Proceedings of 26th International Scientific Conference. Transport Means 2022.

Tactile Arrangements for Visually Impaired People – Conceptual Framework

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Abstract

Save and independent movement of visually impaired people require specific adaptations. If transportation is supposed to be accessible as a whole, then all its subsystems must be accessible – vehicles, infrastructure, information systems, carriers´ staff, transport technology and also services provided in connection with transport. The Article is focused on one subsystem (infrastructure) especially on tactile surface arrangements for visually impaired (blind) people using white cane. There are mentioned Czech approach and comparison with arrangements in other European countries. Although basic tactile surface arrangements for visually impaired people in many countries are based on the Japanese system, particular types of tactile systems in individual countries are different.

KEY WORDS: *accessibility; safety; tactile surface indicator, visually impaired people*

1. Introduction

Safe and independent movement is of essential importance for people with reduced mobility including visually impaired (VI) people, as it is indicated e.g. by [1]. According to [2-4] connection between public transport accessibility and social bonds of people with disabilities is also important. Another aspect associated with accessibility is quality of their life. Continuous research of PRM satisfaction with quality of transport services is addressed by [5]. There are 19 factors evaluating passenger rail transport in Serbia pursuant to [6] within the range 1-5 (1 not important, 5 – most important): ‘Simple and safe entrance or exit to the station building and platform for passengers with reduced mobility (PRM)’ rating buildings 2.67, or platforms 2.54. ‘Personal safety’ turned out to be the most important factor of 3,55 rating. According to the [7] is accessibility of infrastructure including access paths (pavements) defined as the greatest challenge when using public transport in the Czech Republic while in Slovakia and Hungary it is accessibility of information systems and in Poland accessibility of vehicles. Assistant technologies are not as widespread in the Czech Republic in contrast to foreign countries. A system of guiding VI people in interiors and exteriors using various assistive applications and technologies (e.g. RFID, GNSS technology, NFC reader) suggests [8]. Also [1] proposes application (for mobile phones), ensuring information for visually impaired and deaf-blind passengers in public transport increasing safety and independence. Visually impaired people have had access to original Czech acoustic information system TYFLOSET since 1994. Nonetheless, white cane and tactile arrangements are still used for orientation and safe movement. Therefore, this article focuses on tactile arrangements for white cane.

2. Accessibility of public transport

Authors have defined ‘accessible public transport’ as such status of public transport system which ensures safe and independent access, adequate use for maximum time and safe movement without assistance to all passengers. ‘Adequate use’ is considered only such access, use and movement, which is independent on location (origin – destination stop), time (from – to) and function (which way). This definition highlights aspects defining the spirit of accessible environment, i.e.:

- safety: eliminating hazards (passenger ‘s life or health) to the greatest extent possible;
- independence: without assistance, if possible;
- access, use and movement: not only using means of transport (origin, destination stops) but also accessibility of stops/platforms and using all object related to transport, facilities, and services provided;
- adequacy: ensuring features and offer for all passengers to the same extent.

Above-mentioned definition emphasises the importance of guaranteeing accessibility within whole transport chain. Therefore, all subsystems need to meet barrier free requirements as for access, use and movement:

1. fleet (vehicles),
2. infrastructure (transport routes, buildings, platforms, etc.),
3. information, orientation and communication systems,
4. facilities and additional services (vending machines, left-luggage offices, information centres, etc.),
5. staff, especially those ones who are in contact with passengers,
6. transport technology – transfer time (considering how and how fast PRM move), low-floor vehicles, etc.

Concept of transport chains has been applied in other European countries as well, e.g. in Germany [9] where the vehicle – platform correlation is referred to as the basis of accessible transport chain. The best solution for all passengers (not only PRM) is represented by a coherent transport chain according to [10]. Some other aspects of accessibility are regarded in different ways (sometimes completely neglected) in different countries. Also, the definition of the term 'barrier-free transport' almost does not exist abroad with the exception of [11], dealing with the term 'accessibility' both from the general point of view, public transport and mobility of persons including PRM. In Malaysia, 'Accessibility (of service)' is understood as 'availability to accommodate as many users as possible and ease of boarding and alighting the train' [12].

Table 1 presents historical overview of regulations, directives and standards regulating issues of public areas or transport related to selected countries since the given year. They mostly cover the definitions of terms 'barrier', 'accessibility', 'disability' or 'person with disability/ person with reduced mobility' (PRM). Some countries have addressed the issues of disability by regulations starting in the late 1970s and early 1980s; the predecessors to ADA (Americans with Disabilities Act) were also Architectural Barriers Act (1968) or Rehabilitation Act (1973). Another approach which has been applied since the 1990s in the USA is so called 'Adaptable Design' using common elements to create barrier-free environment without drawing attention to them. Using special elements or adaptations is recommended only in necessary cases. Some of the regulations were amended or changed the name, e.g. in UK (DDA → Equality Act, 2010) or USA (ADA → ADA Amendments Act, 2008).

Table 1

International laws and standards

Country	Law / Standard	Year	Term definition
Australia	Disability Discrimination Act, DDA	1992	Disability, PRM
Austria	Bundes-Behindertengleichstellungsgesetz	2006	Accessibility, disability, PRM
Belgium	Zugänglichkeitserlass	2007	Disability, barrier-free, PRM
Czech Republic	ČSN 73 4959	2009	Accessible rail platform for PRM
Croatia	Pravilnik 151	2005	Accessibility
EU	Regulation 1107/2006	2006	PRM (in air transportation)
Germany	Behindertengleichstellungsgesetz	2002	Barrier-free
Ireland	Disability Act	2005	Universal design
Japan	Shougaisha Kihonhou**	1993	Person with disability
Norway	-	1997	Universal design
Poland	Karta praw osób niepełnosprawnych	1997	Person with disability
PR of China	PPD*	1990	Disability, PRM
Slovakia	Technické podmienky 10/2011	2011	Barrier
Serbia	Zakon 33/2006	2006	Person with disability
Spain	Ley 51/2003	2003	Universal accessibility
Sweden	Diskrimineringslag Nr. 567/2008	2008	Disability
Switzerland	Behindertengleichstellungsgesetz	2004	Disability, PRM
UK	Disability Discrimination Act, DDA	1995	Disability
USA	American with Disability Act, ADA	1990	Disability

* Law of the People´s Republic of China on the Protection of Person with Disabilities;
** Revised version Shintai Shougaisha Kihonhou (1970) – Japanese Disability Law.

3. System of tactile surface indicators in the Czech Republic

In principal, the tactile surface indicators for the VI people with white cane involve *combinations of tactile surface pattern and size (width)*. Combination of these two specific parameters gives the visually impaired people information about the specific tactile arrangement. [14] As each tactile surface indicator is used in a specific way, the visually impaired people can unmistakable identify where they are. That corresponds to the general principles of using tactile surface indicators based on the fact that visually impaired person has a limited capacity to remember different tactile surfaces. [15] Therefore, it should be specifically determined how to use each of them.

Unlike most European countries, tactile surface indicators in the Czech Republic include only two basic types of width and two basic types of pattern (+ one exception) – see Table 2.

Grooves and ribs have a guiding function. Grooves are mostly carved to the pavement (they have so-called negative pattern, 4-6 mm under surface, spacing 10-16 mm), whereas ribs have so-called positive pattern (2-4 mm over surface, spacing 10-16 mm). Both patterns create (so-called artificial) guiding lines in places where natural guiding (in exterior) is missing in the length of more than 8 metres. In the Czech Republic are used these (artificial) guiding lines rather exceptionally, the goal is to prefer natural guiding lines in exterior (foundation walls of fencings, lawn curbs, buildings walls, etc. – see Fig. 1). In Czechia, there are 3 types of grooves / ribs regarding their shape.

Blister tactile paving (high 4-5.5 mm, spacing 50-100 mm) has a warning or signalling function e.g. signal strip guides the visually impaired person to the pedestrian crossing – see Fig. 1, public transport stop, shelter, stairs or lift on the railway platform, to another guiding line or, rarely, to the public building entry. Warning strip indicates the border between a safe and a dangerous place e.g. between pavement and pedestrian crossing.

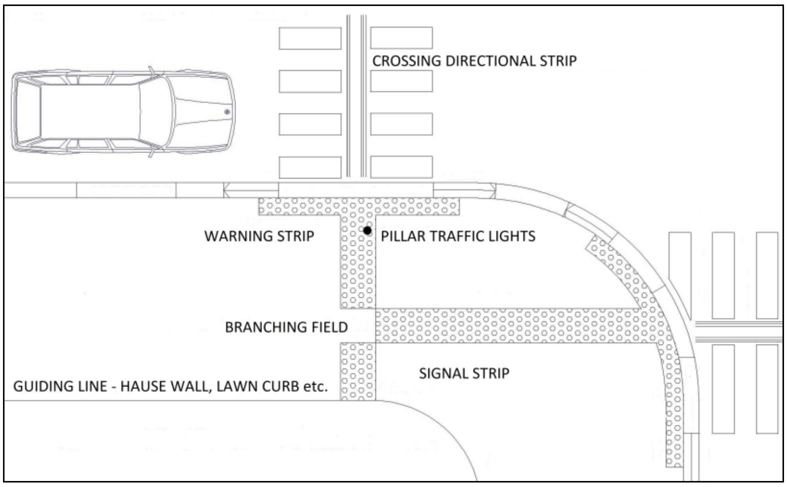


Fig. 1 Typical Czech tactile surface indicators at a pedestrian crossing

Table 2 shows mentioned combinations of width and pattern and their typical application in the Czech Republic. The exception is 150 mm wide blistered warning strip on underground platforms. However, that is acceptable, because the VI people always know that they are on the underground platform. The Table 2 does not present one more type of tactile surface indicator – crossing directional strip (a pair of two or three longitudinal ribs with total width of 550 mm, 2-4 mm high) – see Fig. 1. That is an acceptable exception as well, as it is used only for pedestrian crossings and nowhere else.

Table 2

Parameters and use of tactile surface indicators in the Czech Republic

Width (mm)	Surface pattern	Tactile surface indicator	Typical application
400	Blister shape	Warning strip Tactual strip	Pedestrian crossing, platform edge, inaccessible place; Separating of cycling lane and pedestrian lane on path
400	Grooves / ribs	Guiding line Guiding line with function of warning strip	Guiding the visually impaired; Guiding on the railway platform in safe distance from the platform edge; demarcation of safe area on the railway platform
800	Blister shape	Signal strip	Guiding to pedestrian crossing, public transport stop, railway platform shelter, public building (rarely)
150	Blister shape	Warning strip in the underground	Demarcation of safe area on the underground platform

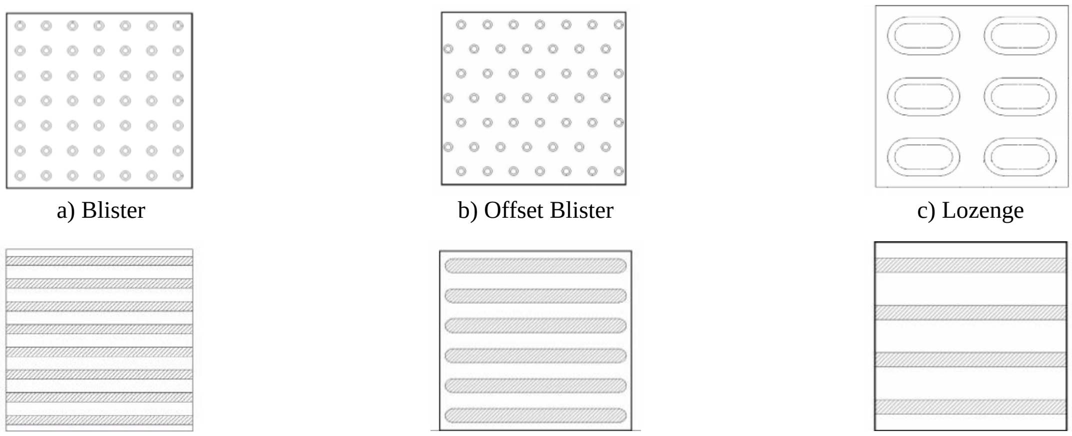
In the Table 2, there are basic combinations of two patterns (blister, grooves / ribs) and two basic widths (400 and 800 mm) of the tactile surface indicators. Simply: narrow strip + blister = warning; wide strip + blister = signaling, informing (rarely guiding), narrow strip + grooves / ribs = guiding.

4. International Comparison

In Germany, the tactile surface indicators follow a different approach. It is not possible to track system in ‘width + pattern’. Longitudinal ribs are used to guide the VI people, to alert them to places like the borderlines, e.g. pavement × road (pedestrian crossings) and to stairs or a ramp edge. According to [16] there were 9 types of tactile surface indicators (guide strip, location strip, ending strip, delineator strip, branching field, entrance field, attention field, directional field, kerb-drop field). There are 6 types of longitudinal ribs with different shape, spacing and height (h = 3, 3.5, 4, 5 mm), 2 types of grooves with depth 3 and 6 mm, 8 types of blister paving with 8 different heights of blisters (1.5-8 mm) and spacing (13-80 mm) – see [17]. The latest overview and commentary to Standard DIN 32984:2020-12 gives [18].

In Slovakia, there are according to [19] two types of tactile surface patterns. Longitudinal ribs for guiding (e.g. 400 mm wide guiding line) and blister for warning or signalling (e.g. 400 mm wide warning strip or 800 mm wide signal strip). Ribs are 5±1 mm high, dome-shaped blister paving is of the same height. Some tactile indicators, e.g. signal strip or guiding line with function of warning strip on railway platform have a different pattern shape. Tactile surface indicators can be made of stone, concrete, plastic or metal (like in the Czech Republic).

In UK, Standard BS 8300-1:2018 (Design of an accessible and inclusive built environment, Part 1: External environment – Code of practice) gives also two types of tactile pattern (blister and ribs) with warning, guiding or informing function. Visually impaired people must distinguish 6 types of surface patterns [15]. Tactile surface indicators include 3 types of blister tactile paving (2 types of dome-shaped and one type of lozenge shaped) – see Fig. 2a)-c) and 3 types of longitudinal ribs (ribs spaced 20, 30 or 70 mm, wide 30, 30, 35 mm) – see Fig. 2d)-f). Each type is used specifically – blister paving at e.g. pedestrian crossings, edges of platforms at public transport stops (Fig. 2c) – on-street stops), or light rail transit (LRT) platforms. Longitudinal ribs are used to alert the visually impaired person to dangerous places (stairs, crossings) or to guide them to the LRT stop. Ribs have guiding function (like in the Czechia), they also separate (among other functions) cycling and pedestrian lane on a cycling path.



a) Blister b) Offset Blister c) Lozenge

d) Corduroy e) Linear f) Cycle way

Fig. 2 Tactile surfaces in UK [15]

Table 3 shows the basic functions of tactile patterns and their different shapes in each country. In Germany and UK have blisters warning as well as signalling function; ribs / grooves have guiding, warning and signalling function in contrast with Czech system.

Table 3

Comparison of tactile patterns according to function

Function		**Czech Republic**	**Germany**	**United Kingdom**
Guiding	Public area	Ribs	Ribs	Ribs (Fig. 2e)
	Railway platform	Ribs / Grooves	Ribs	Ribs / Blisters
	Underground	Grooves	Ribs	Ribs
	Pedestrian crossing	Ribs	without tactile indicator 1)	without tactile indicator 1)
Warning	Pedestrian crossing	Blisters	Blisters (Kerb-drop field)	Blisters (Fig. 2a)
	Railway platform end	Blisters	Ribs (Fig. 2d)	Ribs (Corduroy) / Blister
	Railway platform edge	Ribs / Grooves	Ribs	Blisters (Fig. 2b)
	Underground platform edge	Blisters	Ribs	Blisters of-street (Fig. 2b)
	Public transport stop edge	without tactile indicator	Ribs	Longitudinal ribs on-street
	Stair, ramp, escalator	without tactile indicator	Blisters	Ribs / Blisters
Signalling Informing	Public transport stop	Blisters	Ribs	without a tactile indicator
	Pedestrian crossing	Blisters	Blister + Ribs	Blisters (Fig. 2a)
	Public building	Blisters	Ribs	Ribs
	Other important points 2)	Blisters	Ribs + Blister	Ribs (Fig. 2e)
Branching		without tactile indicator	Blisters	Blisters
According to		*Decree 398/2009 Sb.*	*DIN 32984*	*BS 8300-1:2018, [15], [22]*

1) in a zebra (road), 2) e.g. stairs, lift on the railway platform

The Czech system e.g. does not use tactile patterns before stairs, ramps and elevators - they are not dangerous places for people sing white cane. Another Czech specific tactile arrangement ‘crossing directional strip’ was seen in Serbia (Beograd) only. Unlike foreign countries, paving without tactile patterns is used for branching of signal strips or guiding lines.

Tactile indicators for visually impaired people are regulated by International Standards ISO 23599 (Assistive products for blind and vision-impaired persons – Tactile walking surface indicators), valid since 2012 (revised in 2019). In the form of recommendations, it defines ‘Attention pattern’ and ‘Guiding pattern’ (rib and blister shaped), their size and design. Blister paving is 4-5 mm high, ribs as well (4-5 mm) spaced 57–85 mm in dependence on the top width of longitudinal ribs. This standard also recommends visual contrast (luminance contrast for better identification by visually impaired person). It should be noted that this standard, although internationally applicable, is different in some respects not only from the Czech system (e.g. does not define crossing directional strip or warning strip on the underground platform). However, this standard is very similar to the British, German or Hungarian systems of tactile arrangements (attention pattern in front of stairs or inclined ramp, tactile indicators on railway platforms, etc.).

Another standard is ISO 21542:2021 (Building construction – Accessibility and usability of the built environment) dealing with wider scope of environmental adaptations for people with reduced mobility including visually impaired. In the field of tactile indicators for visually impaired people it broadly reproduces parameters and system of tactile indicators from ISO 23599. Standard ISO 21542:2021 also introduces some adaptations which are new or different from the Czech system, e.g. principles of tactile indicators (overuse of guiding lines, preferring raised pattern, attention pattern in front of stairs, etc). However, its strength lies in conceptual approach of built environment adaptations for all groups of PRM within the transport chain and public areas.

Discussion

Conditions, means and approaches when building accessible environment for visually impaired people can be characterised in European countries as follows:

- system of ‘size + surface pattern’ is not applied, which brings challenge that visually impaired face when identifying elements, places, situations;
- natural guiding lines are not used (with exceptions), even in situations where guiding line could be represented by e.g. walls, railings, fence foundations, artificial guiding lines (ribs). That generates increased costs of environmental adaptations and, moreover, visually impaired people are guided through places with higher density of pedestrian flow;
- tactile surface is usually created in the shape of longitudinal ribs (with positive relief) which can cause problems not only to people with disabilities;
- erroneous adaptations across European countries [13] are often similar to such places in the Czech Republic: guiding the visually impaired person out of the pedestrian crossing axis, guiding lines which are not followed by other guiding lines, space under stairs is not protected etc.;
- when determining the obstacle-free zone along guide lines or obstacles, it is necessary to consider the laterality of blind people (right-handedness, left-handedness) as well as the possibility of walking with a guide dog.

Across borders and continents but especially in European countries, there are two approaches to creating accessible environment. The concepts like ‘Universal Design’, ‘Accessibility for All’, ‘Inclusive Design’ or ‘Transport for All’ have been put through in Europe, especially in Scandinavian countries [20] but also in Germany, Spain or Great Britain since the end of the 20th century. The term ‘Universal design’ appeared in the USA in connection with Americans with Disability Act. This is a conceptual approach to creating environment accessible for all groups of users. It has been gradually taken over by other countries e.g. Ireland [21]. The second approach, applied in most Central and Easter Europe, still lies in ‘ad hoc’ environmental adaptations. A positive overall assessment can be made of the fact that in this part of Europe (e.g. in Czech Republic) new barrier-free routes emerge in cities.

Conclusion

System of surface tactile indicators for visually impaired people developed in Japan has spread to numerous countries all over the world. In every country or region can be found not only modifications to it but also original tactile arrangements and their specific use. This can be identified as one of the reasons for complications which VI people face when travelling. As is suggested in [13], unification of tactile surface indicators could be considered but it is obvious that world-wide unification is not possible. Nevertheless, even the Authors support, in principle, the idea of two types of tactile surface patterns and their size / width (grooves – guiding function, blister paving – warning function). Such unification together with observing rules when using each type of surface would facilitate movement and orientation of visually impaired people in foreign countries or at least at railway stations and coach terminals where they can arrive without assistance.

The area of recommendations relates to preferred using grooves carved into pavement as guiding lines. Such tactile surface indicator is friendly for everyone, not only for people with disabilities. This alternative has the advantage of not being worn when paved areas are cleaned or maintained. This alternative has another advantage - it does not wear, unlike raised pattern (blister, rib) when paved areas are cleaned or maintained.

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