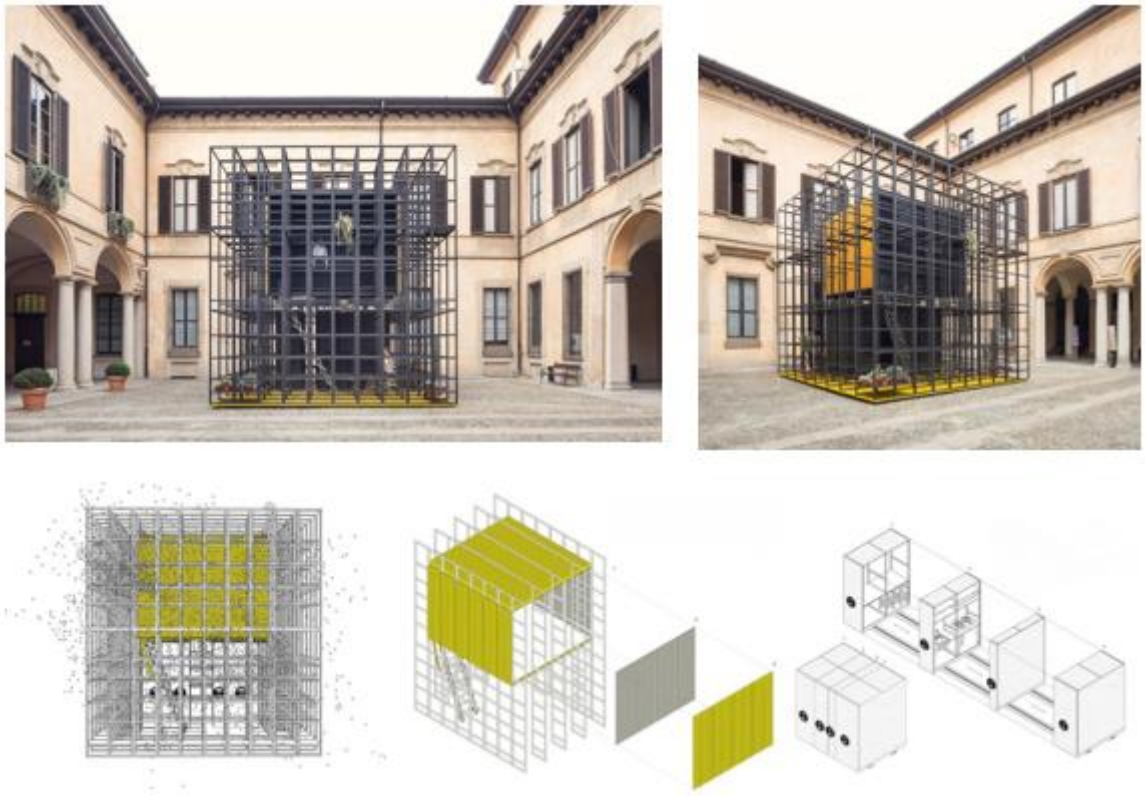

Figure 9. *RAM house or Airplane mode house building (space caviar) [112].*

Fig. 9 shows RAM house or Airplane mode house building (space caviar). It includes open house (free signal traffic material: none, open facade) and RSVP, which selected signal transmission material metal mesh, and Airplane Modem which is total signal silence material RF absorber foam. Fig. 9 also contains the cabinet modules.

4.3 National Security Agency Headquarters in Fort Meade, Maryland, US

The National Security Agency (NSA) Headquarters, located in Fort Meade, Maryland, is a distinctive complex in both function and architectural design, prioritizing security, resilience, and efficiency. Architecturally, the facility em- bodies a fortress-like aesthetic, with robust, modern structures that integrate advanced materials and security features designed to protect highly classified operations. The building is designed to hold sensitive information, which the agency processes and secures inside the building. The complex uses minimalist and geometric forms, which contribute to its commanding presence while emphasizing functionality and structural integrity. In line with its purpose, the design restricts visibility and public access, incorporating layered security perimeters and controlled access points. Additionally, the NSA Headquarters integrates technology within the architectural fabric to support its secure

communication and data processing needs, blending high-performance engineering with specialized architectural solutions tailored for national security operations. The design addresses the propagation of electromagnetic waves. One can recognize a smooth opaque facade that reflects light from the dark glass panels. Research says its interface doubles as a Faraday cage, protecting against eaves- dropping by various active and passive wireless spying techniques. Devices such as Leon Theremin's Thing (capacitive membrane + antenna) enabled remote listening by "illuminating" the antenna inside with a radio signal at the correct frequency [113]. The shielding was installed around the equipment and not the entire building, but electromagnetic shielding installations demonstrate how vulnerable buildings are to radiation. The contradiction between architecture as a shelter from the weather and from electromagnetic radiation appears.

The electromagnetic radiation can be seen by eyes as the light [76]. Specifically, unlike light - the only way signal propagation can be visualized is through hardware and software tools capable of measuring and representing signal values in a tangible way. Professional signal monitoring tools can produce heat maps, representing more complex situations on multiple levels.

It is clear from the heat map that walls and spatial configuration affect the propagation of wireless signals. The headquarters of the NSA, located at Fort Meade in Maryland, is a high-security complex at the heart of U.S. intelligence and cybersecurity efforts. Known for its highly secure and restricted infrastructure, this facility houses numerous specialized buildings, each designed to support classified operations, data processing, and cybersecurity research.

The architectural design of the NSA headquarters is centered around maximizing both security and discretion. The buildings are clad in dark glass facades that mask internal operations while incorporating electromagnetic shielding (or Faraday cage technology) to prevent signal leakage, thus securing the agency's sensitive communications and blocking digital and radio transmissions from external interception. Tasked with signals intelligence (SIGINT), the NSA intercepts, analyzes, and processes foreign communications to protect U.S. interests. In addition, the agency is a leader in cybersecurity, working to safeguard government networks against cyber threats and continually advancing protocols for secure information management.

Supporting its mission, the NSA's data infrastructure includes high-performance data centers and supercomputers capable of real-time analysis, where artificial intelligence and advanced algorithms help to detect potential threats. The NSA's operations have long been at the center of public discussion, especially after the 2013 leaks by former contractor Edward Snowden, which raised questions on privacy versus national security. This incident spurred legislative reform on surveillance practices, yet the NSA maintains considerable intelligence-gathering authority. The agency also pioneers research in encryption and cybersecurity protocols that set global standards, further expanding its role to support both federal and private entities in defending critical infrastructure against cyber threats.

With the emergence of quantum computing, the NSA faces new security challenges, as quantum technology could undermine traditional encryption methods. To address this, the agency is actively pursuing the development of quantum- resistant encryption. Meanwhile, AI and machine learning are being integrated into NSA operations, accelerating the detection and analysis of security threats. The NSA headquarters thus stands as a model for secure government facility design, balancing advanced operational needs with stringent electronic and phys- ical safeguards—a design approach that sets a benchmark for both government and high-security private sector buildings.

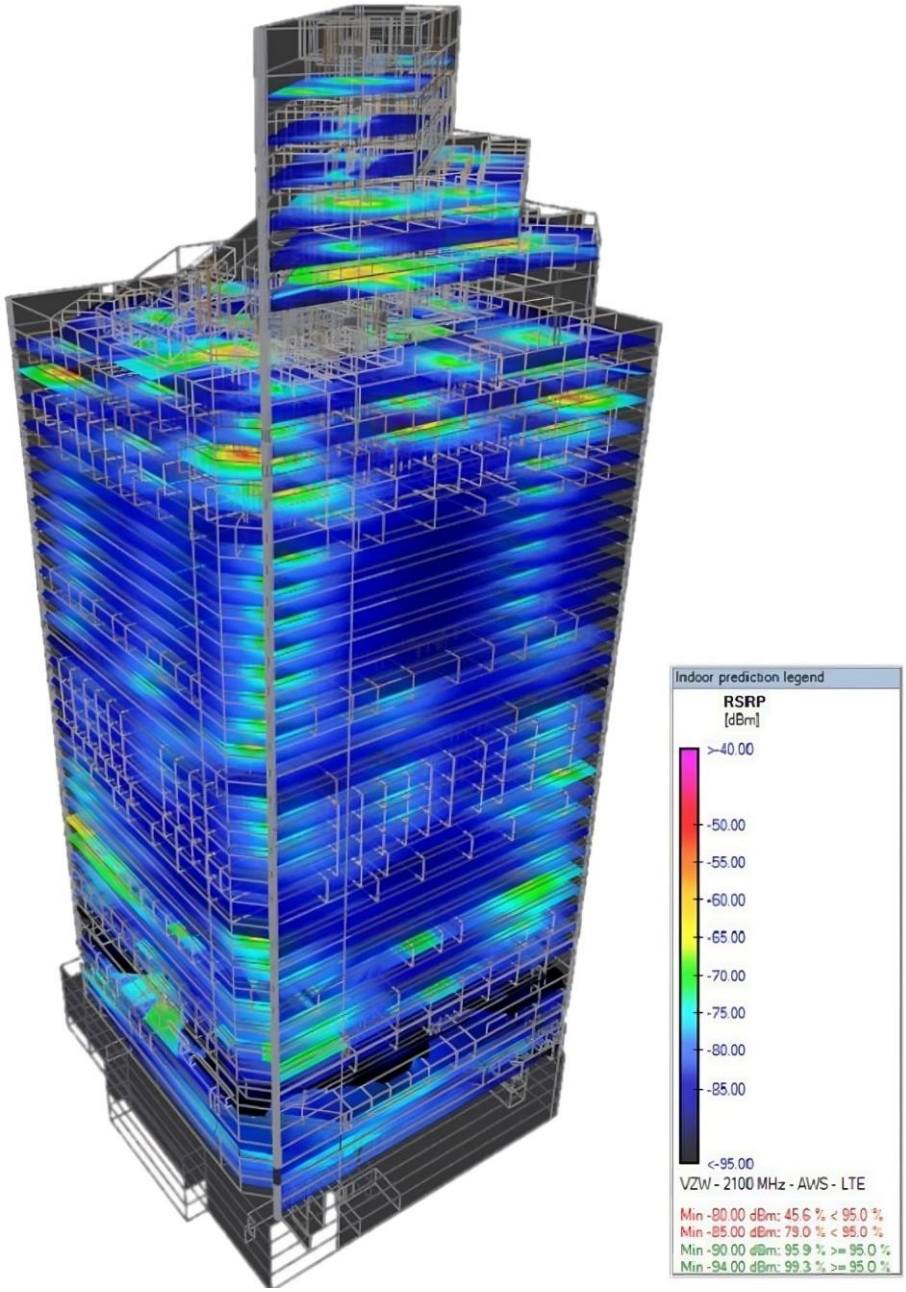

Figure 10. *Visualization of wireless communication signal measurements: LTE AWS RSRP I-DAS Heat Map for a 42-story building (iBwave design) [114].*

Figure 11. *NSA headquarters [114].*

5. Conclusion and Future Work

In this paper, we have developed a comprehensive framework connecting quantum energy and perception within architectural spaces. First, we established essential concepts, including energy's role in architecture and the nature of perception in shaping spatial awareness and human engagement within environments. We then discussed the impact of quantum energy on architectural dynamics, examining how quantum principles interact with spatial design. In exploring perception, we examined how architectural forms and senses influence user experience, followed by an analysis of energy behavior in shaping human interaction with space. This progression offers a structured perspective on how architecture can integrate quantum energy to actively shape perceptual experiences. In addition, we provided practical insights by examining the use of Earth's electromagnetic energy lines in facade design and reviewed case studies where such considerations have already been applied. This research thus presented an understanding of how quantum and electromagnetic energy principles can enhance architectural design.

We found that analyzing the magnetic levels through sensor technology, alongside a thorough site assessment, can reveal critical insights into magnetic current pathways, underscoring the significance of site-specific factors in architectural design. A thorough analysis is required to shape the concept and establish a project process that can adeptly navigate the intricate creative land- scape, potentially leading to the formation of an entirely new reality. Besides, we have found that in building design, understanding how to gather both urban and ordinary data is essential and holds equal importance to the design itself. Furthermore, establishing criteria for the detailed use distribution within the urban fabric requires comprehensive data on underground streams, green zones, parking facilities, and road networks—elements essential to an energy-aware architectural strategy that resonates with the quantum perspective. In addition, this research found that the magnetic analysis standard should not conflict with the initial idea of the design, because it should be integrated with the structure of the building after distinguishing other uses. We found that from an architectural standpoint, the idea of mutual influence between the building and its user can brought to new dimensions that are not limited only to the limits of human perception, but also to the energetic impact of the space used.

Future research may consider the development of materials and structures that harness quantum phenomena, potentially allowing buildings to self-regulate their energy use or transform according to environmental demands. This integration of quantum physics into architectural practice could ultimately lead to a new paradigm in sustainable design, one where energy flows within a space mirror the subtle interactions seen at the quantum scale. Embracing these concepts could bridge science and architecture, pioneering a field that redefines how we perceive and construct energy-conscious environments.

References

1. J. McArthur and C. Powell, "Health and wellness in commercial build- ings: Systematic review of sustainable building rating systems and align- ment with contemporary research," Building and environment, vol. 171, p. 106635, 2020.
2. Y. Li, Y. Rong, U. M. Ahmad, X. Wang, J. Zuo, and G. Mao, "A compre- hensive review on green buildings research: bibliometric analysis during 1998–2018," Environmental Science and Pollution Research, vol. 28, pp. 46 196–46 214, 2021.
3. S. Altomonte, J. Allen, P. M. Bluyssen, G. Brager, L. Heschong, A. Loder, S. Schiavon, J. A. Veitch, L. Wang, and P. Wargocki, "Ten questions con- cerning well-being in the built environment," Building and Environment, vol. 180, p. 106949, 2020.

4. A. J. Marszal, P. Heiselberg, J. S. Bourrelle, E. Musall, K. Voss, I. Sartori, and A. Napolitano, "Zero energy building–a review of definitions and cal- culation methodologies," Energy and buildings, vol. 43, no. 4, pp. 971–979, 2011.
5. A. Prochorskaite and V. Maliene, "Health, well-being and sustain- able housing," International Journal of Strategic Property Management, vol. 17, no. 1, pp. 44–57, 2013.
6. M. Dovjak and A. Kukec, Creating healthy and sustainable buildings: an assessment of health risk factors. Springer Nature, 2019.
7. M. Awada, B. Becerik-Gerber, S. Hoque, Z. O'Neill, G. Pedrielli, J. Wen, and T. Wu, "Ten questions concerning occupant health in buildings during normal operations and extreme events including the covid-19 pandemic," Building and Environment, vol. 188, p. 107480, 2021.
8. A. Borisuit, F. Linhart, J.-L. Scartezzini, and M. Mu¨nch, "Effects of real- istic office daylighting and electric lighting conditions on visual comfort, alertness and mood," Lighting Research & Technology, vol. 47, no. 2, pp. 192–209, 2015.
9. M. Boubekri, J. Lee, P. MacNaughton, M. Woo, L. Schuyler, B. Tinianov, and U. Satish, "The impact of optimized daylight and views on the sleep duration and cognitive performance of office workers," International jour- nal of environmental research and public health, vol. 17, no. 9, p. 3219, 2020.
10. E. K. Hansen, T. Bjørner, E. Xylakis, and M. Pajuste, "An experiment of double dynamic lighting in an office responding to sky and daylight: Perceived effects on comfort, atmosphere and work engagement," Indoor and Built Environment, vol. 31, no. 2, pp. 355–374, 2022.
11. W. W. Nazaroff, "Residential air-change rates: A critical review," Indoor Air, vol. 31, no. 2, pp. 282–313, 2021.
12. S. K. Adhikary, Zˇ. Rudˇzionis, and D. Vaiˇciukyniene˙, "Development of flowable ultra-lightweight concrete using expanded glass aggregate, silica aerogel, and prefabricated plastic bubbles," Journal of Building Engineer- ing, vol. 31, p. 101399, 2020.
13. S. Chen, G. Zhang, X. Xia, S. Setunge, and L. Shi, "A review of internal and external influencing factors on energy efficiency design of buildings," Energy and Buildings, vol. 216, p. 109944, 2020.
14. H. Samanta, R. Maity, S. Laha, and P. K. Talapatra, "A review on energy- efficient building," Advances in Air Conditioning and Refrigeration: Select Proceedings of RAAR 2019, pp. 257–268, 2021.
15. J. J. Hess, J. Z. McDowell, and G. Luber, "Integrating climate change adaptation into public health practice: using adaptive management to in- crease adaptive capacity and build resilience," Environmental health per- spectives, vol. 120, no. 2, pp. 171–179, 2012.
16. J. Andres, "Adaptive human bodies and adaptive built environments for enriching futures," Frontiers in Computer Science, vol. 4, p. 931973, 2022.
17. T. C. Bosch, M. Wigley, B. Colomina, B. Bohannan, F. Meggers, K. R. Amato, M. B. Azad, M. J. Blaser, K. Brown, M. G. Dominguez-Bello et al., "The potential importance of the built-environment microbiome and its impact on human health," Proceedings of the National Academy of Sciences, vol. 121, no. 20, p. e2313971121, 2024.
18. C. McGinty, "Meq-enhanced renewable energy systems: Optimizing sus- tainability with quantum insights," IJTC Physics, vol. 5, no. 3, pp. 1–3, 2024.
i. S. S. Gill, O. Cetinkaya, S. Marrone, E. F. Combarro, D. Claudino, D. Haunschild, L. Schlote, H. Wu, C. Ottaviani, X. Liu et al., "Quan- tum computing: Vision and challenges," arXiv preprint arXiv:2403.02240, 2024.
19. A. Ahmad, A. B. Altamimi, and J. Aqib, "A reference architecture for quantum computing as a service," Journal of King Saud University- Computer and Information Sciences, vol. 36, no. 6, p. 102094, 2024.

20. M. Caleffi, M. Amoretti, D. Ferrari, J. Illiano, A. Manzalini, and A. S. Cacciapuoti, “Distributed quantum computing: a survey,” Computer Net- works, vol. 254, p. 110672, 2024.
21. P. Kashyap, Applied Quantum Computers: Learn about the Concept, Ar- chitecture, Tools, and Adoption Strategies for Quantum Computing and Artificial Intelligence (English Edition). BPB Publications, 2023.
22. S. Tull, R. A. Shaikh, S. S. Zemljiˇc, and S. Clark, “From conceptual spaces to quantum concepts: formalising and learning structured concep- tual models,” Quantum Machine Intelligence, vol. 6, no. 1, p. 21, 2024.
23. C. E. Robertson and S. Baron-Cohen, “Sensory perception in autism,” Nature Reviews Neuroscience, vol. 18, no. 11, pp. 671–684, 2017.
24. M. Parker, D. H. Spennemann, and J. Bond, “Sensory perception in cultural studies—a review of sensorial and multisensorial heritage,” The Senses and Society, vol. 19, no. 2, pp. 231–261, 2024.
25. A. Rapoport, Human aspects of urban form: towards a man—environment approach to urban form and design. Elsevier, 2013.
26. M. Carmona, Public places urban spaces: The dimensions of urban design. Routledge, 2021.
27. Q. Li, L. Mou, Y. Sun, Y. Hua, Y. Shi, and X. X. Zhu, “A review of building extraction from remote sensing imagery: Geometrical structures and semantic attributes,” IEEE Transactions on Geoscience and Remote Sensing, 2024.
28. S. Abdel-Hamid, “Aesthetic preference-a study in the psychology of artis- tic appreciation,” The World of Knowledge Series, 1986.
29. H. H. G. Al-Jubouri, “The aestheticof balance and its relationship to the design of the industrial product shape,” Al-Academy, pp. 125–148, 2023.
30. X. Chen, Y. Liu, S. Li, and W. Sun, “Sensory perception mechanism for preparing the combinations of stimuli operation in the architectural experience,” Sustainability, vol. 14, no. 13, p. 7885, 2022.
31. A. Kudaligama and C. Udawattha, “Exploring building materials: human skin as a sensory reference in the absence of visual cues,” Frontiers in Built Environment, vol. 10, p. 1431780, 2024.
32. G. Chinazzo, J. Wienold, and M. Andersen, “Effect of indoor temperature and glazing with saturated color on visual perception of daylight,” Leukos, vol. 17, no. 2, pp. 183–204, 2021.
33. M. R. Shirazi, “On phenomenological discourse in architecture,” Environ- mental and architectural phenomenology, vol. 23, no. 3, pp. 11–15, 2012.
34. T.-Y. Chung, “A study on the background and characteristics of pallas- maa’s architectural phenomenology,” Korean Institute of Interior Design Journal, vol. 24, no. 2, pp. 42–49, 2015.
35. M.-K. Lee, “Study on characteristics of body sense in contemporary ar- chitectural design-focused on works of herzog & de meuron, steven holl, peter zumthor, kuma kengo,” Korean Institute of Interior Design Journal, vol. 24, no. 1, pp. 82–92, 2015.
36. R. McCarter, The space within: Interior experience as the origin of archi- tecture. Reaktion books, 2016.
37. C. Spence, “Senses of place: architectural design for the multisensory mind,” Cognitive research: principles and implications, vol. 5, no. 1, p. 46, 2020.
38. M. Zallio and P. J. Clarkson, “Inclusion, diversity, equity and accessibil- ity in the built environment: A study of architectural design practice,” Building and Environment, vol. 206, p. 108352, 2021.
39. K. Lee, “The interior experience of architecture: An emotional connection between space and the body,” Buildings, vol. 12, no. 3, p. 326, 2022.

40. J. Pallasmaa, The eyes of the skin: Architecture and the senses. John Wiley & Sons, 2024.
41. T. Deckker and G. Murray, “A new type of architecture exhibition; em- pathies between mackintosh and holl in glasgow,” arq: Architectural Re- search Quarterly, vol. 18, no. 2, pp. 101–105, 2014.
42. J. Reynolds, “Jessica reynolds on the royal academy’s sensing spaces: Architecture reimagined exhibition,” ARQ-ARCHITECTURAL RE- SEARCH QUARTERLY, vol. 18, no. 1, pp. 85–87, 2014.
43. Y.-c. Jeon, D.-s. Kim, and H. Song, “A study on the simulated surface effect in contemporary architecture: The relationship between simulacra and digital fabrication technology,” Journal of Asian Architecture and Building Engineering, vol. 14, no. 1, pp. 25–32, 2015.
44. A. Andrasek, “Xenocells: In the mood for the unseen,” Architectural De- sign, vol. 86, no. 6, pp. 90–95, 2016.
45. M. Behrens, “Sentiment architectures as vehicles for participation,” Ar- chitectural Design, vol. 87, no. 1, pp. 98–103, 2017.
46. J. D. Cho, “A study of multi-sensory experience and color recognition in visual arts appreciation of people with visual impairment,” Electronics, vol. 10, no. 4, p. 470, 2021.
47. L. Cavazos Quero, C.-H. Lee, and J.-D. Cho, “Multi-sensory color code based on sound and scent for visual art appreciation,” Electronics, vol. 10, no. 14, p. 1696, 2021.
48. Z. Li, J. Zhang, M. Li, J. Huang, and X. Wang, “A review of smart design based on interactive experience in building systems,” Sustainability, vol. 12, no. 17, p. 6760, 2020.
49. K. Alanne and S. Sierla, “An overview of machine learning applications for smart buildings,” Sustainable Cities and Society, vol. 76, p. 103445, 2022.
50. K. H. Lam, W. M. To, and P. K. Lee, “Smart building management system (sbms) for commercial buildings—key attributes and usage intentions from building professionals’ perspective,” Sustainability, vol. 15, no. 1, p. 80, 2022.
51. X. Chen, W. Duan, Y. Liu, S. Li, and G. Song, “The influence of material and spatial size on indoor environment preference evaluation,” Journal of Asian Architecture and Building Engineering, pp. 1–11, 2023.
52. N. Armaroli and V. Balzani, “The future of energy supply: challenges and opportunities,” Angewandte Chemie International Edition, vol. 46, no. 1-2, pp. 52–66, 2007.
53. Z. Lou, R. Li, J. Liu, Q. Wang, Y. Zhang, and Y. Li, “Used dye adsorbent derived n-doped magnetic carbon foam with enhanced electromagnetic wave absorption performance,” Journal of Alloys and Compounds, vol. 854, p. 157286, 2021.
54. A. Wafik, A. Abdin, and I. Karim, “Assessment of electromagnetic fre- quencies in office spaces,” Journal of Al-Azhar University Engineering Sector, vol. 17, no. 63, pp. 653–666, 2022.
55. A. H. Suwaidan, I. R. Al-Marsi, I. S. M. S. Al-Baydaq, and S. S. Noman, “Interior design strategies to protect against the hazards of electromag- netic pollution,” Journal of Arts & Applied Sciences (JAAS), vol. 11, no. 3, pp. 57–82, 2024.
56. S. Soltani and N. Kirci, “Phenomenology and space in architecture: ex- perience, sensation and meaning,” International Journal of Architectural Engineering Technology, vol. 6, pp. 1–6, 2019.
57. Y. Han, C. Qin, L. Xiao, and Y. Ye, “The nonlinear relationships between built environment features and urban street vitality: A data-driven explo- ration,” Environment and Planning B: Urban Analytics and City Science, vol. 51, no. 1, pp. 195–215, 2024.
58. A. C. Michalos et al., Encyclopedia of quality of life and well-being re- search. Springer Netherlands Dordrecht, 2014, vol. 171.
59. S. Caan, Rethinking design and interiors: Human beings in the built en- vironment. Hachette UK, 2011.

60. D. G¨ok¸cen and M. O¨ zbayraktar, “Integrating space syntax and system dynamics for understanding and managing change in rural housing mor- phology: a case study of traditional village houses in du¨zce, tu¨rkiye,” Environment, Development and Sustainability, pp. 1–29, 2024.
61. W. Pei, X. Guo, and T. Lo, “Pre-evaluation method of the experiential architecture based on multidimensional physiological perception,” Journal of Asian Architecture and Building Engineering, vol. 22, no. 3, pp. 1170– 1194, 2023.
62. C. Villeneuve, A. Hashmi, I. Ylivinkka, E. Lawson-Keister, Y. A. Mirosh- nikova, C. P´erez-Gonz´alez, S.-M. Myllym¨aki, F. Bertillot, B. Yadav, T. Zhang et al., “Mechanical forces across compartments coordinate cell shape and fate transitions to generate tissue architecture,” Nature Cell Biology, vol. 26, no. 2, pp. 207–218, 2024.
63. T. Montanez, “An architecture of dimensions: 2d, 3d, 4d, etc.” 2014.
64. K. W. Wright, “Binocular vision and introduction to strabismus,” in Pe- diatric ophthalmology and strabismus. Springer, 2003, pp. 144–156.
65. H. C. G´omez-Tone, J. Bustamante Escapa, P. Bustamante Escapa, and J. Martin-Gutierrez, “The drawing and perception of architectural spaces through immersive virtual reality,” Sustainability, vol. 13, no. 11, p. 6223, 2021.
66. X. Kong, H. Ma, J. Kang, and C. Wang, “Acoustics perception in special- shaped spaces: A systematic review,” Buildings, vol. 14, no. 2, p. 337, 2024.
67. R. Weber, On the aesthetics of architecture: a psychological approach to the structure and the order of perceived architectural space. Taylor & Francis, 2024.
68. T. Brosch, G. Pourtois, and D. Sander, “The perception and categorisa- tion of emotional stimuli: A review,” Cognition and emotion, pp. 76–108, 2010.
69. Q. Chen, T. Kalpoe, and J. Jovanova, “Design of mechanically intelligent structures: Review of modeling stimuli-responsive materials for adaptive structures,” Heliyon, 2024.
70. J. Wang, L. Jiang, H. Yu, Z. Feng, R. Castan˜o-Rosa, and S.-j. Cao, “Com- puter vision to advance the sensing and control of built environment to- wards occupant-centric sustainable development: A critical review,” Re- newable and Sustainable Energy Reviews, vol. 192, p. 114165, 2024.
71. K. Thoring, P. Desmet, and P. Badke-Schaub, “Creative environments for design education and practice: A typology of creative spaces,” Design Studies, vol. 56, pp. 54–83, 2018.
72. F. Utama and D. Daryanto, “Identification of architectural functions in a four-dimensional space,” ComTech: Computer, Mathematics and Engi- neering Applications, vol. 3, no. 1, pp. 59–68, 2012.
73. C. O. Mmo, “The hazards of building in the vicinity of electromagnetic fields: Lessons for building code enforcement in nigeria,” 2019.
74. J. Bhattacharjee and S. Roy, “Smart materials for sustainable energy,” Nat Resour Conserv Res, vol. 7, p. 5536, 2024.
75. K. M. F. Youssef and I. M. Askar, “Sick building syndrome experimental study on the effect of bio geometry design on electromagnetic (wi fi) waves in architectural spaces,” HBRC Journal, vol. 20, no. 1, pp. 483–503, 2024.
76. S. M. Reddy, D. Chakrabarti, and S. Karmakar, “Emotion and interior space design: an ergonomic perspective,” Work, vol. 41, no. Supplement 1, pp. 1072–1078, 2012.
77. M. S. M. Subri, K. Arifin, M. F. A. M. Sohaimin, and A. Abas, “The parameter of the sick building syndrome: A systematic literature review,” Heliyon, 2024.
78. I. L. Niza, M. P. de Souza, I. M. da Luz, and E. E. Broday, “Sick building syndrome and its impacts on health, well-being and productivity: A sys- tematic literature review,” Indoor and Built Environment, vol. 33, no. 2, pp. 218–236, 2024.

79. I. Morawska, K. Anielska, J. Gadecki, and L- . Afeltowicz, "Changes in urban fabric–a cause or a result of an innovation district?" Journal of Ur- banism: International Research on Placemaking and Urban Sustainability, vol. 17, no. 1, pp. 89–110, 2024.
80. A. Salehi and N. Nasrollahi, "Assessing vegetation distribution based on geometrical and morphological characteristics of the urban fabric to pro- vide thermal comfort for pedestrians: A case study in sanandaj," Sustain- able Cities and Society, vol. 104, p. 105297, 2024.
81. U. Matthew, K. Bakare, D. Oyekunle, A. Nkeiruka, and G. Ebong, "Envi- ronmental health ecosystem sustainability in the era of electromagnetic ra- diation contamination," J Comm Med and Pub Health Rep, vol. 5, no. 02, 2024.
82. A. E. Ubhenin, J. Isabona, F. Anura, and R. I. Idris, "Unraveling the impact of electromagnetic radiation on human health: A comprehensive review," African Journal of Pharmaceutical Research and Development, vol. 16, no. 1, pp. 91–99, 2024.
83. S. M. Awrang, S. A. Obaidi, and S. Sami, "The side effects of electromag- netic waves on human health: A comprehensive review," British Journal of Physics Studies, vol. 2, no. 1, pp. 01–10, 2024.
84. J. Abu Qadourah and S. Alnusairat, "Integrating aesthetics and sustain- ability: evaluating the aesthetic perception of photovoltaic installation on the apartment building fa¸cade in jordan," Archnet-IJAR: International Journal of Architectural Research, 2024.
85. R. Penrose and S. Hameroff, "Consciousness in the universe: Neuroscience, quantum space-time geometry and orch or theory," Journal of Cosmology, vol. 14, pp. 1–17, 2011.
86. A. Messiah, Quantum mechanics. Courier Corporation, 2014.
87. B. J. Baars and D. B. Edelman, "Consciousness, biology and quantum hypotheses," Physics of life reviews, vol. 9, no. 3, pp. 285–294, 2012.
88. A. Melo, "Reflexiones en torno a la conciencia y las experiencias cercanas a la muerte," Open Archives, vol. 12, p. 2012, 2012.
89. M. Izquierdo-Aymerich and A. Adu´riz-Bravo, "Physical construction of the chemical atom: Is it convenient to go all the way back?" Science & Education, vol. 18, pp. 443–455, 2009.
90. M. Palme, A. Isalgue, H. Coch, and R. Serra, "Robust design: A way to control energy use from human behavior in architectural spaces," in Proceedings of the PLEA Conference, 2006, p. 1.
91. V. L. Erickson, Y. Lin, A. Kamthe, R. Brahme, A. Surana, A. E. Cerpa, M. D. Sohn, and S. Narayanan, "Energy efficient building environment control strategies using real-time occupancy measurements," in Proceed- ings of the first ACM workshop on embedded sensing systems for energy- efficiency in buildings, 2009, pp. 19–24.
92. T. L. Dawson, "Beyond the visible: ultraviolet and infrared radiation," Review of Progress in Coloration and Related Topics, vol. 35, no. 1, pp. 31–41, 2005.
93. A. M. Syed and C. Hachem, "Review of construction; geometry; heat- ing, ventilation, and air-conditioning; and indoor climate requirements of agricultural greenhouses," Journal of Biosystems Engineering, vol. 44, pp. 18–27, 2019.
94. W. Gunn and C. Clausen, "Conceptions of innovation and practice: De- signing indoor climate," in Design Anthropology. Routledge, 2020, pp. 159–179.
95. M. Hofmann, C. Geyer, and O. Kornadt, "Indoor climate measurements in buildings and design functions for building simulations," in IOP Con- ference Series: Materials Science and Engineering, vol. 960, no. 4. IOP Publishing, 2020, p. 042029.
96. E. Arens, T. Hoyt, X. Zhou, L. Huang, H. Zhang, and S. Schiavon, "Mod- eling the comfort effects of short-wave solar radiation indoors," Building and Environment, vol. 88, pp. 3–9, 2015.
97. A. Luna Navarro, J. Diego Blanco Cadena, F. Favoino, M. Donato, T. Poli, M. Perino, and M. Overend, "Occupant-centred control strategies for adaptive facades: preliminary

study of the impact of shortwave solar radi- ation on thermal comfort," in Building Simulation 2019, vol. 16. IBPSA, 2019, pp. 4910–4917.
98. A. Banyal, D. Singh, and R. Kumar, "5 bioclimatic building technology," Thermal Evaluation of Indoor Climate and Energy Storage in Buildings, p. 126, 2024.
99. P. Wang, Y. Yang, C. Ji, and L. Huang, "Influence of built environment on building energy consumption: a case study in nanjing, china," Envi- ronment, Development and Sustainability, vol. 26, no. 2, pp. 5199–5222, 2024.
100. Pavlospieridis. Magnetism. [Online]. Available: https://nocloudinthesky.wordpress.com/2015/01/27/magnetism/
101. P. Campbell, "Permanent magnet materials and their application," 1996.
102. J. Ebbing, C. Braitenberg, and S. Wienecke, "Insights into the lithospheric structure and tectonic setting of the barents sea region from isostatic considerations," Geophysical Journal International, vol. 171, no. 3, pp. 1390–1403, 2007.
103. Future Architecture. Electromagnetism structure: Architecture that grows and disappears into action of homo mobilis. [Online]. Avail- able: https://futurearchitectureplatform.org/projects/8db6e6e6-7bb4- 47e9-9dec-c5b045b53bfa/
104. A. S. Y. Mohamed, "Smart materials innovative technologies in architec- ture; towards innovative design paradigm," Energy Procedia, vol. 115, pp. 139–154, 2017.
105. A. Aksamija, Integrating innovation in architecture: Design, methods and technology for progressive practice and research. John Wiley & Sons, 2017.
106. M. Sobczyk, S. Wiesenhu¨tter, J. R. Noennig, and T. Wallmersperger, "Smart materials in architecture for actuator and sensor applications: A review," Journal of Intelligent Material Systems and Structures, vol. 33, no. 3, pp. 379–399, 2022.
107. A. Z. Aydemir and S. Jacoby, "Architectural design research in small prac- tices," Archnet-IJAR: International Journal of Architectural Research, vol. 18, no. 1, pp. 191–205, 2024.
108. J. Ivanovi´c-Sˇekularac, J. Cˇiki´c-Tovarovi´c, and N. Sˇekularac, "Application of wood as an element of fa¸cade cladding in construction and reconstruc- tion of architectural objects to improve their energy efficiency," Energy and Buildings, vol. 115, pp. 85–93, 2016.
109. Archdaily. The University of Wollongong AIIM / SKM - S2F. [Online]. Available: https://www.archdaily.com/242297/the-university- of-wollongong-aiim-skm-s2f
110. University of Wollongong. Molecular Horizons Build- ing at the University of Wollongong. [Online]. Available: https://richardcrookes.com.au/tag/uow/
111. Space Caviar. RAM house or Airplane mode house building (space caviar). [Online]. Available: https://archeyes.com/ram-house-or-the- airplane-mode-house-space-caviar/
112. B. B. Fischer, "Leon theremin—cia nemesis," Studies in Intelligence, vol. 46, pp. 29–39, 2010. digicult. Architecture: Between Weather and Electromagnetic Radiation. [Online]. Available: https://digicult.it/news/architettura-tra-condizioni- atmosferiche-e-radiazioni-elettromagnetiche-parte-2/