

Tactile Elements on Rail Transport Platforms – Assessment of Solutions in the Light of Binding Acts of Law

Janusz POLIŃSKI¹, Krzysztof OCHOCIŃSKI²

Summary

Platform accessibility for the visually impaired passengers depends on ensuring conditions for safe movement on their surfaces. This safety is provided for the blind by tactile elements. In Poland there is no standard in force regulating the use of tactile elements in transport. Consequently, various ways of indication against the same danger are encountered. The article defines principles devised for the underground and railways as well as variety of markings in reference to tram platforms. Moreover, encountered errors in marking and the significance of appropriate maintenance of tactile elements as regards providing information for visually impaired and blind persons have been discussed.

Keywords: platform, danger zone, tactile elements

1. Introduction

According to the World Health Organization (WHO), there are around 300 million visually impaired persons living in the world, including approximately 39 million blind ones. Within the European Union, the ratio stands at four blind or partially sighted persons for 1000 inhabitants [5]. According to Central Statistical Office of Poland (GUS), there are about 1,800,000 visually impaired people living in Poland [16].

The accessibility for blind and visually impaired persons plays a vital role in the process of transport infrastructure adaptation for persons with disabilities. Accessibility improves significantly the system of indication, guidance and information based on tactile elements. A great improvement has been noticed in Poland relating to equipping the public space with tactile elements, however, there is still observed lack of uniform regulations and standard solutions common for all modes of transport in this respect. At present the use of tactile elements has been regulated in regulations covering the underground [11] and railway stations [10] infrastructure.

As regards tram infrastructure (platforms) there are many publications reflecting good practices, however, it is not a uniform law. In practice, we have failed to implement a uniform tactile indicators at tram stop on the entire area of Poland. The lack of coherent

marking of dangerous places causes confusion, while incorrect interpretations can lead to grave accidents.

2. Methodology

Rail transport in Poland has been undergoing a process of deep rolling stock and infrastructure upgrade. Consequently, many tram and railway platforms have been modernised. The lack of uniform regulations for all modes of transport connected with the principles of placing tactile elements on platform surfaces has resulted in numerous solutions.

In 2009–2013, the authors of the article carried out a number of diagnostic surveys for blind and visually impaired persons, which referred to the need to use tactile elements on tram, underground and railway platforms. They also pooled this group's with disabilities opinions with respect to used tactile information. This knowledge was used while drawing up normative documents for the Warsaw Metro, which was described in an article published in LogForum [7], and in railway transport [10]. The latest Polish developments in relation to the infrastructure accessibility, inter alia for the blind, have been reviewed.

In order to explore the problematics more extensively, the principles of using tactile elements for the blind in various European countries have been examined, as well as encountered irregularities in

¹ Ph.D. Eng.; Instytut Kolejnictwa, Zakład Dróg Kolejowych i Przewozów; e-mail: jpolinski@ikolej.pl.

² M.sc. Eng.; Instytut Kolejnictwa, Zakład Dróg Kolejowych i Przewozów; e-mail: kochocinski@ikolej.pl.

placing them in urban infrastructure. Moreover, available American, Australian and Asian literature has been searched to find outcomes of current operation of applied tactical elements solutions [inter alia 1, 2, 3, 6, 14,]. The results of a wide exploration in this respect have been published in a separate book [8].

3. The Warsaw Metro platforms

The Warsaw Metro belongs to this mode of transport whose all platforms have been marked in a uniform way with tactile elements for blind and visually impaired persons. This indication was consulted with blind people's environment and was included in the PZN – Polish Blind Association's standards. In order to provide contrast of the warning line, a black strip next to it is mounted on light platform surfaces. Examples of marking is shown in Fig. 1, 2.

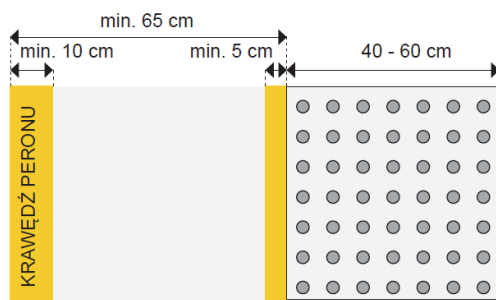


Fig. 1. Size of platform edge marking [9, 11]



Fig. 2. View of marking on underground platform [Photo J. Poliński]

4. Railway platforms

Railway platforms may pose a big threat for blind and visually impaired passengers as trains can move without stopping along railway station platforms. When a train moves with high speed, passengers on the platform should be in a safe distance from the edge

of the platform. The aerodynamic forces arising during the train drive may be the cause of an accident. Therefore, the so called danger area has been provided along the platform edge in order to prevent it. Staying in the area by passengers during the rolling stock traffic at the platform is not permitted. The Technical Specification for Interoperability PRM TSI [4] requires the boundary of the danger area situated the furthest from the platform edge from the side of the platform to be marked with visual and tactile walking surface indicators. Nevertheless, the mentioned above European Union's document does not precisely state what tactile elements should look like. The necessity of their use, however, continues to be permitted according to national regulations. In reference to railway platforms, this issue has been regulated by appropriate provisions of the Minister's of Infrastructure and Development Regulation [10]. According to this regulation (§ 98, item 12), a danger area is marked with:

- warning tactile surface of constant width not smaller than 0.40 m and not larger than 0.60 m,
- warning visual line of constant width not smaller than 0.10 m and not larger than 0.20 m in yellow or other colour contrasting with the floor, placed on the danger area surface at its boundary with the warning tactile surface.

During the past ten years, there were carried out upgrade, construction and revitalisation work in Poland relating to railway linear and point infrastructure, platforms including. The intensity of these efforts fell on the time of preparing to the UEFA European Championship EURO 2012. Lack of regulations as regards the rules to use tactile markings for the blind resulted in the fact that designers proposed different solutions, which do not comply with current requirements in force.

5. Tram platforms

Trams have been used in urban transport in 15 Polish cities, i.e. Bydgoszcz, Częstochowa, Elbląg, Gdańsk, Gorzów Wielkopolski, Upper Silesian Industrial Region (Górnośląski Okręg Przemysłowy), Grudziądz, Kraków, Łódź, Poznań, Olsztyn, Szczecin, Toruń, Warszawa and Wrocław.

As regards urban (public) transport stops (inter alia tram platforms), PZN recommends the following solution [10]: the danger area of the platform at the stop should be marked in the following way: „(...) 0.10–0.15 m from the edge – a yellow strip (line), 0.10–0.15 m – a contrasting black strip (line), 0.30 m – a grey slip-resistant area, and a warning strip of 0.40–0.50 m width along the entire length of the platform. The total width of the danger area should amount to 0.90–1.1 m” – as presented in Fig. 3.



Fig. 3. Edge of tram platform made in accordance with PZN recommendations – general view [20]

Having reviewed different solutions used so far of tram platform edges, it can be stated that there is a great deal of freedom in the tactical elements' shape, size, spacing and shape of truncated domes, width of warning surface, principles of placing tactile elements in relation to platform edge, choice of material that tactical elements are made of, colours guiding movement on the platform and ensuring safe distance to the edge of the platform. Examples are shown in Figures 4.

Tram platforms do not appear in tram transport operating in old city centres where rails are not placed in separate tracks but directly on the street surface. Apparently, such solutions occur in all cities with tram transport. In order to facilitate passengers' boarding



Fig. 4. Examples of new tram platforms' markings in different Polish cities: a) Tram platform in Tri-City [17], b) Tram platform in Łódź [19], c) Tram platform in Chorzów [18], d) Tram platform in Wrocław [21], e) Tram platform in Olsztyn [22], f) Tram platform in Częstochowa [23]

the tram, the solution called Vienna style tram stop is often used. It is a kind of a tram platform where the level of the street is the same as the pavement's. Such a solution facilitates safe boarding and exiting the tram for persons with disabilities and decreases a possibility of collision with other means of transport. Moreover, it serves as a natural barrier acting as a speed bump. Appropriate platform construction makes the driver slow down in its area. Therefore, there is a limited risk of hitting a passenger entering or leaving the tram. Examples of tram platform Vienna style markings are shown in Fig. 5.

The PZN document does not take into account markings for the blind on such a type of tram platforms. Thus the Warsaw and Poznań solutions are worth taking into consideration. Markings on such types of tram platforms in Poznań are located before a raised lane and consist of a yellow line of 200 mm width with a tactile warning surface. It is adjacent to a fragment of contrasting surface of the pavement

situated on the same height as the platform. The edge of the lane raised from the trackside is marked with a white line contrasting with the surface. Chosen colours are important for partially sighted persons.

A different solution for the Vienna style tram stops has been applied in Warsaw where tactile markings are placed in the lane which passengers walk on after the tram stops. There is also a warning surface on the pavement next to the kerb, forgetting the road gauge. Pillars situated there constitute an additional obstacle for the blind waiting for the tram. It is worth noticing that this disputable solution is included in the draft of standards developed for the capital city of Warsaw [13].

6. Analysis of existing solutions and irregularities noted

During the upgrade of railway platforms, concrete tiles with edges of 1.00×2.00 m have been com-



Fig. 5. Examples of tram platform Vienna style markings: a) Poznań [24], b) Kraków [25], c) Warszawa [26], d) Wrocław [27]

³ Decision of 21 December 2007 concerning the technical specification for interoperability relating to 'persons with reduced mobility' in the trans-European conventional and high-speed rail system, stated in point 4.1.2.19 that „The boundary of the danger area, furthest from the rail side edge of the platform, shall be marked with visual and tactile warnings. The tactile marking shall be in accordance with National Rules.”

monly applied. Such a solution had been used before PRM TSI of 2007³ entered into force. Therefore on the first tiles, apart from a warning surface produced in different techniques (see Fig. 6a) tactile markings were not placed. When the mentioned above specification for interoperability was implemented and due to lack of legal regulations as regards tactical elements' use, some producers of platform tiles placed tactical elements on the warning line (see Fig. 6b).

However, it should be stressed that such a solution was marred by at least several irregularities.

Firstly, the warning line is situated in the danger area. In case of blind passenger walking on this line along the platform, that person is too close to the platform edge which might result in an accident caused by aerodynamic forces from a passing train.

Secondly, the warning line has a width of 0.2 m, thus the tactile warning surface is of the same width. Due to this dimension, the surface might be crossed

unnoticed by a blind person what can result in a dangerous incident.

Thirdly, certain parameters of tactile elements regarding the shape and size of a single truncated dome have not been defined. Moreover, it has not been stated if the truncated domes could be placed alternately as shown in Fig. 6.

At some railway stations such as Warszawa Śródmieście or Warszawa Centralna, the tactile warning surface was placed on the danger area's surface (see Fig. 7a). Metal truncated domes pose a threat not only for blind persons but also for all passengers leaving a train due to an increased possibility of slipping even on a dry surface of the platform (see Fig. 7b).

On many railway platforms, especially at small or middle-size stations, tactile guiding paths are not used. Such paths allow safe movement for the blind, and in case of their contrastive colour indication – for visually impaired persons as well. In case of the lack of



Fig. 6. Examples of platform tiles: a) damaged warning line on tiles without tactile elements, b) tactile warning surface placed on warning line [Photo J. Poliński]



Fig. 7. Truncated domes within danger area at Warszawa Śródmieście railway station (a), direct exit from the carriage onto slippery truncated domes poses a threat for passengers (b) [Photo J. Poliński]

guidance paths, such a role can be taken over by tactile warning surfaces, which is stated in point 4.2.1.1.2 item 8 of Commission Regulation No 1300/2014 [4]. In the case of Warszawa Śródmieście railway station where platforms are not fitted with guidance paths, the use of tactile warning surface for movement in a direct neighbourhood of the platform edge collides with providing safety for blind persons.

In some railway objects and facilities, it is practiced to use tactile elements (truncated domes, corduroy paving) of steel. The drawback of such elements is their slippery surface. Slipperiness is increased in case of moisture or frosting during the winter months (it refers mainly to tactile elements exposed directly to weather conditions). Therefore this kind of tactile elements is criticised by passengers. Furthermore, single tactile elements should be carefully and firmly fitted to the surface. Losses of truncated domes (see Fig. 8), which should be immediately refilled, have been noted on some platforms.



Fig. 8. Torn off truncated dome from the warning strip
[Photo J. Poliński]

Also corduroy paving, especially metal bars badly fitted to the surface of guiding paths (see Fig. 9) pose a threat for passengers' safety. It happens that curved bars may cause an accident involving pedestrians and



Fig. 9. Damaged corduroy bars in an underground passage under platforms at Warszawa Wschodnia railway station [Photo J. Poliński]

eliminate the possibility to use the guidance path by blind persons.

Tactile warning surfaces are placed on railway platform tiles' edges, however, the need to mount tactile elements in other dangerous places (e.g. before staircases, lifts) is often neglected. It is also an error to install tactile warning surface directly at the edge of the first step of staircase. There are many objections to tram platforms. The lack of uniform regulations relating to marking of their edges has caused a great variety of tactile indications. So far guidance paths have not been mounted.

Tram platforms in Warsaw are marked in accordance with the requirements of the Polish Blind Association. Here not only blind persons have been cared for, but also partially sighted persons, for whom a contrastive (yellow – black) line is placed at the edge of the platform. An important deficiency, however, is the loss of original colour intensity due to sun rays and changeable weather conditions. In the case of Warsaw, there are also reservations relating to quality and durability of concrete tiles with tactile elements of height over 4–5 mm and lenticular shape, the base diameter of 20 mm (see Fig. 9a). In places of intense passenger traffic flow, these elements are prone to accelerated wear and consequently tactile by feet characteristics are seriously affected. In wintertime when shoe soles are thick, the possibility to detect small domes is poor or nonexistent. Due to this fact, during the modernisation work being carried out, tiles are being exchanged into new ones on which tactile elements are much better discernible for blind persons, similarly to truncated domes mounted in the Warsaw Metro (see Fig. 9b).

Access to a tram platform is usually connected with crossing a street. It is disputable to place warning surface directly at the kerb. The regulation relating to roads and streets used by cars [12] introduces the notion of road gauge (strip of 0.5 m width on each side of the



road/street) which makes it impossible to place there any elements (road sign and lamp posts, barriers etc.).

Blind people who feel tactile elements with their feet may stand in the road gauge area and be exposed to collision with any protruding element of a vehicle in motion. Therefore the provision included in PZN guidelines [9] is highly disputable:

„We grant permission to two ways of marking pedestrian crossings:

- **The warning surface of 80–100 cm width is to be placed directly at the edge of the pavement (out of kerb) on the whole width of the crossing(!).**
- The warning surface of 50–60 cm width is to be placed on the whole width of the crossing in 0.5 m distance from the edge of the street”.

Another provision which is included in the standards for Warsaw [13] is also disputable, i.e.: „The warning surface of 0.7–1.0 m width should be mounted on the contact where the pavement and street lane meet (on the pavement side directly behind the kerb). It should join the guidance path (signaling the crossing and its height)”.

In the expert report carried out for the Office of Rail Transport [15], its authors rightly pointed out the need to maintain road gauge, behind which the warning surface for blind persons is mounted (as presented in Fig. 5.28–5.30 of the report). Such a solution should be binding nationwide as only it ensures safety for blind persons waiting for a safe crossing of the street and reaching a tram platform.

The exchange of destroyed or damaged tram platform elements should aim at mounting identical products. There is no point in replacing elements with different ones. Incorrect maintenance of platform surface results in the loss of properties assumed by the designer and downgrading the construction aesthetics (see Fig. 10).



Fig. 10. Example of incorrect maintenance of platform edge
[Photo J. Poliński]

7. Conclusions

1. Blind persons' use of tactile elements mounted in public space, inter alia on rail transport platform surfaces, should refer to the system of marking which is uniform for the whole country. This system should be based on truncated domes and guidance paths identical in shape, size and surface roughness. Warning surfaces, areas and guidance paths should be defined with respect to tactile elements' width and placing. As far as accessibility for partially sighted persons is concerned, specific colours of surface and lines should be defined.
2. Poland suffers from lack of comprehensive legal regulations relating to the rules of tactical elements' use for blind and visually impaired persons in transport infrastructure. Fragmented approach to this issue results in mounting different solutions in transport infrastructure. Their abundance requires the blind to remember various ways of marking appearing on different transport objects. Due to the lack of national uniform requirements for tactical elements, it is not advisable to indiscriminately import ready-made foreign solutions as it is often connected with „importing errors”. Different marking of the same hazard leads to creating new accessibility barriers, which in extreme cases may cause an accident.
3. On the basis of the conducted considerations it could be stated that legal regulations of problems concerning the tactical elements' marking of railway and underground platform edges eliminates incorrect solutions. Tram infrastructure discloses some mess in this respect where there is an urgent need to use the edges' marking suggested by the Polish Blind Association.
4. Blind persons' use of tactile elements requires their ongoing maintenance, as well as rapid replacement of damaged or worn-out elements. Products of identical characteristics and properties should be used for such a replacement. While designing this system of information, it should be remembered that these products must be durable, wear resistant, appropriately rough and in case of partially sighted persons – of appropriate colour. As regards elements exposed to different weather conditions, tactile elements should be resistant to sub-zero temperatures, colour durable, resistant to mechanical damage (snow clearance) and to chemical damage (de-contamination cleaning). Careful selection of colour also plays a vital role in accessibility for visually impaired persons.

Literature

1. Arai K., Mizuno T., Nishidate A., Tokuda K.: *Installation errors and corrections in tactile ground surface indicators in Europe, America, Oceania and Asia*, IATSS RESEARCH vol.32, no 2, 2008, pp. 68–80.
2. AS/NZS 1428.4.1:2009: Design for access and mobility – Means to assist the orientation of people with vision impairment – Tactile ground surface indicators, Sydney, NSW and Wellington, NZ.
3. Bentzen B.L., Barlow J.M., Tabor L.: *Detectable warnings: Synthesis of U.S. and international practice*, Washington 2000, DC, US Access Board.
4. Commission Regulation (EU) No 1300/2014 of 18 November 2014 on the technical specifications for interoperability relating to accessibility of the Union's rail system for persons with disabilities and persons with reduced mobility.
5. International Classification of Diseases, World Health Organization 2011, Accessible at: www.who.int/classifications/icd/en/ [22.07.2014].
6. Newman E.: *Att vara blind på passage och perrong – som en resa utan skyltar och signaler. Institutionen för Teknik och samhäll*, Lunds Universitet, 2010, Accessed on July 27, 2013, from: <http://lup.lub.lu.se/luur/download?func=downloadFile&recordingId=1668828&fileId=2094610>.
7. Poliński J., Ochociński K.: *Selection and application of the touchable elements for blind and people in the Warsaw Underground*, LogForum 2013, 9(4), pp. 239–246.
8. Poliński J.: *Elementy dotykowe dla niewidomych – rodzaje, rozwiązania i wymagania ogólne* [Tactile Elements for the Blind – types, solutions, general requirements]. Warszawa 2012, Kolejowa Oficyna Wydawnicza.
9. *Projektowanie i adaptacja przestrzeni publicznej do potrzeb osób niewidomych i słabowidzących zalecenia i przepisy*, (Designing and adaptation of public space for visually impaired and blind persons. Recommendations and rules) PZN. Warsaw 2016.
10. Regulation of the Minister of Infrastructure and Development of 5 June 2014 amending regulation concerning technical requirements for railway constructions and their placement (Journal of Laws of 2014, item 867).
11. Regulation of the Minister of Infrastructure of 17 June 2011 on technical requirements for underground constructions and their placement (Journal of Laws of 2011, no 144, item 859).
12. Regulation of the Minister of Transport and Maritime Economy of 2 March 1999 on technical requirements for public roads and their placement (Journal of Laws of 1999, no 43, item 430).
13. Rymśa B., Kasperczyk K.: *Standardy dostępności dla Miasta Stołecznego Warszawy* (Standards of accessibility for the capital city of Warsaw), IBDiM 2015.
14. Tokuda K., Mizuno T., Nishidate A. and Arai K.: Standardization and Classification, Substandard Installation and Improving the Tactile Ground Surface Indicator (TGSI), IATSS Review 33(1): pp. 98–107.
15. Wysocki M., Załuski D.: *Ekspertyza w zakresie dostępności kolejowych obiektów obsługi podróżnych z niepełnosprawnościami oraz ograniczoną możliwością poruszania*, (Expert report on accessibility of railway service facilities for persons with disabilities and persons with reduced mobility), Gdańsk 2016, Document available at: <https://drive.google.com/open?id=0B9wn7ZuOXL0bMUFqU2JFdIz6cjcj> [11.01.2017].

Internet sources

16. <http://www.rynekzdrowia.pl/Uslugi-medyczne/W-Polsce-zyje-az-1-8-mln-niewidomych-lub-slabowidzacych,155889,8.html> [28.12.2016].
17. <http://www.trojmiasto.pl/wiadomosci/Kolejnafuszerka-na-al-Havla-Tramwaje-hacza-drzwiami-o-peron-n63589.html#> [29.12.2016].
18. <http://www.chorzow.eu/aktualnosci/5217-centrum-przesiadkowe-juz-gotowe.html> [29.12.2016].
19. <http://www.miastarytm.pl/single-post/2016/07/09/Tramwaje-w-stajni-jednoro%C5%BCc%C3%B3w> [29.12.2016].
20. <http://old.tw.waw.pl/promedia?page=6> [29.12.2016].
21. <http://www.wroclaw.pl/tramwaje-pesy-debiutujaw-ten-weekend-rozklad-jazd> [29.12.2016].
22. <http://autobusczerwony.blox.pl/html/1310721,262146,14,15.html?0,2016> [29.12.2016].
23. <http://forum.zm.org.pl/viewtopic.php?f=2&t=2620> [29.12.2016].
24. <http://www.lepszypoznan.pl/wp-content/uploads/2014/04/84rxcH.jpg> [12.07.2016].
25. <http://krakow.pl/aktualnosci/42503,26,komunikat,bedzie-wiecej-przystankow-wiedenskich.html> [29.12.2016].
26. <http://www.rynek-kolejowy.pl/wiadomosci/pierwsze-przystanki-wiedenskie-w-warszawie-31229.html> [29.12.2016].
27. <http://www.transport-publiczny.pl/wiadomosci/wroclaw-buduje-przystanki-wiedenskie-381.html> [29.12.2016].

Elementy dotykowe na peronach transportu szynowego – ocena rozwiązań w świetle obowiązujących aktów prawnych

Streszczenie

Dostępność peronów dla osób niewidomych zależy od zapewnienia warunków bezpiecznego poruszania się po ich nawierzchni; takie bezpieczeństwo zapewniają osobom niewidomym elementy dotykowe. W Polsce nie ma normy dotyczącej stosowania elementów dotykowych w transporcie. W efekcie istnieją różne sposoby oznaczeń przed tym samym zagrożeniem. W artykule opisano zasady opracowane dla metra i kolei oraz wykazano różnorodność oznakowania peronów tramwajowych. Opisano także błędy w oznakowaniu i znaczenie odpowiedniego utrzymania elementów dotykowych w zakresie przekazywanych informacji osobom niewidomym i słabowidzącym.

Słowa kluczowe: peron, strefa zagrożenia, elementy dotykowe

Тактильные элементы на перронах рельсового транспорта – оценка решений в свете действующего закона

Резюме

Доступность перронов для невидящих зависит от обеспечения условий для безопасного движения по их поверхности. Эту безопасность невидящим обеспечивают тактильные элементы. В Польше отсутствуют нормы регулирующие употребление тактильных элементов в транспорте. В результате встречаются разные виды маркировки предупреждения перед одной угрозой. В статье обсуждены правила разработанные для метро и железной дороги и разновидность в маркировке по отношению к трамвайным перронам. Обсуждены также встречаемые ошибки маркировки а также значение правильного содержания тактильных элементов в области передаваемых информации невидящим и слабовидящим.

Ключевые слова: перрон, зона опасности, тактильные элементы