

RESEARCH ARTICLE

Open Access



# Enhancement of work place comfort through the use of soft landscape

Taiwo Ayomide Ale<sup>1\*</sup> , Dorcas Aina Ayeni<sup>2</sup> and Olatunde Folaranmi Adedayo<sup>3</sup>

## Abstract

The work environment has been shown to have a great influence on employees' physical and mental state, as such employers try as much as possible to provide a comfortable working environment. However, recent studies have shown that the work environment is no longer as comfortable as it used to be due to heat gain from the increasing use of hard landscape features and neglect of soft landscape features in the work environment. This has resulted in stress causing both mild and severe health conditions for employees. Thus, this study aims to analyze the use of soft landscape in enhancing users' comfort with the view of reducing stress and health-related issues in the work environment. The paper adopted a mixed method using observation checklists, structured interviews, questionnaires, and case studies. A total of eighteen office complexes were selected to describe the existing situation as related to most office complexes and to also gain insight into the subject matter as already applied to life situations. Structured interviews and questionnaires were also conducted with occupants of the buildings and professionals to hear their perceptions and expectations of their work environment. Results showed that 20 percent of the offices give proper consideration to the use of soft landscapes in the work environment, and 40 percent give inconsiderable attention to soft landscapes while making use of them in small quantities solely for improving the aesthetical value of the building. In comparison, the remaining 40 percent do not consider landscape use as a means of improving comfort in the work environment. Findings also revealed that 80 percent of office buildings give major consideration to parking space using hard landscapes without a proper blend of soft landscapes after building design which hurts occupant comfort. The research concluded that the incorporation of soft landscape elements both within the building using recesses and protrusions and on the building walls through the use of exoskeleton and climbers while incorporating trees, shrubs, flowers, hedges and water around the building can have these required effects on employee's comfort.

**Keywords** Comfort, Landscaping, Soft landscape, Stress, Work environment

## Introduction

The work environment is of great importance in an individual's working life and it is a dynamic environment to which people must adapt. Grant and Parker (2009), stated that the work environment is simply, the surrounding environment in which people work and is said to be suitable for humans if work activities can be carried out seemly, healthily and comfortably. Comfort in the work environment is a salient factor that must be considered in the process of improving work productivity (Bushiri 2014; Chowdhury et al. 2020). For comfort to be achieved, the human body requires a narrow range

\*Correspondence:

Taiwo Ayomide Ale  
aleayomide@gmail.com; taiwo.ale@aaau.edu.ng

<sup>1</sup> Department of Architecture, Adekunle Ajasin University, Akungba-Akoko, Nigeria

<sup>2</sup> Department of Architecture, Federal University of Technology, Akure, Nigeria

<sup>3</sup> Department of Architecture, Joseph Ayo Babalola University, Ikeji-Arakeji, Nigeria

of environmental conditions for air temperature, mean radiation temperature, relative humidity and air velocity (Mora and Bean 2018). Air temperature and relative humidity are the most important factors affecting human comfort (Giannopoulou et al 2014). Generally, people experience comfort when staying in environments with temperatures between 22 and 27 °C and relative humidity of 40–60% (Chao et al 2021).

However, the continuous use of hard landscapes around the work environment with little attention paid to soft landscapes has contributed greatly to heat stress which has created a great level of discomfort in the work environment (Lobaccaro et al 2019; Hastings et al. 2020). Besides, the rapid increase in temperature due to climate change has made the risks more severe for large shares of the global working population (Kjellstrom et al. 2009; Ebi et al. 2021). In January 2016, the World Meteorological Organization (WMO) commended that there is a likelihood that the average global temperature change had already reached 1 degree Celsius (or 1.8° Fahrenheit) (WMO 2015). This rising air temperature in the work environment has resulted in heat stress which is a major worry to persons working outdoors or indoors without climate management or with ineffective management of ambient temperatures (IPCC 2015). According to Parsons (2014), the consequence of heat stress has a different effect on employee's health and comfort and indirectly affects the absenteeism rate among the occupants of the building. Rabiatal et al, (2013), opined that for the proper realization of a comfortable work environment, the development of outdoor spaces is important as nature performs a fundamental part in promoting the well-being of any environment. The natural environments are not the only therapeutic but they seem to have considerable advantages over other settings (Kaplan 1995; Norwood, et al 2019), as they play a dominant role in human comfort and well-being (Ulrich 1984; Dong et al 2021). Therefore, this study aims to analyze the use of soft landscape in enhancing users' comfort in the workplace with the view of reducing stress in the work environment.

## Literature review

### Soft landscape in work environment

Landscape is a 'scenery of natural and man-made features within the environment defined by man's relationships and activities within his surroundings (Ayeni 2012). Landscaping is an essential component of our culture and plays an important role in the quality of our environment, the economic well-being of the people, as well as their physical and psychological health (Marques et al 2020). It is also a way of sustaining and increasing the quality of human life by preserving and conserving the environment (Adekunle

and Basorun 2016). According to Hakim (2003), there are two major types of landscape material, namely soft materials and hard materials. The Hard landscape materials include inanimate materials which are inert and the artificial elements of space such as roads, buildings, walkways, fences, sculptures and statues, (Adekunle and Basorun 2016), while the soft landscape materials include plants i.e. trees, shrubs, flowers, grass, water and earth modeling (Adedeji and Fadamiro 2011; Ayeni 2012; Supplementary Planning Guidance 2013). In the same vein, Shah et al. (2002) opined that soft landscape materials deal with all types of trees, shrubs, hedges, climbers, ground cover, planning of the garden and their maintenance.

Soft landscaping is used in both outdoor and indoor spaces of the work environment and has a significant role in creating a relationship between humans and the natural environment while strengthening the relationship (Mansouri 2005) and the liveability of the environment (Shamsuddin et al. 2012). As noted by Adedeji and Fadamiro (2011) and Ayeni (2012), soft landscape elements are important components in the built environment including the work environment as they offer amongst others, privacy, break in the monotony of views, provide a habitat for animals, provide security, seasonal colours and splendor, creates shades as well as environmental aesthetics. In addition, soft landscape elements in the work environment help soften the atmosphere, give more seclusion to the worker, and serve an auditory purpose (Zakaria et al 2016; Samuelsson et al 2021; Souter-Brown 2023). The ability of soft landscape elements to enhance air quality by absorbing carbon dioxide is an added advantage (Ahmed Mohamed and Elgizawi 2022). The reports of soft landscape elements in work environments by researchers have also shown that soft landscape enhances employee morale, increases job contentment, increases productivity, and decreases truancy (Kamarulzaman, et al 2011). Besides, Ahmad et al (2014), found that the soft landscape elements in an office make the visitor more comfortable and welcome.

However, soft landscape elements have become a fundamental feature of commercial interiors for many reasons and their use in interior spaces is increasing day by day (Zakaria et al 2016; Şentürk and Altınçekiç, 2018). Interior plants produce a lot of habitual benefits such as brightening mood, improving memory and reducing stress (Yeo 2020; Qin et al 2013; Lohr 2010). Interior landscape design, also known as "plant scaping", is more than the act of introducing plants into the interior spaces; it is about the strategic selection and location of plant species within a building to call attention to and improve every aspect of spatial design.

### Environmental stress in the workplace

Work environmental stress is also known as the cognitive, emotional, and behavioral responses to an environmental stimulus or stressor (Gatersleben and Griffin 2017). Sara et al (2017); Saqib and Zaffer (2019), and Sajid et al (2021), opined that the work environment stressors include external factors such as noise, temperature extremes, chemical hazards, physical danger, physical exertion, and ergonomics while those that are internal to the job include long hours, work overload, time pressure, difficult or complex tasks, lack of breaks, lack of variety, and poor physical work conditions. Evans and Cohen (1987), classified environmental stressors into four types: awful events which are uncommon events such as natural disasters that have a trivial impact on people and their surrounding environment; stressful life events; daily hassles; and ambient stressors. The ambient stressors are significant, important, and critically valued environmental stressors that are noticeable but may go unnoticed (Campbell 2016). However, the key ambient environmental stressors are light (Malinin 2017; Mathalamuthu and Ibrahim 2014; Osman et al. 2017; Shepley et al. 2017), color (Al-Ayash et al. 2016; Jalil and Yunus 2012), noise (Bluyssen 2013; Frackiewicz et al. 2015), and temperature (Ghasemi 2017).

The effect of environmental stress in the work environment has been encapsulated into three groups, which include; physiological, psychological, and behavioral (Sharma and Agarwal 2021). The Physiological strain is revealed by changes in heart rate, blood pressure, and other instant responses (Smith and O'Brien 1976; Pilch et al. 2014), and the lasting effect of this can cause psychosomatic diseases coronary heart disease, hypertension, and ulcers (Weiman 1977). The psychological effects of stress include cognitive effects, such as job satisfaction and weariness; depression and anxiety; and somatic symptoms, (Singh et al. 2019; Chitra and Karunanidhi 2021). In comparison, the behavioral factor includes performance-productivity, errors, and absenteeism; self-destructive behaviors, such as smoking and substance abuse; and behavior at home and participation in community affairs (Chitra and Karunanidhi 2021). Thus, environmental stress in the workplace poses a serious threat not only to the well-being of workers but also to the success of the organizations.

### Concept of human comfort in the work environment

The term "comfort" derives from the Latin "*confortare*" which means "become strong, relief or encourage." (Tutton 2003). Duru et al. (2019), define comfort in a scientific way as a "satisfying condition of physiological,

psychological, and physical harmony between human beings and the surrounding environment. According to Pearson (2009), comfort is best described as the absence of discomfort. Comfort can also be a condition, which is linked to outcomes such as ease, well-being and satisfaction (Pinto et al. 2017). Even though the inconsistency in the definition of comfort has led to different meanings and interpretations, these definitions still indicate that comfort has positive effects on an individual's health and well-being.

However, the idea that workplace comfort should serve as a foundation for environmental standards emerged from the realization that people need more from their buildings than just to be safe and healthy (Vischer 2007; Ali et al. 2015). Building users need environmental support for the activities they perform, and this state of environmental support is what is meant by comfort (Vischer 2018). Ali et al. (2015) and Al-Omari and Okasheh (2017), having undertaken an extensive literature review concluded that, comfortable employees, were instrumental in their productivity levels. Comfort links the psychological aspects of workers', environmental satisfaction with concrete outcome measures such as improved task performance with organizational productivity (Samani and Alavi 2020; Vischer 2007). Besides, Vischer (2007), and Lai et al. (2020), established that there are three levels of relationship to environmental comfort which include: Psychological, physical and functional comfort.

Physical comfort is achieved when a human stays in a steady state (thermal, visual, acoustical and air quality) to be able to perform tasks with the maximum energy possible and without any stress (Fekry et al. 2014). Psychological comfort links psychosocial aspects with the environmental design and management of the workspace through the concepts of territoriality, privacy and control. In comparison, functional comfort is the mid-way between the basic needs of physical comfort and the opportunities for increasing psychological comfort (Vischer 2007). It addresses how effective the workspace is in helping users perform their tasks rather than how satisfied they are.

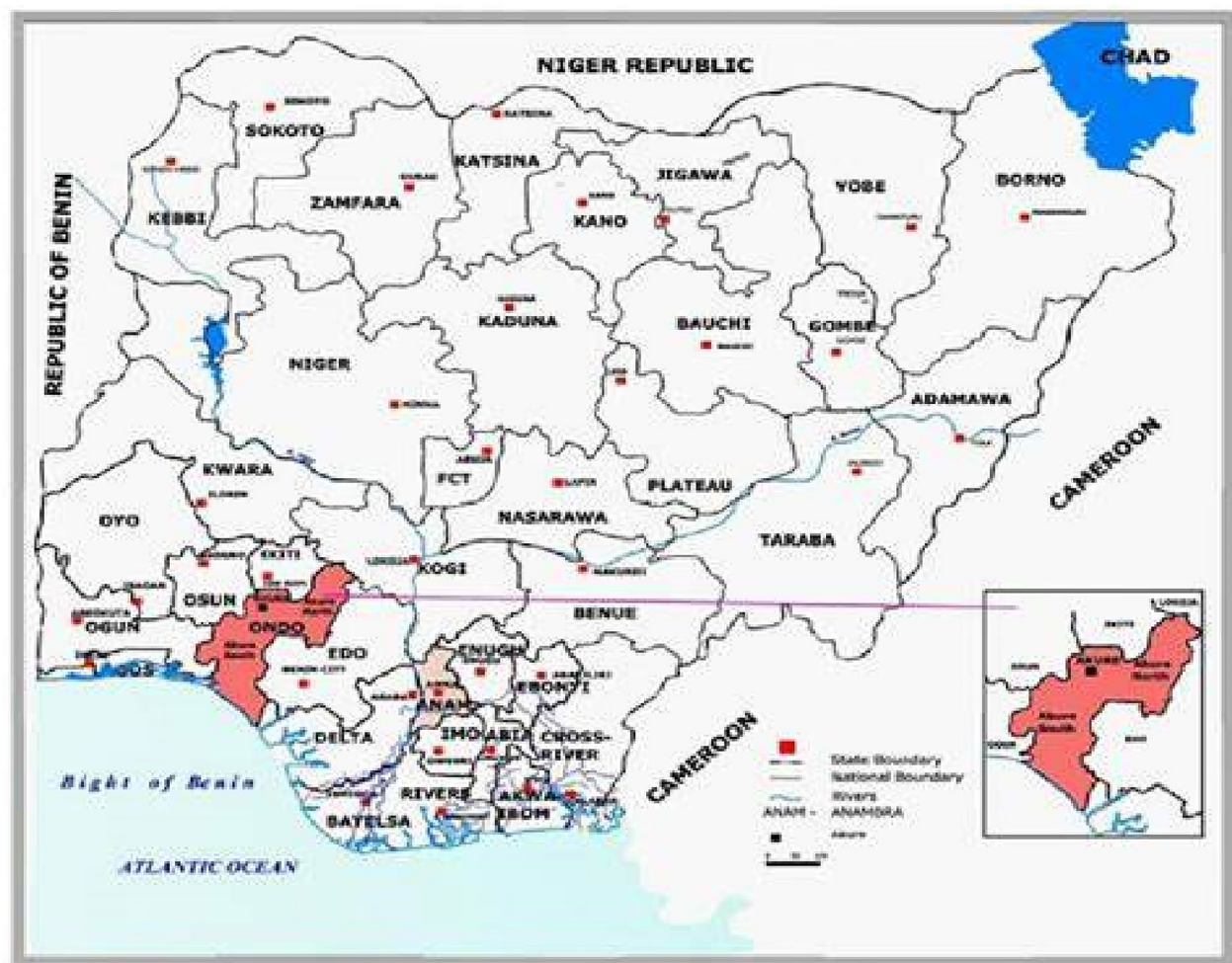
Comfort has also been studied concerning four factors such as visual (view, illuminance, and reflection), thermal (air velocity, humidity, and temperature), acoustical (control of unwanted noise, vibrations, and reverberations), and air quality (smells, irritants, outdoor air, and ventilation) and remained the foundation for additional design and studies until today (Bluyssen 2009). All of these variables affect human comfort, but air temperature is the primary environmental factor that affects an employee or employees because it controls convective

heat dissipation (Qin et al. 2022). Nevertheless, all of these variables must be taken into account to understand comfort because if they are not satisfied, the environment becomes uninhabitable.

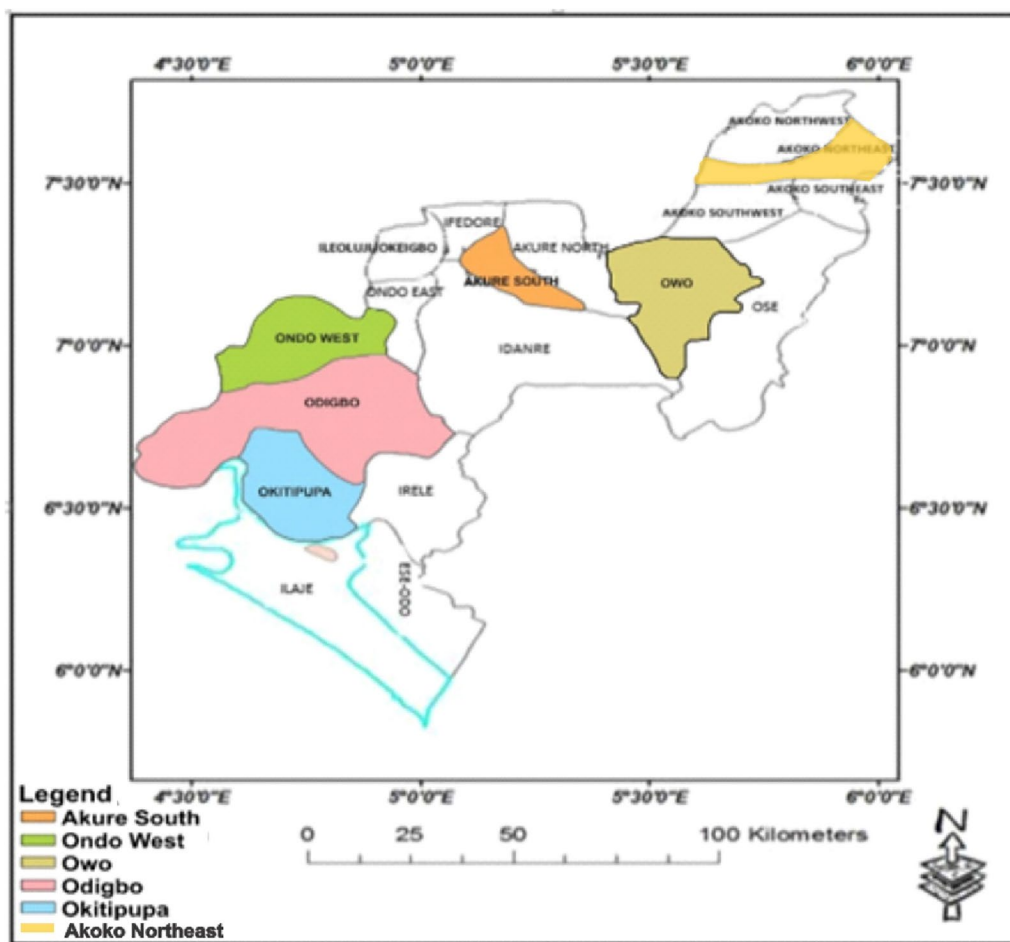
Physical work environment (PWE) is an aspect of the work environment. Workplace environment is the sum of the interrelationships that exist between employees and the environment, in which they work (Kohun 2002). Heath (2006) asserts that this environment involves the physical location as well as the immediate surroundings, behavioral procedures, policies, rules, culture, resources, working relationships, and work location, all of which influence the ways employees perform their work. PWE as an aspect of the work environment has to do with the office layout and design. It constitutes things such as furniture (tables, chairs, etc.), machine layout, ventilation and lighting. Others are noise level, protective equipment, workstations, office gadgets, computers and office space.

### Study area

The study was conducted in Ondo State, which is located in the southwest humid forest of Nigeria, at latitudes  $5^{\circ}45'N-8^{\circ}15'N$  and longitudes  $4^{\circ}45'E-6^{\circ}00'E$  (Figs. 1 and 2). The Atlantic Ocean borders the state on the South, Ekiti and Kogi States to the North, Edo and Delta States to the East, and Osun and Ogun States to the West (Faphounda 2005). In the rainforest zone, Ondo state experiences an average annual rainfall of 1300–1600 mm and average temperatures of  $27.5-32.5^{\circ}C$ . The relative humidity varies from 85 to 100% in the rainy season to less than 60% in the dry season. The State experiences two distinct seasons owing to its geographic location: the dry season (November–March) and the rainy season (April–October). Roughly 3.4 million people are living in the state's 18 Local Government Areas (National Population Commission 2007). According to Mafimisebi and Thompson (2012), the state is ideal for producing fisheries products from both artisanal and aquaculture



**Fig. 1** Map of Nigeria showing the study area (Ondo State)



**Fig. 2** Map showing the location of where the office complexes are located

sub-sectors, as well as arable crops. Ondo State has three distinct ecological zones; the mangrove forest to the south, the rain forest in the middle and the guinea savannah to the north.

**Research method**

A mixed methods approach was adopted for the study using case studies, observation checklists, interview guides and questionnaires. Eighteen offices, comprising three offices from each of the six major Local Government Areas in Ondo State, were chosen. Based on the number of office complexes and the high population use of the office, a purposeful selection of office buildings was made. The appraisal of the existing office complex was carried out by physical visitation to the site. This is done to describe the existing situation as related to most office complexes and also to gain insight into the subject matter as already applied to life situations while examining the merits and shortcomings of the office complex especially on technical issues relating

to employees’ comfort. A structured interview was also conducted with 22 professionals in the construction industry who are occupants of the buildings and 32 senior executive officers. The respondents who were randomly selected were interviewed on the comfort level experienced in their work environment to hear the perceptions of the user’s needs and expectations towards their work environment. The interview method that was adopted ensured that all the interviewees were provided with the same questions; this allowed for proper investigation of the topic and provided opportunities for both interviewer and interviewee to discuss the area of interest in detail. In administering and determining the sample size for the questionnaire the study adopted a stratified random sampling method, a sample size of 251 respondents was considered adequate for the study as established by Marshall et al. (2013), A total of 150 copies of the question were returned giving a return percentage of 59.8% which was considered adequate for analysis in qualitative research according to Boddy (2016). The

results were presented in tables and charts to establish the findings of the study. In determining the decisions on each variable from the question, the calculation and rating were done based on these:

The weighted score of 1–4 was allocated to the rating options of adequacy based on the perception of the respondents regarding the variable measured;

Very adequate	1
Adequate	2
Inadequate	3
Very inadequate	4

The results obtained from the analysis of the questionnaire are based on the calculation of the mean of the individual response of the respondents using a Likert scale of measurement as presented in Table 2:

1.0–1.49	Strongly agree
1.5–2.49	Agree
2.5–3.49	Disagree
> 3.5	Strongly disagree

## Findings

### General office type description

Using an observation checklist, the offices were examined to determine the features and design decisions that could affect the comfort of the occupants of the buildings. It was observed majority of the offices had windows that were centrally located within the office space in cases where that was the only window on the wall while in cases of two windows, they were located at the right angles of the walls. The offices were aligned along corridors.

### Window sizes and types in offices

80% of the respondents considered the window openings as being insufficient to serve the ventilation needs of the occupants of the offices.

60% of the window types are sliding windows hence reducing the effective opening by 50%, while 40% is casement window.

### Building orientation

20% of the buildings took cognizance of building orientation during the design and construction stage, 20% did not fully realize proper orientation while 60% of the buildings didn't take into consideration the proper orientation of the building.

### Surrounding features in the offices

It was observed from the cases examined as shown in Fig. 7 that some of the offices have high temperatures due

to the surrounding features. 60% of the office complex made use of soft landscape, however, 20% was sufficient while 40% was insufficient.

### Interior plant

In the case of the offices examined, it was noted that 20% of the offices incorporated plants internally through the provision of potted plants along the corridors and reception where plants were hung on the wall while 80% of the offices did not incorporate the use of plant within the office building as shown in Fig. 8.

### Effect of soft landscape in office environment

The perception of the respondents on the questions put them.

## Discussion

### General office type description

The orientation of the building appeared to have been determined by the size of the site concerning the shape of the building placed on it. It was easy to observe that some buildings had more windows along the sun path thereby allowing more heat gain in addition to the large wall section facing the sun path. This was done to accommodate other features required to be placed on the site as consideration was given to the provision of more function space for the carpark, hence cases of buildings with setbacks of less than 2 m from the boundary lines of the site despite being high-rise buildings. The landscape aspect of the office premises was treated as a secondary feature given the fact that many of the buildings surrounding were left plain as the existing vegetation was not integrated into the initial design of the building. In very rare cases would one find large trees that pre-date the building. The common building design in the office examined can best be described as corridor design. Two clear examples of this corridor design were observed:

1. The enclosed corridor design had offices along both sides of the corridor as seen in Fig. 3.
2. The open corridor design had offices along one side of the corridor.

In either case, little attention was paid to taking advantage of possible opportunities to place windows along the corridors.

It can be observed that the building generally offered opportunities for achieving comfort for the occupants which appeared to have been ignored from the design viewpoint. The realization of this error has led to several attempts to mechanically cool the building interior given the fact that every office had air conditioners installed in it. The use of soft landscape elements is another



**Fig. 3** View of office along a corridor without windows or openings

attempt to provide natural cooling for the building and its occupants.

**Window sizes and types in offices**

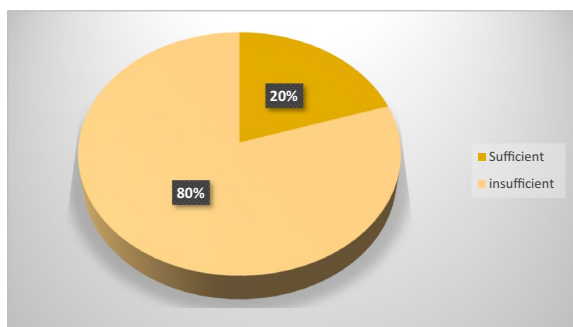
The window is an essential element in a building and can be defined as an opening in a wall that allows the flow of air and light into the building. It was observed from the study that 20% of the office spaces make use of a shared window, 60% were provided with one opening, and 20% have either a cross or parallel opening for ventilation. Although the sizes of the windows vary according to the width of the room, it was noticeable that 80% of the spaces have inadequate windows as shown in Fig. 4. Respondents opined that poor performing fenestration is a significant source

of discomfort in buildings as the employee feels uncomfortable in spaces when mechanical systems are not in use.

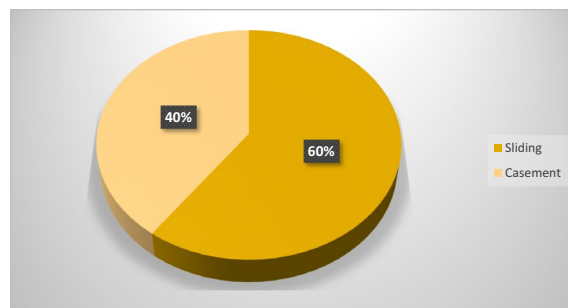
Windows contributes significantly to human comfort in a building, especially for those sitting close to it. The window regulates the winds and thus helps to ameliorate human comfort. Respondents opined that the windows ventilate the building naturally without mechanical systems thus achieving comfort. However, some of the respondents believe that the window cannot effectively serve a place without a mechanical system. This suggests that some of the respondents are not fully aware of the usage of windows in buildings. This is because they always make use of the air conditioners once they are in the office and in situations when this is not available they can not feel the air moving into their office, which unknown to them is a function of the poor design and the unavailability of the outlets for air inlet.

The type of window used also determines the amount of ventilation gained in the building. 60% of the offices made use of sliding windows. In this type of window, only half of it is openable for ventilation while the other half is fixed. The remaining 40% made use of casement windows which allowed for full use of the window space as shown in Fig. 5.

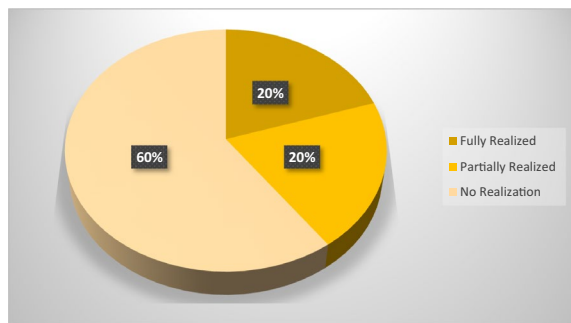
The window not only provides ventilation in the building it also allows occupants of such buildings to create a connection with the surrounding environment. Occupants have a visual connection with nature, this connection mitigates the negative impact of job stress while improving employee comfort. As noted by some of the respondents, windows in buildings are the primary means of providing connections with the outdoors and visual connection moderates the negative impact of the job such as stress while improving human comfort. The challenge with window type selection for office buildings is that sliding windows offer what many consider aesthetically pleasing for such buildings



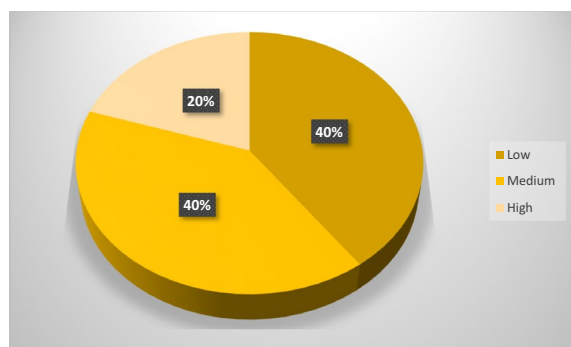
**Fig. 4** Percentage with sufficient/insufficient openings



**Fig. 5** Percentage of window types



**Fig. 6** Percentage of building orientation



**Fig. 7** Percentage of offices with adequate/inadequate soft landscape material

despite their shortcomings. This shortcoming unknown to many of the occupants of the building equally affects their perception of the window functionality.

However, the issue of comfort has been long associated with issues that surround thermal comfort. This is why focus must be given to the provision of cross ventilation where possible and large windows, this was clearly stated by some of the interviewees. This goes to show that even the prospective users of the building are concerned about the human comfort in the building because this will certainly affect their efficiency which is a component of the success of the business being carried out in the space.

### Building orientation

The orientations of the building determined the amount of radiation and ventilation received by such buildings concerning the main facade. Proper orientation of buildings is a low-cost way of improving indoor comfort. This is so because the appropriate orientation of the building helps in minimizing heat gain. This was agreed to by respondents who are professionals in the built environment that proper orientation of the building prevents excessive heat gain and hot air into the building. It is clear from the study that the orientation of the

building was either overlooked by the professional or was not fully realized as shown in Fig. 6.

For a space to be comfortable the air temperature within such a place must be considered favorable for the occupants of the building. Heat earned in the building is one of the major causes of stress especially for employees who are actively engaged. Stress build-up due to heat gain hampers employee comfort making them unproductive.

A major point of concern is the quantity of heat received by the building and the surrounding environment, this is often considered when determining the orientation of the building. Based on the cardinal points the eastern and western façade of the building is the best place for the provision of windows. However, to reduce the hot breeze there should be more placement of more windows along the western part of the building. According to the respondents heat gain in buildings is through openings and is a major cause of discomfort. This must be taken care of by taking advantage of the orientation to ensure comfort. The benefits of achieving good building orientation in terms of capturing the best opportunities available on site given the climatic conditions of the area was something that many of the respondents could not easily relate to and this was understood because it was supposed to be a passive factor in building design. In many offices, the respondents stated that they preferred to pick the space away from direct sunlight impact.

### Surrounding features in the offices

The surrounding features of any built environment have a direct effect on the building and play a key role in the comfort level of occupants. The office with insufficient landscape solely used the landscape to line the walkway and the car park area while the office with sufficient landscape used a various mix of vegetation to create a conducive microclimate. The remaining 40% made use of purely hard landscape this was because the sole consideration after the office building was giving to parking spaces for both the employees and clients. It was quite noticeable that there was a difference in air temperature due to the surrounding features in the area. Where there was sufficient use of a soft landscape the occupants of the office appeared to be more comfortable than the others. While in the office with an insufficient soft landscape, the air temperature in the office area was noticeable to be moderate and good with the use of a mechanical cooling system. The offices without landscape consideration had high air temperature and were not conducive for workers even with the use of mechanical systems. The use of a hard landscape in the office environment contributed significantly to the increases in the surrounding temperatures in and around the office



making employees very uncomfortable with their work as shown in Fig. 7.

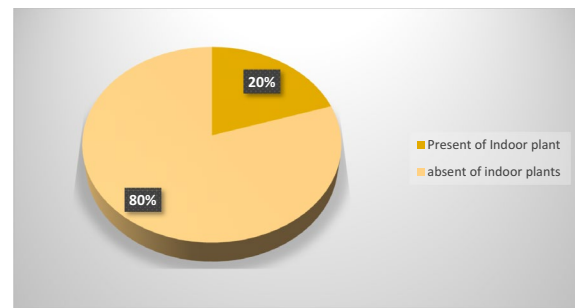
It was noted from the interview, that respondents considered vegetation as a cooling element for both the surrounding and interior of the building. The use of soft landscape in any work environment is useful in reducing the air temperature which is a major consideration for comfort. Access to nature and green environments yields better mental health and increases the comfort level of employees. Even in the absence of cars, some respondents felt that it was impossible to create a visually appealing and energetic atmosphere. The car park is a major consideration as many usually love to have their personal space to park their vehicle. It is therefore not uncommon to find the entire external space dedicated to the parking area for the vehicles associated with the building. Some of the interviewees agreed that the parking lot's design is frequently used as a hard landscape element to enhance the surrounding area.

The application of the soft landscape is often limited or viewed as the flowers or shrubs that line the walkways to the office the car park or the fence of the office. However, respondents agree that the provision of suspended flower beds on higher floors could improve the application of soft landscape in the building but they equally cited the cost of construction and the ease of maintenance as a reason for not adopting the method. The beautification that the building design could provide for the environment and the health benefits were not disputed but they were quickly shelved when costs were introduced. This view was echoed by some of the interviewees however, they did not seem to have any problem with providing spaces to place the outdoor units of air conditioners outside the building even without access routes to service them except with the use of the ladder. The professionals seem to forget that there were plants regarded as climbers whose roots could be on the ground and are easy to maintain when provided with a platform to climb.

### Interior plant

The use of indoor interior plants is an ideal way of creating an attractive and comfortable setting for both users and clients. The indoor plants within a building help in the purification of the air by converting carbon dioxide to oxygen, they also trap and absorb many pollutants that are released into the air. This function of indoor plants helps to improve comfort within the office space. As can be observed in Fig. 8.

The use of plants within the office was done to improve the outlook of the building and make it more welcoming. Offices with interior plant/s were seen to contribute to the life of the space as occupants felt more relaxed and



**Fig. 8** Chart showing the percentage of offices with/without indoor plant

were not in a haste to leave the building. This was agreed to by the respondents as it was noted that offices with indoor plants contributed to the level of patience of the clients as they feel relaxed and tend to wait a little more than usual.

It was clear from the interview that respondents agree that the use of plants within the building is a form of distraction from a worrisome environment as users have something to constantly gaze at helping them to feel more at ease with work. However, some of the respondents especially in offices where plants were not used stated that:

*“Keeping plants indoors to a large extent doesn't purify the air as it is not an array of plants while the potted plants are often an afterthought when the users have occupied the building.”*

These responses showed the lack of knowledge of the health and environmental benefits of soft landscaping in the office environment. Some of the respondents suggested that the provision of a courtyard is an effective way of bringing nature into the office area however, all respondents agreed that using potted plants or flowers on the floor or table in enclosed office buildings without courtyards is a matter of personal preference that the building's design cannot dictate. 80% of the respondents agree that offices with potted plants always appeared more beautiful and that the quality of the air in such offices was a lot better than those without it.

These explanations of the benefits of soft landscaping in the office are adequate to give users and developers of office building design the push to ensure that offices are designed to accommodate the opportunities of installing soft landscapes in the office workspaces.

### Design features for integrating soft landscape into office spaces

There are generic formats for design concepts and types of walls used in the construction of offices and work

environments. In many cases, the walls are vertical and built in a simple form such that it does not hinder circulation within and around the building. When office interiors are examined after an interior decoration has been undertaken it is common to find that a few objects are either hung on the wall or placed along the wall. It was agreed with the architects interviewed that two good opportunities were available for the application of soft landscape in the office environment especially as it relates to walling.

### **Recesses and protrusions**

The introduction of pockets of recessions and protrusions on the wall either at the design stage of the building or during modifications when adapting the building will offer the architects the opportunity to provide designed spaces for the office users to place potted plants along the wall of the building. An opinion shared by one of the interviewees was that:

*It is possible to create hollow spaces along the free walls in offices or corridors so that it is possible to place flowers and plants in small vases in such spaces and this will allow for the integration of landscaping in the interior spaces.*

It is therefore possible to apply a similar principle of hanging the flower vases underneath the protrusions which would equally change the general outlook of the space and give some form of human comfort to the users' space.

### **Exoskeleton and climbers**

In the words of one of the respondents, the use of claddings in building developments offers the best opportunity to apply soft landscaping on office spaces because it is devoid of the structural elements of the building:

*Many buildings in recent times are using claddings*

*to improve their beauty, these claddings can also be used to allow for the climbers of flowers to move from the ground to higher levels.*

Using this principle it is possible to have a building that has an exoskeleton designed as an integral part of the building with the sole purpose of allowing for soft landscape elements to be integrated into it depending on the aim of the professions. The exoskeleton can be made from aluminum cladding materials or simple lightweight iron welded to give character to the building which the climbers could follow to further improve the benefits of the soft landscape on human comfort.

### **Effect of soft landscape in office environment**

In examining some of the benefits of the application of soft landscaping in the office environment the respondents were required to respond to questions to obtain their perception about the benefits of applying soft landscape in the office environment. The result is presented in Table 1 where it appears to show that the major benefit of soft landscaping is considered to be the improvement of the thermal conditions of the space. Ninety-nine of the respondents strongly agreed with that benefit.

In determining which benefit is considered the most accepted benefit the mean score for the selected opinions was calculated and it could be observed from Table 2 that the thermal comfort variable was considered as the most agreed benefit of the application of soft landscaping in the office environment. The variables related to keeping of environment neat and offering better interaction were rated as the lowest with a score of 2.4 which could imply that the respondents believed that other factors and elements could accomplish this more successfully. The evaluation of the advantages of using soft landscape design in the workplace indicates that conscious effort must be made to make sure that this idea is realized as

**Table 1** Respondents' opinions on the benefits of the application of soft landscaping in the office environment

Item description	Strongly agree (X1)	Agree (X2)	Disagree (X3)	Strongly disagree (X4)	Total
Flowers improve the mood through visual perception	48	72	18	12	150
Soft landscaping can reduce stress feeling	72	54	12	12	150
Indoor plants can improve the air quality of the space	90	39	21	0	150
A soft landscaped environment creates a relaxed atmosphere	48	60	21	21	150
Soft landscaping in office interiors keeps the environment neat	21	69	39	21	150
Soft landscaping helps regulate the thermal condition of the space	99	39	12	0	150
Soft landscaped environments create a welcoming space	30	99	21	0	150
Soft landscaped space creates a space for better interaction	12	81	45	12	150

**Table 2** Respondents' opinions of on benefits of the application of soft landscaping in the office environment interpretation

Measured variable	Sum	Mean	Interpretation
Soft landscaping helps regulate the thermal condition of the space	213	1.42	Strongly agree
Indoor plants can improve the air quality of the space	231	1.54	Agree
Flowers improve the mood through visual perception	294	1.96	Agree
Soft landscaped environments create a welcoming space	291	1.94	Agree
A soft landscaped environment creates a relaxed atmosphere	315	2.1	Agree
Soft landscaping can reduce stress feeling	264	1.76	Agree
Soft landscaping in office interiors keeps the environment neat	360	2.4	Agree
Soft landscaped space creates a space for better interaction	312	2.08	Agree

a fundamental component of office space and building design.

## Conclusion

The improvement of human comfort is deep in every corner of the work environment as it impacts the ability of employees to function effectively without stress and other sicknesses associated with stress. From the data analyzed it can be concluded that most offices do not employ soft landscape as a means of improving comfort in the work environment. The study observed that soft landscapes in offices were used for aesthetic purposes and not to enhance comfort in such environments. This has resulted in insufficient cooling of the human body to maintain a core body temperature while carrying out physical activities at work and this is a major challenge affecting employees' comfort given the rate of ill health among employees. The need to blend comfort and soft landscape was examined among employees which also includes professionals in the built environment and results show that it can be achievable using recesses and protrusions within the building and exoskeleton and climbers on the building walls while incorporating trees, shrubs, flowers, hedges and water around the building can have these required effects on employee's comfort. The use of concrete material should be reduced as the effect of temperature gain affects occupants' comfort. The application of soft landscape offers a priceless chance to improve worker comfort, well-being, and general output. Employers and designers can create a more aesthetically pleasing, health-supportive, peaceful, and focused work environment by incorporating soft landscapes. Including soft landscapes in the workplace provides a variety of ways to improve worker comfort and wellness and fostering a relationship with nature helps address environmental issues, which in turn boost worker happiness, productivity, and have a

favorable effect on business success. It is therefore established that employee comfort, calls for urgent attention in our today's dispensation as a comfortable work environment is of extreme importance.

## Recommendations

1. Focus should be placed on how better to integrate soft landscape elements into the work environment rather than just provision for vehicular and pedestrian access. The incorporation of landscapes in the work environment contributes to healthy lifestyles in terms of physical activity, mental and emotional relaxation and this should be given appropriate attention to help the employee relax better while at work by viewing these elements.
2. Policies should be made and implemented for all facets of office building to embrace both outdoor and indoor landscaping. This will not only help to increase occupant comfort but also help in better work performance.

### Author contributions

The authors confirm contribution to the paper as follows: study and conception Ale, T. A.; data collection: Adedayo, O. F.; analysis and interpretation of results: Ale, T. A. Ayeni, D. A. & Adedayo O.F.; draft manuscript preparation: Ale, T.A. All authors reviewed the results and approved the final version of the manuscript.

### Funding

There is no funding available for this research.

### Declarations

#### Consent for publication

Not applicable.

#### Competing interests

On behalf of all authors, the corresponding author states that there is no competing interests.

Received: 22 March 2023 Accepted: 13 April 2024  
Published online: 04 May 2024

## References

- Adedeji JA, Fadamiro JA (2011) The duo building setback and landscape quality: Lautech Nigeria. *J Archit Built Environ* 38(1):23–30. <https://doi.org/10.9744/dimensi.38.1.23-30>
- Adekunle OJ, Basorun JO (2016) The evolving roles of landscaping in campus space management: Ekiti State University, Ado-Ekiti, Nigeria in Focus. *J Environ Prot* 7:1380–2138. <https://doi.org/10.4236/jep.2016.710119>
- Ahmad ZZ, Ismail HS, Mohd SAR (2014) Plants in landscape design as a catalyst for Malay Cultural Heritage, IFLA Asia Pacific Congress, Sarawak, Malaysia; 234: 228–238. <https://doi.org/10.1016/j.sbspro.2016.10.238>
- Al-Ayash A, Kane RT, Smith D, Green-Armytage P (2016) The influence of color on student emotion, heart rate, and performance in learning environments. *Color Res Appl*. <https://doi.org/10.1002/col.21949.16>
- Ali AS, Chua SJL, Lim ME-L (2015) The effect of physical environment comfort on employees' performance in office buildings: a case study of three public universities in Malaysia. *Struct Surv* 33(4/5):294–308. <https://doi.org/10.1108/SS-022015-0012>
- Al-Omari K, Okasheh H (2017) The influence of work environment on job performance: a case study of an engineering company in Jordan. *Int J App Eng Res* 12(24):15544–15550
- Ayeni DA (2012) Emphasizing landscape elements as important components of a sustainable built environment in Nigeria. *Dev Ctries Stud* 2(8):33–42
- Bluyssen PM (2009) The indoor environment handbook: how to make buildings healthy and comfortable, Earthscan. Routledge, London. <https://doi.org/10.4324/9781849774611>
- Bluyssen PM (2013) What do we need to be able to (re)design healthy and comfortable indoor environments? *Intel Buildings*. <https://doi.org/10.1080/17508975.2013.866068>
- Bushiri CP (2014) The impact of working environment on employees' performance, the case of Institute of Finance Management in Dar es Salaam Doctoral dissertation, The Open University of Tanzania
- Campbell JM (2016) Ambient stressors. *Environ Behav* 15(3):355–380. <https://doi.org/10.1177/0013916583153005>
- Caza BB, Tiedens LZ, Lee F (2011) Power becomes you: the effects of implicit and explicit power on the self. *Organ Behav Hum Decis Process* 114:15–24. <https://doi.org/10.1016/j.OBHDP.2010.09.003>
- Chao L, Yalin Z, Limei S, Weijun G, Xiaotong J, Weirui Y (2021) Influence of indoor air temperature and relative humidity on learning performance of undergraduates. *Therm Eng* 28(10):14–58. <https://doi.org/10.1016/j.csite.2021.101458>
- Chitra T, Karunanidhi S (2021) The impact of resilience training on occupational stress, resilience, job satisfaction, and psychological well-being of female police officers. *J Police Crim Psychol* 36(1):8–23. <https://doi.org/10.1007/s11896-018-9294-9>
- Chowdhury MMI, Othman KB, Khan MA, Sulaiman IF (2020) Role of effective corporate governance and motivational leadership in increasing productivity and efficiency of human resources. *Glob J Manag Bus Res* 20(A10):29–39
- Dong X, Wu Y, Chen X, Li H, Cao B, Zhang X, Li X (2021) Effect of thermal, acoustic, and lighting environment in underground space on human comfort and work efficiency: a review. *Sci Total Environ* 786:147537. <https://doi.org/10.1016/j.scitotenv.2021.147537>
- Duru SC, Candan C, Nergis BU (2019) Innovation in the comfort of intimate apparel. In: Uddin F (ed) *Textile manufacturing processes*. Intech Open, London
- Ebi KL, Capon A, Berry P, Broderick C, de Dear R, Havenith G, Jay O (2021) Hot weather and heat extremes: health risks. *Lancet* 398(10301):698–708. [https://doi.org/10.1016/S01406736\(21\)01208-3](https://doi.org/10.1016/S01406736(21)01208-3)
- Evans RB, Cohen JB (1987) The American journal of psychology: a retrospective. *Am J Psychol* 100:321–362
- Evans GW, Werner RE (2007) Crowding and personal space invasion on the train: please don't make me sit in the middle. *J Environ Psychol* 27(1):90–94. <https://doi.org/10.1016/j.jenvp.2006.10.002>
- Fekry AZ, Shamseldin A (2014) Develop an environmental assessment technique for human comfort requirements in buildings. *HBRC J*. <https://doi.org/10.1016/j.hbrj.2013.05.013>
- Fink G (2016) Stress, definitions, mechanisms, and effects outlined: lessons from anxiety. In: Fink G (ed) *Stress: concepts, cognition, emotion, and behavior*. Academic Press, Cambridge, pp 3–11
- Frackiewicz M, Kim K, Sandhu A, Uy E (2015, April 28) The relationship between noise and privacy in UBC students' study spaces and reported stress levels. <https://doi.org/10.14288/1.0228115>
- Gatersleben B, Griffin I (2017) *Environmental stress handbook of environmental psychology and quality of life research*. Springer, New York, pp 7–25. <https://doi.org/10.1007/978-3-319-31416>
- Giannopoulou K, Livada I, Santamouris M, Saliari M, Assimakopoulos M, Caouris Y (2014) The influence of air temperature and humidity on human thermal comfort over the greater Athens area. *Sustain Cities Soc* 10:184–194. <https://doi.org/10.1016/j.scs.2013.09.004>
- Grant AM, Parker SK (2009) Redesigning work design theories: the rise of relational and proactive perspectives. *Acad Manag Ann* 3(1):317–375. <https://doi.org/10.1080/19416520903047327>
- Hakim R (2003) *Components of landscape architecture design*. Bumi Aksara, Jakarta
- Hastings S, Kim SW, Brown RD (2020) Face temperature as an indicator of thermal stress in outdoor work environments. *Atmosphere* 11(6):627. <https://doi.org/10.3390/atmos11060627>
- Heath B (2006) Effect of perceived work environment on employee's job behavior and organizational effectiveness. *J Appl Psychol* 41:103–111
- Jalil NA, Yunus RM, Said NS (2012) Environmental colour impact upon human behaviour: a review. *Proc Soc Behav Sci* 35:54–62. <https://doi.org/10.1016/j.sbspro.2012.02.062>
- Kamarulzaman N, Saleh AA, Hashim SZ, Hashim H, Abdul-Ghani AA (2011) An overview of the influence of physical office environments on employees. *Proc Eng* 20:262–268
- Kaplan S (1995) The restorative benefits of nature: toward an integrative framework. *J Environ Psychol* 15:169–182. [https://doi.org/10.1016/0272-944\(95\)90001-](https://doi.org/10.1016/0272-944(95)90001-)
- Lai D, Lian Z, Liu W, Guo C, Liu W, Liu K, Chen Q (2020) A comprehensive review of thermal comfort studies in urban open spaces. *Sci Total Environ*. <https://doi.org/10.1016/j.scitotenv.2020.140092>
- Lobaccaro G, Acero JA, Sanchez Martinez G, Padro A, Laburu T, Fernandez G (2019) Effects of orientations, aspect ratios, pavement materials, and vegetation elements on thermal stress inside typical urban canyons. *Int J Environ Res Public Health* 16(19):3574. <https://doi.org/10.3390/ijerph16193574>
- Lohr VI (2010) What are the benefits of plants indoors and why do we respond positively to them? *Acta Hort* 881(2):675–682
- Mansouri SA (2005) *An introduction to landscape architecture identification*. Bagh-E-Nazar 1(2):69–78
- Marques B, Freeman C, Carter L, Pedersen Zari M (2020) Sense of place and belonging in developing culturally appropriate therapeutic environments: a review. *Societies* 10(4):83. <https://doi.org/10.3390/soc10040083>
- Mathalamuthu AD, Ibrahim NLN (2014) Evaluation of daylighting at public school classrooms in Ipoh, Perak. *Int J Sustain Trop Design Res Pract* 7(1):27–34
- McCoy JM, Evans GW (2002) The potential role of the physical environment in fostering creativity. *Creat Res J* 14:409–426. [https://doi.org/10.1207/S1532-6934CRJ1434\\_11](https://doi.org/10.1207/S1532-6934CRJ1434_11)
- Mohamed AA, Elgizawi L (2022) Interior landscape techniques and its contribution to the interior places environmentally. *MEJ. Mansoura Eng J* 47(5):93–102. <https://doi.org/10.21608/bfemu.2022.268322>
- Mora R, Bean R (2018) Thermal comfort: designing for people. *ASHRAE J* 60(2):40–46
- Norwood MF, Lakhani A, Fullagar S, Maujean A, Downes M, Byrne J, Kendall E (2019) A narrative and systematic review of the behavioral, cognitive and emotional effects of passive nature exposure on young people: evidence for prescribing change. *Landsc Urban Plan* 189:71–79. <https://doi.org/10.1016/j.landurbplan.2019.04.007>
- Osman M, Ghaffarzadeh M, Sirous Z, Khatibi M, Azami A (2017) Analyses of daylighting effects on human health in buildings. *J Solar Energy Res* 2(1):54–59

- Pearson E (2009) Comfort and its measurement—a literature review. *Disabil Rehabil Assist Technol* 4:301–310. <https://doi.org/10.1080/17483100902980950>
- Pilch W, Szygula Z, Palka T, Pilch P, Cison T, Wiecha S, Tota L (2014) Comparison of physiological reactions and physiological strain in healthy men under heat stress in dry and steam heat saunas. *Biol Sport* 31(2):145–149. <https://doi.org/10.5604/20831862.1099045>
- Pinto S, Fumincelli L, Mazzo A, Caldeira S, Martins JC (2017) Comfort, well-being, and quality of life: discussion of the differences and similarities among the concepts. *Porto Biomed J* 2(1):6–12. <https://doi.org/10.1016/j.pbj.2016.11.003>
- Qin J, Sun C, Zhou X, Leng H, Lian Z (2013) The effect of indoor plants on human comfort. *Indoor Built Environ* 23:709–723. <https://doi.org/10.1177/1420326X13481372>
- Qin Y, Zhang X, Tan K, Wang JA (2022) Review on the influencing factors of pavement surface temperature. *Environ Sci Pollut Res* 29:67659–67674. <https://doi.org/10.1007/s11356-022-22295-3>
- Rabiatul AN, Sabarinah SA, Azni ZA (2013) Physical activity and human comfort correlation in an Urban Park in hot and humid conditions. *Proc Soc Behav Sci* 105:598–609. <https://doi.org/10.1016/j.sbspro.2013.11.063>
- Sajid U, Ihsan M, Reba A (2021) Work environment stress: causes and outcomes. *Work* 15:754–761
- Samani SA, Alavi SMSZ (2020) Are open-plan office designs still popular after coronavirus pandemic? *Perform Improv* 59(8):24–32. <https://doi.org/10.1002/pfi.21931>
- Samuelsson K, Barthel S, Giusti M, Hartig T (2021) Visiting nearby natural settings supported wellbeing during Sweden's "soft-touch" pandemic restrictions. *Landsc Urban Plan*. <https://doi.org/10.1016/j.landurbplan.2021.104176>
- Sara P, Laís F, Alessandra M, Sílvia C, José CM (2017) Comfort, well-being and quality of life: discussion of the differences and similarities among the concepts. *Porto Biomed J* 2(1):6–12. <https://doi.org/10.1016/j.pbj.2016.11.003>
- Şentürk E, Altınçekiç H (2018) Elements of hard landscape design and new approaches on their use. *Kastamonu Üniversitesi Orman Fakültesi Dergisi* 18:327–340. <https://doi.org/10.17475/kastorman.349918>
- Shah MG, Kal MC, Patki SY (2002) *Building drawing: with an integrated approach to built environment*. Tata McGraw-Hill, New York
- Shamsuddin S, Hassan R, Bilyamin S (2012) Walkable environment in increasing the liveability of a city. *Proc Soc Behav Sci* 50:167–178. <https://doi.org/10.1016/j.sbspro.2012.08.025>
- Sharma MS, Agarwal PK (2021) Effect of stress at workplace and its management. *Int J Bus Manag Res* 11:1–12
- Shepley MM, Watson A, Pitts FM, Garrity A, Spelman EV, Fronsman AE, Kelkar J (2017) Mental and behavioral health settings: importance & effectiveness of environmental qualities & features as perceived by staff. *J Environ Psychol* 50:37–50. <https://doi.org/10.1016/j.jenvp.2017.01.005>
- Singh MM, Amiri M, Sabbarwal S (2019) Role of job stress on job satisfaction. *Int J Manag Stud* 6(4):57–60. <https://doi.org/10.18843/ijms/v6i4/08>
- Smith WS, O'Brien C (1976) A system for rapid analysis of long-term recordings of heart rate and other physiological parameters. *Biomed Eng* 11:128–131
- Souter-Brown G (2023) Urban health: applying therapeutic landscape design. Methods, design strategies and new scientific approaches. In: Capolongo S, Botta M, Rebecchi A (eds) *Therapeutic landscape design*. Springer, Cham. [https://doi.org/10.1007/978-3-031-09439-2\\_1](https://doi.org/10.1007/978-3-031-09439-2_1)
- Supplementary Planning Guidance (2013) *Landscape design London borough of Croydon*. [www.croydon.gov.uk](http://www.croydon.gov.uk). Accessed 26 Feb 2013
- Tutton E (2003) An exploration of the concept of comfort. *J Clin Nurs* 12(5):689–696. <https://doi.org/10.1046/j.1365-2648.2002.02329.x>
- Ulrich RS (1984) View through a window may influence recovery from surgery. *Science* 224:420. <https://doi.org/10.1126/science.6143402>
- Vischer JC (2007) The concept of environmental comfort in workplace performance *Ambiente Construido*. *Porto Alegre* 7(1):21–34
- Vischer JC (2018) Building-in-use assessment: foundation of workspace psychology. In: Preiser W, Hardy A, Schramm U (eds) *Building performance evaluation*. Springer, Cham. [https://doi.org/10.1007/978-3-319-56862-1\\_10](https://doi.org/10.1007/978-3-319-56862-1_10)
- Weiman CG (1977) A study of occupational stressor and the incidence of disease/risk. *J Occup Med* 19(2):119–122
- Yeo LB (2020) Psychological and physiological benefits of plants in the indoor environment: a mini and in-depth review. *Int J Built Environ Sustain* 8:57–67. <https://doi.org/10.11113/ijbes.v8.n1.597>
- Zakaria A, Ahmad S, Rashid S (2016) The importance of soft and hard landscape elements to the Malays Sub-ethnic in Perak. *Proc Dia Soc Behav Sci* 234:228–238. <https://doi.org/10.1016/j.sbspro.2016.10.238>

## Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.