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Article

Transit-Oriented Development and Livability: The Case of the Najma and Al Mansoura Neighborhoods in Doha, Qatar

Almaha Al-Malki¹, Reem Awwaad¹, Raffaello Furlan^{1,*}, Michael Grosvald², and Rashid Al-Matwi¹

¹ Department of Architecture and Urban Planning, Qatar University, Qatar

² Department of English Literature and Linguistics, Qatar University, Qatar

* Corresponding author (rfurlan@qu.edu.qa)

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Abstract

Since the 1970s, Qatar's rapid urban growth has resulted in a segregated and poorly connected urban form, particularly in the country's capital, Doha. Although the recent opening of the Doha Metro has begun to mitigate some of the city's challenges, local authorities recognize the need for a more comprehensive urban design which can ensure safe and convenient connectivity with the public transportation system. To this end, the government has developed the Qatar National Development Framework, an action plan for the management of Qatar's urban development. One of its aims is to integrate the Doha Metro with the urban fabric of the city and to ensure that urban growth follows the principles of transit-oriented development, referring to a pattern of development centered on transit hubs supporting a mix of land uses in a well-connected and safe urban environment. This research article attempts to assess the effects of transit-oriented development on livability in mixed-use neighborhoods. The area around the Al Mansoura metro station within the Najma and Al Mansoura neighborhoods is selected as a case study. This analysis of urban form uses integrated modification methodology and focuses on three main determinants: compactness, complexity, and connectivity. Based on this analysis, several recommendations are made, whose implementation should enhance livability throughout the study area.

Keywords

Al Mansoura; livability; Najma; sustainable urbanism; transit-oriented development; urban design

Issue

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1. Introduction

Beginning at the turn of the 21st century, a construction boom in the State of Qatar has transformed the capital city, Doha, into a modern, global city. This rapid urbanization has necessitated the implementation of a physical planning process to guide the development (Salama & Wiedmann, 2016). This planning process has been largely centered around urban policies based on a 1970s master plan (Azzali & Tomba, 2018), but the government has recently developed a new Qatar National Master Plan 2032 and a Qatar National Development Framework. These aim to control the planning and management of

urban growth for the upcoming two decades by building communities which are strong, sustainable, and livable. These plans include the improvement of public transport (PT) in the country, including the development of the Doha Metro, which began operation in 2019.

One of the aims of the Qatar National Development Framework is to integrate the Doha Metro project with the urban fabric of the city via the implementation of transit-oriented development (TOD). TOD is an approach to urban development in which transit hubs like metro stations are surrounded by a mix of land uses within a well-connected and safe environment. The analysis of the effects of TOD on the degree of livability in mixed-use

neighborhoods can aid the development of effective urban design frameworks. In the present case, the existing mixed-use neighborhoods in Doha lack a clear urban hierarchy which would help revitalize many areas of the city and make them more livable. The neighborhoods of Najma and Al Mansoura have been selected for investigation in this article as they exhibit features making them suitable for TOD implementation. Each neighborhood has a high population and urban density and is located in the central zone of Doha within the B and C Ring Roads; this is a busy area with a variety of activities being performed at any given time. The location of this area within Doha is shown in Figure 1. The framework proposed in this article can be used as a guide for promoting livability in Najma and Al Mansoura, as well as in other neighborhoods with similar characteristics.

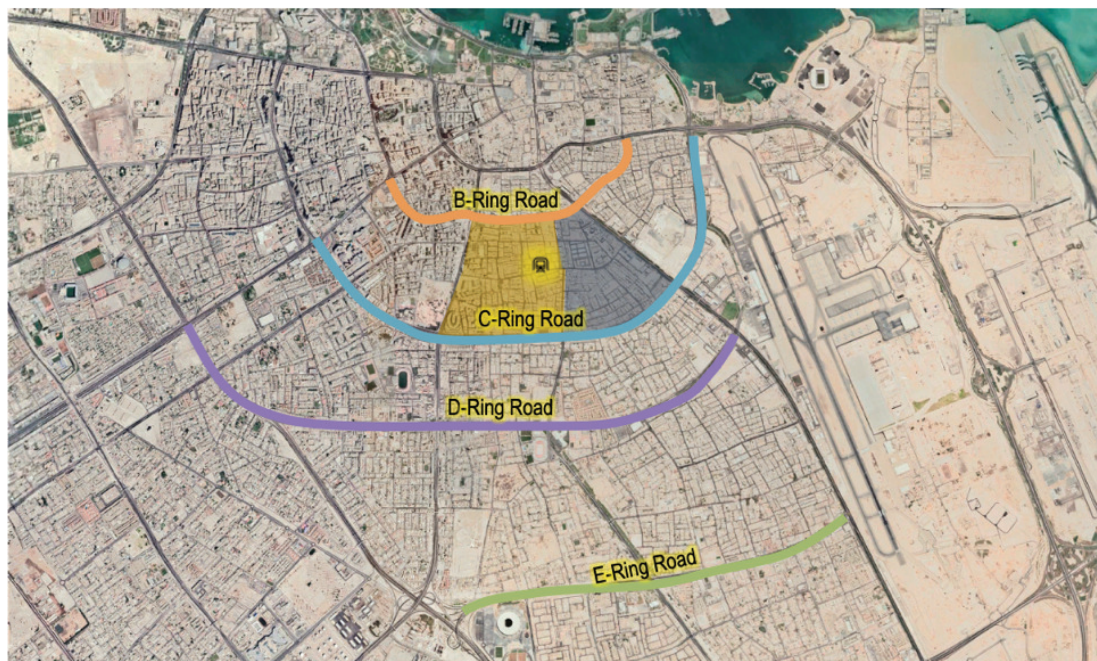
The objectives of this research article are to (a) assess the current condition of TODs in mixed-use neighborhoods in Doha, (b) select a study area for analysis in order to develop an urban design framework to be used as a prototype for other mixed-use neighborhoods in Doha, and (c) to investigate the level of livability in the selected study area.

The rest of this research article is divided into four main sections. The literature review provides an overview of relevant concepts and studies. The methodological approach section provides a description and definition of the methods and tools used for data collection. The findings section presents the results, identifies gaps in the present urban design, and presents an improved urban design framework for the study area. The last section of the article is a discussion and conclusion.

2. Literature Review

Kashef (2016) defines livability as the quality of life in the urban environment. Urban livability thus relates to the suitability of a particular urban location for specific users, as well as ways to improve it. In a broad sense, it aims to understand the urban environment from socioeconomic and environmental perspectives, as opposed to strict urban planning. This includes an evaluation of the conditions of space, and how and whether people perceive it as being suitable for living (Ahmed et al., 2019, pp. 167–168). A number of researchers have helped define and fine-tune some parameters and indicators for evaluating livability in the urban environment. These can be summarized in terms of four major categories: (a) accessibility, (b) social diversity, (c) affordability, and (d) economic vitality. One of the main approaches to assessing and enhancing livability is through well-connected transit networks, understanding of which can be enhanced through the study of TOD.

The notion of TOD has become increasingly important in studies of urban planning and urban mobility since the mid-1990s (Ibraeva et al., 2020). Some studies have examined connections between the built environment and the modes of transportation that existed at the beginning of the 20th century before car ownership became widespread (Knowles, 2012). Understanding how the built environment connects to urban transportation and how to plan for it is a key factor in urban planning. Between the end of the Second World War and the 1970s, many countries faced rapid urban expansion and population growth resulting from the large-scale



Legend

- Al Mansoura neighborhood
- Najma neighborhood
- 🚊 Al Mansoura metro station

Figure 1. The location of the study area within Doha.

movement of people from suburbs into cities (Knowles & Sweetman, 2004). This has tended to result in urban sprawl, characterized by low-density settlements, and increased car ownership (Knowles, 2006).

Arrington and Cervero (2008) define TODs as neighborhoods which are walkable and compact, with mixed commercial and residential land uses. Similarly, Bishop (2015) describes TOD as a development pattern based around transit hubs, supporting mixed land uses in a well-connected and safe urban environment. Therefore, the use of the term TOD generally implies that a given area is walkable and well-integrated with its surroundings; the area should host a large number of commercial activities and offer a variety of residential options and employment opportunities (Calthorpe, 1993, p. 53; Ganning & Miller, 2020).

2.1. Transit-Oriented Development in Mixed-Use Neighborhoods

TODs are generally located in areas with a dense urban center which spreads outward into areas of lower urban density in which a variety of land uses are found (Kumar et al., 2020). TODs are located near transit centers or public transportation nodes, such as metro/train stations or tram/bus stops; hence, TODs offer optimized access to such nodes. TODs are defined as the area located within a radius of 800 m from a particular transit hub, because this is the distance a person can typically walk in 10 minutes, meaning that all parts of the TOD are easily reached on foot from the transport hub at its center (Cervero & Kockelman, 1997; Galelo et al., 2014, p. 901). Therefore, the area around the transit hub should be well connected so that access to the area's services, facilities, and businesses is facilitated. TODs are divided into two sub-areas; the area within 400 m of the hub is called the transit-oriented priority envelope, and the area within 800 m is the transit-oriented development area. The difference between the two is that the transit-oriented priority envelope is expected to have a higher urban density, so mobility within that area is especially important as this has a direct impact on the area's business activities.

Experts on TOD recognize four characteristics of TODs which make neighborhoods attractive and livable. These are (a) real estate demand, (b) accessible land for improvement, (c) available land for improvement, and (d) efficient transit lines which connect people to their workplaces (Furlan & Faggion, 2015, p. 125). The area around the central hub should be well maintained and safe for users.

TOD in mixed-use neighborhoods allows residents and visitors to perform a variety of tasks throughout the day. To keep the area sustainable in the long run, employment opportunities must be available, as this is a primary attraction of a TOD area. Urban design elements such as pedestrian pathways add additional value and attract more visitors and residents (Arrington & Cervero, 2008), and livability is further enhanced when a variety

of services are available at convenient locations and in appropriate ratios (De Chiara et al., 1995). These include medical, educational, recreational, and retail facilities. An integral element of livability is how easily those facilities can be accessed (Pacione, 1989). A convenient number of public open spaces and other recreational settings should also be provided, as this yields additional social, environmental, and economic benefits (Jaafar Sidek et al., 2020; Stojanovski, 2019).

An increase in urban density around the central hub allows the built environment to expand vertically rather than horizontally (Liu et al., 2020). This emergence of high-rise mixed-use buildings can, in turn, exert a strong influence on a city's image, especially for cities that have previously been characterized by low-rise buildings (Berawi et al., 2020; Febrian Dhini & Wonorahardjo, 2020, pp. 4–5). For TODs to be successful, it is critical to assess the role of the urban visual environment and decide whether it will be seen as hindering or facilitating users' access to PT.

2.2. Benefits and Challenges Stemming From Transit-Oriented Development

The reviewed literature confirms the potential of TOD to facilitate access to destinations within the TOD area by offering transportation alternatives to users. In particular, PT ridership increases when a pleasant and safe pedestrian environment around transit stations is offered (Besser & Dannenberg, 2005). TOD also encourages multi-purpose parking lots and varied transportation alternatives that can help reduce the need for parking space and concomitant urban sprawl (Venner & Ecola, 2007). Similarly, Galelo et al. (2014) and Knowles (2012) emphasize that such strategies help boost sustainable growth, making TOD a major component of new urbanism principles.

Mixed-use neighborhoods offer a variety of land uses, which makes them an ideal setting for the development of TODs. One important advantage of such neighborhoods is that they typically provide good connections to employment centers. Curtis et al. (2016) detail the benefits associated with the use of TODs for both the private and public sectors. For example, from a safety perspective, TODs provide people with more opportunities for pedestrian activities, thus creating what Jacobs (2016) refers to as "natural surveillance" for the urban environment.

On the other hand, TODs are associated with a number of challenges. Namely, the lack of potential sites for TOD implementation, as the number of available undeveloped lands is few, and, if found, these lands would be small in size, making them unsuitable for any infill development (Cervero, 2004). For old neighborhoods, it may be difficult to incorporate TOD as the existing development structure may not support it. Also, the real estate development around the transit hub may cause a spike in rents and high building costs (Li & Huang, 2020). Other challenges for TODs involve the huge construction

and lengthy approval process with government bodies to be implemented.

2.3. Transit-Oriented Development in Doha

In recent years, there have been several TOD studies conducted for Doha, investigating neighborhoods such as Al Sadd, West Bay, and Al Waab, as well as the areas surrounding the Qatar National Museum and Souq Waqif (Alattar & Furlan, 2017; Al-Harami & Furlan, 2020; AlKhereibi et al., 2022; Alsaeed & Furlan, 2019; AlSuwaidi & Furlan, 2018; Furlan & Al-Mohannadi, 2020; Tannous et al., 2020). The present study is the first to focus on the Najma and Al Mansoura neighborhoods, which are known for their substantial daily traffic and assortment of business services. These neighborhoods are adjacent and are served by the Al Mansoura metro station on the Doha Metro’s green line.

This new metro station serves as a hub for the implementation of a TOD, consistent with one of the aims of the Doha Metro project, which seeks to integrate metro stations with the existing land use and urban fabric of the areas in which they are located. With a total investment of over \$35 billion, this development program will ultimately include not just the Doha Metro, but also a light rail system and a freight railway linked to wider international networks (Furlan & Sipe, 2017).

3. The Research Design

This research article aims to identify gaps in urban design approaches within the prospective TOD centered

around Al Mansoura station. The theoretical framework is derived from the review of literature on topics related to TOD and livability and is supported by data collection, site analysis, and semi-structured interviews. The research design of this study is illustrated in Figure 2.

3.1. Methodological Approach

The methodological approach for this research article incorporates a qualitative method of data collection which includes a series of site visits and resultant observations, as well as semi-structured interviews with relevant professionals. The methodology is supported by the literature review in the sense that it confirms these tools as being appropriate for the aims of this study. According to the literature, the majority of researchers exploring TOD-related topics have employed a number of data collection methods, including the following:

- Use of case studies to analyze the effects of TOD on the urban environment (Al-Harami & Furlan, 2020; Alsaeed & Furlan, 2019; Furlan & Almohannadi, 2016; Furlan & Al-Mohannadi, 2020; Furlan et al., 2018, 2020, 2021; Furlan, Al-Mohannadi, et al., 2022; Furlan, Grosvald, et al., 2022; Furlan & Sinclair, 2021; Furlan & Sipe, 2017; Tannous et al., 2020, 2021);
- Field observations to assess the urban dynamics of a given study site;
- Site analysis approaches such as integrated modification methodology (IMM), a process whose goal is to assess the complexity of a city’s systems at

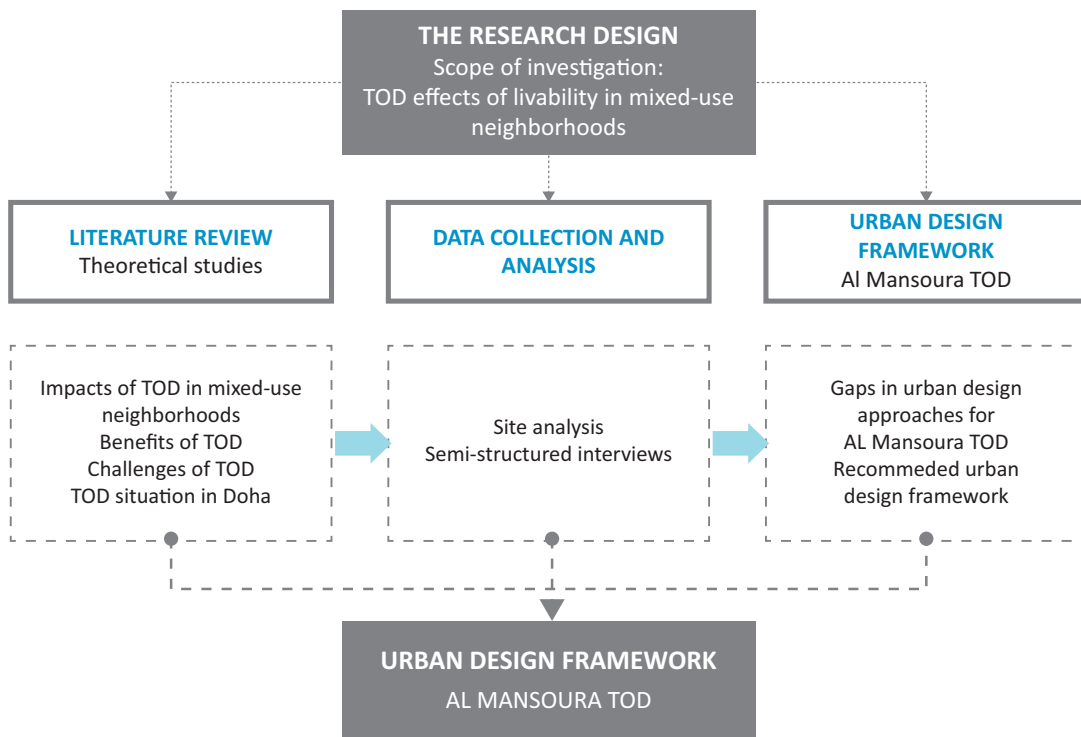


Figure 2. The research design.

various levels, ultimately seeking to improve the city as a whole, particularly with respect to its environment (Tadi et al., 2017, pp. 1–2; Tadi & Bogunovich, 2017).

The methodologies used in this research project are as follows:

- Site observation: Several site visits were required in order to understand the existing conditions in the selected study area;
- Selected parameters from IMM methodology were used in order to facilitate the site analysis (Tadi et al., 2017);
- Semi-structured interviews were conducted with professionals from Qatar Museums, Qatar Foundation, Astad project management, and Qatar University. The interviews were organized into two parts: (a) general discussions about TOD and (b) ongoing development projects in the Najma and Al Mansoura neighborhoods.

3.2. Study Site

The urban areas between the B and C Ring Roads in Doha have witnessed rapid urban growth beginning in the 1980s, due to a laissez-faire approach which had many unfortunate effects on the urban landscape. The selected study site for this research project is located in an area at which Doha’s Najma and Al Mansoura neighborhoods intersect; specifically, this is defined as the area within 400 m of Al Mansoura station, whose operations began in December 2019. The study site is shown in Figure 3.

The Najma neighborhood is classified by Qatar’s Ministry of Municipality and Environment (2015) as a district center, based mostly on its population density

and size. As of 2015, and as shown in Figure 4, the Al Mansoura and Najma neighborhoods have almost double the population of other typical neighborhoods of similar area, highlighting how densely populated these areas are.

4. Findings

The findings section of this research article is divided into three parts. The first part presents an analysis of the area within 400 m of Al Mansoura station. The second part discusses some insights gleaned from the interviews with field professionals. The third part begins by identifying gaps in urban design in this region and then continues by presenting a set of recommended urban design guidelines which, if implemented, can improve livability in the neighborhood.

4.1. Site Analysis

The site analysis for the defined area around the metro station is based on selected design principles of IMM methodology (Tadi et al., 2017; Tadi & Bogunovich, 2017). As identified by Tadi et al. (2017), these design principles fall into the three categories of compactness, complexity, and connectivity. The findings of this section of the article are organized accordingly.

The urban compactness of the area was evaluated through the analysis of ground use balance and walkability via established pedestrian networks. As for urban complexity, this is characterized in terms of mixed-use spaces, community and public spaces, and how well-connected the open spaces are. Finally, the analysis of urban connectivity is based on the transportation modes, hubs, and networks available around the site.

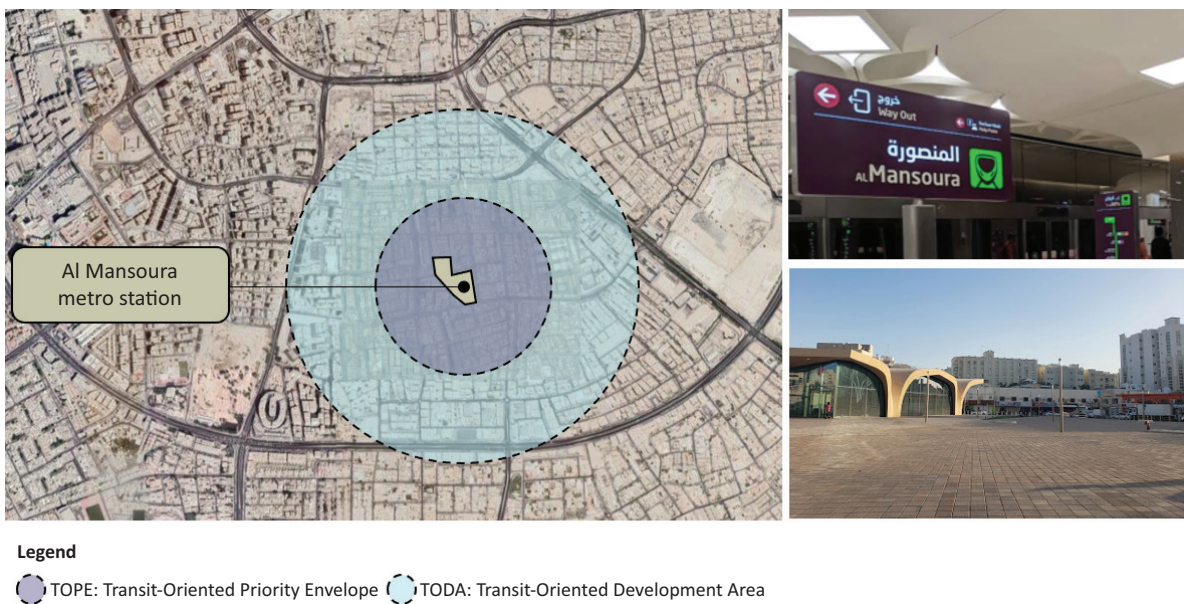


Figure 3. The study site, with Al Mansoura metro station at its center.

Year	Total Population	Year	Total Population
1986	10,658	1986	9,141
1997	14,074	1997	10,826
2004	19,024	2004	16,697
2010	31,573	2010	24,763
2015	37,082	2015	28,228

(a) Al Mansoura's population (Zone 25) (b) Najma's population (Zone 26)

Zone no.	Neighborhood	Area (km ²)	Population density per 1 km ²
23	Fereej Bin Mahmoud	1.2	14,707.1
24	Rawdat Al Khail	1.7	18,200
25	Al Mansoura	1.5	24,898.9
26	Najma	1.1	24,855.4
35	Fereej Kulaib	1.1	5,819.8
44	Nuaija	1.2	3,839.2

(c) Population density per 1 km²

Figure 4. Al Mansoura's and Najma's population and population density in relation to other neighborhoods of similar area. Source: Authors' work based on Ministry of Development Planning and Statistics (2015).

4.1.1. Compactness: Ground Use Balance and Walkability

Najma is a high-density neighborhood with a variety of land uses which are integrated both horizontally and vertically. The area around the metro station is particularly dense and includes several types of building morphology, including traditional courtyard houses dating back to the 1960s (Al-Malki, 2017, pp. 97–98). As already noted, the Najma neighborhood is much denser than other neighborhoods of similar size (see also Figure 5).

The scale of buildings in the area was determined through a series of site visits. This analysis also incorporated design software and revealed how limited the number and size of urban voids are in relation to areas devoted to buildings. Some areas of the neighborhood seem problematic in terms of privacy, with some medium-rise buildings being located near some residential villas.

As illustrated in Figure 6, there are two main street typologies in the immediate surroundings of the Al Mansoura metro station. These are (a) streets enclosed by buildings on both sides (i.e., “building x building” cross-sections), and (b) streets situated between building blocks and voids (i.e., “building x void” cross-sections). In most cases, the voids are simply vacant land.

The streetscapes require major retrofitting, especially along the main streets, as they do not exhibit any design rationale or cohesiveness. Most are damaged despite being active. There is a general lack of designated pedestrian pathways and shading devices throughout the area.

4.1.2. Complexity: Mixed Uses, Building Conditions, and Open Spaces

The Najma and Al Mansoura neighborhoods are largely mixed-use areas, with mostly residential and commercial land uses. The land around the metro station is mostly privately owned and includes residential villas, apartments, and work camps. There is also a notable amount of business activity, with most or all of the roads occupied by retail shops; these include car dealerships, lodgings, markets, cinemas, workplaces, and Souq Al Haraj, which is situated in the central area of the neighborhood. The study area is generally comprised of low-rise residential buildings with commercial frontages around the main streets. The tallest building in Najma is the Toyota Tower with a height of approximately 30 m, located in the southeast part of the neighborhood. More generally, the Najma and Al Mansoura neighborhoods contain mainly low- to medium-rise areas, as the maximum height allowed as per the Ministry of Municipality and

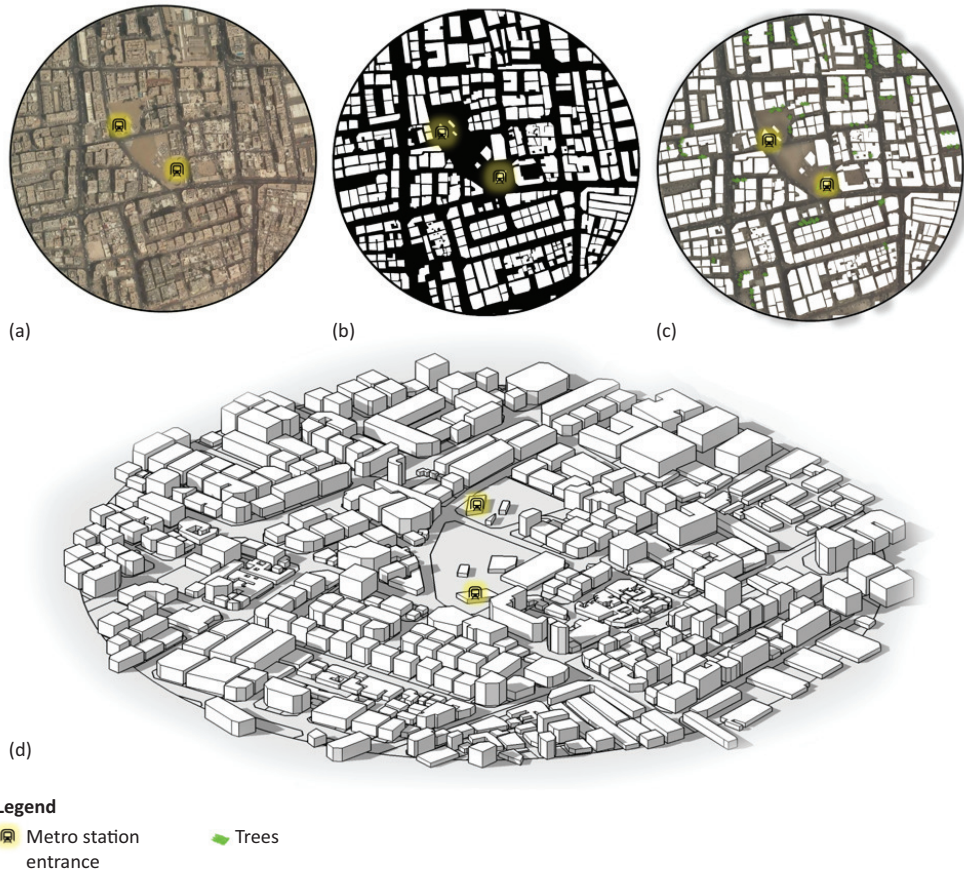


Figure 5. The surroundings of the metro station: (a) Buildings within a 400 m radius of Al Mansoura metro station, (b) built form coverage, (c) existing (and very minimal) greenery, and (d) building forms.

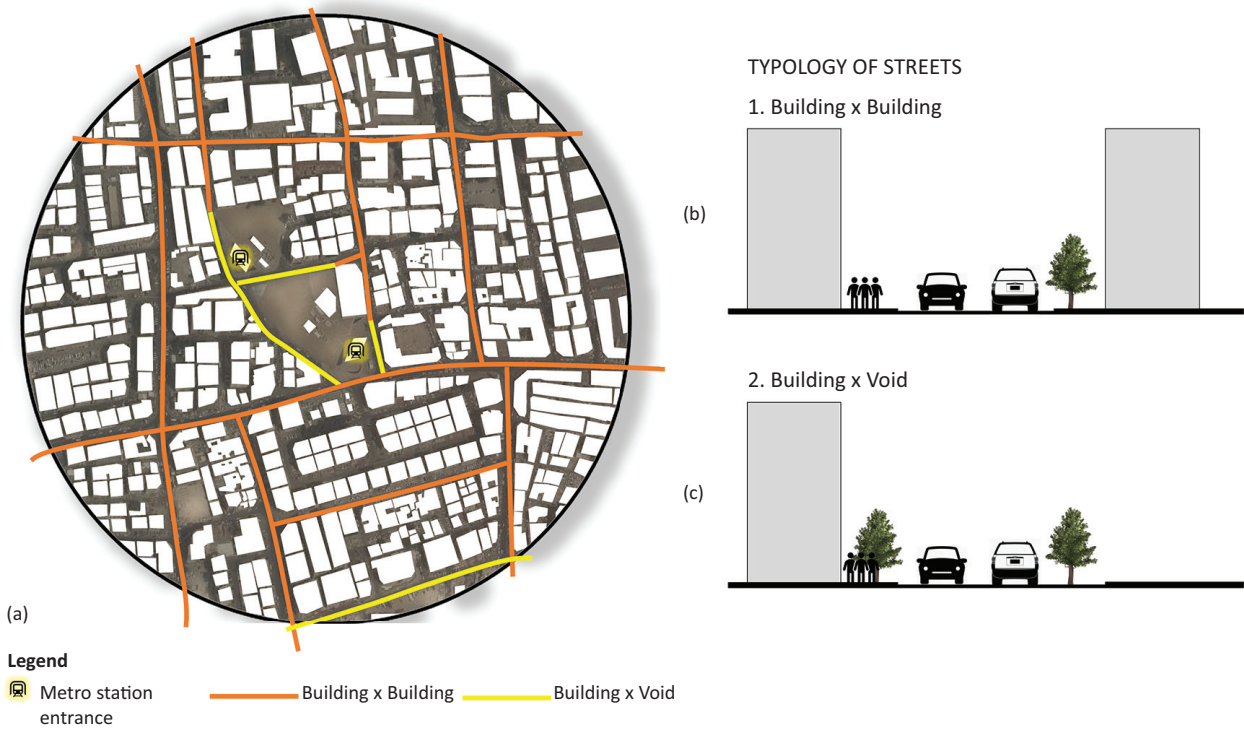


Figure 6. Typology of streets: (a) Main street typology types in the 400 m around Al Mansoura station, (b) building x building cross-section illustration, and (c) building x void cross-section illustration.

Environment is G + M + 7 for commercial buildings, and G + 7 for residential buildings (see Figure 7). G stands for ground floor and M stands for mezzanine floor.

The condition of buildings adjacent to the main streets is overall acceptable, but this is not the case with the buildings within the area's local streets. Many of those buildings show evidence of extreme deterioration, with main entrances often open and/or damaged, posing a serious problem for privacy and safety. As illustrated in Figure 8, the conditions of buildings immediately around the metro station were categorized as being of (a) sound state, (b) recoverable state, or (c) irrecoverable state. Sound buildings are those showing good archi-

tectural and structural integrity, and which generally abide by local fire and safety regulations. Recoverable buildings are those which seem to be in good condition but do not seem to adhere to local building regulations. Finally, irrecoverable buildings are those needing a substantial amount of work, as they pose a serious hazard to their occupants.

The site visits showed that there are no open spaces in the area immediately around the metro station. In addition, most of the observed greenery in the greater area appears to lack clear arrangement or design (see Figure 5c). This general absence of open spaces appears to be due to the density of the neighborhood; the open

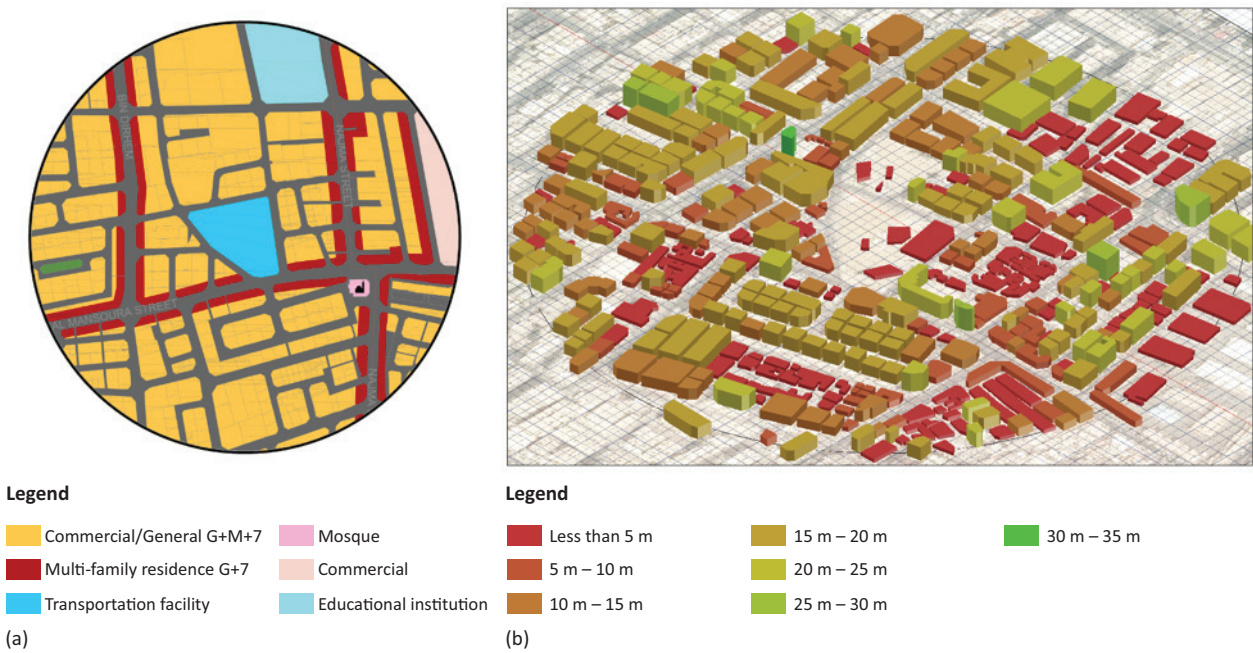


Figure 7. The surroundings within a 400 m radius: (a) Land use within 400 m of the metro station and (b) building heights within 400 m of the metro station.

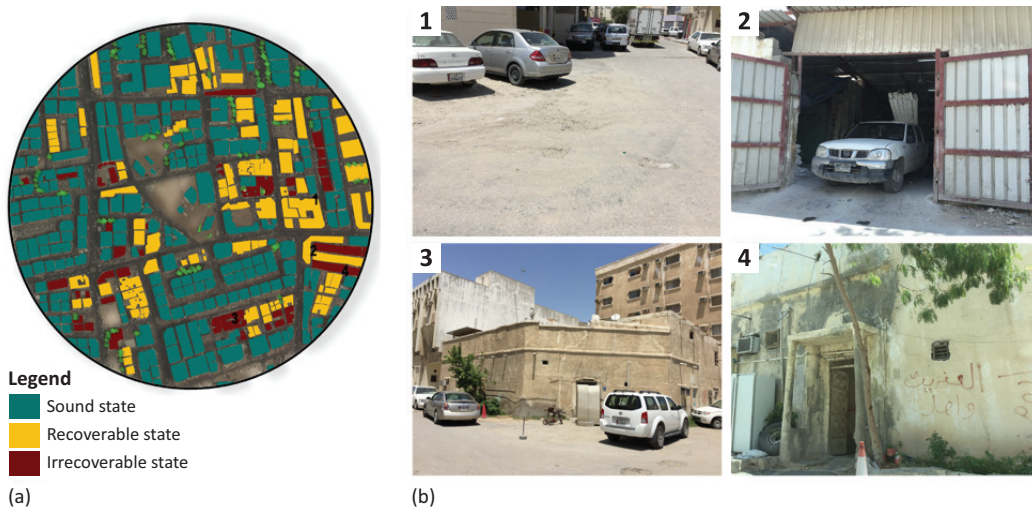


Figure 8. The surroundings within a 400 m radius: (a) Condition analysis of the area within 400 m of the metro station, and (b) photos of buildings on secondary streets which are in deteriorating condition.

spaces that do exist are currently being used as temporary parking lots or are left vacant, as shown in Figure 9.

One of the prominent landmarks in the neighborhood is Souq Al Haraj. However, the urban structure around the souq's entrance does not enhance the look or feel of the place. It suffers from a general lack of pedestrian pathways and proper signage. This is illustrated in the images shown in Figure 9.

4.1.3. Connectivity: Transportation Modes, Hubs, and Networks

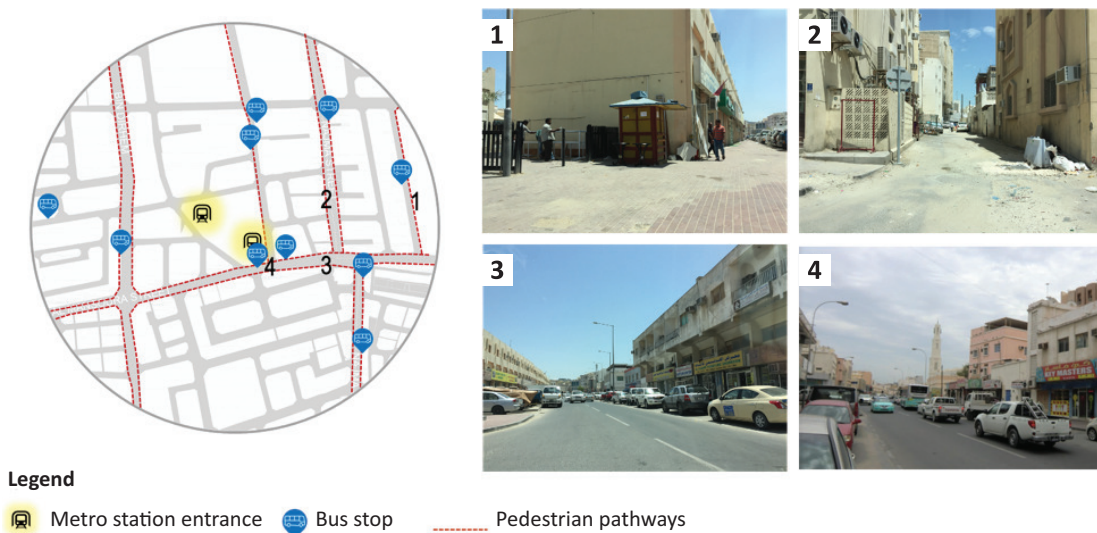
Najma and Al Mansoura neighborhoods are seen as an affordable living environment because of the predominance of low-middle income people living there. Although the major streets in the neighborhood are generally in good condition and are convenient for pedestrians to use, the local roads are extremely narrow without proper consideration for pedestrian movement.

The street furniture does not encourage social interaction and lacks shading devices, road benches, and trash bins. Signage and wayfinding are another significant flaw here, as the majority of local streets do not have visible street names and lack a legitimate signage system. These observations are supported by a series of photographs taken during the site visits in order to document the existing conditions of the study area, some of which are shown in Figure 10.

These observations show that the area around the metro station can be accessed from three main streets and two local streets. The streets in this area show a high level of traffic congestion during the day as cars are the main mode of commuting. Other modes of transportation include public buses. Several bus stops can be found



Figure 9. Photographic survey of the area's open spaces, showing a lack of a sense of place as well as a lack of adequate signage and pedestrian facilities.



Legend
 Metro station entrance Bus stop Pedestrian pathways

Figure 10. Available transportation modes within 400 m of the station.

in the neighborhood and three bus routes pass through the area; however, these are relatively underutilized as they are dominantly used by male workers. Cycling lanes were not observed within the neighborhood. However, a fair amount of cycling activity was seen in the streets of both Najma and Al Mansoura neighborhoods, despite the fact that neither neighborhood seems to have any established depot system for bicycles or any cycling networks. A great deal of pedestrian activity was observed during the daytime, although, as already noted, pedestrian pathways are only provided on the main streets and have minimal shading.

4.2. Interviews

The interviews followed a semi-structured format and were conducted with field professionals with varied backgrounds. Participants included architects, urban planners, and sociologists. The two main topics of discussion were TOD in general and development projects in the Najma and Al Mansoura neighborhoods in particular.

Concerning TOD, these professionals broadly agreed that the local status of TOD is not up to international standards. This is especially important since the Al Mansoura station will be one of the metro's busiest. The issue of connectivity was brought up multiple times in these interviews and is of particular concern in Doha, given the hot climate of the country and the overall lack of dedicated pedestrian and cycling lanes there. As a result, these two neighborhoods are under serious consideration for urban regeneration by the Qatar Museums Authority.

Urban regeneration feasibility studies for Najma and Al Mansoura are currently underway; these aim to preserve the urban and social diversity that is now characteristic of the two neighborhoods. One of the interviewees explained specifically that Souq Al Haraj will host a facility to teach carpentry and other crafts to interested students; carpentry workshops are one of the main businesses that these two neighborhoods are known for.

4.3. Contribution to Knowledge: Gaps in Urban Design

In recent times, there has been a noticeable shift in the urban planning approach for mixed-use neighborhoods in Doha. The current focus is on design methodologies and initiatives seeking to integrate retail and residential land uses in existing neighborhoods. Newly developed or regenerated neighborhoods, such as Lusail and Msheireb, have followed urban planning schemes which encourage urban connectivity and offer multi-modal transportation networks. However, existing neighborhoods tend to be faced with challenges related to urban sprawl and gentrification, rather than being characterized by interconnectivity. A major contributor to this is the heavy reliance on personal vehicles as the main mode of transportation. In summary, the main issues in the development of mixed-use neighborhoods, accord-

ing to the literature review and case study analysis, are:

- Neighborhood characteristics, and how well these interact with the local context;
- Urban connectivity, referring to how well a given neighborhood is connected to adjacent neighborhoods and to the wider urban infrastructure;
- Accessibility, meaning how easily people can access and use the neighborhood;
- Inclusivity, meaning to what degree the neighborhood is welcoming to all types of people regardless of their background or income level;
- Whether the area can be characterized as mixed-use in nature, hosting or favoring a variety of activities.

As in many modern cities, there has been a trend for people in Doha to live in urban areas which are less interconnected and, thus, increasingly segregated. Current urban renewal and restoration initiatives often tend toward gentrification; this is implemented by shifting low-income residents from central areas to the periphery of Doha. This is the case, for example, with the Msheireb project. However, for a neighborhood to be effectively mixed-use in nature, it should incorporate individuals from every social standing and income level. Najma and Al Mansoura neighborhoods are two of the earliest-established neighborhoods in Doha, so the development of the area should be carried out in such a way that its old urban fabric is preserved, thus, maintaining the historical value of the place.

In regard to the government's role in the development of mixed-use neighborhoods, any viable approach must take into account established land use guidelines. One issue in Qatar is that many of the country's urban planning strategies are not readily available; this is in contrast to many other nations, whose approaches are published online to allow researchers, urban planners, and stakeholders to stay well-informed about design and construction processes. At present, planning processes involve many stakeholders and other entities, making the decision-making process needlessly complex and lengthy.

A city's urban fabric and its transportation network do not exist in isolation from each other; each is critical in determining how individuals interact with one another and travel within the public realm. They also affect the land uses and population density suitable for a given area. Traditional urban planning in Doha recognized all of this and, thus, reflected individuals' needs, interactions, social standing, and culture, which were the major factors that influenced the early formation of Najma and Al Mansoura.

4.4. Recommended Framework

The recommended framework developed in this article is based on the findings of the site analysis and literature

review. This framework provides urban design guidelines for land use distribution, open spaces, the transportation system, and the built environment. Al-Malki (2017, p. 149) identifies four parameters that are needed to enhance livability in mixed-use neighborhoods; these are used here in order to develop an urban design framework for the area within 400 m of Al Mansoura station. In addition to those parameters, key recommendations include:

- Using existing urban voids or infills as open spaces or plazas;
- Demolishing old buildings which have deteriorated and which are not in accordance with basic fire and other safety requirements;
- Giving clear names to streets which currently do not have names;
- Preserving and enhancing the mixed-use character of Najma and Al Mansoura neighborhoods;
- Encouraging and facilitating the use of local businesses on the part of neighborhood inhabitants;
- Providing and upgrading connectivity between Najma and Al Mansoura and the surrounding neighborhoods.

4.4.1. Land Use and Open Spaces

It is desirable to ensure that a mix of land uses is well established. The introduction of more community and public facilities would help revitalize the study area, as would the introduction of a multi-purpose parking system in order to reduce haphazard parking behavior on the area’s main streets. Additional greenery and open plazas should be provided around the metro station, as

the site visits showed this area to be lacking in well-designed and well-maintained greenery. Open spaces should be conveniently linked to recreational and public facilities in order to facilitate a smooth flow of people at all times. In turn, this will enhance the area’s safety by supporting “natural surveillance.”

As illustrated in Figure 11, Al Mansoura Street directly faces Al Mansoura station. The proposed location for the open plaza puts the plaza directly adjacent to each entrance of Al Mansoura station. It is important for this sort of open place to be provided adjacent to metro stations, as it helps shape the development pattern around the station, supports the creation of wide pathways accommodating the flow of people, and provides a convenient place for people to rest before and after traveling to/from their destination. In addition, the proposed green spine is equally important. It will act as a natural shading device in the neighborhood and as a buffer zone helping to reduce the noise generated around the metro station entrances.

4.4.2. Circulation and Built Environment

Recommendations for improving the circulation in the area within 400 m of Al Mansoura station include a new cycling network, upgrades to existing pedestrian pathways, and the installation of signalized crossings. Also, to mitigate parking issues in the area, multi-story parking facilities should be integrated with residential and commercial activities. These recommendations are illustrated in Figure 12.

With respect to the built environment, two main strategies are recommended, both of which take into

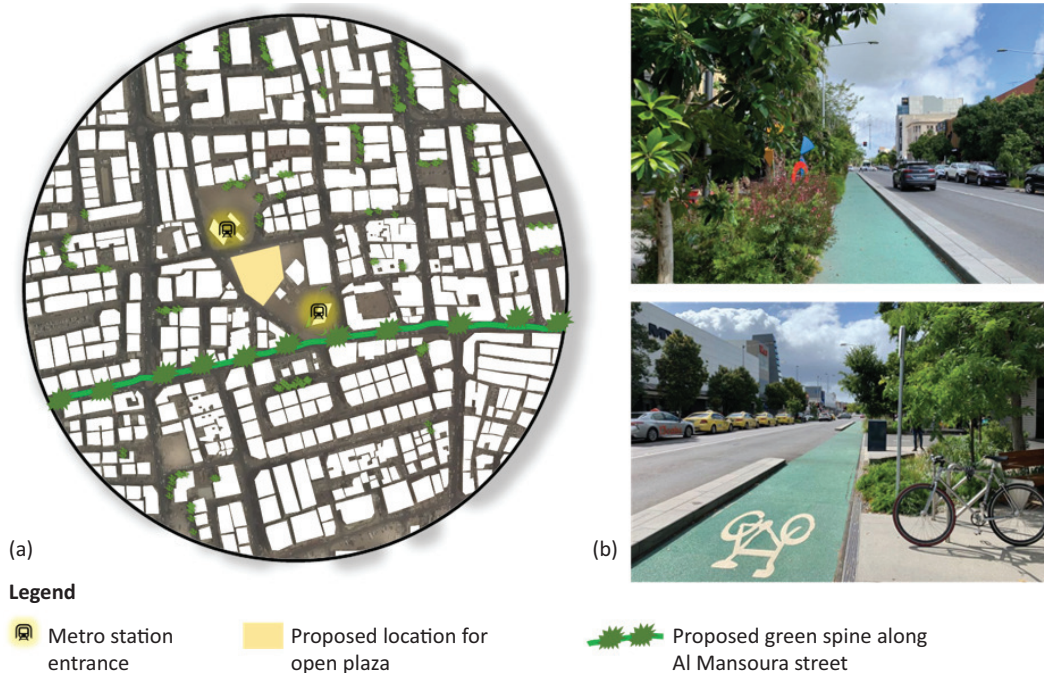


Figure 11. Proposed projects near the metro station: (a) Proposed green spine along the main street, (b) envisaged features of the green spine. Sources: (a) Authors’ work; (b) Mills (2020).

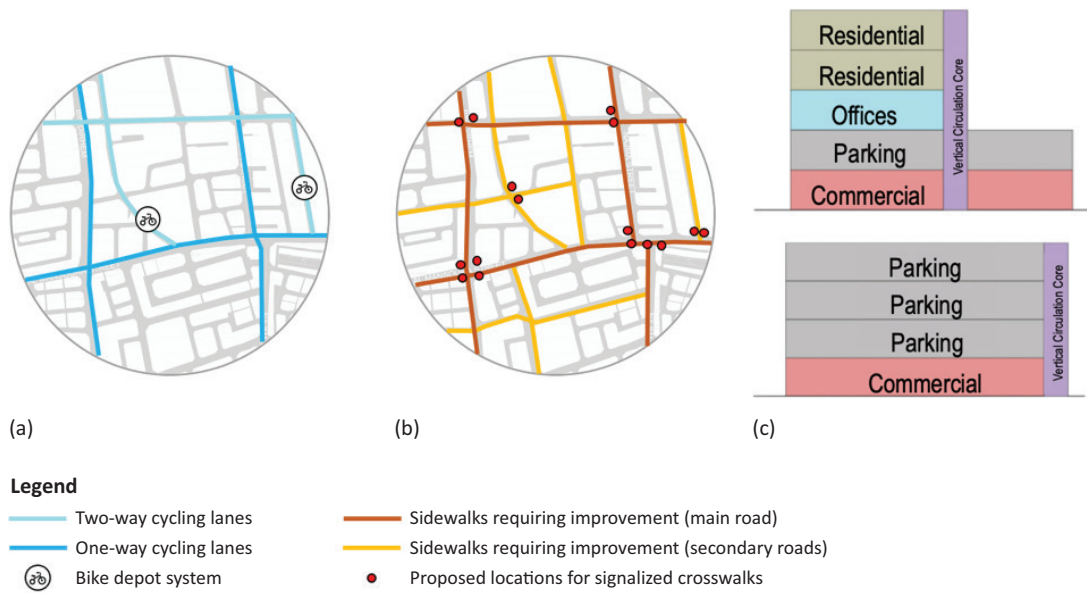


Figure 12. Transportation ideas: (a) Proposed cycling networks, (b) proposed pedestrian pathways, and (c) proposed parking strategies.

consideration the special character of Najma and Al Mansoura neighborhoods. First, buildings of historical significance, such as at Souq Al Haraj, should be restored and renovated. Second, the built form around the metro station should be rethought, in order to ensure that the varied needs of metro users are accommodated, while at the same time controlling the flow of people coming to and from the metro station. For example, revitalizing the immediate area around the metro station attracts visitors to stop and explore the area.

5. Discussion and Conclusion

In the recent past, Qatar has faced rapid urban and population growth, particularly during the last two decades. As a result, planning for a well-connected transportation network has become necessary, in order to reduce car usage and accompanying traffic congestion. With the recent implementation of the Doha Metro project, it is necessary to reanalyze the built forms of areas around the metro stations, as it is critical to ensure the livability of mixed-use neighborhoods and the sustenance of business activities. TOD can address such challenges, helping to solve transit-related problems while creating accessible, pedestrian-friendly urban areas. The study has been undertaken to assess the status of TODs in mixed-use neighborhoods in Doha and to develop an urban design framework for analyzing other mixed-use areas.

The literature review presented in this research article has focused on the topics of TOD and mixed-use neighborhoods in order to determine suitable parameters for the site analysis, which investigated Doha's Najma and Al Mansoura neighborhoods. The study site, consisting of the area within 400 m of the Al Mansoura metro station, was analyzed using IMM

methodology, allowing the development of an appropriate urban design framework. Accordingly, the site analysis was undertaken through the three design principles defined in IMM methodology: compactness, complexity, and connectivity.

The first part of the findings related to the site analysis, making clear that the Doha Metro has helped to reduce traffic congestion, especially in dense neighborhoods such as Najma and Al Mansoura. Pedestrian facilities should always be considered, especially the pathways to and from the metro stations. In fact, there are two significant questions to consider when reconfiguring the connections between any given metro station and other parts of the neighborhood. First, what do visitors first see when they exit the metro station? Second, how are other parts of the neighborhood integrated with the metro station? Due to the need to preserve a neighborhood's character, local consultants should be involved when a city's PT system is designed, as such people can provide a better understanding of the local culture and site requirements that may be missed or disregarded by non-local people, such as international consultants. Successful implementation of TOD also requires that different modes of transportation be available within a given neighborhood.

The second part of the findings summarized interviews with experts about the current status of TOD in these two neighborhoods. The insights provided by the foregoing help support an urban design framework for promoting TOD around the study site, focusing on land use, open spaces, circulation, and the built environment. For land use, it is important to capitalize on the pedestrian flow to and from the station by enhancing the surrounding commercial and recreational facilities with a well-connected circulation pathway. As for open spaces,

the open plaza between the two entrances leading to the metro station can be revitalized by providing seasonal and temporary activities. Open spaces should be conveniently linked to recreational public facilities to facilitate a smooth flow of people. This will enhance the area's safety by supporting "natural surveillance." Additionally, the proposed green spine in the design framework can act as a noise buffer for the metro station, while at the same time improving the aesthetics of the main street. In terms of circulation and built environment, urban design recommendations were given to enhance the surrounding built environment. Introducing more community and public facilities would help revitalize the study area. Additional greenery and open plazas should also be provided around the metro station.

Nowadays, such a study of TOD within a mixed-use neighborhood is essential to Doha, as the metro is a recent introduction to Doha's transportation infrastructure. Moreover, since the Najma and Al Mansoura neighborhoods are two of the earliest-established neighborhoods in Doha, the development of the area should be carried out in such a way that its old urban fabric is preserved. Any viable approach must take into account established land use guidelines. Thus, researchers and urban planners can use this case study of Al Mansoura TOD as a precedent when establishing guidelines for the urban development of other mixed-use neighborhoods. This is especially so for other densely populated areas within central Doha.

Recommendations for further research include studying nearby metro stations, such as the Al Doha Al Jadeda station, which is near Al Mansoura station and thus serves a similar area. Incorporating several other parameters in the site analysis can provide a more comprehensive understanding of a neighborhood; these include the socio-economic characteristics of the neighborhood, energy use and natural environment, and cultural diversity. This would allow one to ascertain additional measures that should be incorporated into the urban design framework for improving livability within TODs in mixed-use neighborhoods.

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Conflict of Interests

The authors declare no conflict of interests.

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About the Authors

Almaha Al-Malki holds a bachelor’s degree in architecture and a master’s degree in urban planning and design from Qatar University. She is currently pursuing her PhD in architecture at Qatar University. Almaha is a senior architect with over seven years of experience in the construction industry in Qatar. She has worked on projects across a variety of sectors, including healthcare facilities, historic structures, schools, and office buildings.

Reem Awwad holds a bachelor’s degree in architecture (honors) and a master’s degree in urban planning and design from Qatar University. She is currently pursuing her PhD in urban planning at Qatar University. She is currently working as a graduate researcher and teaching assistant in Qatar University. She has been also employed as research assistant under the Qatar University Collaborative Grant for three years. She has five years of professional experience as a transportation planner with Seero Engineering Consulting, which specializes in conducting traffic-impact studies and transport modeling for new urban developments in Qatar.

Raffaello Furlan holds a master’s degree from IUAV University in Venice, Italy, and a PhD in architecture from Griffith University in Brisbane, Australia. He has held visiting and permanent academic positions at the University of Queensland and Griffith University in Australia and at the Canadian University of Dubai in UAE. He has approximately 20 years of experience in practice in Italy, Australia, UAE, and Qatar, where he has been involved in managing design concepts, documentation, construction, and supervision of residential and commercial developments. He is currently serving as an associate professor and head of the Department of Architecture and Urban Planning at Qatar University.

Michael Grosvald completed his master's degree in mathematics at the University of California at Berkeley and his PhD in linguistics at the University of California at Davis, both in the United States. He has teaching, research, and business experience in the United States, Europe (Germany and the Czech Republic, five years), East Asia (Taiwan, one year), and the Middle East (Qatar, eight years). He currently serves as associate professor of linguistics at Qatar University in Doha, Qatar.

Rashid Al-Matwi is an assistant professor of architecture and urban design in the Department of Architecture and Urban Planning at Qatar University. He holds bachelor's and master's degrees in architecture from the Southern California Institute of Architecture, and a PhD in urban and regional development from Cairo University. Prior to joining Qatar University, he has worked at Qatar Development Bank, where he was secretary of the board and consultant. Before that, he worked as senior advisor for the renowned architecture firm AS&P—Albert Speer & Partner. In addition, he worked in the Urban Planning Department in the Ministry of Municipality in Qatar.