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Research Article

Implementation of Passive Design Strategies in Coworking Spaces in Providing a Healthy Workplace for the Occupants

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Abstract: This study explores sustainable wellness approaches through the implementation of passive design strategies in coworking spaces, aiming to provide a healthy workplace for occupants. Focusing on qualitative approach on three existing coworking spaces in Golden Triangle of Kuala Lumpur, the research employs a comparative study to evaluate the effectiveness of these design strategies in enhancing occupant well-being, utilizing checklist and observation as the main instruments. Coworking space, shared work environments where individuals from diverse backgrounds, such as freelancers, remote workers, and small businesses, operate independently while sharing resources and networking opportunities, known to blend flexible, dynamic work environments with a focus on community, health, and well-being. It has been perceived as ideal selection of workspaces as it often incorporates sustainable design principles and environmental wellness, in line with passive design strategies, which leverage natural environmental elements such as lighting, ventilation, noise, and thermal comfort, in creating sustainable and health-promoting indoor environments. This study contributes to the growing body of knowledge on sustainable workplace design by highlighting the importance of passive design strategies in working environments and how these strategies are integrated into coworking spaces to benefit the occupants of the space. It provides practical insights on the implementation of these strategies through the recommendations on creating healthier and more sustainable workplaces, especially in the post-pandemic era.

Keywords: sustainable, wellness, passive design strategies, coworking space, healthy workplace

1. Introduction

In recent years, especially post-pandemic, there has been a growing recognition of the importance of creating healthy workplace environments that support the well-being and productivity of occupants. As the modern workforce becomes increasingly aware of the impact of their work environment on their physical and mental health, there is a pressing need to develop and implement strategies that promote wellness. Coworking spaces, as flexible and dynamic work environments, are uniquely positioned to lead this transformation [1]. By integrating these strategies into coworking spaces, it is possible to create environments that are not only more sustainable but also more conducive to the health and wellness of their occupants. Thus, this research focuses on exploring how passive design strategies can be leveraged to create healthy workplaces within coworking spaces through sustainable wellness approaches in benefiting its occupants.

Coworking spaces are shared work environments where individuals from diverse backgrounds, such as freelancers,

remote workers, and small businesses, operate independently while sharing resources and networking opportunities. These spaces are designed to foster flexibility, collaboration, and community-building. In relation to sustainable wellness, coworking spaces promote physical, mental, and environmental well-being by incorporating eco-friendly designs, ergonomic setups, and social support systems that enhance work-life balance and reduce isolation, issues that became critical post-pandemic. Research highlights that coworking spaces can positively impact overall well-being by offering flexible and healthier work environments that align with the growing focus on sustainability and wellness in modern workspaces [2-3].

Passive design strategies, which utilize natural elements and environmental principles to enhance building performance, offer a promising solution for creating healthier work environments. Unlike active design strategies that rely on mechanical and technological interventions, passive design emphasizes the inherent properties of materials and the natural environment to improve indoor air quality, lighting, thermal comfort, and overall well-being. The importance of passive design strategies lies in their ability to address multiple dimensions of workplace wellness simultaneously and promote a sustainable wellness approach to be part of the lifestyle going forward in creating a resilient infrastructure and community, in line with the UN's Sustainable Development Goals (SDGs) [4] and advancing towards net-zero energy building status. These strategies contribute to SDG goals related to health and well-being (SDG 3), affordable and clean energy (SDG 7), and sustainable cities and communities (SDG 11). Over time, passive strategies minimize the need for energy-intensive mechanical systems, making net-zero energy consumption achievable while promoting a healthier, more resilient indoor environment.

This research aims to provide a comprehensive analysis of the effectiveness and availability of passive design features in coworking spaces and their role in promoting a healthy working environment. By examining various coworking spaces that have successfully implemented passive design strategies, this study seeks to identify best practices through recommendations associated with these approaches to construct a solid reference in gearing towards an agile and healthy working environment post-pandemic. Utilizing qualitative approach through comparative case studies on these premises, the research will gather insights into variation of approaches in integrating these strategies within the design of the workspaces.

2. Literature review

Coworking spaces are "subscription-based workspaces in which individuals and teams from different companies work in a shared, communal space" [5]. This allows for cost savings and convenience by using common infrastructures, such as receptionist services, utilities and equipment [6]. Advocates of coworking spaces often claim that sustainability is regarded as one of the core values that the coworking movement aspires to [7]. Research on sustainability in coworking spaces is still in its infancy, and despite being a core value, recent reviews on coworking spaces are not comprehensive on the elements and the effectiveness of sustainable approaches and values implemented within these establishments [8-9]. A previous study identified a lack of consensus on what sustainability and the implementation in a coworking space entails [10]. Regarding sustainability, the coworking literature has mainly focused on sharing economy [2], sustainable mobility [11], sustainable business models, sustainable identity and certain factors that can make the coworking business more sustainable, such as renewable energy sources, waste management systems and eco-friendly building materials [12]. Ultimately, this research aspires to contribute to the broader discourse on workplace design by demonstrating that sustainable wellness approaches, when integrated through passive design strategies, can significantly enhance the health and well-being of occupants. By providing evidence-based recommendations and showcasing successful implementations, this study aims to inspire coworking space designers, managers, and policymakers to prioritize passive design principles in the creation of healthier, more sustainable work environments, through the implementation of passive design strategies in the workplace design.

Passive design strategies refer to a set of design approaches that focus on utilizing the natural environment to provide heating, cooling, ventilation, and lighting to a building. Unlike active design strategies that rely on mechanical systems and processes, passive design strategies depend on the laws of nature. Passive design strategies aim to create a comfortable and energy-efficient indoor environment while minimizing the use of mechanical systems and reducing the building's energy consumption. They take advantage of the climate, site conditions, and materials to create a

building that functions in harmony with the environment. These strategies relate to the design that provides the users with the convenience of using natural components. These components can provide heating and cooling for buildings, such as lighting and ventilation for user's comfort [13-14]. It will reduce the use of mechanical systems in buildings where temperature cooling and lighting can be controlled [15]. Passive design refers to architecture design that utilizes minimal energy consumption and decreases the use of active mechanical devices and enhances consumer convenience.

When various passive buildings strategies are adopted, it facilitates airflow and comfort which enhances productivity as it has been observed that when there is little or no airflow, productivity is barely at 44% in humid climates. Airflow of just about 0.7 m/s can increase users' productivity by 100% [16-17]. Passive design strategies, when appropriately designed, have positive impressions on the psychological and physical health of occupants. Passive design promotes natural ventilation, which helps circulate fresh air and remove indoor pollutants. Journal of Environmental Research and Public Health, found that buildings with natural ventilation experienced a 30% improvement in indoor air quality compared to mechanically ventilated spaces, leading to a reduction in symptoms like headaches and respiratory discomfort. The use of thermal mass helps maintain stable indoor temperatures by absorbing and releasing heat, reducing the need for mechanical heating and cooling systems in the design strategies of the workplaces, as it experienced a 40% reduction in temperature fluctuations, improving occupant comfort and productivity [18]. Maximizing natural light improves well-being, productivity, and reduces energy use. In Journal of Building Performance [19], it is revealed that employees in offices with access to natural daylight experienced a 25% improvement in productivity and a 15% reduction in absenteeism. Patel and Kumar [20] that integrating passive design strategies can lower energy consumption by up to 60%, significantly reducing operational costs and carbon emissions, indirectly reducing the reliance on energy-intensive mechanical systems, lowering operational costs and environmental impact. This matter was also supported by findings that office workers in spaces designed with biophilic and passive strategies showed a 20% reduction in stress levels and a 12% improvement in mood and job satisfaction [21].
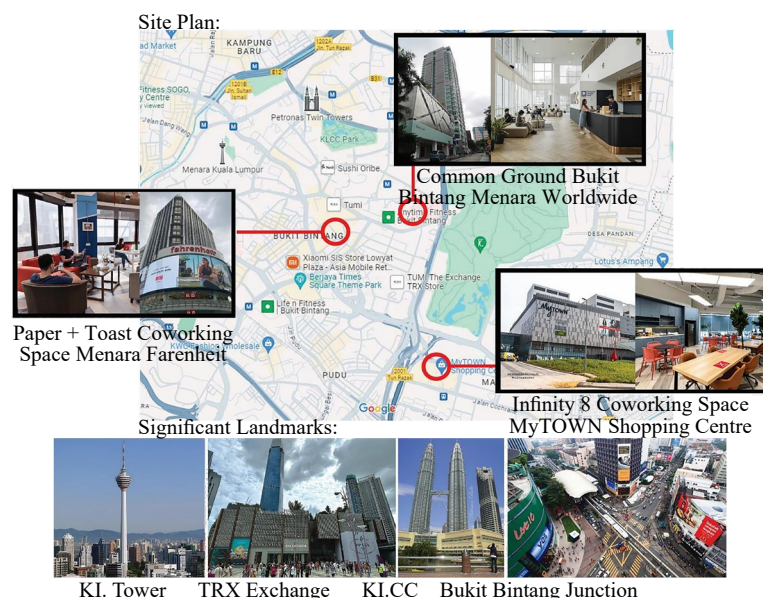
3. Research methodology

Figure 1. Site context for selected coworking spaces in KL Golden Triangle

For the comparative research involving selected coworking spaces in Malaysia, researchers conducted comparative study at three (3) different coworking spaces in the vicinity of Kuala Lumpur City Centre, also known as Kuala Lumpur Golden Triangle as shown in Figure 1. Known as Kuala Lumpur's business, shopping and entertainment hub, the

Golden Triangle comprises various significant boulevards and landmarks in Kuala Lumpur. Three roads-Jalan Imbi, Jalan Sultan Ismail, and Jalan Raja Chulan structure a triangle which fringes the whole Golden Triangle zone. Within this area, towering skyscrapers, shopping centers and world-class hotels penetrate the scene and become an important business district. The qualitative approach used in this research utilizes a set of checklists in comparative case studies on these coworking spaces, with data collected using observations and checklists. The selection of coworking spaces in this study comprises variation of sizes in the establishment: from large scale (Common Ground), medium scale (Infinity 8) and small scale (Paper + Toast), in identifying the potential for these strategies to be implemented in most workspaces. In constructing a checklist for the case studies, it will be referencing 9 Foundations of Healthy Building by Harvard T. H Chan School of Public Health, which is designed to be a clear and actionable distillation of the core elements of healthy indoor environments, which align with the goals in implementation of passive design strategies.

Coworking, a modern working style that first began in Malaysia around 2010-but only getting popular and recognized from 2016 onwards among local people and foreigners in Malaysia. It has been relentlessly developing in recent years with the amount of coworking spaces in Kuala Lumpur multiplying every single year. The selected coworking spaces for this case study were chosen based on a few different factors; the scale of establishment, target demographic and the building typography where these coworking spaces are located as demonstrated in Table 1. In identifying the potential of these coworking spaces in providing a healthy workplace and improving the socioeconomic of the occupants, three different models of coworking spaces are used for the comparative study in this chapter. All selected coworking spaces are located in Kuala Lumpur city center and owned by local operators. Brief information on the selected coworking spaces in Kuala Lumpur shown below.

Table 1. Background information on the selected coworking spaces in Kuala Lumpur

Coworking Space Premises	Paper + Toast	Infinity8	Common Ground
Site Image			
Origin of Business	Claimed to be the first coworking space in Malaysia, the establishment founded 10 years ago in KL prime area	Johor Bahru is the first branch and headquarters of the establishment	Based in Damansara, Common Ground grows to be one of the most prominent coworking space provider in Southeast Asia
Type of Business	Local establishment, focusing on events and coworking	Local establishment, focusing on events and coworking	Local establishment, focusing on events and coworking
Target Users	Small and Medium Entrepreneurs (SMEs) and business owners	Medium to High End customers who enjoy the convenience of location and facilities	Medium to High End. Focusing on career and business-oriented individuals.
Building or space Capacity	Medium capacity for members and events One-storey space in Fahrenheit office tower, which connected to office buildings and commercial shopping mall	Medium capacity for members and events One-storey of total combined of 4 shop lots of leading shopping mall in commercial-oriented building	High Capacity. The coworking members can have up to 150 members at a time. High capacity for events, can optimize up to > 250 pax at a time.

4. Passive design strategies indicators

Comparative case studies allow for the qualitative assessment of the impact and practices of passive design strategies in promoting sustainability and health in coworking spaces. Researchers are able to evaluate factors such as energy efficiency, indoor air quality, occupant satisfaction, and productivity across different coworking spaces to determine the effectiveness of these strategies. In constructing comprehensive checklists in identifying elements and implementation of passive design strategies within the selected coworking spaces, it enables researchers to identify the availability and the implementation approaches associated with promoting sustainable wellness within the working environment. The comparative case studies will focus on the nine (9) Foundations of Healthy Building parameters as shown in Figure 2, created by a multidisciplinary team of experts from the Healthy Buildings Program at the Harvard T.H. Chan School of Public Health, which published in www.ForHealth.org. These 9 Foundations are designed to be a clear and actionable distillation of the core elements of healthy indoor environments, which can be evaluated through qualitative manners from observations, actionable measures and tangible design elements within the spaces.

Figure 2. The 9 foundations of a healthy building by Harvard T. H Chan School of public health
Source: https://forhealth.org/9_Foundations_of_a_Healthy_Building.February_2017.pdf

5. Results

Based on the systematic checklist prepared for this data collection, all three (3) coworking spaces have been evaluated and documented in Table 2 based on the quality and condition of these indicators in providing healthy and efficient working environments for their occupants. A well-regarded model for passive design strategies in workspace design that promotes sustainable wellness is the Biophilic Design Model, which integrates natural elements into the workspace to support the occupants' physical and mental well-being. This model incorporates strategies such as maximizing natural light, reducing reliance on artificial lighting , allowing natural airflow through cross-ventilation or operable windows, reducing the need for mechanical heating or cooling for enhanced comfort, incorporating plants and green walls to improve air quality and utilizing natural materials. The findings underscore the implementation of passive design strategies in creating a healthy working environment in selected coworking spaces in Golden Triangle of Kuala Lumpur.

Table 2. Data collected using checklist on 9 foundations of healthy building

Bil	Indicators	Case study premises		
		Paper + Toast	Infinity 8	Common ground
	Foundation 1: Ventilation			
1	Any type of mechanism designed to bring outdoor air to the space	√	√	√
2	Any type of mechanism to filter the air and deliver to the occupants	√	√	√
3	The space provides a good temperature to the occupants (between 20 to 24.5 Celsius) if using air-conditioning	√	√	√
4	The semi-private spaces are properly ventilated and allows the air to flow	√	√	√
5	The interior space avoids outdoor air intake from street level or outdoor pollutants	√	√	√
6	The ventilation system well-maintained	√	√	√
	Foundation 2: Air quality			
1	There is system on disposing garbage promptly and properly	√	√	√
2	Providing indoor plants and maintain them properly	√	√	√
3	Control usage of machinery which could release harm gasses (e.g.: printers, fax machine, Photostat machine etc)	√	√	√
4	Placing the furniture or equipment close to the source of air ventilation	√	√	√
5	Minimum renovations or refurbishment works that could affect the users	√	√	√
	Foundation 3: Water quality			
1	The premise installed wastewater treatment or management in the premise	√	√	√
2	Providing a filtration or purifying water system for drinking to the occupants	√	√	√
3	Maintain and clean the plumbing, faucet, and filter regularly by the management	-	-	√
	Foundation 4: Thermal health			
1	Install Heating, Ventilation or Air-Conditioning (HVAC) that can measure Mean Radiant Temperature (MRT) of the space	√	√	√
2	Providing an action plan there is leakage to HVAC within the system	√	√	√
3	HVAC system within the premise can be controlled by the occupants	-	-	-
4	The space has a pleasant temperature for the occupants	√	√	√
	Foundation 5: Dusts & Pests			
1	The surfaces and materials used within the interior could prevent from accumulating dust	√	√	√
2	Cleaning activities by management done regularly	√	√	√
3	Install any mechanism or system to filter the air within the space	√	√	√
	Foundation 6: Lighting & Views			
1	The space allows adequate natural lighting for visual comfort to the occupants	-	-	√
2	Install blue enriched light to the spaces within interior space, especially at the working stations	√	√	√
3	Reduce unwanted dark spots or shadows by installing direct & indirect lighting in the space	√	√	√

Table 2. (cont.)

Bil	Indicators	Case study premises		
		Paper + Toast	Infinity8	Common ground
4	Adjust the glare from the direct source of light if necessary	√	√	√
5	Installing the right color temperature (cool color temperature) for the working space	√	√	√
6	Provide a line of sight towards exterior view from the space(s)	-	-	√
7	Incorporate nature or nature-inspired within the interior of the space	√	√	√
	Foundation 7: Noise			
1	Install soundproofing insulation or any system that could reduce the noise within the space	√	√	√
2	The space avoids, eliminate, or manage to reduce direct abrupt noise from the surroundings	√	√	√
3	Usage of materials, plants and finishing that could improve the acoustic in the space	√	√	√
4	Placing noisy machinery or equipment further from working area	√	√	√
	Foundation 8: Moisture			
1	The space maintains the condition of plumbing, roofs, windows, or any spot that could be the sources of moisture in building	√	√	√
2	Conduct regular maintenance arrangement by the management	√	√	√
	Foundation 9: Safety & Security			
1	Meet fire safety and carbon monoxide standards in the space	√	√	√
2	Provide adequate lighting in all spaces, especially hallway, utility room, exit route etc	√	√	√
3	Establish mechanism of communication between occupants & management of the premise	√	√	√
4	Maintain a holistic emergency action plan if required	√	√	√
	Smoking policy			
1	Providing designated smoking area in the premises or building	√	√	√
2	Indicate a clear signage on the prohibition of the act or designated space for smoking	√	√	√

Based on the comparative study conducted in three (3) selected coworking spaces in Golden Triangle of Kuala Lumpur, it can be concluded that coworking spaces have taken initiatives and approaches in implementing passive design strategies within its establishments. These strategies are able to enhance physical health by incorporating natural ventilation through strategically placed windows, vents, and open spaces. Workplaces can ensure a constant flow of fresh air, reducing the concentration of indoor pollutants and improving overall air quality. Utilizing natural light through large windows, skylights, and light shelves reduces the need for artificial lighting, which can strain the eyes and cause fatigue. Exposure to natural light helps regulate circadian rhythms, promoting better sleep patterns and overall health as it enhances the synthesis of Vitamin D, vital for bone health and immune function. Passive design elements like thermal mass and natural shading help maintain comfortable indoor temperatures, reducing the need for artificial heating and cooling. Consistent, comfortable temperatures contribute to physical well-being and productivity.

Integrating natural elements such as plants, water features, and natural materials within the workplace creates a biophilic environment. This connection to nature has been shown to reduce stress, enhance mood, and improve cognitive function. Providing employees with views of outdoor landscapes or greenery can significantly reduce stress levels and increase feelings of relaxation and satisfaction. Passive design strategies often result in aesthetically pleasing spaces that

are visually stimulating and enjoyable to occupy. A well-designed, beautiful workplace can boost morale and foster a sense of pride and ownership among employees.

5.1 *Recommendations on the implementation of passive design strategies in the workplace*

The study provides compelling evidence that passive design strategies are not only effective but also essential in creating a healthy working environment in coworking spaces. The integration of these features not only enhances the physical and mental well-being of coworkers but also contributes to sustainability, energy efficiency and health, ultimately contributing to a more sustainable and user-friendly environment. Based on the comparative study conducted, here are the recommendations on the implementation of passive design strategies to the new or existing working spaces as shown in Table 3, in creating a healthy workplace for the occupants.

For the provider, the implementation of passive design strategies could be a form of investment as it significantly lowers energy consumption by maximizing the use of natural light and ventilation. This not only reduces operational costs but also decreases the environmental footprint of the workplace. Another approach in supporting this element in the workplace is using sustainable, low-impact materials in construction and design. Overall, passive design strategies create resilient workplaces that can adapt to changing environmental conditions and future health crises. This adaptability ensures the long-term viability and functionality of the workplace.

5.2 *Recommendations of implementation of passive design strategies in workspace*

Table 3. Recommendations on the implementation of passive design strategies in the workspace
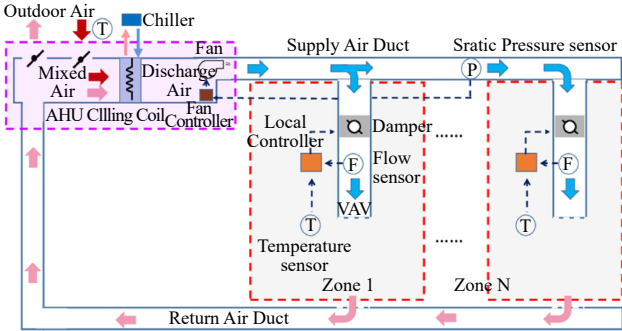
Bil	foundation	Sustainable wellness approaches	Recommendations of implementation	Examples of strategies implementation
1	Ventilation, Air Quality and Thermal Health.	Facilitate natural airflow the design and layout.	Incorporate windows, vents, and open spaces in the office design and layout, if the weather permits.	Configuration of HVAC system in office building.
		Using advanced ventilation systems with HEPA filters can capture bacteria, viruses, and other microorganisms.	Installation of HVAC systems. Regularly maintained, and filters are replaced periodically to function effectively.	HVAC system installed in Infinity8.
		Maintain appropriate humidity levels (typically between 30-50%).	Complement ventilation systems with air purifiers, especially in areas with high pollution levels.	

Table 3. (cont.)

Bil	foundation	Sustainable wellness approaches	Recommendations of implementation	Examples of strategies implementation
1	Ventilation, Air Quality and Thermal Health.	Track and manage indoor air quality in real-time.	Implement air quality monitoring systems.	
		Limit the use of materials and products that release VOCs and other harmful pollutants.	Using eco-friendly and low-emission products.	Optimization of window to facilitate airflow.
2	Water Quality	Test for common contaminants such as bacteria, heavy metals, chlorine, pesticides, and other pollutants.	Conduct regular water quality testing.	
		Remove contaminants and improve taste and odor of drinking water.	Install water filtration systems; options include carbon filters, reverse osmosis systems, and UV purifiers.	Built-in and refillable water filtration system in providing accessible drinking water to the occupants.
		Prevent leaks, corrosion, and contamination.	● Regular maintenance of plumbing systems, water coolers and filtration units. ● Keeping detailed records of maintenance activities and water quality test results could help the management keep track of the maintenance works conducted. ● Usage of safe and clean storage practices for water, especially in dispensers and coolers.	
		Having alternative water sources or additional treatment options ready, for the time of emergency.	● Develop and implement contingency plans for potential water contamination events. ● Establishing a protocol for rapid response to water quality complaints or contamination events.	Conduct regular testing and maintenance in prevent leaks, contaminations, and operational quality.

Table 3. (cont.)
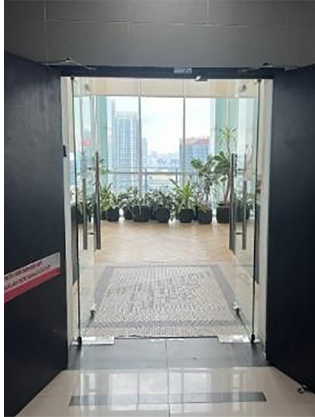
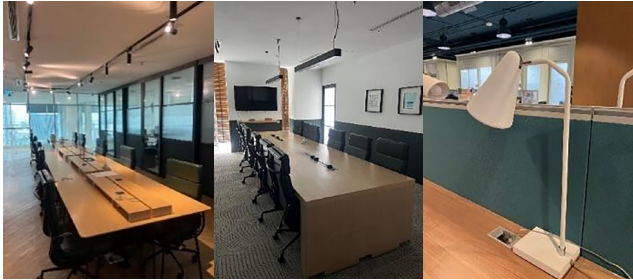| Bil	foundation	Sustainable wellness approaches	Recommendations of implementation	Examples of strategies implementation
3	Moisture, Dusts and Pests	Track and manage dust and pests in the interior.	Regular inspection the office space for potential entry points such as gaps around windows, doors, and utility openings.	Incorporation of indoor plants to control accumulation of dusts and pests.
		Manage the waste inside the establishment to prevent accumulations of garbage and dust.	● Establish a proper waste management system within the establishment. ● Ensure that garbage bins are covered and emptied regularly. ● Implement recycling programs with clearly marked bins to avoid attracting pests.	
		Control and prevent the issue through proper channels.	Establishing clear procedures for employees to report pest sightings or excessive dust build-up.	Designated waste management at the strategic areas.
4	Lightings and Views	Allow maximum natural light through natural light integration structures.	● Designing office spaces with windows, skylights, and open spaces. ● The usage of glass partitions as division of the space also helps to spread natural light throughout the office.	
		Ensure the adequate exposure of lighting in providing comfortable and well-lit space.	Implement a layered lighting system, a combination of ambient, task, and accent lighting to create a balanced and adaptable lighting environment.	Incorporation of full height glass to maximize dayligh exposure.

Table 3. (cont.)

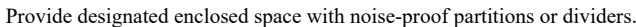| Bil	foundation	Sustainable wellness approaches	Recommendations of implementation	Examples of strategies implementation
4	Lightings and Views	Invest in a well-planned lighting system in the workspace.	● Choosing energy-efficient LED lighting that mimics natural light and can be adjusted for intensity and color temperature. ● Designing office spaces include sensor motion system, daylight harvesting system and self-controlled lighting system.	
		Application of well-chosen interior materials and finishes.	● Usage window treatments that diffuse light but still allow it to enter, reducing glare while maintaining brightness. ● Installing adjustable louvers that can be tilted to direct light. ● Choosing flooring materials that reflect light tiles and translucent materials for interior doors and partitions could maximize the exposure of lighting throughout the spaces.	 Usage of low-profile furniture to allow the light to move within the spaces.
		Provide positive distractions for the occupants.	● Designing office layouts to provide views of the outdoors. ● Consider indoor plants, green walls, or images of nature, if the view towards outdoors is not possible. ● Including areas with comfortable seating and views, where employees can take breaks and relax.	 Provide adequate lighting from layered lighting system combining ambient, task and accent lights.
		Create a connection with nature.	Integrating natural materials, colors, and patterns into the office design, which includes wood finishes, natural fabrics, and organic shapes in the interior elements to evoke the effect of nature.	 Create space overlooking the views towards nature as positive distractions.

Table 3. (cont.)
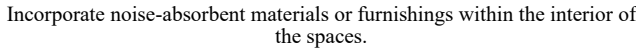
Bil	foundation	Sustainable wellness approaches	Recommendations of implementation	Examples of strategies implementation
5	Noise	Add soundproofing materials and designs.	Installation of acoustic panels, sound-absorbing ceiling tiles, and upholstered furniture or carpets.	Usage of upholstered furniture to absorb sound.
		Categorize the workers based on the niche of their works.	● Rearranging the furniture layout or operation of the space to minimize noise. ● Using partitions and barriers to create quieter zones and reduce the spread of noise in open-plan offices. ● Establish designated quiet zones where employees can work without interruptions.	Provide designated enclosed space with noise-proof partitions or dividers.
		Help mask background noise and create a more serene environment using technologies.	Implement noise-canceling technologies, such as white noise machines or noise-canceling headphones	
		Prevent noise from malfunctioning or poorly maintained machinery.	Ensuring regular maintenance of office equipment.	Incorporate noise-absorbent materials or furnishings within the interior of the spaces.
		Foster a workplace culture that respects quiet working environments.	Implement policies that encourage employees to be mindful of noise, such as keeping conversations at a reasonable volume and using meeting rooms for discussions.	

Table 3. (cont.)

Bil	foundation	Sustainable wellness approaches	Recommendations of implementation	Examples of strategies implementation
6	Safety and security	Usage of electronic access control systems.	Implementing access control systems on the premises, done by the management whether manually (keycards or badges) or digitally (face or thumb scanner).	Incorporate digital access control to the premises.
		Provide a monitoring and recording system.	Ation of closed-circuit television (CCTV) cameras at entrances, exits, and key areas to monitor and record activities.	
		Establish physical barriers to their premises.	● The usage of fencing, gates, and bollards was built to secure the perimeter of the workplace. ● Requirement of badge to access the operation floors.	Visible Fire Compliance features throughout the workspace.
7	Smoking Policy	Ensure smoking zone or non-smoking zone established in the premise and the compliance by the occupants.	● Clear indication of designated smoking areas, away from building entrances, windows, and ventilation systems. ● Establishing the coworking space as non-smoking zone by designating all indoor areas. ● Installation clear signage indicating smoking and non-smoking areas.	
		Ensure the policy is consistently enforced.	Display of signages and information outlining clear consequences for violating the smoking policy to deter non-compliance.	Allocation a specific space of the balcony for smoking zone.

6. Conclusion

The COVID-19 pandemic has dramatically reshaped our understanding of workplace environments, emphasizing the importance of health, well-being, and sustainability. As we transition into a post-pandemic world, implementing passive design strategies in workplaces becomes crucial in promoting a healthy and sustainable working environment.

From this study, here are important findings in providing healthy working environment through passive design strategies for the occupants:

● Implementation of strategies through maximizing the natural energy in the workplace design. As an example, daylighting optimization can be done through various approaches, such as retrofitting existing windows with shading devices, rearranging furniture for a well-lit environment and installing reflective surfaces to distribute effectively.

● Rather than overhauling the structure, adaptable strategies can be done optimizing space usage, and making incremental improvements that align with the building's existing design. Examples of this approach can be observed in thermal zoning in the workplace, where adaptation the layout of the workspace by grouping heat-sensitive or heat-generating activities into specific zones, thereby controlling temperature regulation more effectively. For instance, placing offices or meeting rooms in cooler zones (north-facing sides) can enhance comfort, without having to change the structure or renovate the space.

● Introduction of new elements and enhancements to the space also can be implemented without major planning or changes. Taking biophilic enhancements as the best approach, integration of plants and natural materials within the workspace to improve air quality and create a connection with nature. Green walls or indoor gardens can be introduced in spaces with good natural light, promoting both passive cooling and mental well-being without structural changes.

● Continuous prevention, maintenance, and repair measures can be implemented by the management of the workplaces from time to time, with a clear procedure and cooperation from the users of the spaces.

● Investing in systems as part of passive design strategy implementation involves enhancing the building's natural elements with integrated systems that optimize performance while minimizing energy use. These systems include ventilation systems, energy monitoring systems and thermal storage systems.

Through natural ventilation, daylighting, and thermal mass, these strategies enhance indoor air quality, stabilize temperatures, and reduce the need for mechanical systems, leading to lower energy consumption and operational costs. Additionally, the incorporation of biophilic elements promotes mental well-being and reduces stress. Over time, these features contribute to improved occupant health, productivity, and satisfaction, while supporting environmental sustainability and reducing the building's carbon footprint.

Conflict of interest

The authors declare no competing financial interest.

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