Al-Azhar Engineering 16th International Conference
Vol. 19, No. 72, July 2024, 127 - 153

THE IMPACT OF MONORAIL STATIONS ON LAND USE (STUDY OF THE NASR CITY LINE)

Hanan S. Zaghloul [1], Asmaa S. Gabr [2], Mohamed E. Serag[1]

[1]Department of Urban Planning, Faculty of Engineering, Girls, Al-Azhar University, Nasr City, 11884, Cairo, Egypt,
[2]Department of Urban Planning, Faculty of Engineering, Boys, Al-Azhar University, Nasr City, 11884, Cairo, Egypt.

***Correspondence:** Assmaa.gabr2015@yahoo.com

Citation:

H. S. Zaghloul, A. S. Gabr, M. E. Serag, "The Impact of Monorail Stations on Land Use (Study of The Nasr City Line) ", Journal of Al-Azhar University Engineering Sector, vol. 19, pp. 127 - 153, 2024.

Received: 14 December 2023

Revised: 04 May 2024

Accepted: 16 May 2024

DOI: 10.21608/auej.2024.255350.1524

ABSTRACT

The monorail represents one of the elements of the environmentally friendly transportation system as a development hub linking the Administrative Capital to Cairo, and reduces the effects of congestion and traffic congestion, which have a strong impact on the urban structure system, especially land uses that are the sources and destinations of the city's various trips. Therefore, the research attempts to know the impact on land uses and changes in them. As it is expected that the prices of lands located near the monorail line and its stations will rise, as they are attractive areas for investment and trade, with an impact on urban expansion and restructuring of uses, which leads to the effective use of urban lands with limited resources. This impact on land use at the (Stadium and Hisham Barakat) stations of the monorail line (Administrative Capital - Nasr City) varies depending on the location of the station on the route, whether the stations (interchange or subsidiary), as it is expected that the number of passengers at the Stadium station will double to meet it with the third line of the metro, with an increase Interview on services and activities and focus on the quality and level of service and activity according to passengers' requirements. The results indicate that development is expected in the commercial spaces at the monorail stations, and they appear in the first zone at a rate of 30%, with an increase of 4 floors, followed by administrative use at a rate of 23%, with an increase of 3 floors, then residential use at a rate of 46%, with an increase of 6 floors, with land prices near the stations increasing and decreasing. The further we get, while achieving connectivity between the station, transport stations and the roads leading to the station.

KEYWORDS: Monorail , Land use , Interchange Stations , Urban Development.

أثر محطات المونوريل على استعمالات الأراضى (دراسة خط مدينة نصر)

حنان سعد زغلول [1]، أسماء صلاح جبر[1]، محمد إبراهيم سراج [2]

[1] قسم التخطيط العمرانى بنات، كلية الهندسة بنات، جامعة الأزهر، مدينة نصر، 11884، القاهرة، مصر.
[2] قسم التخطيط العمرانى بنين، كلية الهندسة بنين، جامعة الأزهر، مدينة نصر، 11884، القاهرة، مصر.
***البريد الاليكتروني للباحث الرئيسي :** Assmaa.gabr2015@yahoo.com

الملخص

يمثل المونوريل أحد عناصر منظومة النقل الصديقة للبيئة كمحور تنموى يربط العاصمة الإدارية بالقاهرة ، ويخفف من أثار الإزدحام والاختناقات المرورية ذات تأثيرات قوية على منظومة هيكل العمران خاصة استعمالات الاراضي التى هي مصادر وغايات الرحلات المختلفة بالمدينة، ولذا يحاول البحث معرفة الأثر الواقع على استعمالات الأراضى والتغير فيها، حيث أنه من المتوقع ارتفاع اسعار الأراضى الواقعة بالقرب من خط المونوريل ومحطاته، بإعتبارها مناطق جاذبة للاستثمار والتجارة، ذات أثر على التوسع الحضرى وإعادة هيكلة الإستعمالات، مما يؤدى إلى الاستخدام الفعال للأراضى الحضرية محدودة الموارد. ويختلف ذلك التأثير على استعمالات الاراضى المحيطة بمحطات (الاستاد وهشام بركات) لخط المونوريل(العاصمة الإدارية - مدينة نصر) بإختلاف موقع المحطة علي المسار سواء المحطات (تبادلية - فرعية)،حيث يتوقع أن يتضاعف أعداد الركاب بمحطة الاستاد لتقابله مع الخط الثالث للمترو، مع زيادة مقابلة فى الخدمات والأنشطة والتركيز على نوعية ومستوى الخدمة والنشاط وفقاً لمتطلبات الركاب.

وتشـير النتائج إلى أنه من المتوقع التطور فى المسـاحات التجارية على محطات المونوريل وتظهرمن خلال نطاقات (النطاق الاول بنسبة 30% بارتفاع 4 أدوار، يليها الإستعمال الإدارى بنسبة 23% بإرتفاع 3 أدوار، ثم الإستعمال السكنى بنسبة 46% بارتفاع 6 أدوار)، مع ارتفاع أسعار الأراضى بالقرب من المحطات وتقل كلما ابتعدناعنه.

الكلمات المفتاحية: المونوريل، استعمالات الأراضي ، المحطات التبادلية، التنمية الحضرية.

INTRODUCTION

The transportation sector represents an essential element in the comprehensive and sustainable infrastructure system of cities, and these projects have received special attention from the concerned authorities in light of the expansion of cities, the increase in population numbers, and the congestion of traffic, and therefore the provision of public transportation has become an urgent necessity [24]. Cairo is also witnessing a significant increase The population size represents (10 million and 250 thousand people) [9], and this led to an increase in the volume of traffic within the city, which directed the transfer of all ministries and agencies to the new administrative capital, and the state began establishing two monorail lines, which is an electric train that runs on rails. Single steel bars, as these bars are installed on a concrete beam far from the surface of the ground and traffic intersections [33]. To connect the Greater Cairo region and the New Administrative Capital, and also with the aim of reducing pressure on the city of Cairo and linking it to the new cities around it or in its broader scope. The Eastern Monorail is the second train linking the New Administrative Capital and the older areas of Cairo after the Capital Train, and the two monorail branches together will represent the longest monorail line on World level, with a length of 96 km, which surpasses the longest monorail line currently recorded, which is the monorail in the Chinese city of Chongqing, which extends for a distance of 55 km, according to the Guinness Book of World Records. The monorail will create a boom in the transportation system in Cairo and the New Administrative Capital [32].

One solution for the city to deal with traffic is to integrate land use planning and public transportation planning [27]. Recently, monorails have been planned and built as an integral part of intermodal urban transport systems [10]. The monorail changes the composition of the land use structure at the city level, and affects the speed of urban development of the areas through which it passes, leading to an increase in the value of land in those areas, and then a change in the land uses therein, whether through the emergence of new uses or an increase in the level of existing uses to keep pace with that urban development. In the region [32]. Therefore, the problem of the research lies in the existence of a relationship and mutual influences between the traffic and urban structure systems in the areas surrounding the path of the traffic artery, resulting in changes in land uses. In light of the construction of the monorail line in Cairo, the positive and negative impacts on the uses of the surrounding lands must be studied and analyzed, with the aim of forming a complete perception of the impact. The tangible and expected results of the stations of the monorail train project currently being implemented on land uses, by application on the scale of Nasr City, in addition to evaluating the negative impact resulting from the impact of the construction of the stations.

METHODOLOGY

The research uses the inductive approach by monitoring and analyzing previous studies and theoretical studies of the mutual effects between the dynamics of land uses when creating a main traffic artery on it and the interaction between them, by monitoring the experiences of international countries that dealt with studying the effect of a main traffic artery on land uses, and

then studying the monorail line (Nasr City) as a case study through (study of land use before and after the construction of the monorail) at (Stadium, Hisham Barakat) stations, to measure the extent of the change occurring in land use therein by applying it to the traffic and urban systems and then arriving at the results and recommendations that the study deems necessary to take. Into account.

1. Previous studies

The study used some previous studies related to the subject of the research to extract the impact of transportation systems (train - railway line - monorail) on land uses, to arrive at the realistic impact of transportation stations represented by monorails on the surrounding land uses, as **Table 1** shows. These studies have proven The existence of a relationship and mutual influences between the traffic and urban structure systems in the areas surrounding the traffic artery path, resulting in changes in land uses.

Table 1. Previous studies

Study	Titel	Results
Wael Youssef ,1999.	The impact of the subway on land use in the surrounding areas (an applied study on the city of Alexandria) [28].	•The metro helps the city transform from centralization to decentralization according to the growth trends determined by the city's master plan. •Its rapid growth and expansion reduces the city's population density, Land values rise.
A case study Fresno, California,2001.	The potential application of monorail technology as a tool for economic redevelopment [1].	The large-scale application of monorail technology whlch is unique for North America. Second, the purposeful use of transit as a major tool for redevelopment, curbing urban sprawl and improvement in the quality of life.
Muhammad Ahmed Suleiman, 2003.	Strategies for developing the areas surrounding the metro lines (D Subway case report - Cairo) [23].	•The study demonstrated the effects resulting from the construction of the metro line on the movement structure, urbanization, land use structure, and land prices. It also identified some proposed strategies for development of the areas surrounding the metro tracks.
Haixiao Pan and Ming Zhang, 2008.	Rail Transit Impacts on Land Use: Evidence from Shanghai, China[16].	•The price of land near the metro station rises to about 152 yuan/m2 for every 100 meters closer. •Rail transportation is a new attraction for redevelopment, urbanization and restructuring. •Efficient use of limited urban land.
Amr Muhammad Al-Adawi, 2017.	The monorail system as a sustainable urban transport (case study of the city of Alexandria)[8].	•It demonstrated through the questionnaire the importance of establishing a new technological line for citizens and its impact on the social and economic environment, and it clarified the effects of UMS on urban planning, both urban and environmental.
Salsabil Panji Arum, Daisuke Fukuda, 2020.	The impact of railway networks on residential Land values within transit-oriented development areas, [27].	•TOD factors sinificantly affect ersidentialland value. •across railway lines responsible for creating alarge share of land value variation.
Dhabiya Nasser Al-Hazmi Al-Afri, 2022.	The impact of light rail transportation on the urban development in Dubai UAE [11].	•Improving infrastructure, enhancing communication, economics and sustainable development. •Developing residential and commercial land uses and increasing their area, Reduced spaces and green areas.

It turns out that monorails have an effective role in reducing congestion and relieving pressure on other means of transportation. I also mentioned the impact of railway and metro lines on land uses and the speed of urban development of the areas through which they pass. However, monorails differ from regular trains, as studies have not analyzed the impact of monorails on uses. As a modern means of transportation pending implementation in Egypt.

2. Means of transportation (monorail)

It represents a dense, single-rail mass transit means that runs on a suspended concrete beam. Its maximum capacity is about one million passengers per day. Its trains run on a single iron rail installed on top of an extended bridge body and are powered by electricity [20]. The monorail differs from the metro in that it is without a driver, while the metro needs a driver to drive it, and the metro tracks are either at ground level or underground, while the Egypt monorail tracks are above ground level or at the same level, and the monorail moves on one rail while the metro moves between two.

2.1. The history of the monorail's inception

In 1888, a staggered-type monorail powered by a steam locomotive was installed in Ireland on a line about 15 km long and was used to transport goods for 36 years until 1924. In 1901, a suspension-type monorail with iron wheels was built in Wuppertal, Germany. With a length of 13.3 km, it still serves as the oldest monorail operating as a major transportation system. The monorail was constructed in 1957 in a suburb of Cologne, Germany, and the world's first ALWEG monorail was put into operation in 1959 at Disney Land in Los Angeles, followed by Turin (1961), Seattle (1962), and Disney World in Florida (1971), and in 1960, an experimental suspended monorail type (SAFEGE type) was installed in a suburb of Orleans, France. These two systems represent the beginning of the development of modern monorails[17].

2.2. Types of Monorail Systems

Two types of monorail systems emerged from the early stages of development:
The suspension railway systems on which the vehicle hangs under the fixed track—originally designed as freight transportation. The earliest urban application was the Wuppertal Monorail that was installed in 1901 and is still in use today[25].

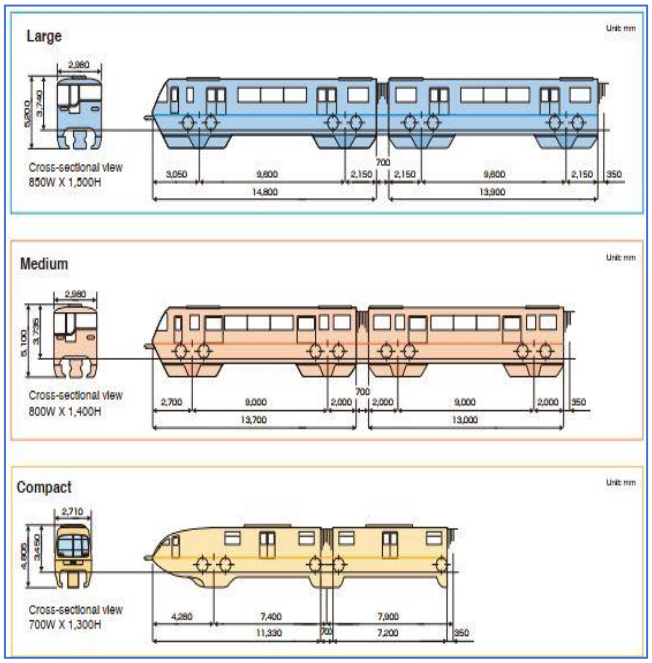
- **The Urban Monorail**: suspended from, or ride on, a track constructed over a road in principle, and most of which are installed within an urban planning area **Fig. 1**.

- **Straddle-type and Suspended-type Monorail Systems:** Monorails are classified into straddle and suspended-type systems. Since the straddle-type travels by straddling the track, its center of gravity is situated above the track. The suspended-type, on the other hand, is configured suspending from the track, with its center of gravity under the track **Fig. 2** [25].

Fig. 1. Straddle-type Monorail System

Fig. 2. Suspended-type Monorail System

- **Large, Medium, and Compact Monorail Systems**: Monorails developed in Japan are classified into large, medium, and compact systems **Fig. 3** depending on the size of the cars and the overall system scale, and can carry over 125,000 passengers daily[17].



Large	Train length	61 m
	Shaft weight	11 t
	Nominal riding capacity (0.3 m²/person)	415 Persons
	Planned passenger volume (0.14 m²/person)	693 Persons
	Full capacity (0.1 m²/person)	966 Persons
Medium	Train length	57 m
	Shaft weight	10 t
	Nominal riding capacity (0.3 m²/person)	348 Persons
	Planned passenger volume (0.14 m²/person)	580 Persons
	Full capacity (0.1 m²/person)	858 Persons
Compact	Train length	40 m
	Shaft weight	9 t(Average)
	Nominal riding capacity (0.3 m²/person)	170 Persons
	Planned passenger volume (0.14 m²/person)	280 Persons
	Full capacity (0.1 m²/person)	380 Persons

Fig.3. Large, Medium, and Compact Monorail Systems

The monorail train ensures a comfortable and safe travel process from traffic jams and congestion, and is resistant to natural conditions such as heat and wind. The capacity of the monorail varies depending on the size and operating time interval, ranging from approximately 2,000 to 33,000 passengers. In addition, its cost is equivalent to the cost of the subway, a means of transportation that supports people with special needs and the elderly, and supports commercial activities and daily communications.

If a compact monorail system consisting of four cars is operated at 10-minute intervals, its one-way carrying capacity per hour will be 2,000 passengers, and if operated at-2.5 minute intervals, the capacity increases to 7,000 passengers. This carrying capacity is approximately half of that of a large monorail system, 1.6 times of LRT, and about four times of buses.

2.3. The effect of monorail on uses

2.3. 1 Effective Utilization of Urban Space

Monorails can be constructed over existing roads, parks ,squares, rivers, railroad tracks, etc., exploiting the potential for flexible alignment. Less requirement of acquiring new land plays a significant role in efficient installation of monorails.

2.3.2 Contributing to urban renewal

The installment of a monorail system in company with the construction of urban facilities such as shopping centers ,hospitals, cultural buildings, and general playgrounds can act as an integral part of urban development/renewal projects to help resolve various urban issues such as reactivation of downtown areas and enlivenment of cities, while efficiently reorganizing urban traffic systems[25].

2.3.3 low pollution and environmental impact

Monorail is environmentally friendly as CO_2 emission from monorail is almost equal to that of railway. Proponents of monorails argue that monorails have both low construction and operating costs, have very low accident rates

because of being elevated away form surface traffic, are environmentally friendly and aesthetically pleasing [1].

2.3.4 Increasing the number of daily trips on the monorail compared to other means of transportation to reach 48,000 people per hour **Fig. 4** Number of people crossing a 3–5 m-wide space in an hour in an urban environment. Source International Association of Public Transport (UITP) [12].

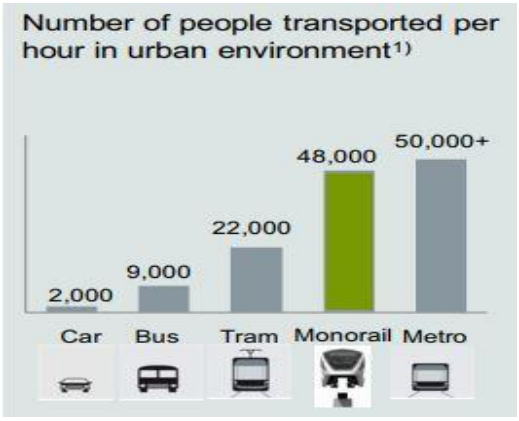


Fig.4 . Transport capacity**.**

3. The urban system of the city

3.1 Formation of the city's urban system

The city's urban system consists of three systems as follows: [23].

- Urban structure: in terms of the spatial distribution of activities (land uses) and the urban condition of the buildings they contain.
- Movement structure: It consists of movement channels (network of motorized movement paths - pedestrian paths) and flow (transportation), which includes the movement of people and goods.
- Visual formation of the city: Resulting from the relationship of the interstitial spaces between urban structures and movement. The urbanism and movement systems are linked to each other through the influential relationships between them, as the movement structure system aims to achieve the possibilities of access to various activities within the city. The urbanism system is also linked to the spatial distribution of activity structures, and the interaction of the components of the urban system leads to a continuous interaction between them to a successive development in each of them, as they are linked. Transportation movement in the city using its land uses as the source of the beginning and end of trips.

3.2 Factors affecting land use in the city

There are factors influencing the spatial change in land use in major cities, including [19]:

- **Economic factors**: They are (supply and demand - land ownership and profit motives - ease of access and movement network - land value and competition factor)
- **Political and organizational factors**: (the political and administrative system of the state - political decisions - the ability of administrative authorities to understand the problems of the current situation).
- **Social factors**: (social and cultural interactions - employee mobility process - class composition - extent of mobility and spatial relocation)
- **Urban factors**: (spatial and functional relationships of uses - the impact of planning decisions and projects).

Population numbers, population density, and time are considered variables that affect the city's growth by 95.4%, and the rest represents 4.6% of the reasons for growth, such as (land use) or others[13].

3.3 The impact of axes on the structure of uses

The axis varies from being (road - metro line - railway line - monorail line - electric train), and commercial use is linked to the networks of those axes through expected impacts on the surrounding uses, the most important of which are the following:

Localization of commercial activities and uses along the main traffic arteries: Commercial and administrative activity grows along the traffic arteries and its attraction increases with increased traffic along those axes **Fig. 5** shows the theoretical relationship between the road network and land uses in the city[7]. When any new axis is created in the heart of existing urbanization, changes occur in the structure of that urbanization and the uses of existing lands 4. So that there are changes to the urban area [3]. **Fig. 6.** [2]. shows the effect of opening new roads on commercial uses, as spaces increase. Commercial to increase traffic volumes.

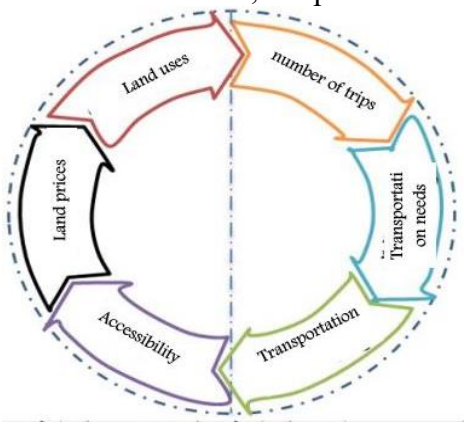


Fig.5. The theoretical relationship between axes and land uses

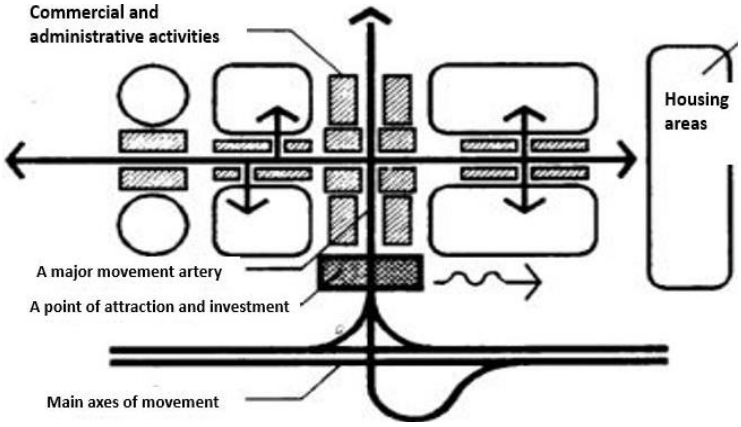


Fig. 6. Localization of commercial uses on the main center's arteries

Since the monorail is a suspended means that does not interfere with other uses, it represents a light means of transportation, which confirms the growth of commercial uses on the surrounding streets, especially at the monorail stations (interchange and subsidiary), which are considered a commercial and service attraction point. Traffic congestion is expected.

3.4 Theories for explaining the relationship between axes and land uses (Economic Theories):

Economic theories: The theory assumes the following foundations:

- Land value: The plot of land is used to achieve the highest economic return. The higher the expected return, the greater the competition for it until a balance occurs through market forces of supply and demand.

- Return: The value of the land is directly proportional to the return expected from it, depending on the area in which the plot of land is located and the ease of access to it.

- Ease of access: Distribution of locations of services and activities according to ease of access to them, accessibility, in order to achieve the appropriate economic return. This is explained by the fact that with the passage of time, the city grows horizontally, and the price of the land in its center increases due to its increasing importance, so the center extends vertically to increase the degree of investment so that the ratio of the return that the land generates to its value remains constant. At least as it is, residential uses are expelled from the center to be replaced by commercial and administrative uses, which achieve greater economic returns [23].

There are also two factors that affect the location: (the value of the land - transportation costs) and increasing the price of the land increases the degree of investment, and thus the main extension increases until it overwhelms the neighboring residential areas and is replaced by commercial uses that achieve a greater return.

The localization of a new transport axis leads to a change in the degree of accessibility, and thus a change in uses, and the value of the land investment becomes what determines the method of its use [3] **Fig. 7**. The distribution method depends on knowing the characteristics of these activities, their competitive ability, and the total return from their exploitation, **Fig. 8** [14]. The rental value is considered an important variable that expresses the size of the net return for urban activities and uses in general and commercial uses in particular **Fig. 9** expresses the spatial organization of uses according to their ability to operate urban spaces [7].

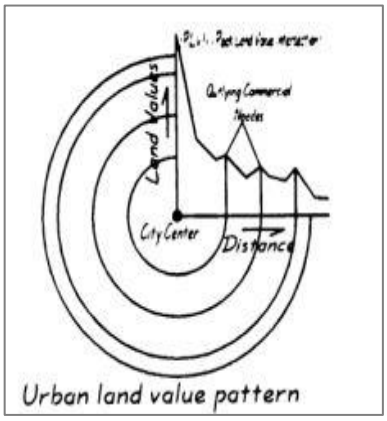


Fig. 7. The relationship between land value and distance from the heart of the city

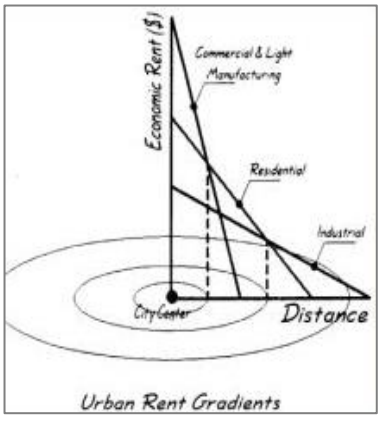


Fig. 8. The economic return curve from the site and the distribution of uses

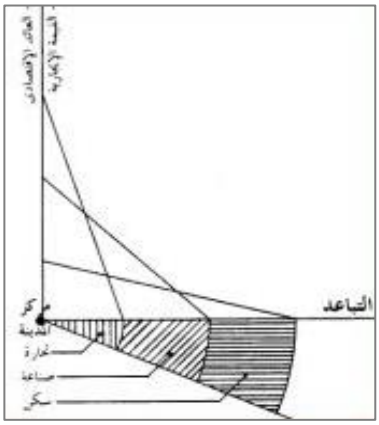
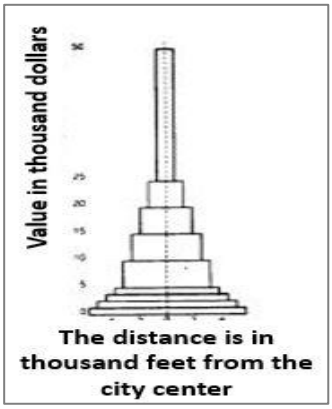


Fig.9. Distribution of uses according to the value of the land

The difference in the price of land affects the redistribution of uses and the change in its functions, and it becomes clear that commercial land commands the highest price, as **Table 2** shows the relationship between the uses of the land and its value[7].

Table 2. Relationship between the uses of the land and its value.

Land use	Land value
Commercial area (central)	The highest value of any area in the city.
Industry areas	The value of the land is as great as the accumulated hills.
Residential areas have a density ranging from center to end The intensity of use of the place decreases as we move away from the center.	The value of land is inversely proportional to its distance from the center The simplified form of land value is more complex.
The value of the land affects the intensity of use of the site.	The intensity of site use affects the value of the land.



- **Land-use succession theory** to explain the relationship of axes to land uses [23].

It is clear from these theories that there is a strong relationship between land uses and the possibilities of access to them within the framework of the urban and movement systems, as each of them is affected and affected by the other in an impact that extends to changing the nature of use in the urban structure, especially land uses, and to the development of the movement structure system. By studying the theoretical relationship between land use in the urban structure and transportation services in the movement structure, taking into account the identification of other influencing factors, the following becomes clear:

- Identify each use within the city (residential - commercial - administrative - ….).
- Each use results in a certain amount of trips depending on the type of use, its size, and the intensity of its activity.
- The increase in trip rates increases the demand for transportation in quantity and quality to accommodate this increase in trips.
- The increasing needs for transportation and traffic are met by improving transportation services, including roads, vehicles, traffic operating systems, etc. Thus, the city's land use affects transportation services by generating various trips.
- Increasing transportation services increases access for a larger number of people for these uses.

• When these uses are easily accessible, their demand increases and their economic return increases, and thus the value of those lands increases.
• As the value of the land changes, some of the existing uses become unsuitable, because they do not give the economic return that is commensurate with the new value of the land, so these uses gradually change to other suitable uses, and thus improving transport and communications services affects the uses of the lands by increasing accessibility to them.
• As land uses change, the cycle returns to its beginning, and the reciprocal cycle between land uses and transportation services begins again, taking into account that if transportation and communication services are not improved, the cycle will tend toward decline until the influence of the various variables appears after a period.

The influential relationships between urban structures and movement can be explained as follows:

• Uses are affected by transportation services: through their need for new requirements for transportation and traffic, as well as their need for a certain accessibility in order for the development process to continue, as land uses generate large numbers of trips that require their service by means appropriate in type and quantity.
• The impact of transportation services on land uses: By providing transportation and traffic services for accessibility as a tool that controls land uses, and thus affects the structure of these uses and constantly reshapes them, whether in existing urban areas or in new urban areas that join the city, as well as affecting the density of uses. Various things in the city.
• It turns out that when transport and communications services are increased, for example, establishing a new traffic artery or developing a traffic artery, this has an impact on the urban structure, especially land use, and therefore this requires studying these impacts and how to invest optimally in them **Fig. 10.** shows the relationship between transportation and land use[26].

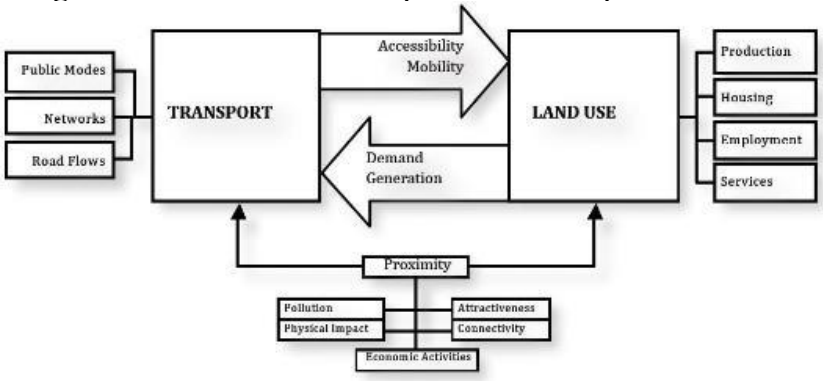


Fig. 10. The relationship between transportation and land use

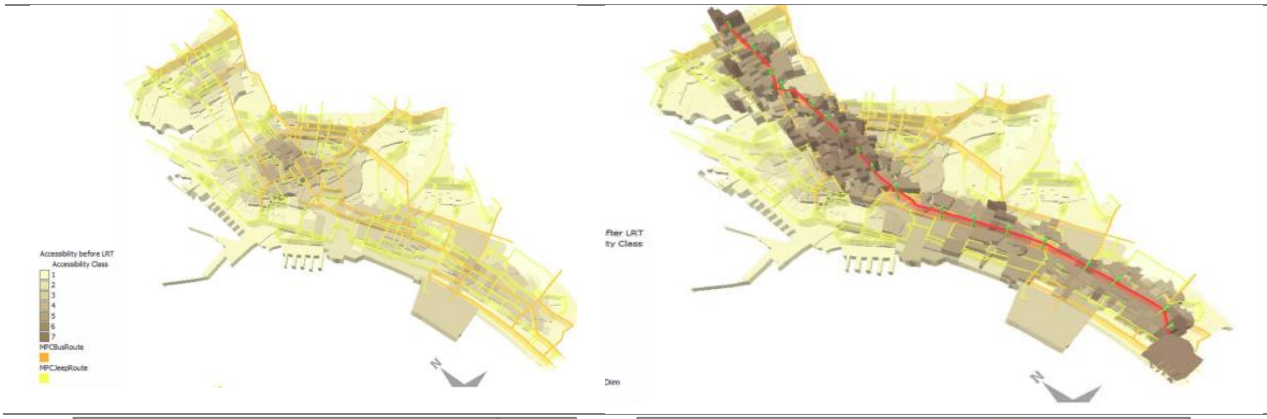
4. The effect of using monorails on the change in land use (experiment analysis

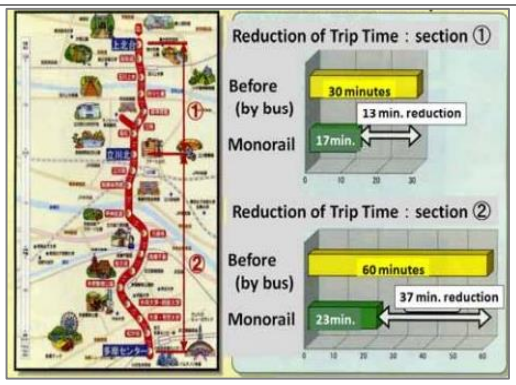
4.1 Case study (Manila in the Philippines - Tama in Tokyo - Dubai in the Emirates).

Looking at **Table 3** shows the methodology for measuring change in land use in the areas surrounding transportation in the city of Manila, Philippines, And Beijing City, China [30], And Tama in Tokyo, and the observed results, **Fig. 11** shows the impact of the Tama Monorail in Tokyo on land use[31].

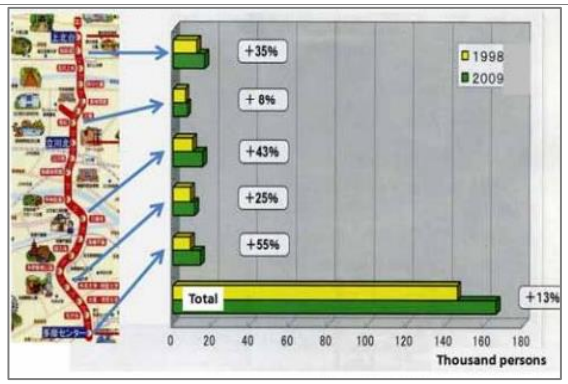
Table 3.

the Study	Measurement methodology		Results
Manila, Philippines (Ragos (2010,	Geographic Information System (GIS), to determine the impact, accessibility indicators were compared through variables (residential and commercial property values; residential and commercial land use and population density). From 1986 to 1996.	• The population declined due to the growth of the city, the development of new local central business districts, and residents' desire for open spaces free of congestion, which led to a migration away from the city centre.	• After the construction of the metro, residents preferred to live in places farther from the city center. There was also little association between distance/accessibility[31],With land value affected by accessibility, Commercial land values stabilized and residential land values increased.

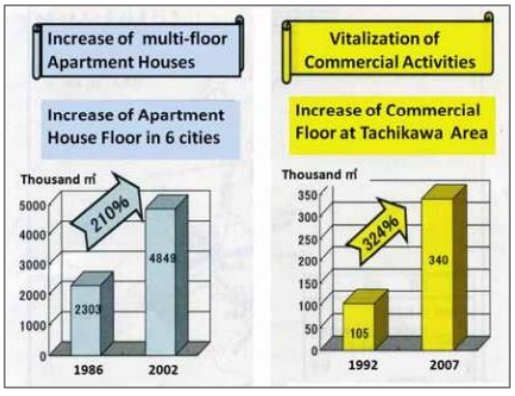




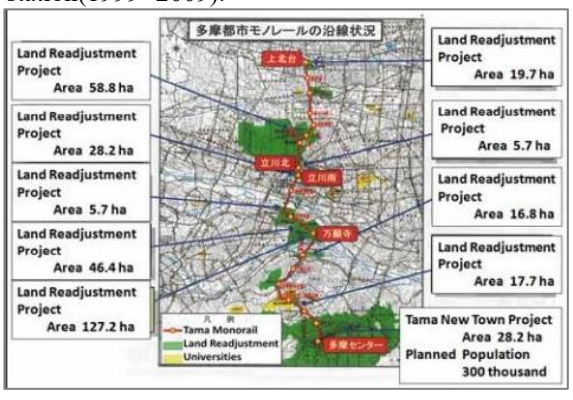
Reduction of Trip Time



Population Increase at the areas surrounding main station(1999- 2009).



Increase of multi- fioor Apartment Houses(Increase of Apartment House floor in 6 cities).Vitalization of commercial Activities(Increase of commercial fioor Tachikawa Area)



Monoril and alonge side Urban Development Projects

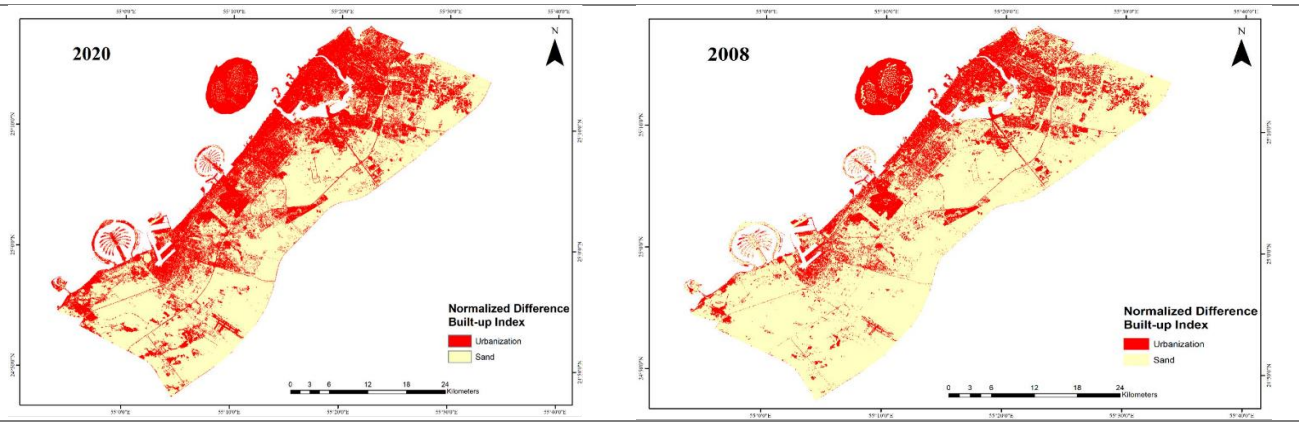
Fig. 11. The impact of the monorail in Tama City, Tokyo on land use change

4.2 Study the impact of using the Dubai Metro on the change in land use

Studies indicate that there is a significant success in public transportation infrastructure in Dubai. Since the Dubai Metro system is widely known as one of the most advanced systems in the Gulf region, the establishment of the Dubai Metro system played an important role in ensuring the sustainability of the city. The world's longest automated driverless train system was built in less than four years with the inauguration of the Gulf region's first Metro [6]. An LRT system offers a large carrying capacity and is environmentally friendly spanning 75 kilometers [21] . It uses about half as much energy per passenger kilometer as a road-based system. The first phase of the metro includes 70 kilometers of lines and 47 main metro stations as well as 9 underground stations. It consists of two metro lines: the Red Line, which serves 29 stations with a route of 67 km, and the Green Line, which serves 18 stations, with a route of 23 km. The metro serves 32,000 passengers every hour, or about 10% of Dubai's population [29] **Table 4**.

Table 4. the impact of the Dubai Metro on land use.

• **Developing commercial lands and developing buildings next to the Dubai Metro, which helped localize new projects in the surrounding metro stations such as Discovery Gardens, Al Furjan, Jumeirah Golf Estates, and Dubai Investment Park.** • **Achieving connectivity and connectivity to these highly populated urban areas. It also serves new vital projects and operates them with great speed.**	•Dubai's land area is covered by 27.49%, approximately 15% of the land has been developed, Population densities increased from 2008 to 2020, from 58 people per km2 to 118 km2, High densities in areas around the metro. •The metro helped provide accessibility, which increased land values, High demand for residential purposes and commercial activities. •Residents settle near the metro due to the availability of services and its proximity to the city center.



Land uses in Dubai in 2008 and 2020

Areas in red (red) show building infrastructure, including the road network, buildings, parks, and other constructed features, and light yellow shows the non-buildable area and the sandy area that is not built. . The urbanization rate represents 42.18% compared to 27.49% in 2008.

It appears that the Dubai Metro had an impact on land use through the following:

- Commercialization represents a major element and attractive core of the TOD model.
- Achieving connectivity and linking uses.
- Improving facilities on roads connected to the metro.
- High building densities and expansion of residential areas.
- Increase in residential buildings, green spaces, and commercial and industrial spaces due to the availability of rapid transportation.
- The value of the area has increased through the connectivity and accessibility provided by the new transportation network.

International experiences have shown that a major impact is expected on the movement and urbanization system, especially at the sites of monorail train stations, as they indicate a change in traffic flows, whether pedestrian or vehicle traffic, and thus this affects the occurrence of congestion in the main axes surrounding the stations, in addition to the emergence of random parking and the spread of Commercial activities. Urban growth and random sprawl also occur on vacant lands, which requires the development of plans and controls to control the expected effects. The following figure shows the main axes expected to increase the intensity of vehicle and pedestrian traffic in them, in addition to the urban growth trends for stations that are surrounded by vacant lands.

5. Study of the Nasr City Monorail (Greater Cairo)

Greater Cairo has been suffering from transportation problems for many years as a result of the huge concentration of various activities there, Its population is constantly increasing significantly until it reached about 14.0 million people in 2001[5],The means of urban transportation in the Greater Cairo region are diverse, including: (metro, tram, monorail, public transportation network, private transportation network, and car). Nasr City is considered one of the most important urban areas in Cairo [15] and one of the planned areas nationwide. Its urban plan differs from the rest of the neighbourhoods, as it has a grid layout of roads and axes in the form of parallel and perpendicular roads, which affects the means of transportation in terms of the large number of intersections and traffic signals [22].

It represents the first monorail to be implemented in Egypt and represents a major cultural shift in public transportation. Its trains will run automatically without a driver, have a high-capacity air conditioning system, and be equipped with a safe corridor that allows passengers to move between cars for greater comfort, and its speed will reach 80 km/h. Two lines with a length of approximately 98 km are currently being implemented, the first is the Administrative Capital - Stadium and the second is 6th of October - Mohandessin.

The Administrative Capital Monorail train has 22 stations, **Fig. 12** [20]. It is (Stadium - Hisham Barakat - Al-Azhar University - Seventh District - Free Zone - Al-Mushir Mosque - 90th Street - Air Hospital - Twist Hotel - Future University - Emaar - Al-Nafoura Square - Al-Barwa - Beit Al-Watan - Al-Fattah Al-Aleem Mosque - Residential District R2 - The Ring Road Regional - Al Masa Hotel - Governmental District - Embassy District - Administrative Capital) [34] Nasr City has 5 stations: (Loyalty and Hope - Al Salam Mosque - Hassan Maamoun - Al Ahly Club - Workers University). The Administrative Capital monorail passes through the cities: (Nasr City and Al-Mosheer Axis / Settlement and New Cairo / Central and Regional Ring Road / Administrative Capital).

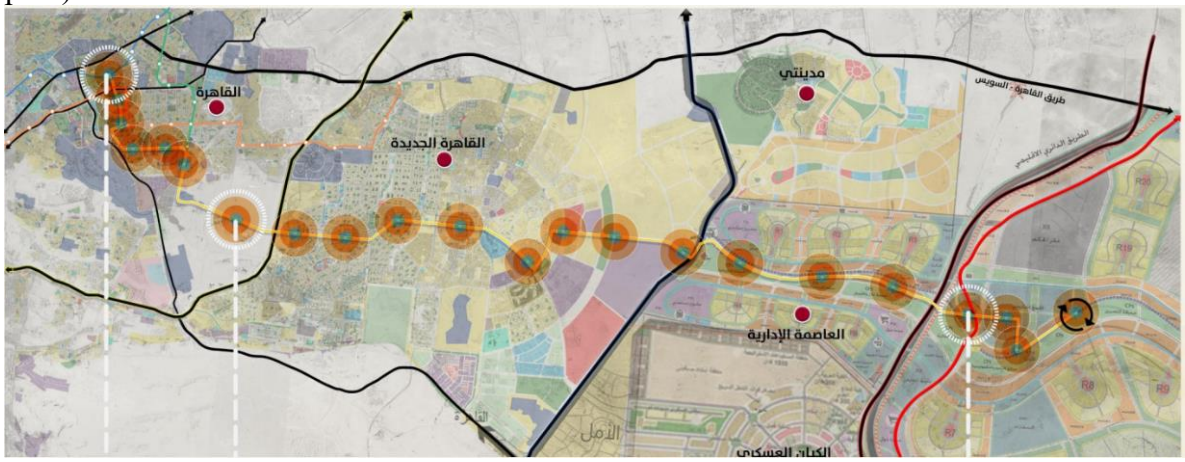


Fig. 12. Nasr City Monorail route and stations

As for the 6th of October Monorail: The length of the 6th of October City monorail line is 42 km and the number of stations is 12 stations, including (New October - Industrial Zone - Sadat - 6th of October Authority - Engineers Syndicate - Nile University - Hyper One - Alexandria Desert Road - Mansourieh Road). - Mariouteya Road - Ring Road - Nile Valley).
The capacity of each of the two monorail lines is 600,000 passengers per day, and its trains are characterized by the fact that they operate without a driver and their design speed is 90 km/hour, and the crossing time in the monorail lines is 90 seconds.

5.1 Land uses in Nasr City

There are vital land uses in Nasr City such as Al-Azhar University, Cairo International Stadium, Cairo International Conference Center, many clubs, many national and international schools, many government buildings, several shopping malls and the pyramid-like landmark representing the Soldier's Monument. All of these vital land uses have put the region under pressure,

Nasr City enjoys many different services and features at the same time, as it has:
Health services (hospitals and clinics), famous schools, shops and commercial markets, public parks, restaurants and cafes, sports clubs, administrative buildings and halls designated for events, famous government buildings. Residential use dominates the area and amounts to 14.25% of the area, and commercial activity represents 7.87%, **Fig. 13** ., **Fig. 14.**

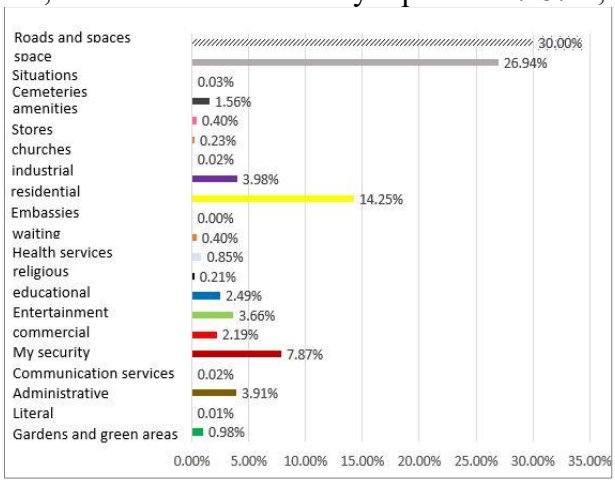


Fig. 13. Land use percentages in the Nasr City area

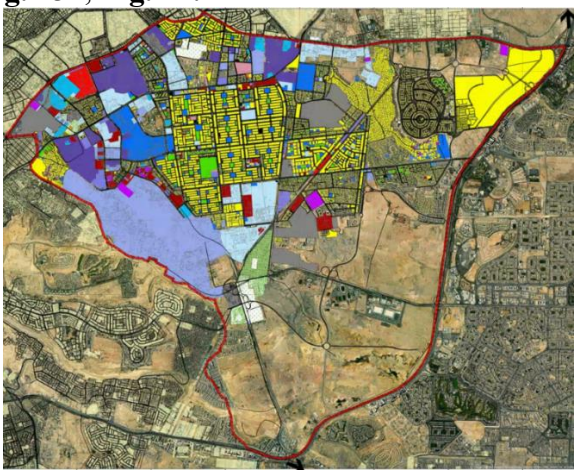


Fig. 14 . Land uses in the Nasr City area.

This had a negative effect in reducing the green spaces on the main roads, as the central islands were removed from the roads, causing the absence of a green corridor on the roads [18]. **Fig. 15.**

Fig. 15. New bridges in Nasr City

The analytical study on the Nasr City neighborhood shows the following:

- Nasr City is considered a planned city that contains a distinct urban structure and a network of good streets and commercial hubs that make it a distinguished center for many commercial activities.

- There is a high population density growth and many citizens tend to live in Nasr City despite the high price of land, but it is considered one of the attractive areas due to the large number of commercial activities, offices and services.
- There are many unexploited urban lands whose ownership is subject to the state and the armed forces. Therefore, future detailed plans must be made to control the urban growth of these areas and set controls and requirements to prevent random growth.
- The need to activate the role of the plans being implemented for the areas of Ezbet Al-Hagana and Ezbet Al-Arab to limit the spread of slum areas.
- A number of bridges and axes were constructed to reduce traffic congestion, which had a bad impact on the green spaces, added to the city's appearance, and distorted the visual image in some areas.
- Nasr City is considered the main gateway for transportation, and therefore many development plans have been implemented. One of the most important plans proposed by the state is the establishment of a new monorail line linking the metro lines and traffic networks to the new administrative capital, which is the monorail line.
- The importance of the monorail is not limited to linking the Greater Cairo region to the Administrative Capital and facilitating the movement of employees and expatriates from Cairo and Giza to New Cairo and the Administrative Capital, but in fact, the monorail is considered a turning point in the regions through which it passes because of its impact on the urban structure system and the movement system, as it contributes In developing these areas, especially the areas around the interchange stations, due to the large number of passengers, which reach one million passengers daily.

5.2 The importance of the Nasr City monorail

The project will contribute to accelerating the development of the Administrative Capital, linking Greater Cairo to the capital and facilitating the movement of employees and expatriates from Cairo and Giza to New Cairo and the Administrative Capital by integrating it with the third line of the metro at the Stadium Station in Nasr City and with the electric train at the City of Arts station in the New Administrative Capital. It also works to reduce pressure on Cairo and connect it to new cities.The project's design speed is 80 km/h, and it can accommodate a quarter of a million passengers daily. The Nasr City monorail line connects Cairo and the New Administrative Capital in a time period of 60 minutes. This line (Administrative Capital - Nasr City) extends over a length of 56.5 km. The monorail route includes 21 stations, and the length of the monorail in the Administrative Capital is 52 km. The monorail in Egypt will also change the residential map of the areas in which it is located. In addition to connecting various parts of Cairo to each other, the monorail will also accelerate movement between these neighborhoods.

5.3 Monorail route

The monorail is distinguished by its ability to be implemented in difficult places, narrow and crowded streets that have large horizontal curvatures, and does not require many modifications to the facilities, and the expropriation of property is greatly reduced. The monorail will connect Nasr City to the Administrative Capital, where it will exchange service with the third line of the metro at the Stadium Station on Street. Youssef Abbas, reaching Al-Khalifa Al-Dhafer Street and the Seventh District, passing through Zakir Hussein Street, arriving at Loyalty and Hope, then heading to the Field Marshal Tantawi Axis and the southern 90th Street, arriving at Beit Al-Watan, then passing through the neighborhoods of the New Administrative Capital.

This path has many high-density residential blocks, and the monorail is distinguished by its implementation on an upper path in the central island of the streets through which it passes and does not occupy any parts of the street.

The monorail passes within the boundaries of the Nasr City neighborhood at 7 stations: (Stadium, Hisham Barakat, Nouri Khattab, Seventh District, Zakir Hussein, Free Zone, Field Marshal Tantawi **Fig. 16** and a model of analytical studies of monorail train stations will be presented to determine their impact on land use. The surrounding stations were chosen (Stadium - Hisham Barakat).

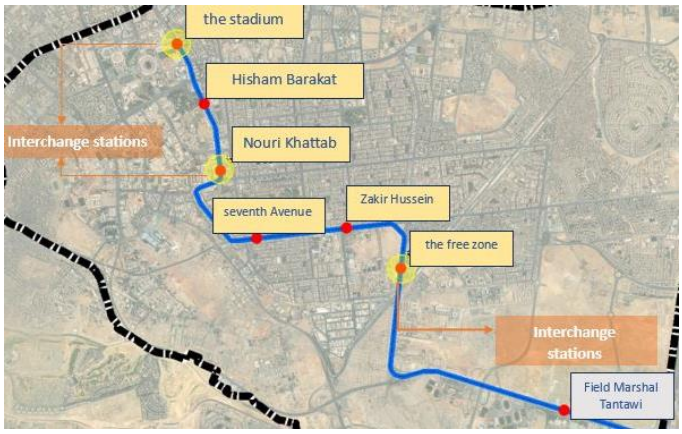


Fig. 16. Nasr City monorail route

5.3.1 Stadium Station (interchange station)

The Stadium Station is located at the beginning of the monorail line **Fig. 17** and it is considered the first station. It also interchanges with the third line of the metro, and it is expected that the station will have the largest daily volume of passengers. The Stadium Station is located on the Youssef Abbas axis in front of Khader Al-Tuni Street, and it is considered It is one of the most important monorail stations because it is located in a group of distinguished uses that are frequent and attractive to citizens, as there are a group of administrative services (the Central Auditing Organization - the conference hall - the Ministry of Planning -...), and many educational and health services and commercial activities with the presence Cairo Stadium, which is considered the official stadium of the Egyptian national football team.

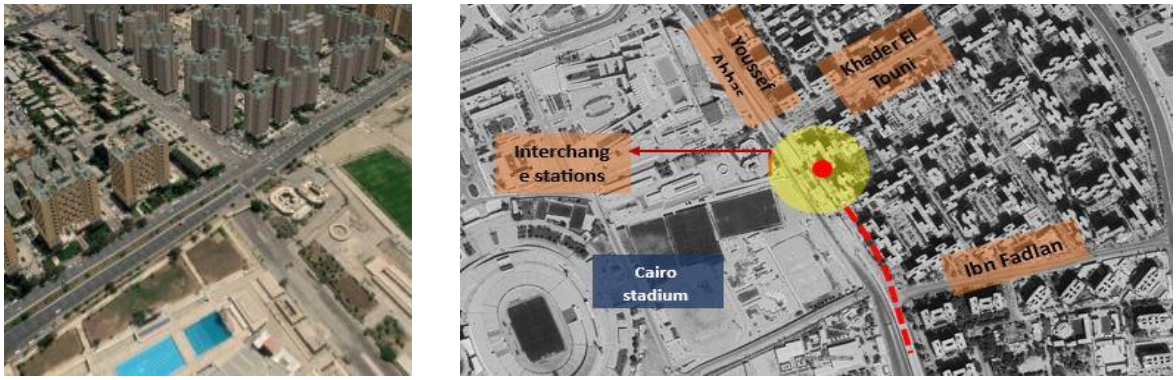


Fig. 17. Stadium station location

An analytical study was conducted on the expected change in land use within the scope of influence of the interchange stations, which is expected to reach 800 metres, in addition to studying the expected change movement in the axes surrounding the station.

Fig. 18. Land use surrounding the stadium station with an area of influence of 800 metres.

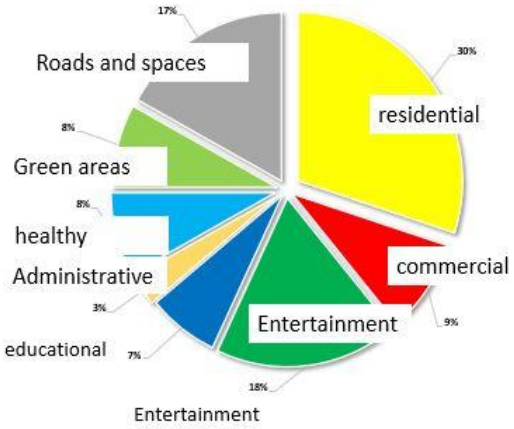


Fig. 19. Land use percentages in the stadium area

According to the map of the uses of the current status of the stadium station, as shown in **Fig. 18** the following effects are expected to occur **Fig. 20** :

It has been shown that there have been changes in the rates of some uses. According to the current status rate of residential use, which reached 30% and the rate of commercial activity, which reached 9%, it is expected that the proportion of commercial activities will increase to reach 12%, especially in the ground floors, where

The ground floor of buildings is exploited as commercial activity units, **Fig. 19.**

- There is an increase in the prices of surrounding lands, especially those located in the direct range, and they gradually decrease as we move away from the station's range of influence. The range was divided as shown in the figure, and it is expected that there will be an increase in prices in the first direct range of up to 25%.
- The spread of street vendors in the main axes and surrounding streets.

It is expected that commercial activities will focus on the Cairo Stadium wall, whether in kiosks or a spread of street vendors.

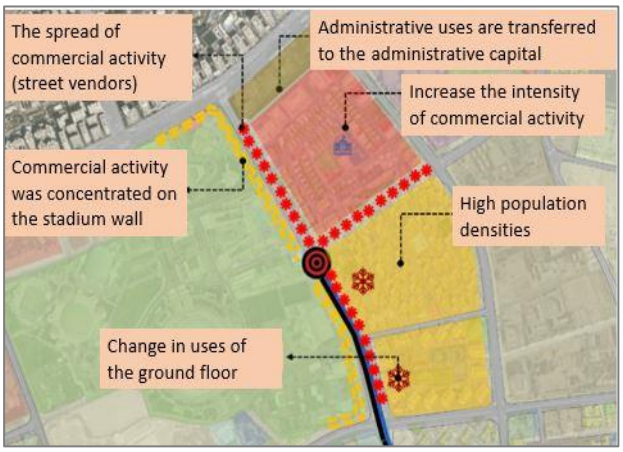


Fig. 20 . Changes expected to occur in the urban structure

- Within the scope of the station's influence, there are some administrative uses, such as the Ministry of Planning, which was transferred to the Administrative Capital, and thus they became unexploited plots of land and it is expected that urban expansion or the spread of commercial activities will occur.
- Increased population density in the surrounding areas as a result of vertical densification near the stations and gradually decreases as we move away from the station.
- There is a change in some existing activities and replacing them with new activities that are more suitable for For the region and is more economically feasible, whether that is (by maintaining the quality With a change in the nature of the activity (or replacing one type with another), such as Replace housing activity with commercial or service activity.
- The stadium station is considered one of the most important stations, as it is expected that the rate of passenger flows will increase, especially during match times, and it is also the connection point with the metro line.
- There is a development in existing activities due to the new situation, as the quality of service develops. Introduction and its level increases.

- The emergence of random stops for public transportation, such as buses, minibuses, and microbuses, especially in the immediate vicinity of the station and on the main axes, which causes traffic jams.
- Traffic congestion occurs in front of the station, especially during peak times and times when there are activities and matches taking place in the stadium.
- Increased parking on surrounding roads and axes, which may cause traffic congestion.

The development scopes of the stadium station can be determined according to Fig. 21 .three scopes as follows:

- An area within the immediate area of 250 m. Land prices will rise by25%.
- An area within the immediate area of 800 m. Land prices will rise by 15%.
- An area within the immediate area of 1500 m. Land prices will rise by 5 to 10%.
- The impact of the stadium monorail station appears through (the occurrence of traffic knots in the axes in the immediate area, an increase in the density of motorized traffic, the appearance of random parking, density in pedestrian traffic, density due to the stadium, especially at peak times, traffic and pedestrian congestion around the station in the direct area), **Fig. 22 .**

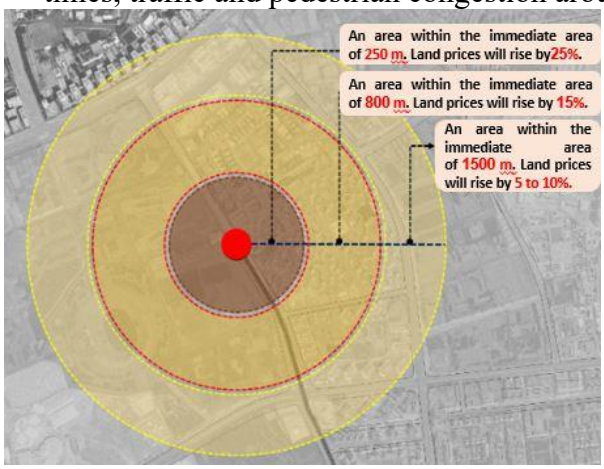


Fig. 21 . Scopes of expected development at Stadium Station

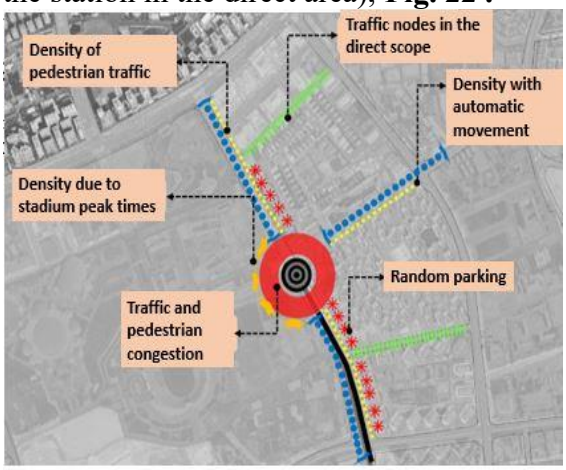


Fig. 22 . The impact of the stadium station on the surrounding area

5.3.2 Hisham Barakat Station (substation)

Fig. 23 . Location of Hisham Barakat station

It is the second station and is located on Youssef Abbas Street and Al-Nasr Road, **Fig. 23** and is located next to central services such as Dar Al-Fawaed Hospital and Health Insurance Hospital. The direct scope of the station is divided into two parts. The first: a group of mixed uses, including commercial activities, educational services, health services such as a health insurance hospital, and residential use amounting to approximately 22%, **Fig. 24** of the total surrounding uses. As for the second part: it is a military area and an entertainment services area. Such as Al Bus. Hisham Barakat station location tan Park and health services (Dar Hospital).

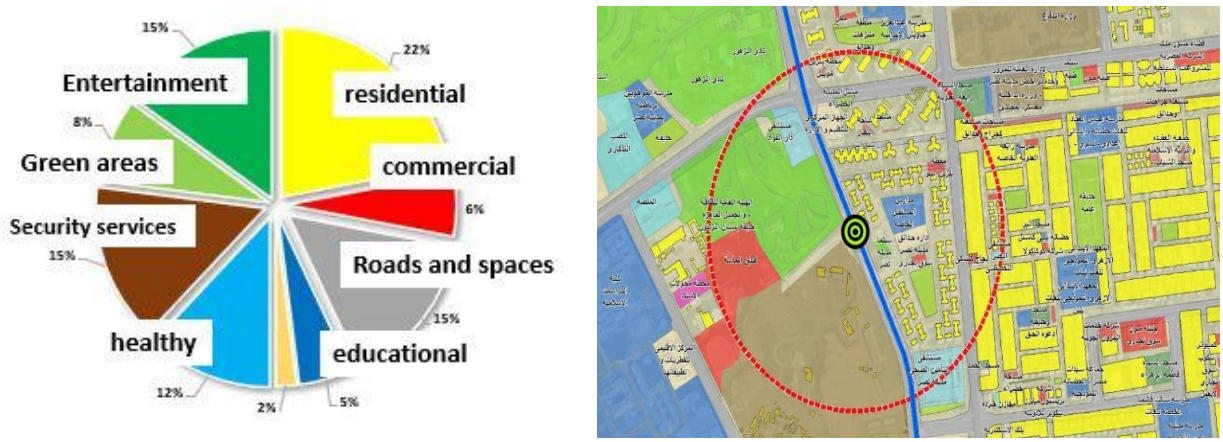


Fig. 24 . Land uses surrounding the Hisham Barakat station

An analytical study was conducted on the expected change in land use within the expected range of the impact of the substations, which reaches 500 metres, in addition to studying the expected movement of change in the axes surrounding the station.

Fig. .The changes expected to occur in the urban structure within the Hisham Barakat station **25**

According to the map of the uses of the current status of the Hisham Barakat station, the following effects are expected to occur Fig. 25 :

- There will be changes in the percentages of some uses. According to the current status rate of residential use, which reached 22% and the percentage of commercial activity, which reached 6%, it is expected that the percentage of commercial activities will increase to reach 10%, especially in the ground floors, where the ground floor of buildings is exploited as commercial activity units.

- There will be an increase in the prices of surrounding lands, especially those located in the direct area, and they gradually decrease as we move away from the station's area of influence. It is expected that there will be an increase in prices in the first direct area of up to 20%.
It is expected that commercial activities will be concentrated on the garden wall and the hospital, with kiosks or street vendors spreading out.
- Increased population density in the surrounding areas as a result of vertical densification near the stations and gradually decreases as we move away from the station.

- There is a change in some existing activities and replacing them with new activities that are more suitable for for the region and is more economically feasible, whether that is by preserving the quality while changing the nature of the activity) (or replacing the quality with another), such as Replace housing activity with commercial or service.
- There is a development in existing activities due to the new situation, as the quality of service develops. The introduction is increasing and its level is rising.
- The emergence of random stops for public transportation, such as buses, minibuses, and microbuses, especially in the immediate vicinity of the station and on the main axes, which causes traffic jams.
- Increased parking on surrounding roads and axes, which may cause traffic congestion.

The range was divided, as shown in **Fig. 26** into three ranges as follows:

- An area within the immediate area of 250 m. Land prices will rise by 20%.
- An area within the immediate area of 500 m. Land prices will rise by 10%.
- An area within the immediate area of 1000 m. Land prices will rise by 5%.

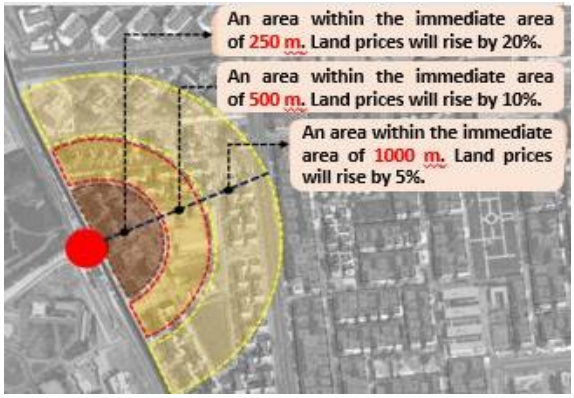


Fig. 26 . Expected development scopes at Hisham Barakat station

5.3.3 Analysis of the expected impact on monorail stations (Stadium Station)

It is possible to analyze one of the monorail stations(Stadium Station) and its impact on the surrounding areas, which appear through the previously identified areas, as the following, and reach the proposed uses in light of the station's impact, while determining the strategic decisions for development around it and the principles of planning the buildings and the proposed heights, , as well as the proposed uses, in light of that analysis **Fig. 27.** It includes the following ranges:

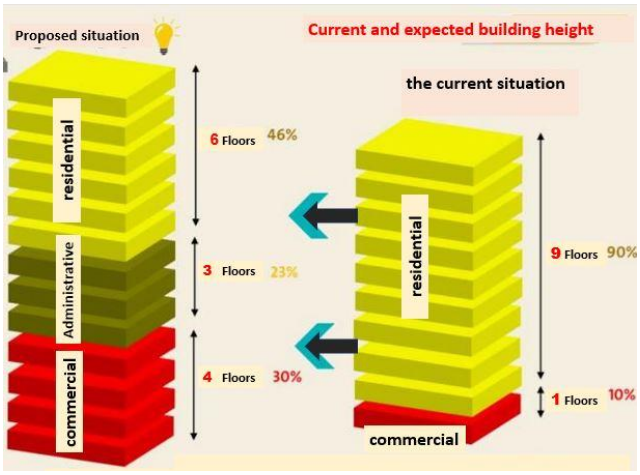


Fig. 27. Expected building heights around the monorail station

5.3.4 Ranges

✓ **First domain (direct)**

− Introduction to the region

The area located directly around the station within a range of about 250 meters from the center of the station, and is integrated with pedestrian, bicycle and car paths and transportation networks,

− the current situation

•There was an increase in the percentage of residential use by about 25%.
•There is a deficit in the percentage of commercial use of about 25%.
•There is a deficit in the administrative utilization rate of about 25%.
•There is a deficit in the percentage of green and open areas of about 7%.
•An increase in the proportion of roads for vehicles and vehicles and the absence of pedestrian roads.

•An increase in the proportion of vehicle and automobile roads, the absence of pedestrian roads and the presence of local uses, which are then not compatible with the presence of the station and the high-frequency traffic on it.

- **Suggested uses**
  - Connecting the station with the surrounding buildings via a pedestrian bridge to increase traffic volume and frequency
  - Increase the proportion and intensity of commercial activity in the region so that it can accommodate the volume of movement and changes in the region
  - Connecting the station to Cairo Stadium and localizing uses that integrate with the station and the stadium
  - Increasing pedestrian roads leading to the station and localizing commercial uses on both sides
  - Localize and increase the proportion of administrative activity in proportion to the nature and function of the new region

✓ **The second domain (perimeter)**

- **Introduction to the region**

It is the area located outside the station center and 500 meters from the station, which includes the largest concentration of housing. It is a community consisting of a mixture of residential, commercial and administrative uses and green areas.

- **the current situation**

•There is an increase in the percentage of residential use
•There is a deficit in the percentage of commercial use of about 12%.
•A deficit in commercial services in the region.
•Deficit in administrative utilization rate.
•There is a deficit in the percentage of green and open areas.
•An increase in the percentage of vehicle and car roads and the absence of pedestrian roads. An increase in the percentage of vehicle and car roads and the absence of pedestrian roads. The presence of local uses, which are then not compatible with the presence of the station and the high-frequency traffic on it.

- **Suggested uses**

Reuse of the residential areas and ministries that will be transferred to the capital
•Increase the proportion and intensity of commercial activity in the region so that it can accommodate the volume of movement and changes in the region
•Reusing unused green areas and connecting the station to all surrounding bus stations
•Connecting the station to commercial axes and streets with surrounding and endemic uses to integrate with it

✓ **The third (most comprehensive) scope**

- **Introduction to the region**

It is the area located outside the station center and 2 km from the station, which works to connect the station to the city center and increase connectivity with the surrounding regional areas and uses.

- **the current situation**

•High connectivity in the administrative capital.
•High connectivity to surrounding areas and uses, high-frequency uses.
•The uses that will be transferred to the administrative capital.
•The presence of large brown field areas
•The presence of local uses, which are no longer compatible with the presence of the station and the high-frequency traffic on it, the increase in the proportion of roads for vehicles and vehicles, and the lack of pedestrian roads.

- **Suggested uses**

Localizing an investment area that includes the following uses

•A health club, a playground area for clubgoers, a sports hotel, a squash building, international tennis courts, a children's play area, a services building, a cinema building, a swimming pool building, a multi-purpose hall, a social building, a youth library, commercial stores, a cultural center, and restaurants. Equestrian club, medical center, training center.

5.3.5 Key decisions

• Converting the streets leading to the station into pedestrian streets and paths instead of motorized roads, with commercial uses distributed on both sides of the street to serve passengers boarding and descending from the station, and re-utilizing the green areas to suit the proposed uses and suit the nature of activities in the area.

• Connecting the station to Cairo Stadium to avoid traffic paralysis during matches.
• Settling a hotel to receive guests and the sports delegation.
• Increase the density of commercial activity by linking the buildings surrounding the station.
• Settling a hotel to receive guests and the sports delegation.
• Increase the density of commercial activity by linking the buildings surrounding the station.
• Converting parking areas into commercial areas.
• Connecting the station with the stadium's entry gate from inside the stadium to reduce congestion on the road and avoid traffic paralysis.

Regarding building heights, according to the following **Fig. 28:**
Increasing floors for commercial use, increasing the density of commercial use, increasing floors for commercial use, vertical condensation of some residential floors.

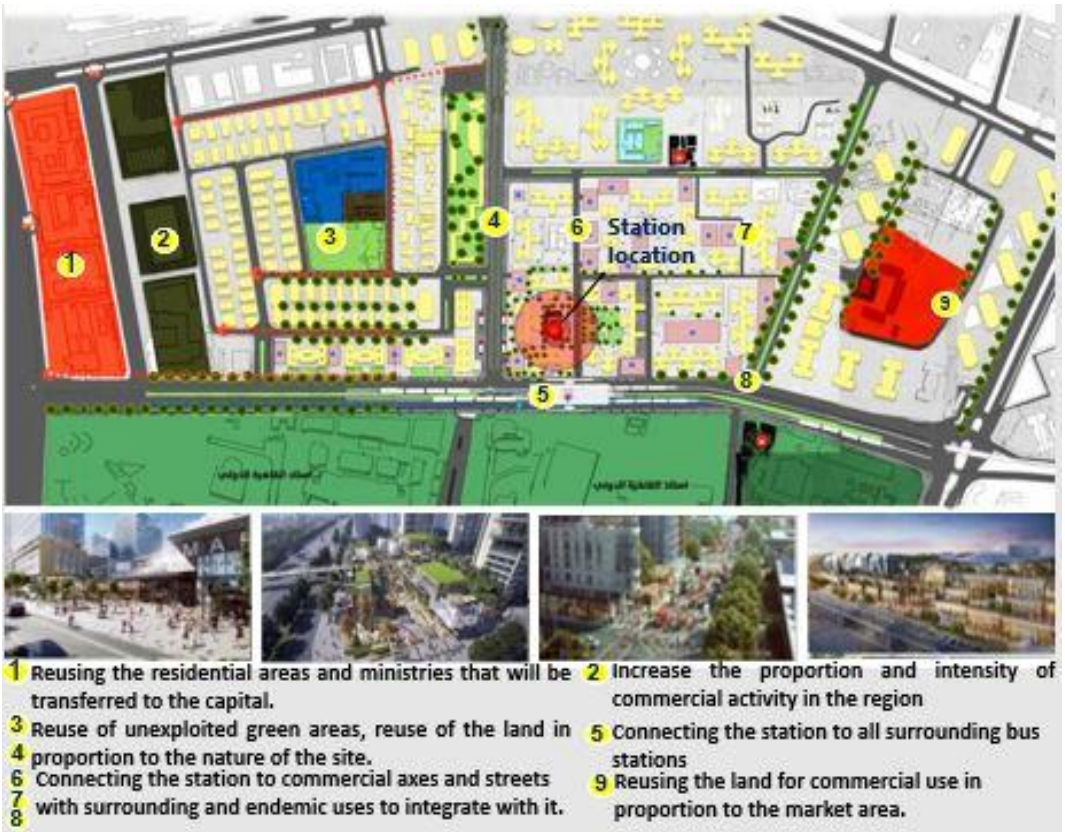


Fig. 28. The proposed plan is based on an analysis of the impact of the stadium monorail station

Through the above, an influence range was created for each station, whether exchange or substation, which includes a direct influence range of up to 500 meters for substations and 800 meters for exchange stations, and a more comprehensive influence range of up to 1000 meters for substations and 1500 meters for exchange stations.

From the analysis, it is expected that commercial activities will spread with a large amount of traffic congestion around interchange stations such as the Stadium Station, which meets the third line metro station, which will double the number of passengers at the Stadium Station area, and is reflected in the increase in services and commercial activities at that station to meet the needs of passengers. The spread of activities Commercial and traffic congestion around interchange stations. Like Hisham Barakat station.

6. The impact of the monorail on the movement and urbanization system

6.1 The expected impact of the monorail on the movement structure system

The monorail affects the two poles of the movement structure system (human flow and movement channels) and represents (road networks, parking lots, public transportation, and pedestrian paths) as follows:

6.1.1 The impact of the monorail on human flow, as the monorail will contribute to transporting huge numbers of passengers, and can accommodate a quarter of a million passengers daily/one hour direction for each monorail line during peak hours, without affecting surface traffic. As for the duration of the trip, it is as follows: Nasr City Monorail between Cairo and the New Administrative Capital in a time period of 60 minutes, representing 80 km/hour.

6.1.2 The effect of the monorail on traffic channels

• **Road networks**: By studying the nature of the monorail path, we find that it does not need a path isolated from surface traffic along the length of the path, except in the case of the presence of stations, as it needs a path isolated from the surface traffic of the monorail in order to transfer motorized traffic between the two sides of the path to connect the parts of the city that the path crosses, and this will lead to Until these roads become major cross-traffic routes in Nasr City and important roads for the routes surrounding those stations, then they will need a larger width to increase their traffic capacity.

• **Car parks:** Due to the tremendous speed of the monorail, passengers will tend to leave the car and take the monorail to move to (New Cairo - the Administrative Capital), but sufficient areas have not been provided to park large numbers of cars due to the lack of open areas of land near some stations, and this leads to Cars are parked in the streets surrounding the stations in an unsafe manner, which hinders the movement of pedestrians and vehicles, so it is necessary to establish parking lots and multi-storey garages.

• **Public transportation**: Due to the monorail meeting with the third line of the metro, there will be a group of public transportation means and some random service cars to be located on the width of the road to meet the needs of passengers in reaching the stations, but the necessary places for auxiliary means of transportation have not been provided in some stations. Due to the narrow width of the street for transit means of transport, or the lack of space near the stations for final stops, therefore final stops will be established for auxiliary public transport means that supply the monorail with passengers from areas relatively far from it.

• **Pedestrian paths**: Monorail stations will attract large numbers of passengers throughout the day, and these passengers leave the station in large numbers and need to move from the station building to various places around it. Therefore, safe pedestrian paths must be provided for them and with sufficient widths to accommodate the expected numbers and in directions that serve For various purposes so as not to cause confusion in pedestrian movement around the station, which was not planned due to the lack of pedestrian paths on both sides of the metro stations due to the narrow paths for motorized movement and their failure to accommodate the increasing volumes of car traffic, which leads to dense pedestrian movement around the station area through the surrounding

road network. This hinders motorized movement around the station and exposes pedestrians to dangers while crossing the streets.

6.2 The expected impact of the monorail on the urban structure system

The monorail network is considered a major transportation hub within Cairo, and due to its high speed and its service to large numbers of passengers, it gives high access to the areas through which it passes, and will lead to huge numbers of visitors to the stations, whether residents of the station area or those crossing through it to other nearby areas, and thus The stations will become major centers of attraction for various commercial and service uses to benefit from the flow of these large numbers of passengers, which will lead to intense competition for lands and facilities around the station, which will increase their value by rates ranging from 200% to 300%, As the value of land and facilities increases, building and population densities will increase as we get closer to the monorail route, or the density of areas populated by buildings will increase through the construction of high-rise residential buildings.

In general, the heights of buildings near metro stations will increase and gradually decrease as we move away from the station. Therefore, the impact of the monorail on the urban structure will appear in structuring land uses in the areas surrounding its route and increasing the density of urban growth therein, as follows:

6.2.1 Land use structure: With the increased demand for housing and work in the areas surrounding the monorail route, competition will occur for lands in those areas, leading to an increase in the value of lands there, especially near stations, which will lead to changes in land uses, as commercial and service uses will appear. As close as possible to the stations, as the distance from the station increases, commercial and service uses will decrease and residential uses in buildings will increase. This in turn results in the spread of many activities randomly around the stations, from street vendors or random kiosks around the stations to take advantage of the density of pedestrian traffic flowing to and from the stations. Therefore, the elements of the influence of the monorail on the activities surrounding its path will appear through the following patterns:

• **Development**: as the quality of the service provided will develop and its level will rise, and thus the monorail will help advance the region and improve the quality of service there.

• **Change:** Existing activities will change and be replaced with new activities that are more suitable for the region and more economically feasible.

• **Addition:** New activities will be added to the area, as new activities will be created around the station.

6.2.2 Growth of urban areas: This includes the following:

Parties (New Administrative Capital): The monorail will accelerate its development processes due to the presence of relatively large vacant lands in it that are quickly affected by the new variables resulting from the entry of the monorail into the region, as it will attract large numbers of residents, and the effect will vary according to the different stations according to the development capabilities of each region.

Central areas (New Cairo): It will become closer to all parts of Cairo via the monorail, which will increase the value of the lands there and help restructure the land uses therein through the development of existing uses and the emergence of new uses, as well as the change of some uses that are not compatible with the development brought about by the monorail in the region. Its population and building densities also increase. Show **Fig. 29.** The expected development pattern and expected land prices.

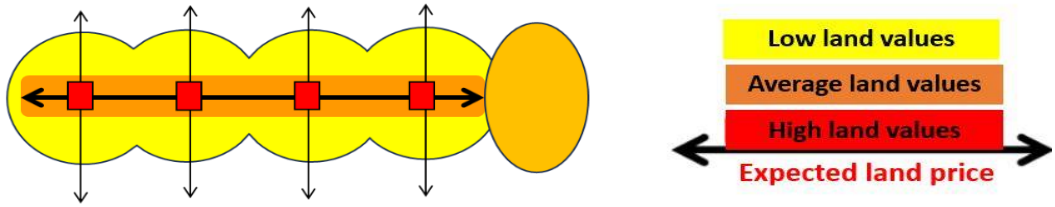


Fig. 29. The expected development pattern and expected land prices

Result

Its impact on the ranges of the stations appears through (3 ranges), which are as follows:

• The first zone (direct), the second zone (perimeter) is expected to increase the proportion of commercial activity by 25%, and its localization on both sides of the district, the proportion of administrative activity to increase by 25%, a decrease in residential use by 25% around the stations, and an increase in the proportion of open areas by 7%. Converting motorized roads into pedestrian paths, localizing uses that integrate with stations, achieving connectivity and linking between (transport stations - surrounding buildings - main activities such as the stadium).

• The third (most comprehensive) scope: settling new projects to attract and attract residents and spread development in the region.

This results in the development of commercial spaces at the monorail stations, which appear in the first zone at a rate of 30%, at a height of 4 floors, followed by administrative use at a rate of 23%, at a height of 3 floors, then residential use at a rate of 46%, at a height of 6 floors, with land prices near the stations increasing and decreasing the farther away we go.

Conclusions

Monorail is an electric train that runs on a single rail line running on an overhead track completely isolated from the surface of the ground and traffic intersections. It is a safe, fast, and environmentally friendly means, at a cost (similar to the cost of a meter), and its polarity varies according to the size and separation (Large, Medium, and Compac)t Monorail Systems It works to attract 600,000 passengers daily. The Nasr City monorail consists of 22 stations. The stations represent a service and investment attraction center with a direct impact on the structure (traffic and urbanization) in the areas surrounding the monorail stations, especially (the interchange stations), and this effect varies depending on the location of the station. On the track of being (an interchange station in an existing area) such as the Stadium Station or the Field Marshal Tantawi Station (a station in a new area with vacant lands that can be exploited), Through the scope of influence of each station, whether the exchange or substations, up to 500 meters for the substations and 800 meters for the exchange stations, and a more comprehensive scope of influence of up to 1000 meters for the substations and 1500 meters for the exchange stations, and its impact on the uses of the surrounding lands appears, whether (by development, change or addition), The distances between the stations of the monorail line in Nasr City are close, linked to the metro stations (between Greater Cairo and the Administrative Capital).

Recommendations

- Redeveloping the general plan of the areas surrounding the monorail route, taking into account the resulting change in activities and uses within the framework of the urban system.
- Encouraging organized investment through the private sector’s use of the right to exploit monorail stations and their surrounding areas, to emphasize the necessity of adhering to general plans and avoiding random uses that are growing rapidly around metro stations due to their attractive scope.

- Connecting large service centers to monorail stations through a good network of roads and transportation, especially perpendicular to the monorail route.
- Adding grouped waiting areas near the monorail stations, whether horizontal or vertical garages, to encourage private car users to use the monorail, and a group of lands near these stations can be offered with a system to encourage investment as well.
- Emphasis on establishing vertical movement axes on the monorail route, thus providing the opportunity to transport the largest number of citizens easily using the monorail.
- Developing the periphery areas to which the monorail reaches by establishing service centers there, drawing some of the activities concentrated in the city center area to them due to their ease of access and cheap land price.
- Replanning the pedestrian paths in the areas surrounding the monorail stations, while providing adequate widths for these paths, linking them to the site's landscaping elements, and taking into account their visual and aesthetic elements.
- Doubling services and commercial activities around the stadium station to meet the needs of passengers for the monorail and metro stations, taking into account the quality of services and their level according to the quality of passengers.

References

[1] A case study Fresno,2001 ,California, The potential application of monorail technology as a tool for economic redevelopment, College of Business, California Polytechnic State University,San Luis Obispo, California 93407, USA Transactions on the Built Environment vol 52, © 2001 WIT Press, www.witpress.com, ISSN 1743-3509.

[2] Abdel Baqi Ibrahim, 1988, The Islamic Perspective of Urban Development.

[3] Abdel-Aal, Sayed Jaber, 1978, The influences of development on the planning of the mother city and regional cities, Dar Al-Kutub Al-Aamah, Cairo.

[4] Abdul Hamid Abdul Wahed, 1986, Introduction to Urban Transport Planning, Qatar University.

[5] Ahmed Ali Ismail, 1993 - Studies in the Geography of Urban Affairs - House of Culture, Publishing and Distribution

[6] Al Masar. (2019). Dubai Metro. 10 Years, Happy 1.5 billion passengers. Al Masar, Roads &Transport Authority. Retrieved October 7, 2021, from https://www.rta.ae/links/magazine/masar/Al_Masar_136_Eng.pdf.

[7] Ali Tariq Muhammad, 2000, Change in the Structure of Land Uses Located on the Main Traffic Arteries (An Analytical Study of Some of the Main Traffic Arteries in Greater Cairo), Unpublished Master's Degree, Faculty of Regional and Urban Planning, Cairo University.

[8] Amr Muhammad Al-Adawi, 2017 The monorail system as a sustainable urban transport (case study of the city of Alexandria), ournal of Engineering Research, Faculty of Engineering, Menoufia University - Master's degree, Department of Architecture and Environmental Planning, Arab Academy for Science, Technology and Maritime Transport.

[9]Central Agency for Public Mobilization and Statistics, October 2023 http://www.cairo.gov.eg/ar/Statistics/population2023.pdf.

[10] Daisuke Fukuda. 2020, The impact of railway networks on residential Land values within transit-oriented development areas,Asian Transport Studies, www.journals.elsevier.com/asian-transport-studies,EL SEVIER.

[11] Dhabiya Nasser Al-Hazmi Al-Afri, 2022 The impact of light rail transportation on urban development in the Dubai), The United Arab Emirates, UAE , MASTER, THESI,United Arab Emirates University, College of Engineering, Department of Architectural Engineering

[12]Didrikson PV (2008) Specification and procurement of fully automated transit systems. Presented at rail solutions asia conference, Kuala Lumpur, 12 June 2008.

[13] Eman Atia,2017, Measuring the chamge in commercial uses amd its impact as a guide for

urban growth of the city, Case study: Banha City, Master's degree, Faculty of Engineering, Al-Azhar University.
[14] Fathi Muhammad Moselhi, 1995, The Arab City between the Theoretical Framework, Reality, and the Future, Cairo.
[15] Fathi Muhammad Moselhi: The development of the Egyptian capital and Greater Cairo, Part One,Second edition, Menoufia University Press, 2001.
[16] Haixiao Pan and Ming Zhang, 2008. Rail Transit Impacts on Land Use: Evidence from Shanghai, China.
[17] Japan Monorail Association2019 http://www.nihon-monorail.or.jp Nishi-Tech Building, 2-12-10 Uchi-kanda, Chiyoda Ward, Tokyo 101-0047, Japan TEL 03-3258-6471 FAX 03-3258-6472.
[18] Mahmoud Abdel Moneim Hashish, 2023, Spatial variation of bridges and traffic on them in the Nasr City neighborhood (east of Cairo) and their role in solving traffic problems, teacher of economic geography- Faculty of Arts, Port Said University.
[19] Marwa Sibawayh Hamed, Nahla Ehab Fahmy Wasel, 2023, Policies for dealing with administrative land use patterns in major cities, a case study of the Greater Cairo region, Journal of Engineering Sciences, Faculty of Engineering, Assiut University Received 11 January 2023; Revised 1 March 2023; Accepted 9 March 2023.
[20] Mohamed Abdel Fattah Abu Issa, 2021, Land Planning around the Interchange Stations of the Public Transport Route "Monorail in the Administrative Capital - Sarra City", Master's Degree, Faculty of Regional and Urban Planning, Cairo University.
[21] Mohan, S., CEng, BTech, MIRSE, PMP, MIET, MIEEE, & Serco Dubai Metro. (2012). Dubai Metro Signalling & Train Control System. Institution of Railway Signal Engineersn-IRSE.webinfo.uk. Retrieved October 8, 2021, from https://webinfo.uk/webdocssl/irse-kbase/refviewer.aspx?refno=1559669757&document=3.07%20mohan%20-%20dubai%20metro.pdf
[22] Mona Sobhi, 2018, Mass transit stops in Cairo Governorate, an applied geographical study on the central region, published research, Egyptian Geographical Society, Geographic Research Series, Issue 21.
[23] Muhammad Ahmed Suleiman, 2003, Strategies for developing the areas surrounding the metro lines (D Subway case report - Cairo), Journal of Engineering Research - Faculty of Engineering, Matareya - Helwan University.
[24] Muhammad bin Saad Al-Muqri, 2022, King Abdulaziz Public Transport Project in Riyadh and similar global projects: a comparative study, Volume 53, Issue 79.
[25] Peter E. Timan , 2015 Why Monorail Systems Provide a Great Solution for Metropolitan Areas, Urban Rail Transit, http://www.urt.cn/
[26] Raguz, J. (2010). Assessing the impacts of Light Rail Transit on urban land in Manila. CORE – Aggregating the world's open access research papers. Retrieved April 17, 2021, from https://core.ac.uk/download/pdf/190880631.pdf.
[27] Salsabil Panji Arum, Daisuke Fukuda. 2020, The impact of railway networks on residential Land values within transit-oriented development areas,Asian Transport Studies, www.journals.elsevier.com/asian-transport-studies,EL SEVI
[28] Wael Muhammad Youssef, 1999 - The impact of the subway on uses in the surrounding areas (with application to the city of Alexandria) - Master's degree - Faculty of Engineering - Al-Azhar University.
[29] World Health Organization (WHO). (2022). Road traffic injuries; World Health Organization (WHO). Brussels, Belgium. Retrieved April 27, 2022, from https://www.who.int/newsroom/fact-sheets/detail/road-traffic-injuries
[30] Xia, H., Shen, C., Zhang, C., Wang, X., & Zhang, D. (2017). Challenges in the integration of light rail and land use: A case study of Yizhuang line in Beijing. Urban Rail Transit, 3(1), 45–53. https://doi.org/10.1007/s40864-017-0055-3.

[31] Yuji HINO,2013 , Monorail and Urban Development in Japan, Managing Director , Japan Monorail Association.
[32]https://www.mobilitycairo.com/explore/latest-news/dive-into-green-transport-world Accessed on 11-1-2023
[33] https://www.propertyfinder.eg/blog/%D8%A7%D9%84%D9%85%D9%88%D9%86%D9%88%D8%B1%D9%8A%D9%84/. Accessed on 11-10-2023
[34] https://www.almasryalyoum.com/news/details/2365190 Accessed on 16-11-2023