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Post-Occupancy Evaluation of Landscapes of High- Rise Green Buildings in Doha

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Abstract

Green building is one of the buildings sustainability applications; which represented the use of construction applications that reduce the negative effects of the building on the environment and human health. This paper basically aims to realise the effectiveness of landscaping in high-rise green building with post-occupancy evaluation methods. It also purposes to prepare a detailed survey in order to measure the effects of landscapes on functional, technical and social performance of high-rise buildings. In order to achieve the aims of this study, the quantitative analytical method was adopted. It will utilize the quantitative survey in order to provide a full background with the most knowledge that explains the phenomenon (Post-occupation evaluation of high-rise green building landscapes in Doha). Indicators will be measured for social performance by conducting interviews with users, and for job performance by monitoring the selected buildings, and indicators for technical performance will be measured through interviews with professionals (Cresswell, 2008). The Study



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population consists of the occupants of high-rise green buildings with landscape in the city of Doha. A simple randomly selected sample which composed of (300) individuals from residents, students, visitors and workers in three of these green buildings, were selected as the study sample. The results of the study indicated that there is great agreement on the effectiveness of the landscape of green high-rise buildings in the post-occupancy period in terms of social performance. It also concluded that there is a positive impact of landscapes on the functional, technical, and social performance of high-rise buildings.

Keywords: Green building, post-occupancy, landscapes, functional, technical, social performance, Doha.



المخلص

يُعد المبنى الأخضر أحد تطبيقات استدامة المباني المتمثلة في استخدام تطبيقات البناء التي من شأنها تقليل آثار المباني السلبية، ومن ثم الحفاظ على البيئة وصحة الانسان. تهدف هذه الورقة البحثية بصورة رئيسية إلى تحقيق فعالية المناظر الطبيعية في ناطحات السحاب الخضراء باستعمال أساليب تقييم ما بعد الإسكان. تقترح الدراسة إعداد استبيان مفصل أيضاً بهدف قياس تأثير المناظر الطبيعية في أداء ناطحات السحاب الاجتماعي والتقني والعملي. اعتمد الأسلوب التحليلي الكمي من أجل تحقيق أهداف هذه الدراسة، إذ سيستخدم الاستبيان الكمي ليوفر خلفيةً كاملةً مدعّمةً بأكبر قدر من المعلومات التي تفسر ظاهرة تقييم ما بعد الإسكان للمناظر الطبيعية في ناطحات السحاب الخضراء الموجودة في الدوحة. وفقاً لأسلوب كريسويل لعام 2008، ستُقاس مؤشرات الأداء الاجتماعي عن طريق إجراء مقابلات مع السكان، ومؤشرات الأداء الوظيفي عن طريق مراقبة المباني المختارة، وأخيراً ستُقاس مؤشرات الأداء التقني عن طريق إجراء مقابلات مع خبراء. تشمل الدراسة المقيمين في ناطحات السحاب الخضراء ذات المناظر الطبيعية في مدينة الدوحة. اختيرت مجموعة عشوائية بسيطة تضم 300 فرد من بينهم مقيمين وطلاب وزوار وعاملين في المباني الخضراء الثلاثة هذه كعينة للدراسة. بينت نتائج الدراسة وجود إجماع كبير حول فعالية المناظر الطبيعية لناطحات السحاب الخضراء في فترة ما بعد الإسكان فيما يتعلق بأدائها الاجتماعي. واستنتجت أيضاً إيجابية تأثير المناظر الطبيعية في أداء ناطحات السحاب الاجتماعي والتقني والعلمي.

الكلمات المفتاحية: مبنى أخضر ، إشغال ، مناظر طبيعية ، وظيفي ، فني ، أداء اجتماعي ، الدوحة.



1- Introduction

Today's global topics such as climate change, energy shortages, increasing environmental pollution, increasing population and rapid urbanization pose enormous challenges to the sustainable development of human society (Sharma, 2018). Therefore, several countries recognized that using high-rise buildings is essential to manage the big increases in population numbers and expensive land prices influenced the architectural style of their buildings (Fenga & Xingkuanb, 2011).

High-rise buildings are known to be big energy consumers. As a result, one of the most significant current architectural trends is to improve the environmental performance of these structures and reduce their negative impacts on the environment and public health. Thus, the landscape in these buildings developed with the tendency to high-rise structures and the appearance of environmental issues. This man-made ecosystem involves green roof, sky garden, podium parks, and greenery (Xue & Lau, 2013).

The landscaping in high-rise buildings improves the form of the building and helps to boost the air quality within the structure by producing significant amounts of oxygen and absorbing carbon dioxide and suspended particles. It also enhances water and energy efficiency (Golasz-Szolomicka & Szolomicki, 2019; Moor & Erysheva, 2018).

Nevertheless, users of green high-rise buildings have noticed a number of issues with project efficiency, thus this study is based on the use of the post-occupancy evaluation approach in the Qatari capital, Doha. This approach focuses on evaluating the efficiency of building performance



after deployment and operational procedures. Additionally, It provides feedback on the present condition of high-rise green building green diminutions (after use) and recommends solutions to current challenges, as well as proposing design guidelines and practices to ensure higher-quality future projects (Hadjri & Crozier, 2009).

2- Research Problem & Questions

With the beginning of the industrial and technological advancements, the necessity to establish new civilizations and projects developed to keep pace with the latest events and social requirements. Moreover, there is a significant gap between the designer's ideas and the user's needs, particularly after the supply and demand market took control of the construction process and the formation of the final product without the user's actual participation, whether in the planning, design, or implementation process.

Despite the critical necessity of managing and maintaining buildings and infrastructure in Doha, there is no coordinated and standardized system in place. Many complaints from building users concern defects after occupancy, including performance and functional efficiency, accessibility, day lighting, thermal comfort, productivity, security, and safety.

As a result, the advantage of adopting a post-occupancy assessment technique is obvious to determine how well projects are working after users have completed the installation and maintenance stages. Hence, the goal of this study is to evaluate high-rise green building landscapes using



a post-occupancy evaluation technique in Doha, this is carried out through answering the following main research question;

“To what extent are landscapes of high-rise green buildings effective during the occupancy period?” In addition, the following sub-questions:

1. What are the functional performance indicators of high-rise green building's landscapes?
2. What are the technical performance indicators of high-rise green building's landscapes?
3. What are the social (user-oriented) performance indicators of high-rise green building's landscapes?

3- Research Hypothesis

This study will test the following hypothesis:

- 1- There is a significant positive effect of landscapes on functional performance of high-rise buildings in Doha.
- 2- There is a significant positive effect of landscapes on technical performance of high-rise buildings in Doha.
- 3- There is a significant positive effect of landscapes on social performance of high-rise buildings in Doha.

4- Theoretical background

4.1 Green High-Rise Building

The concept "green" in architecture refers to the architectural structure, treatments, and environmentally friendly technology used in a building's interior or external design (Leskinen et al., 2020). The building's sustainability is influenced by the use of green, environmentally friendly



building materials. Green buildings includes all strategies, architectural vocabulary, and technical solutions related to renewable energy that improve the person's health and well-being, while also dropping the building's running costs (Agyekum et al., 2019).

Green buildings are designed to minimize energy consumption, protect natural resources from deterioration, increase building efficiency, and promote the health and wellbeing of its occupants (Lavasani, 2018; Singh et al., 2010).

High-rise buildings have a significant influence on defining the characteristics of cities and creating their architectural identities; they also have a significant impact on the adjacent structures (Moor & Erysheva, 2018). With the significant increase in land prices and the large growth in population density in cities, high-rise structures have emerged as a new architectural style that solves a problem (Begec & Hamidabad, 2015). Because these buildings require a lot of energy over their life cycle, the way they work and the type of their structural system have an impact on how much energy they consume (Ali & Armstrong, 2008).

With the increase of issues in high-rise building performance, green design principles began to be used in their construction. As a result, landscape in high-rise buildings has essentially evolved into an artificial ecosystem of the building's external and internal environment, which includes green roofs, sky gardens, podium parks, and greenery (Xue & Lau, 2013).



4.2 Landscaping Green High-Rise Buildings

The term "landscape" refers to a place whose character is the outcome of natural and/or human influences interacting (European Landscape Convention). Landscape, as defined by the Home Quality Mark, is "an area, as seen by people, whose visual features and character are of environmental, social, and economic value, usually as a result of the interaction and interaction of natural and human factors, such as aesthetic, heritage, landscape, cultural, and recreational value."

Landscaping is noticeably more than just planting shrubs and trees and cleaning the grass, it includes a number of operations such like masonry construction, retaining wall installation, driveway meshing, and other services that can improve appearance. It can also improve the property's value and usability (Abdel Maaqoud, 2010).

Landscape design could be used in a wide variety of fields, including parks and green spaces, sports arenas, and huge real estate developments such as residential projects, business complexes, universities, and hospital complexes, and others. It can also be used to renew or enhance places like abandoned field sites or contaminated sites (Arcitects, 2005).

Since towering landscapes are still new to the design and development sectors, they lack a lot of crucial financial study and analysis. However, a research from the General Services Administration (GSA) identifies many costs associated with dense building greenery, such as green roofs. The appeal of towering landscapes among design professionals will lead to more local, region, and national restrictions. After it has expanded into



more than merely vertical gardens, the towering landscape has the ability to change the entire cityscape (Ismat & Abdel Qader, 2006).

While some are suspicious about the buildings' feasibility and the maintenance work required, the benefits that these structures can give if they are effective cannot be overlooked. These benefits include filtering sunlight and absorbing dust in the air. "Live plants help humidify interior air, minimize rainfall runoff and the urban heat island effect, and assist insulate the structure," explains Fehrenbacher. " All of these trees and plants will be beneficial to the building's occupants, neighbors and the local environment." (Jasim, 2020).

5- Methodology

The quantitative analytical approach is used for this research study in order to achieve the study's goals and objectives. The functional, technical, and social performance of landscapes in green tall buildings was assessed using a post-occupancy evaluation technique. Based on the three dimensions, an assessment tool is constructed (functional, technical and social). Indicators for social performance will be assessed through interviews with users, while job performance will be assessed through observing the selected buildings. Lastly, technical performance will be evaluated through interviews with specialists (Creswell, 2008).

The Study population consists of the residents of high-rise green buildings with landscape in the city of Doha. The data will be divided into three parts: workers, public visitors, and residents of the site or students. A questionnaire will be used to collect primary data and test the study



hypotheses in order to evaluate Post-occupation of high-rise green building landscapes in Doha.

A random sample of (300) individuals from residents, students, visitors, and workers in three of these green buildings was selected in terms of cost and time consumption, and electronically designed questionnaires were distributed online via google forms for the target sample. The questionnaire mainly consisted of three axes; the first one is related to measuring the effects of landscapes on functional performance of high-rise buildings in Doha. The second is related to measuring the effects of landscapes on technical performance of high-rise buildings in Doha, while the last part of the questionnaire is associated to the effects of landscapes on social performance of high-rise buildings in Doha.

6- Research Analysis

After the questionnaires were distributed and filled out by the 300 randomly selected respondents, a descriptive statistical analysis was performed by SPSS program to determine the social and demographic characteristics of the sample members.

6.1 Demographic Characteristics Analysis

According to the descriptive statistics of the study sample's socio-demographic characteristics, the study participants were divided almost evenly between males (53.3%) and females (46.7%). This percentage indicates that the sample is representative of society and that it considers the perspectives of both males and females in Doha. The study participants' characteristics are shown in Table (1) below.

Table 1. Descriptive Statistics of Respondents

Variable	Categories	Frequency	Percentages
Gender	Male	160	53.3%
	Female	140	46.7%
Age	20-30 years	74	24.7%
	31-40 years	157	52.3%
	41-50 years	59	19.7%
	More than 50 years	10	3.3%
Qualifications	Diploma	99	33.0%
	Bachelor's degree	181	60.3%
	Master's degree	20	6.7%
Position	Occupant (resident)	120	40.0%
	Construction worker	74	24.7%
	Architect	59	19.7%
	Architecture student	30	10.0%
	Visitor	17	5.7%
Years of experience	Less than 1 year	80	26.7%
	1-5 years	150	50.0%
	6-10 years	40	13.3%
	More than 10 years	30	10.0%
Actual hours of work	Full-time	178	59.3%
	Part-time	94	31.3%
	Casual	28	9.3%
Overall		300	100%

Furthermore, as can be seen in table (1), the age category 31-40 years old had the highest percentage of participants (52.3%), followed by (24.7%) participants aged 20-30 years old, and (19.7%) participants aged 41-50 years old. However, the age category more than 50 years old had the lowest percentage of participants (3.3%) in this study. This means that this sample includes people of various ages, from the advanced age group who have experience with the concept of sustainability and green buildings in the



architecture and construction sector, to the ambitious age group, who are under fifty years old and have a desire to succeed in the construction sector.

It is notable that the great majority of survey participants (60.3%) have a bachelor's degree, while 33% have a diploma, and only 6.7 percent have a master's degree. This can also be explained by the fact that green buildings that meet sustainability standards and contribute to improving functional, technical, and social functions stir up the interest of people from all backgrounds regardless of their scientific qualifications.

In terms of job title, the participants in this survey had a wide range of occupations, but the majority (40%) are residents of high-rise buildings, followed by construction workers (24.7%), architects (19.7%), architecture students (10%), and visitors (5.7%). Lastly, when it comes to years of experience, the majority of participants (50%) have 1-5 years of experience, followed by those with less than 1 year of experience (26.7%), then those with 6-10 years of experience (13.3%), and finally down to those who have less than 10 years of experience (10 %). This indicates that the study sample consists of individuals with diverse backgrounds, giving the impression that they have extensive knowledge in the field of stud.

6.2 Descriptive Data Analysis Results

The descriptive statistics (means and standard deviation) of the responses and their ranks, which were elicited using a five-point Likert scale, were calculated via SPSS program in order to descriptively identify the landscaping effectiveness of high-rise green buildings in the post-occupancy period in terms of functional, technical, and social performance.

6.2.1. The effects of landscapes on functional performance of high-rise buildings in Doha

The descriptive analysis of the collected data in this section focuses on investigating the landscaping effectiveness of high-rise green buildings in terms of functional performance in the post-occupancy. To assess this effect, a descriptive summary (means and standard deviation) of the responses to the variable items was calculated, as shown in Table (2).

Table 2. Descriptive summary for the impact of landscapes on functional performance of high-rise buildings in Doha.

No.	Statement	Mean	Std. Deviation	Rank	Level
1	Landscaping of high-rise green buildings helps reduce glare and temperature for people inside the building.	4.08	0.88	3	High
2	Landscapes of high-rise buildings affects adequacy and quality of artificial lighting levels in all spaces	3.96	0.99	15	High
3	Landscapes of high-rise green buildings affects the health, well-being, and productivity level of its occupants	3.98	0.87	13	High
4	Landscapes of high-rise green buildings affects the performance of tasks and productivity of building occupants	3.93	0.96	17	High
5	Landscapes of high-rise buildings can affect feeling of safety and creates positive motivation.	4.04	0.83	7	High
6	Landscapes of high-rise buildings and natural ventilation system through windows and other openings increase the functional performance of building	3.99	0.96	12	High



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7	Strategic landscape design of high-rise green buildings can help enrich the appearance and value of the property	4.07	0.89	4	High
8	landscape of high-rise buildings reduces problems that hamper efficiency and production in workplaces and living environments	4.00	0.93	10	High
9	The landscape of high-rise green buildings achieves optimum audio performance and a safe and sound environment.	4.05	0.83	6	High
10	The landscape of high-rise green buildings achieves natural lighting and visual comfort	4.06	0.88	5	High
11	Landscape of high-rise green buildings provide the infrastructure necessary to carry out activities according to the type of activities performed inside the building	3.95	0.93	16	High
12	A landscape of high-rise green buildings helps improve ventilation (same with Q8)	4.03	0.87	8	High
13	Landscape of high-rise green buildings provide thermal comfort.	4.10	0.86	1	High
14	A landscape of high-rise green buildings provides access to essential facilities.	4.09	0.86	2	High
15	Strategic landscape design helps provide screening for privacy and buffer in high-rise green buildings.	3.99	0.92	11	High
16	landscape could reduce the usage supplementary of cooling agent like air-conditioner in high-rise green buildings	4.02	0.94	9	High
17	Landscape of high-rise green buildings helps to conserve energy and water.	3.97	0.95	14	High
Overall		4.02	0.89	High	



It can be noticed from Table (2) above that the arithmetic means that measure the impact of landscapes on functional performance of high-rise buildings in Doha are high and ranging from (4.08-4.10). Entry (13) which states that: "Landscape of high-rise green buildings provide thermal comfort", represents the highest agreed mean statement (4.10). It was followed by entry (14) in which it stated that: "A landscape of high-rise green buildings provides access to essential facilities" with a mean (4.09). Thirdly, entry (1) in which it stated that: "Landscaping of high-rise green buildings helps reduce glare and temperature for people inside the building" with a mean (4.08).

This indicates agreement on the effectiveness of landscaping of green high-rise buildings in the post-occupancy period in terms of functionality, in terms of reducing glare and temperature for people inside the building. Also, increases health, well-being and productivity for occupants, improves task performance and occupant productivity, and affect the sense of safety and create a positive motivation. These results are in agreement with the studies of Harmon and Truby (2019) as well as Begec and Hamidabad (2015), where they pointed out the importance of the landscape and the great role in improving the functionality of the buildings.

6.2.2. The effects of landscapes on technical performance of high-rise buildings in Doha

The descriptive analysis of the collected data in this section focuses on determining the landscaping effectiveness of high-rise green buildings in terms of technical performance in the post-occupancy. To assess this



influence, we computed a descriptive summary (means and standard deviation) of the responses to the variable items, as shown in Table (3).

Table 2. Descriptive summary for the impact of landscapes on technical performance of high-rise buildings in Doha

N o.	Statement	Mean	Std. Deviation	Rank	Level
1	The focus on landscape design and operation of high-rise green buildings plays a large and important role in reducing global warming.	4.08	0.83	3	High
2	The focus on landscape design and operation of high-rise green buildings impacts the health of individuals and communities.	3.98	0.95	14	High
3	Strategic landscape design of high-rise green buildings may help improve a building's energy efficiency, reduce costs and need for additional systems.	3.95	1.00	17	High
4	Landscape design is ideally part of the broader design process, allowing for interaction between building orientation, building design, site conditions and proposed landscape development.	3.93	0.96	18	High
5	Landscaping provides many important green services for the building including water efficiency	3.98	0.87	13	High
6	landscape of high-rise green buildings in dealing with sanitary facilities helps achieve the sustainable water recycling of buildings and individual	4.07	0.88	4	High
7	Building defects are identified, design and construction standards are formulated, and performance measures are supported for asset and facility management, and building	3.97	0.99	15	High



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	lifecycle costs are reduced by identifying design errors.				
8	Landscape helps to continuously improve the quality and performance of facilities.	3.99	0.87	11	High
9	Building performance evaluation helps to ascertain if organizations are managing existing building stock responsibly.	3.92	0.96	19	High
10	Adequacy of opening design (doors and windows) is good	4.04	0.83	7	High
11	Overall quality of building layout is good	3.99	0.96	12	High
12	There is adequacy of horizontal circulation routes in the building	4.05	0.89	6	High
13	There are adequacy vertical circulation routes within the building	4.00	0.93	10	High
14	Noise control can be provided through walls, floors, windows, and doors that provide adequate reduction of sound from adjacent activities	4.04	0.83	8	High
15	The application of landscape is pertinent, effective, and successful in determining the users' satisfaction level and providing recommendations for improving building performance.	4.06	0.88	5	High
16	landscape plays a vital role in the strategic planning of building management	3.96	0.93	16	High
17	Landscape of high-rise green buildings help to reduce the negative impact on the natural environment, reduce the consumption of non-renewable resources, and reduce the use of environmentally harmful materials.	4.04	0.87	9	High



18	A landscape of high-rise green buildings helps manage materials, resources and waste management.	4.10	0.86	1	High
19	Landscape of high-rise green buildings may improve the storm water management.	4.09	0.86	2	High
Overall		4.01	0.88		High

It can be noticed from Table (3) above that the arithmetic means that measure the impact of landscapes on technical performance of high-rise buildings in Doha are high and ranging from (4.08-4.10). It can be noticed that item (18), which states that: "A landscape of high-rise green buildings helps manage materials, resources and waste management", represents the highest agreed mean statement (4.10). It was followed by item (19) in which it stated that: "Landscape of high-rise green buildings may improve the storm water management" with a mean (4.09). Thirdly, item (1) in which it stated that: "The focus on landscape design and operation of high-rise green buildings plays a large and important role in reducing global warming" with a mean (4.08).

This shows that there is a high agreement on the effectiveness of the landscape of green high-rise buildings in the post-occupancy period in terms of technical performance, in terms of contributing to improving the energy efficiency of the building, reducing costs and the need for additional systems. As well as improving the efficiency of water use and sanitation in the building, managing natural resources, managing rainwater and waste, and other matters related to achieving safety, security and health for its occupants. Consequently, these results are in agreement with (Hussain et al., 2014; Jasim, 2020; Begec & Hamidabad, 2015) studies, where they



indicated the importance of landscapes and their great role in improving the technical performance of buildings.

6.2.3. The effects of landscapes on social performance of high-rise buildings in Doha

The descriptive analysis of the collected data in this section focuses on determining the landscaping effectiveness of high-rise green buildings in terms of social performance in the post-occupancy period. Therefore, in order to assess this impact, we computed a descriptive summary (means and standard deviation) of the responses to the variable items, as shown in Table (4).

Table 4. Descriptive summary for the impact of landscapes on social performance of high-rise buildings in Doha

No.	Statement	Mean	Std. Deviation	Rank	Level
1	The landscape of high-rise green buildings really brings convenience to the workers inside the building	3.99	0.92	11	High
2	Landscapes affect people's feelings, so they become more positive and motivated	4.03	0.94	6	High
3	Landscaping provides many important green services for the building, as it may provide recreational opportunities for individuals.	3.97	0.94	13	High
4	Strategic landscape design can help prevent widespread heat gain in buildings and produce a healthy, natural environment for the surroundings.	4.07	0.83	2	High
5	Landscape may increase the value of your property by adding a real green component to the building.	3.98	0.95	12	High



6	landscape added to the high-rise green buildings and the surrounding site are visually persuasive to me in representing the green icon of the building	3.95	1.00	15	High
7	Functional divisions, spaces, and environmental conditions of the landscape of high-rise green buildings affect the behavior of people within the building	3.92	0.98	16	High
8	Landscape of high-rise green buildings helps create a connection between the occupants' activities and the physical environment within the building.	4.01	0.92	9	High
9	landscape affects the size and number of persons that share it upon a building's occupant	4.05	0.88	4	High
10	Spatial attributes, the sequence, location, relationships, shape, size, and detail of spaces affect occupant behavior	4.03	0.96	7	High
11	The layout of space, furniture, and storage and the convenient circulation and accessibility to various usable spaces within a building affect occupant behavior	4.06	0.85	3	High
12	The exposure of individuals to sunlight and natural air in buildings designed as green or environmentally friendly buildings, increases their productivity and maintains their health	3.96	0.99	14	High
13	Office workers could be more productive, and students' academic achievement would go up if the buildings they were in were environmentally friendly and sustainable	4.08	0.87	1	High
14	Strategic landscape design can help produce a natural and healthy	4.00	0.93	10	High



	atmosphere for employees and thus increase their productivity.				
15	Strategic landscape design of high-rise green buildings may help provide privacy for employees	4.04	0.88	5	High
16	landscape helps control the behavior of building users by emphasizing the positive interactions between the user and the building	3.91	0.95	18	High
17	Landscape of high-rise green buildings can be used as natural retreats for the building users.	3.93	1.00	17	High
18	Green roofs indirectly help mitigate air pollution problems in the building and thus improving the health of people inside.	4.02	0.94	8	High
Overall		4.00	0.91	High	

It is noticeable from Table (4) above that the arithmetic means that measure the impact of landscapes on social performance of high-rise buildings in Doha are high and ranging from (4.06-4.08). Item (13), which states that: "Office workers could be more productive, and students' academic achievement would go up if the buildings they were in were environmentally friendly and sustainable", represents the highest agreed mean statement (4.08). It was followed by item (4) secondly in which it stated that: "Strategic landscape design can help prevent widespread heat gain in buildings and produce a healthy, natural environment for the surroundings" with a mean (4.07). Lastly, item (11) in which it stated that: "The layout of space, furniture, and storage and the convenient circulation and accessibility to various usable spaces within a building affect occupant behavior" with a mean (4.06).



These results are consistent with what was indicated by (Moor & Erysheva, 2018; Alzubaidi, 2013) studies, where they emphasized the importance of landscaping and its great role in improving the social performance of buildings.

6.3 Hypothesis testing

This section focuses on putting the study's theories about the impact of high-rise green building landscapes on their functional, technical, and social performance to the test. As a result, Pearson correlation and multiple linear regression analysis were used to test the existence and significance of relationships (hypotheses) between the independent variable (high-rise green building landscapes) and the dependent variables (functional, technical, and social performance).

6.3.1 The Effect of landscapes of high-rise green buildings on functional performance

The model summary and overall fit statistics indicates that there is a statistically significant positive impact of landscapes on functional performance of high-rise buildings in Doha. This study is in agreement with a study by (Davis, 2007; Golasz-Szolomicka & Szolomicka, 2019; Moor & Erysheva, 2018) who found that the landscape has a positive impact on the artistic performance of high-rise buildings in Doha. They emphasized that landscapes contribute to improving the functional performance of buildings, which includes accessibility, spatial capacity of activities, adequacy of facilities, communications, response to additional change, communication efficiency, and air, temperature, and lightning circulation.



6.3.2. The Effect of landscapes of high-rise green buildings on technical performance

The model summary and overall fit statistics indicates that there is a statistically significant positive impact of landscapes on technical performance of high-rise buildings in Doha. This finding is in accordance with that of (Hussain et al., 2014; Jasim, 2020; Begec & Hamidabad, 2015), who found that landscaping has a positive impact on the technical performance of high-rise buildings in Doha, emphasizing that green building landscaping benefits a wide range of stakeholders in the construction industry, including building residents and the general public.

6.3.3. The Effect of landscapes of high-rise green buildings on social performance

The model summary and overall fit statistics indicates that there is a statistically significant positive impact of landscapes on social performance of high-rise buildings in Doha. This finding is in consistent with the findings of (Moor & Erysheva, 2018; Alzubaidi, 2013), who found that landscapes in green buildings contribute to providing psychological and visual comfort to residents, making them more positive and stimulating, and that the presence of landscapes contributes to creating a social connection between residents.



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7- Conclusion:

The goal of the study is to use post-occupancy evaluation methodologies to determine the effectiveness of landscaping in high-rise green buildings. Also to develop a complete questionnaire to measure the effects of landscapes on the functional, technical, and social performance of high-rise structures. The results of the study showed that there is an agreement on the effectiveness of the landscape of green high-rise buildings in the post-occupancy period in terms of social, functional, and technical performance of high-rise buildings.



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