Bıcycle Parkıng Desıgn Rules

Senan Guliyev
İstanbul Aydın University, Turkey
senanguliyev@stu.aydin.edu.tr

Abstract
This study examines the design rules of bicycle racks in depth and addresses the various stages and challenges encountered in this process. First, it starts with a needs analysis for bicycle parking spaces. This stage includes research to understand users' needs and expectations. Next, the site selection process is detailed; In this process, emphasis is placed on how parking spaces should be strategically positioned. Site selection aims to ensure safe and easy access for cyclists. In determining the capacity of bicycle parking spaces, the study conducts capacity planning based on current bicycle usage rates and future usage forecasts. This study aims to be a valuable resource for urban planners, architects and other relevant stakeholders by providing a comprehensive guide to the design of bicycle racks.

Keywords
Bicycle Parking Design, User Experience, Site Selection, Capacity Determination, Needs Analysis, Prototyping

1.INTRODUCTION

The design of bicycle parking spaces is an important topic that promotes sustainable transportation in modern urban areas. Increasing bicycle usage offers various benefits, such as environmental sustainability, reducing traffic congestion, and improving public health. In this context, the effective design of bicycle parking spaces is crucial to ensure that users have a safe, accessible, and comfortable parking experience.

This study examines the design rules for bicycle parking spaces and addresses key stages such as needs analysis, site selection, capacity determination, user research, design concepts, prototyping, implementation management, project planning, and cost analysis. Utilizing current and scientific sources, this study highlights the fundamental principles required to ensure that bicycle parking spaces are user-friendly, safe, and aesthetically pleasing.

It also provides recommendations to enhance the sustainability and efficiency of bicycle parking spaces. The primary aim of this study is to develop effective and sustainable solutions in the design of bicycle parking spaces and to identify the fundamental principles that should be considered in this process. The focus of the study is particularly on increasing bicycle usage in urban transportation and designing parking spaces that meet the needs of bicycle users.

To this end, the study examines the challenges encountered in the design of bicycle parking spaces and the strategies that can be used to overcome these challenges, providing a comprehensive analysis based on current scientific literature. In this way, the goal is to ensure that bicycle parking spaces are designed to be both user-friendly and environmentally sustainable.

Within urban transportation modes, bicycles hold a significant place due to their environmental sustainability, economic efficiency, and health benefits. Scientific literature shows that increasing bicycle usage is effective in reducing traffic congestion, lowering air pollution, and minimizing the carbon footprint of cities (Pucher and Buehler, 2008). Bicycles offer time savings, especially in heavy urban traffic, by allowing individuals to move more quickly and flexibly. Additionally, the lack of parking issues and low maintenance costs make bicycles economically attractive.

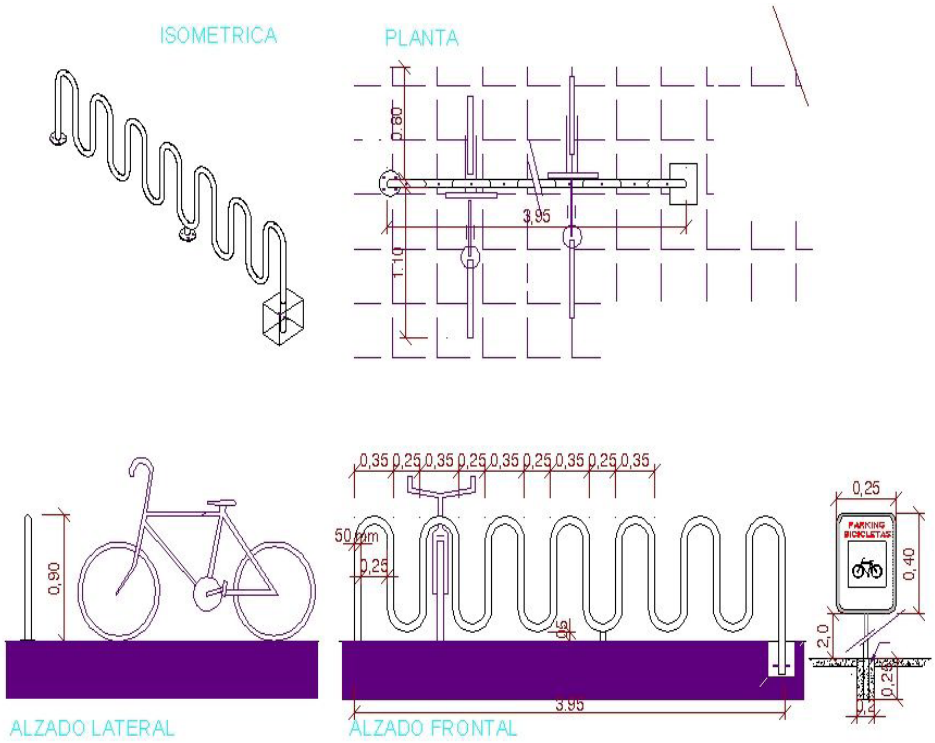

Figure 1. Bicycle park design

Bicycle parking areas need to be adequately spacious and well-organized. The width of the parking spaces should be designed to allow bicycles to be parked and removed comfortably. It is generally recommended to provide at least 0.6 meters of width and 2 meters of length for each bicycle. Furthermore, sufficient distance should be maintained between bicycle parking spaces to ensure that users can easily park their bicycles. Bicycle parking spaces should be safe and secure. Security cameras, lighting, and sturdy bicycle locking systems provide protection against theft and vandalism. The surroundings of the parking areas can be protected with enclosed or semi-enclosed structures to ensure that users can leave their bicycles securely (Jorink, 2020).

The proximity of bicycle parking spaces to public transport stops, commercial centers, and other key locations increases accessibility. Appropriate ramps and wide passage areas should be provided for disabled bicycle users. Parking spaces should be clearly marked so that users can easily find and use them (Çelik and Taşçıoğlu, 2020). Bicycle parking spaces should be surrounded by green areas that support environmental sustainability. Trees, shrubs, and flowers provide an aesthetically pleasing appearance and protect the environment. These green areas improve air quality in cities and reduce the urban heat island effect (Cervero and Duncan, 2019).

Recyclable and environmentally friendly materials should be used in the construction of parking spaces. These materials should be durable and long-lasting while minimizing environmental impacts. Additionally, water management should be considered, and rainwater drainage systems should be implemented to prevent water pooling in parking areas. Making bicycle parking spaces aesthetically appealing encourages users to prefer these areas. Landscaping, tree planting, and decorative elements make parking spaces more attractive. Additionally, colorful and eye-catching markings ensure the parking spaces are easily found.

Informational and directional designs in parking areas allow users to easily obtain information. Entry and exit directions, the location of bicycle parking spaces, and other important information should be clearly indicated with graphic design elements. These markings, designed according to visual perception theories, help users utilize parking spaces more efficiently (Çelik and Taşçıoğlu, 2020). Artistic touches can be added to specific points of bicycle parking spaces. Elements such as sculptures, murals, or colorful floor coverings enhance the aesthetic value of parking spaces and offer a pleasant experience for users (Jones, 2020).

In the design of bicycle parking spaces, it is necessary to balance aesthetics and functionality. Successful bicycle parking spaces should provide security, comfort, and easy access for users. Jorink (2018) states the fundamental principles to be considered in bicycle parking space design as “adequate space,” “comfort and safety,” “correct location and route,” and “design appropriate to the local context.” These principles are critical for bicycle parking spaces to meet both current and future needs.

Security and comfort are among the most important factors in the preference of bicycle parking spaces by users. Parking spaces should be designed considering elements such as lighting, visibility, and ease of use. Additionally, it is important to design parking spaces so that users can securely lock their bicycles and that the bicycles are not damaged (Jorink, 2018).

Design concepts form the initial ideas of how bicycle parking spaces will look and function in terms of aesthetics, functionality, and user experience. At this stage, different concepts are developed by considering various design principles and theories. Jorink (2018) emphasizes that successful bicycle parking space designs should be “attractive, safe, and healthy.” Accordingly, while creating design concepts, factors such as aesthetic values, safety measures, and user comfort should be taken into account.

2. METHOD

This study was conducted to determine the design criteria for bicycle parking spaces and to evaluate the effectiveness of these criteria in practice. The study includes qualitative research methods such as literature review, on-site observation, photography, and user experience research. As a result of the literature review, a checklist containing critical design criteria for bicycle parking spaces was created. This checklist encompasses headings such as safety, accessibility, comfort, capacity, aesthetics, and environmental sustainability.

To evaluate the current state of bicycle parking spaces in Turkey, two sample areas located in Istanbul and Izmir were selected. The selection criteria were based on the areas being in regions with high bicycle usage and considering user diversity. On-site observation and photography studies were conducted in the selected sample areas. During this process, the design features and user experiences of the existing bicycle parking spaces were examined according to the criteria in the checklist. In the final stage of the study, a prototype of a bicycle parking space was created according to the proposed design criteria based on the findings obtained, and this prototype was tested by users, with feedback collected. User feedback played an important role in finalizing the design.

Bicycle parking spaces in Izmir and Istanbul were compared according to various design and usage criteria. These criteria were determined to evaluate the effectiveness and user satisfaction of bicycle parking spaces. The main criteria used in the comparison are as follows:

1. Security
   - **Lighting**: The adequacy and safety of the lighting in bicycle parking spaces were evaluated.
   - **Camera Systems**: The presence and effectiveness of security cameras were examined.
   - **Visibility**: The overall visibility of the parking spaces and their security against bicycle theft were assessed.
   - **Reflective Surfaces**: The use of reflective surfaces to enhance safety during nighttime use was observed.
2. Accessibility
   - **Location**: The proximity of bicycle parking spaces to central locations in the city, public transport stops, and main transportation arteries was evaluated.
   - **Disabled Access**: The availability of suitable access for disabled individuals was examined.

○ **Sidewalk Condition**: The connection of the parking spaces with sidewalks and road crossings and the condition of these areas were reviewed.

3. Capacity and Usage Intensity

○ **Capacity**: The total bicycle capacity of the parking spaces was evaluated.

○ **Usage Intensity**: The occupancy and user density of the parking spaces at specific time intervals were examined.

4. Comfort and Attractiveness

○ **Comfort Features**: The comfort features provided in bicycle parking spaces, such as seating areas and shelters, were evaluated.

○ **Aesthetics**: The aesthetic design and landscaping of the parking spaces were examined.

○ **Maintenance Condition**: The overall cleanliness and maintenance condition of the parking spaces were observed.

5. Continuity and Linearity

○ **Connecting Paths**: The connection of the bicycle parking spaces to bicycle lanes and other modes of transportation was examined.

○ **Continuity**: The continuity and linear connections of the parking spaces within the bicycle lane network were evaluated.

6. Integration

○ **Integration with Public Transport**: The integration of the parking spaces with public transport stops and their proximity to public transport vehicles was examined.

○ **Multimodal Transportation**: The contribution of bicycle parking spaces to multimodal transportation options was evaluated.

7. Environmental Sustainability

○ **Green Areas and Landscaping**: The landscaping and green area arrangements used in the parking spaces were observed.

○ **Use of Sustainable Materials**: The environmental sustainability of the materials used in the construction of the parking spaces was evaluated.

These criteria were used to assess the current state of bicycle parking spaces in Izmir and Istanbul and how well they meet user needs. As a result of these evaluations, the strengths and weaknesses of bicycle parking spaces in the two cities were identified, and improvement suggestions were made.

The following criteria were considered in the selection of study areas:

- **High Bicycle Usage**: Areas with high bicycle traffic were preferred.
- **Diverse User Profiles**: Areas with users from different age groups and with different purposes of use were selected.
- **Infrastructure Diversity**: Areas with bicycle parking spaces of different designs and capacities were selected to ensure diversity.
- **Accessibility**: Areas that are accessible in terms of proximity to public transportation and pedestrian traffic were preferred.

On-site detection and observation studies were conducted in the selected study areas. During this process, the physical condition of the bicycle parking spaces, user density, security features, and general design elements were examined in detail. Additionally, information on the effectiveness and user satisfaction of bicycle parking spaces was gathered through interviews and surveys with users.

Table 1. Features of Istanbul and Izmir bicycle parks

	Istanbul bicycle park	Istanbul bicycle park
Location	 Bağdat caddesi, İstanbul	 Konak Katlı Otoparkı
Coordinates	45° 33′ 10″ N, 122° 54′ 36″ W	C49M+8J Konak, İzmir
Parking type	Public Bicycle Parking, Street Side Bicycle Parking	Public Bicycle Parking Lots, Bicycle Stations
Ownership	İBB Department of Transportation	Special
		

3.RESULTS

The bicycle parking areas on Bağdat Street have been evaluated in terms of security, considering various factors. This assessment aims to determine how safe these areas are for cyclists. Adequate lighting is present in the bicycle parking areas on Bağdat Street, designed to ensure safety during nighttime use. The lighting systems ensure visibility of the parking areas even in the dark, thereby reducing security risks such as theft. Some bicycle parking areas are equipped with security cameras, allowing for monitoring of the park areas. The camera systems serve as an important deterrent against bicycle theft and aid in identifying perpetrators.

The bicycle parking areas on Bağdat Street are strategically located in areas with high pedestrian and vehicular traffic. This positioning enhances their overall visibility and reduces security risks. High visibility contributes to lower risks for bicycles in these areas.

To enhance safety during nighttime use, reflective signs and paints have been utilized in the bicycle parking areas on Bağdat Street. These reflective surfaces improve visibility at night, thereby enhancing safety. In a security evaluation, it has been determined that the bicycle parking areas on Bağdat Street generally have adequate security measures in place. Elements such as lighting, camera systems, visibility, and reflective surfaces are highlighted as effective measures for ensuring the safety of cyclists. However, some areas exhibit issues such as the absence or inadequacy of security cameras, suggesting the need for additional security measures in those locations.

Regarding accessibility for individuals with disabilities, it was observed that some bicycle parking areas lack necessary facilities such as ramps and wide passage areas. These features are crucial for providing accessibility to disabled cyclists and their absence restricts their access to these parking areas.

The connectivity of bicycle parking areas with sidewalks and road crossings was evaluated, revealing that overall, sidewalk crossings are in good condition and provide easy access for cyclists. However, in some areas, challenges such as sidewalk elevations and narrow passages make it difficult for bicycles to be parked and maneuvered comfortably. Addressing these issues would improve the overall usability and convenience of the bicycle parking areas on Bağdat Street.

The capacity and usage intensity of bicycle parking lots on Bağdat Avenue have been evaluated to determine how well these areas meet the needs of bicycle users. This assessment reveals how intensively the parking lots are used and whether their capacity is adequate. Upon examining the capacity of bicycle parking lots on Bağdat Avenue, it has been observed that these facilities are generally designed to accommodate the level of bicycle usage in the area. The capacities of the parking lots are sufficient to comfortably handle the intensity at specific times. However, it has been noted that in some popular areas, the capacity is insufficient, indicating the need for additional parking areas.

The usage intensity of bicycle parking lots has been observed at different times of day and various days of the week. Particularly during weekends and after work hours, there is an increase in congestion at the parking lots. During these periods, it has been identified that some parking lots are completely full, making it challenging for bicycle users to find available spaces. This situation highlights the necessity of increasing capacity during specific hours and days.

The evaluation of bicycle parking lots on Bağdat Avenue in terms of comfort and attractiveness aims to determine how comfortable and pleasant these areas are for users. This assessment considers the comfort and aesthetic elements provided by the parking lots. Upon examining the comfort features offered at bicycle parking lots on Bağdat Avenue, it has been observed that in some areas, seating areas and shading elements are lacking. These deficiencies prevent bicycle users from finding adequate opportunities to rest and relax while using the parking facilities. Additionally, it has been noted that the design of the parking lots facilitates easy parking and retrieval of bicycles, with well-maintained surfaces.

The aesthetic evaluation of bicycle parking lots focuses on their environmental landscaping and overall appearance. Most of the parking lots along Bağdat Avenue are surrounded by green spaces and plants, providing an aesthetically pleasing environment. However, some areas lack proper landscaping and maintenance. Increasing efforts in landscaping and gardening are recommended to enhance the aesthetic appeal of these locations.

The evaluation from a continuity and linearity perspective assesses how well these areas integrate with the bicycle network and provide uninterrupted usability. This examination specifically examines the continuity and linear connections that the parking lots offer to bicycle users.
The bicycle parking lots on Bağdat Avenue are well-connected to the existing bicycle network. These facilities are conveniently located along main routes where cyclists can easily access them. Transitions from parking lots to bicycle paths offer a smooth and uninterrupted riding experience. This ensures that cyclists encounter no obstacles or difficulties when transitioning from parking lots to the road.

In terms of continuity within the bicycle network, the distances between parking lots on Bağdat Avenue are generally appropriate. Cyclists can find parking spaces without having to cover long distances, facilitating ease of use and encouraging cyclists to utilize the bike paths.

Bağdat Avenue's bicycle parking spaces are strategically placed to facilitate seamless and linear movement for cyclists along the route. The regular spacing of these parking spots enables users to travel continuously along a linear path and easily meet their parking needs. These linear connections accelerate access to parking for users and enhance the overall user experience.

The bicycle parking spots along Bağdat Avenue are positioned near public transport stops. This placement enables cyclists to easily access public transportation

vehicles. Particularly, the parking spots are within walking distance of bus stops and minibus routes. This integration facilitates users to continue their journeys using public transport after parking their bicycles.

The bicycle parking facilities on Bağdat Avenue contribute to multimodal transportation options. Cyclists can safely leave their bikes at these spots and transition to different modes of transportation, either by walking or using public transport. This enhances transportation choices for cyclists and promotes urban mobility within the city.

The integration of bicycle parking facilities with public transport and other modes of transportation enhances the efficiency and sustainability of urban transportation. After securely parking their bicycles, users can easily access public transport vehicles, thereby reducing traffic congestion. Additionally, multimodal transportation options allow users to save time and costs by utilizing various transportation modes.

Bicycle parking spots along Bağdat Avenue are surrounded by green spaces and landscaping efforts. The plants and trees around these spots not only provide an aesthetically pleasing environment but also support environmental sustainability. These green areas improve urban air quality and create a natural setting. The materials used in constructing bicycle parking facilities are selected in accordance with environmental sustainability criteria. They are recyclable, environmentally friendly, durable, and contribute to reducing environmental impact and maintenance costs.

Overall, these efforts contribute to creating a more sustainable and pleasant urban environment along Bağdat Avenue, promoting both active transportation and environmental stewardship.

Energy-efficient lighting systems have been used in the bicycle parking facilities along Bağdat Avenue. LED lights reduce energy consumption and support environmental sustainability due to their long lifespan. These lighting systems ensure the security of the parking areas while minimizing environmental impact.

Tabl3 2. Evaluation of Bağdat Street Bicycle Parking Areas

Criteria	Evaluation	Details informations
Security	High	Lighting: Sufficient and secure lighting ensures safety during nighttime use. Camera Systems: Cameras aimed at preventing theft and vandalism. Visibility: High visibility due to heavy pedestrian and vehicle traffic. Reflective Surfaces: Reflective markers and paints to enhance nighttime safety. 3.5
accessibility	Middle	Location: Centrally located areas near public transport stops. Accessibility for Disabled: Some parking spots lack ramps and wide passage areas. Sidewalks and Road Crossings: Generally in good condition; some areas have sidewalk elevations and narrow passages.
Capacity and Usage Intensity	Middle	Capacity: In general, adequate, but insufficient in some popular areas. Usage Density: High during weekends and rush hours, requiring additional parking spaces during these times.
Comfort and Attractiveness	Middle	Comfort Features: Lack of seating areas and shelters. Aesthetics: Surrounded by green spaces and plants; some areas lack landscaping and maintenance. .
Continuity and Linearity	High	Connection Paths: Well-connected with the existing network of bicycle lanes. Continuity: Adequate distances between parking spots provide a seamless riding experience. Linear Connections: Positioned at regular intervals, ensuring uninterrupted and linear routes.
Integration	High	Integration with Public Transport: Located near bus and minibus routes. Multimodal Transportation: Integration of cycling with other modes of transportation. Advantages of Integration: Reducing traffic congestion, saving time, and cost.
Environmental Sustainability	High	Green Spaces and Landscaping: Supporting environmental sustainability with green areas and plants. Sustainable Material Use: Utilizing recyclable and eco-friendly materials. Energy-Efficient Lighting: LED lighting used to reduce energy consumption.

Green Spaces and Landscaping: Supporting environmental sustainability with green areas and plants.

Sustainable Material Use: Utilizing recyclable and eco-friendly materials.

Energy-Efficient Lighting: LED lighting used to reduce energy consumption.

This table summarizes the evaluation of bicycle parking facilities on Bağdat Avenue based on various criteria.

Security Evaluation of Enclosed Bicycle Parking in Konak, Izmir: The evaluation aims to assess how safe the enclosed bicycle parking facility in Konak, Izmir, is for bicycle users. The facility is equipped with adequate and secure lighting systems that cover every corner, preventing the formation of dark areas and enhancing safety for users cycling at night.

Security cameras are present in the enclosed parking facility, ensuring continuous monitoring of the parking area. These cameras play a deterrent role against security threats such as theft and vandalism. Additionally, camera recordings are used to identify and resolve potential incidents.

The overall visibility of the enclosed parking area has been designed to enhance users' sense of security. Clear and visible markings ensure that bicycle users can easily locate and safely use the parking spaces. Moreover, the regular cleanliness and organization of the parking area contribute to improved visibility.

This evaluation underscores the efforts made to provide a safe environment for bicycle users in the enclosed parking facility in Konak, Izmir, focusing on adequate lighting, surveillance, and visibility enhancements.

The evaluation of accessibility for the enclosed bicycle parking facility located in Konak, Izmir aims to determine how accessible and user-friendly the area is for its users. Situated in a central area close to public transport stops, the enclosed bicycle parking facility in Konak allows easy access for bicycle users. This strategic location facilitates integration with urban transportation networks and promotes cycling as a mode of transport.

Accessibility features for disabled individuals have been provided in the enclosed bicycle parking facility. Adjustments such as ramps and wide passage areas enable disabled users to access the bicycle parking spaces comfortably, ensuring inclusivity in terms of accessibility.
Connections with sidewalks and road crossings have been designed to facilitate bicycle users' access to the parking facility. Sidewalk crossings are smooth and unobstructed, with sufficient width for bicycles to move freely. Additionally, road crossings are equipped with appropriate markings to attract cyclists' attention and ensure safety.

The capacity of the enclosed bicycle parking facility in Konak has been designed to meet the needs of bicycle users in the area. The total capacity of the parking facility is sufficient to allow users to comfortably park their bicycles even during peak hours. However, on certain days and times, the facility may experience high occupancy rates. This indicates the popularity and intense usage of the parking facility.

The usage density of the enclosed bicycle parking facility has been observed at different times of the day and on various days of the week in Konak. It has been noted that the facility is heavily used, especially during weekdays and working hours. On weekends and in the evenings, the usage density tends to decrease slightly. This pattern indicates that users predominantly utilize the parking facility during their commute to and from work.

Various comfort elements have been provided in the enclosed bicycle parking facility to enhance user comfort. The facility includes sturdy and convenient bike racks where bicycles can be securely parked. Additionally, the advantage of being indoors protects bicycles from adverse weather conditions.

However, it has been observed that there is a lack of seating areas and rest points in the parking facility. This absence makes it challenging for users to spend longer periods comfortably in the parking area.

The aesthetic evaluation of the enclosed bicycle parking facility focuses on its overall appearance and attractiveness to users. Keeping the parking facility clean and well-maintained facilitates user preference for this area. However, the lack of aesthetic elements such as landscaping and decorative features indicates a need for improvement to enhance the appeal of the parking facility.

To break the monotony of the indoor space, aesthetic enhancements can be implemented.

The enclosed bicycle parking facility in Konak is well connected to the existing network of bicycle paths. Transitions from this parking facility to the bicycle paths have been designed to offer a comfortable and uninterrupted riding experience. Cyclists can directly access the bicycle paths after leaving the parking facility, ensuring a safe and convenient ride.

When examining the continuity of the enclosed bicycle parking facility within the bicycle network, it has been observed that its distance to and connections with bicycle paths are appropriate. Transitions from the parking facility to the bicycle paths are seamless, allowing users to continue cycling without having to cover long distances. This continuity encourages cyclists to preferentially choose the parking facility for their needs.

The linear connections of the enclosed bicycle parking facility enable cyclists to move along a continuous and linear route. The facility is strategically placed at regular intervals, facilitating cyclists to ride continuously along their route and meet their parking needs conveniently. These linear connections expedite access to parking spaces and enhance the overall user experience.

The enclosed bicycle parking facility in Konak is located near public transportation stops, facilitating easy access for cyclists to public transport vehicles. Its proximity to bus and metro stops, especially within walking distance, allows users to continue their journeys using public transportation after parking their bicycles. This integration enhances the efficiency of urban transportation for cyclists.

The enclosed bicycle parking facility contributes to multimodal transportation options. After securely parking their bicycles, users can transition to different modes of transportation by walking or using public transit. This integration promotes the combination of cycling with other modes of transport, enhancing the flexibility and efficiency of urban transportation.

The integration of bicycle parking facilities with public transportation and other modes of transport offers significant advantages for the sustainability and efficiency of urban transportation. Bicycle users can access public transport quickly without losing time in traffic, thereby reducing overall urban traffic congestion. Moreover, with multimodal transportation options, users can consider various transportation modes to achieve faster and more economical travel. This enhances the overall efficiency and sustainability of urban mobility.

In Konak, the indoor bicycle parking facility does not directly include green spaces and landscaping due to being an enclosed area. However, the presence of green spaces around the parking facility and landscaping efforts in the vicinity have a positive impact on overall environmental sustainability. These green areas enhance air quality within the city and provide a natural environment, contributing positively to the surroundings.

The materials used in the construction and outfitting of the indoor bicycle parking facility have been selected in accordance with environmental sustainability criteria. These materials are recyclable and possess eco-friendly qualities, ensuring they are durable and long-lasting. This selection helps to minimize environmental impacts and reduces maintenance costs associated with the parking facility.

The indoor bicycle parking facility utilizes energy-efficient lighting systems. LED lights have been installed to reduce energy consumption and support environmental sustainability due to their long lifespan. These lighting systems not only enhance the safety of the parking area but also minimize environmental impacts.

Table 3. Evaluation of Izmir Konak Parking Garage Bicycle Parking Space

Criteria	Evaluating	Details
Security	High	Here is the translation of your text into English: • Lighting: Adequate and safe lighting covering every corner. • Camera Systems: Continuous monitoring playing a deterrent role against theft and vandalism. • Visibility: Clearly marked parking spaces, orderly and clean areas. • Security Personnel: Security is ensured with regular patrols.
Accessibility	High	Location: Central area and close to public transportation stops. Disabled Access: Ramps and wide passage areas are provided. Sidewalks and Road Crossings: Unobstructed, smooth sidewalk crossings and safe road crossings.
Capacity and Utilization Intensity	Adequate	Capacity: Designed to meet the needs of users in the area, with sufficient capacity even during peak hours. Usage Density: High usage during weekdays and working hours, with less usage during weekends and evenings.
Comfort and Charm	Middle	Comfort Elements: Secure bike racks are available, but seating areas and resting points are lacking. Aesthetics: Kept tidy and clean, but lacks landscaping and decorative elements.
Continuity and Linearity	High	Connection Paths: Well-connected with existing network of bike lanes, providing a seamless riding experience. Continuity: Smooth transitions to bike paths, with appropriate distances between them. Linear Connections: Regularly placed at intervals, offering uninterrupted and linear routes.
Integration	High	Integration with Public Transport: Close proximity to bus and metro stops, providing easy access. Multi-Modal Transportation: Integration of cycling with other modes of transportation. Advantages of Integration: Reducing traffic congestion, saving time and costs.
Environmental Sustainability	High	Green Spaces and Landscaping: Since it is an indoor area, there are no direct applications, but green spaces are present in the surrounding environment. Use of Sustainable Materials: Recyclable, environmentally friendly, and durable materials have been used. Energy-Efficient Lighting: LED lighting has been used, with low energy consumption.

This table summarizes the evaluation of parking garage bicycle parking in Izmir Konak based on different criteria.

4.DISCUSSION

The accessibility of bicycle parking spaces on Bağdat Street has been evaluated in terms of the ease with which users can access and use these spaces. This assessment aims to determine how accessible and user-friendly the parking lots are. Bicycle parking spaces on Bağdat Street are located in central areas and in areas with heavy pedestrian traffic. Proximity to public transportation stops increases the accessibility of these parking spaces for bicycle users. In addition, proximity to main transportation arteries makes parking spaces easy to find.

In terms of accessibility, it has been determined that bicycle parking spaces on Bağdat Street are generally located in central and accessible locations, but there are some deficiencies in terms of disabled access. The proximity to public transportation stops and main transportation arteries ensures that these parking spaces are easily found and used by users. The pavement condition is generally good, but there are some obstacles. It is recommended that arrangements be made to facilitate access for disabled people in these areas.

In terms of capacity and intensity of use, it has been determined that bicycle parking spaces on Bağdat Street have sufficient capacity in general, but additional parking spaces are needed at certain times and in busy areas. The intensity of use of the parking spaces reflects the demand for these spaces by bicycle users and shows that the capacity is insufficient from time to time. Therefore, it is recommended to increase the capacity and create new parking spaces at peak times and areas.

In terms of comfort and attractiveness, the bicycle parking lots on Bağdat Street are generally user-friendly, but some areas lack comfort elements. In terms of aesthetics, the landscaping of most parking lots is in good condition and provides a pleasant environment for users. However, some areas need more maintenance and landscaping work. For this reason, it is recommended to add seating areas and shades to increase the comfort of the parking lots, and to carry out regular maintenance and planting works to improve the aesthetic appearance.

In terms of continuity and linearity, it has been determined that the bicycle parking lots on Bağdat Street are well integrated with the existing bicycle lane network and offer an uninterrupted use. The connections of the parking lots to the bicycle lanes allow users to easily access the parking lots and are located at appropriate distances in terms of continuity. Linear connections allow users to have an uninterrupted and comfortable riding experience on the bicycle paths. Therefore, it is recommended that the continuity and linear connections of the parking spaces be maintained and improved where necessary.

In terms of integration, the proximity of bicycle parking spaces on Bağdat Street to public transportation stops and their contribution to multimodal transportation opportunities were found to be positive. The parking spaces make it easier for users to continue their journey by using public transportation after parking their bicycles and contribute to more efficient urban transportation. It is recommended that this integration is maintained and improved where necessary.

In terms of environmental sustainability, it has been determined that the bicycle parking lots on Bağdat Street are surrounded by green areas and plantings, constructed using sustainable materials and have energy efficient lighting systems. These features increase the environmental sustainability of the parking lots and contribute positively to the quality of the urban environment. It is recommended that environmental sustainability practices be maintained and improved when necessary.

In terms of security, it was determined that the parking garage bicycle parking lot in Izmir Konak has generally high security standards. Elements such as lighting, camera systems and security personnel ensure that the parking lot provides a safe environment. Therefore, it is concluded that the parking garage bicycle parking lot is suitable for users in terms of security and provides a safe parking area.

In terms of accessibility, it was determined that the parking garage bicycle parking lot in Izmir Konak is user-friendly and accessible thanks to its central location, disabled access and appropriate arrangements of sidewalk and road crossings. These elements enable bicycle users to easily access and use the parking lots. Therefore, it is concluded that the parking garage bicycle parking lot is suitable in terms of accessibility and meets user needs.

In terms of capacity and intensity of use, it was determined that the parking garage bicycle parking lot in Izmir Konak has sufficient capacity in general and meets user needs. The capacity of the parking lot allows users to park their bicycles comfortably even during peak hours. The intensity of use increases during working days and working hours, which shows the functionality and popularity of the

parking lot. Therefore, it is concluded that the parking garage bicycle parking lot is suitable for users in terms of capacity and intensity of use.

In terms of comfort and attractiveness, it was determined that the parking garage bicycle parking lot in Izmir Konak is generally user-friendly, but lacks some comfort and aesthetic elements. The parking lot's indoor space advantage and secure parking facilities allow users to leave their bicycles safely. However, the lack of seating areas and aesthetic arrangements may negatively affect the user experience. Therefore, it is recommended to add seating areas and aesthetic improvements to increase the comfort of the parking lot.

In terms of continuity and linearity, it has been determined that the parking garage bicycle parking lot in Izmir Konak is well integrated with the existing network of bicycle lanes and offers an uninterrupted use. The parking lot's connections to the bicycle lanes allow users to easily access the parking lots and are located at appropriate distances in terms of continuity. Linear connections allow users to have an uninterrupted and comfortable riding experience on the bicycle paths. Therefore, it is concluded that the parking garage bicycle parking is suitable for users in terms of continuity and linearity.

In terms of integration, the proximity of the parking garage bicycle parking lot in Izmir Konak to public transportation stops and its integration with multimodal transportation facilities were found to be positive. Parking facilities make it easier for users to continue their journeys using public transport after parking their bicycles and contribute to more efficient urban transportation. It is recommended that this integration is maintained and improved where necessary.

In terms of environmental sustainability, it was determined that the parking garage bicycle parking lot in Izmir Konak was constructed using sustainable materials and has energy efficient lighting systems. These features increase the environmental sustainability of the parking lot and improve urban environmental quality.

Tabl4 4. Comparison of Bicycle Parking Spaces in Bagdat Street and Izmir Konak Parking Garage

Criteria	Subheading	Bagdat Street	İzmir Konak Indoor Parking
Security	Lighting	High	High
	Camera Systems	High	High
	Visibility	High	High

	Other Aspects	middle 	High 
Accessibility	Location	High 	High 
	Disabled Access	middle 	High 
	Sidewalk and Road Crossings	middle 	High 
Capacity and Utilization Intensity	Capacity	middle 	High 
	Intensity of Use	middle	High
Comfort and Charm	Comfort Elements	middle 	middle 
	Aesthetics	middle	middle

Continuity and Linearity	Bağlantı Yolları	High	High
	Continuity	High	High
	Linear Connections	High	High
Integration	Integration with Public Transportation	High	High
	Multimodal Transportation	High	High
	Advantages of Integration	High	High
Environmental Sustainability	Green Areas and Planting	High	middle
	Sustainable Material Use	High	High
	Energy Efficient Lighting	High	High

This table includes the evaluation of parking garage bicycle parking spaces in Bağdat Street and Izmir Konak according to various criteria and the rating of each criterion as medium, high or low.

4.1. Recommendations

The design of bicycle parking facilities requires careful planning and calculation to ensure that users can park their bicycles in safe, comfortable and accessible spaces. There are many factors to consider in this process. When choosing the location of bicycle parking spaces, the areas that are heavily used by users should be prioritized. Areas such as train stations, shopping malls, university campuses and business centers are strategic locations for bicycle parking. Placement in these areas reduces the time it takes cyclists to find a parking space and provides a safe parking experience. For example, each bicycle requires a minimum width of 0.6 meters and a length of 2 meters.

It is important to determine the total bicycle capacity and calculate the total space accordingly. For a space with 10 bicycle capacity, the calculation can be as follows: 0.6m x 10 + 2m x 10 = 6m² + 20m² = 26m².

Safety and accessibility are among the most important factors for bicycle parking spaces to be preferred by users. Parking lots should be designed taking into account factors such as lighting, traceability and ease of use. It is also important that parking lots are designed in such a way that users can lock their bicycles securely and that bicycles are not damaged. Security cameras, lighting and robust bicycle locking systems protect against theft and vandalism. The perimeter of parking areas can be protected by enclosed or semi-enclosed structures so that users can safely leave their bicycles.

The types of bicycle parking can vary depending on the size of the area and the intended use. Strut-type bicycle parking spaces are parking spaces where bicycles are placed vertically and are generally preferred in narrow spaces. These types of parking spaces are widely used to save space. Horizontal bicycle parking spaces, on the other hand, are spaces designed for bicycles in a horizontal position, usually in such a way that both wheels and frame can be fully secured. Wall-mounted bicycle parking spaces allow bicycles to be parked vertically or horizontally with the help of wall-mounted apparatus.

Covered bicycle parking spaces are enclosed or semi-enclosed spaces that provide protection for bicycles from the weather and theft. Such parking spaces are often found in city centers, public transport stops, large shopping malls and workplaces. Covered parking spaces provide bicycle users with a high level of security and are usually equipped with security cameras, locked gates and security personnel. In addition, covered areas protect bicycles from weather conditions such as rain, snow and sun, extending the life of the bicycles.

Bicycle parking areas may also include additional equipment such as repair stations and pump areas. Separate quantities should be calculated for each of these equipment. In addition, green areas and plantings can be planted around the bicycle parking areas. Trees, shrubs and flowers provide an aesthetically pleasing appearance and protect the environment. These green spaces improve air quality in cities and reduce the urban heat island effect.
Concrete pavements are an ideal choice for the durability of bicycle parking. Concrete withstands the load of heavy bicycles and intensive use and requires low maintenance. Concrete surfaces can be non-slip, which increases the safety of cyclists. In addition, concrete can be made aesthetically appealing with colored and patterned surfaces, making bicycle parking visually pleasing.

Asphalt is a good choice for bicycle parking.
Steel is the material of choice for bicycle parking structures. Steel constructions are robust and durable, which allows bicycles to be parked safely. Stainless steel is resistant to external factors and has a long service life. Steel also offers a variety of aesthetically pleasing designs; stainless steel and painted steel options provide a modern and stylish look. Aluminum is a lightweight and durable material and can be used in bicycle parking structures. Offering strong and secure locking systems, aluminum is ideal for modern and aesthetic designs. Corrosion resistance reduces the maintenance requirements of aluminum and ensures a long service life.

Polycarbonate is a material frequently used in indoor bicycle parking lots. Resistant to UV rays and impacts, polycarbonate offers an aesthetically appealing appearance with its transparent or semi-transparent panels. Polycarbonate coatings are easy to clean and long-lasting with low maintenance requirements. Wood provides a natural and warm look in covered and semi-covered bicycle parking lots. Well treated and preserved wood is durable and offers an aesthetically pleasing option. Wooden structures can be long-lasting with regular maintenance and protective varnishes.

Locking systems used in bicycle parking lots are critical in ensuring security. Steel or aluminum locks should be resistant to cutting and breaking. High-security locking mechanisms ensure that bicycles are parked safely.

Green areas and plantings can be planted around bicycle parking lots. Hardy plant species suitable for the local climate should be selected and regular maintenance should be ensured. Trees, shrubs and flowers provide an aesthetically pleasing appearance and support environmental sustainability. Green spaces improve air quality in cities and reduce the urban heat island effect. The durability, safety and aesthetic properties of the materials used in the design of bicycle parking spaces directly affect the user experience. Therefore, being careful in material selection and choosing materials that are suitable for the intended use are critical to creating successful and effective bicycle parking facilities.

5. CONCLUSION

In this study, important findings were obtained as a result of the analysis and research on the design of bicycle parking spaces. These findings reveal the basic principles for the effective and sustainable design of bicycle parking spaces.
The need for bicycle parking facilities has become more evident as urban bicycle use has increased. The need for safe, accessible and comfortable parking spaces has been clearly demonstrated by research. Especially bicycle users attach great importance to factors such as safety, lighting and easy accessibility. Understanding the criteria of users' preference for parking spaces plays a critical role in the design process. In this context, user surveys are considered as an indispensable tool to identify the key elements that should be considered in the design of bicycle parking facilities.

It was emphasized that bicycle parking facilities should be located in strategic locations, especially close to areas of high use such as public transport stops, shopping malls, university campuses and business centers. Placement in these areas shortens the time for bicycle users to search for a parking space and provides a safe parking experience. Current bicycle usage rates and future increases in usage should be taken into account when determining capacity. Flexible and expandable designs ensure that parking spaces can be used effectively in the long term.

The design of bicycle parking spaces should balance safety, aesthetics and functionality. It is important to design in such a way that users can lock their bicycles safely and that the bicycles are not damaged. The prototyping process enabled the refinement of the designs based on user feedback and ensured that the final product best meets user needs. The design concepts developed during this process provided initial ideas on how the bicycle parking would look and function aesthetically and functionally.

Effective management and maintenance of bicycle parking is critical to increase user satisfaction and utilization rates. Measures such as security cameras, regular maintenance and lighting increase the safety and durability of the parking lots. Project planning and cost analysis have been considered in detail to ensure the viability and sustainability of the bicycle parking lots. Proper planning of parking lot maintenance and management strategies plays an important role in creating a sustainable bicycle parking infrastructure in the long term.

The assessment of bicycle parking in terms of environmental sustainability has revealed the importance of using recyclable and environmentally friendly materials. Bicycle parking integrated with green spaces and landscaping enhances the aesthetic value of cities and improves air quality.

The evaluation of user experiences emphasized the importance of prioritizing user needs in the design of parking lots. By integrating user feedback into the design process, the functionality of the parking spaces and user satisfaction were improved. This feedback is critical for identifying challenges and solutions for the daily use of bicycle parking spaces. A user-centered approach is an important factor in increasing the effectiveness and utilization rates of bicycle parking facilities.

These results provide valuable contributions to sustainable urban transportation solutions by providing information and recommendations for the effective and user-friendly design of bicycle parking facilities. Creating safe, accessible and aesthetically attractive parking spaces that meet the needs of bicycle users has positive impacts on environmental sustainability and public health by encouraging bicycle use.

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