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ASSESSING THE USER PREFERENCES AND PERCEPTION ON GREEN WALL : CASE STUDY AT TRX EXCHANGE

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ABSTRACT

As urban temperatures rise due to climate change, cities face challenges that reduce comfort and the vitality of public spaces. This study evaluates the effectiveness of green walls compared to conventional concrete facades, focusing on thermal regulation, air quality, energy efficiency, aesthetics, and maintenance. Data will be collected through surveys of 34 respondents, users of spaces around the TRX Exchange, to assess perceptions and satisfaction with green walls. The research aims to identify the benefits of green walls in urban environments, expecting to find lower temperatures, reduced energy use, and improved air quality. The analysis reveals strong user preference for green walls, particularly for their environmental benefits, such as air purification and heat reduction. Users also perceive green walls as enhancing well-being, productivity, and focus, making them important for sustainable urban planning and improving quality of life in cities.

Keywords: *Green walls, User perception, User preferences.*

INTRODUCTION

Rapid industrialization, vehicular emission increase, and the widespread utilisation of heat-retaining materials such as concrete and asphalt in an area contribute to rising urban temperatures. The effect, technically referred to as an urban heat island, enhances energy consumption, has a relation with air pollution, and forms a health hazard to the citizens of a city. The traditional methods of cooling, such as the use of air conditioning and reflective surfaces, have traditionally been engineered for efficiency rather than sustainability, consuming more resources with a greater carbon footprint (Wang et al., 2024)

Consequently, there is increasing interest in finding natural, ecologically friendly ways to cool cities. Among the new solutions currently in research, moss-cement is one of the bio-receptive building materials that can integrate moss into cement structures/frames. Moss is intrinsically a temperature controller, pollutant absorber, and a moisture retainer, hence gaining momentum as a promising method to fill in the lacuna between modern architecture and green design principles (Marsaglia et al., 2023)

This research aligns with global frameworks like Sustainable Development Goal 11: Sustainable Cities and Communities, which promotes sustainable urbanization and green infrastructure. It also adheres to Malaysia's Green Building Index (GBI) and the Town and Country Planning Act 1976 (Act 172), which guide sustainable land use planning and green building practices. Furthermore, this initiative supports the goals of the National Policy on Climate Change and the Environmental Quality Act 1974, emphasizing the importance of reducing carbon emissions and enhancing environmental resilience.

The primary objectives of this research are to identify benefits and impact of green walls on green building practices in Malaysia and to evaluate user perceptions and preferences regarding green walls in urban spaces. This will be achieved through a desktop analysis of existing literature and surveys addressing relevant issues and challenges for users in green wall areas.

LITERATURE REVIEW

The Role of Green Walls in Transforming Urban Spaces: Benefits, Design, and Sustainable Impact

Moss has been identified as a highly effective material for advancing sustainable and eco-friendly solutions in urban environments. As living wall systems are complex technologies, plant selection becomes crucial, particularly for vertical surfaces that impose artificial conditions on plant growth. Moss demonstrates unique adaptability to such environments, making it an ideal candidate for green wall systems. Studies indicate that in Mediterranean climates, living walls and green facades can significantly enhance energy efficiency during cooling seasons, with improvements ranging from 34% for facades to 59-66% for living walls (Marsaglia et al., 2023). Additionally, moss concrete, a sustainable innovation, supports urban heat island mitigation by leveraging the water retention capabilities of moss species like Bryum apiculatum, Barbula indica, and Hyophila involuta. Moss concrete can absorb up to 20 times its dry weight in water, aiding sustainable urban drainage systems and improving water quality. Over time, the growth of moss within concrete enhances its durability, acid resistance, and structural integrity (Awais & Khattak, n.d.). Furthermore, the integration of sphagnum moss on specifically designed panels, such as panel P02, demonstrates additional benefits. These include moisture retention, water absorption, air purification, and aesthetic contributions to building facades, aligning with sustainable urban design goals (Elhady et al., 2019). Collectively, these findings highlight moss as a multifunctional material with immense potential in technological greenery systems.

Green walls provide a range of benefits that enhance the quality of life for building occupants and contribute to sustainable urban development. These installations improve indoor air quality by filtering toxins and converting carbon dioxide into oxygen, creating healthier environments by alleviating issues like eye irritation, headaches, and respiratory discomfort (Greenleaf Interior Plant Solutions, 2021). Additionally, green walls regulate indoor temperatures through insulation and evapotranspiration, reducing the need for air conditioning in hot climates and lowering heating costs in colder weather, thereby contributing to energy efficiency (Earth.

Org, 2020). Beyond environmental and economic advantages, green walls also absorb sound, mitigating ambient noise and providing a quieter and more comfortable environment, particularly in urban areas. The presence of greenery fosters a calming atmosphere, positively influencing mental well-being and reducing stress (Conserve Energy Future, 2021). These diverse benefits make green walls a valuable feature for both residential and commercial spaces in increasingly urbanized landscapes.

Green walls serve as an innovative solution to address built environmental challenges, improving both the visual and functional aspects of urban spaces. They enhance the aesthetic and sensory experience of public areas, contributing to a satisfying urban image and influencing spatial behavior (Karmoker et al., 2023). Functionally, green walls reduce thermal gain in buildings, as evidenced in studies conducted in arid and Mediterranean climates. These systems act as passive cooling methods, decreasing surface temperatures, reducing the urban heat island (UHI) effect, and providing economic and environmental benefits such as energy savings and improved air quality (Campos-Osorio et al., 2020). Additionally, green walls store heat, cool surfaces, and lower maximum daytime temperatures through reduced heat flow and evapotranspiration, showcasing their potential to mitigate rising urban temperatures caused by a lack of vegetation (Oquendo-Di Cosola et al., 2022). By integrating greenery into urban infrastructure, green walls contribute significantly to urban sustainability and comfort.

User Preferences and Perceptions

In Psychological Types, Carl Jung discusses how individual preferences and perceptions fundamentally shape people's interactions with the world. He argues that personality types influence how individuals perceive reality, process information, and respond to their environments. For instance, introverts often prefer reflective thinking and depth in their interactions, while extraverts typically seek external stimulation and engagement with others. This distinction highlights that preferences are not simply personal choices; they profoundly affect how individuals experience and interpret their surroundings (Jung, 1921). Research on urban greenspaces supports Jung's theories, showing that users' perceptions of these environments are influenced by their personal preferences, which can significantly enhance

their mental well-being. Studies indicate that people often favor spaces that integrate natural elements, leading to a greater sense of comfort and satisfaction in their environments (Kaplan & Kaplan, 1989; Ulrich, 1984).

In "Urban Green Space Perception and Its Contribution to Well-Being" explores the distinction between preferences and perceptions in how individuals interact with green spaces. Preferences refer to personal likes or dislikes, shaped by personality and experiences, which influence the types of spaces individuals are drawn to (e.g., open fields vs. secluded gardens). In contrast, perceptions are how individuals interpret and respond to their environment, such as feelings of safety or comfort. While preferences guide space selection, perceptions shape emotional and psychological well-being, suggesting that both are crucial in enhancing mental health through urban design (Sushinsky et al., 2020; Kaplan & Kaplan, 1989).

RESEARCH METHODOLOGY

Research Design

Data was collected using a purposive sampling technique from 34 respondents who were users of the space, ranging in age from 18 to over 55 years. Respondents were approached directly in the area, and participation was facilitated through a QR code linking to a Google Form. This method ensured convenience for participants while maintaining data accuracy. The sample size of 34 respondents is considered sufficient for quantitative and exploratory research, as supported by studies suggesting that 30–50 participants can provide reliable insights into user perceptions and experience (Creswell & Poth, 2018). Respondents were selected based on their direct experience and interaction with the space, ensuring the inclusion of both regular users and occasional visitors to TRX. This diverse group represented various demographics and usage purposes, providing comprehensive insights into their perceptions and experiences. The data collection was conducted over one week, covering both weekday and weekend activity patterns, allowing for an in-depth exploration of how different user groups perceive and interact with the green elements in this urban setting. These insights offered valuable findings on the integration

of natural features in modern city design.

Figure 1. Green Wall on TRX Exchange

Research Instrument

A quantitative approach was employed in this research to collect data, allowing for an in-depth analysis of user preferences and behaviors. By focusing on user preferences, the study provides valuable insights into decision-making processes that can inform future design improvements and guide policy development related to green walls in urban spaces (Creswell & Creswell, 2018). The questionnaire was carefully structured, comprising 6 questions focused on user preferences and 5 questions related to user perceptions of green walls. This design enables a comprehensive understanding of both the functional and psychological impact of green walls on individuals. According to Saunders et al. (2019), a sample size of at least 30 respondents is adequate for capturing trends and patterns in exploratory research, ensuring the collection of meaningful insights while maintaining efficient data management. This sample size offers a balanced approach, providing a preliminary understanding of the target population's views without overwhelming the research process. By using this approach, the study lays the groundwork for a more extensive investigation into user preferences and perceptions, which can guide future urban design practices.

Figure 2. Research Survey Qr

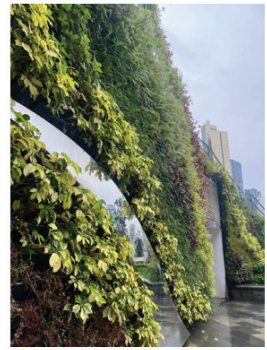

Figure 3. Close-up view of the green wall

Figure 4. The survey collection area (Angle A)

Figure 5. The survey collection area (Angle B)

Scope of the Study

The TRX Exchange Building was selected for this research due to its inclusion on the GBI-certified building list. Additionally, its green wall is highly accessible, allowing direct interaction as it is not enclosed behind glass. The green wall seamlessly integrates with the surrounding spaces, such as the playground and social areas, enhancing its functionality and user engagement.

Limitation of the Study

A limitation of this study is that the environment primarily attracts a specific age group, with limited representation of older individuals, as it is located in an urban area. With more time, the research could be expanded to include a broader demographic, providing a deeper and more comprehensive

understanding of the subject.

Data Collection

Data collection involved sampling procedures by selecting a subset from a larger population to collect data efficiently and representatively, supported by recent studies and online research. This approach was employed to gather insights into TRX Exchange, visitors' experiences, human perceptions, and Psychological Types (McCrae & Costa, 2008) specifically tailored to destination personality. By exploring multiple databases, relevant sampling studies were identified to align with the research objectives. This method provided valuable findings that enhanced the understanding of user perceptions and preferences.

ANALYSIS AND FINDINGS

Demographic Study

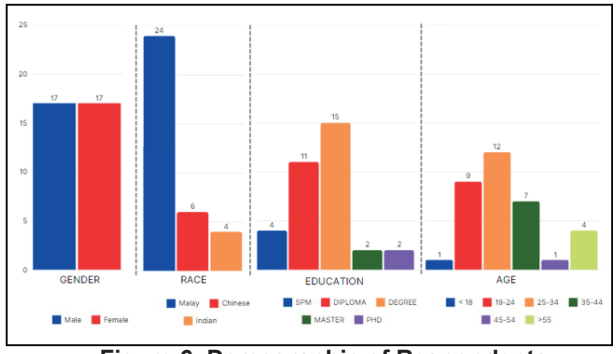

Figure 6. Demographic of Respondents

The participants consist of diverse individuals, including students, professionals, and urban residents, providing varied perspectives on green walls in urban spaces. This diversity allows for a well-rounded understanding of the impact of green walls in urban settings.

The participants involved in this study were primarily urban residents from diverse age groups and professional backgrounds. The majority were individuals who frequently interact with urban environments, including

students, working professionals, and general city dwellers. Their responses reflect varied experiences and perceptions regarding the presence of green walls in both public and workplace settings. This diverse background provides a comprehensive understanding of how green walls influence aesthetic appeal, air quality, cognitive function, productivity, and stress levels across different demographics.

The graph shows participants' backgrounds across gender, race, education, and age. Most participants are female (47.1%) and Malay (70.6%), with a significant number holding Diplomas (32.4%) and Degrees (44.1%). The largest age group is 25–34 years old (35.3%), followed by aged 19–24 (26.5%). This diverse sample, dominated by young adults with higher education, provides valuable insights into perceptions of green walls in urban spaces.

Data Analysis on User Preference Regarding Green Walls

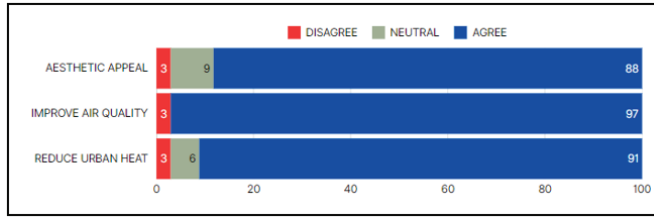

Figure 7. Analysis on User Preference Regarding Green Wall

Examining user preferences and perceived benefits of green walls in urban sustainability involves understanding how individuals value and experience these green features in city environments. The bar chart provides a detailed analysis of participants' perceptions regarding the benefits of green walls, specifically focusing on aesthetic appeal, air quality improvement, and urban heat reduction. For aesthetic appeal, 88% of respondents agreed that green walls significantly enhance visual attractiveness in urban spaces, while 9% remained neutral and only 3% disagreed, indicating a strong positive response toward the aesthetic value of green walls. Regarding improving air quality, an overwhelming 97% of respondents agreed that green walls contribute to cleaner air, making this the most strongly supported benefit. A small portion (3%) disagreed, while no significant neutral responses were recorded, reflecting near-universal agreement on the air-purifying qualities

of green walls. For reducing urban heat, 91% of respondents acknowledged that green walls help mitigate heat in urban environments, 6% remained neutral, and 3% disagreed.

This analysis aligns closely with the data analysis on user preferences regarding green walls. Both highlight a strong positive preference of green walls as beneficial for enhancing environmental quality, with a significant majority of respondents recognizing their role in improving air quality, reducing urban heat, and contributing to sustainable urban living. Users overwhelmingly prefer green walls, as evidenced by high levels of agreement across various aspects, including aesthetics, air purification, and heat reduction. The minimal disagreement and neutral responses further support the widespread acceptance of green walls as essential elements in promoting a more sustainable and livable urban environment.

Data Analysis on User Perception Regarding Green Walls

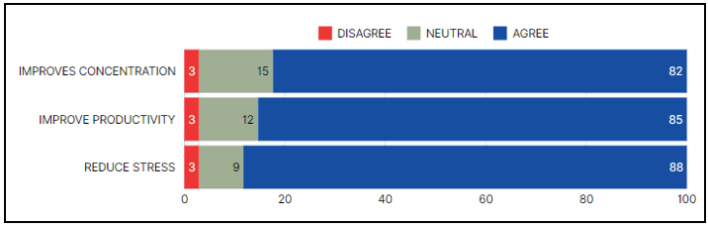

Figure 8. Analysis on User Perception Regarding Green Wall

Examining the role of green walls in enhancing user perception focuses on how these biophilic elements contribute to improving focus, productivity, and stress reduction in work and learning environments. The bar chart shows survey results assessing perceptions of three benefits: "Improves Concentration," "Improve Productivity," and "Reduce Stress." The responses are categorized into three groups: Disagree (3%, red), Neutral (9-15%, green), and Agree (82-88%, blue). Reduce stress received the highest agreement at 88%, indicating strong recognition of its benefits, followed closely by improve productivity at 85% and improves concentration at 82%. Neutral responses decline progressively across the statements (15%, 12%, and 9%), suggesting increasing confidence in the latter two benefits. Importantly, disagreement remains consistently low (3%) across all categories, highlighting a positive consensus among respondents.

This analysis reveals that while all three aspects are well-received, stress reduction is perceived as the most significant benefit, with productivity and concentration improvements also garnering strong support.

These findings indicate that users perceive green walls as more than just visually appealing; they significantly enhance well-being, productivity, and focus. Respondents recognize green walls for reducing stress, fostering relaxation, and creating environments conducive to concentration and efficient work. By improving mental health and cognitive performance, green walls enhance overall user experience in work and living spaces. This highlights their importance as essential elements in sustainable urban planning, addressing both environmental challenges and the quality of life in urban areas.

DISCUSSION

The findings from the data collection highlight a strong positive perception of green walls across various aspects of urban environments, emphasizing their importance in visual appeal, air quality, cognitive function, productivity, and stress reduction. The discussion integrates key insights from user preferences and perceptions, showcasing how green walls can significantly contribute to enhancing urban spaces and improving the quality of life.

User Preferences Regarding Green Walls

The bar chart provides a clear analysis of user preferences regarding the benefits of green walls in urban environments, focusing on aesthetic appeal, air quality improvement, and urban heat reduction. The data shows that user preference for green walls is strongly influenced by their perceived benefits. For aesthetic appeal, 88% of respondents agreed that green walls enhance the visual attractiveness of urban spaces, suggesting that users favor environments where green walls contribute to a more pleasant and appealing atmosphere (Kaplan & Kaplan, 1989). Regarding air quality improvement, an overwhelming 97% of participants agreed that green walls help purify the air, indicating a significant preference for green walls in spaces where air quality is a concern, reflecting their prioritization of health and environmental benefits (Ulrich, 1984). In terms

of urban heat reduction, 91% of respondents agreed that green walls help mitigate heat, showing a preference for green walls in creating cooler and more comfortable environments, which aligns with research on the role of vegetation in reducing urban heat islands (Getter & Rowe, 2006). The minimal disagreement across all categories highlights the strong inclination of users toward green walls as a preferred solution for enhancing aesthetics, improving environmental quality, and promoting user comfort. Overall, the data emphasizes that user preference for green walls is driven by their multifunctional benefits making them a highly favored element

The analysis reveals that user preferences for green walls are primarily driven by their perceived benefits, including enhanced aesthetics, improved air quality, and reduced urban heat. With 88% agreeing on their visual appeal, 97% recognizing air quality improvements, and 91% acknowledging heat reduction, it is clear that users favor green walls for their multifunctionality. The minimal disagreement highlights widespread acceptance, suggesting that green walls are valued for creating attractive, healthier, and more comfortable urban spaces, reinforcing their importance in sustainable urban design (Dunnett & Kingsbury, 2008).

User Perception Regarding Green Walls

The analysis highlights strong user recognition of the benefits provided by green walls, particularly in reducing stress, improving productivity, and enhancing concentration. "Reduce Stress" stands out with the highest agreement at 88%, underscoring the significant role of green walls in promoting relaxation and mental well-being, as supported by studies showing that exposure to nature can lower stress and improve emotional health (Ulrich, 1984). Similarly, 85% of respondents agreed on their contribution to increased productivity, indicating that green walls help create more stimulating and motivating work environments, aligning with research on how biophilic design fosters cognitive function and creativity (Kellert, 2008). The 82% agreement on improved concentration further emphasizes their effectiveness in supporting focus and cognitive performance, a finding consistent with studies linking nature exposure to improved attention and mental clarity (Kaplan & Kaplan, 1989). The progressively lower neutral responses (15% to 9%) suggest growing confidence in the positive impact of green walls, while the consistently low disagreement (3%) reinforces

broad acceptance among users. Overall, these findings indicate that green walls are perceived as valuable additions to work and study environments, enhancing user well-being and performance, and solidifying their role as a preferred element in sustainable urban spaces.

The analysis demonstrates that green walls are widely perceived as beneficial for reducing stress, improving productivity, and enhancing concentration. With high agreement levels across all categories and minimal disagreement, users recognize green walls as valuable features in creating supportive, relaxing, and stimulating environments. These findings highlight the significant role of green walls in promoting well-being and performance, reinforcing their importance in sustainable urban and workspace design (Dunnett & Kingsbury, 2008).

CONCLUSION

Overall, the discussion reveals that green walls are perceived as valuable additions to urban spaces, offering aesthetic, environmental, and psychological benefits. Their ability to enhance visual appeal, improve air quality, and promote concentration, productivity, and stress reduction underscores their significance in modern urban design. Integrating green walls into urban planning and workplace environments can address sustainability challenges while improving user experiences and fostering healthier, more engaging spaces. Additionally, exploring green walls in other urban buildings or public spaces would widen the scope of the research and provide a more comprehensive understanding of the role of green wall in enhancing urban sustainability and well-being.

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