

Introducing the Walkability Index, an Index That Measures the Walkability of Public Spaces

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In recent years an increasing number of cities and transport planning documents (such as Sustainable Urban Mobility Plan) aim to reduce car traffic and promote active modes of transport – walking and cycling. The development of active modes of transport is increasingly becoming a focus of urban planning. However, detailed information on the needs of pedestrians and aspects of the assessment of a pedestrian-friendly environment are usually not available. In most cases, the only indicator of the effectiveness of improvements is the modal split and the rate of pedestrians. An objective assessment method is needed to help identify areas that need to be developed for walking.

The various planning regulations and legislation provide a framework for the design of pedestrian infrastructure, but many aspects that make public spaces attractive and pedestrian-friendly (green spaces, aesthetics, sense of safety, etc.) are not included in the regulations.

This problem can be addressed by the walkability index, which can provide an objective, data-based measure of how pedestrian-friendly an area is. It can also be a tool for analysing and monitoring. It can show areas where walking conditions are inadequate and intervention is needed. Regularly carrying out the survey can also serve to analyse the impact of measures taken in the meantime. This article describes the methodology and application of the walkability index.

1. Introduction

Given the increasing demand for travel and concerns over climate change, transport policy should place more emphasis on environmental elements in transport infrastructure. The transport sector is one of the main contributors to environmental pollution. The key tool for solving this problem is the creation of a sustainable transport system (Bencekri et al., 2021). Walking plays a key role in the mobility of cities and is one of the most sustainable modes of transport when it comes to travel for shorter distances. In addition, regular walking is health-enhancing, helps to build urban life and human connections, and is an essential form of transport, whether as a single walk or as a combined transport (e.g., walking to a public transport stop). Virtually all movements begin and end with walking (Grob and Michel, 2011). Walking is also a diverse mode of transport, which has many other functions beyond its transport function. For example, walking is the most common form of physical activity.

1.1 Types of walking

Before considering walkability, it is important to talk about the different forms of walking. In a settlement context, the following basic forms of walking can be identified (Figure 1):

- Walking combined with other modes of transport (top part of Figure 1);
- Walking as transport: the entire change of location is made on foot (middle part of Figure 1);
- Recreational walking: non-transport walking, exercise, socialising, taking the dog for a walk, etc. (bottom part of Figure 1).

For each of the above categories, walking can be planned, regular or unplanned, occasional. It is also true that different motivations for walking are associated with different characteristics of areas that are considered pedestrian-friendly (Forsyth, 2015).

For those walking for transport, reducing travel time is a primary consideration over other qualitative attributes, while for those walking for recreation, the quality of the route taken and an attractive and walking-stimulating environment are the primary considerations (Heuman et al., 2005).

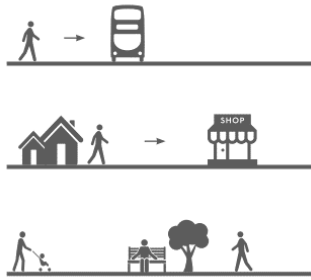


Figure 1: Types of walking (Transport for London, 2018)

As almost everyone who can move around is used to walking (broadly speaking, this includes wheelchairs and other assistive devices), there are many different demands on pedestrian infrastructure and environments. These needs depend on age (different needs of different age groups, from children to the elderly), gender (e.g. different lifestyles and transport habits), living situation (e.g. raising children), health (e.g. difficult, slow movement) and many other factors (e.g. travelling with heavy luggage).

1.2 Benefits of walking and a pedestrian-friendly environment

The world recognises walking and cycling as major means of transportation for urban transport (Ku et al., 2021). Improvements in the design and layout of urban spaces can have a significant impact on encouraging people to walk and stroll. From a transport perspective, walking is the most basic and important component of sustainable urban transport systems, and there are also many health, environmental, social, safety, and economic benefits to be gained from a walkable city.

Walking is an independent and reliable mode of transport, in the sense that it is always available to everyone, as the motto says: "The foot is always at hand". As a consequence, increasing walkability offers an opportunity to improve the liveability of the city, a key aspect to keep pace with its rapid transformation and development. Walking reduces dependency on different transport facilities and systems, making the city less vulnerable to potential breakdowns in transport systems. It also contributes to promoting sustainable behaviour by reducing dependence on non-renewable energy sources and plays an important role in improving the well-being of cities and increasing community cohesion by creating an attractive environment. These positive effects may not be immediate. Strategic choices need to be made that promote a shift from car-centred planning to sustainable urban mobility planning. As a result of the urban planning policies of the second half of the 20th century, walking is often at a competitive disadvantage compared to other modes of transport, and the development of pedestrian infrastructure is often pushed into the background. To build a stable and reliable infrastructure, systemic thinking is needed, and the development of different modes of transport must be implemented in a coherent way, considering local conditions.

2. Literature overview

Some of the research on walkability approaches the issue from the perspective of physical activity and regular exercise and looks at the relationship between pedestrian-friendly design and regular exercise. An early work on this topic (Frank et al., 2005) examines the Atlanta agglomeration with the aim of looking for a relationship between regular physical activity and the built environment. Frank et al. (2005) consider three aspects to construct the index:

- Density (number of households per km²),
- Road network connectivity (number of intersections per km of road network),
- Land use indicator (type of land use according to a weighted formula: commercial, office, administrative, residential, green, industrial).

The study concludes that people living in compact, mixed-use neighbourhoods get more and more regular exercise, with significant health and social benefits. Other studies have reached similar conclusions.

Kelly et al. (2007) used the example of Leeds (UK) to analyse the walkability of public spaces at a micro level using three different methodologies: a preference assessment method and an on-site questionnaire to assess expectations of pedestrian surfaces, complemented by an on-the-fly questionnaire.

The preference assessment questionnaire classifies the aspects assessed into three main groups: pedestrian facilities, traffic safety and public safety.

Within the above three groups, the questionnaire assessed the importance of 47 factors for walkability on a five-point scale (not important to very important). The 9 factors considered most important were vehicle speed, cyclists on the pavement, pavement width, pedestrian crossings, lighting, volume of vehicle traffic, cleanliness, and surface quality.

The study by Ribeiro and Hoffmann (2018) developed a neighbourhood-level walkability index for the agglomeration of Porto (Portugal) and investigated the relationship between the walkability index and walking for regular transport purposes. The previous example from Atlanta (Frank et al., 2005) was used as a basis for the criteria and the calculation. The study concluded that the walkability index, constructed according to the methodology described above, is related to regular walking: the higher the value of the index, the more often the inhabitants of a given neighbourhood walk.

Appolloni et al. (2019) present a detailed, step-by-step description of the methodology they developed ("Walking Suitability Index of the Territory, T-WSI), which is based on four main aspects: comfort, safety, urbanity, and attractiveness. Each criterion is rated between 0 and 1 (1.00 perfect, 0.70 good, 0.35 poor, 0.00 unacceptable) and the weighting of each criterion is determined by a peer review.

London's most recent pedestrian-friendly innovation is Healthy Streets, developed by Lucy Sanders and implemented by Transport for London to improve the city's air quality, reduce congestion, and generally make the city more attractive to residents (Transport for London, 2017). The methodology has been adapted to Hungarian conditions by the Járókelő Public Benefit Association. The toolkit is based on the above-mentioned Healthy Streets guide, which, like the Hungarian adaptation, uses 10 indicators to assess walkability. The 10 indicators are: everyone feels at home; it's easy to cross the road; there are shady and sheltered places; there is space to stop and rest; there is not too much noise; people like to walk, cycle or use public transport; people feel safe; there is something to see and do; people have fun, and the air is clean.

The toolbox consists of three tools:

- Guide to Healthy Streets Indicators: a qualitative measurement methodology that explains the 10 indicators listed in the paragraph above. The tool is recommended for use in the early stages of development. The description is simple and easy for anyone to understand. Each indicator is illustrated by good practices and guided questions.
- Healthy Streets Check for Designers (HSCD): a technical approach that examines the design of streets according to 31 quantitative criteria along the themes defined by the 10 indicators above. The survey results are scored on a scale of 0-100. The tool is primarily aimed at designers who want to ensure the quality of their work.
- Healthy Streets Survey: a field survey where people on the streets are interviewed. The theme of the questionnaire covers 8 of the 10 indicators above. The questionnaire asks for opinions and expectations about the current situation. Accordingly, the results of the survey are a Healthy Streets Experience Score on a scale of 0-10 and a Healthy Streets Expectation Score on a scale of 0-10, so that opinions about the current situation can be compared with expectations. The tool is primarily designed to reach out to local communities, but its use is limited due to its resource-intensive nature.

The Walk Score Methodology is used to assess the walkability of cities in the United States and Canada (many of which are car-centric compared to Europe), and the results are used by urban planners, real estate investors and public health professionals. The methodology was developed by a team of experts and has been used by many academics. In addition to walkability, it also assesses the public transport coverage and cyclability of an area.

The methodology calculates the index based on the distances of each traffic-generating facility (the traffic-generating facilities form different categories). If the destination can be reached within 5 min (within about 400 m), you get maximum points, then proportionally fewer points up to 30 min, and 0 points for walking times longer than that. Other criteria: density of population, urban structure (block size, density of intersections). Data sources used: various online sources, census data, and own surveys (Walk Score Methodology, 2023).

The Interreg Danube Transnational Programme project CITYWALK 2016-2019 has identified the main characteristics of a pedestrian-friendly city, where walking is a useful and convenient mode of transport due to the high and diverse density of services; walking is safe, supported by road safety and public safety indicators; walking is comfortable because it is made possible by convenient and barrier-free infrastructure without detours; walking is interesting because of the diversity of the built environment (attractive architecture and facades, green spaces and meeting points make public spaces attractive).

A study by the Lechner Knowledge Centre examined the walkability of Hungarian cities (Kapitány, 2019). The analysis used institutional coverage data extracted from the TETA module of the National Spatial Development and Planning Information System (TeIR) to examine the density of services regularly visited to meet everyday

needs. The results of the analysis are service density maps showing how many basic services are accessible within 7-8 min walking distance from a given point in a settlement. The methodology generally quantifies the following four aspects when assessing walkability:

- Safety - does the pavement have sufficient width to allow pedestrians to feel safe from passing vehicles;
- Reachability - the walking distance to services used daily by people in the area;
- Comfort - how easy and comfortable it is to walk around the neighbourhood;
- Attractiveness - how attractive are the walls, green features and public spaces to local residents and visitors passing through the area.

Through the literature search, we found that there are several international methodologies that have been used to analyse the walkability of public spaces, but there are few similar studies in Hungary. As mentioned earlier, today, the development of pedestrian infrastructure is taking a back seat to other modes of transport and needs to be changed to meet the demands of the times. The first step is to develop a walkability index that can be used to make a comprehensive assessment of the walkability of public spaces, identify areas where intervention is needed and provide a post-intervention monitoring tool.

3. Walkability Index, an index that measures the walkability of public spaces

3.1 Definition of walkability

As discussed in the previous chapters, walkability and the walkability index are described in the following definition:

Walkability refers to the comfort level of walking and the quality of walking conditions. The walkability index is an objective measure of the quality of walking, calculated on the basis of infrastructure and the quality of the urban fabric. The walkability index shows how easy, comfortable, safe, natural and attractive it is to walk in an area.

It is worth noting that, in addition to physical conditions, public policy, legislation, organisation and material conditions also influence and determine the walkability of public spaces. These should also be borne in mind in the assessment as forces that determine the framework – certainly when proposing pedestrian-friendly measures.

3.2 Methodology

As walkability is not only influenced by easily, objectively measurable aspects, a methodology must be developed that is able to take into account both objective and subjectively perceived aspects. The aspects to be taken into account should be defined, taking into account individual needs and expectations.

The analysis considers walkability at two levels:

- Macro (area-based approach): whether, given the characteristics of the area, walking is an attractive and obvious option, and whether the various urban functions that residents regularly visit are accessible within walking distance;
- Micro (street-level approach): the physical design of streets is assessed in terms of walking.

For the development of the index measuring the walkability of public spaces, the criteria influencing the walkability were determined on the basis of the literature research presented in the previous chapter and interviews with Hungarian experts and stakeholders (blind and partially sighted, large families, pensioners, deaf and hard of hearing people). Each aspect was grouped into five categories:

- Infrastructure: the minimum conditions necessary for walking are given, quality of walking surfaces;
- Safety: a pedestrian-friendly environment is safe, where everyone can walk safely and feel safe;
- Integration into the transport network: a pedestrian-friendly environment means that destinations are within walking distance and walking is a convenient mode of transport;
- Accessibility: walking in a pedestrian-friendly environment is accessible to all;
- Attractiveness: conditions create an attractive environment for walking.

Once the criteria had been developed, the weight to be given to each criterion was determined by re-engaging the experts. To do this, the experts ranked the criteria by category (5 to 10 criteria per category, for a total of 39 criteria) using an online questionnaire. The overall ranking was used to determine the weighting system, with the most important aspect receiving a multiplier of 2.0 and the last ranked aspect a multiplier of 1.1.

The questionnaire also assessed the importance of the five categories using a pairwise comparison method. Following a Ross optimal distribution, the relative importance of each category had to be determined by the experts. The rankings of the respondents were self-consistent, with one of the experts having a lower consistency score ($K = 0.8$) and the others having a zero inconsistent round three score ($K = 1$). This result is not so surprising, as walking is the most basic, common mode of transport available to everyone, and has a

wide range of needs. The ranking shows that the experts clearly prioritised physical attributes, with qualitative aspects such as attractiveness and integration into the transport system as a whole coming at the bottom of the ranking. To test the practical applicability of the index, a field survey was carried out in a selected area. The location for testing the walkability index was selected based on the following criteria:

- Metropolitan environment,
- Multifunctional area with heterogeneous settlement structure,
- Area with no pedestrian extremes (no motorway intersection, no public park closed to motorised traffic).

For the auditors, it is defined which parameters are taken into account when the conditions for each of the values to be included are fulfilled. The defined values ensure that the result is independent of the auditor's value judgement. Accordingly, in preparation for the measurement, a five-point scale was defined (1-not adequate, 2-satisfactory, 3-average, 4-good, 5-excellent), and an explanation was provided for each aspect scale. During the on-site survey, the auditors found that some of the scoring explanations were too subjective - the auditor's personal judgement plays too large a role in the survey - so the description of the scores was revised and validated to obtain a more objective result, regardless of the auditor.

The index measuring the walkability of public spaces is derived from the scores obtained from the field survey, the weighting system values and the category multipliers obtained from the pairwise comparison. The final result can be presented on a map, both separately for each of the five categories and in summary. The following shows the latter, both separately for each of the five categories and in summary. The following shows the latter.

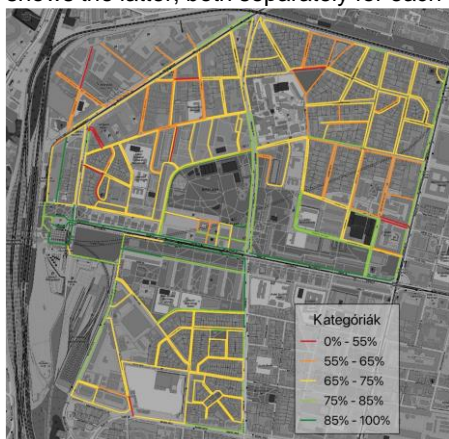


Figure 2: Results of areas assessed by the walkability index (XI. district Andor utca – Bartók Béla út – Tétényi út – Borszéki utca – Vasút utca)

The walkability index is a complex methodology, largely incorporating aspects of previous indices presented in the literature review, but compared to the latter, we have placed a strong emphasis on the needs of people with disabilities (e.g. hearing impaired, visually impaired), people with more difficult mobility (e.g. elderly, people with children) during pedestrian transport as a pedestrian surface is "good" if everyone can use it. The methodology includes aspects such as the presence of ramps, recessed kerbs, tactile signs, support points, detectable traffic light changes, and audio-visual signs.

4. Possible applications of the walkability index for different types of settlements

The index measuring the walkability of public spaces was developed for the conditions of the capital of Hungary. In the following steps of the research, we will examine how the index can be applied to different types of settlements and what modifications are necessary to ensure its proper applicability.

We have defined the types of settlements on the basis of the number of inhabitants: in Hungary, a town with more than 100,000 inhabitants can be considered a large town, a town with between 20,000 and 100,000 inhabitants can be considered a medium-sized town, a small town with between 5,000 and 20,000 inhabitants can be considered a small town and a village with less than 5,000 inhabitants can be considered a village. For the further analysis we selected five settlements (Székesfehérvár, Érd, Enying, Magyaralmás, Mátyásdomb) and we plan to examine the necessary modifications of the methodology on the basis of these examples.

We also considered it necessary to get the opinion of the local authorities on walking and walkability - perception of walking, walking habits in the municipality, quality of walking infrastructure, and importance of its development - and to this end, we visited the municipalities to conduct interviews. Unfortunately, only two municipalities - Enying and Magyaralmás - responded to the request, but only in the latter case an interview was conducted.

The study concluded that the index measuring the walkability of public spaces can be applied with minor modifications in large and medium-sized cities, slightly more in small towns, while in municipalities, it can usually be applied with more modifications and by examining fewer aspects but that further research is important to ensure that the index is fully applicable to different types of municipalities and municipal tissue.

5. Conclusions

This paper presents the development of an objective measure of how pedestrian-friendly a public space is, i.e. how easy, comfortable, safe, natural and attractive it is to walk in a given area. We reviewed the national and international literature on the methodology for developing a pedestrian index and then defined the concept of pedestrianisation. Based on the literature review and interviews with experts and various stakeholders, the criteria to be considered for measuring walkability were identified and then ranked and weighted by iteratively involving the interviewees. Finally, the methodology was tested and validated through field surveys and data analysis, and the results were visualised through a map. The paper also mentions the possible application of the walkability index to different types of settlements, but in this case further studies are needed.

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