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ACCESSIBLE TRANSPORTATION – UNIVERSAL OR INCLUSIVE DESIGN?

Summary. The accessibility of public utility buildings, including transportation infrastructure, especially railways, is a prerequisite for the independent functioning of individuals with diverse needs. Despite the enactment of the law in 2019 and its enforcement since September 2021, both architectural and digital accessibility, as well as information and communication accessibility, often fail to meet its requirements. Ensuring accessibility is undoubtedly a long-term process. It is easiest to achieve by designing new facilities in accordance with universal design principles, and somewhat more challenging when modernizing existing ones. Transportation, and therefore railway infrastructure, such as stations, terminals, and platforms, plays a crucial role in social life. This article presents various design strategies, with a particular emphasis on universal and inclusive design. It highlights the differences and similarities and demonstrates the validity of their application to ensure transport accessibility. General requirements for railway infrastructure accessibility are formulated, while detailed requirements specific to these types of facilities are incorporated into the developed accessibility assessment method, which has been implemented in a selected example of existing infrastructure. The article also presents the results of surveys on the accessibility of railway transportation for people with disabilities,

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confirming the need for auditing railway infrastructure. The results obtained allowed for the identification of the most common barriers that hinder individuals with diverse needs from using railway transportation freely.

Keywords: accessibility, universal and inclusive design, people with special needs

1. INTRODUCTION

Unfortunately, the intensive development of cities does not always align with meeting the transportation needs of their residents. Therefore, the most important goal, forming the basis of the current approach and solutions regarding future mobility, is considered to be "more sustainable development" [33]. According to experts from the European Commission, the authors of the White Paper published in 2011 [30], a sustainable transportation system is one that, among other things, "ensures the accessibility of communication goals in a safe manner, without endangering the health of people and the environment, in an equitable way for the present and future generations." In the White Paper, in the section regarding strategies, it is also stated that "the quality, accessibility, and reliability of transportation services will become increasingly important in the coming years, partly due to an aging society and the need to promote public transport."

In response to the demands of transportation policy to increase people's mobility, it is essential to ensure accessibility to means of transportation and transportation infrastructure for all passenger groups. At first glance, this might seem obvious because transportation services are designed for all users. However, the reality is somewhat different. It is important to realize that users, the passengers of transportation systems, also include individuals with diverse abilities. Limitations in ability and, as a result, mobility can affect two significant groups of people, namely, older individuals and those with disabilities, as discussed in various studies, including [8, 12, 22]. One can also include individuals with temporarily limited mobility, such as pregnant women or those with small children. This group of people is even more extensive, which is why it is referred to as the group of individuals with specific needs [5].

In the Bulletin of the Ombudsman for Citizens' Rights [29], it is stated that "the concept of universal design is a strategic approach to planning and designing both products and the appropriate environment, aimed at promoting an inclusive society that includes all citizens, ensuring full equality and the opportunity to participate." The question arises as to whether such a design approach will truly meet the expectations of recipients with varying abilities?

Considering the preceding points, the authors focused on identifying barriers at railway stations. The removal of these barriers can be achieved by using both design approaches described in the literature review, but they prioritized the approach aligned with the principles of universal design [13]. They developed a method for auditing the accessibility of a railway station based on the Technical Specifications for Interoperability criteria, which is described in the methodology section. Then, they presented its implementation using Warsaw's Central Station as an example. The audit results are included in section 4.2.

2. LITERATURE REVIEW

We should not design just for people but, above all, design with people. This is precisely objectivity in design. Currently, in numerous scientific publications [16-18], as well as documents forming the basis for design actions [28], detailed guidelines for accessible spaces have been extensively described. It is worth noting that many design trends have emerged, each involving tailoring products to end users. These include ergonomic design, user-centered design, universal design, and inclusive design, as discussed in various studies [6, 7, 21]. Let's focus on two trends: universal design and inclusive design. Universal design was pioneered by Ronald Mace and is defined as follows: "Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" [32]. Ronald Mace formulated 7 key principles of design, described in [34].

These principles were complemented by an eighth one, namely "Perception of Equality" - in universal design, the aim should be to minimize the possibility of individuals perceiving the design as discriminatory. The provided accommodations should not stigmatize disabilities or other circumstances limiting the users' functionality. The application of universal design principles continues to function, especially in the United States but also in other parts of the world, including Poland, as described by authors such as [1, 2, 4, 6, 14]. The concept of universal design is applicable in various fields, including transportation, information and communication technologies (ICT), education, construction, and the design of green spaces. However, as emphasized by the authors, most research focuses on eliminating architectural and communication barriers with the aim of ensuring accessibility [15, 16]. Considering that universal design seeks to provide one solution that accommodates the largest possible number of users, it may inevitably result in some users being left out. In some cases, additional efforts and resources may be necessary to adapt solutions to more individualized needs. Inclusive design does not mean one solution for all users, but rather multiple solutions that enable achieving the same goal. Inclusive design places an emphasis on understanding the diversity of users when making design decisions to encompass as many people as possible. It involves including people with different perspectives in product design and, in doing so, learning from them how to tailor specific solutions. This aspect has been discussed in works by authors such as [3, 9, 11, 20]. It means that inclusive design focuses on eliminating barriers and actively ensuring participation for everyone, including individuals with special needs. It considers a broad group of people representing various identities, characteristics, and perspectives during the design process. The issue of ensuring accessibility for individuals with special needs to daily goods, services, and spaces remains unresolved. It is important to emphasize that accessibility to public transportation is increasingly recognized as a key element of the quality of life for people with disabilities. In the context of railway infrastructure, universal design can lead to the adaptation of platforms, vehicles, and stations to various needs, including individuals with limited mobility, visual, or auditory impairments, as noted by [23]. This may include access to ramps, information in visual and auditory formats, and facilities for wheelchair users. It is worth noting that each project may require different design approaches depending on its context and user specifics. In practice, the ideal solution may involve combining different design approaches to ensure the highest level of accessibility, convenience, and equality for all railway infrastructure users. A designer in the modern era should be able to anticipate the needs of future users and often shape those needs. It is crucial for every designer to be aware that "we are dealing with people as they are, not as they should be, so the goal is to adapt the product to the user, not the other way around" [19].

3. METHODOLOGY

The implementation of the research presented consisted of two stages. In the first stage, an analysis of the opinions of railway transport users regarding its accessibility was conducted, utilizing surveys from the Railway Transport Office [31]. Subsequently, an audit questionnaire for railway stations was developed, encompassing selected requirements to ensure the accessibility of railway infrastructure according to TSI PRM (Technical Specifications for Interoperability relating to People with Reduced Mobility).

3.1. Requirements ensuring accessibility of transport infrastructure

Minimum requirements for accessibility at railway stations cover architectural, digital, and information-communication aspects, including, but not limited to platforms, stations, stops, Railway station buildings, Interchange hubs, along with all their components such as building entrances, parking lots, taxi stands, pedestrian access to buildings, access to ticket counters and waiting areas, ticket counters, waiting areas, restrooms, other possible amenities, access to platforms, platforms, passenger information systems, including schedules and navigation aids and rolling stock from various carriers, including urban, regional, and long-distance services.

One fundamental issue concerning legal regulations in the field of public transport accessibility is the lack of uniform standards.

In the case of railway transportation, which is the subject of these analyses, both railway infrastructure and rolling stock have well-defined accessibility requirements outlined in the Technical Specifications for Interoperability related to the accessibility of the European Union railway system for persons with disabilities and persons with reduced mobility. These specifications are described in the following documents: [10, 24, 25]. The current binding form is [24, 25, 26] from November 18, 2014, concerning the technical specifications for interoperability related to the accessibility of the European Union railway system for persons with disabilities and individuals with reduced mobility, hereinafter referred to as TSI PRM. TSI PRM applies to both infrastructure and railway vehicles, and the requirements are uniform for all European countries. According to section 2.1.1 of TSI PRM, the scope of TSI PRM includes all public spaces and publicly accessible areas of stations, stops, or integrated interchange hubs used by passengers and managed by railway companies or other infrastructure owners (including PKP S.A., PKP PLK S.A., local governments or their authorities, potentially other entities as well).

Furthermore, there is also the Regulation of the Minister of Transport and Maritime Economy dated September 10, 1998, regarding the technical conditions that railway structures and their locations should meet [27]. However, this regulation is less detailed than TSI PRM. It is worth mentioning the Regulation (EU) 2021/782 of the European Parliament and of the Council of April 29, 2021, concerning the rights and obligations of passengers in rail transport. This regulation emphasizes that railway companies and station managers should consider the needs of persons with disabilities and persons with reduced mobility to ensure, in accordance with community principles of public procurement, the accessibility of all buildings and rolling stock by gradually eliminating physical barriers and functional obstacles through the purchase of new equipment, construction work, or significant renovations [10, 24-26].

In the case of railway infrastructure in areas managed by PKP PLK S.A., there is also the document "Architectural Guidelines for Passenger Infrastructure Ipi-1" [35, 36]. This document was created in 2020 and is intended for use by all entities involved in the investment process, dealing with the design and maintenance of passenger infrastructure managed by PKP PLK S.A. These guidelines were introduced to ensure maximum access to passenger infrastructure for travelers, with particular consideration for persons with disabilities and persons with reduced mobility. They were also introduced due to the lack of uniform guidelines covering passenger infrastructure areas. The aforementioned legal documents are highly detailed and provide comprehensive descriptions of requirements related to elements of small architecture, equipment, general principles of passenger infrastructure design, surface signage, vertical transportation devices, and shelters.

In the field of railway transportation, there are many legal documents that can or should be taken into account in adapting railway infrastructure to the needs of individuals with specific requirements.

4. EVALUATION OF THE ACCESSIBILITY OF SELECTED ELEMENTS OF WARSAW CENTRAL STATION

4.1. Object description

For the assessment of accessibility, Warsaw Central Station, named after Stanisław Moniuszko, located in the very center of Warsaw at the intersection of Al. Jerozolimskie and Al. Jana Pawła II, was selected. Warsaw Central Station was constructed in the 1970s. The station was built as an underground facility, with the main building situated above the platforms. The main hall of the station houses facilities such as ticket counters and passenger service points. In 2010, the station underwent a comprehensive renovation, including improvements to enhance accessibility for individuals with limited mobility. According to 2019 data, the daily passenger exchange at the station exceeds 45,000 people. On average, around 14 trains depart per hour, with approximately 140 trains departing throughout the day. This number is higher during the summer and winter holiday periods. Presently, it serves as the most important long-distance railway station in Warsaw, and it also accommodates a small portion of suburban railway traffic.

4.2. Audit results

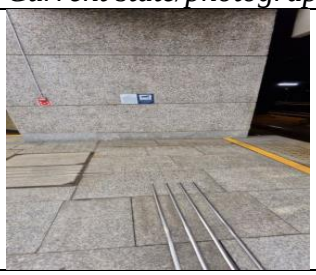
Table 1 presents the audit questionnaire along with the assessment results obtained during the audit of Warsaw Central Station.

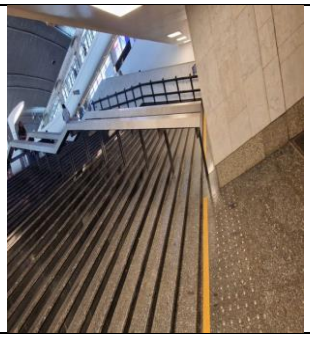
Tab. 1.

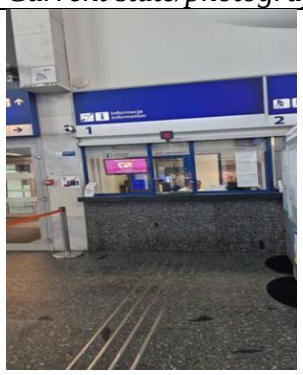
Accessibility Assessment Criteria

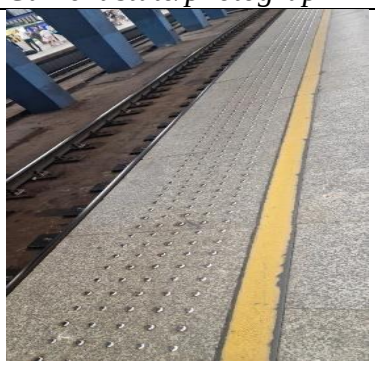
O. N.	Subject of assessment
1.	Are there sufficient and adapted parking spaces reserved for people entitled to use parking spaces for individuals with disabilities at the station?

	Description of the state/evaluation	*Current state/photograph*
	There are 2 parking spaces for people with disabilities at the station. The dimensions of these spaces do not comply with the TSI guidelines. Parking spaces for passenger cars used by people with disabilities should be at least 3.6 meters wide and 5 meters long. The dimensions of the analyzed spaces are 6m x 2.25m. The spaces should be entirely painted in blue, but the paint is faded and not refreshed. The requirements are not fully met. There are 80 parking spaces at the station, and according to regulations, there should be at least 3 spaces for people with disabilities. This requirement is also not met.	
2.	The station lacks barrier-free pathways connecting to the following public areas of the infrastructure: *Points for stopping other means of transportation on the station premises, such as taxi stands, bus stops, tram stops, metro, ferries, etc. *Entrances and exits accessible for individuals with limited mobility. *Information points. *Ticket counters and vending machines. *Customer service areas. *Waiting areas. *Restrooms. *Platforms.	
	Description of the state/evaluation	*Current state/photograph*
	*On the station premises, there are interchange points for other modes of transportation, but there are no markings. The tactile path ends before the entrance to the station hall. * Parking spaces as mentioned before, also lack a tactile path outside the station hall. * Obstacles on paths with tactile guidance within the ticket counters and information areas. * Lack of tactile paths to the restroom. * Poorly marked platform numbers, unintuitive. Lack of paths leading to benches on the platforms *The tactile paths on the platforms lead to obstacles. *At the station, significant deficiencies and damage to the warning paths were observed. There was no tactile information on the walls within reach, along the path free from obstacles leading to the platforms in the station building.	
3.	Do all obstacle-free routes, footbridges, and underpasses have a minimum obstacle-free width of 160 cm, except for areas defined in TSI PRM 1300/2014, point 4.2.1.3 point 2 (doors), 4.2.1.12 point 3 (platforms), and 4.2.1.15 point 2 (single-level level crossings)?	
	Description of the state/evaluation	*Current state/photograph*
	Yes	

<table>
<tr><td rowspan="3">4.</td><td colspan="2">Have thresholds been installed on the horizontal route, and do they contrast with the surrounding floor and are not higher than 2.5 cm?</td></tr>
<tr><td>Description of the state/evaluation</td><td>Current state/photograph</td></tr>
<tr><td>Consistent contrasting signage has not been applied to the stairs leading to the buildings and the stairs leading to the platforms. Contrast markings are only present on the first step, but they are faded and unclear. Attention has also been drawn to the lack of contrast between the floor and the walls.</td><td>  </td></tr>
<tr><td rowspan="3">5.</td><td colspan="2">Is there an alternative stair-free route provided for people with limited mobility?</td></tr>
<tr><td>Description of the state/evaluation</td><td>Current state/photograph</td></tr>
<tr><td>Elevators and platforms are available, but they require assistance or a phone for operation. The elevators have Braille signage and voice announcements. However, there is a lack of proper signage for elevators in the station hall.</td><td>  </td></tr>
<tr><td rowspan="3">6.</td><td colspan="2">Is there a ramp installed in the place where there is no lift for people with disabilities and those with limited mobility who cannot use stairs?</td></tr>
<tr><td>Description of the state/evaluation</td><td>Current state/photograph</td></tr>
<tr><td>Two stair lifts have been installed: one leading to the station hall and another outside the building, which is protected with plastic wrap. To operate them, you need to make a phone call for assistance.</td><td>  </td></tr>
<tr><td rowspan="2">7.</td><td colspan="2">Are the stairs and ramps equipped with handrails on both sides, on two levels?</td></tr>
<tr><td>Description of the state/evaluation</td><td>Current state/photograph</td></tr>
</table>

	The stairs lack double handrails on both sides, which poses difficulties for individuals with visual impairments and those with mobility restrictions	
8.	Are the barrier-free routes clearly marked with visual information as required by TSI PRM 1300/2014, point 4.2.1.10?	
	Description of the state/evaluation	*Current state/photograph*
	Yes, in most cases. Fonts, symbols, and pictograms used for visual information, especially on multimedia displays, contrast with their background. However, in the case of timetable boards and other information displays, they are hung at a height that makes it difficult for visually impaired individuals to read. Additionally, the use of foil in the display cases creates a reflective effect. There is a lack of information for routes designated for wheelchairs. Signs indicating wheelchair boarding areas on the platforms are difficult to access. A tactile path from the doors to the station map is also present, using Braille. However, it is highly illegible, and the appropriate contrast and font have not been applied.	
9.	Do the doors have an obstacle-free opening width of 90 cm and can be operated by people with disabilities and limited mobility?	
	Description of the state/evaluation	*Current state/photograph*
	Yes	
10.	Is door operation exclusively manual, semi-automatic, or automatic?	
	Description of the state/evaluation	*Current state/photograph*
	Automatic, with manual doors leading to the passenger service center (COP) that are hard to open. The glass surfaces near the COP are unmarked and pose a hazard to visually impaired individuals.	
11.	Is there no surface on the station premises where people move that has irregularities greater than 0.5 cm, except for thresholds, drainage channels, and tactile warning signals on surfaces where people move?	
	Description of the state/evaluation	*Current state/photograph*
	Irregularities exceeding 0.5 cm are present on the platforms.	
12.	Are transparent obstacles within or along the routes used by passengers, including glass doors or transparent walls, marked?	
	Description of the state/evaluation	*Current state/photograph*

	Yes, with the exception of the COP.	
13.	At least one cabin available for both genders is wheelchair accessible?	
	Description of the state/evaluation	*Current state/photograph*
	The accessible toilet did not have Braille markings indicating the coin insertion order and how to operate the fee machine for using the toilet (opening the door of this room). The toilet was incorrectly marked, locked, and required payment. There was no directional path.	
14.	Is there at least one area with seating and a place for a wheelchair on every platform where passengers can wait for a train, and in each waiting room?	
	Description of the state/evaluation	*Current state/photograph*
	Yes, although there is a lack of directional paths leading to the waiting areas on the platforms.	
15.	If ticket counters, information points, and customer service points are located along an obstacle-free route, at least one window is accessible for wheelchair users and people of short stature. Additionally, at least one window is equipped with an induction loop system for the use of hearing aids.	
	Description of the state/evaluation	*Current state/photograph*
	The information is not accessible for people with limited mobility, especially those using wheelchairs. There is no cashier counter with a lowered counter. The counter and information point are 1.2 meters high, while a maximum height of 90 cm is allowed. There is no wheelchair ramp under the counter. An induction loop is available at one window. The signage of the induction loop does not comply with the requirements of the adopted European standard.	
16.	Is at least one ticket vending machine (along the obstacle-free route at the station) equipped with an interface that can be reached by a wheelchair user or a person of short stature?	
	Description of the state/evaluation	*Current state/photograph*
	Yes, the ticket vending machines are equipped with an interface that can be reached by a wheelchair user or a person of short stature, although out of 6 stations, only 2 were operational.	
17.	Is at least one ticket control machine equipped with a free passage of a minimum width of 90 cm that allows wheelchairs with users, up to 1,250 mm in length, to pass through?	
	Description of the state/evaluation	*Current state/photograph*
	Yes	

<table>
<tr><td>18.</td><td colspan="2">Are the following pieces of information available:
Safety information and instructions,
Warning signs, prohibition signs, and mandatory signs,
Train departure information,
Signage of station facilities (where applicable) and access routes to them?</td></tr>
<tr><td></td><td>Description of the state/evaluation</td><td>Current state/photograph</td></tr>
<tr><td></td><td>As a result of the assessment, the lack of consistent, uniform, and factually accurate passenger information addressing people with disabilities was identified - both on station plans and within directional signage. This created a risk of disorienting passengers using the station.
Additionally, printed timetables are unreadable due to the reflection phenomenon, or in some places, blank boards are displayed.</td><td>  </td></tr>
<tr><td rowspan="3">19.</td><td colspan="2">Are departure information regarding trains (including destinations, intermediate stops, platform numbers, and departure times) located at a maximum height of 160 cm at least in one location at the station?</td></tr>
<tr><td>Description of the state/evaluation</td><td>Current state/photograph</td></tr>
<tr><td>For dynamic displays - yes, for printed information - no.</td><td></td></tr>
<tr><td rowspan="3">20.</td><td colspan="2">Are the time indications presented in digits given in the 24-hour format?</td></tr>
<tr><td>Description of the state/evaluation</td><td>Current state/photograph</td></tr>
<tr><td>Yes</td><td></td></tr>
<tr><td>21.</td><td colspan="2">Was a barrier preventing free access installed at the end of the platform, or were visual and tactile foot indicators with a warning pattern indicating a hazard placed on the surfaces used by people?</td></tr>
<tr><td></td><td>Description of the state/evaluation</td><td>Current state/photograph</td></tr>
<tr><td></td><td>At the ends of the platforms, tactile foot indicators with a warning pattern indicating a hazard have been placed on the surfaces used by people. The signage is incorrect. According to the guidelines, the signage of the hazard zone should be in the following order, depending on the allowable speed of vehicle movement at a given edge: track, yellow warning line, tactile foot indicators. On the station platforms, the tactile foot indicators have been placed in the area between the platform and the yellow line, which poses a direct life-threatening risk to blind individuals.</td><td>  </td></tr>
</table>

4.3. Summary results

As a result of the conducted audit, the main groups of accessibility issues were defined, including problems related to accessibility for individuals with visual impairments, mobility impairments, and hearing impairments. The first group of problems primarily concerned deficiencies in obstacle-free paths (including directional paths for blind individuals) and poor

audibility of voice announcements. Adequate contrast between horizontal and vertical surfaces was also not maintained. Attention was drawn to the lack of a clear yellow warning line on the stairs, and it was considered unacceptable to place warning indicators right at the edge of the platform. In the station plans and the indication of access directions, there was a lack of consistent, uniform, and factually accurate passenger information addressed to individuals with disabilities. This created a risk of passengers becoming disoriented while using the station. During the assessment, the authors encountered individuals inquiring about various pieces of information, primarily from station staff or police officers. Other issues of this kind include the absence of Braille information, especially in front of the restroom for individuals with disabilities. In many places, the path for the visually impaired intersected with the station's small and large architecture.

On the other hand, the second group of problems, which are barriers related to mobility impairments, primarily includes the lack of double handrails on stairs and the placement of informational signs and devices at heights that make it difficult or impossible to read the information. Furthermore, in the main hall of the station, there is not a single lowered counter window or information window adapted for individuals in wheelchairs. The Passenger Service Center is equipped with manually operated glass doors, significantly hindering wheelchair mobility. In addition, the stair platforms are difficult to access, only available by phone request. There is inadequate signage for the elevators leading to the platforms in the hall. During the assessment, no information about areas designated for wheelchair users to board was found on the dynamic displays on the platforms. While the ticket vending machines were indeed lowered, out of six machines, only two were operational. Printed information, including the timetables, was entirely illegible.

The third group of barriers relates to issues of accessibility for individuals with hearing impairments. The main shortcoming was the poor signage for the induction loops. The authors did not assess the proper functioning of the induction loops. Overall, the evaluation, despite undoubtedly having some correct solutions, is negative. It gives the impression that only the minimum requirements have been met, although a renovation of the station was relatively recently completed.

5. CONCLUSIONS

Barriers to access to infrastructure and transportation can significantly contribute to the social exclusion of individuals with disabilities. These barriers restrict the ability to move freely and, in particular, lead to dependency on the assistance of others, such as family members or specialized institution staff. Therefore, efforts should be made to minimize barriers and enable people with limited mobility to lead independent lives and fully participate in all aspects of life, as emphasized in Article 9(1)(a) of the Convention on the Rights of Persons with Disabilities. Each approach to design discussed in the article is considered effective if it results in increased accessibility of buildings and the surrounding environment.

The current state of railway station infrastructure cannot be considered satisfactory. Individuals with diverse needs encounter various barriers. It appears that there is a lack of a comprehensive approach to solving this problem, understood as defining precise requirements, involving accessibility experts in the design and modernization of railway infrastructure, who possess knowledge of various possible technical and organizational solutions, as well as the participation of the end-users themselves.

It is worth remembering that accessibility concerns all of us, but in everyday life, the lack of it is primarily recognized by individuals with specific needs resulting from their lack of full functionality. Universal design, which aims to ensure accessibility, is undoubtedly a philosophy of designing everything with consideration for everyone.

References

1. Aarhaug J., B. Elvebakk. 2015. „The impact of universally accessible public transport – a before and after study". *Transport Policy* 44: 143-150. DOI: https://doi.org/10.1016/j.tranpol.2015.08.003.
2. Allen J., S. Farber. 2020. „Planning transport for social inclusion: An accessibility-activity participation approach". *Transportation Research Part D: Transport and Environment* 78: 102212. DOI: https://doi.org/10.1016/j.trd.2019.102212.
3. Audirac I. 2008. „Accessing transit as universal design". *Journal of Planning Literature* 23(4): 4-16.
4. Bęczkowska S., Z. Zysk. 2021. „Safety of People with Special Needs in Public Transport". *Sustainability* 13(10733). DOI: https://doi.org/10.3390/su131910733.
5. Bjerkan K.Y., L.R. Øvstedal. 2020. „Functional requirements for inclusive transport". *Transportation* 47: 1177-1198. DOI: https://doi.org/10.1007/s11116-018-9939-7.
6. Cepeda E.P., P. Galilea, S. Raveau. 2018. „How much do we value improvements on the accessibility to public transport for people with reduced mobility or disability?" *Research in Transportation Economics* 69: 445-452.
7. Chapman K., K. Ehrlich, J. O'Loghlen, E. Kendall. 2023. „The dignity experience of people with disability when using trains and buses in an Australian city". *Disability & Society* 10: 1-25.
8. Grisé E., G. Boisjoly, M. Maguire, A. El-Geneidy. 2019. „Elevating access: Comparing accessibility to jobs by public transport for individuals with and without a physical disability". *Transportation Research Part A: Policy and Practice* 125: 280-293. DOI: https://doi.org/10.1016/j.tra.2018.02.017.
9. Park J., S.Chowdhury. 2022. „Towards an enabled journey: barriers encountered by public transport riders with disabilities for the whole journey chain". *Transport Reviews* 42(2): 181-203. DOI: https://doi.org/10.1080/01441647.2021.1955035.
10. Swift A., L. Cheng, B.P.Y. Loo, et al. 2021. „Step-free railway station access in the UK: the value of inclusive design". *European Transport Research Review* 13(45). DOI: https://doi.org/10.1186/s12544-021-00504-3.
11. The Regulation Act of July 19, 2019 on ensuring accessibility for persons with special needs (Dz. U. of 2020, item 1062).
12. The Regulation of the European Parliament and of the Council (EU) 2021/782 of April 29, 2021, concerning the rights and obligations of passengers in rail transport.
13. Gabryelski J., P. Kurczewski, M. Sydor, A. Szperling, D. Torzyński, M. Zabłocki. 2021. „Development of Transport for Disabled People on the Example of Wheelchair Propulsion with Cam-Thread Drive". *Energies* 14(23). DOI: https://doi.org/10.3390/en14238137.
14. Pineda A. 2015. „Disabilities, the design of urban transport systems and the city: a situational analysis". *Universitas Humanística* 81. DOI: 10.11144/Javeriana.uh81.ddut.

15. Salha R., M. Jawabrah, U. Badawy, A. Jarada, A. Alastal. 2020. „Towards Smart, Sustainable, Accessible and Inclusive City for Persons with Disability by Taking into Account Checklists Tools". *Journal of Geographic Information System* 12: 348-371. DOI: 10.4236/jgis.2020.124022.
16. Seriani S., V.A. Fernandes, P. Moraga, F. Cortes. 2022. „Experimental Location of the Vertical Handrail o Improve the Accessibility of Wheelchair Passengers Boarding and Alighting at Metro Stations – A Pilot Study". *Sustainability* 14(9224). DOI: https://doi.org/10.3390/su14159224.
17. Commission Regulation (EU) No. 1300/2014 of November 18, 2014 on technical specifications for interoperability relating to the accessibility of the Union railroad system for disabled persons and persons with reduced mobility.
18. Gawron G. 2015. „Universal Design - universal design as an idea in the pursuit of achieving social participation of people with disabilities". *Annals of Social Sciences* 7(43): 125-144.
19. Park J., S. Chowdhury. 2018. „Investigating the barriers in a typical journey by public transport users with disabilities". *Journal of Transport & Health* 10: 361-368. DOI: https://doi.org/10.1016/j.jth.2018.05.008.
20. Pheasant S., Ch.M. Haselgrave, 2006. *Bodyspace. Anthropometry, Ergonomics and the Design of Work.* UK: Taylor&Francis.
21. Bjerkan K. 2022. „Funksjonskrav for inkluderende transport". In: Fearnley N., K. Øksenholt (eds.). *Universell utforming in transportsektoren*. NHEF.
22. Grabarek I. 2018. *Ergonomic design of urban transportation means*. Warsaw: Publishing House of Warsaw University of Technology.
23. Doi K., T. Sunagawa, I. Hiroto, K. Yoh. 2016. „Transitioning to safer streets through an integrated and inclusive design". *IATSS Research* 39(2): 87-94. DOI: https://doi.org/10.1016/j.iatssr.2016.03.001.
24. Grisé E., G. Boisjoly, M. Maguire, A. El-Geneidy. 2019. „Elevating access: Comparing accessibility to jobs by public transport for individuals with and without a physical disability". *Transportation Research Part A: Policy and Practice* 125: 280-293. DOI: https://doi.org/10.1016/j.tra.2018.02.017.
25. Webpage of Accessibility standards for the capital city of Warsaw. Design standards for pedestrian infrastructure. Available at: https://transport.um.warszawa.pl/-/standardy-projektowaniainfrastruktury-dla-pieszych-1.
26. Webpage of Dubai Universal Design Code, Government of Dubai. Available at: https://mycommunitydubai.com/media/281/Dubai%20Universal%20Design%20Code.pdf
27. NSCU. Principles of Universal Design. Available at: https://design.ncsu.edu/wp-content/uploads/2022/11/principles-of-universal-design.pdf.
28. White Paper European Transport Policy 2010. Sustainable urban transport plans. Available at: http://www.europarl.europa.eu/studies.
29. UTK. Passenger Satisfaction Study 2021. Available at: https://utk.gov.pl/pl/dokumenty-i-formularze/opracowania-urzedu-tran/19585,Badanie-satysfakcji-pasazerow-kolei-2021.html.
30. The Center for Universal Design. The Principles of Universal Design. Available at: http://www.ncsu.edu/project/design-projects/udi/center-for-universal-design/theprinciples-of-universal-design/.
31. Bulletin of the Ombudsman for Citizens' Rights 2011. Accessibility strategies and challenges. Available at: https://bip.brpo.gov.pl.

32. Sustainable Urban Mobility: The Need for Inclusive Design. European Commission. 2011. Available at: https://ec.europa.eu.
33. Grisé E., G. Boisjoly, M. Maguire, A. El-Geneidy. 2019. „Comparative analysis of transit accessibility for persons with disabilities". *Transportation Research Part A* 125: 280-293.
34. Pineda A., G. Gawron. 2016. „Inclusive city design: Best practices in urban mobility". *Universitas Humanística* 81: 23-42.
35. The Regulation of the Minister of Transport and Maritime Economy of September 10, 1998 on the technical conditions to be met by railroad structures.
36. European Union Agency for Railways. 2022. Accessibility and Mobility of Persons with Disabilities in Rail Transport. DOI: https://doi.org/10.2863/23942.

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