What is biophilic design and what influence does it have on mental health? What can be learnt from past and recent projects?

An exploration of how merging nature and architecture positively impacts mental health and how biophilic design can be used on a larger scale in the built environment.

Figure 1: Ho, L. *Factory in the Forest Walkway View* (2017)

Kingston School of Art

HA6101 Dissertation

The Relationship Between Biophilic Design and Mental Health

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Key Words:

1. Biophilic Design: “This is an approach to architecture that seeks to connect building occupants more closely to nature. Biophilic designed buildings incorporate things like natural lighting and ventilation, natural landscape features and other elements for creating a more productive and healthy built environment for people.” (Gloede, 2015).

2. Mental Health: According to the World Health Organisation (WHO): “Mental health includes our emotional, psychological, and social well-being. It affects how we think, feel, and act. It also helps determine how we handle stress, relate to others, and make choices. Mental health is important at every stage of life, from childhood and adolescence through adulthood.” (World Health Organisation, 2020).

3. Social Cohesion: The U.S Department of Health and Human Services stated that: “Social cohesion refers to the extent of connectedness and solidarity among groups in society. It identifies two main dimensions: the sense of belonging of a community and the relationships among members within the community itself.” (Manca, 2014).

4. Colour Theory: Focuses on the relationship colours have with psychology and how different colours can influence people’s emotions. It also examines how colour theory can be used intentionally in design (Brody, 2015).

List of Content:

List of Figures:

Figure 12: Ho, L. (2017) *Factory in the Forest Interior View*. Available at: https://www.archdaily.com/947771/factory-in-the-forest-design-unit/5f60a86863c0178c49000c74-factory-in-the-forest-design-unit-photo?next_project=no (Accessed: 10 January 2022).

Figure 13: Ho, L. (2017) *Factory in the Forest Natural Ventilation*. Available at: https://www.archdaily.com/947771/factory-in-the-forest-design-unit/5f60aa7e63c0178eee0009a9-factory-in-the-forest-design-unit-photo?next_project=no (Accessed: 10 January 2022).

Figure 14: Halbe, R. (2006) *Casa Levene Initial Planning Sketches*. Available at: https://www.archdaily.com/445022/casa-levene-en-el-escorial-no-mad/5275b571e8e44e88a0000788-casa-levene-en-el-escorial-no-mad-photo?next_project=no (Accessed: 10 January 2022).

Figure 15: Halbe, R. (2006) *Casa Levene Exterior View House With Trees*. Available at: https://www.archdaily.com/445022/casa-levene-en-el-escorial-no-mad/5275b571e8e44e88a0000788-casa-levene-en-el-escorial-no-mad-photo?next_project=no (Accessed: 10 January 2022).

Figure 16: Peñalver, X. (2006) *Casa Levene Roof View With Reflected Trees*. Available at: https://archello.com/story/39637/attachments/photos-videos/4 (Accessed: 10 January 2022).

Figure 17: Halbe, R. (2006) *Casa Levene Interior View Panorama Windows*. Available at: https://www.archdaily.com/445022/casa-levene-en-el-escorial-no-mad/5275b58ee8e44e88a0000789-casa-levene-en-el-escorial-no-mad-photo?next_project=no (Accessed: 10 January 2022).

Figure 18: Astbury, J. (2019) *Interior View Courtyard Home.* Available at: https://www.dezeen.com/2019/07/04/kyoto-home-07beach-glass-fronted-bathroom/ (Accessed: 10 January 2022).

Figure 19: Astbury, J. (2019) *Interior View Open Floor Plan House.* Available at: https://www.dezeen.com/2019/07/04/kyoto-home-07beach-glass-fronted-bathroom/ (Accessed: 10 January 2022).

Figure 20: Astbury, J. (2019) *Interior View Bathroom Tile Wall.* Available at: https://www.dezeen.com/2019/07/04/kyoto-home-07beach-glass-fronted-bathroom/ (Accessed: 10 January 2022).

Figure 21: SETAC World Congress. (2021) *Aerial Shot of Singapore Bay.* Available at: https://singapore.setac.org/setac-world-congress-postponed/# (Accessed: 16 January 2022).

Figure 22: Getty. (2020) *Singapore's Changi Airport.* Available at: https://www.nationalgeographic.co.uk/travel/2019/06/whats-new-singapores-changi-airport (Accessed: 16 January 2022).

Introduction:

This dissertation will focus on biophilic design and will look at how such design moves in architecture influence people's mental health. There is accumulating evidence that green spaces have a beneficial effect on mental well-being. This could be observed in the early stages of the Covid-19 pandemic. It was during the pandemic that many of us sought out green spaces more regularly and it became part of our daily routine to go for a walk in the park or forest. Not only for the sake of physical activity but also to calm our minds to cope with our new living situation. This raised questions such as: why does the public need to go outside and leave their homes to get in touch with nature? Why are green spaces not combined more often with design and architecture? These questions will be used to guide my research on the effect of green spaces on people's mental health. The examination of a range of historic and current case studies, in private and public spaces, and how they have successfully or unsuccessfully used biophilia in their built environments will allow for a critique on the use of biophilia in design and support my arguments on the benefits of green spaces merging with design.

Sustainability has become a widely used term in many fields of study and work, specifically in design. However, biophilic design, as often assumed, is not part of the sustainable design movement. Rather has a focus on restoring and improving the human connection with nature through combining architecture with green spaces.

This dissertation seeks to answer these main questions: What is the mental health benefit of combining green spaces with architecture? How can we further develop and apply biophilic design to promote mental health and societal cohesion? The dissertation has been divided into different chapters that aim to answer these questions. Chapter one will introduce the history of our relationship with nature, explain what biophilic design is, expand on the history of biophilic

design, and what the main aim is. It will introduce a past case study and start to create links between biophilic design and the impact it has on mental health. The second chapter examines case studies that have been unsuccessful in implementing the principles of biophilic design. This gives a greater insight into the aim of biophilic design and how a built environment has an impact on mental health. Chapter three focuses on successful biophilic projects and compares those projects against ones that were unsuccessful. This is done through analysing the projects against the key core principles of biophilic design and using visual aids. The last chapter examines what the future of biophilic design may look like and what impact this will have on the mental health of a larger group of people.

The main goals for this dissertation are to explain and prove that being in touch with nature is beneficial for our mental health and how different case studies effectively show different ways this can be achieved through design. To bring awareness to the current modern urban lifestyle and how that is not mentally sustainable, but that combining architecture with biophilia, some mental health problems could be resolved. Lastly, to bring further attention to biophilic design as it can be a vital part of our future in design as well as affect how the public live as a community. The research completed will strengthen my knowledge on spatial design and how people are sensitive and easily impacted by their environments. Having a solid understanding of how design links to people and their mental health ensures becoming a more critical thinker as well as a more understanding designer.

Chapter I - Biophilia in Design & Mental Health:

Society's relationship with nature is broken and it can be identified from the contact the public have with green spaces as these are now being seen as a luxury good in the modern urban lifestyle. When in reality from the beginning of time, humankind has always lived with nature.

Why has this changed? Humans have relied on nature for all of their needs such as food, water and resources, so there has always been a strong bond between humans and nature. However, in recent times, as industry expanded its influence on human existence, particularly during the industrial revolution, this bond has decreased. Humans were gradually alienated from nature as they became more reliant on man-made services in industrialised cities than on (pure) nature (Moghadam, 2015). Can biophilic design mend that bond?

The term "biophilia" was defined as "love of life" in ancient Greece (Duduch, 2021). Oliver Heath, an English sustainable architect and interior designer whose work is focused on improving health & well-being through biophilic design, defined being a biophilic designer in an interview with Dezeen as “somebody that tries to enhance the human connection between nature and the building. It’s a form of human centre design and predominantly looks at health. It then also focuses on creating a connection with nature and the many benefits it can bring to the built environment.” (Fairs, 2021). Although it may appear to be a new trend in architecture and interior design, the concept of biophilia was first presented by psychologist Erich Fromm in 1964 and emphasised in the 1980s by biologist Edward O. Wilson, who examined the lack of relationship to nature induced by urban life. The guiding premise is straightforward: connect individuals to the environment in order to improve their mental health and quality of life. How might architecture do that? By looking for ways to incorporate nature into its designs through natural elements or processes. Incorporating natural characteristics into the constructed environment is the most typical strategy. Natural components, such as water, flora, and sunlight, are frequently utilised. The use of organic shapes and silhouettes rather than straight lines is another common feature of biophilic projects, even though the relationship with nature is not always formal, but rather a process of emulating nature's distinctive techniques (Duduch, 2021). Oliver Health related biophilic design and its beneficial attributes to the Savannah

Hypothesis by Kaplan & Kaplan. It suggests that when individuals have access to healthy forms of nature and can be in direct contact with those spaces from a point of safety, it has the ability to reduce heart rates and blood pressure levels. Simply put, when people look over spaces filled with healthy forms of nature, such as greenery, water, and natural light, it makes them feel content and positive. Lots of the ideas of biophilic design are wrapped up in this vision of the spaces that make us feel at ease. The problem with this is that a large percentage of the world's population lives a modern urban life. So the question remains, how can designers and architects translate these ideas from the Savannah Hypothesis into our built environment? That is where biophilic design comes in (Fairs, 2021)..

There are three core principles to biophilic design. Firstly, direct contact with nature is where real sensory forms of nature are brought into the built environment. This includes trees, plants, light, water and fresh air. Secondly is the indirect reference to nature and that is how mimicking or evoking a feeling of nature using natural materials, colours, patterns, textures and shapes. Thirdly is the human spatial response, this is how to create spaces that nurture us and support us. It has a focus on creating energising, relaxing and restorative spaces for the people that use them (Kellert, Heerwagen and Mador, 2013).

In recent years, biophilic design has become more popular and supported. An issue that arises is that by combining nature and architecture, projects are often classified as being biophilic without making a real difference to the design process, its key features or the finished product. However, since the criteria for biophilic design vary depending on who the judge is, creating specifications for the purpose of this dissertation to assess different case studies will allow for more of a non-bias, thorough and fair examination. The projects have been subjected to these following questions based off of the key core principles: 1) Has it integrated multiple natural

elements into the built environment? e.g.) green spaces, plants, natural ventilation and sunlight. 2) Has it included other sustainable design moves? e.g.) natural materials. 3) Has the shape of the built environment been adapted to the natural environment? e.g.) biophilia, where there is a strong use of organic shapes and silhouettes. 4) Does the built environment have a positive influence on people's mental health? A successful study of using an indirect reference to nature was done by Joanneum Research in 2008 in Austria and they compared a classroom of mainly solid wood materials with a standard classroom. They looked at the effect of using natural materials in a classroom of 52 children and the study showed that the heart rates of the children in the wooden classroom were significantly reduced by an average of 8600 beats per day. There was a decreased perception of stress, the children were visibly more relaxed and it had a positive impact on their performance (Heath, 2021).

Design Case Study 1: New Ash Green

Even with biophilic design becoming more popularised in recent years, its concept has been used in practice starting decades ago. A successful project is New Ash Green, a village in the Sevenoaks District of Kent, England designed by Eric Lyons and Span in the 1960s. It was intended that New Ash Green would provide a range of functions such as accommodation, a church, shops, a primary school and a community centre. Construction was similar to that of industrial buildings and all of the amenities in the houses were standardised. When asked about their construction technique, Eric Lyons said that; “we have produced from this basic core house a method of construction of large, preformed timber floor panels, wall panels and roof panels. The panels are made in the factory on the site.” (figure 2) (Simms, 2006). This construction technique is very sustainable and can be seen in modern construction approaches today. Lyons thought that each neighbourhood should function on an intimate pedestrian level. The compact layout of the residences, pathways and communal green spaces encourages

inhabitants to engage more socially, creating a cohesive society. Additionally, the concept of having constant access to common green spaces was of great value. Rather than one individual park, plots of greenery are all over the Village, ensuring there is no need to commute to a common green area, as can be seen in figure 3 (Simms, 2006). “This Village project provides the chance to extend the experience we have had. As a means of maximising natural light penetrating into the houses, solar orientation was taken into consideration at the planning stages of a new neighbourhood.” (Simms, 2006). The houses are also placed following the contours of the land, showing that there was an appreciation for the farmland and nature surrounding New Ash Green rather than a need to just build a community without any regard for its context. This case study shows that biophilic design is not a new trend that has recently gained popularity, but rather has been a building technique for many decades now, just often overlooked. With its access to green spaces within the community and vast green land outside, as well as lots of natural light and sustainable building techniques, this is a core case

Figure 2: Simms, B. *Construction of First Houses on Over Minnis* (2006)

Figure 3: Mansell, E. *New Ash Green II* (2016)

study on the start of biophilic design and its current impact on how designers design and construct today.

There is a greater desire to create and design greener and healthier cities. However, it is a juxtaposition to have public green spaces, such as parks, playgrounds, and residential greenery in an urban area but with a clear divide between the two. The separation could be literal such as a fence or a visual divide where the park is a square plot in the middle of a residential area. An example of this is Central Park in New York City where in the middle of the city, a large park was placed without merging it with the buildings creating a clear divide between nature and urban, as can be seen in figure 4. Rather than suggesting people live together with nature, our cities are still designed to live separately. In a nationwide study in Denmark, researchers from the University of Aarhus found that childhood exposure to green spaces such as parks, forests and residential greenery, reduces the risk of developing a range of psychiatric disorders during adolescence and adulthood (Engemann, 2019). Researchers from the VU University Medical Centre in Amsterdam revealed that from the 300,000 Dutch adults and children that took part in a research study, people living close to green spaces were less likely to suffer from anxiety and depression and tended to have lower rates of psychiatric disorders compared to those living the modern urban lifestyle. (Norton, 2019). In a study in Germany at

Figure 4: That's Earth. *Aerial View of Central Park, New York* (2014)

the University of Bonn, research was done on the impact of academic green space and its effect on the mental health of students. The results revealed that having green spaces on and around campus is a health-promoting environment and benefited the academic success of the students and helped increase their focus, mental health and performance (Foellmer, Kistemann and Anthonj, 2021).

The Covid-19 pandemic indicated that being in touch with the natural environment could ease the strain on mental health problems. As suggested by Violeta Berdejo-Espinola and her team in a report on how urban spaces are used in a time of stress: “The pandemic presented an opportunity to measure the role of green spaces as a nature-based coping mechanism during a stressful life event that was simultaneously experienced by a large portion of the global community.” (Berdejo-Espinola et al., 2021). The fast-moving situation, paired with poor or insufficient information, resulted in a variety of wide-ranging psychological effects. A study in Brisbane, Australia showed how badly people were affected by the Covid pandemic and all ensuing restrictive measures and lockdowns and how seeking urban green spaces was a great benefit to people's mental health. In one survey, more than half said the psychological effects of COVID-19 were moderate to severe, and one-third said they had moderate-to-severe anxiety. Out of the people surveyed, about 81% increased their urban greenspace use (Berdejo-Espinola et al., 2021). Increased usage of urban green space during stressful times, such as the COVID-19 epidemic, has the potential to mitigate some of the stressor's harmful impacts. The ability to use nature-based coping strategies during times of personal or communal stress will be maximised if sufficient urban green space is provided for all parts of a community. This is where biophilic design can make a difference. Combining architecture with nature, allows people to get those same psychological benefits at home, as they would outside. Research has demonstrated that green spaces, even if small, do a lot for an individual's mental health.

However, even with all of this accumulating evidence of green spaces having a positive impact on mental health, designers still model our cities to live separately from nature, not with it.

Chapter II - Unsuccessful Case Studies:

Some projects are deemed to be successful biophilic design projects, but do not adhere to the core principles. Using nature in design may have positive effects on mental health, but that is only the case if each project follows the principles; direct contact with nature, indirect reference to nature and the human spatial response (Kellert, Heerwagen and Mador, 2013). These projects have shown that whilst the trend of combining nature with architecture grows, it does not immediately suggest it is a successful biophilic building.

Design Case Study 2: Tower House

Designed by the architect Albor Arquitectos in 2021, the Tower House in Cuba gets its name from the concrete dwelling that overlooks the Cienfuegos skyline with views of the sea and urban life (figure 5). The main intention of this building was to creayte a house that allows for blended indoor and outdoor living (Barandy, 2021). The architects said that “the general residential functions of the house have a direct connection with their surroundings, either the

Figure 5: Arquitectos, A. *Exterior Photograph Tower House* (2021)

intimate garden at the ground level or the town and sea beyond. The garden unfolds from its confines and travels vertically, climbing the full height of the tower. With this, the private lush courtyard is expressed from far across the neighbourhood and defines the identity of the house." (Coulleri, 2021). The garden is meant to act as a natural shade during the tropical climate all year round, and the concrete building in combination with the gardens will act as a natural ventilation system (Barandy, 2021). However, the residents still live separately from nature. When they close the windows and doors, there is a complete disconnect from what was achieved when the doors were open, as can be seen in figure 6 & 7. The watchtower also acts as a metaphor for observing the relationship between the sea and urban life but does not find a way to mend that relationship. Having the garden come to life more vertically up onto the house is a great indication for how the interior of the house should be; allowing the green spaces that are luscious outside, to become a part of the architecture of the tower on the inside.

Figure 6: Arquitectos, A. *Interior Photograph Tower House* (2021)

Figure 7: Arquitectos, A. *Interior Photograph Kitchen Tower House* (2021)

Furthermore, the geometry and shapes of the tower are very geometric and linear and have no connection to the environment outside.

What was successful was the use of windows and allowing natural light to interact efficiently. Because of its tropical location and the long tower, the sun had to be blocked constantly to prevent overheating and losing its natural ventilation. There is no glazing which allows for continuous natural air conditioning and the shades placed in the window gaps can be adjusted depending on the time of day. The concrete was also a wise choice for acting as a continuous cooling system and because of its ability to absorb and release heat slowly, it distributes temperatures over time, making daytime cooler and nighttime warmer, which is ideal given its tropical location.

Although this residential project in Cuba seems to embody the essence of biophilic design, a closer analysis will show why it is not a successful and completed biophilic project. Comparing this built environment to the core principles of biophilic design, this residential space is an unsuccessful biophilic project. Starting with the disconnect it has from nature when closing the doors and windows, it shows how nature plays no further role in the interior or relates to the architecture. Additionally, the built environment has not adapted its shape to the natural environment but has remained linear and geometric, giving a stronger reflection of the urban life outside. There is a focus on natural ventilation in the use of materials, the placement, and types of windows. The effect biophilic design could have on people's mental health within this space is limited because of its disconnect when the doors are closed. In the daytime and during dry weather, the essence can be experienced more and create that sense of calm. In other times, one resorts to more of an urban experience than with nature.

Design Case Study 3: Apple Store

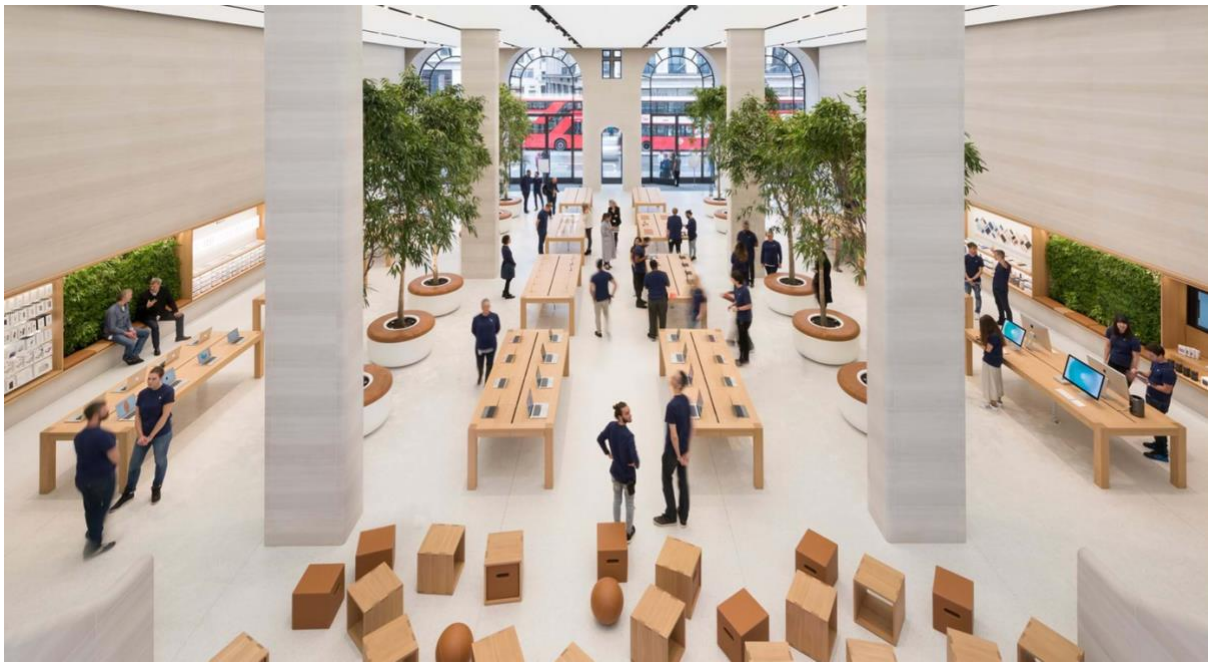

Figure 8: Foster & Partners. *Interior Photograph Top View* (2016)

Another project that seems to have the basis of a biophilic design project is the Apple store on Regent Street in London. Designed by Foster + Partners and completed in 2016, the site has a Grade II listed historic façade now restored and preserved. As described by the architects, the store has "the essence of a town square that is flexible and welcoming." (Foster + Partners, 2016). Created in the trademarked style of all Apple stores around the world, this one brings great emphasis to its large windows and bright lightbox ceiling. The windows create a dynamic relationship between the indoor environment and the street, an interactive shopfront experience when first approached (figure 8). Once inside, the open floor plan makes everything easily accessible and brings emphasis to its large 7.2-metre double-height ceiling. This allowed for enough space to add twelve Ficus Ali trees on the ground level. These are potted and surrounded by cushioning, acting as another place to sit (figure 9) (Morby, 2016). The materials that were chosen for this project include sandblasted Castagna stone for the walls and staircase, terrazzo flooring and wood for their iconic display cases which are a sympathetic reflection of the historic nature of the site (Foster + Partners, 2016).

Figure 9: Foster & Partners. *Interior Photograph Wide View Ground Floor* (2016)

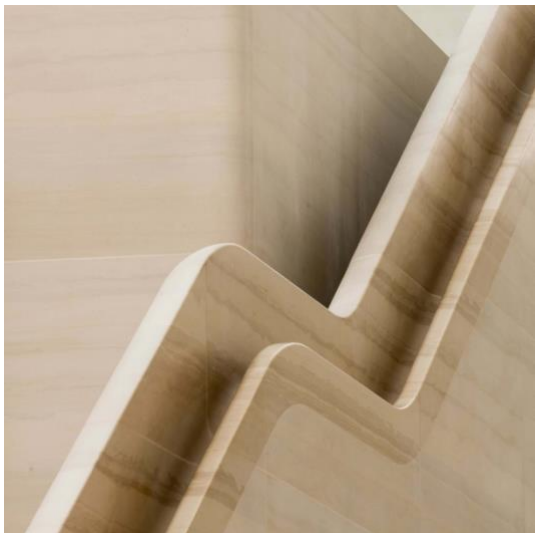

Figure 10: Foster & Partners. *Interior Photograph Detail View Handrail* (2016)

Looking at the site, initially, it does give off an ambience of biophilic design. The natural materials that were included, the large windows allowing great sources of natural light, the trees that were added to the design introduce a connection with nature inside. Some of the details within the space have organic shapes, such as the staircase which creates a connection to nature, as can be seen in figure 10. However, the way that the biophilic core principles have been applied is lacking and therefore it cannot be considered a successful biophilic design project. The trees have been strategically inserted into the built environment and are seen more as a prop, than a source of creating a greater connection to nature. The vertical green walls that have been added to the space have a similar limited effect as they are not real plants. The shape of the built environment has adapted some elements to the natural environment but otherwise has remained linear, creating more of a connection to urban life than nature. Overall, the shop has some biophilic elements but they don't create an integrated experience. That is the main issue with biophilic design becoming more popular, it is often more of an aesthetic, rather than a goal. Occasional, transient, or isolated experiences of nature are not good biophilic design.

It can be argued that there is difficulty in creating a connection to nature on one of the most iconic shopping streets in the world in a highly urban area, however, the point of biophilic design is to open up any built environment to connect with nature. The employees have stated online that working in an Apple store with a large source of natural light is more engaging and keeps them in touch with the urban life outside. Customers have similarly said online that the interior is very bright and open and allows for a clear overview of the interior and all the products. Yet they mentioned that the interaction with the trees is "limited", that they "don't blend in as part of the architecture", that the "architecture is intimidating with overly high ceilings and the luxury materials apple use" and that the trees are "inserted in to try to make up for the architecture of the space" (Anonymous, 2021). This is the opposite of what Fosters & Partners wanted to achieve as they wanted the natural materials, and green spaces to create a grounded experience. In conclusion, comparing this project to the core principles of biophilic design and my specifications, this project is not a successful biophilic design project.

Chapter III - Successful Projects in Biophilia:

Biophilic design seeks to re-connect and re-build our bond with nature, through the spaces consumers and visitors live, work, converse and entertain in. It can have a positive impact on people's mental health. Looking at successful biophilic design projects will reiterate the positive relationship between our built environments and the psychological impact of those spaces. These projects have shown successful ways in which this can be accomplished, unlike the projects evaluated before.

Design Case Study 4: Factory in the Forest

Some buildings are strong in the blending of biophilia and design/architecture. A great example of how biophilic design can have a positive influence on people's mental health and can enhance productivity is an office building and factory in Penang, Malaysia. The project is from 2017 and was designed by Design Unit Architects Sdn Bhd for Paramit, an electronics manufacturing plant company specialising in medical & satellite equipment.

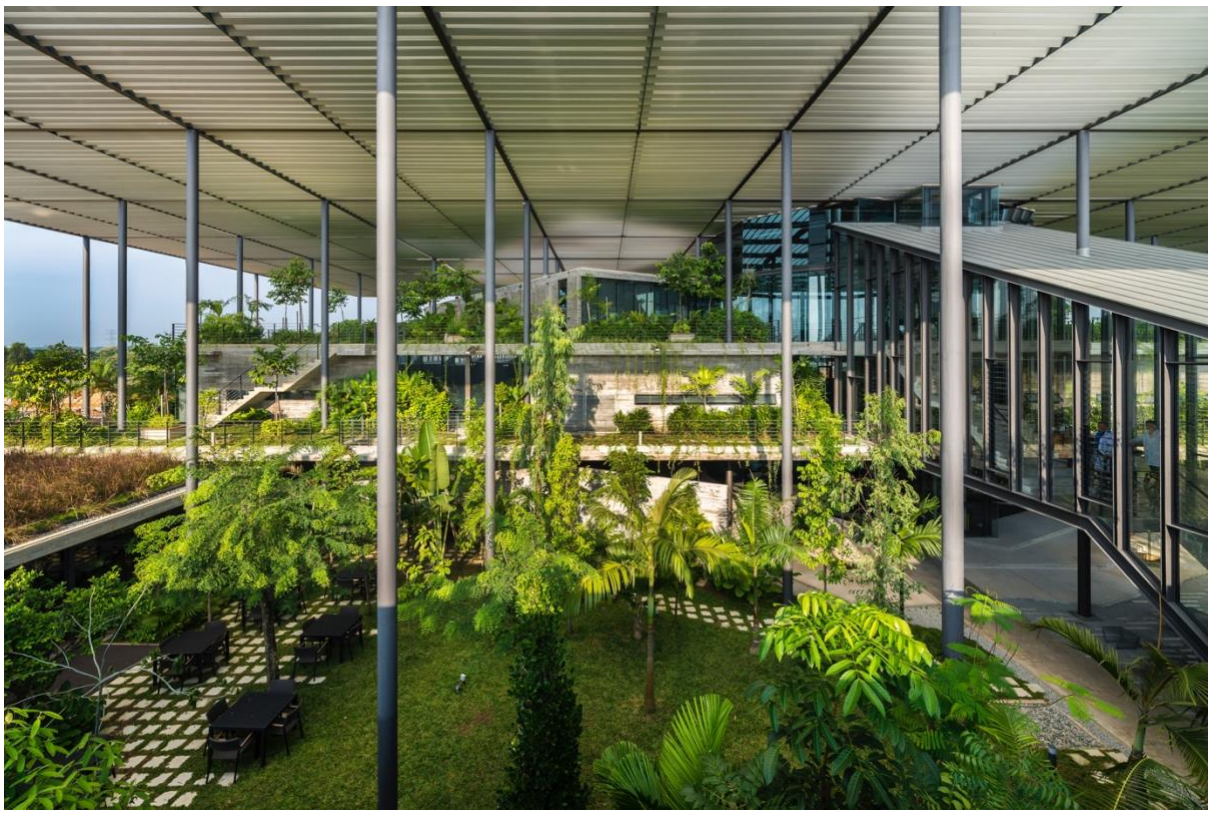

Figure 11: Ho, L. *Factory in the Forest Building View* (2017)

The main aim for this building was to create a factory and office site that was climate-responsive and focused on energy efficiency, two key elements that are normally very polluting and damaging for a factory. The most important factors were energy efficiency, water efficiency, and focussing on biophilia. This project has achieved biophilia through the range of materials, construction methods and using biophilic design moves. This site is designed as a forest that penetrates, surrounds, and steps over the building, allowing for the most possible contact with nature - green, breeze, scent, sound, touch (figure 11). A canopy supported by a

'forest' of columns ties the office and courtyard together while also providing shade from the tropical sun. Roof gardens are accessible from the office floors, and employees are invited to use them for breaks and meetings. The office and factory are separated by a green courtyard with views and access from both parts of the building. By combining forests and architecture they are promoting working and spending time outdoors. Trees and vegetation provide additional shade which in turn help reduce the building's cooling load in a passive manner. The limited materials, as can be seen in figure 12, reinforced concrete, steel structure, windows, and natural landscape, that have been chosen for this project, serve a purpose as they act as a primary cooling system. The structure is designed to protect from the sun while allowing diffused natural light to enter, decreasing the need for artificial lighting, as can be seen in figure 13 (Abdel, 2020). The architects mentioned that "a series of vertical plasterboard reflector panels are positioned underneath the vertical glazing to block the direct low sun at certain times of day, and to reflect diffused daylight into the factory space to achieve an even

Figure 12: Ho, L. *Factory in the Forest Interior View* (2017)

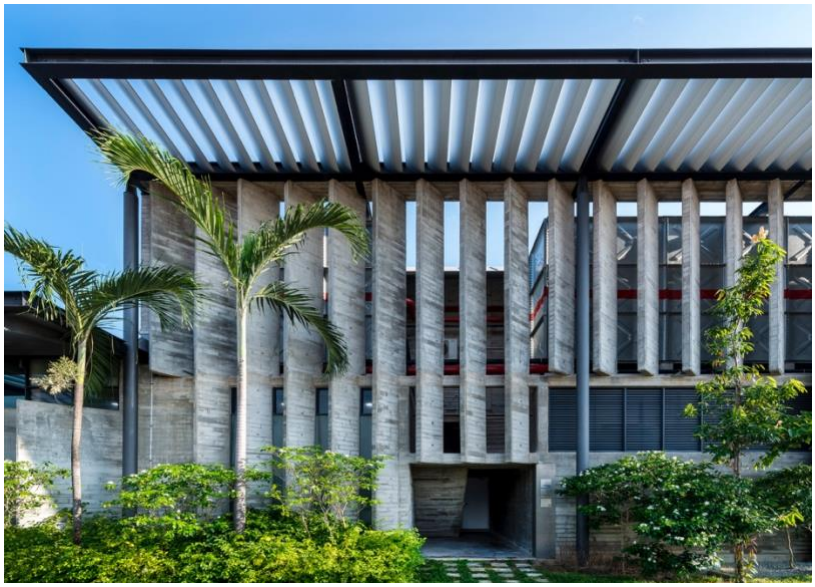

Figure 13: Ho, L. *Factory in the Forest Natural Ventilation* (2017)

daylight distribution. The overall result is a pleasant natural light without glare all year round." (Kishnani, 2018).

To evaluate the success of this project successfully and fairly in biophilia, it can be analysed against the three core principles of biophilic design. There is a strong use of direct contact with nature which includes plants, natural light, ventilation, and fresh air. The plants dominate the exterior and interior landscape of the built environment, which creates a healthy work environment. There are large windows and glass doors that, even when indoors, connect workers to the outside directly, creating a flexible and modular space adjustable to people's needs. The structure has been created so it does not trap heat but creates a natural source of ventilation to cool the space making it a comfortable working environment. The sunlight that shines through is also filtered down so that instead of a glare during a specific time frame, it is constant throughout the day. These elements create a strong relationship between the built environment and the natural elements. Unlike the Tower House project by Albor Arquitectos, this project connects the people working in this environment with nature, not just with the plants that have been placed indoors or clad outside of the building. The entire experience connects the people that interact with the space to the natural environment, from the plants to the sunlight and the breeze. It is a more engaging space, compared to the Tower House with a limited experience kept to the garden, regardless of it being a public or private space. As with biophilic design, the aim is the same so there should be no boundaries depending on the scale of the project or its use. This office and factory has become a more pleasant work environment and increased productivity in doing so. Workers stated that they preferred working in this building to their previous office and factory site. This environment has led to increased productivity, overall work ethic and enthusiasm in the work environment. Furthermore, the workers revealed they were feeling "happier and healthier" in this new working environment

(Kishnani, 2018). This is further proof of what studies have already shown; “respondents to the Human Spaces Global Report who worked in environments with natural elements reported a 15% higher level of well-being, a 6% higher level of productivity and a 15% higher level of creativity” (Birrane, 2016). To conclude, comparing this project to the core principles of biophilic design, this project is a highly successful biophilic design project.

Design Case Study 5: Casa Levene

Having looked at how biophilia was successfully integrated in a public building, the research will extend to how it can be used and successful in the private and domestic sectors. In Madrid, Spain, Spanish architect Eduardo Arroyo from the NOMAD Studios went about the challenge of building a home on a plot of land in the middle of an ancient pine tree forest. The house was completed in 2006 and Casa Levene is now one of the most famous Spanish design houses of the past decade (Panalever, 2007).

The main task for Arroyo was to build a functional custom family home on a plot of land heavily populated by trees without damaging the original land. An issue that arose with the construction of this house was building so close to the trees. Typically, you need to be outside of the tree canopy because that is where the roots are. Trees are so vulnerable that severing the roots will kill a tree. What the architect worked out is that he could put micropiles down between the tree roots, initial planning can be seen on figure 14. These are drilled into the ground, and then you have a building built off these delicate

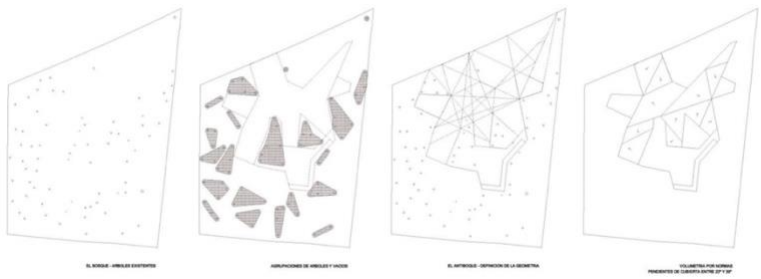

Figure 14: Halbe, R. *Casa Levene Initial Planning Sketches* (2006)

fingers of steel that go down between the roots (Arroyo, 2013). So the way this house was built was an environmentally friendly solution.

Figure 15: Halbe, R. *Casa Levene Exterior View House With Trees* (2006)

Figure 16: Peñalver, X. *Casa Levene Roof View With Reflected Trees* (2006)

The finished built environment is a maze of angular engineering. The floor plan of this contemporary structure cleverly takes its shape from voids left between the trees (Panalever, 2007). What you then end up with is a building that has taken the shape of the site, rather than an architectural tradition. Outside the building has been entirely clad in basalt, a type of dark volcanic rock that reflects the surrounding trees and almost allows the house to blend into the pine forest, as can be seen in figure 15 & 16. The geometry of the building creates an original landscape in itself, ensuring it connects well with the pure nature of its surroundings and respects the environment it's in and the land it is built on. The form of this building shows

a complete empathy for the forest. On the inside, this relationship is shown more deeply with a mix of organic and geometric shapes.

Figure 17: Halbe, R. *Casa Levene Interior View Panorama Windows* (2006)

There are large windows in every room creating a personal relationship between nature and the inside (Arroyo, 2013). This also creates dynamic shadows every day from the trees outside shining in. Bright colours have been used on the inside, following colour theory, as can be seen in figure 17. This is where colours are used in design to influence the occupier's mood and set the tone. Reds and oranges create a sense of warmth and lift your mood whereas blues and greens create a sense of calm and bring focus (Interaction Design Foundation, 2018). Casa Levene is a prime example of how using colour theory can create a calming human spatial response. The materials used are very low-tech, ranging from acrylic panels and stainless steel, bringing focus to the shapes of the interior and the views outside. The interior surfaces allow

the light to bounce around indoors, creating a continually changing interior and dynamic relationship. Because of its large windows, there is a connection with the outdoors and one can live its day alongside nature. It is an invitation to live more outside and experience the terrace and swimming pool with nature, rather than just observing it from a distance.

Analysing this project against the three core principles of design, it is a successful biophilic design project. Although it does not incorporate physical sensory forms of nature into the built environment, this does not change the success of the project as the large windows create a strong visual relationship with the outdoor environment. The climate of Madrid also allows the inhabitants to mostly live outdoors with the forest to have a more first-hand relationship between them, the house and nature. This creates a relaxing human spatial response, another core element to a successful biophilic design project. Thirdly is the indirect reference to nature, which refers to the shape of the building and the respect it showed to the natural environment. The building takes shape around the trees rather than adapting the environment to the shape of the house, it has respected the landscape and kept it in its pure and respected state. This creates a bond with nature, as instead of creating a plot of land next to trees, the trees surround the house, which is where the term of biophilic design started. Respecting nature enough to live with it, rather than next to it. The materials that clad the outside and top of the house reflect the natural environment outside the house, creating harmony between the built environment and nature. This is exactly what biophilic design is all about.

Design Case Study 6: Traditional Hinoki Home

Another example of a successful private biophilic design project is a family house in Kyoto, Japan. Designed by architect Joe Chikamor from 07BEACH in 2019, this family home is a combination of a modern and traditional Japanese style. The house is placed in a densely populated area and is edged in by homes in the east, west and south. The design is simple in its essence with an open-plan layout and a double-height living room, as can be seen in figure 18. Chikamor included a gabled roof with large skylights to bring daylight into the home (Pintos, 2021). “Since the compact site and programming left little room for a backyard garden, the living area was developed as an interior courtyard situated around an indoor tree.” (figure 19) (Wang, 2019). Inserting a tree into the interior courtyard was a challenge as “the conditions a tree needs and the ones humans need are almost the opposite.” (Pintos, 2021). After much research, a ficus tree was chosen for its evergreen nature and easy care. As they prefer bright indirect or filtered light it makes them ideal for its indoor location (Pintos, 2021).

Figure 18: Astbury, J. *Interior View Courtyard Home* (2019)

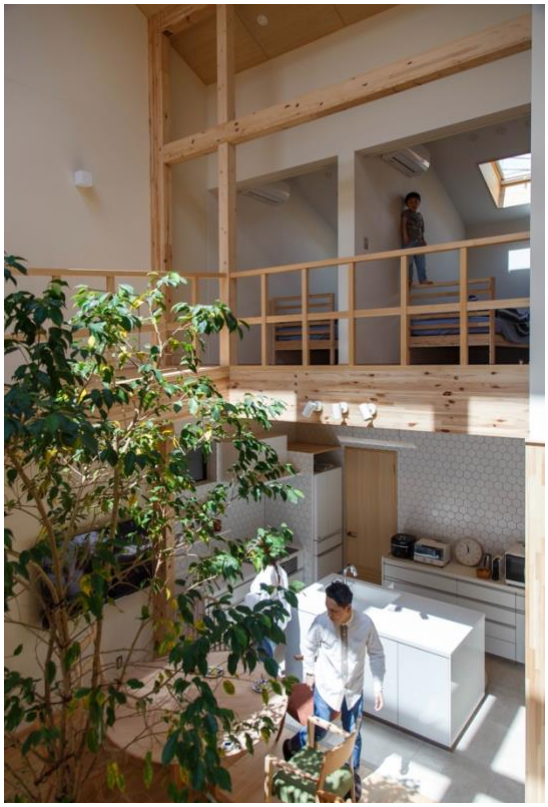

Figure 19: Astbury, J. *Interior View Open Floor Plan House* (2019)

Figure 20: Astbury, J. *Interior View Bathroom Tile Wall* (2019)

Hinoki timber strongly dominates the interior, where the walls, floors, ceilings and interior elements are all made of hinoki. It was selected for its calm and plain grain as well as its bright colour. Hinoki wood also functions as great heat insulation and is light and soft making it easy to build with and soft to walk barefoot, which is traditional etiquette in a Japanese home. The kitchen and bathroom are, however, not fully clad with wood for functional reasons. The materials that have been chosen for those spaces are tiles that are minimal in colour and texture, to allow the wood to visually strike through more strongly. This creates a harmonious balance between the different rooms of the open-plan house. The bathroom tiles are a similar kind of green as the tree selected, which connects that natural essence throughout different spaces of the interior. Chikamor, mentioned he wanted two combinations of green. "One is the central tree as a living creature and another is manmade green on the bathroom wall. They emphasise each other's charm." (Wang, 2019). As can be seen in figure 20, at first glance the tiled green wall has the effect of an indoor green wall and brings a similar kind

of peace and calm. This also relates to colour theory used in Casa Levene by NOMAD Studios as previously discussed, where a variety of natural colours were used to zone out different parts of the house, evoking different emotions for each area. In this house, however, there is limited use of colour aside from the contrasting green elements. The colour green creates peace, rest, and security. Having it in the centre of the house and in the bathroom allows for constant relations to this colour and its psychological effects. This is where the open-plan layout becomes highly effective as the green and calming elements can be experienced from all areas of the house.

Initially, this project might seem too simplistic for a successful biophilic design project. However, it embodies a lot of the key core principles of biophilic design, most specifically the indirect reference to nature and how to mimic or evoke a feeling of nature using natural materials and textures. This can be seen in the strong use of natural hinoki timber wood throughout the entire house. Studies have shown that wood's inherent warmth and comfort have the impact of lowering blood pressure and heart rates, reducing stress and anxiety, and enhancing social connections among people. Wood products have also been demonstrated to improve indoor air quality by regulating humidity within a room (Chua, 2015). Additionally, the use of creative natural light in the space. Since the site is located in a dense and compacted area, having natural light that does not disturb the privacy of the home is key, as this brings further calm to the interior experience. The skylights were an effective way of keeping natural light all day long and creating a direct relationship with the outdoor environment. This further links to the success of this project, as it creates a positive human spatial response through the selection of materials. The space that was created does have a focus on creating an energising, relaxing and restorative space for its inhabitants, making it a successful biophilic design project. The built environment uses the chosen materials, the open-plan layout, sources of

natural light and plants to create an environment that is peaceful and rejuvenating. There is also a sensory experience with the tree that is placed in the middle. Unlike the trees that were placed in the Apple store on Regent Street, this tree provides for a relationship with the inhabitants, the house and the natural environment, rather than it being a decorative spatial element. The tree acts as the centrepiece of the household and allows for direct contact with nature and the different materials and colours that all tie back into the tree. This project shows that a successful biophilic design project does not need to have a lot of different elements going on but can focus on a few key features, expand on them intently and make them successful in the built environment. Similar to the case study of the primary school in Austria previously discussed, where the use of natural wood had a positive effect on reducing the heart rate as well as relieving the stress of primary school children. The strong use of hinoki wood has the same effect on the family that lives inside the house. The natural materials bring a sense of "tranquillity" and "serenity" as stated by the owners of the house (Angelopoulou, 2019).

To conclude, all three of these successful projects embody a different key point of biophilic design: Factory in The Forest mainly looks at the physical relationship with nature. Casa Levene looks at creating a beneficial human spatial response through the natural elements and the Hinoki Home focuses on the indirect reference to nature through materials. This comes to show that a project does not need to include all elements (direct contact with nature, indirect reference to nature and the human spatial response) for it to become successful in biophilia and can still have the same influence on people and their mental well-being. The projects might also fulfil each key point differently, for example using natural light in different ways. The Casa Levene home opens up to the view of the landscape allowing light to enter through those windows. Whereas the 07BEACH house uses fewer windows and more dominantly skylights. This makes no difference in the success of a biophilic design project, the natural surroundings

were different for each project so the site has to be adjusted accordingly. Since these projects span across the entire world, it indicates that biophilic design isn't specific to one area or culture of design, but a global movement. It also shows that biophilic design is not dependent on a specific climate, as some might think that it is only successful in a tropical climate. On the contrary, each piece of architecture can be adjusted according to its surrounding environment and climate and still be biophilic and have those same psychological benefits.

Chapter IV - The Future of Biophilic Design and the Impact on Mental Health:

While there has long been a pattern of commemorating and emphasising the importance and advantages of parks and forests for the use of people, the last decade has seen an explosion of scientific evidence and scholarly studies documenting and illustrating the different ways in which exposure to nature benefits us. Knowing how biophilic buildings have a large impact on our mental health, promotes the importance of living with nature on a larger scale. There is progress in how biophilic design projects have progressed from New Ash Green in Kent, to a factory office in Malaysia or a residential space embedded in a forest in Madrid. Even with single buildings being successful, the aim is to have entire biophilic cities where people live on a larger scale together. In 2013 the 'Biophilic Cities Network' was launched and since then 25 cities have been added to the international list of biophilic cities, showing that biophilic design has gained more traction around the world (Beatley, 2013).

Biophilic city planning builds upon the construct of biophilic design. Where biophilic design focuses on the building scale, a biophilic city systematically integrates nature into the urban fabric. It is a further expansion of the first and develops it on a much greater scale. According to the UN, in less than fifteen years more than 60% of the world's population will live in urban places (Walker, 2016). One of the select few cities that are named as 'biophilic cities' is

Figure 21: SETAC World Congress. *Aerial Shot of Singapore Bay (2021)*

Figure 22: Getty. *Singapore's Changi Airport (2020)*

Singapore. After the British colonised Singapore, more than 95% of the island's vegetation had been cleared. This was due to its rapid growth in both infrastructure and population. In 1967, two years after its independence, plans were launched to transform Singapore from a polluted industrialised city to a 'garden city' (Triman, 2021). The results of this can be seen in figures 21 & 22. In a documentary created by Peter Newman and Timothy Beatley, they show that the biophilic focus of Singapore began with the mayor advocating that the environment is as important as the economy. Singapore shows that a city can support intense development and population increase while also protecting and growing nature. Nature can be found not only in parks but has also been integrated into the designs of tall buildings, both residential and public. It was mainly through educational outreach, awareness campaigns, and changes to infrastructure that it became so successful. In 2005, the Singaporean government launched a 'Community In Bloom' project with which 480 organisations are currently involved. Ranging from schools, churches, mosques, hospitals and private housing estates. It aims to promote a community spirit and bring together residents all

the while growing nature as part of all built environments (Newman 2014). This is the exact aim of biophilic cities.

It can be argued that if biophilic design and cities improve, individual mental health increases, and a more cohesive society will be established. Research has shown that social cohesion is a potentially modifiable determinant greatly influenced by the mental health of a population. Using Singapore as an example, their crime rates are some of the lowest in the world (Beatley, 2013). This suggests that creating an environment that is amiable for the population and prompts a healthy and happy living situation, from their homes, to their workspaces and entertainment locations, increases mental health on a larger scale. It is evident that there is a correlation between individual mental health and social cohesion.

The question of how our future cities will look remains open-ended as new ways of designing emerge frequently but using the research from past studies and our first-hand experience with COVID-19 as an indicator, biophilic design is a successful way of designing our homes and cities. In a way that accommodates our growing population and at the same time takes our mental well-being into account and has a strong focus on living cohesively with nature.

Conclusion:

This dissertation aimed to answer these questions: What is the influence of combining green spaces with architecture on mental health? What have we learnt from different biophilic projects? How can we further develop and apply biophilic design to promote mental health? Based upon an evaluation of previously stated research material it can be argued that biophilic design has a strong influence on mental health, decreases anxiety levels and depression for all ages, increases productivity in the workspace and increases calmth and happiness. The different

case studies showed that people are sensitive to their environments and react positively to biophilic design. The research also suggests that mental health and societal cohesion are strongly interlinked and that promoting mental health via biophilic design would also improve the social cohesion of a population. The analysis of several biophilic projects also suggested that these benefits only appear if the core principles of biophilic design are met. This means that having some green spaces is not enough, rather it needs to be successfully integrated into the built environment and have indirect references to nature to provide a positive spatial response and have an effect on mental health.

Ways in which this can be promoted further is through designing environments that are good for people's mental health, as well as restore our bond with the natural environment. Starting to design with biophilia is where architects and designers need to start. Working on individual buildings in the private and public sectors pave the way for later development to entire city landscapes. Changing the urban fabric of all cities takes time, as can be seen with Singapore. It is not just governments that need to start taking action but it is a communal effort. With individual organisations, schools, stores, hospitals and homes coming together and restoring the human bond with nature. With the UN estimating that in less than fifteen years more than 60% of the world's population will live in urban places, it is essential that these cities promote mental health and are built with the natural environment rather than destroying it (Walker, 2016).

It is already evident that mental health has become a prominent topic in our daily lives. The question remains if biophilic design will get that same attention. Will our future living spaces and offices be blended with nature? Or will we ignore the already evident research and need to continue to go to parks and forests to get in touch with the natural environment? This is

something that can only be explored over time. Having done this research, my way of designing spaces in the future has changed to using the natural environment more strongly to provide positive spatial responses, for people and communities. Will that be the same for other designers?

It is time to stop thinking of building in black and white terms; construction corporations destroy habitats in order to create spaces for humans, or habitats are kept separate from the built environment. Biophilic design aims to restore our relationship with nature. As Beatley suggested already; “nature is not just something to be found in a park here and there that you have to walk to, but rather we need to re-imagine the city as a park, or as a forest.” (Beatley, 2017).

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