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4. JUST CITY. MODERN MOBILITY IN THE CONTEXT OF CREATING JUST CITIES

4.1. Introduction

The chapter deals with modern means of mobility in the context of creating just cities. The issue was taken up in the belief that in the era of VUCA (volatility, uncertainty, complexity, ambiguity)[2] the priority should be to take all measures aimed at creating urban justice, which can be realized, among others, through modern mobility – which the Author tries to prove.

Adopted research theses:

- Modern mobility is a condition for building good accessibility for different social groups to important areas and objects of the city.
- Good transport accessibility is a condition of a just city.
- The introduction of modern mobility systems to the existing spatial structures of the city may be a means to their reconstruction, modernization, revitalization and making them more attractive.

The concept of a just city was based on an understanding of justice defined as "equality before the law, equality of opportunity or equality of accessibility"[3]. In order to explain the connection of urban justice with urban planning and mobility, the theoretical part of the paper discusses selected ideas of city planning. It is shown that their postulates to improve the quality of life of inhabitants, link justice with transport accessibility and appropriate spatial planning. The main objective of this research is to recognize the influence of modern mobility on the creation of an just city, to demonstrate

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[2] Rose J.F.P.: Dobrze nastrojone miasto. Karakter, Kraków 2019, p. 27.
[3]Karwińska A.: Miasto sprawiedliwe. Idee i możliwości realizowania. „Prakseologia" nr 156/2014, Instytut Filozofii i Socjologii Polskiej Akademii Nauk / Akademia Leona Koźmińskiego, Warszawa 2014, p. 79–106.

the dependence of the existence of an just city on accessibility, and the existence of accessibility on the selection and operation of mobility types. The focus is also on formulating concrete conclusions to the theory of urban planning and design practice.

The topics of the work include the elucidation of the concept of the just city and the analysis of the influence of mobility on the formation of accessible spaces within its framework. The scope includes public transport issues in medium-sized cities.

The research methods used in the chapter include: a case study based on the author's criteria, an analysis of the situation of the public transportation system in a selected city (Gliwice), the author's analysis of the distribution of urban zones in the city (Gliwice), and the preparation of concepts for the reconstruction of the public transportation system and architectural-urban concepts for selected parts of the city in the context of public spaces (as a Project Based Learning method)**.**

4.2. Just city

4.2.1. Ideas of city planning- state of the art

The earliest idea of city planning, which has been the foundation for later assumptions, is the ideal city. The broad concept of the "ideal city" can be understood in various ways – due to the fact that concepts based on the "ideal" shaping of cities were developed in different historical epochs, and therefore reflected a different hierarchy of values depending on the era – but above all, they were to strive to meet the needs of people. As Zbigniew Paszkowski notes[4] "the ideal city is understood as a certain challenge to create an ideal environment for people to live. This environment should meet the needs of a single individual (person, inhabitant), as well as the collective forming a particular community".

As one stage in the development of the ideas of city planning, the concept of the smart city emerged, which prioritizes the basic postulates of the idea of sustainable development in the processes of design and adaptation of cities[5]. It defines six areas of a smart city – smart economy, smart environment, smart people, smart living conditions,

[4] Paszkowski Z.: Miasto idealne w perspektywie europejskiej i jego związki z urbanistyką współczesną. Wydawnictwo Universitas, Kraków 2011, p. 20.
[5] Wach-Kloskowska M., Rześny-Cieplińska J.: Inteligentny i zrównoważony rozwój transportu jako element realizacji założeń koncepcji smart city – przykłady polskie i europejskie. Studia Miejskie, t. 30, 2018.

smart governance and smart mobility[6], which, according to experts, is one of the most important drivers to improve the quality of life of citizens[5]. Intelligent mobility is understood as innovative and integrated transport systems using energy from renewable sources, as well as the spatial and functional integration of the public transport system through the creation of elements linking different types of mobility: transfer hubs, park&ride and bike&ride hubs, intelligent transport systems, passenger information systems, compatible and synchronized timetables[7] and uniform transport fares. By reducing exhaust emissions, noise, travel time and chances of congestion, and above all by using modern means of transport, the accessibility of city space and comfort of living in it increases.

Another concept discussed in the work is the compact city[8], which calls for the creation of dense, intensively and multifunctional used living spaces that implement the principles of sustainable development, served by efficient, multimodal public transport systems (in combination with walking and cycling – "while reducing the need for individual car transport"[8]). Examples of the implementation of the idea of a compact city are the concepts of a 15-minute or 1-minute city[9].

Also cited is the concept of the happy city[10] in which the aspect of equity, mobility and accessibility to urban goods is explicitly emphasized. It calls for the city to offer "real freedom to live, move around and shape our lives as we see fit as well as a "fair and equitable distribution of space, available services and mobility to its inhabitants"[10].

In conclusion, the synthesis of the aspirations, demands and goals of the mentioned ideas is a just city, which is based on comprehensive, equal and socially just assumptions based on accessibility and equality of opportunities, which can be realized, among others, through modern mobility.

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[6] Giffinger R., Fertner C., Kramar H., Kalasek R.: Smart cities: Ranking of European medium-sized cities. Centre of Regional Science (SRF), Vienna University of Technology, Vienna 2007.

[7]Gadziński J., Goras E. (eds.): Raport o stanie polskich miast. Transport i mobilność miejska. Instytut Rozwoju Miast i Regionów, Warszawa 2019.

[8] Mierzejewska L.: Miasto zwarte, rozproszone, zrównoważone. Studia Miejskie, t. 9/2015, p. 14-15; Neuman M.: The Compact City Fallacy. Journal of Planning Education and Research, 2005, Vol. 25, No. 1, p. 14.; Węcławowicz-Bilska E.: Miasto przyszłości – tendencje, koncepcje, realizacje. Czasopismo Techniczne. Architektura, z. 1, 2012, p. 328; Polit A.: Idea miasta zwartego a rzeczywistość. Czasopismo Techniczne. Architektura, z. 14, 2010, p. 88; Stangel M.: Kształtowanie współczesnych obszarów miejskich w kontekście zrównoważonego rozwoju. Wydawnictwo Politechniki Śląskiej, Gliwice 2013; OECD. Compact City Policies: a Comparative Assessment. OECD Green Growth Studies, OECD Publishing, 2012, p. 15; Sepioł J. (ed.): Przestrzeń życia Polaków. Warszawa 2014; Ogrodnik K.: Idea miasta zwartego – definicja, główne założenia, aktualne praktyk. ARCHITECTURAE et ARTIBUS t. 4/2015, p. 15; Ministerstwo Infrastruktury i Rozwoju: Krajowa Polityka Miejska 2023. Warszawa 2015.

[9] O'Sullivan F.: Make Way for the 'One-Minute City'. Bloomberg CityLab, 2021. Available online: www.bloomberg.com/news/features/2021-01-05/a-tiny-twist-on-street-design-the-one-minute-city [accessed on April 2021].

[10] Montgomery Ch.: Miasto szczęśliwe. Jak zmienić nasze życie, zmieniając nasze miasta. Wydawnictwo Wysoki Zamek, Kraków 2015.

4.2.2. Accessibility

Special attention is given to accessibility formulated through access to social life, resources of the city, all necessary (most public) services and fulfillment of basic needs, regardless of an individual's capabilities, life situation, financial and intellectual resources. One of the most important factors realizing the aforementioned "accessibilities" is transport accessibility that provides all inhabitants with equal opportunities to participate in social and professional life. These needs can be met through mobility (specified in the city planning concepts discussed in the work). Mobility that is realized by intelligent, modern and integrated transport systems makes it possible to create a just city.

Accessibility is also defined in the research as the design of spaces, transport stops or means of transport according to the principles of universal design[11], which state that they should be designed and adapted in an inclusive way for all users, ensuring equality and opportunities to use urban goods and social life in a non-stigmatizing way.

4.2.3. Relation to priority research areas of the Silesian University of Technology, POB4: Smart Cities and Future Mobility

The research under discussions in line with the activities undertaken by the Silesian University of Technology under Priority Research Area 4 (POB4), focusing on Smart Cities and Future Mobility. One of the main sub-areas of research is technological and spatial development to meet identified needs, overcome contemporary constraints, improve the efficiency of solutions, and reduce the negative impacts of the expansion of human activities on the environment and human quality of life. The following issues were cited as topics for POB4[12]:

- development of means of road and off-road transport, with special emphasis on environment-friendly and performance-improving solutions,
- developing collective public transport systems available to different passenger groups, with particular regard to the persons of special needs and limited mobility.

[11]Benek I., Labus A., Kampka M. (ed.) – Fundacja Laboratorium Architektury 60+: Wytyczne w zakresie projektowania uniwersalnego mając na uwadze potrzeby osób niepełnosprawnych. Ekspertyza wykonana na zlecenie Ministerstwa Infrastruktury i Budownictwa, Warszawa 2016.

[12] Sierpiński G. (ed.): Priorytetowy Obszar Badawczy 4: Inteligentne miasta i mobilność przyszłości. Gliwice 2021, Available online: www.polsl.pl/pob4/en/research-topics/ [accessed on May 2022].

4.3. Characterization and analysis of modern means of mobility

Five modern modes of transportation were selected for analysis in the research portion of the work. The selection was dictated by their characteristics related to range, capacity, location, innovation, and ownership type. For the case study, vehicles were selected that have local coverage and are collective or group, road and above-ground, modern and public.

4.3.1. Typology – criteria for evaluation of means of transport

In order to conduct a study of selected means of transport and to prove the thesis that modern means of transport can be an important factor in creating a just city, evaluation criteria were adopted. Aspects and factors affecting the city space and inhabitants were also taken into consideration.

Table 4.1

Criteria for evaluation of means of transport

No.	SPATIAL	
1.	Spatialabsorptivity	
	spatial--devouring	Means of transport that require the use of a large amount of urban space, and the introduction of which requires significant transformation of the spatial tissue (demolition, redevelopment, actions significantly changing the cityscape)
	intrusive into spatial issue	requiring changes in the city's structure (in infrastructure spaces or public spaces), slight reconstructions and transformations to a small but visible extent
	spatial-saving	making use of the existing layout and structure of the city, not requiring significant transformations of the urban tissue, not generating spatial conflicts or collisions with the existing types of mobility.
2.	Type of spaceimpact	
	agressive	dominating the space, due to their size, amount, way of moving, appearance, way of functioning in the urban mobility system, taking away the possibility of democratic use of urban space
	neutral	non-interfering with the city tissue, not requiring significant amounts of space for functioning, not causing congestion, not bringing disharmony to the spatial and visual order
	friendly	integrated into the city's structure, interacting with existing urban mobility systems and extending their functionality and efficiency, supporting the democratisation of the use of urban space

continue table 4.1

FUNCTIONAL		
3.	flexible	able to respond and adapt to changing user needs
4.	reliable	not subject to congestion, meeting the needs of users, enabling easy, fast and convenient travel, accessible in time and space, giving access to other means of mobility within a wider multimodal system
FORMAL		
5.	Enhancing valours	positively influencing the attractiveness of the city in terms of: aesthetic and visual, convenience and comfort, investment, competitiveness and accessibility
6.	transport stops	evaluation of the form of transport stops in terms of their accessibility (based on universal design principles), functionality and spatial aspects. The analyses also pay attention to the development of the space in the immediate vicinity of the stops
ECOLOGICAL		
7.	with environmental impact	emitting harmful substances to the environment, having a large ecological footprint, requiring the use of non-organic and non-recyclable materials, threatening blue and green infrastructure
8.	Without environmental impact	environmentally neutral, made of sustainably sourced and recyclable materials, with no harmful emissions, using renewable energy sources, promoting (or at least not threatening) blue and green infrastructure
9.	Environmentally friendly	meeting the requirements described above and additionally supporting sustainable urban development, plus-energy: producing more energy than they use, cleaning the air, etc.
SOCIAL		
10.	Accessibility	
	Decreasing accessibility	reinforcing or contributing to “urban sprawl”, strengthening transport exclusion (not only the means of transport themselves, but also their organisation and use as an argument for creating inaccessible spaces), having a “monopoly” on the use of space, while reducing access to it for other users
	Increasing accessibility	supporting the “compactness” of the city, allowing to fight against transport exclusion, having the possibility to connect places without public transport connections (or with small number of such connections) with bigger centres/destinations, equalising opportunities, giving the possibility to meet basic needs

continue table 4.1

11.	Universality	
	inaccessible, exclusive	not meeting the principles of universal design, generating spatial barriers, not dedicated to all users - the use depends on physical and intellectual abilities, financial resources; perpetuating social differences
	accessible, inclusive	which can be used by everyone, fulfilling the principles of universal design, meeting the needs of many user groups, not excluding anyone, not generating spatial barriers, democratic and inclusive, enabling everyone to move freely to the same extent, inexpensive or free, ensuring freedom and independence, not perpetuating social differences, intended for everyone
12.	safe	in the literal sense and in the sense of security

Source: Own elaboration based on the research question.

4.3.2. Selected modern means of mobility

The following modern transportation means were selected for analysis using the case study method and for evaluation according to the adopted criteria. Below is a summary of the scores (scale 1 to 5) given to the means of transport analysed in the case study – to be interpreted in accordance with the description of the criteria detailed in section 4.1.

Table 4.2

TEB-1

No.	Criteria	Rating	Description
1.	SPATIAL		
	Spatial absorptivity	3	Introducing it into the complex and heterogeneous space of the city is impossible. All the roads on which TEB-1 would travel would have to be exactly the same width, plus there would be a need to create additional lanes for regular buses, trucks and other taller vehicles. In practice, it is impossible not to interfere with the existing infrastructure and to avoid major reconstruction.
	Type of space impact	1	Due to its size, TEB-1 is heavily dominant in space. Its operation is aggressive – the organisation of traffic in the city would have to be subordinated to its crossings – especially at intersections, when drivers of cars driving under the TEB-1 platform would want to make any manoeuvre. The form of a kind of tunnel, which gives the impression that it is 'pulling in' the other vehicles, would cause anxiety and discomfort to traffic participants.
2.	FUNCTIONAL		
	flexible	2	No high adaptability – low flexibility to adapt travel routes to changing user needs in terms of line routing and destinations – requires road adjustments.
	reliable	4	The main strength of the TEB-1 concept is its reliability – adapted to move over traffic, it cannot be blocked by a traffic jam and should therefore always arrive on time. It increases travel convenience and reduces travel time.

continue table 4.1

3.	FORMAL		
	Enhancing valours	3	The announcements of the introduction of TEB-1 into Qinhuangdao City's transport system has resulted in increased investment potential and an increased number of contracts awarded for the construction of new infrastructure – making the city more attractive and competitive.
	transport stops	2	The bus stop has not been designed according to the principles of universal design in any respect, which excludes many user groups. The form of the bus stop itself is visually intrusive and can negatively affect the perception of the space.
4.	ECOLOGICAL		
	environmental impact	3	The planned electric propulsion system, if the announced alternative energy sources (photovoltaic panels) are used, has a neutral impact on the environment (excluding the production process of the panels themselves from the assessment). There is no information on the recyclability of used batteries or on the origin of the materials from which the vehicle is made.
5.	SOCIAL		
	Accessibility	3	TEB-1 travel routes must be straight-line (only forward and backward movement possible), which would only work well for a rapid transit line, for example between the centres of neighbouring cities, or for shorter intra-urban distances, which would not increase accessibility or create urban compactness, only the speed of travel.
	Universality	3	There is a lack of information about the adaptation of platforms for people with different dysfunctions. Because of its limited mobility within the urban structure, it does not remove transport exclusion or add value to social equalisation. A means of transport that is easy to use, uncomplicated and usable by everyone.
	Safety	1	TEB-1, through its tunnel-like, enclosed form, generates many dangers and opportunities for collisions. Drivers of vehicles underneath the bus have no view of their surroundings and no knowledge of what is happening on the road outside its structure. Also dangerous are the very attempts to manoeuvre when passing under the TEB-1, with all junctions, exits and turns becoming even more collision-prone. Driving under the bus platform, as well as the arrival of the bus and the car driver suddenly finding themselves in an enclosed tunnel, generates disorientation, anxiety and unpredictable behaviour.
average rating:		**2,4**	

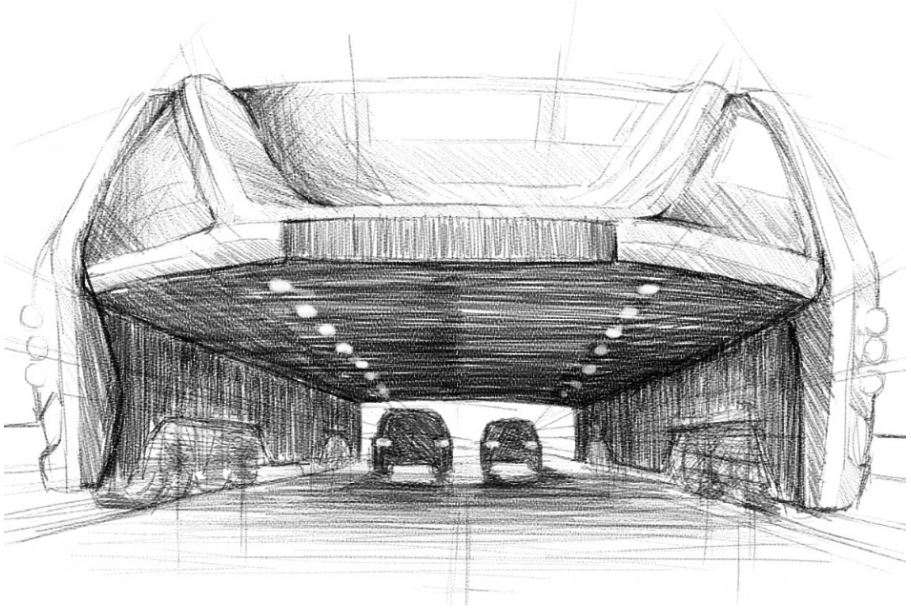

Fig. 4.1. TEB-1
Rys. 4.1. TEB-1
Source: Own elaboration based on: www.transport-publiczny.pl/wiadomosci/chiny-pamietacie-autobus-pod-ktorym-przejezdzaja-auta-zbudowali-go-52659.html, [access on 07.05.2022].

Table 4.3

Skyway

No.	Criteria	Rating	Description
1.	SPATIAL		
	Spatial absorptivity	3	It does not require a significant amount of urban space to be developed exclusively for its operation – the movement of the cabins takes place above ground, so no significant transformation of the urban structure is needed – SkyWay uses and fits into the existing layout. It can use the undeveloped space above the roads and other undeveloped tracts without significant interference.
	Type of space impact	4	SkyWay has the potential to develop the functionality and efficiency of existing transport systems – it can be a new, additional link to extend the capacity and efficiency of a city's multimodal systems. The form of the vehicles themselves is not overwhelming, giving the impression of being light and friendly.
2.	FUNCTIONAL		
	flexible	4	It is possible to adapt routes to meet the changing needs of users in terms of line routing and destinations. It is also possible to expand the cabins with further modules to meet the increased demand for passenger volumes. The designed timetable-free continuous transit system can automatically adjust the frequency of the carriages (in real time) thanks to artificial intelligence, increasing the efficiency of the city's transport system. Traffic tracks must be routed in a straight line, which limits the flexibility of routing.
	reliable	5	SkyWay is being designed primarily to make travel reliable and comfortable – the concept is to make travel independent of traffic and worsening congestion.

continue table 4.3

3.	FORMAL		
	Enhancing valours	4	It can have a positive impact on the city's attractiveness, especially in terms of accessibility, competitiveness (in terms of innovation, convenience of travel and living comfort) and can thus enhance the city's investment appeal, positively influencing development.
	transport stops	4	The architecture of interchanges can be adapted to the qualities of a specific location. Due to their size and the amount of space required (open spaces around the facility) they cannot, however, be used in spaces with limited space, but located, for example, in suburban areas they can have “place-making” potential – provide an opportunity to create attractive locations for interpersonal integration and a variety of functions that can increase the potential of a place. It is possible to design bus stops in the trend of universal design.
4.	ECOLOGICAL		
	environmental impact	3	The planned electric propulsion, if alternative energy sources (photovoltaic panels) are used, has a neutral impact on the environment (excluding the production process of the panels themselves from the assessment). Information is given on the use of a very small amount of raw materials and materials to create all the infrastructure dedicated to SkyWay, compared to the creation of infrastructure for other modes of transport. Its construction and location do not interfere with existing ecosystems, green areas.
5.	SOCIAL		
	Accessibility	5	It has great potential to combat transport exclusion. Due to its low implementation costs and the ease of adapting the line's routing to transport needs, SkyWay has the potential to connect places without public transport links to larger centres, thus having a positive impact on generating accessibility and urban compactness.
	Universality	3	The need to board cabs at high interchange stations creates a spatial barrier, but on the other hand, stops can be adapted to the needs of all user groups. By being able to adapt the route to mobility needs, it has the potential to bridge transport exclusion, thus bringing new opportunities for social equalisation. A means of transport that is easy to use, uncomplicated and can be used by everyone.
	Safety	4	By elevating the rail structure above the ground, the possibility of collisions with other traffic participants is eliminated. With regard to the feeling of safety, the fear of heights, probably determined by the overall glazing of the cabs, may be a problem.
average rating:		**3,9**	

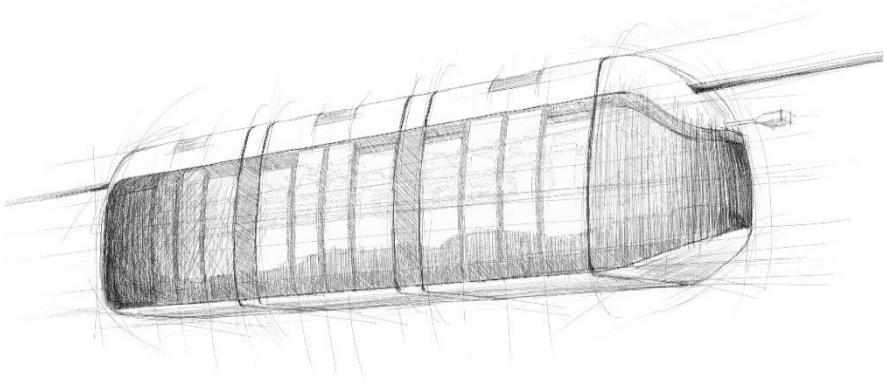

Fig. 4.2. Skyway
Rys. 4.2. Skyway
Source: Own elaboration based on: www.skyway.capital/technology [access on 07.05.2022].

Table 4.4

Cable car

No.	Criteria	Rating	Description
1.	SPATIAL		
	Spatial absorptivity	3	The most space is required for the location of interchange stations needing significant space horizontally and vertically. Support structures for cable systems take up relatively little space near the ground. The routing of the routes can, however, depend on the layout and height of the buildings. This results not so much in interference with the urban fabric itself, but in the need for an often complex (and in many locations impossible) adjustment to it.
	Type of space impact	3	The interchange stations themselves can take on attractive forms that are consistent with their surroundings. Carriages or gondolas can be personalised to suit the needs of a particular city. On the other hand, it can be quite aggressive for the cable system and moving cabs to take over the “sky space”, introducing new, alien elements. This can cause discomfort and anxiety.
2.	FUNCTIONAL		
	flexible	4	Cable cars routes can be established in locations inaccessible to conventional modes of transport and despite spatial barriers such as tracks, motorways, rivers, etc., so in open spaces route flexibility is at a high level. In denser urban areas, routing depends on spatial considerations. Timetables, frequency and number of cabs can be adapted to user demand dynamically, responding in real time.
	reliable	5	Because of their complete independence from traffic, conditions, rush hour or congestion, cable cars are reliable. Breakdowns are very rare, and if there is a power outage, for example, it is possible to bring the cabins manually to the station. They offer the possibility of effectively complementing a city's existing multimodal systems.

continue table 4.4

3.	FORMAL		
	Enhancing valours	5	Thanks to their advantages, they significantly increase the attractiveness of the city in terms of quality of life, access to goods and investment and tourism. They increase the city's development potential and help promote it.
	transport stops	4	It is in the hands of architects to design the stations – they can take any form, can be adapted to local conditions and locate boarding points at pavement level. Stations have place-making potential (placemaking) which would encourage the development of local centres and attractive public spaces.
4.	ECOLOGICAL		
	environmental impact	4	Cable cars use electric propulsion, so (assuming it comes from clean sources) they do not emit harmful substances into the environment. They have few breakdowns and do not require frequent maintenance. Stations can be equipped with photovoltaic farms to generate the required energy in a sustainable way. They do not pollute the air or emit noise. Far fewer raw materials are needed to build the routes than for conventional modes of transport.
5.	SOCIAL		
	Accessibility	5	They increase accessibility to jobs, education, services, commerce, healthcare and the whole range of cultural and social assets of the city. Due to their flexibility, they are able to connect remote, hard-to-reach neighbourhoods with other locations, increasing opportunities and equality for residents. They have the potential to bridge transport exclusion.
	Universality	4	The use of cable cars is open to everyone, regardless of fitness, age or financial resources. Station buildings and cabins are adapted to the needs of people with disabilities, they are boarded from floor level and have adapted spaces for wheelchairs, bicycles, prams, luggage or bicycles. A means of transport that is easy to use, uncomplicated and can be used by anyone.
	Safety	4	Due to the separation from traffic, there is no possibility of any collisions, accidents or crashes. Some people may experience anxiety due to heights or open space, and (from a position on the ground) anxiety due to cabs moving overhead.
average rating:		**4,1**	

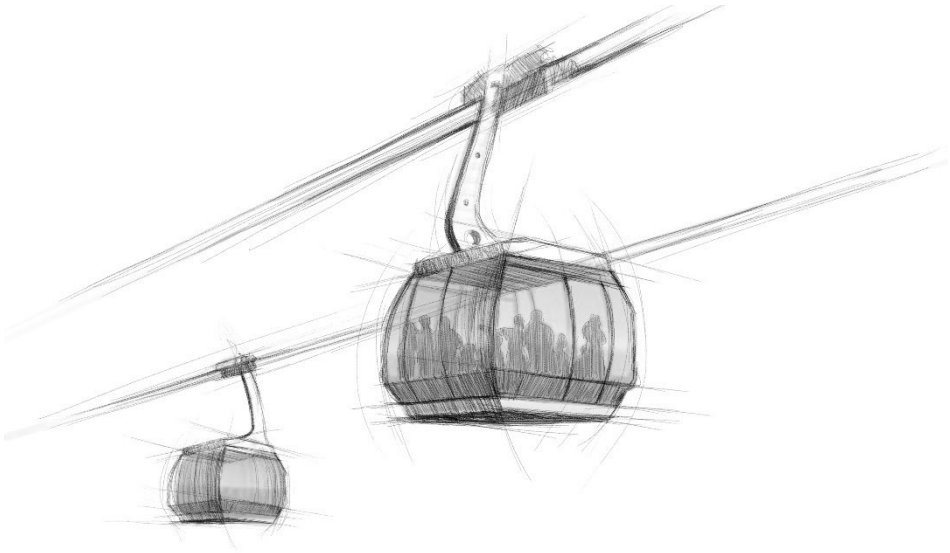

Fig. 4.3. Cable car
Rys. 4.3. Cable car
Source: Own elaboration based on: www.hollywoodreporter.com/lifestyle/lifestyle-news/la-mayor-eric-garcetti-proposes-gondola-dodger-stadium-1106141/ [access on 07.05.2022].

- Personal Rapid Transit – PRT

Table 4.5

Personal Rapid Transit – PRT

No.	Criteria	Rating	Description
1.	SPATIAL		
	Spatial absorptivity	4	They are not as space-consuming as road infrastructure for cars or buses, however they do require a certain amount of space to be adapted to their needs. Routes could be located on a similar basis to tramways. The routing of routes within the city structure must depend on spatial considerations and the amount of space available.
	Type of space impact	5	Depending on how the track is run (above ground, elevated or overhead) the nature of the impact on space would be different. Above-ground tracks would be the least aggressive, and would not stand out too much visually, as might be the case with elevated or suspended systems. The vehicles themselves are small, giving the impression of being friendly, not overwhelming.
2.	FUNCTIONAL		
	flexible	5	Already at the level of the idea, the system can be considered highly flexible, dynamically adapting to the situation and responding to changes in demand. Arrival times and routes are individually tailored to circumstances. Due to the need to build dedicated tracks for the PRT, the designation of the transport network is dependent on the existing structure of the city (width of traffic routes, amount of free space) and must conform to it.

continue table 4.5

	reliable	5	The PRT is very reliable, not subject to major breakdowns that, for example, immobilise the entire system for an extended period. Highly efficient and personalised journeys and decoupling of movement from traffic and worsening congestion.
3.	FORMAL		
	Enhancing valours	5	The PRT can be a major competitor to individual modes of transport, thus providing an opportunity to change the mobility habits of city users and thus be a leaven for improving all aspects of urban living and commuting, which is attractive in terms of investment, development and increasing competitiveness against other centres.
	transport stops	5	Stops can take a variety of forms, from larger interchanges bringing together multiple vehicles to stand-alone, single-stop stops. The possibility to board vehicles directly from the pavement means that access to this mode of transport is not restricted to a narrow group of users and therefore does not exclude the elderly, people with disabilities or people with pushchairs.
4.	ECOLOGICAL		
	environmental impact	3	PRT uses electricity, which has no negative impact on the environment (if the energy is obtained from renewable sources). It does not pollute the air or emit noise. Far fewer raw materials are required for the construction of special routes than for conventional means of transport. Thanks to intelligent management systems, energy to power the vehicles is not wasted by unnecessary trips, so losses are reduced as much as possible.
5.	SOCIAL		
	Accessibility	4	They could successfully serve passengers from further away neighbourhoods (several kilometres), providing them with a fast connection to the city centre, other neighbourhoods or functional areas (workplaces, education centres, etc.). They could positively contribute to the accessibility and connectivity of the city.
	Universality	4	PRT vehicles are adapted to carry people with disabilities. The journeys are not costly and can be customised, increasing transport accessibility. The only problem may be service – you have to hail the vehicle in person and then choose the destination station yourself, which may be problematic for e.g. digitally excluded people.
	Safety	4	The system is almost accident-free. The routes are collision-free, separated from other means of transport and traffic participants. Thanks to central control and autonomy, the human factor is also eliminated. The sense of security may depend on the size of the cabins.
average rating:		**4,4**	

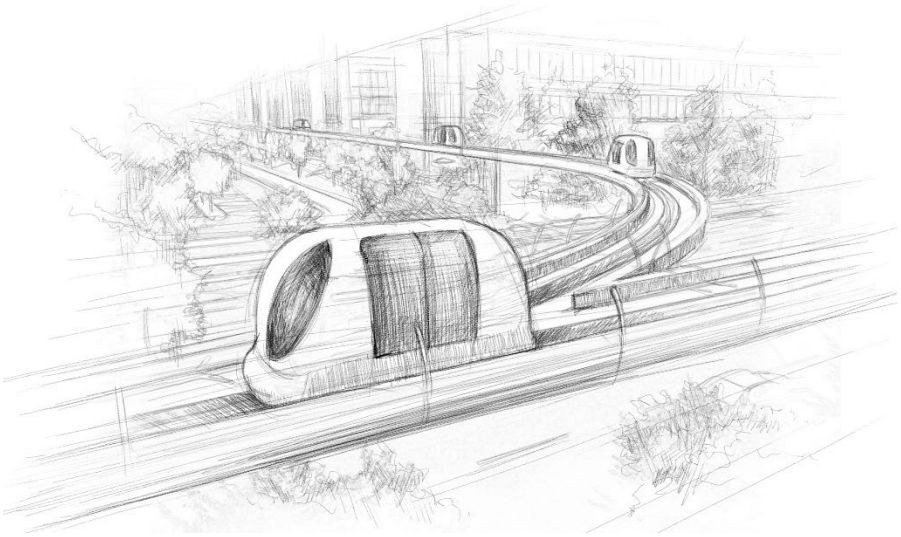

Fig. 4.4. Personal Rapid Transit
Rys. 4.4. Personal Rapid Transit
Source: Own elaboration based on: www.greenvillejournal.com/news/self-driving-pods-could-be-the-future-of-urban-transport-in-greenville/ [access on 07.05.2022].

Table 4.6

Shweeb

No.	Criteria	Rating	Description
1.	SPATIAL		
	Spatial absorptivity	4	The routes can be adapted to the existing structure of the city, they do not have to be straight, which helps to avoid spatial conflicts or forced line routes that are not adapted to the needs. There is no need to interfere with the existing fabric of the city – Shweeb uses the existing shape of the space and fits into it.
	Type of space impact	4	The capsules themselves are small in size, with transparent walls, so they do not overwhelm with their appearance. The tracks on which passengers move have a small cross-section, so they do not obstruct the view, the sky, or block access to light. Support structures may be a problem – due to the track span of 20 meters, the density of masts can be overwhelming.
2.	FUNCTIONAL		
	flexible	4	The line itself is very susceptible to changes and is easy to rebuild and modify. The lack of the need for a straight-line transport network allows for flexible adaptation to the existing urban structure, offering freedom in determining the route of the network connecting various destination points.
	reliable	3	With good organization and management, Shweeb has the potential to be reliable. However, it is questionable what will happen to the capsules from which the passenger will get off at the intermediate station – after all, the cabins are powered only by pedaling by the person inside, so it is not possible to automatically control the units from the central system.

continue table 4.6

3.	FORMAL		
	Enhancing valours	5	The introduction of the Shweeb system into the urban transport system would have a positive impact on the investment and tourist attractiveness of the city. It would also have a positive impact on the attractiveness of individual places that would use this method of traveling between slightly separated points.
	transport stops	2	The stops must be raised above the level of the sidewalk due to the technological solutions of vehicle drive. Taking into account the exclusionary nature of Shweeb (it is intended only for able--bodied people), its transfer stations can also be described in a similar way.
4.	ECOLOGICAL		
	environmental impact	4	The Shweeb is powered by muscle power by pedaling, like a bicycle. It uses no fuel or electricity. It is cheap to operate, and when designing the rails, the authors took into account the possibility of reusing the material when transport networks were to be dismantled, modified or liquidated. Shweeb could also be environmentally friendly, as it could itself produce energy generated by user traffic.
5.	SOCIAL		
	Accessibility	1	Due to the fact that the system requires significant expenditure of the user's physical strength, it is difficult to imagine that it would be possible to use it to travel, for example, from distant suburbs or to work in economic zones, which are most often far from city centers.
	Universality	1	Shweeb is not available to many user groups. To use this means of transport you must be physically fit, have a good level of fitness, and have standard body dimensions (all cabins are the same size, people who are overweight, very tall or very short might not be able to use this type of mobility), be well oriented in space and have good reflexes and skills in operating the cabin – the passenger himself has to switch to adjacent traffic lanes in order to change the route, which can be very discouraging. Due to its strongly urban character, Shweeb will not improve the accessibility of the city for people from places excluded from transport.
	Safety	2	Moving in the cabin is safe, and collisions with other road users are excluded by separating the movement space. However, the feeling of safety when driving a Shweeb may be low. A feeling of danger may be caused by situations when a passenger traveling at a higher speed catches up with the driver in front of him and “connects” the two capsules. This is done by a kind of impact and then by accelerating the movement of the slower passenger. Despite the installed shock absorbers, such an event can cause disorientation, fear and pressure to move at speeds beyond one's strength.
average rating:		**2,9**	

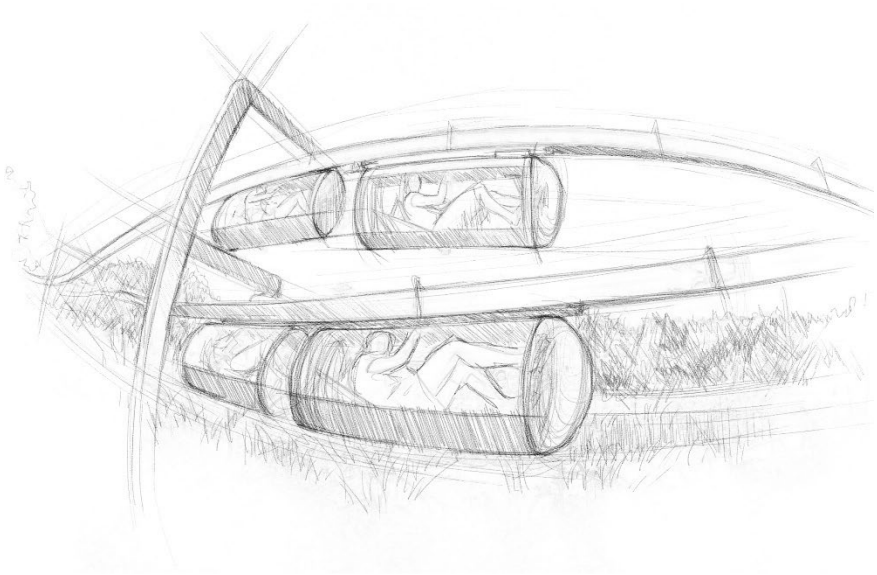

Fig. 4.5. Shweeb
Rys. 4.5. Shweeb
Source: Own elaboration based on: http://obviousmag.org/en/archives/2011/12/schweeb_revolution_skycyling_through_the_city.html [access on 07.05.2022].

The highest rated (average rating above 3,5) transportation means were selected for the conceptual section of the study: Skyway, cable car and Personal Rapid Transit.

4.3.3. Summary and conclusions of the analyses

The shared features of the highest rated transport means (Skyway, cable car, PRT) were:

- possibility of introduction without strong interference in the spatial structure;
- possibility of serving areas which are difficult to access by conventional means of transport;
- possibility to adapt to the needs of hygiene and sanitary safety;
- creation of new, efficient connections adapted to the needs of city users;
- zero-emission;
- collision-free, separated from the traffic of standard means of transport;
- dynamic adjustment of frequency to the needs of users, high flexibility in response to changes
- egalitarian;
- accessibility: stops/stations accessible from the sidewalk or adapted to people with special needs;
- place making potential.

4.4. Conceptual part

The conceptual part of the work proposes an optimal urban planning solution that involves increasing accessibility, streamlining and democratizing the space of selected urban areas and methods of movement. The concept was made atthree scales:

- Macro scale: includes solutions within the borders of a selected city (Gliwice), i.a. division into characterized spatial-functional zones and proposal of layout of the network of connections;
- Meso scale: includes a model of the network of connections and location of stops in selected fragments of the city's zones
- Micro/urban scale: solutions including fragments of public spaces which serve selected transportation stops of the proposed mobility means.

4.4.1. Selection of means of transport to the spatial-functional zones of the city

The recommendation for the selection of modern mobility for inclusion in the existing transport systems was based on the characteristics of the individual spatial--functional zones of the chosen city (Gliwice).

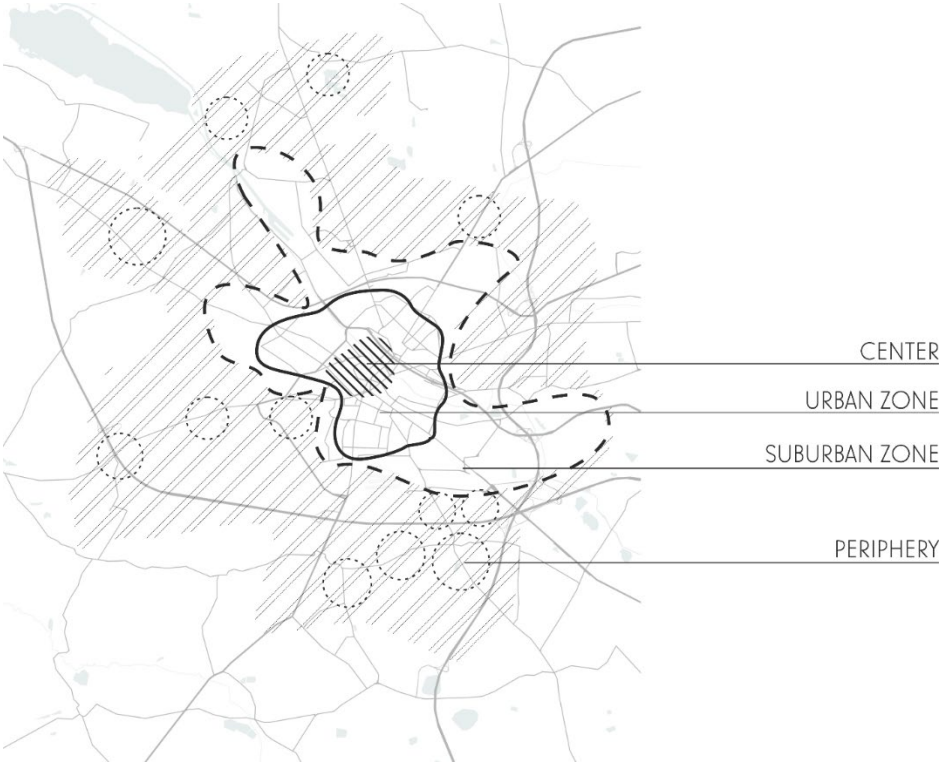

Fig. 4.6. Zoning of the city Gliwice
Rys. 4.6. Podział miasta Gliwice na strefy
Source: Own laboration.

The following zones were identified in analyses whose main criterion was the physical and spatial structure of the city: center (1), urban zone (2), suburban zone (3), periphery (4) – and then, on the basis of these characteristics, appropriate modern mobility measures were selected to meet the desired features for each zone.

Table 4.7

Recommended allocation of modern mobility measures to city zones

Zone	Desired characteristics of the means of transport		Complementary means of transport
CENTER	fast and dynamic transit, short distance, on demand, spatial-saving		Personal Rapid Transit Cablecar
URBAN ZONE	Fast transit, medium and long distance, frequent, on-demand or timetable-free, on fixed routes, low or mediumlevel of spatialabsorptivity	Traditionalmeans of transport +	Personal Rapid Transit Cable car SkyWay
SUBURBAN ZONE	medium and long distance, frequent, running every 15/30 minutes on fixed routes, medium or higher level of spatial absorptivity		Cablecar SkyWay
PERIPHERY	long distance, running according to needs, without timetables along fixed routes		SkyWay

Source: Own elaboration based on the research question.

The introduction of modern means of transportation into existing transportation systems should be based on the following aspects:

- dependence on local conditions and the spatial structure of the city, as well as the character of individual urban zones;
- complementing the existing means of transport and creating with them a complementary multimodal transport system as an interconnected, coherent network (in terms of routes, timetables, interchanges, unified ticketing system and e.g. the application supporting it)
- consistent wayfinding and visual identification;
- low fares or completely free public transport

4.4.2. Assumptions of the proposed model of communication systems and connection networks – macro scale

The proposed transportation model assumes that all zones of the city can be connected by supplementing existing transportation systems with modern means of mobility in a way that allows direct travel between zones and individual centers by

identifying traffic generators. The model also seeks to increase the quality of intra-zone travel. Due to the character of the central zone, the aim is to reduce the amount of motorized traffic in it, so that pedestrians and cyclists take the lead. Transport interchanges are planned (e.g. typical interchanges connected with park-and-ride hubs) It is proposed to incorporate modern means of mobility into existing systems to address areas of need not met by traditional, commonly used means of transportation and to increase their efficiency and reliability.

A concept on a macro scale has been shown on Fig. 4.7.

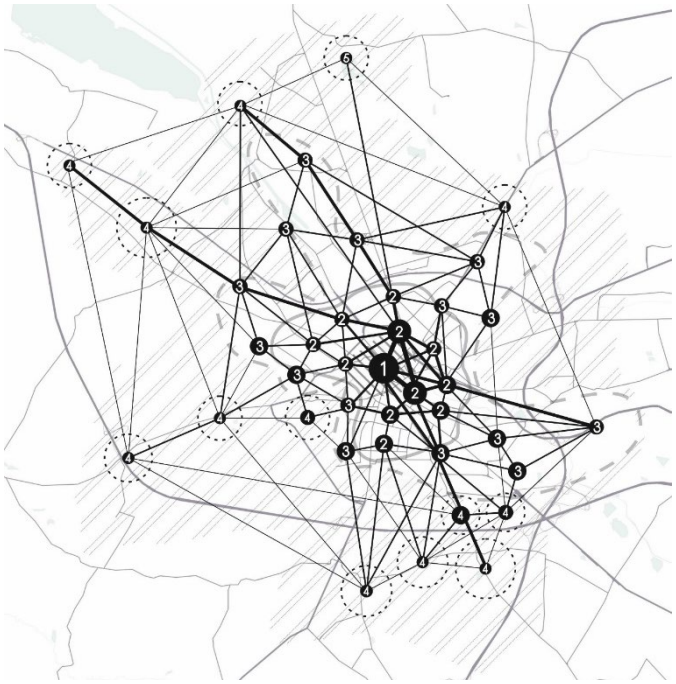

Fig. 4.7. Scheme of the proposed model of communication systems and connection networks in a sample city.[(1) – point-designated traffic generator in centre zone, (2) – in urban zone, (3) – in suburban zone, (4) – in periphery]

Rys. 4.7. Schemat proponowanego modelu systemów komunikacji i sieci połączeń w przykładowym mieście. [(1) – punktowo wyznaczony generator ruchu w strefie centrum, (2) – w strefie miejskiej, (3) – w strefie podmiejskiej, (4) – w strefie peryferiów]

Source: Own elaboration.

4.4.3. Conclusions and recommendations from the analyses, solution proposal, expected effects of introducing the proposed model – meso scale

The analytical section of the concept part characterizes the existing transportation system in the selected inter zone area, and examines local conditions in terms of transportation exclusion, mobility needs, travel purposes, and opportunities for deployment of the proposed mode of travel.

After summarizing the analyses, design guidelines are presented:

- complementing the existing transport system with modern means of mobility to complement its inadequate functioning;
- locating new stops in areas of "transportation white spots" devoid of access to public transportation;
- densifying the network of intra-zonal connections;
- increasing the frequency of services;
- creating a fast, long-distance line connecting the suburban zone directly with other zones
- increasing the competitiveness of public transportation in relation to individual car transport;
- introducing the aspect of multimodality and locating functional interchanges;
- increasing accessibility to urban goods for residents of all zones;
- increasing the attractiveness of undeveloped areas for investment purposes by running a high-speed transportation network through them.

Based on the conclusions and recommendations from the analyses, a model of a network of modern means of mobility and location of stops was proposed. Its main assumption is to complement the existing transportation system in order to eliminate "transportation white spots" and thus increase accessibility in meeting the basic needs of inhabitants from many social groups. The model was created for each mode of transportation:

A. Skyway – As a fast, almost direct connection between the suburban zone with the urban zone and the city center. Stops are located near important places such as a local center, a concentration of educational functions, or an interchange.

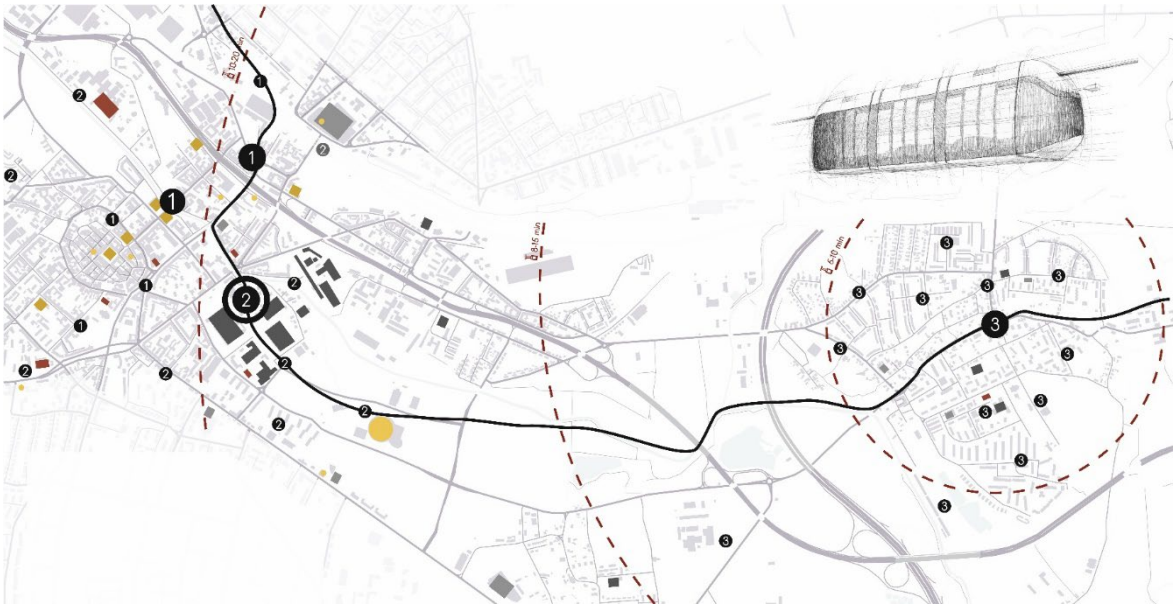

Fig. 4.8. Model of network and stops for Skyway
Rys. 4.8. Model sieci i przystanków dla Skyway
Source: Own elaboration.

B. Cablecar – increases accessibility to selected areas by filling in gaps in the existing transportation grid, connecting the most significant locations in a given zone.

Fig. 4.9. Model of network and stops for Cable car
Rys. 4.9. Model sieci i przystanków dla kolei linowych
Source: Own elaboration.

C. Personal Rapid Transit – a complementary, dynamic element of the transportation system in the center, which allows direct access from point A to point B – so it can compete with individual means of transport, and thus can relieve traffic congestion in the compact spaces of the central zone.

Fig. 4.10. Model of network and stops for PRT
Rys. 4.10. Model sieci i przystanków dla PRT
Source: Own elaboration.

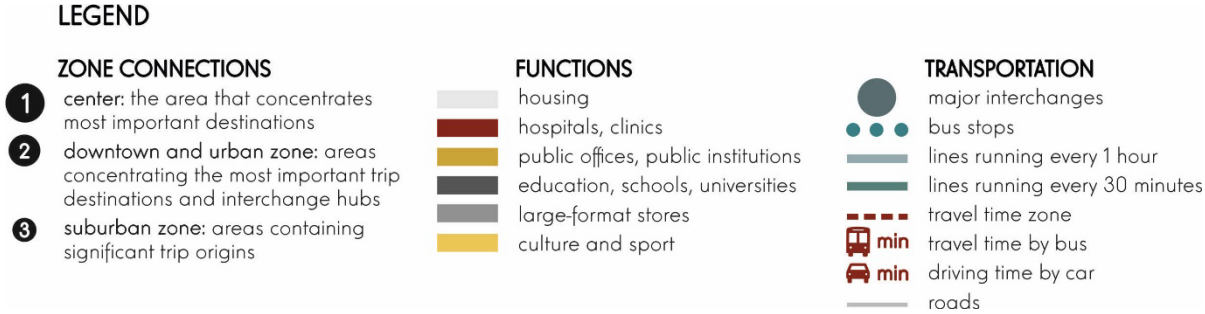

Fig. 4.11. Legend for network and stop models in meso-scale
Rys. 4.11. Legenda do modeli sieci i przystanków w skali mezo
Source: Own elaboration.

Desired outcomes of the proposed concept:

- increasing accessibility and urban justice by complementing the existing single--mode transportation system to eliminate transportation white spots that impede access to the use of the city's basic services and goods;
- a proposal to open a direct transportation line to the most important locations in the city center;
- creating the competitiveness of public transportation in relation to individual means of transport: shortening the time and increasing the speed of travel, decreasing the need for changes, and decreasing the distance of stops from the place of residence;
- individualized public transportation;
- transport system based on many different means of mobility – traditional and modern;
- place making – creating new multifunctional public spaces, including local centers;
- making undeveloped areas of the city more attractive for investment

4.4.4. Description of solutions in the urban concept – micro scale

For the conceptual design: the determinants of an accessible street identified in the article "Accessibility in the design of woonerfs in historic centers of European cities"[13] were taken into consideration, such as:

- "increasing safety,
- eliminating spatial barriers,
- clarity of space,

[13] Labus A., Malicka-Skrzek S., Gajewska A., Goleśna A., Jonda J., Konsek P., Ławecka A., Dostępność w projektowaniu woonerfów w historycznych centrach miast europejskich. Builder 2021, R. 25, No. 6, p. 64–68.

- increasing the amount of urban greenery,
- making it possible to spend time in the street space."

A. Center – green areas have been arranged, the form of which allows for the creation of places to sit, places for bicycle racks and urban furniture. Personal Rapid Transit traffic lanes in the central area have been separated from the pedestrian and bicycle zones by green spaces and a lines of trees. Pedestrians and cyclists have priority throughout the street, and thanks to the intelligent PRT system there are no collisions at pedestrian crossings.

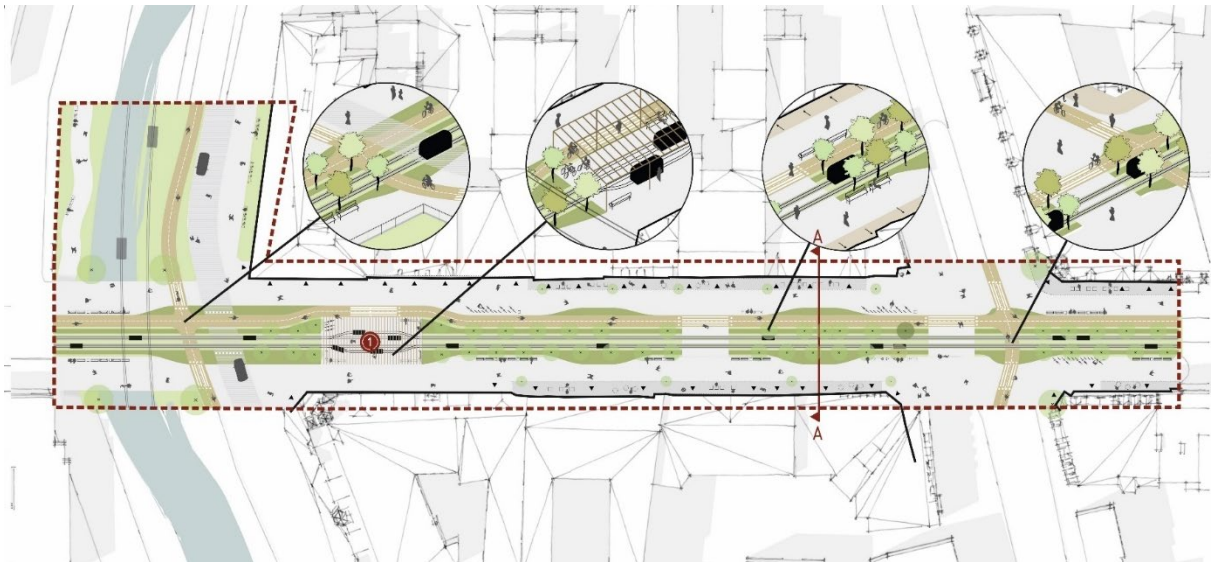

Fig. 4.12. A schematic concept of the center zone development
Rys. 4.12. Schemat koncepcji zagospodarowania terenu strefy centrum
Source: Own elaboration.

Fig. 4.13. Legend and site section for A schematic concept of the center zone development
Rys. 4.13. Legenda oraz przekrój terenu do schematu koncepcji zagospodarowania terenu strefy centrum
Source: Own elaboration.

B. Suburban zone - in the suburban zone there are located interchange stations for cable cars and SkyWay. Thanks to the proximity of the bus stop and city bike station a kind of multimodal transfer hub has been created. Pedestrian and bicycle space was designed as a woonerf with services and gastronomy. Spaces by the revitalised stream have been developed for recreational functions. Car lanes were narrowed to the minimum allowable widths to slow traffic and reclaim territory for pedestrians and cyclists.

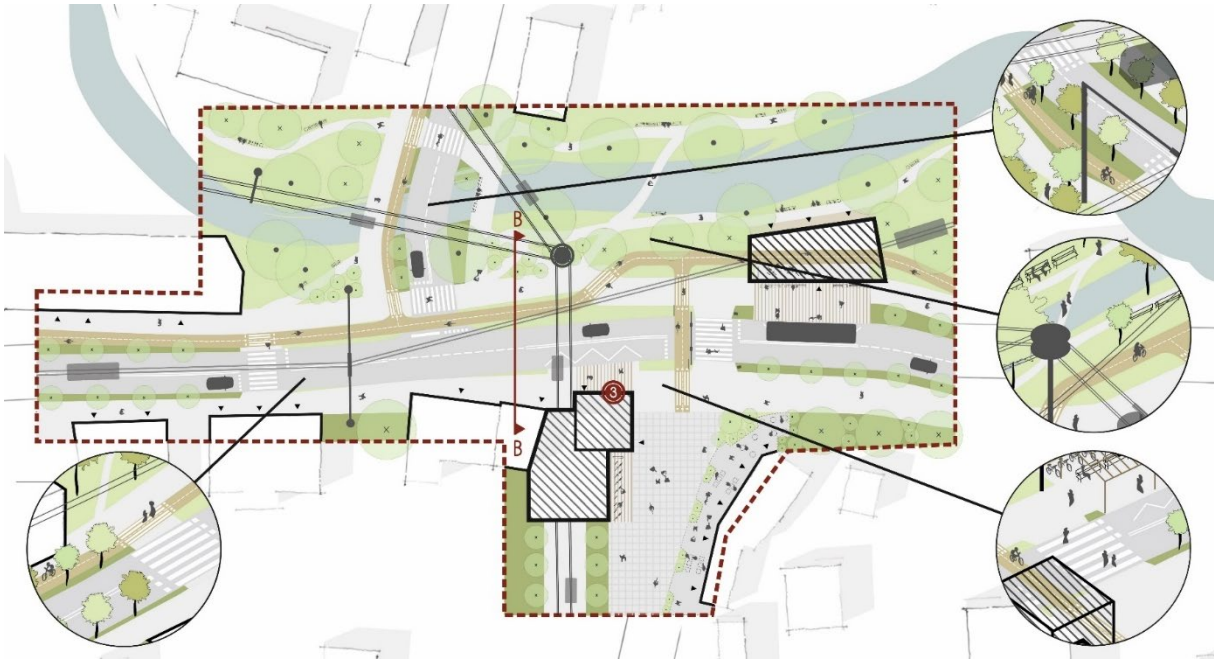

Fig. 4.14. A schematic concept of the suburban zone development
Rys. 4.14. Schemat koncepcji zagospodarowania terenu strefy podmiejskiej
Source: Own elaboration.

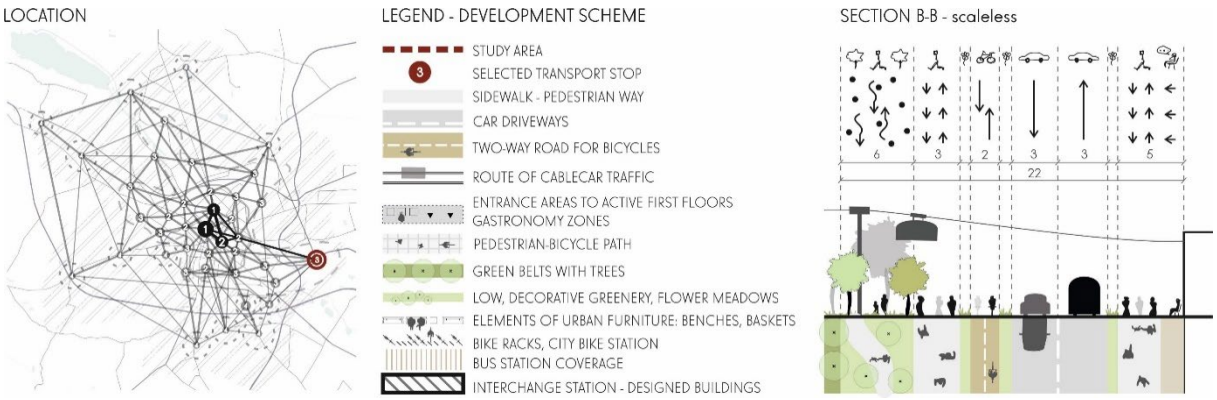

Fig. 4.15. Legend and site section for A schematic concept of the suburban zone development
Rys. 4.15. Legenda oraz przekrój terenu do schematu koncepcji zagospodarowania terenu strefy podmiejskiej
Source: Own elaboration.

4.5. Conclusions and summary

The final conclusions of the paper are that the analytical work points to the crucial importance of accessible public transport in the construction of a just city, the conceptual work points to the feasibility of such solutions that can respect the evaluation criteria adopted at the outset, and it is cosidered that the theoretical and conceptual work is worth continuing. Such continuation should be of an interdisciplinary nature, in which the participation of the architect and urban planner will be significant.

By reviewing selected relevant urban design ideas in terms of mobility issues and defining the just city, it can be concluded that accessible, efficient, safe, reliable, inclusive, complementary and multimodal modern public transport systems are the basis for creating accessible, just city spaces. They enable users to move freely, to improve their opportunities (through access to jobs, education), to have equal access to the services and goods of the city, to participate in social life and through their continuous development to improve the quality of life of their inhabitants. The proper selection of criteria in the implementation of modern means of mobility creates the possibility of sustainable city development.