# Case Study for Solution of Ostrava-Svinov Transfer junction Aimed at Movement and Orientation of Blind and Visually Impaired People

Alžběta Bílková, Bohuslav Niemiec and Diana Orsáková

***Abstract*— This paper is focused on evaluation of barrier-free accessibility of the significant regional transfer junction in Ostrava made up of the Ostrava-Svinov railway station and upper and lower stops of the urban mass transportation. The outcome is focused on solving the problems of movement and orientation of blind and visually impaired people.**

***Index Term*— Availability, Civil engineering, Safety, Standardization.**

## I. Introduction

PUBLIC transport is an important part of public area of cities and municipalities. The most important part of public transport happen the transfer junctions in which all kinds of means of transport and a large number of people (passengers) meet and who move within the transfer area following the rhythm and intensity of the traffic [1]. Thanks to intensive utilisation of these transfer areas, it is necessary to assess these places, among others, also in light movement of man in all of his life stages and primarily in light of barrier-free accessibility. Therefore, when designing and making adaptations, the emphasis should be placed primarily on creation of a suitable and good quality environment offering its users necessary convenience, easy orientation, safe and quick movement, rest and services. The problems of barrier-free access to public area are made up of many spheres resulting from types of limitation of users. This paper is aimed only at the problems and solving movement and orientation of the blind and visually impaired people, represented on the example of the Ostrava-Svinov, the significant regional transfer junction evaluated with the help of a blind person.

A. Bílková, Internal Doctoral Student, Department of Urban Engineering, Faculty of Civil Engineering, VŠB - Technical University of Ostrava, Ludvíka Poděště 1875, Ostrava-Poruba, phone: +420 597 321 972, e-mail: alzbeta.bilkova.st@vsb.cz..

B. Niemiec, External Doctoral Student, Department of Urban Engineering, Faculty of Civil Engineering, VŠB - Technical University of Ostrava, Ludvíka Poděště 1875, Ostrava-Poruba, phone: +420 734 878 222, e-mail: bohuslav.niemiec.st@vsb.cz.

D. Orsáková, Internal Doctoral Student, Department of Urban Engineering, Faculty of Civil Engineering, VŠB - Technical University of Ostrava, Ludvíka Poděště 1875, Ostrava-Poruba, phone: +420 597 321 972, e-mail: diana.orsakova.st@vsb.cz.

### *A. Visually impaired people*

For understanding the problems and solutions of movement and orientation of the blind and visually impaired people, it is important to define and specify all types of visual impairment. A visually impaired person is primarily understood as an individual suffering from an eye defect or disease affecting their visual perception and making them considerable problems in ordinary life [2]. In the following, seriously visually impaired people are distinguished for whom standard spectacle correction improving the independence of the handicapped in daily activities is not sufficient. This group is divided into the partially sighted and the blind. Blindness, not allowing the given individual to perceive by sight (although light perception is retained) is regarded as the most serious degree of visual impairment [3]. According to WHO international classification, the eye defects are divided into 5 categories - moderate asthenopia, serious asthenopia, seriously weak sight, practical blindness and complete blindness.

People with serious visual impairment orientate themselves in the environment primarily by touch, hearing, and partly by smell. Hearing, processing and aiming the sounds from surroundings, plays an important role in spatial orientation. It is the so-called macro-orientation. Perceiving the environment with hearing is often distorted by wind, rain, overlapped sounds (noise), cap, etc. The most important means by which the visually impaired person perceives the surroundings becomes the sense of touch. It is the so-called micro-orientation. With the use of touch, these people obtain information on the type of surface, its structure and layout. Perception with touch takes its course from parts to a unit and it can be subdivided into active and instrumental touch (mediate) [4]. The active touch is meant touching an object by the visually impaired person apart from instrumental touch during which the visually impaired person feels using an instrument (e.g. a white cane). Spatial perception by touching is often distorted by snow, frost, leaves, footwear, gloves, etc.

### *B. Mobility of the blind and visually impaired people*

Pursuant to the limitations resulting from visual defects themselves it is clear that independent mobility of the people with such defects is not fully possible and it is realised using several techniques. The mobility and orientation techniques are then unfolded, to a great extent, from the environment in which the visually impaired person is found. Basic mobility techniques used are as follows - a long cane (Fig. 1) and the movement without a cane, which is subdivided into safety holding (i.e. postures), walking with a seeing guide, sliding technique (i.e. trailing) and walking with a guide dog (often completed with a white cane).

Postures are divided into low and high holding. Low holding is used for securing before obstacles found at the height of waist. High holding is used for protection of the face and head [5]. Walking with a seeing guide (Fig. 1) consists in a continuous verbal contact (giving information o the surroundings) and giving the blind one's arm who holds the seeing person in the position under the elbow or forearm. The guide does not draw the blind, (s)he walks half a step before the blind, always on the less safe side [6]. When moving in buildings or rooms that are familiar to the visually impaired, they use trailing (Fig. 1). The blind gets about in a parallel way with the wall, holding his/her hand waist-high slightly forward and his/her slightly bent fingers are sliding across the wall. Walking with a guide dog (Fig. 1), in terms of ensuring the safety of mobility for the visually impaired, it is comparable to walking with a seeing guide. The so-called guide dogs are trained specially for this purpose; they cope with noise, traffic, escalators, indication of a dangerous obstacle in the way (possibly getting out of the way) and safe delivery of its master to the place needed [6].

The term long cane technique is understood as purposeful and instructed use of a white cane providing the visually impaired with safety and subjective confidence of moving [5].

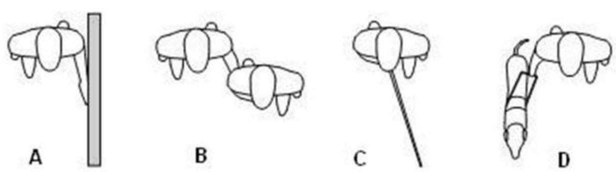

Fig. 1. Basic mobility techniques used by the blind: A – trailing, B – walking with a seeing guide, C – walking with a white cane, D – walking with a guiding dog.

The white cane provides the visually impaired with a contact with the route they get along and ensures three basic functions – signalling (warns a passer-by of the blind), protective (avoids a collision) and orientating. The use of the white cane can be divided into four techniques - fundamental posture, sliding technique, pendulum technique, and diagonal technique. Sliding technique (Fig. 2) is used for specification of the surface structure of the ground and of dangerous locations implemented by the blind using a sliding motion and circumscribing an arc within the arm width. Most frequently used technique is the pendulum (Fig. 2) consisting in moving the white cane along an arc above ground and in contacts only in its end points. Diagonal technique is applied primarily when moving within familiar facilities [5].

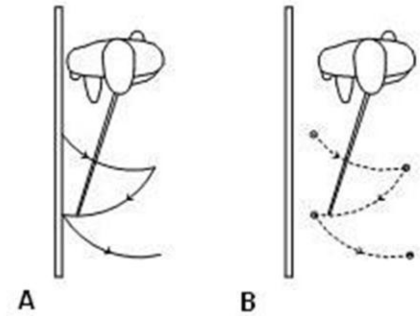

Fig. 2. Frequently used long cane techniques: A – sliding, B – pendulum.

## II. Orientation of the Blind and Visually Impaired People

Spatial orientation of the blind is dependent on correct, understandable, unequivocal and logical tracing, location, tactile marking and identification of dangerous places completed with acoustic signalling. The blind people perceive the space as a set of guiding lines, orientation points and markers [7]. The guiding lines then connect various orientation points and determine direction of movement and they can be subdivided into guiding lines natural (facades, walls, kerbs, etc.) and artificial ones that are created in such a way so that they can be perceivable with a white cane and by threading and ensure a tactile contrast against surroundings. This includes a warning strip, signal strip, guiding line with warning strip function,tactile strip, guiding strip in crossing and information labels in Braillle tactile writing. An orientation point on the route is a location that is distinguished from the surroundings that can be found easily and quickly (corner of the building, escalator, phone box, etc.). The term orientation signs includes phenomena creating the final nature of the location in the space and the blind perceives them using hearing, smell, touch, temperature, and balance (ascent, descent, curvature). Using these signs, the blind puts the finishing touches to the imagination of the surroundings.

It is substantial for orientation of the blind that acoustic elements in the form of acoustic signalization are properly and unambiguously and identifiably placed in crossings and cross-overs as well as acoustic orientation and information beacons.

All of these elements influence the amount of ability of the blind to perceive substantial pieces of information from the environment in which he gets about. Therefore, it is necessary to create the environment with a number of natural orientation points and guiding lines located in the space so that its nature and direction of routes are identified clearly. In case of their misunderstanding and misinterpretation, whereas the safety of mobility of the blind is reduced and the threat of collision with an obstacle is increased.

### III. Solutions to Accessibility, Mobility and Orientation of the Blind and Visually Impaired People at the Ostrava-Svinov Transfer Junction

The Ostrava-Svinov transfer junction is located on the crossings of frequented and fully charged main lines (motorway D1, railway route Bohumín-Praha and Opava, roads 11 and 479). Due to this significant position, it is one of the most important transfer junctions in the Moravian-Silesian Region. In 2006, the areas of railway station were reconstructed and in 2013, the area of Svinov Bridges low and high stops were reconstructed and adapted. Main urban public transport stops are found on the Opavská overhead road (Svinov Bridges high stop), under the structure itself there are positions of suburban lines (Svinov Bridges low stop) and the stop (Svinov Railway Station) is found right in front of the railway building. The distance between the stops of urban public transport and the railway station is approximately 400 metres and passengers must cope with several height levels that may cause problems primarily to people with reduced ability of orientation. We selected the investigated route in the direction of the Svinov Bridges high stop to the Ostrava-Svinov Station (Fig. 3).

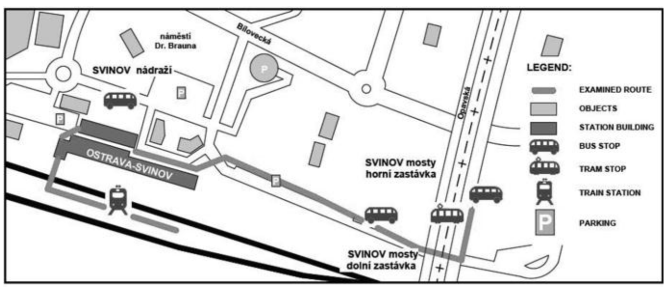

Fig. 3. Investigated route layout.

Boarding points of tram and bus stops are designed in an identical way. The surface of boarding points is elevated above the carriage way (rails) by 200 mm. The surface is made of concrete, the walking area of which is painted red. The boarding edge is distinguished in a contrastive way with 400 mm wide white paint. Individual boarding points are provided with adhesive tactile signal strips in white colour. The natural guiding line here is made up of the glazed facade in the structure of which there are columns carrying the roof. These columns are protruding in the space (200-400 mm) and there are provided with seats and waste bins making problems to the blind during their movement as they are not always able to identify these elements and collision with them or with sitting people may happen (Fig. 4).


Fig. 4. Design of the boarding point surface.

Access to individual boarding points is ensured by staircases, escalators and lifts. The surface and colour design is identical to the surface of the boarding points, exit and entrance steps are painted and along the entire width and length of tread boards and risers with white paint and so they make a sufficient contrast for visually impaired people. However, the staircases in these places are not provided with an acoustic element which would warn the blind of their presence. In case of the escalators and staircases in the area on the ground it is different as this vertical route is provided with such elements

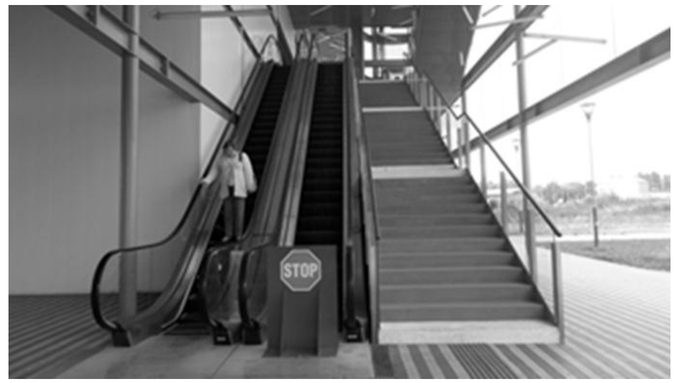

Fig. 5. Contrast treatment of the steps on staircases.

(Fig. 5).

The central part of the communication area between individual boarding points is provided with a 300 mm wide artificial guiding leading through the centre of the communication with

Fig. 6. Area of the central part with the artificial guiding line.

branching to individual staircases (Fig. 6).

However, this design does not provide the blind people with sufficient tactile contrast and it becomes unreadable for them. Utilization of the natural guiding line in the form of walls of the passage is unsatisfactory in this place due to access to individual boarding points. The route of the blind would cross these directions and a collision with another passenger could happen. Another questionable element of the new areas of the transfer junction is the actual aesthetic interpretation composed of glass, concrete, and metallic (predominantly columnal) structures. The aesthetic appearance of the entire area is perfectly unified (the combination of white, red, black, and grey colours is repeated in it) which may cause considerable difficulties to the visually impaired people in recognition of individual areas and their functions, not speaking of glass areas where there are contrast marking in their central part (represented here by handrail). Two lifts found behind the staircases and escalators are accessible from the ground. They are accessible using a natural guiding line formed by the red facade. The lifts are in compliance with applicable regulations in terms of space and equipment (the controls are at a height of 1000-1200 mm, they are provided with Braille fonts, they contain a tilting seat, etc.). In vicinity of the lift there are draw-bars on the structure interfering with the communication area

Fig. 7. Draw-bars in the communication area.

and the blind and visually impaired people have no chance to register them with the mobility techniques they use. Thus this structure becomes very dangerous (Fig. 7).

The entire area of the Svinov Bridges low stop is found on the ground level. Analogous to the other areas, it is made up of a uniform surface made of smooth concrete pavement in grey-white colour combination. Tactile warning elements (signal and warning strips) are made of red pavement and so they create a sufficient contrast both for the visually impaired and the blind. The artificial guiding lines here are constructed in two ways – the elevated kerb and the pavement in black colour with tactile 400 mm wide grooves which is primarily found in the area of the stops and on the footpath towards the railway station. The wrong placement of the bus stop roof is

Fig. 8 Unsuitable location of the stop roof.

questionable as it affects unsuitably and unnecessarily the smoothness of the artificial guiding line and makes the mobility of the blind people difficult (Fig. 8).

Fig. 9. Solution of the barrier-free parking stands.

The barrier-free parking stands found at the edge of the parking area are placed and designed suitably close to the stops (Fig. 9).

Another problem on the connecting pavement is taking the artificial guiding line at the edge and along the parking area. The artificial guiding line keeps the necessary 800 mm

Fig. 10. Unsuitable placement of the artificial guiding line.

distance from the edge of the kerb but parking cars are not prevented from overreaching into the pavement area. When the blind walks along this artificial guiding line, they can touch the parked vehicles (Fig. 10).

The area in front of the railway station building lacks contrasts and tactile elements which would guide the blind and visually impaired people. The entrance to a newly built area of the railway station is provided with a wrongly installed acoustic beacon which will not guide the blind towards the axis of the entrance door (Fig. 11).

Inside the station hall, there is an artificial guiding line created by means of grooves milled in the pavement with a contrast shade. However, the milled grooves do not provide the blind with a sufficient tactile contrast and do not fulfil its function adequately (Fig. 12).

Fig. 12. Placement of the artificial guiding line.

Another disputable issue is the connection of the new and old parts of the building. In the premises of the old station building, no artificial guiding lines are designed owing to historical value of the premises and the blind are oriented in the area only according to natural lines (walls) that are not fully adapted to this use. In many places there are elements causing barriers and obstacles (advertising stands, piano, etc.) complicating the blind their fluent walking (Fig. 13).

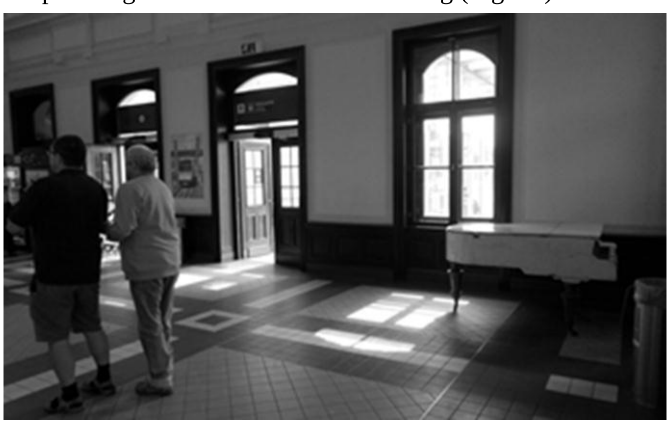

Fig. 13. Elements affecting the natural guiding line.


Fig. 11. Unsuitably placed acoustic beacon.

Access to individual boarding points is ensured by the underpass with staircases, escalators and lifts. All vertical communications are marked with acoustic, tactile and contrast elements according to applicable regulations, the only thing missing are the tables with Braille type on handrails that have not been installed. The surface of boarding points is provided with an artificial guiding line with the function of a 400 mm wide warning strip and with a 150 mm wide visually contrast marking.

## IV. Evaluation of Solution to the Case Study Related to the Selected Route of the Ostrava-Svinov Transfer Junction

This case study has been focused on the evaluation of the route and execution of barrier-free elements for the blind and visually impaired people and complete layout of the area in the environment of the fully occupied Ostrava-Svinov transfer junction. It is necessary to emphasise that this area (owing to its heftiness) will not be used by the blind and/or visually impaired without previous training with accompaniment of a seeing guide. This implies that the elements designed in this area, despite not a few minor defects, allow the blind and visually impaired people safe and quick walking among the urban public transport stops and the railway station. There is a possibility of using the bus line No. 37 travelling through the Svinov Bridges high stop and the Svinov Station by which means the blind (and also other handicapped people) can move between these points more easily.

The investigation also implies that the value of the barrier-free area unfolds from the age of building, adaptation or reconstruction. So the public area of the newer part of the urban public transport stops contains all elements necessary for barrier-free mobility. On the other hand, the reconstruction of the railway station contains many mistakes and only the area of boarding points is free of greater shortcomings. Many limitations in the area of the old station building result from well-meant endeavour to keep the original premises of this building. A great nuisance is the incomplete implementation itself and misunderstanding of structuring and continuity of individual elements of the barrier-free route that create obstacles paradoxically and complicate the smooth motion of the visually impaired people (refer to unsuitable placement of the stop roof or artificial guiding lines).

However, it can be said globally that this area (on assumption of previous familiarization in the presence of a seeing person) allows independent motion of the visually impaired people. They will get to the required locations connected with movement and provision of travelling (boarding points, lifts, escalators, booking offices, etc.).

## V. Conclusion

Nowadays, we encounter barriers in our near environment. Thanks to intensive utilisation of transport changing areas, it is necessary to assess these locations primarily in light of barrier-free access. Therefore, when designing and making adaptations, the emphasis should be placed primarily on creation of a suitable and good quality environment offering its users necessary convenience, easy orientation, safe and quick movement, rest and services.

This paper deals with the assessment of barrier-free access to the particular area of the Ostrava-Svinov transfer junction and focuses on solutions simplifying the mobility and orientation of the blind and visually impaired people. This area has been assessed and evaluated in accordance with theoretical terms and techniques of motion of the blind, resulting from applicable standards and regulations.

The evaluation itself indicates that the investigated locality of the entire transfer junction, despite its exigence, allows the independent motion of the visually impaired people. Created routes and their elements, even with several shortcomings resulting from misunderstanding this issue, are able to lead the visually impaired people safely and adequately precisely from one stand to another.

ACKNOWLEDGMENT

The work was supported by the Student Grant Competition VŠB-TUO. Project registration number is SP2015 / 187.

REFERENCES

[1] M. Lánská, M. Čepa, "Inovace přestupních uzlů z hlediska pohybu cestujících - Úvod do problematiky," Perner's contacts, vol. IV, no. 6, pp. 205-213, Nov. 2011.
[2] L. Ludíková, "Úvod" in Tyflopedie předškolního věku, 1th ed., Olomouc: Univerzita Palackého, 2004, pp. 1-5.
[3] L. Květoňová-Švecová, "Úvod" in Oftalmopedie. 2 th ed., Brno: Paido, 2008, pp. 1-6.
[4] Z. Nováková, "Kapitoly ze speciální pedagogiky" in Oftalmopedie. 1th ed., Brno: Paido, 2007, pp. 25-37.
[5] P. Wiener, "Zásady pohybu nevidomých a slabozrakých osob" in Prostorová orientace a samostatný pohyb zrakově postižených. 1th ed., Praha: Avicenum, 1986, pp. 42-58.
[6] M. Fillová, "Vodící pes – jeho výchova a význam pro nevidomé," B.S. thesis, Special Education Department, Masaryk University, Brno, Czech Republic, 2009.
[7] R. Zdařilová, "Charakteristika požadavků přístupného prostoru" in Bezbariérové užívání staveb - Základní principy přístupnosti v městském inženýrství. 1th ed., Ostrava: VŠB-TOU, 2012.

**A. Bílková** was born in Frýdek-Místek, Czech Republic, in 1990. She received the B.S. degrees in Architecture and Construction from Faculty of Civil Engineering, VŠB-Technical University of Ostrava, Czech Republic, in 2013 and the M.S. degree in civil engineering from Faculty of Civil Engineering, VŠB-Technical University of Ostrava, Czech Republic, in 2015. She received the M.S. degree in cultural history from Faculty of Arts, University of Ostrava, Czech Republic, in 2015. She is currently pursuing the Ph.D. degree in civil engineering from Faculty of Civil Engineering, VŠB-Technical University of Ostrava, Czech Republic.

Her research interests include the issue of barrier-free environment cities, design for all and history, evolution a construction technology of prefabricated houses in Czech Republic.

**B. Niemiec** was born in Třinec, Czech Republic, in 1982. He received the M.S. degree in land and industrial buildings from Faculty of Civil Engineering, VŠB-Technical University of Ostrava, Czech Republic, in 2006. He is currently pursuing the Ph.D. degree in civil engineering from Faculty of Civil Engineering, VŠB-Technical University of Ostrava, Czech Republic. In 2006 he began working as a teacher of vocational subjects at the Secondary School Building in industry in Havířov. In 2011, he became a professional consultant NIPI o.s.p.

His research interests include the issue of barrier-free environment cities, design and architecture.

**D. Orsáková** was born in Slavičín, Czech Republic, in 1990. She received the B.S. degrees in Architecture and Construction from Faculty of Civil Engineering, VŠB-Technical University of Ostrava, Czech Republic, in 2013 and the M.S. degree in civil engineering Faculty of Civil Engineering, VŠB-Technical University of Ostrava, Czech Republic, in 2015. She is currently pursuing the Ph.D. degree in civil engineering from Faculty of Civil Engineering, VŠB-Technical University of Ostrava, Czech Republic.

Her research interests include the issue of barrier-free environment cities, urbanism, architecture and public space.