University of Pardubice
Faculty of Transport Engineering

ACCESSIBILITY OF TRANSPORT STRUCTURES IN PUBLIC TRANSPORT SYSTEMS

DOCTORAL THESIS PRECIS

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Introduction

One of the key features of public transport as a whole is accessibility. The trend that is gradually gaining ground in the Czech Republic is to take into account the principles of Universal Design (UD) and integrated transport planning. In the past, the removal of barriers was perceived as above standard or a necessity arising from the given legislation that only considered the needs of people with disabilities. Universal design sees accessibility as an integral part of the functioning of the whole society, and it shifts the focus from people with disabilities to all users of the environment. Nevertheless, there are still shortcomings in the design and implementation practice, which fundamentally negatively affect the resulting level of accessibility of interchanges. The presented dissertation responds to this situation; the author proposes a general methodology for creating an accessible environment of transfer hubs and some specific solutions, such as the arrangement of a standard edge-to-edge platform.

1 Current state

Accessibility is the state of functional units (parts of buildings, the outdoor environment, information and communication systems, means of transport, services or products), enabling all users to integrate into society. Accessibility includes independent access, entry, evacuation and use of services or facilities by all potential users with the guarantee of health, safety and well-being [1].

Integral accessibility is the integration of barrier-free use at all stages of designing an interchange hub. These stages include preparation, design, implementation and operation. Integral accessibility enables the design of an environment which is suitable for all people regardless of their state of health, age or gender; such an environment ensures independent and safe use throughout its lifetime [1].

Directional guidance, so-called wayfinding (not only for the disabled), consists of gradually connected information that leads the user to a specific destination in the transfer hub from the entry point. It comprises four steps that lead to the goal [1]. The first step is to get an idea of the space at the entrance point and an unmistakable landmark where acoustic and visual information can be obtained. The second step is to find an access route to the desired destination. The third step is to follow the chosen path and its identifiability. The fourth step is recognising the target using tactile or acoustic information. Directional guidance is part of a functional multisensory orientation system.

1.1 Current state of accessibility

The requirements for a common platform are specified in the legislation based on the modes of transport. However, only regulation [2] states the main solution principle without specific details. That is why the already implemented platforms are solved differently, frequently conflicting with barrier-free design and principles.

Due to the harmonisation of standards on the railway system interoperability, and especially to the binding internal documents of the leading railway network operator in the Czech Republic – the Railway Administration, a state organisation, the requirements for barrier-free accessibility of the railway infrastructure environment at the national level are formulated in detail in [2], [3].

The accessibility of bus/coach terminals and bus/coach stations is, in the legislation and standards, described only in general terms and does not correspond to current needs [4]. Therefore, transfer hubs are being implemented without considering the context (territorially technical and transport) and without connecting to other modes of transport. Ultimately, this has the most significant negative impact on passengers with reduced mobility (PRM).

Requirements for accessibility of transfer hubs, stations of cableways and water transport (ports/wharves with the operation of public passenger – water transport) remain unresolved. Generally, only the parameters of cableway vehicles are determined – see Decree No. 173/1995 Coll. [5].

1.2 Methodologies

The methodology and recommendation on Decree no. 398/2009 Coll. on general technical requirements ensuring barrier-free use of buildings, published in 2011 [6], is currently the most widely used document. It is a certified methodology by Renata Zdařilová from VŠB-TUO, Faculty of Civil Engineering (No. 06-ÚÚR-19-2012 / 03-WD-05-07-3, issued on January 17, 2012). It recommends how to evaluate a specific building in terms of disabled people's accessibility.

Another document worth mentioning is the Prague Wheelchair Users Organization (POV) methodology, which is available at https://www.presbariery.cz/cz/. This methodology maps barriers in civic and transport facilities, parks, etc. The output categorises buildings, routes, roads, reserved parking, and public transport stops accessibility; it also includes a graphic output - maps. The concerned methodologies do not deal with designing and implementing an accessible environment.

Within the R & D & I project for the Ministry of Transport of the Czech Republic, "System means, measures and mechanisms for the successful design and implementation of a barrier-free environment in public transport chains", 1F54E / 039/520. 2005-2007, a multimedia methodological tool was created for designing and checking a barrier-free environment. It defines critical points/places [7, pp. 21-23], basic parameters, and characteristics of individual elements. It decomposes the transport buildings system into four levels:

1. the kind of the building;
2. the function of the building;
3. the particular functioning part of the building;
4. a variation of the particular functioning part of the building.

Level 3 and level 4 allow adding essential characteristics of individual elements so that all users can access them.

The author of the dissertation prepared an evaluation of TUL facilities in terms of barrier-free accessibility for students and employees as part of her professional activities at her workplace. The POV methodology with the colour evaluation of objects was applied. The TUL methodology is extended to visually and hearing-impaired people. It takes into account the overall contexts of the site and contains floor plans and photos of the buildings.

1.3 Analysis conclusions

The conducted analysis of the current state of accessibility concludes:

a) It does not matter whether the building is designed in 2D or 3D, as the context is the most important. In practice, it depends on the context and current possibilities, especially in the case of changes to completed buildings or buildings with monument protection. Therefore, it is also necessary to pay attention to urban plans, territorial limits and barrier-free generations in the territory.
b) The author's practical experience and a survey among designers show that in practice, designers use only the first step in the diagram of searching for critical points and barriers, i.e., identifying barriers. Only 10 % of designers use the follow-up steps leading to the check of the proposed measure.
c) The platform edge–edge (without more detailed legislation) is not that common; they are designed without necessary legislation support when they appear.
d) The author's survey has proved that tactile elements are more readily perceptible in layout segmented halls than the information on walls. That is why it is advisable to use tactile elements in the areas with a higher intensity of pedestrians, such as passages, and passageways, where crossing occurs.
e) The analysed methodologies similarly divide the disabled people into similar groups, and their solutions do not consider the continuity of the area and functional units.
f) The EU regulations are gradually implemented in the national legislation; the railway system regulations are synchronised, and the same applies to the regional transport system, apart from some exceptions. TSIs are required in all public areas designed for the transport of passengers, which the railway company manages. Therefore, it is necessary to specify the functional units according to which legislation will be proposed or assessed.
g) For places with the expected higher intensity of pedestrians, placing tactile elements in the middle or within 1/3 of the through width would improve the movement of visually impaired people and significantly speed up the movement and safety of all persons.

h) The problem is the phasing of individual project parts, where each specialist designs only their area, part or element and does not place it in line with others.

The analysis of legal regulations in the field of accessibility abroad reveals two basic approaches to designing a barrier-free environment:

I. The first is closely related to the US Disability Act of 1990 ("ADA"). Similar legislation exists in Canada, the United Kingdom, Australia, New Zealand and Japan. Disability is not strictly differentiated into groups of people, but the proposals apply seven principles of Universal Design (UD).
II. The second approach emphasises the need to analyse the type of disability into categories and to take into account the needs of individual groups of PRM. The proposals contain adjustments that can be used mainly for a particular group of people, and accessibility is divided into sub-sections accordingly. This approach is applied in Europe. Currently, there are organisations in most countries that are dedicated to the promotion of the UD method and address it from a theoretical and practical point of view.

If both approaches are applied comprehensively and consistently, the same result will be obtained.

2 Aim

The dissertation thesis aims to create a methodology for designing and assessing transfer hubs' accessibility concerning their transport function and in the context of territorial and construction-technical links of buildings. The methodology focuses mainly on transfer hubs on regional railways.

To achieve the aim, the following steps have to be completed:

1. The building must be set in a context; there must be the continuity of the barrier-free passes, transportation and accessibility of the objects.
2. The decomposition of the transfer hub to subsystems (their interconnection).
3. An experiment for determining the selected parameters of the shared platform.
4. The composition of all the subsystems of the transfer hub in connection to other transport systems and the design of the Layer Model.

The methodology will support the design and implementation of a barrier-free environment of transfer nodes for all its users. It will also support the implementation of the EU Resolution ResAP (2001) 1 on universal design in the Czech Republic, prioritising changes to completed buildings.

It is assumed that the compiled methodology will be intended for architects, urban planners, engineers and specialists of other professions and the local government ordering Urban Planning Documentation. In the pedagogical process, it finds application in teaching at secondary schools and universities and in lifelong learning.

3 Research methods

The dissertation structure copies the course of the research, which is related to the accessible environment in the transfer node. It can be divided into theoretical, research and practical parts.

The theoretical part involved studying available literature, professional articles, laws and regulations related to the topic. The topic is broad and interdisciplinary. It was necessary to gain detailed knowledge and then put it into context. Consultations with experts took place, and the author also drew on her knowledge from her own pedagogical and consulting practice. To evaluate the performed experiments with the subsequent elaboration of the methodology, it was necessary to study the theory from related fields: introduction to ophthalmology, orthopaedics, hearing impairment or behavioural disorders, materials engineering, urban planning, architecture and mathematics.

The empirical research took place in the form of consultations on the issues addressed on construction sites, in the form of questionnaire surveys and the incorporation of knowledge gained through our expert activities.

As **part of the research**, an analysis of the accessibility of transfer hubs (TH) in the Czech Republic, Germany and Japan was performed, focusing on the E-E platform. Furthermore, two experiments were conducted to obtain exact data on the use of space and the walking of visually impaired people on the platforms and in the adjoining area.

To use the mentioned scientific methods, it is necessary to obtain and correctly evaluate the data and the feedback (to understand the life cycle of the transfer hubs, where barrier-free accessibility manifests itself in all phases).

3.1 Universal design

As the theoretical part of the research showed, an accessible environment for all contributes to a safer environment because the requirements for TH ensure convenient access and comfortable use for persons with reduced mobility (PRM) and a more comprehensive range of users. Accessibility is addressed comprehensively and in context. The author structured the application of seven UD principles in PU and gave specific examples of where the application of these principles in PU manifests itself. Emphasis is placed on reducing risks and the functionality of individual units (areas, operations and information).

3.2 Fuzzy logic

The degree of usability of tactile walking surface indicators (TWSI) in the built environment can be calculated by Fuzzy logic [8, p. 17]. This is an exact evaluation of individually perceived elements determining the directional line in the publicly accessible part of the station building or check-in hall for reconstructions, where it is necessary to assess the usefulness of the original architectural design (paving, glass panels, original tiles). It is not easy to add aesthetically pleasing yet functional tactile elements to existing buildings, which have monument protection, which often constitute an obstacle for people with physical disabilities.

Tab. 1 Usability of TWSI for TH users

Evaluation of usability of TWSI related to the specified types of persons					
User	**PD / mobility**	**VD / vision**	**HD / hearing**	**MD orientation**	**Usability of TWSI**
I.	0.2	0.2	0.3	0.7	**0.37**
II.	0.2	0.2	0.3	0.7	**0.37**
III.	**0.4**	**0.3**	**0.3**	**0.2**	**0.37**
IV.	0.7	0.3	0.5	0.4	**0.37**
V.	0.9	0.3	0.2	0.3	**0.37**
VI.	0.3	0.5	0.1	0.3	**0.61**
VII.	0.3	0.7	0.1	0.3	**0.65**
VIII.	0.1	0.9	0.3	0.3	**0.66**

Source: adapted according to [13]

Output: decision on additional placement of elements, price increase.

The mathematical model created with the support of the Fuzzy Logic Toolbox confirmed the assumption that for small waiting rooms, the usability of tactile elements in the middle area is only an intuitive use for non-visually impaired users – see Tab. 1.

3.3 Checkland's methodology

The problem of complex systems lies in the need to reduce the investigated properties to essential entities and attributes [9]. The model phase of this methodology aims to design an integrally accessible transfer node and streamline the use of existing methods and regulations in design. The model phase contains six sub-steps marked M1 to M6, which take place at the abstract level of systems thinking [10, p. 61]:

- M1 – stating the fundamental definition (CATWOE analyses);
- M2 – conceptual model (compilation of sub-activities that must be performed to ensure the transformation in the fundamental definition, each sub-activity is performed in a particular subsystem;
- M3 – fundamental definition of subsystems of sub-activities (CATWOE activities analysis from M2);
- M4 – further decomposition (second and third grade of the concept model);
- M5 – fundamental definition of selected subsystems of sub activities (CATWOE analysis);
- M6 – adequacy and adjustment analysis (return to previous steps up to the cognitive phase, assessment of the adequacy of the model with reality, assessment of the methodological correctness of the procedures used).

The four available TH systems in the first stage are decomposed into subsystems of the second stage (phase): the preparatory phase, design, implementation and operation. The design phase subsystem is decomposed into six areas: legal framework, territorial requirements, building requirements, transport connections and landscaping, environmental impact, civil protection of the population and requirements for the organization of construction.

From the analysis of individual activities, the author conducted a questionnaire to determine the actual use of the existing regulations and other aids. Among the respondents, 25 % were architects, and 25 % were traffic engineers who had already designed the traffic facilities. This value could not be determined objectively for building designers. All three groups must incorporate these materials or follow them in their proposals and request them as a basis for design activities.

Of the 92 respondents surveyed, 64 % have never worked with a general and only 9 % use it regularly in their work. The work with the Special Situational Drawing reached weaker values, which is regularly mentioned in the documentation by only 9 % of respondents, and all of them were transport construction designers. Only 50 % of designers who regularly prepare or work with a drawing know what required information needs to be provided and read from the drawing.

3.4 Statistical analysis of visually impaired people's walk

The collection of data on the walking of visually impaired people in dispatch buildings, on platforms and in the pre-station, area took place according to predetermined criteria. The experiment was focused on finding two basic parameters:

A. the actual passage width for disabled on platforms;
B. the deviations from the straight walking axis at a distance of 8 m without a guideline.

A total of 275 measurements were collected: 110 for parameter "A" and 165 for parameter "B". In total, 11 severely disabled people took part in the whole experiment. All persons underwent spatial orientation training but adapted to independent walking over time. Their walking style is influenced mainly by the experience gained, their current physical and mental condition, which changes during the day and the current situation in the urban environment.

Parameter "A "- The pass-through experiment was performed on a railway platform. The same conditions were set: higher caution, slower walking speed, the flatness of the walking surface (identical transverse and longitudinal slope), pre-expected tactile elements and acoustic information.

Parameter "B "- Experiment with the deviation from the walking axis at a distance of 8 m without a guideline - see Fig. 1. It was carried out in the pre-station area. Each person completed an 8 m long section 15 times, where the walking surface changed (smooth surface - e.g., asphalt), large-scale paving, concrete paving, small granite cube), transverse slope (slope up to 6 %) and local noise (pre-station area, square - pedestrian zone).

The experiment confirmed that the minimum pass-through width of visually impaired persons with the long white cane technique at the guideline is at least 1200 mm wide. If the artificial guideline is accessible from one side only, as is the case on the standard rail and non-rail platform, only 800 mm of unobstructed passage cannot be maintained.

The measurements also showed that if the guideline is interrupted for a length of 8 meters, then the visually impaired persons may deviate from the ideal axis of the straight direction by a deviation of up to 650 mm on both sides. The value of 8 meters for measurement was determined from the requirements of Decree No. 398/2009 Coll., Where the guideline must not be interrupted for a distance longer than 8 m [11].

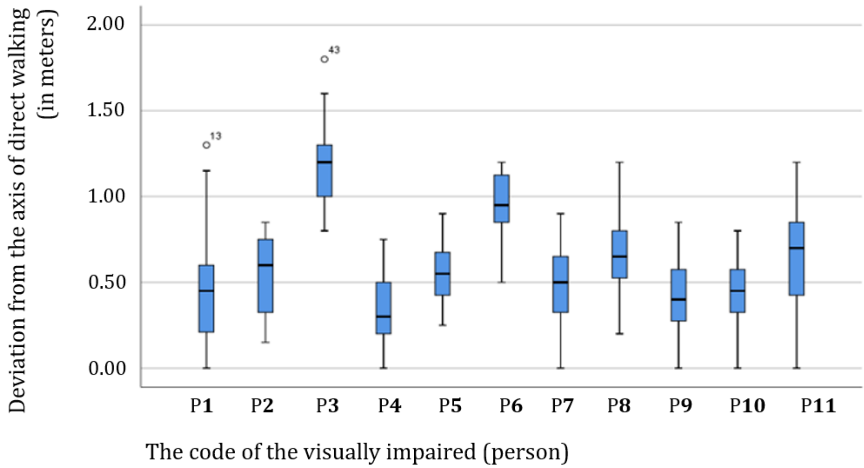

Figure. 1 Box and whiskers plots for walking of the visually impaired

Source: program [14], author

3.5 Summary of the methods used and their application

During the elaboration of the dissertation, four main research methods were used - see Tab. 2, which also states their specific application. Other supporting methods used were: the CATWOE analysis method (identification of objectives and problem areas from the point of view of individual users), decomposition of the environment (transfer node) and sensitivity analysis (finding out the financial demands of extending the construction parameters of the standard platform) [12].

Tab. 2 Applied methods

Number	Method	Characteristics	Application
1	Checkland's methodology	Improving human activities systems	Design improvement models Non-functional parts of legislation
2	Universal design	Principles of UD and its elements in the transport chain	Accessibility functionality and use User analysis
3	Fuzzy logics	Questionnaire surveys for the question-and-answer database Mathematical model for Fuzzy Logic Toolbox	TWSI utilization rate
4	Statistical analysis	Walking visually impaired persons Data collection Measurement experiment	Passage widths of disabled on a standard platform Deviation of walking without TWSI from the axis in a straight line

Source: author

4 Methodology of transfer hub accessibility

The proposed Methodology points at weaknesses – the systematically repeated activities, which are important to be connected, and to increase awareness of their consequences, if they are not addressed in advance. These are:

- the urban territory plan and its details (acquirers, contractors/ authorities, private sector, public, network administrators, etc.);
- a specific and meaningful assignment and, above all, the evaluation of an architectural competition with the participation of traffic engineers;
- in practice unused situational drawing and Map barrier-free transport;
- facility users' feedback and its impact on its operation.

A simplified graphic expression of the **"Methodology of Integral Accessibility of Transfer Hubs"** can be seen in Fig. 2. The methodology uses the following blocks:

1. Transfer hub design and implementation flow chart;
2. Model of integral accessibility levels;
3. TH user categorisation based on the UD and its specific features;
4. Diagram of relations;
5. Functional area.

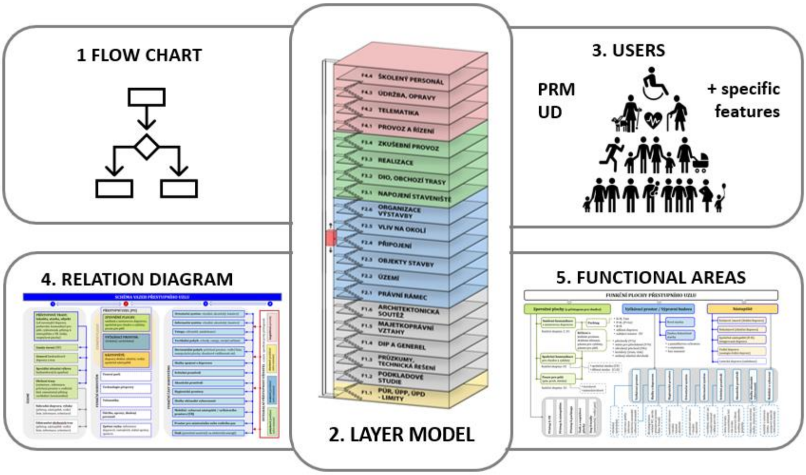

Figure. 2 Methodology of Integrated Accessibility of transfer hubs diagram

Source: author

4.1 Flowchart

The flowchart shows the simplified design flow of a barrier-free TH. It contextualizes the selected levels of the Layer Model. In a simplified way, it shows the continuity of the stages:

phase 1: preparation (yellow);
phase 2: design (blue);
phase 3: implementation (red);
phase 4: operation (grey).

The flowchart shows that the document Limitation in using space resulting from Spatial Planning Document (see Chapter 4.1.1 dissertation thesis) plays an important role when contracting a construction work, particularly high-speed rail transfer hubs (HSR). In practice, some limitations will not be fully manifested until the end of the second design phase, which means a time and, above all, an economic loss. Identifying critical points is a sub process labelled ①. Due to the limited scope of the Theses, it is presented only in the dissertation in Chapter. 4.1.1). Its purpose is to gradually check the correctness of the project documentation and identify critical points, including the consequences of an erroneous design solution.

4.2 Layer Model

The transfer node (TH) accessibility layer model was created by decomposition using Checkland's methodology. It is structured into four phases, forming individual levels affecting barrier-free use. The specified sequence of phases is not to be confused since the previous layers form the basis for the following ones. The continuity of individual steps and phases is equally important. The graphic form of the Layer Model can be found in the dissertation in the chapter- 4.1.2. (Fig. 4-4).

4.3 Users and their specific features

The users of a TH are passengers and other persons using transport-related services or civic amenities services of the station. Concerning the Universal Design (UD) method, individual groups of potential TH users have been defined – see Fig. 3. This graphic sheet shows that some groups of people are forgotten during the process of designing, especially people with assistance or guide dogs. For a basic understanding, it is necessary to assign fundamental barriers in TH to users. In an accessible environment, it is necessary to maintain the right to choose the route used (according to the length, height differences and auxiliaries on it), the control, the payment method or the acquisition of information.

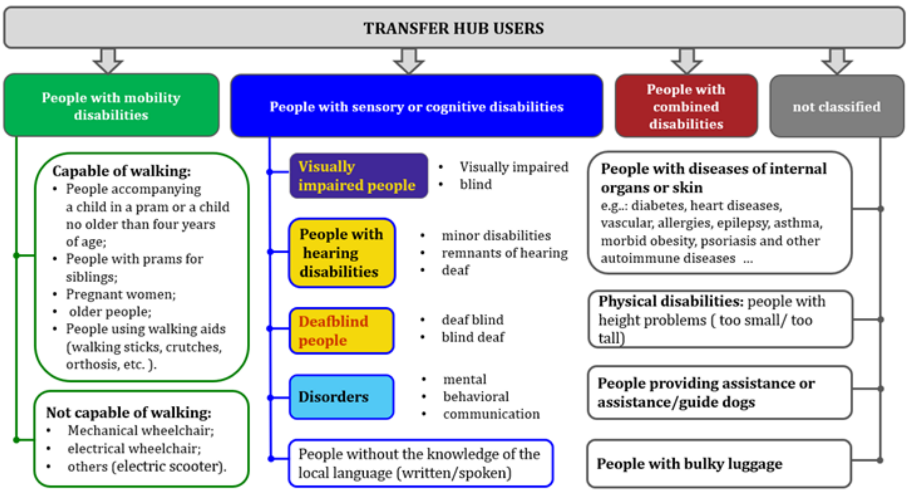

Figure. 3 Transfer hub users

Source: author

4.4 Transfer hub scheme

In terms of integral accessibility, the author compiled an overview of functional subsystems of THs and their links, without which the integral accessibility would not be complete. The system of ties completes the integrity of the view of THs. The first column shows the elements that affect the selected area, and this reformats the position and orientation of THs - see Fig. 4.

The second column lists the functional subsystems that directly affect the overall accessibility. There is also a subsystem "feedback" - a long term significantly underestimated part of the design and implementation process of (not only) a TH.

The third column lists the parts of the subsystems that affect the functionality of the entire TH in detail. The specialist in the field must take into account their interconnectedness. As the analysis of the current situation has shown, designers need to improve their creative thinking and consideration of links to other possible subsystems.

The fourth column generalizes user accessibility using the UD methodology for four groups of people affected by the most significant number of critical points in the TH. Critical points cannot be entirely eliminated, but it is necessary to ensure their safe use within the fifth principle of UD (safe use).

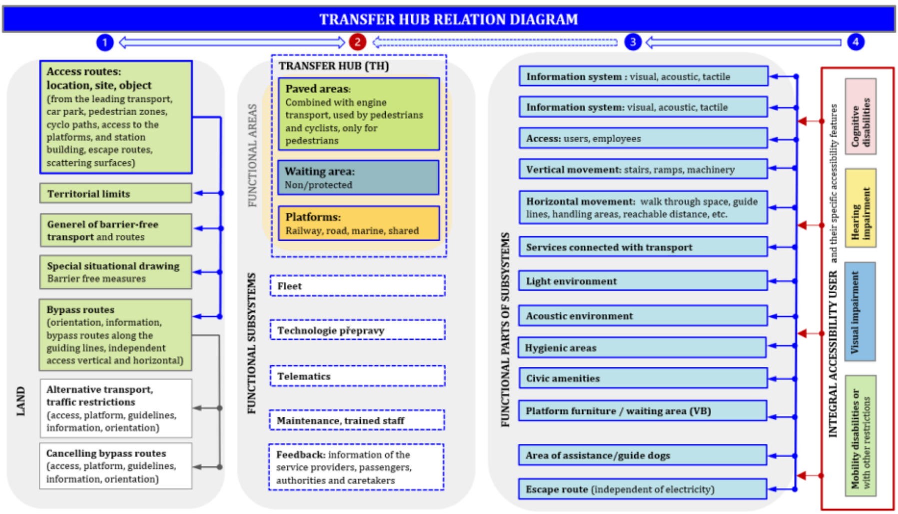

Figure. 4 Integral Accessibility- relationship diagram

Source: author

4.5 Functional areas of the transfer hub

The areas of the transfer node can be divided into paved, waiting and platform. The author compiled a straightforward design of tactile elements at the interface of functional groups in the connection of paved surfaces, see Chapter 4.1.5 dissertation work. For people with disabilities, the vital information from traffic signs is converted into tactile signs. This overview is not mentioned anywhere in the current regulations, and this is the most common mistake in practice for the design of tactile elements. The function of the tactile elements and their continuity is essential for the smooth and safe operation of the surfaces/areas. Concerning the complex accessibility, it is necessary to maintain the choice of access routes and their connection to the paved areas of the transfer hub.

5 Application of the methodology

When designing the E-E platform layout, the author considered the experiment's outcomes, which assessed disabled people's walking, consultations with specialists from the field and partial user correction (cooperation with disabled people). The application of the Methodology on the standard platform E-E was carried out in accordance with the design approach, which assumes compliance with the basic three steps: 1. analysis and scientific substantiation of the design, 2. consultation with industry specialists, 3. user feedback.

The author's focus, when applying the Methodology, was on designing a standard platform H-H for rail and non-rail transport (7.00 m, opposite boarding edges without lost slopes). There are new requirements for the safe and independent transfer of all passengers, especially PRM - see Fig. 5.

The following steps were taken:

1. assessment of critical points in terms of design;
2. assessment of KM from the users' point of view;
3. assessment of functional ties;
4. design of the directional line: an important point in terms of orientation, visual and acoustic information on access and obtaining information on the space and departure of connections in connection with the information system;
5. assessment of the UD principles application in the design of functional parts of the building (subsystem).

The experiments measuring walking of visually impaired people show that the disabled person uses not only the technique of a long white cane but also a tread to move independently on the platform. They check the interface of the artificial line with one foot and try to keep in touch with it. Therefore, the movement along any artificial guideline is always described from their axis. Suppose it is an artificial guideline (tactile element with a longitudinal groove in the exterior width of 0.40 m) designed for the walking area. In that case, keeping the free space on both sides of this line is necessary and never place obstacles in it (benches, roofing poles, waste bins, etc.).

For standard E-E platforms (≤ 7.0 m), tactile elements on the walking surface must not be interchanged for safety reasons. This means that directional guidance cannot be supported by placing a second artificial guideline interchangeable with a guideline with a warning strip function. It will also be possible to place a QR code [15] at the point of interruption (at the decision point), which does not form an obstacle in the walking area and will provide information on the site's designation. A visually impaired person does not have to walk to the stop sign and will orient himself more quickly on the platform. The interrupt is where QR codes are expected from the perspective of all users. Random placement of codes would not entirely fulfil its function for the person's disability. In transfer hubs, QR codes can facilitate the movement of all persons with a smartphone who do not regularly move in the given places and need to orientate themselves more quickly in space, i.e., they are not intended for only one group of users.

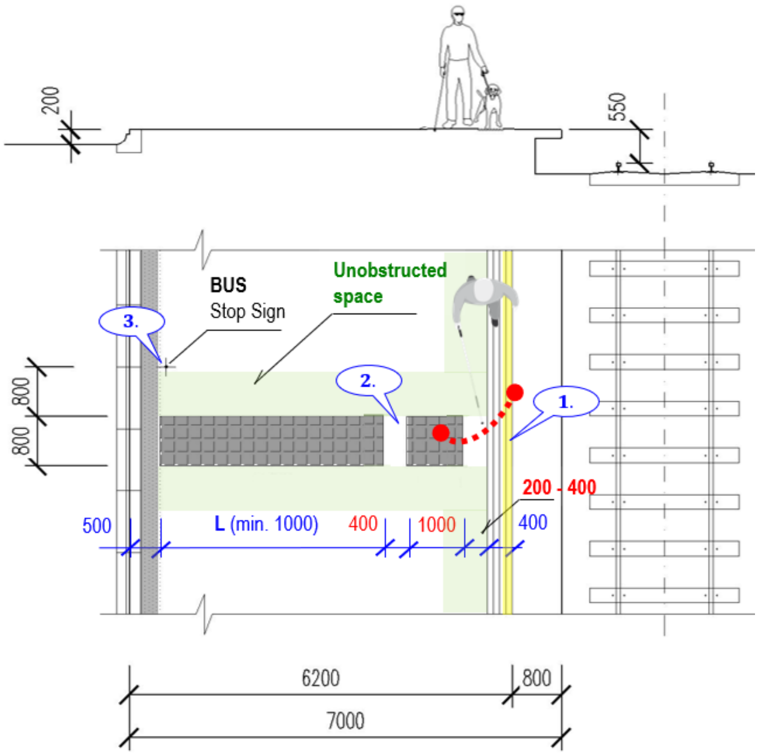

Figure. 5 Signal strip (SP) from the marker without interruption guide line at the edge (1) with offset and interruption SP to a width of 400 mm (2) and marker with an embossed label with Braille – Bus Stop Sign (3)

Source: author

The proposed Methodology supports systemic and independent thinking, thinking in the context and mutual coordination of individual functional parts of subsystems and connections, especially in TH. The proposal of tactile guidance for the disabled on a standard platform represents an original solution published in [16].

6 Contribution to the science and practice

The author tested the contribution of the methodology in practice on six transfer hubs (terminals or railway stations). Those six hubs were discussed with specialists only at the design phase, as the time available was eighteen months only. Table 3 displays a summary of selected monitored features from the methodology (the complete table with all the monitored features can be seen in Chapter 5.2. of the dissertation thesis). Table 3 points at the most frequent mistakes the designers make when preparing a new transfer hub. The last column presents "system mistake" - **Δ_F**. This parameter expresses the percentage of documentation not handled in accordance with integral accessibility. Based on the parameter ΔF, it is possible to state simply to what extent the accessibility of the transfer hub can be improved when applying the proposed Methodology.

Table 3 Example of monitored features for the purposes of Integral Accessibility Methodology

N.	Description of the observed feature	Level	Kadaň	Vsetín	Semily	Chrastava	Hrádek n. N.	Jablonec n. N.	Δ_F (%)
1.	Using the urban limits	F1.1	●	●	●	◐	◐	◐	**75**
2.	Incorporated Map of barrier-free routes	F1.4	◐	●	●	●	●	◐	**83**
3.	Special situational drawing	F2.2	●	●	●	◐	◐	●	**83**
4.	The length of the crossing for a pedestrian, access to the platform	F2.2 F2.4	◐	●	●	✓	✓	●	**58**
5.	Suitable placement of equipment and the passage way	F2.3	●	◐	●	◐	◐	●	**75**

Explanations: ● Missing element
◐ Minor corrections in the design
✓ Correct solution
Δ_F (%) System Error

Source: author

The benefit of the completed research and proposed methodology lies in improvement of the preparation documents and consequent implementations of transfer hubs, which will eliminate the current shortcoming in the preparation for implementation and operational phase of the transfer hub.

The author of the Methodology of Integral Accessibility has also used the methodology in the course "Barrier Free Buildings ", which she introduced in the academic year 2021/2022 at the FAA TUL in the first year of master studies. The course is designed as an interdisciplinary and educates students in the field of architecture, art and urbanism in the context of designing barrier-free adaptations of public space, in which public passenger transport plays a significant role. It is presumed that the teaching materials, including the application of the methodology, will be will be applied at the FTE University of Pardubice and FAA TUL. More information on the benefits of the thesis outcome can be seen on Chapter 5.2 of the thesis.

Conclusions

The main principles and ideas on which the Methodology of Integral Accessibility of the Transfer Hub is based are a consistent application of the UD principles (defining the user groups and their requirements). Further, on the systematic search and removal of critical points, consideration and continuity of design and implementation individual phases via cooperating with specialists and defining the functional areas of the transfer hubs and their elements.

When designing a new area of shared rail-non-rail platform, the author believed that each innovative element must be scientifically supported and discussed with the field specialists, subsequently it must be commented on/ corrected by the users. The author has already implemented the first two steps, and a more extensive user correction will be made.

The methodology can be applied in the process of preparation and implementation of transfer hubs for regional, light rail and high-speed transport.

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Abstract

The identified unsatisfactory situation in the process of preparation and implementation of transport constructions as well as the resulting level of the error rate of already implemented interchanges is the starting point for the proposed Methodology of integral accessibility of interchanges. The main principles and ideas on which the Methodology is based are the application of UD principles (defining user groups and their requirements), systematic search and removal of critical points, consideration and continuity of individual phases of design and implementation of the transfer node in cooperation with all participating specialists and defining functional areas. transfer node and their elements.

When designing the new layout of the common platform for rail and non-rail transport, the author was convinced that each innovative element must be scientifically substantiated, consulted with experts in the field and then undergo user correction. The author has already implemented the first two steps, a more extensive user correction will be performed.

The dissertation deals primarily with interchange nodes in regional transport. The methodology is compiled so that it can also be used in the design of interchange nodes on the HSR network or LRT systems for suburban transport, where there is a presumption of higher use of common platforms for rail and non-rail transport.

Appendix 1

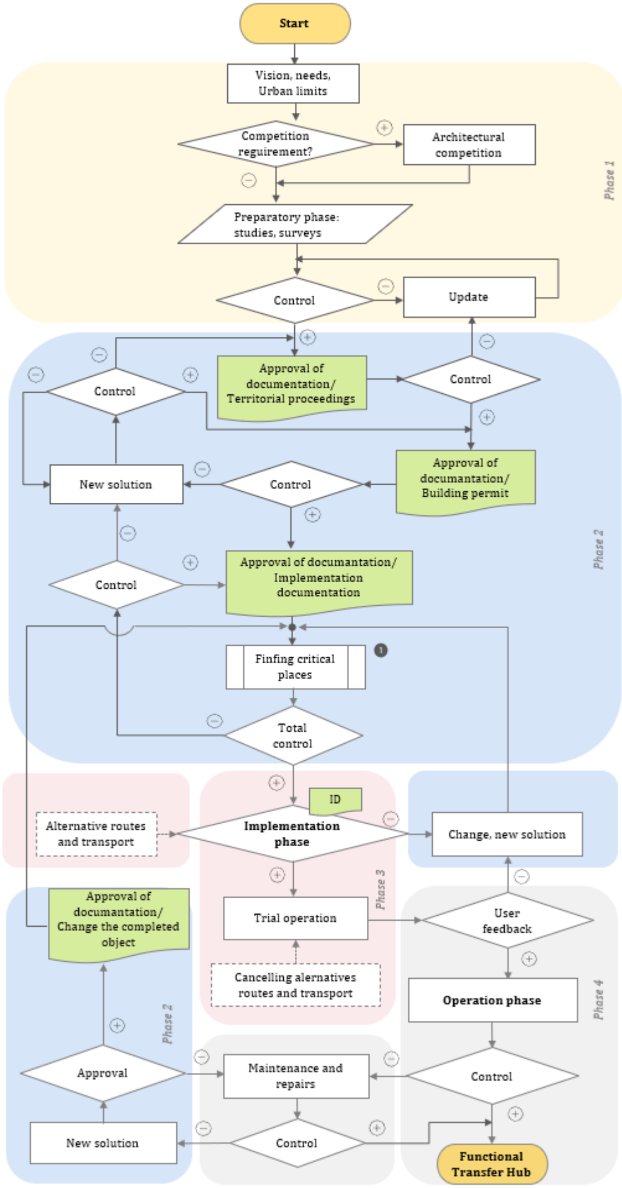

Figure. 6 Transfer hub accessibility diagram

Source: author