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6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023

SUSTAINABLE BUILT ENVIRONMENT

25 - 27 SEPTEMBER 2023

E-PROCEEDING

USBET 2023

e-Proceeding

6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023

SUSTAINABLE BUILT ENVIRONMENT

Published by,
Department Of Built Environment Studies And Technology
Faculty Of Architecture, Planning & Surveying
Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus
usbet.fspuperak@gmail.com

eISSN 2821-3076

02 October 2023 | Perak, Malaysia
Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus

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THE IMPACTS OF SITE FACTORS TOWARDS BUILDING MORPHOLOGY IN KUALA LUMPUR

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ABSTRACT

Site factors can give impacts on the building morphology and cost may be overrun. The presence of slopes, uneven terrain, and varying soil conditions can affect the stability of the building and the cost of implementing building construction increases depends on the site location. The objective of this research is to identify the impacts of site factors towards building morphology in Kuala Lumpur. A quantitative approach is used in this research and the data collected by using questionnaires survey. The findings reveal that there are three most significant impact on site factors are (i) transportation costs, (ii) type of foundation and (iii) site location. While the three least significant impact on site factors are (i) the presence of endangered trees, (ii) congested site, and (iii) occurrence of natural disaster. Therefore, these findings are important in determining building morphology, as well as for the designer to comprehend the effect on building morphology towards site factors.

Keywords: *Site Factors, Building Morphology, Impacts, Cost, Kuala Lumpur.*

INTRODUCTION

Building construction is the process of assembling and erecting many building-related components. People who use buildings as shelter can adapt to varied climatic conditions. The success of the construction is essential, and the success of a building project can be determined by several variables. According to (Ahmad, 2019), it is critical to comprehend the client's needs while implementing cost planning, including price certainty, project completion on schedule and within budget, and the finest quality at an affordable price. The site factors can give impacts on the building and the cost overrun that effect client's budget. The design. For instance, if the site is located far away from the available resources, the cost will increase due to the need to transport the materials. More complicated a building's design, the more structure involves (Belniak, 2013), where it will affect cost. The complexity of the design may also cause by site factors. Therefore, this study examines site characteristics that affect the design morphology.

PROBLEM STATEMENT

New buildings have emerged in this modernised world, where there are more buildings than trees and structures taller than trees, while older buildings have been renovated or demolished. Countries always compete to construct the most abundant structures. The site variables are important when developing a new building. If site factors are not taken seriously, they may cause issues related to building morphology. Site-related considerations may have an impact on a building's structure. Hilly terrain frequently necessitates concerns in design foundation. The existence of slopes, uneven terrain, and various soil types may impact the stability of the building. For instance, the size, shape, and design. Site factors is important to consider before designing and constructing a building. This is due to the facts that it will give impact on the building such as soil instability. Building foundation issues like settling, sinking, or shifting might result from unstable soil at the location. This may result in structural problems, such as wall and floor cracks. According to (Kazmi et al., 2017), on December 11, 1993, a building known as Highland Tower collapsed due to the soil erosion of the land. The foundation of the building could not withstand soil erosion and landslide. From the design morphology of the building, another problem would arise, which is the cost of implementation of the construction of the building. Not only does structurally need to be considered while constructing a building, but financially, it is also important. From the site factors, it must check what is the load-bearing capacity of the soil on-site so that it can be determined what type of foundation is suitable for the building to be built on it.

Besides, the location of the site also important as it will impact the building lifespan especially if located in a flood-prone area. The building may be at risk of flooding if it is situated in a flood plain or on a low-lying site. Flooding can endanger people's safety as well as seriously harm the building's structure, electrical systems, and equipment. In addition, the location of the site also impacts the availability of the materials, labour and the cost where it requires transportation to deliver the materials to the site as well as determine the building design and shape. Limited access to the building site can make it difficult to transport equipment, provide materials, and remove debris. Construction costs and time may rise due to narrow roadways, crowded cities, or remote sites. (Gao & Asami, 2007), stated that sites located in urban areas have specific problems in implementing urban redevelopment which raises residents' objections to the limited lot size and shape. Limited access to the building site can make it difficult to transport equipment, provide materials, and remove debris. Construction costs and time may rise due to narrow roadways, crowded cities, or remote sites. Hence, it is very crucial for the design team to acknowledge the factors that are available at the site so that the change in design will only occur after the planning and designing are made. The changes will increase the cost of construction and cause the construction period to be delayed. Therefore, before creating a structure, it is crucial to thoroughly evaluate the site characteristics to reduce potential issues and guarantee long-term durability, safety, and tenant happiness.

2. LITERATURE REVIEW

Definition of Site Factors

Each construction site has a unique feature and requires special attention, which should be focused on site factors to facilitate construction. According to (Lam et.al., 2007), site factors are terrain characteristics and site conditions that should be included in planning to increase buildability. Typically, a site will have either a narrow frontage and a small area or a wide frontage and a large area (Ahmad, 2019). This means that, the shape of the building will be design by the designer according to the shape of site to maximize the land usage especially when the land cost is expensive. The factor that needs to be considered is the nature of the construction site, such as the site topography, the size and shape of the construction site, the location. The factors of the site need to be identified properly so that it will not cause any problems on the building performance.

Impacts of Site Factors Towards Building Morphology

The site factor will determine the type of building design that is suitable according to the site's condition so that the cost of the building will not change after the building is completed. According to (Jayawickrama et.al., 2019), the complexity of the project, market rate, project timetable, the quality of the designs, regulatory requirements, and the location, nature, and size of the project are all factors that have a significant impact on the project cost estimate. Behavioral Healthcare Executive (2015) stated that design is impacted by a location's physical features, such as its climate, terrain, and site features, as well as by its social characteristics, such as its culture, industry, design aesthetic, or history. This means that, the location of the site is proven to have an impact on the morphological building design. Thus, it is very important for the design team to consider the site factors so that the building is buildability and is value for the money especially for the client since they spend their money for the construction to be successful.

Table 1: Impacts of site factors

Impact	Element	Nazir, (2019)	Yana et.al (2015)	Weerasekara et.al (2021)	Ibrahim et.al (2014)	Sahid et.al (2017)	Jayawickrama et.al (2019)	Belniak et.al (2013)	Kazmi et.al (2017)	Ahmad (2019)	Frequancy
Natural disaster	Occurrence of natural disaster like earthquake, landslide, and flood affect design and the performance	/	/						/		3
Weather condition	change of weather condition affect design	/	/								2
Location	Delay in supply of material used in construction affect design	/					/				2
	Easy of excess in the building					/					1
	Transportation cost						/				1
	Shape of a building has an important effect on its cost			/	/		/	/		/	5
Site topographical	Type of foundation will be changed due to the swampy soil				/				/		2

	Geological condition	/	/				/	/			4

Impacts on Site Location

The building's design and construction are influenced by the site's natural characteristics, ground obstacles, neighbouring and existing structures, and subterranean and above-ground services (Pinconsult Associates Limited, 2022). High-value projects are drawn to valuable locations. Therefore, it is improper to build low-value developments on valuable sites. This means that the building needs to be construct suitable with the value of the site. According to (Radziszewska-Zielina and Kania, 2017), an urban agglomeration is an area with a highly dense built environment and a dense populace, both long-term residents and transients. The location of the building or the construction is crucial as it will determine the design that will be used to suit the site itself, especially if it is in urban areas. For example, if the site is in Urban areas, the size of the land is limited due to the dense population compared to rural areas, so the building needs to be constructed maximizing the use of the land so that the land will not be wasted just like that. The building can be constructed either landed or multi-storey depending on the demand for the building. (Ruwanpura et al., 2007) stated that small spacing between pieces of equipment, a lack of working spaces, and a lack of easy access points are all signs of congested conditions on a construction site. Heavy traffic and a lack of parking places are frequent problems in congested neighbourhoods, making it challenging for staff, customers, and suppliers to get to the location. This may cause delays, longer commutes, and ineffective delivery of products and services. Additionally, it can make shipping and receiving difficult, complicating logistics.

Impacts on Building Cost

Site factors will impact the construction cost of the building to be increased. The cost will be higher if the building is construct at hilly areas where the land surface is not stable compared with the building constructed in landed area. In research from The Constructor (2014), the Site conditions such as poor soil conditions, wetlands, contaminated materials, and conflicting utilities can affect the cost of a project. This means it will require extra precautions such as other structures like sheet piles to prevent the landslide. Besides that, the building orientation also gives impacts the building cost. According to (Soufiane et al., 2019), The building's orientation affects the amount of direct sunlight it receives and how much wind it experiences. The building orientation also gives impact on the cost of materials. Artificial lighting may be needed during the day if the orientation does not maximize the potential for daylighting, which would increase energy consumption and need the installation of lighting equipment and controls.

Impacts on Building Performance

There are some impacts of the site factors that can cause the performance of the building to deteriorate over time due to the weather conditions. Hilly regions, though tempting to construct a structure at, have wide variations in geology, geomorphology, climate, altitude, and materials resources. (Chen et al., 2021) stated that buildings are at serious risk from prolonged periods of severe rain and consequent floods. Particularly vulnerable to increasing hydrostatic pressure, which can cause foundation settlement and structural failure, are structures situated in flood-prone areas. According to (Pawar and Sohani, 2017), Buildings resting on sloped ground have less base shear than those on flat ground. That is why the building that is located in the hilly areas requires extra cost so that it will not affect the building's performance itself. The failure of the building performance like soil erosion which can cause the building to collapse and this will make the client loses because the client cannot use the building for a long period of time. Besides that, natural disasters like earthquakes and floods can impact how well a structure performs. Depending on the type and severity of the disaster as well as the building's design and structure, the impacts may differ. (Kusar, 2008) stated that the ground movement brought on by an earthquake could cause the supporting framework of a building to come free and cause it to collapse.

Impacts on Building Design

Site topography will influence the building design through the foundation and structure of the building. The slope and stability of the site affect the foundation design. Steep slopes may require extensive excavation or the use of retaining walls to create a flat building base. Structural design must also consider site stability and the potential for soil erosion, landslides, or seismic activity. If this is overlooked from the start, the building will develop cracks and its lifespan will be short. Besides that, buildings in crowded places must consider several things, such as site restrictions, municipal ordinances, and the need to use available space efficiently. The limited size of the land will limit the building size to be built (Ahmad, 2019). Due to many circumstances, such as a lack of space, congested locations have a considerable impact on building design. The architect would design the structure vertically to maximise the use of the site due to the limited construction space. In crowded environments, it is critical to utilise available space effectively.

METHODOLOGY

This research method is using quantitative method. Quantitative method will be done through the data collection from the questionnaires survey. Questionnaire's survey is designed to identify the impacts of site factors towards building morphology in Kuala Lumpur because the population is higher and there have been building collapses caused by landslides such as highland tower and 2 storey terrace houses in Taman Pertama. The population involved in this study are construction industry practitioner which are Quantity Surveyor, Architect, and Engineer in Kuala Lumpur with a total number of 1,515 respondents that are obtained from the Board of Quantity Surveyors Malaysia, Board of Engineer Malaysia, CIDB and Board of Architect Malaysia. The population sample size which is 307 respondents were obtained through Raosoft. Then, the questionnaires survey is distributed to 307 respondents by using Stratified random sampling as the sample technique. Only 188 out of the 307 total respondents for this study responded, equal to 61%. The data collection will be analysed by using descriptive analysis. Statistical Package for Social Science (SPSS) version 29 are used to present the frequencies, means, percentages, bar charts and tables on the results. The techniques of frequency and mean will be used to gather the data to achieve the result. On top of it, there are also some limitations while conducting the survey such as low response rate due to the respondent that refuse to answer or choose not to complete the survey which can affected the overall quality of the study. Respondents may also misinterpret questions that are poorly written or have confusing wording. This may lead to data for the study is incorrect or inaccurate.

RESEARCH FINDINGS

The Impacts of Site Factors Towards Building Morphology

Table 2: Rank on the impact of site factors towards building morphology

Descriptive Statistics	Mean	Standard Deviation	Rank
Site factors have good impacts towards the building morphology	3.64	1.315	4
The site location has good impact towards building cost.	3.65	1.284	3
The accessibility of the materials gives a good influence on the construction period	3.59	1.245	5
Occurrence of natural disaster like earthquake and flood does not affect building performance	3.21	1.446	12
The site location has good impact on the number of building storey.	3.47	1.314	8
The topographical condition of the site gives good influences on the construction cost	3.56	1.357	6
The soil characteristics influence the selection of the type of foundation pole and piling method	3.96	0.989	2
Sites located in congested area manageable.	3.18	1.316	11
Change of weather condition does not affect design	3.45	1.301	7
Transportation costs are influenced by the site location	4.11	0.906	1
The surrounding building does not affect the building design	3.43	1.352	9
The presence of trees preservation does not affect the orientation of the building	3.26	1.328	10

Based on Table 1, there are 12 variables that have been determined to identify the impacts of site factors on building morphology in Kuala Lumpur. The average mean was 3.54 which indicates that most of the respondents agreed that all the significant factors give impacts on the building morphology. The top three factors that give has implications on the building morphology are transportation costs are influenced by the site location, soil characteristics influence the selection of the type of foundation pole and piling method, and the site location has a good impact towards building cost. While the least are the presence of trees preservation does not affect the orientation of the building, sites located in congested area manageable and occurrence of natural disaster like earthquake and flood does not affect building performance.

The highest score means for the impacts of site factors towards building morphology was 4.11 on average, which means transportation costs are influenced by the site location. this finding is correlated with studies by Odusami and Onukwube (2008), as the distance grows, the cost of transporting the materials to the construction site rises. The cost of transportation will also increase and delay in construction completion due to the need to transport the materials to the site, mainly if the site is located far away from the supplier, such as in rural areas.

Other than that, the soil characteristics influence the type of foundation pole and piling method selection, which ranked second with a mean score of 3.96. The result demonstrated that the selection of the foundation and piling method depends completely on the soil characteristics. Thus, this finding corresponds to Blondet (2005), in steep terrain, buildings are more vulnerable to demolition. The behaviour of the soil and the effectiveness of foundations can be impacted by the presence of groundwater. Therefore, construction in hilly areas requires special equipment, materials, and workmanship that has good skill in compacting the soil.

The location of the site has a good impact on the cost of the building and was ranked in third place, which contributes to the most significant factors that have an impact on the site. The mean score for this factor was 3.65, and this factor can also be regarded as project size and the material used since it involves the location of the project. If a site is easily accessible with good transportation infrastructure, it reduces the cost of transporting construction materials and equipment. This study correlated with Koushki and Kartam (2004). Previous researchers discovered that material management is crucial since construction materials account for 50–60% of a project's cost. Therefore, it is proven that material management helps reduce the cost of the building due to its accessibility, which can reduce transportation costs.

Meanwhile, the lowest three the presence of tree preservation does not affect the orientation of the building was ranked tenth with a mean score of 3.26. This finding is contradicted by Abdel Aziz (2014), who found that the energy usage of the structure will be indirectly impacted by the presence of trees. The amount of daylight that a building receives can be dramatically impacted by trees that offer shadow. If there are already trees on the site, their position and height may have an impact on the building's orientation to maximise sun exposure. On the other hand, airflow may be restricted by dense tree canopies, creating stagnant air pockets, and impeding natural ventilation. The Sites located in congested area manageable was ranked eleventh on the list and had a mean score of 3.51. This finding is contradicted by studies by Ruwanpura et al. (2007) stated that small spacing between pieces of equipment, a lack of working spaces, and a lack of easy access points are all signs of congested conditions on a construction site. Most of the respondents disagree that the site located in a congested area is manageable due to the space limitation and requires special equipment and requires careful consideration of noise and environmental impacts on the surrounding community. In addition, buildings located in congested areas also require adequate noise and dust control to minimize disturbance as they are surrounded by residential or commercial buildings.

The occurrence of natural disasters like earthquakes and floods does not affect building performance, which was ranked the least with a mean of 3.14. This finding is contradicted by studies by Kusar (2008), who found that the ground movement caused by an earthquake could potentially cause the building's supporting framework to break loose and lead it to collapse. Different kinds of forces can be applied to buildings because of ground movement. The structural components of the building, such as the columns, beams, and foundations, may experience stress and strain because of these forces. The supporting framework may fail, causing the building to collapse, if the loads being applied are more significant than the building can withstand or if there are structural defects or flaws.

In conclusion, transportation costs are influenced by five factors, namely, (i) site location, (ii) soil characteristics and piling method, (iii) site location, (iv) site factors relate to building morphology, and (v) accessibility of materials. Therefore, from the analysis found, these are five criteria most impactful on-site factor towards building morphology.

CONCLUSION AND RECOMMENDATION

As a conclusion, the survey findings have provided valuable insights into the site factors that give impacts on the building morphology. Based on the data analysis, it can be concluded that the highest score means is site location, which has great impacts on transportation costs. The site location far away from the resources will make the transportation cost increase due to the need to transport the material, labour, and plant and equipment. This will indirectly cause the cost of construction to increase. Site factors also helps architects and designers in comprehending the environment where a structure will be situated. The topography, climate, nearby structures, vegetation, and local culture all play a part in the site's distinctive personality. By considering these elements, architects can create buildings that blend in with the landscape, boosting the area's aesthetic appeal and creating a sense of place. Given the scope is limited to the design team in Kuala Lumpur, it is critical to visualise the larger context of the design team that experienced site factors during construction. Therefore, it is suggested that future researchers broaden the scope of their research to include design teams all over Malaysia. Besides that, it is also recommended that future research further their studies through the contractor’s perspective on how they managed the site factors and challenges that occurred during the construction.

ACKNOWLEDGEMENT

Alhamdulillah by the grace of God, He gave me the idea, strength, and time to finish this research. Without His will, I certainly will not be able to complete this dissertation within the specified time.

First of all, I would like to thank my supervisor, Prof. Madya Sr Dr Yuhainis Bt Abdul Talib who gave me the encouragement and motivation in completing this research. My gratitude also goes to all my lecturers for all their guidance in the course of my study to obtain my degree.

Special and greatest appreciation towards my beloved parents for always supporting my ever since I was born. Sincere love towards my lovely siblings, friends and all who are involved direct or indirectly in my study experience. And also thank you to my lovely friends, Athirah, Maizatul Rahmah, and Intan Syakila that willing to help me from zero until I finish this research. The continuous support and encouragement given have provided great motivation to the success of completing this research report.

Last but not least, thanks to all my respondents for giving a good cooperation in the process of collecting and managing the data of this research. Only Allah swt is able to repay the kindness, moral support and courtesy that all of you have given to me. Thank you form the bottom of my heart.

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