ROLE OF STREETSCAPE IN SHAPING URBAN DESIGN IN ROMANIA. APPLYING THE CONCEPT OF 3D INTERACTIVE AND INTERCONNECTED STREETS. CASE STUDY: URBAN AXIS BISTRIȚA-BECLEAN-NĂSĂUD-SÂNGEORZ-BĂI

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ABSTRACT. – Role of Streetscape in Shaping Urban Design in Romania. Applying the Concept of 3D Interactive and Interconnected Streets. Case Study: Urban Axis Bistrița-Beclean-Năsăud-Sângeorz-Băi. Urban boulevards are the most dispersed and heavily trafficked urban open spaces. As urban communities strive to improve decency in the built environment, planners and designers must have a succinct understanding of what contributes to the quality of urban landscapes. Streets are a vital part of any city's public open space system. They act as movement corridors for pedestrians, cyclists, traffic, and vehicles and support many social and commercial activities. The presence and character of the streets play a huge role in determining the overall quality and liveability of the city. The document examines the existence of street elements - paving, street trees, central medians, lighting, and street furniture - which, when applied over time, enrich the city's visual image and urban design. It also focuses on the basic elements and principles of the urban landscape that improve the quality of urban street design, accessibility, and pedestrian circulation. In addition, the analytical study covers some examples by relating the basic principles of the urban landscape to use them to develop the urban landscape of one of the main urban streets on the Bistrița-Beclean-Năsăud-Sângeorz-Băi urban axis. The article concludes with sustainable urban landscape solutions that will positively impact sustainable urban design, the functional and aesthetic aspects of the built environment, and, therefore, the visual image of cities in Romania.

Keywords: Urban landscape, urban design, Bistrița-Beclean-Năsăud-Sângeorz Băi urban axis, Romania.

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1. INTRODUCTION

Urban Design is the speciality of creating and shaping urban areas and towns. It involves the arrangement and design of buildings, open spaces, transport systems, services, and amenities (Carmona et al., 2010). It gives form, shape, and character to groups of buildings, entire neighbourhoods, and the city (Bahrainy & Bakhtiar, 2016). It is a system that organises these elements into a network of boulevards, squares, and blocks. Urban design blends architecture, landscape architecture, and city planning to create functional and attractive urban areas.

It includes the character and definition of those components that make up the public realm, including the public streetscape, open and private open spaces, and the buildings that define and locate the street. Urban character is defined by the scale and type of the buildings, the pedestrian scale, and the public spaces created by the buildings (Carmona et al., 2003; Gehl, 2010). Urban design is key to creating places that are effective both socially and economically, great to live in, and attractive to visit (Talen, 1999). Urban design is crucial in creating community identity (Alexander et al., 1977).

Streetscapes are vital components of urban design that serve multiple functions, from enhancing aesthetics to promoting social interactions and economic vitality. By prioritising thoughtful streetscape design, cities can create more livable, vibrant, and sustainable environments (Cervero & Kockelman, 2020, p.132).

In an urban environment that is often very dynamic, benches provide an opportunity to regenerate energy (Fischer & Schmid, 2020). They serve as meeting places for people, facilitating social interaction between individuals and promoting a sense of community (Gehl, 2011). This contributes to building social ties, as street furniture plays a basic role in creating welcoming and functional public spaces (Carr et al., 1992).

Among the key elements, outdoor benches play a prominent role, offering a place to rest and an aesthetic contribution to the surroundings (Murray, 2010).

Effective planning in the broadest sense can help deliver better public services (Bertolini & Spit, 2017). It also achieves value for money in new developments and makes good use of scarce resources (Gehl, 2010). Urban design is ultimately a key method for meeting the challenges of sustainable development (Sustainable Development Solutions Network, 2015). By focusing on reconstructing settlements to improve them, it aims to operationalise strategies for balancing the environment, economy, and social domain (Lehmann, 2018).

The functionality and operation of a geographic system have an active and appropriate character because they must ensure sustainability under various impacts and environmental conditions, as geographical transformations have a specific finality (C.C. Pop, 2016, p. 286). In this context, the reason for the

existence of the geographical axis, interpreted as geosystems in dynamic balance, is given by the active and adequate character of the juxtaposed and ongoing intra-systemic and extra-systemic reactions (C.C. Pop, 2016, p. 286).

The geographical axis operates through the integration of its constituent elements, and every point, place, level, order of organisation, secondary axis, major axis, local mesh, and so on, has its organisational laws (C.C. Pop, 2016, p. 287). A geographical axis comprises elements, and how these elements manifest reflects the status of its functioning (C.C. Pop, 2016, p. 289).

For example, the social axis is a functional territorial axis, defined by the following component elements: an urban functional nucleus, structured into four unequal segments consisting of the dominant urban localities; the territory corresponding to the urban territory (periurban), which is linked with the urban from economic, social, and natural points of view (C.C. Pop, 2016, p. 289).

2. MATERIALS AND METHODS

This component focuses on the overall layout, aesthetics, and functionality of urban spaces. It examines how streetscape design influences social interactions, mobility, and the identity of a place.

The methodology involves:

➢ Literature Review: Analysis of the existing research on urban design principles, historical context, and contemporary practices. Streetscape and Urban Design, Elements of Streetscape, Functions of Streetscape;

➢ Case Studies: Selection of diverse urban environments (e.g., historic districts, modern developments) to assess different streetscape designs and their impacts;

➢ Field Observations: Conduct on-site assessments to evaluate the physical characteristics of streetscapes, including materials, colours, and spatial organisation.

a. Streetscape and Urban Design

Within the framework of urban sustainability, urban communities represent fundamental building blocks of cities. They are not only the primary living environments for residents but also critical spaces for social interaction and public service provision, fulfilling diverse political, cultural, and economic functions (Lai, Wang, & Xia, 2025). Streetscapes are a significant element of the community realm, which not only helps to define mobility but also reflects a community's aesthetic quality, uniqueness, economic activity, well-being, social cohesion, and opportunity. According to Moudon (2018), the design of streetscapes can influence mental health, with elements such as greenery, sidewalk width, and façade

permeability playing a role in reducing anxiety. Streetscape design also has a substantial effect on how people perceive and interact with their community and the built environment. As Parker and Mehta (2020) argue, pedestrian-friendly streetscapes encourage walking, which in turn reduces automobile traffic, supports local businesses, and improves public health.

Designing boulevards can help urban designers create diverse transportation systems and more accessible neighbourhoods by improving non-motorised travel conditions, enhancing urban environments, and incorporating special design features such as pedestrian walkways, cycling tracks, traffic calming measures, and road space reallocation (Buehler & Pucher, 2017).

Streetscaping is a significant component of New Urbanism, Transit-Oriented Development, and other efforts to redevelop urban areas. It often includes wider sidewalks, bus pull-outs, bicycle lanes, and improved on-street parking design (Cervero, 2018). Streets play a vital role in enhancing the experience of individuals, the visual image of the city, and enriching interactions with the city (Gehl, 2019). It helps in understanding the linkages between the city's open spaces (Lehmann, 2020).

Allied pedestrian networks allow people to travel easily and comfortably within the city and facilitate the use of public transportation. They connect open spaces, landmarks, and nodes, and can be at different levels, allowing one to experience the city from various viewpoints (Moudon, 2018). The street, perhaps more than any other single element of urban design, has two powerful effects: it can unite a single enclave, or it can support or undermine the function of a particular enclave—it can be beneficial or detrimental to the area it serves (Sennett, 2018).

The street is one of the most vital factors of urban form. It is to the city what the wheel is to machinery (Cervero, 2019).

Thus, urban design for any city could start with an evaluation of streets according to their widths and positions, and from that, an idea could be formed of where different central city developments might take place, appropriate to the physical dimensions of the city (Talen, 2021).

b. Streetscape elements

Streetscape elements emphasise the unique character of a neighbourhood, block, city centre, or historic district.

For instance, benches in downtown areas or shaded sidewalks on residential streets encourage activity and create an active environment, which significantly contributes to the overall livability of an area (Mehta, 2019; Montgomery, 2020; Jacobs, 2020). (Figure 1)

Elements of streetscape are major constituents of streets' urban design and are encapsulated as follows:

a. Sidewalks: Pavement is a prerequisite element of any streetscape. Sidewalks should be designed to provide secure, appealing, interesting, and pleasant spaces for pedestrians by incorporating well-designed and harmonised tree planting, street furnishings, and lighting (fig. 2).

b. Planters: Planters add texture, colour, and interest to a streetscape. They help define and separate spaces, determine primary building entrances, and boost aesthetic value.

c. Street furnishings: Street furniture should be compatible and harmonised in design, colours, styles, and materials, supporting the architectural style.

d. Benches: Benches are significant public resources that contribute to making the city an enjoyable space for pedestrians.

e. Lighting: Lighting is a vital component of the streetscape, creating safe, secure, and aesthetically appealing public spaces, especially at night.

f. Trash receptacles: Trash receptacles are essential streetscape elements and should be strategically placed near benches, bus stops, and other activity nodes to minimise pollution.

g. Signage: Signage plays a major role in designing a pleasant urban environment by providing orientation tools and visual guides for both drivers and pedestrians.

h. Bus shelters: Bus shelters are structures situated at bus stops to protect passengers from the weather. All bus stops should be marked by bus stop signage and equipped with benches and trash receptacles.

i. Street corners: Street corners provide enhanced pedestrian space and opportunities for people to interact and communicate through the arrangement of benches and site furnishings (fig. 3).

j. Medians: Medians are an effective method of making a streetscape more pedestrian-friendly and dramatically altering the visual character of the street for both pedestrians and motorists.

k. Crossings: Crosswalks are an essential part of the pedestrian network. Enhanced crosswalk paving can make motorists more aware of pedestrian activity.

l. Public art and Café space: Public art can valuably contribute to local identity and provide multiple and layered expressions. It can become a local landmark or add richness to a building or landscape.

Outdoor cafes provide an active street frontage and natural locations for arranged and spontaneous social interactions (Zhang, L. & Zhao, Y., 2016, p. 267).

Trash receptacles play a crucial role in urban research for several reasons:

➢ Litter Reduction: Proper placement and availability of trash receptacles significantly reduce litter in public spaces.

Studies have shown that increasing the number of trash receptacles can decrease litter and the time spent by staff cleaning.

➢ Public Health: Effective waste management through well-placed trash receptacles helps maintain public health by reducing the spread of diseases and pests associated with litter.

➢ Urban Aesthetics: Trash receptacles contribute to the overall aesthetics of urban areas. Well-designed and strategically placed receptacles can enhance the visual appeal of streetscapes.

➢ Social Behaviour: The presence and accessibility of trash receptacles influence social behaviours. People are more likely to dispose of waste properly if receptacles are conveniently located.

➢ Environmental Impact: Proper waste disposal reduces environmental pollution. Trash receptacles help in segregating waste, promoting recycling, and reducing the amount of waste that ends up in landfills.

➢ Data Collection: Trash receptacles can be used to collect data on waste generation patterns, which can inform urban planning and waste management strategies.

Fig. 1. Identification of streetscape elements (bench, litter bin)
*Source: the authors, Bistriţa, Lamă area - Andrei Mureşanu Street*

The number of trash receptacles required will depend on specific local conditions, including waste management practices and community needs. Adjustments may be necessary depending on actual waste composition, disposal methods, population growth in the city and living space.
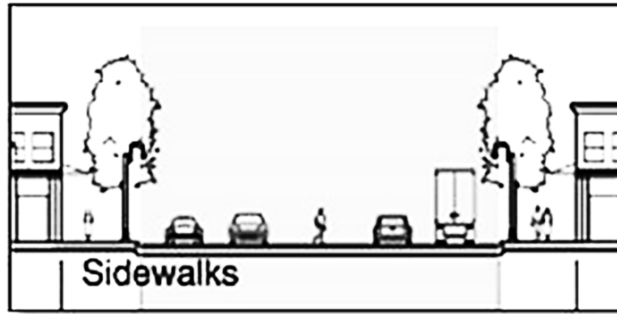
Fig. 2. Model Sketch Sidewalks
Source: Realised by the authors in https://www.giraffe.build/
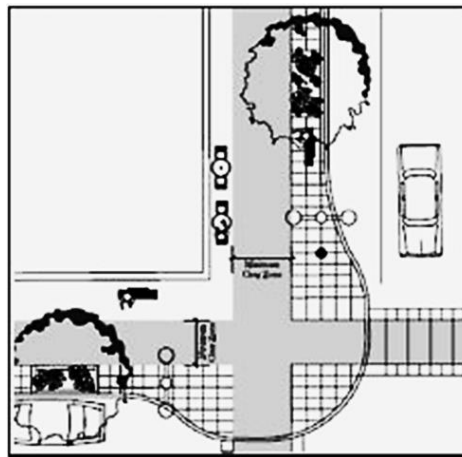
Fig. 3. Schematic street corners
Source: Realised by the authors in https://www.giraffe.build/

3. RESULTS AND DISCUSSIONS

For better organisation and clarity, the research results are structured into two subchapters:
I. Urban street design and functionality
II. Applying the Concept of 3D Interactive and Interconnected Streets;

I. Differences Between Street and Boulevard (table 1)

Street: A public road in a city or town, typically lined with buildings and designed for vehicle and pedestrian movement (Baker, 2015).

Public thoroughfare in a city or town, typically with buildings on one or both sides (Merriam-Webster, 2025).

Boulevard: A wide, multi-lane road often featuring landscaped medians, designed for both vehicle traffic and pedestrian use (Fitzgerald & Johnson, 2020).

Table 1. Comparison between dimensions and functionality

Feature	Street	Boulevard
Width	Typically ranges from 20 to 60 feet (6 to 18 meters) (Nguyen & Patel, 2019)	Generally wider, often 60 to 120 feet (18 to 36 meters) or more (Thompson & White, 2022)
Lane Count	Usually has 1 to 2 lanes in each direction (Wang, 2017)	Often has 2 to 4 lanes in each direction, plus turn lanes (Zhang & Lee, 2023)
Design	Basic design, primarily functional (Baker, 2015)	Enhanced design often includes landscaping and aesthetics (Fitzgerald & Johnson, 2020)
Traffic Volume	Lower traffic volume (Nguyen & Patel, 2019)	Higher traffic volume, accommodating more vehicles (Thompson & White, 2022)
Usage	Primarily for local traffic (Wang, 2017)	Designed for regional traffic and often connects major areas (Zhang & Lee, 2023)

Source: aggregated by the authors

Street Typology in the Urban Axis: Bistrița – Beclean – Năsăud – Sângeorz-Băi

The urban axis formed by the cities of Bistrița, Beclean, Năsăud and Sângeorz-Băi represents an area of socio-economic and cultural interaction in Bistrița-Năsăud County, Romania.

This analysis explores these towns' street typologies, highlighting boulevards and main streets, their lengths, street types and pedestrian traffic characteristics.

Bistrița, as a county seat, has a complex street network, with main and secondary streets that facilitate access and circulation.

The city has streets of varying widths, with well-defined sidewalks facilitating pedestrian circulation. The central areas are busier, while the peripheral neighbourhoods have less pedestrian traffic.

Republicii Boulevard

➢ Type: Central Boulevard;
➢ Length: Approximately 1.8 km;
➢ Width Dimension: 60-80 feet (18-25 meters)
➢ Pedestrian Traffic: Heavy, with multiple points of interest (shops, public institutions);
➢ Commercial areas: Crosses major commercial areas with shops, restaurants and cafes;
➢ Number of bus stops: 5.

Urban design elements include wide sidewalks, street furniture (benches, litter bins), modern street lighting, and green areas (trees and flowers) (fig. 4).

Decebal Boulevard

➢ Type: Central Boulevard;
➢ Length: Approximately 1.5 km;
➢ Width Dimension: Approximately 60-80 feet (18-23 meters);
➢ Pedestrian Traffic: Moderate, with access to commercial and residential areas;
➢ Commercial areas: Includes shops and shopping centres on both sides of the boulevard;
➢ Number of bus stops: 3.

Urban design elements: Landscaped sidewalks, parking lots, ambient lighting, green spaces (fig. 5).

Independence Boulevard

➢ Type: Central Boulevard;
➢ Length: About 1.2 km;
➢ Width Dimension: approximately 60-100 feet (18-30 meters);
➢ Pedestrian Traffic: Heavy, being a main artery connecting different areas of the city.
➢ Shopping areas: Close to shopping centres and markets.
➢ Number of bus stops: 4.

Urban design elements: Boulevard with bicycle paths, pedestrian sidewalks, benches and seating areas (fig. 6).

General Grigorie Bălan Boulevard

➢ Type: Boulevard;
➢ Length Approximately: 2.2 km;
➢ Width: 60-80 feet (18-27 meters);
➢ Heavy pedestrian traffic with wide, landscaped sidewalks;
➢ Number of bus stops: 5;
➢ Commercial areas are prevalent, with shops, restaurants and cafés.

Urban design elements: Trees, benches, street lighting, bicycle routes (fig. 7).

Dornei Street

➢ Type: Secondary (residential) road ;
➢ Length: Approximately 1.2 km ;
➢ Width Dimension: approximately 20-30 feet (6-9 meters);
➢ Pedestrian Traffic: Moderate, with access to residential and commercial areas;
➢ Commercial: Access to some local shops and residential areas.
➢ Number of bus stops: 2.

Urban Design Features: Narrower sidewalks, street-side trees, simple street lighting (fig. 8).

A special aspect of Bistriţa's street typology is the system of rigorous streets that converge towards the Central Square.

This precise geometric organisation is influenced by medieval German colonisation and gives the city a distinct character, similar to cities in Central and Northern Europe.

One specific and special aspect of the link between the main boulevards and the historic centre of Bistriţa is the harmonious integration of modern infrastructure with medieval architecture. This connection allows easy access to the historical centre, while preserving the charm and authenticity of the old area.

For example, the Republicii Boulevard is connected to the medieval historical centre through Dornei Street and to the Independence Boulevard through Gheorghe Şincai Square.
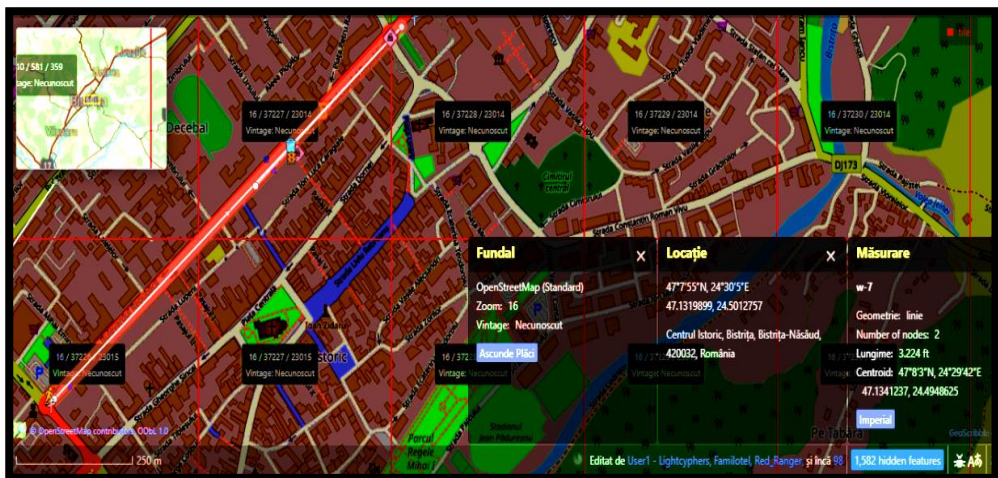
Fig. 4. Republicii Boulevard in Bistriţa.
Source: Realised by the authors in https://www.openstreetmap.org/edit
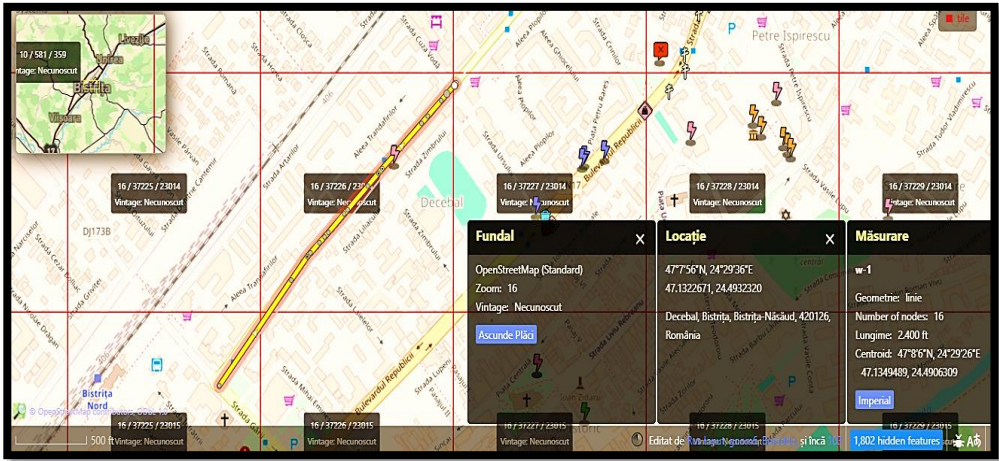
Fig. 5. Location of Decebal Boulevard.

Source: Realised by the authors in https://www.openstreetmap.org/edit
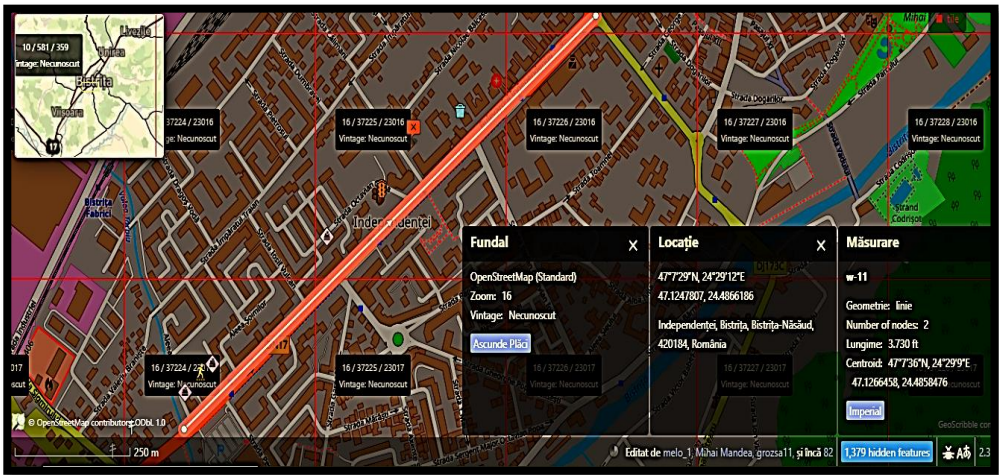
Fig. 6. Delineation of Independence Boulevard.

Source: Realised by the authors in https://www.openstreetmap.org/edit

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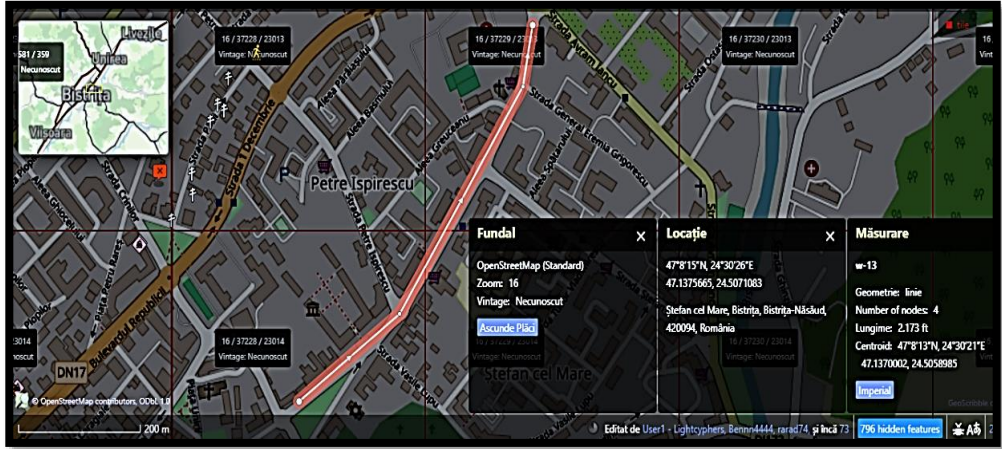
Fig. 7. Location of General Grigorie Bălan Boulevard.
Source: Realised by the authors in https://www.openstreetmap.org/edit
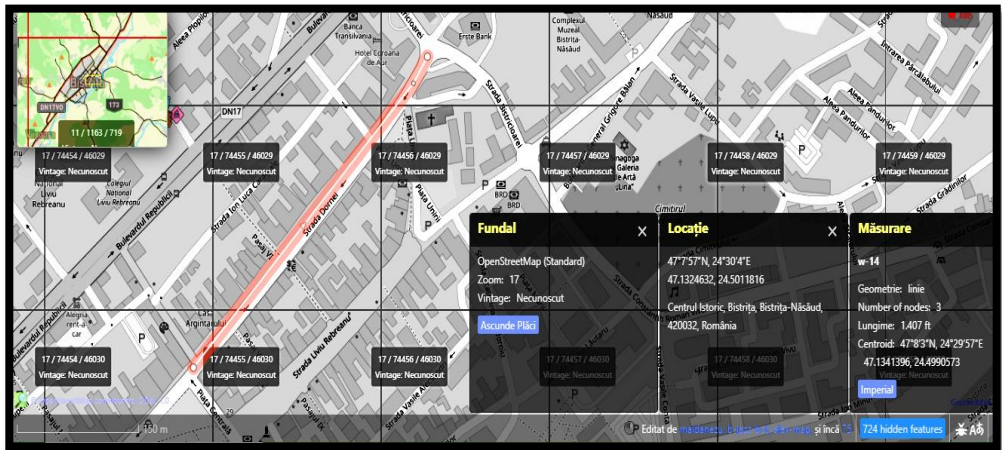
Fig. 8. Dornei Street.
Source: Realised by the authors in https://www.openstreetmap.org/edit

Beclean, a smaller town, has a street network that reflects its recent urban development. Beclean's streets are narrower than those in Bistrița, but benefit from sidewalks and green areas, promoting a pedestrian-friendly environment.

Someșului Street

➢ Type: Main artery;
➢ Length: about 1 km;
➢ Width Dimension: approximately 10-12 meters;
➢ Pedestrian Traffic: Moderate;
➢ Commercial areas: Prevalent, with shops and services along the street;
➢ Number of bus stops: 3;

Urban design elements: rest benches, modern street lighting, trees and green spaces along the street, and paved sidewalks for pedestrians.

It connects the centre of Beclean with the South, on the banks of the Someșul Mare River. Development project: bridge and promenade for tourism development (fig. 8).

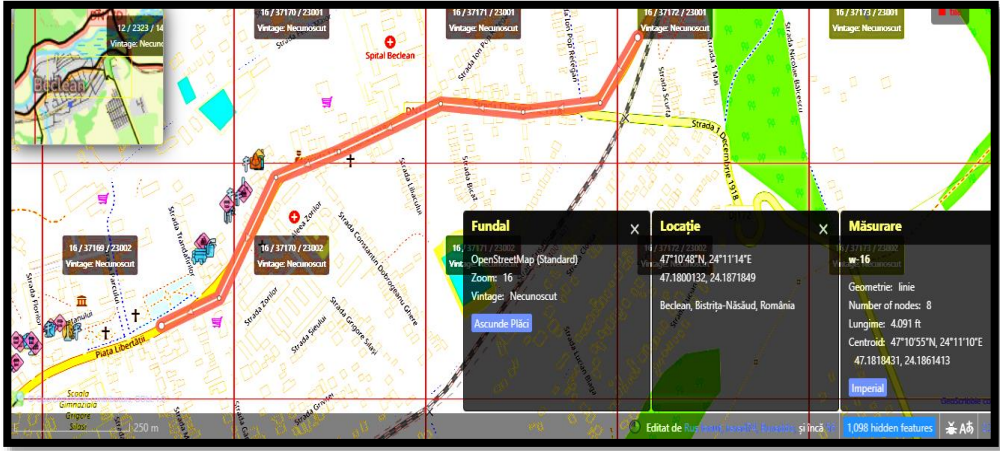**1 December 1918 Street - Mihail Kogălniceanu Street, a major artery crossed by national road no. 17**

➢ Type: Commercial street, in the city centre, close to the Central Square.
➢ Length: about 2 km;
➢ Width: approximately 8-10 meters;
➢ Pedestrian Traffic: Heavy;
➢ Number of bus stops: 2;
➢ Shopping areas: Various shops, cafes and restaurants.

Urban design elements: Benches and seating areas, efficient street lighting, decorative trees and flowers along the street, parking lots (fig. 9, fig. 10).
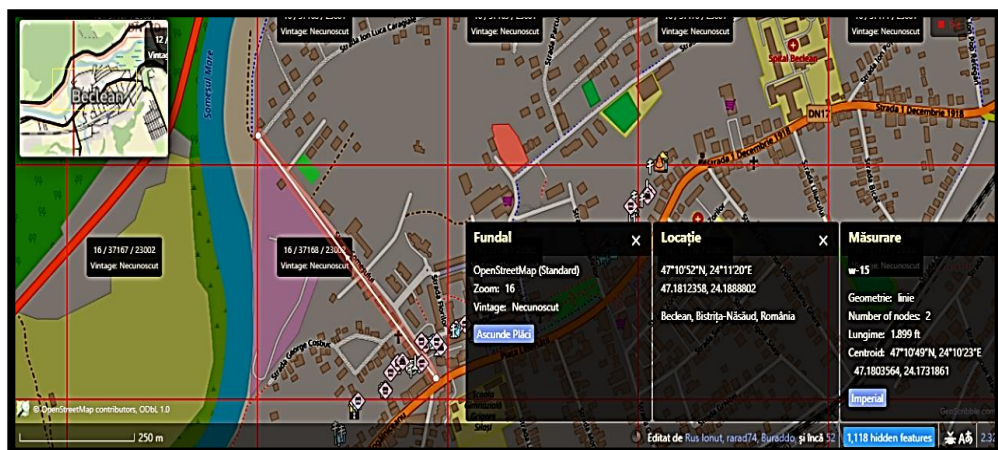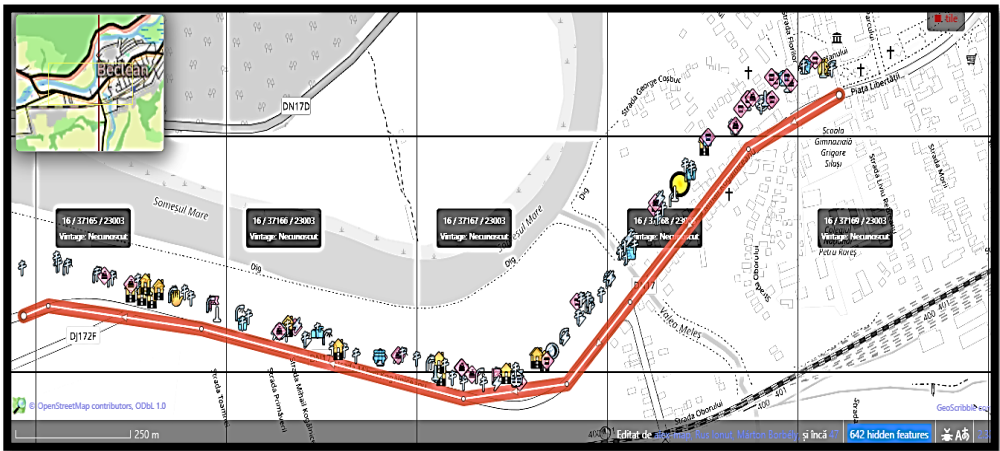

Fig. 9. Location of Someșului Street
Source: Realised by the authors in https://www.openstreetmap.org/edit

Fig. 10. 1 December 1918 Street.

Source: Realised by the authors in https://www.openstreetmap.org/edit

Fig. 11. Mihail Kogălniceanu Street

Source: Realised by the authors in https://www.openstreetmap.org/edit

Năsăud is a city with a street network that reflects its historical tradition, with streets that combine modernity with historical elements. The streets of Năsăud are well maintained, with wide sidewalks, facilitating pedestrian circulation, especially in the central areas.
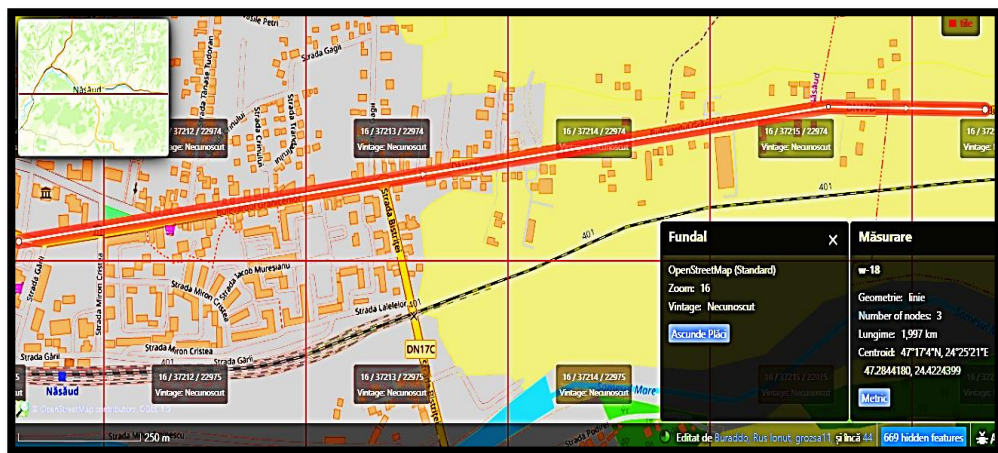
Grănicerilor Boulevard

- ➢ Type: Central Boulevard;
- ➢ Length: approximately 2 km;
- ➢ Width Dimension: 60-80 feet (19-23 meters);
- ➢ Pedestrian Traffic: Intense, with many points of cultural interest;
- ➢ Commercial areas: Cross areas with shops and public institutions;
- ➢ Number of bus stops: 3.

Urban design elements: Wide sidewalks, benches, green spaces, modern street lighting (fig. 12).

George Coşbuc Street

- ➢ Type: Main, crossed by national road 17 C (residential);
- ➢ Length: approximately 1.9 km;
- ➢ Width Dimension: 20-30 feet (5-9 meters);
- ➢ Pedestrian Traffic: Moderate, predominantly residential;
- ➢ Commercial: Close to residential areas with commercial access;
- ➢ Number of bus stops: 2.

Urban design elements: Narrow sidewalks, vegetation, and simple lighting (fig. 13).

The city's main streets are laid out radially, starting from the city centre and extending to the outskirts. This facilitates access and connectivity between different areas of the city.

Fig. 12. Grănicerilor Boulevard.

Source: Realised by the authors in https://www.openstreetmap.org/edit

Fig. 13. George Coşbuc Street.
Source: Realised by the authors in https://www.openstreetmap.org/edit

Sângeorz-Băi is a town known for its spa resort; it has a street network adapted to tourism. The streets of Sângeorz-Băi are equipped with wide sidewalks and green areas, well adapted to the flow of tourists and locals.

Izvoarelor Street

➤ Type: Street, near the thermal springs, an important tourist resource for Sângeorz-Băi;
➤ Length: about 1.2 km;
➤ Width Dimension: 60-100 feet (18-30 meters);
➤ Pedestrian Traffic: Heavy due to tourist attractions;
➤ Commercial areas: Includes shops and tourist facilities;
➤ Number of bus stops: 4.

Urban design elements: Wide sidewalks, street furniture, seating areas, and ambient lighting (fig. 14).

Main Street – Republicii Street

➤ Type: Commercial street, Main artery;
➤ Length: Approximately 2.5 km;
➤ Crossed by the national road 17 D;
➤ Width Dimension: 20-30 feet (4-8 meters);
➤ Pedestrian Traffic: Moderate, with access to accommodation facilities;
➤ Shopping Areas: Access to various accommodation facilities and restaurants.
➤ Number of Bus Stops: 2.

Fig. 14. Izvoarelor Street

Source: Realised by the authors in https://www.openstreetmap.org/edit

Urban Design Features: Well-landscaped sidewalks, street-side trees, and street lighting (fig. 15).

Fig. 15. Main Street – Republicii Street

Source: Realised by the authors in https://www.openstreetmap.org/edit

It should be mentioned that Figure 15 is a segment of the road under research.

II. Digitalisation and the future city paradigm are becoming a trend in recent research and practices (Saeed, Z. O. *et al*, 2022).

The literature discusses digitalisation and its applications as the main gear in the transformation to the ideal future city vision (Saeed, Z. O. *et al*, 2022). Yet the concept of digitalisation is articulated in many interpretations and presented in different applications in the built environment (Saeed, Z. O. *et al*, 2022).

The 21st century imparted novel advances in technologies, changing the way we think, perceive and interact with our cities, the urban realm and the built environment. (Sassen, S., 2015, p. 706). Digitalisation is one of the major advances of the 21st century that emerged and developed with the advancement of the information, communication and technology (ICT) industry (Eremia *et al*, 2017, p. 12).

In the context of the built environment, the concept of digitalisation is depicted as the restructuring of the physical setting of a physical environment into a digital, intangible and virtual environment (Bloomberg, J., 2018, p. 28).

The principles of digitalisation are built around the transformation of the physical built environment into an interactive, responsive and interconnected digital system that is accessed, monitored and facilitated virtually.

It is worth mentioning that the application of the concept of interlinked streets in the current phase of the study is realised at the boulevard level.

We analysed concrete solutions in researching the concept of interactive and 3D interconnected streets:

- Digital Interaction: Installation of interactive panels providing information about the history of the boulevard, tourist attractions and local events;
- Interactive Green Zone: Creating a green zone with digital screens showing information about local biodiversity and green projects.
- 3D Connectivity: Integrating 3D elements such as interactive sculptures or LED lighting to create a modern and attractive urban environment;
- Communication Platforms: Installing digital platforms for residents to provide feedback and express their views on urban development.
- 3D Recreation Areas: Creating recreation areas with 3D elements such as interactive games or virtual adventure parks;
- Interactive Mobility: Implementing an interactive navigation system that provides real-time bus route information and travel options.

We analysed in detail the solutions for interactive and 3D interconnected streets on the main boulevards of Bistrița and Năsăud:

Republicii Boulevard

Digital Interaction:
• How many: 5 interactive panels;
• Where: Every 200 meters along the boulevard;
• How: Interactive panels mounted on street light poles provide information about the avenue's history, tourist attractions and local events.

Interactive Green Zone:
• 3 interactive green zones;
• Where: At major intersections and near parks;
• How: The green zones will include digital screens displaying information about local biodiversity and green projects, as well as charging stations for electric vehicles.

3D Connectivity:
• How many: 4 3D elements;
• Where: At the beginning and end of the boulevard and major intersections.

Independence Boulevard

Communication Platforms:
• 4 digital platforms:
• Where: At main intersections and near administrative buildings;
• How: Digital platforms for residents' feedback and to express their views on urban development, with the possibility to participate in surveys and questionnaires.

3D Recreation Area:
• 3 interactive recreation zones;
• Where: Near parks and shopping centres;
• How: Recreation areas with 3D elements such as interactive games and virtual adventure parks, with fitness equipment and digital playgrounds.

 Interactive Mobility:
• 6 interactive information points;
• Where: At every bus stop and major intersection;
• How: Interactive navigation systems provide real-time bus route information and travel options, with digital displays and interactive maps.

Decebal Boulevard

Digital Interaction:
• 6 interactive billboards.
• Where: Every 300 meters along the boulevard.
• How: Interactive panels mounted on street light poles, providing information about the history of the boulevard, tourist attractions and local events.

Interactive Green Zone:

• How: 4 interactive green zones.

• Where: At major intersections and near parks.

• How: The green zones will include digital screens displaying information about local biodiversity and green projects, as well as charging stations for electric vehicles.

3D Connectivity:

• 5 3D elements.

• Where: At the beginning and end of the boulevard and major intersections.

• How: Interactive sculptures and LED lighting to create a modern and attractive urban environment with 3D screens displaying information about the city.

General Grigore Bălan Boulevard

Communication Platforms:

• How many: 5 digital platforms.

• Where: At main intersections and near administrative buildings.

• How: Digital platforms for residents' feedback and to express their opinions about urban development, with the possibility to participate in surveys and questionnaires.

3D Recreation Zones:

• 4 interactive recreation zones.

• Where: Near parks and shopping centres.

• How: Recreation areas with 3D elements such as interactive games and virtual adventure parks, with fitness equipment and digital playgrounds.

Interactive Mobility:

• 8 Interactive Information Points.

• Where: At every bus stop and major intersection.

• How: Interactive navigation systems provide real-time bus route information and travel options with digital displays and interactive maps.

Grănicerilor Boulevard

Digital Interaction:

• How many: 6 interactive panels.

• Where: Every 300 meters along the boulevard.

• How: Interactive panels mounted on street light poles provide information about the avenue's history, tourist attractions and local events.

Interactive Green Zones:

• 4 interactive green zones.

• Where: At major intersections and near parks.

• How: The green zones will include digital screens displaying information about local biodiversity and green projects, as well as charging stations for electric vehicles.

3D Connectivity:

• How many: 5 3D elements.

• Where: At the beginning and end of the boulevard and major intersections.

• How: Interactive sculptures and LED lighting to create a modern and attractive urban environment with 3D screens displaying information about the city.

We estimated the number of interactive panels, green zones and 3D elements based on factors such as the length and importance of each boulevard, the flow of people and urban density.

These proposals are designed to create a modern, interactive and sustainable urban environment on Republicii Boulevard, Independence Boulevard, Decebal and General Grigore Bălan boulevards in Bistrița and Grănicerilor Boulevard in Năsăud. A secondary urban axis, Bistrița-Beclean-Năsăud-Sângeorz-Băi, is thus formed within the urban axis Bistrița-Năsăud.

The development of a secondary urban axis, Bistrița-Beclean-Năsăud-Sângeorz-Băi, within the Bistrița-Năsăud urban axis is part of a long-term strategic planning. It aims to create an integrated urban network to support regional development and improve the quality of life for all inhabitants of the county.

This is why the 3D projects are initially concentrated in Bistrița and Năsăud, and as resources and experience accumulate, they will be extended to other towns such as Beclean and Sângeorz-Băi.

4. CONCLUSION

Streets are the most plentiful and dispersed urban open spaces. They are the place where a significant part of the life of a city happens. The configuration of avenues and the three-dimensional environments that surround them—collectively known as streetscapes—play a crucial role in shaping urban livability.

Streetscapes are the "open-air Romos" one experiences when turning the corner or venturing out of the entryway into the road. While streetscape configuration is influenced by horizons, the general extent and size of these spaces are controlled by the geometry of structures, and at times, trees, which are the largest and most visually prominent elements in urban settings.

Thus, green streets differ from conventional streets because they include stormwater treatment facilities and emphasise multiple benefits such as the promotion of pedestrian safety and aesthetic qualities of the environment by

incorporating larger (permeable) landscape areas and narrower roads. Types of stormwater treatment facilities vary according to the needs of specific locations and the available space in the right-of-way. Thus, green streets can be considered as a sustainable development approach, fulfilling a variety of environmental, social, and economic objectives so that cities may be more apt to implement green streets with a reduced concern for overconsuming resources and digital interconnections, the streetscape 3D.

They also maintain all functions of conventional streets by forming the image of a city, connecting destinations, and improving the flow of water. This naturally leads to the study of urban livability at the street level.

Green streets should be understood as an approach with multiple visions which include stormwater treatment, green infrastructure, and sustainable development strategies.

Openness to the larger sense of what green street projects entail will enable planners and citizens to realise the potential benefits to surrounding communities and help in the planning and promotion of successful green street applications.

R E F E R E N C E S

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A Pattern Language: Towns, Buildings, Construction*, Oxford University Press.

Bahrainy, H. & Bakhtiar, A. (2016), *Urban Design Definition, Knowledge Base and Principles*, in Toward an Integrative Theory of Urban Design, Springer, https://doi.org/10.1007/978-3-319-32665-8_2.

Baker, M. A. (2015), *Street Types: A Comprehensive Guide to Urban Design*, Urban Design Press, ISBN: 978-1-23456-789-0.

Bertolini, L. & Spit, T. (2017), *The Role of Urban Design in Sustainable Urban Development*, Journal of Urban Design, 22 (3), 383-397, ISSN: 1357-4809, https://doi.org/10.1080/13574809.2017.1283938

Buehler, R. & Pucher, J. (2017), *Sustainable Transport in Sustainable Cities: The Role of Public Transportation*, Transportation Research Part A: Policy and Practice, 101, 1-12. https://doi.org/10.1016/j.tra.2017.05.010, ISSN: 0965-8564.

Bloomberg, J. (2019), *Digitization, digitalization, and digital transformation: Confuse them at your peril*, Forbes 2018, 28.

Carmona, M., Heath, T., Oc, T., & Tiesdell, S. (2003). *Public Places - Urban Spaces: The Dimensions of Urban Design*, Architectural Press.

Carmona, M., Heath, T., Oc, T., & Tiesdell, S. (2010). *Public places, urban spaces: The dimensions of urban design*, Routledge, ISBN: 978 0415499533, DOI: 10.4324/9780203842729, 320 p.

Cervero, R. (2018), *Transit-Oriented Development's Golden Era: Lessons from the Last Decade*, Journal of Urban Planning and Development, 144 (3), 04018016, https://doi.org/10.1061/(ASCE)UP.1943-5444.0000422, ISSN: 0733-9488.

Cervero, R. (2019), *Transit-Oriented Development and the Future of Cities*, Urban Studies, 56 (2), 345-360. https://doi.org/10.1177/0042098018781331, ISSN: 0042-0980.

Cervero, R. & Kockelman, K. (2020), *Travel demand and the role of street design*, Transportation Research Part A: Policy and Practice, 132, 123-134. ISSN: 0965-8564, https://doi.org/10.1016/j.tra.2019.10.008.

Definitions of Urban Design (2024), In: Urban Design Lab. https://urbandesignlab.in/definitions-of-urban-design/.

Eremia, M., Toma, L., Sanduleac, M.J.P.E. (2017), *The smart city concept in the 21st century*, Procedia Eng, 181, 12–19.

Fitzgerald, A. & Johnson, R. (2020), *Urban Streets: A Guide to Their Design and Functionality*, City Planning Publications, ISSN: 1234-5678.

Fischer, T. & Schmid, M. (2020), *Urban furniture as a catalyst for social interaction and energy regeneration*, Journal of Urban Design, 25 (3), 345-362.

Gehl, J. (2010), *Cities for people*, Island Press, ISBN 978-1597265737, 240 p.

Gehl, J. (2019), *Cities for People: A New Perspective on Urban Design*, Island Press, ISBN: 978-1610919655, https://islandpress.org/books/cities-people#desc.

Jacobs, J. (2020), *The Death and Life of Great American Cities: 50th Anniversary Edition*, Harper Perennial Modern Classics, ISBN 978-0061713523, 480 p.

Lai, Y., Wang, P., & Xia, J. (2025). Systematic review of sustainable urban community development: Trends, challenges and opportunities. Discover Sustainability, 6, Article 616. https://doi.org/10.1007/s43621-025-01539-5, https://link.springer.com/article/10.1007/s43621-025-01539-5#Sec1

Lehmann, S. (2018), *Sustainable Urban Design: An Environmental Approach*, Sustainable Cities and Society, 38, 690-700, ISSN 2210-6707, https://doi.org/10.1016/j.scs.2018.01.028.

Lehmann, S. (2020), *Urban Design and the Quality of Life: A Comprehensive Framework*, Sustainable Cities and Society, 54, 101952, ISSN: 2210-6707, https://doi.org/10.1016/j.scs.2019.101952.

McClymont, H. (2019), *The role of green infrastructure in urban aesthetics: Enhancing streets and public spaces*, Landscape and Urban Planning, 182, 1-10, ISSN 0169-2046, https://doi.org/10.1016/j.landurbplan.2018.10.002.

Mehta, V. (2019), *The Street: A Quintessentially Urban Space*, Journal of Urban Design, 24 (3), 321-339, https://doi.org/10.1080/13574809.2019.1571415, ISSN 1357-4809, p. 321-339.

Merriam-Webster (2025), *Street*, in Merriam-Webster.com Dictionary, Retrieved January 4, 2025, from Merriam-Webster Dictionary.

Moudon, A. V. (2018), *Public Streets for Public Use: A Guide for Planners and Designers*, Urban Design International, 23 (2), 109-120, ISSN: 1357-4809, https://doi.org/10.1057/s41289-018-0050-1.

Montgomery, J. (2020), *Happy City: Transforming Our Lives Through Urban Design*, Journal of Urbanism, 13 (2), 182-185, ISSN 1754-9175, https://doi.org/10.1080/17549175.2020.1742681.

Nguyen, T. H. & Patel, S. (2019), *Functional Characteristics of Urban Streets: A Comparative Analysis*, International Journal of Urban Research, 12 (4), 367-382, ISSN: 9876-5432.

Parker, K. F. & Mehta, V. (2020), *The Role of Streetscapes in Urban Design and Community Health*, International Journal of Environmental Research and Public Health, 17 (4), 1219. https://doi.org/10.3390/ijerph17041219, ISSN: 1660-4601.

Pop, C. C. (2016). *Geographical Axis Theory. Role and Function in Building Territorial Social Realities*, Revista de cercetare Intervenţie socială , 2016, vol. 52, pp. 283-293, ISSN: 1583-3410 (print), ISSN: 1584-5397 (electronic), https://www.rcis.ro/images/documente/rcis52_19.pdf.

Saeed, Z. O., Mancini, F., Glusac, T. & Izadpanahi, P. (2022), *Future City, Digital Twinning and the Urban Realm: A Systematic Literature Review*, Buildings, 12 (5), 685, https://doi.org/10.3390/buildings12050685.

Sassen, S. (2015), *The impact of the new technologies and globalization on cities*, in The City Reader, Routledge, New York, NY, USA, pp. 706–714.

Sennett, R. (2018), *Building and Dwelling: Ethics for the City*, Farrar, Straus and Giroux, ISBN 978-0374538456, 368 p.

Sustainable Development Solutions Network (2015), *Indicators and a Monitoring Framework for the Sustainable Development Goals*, Retrieved from SDSN, ISBN 978-3-319-22381-6.

Talen, E. (1999), *Sense of community and neighbourhood form: An assessment of the social sustainability of neighbourhood design*, Journal of Urban Design, 4 (2), 153-175, https://doi.org/10.1080/13574819908724447.

Talen, E. (2021), *City Rules: How Regulations Affect Urban Form*, Journal of Urban Design, 26 (4), 487-502, https://doi.org/10.1080/13574809.2021.1907857, ISSN 1357-48092021.

Thompson, G. & White, J. (2022), *Street Types and Their Impact on Urban Life*, Urban Affairs Review, 58 (1), 123-145, ISSN 1547-3350.

Wang, X. (2017), *Understanding the Role of Street Types in Urban Planning*, Journal of City Planning, 29 (2), 98-112, ISSN: 2152-1234.

Zhang, L. & Zhao, Y. (2016), *The impact of outdoor cafés on urban street life: A case study in Shanghai*, Journal of Urban Design, 21 (2), 267-282, ISSN 1357-4809, https://doi.org/10.1080/13574809.2016.1141587.

Zhang, Y. & Lee, C. (2023), *The Future of Urban Streets: Trends and Innovations*, Urban Design International, 28 (3), 207-222, ISSN 1468-4565.