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Importance and planning of pedestrian streets in urban environment

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Abstract. An increasing problem in cities is the growth of the number of motorised vehicles making the urban environment unsafe and unattractive and reducing residents' willingness to walk. The study explores the problems associated with the development of pedestrian-friendly infrastructure in the city. The importance of pedestrian movement in the urban environment was studied and several pedestrian streets in Latvia were analyzed. The method for evaluation of the quality of a pedestrian street was developed based on the summarizing and analysis of the information from the available literature sources. The method includes criteria that make a pedestrian street high-quality and easy-to-use public space that is suitable not only for walking but also as a multifunctional place for various activities. The authors have worked out recommendations for creating a spatial structure and landscape design in urban environment focusing on the necessity to install good quality and sustainable outdoor design elements, to provide environmental accessibility as well as to include pedestrian streets in the city's overall green infrastructure network, based on both social and environmental aspects. The recommendations provided can be used for the development of design guidelines and as educational material for landscape architects and urban planners.

Key words: pedestrian streets, sustainable city, public space, urban landscape

Introduction

The characteristics of a sustainable, functional, pleasant and strategically planned city are its suitability for pedestrian traffic and well-maintained urban environment on the whole. Street planning determines the quality of life in the city, but vivid public activities in the urban environment contribute to the development of the local economy. The population growth in cities leads to increased traffic intensity which contributes to environmental pollution with negative effects on climate change and public health in general. [10].

Historically, the streets have always been the place where most of the people's social activities took place: trading activities, gatherings, entertainment, socializing, demonstrations and children's games. At the start of using motorised vehicles for moving around, the number of cars and people on the streets was in balance, but as the time went on and technology developed, the balance disappeared [9]. Despite the fact that the fast pace of life and constant movement is one of the basic elements of the city, overcrowding and reluctance of people to walk caused unwanted side effects – monotonous urban landscapes, congestion, deteriorating air quality, general anxiety and insecurity [10]. The road transport and its place in the urban environment have been a key priority in urban planning for too long. Such urban development does not promote pedestrian traffic as the main mode of transport, it worsens the social and cultural functions of the city. The city's traditional core function, a meeting place, is threatened [10].

A pedestrian street is a linear structure in the urban environment, which serves as the mainpedestrian path in the daily route of residents, and, in addition, as a tourist attraction. A strategically planned pedestrian street encourages residents to move around on foot in the urban environment, creates a positive image of the city's public space and becomes a city's business card, by diversifying the urban landscape with green space and outdoor elements. A pedestrian street in the central part of a city connected to the most important nodes of the city may ensure an intensive flow of pedestrians not only during a warm season, but also throughout the year.

Contemporary trends in urban development focus on reducing and adapting to the effects of climate change, sustainable and healthy lifestyles and preserving existing values, therefore pedestrianisation policy is a way to keep up with the trends by encouraging people to walk without using cars on a daily basis. Pedestrian streets also form an accessible public space, which is part of the city's overall greenery structure [3].

Pedestrianisation strategy's aim is to revitalize city centres by creating a pleasant and functional public space, encouraging people to move in public space and communicate. As the number of pedestrians increase, it is possible to reduce the motorised traffic, thus decrease congestion, air and noise pollution in the urban environment [2]. Based on current developments and effective landscape planning of pedestrian streets, it is possible to create "green corridors", which harmoniously fit into the network of green infrastructure of cities.

Since the 1950s, there has been a growing concern that greenhouse gases, which increase global temperatures, could cause negative globalclimate change. Growing concerns and research over time into the effects of human habits regarding

Fig. 1. Benefits from pedestrian streets and urban infrastructure suitable for pedestrians [the author of the diagramme E. Mendzina]

climate change are a major reason for humanity to focus on a holistic approach to urban planning and management. [20].

On the one hand, global climate change affects the quality of life in cities, but on the other hand, functions of the urban environment have a significant impact on climate change. Climate change will have an irreversible effect on urban life, but it is also important to bear in mind that the extent of change depends on how cities function [20].

Walking is the most sustainable mode of transport and is a very important part of the city's transport system. Walking is the only way to get around that is completely free of charge and CO2-neutral [2]. Gains from increasing number of pedestrians and cyclists are the following: reduced congestion, improved public health, low costs, reduced air pollution and CO2 emissions. Urban residents prefer environmentally friendly modes of transport if urban infrastructure is appropriate, there are restrictions on the use of motorised transport, easy access to public transport [17].

Latvia has plans how to improve air quality by reducing CO2 emissions. For example, the National Energy and Climate Plan for the period 2021-2030 describes the desired situation to be achieved by 2030: the use of private cars is reduced in cities, and public transport is widely used. Pedestrian zones are linked with the public transport network to promote its use [14]. Benefits for society are the following: improved air quality in the city, increased well-being and health of the residents; good quality and improved urban space, attractiveness to tourists, entrepreneurs and local residents [15].

Data on the current situation in the capital of Latvia, Riga, show that in recent years not enough attention has been paid to the creation of new cycling infrastructure, but walking on foot is not friendly to residents and does not encourage residents to walk on a daily basis [16]. Therefore the Action Plan for Reduction of Emission of Atmospheric Pollutants for 2019-2030 has been worked out which includes the construction and improvement of pedestrian streets and pedestrian-friendly infrastructure in large city centres, as well as the implementation of pilot projects on traffic restrictions in some parts of cities as one of the directions for reducing air pollution in urban areas [7].

Pedestrian zones in the city promote a healthy lifestyle, make cities attractive to both visitors and local residents, strengthen the sense of community of local residents, as well as are environmentally friendly. Pedestrian areas help to preserve the cultural heritage and promote the economic development of the city [13, 6].

Streets adapted to pedestrian traffic create a suitable environment for social activities [1]. Vibrant public activities contribute to economic development by improving the economic situation of the city and its ability to ensure the personal safety of residents, parks, public greenery and attractive landscapes, cleanliness in the streets and proper waste management (Fig. 1.) [12].

The desire to walk on foot in the city is suppressed by unattractive and inconvenient infrastructure. Often, pedestrian sidewalks are too narrow or non-existent, cars are parked on pavements; there are various obstacles such as road signs and other information signs on the sidewalks. The long waiting time at traffic lights and insecurity of crossing streets at pedestrian crossings are also undesirable for pedestrians [13].

Walking is not only the most sustainable possible way to move around the city, but also a way to reduce inequality in society and to socialize with other people [6]. Streets, paths and other routes should be seen as a public space where city life takes place. Arcades, streets and sidewalks are places where city residents communicate, meet, wait, etc. The public space can be easily improved by placing the hard surfaced pavements, creating or adding greenery, placing functional outdoor elements [9].

The evaluation of recent events in the world and in Latvia related to the COVID-19 pandemic suggests that potential changes in urban planning and public space design are possible, which will also affect the design of pedestrian streets. Although major changes in planning trends will be seen over time, already now actions are taken to reduce a physical contact among people with the aim of limiting the spread of the disease, such as the

appearance of temporary cycle lanes in several European cities [4], including Riga [19], creating circles of physical distance in Domino Park, New York, the USA [11].

As regards Latvia, not so many cities have clearly defined pedestrian streets. The most impressive of them are: *Mazā Tirgus* street in Krāslava, *Rīga* street in Daugavpils, *Liepāja* street in Kuldīga, *Joma* street in Jurmala, *Tirgoņi* street in Liepāja, *Driksa* street in Jelgava. Speaking about Riga, the capital city, *Kaļķi* street in the old town is closed for cars in order create a pedestrian and cycling zone in the area from the Monument to Liberty up to *Skārņi* street in Old Riga. In 2011 the research was conducted to find out if it is possible to arrange a pedestrian zone in *Terbata* street, however, no further actions were taken [18]. The opinion was expressed that such streets as *Skola, Baznīca, Tērbata* and *Kr. Barons* in terms of their parameters are also suitable for conversion into pedestrian zones [8].

Transport Development Thematic Plan developed by Riga City Council mentioned that one of the main problems related to pedestrian infrastructure is the lack of pedestrian streets in the city, solutions for environmental accessibility and the low quality of public outdoor space [18].

At the beginning of 2020 Riga City Council decided to start the initiative for the period of one year: to close one of the city centre streets for car traffic on the first Saturday of each month, allocating it to pedestrians with the aim of revitalize the city centre, promote the mobility of residents and the development of the city [16].

The aim of the study is to identify the landscape quality, significance and planning principles of pedestrian streets in the urban environment, as well as to summarize and develop recommendations for pedestrian zone landscape planning and design, taking into account aesthetic, functional and social aspects which should be used in planning new pedestrian streets and improving existing ones.

Methodology

The literature and pedestrian streets of several European cities were explored in the framework of the study. The pedestrian Strøget street in Copenhagen (Denmark), pedestrian zones in Ghent (Belgium) and Zutphen (the Netherlands) as well as Vilnius street in Kaunas have been chosen as examples from foreign countries for the analysis. The above mentioned pedestrian streets and areas have successfully addressed issues related to environmental accessibility, functionality and aesthetic design, they have been successfully integrated into the urban environment and are widely used. Furthermore, Joma street in Jūrmalā, Brīvības street in Ogre un Rīga street in Daugavpils, notable examples from Latvia, were analyzed in Latvia. Over time these pedestrian streets have gained iconic significance in urban and national contexts, they are functional, pedestrian-friendly and attractive.

Based on the literature review on pedestrian street planning and quality, criteria were worked out to assess the aesthetic quality, functionality, comfort level, facilities and necessary improvements for the purpose of evaluating and comparing pedestrian streets. Table 1 shows the criteria according to which three selected pedestrian streets in Latvia were evaluated and which could serve as recommendations for the pedestrian street plan and general infrastructure design to create a safe, comfortable and pleasant space with a beautiful landscape for pedestrians in the urban environment (Table 1).

TABLE 1

Quality criteria for evaluation of a pedestrian street
[the scheme was made by the authors]

Name of a pedestrian street, city, country		
Parameters	Length of pedestrian street	
	Width of street	
	Average building height	
Restrictions	Motorised traffic	Completely closed
		Permitted at certain times of the day and night
	Cycling	Permitted
		Forbidden
Outdoor elements	Surface	
	Benches	
	Waste bins	Bins for dog excrements
		Waste sorting bins
		Small waste bins
	Lighting	Tall street light poles
		Average height street lights
		Street lights are installed in surfaces
		Illuminated facades
	Bike parking racks	
	Game elements	
Greenery	Trees	Deciduous trees
		Coniferous trees
	Fencing greenery	
	Flower box street furniture	
	Inclusion in the city's green infrastructure network	
Sustainability and ecology	Management of rain water	Central storm drain grid
		Rain garden
	Materials used	

CONTINUATION TABLE 1

Name of a pedestrian street, city, country,	
Integration in urban environment	Connection to city node points
	Traffic comfort
Environmental accessibility	Central lines, tactile cover
	Slopes, ramps
Landmarks	Art objects
	Informations stands
	Sign Posts
	Water elements, fountains
Street's spatial structure, architectural compositional solutions	Vertical dominants
	Squares integrated into the street infrastructure
Other typical elements	

Results and Discussion

The most intense pedestrian flows are found in city centres, therefore pedestrian street planning is expected to happen in the central part of the city. When spatial structure of a street is planned, it is necessary to embed its existing architectural plan in the general laws of composition. The main and the subordinate details have to be linked in a compositional unit, therefore the same scale, proportions and contrasts, rhythm, asymmetry and symmetry have to be observed [3]. The pedestrian street infrastructure must be included in an overall compositional solution of the city (Fig. 4)

All three analysed pedestrian streets are located in the central parts of cities, successfully connected with significant traffic, cultural, educational, etc. node points. They are strategically planned, multifunctional, comfortable and safe, designed to match the city's overall compositional image and identity, which is in line with J.Briņķis and O.Buka city planning theory [3]. According to Wertheimer et al. [20], the streets have functional amenities - seating surfaces, hard surfaces for easy movement. The analysed pedestrian streets of Latvia are conveniently connected to other objects important for the residents of the city, for example, *Joma* street in Jūrmala city leads to an important cultute centre – Dzintari Concert Hall; then in the city of Ogre, *Brīvība* street is directly linked with Ogre railway station and Ogre municipality culture centre (Table 2), as regards the city of Daugavpils, *Rīga* street connects Daugavpils railway station with the city centre.

The pavement of pedestrian streets in Ogre and Daugavpils is designed to divide the street infrastructure into functional zones. In addition, the pavement creates a visually attractive view that enlivens the overall image of the street, seemingly shortening the distance to be covered. The advantages of pavement's patterns are less used in the pedestrian street in Jūrmala. The analysed pedestrian streets of Latvia include such elements as flower pots, stands and enclosing poles, which protect pedestrian areas from unauthorized entry by cars; there are decorative water elements and greenery which create a relaxing impression and perform a cooling function in hot weather conditions; lighting suitable for pedestrians illuminates the streets during the dark hours and creates a sense of safety; there is also decorative lighting that highlights architectural elements. Additionally, pockets and small squares are integrated into straight sections of *Joma* street and *Brīvība* street, where pedestrians can meet and relax (Fig. 3).

Planning the city's public space and its green areas requires specialists to focus primarily on the street landscape, not just parks and squares, because the street landscape directly affects the daily life of the city, when pedestrians move through the streets in their daily lives, when they are not home, work or leisure [9]. It is important to ensure the public function of the city so that the city's outdoor space becomes a meeting place that promotes social sustainability [10].

According to the opinion of J. Gēls on the role of street landscape in the urban environment [10], *Joma* street in Jūrmala is a good example of how a pedestrian street performs the main function of a public outdoor space in a city. *Joma* street complies with the principles of pedestrian infrastructure planning, it is convenient for users and over time has acquired the status of a positive image representing the city of Jūrmala. The pedestrian street in Jūrmala has some shortcomings related to trends and construction principles during the street renovation works, for example, the use of standard concrete paving which does not highlight the individual features and identity of the area; rain gardens and green areas are at the same level as the street surface; waste sorting bins and bins for dog excrement. It is necessary to increase the number of bicycle parking racks in *Joma* street taking into account the fact that it is forbidden to ride bicycles on the street, but the area of Jūrmala cycling route network is in short distance from the pedestrian street. In many parts of Europe mixed types of traffic is practiced in residential areas and pedestrian zones, however, a significant precondition is the priority given to an pedestrian otherwise traffic participants should be separated [10]. Bicycle parking racks are an important street element not only in the conditions when cycling is forbidden in the pedestrian street, but also in the conditions when it is allowed because racks are necessary to maintain comfortable and dynamic movement around the urban environment.

According to the theories of J. Briņķis, O. Buka [3] on the importance of greenery in the improvement of aesthetic appearance of the urban environment, maintenance and improvement of its ecological and climatic conditions, as well as in the organization of recreation, *Joma* street greenery is

appropriate and functional in the urban context. The evaluation of seasonal greenery in the area of *Joma* street leads to a conclusion that there is a lack of decorative greenery that would maintain its splendour also in the cold months of the year, for example, small ornamental shrubs and perennials that keep their decorative function for a long time. A positive image in the greenery infrastructure of *Jomas* street is created by coniferous trees which look attractive also in the cold season and which are characteristic of the natural vegetation of the territory of Jūrmala city.

The pedestrian street in Ogre is functional, visually attractive and user-friendly. The entire length of the street is designed to allow a variety of uses: the city square with a stage for events, loungers and areas with benches for relaxation, a square with swings for children, greenery and art objects for aesthetic enjoyment, enough free space for outdoor commercial stands during city festivals.

Similar principles apply both to the planning of pedestrian streets and to the planning and reconstruction of residential quarters, since it is necessary to preserve historically valuable street planning and cultural and historical landscapes [3]. Accordingly, historic building elements play a significant role in *Brīvības* street.

Public toilets are also located in *Brīvības* street. During the dark hours, the street is illuminated with street lamps placed at regular distances at different heights, as well as the lighting is complemented by decorative lighting of architectural elements of buildings. The greenery infrastructure in the pedestrian street is functional, well-kept, decorative and visually matching.

The design of pedestrian areas requires to understand the physical dimensions of the human body and the nature of movement in different conditions [20]. The main shortcoming in the pedestrian street infrastructure, which is not in line with the generally accepted basic principles of user-friendly planning, is the underground pedestrian walkway connecting *Brīvības* street with Ogre railway station. It is inconvenient for pedestrians to move through the walkway, and there is limited access to the environment.

When planning pedestrian streets, it is important to provide a connection with public centres, schools, parks, transport destinations and other urban nodes in order to ensure a continuous flow of pedestrians [5]. Boulevards and pedestrian streets can be traced in the direction of the pedestrian flow, providing convenient connections to workplaces, public transport stops, public and shopping centres, residential gardens, sports complexes, etc. [3]. *Rīgas* street in Daugavpils is functional, easily accessible, located in connection with important objects for the city's residents. The street infrastructure is partly included in the city's green infrastructure network due to small squares that are connected to the street infrastructure, however, wider green areas are not connected to the pedestrian street.

Relaxation places, waste bins as well as bicycle parking racks are located along the entire length of the pedestrian street. Decorative and interactive environmental objects, water elements are located in some sections. The missing elements include outdoor objects such as waste bins for dog excrements and waste sorting bins.

Some new chestnut trees have been planted in the green areas of the street, however, there is a lack of ornamental herbaceous plants, shrubs and flower beds. Decorative flower beds can be found only at the beginning of the street in the square next to Daugavpils St. Peter's Church.

The disadvantages include the lack of a sustainable rainwater management system and rain gardens in *Rīga* street.

Unobstructed movement requires free space to keep pace, perceive the surroundings and react to others. The pedestrian street must be attractive and well-maintained, however, there must be no obtrusive objects in the way of pedestrian paths, i.e., signs, advertisements, greenery, and other objects which should be avoided.

The capacity of footpaths depends on their quality and the speed of the pedestrian flow. The distance and speed are the main limiting factors for pedestrian zones. A person is ready to cover distances not more than 800 m of length in their daily routine on average [20]. Due to the fact that an average pedestrian speed is 5 km / h, the distance is covered in about 12 minutes. If the distance is longer than 800 m, a pedestrian will prefer the motorised transport. The analysed streets are designed to be comfortable for the residents and to fulfill their main functions, i.e., to provide a pleasant public outdoor space and to create a link in which to move between important nodes of the city to compare with the findings of Wertheimer et al. [20] on the length of a pedestrian's distance.

Recommendations and Conclusions

The environment and pedestrian streets in cities must be designed to encourage people to walk on a daily basis. The plan should encourage people to look for work close to home, use the services around them and become part of the local community. Together, these factors would reduce the use of private cars.

Prior to the planning of a pedestrian street in the city, it is necessary to define the meaning of the pedestrian street in the context of the city and the need for it. When designing a pedestrian street, it is important to take into account the basic principles, which should be followed to create a functional

pedestrian street. Recommendations and conclusions based on the literature review and the evaluation of pedestrian streets in European and Latvian cities are given below.

Connectivity: a network of pedestrian zones connecting all major nodes in the city between which pedestrians have to move. It is necessary to ensure the satisfaction of people's basic needs in a pedestrian street: the need for fresh air, water, recreational opportunities, as well as public toilets should be available. The access to public transport is important and it must be possible to move within the city's green infrastructure network.

Convenience: primary routes should be direct, but awkward solutions and obstacles should be avoided. Road crossings must be easy without long waiting time, pedestrian crossings should be clearly defined and safe.

Comfort: pedestrian streets and areas must be of appropriate width. Appropriate materials should be used in their planning, which ensure comfortable movement; steep slopes, slipping risk should be avoided. Pedestrian paths should be positioned in such a way that it is possible to move safely. The amenities of the pedestrian street must be designed in accordance with the climatic conditions of the area.

Ethic conditions: a footpath must be illuminated during the dark hours, it should be suitable for communication among people without unnecessary noise and air pollution. The overall image of a pedestrian street should be visually attractive, in accordance with the city's identity with respect to the cultural and historical heritage.

Clarity: pedestrian routes should be easy to understand with clear signs, images, pavement markings, landmarks and sign posts. Prior to planning pedestrian streets, it is important to make the right strategic decisions regarding the use of open spaces. The location of landmarks, the strategic planning of squares and "pockets" encourage the use of infrastructure. The design of open spaces and greenery are crucial factors in maintaining an appropriate climate in the area; potential climatic conditions in the given area should be taken into account when planning the activities to be carried out [13].

Inclusion of a pedestrian street in the city's green infrastructure network: an open green space is planned in relation to the surrounding buildings. It is important to strengthen the green network in the city in order to improve the climate, biodiversity, water absorption, general comfort and recreational opportunities [13].

Pedestrian streets should be planned as part of the urban public space turning them into a good quality and multifunctional outdoor space. Thus it is possible to improve the overall image of the city by creating diverse landscapes, to promote pedestrian mobility and mental health by facilitating a city's economic growth and the quality of the environment.

It is of crucial importance now to improve urban infrastructure and public space, to make it pleasant for residents and improve the quality of life and the environment in the city.

Purposeful and strategic planning of pedestrian streets provides an opportunity to expand public space in the city, makes walking interesting, comfortable and safe. Clearly defined and well-maintained pedestrian streets in the city are a place to move, meet, relax and do shopping.

The design of green infrastructure in the pedestrian street may be included as a component in the city's green infrastructure network, in which greenery performs aesthetic and climate improvement functions. Green areas at the level of the pavement solve problems related to rainwater management. Pedestrian streets ensure divide pedestrians from car traffic, improve the quality of life in the city center; in addition, an aesthetically attractive pedestrian street has a positive image in the eyes of tourists.

The planning of traffic infrastructure in the urban environment is a long-term process that requires research and adaptation of the situation to changes, therefore it is necessary to include the intended conversion of pedestrian streets in the long-term urban development plans.

In the future there is a need for a more thorough evaluation of pedestrian infrastructure, in particular, pedestrian-oriented legislation and planning strategies to identify the necessary changes. When providing recommendations for the pedestrian street planning in urban planning documents, it is necessary to clearly define the conditions according to which pedestrian streets have to function in urban environment to create a balance between pedestrians and motorised vehicles in urban traffic.

There is a need to encourage people to walk on a daily basis, inform them of potential benefits for both health and improvement of the urban environment. Attractive public space where the use of motorised vehicles is prohibited could change the opinion that the dominant transport in urban areas is a car.

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Kopsavilkums. Ilgtspējīgas, funkcionālas, patīkamas un stratēģiski plānotas pilsētas raksturojošās iezīmes ir tās piemērotība kājāmgājēju satiksmei, kā arī sakārtota pilsētvide kopumā. Stratēģiski plānojot gājēju ielas, iespējams atdzīvināt pilsētu centrus, veidojot ainavisku un funkcionālu publisko ārtelpu. Pētījums apskata gājēju kustības nozīmi pilsētvidē, gājēju ielu struktūras un ainavtelpu plānošanas principus pilsētvidē. Ir izpētītas un analizētas vairākas gājēju ielas pasaulē un Latvijā. Pētījuma ietvaros izstrādāta gājēju ielas kvalitātes kritēriju novērtēšanas metode, kurā iekļauti kvalitātes kritēriji, kas veido gājēju ielu par kvalitatīvu, ērti lietojamu publisko telpu, kas izmantojama ne tikai pārvietošanās nolūkos, bet arī kā daudzfunkcionāla vieta dažādām aktivitātēm – atpūtai, tirdzniecībai, komunikācijai u.tml.

Noslēgumā sniegti ieteikumi gājēju ielu telpiskās struktūras un ainavtelpu veidošanai pilsētvidē, uzsverot nepieciešamību gājēju ielas aprīkot ar kvalitatīviem un ilgtspējīgiem ārtelpas elementiem, nodrošināt vides pieejamību, kā arī iekļaut gājēju ielu pilsētas kopējā zaļās infrastruktūras tīklā, pamatojot to gan no sociālajiem, gan vides aspektiem.