



GRIFFITH COLLEGE

**THE RELATION BETWEEN BIOPHILIC DESIGN AND LEVELS OF STRESS, ANXIETY AND
DEMOTIVATION AMONG EMPLOYEES IN OFFICE ENVIRONMENTS IN FEIRA DE SANTANA,
BRAZIL**

Research dissertation presented in partial fulfilment of the requirements for the degree of
MSc in International Business Management
Griffith College Dublin

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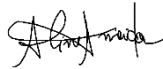
6th Sep 2024

CANDIDATE DECLARATION

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I certify that the dissertation entitled: **The relation between biophilic design and levels of stress, anxiety and demotivation among employees in office environments in Feira de Santana, Brazil** submitted for the degree of MSc in International Business Management is the result of my own work and that where reference is made to the work of others, due acknowledgment is given.

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DEDICATION

To Alice, Carlos Junior, Carlos Neto, and Carine, you are the foundation of my life. This research would not have been possible without your help.

To my grandmothers, whom I left in tears, there are no words to express how I miss you.

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ABSTRACT

This study investigates the relation between the presence of biophilic design and levels of stress, anxiety and demotivation among employees currently working in office environments, focusing on Feira de Santana, Brazil. With increasing global interest in biophilic design – an approach integrating natural elements into built environments – this research explores its relevance and effectiveness within a specific local context. The primary research question addressed is: "What is the relationship between the presence or absence of biophilic design in office environments and levels of stress, anxiety, and demotivation among employees in Feira de Santana, Brazil?"

A quantitative methodology was employed, using a structured questionnaire survey to collect data from 135 office workers, of whom 115 met the criteria for analysis. The survey assessed participants' experiences with biophilic design elements, their perceptions of stress, anxiety, and demotivation, and their overall evaluations of their office environment.

The findings revealed no consistent or strong correlation between biophilic design elements and reduced levels of stress, anxiety, or demotivation. Surprisingly, some offices with more natural elements were associated with higher levels of stress, which challenges existing literature that typically supports the positive impact of biophilic design on well-being. The study also found that employees in Feira de Santana had not reported a frequency of the highest levels of these emotional states, suggesting a more positive local context compared to global trends.

Despite the lack of direct correlation, employees expressed a preference for workplaces that include biophilic elements such as natural light and indoor plants. This indicates a general appreciation for these features, even if their impact on well-being is not immediately apparent.

The research highlights the importance of contextual factors in understanding the effects of biophilic design and suggests that future studies could benefit from a mixed-methods approach to provide deeper insights that are beyond, however, an extension of this paper. This study contributes to the existing literature by offering a localised perspective and identifying gaps in the research on the practical application of biophilic design in office settings.

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1. INTRODUCTION

1.1. OVERVIEW

In an era characterised by rapid urbanisation and technological advancements, modern lifestyles have increasingly distanced humans from their natural environments. This shift has been particularly pronounced in workplace settings, where employees spend most of their time indoors, often disconnected from the natural elements that historically played a crucial role in human health and well-being. Recognizing this disconnection, the concept of biophilic design has emerged as a transformative approach in architecture and interior design, aiming to reintegrate natural elements into built environments.

Biophilic design, an approach that is part of the study of Neuroarchitecture, seeks to address the innate human need for a connection with nature by incorporating natural light, vegetation, water features, other organic forms into the design of indoor spaces and more nature-based elements. The application of these principles in office environments has gained significant attention due to its potential to enhance mental health, reduce stress, and improve overall employee well-being.

This research focuses on Feira de Santana to explore the relationship between the presence or lack of biophilic design in office environments and the levels of stress, anxiety and demotivation among employees with the objective to understand how important this Neuroarchitecture approach is to enhance overall well-being in the workplace and further business outcomes in this particular city.

1.2. RESEARCH PURPOSE

Throughout history, humans have maintained a deep connection to nature, spending millions of years immersed in natural environments before the advent of modern cities (Kellert and Calabrese, 2015). As societies evolved and urbanisation took hold, human lifestyle has become increasingly disconnected from the natural world, despite this profound shift, our brains have not fully adapted to the rapid environmental changes brought about by technological advancements (Kellert and Calabrese, 2015). Today, an impressive 90% of our time is spent indoors (Tavis and Browning, 2016), analysing employees that work in offices, the workplace is the primary environment that affects those individuals who spend a massive portion of their workdays.

This reality prompts an inquiry into how companies can recapture the human connection with nature even being indoors from the perspective of the structure of the buildings and the rooms – through biophilic design. As part of Neuroarchitecture studies, biophilic design aims to reconnect humans with nature within built environments, offering a capable method to address the human innate biological needs at modern workplaces (Kellert and Calabrese, 2015) and consequently improving business performance (Terrapin, 2012).

In a business context, understanding and integrating biophilic design is not merely about aesthetics; it's about creating work environments that can reduce stressors, enhance productivity, job satisfaction and overall business outcomes. Focusing on Feira de Santana, Brazil, this research seeks to understand the relation between the presence of biophilic design in office environments and stress/anxiety levels among employees at this city, which will help to enhance Brazilian, and further global, results in the field of Neuroarchitecture, also offer actionable insights for businesses seeking to optimise their work environments for better employee performance and organisational success.

1.3. FEIRA DE SANTANA

Brazil is a vast and diverse country divided into five regions, 26 states, and over 5,570 cities, each with its own unique socio-economic landscape (Belandi, 2023). While state capitals often receive higher governmental investments—leading to better infrastructure, more services, educational institutions, healthcare facilities, employment opportunities and are the ideal location for international and/or bigger companies—the majority of Brazilian population lives outside these urban hubs. This creates a huge contrast between the capitals and the smaller cities across the country.

In the state of Bahia, for example, the capital, Salvador, has more than 2,5 million people, yet the entire state covers a population of 15,13 million spread across 417 municipalities (IBGE, 2022b). This study focuses on Feira de Santana, a major non-capital city in Bahia, precisely because it presents a more typical example of urban life in Brazil, reflecting the realities faced by many other similar-sized cities across the state and country.

Feira de Santana, often referred to as the "Gateway to the Sertão," is a key economic and logistical hub in the interior of Bahia for its strategic location, known for being the largest road junction of the North and Northeast of Brazil (Prefeitura Municipal de Feira de Santana, 2024). Despite its significant population of more than 600 thousand people (IBGE, 2022a) and economic activity, it does not receive the same level of attention or resources as the capital. By focusing

on Feira de Santana, this research aims to provide insights into the working conditions and mental well-being of employees in a setting that is more representative of the broader, often underserved, regions of Brazil. This approach allows for a deeper understanding if the lack of biophilic design is directly connected with high levels of stress, anxiety and demotivation among employees in office environments. The findings could offer valuable insights for business improvements from the perspective of workplace structure in companies located in the city and in similar contexts across the country.

1.4. SIGNIFICANCE OF STUDY

This study on the impact of biophilic design in office environments holds value for multiple stakeholders such as corporate employees; employers and business owners; architects, interior designers, civil engineers; research community.

By identifying how biophilic design can enhance well-being and reduce stress, anxiety and demotivation, employees will benefit from a healthier work environment that supports their mental health and will also lead to increased productivity and job satisfaction, contributing to a more fulfilling and efficient work experience (Cooper and Browning, 2015).

This understanding of enhancing employee performance, reducing absenteeism and turnover with a well-designed workplace will lead to better overall business outcomes, saving costs of constant recruitment and training (Ryan, Browning and Walker, 2023).

The research will provide valuable insights into effective biophilic design strategies for office spaces, guiding professionals – architects, interior designers and civil engineers - in creating environments that are aligned with human biological needs.

The study will add to the existing body of knowledge on biophilic design and its impacts, providing a basis for further research and exploration in the field of Neuroarchitecture. And focusing on Feira de Santana, the research offers context-specific insights that can be compared with global studies, enriching the understanding of biophilic design's universal vs. localised effects and practices.

Overall, this research aims to demonstrate the significant potential of biophilic design in creating healthier office environments, benefiting employees, employers, designers, planners, and the broader academic community.

1.5. RESEARCH QUESTION AND OBJECTIVES

The main question of this research is: "What is the relationship between the presence/ or the lack of biophilic design in office environments and levels of stress, anxiety and demotivation in employees currently working in Feira de Santana, Brazil?". This exploratory study aims to bridge existing literature with practical applications in office settings within the studied city. To address the primary research question, the study will pursue the following four objectives:

1. To analyse the relationship between indoor lifestyle and inner connection with nature;
2. To critically review approaches of biophilic design to apply specifically for offices;
3. To evaluate the impact of biophilic design elements on well-being indicators of employees working in offices;
4. To analyse local factors – the reality lived in Feira de Santana regarding the presence of biophilic design and levels of stress, anxiety and demotivation related to the office workplace.

These objectives will guide the research to analyse the historical context that justifies human inner connection with nature, tracing the evolution of the office environment itself and how it was improved over time to provide better structure for employees and more nature-based design. The research will also lead to examine the patterns of biophilic design strategies and their specific applications in office settings, assess how this approach contributes to employee well-being indicators such as reduction of stress, anxiety and demotivation levels. Moreover, it will explore the understanding of how the predominantly indoor lifestyle in Feira de Santana is influencing the adaptation and improvement of office workplaces through biophilic design strategies and evaluate the current levels of stress, anxiety and demotivation arising from the workplace.

1.6. STRUCTURE OF THE STUDY

The thesis is structured as follows - Chapter 1: Introduction and Objectives. This chapter introduces the research topic, stating the main research question and objectives. It provides an overview of the importance of studying biophilic design in office environments for improvements of business performance, particularly within the context of Feira de Santana, Brazil. Chapter 2: Critical Literature Review. This chapter reviews the existing literature on biophilic design, its theoretical foundations, and empirical studies related to its impact on workplace environments. It also examines the effects of urbanisation and indoor lifestyles on

human well-being and productivity. This chapter includes the Conceptual Framework, that outlines the conceptual framework guiding the study, drawing from the literature review. It integrates key concepts and theories related to biophilic design employees' overall well-being indicators impact. Chapter 3: Research Methodology and Methods. This chapter details the research methodology, describing the quantitative method used to gather and analyse data. It explains the rationale behind the chosen method and how it is applied to study office environments in Feira de Santana. Chapter 4: Presentation and Discussion of the Findings. This chapter presents the data gathered from the research supported by relevant graphics and tables followed by the analysis and interpretation of these findings – that are contextualised within the existing literature, and the implications of these results are discussed in relation to the research questions. It concludes with a synthesis of the research findings and strategic conclusions. Chapter 5: Conclusions and Recommendations. The final chapter provides a summary of the main findings and their implications for the research questions. It compares these findings with the literature reviewed in Chapter 2, highlighting any significant differences. The chapter includes recommendations for practical applications or further research, as well as a discussion of the study's limitations and contributions. The final paragraph reflects on the learning experience gained through the completion of the dissertation, offering a personal reflection on the research journey.

This structure ensures a logical flow of information, guiding the reader from the introduction and theoretical background through to the research findings and their practical applications.

2. LITERATURE REVIEW

2.1. OVERVIEW

The literature review for this study aimed to establish a foundational understanding of the relationship between biophilic design and employee well-being, particularly focusing on stress, anxiety, and demotivation in office environments. It explored the theoretical underpinnings of biophilic design, which emphasises integrating natural elements into built environments to enhance human health and productivity. Key theories and models, such as the biophilia hypothesis proposed by Edward O. Wilson and the principles outlined by Stephen Kellert, were reviewed to understand how biophilic design can positively influence workplace environments.

The review examined empirical studies that investigate the impact of biophilic elements, such as natural light, vegetation, and water features, on employee well-being. Existing research

highlighted the benefits of these elements in improving mood, reducing stress, and increasing job satisfaction. For instance, studies by Kaplan & Kaplan (1989) and Ulrich (1984) suggest that natural views and green spaces can lower stress and enhance cognitive performance.

However, the literature also revealed some inconsistencies and gaps. While many studies confirm the positive effects of biophilic design, others report minimal or no significant impact on employee well-being. This divergence suggests that the effectiveness of biophilic design might vary depending on contextual factors, such as geographical location, cultural differences, and the specific characteristics of office environments.

This review also explored the historical evolution of office environments and biophilic design strategies, noting that while there is growing global interest in biophilic design, its practical application and impact are not uniformly experienced. The findings underscore the importance of context-specific research to understand how biophilic design elements influence employee well-being in different settings.

2.2. THEORETICAL BACKGROUND

2.2.1. HUMAN BEINGS' HISTORICAL EVOLUTION AND BIOPHILIC DESIGN

The term "biophilia," derived from the Greek words "bio" (life) and "philia" (love), was popularised in 1984 by the biologist Edward Wilson, who described it as the innate connection between humans and nature (Wilson, 1984). Kellert and Calabrese (2015) expanded on this concept, emphasising the ongoing importance of this relationship with natural elements for mental and physical health and well-being. However, despite these assertions, the practical integration of biophilic principles into contemporary design remains inconsistent and underutilised.

Kellert and Calabrese (2015) provide a historical context, noting that humans spent around 120,000 years in direct contact with nature before the advent of cities, which means approximately 6,000 years ago and the onset of electronic technology merely two hundred years ago. Wilson and Kellert (1995) also illustrate that for about 90,000 years, humans lived as nomads closely intertwined with nature before transitioning to stable settlements. This significant and relatively recent shift to urban living has not been paralleled by corresponding evolutionary adaptations in the human brain, which remains attuned to natural environments (Kellert and Wilson, 1995).

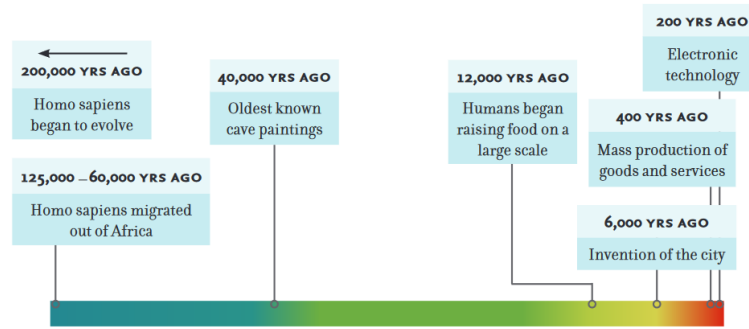


Figure 1 - Chronological human's evolution. (Kellert and Wilson, 1995)

Contemporary lifestyles exacerbate this disconnect, with modern humans spending an estimated 90% of their time indoors (Tavis and Browning, 2016). This indoor lifestyle correlates with rising levels of mental health issues, including stress, anxiety, and depression. Brazil, for instance, ranks as the second-highest country for depression and anxiety prevalence (WHO, 2017), highlighting the urgent need for effective interventions. Despite these alarming statistics, the design of urban environments often neglects the incorporation of natural elements that could mitigate these adverse effects (Klotz and Bolino, 2021).

In conclusion, the principles of biophilic design present a promising approach to bridging the gap between humans' evolutionary predispositions and contemporary indoor lifestyles. However, there is a pressing need for more comprehensive research and practical frameworks to ensure its effective application. By addressing these gaps, biophilic design can play a crucial role in promoting mental health in urban populations.

2.2.2. OFFICES LAYOUT THROUGH HISTORY

With the relatively recent Industrial Revolution, in the 21st century the big transition between rural activities and urban workplace has started (Mohajan, 2019). According to the same author, the poor conditions were highlighted by the financial power creating a huge gap between the rich and the poor. Analysing the end of this century, the Taylorist Model was implemented, not to improve workers conditions, but to elucidate what was being already done – create a spatial segregation according to the hierarchy of the company, standardised activities and workers seen as machines (Andrade, 2007). The spatial organisation of the buildings was geared towards controlling low-level employees – the higher the hierarchy, the more usable area there was for each worker, more luxurious furniture and the higher the location in the building. The highest

positions were in closed rooms with some glass openings to improve the lighting of this area and provide visibility for the employees (Andrade, 2007).

Passing to the 20th century, the post-war period was characterised by the decentralisation of companies and restructuring of offices, which led to greater flexibility and a policy of valuing workers (Andrade, 2007). Unlike the previous period with standardised and mass production, productivity was directly focused on the employee's perception - a more humanised environment era has started (Andrade, 2007).

The 20th century was also marked by three important changes: in the 1950s, the *Landscape Office* concept emerged in Germany (Peczöli and Szabó, 1999). It consisted of an environment with a more horizontal hierarchy, a fluid and flexible layout that followed the needs and flows of the company (Peczöli and Szabó, 1999) - it was completely open so that managers were more accessible. In addition to this study, Andrade (2007) describes that this office layout had common areas, lounges for employees to enjoy, and an increase in works of art and ornamental vegetation with the aim of making the environment more human and informal. However, at times, the organic layout was too fluid to the point of being chaotic, and generally with acoustic problems and lack of privacy (Andrade, 2007).

In view of the growing dissatisfaction with privacy and acoustic-related problems in the United States, the furniture system developed by Robert Prost emerged in the late 1960s: the Action Office System (Andrade, 2007). It consisted of optimising the space division system, making them more individualised, providing privacy or connecting spaces depending on the height used. The screens were also structural elements that were part of the workstations – it was possible to place hanging cabinets, lamps, shelves, individual decoration, for example, and they could be covered with fabric for better acoustic performance.

The spatial configuration of the previous paragraph characterises the cubicles of the Open Space concept, unlike the layout based on the company's communication flow in Landscape Office, where the priority was on the individual, screens with a height of 1.60 m demarcated the spaces, creating marked corridors and integrated rooms (Stouhi, 2020). In addition to this layout structure, the end of the century was marked by the introduction of computers, which were increasingly practical and lightweight and were present on work desks from the 1980s onwards (Andrade, 2007).

Large offices in the 21st century are characterised by a diversity of spaces, as different types of activities are carried out daily, prioritising comfort, lighting, ergonomics, and adequate acoustic and thermal treatment. The spatial configuration includes open spaces – with varying sizes of

tables and furniture depending on the level of integration desired for the team; closed rooms for confidential and private activities; multimedia rooms with flexible layouts; formal rooms for internal or external meetings with partitions that allow the space to be resized depending on the number of participants; social integration environments that allow contact between employees from different areas of the company; and decompression environments to reduce stress (Andrade, 2007).

“As office designs continue to evolve, contemporary workplaces are no longer limited to just work, but rather draw inspiration from homes and the outdoors. Pinball machines, board games, table tennis, and video games have become crucial parts of offices. Due to its numerous health benefits, there has also been a significant rise in biophilic designs, bringing a little of the outdoors inside.”(Stouhi, 2020)



Figure 2 - Ground floor plan of Geração Digital Santander. (ArchDaily, 2019)

According to these authors (Andrade, 2007, et al), the evolution of office layouts over the centuries reflects a continuous effort to balance productivity, employee satisfaction, and the practical needs of businesses. From the rigid, hierarchical spaces of the Taylorist Model to the more fluid and human-centred environments of the 21st century, office design has increasingly acknowledged the importance of worker well-being (Andrade, 2007). The incorporation of

biophilic elements into modern office spaces represents the latest development in this trajectory, aiming to address the mental health challenges posed by prolonged indoor work (Stouhi, 2020; De Paiva and Jedon, 2019).

2.2.3. BIOPHILIC DESIGN AND ITS PATTERNS IN OFFICES

In accordance with (Browning, Ryan and Clancy, 2014) biophilic design has 14 patterns that have a wide range of applications for both indoor and outdoor environments, they are divided into three classifications: nature in space patterns, natural analogues patterns and nature of space patterns. Nature in the space is divided in visual connection with nature, non-visual connection with nature, non-rhythmic sensory stimuli, thermal & airflow variability, presence of water, dynamic & diffuse light and connection with natural systems. Natural analogues patterns are defined as biomorphic forms & patterns, material connection with nature and complexity & order. Ending with the approaches of prospect, refuge, mystery and risk/peril that are classified as nature of space patterns (Browning, Ryan and Clancy, 2014).

14 PATTERNS	* STRESS REDUCTION	COGNITIVE PERFORMANCE	EMOTION, MOOD & PREFERENCE
NATURE IN THE SPACE	Visual Connection with Nature <ul style="list-style-type: none"> * Lowered blood pressure and heart rate (Brown, Barton & Gladwell, 2013; van den Berg, Hartig, & Staats, 2007; Tsunetsugu & Miyazaki, 2005) 	Improved mental engagement/ attentiveness (Biederman & Vessel, 2006)	Positively impacted attitude and overall happiness (Barton & Pretty, 2010)
	Non-Visual Connection with Nature <ul style="list-style-type: none"> • Reduced systolic blood pressure and stress hormones (Park, Tsunetsugu, Kasetani et al., 2009; Hartig, Evans, Jamner et al., 2003; Orsega-Smith, Mowen, Payne et al., 2004; Ulrich, Simons, Losito et al., 1991) 	Positively impacted on cognitive performance (Mehta, Zhu & Cheema, 2012; Ljungberg, Neely, & Lundström, 2004)	Perceived improvements in mental health and tranquility (Li, Kobayashi, Inagaki et al., 2012; Jahncke, et al., 2011; Tsunetsugu, Park, & Miyazaki, 2010; Kim, Ren, & Fielding, 2007; Stigsdotter & Grahn, 2003)
	Non-Rhythmic Sensory Stimuli <ul style="list-style-type: none"> * Positively impacted on heart rate, systolic blood pressure and sympathetic nervous system activity (Li, 2009; Park et al, 2008; Kahn et al., 2008; Beauchamp, et al., 2003; Ulrich et al., 1991) 	Observed and quantified behavioral measures of attention and exploration (Windhager et al., 2011)	
	Thermal & Airflow Variability <ul style="list-style-type: none"> • Positively impacted comfort, well-being and productivity (Heerwagen, 2006; Tham & Willem, 2005; Wigö, 2005) 	Positively impacted concentration (Hartig et al., 2003; Hartig et al., 1991; R. Kaplan & Kaplan, 1989)	Improved perception of temporal and spatial pleasure (alliesthesia) (Parkinson, de Dear & Candido, 2012; Zhang, Arens, Huizenga & Han, 2010; Arens, Zhang & Huizenga, 2006; Zhang, 2003; de Dear & Brager, 2002; Heschong, 1979)
	Presence of Water <ul style="list-style-type: none"> * Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure (Alvarsson, Wiens, & Nilsson, 2010; Pheasant, Fisher, Watts et al., 2010; Biederman & Vessel, 2006) 	Improved concentration and memory restoration (Alvarsson et al., 2010; Biederman & Vessel, 2006) Enhanced perception and psychological responsiveness (Alvarsson et al., 2010; Hunter et al., 2010)	Observed preferences and positive emotional responses (Windhager, 2011; Barton & Pretty, 2010; White, Smith, Humphries et al., 2010; Karmanov & Hamel, 2008; Biederman & Vessel, 2006; Heerwagen & Orians, 1993; Ruso & Atzwanger, 2003; Ulrich, 1983)
	Dynamic & Diffuse Light <ul style="list-style-type: none"> * Positively impacted circadian system functioning (Figueiro, Brons, Plitnick et al., 2011; Beckett & Roden, 2009) • Increased visual comfort (Elyezadi, 2012; Kim & Kim, 2007) 		
	Connection with Natural Systems		Enhanced positive health responses; Shifted perception of environment (Kellert et al., 2008)

NATURAL ANALOGUES	Biomorphic Forms & Patterns	*			Observed view preference (Vessel, 2012; Joye, 2007)
	Material Connection with Nature			Decreased diastolic blood pressure (Tsunetsugu, Miyazaki & Sato, 2007) Improved creative performance (Lichtenfeld et al., 2012)	Improved comfort (Tsunetsugu, Miyazaki & Sato 2007)
	Complexity & Order	* *	Positively impacted perceptual and physiological stress responses (Salingaros, 2012; Joye, 2007; Taylor, 2006; S. Kaplan, 1988)		Observed view preference (Salingaros, 2012; Hägerhäll, Laike, Taylor et al., 2008; Hägerhäll, Purcella, & Taylor, 2004; Taylor, 2006)
NATURE OF THE SPACE	Prospect	* * *	Reduced stress (Grahn & Stigsdotter, 2010)	Reduced boredom, irritation, fatigue (Clearwater & Coss, 1991)	Improved comfort and perceived safety (Herzog & Bryce, 2007; Wang & Taylor, 2006; Petherick, 2000)
	Refuge	* * *		Improved concentration, attention and perception of safety (Grahn & Stigsdotter, 2010; Wang & Taylor, 2006; Wang & Taylor, 2006; Petherick, 2000; Ulrich et al., 1993)	
	Mystery	* *			Induced strong pleasure response (Biederman, 2011; Salimpoor, Benovoy, Larcher et al., 2011; Ikemi, 2005; Blood & Zatorre, 2001)
	Risk/Peril	*			Resulted in strong dopamine or pleasure responses (Kohno et al., 2013; Wang & Tsien, 2011; Zaid et al., 2008)

Figure 3 - Biophilic design patterns and potential impacts. (Browning, Ryan and Clancy, 2014)

Although, one year later, Kellert and Calabrese (2015), delivered a more complete study regarding the subject – biophilic design encompasses a variety of strategies within built environments, tailored to the unique economic, logistical, cultural, and ecological conditions of each project. The authors also categorise biophilic experiences into three classifications that are overall similar in its division, however more detailed: direct experience of nature, indirect experience of nature, and the experience of space and place. Despite the comprehensive approach, both frameworks remain general and lack specific application to office environments, which this research aims to address focusing on Kellert and Calabrese definitions that cover a more recent and complete study.

The direct experience of nature involves integrating elements such as natural light, air, water, plants, animals, and natural landscapes into the built environment (Kellert and Calabrese, 2015). In office settings, this can be manifested through large windows that allow ample natural light, indoor plants, water features like aquariums or fountains, and the inclusion of natural ventilation systems.

Indirect experiences of nature pertain to the representation of natural elements. This includes the use of natural materials (e.g., wool, wood), natural colours, images of nature, and designs that mimic natural shapes and forms (Kellert and Calabrese, 2015). Offices can incorporate these elements through the use of natural materials in furniture and decor, biophilic artwork, and architectural features that emulate organic shapes. While there is growing awareness of the importance of these elements, their implementation is often superficial, driven more by

aesthetic trends than by a genuine commitment to enhancing employees' connection to nature (Klotz and Bolino, 2021).

The experience of space and place refers to spatial characteristics that echo natural environments, such as prospect and refuge, organised complexity, and the integration of parts to whole. In office design, this can be achieved through open floor plans that offer clear sightlines and private areas that provide a sense of refuge. Additionally, incorporating transitional spaces and wayfinding elements can enhance the overall spatial experience. Despite the potential benefits, the application of these principles is frequently limited by budget constraints and a lack of understanding among designers and employers about their significance (Kellert and Calabrese, 2015).

Critically, while Kellert and Calabrese (2015) offer a detailed taxonomy of biophilic design strategies, their study predominantly focuses on general buildings rather than specific types like offices that are the objective of this research. This generalised approach overlooks the unique needs and challenges of office environments, where employees spend a substantial portion of their day.

2.2.4. IMPACTS OF BIOPHILIC DESIGN ON EMPLOYEES

Byung-Chul Han (2010) identifies the epidemic of the 21st century as one of exhaustion, mental overload, and mental health disorders. While Han does not directly link these issues to architectural design or spatial environments, the relevance of this perspective becomes evident when considering that individuals spend approximately 90% of their time indoors (Tavis and Browning, 2016). Within corporate workplaces, employees spend a significant portion of their working day confined to indoor spaces (Cooper and Browning, 2015). In addition, De Paiva and Jedon (2019) research elucidates that the impacts of architecture on the human brain using neuroscience is still limited due to technological limitations requiring people to be inside the machines to scan and get proper results.

“Several other factors can influence how a built environment affects individuals: the time and frequency of use, the way individuals interact with the environment (the activities they will do in each space), culture and personal experience, and the social environment. Furthermore, spaces are rich in information, and each feature is hard to isolate from one another to understand its impacts individually.” (De Paiva and Jedon, 2019)

Human brain is naturally adapted to the environment where it is included to enhance survival chances, even though it will not always be a positive adaptation (De Paiva and Jedon, 2019), especially for employees that have long-exposure to the environment – their workplace can cause long-term effects. This research aims to elucidate the role of appropriate office design, specifically using biophilic design, in helping to enhance well-being in the workplace, reduce stress, anxiety and demotivating levels in the workplace.

Biophilic design, utilising the three natural experiences described by Kellert and Calabrese (2015)—direct experience of nature, indirect experience of nature, and the experience of space and place—reconnects human’s innate affinity for nature with architectural practices. Empirical research by Cooper and Browning (2015), which encompasses a large sample of office workers across a variety of roles and sectors from 16 countries across the world, including Brazil, provides substantial evidence of the benefits of biophilic design in office environments. Their findings indicate a 6% increase in productivity in offices designed with biophilic principles. Additionally, levels of creativity were reported to be 15% higher, and improvements in well-being led to reduced stress levels and increased motivation among employees. The study highlights specific elements desired by employees, such as natural light, indoor plants, quiet working spaces, sea views, and bright colours. Focusing on internal green space, employees reported being more anxious entering a workplace without greens in contrast to those with more natural patterns applied in their offices (Cooper and Browning, 2015).

From the perspective of company owners and managers, whose primary focus is often on profitability, biophilic design presents a compelling case. According to Terrapin (2012), the main causes of deficient employee productivity are absenteeism, loss of focus, negative mood, and poor health quality. While architectural design alone cannot resolve these issues, well-designed biophilic workplaces can significantly minimise these stressors. Terrapin (2012) reports that 10% of employee absences can be attributed to a lack of connection to nature in the workplace; by reducing stressors, biophilic design can lower absenteeism, reduce complaints, and increase overall productivity. Back to Cooper and Browning (2015), a third of the office workers stated that the design of an office would affect their decision to work at a company.

Moreover, a correlation between Kellert and Calabrese (2015) study about direct and indirect experience of nature and Ulrich *et al.* (1991) research, shows that intuitively based beliefs that exposures to trees, water and natural resources tend to be a restoration from stress also fostering psychological well-being. Studies with different populations suggest that overall, the presence of nature tends to reduce stress levels (Ulrich *et al.*, 1991) .

In conclusion, while biophilic design offers a promising solution to enhance well-being and further mental health in the workplace, its potential is yet to be fully realised (Cooper and Browning, 2015). There is a critical need for more rigorous empirical studies to validate the long-term benefits of biophilic design and to develop practical frameworks for its implementation in diverse office settings. By addressing these gaps and providing a nuanced understanding of how biophilic elements can be effectively integrated into office environments, this research aims to contribute with further studies and to the creation of healthier workplaces.

2.2.5. LOCAL CONSIDERATIONS

Once that is clarified by the previous literature cited in the research about how the structure and layout of offices have been evolved, how humans are being adapted to this modern life, what is biophilic design and how it can impact employees' well-being, other questions emerged: what is Brazilian reality regarding overall well-being indicators in office environment? Are employees in need of significant attention? Is biophilic design being applied in Feira de Santana?

According to the World Health Organization (2017), Brazil has the highest anxiety level in the world, more than 18.6 million people, which represents 9.3% of Brazilian population. Presenting also a negative ranking regarding depression, Brazil has the highest depression level in comparison with other Latin American countries, equivalent to 11.5 million people, a total of 5.8% of the Brazilian population, compared with the whole of America, which is the second highest level, behind of the United States (WHO, 2017). Despite this data referring to mental disorders, and not only due to work environment – what is the focus of this research – the data elucidates a special attention for the need to reduce these levels.

Focusing the discussion to employees, Lipp (2020) reported that the rate of absenteeism in Brazil had increased 28% in only one year – comparing 2010 and 2011. And in accordance with a more recent study, the prevalence of stress in Brazil stands at around 35% (Lipp *et al.*, 2020).

While there are no specific studies on the impact of biophilic design in office environments in Feira de Santana, examining the broader Brazilian context offers valuable insights. According to a Brazilian journal, *o Globo*, biophilic design is seen as an architectural trend not only in order to achieve a great visual, but also recognizing its importance for well-being improvements and positive impacts reconnecting the indoors with nature (Sanchez, 2021). Especially in bigger cities and capitals, this “relatively new trend” (Portobello, 2019) is being used by a society that is

progressively connected to screens (mobiles, laptops, tablets, etc) and the real world is left behind.

In addition, research in one of Brazilians capitals – Recife, across offices in the city with 82 employees from different areas, shows that even in a capital 56% of the sample don't have any biophilic design element in their workplace (Camêlo, 2023) number that is way above than the global margin of 19% (Cooper and Browning, 2015).

While biophilic design is gaining traction in larger Brazilian cities, even seen as a trend, it enhances well-being and reconnects individuals with nature, its adoption in smaller cities like Feira de Santana remains not clear and with a lack of information for this region. As this research explores the relevance and application of biophilic design in office settings, it aims to contribute to a broader understanding of how integrating natural elements into workspaces can play a crucial role in improving mental health and how a small city as the one specified in this paper is already implementing biophilic design strategies in order to foster a healthier and more satisfied workforce.

2.3. CONCEPTUAL FRAMEWORK

The conceptual framework for this study is grounded in the interdisciplinary field of neuroarchitecture, which examines the profound impact that built environments have on human well-being and behaviour (de Paiva, 2018). According to Paiva (2018), “the built environment has a direct impact on the human brain”, which means that physical structure of spaces influences not only psychological and emotional states but also cognitive functions and overall mental balance. In the context of this study, the conceptual framework explores the connection between the office structure and employees' stress, anxiety, and demotivation levels, with a specific focus on the mediating role of biophilic design elements. The aim is to analyse the relevance of biophilic design in office environments in Feira de Santana, Brazil, and determine whether the presence of biophilic elements is associated with lower levels of stress, anxiety, and demotivation among employees.

To achieve this result, the framework presents an independent variable – office structure. It is defined as the overall physical building including the layout of the workspace, architectural features, spatial organisation, colours, materials, landscape design that can cover the presence or absence of biophilic elements. Various offices in Feira de Santana will be analysed to have a better understanding of the impact of these buildings in the overall well-being of the employees.

The concept of dependent variable is the employees' levels of stress, anxiety and demotivation, which are affected by the office structure presenting or not biophilic strategies included. While the mediating variable is the biophilic design – that connects both independent and dependent variables with natural based elements. This study will focus on the presence of elements such as light, air, water, weather representing the direct experience of nature and natural materials as an indirect experience of nature (Kellert and Wilson, 1995).

Due to the lack of literature regarding the location of this research, four questions have emerged to guide the study and analyse if the same connection between the occurrence of biophilic design and overall improvements in employees' well-being is present and/or relevant for Feira de Santana:

1. Is biophilic design prevalent in office environments in Feira de Santana?
2. Are employees in Feira de Santana experiencing high levels of stress, anxiety, or demotivation due to the workplace?
3. Is the workplace structure contributing to decreased levels of stress, anxiety and demotivation among employees?
4. Is the use of biophilic design in offices relevant for business in Feira de Santana as suggested by the literature?

This conceptual framework guides the research design, including the formulation of research questions, the selection of appropriate measurement tools, and the data analysis strategies. Further, being essential in lead to get focused results following the aim of this research previously defined, also in the interpretation of findings, which will connect the results with the theoretical foundations and answer the questions emerged from the literature review.

In conclusion, this framework provides a clear pathway from theory to empirical investigation, ensuring that the study contributes valuable insights to the fields of neuroarchitecture and business improvement – by looking at the foundation of the company, the employees -and understand how relevant is for Feira de Santana the investment in biophilic design offices in order to decrease levels of stress, anxiety and demotivation in the workplace.

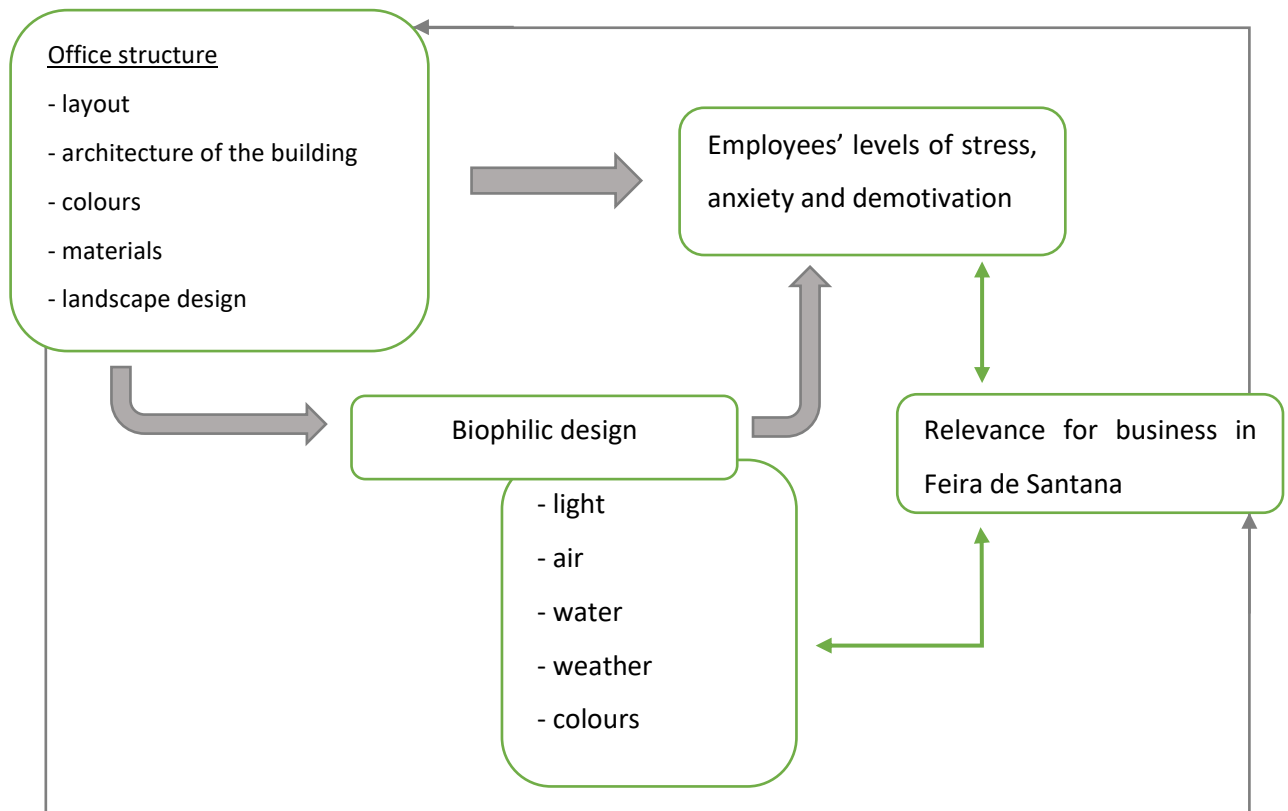


Diagram 1- Conceptual Framework

2.4. CONCLUSION

The literature review has provided a comprehensive overview of the theoretical and empirical foundations of biophilic design and its impact on employee well-being. The conceptual framework underpinning this study is rooted in the biophilia hypothesis, which suggests that humans have an innate connection to nature that influences their health and productivity. This framework guided the exploration of how biophilic design elements, such as natural light, vegetation, and water features, could affect workplace well-being.

The majority of studies reviewed support the notion that integrating natural elements into office environments can improve mood, reduce stress, and enhance job satisfaction. This is consistent with the biophilia hypothesis, which posits that natural environments positively affect psychological and physiological states. Key theories, including those by Kaplan & Kaplan (1989) and Ulrich (1984), have been instrumental in understanding these relationships.

However, the review also highlighted notable inconsistencies and gaps in the literature. While many studies affirm the benefits of biophilic design, some report minimal or no significant impact on employee well-being. This divergence suggests that the effectiveness of biophilic

design might vary based on contextual factors, such as geographic location, cultural differences, and specific characteristics of office environments.

The conceptual framework also suggests that these contextual factors are crucial in understanding how biophilic design influences well-being. The variation in findings indicates that the impact of biophilic design elements may not be universal and could be influenced by factors such as the cultural and environmental context of the workplace.

Overall, the literature review underscores the potential benefits of biophilic design for enhancing workplace well-being while also pointing to the necessity of context-specific studies to fully understand its impact. Future research should aim to address these gaps and explore the nuanced relationship between biophilic design elements and employee well-being in diverse settings.

3. METHODOLOGY AND RESEARCH DESIGN

3.1. OVERVIEW

This chapter outlines the methodology and research design adopted in this study to explore the relation between the presence of biophilic design elements and levels of stress, anxiety and demotivation among employees in office environments in Feira de Santana, Brazil. The chapter begins with a discussion of the research philosophy and approach, which guided the overall design of the study. It then details the research strategy and methods used to collect and analyse data, including the rationale for choosing a quantitative approach and the use of a structured questionnaire survey. The chapter also addresses the ethical considerations involved in conducting the research, ensuring compliance with ethical standards and maintaining the integrity of the data collection process. Finally, the approach to data analysis is discussed, outlining how the collected data will be interpreted to draw meaningful conclusions that contribute to the understanding of the connection between biophilic design elements and workplace well-being.

3.2. RESEARCH PHILOSOPHY AND APPROACH

3.2.1. LAYER I - PHILOSOPHIES

The research philosophy adopted in this study is positivism. Positivism is a philosophical stance that emphasises the use of scientific methods to study and understand social phenomena (Saunders, Lewis and Thornhill, 2007). It is grounded in the belief that reality is objective, observable, and measurable, independent of the researcher's influence. This approach relies heavily on quantifiable data and often uses statistical analysis to derive conclusions (Saunders, Lewis and Thornhill, 2007).

In a positivist paradigm, the researcher assumes a detached, objective stance, aiming to uncover patterns and regularities in the data that can be generalised to a wider population. The emphasis is on the collection of empirical evidence through structured methods such as surveys, experiments, or standardised tests, which are considered reliable and valid for producing factual knowledge (Bhattacharjee, 2012).

Positivism is particularly suited to this study because the research seeks to measure if the presence of biophilic design is connected with lower levels of stress, anxiety and demotivation levels among employees that are working in office environments in a systematic and replicable manner. By adopting a positivist approach, the research can objectively assess the relationships between variables (e.g., biophilic design elements and stress levels outcomes) and establish cause and effect through the use of statistical analysis (Hussey, 2019).

3.2.2. LAYER II - APPROACHES

The approach taken in this research is deductive, which aligns with the positivist philosophy. Deduction involves starting with a theory or hypothesis and designing a research strategy to test the hypothesis through empirical observation. The deductive approach typically follows a logical sequence:

1. Theoretical framework or existing literature is used to develop hypotheses.
2. Data is collected through a method designed to test these hypotheses.
3. The results are analysed to confirm or reject the hypotheses (Saunders, Lewis and Thornhill, 2007).

This research adopts a deductive approach by hypothesising that biophilic design elements positively affect employees' mental health and well-being. Based on existing literature and theories, the study then collects quantitative data through a structured questionnaire to test this hypothesis. The deductive approach ensures that the research is grounded in established

theories and allows for the testing of these theories in the context of a specific population (Bhattacharjee, 2012) – office employees in Feira de Santana, Brazil.

By using a deductive approach, the study can provide clear, testable propositions that contribute to the existing body of knowledge on biophilic design and mental health. This approach also allows for the possibility of falsification, a key tenet of the scientific method, where the researcher can objectively confirm or refute the initial hypotheses based on the data collected (Robson, 2005).

3.3. RESEARCH STRATEGY

3.3.1. LAYER III - STRATEGIES

The research strategy selected for this study is a questionnaire survey, complemented by a descriptive analysis approach for data interpretation. As a quantitative research method, a questionnaire survey systematically gathers data from a large sample of respondents – that will be further detailed –through structured, predefined questions. This strategy is particularly effective in collecting standardised data, which can be compared and analysed statistically, aligning well with a positivist research paradigm and a deductive approach (Saunders, Lewis and Thornhill, 2007).

The questionnaire survey is especially well-suited to achieving the research objectives, as it enables efficient data collection from a substantial number of employees in Feira de Santana. The structured format ensures that all respondents answer the same questions in a consistent manner, thereby enhancing both the reliability of the data and the validity of the conclusions (Robson, 2005). Moreover, this approach allows the researcher to capture a comprehensive snapshot of employees' perceptions and experiences with biophilic design elements in their workplaces. Through descriptive analysis, these perceptions and experiences can be examined to identify patterns, relationships, and trends, providing valuable insights into the relation between the biophilic design in office environments and employee's level of stress, anxiety and demotivation (Robson, 2005).

3.3.2. LAYER IV - CHOICES

The research employs a mono-method approach, which means that only one type of data collection technique and corresponding analysis procedure is used. In this case, the study relies exclusively on quantitative data collected through the questionnaire survey. The mono method is consistent with the positivist philosophy and deductive approach because it focuses on

generating measurable, objective data that can be analysed statistically (Saunders, Lewis and Thornhill, 2007).

The use of a mono-method ensures consistency in data collection and analysis. Focusing on a particular approach is advantageous in a cross-sectional study, where the aim is to gather and analyse data within a specific time frame (Saunders, Lewis and Thornhill, 2007).

3.3.3. LAYER V – TIME HORIZONS

The research design will be cross-sectional, meaning that data will be collected at a single point in time from a specific population to assess the current state of the phenomenon under study. This design is particularly suited to the study due to its time-limited nature. The survey will have a specific deadline for response submission, ensuring that all data is collected within a defined timeframe. This approach is efficient and allows for the timely completion of the research, which is essential given the constraints on the project duration.

A cross-sectional design enables the researcher to capture a snapshot of the relationship between the presence of biophilic design and levels of stress, anxiety and demotivation among employees working in office environments in Feira de Santana at that specific moment. By setting a clear deadline for responses, the research can maintain consistency in data collection, ensuring that all participants' responses reflect the same period. This is crucial for drawing accurate and reliable conclusions from the data within the limited timeframe available for the study (Saunders, Lewis and Thornhill, 2007).

This research adopts a positivist philosophy and a deductive approach, aiming to objectively assess the relationship between biophilic design and employee well-being in Feira de Santana, Brazil. By employing a questionnaire survey as the primary research strategy, the study gathers standardised, quantitative data from a significant sample of office employees. This method aligns with the study's objective to test hypotheses grounded in existing theories, allowing for statistical analysis of the collected data. The research employs a mono-method approach, focusing solely on quantitative data, and is designed as a cross-sectional study, capturing a snapshot of the current state of biophilic design's impact on employee stress, anxiety, and demotivation within a specific timeframe. As indicated in the Figure 4 the chosen layers for this study, based on the Research Onion (Saunders, 2019).

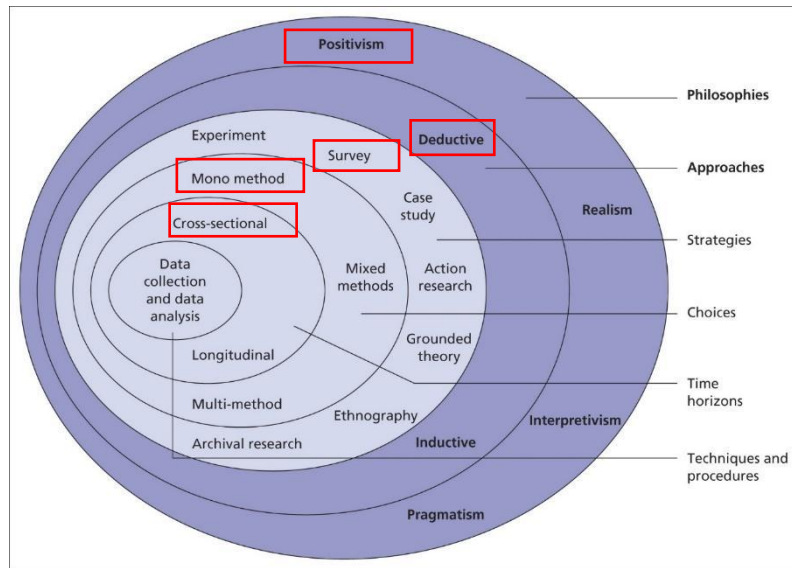


Figure 4- Research Onion (Saunders, 2019), adapted with the chosen layers for this research.

3.4. COLLECTION PRIMARY DATA

The primary data for this research was collected through a questionnaire survey, targeting a specific group of respondents selected via purposive sampling. This non-probabilistic sampling method was employed due to the need to specifically target individuals who met criteria relevant to the research questions, ensuring that the collected data was pertinent to understanding the relationship between the presence or absence of biophilic design in office environments and levels of stress, anxiety, and demotivation among employees in Feira de Santana, Brazil.

Purposive sampling was chosen for the reason that it allowed the researcher to intentionally select participants who were most likely to provide insightful data based on their exposure to and experiences in office environments (Robson, 2005). This approach is particularly effective in exploratory studies or when the research focuses on a specific phenomenon within a particular subgroup. In this study, the selected participants were office employees who met predefined criteria (that will be described in the following topic *Sources*), ensuring that the collected data would be highly relevant to the research objectives and aligned with the research question.

The questionnaire was carefully designed to gather quantitative data on the perceptions and experiences of employees working in office environments in Feira de Santana. The questions were developed based on principles of biophilic design as outlined in the literature review, according to Kellert and Calabrese (2015), there are three divisions: direct experience of nature, indirect experience of nature, and the experience of space and place. Using a survey as a source

of collection of primary data, the researcher has focused on direct experiences with nature, as described by the same authors and one feature of the indirect experience of nature – natural materials. These patterns are clearly identified by people that are not familiar with the subject of biophilic design and do not require a complex understanding of the structure of the place.

Due to the quantitative nature of the study, the questionnaire included closed-ended questions, simplifying the data collection process while ensuring that respondents could easily understand and respond to the survey, once more, with no previous knowledge about Neuroarchitecture. Since the survey was administered online, the questions were formulated to be clear and straightforward, and avoiding complex terminologies that might confuse the respondents.

3.4.1. SOURCES

The primary data for this research was sourced from a carefully selected sample of respondents who met specific criteria designed to ensure that the data would be both relevant and reliable. The sample consisted of individuals who (1) were adults – aged between 18 and 59 years, (2) were currently employed, (3) worked in an office environment, and (4) spent a minimum of three days per week working in their office, excluding those in a fully remote work regime. These criteria were established to ensure that participants had sufficient exposure to their office environment, allowing them to provide informed and accurate feedback.

The definition of an "office" was clearly articulated in the survey to ensure respondents precisely identify their work environment. For the purposes of this study, an office was defined as "a room, set of rooms, or building used as a place for commercial, professional, or bureaucratic work" (Oxford, 2024). This included any indoor workspace where administrative, managerial, or professional tasks were performed, such as activities related to administration, project development, accounting, finance, human resources, and information technology. Specific exclusions were made, such as hospital buildings, due to the significant differences in Brazilian architectural legislation governing those environments. Which means that doctors, physiotherapists, nurses, dentists, veterinarians, etc. are not included in the sample of this research.

The inclusion of these criteria was justified by the research objectives and the need to address the set of key questions previously stated:

1. Is biophilic design prevalent in office environments in Feira de Santana?
2. Are employees in Feira de Santana experiencing high levels of stress, anxiety, or demotivation due to the workplace?

3. Is the workplace structure contributing to decreased levels of stress, anxiety and demotivation among employees?
4. Is the use of biophilic design in offices relevant for business in Feira de Santana as suggested by the literature?

In order to address those questions with a pioneer study focusing on Feira de Santana, a broader age range was applied to this research, followed by a more precise, focused definition of workplace and developed activity at work. This decision was also informed by data indicating that, in 2022, almost 140,000 people in Feira de Santana were employed by Micro and Small Enterprises (MPEs) and Medium and Large Enterprises (MGEs) (Data MPE, 2022). The majority of these employees fell within the 18-54 age range, which aligns with the selected criteria for this study. However, it is important to note that not all individuals within this group worked in office environments, as many were employed in roles such as sales, which do not meet the criteria established for this paper. For example, salespeople and disassemblers represented 20% of the total workforce employed by MPEs (Data MPE, 2022).

Overall, this strategic approach to participant selection with key criteria, ensured that the data collected was relevant, reliable, and directly applicable to the study's aims, providing a solid foundation for analysing the relationship between biophilic design and employee well-being in the context of Feira de Santana.

The online survey was conducted using Google Forms planned to have 105 respondents using the Sample Size Calculation (Sample Size Calculator, 2024), ensuring anonymity by not requiring names or email addresses, in full compliance with Griffith College Dublin's ethical regulations (Appendices A and B). The survey was initially circulated through the researcher's personal network via social media platforms such as WhatsApp, Instagram, and LinkedIn. However, the last platform was not useful due to the lack of companies registered on LinkedIn and at times, messages can only be sent between accounts that are already connected. Respondents were also encouraged to share the survey with colleagues and other office employees, broadening the participant pool. At the end, the researcher has stopped the access to the survey after achieving 135 answers – being 115 contributors following the criteria of this study.

The questionnaire was structured into four sections: (1) demographics, (2) presence of biophilic design elements in the workplace, (3) employee perceptions of stress, anxiety, and demotivation, and (4) evaluation of office settings. On average, the survey could be completed in approximately 10 minutes.

Section 1 – demographics

This section aimed to gather essential background information about the respondents, also ensuring that they fit within the sample criteria for this research. Questions in this section covered various demographic aspects, including gender, age, profession, job position, and industry sector. Additionally, respondents were asked about their period at their current company, company size, work frequency in the office, education level, and work regime. This information was crucial in understanding the context of each participant's responses and ensuring the study's relevance to their professional experience.

Section 2 – presence of biophilic design in the workplace

Following Kellert and Calabrese (2015) definition of direct experience with nature, the patterns presented by the authors were divided into separated questions so the respondents could identify the presence of the analysed architectural approach in their workplace. Just excluding from this research, the presence of the feature *fire* due to the cultural aspects and weather conditions in Feira de Santana. The survey asked about natural light, views, ventilation, water features, vegetation, and the use of natural materials in their work environment.

Section 3 – employee perceptions of stress, anxiety, and demotivation

This section aimed to explore the respondents' perceptions of their stress, anxiety, and demotivation levels in the workplace. Rather than diagnosing mental health disorders, the questions were designed to gauge emotional responses to the workplace environment. Respondents were asked to rate the frequency of stress, anxiety, and motivation at work, providing insights into how their work environment may influence their emotional well-being and if levels of stress, anxiety and demotivation were as high as global data presented by the literature.

Section 4 – evaluation of office settings

This section aimed to determine whether employees perceive their office environment as contributing to their overall well-being indicators. Respondents were asked to evaluate how the physical layout, including furniture arrangement, lighting, colours, and natural elements, impacted their stress and anxiety levels. Additionally, they were invited to suggest potential improvements to create a more satisfying and supportive work environment. The final question presented a scenario of working in an office designed using natural patterns, asking respondents if this workplace would be able to generate stress, anxiety and demotivation reduction.

The picture presented was intentionally not a usual reference of an office with many indoor vegetation or even natural trees inside of the workplace, it was more practical for many different realities that are covered in this research such as the activities previously cited: administration, project development, accounting, finance, human resources, and information technology. The picture represents light, plants, weather, natural colours and natural materials as listed by Kellert and Calabrese (2015) and (Browning, Ryan and Clancy, 2014).

3.4.2. ACCESS AND ETHICAL ISSUES

The study was conducted through an online survey, distributed via social media platforms and the researcher's personal network. The selection of this distribution method was influenced by the need to reach a diverse group of office employees within a limited timeframe, while also ensuring broad participation across different sectors in Feira de Santana. Respondents were asked to voluntarily participate in the survey, and they were encouraged to share the survey with colleagues who met the study's criteria. To enhance accessibility, the survey was designed to be user-friendly, with clear instructions and questions that could be easily understood by individuals with varying levels of education and familiarity with biophilic design concepts.

Ethical issues were carefully considered and addressed throughout the research process, guided by several key principles. Participants were fully informed about the purpose of the study, the nature of their participation, and how the collected data would be used. Consent was implied by their voluntary completion of the survey, with assurances given that they could withdraw at any time without facing any consequences. To protect participants' privacy, the survey was conducted anonymously, with no identifying information such as names or email addresses being collected. The data was securely stored and only accessed by the researcher, ensuring that respondents could share their opinions and experiences openly, without fear of retribution or identification.

The research followed strictly to the ethical guidelines set forth by Griffith College Dublin, including obtaining approval from the relevant ethics committee before the survey was conducted and ensuring compliance with institutional and legal standards throughout the research activities. The questionnaire was carefully designed to avoid any potential discomfort or distress for participants, with questions worded to prevent leading or biased language and without requiring sensitive personal information. The focus remained on participants' perceptions and experiences in the workplace rather than on personal health issues, thereby minimising any risk of harm. Transparency was also a priority, with participants being informed

that the study's results would be used for academic purposes and might be published, though individual responses would remain unidentifiable in any reports or publications. This transparency helped to build trust and encouraged honest participation.

3.5. APPROACH TO DATA ANALYSIS

For this research, data analysis will be conducted using descriptive statistics. This approach will focus on summarising and presenting the data in a clear and understandable manner followed by visual representation such as bar charts, pie charts and tables. Descriptive statistics are particularly useful for providing an overview of the key characteristics of the data without making inferences about the sample.

The tools used in the study were (1) frequency distributions, that analyse the frequency of responses for each survey question will be calculated and presented in tables. This will show how often each response option was selected by the participants, giving a clear picture of the distribution of answers. (2) measures of central tendency, being descriptive quantitative research, the terminologies of measurement were used such as *mode*, the most frequently occurring value, identified for each categorical variable – for example, the most frequency of stress (Never, Rarely, Sometimes, Frequently, Always) reported by employees in offices in Feira de Santana. And *median*, the middle value when data is ordered, will be reported for ordinal variables to provide insight into the central tendency. (3) percentage calculations, the percentage of participants selecting each option will be calculated to help quantify the relative prevalence of certain responses. For example, the percentage of employees who perceive their work environment as it greatly improves their well-being and productivity. (4) cross-tabulations, to explore relationships between two categorical variables such as the presence of plants in the office and reported stress levels.

The results from the descriptive analysis will be interpreted to identify trends and patterns within the data. These insights will be used to answer the research questions, such as whether biophilic design elements are associated with lower levels of stress and anxiety among employees.

3.6. CONCLUSION

In conclusion, this study adopts a systematic and rigorous research design to explore the relationship between biophilic design elements and the levels of stress, anxiety, and

demotivation among office employees in Feira de Santana, Brazil. By employing a positivist philosophy and a deductive approach, the research relies on quantitative data collected through a structured questionnaire survey. The use of purposive sampling ensures that the data is relevant and applicable to the research objectives, while ethical considerations are carefully addressed to protect participant privacy and data integrity. Through descriptive statistical analysis, the study aims to uncover meaningful patterns and insights that can contribute to the understanding of the impact of biophilic design on workplace well-being, providing valuable information for future research, practical applications in office design and the importance of this topic for business in Feira de Santana.

4. PRESENTATION AND DISCUSSION OF THE FINDINGS

4.1. OVERVIEW

This section presents and discusses the key findings from the study conducted on the impact of biophilic design elements in office environments on employee well-being in Feira de Santana, Brazil. The research aimed to investigate whether the presence of natural elements in the workplace correlates with lower levels of stress, anxiety, and demotivation among employees. Despite the growing global interest in biophilic design, the findings from this study suggest that these elements may not have as significant an impact on employee well-being as previously assumed, at least within the context of Feira de Santana.

The findings are based on a combination of demographic data, the presence of biophilic elements in workplaces, employee perceptions of stress, anxiety, and demotivation, and their evaluations of office settings. The discussion explores the potential reasons behind the observed trends and raises questions for further investigation into the relationship between workplace design and employee well-being.

4.2. FINDINGS

4.2.1. SECTION 1 – DEMOGRAPHICS

The study sample consisted of employees currently working in office environments in Feira de Santana, being the majority (64%) working in a presidential regime with five days per week, and just 12% of the respondents work more than the usual working hours in Brazil with more than five days per week, Chart 1.

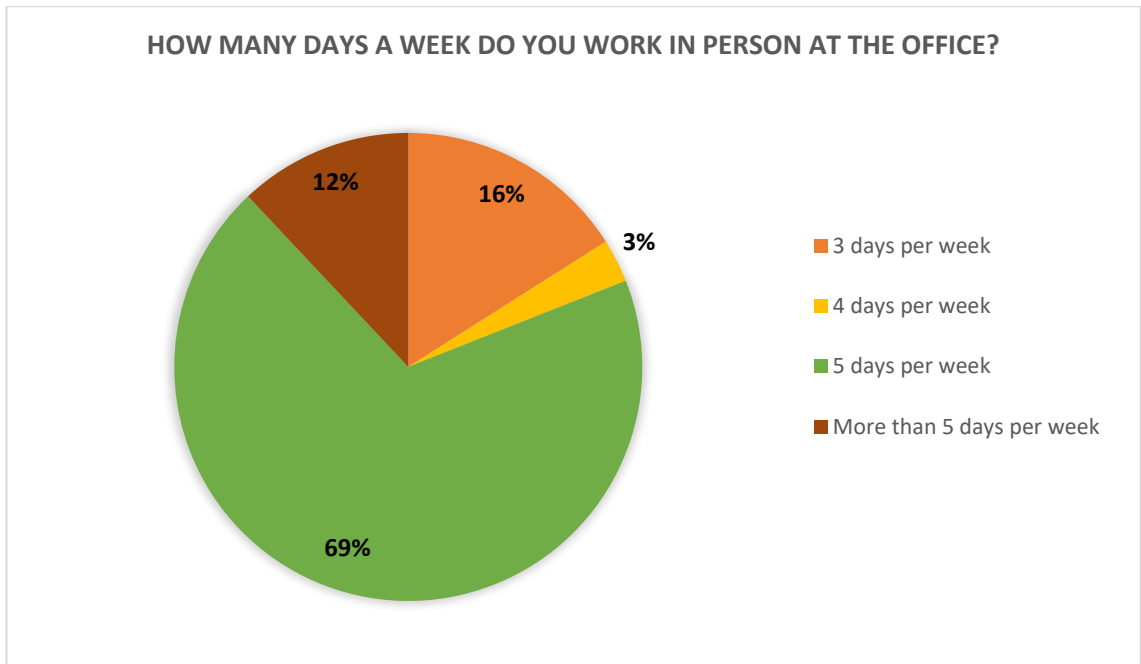


Chart 1- Result of the answers for the Question 8 of the Section 1

The majority (67%) of respondents identified as female, with 65% of the sample represented by the age range of 25-44 years old. Interestingly, a model was found that 31 employees were working in the company for over 10 years and the same number of employees that have been working for 3-5 years, representing the higher percentage of 27% each duration. Also, a mode in the percentage of 16% percent of the sample was represented by the duration of less than a year and 6-10 years in the same office. This variation suggests that the study captured a diverse range of experiences in terms of job tenure as shown in the Chart 2.

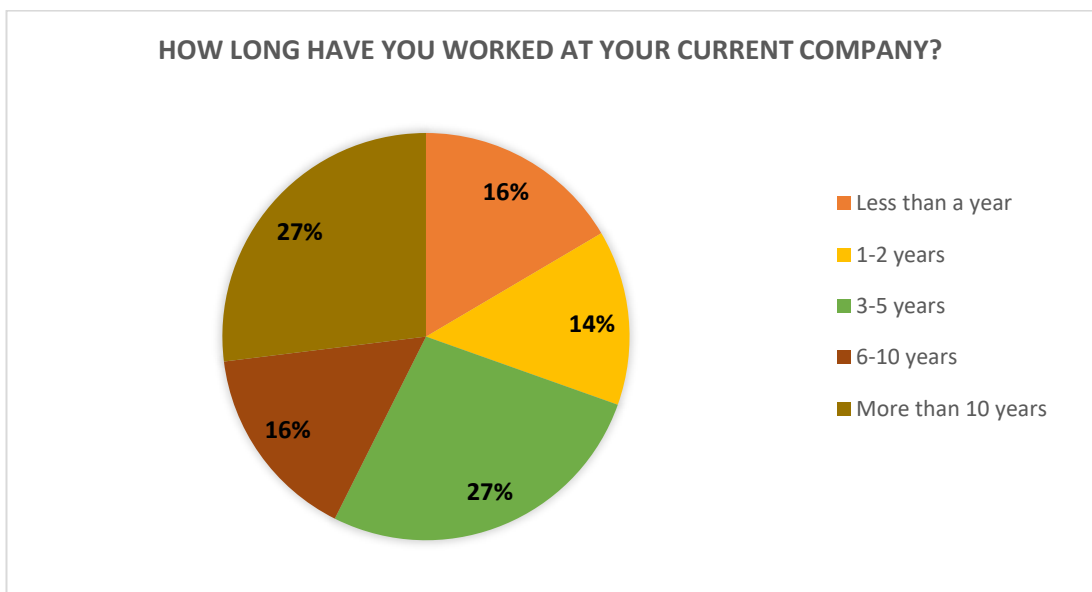


Chart 2- Result of the answers for the Question 6 of the Section 1

The predominant sector represented in the sample was administration, with 42 respondents working in this field. Over half of the respondents worked for Medium and Large Enterprises (MGE), with nearly 50% of them being employed by large enterprises with over 100 employees.

In terms of educational background, a significant portion of the sample held a graduation degree (46%), followed by post-graduation or MBA (29%), and vocational technical education (9%). This indicates that the respondents were generally well-educated, which may influence their perceptions of workplace design and its impact on their well-being.

4.2.2. SECTION 2 – PRESENCE OF BIOPHILIC DESIGN IN THE WORKPLACE

The analysis of the presence of biophilic design elements revealed some concerning trends. A substantial portion of the respondents (49.6%) reported working in environments with only artificial lighting, and a majority (63%) had no outdoor views, with 34% working in spaces without any windows at all. This lack of natural light and views is a significant finding, as exposure to natural light is known to have positive effects on mood and productivity.

Air circulation in the workplaces was also predominantly artificial, with 63% of respondents indicating that they work in offices with only air conditioning or fans, and only 4% of the participants reported having just natural ventilation. The scarcity of water features in the office environments was another notable finding, with only 10% of the participants reporting the presence of elements such as fountains or aquariums.

The presence of vegetation in these offices was minimal, with 70% of respondents indicating that their workplaces had no vegetation – natural or artificial. However, 19% reported having natural vegetation, 7% artificial plants, followed by 4% of participants with a winter garden in their workplace, which suggests that while biophilic design elements are not common, there are some instances where they are incorporated. Similarly, the presence of external vegetation was limited, with 44 out of 115 respondents reporting none and 71 indicating external vegetation in their workplace – 47 identified private external gardens of the office and 24 have public vegetation on the outside.

Natural materials were also not commonly used in these office environments. A significant portion of the respondents (45%) reported the absence of natural materials, and only 15% indicated that their workplaces extensively used natural materials.

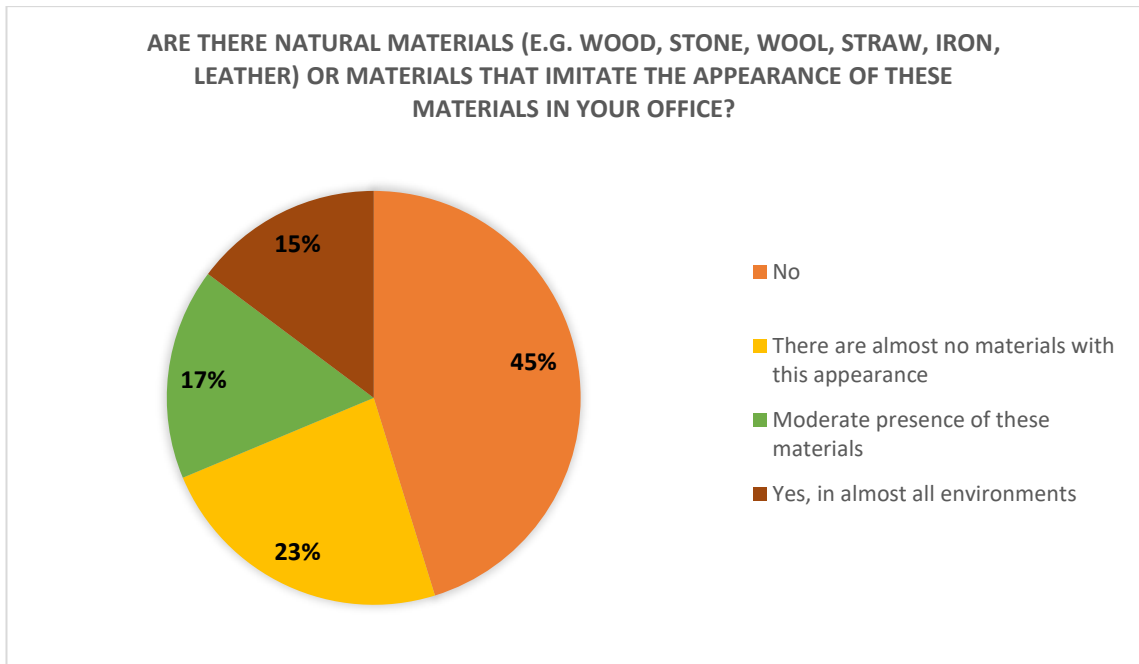


Chart 3- Result of the answers for the Question 7 of the Section 2

4.2.3. SECTION 3 – EMPLOYEE PERCEPTIONS OF STRESS, ANXIETY, AND DEMOTIVATION

When asked about their experiences with stress, anxiety, and demotivation in the workplace, a distinct pattern emerged among the respondents. A significant portion of the sample reported experiencing these negative emotional states occasionally, with 52% indicating they felt stress "Sometimes," 40% feeling anxiety "Sometimes," and 43% reporting demotivation at the same frequency. This suggests that while these negative emotional states are present within the workforce, they are not constant but occur sporadically for most employees.

Further analysis showed that stress was the most frequently reported emotional state, with 30% of respondents identifying themselves as feeling stressed "Always" or "Frequently." Anxiety followed closely, with 28% of the sample indicating they experienced anxiety "Always" or "Frequently." However, demotivation was less commonly reported, with only 17% of respondents indicating that they felt demotivated at these higher frequencies. This means that demotivation was reported at nearly half the rate of stress, making it the least frequent emotional state among the three being studied.

Additionally, there was a notable difference in the distribution of responses between the emotional states. Stress presented a unique distribution pattern, with respondents indicating that they felt stressed "Sometimes," "Frequently," and "Rarely" in descending order of

frequency. In contrast, the frequency of anxiety and demotivation responses followed a different sequence. For both anxiety and demotivation, the most common response was "Sometimes," followed by "Rarely," and then "Frequently." This variation suggests that while stress was more evenly spread across different frequencies, anxiety and demotivation were less frequently reported at the "Frequently" level.

Delving deeper into the response patterns regarding stress, the mode, representing the most commonly reported frequency of stress, was 2, which corresponds to those who reported feeling "Always" or "Never" stressed. This was notably lower than the mean value, which was 23. This difference indicates that although there were some extreme responses, the overall tendency was toward more moderate levels of reported stress. Such variability in response patterns provides a detailed view of the emotional experiences within the workforce, highlighting the relative prominence of stress, followed by anxiety and demotivation at differing frequencies

These findings highlight a not alarming presence of stress, anxiety, and demotivation among employees, with stress emerging as the most prevalent and frequent emotional experience, followed by anxiety and, finally, demotivation, which was reported at lower frequencies across the sample.

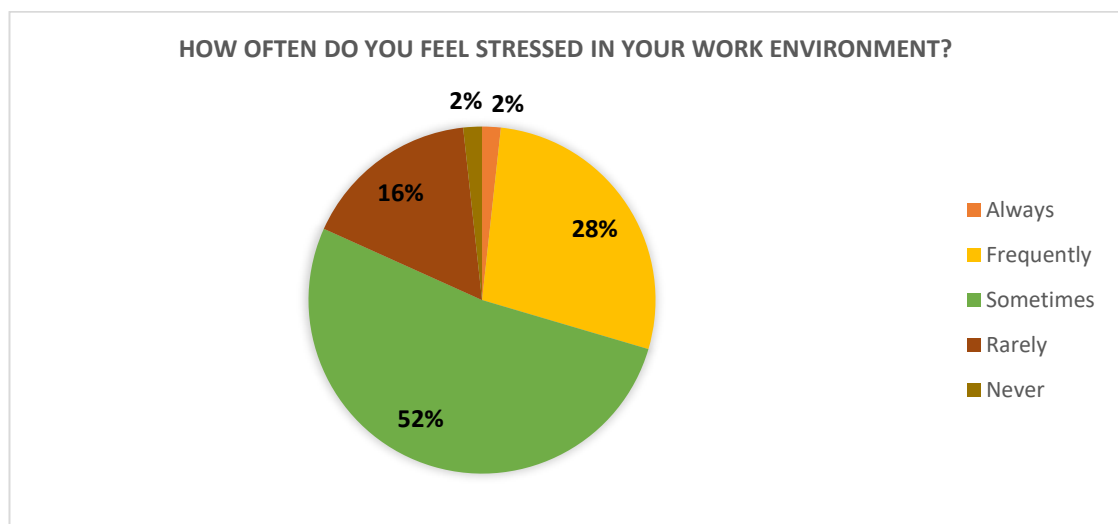


Chart 4- Result of the answers for the Question 1 of the Section 3

4.2.4. SECTION 4 – EVALUATION OF OFFICE SETTINGS

In evaluating their office settings, respondents were asked whether the physical space contributed to their stress, anxiety, and overall well-being and productivity levels. The responses indicated that most participants felt that their workplace did not have a significant impact on their stress, anxiety or demotivation levels. Expressed in numbers, 54% states that the office setting does not contribute to increased levels of stress, the half of the sample states the same for levels of anxiety and 47% reported that the office has no significant impact on their productivity and well-being in the work. However, 45 (39%) respondents stated that their workplace "increases stress a lot" or "Yes, it increases stress moderately" in comparison with 62 (54%) respondents considering that office design has no influence on their stress levels. Similarly, when asked if the work environment contributes with anxiety levels, 57 (50%) affirmed that the office design has no influence, although 51 (44%) declared that "Yes, it increases anxiety a lot" or "Yes, it increases anxiety a little", suggesting that for a notable portion of the sample, the office environment impact to increase stress and anxiety levels.

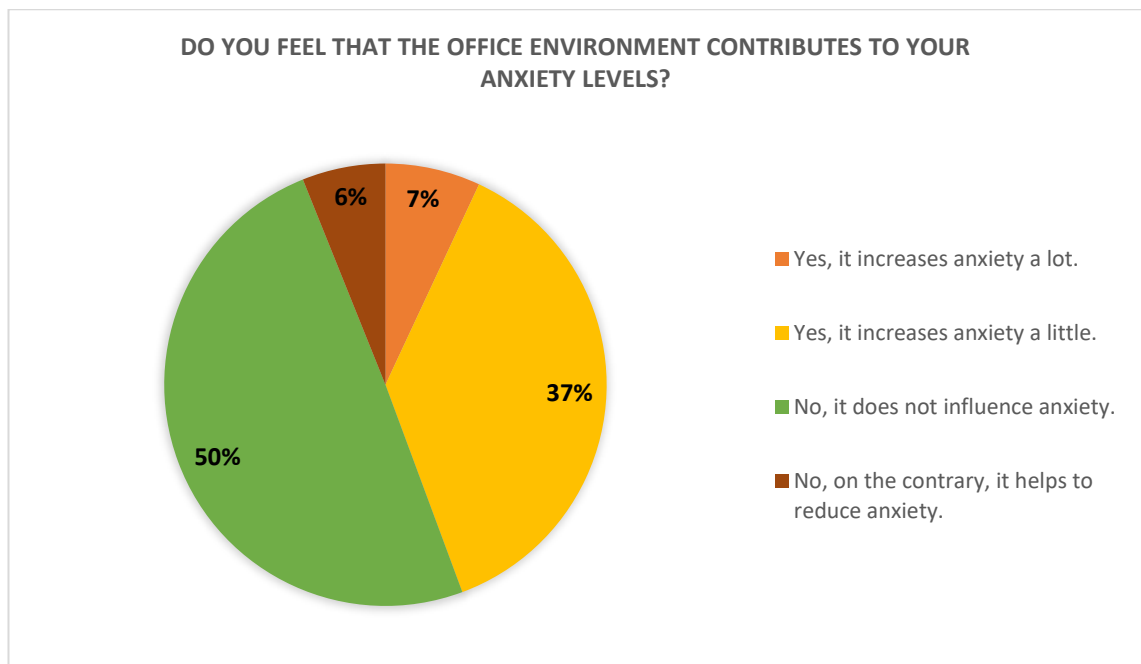


Chart 5- Result of the answers for the Question 2 of the Section 4

Concluding the analysis of patterns found in the answers for “Does the physical space of your office contribute to your stress levels?” and “Do you feel that the office environment contributes to your anxiety levels?” (question 1 and 2 of the section 4 of the questionnaire survey) the responses were mixed. This finding suggests that while some employees may be indifferent to their physical surroundings, others are clearly affected by the built environment, causing a negative impact in their levels of stress and anxiety during the work.

In contrary of the data presented that associates stress and anxiety levels with the workplace, the answers related to the office settings and well-being and productivity were more positive – the similar pattern, however, was found when 54 (47%) participants have declared that are no significant impact regarding the relation between well-being/ productivity and workplace, while a total of 35 (31%) admitted that the office environment actually improves a lot or improve the levels of well-being and productivity.

Furthermore, all the respondents identified at least one biophilic design pattern to be incremented or improved in their current workplace, as shown in the table down – from the most required change to the lower required. The majority included vegetation indoors, more windows or natural light and creation of spaces with views of outdoor or natural areas, 50.4% and 49.6% respectively, what is directly related to the answers of presence of vegetation in the workplace: 70% of the sample with no plants; and Question 13 – “What is the view from the window of your workspace?”: 63% of the sample have no window or the window view is from inside of the building.

Then, an expressive number of responses indicates the need for “Creating spaces with views of outdoor or natural areas”, “Changing the colours of the environment to more pleasant tones” and “Using works of art or decorative elements that refer to nature” respectively 39.1%, 34.8% and 30.4%. The least chosen strategies were also represented by a considerable number of 21 and 23 respondents, that means 20% and 18.3% of the sample points for “Installing water fountains or aquariums” and “Using natural materials (wood, stones) in decoration”.

Furthermore, all respondents identified at least one biophilic design pattern that they believe should be incremented or improved in their current workplace, highlighting areas where the introduction of natural elements could enhance their work environment. The preferences for these changes are displayed in the table below, ranked from the most to the least required modifications. The majority of participants expressed a strong desire for more vegetation indoors, with 50.4% of the sample indicating the need for increased greenery, and 49.6% calling for more windows or natural light to be integrated into the office design. These preferences are closely tied to the current lack of these features in their workplaces, as revealed by other survey data.

For instance, when asked about the presence of vegetation in their current workplace, 70% of respondents reported that their work environment lacks any form of indoor plants. Additionally, when asked about their workspace views in Question 13 – “What is the view from the window of your workspace?” – a notable 63% of participants revealed that either they do not have a

window or that their window offers a view of the interior of the building rather than an outdoor or natural setting. This data directly correlates with the strong preference for more windows and access to natural light, as well as the desire for views of outdoor or natural areas.

Beyond the need for more plants and windows, a notable number of respondents also indicated the necessity for "Creating spaces with views of outdoor or natural areas," with 39.1% expressing this as a priority. Alongside this, a notable 34.8% of participants advocated for "Changing the colours of the environment to more pleasant tones" and 30.4% of respondents emphasised the importance of "Using works of art or decorative elements that refer to nature".

The least chosen biophilic design strategies, though still supported by a considerable number of respondents, included "Installing water fountains or aquariums" (20%) and "Using natural materials like wood and stones in decoration" (18.3%). While these options were less popular, they were still identified by 21 and 23 participants, respectively, indicating that a significant portion of the sample sees value in integrating water elements and natural materials into the office space.

	Biophilic design strategies	Number of participants	Percentage of the sample
1	Including more indoor vegetation (plants, vertical gardens, etc.)	58	50.4%
2	More windows or natural light in the environment	57	49.6%
3	Creating spaces with views of outdoor or natural areas	45	39.1%
4	Changing the colours of the environment to more pleasant tones	40	34.8%
5	Using works of art or decorative elements that refer to nature	35	30.4%
6	Installing water fountains or aquariums	23	20.0%
7	Using natural materials (wood, stones) in decoration	21	18.3%

Finalising the survey with the last question, participants were asked about the potential impact of working in an environment with natural elements and good lighting on reducing stress and anxiety levels. The responses revealed a clear inclination towards a positive belief in the benefits of biophilic design – even not knowing the concept. A significant majority of 73% of the respondents answered “Yes, definitely,” indicating a strong belief that incorporating natural

elements such as plants, greenery, and ample natural light into their workspace could indeed help reduce stress and anxiety.

On the other hand, 18% of the participants expressed a more moderate viewpoint, selecting “Maybe, a little.” These respondents acknowledged that natural elements and lighting might have some effect, but they were less certain about the extent of their impact. Their responses suggest that while they recognize the potential benefits, other factors may also contribute significantly to their overall emotional state in the workplace.

A smaller percentage of the sample, 7%, believed that these environmental features do not make any noticeable difference, responding with “It doesn't make any difference.” This group represents a minority who may feel that the presence of natural elements and good lighting is less important in influencing their stress and anxiety levels.

Lastly, only 2% of the respondents were firmly opposed to the idea, answering “No, definitely not.” This small group was convinced that the presence of natural elements and good lighting would not have any positive effect on their emotional well-being.

In conclusion, the responses to this final question indicate that a large majority of the employees surveyed hold a positive view of the potential benefits of biophilic design. While there is a smaller segment of the population with more neutral or negative views, just focusing on this last question, the results suggest a strong belief that natural elements and good lighting could be a valuable tool in reducing workplace stress and anxiety.

4.3. DISCUSSION

Feira de Santana has a tropical climate characterised by warm temperatures throughout the year with average temperatures typically range from 22°C to 30°C, with the hottest months occurring between December and March. (Leal Santos and Andrade, 2008). Due to the consistently warm weather, air conditioning or fans are often necessary to maintain comfort indoors. Air conditioning is especially common in offices and commercial spaces to provide relief from the heat and to create a more comfortable working and living environment. Fact that was confirmed in this research – only 4% of the offices are maintained with natural air circulation in contrast with 62% of the workplaces that are using only artificial air – such as air conditioning and fan.

The use of artificial air, however, does not explain the lack of windows in office buildings where more than a half of the sample don't have the perception of the weather (Kellert and Calabrese,

2015). Having no external views lead to a disconnection from natural elements, such as sunlight, wind, and rain, which can diminish employees' awareness of time and their connection to the outdoors, potentially affecting their overall well-being (Kellert and Calabrese, 2015; Cooper and Browning, 2015).

Knowing Feira de Santana local climate, the presence of vegetation would help to reduce the air temperature (Boukhabl and Alkam, 2012) generating a more comfortable working environment, although, the research showed an expressive lack of greenery indoors, over 70% of the sample with no plants, and a reduced amount of 38% with no vegetation outdoors. Similarly, the presence of water would also promote a climate equilibrium with the use of fountains for example, (Browning, Ryan and Clancy, 2014), even so, the result of the participants answers clarifies that water elements is not a common design pattern indoors, less than 10% of the sample works in a presence of water.

Despite the fact that biophilic design has gained significant traction in Brazil, as highlighted by the journal *O Globo* (2021), and is experiencing growing recognition worldwide (Stouhi, 2020), the offices in Feira de Santana appear to lag behind this trend. The findings from the study show that natural materials such as wood, stone, wool, straw, iron, and leather are far from being common features in the local workplace environments. Only a small portion of the sample, approximately 15%, reported a notable presence of these materials throughout their office spaces. This lack of integration of biophilic design principles, particularly in the use of natural materials, suggests that the trend has yet to make a meaningful impact in Feira de Santana. The limited adoption of these elements not only distances the workplace from nature but also misses an opportunity to enhance the physical and psychological well-being of employees through connection with organic textures, materials and shapes.

While biophilic elements are not prevalent in the majority of workplaces, either indoors or outdoors, in Feira de Santana, some offices in the study did incorporate aspects of this design approach. Despite its limited adoption, the research findings reveal that the city does not align with global data on stress, anxiety, and demotivation levels, which are often considered critical to employee well-being and further business outcomes (Terrapin, 2012). In this study, most employees reported experiencing these emotions only "Sometimes" in the workplace, with stress being the most frequently cited, although only 2% of respondents indicated they "Always" feel stressed at work. Anxiety and demotivation were more often reported as being felt "Rarely" followed by the answer "Frequently," with nearly equal percentages of respondents stating they "Never" feel demotivated (11%) or "Frequently" experience demotivation (14%).

Interestingly, the research findings suggest that office employees in Feira de Santana present a better overall well-being in the workplace than the global expectations (Cooper and Browning, 2015). This raises important questions for businesses: Are employees with lower levels of stress, anxiety, and demotivation working in environments that incorporate biophilic design elements?

To address this question, a cross-tabulation study was conducted based on the local climate, given answers of the presence of biophilic design patterns and choosing patterns that are more evident inside of the workplace, this research focuses on three main aspects that describes nature-based office design: (1) presence of vegetation indoors, (2) presence of natural elements indoors and lastly (3) presence of window in the room for a cross-tabulation analysis to understand what is the relationship between the presence of biophilic design and levels of stress, anxiety and demotivation in offices across Feira de Santana.

The Chart 6, 7 and 8 reveal a pattern emerged from the questionnaire survey – the presence of biophilic elements in the workplace does not necessarily correlate with employees feeling better, nor does their absence always lead to negative experiences. In some cases, the opposite was observed—rooms designed with more natural-based features were associated with higher reported stress levels among employees. Conversely, lower levels of anxiety were not linked to strategies designed to integrate people with nature.

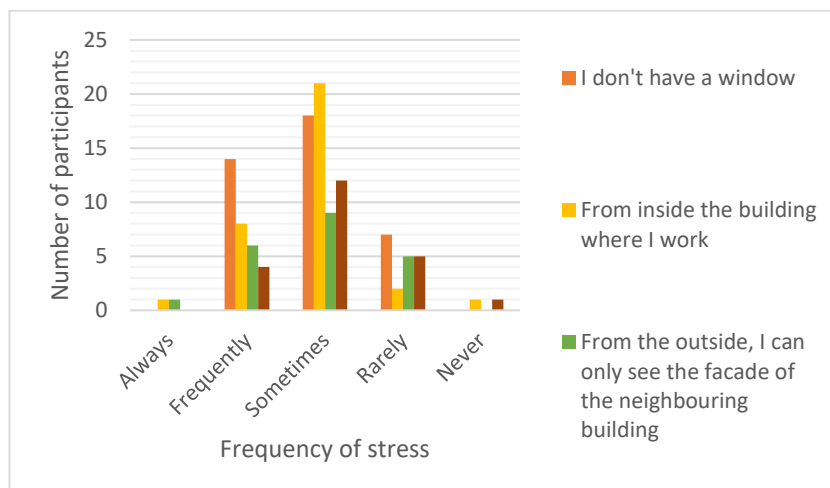


Chart 6- Relation between frequency of stress in the workplace and window views.

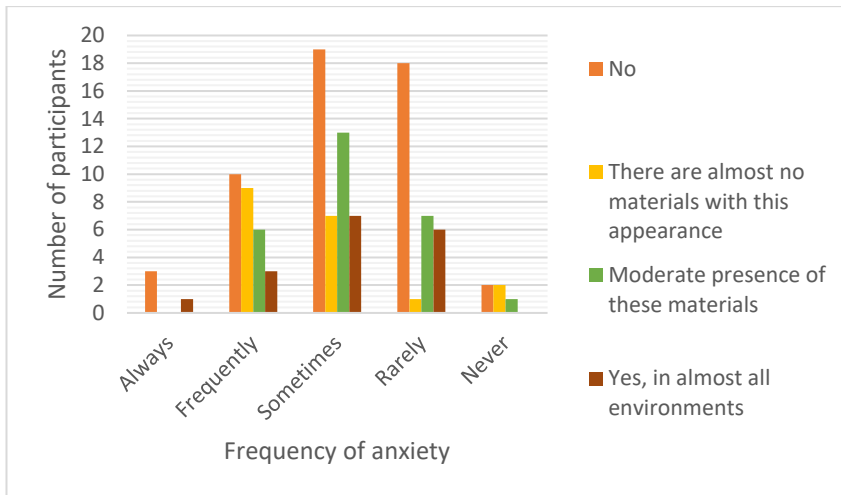


Chart 7- Relation between frequency of anxiety in the workplace and presence of natural materials.

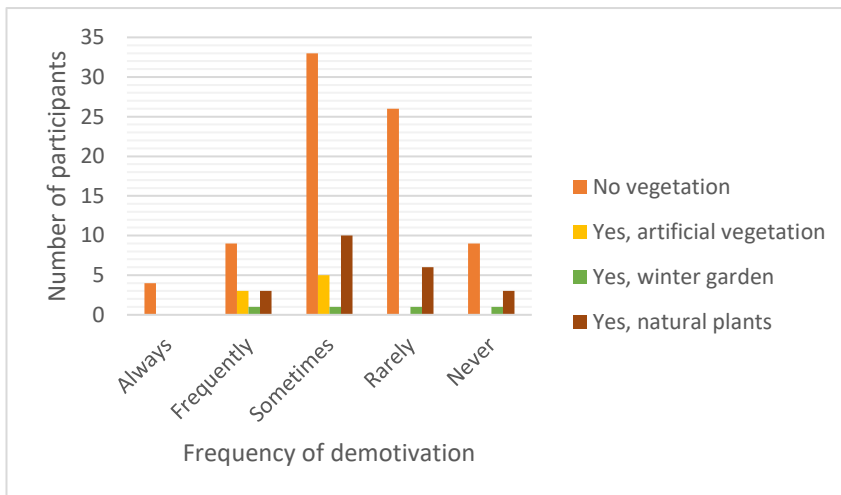


Chart 8- Relation between frequency of demotivation in the workplace and presence of vegetation.

This trend is consistent across the three emotions analysed—stress, anxiety, and demotivation—and the biophilic strategies previously discussed. This pattern is also reinforced by the initial responses in Section 4 of the study, where the majority of participants indicated that they do not believe their office settings significantly affect their stress, anxiety, or demotivation levels.

However, a contradiction emerges in the responses to the final two questions. Despite initially downplaying the impact of office environments on their emotional states, all participants identified at least one element they would like to improve in their workplace. Out of seven proposed strategies, the “inclusion of more indoor vegetation” was the most popular choice, followed by “more windows or natural light in the environment” and “creating spaces with views of outdoor or natural areas,” both directly related to the presence of windows in the office.

Furthermore, while many respondents initially dismissed the role of their work environment in influencing stress, anxiety, and demotivation, over 70% acknowledged that working in spaces with natural elements and good lighting could help reduce these feelings. This aligns with the literature, which suggests that biophilic design does enhance overall employee well-being, even if this connection wasn't immediately evident to all participants in the survey.

The research employed a questionnaire survey to ensure the validity, reliability, and trustworthiness of the findings. Feira de Santana was selected as the study's focus due to its characteristics that mirror those of many mid-sized Brazilian cities, particularly in terms of population size and the relatively lower level of government attention compared to major urban centres – the capitals.

The sample consisted of 135 respondents, but only 115 fully met the key criteria established for this study, ensuring that the analysis was based on relevant and targeted data, still ensuring the minimum of participants 105 was achieved for relevant research. However, there remains some uncertainty regarding the consistency and clarity of the responses provided by the participants.

The research findings indicate that the presence of biophilic design elements in office environments in Feira de Santana does not correlate with lower levels of stress, anxiety, and demotivation among employees. This suggests that investing in nature-based elements may not be as crucial for improving employee well-being and business outcomes in this context as previously thought.

Nevertheless, the evident disconnection between the presence of biophilic design elements and employee well-being prompts a deeper exploration into why employees' perceptions and actual experiences may not align. Future research could explore these inconsistencies and provide a more detailed understanding of the role of biophilic design adding an in-site qualitative research with observation and interviews across offices in Feira de Santana through a deeper analysis of office environments and cultural peculiarities among employees.

Concluding the discussion of findings, even choosing the easiest approaches of biophilic design that could be identified by any person without previous knowledge of the field, further observations by an architect perspective would better judge the levels of nature-based strategies adopted in offices. Additionally, interviews across employees would generate more demographic data such as particularities in social-economic factors (addressing to the Section 1 of this research) and a better understand whether or not the structure of the work place is impacting the levels of stress, anxiety and demotivation among the participants (adding data for the Section 3 and 4 of this study) and lastly, a better understanding of what aspects of the work

are considered as relievers of these three emotions and what exactly settings are influencing increase those levels. So future research could address the actual uncertainty raised of whether employees in Feira de Santana are experiencing and what are their perceptions.

4.4. CONCLUSION

The findings of this study challenge the widely held assumption that biophilic design elements directly contribute to reducing stress, anxiety, and demotivation among employees in office environments. In Feira de Santana, despite the minimal presence of natural elements such as vegetation, natural materials, and access to natural light, a significant portion of the respondents did not perceive these aspects as influential in their emotional well-being at work.

Interestingly, while the majority of employees experienced stress, anxiety, and demotivation only "sometimes," there was no clear correlation between the presence of biophilic design elements and lower levels of these negative emotions. This suggests that other factors, perhaps socio-economic or organisational, might play a more significant role in shaping employees' experiences of stress and well-being.

Moreover, despite the lack of a strong perceived impact of biophilic design on well-being, a notable number of respondents still expressed a desire for more natural elements in their workplaces, such as indoor vegetation, natural light, and views of outdoor areas. This contradiction between the desire for biophilic elements and their perceived effectiveness highlights the complexity of the relationship between workplace design and employee well-being.

In conclusion, the chapter underlines the need for further research to explore the reasons for these findings. It raises deeper analysis about the understanding of *how* office settings are impacting employees' overall well-being. Future studies should explore more research methods to be closer to the employees – qualitative research, gathering observations and interviews across offices in Feira de Santana in order to clarify the connections between the stress, anxiety and demotivation and office settings.

5. CONCLUDING THOUGHTS ON THE CONTRIBUTION OF THIS RESEARCH, ITS LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.1. OVERVIEW

The subject of this study is the analysis of the impact of the office environment on employees' overall well-being to understand if biophilic design plays a crucial role to enhance performances in businesses located in Feira de Santana, Brazil. This paper follows the research question "what is the relationship between the presence/ or the lack of biophilic design in office environments and levels of stress, anxiety and demotivation in employees currently working in Feira de Santana, Brazil?". Based on this question, four objectives guided the study for a clarification through a chronological order (1) to analyse the relationship between indoor lifestyle and inner connection with nature; (2) to critically review approaches of biophilic design to apply specifically for offices, also evaluating the historical evolution of office environment; (3) to evaluate the impact of biophilic design elements on well-being indicators of employees working in offices; at the conclusion, (4) to analyse local factors – the reality lived in Feira de Santana regarding the presence of biophilic design and levels of stress, anxiety and demotivation related to office workplace.

The research employed a quantitative methodology using a structured questionnaire survey to collect data. The data gathering instrument consisted of a comprehensive questionnaire designed to assess participants' experiences with biophilic design elements, their perceptions of stress, anxiety, and demotivation, and their overall evaluations of their office environment. The survey included demographic questions, queries about the presence of biophilic elements, scales measuring stress, anxiety, and demotivation and if these levels were correlated to the workplace.

Data analysis involved descriptive statistical methods to summarise the demographic characteristics of the sample and the prevalence of biophilic design elements in the workplaces. This approach provided a clear overview of the data distribution and the relationships between biophilic design elements and reported levels of stress, anxiety, and demotivation. The sample included 135 participants, but only 115 fully met the criteria for analysis, ensuring the reliability and relevance of the data – still a higher number of responses than what was needed by the sample calculation, which could be represented by 105 participants.

5.2. IMPLICATIONS OF FINDINGS FOR THE RESEARCH QUESTIONS

This study examined the relationship between biophilic design in office environments and its influence on employee well-being in Feira de Santana, Brazil, particularly regarding stress, anxiety, and demotivation. Through a cross-sectional survey of office workers, the research explored how biophilic elements such as vegetation, natural materials, and access to windows affected those specific emotional well-being.

- Is the presence of biophilic elements in office environments associated with lower levels of stress, anxiety, and demotivation among employees?

The findings did not reveal a consistent or strong correlation between the presence of biophilic design elements and reduced levels of stress, anxiety, or demotivation. In some cases, offices featuring more natural-based design elements were linked to higher levels of stress, which challenges existing literature that largely supports the positive impact of biophilic elements on well-being (Kellert and Calabrese, 2015; Cooper and Browning, 2015). This suggests that introducing biophilic elements alone may not be sufficient to reduce stress in workplaces in Feira de Santana.

Although these findings contradict certain aspects of the literature, where they are consistent with research that highlights the importance of contextual factors – such as the overall design of the workplace and organisational practices – in shaping employee well-being (Browning, Ryan, and Clancy, 2014).

- Are employees in Feira de Santana experiencing high levels of stress, anxiety, or demotivation due to the workplace?

The data suggest that employees in Feira de Santana do not experience particularly high levels of stress, anxiety, or demotivation as a result of their work environment. Most respondents reported only occasional feelings of these emotions, with very few indicating chronic or severe levels. Stress was the most frequently cited emotion, but even then, only a small percentage reported experiencing it regularly. Anxiety and demotivation were reported even less frequently.

These results indicate that employees in Feira de Santana may have better overall emotional well-being than global studies on workplace stress suggest (Terrapin, 2012). This finding could

be attributed to other factors as described by Lipp *et al.* (2020) such as social-economic reality (being economy the most expressive stressor indicator in the study) or even lower expectations regarding workplace conditions, offering a more optimistic view than the generally higher levels of stress, anxiety, and demotivation reported in international studies.

- To what extent do employees perceive the office environment, with or without biophilic elements, to impact their levels of stress, anxiety, and demotivation?

Although the analysis did not show a strong correlation between biophilic elements and emotional well-being, the perceptions of employees offer important insights. Most participants did not believe that the presence or absence of biophilic design directly affected their levels of stress, anxiety, or demotivation. Nevertheless, when asked about potential improvements to their work environment, all the participants had chosen to introduce at least one natural element, such as indoor plants, windows, outdoor views, and rooms with more pleasant tones. This indicates that while employees may not explicitly link biophilic design to reduced stress, they still value a work environment that incorporates nature.

These findings partially align with existing literature, as studies like Terrapin (2012) and Cooper and Browning (2015) have suggested that biophilic design is generally viewed positively, even if the psychological benefits are not always immediately apparent. However, there appears to be a disconnection between the actual experiences of employees and their perception of what constitutes a well-designed, stress-reducing workspace.

- Is the use of biophilic design in offices relevant for business in Feira de Santana as suggested by the literature?

The findings of this research indicate that while biophilic design is becoming more popular globally and is often associated with improved employee well-being (Andrade, 2007; Stouhi, 2020), its relevance in Feira de Santana appears limited. Despite the growing trend, businesses in this region have not fully embraced the use of natural elements in office design. Moreover, the results did not show a strong connection between the presence of biophilic elements and reduced emotional stress. However, the desire among employees for features like plants and natural light suggests that incorporating biophilic design may still offer benefits in terms of employee satisfaction, even if its direct impact on well-being is less clear.

This finding suggests that biophilic design may not be as crucial for immediate business outcomes in Feira de Santana and further research would be needed to determine the exact business benefits of integrating biophilic design in the studied local context.

Furthermore, this study highlights a gap in the existing literature regarding the perception of the effectiveness of biophilic design across diverse contexts. Most research presents more general local factors covering a vast range of cities and countries, at times regarding residential, health centres, commercial or hospitality buildings. This study contributes to filling this gap by offering insights from a specific scenario, office environment in a mid-sized city in Brazil.

Additionally, the findings reveal an underexplored area in the literature: employee perceptions of the impact of biophilic design on their emotional state. While global studies typically emphasise the positive impacts of biophilic environments, this research suggests that employees may not always directly experience or perceive these benefits, even if they value the presence of natural elements in theory.

5.3. CONTRIBUTIONS AND LIMITATIONS OF THE RESEARCH

This research contributes to the field of architecture and business, especially Human Resources, by providing an understanding of how biophilic design elements impact levels of stress, anxiety and demotivation in a specific local context. The study challenges the assumption that biophilic design universally improves well-being, highlighting the need for a contextual approach to understand this relationship. The findings offer a localised perspective, showcasing that even in environments where biophilic elements are not widely incorporated, employees do not necessarily report high levels of stress, anxiety, or demotivation. This understanding is crucial for businesses and designers working in similar settings who may be considering the benefits of investing in nature-based office designs.

Moreover, the study explores the disconnect between the global trends in biophilic design and the actual conditions in workplaces in Feira de Santana, raising questions about the universal impact of these design principles. The research also contributes to discussions on the relationship between physical environments and employee's levels of stress, anxiety and demotivation by providing data that challenge the assumption that nature-based design is a straightforward solution for improving overall well-being in office settings.

However, some limitations were noted in this study. As a novice researcher, the analysis may have lacked the depth and rigour that a more experienced researcher could bring to the study.

While the research question was addressed through the analysis of participant responses, the answers given were not in alignment between each other and the findings were not entirely clear. A more experienced researcher might have considered additional methodologies to better interpret these discrepancies. For instance, incorporating qualitative methods, such as interviews, could have provided richer insights and elucidate inconsistencies that were not fully captured by the quantitative survey alone.

Another significant limitation was related to participant recruitment. The study faced challenges in accessing participants who met the key criteria—specifically, those working in office environments in Feira de Santana. Many potential participants were either not working in traditional office settings, had switched to remote or home-office arrangements, or had moved away from the city. This limitation affected the total contributions for this research.

Additionally, the limited time frame of the study restricted the scope of the analysis. With more time, the research could have focused on specific professional groups, providing a more in-depth exploration of how biophilic design affects well-being in different office environments and what is the representativeness of this particular group for the economy in Feira de Santana. A longer study period would have allowed for a more comprehensive investigation of the target population, leading to more robust findings that could offer greater relevance to certain sectors.

5.4. RECOMMENDATIONS FOR PRACTICE AND FOR FUTURE RESEARCH

While this study did not find a strong correlation between biophilic design and employee well-being in Feira de Santana, it is still valuable for organisations to consider incorporating biophilic elements where feasible. Office environments that include natural light, indoor vegetation, and natural materials may contribute to overall aesthetic improvement and potentially enhance workplace satisfaction, even if the impact on stress, anxiety, and demotivation is not immediately evident.

Organisations could also actively seek feedback from employees regarding their preferences for office design improvements. Creating spaces that align with employees' desires, such as increased natural light or more greenery, could improve workplace morale and overall satisfaction.

For future research, a mixed-methods approach is recommended. Incorporating qualitative methods alongside quantitative analysis could provide a richer understanding of the relationship between biophilic design and employee well-being across Feira de Santana. Interviews could

reveal deeper insights into employees' personal experiences and perceptions, complementing the quantitative data obtained from surveys. As a result of the participants alignment in their answer, would be ideal an interpretation-based approach in order to elucidate to the interviewed how workplaces could impact their overall well-being, show more references of biophilic design offices and go through deeper questions about their perception of the relationship between the built environment and levels of stress, anxiety and demotivation. As shown by Camêlo (2023), participants' responses to questions about workplace satisfaction shifted after they paused to reflect on the significance of the architectural design in relation to their overall well-being. This suggests that when given the opportunity to consider how the physical environment influences their comfort and productivity, individuals may reassess the impact that workplace architecture has on their satisfaction and health.

5.5. FINAL CONCLUSION AND REFLECTIONS

This study has examined the relationship between biophilic design in office environments and its impact on employee well-being in Feira de Santana, Brazil. By focusing on the presence or absence of biophilic elements and their association with levels of stress, anxiety, and demotivation, the research aimed to provide insights into the relevance of biophilic design for improving workplace conditions in this specific context.

The findings did not reveal a clear or strong correlation between biophilic design elements and reduced levels of stress, anxiety, or demotivation among employees. Some offices with more biophilic features were even associated with higher stress levels, challenging the generally positive literature on biophilic design (Kellert and Calabrese, 2015; Cooper and Browning, 2015). This suggests that while biophilic elements are increasingly popular globally, their direct impact on emotional well-being in Feira de Santana is less evident. The data also indicate that employees in Feira de Santana do not experience particularly high levels of these negative emotions, with stress being the most reported but not overwhelmingly prevalent. These finding contrasts could be attributed to local socio-economic factors (Lipp et al., 2020) or lack of awareness of how a built environment can impact human beings (Camêlo, 2023).

Although biophilic design is valued by employees, who expressed a preference for natural elements in their work environment, there was no substantial evidence linking these features to improved emotional well-being. This disconnect between perceived and actual benefits of biophilic design suggests that more complex factors, such as overall workplace design and organisational culture, may play a significant role in shaping employee satisfaction.

Reflecting on the research process, engaging with the field of biophilic design proved both enlightening and challenging. The journey of exploring how biophilic design impacts employee well-being in Feira de Santana revealed complexities that extended beyond the initial scope of the study. While the primary research question was addressed, the inconsistency in participants' responses prompted further inquiry into the broader implications of workplace environments on stress, anxiety, and demotivation.

This experience has highlighted the need for a greater understanding of how office settings affect these emotional states. If given the opportunity to conduct further research in this field, I would employ a mixed-methods approach. This would include qualitative techniques such as interviews and observations to complement the quantitative data and provide deeper insights into the relationship between biophilic design and employee well-being. Such an approach would offer a more comprehensive view and help address the questions raised about the true impact of workplace environments on employees' emotional health.

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APPENDICES

APPENDIX A - PLAIN LANGUAGE STATEMENT FOR RESEARCH PARTICIPANTS

PLAIN LANGUAGE STATEMENT

Introduction to the Research Study

Research Study Title: THE RELATION BETWEEN BIOPHILIC DESIGN AND LEVELS OF STRESS, ANXIETY AND DEMOTIVATION AMONG EMPLOYEES IN OFFICE ENVIRONMENTS IN FEIRA DE SANTANA, BRAZIL

University: Griffith College, Graduate Business School.

Principal Investigator: Dr Garrett Ryan.

Researcher Name: Aline Azevêdo de Almeida

Email: aline.azevedodealmeida@student.griffith.ie

II. Details of what involvement in the Research Study will require

This project involves taking part in completion of a survey. The interviews/survey responses will be recorded, and seek to gather information on your experience of correlation between biophilic design in office environments and employees' levels of stress, anxiety and demotivation currently working in Feira de Santana, Brazil. Questions are directed towards your thoughts on participants' gender, age generation, position/profession, the presence of natural elements in their workplace, office design satisfaction, if they already experienced or are experiencing anxiety, demotivation or stress due to their workplace. I estimate the interviews/survey will take no longer than 15 minutes to complete.

III. Potential risks to participants from involvement in the Research Study (if greater than that encountered in everyday life) I do not anticipate any risk to participants as a result of participation in this Research Study.

IV. Benefits (direct or indirect) to participants from involvement in the Research Study

The objective of this Research Study is to gain new knowledge that will enable us to understand the direct relation between the presence of biophilic design office environments and levels of stress, anxiety and demotivation among employees in Feira de Santana. Which will also help to understand how important this Neuroarchitecture approach is to enhance overall well-being in the workplace and further business outcomes in this particular city. This study may, therefore, be of benefit to you by providing you with the opportunity to contribute to the body of knowledge on the impact of biophilic design in the office environment on employees' well-being in Feira de Santana, Brazil so that you and or society may benefit.

V. Advice as to arrangements to be made to protect the confidentiality of data, including that confidentiality of information provided is subject to legal limitations

Every effort is made to ensure the confidentiality of the participant. Participant names will not be recorded, as all participants will be assigned a code. Where used, recorded interviews/survey data will be downloaded to a password-controlled computer, typed transcripts/survey results are held within password-controlled documents. Participant biographical details and or mention of other persons will be omitted in the final report. Confidentiality of information provided is subject to legal limitations.

VI. Advice as to whether or not data is to be destroyed after a minimum period

Audio tapes/Survey data will be destroyed on the successful completion of this master's degree in full compliance with GDPR regulations.

VII. Statement that involvement in the Research Study is voluntary

Involvement in this Research Study is voluntary. Participants who decide to take part may withdraw from the Research Study at any point. There will be no penalty for withdrawing before all stages of the Research Study are complete.

If participants have concerns about this study and wish to contact an independent person, please contact:

Dr Garrett Ryan
Graduate Business School
Research Committee
Griffith College
South Circular Road, Dublin 8, Ireland

Phone: + 353 1 416 3324

Email: garrett.ryan@griffith.ie

APPENDIX B - INFORMED CONSENT FORM

INFORMED CONSENT FORM

I. Research Study Title: THE RELATION BETWEEN BIOPHILIC DESIGN AND LEVELS OF STRESS, ANXIETY AND DEMOTIVATION AMONG EMPLOYEES IN OFFICE ENVIRONMENTS IN FEIRA DE SANTANA, BRAZIL

University: Griffith College, Graduate Business School.

Principal Investigator: Dr Garrett Ryan.

Researcher Name: Aline Azevêdo de Almeida

Email: aline.azevedodealmeida@student.griffith.ie

II. Clarification of the purpose of the research

The aim of this research is to understand the direct relation between the presence of biophilic design office environments and levels of stress, anxiety and demotivation among employees in Feira de Santana. Which will also help to understand how important this Neuroarchitecture approach is to enhance overall well-being in the workplace and further business outcomes in this particular city. This study focuses on direct experience of nature that includes - such as natural light, air, water, plants, animals, and natural landscapes into the built environment and an indirect experience of nature – natural materials. Furthermore, through a combination your participation and the latest research into the impact of biophilic design in office environment in employees' well-being in Feira de Santana, Brazil, this research will add to body of academic understanding of the relationship between the presence/ or the lack of biophilic design in office environments and levels of stress, anxiety and depression in employees currently working in Feira de Santana, Brazil.

III. Confirmation of particular requirements as highlighted in the Plain Language Statement

This project involves taking part in completion of a survey. The interviews/survey responses will be recorded, and seek to gather information on your experience of correlation between biophilic design in the office environment and employees mental health currently working in Feira de Santana, Brazil. Questions are directed towards your thoughts on participants' gender, age generation, position/profession, the presence of natural elements in their workplace, office design satisfaction, if they already experienced or are experiencing anxiety, depression or stress due to their workplace. I estimate the interviews/survey will take no longer than 15 minutes to complete.

Participant – please complete the following (Circle Yes or No for each question)

Have you read or had read to you the Plain Language Statement	Yes/No
Do you understand the information provided?	Yes/No
Have you had an opportunity to ask questions and discuss this study?	Yes/No
Have you received satisfactory answers to all your questions?	Yes/No
Are you aware that interviews will be audiotaped?	Yes/No

IV. Confirmation that involvement in the Research Study is voluntary

Involvement in this Research Study is voluntary. Participants who decide to take part may withdraw from the Research Study at any point. There will be no penalty for withdrawing before all stages of the Research Study are complete.

V. Advice as to arrangements to be made to protect confidentiality of data, including that confidentiality of information provided is subject to legal limitations

Audio tapes/Survey data will be destroyed on the successful completion of this master's degree in full compliance with GDPR regulations.

VI. Participant Signature:

I have read and understood the information in this form. My questions and concerns have been answered by the researcher, and I have a copy of this consent form. Therefore, I consent to take part in this research project

Participants Signature: _____

Name in Block Capitals: _____

Witness: _____

Date: _____

APPENDIX C – QUESTIONNAIRE SURVEY


This questionnaire was originally written and sent to the participants in Portuguese (BR) – the official language of Feira de Santana.

Section 1 - demographics	
QUESTION	ANSWERS OPTIONS
1. Gender	Female
	Male
	Non-binary
	I prefer not to answer
2. Age	18-24 years old
	25-34 years old
	35-44 years old
	45-54 years old
	55-59 years old
3. What is your profession?	open-ended answer
4. What is your current position in the company?	Intern
	Assistant
	Analyst
	Coordinator
	Manager
	Director
	Other: (open-ended answer)
5. What is the sector of your company?	Administration
	Accounting
	Marketing
	Human Resources
	Information Technology
	Sales
	Engineering
	Legal
	Other: (open-ended answer)

6. How long have you worked at your current company?	Less than 1 year
	1-2 years
	3-5 years
	6-10 years
	More than 10 years
7. How big is the company you work for?	Micro-enterprise (up to 9 employees)
	Small company (10-49 employees)
	Medium-sized company (50-99 employees)
	Large company (more than 100 employees)
8. How many days a week do you work in person at the office?	3 days a week
	4 days a week
	5 days a week
	More than 5 days a week
9. What is the highest level of education you have completed?	High school diploma
	Technical/vocational education
	Graduation (Bachelor's degree, Teaching degree)
	Postgraduate (Specialization, MBA)
	Master's degree
	Doctorate
	Other: (space for answer)
10. What is the work regime at your company?	100% in-person
	Hybrid (part in-person, part remote)
	In-person with frequent external travel (visits to clients, field work, etc.)

Section 2 – presence of biophilic design in the workplace	
QUESTION	ANSWERS OPTIONS
1. What is the lighting like at your workplace?	Only natural (the light coming in through the window is sufficient)
	Combined (both natural and artificial light)
	Only artificial (the lights are always on)
2. What is the view from the window of your workspace?	I don't have a window
	From inside the building where I work
	From the outside, I can only see the facade of the neighbouring building
	From the outside, I can see the city
3. What is the ventilation like at your workplace?	Only natural (the wind coming in through the window is sufficient)
	Combined (natural and artificial ventilation)
	Only artificial (the air conditioning or fan is always on)
4. Is there any water feature in your workplace (e.g. fountain, aquarium)?	Yes
	No
5. Is there vegetation in your workspace?	Yes, natural plants
	Yes, winter garden
	Yes, artificial vegetation
	No vegetation
6. Is there vegetation outside your office?	Yes, public vegetation
	Yes, office garden
	No external vegetation
7. Are there natural materials (e.g. wood, stone, wool, straw, iron, leather) or materials that imitate the appearance of these materials in your office?	No
	There are almost no materials with this appearance
	Moderate presence of these materials
	Yes, in almost all environments

Section 3 – employee perceptions of stress, anxiety, and demotivation	
QUESTION	ANSWERS OPTIONS
1. How often do you feel stressed in your work environment?	Never
	Rarely
	Sometimes
	Frequently
	Always
2. How often do you feel anxious in your work environment?	Never
	Rarely
	Sometimes
	Frequently
	Always
3. How often do you feel unmotivated in your work environment?	Never
	Rarely
	Sometimes
	Frequently
	Always
Section 4 – evaluation of office settings	
QUESTION	ANSWERS OPTIONS
1. Does the physical space of your office contribute to your stress levels?	Yes, it increases stress a lot.
	Yes, it increases stress a little.
	No, it does not influence stress.
	No, on the contrary, it helps to reduce stress.
2. Do you feel that the office environment contributes to your anxiety levels?	Yes, it increases anxiety a lot.
	Yes, it increases anxiety a little.
	No, it does not influence anxiety.
	No, on the contrary, it helps to reduce anxiety.
3. How does the physical layout of your workspace (furniture, division of spaces,	It greatly improves my well-being and productivity
	It improves my well-being and productivity

colours, vegetation, etc.) affect your level of well-being and productivity?	It has no significant impact
	It reduces my well-being and productivity
	It greatly reduces my well-being and productivity
4. How do you think the physical layout of your workspace could be improved? (Choose all that apply)	Changing the colours of the environment to more pleasant tones.
	Including more indoor vegetation (plants, vertical gardens, etc.).
	More windows or natural light in the environment.
	Installing water fountains or aquariums.
	Using natural materials (wood, stones) in decoration.
	Creating spaces with views of outdoor or natural areas.
	Using works of art or decorative elements that refer to nature.
15. Do you believe that working in an environment with natural elements and good lighting, as shown in the image, can help reduce stress and anxiety levels?	Yes, definitely.
	Maybe, a little.
	It doesn't make any difference.