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ORIGINAL

Evaluation of pedestrian and bicycle mobility on Mazatlan's Malecon: Successes and opportunities for sustainable urban mobility

Evaluación de la movilidad peatonal y ciclista en el Malecón de Mazatlán: Aciertos y oportunidades para una movilidad urbana sostenible

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ABSTRACT

Traditional urban development has prioritized road infrastructure for automobiles, relegating pedestrian and bicycle mobility, which has negatively impacted the quality of life in cities. Models such as Copenhagen's "Fingers Plan" (1947) have demonstrated the feasibility of integrating sustainable urban design by combining transportation networks and green spaces. In this context, the Mazatlán Malecón represents a key scenario for analyzing the progress and challenges in sustainable urban mobility. This study evaluates the current conditions of pedestrian and bicycle mobility on the Malecón, identifying strengths and areas for improvement to promote a more inclusive and efficient environment.

Keywords: Mobility; Urban Planning; Sustainability.

RESUMEN

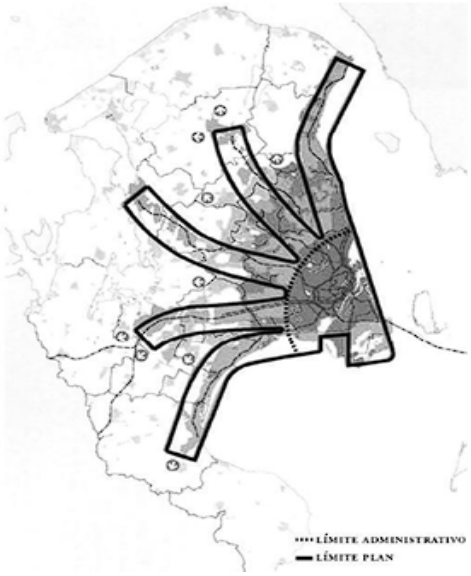
El desarrollo urbano tradicional ha priorizado la infraestructura vial para automóviles, relegando la movilidad peatonal y ciclista, lo que ha impactado negativamente la calidad de vida en las ciudades. Modelos como el "Plan Dedos" de Copenhague (1947) han demostrado la viabilidad de integrar un diseño urbano sostenible mediante la combinación de redes de transporte y espacios verdes. En este contexto, el Malecón de Mazatlán representa un escenario clave para analizar los avances y desafíos en la movilidad urbana sostenible. Este estudio evalúa las condiciones actuales de la movilidad peatonal y ciclista en el Malecón, identificando fortalezas y áreas de mejora para promover un entorno más inclusivo y eficiente.

Palabras clave: Movilidad; Urbanística; Sostenibilidad.

INTRODUCTION

The development of cities from a modern perspective conceives the city as a machine, composed of independent parts organized by function and connected through streets for vehicular traffic, which has minimized the human dimension as a guiding principle in urban design, affecting its inhabitants in various ways.[1]

In the case of Denmark, the city of Copenhagen developed the "Finger Plan" in 1947, which established the foundations for regional planning in Copenhagen. This plan consists of organizing growth along five principal axes that expand radially from the central core of the city, resembling the shape of fingers. Roads and railways are developed along these axes, transforming open areas into green wedges without buildings (figure 1).[2]



Source: López[2]

Figure 1. Finger Plan

Note: adapted from Innovative perspectives on the urban-rural interface: the Amsterdam Extension Plan, the London County and Greater London plans, and the Copenhagen Finger Plan.

As a result of the "Fingers Plan," the town's population began to migrate to the outskirts, abandoning the city center. As proposed in 1962, it was decided to pedestrianize the city's traditional boulevard, "Strøget," increasing the number of pedestrians by 35 % in the first year alone and by sevenfold by 2005 (figure 2).

Figure 2. Strøget, before and after

Note: adapted from Strøget, the pedestrianized main thoroughfare of Copenhagen's old town, before and after the transformation.

The city of Copenhagen is known for having one of the highest levels of satisfaction with the quality of life, largely due to the implementation of urban design measures that prioritize people's needs.[3]

Similarly, in Santiago, Chile, the Mapocho Pedestable project proposes to reclaim the Mapocho riverbed with minimal infrastructure and rescue it from its current state of neglect (figure 3).

Source: Echiburú et al.[4]
Figure 3. Western end of the channelized riverbed

In 2011, a short film was made of four people cycling, generating significant support for the project (figure 4).

Source: Echiburú et al.[4]
Figure 4. Record from yovivomap8
Note: Activity carried out on May 4, 2013.

Thus, a space that had been ignored and that crosses the main east-west axis was reclaimed by citizens who promoted its transformation into an urban corridor for non-motorized means of transport and a recreational area (figure).[4]

Source: Echiburú et al.[4]
Figure 5. Providencia Poniente promenade and track
Note: Mapocho Pedalable Project.

Latin America is increasingly prioritizing pedestrians, bicycles, and public transportation at the center of city construction in the future. In Mexico, the Cycle Cities Manual[5] was published in 2011 as a guide for developing cycling cities in Mexico. Based on international best practices and adapted to the urban context, it was created by the Institute for Transportation and Development Policy (ITDP) Mexico, in collaboration with Cycling Expertise (I-CE).[6]

In Mexico, the city of Monterrey, Nuevo León, is implementing the "Urban Parks and Green Corridors System", (figure 6) providing citizens with safe and accessible spaces for recreation, where they can socialize, practice sports, and enjoy culture and nature.

Figure 6. Section of the "Urban Parks and Green Corridors System" project

As part of the "Urban Parks and Green Corridors System," the "Green Bridge" (figure 7) connecting España Park and Fundidora Park was inaugurated on August 29, 2023.

This bridge, more than half a kilometer long, is a safe crossing with natural trees and lighting, featuring wide sidewalks for walking or running, a 475-meter bike path, and two viewpoints overlooking the metropolitan area, Cerro de La Silla, and Horno 3 in Fundidora Park.[7]

Source: Garcino[7]

Figure 7. Aerial view of the Green Bridge in Monterrey

The same is happening in Los Mochis, Sinaloa, Mexico, where the Zone 30 mobility project was adopted, which consists of reducing the speed of motor vehicles to 30 kilometers per hour. This space seeks to promote coexistence between motor vehicles, pedestrians, and cyclists, where respect is the priority (figure 8).

This zone has a special lane for cyclists, a special yellow-colored strip for people with disabilities on sidewalks, newspaper and magazine kiosks with a single design, and bus stops that are more comfortable for users.[8]

Figure 8. Zone 30, Los Mochis, Sinaloa, Mexico

In the city of Mazatlán, Sinaloa, Mexico, there is the Avenida del Mar (Malecón), which is one of the most important icons of the town because it borders the city's greatest attraction, its beaches. This avenue, and in particular the section between Av. Gutiérrez Nájera and Av. Rafael Buelna, is part of the largest public recreational space available to residents (figure 9).

Figure 9. Mazatlán Malecón

Construction of this avenue began in the 1820s, but this particular section began in 1910 as a celebration of the Centennial of Mexican Independence (figure 10).[9]

Figure 10. Mazatlán boardwalk in the 1950s

It is worth noting that this avenue has undergone several changes to its infrastructure. On June 29, 2017, remodeling began, resulting in adjustments to roadways and sidewalks that promote changes in mobility, social interaction, and accessibility for people with different abilities.[10] Added to this is the accelerated construction of buildings with a distinct style and dimensions that differ from those previously built.

Furthermore, on October 17, 2013, the Durango-Mazatlán Highway was inaugurated,[11] positioning the city of Mazatlán, Sinaloa, as a key destination in the state, which received 1 921 951 visitors in 2013.[12] By 2023, the number of tourists had increased to 4,1 million.[13]

In the city of Mazatlán, located in the state of Sinaloa, Avenida del Mar is undergoing adjustments to enhance pedestrian and bicycle mobility and accessibility in the area. Added to this is the number of new buildings being constructed on this avenue, generating an impact on the way users utilize this public space.

In turn, in the vicinity of the Malecón, there are several properties with significant uses that interact closely with this site, including shops, hospitals, schools, parks, sports centers, and the Mazatlán Aquarium, a popular tourist attraction frequented by both tourists and locals.

In Mazatlán, bicycles are used for sports, recreation, and transportation. However, it was not until the early 21st century that they gained relevance in the recreational and tourist sectors, as well as for transportation, especially among the working class.[14]

A detailed analysis of pedestrian and bicycle mobility on the Malecón de Mazatlán can provide valuable information for implementing improvements that support sustainable and efficient urban development.

The social benefits of this work aim to find solutions and contribute to the development of sustainable urban mobility for the city, positively impacting its residents and visitors.

International Research

In the city of Barcelona, Spain, research is being conducted to study the profiles of users of these modes of transport and their routes, which have been modified due to the pandemic, thereby contributing to research in this field.

The findings indicated that approximately one-third of the residents studied changed their means of transportation as a result, especially those who used public transportation or walked. Micromobility was discussed as a means of reducing emissions, with a focus on the social implications of its use, particularly in relation to sociodemographic characteristics, including its impact on health and public space.

There are modes of transport designed for specific uses, such as skateboards for commuting or electric motorcycles for leisure, while others, like bicycles, are more versatile.

In a city like Barcelona, with a high volume of short-distance travel and unlike other metropolitan areas where long distances make cycling impractical, this mode of transport could successfully become one of the mainstays of everyday mobility.[15]

Secondly, a study was conducted in the city of Marrakech, Morocco,[16] focusing on parks and gardens, which are important elements within the urban environment.

Here, residents can enjoy leisure and recreational activities, as well as meeting places and cultural expressions.

These places must provide comfort and safety, without excluding people with disabilities.

Inclusive tourism must be based on principles of commitment to equity and equality. Accessibility must be comprehensive, encompassing the entire tourism chain. However, this does not mean that other links should be neglected; rather, a connection between the two is necessary.[16]

A set of indicators for integrating universal accessibility with design specifications for all is being developed, in accordance with the international standard ISO 21542:2011, Building construction—Accessibility and usability of the built environment, adopted by the Moroccan standard NMISO 21542:2018, Construction immobilière. Accessibilité et facilité d'utilisation de l'environnement bâti.

Research in Latin America

Continuing with the examples, in the city of Concepción, Chile, the Biobío River is a location where research analyzes the influence of urban design on the vitality of public space.

User experience is assessed through indicators. Their analysis helps to identify the relationship between urban design and the perception of those who use the space, thus distinguishing the elements that favor or limit it.

The case study focuses on the Costanera Park on the Biobío River in Concepción, Chile (figure 11 and figure 12), chosen because it is an attractive, well-located, and well-designed project, yet one that lacks activities and appropriation. Among the main results, safety, accessibility, and diversity of activities emerge as the urban design factors that most influence the vitality of public space.

Source: Delpino-Chamy et al.[17]

Figure 11. Planimetry of the Biobío River Waterfront Park

Source: Delpino-Chamy et al.[17]
Figure 12. Image of Biobío Waterfront Park

Regarding universal accessibility, there is consensus among residents, visitors, and planimetric analysis that it is inadequate, as the project does not facilitate access and habitability for people with reduced mobility.

In relation to the valuation of activities and uses, the difference between residents and visitors remains. Although among residents, there is a percentage of equal responses regarding the availability or lack of activities to do (43 %), 80 % of visitors believe that there is a lack of alternatives.

The field study identified a small number of programs associated with the park: multi-purpose sports fields, playgrounds, a skating rink, a bike path, and a pedestrian walkway. There are no shops or supply programs.

Finally, the results obtained identify some significant factors that explain which elements of urban design are limiting the vitality of the Costanera Biobío Project. These include the project's lack of accessibility and connectivity with more distant neighborhoods, which primarily favors access for residents living in the immediate vicinity via the existing pedestrian walkway.[17]

On the other hand, a study on urban mobility in Curitiba, Brazil,[18] addresses a topic of vital importance for large cities, directly impacting the quality of life of citizens. Curitiba has been recognized worldwide for the quality of its public transportation, especially with the introduction of the Rapid Transit Bus and its exclusive lanes. However, in recent years, the city has suffered a negative impact due to the growth of its vehicle fleet and the lack of investment in new modes of public transportation to meet user needs.[19,20,21]

The city has been experiencing serious problems, including overcrowded public transportation and traffic congestion. This article aims to conduct a case study of mobility in the city of Curitiba.[22]

The systematic literature review methodology called Methodi Ordinatio was used to select the most relevant articles on the subject. It was possible to verify that, even with a public transport infrastructure with exclusive lanes for BRT, the city is suffering the impacts of the growth of the vehicle fleet. It is necessary to implement public policies to prevent the exhaustion of the public transport system, with investments in new modes, flexible working hours, and the creation of new bicycle lanes.[23,24,25]

The city of Curitiba, although it has been a model of urban mobility for years, is suffering the impact of these transformations and is in a situation where it is necessary to implement public policies for the implementation of new modes of transport, so that the public transport system does not collapse in the coming years.[26,27,28]

The implementation and maintenance of the BRT were the right solutions for the city for many years, but due to the problem of intense congestion, several projects were created to implement new modes of transportation. The bicycle was one of the focuses, as it is an ecologically clean, healthy, and straightforward solution compared to other projects.[29,30]

In recent years, Curitiba has invested in creating new bicycle lanes, thereby providing a more suitable environment and infrastructure for cyclists. However, this implementation is still far from being completed, since on the main streets and avenues of the city, especially in the city center, bicycles still share space with other modes of transport, such as cars, buses, motorcycles, and BRT.[18]

Again, in Brazil, Bastos et al.[19] demonstrate the importance of pedestrian streets as part of an urban rehabilitation strategy in central areas. There are several types of pedestrian streets, but they are primarily concentrated in the central commercial areas.

Urban planning in Brazil is addressed through a historical and phased analysis of Villaça, which conceptualizes strategies related to human intervention and identifies experiences of urban rehabilitation in central areas of Brazil.

National research

The Cancún Cycle Path Phase 1, "Downtown Area," is part of a trunk network of cycle paths that aim to enhance mobility in the city through non-motorized transportation. The aim is to enhance the urban image in the central area by promoting sustainable modes of transportation. This project, led by IMPLAN[20], begins at Bonampak Avenue (figure 13) and involves the restoration of urban public spaces by integrating accessible bike lanes and pedestrian walkways, thus connecting the downtown area with the hotel zone.

IMPLAN[20] considers this project to be one of the first actions addressing the city's mobility problems, resulting from approximately 12 % population growth over 10 years, and provides alternatives for sustainable and safe mobility.

The project consists of the construction of one kilometer of bicycle infrastructure on Bonampak Avenue, which has a 14-meter service berm for underground infrastructure and currently lacks continuous and adequate paving, in addition to unconsolidated green areas and invasion of public space by private individuals, This hinders the free movement of pedestrians and cyclists, putting their safety at risk as it is an area with heavy traffic (figure 14).

Source: IMPLAN[20]

Figure 13. Bonampak Avenue, Cancún

Source: IMPLAN[20]

Figure 14. Result of the completed project

Local research

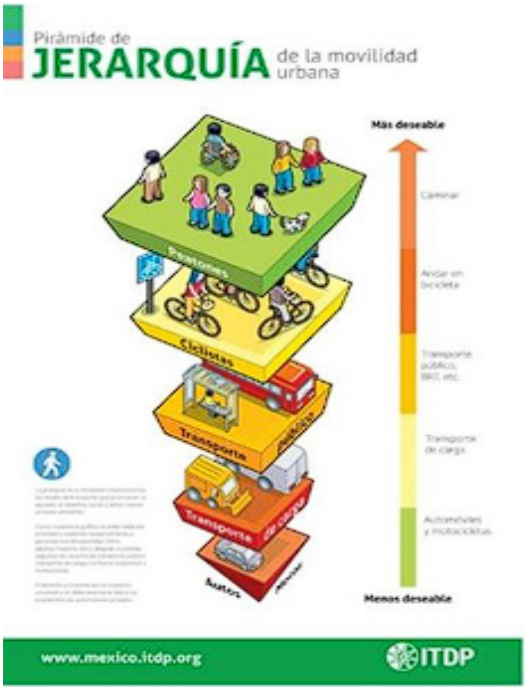
Las Riberas Park, located in Culiacán, Sinaloa, Mexico, is the city's primary public, recreational, and sustainable space, seamlessly integrating the urban area while preserving its natural characteristics. It has established itself as a place that identifies, inspires pride, and elevates the quality of life of its inhabitants.[21]

The primary objective of this park is to transform this sector into an urban park that, through recreational and leisure activities, serves as the ecological, recreational, and natural hub of the city. In addition, another objective is to implement various easy and convenient alternatives for mobility and accessibility to Las Riberas Park for the entire population of the city of Culiacán (figure 15).[21]

Figure 15. Las Riberas Park, Culiacán, Sinaloa, Mexico

Sustainable Urban Mobility

The contemporary model of urban transport proposes shifting priorities, making pedestrians the priority, as they have often been overlooked in mobility. Pedestrians are essential to any form of mobility because, at any point during a journey, it is necessary to walk some distance. From this perspective, reversing mobility needs becomes an investment in public transportation and pedestrians (figure 16).[5]



Source: ITDP[6]

Figure 16. Pyramid of the urban mobility hierarchy

Mobility is now understood as sustainable. Mobility projects are no longer limited to the development of systems to minimize time and costs, but also focus on analyzing social contributions, utilizing scarce resources (such as energy and urban space), and mitigating environmental impacts. This invites us to consider mobility from a different perspective.[22]

Sustainable urban mobility involves integrating transportation systems with the creation of more compact cities. In addition, to promote modal behavior regarding the use of bicycles, pedestrian spaces, public transportation, or even cars, a participatory approach must be adopted.[5]

Pedestrians

Pedestrians play a crucial role in urban mobility, as they integrate the most basic form of transport with other modes of transportation and urban activities, giving rise to diverse mobility environments and pedestrian spaces.

Thanks to this, it is possible to delve deeper into the factors of the built environment that have the most significant influence on pedestrians, improving the quality of pedestrian mobility and making central areas, public transport, and public spaces more accessible.[23]

Likewise, the presence of users on streets is related to the city, whether for recreational purposes or to access goods and services, with other activities being referred to as "pedestrian uses of public roads."[24]

Bicycles

Bicycles can play different roles, whether as door-to-door transportation, complementary transportation, work transportation, or public transportation.

Economic, environmental, and social conditions make bicycle use in a city a special case. However, the concept of mobility remains the same: to meet transportation needs, reduce emissions, and keep a community active.[25]

On the other hand, Venegas[26] highlights that bicycles are characterized by their interaction with the urban environment, including factors such as temperature, smells, and the quality of public space, among others.

Private motor vehicles

The increase in motorized means of transport and the expansion of road infrastructure to enhance traffic capacity create a phenomenon of accessibility that is segregating and is only complete when private motor vehicles are utilized.[33,34,35] This translates into a high-cost alternative for society in terms of travel time, money, and air pollution.[27]

As background, since the 1970s, theorist Alexander[28] has discussed the use of cars, considering that they offer great freedom and increase possibilities for users. However, they affect both the environment and social life.

Although cars are suitable for long trips, they are not for short trips within the city. To make a city efficient and generate a high level of well-being for its inhabitants, he suggests that cities be divided into areas approximately 1,50 km wide so that cars are used only to leave those areas and, within that range, travel is by slower means such as bicycles, horses, taxis, or walking.

The use of cars generates a range of social problems, including air pollution, noise, danger, unsanitary conditions, congestion, parking issues, and environmental degradation. However, they also have virtues such as flexibility, privacy, door-to-door travel without transfers, and immediacy.

Human dimension

The human-scale city model places the inhabitant as the "unit of measurement" in urban design, promoting the improvement of their quality of life through the recovery of pedestrian spaces and the promotion of bicycle use, giving special importance to public space.[1]

The success of public space will depend on the scale at which it is designed. If a public space has an urban architectural design that takes human dimensions into account, people will feel comfortable using it, use it daily, and therefore it will be successful.[1]

Urban accessibility

Urban accessibility is an attribute of a given space related to the ease of covering a distance, defined by temporal (travel times), spatial (distribution of activities within the territory), and technological (transportation or communication) elements.[27]

In recent years, urban accessibility has been affected by the expansion of housing, schools, workplaces, hospitals, and commercial centers. This has been evident in most cities, especially in developing countries, and has been facilitated by the use of cars.[42,43] This mode of transport has not only facilitated dispersion but also enabled users to move around flexibly according to their needs. However, this expansion has made car use indispensable, causing a detachment from meaningful spaces.[29]

Universal accessibility

All human beings, regardless of race, physical appearance, or socioeconomic status, share the same rights and obligations; therefore, everyone deserves the same respect and attention.[30]

Some people have more pronounced differences, such as those with physical disabilities or other conditions, which often limit their ability to understand their environment or interact with others.

To address this, biomechanics are used, such as crutches, walkers, or wheelchairs, hearing aids for hearing problems, or canes for visual impairments. However, this is not enough if the city is not adapted to help them overcome these barriers and obstacles.[44,45]

It is essential that the city and its architecture, as well as the various services provided within the city, have the necessary conditions to be accessible to all people, including those with disabilities.[30,46]

Regarding universal accessibility, according to Carrillo et al.[16], it is based on the definition of the functional conditions that must be met by the various elements that guarantee access, use, and full enjoyment without discrimination for people with disabilities in safe conditions and with the most significant possible autonomy.

CONCLUSIONS

The research presented emphasizes the importance of considering a city in terms of its people, where pedestrian and bicycle mobility, as well as alternative transportation options, are crucial for a high quality of life for residents.

Interventions that generate sustainable urban mobility are mentioned. However, although these may have the necessary infrastructure for sustainable urban mobility, there are cases in which they compromise other aspects that need to be taken into account, such as accessibility, which affects the sense of belonging to public space.

Likewise, the research to be carried out on pedestrian and bicycle mobility on the Malecón de Mazatlán investigates whether the infrastructure intended for these modes of mobility is accepted and suitable for the area, as well as the accessibility of this site using these means of transportation.

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FINANCING

None.

CONFLICT OF INTEREST

None.

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