ISCU 2025

17TH RISM INTERNATIONAL SURVEYING CONFERENCE FOR UNDERGRADUATES

Embracing Construction Revolution 4.0 (CR4.0): Transforming Malaysia's Built Environment

16th - 17th May 2025 I Friday - Saturday

E-ISBN PROCEEDING

VOLUME I

Published by
Royal Institution of Surveyors Malaysia
3rd Floor, Bangunan Juurukur
64 & 66, Jalan 52/4
46200 Petaling Jaya
Selangor

E- PROCEEDING 17th RISM ISCU 2025 Volume 1

Editors: Lizawati Abdullah, Nor Suzila Lop, Nor Nazihah Chuweni, Suriani Ngah Abdul Wahab, Hasnan Hashim

eISBN 978-629-94789-0-4

9 786299 478904

(online)

WELCOME SPEECH FROM THE CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

بسم الله الرحمن الرحيم السلام

عليكم ورحمة الله وبركاته

Greetings to all,

It is with great pleasure that I welcome you to the 17th RISM International Surveying Conference for Undergraduates (ISCU 2025), themed *"Embracing Construction Revolution 4.0: Transforming Malaysia's Built Environment."* On behalf of the Royal Institution of Surveyors Malaysia (RISM), I also wish to express our sincere appreciation to Universiti Teknologi MARA (UiTM), Perak Campus, for graciously hosting this significant event.

As we navigate the era of the Fourth Industrial Revolution (IR4.0)—or in our context, Construction Revolution 4.0 (CR4.0)—we are witnessing transformative advancements across the global construction sector. Technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), artificial intelligence (AI), robotics, big data analytics, and cloud computing are redefining the way we build, manage, and interact with our built environment. For Malaysia, embracing CR4.0 is a strategic imperative to achieve our socio-economic and environmental goals.

This conference serves as a vital platform to unite surveying undergraduates from various disciplines, fostering critical dialogue on industry challenges, enhancing professional networking, and preparing a new generation of talent for the rapidly evolving construction landscape. It is also an opportunity for employers to engage with and inspire our future professionals.

I would like to extend my heartfelt thanks to all industry speakers, paper presenters, judges, and participants for their time, contributions, and support in making ISCU 2025 a success. I also commend the organising committee for curating a meaningful and dynamic conference experience.

May the knowledge gained, connections formed, and ideas exchanged during this event inspire all participants to lead and innovate in their future endeavours.

Wishing everyone a productive and memorable conference.

Prof. Ts Sr Dr. Adi Irfan Bin Che Ani'
Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM CO-CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

Bismillahirrahmanirrahim.

السلام عليكم ورحمة الله وبركاته and greetings to all.

It is my great pleasure to welcome everyone to the 17th International Surveyor Conference for Undergraduates (ISCU 2025), proudly hosted by Universiti Teknologi MARA (UiTM) Perak Branch in collaboration with the Royal Institution of Surveyors Malaysia (RISM). This event is a meaningful platform for students in the built environment to share ideas, showcase innovations, and build professional networks. We are honoured by your presence and enthusiastic participation, with 135 accepted papers and 78 poster presentations this year.

UiTM Perak, home to the College of Built Environment, has long been a hub for academic excellence in architecture, planning, and surveying. Our commitment remains strong in nurturing competent graduates who meet industry demands and contribute to nation-building.

While you're here, we invite you to experience the heritage and culture of Perak Tengah from the architectural richness of Rumah Kutai to the historical towns of Pasir Salak, Bota, and Kampung Gajah.

To all presenters and winners, congratulations on your achievements. Let your work today be a catalyst for future success and academic growth. We hope this conference will inspire you to explore new ideas, foster collaboration, and make lasting memories.

My deepest thanks to the Royal Institution of Surveyors Malaysia (RISM) and the organising committee for making this event a success.

We hope your experience here will be rewarding and unforgettable.

Thank you. Selamat datang dan selamat berjaya.

Associates Professor Dr. Nur Hisham Ibrahim, *PMP*
Co-Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM THE PROJECT DIRECTOR

RISM 17th International Surveying Conference for Undergraduates 2025

Alhamdulillah, all praise to Allah S.W.T. for His guidance and blessings in making the RISM 17th International Surveying Conference for Undergraduates (ISCU) 2025 a reality.

It is with great honour and gratitude that I welcome all participants, guests, academicians, and industry professionals to this prestigious event, proudly organized under the Royal Institution of Surveyors Malaysia (RISM). This 17th edition of ISCU stands as a proud testament to our collective dedication toward academic excellence, professional collaboration, and youth empowerment in the field of surveying.

I extend my heartfelt appreciation to RISM for its unwavering support, to the hardworking ISCU 2025 Organising Committee, and to all 16 partnering universities across Malaysia for their commitment and contributions. Your efforts have shaped this conference into a dynamic platform for knowledge exchange, innovation, and professional growth.

To the academicians and practitioners present, your insights are invaluable in bridging the gap between academic theory and real-world practice. To our undergraduate participants, your passion, curiosity, and commitment are the very foundation of our future. May this conference not only deepen your academic journey but also ignite a spirit of leadership, integrity, and sustainable thinking.

Let this gathering serve as more than an academic milestone. May it foster lifelong networks, inspire transformative ideas, and chart new directions in our shared professional journey.

Wishing everyone a rewarding and inspiring conference experience.

Sr Dr. Nurul Fadzila Zahari
Project Director
RISM 17th ISCU 2025

THE GREEN DESIGN STRATEGIES OF HIGH-RISE BUILDING PERFORMANCE IN HOT AND HUMID CLIMATES

Lee Kang Jing[1], Md Azree Othuman Mydin[2*]

[1,2*] Department of Building Surveying, School of Housing, Building and Planning,
Universiti Sains Malaysia, Penang, Malaysia.
Email: azree@usm.my
*Corresponding Author

ABSTRACT

Green design process begins at designing and briefing development stage focuses on human health and a way that minimizes environmental impacts. In line with the rapid development growth of the construction industry in Malaysia, green building design has become familiar especially in high-rise buildings in city areas that have many citizens. However, the hot and humid weather is a limitation of green designs for high-rise buildings due to the tropical location of Malaysia. Green design remains in the early phase of the science and approach underlying the green building concepts. Numerous concerns persist and obstacles must be addressed before the industry can achieve substantial advancement in the implementation of efficient green design programs. Malaysia faces numerous issues regarding the environmental and economic performance of green buildings. A considerable volume of critiques regarding the actual environmental performance of buildings that have received green building certifications for new construction. The execution is deficient due to inadequate knowledge among stakeholders' consultants and contractors. The goal of this study is to determine the performance of the green designs for high-rise buildings in hot and humid weather. The research also covered establishing a criterion of the green design in high-rise buildings under hot and humid weather. However, the last objective of this research is to propose alternatives for improving green design practice for high-rise buildings in hot and humid weather. In addition, the study aims to determine the efficiency, sustainability and security of green designs that can be used in high-rise buildings to facilitate the transformation of Malaysia's construction industry into a more sustainable and environmentally friendly sector. It will ultimately create healthier and more productive spaces by reducing greenhouse gas emissions, improving air quality and saving natural resources.

Keywords: Green Design, High-rise Building, Hot and Humid Weather, Criteria, Alternatives

I. INTRODUCTION

Green building, which is also commonly referred to as sustainable building, focuses on the processes implemented that are environmentally efficient and responsible throughout the lifecycle of the building (Harries et. al., 2022). To design, operate and maintain buildings energy, water and new materials are utilized as well as amounts of waste causing negative effects to health and environment. To limit these effects, green designs must be introduced, clarified and practiced (Ragheb et. el., 2016). Furthermore, it is projected that by 2050, the urbanisation rate will increase to 69%. Currently, there are over 4.2 billion people or 55% of the global population living in urban regions compared to 30% in 1950 (United Nations, 2018), which construct high-rise buildings to increase urban density. As urban growth increases, it gives rise to problems that threaten the sustainability of the environment, such as overpopulation, increased energy consumption, noise pollution and lack of housing and poor living conditions. Figure 1 shows the annual exposure to ambient fine particular matter (PM2.5) in urban areas.

According to data from the United Nations, in 2016, all regions except Australia and New Zealand, the annual mean levels of fine particulate matter (PM2.5) exceeded the World Health Organization air quality guidelines of 10 micrograms or less per cubic metre (United Nations, 2018). It is important to note that cities use about 80% of resource and responsible for almost 80% of global CO2emission, even though they are located on only 5% of the earth surface (Carreon & Worrell, 2018). and the buildings in cities consume 32% of global energy and produce around 19% of greenhouse emission. It is expected to increase in future due to urbanisation in the developing countries (United Nations, 2020). Indeed, high-rise buildings are massive consumers of energy.

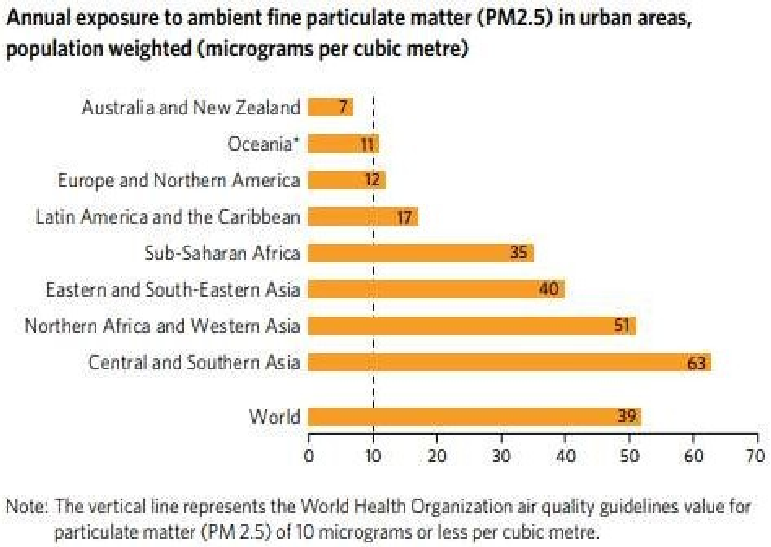

Figure 1.0 Annual exposure to ambient fine matter (PM2.5) in urban areas [5]

The relationship between building designs and the surrounding outdoor environment is a multidisciplinary imperative for urban climate and outdoor thermal comfort. In view of the impacts of the urban heat island effect, its significant influence on urban comfort (Amirhosein, et al., 2015). It influences the functionality of green design. Designing low energy buildings for hot and humid regions is a great challenge. Under climatic conditions of increased rainfall and humidity coupled with high ambient temperature, typical energy efficiency technologies are not always sufficient (Kolokotsa, et al. 2019). In this case, people tend to spend an excessive amount of time in air-conditioned indoor spaces, which imposes negative effects on health and increases building energy consumption (Jiahao Yang, et al. 2022). The US Environmental Protection Agency defines green buildings as "the practice of creating structures and using processes that are environmentally responsible and resources-efficient throughout a building's life-cycle". It focuses on the significant environmental benefits of green building designs. Countries including the United Kingdom, China, Sweden and South Africa have recognized these benefits by developing their own green building certification systems (Andrew Thatcher & Karen Milner, 2016).

In Malaysia, there are various challenges in environmental and economic performance of green buildings. Most stakeholders in Malaysia believe that adopting green practices requires high costs for materials, resources, technologies and skilled workers (Al-Aidrous, 2023). It is common that there is always the perspective of communities that the cost required for the green building designs are always higher than the conventional building designs. The additional costs can be affected by other aspects, including higher purchase cost, learning curve cost, skilled labour cost or special design work (Slaiman Faraj, 2018). Integrating green design and sustainable infrastructure in high-rise buildings presents a variety of challenges. It includes structural challenges, maintenance challenges and water management issues (Theingi, 2023).

The effectiveness of the green design policies barriers is significant to the development of green designs. The community has questioned the effectiveness of the implementation of some current green design policies (Li, et al., 2012). Some countries' current green design evaluation policies are not standardised or equitable for different cities with regional differences in economic development. A case study in China found that in developed cities such as Beijing and Shanghai, the green design evaluation standards are extremely low, resulting in many development projects that can easily achieve the requirements. However, in regions with a lagged economic development such as Guizhou and Gansu, the green design evaluation standards are considered high and few projects can achieve the requirements (Matisoff, et al., 2016). In addition, there is a need to pay enough attention during the process of policy revision and criteria formulation to feedback from the public. Moreover, increased penalties and tougher legislation for non-compliance are feasible ways to promote green design development (Ayman, et al., 2020)

II. RESEARCH OBJECTIVES

1. To determine the performance of the green designs for high-rise buildings in hot and humid weather.
2. To establish the criteria of the green designs for high-rise buildings in hot and humid weather.
3. To propose alternatives for improving green design practise for high-rise building in hot and humid weather.

III. LITERATURE REVIEW

1. Green Design

Hoffman and Henn (2008) stated that the green design concept covers construction methods, technologies, materials and products that don't require a lot of resources or pollute the environment compared to conventional construction. According to the Pacific Northwest National Laboratory, the concept of ecologically sound or green architecture originated in the 1960s. The energy crisis in the 1970s further fuelled the development of renewable energy resources, including solar, geothermal and wind energy as well as more energy-efficient buildings. Authorities across the world are very active in promoting and implementing green designs in building projects. Green roof technologies are one of the most popular green features across the world (Fioretti, et al., 2010). For instance, more than 10% of houses in Germany possess green roofs (Zhang, et al., 2012). Based on the research of World Wild Fund (2012). since the 1970s, humanity's yearly demand on the natural world has surpassed what the Earth can renew a year, and the ecosystem will probably collapse if the current consumption rate continues. According to National Geographic (2023), the rise of greenhouse gas emission is more rapid than expected and the world is warming more quickly in return. This has been irreversibly changing the world through the rise of sea level, droughts, floods, storms and heat waves. Therefore, the green design and its criteria play a crucial role in the sustainability of the construction industry. Figure 2.0 shows the percentage urban by region and subregion

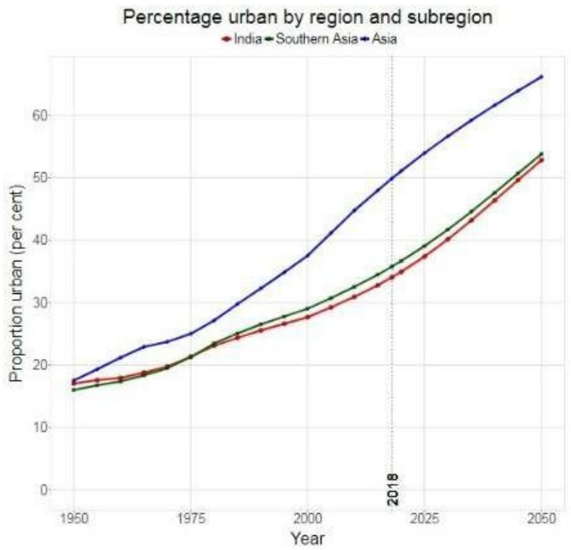

Figure 2.0 Percentage Urban by Region and Subregion [15]

According to data from the United Nations (2020), in 2050 around 68% of humanity will live in cities. These represent only 3% of the plant's surface but consume 78% of energy and produce 60% of greenhouse gas emissions. By 2050, it is projected that India will have added 416 million urban citizens, China 255 million and Nigeria 189 million (Satish Kumar, 2018). A rapid and not well-planned urbanization caused environmental problems such as the decrease of vegetation cover in urban areas because of the expansions of impervious surfaces like buildings, parking lots and pavements (Ranagalage , et al., 2017). The effect of climate change has spread around the world. For this reason, in 2016 the UN itself improved the New Urban Agenda to advise countries on their urbanisation processes and make cities more habitable, inclusive, healthy and sustainable.

The United Nations Environment Programme (UNEP) (2009) reports that 30% of total global greenhouse gas emission is released from the built environment while 40% energy consumption of all energy worldwide. The identified environmental impacts from the built environment include high energy consumption, solid waste, generation, rising GHG emissions, and pollution (De Luca , et al., 2021). According to Ifeanyichukwu et al. (2021), green architecture reduces the harmful effects of construction operations. It includes the 3Rs such as reduce, reuse and recycle through environmentally beneficial methods (Yee , et al., 2020).

2. Green Design Criteria

The introduction of green building certification systems into the construction industry was welcomed and beneficial as it motivated the growing global sustainability approach (Blackburne , et al., 2022). Green building certification systems were part of the sustainable development process and have continued to retain their value until today (Gharehbaghi & Rahmani, 2018). Case study of Blackburne, et al. (2022) found that there is a flaw in the rating system is the lack of consideration of buildings in a specific region under the same environmental and weather conditions. One factor that might contribute to this confusion is that different regions use diverse green rating systems.

The most widely used green building rating in the world is named as LEED, which is Leadership in Energy and Environment Design developed by the United States Green Building Council. LEED certification is a global solution that can help buildings to reduce carbon emissions, energy and waste, conserve water, prioritize safer materials and lower exposure to toxins (U.S. Green Building Council., 2021). It provides guidelines for evaluating the sustainability of different types of projects. Data from U.S. Green Building Council, since 2021, there are more than 82,000 commercial projects participating in the LEED programme worldwide. The world's second tallest building, Taipei 101 was intended to apply for the LEED certification, it aims to become the first skyscraper that obtained the LEED Gold certification (Council on Tall Buildings and Urban Habitat, 2009). Malaysia has scored impressive performance in the green building niche, which is the Green Building Index (GBI). In Singapore, Singapore Government took various initiatives, including providing a $100mil fund for developers to retrofit their buildings to green standards and $20mil for building owners and other relevant stakeholders of implementing green design techniques (Low et al., 2014).

3. Green Design in High-rise Buildings

In Middle Eastern nations, skyscrapers have emerged as the prevalent architectural trend due to rapid economic growth in regions (Ilgın, 2022). This development continues vigorously, in the Middle East, establishing the region as one of the most active centres for high-rise building construction (Moon, 2015). The Construction Industry Development Board (CIDB) (2023) emphasized that the concept of green building is reshaping construction approaches in Malaysia and Malaysia stands ready to embrace it early on, acknowledging the potential economic and environmental advantages it offers. Moreover, the growing number of green buildings erecting in the middle of Kuala Lumpur, strengthens the demand for evidence of sustainable building practices in Malaysia.

Mohamad et al. (2015) found that most Malaysian government office buildings consume energy inefficiently due to lack of energy optimization, leading to high energy consumption. Office buildings use the most electrical energy during the maintenance and operating stage such as elevator systems, office appliances and the heating, ventilation and air-conditioning (HVAC) system. A case study on multiple-rise office buildings found that the largest air-conditioned area will consume the highest energy consumption. Table 1 and 2 show the annual energy consumption of each building of case study (Tan, et al., 2023).

Table 1.0 Building Floor Area

Building	Number of Floors	Number of Occupants	Area (m2)	Air-conditioned
A	4	34	2,475	1,975.56
B	4	11	2,115	1,652.11
C	4	189	2,525	1,978.28
D	4	138	2,515	1,990.38
E	3	9	1,880	1,278.85
F	17	687	26,460	19,777.81

Table 2.0 Annual Energy Consumption of Each Building [36]

Building	Annual Energy Consumption (kWh)	
	2019	2020
A	146,349.60	138,272.06
B	134,870.43	119,303.05

C	252,577.92	215,649.04
D	180,688.67	155,244.82
E	154,441.53	209,143.66
F	2,665,940.60	2,614,779.99

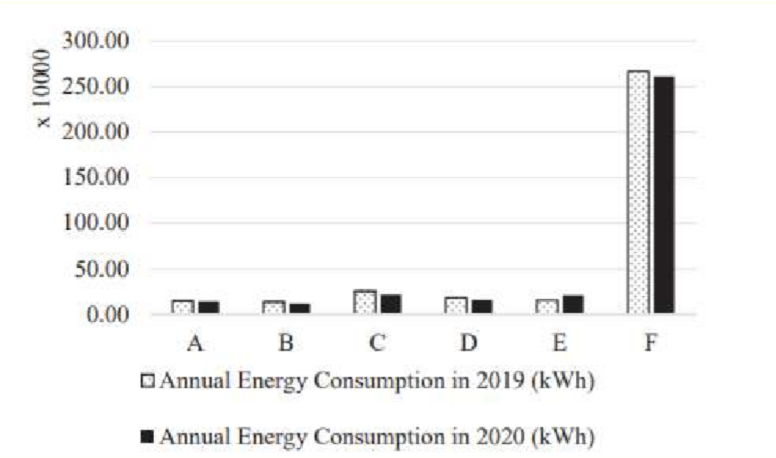

Figure 3.0 Annual Energy Consumption of Each Building

A case study on multiple-rise office buildings found that the largest air-conditioned area (Building F) at 19,777.81m2 consumerfed highest energy consumption with 2,665,940.60 kWh annual in 2019 and 2,614,779.99 kWh in 2020, illustrated in Table 1. and 2. and Figure 3 above. The room function of the area is mainly individual office rooms and open space office areas (Tan, et al., 2023). Case study of Laura Blackburne et al. (2022). determined the life-cycle engineering is the central consideration for any high-rise building design, the result showed the operating energy consumption represents around 85% of the total energy consumed at the end of the 50 years cycle of the building.

4. Green Design in Hot and Humid Weather

According to the report published by the World Bank India (2011), the heating and cooling requirement was about 35% of the energy used in Indian households back in 2008. In tropical climates a lot of energy is consumed for cooling and conventional air-conditioners are widely used. Commercial cooling systems are inefficient, require a lot of energy to run and cause pollution (Sudhakar, et al., 2019). In a case study carried out by Altan and Ozarisoy, (2022), they found that the difference between the expected building energy consumption and the actual energy consumption depended on occupancy and their behavioural patterns. For instance, lack of quality insulation in exterior walls will lead to high cooling demand in the tropical hot climate. Building orientation is also a major contributor to thermal discomfort.

A study on three Malaysian government office buildings found that the air-conditioning system consumed the most energy at 51%, followed by the lighting system (34%), plug load (8%) and other office appliances at 7% (Mohamad, et al., 2017). According to the case study of Mohammad et al. (2020), illustrated in Figure 4. below, solar radiation in Malaysia in August 2018 recorded the lowest monthly average of daily solar radiation at 120W/m2/day while February 2018 recorded the highest monthly average of daily radiation at 191W/m2/day, corresponding to February 2018 recorded a high maximum outdoor temperature of 30.28℃.

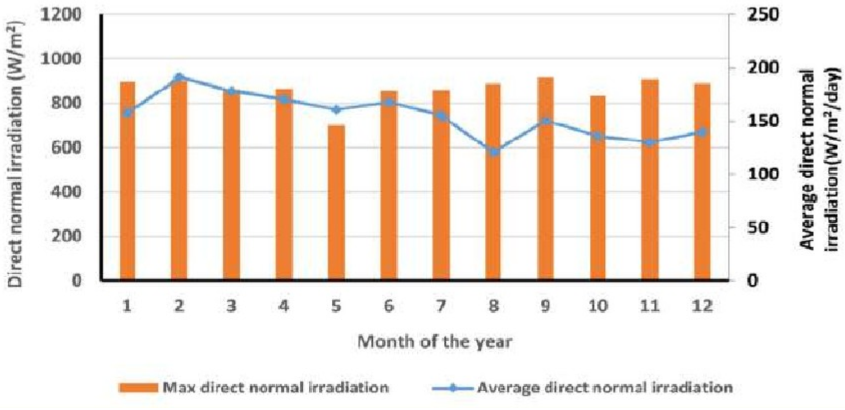

Figure 4.0 Solar Radiation in Malaysia [42]

IV. METHODOLOGY

A. Research Theoretical Framework

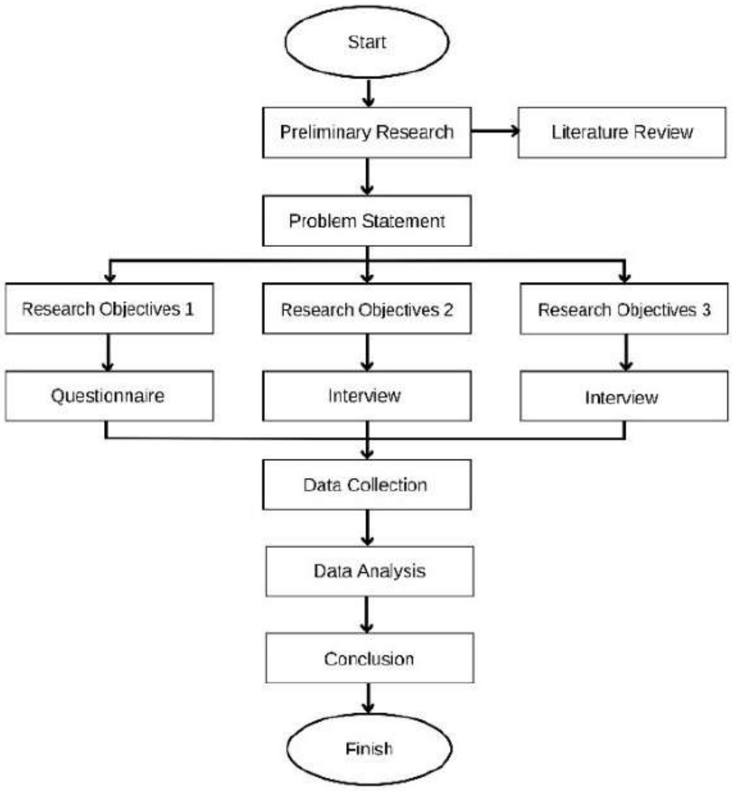

Figure 5.0 Research theoretical framework

Figure 5 above summarizes the research theoretical framework employed in this study. Research depends much on the theoretical framework since it provides a fundamental foundation linking the study problem to accepted theories and ideas. It clarifies the research question, directs the development of hypotheses, and shapes the approach by identifying crucial elements and links for study. Moreover, it places the research in the vast corpus of information so that the researcher may examine results in line with accepted theories and offers ideas that can help to expand the field of knowledge. Theoretically, the framework assures the research stays relevant and focused.

B. Research Process

Figure 6 above summarizes the research process of this study. Three stages were conducted to achieve research objectives. A reviewed literature is conducted and helps establish the problem statement, research objectives, scope of research, research significance and methodology. The outcomes involved determine performance, establish criteria and propose alternatives for green design practices for high-rise buildings in hot and humid weather.

I: Stage 1 encompassing preparation of questionnaire form that is related to the RO1, which is the performance of green design for high-rise buildings in hot and humid weather. This phase also determines the sampling method and population target group of respondents in order to identify scores of each aspect based on the one-to-five points linear scale.

II: Stage 2 encompassing preparation of interview questions from literature review that is related to the RO2 and RO3, which are the criteria and best practices improvements of green design for high-rise buildings in hot and humid weather. This phase also determines the sampling method and population target group of respondents in order to gather their actionable insights and perspectives on green design from their experiences. An arrangement of interview sessions is also implemented in this section after determining the targeted respondents.

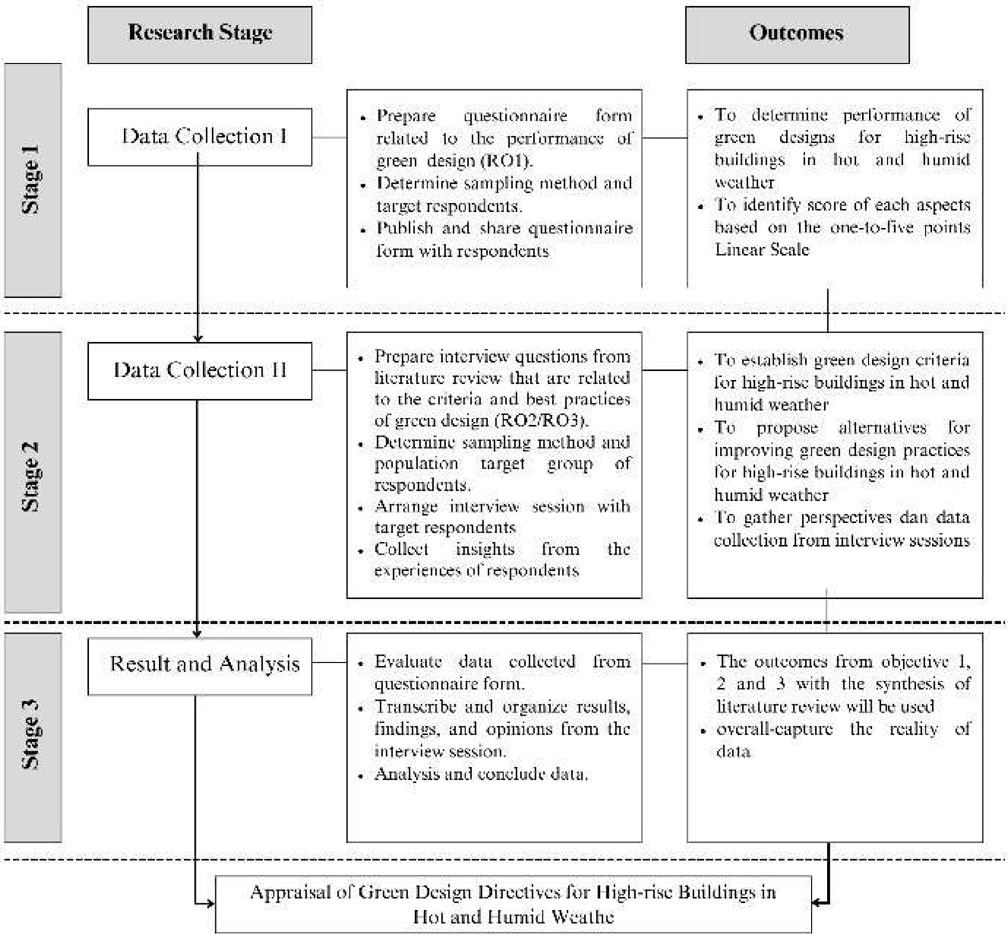

Figure 6.0 Research Process

III: Stage 3 encompassing alternatives to evaluate data collected from questionnaire form as well as transcribe and organize results, findings, and opinions from the interview session. This phase comes out with data conclusion and result analysis.

C. The Study Populations

The targeted population is selected based on respondents' expertise and direct involvement in the construction industry. The research questions can be addressed effectively by them from their professionals, expertise, and experiences. The professionals involved in this research include building surveyors, mechanical and electrical engineers, environmental auditors, architects, and green building assessors. Intended to achieve research objectives regarding green design directives for high-rise buildings in hot and humid weather.

Table 3.0 The Study Populations

No.	Professionals	RO1	RO2	RO3
1	Building Surveyors	✓	✓	✓
2	Mechanical and Electrical Engineers	✓	✓	✓
3	Green Building Assessors	✓	✓	✓
4	Architects	✓	✓	✓
5	Environmental Auditors		✓	✓

Building surveyors can play their roles in assessing the functional performance of building services (RO1), identifying practical criteria from an operational perspective and how green design can meet building regulations (RO2), as well as assessing the feasibility of green fixture alternatives (RO3). However, M&E engineers can evaluate the efficiency of energy, ventilation, and cooling systems (RO1), provide technical criteria for energy-efficient systems (RO2), as well as recommend alternative technologies (RO3). In addition, green building assessors can provide insight into the overall performance of green building certifications and benchmarks (RO1), offer insights into green certification systems and their criteria suitable for tropical weather (RO2), as well as highlight gaps in current green practices and give their recommendations (RO3). Moreover, architects can provide insight into the design intent, material selections, and techniques in green design (RO1); describe design principles, material selection, and spatial planning (RO2); as well as suggest innovative design solutions (RO3). Besides that, environmental auditors can ensure established or current criteria align with environmental regulations (RO2) and provide their insights into sustainable alternatives (RO3).

D. Questionnaire Survey

The questionnaire survey is conducted to identify the performance of green design for high-rise buildings in hot and humid weather (RO1). The questionnaire form is developed by performance of various aspects, including green architectural designs, green features, green materials, green maintenance, energy efficiency and water efficiency. Each identified aspect is assigned a score based on a one to five points Linear Scale (1-strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree). The respondents are invited to mark the relative significance of each aspect of the performance of green designs for high-rise buildings in hot and humid weather. Sampling method used for this data collection is non-probability sampling which are snowball and purposive sampling. The research targeted over 30 professionals who with more than five years' experience and are familiar with green design for high-rise buildings in hot and humid weather participated in this questionnaire. Respondents' profiles consist of architects, mechanical and electrical engineers, building surveyors and green building assessors engaged in public, private and academic sectors.

E. Semi-structured Interview

The semi-structured interview with construction stakeholders is conducted to achieve research objectives which are to establish green design criteria and alternatives for improving green design practices for high-rise buildings in hot and humid weather (RO2 & RO3). The interview session is conducted online and face-to-face depending on the interviewee. The interview questions are developed by the expertise and involvement of professionals in the green design construction industry. The respondents are invited to provide their relative insights, perspectives, recommendations and opinions regarding the criteria and improvements of green designs for high-rise buildings in hot and humid weather. Sampling method used for this data collection is non-probability sampling which are snowball and purposive sampling. The research targeted over 8 professionals who with more than five years' experience and are familiar with green design for high-rise buildings in hot and humid weather participated in this semi-structured interview. Respondents' profiles consist of architects, mechanical and electrical engineers, building surveyors, environmental auditors and green building assessors engaged in public, private and academic sectors.

V. DATA ANALYSIS

Linear scale is the primary method to analyse the data from the questionnaire form to identify the performance of green designs for high-rise buildings in hot and humid weather from the insights of respondents. Each identified aspect is assigned a score based on a one-to-five-point linear scale (1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree). The results are utilised by Statistical Product and Service Solutions software to evaluate and come out with a chart. However, the information from semi-structured interview sessions and the answers from interview questions will be gathered from different construction stakeholders' perspectives and evaluated by using quantitative data analysis software, which is named Atlas. The results are analysed, and a conclusion comes out.

VI. FINDINGS

Green designs for high-rise buildings in hot and humid weather significantly improve energy efficiency and occupant comfort. Respondents are agreeing that green design can reducing cooling demands, enhancing thermal insulation, and integrating renewable energy systems. Respondents from construction field were provided their valuable perspectives and insight against the efficiency of green design and green design criteria establishment. The key criteria for green designs in high-rise buildings in hot and humid weather include passive cooling strategies, high-performance building envelopes, renewable energy integration, water-efficient systems, and the use of sustainable materials. These criteria ensure optimal energy efficiency and environmental sustainability in hot and humid weather. Experienced in green design's respondents were suggested some recommendations of green design in order to improve green practices in future. Alternatives such as the incorporation of advanced smart building technologies, adoption of vernacular architectural principles, implementation of stricter building codes, and promotion of community-based green initiatives can enhance green design practices for high-rise buildings in hot and humid climates.

ACKNOWLEDGEMENT

I would like to express my deepest appreciation to Assoc. Prof. Sr. Ts. Dr. Md Azree Othuman Mydin for his continuous support, invaluable guidance and feedback throughout this research. His expertise and encouragement were highly beneficial in shaping the direction of this study. I am also grateful to Universiti Sains Malaysia for providing me the resources and facilities that were needed for conducting this research. Special thanks to my faculty, The School of Housing, Building and Planning for their technical support and collaboration. In addition, I also extend my appreciation to respondents who offered useful discussions and suggestions that are significantly improving the quality of the works. Finally, I wish to acknowledge my financial support provider, my parents, which made this research possible, and can be conducted without any financial constraints. I am indebted to my family and friends for their unwavering support, patience and encouragement during this challenging phase of the journey.

REFERENCES

Al-Aidrous, A. Hussein M. H., Shafiq, N., Rahmawati, Y., Mohammed, B. S., Al-Ashmori, Y. Y., Baarimah, A. O., & Alawag, A. M. (2023). Major blocking factors affecting the application of industrialized building systems. Ain Shams Eng. J., 14(10), 102-151. https://doi.org/10.1016/j.asej.2023.102151

Altan, H. and Ozarisoy, B. (2022), "An analysis of the development of modular building design elements to improve thermal performance of a representative high rise residential estate in the coastline city of famagusta, Cyprus", Sustainability, (2022), 14. https://doi.org/10.3390/su14074065

Amany Ragheb, Hisham El-Shimy & Ghada Ragheb. (2016, January 21). Green Architecture: A Concept of Sustainability. *Journal of Procedia-Social and Behavioral Sciences*, 216, 778-787. https://doi.org/10.1016/j.sbspro.2015.12.075

Amirhosein Ghaffarianhoseini, Umberto Berardi & Ali Ghaffarianhoseini. (2015, May). Thermal Performance Characteristics of Unshaded Courtyards in Hot and Humid Climates. *Journals of Building and Environment*, 87, 154-168. https://doi.org/10.1016/j.buildenv.2015.02.001

Andrew Thatcher & Karen Milner. (2016, November 1). Is a Green Building Really Better for Building Occupants? A Longitudinal Evaluation. *Journals of Building and Environm*ent, 108, 194-206. https://doi.org/10.1016/j.buildenv.2016.08.036

Ayman, R.; Alwan, Z.; McIntyre, L. (2020). BIM for sustainable project delivery: Review paper and future development areas. Architects Science Review, 63, 15–33. https://doi.org/10.1080/00038628.2019.1669525

Blackburne L., Gharehbaghi K., Farnes K. Olivia M. & Melisa R. (2022). Application of confirmatory factor analysis (CFA) as the basis of the evaluation of the green building certification systems. *Journal of Science and Technology Policy Management,* 14(4). 696-712. https://doi.org/10.1108/JSTPM-04-2021-0066

Blackburne, L., Gharehbaghi, K. and Hosseinian-Far, A. (2022), "The knock-on effects of green buildings: high-rise construction design implications", *International Journal of Structural Integrity*, 13(1). 57-77. https://doi.org/10.1108/IJSI-06-2021-0062

Carreon, J., Worrell, E. (2018). Urban energy systems within the transition to sustainable development. A research agenda for urban metabolism, *Journal: Resources, conservation & Recycling*, 132, 258-266. https://doi.org/10.1016/j.resconrec.2017.08.004

Construction Industry Development Board (CIDB). (2023). 2023 Annual Report.

Council on Tall Buildings and Urban Habitat (2009, December) CTBUH Tall Building newsletter. http://newsletter.ctbuh.org/newsletter/09-12ctbuhnewslet ter.html

D.Kolokotsa, Junjing Yang & Alexandros Pantazaras. (2019, April 27). Energy Efficiency and Conservation Consideration for the Design of Buildings for Hot and Humid Regions. *Journals of Building in Hot and Humid Regions*, 107-135. DOI: 10.1007/978-981-13-7519-4_5

De Luca, A., Chen, L. and Gharehbaghi, K. (2021), "Sustainable utilization of recycled aggregates: robust construction and demolition waste reduction strategies", *International Journal of Building Pathology and Adaptation*, 39(4), 666-682. https://doi.org/10.1108/IJBPA-04-2020-0029

Fioretti, R., Palla, A., Lanza, L.G. and Principi, P. (2010),"Green roof energy and water related performance in the Mediterranean climate", *Building and Environment*, 45(8). 1890-1904. https://doi.org/10.1016/j.buildenv.2010.03.001

Gharehbaghi, K. and Rahmani, F. (2018), "Practicalities and developments of high-rise composite structures: case studies", *Materials Science Forum*, 940. 153-159. https://doi.org/10.4028/www.scientific.net/MSF.940.153

Hoffman, A.J. and Henn, R. (2008), "Overcoming the social and psychological barriers to green building", *Journals of Organization and Environment*, 21(4), 390-419. https://doi.org/10.1177/1086026608326129

Ifeanyichukwu, N.E., Anosike, N.M., Ikenna, A.O. and Chidiebere, U.O. (2021), "Militating factors against the practice of green building as a new paradigm in construction projects", *International Journal of Sustainable and Green Energy*,10(1),13-18. https://doi.org/10.11648/j.ijrse.20211001.13

Ilgın, H.E. (2022), "Use of aerodynamically favorable tapered form in contemporary supertall buildings", Journal of Design for Resilience in Architecture and Planning, 3(2). 183-196. https://doi.org/10.47818/DRArch.2022.v3i2052

Jiahao Yang, Yang Zhao, Yukai Zou, Dawei Xia, Siwei Lou, Tongyue Guo & Zhengnan Zhong. (2022, September 30). Improving the Thermal Comfort of an Open Space via Landscape Design: A Case Study in Hot and Humid Areas. *Journals of Atmosphere*, 13(10), 1604. https://doi.org/10.3390/atmos13101604

Li, T.H.Y.; Thomas Ng, S.; Skitmore, M. (2012). Public participation in infrastructure and construction projects in China: From an EIA-based to a whole-cycle process. Habitat International, 36, 47–56. https://doi.org/10.1016/j.habitatint.2011.05.006

Low, S.P., Gao, S. and Tay, W.L. (2014), "Comparative study of project management and critical success factors of greening new and existing buildings in Singapore", Structural Survey, 32. (5). 413-433. https://doi.org/10.1108/SS-12-2013-0040

Matisoff, D.C.; Noonan, D.S.; Flowers, M.E. (2016). Policy monitor-green buildings: Economics and policies. Environmental Economic Policy, 10, 329–346. DOI:10.1093/reep/rew009

Mohamad, Z.T., Mohamad, F.R. and Nawi, M.N.M. (2015), "Building energy index: a case study of three government office buildings in Malaysia", Advanced Science Letters, (21), 1799-1802. https://doi.org/10.1166/asl.2015.6239

Mohamad, Z.T., Nasrun, M., Nawi, M., Jamaludin, R. and Baluch, N. (2017), "Building energy index (BEI): a study of government office building in Malaysian public university", *Journal of Engineering Science and Technology*, 12. 192-201.

Mohammad, S.T., Al-Kayiem, H.H., Aurybi, M.A. and Khlief, A.K. (2020), "Measurement of global and direct normal solar energy radiation in Seri Iskandar and comparison with other cities of Malaysia", Case Studies in Thermal Engineering, 18, 100-591. https://doi.org/10.1016/j.csite.2020.100591

Moon, K.S. (2015), "Supertall asia/Middle East: technological responses and contextual impacts", Buildings, 5 (3), 814-833. https://doi.org/10.3390/buildings5030814

National Geographic. (2013). The Greenhouse Effect and our Planet. *National Geographic.* https://education.nationalgeographic.org/resource/greenhouse-effect-our-planet/

Ranagalage, M., Estoque, R.C. and Murayama, Y. (2017), "An urban heat island study of the Colombo metropolitan area, Sri Lanka, based on Landsat data (1997–2017)", *ISPRS International Journal of Geo-Information*, 6(7), 189-206. https://doi.org/10.3390/ijgi6070189

Satish Kumar. (2018, May). 68% of the world population projected to live in urban areas by 2050, says UN. *Linkedin.com*. https://www.linkedin.com/pulse/68-world-population-projected-live-urban-areas-2050-says-satish-kumar

Slaiman Faraj., Chrystal L. D., Simon K., Navid N., & Azlinda A.H. (2018). The challenges of sustainable green building design in Malaysia. *Advance journal of technical and vocational education,* 2(1).01-06.

Sophia Harries, Gianna Ryan, Micheal Marino & Koorosh Gharebaghi. (2022, June 15). The Green Design of High-rise Buildings: How is the Construction Industry Evolving. *Journal of Technological Sustainability*, 6(1). https://doi.org/10.1108/TECHS-04-2022-0017

Sudhakar, K., Maximilian Winderl & Shanmuga Priya, S. (2019, March). Net-Zero Building Designs in Hot and Humid Climates: A State of Art. Case Studies in Thermal Engineering, 13. https://doi.org/10.1016/j.csite.2019.100400

Theingi A., S. Reng L, Arkar H. & Amiya B. (2023). Using machine learning to predict cost overruns in construction projects. *Journal of Technology Innovations*. 2(2). 01-07. https://doi.org/10.56556/jtie.v2i2.511

U.S. Green Building Council. (2021), "USGBC announces international ranking of top 10 countries for LEED", [last viewed 16 December, 2021].

United Nations Environment Programme (UNEP) (2009), Buildings and Climate Change: Summary for Decision-Makers, UNEP publications.

United Nations. (2018). The Sustainable Development Goals Report, 0 – 64.

United Nations. (2020). The Sustainable Development Goals Report, 0 – 64.

World Bank. (2011). Energy Intensive Sectors of the Indian Economy Report.

World Wild Fund (WWF). (2012). 2012 Living Planet Report.

X. Y. Tan, Norhayati M., Nizam K., Norhayati W. & Zainal B. (2023). Investigation into performance of a multi-building complex in hot and humid climate: efficacy of energy saving measures, Open House International: Sustainable & Smart Architecture and Urban Studies, 49(3), 489-513. https://doi.org/10.1108/OHI-04-2023-0085

Yee, H. C., Ismail, R. and Jing, K. T. (2020), "The Barriers of Implementing Green Building in Penang Construction Industry", *Progress in Energy and Environment*, 12. 1-10.

Zhang, X., Shen, L., Tam, V.W. and Lee, W.W.Y. (2012), "Barriers to implement extensive green roof systems: a Hong Kong study", *Renewable and Sustainable Energy Reviews*, Vol. 16 No. 1, pp. 314-319. https://doi.org/10.1016/j.rser.2011.07.157

Cawangan Perak

eISBN 978-629-94789-0-4

9 786299 478904

(online)