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URBAN REGENERATION AND URBAN RESILIENCE PLANNING THROUGH CONNECTIVITY: THE IMPORTANCE OF THIS PRINCIPLE OF NEW URBANISM

Abstract. Urban regeneration, which is increasingly having to include methods of adapting urban areas to escalating climate change, is one of the main challenges for the contemporary development of European cities, especially in densely built-up central areas. This multi-level process requires major financial outlays, which is why it is so important to identify the factors that ensure the effectiveness of implemented projects. This article attempts to define the meaning of the New Urbanism principle of connectivity, ensuring freedom of movement in the urban regeneration process. The conducted research has been intended to verify the hypothesis that improving connectivity is critical for the success of the processes of regenerating and improving resilience in degraded urban fabric. The research was conducted using the area regeneration of the centre of Lodz as an example, being the largest project of this type in Poland. The analyses were made by comparing the current status, based on an inventory of the existing situation, and the planned status on the basis of design documentation. The research demonstrates that increasing connectivity will improve the accessibility of properties located within municipal quarters and will help obtain more attractive public spaces. The planned activities will also help bolster climate change in the location by increasing green areas, improving the use of wasteland, and by developing a network of green infrastructure. The execution of the revitalisation project in the centre of Lodz will not only improve the quality of space, but will also increase the resilience of the intensively urbanised inner-city areas to climate change.
Key words: Lodz, New Urbanism, resilience, urban regeneration.

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1. INTRODUCTION

The article evaluates how a set of projects can potentially increase connectivity in the city of Lodz. The concept of connectivity is largely related to the structure of the network of streets in an area, being one of the basic principles of New Urbanism. Increasingly, extreme weather phenomena and their consequences are forcing all of us to work from a multidimensional perspective in the management of urban resources. The efficiency of urban land use is one of the bases for building urban resilience. In the centre of Lodz, efficiency can be improved by, among other things, reducing the area of undeveloped or unused plots. This article describes a project aimed at effectively improving the accessibility and connectivity of areas located in the middle of large quarters. There are many ways of analysing connectivity, the methods presented in the article demonstrate the real possibility of evaluating this variable in the context of actual data from a project in Poland.

2. THEORETICAL FRAMEWORK

2.1. Relevance of the topic

Changes in historic city centres always affect multiple aspects simultaneously and it is clear that revitalising existing valuable resources is not simply a matter of implementing selected architectural forms or following urban trends. Such activities should also include increasing the resilience of urban areas to climate change. This research shows the relationship between the currently implemented city centre revitalisation project in Lodz and the rules of New Urbanism, presenting the effects of the planned changes on urban resilience in the city centre.

Urban regeneration and resilience are among the main challenges of contemporary urban planning. Urban regeneration projects consist of measures aimed at improving the spatial, social, and economic aspects of the quality of life. Many European towns and cities are implementing urban regeneration projects that introduce dynamic and intense changes to their centres (Stryjakiewicz *et al.*, 2018; Majewska and Denis, 2020). Urban regeneration is a long-term and complex process that requires substantial funding and cooperation between many parties: the local authorities, local businesses, and residents. Therefore, it is important to know which factors ensure the maximum effectiveness of urban regeneration projects and enable towns and cities to be transformed in the most cost-effective manner. Here we must highlight the importance of urban resilience planning, understood not only as the ability to adapt to new conditions (Hudson, 2010), but

also the ability to anticipate changes and to respond to them efficiently (Foster, 2007; Meerow, Newell, Stults, 2016; Desouza and Flanery, 2013). This is especially true in post-industrial cities such as Lodz, where wastelands are intertwined with valuable urban fabric building the city's identity (Kaczmarek, 2011). In such cities, it is important to improve the accessibility of wastelands and encourage their reuse in a productive way. Improving the connectivity and accessibility of city centre areas influences the elements enhancing the resilience of a city – increasing the efficiency of links, preventing fragmentation, improving the efficient use of resources, and reducing inefficiencies in urban areas by diversifying traffic flows (Drobniak, 2014).

Improving the quality of life in city centres decreases the outflow of residents to suburbs. Researchers indicate that New Urbanism (NU) includes frameworks and guidelines addressing the problems of urban sprawl (Dixon and Dupuis, 2003; Bohl, 2000; Moore and Trudeau, 2020). Specific urban design principles originating from traditional planning concepts (Duany and Plater-Zyberk, 1992, 1994) can today provide guidance on how a degraded city can develop again towards its centre – urban infill development (Katz, 1994; Cysek-Pawlak and Pabich, 2020; Cysek-Pawlak and Krzysztofik, 2018). Connectivity is identified as one of the basic principles of NU.

This article attempts to define the meaning of the New Urbanism (NU) principle concerning connectivity in the urban regeneration process. The conducted research has been intended to verify the hypothesis that improving connectivity is critical for the successful implementation of the processes of regenerating the degraded urban fabric of the city centre. The following important aspects were considered in particular: improving pedestrian accessibility, making public spaces more attractive, and increasing the possibility of complementing the existing building structure with new investments. These elements are important from the point of view of both residents and other users of the area, as well as investors. A detailed description of the determinants of improving connectivity in the context of the examined areas is included later in the article.

2.2. Connectivity and New Urbanism

The theoretical framework of the research is the basic document of New Urbanism – the New Urbanism Charter (Calthorpe, 1993; Katz, 1994). The charter indicates those urban strategies that promote environmental and sustainable social development. New urbanist design principles have become a means of developing a sense of community by facilitating social interaction through interconnected streets and open spaces, the diversity of uses, and local architecture. The Congress for New Urbanism states that "Many activities of daily life should occur within walking distance, allowing independence to those who

do not drive, especially the elderly and the young. Interconnected networks of streets should be designed to encourage walking, reduce the number and length of automobile trips, and conserve energy" (CNU, 2000). NU studies the needs of pedestrians and considers the diversity of the various conditioning of social groups, example.g., in terms of the levels of income, age, disability, gender, cultural diversity, etc. (Alfonzo, 2005; Talen, 2019; Girling *et al.*, 2019; Aghaabbasi *et al.*, 2019; Carpio-Pinedo *et al.*, 2019; Dutton, 2000). In this way, New Urbanism has become a method of improving connectivity in inner cities (Bohl, 2000).

The principle of connectivity is significant among the NU guidance (Bocarejo, 2012; Preisner, 2007; Litman 2012). The key protagonists of the examined urban movement, Duany and Plater-Zyberk (1994), have argued that a network of interconnected streets determines neighbourhood structures building sites and traffic. As contemporary researchers have stressed, over the last two decades, street network connectivity has gained widespread acceptance as a key consideration of walkable urban places (Southworth and Ben-Joseph, 1997; Paterson and Butler, 2003; Marshall and Garrick, 2010; Bern and Marshall, 2013). The possibility of pedestrian travel, which is conducive to public health and urban vitality, is closely connected with other NU principles such as the land use mix and ensuring better access to basic services (Carpio-Pinedo *et al.*, 2021). Connectivity correlates directly with transportation choices and maximising land use (Levine, 1998; Talen, 2002). In the context of urban patterns modelled on new urbanist principles, it also translates into reduced travel time and increased accessibility (Cervero and Gorham, 1995). This is particularly important for often repeated routes, example.g., between the place of work and the place of residence (Talen, 2000). In the literature of the subject assessment, attempts have already been made to study the relationship between travel behaviour and new urbanist structures (Joh *et al.*, 2008; Khattak and Rodriguez, 2005; Nasar, 2003). However, none of the existing research has presented the issue of connectivity in correlation to the urban regeneration process. In this article, we assume the definition of connectivity within its NU meaning, understood as the integration of interconnected networks of streets and open spaces (Jackson, 2018).

2.3. Relationships between urban resilience and connectivity

Defining the efficiency of using resources, including the efficient use of urban land, should be seen as one of the basic elements of building urban resilience (UN-HABITAT, 2017; the European Commission and the European Environment Agency, 2022). Lodz has many of the characteristic of post-industrial cities, contributing to its low resilience. These include large areas of wasteland, including in the centre, a low density of pedestrian connections, a large number

of spatial barriers, de-urbanisation, and the polarisation of living conditions and space quality depending on the place of residence (Drobniak, 2014; Kaczmarek 2001; Warzywoda-Kruszyńska and Jankowski, 2013). A challenge for improvement here is also the low efficiency of land use in the centre – in Lodz, plots located in the middle of quarters are often wasted due to a lack of transport access. This results in a low intensity of development and relatively large areas of wasteland at the heart of the city. A more efficient use of urbanised areas is one of the challenges defined in the city's policy (Adaptation Plan..., 2018). New pedestrian links should serve to increase the amount of pedestrian travel in the centre. At the same time, revitalisation projects for Lodz' city centre introduce solutions that should contribute to reducing the intensity of car traffic in the city in favour of more people using bicycles and public transport. Such solutions include cycle lanes and pedestrian/cycle paths, giving priority to public transport, limiting the speed in the city centre by introducing 30 km/h zones, and reducing the number of parking spaces. The research attempts to assess the impact of measures for improving connectivity on the effects of regeneration and resilience.

3. METHODS, BACKGROUND AND SUBJECT OF RESEARCH

3.1. Research methods

Various methods have already been tested in connectivity studies, with the connectivity index, intersection density, and street density being the most popular (Knight and Marshall, 2015; Straatemeier and Bertolini, 2020), but also involving connectivity metrics based on graph theory (Marshall, 2005; Peponis *et al.*, 2007). In order to better understand street network connectivity, the index of increasing accessibility to urban function is also used, by checking the number of functions available within certain zones (Moseley *et al.*, 2013). GIS containing complex characteristics of urban tissue is another commonly used tool (Higgs, Fry and Langford, 2012). This methodology is based on specifying the distance of potential users from characteristic urban points (such as a park) (La Rosa, 2014). Research on pedestrian access for quantifying the urban quality enabled researchers to establish an acceptable walking distance (Song and Knaap, 2004; Knaap *et al.*, 2005; Yang and Diez-Roux, 2012; Millward *et al.*, 2013).

In response to existing metrics and the specific context of regenerated urban tissue, in the presented research we developed our own method based on four indicators. The first analysis concentrates on the changes in the spatial network density index by calculating the ratio of the length of the connections to the

area. This index is often used in research on networks of spatial links, similar to those already mentioned: the connectivity index, intersection density, and street density. It enables researchers to estimate the scale of spatial changes within the examined scope. The second involves analysing changes in pedestrian access to three types of facilities: public transport stops, city parks, and primary schools. Here, we compared the length of access before and after the spatial changes. The literature describes research into the availability of basic services, but this kind of research tends to have been conducted in order to confirm whether the availability of services is sufficient or not for residents (e.g., schools and parks – Talen, 2002), or to investigate the influence of actual distances on real property prices (Song and Knaap, 2004). The same research may be used to identify the location of new residential projects that can be served by the existing services. Our study does not concern only the location of services, but applies to a larger scale. The purpose is to specify the effectiveness of new links, namely whether new crossings really facilitate access to services and encourage walking, and whether they help increase quality of life. Daily services were selected that should be accessible within five minutes walking distance. However, where not all of them are within acceptable walking distance, the need to shorten the distance is justified. In addition, an analysis of accessibility to attractive public spaces was also conducted. This indicator is defined as changes in the size of green areas. This indicator answers a serious problem for the residents of Lodz city centre, namely no access to green areas. This is particularly important due to climate change (for instance, it helps prevent the creation of heat islands) and builds urban resilience. The improvement of investment opportunities in the areas neighbouring the designed connectivity is another analysed indicator. This indicator stems from the specific nature of the spatial structure in Lodz, with its many unmanaged areas, especially inside large quarters (described further in the article). Since facilitating access to such areas is one of the objectives of constructing new crossings, it is reasonable to check whether they have the intended effect.

The research was performed using quantitative and statistical methods. Statistical surveys show the differences between the length of existing and new connections in city blocks, and quantitative surveys show changes in the accessibility of public transport, green areas and schools. Research of an empirical nature was also used, leading to pragmatic conclusions that can be used in practice. This is an analysis of the assumptions of the local law and the impact of potential changes that have been allowed in the legal provisions in the examined areas on space. Quantitative research was also used here, in the form of collecting and collating area indicators using several techniques: site surveys, documentary analysis, and the compilation of databases. All the indicators were presented by a description of case studies – changes in the accessibility of revitalised areas in eight areas in the centre of Lodz were indicated. Descriptive analyses and a comparative analysis

of the materials obtained from analysing the current status and the project documentation were conducted when compiling the studied cases. By concentrating on the four described indicators we have attempted to develop an innovative methodology of assessing the revitalisation results in line with the principles of New Urbanism and urban resilience. Even though they were applied for the purposes of this article in a specific case study, we can see the possibility of developing the method and applying it in comparative studies.

3.2. Local conditions

Lodz is the third-largest Polish city in terms of population (682,679 residents in 2019, according to Statistics Poland). In the second half of the 19th and the early 20th centuries, the city underwent intensive development linked to the industry. It used to be a city dominated by the textile industry, with an unprecedented rate of development, but has been struggling with the problems of a post-industrial city for several decades, suffering particularly from deurbanisation and depopulation. The city structure mirrors its history. Lodz' city centre is characterised by a mixed spatial structure, consisting primarily of compact tenement and post-industrial buildings that have been heavily spoiled. As a result, the number of vacant and undeveloped plots of land is increasing in the "unfinished" spatial structure of the city centre. Another important feature of Lodz' city centre is the large size of city blocks, most of which are between 3 and 10 hectares in size, and where post-industrial buildings are predominant – even exceeding 20 hectares. These block sizes are significantly larger than in other 19th century European city structures and that results in major constraints on spatial connectivity and mobility. The quantity and quality of public spaces, especially public squares and green areas, is also insufficient. At the same time, it is an area with a large stock of cultural assets and is crucial to the identity of Lodz. It is also the heart of urban life, with important service, administrative, cultural, and transportation functions.

3.3. Objectives and scope of regeneration and investment activities in Lodz' city centre

In order to stop the progressive degradation of Lodz' city centre, to bring it out of crisis, and protect and utilise its preserved assets, it is necessary to conduct a regeneration process. In a broader perspective, such an approach will contribute to improving quality of life and use of the city centre which may result in its revival and the transition of Lodz into the reurbanisation phase. Activities related to the renewal of the city centre have been conducted for a long time, but have only actually gained real momentum after the introduction of new legal regulations in Poland in the form of the Revitalisation Act of 2015 and upon the prospects of

attracting significant funding from the European Union. In 2016, a resolution was passed including the entire city centre of Lodz in what is known as a revitalisation zone and a degraded zone (Resolution No. XXV/589/16, 2016). It covers an area of 1,783 ha, which accounts for 6.1% of the city (Fig. 1a).

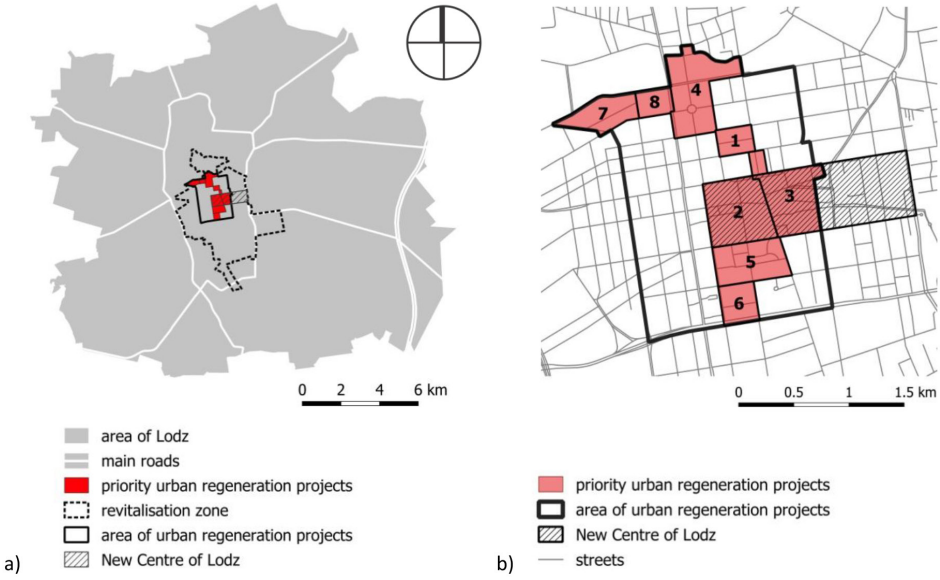

Fig. 1. The location of the priority urban regeneration projects

Source: own work using data from the Head Office of Geodesy and Cartography (GUGiK).

Due to the size of the zone and given the widespread needs, eight areas have been identified for priority action (numbered 1 through 8). They cover 164 ha, which is 9.2% of the revitalisation zone (Fig. 1b). Public investments conducted as part of Lodz City Centre Urban Regeneration Programme concentrate on these eight areas. Urban regeneration projects include: the reconstruction of the transport system, the renovation of parks and public squares, the construction of pocket parks, and the renovation of tenement houses. Among these tasks, priority is given to projects involving the introduction of public spaces to the currently unavailable interiors of city blocks. They include the construction of new streets, passages, and mixed-use paths. The constructed public spaces are intended to improve connectivity and encourage pedestrian and cyclist traffic, but also to provide residents with access to attractive places of high utility and visual quality.

In addition to urban regeneration measures, the investment programmes have also been designed to renovate the city centre. The New Centre of Lodz

(NCL) is an area subject to intensive reconstruction. This area of 100 ha is located around a railway station and a bus station. The location of the rebuilt railway line underground has freed up significant land for investment. New office and residential buildings and a system of public spaces have been constructed around the station.

Projects involving spatial changes in urban areas, including regeneration projects, must be implemented with urban resilience planning in mind in order to ensure that the effects will be visible in the long term. Adapting cities to climate change is one of the main objectives of European policy. The new EU Strategy on Adaptation to Climate Change emphasises that there is a need to increase the resilience of our cities in response to climate change. In 2013, Poland adopted the Strategic Adaptation Plan for sectors and areas vulnerable to climate change until 2020, with an outlook to 2030. The Climate Change Adaptation Plan for Lodz was adopted in 2018. It indicates that areas of intensive housing blocks, including densely built-up inner-city quarters, are particularly vulnerable to climate change. Improving the quality of life in the city centre was defined as one of the main challenges of the local urban policy.

3.4. Research area and subject matter

The research concentrates on the eight priority projects of the Lodz City Centre Urban Regeneration Programme. The analysis concentrated on projects currently being implemented that improve connectivity. Due to the fact that Area No. 2 and most of Area No. 3 of the regeneration are also covered by the NCL scheme, we included measures implemented in that scheme in the research. The projects analysed in detail mainly include public measures involving the construction of new streets, passages, mixed use paths, and public squares. Special cases that we have considered are the reconstruction of the existing passage (Pasaż Schillera) in Area No. 5 and the construction of a mixed-use path with an underground street (ul. Hasa) in Area No. 3. In the latter area, a private investment involving the construction of a passage between two office buildings (known as Brama Miasta or the City Gate) was also included in the analysed cases. Construction work for individual tasks is at various stages of execution or is still to be commenced, but they should all be completed by the end of 2022 (Lodz City Centre Urban Regeneration Programme). Fig. 2 presents the new projects improving connectivity.

The research conducted in the areas of eight priority regeneration projects in the inner city of Lodz made it possible to assess the impact of improving connectivity. The benefits achievable through this include improved pedestrian accessibility, increased attractiveness of public spaces, and the activation of areas along the newly constructed connections.

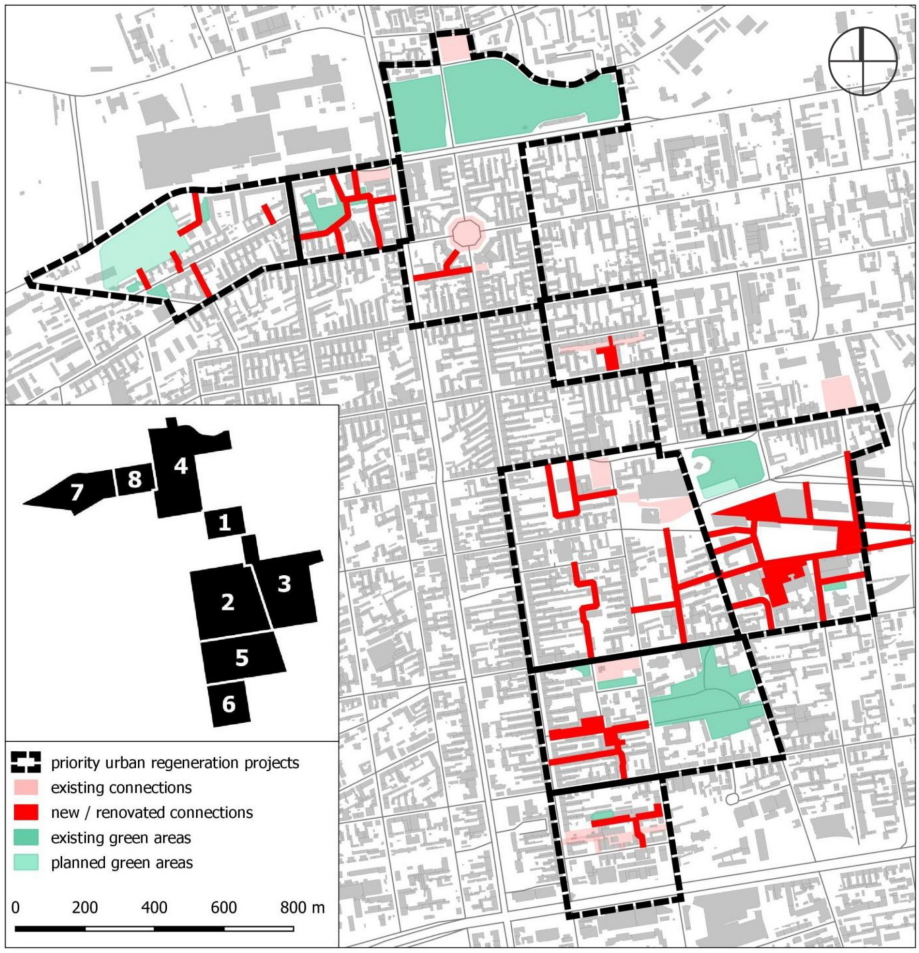

Fig. 2. Undertakings improving connectivity subject to the research

Source: own work using data from the Lodz Geodesy Centre (ŁOG) and the Head Office of Geodesy and Cartography (GUGiK).

4. RESULTS

4.1. Improvement of connectivity

The study of the improvement of connectivity was based on the calculation of the connections' network density index, i.e., the ratio of their length to the analysed area. The area measurement omits city blocks where city parks are located as none

of the researched projects are executed there. The indicator was calculated for the state before and after the introduction of the new connections. The change in the indicator for each area is presented in percentage increments. The survey shows that connectivity has improved in every project (Table 1).

Table 1. The indicators of connections density

Regeneration area	Existing connections [m]	New connections [m]	Area [ha]	Connectivity Density Indicator		
				Status before [m/ha]	Status after [m/ha]	Indicator Change
Project 1	1699	83	7.28	233	245	+ 5%
Project 2	4102	1444	31.60	130	176	+ 35%
Project 3	2321	1932	22.18	105	192	+ 83%
Project 4	2622	260	16.52	159	174	+ 9%
Project 5	2158	364	11.00	196	229	+ 17%
Project 6	1997	301	9.83	203	234	+ 15%
Project 7	1813	249	10.32	176	200	+ 14%
Project 8	1070	760	7.03	152	260	+ 71%

Source: own work.

Before the regeneration projects were commenced, the density of the network of connections was the weakest in large city blocks, as well as in blocks with building structures other than the typical tenement buildings in the city centre. Area No. 3 stands out here, still dominated by railway infrastructure and industry at the beginning of the second decade of the 21st century, with the largest city block of 26.5 ha. The highest value of the indicator was obtained in areas where investments had already been made to facilitate access to real properties or movement through the interior of city blocks. For example, in Area No. 1, the street running through the middle (ul. Włókiennicza) has been designed secondary to the original urban layout, dividing the large city block into two smaller ones. In addition, as part of the restructuring of the historical buildings, the outbuildings were demolished and an additional street was placed at the back of the street frontage. Similarly, in Area No. 6, apart from the secondary street (ul. Roosevelta), the space of the former industrial estate (known as Off Piotrkowska) was developed and made public by a private investor.

The greatest improvement in the network of connections occurred in the areas that originally had the lowest indicators (Areas No. 2, 3, and 8). In Area No. 3, the significant development of the network of connectivity is associated with a change in function and land use. As part of the NCL scheme implemented there,

developments are being executed in the post-railway areas that have been freed up by placing the railway line underground, as well as post-industrial areas, including the buildings of the first Lodz power plant, adapted for cultural purposes. Ongoing and planned building investments are accompanied by the construction of a system of public spaces, including streets, pedestrian passages, and mixed-use paths, as well as three public squares. In addition, the underground street under construction will provide direct access to the parking areas located beneath the buildings, freeing the ground level from vehicle traffic. The developments in Area No. 2 include new streets dividing three large city blocks (between 5 and 8 ha), while in Area No. 8, a system of pedestrian routes and pedestrianised courtyards is being implemented to allow movement within the block, providing easier access to a church, with its garden and nursery school located there.

4.2. Improving pedestrian access

Improvements to pedestrian accessibility were examined using three types of facilities as examples of targets of daily walking trips by residents of the analysed areas. These include public transport stops, city parks, and primary schools. In the case of public transport stops, access to the stops along a chosen tram or bus line was examined. The centre of Lodz is the part of the city best served by public transport. As calculated, the access range to a public transport stop with a radius of 250 m covers 98% of the analysed areas. It can, therefore, be concluded that almost the entire area is within acceptable walking distance of up to five minutes, so there is no particular need to shorten walking routes to the nearest public transport stop. In this situation, the stops of a selected line became a more reasonable object of study. As regards city parks, in addition to the existing ones, the planned park in Area No. 7 has also been included.

Table 2. Indicators of improved pedestrian accessibility to public transport stops, parks and primary schools

Regeneration area	Analysed access target	Length of walking distance [m]		Indicator [m / 100 m of connection]
		Status before	Status after	
Project 1	public transport stop	461	461	0
	city park	662	662	0
	primary school	456	456	0
Project 2	public transport stop	603	472	9
	city park	686	550	9
	primary school	900	900	0

Regeneration area	Analysed access target	Length of walking distance [m]		Indicator [m / 100 m of connection]
		Status before	Status after	
Project 3	public transport stop	710	530	9
	city park	361	361	0
	primary school	581	581	0
Project 4	public transport stop	676	594	32
	city park	582	582	0
	primary school	645	645	0
Project 5	public transport stop	482	482	0
	city park	449	449	0
	primary school	508	508	0
Project 6	public transport stop	408	429	0
	city park	716	737	0
	primary school	459	459	0
Project 7	public transport stop	553	384	68
	city park	528	487	16
	primary school	743	671	29
Project 8	public transport stop	489	427	8
	city park	585	515	9
	primary school	676	681	0

Source: own work.

In order to conduct the study in each area, a residential building was selected with the longest distance to the access target. The access distance was then measured before and after the introduction of the new connections. Based on the measurements, the indicator was calculated showing by how many metres the distance would be shortened per 100 m of new connection (Table 2). The measured connections, studied residential buildings, and access targets were illustrated using Areas No. 7 and 8 as examples (Fig. 3).

The research indicates that the construction of new connections will have a limited effect on improving pedestrian access. Walking distances were shortened in one-third of the examined cases. The projects implemented in Area No. 7 were the most effective in terms of the analysed issue. They enable a shorter walking distance to each of the examined targets. In addition, differences in walking distances give the highest values using the ratio per 100 m of constructed connection. In four areas (No. 2, 3, 4, and 8), the walking distance to public transport stops is shorter, as is the distance to the city parks in two of them. Connections constructed in other three areas (No. 1, 5, and 6) do not offer any advantage in terms of improving access for pedestrians.

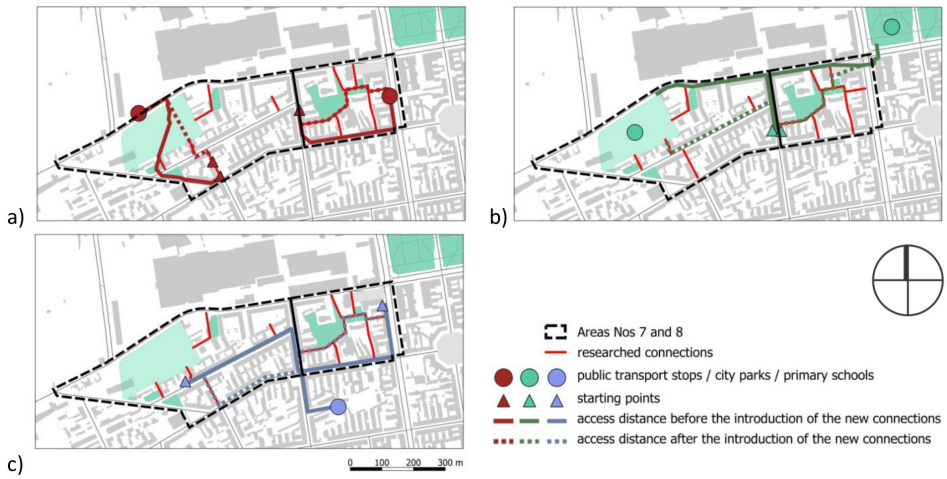

Fig. 3. Study on improving pedestrian accessibility to: (a) public transport stops, (b) city parks, and (c) primary schools, using Areas No. 7 and 8 as examples

Source: own work using data from the Lodz Geodesy Centre (ŁOG) and from the Head Office of Geodesy and Cartography (GUGiK).

The analysis of the study's results has revealed a number of factors that facilitate pedestrian links by dint of the introduction of newly constructed connections. The best results can be achieved provided that the following conditions are met:

– connections should be constructed near potential access targets,

– constructing connections parallel to existing streets and meandering between existing buildings should be avoided,

– a system of connections linking adjacent city blocks should be created,

– alternative exits should be enabled from real properties directly next to the connections.

Clearly, these conditions are sometimes impossible to be met or would require extremely high financial outlays, meaning that shortening the walking distance often fails to be the priority. In Lodz' city centre, optimising the geometry of connections is a challenge due to certain local conditions, e.g., the prevailing orthogonal grid layout of streets and plot boundaries, the dense existing development, and the diverse forms of property ownership.

4.3. Analysis of accessibility of attractive public spaces

A shortage of green areas is observed in Lodz' city centre. There are not enough parks, while the streets and squares are most often deprived of greenery. The urban regeneration activities are aimed at improving this situation. Streets are being re-

constructed with new trees and shrubs being planted. However, due to the limited width of the streets and the city's traffic and parking needs, their recreational function is limited. Therefore, for the purpose of this study, we have assumed that the attractiveness of the analysed connections may be best expressed in the designed green areas. Green areas introduced inside city blocks and ensuring easy access to local residents may compensate for the lack of close access to a city park.

Over 80% of the analysed projects have green areas of various forms: trees and shrubs planted along streets or pedestrian passages, garden squares, green courtyards, and public plazas. Nearly 90% of the designed green areas are suitable for recreational purposes by dint of their layout and street furniture, benches at the minimum. Playgrounds or landscaping elements typical of parks or gardens, such as pergolas, gazebos, fountains or drinking fountains, are also often designed. The planned plantings are of various types. They include various species of trees, shrubs, perennials, grass, flowers, and climbing plants. In addition, inside city blocks there are areas developed with greenery but currently available only to a limited number of users, for instance the church garden and the green square next to the nursery school in Area No. 8. The introduction of intra-block connections enabled these areas to be used and incorporated into public spaces, if not physically then at least visually as the green space by the church and nursery school will be fenced.

Plans for new connections (ZIM) were used to conduct the study. On the basis of these plans, the designed green areas were determined and measured. In addition, on the basis of an up-to-date orthophoto (ŁOG), the existing green areas that through the implementation of the projects will be made available to residents physically or visually have been identified and measured. An indicator corresponding to green areas per 100 m of new connection was then calculated (Table 3.).

Table 3. Green areas and indicators in the analysed connections

Regeneration area	Green areas [sq. m]		Indicator [sq. m / 100 m of connection]
	existing	planned	
Project 1	–	765	922
Project 2	638	2,338	206
Project 3	1,616	5,243	355
Project 4	–	1,114	428
Project 5	–	2,432	668
Project 6	–	2,431	808
Project 7	–	2,537	1,019
Project 8	8,031	2,434	1,377

Source: own work.

The best results were achieved in an area with a significant proportion of existing greenery in the interior of a city block (Area No. 8). Planned greenery produced the best results in Areas No. 1 and 7. Area No. 1 has Pasaż Majewskiego, a major section of which will constitute a square with greenery, a playground, benches, and fountains (Fig. 4). In Area No. 7, a large green square is planned along one of the routes, while the short lengths of new connections help bring high efficiency. The worst results were found in areas where the public spaces are dedicated more for transport and access purposes (Areas No. 2 and 3). This is despite the presence of existing small green spaces and the largest single area of new green space in Area No. 3. The results of the study in the latter area seem to be confirmed by the already executed public spaces, created during the construction of the new railway station and the reconstruction of the former power plant. The lack of greenery is noticeable there and has been highlighted in negative feedback from residents.

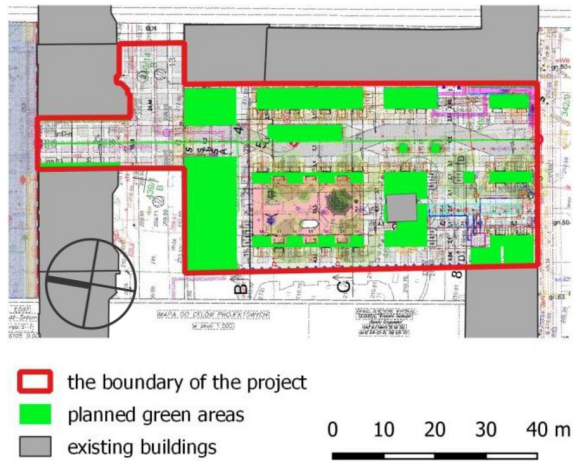

Fig. 4. Planned green areas in Pasaż Majewskiego (Area No. 1)

Source: own work based on a project provided by the Municipal Board of Investment in Lodz (ZIM).

4.4. Improving investment opportunities in neighbouring areas

The construction of connections inside city blocks will facilitate new investments in the areas directly adjacent to them. Such areas often lack proper access services or are developed and used extensively as back-up areas to building plots. Buildings located by new connections should face them, for mutual benefit. Public spaces acquire an architectural setting and their users feel safe, while the new buildings gain direct transport services and the ability to introduce functions requiring public

access, e.g., commercial services on the ground floor. The possibilities and conditions for locating new buildings are defined in local zoning plans (MPU).

Fig. 5. New investment opportunities with connections in Areas No. 2 and 3

Source: own study using data from the Lodz Geodesy Centre (ŁOG) and from the Head Office of Geodesy and Cartography (GUGiK).

The study of investment opportunities consisted of plotting new buildings that could be constructed along the studied connections on the basis of local zoning plans (Fig. 5) and then measuring their area. The presented indicator expresses the area of development per 100 m of new connection (Table 4).

Table 4. Indicators of new investment areas adjacent to the analysed connections

Regeneration area	New investment area [sq. m]	Indicator [sq. m / 100 m of connection]
Project 1	1,372	**1,653**
Project 2	14,221	**985**
Project 3	15,394	**797**
Project 4	691	**266**
Project 5	1,780	**489**
Project 6	2,384	**792**
Project 7	1,666	**669**
Project 8	4,090	**538**

Source: own work.

The best new investment opportunities are provided by connections constructed in the post-railway and post-industrial areas allocated for new development (Area No. 3). Slightly less investment land can be acquired in city blocks with peripherally located tenement buildings and undeveloped internal areas (Area No. 2). The highest value of the indicator can be seen in Area No. 1 where new investments can be executed on the western side of the constructed passage, in place of a tenement house that is in a bad technical condition. The fewest opportunities for new development, both in terms of area and the indicator, are found in areas with dense tenement structures (Area No. 4). Hence, the existing development, the number of buildings, intensity, and technical condition should be indicated as the main determinant for the formation of investment opportunities at the intra-quarter connections.

5. CONCLUSIONS

One of the ten principles of New Urbanism concerns connectivity understood as an interconnected street grid that helps disperse traffic and encourage walking. Lodz is a city with a particular structure resulting from its history as the centre of the textile industry. The low density of the street grid means that areas in the middle of city blocks cannot be put to good use because they are usually not accessible. It is also a structure that is not friendly to pedestrians – excessive distances between intersections do not encourage walking and are not conducive to traffic dispersal. Major changes in this area include the city centre regeneration projects that are currently being implemented. As part of the implemented changes, new pedestrian or mixed-use paths are to be created through previously inaccessible large inner-city blocks. This solution is intended not only to ensure the accessibility of the existing wasteland in the city centre, but also to contribute to a new pedestrian-friendly network of paths and small boulevards. The densification of the communication network will not only improve connectivity, but will also ensure the creation of high-quality public spaces with improved resilience to climate change. The creation of the planned routes, with lots of greenery and street furniture, will not only contribute to an increase in the numbers of pedestrians and cyclists, but will also help reduce the inefficiencies of the transport system, improve connectivity, reduce the unsuitability of urban wastelands for new functions, and increase the amount of publicly accessible green areas.

The basic recommendations for the case of Lodz are, therefore, to implement the New Urbanism principles within the urban tissue. Connectivity, being one of the main principles of NU, is one of the necessary elements proving that regeneration results were successful. This was examined using the example of projects

for the regeneration of the centre of Lodz. The changes introduced in terms of connectivity and accessibility were examined by calculating the indicator of the density of connections in the priority areas for urban regeneration in the centre. In each of the eight areas, the connectivity rates increased, with differences ranging from 5% to 83%. Walking distances to public transport stops, city parks, and primary schools were analysed in detail. The densification of the pedestrian route network will reduce walking distances in approximately 30% of cases. Another indicator examined was the improvement of the accessibility of attractive public spaces. The projects envisage the creation of new green spaces in 80% of the developments, 90% of which will be recreational. Another study analysed changes in investment opportunities. According to the calculations, densifying the access network and ensuring accessibility for plots in the middle of city blocks will generate new development sites in each area that could not be developed so far due to a lack of accessibility. In addition to the investments that are the subject of the study, other public tasks, not currently selected for implementation, are also specified in the local zoning plans, which will complete the system of public spaces, strengthen and extend the expected effects of urban regeneration and urban resilience planning in the future. In addition, public tasks are complemented by private initiatives creating one coherent system of connections. Examples of this include conversions of post-industrial development complexes with public spaces or walkways through the courtyards of tenement houses where services are located.

The research has also shown the specific features of the Polish context related to connectivity and urban regeneration, in particular in post-industrial shrinking cities, like in the case of Lodz. The morphology of inner-city quarters is a result of the history of this location. Rows of long and narrow plots of land had been placed in the city centre for future dwellings, which in time transformed into a densely developed agglomeration centre. The spatial structure here is not consistent, it has many deficiencies and contrasts, often related to the spatial policy implemented before the change to the political system, meaning that current activities should aim to be gradually adding to this structure and making it more balanced. For many years, there were no urban planning documents available, as those created under the previous planning system became invalid. This resulted in a chaos when trying to develop many places, including multiple investment decisions within the boundaries of one or more plots of land. It has been detrimental to public spaces for many years, leading to today's investment in these areas through revitalisation projects. The Revitalisation Act (2015) has defined the framework for certain methods of governance of these projects, though implementing the connectivity principle in operational plans is also recommended, despite being insufficiently regulated in the Polish urban planning system.

Studies have shown that the densification of the transport network by constructing additional routes inside the quarters will not only improve connectivity in many respects, but will also provide accessibility to areas that have so far been

blocked from investment. The example of Lodz shows that, when defining the assumptions for area regeneration, it is necessary to consider the good quality of connectivity. Connectivity and accessibility should be among the basic assumptions in regeneration projects aimed at raising the standard of living and improving the quality of space.

REFERENCES

AGHAABBASI, M., MOEINADDINI, M., ASADI-SHEKARI, Z. and ZALY SHAH, M. (2019), 'The equitable use concept in sidewalk design', *Cities*, 88, pp. 181–190. https://doi.org/10.1016/j.cities.2018.10.010

ALFONZO, M. A. (2005), 'To Walk or Not to Walk? The Hierarchy of Walking Needs', *Environment and Behavior*, 37 (6), pp. 808–836. https://doi.org/10.1177/0013916504274016

BERN, B. and MARSHALL, W. E. (2013), 'Capacity Analysis of Pedestrian Treatments at Large Arterial Intersections & Comparison with Lane-Equivalent, Small Intersection Gridded Networks', *ASCE Journal of Urban Planning and Development*, 139 (4), pp. 241–249.

BOCAREJO, J. P. (2012), 'Transport accessibility and social inequities: A tool for identification of mobility needs and evaluation of transport investments', *Journal of Transport Geography*, 24, pp. 142–154.

BOHL, C. C. (2000), 'New Urbanism and the city: Potential applications and implications for distressed inner-city neighbourhoods', *Housing Policy Debate*, 11 (4), pp. 761–801. https://doi.org/10.1080/10511482.2000.9521387

CALTHORPE, P. (1993), *The Next American Metropolis: Ecology, Community, and the American Dream*, New York: Princeton Architectural Press.

CARPIO-PINEDO, J., BENITO-MORENO, M. and LAMÍQUIZ-DAUDÉN, P. J. (2021), 'Beyond land use mix, walkable trips. An approach based on parcel-level land use data and network analysis', *Journal of Maps*, 17 (1), pp. 23–30. https://doi.org/10.1080/17445647.2021.1875063

CARPIO-PINEDO, J., DE GREGORIO HURTADO, S. and SÁNCHEZ DE MADARIAGA, I. (2019), 'Gender mainstreaming in urban planning: the potential of Geographic Information Systems and open data sources', *Planning Theory & Practice*, 20 (2), pp. 221–240. https://doi.org/10.1080/14649357.2019.1598567

CERVERO, R. and GORHAM, R. (1995), 'Commuting in transit versus automobile neighbourhoods', *Journal of the American Planning Association*, 61 (2), pp. 210–225.

Cities of the future, challenges, visions, perspectives, European Union Regional Policy, 2011.

Climate change adaptation plan for the city of Lodz, Lodz, UMŁ (2018), https://uml.lodz.pl/ekoportal/eko-wiedza/miasto/miejski-plan-adaptacji-do-zmian-klimatu/ [accessed on: 30.09.2020].

CNU – Congress of the New Urbanism (2000), *Charter of the New Urbanism*, http://www.cnu.org [accessed on: 23.01.2018].

CYSEK-PAWLAK, M. M. and KRZYSZTOFIK, S. (2018), 'The New Urbanism principle of quality architecture and urban design versus place identity. A case study of Val d'Europe and the Manufaktura complex', *European Spatial Research and Policy*, 25 (2), pp. 99–115. https://doi.org/10.18778/1231-1952.25.2.06

CYSEK-PAWLAK, M. M. and PABICH, M. (2020), 'Walkability – the New Urbanism principle for urban regeneration', *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*. https://doi.org/10.1080/17549175.2020.1834435

DESOUZA, K. C. and FLANERY, T. H. (2013), 'Designing, planning, and managing resilient cities: A conceptual framework', *Cities*, 35, p. 89.

DIXON, J. and DUPUIS, A. (2003), 'Urban Intensification in Auckland, New Zealand: A Challenge for New Urbanism', *Housing Studies*, 18 (3), pp. 353–368. https://doi.org/10.1080/02673030304239

DROBNIAK, A. (2014), *Urban resilience concept and post-industrial cities in Europe*, Katowice.

DUANY, A. and PLATER-ZYBERK, E. (1992), 'The second coming of the American small town', *Wilson Quarterly*, 16.

DUANY, A. and PLATER-ZYBERK, E. (1994), 'The neighbourhood, the district and the quarter', [in:] KATZ, R. (ed.) *The New Urbanism*, New York: McGraw-Hill.

DUTTON, J. A. (2000), *New American urbanism: reforming the suburban metropolis*, Milano: Skira Architecture Library.

DWORNICZAK, Ł. and REDA, P. (2019), *Standardy kształtowania zieleni w Łodzi (Green shaping standards in Łódź)*, Order No. 8378/VIII/21 of the mayor of Łódź, dated 24 September 2021 on shaping, maintaining and protecting the green areas of Łódź.

EUROPEAN COMMISSION (2021), *Forging a climate resilient Europe – The new EU strategy on adaptation to climate change* (COM/2021/82 final). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2021%3A82%3AFIN

EUROPEAN COMMISSION & EUROPEAN ENVIRONMENT AGENCY (2022), *Climate – ADAPT strategy 2022–2024. Sharing knowledge for a climate-resilient Europe*, https://climate-adapt.eea.europa.eu/about/climate-adapt-strategy-2022-2024-final.pdf.

EUROPEAN ENVIRONMENT AGENCY (2016), *Urban adaptation to climate change in Europe 2016: Transforming cities in a changing climate* (EEA Report No. 12/2016). https://www.eea.europa.eu/publications/urban-adaptation-2016

GIRLING, C., ZHENG, K., MONTI, A. and EBNESHAHIDI, M. (2019), 'Walkability vs. walking: assessing outcomes of walkability at Southeast False Creek, Vancouver, Canada', *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, 8 (2), pp. 456–475.

GUGIK – Główny Urząd Geodezji i Kartografii – The Head Officeof Geodesy and Cartography, https://mapy.geoportal.gov.pl/imap/Imgp_2.html [accessed on: 07.12.2020].

GUS – Główny Urząd Statystyczny – Statistics Poland, Local Data Bank, https://bdl.stat.gov.pl/BDL/start [accessed on: 25.11.2020].

HANDY, S., PATERSON, R. and BUTLER, K. (2003), 'Planning for Street Connectivity: Getting from Here to There', *Planning Advisory Service*, Report 515, American Planning Association.

HANZL, M., TOFILUK, A., ZINOWIEC-CIEPLIK, K., GROCHULSKA-SALAK, M. and NOWAK, A. (2021), 'The Role of Vegetation in Climate Adaptability: Case Studies of Lodz and Warsaw', *Urban Planning* 6 (4), pp. 9–24. https://doi.org/10.17645/up.v6i4.3931

HIGGS, G., FRY, R. and LANGFORD, M. (2012), 'Investigating the Implications of Using Alternative GIS-Based Techniques to Measure Accessibility to Green Space', *Environment and Planning B: Planning and Design*, 39 (2), pp. 326–343. https://doi.org/10.1068/b37130

HUDSON, R., (2010), 'Resilient regions in an uncertain world: wishful thinking or a practical reality?', *Cambridge Journal of Regions, Economy and Society*, 3 (1), pp. 11–25.

JACKSON, A. (2018), 'Barriers to Integrating New Urbanism in Mixed-Income Housing Plans in Chicago: Developer, Housing Official, and Consultant Perspectives', *Housing Policy Debate*, 28 (5), pp. 695–726. https://doi.org/10.1080/10511482.2018.1433703

JOH, K., BOARNET, M. G., NGUYEN, M. T., FULTON, W., SIEMBAB, W. and WEAVER, S. (2008), 'Accessibility, travel behavior, and new urbanism: Case study of mixed-use centers and auto-oriented corridors in the South Bay region of Los Angeles, California', *Transportation research record: Journal of the Transportation Research Board*, 2082, pp. 81–89.

KACZMAREK, S., (2001), *Rewitalizacja terenów poprzemysłowych. Nowy wymiar w rozwoju miast*, Łódź: Wydawnictwo Uniwersytetu Łódzkiego, p. 9.

KATZ, R. (1994), *The New Urbanism: Toward an Architecture of Community*, New York: McGraw

Hill.
KHATTAK, A. J. and RODRIGUEZ, D. (2005), 'Travel behavior in neo-traditional neighborhood developments: A case study in USA', *Transportation Research Part A: Policy and Practice*, 39 (6), pp. 481–500.
KNAAP, G.-J., SONG, Y., EWING, R. and CLIFTON, K. (2005), 'Seeing the Elephant: Multi-Disciplinary Measures of Urban Sprawl', *Urban Studies and Planning Program*, University of Maryland.
KNIGHT, P. L. and MARSHALL, W. E. (2015), 'The metrics of street network connectivity: their inconsistencies', *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, 8 (3), pp. 241–259. https://doi.org/10.1080/17549175.2014.909515
LA ROSA, D. (2014), 'Accessibility to greenspaces: GIS based indicators for sustainable planning in a dense urban context', *Ecological Indicators*. https://doi.org/10.1016/j.ecolind.2013.11.011
LEVINE, J. (1998), 'Rethinking accessibility and jobs-housing balance', *Journal of the American Planning Association*, 64 (2), pp. 133–149.
LITMAN, T. (2012), *Evaluating accessibility for transportation planning*, Victoria, Canada: Victoria Transport Policy Institute.
Lodz City Centre Urban Regeneration Programme. On-line portal. https://rewitalizacja.uml.lodz.pl/ [accessed on: 27.11.2020].
ŁOG – Łódzki Ośrodek Geodezji – Lodz Geodesy Centre. http://mapa.lodz.pl/index.php?strona=prof, WMS and WFS service [accessed on: 25.11.2020].
MAJEWSKA, A. and DENIS, M. (2020), 'New directions of small city development – case study of Mszczonów', *Space and Form, Przestrzeń i Forma*, 43, pp. 215–228. https://doi.org/10.21005/pif.2020.43.C-07
MARSHALL, S. (2005), *Streets & Patterns*, New York: Spon Press.
MARSHALL, W. and GARRICK, N. (2010), 'The Effect of Street Network Design on Walking and Biking', *Transportation Research Record: Journal of the Transportation Research Board*, 2198, pp. 103–115. https://doi.org/10.3141/2198-12
MEEROW, S., NEWELL, J.P. and STULTS, M., (2016), 'Defining urban resilience: A review', *Landscape and Urban Planing*, 147, p. 39.
MILLWARD, H., SPINNEY, J. and SCOTT, D. (2013), 'Active-transport walking behavior: destinations, durations, distances', *Journal of Transport Geography*, 28, pp. 101–110.
MOORE, S. and TRUDEAU, D. (2020), 'New Urbanism: From Exception to Norm – The Evolution of a Global Movement', *Urban Planning*, 5 (4), pp. 384–387.
MOSELEY, D., MARZANO, M., CHETCUTI, J. and WATTS, K. (2013), 'Green networks for people: Application of a functional approach to support the planning and management of greenspace', *Landscape and Urban Planning*, 116, pp. 1–12. https://doi.org/10.1016/j.landurbplan.2013.04.004
MPU – Miejska Pracownia Urbanistyczna w Łodzi – Municipal Urban Planning Studio in Lodz. Local zoning plans, https://mpu.lodz.pl/opracowania/plany-miejscowe [accessed on: 21.10.2020].
NASAR, J. L. (2003), 'Does neotraditional development build community?', *Journal of Planning Education and Research*, 23 (1), pp. 58–68. https://doi.org/10.1177/0739456X03256224
PEPONIS, J., ALLEN, D., HAYNIE, D., SCOPPA, M. and ZHANG, Z. (2007), *Measuring the Configuration of Street Networks: the Spatial Profiles of 118 Urban Areas in the 12 Most Populated Metropolitan Regions in the U.S. 6th International Space Syntax Symposium*, Istanbul, Turkey.
Plan to adapt the City of Lodz to climate change, Lodz: UMŁ [online], https://uml.lodz.pl/ekoportal/eko-wiedza/miasto/miejski-plan-adaptacji-do-zmian-klimatu/ [accessed on: 30.09.2020].
Poland's Strategic Adaptation Plan for Climate Vulnerable Sectors and Areas to 2020, with an outlook to 2030 (2013).
PREISNER, W. F. (2007), *Integrating the seven principles of universal design into planning practice. Universal design and visitability: from accessibility to zoning*, Columbus, Ohio, USA: The

John Glenn School of Public Affairs, pp. 11–30.
Resolution No. XXV/589/16 of Lodz City Council of 10 February 2016 on indicating degraded zone and regeneration zone in Lodz (2016).
Revitalisation Act of 9 October 2015 (2015).
SONG, Y. and KNAAP, G.-J. (2004), 'Measuring the effects of mixed land uses on housing values', *Regional Science and Urban Economics*, 34 (6), pp. 663–680.
SOUTHWORTH, M. and BEN-JOSEPH, E. (1997), *Street and the Shaping of Towns and Cities*, New York: McGraw-Hill.
STRAATEMEIER, T. and BERTOLINI, L. (2020), 'How can planning for accessibility lead to more integrated transport and land-use strategies? Two examples from the Netherlands', *European Planning Studies*, 28 (9), pp. 1713–1734. https://doi.org/10.1080/09654313.2019.1612326
STRYJAKIEWICZ, T., KUDŁAK, R., CIESIÓŁKA, P., KOŁSUT, B. and MOTEK, P. (2018), 'Urban regeneration in Poland's non-core regions', *European Planning Studies*, 26 (2), pp. 316–341. https://doi.org/10.1080/09654313.2017.1361603
TALEN, E. (2000), 'New Urbanism and the culture of criticism', *Urban Geography*, 21 (4), pp. 318–341. https://doi.org/10.2747/0272-3638.21.4.318
TALEN, E. (2002), 'Pedestrian Access as a Measure of Urban Quality', *Planning Practice & Research*, 17 (3), pp. 257–278. https://doi.org/10.1080/026974502200005634
TALEN, E. (2019), *A Research Agenda for New Urbanism*, Cheltenham, UK, Northampton, USA: Edward, Elgar.
United Human Settlements Programme (UN-HABITAT) (2017), Trends in Urban Resilience. ISBN: 978-92-1-132743-4.
WARZYWODA-KRUSZYŃSKA, W. and JANKOWSKI, B. (2013), *Ciągłość i zmiana w enklawach biedy*, Łódź: Wydawnictwo Uniwersytetu Łódzkiego.
YANG, Y. and DIEZ-ROUX, A. V. (2012), 'Walking Distance by Trip Purpose and Population Subgroups', *American Journal of Preventive Medicine*, 43 (1), pp. 11–19.
ZIM – Zarząd Inwestycji Miejskich w Łodzi – Municipal Board of Investment in Lodz. Plans of examined investments [accessed on: 5–13.11.2020].