The importance of studying human perception when designing high-rises and their surrounding environment: The case study of Amman city

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Bushra Zalloom
Associate Professor, Zarqa University, Jordan

She received her PhD on the social sustainability of the urban landscape from Birmingham University, UK. Bushra has been recognised in the field of architecture and has received awards nationally and internationally. She has created a novel methodology for humanising the city, and for assessing the impacts of new developments on social sustainability.

Technical Engineering Department, School of Architecture, Zarqa University, Jordan
E-mail: bzalloom@zu.edu.jo

Abstract In recent decades, the cityscape of Amman, the capital of Jordan, has been transformed, especially in terms of high-rise buildings, urban regeneration projects and shopping malls. This paper focuses on the design of high-rise buildings in Amman and explores how the areas surrounding the high-rises are designed and perceived by users. It tries to justify the reasons behind the rejection of these blocks by the citizens of Amman. It also discusses some of the outcomes of the high-density mixed-used (HDMU) strategy that was implemented by the Greater Amman Municipality (GAM) in 2008 to organise the high-rises' location and design. The paper proposes a set of design strategies for the outdoor spaces surrounding the high-rises to reduce their impact on the adjacent environment and make them more acceptable to the citizens, including strengthening the image of the landscape elements and weakening the visual effect of the buildings' mass. To achieve the research's aim, the paper describes how these masses emerged in Amman, followed by an analysis of the HDMU strategy's strength and weakness. It further discusses human recognition as a tool that helps in humanising the outdoor spaces surrounding the high-rises, and finally, it assesses the current status of the high-rises in Amman based on recognition factors.

Keywords: *high-rises, urban regeneration, HDMU strategy, human perception, outdoor spaces*

INTRODUCTION

Towers are not new elements in the Arab and Islamic world. The pyramids of Egypt, the Tower of Babylon, the minarets of mosques and the spires of churches are good witnesses to the spread of high-rises across cultures as a symbol of power and religious authority.[1] Some of the towers and high-rise buildings previously used for military or defensive purposes have a square shape called *Muraba'at* in Arabic, while others have a round shape called

Abraj.[2] Today, however, the towers have become landmarks for investment and symbols for real-estate development.

According to Amman's 1979 Building and Planning Regulations, the high-rise building is defined as a construction that exceeds four floors high from the road level, or from the lowest road level in the case of multiple roads.[3] Likewise, the 1999 modified draft of the regulations states that the high-rise building is a construction whose height exceeds the number of floors designated for the plot of land under the provisions of the Planning Regulation.[4]

OBJECTIVES

The paper aims to propose a range of design treatments for the outdoor spaces surrounding the high-rise buildings in Amman, in a way that respects the human scale and responses to the human senses; these treatments could help Jordanians to accept these huge and rigid blocks. This could be achieved by studying the main factors that affect the human recognition, and then assessing the current status of the high-rises in Amman based on the recognition factors to justify the reasons behind the rejection of these masses.

METHODOLOGY

The case study method has been used to achieve the research aims by assessing the design of the existing towers in Amman and their surrounding environment; this includes analysing the outcomes of the high-density mixed-used (HDMU) strategy and clarifying the shortcomings of the suggested treatments for the outdoor spaces, then proposing some design treatments based on studying the recognition factors to minimise the high-rise effects. The physical characteristics have been tested by conducting site visits and analysing the high-rise masses and the design of the outdoor spaces adjacent them.

This research has faced some limitations and constraints since the HDMU strategy is not implemented yet on any project in Amman. Therefore, it is the proper time to assess the strategy and overcome its shortcomings.

THE CITYSCAPE TRANSFORMATION OF AMMAN

Political and economic circumstances contributed to the spread of high-rises in Amman during the 20th century.[5,6] These blocks had emerged in the city since the beginning of the 1960s when the Arab Bank was established in the city centre, followed by the Insurance Company Building in the Jabal Amman district, where the height of these buildings reached 40m.[7] In the 1970s, the Housing Bank building in Al-Shmisani district was built with a pyramid design and a height reached 80m,[8] followed by Al-Burj tower in Jabal Amman district with a cylindrical shape and a height exceeding 90m.[9]

During the 1980s, Amman was affected by the Iraqi-Iranian war, and part of the business in the Arab region transferred to the city of Amman, which led to the growth of the city.[10] The first Gulf War in 1990 also contributed to the increase of the population by 20 per cent of the returnees from Kuwait,[11] followed by the second Gulf War in 1993, which was accompanied by the migration of a large number of Iraqis to the city.[12] The number of high-rise buildings increased during the 1990s, and their heights increased as the Zara commercial project was established in the Zahran district, the Sheraton Hotel on the Fifth Circle, the Regency Hotel near the Dakhiliyah roundabout and the Royal Hotel on the Third Circle (see Figure 1).[13] These buildings became visual attractions in the city.

Moreover, the economic aspect played an essential role in the spread of high-rise buildings during the so-called economic boom from 2004 to 2008. Investments flowed to the city of Amman, accompanied by some proposed developments, such as the Jordan-Gate twin towers project consisting of two towers with a height of 180m, which has been under construction since 2005.[14] Likewise, the Abdali regeneration project, which began in 2005 and is still under construction to date,[15] includes 20 towers, only ten of which had been constructed by the end of 2017.[16] Other proposed towers, such as Limitless Towers in Wadi Abdoun, have not been built because of the global economic crisis that affected the Arab region in 2008. The towers randomly spread through Amman and transformed the urban fabric. This transformation has caused many urban problems and has harmed the cityscape. Therefore, in 2008, the Greater Amman Municipality (GAM) launched the Amman Comprehensive Plan, known as 'Amman 2025'.

Amman 2025 includes various strategies; however, this paper focuses on the HDMU strategy that manages the construction of high-rise buildings, their location and their architectural design. According to HDMU, the high-rise building is any building that exceeds 30m or eight floors.[17] The construction of the high-rises is only allowed in three main zones (A, B, C) plus Abdali district (see Figure 2). Zone A is considered as the middle gate to Amman, zone B is the northern gate and zone C is the southern gate to the city. Moreover, the GAM has set out special requirements that show the height of the building, the permitted percentage of construction, and the setbacks.[18]

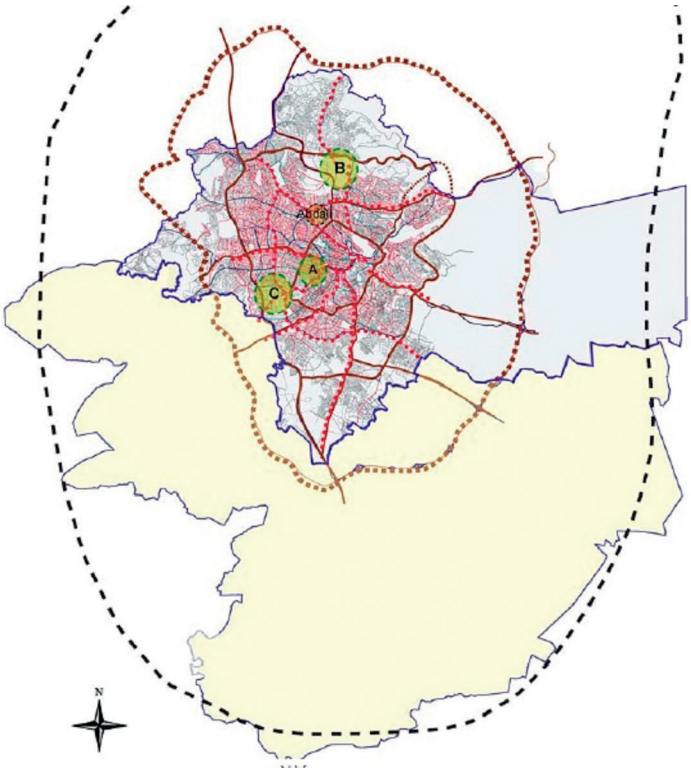


Figure 1: Areas of the HDMU

Source: GAM[19]

The location of the proposed sites for high-rise buildings is selected to be in the valleys instead of the mountains (see Figure 2); these sites have been chosen so that the high-rises have the least impact on the skyline of the city of Amman. Thus, the blocks respect the topography of the surrounding area and correspond to the mountainous nature of the city.

Moreover, Amman's HDMU strategy has encouraged the architects to design high-rise blocks that are taller and thinner rather than shorter and bigger, to reduce their visual impact on the surrounding environment (see Figure 3).[21]

The height of the high-rise buildings according to the HDMU is from 18m to 101m and more, and it is divided regarding the design into two main types:[23]

- *The first type*: The buildings with a height from 18m to 24m are designed as block only units that meet the ground directly without having base or platform (see Figure 4);
- *The second type*: The buildings with a height more than 24m and consists of a block constructed on a base or platform and known as block and base (see Figure 5).

According to the HDMU, the percentage of the open spaces around these buildings should not be less than 20 per cent of

A. The rejected proposal suggested the construction of the high-rise buildings on top of the mountain

B. The accepted proposal suggested the construction of the high-rise buildings in the valleys

Figure 2: Proposals representing the suggested sites for the high-rise buildings and their impact on the skyline

Source: GAM[20]

Figure 3: Designing the high-rise blocks that are taller and thinner rather than shorter and bigger

Source: GAM[22]

the land; this percentage is divided into the setbacks which must not be less than 12.5m each side.[26]

The construction of the high-rise buildings in Amman has become a reality that cannot be ignored, whether these blocks fit in the city fabric or are imposed by foreign real-estate developers. The real challenge facing the Jordanian architects during the design of the high-rises is how to respect the human aspects when dealing with those inhuman blocks. These huge masses ignore the human scale in a way that is hard to deny, sometimes causing fear or discomfort; consequently, it is difficult for Jordanians to accept these emerged blocks since they have not been part of their mental map. Therefore, understanding how people recognise these blocks will help architects to find design treatments for the building and its surrounding that meet the human needs and integrate positively with the mental image of the user.

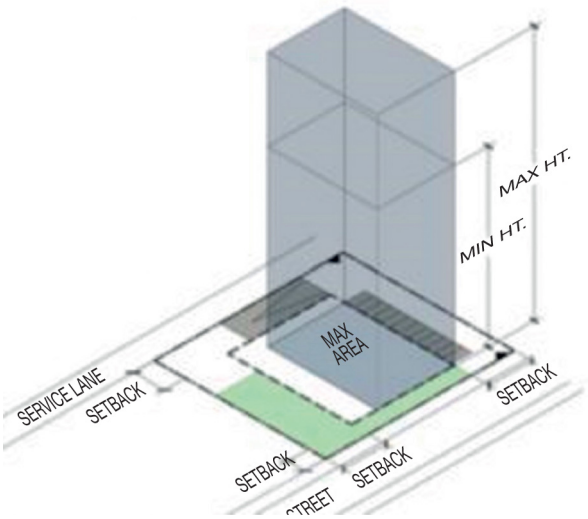


Figure 4: The first type of the high-rise building: block only

Source: GAM[24]

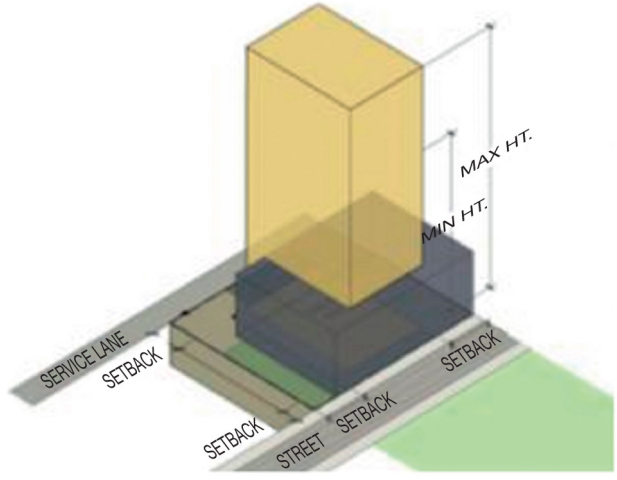


Figure 5: The second type of the high-rise building: block and base

Source: GAM[25]

HUMANISING THE OUTDOOR SPACES SURROUNDING THE HIGH-RISE BUILDINGS

This section studies the main factors that affect the human recognition to be used to minimise the impact of the high-rises on their surroundings; this could be achieved by humanising the outdoor spaces adjacent to the high-rises. Humanisation is a contemporary approach which aims at respecting the human senses that receive various influences from the built environment and studying their impact on the individual's behavioural pattern, so that users become the core of the design process.[27,28] Studying the sensory perception is essential in creating a humanised environment that surrounds the high-rises to minimise their effects.

The human cognition is defined by the Egyptian architect Ahmad Ouf as a process whereby tangible physical effects that are perceived by the five senses turn into a mental process.[29] This process goes through different stages; the most important stages are general observation, followed by formation of the mental

image, then understanding the general form, after that generating feeling towards those effects, and finally the reaction to them.[30] The physical effects are tangible ones that require the use of the five senses, and through these senses we can recognise the shape, colour, light, texture, tone of voice, taste, time, movement and aesthetic aspects.[31,32] The mental image, meanings, perceptions and reactions change according to the physical effects of the site, therefore our perception of the environment varies by these influences.[33]

The human mind receives information in a composite way, where the functions of the senses are integrated to form the appropriate mental image.[34,35] Therefore, the architect should take advantage of this fact when designing the spaces surrounding the high-rise buildings by strengthening the mental image for the users of that space. As a result, when the designer has mastered the use of the sensory system, he will be able to create a strong sense of place.

Ibrahim Al-Feki asserts that our perception of the surrounding environment is mostly visual.[36] Accordingly, the designer has to give attention to the visual elements of the high-rise building and its surrounding, and should improve the integration of these elements, thus reducing the impact of the huge masses. Exposure, form, meaning and structure are four essential factors that strengthen the human recognition in general.[37] By studying and understanding these factors, architects can reduce the impact of the huge constructions on the user's behaviour, while strengthen the impact of the spaces surrounding these masses to reach the desired image. The following subdivisions briefly explain how these four factors affected the design of the Jordanian high-rises and their surroundings, including the most recognised high-rises in Amman's cityscape: the Rotana, the Abdali Towers, the Jordan-Gate, the Royal Hotel and the Housing Bank.

The exposure

The more exposure is the element to viewers, the more precise the mental map is, and the more people can perceive the image on the public space.[38] Accordingly, architects should reduce the exposure of the high-rise's mass to mitigate its effect on the urban environment and thus reduce its impact on the mental image of the citizen. In contrast, architects should intensify the use of the green masses and the vast water elements to maximise the impact of the surrounding areas. Figure 6 shows how the exposure of the high-rise building decreased by using the green masses. It is also necessary to emphasise the exposure of the main entrances of the tower and increase its span, which positively affects the behaviour of users, where previous studies have confirmed that the clarity of the entrances and wide spans create a kind of psychological comfort for users and directs their behaviour.[39]

Figure 6: The use of green masses to decrease the exposure of high-rises

Source: Author

The formation

The form must be stable, clear, simple and balanced to strengthen its effects on the mental image of the users, as imbalanced situations may be attractive for a while but do not leave a real meaning.[40] Therefore, it is proposed to design huge, large-sized sculptures or monuments that mediate the outdoor space enclosed by a group of high-rise buildings to attract users and thus reduce the impact of the high-rise constructions. Figure 7 shows a huge sculpture called the clock tower located at a major roundabout in Dubai. The sculpture's form and design are simple and stable, thus attracting the viewer more than the surrounding high-rises.

Meaning

Elements with meaning are attached to the mind and have a strong impact on users.[41] Therefore, it is necessary to give meaning or identity to a high-rise and its surrounding, so that it becomes a distinctive landmark in harmony with the nature and architecture of the area, which makes it easier to be recognised and accepted.[42] Burj al Arab in Dubai, built on an artificial island, has the shape of a sail that relates to the shore environment (see Figure 8); this shape gives a strong meaning to the building.

Likewise, Jordan has its own identity and character. Therefore, architects must be innovative in designing the high-rises of Amman and their surrounding landscape elements, including the sculptures, landmarks and water elements that are distinguished regarding form, function and meaning. The components of the outdoor space should also constitute a unique visual sight in design and colours. The citizens must understand and accept the design before it becomes meaningful to them.

The composition

The human mind tends to simplify perceptions, and therefore the most successful mental elements regarding the composition are the easiest to understand.[43,44] The elements of the design and its components must be simplified and linked to each other in a streamlined

Figure 7: The stable formation of the clock tower sculpture

Source: Author

Figure 8: Burj al Arab in Dubai has the shape of a sail

Source: Author

manner that guides the movement of the users, fulfils their desires and gives them a vibrant space.[45] Moreover, our perception of the resulting composition and our sense of direction vary according to the influences surrounding us, such as the movement of people at night and day, the sound effects or the distribution of lighting.[46] The type of light and its intensity leads to a different visual condition, which affects the appearance and shape of visual elements.[47] Figure 9 shows the influence of lighting at the Royal Hotel in Amman.

ASSESSING THE CURRENT STATUS OF AMMAN'S HIGH-RISES IN THE CONTEXT OF RECOGNITION FACTORS

This section aims to evaluate the existing designs for the high-rises in Amman by applying the recognition factors of composition, meaning, form and exposure. The following table highlights in brief the implementation of these factors on the most recognised high-rises in Amman; the mentioned high-rises are selected because all of them are planted at the heart of Amman and built before initiating the HDMU strategy, they are all considered as landmarks in Amman during a specific period of time, and they have all harmed the city identity and affected its skyline (see Figure 10). It is worth mentioning that HDMU strategy is not implemented on any tower in Amman yet. Table 1 shows the analyses of the current status of Amman's high-rises based on the recognition factors.

It is clear that the design of the high-rises and their surroundings, in general, increases the impact of the building block rather than the landscape elements. Only in some cases, such as the Housing Bank at Shmisani district, the planted terraces and the pyramid form for the building decrease its impact on the surrounding areas — unlike the Rotana Tower across the street, where the huge cylindrical block landed on ground directly without having any base or podium and where the landscape adjacent to the building is minimal, thus increases the block's impact.

Figure 9: The influence of lighting at the Royal Hotel in Amman

Source: Author

DISCUSSION AND RECOMMENDATIONS

Although the HDMU strategy is a strong base to control the high-rises' distribution and to preserve the urban fabric of the city, it has some shortcomings. The comprehensive design should not be limited to studying the location of the high-rises, their height, function and the infrastructure needed, which forms the initiative of the GAM's plan; instead, it should extend to include the study of the impacts of these high-rises on their surroundings and the citizens' acceptance of them. This could be achieved by activating community participation during the planning and design stages, where the designer must take into account the needs of the community, then work to

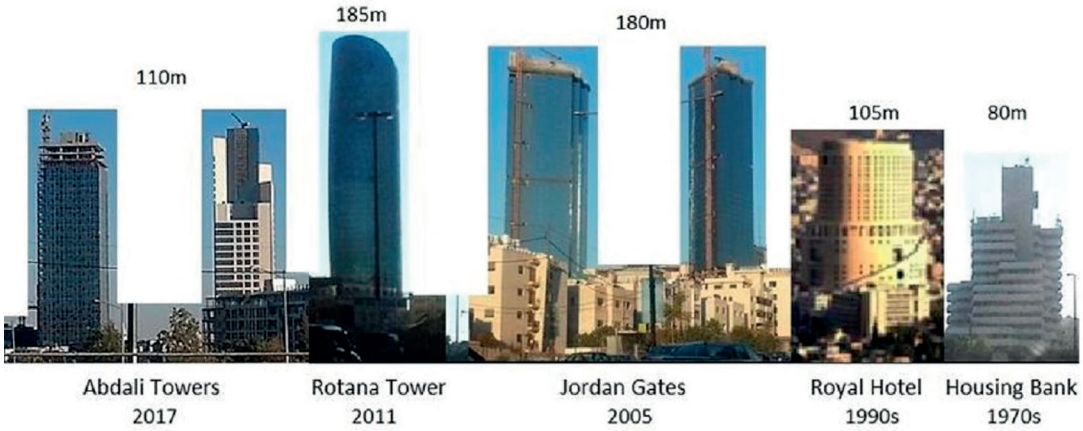
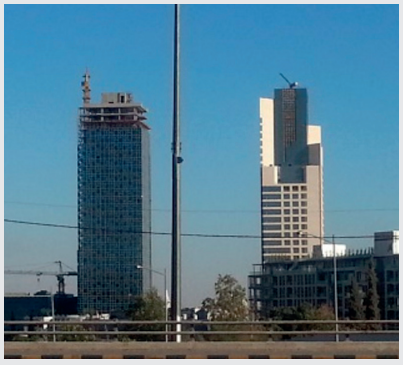


Figure 10: The current status of Amman's high-rises

Source: Author

Table 1: The current status of Amman's high-rises based on the recognition factors

High-rise	Composition	Meaning	Form	Exposure
Abdali Towers Opened in 2017. Located at Abdali Project which has special regulations	The building composition is simple. It reflects the international style. The use of local stone in large parts of the façade give it a distinctive identity.	Imposed on the region Motivated by real estate development. The project caused the displacement of indigenous people.	Rectangular blocks cladded with local stone and glass to reflect the city architecture than the international style	The proportions of the building are visually acceptable, and it is visible from a major road, thus it is recognised by the citizens. The surrounding space is not well designed, however, and lacks green areas, therefore, the impact of the tower is very high.
				

High-rise	Composition	Meaning	Form	Exposure
The Rotana Tower Opened in 2011. Located at Abdali Project has special regulations	The project composition is simple and easy to understand. The project reflects the international style	Does not have a positive meaning since it is imposed on Amman and caused the displacement of the indigenous people.	A huge cylindrical block covered with glass and built directly on ground without having a base Therefore, the impact of the building on the surrounding environment is great	The proportions of the building are visually acceptable, and visible by a major road, thus it is recognised by the citizens. The surrounding space is not well designed, however, and lacks green areas, therefore, the impact of the tower is very high.
				
The Jordan Gate Towers Built in 2005	The project composition is simple and easy to understand. The project reflects the international style	It is negatively perceived by locals because it caused the displacement of a residential park	The project comprises two slim glass-elevation towers, rising above a multi-story stone podium. This design minimises the effect of the building block.	The building and its surrounding lacks green masses and landscape elements. The towers are located at the heart of the urban environment.
				

High-rise	Composition	Meaning	Form	Exposure
The Royal Tower Built during the 1990s	The building composition is not simple, it has a huge base and bulk blocks. Lighting was distributed on the massive stone building to reduce the impact of the tower on the surrounding environment.	The local stone is used to reflect the city identity	A huge cylinder cladded with stone. The base reduces the impact of the huge mass of the building.	The exposure of the building is open as it is built on a hilltop; however, the landscape of the surrounding area and the greenery masses reduce this impact.
				
The Housing Bank Built during the 1970s	The building composition is simple. It has a pyramidal shape, with planted terraces that decreases the effect of the high-rise building.	It has a positive effect on the locals' mental map because it serves the middle class and has various facilities such as shops, restaurants, cafes and banks.	The pyramidal form minimises the impact of the building on its surroundings	The building is visible from a major road and recognised by the citizens
				

meet those needs, which make it easier for them to accept the emerged masses.

Analysing the main outcomes of the HDMU strategy and the proposed designs for the spaces surrounding the high-rise buildings confirms that the planners did not observe the specificity of the design for each type (see Figure 11). The proposed setbacks of 12.5 each side of the tower may suit the first type of high-rise, which consists of a building block not exceeding 24m height. This distance, however, does not suit the second type of high-rise, which contains the block and its base and may reach a total height of 101m and above.

In the second type, the area between buildings is not big enough to contain large numbers of users and to receive sufficient amounts of sunlight; moreover, the narrow space sometimes produces wind tunnels between the towers where the users do not feel comfortable. Therefore, to achieve a sufficient design, each type of high-rise building must be considered and given specificity when designing the surrounding spaces, such as increasing the setbacks between the high-rise buildings to suit the overall height and increasing the percentage of green areas to become more than 20 per cent of the land. These spaces should be designed to be liveable, comfortable and represent a gradual transition from public boundaries to private properties, through designing open squares and pedestrian walkways, distributing the lighting elements, furniture, shelters and trees.

It is clear that Amman is going through a transitional phase of architecture. The study confirms that the architect can create liveable spaces surrounding the high-rise buildings if the design includes various elements that are distributed in a manner that helps in forming a sharp mental image for the users of that space. The study shows that high-rises, as a contemporary component that emerged in the city,

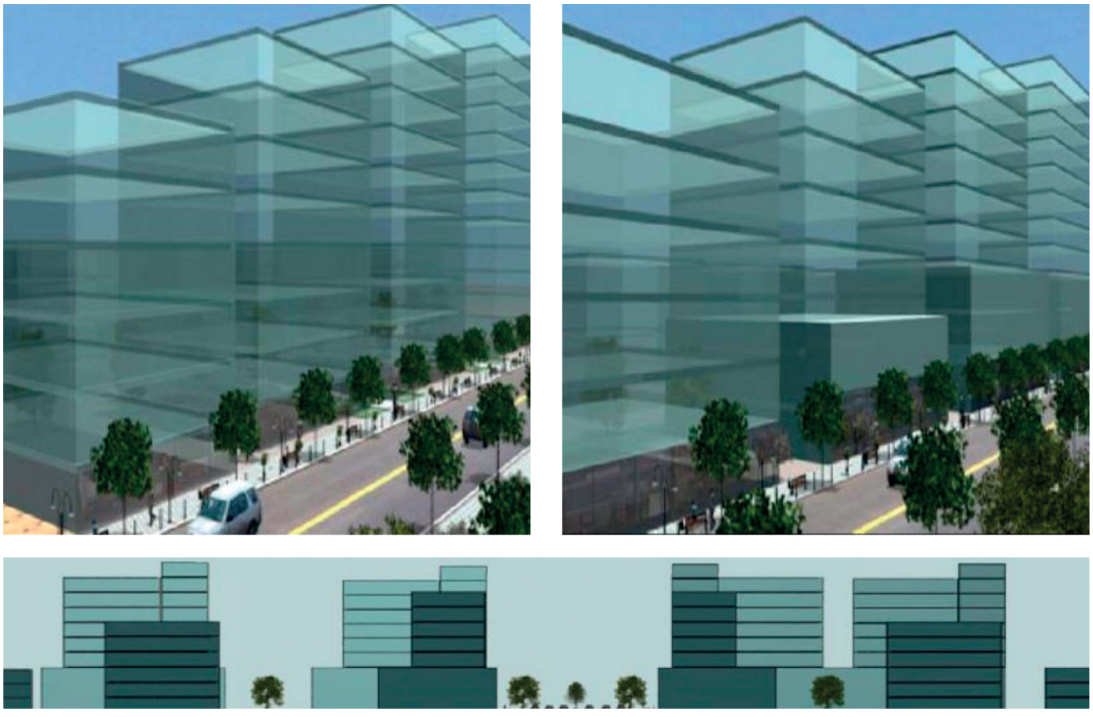


Figure 11: The proposed treatments of high-rise buildings according to the HDMU strategy

Source: Al-Fiqi[48]

will be accepted by the locals of Amman gradually in time. Therefore, the study proposed various treatments to reduce the impact of the high-rise buildings on the surrounding environment, considering that the establishment of high-rise buildings in a vacant area and outside the boundaries of the urban area is different from planting them at the heart of the city centre, which is characterised by its historical pigment and human architecture. Accordingly, the following aspects must be taken into consideration when designing the high-rise building and its surrounding environment:

1. Connecting the high-rise buildings with the existing low-rise buildings of four floors by studying the architectural façades of the high-rises and linking them with the existing fabric of the city, while trying to narrow the gap between them in height, materials and formation. Here, it is necessary to study the outdoor spaces that connect these buildings;
2. The formation of a strong base podium bearing the tower block, so that the height of the base is not more than 20m and is designed in an attractive manner that gives pleasure to the urban environment;
3. Studying the architectural organisation of the space surrounding the high-rise buildings, which helps the user to accept the idea of the high-rise building through its visual diversity, in terms of colour, shape, size and texture. This can be considered as one of the most important aspects that combine the study of urban fabric and affect the human behaviour at the same time;
4. Emphasising the importance of community participation and involving residents during the different design stages of the high-rise buildings and their surrounding areas;
5. Strengthening the impact of the landscape elements surrounding the building to reach a desirable image accepted by the users. This could be achieved by studying the four factors of exposure, formation, meaning and composition;
6. Using the design solutions that reduce the sharpness of the huge masses, such as plantation in a gradual way in front of them, either through the gradient in the blocks and sizes, or through the planted terraces in front of the blocks, or planting the roofs of the high-rises, or planting the façades of the huge blocks;
7. Studying the outdoor spaces surrounding the high-rises and focusing on how to distribute plants, pavements, public squares and water elements in a way that creates a balance between the soft and hard landscape. For the first time, the residents of the high-rises can perceive the plan of the outdoor areas from high elevations and the users can sense the aesthetics of the site plan;
8. Designing huge sculptures or large structural elements near the high-rise buildings to represent distinctive signs that attract attention and at the same time weaken the control of high-rises on the urban environment;
9. Studying the movement of pedestrians in these spaces to create a network of walkways that provide a sensory experience;
10. Studying the environmental impacts of the high-rises, such as, the movement of wind and the shadows of those buildings, so that those spaces confined between the high-rise buildings become liveable.

There are other cities in the region that presented a successful example in designing outdoor spaces surrounding high-rise buildings, such as Dubai and

Figure 12: The urban design elements surrounding the Marina high-rises of Dubai

Source: Author

Abu Dhabi in the United Arab Emirates. These cities link together many points that are mentioned above in the proposed list when designing the outdoor spaces near these high-rises, such as the Dubai Marine Project, which was built by Eamar real-estate developer in 2005. Figure 12 shows some urban design elements in the surrounding area at the Dubai Marina, including the formation of the podium bearing the tower block, the planting of terraces to minimise the visual effect of the podium, the palm plantation in front of the facades, the design of an attractive urban environment surrounding the high-rise buildings, the huge water feature at the centre of the main plaza and the wide pavements; all these elements highlight the landscape elements and reduce the effect of the high-rises, thus helping the user to admire the high-rise buildings in the context of a visually diverse environment.

This study confirms the importance of researching human perception when designing high-rises and their surrounding environment. Taking into account the ten previously proposed factors to consider helps to create humanised outdoor spaces which weaken the impact of high-rises and improve the perception of the urban environment. Improved urban design spaces can be achieved by studying the form, composition, meaning, visibility and perception of buildings and their surroundings. This study opens the door for future research to explore in detail the criteria for designing high-rises and their surroundings in a way that considers the users of the spaces and their culture.

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47. *Ibid*., note 28.
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