

The Architectural Design Strategies That Promote Attention to Foster Mindfulness: A Systematic Review, Content Analysis and Meta-Analysis

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Abstract: Attention is a pivotal component and a central vehicle of mindfulness, a psychological factor improving mental health. Despite architecture's potential to encourage attention and mindfulness, there is still a research gap. This study aimed to investigate architectural design strategies that promotes attention in order to foster mindfulness. The research was carried out in three primary stages. The first step entailed conducting a systematic review by searching publications related to architecture that promotes attention from Scopus in February 2024. After considering the suitability and accessibility, 32 articles were included. No studies were found to have investigated the field of enhancing mindfulness. The second step utilized content analysis to decode the selected articles using a framework developed from literature reviews. All three coders decoded the data independently, allowing the main researcher to compile it into the final dataset. Finally, the data underwent Python meta-analysis for word frequency and association. The result revealed certain qualities that help achieve attention through architecture. The architectural atmosphere is most effective when it features natural forms and spaces that evoke a sense of enclosure. The lighting should emphasize natural light and uniformity, whereas the sound designs primarily concern acoustics, ambient, and noises, with controlled weather emphasizing air aspects. The building should utilize natural materials and incorporate object elements; the facade and entrance are particularly crucial components. Moreover, the colors of brick and green and views encompassing gardens and vegetation are among the qualities mentioned. Based on the analysis, the material, view, and color features were most congruent with the biophilic design concept. All these factors are expected to foster mindfulness, thereby improving mental health.



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1. Introduction

According to the World Health Organization (WHO), approximately 280 million people worldwide are presently experiencing a state of depression [1]. One out of ten individuals is grappling with mental illness [2], and up to one-half of the population will encounter instances of a significant psychological ailment at some point in their lifespan [2–5]. The recent COVID-19 pandemic has worsened the mental well-being of the public through stress, anxiety, insomnia, panic, and depressive manifestations [6–18].

In order to cope with the psychological impact of the COVID-19 pandemic, mindfulness has received significant attention from the general public, major organizations, and certain governments [19–22]. The surge in interest in mindfulness was due to its effects as a psychological mechanism that plays a crucial role in mitigating negative emotions, stress,

anxiety, rumination, burnout, and depression [23,24]. Additionally, it promotes positive mental health [25–27], well-being, sleep quality, and overall quality of life [28,29].

The concept of mindfulness has ancient roots dating back over 25 centuries from Buddhist philosophy [30,31] and subsequently gained widespread recognition in the broader context in 1994 by Jon Kabat-Zinn’s dissemination [32–34]. Both contexts of mindfulness emphasize the cultivation of mindfulness through repetitive training, which requires a period of time [35,36]. Nevertheless, recent investigations revealed opportunities for immediate access to a state of mindfulness by drawing influence from environmental determinants, such as architecture [37–40].

Even though architecture tends to foster a state of mindfulness, explicit knowledge of architecture designed for mindfulness remains scarce [41,42]. Prior to this, we conducted a systematic literature review to gather scholarly knowledge regarding architecture and mindfulness, revealing a significant hiatus in this field [43]. In addition, we conducted content analysis on Instagram to examine a large dataset generated by laypeople. This analysis revealed that the architectural features that may induce a mindful state is inconclusive [44].

The literature review indicates that architectural characteristics can indirectly foster mindfulness states. Some scholars view the state of mindfulness as a multidimensional construct [45–47], dissecting it into several constituent elements, which include a moment of awareness, openness, focus, connection, and calmness [48–58]. Nevertheless, the factor often perceived as the pivotal component and a central vehicle of mindfulness [59–62], which can be augmented by architectural influences [63,64], is a sensory aspect called attention.

Attention is a vital aspect of cognitive control that has a significant impact on our mental well-being [65,66]. Individuals who cultivate attention are better equipped to regulate emotions and experience heightened serenity [67–69]. Conversely, people experiencing attentional fatigue tend to make suboptimal decisions [70,71]. According to the research, those with attentional bias may exhibit increased vulnerability to various mental disorders [72–74]. With attention demonstrating a pronounced correlation with human mental health, it emerges as a compelling variable for exploration in this study.

Following the discussion above, this research attempts to optimize human mental well-being by promptly eliciting a state of mindfulness via architectural means. However, it was found that the architectural elements conducive to inducing mindfulness remain ambiguous. The academic evidence suggests the feasibility of architecting features that indirectly cultivate mindfulness through attentional mechanisms. The recently published systematic literature review reveals an absence of substantial data on architectural design principles conducive to attentional enhancement [75]. Consequently, this study aims to bridge this knowledge gap by investigating the architectural design strategies that promotes attention with the indirect goal of fostering mindfulness. It is anticipated that these efforts will contribute to promoting human mental health.

To facilitate greater understanding for readers, we have compiled the keywords of this article as shown in Table 1.

Table 1. The definition of keywords in the article.

Keyword	Definition
Design strategy	The design direction and criteria for each component in building development [76,77].
Architecture	The art, technique, and discipline of designing buildings and spaces [78–80].
Attention	The focused cognitive process of relevant information while ignoring distractions [69,81,82].
Mindfulness	The temporary psychological state of paying attention to the present moment [35,50,83].

2. Literature Review

The design strategy of architecture refers to providing details for each architectural component to achieve the desired objectives [76,77]. Therefore, when seeking the architectural design strategy that promotes attention leading to mindfulness, the literature review

examines which architectural components are crucial for promoting attention for mindfulness. Subsequently, to obtain details of each component, the study investigates which architectural design concept is most likely to encourage attention and mindfulness effectively.

2.1. Architectural Components Influencing Attention in Order to Foster Mindfulness

With regard to architectural features, architectural atmospheres tend to have the highest potential to support attention, mainly when the goal is to promote mindfulness. The architectural atmosphere influences attention processing and is also associated with sustaining attention [64,84]. Furthermore, several pieces of research have also indicated that the architectural atmosphere itself is the component that supports mindfulness the most [57,85,86].

The architectural atmosphere comprises several architectural components [87]. Gernot Böhme and others have identified that the architectural atmosphere comprises form, space, light, color, sound, and view [88–90]. Some articles also emphasize that materials and objects are part of the atmosphere [86,91,92]. Some studies also specify that the weather and the sense of movement, which are intangible elements, are part of the architectural atmosphere [93].

The architectural components are organized by their relevancy and importance to the research subject, from the most relevant to the least relevant. The architectural atmosphere, which is significant for attention and mindfulness, comprises ten factors: form, space, movement, light, color, material, object, view, sound, and weather.

2.2. Architectural Concept Enhancing Attention in Order to Foster Mindfulness

Biophilic design is an architectural concept that effectively promotes attention and mindfulness. Biophilic design is the foundation of the architectural design concept that blends nature with the built environment, resulting in attention-restoration effects [94–96]. As evidenced by the study conducted by Raanaas et al. [97], having plants in the office space helps increase attention capacity in adults. The presence of indoor nature was proved to enhance self-reported attention in secondary education students [98]. A study in 2023 demonstrated that the components of biophilic design contribute to increased visual attention in preschool children [99]. Several research studies have found that biophilic design can support the cultivation of mindfulness in individuals [31,42].

The biophilic design appears to be defined in various ways [100]. As this study seeks to cultivate mindfulness through attention, it defines biophilic design based on prior research that outlined the attributes of biophilic architectural design associated with mindfulness [43,101].

When summarizing the characteristics of biophilic design according to the architectural atmosphere components outlined in Section 2.1, it can be explained that the space aspect of biophilic design is the exposure and connection to nature. The section on light encompasses natural light, daylight on the wall, white light, spotlight, light rays, darkness to light, hard light and shadow, and external light. Color refers to vivid hues in primary colors and color rays. In terms of material, natural materials such as wood, clay, and stone, as well as synthetic materials like concrete and highly tactile surface items, are found to be among the outlined aspects. The objects consist of three elements: an image reminding of nature, a word evoking nature, and a symbol representing nature. The view in biophilic architecture contains plants, trees, green spaces, natural landscapes, river views, rainwater, and immersive water features. Sound encompasses quiet environments, natural sounds, meditation bell chimes, soothing ambient noises, and Zen-style music. The information provided lacks details on the form, movement, and weather.

Based on the literature review, it can be concluded that the architectural design strategy, aimed at promoting attention with the indirect objective of nurturing mindfulness, involves designing components of the architectural atmosphere with biophilic design details. The characteristics of each component can be summarized by considering the views of the three architects, as presented in Table 2.

Table 2. The characteristics of biophilic architectural atmosphere.

Component		Characteristic	References
Form	None		[43,88–90,101]
Space		“Exposure to nature”, “Connection to nature”	[43,88–90,101]
Movement	None		[43,93,101]
Light		“Natural light”, “Daylight on wall”, “White light”, Spotlight, “Light ray”, “Darkness to light”, “Hard light and shadow”, “Light from outside”	[43,88–90,101]
Color		“Vivid hue in primary color”, “Color ray”	[43,88–90,101]
Material		Wood, Clay, Stone, Concrete, “Highly tactile”, Natural	[43,86,91,92,101]
Object		“Image of nature”, “Word of nature”, “Sign of nature”	[43,86,91,92,101]
View		Plant, Tree, Greenery, “Natural view”, “River view”, Rainwater, “Immersive water”	[43,88–90,101]
Sound		“Quiet environment”, “Natural sound”, “Meditation bell”, “Ambient noise”, “Zen music”	[43,88–90,101]
Weather	None		[43,93,101]

After conducting a literature review on the research subject, research question 1 is formulated to ensure that this study will focus on the most significant components, namely architectural atmosphere, as outlined in Section 2.1. Meanwhile, research question 2 is established to verify whether the characteristics of the discovered architectural atmosphere align with the biophilic design concept as described in Section 2.2. Both research questions are detailed as follows:

Q1: What are the characteristics of architectural atmospheres that tend to promote attention in order to foster mindfulness?

Q2: What degree of similarity exists between the architectural atmospheres that promote attention in order to foster mindfulness and the biophilic design concept?

3. Methodology

To investigate the architectural design strategy that promotes attention with the indirect goal of fostering mindfulness and in response to research inquiries, the research methodology of this study comprises the following three steps: systematic review, content analysis, and meta-analysis.

3.1. The Systematic Review

This study employs systematic reviews to fill the substantial gaps in academic research between architectural design and attention enhancement in order to foster mindfulness indirectly [102–104], as mentioned in Section 1. This method is particularly suitable for seeking improvement strategies in design efficiency [105,106], especially when gathering data from interdisciplinary fields beyond the scope of architectural design research [107].

The systematic review was conducted in February 2024. Scopus is the selected data source, as it is a commonly used academic database that serves as the largest repository of scholarly knowledge [105,106]. The search was conducted by employing specific keywords in titles, abstracts, and keywords [107]. To narrow down the search results, the search criteria were limited to documents published in English, classified as articles, reviews, conference papers, and conference reviews [108], and categorized under engineering containing content related to architecture [109].

To ensure that the design strategies aimed at promoting attention for fostering mindfulness in this study were synthesized accurately and transparently, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed [110–112].

To illustrate the four primary phases according to the PRISMA model, the data are compiled in Figure 1.

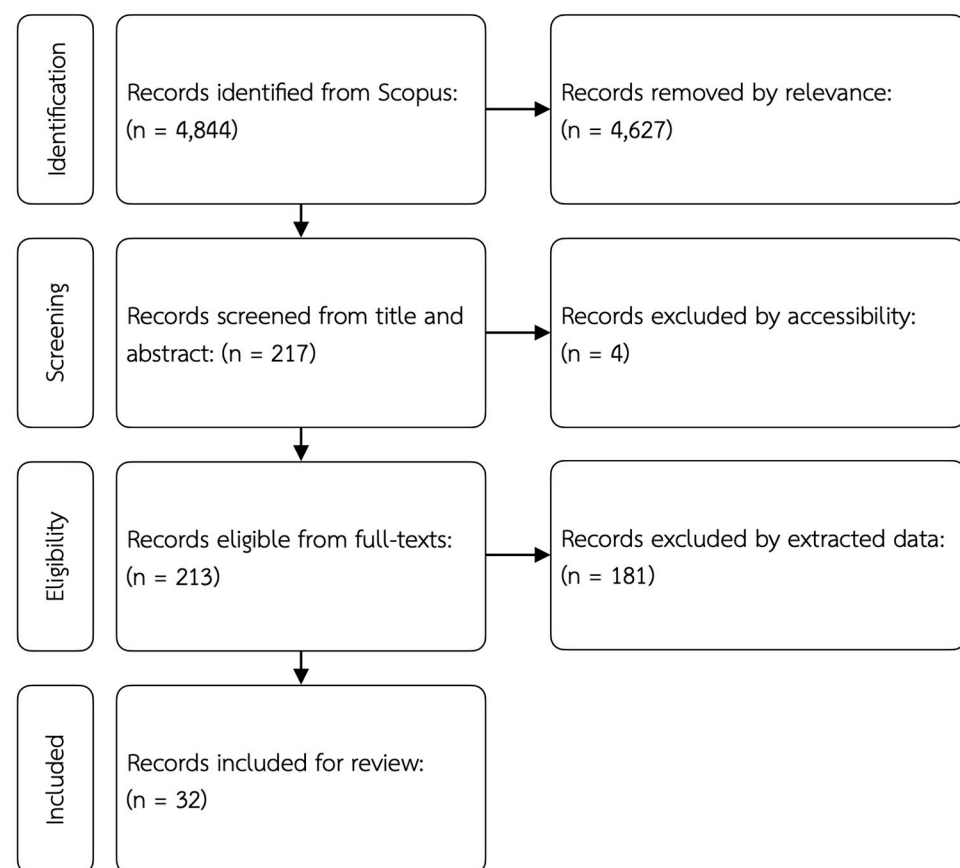


Figure 1. The PRISMA flow diagram of the systematic review.

Step 1. In the identification phase of this study, which aims to explore architectural design strategies trending toward promoting attention to foster mindfulness, a specific search was employed [113–115]. The selection of this method is based on considering this article as the first systematic review of architecture and attention. This approach utilizes at least one search term to focus on targeted queries [116–119]. This will serve as the foundation for future related studies. Thus, the terms “architecture” and “attention”, pertinent and widely used in the relevant field, are defined. The “AND” operator is utilized to search specifically for articles that contain both “architecture” and “attention”. The term “mindfulness” is not included in the search query due to a lack of related studies, which could result in overly narrow outcomes [41,42].

After conducting the specific search, it was found that there were a total of 4844 relevant publications. In this step, three undergraduate architecture students carried out and cross-checked the process for validity [120].

However, prior to recording the discovered documents, The research team examined the relevance of their content to ascertain whether they align with the research subject. For accuracy, one architecture graduate student reviewed the titles and abstracts of all articles, resulting in the exclusion of 4627 articles.

Step 2. In the screening phase, the 217 selected publications related to architecture will be examined for accessibility of content.

After screening, 4 articles were removed because the documents were the research subject or were inaccessible. The previously mentioned architecture graduate student was responsible for this step.

Step 3. In the eligibility phase, the primary researcher, along with a graduate student, assessed the suitability of the remaining 213 documents for alignment with the review’s objectives.

The 181 articles that do not contain content relevant to the architectural characteristics that support attention will be excluded.

Step 4. After careful consideration and discussion among the authors by the primary author, the including phase can conclude that 32 publications (See Appendix A) were included in this review.

As observed in numerous publications [116,121–123], the selected articles will be reported regarding their publication type and the year of publication. Then, the sources of the publications will be reported, comprising the names of the journals or conferences. This article will report on the relevance of the critical theme by discussing the types of architecture, aspects of attention, and references to mindfulness.

3.2. The Content Analysis

This step aims to compile architectural design strategies that enhance attention and foster mindfulness, extracted from selected articles in Section 3.1. Content analysis is utilized to decode the data because it can be integrated with systematic review to offer a clear procedural framework [124,125], ensuring structured analysis, increased reliability, replicability, and reduced bias in the research process [126–129].

According to the method of qualitative content analysis, a coding framework was developed from a literature review in Section 2 [130]. The codebook is divided into 12 columns. The first 10 rows represent the architectural atmosphere from Section 2.1, which includes form, space, movement, light, color, material, object, view, sound, and weather. The row before the last one is designated as ‘concept’ to gather data on architectural design concepts obtained from other articles for comparison with findings in Section 2.2. To avoid limiting data coding to the architectural components obtained from this literature review, an additional row labeled ‘other’ is added to allow coders to specify characteristics of architecture that cannot be categorized into other columns.

To ensure that all coders understand the compositions of each component as closely as possible, the main researchers specified the content relevant to each column. The details of each component were considered to encompass the summaries from the literature review, as outlined in Table 3.

Table 3. The compositions of each component.

Component	Composition
Form	Form, Shape, Size
Space	Space, Distance, Boundary
Movement	Movement, Circulation, Entrance
Light	Light, Shadow, Brightness
Color	Color, Color shade, Color tone, Color tint
Material	Material, Texture, Surface
Object	Object, Element, Decoration
View	View, Scenery, Landscape
Sound	Sound, Music, Noise
Weather	Weather, Temperature, Condition of the atmosphere
Concept	Concept, Style
Other	Others beyond what has been specified.

To confirm that the process in this step is conducted accurately and fairly, the method of triangulation with multiple researchers was utilized [120]. Filling the knowledge gap between architecture and mindfulness requires insights from experts in architecture, particularly architects [42]. In this step, the process is carried out by one professor of ar-

chitecture, one associate professor of architecture, and one architect who has completed a master's degree.

All three coders have thoroughly read all selected articles from Section 3.1. By considering and examining the architectural design strategies that enhance attention and mindfulness, as outlined in the coding framework. In this step, all readers have independently conducted their work without consulting each other to ensure genuine opinions from all three individuals [131,132].

For analyzing purposes, the main researcher compiled the dataset by considering the decoded data from all three coders without revisiting the full text to minimize bias. The consideration begins with selecting data that represents the majority opinion. Subsequently, the minority opinions are integrated if the researchers perceive them to align or resemble other selected characteristics.

Finally, the final dataset of architectural design strategies for promoting attention to enhance mindfulness derived from the previous studies can be summarized according to the categories outlined in Table 3.

3.3. The Meta-Analysis

The final step is conducted to derive conclusions from the final dataset obtained from Section 3.2. The meta-analysis, a statistical strategy [133,134], was conducted to aggregate findings from previous studies on the characteristics of an architectural design strategy that promotes attention [112,135], to serve as a guideline for promoting mindfulness. This analysis is divided into 2 steps in order to accurately address the research questions.

3.3.1. Word Frequency Analysis

To answer research question 1, we utilized word frequency analysis. This technique falls under the natural language processing (NLP) field, which concerns the use of artificial intelligence to manipulate and extract insights from textual data [136]. Word frequency analysis operates by converting a corpus of texts into a numerical matrix, which is then processed and analyzed quantitatively before being translated into insights [137]. In our study, text preprocessing techniques were applied, including converting all words to lowercase and removing punctuation and numerical characters. Additionally, stopwords, commonly occurring words devoid of contextual significance (e.g., "a", "of", "from") were eliminated to highlight words relevant to our investigation. Finally, we extracted word frequencies to identify the most frequently mentioned terms, thereby identifying them as pivotal themes.

The Python programming language served as our primary tool for conducting NLP tasks [138]. For theme extraction and visualization, we employed the CountVectorizer function from the Scikit-learn package [137] and the wordcloud function from the wordcloud package [139], respectively. After normalizing words in the document to their base form, we curated a list of customized stopwords tailored to our specific context, in addition to common stopwords. These included architecture, design, shape, form, space, light, color, object, view, sound, weather, and material, from Section 2.1 and the researcher's opinion. The rationale behind selecting these stopwords was to eliminate words that are inherent to the architectural discourse and may not contribute significant insights beyond their obvious association with the topic. Since the focus of our analysis is on architectural design, these terms, although frequently occurring, might not reveal any hidden patterns as they are expected within the context. Consequently, we opted to exclude them from our analysis to enhance the clarity of our findings.

After removing the stopwords, we performed the analysis by counting and visualizing all remaining words through both bar charts and word clouds, providing a holistic representation of the extracted common words and their frequencies. For the word cloud visualization, words that are mentioned more frequently are represented as larger in the cloud, indicating their greater quantitative importance. Conversely, words with fewer mentions and, thus lesser quantitative significance are depicted as smaller in the cloud.

This approach allows for an intuitive and visually meaningful representation of the relative importance of each common word within the analyzed text corpus, thereby formulating them into themes of each architectural component.

3.3.2. Word Association Analysis

To answer research question 2, we employed semantic distance analysis. The objective is to explore the semantic associations between the corpus extracted from the included article and keywords relevant to biophilic design. This NLP technique evaluates the degree of relationship between text elements by leveraging a common distributed representation (i.e., dictionary), such as Word2vec or Latent Semantic Analysis language models [136,140]. These language models are typically developed and trained on extensive datasets, such as entire English Wikipedia articles, the Touchstone Applied Science Associates (TASA) corpus, or even social media data from platforms like X (formerly known as Twitter) [136,140,141]. Among these models, global vectors for word representation (GloVe) have emerged as one of the most widely used due to their versatility [142,143]. The GloVe model has been trained on a vast vocabulary, ranging from 400,000 words in its lightest variant to 2.2 million in its largest variant, with a data source encompassing 2 billion tweets, indicating its extensive coverage [142]. The GloVe model exhibits comparable performance to other popular models while being less computationally demanding, particularly when utilizing its lighter variant [142]. Therefore, we opted for the GloVe algorithm for its practical implementation advantages.

The algorithm was implemented using the torchtext package in Python, designed to facilitate the utilization of pre-trained language models [144]. We employed the 400,000 words variant of the GloVe model [142]. Once the model was instantiated in the workspace, we leveraged its semantic space to assess the distance between keywords pertaining to biophilic design and the corpus derived from the included article. Biophilic design keywords conform to the specifications outlined in Table 2, eliminating sections with no data and adding characteristics of the concept design, defining what is meant by biophilic design.

We conducted quantitative association calculations at two levels: document-to-keyword (i.e., between each corpus and each keyword) and document-to-document (i.e., between all keyword corpora and all document corpora). Bar charts were generated at the document-to-word level to effectively convey the disparities in association between each keyword and the document corpus. In terms of interpretation, higher semantic distance values signify greater similarity between words or documents, indicating stronger semantic associations.

4. Results

According to the research methods in Section 3, the study results are divided into three parts: the results of systematic review, the outcomes of content analysis, and the findings of meta-analysis.

4.1. The Result of a Systematic Review

The selected articles will be shown regarding the types of architecture, aspects of attention, and the correlation with mindfulness in this section.

The selected studies [99,100,145–174] were published from 2011 to 2024. Interestingly, the first seven years of this period (2011–2017) saw only five published studies, with 60% ($n = 3$) of them appearing in conference papers and the remaining 40% ($n = 2$) in articles. However, the latter six years (2019–2024) saw an increase in attention to this topic, with 27 studies published (84.38% of all the selected studies). The highest number of publications occurred in 2023. Articles made up more than 60% ($n = 22$) of the studies, followed by conference papers, reviews, manuscripts, and case studies at 9.38% ($n = 6$), 6.25% ($n = 2$), 3.13% ($n = 1$), and 3.13% ($n = 1$) (Figure 2).

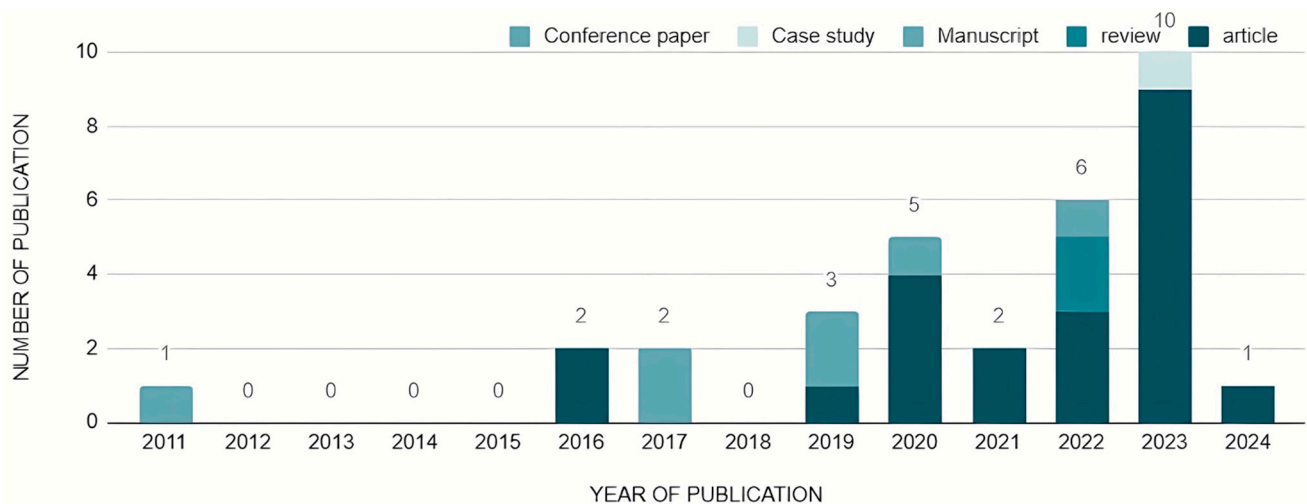


Figure 2. The types and years of publication.

A total of selected studies were published in various journals and conference papers, as shown in Table 4. These numbers indicate a growing interest in exploring this field. Most of these studies, accounting for seven (21.88%), were published in the *Frontiers of Architectural Research* journal. The *IOP Conference Series: Materials Science And Engineering* followed closely, with five (15.63%) publications. *Buildings* and *Sustainability* tied for the third most publications, making up 3 publications each.

Table 4. The source of publications.

Journal, Conference Paper and Others	Number of Studies	Percentage
Frontiers of Architectural Research	7	21.88%
IOP Conference Series: Materials Science and Engineering	5	15.63%
Buildings	3	9.38%
Sustainability	3	9.38%
Building and Environment	2	6.25%
Journal of Asian Architecture and Building Engineering	2	6.25%
Civil Engineering and Architecture	2	6.25%
Systems	1	3.13%
Gazi University Journal of Science	1	3.13%
Journal of Architectural/Planning Research And Studies	1	3.13%
Sciend	1	3.13%
Advanced Science Engineering Information Technology	1	3.13%
Journal of Construction in Developing Countries	1	3.13%
Archnet-IJAR	1	3.13%
WIT Transactions on the Built Environment	1	3.13%
Total	32	100.00%

From the selected studies, various architecture types were discovered. The majority of these were educational and residential buildings as well as landscapes, each comprising 11.1% ($n = 5$). Office and religious buildings came in second, each accounting for 8.9% ($n = 4$). Historical buildings, museums, retail spaces, and unspecified types made up 9.38% each ($n = 3$). Palaces, hospitals, and transportation hubs rounded out the findings at 6.25% ($n = 2$), with the theater, monument, hotel, and stadium being the least at 2.2% ($n = 1$).

More than 50.9% ($n = 27$) of selected articles are focused on visual attention. Attention to space follows at 9.43% ($n = 5$), while attention restoration theory accounts for 7.55% ($n = 4$). There are two types of attention: acoustic and nature with sustainability, which are around 5.66% ($n = 3$). For touch and texture attention, conceptual attention

and local culture attention were published for 3.77% ($n = 2$). The published studies have only one each that mentions thermal and ventilation, privacy, function, olfaction, and social experiences.

Two articles (6.3%) discussing mindfulness are situated within the context of educational buildings without specifying the architecture that promotes attention leading to mindfulness [99,147]. The first edition cites the attention restoration theory [147], whereas the second examines visual attention [99]. One article discusses mindfulness from the perspective of alpha brainwave activity [147], while another regards mindfulness as a silent condition [99].

4.2. The Result of Content Analysis

This section of the results illustrates the characteristics of the architecture that impact attention, indirectly implying influence on mindfulness, derived from decoding each selected article.

The results from Section 4.1 revealed that out of the total of 32 selected articles (See Appendix A), none of them provided studies that offered information on architectures promoting attention and specified that they led to the emergence of mindfulness. Thus, this result illustrates the decoding of all 32 articles pertaining to the characteristics of architecture that promote attention, with the rationale that architectural designs promoting attention tend to support mindfulness indirectly [59–64]. However, for a more explicit demonstration, the results from decoding articles referencing mindfulness will be highlighted in Appendix B.

As seen in Appendix B, only 17 (53.12%) articles provide detailed information on the form. There are 15 (46.87%) articles that specify the characteristics of space. While the movement is discussed in eight (8%) articles, characteristics of light are found in thirteen (40.62%) articles, and color is addressed in twelve (37.50%) research articles. Materials and objects that promote attention are found in 14 (43.75%) and 15 (46.87%) studies, respectively. Views are found in up to half of the studies. Seven (21.87%) and five (15.62%) articles provide details on sound and weather. Details on other architecture-related aspects that promote attention are published in 18 (56.25%) out of 32 issues. Finally, up to 62.5% ($n = 20$) specify concepts of architecture that promote attention.

Upon considering the two articles referencing mindfulness, the first article [147], as decoded, exhibits characteristics related to space, objects, view, sound, and others. In the second article [99], characteristics of form, space, light, color, material, object, view, concept, and others are evident. All details are contained in Appendix B.

4.3. The Result of Meta-Analysis

From conducting a meta-analysis according to Section 3.3, the final data were analyzed using two methods to address both research questions.

4.3.1. The Result from Word Frequency Analysis

As stated in Section 3.3.1, word frequency analysis was conducted to address research question 1: the outcomes include integrating word clouds, standard word bar charts, and themes associated with each architectural aspect. The word clouds offer a visual depiction of prominent keywords corresponding to each architectural element, facilitating a comprehensive comprehension of the data. Meanwhile, the bar charts convey the frequencies of individual words, providing quantitative information. The formulation of themes is derived from an amalgamation of these two components—the word cloud and the word frequency bar chart—thereby making sense of the keywords.

By distributing the results according to the architectural atmospheres outlined in Section 2.1, including form, space, movement, light, color, material, object, view, sound, weather, and others. Finally, the calculation of the concept design aspect of the architectural atmosphere will be considered to elucidate the architectural design concepts encountered in the preceding research.

Regarding the form aspect, the identified theme revolves around “Natural composition featuring rounded edges and curves”. This theme emerged from the high frequency of “natural” as the most mentioned word, complemented by “composition” and “round” as the second-most mentioned words (Figure 3).

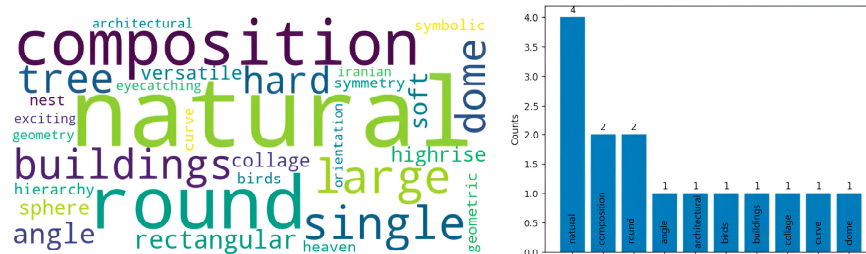


Figure 3. The word frequency of form.

For the space aspect, the discovered theme is “Striking a balance between enclosed and open spaces while maintaining exposure or connection to nature”. Although seemingly contradictory, this theme is deduced from the prevalence of “enclosed” as the most frequently used word and “open” as the second-most mentioned word. Additionally, the emergence of “exposure” and “natural” further reinforces the notion of achieving harmony between these contrasting elements (Figure 4).

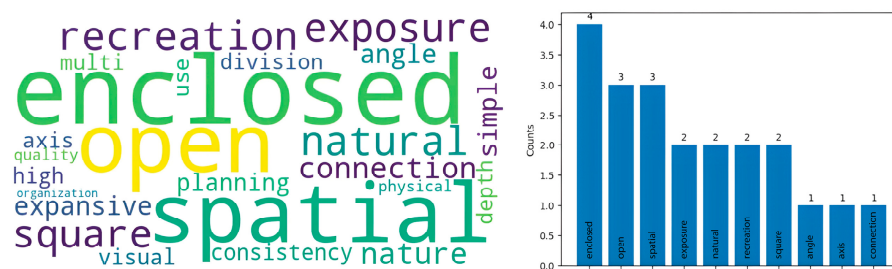


Figure 4. The word frequency of space.

For the movement aspect, the identified theme centers on “Accessible entrances and pathways”. explained by the prevalence of “entrance” as the most frequently mentioned word, followed by “pathway” and “accessibility” as the second- and third-most mentioned words, respectively (Figure 5).

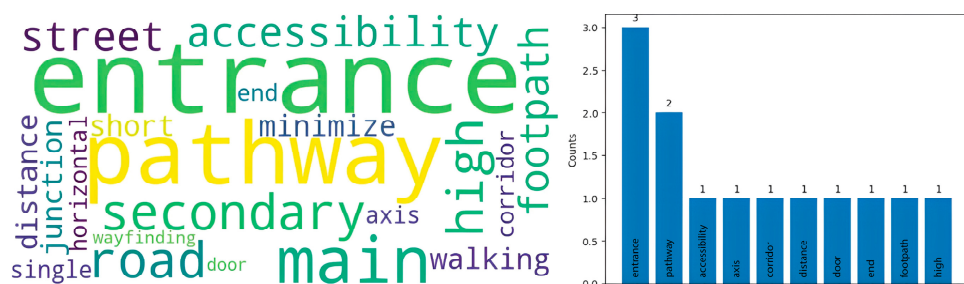


Figure 5. The word frequency of movement.

For the light aspect, the theme emerged as “Uniform and natural lighting with a warm tone”. This theme is supported by the equal occurrence of “lighting”, “natural”, and “uniform” as the most frequently mentioned words, with “warm” also contributing significantly to the theme formulation (Figure 6).

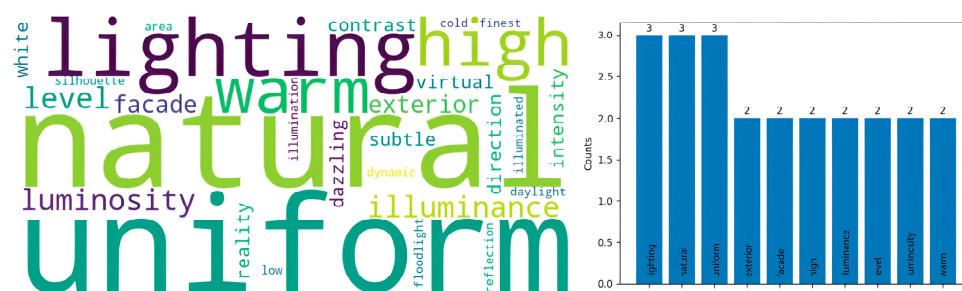


Figure 6. The word frequency of light.

Regarding the color aspect, the theme revolves around “Harmony between colors, including brick, green, red, brown, and cream”. This theme is informed by “brick” as the most frequently mentioned word, with “green” and “harmony” closely following the second- and third-most mentioned words, respectively (Figure 7).

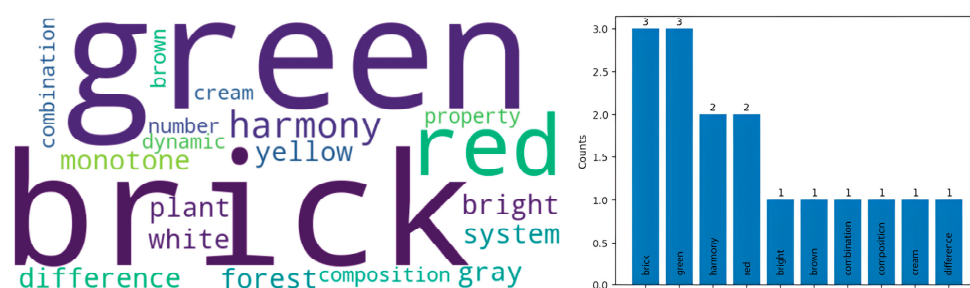


Figure 7. The word frequency of color.

In the material aspect, the identified theme revolves around “Utilizing natural materials such as wood, stone, birch, and brick”. This theme is substantiated by the occurrence of “natural” as the most frequently mentioned word, with “pattern” and “wood” closely following the second- and third-most mentioned words, respectively. Additionally, the presence of “stone”, “birch”, and “brick” further reinforces the emphasis on natural elements (Figure 8).

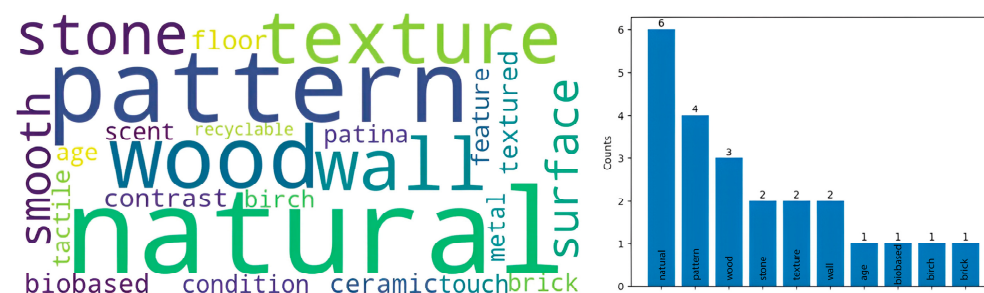


Figure 8. The word frequency of material.

For the object aspect, the theme centers on “Incorporating objects with natural elements such as artwork, figures, or potted/unpotted plants”. This theme is supported by the high frequency of “element” as the most mentioned word, with “natural” and “artwork” as the second- and third-most mentioned words, respectively. The inclusion of “figural”, “plants”, and “potted” as keywords further emphasizes this theme (Figure 9).

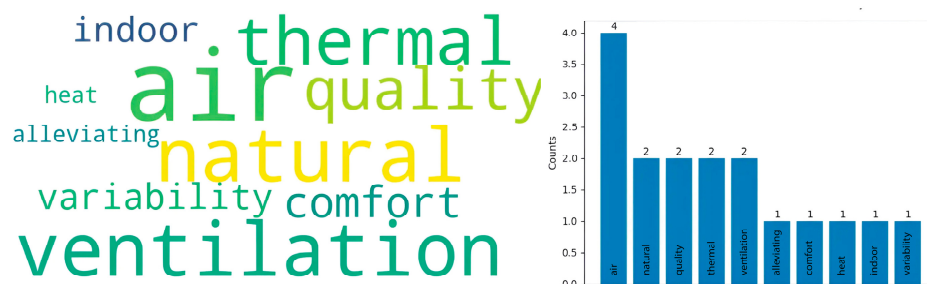


Figure 12. The word frequency of weather.

For the other aspect, the discovered theme is “Using facades or roofs that allow for a natural atmosphere”, as informed by “facade” as the most frequently mentioned word, followed by “roof” as the second-most frequently mentioned word. The words “natural” and “children” also appeared in the result as one of the keywords. For the other (component/atmosphere) aspect, the formulated theme is “Incorporating facades or roofs that promote a natural atmosphere”. This theme emerges from the emergence of “facade” as the most frequently mentioned word, followed by “roof” as the second-most mentioned word. Additionally, the inclusion of “natural” suggests an overarching emphasis on integrating architectural elements that enhance the overall ambiance. At the same time, the mention of “children” as a keyword may hint at considerations for child-friendly design features (Figure 13).

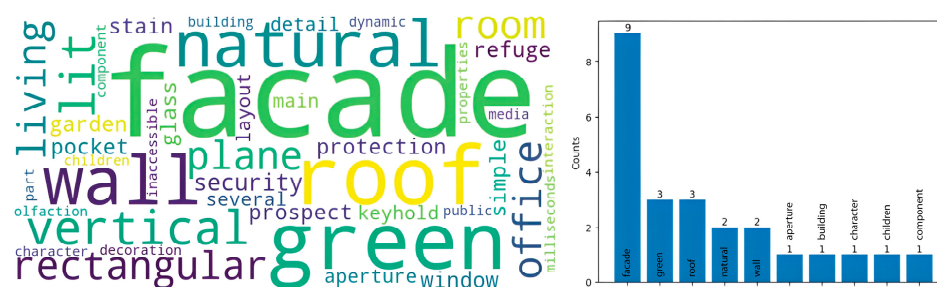


Figure 13. The word frequency of other.

For the concept and style aspect, the prevailing theme extracted from the keywords is “Historical style with the biophilic concept. Focusing on blending the structure with nature”. This theme is substantiated by the frequent occurrence of “biophilic” as the most mentioned word and “historical” as the second-most mentioned word (Figure 14).

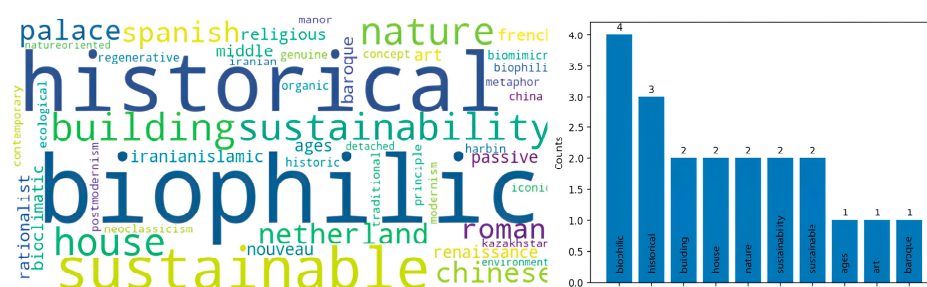


Figure 14. The word frequency of the design concept.

4.3.2. The Result from Word Association Analysis

As described in Section 3.3.2, word association analysis was conducted to address research question 2: The result depicts the semantic distance between the keywords of biophilic design and the corpus identified from the included articles in the systematic review (document-to-keyword level). Additionally, accompanying bar charts offer insights into the association patterns at this level, highlighting any keywords that exhibit notably

higher association compared to their peers. This visualization aids in identifying keywords that stand out in terms of their association with the corpus. Furthermore, the association between the entire keyword corpus and the corpus from the selected articles is reported to examine the architectural aspect that demonstrates the highest association at the document-to-document level. This analysis provides insights into the architectural elements most closely aligned with the biophilic design principles explored in the study, as mentioned in Table 2.

The following section will present the calculation results for the architectural components of space, light, color, material, object, view, and sound, which are features of biophilic design as outlined in Section 2.2. Furthermore, as per the research question, additional details on the concept design will be included to examine its relevance to biophilic design.

For the space aspect, the keywords “exposure to nature” and “connection to nature” demonstrate identical associations of 0.3685 at both levels. Consequently, the association at the document-to-document level remains consistent (Figure 15).

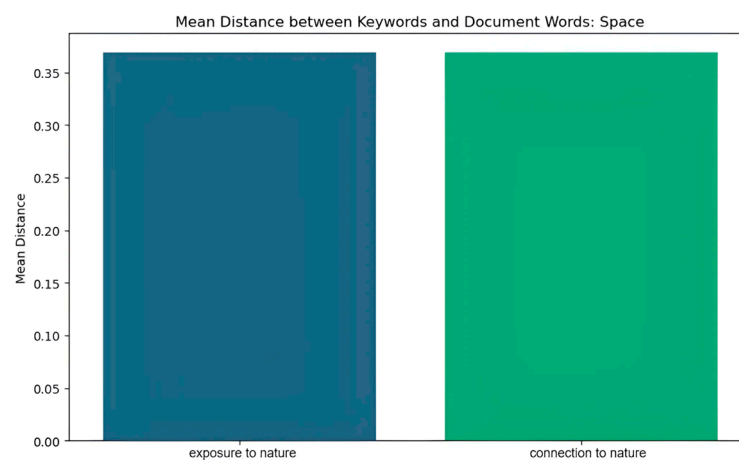


Figure 15. The word association of space.

In the light aspect, the keyword “spotlight” was found to have the highest association with the corpus from the selected articles, exhibiting a semantic distance value of 4.980. Other keywords such as “natural light”, “daylight on the wall”, “white light”, “light ray”, “darkness to light”, “hard light and shadow”, and “light from outside” share a typical level of semantic association, recorded at 1.561. The overall document-to-document association for this aspect is calculated as 1.988 (Figure 16).

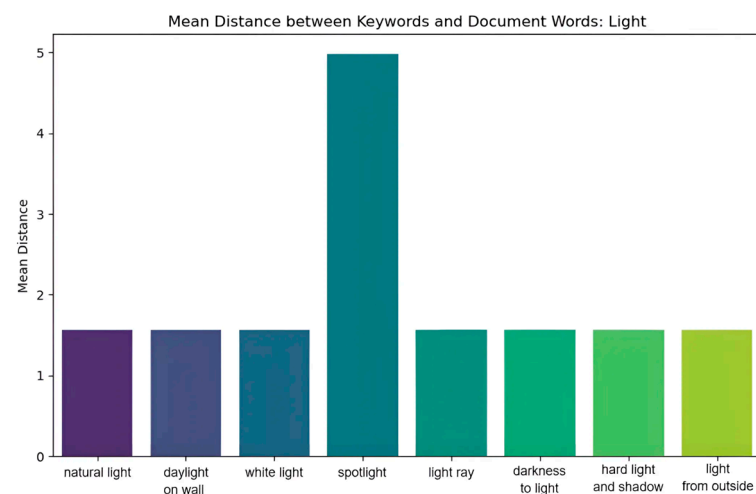


Figure 16. The word association of light.

Regarding the color aspect, the keywords “vivid hue in primary color” and “color ray” exhibit identical associations of 3.653 at both levels, resulting in consistent associations at the document-to-document level (Figure 17).

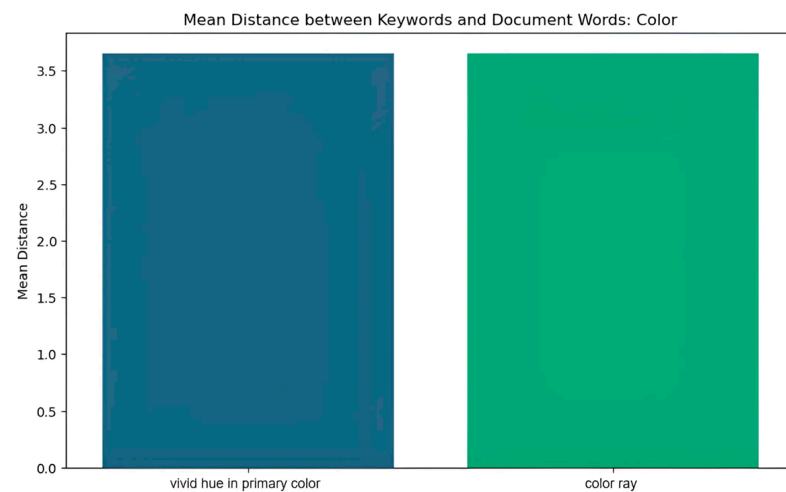


Figure 17. The word association of color.

In the material aspect, varying levels of association are observed across keywords. At the document-to-keyword level, “concrete” demonstrates the highest association (5.963) with the document corpus from the selected articles, followed by “clay” (5.878), “natural” (5.782), “wood” (5.608), “stone” (5.431), and “highly tactile” (1.215). The overall document-to-document association for this architectural aspect is calculated as 4.979 (Figure 18).

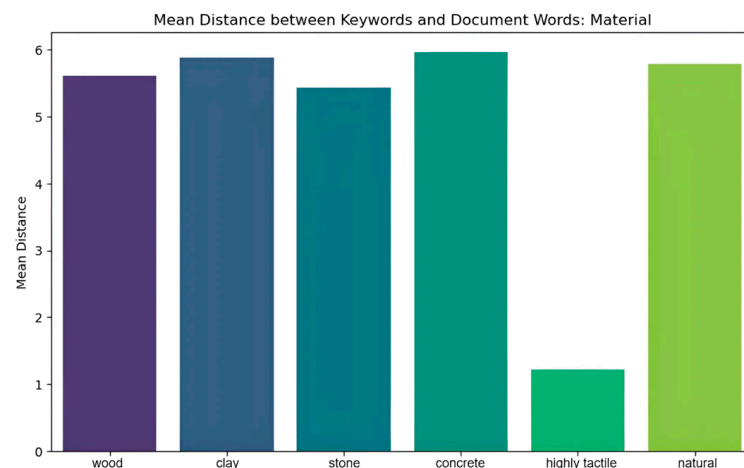


Figure 18. The word association of material.

In the object aspect, the keywords “image of nature”, “word of nature”, and “sign of nature” share an equal association of 0.424 at both document-to-keyword and document-to-document levels (Figure 19).

For the view aspect, varying levels of association are also observed across keywords. At the document-to-keyword level, “plant” demonstrates the highest association (6.385) with the document corpus, followed by “tree” (6.121), “rainwater” (5.377), and “greenery” (4.548). The remaining keywords, “natural view”, “river view”, and “immersive water”, share the same association level of 1.099. The overall document-to-document association for this architectural aspect is calculated as 3.675 (Figure 20).

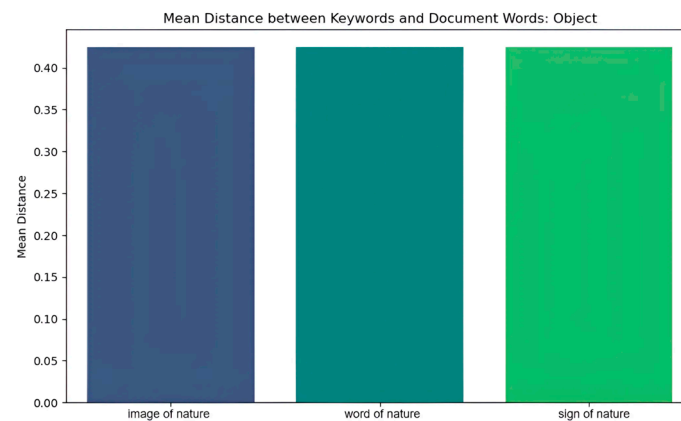


Figure 19. The word association of object.

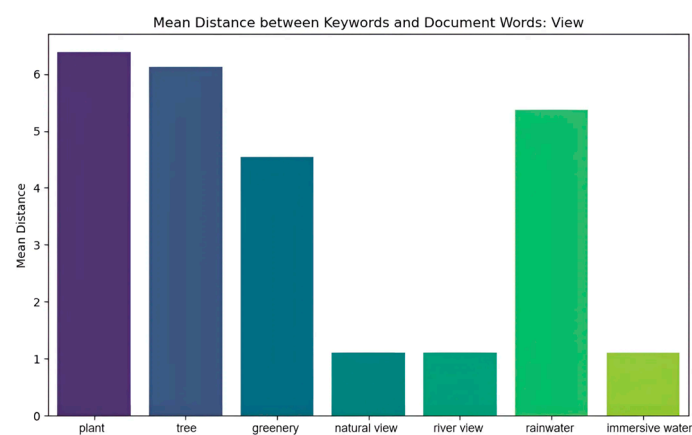


Figure 20. The word association of view.

In the sound aspect, the keywords “quiet environment”, “natural sound”, “meditation bell”, “ambient noise”, and “zen music” share an equal association of 0.708 at both document-to-keyword and document-to-document levels (Figure 21).

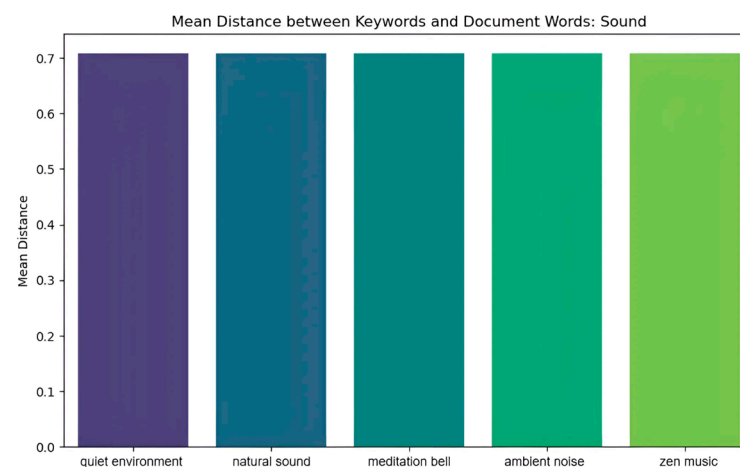


Figure 21. The word association of sound.

Finally, in the concept aspect, the only keyword “biophilic design” exhibits a semantic distance of 0.435 at both document-to-keyword and document-to-document levels (Figure 22).

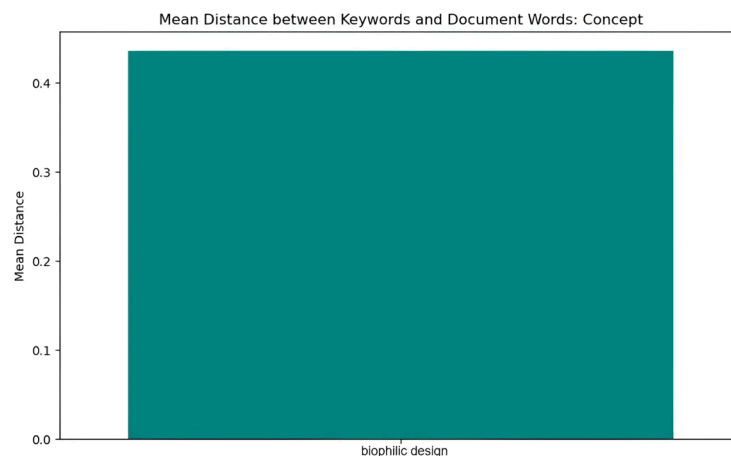


Figure 22. The word association of the concept.

5. Discussion

COVID-19 has exacerbated individuals' mental health [6–13] and consequently heightened interest in mindfulness as a solution to mental illness problems [19–22]. Although previous studies have identified certain strategies to promote mindfulness through architecture, related studies remain limited [41–44]. However, since mindfulness is a multidimensional construct [45–47], promoting mindfulness indirectly through attention may be feasible. Attention serves as the pivotal component and a central vehicle of mindfulness [59–62], with the potential to support mental health [67–74]. While architecture can promote attention similarly [63,64], research in this area remains scarce [75]. From the literature review, it is found that architectural atmosphere is the component with the highest potential [57,64,84–86]. Biophilic design is an architectural design concept that has the capability to promote attention and mindfulness [94–98]. Thus, a systematic review was conducted to explore the literature on architecture and attention while reporting the correlation with mindfulness accordingly. Subsequently, content analysis was performed to identify the characteristics of architecture that can promote attention by considering the relevance of mindfulness afterward. Finally, a meta-analysis was conducted to summarize an architectural design strategy that supports attention to indirectly foster mindfulness. The discussion section, which encompasses limitations and future research, will be detailed step by step in this instance as follows.

5.1. The Discussion from the Systematic Review

The selected publications were published from 2011 to 2024. One in three documents was published in the *Frontiers of Architectural Research* and *IOP Conference Series: Materials Science and Engineering*. Most of the content was related to education buildings and the landscape of the buildings, while residential, office, and historical buildings were found to be approximately equal to works of unspecified building types. Over 40% of the selected articles focused on visual attention. Upon detailed consideration, none of them provided studies that offered information on architectures promoting attention and specified that they led to the emergence of mindfulness.

However, the results obtained are from a specific search for articles containing the words 'architecture' and 'attention' in the title, abstract, and keywords. Although this method yields precise results from directly relevant research, it may result in missing data from relevant studies that do not use terms matching the search query [175]. An example of relevant studies that were not found includes the research by Anna D. et al. in 2019 [176], the article by Ana T. et al. in 2020 [177], and the study by Carmen L. et al. in 2021 [178]. Therefore, future research may utilize a sensitive search method that includes synonyms and closely related terms in the search query [113–115]. Furthermore, the criteria for selection, the selection process, and the sources used for searching may also serve as

limitations of this study. Therefore, setting criteria for selecting articles using different methods or searching in other data sources may lead to different research outcomes.

5.2. *The Discussion from the Content Analysis*

The results revealed that out of the total of 32 selected articles, none of them provided studies that offered information on architectures promoting attention and specified that they led to the emergence of mindfulness [59–62]. After decoding all 32 articles by considering the attention improvement, it was found that architectural design concepts are the most frequently discussed topic. Other components beyond the coding framework are the second-most discovered aspect. Form and view are two additional components commonly found in articles discussing architecture that promote attention.

This finding may indicate that all four components influence attention. However, this study did not examine each component's impact on attention and mindfulness, which could be a direction for future research.

5.3. *The Discussion from the Meta-Analysis*

For question 1, the results of the word count analysis for each category according to the coding framework revealed the most frequently encountered characteristics. The architectural atmosphere promotes attention most effectively when it features natural forms. The space evokes a sense of enclosure. In terms of movement, particular attention should be given to the entrance. The lighting emphasizes natural light and uniformity. There are colors of brick and green. The building utilizes natural materials and incorporates object elements. The view encompasses gardens and plants. Sound is being designed considering acoustic, ambient, and noise. Weather is controlled with a focus on air aspects. The facade is a particularly crucial component. In addition, biophilic design is the most mentioned concept, aligning with the literature review [94–98]. However, the architectural characteristics categorized as commonly and less frequently found differ by only 1–2 instances. Only the 'other' category shows a clear disparity in frequency between the most commonly identified characteristic and the second-ranked one. Therefore, the factors identified most frequently may not necessarily indicate the highest importance, while other less frequently identified factors may merit further study due to its lack of conclusivity in the word frequency difference.

To answer question 2, a word association analysis was conducted. The material aspect demonstrated the highest association with the provided keyword corpus, followed closely by the view aspect. The color aspect exhibited a slightly lower association, while the light aspect follows with a value. Subsequently, the sound aspect presented a lower association, while the concept aspect and the object aspect showed even lower associations. Finally, the space aspect displayed the lowest association among all architectural aspects.

The outcomes of this study are architectural design strategies aimed at promoting attention. It is anticipated that these strategies could indirectly foster mindfulness and promote mental well-being. In future studies, the findings from this research could be utilized to investigate whether the implemented design strategies can contribute to improving mindfulness and mental well-being and how they may do so. The summarized architectural design strategies that influence attention remain uncertain. Hence, further testing is warranted.

6. Conclusions

This study aimed to support mental health improvement via architectural design by fostering mindfulness through promoting attention. The literature review revealed that the architectural atmosphere is the most significant component. It can be concluded that the characteristics of architectural atmospheres that tend to promote attention to foster mindfulness include natural forms and spaces that evoke a sense of enclosure. The lighting should emphasize natural light and uniformity, whereas the sound designs primarily concern acoustics, ambient, and noises, with controlled weather emphasizing air aspects.

The building should utilize natural materials and incorporate object elements; the facade and entrance are particularly crucial components. Moreover, the colors of brick and green and views encompassing gardens and vegetation are among the qualities mentioned. Previous research indicates that biophilic design has shown the strongest tendency to promote attention and mindfulness. Based on the analysis, the material, view, and color features that were identified were most aligned with the biophilic design concept.

Author Contributions: Conceptualization, C.T.; data curation, formal analysis, methodology, visualization, writing, C.T., T.W., P.C. and P.P.; investigation, C.T., S.B., P.P. and R.W.; supervision, S.B. and R.W. All authors have read and agreed to the published version of the manuscript.

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Appendix A

Table A1. The list of selected articles from a systematic review.

Ref.	Authors	Year	Title	Type	Source	Relevance to Key Theme		
						Type of Building	Type of Attention	Mindfulness Relation
[145]	Gargiulo, M.; Carleo, D.; Ciampi, G.; Masullo, M.; Chias Navarro, P.; Maliqari, A.; Scorpio, M.	2024	Assessment of the historical gardens and buildings lighting interaction through virtual reality: the case of Casita de Arriba de El Escorial.	Article	Buildings	Historical building	Visual attention	-
[146]	Zhang, D.; Shan, X.; Zhang, X.; Chen, H.; Zheng, Y.	2023	Spatial feature analysis of the Beijing forbidden city and the Shenyang imperial palace based on space syntax	Article	Buildings	Palace	Privacy attention	-
[147]	Asim, F.; Chani, P. S.; Shree, V.; Rai, S.	2023	Restoring the mind: a neuropsychological investigation of university campus built environment aspects for student well-being	Article	Building and Environment	Educational building	Attention restoration theory	Increasing alpha brainwave activity, such as mindfulness
[148]	Zhong, W.; Schroeder, T.; Bekkering, J.	2023	Designing with nature: advancing three dimensional green spaces in architecture through frameworks for biophilic design and sustainability	Case study	Frontiers of Architectural Research	Hotel and hospital (2 case)	Attention restoration	-
[99]	Fadda, R.; Congiu, S.; Roeyers, H.; Skoler, T.	2023	Elements of biophilic design increase visual attention in preschoolers	Article	Buildings	Educational building	Visual attention	Mindful-silence condition
[149]	Wang, P.; Song, W.; Zhou, J.; Tan, Y.; Wang, H.	2023	AI-based environmental color system in achieving sustainable urban development	Article	Systems	Historical center	Visual attention	-
[150]	Luo, Y.; He, J.; Long, Y.; Xu, L.; Zhang, L.; Tang, Z.; Li, C.; Xiong, X.	2023	The relationship between the color landscape characteristics of autumn plant communities and public aesthetics in urban parks in Changsha, China	Article	Sustainability	Landscape	Visual attention	-
[151]	Ghouchani, M.; Taji, M.; Roshan, A. H. Y.	2023	Spirituality of light in the mosque by exploring Iranian-Islamic architectural styles	Article	Gazi University Journal of Science	Religious building (Mosque)	Visual and conceptual attention	-

Table A1. Cont.

Ref.	Authors	Year	Title	Type	Source	Relevance to Key Theme		
						Type of Building	Type of Attention	Mindfulness Relation
[152]	Chanbenjapipu, P.; Chuangchai, W.; Thepmalee, C.; Wonghempoom, A.	2023	A review article: fall incidents and interior architecture— influence of executive function in normal ageing	Article	Journal of Architectural/Planning Research and Studies	Ageing residential	Visual attention	-
[153]	Krastiņš, J.	2023	Nancy art nouveau architecture	Article	Sciendo	Historical building	Visual attention	-
[154]	Kujundzic, K.; Vuckovic, S. S.; Radivojević, A.	2023	Toward Regenerative Sustainability: A Passive Design Comfort Assessment Method of Indoor Environment	Article	Sustainability	-	Environment attention (visual, function, space, acoustic, thermal, ventilation)	-
[155]	Pei, W.; Guo, X.; Lo, T.	2022	Pre-evaluation method of the experiential architecture based on multidimensional physiological perception	Article	Journal of Asian Architecture and Building Engineering	Landscape of educational building	Environment attention (visual, audition, olfaction and touch)	-
[156]	Truspekova, K. K.; Sharipova, D. S.	2022	Architecture of post-soviet Kazakhstan: key stylistic references in public facilities	Article	Civil Engineering and Architecture	Palace/Theater/Retail/Monument/Office building	Visual attention and space attention	-
[157]	Almssad, A.; Almusaed, A.; Homod, R.Z.	2022	Masonry in the context of sustainable buildings: a review of the brick role in architecture	Review	Sustainability	-	Visual attention	-
[100]	Zhong, W.; Schröder, T.; Bekkering, J.	2022	Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review	Review	Frontiers of Architectural Research	Museum, Plaza, Educational building, Residential, Transportation hub, Religious building, Hospital	Attention Restoration Theory	-
[158]	Alajmi, M.; Al-Haroun, Y.	2022	An architectural analytical study of contemporary minaret design in Kuwait	Article	Frontiers of Architectural Research	Religious building (Minaret)	Visual attention	-

Table A1. Cont.

Ref.	Authors	Year	Title	Type	Source	Relevance to Key Theme		
						Type of Building	Type of Attention	Mindfulness Relation
[159]	Lianto, F.; Trisno, R.	2022	Discovering the factor of the bird's nest stadium as the icon of Beijing city	Manuscript	International Journal on Advanced Science Engineering Information Technology	Stadium	Visual attention and local cultural value	-
[160]	Fang, Y.; Que, Q.; Tu, R.; Liu, Y.; Gao, W.	2021	How do landscape elements affect public health in subtropical high-density city: the pathway through the neighborhood physical environmental factors	Article	Building and Environment	Landscape in high-density urban	Attention restoration	-
[161]	Lee, J. H.; Ostwald, M. J.	2021	Fractal dimension calculation and visual attention simulation: assessing the visual character of an architectural façade	Article	Buildings	Residential	Visual attention	-
[162]	Suárez, L. A. F.	2020	Subjective experience and visual attention to a historic building: A real-world eye-tracking study	Article	Frontiers of Architectural Research	Historical building	Visual attention	-
[163]	Xu, R.; Xia, H.; Tian, M.	2020	Wayfinding design in transportation architecture—are saliency models or designer visual attention a good predictor of passenger visual attention?	Article	Frontiers of Architectural Research	Transportation hub (images)	Visual attention	-
[164]	Sami, Z.; Dincer, M. E. E.	2020	Study of physical, social and functional structures in bagdat Street (Istanbul) as public space	Article	Civil Engineering and Architecture	Landscape (street)	Visual attention	-
[165]	Szuta, A. F.; Szczepański, J.	2020	Striking elements—A lifebelt or a fad? searching for an effective way of adapting abandoned churches	Article	Frontiers of Architectural Research	Religious building (churches adaptive re-use)	Visual attention	-
[166]	Dutsev, M. V.	2020	Contemporary urban environment: the image of the history and the history of the image	Conference paper	IOP Conference Series: Materials Science and Engineering	Museum/residential building	Visual and space attention/Local nature and historic	-

Table A1. Cont.

Ref.	Authors	Year	Title	Type	Source	Relevance to Key Theme		
						Type of Building	Type of Attention	Mindfulness Relation
[167]	Aatty, H. M. S.; Al Slik, G. M. R.	2019	Iconic architecture and sustainability as a tool to attract the global attention	Conference paper	IOP Conference Series: Materials Science and Engineering	Iconic architecture (museum, office building)	Visual attention/Sustainability concept	-
[168]	Bystrova, T. Y.	2019	Concept of organic architecture in the second half of the xx th century in the context of sustainable development	Conference paper	IOP Conference Series: Materials Science and Engineering	Group of office buildings (bank)	Visual and touch attention on natural materials tactile	-
[169]	Sadafi, N.; Sharifi, M. A.	2019	A study of the concept of Iranian traditional architecture in bazaars and shopping centers	Article	Journal of Construction in Developing Countries	Retails	Visual and space attention/Attention to the nature-oriented and sustainable architecture	-
[170]	Kłopotowska, A.	2017	Tactile architectural models as universal ‘urban furniture’	Conference paper	IOP Conference Series: Materials Science and Engineering	-	Visual attention and social experiences	-
[171]	Halarewicz, A.	2017	Study of selected components of architectural environment of primary schools—preferences of adults and analysis of the specialist literature	Conference paper	IOP Conference Series: Materials Science and Engineering	Educational building	Visual and space perception attention	-
[172]	Cho, H.	2016	A study on the comparison of the visual attention characteristics on the facade image of a detached house due to the features on windows	Article	Journal of Asian Architecture and Building Engineering	Residentials	Visual attention	-
[173]	Moghaddam, E. V.; Ibrahim, R.	2016	People’s evaluation towards media façade as new urban landmarks at night	Article	Archnet-IJAR	Office buildings Retails	Dynamic visual attention	-
[174]	Butko, D. J.	2011	The sound of daylight: the visual and auditory nature of designing with natural light	Conference paper	WIT Transactions on the Built Environment	Educational building (Design studios)	Visual and auditory attention	-

Appendix B

Table A2. Results.

Ref.	Form	Space	Movement	Light	Color	Material	Object	View	Sound	Weather	Concept	Other
[145]	-	Enclosed space	- Entrance - Main pathway - Secondary pathway	- High contrast - Warm white - Virtual reality	Monotone	Smooth	- Historical monument - Pathside object - Sphinxes	- Tree - Plant - Garden	-	-	- Spanish - Roman	- Facade - Lit facade - Vertical rectangular plane
[146]	-	- Enclosed Space - Recreation Space	- Road - High accessibility	-	-	-	Central object	Garden	-	-	Chinese palace	- Office space - Living space - room
[147]	-	- Recreation space - Nature connection - Natural exposure - Expansive space - Open space	-	-	-	-	Natural element	- Nature - Garden - Vegetation - Unrestricted view - Reflection on water	- Acoustic ambient - Ambient sound	-	-	- Security - Protection - Prospect - Refuge
[148]	- Natural form - Natural shape	Enclosed space	-	-	Green	- Surface wall - Bio-based - Natural pattern - Wood	Natural element	- Green area - Indoor green area - Atrium garden - plant - garden	Low noise	Natural ventilation	- Biophilic design - Sustainable design - Netherland	- Roof garden - Green pocket
[99]	- Natural form - Natural shape	Natural exposure	-	Natural light	Green	Natural pattern	Potted plants	- Indoor nature - Nature - Flowers - Plant - Indoor plant	-	-	Biophilic design	Green wall
[149]	Large single buildings	- Square - Angle	Street	-	- Bright color - White - Red - Yellow - Color system - Color difference - Green - Gray	-	- Nearby object - Natural element - Panoramic view	-	Ambient sound	-	Historical building	-
[150]	Tree form	Open space	Footpath	-	- Plant color - Forest color - Harmony - Composition - Number	-	-	- Green area - Blue sky - Tree - Park - Forest - Plant	-	-	-	-

Table A2. Cont.

Ref.	Form	Space	Movement	Light	Color	Material	Object	View	Sound	Weather	Concept	Other
[151]	Dome	Enclosed space	-	- Subtle - Uniform - Dazzling - Luminosity - Intensity - Direction	-	Ceramic wall	-	-	-	-	- Iranian-Islamic - Religious - Historical	Stain glass window
[152]	-	- Simple planning - Consistency design	- Minimize junction - Short walking distance - Single entrance	Uniform	Harmony	- Textured floor - Contrast - Texture	-	-	-	-	-	-
[153]	-	-	-	Silhouette	-	-	-	-	-	-	- Renaissance - Middle ages - Baroque - Art nouveau - French - Rationalist architecture	- Simple facade - Keyhold shape aperture - Several detail
[154]	- Hard - Angle - Rectangular - Soft - Round	- Too high - Multi use - Division	-	- Low illuminance - Warm light - High illuminance - Cold light - Level	Light property	- Natural - Condition - Patina - Scent - Age - Texture - Wood	- Natural element - Potted plants - Nature artwork - Landscape artwork - Flower artwork - Garden artwork - Positive gesture - Positive facial expression - Furniture - Equipment	- Garden - Visual comfort - Biophilic aspects of comfort	- Quality - Avoid noise - Acoustic comfort - Diversity	- Thermal comfort - Air quality - Thermal variability - Indoor ventilation	- Bioclimatic architecture - Passive design - Regenerative sustainability - Biophilic design	Wall layout
[155]	Composition	- Axis - Depth - Spatial	- Horizontal corridor - Entrance - End of axis	Light	Color	- Touch - Stone	- Craved ground stone - Guide system - Pathside object	- Plant - Landscape belt	Audition	-	- Contemporary architecture - Harbin - China	- Main building facade - Olfaction
[156]	- High-rise - Sphere - Versatile collage	-	-	-	-	-	-	-	-	-	- Neoclassicism - Modernism - Postmodernism - Kazakhstan	-
[157]	-	-	-	-	- Brown brick - Cream brick - Red brick - Combination	- Brick - Pattern	-	-	-	-	-	-

Table A2. Cont.

Ref.	Form	Space	Movement	Light	Color	Material	Object	View	Sound	Weather	Concept	Other
[100]	-	-	-	Daylight	-	-	Plant	Landscape	-	Air	Biophilic design	- Green roof - Natural interaction
[158]	- Hierarchy - Symmetry	-	-	-	-	-	-	-	-	-	-	-
[159]	- Bird's nest - Round - Heaven symbolic	-	-	-	-	-	-	-	-	Natural air	- Metaphor - Sustainable - Biomimicry	-
[160]	-	-	-	-	-	-	-	- Green space - Blue space	Reduce noise	- Air quality - Alleviating heat	-	-
[161]	Geometric	Spatial	-	-	Color	Natural pattern	- Geometric image - Natural element - Salient proto-object	- Tree - Natural aesthetic work	-	-	Biophilia	Facade
[162]	-	-	-	- Illuminated area - Light - Luminosity	Color	-	- Contrasting element - Artwork - Decorative textile	Visual quality	-	-	- Historical Building - Historic manor house	150 Milliseconds
[163]	-	-	Wayfinding	-	-	-	-	-	-	-	-	-
[164]	-	-	-	-	-	Natural feature	-	-	-	-	-	Decoration on facade
[165]	-	-	-	-	-	-	External element	-	-	-	-	-
[166]	Curve	-	-	Light reflection	-	-	-	Lines of the landscape	-	-	-	-
[167]	- Eye-catching - Exciting	-	-	-	-	-	-	-	-	-	- Ecological principle - Genuine concept - Iconic Architecture - Sustainability	-
[168]	-	-	-	-	-	- Tactile - Natural wood - Birch - Metal	-	-	-	-	Organic architecture	-
[169]	- Iranian architectural geometry	- Visual - Physical	-	Natural light	-	Recyclable material	Natural element	Water	-	-	- Iranian traditional architecture - Nature-oriented architecture	Natural properties

Table A2. Cont.

Ref.	Form	Space	Movement	Light	Color	Material	Object	View	Sound	Weather	Concept	Other
[170]	Composition	- Spatial - Quality - Organization - Square	-	-	-	Stone	Elegant gadget	-	-	-	-	- Roof - Inaccessible part - Public space
[171]	Shape	-	-	-	-	-	-	-	-	-	Nature of the environment	Children space
[172]	-	Open space	Door	-	-	-	-	- Window - Reflecting window	-	-	Detached house	- Facade - Facade component
[173]	-	-	-	- Uniform - Exterior lighting - Exterior facade lighting - Facade lighting - Dynamic - Floodlight illumination	Dynamic	-	-	Visual quality	-	-	-	- Dynamic character - Media facade
[174]	Orientation	-	-	- Natural light - Finest level	-	Material	- Television - Printed media	-	- Acoustic - Acoustical intricacy	-	Nature	-

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