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ANALYZING SIDEWALK ACCESSIBILITY FOR PEOPLE WITH DISABILITIES: A CASE STUDY OF LVIV, UKRAINE

Bakun A.,
Master of Architecture and town planning,
arynabakun@gmail.com

Lytvynenko M.,
Master of Architecture and town planning,
lytvynenko.mariia.ua@gmail.com

Odesa State Academy of Civil Engineering and Architecture, Odesa

Barat Vakili I.,
Master of Urban Design,
imanbaratvakili.a@gmail.com

Malko A.,
Dr.-Ing., Senior Researcher,
anastasia.malko@kit.edu

Karlsruhe Institute of Technology, Karlsruhe

Abstract. This article analyzes sidewalk accessibility in Lviv, Ukraine, particularly for people with disabilities. The study classifies and identifies problems related to pedestrian infrastructure that hinder mobility for this social group. Various subgroups of people with disabilities are considered, each with specific needs that impact pedestrian movement and can lead to conflicting interests. The case study of Lviv sheds light on the challenges related to accessibility in the city. The vector of the "City of Short Distances" concept development was considered together with the requirements for a pedestrian zone. Through the identified indicators, the study conducted a comparative analysis of the sidewalk's accessibility between distant stops. The findings of this research contribute to the development of social practice theories and enrich the understanding of barrier-free accessibility in urban environments.

Keywords: sidewalk, accessibility, disability, infrastructure, mobility, pedestrian.

Introduction. The main problem highlighted in the article is the lack of adequate sidewalk accessibility for individuals with disabilities in Lviv. The article focuses on the challenges faced by people with disabilities in navigating the city's pedestrian infrastructure, particularly sidewalks, which pose barriers to mobility and independence. Accessibility creates inclusive opportunities for people with disabilities, allowing them to enjoy their civil, cultural, political, social, and economic rights and entitlements. It is also a precondition for independent living, full and equal social participation by children and adults with disabilities. Ensuring inclusive urban environments that cater to the needs of all residents, including those with disabilities, is a fundamental aspect of sustainable and equitable urban development. Among the various elements crucial to the mobility and accessibility of people with disabilities, sidewalks are pivotal in facilitating independent and safe movement within cities. This article presents a comprehensive case study focusing on Lviv, Ukraine, and its efforts to enhance sidewalk accessibility for people with disabilities.

Lviv, particularly the historical center, was chosen for the accessibility analysis. It has a structure typical of European cities. Lviv's historical center has a distinct radial structure. Historically, major transportation routes headed downtown were bounded by old fortification walls. Seven out of ten tram and trolley bus routes and over 50% of bus routes run through or near the central part of the city. Historically, streets and paths have evolved, passing the arrays of the hills of the High Castle, Znesinnya, Citadel, Kortumova Mountain, and Main Market Square. As a result, seven out of ten tram and trolley bus routes, and more than half of all bus routes, pass through or are close to the city center. Since the 1990s, car ownership and usage have increased in Lviv, causing congestion and pollution in the city center. The city began to experience problems moving people efficiently, as the streets were not designed to handle such an influx of passenger vehicles alongside public transit, which was getting increasingly slow. For pedestrians with disabilities, which encounter many problems on the sidewalks of Lviv Center, it is a complicated challenge.

The case study delves into the key dimensions of sidewalk accessibility in Lviv, examining various factors that impact the ease of movement of people with disabilities. It seeks to identify existing challenges, highlight successful initiatives, and propose actionable recommendations to create a more disability-inclusive urban environment. By analyzing the current state of sidewalk accessibility in Lviv, this study aims to shed light on the experiences of individuals with disabilities, understanding the obstacles they face and the opportunities to enhance their mobility. Furthermore, it explores how the city's efforts align with broader national and international principles of disability rights and accessibility standards.

Analysis of the recent research and publications. The Sustainable Urban Mobility Plan (SUMP) for Lviv is a comprehensive strategy to transform the city's transportation system into a more sustainable and efficient one [17]. The plan has garnered considerable attention from researchers and urban planners due to its potential to address the growing challenges of urban mobility, and environmental concerns and improve Lviv's residents' overall quality of life. Submitted at the conference on the regulation of the urban situation in Lviv has been a discussion about the fact that people with disabilities should not feel disadvantaged. Therefore, the government and society should do everything possible to improve the quality of life for this group. The definitions of world united organizations divide the focus group into 6 main subgroups: people with blindness or people with low vision, deafness or hard of hearing people, elderly people, people with mental disorders, people with intellectual disability, and people with locomotor disability. The research and publications on the Sustainable Urban Mobility Plan for Lviv highlight its potential to transform the city's transportation landscape towards a more sustainable, efficient, and eco-friendly system. By addressing mobility patterns, environmental impacts, stakeholder engagement, infrastructure development, and financial considerations, the plan offers a holistic approach to urban mobility challenges. Continued research and active collaboration among stakeholders will be instrumental in ensuring the successful implementation of the SUMP, ultimately leading to a greener, more livable city for the people of Lviv.

The article on the topic "Lviv – From Streets for Cars to Streets for All" discusses the problems of the pedestrian infrastructure of the city of Lviv [20]. The data indicate that Lviv's urban planning historically favored cars over pedestrians, leading to an oversight of the needs of those traveling on foot. However, the recent developments show a conscious effort by the city to rectify this imbalance and prioritize the well-being of pedestrians. By acknowledging that nearly all Lviv residents utilize walking at some point in their journeys, the city has recognized the necessity of creating safer, accessible, and attractive pedestrian spaces. The analysis highlights the city's commitment to improving and creating new pedestrian spaces throughout Lviv. Over 40 pedestrian spaces enhanced or established within the last five years indicate a significant investment in urban design and infrastructure that benefits pedestrians.

This approach can lead to several positive outcomes, including increased social interaction, better physical health, and reduced reliance on cars for short-distance trips. Lviv's strategy of reallocating street space from cars to pedestrians and sustainable travel modes is a bold step towards fostering a more inclusive and environmentally friendly city. By opening streets previously dominated by cars to people, such as Rudanskoho Street, Lviv encourages active mobility and enhances the attractiveness of the urban environment for residents and visitors alike. This approach aligns with the broader global trend of prioritizing people-centric urban planning. The analysis underscores Lviv's focus on accessibility for all, including people with disabilities. Implementing at-grade road crossings, lower floor ramps at public buildings, and improved lighting enhances safety and ease of movement for pedestrians, particularly those with mobility challenges. This commitment to inclusivity reflects a more equitable approach to urban planning, ensuring that all residents can participate in and benefit from the city's public spaces. Upgrading lighting along pathways and intersections is crucial in enhancing nighttime safety for pedestrians. Well-lit areas reduce the risk of accidents and increase the sense of security, encouraging more people to walk at night. Lviv fosters a vibrant and active urban life beyond daylight by making nighttime mobility safer and more appealing.

Lviv's transformation from streets designed primarily for cars to inclusive and pedestrian-friendly spaces is a commendable endeavor that prioritizes the needs and well-being of its residents. By allocating more space to pedestrians, promoting accessibility, and improving nighttime safety, the city is fostering a more sustainable, people-centric urban environment. This shift encourages active mobility and contributes to a healthier, more socially connected, and environmentally conscious city. As the city continues implementing these pedestrian interventions, it sets an example for other urban centers seeking to create more livable and accessible spaces for their communities.

The research of “Doslidzhennia dostupnosti miskykh prostoriv” focuses on studying the accessibility of urban spaces within Ukrainian cities, with a particular emphasis on Lviv [1]. Accessibility is a critical aspect of urban planning and development, directly affecting residents' quality of life and opportunities. The study assesses how easily residents can access essential services, amenities, public transportation, employment centers, green spaces, and other vital urban elements. The research identifies the challenges and inequities related to accessibility in urban areas. These challenges could include inadequate infrastructure, barriers for people with disabilities, limited public transport options, traffic congestion, and spatial inequalities that disproportionately affect certain neighborhoods or population groups. The study delves into the mobility patterns of residents within the city, exploring how people move around, the modes of transport they use, and the distances they travel for various purposes. Understanding these patterns can help inform targeted interventions to improve accessibility and mobility options. Assess the impact of urban design and infrastructure on accessibility. This includes evaluating the effectiveness of pedestrian infrastructure, public transit networks, cycling lanes, and the presence of green and recreational spaces. Examine the role of mixed land-use development and the availability of public facilities in promoting accessibility. Based on the research findings, the study proposes policy and planning recommendations to enhance urban accessibility. This involves suggesting improvements in transportation systems, land-use zoning, pedestrianization initiatives, smart city technologies, and inclusivity measures for people with disabilities. To ensure the relevance and effectiveness of the research, the study involves engaging stakeholders, including local communities, government officials, urban planners, and advocacy groups. Various stakeholders' involvement helps understand diverse perspectives and develop actionable solutions.

Research on the accessibility of urban spaces, such as "Doslidzhennia dostupnosti miskykh prostoriv" by Big City Lab, Ministry of Development of Communities and Territories of Ukraine, is crucial for informed and sustainable urban development. By understanding the

challenges, inequities, and opportunities related to urban accessibility, cities like Lviv can work towards creating more inclusive, efficient, and livable urban environments for all residents.

Materials and Methods. The study is conducted by the method of remote urban planning: a combination of graphic-analytical analysis, photo-election, and elaboration of existing studies. The results were obtained in 3 stages: the analysis of the focus group, the analysis of the accessible infrastructure, and the problem analysis of the infrastructure's mobility and accessibility.

Table 1

Sidewalk Feature	Standard	Document
Running Slope	5% maximum slope or equal to the roadway slope	DBN V.2.2-40:2018 Inkliuzyvnist budivel i sporud. Osnovni polozhennia.
Cross-Slope	2% maximum cross-slope	DBN V.2.2-40:2018 Inkliuzyvnist budivel i sporud. Osnovni polozhennia.
Clear Sidewalk Width	Minimum 1.5m, down to 1.0m for driveway; All hanging or protruding obstacles are located at the height of not less than 2.1 m; Forbidden to install road fences, advertising structures, temporary structures, pits from hatches and rain receivers, stairs, porches of houses, etc.	DBN V.2.3-5:2018 Vulytsi ta dorohy naselenykh punktiv. Zmina № 1.
Pavement Material	Smooth and non-slippery with a joint thickness of no more than 15 mm (cobblestone without chamfer, asphalt, etc.).	DBN V.2.2-40:2018 Inkliuzyvnist budivel i sporud. Osnovni polozhennia.
Changes in Level	Sidewalks are placed on the same level as the curb, at a height of 150 mm above the road; The slope of the external ramps on the traffic routes and at the entrance to the building ≤ 8% (1:12); At short intervals with a change in the level in the traffic routes up to 0.2 m and at the crossing from the sidewalk to the roadway, the slope is ≤ 10% (1:10); The width of the ramp with one-way traffic is 1.2 m, with two-way traffic – 1.8 m. The maximum height of one ramp ≤0.8m.	DBN V.2.2-40:2018 Inkliuzyvnist budivel i sporud. Osnovni polozhennia. DBN V.2.3-5:2018 Vulytsi ta dorohy naselenykh punktiv. Zmina № 1.
Tactile Navigation	The guiding tactile strips should provide free orientation and be ≤ 0.3 m wide. They should be installed when laying a route to a specific object; Warning tactile strips should warn of a barrier, danger, or obstacle and be ≤ 0.4–0.6m wide.	DBN V.2.2-40:2018 Inkliuzyvnist budivel i sporud. Osnovni polozhennia.

Table 1. Ukrainian Sidewalks Standart Features, 2023, Bakun A., Lytvynenko M.

The main tools were studies of the accessibility of urban spaces with a focus on user experience, surveys, existing regulatory documents, Google Maps, and satellite images [1]. People with disabilities were chosen as a focus group. A generalization was made that people with disabilities are more likely to be considered pedestrians rather than drivers [2]. The object

of the research was the historical center of Lviv, specifically its structures: sidewalks, spaces, and roads. The choice was determined by the planning structure typical for European cities, the concentration of transport routes, and the problems of post-industrial cities. The received information was processed using remote materials analysis emphasizing digital tools. This approach has become relevant for the scientific and student community after the Covid-19 pandemic and takes on a wider meaning in wartime when it is not physically possible to be present in the research area in Ukraine [3]. As part of this study, freely accessible materials that do not conflict with the confidentiality policy were used.

The Ukrainian standards, based on which the assessment of the characteristics of sidewalks started, are presented in Table 1. The containers were elaborated on in the Automated Sidewalk Quality and Safety Assessment System final report, 2015, and in the research on the Accessibility of the Urban Environment, 2021 [3,5]. The article's analytical part uses several terms used to identify and classify problems. These have different meanings depending on usage and understanding; therefore, the text provided their definition. The maps of transport routes of Lviv considered the functional diversity of streets, the city center's pedestrian network, and the presence of city transport stops. The article identified spatial distribution and environmental indicators of inaccessibility based on the characteristics defined in practical guidelines and scientific articles [3,5,6]. According to these indicators, the Main Market district's most problematic areas and paths were found.

With the resulting theoretical instrument and modern digital research tools, the journey from the public transport stop near National Drama Theatre to the stop on the Main Market Square was verified. To compare sidewalk segments to become a detailed study, high-quality photographs and accurate data on their physical characteristics must be employed. The implemented study technique gives a great advantage in remote urban planning, but the inaccuracy of current tools creates its research limits.

Although many reforms have already been made in the city for pedestrian accessibility, the historical context, the existing condition of the streets, and the attitude of people to the issue of accessibility create new conflicts. Isolation of the center from cars partially considers drivers with passes: street residents, trucks, and businessmen [8]. Therefore it is impossible to place the food establishments' terraces on the roadway, and as a result, it creates barriers on the sidewalks. The chosen development vector requires a high-quality built environment, which currently does not provide pedestrian walkability [9]. Being deprived of social establishments, people with disabilities face numerous accessibility problems. Research on the Accessibility of the Urban Environment, an Album of Barrier-Free Solutions, and other practical guides give selective explanations of typical problems [1,10,11]. Developing effective solutions requires comprehensive research on accessibility detection in the existing city, in that case - Lviv.

Main material and results. People with disabilities (PwDs) represent a large part of society in Lviv. From open sources of Lviv, it is known that in 2021, about 15% of residents were considered PwDs. It is about 213,800 persons in total [12]. The accessibility of a mobility infrastructure considers the needs of these people. The research used the groups of PwDs: blindness or people with low vision, deafness or hard of hearing people, elderly people, people with mental disorders, people with intellectual disability, people with locomotor disability, incl. wheelchair people, prosthesis substitutes, and leg pain. Some individuals share more than one impairment [13]. Each type of disability in the focus group has common and special needs. Common needs are socialization, adaptivity, recreation, and safety. Special needs for blind and low vision are easy-to-access public transport, understandable spaces on flat surfaces, gentle cross-slope, and clear sounds. Deaf or hard-hearing people need simple navigation, and older people need healthcare and shopping. Blind and low vision, hard of hearing, deaf people, and locomotor disability share the need for employment and special education. And people with

disabilities such as locomotor and intellectual disability and mental disorders need proper recreation and healthcare [1]. Main Market District includes all these functions; nevertheless, existing infrastructure makes some inaccessible and reduces opportunities for PwDs.

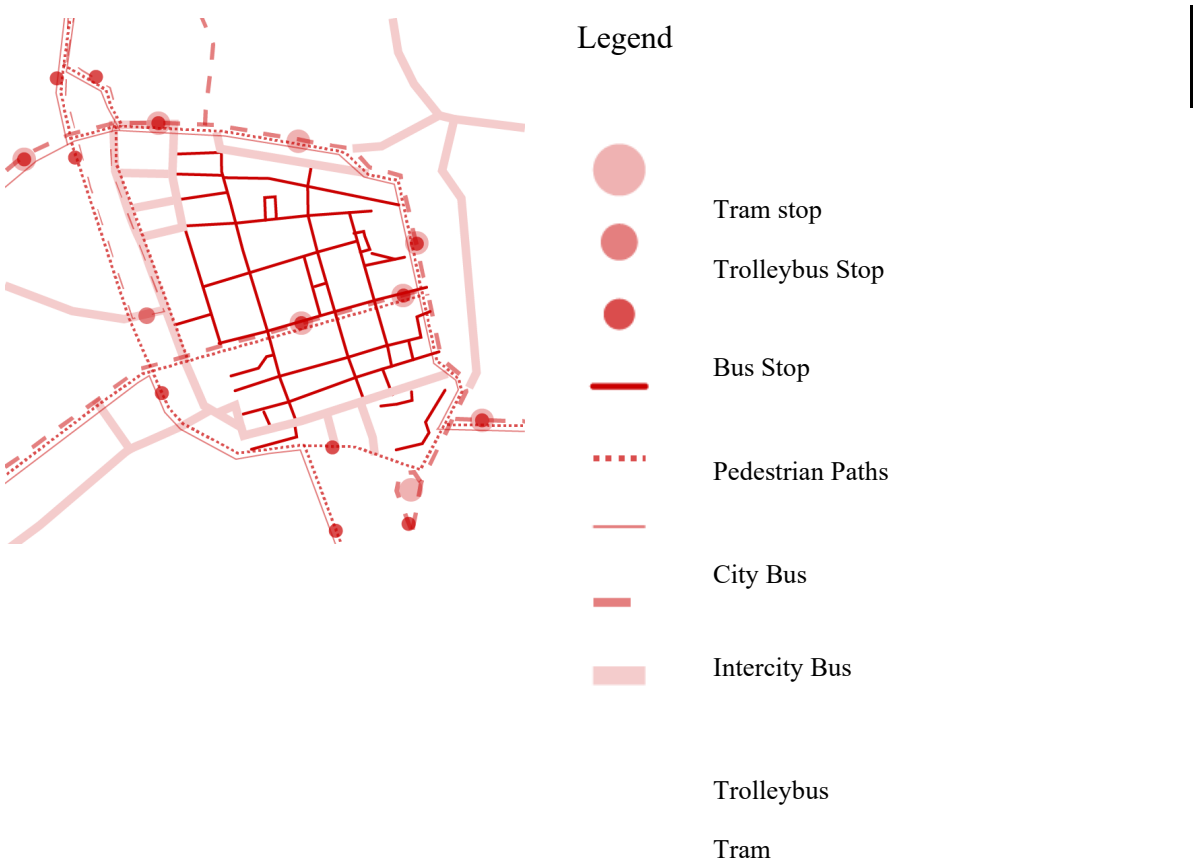
The pedestrians in Lviv Center encounter various infrastructure problems, which can be categorized based on different characteristics. Moving on the sidewalk from the starting point to the destination comprises footpaths, crossroads, and spaces, collectively representing the accessibility mobility challenges within the city [14]. Local unmet needs result in minor yet disruptive issues along the way, gradually complicating daily life and giving rise to infrastructure-related problems [15]. Being deprived of the numerous attractions in Lviv, people with disabilities perceive public spaces as concentrated sources of problems and hazards for their mobility. According to the official tourism website of Lviv, popular places to visit in the researched area include the Opera House, the National Drama Theater, the Boim Chapel, the Armenian Cathedral, and Main Market Square — the center of the political, public, cultural, and commercial life of the city for 500 years [16]. While the city's historical background has led to the preservation of numerous cultural landmarks, it also caused many infrastructure problems. The urban design, characterized by complex cobblestones, primarily intended for pedestrian use, was implemented without considering the rapid industrialization and the increasing number of cars on the roads. The needs of people with disabilities and their access to various functions were disregarded, leading to the absence of improved sidewalks and specialized infrastructure. Their specific needs follow the lifestyle of people with disabilities. Their specific needs follow the lifestyle of people with disabilities. Main Market District offers many recreational possibilities for those seeking coffee and exploring Ukrainian culture or modern art. Concentrating on these specific functions enables the assessment of potential district load and predicting everyday routes for people with disabilities. The most accessible and convenient locations are typically associated with entertainment, predominantly found on the ground floors of buildings, primarily used for commerce and food establishments. However, a map analysis reveals a low density of pharmacies and first aid points. This lack of quality healthcare options can result in isolation from the northern part of the district, leaving few options for socialization, recreation, and education. The situation is further exacerbated when sidewalks and trails that link individually accessible facilities become barriers on a person's way.

The importance of accessible infrastructure for PwD social functioning can be found in the definition of accessibility. This is unimpeded access for people with reduced mobility to independent use of urban infrastructure. The most common terms related to accessibility are inclusiveness and safety. Inclusive design means incorporating universal design principles that accommodate a range of abilities and disabilities. Inclusive design features can include tactile paving, audio-tactile maps, visible and audible signals, and clear communication systems that ensure people with disabilities can comprehend and respond to safety instructions and information. Safety refers to the absence of physical hazards or obstacles that could pose a risk to individuals with disabilities. It ensures accessible infrastructure, such as curb cuts, ramps, handrails, and tactile indicators, to facilitate safe movement and navigation. Creating an inclusive and accessible environment that promotes social inclusion and addresses their specific needs, ensuring they can move around public spaces with dignity and independence and without unnecessary risk or barriers. Mobility is an important factor in assessing the accessibility of the environment. Mobility is the act or ability to move from one's present position to one's desired position in another part of the environment safely, gracefully, and comfortably. For this, people use the surrounding infrastructure. The problem of everyday infrastructure usage increases the probability of poor perception of infrastructure. The negative association between perception toward infrastructure and the problem of infrastructure usage is strong. People with disabilities report lower perceptions than other social groups [11]. In this

work, further identification and classification of problems related to accessibility, mobility, and infrastructure require a proper definition of such polyseme terms.

Accessible infrastructure is crucial in social functioning, directly impacting social well-being, earnings, education, and health for people with disabilities. The term “accessible infrastructure” refers to the efficient movement between desired origins and destinations while ensuring the safety and comfort of citizens. It encompasses the interconnectedness between buildings and the surrounding environment, encompassing various modes of transportation such as walking, biking, bus travel, and other forms of movement within the city (pic.1). In Lviv, the citywide perspective outlined in the Sustainable Urban Mobility Plan (SUMP) and described in the Urban Development Concept for Lviv aims for a comprehensive and integrated development of all urban areas [17]. The concept of a city with short distances has influenced the development of transport networks connecting to the city center.

However, individuals with special needs still face significant challenges in covering the same distances within the city. To realize the idea of a "City of Short Distances," first of all, paying attention to such people's main mode of movement is necessary. Due to a combination of factors, such as the difficulty in obtaining a driver's license, the lack of an opportunity to use a bicycle, the difficulty in using a taxi, and the availability of benefits from



Pic. 1. Diversity of the Street’s and Sidewalk’s Function in the City Center, 2023, Bakun A., Lytvynenko M.

the country, push people with disabilities to prefer public transport. Public transport cannot run in the central city, a pedestrian zone. To conclude, it is on the sidewalks that people with

disabilities move. Therefore, the focus is on the sidewalks and what problems with their accessibility can be identified.

The issue of accessible sidewalks in the center of Lviv is widespread, primarily due to the historical context of the city's paving and planning, which originated in 1452. The tradition of using stone paving for streets coincided with the advent of stone construction in Lviv. However, the maintenance of sidewalks was later delegated to the owners of the adjacent houses, leading to gradual deterioration and haphazard reconstruction of sidewalks and public spaces. With the advent of industrialization, the use of private vehicles grew in popularity in the city. As the number of private cars increased and parking space became scarce, sidewalks were narrowed and shortened. Over time, the emphasis on commercial functions outweighed the importance of pedestrian convenience, neglecting sidewalks for advertising purposes and creating various zones [18].

Table 2

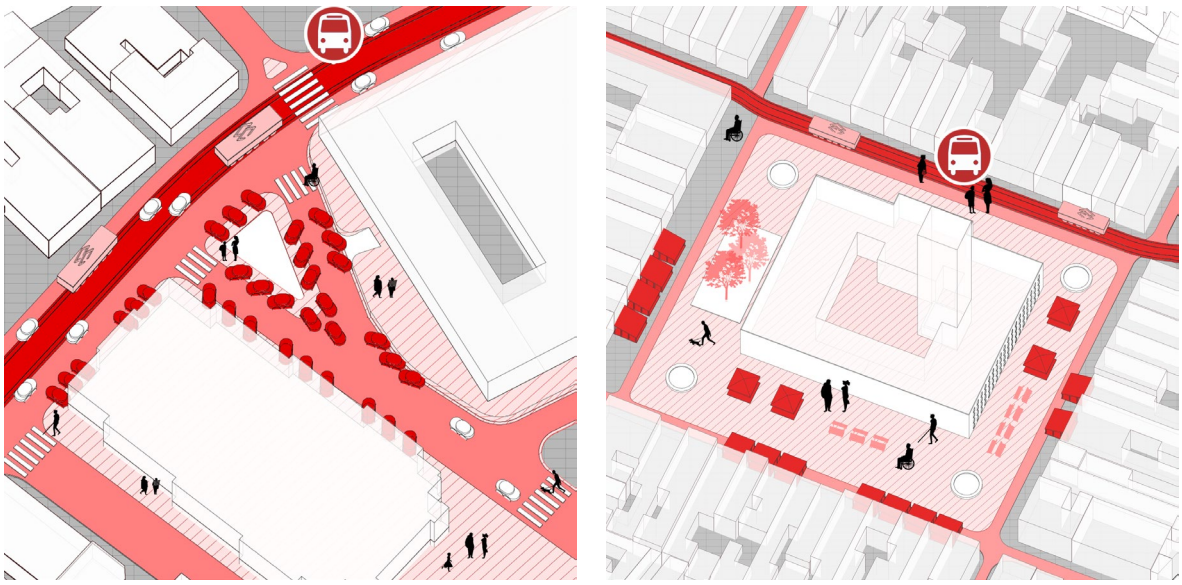
Spatial distribution indicators		**Environment indicators**	
Footpath	- Amount of obstacles on the way; - Presence of parked sidewalks; - Presence of terraces of catering facilities; - Presence of relief and uneven pavement; - Density of paths conflicts; - Small width;	Orientation	- Lack or improper placement of ramps; - Sameness of street surface's color and materials; - Isolated stops; - Lack of address indicators, and tactile navigation. - Incorrect address indicators and tactile navigation.
Crossroads	- Raised sidewalk; - Traffic volume; - Lack of road markings; - Lack of traffic light;	Vertical Clearance	- Curbs and sudden drops; - High ramp slopes; - Raised sidewalk;
		Horizontal Clearance	- Presence of physical objects on the user's paths; - Illegal placement of catering facilities terraces; - Presence of ramp obstructions;
Space	- Small distance between public spaces and the road; - Lack of shade and landscaping; - Social establishments entrances unapplied to people with disabilities; - Lack of access to water; - High value of visual and audio noise;	Quality	- Remoteness to parks; - Remoteness to retail; - Remoteness to places of public accommodation; - Low percent of landscaping; - Improper placement of traffic lights; - Lack of lighting scenarios; - Lack of shade; - Old state of the lighting system;

Table 2. Inaccessible Indicators for Sidewalks in the Lviv Old Center, 2023, Bakun A., Lytvynenko M.

Regrettably, modern urban instruments designed to assist people with disabilities, such as information tables, tactile tiles, or sound accompaniment for pedestrian crossings, are not utilized in Lviv. But everything related to changes in the historical cobblestones must be coordinated according to the rules and laws. The movement's representatives actively condemn attempts to add inclusive traffic signs to the cobblestones to preserve the identity of Lviv, which creates even more conflicts between the issue of accessibility and the importance of preserving the historical appearance. A lot of problems appear while designing and building sidewalks with new tiles. Ceramic tiles were used to reconstruct the square near the Opera House. It is suitable for places with large crowds in durability and endurance. However, the main disadvantage is the slippery surface, which makes the movement of people with disabilities

very difficult, and rain and snow make being in this area dangerous due to the high probability of injuries [19]. According to official data from the patrol police of Lviv, these hazards include unregulated sections of pedestrian crossings and areas where various types of transportation intersect with pedestrian paths [20]. For people with disabilities, crossing these sections quickly via high-curb sidewalks is not feasible. For the environment to be accessible, it must contain a spatial distribution of potential destinations, the ease of reaching each destination, and the magnitude and character of activities found there. [6]. Infrastructure design encompasses various characteristics: orientation [1], vertical and horizontal clearance [6], and quality of the environment [1,6]. Conflicts in one of these categories lead to a decrease in the quality of the environment and the emergence of problems related to its accessibility. City orientation is vital in providing users with information about the environment. In the Main Market District, misinformation arises due to incorrect or missing tactile tiles, uneven or textured pavements, and a lack of address indicators. Vertical clearance involves leveling - changes in height and vertical transitions between adjacent surfaces or along a path's surface [19]. In the district's sidewalks, sudden changes in height, high ramps, and a lack of ramps significantly restrict accessibility. Adequate lighting simplifies orientation and enhances safety on the streets. However, the absence of lighting scenarios, outdated lighting systems, and existing dark areas diminish the district's attractiveness (table 2). Not only do people with disabilities face limitations, but even those without disabilities suffer from a lack of resting places, comfort, and inadequate landscaping.

In recent years, the city of Lviv has undertaken a transformative initiative to alleviate traffic congestion and enhance the historic charm of its Old Town. Recognizing the importance of preserving its architectural heritage and creating a pedestrian-friendly environment, the local government has made significant changes by converting some car roads into expansive sidewalks. This bold decision has revitalized the city's historical center and promoted sustainable mobility, fostering a more enjoyable and immersive experience for residents and tourists. In response to the mounting traffic congestion and environmental concerns, the local government of Lviv embarked on a visionary plan to reclaim the city center for pedestrians. By restricting car access in certain areas and expanding sidewalks, they aimed to create an inviting space where people could freely explore and appreciate the city's cultural heritage. This initiative aligns with a broader global trend towards sustainable urban development and prioritizing the needs of pedestrians over motorized vehicles. Introducing new regulations and prohibiting many cars in the historical center gave significant advantages to this area. The conversion of car roads into sidewalks has vastly improved the walkability of the Old Town. Pedestrians can now stroll, explore hidden corners, and enjoy the city's atmosphere without the constant noise and congestion associated with vehicular traffic. Pedestrianizing the Old Town has prioritized the safety of residents and visitors alike. With fewer cars maneuvering through narrow streets, the risk of accidents has significantly reduced, allowing people to enjoy their surroundings with peace of mind.



Pic. 2. Inaccessible areas in Lviv's city center: National Drama Theatre and Main Market Square, 2023, Bakun A., Lytvynenko M.

The transformation of car-centric areas into pedestrian zones has stimulated a vibrant street life. Sidewalk cafes, street performers, and local vendors have flourished, creating a lively and engaging atmosphere that encourages social interaction and cultural exchange. While the pedestrianization of Lviv's Old Town has brought numerous benefits, it also presents certain challenges. The government must consider alternative transportation options, provide adequate parking facilities outside the historical center, and ensure accessibility for people with disabilities.

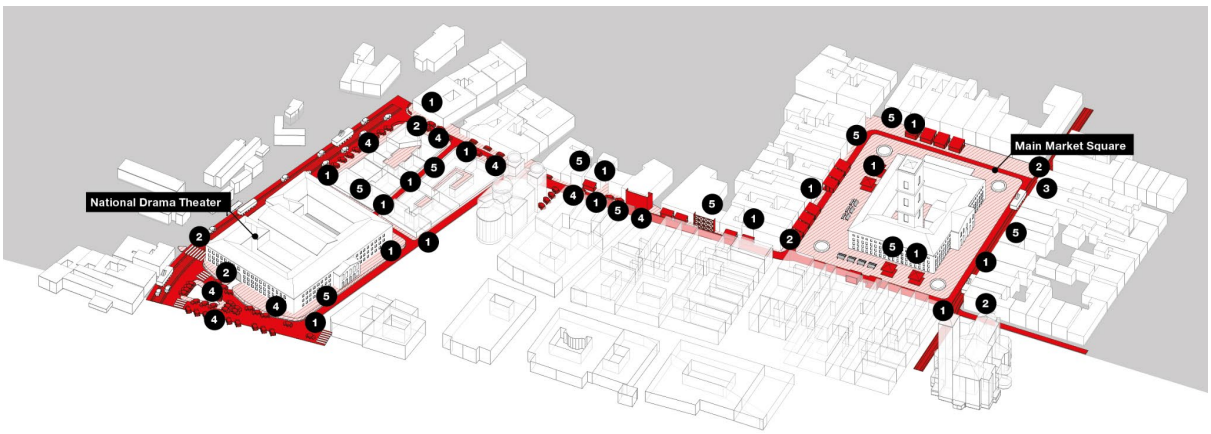
The city center, particularly the area around Main Market Square, accommodates many functions. Approximately 70% of tram and trolley bus routes and over 50% of bus routes traverse the central part of the city [7]. The most direct route to the center starts at the National Theatre and concludes at Main Market Square. This path begins and ends at public transport stops. However, individuals with disabilities face challenges upon disembarking at the Teatralna stop, as there are no equipped ramps. They must navigate a pedestrian crossing without a specialized traffic light system with sound cues. Furthermore, a common issue in historical centers occupies significant sidewalks, creating various obstacles. Insufficient control over parking exacerbates the problem, resulting in haphazardly parked cars in pedestrian areas. In some sections, the sidewalks along the route may not provide sufficient width for individuals with mobility devices to pass each other comfortably. This limitation can create congestion and hinder the flow of pedestrian traffic, potentially leading to difficulties maneuvering through crowded areas. Furthermore, due to limited available space, cafes and restaurants encroach upon pedestrian zones for commercial purposes, further limiting the space intended for pedestrians. Cobblestone streets and uneven surfaces along the journey can pose significant challenges for individuals with mobility aids, such as wheelchairs, walkers, or crutches. These uneven surfaces may make it difficult to traverse the route smoothly and increase the risk of accidents or discomfort.

The concentration of various problems gives rise to the most hazardous areas for all citizens. Based on the previous analysis, several similar areas can be identified within the whole Main Market District (pic.2). Firstly, the pedestrian zone of the Main Market Square in Lviv is intertwined with tram traffic, stops, and special passes for building maintenance. The absence of a clear division between the roadway and pedestrian areas creates conflicts in movement.

Secondly, Mickiewicz Square presents an intersection of the pedestrian zone, vehicle path, and parking lot near a bus stop. Most problematic areas are found in the zones intended for socialization. The pedestrian zone with unregulated intersections and car parking disrupts access to Hlyniany Gate. The topography of the territory caused a large difference in height, stairs, and irregular ramps. The crossing area of pedestrian and transport routes makes it challenging to visit or even pass by the National Drama Theater or the Lviv National Opera (pic.3).

The historical center of Lviv has mainly pedestrian traffic for several reasons related to its history, architecture, and preservation of cultural heritage. One of the main reasons is the age-old history of the very center of Lviv. Many of the streets and squares in the area have their roots in the Middle Ages when cars did not exist. Therefore, they were designed with pedestrians and horse riding in mind. Narrow streets, many pedestrian zones, and convenience for pedestrians - all contribute to the absence of car traffic. In addition, Lviv is a city with a great cultural heritage. Many buildings, churches, and architectural monuments are historical monuments. Prohibiting car traffic in the center helps to preserve these monuments, as it minimizes the risk of damage or wear from heavy traffic.

In 2008, a pedestrian zone was recreated in Lviv, and 26 streets and squares in the city's historic center were closed to cars. Svobody Avenue and Mickiewicz Square also become pedestrianized on Sundays and holidays. Since then, more people have been walking the streets; landscaping, new street furniture, summer playgrounds, cafes, restaurants, and street musicians have appeared. Of course, there may still be roads in the historic center of Lviv, but their number is limited, and they are mainly used to serve local residents and deliver goods. Such restrictions help. The city has a bollard system that is lowered only in special cases. Trams run through Main Market Square with a stop near the Town Hall. But there are also negative consequences of such an infrastructural solution (table 3). The streets around the center have become densely parked, but almost all parking spaces are paid for. Another negative consequence of the commercialization of pedestrian space in Lviv is called the displacement of pharmacies, grocery stores, non-tourist services, and shops. The balance between the development of tourism and the preservation of living conditions for residents is the most difficult task because such changes are viewed negatively. The changes, which were supposed to facilitate and make the historical center of Lviv accessible for pedestrians, actually made it interesting only from a commercial point of view. Which, in turn, put the issue of access to the site and ease of use on the back burner (table 4).



Pic.3. The journey from National Drama Theatre to Main Market Square,
2023, Bakun A., Lytvynenko M.

Table 3

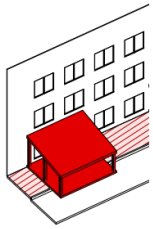
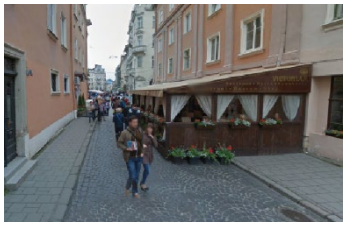
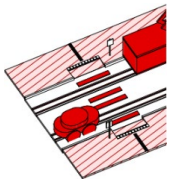
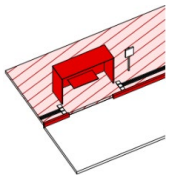
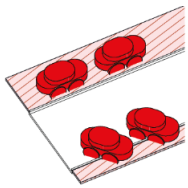
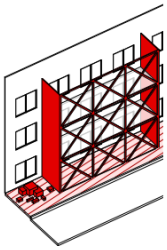
N	Structure of Sidewalks		Typical Problems	Q	Photo fixation
1	Footpath		Lack of places to rest; Blocked paths with catering facilities terraces; Barriers on the way.	17	
2	Crossroad		- Conflict of paths: pedestrian and drivers; - High sidewalk; - Lack of traffic markings; - Lack of traffic lightning; - Underground passages.	6	
3	Stop		Inappropriate height of the stop Lack of schedule Advertising and catering facilities Location of the stop near to the road; Metall poles.	1	
4	Parking		Parked driveways; Parked sidewalks; Lack of parking spaces; Lack of parking spaces for PwDs; Lack of bicycle parking.	8	
5	Entrance		Inappropriate or lack of lightning; The narrow passage in the door; Heavy doors; High thresholds; Parked entrances; Blocked paths.	10	

Table 3. Inaccessibility in the pedestrian zone, 2023, Bakun A., Lytvynenko M.

Table 4

N	Sidewalk	Characteristics								
		Function	Width	Paving	Navi-gation	Horiz. clear-ance	Vert. clear-ance	Stops		Safety
								Presence	Access	
1	Yaroslav Osmomysl Square	Pedestrian, road	0.75m, 1.5 m, 3.0m, 5.0m	Cobble-stones and concrete block pavement (diagonal textures)	Contrast paving materials	Illegal place-ment of catering facilities terraces; road fences.	Running slopes, high intense of cross-slope and running slope	one tram & bus stop	From tram-, bus-stop shelters	Danger: The closeness of the road to the sidewalk; active traffic; no traffic marks
2	Krakivska Street	Pedestrian	1.5 m, 4.5m	Cobble-stones and concrete block pavement (diagonal textures)	Contrast paving materials	Illegal place-ment of catering facilities terraces; adverti-sing structures	Running slopes; raised curbs.	-	-	Safe: Rare encounters with cars at the crossroads
3	Main Market Square	Pedestrian	1.5m, 3.0m, 4.0m	Cobble-stones and concrete block pavement (radial, mixed textures)	Contrast paving materials	Illegal place-ment of catering facilities terraces; adverti-sing structures	Low curbs, and lack of running slopes.	One tram stop	From pedest-rian transit zone	Danger: The conflict between walking and tram routes; the closeness of the tram to the sidewalk

Table 4. Accessibility of Lviv's Sidewalks, 2023, Bakun A., Lytvynenko M.

The UNESCO Convention on the Protection of World Cultural and Natural Heritage (1972) aims to preserve and protect outstanding cultural and natural heritage of world importance [7]. The Convention defines world heritage as "belonging to all mankind" and calls for preserving these values for future generations. In the historical center of Lviv, there are conflicts between the UNESCO rules for preserving world heritage and the need to create convenient mobile infrastructure for people with disabilities. These conflicts arise from the effort to ensure the availability of infrastructure for all while preserving the city's historical value. In the case of historical cities or districts, such as the historical center of Lviv, the value lies in their architecture, uniqueness, and authentic appearance. Therefore, when making changes in such places, it is important to balance between ensuring accessibility and preserving the values of the historic environment. One of the main conflicts concerns the use of paving stones. UNESCO imposes restrictions on changes to the existing cobblestones to preserve the authentic appearance of the streets. However, this can pose problems for people with disabilities, as bumps, narrow passages, and lack of ramps can make it difficult for them to move.

Accordingly, there is a need for modernization and adaptation of paving stones considering the needs of people with disabilities. Another conflict is the placement of modern infrastructure elements. On the one hand, the historical center of Lviv appears to be maintained

in one style, and the installation of modern ramps, elevators, or other elements can disrupt this harmony. On the other hand, it is necessary to ensure accessibility for people with disabilities. However, given the general principles and values underlying the Convention, implementers may consider changing to improve accessibility and infrastructure at World Heritage sites. This requires careful analysis and a balanced approach in order to ensure the preservation of the object's values. The decision to make changes to the Market Square to improve infrastructure for people with disabilities mainly depends on local authorities and project developers, who must consider safety requirements, preservation of architectural heritage, and the needs of all population groups, including people with disabilities. It is important to consider that making changes to world heritage sites is subject to a consultation procedure with UNESCO and considering the recommended principles of world heritage protection. When implementing, project developers and authorities should strive to preserve the object's historical, cultural, and architectural value.

Conclusions. Every year, the statistics of people with disabilities in Lviv grow, but developing the necessary infrastructure for them still faces many problems. In order to successfully solve them, a clear understanding of what they consist of is necessary. The main purpose of accessibility detection is to systematize and categorize different problems initially, to understand their characteristics better, and effectively influence them. Awareness and understanding: The classification helps increase awareness and understanding of the challenges faced by people with disabilities in the city. Identifying and classifying these problems can improve understanding of their nature, causes, and consequences. This creates an opportunity to take appropriate measures to prevent such situations. Planning and development: The classification helps determine priorities and directions for improving the city's infrastructure regarding accessibility and usability for people with disabilities. It allows us to focus on specific aspects requiring immediate action and changes. Inclusiveness and equal opportunities: The classification of problems helps to ensure the implementation of the principle of inclusiveness and equal opportunities for all city residents, including people with disabilities. It allows us to identify which aspects of the infrastructure do not meet the needs of this group of people and need improvement.

In general, classifying city accessibility problems from the point of view of problems for people with disabilities contributes to greater attention to their needs and improving their living conditions in the urban environment. Master plans of Lviv for different years suggested the city's construction change. However, the implementation of the system of traffic organization has historically been complicated by the presence of valuable historical areas in the city. Therefore, the created classification of problems based on the historical center of Lviv can be used for other European historical centers as well. The decision to make changes to the Market Square to improve infrastructure for people with disabilities mainly depends on local authorities and project developers, who must consider safety requirements, preservation of architectural heritage, and the needs of all population groups, including people with disabilities. It is important to consider that making changes to world heritage sites is subject to a consultation procedure with UNESCO and considering the recommended principles of world heritage protection. When implementing, project developers and authorities should strive to preserve the object's historical, cultural, and architectural value. Since then, many reforms and organizational measures have been implemented: the expansion of the pedestrian zone in the old city center, the start of traffic control center operation, and the development and adoption of the Sustainable Urban Mobility Plan (SUMP). It became possible to simplify and regulate the transport system for all citizens.

The understanding of the lifestyle of PwDs in Lviv helps to clarify their current needs and problems. This is a serious challenge for the city authorities in today’s agenda. Due to conflicting needs between groups of people with different types of disabilities, such as making

a minimum of ground obstacles for people with musculoskeletal disorders and creating a clear demarcation of space for people with visual and hearing disabilities. Nevertheless, many of the necessary changes are impossible due to restrictions in the existing state building regulations. All this creates obstacles to fully implementing high-quality, accessible infrastructure in Lviv. Evaluation of different kinds of accessibility forms the requirements for a decent, sustainable environment.

The research shows how those problems go beyond one discomfort street and affect the habitat of many social groups. The accessibility of the streets and sidewalks affects their everyday movement, which is crucial in urban spaces. In the example of Lviv, without positive changes in accessibility, any social group is deprived of an attractive city with good quality of life. In the future, this study can be supplemented with a detailed analysis and comparison of Lviv's sidewalks or urban structures.

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АНАЛІЗ ДОСТУПНОСТІ ТРОТУАРІВ ДЛЯ ЛЮДЕЙ З ОБМЕЖЕНИМИ МОЖЛИВОСТЯМИ: ПРАКТИЧНИЙ ДОСВІД ЛЬВОВА

Бакун А.М.,
магістр архітектури та містобудування,
arinka175@gmail.com

Литвиненко М.В.,
магістр архітектури та містобудування,
lytvynenko.mariia.ua@gmail.com
Одеська державна академія будівництва та архітектури, Одеса

Барат Вакілі І.,
магістр містобудування,

imanbaratvakili.a@gmail.com

Малко А.,
д-р. техн. наук,
anastasia.malko@kit.edu, ORCID: 0000-0002-0350-9182
Karlsruhe Institute of Technology, Karlsruhe

Анотація. У статті розглянута тема недоступності міських структур для людей з інвалідністю. Були розглянуті проблеми мобільності пішохідної інфраструктури шляхом їх виявлення та класифікації. Як соціальна група, люди з інвалідністю відчувають недоступність найсильніше та не завжди мають можливість впоратись з усіма бар'єрами на початку, або вже на шляху до пунктів свого призначення. Можливість доступу до урбаністичних структур утворюється за допомогою інклюзії середовища. Залучення людей до міського життя стає дедалі актуальнішим у світовій практиці, що породжує нові виклики для старих європейських міст. Львів має характерну радіальну структуру, що впливає на транспортну та пішохідні системи. З XX ст. та зі зростанням попиту на автомобілі починаються проблеми з ефективним розподілом потоків пішоходів, автомобілів, та громадського транспорту, який дедалі стає повільнішим.

В статті методом дистанційного дослідження було проаналізовано перспективний розвиток та типові проблеми пішохідної зони центральної частини Львова: нерівне або слизьке покриття, відсутні адресні покажчики, тактильна навігація, домінування приватного транспорту. Під час аналізу були виявлені ознаки доступності, а саме легкість досягнення кожного пункту призначення, їх просторовий розподіл, масштаб і характер діяльності, що там знаходиться. Через недоступність середовища люди з інвалідністю опиняються в ізоляції від установ та закладів, що задовольняють їх базові потреби. Складність отримання водійських прав, відсутність можливості користування велосипедом, складність користування таксі, а також наявність пільг від країни, спонукають обрану фокус-групу до використання громадського транспорту. В умовах «Міста коротких відстаней» його центральна частина передбачає пішохідну зону з активним рухом, що зобов'язує притримання високого рівня обслуговування тротуарів. Результати дослідження доступності тротуарів розвивають теорії соціальної практики та сучасне розуміння безбар'єрних просторів.

Ключові слова: тротуар, доступність, інвалідність, інфраструктура, мобільність.