Suitability of map data for processing of pedestrian analysis questionnaire in small towns

Z Kramářová

1Department of Civil Engineering, Faculty of Technology, Institute of Technology and Business in České Budějovice, Okružní 517/10, 370 01 České Budějovice, Czech Republic

E-mail: kramarova@mail.vstecb.cz

Abstract. From a historical point of view, pedestrian movement is the oldest way one moves from place to place. It is a basic, most natural and environmentally friendly means of transport, which is unattractive for many individuals in terms of today's trends. Walking is absolutely indispensable for the creation of cities, especially their public space, as it alone allows people to interact with their surroundings. Public space in cities is an essential element that ensures the existence of a settlement, its life and the life of its inhabitants. If we consider as a premise the fact that cities are created for people's living, public space fulfills the functions of socializing, communicating, passing, etc. - that is, a function that supports the community of society. The analysis of the permeability of settlements, especially of small towns, is one of the most important documents for the creation and regeneration of the public space. A questionnaire survey is one of the methods for its quality processing, which is most easily done by plotting the map. Choosing a suitable map background that is sufficiently understandable to the general public is the first prerequisite to obtain quality data for this analysis.

1. Introduction

In order to better understand the whole issue, it is necessary to define the basic concepts first.

1.1. Walking versus running

Walking is the basic way people move from point A to point B. Historically, it is the oldest way to move a person. This movement uses the support of the lower limbs, respectively their alternating movement. Whittle [1] defines gait as a locomotive manifestation and as a method of locomotion, which is characterized by alternating movements of the lower limbs. Similarly, other authors, Vaughan, Kolář, etc., define walking similarly [2, 3]. However, the definition of wikipedia must be mentioned like the most comprehensible and comprehensive way for the general public:

"Walking is a locomotion movement using the lower limbs and is inherent in bipedal animals like humans. Allows you to move from one location to another. Walking consists of one step at a time, one leg at a time, moving one by one. Walking is usually slower than running, but while running an untrained person can only exercise for a short time, he can walk for many hours without a break."

(Source: [4])
Very close to walking is running. It is a similar movement, but it is faster, more demanding and less comfortable. Due to the scope of the text, professional definitions of run will not be given. The main difference between walking and running lies in contact with the ground. During the run, there is a phase where none of the limbs touches the ground (support). However, one foot is always in contact with the ground when walking. Contact with the ground minimizes the vertical movement of the head and thus stabilizes it (Figure 1). Therefore, when walking, it is very easy to observe the environment that a person is going through.

![Figure 1. Step cycle phases. (Source: [3])](image)

At the same time, walking is a significantly slower way of moving than other translational ways of movement (running, cycling, driving,...). Therefore, it imposes considerably higher demands on public space quality of the moving individual. When walking, unlike other types of motion, the reaction distance is minimal (based on the reaction time and the speed of movement), so one can stop almost immediately on the spot and react - to see what intrigued him, greet another person, talk, etc.

For these reasons, walking is indispensable as one of the main elements that help to shape the environment of man, his living space, and thus the city and hence his public space.

1.2. Public space
The structure of the city can be divided into two basic elements - buildings and space between buildings. The space between buildings can be further divided into private, dedicated and public. A private space is a space used by the owner or a person close to him. The owner's consent is a condition for use and access to this area. Examples include a private garden, a courtyard, an atrium.

The space reserved depends on the date of reserved greenery, i.e. greenery accessible under certain conditions. Similarly, this space is only accessible to a specific group. Examples include the school garden and courtyard, the castle park without free entry, the greenery in the factory areal, etc.

Public space is by its very name intended for all. Access to such space is not limited by age, gender, religion, or any other factor. These include street space, squares, embankments, pedestrian zones, parks, etc.

At present, public space can be divided into the physical public space and the virtual public space [5]. From the point of view of the contribution, especially the physical public space, which can also be
called public place, is significant. Act No. 128/2000 Coll., The Act on Municipalities (municipal establishment) in §34 defines public space in the Czech Republic in a binding manner.

"Public areas are all squares, streets, marketplaces, sidewalks, public green areas, parks and other areas accessible to everyone without restrictions, that is, serving the general purpose, regardless of ownership of the area."
(Source: [6])

The second legislative reference can be found in Decree No. 501/2006 Coll., On General Requirements for Land Use. This Decree lays down general requirements for the use of land, delineation of land and land and placement of buildings in the territory. This Decree says in §7:

"Areas of public spaces

1) Public space areas are usually self-defined in order to ensure conditions for the adequate location, extent and availability of land plots and to ensure conditions for their use in accordance with their importance and purpose.

2) Public space areas generally include existing and proposed plots of each type of public space and other land of related transport and technical infrastructure and civil facilities compatible with the purpose of public spaces. For each two hectares of built-up area of housing, recreation, civic amenities or mixed dwelling, the associated area of public space of at least 1000 m² is defined with this built-up area; this area does not include roads."
(Source: [7])

Another interesting definition is given in the Glossary of Terms, which is maintained on its website by the Department of Urban Design, Town and Regional Planning of the Faculty of Civil Engineering CTU in Prague.

"Public space is the space of society's life, the space of social communication. It is a place where society "happens", where there is contact and communication between people, to share, inspire and create everything that transcends individuals. Public space is a widely open space where a distinction is made between high and low, beautiful and ugly, important and insignificant. This space is an open space in a very broad sense: it is open to all members of the society, but also to a space where this society opens up to things and to strangers; this space is also open to a wide range of activities and uses; it is a void where something unexpected can happen and is also a space where society opens up for the future. ..."
(Source: [5])

Obviously, the world's leading and Czech urban designers also define public space, but due to the legally binding definition and the great similarity of these definitions, other examples will not be mentioned.

The third definition is a definition that understands public space in particular as regards its possible interactions between the environment and the individual and their interaction. This is the second very important aspect of public space. This is to be understood not only in terms of physical spatial significance (place of residence and transport), but also in terms of socialization (place for contact, life and action). In addition, public spaces can of course be perceived, analyzed and created from other perspectives - such as transport, environmental, air quality, aesthetic, functional, etc.

2. Pedestrian movement analysis – map requirements
Due to the fact that the contribution is linked to the implementation of the project TAČR TL02000559 "Safe Cities for Pedestrians and Seniors", which deals with the public space in small towns of the Czech Republic, all the facts will be presented for small towns. A small town in the Czech Republic is understood to be a seat with a town status and a population of between 5,000 and 29,999.
Materials for analyzing pedestrian movement in a territory can be obtained in many ways. The three most commonly used are questionnaire surveys, local surveys at critical points, and traffic diaries.

Keeping a diary is based on recording individual routes and data when and how they were implemented. As a rule, this evidence is recorded verbally in the "start - over - destination" manner. Very little is done using map drawings (only in digital form).

Local survey at critical points is based on profile census - survey of traffic flow intensity. It is a local survey where a worker at a critical point physically calculates a passage for a predetermined time. This method does not require mapping to the map except for the critical point position plot.

Data collection for pedestrian movement analysis using a questionnaire survey is probably the most commonly used method. It can be implemented in two basic ways. Either it is a verbal description of the journey, when the respondent verbally describes the individual routes - their frequency, route ("start - through - destination"), period, etc. Or these data are recorded directly into the map by direct plotting of the route and for example color resolution. This data collection method can be successfully implemented both in paper and digital records, eg via a web interface. Among disadvantages of this method is also the necessary orientation in the presented map, ie. "respondent can read map".

Because it is important for the analysis that the sample is relevant, it must include respondents of all ages, gender, education, etc. in a balanced population mix. In practice this means that the questionnaire must be processed in the simplest way possible so that it is understood by children, adults and seniors, people with lower and higher education, technical and humanitarian orientation population, etc. This is not difficult at all, but the opposite is true.

From the practice of conducting local surveys over the last 20 years, it should be noted that the level of map orientation varies widely among the general public. It is inconceivable for a technician (a builder, an architect, a land-use planner) can not read the situation on the map / plot, but the general public does not share this need. Today's modern applications such as GPS navigation are very "recording", which guides the individual visually and verbally from place to place without having to read the map.

![Figure 2. Example of changing the legibility of the map when changing color. (Source: [8], editing: own)](image)

Elements that facilitate orientation include larger green areas (parks, alleys), important buildings (office, school, health centre, shop, church, library, cinema, post office, etc.), large areas and spaces (squares, car parks, roundabout, traffic lights, etc.), sports facilities, areas and playgrounds (winter
stadium, summer stadium, tennis courts, workout, swimming pool, playground, etc.), high-rise objects (factory chimney, transmitter, lookout, etc.) memorials, statues, ATMs, bus stops. In summary, these objects can be characterized as important objects visually, aesthetically or attending (destination). These are the objects the public notices and according to which they are oriented in the area. If these points are clearly shown in the map, it will greatly facilitate the orientation of the respondents on the map.

Another criterion for usability is the colour and contrast of the map. Map orientation in black/white is very limited by its own display options. If only the black/white contrast can be used, the display and expression capability is very limited (Figure 2). Perception of the colour spectrum is an individual matter. However, it can be generally stated that most of the population prefers light colours rather than rich dark colours. In addition, light colours make it possible to add a textual description to the colour background (Figures 7, 8, 9, 10). Dark text on a lighter background is also more readable than light text on a dark background.

3. Types of maps and their analysis
The basic selection criterion was the representation of the whole built-up area of the town on a sheet of max A3. The second condition was to differentiate between individual blocks of buildings and individual streets. The last criterion was the relative ease of availability of the map - the map must be either freely available or available commercially (purchase). Based on these three criteria, these maps were selected for analysis:
- Cadastral map (Figure 3) - has been chosen because of its frequent use in land-use studies and projects by architects and civil engineers.
- Basic map of the Czech Republic 1:10 000 (Figure 4) - is an official map with the closest smaller scale to the cadastral map;
- Map data of Mapy.cz and Google maps servers (Figures 5, 6) - are most commonly used by the general public.
- Maps from the information centres of Chotěboř and Milevsko (Figures 7, 8, 9 and 10) - are maps specially designed for easier orientation of tourists and other visitors to the city.
- Orthophotomap (Figure 11) - a very popular map by the general public, which is freely available on the Internet in many views, at the same time displays real reality at a given time point.

Unsuitable from the point of view of insufficient details and size, tourist maps and cycling maps were excluded, the map of the Czech Republic 1:25,000 and other smaller scales, road maps (maps of cities in road maps only detail the city centre, not the whole seat) and other similar maps.

For better clarity and comparison, the display of approximately the same area of the city centre Chotěboř was chosen (Figures 3, 4, 5, 6, 7, 9 and 11). This is not the case with Milevsko maps (Figures 8, 10).

The observed criteria were selected on the basis of public interviews in field surveys over the past 20 years. These are, in particular, the contrast and colour of the map, street names and local names, important objects (e.g. schools, post offices, sports facilities, etc.), larger green areas (e.g. parks, alleys, greenery at monuments) and works of art (e.g. statues, monuments, etc.). Other orientation elements in space include objects that evoke a strong emotion - positive or negative. These are places that the respondent perceives as either very positive (such as building a house he likes very much by his appearance) or as a very negative one (e.g. a ruin of an house). Unfortunately, they do not exist in the analyzed maps because they are not officially labeled or categorized.
Figure 3. Example of cadastral map. (Source: [9])

Figure 4. Example of a basic map of the Czech Republic 1:10 000. (Source: [9])
Figure 5. Example map from Mapy.cz. (Source: [8])

Figure 6. Example map from Google maps. (Source: [10])
Figures 7 and 8. Examples of maps from the information centers of town Chotěboř and town Milevsko - information maps. (Source: [11, 12])

Figures 9 and 10. Examples of maps from the information centers of town Chotěboř and town Milevsko – „draw“ maps with pictures. (Source: [11, 12])

Figure 11. Example of ortofotomap. (Source: [9])
The comparison shown in Figure 12 shows that none of the analyzed map data meets all the highest quality criteria. The most successful one is the map of Mapy.cz and also the Information Map from the Chotěboř Information Centre. Both maps are very useful for easy orientation of the general public. If we would like to improve the quality of the map for the questionnaire survey, it seems to be the best way to create a map based on the above mentioned maps. These were to be supplemented by the names of important objects and possibly a reference to a photo of a positive or negative point (see above).

If the survey is to be combined - designed to get pedestrian movement data and, for example, feeling data (localization of sites perceived positively, negatively, pride points, etc.), the use of photos is totally inappropriate. This is due to the inconsistency of the information and thus the overall distortion of the information obtained. Therefore, it is very important to first decide on the data that will be obtained by the questionnaire and only then to find the most suitable map.

4. Conclusion
The analysis of pedestrian mobility is one of the most important, but little processed documents for the revitalization of public space and the solution of conflicts of pedestrians and road transport in small towns in Czech Republic. One of the most widespread methods of processing this analysis is the method of questionnaire survey with drawing of pedestrian movement into the map. One of the prerequisites for obtaining relevant data is the easy and good orientation of the general public in the used map.
The analysis of the selected map types showed that there is no map that meets all the criteria. Maps of Mapy.cz server and locally prepared information maps for tourists and visitors of the city were the most suitable. For even better orientation, it would be necessary to add further description, possibly other points, based on the local survey of the city.

The processed analysis of the maps will serve as a basis for the compilation of the real pedestrian mobility questionnaire and its implementation in the framework of the project “Safe Cities for Pedestrians and Seniors”. One of the aims of this project is to create a methodology for the regeneration, revitalization and creation of safe public spaces in small towns in the Czech Republic.

Acknowledgments
The research described in this paper has been financed by TAČR - program ÉTA-project TL02000559 Safe and secure cities for pedestrians and senior citizens, (Bezpečná města pro chodice a seniory).

References
[1] Whittle M W 2007 Gait Analysis: An introduction.4.ed. (China: Elsevier) ISBN 9 780 7506 8883 3
[2] Vaughan Ch L Davis B L O’Connor J C 1999 Dynamics of human gait. 2. ed. (Cape Town, South Africa: Kiboho publishers) p 9 ISBN: 0 620 23558 6
[3] Kolář P et al. 2009 Rehabilitace v klinické praxi. 1. ed. (Praha, Czech Republic: Galén) ISBN: 978-80-7262-657-1
[4] Wikipedie open encyklopedy 2019 Chůze. In cs.wikipedia.org [online]. Available from https://cs.wikipedia.org/wiki/Ch%C5%AFze [cit. 2019-05-03].
[5] Department of Urban Design, Town and Regional Planning 2019 Urban dictionary. In www.uzemi.eu [online]. Available from http://www.uzemi.eu/pojmy/verejny-prostor [cit. 2019-05-03].
[6] Czechia 2000 Act No. 128/2000 Coll., Act on Municipalities (municipal establishment). [online] (Praha, Czech Republic) Available from https://www.zakonyprolidi.cz/cs/2000-128 [cit. 2019-05-03]
[7] Czechia 2006 Decree No. 501/2006 Coll., On general requirements for land use. [online] (Praha, Czech Republic) Available from https://www.zakonyprolidi.cz/cs/2006-501 [cit. 2019-05-03]
[8] Mapy.cz 2019 Map of Czech Republic. In www.mapy.cz [online]. Available from https://mapy.cz/zakladni?x=15.6721989&y=49.7189213&z=18&l=0 [cit. 2019-05-03].
[9] State Administration of Land Surveying and Cadastre 2019 Consultation of the Cadastre of Real Estate – map view In www.cuzk.cz [online]. Available from https://nahlizenidokn.cuzk.cz/VyberKatastrMapa.aspx [cit. 2019-05-03].
[10] Google maps 2019 Map of Czech Republic. In www.google.com [online]. Available from https://www.google.com/maps/@49.7189464,15.6718553,18z [cit. 2019-05-03].
[11] Town Chotěboř 2019 Chotěboř – official website [online]. (Chotěboř: Czech Republic) Available from: https://chotebor.cz/ [cit. 2019-05-03].
[12] Town Milevsko 2019 Milevsko – official website [online]. (Milevsko: Czech Republic) Available from: http://www.milevsko-mesto.cz/ [cit. 2019-05-03].