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MASTER'S THESIS

Title of the thesis: What should satellite cities be equipped with so that they can play the role of a full-fledged city. Catalogue of Ready Architectural Solutions in example of Pabianice.

Title of the thesis (in Polish): W co powinny być wyposażone miasta satelickie, aby mogły pełnić rolę pełnowartościowego miasta. Katalog Gotowych Rozwiązań Architektonicznych na przykładzie Pabianic.

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Preface

Over the past decades, the urbanization process has dramatically transformed the face of cities, giving rise to the phenomenon of satellite cities, small urban areas that are part of a larger metropolitan area but not as integral to it. These satellite cities, with their own set of problems and opportunities, are an essential part of the overall urban structure. However, a number of satellite cities are still developing in their capacity to function as nearly independent urban places, often in the shadow of their larger partners.

The purpose of this paper is to explore what factors are necessary for the viability of satellite cities as independent yet interconnected urban entities. The analysis will be based on the historical evolution of the concept and the issues that are currently encountered in the context of the studied cities, in order to present a clear and comprehensive understanding of the dynamics of the studied communities.

The paper will also engage with existing literature and case studies on communities in order to identify best practices that can be employed in future urban planning. In order to contribute practical insight that can be useful to policymakers, urban planners and other stakeholders, this work proposes a universal research methodology that can be adapted for use in satellite cities.

Pabianice, the satellite city in the Lodz metropolitan area, has been used as a case study to develop and apply modular design solutions to address specific local issues. This practical application of the importance of flexibility and innovation in urban planning provides a model for other satellite cities with similar problems.

It is crucial to establish the interrelationship between the satellite cities and the larger cities that they support. Caring about these communities may help to bring about more equitable and sustainable ways of developing cities, which will benefit the residents and the environment and increase their attachment to the city.

I would like to extend my appreciation to my advisors, colleagues, and the people who shared their time and experiences for this study. We can all make a difference to create a future where satellite cities are not just extensions of larger urban centres, but also vibrant, independent communities.

Abstract

The aim of the work is to examine what satellite cities should be equipped with so that they can function as full-fledged cities. The analysis will be directed towards the common challenges and needs of the small to medium-sized satellite cities. Recognizing the diversity of these needs, a deeper examination of potential research methods will be made to gather accurate data on specific urban requirements. To do so, analysis of existing social research will be made and conducted as part of architectural and urban planning projects which aim to improve the quality of life in urban structure. A universal research methodology will be developed based on these findings. This methodology will be applied in the second part of the work, which will be a proposal for a modular design concept for the satellite city of Pabianice in the Lodz agglomeration.

KEYWORDS: Satellite cities; spatial planning; analytic methods; spatial planning; full-fledged city; Pabianice; Lodz agglomeration; modular solutions.

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1. Introduction

1.1. Background of the Problem

In small towns or medium-sized towns, their problems are very often underestimated. Projects and programs aimed at improving residents' quality of life are most often carried out in larger agglomerations. [1]It is in them that we can most often see continuous progress. Another equally underestimated topic, inconspicuously very strongly affecting the life of large cities, is their satellite cities. It is in these small or medium-sized towns that a large part of the users of a significant city return in the evening. This lack of interest becomes especially interesting when we consider demographic changes and how more and more people are more willing to live in villages, small or medium-sized cities, in particular those located in the vicinity of large cities. For example, in Poland, according to the National Population and Housing Census 2021, the number of urban residents decreased by about 3 per cent, and the number of people living in the countryside increased by about 1 per cent. Accurate data shows that many people leave the city and move to the countryside. But not so far from the metropolis. It is mainly about communes adjacent to cities, i.e., satellite cities or, commonly known as bedroom cities.

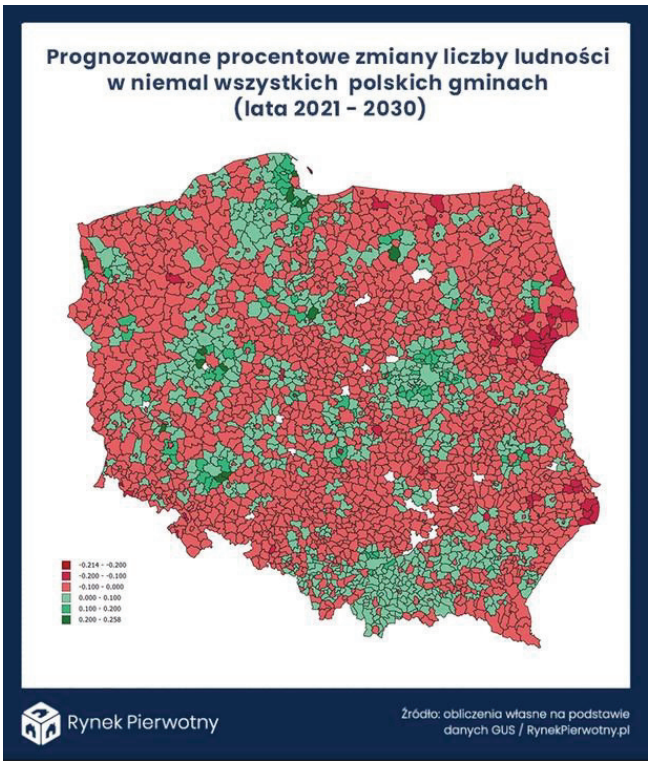

Figure 1 Projected percentage changes in population in almost all Polish municipalities (2021-2030) Source: Statistics Poland, 2021, "Demographic Future of Poland," available at https://forsal.pl, Accessed: June 24,2024

[1] Statistics Poland. *"Release calendar".* available at: https://stat.gov.pl/en/release-calendar/06-12-2022.html

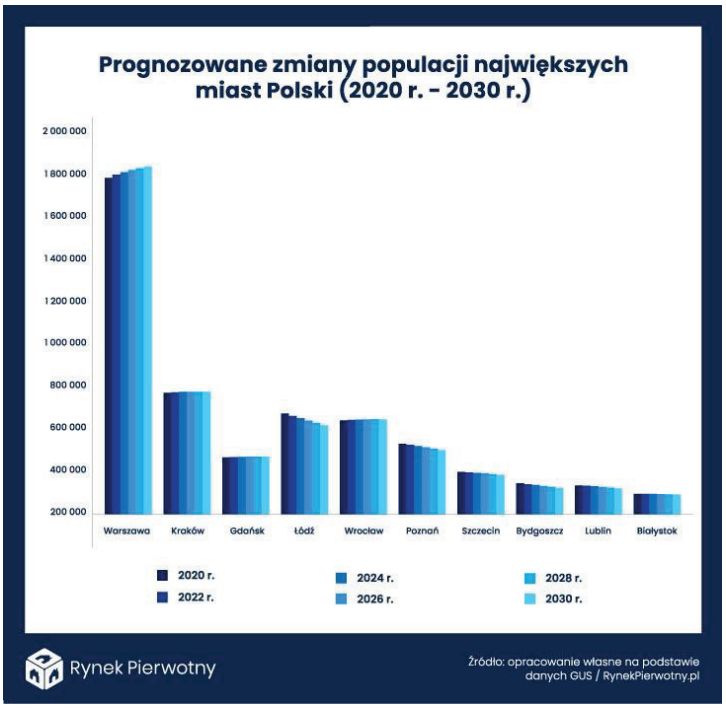

Figure 2 Projected population changes in Poland's largest cities (2020-2030). Source: Rynek Pierwotny, 2023, "Które miasta wyludniają się najszybciej?" available at https://rynekpierwotny.pl, Accessed: June 24,2024

The main statistical office in Poland informs in its report on the forecast of the population of communes for the years 2017 - 2030 that:

The greatest increase in population was noted primarily in communes located in the immediate vicinity of the largest urban centers, which results from the power of attraction of large agglomerations as attractive labor markets. It should be mentioned, however, that the suburbanization process also applies to medium-sized cities. It is worth noting that most of the major urban centers are seeing a decline in population.[2]

From the above data, we can also conclude that out of 37 large cities (over 100,000 inhabitants), only 8 had an increase in population. Among them are the following voivodeship cities: Zielona Góra, Warsaw, Rzeszow, Wroclaw, Cracow, Gdansk, Opole, and Bialystok. Other voivodeship cities recorded losses, the largest in Katowice and Lodz.

1.2. Rationale for the Topic Choice

The increase in the population interested in living in satellite cities and the insufficient attention paid to a thorough analysis of the quality of life in European small and medium-sized cities seem to suggest a desire to deepen this

[2] Statistics Poland. *"Prognoza ludności gmin 2017–2030"*. available at: https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5469/10/1/1/prognoza_ludnosci_gmin_2017_2030.docx

topic. A general study of the satellite cities of European agglomerations and drawing common and universal conclusions about what utility functions may be missing in them is quite possible, and this will be a partial goal of this diploma thesis. However, the design part aims to find solutions using architecture for such cities and then to thoroughly analyse what a given city should be additionally equipped with, in what quantity, with what area, for how many and for what users, but also in what location, it seems to be necessary.

Part of almost every architectural or urban project is, of course, analysis, often also social research, to ensure that the project contributes something to the urban and social fabric. In other words, it is nothing new that such analysis and research should be done before preparing the concept for the project to be valuable. However, it should be emphasized that the primary goal of the design part is to be ready-made solutions in the form of a catalogue of modules that are universal and possible to be used in every satellite city so that it can be considered full-fledged. Consequently, in order for the designed modules to be placed in the urban tissue of a given satellite centre and to meet its specific needs, apart from the catalogue of ready-made solutions, it should be provided with a ready research scheme needed to answer the question of what is missing in this particular city, what can it choose for itself from the provided catalogue.

1.3. Problem Statement

Most satellite cities in Europe do not face problems of depopulation or overcrowding. It is worth noting, however, that one of the most important challenges that satellite cities must overcome is the lack of an adequate amount of local services and amenities appropriate for the various social groups living there, which can make everyday life less convenient or less enjoyable. In many of these cities, we can see a lack of space for social interactions, cultural activities or simply recreation. This is one of the reasons why residents are forced to visit a larger metropolis every day or simply give up on this type of activity due to the lack of access. In order to increase the self-sufficiency of such cities and, above all, their residents, it is crucial to fill these gaps. Hence, this work is not intended to explore what attracts residents to satellite cities or what factors prevented them from migrating to a larger city; it is intended to explore how we could diversify satellite cities and the quality of life in them for current residents.

1.4. Research Questions

How can we additionally equip satellite cities with additional functions to make them more like full-fledged cities, and how can we improve the quality of life of their inhabitants?

How do we use architecture to create a catalogue of ready-made solutions that can be used in each case?

How to create an ideal universal research scenario that could prepare a satellite city for the selection and use of modular solutions from the proposed catalogue?

1.5. Methodology

The methodology of the work will include literature analysis, comparison of case studies and identification of good practices in satellite city planning. The research will start with a review of literature in order to define and understand the concept of satellite cities and their role in metropolitan areas.

According to the new structure, the analysis will be conducted in two blocks. The first will include case studies of European and global satellite cities—including Ząbek, Milton Keynes, Ratingen, and Tsukuba—taking into account various approaches to urban planning and infrastructure. The second block will be devoted to examples of community involvement in spatial planning processes that can increase cities' resilience and the effectiveness of local solutions.

Then, the case of Pabianice will be analyzed to assess its development potential. Based on the conclusions from both blocks of case studies, recommendations for urban strategies will be formulated.

2. Understanding Satellite Cities

2.1. Definition and Characteristics

What are satellite cities? A large part of society lives in them and is not even aware of it or does not use this term on a daily basis. The easiest way to explain the idea of satellite cities is to compare them, as the name suggests, to a satellite. A satellite according to the Cambridge dictionary is a *natural object moving around a larger object in space.*[3]

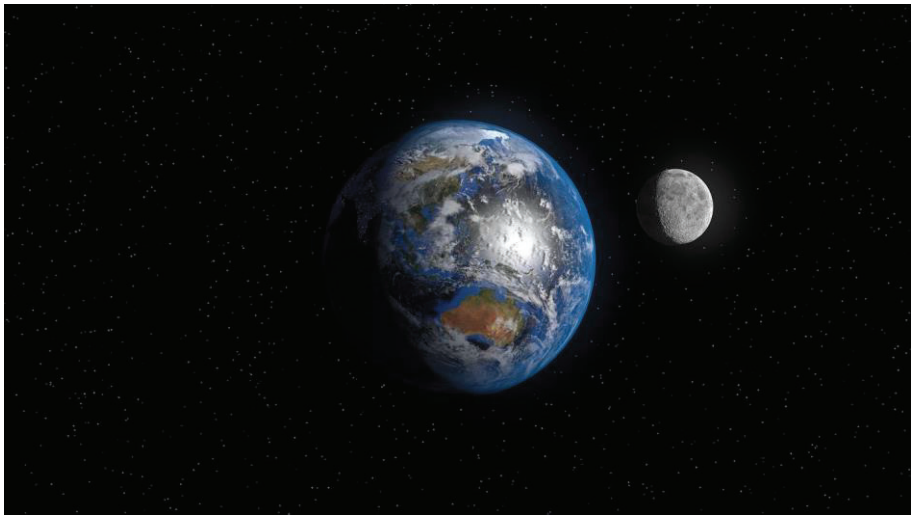

Figure 3 Earth and Moon. Source: Seti Institute, "Did Early Earth Spin On Its Side?, 2023," available at https://www.seti.org/. Accessed: June 24, 2024.

A perfect example for this comparison would be the moon, which is a satellite of the earth. Just as the moon revolves around a larger object and is somewhat dependent on it, satellite cities are usually smaller or medium-sized cities, partly dependent on a nearby larger urban center, and we can confidently say that life in it revolves around a larger city.

[3] Cambridge Dictionary. *"Satellite"*. available at: https://dictionary.cambridge.org/dictionary/english/satellite

The described cities are to some extent independent in terms of administration, jobs, or basic services, while the larger neighboring city makes them dependent on each other in terms of better paid jobs, higher education, and cultural services. For the most part, satellite cities remain very attractive in terms of housing and that is why many people decide to, for example, work in a larger urban center and return to the satellite city in the evening. For this reason, satellite cities are also commonly referred to as *bedroom cities*.

2.2. Historical Development of the Concept

To better understand the concept of a satellite city, it is necessary to go back to the moment when the term was first used. In the United States, the term satellite city was first used in 1915 in the book *Satellite cities: A study of industrial suburbs*[4], by American urban planner Graham Romeyn Taylor. The author used this term in relation to the small industrial cities he described, founded by companies moving their headquarters to the suburbs of larger cities.

In Europe, however, the idea of a satellite city brings to mind the concept of a garden city which was introduced in 1898 by Ebenezer Howard in *To-morrow: a Peacefull Path to Real Reform*, reissued in 1902 as *Garden Cities of To-morrow*[5]. Howard in his book introduces us to the concept of establishing new, smaller, and less populated cities located near a larger central city, which would combine the advantages of cities and the countryside, while avoiding duplicating their disadvantages. Charles Purdom, one of Howard's collaborators, described one of the cities founded on this idea in 1918, Welwyn Garden City, as a satellite city. He believed that as a garden city, located so close to a larger city (London in this case), it must be dependent on it to some extent. Significantly, this fact was considered a key factor in the success of this garden city.

In an attempt to clarify the meaning of the term satellite city, in 1956, the French geographer Pierre George, in his work called *City*, defined a satellite as:

> *Satellite - agglomeration, housing estate or satellite city - a settlement unit spatially separated from a large city, which, however, is socially and economically dependent on it.*[6]

George also emphasizes there that the relationship between a smaller and a larger city consists, among other things, in the fact that some residents of a smaller city commute to work in a larger city and use some of its services.

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[4] Taylor, G. R., *Satellite Cities: A Study of Industrial Suburbs.* D. Appleton, 1915.

[5] Howard, E., *Garden Cities of To-Morrow: Urban Planning,* CreateSpace Independent Publishing Platform, 2016.

[6] Pierre George, *Miasto,* 1956, s. 404

2.3. Potential Challenges Facing Satellite Cities

Although satellite cities have their potential, there are several problems that can limit their growth and effectiveness as proper urban areas. Some of the most important issues include:

INFRASTRUCTURE AND SERVICES: Many satellite cities have poor infrastructure and have limited facilities for education, healthcare and public transport. Such deficiencies can negatively influence standard of living for citizens.

DEPENDENCE ON THE CENTRAL CITY: Economically and socially, satellite cities are often closely linked to their larger neighbor, which can influence their development and their ability to function independently.

SPATIAL PLANNING: Inadequate spatial planning can result in fragmentation of the urban area and degradation of the lives of its residents. Many satellite cities do not have a clearly defined development vision, which leads to haphazard development.

SUSTAINABLE DEVELOPMENT: With growing ecological concerns, satellite cities are faced with environmental challenges. Sustainability is becoming an important factor, and its absence can contribute to the degradation of urban spaces.

SOCIAL AND CULTURAL COOPERATION: Finally, satellite cities often lack a social and cultural character. Insufficient involvement of local communities in decision-making processes can make residents feel alienated and disconnected from the urban space.

Each of these difficulties requires analysis to determine what impact they may have on the future of satellite cities and their ability to function as full-fledged urban units.

2.4. Comparative Analysis of Satellite Cities in Europe

To demonstrate the variety of development strategies and challenges, satellite cities across Europe are analyzed. The ability of each of these cities to serve as a complete urban unit is impaired by some problems. Here are number of points which comes from the analysis:

INFRASTRUCTURE AND SERVICES: The availability of public services and infrastructure is a key factor in the attractiveness of satellite cities like La Défense in France and Harlow in the UK. Harlow is lacking in health and education facilities for a place that is so close to London, which decrease the standard of living of its residents. On the other hand, La Défense is a thriving business city but has inadequate housing and cultural amenities, which results in low population density.

DEPENDENCE ON THE CENTRAL CITY: This is especially the case for cities like Wroclaw and its satellite cities including Świdnica where the relationship with the larger city is very important. Wroclaw is able to attract many investments and residents, but it is not always the case with the smaller cities which are not always able to see this as an opportunity for their development. This can result in their marginalization and low socio-economic

potential. Therefore, cooperation between the central city and its satellites is crucial for sustainable regional development.

SPATIAL PLANNING: The problems of the inappropriate spatial planning are visible in the city Shevchenko in the Czech Republic. A city with disorganized development and without a clear urban vision is not a good place to live. On the other hand, Copenhagen and its surrounding cities reveal the results of sustainable planning which has not only the functional but also aesthetic and ecological aspects in mind. The money is spent there on green spaces, bicycle facilities, and public transportation systems, which help in the growth of well-organized and attractive urban environments in these cities.

SUSTAINABLE DEVELOPMENT: In this field, new approaches that are focused on energy efficiency and the conservation of natural resources can be noticed in some satellite cities in Germany, such as Freiburg. These approaches are, investment in green infrastructure, (parks, rain gardens or other forms of rain water management systems). They not only improve the quality of life, but also build the character of the cities environment. This means that the cities that ignore these aspects may lose their attractiveness.

SOCIAL COOPERATION AND CULTURE: A challenge of developing a local identity is observed in satellite cities like Paris and its surrounding areas. The residents often lack social and cultural ties. Thus, cultural and social life initiatives that increase the involvement of local communities are crucial to solve these problems, such as festivals, educational programs or community centers. A strong identity and community can only be built through various forms of cooperation between residents to strengthen the bonds between them.

From the above analysis, it is clear that the development of satellite cities in Europe has both similarities and differences in terms of challenges and opportunities. It is crucial to understand the various factors that influence their growth and effectiveness as independent urban centers. Discussing these problems puts us in a better position to envision how to design the right strategies that can effectively aid in the development of satellite cities in the future.

2.5. Summary of Key Insights

This leads to the identification of key consequences, which can help in understanding the role of different factors in shaping the development of satellite cities in Europe. Lack of access to education, healthcare, and public transport can greatly restrict the development of the city and make satellite cities unpopular to live in. This makes the need for improvement in essential services clear.

This analysis also reveals the complex and reciprocal relationship between the satellite cities and the central cities. This relationship can be beneficial as it can create jobs and provide resources; however, it can also be disadvantageous if the small towns do not use their proximity to attract investments and developments. There is the need for positive collaboration between the main cities and their satellites to promote regional sustainability and to make sure that all the regions have access to the economic opportunities.

Spatial planning has also proved to be a crucial factor in determining the success of satellite cities. The Copenhagen model is a good example of how a comprehensive and sustainable urban planning system should work. On the other hand, the cities with poor and chaotic urban planning are more likely to have poor quality of life and unpleasant environment. This is where there is the need for a good long term urban vision that is a balance between the functional, aesthetic, and ecological aspects.

The need for sustainable development strategies has become apparent, especially with the increasing environmental problems that we are encountering. Solutions presented in the example in Germany of blending green infrastructure into urban strategy are a good model to follow. By including sustainability, satellite cities can improve their competitiveness and be viable places to live for future generations.

Finally, establishing a distinct social and cultural character of satellite cities helps in strengthening social cohesion and reducing feelings of isolationism among the residents. Community engagement plans such as cultural events and projects help in enhancing social capital and feeling of belonging. As satellite cities struggle with their unique problems, these insights offer a foundation for developing solutions that support the growth and integration of these cities into the broader urban system.

It is important to acknowledge these key insights because they reveal the correct measures that should be employed to ensure the future of satellite cities as independent and thriving urban entities. In this regard, fixing infrastructure deficiencies, promoting partnership, following proper spatial planning, embracing sustainability, and developing community identity are important measures that would make satellite cities better for their citizens.

3. Case studies of Successful Satellite Cities

3.1. Example 1: Ząbki, Poland

A satellite city in Poland is Ząbki, a suburb of the capital, Warsaw. It is rather close (about 8 km from the city center), but still Ząbki has the feeling of a normal city and not some part of the huge Warsaw megapolis. It attracts mostly young professionals and families because it is close to the capital but the cost of living is lower.

Ząbki is a full-fledged satellite city of Warsaw thanks to social and communication infrastructure investments. The city has kindergartens, primary and secondary schools and many other additional activities. There are many bus connections and a fast railway line which allows the residents to travel to work in Warsaw and thus reduce the need for cars and promote sustainable development. Ząbki has also well-developed sports and recreational infrastructure with modern sports facilities, parks and green spaces which are beneficial to its citizens. The city is attempting to put all the necessary services there so that people who live there don't have to go to the capital to solve their everyday problems.

3.2. Example 2: Milton Keynes, UK

In the UK, one of the most fascinating examples of a satellite town is Milton Keynes in Europe, about 80 km from London. Milton Keynes was established in the 1960s as one of the so called ‘new towns’ to help relieve the overcrowding in London. Milton Keynes is most definitely a post war modernist town in its layout of wide avenues

and many green space and parks where it differs from the congested capital. A good rail link and being on the M1 motorway has also made Milton Keynes a good choice for people working in London but wishing to live in a quieter, more spacious environment.

In a way, Milton Keynes is a positive example of a well-endowed satellite town through its housing and transport infrastructure, as well as other facilities and services. The town has a great number of educational, medical, cultural and recreational facilities and services available for residents, so they do not have to go to London to satisfy their basic needs. There has been thought in the design of the town, and shopping and entertainment sites such as the Xscape center have been created to bring in tourists and residents from other cities. Milton Keynes is therefore a real city which supports London but also has its own economic development strategy based on quality of life and sustainability.

3.3. Example 3: Ratingen, Germany

Ratingen, a small town in North Rhine-Westphalia, Germany, is another example. This is a historic town which has its character and is more intimate than the large cities since it is only about 10 km north of Düsseldorf. This attracts people who want peace and those who want to be near the economic region. Ratingen has established itself as an attractive suburban area because it has an increasing technological and industrial sector that enhances job opportunities within the area.

Ratingen is a good example of a satellite town because it does not only provide the basic needs of its citizens but also a good recreational, educational and health system. Schools, clinics, shops and parks in the area imply that the needs of the residents can be met within the town. A strong economy, which has technology companies, makes Ratingen a better place for professionals to work and there is no need to commute to Düsseldorf to work. Ratingen is an example of how a well-developed satellite city can be almost self-containing, contributing to the development of the area, at the same time providing its inhabitants with the conditions for comfortable living.

3.4. Example 4: Tsukuba, Japan

The last example is Tsukuba in Japan, which is about 60 km northeast of Tokyo. The city was called a ‘Science City’ because it is a specially planned research and development center. It's goal is supporting the development of new technologies and innovations in Japan. Tsukuba is one of the major research and development centers of the country having numerous universities, research organizations and offices of big technology companies. This is because the city is connected to Tokyo by the high-speed rail link (Tsukuba Express) on which many people who reside in Tsukuba commute to and from Tokyo to work or to associate with research facilities and institutions in the capital.

Tsukuba is a unique model of a satellite city which has grown around the development of science and technology. The life in Tsukuba is high since the city has many universities, research institutions, technology parks and a well-organized health and culture sector. At the same time, the residents have access to recreational facilities, sports facilities and institutions that support both their professional and personal growth. This is the kind of satellite city

that does not only relieve the main center but also plays a significant economic and scientific role in the region in attracting specialists and investors interested in modern technologies and science, and that is Tsukuba.

3.5. Comparative Analysis of Findings

Analysis of the provided examples of well-organized satellite cities, Ząbki, Milton Keynes, Ratingen, Tsukuba and Espoo presents some key features that make these cities real centers in their own right, yet dependent on the bigger metropolises for growth while at the same time having their own distinct personality. In the first place, every of these cities has a good transport network to make it easy to get to the main city. Construction of high speed rail lines, highways and having many buses reduces the use of private cars and thus promotes sustainable development and integration with the metropolitan area. In addition, all of these cities have many facilities and services including education, health, culture and recreation and therefore the people living there can lead normal lives without having to commute daily to the main city. These cities also create and develop industrial or technological parks to create employment for the locals, attract professionals and enhance economic growth. In this regard, Tsukuba and Espoo are notable as research and development centers that do enhance the innovation ecosystem and are centers of partnership with the big cities in the area of research and new technologies.

Moreover, each of the studied satellite cities has many parks and other green areas for recreation. Such measures make the cities more populated and acceptable to people and able to attract new population. It is also important to mention that each of these cities also develops culturally, providing the residents with cultural centers, art galleries or various events that help to establish their identity and enhance cooperation among people. Thus, satellite cities are not just the suburbs of the metropolis but also the centers of social, economic and cultural life.

3.6. Summary of Case Study Insights

From the analyses it is clear that properly constructed satellite cities are in a position to ease the burden on the major cities and at the same time serve as complete and attractive centers of population. For instance, Espoo and Tsukuba are mentioned as satellite cities which have stumbled upon an area of interest, i.e. technology and science which attracts investments and specialists. As for Milton Keynes and Ząbki it shows that a good transport interconnection and availability of necessities and leisure facilities enhances the status of these cities and makes people settle there for a longer period.

From the analysis it is also concluded that the satellite cities should strive to develop their brand and cultural content so that they are perceived as places with good life quality and not just as satellite cities of other cities. This allows them to attract not only commuters but also investors and entrepreneurs which is good for the development of the local economy in the long run. In order to be able to perform a similar function to the above mentioned cities, such satellite cities as Pabianice should pay attention to the same factors that contributed to the success of the cities under consideration: a well-developed transport infrastructure, easy access to public and cultural services and the care of recreational spaces.

4. Examples of Community Involvement in Urban Planning Processes

4.1. Example 1. Project “Wileńska – Take Part” in Warsaw

DESCRIPTION: As part of the Polish edition of the Europan X competition in Warsaw, the project “Wileńska – Take Part” was a project that aimed at engaging residents in the transformation of Wileńska Street in the Praga district of Warsaw into an active neighborhood. The vision of the space could be interactively co-created by participants using models and colorful elements representing different functions of urban space.

Figure 4 Event organized as part of the "Wileńska Take Part" project. Source: http://w-a.pl/aktualnosci.php?artykul=1392, Accessed: December 10, 2024

METHODOLOGY: The organizers of the event came up with a happening on the street where residents could collaborate on the street concept. The participants used models and colorful blocks to represent different types of urban elements:

• Yellow – elements that improve the standard of living of residents (e.g. playgrounds, benches, kindergartens).

• Orange – socio-cultural spaces (e.g. community centers, libraries).

• Red – external services (e.g. hotels, offices).

• Green – green spaces (e.g. parks, trees).

RESULT: This consultation method applied by the designers made it possible to understand the needs and preferences of the residents in depth. It was shown through 40 different layouts of the model which elements of the urban space are most important for the community – recreational, social and cultural spaces. The street event proved to be a very effective way of communicating the needs and wants of the designers to the residents, but also served as a social event that created interest in the area. Additionally, this method showed that the residents are

capable of participating consciously in the design process which increases the trust in both the designers and the entire revitalization process. The results of the consultations formed a solid foundation for the final urban design, which presented the visions of various social groups.

4.2. Example 2. Use of Virtual Reality (VR) in public consultations in Suwałki

DESCRIPTION: This was a study conducted in Suwałki to explore how people could be involved in the planning of space using VR technology. The virtue of it is that people could comment on the planned changes by walking around a virtual model of the city.

Figure 5 Use of Virtual Reality goggles in urban planning. Source: https://stockcake.com/i/vr-urban-planning_1229697_170107, Accessed: December 10, 2024

METHODOLOGY: In this study, residents were able to interact with and provide feedback on the proposed urban space designs through the use of VR goggles. After the virtual tour, they filled out surveys that contained the participant's opinion on the proposed solutions.

THE RESULT: The Suwałki VR project has changed the way people can be involved in the spatial planning process. The use of VR technology made the abstract urban plans more meaningful to the layman resident. The participants were able to virtual walk through the areas where investments would be made and judge the appearance, usefulness and harmony of the changes with the existing physical environment. The surveys conducted after the consultations offered valuable information on the needs of the people that designers could have overlooked, and hence the designers could come up with solutions that met the people's needs. Additionally, the VR technology attracted the youth to come and give their input on the development of the area, which was a group that had not been well represented in the past. The project helped in developing sustainable and socially acceptable solutions and also informed the public of the importance of their input in the decision making process.

4.3. Example 3. City Game “Discover Polish-Jewish History” in Gdansk

DESCRIPTION: As a part of the educational activities of the POLIN Museum of the History of Polish Jews in Gdansk, a city game was organized in order to familiarize residents with the Polish-Jewish history of the city.

Figure 6 Polin Museum of the History of Polish Jews in Warsaw. Source: https://www.polin.pl/pl/wydarzenie/noc-muzeow-co-slychac-w-polin, Accessed: December 10, 2024

METHODOLOGY: Using a map, participants visited places related to Jewish history in Gdansk and performed tasks such as solving puzzles or proposing ways to revitalize the space.

EFFECT: The city game in Gdansk did not only enrich the participants with knowledge about local history, but also increased their interest in urban space as a place of living cultural memory. During the game, participants not only solved puzzles, but also had the opportunity to propose their own ideas for preserving or revitalizing places related to Jewish heritage. Such activities strengthen the sense of local identity and build a bond between residents and their city. The game results were used by the organizers to develop a report on social expectations regarding historic spaces which became a reference point for city authorities and local organizations when it comes to planning future revitalization activities.

4.4. Example 4. FixMyStreet – a mobile app in London

DESCRIPTION: FixMyStreet is a London based mobile app which enables citizens to report any problem they have with the city’s infrastructure such as potholes, broken traffic lights or illegal dumping. Later versions of the app also allowed users to submit ideas for the development of public spaces.

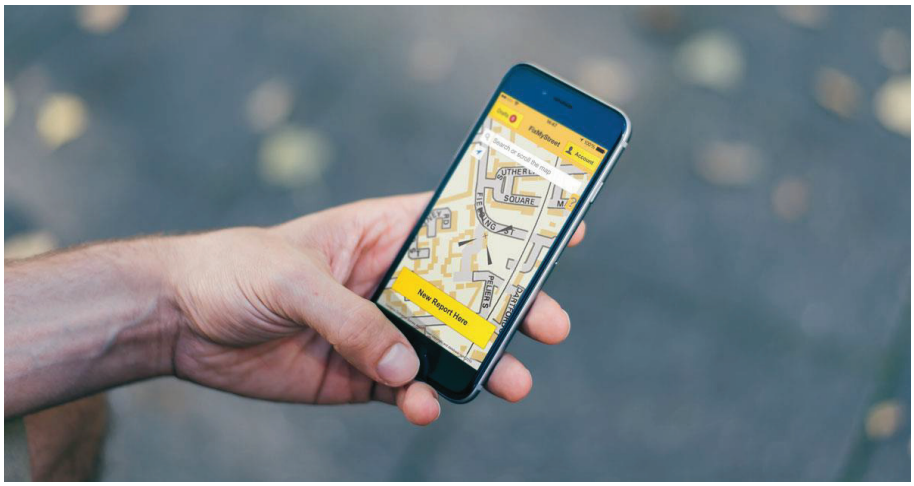

Figure 7 FixMyStreet App representation. Source: https://www.fixmystreet.com/, Accessed: December 10, 2024

METHODOLOGY: Residents could use the app to send photos, descriptions of problems and suggestions for their local spaces. The data was analyzed by local authorities, who then contacted users to discuss the reported issues.

EFFECT: FixMyStreet greatly improved the way of reporting the urban problems and the level of residents' engagement in the management of the urban infrastructure. Thanks to the application with both reporting and tracking of the problems, the residents felt that they have a real say in the improvement of the life in the city. The ability to suggest changes in public space, which was introduced by the application, made the community active in the development of the area, and as a result, the city hall understood the needs of the people better. Also, it contributed to the increase in the transparency of the activities of the administration: the users could at any time monitor the progress of the addressed issues, which improved the relationship between the residents and the London authorities. FixMyStreet has also served as a model for similar projects in other cities around the world, which shows that the idea is universal and effective.

4.5. Conclusions

The included examples demonstrate that people's engagement in the urban planning processes is beneficial for both the society and the designers as well as the city authorities. First of all, the use of techniques like models, city games or virtual reality visualizations makes the process more understandable and enjoyable to different groups of people. In addition, the application of new technologies, as in the case of FixMyStreet, improves the consultations outcomes and the sense of shared responsibility for the space by the residents. Lastly, the involvement of the local people results in the development of better, sustainable, and appropriate solutions for the real needs of the city. This also reveals that it is not only important to listen to the residents and invite them to the conversation, but also to be able to transform their comments into actual design and administrative changes.

5. Pabianice as an example of satellite city

5.1. Overview of Pabianice

Pabianice is a middle sized town in the Lodz Voivodeship and is the administrative seat of the Pabianice poviat. This makes it an important part of the region due to its size as the second largest city in the Lodz agglomeration.

Pabianice is also famous as the birthplace of the patron, Maximilian Maria Kolbe, and the place where the Polish footballer of the world fame, Paweł Janas kicked his first ball.

Pabianice came into being as one of the major hubs of the textile industry in the 19th century; therefore, it is significant from the economic point of view. Lodz people often refer to it as a satellite city, and occasionally as the 'bedroom' of Lodz, which means that it is a residential area where the greater number of people commute to Lodz for work and study.

The above information tells about historical development of Pabianice, its cultural connections and its current dependence on the Lodz city. Therefore, this community is lively but dependent one in the Lodz agglomeration.

5.2. Urban Layout and Infrastructure

To know more about the city, the following basic information about the city of Pabianice is provided below:

- TOTAL AREA OF THE CITY: 32,99 km^2
- HEIGHT ABOVE SEA LEVEL: 174-203 m
- NUMBER OF INHABITANTS (According to Central Statistical Office data from December 31, 2020): 63 945
- DENSITY OF POPULATION: 1938 people per km^2
- VOIVODESHIP: Lodz voivodeship
- COUNTY: Pabianice county
- CITY FOUNDING DATE: X/XI century
- DATE OF GRANTING CITY RIGHTS: year 1297
- CITY PRESIDENT: Grzegorz Mackiewicz

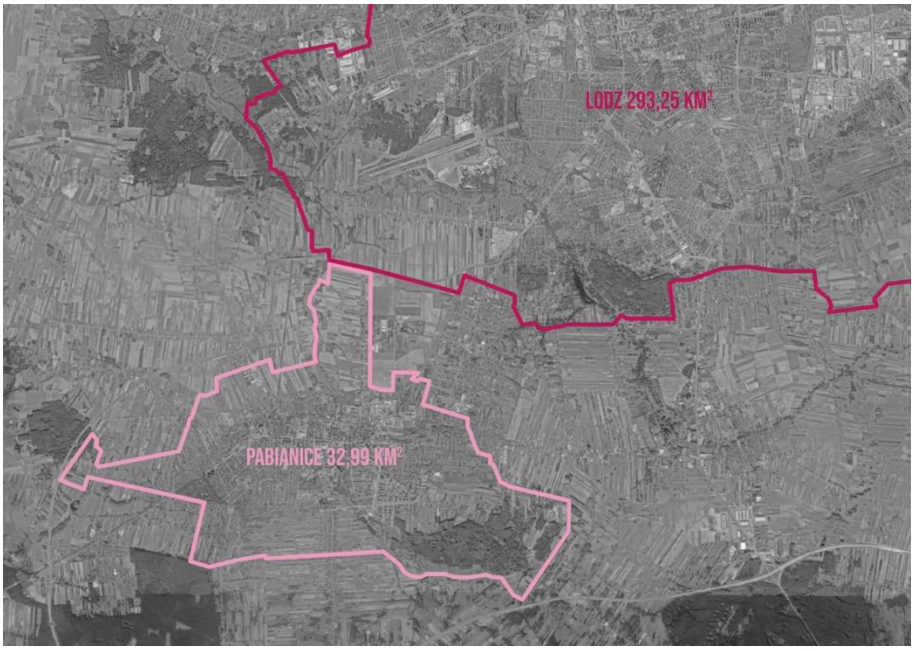

Figure 8 Outlines of Pabianice and Lodz with the areas. Source: Own elaboration

Above is a map with the marked borders of the city of Pabianice and the adjacent borders of Lodz with the area of both cities taken into account.

5.3. Historical Context and Development

The city has its history from the Middle Ages and the first settlements were made in the area known as Opole Chropskie. In the middle of the 14th century, Pabianice received its city rights and the three gold crowns on a silver background as its coat of arms.

Two monuments of the Renaissance were created in Pabianice in the second half of the 16th century and are still standing. The manor house of the Krakow chapter was built in 1566, and the brick church of St. Matthew and Lawrence in 1583. Despite the fact that there were many wooden buildings which were very dense and thus led to several fires in which the city had to be rebuilt, Pabianice has been developed slowly. It was annexed by the Prussian administration in 1796. It gained a chance to rise from the fall in 1807 when the city became part of the Duchy of Warsaw.

The slow development of the industry in the city, especially weaving mills, can be stated to have begun from the year 1816, when the Kingdom of Poland issued a decree that contained several concessions to immigrant settlers. It can be regarded as the beginning of a powerful textile industry centre. A regulation plan for Pabianice was developed in 1823. At that time, weavers from abroad began to settle in Nowe Miasto, and therefore a decision was made to build an Evangelical-Augsburg church and a synagogue.

The textile industry was the leading sector in Pabianice in the second half of the 19th century due to the existence of two big companies, Kindler family and Krusche-Ender. On top of that, there was the development of the town, which was also seen through the establishment of a paper mill by R. Saenger and the Pabianice Chemical Society. As a result, the first trade school, bookstore, printing house, pharmacy and fire brigade were established in Pabianice. The built telegraph station and the workers' housing estate, as well as the lighting of Zamkowa Street with electric lamps, are also changes that would not have taken place without the development of industry in the city. In 1900, Pabianice and Lodz were connected by an electric tram line and in 1901 a railway station was built on the Warsaw-Kalisz railway route. In 1909, a city hospital was built, and a bank was established. The construction of two churches was also completed. There was a revival of cultural and social life. Factory libraries, sports societies, a museum were founded. The first local newspaper and cinematograph appeared. During World War I, a girls' gymnasium was established. In the interwar period, a new telephone exchange was built in Pabianice, the city was electrified, and cooperative houses were built.

The First World War brought scarcity of population and economic stagnation. The people of Pabianice participated in the struggle for independence, being in the Legions, the Polish Military Organization and other military formations.

The development of education and establishment of cultural and educational institutions and associations took place during the years 1918–1939. At that time, male and female gymnasiums were nationalized, new schools, two cinemas and a light bulb factory were opened. Pabianice received a telephone exchange. The city was

electrified and a housing estate for workers was erected. The growth of Pabianice was slowed down by the great economic crisis and the outbreak of World War II.

The city was in the Wartheland during World War II, according to sources. The Germans killed about 9,000 Jews in the Old Town of Pabianice, which was a ghetto. On January 19, 1945, the first Belorussian Front of the Soviet troops entered the city.

5.4. Interaction with the Metropolitan Area

Pabianice is located in the Lodz metropolitan area and is situated on the northern border of the city of Lodz and is its satellite city.

Lodz is the fourth biggest city in Poland by population and area and is positioned in the central part of the country. Lodz is an academic hub with 19 universities and hence a major higher education hub. This has something to do with the key dependency of Pabianice on Lodz because the latter is the primary destination for the residents in search for higher education.

The relationship between Pabianice and Lodz is one of people and resources flowing, and many people from Pabianice travel to Lodz for educational and work purposes. This relationship also reveals the contribution and the challenges of Pabianice as an urban area within the larger urban system and as a satellite city respectively.

5.5. Summary of Pabianice's Strengths and Weaknesses

The city of Pabianice, the Lodz satellite city, has its own set of strengths and weaknesses that determine the character of the city in the metropolitan area.

STRENGTHS:

- PROXIMITY TO ŁÓDŹ: The major advantage of Pabianice is that it is quite close to Lodz which is quite convenient for the residents as they have access to a big city and all the economic and cultural features of the city. This relation is very useful for work, education and leisure and thus enhances the standard of living of Pabianice residents.
- RESIDENTIAL APPEAL: Pabianice is often preferred by people who are looking for more affordable housing than in Lodz. Its residential areas provide a more peaceful environment but are still part of the urban area of the agglomeration.
- HISTORICAL AND CULTURAL HERITAGE: The former textile industry stronghold and the cradle of Maximilian Maria Kolbe, Pabianice has its own character. It also has the ability to generate the spirit of community pride and engagement among the residents to some extent.
- LOCAL SERVICES AND AMENITIES: Shopping areas with some schools and health facilities, making the town to some extent self sufficient to meet the needs of the residents within the town, there are.

WEAKNESSES:

- DEPENDENCE ON ŁÓDŹ: The lack of universities and limited medical facilities is a CONCERN in that Pabianice is dependent on Lodz for higher education and other specialized facilities. Not having universities and limited medical facilities implies that people have to go to the bigger city for these essential services, which can be a burden on the community and hamper development.
- ECONOMIC LIMITATIONS: Although Pabianice has some economic activities, it may not provide the job opportunities that Lodz offers. This can lead to the population having to commute for work, which can hamper economic development in the satellite city.
- INFRASTRUCTURE CHALLENGES: As Pabianice expands, it may face problems with the development of the infrastructure. Poor public transport links and road networks density can affect how easily commuters can get to Lodz and thus affect the viability of the town as a residential area.
- LIMITED CULTURAL AND RECREATIONAL ACTIVITIES: Being an independent town, Pabianice has its own facilities, but the number of cultural and recreational activities may not be as big as in Lodz. This can make residents who prefer to be around a thriving social and cultural environment feel isolated.
- In conclusion, Pabianice advantages include its location and attractiveness as a residential area, but it is limited by its dependence on Lodz and the lack of development in the area and job opportunities. The latter needs to be improved for Pabianice to become a viable urban center within the Lodz agglomeration.

6. Recommendations for Future Development of Satellite Cities

6.1. Essential Infrastructure and Services

For satellite cities to operate as genuine urban areas, it is necessary to put money into the development of the right infrastructure and access to services. Some of the important issues that should be considered include:

TRANSPORT: Transport system is the greatest way in which satellite cities can be linked to the larger systems of settlements. It should include a number of transport modes such as buses, trams and trains so that the population can easily move to work, schools and other facilities. An integrated ticketing system should also be introduced and transport infrastructure such as bicycle and pedestrian paths should also be invested in to promote sustainable transport.

HEALTH: Presence of good health services is a daily life factor that enhances the well-being of the population. This means that satellite cities should have medical facilities like clinics, hospitals and rehabilitation centers to meet the needs of the local population. It is also useful to invest in telemedicine and other health programs that can enhance health care provision.

EDUCATION: This paper also looks at educational facilities like kindergartens, primary and secondary schools as critical factors in the development of local societies. The satellite cities should, therefore, be modern in the facilities they provide for learning and for students and parents. Additional, the cooperation with universities can benefit for the development of the local labor market and the attractiveness of the region.

SOCIAL AND CULTURAL SERVICES: To increase the social cohesion and identity of place, social centers, community centers and meeting places in the satellite cities should be developed. A good solution in this matter seems to be flexible and universal urban units that could be easily adapted to the needs of a specific satellite city, providing local commercial, sports, health or recreational services. This would reduce the need to travel to larger cities, but also by involving residents, for example in the selection processes of such modules, would increase their belonging to their city and increase social integration. Social events, festivals and art workshops should also be organized to make the residents to gather and feel proud to be part of the area.

DIGITAL INFRASTRUCTURE: This is an age of digitalization and therefore access to modern digital technologies is becoming crucial. Therefore, the satellite cities should also invest in the development of internet infrastructure so that the residents can have access to fast internet connection and other digital services. This in turn will help in the development of business and remote work which is very advantageous in the current market trends.

SUSTAINABLE DEVELOPMENT AND GREEN INFRASTRUCTURE: This paper also discusses the future development of satellite cities in the context of sustainable development. The investment in the green spaces, parks, community gardens and storm water management systems is also very important because they contribute to the improvement of population live and protection of the environment. Construction industry should also be made to adopt pro-ecological solutions such as solar panels or water recovery systems.

In conclusion, the development of infrastructure and services in satellite cities should be integrated and sustainable to meet the needs of the population and to support their activity. The implementation of these recommendations will lead to the development of dynamic, autonomous and attractive places to live.

6.2. Possible Strategies for Satellite Cities

For satellite cities to operate as full-fledged urban units it is worthwhile to consider ways of promoting the development of modular infrastructure and services. Among the suggested solutions there is the concept of service centers in the form of modular units that can be easily adjusted to the needs of the population. These modules including cafes, grocery stores, service points and leisure areas that can assist residents with their day to day needs from the comfort of their homes thereby improving their well-being. This also includes the creation of modular educational facilities which can be used for early learning and other forms of training for adults thus supporting social cohesion and local capacity building. It is also important to discuss the possibility of using ecological systems, including green infrastructure, that can be adjusted to the needs of residents and serve as a place for relaxation and physical activity, such as community gardens or other recreational areas. Further, the development of the digital service modules that will provide access to technologies such as telemedicine or e-services can help enhance the health and education status of residents through easy access to these services. Such solutions are efficient as they promote green development, integration and well-being of people which in the long run will make the satellite cities more attractive and stable.

6.3. Policy Recommendations for Local Governance

There are few actions that local authorities should take to support the development of modular infrastructure in satellite cities. First of all, introducing subsidy programs or tax breaks for investors who wish to construct modular service centers may well encourage investment in local infrastructure. This also would allow, by way of example, the organization of workshops and public consultations, at which residents could pose their needs and ideas and contribute to the creation of the spaces they want.

It is also worth considering whether or not to establish partnerships with the private sector and non-profit organizations in order to implement jointly projects in the area of education and health, which will be beneficial for both investors and local communities. Additionally, the creation of educational programs and training in the field of sustainable development and innovative technologies would increase the skills of residents and their activity in the local community.

In conclusion local authorities should also invest in the development of digital infrastructure to enable residents to access modern technologies for instance for telemedicine or e-learning support services. These actions if implemented effectively can in the long term be of benefit to the entire community for the promotion of modular infrastructure development.

Project

7. Catalogue of ready solutions for satellite cities

7.1. Description of the idea of a catalogue of ready-made solutions for satellite cities

This is a tool to support the self-reliance and sustainable development of satellite cities through ready-made design solutions for such cities. They are universal and modular, and can be easily embedded in the urban space, and can be adapted by local designers in cooperation with the local specificity, for recreational and service pavilions.

CATALOG CONCEPT AND FUNCTIONS OF THE PAVILIONS

The pavilions are divided into six main functional categories. Each category contains 5 different functions that are distinguished in the design by colors selected using color psychology, which include:

TRADE AND DAILY SERVICES:

1. Grocery store - green symbolizing freshness.
2. Bakery - warm beige evoking the atmosphere of home-cooked food.
3. Greengrocer's - light green emphasizing the naturalness of products.
4. Drugstore - blue associated with cleanliness.
5. Hairdresser/beautician - powder pink evoking associations with luxury and care.

GASTRONOMY:

1. Coffee shop - brown evoking warmth.
2. Restaurant - burgundy, elegant.
3. Confectionery - pastel pink, sweet and mild.
4. Food court – yellow, dynamic.
5. Salad bar – fresh green, a symbol of health.

SPORTS AND RECREATION:

1. Intimate gym – grey, modern and neutral.
2. Swimming pool – turquoise, refreshing.
3. Sports field – lime yellow, energizing.
4. Skate park – orange, inspiring to move.
5. Fitness points – purple, motivating to be active.

HEALTHCARE:

1. Clinic – blue, stabilizing.
2. Dental point – mint, calming.

3. Diagnostic point – light grey, professional.
4. Mental health point – lavender, relaxing.
5. Pharmacy – blue, strengthening trust.

CULTURE AND ENTERTAINMENT:

1. Library – navy blue, conducive to concentration.
2. Intimate cinema – burgundy, creating an intimate atmosphere.
3. Games room – yellow, full of energy.
4. Art gallery – white, neutral.
5. Workshops for adults – light purple, supporting creativity.

SERVICES FOR FAMILIES WITH CHILDREN:

1. Kindergarten/nursery – pastel yellow, friendly.
2. Playground – bright green, energizing.
3. Educational zone – light blue, conducive to learning.
4. Family café – bright orange, warm.
5. Children's club with workshops – pink, stimulating creativity.

In addition to pavilions, the catalogue includes proposals for green and recreational spaces:

1. Public greenhouses and community gardens – places conducive to social integration and ecology.
2. Picnic areas – places to relax in the fresh air.
3. Green areas for sports recreation – spaces for physical activity.
4. Mini parks – intimate green areas.
5. Squares for outdoor events – spaces for organizing local events.
6. Sensory and educational paths – enriching the user experience.

STRUCTURE AND FLEXIBILITY

Pavilions come in different sizes:

- Small pavilions (21 m², 42 m²) – ideal for smaller services.
- Medium modules (51 m²) – enable the implementation of more complex functions.
- Large complexes (75 m²) – for larger services, e.g. cultural centers.

These pavilions can be configured and adapted to local needs and because they are modular they can be easily integrated into the urban space. Moreover, their implementation is carried out in cooperation with local architects, which ensures that the implementation of these projects does not replace local architects, but rather offers the chance for creative involvement in the development of the city.

PRACTICAL APPLICATION OF THE CATALOGUE

The implementation of the catalogue of ready-made solutions in a satellite city is initiated by the assessment of people's needs and the current state of the urban environment. In the city, with the possible participation of local authorities, urban planners, and the community, major areas that lack the necessary commercial services, catering, or recreational facilities are pinpointed. This analysis facilitates the accurate identification of which of the catalogue modules best meets the needs of residents and where in the community they would be most beneficial.

When the analysis is complete, the city proceeds to choose the pavilions and their locations. At this stage, several urban considerations are taken into account, including layout, transport links, and compatibility with other buildings. The chosen pavilions are then tailored to the urban environment so that they fit in with the existing physical structure.

The installation of the pavilions is done in collaboration with local designers and architects, which allows for the creative modification of the projects to fit the character of the city. This approach guarantees that the work of local specialists is not replaced by ready-made solutions but instead is augmented and enhanced by new ideas. Local architects can also ensure that the pavilions are designed differently and to complement the character, atmosphere, and traditions of the city, thus resulting in a unified urban environment.

BENEFITS OF IMPLEMENTING THE CATALOG

Using the catalog has several advantages, and one of them is the flexibility and scalability of the solutions. Modular pavilions can be introduced at any pace, with individual objects and then gradually adding more as needed by residents. This allows cities to dynamically respond to changes in demographic and economic trends.

Local designers' support is another important factor. Because of the customizable design, architects and urban planners from the area can actually be involved in the implementation and add their unique touch and alter the pavilions to suit their tastes and norms. This makes their input an actual part of the process, and ready-made solutions are there to help, not replace, their work.

In the end, the application of the catalog leads to the improvement of the population's living standard. With easier access to services and facilities and enjoyable and useful urban space, the residents can benefit from a higher quality of life. This in turn fosters social cohesion, raises the attractiveness of the city as a residence and draws new residents and businesses. Therefore, the directory aids in growing the satellite cities which can effectively support their citizens and become stronger, more independent communities within the larger regions.

7.2. Scheme of selecting the location for modular solutions

The way of choosing the places for modular solutions from the catalog depends on a simple two-step scheme that can be adapted to the specific of the city. Two main approaches are presented:

OPTION 1: Location specific to a given need

In the first case, when a specific function is missing in a specific area, the process is rather simple: We identify the necessary pavilions from the catalog and place them on the most needy plots. Such selection is useful for quick and easy provision of missing services where they are most needed, for example, in a residential area without a grocery store or a health center.

OPTION 2: Selecting a location on a city-wide scale

The second option is used when the need for new services occurs on a citywide level and it is necessary to select the best location. In this case, the process can be carried out using a spatial analysis inspired by the idea of the 15-minute city, which was originally formulated by the urban planner Carlton Reid and popularized by the former Mayor of Barcelona, Joan Cuscó, who assumed that residents should have access to the most important services and workplaces within a 15-minute walking distance.

DEFINITION OF THE 15-MINUTE CITY: This concept is based on the assumption that in a well-planned city all basic needs of residents (work, education, health care, shopping, recreation) should be located within a 15-minute walk from their place of residence. More information on this topic can be found, for example, in urban studies on sustainable development of cities[7].

LOCATION SELECTION PROCESS

The following steps should be followed to apply this method:

- MARKING RESIDENTIAL AREAS: Mark residential areas on a city map (e.g. Pabianice).
- MARKING SCHOOLS AND KINDERGARTENS: On the map, mark the locations of all schools and kindergartens, then overlay circles on the map which are the area of a 15 minute walk from these points.
- IDENTIFICATION OF WORKPLACES: From the map select larger clusters of workplaces such as office buildings, factories and other industrial plants and overlay circles of the same radius.
- COVERAGE ANALYSIS: All the circles on the map should reveal the areas that overlap most often. These are the places where a 15 minute walk includes both housing, educational institutions and workplaces.
- PLOT SELECTION: In the area most often covered by the superimposed circles, you can look for available plots to support implementation of solutions of the catalog type. Such plots are the best locations for introducing new functions because they maximize accessibility of residents who can reach them on foot within 15 minutes or less.

[7] Moreno, C., *The 15-Minute City: A Solution to Saving Our Time and Our Planet,* John Wiley & Sons, 2024.

PRACTICAL APPLICATION IN THE PABIANICE PROJECT

I will use this scheme in the Pabianice project to select the optimal locations for modular service pavilions. This analysis will enable me to identify the most strategic places where the introduction of new functions will most benefit residents. Thus, the city will get a better organized and more functional system that supports development and enhances quality of life.

7.3. Concept of community involvement in the selection of modular solutions

It is very important for the effectiveness of the process that residents are engaged in this process positively and faithfully, and that the experience itself is enjoyable for them and not a boring experience that only consists of traditional surveys.

In Pabianice I used a new approach and designed a survey as a game to invite residents to help in the designing of the urban space. In this interactive survey, the respondents would design their own satellite city and choose functions and services from a previously developed list of pavilions available in the catalog. The link to the survey is: survey in the form of a game.

To design and distribute the survey, I had two main objectives: The appearance of the survey and how easy or difficult it is to use. I didn't just want people to answer the questions, I wanted them to feel they were helping to build the future of their city. The survey was made to be visually attractive and the interface was very simple and anyone with or without skills in technology could easily interact with it.

I did not make the survey available to residents of Pabianice, I first made it available to people who are not architects or urban planners just to get their feedback. These tests were conducted in different groups based on the level of technology literacy of the participants to ensure that the content of the survey is easy to comprehend and the tool itself is easy to use, regardless of age or level of technological literacy.

The game form proved to be the golden mean that enabled the creation of an enjoyable experience without the need for advanced software for creating games or applications. This makes the whole process more enjoyable for the respondent to receive than the traditional survey. Some elements of the gamification of the survey encourage the respondents to take their time and explore all the available options carefully, which usually leads to more sincere and thoughtful answers.

The survey in the form of a game can be presented to residents in various ways. Besides, it can also be used in a stationary form during special city events, and it is easy to make it available online as a mobile app or web game. This approach also helps in promoting community engagement and allows the local authorities and designers to come closer to the people and understand their requirements.

Such involvement of residents makes the process of choosing modular solutions more democratic and transparent. It also makes the people more interested in the environment they live in and more willing to contribute to the development of the area.

8. Pre-design analyses for the selected location in Pabianice

8.1. City-scale analyses

LOCATION SELECTION ANALYSIS

In the case of Pabianice, it was decided to use option 2 – selecting a location on a city-wide scale. This is the first city where our solutions will be presented, acting as a pilot, so it was crucial to understand the needs at the city level, and not just respond to local deficiencies.

As mentioned earlier in the general method instructions, the analysis began by marking the areas with the highest density of residential buildings on the city map. Then, the locations of schools and kindergartens were marked, around which zones corresponding to a 15-minute walk were designated – in accordance with the concept of a 15-minute city. In the next step, analogous zones were designated for workplaces. Considering the dispersion of individual places of employment, it was decided to include only larger clusters, such as industrial plants, office buildings or larger service complexes. After comparing the ranges of the three main functions – residence, education and work – it was possible to indicate the areas where their greatest overlap occurs. Although theoretically there could have been several such places or larger areas, in our case one, relatively small area in the strict city center naturally emerged.

A significant facilitation was the fact that one specific plot met all the requirements: in the local spatial development plan it has been assigned a service function, its size allows for the arrangement of all planned modules, and the location itself is located in an area intensively developed by the city and investors (in the vicinity of, among others, the Wool Factory, Weaving Mill, Freedom Park and the modernized Zamkowa Street). What is more, despite its service purpose, this plot currently serves an industrial function - there are abandoned, small buildings and a neglected, mostly concreted area. An additional advantage is the excellent communication of the plot, thanks to the direct vicinity of two main arteries of the city - Zamkowa and Kilińskiego Streets. All these factors make the selected location ideally suited for the implementation of modular solutions complementing urban functions and supporting the sustainable development of satellite cities.

ANALYSIS OF THE QUESTIONAIRE RESULTS

The survey game was conducted among the residents of Pabianice. The main purpose of this part as it was mentioned before is to assess the opinions of the residents concerning the proposed additional features of the satellite city. The results presented are the results of the participants' choices in the individual thematic categories, which of the functions was the most popular. These results form the basis for further design and adjustment of urban spaces to the real needs of the local community.

The game was divided into four stages, each of which played a specific role in the data collection process:

CREATING A RESIDENT PROFILE - the players gave information about themselves (age, professional situation, having children), their district of residence, place of work or study (Pabianice or Lodz) and ways of

transport. Furthermore, they specified for what reasons they most often go to a larger city and what things are important to them.

SELECTING SERVICE FUNCTIONS - the participants had to choose two services from a list of previously designed pavilions in six thematic categories (daily services, gastronomy, sports, health, entertainment, family functions). Then they placed them in the city centre, in their residential area or at their place of work.

SHAPING GREEN SPACES - the players enriched the city with mini parks, community gardens, sensory paths, recreational sport areas, spaces for events and picnic areas.

ADAPTING THE CITY TO THE NEEDS OF DIFFERENT SOCIAL GROUPS - the last stage gave the participants the opportunity to adapt their city by adding quiet zones, remote work areas, family zones and animal-friendly spaces.

In the end the participant got the result of his game, the evaluation of the potential of the created city. This result depended mainly on the number of the chosen green elements and the level of social adaptation which was to indicate their importance in sustainable urban development in a subtle way.

Thus, this way of the game helped to make the process of filling out the survey more interesting and to obtain more thorough and adequate data.

250 residents of Pabianice took part in the study and made their choices in six main categories during the game: daily services, gastronomy, sports, health, entertainment and places for families with children (for people who have or plan to have children). Also, participants chose elements of green infrastructure and functional zones adapted to various social needs.

The data was presented in the form of graphs which showed the percentage share of the individual functions. This way of presenting data makes it possible to easily compare the popularity of particular solutions and their importance in the future design.

The most chosen functions in individual categories:

DAILY SERVICES: The results showed that the most chosen were bakery (27%) and greengrocer's (25%). This suggests that people like to have easy access to local and simple retail outlets which are the base of daily life.

GASTRONOMY: The most popular in this category was a restaurant (30%), then café (23%). These preferences indicate a high demand for places that are suitable for social contacts and for spending time with others.

SPORTS: The swimming pool (37%) was the clear favourite, the fitness centres (29%) were the second. These choices indicate that the residents would like to have access to facilities that support a healthy lifestyle in one way or the other – both for recreation and for more intense.

HEALTH: The highest score was obtained by the mental health point (30%), which is an important signal about the rising awareness and need of the local community for mental health. The clinic (27%) and diagnostic point (26%) were also highly rated.

ENTERTAINMENT AND EDUCATION: The most interesting for the participants were workshops for adults (40%) and a small cinema (35%). This shows that residents expect to have access to useful ways of spending free time that include both entertainment and self-development.

FAMILIES WITH CHILDREN: The children's club with workshops received support from 36 percent of respondents while the family café received backing from 28 percent. The results demonstrate the necessity of developing spaces that serve families with children through a combination of caregiving facilities and educational and integrative areas.

The section focusing on green spaces and special zones received the most attention from participants who selected MINI PARKS AND PICNIC ZONES: The solution received support from 71% of respondents.

An animal-friendly area received support from 76% of study participants which stood as the highest rating in the research.

The respondents showed strong interest in both Green Areas for Sports Recreation (64%) and sensory and educational paths (50%).

The most selected social adaptation choices included zones for families with children (65%) and places for remote work (47%).

In addition, players could give their own proposals for functions, which also allowed for the collection of qualitative data and new ideas

8.2. Neighbourhood-scale analysis

FUNCTIONAL ANALYSIS

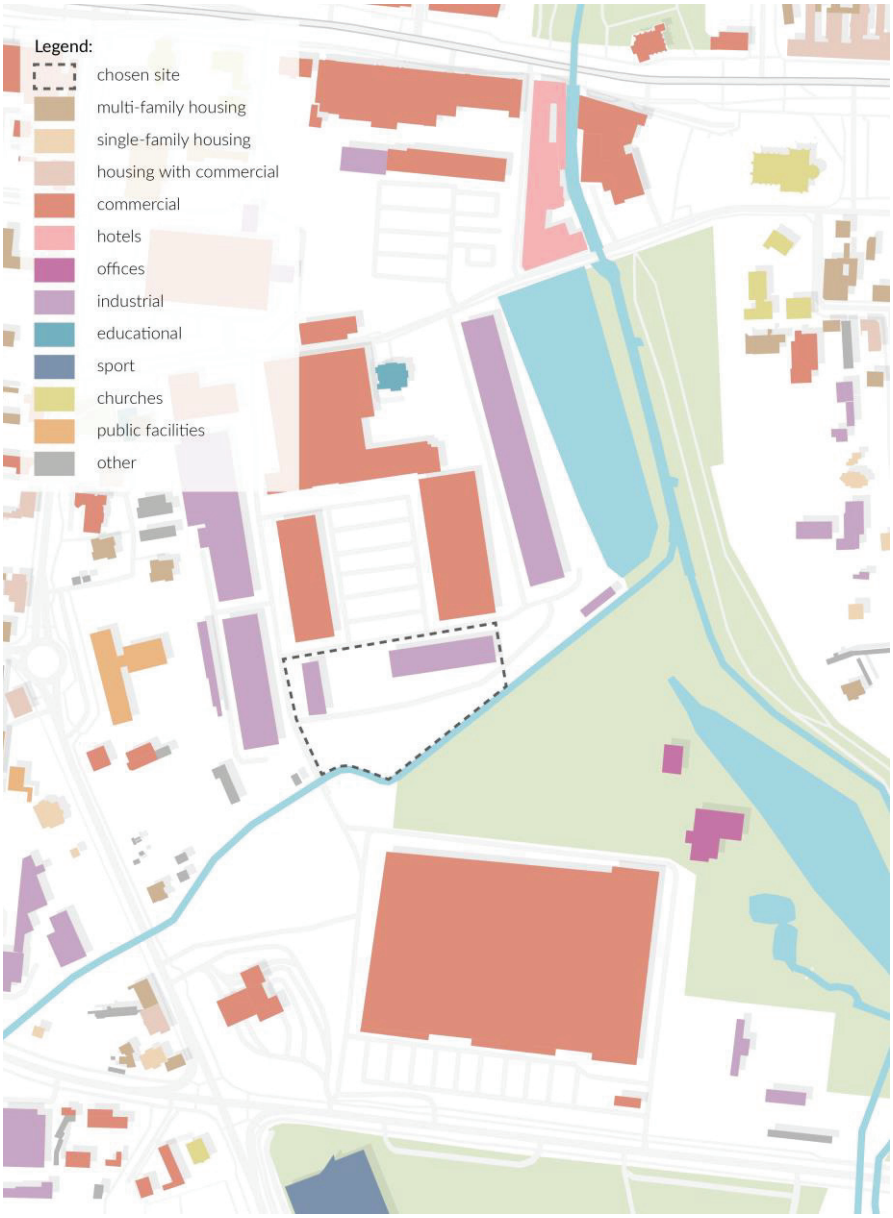

Figure 9 Functional Analysis. Source: Own elaboration

The functional analysis of the area shows a large diversity of use of the space around the selected plot, but in terms of volume, service functions dominate, followed by industrial functions. Single-family and multi-family housing, trade, education, sports, public and religious spaces - all are present, but in terms of scale and intensity of development they are inferior to service functions. The plot is located on the border of this mosaic, between industrial and service zones and the more residential fabric of the city, which makes it a key point of contact and a potential node integrating functions. It is worth noting that this part of the city already has a historically established production and service identity - in the past there were textile factories here, the heritage of which is continued, among others, by the aforementioned Fabryka Wełny hotel. Its presence not only refers to the past, but also creates a new, attractive character of the place. This shows that the transformation of post-industrial space can harmoniously interact with the modern development and needs of a satellite city, such as Pabianice.

COMMUNICATION ANALYSIS

Figure 10 Communication Analysis. Source: Own elaboration

The transport analysis for the selected location in Pabianice shows a very well-developed transport infrastructure in its immediate vicinity. Tram line no. 41 runs through this area – the only tram line in Pabianice – which is a key connection between the city and Lodz, providing a direct access to the center of the Lodz agglomeration. The tram runs along the axis of Zamkowa Street, which has recently undergone a thorough modernization covering the tracks, roadway and pedestrian and bicycle infrastructure. Zamkowa Street runs on the east-west axis and leads towards Lodz in the east and towards Lutomiersk and Poddębice in the west. In turn, Kilińskiego Street, running from north to south, connects the center of Pabianice with Piątkowisko, Kudrowice and further with the national road leading, among others, to Bełchatów and Rzgów. Although some of these towns are smaller, they are characterized by dense residential development and high residential density, which makes them important access points for residents. In the analyzed area, there are also numerous bus stops and a network of bicycle paths, which

provides diverse and convenient travel options. Such transport accessibility and a favorable location in relation to the main traffic directions make the location exceptionally attractive from a functional and urban point of view.

ENVIRONMENTAL ANALYSIS

Figure 11 Environmental Analysis. Source: Own elaboration

The analysis of the greenery reveals a rich, although qualitatively diverse green area of the selected plot. To the north-east of it, there is a vast area of high-quality greenery intended for activity - a beautifully arranged golf course. Although it is a closed space, available on a daily basis only to club members (with a high financial threshold), from the side of the plot it provides exceptional scenic values. What is more, it happens that as part of sponsorship or promotional activities, this facility is occasionally opened for larger city events, such as the Pabianice Days. In the southern part of the study, only a small fragment is another space of active greenery visible - more accessible to residents. This is the area of the Municipal Sports and Recreation Centre, which, apart from

sports functions, also occasionally serves a utility function, e.g. as a cheap, temporary parking lot during All Saints' Day, due to the close proximity of the cemetery - the income from this supports local sports groups.

Along the Dobrzynka River, there is an exceptionally attractive park - the Boulevards, characterized by a natural landscape and natural quality. It flows smoothly into the smaller, more landscaped Park Wolności, which has recently undergone a thorough modernization, enriching the local recreational offer. Part of the river between these two parks flows through the area of the Fabryka Wełny hotel complex – a facility of high architectural and historical value, constituting a contemporary example of post-industrial revitalization. Despite the local fragments of lower quality greenery (mainly accompanying the development), there are relatively few of them, and a fragment of the selected plot is just begging to be filled with new greenery. This would make it possible to close and connect the attractive areas between the golf course and the Boulevards – which is clearly visible in the graphic analysis.

8.3. Selected area-scale analysis

LOCAL DEVELOPMENT PLAN GUIDELINES

CATEGORY	MPZP REQUIREMENT
Primary land use	Service area
Complementary land uses	- Warehouse services - Manufacturing services - Multi-story garages - Technical infrastructure networks and facilities
Biologically active area	Minimum 20% of the plot area
Building coverage	Maximum 60% of the plot area
Development intensity index	Minimum 0.2 / Maximum 1.5
Parking spaces	- Gastronomic services: min. 1 space per 5 m² of customer area - Other services: min. 1 space per 50 m² of usable area
Building height	Maximum 10 m to the highest point of the roof
Roof slope	Up to 20° (flat, saw tooth and industrial-type roofs allowed)
Facade color scheme	Unified color scheme required for the entire building complex
Existing development (temporary use)	Redevelopment/extension/superstructure only allowed to reduce environmental impact

Flood-prone area	For areas within the zone potentially exposed to periodic flooding, the following is established: 1) the possibility of consolidating existing development through renovation and modernization works, with the requirement for the introduction of technical solutions that eliminate the occurrence of damage as a result of flooding for renovated and modernized development; 2) a ban on changing the terrain shape, except for works related to the flood protection system; 3) the possibility of constructing facilities on the condition that: a) technical solutions that eliminate the occurrence of damage as a result of flooding are introduced, b) the development is implemented as a non-basement development; 4) a ban on locating facilities in which movable cultural monuments are stored; 5) a ban on the implementation of individual sanitary sewage systems and underground water intakes; 6) a ban on waste recovery or disposal, including in particular their storage; 7) the possibility of locating water retention tanks.
Archaeological protection zone	In the archaeological protection zone (the entire area covered by the plan) covering areas of potential archaeological sites during the implementation of earthworks, an order to conduct archaeological research in the form of supervision. The issuance of permits for archaeological research and their scope are regulated by separate regulations concerning the protection of monuments;[8]

[8] *Miejscowy plan zagospodarowania przestrzennego miasta Pabianice – obszar położony w kwartale ulic: Partyzancka – Skłodowskiej-Curie – Wiejska – granica miasta*, Uchwała nr XXIV/268/16 Rady Miejskiej w Pabianicach z dnia 3 marca 2016, available at: https://dziennik.lodzkie.eu/WDU_E/2016/1411/akt.pdf

Figure 12 Local Development Plan Guidelines. Source: Own elaboration

Based on the analysis of the provisions of the local spatial development plan (MPZP) and the graphic analysis, it is possible to determine the most important guidelines and restrictions that should be taken into account when designing the complex.

The area covered by the analysis has a basic purpose as a service area (2U), which fully corresponds to the design assumptions. Additional functions are also permitted, such as warehouse and production services, multi-level garages or technical infrastructure - which gives the project additional functional flexibility. Key restrictions resulting from the MPZP include, among others: maximum building height of up to 10 meters, roof pitch of up to 20° (flat, shed and industrial roofs are permitted) and maximum building area of up to 60% of the plot. Additionally, at least 20% of the plot area must remain biologically active, which creates the need to integrate greenery with the functional layout.

Another important aspect is the differentiation of the number of parking spaces depending on the function - for catering services, 1 space is required for every 5 m² of customer service area, while for other services - 1 space for every 50 m² of usable area. .

The analyzed area is partially located in a zone at risk of periodic flooding, which requires the use of specific design solutions: e.g. no basement, implementation of technical protection against the effects of flooding, as well as a ban on the implementation of individual sewage systems. According to the MPZP, it is permissible to locate retention tanks in this zone, which may be an additional advantage in the context of rainwater management within the complex.

The entire area is also located in an archaeological protection zone, which means that archaeological supervision is necessary during all earthworks, in accordance with separate regulations on the protection of monuments.

Based on the map, it can be seen that despite the presence of a zone excluded from development (marked with a hatch) and a zone at risk of flooding, a significant part of the plot remains with a regular shape, fitting into the development line, with communication access and convenient exposure. The key will be the appropriate planning of the spatial layout to use the maximum available area in accordance with the MPZP, while maintaining the functional flexibility of the complex.

Therefore, the design of a modular service complex in this location must take into account both the potential of the area (good communication, service function, the city's emphasis on the development of the area) and planning and environmental restrictions.

9. Design of a universal modular pavilion

The pavilions in this concept are designed in a modular and flexible way to suit different urban functions. The circle as the basic shape of each pavilion is the most universal architectural shape despite the appearance of instability. The circle is the most space-efficient shape that requires the least amount of materials for its construction which results in both economic savings and reduced construction costs. The corner less design enables uninterrupted internal space movement and enhances freedom in design choices essential for pavilion functions.

Each pavilion consists of concrete ceilings - the floor and ceiling, which will connect to adjacent building ceilings at target locations. Between these ceilings there are wooden posts with a cross-section of 5x5 cm, evenly distributed in a circle and offset inwards by 40 cm from its edge, dividing the space into 32 sections. The space between the posts receives rounded 2 cm thick panels made from wood or glass materials based on functional requirements. Open spaces remain where entrance or window openings need to be placed for creating flexible internal layouts.

The construction materials used for pavilions present both an ecological and modern character. The dominant construction material is wood, which comes in a natural oak color or is covered with a color adapted to the local context. LED diodes embedded in 20 cm wide semi-transparent plastic panels cover the outer edge of the pavilion. . Their subtle illumination in colors corresponding to a given function (in accordance with the psychology of colors) gives the structure a modern and recognizable appearance, while emphasizing its visual lightness. These

panels are arranged in the axes of the posts, but in places where a wider passage is necessary, only their upper part with LED lighting is left.

Every pavilion maintains an interior height of 2.8 meters which provides comfortable usage along with suitable conditions for different functions. The pavilions maintain organic shapes through their functional adaptations of interior space which creates harmonious divisions that promote friendly and intuitive interior organization. The modular structure allows for combining smaller forms into larger groups, which additionally increases their functionality and adaptability to various needs of users.

Thanks to their versatility, modularity and flexibility, these pavilions constitute a modern solution supporting the development of sustainable satellite cities, allowing for their harmonious integration into the urban space and adaptation to local conditions and community expectations.

10. Modular pavilions in a selected location

10.1. Concept Of Land Development

10.1.1. Existing Condition

The selected plots (15/24, 15/25 and 15/28) are situated in the central part of Pabianice, in the Lodz province. This area, in accordance with the applicable local spatial development plan, is intended for service functions. At present, this area is mainly paved and flat, with warehouse buildings prevailing. The old warehouses situated on it are in a bad technical condition and are qualified for demolition. The only object that remains in use and is not subject to removal is the telephone tower.

As for greenery, most of the plots are currently empty of vegetation, with the exception of a few smaller clusters of greenery and a strip of tall greenery in the southern and western parts of the plot, which is worth preserving as a natural spatial buffer. Furthermore, the southern border of the plot directly borders the narrow riverbed of the Dobrzynka River, which is an important landscape and natural element that should be taken into consideration in the design process.

The plots are fully equipped with technical infrastructure. Within the area there is a water supply network, sanitary and rainwater sewerage, heating and electricity, which facilitates future development. On the north and west sides, the plots border public roads, providing convenient communication. At present, the main entrance to the area is located in the middle of the western border of the plot and is a key element of the communication system.

Because of its location, infrastructure availability and the potential resulting from the local spatial development plan, the area is an attractive location for the implementation of modular service pavilions that will fit into the urban context of the city and create a new, functional urban space.

10.1.2. Designed Condition

The land development project involves a complete rearrangement of the existing space by removing the existing warehouses and reusing the functioning telecommunications tower that cannot be removed due to its utilization. The urban context analysis revealed that the tower being a closed and tall structure separates the main part of the investment from the park view along a wider section of the Dobrzynka River. A decision to shape the elevation in the eastern part right in front of the tower was made in the form of a green roof which smoothly connects to the ground level. It aims to both block the investment area from the technical aspect of the tower surroundings and neighboring plots as well as establish a natural observation point that faces the park. The space under the roof received utilization as a parking area because the plot stood within an area prone to periodic flooding that made building construction below ground level impossible. This process provides optimal usage of the space while creating visual barriers to separate the parking lot from the main functional and attractive investment areas. The entrance and exit to the car park were positioned from the northern boundary of the plot because the access road to the adjacent shopping center ran through this point thus creating a natural and logical connection. The eastern section of the plot received designated intensive and naturally developed greenery because of its restricted accessibility which also served to create a visual barrier between the usable area and less attractive spaces near the plot and park. Four buildings with organic circular shapes and irregular recesses at different levels formed the primary urban design section in the western part of the plot. The functional layout of the development was based on the division into two larger facilities, housing gastronomic, family, entertainment and commercial pavilions, and two smaller ones - dedicated to health and sports services. The building locations balanced user accessibility with functional requirements since noisy public areas face the street while health and sports facilities were shifted to quieter spots near the greenery.

Two wide ramp pathways form the core of the layout by encircling buildings like ribbons to establish spatial connections and smooth transitions between different terrain levels. A strategic node located in the north-western part of the plot serves as the starting point for both paths which can be accessed from three different directions. The first path serves as a boundary between large commercial buildings and sports facilities and smaller health facilities. The path continues its ascent behind the sports building before rising above the car park to end at its best vantage point for the park view. The second path starts from the health building's southern side by ascending to the first floor level before linking to the facility balcony and crossing the first path at two points before descending gently to the ground level in the southern plot section where it provides views of the Dobrzynka thinner part and adjacent golf course. Due to the attractiveness of the presence of water in urban space and the potential threat of flooding, the project includes rain gardens with organic forms. They have a dual function - they protect the area from the effects of heavy rainfall, and at the same time they are aesthetic water reservoirs that harmoniously fit into the space between buildings and paths in the greener part of the plot.

Standard pedestrian paths serve as part of the project alongside the main ramps to connect buildings and essential recreational areas. . In the southern part of the plot, a landscape path was designed running along the most attractive areas in terms of views. In the northern part, between the paved paths, a geogrid with appropriate load-bearing capacity was used, thus creating an aesthetic and functional fire road, invisible at first glance.

The development contains five thematic green modules which take their design from service pavilion forms. The designated areas serve different purposes as picnic sites, sports areas, mini parks, sensory educational pathways and public gardens. The arranged spaces match the purposes of adjacent buildings and also some areas are located above the car park structure.

A deliberate section of car park elevation received a cutout to provide natural lighting and safer user conditions during nights or when the car park is unattended.

The proposed development plan unifies multiple functions into one cohesive space that provides accessibility to all users through balanced functional and aesthetic design.

10.1.3. Terrain Balance

	[m^2]	[%]
TOTAL LAND AREA	12 537,70	100
BUILDING AREA	1 428,98	11,40
PARKING ROAD AREA	505,37	4,03
PARKING AREA	509,50	4,06
ROAD FROM THE GEOCRAT AREA	128,48	1,02
AREA OF PATHS	1 446,69	11,54
GRAVEL AREA	586,86	4,68
AREA OF RETENTION GARDENS	439,75	3,51
BIOLOGICALLY ACTIVE AREA	7 492,07	59,76

10.2. Architectural Concept

10.2.1. Architectural Form

The architectural concept is a synthesis of modularity and organic forms to achieve a modern and harmonious space that responds to the needs of the users in the present. Four buildings were developed using circular bases and functional modular pavilions were located inside them. The design was not random; it was created to meet the functions of each building and the interactions between them. Each level is distinguished by recesses in relation to the circular base, which create natural spaces for balconies or green, hanging gardens, enriching the aesthetics of the buildings and emphasizing their friendly character. The key visual element is the glass façade that is wrapping the buildings like a delicate fabric, which is a reference to the textile history of Pabianice. It is a very subtle connection to the industrial heritage of the city, but in a modern and innovative way. Additionally, the use of metal panels with perforations inspired by traditional weaves allows for control of the amount of light entering the buildings. The perforation patterns are different for every floor and building which gives the architecture a special, layered look. This project is the first attempt of using modular pavilions, therefore the architecture should not only

fit with the character of the pavilions themselves but also stress their idea as a flexible, ready-made urban solution for satellite cities. The structure that consists of circular and rhythmically arranged ceilings, slightly recessed glass facade, and industrial details such as perforated panels refer to the tradition of the city but at the same time create a contemporary space with a unique character. Importantly, the separation of individual functions between separate buildings, rather than closing them in one compact block, allows for better integration of the architecture with the surroundings. The layout of the spaces between the buildings that are organic, have ramps, paths, greenery and recreational areas well thought out promote openness and free use of the area, thus creating a fluid and dynamic urban space. This way the project not only stresses out its unique and modular character, but also complies with the idea of solutions for the future of developing cities.

10.2.2. Functional And Spatial Program

The project assumes the division of functions into four separate buildings. It allows for better adaptation of the space to different user groups and more flexibility in the organization of urban space. Each of the buildings plays a specific role, responding to the different needs of residents - from services and gastronomy, through culture and recreation, to health and physical activity. The largest of the buildings serves a commercial and gastronomic function. On the ground floor there is a bakery, a grocery store, a greengrocer's and facilities such as a mother and child room and toilets. On the first floor there is a café, a restaurant and a balcony space, providing additional quality of use and contact with the surroundings. It is also located closest to the car park, which makes it easier to move around with heavy purchases. The second largest building is a cultural and educational center. On the ground floor there are three cinema halls, while on the first floor there is a café for families with children, a children's club with workshops and a mother and child room. The second floor, which is the only third floor in the complex, offers space for adults - workshops and a library. The next two buildings are dedicated to health and recreation. The sports building contains two intimate gyms on the ground floor, while a swimming pool is located on the first floor, creating a place for a wide range of physical activities. The last building, fulfilling a pro-health function, includes a clinic on the ground floor and mental health offices on the first floor. Each of the buildings was designed to be as open to users as possible - the functions were arranged to encourage the natural flow of people between the buildings and their mutual integration. In addition, the space between pavilions received green areas, ramps and paths and recreational zones which formed an interactive and relaxing environment. The project has basic urban functions and actively integrates with modern sustainable development through its combination of architectural design with natural elements and users' needs.

10.3. Technical Description

10.3.1. List Of Rooms

RECREATION AND ENTERTAINMENT BUILDING		
Ground Floor		
Number	Room	Area [m^2]
0.1	Hall	99,94
0.2	Women's restroom	6,13

0.3	Men's restroom	6,13
0.4	Restroom for disabled	4,23
0.5	Intimate cinema	39,82
0.6	Intimate cinema	39,82
0.7	Intimate cinema	39,82
0.8	Staircase	12,09
First Floor		
1.1	Hall	80,98
1.2	Women's restroom	6,13
1.3	Men's restroom	6,13
1.4	Restroom for disabled	4,23
1.5	Parents and kids room	20,59
1.6	Family café	53,48
1.7	Kitchen	12,42
1.8	Stuff room	4,21
1.9	Stuff restroom	2,27
1.10	Staircase	12,09
1.11	Children's club with workshops	49,76
Second Floor		
2.1	Hall	102,81
2.2	Women's restroom	6,13
2.3	Men's restroom	6,13
2.4	Restroom for disabled	4,23
2.5	Library	39,82
2.6	Workshops for adults	73,28
2.7	Staircase	12,09

GASTRONOMY AND COMMERCIAL BUILDING		
Ground Floor		
Number	Room	Area [m^2]
0.1	Hall	272,86
0.2	Staircase	12,09
0.3	Parents and kids room	20,59

0.4	Women's restroom	6,13
0.5	Men's restroom	6,13
0.6	Restroom for disabled	4,23
0.7	Grocery store	53,48
0.8	Stuff room	4,21
0.9	Stuff restroom	2,27
0.10	Storage	12,42
0.11	Bakery	13,57
0.12	Storage	2,17
0.13	Stuff restroom	3,30
0.14	Greengrocer's	13,57
0.15	Storage	2,17
0.16	Stuff restroom	3,30
First Floor		
1.1	Hall	178,48
1.2	Staircase	12,09
1.3	Parents and kids room	20,59
1.4	Women's restroom	6,13
1.5	Men's restroom	6,13
1.6	Restroom for disabled	4,23
1.7	Restaurant	53,48
1.8	Kitchen	12,42
1.9	Stuff room	4,21
1.10	Stuff restroom	2,27
1.11	Café	30,66
1.12	Stuff restroom	2,93
1.13	Storage	5,15

SPORT BUILDING		
Ground Floor		
Number	Room	Area [m^2]
0.1	Hall	89,19
0.2	Women's restroom	6,13

0.3	Men's restroom	6,13
0.4	Restroom for disabled	4,23
0.5	Staircase	12,09
0.6	Intimate gym	20,59
0.7	Intimate gym	20,59
First Floor		
1.1	Hall	50,09
1.2	Women's restroom	6,13
1.3	Men's restroom	6,13
1.4	Restroom for disabled	4,23
1.5	Staircase	12,09
1.6	Swimming pool	53,48
1.7	Women's changing room	3,25
1.8	Women's restroom	4,65
1.9	Men's changing room	3,25
1.10	Men's restroom	4,65
1.11	Sauna	2,87

HEALTH BUILDING		
Ground Floor		
Number	Room	Area [m^2]
0.1	Hall	
0.2	Women's restroom	6,13
0.3	Men's restroom	6,13
0.4	Restroom for disabled	4,23
0.5	Staircase	12,09
0.6	Clinic's hall	23,47
0.7	Doctor's office	9,53
0.8	Doctor's office	9,53
0.9	Doctor's office	10,94
0.10	Doctor's office	10,94
0.11	Restroom	2,87
0.12	Storage	4,46

First Floor		
1.1	Hall	78,47
1.2	Women's restroom	6,13
1.3	Men's restroom	6,13
1.4	Restroom for disabled	4,23
1.5	Staircase	12,09
1.6	Mental health point	20,59
1.7	Mental health point	20,59

10.3.2. Construction And Material Solutions

CEILINGS

The primary buildings' main ceilings consist of monolithic concrete which provides both strength and stability across extensive spans. The buildings incorporate reinforced concrete ceilings which provide structural support for the modular structures throughout their internal spaces. The extended ceiling slabs beyond the facade perimeter create protected outdoor areas with integrated vertical planting spaces.

CONSTRUCTION OF THE PAVILIONS

The pavilions utilize wooden construction elements which support the modular design and functional adaptability of the buildings. The glued laminated timber (GLT) skeleton provides both long-term durability and simplifies prefabrication processes. The wooden construction of the pavilions produces friendly indoor conditions and excellent acoustics throughout their spaces.

EXTERNAL WALLS AND FACADE

A glass façade envelops the buildings to mimic Pabianice textile traditions by creating a light and translucent textile effect. Movable metal panels with weaved designs and sunlight control functions were installed in specific locations. The pavilions employ CLT technology (cross-laminated timber) construction for their walls which provides both stability and superior surface finish.

COLUMNS AND SUPPORTS

Each building floor receives its supporting structure from columns that conform to functional needs and architectural shapes of their respective floors without following a standard pattern. The reinforced concrete columns that carry ramps and the car park roof structure are designed for durability because they must resist dynamic loads. These elements will be partially covered with climbing greenery, which is in line with the ecological assumptions of the project and allows for their subtle integration into the landscape.

ROOFS

The roofs of every building feature extensive vegetation which provides thermal insulation and improves microclimate conditions and enhances rainwater collection.

ADDITIONAL ELEMENTS AND ECOLOGICAL SOLUTIONS

The rain gardens and water retention systems in the project serve to decrease runoff while enhancing the local environment. The modular design enables future function reorganization without needing expensive structural modifications.

10.3.3. Installations

WATER AND SEWAGE SYSTEM

The buildings are connected to the municipal water supply network, the sanitary and rain sewage system. On the investment site, a system of retention gardens was designed to help in the management of rain water and enhance the micro climate. From the roofs of the two largest buildings, rain water will be collected and stored in an underground tank with a capacity of about 50 m3 located between these buildings. Total area of 851 m². Rainwater will be utilized for watering the greenery on the investment site and will be available to the users of public gardens.

ELECTRICAL INSTALLATION AND LIGHTING

All buildings and technical devices are powered by the municipal power grid. The roofs of the buildings are planned to have photovoltaic panels installed to generate power for external lighting and building automation systems. The external lighting is of the energy-saving LED type and is fitted with twilight and motion sensors in order to reduce on energy consumption.

HEATING INSTALLATION AND VENTILATION The buildings are connected to the municipal heating network which enables efficient heating of buildings and reduces CO_2 emissions than individual heating systems. The mechanical ventilation system with recuperation provides thermal comfort and reduces heat loss. Additionally, passive solutions have been used to limit overheating of rooms in the summer - The glazed facades are provided with movable perforated metal panels that reduce the amount of incoming light depending on sunlight.

RAINWATER RETENTION AND MANAGEMENT SYSTEMS Besides the main rainwater tank, permeable surfaces have been incorporated into the investment site to prevent runoff of rainwater. Rain gardens and a green roof system assist in the natural water retention and purification. Rainwater, apart from being used for irrigation of plants, can be adapted in the future for use in grey water installations, for instance, flushing toilets.

ECOLOGICAL SOLUTIONS AND INTELLIGENT MANAGEMENT SYSTEMS The buildings are equipped with an intelligent energy management system which monitors the consumption and optimizes the operation of the installation. High efficiency sanitary facilities and fittings were used in order to reduce the consumption of

water. Waste collection points for segregated waste and composters for the use of public garden users have been put in place in the investment area.

This project has been implemented with solutions that reduce energy consumption, support local water management, and enhance user comfort while respecting the environment. Furthermore, such measures can be made transparent and their benefits and savings will be public, for instance, through exhibitions, educational events, or through the presentation of real savings and benefits accruing from the technologies used, which can encourage users to adopt similar measures in their homes and investments. Such an approach not only fosters pro-ecological thinking, but also enhances the self-sufficiency of satellite cities in the face of climate change and the well-being of the residents.

10.3.4. Accessibility

The project design include complete accessibility features to create an inclusive architectural example which provides safe and comfortable accessibility for users with various disabilities.

HORIZONTAL AND VERTICAL COMMUNICATION

All buildings have wheelchair-accessible elevators with suitable dimensions and operational features for user convenience. Ramps leading between buildings provide full wheelchair accessibility through proper installations of railings and additional landings when slopes exceed recommended standards. The main entrances to the buildings are accessible because they do not have thresholds and feature automatic doors.

SANITARY FACILITIES AND INTERNAL AMENITIES

Every floor of the buildings contains restrooms that are accessible for people with disabilities. Service points together with utility areas including cafes and restaurants and libraries feature lowered service counters and seating arrangements for convenient use.

ACCESSIBILITY FOR THE BLIND AND VISUALLY IMPAIRED

The walking paths contain textured guide markers which help people navigate through space. Buildings along with important path junctions utilize Braille information signs. The circulation routes feature contrasting marks which highlight stairs and doors and ramp edges.

ACCESSIBILITY FOR THE DEAF AND HEARING IMPAIRED

The public buildings including cafes the library and workshop center have induction loop systems available for users who wear hearing aids. The multimedia screens together with information boards serve as orientation tools and display essential details without needing audio announcements.

ADAPTATIONS FOR THE ELDERLY

The space features comfortable movement design through wide pavements and ergonomic benches and additional rest areas placed along main pedestrian routes. The buildings receive lighting design that reduces glare while providing better visibility through the night.

PARKING AND TRANSPORT

Specialized parking spaces reserved for people with disabilities are located close to all building entrances. The walking paths lead to the buildings through minimal height changes and feature gentle ramps for smooth accessibility..

10.3.5. Fire Protection Conditions

The design of the complex meets the requirements of applicable fire protection regulations, including technical conditions of buildings and Polish Standards related to fire safety.

FIRE RESISTANCE CLASS OF BUILDINGS

In accordance with § 212 of the Technical Conditions (WT), the buildings have been classified into the appropriate fire resistance classes:

Main service buildings (commercial, catering and cultural) – class B (due to height and function)

Sports building and health building – class C (low-rise, public utility buildings)

ALL BUILDINGS MEET THE MINIMUM REQUIREMENTS FOR FIRE RESISTANCE OF THE MAIN STRUCTURAL ELEMENTS:

Main load-bearing ceilings and walls: REI 120

Ceilings in modular pavilions: REI 60

Fire separation walls: REI 120

Construction of wooden pavilions: protection with fire retardants up to class R 60

Glazed facade of buildings: fire-resistant glass in the required zones

PEOPLE HAZARD CATEGORY (ZL)

In accordance with § 209 of the WT, the buildings have been classified into the following categories hazards to people (ZL):

Service building (trade, catering): ZL I

Cultural building (cinema, library, children's club): ZL I

Sports building: ZL III

Health building (clinic, psychological offices): ZL II

FIRE ROAD AND ACCESS FOR RESCUE UNITS

A hardened fire road was designed that meets the requirements for width (min. 4 m), load-bearing capacity (100 kN/axle) and turning radius for fire brigade vehicles.

Each building has access for the fire brigade from at least one side in accordance with § 12 WT.

FIRE WATER INSTALLATION

Two fire hydrants are already located on the investment site to provide access to water for fire brigade units.

Internal hydrants of 25 mm, placed in accordance with PN-B-02861:2017, were provided in the commercial and cultural buildings.

EVACUATION AND SAFETY SYSTEMS

Two independent evacuation routes for each building.

Evacuation signage and emergency evacuation lighting in accordance with PN-EN 1838:2013.

Gravitational and mechanical smoke extraction systems for staircases.

Fire alarm system (SSP) in ZL I and ZL II buildings, in accordance with the Regulation of the Ministry of Interior and Administration.

Evacuation doors with a width of at least 1.2 m, opening in accordance with the evacuation direction.

11. Conclusions

This paper presents a systematic approach toward the creation of satellite cities, with attention to their location within the metropolitan area and their capacity for self-containment. This research paper covers a broad analysis of the definition, genesis and specificity of satellite cities, including their historical background and contemporary difficulties. The main challenges that hinder their growth were recognized: deficiency of local services, absence of social and cultural infrastructure, low quality of spatial planning, subordination to the central city and lack of local identity. The comparative analysis of European and global cases, including Ząbki, Milton Keynes, Ratingen, and Tsukuba, helped to determine certain good practices that help enhance the self-containment of these cities. This work also considers the role of social participation in planning processes and the innovative methods of engaging residents, from VR consultations to city games and mobile applications, which are important elements in the formation of social bonds and the creation of spaces that meet the actual needs of users.

The theoretical study and contextual review ended with the design part which presented a particular answer to the problems discovered earlier by offering a catalogue of universal, modular service and recreational pavilions for satellite cities. An analysis of the spatial and social needs of residents was carried out using the example of Pabianice, a satellite city of Lodz, with an original research tool in the form of an interactive survey game. The results of the survey allowed the development of a functional and spatial program tailored to the local context. The modules are flexible and can be freely configured, adjusted to the needs of local communities and implemented with the involvement of local architects and urban designers, which underlines the importance of the co-creating the city process.

It can be concluded that the development of satellite cities needs an integrated approach that involves urban analysis, recognition of local needs, flexible architectural solutions, and the participation of residents. The proposed solution – a catalog of modular pavilions supported by a universal research methodology – is a tool that can be applied to any satellite city, regardless of its size or type. It is a response to the real needs of local communities, which increasingly expect a quality of life comparable to large cities, but at the same time value a smaller scale, neighborliness and accessibility. This way a satellite city can change from a peripheral 'bedroom' to a fully-fledged, sustainable and independent urban center.

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