Civil Engineering and Architecture 10(3A): 108-117, 2022 http://www.hrpub.org
DOI: 10.13189/cea.2022.101314

Healing Architecture

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Received September 15, 2021; Revised March 15, 2022; Accepted April 19, 2022

Cite This Paper in the following Citation Styles

(a): *[1] Menatalla Ghazaly, Deema Badokhon, Naelah Alyamani, Sarah Alnumani, "Healing Architecture," Civil Engineering and Architecture, Vol. 10, No. 3A, pp. 108 - 117, 2022. DOI: 10.13189/cea.2022.101314.*

(b): *Menatalla Ghazaly, Deema Badokhon, Naelah Alyamani, Sarah Alnumani (2022). Healing Architecture. Civil Engineering and Architecture, 10(3A), 108 - 117. DOI: 10.13189/cea.2022.101314.*

Abstract The healing environment is one of the indispensable things for humans. It could be fulfilled through different means; one of them is in the hands of an architect. Healing through design has existed for a very long time, but now it is developed with new techniques. This paper discusses this topic in terms of spiritual, psychological and physiological health recovery for people because it is so important for a person to live in balance and mind safety. The aim of this study is to examine the diversity of aspects, in which the healing could be reached through. It also focuses on the essential design strategies for architects and other specialties. This study includes the healing elements of buildings, healing in the urban-scale and healing through biophilic design. The healing elements of architecture describe the integration of light and color, circulation and spatial organization, form and building system, building envelope and the application of healing architecture in medical buildings. The urban-scale healing will cover circulation and open areas, followed by outdoor spaces and healing gardens. At the same time, healing through biophilic design will include biophilic effect rules, biophilic design strategies, design considerations and design culture of biophilic versus biophobia. All in all, the main objective of this study is to develop a set of design recommendations, by which designers can design healing environments.

Keywords Healing Architecture, Healing Environment, Urban-Scale, Biophilic Design

1. Introduction

Healing environment had a direct connection with religious structures such as churches and mosques, making these structures a place for physical, spiritual and psychological healing. Such examples appear in the early Islamic architecture of mosques which also included schools and hospitals “Bemaristan” in the same structure [1]. These mosques were carefully designed to follow environmental and cultural standards ensuring occupants’ comfort and creating an environment which is healing on all aspects.

A good example is Bimaristan AL- Arghoni located in Bab Quinnisreen quarter, Syria. It is one of the most important hospitals in the 14 century in the Islamic world [2]. The main courtyard has water features and natural lighting. The courtyard leads to the two iwans in the south and north sides [2]. Every closed place in the Bimaristan AL- Arghoni has an open dome to provide a good amount of natural lighting and ventilation. Therefore, the place is based on the purpose of treating people through water therapy and sound therapy through the dome, and through natural light.

Healing through architecture has been practiced by architects and artists throughout the different eras of architecture history using different techniques. One of these techniques is incorporating the natural environment in the building’s exterior and interior design, like the carvings of plants and vegetation in the Rococo style and the fluid natural forms of art nouveau. Studies have proved that having such natural elements in the facade design with high levels of detailing are generally healing and more reassuring [3]. Browning introduced in his article “14 patterns of biophilic design”, Hotel Tassel by Vector Horta as an example of such style [3]. This is an early example of art nouveau, in which fluid natural forms and colors create a calming, restorative effect.

Focusing mainly on function and forgetting all the meaningful aesthetics, this trend has suddenly stopped in the 20th century with the industrial revolution, which introduced the minimalistic approach of modern architecture and healing effects a building could have on its user [4]. This movement has spread widely becoming international and spreading its hazardous effects on human beings in different regions, and raising the first cases of sick building syndrome.

Many architects and physicians are currently fighting the sick glass buildings of the international style with green architecture and many new emerging theories leading back to biophilic design, which aims to reincorporate the natural environment into human dwellings with the purpose of healing and producing healthy communities on the building scale and urban scale. This approach is especially encouraged in -yet not limited to-health care buildings, because of its effect in helping patients heal faster [3].

Many previous researchers have approached healing environments from a theoretical perspective. This research focuses on the methods of implementing the concept of healing architecture in place design. It explores different building elements which can be designed to aid healing, and further expands the scale into healing gardens and restorative urban design. All with the aim to set a list of recommended strategies and approaches including new trends of biophilic designs that can lead to healthy, and well-designed spaces that promote healing and stress reduction.

2. Healing Elements of a Building

Figure 1 shows the architectural healing elements, including the fusion of light and color, circulation and space organization, form and building system, building envelope, and finally the application of healing architecture in medical buildings.

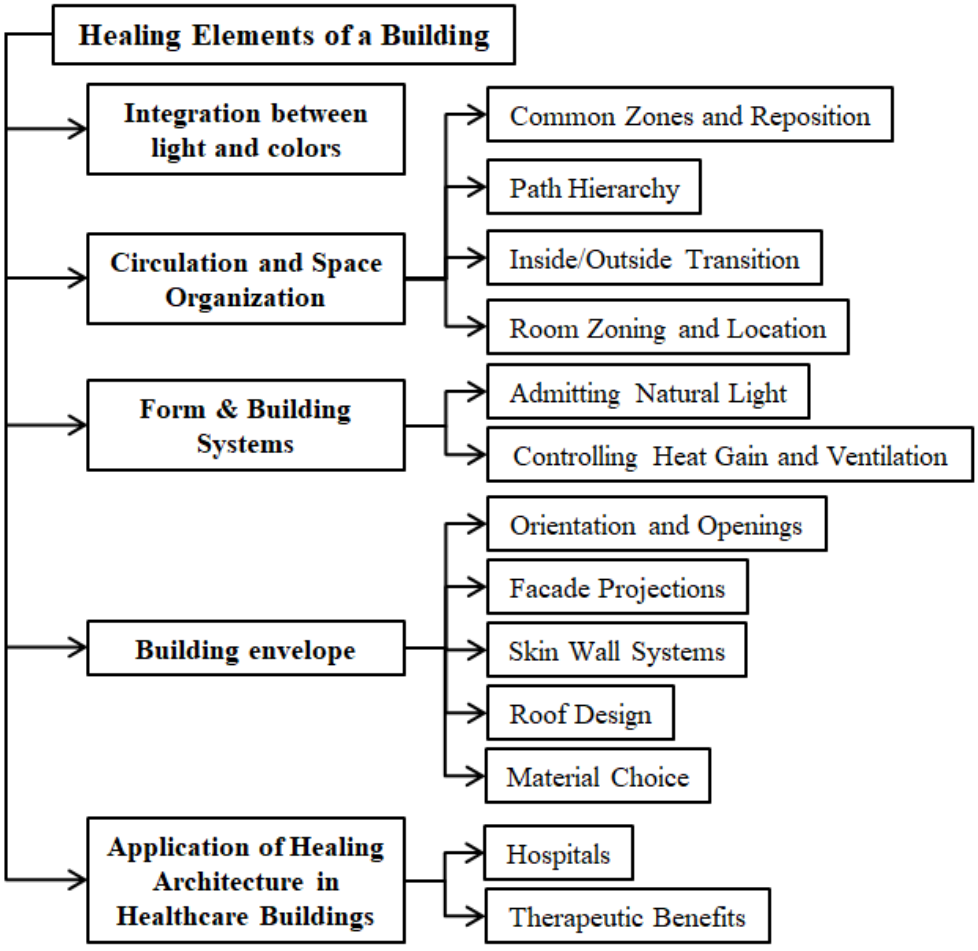

Figure 1. The healing element of the building

2.1. Integration between Light and Colors

Since colors have an effect on human, it makes him/her be active, optimistic, or it may make them be pessimistic, and sad. Therefore, the effect of color and light together may make the person feel better. [5, 6]

Light is a main element in the healing environment concept. Some studies done by Beaushmin and Hays in 1996, found that natural lighting have an ability to make the patient feel better soon, and this may because of the vitamin from sunlight [7]. Therefore, the amount of the sunlight that is getting inside any building to make it more alive, is letting the users feel better and active, especially here in Saudi Arabia where the houses are designed to block some of these light to avoid the heat gain that may cause by the sunlight. Also, the artificial type of the lighting in the place makes the user awake and active. However, the type and the colors of these artificial lighting may have some bad effects depending on the color and the amount of this light. For example, the red or orange light is not very useful in the normal type of rooms, like office, class room, and living room, because as the red color gives the feeling of heat, so the light of it will be the same effect, for giving the person the feeling of heat and danger.

Therefore, Kruithof in 1941 found that people prefer a cool color temperature when illumination is intense and a warmer color temperature when illumination is low [8]. Besides, the objects and surfaces will be so clear when under exposure of warm lighting at low intensity and under cool lighting at high intensity. The designer should know the function of the place to know how much intensity that the place need and what color to make the place more useful for people. However, the red lighting may have a good effect to improve the concept of healing architecture in indirect way; some studies found that the red lighting is very effective and good for the green plant to grow up in a good health and shape as well, because the chlorophyll will absorb more light, to make the photosynthesis work better in the plant. Therefore, this will reflect on the plant. Landscaper or the architect may use this method to increase the lifetime of greenery and vegetation.

Moreover, blue lighting is coming from sunlight and the artificial lighting as well, but in different levels. This may be useful to create the relaxing mood for the person. However, the amount of lighting should be controlled to avoid harming the eye. Therefore, the amount of this lighting should be less and it is better to be indirect lighting scheme.

2.2. Circulation and Space Organization

2.2.1. Common Zones and Reposition

It is important to avoid creating nets of paths in complex buildings as they lead to confusion, stress, and time loss. On the other hand, adapting a focal points or common zones system where wider areas located in the place of several path intersections can serve as rest areas and reposition where people can make sure of the right path to take. This would make their trip through the building much easier, more comforting and less stressing, which in turn enhance the healing effect of the environment.

2.2.2. Clear Paths - Path Hierarchy

Healing can never happen in spaces with much noise, crowd and disregard of privacy. Paths should be clearly directed and defined as public, semi public or private without much intersection to secure the privacy of staff and special users of the building, and enhance the comfort of both visitors and staff crew. Paths should also be carefully designed to serve their purpose efficiently, reducing time of walking from one place to the other with direct connections and back routs to the functions they link.

2.2.3. The transition between outside and inside

Integrating greenery and nature in the building's spaces is an important factor of creating a healing environment. The transition between these spaces though can affect comfort negatively if designed poorly. Shaded transitional spaces and semi enclosed spaces can ease this transition and prevent the momentary discomfort caused by sudden change in lighting intensity and climatic conditions. This approach is especially important in open plans and buildings that encourage heavy use of the outdoors such as day care buildings.

2.2.4. Room Zoning and Location

Rooms are grouped and located based on its functions. If these functions require natural light, the room is placed in a daylight zone. In other words, spaces that need the most light are placed near the light source, and spaces with similar needs are grouped together so their need can be met with similar architectural solutions. This assures natural light penetration to important spaces and makes it easier for the occupant to navigate the spaces which in turn, enhance the healing effect.

2.3. Form & Building Systems

Form and building systems play grand roles in shaping and assuring the efficiency, and functionality of the healing environment. Through the building's form, the design should consider the dictate lit and shadowed surfaces as well as air speed and movement around masses. It also helps in ensuring natural light penetration and adequate temperature of interior and exterior spaces and surfaces. Form can also suggest places of social interaction, and aids way finding. All these factors by turn enhance the quality of healing in the built environment.

Manipulating the parts of a building's form for these purposes creates the building's systems. For the purpose of healing, it is important to use passive building systems which make use of nature's strengths to facilitate well-being. Passive systems are easily achievable through design and are much cheaper to implement compared to

active systems. There are also several systems and strategies that make use of form to achieve the purposes of natural lighting and ventilation for the building's spaces.

2.3.1. Admitting Natural Light

Suitable strategies for admitting natural light differ with the building's form and shape. Tall thin buildings employ side light from windows designed in relation to room depth. While short buildings make use of roof form to create topflight opportunities. Tall-Fat buildings on the other hand undergo more form variations to allow natural light with courtyards and atriums being the most common solutions. All these buildings can use a mix of strategies to fulfill certain criteria, but they should all incorporate reflective light strategies where sun angels are mostly vertical, as glare is proved to have harmful effects to occupant's mental and physical health.

Aside from envelope related components, form can be manipulated to facilitate reflected light to light spaces or rooms that require diffuse lighting. Such strategies include oblique surfaces and light wells which are especially useful in tall fat buildings.

2.3.2. Controlling Heat Gain and Ventilation

Form can be oriented to overshadow surfaces and outdoor spaces which make it absorb less heat. This also creates a difference in pressure between shaded and un-shaded areas, which in turn enhances natural ventilation and wind speed through these areas. Encourage occupants to use outdoor spaces more and at the same time reduce heat transfer to interior spaces. The form of the building can also be shaped to create stack-ventilation systems and inlets, outlets for natural ventilation and cross ventilation when needed.

2.4. Building envelope

Healing environments must first achieve human comfort. The envelope should be designed to allow natural light, facilitate ventilation, and reflect heat. When an architect works with these forces, it can result in a creation of spaces that are not only useful, but are also comfortable and alive, and therefore healing. Failing to achieve these criteria, results in a sick building which can affect user's health negatively. This section states several methods to achieve these purposes through envelope design.

2.4.1. Orientation and openings

The surfaces and orientation is the key in attracting prevailing wind and adequate sunlight. However, the most important elements of the envelope are openings and windows. They should be located to admit light without heat or glare, and designed in relation to room depth to satisfy its function. Windows for admitting light could be separated from those that attract the prevailing wind to prevent unnecessary heat gain through glazed facades. Windows and openings that attract the prevailing wind should be generally lower than those that are used as vents and located where wind can circulate throughout the whole room. Windows that face direct sun angled should be shaded to prevent glare and heat.

2.4.2. Façade Projections

Facade projections usually work as shading and reflecting devices. Techniques like light shelves and horizontal, vertical louvers can be utilized to prevent harmful sunrays and facilitate natural light. Though orientation of walls is important, projections could also be oriented to catch adequate sunlight and prevailing wind and achieve similar results. Light colored projections should be used to reflect light to the interior, while dark colored projections prevent glare on outdoor passersby.

2.4.3. Permeable, Breathing, and Double Skin Wall Systems

Researchers have studied and developed many adaptive kinetic facade systems through the recent years. However, passive systems remain the most suitable for many because it is cheaper and easier to maintain. Passive wall systems include permeable, breathing, and double skin walls. The main functions of these systems are to cool the masses of the building to avoid excessive heat gain and vent the stored heat in building materials. Breathing walls however, were developed to also vent excess carbon dioxide from interior spaces and sometime provide fresh cool air. Breathing walls could be utilized for any weather, though for a breathing wall to work, it needs to have a perfect size of openings in the skin.

Permeable wall on the other hand, promote cross ventilation and stack ventilation through all planes with unobstructed wind passages. The use of such systems is mainly for ventilation in hot humid areas and it is not suitable for all conditions.

2.4.4. Roof design

Roofing is the facade of the building that is always facing the sun light all day long, so it has to be treated in a way that reduces the amount of the heat that the building may gain from this area. Therefore, architects must utilize roof design and materials to reflect this radiation especially in hot areas, so there will be less heat that may enter the building. Flat roofs generally gain less heat as their surface area is smaller, though pitched, domed, and vaulted shapes could facilitate cross and stack ventilation when combined with proper opening size and location.

2.4.5. Material Choice

Protection of public health is one out of three objectives of green buildings. Out of these objectives, two main fields were developed in the building industry to enforce these criteria on new construction: building biology, and building ecology. While building ecology is concerned with minimizing harmful effects on the environment, building biology focuses on the impact of a building on its

occupants. Effects on the environment indirectly affects humans as well, thus, these two fields are connected on some points like protection of natural resources. When designing a building's envelope, the hardest task could be choosing the right materials to balance and minimize the harm on the two directions as a perfect material palette that fully satisfies each does not exist [9].

The main criterion of building biology is reducing the use of chemical pollutants to achieve the aim of occupant comfort. Though there are no fully pollutant free materials that meet ecological criteria, products groups with lower toxicity can be used instead, with other measures like exchanging indoor air regularly. Toxic hazardous materials include asbestos, volatile organic compounds (VOC), biocides, formaldehyde and others. Architects can check the toxicity of used materials as well as other negative effects the material could produce through many credible eco-labels like ECHA (European Chemical Agency [9].

On the other hand, many sustainable materials are emerging all the time. Now, architects can make use of adaptive new materials like Phase Change Materials "PCMs", which work to absorb heat from the space and release to moderate temperature for user comfort.

Some materials were also proved to have a healing effect on building users. Wood for instance is known to reduce stress and raise spirits [10]. Other than psychological effects, material choices also affect indoor air quality and noise reduction according to the material's thickness and specifications like thermal mass, thermal storage, and opacity of glazed facades should also be taken into consideration when aiming to design a healing environment. Many online platforms have a list of used materials and specifications that architects should refer to when choosing facade materials.

2.5. Application of Healing Architecture in Healthcare Buildings

A spa, a garden, perhaps a space or a room in the house, these are what come in minds when a person thinks of a healing environment. Few also would think of their hospital or clinic. As healthcare organizations pay attention to the benefits of the healing environment, it all began to change. A specific design changes in healthcare environment was revealed through a lot of researches that can handle the reduction and solutions of stress.

2.5.1. Hospitals

The lobbies feature a bright, beautiful atrium that is filled with greens and flowers. Rooms have a view on the outdoor gardens, with big windows. These are the innovative new hospital designs that have changed patients' expectations and experiences of what a hospital is like. These buildings have design features that express the goals which are not only of improving outcomes and reducing costs, but of increasing patient satisfaction and healing chances.

2.5.2. Therapeutic Benefits

Today, many hospitals are characterized by gardens of various species, whose impact on health care has been studied more strictly. According to a study, 95% of people who walk through hospital gardens gain therapeutic benefits of being in the hospital. The sense of nature not only accelerates the patient's recovery; it also helps the hospital staff and the patient's family to deal more effectively with the stress of providing care. But it is better when the geographic location gives a beautiful outdoor space.

3. Healing in the Urban Scale

Healing environment does not mean only to designing houses and official buildings for users to feel comfortable and productive. Healing can also happen in the urban planning and through designing open spaces. Therefore, the outdoor area in general should be designed well, because people should always feel comfortable while he /she are out of the buildings, especially in the hot countries such as, Saudi Arabia and Egypt. Their outdoor area should contain the right treatment for it, so they should know the climate of the space and the sun path, to have an efficient outdoor area that people can use.

3.1. Circulation and Open Areas

The circulation in the city is really important, and it can be through street, walk path for the pedestrian ways, transport ways or special transport ways. Therefore, streets are the most important path in the city, and it is the movement vain for the cars and people, so it must be designed well and is able to have an extension in the future. Also, streets can be considered as an open area, but it is the type of open areas that have the high level of activities and movements in it, so it needs a treatment to do its job probably. Thus, old streets in Egypt or Saudi Arabia have a special character that it is not opened 2 or 3m street parallel walls. Therefore, when the street ends up with an open place like a courtyard, it will help to regulate the heat which will make the place more comfortable because these types of streets are applying the concept of the air circulation. Moreover, the old urban pattern of the old streets in the cities always kind of crusty for the users of the place to know more what is next of this building, or what the minaret of this mosque is. Also, these types of streets do not reach more than 200m length, because it is divided into several parts, and these streets should end up with an iconic building in the area. For Example, Suqal-alawy street is not a strait street, and in the end of the street, there is a Bait Nassef, and the street itself is not so hot because there are buildings on the both sides of the street, which create a shade for the place, and it make the place cool all day long.

3.2. Outdoor Spaces & Healing Gardens

3.2.1. Salutogenic Design

A salutogenic approach in landscape design combines healing, sensory, and therapeutic gardens to design a healing environment that covers different aspects of human health and well-being. It also focuses on the interdisciplinary approach in gathering and implementing design ideas in a sustainable and financially efficient way.

3.2.2. Aims of Salutogenic design

The aims of salutogenic design are to prevent illness through promoting active healthy lifestyle using natural sensory rich environments. Next, soften the built environment and work with it to create holistic environments that maximize potential of the site, the budget, and community wellbeing. Furthermore, promote wellness and reduce rehabilitation times, improve mobility, memory, and mood.

3.2.3. Essential Components of a Healing Garden

The seven basic components of nursing homes and its explanations are presented in Table 1.

Table 1. Basic components of nursing homes

Components	Descriptions
Light and Shade	Variations of light and shadow enhanced perception and add depth to the experience especially for sensory impaired people. Sunlight has the benefits of vitamin D, and natural and manufactured shading at different heights controls its intensity.
View or Save Vantage Point	A distant view from an elevated place to an accessible garden is uplifting and refreshing. It also provides options for social interaction.
Comfortable Seating	Having a place to relax balances the intensity of outdoor activities. Natural setting areas enhance imagination and social skills, which reflects to society.
Texture and Surfacing	Through choices of natural materials and designs creates sensory rich paths. Uneven paths and different slopes and levels are important for child development. It is also important to provide smooth level surfaces for accessibility.
Scale	Healing gardens should be human scale as in that the user does not feel intimidated when walking through. This could be achieved by having different zones and plants, and shading height variations.
Cultural Reference	Helps create a point of reference to the place through culture indicators like local planting and sculptures.
Personal Reference	Creating a place people belong to "... To be able to create a path through planting, to trim, pick flowers, and eat some fruit allows local people to feel it is their garden." [11]

3.2.4. Guidelines for designing with the salutogenic approach

Table 2 demonstrated the guidelines with the salutogenic approach for designing healing environment.

Table 2. Salutogenic approach for designing healing environment

Guidelines	Descriptions
Using nature's simplicity	Nature is simple yet complex. Its simplicity reduces the current information overload of everyday life. It restores balance and equilibrium in contrast to the monochromatic flat planting.
Form and function	This is achieved by working with natural systems. "When we work with nature, required input becomes less and output -benefits- becomes more … Nature does its work, and the garden costs less to maintain". [11]
Full accessibility in different scales and contexts	An interdisciplinary approach is needed to make the garden accessible on all scales. In high rise buildings, balconies and open air planted terraces can be employed. In slums, mainly soft landscape like fruit trees in walkways aid community health. Healing gardens can be designed in neighborhood communal zones or even in car parks of public buildings.
Including natural play areas	These are landscaped areas with many loose parts designed to look and feel natural. Kids use these areas to explore, examine, dream, and pretend. It enhances their social and cognitive skills as well as their physical health.
Making use of jungle planting, lawns, wild flower meadows, and herb gardens	Substituting lawns with herb gardens and using annual or perennial plants and flowers are low maintenance options that enhance biodiversity.
Other considerations	Like orientation, and sustainable rainwater harvesting drainage can be employed to support the sustainability of a healing garden.

4. Healing through Biophilic Design

Overwhelming evidence from empirical studies has proved the positive restorative effect of nature to cognitive, physiological, and psychological functions of human body. This evidence has led to the development of the biophilic design field. Authors like Stephen Kellert in "Biophilic Design" [12], researchers like Nikos Salingaros, and organizations like Terrapin Bright Green have took upon themselves developing the scientific base and illustrating practical methods of implementation for designers and practitioners [4].

Biophilia literally means "Love of life". Biophilia theory suggests that human's connection with nature is engraved in their genes from the historic humans' age when they lived in environments like the savannas. Salingaros further explains the term as "the intuitive attraction to living

things". It includes several terms like "photophilia" – a craving for natural light –, and "Topophilia" which is the instinctual need for nature. Biophilic design means designing places that make its users at ease and create a healing effect that relieves their stress and replenish their power through thoughtful connections with nature [4].

Nikos Salingaros is a researcher in the scope of urban theory, architectural theory, complexity theory, and design philosophy [4]. He stressed on the important rule of Biophilic design in creating a healing effect through the built environment and developed a set of rules and patterns as a framework for designers to develop effective biophilic design solutions.

4.1. Rules of the Biophilic Effect

Table 3 outlines the rules of the biophilic effect for healing environment. These rules can work as a checklist to be applied through form generation, material choices, facade treatment and interior design to ensure the design is biophilic, and healing.

Aside from those, William Browning et al [3] of Terrapin Bright Green have listed several patterns or strategies that could be interpreted through endless design solutions. Each pattern generates positive healing effects if correctly designed. Accordingly, designers can choose to incorporate the patterns that serve the purpose of their project. These patterns were categorized in three categories according to the relationship between nature and the built space.

4.2. The Strategies of Biophilic Design

The strategies of biophilic design for healing environment can be divided into three categories namely nature in the space, natural analogues, and nature of the space. The explanations of these strategies are tabulated in Table 4.

Table 3. Rules of the Biophilic Effect for healing environment

Rules	Explanations
Light	Natural light is required for many metabolic functions, skin health, and vision clarity, preferably diffused light as it enhances human's perception. Sun-light is also needed to re-set, and regulate circadian rhythms that are important for proper functioning of human body and fatigue prevention as well as for other biological functions.
Color	"Gray, colorless surroundings are associated by our mind's eye with illness, decomposition, and death" [4]. Color is associated with many psychological and physiological effects. "Pigmentations of partial intensity yet general harmony generate a healthy effect". It is indispensable for human well-being.
Gravity	As in structural balance. Structures that have a forced perspective which gradually get lighter as human go up exist in most natural forms as in mountains, thus they ease their mind. On the other hand, buildings that are designed in deconstruction methods of forms that look imbalanced in human eye are "biophobic" and stressing.
Fractals	Fractals are complex geometrical structures linked on many different levels. They exist in many forms and scales in nature for example in fern leaves and the patterns of natural materials. Complexity in ordered hierarchy is natural, thus provokes a positive response. Contradicting shiny or smooth surroundings cause alarm and discomfort.
Curves	In nature, almost only fractals and curved forms exist, in contrast to straight lines and right angles which are unexpected. Unless curves are gravitationally unbalanced, it can generate a positive emotional response through natural symmetry.
Detail	As in the complexity of a leaf, human expect complex details on variable scales ranging from a minimum of arm length, touchable meaningful details and patterns to larger scales. On the other hand, designs that lack details or have it in an unorganized way are chaotic and indecipherable, thus, unnatural and disturbing.
Water	Salingaros listed water as a rule and pattern because it can be one of the most important healing factors in a design as humans love to hear it, touch it, and feel it instinctively [4].
Life	This is the most obvious perception of biophilic design, including vegetation with different strategies and attracting certain habitats like birds and butterflies creates a bio diverse environment which is proven for its vast healing benefits.

Table 4. Strategies of biophilic design for healing environment

Categories	Strategies	Explanations
Nature in the space	Visual connection with nature	A direct visual link between nature and the building. It is relaxing to the eye and it is used for the purpose of reducing cognitive fatigue.
	Non visual connection with nature	This happens through sound, smell, touch, or taste. It creates an environment which reduces stress and improves perceived physical and mental health.
	Non-rhythmic sensory stimuli	Happens randomly, or are temporary. It can be achieved through sensory gardens which attracts different types of habitats to create different sounds and smells.
	Thermal & airflow variability	Provide combinations of ambient and surface temperatures, humidity and airflow, similar to those experienced outdoors, while also providing some form of personal control over those conditions.
	Presence of water	Water is both a rule and a pattern because it can be used for healing in many ways as mentioned before. Some research proven benefits include reduced stress, increased feelings of tranquility, and lower heart rate and blood pressure as well as improved concentration and memory restoration.
	Dynamic & diffuse light	Using this strategy creates varying intensities of light and shadow which change through time similar to what happens in nature. The goal is to stimulate the eye to maintain attention in a manner that encourages positive response, as well as to maintain circadian functions.
	Connection with natural systems	Connecting the users with a space that undergo natural change over time like a garden that changes with seasons. It is relaxing and enlightening as it developed the user's awareness of ecosystems and enhances his feeling of being connected to a whole.
Natural Analogues	Biomorphic Forms & Patterns	Design elements that represent natural forms makes the user receive the benefits of stress reduction and enhanced cognitive performance through making connections with a naturally pleasing environment.
	Material Connection with Nature	Using natural materials, preferably with layers of information like fractals and familiar texture creates positive cognitive and physiological responses and a sense of place. Even, if it is minimally processed.
	Complexity & Order	Browning quoted Salingaros stating: "The objective is to provide symmetries and fractal geometries, configured with a coherent spatial hierarchy, to create a visually nourishing environment that engenders a positive psychological or cognitive response" [3, 4].
Nature of the Space	Prospect	An uninterrupted view over a distance. It is useful for surveillance of hazards and opportunities, creating a sense of safety and freedom.
	Refuge	It is a space of withdrawal away from the flow of activity and protected from environmental conditions from several sides, it is important for restoration.
	Mystery	A space that is partially hidden encourages exploration in a manner that promotes stress reduction and cognitive restoration.
	Risk/Peril	"Identifiable threat coupled with a reliable safeguard" enhances problem solving skills, refreshes memory, and arouses attention and curiosity. The applicability depends on the user; it should not be extreme as to endanger psychological health.

4.3. Design Considerations

This section further analyzes design considerations in terms of time and expected effects, local appropriate design, as well as scale and applicability.

4.3.1. Time and Desired Effect

Health related priorities differ according to the function of a building. Designers should choose the appropriate design patterns to satisfy these priorities and create the desired response. Positive effect can happen through 5 to 20 minutes from connecting with nature [3]. However, some buildings functions do not allow for that much free time. For instance, emergency room nurses in hospital face great stress due to nature of their work, and they rarely find time to relax. In this case, biophilic interventions in busy paths could create the distressing effect.

4.3.2. Locally Appropriate Design

Design should be appropriate to character and density of space. Naturally, vernacular architecture is both biophilic and adaptive because it is specifically designed out of local materials and for their user's best interest [13]. On the other hand, compact and high-rise buildings in urban spaces can also achieve the biophilic effect through open balconies and terraces which create a prospect-refuge feeling, as well as in interior components and décor [13]. In landscaping, biophilic is not necessarily green; anti-drought and climate responsive vegetation can be used. However, biodiversity should exist at all times; empty

desert landscaping cannot create a biophilic effect.

4.3.3. Scale and Applicability

Biophilic design patterns can scale up from a small room to an entire district. Size and availability of space influence the applicability of some patterns like mystery, prospect, and others. It should be well understood that psychological benefits from biophilic design are enhanced by biodiversity rather than area of natural vegetation [13, 14].

4.4. Design Culture, Biophilia VS. Biophobia

Salingaros criticized the current design culture explaining that, when designing biophilic solutions, using a bottom-up approach is important, as biophilic design should be explored in terms of the user's experience and interactions through different spaces. It cannot be as effective if applied only through materialization or add in methods [4]. Sketching, can significantly aid the imagination and implementation of applying different solutions to enhance user experience, unlike using 3D modeling software in conceptual phases as what dominates the culture today which is not nearly as effective.

Biophilic design is healing to both users and architects, because "creating wholeness heals the maker". It is very satisfying and encouraging. On the other hand, there exist a darker side to some architects, who tend to satisfy themselves and their ego through combining unbalanced abstract forms. These are called "Biophobic", which causes more harm than good to its user's health in contrast to biophilia. Architects should remember the biophilic design goals of creating spaces that are inspirational, restorative, and healthy, as well as integrative with the functionality of the space and the urban ecosystem, to which it is applied. Besides above all, biophilic design must nurture a love of place. When these goals are met, it can enhance the occupants and the designers' well-being significantly.

5. Conclusion

This study examines the diversity of curable, focusing on basic design strategies for architects and other professionals. The discussion covers the healing elements of buildings, urban-scale and healing through biophilic design. The healing elements of the building compromise between light and color, circulation and spatial organization, form and building system, building envelope and healing system application in healthcare buildings. In addition, the urban scale healing highlights the circulation and open areas as well as outdoor spaces and healing gardens. Finally, the healing through biophilic design in this study outlines the rules of biophilic effects, biophilic design strategies and the design considerations. In general, this study puts forward a set of design recommendations, through which designers can design a rehabilitation environment.

Acknowledgements

The authors would like to acknowledge the assistance provided by project supervisor and the unconditional support of the Department of Architecture, Effat University.

REFERENCES

[1] U. Akhtam. Medieval Hospital Pharmacy Network of Cities of Muslim East, Problems of Architecture and Construction, Vol. 2, No. 3, 2019, Online available from https://uzjournals.edu.uz/samgai/vol2/iss3/1

[2] Bimaristan Arghun al-Kamili, Online available from https://archnet.org/sites/1801

[3] W. D. Browning, C. O. Ryan, and J. O. Clancy. 14 Patterns of Biophilic Design, New York: Terrapin Bright Green, LLC, 2014, Online available from https://www.terrapinbrightgreen.com/report/14-patterns/#sthash.Pf9mEHbT.dpuf

[4] Nikos A. Salingaros. Biophilia and Healing Environments: Healthy Principles for Designing the Built World, New York: Terrapin Bright Green, LLC, 2015.

[5] L. Cao. How Color Affects Architecture, 2019, Online available from https://www.archdaily.com/930266/how-color-affects-architecture

[6] R. Babakhani. Color and Light in Architecture and its Effects on Spirits of Space Users in a Psychological View, Journal of Architectural Engineering Technology, Vol. 6, No. 184, 2017, DOI=10.4172/2168-9717.1000184.

[7] K. M. Beauchemin, and P. Hays. Sunny hospital rooms expedite recovery from severe and refractory depressions, Journal of Affective Disorders, Vol.40, No. 1-2, 49-51, 1996.

[8] Kruithof. Tubular Luminescence Lamps for General Illumination, 1941.

[9] S. khouli, V. John, and M. Zeumer. Sustainable construction techniques, From structural design to material selection: Assessing and improving the environmental impact of buildings, 2015.

[10] M. Kairi. The positive health effects of wood as a building material, Online available from http://www.woodarchitecture.fi/articles/positive-health-effects-wood-building-material

[11] G. Souter-Brown. Landscape and urban design for health and well-being, London: Routledge, 201-264, 2015.

[12] S. R. Kellert, J. Heerwagen, and M. Mador. Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life 1st Edition, Wiley, 2013.

[13] W. Zhong, T. Schröder, and J. Bekkering. Biophilic Design in Architecture and Its Contributions to Health, Well-Being, And Sustainability: A critical review, Frontiers of Architectural Research, 2021, Doi:10.1016/j.foar.2021.07.006

[14] B. Grinde, and G. G. Patil. Biophilia: Does Visual Contact With Nature Impact On Health And Well-Being?, International Journal Of Environmental Research And Public Health, Vol. 6, No. 9, 2332–2343, 2009, Doi:10.3390/ijerph6092332